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SafeGreece new technologies & civil protection

HELLENIC REPUBLIC
REGION OF ATTICA

SafeAttica 2023
new technologies & civil protection

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25-27.09

proceedings

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about

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ΠΕΡΙΦΕΡΕΙΑ ΚΡΗΤΗΣ
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E.P.P.O
Earthquake Planning & Protection Organisation

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topics

Special Sessions

- **Turkey-Syria Earthquake 2023**: special features, lessons learned
- **Region of Attica**: Risks, Prevention Actions, Adaptation to Climate Crisis
- **Volunteerism**: Problems, Challenges and Proposals
- **Prediction and Forecasting / Early Warning Systems:** (meteorology, climate change, earthquakes, tsunamis etc.): technology, applications, crisis management, methods, success-stories, lessons learned, social dimensions
- **Climate Crisis**: Resilience, Adaptation, Good Practices

Regular Topics

- **Natural Disasters:** causes, prevention, management, best practices, lessons learned
- **Technological & Man-made Disasters:** causes, prevention, management, best practices, lessons learned
- **Natech (Mixed Natural & Technological) Disasters:** causes, prevention, management, best practices, lessons learned
- **Marine, Road, and Air Accidents:** Prevention and management, lessons learned
- **Innovative technology and methods** on disaster study, prevention and management (Decision Support Systems, 3D-Printing, Artificial Intelligence, Applications, Remote Sensing etc)
- **COVID-19**: studies, actions, good practices, consequences, challenges
- **Multi-hazard Crisis Management**
- **Prediction and Forecasting / Early Warning Systems**: (meteorology, climate change, earthquakes, tsunamis etc.): technology, applications, crisis management, methods, success-stories, lessons learned, social dimensions
- **Standardization**
- **Human Activity** and its impact on Natural Phenomena (Hydrocarbon Research, Mining etc)

- **Biodiversity:** the impact of Climate Change/Crisis and destructive Phenomena on Biodiversity
- **Security:** Critical Infrastructure protection from malicious actions, terrorist acts management, Cyberprotection
- **Crises Management Issues**
- **Institutional & Legislative Framework** for Civil Protection
- **Training:** to citizens, volunteers, teachers, students, staff
- **Search & Rescue, Humanitarian Aid**
- **Civil Protection & Media:** Information dissemination and interactions between the stakeholders and the media
- **Civil Protection - Insularity - Tourism**
- **Civil Protection & People with Special Needs / Third Age**
- **Civil Protection & Cultural Heritage**
- **Economic dimension of disasters, crises, prevention**
- Civil Protection & **GDPR** (EU General Data Protection Regulation)
- **Cross-border dimensions: International, European and Mediterranean Programmes & Civil Protection Synergies**

thanks to:

Profile

Satways Ltd. is a privately held organization founded in May 2006 and is based in Athens, Greece. The company is dedicated to develop integrated Geospatial command and control solutions for Security and Public Safety applications for police, coast guard, emergency medical service, civil protection and fire & rescue operations, critical public infrastructure protection, transportation security and border monitoring.

With core technology built on open standards, we offer an unmatched range of mission critical enterprise solutions empowering governments and businesses around the world to make better and faster operational decisions.

Our product line includes C2 and C3I enterprise software packages that respond to different operational requirements of Public Safety Agencies such as Distributed Geospatial Data management, Operational Resources Tracking, Incident Management and dispatch, Physical Security Information Management and Natural & Technological Hazards Crisis Management respectively. The common goal though, is to provide effective decision support, to simplify operations, to provide a Common Operational Picture (COP) and collaboration tools across organizations, to collect and disseminate data in the field and to coordinate response units and system users.

Satways is ISO 9001:2008 certified for the development of geospatial command and control products and solutions.

Mission

Our mission is to provide integrated solutions for the Security and Safety business sectors that enable the fusion, orchestration and seamless access of vast amounts of complex data from disparate information sources, tools and methods to coordinate the interaction between people, technologies, and responses. Through advanced software, and hardware we facilitate our customers to command, control assets and infrastructure by combining distributed software technologies, mobile data and geomatics with superior voice and data communication networks. SATWAYS is committed to delivering next generation geospatial security solutions to people, businesses and governments. We seek to earn the respect and trust of our customers through a total commitment to their success, industry expertise, and technical innovation.

Commitment

We are committed to enhance the operational efficiency of our customers by providing them with affordable, modular and expandable solutions that meet their business requirements and ensure the future value of their investments. Today's diverse voice and data networks demand ICT solutions that leverage existing infrastructure and adapt to the business goals of each customer. We consider each customer as a unique case and our solutions unique characteristics is the flexibility to map different business rules, operations and policies under a common platform reducing the implementation time of cost-efficient solutions.

Expertise and Experience

Our expertise lies in delivering end-to-end integrated solutions, in implementing large scale turn-key projects and in providing a wide range of engineering professional services. Our competitive advantage is based on our experience to deliver Nation-wide mission critical civil security and safety projects. Our products have been designed and developed to accommodate incongruent information sources, vast amounts of data, multi-agency and multi-site installations and a multitude of voice and data networks. Our Vision is to apply our insight of public safety and security issues, policies and approaches to the enterprise security management market that includes border monitoring, transportation and critical infrastructure protection.

Solutions

Our product lines include software systems for Incident Command and Response, Decision support, telematics, physical security, mobile data as well as state-of-the- art decision support tools. Our advanced and cost-effective solutions enable our customers to preserve operational integrity, to harness the power of geospatial information systems and to concentrate on operations rather that complex ICT integration and interoperability issues.

www.satways.net

Vision & Mission

To enable people to act in an aware and timely manner in order to live better and preserve the Earth. We simplify the adoption of geospatial data in order to understand the world better.

Planetek Hellas is a Greek company, member of the Planetek Group that since 1994, operates in the field of satellite remote sensing, spatial data infrastructure and software development for the "on board" and "ground" segment space applications.

Founded in 2006, Planetek Hellas provides solution oriented services in the field of Geomatics, involving the use of EO data and systems for environmental & critical infrastructure monitoring, urban planning, civil protection and security.

Our activities in the Earth observation and Space domains.

Planetek is one of the very few European space companies having activities in both the downstream and upstream sector. Planetek designs, prototypes and commercializes the SPACE product line of on-board software tools that extent from the compression on board of satellite EO data, and the attitude and orbit control. Planetek offers also within its SPACE product line the SpacePTS product (Payload Testing System) which is the perfect personalizable solution for complex payload testing activities. Space PTS has been tested and used for one of the payloads of the Solar Orbiter Mission (SWA-DPU) launched in February, 2020.

The company has in its portfolio a variety of successful contracts with European Space Agency, through which it has acquired in-depth knowledge of the Agency's procedures and high quality requirements.

Planetek Hellas is also very active in R&D, participating in many research European (FP7, HORIZON) and National Projects. About 15% of the company's revenue is invested each year in R&D.

Planetek Hellas bases its offer in the high involvement in the research and in the analysis of new techniques, which process and integrate remote sensing information with state of the art technologies such as HPC and AI. Rheticus integrates and makes use of all the above.

www.planetek.gr

Specialty Therapeutics is Company focused on the following Therapeutic areas:

- Oncology/Haematology
- Gynecology/Endocrinology
- Respiratory
- Rare (Orphan) Diseases

Specialty Therapeutics specializes in in-licensing and commercializing approved products from multinational pharma companies to address the unmet medical needs of patients with Oncological/ Haematological, Gynecological, Respiratory & Rare (Orphan) Diseases.

Our initial focus is on products for Oncologists/Haematologists, Gynecologists/Endocrinologists, Respiratory and Rare (Orphan) Diseases key opinion leaders.

Mission

Our mission is to become the uniquely qualified partner of choice for Oncology/Haematology, Gynecology/Endocrinology, Respiratory and Rare (Orphan) Diseases pharmaceutical companies seeking trusted business partner in Greece, locally or regionally. (footprint in 13 countries, 66 million population, 3rd biggest territory in Europe).

We are fully committed to **bring innovative treatments** for patients suffering from of Oncological/ Haematological, Gynecological, Respiratory & Rare (Orphan) Diseases.

Strategy

Specialty Therapeutics' objectives are:

- Strategic in-licensing of innovative Oncology/Haematology, Gynecology/Endocrinology, Respiratory, Rare (Orphan) Diseases products
- Successful commercialization of innovative Oncology/Haematology, Gynecology/Endocrinology, Respiratory, Rare (Orphan) Diseases products in Greece and 12 other European countries
- Operational excellence and building of win-win business mode

www.specialtytherapeutics.gr

totalview

Your Experts in Greece and Beyond

Based in Athens Greece and established in 2011, totalview is an innovative establishment focusing on very high resolution (VHR) satellite images and software developing. With over 25 years of experience, Totalview has developed a reputation in Greece, Cyprus and internationally for its unique services, delivery of high-quality products and pioneering solutions for each customer individually.

In addition, Totalview is the only company in Greece and one of a few in Europe capable to provide very high-resolution satellite images, as it is a partner with the leaders in this field.

Also is one of the first companies in Greece to participate in the construction of multiple ground stations in several locations in Greece.

Partners

- MAXAR
- European Space Imaging
- Planet
- Capella Space
- Kongsberg Satellite Services (KSAT)
- GHGSat
- SI Imaging Services(SIIS)
- Space View Technology Co., Ltd.
- Spire
- Satellogic
- eOsphere
- Twenty First Century Aerospace Technology (Asia) Pte. Ltd. (21AT Asia)
- KGS Space Technology
- Orbita Aerospace Science & Technology Co. Ltd.
- CG Satellite
- ICEYE

Memberships

- Hellenic Manufacturers of Defence Materiel Association
- Hellenic Association of Space Industry
- European Association of Remote Sensing Companies
- HellasGIs
- Hellenic Defence Industries Catalogue 2023-2024

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new technologies & civil protection

program

OPENING

25.09

Amphitheater "Ioannis Kapodistrias"

09:00 - 09:30	**Registrations**
09:30 – 10:15	**Welcome Greetings (under update)** **Giorgos Patoulis**, Regional Governor of Attica, Greece **Stavros Arnaoutakis**, Regional Governor of Crete, Greece **Athanassios Ganas**, Geological Society of Greece, President **Menelaos Gardikiotis,** Geotechnical Chamber of Greece, President **Nikolaos Passas**, Civil Protection Director, Region of Attica, Greece **Efthymios Lekkas,** Earthquake Planning and Protection Organization of Greece, President
	Keynote Lectures
10:15 – 10:45	**Gerasimos Papadopoulos,** *EU and UNESCO Scientific Collaborator, SafeGreece President* **The Value of Foreshocks for the Earthquake Prediction**
10:45 – 11:15	**Efthymios Lekkas,** *Earthquake Planning and Protection Organization of Greece, President* **The Operational Contribution and the International Impact of the Hellenic Mission in the 6 February 2023 Earthquake in Turkey**
11:15 – 11:30	**Coffee Break**

Special Session

Attica

25.09

Amphitheater "Ioannis Kapodistrias"

Chair:	**Nikos Passas**
11:30 – 11:45	**Ioannis Kapris**, Areti Plessa, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** Best Practices of State Body Handling Forest Fires During the Pre-Disaster Phase. The Case of Mount Penteli (19-26 July 2022)
11:45 – 12:00	**Theodora Kapatseli**, Ioannis Kapris, Aikaterini Balantinaki, Areti Plessa, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** Best Practices of State Body Handling Forest Fires During the Response Phase. The Case of Mount Penteli (19-26 July 2022)
12:00 – 12:15	**Aikaterini Balantinaki**, Theodora Kapatseli, Ioannis Kapris, Areti Plessa, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** Best Practices of State Body Handling Forest Fires During the Recovery Phase. The Case of Mount Penteli (19-26 July 2022)
12:15 – 12:30	**Christina Dakou**, Ioannis Kapris, Areti Plessa, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** Actions and Initiatives of Civil Protection in the Territorial Area of Piraeus and the Argosaronic Islands for the Year 2022
12:30 – 12:45	**Areti Plessa**, Miranda Dandoulaki, Katerina Orfanogiannaki, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** Risk Perception of Industrial Accidents Involving Dangerous Substances in the Region of Attica, Greece
12:45 – 13:00	**Aikaterini Balantinaki**, Ioannis Kapris, Areti Plessa, Nikos Passas | **Independent Direction of Civil Protection, Region of Attica, Greece** The Contribution of a Second-Degree Public Entity to Forest Fires: A Case Study of the Regional Unit of East Attica for the Period 2018-2022"
13:00 – 13:15	**Vana Giavi** | **totalview, Greece** Attica: Using Multi-Sensor, Very High Resolution Satellite Data, for a Timely and Effective Prevention of Floods and Wildfires In Semi-Urban Environments
13:15 – 13:30	**Antonis Kostaridis,** Polyzois Parthymos, Nikos Karvounakis, Konstantinos Pappas, Aggelos Aggelis, Lefteris Voumvourakis, Marianna Koultouki, Leonidas Perlepes, Dimitris Diagourtas, Chrysi Ntarda, Ilias Kasoutsas, Leonidas Vasilakakis, Kostas Tsakiroglou, Nikos Sigalas, Maritina Gatou, Alexandros Malounis, Giorgos Koromilas, Thanasis Ioannidis, Miltiadis Apostolatos, Apostolos Oikonomou, Manos Androulakis, Katerina Makri | **Satways, Greece, Hellenic Fire Service, Ministry for Climate Crisis & Civil Protection, Information Society S.A., Greece** The Collaborative Incident, Resource and Telematics Management System of Civil Protection Agencies

13:30 – 14:30 **Light Lunch Break**

Session 2

earthquakes

25.09

Amphitheater "Ioannis Kapodistrias"

Chair:	**Athanassios Ganas, Filippos Vallianatos**
14:30 – 14:45	**Athanassios Ganas**, Varvara Tsironi, Eirini Efstathiou, Emmanouela Konstantakopoulou, Nikoletta Andritsou, Vasileios Georgakopoulos, Anna Fokaefs, Panagiotis Savvaidis and Nikolaos Madonis | **Institute of Geodynamics, National Observatory of Athens, Greece** The National Observatory of Athens Active Faults of Greece Database (NOAFAULTs) as a Tool for Civil Protection and Education
14:45 – 15:00	**Filippos Vallianatos**, Ioannis Spingos, George Hloupis , Andreas Karakonstantis and Nikolaos Sakellariou | **National and Kapodistrian University of Athens, Greece, Institute of Physics of the Earth's Interior and Geohazards, Hellenic Mediterranean University Research Center, University of West Attica, Greece** Estimation of the Earthquake Early Warning Scaling Properties of Peak Ground Acceleration with the Integral of Squared Velocity. First Results for Eastern Corinth Gulf and Western Attica Region
15:00 – 15:15	Konstantinos Papatheodorou, Nikolaos Theodoulidis, Nikolaos Klimis, Can Zulfikar, Dragos Vintila, Vladlen Cardanet, Emmanouil Kirtas, Dragos Toma-Danila, Basil Margaris, Yasin Fahjan, **Georgios Panagopoulos**, Christos Karakostas, Georgios Papathanassiou | **International Hellenic University, Greece, Democritus University of Thrace, Greece, Gebze Technical University, Turkey, Ovidius University of Constanta, Romania, Institute of Geology & Seismology of Moldova** Rapid Earthquake Damage Assessment System to Support Earthquake Response
15:15 – 15:30	**Spyridon Mavroulis**, Efthymios Lekkas | **National and Kapodistrian University of Athens** 70 Years after the August 1953 Earthquakesin the Ionian Sea (Western Greece): Reviewing Prior Research and Utilizing New Data Sources with Emphasis on the Earthquakes Environmental Effects
15:30 – 15:45	**Anastasios Biris**, Asimina Kourou | **Civil Protection Department, Municipality of Istiaia-Edipsos, Greece, Earthquake Planning and Protection Organization of Greece** Enhancing the Vital Role of the Civil Protection Department of the Municipality of Istiaia-Edipsos in Seismic Risk Reduction

15:45 – 16:00

16:00 – 16:15 **Spyridon Mavroulis**, Emmanuel Vassilakis, Ioannis Argyropoulos, Panayotis Carydis, Efthymios Lekkas | **National and Kapodistrian University of Athens, European Academy of Sciences and Arts, Greece**
Primary and Secondary Environmental Effects Induced by the 6 February 2023 Turkey-Syria Earthquakes and their Impact on The Nature and Spatial Distribution of Building Damage

16:15 – 16:60 **Maria Mavrouli**, Spyridon Mavroulis, Efthymios Lekkas, Athanassios Tsakris | **National and Kapodistrian University of Athens, Greece**
Risk Factors for Infectious Diseases Emergence in the Area Devastated by the 2023 Turkey-Syria Earthquakes and Measures for Preventing an Imminent Health Crisis

16:30 – 16:45 **Spyridon Mavroulis**, Katerina-Navsika Katsetsiadou, Michalis Diakakis, Maria Mavrouli, Christos Filis, Evelina Kotsi, Sofia Laskari, Elina Kapourani, Stylianos Lozios, Konstantinos Soukis, Eftymios Lekkas | **National and Kapodistrian University of Athens, Greece**
Lessons Learned from Emergency Site Selection in Turkey after the 6 February 2023 Earthquakes and Integration in Disaster Management Plans of the Attica Region, Greece

16:45 – 17:00 **Spyridon Mavroulis**, Maria Mavrouli, Emmanuel Vassilakis, Ioannis Argyropoulos, Panayotis Carydis, Efthymios Lekkas | **National and Kapodistrian University of Athens, European Academy of Sciences and Arts, Greece**
Selection of Debris Disposal Sites after the 6 February 2023 Earthquakes in Southeastern Turkey, Related Hazards, and Risk Reduction Strategies

17:00 - 17:30 **Invited Talk | Chair: Gerasimos Papadopoulos**

Ross S. Stein
Temblor Inc, Stanford University. USA
Implications of the massive, interacting 2023 M7.8 and M7.6 Türkiye earthquakes for Greece

17:30 – 17:45 **Coffee Break**

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Session 3
administration

25.09

Amphitheater "Ioannis Kapodistrias"

Chair:	Miranda Dandoulaki, Evangelos Katsaros
17:45 – 18:00	**Sofia Kalogeromitrou**, Miranda Dandoulaki | **National and Kapodistrian University of Athens, Greece, Disaster management expert, BoD IDRiM Society** Dwelling after Disaster: Formal Design and Spatial Improvisation in Transitional Shelter
18:00 – 18:15	**Michail Christos Tsoutsos**, Charalampos (Haris) Kontoes, Vassilios Vescoukis | **National Technical University of Athens, Greece, National Observatory of Athens, Greece** Devastating Natural Hazards in Greece during the Last Twenty Years
18:15 – 18:30	**Konstantina - Theodora Panagou**, Vasileios Martzaklis | **National and Kapodistrian University of Athens, Greece** Influence of Climate Change on Natural Disasters. The Dimension of Time in Decision Making during their Event
18:30 – 18:45	**Ioannis Bakouros**, Amalia Kouskoura, Eleni Kalliontzi, Ioannis Amanatidis, Ilias Tsiotsias | **Institute of Civil Protection, University of Western Macedonia, Greece, Hellenic Fire Brigade, Hellenic Police** Interactions in Civil Protection: Stakeholders in Cases of Disasters in Western Macedonia
18:45 – 19:00	**Theodora Blioumi** | **University of South Bohemia in Ceske Budejovice, Czech Republic** Institutional and Legislative Framework of Civil Protection in the Executive Greek State
19:00 – 19:15	Amalia Kouskoura, **Evangelos Katsaros**, Eleni Kalliontzi, Ioannis Bakouros | **Institute of Civil Protection, University of Western Macedonia, Greece** A Civil Protection Institute as Facilitator of Disaster and Emergency Management
19:15 – 19:30	Antonios Antoniades, Ioannis Kapris, Aikaterini Tsoukala, **Costas Antoniades** | **National and Kapodistrian University of Athens, Greece, Independent Direction of Civil Protection, Region of Attica, Greece** Climate Crisis, Civil Protection & Degrowth. Protecting the Environment, Reducing Vulnerability and Strengthening Resilience

Session 4

floods

26.09

Amphitheater "Ioannis Kapodistrias"

Chair:	Michalis Diakakis, Michalis Sioutas
09:00 – 09:15	**Theophilos Valsamidis** | **Planetek Hellas** Copernicus Emergency Management Service (CEMS) Contribution in Rapid Emergency Response
09:15 –09:30	**Michalis Diakakis**, Katerina Papagiannaki, Meletis Fouskaris | **National and Kapodistrian University of Athens, Greece, National Observatory of Athens, Greece** How Frequent are High-Mortality Floods in the Eastern Mediterranean?
09:30 – 09:45	**Vasiliki Vasilopoulou**, Emmanouel Andreadakis, Maria Stavropoulou | **National and Kapodistrian University of Athens, Greece** Debris Flow Simulation during the Flash Floods of November 2017 (Attica, Greece)
09:45 – 10:00	**Michalis Sioutas**, Vassilis Lekidis, Constantinos Kokolakis | **Technical Chamber of Greece/Section of Central Macedonia, Hellenic Agricultural Insurance Organization** Flooding Phenomena in the Metropolitan Area of Thessaloniki: Anthropogenic and Climate Change Effects
10:00 – 10:15	**Alexandros Ziogas**, **Evangelos Romas**, Eleni Athanasiou, Konstantinos Papaspiropoulos | **EMVIS Consultant Engineers SA, Hellenic Ministry of Environment & Energy** Operational Flood Early Warning System in Evros/Maritsa Rransboundary Basin (Greece)
10:15 - 10:45	**Invited Talk** | Chair: Gerasimos Papadopoulos **Sigurd Melin,** *NOAQ, Sweden* **The NOAQ Boxwall and the Potential of Mobile Flood Barriers**
10:45 – 11:00	**Eleni Gounela,** Emmanouela Ieronymidi, Theophilos Valsamidis, Stelios Bollanos | **Planetek Hellas** Post-disaster Landslide Evaluation and Risk Assessment in Ischia island (Italy), by using Copernicus Emergency Management Service (CEMS)
11:00 – 11:15	**Chrysoula Papathanasiou**, Petros Mouzourides, Marios Vlachos, Marina Neophytou, Valantis Tsiakos, Georgios Tsimiklis, Angelos Amditis | **Institute of Communication and Computer Systems – ICCS, National Technical University of Athens, Greece, University of Cyprus** Enhancing In-Situ Environmental Observation to Support Desert Dust Storm Events Monitoring

11:15 – 11:30	**Coffee Break**

Session 5

local gov - tech

26.09

Amphitheater "Ioannis Kapodistrias"

Chair:	**Konstantinos Chouvardas, Paschalia Machaira**
11:30 – 11:45	**Ioannis Kontos, Anastasia Mavridaki** | **Marathon Data Systems, Greece** ArcGIS & Crowdsourcing: A Powerful Decision-making Tool
11:45 – 12:00	**Konstantinos Chouvardas** | **Civil Protection Directorate, Region of Eastern Macedonia and Thrace, Greece.** Utilization of Technological Tools and Automation in Risk and Disaster Management at Regional Level Based on the Planning of the General Secretary of Civil Protection Requirements. The Case of the East Macedonia & Thrace Region
12:00 – 12:15	**Paschalia Machaira**, Argyro Theodoraki, George Papadakis, Eleni Ploumidi | **Technical University of Crete, Greece, Civil Protection Directorate, Region of Crete, Greece** A GIS-Platform for Emergency Response Bodies in the Management of Technological Accidents: The Case of External Emergency Plans for SEVESO Sites
12:15 – 12:30	**Evanthia Fraktopoulou**, Aliki Konsolaki, Grigorios Konstantellos, Emmanuel Vassilakis, Efthymios Lekkas | **Municipality of Vari Voula Vouliagmeni, National Kapodistrian University of Athens, Greece** Comprehensive Operational Model for Prevention and Response to Natural Disasters at the Local Government Level with Innovative Technological Equipment - The Example of the Municipality of Vari Voula Vouliagmeni
12:30 – 12:45	**Harris Georgiou**, Alexios Vlachopoulos, Aspasia Tzeletopoulou, Anastasia Andriopoulou | **Hellenic Rescue Team of Attica, Greece** Lessons from Recent Disaster Events and New Technologies for Future USAR Missions – INTREPID (Eu H2020)
12:45 – 13:00	**Chrysoula Papathanasiou**, Orestis Sampson, Thanasis Douklias, Lazaros Karagiannidis, Panagiotis Michalis, Angelos Amditis | **Institute of Communication and Computer Systems – ICCS, National Technical University of Athens, Greece** Evolution of an ICT Tool through Co-Creation for Effective Disaster Risk Management
13:00 – 13:15	**Paraskevi Petsioti**, Costas Rizogiannis, Efstathios Kassios, Christos Papaioannidis, Vasileios Mygdalis, Ioannis Pitas | **Center for Security Studies (KEMEA), Greece, Aristotle University of Thessaloniki, Greece**

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	Big Data Technologies for Emergency Management - End Users Needs and Technological Capabilities in the Context of TEMA Project
13:15 – 13:30	Efstathios Skarlatos, **Vagia Pelekanou**, Zeta Aggariti, Ioannis Petropoulos, Georgios Kyragiannis, Manolis Grafakos | **Center for Security Studies (KEMEA), Greece, Hellenic Police, Hellenic Ministry of Environment and Energy** Geospatial Intelligence for the Protection of the European Territory From Organized Environmental Crime (PERIVALLON Project))

13:30 – 14:30 **Light Lunch Break**

8

Poster Session

26.09

Hall "Rigas Ferraios"

Chair:	**Katerina – Navsika Katsetsiadou**
11:45 – 11:50	**Anastasia Avatagelou**, Emmanuel Andreadakis | **National and Kapodistrian University of Athens, Greece** Fire Risk Level and Trends in Attica Region, 2014-2022
11:50 – 11:55	**Eleftheria Stamati** | **National and Kapodistrian University of Athens, Greece, Central Union of Municipalities of Greece** Mechanism Direct Response and Support of Local Government Organizations for the Management of Risks, Disasters, and Crisis
11:55 – 12:00	Steven Deere, Darren Blackshields, Peter J Lawrence, **Lazaros Filippidis**, Lynn Husle, Edwin R Galea | **University of Greenwich, U.K.** matEXODUS: Simulating Terrorist Attacks on Crowds)
12:00 – 12:05	**Fotios Tsopelas**, Miltiadis Statheropoulos, Sari Yli- Kauhaluoma, Dario Ruiz Lopez, Andreas Walte, G. Eiceman, P. Vaninen | **National Technical University of Athens, Greece, University of Helsinki, Finland, ATOS, Spain, AIRSENSE, Germany** Chemical Risk Perception and Augmented Reality
12:05 – 12:10	**Vasiliki Metou**, Vasileios Martzaklis | **National & Kapodistrian University of Athens, Greece** The Importance of Environmental Awareness and Protection from Natural Disasters, through the Educational Process
12:10 – 12:15	**Ioannis Trigkas** | **National and Kapodistrian University of Athens, Greece, Central Union of Municipalities of Greece** Municipal Authorities and Climate Change
12:15 – 12:20	**Eleni Iordanidou**, Konstantinos Kokolakis | **National & Kapodistrian University of Athens, Greece, Technical Chamber of Greece/Section of Central Macedonia** Crises Management in Highway Tunnels. The Case of Tunnels on "Egnatia Motorway SA" Road Network
12:20 – 12:25	**Maria Daskalaki** | **Municipality of Chania, Crete, Greece** Actions to Inform and Raise Awareness Humans about Environmental Risks and Civil Protection
12:25 – 12:30	**Nikos Passas**, Nikos Bartsotas, Mariza Kaskara, Charalampos Kontoes, Areti Plessa, Ioannis Kapris | **Independent Direction of Civil Protection, Region of Attica, Greece, National Observatory of Athens, Greece** Mediterranean and pan-European Forecast and Early Warning System against Natural Hazards

12:30 – 12:35	**Nikos Passas**, Ioanna Xalari, Vassilis Amiridis, Thanasis Georgiou, Anna Kampouri, Ioannis Kapris | **Independent Direction of Civil Protection, Region of Attica, Greece, National Observatory of Athens, Greece** GOBEYOND: Advancing GeO and Weather Multi-Risk Impact-Based Early Warning and Response Systems for Rapid Deployment of First Responders in the EU and Beyond
12:35 – 12:40	Georgios Tsounis, Nektarios Kaftanakis, Vasileios Lainas, Vasileios Pyrkatis, **Anastasios F. Mavrakis** | **Hellenic Ministry of Education, University of West Attica, Greece** Weather Conditions During Passenger Sunk Ships (Technological Disasters) in the Aegean Sea
12:40 – 12:45	**Anastasios F. Mavrakis**, Luca Salvati | **Hellenic Ministry of Education, University of West Attica, Greece, Sapienza University of Rome, Italy** Completion Em-Dat Database Records Regarding Natural and Technological Disasters in Greece
12:35 – 12:40	Georgios Tsounis, **Anastasios Mavrakis** | **Hellenic Ministry of Education, University of West Attica, Greece** A Review Of Free Available Greek Web Tools Concerning Precaution Measures For Secondary Education Students
12:40 – 13:30	

13:30 – 14:30 **Light Lunch Break**

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Session 6

26.09

Synergy

Amphitheater "Ioannis Kapodistrias"

Chair:	**Ilias Argyris, Ermioni Gialiti**
14:30 – 14:45	**Dimitris Diagourtas,** Giorgos Eftychidis, Leonidas Perlepes, Kostas Kandakis, Aggelos Iliakidis, Daniel Segura, Aggelos Aggelis, Nikos Siagas, Antonis Kostaridis, Zoi Papavramopoulou, Dionisios Mantas, Lykourgos Antonopoulos | **Satways Ltd, Greece, COSMOTE S.A. Greece** Innovative Civil Protection System of Orchomenos Municipality
14:45 – 15:00	**Panagiotis Michalis**, Spyridon C. Athanasiadis, Lazaros Karagiannidis, Eleftherios Ouzounglou, Angelos Amditis | **Institute of Communication and Computer Systems – ICCS, National Technical University of Athens, Greece** Pathway to Standardisation Activities in Crisis Management Area

Workshop

26.09

15:00- 17:00

"Co-Protect, the Greek Cluster for Civil Protection"

In the era of climate change and the increased frequency and intensity of natural phenomena associated with catastrophic outcomes, the need for comprehensive solutions is more pressing than ever to manage the associated risk. **CO-PROTECT**, is co-financed by the European Union and national resources, under the auspices of EPANEK, aiming to create the Greek cluster for civil protection technological solutions. The project is coordinated by the **Satways Ltd**, aiming to strengthen cooperation between Greek companies that pioneer the development of innovative technological solutions to deal with natural and man-made disasters with an emphasis on disaster and crisis management caused by earthquakes, floods and forest fires, as well as in the protection of critical infrastructures. Through CO-PROTECT, the 20 SMEs with the collaboration of 6 public Academic and Research organizations are working on possible synergies to create integrated solutions from the combination of specialized products developed by each company. In this way, CO-PROTECT's SMEs can collectively be more competitive both in the Greek and the European as well as the international market.

A second key objective of the project is to develop a data, process and service interoperability model using common standards between the various technical solutions of each partner in order to achieve both the integration of the individual products they have in more complex systems and to ensure cooperation between systems developed by Greek companies on a local, regional and national scale. Interoperability of systems is important for agencies to communicate with each other, share information and cooperate during crises.

The CO-PROTECT workshop, organized as part of the International Conference SafeAttica 2023, will give the opportunity to participants to get to know the technologies developed by the companies of the cluster, to explore possible synergies (if they belong to the research or academic community) and to consider possible solutions in problems that may concern them (since they represent management and self-government bodies). In addition, the importance of interoperability between companies' products and solutions, using common standards, for effective crisis response will be discussed. Finally, the infrastructure created to demonstrate the integrated solutions of Greek companies for dealing with natural and man-made disasters will be presented, namely:

The Greek cluster in the field of Civil Protection (Satways)
The Civil Protection Systems Interoperability Framework (Space Hellas)
Earthquake Crisis Management Tools (Satways)
Flood management and response tools (Telenavis)
Forest Fire Management Tools (Satways)
Critical infrastructure protection tools (European Dynamics)

Intro Presentations:

Ilias Gkotsis, George Eftychidis, Dimitris Diagourtas | **Satways Ltd, Greece**
Cluster of Interoperable and Holistic Civil Protection Systems

Eirini Marinou | **Geosystem Hellas, Greece**
Experimental development and operation

European Union
European Regional Development Fund
HELLENIC REPUBLIC
Ministry of Economy and Finance
Special Secretariat for ERDF & CF Programmes
Managing Authority of "Competitiveness" Programme
GENERAL SECRETARIAT FOR RESEARCH AND INNOVATION
EPAnEK 2014-2020
OPERATIONAL PROGRAMME
COMPETITIVENESS
ENTREPRENEURSHIP
INNOVATION
ΕΣΠΑ 2014-2020
ανάπτυξη - εργασία - αλληλεγγύη
Partnership Agreement
2014 - 2020
Co-financed by Greece and the European Union

17:00 – 17:15 **Coffee Break**

Session 7

human - tech

26.09

Amphitheater "Ioannis Kapodistrias"

Chair: **Lazaros Filippidis, Christina Patitsa**

17:15 – 17:30 **Paraskevi Papadopoulou**, Stella Apostolaki | **The American College of Greece**
Exploring the Role of Artificial Intelligence towards Reducing the Climate Change Impacts on Public Health

17:30 – 17:45 **Christina Patitsa**, Konstantinos Mitrou, Spyros Sapounas, Panagiotis Damaskos, Venetia Giannakoulis, Vasiliki Theocharidou, Stavros Kalogiannidis | **National Public Health Organization, Greece, National and Kapodistrian University of Athens, University of Western Macedonia, Greece**
Distance Education and Lifelong Learning in Mental Health Issues for Front-line Health Professionals and First Responders of Refugees' Camps during Pandemic

17:45 – 18:00 **Lazaros Filippidis**, Peter J Lawrence, Edwin R. Galea, Marcello Marzoli, Stefano Marsella | **University of Greenwich, U.K., Ministero dell'Interno, Corpo Nazionale dei Vigili del Fuoco, Italy**
Notifying the Public: Evacuation Simulation and Emergency Services Actions

18:00 – 18:15	**Maria Zacharopoulou**, Stamatina Tounta, Despoina Bafi, Marianthi Karatzia, Issaak Parcharidis | **Harokopio University, Greece, National Technical University of Athens, Greece** Water Quality Monitoring Using Sentinel 2 Satellite Data During Wet and Dry Season in the Lakes of the Region of Central Greece
18:15 – 18:30	**Georgia Kalantzi**, Athanasios Partozis, Stefanos Stefanidis, Stergios Diamantopoulos | **OMIKRON Environmental Consultants SA, Greece** An Integrated Platform for Natural Hazard Risk Management at Local Level: The LocalPro Project
18:30 – 18:45	**Lydia Prokopiou**, George Papadakis | **Technical University of Crete, Greece** A Major Accident Database: Analyzing Formal Data of Past Chemical Incidents towards More Reliable Statistics
18:45 – 19:00	**Zacharias Karantonis**, Olympia Papaevangelou, Ioannis Papadomarkakis, Theodora Skorda, Stavros Kalogiannidis | **University of Western Macedonia, Greece, Hellenic Ministry of Education and Religious Affairs** Armed attacks on educational institutions: A Global perspective
19:00 – 19:15	Antonios Antoniades, Panagiota Fragalioti, Aikaterini Tsoukala, **Costas Antoniades** | **National and Kapodistrian University of Athens, Greece** Assessment of Natural Disasters and Climate Crisis, Greece 2020 – 2022

Special Session

Attica

27.09

Amphitheater “Ioannis Kapodistrias”

Chair:	**Alexia Tsouni, Palaiologos Palaiologou**
09:00 – 09:15	Charalampos (Haris) Kontoes, Anastasios Anastasiadis, **Georgios Panagopoulos**, Constantinos Loupasakis, Konstantinos Chousianitis, Nikolaos Stathopoulos, Emmanouil Kirtas, Evi Riga, Kyriazis Pitilakis, Christos Karakostas, Sotiria Stefanidou, Konstantinos Papatheodorou, Elissavet Chatzicharalampous, Agavni Kaitantzian, Eleni Grigorakou | **National Observatory of Athens, Greece, Aristotle University of Thessaloniki, Greece, International Hellenic University, Greece, National Technical University of Athens, Greece, Earthquake Planning and Protection Organization of Greece** The Application of a Holistic Methodology for the Seismic Risk Assessment in the Region of Attica, Greece
09:15 –09:30	**Ioanna Triantafyllou**, John Tsaloukidis | **Center for Security Studies (KEMEA), Greece** Major Hazards Affecting the Île-De-France and Attica Regions and Risk Mitigation Policies: Preliminary Results of the Pantheon Project

09:30 – 09:45	**Alexia Tsouni,** Stavroula Sigourou, Vasiliki Pagana, Panayiotis Dimitriadis, Theano Iliopoulou, G.-Fivos Sargentis, Romanos Ioannidis, Efthymios Chardavellas, Dimitra Dimitrakopoulou, Nikos Mamasis, Charalampos (Haris) Kontoes, Demetris Koutsoyiannis | **National Observatory of Athens, Greece, National Technical University of Athens, Greece** Multi-Parameter High-Resolution Flood Risk Assessment in the Region of Attica
09:45 – 10:00	**Palaiologos Palaiologou**, Dimitrios Zianis, Anastasia Pantera, Andreas Papadopoulos, Stavros Zografakis | **Agricultural University of Athens, Greece** Post-Fire Vegetation and Regeneration & Proposed Fuel Management on the Burnt Areas of 2021 Varibobi Wildfire
10:00 – 10:15	**Anastasia Yfantidou**, Melpomeni Zoka, Stella Girtsou, Martha Kokkalidou, Michail-Christos Tsoutsos, Nikolaos Stathopoulos1, Charalampos (Haris) Kontoes | **E National Observatory of Athens, Greece, Cyprus University of Technology** Fire Risk Assessment at a Building Block Level: the Case of Mandra, Attica Region, Greece
10:15 - 10:45	**Invited Talk |** Chair: Gerasimos Papadopoulos
	Andrey Babeyko, *GFS Helmholtz-Zentrum Potsdam, Germany* **Real-time GNSS for Rapid Rupture Inversion and its Implication for Tsunami Early Warning and Ground Shaking Prediction**

Sessions 9

forest fires

27.09

Chair:	**Vasileios Martzaklis, Nikolaos Kalapodis**
10:45 – 11:00	**Gorkem Gokhan Arpakci**, Alberto Croci, Paola Allamano, Edoardo Arnaudo, Claudio Rossi | **WaterView srl, Italy, Politecnico di Torino, Italy, LINKS Foundation, Italy** A Low-Cost AI-based Smoke and Fire Detection System for Early Warning
11:00 – 11:15	**Petros Papakalos** | **Draeger Hellas** Timely and Accurate Geographical Localization of Forest Fires

11:15 – 11:30	**Coffee Break**

Round Table

11:30- 13:30

27.09

"The contribution of science and technology to forest fire early detection and response"

Presentations by representatives of research and business organizations followed by open discussion.

***Panel**:*
***Gerasimos Papadopoulos**, Hellenic Mediterranean University, Board of Directors, Member*
***Theodoros Giannaros**, National Observatory of Athens, Institute for Environmental Research & Sustainable Development, Researcher*
***Marios Anagnostou**, Ionian University, Faculty of Information Science & Informatics, CmodLab, Researcher*
***Aristotelis Papadopoulos**, Fire Brigade*
***Nikos Passas**, Region of Attica, Independent Direction of Civil Protection Civil Protection, Director*
***Dimitris Diagourtas**, Satways*

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13:30 – 14:30 **Light Lunch Break**

Chair:	**Aristeidis Bozas, Nikolaos Kalapodis**
14:30 – 14:45	**Irene Gamatsi** | **Hellenic Society of Plastic Reconstructive & Aesthetic Surgery** Burn Injuries in Greece
14:45 – 15:00	**Sofia Papadopoulou** | **Hellenic Society of Plastic Reconstructive & Aesthetic Surgery** Burn Mass Casualty Incidents: National Preparedness Plans and Connection to European Response Plans
15:00 – 15:15	**Alexandridis Vasileios**, Kalantzi Georgia, Stefanidis Stefanos, Theodoridou Theodora, Diamantopoulos Stergios | **OMIKRON Environmental Consultants SA, Greece, Greece** AI-FIREMAP: An AI-Based Tool for Smart Sensor Placement
15:15 – 15:30	**Aristeidis Bozas**, Georgios Sakkas, Yiannis Kouloglou, Anastasia Moumtzidou, Nikolaos Kalapodis, Konstantinos Demestichas, Ilias Gialampoukidis, Alexandros Giordanis, Iosif Vourvachis, Stefanos Vrochidis, Ioannis Kompatsiaris | **Centre of Research and Technology Hellas, Center for Security Studies (KEMEA), Greece, Agricultural University of Athens, Greece, Hellenic Rescue Team** Social Media Sensing for Forest Wildfires - A Case Study from Greece

15:30 – 15:45	**Konstantinos Spyropoulos**, Efi Simou | **Hellenic Fire Brigade, University of Western Attica, Greece** Knowledge and Effectiveness of 112: The Case of the 2021 Forest Fire in Ancient Olympia
15:45 – 16:00	**Michalis Diakakis**, Spyridon Mavroulis , Emmanuel Vassilakis Vassiliki Chalvatzi | National and Kapodistrian University of Athens, Greece | **National and Kapodistrian University of Athens** Estimating the Possibility of Debris Flow Occurrence in a Post-Fire Environment. The Case of Schinos, Greece
16:00 – 16:15	**Nikolaos Kalapodis**, Danai Kazantzidou-Firtinidou, Mariza Kaskara, Georgios Sakkas | **Center for Security Studies (KEMEA), Greece, National Observatory of Athens, Greece** Fire Up the Transdisciplinary Dialogue for Wildfire Risk Management
16:15 – 16:30	Georgios Tasionas, Vasileios Drosos, **Ioannis Koukoulos**, Konstantinos Sourlamtas | **Democritus University of Thrace, Greece, Lund University, Sweden** The Role of Remote Sensing in the Assessment of a Post Fire Event. Case Study: Wildfire in Ancient Olympia 2021
16:30 – 16:45	**Nektaria Evangelia G. Siampou**, Vasileios Martzaklis | **National and Kapodistrian University of Athens, Greece** Evaluation of New Technologies in Disaster Management Strategies from Design to Implementation. Fire Management in Greece
16:45 – 17:00	**Coffee Break**

Sessions 10

Education- Perception

27.09

Chair:	Paraskevi Georgiadou, Foebe Speis
17:00 – 17:15	**Paraskevi Georgiadou**, Dimitra Pinotsi, Michail Chalaris, Maria Roussi, Antonis Targoutzidis | **Hellenic Institute for Occupational Health and Safety (ELINYAE), International Hellenic University, Greece** Training Needs Analysis for Civil Protection in Greece
17:15 – 17:30	Georgia Solomonidou, Evangelos Katsaros, Georgie Boustras | **Centre of Excellence In Risk and Decision Sciences - European University Cyprus** Emergency Management by Communities' Interaction through Youth (EM-CITY)
17:30 – 17:45	**Foebe Speis**, Alexia Grampa, Andreas Metaxas, Nikolaos Vlassiadis, Christina Lekka, Assimina Antonarakou, Emmanoul Vassilakis, Vasiliki Alexoudi, Eleyfteria Stamati, Konstantinos Papaspyropoulos, Sotirios Moraitis, Efthymios Lekkas | **National and Kapodistrian University of Athens, Greece, Creta Maris Resort, Hersonissos, Crete, Greece** Tourist Perceptions and Disaster Preparedness: The Case Study of Creta Maris Resort Hotel Unit in Crete
17:45 – 18:00	Olympia Papaevangelou, Soultana Rousaki, **Eirini Eleni Nikolaou**, Fotios Chatzitheodoridis, Stavros Kalogiannidis | **Hellenic Ministry of Education and Religious Affairs, University of Western Macedonia, Greece** Utilizing educational institutions' systems as a focal point for the management of risks and disasters : A Case Study of Greece

17:30 – 17:45 **Closing**

SafeAttica 2023

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proceedings

oral presentations

BEST PRACTICES OF STATE BODY HANDLING FOREST FIRES DURING THE PRE-DISASTER PHASE. THE CASE OF MOUNT PENTELI (19-26 JULY 2022)

Ioannis Kapris[1], Areti Plessa[1], Nikos Passas[1]
[1,] Independent Direction of Civil Protection, Region of Attica, (Greece).
(E-mail: ikapris@patt.gov.gr, aplessa@patt.gov.gr, npassas@patt.gov.gr)

ABSTRACT
This paper discusses the causes, impacts, and effectiveness of biotic, abiotic, and infrastructure protection planning related to the fire that occurred at Mount Penteli in July 2022, with a focus on the operational management of the second-degree state Civil Protection body. Research indicates that the fire was caused by a combination of warm and dry weather, high temperatures, and winds, known as Hot Dry Windy Weather. The fire had a significant impact on the local natural environment, but had relatively little effect on buildings and infrastructure due to factors such as dilute fuel and resilient buildings. Overall, the actions of the state body during the pre-disaster stage were effective but with room for improvement given the challenges of the accelerating climate crisis. In conclusion, it is imperative to conduct a thorough analysis of the causes, impacts, and protection planning for citizens, property, and the environment concerning the Mount Penteli fire in July 2022. Such an analysis should fall under the purview of the state civil protection body of the second-degree local government during the pre-disaster stage. This examination is critical and decisive for fully understanding the incident, enhancing emergency response, improving interoperability, and updating strategies for prevention, preparedness, and resilience against future disasters and crises in the Attica region.

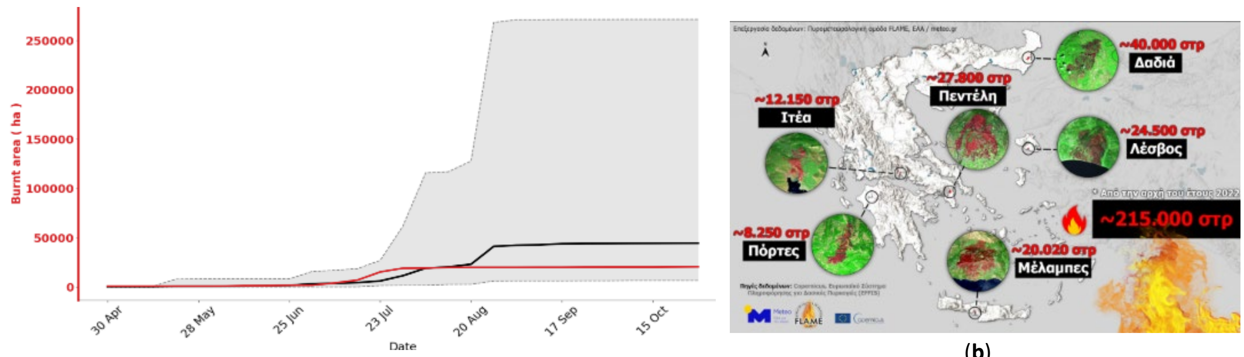
Keywords: Civil Protection, Forest Fires, Prevention, Preparedness

1. INTRODUCTION

The fire that broke out in Mount Penteli in July 2022 was a significant forest fire in Greece that year [1]. This essay emphasizes the significance of exploring the Mount Penteli fire under the context of operational management of the State Civil Protection Body of the Second Degree during the pre-disaster stage, which involves prevention and preparedness.

During the summer of 2022, several European countries experienced extreme temperatures as well as large burned areas as a result of forest fires. Analyzing the climate data from Copernicus Climate Change Service (C3S) highlights the fact that the summer of 2022 in Europe was the hottest ever recorded. In summary, the fire season of the year 2022 in Europe, was characterized by unprecedented extreme weather conditions favorable to the occurrence of fires, due to extremely high temperatures and periods of prolonged drought [2].

The fire season of the year 2022 in Greece had two main characteristics: a) the amount of total burned areas was less than the corresponding average and b) the prevalence of almost normal weather conditions of fires. According to data from the European Forest Fire Information System (EFFIS), the total burnt area in Greece from 1 January to 31 October 2022 was estimated at around 20,000 hectares, which corresponds to approximately 50% of the average annual burnt area in the period 2006 to 2021 [3,4,5].



(**a**) (**b**)

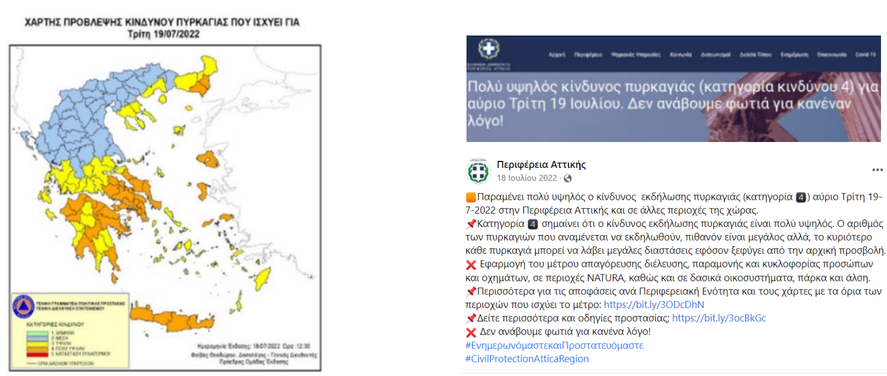
Figure 1. (**a**): Cumulative burnt areas in Greece during the fire season of 2022 (red line) compared to the long-term average 2006 – 2021 (black line). Gray shading represents the range of burnt area data for the period 2006 - 2021. Source: Copernicus Climate Change Service (C3S). (**b**) The largest forest fires for the year 2022 [2].

Regarding the outbreak of the forest fire in Penteli in July 2022, the Independent Directorate of Civil Protection, implemented in their entirety, the planned actions of the Prevention stage of the Disaster Management Cycle, as defined in the current legislation [6,7,8,9,10,11].

2. METHOD

On July 18, 2022 (one day before the incident), during the Preparedness stage, the Independent Directorate of Civil Protection implemented measures to inform the public about the high risk of fire. They posted an update on the Region of Attica's website (in the specially designed section on Civil Protection), on social media networks (Facebook, Twitter), and on the Civil Attica application for Android OS, providing relevant protection instructions.

They also sent documents, informative SMS messages, and emails to critical services, involved bodies and organizations, as well as businesses on its Contractors' Register, with attached files such as maps and letters from the G.S.C.P. The purpose was to inform them about the increased risk of fire on July 19, 2022.



(**a**) (**b**)

Figure 2. (**a**): Fire Risk Prediction Map for 19/07/2022, General Secretariat for Civil Protection (**b**): Informing the public by posting on the website of the Region of Attica, at social media networks.

Indicatively, it is mentioned that from the Independent Directorate of Civil Protection documents, sms and e-mails were received by the involved bodies mentioned in the table below, whenever the risk for fire is high (cat. 3), very high (cat. 4) or in an alarm situation (cat. 5), always according to the indicators of the G.S.C.P. are:

Table 1. Stakeholders & means of updating

Document	SMS	E-mail
-	Campgrounds	Campgrounds
-	Agricultural Cooperatives-Beekeepers	Agricultural Cooperatives-Beekeepers
Municipalities	Majors	Majors
	Deputy Majors	Deputy Majors
General Police Direction of Attica	Directions of Traffic Control	Directions of Traffic Control
	Forest Department	Forest Department
Fire Brigade	Fire Brigade	Fire Brigade
Port Authority	Port Authority	Port Authority
Involved agencies of the Attica region	Involved agencies of the Attica region	Involved agencies of the Attica region

The Independent Directorate of Civil Protection had activated the readiness stage based on its design since the fire risk index had been maintained in category 4 - very high risk, from July 14, 2022 to July 30, 2022. This means that the human resources and the project machinery-vehicles of the Contractors' Register were already on alert and waiting, and in specific locations, the project machinery-vehicles such as water trucks, loaders, JCB, OX, etc., of contractors were also present.

3. RESULTS AND DISCUSSION

Examining the fire at Mount Penteli under the scope of operational management of the State Civil Protection Body of the Second Degree during the pre-disaster stage is important for several reasons. Firstly, it allows for an assessment of the response of civil protection authorities and the identification of areas for improvement. This analysis and investigation can help prevent future forest fires and ensure even more effective responses to future events. Secondly, it provides valuable information for researchers and policy makers to develop strategies to reduce the risk of forest fires in Greece, particularly in mixed urban and green environments like that of the Penteli area. Finally, examining the fire on Mount Penteli during the pre-disaster stage is particularly important for the local community as it provides information about the cause of the fire and measures that can be taken to prevent similar incidents in the future.

4. CONCLUSION

The forest fire that occurred in Mount Penteli in July 2022 was a significant event among the forest fires that took place in Greece that year. While it is widely acknowledged that extreme heatwaves and prolonged droughts are the major contributing factors to such incidents, there is a lack of literature that examines the pre-disaster operational management and response of the State Civil Protection Body of the Second-Degree Local Government. Further research is necessary to better understand the challenges faced by this body and its role in preventing and preparing for forest fires. An investigation of the perspective of the State Civil Protection Body of the Second Degree could lead to the development of more effective strategies for prevention, preparedness and enhanced interoperability, ultimately improving the safety and security of local communities in the face of future forest fires.

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BEST PRACTICES OF STATE BODY HANDLING FOREST FIRES DURING THE RESPONSE PHASE. THE CASE OF MOUNT PENTELI (19-26 JULY 2022)

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ABSTRACT
The paper discusses the biotic, abiotic environment, and infrastructure response actions, in relation to the fire that occurred at Mount Penteli in July 2022. It analyzes the causes and impacts of the fire and evaluates the effectiveness of the state Civil Protection body of second degree in managing the fire incident, at the response phase. According to the research, the fire was caused by a combination of warm and dry weather, high temperatures, and winds. Although the fire had a significant impact on the local natural environment, the damage to buildings and infrastructure was minimal due to the relatively dilute fuel and the resilience of the buildings. The firefighting forces successfully managed the fire. The state body's actions during the incident were effective, but could be improved in light of new data and the challenges posed by the accelerating climate crisis. The paper concludes that a thorough examination of the causes, impacts, and response actions for the protection of citizens, property, and the natural environment during the response phase is crucial for understanding the incident and improving emergency response, interoperability, and prevention strategies in the Region of Attica against future disasters and crises.
Keywords: Civil Protection, Forest Fires, Response, Immediate Response

1. INTRODUCTION

The Mount Penteli forest fire that occurred in July 2022 was a significant event in Greece that year [1]. This essay explores the importance of investigating the fire under the operational management of the State Civil Protection Body of the Second Degree during the response phase.

Throughout the summer of 2022, many European countries experienced extreme temperatures and large burned areas due to forest fires. Data from the Copernicus Climate Change Service (C3S) shows that this was the hottest summer ever recorded in Europe. The 2022 fire season in Europe was characterized by unprecedented extreme weather conditions, with high temperatures and prolonged drought periods, making it favorable for fires to occur [2].

The 2022 fire season in Greece had two main characteristics: a) the total burned area was lower than the corresponding average, and b) there were almost normal weather conditions for fires. According to the European Forest Fire Information System (EFFIS), the total burned area in Greece from January 1 to October 31, 2022, was approximately 20,000 hectares, which is about 50% of the average annual burned area between 2006 and 2021 [3,4,5].

Regarding the outbreak of the forest fire in Penteli in July 2022, the Independent Directorate of Civil Protection implemented all planned actions of the Response stage of the Disaster Management Cycle as defined in current legislation [6,7,8,9,10,11,12,13,14].

2. METHOD

At the start and during the event, the Autonomous Directorate of Civil Protection of the Attica Region was called upon to assist with water-carrying vehicles and construction machinery in the Fire Service that was already operating at the front line of the fire in Penteli (in addition to the construction machinery that was already on standby at Fire Stations and Municipalities that provided assistance from the first moment). Specifically, from 17:30 on July 19th, 2022, the following were requested to reinforce the firefighting forces, in chronological order, by the P.E.K.E. of the Fire Brigade Headquarters of the Regional Fire Brigade Administration of Attica:

- Eighteen (18) 20-ton water-carrying vehicles and five (5) buses
- One (1) D9 bulldozer
- Three (3) rubber loaders
- Three (3) JCB-type construction machines
- One (1) D8 bulldozer
- One (1) additional 20-ton water-carrying vehicle

The above construction machinery and vehicles were added to the vehicles that were already on standby from the previous day of the fire to reinforce the Fire Brigade forces, specifically from the Fire Brigades of Markopoulo, Kropi, and Nea Makri and the Municipalities of Penteli, Rafina-Pikermi, and were active in extinguishing the fire on July 19th, 2022.

The total number of water-carrying vehicles and construction equipment from the Attica Region that contributed to extinguishing the fire on July 19, 2022 was forty (40). Additional construction equipment and vehicles requested by the Fire Brigade headquarters began to be released gradually from July 21 to July 26, 2022. While the reserve construction equipment and vehicles, which had been made available by the Autonomous Directorate of Civil Protection at the prevention stage and as long as the danger index remained high, very high, and in a state of alert, continued to remain in their positions, following requests from the Fire Brigade and other agencies.

Immediately after the onset of the natural catastrophic phenomenon, and as long as the area where the fire phenomenon was unfolding was particularly vulnerable and high-risk due to the mixed land use, coexistence of forested areas with residences, stores, and critical structures (children's hospitals and institutions), in addition to the fact that the fire was spreading rapidly due to the extreme fire-weather conditions prevailing in the area, from the regional unit of Northern Sector (Penteli) to the regional unit of Eastern Attica (Anthousa, Pallini, and Drafli), a Mixed Extraordinary Coordinating Body of Civil Protection for Eastern Attica and the Northern Sector was called upon. The members of SΟΠΠ were notified and invited via telephone communication, SMS, and e-mail.

In the context of the excellent cooperation between the Autonomous Directorate of Civil Protection and the Fire Brigade, the Service provided employees, upon oral request, to cover 24-hour shifts at the mobile operational center "OLYMPUS" to facilitate the work of the Fire Brigade, although this is not legally provided for.

Organized Evacuation of Citizens - The assistance of the Autonomous Directorate of Civil Protection of the Attica Region.

On the organized evacuation of citizens on July 19, 2022, following the recommendation and suggestion of the head of the Fire Service, the Autonomous Directorate of Civil Protection of the Attica Region participated by providing five (5) buses from the Registry of Contractors and proceeded to the safe transportation of:

Fifty-five (55) sick children and their guardians from Penteli Children's Hospital to Aglaia Kyriakou and Children's Hospital "Agia Sophia" and returned.

Thirty-six (36) elderly people from the Aris Elderly Care Unit in Gerakas to the Thalpi Elderly Care Unit in Dionysos. While seven (7) elderly people were transferred to hospitals by ambulance due to their inability to move. The elderly were returned to the Aris Elderly Care Unit on July 22, 2022, after the assurance of the Fire Service for their safety, at the expense and responsibility of the Attica Region.

(**a**) (**b**)

Figure 1. (**a**), (**b**): Water Vehicles during the response stage of the incident

3. RESULTS AND DISCUSSION

It is essential to examine the fire that occurred at Mount Penteli under the operational management of the State Civil Protection Body of the Second Degree during the response phase for several reasons. Firstly, this examination offers an opportunity to evaluate the response of civil protection authorities and pinpoint areas that require improvement. This analysis and investigation can also help to prevent future forest fires and ensure a more effective response to future events. Secondly, the examination of the fire at Mount Penteli provides valuable information for researchers and policy makers, who can utilize this data to devise strategies that minimize the risk of forest fires, particularly in mixed urban environments and green incidents like the Penteli area. Finally, this examination is particularly important for all involved parties as it provides information regarding the fire's cause and suggests effective measures to mitigate similar incidents in the future.

4. CONCLUSION

In July 2022, the forest fire that occurred at Mount Penteli was a significant event in Greece that year. Although extreme heatwaves and prolonged droughts are widely considered to be the primary factors behind forest fires, there is limited literature on the State Civil Protection Body of the Second-Degree Local Government's response management during response phase. Further research is necessary to better understand this body's role and challenges in the immediate response to forest fires. Examining the perspective of the State Civil Protection Body of the Second Degree can help develop more effective and efficient strategies for preventing and responding to future forest fires, improving interoperability, and enhancing the safety and security of local communities.

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BEST PRACTICES OF STATE BODY HANDLING FOREST FIRES DURING THE RECOVERY PHASE. THE CASE OF MOUNT PENTELI (19-26 JULY 2022)

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ABSTRACT

The paper explores the response measures taken in relation to the forest fire that occurred in Mount Penteli during July 2022. It assesses the causes and effects of the fire and evaluates the efficiency of the second-degree State Civil Protection body in managing the incident during the recovery stage. The study shows that the fire resulted from a combination of hot and dry weather, high temperatures, and winds. While the fire had a significant impact on the local ecosystem, the damage to infrastructure and buildings was minimal due to the relatively sparse fuel and building resilience. The firefighting team was successful in controlling the fire. Although the state body's response actions were effective, the study suggests that they could be enhanced in light of new information and the challenges posed by the accelerating climate crisis. The paper concludes that a comprehensive analysis of the causes, effects, and relief measures for safeguarding citizens, property, and the environment during the recovery stage is crucial for understanding the incident and improving, coordination and recovery strategies in the Attica region against potential disasters and crises.

Keywords: Civil Protection, Forest Fires, Recovery, Relief

1. INTRODUCTION

The forest fire that occurred at Mount Penteli in July 2022 had a significant impact in Greece that year [1]. This essay emphasizes the importance of investigating the fire's recovery phase under the operational management of the State Civil Protection Body of the Second Degree. During the summer of 2022, numerous European countries experienced extensive burned areas due to forest fires, with record-breaking temperatures reported by the Copernicus Climate Change Service (C3S). The fire season in Europe during that year was marked by unprecedented extreme weather conditions, including high temperatures and prolonged drought periods, which contributed to the favorable conditions for fires to occur [2].

The 2022 fire season in Greece had two main characteristics: a) the total burned area was lower than the corresponding average, and b) there were almost normal weather conditions for fires. According to the European Forest Fire Information System (EFFIS), the total burned area in Greece from January 1 to October 31, 2022, was approximately 20,000 hectares, which is about 50% of the average annual burned area between 2006 and 2021 [3,4,5].

Regarding the outbreak of the forest fire in Penteli in July 2022, the Independent Directorate of Civil Protection implemented all planned actions of the recovery stage of the Disaster Management Cycle as defined in current legislation [6,7,8,9,10,11,12,13,14].

2. METHOD

Immediately after the event, the Directorate of Civil Protection of the Region of Attica immediately notified in writing [15] the Directorate for the Restoration of Natural Disaster Impacts of Central Greece, General Directorate for the Restoration of Natural Disaster Impacts (GDAEFI) of the Ministry of Infrastructure and Transport, of the occurrence of the fire incident in order for the above to subsequently issue decision number 254809/GDAEFI-KE/A325/09.08.2022 for "Delimitation of areas and granting of housing assistance for the restoration of damages to buildings caused by the fire of July 19, 2022, in areas of the Regional Units of Northern Sector of Athens and Eastern Attica of the Region of Attica".

Subsequently, the head of the Autonomous Directorate of Civil Protection sent a document to the responsible Deputy Regional Governors in order to establish Committees for Recording and Compensating damages to businesses caused by the forest fire on July 19th, 2022, as provided by the current legislation and other provisions [16].

Furthermore, the Autonomous Directorate of Civil Protection of the Region of Attica proposed the declaration of the affected areas, namely: the Municipality of Rafina-Pikermi, the Municipality of Pallini, and the Municipality of Penteli, in a state of Emergency Civil Protection, by the General Secretariat for Civil Protection of the Ministry of Climate Change and Civil Protection, so that the affected areas can proceed with restoration procedures.

Decision of declaring a state of emergency civil protection was issued for the Municipality of Pallini with no. A883/22.07.2022 (ADA: 6B8D46NPITH-PSAP), for the Municipality of Rafina-Pikermi with no. A882/22.07.2022 (ADA: RX1Y46NPITH-11S), and for the Municipality of Penteli with no. A955/27.07.2022 (6PS546NPITH-XYTH), and its duration was six months, until January 19, 2023, where it was extended for another six months upon request by the respective municipal authorities and our recommendation.

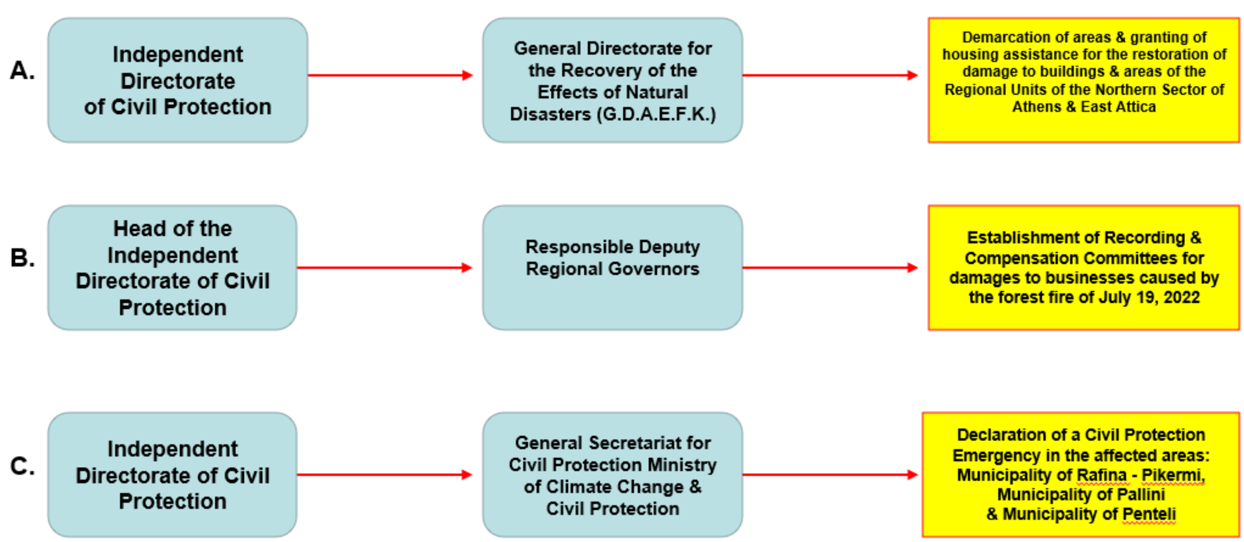

Figure 1. Actions of the Directorate of Civil Protection of the Attica Region during the recovery phase

3. RESULTS AND DISCUSSION

During the recovery phase, it is crucial to investigate the fire that took place at Mount Penteli while under the operational management of the State Civil Protection Body of the Second Degree. This examination serves several purposes. Firstly, it provides an opportunity to assess the response of civil protection authorities and identify areas that need improvement. Moreover, analyzing and investigating this fire can prevent future forest fires and lead to a more effective response to future events. Secondly, researchers and policymakers can benefit from the examination of the Mount Penteli fire by using the gathered data to create strategies that reduce the risk of forest fires, especially in mixed urban environments and green incidents like the Penteli area. Finally, this examination is critical for all parties involved, as it offers insight into the fire's cause and suggests effective measures to mitigate similar incidents in the future.

4. CONCLUSION

The forest fire that took place at Mount Penteli in July 2022 was a significant event in Greece that year. While extreme heatwaves and prolonged droughts are commonly known to be the primary contributors to forest fires, little research exists on the response management of the State Civil Protection Body of the Second-Degree Local Government during the recovery phase. Therefore, additional research is necessary to gain a better understanding of this organization's role and difficulties during the recovery phase of forest fires. Analyzing the perspective of the State Civil Protection Body of the Second Degree can assist in the creation of more effective and efficient approaches to forest fire prevention, response and recovery, improving cooperation and enhancing the safety and protection of local communities.

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ACTIONS AND INITIATIVES OF CIVIL PROTECTION IN THE TERRITORIAL AREA OF PIRAEUS AND THE ARGOSARONIC ISLANDS FOR THE YEAR 2022

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ABSTRACT
The paper discusses the role of the Civil Protection Department of Piraeus and Islands in safeguarding citizens, property, infrastructure, and the environment from natural disasters. Efforts by the Attica Region and the Civil Protection Department aim to enhance disaster preparedness and response. Collaborating with the General Secretariat of Civil Protection, the department has specialized plans for managing floods, snowfalls, forest fires, and earthquakes. Effective communication, cooperation, and coordination among stakeholders are emphasized to address challenges from natural phenomena. Raising public awareness, providing information, conducting exercises, and educating authorities, security forces, fire brigades, and voluntary organizations on risk management are crucial. Integrating these elements with stakeholder coordination represents best practice for effective risk mitigation.

Keywords: Prevention, Preparedness, Field Exercise, Natural Disasters, Civil Protection.

1. INTRODUCTION

Civil protection is the safeguarding of people, the environment, and properties against all types of natural and man-made disasters. In addition to developing forces and equipment to respond to emergencies, its actions also include planning and preparedness for such events. This encompasses conducting risk assessments and establishing protection and rescue plans and procedures.

European Union (EU) action in the field of civil protection aims to:

- Support and complement EU Member States' actions at national, regional and local level in risk prevention, preparation of civil protection personnel and response to natural and man-made disasters;
- Promote fast and effective operational cooperation between national civil protection services and
- Promote consistency in international civil protection works [1].

Greece frequently experiences natural disasters, including earthquakes, forest fires, snowfall, and floods, which vary based on geological profile, relief, and climate. Accurate information is crucial for effective hazard management, enabling immediate stakeholder notification and mobilization of local resources. Objectives involve minimizing casualties, protecting infrastructure and cultural heritage, and assessing damage. Insufficient municipal resources necessitate assistance from higher administrative levels, such as the region.

Knowledge of resources in individual municipalities aids in effective assessment and allocation by higher administrative levels, redistributing resources across areas. Prompt communication with specialized support personnel and voluntary organizations is vital for timely response at the disaster site. The rapid escalation of complexity during catastrophic events requires access to accurate and detailed information and the development of crisis management strategies [2].

Figure 1. Collection of information. Protecting emergency responders, Source: Volume 3, NIOSH Publication No. 2004-144, 2004.

2. METHOD

Planning and conducting exercises are vital for integrated emergency management. Regular exercises ensure thorough testing, training, and evaluation of operational readiness and coordination in managing emergency situations. The "AENEIAS 2022" field exercises in the Piraeus and Islands Regional Unit focused on forest fire suppression and impact management. Well-planned exercises effectively assess the preparedness of the Civil Protection Mechanism in handling imminent or ongoing disasters and their aftermath [3]. The objectives of the exercises are as follows:

- Testing and improving the required cooperation between the organizations involved.
- The test of those involved in a purely urban environment, which gives other peculiarities to the whole project.
- Improving coordination, communications and information management.
- The identification and estimation of the necessary resources (human and material).
- The test of the procedure for convening and operating a Coordinating Local Body (TO) at the site of the incident
- The creation of conditions for simulating emergency situations where decision-making takes place under conditions of increased pressure.
- Preparedness in case of evacuation of the population
- The test of the readiness of volunteer groups and the achievement of cooperation between them.

Kanakia Salamis

The exercise took place on the island of Salamina on June 9, 2022, specifically in the Forest of Agios Nikolaos (Kanakia) in Salamina, Attica (Figure 2). It was selected due to its status as the largest island in the northern part of the Saronic Gulf, situated in close proximity to the Attica coast, featuring a distinctive coastline spanning approximately 100 km. The region exhibits a high degree of fragmentation characterized by numerous bays, peninsulas, capes, beaches, and small islands.

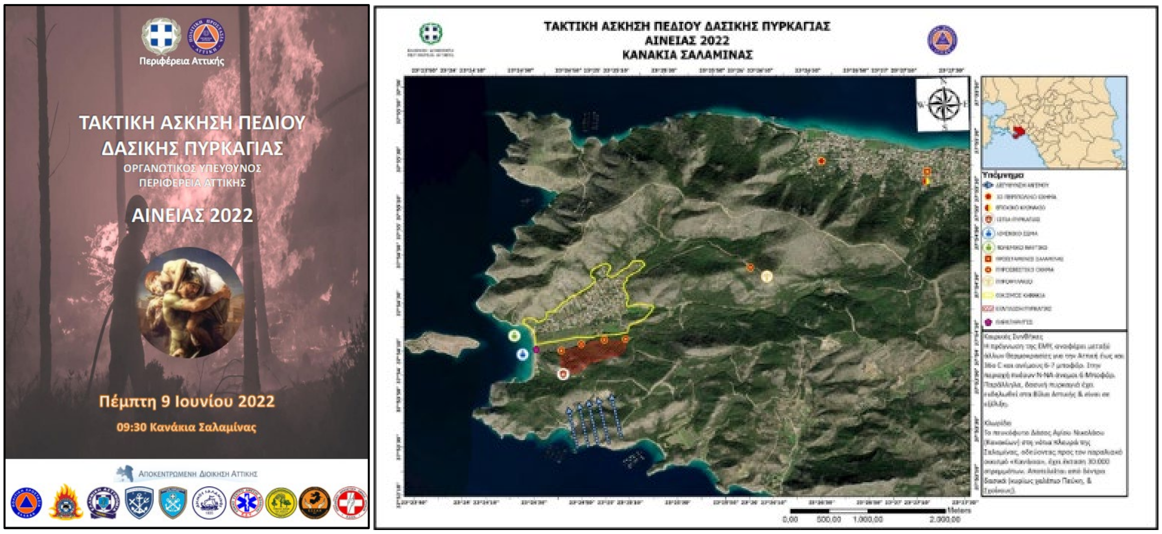

Figure 2.: The cover of the exercise manual and the operational map of the exercise in Kanakia, Salamina. Source: Independent Directorate of Civil Protection of Attica Region [3].

The island features low hills and valleys, along with four main forest areas: Vasilika Batsi Forest (north), Selinia Clay Forest (east), Mavrovouni Forest (northeast), and Perani Aias Club Forest. It also encompasses significant archaeological sites, including the prehistoric acropolis of Kanakia, situated between a pine forest and a rocky promontory near Kanakia settlement beach.

Profitis Ilias, Piraeus

The exercise took place in the Regional Unit of Piraeus, in the Park of Prophet Elias, in Kastella, Piraeus, on June 7, 2022. (Figure 3). The grove of Prophet Elias was created after tree planting efforts that took place in the years 1914 and 1932, during the Occupation and finally in 1948.

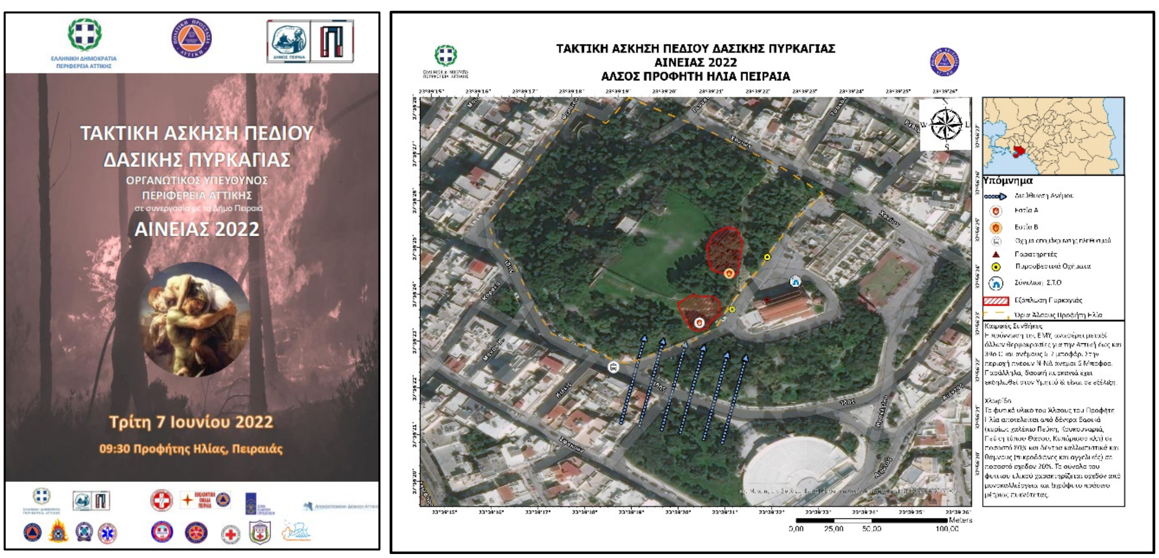

Figure 3.: The cover of the exercise manual and the operational map of the exercise in in the Park of Prophet Elias, in Kastella, Piraeus. Source: Independent Directorate of Civil Protection of Attica Region [3].

The plant material of the Park of Prophet Elias consists of forest trees (mainly Aleppo pine, pine cones, pine trees of Thassos type, cypress, etc.) at a percentage of 80% and ornamental trees and shrubs (oleanders and angelic) at a percentage of almost 20%. In addition, the reason for choosing the area is that it is located within the urban fabric as well as the existence of the Veakeio Theater and the church of Prophet Elias [3].

Online workshop: "Risk identification and risk reduction in Piraeus and islands

The online workshop "Risk Identification and Risk Reduction in Piraeus and Islands" was organized as part of the collaborative research project "Earthquake, Fire, and Flood Risk Assessment in Attica" involving the Region of Attica, the National Observatory of Athens (NOA), and the National and Kapodistrian University of Athens (NKUA). OASP collaborated with NKUA to educate executives, municipalities, and volunteer groups, providing valuable insights on risk identification and reduction [4].

Conducting an informative seminar in Spetses

An information day was organized in Spetses, on September 26, 2022 by the Independent Directorate of Civil Protection, the National and Kapodistrian University of Athens, and the OASP. The event aimed to raise awareness about protective measures against earthquake, flood, and forest fire hazards among citizens, local entities, and voluntary organizations in the Municipality of Spetses. Spetses was chosen as the venue due to its proximity, natural beauty, and historical significance, attracting a significant number of annual tourists [4].

3. RESULTS AND DISCUSSION

The conducted actions served as a successful platform for achieving the set targets and objectives. These exercises in the territorial area of Piraeus and the Argosaronic Islands proved effective in testing the operational planning and enhancing cooperation among the involved bodies. The successful accomplishment of the exercises further fostered interoperability among the stakeholders. These outcomes contribute to the overall preparedness and response capabilities in managing emergency situations. Moving forward, future efforts will focus on civil protection exercises aimed at raising public awareness and promoting self-protection measures. These back-to-back activities will play a vital role in educating the public and empowering them to mitigate risks effectively. In conclusion, these actions yielded positive results by fulfilling the intended objectives. They demonstrated the significance of collaborative initiatives in addressing risk identification and reduction. The accomplishments of these actions provide a solid foundation for continuous improvement in the field of civil protection and emergency management.

4. CONCLUSION

The implemented actions have proven successful in achieving the predetermined targets and objectives. The exercises conducted in the Piraeus and Argosaronic Islands area effectively tested operational planning and strengthened cooperation among participating entities. These actions successful execution further promoted interoperability among stakeholders. These outcomes significantly contribute to overall preparedness and response capabilities in managing emergencies. Future endeavors will focus on civil protection exercises to raise public awareness and advocate for self-protection measures. These activities play a crucial role in educating the public and empowering them to mitigate risks effectively. In conclusion, these actions successfully accomplished their objectives, emphasizing the importance of collaborative initiatives in risk identification and reduction.

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RISK PERCEPTION OF INDUSTRIAL ACCIDENTS INVOLVING DANGEROUS SUBSTANCES IN THE REGION OF ATTICA, GREECE

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ABSTRACT
This paper focusses on risk perception in respect to industrial accidents in Greece. Through a questionnaire survey, it attempts to assess risk perception of industrial accidents compared to other hazards (natural, technological, and others) and to identify main factors that influence risk perception -of industrial accidents and affect risk communication. Our results show that industrial accidents are among hazards that are perceived as less dangerous both for Attica Region in general and at personal level, while earthquakes are perceived as the more dangerous and fearsome hazard. The hazards that respondents fear the most, along with earthquakes, are floods and fires. Knowledge of the protective measures against industrial accidents is low and even less is the percentage of the respondents that have taken self-protection measures, which are both the lowest observed among all hazards. In the case of an industrial accident, an impressively high percentage of respondents (83%) will most probably follow the instructions given by the 112 emergency service. Overall, our findings indicate towards enhancing public awareness, particularly in proximity to industrial installations.

Keywords: risk perception, industrial accidents, technological risks, Attica region

1. INTRODUCTION

Technological disasters are those related to industrial, transport and other (miscellaneous) accidents [1]. Most technological disasters in Greece relate to transport accidents many of which concern water accidents such as sinking of ships carrying migrants (EMDAT data). Industrial accidents involving dangerous substances are rare in Greece compared to other disasters (Figure 1). Emblematic cases are the fire in oil tanks in Kalochori, Thessaloniki, in 1986 and the fire at "Chyma" bulk chemical terminal in Lavrio, Attica, in 2006.

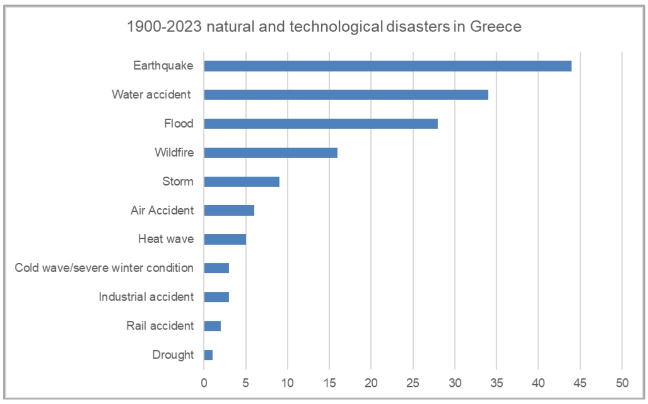

Figure 1. Number of disasters in Greece by type of disaster, based on data from EMDAT.

A distinct category of accidents concerns Seveso-III Directive. There are many Seveso installations in Greece [2], most of them in the region of Attica and mainly at the Regional Unit of West Attica. Many of those are located near populated areas or critical infrastructure, this increasing considerably the risk in case of an accident.

Nonetheless, risk perception and awareness in respect to technological disasters remains a matter to be examined, especially in comparison to other disaster types. Risk perception of individuals may differ considerably from expert risk assessment [3,4] and can be seen through a set of aspects such as awareness, worry and preparedness [5]. For example, terrorism is usually perceived as riskier than traffic accidents despite the actual facts [6]. Factors like personality, age, beliefs, gender, education, knowledge, culture, experience, and trust [7] influence perception, However, according to other studies demographic variables may have weak or inconsistent correlation with risk perception and protective responses [8]. Understanding better how people perceive risks enhances risk communication. However, there are a few studies addressing risk perception of technological threats [8, 9].

Earthquake risk perception is typically high in Greece and there is more knowledge on self-protection measures, due to long efforts at national and local level, however this is hardly the case with technological accidents. To raise awareness about technological disasters, the civil protection exercise “Ktisivios 2023” was organised by the Independent Civil Protection Directorate of the Region of Attica in collaboration with the Hellenic Petroleum Group in April 2023. “Ktisivios 2023” tested operational mechanisms for Natech accidents, simulating an earthquake-induced industrial incident in Attica. Scientific lectures and informational activities took place within the exercise framework to inform a diverse audience including local authorities, NGOs, university students and school students, about industrial accidents. The exercise took place about approximately 1.5 months after the deadliest rail disaster in Greek history in which a head-on collision occurred between two trains south of the Tempe Valley, in the Thessaly region (Tempi train crash).

2. METHODOLOGY

The method used for our research is a questionnaire survey. The questionnaire included 23 questions. Perception of industrial accident risk is examined against seven risks common in Greece: earthquakes, floods, wildfires, heatwaves, frosts, transport accidents and crime. Likert scales were used to measure participants’ attitudes and opinions on a five-point scale, starting from “not at all” at point 1 to “very much” at point 5. The questionnaire was structured into six parts: 1. Perception of industrial accident risk in respect to other types of risks, in terms of psychological, emotional and cognitive dimensions, 2. Previous experience of hazards and disasters, 3. Level of preparedness and knowledge of protection and self-protection measures, 4. Risk governance, 5. Information regarding the participant. The questionnaire was distributed during the exercise “Ktisivios 2023”. To assess the impact of the exercise on risk perception, it was distributed to a wider audience after the exercise. Data collection ended the end of June 2023 and totally 392 questionnaires were collected.
Descriptive statistics were employed to investigate the survey responses and the distribution of the survey variables. Chi-square tests were applied to test whether the differences in risk perception among the survey groups are statistically significant. All statistical analysis were performed using R Statistical Software. In some questions the 1st and the 2nd points of the five-point scale were merged together in the three-point scale standing for "A little", the 3rd point was left alone standing for “Quite” and the 4th and the 5th points were merged together standing for "A lot".

3. RESULTS AND DISCUSSION

Participants were asked to rate how severe they think the impacts of each type of hazard can be to the Region of Attica, to themselves and their close ones as well as how much they fear each hazard. The distribution of respondents across the three-point Likert scale for each of the 8 risks is shown in

Figure 2. Respondents consider earthquake the most fearsome and dangerous hazard both for themselves and for the Region of Attica. Floods and wildfires stand together with earthquakes among the hazards most dangerous to the Region. However, transport accidents and crime are perceived, along with earthquakes, as the most dangerous for the respondent and his/her close ones.

Industrial accidents were included in the group of hazards that are perceived as less dangerous regarding risk at both general and personal level. The percentage of the respondents who fear the industrial accident "a lot", "quite" and "a little" are 41.29%, 23.08% and 35.64%, respectively.

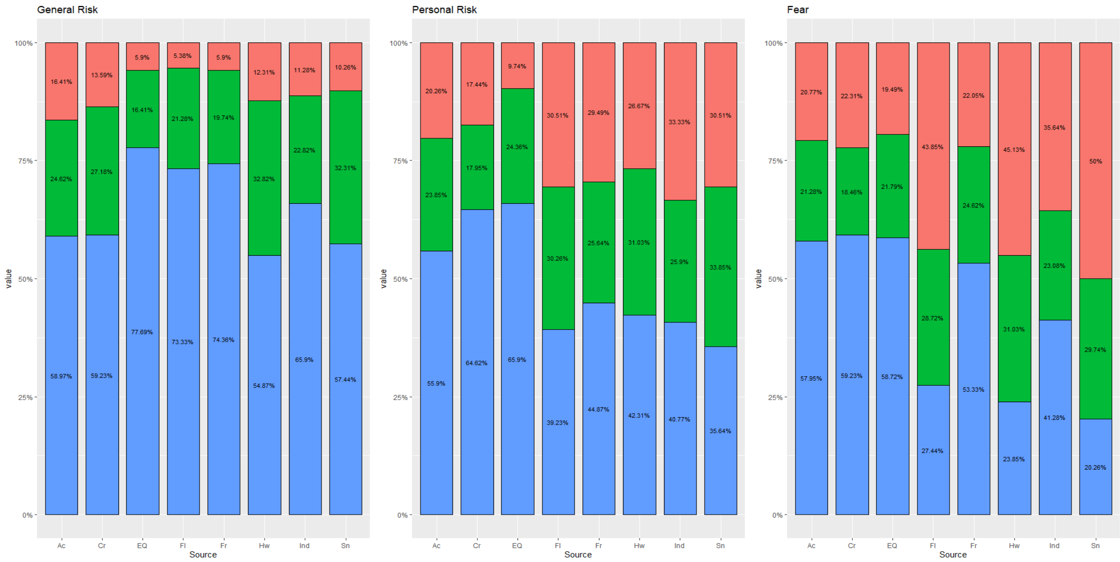

Figure 2 Percentages of responses across the three-point Likert scale for each of the 8 hazards with regard to: risk perception in terms of general impacts (left), risk perception in terms of personal impact (middle), the fear they feel (right). Key: (a) Ac=transport accidents, Cr=crime, EQ=earthquakes, Fl=floods, Fr=wildfires, Hw=heatwaves, Ind=industrial accident and Sn=frost. (b) Salmon="A little", Green="Quite", Blue="A lot".

Based on Chi-square test of independence, age, gender, previous experience, participation to the exercise "Ktisivios 2023" and the capacity in which the respondent participated in the exercise (for example, as a civil protection professional or a first responder), were found to have no effect on risk perception and fear. In respect to industrial accidents, there was no indication of dependence of personal and general risk perception and fear. However, significant differences were obtained among genders in risk perception concerning fear and impacts to the person itself and his/her close ones with men exhibiting lower risk perception and fear. The capacity in which they participated in the exercise and previous experience of industrial accident were found to significantly affect personal risk perception.

Previous experience of an industrial accident has only a 6.9% of the respondents. Statistically significant differences were found in fear of industrial accidents among those who had prior experience compared to those who didn't. The knowledge of the protective measures against industrial accidents (15.1%) is low and even less is the percentage of the respondents that have taken relevant measures, which are both the lowest percentage observed among all hazards. The participants in the survey believe that personalized information (e.g., via 112, email), informative websites, social media, informative signage, television, radio, brochures, press (newspapers, magazines), and friends and family are highly/quite informative regarding preparedness and preventive protection measures at 77.8%, 71.4%, 63.9%, 59.6%, 54.9%, 45.1%, 44.6%, 37.4%, and 29.4%, respectively. Other answers that were provided in the open part of the question include educational activities at specific target groups (e.g., school/work). Specifically, regarding the 112 emergency service which has been used widely during the last years, an impressively high percentage of respondents (83%) will most probably follow the instructions given in the case of an industrial accident. As for the governance, the agents considered responsible for prevention and protection measures against an industrial accident are in order of more responsible to less responsible: the installation, state authorities (ministries, decentralized administrations), the Region, the Municipality, citizens, and volunteer organisations. Overall, the participants place a medium trust to the stakeholders for handling effectively an incident.

4. CONCLUSION

In Attica, risk perception and implementation of self-protection measures in respect to industrial accidents is found low as compared to other risks. As expected, earthquake risk perception is found higher in all respects, while crime and transport accidents were considered more dangerous for the person and his/her close ones. Perception of crime is high in Greece [10] however responses regarding transport accidents may be circumstantial as our research took place immediately after the deadly Tempi train crash. Furthermore, in accordance with the literature [6], previous experience and the role of the person in civil protection system are found to influence the level of risk perception. Low levels of risk perception may be attributed to the rare occurrence of industrial accidents in the Region of Attica. No matter the reason, it is vital to intensify efforts for public awareness and education, especially in areas close to industrial installations.

Personalised information is considered as the most appropriate channel for public information which seems to resonate with the wide acceptance of the 112 outbound emergency communication service. Websites and social media are also considered as significant information sources. In any case, appropriate use of novel media and multiple channels for public information are key for the message to reach everyone. Furthermore, trust to entities responsible for preventing and managing an industrial accident should be enhanced if citizens are to take warnings seriously and act accordingly. In the end, it should be noticed that those are some preliminary findings. Further analysis based on more variables is on the way to provide a better understanding of industrial accident risk perception.

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THE CONTRIBUTION OF SECOND-DEGREE STATE BODY IN HANDLING FOREST FIRES: A CASE STUDY OF THE REGIONAL UNIT OF EAST ATTICA FOR THE PERIOD 2018-2022

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ABSTRACT
The present study constitutes primary research, aiming to gather, consolidate, and highlight quantitative and qualitative aspects concerning forest fires that have occurred in the last five years (2018-2022) within the Regional Unit of East Attica in the Attica Region. The study primarily focuses on the response stage of managing these fires, with a particular emphasis on the role and actions of the Independent Directorate of Civil Protection of the Attica Region. Thus, the stages, roles, and actions of the organization are extensively examined, along with the cases of fires managed during the years 2018-2022, presented with absolute numbers and quantitative analysis of the results.

Keywords: Civil Protection, Forest Fires, Prevention, Preparedness

1. INTRODUCTION
The Regional Unit of East Attica is exposed to a range of natural hazards, including fires, floods, landslides, earthquakes, and severe weather phenomena (such as snowfall and heatwaves), as well as anthropogenic risks like technological accidents [1].

The Regional Unit of East Attica, within the Attica Region, comprises a total of thirteen (13) municipalities. The unit's administrative center is located in Pallini, covering a geographic area of 1,517 km^2. According to the latest census in 2021, the population in the mentioned geographical area is showing an increasing trend. The population growth compared to the 2011 census is approximately 3.26% [2]. The population growth in the Regional Unit of East Attica, along with its diverse geographical area and increasing trend, contributes to the region's vulnerability to natural disasters [1].

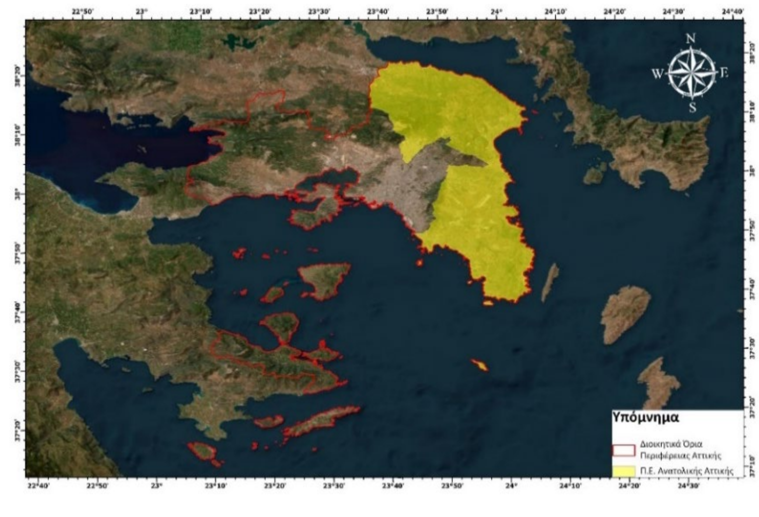

Figure 1: Geographical Boundaries of the Regional Unit of East Attica. [1].

However, the Regional Unit is more severely affected by forest fires and in these cases, particularly during the years 2018-2022, it has been called upon to assist the national civil protection mechanism with its own resources and human capacity [1].

2. METHOD

In the regional unit of East Attica, significant forest fires have been recorded, with the most catastrophic being the Mati wildfire in Nea Makri on July 23, 2018 [3]. This fire has been documented as the deadliest urban wildfire of the 21st century on a European scale, and the second most devastating worldwide to date. Moreover, notable environmentally impactful fires within the study's five-year period include the Varibobi fire on August 3, 2021, and the Penteli fire on July 19, 2022, both resulting in extensive burned forest land [1]. The population of the Regional Unit of East Attica growth compared to the 2011 census is approximately 3.26% [2].
According to statistical data [2], the most populous municipality in the Regional Unit of East Attica is the municipality of Acharnes, followed by the municipality of Pallini. These two municipalities are exposed to the region's most frequent natural disasters, namely wildfires and severe weather phenomena [1]. However, the municipality of Acharnes could be considered more vulnerable due to the extensive coexistence of urban and forested areas. According to the aforementioned legislation, as well as its predecessor, the service of the Independent Directorate of Civil Protection of the Attica Region plays an active role in all stages of the disaster management cycle [6,7,8,9,10,11].

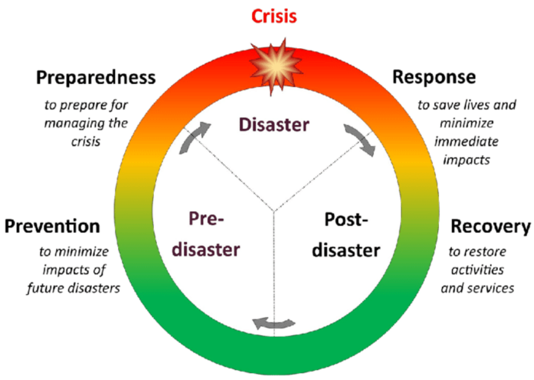

Figure 2: Disaster management cycle [4].

During the period from 2018 to 2023, the Independent Directorate of Civil Protection of the Attica Region, specifically focusing on the geographical area of East Attica, was called upon to respond, manage, and restore extensive natural disasters, primarily encompassing wildfires and severe weather phenomena, including snowfalls in this case. However, for the purposes of this study, the actions of the entity related to forest fires will be analyzed. Specifically, for the years 2018-2022, the entity provided assistance to the Fire Service with vehicles, machinery, and a 24-hour human workforce throughout the events, based upon their request.

In **2018**, the Independent Directorate of Civil Protection of the Attica Region provided assistance in six (6) extensive wildfires spanning from 17.03.2018 to 11.08.2018. During this period, a total of sixty (60) vehicles and machinery were deployed, along with the entire human workforce operating on a 24-hour basis [1,5]. The most significant in terms of area, destruction, and human losses was the wildfire in Mati, N. Voutzas, on 23.07.2018 [3]. For the year **2019**, the Independent Directorate of Civil Protection of the Attica Region provided assistance in ten (10) extensive wildfires spanning from 28.05.2019 to 30.08.2019. During this period, a total of fifty (50) vehicles and machinery were deployed, along with the entire human workforce operating on a 24-hour basis [1,5]. The most significant in terms of area and destruction was the wildfire in Prosilio of Ymittos in the Municipality of Paiania on 12.08.2019 [5]. For the year **2020**, the Independent Directorate of Civil Protection of the Attica Region provided assistance in two (2) extensive wildfires spanning from 16.07.2020 to 09.09.2020. Throughout this timeframe, a total of thirty-three (33) vehicles and machinery were deployed, alongside the entire human workforce operating on a 24-hour basis [1,5]. For the year **2021**, the Independent Directorate of Civil Protection of the Attica Region provided assistance in five (5) extensive wildfires spanning from 06.03.2021 to 30.08.2021. Throughout this period, a total of one hundred and thirty-five (135) vehicles, including machinery and evacuation buses, were deployed, with the entire human workforce of the Independent Directorate of Civil Protection on standby and operational around the clock [1,5]. The most significant in terms of area and destruction was the wildfire in Varibobi on 03.08.2021 [5]. For the year **2022**, the Independent Directorate of Civil Protection of the Attica Region provided assistance in six (6) extensive wildfires spanning from 04.06.2022 to 02.11.2022. A total of one hundred and twenty-two (122) vehicles and machinery were deployed, including sixteen buses specifically for evacuating citizens and transporting them to safe areas. The entire human workforce remained on standby on a 24-hour basis [1,5]. The most significant in terms of area and destruction was the wildfire in Penteli on 19.07.2021, during which the Independent Directorate of Civil Protection assisted the Fire Service and the evacuation of Penteli Children's Hospital, as well as two elderly care facilities [5].

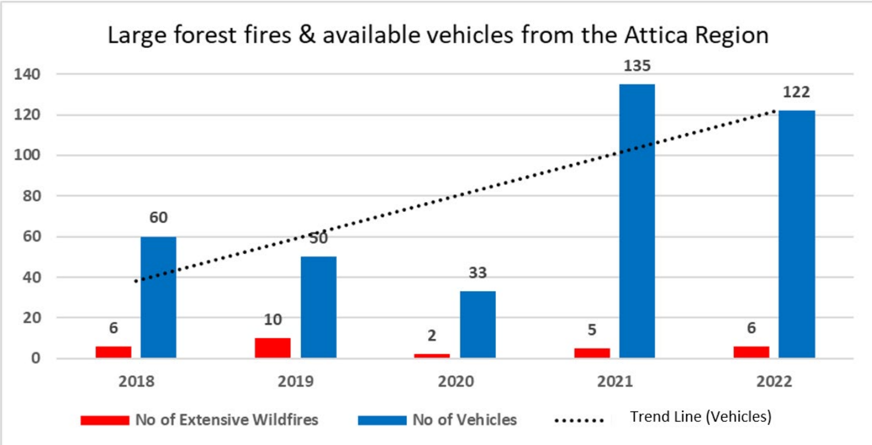

Figure 3: Large Forest fires & available vehicles from the Attica Region [1].

Furthermore, the fire danger indices for the dates of the wildfires ranged between categories (3) high and (4) very high. Therefore, the Independent Directorate of Civil Protection was already in an elevated state of readiness upon the announcement of the fire danger index, having taken actions to inform the public and relevant stakeholders about the indices and precautionary measures [1]. It is worth noting that the provision of vehicles by the Attica Region always occurs upon a justified request from the Greek Fire Brigade.

3. RESULTS AND DISCUSSION

The Independent Directorate of Civil Protection of the Attica Region was in a state of full readiness during the prevention phase, especially when the hazard index was categorized as 3, 4, or 5. It maintained a 24-hour standby status of registered contractors, along with its dedicated human resources. It effectively and successfully responded to the requests of the firefighting service, providing support for a total of twenty-nine (29) fires from 2018 to 2022 in the Regional Unit of East Attica, deploying a fleet of four hundred (400) vehicles and machinery in total [1]. This support greatly bolstered the efforts of the Firefighting Service. Furthermore, it also successfully executed the implementation of proactive citizen evacuation measures during its assistance efforts.

The statistical data regarding fires in the Regional Unit of East Attica within the Attica Region indicate that during the wildfire seasons from 2018 to 2022, the month with the highest percentage of fires supported by the Independent Directorate of Civil Protection is July, accounting for 32% [1,5]. Following this, August holds a contribution of 24%, followed by May and September at 16% each [1,5]. June has a contribution of 12%, while October shows zero participation in terms of fire incidents [1,5].

It's important to emphasize that the supply of vehicles from the Attica Region is consistently in response to a valid request from the Fire Brigade

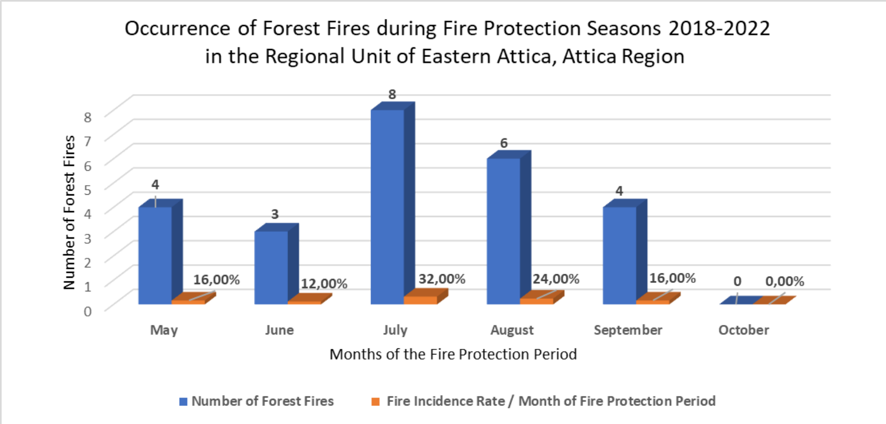

Figure 4: Occurrence of Forest Fires during Fire Protection Seasons 2018-2022 in the Regional Unit of Eastern Attica, Attica Region [1].

Amid the rapidly escalating climate crisis, it is imperative to adopt a proactive approach of adaptation rather than succumbing to complacency. This imperative extends not only to revising planning strategies but also upgrading technological infrastructure and human resources. It is crucial to recognize that the efficacy of actions presently considered successful might fall short in the coming years due to the ongoing and intensifying climate crisis.

4. CONCLUSION

The organization effectively managed disaster stages, especially for forest fires, and aided Fire Department requests using resources and personnel. It promptly responded to various assistance needs, focusing on evacuations. Data for Attica's Eastern Region show July and August as peak months for fires involving the Independent Directorate of Civil Protection during 2018-2022. The study confirms a link between fire danger index (4) and major fires in Eastern Attica (2018-2022). The organization offered extensive aid with resources and staff. Noteworthy blazes include Mati (2018), Mount Hymettus in Paiania (2019), Lavreotiki and Saronida fires (2020), Varibobi fire (2021), and Penteli fire (2022). It's also crucial to highlight that the allocation of vehicles from the Attica Region consistently follows legitimate requests made by the Fire Brigade. Among the accelerating climate crisis, a proactive approach of adaptation, rather than complacency, is essential. This extends to planning strategies, technological infrastructure, and human resources. The effectiveness of current actions deemed successful may prove inadequate in the years ahead due to the unfolding climate crisis.

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THE NATIONAL OBSERVATORY OF ATHENS ACTIVE FAULTS OF GREECE DATABASE (NOAFAULTs) AS A TOOL FOR CIVIL PROTECTION AND EDUCATION

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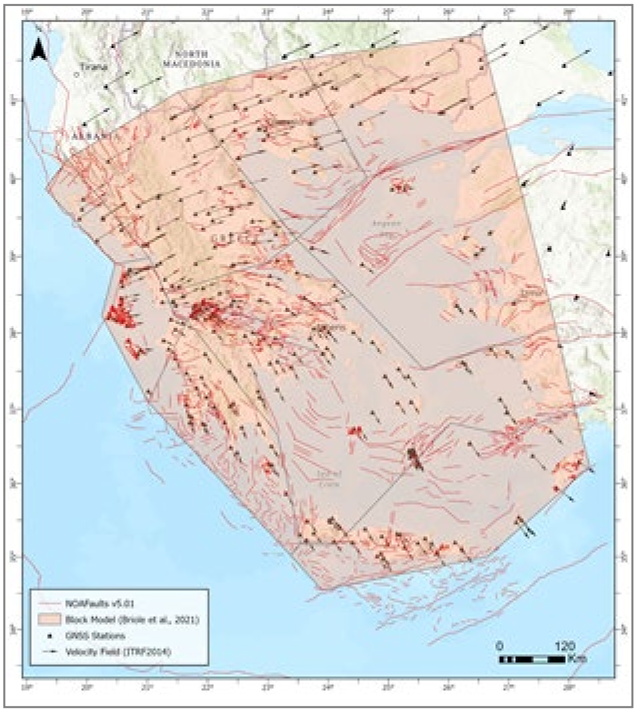
ABSTRACT
The NOAFAULTs database of active faults of Greece is a regional dataset of active fault traces, first published in 2013. In this paper, we present the resources comprising the newer version of the database (version 5.0) and its applications towards civil protection planning and educational activities. NOAFAULTs was originally created towards compiling a digital database of fault geometry and additional attributes (character of faulting, past seismicity etc.) primarily to support seismicity monitoring at the National Observatory of Athens (NOA). The NOAFAULTs dataset includes 2916 crustal faults (incl. the Eurasia-Africa subduction front) spanning a total length of 27894 km. The standard commercial software ARC GIS has been used to design and populate the database. 91.4% of the active faults are normal faults, 5.2% are strike-slip faults and only 3.2% represent the reverse faults. Also, data on instrumental and historical seismicity was recorded for 175 and 132 active faults, respectively. The maximum recorded magnitude of those events ranges between M_w=5 to M_w=7.4. The NOAFAULTs database shows that the 54% of active faults imply high seismic risk level in the broader area of Greece. The database is available through our web portal application https://arcg.is/04Haer supported by ESRI.

Keywords: Active faults, GIS, Hellenic Arc, Aegean, earthquakes

1. INTRODUCTION
Since 2007 NOA has been building a comprehensive, regional dataset of active fault traces of seismogenic concern. The NOAFAULTs database of active faults of Greece was first published in 2013 ([1]; versions 1.0 & 1.1). In this paper we present the resources comprising the newer version of the database (version 5.0) (Fig. 1). The motivation behind NOAFAULTs was a peri-Adriatic initiative of structural geologists, tectonicians and seismologists to compile a first map of active faults [2]. At NOA, the concept was expanded towards compiling a digital database of active fault geometry and additional attributes (character of faulting, past seismicity etc.) primarily to support seismicity monitoring at the National Observatory of Athens (NOA). The focus of the effort is on collecting published fault traces of active faults in the broader Aegean area, that is faults that have slipped at least once during the last 120 ka. The published fault maps were collected from papers in peer-reviewed journals since 1972.

So far the fault data was collected from 140 published fault maps, including offshore structures. The standard commercial software ARC GIS has been used to design and populate the database. In the follow-up versions [3,4], more details on fault geometry, such as the strike, the dip-angle and the dip direction, and kinematics for each individual fault are included. For well-studied faults, information about the slip rate or the creep or the co-seismic slip is also reported. The vector fault layer was produced at the National Observatory of Athens by on-screen digitization of the fault traces contained in the original papers. The NOAFAULTs dataset includes 2916 crustal faults (incl. the Eurasia-Africa subduction front) spanning a total length of ~27894 km. 91.4% of the active faults are normal faults, 5.2% are strike-slip faults and only 3.2% represent the reverse faults. The database is available to the scientific community in ESRI shapefile (SHP), KML/KMZ and TXT formats in WGS84 projection.



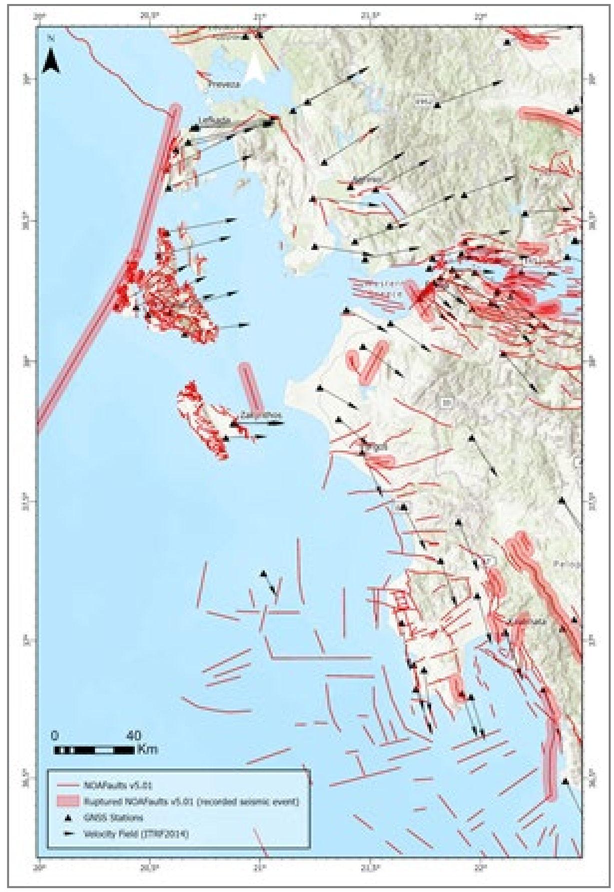


Figure 1. Map showing overview of the database (left) and a zoom on the central Ionian islands (right). The 2021 Aegean crustal block model [5] is shown together with GNSS station velocities (black arrows). Red lines are active faults.

2. CHARACTERISTICS OF THE DATABASE

NOAFAULTs is a high-detail regional-scale geodatabase. It comprises 2916 objects stored in shapefile format with spatial detail sufficient for a 1 : 100 000 map scale. The shapefile format is an open standard for geospatial vector data. Every NOAFAULTs record has a two-dimensional linear shape stored as a polyline. The fault sense, a rank of confidence in activity, information on risk assessment, and a reference to source publications are provided for each database entry. This information is supplemented by a fault name, fault zone name, abbreviated fault parameters (e.g., strike/dip/rake, date of the last motion when available), and text information from the sources.

In the database we assigned a 6-digit unique identifier (ID; starting with letter GR for TR for Turkey etc.) to each fault record in the dataset to avoid possible ambiguities in identifying the faults. Reliable data on slip rates is available for 215 faults. Also, data on instrumental and historical seismicity was recorded for 175 and 132 active faults, respectively. So far, the confirmed spatial correlation between epicentres of strong seismic events (both instrumental and historical) including paleoseismological and geological data on the same events from the literature and location of active faults allowed the identification of 111 events and corresponding seismic faults (Fig. 2). The maximum recorded magnitude of those events ranges between Mw=5 to Mw=7.4. The NOAFAULTs database shows that the 54% of active faults imply *high* seismic risk level in the broader area of Greece. The notation *high* stems from the adopted threshold of 5 km for surface rupture length that is empirically related to an earthquake magnitude of

M=5.5 (based on the data by [6]) and it does not consider structural vulnerability levels. These active faults (L ≥ 5 km) can either generate surface faulting or strong ground motions that can cause damage to buildings and infrastructures (ports, motorways, pipelines, airports etc.) and therefore represent a significant hazard, particularly in the densely populated and industrialized areas of Greece.

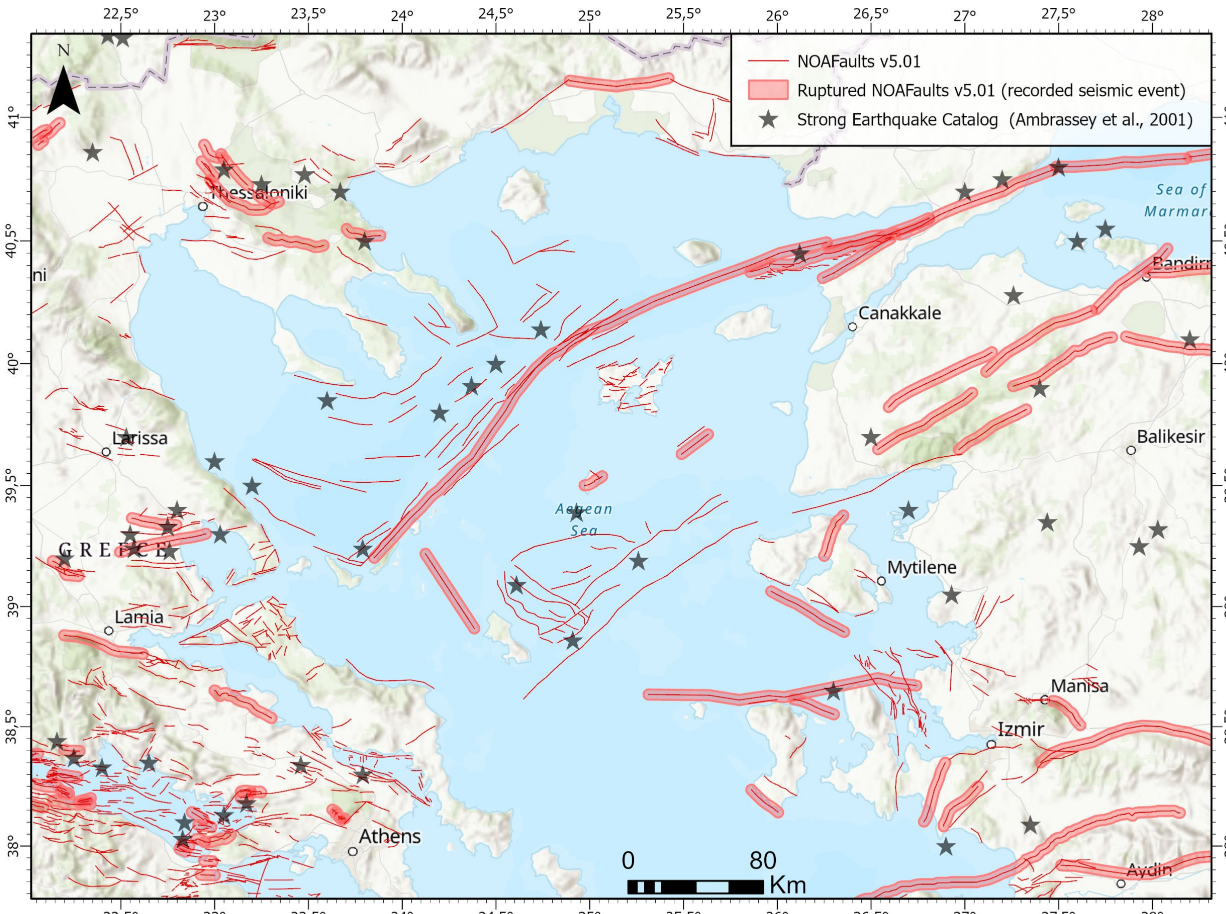


Figure 2. NOAFAULTs map showing fault lines (red lines), ruptured faults (lines with red halos) and epicentres of strong earthquakes during the 20th century (data from [10]). Notice the alignment of epicentres with ruptured fault lines in regions such as south Thessaly, central Macedonia, north Aegean Sea, etc.

3. USES OF THE DATABASE

Besides fault traces and their attributes, 26 thematic layers are included in version 5.0 with information on seismic and GNSS networks (Fig. 1), past strong earthquake locations (Fig. 2), the most recent seismic zonation model for Greece [7], African slab isobath models etc. The database is available through our web portal application https://arcg.is/04Haer supported by ESRI. Recently, NOAFAULTs was included in the 2020 update of the European Fault-Source Model 2020 (EFSM20; [8]). NOAFAULTs was also used a reference for the crustal seismogenic sources of Greece (HeLPOSFAULTs database; [9]).

NOAFAULTs can be used as a spatial search for seismological, seismotectonic, geodynamic, geotechnical and geological studies. It provides sufficient map detail for planning a regional study of a particular fault zone and provides deeper bibliographical information. This database is particularly significant for open dissemination of geological and geophysical data for educational purposes in Greece, where a few such studies exist, they are available mostly in Greek and hard copy. Moreover, the database model provides a tool for regional-scale integrative map services based on geographic information systems (GIS).

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ESTIMATION OF THE EARQUAKE EARLY WARNING SCALING PROPERTIES OF PEAK GROUND ACCELARATION WITH THE INTEGRAL OF SQUARED VELOCITY. FIRST RESULTS FOR EASTERN CORINTH CULF AND WESTERN ATTICA REGION

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ABSTRACT
One of the main goals of an Earthquake Early Warning System (EEWS) is to estimate the expected peak ground motion of the destructive S-waves using the first few seconds of P-waves, thus becoming an operational tool for real-time seismic risk management in a short timescale. EEWSs are based on the use of scaling relations between parameters measured on the initial portion of the seismic signal, after the arrival of the first wave. To explore the plausibility of EEWSs around the Eastern Gulf of Corinth and Western Attica, the integral of squared velocity (I_V^2) and the scaling relations between the peak ground acceleration (*PGA)*, as a function of the I_V^2 which is estimated directly from the first few seconds-long signal window after the P-wave arrival, were analyzed. The latter formulation opens the possibility of using such laws for on-site and inter-site earthquake early warning.

Keywords: Earthquake Early Warning System, Gulf of Corinth, Attica Region, Physics of earthqake source, scaling laws.

1. INTRODUCTION

The increasing urbanization worldwide has led to the establishment of large metropolitan areas near major active faults (whether on land or offshore), which pose a serious threat to the human population and infrastructures. Currently, an accurate earthquake forecast method appears to be far from operational. Consequently, attention has shifted to Earthquake Early Warning Systems (EEWS) for reducing earthquake risk [1-7], offering, in real-time, information for the incoming destructive seismic waves. EEWS leverage the nature of the different seismic waves; since "P waves carry information while S waves carry energy" [1], the fast, yet low amplitude P waves are analyzed to determine the earthquake damage potential, mostly caused by the slower, high-amplitude S-waves.
Scaling laws are of fundamental importance in EEWSs, as they connect early estimated parameters with the strength of impending S-wave. Relations between the integral of squared velocity estimated from the initial P-wave (I_V^2) and a metric of the anticipated shaking, such as the macroseismic intensity or the ground's acceleration during a seismic event, have been proposed [6, 8-10].

In this work, we analyze parameters that are used to determine earthquake magnitude in real-time for the areas of the Eastern Gulf of Corinth (EGoC) and Western Attica (WA). We focused on the correlation of the integral of squared velocity (I_V^2) with PGA on-site and inter-site. The latter aims to investigate whether it is possible to use P waves near the source as a proxy for S-wave shaking at a far target.

2. EMPIRICAL CORRELATION LAWS FOR EASTERN GULF OF CORINTH AND WESTERN ATTICA REGION

Determinations of magnitude and the ground shaking intensity from the initial P wave are two important elements for earthquake early warning. The strength of shaking can practically be represented by PGA. Here we present the first results from an effort to establish the correlation laws required for regional EEWS and that for on-site.

2.1. By-Passing the Earthquake Magnitude Estimation using the Integral of the Squared Velocity (I_V^2)

In Ref. [6] first introduced the use of the integral of the squared velocity (I_V^2) estimated from *P* wave time windows in EEWSs for real-time magnitude estimation. I_V^2 is defined as: $I_V^2 = \int_{t_p}^{t_p+t_w} \upsilon^2(t)dt$. The presented parameter is in cm^2/s. I_V^2 has been adequately correlated with earthquake magnitude [6], as well as Peak Ground Velocity (PGV) and macroseismic intensity [6, 8-10]. We identified a stable correlation between I_V^2 and PGA as reported at the same station [6]. Consequently, the quantity could be used as a proxy for rapid damage assessment. The relationship between I_V^2 and PGA could therefore be used to identify in real-time and before the arrival of S waves whether a site is going to be adversely affected or not, and, thus, has the potential to become key in the design of on-site EEWSs, assisting civil protection in acting immediately, according to the severity of the situation.

Figure 1 presents PGA as a function of I_V^2 in the case of stations LOUT and LTK, located in Loutraki, close to the epicenters of the Alkyonides (1981) earthquakes. For all the cases, a correlation of the form: $\log PGA = a + b * \log(I_V^2)$ exists for all time windows t_w used, with b values quite stable at ~0.5 (the values range between 0.48 to 0.52). It is noted that while I_V^2 is computed from measurements in the vertical channel, PGA refers to the maximum observed acceleration between the two horizontal components of the sensor.

2.2. PGA in Target Site Versus the Integral of the Squared Velocity as estimated Close to Epicenter

While previous works [8-10] have discussed the integration of an on-site approach to a larger regional-based model, by using a first-trigger site near the source to issue an area-wide alert, we investigated the possibility of establishing scaling laws between specific sites. If this proves successful, inter-station relations could be used to estimate the shaking (e.g.**,** PGA) at a target site from a proxy recorded at a near-source receiver. This would remove some of the obstacles raised by regional EEWSs, while, at the same time, removing the main drawback of on-site methods (i.e.**,** being able to predict the ground motion at the site that also evaluates the proxy parameter). In Figure 2, the PGA values, recorded in the stations of Athens, are plotted as a function of the Integral of the Squared Velocity in Loutraki. A clear logarithmic dependence exists with a slope in the range 0.40–0.45. We note that slopes are in agreement with the on-site cases.

3. CONCLUDING REMARKS

Summarizing, in the present work, on-site and inter-site theoretical scaling relations between I_v^2 and *PGA* are presented. Finally, we explored the laws between stations located near the EGoC sources and stations in Athens to estimate inter-site relations for I_v^2 (recorded at the former) and PGA (recorded at the latter). Our results uncovered high correlation between I_v^2 and *PGA* at individual sites, with seemingly identical slope parameters of the linear models in four different sites (stations ATH, ATHU, LOUT and LTK). This similarity bears hope for establishing an on-site hazard estimator. In addition, for a source located 70 km away from Athens, close to Loutraki (LOUT and LTK stations), we investigated a scaling relation to estimating *PGA* in Athens (stations ATH and ATHU). We note that in all the cases recordings for the Hellenic National Seismological Network used [11].

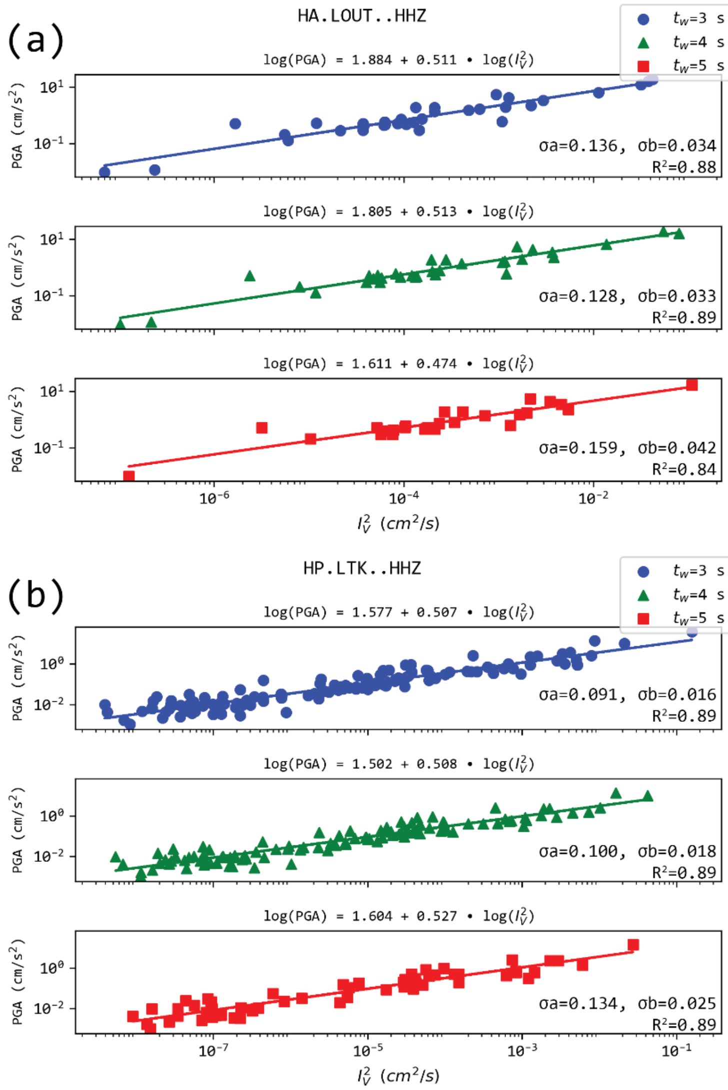

Figure 1. Regression models of PGA and I_v^2 for the two stations located in Loutraki, i.e., LOUT (**a**) and LTK (**b**), for the three time-windows (t_w) after the P arrival. The logarithms of the two quantities show a very high correlation.

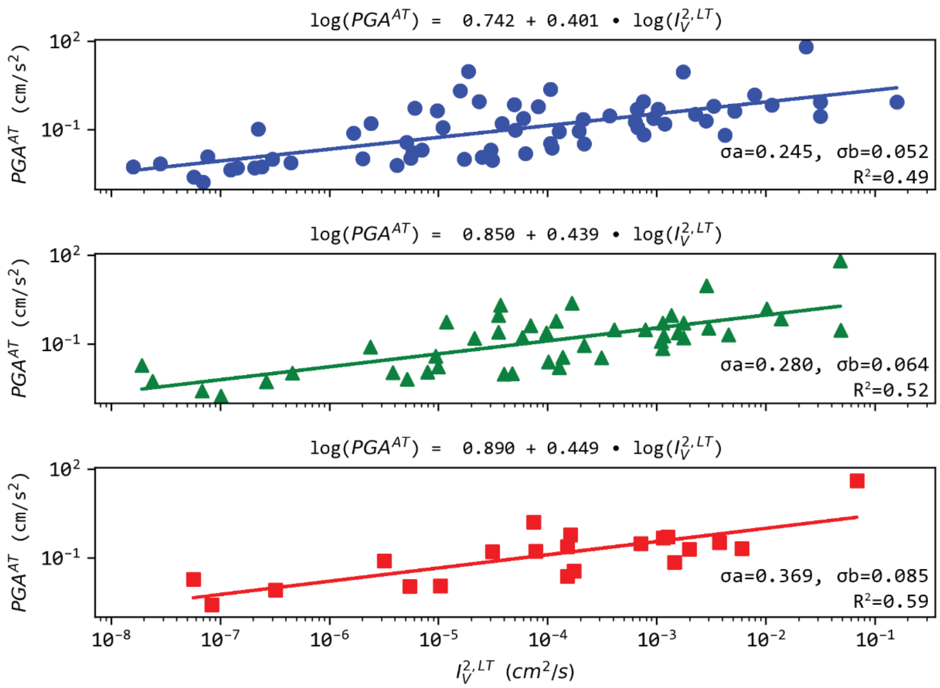

Figure 2. Regression analysis between PGA measured in Athens (AT) and the Integral of the Squared Velocity in Loutraki (LT). The rest of the notation as in Figure 3.

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RAPID EARTHQUAKE DAMAGE ASSESSMENT SYSTEM TO SUPPORT EARTHQUAKE RESPONSE

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ABSTRACT
Rapid earthquake damage assessment is crucial to support Civil Protection Agencies in post-earthquake response and crisis management. A system consisting of a Rapid Earthquake Damage Assessment platform (REDA.p) and an Educational-Hub (Edu.Hub) is proposed, to provide situational awareness and enhance operational preparedness and response capacity of competent authorities and the public, respectively. Focusing on the REDA.p, it is able to provide both scenario based and near real-time earthquake damage assessment of structures, gas pipelines and geotechnical hazards such as landslides and liquefactions. The platform utilizes data input from major earthquake monitoring networks in the Black Sea Basin area, including ITSAK/EPPO (Greece), AFAD (Türkiye), NIEP (Romania), and IGS (Moldova), giving also special attention to Cross Border Areas (CBAs). Strong ground motion data collected from a dense network of next-generation accelerometers installed in carefully chosen school buildings is also utilized in selected pilot cases, improving seismic hazard estimation and offering valuable insights into the spatial variability of strong ground motion in urban areas.

Keywords: Rapid Earthquake Damage Assessment, earthquake hazard, earthquake risk, decision supporting system

1. INTRODUCTION

Over the past two decades, significant progress has been made worldwide in seismic risk assessment of structures and infrastructure. At European level, several efforts to assess seismic risk in urban areas have taken place in the past, many of them in the framework of European-funded research projects, adopting scenario based or classical probabilistic risk assessment approaches, to provide valuable data regarding the anticipated response during a strong earthquake. Recently, there was a systematic effort to adopt common procedures and approaches in estimating the expected earthquake damages and improve society resilience to earthquake consequences. More specifically, one of the objectives of the project SERA (Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe) was to produce a uniform European Seismic Risk Model (ESRM20) covering 45 European countries. The intention is then for the ESRM20 to be integrated within the Global Earthquake Model (GEM) Foundation's mosaic of risk models [1].

Additional to those efforts, the necessity for near real-time information regarding the expected damage level at structures and infrastructure, as well as their spatial distribution in the aftermath of a strong earthquake, remains critical for Civil Protection Services. With such information, better coordination of post-seismic actions can be achieved to mitigate the impact of earthquakes effectively. Moreover, the conventional practice of estimating earthquake effects on a country-by-country basis often results in a lack of harmonized data and results in cross-border regions.

The REDACt project (Rapid Earthquake Damage Assessment ConsorTium, www.redact-project.eu), implemented in the framework of the Black Sea Basin 2014-2020 programme, sought to address those challenges by fostering collaboration among numerous scientists from different disciplines. As a project output, the Rapid Earthquake Damage Assessment platform (REDA.p) was created. The REDA.p is able to provide both scenario based and near real-time earthquake damage assessment of structures and gas pipelines as well as detect possible geotechnical failures such as landslides and liquefactions. Harmonization of data, information and calculation procedures has been achieved, to provide unified results in the investigated areas with special focus on cross border regions. Additionally, an Educational-Hub (Edu.Hub) is proposed, to provide situational awareness and enhance preparedness and response of the public. Access to earthquake events information and educational hub contents is also feasible by means of an interactive smartphone application developed for android and iOS devices.

2. THE RAPID EARTHQUAKE DAMAGE ASSESSMENT PLATFORM (REDA.p)

The Rapid Earthquake Damage Assessment platform (REDA.p) comprises of different modules depending on the examined risk that may refer to buildings, gas pipelines or geotechnical hazards, using scenario based or near real-time calculations (Figure 1). Scenario based analysis is feasible for any end-user after installing the software. On the other hand, near real-time events run automatically, after a carefully planned triggering procedure, only on dedicated servers of the involved institutions. A brief description of the platform and the examined hazards and risks is provided in the following sections.

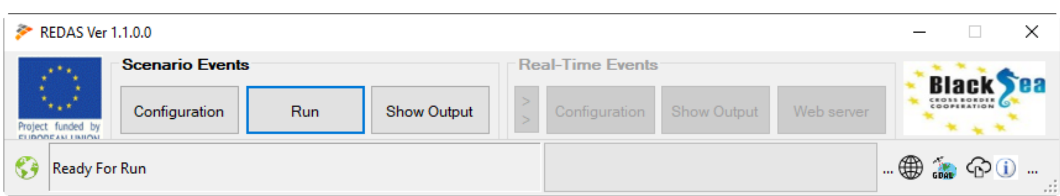

Figure 1. REDA.p interface consisting of the scenario based analysis and near real-time analysis in discrete panels.

2.1. Seismic Hazard Assessment

To achieve harmonized seismic hazard assessment of high accuracy especially in cross border areas, exchange of data was achieved in the project framework among authorities and institutions that control significant part of the earthquake monitoring networks in the involved countries and the broader Black Sea Basin area, namely ITSAK/EPPO (Greece), AFAD (Türkiye), NIEP (Romania), and IGS (Moldova). The most appropriate Ground Motion Prediction Equations (GMPEs) have been incorporated into the REDA.p, varying between areas of different seismotectonic environment [2], whereas ground shaking estimation in CBA is based on harmonized models. To further improve seismic hazard estimation and obtain insights into the spatial variability of strong ground motion in urban areas, recorded data collected from a dense network of low-cost accelerometers installed in carefully chosen school buildings is also utilized in selected pilot cases.

2.2. Assessment of Geotechnical Hazards

REDA platform assessment of geotechnical hazards, i.e. damages related to ground failures such as landslides and liquefaction, aims in the production of maps displaying the spatial distribution of those hazards on a regional scale, which can consequently be incorporated in relevant rapid response maps and loss estimates. To this end, two different methodological approaches are employed for landslide hazard assessment, one statistically based [3, 4] and one related to physically based models and specifically the infinite slope model. On the other hand, liquefaction hazard assessment is based on the correlation of geological, geomorphological and climatic factors, leading to probabilistic liquefaction maps and eventually to loss estimation when integrated with event-specific shaking intensity maps [5]. More details on the geotechnical hazard assessment methodologies incorporated in REDA.p can be found in [6]. The platform outputs were validated through comparison to existing information from past events such as the Lefkas earthquake (M=6.5, 2015), the Thessaly earthquakes (M=6.3 and 6.1, 2021) etc., and were found to provide satisfactory results.

2.3. Seismic Risk Assessment of Buildings

Harmonized seismic risk assessment of buildings in different countries presents certain challenges due to variation in codes and regulations, local construction practices, current trends in seismic risk assessment procedures in each country (building taxonomy, seismic damage definition, etc), geographical unit determination (building block, mahalla, etc), differences in available exposure datasets (level of detail, format, etc). To achieve a homogenized result, certain decisions were made that allow common procedures to be employed, with the most important referring to the building taxonomy and the vulnerability models that will be employed to evaluate the seismic damage level [6]. In the REDA.p, seismic damage states on structures are based on the Martins and Silva fragility curves [7] and the Global Earthquake Model (GEM) building taxonomy scheme [8]. Validation of the platform results that was attempted in the city of Thessaloniki, revealed satisfactory comparison with available damage distribution data of the Volvi earthquake (M=6.5, 1978).

2.4. Seismic Risk Assessment of Gas Pipelines

Earthquake damage assessment of natural gas pipelines in REDA.p is based on a logic tree approach of selected fragility curves with assigned weights, describing the performance of pipelines under wave propagation and peak ground deformation hazards. The selection of appropriate vulnerability functions is based on (a) existing database of damaged pipelines, often including water or sewer pipelines to increase the dataset [9], (b) fragility curves responding specifically to gas pipelines [10] and (c) the relationship proposed by O'Rourke et al. [11] using the damages in water and sewer pipelines located in the regions close to the Kocaeli (Türkiye), in which validation of the REDA.p efficiency is attempted.

3. THE EDUCATIONAL HUB (Edu.Hub) AND SMARTPHONE APP

While the REDA.p is intended for use by authorities, the other project outputs have as a main goal to improve the Public's post-earthquake response, increasing thus societal resilience. The Educational-Hub (Edu.Hub) [12] focuses on helping the public comprehend the risks, on providing simple guidelines regarding preventive, preparedness and response measures inside and outside the house, as well as provide solutions during emergencies to help establish situational awareness with respect to people's main concerns immediately after an earthquake event. Access to Edu.Hub is feasible both via the project's website (www.redact-project.eu) or the smartphone application developed in the project framework. The latter has also interaction capabilities, allowing people to fill in "felt it" reports after earthquake events.

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70 YEARS AFTER THE AUGUST 1953 EARTHQUAKES IN THE IONIAN SEA (WESTERN GREECE): REVIEWING PRIOR RESEARCH AND UTILIZING NEW DATA SOURCES WITH EMPHASIS ON THE EARTHQUAKES ENVIRONMENTAL EFFECTS

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ABSTRACT
The August 1953 earthquakes in the central Ionian Sea were the most devastating seismic events in Greece's recent history. The central and southern Ionian Islands (Cephalonia, Ithaki, and Zakynthos) were heavily affected by the mainshock on August 12 and its foreshocks on August 9 and 11. However, there was a significant gap in getting the whole picture of the environmental effects of earthquakes. This study includes a review of existing information as well as the utilization of new data sources that have not previously been considered. There were 120 examples of earthquake environmental consequences documented in total, including 33 cases of primary effects and 87 cases of secondary effects. Slope failures, coseismic uplift, hydrological anomalies, ground fissures, tsunami, liquefaction, dust clouds, hydrocarbon-related phenomena, leaping stones, and vegetation are listed in descending order of occurrence mainly in Cephalonia, while Ithaki and Zakynthos follow with less impact.

Keywords: 1953 earthquakes, earthquake environmental effects, Ionian Islands, coseismic uplift, landslides.

1. INTRODUCTION

The August 1953 earthquake sequence, which included three significant events, the main quake on August 12 and its foreshocks on August 9 and 11, was the worst disaster to affect the Ionian Islands since the devastating 1867 earthquake as they caused large human and economic losses. They greatly affected the center and southern Ionian Islands including Cephalonia, Ithaki and Zakynthos. The fires that followed entirely devastated the Argostoli and Zakynthos towns.

The literature that has already referred to this earthquake sequence focuses on (a) the extensive structural damage to residential buildings and infrastructure, (b) the impact on the local population (fatalities, injured people, internal migration), and (c) the emergency response and recovery actions implemented by Greek authorities and military vessels operating alongside, who rushed to assist local authorities. As a result, there is a fairly accurate record of human losses and injuries, as well as a complete assessment of the damage to the islands' building stock.

However, this method has left a large gap in our understanding of how earthquakes affect the environment. Secondary effects, including landslides, liquefaction, hydrogeological anomalies, and tsunami, were not previously frequently documented. While Stiros et al. (1994) [1] and Pirazolli et al. (1994) [2] published their interdisciplinary and multiparametric study on coastal coseismic uplift attributed to the 1953 earthquakes almost 40 years after the sequence, the official report of the Hellenic Institute of Geology and Underground Research [3] reported only a small number of rockfalls that caused damage to residential areas.

In this framework, this study emphasized on the environmental effects triggered by the earthquakes in the central and southern Ionian Islands, by reviewing the existing related recorded information and utilizing a variety of new data sources that provided a wealth of pertinent information. This approach allowed for a representative reconstruction of the nature, the distribution and intensity of the environmental effects caused by the 1953 earthquakes, which had not previously been achieved for such an important seismic sequence.

2. METHODOLOGY

The following sources provided data and details on the effects that accompanied the August 1953 earthquakes in the Ionian Sea:

- Every main academic search engines, databases, and sources for scientific research, including GeoRef, Google Scholar, ScienceDirect, Scopus, Springer, and Journal Storage.
- Official deliverables and reports on the outcomes of projects for applied research in the area impacted by the 1953 main shock and its strongest foreshocks.
- Databases with local and national circulation newspapers, such as those at (i) the Digital Library of Newspapers and Magazines of the National Library of Greece, (ii) the Digital Library of the Greek Parliament Press Museum of the Peloponnese – Epirus – Ionian Islands Daily Newspaper Editors Association, (iii) the Digital Historical Archive of the Lambrakis Press Group and (iv) the Vikelaia Municipal Library of Herakleion Crete. Additionally, we referred to data found in issues of the regional publication "I Kefalonitiki Proodos" (Greek: Η Κεφαλονίτικη Πρόοδος, lit: The Cephalonian Progress).
- Reliable web sites that provide relevant details and descriptions from people who lived through the 1953 earthquakes.

These sources were initially evaluated by Mavroulis and Lekkas (2021) [4], who give further information on their content. They provide direct or indirect information on the primary and secondary environmental effects caused by the 1953 earthquakes in the central and southern parts of the Ionian Sea.

Additionally, a field study was conducted in the areas affected by the August 1953 earthquakes to identify the factors contributing to the triggering of such events and controlling their nature and distribution.

3. RESULTS

A total of 120 cases of environmental effects, including 33 primary (**Figure 1a**) and 87 secondary ones, were recorded in Cephalonia, Ithaki, and Zakynthos islands by the August 9 (**Figure 1b**), 11 (**Figures 1c,1d**) and 12 August 1953 (**Figures 1e,1f**) earthquakes. In descending order of occurrence, slope failures, coseismic uplift, hydrological anomalies, ground cracks, tsunami, liquefaction, dust clouds, hydrocarbon-related phenomena, jumping stones, and vegetation effects were most prevalent in Cephalonia Island, with Ithaki and Zakynthos Islands coming in second and third, respectively (**Figure 1**). The primary effects, which included permanent surface deformation (coseismic uplift), were most prominently detected in eastern Cephalonia, in particular from Sami Bay to Skala area, which uplifted up to 70 cm, and secondarily in the western part of the island (Myrtos Bay, northern part of Argostoli peninunsula) with fewer affected sites and lower uplift values. As regards slope failures, they are classified into mainly rockfalls and secondarily soil slides along steep slopes. They generated not only damage to adjacent buildings and infrastructures but also to increase of casualties, especially in mountainous and semi-mountainous settlements in Cephalonia Island. The other effects resulted damage to the built environment, such as damage to ports attributed to liquefaction and lateral spreading in coastal areas, without contributing to the increase of human losses.

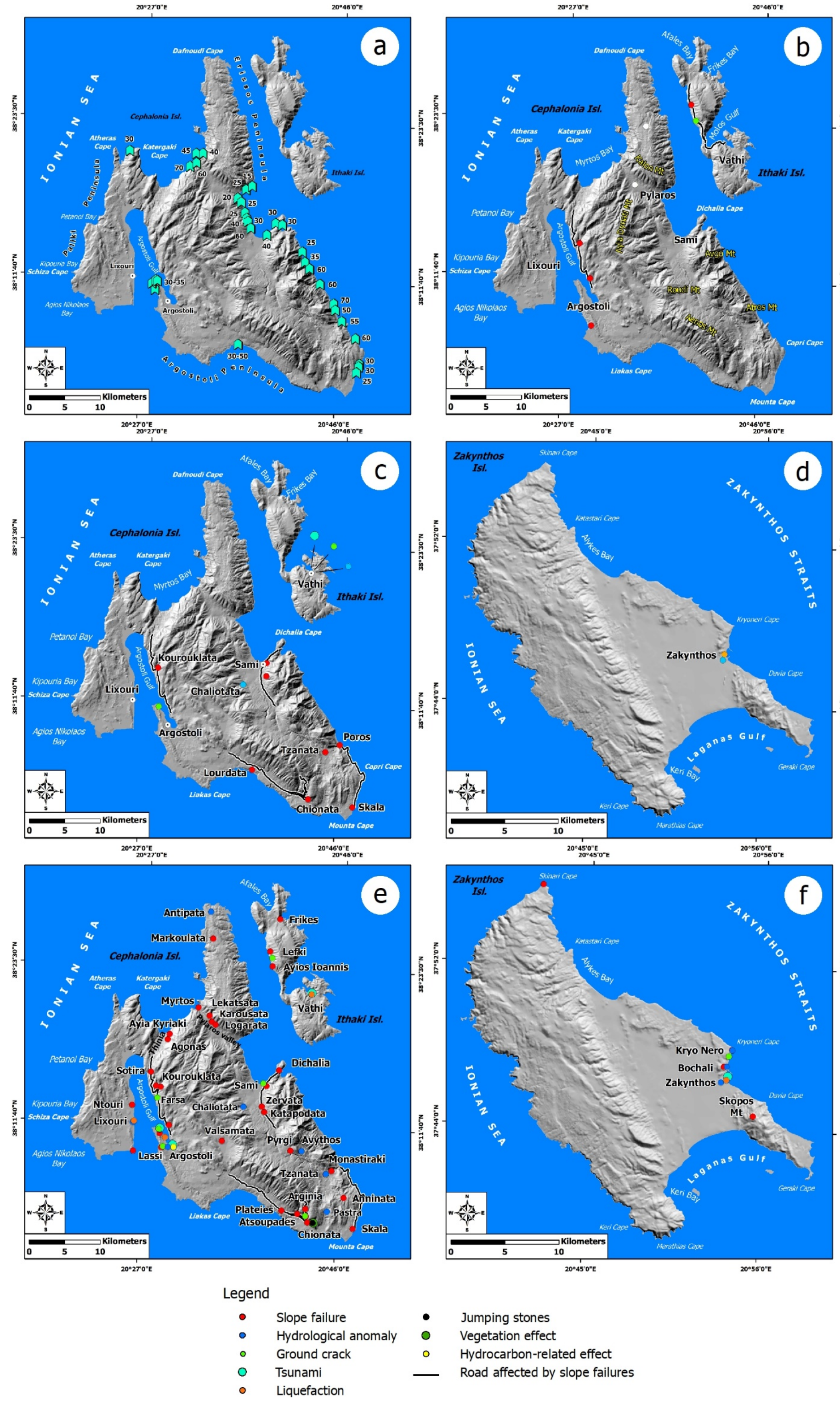

Figure 1. Primary effects caused by the 12 August 1953 earthquake (a) and secondary effects triggered by the 9 (b), 11 (c,d) and 12 (e,f) August 1953 earthquakes in the central and southern Ionian Islands.

The majority of these effects were not randomly distributed in the affected islands, but rather occurred in specific zones with characteristics that make them susceptible to the occurrence of earthquake-related hazards. This conclusion is drawn from the correlation between the inventory of the earthquake environmental effects and the susceptible zones. Rough morphology, including high, steep slopes generated by intense uplift of tectonic origin and extensive incision, characterizes the zones impacted by rockfalls and soil slides. They are primarily found along or close to marginal faults and are built up by a variety of lithologies, which has significantly lowered the mechanical strength of the faulted formations.
The liquefaction-affected coastal areas are characterized by recent deposits, loose and saturated lithologies, susceptible to such effects during strong earthquake ground motion. Coastal segments of funnel-shaped gulfs in the devastated Ionian Islands were most affected by sea roughness and tsunami with mild to moderate impact on the coast. Large tsunami and associated effects were not generated. Regarding the onshore hydrological anomalies, they have been reported in lakes and other water bodies, such as several wells in rural and urban areas, which imply a widespread aquifer disturbance caused by the studied earthquakes.

4. CONCLUSİONS

In the context of this research, emphasis was placed on the environmental effects triggered by the earthquakes generated on August 9, 11 and 12, 1953, by reviewing the existing scientific information and using new sources with a wealth of relevant information. The result of this approach is the most complete record of these phenomena to date.
In the frame of this study, we evaluated the available scientific data and utilizing new sources with a variety of pertinent information and we emphasize on the environmental effects triggered by the devastating earthquakes of the August 1953. This method produced the most thorough documentation of these events to date.
This information and the research are of great importance in reconstructing the type and distribution of the effects triggered by the most devastating earthquakes in the recent history of Greece. Additionally, it describes the nature, the location, and the intensity of the earthquake-related phenomena as well as the potential effects of a similar future event not only in a region that has marked rapid urban growth and infrastructure development in recent years but also to other regions with comparable seismotectonic regime and geoenvironmental properties.

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ENHANCING THE VITAL ROLE OF THE CIVIL PROTECTION DEPARTMENT OF THE MUNICIPALITY OF ISTIAIA-EDIPSOS IN SEISMIC RISK REDUCTION

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ABSTRACT

Emergencies can occur suddenly, unexpectedly, and anywhere. The impact of emergencies may include disruption to services, casualties, and potential loss of life. The Municipality Civil Protection Department helps to prepare the local level and respond to any emergency. This study aims to demonstrate the importance of the Civil Protection Department of the Municipality of Istiaia-Eidipsos, as well as the need to expand its role in seismic risk reduction, with actions implemented from June 2022, until March 2023. The study reports the existing responsibilities of the Civil Protection Department of the Municipality of Istiaia-Edipsos, according to the existing legislative framework, and investigates whether they are sufficient or can be strengthened with new ones. The main role of the above-mentioned Department is to improve the ability at local level to detect, prevent and if necessary, handle disruptive challenges, such as earthquakes. To achieve its mission the Department of the Municipality of Istiaia-Edipsos has close collaboration with multi-agency partners, including the emergency services and voluntary teams, to prepare emergency plans, organize training activities and drills etc. The focus of this paper is on the overall actions taken and measures needed towards reducing seismic risk in the Municipality of Istiaia-Edipsos, in order to enhance the vital role of the Civil Protection Departments of the Municipalities.

Keywords: Disaster and Crisis Management, Crisis Communication, Risk Governance, Seismic Risk Reduction, Resilience, Earthquakes.

1. INTRODUCTION

“Disaster risk reduction is a broad and cross-cutting issue which requires political commitment and public understanding to achieve. It aims to lessen the vulnerability of people and property to the adverse impact of hazards” [1]. The Civil Protection Department is a Municipality structure, supporting the work of the Mayor, who is also the coordinator of the Civil Protection in the Municipality. It is the first Civil Protection structure that is in contact with the citizens and the local Civil Protection agencies (Fire Departments, Police, Coastguard, First Aid Centre) who are the first responders to emergencies due to natural disasters and directly experience the effects of disasters more intensely and closely. It has a key role in disaster governance as it has the ability to link citizens with the Municipality and the management agencies, with scientific knowledge, in a two-way communication relationship. Concerning the prevention and preparedness phase the Civil Protection Department: a. undertakes the process of developing and implementing the preventive awareness actions in order to risk reduction, b. evaluate potential vulnerabilities, c. proposes and ensures for the adoption of precautionary practices at local level to protecting civilians, ensuring their safety, and preserving their property in case of emergency situations (education of specific target groups, emergency drills etc). At response phase the Municipality Civil Protection Department: a. is called upon to dealing with any emergency situation, b. activates and supports mechanisms for waking up, and empowering and organising society. It must and can build a two-way intimate relationship and communication with the local civil protection actors involved, operating as a lifesaver at critical moments. Furthermore, in the short-term recovery phase, it can provide coordinated assistance to external forces that will be called upon to contribute to dealing with natural disasters at the local level. Also, the Municipality Civil Protection Department encourages the creation of channels of communication with presidents of villages, towns, communities and other local bodies and associations thus fostering the resilience of the local community [2, 3, 4]. This paper is part of a study of the first author under the supervision of the second author of a Master's thesis titled "The role of the Civil Protection Department of the Municipalities in the seismic risk reduction. The case of the Municipality of Istiaia-Edipsos." The relevant postgraduate program “Environmental, Disaster and Crises Management Strategies” is offered by the National and Kapodistrian University of Athens (NKUA), School of Sciences, Department of Geology & Geoenvironment. The Master program was successfully completed in July 2023. This paper aims to provide an overview of the methodology for the establishment, organization and operation of the Department of Civil Protection of the Istiaia-Edipsos Municipality, through the investigation and implementation of good practices and through the connection of Local Government with academic knowledge and modern practices and applications. The focus of this paper is on the overall actions taken and measures needed towards reducing seismic risk and exploring ways of improving the role of the specific Civil Protection Municipality Department. The paper also makes recommendations for a wider use of best practices to other local civil protection departments.

2. METHODOLOGY

In the framework of this study were recognized, through investigation of existing literature, the risk identification, vulnerability data of the area, good and modern practices various solutions and systems used to assess the disaster risk in the Municipality of Istiaia-Edipsos and ways of planning for preparedness. The study also proposes best practices for the type of coordination required and the creation of memoranda of action to ensure the safety of citizens. More specifically, the specific paper focuses on reducing the seismic risks through decoding, simplifying, and communicating the Municipality Civil Protection Plans, and the Working Places Emergency Plans to Municipality employees for improvement their operational preparedness. The study implemented from June 2022, until March 2023, which included: **a.** identification of risks of the specific Municipality, **b.** inventorying the vulnerability data of the area, **c.** improvement of methods and communication systems, in disaster management, (e.g. the application ”VIBER”) and ways of designing new ones, for the required coordination, **d.** drafting of emergency plans, memoranda of actions, shelters, preventive evacuation of the citizens, **e.** organization of briefings by the EPPO to the Municipality Kindergartens, for their awareness and preparedness, in the seismic risk [5,6,7], **f.** collaboration with EPPO in planning of an earthquake drill for the Municipality staff [8], **g.** organization and execution of an earthquake preparedness drill at the Istiaia Kindergarten, **h.** implementation of a workshop to inform the Municipality's staff about the seismic risk, memoranda of actions, emergency plans, to improve their operational preparedness, **i.** development of a questionnaire to evaluate the knowledge, attitudes and level of preparedness of the Municipality's services, **j.** planning for the development of Volunteerism at local level.

3. RESULTS AND DISCUSSION

The Municipality of Istiaia-Edipsos is an area of high social, economic and environmental vulnerability, threatened by, a. flash floods, due to the geographical topography, climatic conditions and the catastrophic megafire of 2021, b. fires due to large forest and grassland areas in connection with the climate crisis, c. landslides as a result of the topography of the area, human interventions, climatic conditions, soil quality and as a concomitant effect of earthquakes, d. seismic risk in relation to the structural vulnerability of buildings and obsolete infrastructure. That makes the role of the Civil Protection Department of the Municipality very important, with increased responsibilities in planning prevention and preparedness. The organizational actions that define the vital role of the of the Civil Protection Department of Istiaia-Edipsos, mentioned in the table 1 [9].

Table 1. The Role of the Municipal Civil Protection Department on Seismic Risk Reduction [9]

Category	Organizational Actions	Description	Involved Beneficiaries
Strategic Planning	Role in relation to International Disaster Reduction Strategies	Strengthening the participatory role of local level stakeholders in disaster governance, targeting prevention and preparedness, to increase resilience	Planning and decision makers, civil protection mechanism, citizens
	Specifications	A nodal structure that has direct contact with disaster phenomena, close to citizens, link with the State, operational, social and economic actors and with scientific institutions	Planning and decision makers, civil protection mechanism, citizens, municipal civil protection departments, police and fire services
	Structure	Establishment of a local, autonomous, strong, self-reliant Civil Protection Coordination Centre (CPCC). Upgrade the role of the civil protection departments of the municipalities	
Organization-Planning	Staff Training	➢ Training in risk & disaster management, concepts, risks, guidelines ➢ The Institutional Framework of Civil Protection (IFCP) in Greece ➢ Earthquake risk in Greece, lessons learned ➢ Organizational practices in the reduction of seismic risk ➢ Emergency plans & civil protection drills ➢ Communication & human resources management, leadership	Public relations, staff of civil protection departments of municipalities
	Resources	➢ Human resources ➢ Communication systems, Early warning systems, vehicles etc	municipal civil protection departments
Seismic risk prevention actions	Public relations	Creating communication channels. Communicate with stakeholders to understand the role of the civil protection departments	Citizens, municipal staff, volunteers, agencies
	Data mapping of the Municipality of Istiaia-Edipsos	The work of data collection and mapping of the Municipality of Istiaia-Edipsos includes historical data of seismic risk and associated phenomena vulnerability data and risk assessment	Planning and decision making, municipal civil protection departments
	Educational initiatives in kindergartens	Dissemination of information to kindergartens, for the seismic risk from the EPPO, to raise awareness and strengthen preparedness	Children, kindergartens staff, parents, local associations,
	Collaborations with institutions-agencies	Collaboration with EPPO in raising awareness of earthquake risk and increasing preparedness in kindergartens and municipal employees	Students, educational staff, , municipal employees.
	Connection with scientific knowledge	Participation in seminars (ΕΚΔΑ-ΙΝΕΠ), conferences (SafeGreece), briefings (adaptivegreece), workshops (Jean Monet Chair)	Staff of civil protection departments, institutions.
	Organizational practices to reduce seismic risk	Presentation of organizational practices and actions of the department and EPPO including, employee briefings, knowledge assessment, questionnaires and preparedness assessments of municipality services, planning volunteerism	Citizens, emergency managers, municipal staff, volunteers
Earthquake Risk Preparedness Actions	Memoranda of actions	Planning a memorandum of actions and responsibilities to be undertaken during an earthquake	Municipal presidents, municipal staff, volunteers
	Preventive evacuation of citizens	Planning for organized preventive evacuation of citizens	Emergency managers, volunteers, citizens
	Civil protection drills	Organize and evaluate civil protection drills to test and improve emergency response procedures	Emergency managers, municipal staff, schools
	Coordinating meetings	Organization and participation in Civil Protection meetings	Civil protection bodies
	Shelters recording	Identification of suitable shelters in case of an earthquake	Citizens, municipal authority
	Risk communication management	➢ Communication strategies and protocols implemented for effective disaster response and management ➢ Design of information collection model in the disaster phase	Emergency managers, citizens, municipal staff
	Communication	Public information during disasters	Citizens, volunteers
	Recommendations to the Mayor	Provide recommendations to the Mayor to enhance the City's earthquake risk reduction and preparedness measures	Municipal authority
	Evaluation of actions and redesign	Extract valuable conclusions of effectiveness of the work and operation of the Civil Protection mechanism and improve by redesigning from lessons learned and good practices	Researchers, legislators, emergency management planners

The above action of the Department revealed that no similar actions had ever taken place in the Municipality and there was interest in the information and drills by the Municipality's staff.

4. RECOMMEDNATIONS-CONCLUSION

The increasingly complex world created by the evolution of technology increases the likelihood of crises, both locally and globally. Citizens need to be active and involved in order for modern societies at risk to gain the resilience needed to become more resilient to change. This model of creating empowered cells/entities that can deal directly with crises and risks and act effectively at the local level is the only way forward. Strengthening resilience is not only through strengthening resources, but also through inclusiveness, and improving communication that generates relationships. Relationships aim to strengthen the bonds between community members. It is a one-way street to strengthen the participatory role of social actors at the local level as stakeholders in disaster governance. The need for the necessary link between disaster response and citizens is demonstrated through the civil protection mechanism, and it is understood that the creation of the Independent Civil Protection Departments of the municipalities creates the first link between society and the state, with a relationship of interaction. The valuable conclusions reached should be widely communicated to the specific Municipality. A good number of important suggestions and recommendations are applicable not only to Istiaia-Edipsos but also to other similar Civil Protection Depa critical role played by the Civil Protection Department of the seismic risk and explores the potential for these actions to l contexts.

Figure 1 Civil Protection Cell with the Municipality's Civil Protection Department at its Core.

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PRIMARY AND SECONDARY ENVIRONMENTAL EFFECTS INDUCED BY THE 6 FEBRUARY 2023 TURKEY-SYRIA EARTHQUAKES AND THEIR IMPACT ON THE NATURE AND SPATIAL DISTRIBUTION OF BUILDING DAMAGE

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ABSTRACT
On 6 February 2023, two major earthquakes struck the southeastern part of Turkey and the northwestern part of Syria. Both earthquakes produced primary and secondary environmental effects, which greatly affected buildings and infrastructure. The authors conducted field surveys in the earthquake affected East Anatolia and detected many cases where the aforementioned effects had a considerable impact on the nature and the spatial distribution of building damage. Several cases are presented herein. The identification of zones susceptible to the occurrence of these effects is very important for the comprehensive seismic hazard assessment and the mitigation of the impact on buildings and infrastructure in residential areas and consequently on their population by similar destructive seismic events in the future.

Keywords: Turkey-Syria earthquakes, disaster, public health, health emergencies, infectious diseases, surveillance

1. INTRODUCTION

On 6 February 2023, two major earthquake events struck the southeastern part of Turkey and the northwestern part of Syria. The first Mw=7.8 earthquake struck at night (04:17 local time), and several hours later (13:24 local time) a second Mw=7.5 earthquake caused widespread impacts on the local population and the natural and built environment of 11 provinces in southeastern Turkey (**Figure 1**), home to nearly 14 million Turks and 2 million refugees from neighboring Syria. Human casualties amounted to 50,399 and injuries to 107,204, according to the latest official announcements of the Presidency of the Republic of Turkey [1]. Nearly 2.5 million people live in temporary settlements, while 1.6 million of them are staying in unofficial settlements [1].
These high numbers of casualties, injured and homeless people are attributed to the extensive and very heavy structural damage generated in the earthquake-affected area. In particular, 518,009 buildings either collapsed or sustained heavy structural damage [1], resulting in thousands of trapped residents and millions of affected people.
The obvious reasons that contributed to the large human and economic losses in southeastern Turkey comprised the large earthquake magnitude, the generation of the first earthquake during the night that found the majority of residents in their homes, the demographic characteristics of the region which include densely built-up and populated urban areas as well as the proximity of many residential areas to the seismogenic faults. The earthquakes caused primary effects, including extensive coseismic surface

ruptures, and triggered secondary effects, including liquefaction and landslides, among others, that have largely shaped the type and distribution of the building damage.

This extended abstract provides a presentation of the primary and secondary effects detected during post-event field surveys conducted by the authors in the southeastern part of Turkey and their contribution to the type and distribution of the observed building damage.

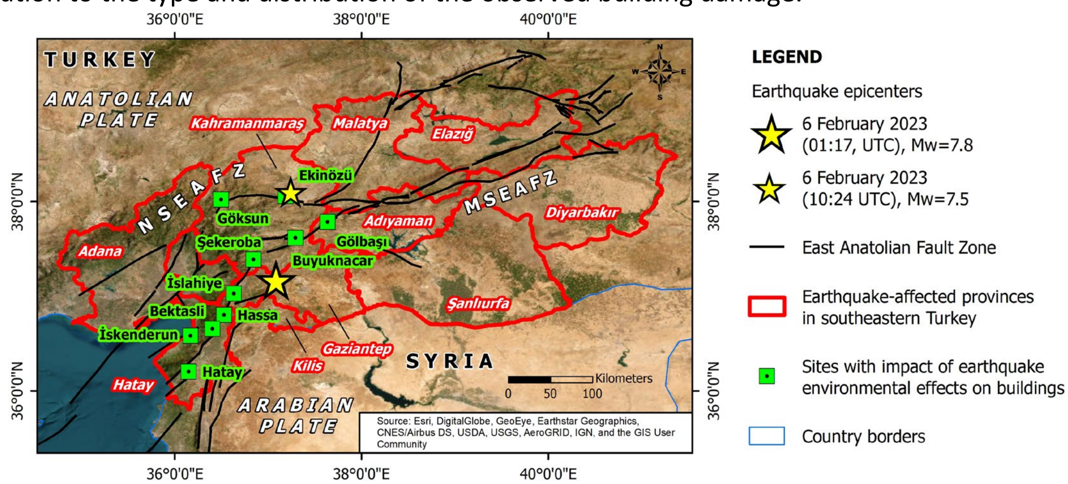

Figure 1. The provinces in southeastern Turkey affected by the 6 February 2023 earthquakes due to rupture of the East Anatolian Fault Zone (EAFZ). The sites where the earthquake environmental effects (EEE) greatly affected the building stock are presented with green symbols and green letters. Red color in letters correspond to the affected provinces. MSEAFZ: Main Strand of the EAFZ; NSEAFZ: Northern Strand of the EAFZ.

2. METHODOLOGY

The data presented in this study have been obtained from post-event field surveys conducted by the authors in several severely affected urban centers in the earthquake-affected area of East Anatolia. The field surveys were conducted both shortly after the devastating earthquakes (6–11 February) and 2 months after the earthquake (31 March–6 April), when access within severely affected urban centers was allowed after the completion of extensive search and rescue operations, providing the opportunity to obtain on-site data.

The authors collected data in the disaster field by applying traditional field mapping techniques and innovative methods, including the deployment of Unmanned Aircraft Systems (UAS). The unmanned aerial photo imaging contributed to the direct identification of the primary and secondary effects of earthquakes within densely built areas and the direct mapping of their impact on the built fabric.

3. IMPACT OF COSEISMIC RUPTURES ON BUILDINGS

The coseismic surface ruptures intersected with cities, towns, and settlements, resulting in a major impact on the performance of buildings and infrastructure during the earthquake. In most cases, the intersection of these ruptures with the built environment resulted in very heavy structural damage to buildings, which mostly collapsed, while infrastructure was partially or completely destroyed. Characteristic examples of this impact were detected along both strands of the East Anatolian Fault Zone (**Figure 1**), which ruptured in early February 2023. Several observations on such impact were made along the main strand of the East Anatolian Fault Zone, in particular from southwest to northeast in Hassa town (Hatay province) (**Figures 2a–2c**), in İslahiye area (Gaziantep province), in Şekeroba area (Kahramanmaraş province) (**Figures 2d–2f**) and in Gölbaşı town (Adiymanan province). Furthermore, similar impact was detected in the building stock along the northern strand of the East Anatolian Fault Zone, in particular in the Ekinözü area (Kahramanmaraş province) along the Sügü segment and in the Göksun area (Kahramanmaraş province) along the Çardak segment. The effects on buildings in these areas are not only attributed to the left-lateral offset along the fault but also to the formation of structures along it, which typically develop in strike-slip settings and include pull-apart basins and pop-up ridges at various observation scales (**Figures 2a–2f**).

4. IMPACT OF LIQUEFACTION PHENOMENA ON BUILDINGS CLOSE TO WATER BODIES

In the provinces affected by the 6 February 2023 earthquakes, many residential areas are built within structures typical of strike-slip settings, such as pull-apart basins filled with recent Quaternary deposits. The evolution of such structures is controlled by ongoing tectonic processes and by active and seismic faults located mainly at their margins. Furthermore, they host water bodies, resulting in recent deposits and conditions of increased instability along their shores as well as high water table. Typical examples of such areas with recorded severe earthquake impact are the Gölbaşı pull-apart basin in the northern part of the affected area, in which the homonymous city is built; the Antakya-Samandağ corridor, in the southern part of the affected area, within which Antakya and Samandağ are built; and the alluvial plain at the front of Ahir mountain, where Kahramanmaraş is located.

In these areas, the Mw=7.8 earthquake triggered several secondary effects that caused additional impact on buildings and structures. These phenomena mainly included liquefaction and extensive lateral spreading. They were initially observed on agricultural land, where they partially covered large areas with liquefied material that reached the surface through ground cracks, resulting in no damage to the building stock. They were also detected within severely affected residential areas in the form of ground cracks attributed to lateral spreading. Lateral spreading was characterized by very large and highly non-uniform ground deformation, causing stretching of building foundations and associated damage.

Such impact was captured within the town of Gölbaşı (Adiymanan Province) (**Figures 2g–2i**) and the coastal town of İskenderun (Hatay Province). A common characteristic of these areas is that they have properties that make them susceptible to liquefaction. These properties include recent deposits with sand and silt as main lithology, and water-saturated soils, since these areas are located near a lake (Gölbaşı) and the sea (İskenderun). The generated building damage, especially in the first case of the foundation in a lakeside environment, was typical of liquefaction and the loss of load-bearing capacity of the foundation. It included mainly (a) tilting and settlement of the building without damage to the superstructure, (b) pancake-type collapse, and (c) outspread multi-layer collapse (**Figures 2g–2i**).

Another typical case of impact attributed to construction within a basin and foundation close to water bodies is the Antakya city, located within the Antakya-Samandağ corridor at the southern end of the earthquake-affected area. During our field reconnaissance in Antakya city, we detected that the most frequent and continuous collapses are located in the part of the city constructed next to the current Orontes riverbed and built up by Holocene alluvial deposits composed of pebbles, sands, and clays. Taking into account the age and the lithology of the Holocene deposits observed along the Orontes River, the fact that these deposits are saturated with water due to the river water table and the high values of maximum ground acceleration in the area, it is concluded that these deposits, on which a large part of Antakya was built, are highly susceptible to liquefaction phenomena in cases of intense earthquake ground motion. This was amply demonstrated north of the Antakya-Samandağ corridor, in particular in the southern part of the Amik Basin, where extensive liquefaction phenomena occurred, including ground cracks and ejection of liquefied material, sand boils, and lateral spreading along or close to the Orontes river bed.

5. IMPACT OF LANDSLİDES ON BUİLDİNGS CLOSE TO STEEP SLOPES

Regarding the landslides caused by the 6 February 2023 earthquakes, they are mainly distributed on steep slopes on the margins and within the macrostructures of the affected area, where semi-mountainous and mountainous parts occur. They did not have extensive effects on the buildings of the large residential complexes of cities and towns in the earthquake-affected area, but only in limited cases of semi-mountainous and mountainous settlements. In these settlements, landslides affected buildings causing not only non-structural damage but also severe structural damage. Typical examples of settlements with landslide impact on their built fabric are the Bektasli village (Kirikhan district, Hatay province) and the Buyuknacar village (Pazarcik district, Kahramanmaras province). The majority of the landslide-induced damage is related to damage to infrastructure, in particular segments of the road network.

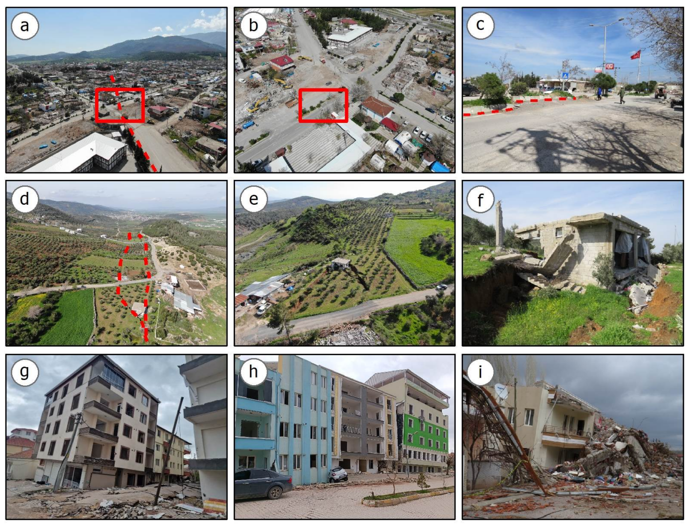

Figure 2. (a) Coseismic surface ruptures (red dotted lines) in Hassa town resulting in collapses. (a, b) Drone views of the intersection (red polygon) where a pop-up ridge resulted in deformation of the road (c) and collapse of the adjacent structures. (d,e,f) Surface ruptures (red dotted lines) in Şekeroba-Yeşilyurt area resulting in total collapse of structures. (e,f) A reinforced-concrete structure located at the intersection of surface ruptures was completely destroyed. (g-i) Damage to buildings in Gölbaşı town, heavily affected by liquefaction and lateral spreading. (j,k) Earthquake-triggered rockfalls in Bektaşlı village (Kırıkhan district, Hatay) and related impact on buildings.

6. CONCLUSIONS

The presented data and examples show the significant impact of the primary and secondary environmental effects triggered by the 6 February 2023 earthquakes on the type and spatial distribution of building damage in southeastern Turkey. The identification of zones susceptible to the occurrence of these effects is very important for the comprehensive seismic hazard assessment and the mitigation of the impact on buildings and infrastructure in residential areas and consequently on their population by similar destructive seismic events in the future.

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RISK FACTORS FOR INFECTIOUS DISEASES EMERGENCE IN THE AREA DEVASTATED BY THE 2023 TURKEY-SYRIA EARTHQUAKES AND MEASURES FOR PREVENTING AN IMMINENT HEALTH CRISIS

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ABSTRACT

Two major earthquakes struck Turkey and Syria on February 6, 2023, causing exceptionally substantial structural damage to buildings and infrastructure in one of Anatolia's most heavily inhabited districts. The authors visited the devastated area shortly after the earthquakes as part of search and rescue and research missions to detect if the newly established conditions had the potential to influence public health further. Based on the disaster-related field data obtained, it has been detected that risk factors linked with the emergence and amplification of infectious diseases were present in the affected residential areas from the first hours of the emergency. As crises and disasters (conflicts, pandemics, and epidemics) have already developed in the area, they could exacerbate the already precarious public health situation. These factors include numerous collapsed medical facilities, cold weather conditions, destruction of life-supporting infrastructures, overcrowding in emergency shelters, poor sanitation, and unfavorable socioeconomic conditions. Among other recommended strategies, effective disease surveillance at the local and regional levels is a critical prerequisite for early warning and prevention against emerging infectious illnesses in the earthquake-affected areas.

Keywords: Turkey-Syria earthquakes, disaster, public health, health emergencies, infectious diseases, surveillance

1. INTRODUCTION

A devastating Mw = 7.8 earthquake that struck Turkey and Syria on February 6, 2023 was caused by the rupture of the southwest portion of the East Anatolian Fault Zone [1]. The epicenter of this earthquake was west of the city of Gaziantep, and its focal depth indicates that it was a shallow event. It was followed by the generation of an Mw = 7.5 earthquake within the same fault zone.

These earthquakes had a significant impact on networks and infrastructure due to their extensive primary and secondary environmental effects [2]. The most important earthquakes' impact was the extensive and severe damage to buildings and infrastructure in one of Anatolia's most densely populated areas. A battle against time and harsh conditions began for those who were still trapped but alive in the rubble until they were rescued as hundreds of thousands of buildings collapsed and thousands of people living in high-rise apartment buildings lost their lives.

For locals still living in the affected area as well as rescue teams, medical personnel, volunteers, and crews working to mitigate hazards during the aftershock period, a new threat emerges and relates to the burden that infectious disease outbreaks, epidemics, and sporadic cases place on public health.

This study aims to identify all risk factors that could contribute to the occurrence and transmission of infectious diseases in the earthquake-affected regions of southeastern Turkey and northern Syria. This will be accomplished by considering the data gathered from the authors not only during field surveys in the affected region soon after the earthquake, but also by their involvement in various stages of the disaster management cycle, particularly during emergency response. In addition, this study intends to give scientists, health professionals, civil protection officials, and disaster management personnel a crucial tool for effective prevention, control, and management of potential infectious disease outbreaks in the post-disaster period.

2. METHODOLOGY

The researchers visited the earthquake-affected region of East Anatolia and gathered disaster-related information about the impact on buildings, including damage to medical facilities, the impact on roads, on drinking-water and electricity supply networks, as well as the main emergency response actions, which included distributing basic necessities to the affected people and providing shelter for temporary accomodation of the affected residents. The methodology was applied to many different areas of the earthquake-affected region, including the cities of Kahramanmaras, Nurdagı, Gaziantep, Osmaniye, Adana, Iskenderun and Antakya with populations of hundreds of thousands to millions of people.
All authors then examined the collected data. The risk factors prevalent in the region that may favor the emergence of infectious diseases were first identified, and then the most effective measures for their prevention and management were chosen and proposed as a valuable tool for health officials, scientists, and operators involved in the emergency response and recovery phase.

3. PREVIOUS EARTHQUAKES IN TURKEY AND INFECTIOUS DISEASES EMERGENCE

Turkey has previously experienced unfavorable circumstances following severe earthquakes. The 17 August 1999, Mw=7.6 Izmit earthquake generated in northwestern Turkey and the 23 October 2011, Mw=7.1 Van earthquake in eastern Turkey caused a great number of casualties, injured and earthquake-affected people [3]. Gastrointestinal infections as well as wound and skin infections were reported following the earthquakes [4]. Immediately after the 1999 Izmit earthquake, diarrhea outbreaks mainly caused by Shigella species increased gradually and then returned to normal levels on September 1999 [5]. Hot summer weather, destruction of infrastructure and obstacles to accessing safe drinking water were the main factors that triggered the occurrence of these outbreaks. Additionally, problems observed in water supply and maintenance of adequate sanitation and hygiene conditions in emergency shelters led to incidence increase of Hepatitis A and E in children living in camps [6].
Extended staying in temporary settlements after devastating earthquakes may contribute to the emergence and persistence of infectious diseases. Even years after the 1999 Düzce earthquake, children who were still living in temporary settlements had much higher giardiasis and enterobiasis incidence rates than children from higher socioeconomic backgrounds living in normal conditions [7].
Following the 1999 Izmit earthquake, damaged infrastructure and unhealthy living conditions, facilitated the occurrence of infections/infestations and dermatoses [8]. Furthermore, traumatic injuries and crush syndrome that occur after the earthquake increase the predisposition to infectious complications [9]. Most of the wound infections recorded following the 1999 Izmit and the 2011 Van earthquakes were hospital-acquired and were mainly caused by resistant Gram-negative aerobic bacteria such as Acinetobacter baumannii [9-11].

4. RISK FACTORS FOR EMERGENCE OF INFECTIOUS DISEASES IN THE 2023 EARTHQUAKE-AFFECTED AREA OF EAST ANATOLIA

The affected areas of Turkey and Syria concentrated many risk factors for the emergence of infectious diseases from the very first hours following the occurrence of the devastating earthquakes.

Collapses of state hospitals resulted in fatal injuries, not only to patients, but also to the doctors and the nursing staff working in these facilities at the time of the earthquakes, leading to a reduction in the medical personnel that could have directly helped the affected residents. Transportation of people injured by debris to hospitals in nearby towns took considerably more time taking into account that the road network was either damaged by the strong ground motion or overburdened by increased traffic.

The severe winter make it difficult for those trapped in the rubble to survive, but also for the homeless. The only option for homeless people is the emergency shelters set up in open spaces, far away from destroyed buildings. However, overcrowding into small spaces without maintaining proper physical distance, insufficient basic items, heating, ventilation, and air conditioning systems, unsafe drinking water, inadequate food provision and poor personal hygiene are among the potential risk factors for developing respiratory infectious diseases in evacuation shelters [4]. The permanent interruption in the drinking water supply and the contamination of the available water sources led to an increase in the risk of gastrointestinal infectious diseases. Due to changing patterns of contact among humans, pathogens, and rodents during the post-earthquake period, rodent-borne diseases may potentially become more prevalent. The affected people can become infected by directly coming into contact with infected animal hosts or being exposed to water, food, or soil contaminated by the urine of infected animals. A breakdown in monitoring and healthcare initiatives, such as immunization campaigns, might provide the perfect environment for the spread of diseases like measles that can be prevented by vaccination. The severity of the disease and the burden of therapy can both rise when continuous treatments, such as those needed to cure tuberculosis, are interrupted.

One of the most effective measures for prevention of earthquake-induced infectious disease outbreaks is the establishment of a proper disease surveillance system. Its main purpose is to rapidly identify the post-disaster sporadic cases of infectious diseases by initially collecting and analyzing relevant information and then to improve disease trends monitoring and validity of early warnings and thus to more fully assess the public health burden of infectious diseases, allowing for a more rapid response and, thus, mitigation of outbreaks with the potential to become public health emergencies [4].

The occurrence of infectious diseases while staying in emergency shelters can be avoided by providing ample quantities of bottled water, canned and dry food and adequate ventilation, distributing personal protective equipment, and making available sufficient quantities of appropriate medical supplies, pharmaceutical products and effective vaccines [4]. More emergency shelters of the same or different type should be utilized to prevent overcrowding in emergency shelters. As soon as evacuees gather in camps, vaccines should be administered to prevent the occurrence and rapid spread of vaccine-preventable diseases. The most effective measure for prevention of waterborne diseases occurrence is the examination of water supply and sewerage systems to detect non-structural and structural failures [4]. Knowledge of modes of disease transmission can enhance the implementation of measures and efforts to control and prevent infectious diseases, seek immediate medical attention and guidance and apply appropriate treatment for reducing morbidity and mortality.

5. CONCLUSIONS

Following natural disasters, outbreaks of infectious diseases can pose serious public health risks. Inadequate emergency and preparedness strategies might jeopardize the prompt management and successful treatment of serious health concerns as well as promote the emergence and quick spread of infectious diseases when combined with the destruction of local healthcare infrastructure.

On 6 February 2023, two earthquakes occurred within the southwestern part of the East Anatolian Fault Zone and devastated the southeastern part of Turkey and the northern part of Syria. Many risk factors for the emergence of infectious diseases have been concentrated in the affected areas of both countries shortly after the earthquakes, including a lack of access to safe drinking water, overcrowding, and inadequate sanitation caused by the collapse of lifeline infrastructures. In addition, a fragile humanitarian situation is further complicated by the coexistence and synergy of crises and disasters of various origins, such as war conflicts, the COVID-19 pandemic in progress, and the cholera epidemic, with people in northern Syria facing another harsh winter, unstable security conditions, and the possibility of aid being cut off from across borders.

The development and implementation of more effective preventive measures can be improved by having a better understanding of the risk factors that underlie the emergence and transmission of infectious diseases. In the earthquake-affected areas of East Anatolia, effective disease surveillance at both the local and regional levels is a crucial prerequisite for early warning and protection against emerging infections and potentially uncontrollable disease transmission. Additionally, a multi-hazard strategy based on good practices and lessons learned from previous compound disasters should be used to prevent and control infectious disease emergence.

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LESSONS LEARNED FROM EMERGENCY SITE SELECTION IN TURKEY AFTER THE 6 FEBRUARY 2023 EARTHQUAKES AND INTEGRATION IN DISASTER MANAGEMENT PLANS OF THE ATTICA REGION (GREECE)

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ABSTRACT
On 6 February 2023, Turkey and Syria were severely struck by a major Mw=7.8 earthquake followed by an Mw=7.5 earthquake nine hours later resulting in tens of thousands of fatalities. As regards homeless people, nearly 2.5 million live in temporary settlements, while 1.6 million of them are staying in unofficial settlements. During post-event field surveys in the earthquake-affected area, several incorrect responses by the Civil Protection authorities emerged. They included selection of sites and the operation of camps in areas close to the sea and to rivers susceptible and vulnerable to the occurrence of tsunamis and floods respectively. These responses were taken into account in updating the database of sites selected for emergency shelters in the Region of Attica (Central Greece). All sites located within high flood risk zones and coastal zones susceptible to tsunami impact were excluded in the framework of a multi-hazard approach in order to reduce risk from the collision of hazards of the same or different type, which has the potential to further affect the local population and extend the recovery period.

Keywords: 2023 Turkey-Syria earthquakes, emergency shelters, camp sites, emergency response, disaster management.

1. INTRODUCTION

The earthquake emergency sites included in the disaster preparedness and emergency response plans can be divided into building evacuation assembly areas, earthquake camps, first aid sites and sites for relocation of critical services, which must be adapted to the needs of the affected population, with emphasis on specific population groups (elderly, children, disabled people, etc.). The specifications and characteristics are different for each of these categories and are described in detail in various guides for the Greek territory [1].

To date, the criteria and standards of these sites have been defined by a simple hazard approach in which hazards are considered and treated as isolated and independent phenomena. However, an increase in the complexity of hazards and their impact has been identified in recent years. These hazards may collide and interact in various ways, affecting to a large extent the population of the disaster-affected area, extending the recovery and thus making the single hazard approach in disaster management anachronistic. One of the innovations recently applied in disaster management is the multi-hazard approach, which should be applied at all steps of disaster management [2].

The motivation for this extended abstract was the approach applied by the Turkey's disaster management authorities to the selection of emergency shelters in the southeastern part of the country after the 6 February 2023 earthquakes. Incorrect responses were detected during the scientific mission of the Department of Geology and Geoenvironment of the National and Kapodistrian University of Athens (NKUA), in the affected area shortly after the Mw=7.8 and Mw=7.5 earthquakes (from 6 to 11 February) and almost two months after the events (31 March – 6 April), when the emergency response actions had been completed and recovery and rehabilitation had started.
The lessons learned were taken into account during the update of emergency shelters of the Attica Region (Greece) in the frame of the research project "Earthquake, Fire and Flood Hazard Assessment in the Region of Attica" conducted by the NKUA and the National Observatory of Athens (NOA).
This study mainly aims to raising awareness of the scientists, the operational staff and the general public about the errors and omissions in the selection of emergency sites after the 6 February 2023 earthquakes. Furthermore, it aims to highlight the risks posed to affected residents in order to avoid them in the future. For the Attica Region, this aim is achieved through the incorporation of lessons learned in the updating of emergency sites of the region in the context of the aforementioned project.

2. LESSONS LEARNED FROM EMERGENCY SITE SELECTION IN THE EAST ANATOLIA AFTER THE 6 FEBRUARY 2023 EARTHQUAKES

The first incorrect response regarding emergency sites in the earthquake-affected East Anatolia is the operation of camp sites in coastal areas, particularly vulnerable to tsunami. The most prominent example of such a site was detected in the coastal part of Samandağ, at the southwestern edge of the affected area. On a football field located a few meters from the coast, a tented camp with capacity of 900 people had been set up by the Disaster and Emergency Management Presidency (AFAD) (**Figure 1**).

Figure 1. Location map and close view of the Samandağ stadium where a tented camp was set up for the accommodation of the earthquake-affected residents. The camp is located in an area highly vulnerable to tsunami.

The morphology of the wider area of the field is gentle and includes the Samandağ dunes, extensive marshland and river estuaries (Figure 1). The history of tsunami events in this coastal area is rich [3]. Furthermore, the aftershock sequence comprised several strong events, that could trigger tsunami either directly by seafloor displacement or indirectly by the occurrence of coastal or offshore landslides. It is important to mention that a strong Mw=6.3 aftershock struck with an epicenter close to Samandağ, aggravated building damage and caused more human losses.
Considering all the aforementioned information, the potential for adverse tsunami effects on the population of the coastal Samandağ area was high during the first weeks of the aftershock period. Thus, the selection of the site and the operation of the camp should have been avoided.

The second incorrect response regarding emergency sites in East Anatolia is the selection and operation of camp sites within floodplains that have an increased flood risk. Typical cases of emergency sites within flood-affected areas were identified mainly in Adiyaman and Şanlıurfa provinces and secondarily in Kahramanmaraş province following heavy rainfall on 15 March 2023 [4]. These floods caused 14 human casualties [4]. Camp sites with tents and container-type structures were heavily affected, causing a casualty from a container drifted away by flooding. Tented areas at risk of flooding were evacuated, while some earthquake survivors were temporarily placed in dormitories.
Apart from the aforementioned case, we detected several emergency sites very close to the banks of streams and rivers. The most prominent example is the tented camp site that had been set up by the AFAD east of Diyarbakir city, next to the bed of the Tigris River (**Figure 2**). Among other important reasons, the inadequacy of this earthquake camp site is mainly attributed to its proximity to the Tigris riverbed and in particular to the fact that at earlier times it was partially or totally inundated by flood waters. The most recent flooding in this area occurred in 2018 due to a structural failure of a dam located upstream during a controlled water diversion downstream of the dam.

Figure 2. Location map of the tent camp east of Diyarbakır city, next to the Tigris River. This area has been affected in the past by floods resulting in inundation and is characterized by high flood risk.

The only measure to deal with the potentially high flood risk was the temporary evacuation of the settlement after the heavy rainfall in Adiyaman, Şanlıurfa and Diyarbakır provinces in 15 March 2023 as the site was partially flooded, but also in fear of the Tigris River overflowing. After many protests, the tents were removed and the site was closed after operating for 70 days.
The inadequacy of the above emergency sites in terms of selection criteria and safe operation standards reveals errors in the preparation of emergency plans and concessions in their implementation as well as a rush for rapid temporary accommodation of the affected people. They also revealed a single hazard approach, which seems to ignore the impact of hazards of the same or different types.

3. UPDATING EMERGENCY SITES IN THE ATTICA REGION FOLLOWING MULTI-HAZARD APPROACH

In the frame of the research project "Earthquake, Fire and Flood Hazard Assessment in the Region of Attica" various work packages have been implemented, including “the Analysis, Evaluation and Selection of Critical Areas for related Actions”. This work package includes the identification and updating of building evacuation assembly areas. Related geospatial data of the Attica Region were used as a basis [5]. These data include (a) geospatial attributes, such as their coordinates and postal address, (b) qualitative attributes, such as their name, current use, ownership, proposed use, and available infrastructure of the site and (c) quantitative attributes, such as their total and active areas and capacity. During the data evaluation process, selected sites were checked in the field and the above attributes were completed for each site, while at the same time the sites were delineated in GIS environment by

editing and creating points and polygons. In order to avoid adverse effects from flood occurrence in emergency sites of the Region of Attica, the Flood Risk Management Plan of the River Basins of the Attica Water Department [6] was taken into account with emphasis on the potentially high flood risk zones. Based on these information, we excluded the sites located within the above zones from the database. Typical examples of such sites are located on either side of large rivers and streams in the Athens Basin, including the Kifissos River and the Chalandri stream.
In order to avoid tsunami impact in coastal emergency sites of the Attica Region, we evaluated data obtained from the action "Geodynamic Risk Management" of the Attica Region research project, which include properties of tsunami with impact on the coast of the Attica Region [7]. Accordingly, we defined a coastal zone, whose outer boundary is the coastline (contour of 0 m) and the inner boundary is the 20 m contour for Kythera and Antikythera Islands and the 10 m contour for the rest of the Attica Region. The initially selected emergency sites found within this zone were excluded from the related database. Typical examples of such excluded sites are those located in the coastal areas of the southern suburbs of the Athens basin. The result of this process was the final selection of 1054 sites out of a total of 1126 initially selected sites.

4. CONCLUSIONS

Incorrect responses were revealed in the selection of emergency shelters in East Anatolia affected by the 6 February 2023 earthquakes highlighting on the one hand problems in operational planning and on the other hand the importance of a multi-hazard approach in managing disasters and crises. In the frame of the research project on the seismic risk assessment of the Attica Region, multi-hazard approaches were applied in updating the database of emergency shelters. This approach should be applied at all stages of disaster management as the aforementioned collision of destructive events can create challenges, that further burden the local population and increase the recovery time.

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SELECTION OF DEBRIS DISPOSAL SITES AFTER THE 6 FEBRUARY 2023 EARTHQUAKES IN SOUTHEASTERN TURKEY, RELATED HAZARDS AND RISK REDUCTION STRATEGIES

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ABSTRACT

On 6 February 2023, southeastern Turkey was struck by two major earthquakes that devastated 11 provinces. Tens of thousands of buildings were collapsed and more were later demolished resulting in a debris volume considered as the largest since the 1994 Northridge earthquake. During post-event field surveys conducted by the authors in the affected area, several disposal sites set up in the most affected provinces were detected and checked for suitability. Based on field observations, it is concluded that all sites had characteristics that did not allow them to be classified as safe sites for earthquake debris treatment and disposal. This inadequacy is mainly attributed to their proximity to areas, where thousands of people live and work in a daily basis and to their operation within or close to surface water bodies. In this context, measures for effective debris management are proposed based on the existing scientific knowledge and operational experience.

Keywords: Turkey earthquake, debris management, earthquake debris, debris disposal sites, asbestos, public health

1. INTRODUCTION

The management of earthquake debris is one of the first and most important tasks during the emergency response and recovery since it poses major threats to the afflicted area's environment and public health. The hazards associated with debris management are associated with the presence of hazardous elements in collapse and demolition waste including putrescible wastes, minerals in various forms comprising long and thin fibrous crystals of asbestos, leaching of chemical preservatives used for treated wood, fecal-contaminated material from damaged parts of the sewage system, industrial waste, such as chemicals, and household hazardous wastes including oils, pesticides etc. [1-3].
Many such debris management challenges emerged in the earthquake-affected area of southeastern Turkey in early February 2023, where two major earthquakes of Mw=7.8 and Mw=7.5 respectively struck a densely built-up area extending in 11 provinces and affected many large cities, towns and settlements (Fig. 1). According to estimations by the United Nations Development Programme (UNDP) [4] and Xiao et al. [5], the 6 February 2023 earthquakes produced between 116 and 920 million tons of

debris, depending on the estimation method, making the largest debris volume recorded from a natural disaster since the 1994 Northridge earthquake (Southern California, US).

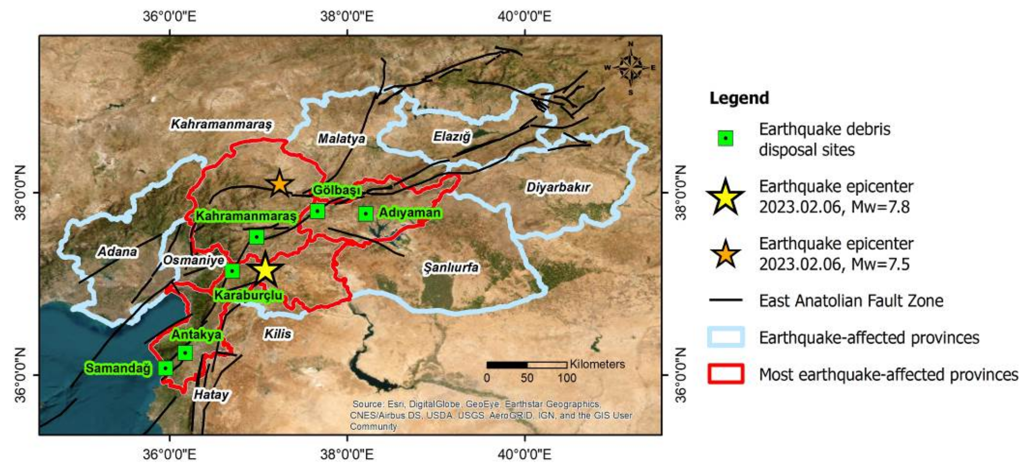

Figure 1. Location map of the studied earthquake debris disposal sites in the most earthquake-affected provinces of Turkey along with the epicenters of the February 2023 devastated earthquakes and the East Anatolian Fault Zone.

The major objective of this study is to increase awareness among scientists, operational employees, and impacted citizens in Turkey about the errors and omissions in debris management, particularly with regard to the selection of earthquake debris disposal sites. The study also presents measures to address and mitigate potential adverse effects on public health and the natural environment in the East Anatolia region. Additionally, it aims to bring attention to both correct and incorrect responses employed by those involved in debris management during the recovery period, as well as the threats posed to public health and the environment. By doing so, the study aims to prevent the repetition of these mistakes in future destructive events.

2. METHODOLOGY

During fieldwork, we detected disposal sites in four of the worst-affected provinces in Turkey's southeast. The on-site identification of the disposal sites' dimensions, properties and activities was made simple by using unmanned aerial systems (UAS). Furthermore, images from the constellation of Planetscope satellites were also used [6]. Due to the high frequency revisiting time, we were able to select cloud-free days photos, work with a high spatial resolution (3 meters) and utilize the near-infrared band in addition to the visible spectrum. Due to the high reflectance of chlorophyll, pseudocolor picture maps were implemented and offered a great contrast between areas covered in plant and concrete features on the earth's surface, such as the investigated disposal sites.

Both methodologies contributed to mapping properties of the studied sites and monitoring actions taking place during debris processing. In addition, they assisted in mapping the presence of human activity and residential structures as well as natural ecosystems in the surrounding areas that could be adversely affected by the operation of these sites.

3. EARTHQUAKE DEBRIS MANAGEMENT IN THE AFFECTED PROVINCES OF TURKEY

Several debris disposal sites were discovered in the field nearby major urban centers with extensive building collapses, including those in Gölbaşı and Adiyaman in the northern and northeastern part, Nurdağı and Kahramanmaraş in the central part, and Antakya and Samandağ in the southern part of the earthquake affected area respectively. Debris management on these sites involves hazards with a significant potential to have a negative impact on public health and the ecological balance.

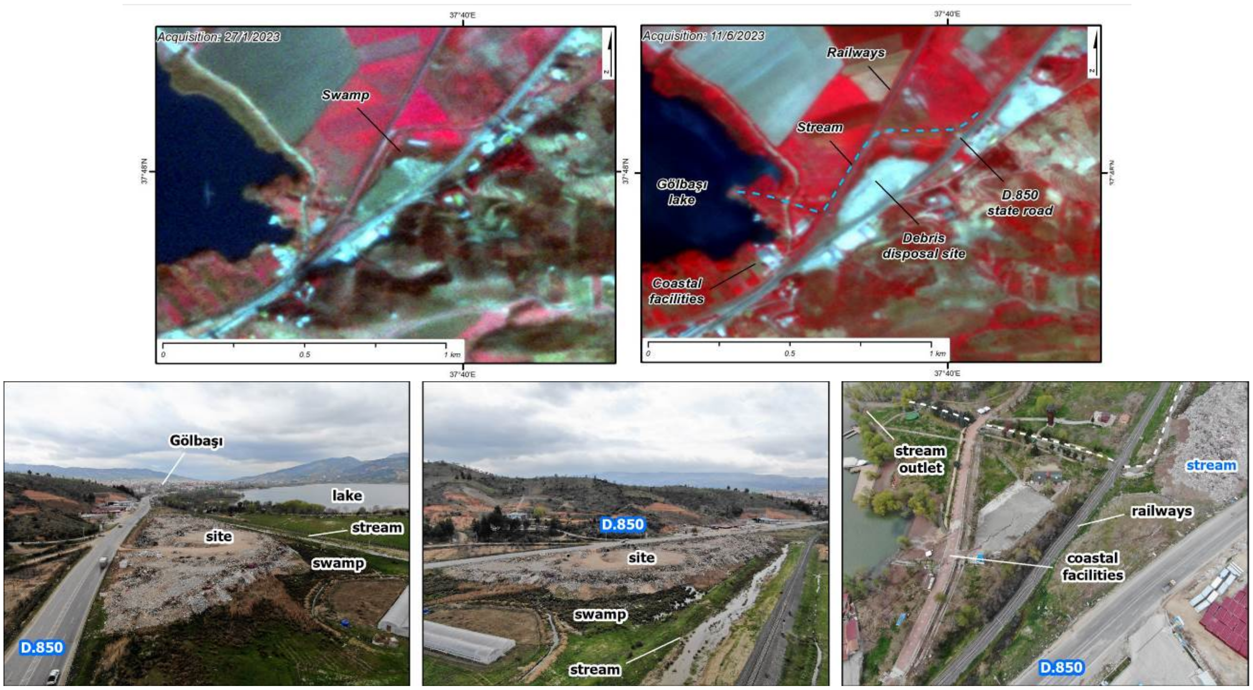

Figure 2. (First row) Pseudocolor picture maps of the Gölbaşı town wider area before (left) and after (right) setting up of an earthquake debris disposal site. (Second row) Drone views of the site and the main elements of the natural and built environment in the site's surrounding area.

The most significant factor contributing to the inadequacies of these disposal locations is their location close to residential areas, earthquake camps with tents and container-type structures, university campuses, and large and small industrial sites.

Regarding the natural environment, these facilities are located within or adjacent to surface water bodies, including perennial and intermittent streams, lakes and lakefront regions, marshy areas along the coast, and the sea, where there was a considerable threat of contaminating both the surface and groundwater systems.

According to field observations, the majority of workers and volunteers at collapse, demolition, and disposal sites did not apply the recommended personal protection measures against hazardous materials, with a few exceptions. Few used dust masks, even fewer disposable or replacement clothing.

Only a small portion of the road network through which debris was transferred to the disposal sites as well as a small part of the debris in disposal sites were watered to avoid dust formation. No other measures were taken to avoid dust formation during transit, such as covering debris on truck beds.

4. ACTIONS TO MITIGATE RISKS FROM EARTHQUAKE DEBRIS MANAGEMENT

To effectively and optimally tackle the impact of earthquake debris on public health and the environment at the mentioned sites, it is crucial to halt debris treatment, segregate hazardous materials from the debris, and securely store them in designated sites with strict safety standards. However, in view of the continuation of the debris disposal processes, the recommendation for the relevant

authorities comprises consistent monitoring of environmental parameters and hazardous elements within and around the disposal sites. If the recorded values indicate a significant risk of harming the local population and the natural environment, the operations should be permanently ceased. Due to the potential for long-lasting effects, the monitoring must continue until complete restoration.
To minimize the contamination of surface water bodies, groundwater systems, and soils, it is recommended to adopt actions that focus on reusing and recycling debris. Previous experiences have highlighted the advantages of such methods, including reduced landfill usage, decreased demand for raw materials, and lower debris management costs [7]. Moreover, appropriate treatments for chemicals and heavy metals that have polluted the soil and water is crucial to mitigate their impact and restore water quality for safe supply and irrigation purposes [8]. In situations involving asbestos, strict adherence to international best practices is essential to minimize its effects on public health [9].
At every phase of disaster debris management, it is essential to adhere strictly to the best health and safety practices and protocols to ensure that all those involved in debris management are protected from any direct or indirect adverse effects.

5. CONCLUSIONS

After surveying the largest earthquake debris disposal sites and their surroundings in southeastern Turkey after the February 2023 earthquakes, it is concluded that none of the sites met the criteria to be classified as safe locations for earthquake debris treatment and disposal. This is primarily due to their close proximity to areas where a significant number of people reside and work on a daily basis and to areas comprising crucial elements of the natural environment.
When disasters do occur, the time for planning is either limited or nonexistent, resulting in severe and long-lasting effects, leading to extended recovery and reconstruction periods. By thoroughly preparing and implementing lessons learned from recent disasters and best practices, the involved authorities can ensure public health and safety and maintain a harmonious balance within natural ecosystems.

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DWELLING AFTER DISASTER: FORMAL DESIGN AND SPATIAL IMPROVISATION IN TRANSITIONAL SHELTER

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ABSTRACT

This research focuses on the relationship between formal design and user interventions, referred to as "improvisation" or "spatial improvisation," in transitional housing provided to beneficiaries after a disaster. The objective is to understand how beneficiaries interact with the designed spaces of transitional shelters and explore the dynamics between formal design and spatial improvisation in that context. Through literature review, case studies and field research, a typology of spatial improvisation in transitional housing is developed. Recurring types of improvisation are identified, initiated by users or prompted by the place. This approach might be useful for policymakers, as observing spatial footprints aids in understanding community needs and developing suitable housing policies. Involving architects in the disaster management cycle contributes to better housing interventions. The importance of recording housing operations is highlighted, along with the suggestion to incorporate participatory procedures for operational and academic purposes.

Keywords: Disaster, Dwelling, Transitional Shelter, Improvisation

1. INTRODUCTION

This work [1] explores the relationship between formal design and interventions by the users (referred to as "improvisation/spatial improvisation") in transitional housing, addressing a research gap in understanding how beneficiaries interact with the designed spaces of transitional shelters provided to them in the aftermath of a disaster.

The objective is to provide insights on the dynamics between formal design and spatial improvisation in transitional housing within that context. Based on empirical evidence from case studies, the main outcome of this research is the development of an improvisation typology, which holds useful implications for policymakers and practitioners involved in disaster management.

2. METHODOLOGY AND CASE STUDIES

2.1. Methodology

The study adopts a comprehensive methodology to investigate the interplay between design and improvisation in post-disaster transitional housing. It starts with an extensive literature review, exploring existing research on the impact of disasters on housing and strategies in transitional housing within the context of disaster management. Based on bibliographic research, we studied cases from Turkey's 1999 earthquake, Japan's 2011 earthquake/tsunami/Natech disaster and Jordan's refugee influx in 2012. The cases present various facets of housing, encompassing social, economic, and cultural dimensions and different disaster management and sheltering policies at national level.

Furthermore, we selected two examples of temporary housing settings within Greece to contact field research: a temporary camp in Athens, which accommodated beneficiaries following the 1999 earthquake and still exists today, and a temporary camp in the island of Crete, housing individuals affected by an earthquake in 2021. In these cases, interviews with key informants were also employed as a method to gather qualitative data on the experiences, preferences, and challenges of users and stakeholders, pertaining to the design and functionality of the transitional housing.

Across all the case studies, we meticulously observed and documented how beneficiaries engage with and adapt the provided spaces to fulfill their needs. To accomplish this, we utilized vast photographic material found on the internet or from other sources, serving as a visual record that captures the spatial situation and illustrates how it is utilized by the users.

By employing a combination of literature review, bibliographical and image analysis concerning specific case studies, and field research, this methodology allows for a comprehensive analysis of the dynamics of transitional housing, shedding light on the intricate relationship between design and improvisation. It yields an understanding of how beneficiaries in different socio-cultural contexts transform transitional housing based on their needs, available resources, and socio-cultural context.

2.2. Images as a basis for the identification of spatial improvisation

In this sub-section visual material will be used to demonstrate our methodological approach in identifying different aspects of self-improvisation.

2.2.1. International case studies

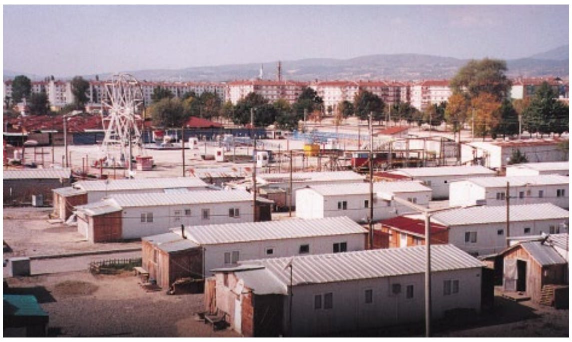

Figure 1: Photo of a transitional settlement in Western Turkey after the 1999 earthquake [2]. The repetition of improvised parts in Prefabricated Units are perceived as an improvisation trend that solves a problem or meets a spatial need. Following the prevalence of these practices, a trend emerges in the local market for specific materials or technical knowledge.

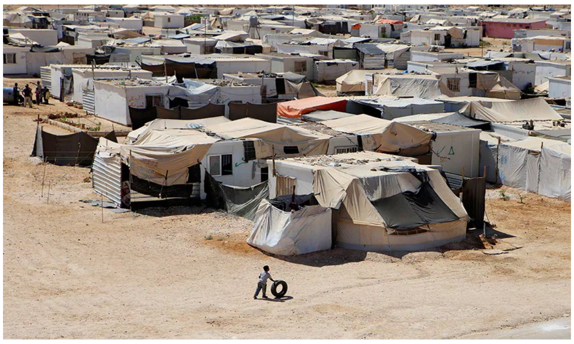

Figure 2: The photo depicts an improvised tent neighborhood in Za'atari's refugee camp [3]. The applicability of this case to the study, a crisis rather than a disaster, is attributed to specific sociocultural and residential factors inherent in both Jordan and Syria. The camp now accommodates a growing population with diverse spatial uses, including a bustling market. Beneficiaries have adapted and transformed living spaces using various materials aligned with individual and collective needs, indicating efforts towards a more permanent settlement.

2.2.2.Greek case studies

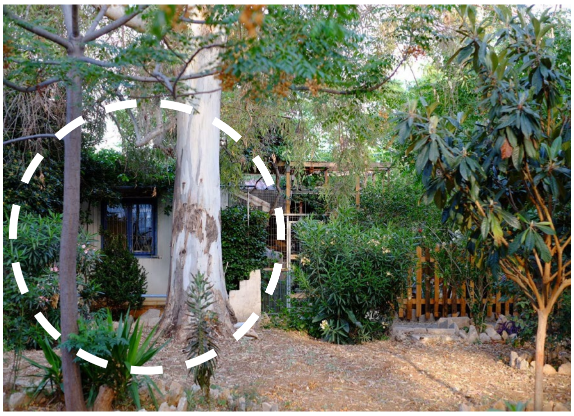

Figure 3: In the photograph captured by S. Kalogeromitrou in June 2023, only a remnant of the original transitional shelter prefabricated unit can be seen, highlighted with the dashed circle. The current state of the camp presents an opportunity to explore the shortcomings in the camp's handover process and the resulting improvisations made by its inhabitants. Originally established after the 1999 earthquake of Athens in the parking lot of the General State Hospital of Nikea, the camp has evolved to accommodate a population beyond its initial beneficiaries. The users have adapted and customized their living spaces, while the significant investments made in the camp by them, force the permanence of the settlement in the urban tissue.

Figure 4: The example of Arkalochori in Crete, here photographed by G. Karpathiotakis in June 2023, can be considered a successful operation of transitional housing, as its cycle has begun to close, synchronized with the initial operation goal for its handover. User interventions distinguish the inhabited dwellings, with a notable need for shade in the outdoor space, creatively addressed through the use of umbrellas: this practice can be considered improvisation due to local climate characteristics. The primary forms of improvisation revolve around appropriation and achieving a comfortable and aesthetically acceptable daily life for the users.

3. FINDINGS AND SIGNIFICANCE FOR POLICY AND PRACTICE

The findings of our research highlight recurring types of spatial improvisation. These findings culminate in the development of a typology of spatial improvisation in transitional housing, which reflects the characteristics of housing in pre-disaster conditions, such as appropriation, comfort, safety, stability, socialization and overall satisfaction of needs using available resources [Figure 5]. The study reveals two groups of improvisation cases: those initiated by the users themselves and those prompted by the characteristics of the place. Understanding these improvisations and their relationship with the space of non-permanent habitation contributes to recognizing settlement tendencies in transitioning communities.

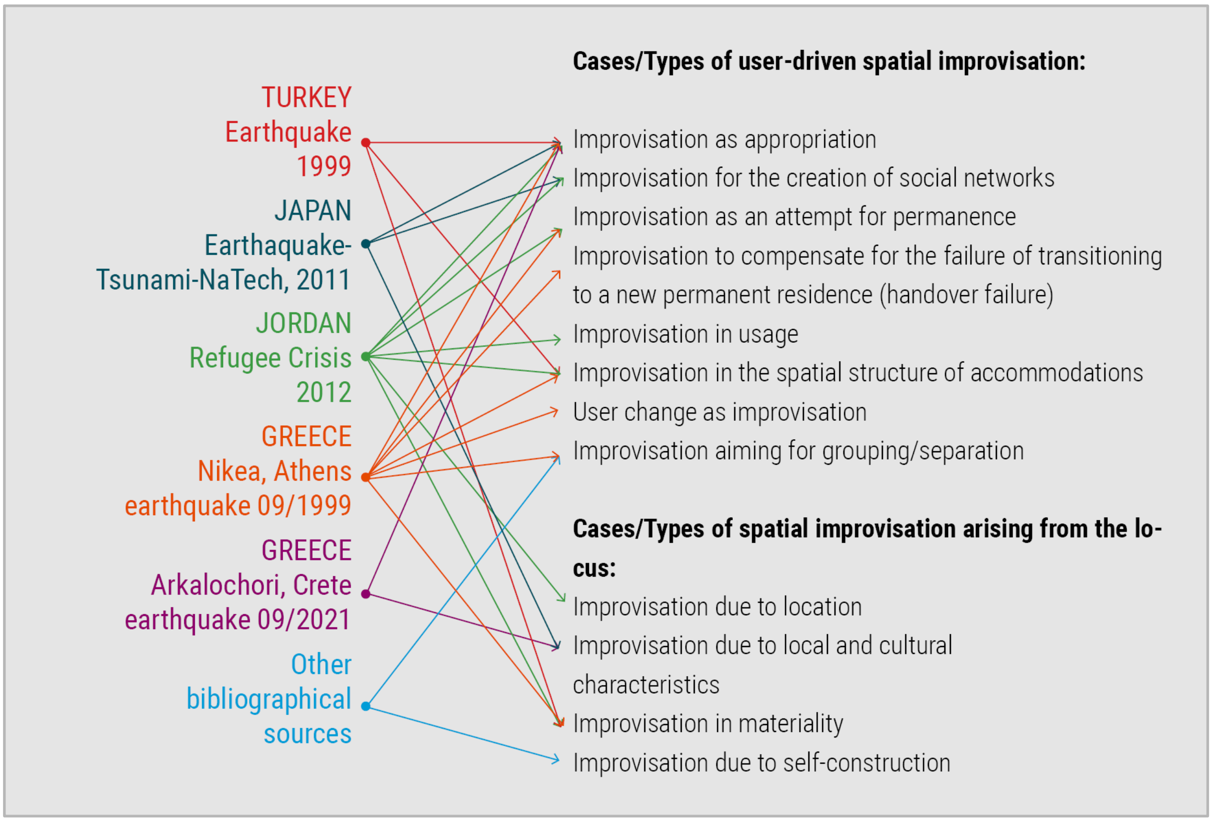

Figure 5. The diagram matches the research's cases with spatial improvisation types, allowing for the categorization of improvisation by beneficiaries in transitional shelters after a disaster. The presence of repeated improvisation types in the examples facilitates this classification process.

The significance of this work extends to its potential implications for policy and practice. By observing and interpreting the spatial footprints of communities in transitional housing, policymakers can gain insights into community needs and develop more suitable housing policies following disasters. The research emphasizes that involving architects throughout the disaster management cycle, can contribute to the implementation of more appropriate housing interventions. Furthermore, the study highlights the importance of recording the trajectory of housing operations and suggests the inclusion of participatory procedures and the utilization of GIS data for operational and academic purposes.

In summary, this study addresses the research gap regarding the interaction between beneficiaries and designed spaces in transitional housing. Through a multi-method approach that includes literature review, case studies and field research, the study develops a typology of spatial improvisations in transitional housing.

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DEVASTATING NATURAL HAZARDS IN GREECE DURING THE LAST TWENTY YEARS

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ABSTRACT

Greece has been affected by various types of hazards during the recent years, where the majority of them had severe impacts in the infrastructures. The gathering of data of these disasters could facilitate the scientific community and the authorities to conduct research and operational projects for the prevention and the mitigation of the consequences. It is noteworthy that there is a source to reach free public data of natural hazards in Greece and more precisely the website of the issues of the Government Gazette which contains in a text form the total of the announcements of the General Directorate of Natural Disasters' Impacts Rehabilitation (GDAEFK in Greek), whose strategic objective is the planning for the confrontation and restoration of the effects of natural disasters on the buildings. Having investigated the issues of the Government Gazette referring to the announcements of GDAEFK from 2003 until 2023, by submitting various keywords, the registration of the type of hazard, the date and the place of occurrence was accomplished, where the latter refers to the administrative boundaries of Greece. The results reveal the abundance of different natural hazards in Greece and the existence of administrative units that have been affected by at least one hazard for a long period of time, as well as, those that sustained repercussions by multiple hazards.

Keywords: *Natural Hazards, Disasters, Local Administrative Units, Greece*

1. INTRODUCTION

Natural Hazards consist of a plethora of different types [1], where each one consists of various parameters for which the data sources are numerous and thereby, when it comes to the multi-hazards modeling from a machine learning approach [2] due to the hazard interactions [3, 4], the data search is much more complicated since there is a need for the extent of multiple hazard events. Therefore, a diachronic catalog that integrates the total of natural hazards that occurred in an area is required, where hazard scenarios can be incorporated in a multi-risk methodology [5]. The aim of this research is to present an analysis of the destructive natural hazard events that took place in Greece from 2003 until 2023 using data extracted from texts from a notable open access data source.

2. METHODOLOGY

2.1. Data

The data source of the natural hazard events derives from text files and particularly from the announcements of the General Directorate of Natural Disasters' Impacts Rehabilitation (GDAEFK in Greek) of the Ministry of Infrastructure and Transportation in Greece. More specifically, when a disaster occurs and impacts on the buildings and the agricultural holdings, GDAEFK is responsible for the delimitation of areas aiming to restore the buildings and to subsidize the agricultural holdings due to the damages caused by natural disasters. Consequently, the data reflects the devastating hazards that severely affected the assets.

2.2. Methods

The delimitation of areas by GDAEFK is publicized into the issues of the Government Gazette (FEK in Greek) and thereby more than 300 issues have been investigated in order to extract the type of the disaster (i.e. wildfire, flood, landslide, etc.), the date and the place of occurrence. The date has been recorded according to the standard "YYYY-MM-DD" without dashes, which refers to the year, month and day (i.e. 20140203), while there are some registrations containing only the year and the month or just the year of the event. GDAEFK corresponds the place of occurrence with the Greek administrative boundaries and considering the importance to know the place of occurrence of the disasters at a local level as much as possible, this research focuses on the level of the municipality, municipal unit and municipal/local community. Subsequently, the geospatial data (polygon shapefiles) of the Greek administrative boundaries, namely the municipalities, municipal units and municipal/local communities, provided by the Hellenic Statistical Authority, were utilized in Geographic Information System (GIS) environment, where the types of disasters were recorded as fields in the attribute table and the date of occurrence was recorded as a value in these fields.

3. RESULTS

During the last twenty years, 2782 Greek administrative units were affected by ravaging natural hazards that did great harm to buildings and agricultural holdings, where 2354 are municipal/local communities (38,3% of the total communities), 339 are municipal units (32,7% of the total municipal units) and 89 are municipalities (27,3 of the total municipalities). According to the table 1, which depicts the number of dates each hazard occurred in Greece pursuant to the level of local administrative units, the detrimental hazards that affected Greece since 2003 are floods, earthquakes, wildfires, tornadoes, landslides and hailstorms. It is worth to mention that the geodatabase is still being updated and therefore the symbol"greater than" is used to identify the total number of registered dates per disaster.

Moreover, there are a lot of administrative units that have been affected by a disaster more than 4 years from the beginning of 2003, such as the municipal community of Pyrgos (Ilia, West Greece) which was afflicted for 5 years due to 1 earthquake event (in 2007), 8 flood (in 2016, 2019, 2021), 3 tornado (in 2016,2022) and 3 wildfire (in 2007, 2021) events, while the municipal community of Kounoupidianon (Chania, Crete) was afflicted for 7 years since 2003 due to 6 flood events (in 2004, 2006, 2014, 2015, 2019, 2022) and one tornado event (in 2020) event. Furthermore, there is a variety of administrative units that have a multi-hazard profile due to the profusion of types of disaster events, such as the municipal communities of Kalamata (Messinia, Peloponnese) and Pyrgos (Ilia, West Greece) and the local community of Varvasaina (Ilia, West Greece) which have been affected by earthquake, flood, tornado, wildfire events, as well as, the municipal units of Oleni, Pineia and Zacharo (all located in Ilia, West Greece) who have been influenced by landslide, earthquake, wildfire and flood events.

Table 1. Number of events of each recorded hazard per local administrative unit

Local Administrative Units	Natural Hazards	Number of events (dates of occurrence)
Municipal/Local Community	Flood	> 4250
	Earthquake	> 890
	Wildfire	> 680
	Tornado	> 490
	Landslide	> 360
	Hailstorm	> 50
Municipal Unit	Flood	> 280
	Earthquake	> 140
	Wildfire	> 90
	Landslide	> 9
	Tornado	> 7
	Hailstorm	> 4
Municipality	Flood	> 100
	Earthquake	> 20
	Wildfire	> 6
	Landslide	> 2
	Tornado	> 2
	Extreme weather event	> 1

4. DISCUSSION

Although the data entry from the text files to the geodatabase constitutes a time-consuming procedure, the result is beneficial for research on disaster risk assessment because the 84,6% of the announcements of GDAEFK refers to the lowest level of the Greek administrative units, specifically the municipal/local communities. Hence, the new datasets supersede the dearth of shapefile polygons containing the extent or shapefile points/csv files containing the coordinates of the exact location of these disasters. Additionally, it is worth to be mentioned that the hazards cited in the table 1 are confirmed by the Secretary General for Civil Protection in Greece [6] as detrimental events in the view of the fact that there is a variety of affected areas that were declared in a State of Civil Protection Emergency due to the presence of these disasters.

5. CONCLUSION

This research harnesses a valuable and primarily public data source of disastrous events in order to present the range of the devastating natural hazards that occurred in Greece from 2003 until 2023. The procedure of the extraction of data from text (namely, the types of disasters, the date and the place of their occurrence) resulted in a huge amount of registrations in the geodatabase. The pernicious hazards can be specialized at a local level, where the intensity of each disaster can be explored, while it is should be pointed out that a multi-hazard profile can be elaborated for each municipality, municipal unit and municipal/local community containing more than two recordings of types of disasters. Furthermore, the registration of disasters in local administrative units enables research on the analysis and quantification of multi-hazard interrelationships [7] and the generation of the disasters' actual extent using Earth Observation (EO) data which can be deployed in the context of early warning systems using artificial intelligence (AI).

6. FUNDING

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INFLUENCE OF CLIMATE CHANGE ON NATURAL DISASTERS. THE DIMENSION OF TIME IN DECISION MAKING DURING THEIR EVENT

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ABSTRACT
Natural disasters are becoming increasingly intense and frequent due to climate change, thus making timely reaction and public notice critical in the effort to tackle such risks. In this context, it is necessary to evaluate the response time when a natural disaster such as fire, flood or earthquake occurs. Qualitative and quantitative data regarding complex relations of networks affected should be collected and processed in order to interpret each emergency effectively. Knowledge of local conditions and continuous monitoring of their evolution and dynamics over time is essential for emergency management, in both local disasters and larger-scale phenomena, triggered by climate change. Several major incidents of earthquakes, floods and forest fires were studied and data about initiating conditions, magnitude, effect and response time was collected. The data was compared to calculated response time available in each type of natural disaster implied by literature. Conclusions revealed that in most cases response time was severely exceeded, which proved that local authorities were not prepared for the incidents. Moreover, climate change heavily affects natural disasters and their impact on striken people.

Keywords: Natural disaster, climate change, response time, emergency management.

1. INTRODUCTION
Climate change is considered one of the largest environmental challenges currently occurring in the world. Greenhouse gas emissions, associated with industrialization and economic development of a global population that has increased sixfold in 200 years, is causing global warming at an unsustainable rate [1]. It is predicted to lead to floods, temperature changes, heat stress, food scarcity, drought and increased exposure to water and vector-borne diseases [2]. Climate change has already had severe impact on fauna [3], nature [4], global economy [5,6] and humans [7,4]. The primary dimensions of natural disasters consist of time, space, size and intensity of the phenomenon. Time includes the temporal progression of the disaster and the sequence of natural phenomena created in an area [9, 10]. Risk analysis is the identification, investigation and monitoring of a risk in order to determine its origin, potential, characteristics and behavior. It aims to estimate of the probability of the occurrence of a particular phenomenon or event in a defined period of time, its intensity and the area it affects.

1.1. Fire
Forest fires are divided into ground/underground fires, surface/creeping fires, crown/peak fires and mixed/sweeping fires according to their characteristics [11, 12]. All forest fires exhibit these stages of development: preheating stage of organic forest material, release of flammable gases (volatile substances), pyrolysis which takes place at approximately 190°C, flame generation at 400°C, wood is converted to coal and further burning leaves ash as a residue. Prevention includes actions such as verification of the causes as well as the collection, evaluation, analysis of statistical data of forest fires, raising awareness and informing citizens, appropriate management of organic forest material, fire emergency planning.

1.2. Flood/Tsunami
A flood is a significant rise in water level in a stream, lake, reservoir or coastal area [13]. Flash floods are a sudden and extreme volume of water that flows rapidly and causes them. Tsunamis are a series of

large waves generated by the sudden displacement of seawater from earthquakes or volcanic eruptions, capable of spreading over long distances and causing a devastating wave on land [14]. They can originate hundreds or even thousands of miles away from coastal areas and can be amplified by local geography. Before a flood, early warning of flash flood events, as well as educating the public about flood hazards can save lives and property [15].

1.3. Landslide

Landslides are the movement of soil and rock down the slope resulting from natural phenomena or man-made actions. These can be different types of movements: falls, slides, flips, side spreads and flows. Important landslide prevention and control methods are avoidance method, i.e. avoiding traffic in the area, excavation method, and retaining structure.

1.4. Earthquake

An earthquake is a sudden rupture in the upper strata of the earth's surface, sometimes breaking the surface, with consequent shaking of the ground, which when sufficiently strong will cause the fall of buildings and the destruction of life and property [13].

2. TIME DIMENSION IN EMERGENCY DECISION MAKING

Decision making is a process of choosing the best scheme among several alternatives to achieve the organizations goal, and the emergency decision making (EDM) process can be divided into six stages: problem definition, goal setting, project planning, project selection, organization implementation, and feedback modification [16].

2.1. Time estimation decision making for earthquakes

The qualitative assessment takes into account the magnitude that constitutes the earthquake phenomenon, the extent of the area affected by the phenomenon, the duration of the earthquake phenomenon, and the possibility of a secondary risk occurring (OLF index: the product of spatial overlap value and spatial coordinate value). The algebraic function created to estimate the decision response time for earthquake phenomena is:

$$t_e^{DM} = f(A, S, D) = \frac{A}{S} + W_e x D$$

where: t_e^{DM} is the earthquake decision response time (measured in sec), *S* is the magnitude of the earthquake, *A* is the radius of influence of the affected area (measured in km), *D* is the duration (measured in sec), and W_e is a weighted factor for the earthquake. Based on the data of the Table 1, the actual decision time can be calculated.

Table 1. Decision time for earthquake. Poulorinaki, 2017).

α/α	M (km)	A (km)	D (sec)	w_e	t_e (sec)
1	177.8279	76.1	25	0.04	1.427941748
2	17.78279	98	25	0.04	6.510944987
3	89.12509	397	25	0.04	5.454413264
4	112.2018	403.5	25	0.04	4.596197535
5	17.78279	622	25	0.04	35.97763043
6	79.43282	317.5	25	0.04	4.997088182
7	22.38721	472	25	0.04	22.08346555
8	44.66836	66	25	0.04	2.477555951
9	12.58925	36.6	25	0.04	3.907241339
10	31.62278	540.5	25	0.04	18.09211075

2.2. Time estimation decision making for flood

The qualitative assessment takes into account peak supply, affected area, extent, size, probability of secondary hazard (OLF index). The algebraic function created to estimate the decision response time for earthquake phenomena is:

$$t_{fl}^{DM}=g(Q,v,A,D)=\frac{Q}{vA}+W_{fl}\times D$$

where: t_{fl}^{DM} is the flood decision response time (sec), Q is the peak flow (m^3/s), v is the propagation speed of the water (m/s), A is the affected area (m^2), D is the duration (sec), and W_{fl} is a weighted factor. Based on the data of the Table 2, the actual decision time can be calculated.

Table 2. Decision time for flood.

α/α	Q (m3/s)	A (m²)	V (m/s)	D (sec)	w_{fl}	t_{fl} (sec)	t_{fl} (min)
1	108	92141000000	2.7	20160	0.01	1008	16.80000003
2	1210	1.21586E+12	4.4	34920	0.01	1746	29.10000006
3	2300	2.64379E+12	4.7	37440	0.01	1872	31.20000006
4	460	4.31896E+11	3.2	36000	0.01	1800	30.00000006
5	1300	1.34135E+12	4.5	23760	0.01	1188	19.80000004
6	115	27315000000	2.8	21600	0.01	1080	18.00000004
7	55	9251000000	2.5	18000	0.01	900	15.00000003
8	95	20422000000	2.6	19800	0.01	990	16.50000003

2.3. Time estimation decision making for fire

The qualitative assessment takes into account intensity, extent, size, probability of secondary risk (OLF index). The algebraic function created to estimate the decision response time for earthquake phenomena is:

$$t_{fi}^{DM}=z(L,A,D)=\frac{L}{A}+W_{fi}\times D$$

where: t_{fi}^{DM} is fire decision response time (min), L is flame length (km), A is the affected area (km^2), D is duration (min), and W_{fi} is a weighted factor of the fire. Based on the data of the Table 3, the actual decision time can be calculated.

Table 3. Decision time for fire. (Poulorinaki, 2017).

α/α	L (km)	A (km)	D (h)	w_{fi}	t_{fi} (min)
1	0.006096	3.784698783	360	0.07	25.2016107
2	0.01524	22.56758334	420	0.07	29.4006753
3	0.012192	9.772050238	360	0.07	25.20124764
4	0.009144	7.35613218	420	0.07	29.40124304
5	0.02286	33.37790589	432	0.07	30.24068488
6	0.009144	7.776816725	330	0.07	23.1011758
7	0.0381	38.55524826	468	0.07	32.76098819
8	0.012192	12.61566261	366	0.07	25.62096642
9	0.06096	53.52372348	540	0.07	37.80113893
10	0.02286	31.41274657	438	0.07	30.66072773

3. CONCLUSIONS

Natural disasters happen unpredictably and uncontrollably. In particular, with the changes occurring in the climate, the occurrences of natural disasters are becoming more and more frequent. Complex infrastructure, population growth and widespread poverty are some of the reasons, but human activities such as land-use practices worsen the effects. Climate-related hazards, such as fires and hydrogeological phenomena, cause widespread damage and casualties around the world. In addition, there is now convincing evidence that climate change is contributing to the increasing frequency and intensity of certain types of "natural" events. The key points of the future application of knowledge management in the disaster emergency decision-making process are reflected in how to establish a knowledge management support system, increase capital investment in knowledge management, adapt to the ever-changing environment, and focus on prevention, mitigation and disaster recovery.

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INTERACTIONS IN CIVIL PROTECTION: STAKEHOLDERS IN CASES OF DISASTERS IN WESTERN MACEDONIA

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ABSTRACT

Disasters can strike at any time, causing devastating impacts on communities and infrastructure. In the region of Western Macedonia, the collaboration between various stakeholders in civil protection plays a vital role in disaster management and mitigation efforts. This article aims to explore the key stakeholders involved in disaster response and their interactions, highlighting the importance of coordination and cooperation in ensuring effective disaster management.

Keywords:
Civil Protection, Cooperation, Regional Stakeholders, Disasters, Natural Disasters, Decision Support

1. INTRODUCTION

The concerted efforts of numerous stakeholder's spring into action, forming the backbone of disaster response in Western Macedonia. These stakeholders encompass a broad spectrum, ranging from local governmental bodies and emergency services to humanitarian organizations, non-governmental entities, and dedicated volunteers. Each stakeholder group brings with it a unique set of skills, resources, and expertise that collectively form a formidable defence against the wrath of disasters [1].

Coordination and cooperation among governmental bodies, emergency services, humanitarian organizations, non-governmental entities, and volunteers are the essential elements that can make or break disaster management efforts. By fostering open lines of communication, sharing resources, harmonizing strategies, and engaging in joint training and exercises, these stakeholders pave the way for a more effective, efficient, and compassionate response to disaster challenges.

2. PRESENTATION OF CIVIL PROTECTION AUTHORITIES AND EMERGENCY SERVICES

Effective disaster management in Western Macedonia relies on collaboration among stakeholders, who play a vital role in mitigating and responding to disasters. This article explores key stakeholders involved in disaster response, emphasizing the significance of coordination and cooperation for successful outcomes.

2.1 Civil Protection Authorities:

Civil protection authorities play a crucial role as the backbone of disaster management in Western

Macedonia. Comprising various government agencies, including the Ministry of Interior, regional authorities, and local municipalities, they form a cohesive network dedicated to ensuring the safety and well-being of the population. One of their primary responsibilities is the development of comprehensive disaster preparedness plans, which involve assessing potential risks and devising strategies to mitigate them effectively. In times of crisis, these authorities assume the critical task of coordinating response efforts, mobilizing resources, and orchestrating relief operations. Moreover, they play a pivotal role in implementing measures aimed at reducing risks and enhancing resilience in the face of disasters. By fostering collaboration and acting as the central point of contact for other stakeholders involved in disaster management, civil protection authorities contribute significantly to safeguarding the community and minimizing the impact of adversities [2].

2.2 Emergency Services:

Emergency services, encompassing the police, fire departments, and medical personnel, hold a paramount position in the realm of disaster response. Positioned at the forefront of rescue operations, they serve as the vanguards, swiftly offering vital aid to those impacted by calamities and communities at large [3]. Their profound expertise and extensive resources assume a critical role in guaranteeing public safety, facilitating evacuations, and delivering indispensable medical assistance in times of crisis. The seamless coordination between civil protection authorities and emergency services stands as a cornerstone, ensuring prompt and efficient responses to disasters, ultimately safeguarding lives, and minimizing the impact of emergencies.

3. INTERACTION OF CIVIL PROTECTION: STAKEHOLDERS IN WESTERN MACEDONIA

At the heart of this collaborative network lie the local governmental bodies, responsible for formulating policies, allocating resources, and coordinating response efforts [4]. Their role extends beyond mere administrative tasks, as they act as the linchpin connecting the various stakeholders and facilitating seamless communication and information exchange. By fostering an environment of synergy and inclusivity, these entities lay the groundwork for effective disaster management and enable swift decision-making during critical moments.

Working hand in hand with the governmental bodies are the emergency services, comprising firefighters, police personnel, medical teams, and other first responders. These brave individuals form the frontline defence, courageously facing the chaos and dangers that disasters bring. Their unwavering commitment, specialized training, and swift response capabilities save lives, provide critical medical assistance, and maintain public order in the face of adversity. Their collaboration with other stakeholders is essential for an efficient disaster response, ensuring a comprehensive approach to both immediate emergency assistance and long-term recovery efforts.

These dedicated groups bring their expertise, resources, and on-the-ground experience to bear, complementing the efforts of governmental bodies and emergency services. They provide vital support in areas such as shelter, food distribution, medical aid, psychological support, and community rebuilding.

4. CONCLUSION

The region of Western Macedonia can stand as a case of how diverse stakeholders in civil protection can come together in the face of adversity. By recognizing the vital role each entity plays, embracing coordination and cooperation, and harnessing the collective power of their expertise and resources, disaster management efforts can be significantly strengthened. With this collaborative spirit at the core of their endeavours, Western Macedonia stands better equipped to navigate the unpredictable nature of disasters, protect its communities, and mitigate the devastating impacts that such events can bring. Through ongoing collaboration and a commitment to building resilience, the region serves as a beacon of hope, inspiring others to recognize the profound importance of coordination and cooperation in the pursuit of effective disaster management.

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INSTITUTIONAL AND LEGISLATIVE FRAMEWORK OF CIVIL PROTECTION IN THE EXECUTIVE GREEK STATE

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ABSTRACT

This text records the institutional and legislative framework of public civil protection as it is shaped in the Greek executive state. Characteristics of the Greek Civil Protection system are recorded and discussed in accordance with the characteristics governing the operation of an executive state. In particular, in light of the Law on the Executive State and the Law on Civil Protection, elements related to the way structures and procedures for the protection of people's lives and property are organized, coordinated and interconnected, are highlighted.

Keywords: Civil protection, executive Greek state

1. INTRODUCTION

Since 2010, Greece has been going through a period of successive crises, starting with the economic crisis, the refugee crisis, the flood in Mandra (2018), the fire in Mati (2019), the health crisis due to the Covid-19 pandemic, the climate and energy crisis that affected and catalyze the implementation of development policy at national and regional level. The risks that the Greek state is increasingly called upon to manage are inextricably linked to every policy and planning at local, regional and national level for the "development" of the country. As crises can interrupt the continuity of historical development mainly under the influence of changes in the external environment and relatively abrupt institutional changes with long-term consequences may occur, states have begun to develop strategies to build resilience.

The form and manner of governance of a country, the organization and operation of the Central Administration are a crucial factor in determining the quality of services provided to the citizen, the correct decision-making and the handling of urgent and emergency situations.

One of the basic constitutional obligations of any modern democratic state is the security and protection of citizens and the environment. To support this obligation, at the strategic level, each state establishes special (administrative) civil protection systems and mechanisms at national, regional and local level, with a single planning and specific rules [1].

This study presents the Greek Civil Protection System, the regulatory framework of operation, the way of organization and administration of this system in the broader context of organization and operation of the executive Greek state [2].

2. METHOD AND DATA

The methodology followed was based on the study of secondary sources, laws of the Greek state, reports and data from authoritative websites. The study focuses on the organizational structure, planning at strategic and operational level, the coordinating operation of the state Civil Protection body that is called upon to cooperate, network with interdependent bodies and act collectively in order to achieve horizontal action in the public civil protection policy of the government.

3. SURVEY RESULTS

The form and manner of governance of a country are cornerstones for the successful implementation of public policies. In a comparative study by the OECD [3], Greece presents the worst performance of its member states in the field of successful implementation of public policies. The OECD report [3] on the Greek public administration in the predominant pathogens recorded the inability of the Greek Governance Centre to set strategic directions and priorities, properly plan, coordinate the activity of Ministries and effectively implement public policies [4]. The Governance Centre, a small set of statutory bodies at the core of the executive function, is the supreme executive government body from which policies emanate, with all the structures that support it for decision-making and their execution.

3.1. Executive State

From an etymological point of view, executive activity is identified with the strategic dimension of state activity and indicates a fixed way of organising that is characterised by a long-term view of issues, a very clear position of priorities and a constant pursuit of specific objectives or results. The executive state is a state organized to plan, coordinate and monitor public policies centrally, i.e. from top to bottom. The aim is to create stable structures and procedures so that the governance system functions effectively independently of individuals [4].

Law 4622/2019 [2] defined in detail the public policy cycle through the planning of actions, their monitoring and evaluation throughout government work. Procedures for the interaction of the Public Administration with the Governance Centre are provided and institutional memory in processes and functions is ensured.

The core function of the Governance Centre is to facilitate coordination and cooperation across the public administration with the aim of ensuring a strong, coherent and collective strategic vision of where the country should go and how to get there.

3.2. Institutional framework for the operation of the GSCP

Although the institutional body for civil protection was created in 1995 with the establishment of the General Secretariat for Civil Protection, it remained invisible while there was strong criticism for the negative actions of the country's civil protection system (overlapping responsibilities, lack of coordination between levels of administration, partial inadequacy of planning and prevention measures, reduced use of modern technologies). The assessment of the events of 2017 and 2018 and the demands of society marked a political and institutional move to align the country with internationally existing best practices and EU guidelines on crisis management and risk management.

On February 7, 2020, with the enactment of Law 4662/2020 [5] the radical reform of civil protection in the country begins on the basis of a ten-year planning. All operational and administrative structures, and Civil Protection functions converge on the National Crisis Management and Risk Management Mechanism. The National Mechanism aims to create a single national civil protection system governed by specific institutional principles and covering the entire spectrum of the disaster and risk cycle (prevention, preparedness, response, recovery), taking into account the needs of all citizens, including people with disabilities (information, individual rescue plans, accessible infrastructure, etc.), informing and raising awareness among citizens.

The General Secretariat for Civil Protection is an overlying operational structure of the National Mechanism which studies, elaborates, plans, organizes and coordinates all civil protection actions of all involved bodies with the aim of protecting life, citizens' property, the natural environment and cultural heritage. The Commission's Spring Semester Assessment Report of February 2020 highlighted the increased risks for the National Crisis Management and Risk Response Mechanism, including overlapping responsibilities, lack of coordination between levels of administration, under-utilisation of modern technologies, partial inadequacy of planning and prevention measures.

With Presidential Decree 70/2021, the GSCP is now under the newly established Ministry of Climate Crisis and Citizen Protection, is an administrative structure and an overlying operational structure of the National Civil Protection Mechanism.

4. RESULTS AND DISCUSSION

The multiplication of asymmetric threats such as the health crisis, natural disasters, the energy crisis has led states to redefine public priorities with emphasis on risk prevention, management and deterrence [6] with the consequent adjustment of the internal organization of the state apparatus in order to achieve the limitation of the impact of risks. In an executive state, the structural role of the state has a consistently symbiotic relationship with the precautionary principle. The state intervenes in a targeted manner, having fully developed the ability to strategically anticipate risks and coordinate organizational units in order to be able to contain risks and limit the likelihood of their occurrence.

The Civil Protection institutions of the Greek executive state utilize all tools for the analysis of "risk engineering" and rational prevention planning utilizing databases. The frequency of "extreme events" and "asymmetric threats" is an "opportunity" for governments to constantly devise public policies and mobilise means, resources and tools to stem increasingly unforeseen crises.

Law 4622/2020 [5] provides for the operation of coordination structures during the planning and implementation of public civil protection and establishes an Interministerial Committee for National Civil Protection Planning creating favorable conditions for breaking the "silos" and ensuring at the same time the continuity of the state through the coordination, evaluation and feedback of administrative action by the executives of the administration in the direction of a staff state.

The establishment and operation of Coordination Structures under Law 4662/2020 [5] on Civil Protection is in line with the framework set by Law 4622/2019 [2] on the Executive State. However, the plethora of crisis management and operational suppression structures provided for in the Law on Civil Protection in combination with the absence of regulatory provisions for the implementation of the law and a presidential decree establishing an Agency of the Ministry weaken the structural response of the public civil protection mechanism to the increased operational readiness requirements that characterize by definition an executive state.

Another inherent feature of the Executive State, "multi-level governance" seems to be attempted in the context of public civil protection. All administrative levels, all parties involved including individuals and volunteers are functionally interconnected, cooperating harmoniously from planning and ensuring operational readiness to implementing a common incident management system with a clear delimitation of roles.

5. CONCLUSION

"The future," said Peter Drucker (1909-2005), "cannot be predicted, but we can prepare it, we can invent it." The executive state is a new model of governance with tangible results for the benefit of society and is based on reforms that make the lives of many more resilient and better. Within the executive state, public civil protection policy is a guarantee for the most effective response to the pressing needs of society and the management of risks and crises that afflict the modern global community.

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A CIVIL PROTECTION INSTITUTE AS FACILITATOR OF DISASTER AND EMERGENCY MANAGEMENT

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ABSTRACT

This article explores the critical aspects of disaster communication, focusing on public information management, Civil Protection Institutes, and community engagement. It highlights the stages of disaster management and the importance of proactive response. Additionally, it emphasizes the role of Civil Protection Institutes in coordinating resources and expertise. Finally, it underlines the significance of community engagement in enhancing resilience.

Keywords: Coordination, Preparedness, Risk Assessment, Mitigation, Emergency Response, Recovery, Public Education, Awareness, Research, Innovation.

1. INTRODUCTION

Public information management plays a crucial role in disaster risk and crisis communication, drawing from both business and government models. These efforts encompass various stages, including mitigation, preparation, response, and recovery, necessitating the formation of a dedicated team that can proactively anticipate and address issues arising in the aftermath of a sudden-onset disaster or an evolving slow-onset disaster.

The Civil Protection Institute plays a vital role in facilitating disaster and emergency management within a society. With its expertise, resources, and coordinated approach, the institute acts as a central body responsible for safeguarding lives, minimizing damage, and promoting resilience during times of crises. This text explores the crucial role of the Civil Protection Institute as a facilitator of disaster and emergency management, highlighting its key functions and the impact it has on society.

The Civil Protection Institute serves as a crucial facilitator of social and psychological aspects within society. Established with the aim of safeguarding and supporting communities during times of crisis and disaster, the CPI plays a pivotal role in addressing the psychological well-being and social cohesion of individuals and groups affected by various challenges [1].

The Civil Protection Institute serves as a crucial facilitator of social and psychological aspects within society. By providing psychological support, fostering social cohesion, collaborating with stakeholders, and promoting public awareness, the CPI plays a pivotal role in ensuring the well-being and resilience of individuals and communities in the face of adversity [2].

To ensure effective disaster management, it is essential for disaster plans to incorporate crisis standards of care. These plans should encompass comprehensive education programs for staff, facilitating their familiarity with alternative procedures through simulations and training exercises [3]. By immersing staff in these practical scenarios, organizations can equip their personnel with the necessary skills and knowledge to navigate complex situations and make informed decisions during times of crisis.

Moreover, fostering community engagement is a critical aspect of disaster preparedness. Local communities should actively participate in exercises and training initiatives to enhance their resilience. [4] By engaging in these activities, community members can develop a deeper understanding of the potential challenges they may face during disasters and acquire valuable skills to respond effectively. This collaborative approach strengthens community bonds, promotes proactive problem-solving, and ultimately builds a more resilient society capable of withstanding and recovering from adverse events.

2. INTEGRATED APPROACHES TO DISASTER MANAGEMENT

The Institute of Civil Protection, driven by its mission, emphasizes the significance of practice and collaboration in preparedness and planning. This involves conducting regular meetings, engaging in exercises, and organizing drills with other relevant stakeholders. [5] By actively participating in these activities, the institute and its partners strive to enhance their preparedness and coordination capabilities, ensuring a more effective response when faced with challenging circumstances.

2.1 Coordination and Preparedness:

The Civil Protection Institute serves as a facilitator in coordinating various stakeholders involved in disaster and emergency management. [2] It brings together government agencies, first responders, non-profit organizations, and the public to establish effective communication channels and collaborative strategies. By promoting coordination, the institute ensures a well-prepared and proactive response to potential hazards, thereby minimizing the impact on individuals and communities.

2.2 Risk Assessment and Mitigation:

One of the primary functions of the Civil Protection Institute is to conduct comprehensive risk assessments and develop mitigation plans. [6] Through research, data analysis, and the expertise of specialized professionals, the institute identifies potential hazards and assesses their potential impact. It then formulates strategies to mitigate these risks by implementing preventive measures, enhancing infrastructure, and promoting public awareness campaigns. By addressing vulnerabilities, the institute actively works to reduce the likelihood and severity of disasters.

2.3 Emergency Response and Recovery:

In times of crisis, the Civil Protection Institute acts as a facilitator of emergency response operations.[3] It ensures the availability of necessary resources such as personnel, equipment, and supplies to efficiently manage emergencies. The institute coordinates the deployment of first responders, organizes evacuation procedures, and establishes emergency communication systems. Moreover, it plays a crucial role in post-disaster recovery, coordinating efforts to restore infrastructure, provide humanitarian aid, and support affected communities in rebuilding their lives.

2.4 Public Education and Awareness:

The Civil Protection Institute recognizes the importance of public education and awareness in disaster and emergency management. [1] It spearheads campaigns to inform the general public about potential hazards, preparedness measures, and appropriate responses during emergencies. By conducting training programs, workshops, and simulations, the institute equips individuals with the necessary knowledge and skills to effectively respond to disasters. Additionally, it collaborates with educational institutions, media outlets, and community organizations to promote a culture of safety and resilience.

2.5 Research and Innovation:

The institute actively engages in research and development initiatives to enhance disaster and emergency management practices. [5] It explores innovative technologies, methodologies, and best practices to improve response capabilities, communication systems, and early warning mechanisms. By staying at the forefront of scientific advancements, the institute ensures that its strategies and operations are constantly evolving to address emerging challenges and effectively respond to evolving threats.

2.6 The Civil Protection Institute as facilitator of social and psychological aspects:

One of the primary responsibilities of the CPI is to provide psychological support and counseling to individuals who have experienced trauma or distressing events. [2] Trained professionals within the institute work closely with survivors, helping them cope with the emotional aftermath of disasters such as natural calamities, accidents, or acts of violence. By offering a safe and supportive environment, the CPI aims to promote healing, resilience, and post-traumatic growth among those affected.

In addition to individual support, the CPI also plays a vital role in fostering social cohesion and community resilience. [1] Recognizing the importance of collective strength during challenging times, the institute organizes workshops, training programs, and community-building activities that encourage collaboration, empathy, and mutual assistance among community members. By fostering a sense of togetherness and solidarity, the CPI helps individuals overcome feelings of isolation and encourages them to support one another, enhancing overall social well-being.

Moreover, the CPI works in collaboration with various stakeholders, including government agencies, non-profit organizations, and community leaders, to develop comprehensive disaster management plans. These plans prioritize the social and psychological aspects of disaster response and recovery, ensuring that the needs of individuals and communities are adequately addressed. By incorporating a human-centric approach into emergency protocols, the CPI helps mitigate the long-term psychological impact of crises and promotes effective social rehabilitation.

The institute also plays a proactive role in education and public awareness campaigns. Recognizing the importance of preparedness in reducing the impact of disasters, the CPI conducts training sessions and disseminates information on psychological resilience, coping strategies, and community support networks. These initiatives empower individuals to develop a better understanding of their psychological well-being and equip them with the skills and knowledge needed to support others in times of crisis.

3. CONCLUSION

The Civil Protection Institute serves as a vital facilitator of disaster and emergency management, bringing together stakeholders, coordinating efforts, and implementing comprehensive strategies to safeguard lives and minimize damage. Through its functions of coordination, risk assessment, emergency response, public education, and research, the institute plays a pivotal role in promoting resilience, preparedness, and effective management of crises. Its tireless efforts contribute to the overall safety and well-being of society, ensuring that communities are better equipped to face and recover from disasters and emergencies.

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CLIMATE CRISIS, CIVIL PROTECTION & DEGROWTH PROTECTING THE ENVIRONMENT, REDUCING VULNERABILITY AND STRENGTHENING RESILIENCE.

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ABSTRACT
Climate Crisis has also been widely addressed as global warming. As known, it is a phenomenon caused by an increase in the average temperature of Earth's atmosphere, mainly due to increasing greenhouse gases, such as carbon dioxide and methane, which trap heat and prevent it from escaping into space. This warming trend, observed over the past century, is causing a number of negative impacts on Earth's ecosystems. It affects natural and anthorpogenic environment, via all kinds of natural disasters, including sea level rise, more frequent and intense heat waves, droughts, as well as negative impacts on health, biodiversity loss etc. Off course, by pure scientific definition, the phrases, global warming & climate crisis [previously climate change] do differ. In most scientific journals "global warming" refers to the planet's surface-temperature increase and "climate crisis [change]" refers to the weather impacts, extreem phenomen & disasters, by those higher temperatures. But even experts often swap those words back and forth. Scientists tend to prefer using climate crisis because it encompasses non-heat-related events & disasters such as ocean acidification and increases in heavy rain events[1]. This paper briefly explores how "degrowth" may contribute to addressing climate crisis by building resilience and reducing vulnerability. The effects of climate crisis and the role of greenhouse gas emissions in increasing global warming are mentioned. The principles of "degrowth" and how it could be applied to deal with climate crisis are presented in the form of "slogans". Its potential benefits and challenges will be weighed in order to mitigate the effects of climate crisis to reduce vulnerability, build resilience and therefore strengthen Civil Protection services for public health and environmental protection [1,2,3].

Key words: Climate crisis, global warming, civil protection, extreme weather, disasters, degrowth, vulnerability, resilience.

1. Climate Crisis & warming in Greece

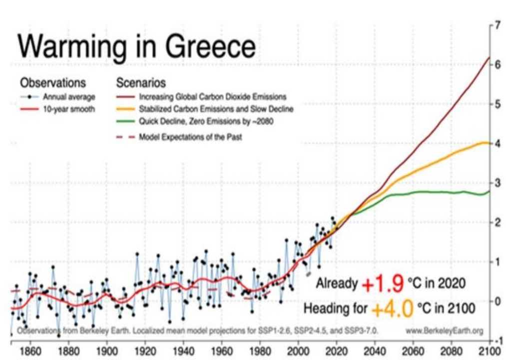

Figure 1. Berkeley Earth [https://berkeleyearth.org/] performed an analysis utilizing climate models to help policymakers and other stakeholders navigate the scale, scope, and science behind the changing climate. In the scenario where, global carbon dioxide emissions stabilize and gradually decrease, it is estimated that there will be a situation where the average temperature of the country will be +4˚C compared to the pre-industrial reference period. MedECC (Mediterranean Experts on Climate and environmental Change) report that the temperature increase in the Mediterranean basin has reached 1.5°C + [Berkeley earth 1.9° C in Greece], compared to pre-industrial levels. In 2040, the increase is expected to reach 2.2°C and may rise to 3.8°C, for a high greenhouse gas concentration scenario, in some parts of the Mediterranean basin by the end of the century. The effects of climate crisis, according to MedWet, can be reduced significantly for a scenario compatible with the long-term goal of the Paris Agreement to keep the global temperature well below +2°C above the pre-industrial leve

[1] https://www.nbcnews.com/science/environment/global-warming-or-climate-change-which-proper-term-n115636
https://news.climate.columbia.edu/2019/02/19/wallace-broecker-early-prophet-of-climate-change/
https://apnews.com/article/664cf2e917604adf90472daa35989ffb

2. Degrowth

Degrowth is a “movement” with proposals that advocate downscaling economic activity. The aim is to reduce the impact of anthropogenic activities on the environment and increase social and environmental well-being. It challenges the idea that economic growth, as known, is necessary for progress and prosperity. Instead it argues that it is often harmful to both people and the planet. Supporters of degrowth state that the current economic system is unsustainable, leads to environmental degradation and social inequality. They support the transition to a post-development society, in which the priorities are peoples well-being and environmental protection over economic growth[2]. This implies a shift towards more local, decentralized economies and a reduction in resource and energy consumption. Sustainable dedevelopment is defined as “an equitable reduction in the scale of production and consumption that increases peoples well-being and enhances ecological conditions locally and globally, in the short and long term”. Also: “Sustainable degrowth will entail a decline in Gross Domestic Product [GDP] as currently measured, due to a decline in the large-scale, resource-intensive productive and consumption activities that make up much of the GDP. “*However, what happens to GDP is secondary. The goal is the pursuit of well-being, ecological sustainability and social equity [7, 8, 9]. GDP can be reduced and yet other dimensions of life can be improved*” (Schneider et al., 2010)[3].

Figure 2

3. Why GDP is not a good measure of well-being

1. GDP is not, and was never intended to be, a measure of human well-being. In contrast, GDP is a national measure of the exchange value of all produced goods and services available on the market. Despite the widespread belief that GDP growth improves living standards, this is not usually the case **[figure 3, on the right[4]].** *Example:* A forest near a city is cut down and sold for timber, this increases GDP. Newly cleared land is used to produce high fructose corn, increasing GDP. This high-sugar food is then sold to the population, worsening public health outcomes and requiring greater spending on hospitals and medical care, further increasing GDP. All of these activities increase GDP but do not improve and may even worsen human well-being and harm the climate, making the causal link between GDP and social outcomes questionable at best. This ambiguous relationship has been explored in Happiness Economics, as evidenced by the ever-controversial Easterlin Paradox. There appears to be little evidence of a correlation between GDP and subjective well-being over time or across countries, despite a strong correlation at the national level. **2.** Much of GDP growth is harmful to the planet and does not directly improve public health. However, governments continue to pursue GDP growth at all costs due to the desire to raise “living standards” [for the few?] and the growth imperative imposed by the structure of the global economy. Degrowth includes the need to become aware of which sectors of the economy need to be developed to improve human well-being (renewable energy, education and public transport), which are of a sustainable size and which types of socially unnecessary, environmentally harmful production need to be curtailed (ex. the fossil fuel industry, and deforestation). So degrowth is not about GDP reduction per se. It advocates a shift to

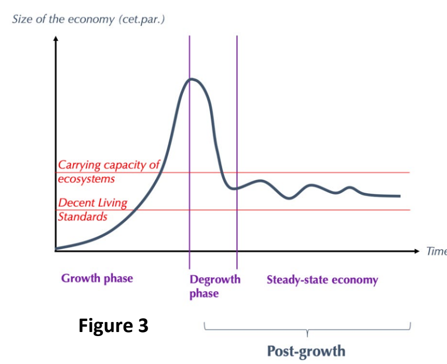

Figure 3

[2] https://climatalk.org/2023/03/05/degrowth-post-growth-policies-green-economics-economy/
[3] https://www.sciencedirect.com/science/article/abs/pii/S0959652610000259
[4] https://nbs.net/degrowth-can-support-business-sustainability/

"growth agnosticism" in rich countries that already enjoy the highest living standards and have historically been responsible for far more than their "fair share" of global emissions. Some economists point out that degrowth need not be accompanied by a change in living standards. **3.** The problem is that consumption is unevenly distributed and production is resource and energy inefficient. Recent research estimates that a high standard of living will be achievable for 10 billion people by 2050, with a reduction in energy consumption of around 60%. If reductions in harmful economic activity are accompanied by redistributive policies and the provision of widespread public goods, emissions can be reduced while improving social outcomes and living standards worldwide. Dedevelopment could therefore be well placed to resolve the apparent trade-off between the well-being of current and future generations assumed in much of the environmental economics literature [10,11,12].

4. Benefits of Degrowth for Tackling the Climate Crisis

1. Reducing greenhouse gas emissions: Degrowth supports the transition to a post-development society in which priorities are the well-being of people and the planet [environmental protection] over economic growth. This entails reducing resource and energy consumption and moving towards more sustainable and fair forms of production and consumption. By reducing dependence on non-renewable energy sources and by switching to renewable energy sources [with minimum impact on environment] a significant reduce of greenhouse gas emissions may be achieved, thus slowing the rate of global warming. **2. Promoting sustainable consumption:** Degrowth encourages reduced consumption, especially of non-essential goods, which can help reduce the environmental impact of production and transport. By consuming less, we can reduce the demand for new products and the resources needed to produce them, which can help reduce our impact on the environment. **3. Building resilience - decreasing vulnerability:** Degrowth emphasizes the importance of local and decentralized economies, which can be more resilient to environmental and economic shocks. By supporting local businesses and food systems, more resilient communities may be achieved that are better able to adapt and recover from disruption. This can help reduce dependence on global supply chains, which can be vulnerable to disruptions, and increase public self-sufficiency. **4. Reducing social inequality:** Degrowth aims to address social and economic inequalities that are often exacerbated by economic growth. By prioritizing people's well-being over economic growth, it could help reduce social inequality and improve people's lives around the world [13,14,15,16].

5. Challenges of Degrowth

While degrowth offers a potential solution to Climate Crisis, there are also several challenges to its implementation. Some of the key challenges include: **1. Political and economic resistance**: There is resistance to degrowth from those who benefit from the current economic system and who may be reluctant to give up the benefits of this type of economic growth-model. Degrowth can also be difficult to implement in a globalized economy in which economic growth is seen as a key indicator of success. **2. Technological and infrastructural challenges:** The transition to a degrowth society will likely require significant technological and infrastructural changes, including the development of renewable energy sources and the creation of more local and decentralized economies. These changes will require significant investment and may take time to implement. **3. Adjustment period:** The transition to a degrowth - developing society may involve an adjustment period during which some individuals may face economic and social challenges. It will be important to ensure that the transition is managed in a way that minimizes negative impacts and ensures that the benefits of degrowth are distributed fairly [17,18].

6. Discussion – Conclusions

1. The abovementioned remarks intend to endorse degrowth thinking by introducing new ideas and challenging common assumptions about well-being. In addition, they pinpoint important challenges that degrowth must address and recommends some ways to resolve them. **2.** The motivation for dealing in this paper with degrowth ideas is presenting thoughts, proposals and a discussion, since policy makers and current generations may have serious concerns about possible negative effects on well-being from degrowth. Hence, this concern is an important reason for the lack of political support of this movement up to date. **3.** It is suggested that involving the general public in deliberative processes that examine perceptions of well-being and considering the needs of future generations, could be one way to advance the degrowth agenda. **4.** Degrowth offers an alternative approach that focuses on reducing anthropogenic impact on the environment and building resilience, less vulnerable communities. By embracing degrowth, people, communities and nations may work towards a more sustainable and just future for all. **5.** Overall, degrowth may offer a potential solution to Climate Crisis, supporting the downscaling of economic activity and a shift towards more sustainable and equitable forms of production and consumption. **6**. While there are challenges to implement degrowth, the potential benefits of reduced greenhouse gas emissions, sustainable consumption, increased resilience, reduced vulnerability and social inequality make it worth considering. [How to reduce vulnerability and increase resilience through degrowth? In other words, beyond the change of the energy production model, societies may utilize small-scale projects with minimal or no impact on the environment, energy communities, geothermal energy etc. Another way is changing urban planning and building "habits" i.e. do not develop housing and activities in mixed environments and/or in streams etc. Initiation of procedures and legal framework for removal of houses and activities from these areas]. **7.** Research, in a variety of fields [economy, biodiversity, natural resources etc.] is needed to explore in more detail the potential benefits and challenges of degrowth, and to identify the most effective strategies for transitioning to a degrowth society. **8.** It is important to consider the effects of degrowth for different sectors and regions, as the effects of degrowth may vary according to local conditions. 9. Degrowth offers a promising approach to addressing climate crisis by building resilience and reducing vulnerability, hence assisting in the country's Civil Protection service. By embracing degrowth, societies can work towards a more sustainable and just future for all, and very much needed, for future generations [3,4,8,10].

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COPERNICUS EMERGENCY MANAGEMENT SERVICE (CEMS) CONTRIBUTION IN RAPID EMERGENCY RESPONSE MAPPING

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ABSTRACT

The Copernicus Programme is the EU Earth Observation and monitoring programme aiming at developing European information services based on satellite Earth Observation and in situ data, monitoring the Earth and its ecosystems, whilst ensuring that citizens are prepared and protected in the face of crises and natural and man-made disasters. One of the six fundamental pillars of the Programme is the Copernicus Emergency Management Service (CEMS), which provides on demand mapping, exposure mapping services and Early Warning & Monitoring services. Rapid Mapping is one of the CEMS On Demand Mapping components and is based on the rapid acquisition, processing and analysis of satellite imagery and other geo-spatial data, and provides users with products in the form of maps and brief analyses.

Keywords: Copernicus EMS, disasters, earth observation, emergency, mapping, satellite monitoring

1. INTRODUCTION

Two or three decades ago, crisis situations were problematic due to lack of information. Now, policymakers, practitioners and politicians are more in a situation of information overflow and challenges of making sense of contradictory information under conditions of complexity and socio-technical interdependencies. Science and knowledge enable a shift from reactive to proactive risk management [1].

Remotely sensed images have become an important source of information for actors involved in disaster management and satellite-based emergency mapping is increasingly used to support the response phase in the first hours and days after a disaster occurs. The delivery timeliness of the crisis information is key to the success [2].

CEMS is coordinated by the European Commission and "provides all actors involved in the management of natural disasters, man-made emergency situations, and humanitarian crises with timely and accurate geo-spatial information derived from satellite remote sensing and complemented by available in situ or open data sources" [3]. CEMS provides maps and analyses based on satellite imagery (before, during or after a crisis), as well as early warning services for disaster risks since April 2012. Through these services, it supports crisis managers, Civil Protection authorities and humanitarian aid actors dealing with natural disasters, man-made emergency situations, and humanitarian crises, as well as those involved in recovery, disaster risk reduction and preparedness activities.

The CEMS On Demand Mapping addresses a wide range of emergency situations resulting from natural or man-made disasters, covering in particular floods, earthquakes, tsunamis, landslides, severe storms, fires, industrial accidents, volcanic eruptions, and humanitarian crises. Namely, it provides on-demand,

free of charge, timely and detailed information derived from satellite or airborne imaging sensor, to support emergency and disaster management activities during all phases of the disaster management cycle, anywhere in the world. The service is provided in two modules. Risk & Recovery Mapping is designed for pre- or post-crisis situations in support of recovery, disaster risk reduction, prevention, and preparedness activities. Rapid Mapping, which is the subject of the current paper, provides high-speed service delivery in the midst of or immediately after catastrophic events or humanitarian crises, and is available 24/7/365.
This service consists of the on-demand and fast provision (hours-days) of geospatial information in support of emergency management activities immediately after a disaster. The service is based on the acquisition, processing and analysis, in rapid mode, of satellite imagery and other geospatial raster and vector data sources, and social media when relevant.

2. METHOD

The methods used vary according to the type of product requested. Generally, they refer to classic remote sensing techniques, hence using High to Very High Resolution images and applying visual photointerpretation and semi-automatic classification techniques, comparing a pre event and a post event image.
The products are standardised following a set of parameters, such as product type and production mode (service levels) the user can choose when requesting the service. The product delivery package of Rapid Mapping contains vector data and ready-to-print maps. More specifically, the rapid mapping products can be categorized in four products; one pre disaster and three post disaster with respective updates called monitoring (Table 1). Those include:

- The Reference product, which aims at quickly providing knowledge on the territory and assets prior to the emergency in case such information is not available. The content consists of selected topographic features on the area affected by the disaster, in particular exposed assets and other available information that can assist the users in their specific crisis management tasks. A reference product is normally based on a pre-event image captured as close as possible prior to the event.
- The First Estimate Product (FEP), which is an early information product that aims at providing an extremely fast (yet rough) assessment of most affected locations within the area of interest. Such information will be derived from the earliest suitable available post-event image and can be of different resolution and sensor type than the image used for producing delineation and grading products. FEP can be used to 1) highlight possibly affected areas, 2) review the initial product specifications (product type, areas of interest) or 3) decide on cancellation of initially requested delineation or grading products.
- The Delineation Product, which provides an assessment of the event impact and extent and, if requested, an update of the situation (monitoring). It is derived from images acquired as soon as possible after the emergency event.
- The Grading product, which provides information about the damage grade, its spatial distribution and extent. An update (monitoring) can be requested. It is derived from images acquired as soon as possible after the emergency event. The grading product is a superset of the delineation product as it contains the event type, impact extent (delineation) and the damage grading.

Special reference must be made in a fifth very new product called Situational Reporting, basically being a storymap that is continuously updated and provides a fully coverage of the series of events from the start of the phenomenon until its ending and the whole spectrum of events that took place in the rapid mapping process, along with visual content of the key findings and outputs of the analysis, like tables, maps etc.

Table 1. Summary of CEMS activation types and products.

Summary of the Copernicus EMS - Rapid Mapping Activations

Type of Disaster	# of Activations	# of First Estimate products	# of Reference Products	# of Delineation Products	# of Grading Products
Earthquake	35	1	118	34	382
Epidemic	4	0	11	8	24
Flood	223	47	422	1815	304
Forest fire, wild fire	23	0	49	102	79
Humanitarian	10	0	23	140	20
Industrial accident	8	0	12	3	4
Mass movement	8	0	7	7	16
Other	73	0	293	281	232
Storm	65	31	73	472	193
Volcanic activity	9	2	3	16	103
Wildfire	190	104	15	568	333
Wind storm	19	0	86	109	71
[Total: 01.04.2012 - 21.07.2023]	667	185	1112	3555	1761

3. RESULTS AND DISCUSSION

Using satellite imagery to acquire information about a situation on the ground, as applied by CEMS On Demand Mapping component, offers numerous advantages:

- Retrieval of information about difficult-to-access locations (e.g. remote, conflict-stricken and border areas)
- Acquisition of images at all-weather (e.g. even when cloudy) /all-day-and-night basis using radar satellites (such as Copernicus' Sentinel-1)
- Simultaneous damage assessment of transport and building infrastructure over large areas, which is particularly valuable in dense urban areas with large populations

The results of the service are the requested products delivered to the user in the form of vectors, maps, tables and reports. More specifically, the products may include an update of the openly available cartographic reference data, the depiction of the observed event, the damage assessment of any relevant features (related to the specific event), the images on which the analyses were based, data in the form of tables of the affected people and infrastructure and a synoptic review of the situation for the whole activation period, from the event day until the activation closure where the analysis officially ends.

Rapid Mapping services through their 24h/day, 365 days/year operational time schedule, aim at a target delivery of mapping products within 7-12 hours, depending on the type of product for main products or even couple hours for first estimate product. These time frames aid users, who are entities and organisations at regional, national, European and international level active in the field of crisis management within the EU Member States, the Participating States in the European Civil Protection

Mechanism, the Commission's Directorates-General (DGs) and EU Agencies, the European External Action Service (EEAS), as well as international Humanitarian Aid organisations, act drastically and immediately after a catastrophic event.

4. CONCLUSION

Summing up, this Service provided by the On Demand Mapping component of CEMS has successfully provided immediate information since 2012, contributing ultimately in assisting the relevant authorities in dealing with natural disasters, humanitarian crises and accidents immediately after the occurrence of the event. The information provided that includes both qualitative and quantitative data in the form of vectors, rasters and printable maps have been valuable assets for people in charge of dealing with human and property losses, environmental and natural habitat losses, informing the public accurately and rapidly and eventually providing information that contribute to more efficient decision making.

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HOW FREQUENT ARE HIGH-MORTALITY FLOODS IN THE EASTERN MEDITERRANEAN?

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ABSTRACT

Despite recent advances in flood risk prevention, many parts of the world continue to experience extreme floods causing extensive loss of lives. Understanding how frequent these deadly catastrophes is difficult, especially in areas where disaster records are scarce. It is, however, very important for preparedness and civil protection to be able to estimate the frequency of such catastrophic high-mortality events, especially taking into account the threat of climate change. This study establishes an extensive database documenting floods with high mortality numbers in the Eastern Mediterranean region. The database spans from 1882 to 2021, allowing for an examination of the deadliest floods and an analysis of their seasonal, temporal, and spatial characteristics. A total of 132 flood events resulting in 10 or more fatalities were identified, occurring at an average frequency of 1.56 years. Although less frequent, higher magnitude events above the 85th percentile were still relatively common, with a return period of 9.1 years. The analysis reveals an increase in the number of flood events during recent decades, as well as the identification of distinct seasonal and spatial patterns. These findings establish a valuable foundation for policymakers and professionals involved in disaster management, aiding in their understanding of the occurrence of catastrophic floods in the region. Furthermore, this research serves as an important milestone towards a comprehensive understanding of historical changes in extreme floods and their potential future evolution.

Keywords: extreme floods, flood fatalities, Mediterranean, flash floods, climate change

1. INTRODUCTION

Despite the significant progress made in flood risk management, extreme rainfall, and flood forecasting and warning, the occurrence of severe floods resulting in multiple human casualties remains alarmingly prevalent worldwide. Recent catastrophic flash flood incidents in central Europe demonstrate that high mortality rates in extreme flash floods persist, even in regions equipped with advanced risk mitigation measures. The southern part of Europe is no exception, as it continues to experience deadly flash floods that lead to a significant number of fatalities. These events, characterized by their high magnitude and mortality, are of particular interest due to their long-lasting impacts on affected communities. Consequently, governments, local authorities, risk professionals, and the general public share a keen interest in understanding the frequency of such events, both in the present and the future, especially considering the looming threat of climate change. The answer to this question holds paramount importance for civil protection and the development of effective risk management policies.

Understanding the answer to the above quesiton poses a challenge particularly in the Mediterranean region and especially in determining the frequency and trends of multiple-fatality flood events due to their infrequent occurrence, significant variability and scarce data. Previous studies exploring flood mortality have been limited by their examination of relatively short timeframes, hindering a comprehensive assessment of the occurrence frequency of very rare events. In this research, we address these limitations by leveraging disaster databases and other sources of information to construct a comprehensive database of high-mortality flash flood events spanning 14 decades from 1882 to 2021. Our objective is to gain a deeper understanding of the temporal, seasonal, and regional patterns of these events and to shed light on their frequency in the Eastern Mediterranean region.

2. APPROACH

In order to analyze the occurrence patterns of flash flood disasters with high mortality rates, we have developed a comprehensive database encompassing the broader Eastern Mediterranean region. This database includes flood events that have resulted in ten or more fatalities in countries such as Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Egypt, Greece, Israel, Italy, Lebanon, Libya, Montenegro, North Macedonia, and Turkey. By examining a time span of 140 years, from 1882 to 2021, we are able to assess the frequency of these events. The selection of events with a minimum of ten fatalities was made based on existing practices found in the literature. This threshold is also used as a criterion for including fatal events in international disaster databases (as for example in EM-DAT) when they do not meet other requirements for classification as catastrophic events. We have taken utmost care to ensure the database's accuracy and completeness by gathering flood event and fatality data from multiple independent sources. These sources include international databases, country-specific reports or studies, country-level databases, scientific publications, and extensive press archives. Each event was cross-referenced and compared using these diverse sources to ensure the highest level of data reliability.

In detail, we based our analysis on publicly available international disaster and fatality databases, including the following:

- EM-DAT (1900-present) [1]
- Global Active Archive of Large Flood Events of Dartmouth Flood Observatory (1985-present) [2]
- Hanze-E (1870-2016) [3]
- European Past Floods (1980-2015) [4]
- FFEM-DB, 1980-2020 [5]

To evaluate the completeness of this dataset, we compared the number of events with the international databases for the respective spatial and temporal coverage. Overall, the results reveal the greater coverage achieved by using multiple sources.

3. RESULTS

Overall, we identified 132 events that caused 6974 flood fatalities in the study area from 1882 to 2021. The fatalities per event ranged from 10 to 598 (M=53, SD=80.7). According to the distribution, 50% of observations were associated with up to 22 FFs. We classified events in three flood impact magnitude classes, namely: FI1 (low impact) for FFs between 10 and 22, FI2 (moderate impact) for FFs between 23 and 82, and FI3 (high impact) for FFs above 82.

The findings of the study reveal that high-mortality flood events are not uncommon in the Eastern Mediterranean region, with an average return period of approximately 1.5 years for the entire study area. As anticipated, smaller events with lower mortality rates occur more frequently compared to high-impact events. Flood events falling under the lower magnitude category (FI1), resulting in fewer than 22 fatalities, exhibit an annual probability of occurrence of 0.64. Conversely, events categorized under the higher magnitude group (FI3), causing more than 82 fatalities, have an annual probability of occurrence of 0.11 and are approximately six times less frequent than the FI1 events.

Distinct regional variations have also been identified, with the Balkans experiencing a lower frequency of extreme flood events. Return periods for floods of FI1 and FI2 magnitude in the Balkans are approximately double compared to Italy and Turkey, while the return period for FI3 magnitude floods is more than double. This indicates a relatively lower occurrence of extreme events in the Balkans when compared to Italy and Turkey. These spatial patterns offer a more comprehensive understanding of the distribution of high-magnitude flood events in the region, which has not been fully acknowledged in previous literature. Although earlier works have described either the West or the East as more prone to catastrophic events, they only partially align with the findings of this study.

It is important to note that frequency and probability values may change due to nonstationarity and could differ in the future. In fact, the frequency of flood events varies even within the study period. Notably, there has been a significant increase in the number of fatalities and high-mortality events, particularly in the more recent decades, as depicted in Figure 1 when the study period is divided into four equal segments. The frequency of high-mortality events has been observed to rise for lower impact events (FI1 and FI2 groups). However, for higher intensity events (FI3), the trend did not exhibit statistically significant changes and remains inconclusive, indicating potential stability in terms of the average rate of occurrence. It is worth considering that gradual changes over different time periods, which are not captured in the present study, may still occur. Nevertheless, the increase in FI1 and FI2 level events suggests a possibility of higher frequency in the future.

Overall, the findings indicate a significant increase especially in the last quarter of the study period, which is confined to events of lower magnitudes in terms of mortality. The most extreme and rare events of this dataset (15%) did not show changes in terms of frequency within the study period. Seasonal patterns were identified as well, with events located in the southeastern part of the study area recording fewer summer occurrences in comparison with the ones identified in the north and northwest.

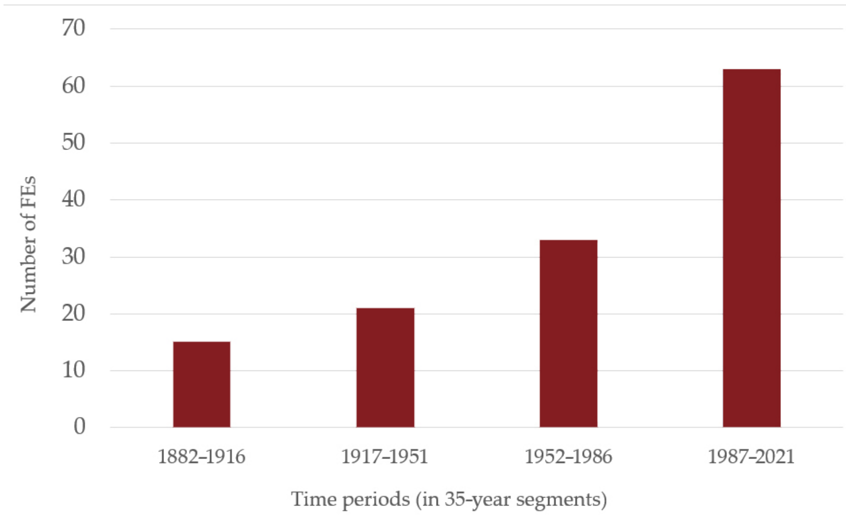

Figure 1. Graph showing the number of flood events (FEs) in four 35-year segments of the study period (1882-2021), indicating an important increase especially in the last segment.

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DEBRIS FLOW SIMULATION DURING THE FLASH FLOODS OF NOVEMBER 2017 (ATTICA, GREECE)

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ABSTRACT

This work presents the attempt to simulate debris flow phenomena between the mountainous area of Pateras Mt and the flash flood striken areas of Mandra and Elefsina in West Attica, during a rare event that took place in November 2017 in Attica, Greece. The whole area east and south of the mountain suffered extreme flooding, severe damage, numerous fatalities, and significant geomorphological effects. For the study of debris flow dynamics, the distribution of debris flows in the Agia Aikaterini stream (upstream from Mandra town) is crucial. Simulation was run using data collected from previous works and detailed mapping of the area, and developed scenarios with a range of values of input for parameters with uncertainty. The Rapid Mass Movements Simulation (RAMMS: DEBRIS FLOW), which can exhibit stream flows as editable visuals fairly rapidly and has a number of useful capabilities, showed results remarkably compatible to field observations.

KEY WORDS : debris flows, RAMMS, simulation, Mandra, Agia Aikaterini

1. INTRODUCTION

In mountain catchments, strong and localized storms frequently result in debris flows, which are rapidly moving mixtures of water, clay, and granular sediments. High velocity, density, and discharge of debris flows all contribute to their destructiveness. There have also been reports of peak discharge rates that are one to two orders of magnitude higher than those experienced during torrential floods, as well as frontal velocities of over 10 m/s. They can carry a substantial volume of material from the bottom of steep slopes to the fan termination, where deposition normally occurs [1]. In the Mediterranean, flash floods are frequent and often catastrophic. Due to monitoring difficulties brought on by the temporal and spatial scales on which flash floods occur as well as the inadequacy of conventional observational networks when it comes to accurately measuring their characteristics, flash floods have received little attention despite their significance until recently. The focus has switched to ephemeral streams and hydrometeorological analyses due to these observational challenges, which are usually accompanied by a lack of instrumental data or even wrecked instruments [2]. The outcomes of mathematical models that explain the depositional process, such as flow depth, velocity, and impact force, can be used to compute the debris flow hazard parameters. The routing models that are now known are built using continuum mechanical equations in one and two dimensions. They commonly mimic the bulk behaviour of one-phase mixtures at the macroscopic scale by using basic rheological concepts without taking debris flow mechanics into account [3]. Using the Herschel Bulkley representation or a rheological formulation for a Bingham fluid, several models for viscoplastic fluids are developed [4]. Its use necessitates substantial topographical and volumetric information as well as difficult-to-quantify rheological characteristics. A back-analysis can provide predictions and reveal crucial rheological information [5]. Several debris flow events on Pateras Mountain were caused by a severe weather event that hit West Attica in November 2017. The downhill towns of Mandra and Elefsina also saw severe flash flooding as a result, even though the area had received little to no rain throughout the storm. The model was tested through simulation of debris flows in one of the tributaries of the main drainage network of the area, the Katsimidi stream, using a hydrograph as calibration parameters. The general behaviour of the model and its sensitivity to the main input parameters are explained through simulations. The findings show that a range of rheological parameters can approximate adequately debris flows in the Katsimidi stream. The model inflates the likelihood of overflow even when it might be restricted. The velocity, flow height, and pressures are validated by field data, and the results appear to depart little to no from previous findings, which is helpful for risk assessment.

2. METHOD & MATERIALS - RESULTS

On November 15-16, a high-intensity convective storm with orographic effects resulted in up to 300 mm precipitation in 13 hours at the foot of Mt. Pateras in Western Attica, with 153 and 194 mm of basin-average total accumulation in the Agia Aikaterini and Soures catchments, respectively [2,6]. Two minor ephemeral catchments that were drained by the two tributaries of the Soures stream experienced an immediate and severe response to the storm. In compared to the catchment area of the two streams, the flood caused inundation of great depth (up to 4.2 m) and extent (around 40 km^2). The unit peak discharge in both basins was between 9 and 10 m^3/s/km^2, which is comparable to values observed during prior extreme flash flood occurrences.

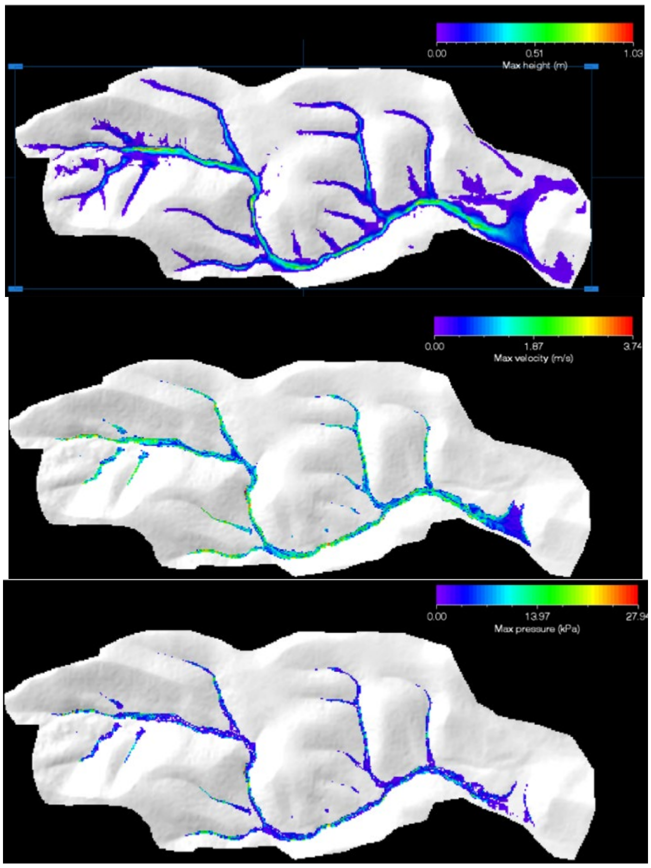

Figure 1. Maximum height (top), velocity (middle) and pressure (bottom) results for Katsimidi stream (Giandotti calculation parameters).

The 2017 flood was a highly rare event, according to all available evidence, including meteorological, botanical, and geomorphological data[2]. Surveys of the Gauckler-Manning type were conducted at the intersection of Soures and Agia Aikaterini under the assumption of a steady flow. Using the Structure from Motion technique, a full Digital Surface Model (DSM) with a resolution of 2.7 cm was produced at these two locations (SfM). The detailed DSM was utilized to extract a vertical cross section, determine the cross-sectional area, and determine the wetted perimeter. The Arcement and Schneider (1989) and Phillips and Tadayon (2006) approaches were used to determine the Manning n. The current effort employed the pre-existing data and results to simulate debris flows using the program Rapid Mass Movement Simulation (RAMMS). The required parameters for the hydrograph were the total volume (V_{ol}), the maximum discharge (Qmax), the time (t_1) at which the maximum discharge occurs, and the water velocity (v). Giandotti and Manning's two formulae were used to calculate these parameters.

The hydrographic data that was input into the program using the Giandotti and Manning calculations result in a variety of values that range from 1.03 to 1.06 m maximum height, 27.54 to 27.98 kPA maximum pressure and 3.71 to 3.74 maximum velocity. The wide range of Qpeak values depending on the Manning's n selection do not seem to affect the final result drastically.

3. DISCUSSION & CONCLUSION

It is always necessary to calibrate the two Voellmy friction coefficients and utilize the Voellmy friction model as described here when simulating gravitational mass flows (such as debris flows). The composition of the materials will affect the rheology of a debris flow and, consequently, the Voellmy friction coefficients (fluid-like or granular). Furthermore, momentum loss during erosion processes is predicted to cause friction to increase as volume grows. The shape of the flowing body can be controlled by the material intake rates, and input hydrographs are reconstructed using empirical correlations or field-measured discharge hydrographs. The hydrograph is supposed to represent more accurate initial conditions for channelized debris flows. The input hydrographs are created using empirical correlations or discharge hydrographs that were measured in the field in order to influence the shape of the flowing body. Actual debris flow occurrences can be modelled using the hydraulic data Giandotti and Manning equations. Therefore, improvements to a hydrograph based on the actual discharge hydrographs in use are achievable. The evaluation and confirmation of how it is represented in the software based on precedents were included in this simulation investigation. This comprises flow metrics that have been measured and mapped, such as maximum velocity and maximum pressure. The latest findings demonstrate how well their simulation matches previously released findings. This covers the hydrograph's long-term impact on pressure, flow rate, and velocity. The movement and deposition of the debris flows appear to match field observations. Small changes in the Katsimidi stream can be seen on a hydrograph, which is a measurement of flow depth over time. There was produced a discharge hydrograph with a volume of 474.265 m^3. According to what has been documented, it is expected that the Voellmy friction coefficients change as the volume grows and are volume dependant. Since a major amount of momentum will be lost because of the significant reworking and entrainment of partially dry sediment deposits, we anticipate that a larger volume will be needed.

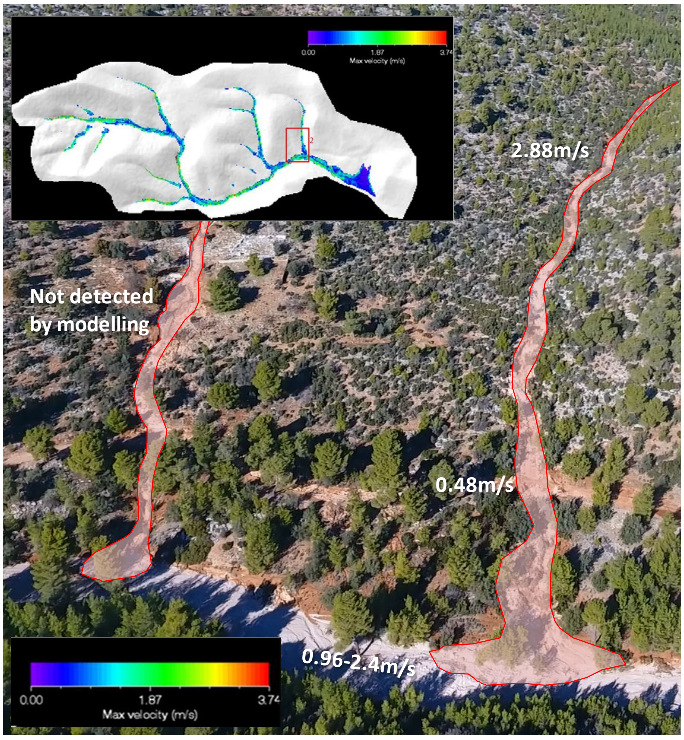

Figure 2. Modeling is based on a digital elevation model prior to the events. As a result, water height refers to the initial conditions of inundation. During the progress of events, erosion widens and deepens the streambeds, changing their capacity, while being loaded with sediment and debris. For location 1, the model shows water height between 0,15 and 0,60m, while in situ measurements have shown incision exceeding these numbers by a varying significant factor.

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FLOODING PHENOMENA IN THE METROPOLITAN AREA OF THESSALONIKI: ANTHROPOGENIC AND CLIMATE CHANGE EFFECTS

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ABSTRACT
The metropolitan area and the town of Thessaloniki are frequently affected by flooding phenomena because of strong thunderstorm downpours but also because of anthropogenic causes. The progressing disappearance of the hydrographic network as streams have been covered by various constructions, the limited capacity of stormwater pipes, the inadequate cleaning of sewer wells, limit the possibility of water removal and increase runoff and flash flood potential. Therefore, rainfalls even of moderate intenisty can flood roads, nearby buildings, low spots such as underpasses, underground garages, basements, and thus low water crossings become dangerous traps. Based on a 47-year (1975-2022) severe weather database, a total of 75 flash floods events are identified for Thessaloniki and the metropolitan area. In the last two decades (2003-2022), the annual number exceeded 3 episodes and in the last decade increased to about 5 flood events per year on average, indicating a possible climate change impact. Based on a statistical model forecasting, an average number of 5 to 8 flood events per year are anticipated in the Thessaloniki metropolitan area for the next 10-year period (2023-2033).

Keywords: Thessaloniki, floods, thunderstorms, climate change, water

1. INTRODUCTION

Flooding phenomena are the most common of all weather-related threats that are related to natural disasters {1,6]. Flash floods frequently occur in the town of Thessalonki and the extended metropolitan area because of intense thunderstorm downpours but also with the significant contribution of anthropogenic factors [2]. The progressing disappearance of the hydrographic network as the natural runoff streams have been covered by various constructions, the limited capacity and inadequate cleaning of stormwater pipes and sewer wells are factors that contribute to urban flash floods.
Main weather types responsible for intense thunderstrom downpours are characterised by cold upper air mass that produces dynamic instability especially in the summer and fall months. Also intense cyclones known as "medicanes" (<u>medi</u>terranean hurri<u>canes</u>) resembling tropical like cyclone feautures and often associated with hurricane-force winds and heavy precipitation [3].
Urban flash floods mainly affect lower elevation areas, roads, underpasses, buildings, basements, and undergrounded streams overwhelmed or plugged by debris. Flooding power is mutliplied because of the increased flow speed results in very quick flooding that affects a larger number of people due to the higher population density. Urban flash floods can happen within minutes of the intense rainfall, limiting dramatically the time available to warn and protect the public.
The main objectives of this research are: a) to idendify flooding prone areas of the Thessaloniki and the greater metropolitan area, b) to examining a 47-year severe weather event database (1976-2022) to determine flooding events and investigate yearly and monthly distributions c) to investigate possible climatic change effects in flooding occurrence trends, and d) to apply a statistical forecasting methodology in an attempt to estimate the anticipated flooding phenomena for the metropolitan area of Thessaloniki for the next 10-year period 2023-2033.

2. FLOODS OCCURRENCE AND CLIMATE CHANGE

2.1. Flooding prone areas in Thessaloniki's metropolitan area

Flooding prone areas in the town of Thessaloniki and the extended metropolitan area, as have been mapped and characterized as potentially high risk areas in Figure 1 [4], are:

- The densely populated urban parts of Thessaloniki, specifically the downtown lowest altitude parts and the coastal zone roads. The upstream areas of the peripheral trench, the municipalities of Evosmos-Kordelio, Ampelokipi-Menemeni and Pavlos Melas on either side of Dendropotamos stream and the sides of Asimakis and Xiropotamos streams.
- The area west of Thessaloniki town, the estuary of the Axios River, the lowland areas between the villages of Gefyra and Agios Athanasios, the settlements of Chalastra and Sindos. The area on both sides of the Gallikos River along its entire length and the settlement of Kalochori.
- The area east-southeast of Thessaloniki, the streams Thermi, Triadi and Anthemounta, the settlements of Perea, Neoi Epivates, Agia Triada, and the estuary of the stream Keramida of Nea Michaniona, along the streams of Epanomi, Patroli and Remataki. Also, the lakeside areas of Lakes Koroneia and Volvi and the lowland areas of Vrasna and Asprovalta.
- Additional high-risk locations include recently burned areas from wildfires.

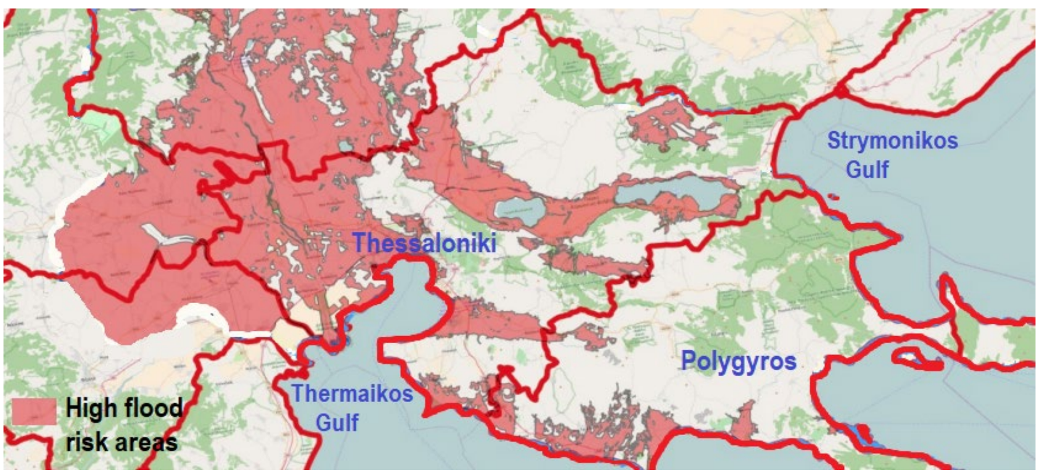

Figure 1. High flood risk areas in the Thessaloniki metropolitan area (source: Greek Ministry of Environment and Energy).

2.2. Floods and climate change

Severe weather databases are very useful for a plethora of applications from monitoring extremes and high impact events up to establishing climatologies and estimate the weather and climate related hazard risk [2,5]. Based on a 47-year (1976-2022) severe weather event database developed for Thessaloniki and the metropolitan area a total of 75 flooding events associated with thunderstorm and heavy rainfall activity have been recorded. In Figure 2 the yearly distribution of flooding events are displayed. As it can be seen very few and sporadic events occurred in the period before the year 2003, with no floods occurred during the 15-year period 1988-2002. The total 47-year time series data correspond to a yearly average of 1.6 flooding events. Considering the last two decades (2003-2022), the mean annual number arises to 3.3 flooding events, while in the last decade (2013-2022) a further increase to 4.6 events per year is appeared. This upward trend of flooding events more pronounced in the last two decades, except urbanization and change land use, can be attributed to a possible impact of climate change as it is occurred in warmer decades compared to previous ones, in a period related to general increase of severe weather events including severe thunderstorms and heavy downpours.

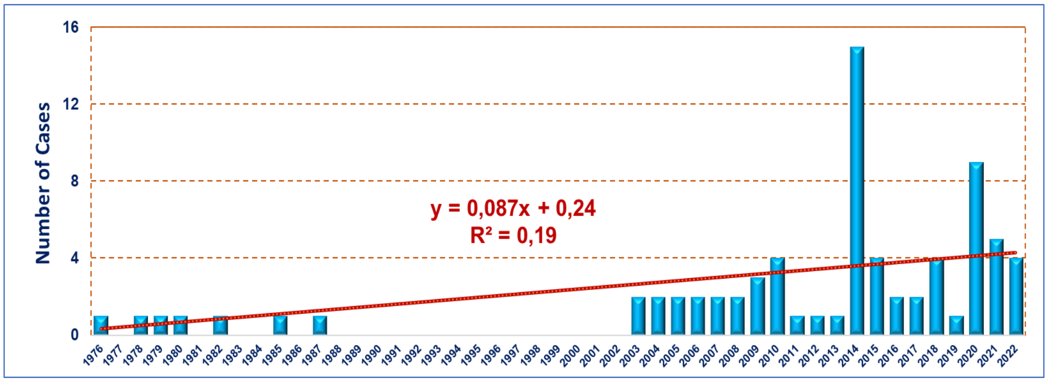

Figure 2. Annual frequency of flooding events in Thessaloniki's metropolitan area in a 47-year period (1976-2022).

Figure 3 displays the monthly distribution of the flooding events occurred during the 47 year period (1976-2022) in the metropolitan area of Thessaloniki. September is the dominant month in flood occurrences with 21.3%, followed by June with 16%, then August with 14.7% and then July and October with 9.3% of the total events. The smallest frequency of flooding events occurs in February and March with 1.3% respectively and in January with 2.7%, months with limited thunderstorm activity in Thessaloniki's metropolitan area and northern Greece. These findings suggest that the most flooding events in the metropolitan area of Thessaloniki are produced from summertime and fall thunderstorm rainfalls and less flooding events from winter and early spring rainfalls.

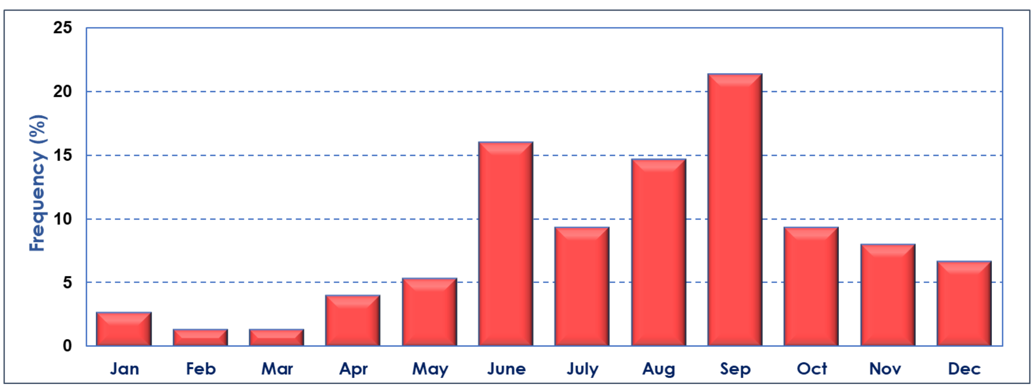

Figure 3. Monthly frequency (%) of flooding events in Thessaloniki's metropolitan area in a 47-year period (1976-2022).

4. LONG TERM FLOOD FORECASTING

In order to have an estimate of flood risk events, a statistical projection based on the historical time series of flooding event records is presented in Figure 4. Assuming of maintaining the same conditions in infrastructure and climate trend, a number of 5 to 8 flood events per year is forecasted for the metropolitan area of Thessaloniki for the next 10-year period 2023-33. Under the extreme scenario, for individual years an increased number of flood events is likely exceeding 8 and reaching up to 14 flooding events. According the most optimistic scenario, from zero up to 2 flooding events are forecasted for individual years in the 10-year period (2023-2033).

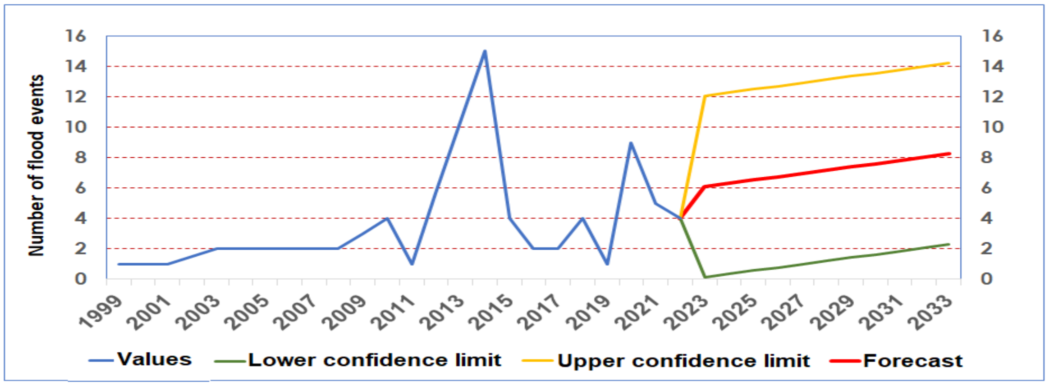

Figure 4. Forecasting of flooding events frequency for Thessaloniki's metropolitan area for the 10-year period 2023-2033.

5. SUMMARY AND CONCLUSIONS

The diachronic ocurrence and future of flooding phenomena in the metropolitan area of Thessaloniki are investigated in this work. Flooding prone areas are determined and temporal distribiutions of flooding events are examined using a 47-year severe weather event database (1976-2022). A possible climatic change effect in increasing of flooding events is appearred in the last decades, with a significant contibution of anthropogenic causes like urbanization, change land use and deforestation. A statistical forecast showed an increasing of about 5 to 8 flooding events annualy for the metropolitan area of Thessaloniki in the next 10-years (2023-2033), with the damaging potential also increasing. This study is offering to increase awareness about climatic change and anthropogenic effects to a higher risk and vulnerability from flooding hazards in the metropolitan area of Thessaloniki and therefore to contribute to development of anti-flood infrastructures, protection systems, management and mitigation plans.

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OPERATIONAL FORECASTING SYSTEM FOR FLOOD EARLY WARNING IN EVROS/MARITSA TRANSBOUNDARY BASIN (GREECE)

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ABSTRACT

We develop an operational, flood early warning system for the Evros River. The system comprises a web-based platform that generates short-term forecasts by combining meteorological, hydrological and hydraulic models, to support proactive decision making in the wider Evors area. The meteorological and hydrological models spatially cover and provide forecasts for the whole Evros/Maritsa basin. The hydraulic model simulates fluvial flooding for the downstream part of the Evros River, covering the area from the Greek-Bulgarian borders, downstream to the rivers outlet to the Aegean see. The web-based interactive platform, deployed using cloud computing services, allows user to visualize the forecasted information from the three coupled models in a user-friendly environment. Warning thresholds have been set based on information from local authorities and Civil Protection, experienced in the study area. The early warning system is based on a modular architecture, easily extendable and updatable to incorporate future needs and corrective actions. The developed system supports, and is part of, a modular platform that sets the standards for a National Flood Early Warning hub.

Keywords: *flood, early warning, operational, modeling, forecasting*

1. INTRODUCTION

Floods are identified globally as a major climatic threat, augmented by climate change. Flood Early Warning Systems (FEWS), as a risk management tool, are recognized as of significant importance with the UN Office for Disaster Risk Reduction advocating for an increase in their use, in accordance with the targets of the Sendai Framework for Disaster Risk Reduction and Sustainable Development Goals (SDGs) [1] while recent discussions focus also on the social aspects of such systems [2, 3], indicating their widespread application. Addressing challenges of flood risk management was taken under an institutional framework on a pan-European level more than fifteen years ago, when Directive 2007/60/EC on the assessment and management of flood risks was issued [4]. Under this frame, the Flood Risk Management Plans (FRMP) of Greece [5] were undertaken and foresee the development of FEWS for all the Water Districts in Greece. A FEWS for the Evros River, in the 12th Water District of Greece, has been developed by EMVIS Consultants SA on behalf of General Secretariat for Natural Environment and Water, Directorate General for Water, under the frame of the EU Cooperation

Programme INTERREG V-A GREECE – BULGARIA 2014-2020, Project "Integrated actions for joint coordination and responsiveness to flood risks in the Cross Border area – FLOODGUARD", which focuses on the challenges of flood risk management via integrated actions for joint coordination and responsiveness to flood risks in the Cross-Border (CB) area of Greece and Bulgaria.

2. SYSTEM DEVELOPMENT

The FEWS comprise three numerical models and four sub-systems, seamlessly connected on a data exchange chain, as shown graphically below (Figure 1). The meteorological model produces forecasts of meteorological parameters which are then used as input data for the hydrologic model. The latter then produces outflow forecasts on specific points of the Evros/Maritsa hydrologic system which are fed into the hydraulic model, to produce forecasts of river flows (speed, depth) and flood inundation. All the data which are produced and used by the models are stored on a sub-system for data management and model coupling and are finally transferred to the front-end system of the FEWS, coupled with warning and alarm thresholds, to be communicated to the end-users.

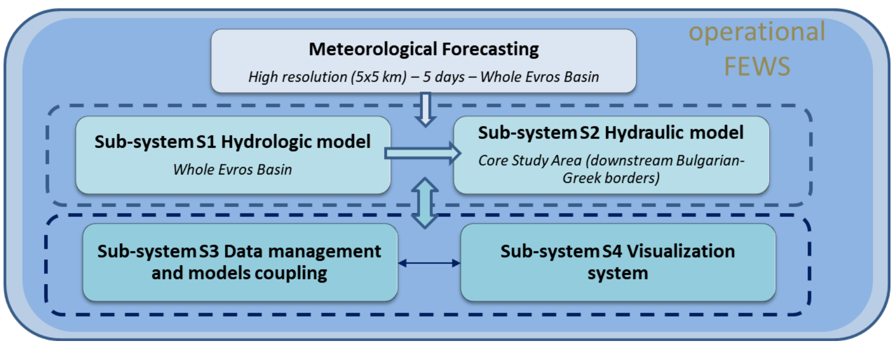


Figure 1. Flood Early Warning System (FEWS) in the river basin of Evros /Maritsa: sub-systems and data flow.

The Weather Research and Forecasting (WRF) Model is used in this project, a state-of-the-art mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications. The model serves a wide range of meteorological applications and is currently in operational use at U.S. NCEP and other national meteorological centers. The Advanced Research WRF (ARW) version of the model is used (Version 4). It produces 5days forecasts, on a horizontal resolution of two downscaling domains, a 1st with a horizontal resolution of 15km and a second, which operates as a nested domain within the first one, with a resolution of 5km. The initial conditions received from GFS have a resolution of 25km. Deterministic forecasting is used as input further down the modeling chain. The meteorological model features also ensemble forecasting, from NCEP Global Ensemble Forecast System (GEFS), that generates 21 separate forecasts (ensemble members) to address underlying uncertainties in the input data and the limitations of the model itself.

The semi-distributed hydrological model HYPE (Hydrological Predictions for the Environment) [6] is used, a conceptual rainfall-runoff model designed specifically for hydrological model applications from river catchments up to continental scales. The model is developed and maintained by the Swedish Meteorological and Hydrological Institute (SMHI) under an open – source license. The model has been set-up and calibrated using discharge data from Bulgaria, Greece and Turkey for the period 2020–2022 at a total of 31 gauging locations (Figure 2a). Explicit representation of reservoir regulation has been included. The model shows good performance across the model domain with best performance in the lower reaches, downstream of Harmanli (Bulgaria). Best performance is obtained at Kipoi – Ipsala area

(Greek-Turkish borders, KGE = 0.89). Peak timing and magnitude are generally captured well. The model has been operationalized using SMHI's SMHF system. It is run twice daily, using the 00:00 and 12:00 WRFM forecasts, and produces forecast discharge for the full WRFM forecast horizon (5 days). Real-time updating of discharge stations is currently implemented at 3 locations, and can be expanded to include additional real-time stations in the future.

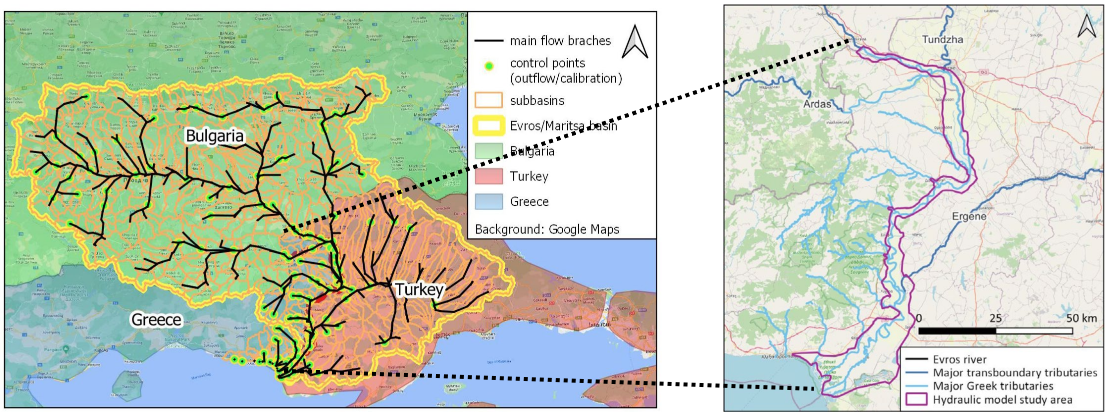


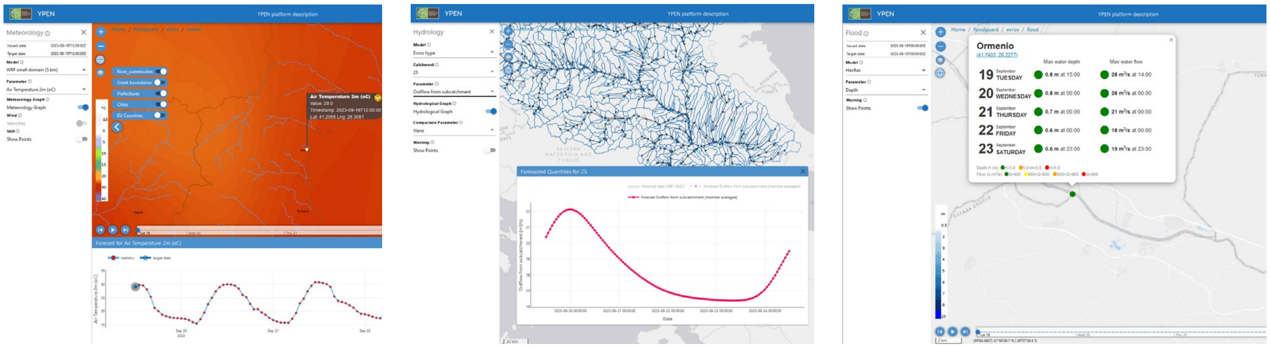
Figure 2. (a) Hydrologic model implementation area, **(b)** Hydraulic model study area.

The flood dynamics and the flow in the main river bed as well as the overtopping of the riverbanks and flow in the floodplains is simulated with the use of the HEC – RAS software, a model designed to perform one and two-dimensional hydraulic calculations for a full network of natural and constructed channels (https://www.hec.usace.army.mil/software/hec-ras/features.aspx, accessed: 01/07/2023). The model extent covers the area that is affected from flood events directly caused or amplified by the flow of Evros River (Figure 2b), using a full 2D approach. The model was calibrated against the flood events of 2010, 2018 and 2021 and is under a validation period.

The services of the FEWS are provided through an operational web-based, interactive platform, deployed using cloud computing services. The overall architecture of the system is based on various, open-source systems and technologies, carefully selected to ensure the robustness, flexibility, and expandability (e.g. DJANGO web framework, PostgreSQL database with PostGIS extension, GeoServer, React JavaScript e.tc). The platform facilitates data exchange and communication of the different technological components and workflows that need to be coupled for operationalizing the complete service line of FEWS. A rich set of API services have been created to allow the individual workflows to communicate with each other as well as to push the generated data into the Graphical User Interface.

3. THE FLOOD EARLY WARNING SYSTEM

The FEWS for Evros/Maritsa basin provides 5days forecast, updated twice per day, for three different sets of parameters, i.e. meteorological, hydrological and hydraulic, organized under three distinct modules of the front-end graphical user interface of the system (Figure 3). It provides a series of customization options for map layouts and variable graphical representations of the results. Warning thresholds are integrated in the system and have been set based on data and experience in the study area provided by the local authorities and Civil Protection. FEWS is currently under a pilot application period during which the performance of the models and the overall system is evaluated and refined.



(a) (b) (c)

Figure 3. Flood Early Warning System (FEWS) in the river basin of Evros /Maritsa: **(a)** Meteorologic module, **(b)** Hydrologic module and **(c)** Hydraulic module.

4. DISCUSSION

The development of the FEWS for the Evros River corresponds to the needs and program of measures defined in the relevant Greek FRMP of WD 12, as well as to the recognized need for operational and flexible measures for the support of flood management in the transboundary area of Evros/Maritsa River. Given the constraints of the models, the complexity of the natural system, the limitations of the available data and flood mechanisms which are not considered (e.g., non – fluvial surface water or groundwater flooding contributions), the system provides a state-of-the-art, flexible tool which may support flood management decisions, locally or transboundary. Future modifications based on the planed validation period are expected to further improve the overall system performance. Based on a modular and expandable architecture, the system is easy to maintain, update and transfer to other river basins, setting the standards and the basis for a National Flood Early Warning hub.

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THE NOAQ BOXWALL AND THE POTENTIAL OF MOBILE FLOOD BARRIERS

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ABSTRACT
Since long people have been protecting themselves and their property by piling sandbags to make temporary flood barriers. This method is however rather inefficient, as it requires lots of sand, lots of manpower – and lots of time. I was watching such an activity on the TV news back in 1993, and thought there might be a better way. As there are already millions of tons of water at the site, wouldn´t it be possible to let a barrier use this water as ballast, instead of sand? It was. Two years later a working product was launched – the Tubewall – and a company founded – NOAQ. Another two years later a second product was launched – the Boxwall. With these new self-anchoring flood barriers, weighing less than 1% of corresponding sandbag barriers, almost everyone will have the ability to protect themselves. The result will be a much more flood resilient society.

Keywords: Flood fighting, mobile flood barriers, temporary flood barriers, flash floods, NOAQ

1. INTRODUCTION
Keeping flood water away from homes and companies isn’t really a difficult technical challenge. We have successfully been doing this by piling sandbags to make temporary flood barriers since the sandbag itself (or maybe the power loom) was invented some two hundred years ago. The problem is that sandbagging is so labour intensive and inefficient. It requires many bags, much sand, many people, and much time. Which we do not always have. Therefore we have often had to choose which buildings and objects to protect, within the time available, and which ones to give up. This situation is now about to change, by the introduction of new purpose designed mobile flood barriers. The development started in 1997 when NOAQ introduced the “NOAQ tubewall”, an air-filled ultra-light tubular barrier. Instead of heavy sand, the tubewall utilized the weight of the flood water for the anchoring. Also the “NOAQ boxwall”, launched in 2007, was built on the same “bookend principle”. A NOAQ boxwall segment with a damming capacity of one meter weighs 15 kg, but it replaces 140 sandbags with a total weight of 2.5 tons. This weight reduction can be transformed into a reduction of deployment time, or a reduction of manpower, an increased amount of objects saved, or all of it. More objects can be protected in shorter time with fewer people. The combination of lighter equipment and increased efficiency also means that many people will now be able to protect themselves. A private home can be protected by the family members alone, the staff of a shop or a factory is able to protect their own company and the school children can save their own school. This also means that society will instead be able to concentrate its resources to protect common property and infrastructure, like roads and railways, electric substations, hospitals etc, and to help those who cannot help themselves, like elderly and disabled. Mobilizing those who were helpless victims in previous disasters, to become resources in the next one, means a new distribution of roles, and a more flood resilient society. We are in fact changing the game of flood fighting.

2. MOBILE FLOOD BARRIERS

Flood barriers can be divided in different categories. As this is a very new field there are no international standards, not even agreed definitions. NOAQ has therefore taken an initiative to create such a standard and below (Figure 1) is shown the suggested categorization, and where the mobile flood barriers fit in.

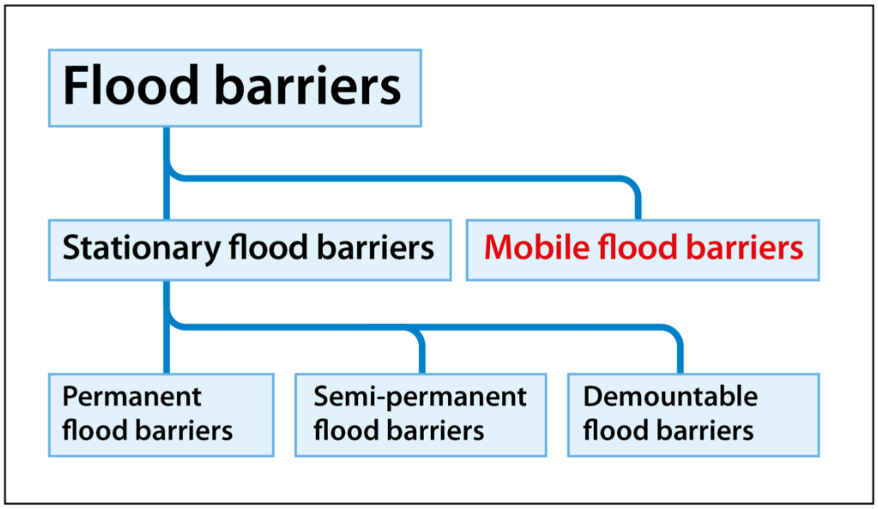

Figure 1. Categorization scheme for flood barriers according to NOAQ proposal.

Here mobile flood barriers are defined as barrier products that are built up to protect a certain site, and that can later be moved to protect another site. Typically a mobile flood barrier does not require any preparations to be made on-site prior to a flood, although some sites can of course be made more suitable, for instance by removing obstacles that would otherwise block the way.

2.1 The NOAQ Tubewall

When the NOAQ Tubewall (Figure 2) was launched in 1997 it was not the first mobile flood barrier, but it was the first self-anchoring one, built on the bookend principle.

Figure 2. A Tubewall saving a private home in Hälsingland, Sweden, in 2000.

2.2 The NOAQ Boxwall

Also the Boxwall, launched in 2007, is built on the same bookend principle design (Figure 3).

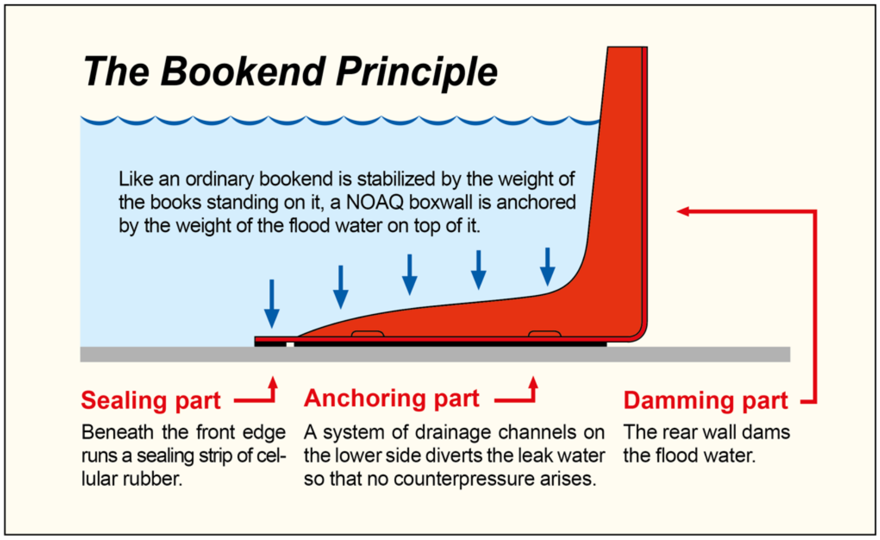

Figure 3. The Bookend Principle, and how a Boxwall makes use of it.

The most common boxwall application is of course to hold back rising waters. To use a boxwall there need to be a free strip of land between the protected object and the water. The ground surface need to be relatively even to minimize leakage, but as some water will always appear even on the intended dry side of the barrier, you also need to have one or more pumps, to pump back the water over the barrier. There is however also another application for he boxwall, to protect against flash flooding, when water comes rushing from higher ground. In this case the water cannot be stopped, it has to be diverted, and led past low lying entrances and other vulnerable objects. In the Austrian city of Kufstein they used a couple of boxwalls to convert an entire street into a canal to lead the water out of town (Figure 4).

Figure 4. Boxwall success stories; Kufstein, Austria, and Quakertown, USA (2021)

The boxwall comes i two sizes, one with a damming ability of 50 cm and one with a damming ability of 100 cm. For both sizes there are three different elements ("boxes"), a straight one, a 30° inward corner box and a 30° outward corner box. There are also a couple of gables, one left and one right. As the boxes share the same coupling mechanism they can be connected in whatever order, which gives the system a flexibility to cope with all kinds of obstacles, like trees, poles, pedestrian refuges etc. There is also a third application of the boxwall. By connecting twelve 30° inward corner boxes you will end up with a circle, which can be used as a temporary basin for whatever liquids, a "boxpool". The boxpool can then be cut in two halves, whereafter a number of straight boxes can be inserted. This way the boxpool can be elongated (and widened) to whatever size, for whatever purpose.

2.3 Other mobile flood barriers

During the last 30 years a great number of other mobile flood barriers have been developed. Some are direct copies of the NOAQ products, other ones are inspired by them, but many ar also designed independently. Most constructions do in fact take advantage of the weight of the flood water for stabilization, at least to some extent, but only the NOAQ barriers are built solely on the "bookend principle". There is no reason to rule out these other products; all constructions have their advantages and disadvantages. And further, as conditions vary very much between different flood events, there is a need of products with different abilities.

2.4 Conclusions and new questions

Mobile flood barriers have a great advantage over stationary ones, in that they can not only protect one object, but many. They can be brought to a flooded area, or to an area where there is a risk of flooding, and be used over an over again. This also means an economic benefit, as the costs of the products will be shared by a number of object owners, not just one. With the mobile flood barriers, the focus of flood protection should now rather be on organization, distribution and responsibility. When a property owner does not need to invest in an own barrier, who should? The local fire brigade, the region, the insurance industry or the rental industry? Or a purpose built organization? And how can he or she be sure to get the barriers needed when a flood is imminent?

2.5. Visions

The new mobile flood barriers makes it possible for many people to protect themselves, instead of just crying for help. Once people realize this, and prepare themselves accordingly, we will get a much more flood resilient society. Over time people will learn about this new possibility by success stories brought to them via media, but to speed things up, and avoid much damage in the near future, society here has an important role to inform.

POST-DISASTER LANDSLIDE EVALUATION AND RISK ASSESSMENT IN ISCHIA ISLAND (ITALY), BY USING COPERNICUS EMERGENCY MANAGEMENT SERVICE (CEMS)

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ABSTRACT

In Ischia Island (Italy), a landslide event has occured between 25-26th November 2022, after extreme rainfall. The disaster affected 28.2 ha in the municipality of Casamicciola, where a complete section of the upper part of Mount Epomeo collapsed, generating an avalanche of mud and loose volcanic rock. Twelve fatalities have been reported, while hundreds of people have been injured. The Italian National Department of Civil Protection has activated the Risk and Recovery module of the Copernicus Emergency Management Service (CEMS). European Union provides CEMS as the main service rendering useful information concerning civil protection. CEMS is based on Earth Observation and in situ data, monitoring the Earth and its ecosystems, in order to ensure that citizens are prepared and protected in case of natural or man-made crises and disasters. The service provides information (before, during or after a crisis) for disaster management through its Mapping and Early Warning components. CEMS Mapping consists of two service modules; (i) Rapid Mapping; and (ii) Risk and Recovery. On-demand Risk and Recovery provides geospatial information (vector data and ready-to-print maps) to support disaster management activities for prevention, preparedness, risk reduction, recovery and reconstruction phases. The analysis and results of the post-landslide activation in Ischia Island mainly demonstrate the extent of the event, the damages and the consequences which have been provoked, as well as the risks which have been looming for other disasters.

Keywords: Ischia Island, Copernicus EMS, Risk and Recovery, earth observation, landslide evaluation, risk assessment

1. INTRODUCTION

The Risk and Recovery module of the Copernicus Emergency Management Service has been activated for a landslide event in Ischia Island (Italy) under the activation EMSN142 by the Italian National Department of Civil Protection. The main goals of this activation were the evaluation of the landslide event, in the recovery phase, and the risk assessment of subsequent disasters, in the preparedness phase.

CEMS is coordinated by the European Commission and "provides all actors involved in the management of natural disasters, man-made emergency situations, and humanitarian crises with timely and accurate geo-spatial information derived from satellite remote sensing and complemented by available in situ or open data sources" [1].

The Risk and Recovery Mapping service is offered in an international context for Disaster Risk Reduction and targeting information layers that support decision making in the emergency management phases that are not directly related to response. The service can be activated on-demand and offers to provide the national authorities with maps, time series or other relevant information to better manage disaster risk [2].

For pre-disaster activities, the service can provide information on the exposure, vulnerability and resilience of people and assets for all types of hazards. For post-disaster activities, it offers detailed impact assessment and assist in the development of recovery plans. The service can be activated through two modalities:

- FLEX: Products and analyses tailor-made to user's needs
- STANDARD: User can choose from a predefined set of standardized products

In both modalities, the service provides three broad product categories: (i) Reference data and maps; (ii) Pre-disaster situation data and maps; and (iii) Post-disaster situation data and maps.
CEMS Risk and Recovery Mapping can be triggered only by or through an Authorized User (AU), which includes National Focal Points in the EU Member States and countries participating in the Copernicus programme, as well as European Commission services and the European External Action Service.

The EMSN142 is a Risk and Recovery activation in FLEX mode, providing different types of products: a) Reference map of the island, b) Post-disaster maps for the landslide evaluation and c) Pre-disaster maps for the risk assessment. The AU of the EMSN142 is the Italian Civil Protection.

2. METHOD

The event under study consists of a landslide that occurred between 25-26th November 2022 and affected 28.2 ha in the municipality of Casamicciola, on the island of Ischia, in the Campania region (Italy). A complete section of the upper part of Mount Epomeo, in the southern part of the town of Casamicciola, collapsed generating an avalanche of mud and loose volcanic rock. Twelve fatalities have been reported, while hundreds of people have been injured.
The area had been heavily affected by rain for several days, before the landslide occurred. During the night of 25th November 2022 and the early hours of 26th November, a deep cyclone centred over Italy brought heavy rains to central and southern Italy, particularly over Campania. More than 120 mm of rain in 6 hours was recorded.
The main objective of this Risk and Recovery activation was to support the evaluation of the post-disaster consequences of the landslide and to provide useful geospatial data for a preparedness analysis of Ischia Island. This activation has been implemented by INDRA consortium, part of which is Planetek Hellas.
The service was activated in FLEX mode and the deliverable products consist of the below parameters:

- Updated Reference mapping of Ischia Island
- Delineation of the landslides that affected the area during the event
- Detailed Damage assessment of the infrustructures affected by the landslide
- Estimation of economic consequences
- Estimation of the volume of the landslides
- 3D simulation video of the landslide
- Landslide Hazard assessment
- Landslide Exposure and Vulnerability assessment
- Landslide Risk assessment
- Assets map
- Potential economic loss due to landslide risk
- Ground motion detection
- Coastal erosion hazard analysis

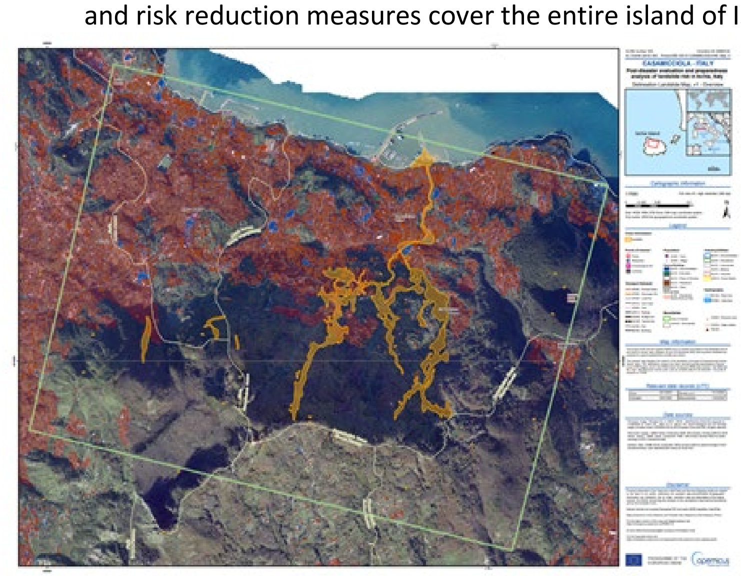
It must be noted that this was the first Risk and Recovery activation for which the CEMS Aerial Component has been activated, using both manned (planes) and unmanned (drones) vehicles. The manned CEMS Aerial component service provider, was tasked to provide images at 10 cm spatial resolution and Lidar data. The aircraft flew over the island on the 27th of November 2023 under optimal weather conditions. The resulting data were delivered on the 29th of November 2023 and enabled the delineation of the affected area, as well as the assessment of the damages caused by the mudflow at very high accuracy and detail. The data provided included:

- RGB orthophotos at 10 cm spatial resolution
- LIDAR classified point clouds, 8-10 points/m^2
- A Digital Terrain Model (DTM) and a Digital Surface Model (DSM)

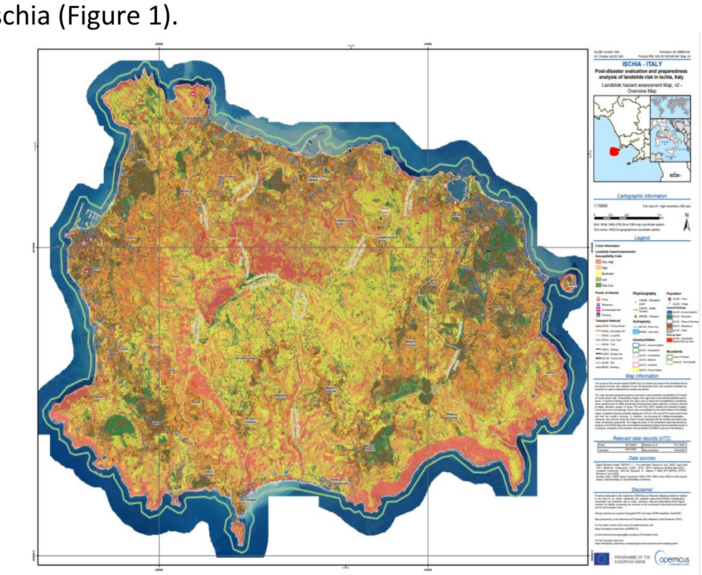
The unmanned aerial acquisition was done on the 1st of December 2023 and delivered a 5 cm/pixel ortho-mosaic, as well as point cloud features for the most affected part of the island.
The consortium produced maps, geospatial and statistical data for post-event analysis by using CEMS Aerial Component data, satellite images and ancillary open access data. The implemented procedures were defined by the consortium.

3. RESULTS AND DISCUSSION

The requested Risk and Recovery results were delivered to the AU in the form of vectors, maps, tables and reports, which constitute the FLEX service products. These products provided the AU a spatial display of the post-event situation, in order to proceed with the rehabilitation procedures. Additionally, the damages occurred to the infrastructures (road network, buildings, facilities) and the economic losses provoked by this disaster were estimated, providing some extra information to the national authorities to face the economic consequences. An additional contribution of the activation was the estimation of Hazard, Exposure, Vulnerability and Risk for subsequent disasters after the landslide event, such as supplementary landslides and coastal erosion.
The post-disaster products are only concerned with the areas affected by the landslide (Casamicciola region), for a more detailed disaster analysis, whilst the products which provide results for prevention and risk reduction measures cover the entire island of Ischia (Figure 1).



(a)



(b)

Figure 1. (a) Delineation Map of the Landslide in Casamicciola region in Ischia; (b) Landslide Hazard assessment Map of Ischia Island.

4. CONCLUSION

The CEMS Risk and Recovery module provides on-demand geospatial information to support emergency management activities outside the immediate response phase. In case of the activation for the post-landslide evaluation and risk assessment in Ischia Island, the service covered the recovery, prevention, preparedness and risk reduction phases of the disaster. The products which have been delivered to the Italian Civil Protection, contributed to the immediate and targeted response of the authorities during the disaster and to the determination of effective ways to deal with subsequent hazards and risks. The results of this activation provided both qualitative data, such as the event extent and the damage assessment of the affected infrastructures, and quantitative data, such as economic losses after the landslide, statistics and tables. In conclusion, the service provided a comprehensive estimate of the extent of the disaster and of the following consequences, which has been useful for those in charge of coping with human and property losses, properly and quickly notifying the public and eventually supplied information that contributed to more efficient decision making.

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ENHANCING IN-SITU ENVIRONMENTAL OBSERVATION TO SUPPORT DESERT DUST STORM EVENTS MONITORING

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ABSTRACT
Desert ecosystems are highly susceptible to global climate change, with rising temperatures, reduced rainfall, and higher atmospheric CO_2 levels significantly impacting their structure and functioning. By combining a network of cost-effective sensing nodes with advanced remote and in-situ data fusion techniques, CiROCCO will be able to cover under-sampled deserts areas, as well as areas highly affected by Desert Dust Storms (DDS) and provide different services to four pilot areas (Egypt, Cyprus, Serbia and Spain). Focusing on the pilot of Cyprus, CiROCCO aims to analyze the interaction between the congested environment in the Municipality of Idalion and the impact of DDS on air quality and public health and eventually provide an air quality Early Warning System (EWS). The established EWS for DDS will be adopted by regulatory authorities in Cyprus and made accessible to the public through a website and mobile application. In conclusion, CiROCCO Project seeks to develop a comprehensive sensing system and EWS for DDS events, with valuable insights for similar areas in Cyprus and eastern Europe.

Keywords: in-situ measurements, remote sensing, Desert Dust Storms, Early Warnıng System, climate change

1. INTRODUCTION
The Eastern Mediterranean Region (EMR) is affected by three distinct Sand and Dust sources: the Middle East, Northern Africa, and the Sahel. Based on meteorological conditions, dust can travel thousands of kilometers depending on the prevailing winds and stability of the atmosphere, and eventually dust is brought to the surface by dry and wet deposition processes. In the EMR, dust emissions are found to be more favorable from Northern Africa and the Sahel during spring, while during autumn the EMR is affected more from the Middle East [1]. The meteorological conditions and the various emission sources in the region are determined primarily by land degradation and sand dunes in the deserts, accompanied by high winds, bare land cover and climate change.

According to climate change scenario, Mediterranean will suffer from greater aridity. Reduced monsoonal rainfall in the Sahel because of intense dry ground conditions, may exacerbate the DDS [2]. An alternative perspective links climate change with reduced Sand and Dust Storm (SDS) events and vegetation growth in the Sahara, as the West African Monsoon was extended to the north [3].

The phenomenon of DDS is strongly related *inter alia* with impacts on human health [4] and its monitoring and early prediction are critical. Recent advancements in technology and science enable SDS prediction and even SDS anticipation. However, due to the significant capital and operational costs and space constraints for building urban air pollution measurement stations, the existing air quality monitoring networks are sparse, even in highly developed and economically strong countries. Consequently, these networks cannot adequately capture spatio-temporal variations of air pollution originating from local emissions sources on top of transboundary pollution. This challenge hinders the ability of regulatory agencies to protect public health and control emissions that contribute to exposure.

The EU funded CiROCCO Project aims to bridge this gap by establishing an advanced sensing system for in-situ and remote sensing measurements, collected via a mixture of wireless communications, including also satellite, and local Wireless Sensor Networks (WSN). This sensing system will be tested in 4 Project pilots that correspond to under-sampled desert areas and ecosystems or areas affected by DDS events.

Pilot 2 of CiROCCO is implemented in the region of Cyprus, which is particularly prone to frequent and severe DDS events, which are characterised by high levels of particles at variable sizes (ranging from fine to coarse). As demonstrated in relevant studies, approximately 10 – 40% of air quality threshold exceedances of the island of Cyprus can be attributed to DDS events [1, 5]. Yet, a recent survey of stakeholders' perceptions and current practices revealed gaps in the implementation of predetermined action plans for public protection during DDS events, in addition to the absence of an adequate EWS [6].

The additional burden due to DDS on an already congested environment, such as the case of the Municipality of Idalion, where intense anthropogenic activity takes place, will be studied in CiROCCO.

2. METHODOLOGY

Overall, CiROCCO aims to establish an end-to-end sensing system composed of a distributed network of cost-effective sensing nodes coupled with state-of-the-art data fusion remote sensing and assimilation modelling techniques. The sensors network will enhance the current lack of ground observation in desert areas offering an operational and also easy to maintain and expand solution. The under-sampled desert areas and ecosystems covered with CiROCCO sensors are located in Egypt, Serbia, Spain and Cyprus.

More specifically, CiROCCO intends to collect data from sensing systems that will integrate low-cost stand-alone electronic sensing nodes, additional higher quality off-the-self sensing stations and medium-cost portable sunphotometers. Data from the different in-situ sensors will be collected through mobile monitoring campaigns and fused [7]. In-situ measurements will then be fused with remote sensing data and further calibrated. For the collection of data, a mix of wireless communications including satellite, and local WSN will be used.

The quality of the collected data will be validated in four different services that will be developed in CiROCCO: *Renewable Energy Systems (RES) Planning*, *Air quality Early Warning System (EWS) for human health*, *Land use and ecosystem management* and *Modelling of Greenhouse Gases (GHGs) and particles emissions*. Each service will be developed for a different Project pilot (in Egypt, Cyprus, Serbia and Spain, respectively) and all four services will jointly drive the sustainability and exploitation path of the overall system. CiROCCO concept is presented in Figure 1.

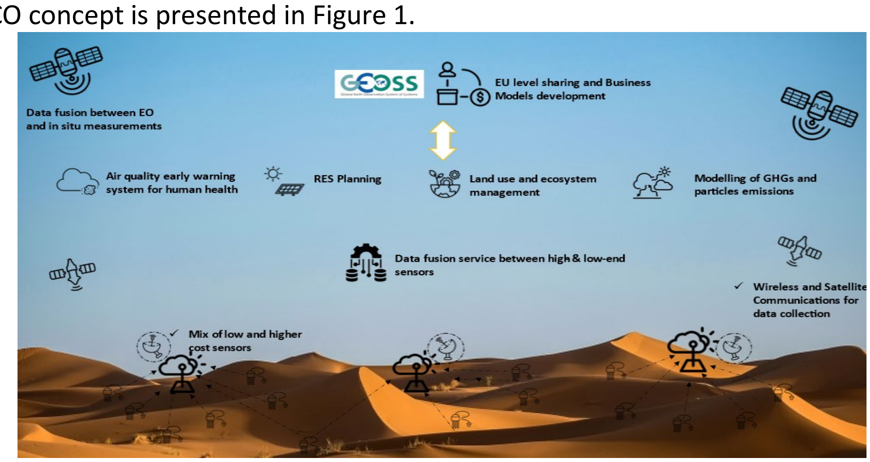

Figure 1. CiROCCO concept.

Focusing on the pilot of Cyprus, the performance of existing operational models of the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) with the inclusion of the additional data generated from the Pilot of Egypt (implemented in a remote location in the Sahara Desert) will be evaluated. Furthermore, the Pilot aims to study the interaction between the congested, due to anthropogenic factors, environment in the Municipality of Idalion and the burden posed by DDS events and their combined impact on air quality and public health. Additionally, the Project will establish an EWS for DDS events, utilizing improved forecasting capabilities, real-time data, and satellite tools. The system will be accessible to relevant regulatory authorities, to mitigate the impact on public health and the environment, as well as to the citizens of the area for their own protection and information.

In the Project and on the pilot site, new technologies will be developed and utilized. Ten (10) newly developed low-cost, stand-alone electronic sensing nodes will be deployed in the congested environment area and serve as data collection points. The sensors will measure *inter alia* air and soil temperature, wind speed, ozone, $PM_{2.5}$ and PM_{10} and the nodes will be designed to capture relevant meteorological and air quality parameters. In addition to the low-cost sensing nodes, one (1) higher quality system will be also deployed. This system is specifically designed to gather more precise and accurate data on meteorological conditions and air quality in congested environment areas. The Ministry of Labour and Social Insurance of the Republic of Cyprus and the University of Cyprus (UCY) both have Air Quality Monitoring Stations (AQMS) located in less than 20 kilometres. These AQMS will be utilised to evaluate the effectiveness of the low-cost systems that will be developed for the needs of the Project. Finally, the in-situ measurements of the pilot study will be transferred and made available to EWS. The architecture of the system is already available from a previous European program, the Life+ MEDEA project. The goal is to enhance and upgrade the system's capacity using the CIROCCOS's results.

3. MAIN RESULTS AND DISCUSSION

As CiROCCO Project is currently at its early stages, this Section summarises the anticipated results. First of all, CiROCCO solution will increase the currently limited number of existing data sources for meteorological models in the region. In addition, numerous meteorological and air quality data will be made available from CiROCCO system, further advancing the understanding of the underlying mechanisms that govern DDS and in particular the understanding of early DDS low altitude dynamics.

Combining satellite tools, products and ground measurements, this Project aims to enhance the forecasting capabilities of existing and under-development meteorological models, which, due to data sparsity, often provide outputs of poor accuracy or low resolution. Through its well-equipped and fully functional meteorological and air quality stations in a remote location in the Sahara Desert (Pilot 1), data will be made available to forecasters for Cyprus in real time.

The exploitation of higher quantity and quality datasets will be complemented by the existing knowledge and know-how accumulated in Cyprus in this domain and will result in the establishment of a robust and accurate EWS for DDS (valid for and exploitable in both the eastern Mediterranean and in broader areas). This EWS will be adopted by the relevant regulatory authorities in Cyprus, *i.e.,* the Municipality of Idalion and the Ministry of Labour, Welfare and Social Insurance of Cyprus and will be available to the general public through a website and also via a mobile application.

4. CONCLUSIONS

For Cyprus, as well as for other sites in the Eastern Mediterranean that are in close proximity to desert areas in the south (Sahara) and east (Middle-East), the lack of in-situ stations to record the meteorological conditions and other soil characteristics (size, mineralogy, etc.) at the source, which are very important for DDS modelling, hinder early forecasting. CiROCCO Project will complement the currently limited number of existing data sources for meteorological models on Cyprus, enhancing by that way the forecasting capabilities of existing and under-development meteorological models and at the same time further advancing the understanding of early DDS low altitude dynamics.

The EWS that will be developed for the pilot of Cyprus will consider local needs and requirements and support public protection during DDS events, which is an issue of high priority in the area. Additionally, frequent and severe DDS events are not a local problem in Cyprus, as several Eastern Mediterranean countries are prone to them. The lessons learnt from the pilot of Cyprus can be easily transferred to similar areas in Cyprus and elsewhere in eastern Europe. By that way, CiROCCO Project can significantly contribute not only to the research made in this domain, but also to the development of relevant technological solutions to address this problem as encountered in other regions.

AKNOWLEDGMENTS

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UTILIZATION OF TECHNOLOGICAL TOOLS AND AUTOMATION IN RISK AND DISASTER MANAGEMENT AT REGIONAL LEVEL BASED ON THE PLANNING OF THE GENERAL SECRETARY OF CIVIL PROTECTION REQUIREMENTS. THE CASE OF THE EAST MACEDONIA & THRACE REGION

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ABSTRACT
The role of technological tools in disaster and crisis management is important and multidimensional. The aim of this paper is to identify and highlight the technologies that can contribute to risk reduction at the regional level in all phases of disaster management. The paper focuses on the regional level and examines tools that can support the disaster management system during the pre-disaster, during the disaster and post-disaster stages. Issues such as the effective and efficient integration of technological tools into the disaster management system at regional level are highlighted. The dependency of the system on technological tools, the knowledge and expertise required by stakeholders to use the tools, the difficulties in maintaining and upgrading the tools over time and as needed, and the security issues of the tools and information are also analyzed. It concludes that modern technological tools and developments can help to improve civil protection operations.

Keywords: Crisis Management Strategies, Technological Tools, Copernicus, Natural Disasters, Anthropogenic Disasters, GIS, Remote Sensing, UAS, UAV, IOT, Databases, Region of Eastern Macedonia & Thrace, Civil Protection.

1. INTRODUCTION

The evolution of Information, Remote Sensing, Machine Learning, AI and Communications Technologies at every level has drastically changed the ability to analyze risk and vulnerability, as well as the planning and response to a disaster itself. A set of tools is now available for information management, for analyzing and presenting scenarios and programs to the decision-making center, for forecasting and warning, and for communicating and mobilizing stakeholders.

Technology has already helped to automate some processes so that time is not wasted when a crisis breaks out. These systems need to be interoperable, interactive with an easy-to-use user interface so that information can be updated immediately and to allow the development of scenarios and simulations. The visualization of information regarding the situation and conditions can add value to the process of risk assessment and decision-making in an evolving situation.

All the above needs a solid communication background, which should be gradually modernized with any technology currently available (5G, NBIoT, LoRaWan, etc.).

Finally, in an organized and structured way, it should be possible to collect data in any form, from multiple sources, which will be open, machine-readable (computer-readable), meet the national interoperability framework, be available to stakeholders so that they are aware of the situation and can be used to make decisions that meet the real needs of society.

Technological development is rapid in areas such as Internet of Things (IoT), Robotics, Augmented reality (AR)/Virtual reality (VR), and Artificial intelligence (AI) and this will help in situational awareness and risk assessment in terms of planning, response and recovery in risk management.

Particular emphasis is placed on interoperability as a function for successful disaster management. According to the European Interoperability Framework, interoperability is defined as the ability of a system or process to share and use information and/or functions from another system or process. The ability of systems, actors and all structures involved to communicate is the most important factor for effective disaster management in all phases of the management cycle (Inspire Directive 2007/2/EC, M.D./F.40.4/1/989/10.4.2012).
Interoperability, according to concerning the ratification of the eGovernment Service Provision Framework, comprises four levels: **a.** Institutional, **b.** Organizational **c.** Semantic d. Technical.
All general emergency plans state that their purpose is to provide an immediate and coordinated response by the central, regional and local authorities involved in order to respond effectively to emergencies and to deal immediately with their consequences. A prerequisite for achieving this purpose is synergy, cooperation and interoperability between the central, regional and local authorities involved.

2. TECHNOLOGIES AND DATA IN THE DISASTER MANAGEMENT CYCLE: THE EXAMPLE OF THE REGION OF EAST MACEDONIA AND THRACE (R.E.M.TH.)

The use of information and communication technologies in prevention, preparedness, response, and recovery is becoming essential because of the advantages they offer in data analysis. Multi-hazard analysis using GIS technologies is more than many separate 'single hazard' approaches, it is about understanding the particular risk that arises from dynamically changing and interdependent multiple hazards. Knowledge management systems, geographic information systems, web-based mapping, satellite remote sensing, Internet of Things (IOT), unmanned aerial systems (UAS), communication technologies, computer simulation models, volunteer information and social networks are among the current approaches to develop tools to document phenomena and support decision making in all phases of natural and technological hazard management.
In the Directorate of Civil Protection of the R.E.M.TH. region, we emphasize the use of valid partner data and critical geospatial data for risk assessment and management. In this effort, geospatial data are used for:

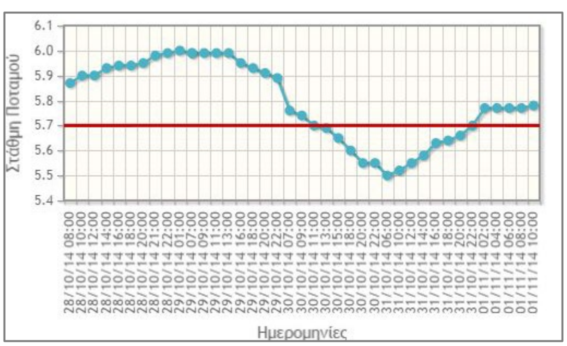
- Geospatial data of the areas that have been declared as being under a civil protection emergency,
- Geospatial data of potentially high flood hazard areas, high flood hazard areas for different return periods and historical flood data [1].
- Geospatial data containing maintenance responsibilities for the country's road network
- Geospatial data from the map portal (http://mapsportal.ypen.gr) of the Ministry of Environment and Energy (102 maps and 565 thematic layers - including natural and built environment, environmental licensing, spatial planning - urban planning), freely available on the Internet and through OWS (Open Geospatial Consortium Web Services).
- Satellite remote sensing data from free satellites and from the Copernicus system, where information can be collected from multiple sensors.
- Data from the activation of the Copernicus-EMS Rapid Mapping system during the emergency response, which produces a series of vector geospatial data and cartographic products representing the affected area derived from the analysis of satellite imagery [2-6].

The Civil Protection Directorate of the R.E.M.TH. has developed a web application containing the contact details of all the actors involved in the management of a hazard. The application has been built with open-source tools. Specifically, it has been written in python, makes use of a MySQL database and uses technologies like angular js, bootstrap. The application can perform search queries either by name, by status or by the entity to which one belongs. It can print categorized lists by entity, by regional section

and by municipality. It also contains a list of community and municipal presidents, who play a key role in risk management in terms of information and immediate mobilization at the scene of an incident. The application can send SMS messages using the free SMS API of the Conjunction public data network.
In terms of automation and data management, the Civil Protection Directorate of the R.E.M.TH. provides operators with access to the database of actors involved (email, phone numbers), the database of emergency declarations and the database of areas demarcated after a disaster.

2.1. The use of IOT telemetry stations on the Evros River

The Independent Directorate for Civil Protection of the Region of Eastern Macedonia and Thrace has installed a monitoring system using IOT (Internet of Things) telemetric stations of the risk areas in the Evros river basin (Kastanies, Didymoteicho and Ormenio) and provides this data on its website https://cp.pamth.gov.gr. It also monitors, using web mining (a technical data mining procedure for extracting information from web services), the flows from the water monitoring agencies of Bulgaria (NIMH) and Turkey (DSI).
At the same time, it has developed an early warning system based on water levels or flows, sending automated emails and SMS to partners, as well as updates on collaborative platforms such as slack and discord using webhook techniques when measurements exceed a set threshold.
In parts of the Evros river, where there are no telemetry stations, water levels are reported by telephone with the help of the Greek army. This information is then digitized and entered into a web application and the result is visualized. The visualization of the data also shows the alert and alarm limits for each area.
The visualization helps to make the situation easier to understand, to understand the rate of change of the level and to initiate further actions and decisions to manage the risk.
The locations where the levels are digitized are three historical sites where telemetry stations existed in the past: the Pythio Bridge, the Petalos-Peplo Road Bridge, and the Kipoi Bridge. The monitoring is carried out through the website of the Directorate of Civil Protection of R.E.M.TH.: http://cp.pamth.gov.gr/civil/. The water level is digitized and recorded online only during periods when a critical rise in water level is observed and is obtained from telemetric stations located elsewhere on the Evros river.



Ημερ.	Στάθμη	Επιφ.	Συν.
01/11/14 10:00	5.78	4.70	5.70
01/11/14 08:00	5.77	4.70	5.70
01/11/14 06:00	5.77	4.70	5.70
01/11/14 04:00	5.77	4.70	5.70
01/11/14 02:00	5.77	4.70	5.70
31/10/14 22:00	5.70	4.70	5.70
31/10/14 20:00	5.66	4.70	5.70
31/10/14 18:00	5.64	4.70	5.70
31/10/14 16:00	5.63	4.70	5.70
31/10/14 14:00	5.58	4.70	5.70

Figure 1: Monitoring Pythio Bridge water level

2.2. The hashtag strategy on social media

The Civil Protection Directorate of the R.E.M.TH. follows the strategy of following a specific hashtag, #cppamth, and encourages citizens and the media to include the hashtag #cppamth when making a post about which they want to inform the Civil Protection of the AMTH region. The R.E.M.TH. Civil Protection Directorate will then verify the accuracy of the information and take the appropriate actions. The use of photos with hashtags also helps to assess the situation, especially in the first moments of a disaster, before the first responders arrive.

CONCLUSIONS

Technology can make a significant contribution at all stages of disaster management. Effective management of data and processed information are key factors for coordination and decision-making, and the use of GIS, IOTs, open data and remote sensing has dramatically changed the ability to analyze risk and vulnerability and to plan for disasters. The ability to visualize information and use models helps in situational awareness during an evolving situation.

In addition, coordination actions can be optimized by using technological tools to ensure interoperability between actors with fast and flexible processes and to ensure a common view of the situation for all actors involved.

Finally, monitoring and early warning systems contribute to immediate response, but also to situational awareness and, combined with information dissemination, allow for timely action and decisions, as well as the possibility of adapting our monitoring systems to the most vulnerable groups.

On the other hand, the use of technological tools requires continuous training of staff, integration of these tools into the organization’s operational planning and monitoring of technological developments. The availability of technological tools is always a key issue in disaster management, as they can also be affected by the evolution of a disaster (power cuts, availability of communications). Problems can also arise in terms of upgrading equipment, compatibility with current technological developments and maintenance or resolution of technical problems with existing equipment.

It has also been observed that agencies have become dependent on the use of technological tools from other agencies or support structures, which are unable to fulfil their original role due to lack of funding. Similarly, some agencies may initially provide data through a project and then stop providing information once the project has ended. Finally, a major problem that often arises is the interoperability of data from IOT devices (e.g. hydro-meteorological data), where agencies only visualize it and do not make it available to other agencies for further analysis and input into forecasting models.

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A GIS-PLATFORM FOR EMERGENCY RESPONSE BODIES IN THE MANAGEMENT OF TECHNOLOGICAL ACCIDENTS: THE CASE OF EXTERNAL EMERGENCY PLANS FOR SEVESO SITES

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ABSTRACT
The purpose of this work is to present a web-based platform to support external emergency plans for technological hazards in accordance with requirements of the SEVESO III Directive (2012/18/EU; KYA 172058-ΦΕΚ 354.Β.17.2.2016). The platform operates in a GIS environment providing online geospatial data to emergecy responders such as mapping all consequence zones of major accident scenarios and the involved land uses per zone. Six (6) External Emergency Plans, for industrial disasters at the SEVESO sites in the Region of Crete, were developed according to the General Emergency Plan "Heraclitus" and incorporated into the platform. İt is worth noting that the integration of the results of external emergency planning into a GIS platform is a significant step towards the management of the emergency plans per se, as well as of all operation data, resources and relevant emergency information of industrial establishments involved, allowing for the systematic training and preparedness of all involved parties (external emergency services, authorities, industry) to promptly and efficiently respond to such accidents.

Keywords: external emergency plan, technological hazards, SEVESO, training, GIS platform.

1. INTRODUCTION

The Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances [1], also known as the "Seveso III" Directive, sets the framework for emergency management of industrial accidents involving hazardous substances in the European Union Member States. According to the Directive in order to prepare for emergencies in the case of establishments where dangerous substances are present in significant quantities, it is necessary to establish internal and external emergency plans and to establish procedures to ensure that those plans are tested and revised as necessary and implemented in the event of a major accident.

The operator of an industrial facility falling into the scope of Article 10 of the Seveso III Directive is required to draw up an internal emergency plan, which describes the measures to be taken inside the establishment in case of a major industrial accident. The respective public authorities are required to draw up an external emergency plan, which describes the measures to be taken outside the establishment.

National emergency management and/or civil protection authorities of many countries or specialized organizations often publish emergency planning guides, designed to assist the work of emergency planners. "Heraclitus" is the code name for Greece's "General Emergency Plan for large-scale

Technological Accidents" [2]. It determines the roles and responsibilities and the cooperation framework of all involved authorities for emergency response and immediate/short-term management of disaster effects related to technological hazards. "Heraclitus" General Plan also provides coordinating instructions to civil protection authorities on how to draw up external emergency plans for SEVESO establishments.

The goal of the present work is focused on the development of a web-based platform to support emergency response bodies to effectively follow the external emergency plans and improve their response to technological accidents. The platform has been developed by the Laboratoty of Cognitive Ergonomics and Industrial Safety (School of Production Engineering and Management; Technical University of Crete-TUC), it operates in a Geographic Information System (GIS) environment and comprises geodatabases for the management of all data and results of emergency plans.

2. METHODOLOGY FOR DEVELOPING THE GIS PLATFORM

The platform was developed as a data base for the management of external emergency plans by the civil protection authorities. The e-platform tools are user-friendly and can be readily used by the responders or other involved bodies, to provide all appropriate training and support for the coordination of emergencies and for the overall control and mitigation of technological accidents. The GIS platform includes geo-referenced graphical information for each study area, critical equipment and land-uses with several features and attributes, allowing for their display, selection and search. The platform includes the following functions:

- Data base with all relevant documents and information of the external emergency plans;
- Mapping of critical infrastructures and networks of the study areas (SEVESO establishments, port facilities, road and other networks, power plants, etc.);
- The location of the critical equipment of the establishments;
- The land uses around establishments in the study areas;
- Critical land uses, critical infrastructures and developments for sensitive recipients such as schools, hospitals, etc.;
- Environmentally sensitive areas;
- Mapping of consequence zones of accident scenarios [3] including, DOMINO ZONE-99% fatality, ZONE I-Very Serious Hazard 50% fatality, ZONE II-Serious Hazard 1% fatality, ZONE III-Significant Hazard No fatality).
- Identification of all land uses and potential recipients of accident effects in the area within the consequence zones of major accidents for each individual industrial SEVESO site.

2.1. Data collection and analysis

Six (6) External Emergency Plans (EEP) for industrial disasters in the Region of Crete were developed and incorporated into the GIS platform. The plans concern three (3) Power Plants with liquid fuel storage, two (2) LPG storage (depots), truckloading and bottling sites, and one (1) storage site for fireworks (explosives). The plans include the principal "scenario-based" arrangements for dealing with the identified hazards and the procedures for unpredictable situations. Accident scenarios with effects outside the establishments' boundaries were examined according to the contents of the relevant Safety Reports (SRs). The phenomena examined with reference to the identified accident scenarios per type of fuel and per SEVESO establishment, are indicatively the phenomena of Pool Fires, Flash Fires, Vapour Cloud Explosions (VCEs), Jet Fires and Boiling Liquid Expanding Vapour Explosion (BLEVE). The extent of the effects and the consequence zones for the individual phenomena per accident scenario, were adopted from the results of Consequence Analysis included in the formally approved SRs for each SEVESO establishment. The consequence zones are defined on the base of the reference values (threshold /end point values) for thermal effects, overpressure and toxic effects, reported in KYA 172058 (SEVESO III in Greece) [3]. The consequence zones were re-evaluated for each accident scenario taking into account the possible wind and leakage directions and depicted in appropriate and updated maps with background information. The main utilities of the GIS platform based on the characteristics of the EEP are the following:

- Identification of accident scenarios, intensity of effects (consequences) with reference to consequence zones reported in the Safety Report of the SEVESO sites and to the type of consequences per phenomenon and per accident scenario;
- Mapping of the Consequence Zones of the accident scenarios;
- Identification of the equipment coordinates where each accident release is located on the map;
- Identification of the affected area around the establishment per accident scenario (area that should be isolated in case of emergency);
- Indentification of the main land uses and points of interest (e.g. high population density points, critical infrastructures, settlements) potentially affected per accident scenario;
- Information for the population and all recipients within the area potentially affected;
- Proposed actions to protect the public and all people involved per accident scenario;
- Identification of control and mitigation measures per phenomenon and scenario; and
- Organization and coordination of authorities for the control and response to emergencies.

3. RESULTS AND DISCUSSION

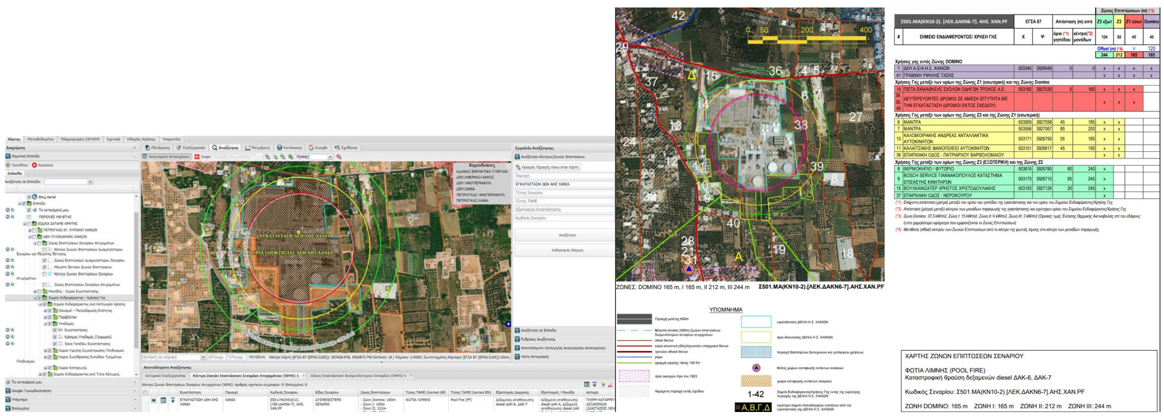
The GIS platfom developed by the Lab of Ergonomics and Industrial Safety of TUC is presented below. In using the GIS technique, a platform was developed for the management of the technological hazards in the context of integrated emergency planning and response. The GIS platform includes a geographically referencing number of information "layers" to facilitate the synthesis of data in order to support and provide guidance for decisions on emergency response. The databases and information of the emergency plans, as clustered and structured per Establishment and EEP, are embeded in a user-frienly architecture of the e-platfrom and presentd in three main interface layers:

- Consequence zones of Accident Scenarios: the layer includes geospatial data on all accident scenarios;
- Units and areas of Establishment: the layer includes information on the main and alternative exits, the critical equipment and the ancillary areas of the establishment; and
- Points of interests/ Land uses: this layer includes land uses per land use category and per coverage type (point, line and polygon data).

The e-platform contains in total 175 accident scenarios for six SEVESO establishments. For each accident scenario, the extent of the consequences, as well as the land uses per consequence zone of accident scenario and per land-uses category were mapped out in the platform. Figures 1(a) and 1(b) show the mapping of the consequence zones and the land uses per consequence zone for the case of a worst-case scenario (Pool Fire - catastrophic rupture of tanks) in a power plant. Figure 2 illustrates the database of the platform with important documents per External Emergency Plan of SEVESO Establishments.

4. CONCLUSIONS

A GIS platform was developed for the management of technological hazards. Six (6) EEP for industrial SEVESO sites in the Region of Crete were developed and incorporated into the platform. It supports the management of information of external emergency plans and provides geospatial data regarding the accident scenarios and land uses within the consequence zones of accident scenarios. The platform is user-friendly and can readily provide systematic training, preparedness and support to all involved parties (external emergency services, authorities, industry) that deal with emergencies. The platform e-tools can facilitate decision-making for emergency response and improve coordination among involved parties and external emergency agencies and can overall support control and mitigation actions for technological accidents. The platform has been approved by the Civil Protection Authority of Crete and will be further enriched with the feedback from external emergency responders and emergency drills.



(a) (b)

Figure 1. GIS Emergency Planning Platform (**a**) Worst case scenario consequence zones and land uses affected by the scenario Pool Fire-catastrophic rupture of tanks in a Power Plant; (**b**) Land uses per consequence zone for the worst-case scenario Pool Fire-catastrophic rupture of tanks in a Power Plant.

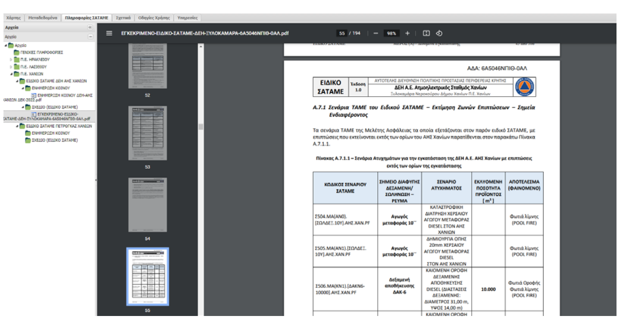


Figure 2. Data base with all relevant documents and information of external emergency plans.

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COMPREHENSIVE OPERATIONAL MODEL FOR PREVENTION AND RESPONSE TO NATURAL DISASTERS AT THE LOCAL GOVERNMENT LEVEL WITH INNOVATIVE TECHNOLOGICAL EQUIPMENT - THE EXAMPLE OF THE MUNICIPALITY OF VARI VOULA VOULIAGMENI

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ABSTRACT
Climate crisis has created new challenges by placing natural disasters on the public agenda as a critical issue having significant impact on all sectors of society, as well as on human life. The Local Government is the authority closer to the public and has comprehensive knowledge of local conditions and particularities. Therefore, the development of an operational model, with innovative technological equipment in municipalities, is an important tool for prevention, increased readiness, response, and recovery in cases of natural disasters; considering that full protection from severe natural events is technically and financially out of reach. The example of the Municipality of Vari Voula Vouliagmeni is described within this manuscript, analyzing the adoption of new innovative application technologies and systems for monitoring, detecting, and predicting natural disasters. Specifically, strengthening immediacy and interconnection with other agencies such as volunteers, Fire Department, Police Department, Coast Guard, Medical Department, Region and other governmental or non-governmental organizations and institutes is always the key requirement. The main scope is to achieve the best combination of innovative technological equipment with an operational model that enhance effective crisis management, based on prevention and early response, to ensure an integrated and successive approach for the protection of cities and generally the reduction of the implications of natural disasters.

Keywords: UAS; natural disasters; civil protection; local government

1. INTRODUCTION
The Local Government in Greece by law is charged with basic responsibilities related to the adoption of the best practices for the functionality of the cities, increasing the quality of the citizens' life [1]. This inevitably includes the protection of life, health, and property, the environment, the cultural heritage, the infrastructures, any natural wealth-producing sources, from natural or technological disasters and other threats that may cause emergency situations, as well as the reduction of risk and treatment, restoration and minimization of the consequences[1].
Climate change has imposed new conditions on the management of citizens' daily lives, taking into account that the increase in the occurrence of natural disasters leads to the need to find effective tools to address the challenges [2]. Technology is an ally, by developing innovative equipment to prevent, react and also combat risks and crises that may threaten a city [3]. The Municipality of Vari Voula

[1]Law 4662/A'/07.02.2020 "National Mechanism for Crisis Management and Risk Management, restructuring of the General Secretariat of Civil Protection, upgrading of the voluntary civil protection system, reorganization of the Fire Brigade and other provisions", article 2, "Field of Action of the National Crisis Management Mechanism and Risk Management ΝΟΜΟΣ 4662/2020 (Κωδικοποιημένος) - ΦΕΚ Α 27/07.02.2020 (kodiko.gr)

Vouliagmeni was faced with a large fire in 2022, at the beginning of the fire prevention season. As a result the Local Government gained valuable experience and important information about both the strong and weak points of the Municipality's services, but mainly the significant deficiencies in decisive means and tools for the quick, efficient and coordinated dissemination of information.
The aim is the rapid, reliable and efficient management of natural disasters by a single Local Government interacting with all competent and involved institutes.

2. EXPERIMENTAL METHOD

In preparation for the work and the extraction of its results, we studied the operation of the operational center of civil protection and the application of an innovative system based on 24-hour surveillance of the Municipality of Vari Voula Vouliagmeni (Fig. 1a) with the use of three unmanned aircraft systems, two of which are DJI MATRICE 30 T-model (Fig. 1b), which the Municipality of Vari Voula Vouliagmeni currently has in its service. They are capable of a maximum flight time of 90 minutes and have built-in cameras with a wide-angle lens with 5x -16x zoom, 200 x maximum Hybrid zoom, 8K photo resolution and 4K video resolution, thermal cameras with 640 x 512 resolution and a laser rangefinder (with a range of 3m – 1200m). They have the ability to adapt immediately to the environment including adverse weather conditions and temperatures ranging from -20^{o}C to 50^{o}C. It worths mentioning that all UAVs have a transporter system that makes them visible from the Athens Airport Control Center and from the aircrafts that approach El. Venizelos International Airport. Additionally, they have high resolution thermal capabilities with the ability to detect high temperature values and all the thermal information of an area[2].

(**a**) (**b**)

Figure 1. (a) The Operational Center of the Municipality and **(b)** Unmanned Aircraft System Dji Matrice 30T (Archival photos from Municipality of Vari Voula Vouliagmeni)

Also, the Municipality of Vari Voula Vouliagmeni has another UAV, model MATRICE 200 of the company DJI Enterprise, which has a maximum flight time of 40 minutes, an operating radius of 7 kilometers and a maximum payload of 2 kilograms. It has the ability to fly extremely close to an object of interest, ensuring great detail and thus enabling it to inspect infrastructure, conduct open sea research and map areas. All three UAV systems support stable video transmission, in real time and in complex working environments, giving a live image in real time with extremely high resolution both to the Operational Control Center of the Municipality of Vari Voula Vouliagmeni and to the mobile phones of the agencies involved.
The referred unmanned aircraft vehicles are in flight on a 24-hour basis, seven days a week throughout the fire season. They are operated remotely by specialized and certified personnel that has all the necessary licenses and degrees certifying flying ability and fully comply with the framework for the protection against the processing of personal data in accordance with the new Regulation 2016/ 679

[2] User Manual of MATRICE 30 SERIES

of the European Parliament (GDPR)[3]. Concurrently, the Municipality of Vari Voula Vouliagmeni as well as the contracting company, have all the necessary legal conditions and special licenses as provided by the Executive Regulation (EE) 2019/947 Regulation of the European Commission[4] on the rules and procedures governing the operation of unmanned aircraft and are approved by the Civil Aviation Authority[5].

3. RESULTS

The implementation of this innovative system has significantly enhanced the interaction of the means and resources of the Municipality, while enabling rapid and real-time image updates for the actual depiction of events. Aerial surveillance has the advantage, through the technological capabilities of UAVs, to detect, for example, a fire in the very initial stage of its occurrence, significantly reducing the response time of the competent authorities, while it has the ability to approach the point by the air, before the approach of the ground forces, broadcasting live the situation in the field, enabling ground assets and resources to be more rationally managed [4]. Accordingly, monitoring the area in a continuous base is fundamental for securing the available resources without wasting them at false alarm cases (e.g., mild weather phenomenon that gives the sensation of smoke, cooking smoke, or even ground construction work that has raised a layer of dust in the atmosphere).

4. CONCLUSION

The application of the 24-hour aerial surveillance system of the Municipality of Vari Voula Vouliagmeni for the management of natural disasters such as fires, floods, frost, landslides, earthquakes is appropriate in other fields such as life-saving assistance, surveillance of points of interest from vandalism, etc. It increases the sense of security of the citizens as well as the competent agencies and significantly contributes to the more effective interoperability of the prevention, suppression, and restoration forces of emergency situations, extreme phenomena, risks, and crises since it universally provides everyone with a live image in real time and high resolution.

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LESSONS FROM RECENT DISASTER EVENTS AND NEW TECHNOLOGIES FOR FUTURE USAR MISSIONS – INTREPID* (EU H2020)

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ABSTRACT
On October 17th-21th, 2022, Hellenic Rescue Team of Attica (HRTA) participated in the 2nd Pilot in Marseille (France), in the context of the INTREPID project (EU H2020). The purpose was to test new technologies developed in the INTREPID project, especially the individual improvements and modules integration during the last 12 months of that period. INTREPID aims to make the first hours of emergency and natural disaster for First Responders safer and more efficient by developing technologies that accelerate operational risk assessment capability by creating a unique platform. This paper presents a brief overview of these activities, under the scope of recent USAR mission deployments of our team that highlighted the importance and operational need for such technologies.

Keywords: Rescue, field tests, crisis management, security and safety, first responders.

1. INTRODUCTION

Every USAR mission is different, as it depends on various external and internal factors. Weather, location, access, local infrastructure, travel time, are only some of these external factors, while team's readiness level, organization, skill level and experience, toolkits available, are a few of the most important internal factors. On the other side, every USAR mission is an effort against time, beginning as a speed race and gradually becoming a marathon run. First Responders (FR) must be physically and mentally capable of adapting to this changing working environment, keeping track of hazards while at the same time maximizing the probabilities of survival for the trapped victims.

In such a pressing, dynamic and dangerous environment, every asset the FRs have at their disposal is invaluable in terms of enhancing any of the three main components of the deployment:

- **The FR team:** Personnel (safety, situational awareness, efficiency, endurance, cooperation, etc) and team assets (drones, cameras, sensors, communication devices, etc).
- **The victims:** Detection (sensing), triage (informed decisions), extrication (safety, speed).
- **The operations:** Situational awareness (top-level), worksite triage (prioritization), asset dispatching (e.g. UxVs, medical teams), communications (horizontal/HQ, vertical/teams), logistics, infrastructure (camp), medium/long-term mission planning, etc.

Each of the components above require special design, pre-mission planning, deployment management and contingencies. Moreover, if the USAR mission is planned for a typical 7-10 days cycle, significant work has to be conducted prior and during the deployment, sometimes 50% of the total team effort, for the supply chain and the logistics support of the field team. This work becomes even harder when there

* This work is supported by the project INTREPID, which has received funding from the European Union's Horizon 2020 (H2020) programme under grant agreement No:883345.

is lack of reliable information regarding obstacles they might be facing, like access routes and worksite hazards, which increase uncertainty and risk level.

The purpose of the INTREPID project [1, 2] is to greatly enhance these team-level success factors and at the same time mitigate the uncertainties and risks during the deployment. It introduces novel technologies that augment and improve all three components of the deployments, i.e., FR team, victim management (detection) and operations [3]. By developing modular and portable devices, it enables safer and more efficient work environment for the FR teams inside the “hotzone”, accelerating the exploration and assessment of potentially hazardous sites. Moreover INTREPID introduces an innovative platform that enhances the mission planning in disaster zones at the wide-area level, i.e., focusing on operational rather than team-level prioritization. From its beginning, the project follows a user-centric approach according to which tools are validated frequently by end-users [2]. The project started on October 2020 and concludes on September 2023.

The following sections present a brief description of the second round of large-scale piloting activities of the INTREPID, conducted at the end of the second year of the project. Additionally, some reflection is added in the scope of the large-scale earthquake in Turkey-Syria (February 2023) [4] and a devastating train crash in Greece (March 2023) [5], discussing the lessons learnt and the operational/technological gaps that are very relevant with the context of this project.

2. METHODOLOGY – DESCRIPTION OF THE FIELD TRIALS

As part of the practical assessment during their development, these new technologies are to be extensively tested and evaluated in the field by FRs. The second such large-scale piloting activity took place at the technical training center C.E.T.I.S. of the Bataillon de marins-pompiers de Marseille (BMPM). This is the elite unit of firefighters of the French navy, i.e. they are additional divers, CBRN experts and specialists in search and rescue at sea.

Figure 1. BMPM training center during the main scenario of the piloting activities, with a simulated car fire outside after an explosion and HRTA field team entering the adjacent building for extricating an already detected victim.

In this piloting event, the complete INTREPID toolkit was deployed and tested at the BMPM’s training center, with the main purpose of evaluating the efficiency of individual modules and functionalities, as well as assessing the integration level between them. Some of the technologies ranged from dynamic 3D mapping inside buildings (visual tracking, LIDAR) and an integrated C&C platform in the operations center, to "hybrid" human/AI decision-making missions and wearables for proximity/distance sensing between team members operating in conditions of zero visibility.

According to the scenarios, the HRTA team participated in one of the pilot's scenarios involving the extrication of a victim from a building (Figure 1). During the scenario, the HRTA team used sensors (wearables for proximity/distance sensing) to collect data for a series of activities, as well as to test and evaluate the C&C platform and the mobile phone application (INMOS).

Some of the modules/services that are worth-noting for their innovation and “breakthrough” functionalities they bring in the FR team capacity are the following:

- Intelligence Amplification Module (IAM), combining information fusion from multiple sensors and platforms together with AI-based decision support for the operations.
- Path Planning Module (PPM), analyzing access routes towards a search location or a detected victim, as well as safely away from identified hazards, dynamically as the environment changes.
- Extended Reality Module (AR COP), introducing “embedded” information in the immediate area where the FR team operates, as well as information to and from the C&C.
- Environment Assessment Module (EAM), featuring “smart” and quick automation of the area assessment, even before the FR team is ready to enter the “hotzone”.
- Environment Mapping Module (EMM), featuring a detailed, dynamic and information-rich presentation of the “hotzone” area to both the FR team and the C&C.

All these features are enabled by multiple sensing platforms, including UGVs and UAVs deployed at the moment the FR team arrives on location and begins preparations to move, as well as modules that the FR team members themselves carry as part of their gear and continue to monitor, map and analyze the environment as they move.

3. DISCUSSION

Even at the very early stages of the INTREPID project, specific design priorities were identified by FRs and prioritized by the development partners. Based on the three main components of focus, i.e., the FR teams, the victims and the operations, special attention was given on addressing the current gaps in terms of operations and available solutions.

For the FR teams, three main priorities are of outmost importance: (a) safety, (b) speed, (c) sensing. For (a) safety, FRs need to ensure individual and team-level risk mitigation regarding possible hazards in an unknown and highly dynamic environment. This means enhancing their situational awareness via sensing modalities and properly designed interfaces, in order to have prompt but non-intrusive information flow between them. In terms of INTREPID, this includes AR, reliable communications, position tracking, location “probing” via UGV, etc. Regarding (b) speed, it is important to have clear and detailed understanding of the “hotzone”, especially during the wide-area assessment stage when FR team deployment needs to be prioritized and planned. Usually, this implies the use of UAVs for mapping, but in INTREPID this includes several other modules (PPM, EAM, EMM, etc) which enable mission-centric information fusion, assessment and AI-based decision making in the C&C. All these features enable fast and reliable scanning for victims, as well as assistance to triage. Finally, for (c) sensing it is important to put distance between the FR team and the immediate area of investigation within the “hotzone”; this is the best way to mitigate exposure to risks and hazards. Moreover, sensors can provide detection capabilities other than the human or K9 senses (look, hear, smell for victims and hazards), typically via special modalities that enhance or supplement these (NV, IR/thermal, CO and other dangerous chemicals, etc).

One of the most crucial aspects that was confirmed again during our team's deployment inside the disaster areas in Turkey after the earthquake was the need for reliable communications inside the "hotzone", as well as in terms of logistics, reporting and support from the remote C&C (long-range). Equally important is the notion of being prepared for any contingencies and being highly adaptive in an unknown, dynamic and dangerous environment, all the time, for several days. This is why it is extremely important to keep the FR team out of harm's way as much as possible, minimizing exposure time (i.e., fast speed) and maximizing distance (i.e., remote multi-sensing) from the hazardous zones. In USAR missions such as the one in Turkey, all these have to be achieved consistently and reliably for several days (typically 7-10), which means planning the logistics and support for all these technical assets for long-term operations.

In contrast, a localized disaster zone like the one created after a devastating train crash has completely different operational aspects and priorities. Smaller scale means faster wide-area assessment, but in the recent event in Greece it was with huge fires (heavy smoke) and during night time, which translates to a very challenging environment for mapping UAVs and severely degraded remote sensing capabilities. At the same time, high number of victims and only limited assets on location means that quick and accurate triage, based on actionable information from inside the "hotzone", is of vital importance for maximizing the impact of SAR operations during the first few moments or hours (at most) from the event.

4. CONCLUSIONS

The second INTREPID pilot was conducted successfully on October 2022, at the closing of the second year of the project. The partners had the chance to closely collaborate for almost an entire week, a very important and valuable aspect of this event after the difficulties imposed during the covid-19 outbreak. The toolkit was deployed and tested in realistic conditions and under multi-aspect scenarios, assessing the performance of each individual module, as well as the integration level between them. The results of the test provided very valuable feedback to all partners regarding the requirements and constraints of real-world SAR operations. These results were revisited by our team (HRTA) during very recent disaster events in Turkey-Syria (earthquake) and in Greece (train crash), confirming the operational gaps and the need of such new technologies.

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EVOLUTION OF AN ICT TOOL THROUGH CO-CREATION FOR EFFECTIVE DISASTER RISK MANAGEMENT

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ABSTRACT

Natural and man-made hazards are eliciting or at least, under certain circumstances, contributing factors to disasters directly associated with significant societal, economic and environmental impacts. Besides, climate change is directly related with increased frequency of occurrence and intensity of impacts of several disasters. Hence, risk mitigation to reduce the impact of potential risks emerges as a high priority issue at local, national and also global level and the design of a targeted, well-organised and coherent strategy for efficient disaster risk management becomes crucial. Advanced technological solutions can serve this purpose under the condition that they foresee and enable the active participation of different actors, representing both Civil Protection Authorities (CPAs) and citizens. The Aeolian AR mobile application that has been developed in the framework of RiskPACC project through a co-creation approach with such actors is a state-of-the-art ICT tool that mainly fosters awareness raising, enhances situational awareness and enables real-time bidirectional communication between citizens and CPAs. This work follows in brief the evolution of this tool from the beginning of the project to now and further discusses its current, almost-final phase. This tool supports all phases of disaster management, addressing both natural and man-made hazards being at the same time easily adopted to different areas.

Keywords: ICT tool, natural hazards, man-made hazards, disaster risk reduction, co-creation

1. INTRODUCTION

Natural and man-made hazards are both typical generating factors of disasters, which, being serious disruptions to the functioning of a community, are associated with significant impacts on society, economy and the environment [1]. Climate change seems to exacerbate such disasters [2], as according to climate change scenarios the frequency of occurrence, as well as the intensity of impacts of such disasters is expected to increase significantly. Efficient disaster risk management is therefore important to mitigate the risk of such disasters.

Disaster risk management concerns the application of policies to reduce existing disaster risk and manage residual risk and strategies to prevent new disaster risk or transfer of hazard adverse effects through activities and measures for prevention, mitigation and preparedness [3]. To achieve efficient disaster risk management, the use of disruptive technologies gains recently increasing importance. A prerequisite for technologies to be considered as disruptive is the provision from these technologies of active participation of different actors [4].

However, such a participation is typically one-way. The standard practice adopted for risk management is the undertaking of measures, tailored to specific needs and particularities of an area [5] and the outlining of informed policy- and decision-making processes from relevant stakeholders. This top-down approach, where appropriate policies and measures are in a way imposed by the relevant stakeholders to the citizens is outdated and also proven to be insufficient [1]. Interaction and bidirectional communication between citizens and CPAs are necessary. This interaction, when combined with advanced technological solutions, allows for efficient disaster risk management.

The interaction between citizens and CPAs can be facilitated by the adoption of a co-creation approach. Such an approach is adopted at iterations, during which different actors, adequately representing groups that can be affected by a decision or an activity are actively involved in the development process of a strategy or an output. A fundamental element of co-creation concerns the establishment of a bidirectional communication flow between the actors.

Co-creation has been adopted in RiskPACC project during the development of new or refinement of existing ICT tools that aim to support bridging the Risk Perception Action Gap (RPAG) in disaster resilience and disaster risk management overall between citizens and stakeholders.

2. METHODOLOGY

RiskPACC project foresees the development of a platform that will host inter alia five ICT tools that address the needs and requirements of seven project case studies that are prone to a wide range of natural and man-made hazards. Some solutions were available prior to the RiskPACC project, while others were developed during the implementation of the project. The tools that were available beforehand were further refined during the project based on targeted feedback received from representatives of case studies, while the other tools were developed from the beginning and shaped along the course of the project. A co-creation approach has been designed during the project and adopted for those tools. The approach was horizontal, across all tools and at the same time tool-specific to a certain extent as it strongly relied on the maturity of each tool (as quantified through its TRL) and the active involvement of case study partners during its co-creation.

This work focuses on the evolution of the Aeolian AR mobile application [7] through this co-creation approach and its current status. The different stages of co-creation that correspond to different development phases of the application are presented in brief in the following. The initial phase, Phase A, concerned a 9-month period from the beginning of the project until the completion of a first round of workshops in three case studies that selected this tool for application, the Municipality of Rafina – Pikermi case study (Greece), the Municipality of Eilat case study (Israel) and the Olomouc Region case study (Czech Republic). Mock-up screens of the envisioned application were presented during these workshops and discussed with attendees aiming to support a co-creation approach for the development of the application.

Phase A was followed by Phase B, another 9-month period. By the end of Phase B, the core functionalities of the application were already decided and the Beta release of the application (Iteration I) was available to case study workshop attendees for initial testing. The application was available for downloading and installation via scanning a QR code. The already defined core functionalities were further refined and bugs were identified and corrected by Phase C of the development of the Aeolian application, a 2-month period which ended with a Beta release of the application (Iteration II). The application was available for downloading and installation at the Google Play Store.

As far as TRL is concerned, prior to workshops the Aeolian application reached approximately TRL 2, and progressively moved to TRL 6 and beyond.

3. MAIN RESULTS AND DISCUSSION

Currently the Aeolian AR mobile application has reached its almost-final stage. The application has five core functionalities: **i)** Hazard Map, that presents an interactive map with pinpoints that correspond to natural or man-made hazard events that have occurred in an area and have been posted by local CPAs for awareness raising and information sharing purposes, **ii)** Reporting, that allows users to create a report during an event and communicate it to the CPAs and optionally to directly interact with them via a chatting functionality, **iii)** Training that is classified into Disaster Training (which includes quiz questions and tasks), AR campaigns (which enables training of users through an integrated AR functionality) and Good to know (which is a repository with documentation on disaster risk management), **iv)** Notifications that are updated when a hazard event is updated or added, a training session is added or the status of a report changes and **v)** Emergency call that enables the user to directly dial the European Emergency Number 112 [6]. Relevant screenshots together with photos during co-creation workshops are presented in Figure 1.

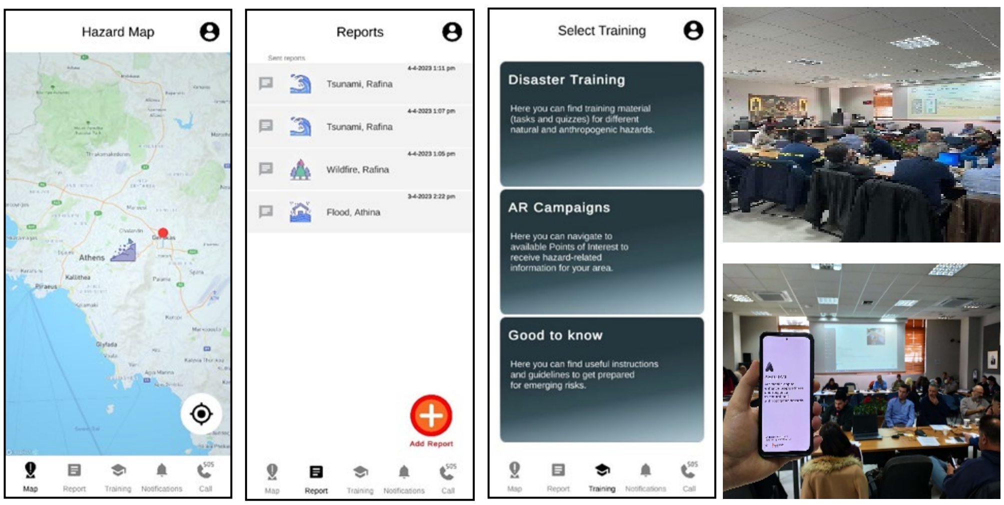

Figure 1. Application screenshots (**a**, **b**, **c**) and photos from co-creation workshops (**d**, **e**).

After some final refinements on the application based on the feedback received from the last round of workshops, the Aeolian AR mobile application will reach its final version.

4. CONCLUSIONS

The different functionalities of the Aeolian AR mobile application support all the phases of disaster management, *i.e.*, prevention and preparedness (awareness raising and undertaking of preparedness activities through training), response (situational awareness via the hazard map, real-time bidirectional communication between citizens and CPAs) and lessons learnt (Good to know footage). At the same time this tool can be used in the context of both natural hazards and man-made hazards.

Further to that, the co-creation approach that was adopted for the development of this tool was properly designed so as to be specific and targeted enough aiming to support the development of a tool that addresses particular needs and requirements, without being at the same time restrictive and exclusive. In particular, even though the co-creation approach supported the development of the tool based on feedback from three project case studies, the tool remains non-case specific, as it can be easily adopted in any other area prone to natural and/or man-made hazards. For its replicability to other areas, only relevant documentation for Training (tests and quiz games for Disaster Training, AR Campaigns and Good to know material) will be needed.

Overall, Aeolian AR mobile application is a state-of-the-art, disruptive ICT tool, easily adopted by different actors and smoothly adapted to the needs of different areas, therefore supporting efficient disaster risk management.

AKNOWLEDGMENTS

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BIG DATA TECHNOLOGIES FOR EMERGENCY MANAGEMENT-END USERS NEEDS AND TECHNOLOGICAL CAPABILITIES IN THE CONTEXT OF TEMA PROJECT

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ABSTRACT

The aim of the TEMA project is to improve Natural Disaster Management (NDM, e.g., for wildfires, floods) by automating precise semantic 3D mapping and disaster evolution prediction to achieve NDM goals in near-real-time. It will analyse and fuse many heterogeneous extreme data sources: smart drone and in-situ sensors, remote sensing data, topographical data, meteorological data/predictions, and geosocial media data (text, image, and videos). The elicitation of the end users' requirements is of particular importance and instrumental to the development of usable, useful, and applicable tools for emergency response. The user requirements gathered from five sources: a) Literature review, b) Grant Agreement, c) Story Telling, from consortium end users regarding an NM event that they have experienced, d) Questionnaire and e) The continuous collaboration with the end users. Following the user requirements, the big data technologies have been defined that will be implemented in the TEMA project. This document presents the needs and requirements that have been identified through aformentioned actions, in order to ensure that a common understanding is obtained on the operations. In this context, achieved a consensus on the most important operations of natural Disaster Management.

Keywords: gaps, technologies, big data, mapping, emergency management

1. INTRODUCTION

1.1. Natural Disasters

"A N*atural Disaster is characterized by the abnormal intensity of a natural agent (flood, mudslide, earthquake, avalanche, drought) when the usual measures to be taken to prevent this damage were not able to prevent their emergence or were not able to be taken"* [1]. Natural disasters occur usually without warning, subjecting people to periods of insecurity, disruption, and economic loss. The disaster cycle is a framework used to base a coordinated plan to respond, recover, prevent, and prepare for a disaster. Access to clean water, proper sanitation, food/nutrition, shelter, and the threat of communicable diseases are concerns that have the potential to be detrimental to the management of a natural disaster, slowing the recovery process [2].

1.2. The need

Natural disasters displace populations, damage infrastructures, hinder economic growth and activity, cause death and injury and increase the risk of infectious disease outbreaks. In 2018, only natural disasters all over the world affected 61.7 million people and caused 10.373 casualties and massive financial losses. European Commission has identified forest fires, earthquakes, and deployment flooding as three of the six natural disaster which pose the greatest threat to Europe; the others are extreme weather, epizootics (animal or plant diseases) and pandemics. From a market perspective, the global disaster preparedness market is expected to grow at a CAGR (Compound Annual Growth Rate) of 7.4% from 2021 to 2028, while big data analytics market in general is expected to grow at a CAGR of 13.5% by the year 2030 [3,4]

1.3. TEMA Project

TEMA will greatly improve Natural Disaster Management (NDM, e.g., for wildfires, floods) by automating precise semantic 3D mapping and disaster evolution prediction to achieve NDM goals in near-real-time. It will analyze and fuse many heterogeneous extreme data sources: smart drone and in-situ sensors, remote sensing data, topographical data, meteorological data/predictions, and geosocial media data (text, image and videos). TEMA will focus on the extreme nature of the data, due to their varying resolution and quality, very large volume and update rate, different spatiotemporal resolutions and acquisition frequencies, real-time needs, and multilingualism. It will develop an integrated, groundbreaking NDM platform, focusing on real-time semantic extraction from multiple heterogeneous data modalities and sources, on-the-fly construction of a meaningful semantically annotated 3D disaster area map, prediction of disaster evolution and improved communication between service providers and end-users, through automated process triggering and response recommendations.

2. END USERS REQUIREMNETS

2.1. Gaps

The first step in planning a trial is to identify crisis management gaps practitioners are experiencing in their daily operations. This needs to be done in close relation to the practitioners who experience one or more gaps. Every gap depends on a role, its responsibilities, and the surroundings. The gaps pointed from the literature review, Grant Agreement, and the storytelling of the end users of the consortium. The stories were about a natural disaster event in the area where the pilots use cases of the TEMA project will take place. In this framework, a detailed questionnaire was also drafted, asking first responders the technical solutions that they would like to have in their operations. Some of the gaps that identified were:

Table 1: *End Users Requirements of TEMA*

Category	Requirement	Description
Non-Functional Requirements	Sharing information and data regarding ND	Sharing information and data regarding fire (how it is developing, etc.) during ND events
	Coordination between authorities during reconnaissance activities	It would be useful to create real-time maps for data sharing for public authorities
	Ability to operate in rescue activities at night or in heavy rains	Need for clearer satellite images in difficult circumstances
Functional Requirements	Geolocation of people who are in danger of life	It would be useful a system for text messaging to citizens to direct them on the actions to take in order to save themselves and warn of the closure of public facilities in order to prevent people from dangerous roads in case of heavy rain events
	Flood propagation modelling	It would be useful to know how the flood will propagate
	Resource planning	When support is requested, more information is required from the additional responders. A means to plan and prepare tasks for the additional support and to oversee planned tasks.

- Lack of communication among the first responders and the command control which increases the risk of the disaster (fire, flood, etc.).

- Information about the accessibility to settlements (roads, bridges, etc.) in an affected area which is crucial for the mission planning and FR (first respondents) reaction.
- Low visibility and health hazards due to smoke. Scarcity of accurate information regarding the wider area, leading to suboptimal response strategies
- Lack of comprehensive maps and data sources that can play a pivotal role in evaluating the situation when a fire or flood occurs
- Lack of organization & preparadness of aerial & terrestrial resources [5,6,7].

2.2. Requirements

In TEMA project, the identified user requirements (URs) are separated into functional and non-functional requirements. Functional requirements refer to features and functionalities of the NDM platform, and the TEMA technologies while non-functional requirements describe the general properties of the system. Some selected requirements for each category are presented in the Tables below:

3. BIG DATA TECHNOLOGIES IN TEMA SOLUTION

TEMA project strives to assist in two major challenges faced by NDM-authorities and first responders during a natural disaster, i.e., timely and precise understanding of the extend of the event, and optimization of the decision making process, to significantly improve the effectiveness of their response plan and minimize NDM harm and danger. The address the above challenges, TEMA will develop technologies for accelerating AI analytics, able to analyse multiple sources of information and data at the same time, technologies improving phenomenon prediction, as well as simulation and visualization technologies and decision support systems, for evaluating different response scenaria [8]. More precisely, the technologies to be developed are clustered into the following categories:

A. **Trustworthy Federated Analytics** technologies:
- Real-time semantic visual analysis and remote sensing technologies, for timely detecting fires and flood from satellite and drone captured videos.
- Geo-social media analysis, for identifying natural disaster events and geopositioning of people in danger, when no other type of information is available.
- Federated learning and distributed analytics, to accelerate the analysis of the different data sources.
- Trustworthy AI analytics technologies, for assessing and improving the quality of the model predictions.

B. **Phenomenon prediction and decision making** technologies:
- Forest fire simulation (provides the expected fire progression and behaviour layers results in space and time)
- 3Di Hydrodynamic simulation (simulate climate events to mitigate the impact of floods)
- 3D smoke modelling and prediction (to assist in the localization of fire sources)
- 3D phenomenon mapping and infrormation fusion (for combining multiple sources of information)
- Response support services (technologies that propose various response strategies, based on the extend of the disaster)

C. **Simulation and visualization** technologies:
- Digital Twin technologies (a phtogrammetric 3D map that is updated and visualizes the Natural Disaster, as well as the response forces on the map)
- Geospatial Information retrieval (algorithms for rapid retrieval of large scale geospatial data)
- Augmented reality visualization (to be used by first responders, showing important information such as the location of survivors)

- SmartDesk platform (an easy to use HW platform including a large, touch screen for optimally visualizing the results of the various tool outputs) [9,10].
-

4. IMPACT

The TEMA solution is expected to have a great scientific impact in European capacity for extreme data analytics, explainability and trustworthiness of AI solutions for NDM management and data analytics. By achieving its scientific goals, TEMA is going to have a huge societal impact. It aims to reduce NDM response times from hours to minutes and significantly improve the decision making process and optimize the actual NDM responses, saving human lives and minimize the natural disaster impact to the environment and the society.

5. CONCLUSIONS

In this paper, the Big data technologies developed in the context of TEMA project for the efficient and effective management of natural hazards, the crisis management gaps that practitioners are experiencing in their daily operations, and the user requirements for the design of the TEMA platform and accompanied technologies are presented. The project’s technologies and the end users’ requirements are of particular importance and instrumental to the development of usable, useful, and applicable tools for emergency response and natural disaster management (during preparation and response phases) and especially in the case of Floods and Wildfires.

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GEOSPATIAL INTELLIGENCE FOR THE PROTECTION OF THE EUROPEAN TERRITORY FROM ORGANIZED ENVIRONMENTAL CRIME (PERIVALLON PROJECT)

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ABSTRACT

This paper addresses the pressing concern of organized environmental crime in the EU, which is on the rise. With offenses increasing by 5-7% annually, traditional methods of detecting and investigating such crimes prove challenging. To combat this issue, the European Commission co-funds the PERIVALLON project, aiming to protect the European territory from environmental crime through intelligent threat detection tools. The project integrates cutting-edge technology, including Artificial Intelligence, geospatial intelligence, remote sensing, and multimodal analytics. It focuses on enhancing capacity building and international cooperation among security practitioners to address the growing environmental crime threat effectively. The main developments of this project are introduced in this paper, along with their relevance for combating environmental crime within the goals of EU, as well as their maturity level (concerning their technology readiness level).

Keywords: environmental crime, intelligent threat detection, geospatial intelligence, remote sensing, multimodal analytics.

1. INTRODUCTION AND OBJECTIVE

Recent developments within the framework of the European Green Deal have aimed at criminalization and an overhaul of regulatory frameworks to address environmental crime and its effects on the financial interests of the EU. In this scene, the EMPACT priorities (2022-2025) highlight environmental crime as a major issue, with offenses increasing at an alarming rate [1]. Despite commendable efforts, the transnational nature of environmental crime and its convergence with organized crime, money laundering and corruption, have not been adequately integrated into current reforms [2]. The types of crime involved include intentional dumping of pollutants, illegal disposal of hazardous waste, cross-border trafficking of waste, and unlawful trade of HFCs. Conventional methods of detection and investigation are inadequate, necessitating advanced solutions for remote identification, evidence collection, and multimodal analysis.

The objective of this paper is to address the growing threat of organized environmental crime and its impact on the EU. Specifically, the research focuses on the ongoing PERIVALLON project, a European Commission co-funded project aimed at protecting the European territory from environmental crime through the use of intelligent threat detection tools. The project aims to develop an innovative environmental crime detection and investigation platform while enhancing capacity building and international cooperation among security practitioners, including Police Authorities, Border Guards, and Regional and National Authorities [3].

2. METHOD AND DATA

The methodology of this paper starts by analyzing the nature and extent of organized environmental crime in the EU and identifying the key challenges in detecting and investigating such crimes. It further examines the specific objectives and the technological tools that are being developed within the context of the PERIVALLON project and their technological readiness level (TRL) [4]. Approximately 17 innovative components, most of them being around TRL 3-5 (Experimental proof of concept - Technology validated in relevant environment; with effective research and development already being validated through designed investigation) will form a unique platform forming a single-entry point for the end-users.

Data for this study primarily comes from various sources, including project documentation, reports, and academic literature on environmental crime and security. Information regarding the PERIVALLON platform's capabilities, which include automatic detection of waste disposal and pollutants, UAV-based site inspection, X-ray scanning, online monitoring, maritime routes prediction, and real-time risk assessment, are gathered from project resources and relevant publications.

3. RESULTS AND DISCUSSION

The paper discusses the state-of-the-art at the advancements in combating environmental crime in EU and offers a brief look at the PERIVALLON project. By leveraging the latest technological innovations that support research in this field, such as Artificial Intelligence, remote sensing and geospatial intelligence, the (under development) platform enables more effective detection, investigation, and prevention of environmental crimes. The integration of multimodal sensor data, including satellite imagery, UAV-captured videos, and online information, strengthens decision-making for security practitioners in addressing environmental crimes.

Moreover, the Environmental Crime Observatory established by PERIVALLON provides comprehensive intelligence on environmental crime in Europe. The observatory identifies different types of environmental crime, their prevalence, societal impacts, and links to organized crime networks. The insights obtained from the observatory inform enhanced investigation processes and methodologies.

4. CONCLUSIONS

In conclusion, organized environmental crime poses a significant threat to the EU, with offenses on the rise. The PERIVALLON project, funded by the European Commission's Horizon Europe, addresses this issue by developing an innovative environmental crime detection and investigation platform. It also promotes capacity building and international cooperation among relevant security practitioners to combat environmental crime effectively. The project's cutting-edge technology and comprehensive intelligence through the Environmental Crime Observatory offer promising prospects for enhancing environmental security and defense in the EU.

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PATHWAY TO STANDARDIZATION ACTIVITIES IN CRISIS MANAGEMENT AREA

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ABSTRACT

STRATEGY project aims at selecting and implementing existing, evolving and new standards within solutions, tools and procedural guidelines and recommendations. The project will streamline and validate technical and organisational interoperability in a fully transboundary configuration with means of standards through the implementation of use cases involving EU and National Standardization bodies. The article focuses on delivering information about the two pre-standardization activities that were developed as part of Stream 7: "Training" and Stream 1: ''Search and Rescue''. The Training stream aimed at conducting pre-standardization in a multitude of areas such as in scenario-building tools, in interoperability solutions for IT training tools, in handbooks, exercise and policy manuals for crisis management systems etc. The Search and Rescue stream aimed at conducting pre-standardization in the domain of the Mass Casualty Incidents (MCI) and the identification, tracking and triaging victims through a digital system. The study provides the pathway to standardization to enable a better understanding of the process followed for the identification of the topics for the two CWAs and the methodological procedure that was put into practice for their development alongside feedback initiatives that led to the improvement of the pre-standardization activities of both streams.

Keywords: Digital Scenarios, Scenario Execution, Search and Rescue, Exercise, Crisis management, First Responders, Triage.

1. INTRODUCTION

The pre-standardization activities were carried out in close collaboration with the technical partners that provide interoperability solutions, national standardization bodies of STRATEGY and end-users [1]. This is considered of key importance considering that relevant authorities are required to manage a range of natural and humanmade hazards which significant impact and cascading effects to critical infrastructure and societal functions [2, 3]. In the first stage of the project, the end-user's needs were collected, based on past research projects and their needs were categorized per stream. Moreover, thorough research on the existing standards in all domains of crisis management, covering all STRATEGY streams, has taken place. Following that, a comparison of end-user needs against available standards was conducted, leading to a number of potential gaps per stream. The standardization opportunities were identified, stemming from existing CEN Workshop Agreements (CWAs) relevant to STRATEGY and solutions developed by project partners which are mainly composed of technological tools and guidelines that could become the basis for standard development. The identified gaps were studied against the available opportunities per partner, which led to a series of recommendations for the new pre-standardization activity of STRATEGY. Based on the aforementioned methodological procedure a gap analysis and prioritisation resulted to the pre-standardization items CWA: "Specifications for Digital Scenarios for Crisis Management Exercises" and CWA: ''Requirements for acquiring digital information from victims during Search and Rescue operations'' [4].

The study presents the pathway to the development of two standardization activities which focused on the development of an interoperable and harmonised process that aims to (i) provide specifications for digital exercise scenarios and assist in efficiently planning crisis management exercises and (ii) recommendations on a digital system that can be used by First Responders to track and triage victims. The development process involved several bilateral meetings that were organised with end users including Table-Top Exercise (TTX) and Full-Scale Exercise (FSX) exercises [5] and technology providers in order to discuss the standardization gaps, verify the technical solutions available and identify the most relevant standardization opportunities for Training and Search and Rescue streams.

2. ASSESSMENT AND EVALUATION OF IDENTIFIED STANDARDIZATION ACTIVITIES

During the development phase of both pre-standardization activities, different end-user-driven activities were carried out to provide valuable feedback that was incorporated into the actual content of the CWAs. The methodological approach that was followed involved both internal and external processes that are presented in the following table 1. The CWA was continuously improved through feedback that was provided by participants and that was discussed thoroughly in each CWA meeting. The CWA has also been assessed by both internal and external participants through a TTX involving, the small group discussions that were carried out during the FSX and the observations and discussion that took place on the actual FSX day.

Table 1. Internal and external processes that were followed for assessment and evaluation of both CWAs.

Assessment & evaluation events of proposed standardization activities	Internal/External participants
Assessment from CWA participants in each document version	Internal/External
Table-top exercise	Internal/External
1st interoperability workshop	Internal/External
1st interoperability event	Internal/External
1st workshop on Crisis management and civil protection	Internal/External
Small group discussion (during FSX)	Internal/External
Full-scale exercise	Internal/External
2nd Interoperability event	Internal/External
2nd workshop on Crisis management and civil protection	External
Open commenting and public consultation period	External
Participation and presentation of CWA scope at workshops, conferences and events.	Internal

2.1. Planning procedure of CWAs

CEN/Technical Committee (TC) 391 Societal and Citizen Security and CEN/CENELEC Sector forum on security have been identified to cover the scope of both proposed CWAs. The STRATEGY project has established a liaison with CEN/TC 391 while both were consulted during the public consultation. The project plan was developed and the date of the kick-off meeting was published on CCMC website and on STRATEGY website to raise awareness, inviting interesting parties to participate in both standardization activities by commenting on the draft CWAs. The general process followed for CWAs development and specific CWAs time plan are provided in the following Figures 1 and 2, while key milestones are provided as follows:

- The draft project plan was submitted on Dec 2021 with requests to participate in the Workshop and/or comments on the project plan required to be submitted by Jan 2022. The Kick-off meeting of CWA was held on Feb2022.
- The CWAs development period was then initiated through a series of at least 5 meetings up to May 2022 with workshops participants with the main scope to discuss each clause that was included the documents.
- The final draft of the CWAs was distributed to external interested parties for public consultation which lasted for a period of 1 month and ended at April 2023.
- The CWAs finalisation period involved addressing comments received during the open commenting period and then the final version of the CWAs was made available for a 2-week internal ballot to receive final comments from CWAs participants.
- Based on the above process the CWAs was finalised and submitted to CEN/CENELEC for publication on May 2023.

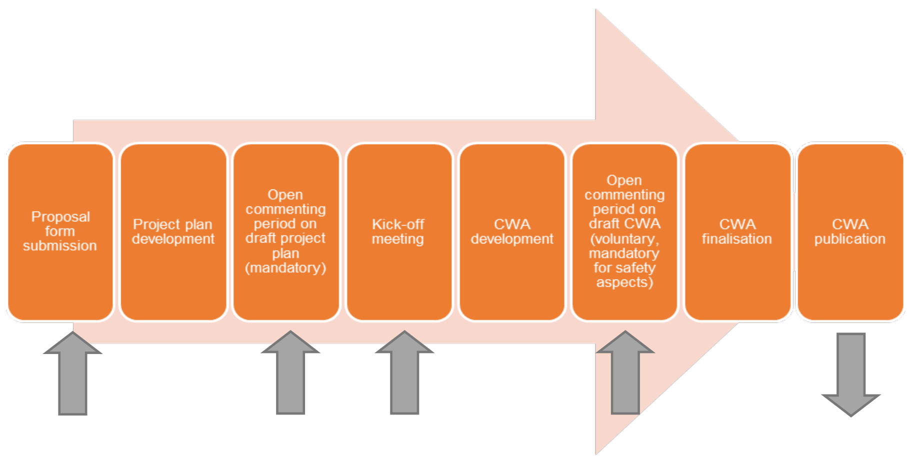
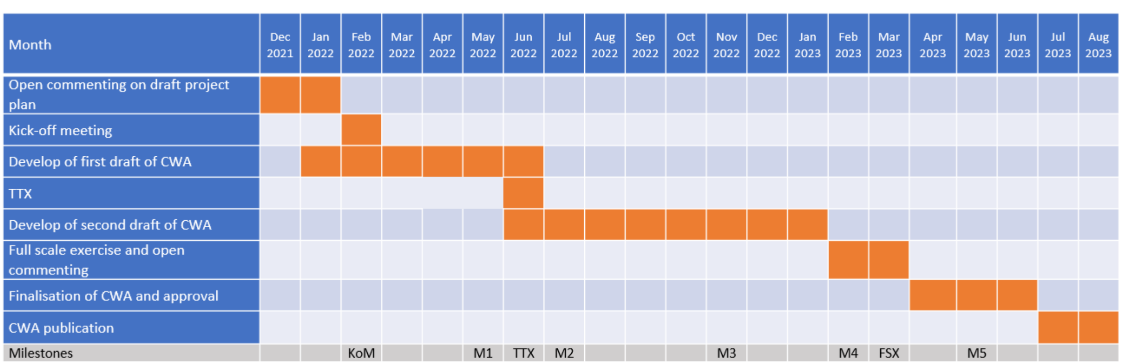


Figure 1: General process followed from Proposal form submission up to the CWA publication.



KoM = Virtual Kick-off meeting, M = Virtual Workshop meeting, TTX = Table Top exercises, FSX = Full Scale exercises

Figure 2: CWAs time plan that was followed during their development process.

2.2. Feedback Process

The CWAs followed various channels to obtain feedback from internal and external participants. During the CWA meetings, feedback was sought during a predefined iterative process. This involved drafting and distributing the updated CWA version prior to each meeting, collection of comments/suggestions by participants and thorough discussions about potential modifications/additions in the document. The TTXs were designed and executed with the participation of end users who provided feedback on the draft CWAs that were demonstrated during the exercise which was analysed and was considered for the update of the CWA towards its finalisation prior to the FSX. The small group discussion that was held during the FSX activities also involved a roundtable discussion/training session to present the proposed CWAs with the participation of stakeholders from different entities and organisations who evaluated the content of the CWA. The results from the small group discussion resulted in further refinement of the CWA document. The two FSX scenarios that were put into practice the digital scenario specifications and digital triage specifications also provided valuable feedback from the main end users, as they followed step by step the CWAs and resulted in interactive discussions and an improvement on the procedure that the CWAs proposed. Both Training and Search and Rescue streams also participated in a number of workshops, conferences and events that provided significant feedback to the CWAs by obtaining responses by a wide external audience which included scientific and operational stakeholders providing implementation and applicability recommendations.

3. CONCLUSIONS

The article provided a pathway for the development and feedback methodological procedures that were followed for two pre-standardization activities related with Training and Search and Rescue streams of STRATEGY project. An outline of the general planning and actual implementation steps of the proposed standardization activities is provided. This comprised of various meetings involving internal and external workshop activities, feedback obtained during the technical and validation exercises organised by STRATEGY project but also during external events which enriched significantly the content of the CWAs.

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CLUSTER OF INTEROPERABLE AND HOLISTIC CIVIL PROTECTION SYSTEMS

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ABSTRACT

CO-PROTECT constitutes a collaborative cluster project, financially supported by the Greek General Secretariat of Research and Innovation, aiming to promote innovation through the cooperation of numerous technological SMEs in Greece. The primary objective of this undertaking is to augment and integrate high TRL (Technology Readiness Level) products, systems, and services on the management and response to natural disasters, environmental crises, and civil protection emergencies.

As an innovative venture within the Greek SME community focused on environmental protection and safety solutions, CO-PROTECT aims to develop interoperable products with potential global market penetration. Launched within the framework of the Greek Disaster Resilience Innovation Cluster (DRIC) “Defkalion”, this project establishes a strategic partnership committed to safeguarding the environment and mitigating risks to public safety.

CO-PROTECT's assortment of interoperable solutions serves a broad spectrum of public and private entities. These include Civil Protection Organizations, Emergency Management Services, Public Safety and Security Authorities, Critical Infrastructure operators, Regional and Local Authorities, and Law Enforcement Agencies such as Fire Brigades and Police Departments. By implementing these solutions, these entities can effectively coordinate operational tasks and missions with enhanced efficiency.

To enhance disaster and crisis management capabilities, CO-PROTECT operates an extensive product repository containing diverse tools and solutions. The repository is systematically structured according to risk categories, encompassing seismic events, flooding incidents, wildfires, and safeguarding critical infrastructures. Furthermore, all pertinent components within the repository are engineered for seamless integration with platforms that facilitate the exchange of interoperable data and services.

Keywords: Civil protection, interoperability, natural hazards, crisis and disaster management, cluster.

1. INTRODUCTION

Climate change and recent environmental shifts have been marked by rapid and intense natural phenomena, posing significant threats to ecosystems and local communities. The intricacy of natural systems and the complexities inherent in modern societies and technological structures present challenges in crisis and disaster management. The amalgamation of these factors, alongside technological advancements, has created a globally intricate web of interactions, necessitating integrated solutions.

The CO-PROTECT innovation cluster serves as a cooperative platform for Greek companies developing disaster technologies, fostering innovation with a global perspective. One of its primary objectives is to achieve interoperability among the products and solutions offered by these companies, utilizing common standards to facilitate effective communication, information exchange, and collaboration during crisis management operations.

Moreover, CO-PROTECT aims to demonstrate the efficacy of integrated solutions in a realistic environment, showcasing their effectiveness in addressing natural and human-induced disasters. By doing so, CO-PROTECT strives to play a pivotal role in promoting disaster resilience and mitigating the impacts of environmental challenges on a broader scale.

2. PROTECT CIVIL PROTECTION TOOLBOX

To achieve the aforementioned objectives, the CO-PROTECT consortium has undertaken a comprehensive assessment of end-user requirements and a review of available relevant civil protection solutions. Subsequently, a Common Data model and a Common Interoperability Framework have been established, delineating the data and service models that must be employed across multiple components. This specification forms the foundation for integrating all project solutions offered by the SMEs of the cluster, thereby optimizing their operational efficiency and commercial readiness. The following subsections present a top-level overview of the implemented steps and corresponding findings.

2.1. Greek Services for natural disaster response and respective needs

Since 2002, "XENOKRATIS" [1] is the primary operational scheme, overseeing the national Civil Protection mechanism, structured into three levels: Strategic, Operational, and Tactical. The mechanism involves four phases for resource mobilization: Normal readiness, Increased readiness, Direct mobilization-intervention, and Rehabilitation-Relief. Various National, Regional, and Local authorities, including Ministries, Regional Authorities, and Emergency Services, are engaged in emergency response. These organizations' indicative needs and requirements are detailed in the provided table

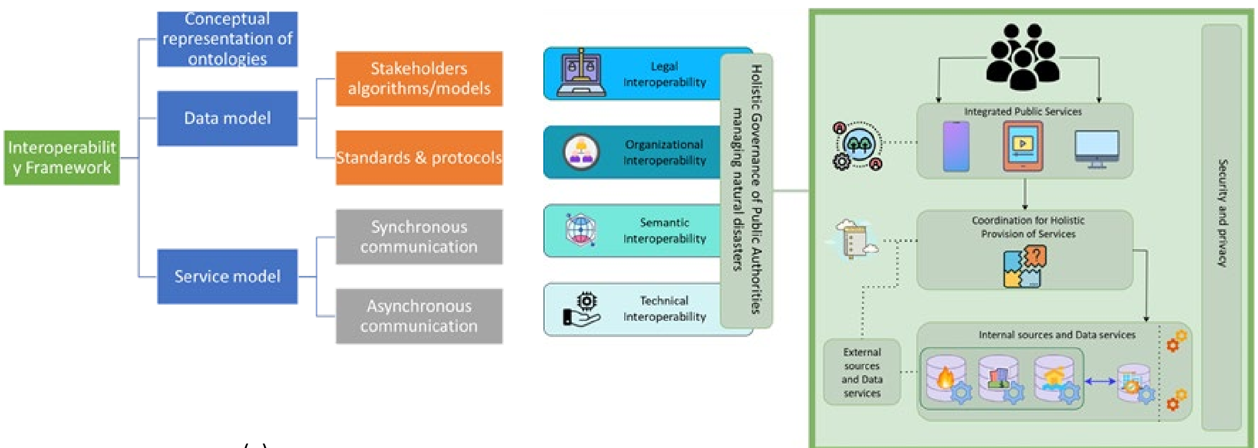
Table 1. Civil Protection Authorities' needs and requirements [2].

Category	Type of Requirements
User interface	Interface customization, display of information, user-friendly and modular interface, standardized or common symbols, integration with sensors and legacy systems
Data provision	Fire-related data, potentially affected people, safe zones, critical infrastructure and services related information, Emergency Response plans
Resource management	Resource tracking, availability/readiness level, available equipment, mission assignment
Common operational picture	Data fusion, Field sensor integration, Critical Infrastructure related information (hospital location and availability, power blackouts, etc.), correlation of different agencies' information (e.g. resources, missions)
Weather Forecast, Warnings and Hazard Classification	Early warning to both agencies and the community, forecasting models, extreme weather detection, integration of weather models with fire propagation models
Reporting and historical data	Access and storage of all measurements and predictions/missions allocated/incidents occurred, forensic support, time stamps, filtering and search capabilities
Communication and information sharing	Live streaming from the field, community warning capabilities, operational information sharing among Agencies, media-enhanced reporting, real-time risk sharing
Security, personal data	User access control, encrypted data storage and communication, access rights, storing info of data creator/editor, GDPR compliant, anonymization of data when possible
Technical specifications	Scalable, modular, and flexible system, interfaces with external sources/organizations, components with appropriate IP, mobile/desktop versions, short latency, resilient, compliance with regulations and standards, interoperable system
Training	Training simulators or C2 should be able to use real-time or simulated data, be able to create reports, simulate communications, etc.

Common Interoperability Framework

Effective cooperation and coordination among individuals, organizations, and systems are pivotal in crisis response and disaster management. CO-PROTECT emphasizes promoting system interoperability to optimize activities and communication during critical situations [3]. This involves facilitating real-time data exchange, seamless communication between entities, and ensuring alignment of procedures.

Figure 1 illustrates the comprehensive interoperability framework, encompassing ontologies from each mechanism, data models for accurate variable mapping, and service models for seamless information exchange within or between organizations and external partners.
The framework outlined above has given rise to a reference architecture that serves as a guideline for any crisis management solution, regardless of the specific natural hazard. Figure 1 depicts four levels of interoperability frameworks: Legal, Organizational, Semantic, and Technical Interoperability.
Legal Interoperability ensures alignment with legislation for seamless cross-border information exchange. Organizational Interoperability determines inter-organizational business goals and processes. Semantic Interoperability fosters a common understanding of exchanged information through interoperability standards and mappings. Technical Interoperability establishes connections between computer systems and services at a technical level.
These frameworks cooperate to provide comprehensive governance for services concerning environmental events. Event information stored in databases is communicated within an organization and from external sources, generating mechanisms for effectively managing specific crises. Standards dictionaries facilitate the interpretation of exchanged data. Users can access interoperable data through diverse devices, enabling efficient control and updates for relevant authorities.



(a) (b)

Figure 1. (a) CO-PROTECT Interoperability framework; (**b**) CO-PROTECT Reference Architecture

2.2. CO-PROTECT solutions

Following the above reference architecture and considering the common interoperability framework, CO-PROTECT has adopted high TRL solutions provided by the partners, adjusting, and integrating them in four systems aiming to manage crises related to four domains respectively: a) earthquakes, floods, forest fires, critical infrastructure protection [4]. In the following table, the tools used per domain are presented.

3. NEXT STEPS AND DISCUSSIONS

In the project's last six months, with the backing of the Greek Disaster Resilience Innovation Cluster (DRIC) “Defkalion”, we aim to establish a realistic, continuous demonstration platform. This platform will present comprehensive crisis management solutions to relevant Greek end-users through vivid, representative scenarios. Not only will this highlight innovative functionalities, but it will also serve as a foundation for further advancement and integration of new technologies within civil protection agencies. A key outcome of these activities will be the CO-PROTECT handbook, compiling lessons learned and guidelines for replicating and scaling these products.

Table 2. CO-PROTECT solutions.

Domain	Category /Tools
Earthquake	Hazard/Vulnerability/Risk Assessment: Structural and conditional monitoring system; Seismic vulnerability assessment of bridges; Seismic vulnerability assessment of highway infrastructure; Probabilistic seismic risk assessment; Probabilistic assessment of short-term and long-term risk and economic-technical consequences for critical infrastructures; Risk assessment software for buildings and infrastructure networks Early Warning and direct impact assessment: Near real time damage assessment system for buildings; Seismic activity monitoring equipment; ShakeMap service; Early warning system; Short-term impact assessment (remote sensing): Interferometry products for assessment of prone areas and micro-movements; Monitoring of ground deformations. Interferometry products on demand via web services; Satellite data search service; Crisis management: Command and Control system; Geospatial visualization and analysis; Available geophysical data; Data visualization platform
Extreme weather events, focusing on flooding	Extreme weather warning and crisis classification system; Platforms for visualization of phenomena and crisis management; Flash floods indicators and static flood risk; Numerical weather prediction models; Management of extreme phenomena in the coastal zone; Telemetric IoT sensors and Weather Stations; Improved point prediction of extreme or not weather conditions and phenomena
Forest fire	Hazard and Risk Assessment (before incident): Automatic Fire Detection system (including video analytics); Automatic risk assessment for forest fires; Meteorological data and numerical weather prediction models; Fuel type mapping. Response and Simulation (during incident): Fire propagation model; Command and Control system Recovery (after incident): Spatial modeler; Web-GIS platform; Satellite data search service; Training: Training platform-scenario builder
Critical Infrastructure Protection	Risk Assessment: Holistic framework of risk management; CI vulnerability assessment; Real time risk assessment Sensing and monitoring: Satellite data search and analysis service Physical Security: Physical Security Information Management system Communication: Incident reporting, risk communication and information sharing

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EXPLORING THE ROLE OF ARTIFICIAL INTELLIGENCE TOWARDS REDUCING THE CLIMATE CHANGE IMPACTS ON PUBLIC HEALTH

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ABSTRACT

This paper explores the potential of Artificial Intelligence (AI) in safeguarding public health from the risks posed by climate change. In addition, it examines AI as a contributor to climate change. Climate change is increasingly impacting human health through various channels, including extreme weather events, such as high temperatures, extreme cold, droughts, fires, floods, huriccanes and monsoons and the impact on natural resources, such as reduced access to drinking water, adverse impacts on food production as well as the increased risks related to infectious diseases such as zoonoses and vector-borne diseases. By leveraging AI technologies, such as machine learning, deep learning, data analysis, and predictive modeling, it becomes possible to enhance public health resilience through engaging into adapted responses. This paper through literature review focuses on AI uses as a tool and various present applications in addressing climate change-related health challenges. It also discusses the potential benefits, limitations, and future directions of AI-enabled solutions. The findings suggest that AI has the potential to revolutionize public health and healthcare preparedness and response to climate change, contributing to the well-being of individuals and communities. At the same time it poses threats which demand development of widely accepted AI strategies across the globe and careful regulatory mechanisms operating at various levels. As a result, it is imperative that scientists, legislators, philosophers and social scientists interact directly with informaticians in order to benefit humanity as a whole.

Keywords: climate change, healthcare, justice, human health, public security

1. INTRODUCTION

The adverse impacts of climate change on human health are a growing concern worldwide as it is evident from a number of world reports and relevant organizations [1-35]. Climate change poses significant risks to human health and public security, necessitating effective mitigation strategies to safeguard individuals and communities. In most countries of the world, the current socioeconomic environment of continuous, and often permanent crises releated to geopolitical tensions, energy crisis, environmental degradation, social inequalities and various austerity policies, including the privatisation of healthcare systems, are factors that critically undermine climate change adaptation of the health sector. The increasing frequency and intensity of extreme weather events, changes in climatic parameters and conditions, increased risks of migration and alterations in disease dynamics all contribute to the complex web of climate change impacts on public health [36- 46]. In this context, leveraging the potential of artificial intelligence (AI) emerges as a promising approach to enhance public health resilience and provide informed responses to the adverse consequences of climate change.

This paper explores how AI can be utilized to safeguard human health in the face of climate change risks, the type of technologies applied, the potential benefits and limitations of AI-enabled solutions and how AI can be harnessed to improve public health preparedness and response to climate change impacts.

The paper aimed to accomplish the following objectives: Review and synthesize the existing literature on AI role and applications in addressing climate change-related health risks through extensive search of databases, recent reports, scientific journals, and conference proceedings; Focus on selected AI-driven models for climate prediction, early warning systems, disease surveillance, and risk assessment; Assess the benefits of AI-enabled solutions; Discuss the implications of AI applications for public health preparedness and response to climate change. Finally, the paper examines the potential improvements in adaptive capacity, emergency response, and decision-making processes. The current paper does not only add on the existing knowledge of the role of AI in addressing the health risks of climate change but also aims to provide recommendations for policymakers, researchers, and practitioners on harnessing the potential of AI technologies to safeguard human health in a changing climate.

2. METHODOLOGY

A comprehensive literature review was undertaken to identify and analyze existing studies that examine the use of AI in addressing climate change-related health risks. It encompasses various databases, scientific journals, conference proceedings and many recent reports. The review focuses on AI applications such as health interventions, disease surveillance, climate modeling, early warning systems, and risk assessment.

3. RESULTS-DISCUSSION

The key findings of the literature review are shown in table 1. Examples include AI-driven models that predict the spread of vector-borne diseases based on climate variables and satellite imagery, AI-powered air quality monitoring systems, and AI-enhanced decision support systems for emergency response during extreme weather events and personalized health interventions. Important reports and resources are hypelinked table 1 [1-34]. AI systems can contribute to the development of adaptation policies and legislation and help us ensure equity and inclusiveness of the society. AI systems can also be contributors to climate change and their ecological footprint needs to be estimated before making use of such systems [47-50]. The positive outcomes and benefits achieved through these AI interventions can outweight the negative results, provided that AI systems are carefully designed and regulated.

There is high need to prioritize climate change adaptation policies at central and local government level with clear strategic coordination, consultation and synergies among all stakeholders, agencies, services and especially citizens [30, 31, 32]. A concrete and realistic action plan for targeted adaptation of the health sector to climate change related risks, is needed in many countries. There is also need to invest in research on monitoring of the impacts of climate change on public health and expand the epidemiological surveillance mechanisms by properly integrating scientific data on climate change at country level and not only [10, 11, 12]. It is important to also ensure a continuous flow of funding, pay attention to equity, privacy issues and inclusiveness, and strengthen awareness and public accountability [30, 31, 32]. Education programs and strategic planning on relevant issues involving all stakeholders are also an urgent necessity while prioritizing vulnerable individuals, groups and areas [30, 31, 32]. AI interventions pose threats and limitations that require the development of widely accepted AI strategies across the globe, a good example being the recent European AI Act [30, 31, 32, 33, 34]. AI research and development stands the risk of being inequitable, unfair and biased if it lacks representation and diversity. Ethical issues [51], privacy and security matters should be a top priority [32, 33, 34]. Careful regulatory mechanisms operating at various levels are needed in order to avoid misuse and abuse of AI systems.

Table 1. AI Examples towards Reducing the Climate Change Impacts on Public Health

AI Use	Description	Source
Selected examples	**Associated risks-Adapted responses**	**Resources**
Personalized and public health interventions	**AI algorithms analyze individual health data**, from genomics, proteomics, metabolomics, exposome, provide personalized recommendations, personalized treatment, personalized heat stress prevention strategies, allergen exposure reduction plans, tailored recommendations for chronic disease management, develop action plan for targeted adaptation of the health sector etc.	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]
Disease surveillance	**AI algorithms analyze health data**, HER, social media posts, and environmental data, data-related to climate-sensitive diseases, monitoring the spread of vector-borne diseases, waterborne diseases, respiratory illnesses, expand the epidemiological surveillance mechanisms, etc.	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,
Climate modeling	**AI-powered climate models** analyze historical data, weather patterns, future climate scenarios, assessing health risks such as heatwaves, extreme weather events, changes in disease vectors, etc.	[17, 18, 19, 20, 21]
Air quality monitoring	**AI algorithms process data from air quality sensors**, satellite observations, meteorological data, monitoring and prediction of air pollution levels, assessing the impact of climate change on air quality, interventions to mitigate respiratory health risks, etc.	[22, 23, 24, 25]
Risk assessment and decision support systems	**AI-driven risk assessment models** use historical and real-time data, evaluate vulnerability of communities. **Decision support systems** powered by AI provide evidence-based recommendations for policymakers and public health officials, develop effective adaptation and mitigation strategies, etc.	[26, 27, 28, 29]
Ensuring funding resources and networks	**AI algorithms can be used as tools to help allocate funding resources and expand networks**	[30, 31, 32]
on adaptation policies and legislation	**AI algorithms can bolster climate research and modeling** **Develop AI strategies, new policies and legislation** can help built confidence and trust and prioritize climate change policies	
on equity and inclusiveness of society	**Equity, inclusiveness, security, privacy and ethical issues should be a top priority**	[32, 33, 34]

4. CONCLUSION-RECOMMENDATIONS

AI technologies have a high potential in providing opportunities and addressing challenges towards safeguarding human health from the risks of climate change. The current paper is forming relevant recommendations for future research as well as policy directions, while it underscores the importance of interdisciplinary collaboration, data sharing, and ethical considerations in harnessing the full potential of AI for climate change resilience and public health protection.

Note: References 1-34 are active hyperlinks under table 1 the last column on source/resources (see links 1-34 under references).

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DISTANCE EDUCATION AND LIFELONG LEARNING IN MENTAL HEALTH ISSUES FOR FRONT-LINE HEALTH PROFESSIONALS AND FIRST RESPONDERS OF REFUGEES CAMPS DURING PANDEMIC

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ABSTRACT
The present study aimed to evaluate the satisfaction of online training delivered to health professionals of the N.P.H.O working on refugees camps. Training was carried out exclusively in the form of synchronous online learning focusing on mental health issues. In total 252 health workers participated in the remote training and completed an online survey. Among the findings were great satisfaction from the quality, content, and utility of synchronous online training.

Keywords: first responders, refugees camps, mental health, distance education

1. INTRODUCTION
Unpredictable public health crises highlight the necessity of stress management and promotion of mental health and well being [1]. Common mental health issues by healthcare professionals include depression, anxiety, fear and worry [1]. Working as frontline healthcare professional in disasters and during a pandemic can negatively impact mental health, leading to increased rates of acute stress disorder, post-traumatic stress, anxiety, and depression [2]. Early interventions are promising and provide support for health care professionals and first responders especially during crises , including covid-19 pandemics [3]. Trainings for promotion of mental health and well being are highly beneficial interventions.
The synchronous distance learning is the new norm during Covid-19 pandemics. Educational programs globally had to adjust to new challenges, adopting remote learning and replacing face to face learning with distance learning. The study focus is to highlight the importance of distance lifelong learning for frontline health professionals who work in the field.
Among the benefits of distance educational programs is that provides flexibility and time-saving particularly for professionals working in refugees Camps across Greece, including mainland and Greek Islands. They maintain demanding full-time schedules and must be readily available to respond to emergencies, that makes it impossible for them to travel [4]. Distance learning affords trainees the opportunity to manage their learning schedules according to their own convenience and in consideration of their work commitments[5] [6]. The combination of video with visuals and sound provides new learning opportunities, fostering modern networks of teaching & learning[7].

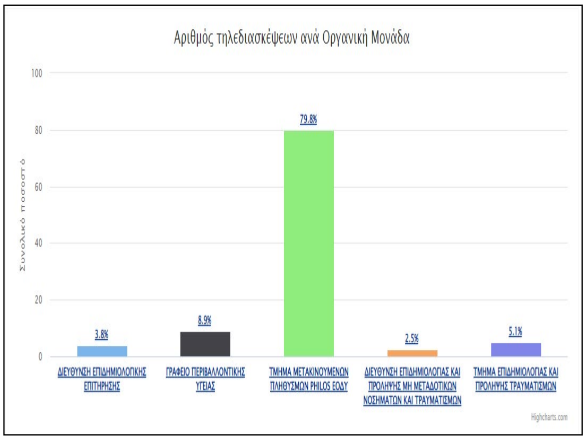
2. PURPOSE OF THE STUDY
The aim of the study is the evaluation of the thematic units related to mental health and the management of GBV incidents in terms of participants' satisfaction with the distance learning, the usefulness of the training, and the adequacy of instructors.
The thematic units that includes this research are the following:
- COVID-19 and psychological resilience. Psychological effects of the pandemic, psychoeducation of stress, empowerment and resilience skills, self-care of health professionals (C. Patitsa).
- Mental Health First Aid- and Covid (panic management, suicide, aggression, etc.) (C. Patitsa).
- Gender identities in refugee settings: Psychosocial management of gender-based violence and best practices (V. Theocharidou).

3. THE EDUCATIONAL TRAINING: METHODOLOGY

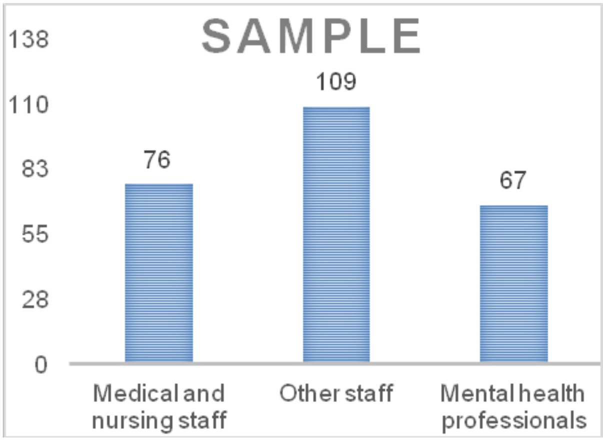
First training cycle had duration three months, from April 5th to July 9th, 2021, with training session held from 14:00 to 20:00. Each topic was presented on two to three different dates in order to provide flexibility and ensure smooth operation inthe refugees' camps. The educational training was divided into various educational units based on preference of topics and the trainees' knowledge background.

The trainings were conducted inthe form of synchronous online education aiming to meet the needs of the target audience. These educational trainings were structured into small groups of participants, 20 trainees per group. Educational material was developed following an extensive review of Greek and International literature. These materials encompassed various educational components, such as educational, videos, interactive exercise and case studies analysis. The educational trainings were recorded under GDPR .

For the synchronous online training, the e:Presence.gov.gr service was selected, which allows Greek public institutions to organize and conduct secure, high-quality, and interactive web conferences.



Graph 1. Participation Precentage of Department



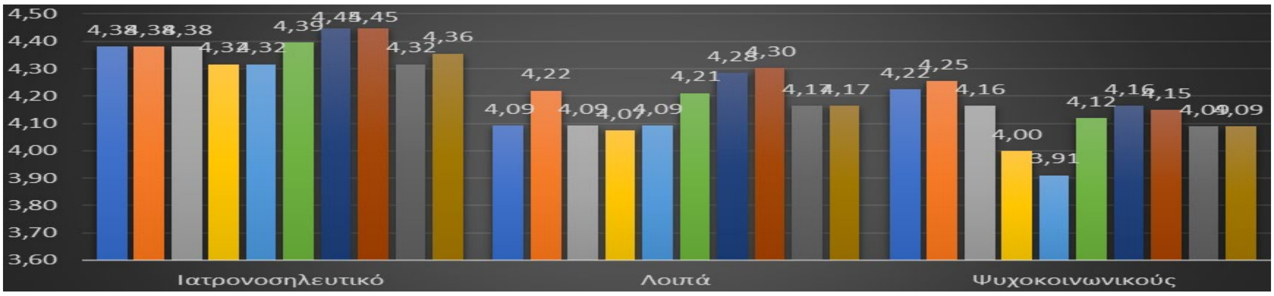
Graph 2. Sample of Study of Mobile Populations

The profile of participants was Healthcare professionals working in Reception and Identification Centers, Refugee Hospitality Centers, the Central NPHO Service, and other facilities for the needs of the program "Overall emergency health intervention for refugees' crisis- PHILOS". With the term health professionals we mean health professionals doctors, nurses, midwives, psychosocial personnel and other personnel. The sample included medical and nursing staff, mental health professionals, and other personnel. It included doctors, nurses, midwives, psychologists, social workers, health visitors, interpreters/mediators, rescuers/translators, and coordinators. Participation in the study was mandatory for all frontline healthcare personnel involved in the PHILOS/NPHO, working across 32 facilities including Reception and Identification Centers, as well as Refugee and Migrant Hosting Centers. At the end of the training sessions, an evaluation was conducted. A total of 252 participants completed the evaluation survey, which covered three thematic units of training.

THEMATIC UNIT 1 : STRESS MANAGEMENT AND BUILDING OF PSYCHOLOGICAL RESILIENCE

The training included scenarios that healthcare professionals could potentially encounter in refugees' camps regarding the provision of medical and mental health services [8].

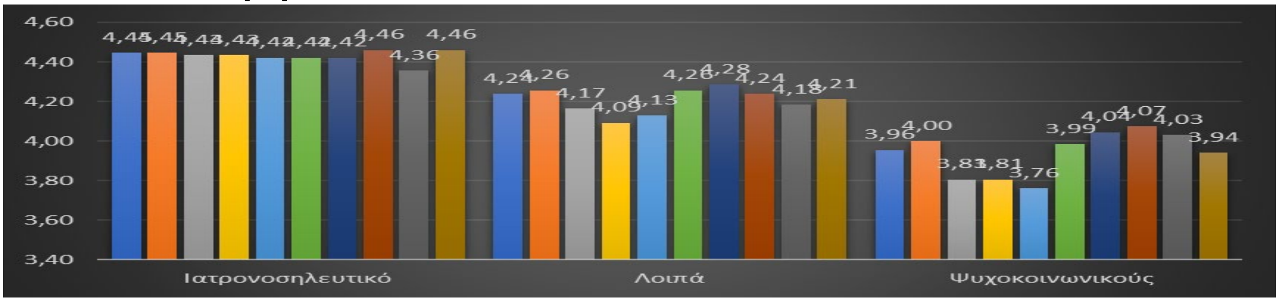
Prolonged psychological distress may lead to further negative consequences, including increased risk of suicide, as well as professional burnout, compassion fatigue, and secondary traumatic stress[2]. The World Health Organization has also highlighted the psychological stress and risk of burnout among healthcare professionals during the pandemic [9]. Frontline healthcare professionals and hospital staff face significant mental health challenges due to work-related stress [10]. Therefore, building resilience is crucial for protecting the mental health of first responders and frontline personnel [2].



Graph 3. Evaluation of Educational Unit 1

THEMATIC UNIT 2: MENTAL HEALTH AID (panic attack, suicide, aggressive behavior etc.)

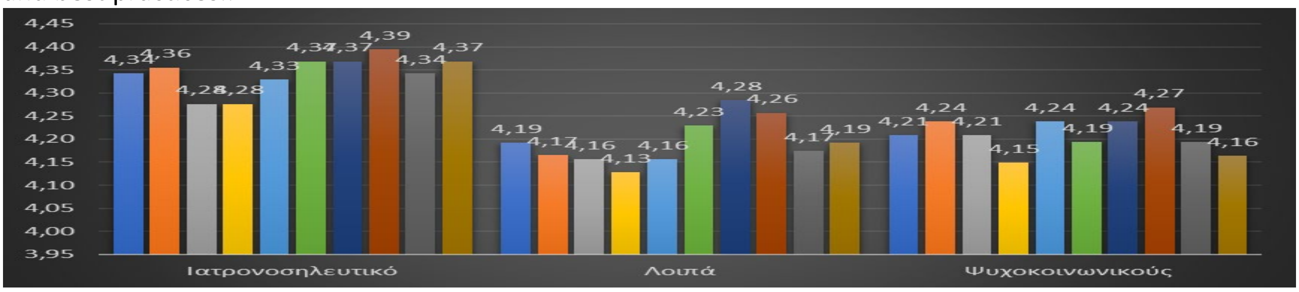
Mental health first aid training offer to participants the necessary skills to effectively support individuals who may develop mental health issues or experience a crisis, providing them with guidance and appropriate care [11]. The training includes case studies' scenarios that healthcare professionals could potentially encounter in healthcare and mental health service centers [8]. Early detection and the provision of mental health first aid play a crucial role in preventing the worsening or development of mental health crisis [12].



Graph 4. Evaluation of Educational Unit 2

Educational Unit 3: Gender Based Violence

This training unit focused on developing skills to address GBV management for frontline health workers, strengthening skills in the detection, prevention and management of GBV incidents and encouraging dialogue about the challenges health workers face with gender-based violence and the sharing of opinions and best practices..



Graph 5. Evaluation of Educational Unit 3

4. CONCLUSIONS

Trainees demonstrated great level of satisfaction with the synchronous distance learning. The swift to an online format resulted in almost overall participation of healthcare professionals of all specialties and maintained a high level of participants' satisfaction, as confirmed by relevant research [13]. It allowed to be approached sensitive issues such as GBV, with scientific manner, sensitivity and interaction between health professionals. Overall, there was great satisfaction with the content and quality of the training, as well as the support they received.

The educational units were considered very useful, especially during the pandemic. The training, in terms of usefulness, provided participants with knowledge and practical skills that they will apply in the field and empowered them to provide qualitative services to beneficiaries. Great satisfaction was reported regarding the presentation, organization, transferability preparation organization, and preparation of the instructors, as well as their in-depth knowledge of the subject. There was a high level of satisfaction with the duration of the training.

While participants were generally satisfied with the specific training, it was challenging to achieve a high user experience due to limited hands-on exercises and discussion prompts.

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NOTIFYING THE PUBLIC: EVACUATION SIMULATION AND EMERGENCY SERVICES ACTIONS

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ABSTRACT
Evacuation models can be used to predict the likely evacuation performance of an area. However, most models do not consider the actions of civil protection agencies or emergency services in taking decisions to protect the population. Real evacuations while often partially spontaneous, by involving self-evacuation, are normally not performed in isolation of these organisations. In this work, some actions of the emergency services, namely the evacuation notification strategies, have been incorporated into an evacuation model and demonstrated in a use case involving the evacuation of a town due to chlorine spill.

Keywords: emergency notification methods, disaster management, AEGL, preparedness, evacuation modelling

1. INTRODUCTION
Most States give the mandate to plan, order, and enforce mass evacuation to specific authorities (the same authorities which must ensure public safety and security) [1]. Civil protection organisations and emergency services are important actors during any emergency, as they drive the response phase, have the means to influence how people respond, and are responsible for making the decision on whether an evacuation should take place. A limiting factor that hinders evacuation efficiency is the time that the population will start their response phase. If an evacuation is deemed necessary then early, clear, and concise notification from authorities will encourage the population to engage in appropriate response behaviours and start evacuating. In recent wildfire incidents the population was instructed through several means to evacuate their areas and follow specific instructions to reach safety (e.g., door-to-door, 112 emergency service number, mass media announcements, etc).

The novelty of this work lies in the explicit representation of the emergency services' notification methods and procedures [2] into an evacuation model. The effect of the notification method on the evacuation process can thus be evaluated. A use case will be presented that was part of the first tabletop exercise (TTX) for the EU Horizon 2020 project IN-PREP [2,3] where an evacuation model was used to forecast the likely evacuation performance of an area of Spoleto, Italy, due to a chlorine (Cl) spill.

2. METHODOLOGY AND TABLETOP EXERCISE SCENARIO
The urbanEXODUS evacuation simulation model is used for this study. This model is a variant of the EXODUS Agent Based Model (ABM) which incorporates specific features to perform large-scale, multi-modal, and multi-hazard evacuation simulations [4,5,6,7]. Within urbanEXODUS each agent is defined by a set of physical (e.g., age, gender, agility, mobility, resilience to fire hazard products, etc.), psychological (e.g., response time, patience, drive, etc.), physiological (e.g., respiratory rate, impact of heat and narcotic and irritant gasses, etc.) and experiential (e.g., distance travelled, travelling time, time wasted in congestion, etc.) attributes. The scenario involves a hypothetical anthropogenic crisis that unfolds in the town of Spoleto, located in the province of Perugia, in central Italy. The scenario starts when a truck carrying chlorine (Cl) is involved in a traffic accident causing the Cl to spill and propagate through the

town. Considering the imminent danger to the community the authorities decide to evacuate parts of the town by issuing warnings and notifying the population. This is conducted in phases and is achieved by using an automated phone call system and by door-to-door notification. During the evacuation, the agents are exposed to Cl and the corresponding Acute Exposure Guideline Levels (AEGL) [8], for each agent, is calculated. The focus of this work is on how the notification methods and Cl levels affect the individual agents as well as the overall evacuation process. In total 32 scenarios were simulated. The variations were due to considering the weather conditions on three different dates, the population distributions on these days, and varied Cl release rates. During the actual TTX a single scenario was executed. The scenario assumed the weather conditions as recorded on 19 July 2018 with a weak S/SW wind. The incident was assumed to take place during the day and the release of Cl was assumed to be 0.15Kg/sec for 80 minutes. Figure 1(a) shows the visual representation of the scenario specification data.

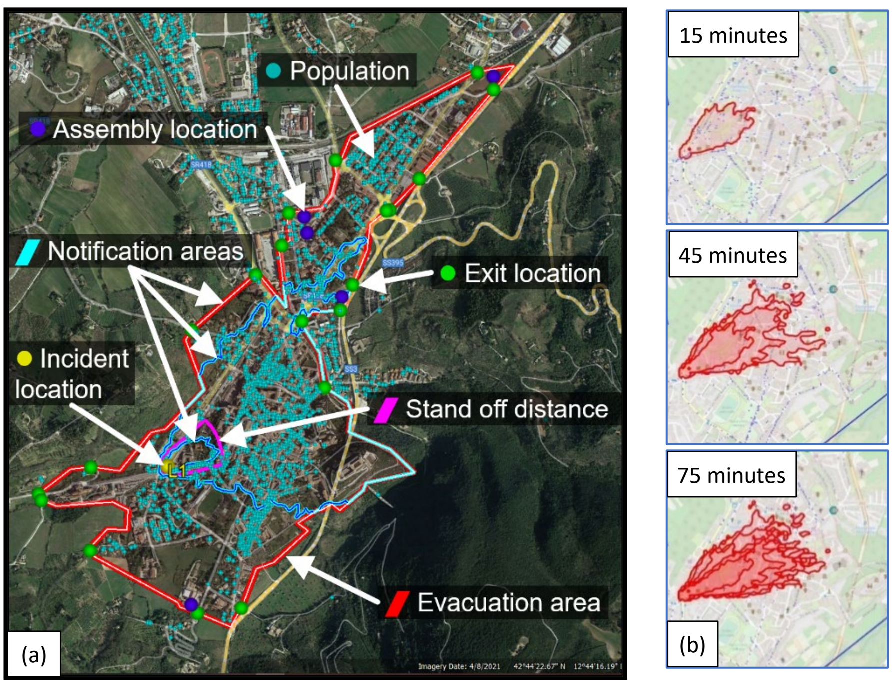

Figure 1. (a) Visual representation of the scenario specification data including the evacuation boundary, population distribution, exit and shelter locations, notification areas, etc. (b) Chlorine propagation at 15, 45 and 75 minutes after the initial chemical spill.

The main trigger for the evacuation was a Cl chemical spill. Hazard information in the form of time-based isochrones were developed by IN-PREP partner IES Consulting, using HYSPLIT [9], and imported into urbanEXODUS. The associated concentration values describing the severity of the hazard, at each time step, is used to determine the effect that the hazard has on the population. A custom toxicity model [10] was developed to assess the impact that Cl had on individuals utilising the Acute Exposure Guideline Levels (AEGL) model [8,11,12]. Figure 1(b) depicts three snapshots of how Cl was predicted to spread in the incident area at 15, 45 and 75 minutes after the initial chemical spill.

The notification of the affected population is perhaps the most significant parameter in determining the evacuation efficiency. A novel and complex notification model was developed and implemented within urbanEXODUS. It allows the representation of several notification methods to be applied progressively to a zone. The agents located within each zone can be notified by the authorities' door-to-door action, automatic phone call or a user-defined "*other*" method. The latter covers notifications by a number of non-specific means, such as notification by neighbours or other cues leading to self-evacuation [13]. The notification model depends on a notification rate (households per minute), an initial success rate (% of households notified) and a subsequent success rate (% of households notified per time period). The values used to setup the model were based on information provided by the Italian Fire Services.

3. RESULTS

During the TTX a single scenario was executed, therefore, its respective evacuation simulation the results are reported. A more detailed analysis, however, would require multiple simulations to be run and analysed. The authorities considered that the conditions ceased to be life threatening from 90 min onwards at which point the evacuation process stopped at 90 min. A total of 4687 people are evacuated within 90 min. The number of successfully notified people is 6175. The average response time of the agents was 44 min [0.2 min - 90 min], the average evacuation time was 58 min [5.3 min - 90 min] and the average distance travelled was 654 m [0.0 m - 2178 m]. In total 688 people were exposed to chlorine (Cl), of which 404 evacuated within 90 minutes. There were 645 people that experienced irritation and discomfort (AEGL-1) with an average exposure time of 31 min [0 min - 90 min]. There where 43 people that sustained life-threatening injuries (AEGL-3) with an average exposure time of 6.5 sec [4.5 sec - 9.8 sec]. However, no people sustained AEGL-2 levels of exposure to Cl. Of those agents that responded to the notifications, 445 were notified by door-to-door action, 1492 by the automatic phone call system, and 3677 by the “other” method. Approximately 61% of the notified agents were located on the streets and open spaces while 39% were initially located within a building.

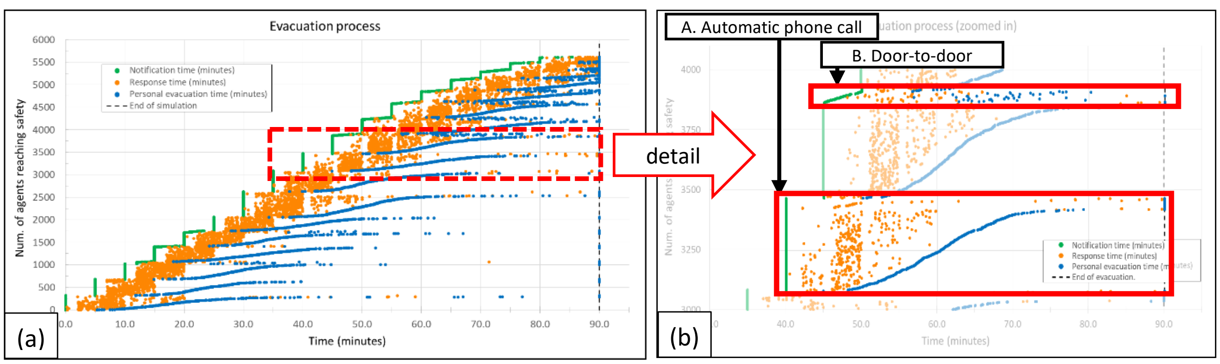

Figure 2. (a) Evacuation process, agents’ notification time in green (automatic phone call, door-to-door), agents’ response time in orange, agents’ evacuation time in blue (b) Detail of two evacuation sub-processes, at around 40 minutes into the simulation.

The whole evacuation process, in terms of the number of agents reaching safety over time, is depicted in Figure 2a. The data is sorted first by the agents’ notification time and then by their evacuation time. The graph shows over time the number of people that successfully got notified (green dots), the response time of those that started evacuating (orange dots), and the number of evacuees (blue dots). For clarity, Figure 2b depicts a small portion of the output data focusing on the area between the 33rd minute to the 90th minute of the evacuation and for the 3000th to the 4000th agent. The vertical portion of the notification data (area A, Figure 2b) represents the concurrent notification of the population by the automatic phone call and the “other” methods. In this example, the “other” notification method is assumed to take place at the same time as the automated phone call and thus these two notification methods cannot be seen differentiated in this diagram. The horizontal portion of the notification data (area B, Figure 2b) represents the sequential notification of the population using the door-to-door method. As each agent is independently assigned a response time (orange dots) the data depicting the response time of the agents appears scattered.

4. CONCLUSIONS

A novel methodology has been developed that allows for complex notification methods to be incorporated into an evacuation model representing the authorities' procedures as a response to a technological hazard. The evacuation model was used to forecast the likely evacuation performance of an area of Spoleto and the impact that a chlorine spill had on this process including the population's exposure levels (AEGL) to this chemical. The authorities can test, evaluate, and assess the validity of various evacuation procedures and notification strategies. Furthermore, they can identify the likely impact of the hazard on the population and help determine any requirements that may be placed on additional medical resources, such as hospitals or for addressing longer-term health issues. The insights offered can be used for improvements in the preparedness level for future incidents enhancing incident management training.

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WATER QUALITY MONITORING USING SENTINEL 2 SATELLITE DATA DURING WET AND DRY SEASON IN THE LAKES OF THE REGION OF CENTRAL GREECE

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ABSTRACT
The present study aims to monitor the water quality in Yliki Lake, Marathon Lake, and Mornos Lake using satellite data. To achieve this, Sentinel 2 Level 1C high-resolution satellite data from 2022 were utilized. Specifically, the data were selected from the cold/wet period and the warm/dry period of the year to examine Total Suspended Matter (TSM) concentration. The methodology of Case 2 regional coast color algorithm was applied for monitoring the TSM. Regional parameters for each lake, such as lake temperature, atmospheric pressure, and elevation were set in the processor's user interface, as well. The C2RCC algorithm calculated effectively the TSM concentration in lakes. The present study results have shown that the TSM concentration in the lakes exceeds the limit of 25 g/m3, set by the Directive 2006/44/EC of the European Parliament and of the Council.

Keywords: Satellite Earth Observation Systems, Optical Data, Lakes, Central Greece, Total Suspended Matter

1. INTRODUCTION

Lake Yliki is located in eastern Central Greece in the prefecture of Voiotia, at the southeastern boundaries of the municipality of Orchomenos and northwest of the municipality of Thebes. It has an area of 22 km^2, which often varies depending on climatic conditions. The maximum depth of the lake is 38. 5 m (with an average depth of 28. 8 m), while the total amount of water when full is about 663,000,000 m^3. Lake Yliki is the 9th largest lake in Greece [1]. The artificial lake of Marathon is located in the region of northeastern Attica, 30 km from Athens, on the border between the municipalities of Marathon and Oropos. It has been built at the confluence of many streams that collect the runoff of the surrounding basin, with the main ones being the Varnavas stream and the Haradros river, which originates from Parnitha. As for the maximum height of the dam, it reaches 54 m and the maximum width at the base is 48 m. In addition, the width of the crest at the level of the traffic road is 4.5 m and the length of the crest is 285 m. The surface of the Marathon artificial reservoir is 2.45 km at the spillway level. Its maximum capacity is 41×106 m^3, while the maximum useful volume is 34×106 m^3 [2]. The artificial lake of Mornos originates from the southern Oiti (altitude 700 m) where it occupies part of the prefectures of Fthiotida and Fokida and flows through Central Greece, emptying into the Corinthian Gulf east of Nafpaktos where it forms a delta. The catchment area of the artificial lake of Mornos is 588 km^2 and has a length of 77 km. As for the Mornos reservoir, it was created in the riverbed with the construction of an earthen dam. It is an inland reservoir with a surface area of 14.80 km^2. In terms of the maximum height of the dam, it reaches 126 m and the maximum width at the base is 595 m. Also, it has a maximum capacity of 764 million. m^3 [3].

Total suspended matter (TSM) refers to substances suspended in water that exceed a certain size. Specifically, TSM includes inorganic matter, organic matter, silt, clay and microorganisms that are insoluble in water. In inland water, the river input adds large amounts of TSM to lakes. Through rivers, terrestrial nutrients readily adsorb to suspended particles and enter the lake, promoting eutrophication of water bodies and the occurrence of aquatic blooms. In addition, TSM affects the visual signal of inland water bodies, which has a significant impact on the growth of aquatic animals and plants. TSM content is an important indicator for measuring water clarity and the degree of water pollution. Therefore, rapid and accurate monitoring of TSM concentrations in water bodies is important for the control of water pollution [4].

Space-born data hold a significant role in monitoring and assessment of the water quality of lakes. The Case 2 Regional CoastColour (C2RCC) processor is a powerful tool that can be used to retrieve water quality parameters, such as the TSM. The processor is comprised of a set of neural networks which are trained on simulated water-leaving & top-of-atmosphere radiances and are used to perform the spectrum inversion for atmospheric correction and & the retrieval of the Inherent Optical Properties (IOPs). The radiative transfer simulations include the full ocean and atmosphere system (a specific water model is included in the simulations). C2RCC is used to generate the Case-2 water products which are the IOPs (absorption and scattering) and the concentrations of the different constituents. The three major optically relevant concentrations are chlorophyll-a, Total Suspended Matter, and Yellow Substance [5].

2. DATA AND METHODOLOGY

Total suspended matter was investigated and mapped for the cold/wet period of the year from mid-October to the end of March and the warm/dry period from April to October for each lake. For this purpose, Copernicus Sentinel-2 MSI Level-1C high spatial resolution satellite data were acquired for dates classified as the coldest months (January-February) and the warmest months (July-August) **(Table 1)**. Firstly, the Sentinel-2 images were preprocessed (resampling to 10m, subset) using the open source ESA SNAP software and then they were processed using the Case 2 Regional CoastColour (C2RCC) processor available in SNAP. This is an algorithm that relies on the Inherent optical properties (IOPs) of water for the final calculation of the TSM concentration. During the implementation of the algorithm, temperature, atmospheric pressure, and altitude data of the lakes were used to parameterize the algorithm. The result is a new product that contains the TSM concentration in g/m3 ("conc_tsm"). Then, for the visualization of each "conc_tsm" product, a colour palette was applied and the file was exported in .kmz format. The mapping of TSM concentration was performed in QGIS software. The TSM concentration was successfully calculated by the C2RCC algorithm.

Table 1. Acquisition dates of Sentinel-2 MSI Level-1C data

Lakes	Dates (wet period)	Dates (Dry period)
Lake Yliki	01.03.2022	16.08.2022
Lake Marathonas	19.02.2022	28.08.2022
Lake Mornos	24.03.2022	16.08.2022

3. RESULTS

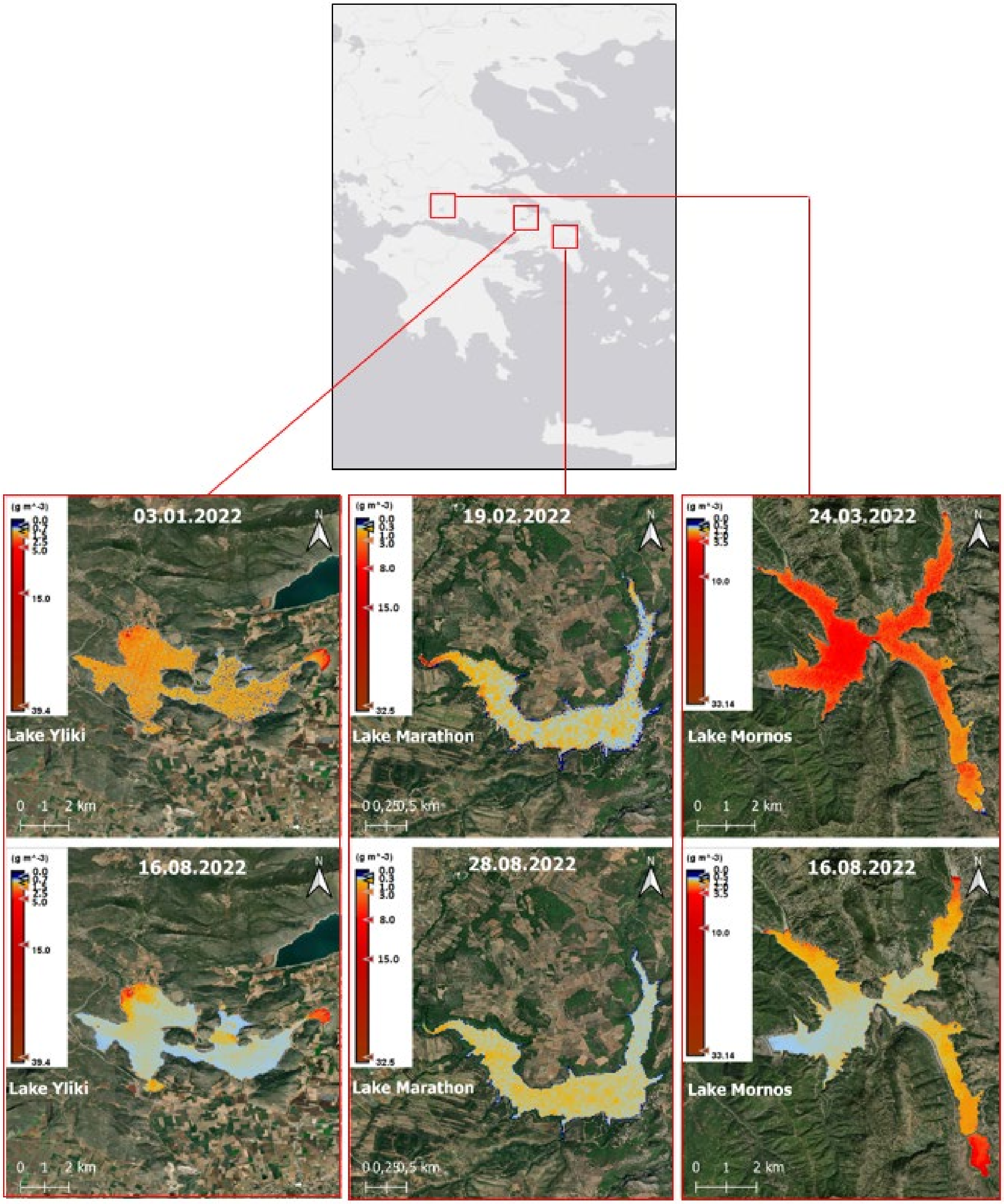

Figure 1. The Total Suspended Matter (TSM) concentration after applying the C2RCC algorithm on Sentinel-2 Level 1C data

- For Lake Yliki, on 3/01/2022 the highest TSM concentration is observed mainly on the eastern side of the lake as well as on the NW side with a range between 1.5 and 20 g/m3. The high concentration of TSM is also observed at the same points for the dry season image on 16/08/2022.

- For lake Marathon, on 19/02/2022 the concentration of total suspended matter is quite high in the western part of the lake with a range between 1.0 and 15.0 g/m3. On 28/08/2022, the concentration of TSM has values ranging from 0.3 to 1.0 g/m3 throughout the lake.

- For Lake Mornos, on 24/03/2022 TSM concentration is high throughout the lake, with the highest values corresponding to 2. 0 to 15. 0 g/m3. On 16/08/2022, TSM concentration is high mainly around the banks with values ranging between 3.5 and 10 g/m3.

4. CONCLUSIONS

- The maximum TSM concentration in the three lakes exceeds the limit of 25 g/m3 set by Directive 2006/44/EC of the European Parliament and of the Council.

- In the wet season, higher TSM values are found throughout the three lakes than in the dry season in the study areas

- According to the TSM concentration results in the three lakes, the highest TSM values are found in Lake Mornos in both the wet and dry season.

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AN INTEGRATED PLATFORM FOR NATURAL HAZARD RISK MANAGEMENT AT LOCAL LEVEL: THE LOCALPRO PROJECT

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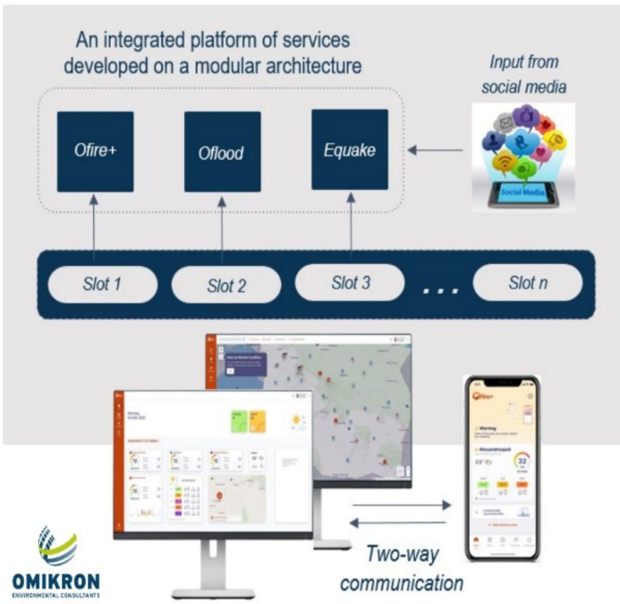
ABSTRACT
According to the Law on Civil Protection (Law 4662/2020), the first and second level local authorities of the country have important responsibilities in terms of reducing the risk of natural disasters at the local level, in order to reduce risk and strengthen resilience. In this context, the LocalPro project, funded by the Innovation Investment Plans of the Region of Central Macedonia, aims to create a single technological platform for local risk management of specific natural disasters, such as wildland fires, floods and earthquakes. Within this framework, an online platform is being created to manage and facilitate the operational processes of the country's municipalities and regions, as defined by the national civil protection legislation for civil protection against natural disasters and the resulting social responsibility. At the same time, the design of the platform allows for easy configuration with functions facilitating the unique operational characteristics of local businesses, working within tourism and other secotrs, as well as can fascilitate their connection to local government before, during and after crises resulting from natural disasters. Herein, we will present the architecture and the development logic of the aforementioned platform.

Keywords: Civil protection, natural disaster risk management, local authorities, wildland fires, floods

1. INTRODUCTION
Throughout the world, local authorities are responsible for operational functions, obligations and civil protection tasks that are of paramount importance for the protection of life, property and the local economy. According to the recent Greek legislation on Civil Protection (Law No. 4662/2020), the first and second level local authorities of the country have important responsibilities in reducing the risk of natural disasters and in including necessary actions/ procedures in prevention, preparedness, response, rehabilitation and feedback to reduce risk and increase resilience of local communities. Such procedures are, among others, crucial to local infrastructures mainly for the protection of life and assets, so immediate and efficient risk management is necessary. New technologies and automated tools can contribute to the digital transformation of these processes, enabling local authorities and local businesses to implement their civil protection plans more efficiently.

The LocalPro online platform includes features to facilitate horizontal processes and actions, such as direct communication, two-way information, reporting and awareness, as well as early warning for preparedness and guidance of safety personnel, field crews and civilians through an interconnected mobile application. In addition, the LocalPro platform has the potential to be expanded with specialised tools, based on the latest scientific methods and solutions, for managing local risk from specific natural disasters such as wildland fires, floods and eathquakes. The basic parts of the system are the web application and the mobile application, which are complementary and the communication channel they create is the main advantage of the product. Specifically, the platform combines a web, administrative interface, where the safety responsible of a local or any other public or private authority can manage all the functions and information, with a mobile application for users, through which they receive information and which facilitates the communication with the "administrator". Users of the mobile application could be local civilians, visitors or even volunteers.

2. ARCHITECTURE



The design of the platform already allows its extension with the Ofire+ specialised commercial tool, which is a local risk management tool for wildland fires [1]. Now the consortium aims to develop two more tools that will be integrated as extensions to the LocalPro platform; one for local risk management with floods (Oflood) [2] and one for seismic phenomena (eQuake). The platform is designed so that it can be easily configured at a later stage to meet the specific local, environmental and administrative needs of other local authorities in Europe, as well as similar businesses, ensuring the ability to transfer and grow in markets beyond Greece.

Figure 1. *Modular architecture of LocalPro platform*

2.1. Functionality

The system includes two interdependent parts, the web interface for the "Administrator" and the mobile application interface of the "Users". In addition, the system is composed of a horizontal platform of civil protection functions called LocalPro, and two separate extension tools with specialised flood and earthquake functions called Oflood and eQuake, respectively.

The web-based interface of the LocalPro horizontal platform for the Administrator includes the following functions/ information:

- an interactive map of the area of interest on an appropriate base map, depicting the critical local infrastructure;
- display on the map of critical points related to civil protection crisis management;
- display on the map of the mobile device snapshots that can be sent by the registered users of the mobile application;
- text messaging for registered and non-registered users of the mobile application;
- display of detailed maps of static risk/ vulnerability to wildfire, flood [3] and earthquake events;
- data on wildland fire, flood and earthquake events of the previous week;
- weather forecast, and
- image from free live camera sources.

The mobile application that accompanies the LocalPro horizontal platform includes the following functions/ information:

- user registration;
- an interactive map of the area of interest on an appropriate base map, depicting the critical infrastructure of the area as previously described;

- display on the map of critical points related to civil protection crisis management as previously described;
- display on the map the location of the user's mobile phone,
- ability to send a message/ flag to the administrator in order to report an incident and/ or a problem related to civil protection issues from a drop-down, specific list;
- display of detailed maps of static risk/ vulnerability to wildfire, flood [3] and earthquake events;
- weather forecast, and
- automatic calls to emergency numbers.

2.2. Architectural model

Architectural design [4] starts with the design of the data and continues with the production of one or more representations of the system's architectural structure. Alternative architectural styles (models or templates) are analysed to deliver a structure that corresponds to the customer's requirements and the quality characteristics of the system. The system architecture is then designed using the appropriate architectural design method. There are three main stages in the architectural design process, which are (a) system structuring where the system is broken down into different subsystems and the communication between the subsystems is determined, (b) control modelling where a model is created to control the relationships between the different parts of a system, and (c) structural analysis (modular analysis) where the subsystems are broken down into building blocks. In the case of the LocalPro platform, all relevant architecture models were evaluated and the "layered architecture" was chosen in which multiple layers are defined, each of which achieves different functions. The general outline of the layered architecture is shown in the following figures.

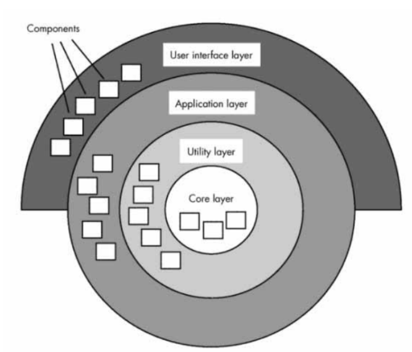


Figure 2. *Multilevel Architecture [4]*

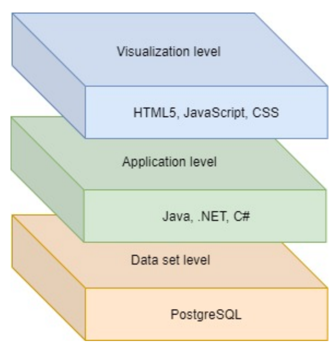


Figure 3. *Multilevel backend pipeline of LocalPro*

2.3. Backend automated pipeline

At the lowest data level, a PostgreSQL™ installation is used to import the data that LocalPro needs to process on a daily basis, whether generated internally or from external sources. At the application level, a Tomcat® web server linked to the J2EE™ java™ ecosystem is used to process the cartographic data, perform the necessary mathematical calculations, convert the cartographic numerical data into images and carry out the visualisation level. The visualisation layer, which is essentially what the end user sees and manipulates, is structured in the javascriptTM ecosystem and works within the web browser, either on PCs or "smart" mobile devices. Communication between the layers is done using standard web technologies such as TCP/ Ajax/ XML. The architecture of the whole system is shown in the diagram below.

3. RESULTS

The main outcome is the entry of the consortium into the national market of natural disaster management systems, using both new technology tools and specialised scientific methodologies. The implementation of LocalPro project leads to the development of three combined products, namely (a) the integrated technology web platform of LocalPro and the extension tools with additional specialised risk management functions based on local characteristics of (b) floods (Oflood tool) and (c) earthquakes (eQuake tool). The overall objective of the production system is to improve society's resilience to natural disasters. In addition, the LocalPro platform will be linked to the existing Ofire+ extension tool, which is a commercial product of OMIKRON Environmnental Consultants SA and aims to manage the risk of rural fires based on local conditions.

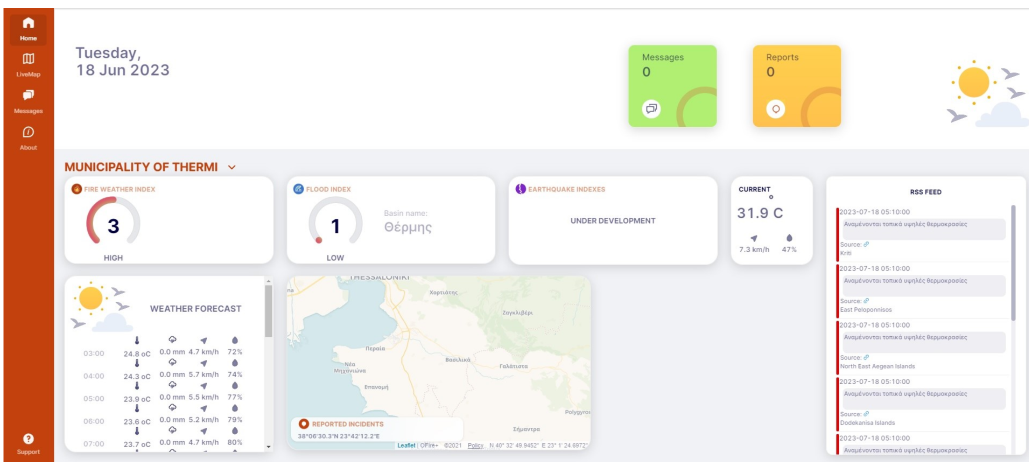


Figure 4. LocalPro web platform interface

Figure 5. LocalPro mobile application interface

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European Union
REGION OF CENTRAL MACEDONIA
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O.P. Region of Central Macedonia
NSRF 2014-2020
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A MAJOR ACCIDENT DATABASE: ANALYZING FORMAL DATA OF PAST CHEMICAL INCIDENTS TOWARDS MORE RELIABLE STATISTICS

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ABSTRACT

Major accidents involving dangerous chemicals pose high risks to health and safety of employees and the public. Such accidents continue to occur, fortunately at lower rates recently, in industrial establishments handling dangerous substances as well as in temporary storage sites, in transport networks and in all stages of supply routes. The analysis of past accident data and the extraction of useful indicators from reliable and comprehensive accident databases assist in identifying case-specific causes, event scenarios, consequence severity and preventative, control and mitigation measures. The accident database and e-platform titled "Report an Incident" was built as part of the LIFE15 CHEREE project carried out under the LIFE Environmental Governance and Information Component of the LIFE 2014-2020 Programme. It contains open-access utilities and an in-house accident database that allows the consultation of accident data and the extraction of useful information related to more than 600 past accidents involving dangerous chemicals. The e-platform supports the analysis of accident data formally notified, the evaluation of indicators, the extraction of accident statistics, the consultation in recordkeeping and the analysis of accident causes and effects. The architecture of the platform provides flexibility in analyzing the data included in the database since, an analysis and verification of all accident data has been performed prior to inserting them in the database, follwing a structured codification in data entering. The aim of the database is to provide an e-platform open to the public for the systematic collection of information on past accidents and for allowing searching and analysis of formal accident reports, extraction of lessons-learnt and of information on tailor-made preventative, controlling and mitigation measures. Reliable accident data assist in higher quality safety studies, in further improvements of best practices and safety and ultimately avoiding recurrence of accidents.

Keywords: Accident database, e-platform, Dangerous chemicals, Accident prevention, Health and safety

1. INTRODUCTION

The accident database and e-platform titled "Report an Incident" has been developed as a web tool according to the LIFE15 CHEREE project provisions for recordkeeping and analysis of accidental spills and injuries. Its functional specifications are similar to the e-MARS notification system (https://emars.jrc.ec.europa.eu/en/emars/content) operated by EC for major accidents. The accident e-platform provides a high level of disaggregation by clustering the accident information in codified data fields referring to details on e.g. accident circumstances, different consequence types, direct and indirect causes, intervention methods, measures taken to avoid recurrence of accidents and limit their consequences, etc. The principal objectives of the platform and the database are among others, to provide evidence in identifying safety problems and accident causes, in quantifying failure characteristics and effects, to allow the exchange of experience in accident analysis and prevention, to indicate the effectiveness of safety measures taken per incident case and to provide evidence on response efficiency and legislation compliance. The primary distinction between “Report an Incident” e-platform and other major accident databases is that it operates with all its functions both in Greek and English. The platform contains the only known structured database in Greece providing data of EU major accidents analysed and verified in Greek. Its architecture provides maximum flexibility and capacity for analyzing the information included in the whole system of clusters offering a quick overview of the accident via its utilities and contents of the accidents' "Short Reports". The e-platform contains today more than 600 verified EU major accidents with full and short reports. Major accidents involving dangerous substances are of different nature and type including safety related industrial incidents, chemical releases, other accidents or near misses, etc. The e-tool has been developed according to the specifications envisaged aiming at satisfying the needs of SEVESO [1] authorities and safety consultants for a reliable Greek reference on major accidents data.

2. ARCHITECTURE OF THE DATABASE

The "Report an Incident" platform is installed in a dedicated server of TUC's CEIS Lab (*Laboratoty of Cognitive Ergonomics and Industrial Safety)* which is responsible to operate/maintain and regularly update the database. The e-tool is based on the functional specifications and structure of the major accident notification system of the European Commission (e-MARS). The notified data of all inserted accidents before being registered are analysed, checked, verified for errors and consistency. The notification forms of the platform contain a codified list of exhaustive choices (multiple choice) per thematic item providing reliable event information in the "short-" and "full- report" sections by using a number of forms which refer to data on the accident type, the substances involved, the causes and consequences, the emergency measures taken (including response and remedial actions) and the lessons learnt. More specificaly, the accident reports are structured in forms according to the EC major accident notification system. Each accident report is divided in 3 parts:

- **Incident profile:** In this section some general information concerning the accident are provided such as; the Title of the accident (date of occurrence of the accident), Type of the incident, the Date and Time that the incident occurred, along with information concerning the Reporting party and some additional information and comments. Confidential information such as companies' names and locations are not identified to avoid cultivating a blame culture. This information comprises the identity of the incident, part of which is obligatory as clearly indicated in the relevant fields.
- **Short report**: The short report provides a quick overview of the accident. In the short report section, one can find a brief presentation of the accident. All the important information that constitute each accident such as the accident types, sources of the incident, information about the substances directly involved, suspected causes and immediate consequences, emergency measures taken and the lessons learnt, are all summarized in the short report.
- **Full report**: In the full report section, a detailed description of all the different aspects that comprise each incident is provided. This section is divided in 3 subsections; the Occurrence subsection, the Consequences subsection and the Response subsection. Considering the importance of the details concerning the occurrence of an accident, the Occurrence subsection is further divided in 7 separated forms presented below:

Type of incident: In this form, the Type of the incident is described. There are 6 different options concerning the type of the incident; Release, Fire, Explosion, Transfer, Transport and Other. Main Occurrence events and Initiating events for each of these types are provided.

Dangerous Substances: In this form, all the substances involved in the accident are presented. More specifically, the form includes a General description of the substances involved in the accident, their proper classification depending on the Regulations in action at the time of the incident i.e. Classification of the substances according to CLP Substance Classification Regulation (EC) No 1272/2008 and other classification-Hazard Indexing, along with a more detailed description of the substances directly and indirectly involved providing information such as the substance CAS number and the quantities of each substance directly or/and potentially involved.

Source of incident: In this form, the Source of the Incident and the Relative Industry to which the site/establishment belongs, is presented.

Installation/unit description: In the Installation/unit description section, the main occurrence and initiating events of the accident under investigation and the main components involved are presented. The form provides 5 main options regarding the occurrence events; Storage, Process, Transfer, Transport, and Other, while options concerning the type of transfer medium and impact, crash, derailment options are also provided.

Meteorological conditions: In this form, the possible Meteorological conditions/ environmental factors that may facilitated or led to the accident occurrence are considered. Different factors like Precipitation, Wind, and Other causative factors such as Temperature and Sudden changes in meteorological conditions are provided.

Causes of Occurrence: In this field the Causes of the accident are presented in great detail. The form provides a General description of the causes that led to the accident occurrence and precise choices of its causative factors. The causative factors are separated in Plant/Equipment, Organizational, Human and External causative factors providing a detailed account of what really happened.

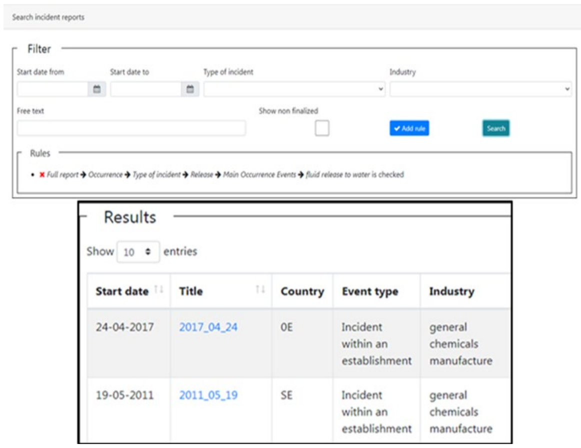
Discussion and contacts: In this form, information about Carrier, Supplier and Client details are presented. For confidential reasons this form is intentionally left blank.

Moreover, in the Full Report, Consequences and Response subsections are presented;

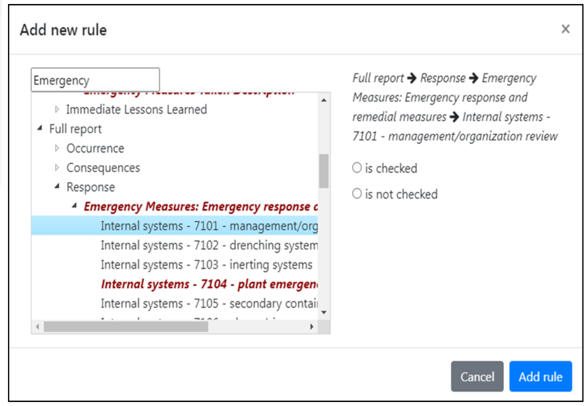
- **Consequences:** This section includes a General description of the consequences, options to determine the Affected or Threatened areas and detailed options regarding the on-site and off-site consequences on Humans, Ecological components, National Heritage Loss, Cost, and Disruption of community life.
- **Response:** The last section of the Full incident report is the Response section. In this section, the Emergency measures, both on-site and off-site, the Initial detection method and the Commanders involved are fully presented.

3. RESULTS AND DISCUSSION

More than 600 major accidents have been analysed, verifiled and inserted (as pilot cases) in the platform database and are available online today. The potential user, whether from an SME, industry, body or Authority, who just wants to collect detailed and reliable information on EU accidents involving chemicals, e.g. in relation to SEVESO requirements, can browse within a wide variety of notified and verified events in both Greek and English and draw relevant knowledge and stastistics. The database contains reliable data and event reports, with referrence to accident type, physical or chemical processes and their conditions, detailed information on accident causes, type of consequences and response measures applied. The platform user interface is an online form that allows for searching in the text and fields of the accident short and full reports, having specific attributes. The basic search contains search parameters for the start and end date of the incident, the event type and the industry. For more advanced searches, the form allows to add additional rules for all options of the reports. The screenshot below (Figure 1a) shows the search form from the perspective of a user. One rule has been added, requiring that the following are checked: Full report → Occurrence → Type of incident → Release → Main Occurrence Events → fluid release to water. The following screenshot (Figure 1b) shows the dialog that allows to add a rule. In this example, incidents that include Management/Organizational Review as an emergency response measure will appear in the screen if the user selects the “is checked” field. Otherwise, all incidents that do not involve this emergency response measure will appear if the "is not checked" filed is selected.



(**a**)



(**b**)

Figure 1. (**a**) Search form from the perspective of a user; (**b**) The dialog that allows to add a rule.

All the above-mentioned features and functions along with snapshots of statistics clearly indicate that the developed platform and accident database provides a user-friendly interface that can be readily used by registered users.

4. CONCLUSIONS

Accurate and up-to-date accident data is crucial for emergency response preparedness in the event of incidents involving dangerous chemicals. By maintaining an accident database such as the developed platform "Report an incident", authorities can identify the types of accidents, the chemicals involved and the response strategies that were effective or lacking. This information is invaluable in training emergency response teams, developing response protocols and ensuring the availability of appropriate resources and equipment to handle chemical spills, leaks, or accidents promptly and safely. The e-tool has been developed according to the specifications envisaged aiming at satisfying the needs of SEVESO authorities and safety consultants for a reliable Greek reference on major accidents data. It is readily available to be utilized as an independent reference database that can be consulted with added value in accident analysis, causes, conditions and recommendations. It can be further utilised when reliable accident data are necessary for the development or/and assessment of SEVESO Safety Report, for the compliance of the SEVESO stakeholders and for the inspections and audit practices performed by SEVESO authorities. Overall it can provide a useful reference database for major accidents involving dangerous substances.

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ARMED ATTACKS ON EDUCATIONAL INSTITUTIONS: A GLOBAL PERSPECTIVE

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ABSTRACT

This study investigates the occurrence of armed conflict inside educational institutions, including schools and universities, across several global regions. These occurrences may include acts of aggression using weaponry or other hazardous items, often resulting in severe ramifications for anyone associated with educational establishments, including students, instructors, and staff members. The specific figures and occurrence rates of these occurrences exhibit variation across different countries and time periods. The causes for these assaults exhibit a range of factors, including mental health issues, societal disparities, as well as political and social tensions. The issue of security in educational institutions continues to be a significant concern, necessitating collaborative efforts from communities to effectively tackle this problem via the implementation of preventive measures and security protocols.

This study presents findings derived from a comprehensive literature review encompassing peer-reviewed international journals as well as print and online publications. The evidence gathered indicates that numerous countries and regions have documented instances of gun violence occurring within educational institutions. Furthermore, these incidents have elicited varying degrees of apprehension and responses from both the community and governing bodies. The present argument posits that the fluctuation in gun violence inside educational institutions is contingent upon a multitude of elements, including social, economic, and political dimensions. The collaborative efforts of authorities, educators, and the community are often used to enact strategies aimed at mitigating and addressing incidents of gun violence inside educational institutions. These endeavors are undertaken with the primary objective of enhancing the overall safety of both kids and school personnel.

The subject of concern is on the occurrence of armed violence incidents against educational institutions, including schools and universities. The primary focus is to understand the underlying motives behind such assaults and explore potential security measures to mitigate these threats.

Keywords: armed violence, attacks, schools and universities, motivations, security measures

1. INTRODUCTION

This study is a first approach to the serious issue of gun violence in educational institutions worldwide. This particular phenomenon is particularly worrying and affects the whole of society, as it is not limited to the borders of a country or a continent but has global dimensions. The number and frequency of these incidents vary by country and time period, for this individualized solutions are required, while in order to take effective preventive measures the motives of the perpetrators should also be studied. Safety in educational institutions is a priority for all democratic societies and to achieve this requires the cooperation of all of us.

2. MATERIALS AND METHODS

Our research was based on two main methodological axes: **the bibliographic review and the review of printed and electronic publications.**

Specifically, for the bibliographic review, the topic was first defined, after we first recognized the importance of the phenomenon of armed violence in educational units. This was followed by the selection of keywords related to our topic. We then searched for scientific papers and relevant bibliographic references in databases and libraries of academic institutions.

For the review of printed and electronic publications, in the first stage, the relevant publications were searched and followed by the evaluation of their reliability, accuracy and scientific value, and then we proceeded to record the main points, the research methodology and the results.

In this way, we integrated elements from scientific papers, presenting overall findings and composing an overall picture of the subject.

3. RESULTS

The phenomena often referred to as "school shooting" may be defined as instances of armed violence occurring inside educational institutions, typically involving the use of firearms by individuals who are either current or former students of the school in question. The term "school shooting" refers to an occurrence whereby an educational institution, ranging from elementary schools to universities, experiences an armed assault including the use of firearms. Certain incidents may also be classified as mass shootings, if they include several victims [1]. The occurrence of this phenomenon is most prevalent in the United States, where it has been shown to have the greatest incidence of school-related shootings. However, it is important to note that comparable phenomena are now being seen in several other places around the globe [2].

When a teenage kid in Tourquein, France, was murdered by a pistol he had taken to school in 1998, sociologists, politicians, and educators were eager to blame it on the spread of American norms on European land. "I don't want the United States to export its violent culture." "We are not a country of cowboys and gangsters," remarked French Education Minister Claude Alegre at the time [3]. Of course, numerous violent incidents in Germany, Russia, France, Finland, and other European countries have gradually forced many of the old continent's leaders to admit that mass murder and armed attack in places of education (primary, secondary, or university) is not solely an American phenomenon, as mentioned in a Washington Post article [4].

A cursory examination of the deadliest events of the twenty-first century in Europe [5] confirms the above depressing fact. In April 2002, a student who had been expelled from Erfurt High School (Germany) fatally shot 16 persons (13 instructors and 2 pupils) before killing himself. Two years later, Europe (and all of mankind) saw the worst catastrophe of all time: an armed assault on a school. On September 3, 2004, highly armed Russian security forces invaded a school in Beslan, Russia, where more than 1,000 people (teachers, parents, and kids) had been held hostage by Chechen terrorists since September 1. Two huge explosions shook the school's gymnasium, causing the roof to catch fire and subsequently fall. The hostage crisis ended in unfathomable horror, with 333 individuals killed, including 186 children. More than 700 people were hurt, according to estimates. Finland was in the epicenter of the violence in the two years 2007-2008, with tragic episodes at Jokela High School (with 9 casualties) and the University of Applied Sciences in Kauhajoki (with 11 victims). It should be highlighted that the Werther Effect was certainly present in the second instance, since the offender was "inspired" by the first murderer [6]. In March 2009, Germany had a second shock (after Erfurt) when a 17-year-old massacred 15 people at a Technical High School in Winenden before dying himself following a struggle with police. In 2011, the world was startled by the devastation perpetrated by far-right terrorist Anders Breivik, who slaughtered 69 youths aged 14 to 19 on the Norwegian island of Utoya. Breivik detonated a large explosive device in a vehicle bomb in Oslo on July 22, 2011, before the mayhem started, killing 8 people instantaneously. Then he proceeded to Utoya, where 600 youngsters were attending summer programs. He summoned all the youngsters to come around him, presumably for a customary inspection after the Oslo attack. He got out his weapon and started shooting indiscriminately when the kids heeded his lethal commands. The police came after 90 violent minutes, and Breivik surrendered softly and freely. In March of the following year, an Islamic terrorist spread murder by killing three children and a teacher at a Jewish day school in Toulouse, France. The infamous Kerk Polytechnic massacre in Russia occurred in 2018, with 21 victims; in 2022, a former inmate of a mental hospital, a neo-Nazi and zealot of the 1999 Columbine High School massacre, broke into a school in the city of Izhevsk and opened fire, killing a total of 15 people, many of whom were children. In truth, he was a graduate of the institution in question. The tragic conclusion to the European drama thus far was written about four months ago, in May 2023, in a primary school in Belgrade; the thirteen-year-old attacker had planned his attack, which claimed the lives of ten people, after a list of the students he wanted to kill, as well as the History teacher who received his merciless fire.

Similar armed and lethal assaults on educational establishments have occurred on other continents, including Asia. The terrible terrorist assault on a school in Peshawar (Pakistan) [7] by 9 Pakistani Taliban lasted eight hours; the tragic toll of the incident included 141 fatalities, including 9 instructors and 132 children and teens aged 10 to 20. at October 2022, at least 34 people were slain at a childcare facility in Nong Bua, northeastern Thailand, by a former police officer who, after finishing his horrible act, killed his wife and kid and committed himself. In April 2009, a 29-year-old man opened fire with a semi-automatic handgun inside the Azerbaijan State Petroleum Academy's classroom building, killing 12 people and injured 13 others before shooting himself in the head. In the March 2008 gun assault on a religious school in Jerusalem, 9 more innocent people were killed.

In terms of armed assaults on educational establishments, the African continent's worst three years were 2013-2015 [8]. Between 2013 and 2014, 145 innocent persons, largely students and students, were killed in three armed assaults in Nigeria, one on a school and two on universities. On 3 April 2015, 147 people were killed when Somali Islamist Shebabs chose to kill innocent students in order to humiliate the government; the attack ended in the evening when, amid heavy exchanges of fire, four attackers detonated the explosives to which they were strapped.

Canada seems to have experienced no mass-death assaults on educational institutions in the twenty-first century, with the exception of the horrible tragedy at Montreal's Ecole Polytechnique in December 1989 (which took 15 lives). The January 2022 assault is important; two people were murdered and seven others were wounded when a 17-year-old student opened fire inside La Loche Community School. The suspect shot and murdered two of his cousins before the school incident.

To conclude this selective - for the sake of this study - review, it is Greece's turn, where, thankfully, except from a few sporadic incidences of knife possession in students' backpacks (mostly in high schools and high schools), there has been no known deadly armed assault in places of learning. The lone tragic exception is the example of D P, a 19-year-old student who came into the OAED school in Petrou Ralli armed, opened fire on a classmate (whom he gravely hurt), and then committed himself in a nearby park. The extraordinary episode occurred in Greek history in April 2009 [9].

4. DISCUSSION AND CONCLUSION

It is almost obvious that such a recurring, abhorrent, and macabre phenomenon cannot be the result of a single cause if we exclude the cases of mass murderous attacks on educational sites that were carried out by (organized or not) terrorists primarily for political, social, and economic reasons (such as in Beslan, Peshawar, Garissa, and, sadly, many other places). Most likely, a wide range of causes contribute to such terrible events. The body of research has identified some of the primary drivers [10] that, when taken together, typically [11], may equip the (adolescent) offender in educational settings. - The references are in a random order:

- Inflexible and ineffective law

- Prolonged and in-depth watching of news reports and social media posts about mass murder incidents.

- Violence is often shown in video games

- Absence of parental guidance and care - Mental disorders

- Social marginalization or isolation

- Experiencing intimidation or bullying

At this point, it is important to draw attention to an innovative method used by Kiilakoski, T., & Oksanen, A. (2011) [12], who analyze the genres of books, movies, and music that school shooting perpetrators "consume." Examining how certain cultural items are woven into the scenario of armed assaults on educational institutions is of interest. The 46 films that the Finnish high school shooter Jokela left behind include music that is examined in the context of the cultural script of execution. In addition to being intrigued by historical events, school performers are often fans of related cultural items. As the offenders continually look for lyrics that support the notion of revolutionary violence, music is actively exploited as a source of reference.

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ASSESSMENT OF NATURAL DISASTERS AND CLIMATE CRISIS, GREECE 2020 - 2022

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ABSTRACT

The purpose is to initially evaluate if there was a "satisfactory" estimate of natural disasters number [except earthquakes] in Greece during 2022, with a relatively simple prediction tool. Hence, in addition an attempt was made to estimate number of disasters per year, up to 2030[1]. The assessment was performed in the paper *"Natural disasters & climate crisis in Greece from 2000 to July 2022"* and presented at the Safe Thessaloniki 2022 conference. There were two approaches in estimating the CD and possible number of disasters. One with disasters from 2000 to July 2022 and one from 2012 to July 2022. The criterion for including a disaster in the calculation was/are the effects of the phenomenon on the anthropogenic and natural environment (life-casualties, impact on infrastructure & environment). By July 2022 fifteen (15) events were considered as significant disasters and were used for a preliminary estimation. According to the simple estimation model, a better CD was obtained in the tests with the number of disasters from 17 to 25 for 2022. Finally, 21 disasters for 2022 were used, indicatively, to estimate the number of disasters for the following years until 2030. All-natural disasters for the year 2022 are now recorded, assessing, as mentioned, their effects on the anthropogenic and natural environment as a criterion. They are considered to be 27, slightly exceeded expectation.

Keywords: Disasters, climate crisis, prediction, temperature rise, Mediterranean Sea, legislation, environmental impact.

1. Climate Crisis - Worldwide data & Mediteranean sea

1.1 It appears that 2022 was a year rich in extreme weather events and natural disasters. The WMO (World Meteorological Organization) climate report stated that the global average temperature in 2022 is so far estimated to be about 1.15 – 1.2°C above pre-industrial levels (figure 1). The UN warns that the world has experienced 350-500 medium to large-scale disasters every year for the past 20 years, according to a report published on March 26, 2022. That is five times higher than in the previous three decades [the Global Assessment Report (GAR 2022) was released by the United Nations on March 26, 2022]. According to the intergovernmental organization, the rapid increase in the frequency of disasters can be attributed to the climate crisis and inadequate risk management & volnerability [1, 4, 10].

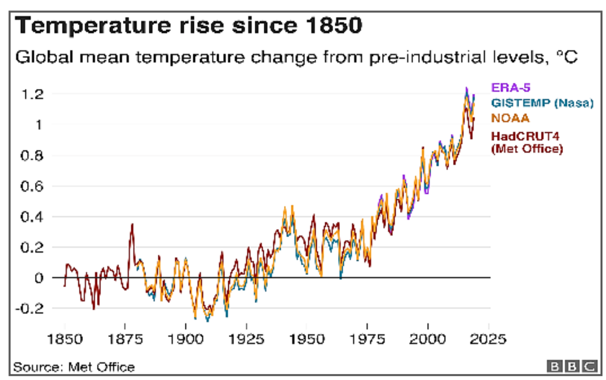
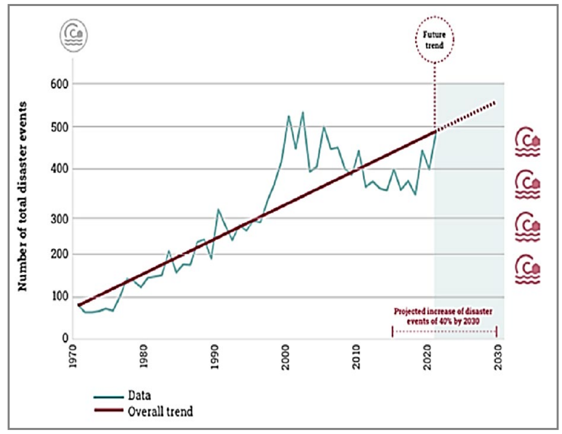


Figure 1

[1] The Coefficient of Determination is calculated and evaluated [CD] - R^2: The coefficient of determination is a number between 0 and 1 that measures how well a statistical model predicts an outcome. The CD is often written as R^2, which is pronounced as "r squared." 0 - The model does not predict the outcome. Between 0 and 1- The model partially predicts the outcome. 1 - The model perfectly predicts the outcome, https://www.scribbr.com/statistics/coefficient-of-determination/



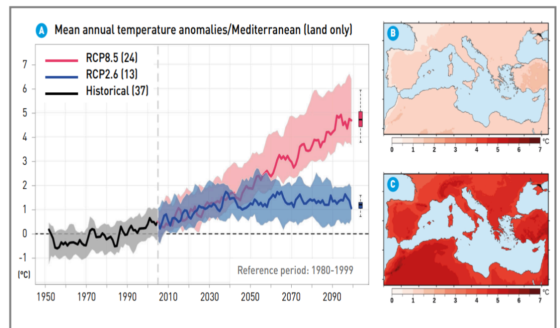


Figure SPM.2 | Projected warming in the Mediterranean Basin over land. Projected changes in annual temperature relative to the recent past reference period (1980-1999), based on the EURO-CORDEX 0.11° ensemble

Figure 2 Source: UN, GAR 2022, March 2 **Figure 3**

1.2 The diagram presents disaster events from 1970–2020 and projected increase in 2021–2030. It is included in the United Nations Office for Disaster Risk Reduction [UNDRR] analysis based on EM-DAT (CRED, 2021). World disaster events in 1970–2020 & projected increase in 2021–2030 via prediction trend line. It is estimated that, the world will face around 560 disasters every year by 2030 (figure 2]. The rapid rise in the disaster frequency can be attributed to climate crisis [could say acting as a catalytic factor] and inadequate risk management, according to IPCC. Note, there is no CD reported. Also, the trend lines (and polynomial approaches) do not consider future climate crisis impacts, accelerating the pace and severity of hazard events, nor the fact that current policy "choices" dictate that the world is set to exceed the Paris Agreement's global average maximum temperature increase target of 1.5°C by the early 2030s (IPCC, 2021, 10, 12).

1.3 MedECC (Mediterranean Experts on Climate and environmental Change) scientists report that the temperature increase in the Mediterranean basin has already reached 1.5°C + compared to pre-industrial levels. In 2040, according to their study, the increase is expected to reach 2.2°C and may rise to 3.8°C, for a high greenhouse gas concentration scenario, in some parts of the Mediterranean basin, by the end of the century (figure 3). The effects of climate crisis can be reduced significantly for a scenario compatible with the long-term goal of the UNFCCC Paris Agreement to keep the global temperature well below +2°C above the pre-industrial level and by the existence of wetlands [ie protect environment and stop emitting greenhouse gases hence eliminate fossil fuels-oil drilling] [1, 2, 14].

2 Disasters and assesment in Greece 2000-2022

2.1 According to the recorded events presented in the diagram, per year, for the period 2000 – 2022, it appears that there is a significant increase in extreme phenomena that led to disasters in Greece, especially after 2017-2019 [figure 4[2]] Apparently, climate crisis acts as a catalyst, but there are other reasons that lead to the increase in vulnerability[3] and disasters (prevention policies, no interoperability, coordination during operations, mixed urban forest /environments, building in flood zones-beds, Hence İncreased volnerability etc.) [1, 8, 11]

2.2 As far as the attempt to predict number of disastrous events, the following diagram 1, shows the prediction based on the recorded 15 events, until July 2022, from 2000 & 2012 to 2030 respectively. Polynomial analysis gives good results in both diagrams based on the coefficient of determination.

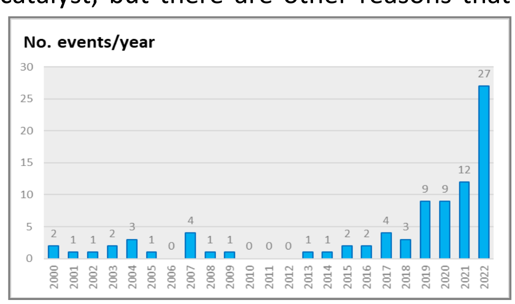


Figure 4

[2] Natural Disasters & Climate Crisis in Greece from 2000 to July 2022, Antonios Antoniades, Panagiota Fragalioti, Constantine Antoniades. Safegreece2022, Thessaloniki, October 2022

[3] Vulnerability: the conditions determined by natural, social, economic and environmental factors or processes that increase the vulnerability of a society to the effects of risks. [law 4662/2020]

Improved prediction for linear analysis for decade data.

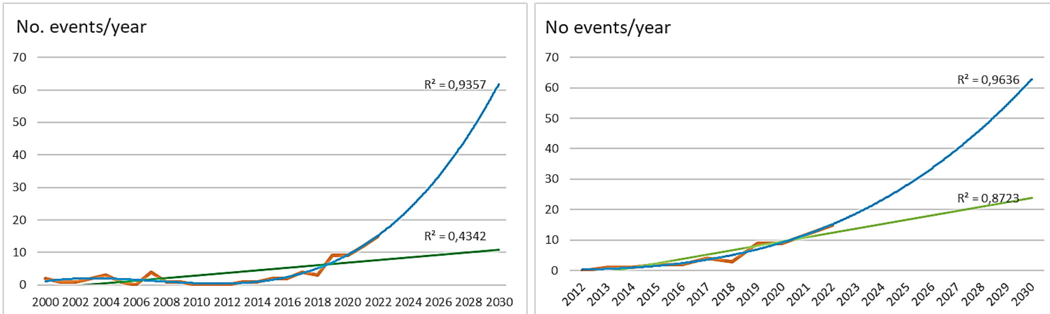
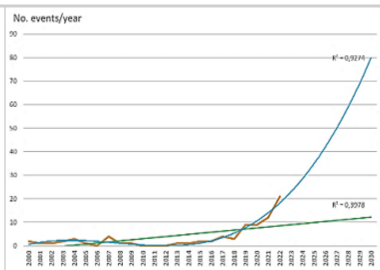
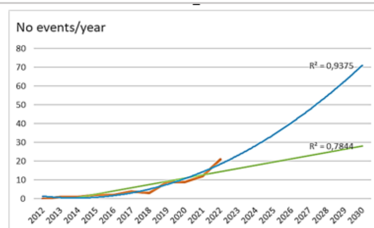


Diagram 1: Prediction based on the 15 recorded events until July 2022
(brown line: recorded events, blue polynomial analysis, green linear analysis)

b. Diagram 2 presents the prediction trend line and a polynomial regression analysis for an indicative number of 21 events Number of events[2]. It was observed that between 17 & 25 events, CD values are > 0,9 (best value for 17 events-0,9403. For 26 events then CD<0,9).



Since 2022 was not over an assumption was to expect a total of 17 to 25 catastrophic events. Number of events between 17 & 25 produced CD values > 0,9 [best value for 17 events-0,9403. For 26 events then CD<0,9]. *Here the trend line and a third-degree polynomial regression analysis are presented for 21 events.*



If data starting from 2012 [i.e. last decade] are used and the same, 21 number of events for 2022 are assumed, it appears that both prediction approaches produce a very good or good CD. However, there is significant difference in the predicted number of events. The polynomial regression analysis [blue line] results very good CD's [reaching 1] for other degrees as well [3rd to 6th] indicating a significant increasing number of events [very extreme hypothesis].

Diagram 2: Prediction for future number of disastrous events per year, based on an indicativley number of 21 events from 2000 & 2012

2.3 Diagram 3 shows the estimated number of disasters, based on the recorded 27 disasters for 2022. The start point is the year 2000 or 2012 for the following years up to 2030, respectively. The polynomial analysis gives better results based on the CD, while the linear analysis also shows improvement when using data only for the last decade.

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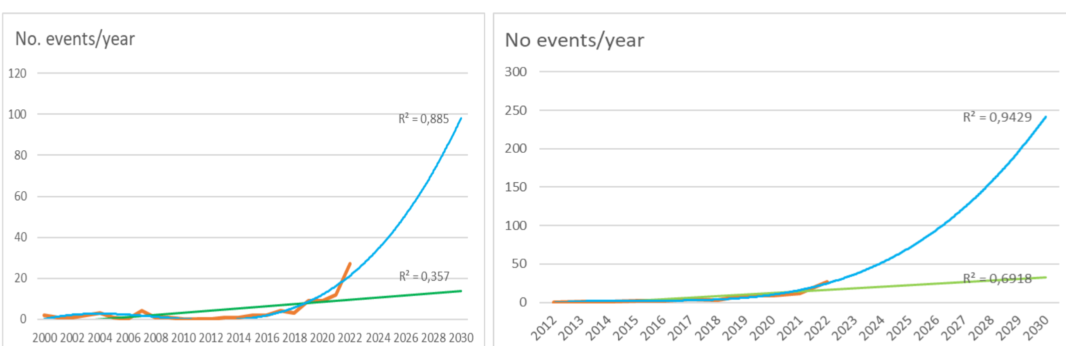

Diagram 3: Estimated disasters up to 2013 based on observed – evaluated events until 2022
(brown line: recorded events, blue polynomial analysis, green linear analysis)

3. Discussion – Conclusions

1. Based on described criteria, accounting from 2000 or 2012, it appears that for the examined year, 2022, there was a satisfactory prediction, since the catastrophic events reached a number of 27 (based on above mentioned criteria). Of course, there was already a number of 15 disasters until July, which probably helped to better estimate when the testing was done with various other numbers (17-25). **2.** When using the recorded number of disasters for 2022, the future estimated number of disasters / years, up to 2030, increases significantly, compared to the use of disasters (15) up to July 2022. **3.** An indicative conclusion is drawn that these phenomena are increasing both in frequency and intensity, causing disasters in a society insufficiently prepared to deal with. **4.** The best, theoretical, prediction estimates, when considering the 27 events of 2022, vary significantly in the number of expected events. For 2030, with CD approx. close and greater than 0.7, which is considered relatively good, the events are roughly between ~ 40 and ~ 240. It seems that the possible maximum number of disasters may be (?) overestimated when using the observed number of 27. It is noted that with 15 disasters up to in July 2022 the estimates, respectively, were for 2030, approximately, from 24 to 60. This discrepancy between the linear and polynomial model predictions, the relatively large difference in the estimation of possible events, as well as the possible maximum number of events is obviously problematic. It is not certain, based on today's data, that the events will reach such a number within the next seven years. What is certain is that the trend for more intense and often disasters is increasing for the next few years. If indeed catastrophic events increase significantly in the coming years, they may lead to disasters that will alter the natural and anthropogenic environment in a way that future large-scale catastrophic events, in the same form and areas, will not result in the same type of disasters (e.g. number of people lives lost, burned areas, economic impact, etc.). As a result, the increased frequency and type of disasters after a few years may not be what was predicted. However, other impacts due to climate crisis will occur and affect the environment (sea level rise, desertification, etc.), maybe in a chaotic pattern. **5.** Data from the last <10 years, or even less, may be more suitable for assessing probabilities, forecasting, planning and preparedness measures, as they account for increased number and intensity of disaster phenomena and point to the future. This indicates that disaster prevention, response & recovery projects should be done with recent years data with the most intense weather events. **6.** The country must prepare and adapt to handle, minimum and maximum number of events, and a variety of large-scale disasters in the near future. The role of the scientific community in the system of governance - policy implementation as well as measures to deal with - adaptation to climate crisis must be strengthened. It is critical that political will and legislation provide for, and ensure the operation of a single scientific body monitoring the country's progress towards climate neutrality with strong and meaningful responsibilities and enhance in every way civil protection. [1,8,12, 13]

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THE APPLICATION OF A HOLISTIC METHODOLOGY FOR THE SEISMIC RISK ASSESSMENT IN THE REGION OF ATTICA, GREECE

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ABSTRACT

The estimation of structural damage during a seismic event poses a challenge due to the incorporation of information and data regarding the seismic faults, geological formations, local soil conditions, composition and vulnerability of the building stock. Its significance becomes even more pronounced in densely populated urban areas, where there is a high concentration of population, buildings, critical infrastructure, and socio-economic activities. In this work we present the main results of the seismic risk assessment for selected municipalities of the Attica Region, conducted within the framework of the research project "Risk Assessment for Earthquakes, Fire and Flood in the Attica Region". The goal of this work is to aid decision-making among pertinent authorities and key stakeholders, to enhance seismic loss reduction efforts and to promote efficient disaster management practices.

Keywords: Attica Region, seismic risk, vulnerability, seismic hazard, earthquake disaster management

1. INTRODUCTION

The Attica Region is a key area with several particular characteristics, such as overpopulation, over-concentration of critical infrastructure and socio-economic activities, significant inland areas, and various geo-environmental units. At the same time, the area is prone to various natural hazards and has recently experienced catastrophic events, such as the Athens 1999 earthquake, the flood in Mandra in 2017, and the fire in Mati in 2018, all being examples of the tragic consequences of the combination of natural hazards and man-made interventions in the region. Reliable quantification of risk and design of mitigation measures in the Region are, therefore, more imperative than ever before.

Within the framework of the research project entitled "Risk Assessment for Earthquakes, Fire and Flood in the Attica Region", funded by the Region of Attica, we have conducted a systematic seismic risk assessment of selected municipalities in Attica. The municipalities that were included in the project for the seismic risk assessment (Figure 1) are Alimos, Glyfada, and Elliniko-Argyroupoli in Southern Athens, Heraklio and Nea Ionia in Northern Athens, Agia Varvara, Agioi Anargiroi-Kamatero, Aigaleo and Ilio in Western Athens, Aspropyrgos, Elefsina, Megareon and Fili in West Attica, Acharnes and Oropos in East Attica, Keratsini - Drapetsona in Piraeus and finally that of the island of Kythira. The project is divided into five phases, and the outcomes of the first four phases have already been submitted. The final phase, which marks the conclusion of the project, is scheduled for March 2024.

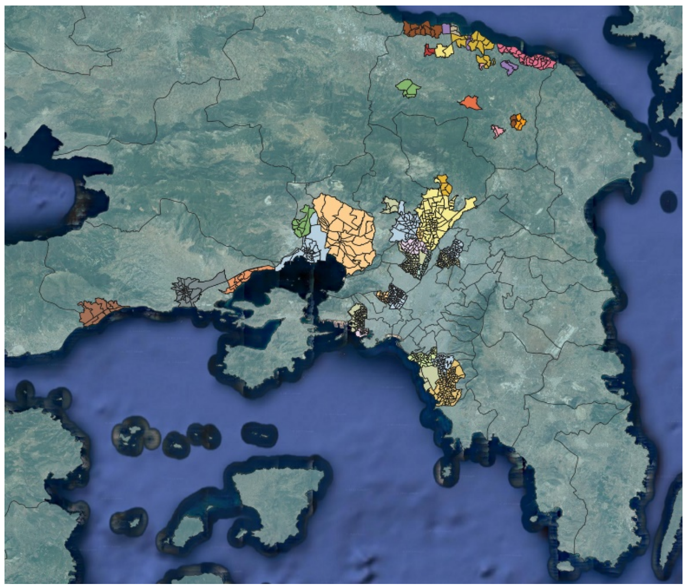
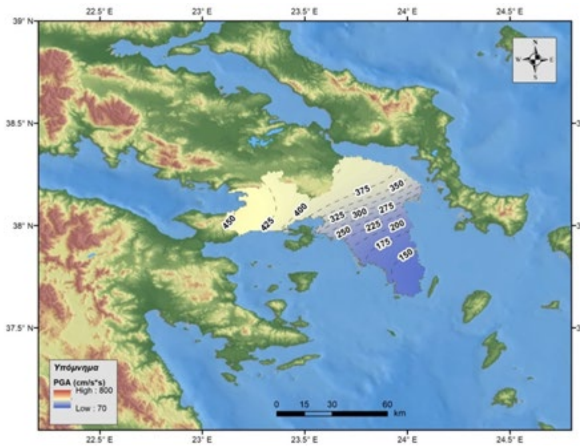


Figure 1. Study area

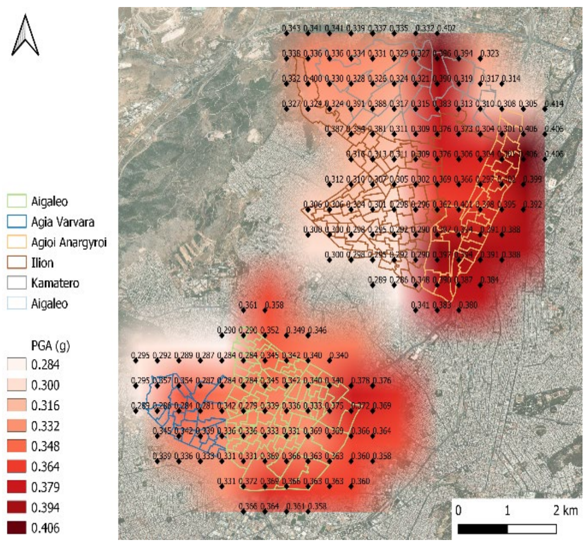
2. SEISMIC RISK ASSESSMENT

The methodological framework for the seismic risk assessment of the Attica Region, described in detail in [1], includes a preparatory phase consisting of (a) the probabilistic seismic hazard assessment for rock conditions (shown in Figure 2a for the whole Attica region, T_R=475yr), (b) the geological mapping of the study area (e.g. Figure 2b for the municipalities of Aigaleo and Agia Varvara), (c) the estimation of the amplification of seismic ground motion due to local site conditions (e.g. Figure 2c for the municipalities of the Regional Unit of West Athens) and (d) the development of appropriate exposure models for the building stock (e.g. Figure 2d presents the seismic code design level distribution of the building stock in the selected municipalities of West Athens). Then, applying appropriate fragility and vulnerability models [2], the final risk estimates are derived, which include the spatial distribution of physical losses (numbers of buildings expected to experience specific damages states, Figure 2e), and economical losses (expressed as mean damage factors (MDF), Figure 2f). The combination of these risk estimates with the locations of the sheltering sites provides useful information towards efficient earthquake disaster management procedures in the urban areas under study (Figure 2f). In addition, an interactive web application has been developed within the framework of the project, with the intention of serving as a valuable tool for seismic risk management by the Attica Regional Authority Services.

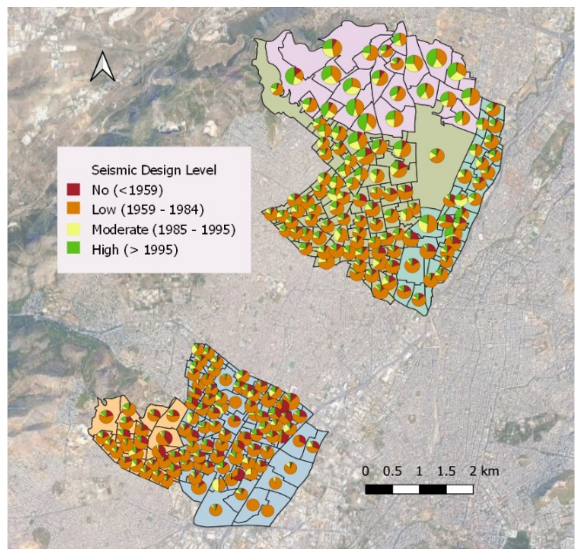


(a) PGA for T_R=475yr at the bedrock level

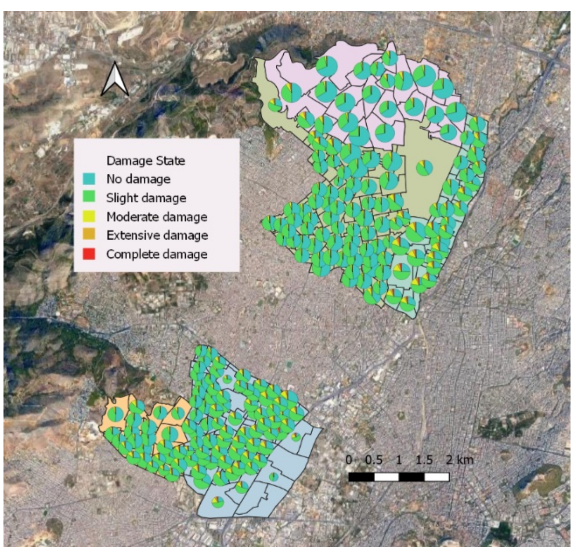
(b) Geological mapping in Aigaleo - Ag.Varvara



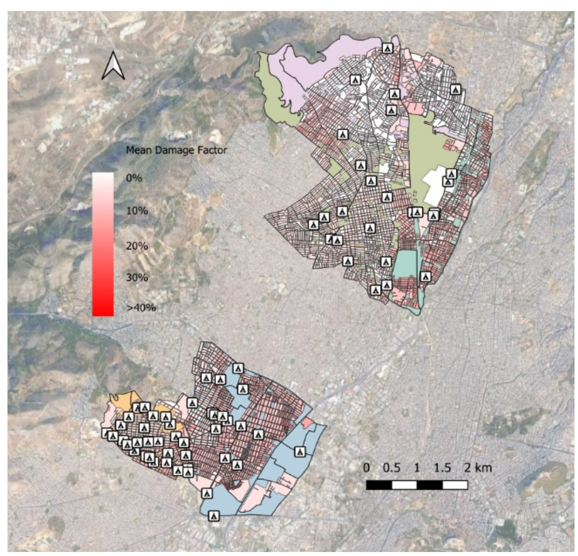
(c) Ground level PGA in West Athens (T_R=475yr)



(d) Building stock in West Athens



(e) Damage state distribution in West Athens



(f) MDF and sheltering sites in West Athens

Figure 2. Risk assessment steps and results

3. CONCLUSIONS

The total number of buildings per damage state of all the municipalities studied so far are shown in Figure 3. The estimates are consistent with the actual seismic damage that occurred during the 1999 earthquake. [3]. Anticipated damage levels are expected to be lower in the Southern Sectors of Athens, whereas the North and West parts are expected to experience more significant effects. This is attributed to higher estimated acceleration values and, in certain instances, the presence of lower-quality building stock, such as unreinforced masonry or low ductility reinforced concrete. It is noteworthy to observe the substantial update of the building stock in the Municipality of Fili, which experienced severe damage during the 1999 earthquake. This transformation was due to the replacement of collapsed or heavily damaged and demolished structures with modern reinforced concrete buildings.

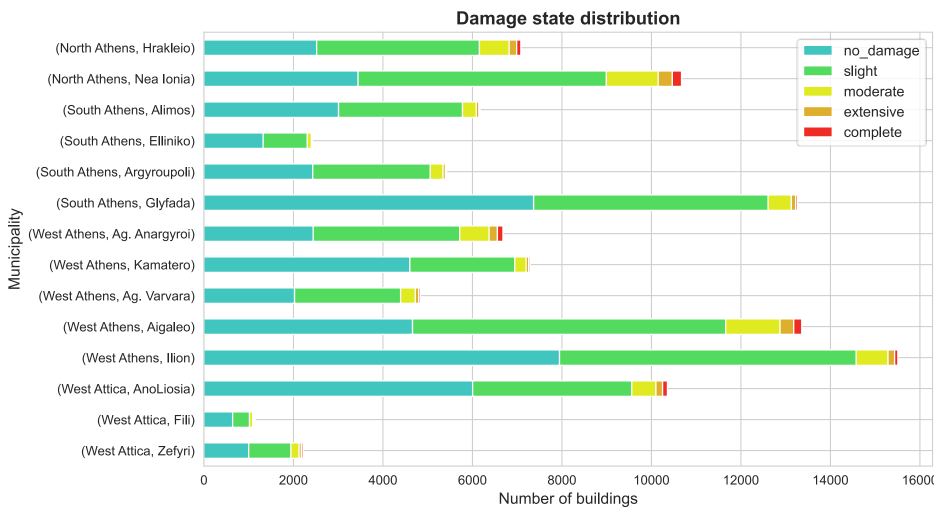


Figure 3. Damage state distribution for the Municipalities in the regions of West Attica, North, South and West Athens

ACKNOWLEDGMENTS

This research was supported by using data and resources from the project "Seismic, Fire & Flood Risk Assessment in Attica Region, Greece" funded by the Region of Attica. The authors would also like to thank the Hellenic Statistical Authority for providing the building stock data gathered in the 2011 National Census, as well as the GIS background.

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MAJOR HAZARDS AFFECTING THE ÎLE-DE-FRANCE AND ATTICA REGIONS AND RISK MITIGATION POLICIES: PRELIMINARY RESULTS OF THE PANTHEON PROJECT

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ABSTRACT

The PANTHEON project aims to design and develop a Community-based Digital Ecosystem for Disaster Resilience with the utilisation of Smart City Digital Twin technology. The final goal is to create a risk, vulnerability and capacity assessment tool fascilitated by a platform and systems based on IoT infrastructure, multi-source data from satellites, in-situ observations and social media. Greece and France, in particular the Regions of Attica and Île-de-France, respectively, have been selected as the pilot areas for the testing, demonstration and validation of the project technologies.

Keywords: *risk assessment, disaster, community resilience, DRR strategies*

1. INTRODUCTION

The objective of the ongoing PANTHEON[1] project is to design and develop a Community-based Digital Ecosystem for Disaster Resilience. By utilising Smart City Digital Twin technology and leveraging emerging innovations, the project aims to improve risk assessment, reduce vulnerability, enhance the operational capabilities of Community Based Disaster Resilient Management teams and, overall, strengthen community disaster resilience. The platform and systems, that will be developed in the frame of Pantheon, will be combined with IoT infrastructure and multi-source data deriving from satellites, in-situ observations and social media in order to create a risk, vulnerability and capacity assessment tool and engage decision and policy makers, citizens and all types of stakeholders in disaster resilience building. Greece and France, in particular the Regions of Attica and Île-de-France, respectively, have been selected as the pilot areas for the testing, demonstration and validation of the project technologies.

The initial step, that comes prior to the technological development, was to study the strategies, policies and initiatives, implemented with the aim to address crises covering all angles of the disaster management cycle, i.e., prevention, preparedness, response and recovery, as well as the main hazards, either natural or human-made, that affect the pilot countries (France and Greece) and regions (Île -de-France and Attica).

The first part of the study includes the documentation and decription of existing disaster risk reduction strategies at three levels, i) international and EU, ii) national, and iii) regional. Moreover, DRR strategies, included in the study, address the four phases of the disaster management cycle and provide guidance related to measures and actions needed to be implemented by stakeholders as well as by the community. In addition, the study depicts the transposition of EU Guidelines into national legislation for

[1] The above study is the outcome of Tasks 2.1 "Analysis of CBDRM National and Regional policies, existing platforms and uptakes" and 2.2 "Regional Multi-Hazards/risk data and assessment" of the PANTHEON project that has received funding from the European Union's Horizon Europe program under Grant Agreement N°101074008.

both pilot countries. Finally, it allows for direct comparison and highlights the differences in the DRR regime between the two countries, enabling the identification and potential adoption of different approaches.

The second part of the study is focusing on the existing multi-hazard approaches based on a literature review as well as on a participatory process that has been performed for Île-de-France (France) and Attica (Greece) regions. The objective of the study is to identify the existing knowledge in order to advance our understanding of multi-hazard events and their potential impact, as well as the methods and approaches available for assessing and mapping multi-hazard risks in the frame of Smart cities with digital twins' technology (SCDT).

Different approaches of multi-hazard events exist. However, throughout the present study the approach of multi-hazard is assumed as (1) the selection of multiple major hazards that the regions face, and (2) the specific context where hazardous events may occur simultaneously or cumulatively over time, by considering the potential for interrelated effects [1]. Multi-hazard approaches are mainly based on the application of quantitative and qualitative methods. However, often they are more qualitative than quantitative and do not incorporate temporal changes in the vulnerability of assets over time, for example during successive hazardous events. As part of the review of practice, interviews were carried out with seven (7) key stakeholders representing seven respective stakeholder organisations. Systematic data collection about exposure, vulnerability and impact was highlighted by several stakeholders as a key barrier for advancing the state-of-the-art of multi-hazard disaster risk management approaches. They also underlined the lack of maintenance and/or upgrading of equipment as well as the need for interoperability and coordination between the relevant sectors. The interviews performed with several stakeholders highlighted that the governments of the selected regions make efforts to move from recognising to assessing interdependencies and interactions between hazards. This approach is in line with the respective holistic national perspectives on assessing hazards.

2. RISK MITIGATION POLICIES

The study is based on an extended desktop research conducted by KE.ME.A. with the assistance of several Consortium partners. The document can be used as a map for existing strategies. The main hazards, which are used as a basis for the policy mapping, derived from the risk assessment study conducted in the context of PANTHEON Task 2.2. The main hazards that are considered are depicted in Table 1:

Table 1: Most significant hazards affecting the pilot areas of the project, Source: PANTHEON D2.1

Natural Hazards	Human-made Hazards
Earthquake	Technological Accident
Volcanic Eruption	Cyber Threat
Tsunami	Terrorist Attack
Landslide	CBRNe Malicious Act
Heatwave	
Storm	
Blizzard	
Flood	
Drought	
Wildfire	
Epidemics/Pandemics	

Political involvement and commitment can provide an efficient way to tackle the negative impacts of disasters and crises. Policies, plans and regulations can increase the capacity of society. The implementation of DRR strategies is one of the seven targets of the Sendai Framework for Disaster Risk Reduction, as disaster risk governance becomes a top priority and the number of countries, which implement national and local strategies, especially the developing ones, increases. Furthermore, countries are encouraged to review existing plans and support the inclusion of different stakeholders in order to holistically approach the subject. Thresholds and indicators should be used for the tangible assessment of the overall level of DRR policies implementation.

The methodology used to conduct this study is structured upon three basic pillars:

- Documentation of strategies and plans at the international and EU level. This stage includes, inter alia, the basic recommendations of the Sendai Framework, the UN International Strategy for Disaster Reduction, the analysis and capabilities provided by the Union Civil Protection Mechanism, the European Programme for Critical Infrastructure Protection, as well as related Directives, issued by the EC, which are transfered into national laws
- Documentation of civil protection plans and strategies at the national level of the two pilot countries. This section includes the plans of the General Secretary for Civil Protection (G.S.C.P.) and of the Hellenic Police (Greece), which address natural disasters, technological accidents and malicious acts, e.g., terrorist acts and cyber attacks. Similarly, civil protection strategies in France are included, along with a presentation of the structure and competencies of stakeholders.
- The third pillar consists of DRR strategies at the regional level, targeting the two pilot Regions of the project, Attica and Île-de-France.

A main result of this study is the development of a comprehensice roadmap of existing initiatives and strategies, which cross-correlate hazards with DRR plans. Through this roadmap it becomes possible for researchers, policy makers and decision makers to familiarise with the CP structure of the two countries, identify differences and potential strengths and weaknesses and exchange ideas, expertise and good practices, aiming at an overall enhancement of the disaster management capacity.

3. MULTI- HAZARD IMPACT ASSESSMENT

The methodology used to identify hazards as well as the impacts for both the region of Île-de-France and Attica is based on the description and identification of major hazards and their interactions, as well as the multi-hazards risk assessment and mapping. In addition, the interviews conducted at national and regional level, will provide an additional level of insight, from the CPAs' perspectives, into their DRM practices,the relationships between them and with the communities, their potential gaps and challenges and suggestions for future disaster risk resilience activities.

The methodology includes (1) the identification of hazards that may include natural disasters, such as floods and earthquakes, wildfires and landslides as well as technological accidents, such as chemical spills and security threats, e.g., terrorist attacks, (2) assessment of exposure, i.e. to assess the vulnerability of the region to the identified hazards. This involves the exposure to the identified hazards of the population, infrastructure, and the environment. For example, in the case of flooding, the assets that are exposed include people, property, and infrastructures, and (3) the risk analysis, which is focusing to the assessment of the impact of the region based on the characteristics of hazards and the assets that are under threat by a potential hazard. The impact may be described by quantitative, qualitative or semi-quantitative approaches. The analysis has based on the risk assessment of each hazard that is analysed as well as on the studies that have been performed.

4. Results

From the identification of major hazards, their potential interactions and the desk-based research, including the collected opinions of stakeholders, it is obvious that the Île-de-France region is mostly threatened by earthquakes, floods, heatwaves, technological accidents and terrorist attacks. Due to the lack of fully quantitative data our analysis has been based on a semi-quantitative approach.
Table 2 illustrates a risk assessment matrix, which categorises and captures the relative likelihood of the potential impact expected for each hazard type examined in the Île-de-France region. This is an effective way to get a holistic view of the identified risks for all relevant stakeholders. Table 2 shows that the earthquake risk is relatively low but the risk from terrorist attacks is relatively high. The relative risk associated to other hazard types, such as floods, heatwaves and technological accidents, varies from medium to medium-to-high.

Table 2. Matrix of semi-quantitative risk assessment for natural and human-made in the Île-de-France region.

	Earthquakes	Floods	Heatwaves	Technological Accidents	Terrorist Attack
Exposure to hazard	Low	Medium	High	Medium	High
Impact from hazard	Low	High	Medium	Medium	High

For the risk assessment analysis in the Attica region, we followed the steps performed for the risk analysis in Île-de-France region. The result is illustrated in Table 3, which shows that the risk from earthquakes and heatwaves is relatively the highest among the various risks examined. On the other hand, the risk associated with wildfires is relatively of medium level. The risks which are caused by landslides, terrorist attacks and cyber-attacks are relatively low. Our results are consistent with the conclusions of other researchers [2] who found that the Attica region is mainly exposed to natural hazards, particularly earthquakes, floods, heat waves and wildfires, than to human-made hazards. The relatively high exposure of Attica to natural hazards is due to the fact that it is characterized by high concentration of population, industrial and economic activities and infrastructures.

Table 3: Matrix of semi-quantitative risk assessment for natural and human-made in the Attica region.

	Earthquakes	Floods	Wildfires	Heatwaves	Landslides	Terrorist Attack	Cyber Attack
Exposure to hazard	Medium	Medium	High	High	Low	Low	Medium
Impact from hazard	High	Medium	High	Medium	Low	Low	Low

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MULTI-PARAMETER HIGH-RESOLUTION FLOOD RISK ASSESSMENT IN THE REGION OF ATTICA

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ABSTRACT
Flood risk assessment in selected and vulnerable areas is crucial for the analysis and design of civil protection measures and the implementation of studies with proper interventions towards mitigating flood risk. This is even more crucial in the region of Attica, which is the most densely populated region of Greece, with critical infrastructures and important social economic activities. Under the Programming Agreement with the Prefecture of Attica, the Operational Unit BEYOND Centre of EO Research & Satellite Remote Sensing of the Institute of Astronomy, Astrophysics, Space Applications & Remote Sensing (IAASARS) of the National Observatory of Athens (NOA), in cooperation with the Research Group ITIA of the Department of Water Resources and Environmental Engineering of the School of Civil Engineering of the National Technical University of Athens (NTUA) study five flood-stricken river basins in the region of Attica, which affect 23 Municipalities. Detailed field visits and flood risk assessments in every area of interest are conducted, high-risk critical points are identified, and mitigation measures are proposed, both structural and non-structural, in order to achieve effective crisis management for the protection of the population, the properties and the infrastuctures. In addition, a web GIS platform has been developped by the BEYOND Centre to store and make available all the collected and produced data, the flood hazard, vulnerability and risk maps, as well as the identified critical points, the refuge areas and escape routes. Detailed presentations are organised for all the relevant stakeholders and the competent authorities who are directly or indirectly involved in civil protection, and the studies' general outcomes are also disseminated to the public to raise awareness.

Keywords: flood, risk assessment, mitigation measures, escape routes, civil protection.

1. INTRODUCTION
The Prefecture of Attica constitutes a region with special features, such as long coastline, large inland area, various geoenvironmental units, high population density (3.792.469 residents, 36,4% of the country's population according to the Hellenic Statistical Authority [1], crucial infrastructures and social economic activities. In March 2021, a Programming Agreement was signed between the Prefecture of Attica and the NOA – Part A – to conduct the study entitled «Earthquake, fire and flood risk assessment in the region of Attica» funded by the Prefecture of Attica [2]. Flood risk is assessed in five river basins (Pikrodafni, Giorgis, Sourres and Agia Aikaterini streams and Sarantapotamos and Kifisos rivers), which affect 23 Municipalities.

2. METHOD AND DATA

2.1. Method

At first all necessary data and the relevant studies are gathered from the competent services, quality control and corrections are performed, and additional data are collected from photo interpretation and field visits (such as dimensions of bridges and culverts, obstacles in the riverbed, feedback by residents). For the three return periods of the EU Flood Directive [3] (50, 100 and 1000 years) and a selected rainfall duration, rainfall hydrographs for each subbasin as well as for the total river basin are derived from ombrian curves which are constructed and adapted to each specific study area following a new advanced methodology [4]. Then, using HEC-HMS rainfall-runoff model, a schematic diagram of multiple sub-basins is developed, and the suitable methods for runoff estimation (estimation of losses, transformation into unit hydrograph) are selected. The three abovementioned scenarios are executed considering medium antecedent soil moisture conditions (CN II) [5]. The flood hydrographs alongside with other input data, are entered in the hydraulic model LISFLOOD. The scenarios are executed using sensitivity analysis of input parameters, and the results are evaluated in order to calibrate the hydraulic model HEC-RAS. A 2D hydraulic model is developed for the river basin using rain-on-grid method, a uniform spatially distributed rainfall method, and rainfall hydrographs. Water depth and velocity maps are produced subsequently for each scenario for the flood hazard assessment.
Vulnerability is considered as a weighted estimation of population density, population age, and building characteristics (construction materials and the presence of pilotis). Specific points of interest are delignated using photo interpretation methods, while exposure is based on the land value. Finally, the hazard, the total vulnerability and the exposure are mathematically combined to estimate the flood risk. Additionally, information about historical flood events and critical points indicated by the authorities is combined with the calls to the fire brigade for help in flooded areas in order to create a flood record and validate the risk assessment. All in all, according to flood risk assessment and in-situ observations, critical points are identified, classified based on their risk level and accompanied by a detailed technical report. Mitigation measures (refuge areas and escape routes) are proposed for the worst-case scenario.

2.2. Data

A 2m spatial resolution Digital Elevation Model (DEM) from the Hellenic Cadastre is used as terrain. Land cover polygons are created using the European Urban Atlas geodatabase of the Copernicus Land Monitoring Service [6] and burnt scar mapping from 1958-2021, provided by the FireHub Service of the BEYOND Centre of IAASARS/NOA [7]. Each class is matched to the corresponding Manning's roughness coefficient [8]. Curve Number polygons for medium antecedent soil moisture conditions (CN II) are provided as well [9]. Technical works such as drainage networks, river bed diversions and arrangements are derived by the relevant studies and available data from the Flood Risk Management Plan of the Attica Water Department (EL 06) [10]. Climatic data (rainfall time series) are gathered from the respective meteorological stations of the Hellenic National Meteorological Service, the National Observatory of Athens and the Ministry of Environment and Climate Change for the 1860-2020 period. Population data (age and total number) and buildings characteristics (number of floors, construction material and year, etc) are provided for each building block by the latest Population-Housing Census of the Hellenic Statistical Authority [1] and the land values are defined by the Ministry of Finance.

3. RESULTS

The geospatial data, modelling results, critical points from the field visits, and the proposed mitigation measures are delivered to the Prefecture of Attica and to the flood-stricken Municipalities both in hard copy and in digital format through a dedicated web GIS platform designed for the needs of the specific project by the BEYOND Centre of IAASARS/NOA. For each study area the following maps are produced: the simulated maximum water depth and flood extent using LISFLOOD and HEC-RAS models (Image 1), the 1st priority critical points for flood risk (Image 2), and the proposed refuge areas and escape routes during the crisis (Image 3).

Examples of the river basin of Mandra:

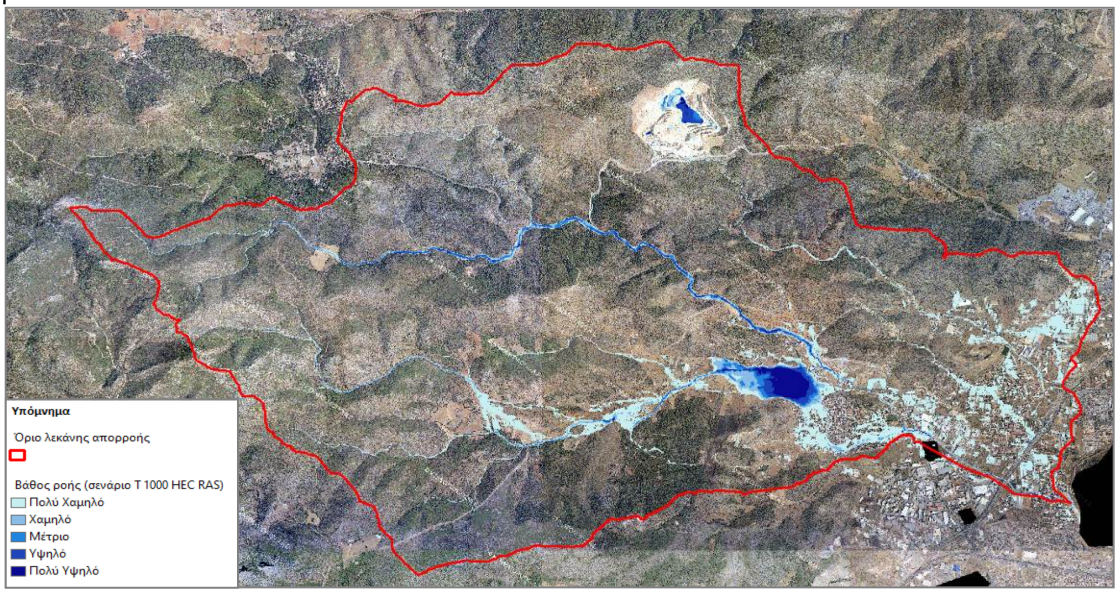
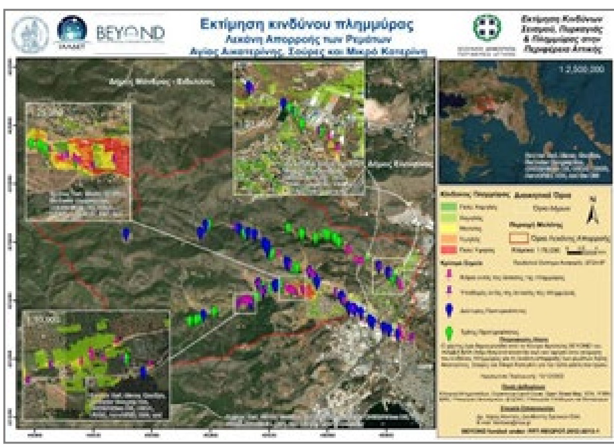


Image 1. Flood map for 1000 years return period and 12 h rainfall duration, using HEC-RAS model.



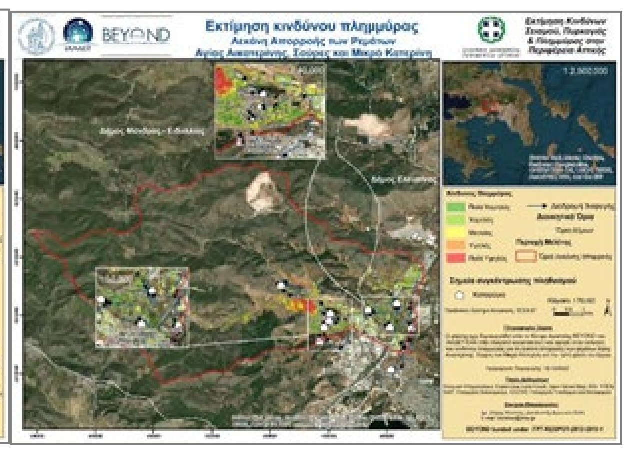


Image 2. 1st priority critical points for flood risk

Image 3. Proposed refuge areas and escape routes during the crisis.

4. DISCUSSION

Many high-risk points were identified in residential areas, road network and other critical infrastructures. Therefore, the proposed mitigations measures are of crucial importance towards increasing the flood resilience. These include flood protection works, such as delimitation of streams/rivers, river bed arrangement using up-to-date environmental terms, removal of constructions inside the river beds, construction of drainage network, small mountain hydrodistribution works and non-structural measures, such as special signs at high risk points, review of the building use, especially of the ground and basement floors, cleaning of the river bed, cleaning and maintenance of flood protection works on a regular and ad-hoc basis after each flood event, tree planting, encouragement of rainwater storage at plot level, training and raising awareness of the population, flood management exploiting the output of the projects. Overall, it is very important to apply strategic design in order to mitigate flood risk towards the implementation of the EU Water Framework Directive [11], the EU Flood Directive [3] and the directions of the National Program of Water Resources Management and Protection [12]. Strategic design should be considered as an organized and planned response to the flood risk, with specific actions (prioritized works and measures), shared according to the responsibilities of each competent authority, accompanied by cost analysis and implementation timeline.

5. CONCLUSION

This study analyses and estimates - in the most objective and reliable way secured by science and technology – the vulnerability and the expossure of the selected river basins to flood risk, in conjuction with the actual physical and socioeconomic parameters of each study area and proposes mitigation measures. It's the first time that such a holistic approach for flood risk assessment is implemented on building block level in Greece. The prototype knowledge created through the project supports the Prefecture of Attica in the optimum implementation of the National Civil Protection Plan and the work of Civil Protection Coordination Bodies. This serves the operational needs during the crisis, as well as the preparedness and the strategic decision making towards disaster resilience. All the above-mentioned were confirmed and evaluated positively according to the stakeholders' feedback.

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POST-FIRE VEGETATION AND REGENERATION & PROPOSED FUEL MANAGEMENT ON THE BURNT AREAS OF 2021 VARIBOBI WILDFIRE

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ABSTRACT

Before implementing fuel management, it is important to conduct a specific forest assessment to determine the current status of vegetation structure and composition and fuel loads. This will help to determine the most appropriate management methods for each site and to identify potential ecological or other risks. As a priority, if it is anticipated that both the speed of spread and the intensity of a wildfire can be reduced in these areas, this is where the optimal location of fuel management projects should be planned, but they must be of the right scale to be able to stop the spread of a fire. If the size of the units where fuel management projects will be implemented is smaller than the size of the expected fires that can burn in each area, they can be easily outflanked and will have little or no effectiveness in reducing intensity and spread rate. To achieve this objective, the effectiveness of possible fire management measures that can be applied in the forest/settlement mix zone and in purely natural areas was assessed using the Treatment Optimization Model algorithm of the FlamMap fire simulation software. We propose a new fuel break network consisting of four zones with total length of 11 km.

Keywords: Treatment Optimization Model, FlamMap, Large-scale wildfires, Fuel breaks, Attica

1. INTRODUCTION

The forest fire in Varybompi, Attica, started on August 3, 2021 at 13:22 in a dense pine forest, lasted five days and burned 8,450 ha of conifer forests, shrublands and agricultural areas. This wildfire created a very hazardous situation for a number of communities and their wildland-urban interface (WUI), as well as cultural monuments (former Royal Palace of Tatoi), and only due to suppression tactics they escaped a complete destruction. The affected region is considered a high amenity landscape with expensive houses due to its scenic natural environment, combined with a favorable climate and its proximity to the urban center of Athens. All the above raised the question of what people should do to help the regeneration of the area. In addition, it is important to understand if a new wildfire starts on the affected area how it will spread and what are the necessary proactive measures we need to apply to reduce fire spread rate and intensity. In this study we used fire simulation modelling with the Treatment Optimization Model (TOM) of FlamMap [1] to find the locations of potential fuel treatment projects, that can include low fuel areas through thinning and removal-burning of biomass, or fuel breaks. Through drone flights, we were able to verify the whether the model outcomes correspond to real-life conditions and if it is possible to propose a new fuel break network in key locations within the burned area to halt the progress of potential future fires.

2. METHODOLOGY

2.1. Post-fire vegetation structure and fuels of the study area

Pre-fire vegetation mainly consisted of high-density shrubs over 2 m in height, and *Pinus halepensis* forests with a high dead fuel load (mainly pine needles) and a dense evergreen understory at the 17% and 15% of the affected area, respectively. Approximately, 14.5% of the area was non-burnable land (bare ground, roads, open spaces covered with cement, etc.), and 14% was dominated by sparse short shrubs mixed with low loads of grasses and annual vegetation. Finally, the 13% of the area represented conditions where annual vegetation and grasses, along with low shrubs or conifer saplings were mixed with dead biomass derived primarily from conifer forest canopies, depicting fuel conditions following a disturbance or intense conifer regeneration. The post-fire vegetation conditions two years after the event shows a very high presence of annual grasses and forbs, up to 1.5 m tall (Figure 1-UL). Shrubs resprouted from either roots or stems at high frequencies, up to 1 m tall in most cases, mostly mixed with annual grasses and forbs (Figure 1-UR). Where conifers prevailed pre-fire, we recorder a very high density of conifer seedlings at densities usually ranging from 20 to 60 seedlings per m^2 (Figure 1-LL). We also noticed that seedlings were present even in areas with sparse pre-fire conifer presence, denoting a very good seed post-fire dispersal (Figure 1-LR). This is a strong indication that natural regeneration has been successfully established, even though the extensive salvage logging (Figure 1-LL).

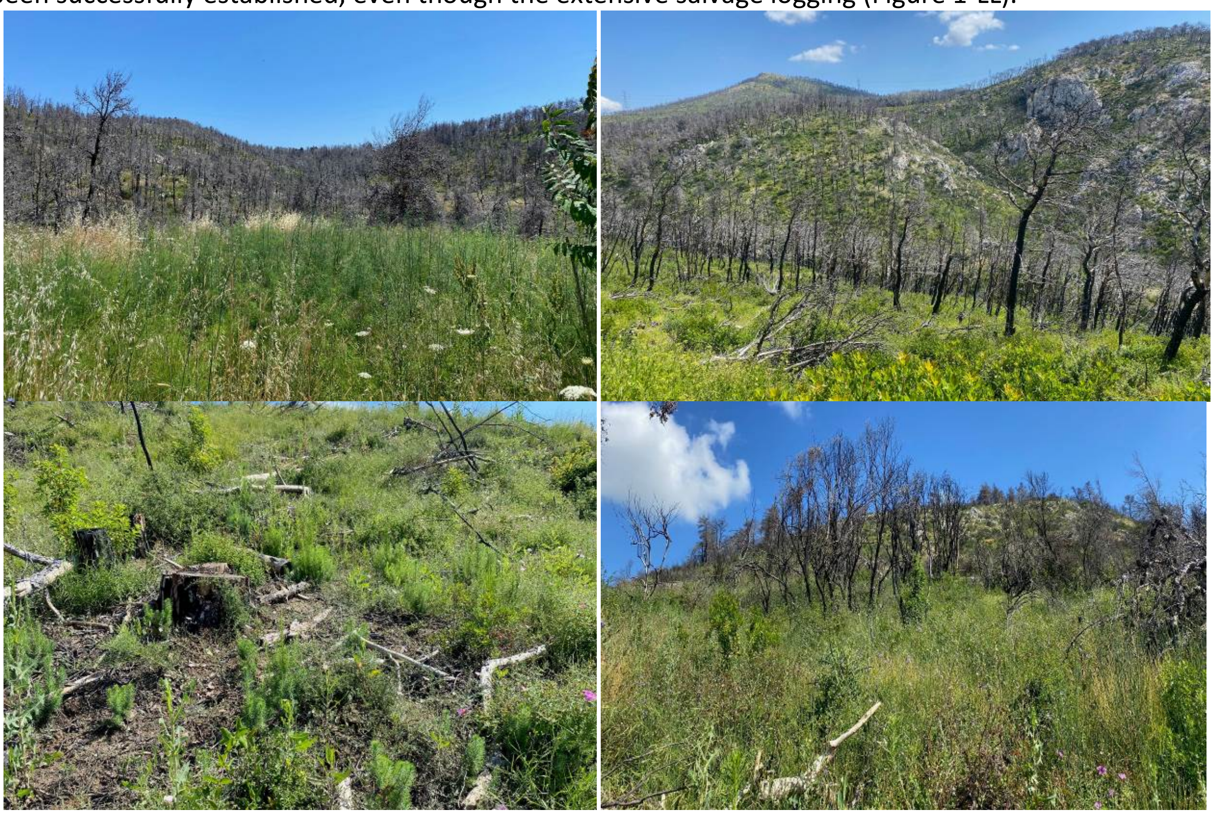

Figure 1. Upper Left (UL): Tall-dense grasses and forbs over 1 m tall in openings of former conifer forests. Upper Right (UR): Shrubs inside burned conifer forests, over 1 m tall mixed with conifer seedlings and annuals. Lower Left (LL): Location of salvage logging with high density of conifer seedlings. Lower Right (LR): Former sparse conifer forest, now dominated with tall shrub, grasses and forbs, including a high number of conifer seedlings.

2.2. Finding fuel management areas with the Treatment Optimization Model

The TOM calculations are based on the Minimum Travel Time (MTT) algorithm to identify the dominant fire transmission paths, aiming to effectively block them by applying fuel management organized into appropriately sized projects [1]. Specific areas are selected having the potential to reduce the fire growth rates as much as possible considering the impact of prevailing weather conditions, for a given

fuel treatment intensity and extent. The MTT calculates the fastest fire growth paths in the landscape, while the TOM suggests (without applying it) the management of those areas that show a reduction in the fire spread rate if fuel management is applied.
A TOM simulation was conducted with the fuel conditions that prevailed before the 2021 fire, similar to previous related works [2,3]. Very dry moisture conditions were specified for all fuel models (1hr: 3%, 10hr: 4%, 100hr: 5%, LH: 30%, LW: 60%), wind speed was set to 28 km/h at 10 m above the ground, prevailing wind direction from 45° and crown foliage moisture 100%. The maximum portion of the landscape that can receive fuel management was set to 20%. The TOM requires an "ideal" spatial landscape description file in which the desired changes in fuel structure and composition are contained, not only in the areas we are allowed and expect to manage but in the entire landscape. We focused exclusively on conifer-dominated stands. Fire spread rate reduction stands are identified by contrasting the simulated fire behavior between those that will be managed versus those that will not. Thus, a comparison of spread rates between two sites shows where fuel management projects reduce spread. The changes to the original baseline landscape data are the following:

- Crown base height: increase at the 1/3 of the stand height. This target will be achieved by pruning from below.
- Canopy cover: 20% reduction horizontally, which will be achieved by thinning.
- Canopy bulk density: 30% reduction in stands with sufficient fuel density (≥ 0.10 kg/m^3).
- Fuel model: conversion to TU1 (Low Load Dry Climate Timber-Grass-Shrub). The surface fuels consist of low load annuals and forbs mixed with shrubs or phrygana and pine needles. At TU1 the fire spread rate is low, as is the flame length.

3. RESULTS & DISCUSSION

The results in Figure 2 show the locations of potential fuel management projects based on the TOM outputs. In total, the model proposed to implement management on up to 1,235 ha over the next three years (2024-2027), before the 6–10-year post-fire period begins where we expect more extreme behavior compared to the current conditions. The minium size of management projects is proposed to be 2 ha. Of the 100 projects proposed by the TOM, the maximum management area is 250 ha and the average is 13 ha. It is important to note that it in the case of *Pinus halepensis*, thinning should be done when stand density ranges between 2,000 to 3,000 trees per hectare, typically when the trees are around 10 to 15 years old. This first thinning should be programed for every stand of the affected area to promote forest health and reduce future extreme wildfire behavior.
Since the dominant wind speed direction in the region is the northeast, we allocated four fuel break zones inside the proposed fuel treatment locations from TOM at the axis northeast to southwest. Using the DJI Mavic 3 Enterprise drone, and considering factors such as slope, connectivity to the current road network, proximity to values-at-risk (communities and monuments) and the dominant pre-fire vegetation conditions, we verified the applicability of the proposed new fuel breaks.
The two southwestern zones (1.8 and 2.9 km length) have the purpose of protecting the former Royal Palace, while at the same time halting the fire progression towards Varibobi and Thrakomakedones. The proposed location has relatively mild slopes, making it feasible to construct them with a width of 60 m with complete removal of vegetation. The middle zone of 3.1 km length is proposed for a location with an existing road crossing the area, in a terrain with slopes ~70%. To avoid visual disturbance and prevent soil erosion, we propose the creation of intense thinning and complete removal of understory vegetation at two 30 m zones at each side of the existing road, leaving approximately 300 – 500 seedings per ha. Last, the northern zone can protect Ippokratios Politeia and Afidnes, including their WUI, having a length of 3 km. Since the slopes are moderate to mild (20-50%), we propose a mixture of a narrow zone of 45 m with complete removal of vegetation, backed by two thinned zones of 30 m at

each side of the proposed fuel break. In total, we proposed the creation of 11 km of new fuel breaks, occupying an area of approximately 78.5 ha.

To conclude, this work recognizes the nature and complexity of the «wicked» problem of wildfires, and we want to emphasize that we are not presenting "one" absolute solution that promises that all issues will be magically and simply improved with our proposed solution. Instead, we recognize the interdisciplinarity required during post-fire management, as embodied in the research initiative "Varibobi Reset". In no way we are suggesting that the risk mitigation approach we propose is the best or only one available, but to our knowledge, it is very well documented in the literature and its basic principles have been designed by leading scientists and agencies (USDA Forest Service) in the field.

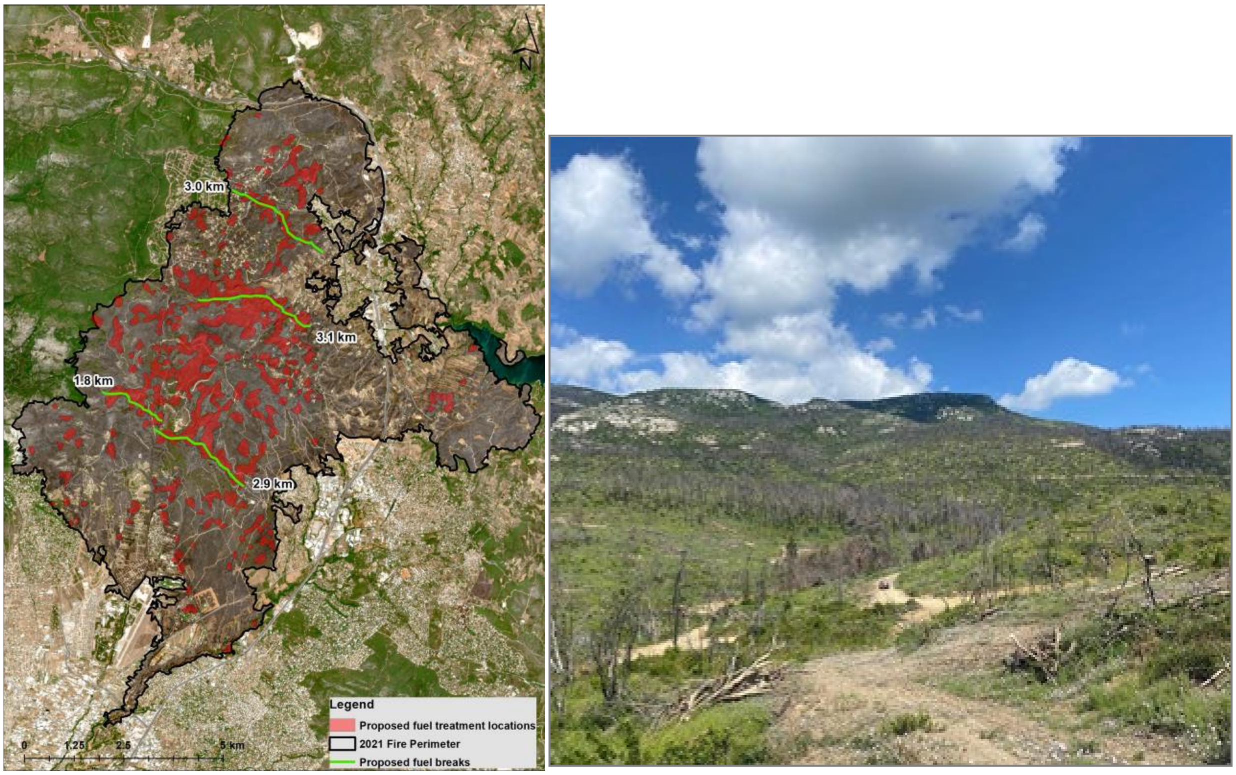

Figure 2. Left: Proposed locations for the implementation of management projects within the burned area in 2021 as estimated by the FlamMap Treatment Optimization Model, including the proposed new fuel breaks. Right: The landscape for the proposed 1.8 km fuel break, with visible new roads opened to retrieve the salvage timber.

ACKNOWLEDGMENTS

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Varibopi Reset

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FIRE RISK ASSESSMENT AT A BUILDING BLOCK LEVEL: THE CASE OF MANDRA, ATTICA REGION, GREECE.

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ABSTRACT

Forest fires are quite destructive events as they induce damage to the environment, properties and infrastructure as well as fatalities. This work illustrates a state-of-the-art methodology for high-detail fire risk assessment and management planning in peri-urban areas that are susceptible to forest fires. The methodology fuses fire AI/ML hazard modelling, vulnerability and exposure estimation accompanied by in-situ observations. The results of this research that took place on 2022, provided fire spread spatiotemporal simulations which are consistent to the actual fire event that took place in the examined area on July 2023. Moreover, the risk map illustrates that the recent burned areas were characterized by mostly high to very high fire risk when this study was conducted.

Keywords: Attica Region, fire modelling, fire risk, vulnerability, fire hazard, fire disaster management.

1. INTRODUCTION

Forest fires have emerged as a critical environmental concern, impacting various aspects such as ecosystems, wildlife, infrastructure, and property. The situation is further exacerbated by the effects of climate change, leading to heightened intensity and frequency of summer droughts [1]. In light of this, prioritizing fire risk assessments and mitigation plans becomes imperative to address forthcoming challenges and facilitate decision-making processes, including emergency evacuation strategies and preventive measures. In response to this need, numerous fire risk assessment methods have been developed internationally over the past decades to support operational actions before, during, and after fire incidents [2-5]. The Attica Region in Greece holds significant importance as it harbors over half of the country's population and has experienced the devastation of several natural hazards over the years, notably the fire event in Mati in 2018. Acknowledging these concerns, the prefecture of Attica Region has allocated funding for the national research project titled "Seismic, Fire Flood Risk Assessment in Attica Region, Greece," which is led and coordinated by the Operational Unit BEYOND of IAASARS/NOA. This project aims to develop comprehensive fire, flood, and seismic risk assessments while devising mitigation plans throughout the entire Attica region.The focus of this project's fire risk assessment methodology combines geoinformatics, machine learning techniques, and field observations, effectively addressing the project's objectives at the city block level. For the purpose of this abstract, the Mandra region and its environs have been chosen as study area. The region of Mandra is characterized by an average elevation of 470 meters and experiences a Mediterranean climate typified by limited precipitation, mild winters, and warm summers. It is noteworthy that the region of Mandra and its vicinity have witnessed several fire incidents over the years spanning from 1984 to 2021, resulting in significant damages.

2. METHODS & DATA

The methodological approach for the fire risk assessment [6] of the broader Mandra region, incorporates (i) fire hazard simulations based on the climatic (e.g. wind intensity and direction) conditions of the region, remote sensing data and land use/cover information, (ii) fire vulnerability (via coupling population density/age and building materials, (iii) exposure based on the land value (€/m^2) information and (iv) extensive field work which supports the evacuation and mitigation planning and highlights the high-risk points and areas of the study site. This circular approach involves seamless integration between office-to-field and field-to-office procedures. The project's outcomes, including risk maps and management plans, are consolidated into a web platform, offering crucial support to civil protection stakeholders in combatting forest-fire outbreaks in high-risk peri-urban and urban areas within the Attica region.

3. RESULTS & DISCUSSION

As far as the results of the fire hazard simulations are concerned, the major outcomes of the research can be visualized below.

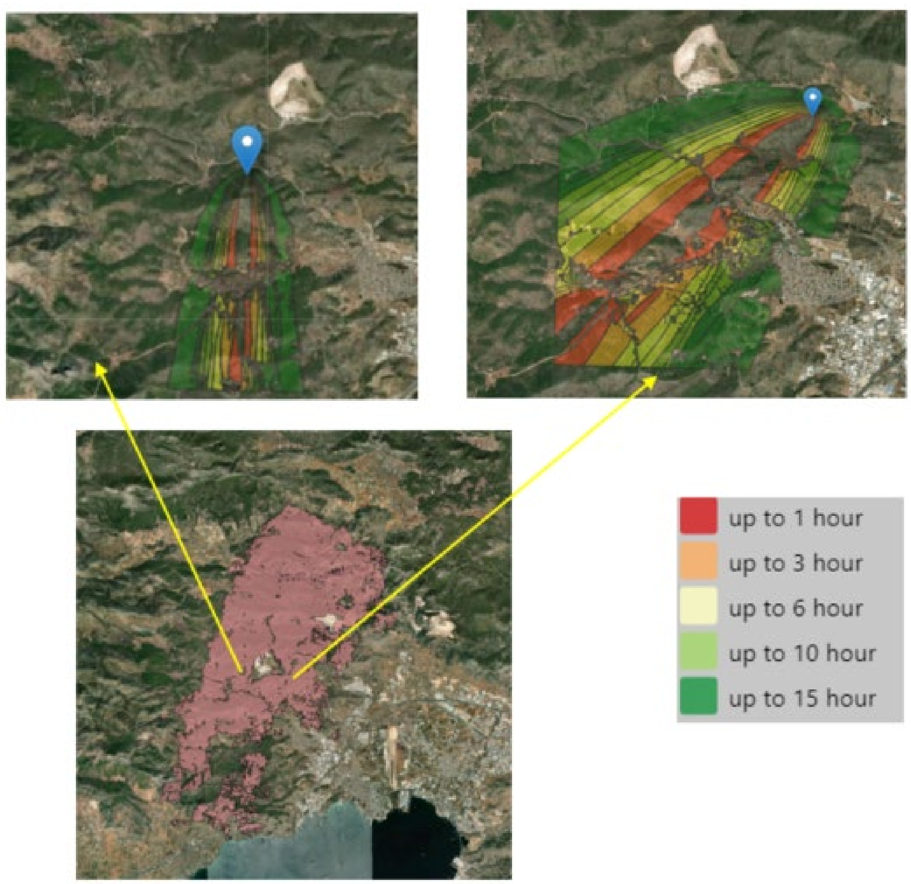

Figure 1. Fire hazard spread simulations of 5 (upper left) and 9 (upper right) Bf in the Mandra area generated on 2022. The fire hazard simulations are characterized by 5 classes that indicate the timing of the fire spread (from 1 minute up to 15 hours). The lower image illustrates the burned areas of the fire event of July, 2023 in the broader area and the yellow arrows display the identical fire influenced areas.

Specifically, in 2022 the study involved the generation of approximately 100 fire hazard simulation scenarios, considering wind speeds of 5 and 9 Beaufort and various wind directions. Among these simulations, Figure 2 (upper part) depicts the selected fire scenarios that closely resemble the actual fire incident that occurred on the 18th of July 2023, in Mandra region (lower part of the figure).The burned areas of 2023 were derived through the processing of high-resolution satellite imagery acquired by the Sentinel-2 mission of Copernicus program.

The risk map of the investigated area is a result of the integration of fire hazard simulations, vulnerability analysis, and exposure assessment. It employs a color-coded representation, ranging from green (very low risk) to red (very high risk), to depict the varying levels of fire risk across the region. Figure 2 visually presents this risk distribution, indicating that a significant portion of the building blocks within the studied area exhibit high to very high fire risk, while the remaining blocks primarily display a moderate level of risk.

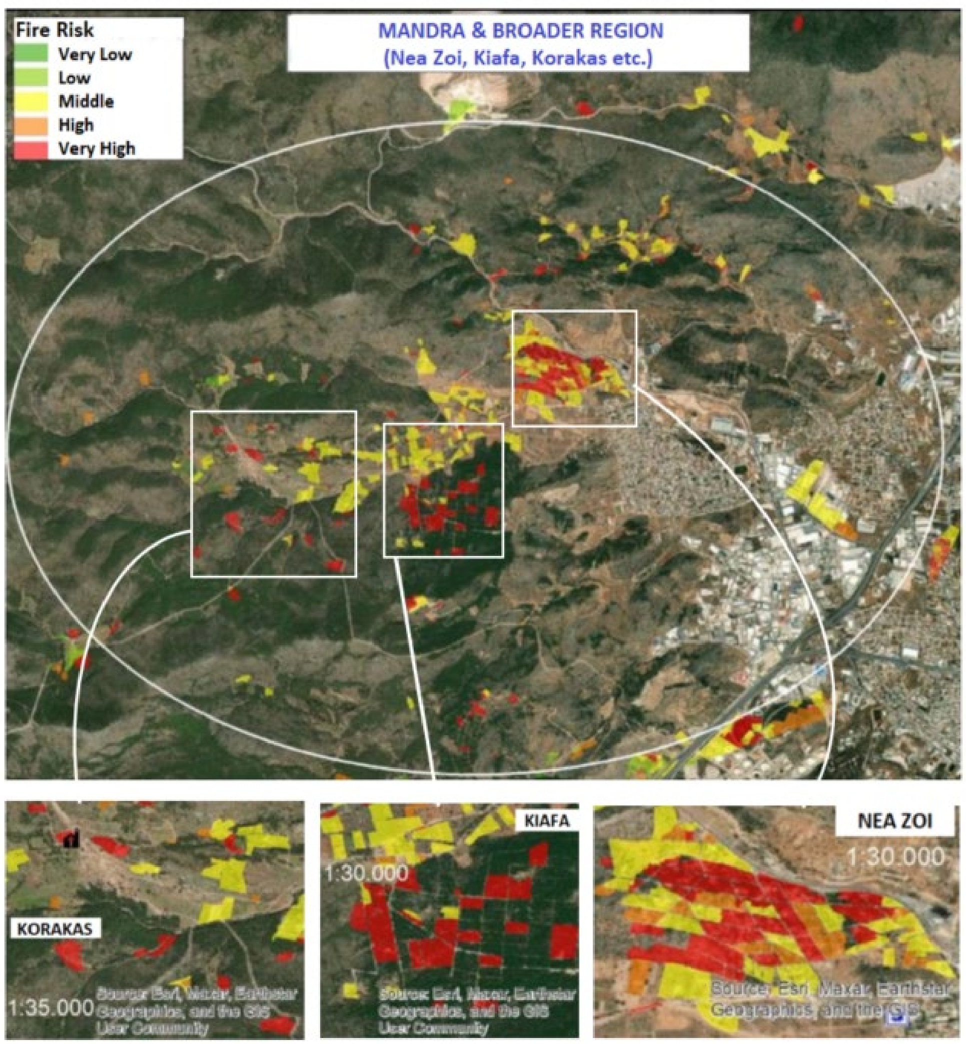

Figure *2*. Fire risk assessment of Mandra and its surroundings (from very low: green to very high: red).

4. CONCLUSIONS

In a nutshell, the fire hazard simulations that were generated in this study are shown in Figure 2. The spatiotemporal evolution of the fire spread of this research scenarios is consistent to the actual fire scar that occurred during the fire event of July, 2023. Moreover, the corresponding fire risk assessment illustrated in Figure 3, highlights the high risk and susceptibility of the area in case of a fire event as the majority of the building blocks are at high or at very high risk. Additionally, this operational support tool was designed for more efficient management pre and during the fire event so that stakeholders can organize an immediate response. As far as the pre-fire event management is concerned, the current work contains information to help all responsible parties (firefighting department, policymakers, traffic police, etc.) focus on high-risk areas (such as flammable infrastructures, intense wildland-urban interface are-as, traffic congestion points, etc.) and take all the reasonable actions to ensure fire risk reduction. During a fire incident, the operational tool could also showcase critical areas in need of immediate response (such as city blocks with a high concentration of population or with people unable to react rapidly due to age restrictions) by the competent bodies, who should guide people to safety. Lastly, the utilized methodology of this work is consisted of state-of-the-art techniques that spotlight a fire risk assessment and management planning at a high analysis level (building block level), which is unique for the Greek territory.

ACKNOWLEDGMENTS

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SFDS-AI: A LOW-COST AI-BASED SMOKE AND FIRE DETECTION SYSTEM

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ABSTRACT

In this paper, we propose the implementation of an AI-based Smoke and Fire Detection System (SFDS-AI), which harnesses an AI-based model and standard surveillance cameras to detect fire and smoke plumes efficiently. Our experimental setup features PTZ (Pan-Tilt-Zoom) cameras to patrol vast areas, and it is installed in four test sites to perform in-field validation. Our AI model is based on a supervised machine learning approach and can accurately discern the presence or absence of smoke and fire thanks to deep artificial neural networks that perform sophisticated image analysis. The model output is packed in an alert message, including the test site's location and time, the precise location of the detected wildfire, and a link to access the image that prompted the alert. These informative messages are seamlessly relayed over an asynchronous communication bus to enable the integration of the proposed service into existing Emergency Management and Early Warning Systems.

Keywords: smoke detection, fire detection, AI, surveillance, emergency management, wildfires, forest fire, resilience.

1. INTRODUCTION AND RELATED WORK

Fires pose a significant threat to human lives and the environment, making early detection and prompt response critical for minimising their impact. Traditional fire and smoke detection methods have often been limited in scope and effectiveness, prompting the need for innovative solutions that can leverage existing infrastructure for improved surveillance.

This paper introduces the AI-based Smoke and Fire Detection System (SFDS-AI) as a novel approach to address these challenges. SFDS-AI harnesses the power of artificial intelligence and standard surveillance cameras to identify fire and smoke plumes with greater accuracy and efficiency. Using PTZ (Pan-Tilt-Zoom) cameras to survey the surrounding areas comprehensively, SFDS-AI can quickly detect and analyse fire and smoke occurrences. The resulting detections are communicated over simple yet effective messages, which contain vital information about the test site and time, the presence/absence of smoke and fire, and the estimated specific location of the detected wildfire, are seamlessly relayed over an asynchronous communication bus to enable the integration of the proposed service into existing Emergency Management and Early Warning Systems.

Several optical remote sensing technologies used in early fire warning systems have been proposed in the literature [1],[2] encompassing terrestrial, airborne, and spaceborne-based systems, while various models aiming to detect fire occurrences with high accuracy in challenging environments have been studied. However, the key advantage of our solution lies in its cost-effectiveness and the capability to be improved over time as more validation data becomes available.

This paper's primary objective and contribution is to present the SFDS-AI system, describing its architecture, service logic, implementation, deployment and to provide an initial assessment of the smoke and fire detection model over a manually constructed dataset.

2. SYSTEM ARCHITECTURE AND SERVICE LOGIC

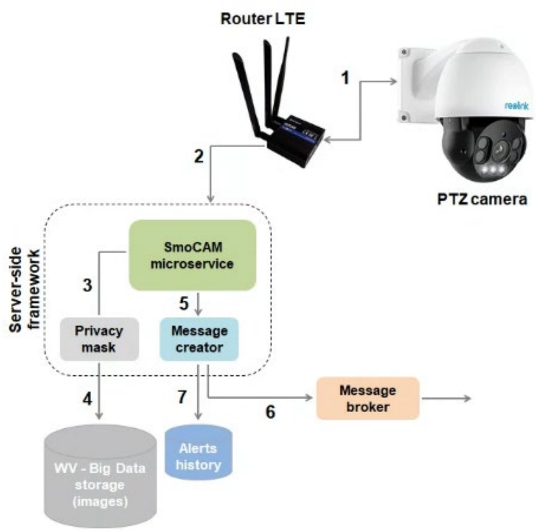

Figure 1. SFDS-AI system architecture and data flow

Figure 1 shows the architectural schema of the SFDS-AI system.

1 The camera is connected to a cellular (LTE) router with a two-way communication link to guarantee connectivity and ensure maximum flexibility for camera management. The router can run very light Python scripts that enable the interaction with the camera through its API to:
   - Automatically start the communication with the camera itself, retrieving its IP address;
   - Control the timing and movements of the camera throughout the different points of view, defined by a set of angles Θ. The camera can be configured to transition between a list of viewpoints, persisting on each one a time t(θ) and providing an image every *s* seconds;
   - extract the acquired images.

2 Once the images are acquired, the router uploads them on a server (SmoCAM microservice), which stores them along with relevant metadata, e.g., the acquisition timestamp and the direction the camera was oriented;

3 Each image is processed to apply privacy masks (if needed) and then evaluated by the *SFDS-AI* model aimed at detecting the presence of smoke and fire;

4 All post-processed images are sent to file storage that enables reference them via a URI;

5 For every image, the model produces a vector of probabilities about the presence of smoke and fire and temporarily stores these values to allow the acquisition of all the needed images from a single point of view. Simple statistics are then used to assess if the time window t(θ) just concluded is supposed to be labelled as with or without smoke/fire. If the presence of a wildfire is confirmed, the model then estimates the location of the event;

6 In case of a positive detection, all the metadata mentioned above and output, together with the corresponding URIs images, are condensed in a Json Alert message sent to an asynchronous message bus (message broker) to allow easy integration with existing Emergency Management System.

7 In case of positive detection (at least one between smoke and fire is labelled as True), the same message is stored in an Alert history.

3. IMPLEMENTATION AND DEPLOYMENT

We deploy our solution by performing four installations, as shown in Table 1. Each installation is equipped with a camera Reolink rlc-823a (~250€) and an LTE router Teltonika RUT-240 (~150€). We selected the Reolink rlc-823a because it represents a good tradeoff between low-cost cameras and high-end hardware (e.g., Axis and Bosch). Although brands like Axis and Bosch guarantee better control and setting of the camera, using the router as the intelligence to handle the camera resulted in an acceptable trade-off. The Reolink camera is compact, only 20cm x 14cm x 14cm, weighs less than 2 kg and has a 5x optical zoom that may allow more focused surveillance of the areas of interest. The camera is a Pan-Tilt-Zoom (PTZ) camera and allows the surveillance of a 360° scene. Considering an additional 100€ for cables and enclosure, plus an on-site installation cost of 500€, our solution costs about 1000€ per site.

Country	**Region**	**Site name**	**Location (lat, lon)**
Italy	Piemonte	SanMichele	45.09865, 7.34275
Spain	Catalonia	ELPerellò	40.91694, 0.69495
Greece	Central Macedonia	MtChortiatis	40.63328, 23.05605
France	Corsica	Furiani	42.66127, 9.43302

Table 1. List of SFDS-AI installation sites

4. THE SMOKE AND FIRE DETECTION ALGORITHM

SFDS-AI features an AI-based detection algorithm trained using an encoder-decoder deep learning approach, selecting EfficientNet [3] as the encoder and DeepLabv3plus [4] as a decoder and using 512x512 pixel images.

The dataset used to train the smoke and fire detection algorithm comprises approximately 6,100 background images representing various environmental conditions, such as day and night scenes, with different weather conditions like clouds, fog, rain, snow, and clear skies. The dataset includes approximately 4,500 images depicting fire and smoke, covering various scenarios, including large and small-scale fires occurring in natural and urban environments during daytime and nighttime. Among these fire and smoke images, 4,100 contain smoke, while approximately 2,200 exhibit flames. Notably, about 2,000 images feature both fire and flames simultaneously. This diverse dataset enables the algorithm to learn and generalise effectively to identify and differentiate between smoke and fire plumes under various real-world conditions. Due to their confidentiality, further details about the specific choices adopted for the training cannot be shared in the present document. For each image, we manually segment smoke and fire to create the ground truth we use to train the model. A few data augmentation algorithms have been applied to increase the model's variability and resilience.

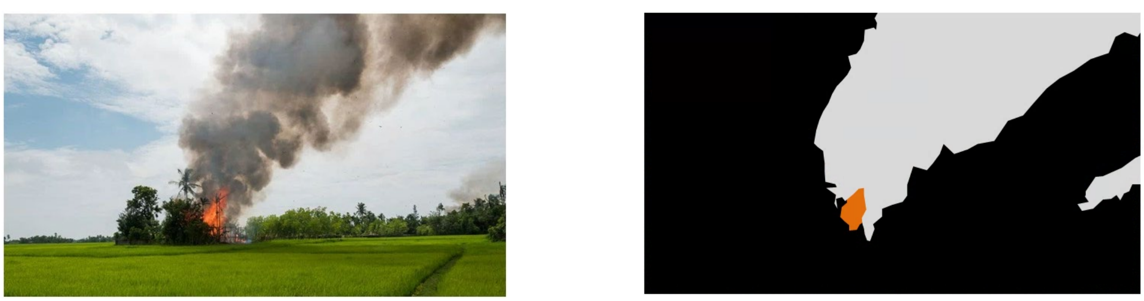

Figure 2. (a) Example of the images used to train the SFDS-AI model. (b) The image refers to the corresponding mask (ground truth) used to train the SFDS-AI model. The black area represents the parts of the image that are not interested in smoke or fire, the grey area represents the smoke class, and the orange represents the fire class.

This approach is more effective than a classification model where the output is only informative of the presence of smoke and/or fire in the image without knowing the position of the wildfire itself. The

segmentation model instead has as output the location of pixels recognised as smoke, fire and background, which allows the application of activation thresholds to minimise the false positives detections. This activation threshold in the first application is fixed to 2% of the image, which may penalise the detection of wildfires located farther from the camera since, in this case, pixels are involved, and the weight of all the pixels in the image is constant. We aim to modify this relation by trying to normalise the weight of each pixel accordingly with the distance of each point framed from the camera location.
The model's output is a vector with the percentage of pixels belonging to the three classes described in Figure 2 (background, smoke, and fire). If one or both smoke and fire are over the activation threshold, then the process will estimate the direction, the distance and the position of the fire event. If no smoke or fire is detected, the process interrupts itself without computing additional information and it only shares a “neutral” message with the last available picture and all the detection fields set to False. The lab tests of the SFDS-AI application have shown a high accuracy level for smoke detection during the daytime and fire detection during the night. As already highlighted, the accuracy is also higher when the wildfire occurs in areas closer to the camera or at least if it takes up a higher portion of the image. Table 2 reports the accuracy and recall values for both smoke and fire calculated on the testing set.

Table 2. Precision and recall for the SFDS-AI model.

Performances	Smoke detection	Fire detection
Precision	0.93	0.96
Recall	0.86	0.88

5. CONCLUSIONS AND FUTURE WORKS

In summary, our proposed SFDS-AI offers a promising solution to the pressing issue of fire and smoke detection, demonstrating its efficacy beyond the confines of the SAFERS project. By providing timely alerts and comprehensive information, this system holds the potential to play a vital role in safeguarding communities and natural resources from the devastating effects of wildfires. Future works will include acquiring validation data and fine-tuning the AI model to increase performance in real scenarios.

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5.

BURN MASS CASUALTY INCIDENTS:
NATIONAL PREPAREDNESS PLANS & CONNECTION TO EUROPEAN RESPONSE PLANS

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ABSTRACT

The complex nature of burn injuries necessitates a diverse range of skills and specialties for optimal care and poses a high demand on staff, infrastructure and resources. Morbidity and mortality worsens when patients are not transferred to a specialized (and not any) unit as soon as possible. Burn units have a limited number of available beds.
Burn Mass Casualty incidents are rare, but occasionally happen, bringing health systems in crisis. The overall aim of implementing a burns-specific plan within the Union Civil Protection Mechanism is to ensure specialized burn care for all victims suffering severe burns following a mass casualty incident in any Member and Participating State in Europe. Local and national plans will dictate the initial distribution of patients to primary hospitals, resource distributions within every country and identify thresholds for national capacities and the need to request cross-border mutual assistance through a UCPM activation.
In the agreed template for UCPM activation for burn mass casualties, a request for assistance to the Emergency Response Coordination Center will typically consist of one or all of three elements:

1) Burn assessment teams to aid specialized in-hospital triage of patients and preparations for patient distribution
2) Specialized burn care bed capacities in European burn centers
3) Medevacuation capacities from participating states

Further development is needed and should focus on:

- Implementation of an acceptable burn center verification scheme
- Electronic burn mass casualty assessment, tracing, and tracking systems
- Regulations for cross-border transfer and patients care coverage
- Regular burn assessment team training courses and largescale exercises

Keywords: Burn Unit, Burn Mass Casualty Incidents, Burn Assessment Teams

AI-FIREMAP: AN AI-BASED TOOL FOR SMART SENSOR PLACEMENT

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ABSTRACT
AI-FireMap aims to enhance an already commercial solution which is used to develop scientifically and technically robust maps depicting the longitudinal wildfire risk of region. These maps are then used to propose an optimum development of ground sensors and/or an optimal coverage of sensors mounted on UAVs, in order to keep sensor placement and flight costs low while securing the protection level is high as possible based on the manufacturer's specifications and the local characteristics of each region. Today, the methodology is based on semi-automated, manual processes utilizing open geospatial and EO data in combination with scientific approaches and expert opinion. AI-FireMap aspires to fully automate the existing processes by integrating smart tools and AI models. Subsequently, an AI-driven optimisation process based on the Monte Carlo or even in a weighted average approach will be developed. The solution aims to identify a fixed number of N sensors required to achieve the average time to detection when the sensors are optimally placed.

Keywords: wildfire hazard map, AI-driven optimization, smart sensor placement, efficient sensor placement

1. INTRODUCTION
Natural disasters are inevitable situations of hazards and threats that can lead to subsequent events. The Intergovernmental Panel on Climate Change (IPCC) [1] defines a hazard or threat as an event originating from natural or human sources that can result in loss of life, adverse health impacts, damage to property and infrastructure, disruption of services, and depletion of environmental resources. In recent years, terrestrial ecosystems, including forests and rural areas, have frequently experienced the adverse effects of wildfires. Extensive research is being conducted to understand and manage this phenomenon, given its persistent presence especially during the summer months. Our current methodological approach utilizes multi-criteria analysis to map the longtidunal wildfire risk [2], by taking into account parameters such as fuelbed characteristics, topography and infrastructure factors in the area of interest. These factors are assessed using openly available geospatial data ensuring the applicability and transferability of the methodology to any region. At first, the project aims to evaluate the automation parts of the semi-automated, manual pipeline process, which includes processing of all input layers for a specific region to generate the wildfire hazard map. Following, an AI-driven optimization of the sensor placement process will be developed based on approaches such as Monte Carlo or weighted average between time and distance. This means that once the hazard maps have been generated, an optimization process for sensor placement will be carried out, taking into account external insights such as the technical specifications of the sensors, in order to ensure the optimal sensor placement, maximum coverage and low costs. In this perspective, using the efficiency frontier method, it is possible to identify the fixed number of N sensors required to achieve the average time-to-detection when the sensors are optimally placed. Therefore, the AI-FireMap tool will take the hazard map as input, along with the technical specifications of the sensors, and will iteratively try to optimally place the sensors in the field in order to minimise the detection time of wildfires and increase the level of protection in the given area.

2. MATERIAL AND METHODS

2.1. Data

Several open access geospatial datasets were used for the automated production of the wildfire hazard map. These datasets include fuel bed types, geomorphological factors such as aspect and slope, and built infrastructure such as road networks and urban areas. Some of the datasets were obtained from the European Space Agency (ESA) Copernicus Access Hub[1] and Open Street Map (OSM)[2], while others were produced by applying remote sensing techniques to raw time series data. All the datasets will be pre-processed into GIS thematic layers using the open source Quantum GIS (QGIS) software package and thereafter will be further imported into the automated tool to generate the hazard map with the corresponding risk classies. The tool will process all the required datasets for specific pilot region/s in Greece or Europe in order to automatically generate the maps by applying mathematical operations between the datasets of an area. The AI-driven optimisation tool for the optimal sensor placement in the field will be developed in Python language using relevant AI/ML libraries. The input will be the hazard map in raster format. Taking into account the technical requirements of the sensors, such as the maximum sensor distance-radius (e.g. 100m radius to detect 2x2m fires within 60 minutes), the tool will simulate random fires. The goal is to determine the optimal placement of a fixed number, N, of sensors that will provide the highest level of coverage while keeping installation costs reasonable.

3. RESULTS

Parts of the semi-automated, manual pipeline processes will be automated and optimized to use the needed geospatial datasets for a specific pilot region/s and generate the hazard map by applying mathematical operations among the datasets. The final hazard map is classified into five classes indicating the level of hazard class. Each class assigned with an adequate hazard class as presented in Table 1. An example of the current visualization of sensors based on the hazard map is presented in the following figure (Figure 1). As it can be seen, the blue dots indicate the very first locations of sensors in the specific area.

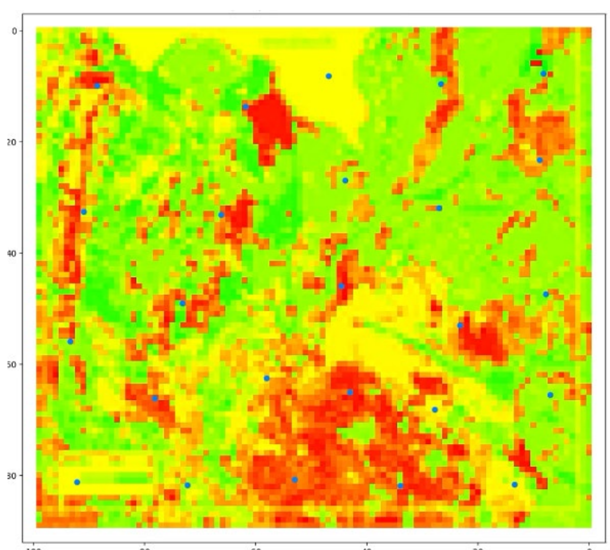

Figure 1. Wildfire hazard map with associated classes of hazard level (green to red color) and the sensors placement (blue color)

[1] https://scihub.copernicus.eu/

[2] https://www.openstreetmap.org/

Table 1. Color code classification and associated hazard classes

Hazard Class	Explanation
1	Very low
2	Low
3	Moderate
4	High
5	Very high

4. CONCLUSION AND DISCUSSION

The AI-FireMap project aspires to develop innovative processes to tackle: a) the assessment of an automation process to surrogate the existing semi-automated, manual pipeline which is used to generate the hazard maps and b) the AI-driven optimisation process for efficient sensor placement by applying weighted average or even Monte Carlo approaches. In this perspective, our solution targets to identify the fixed number of N sensors required to get the average time-to-detection, when sensors are placed optimally. Then, the output time can be compared with the average time-to-detection based on an equally spaced grid and in our current approach which is mainly based on scientific approaches and expert opinion. The methodology is based on well-known scientific approaches, which are combined in a novel way. The developed methodological framework is currently under improvement by focusing on more test areas. The results will be presented in a user-friendly format in order to maximize the positive impact from using this tool to a specific region and for commercial purposes. Apart from that, the impact of this project aims to improve the effectiveness and the efficiency of the sensor network in detecting fires and reducing response time. By optimizing sensor placement, the system aims to achieve maximum coverage, ensuring early detection of fires and minimizing the cost by providing a fixed and appropriate number of sensors for each case. The ultimate goal is to minimize the time between ultra-early detection of an event and critical action; the latter has been identified as a major importance when it comes to managing the adverse effects of wildfires. To evaluate the quality of the activity, several performance metrics can be considered. These may include metrics such as average time-to-detection, coverage percentage.

ACKNOWLEDGMENT

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SOCIAL MEDIA SENSING FOR FOREST WILDFIRES - A CASE STUDY FROM GREECE

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ABSTRACT

Climate change intensifies wildfire risk and impact, leading to more frequent and extreme events that profoundly affect the environment, society, economy, and vital ecosystem services. Wildfires have both consequences, such as loss of life, pollution, and damage, and beneficial effects, including organic material clearance, improved soil fertility, and eradication of invasive species. Technological advancements and mobile devices have proven invaluable for disaster readiness, prevention, and response, with successful real-life applications of social media and sensing tools in emergency management. In this paper, a social media sensing tool is presented that consists of a Social Media Analysis Toolkit, that includes fire event detection and visual analytics, enabling the collection, analysis, and visualization of fire-related tweets. The effectiveness and usability of the tool were tested for the pilot area of Evia in Greece. The social media sensing tool collected fire-related tweets the summer of 2021, analyzed them and filtered them in order to provide an enhanced situational awareness tool the massive wildfire incident that occurred in August 2021. The results illustrate a significant increase in Twitter activity during the wildfire period, demonstrating the tool's effectiveness in monitoring and analyzing social media data for wildfire detection.

Keywords: wildfires, social media, Twitter, fire event detection

1. INTRODUCTION

Climate change has been a major factor in increasing the risk and impact of wildfires, through more frequent and extreme wildfire phenomena, with far-reaching implications for the environment, society, and economy, as well as for essential ecosystem services provided by forests. The paradox of wildfires recognizes that wildfire impacts can be both damaging and beneficial. Negative impacts, indicatively, include loss of human lives and animals, pollution, loss of biodiversity, damage to human assets, soil erosion, and social impacts. The costs resulting from these impacts are substantial. Under circumstances, beneficial impacts exist (e.g., clearing out of the organic materials, increasing soil fertility, clearing out of invasive species). The negative impacts highlight the importance of effective wildfire preparedness and prevention, detection and response, restoration, and adaptation. Technology and the use of mobile devices in our daily lives have been proved as a valuable tool towards preparedness, prevention and response against disasters. There are several real-life cases where social media and social media sensing tools have been used effectively for emergency response. Some indicative examples include emergency events from the past and social media platforms: Boston Marathon Bombing (2013), Nepal Earthquake (2015), Hurricane Harvey (2017), California Wildfires (2017 and 2018), COVID-19 Pandemic (2019-2021), Ushahidi platform, Twitter's Lifeline project in Japan. Numerous scientific studies have been conducted, focusing on the utilization of social media sensing tools to address emergency situations such as fires and floods [1]. For instance, in [2], the authors analyze the use of Twitter during emergency situations, while another study [3] provide a concrete case study of how social media was used for crisis communication during the Zika virus outbreak and an additional work [4] define a methodology supported by a tool-flow, which combines machine learning techniques for identifying informative tweets, in conjunction with a semi-automated mechanism of dispatching information to first responders in [5] found that social media could be used as a human-centric sensor network for early wildfire detection. Moreover, social media sensing could support the coordination of first responders, the efficient allocation of resources and to create situational awareness. Social media can support the provision of real-time information, locate people in danger and monitor the public sediment. On the other hand, the use of social media sensing tools in emergency situations presents limitations and potential ethical implications, including privacy issues, the need to confirm information, and the associated risk of being misled by misinformation [6]. In this light, and in comparison to previous efforts and studies, our work presents the following advantages and distinctive characteristics: a) it focuses on the needs of first responders in cases of wildfires; b) it is co-designed together with the end-users and practitioners, following a user-centered approach; c) it considers privacy and misinformation risks; and d) it is implemented as an interoperable service integrated into an open framework for wildfire prevention and response.

2. METHODOLOGY

The development of the SILVANUS social media sensing tool has been based on a concrete co-design methodology. The initial step involved identifying key stakeholders, including wildfire first responders, forestry departments, social media experts, residents living in wildfire-prone areas. The next step involved defining the requirements of the social media sensing tool to identify specific needs for wildfire scenarios. In this process, it was determined the key data to extract from social media, such as locations of interest, preferred platforms, search criteria, interval for fire event detection, and approaches to handle misinformation and noise. A prototype was developed and tested using simulated wildfire scenarios, with feedback received from first responders and stakeholders regarding its effectiveness and usability.

2.1. Social media sensing tool

The social media framework consists of the following modules: a) a Twitter Crawler that collects tweets based on user defined search criteria (keywords, phrases, accounts); b) a Social Media Analysis Toolkit where the visual and textual content of tweets are analyzed; c) a fire event detection module that filters and clusters the tweets that refer to the same incident with the aim of creating a condensed report for fire incident; and d) a visualization dashboard where the fire events are visualized in graphic user interface. Figure 1 depicts the social media sensing framework. Twitter Crawler is module that retrieves tweets in almost real time by performing complex queries to the filter stream endpoint. It captures tweets that include keywords or phrases that indicate fire incidents (e.g., forest fires, wildfire emergency) or tweets that are posted from official Twitter accounts associated with fire news (e.g., @WildFires, @pyrosvestiki). The focus is on tweets in English, Italian, Greek, Indonesian and French.

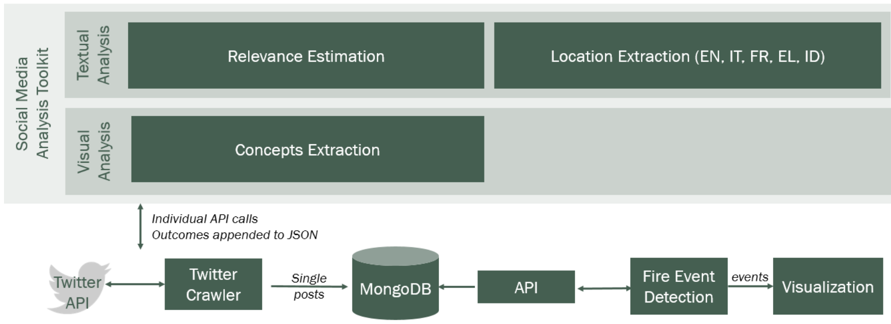
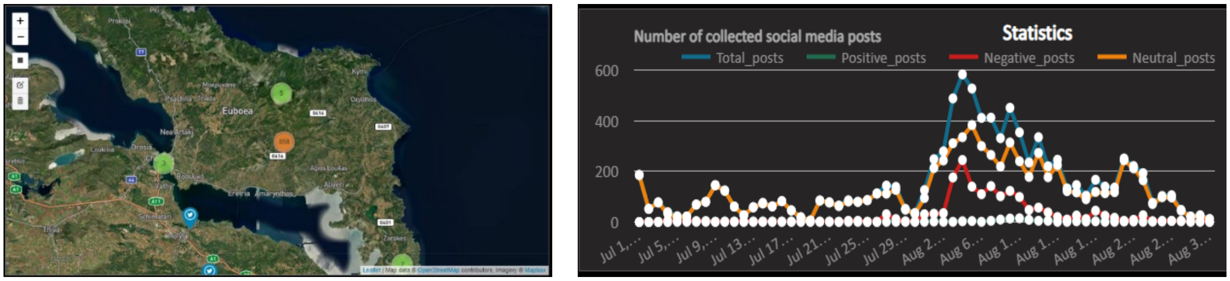


Figure 1: Social media sensing framework.

Collected tweets are sent to the Social Media Analysis Toolkit which consists of several modules using textual and visual analysis to extract higher-level knowledge. Specifically, the Relevance Estimation module analyzes tweet text to determine its relevance to fire incidents using natural language processing and machine learning. The Location Extraction module utilizes a Bidirectional Long Short-Term Memory (biLSTM) network [7] for Named Entity Recognition, identifying locations mentioned in the tweet. These recognized locations are then georeferenced using the OpenStreetMap API. Finally, a visual concept extraction module extracts meaningful visual concepts from images. The analyzed tweets are stored in a database and processed by the Fire Event Detection module. This module has two stages: filtering and grouping. The filtering stage selects only fire-related tweets based on relevance estimation results. The grouping stage groups tweets referring to the same incident using location information. Then, a concise report called a fire event is generated, providing condensed information about the specific fire incident. Finally, the fire events are displayed as pop-ups on a map (Figure 2a) in a user interface. Each event is represented by a pin, showing its location. Clicking on a pin reveals a panel with event details, including location name, coordinates, timestamp, a short description from tweets, event type, most frequent visual concepts as tags from tweet images, and tweet content (i.e., image, text, timestamp).

3. USE OF SOCIAL MEDIA SENSING TOOL BY INVOLVED STAKEHOLDERS

The primary goal of the social media sensing tool in SILVANUS is to create a framework based on crowdsourcing technologies for detecting wildfires early and reliably, by understanding concise text and photographs. The outputs aim to provide a reliable estimation of the fire ignition location, fire severity and indirectly the fire spread through updated information. By accurately identifying the location of the fire in relation to the available resources, firefighting forces can make informed decisions on resource allocation. They can quickly assess the proximity of firefighting teams, equipment, and water sources to the affected area. This allows for a more effective response, the decision on evacuation of nearby locations and the fire severity. The social sensing algorithm will be demonstrated and tested in Evia island, in discussion-based exercise and a field demonstration. In a first testing of the algorithm the objective was to identify the mega wildfire that occured in Evia from August 3rd to 8th based on Twitter data. The tool gathered fire related tweets for the summer of 2021 in Greek and English. The retrieved tweets analyzed in order to extract the locations of the tweets and their relevance to fires. Afterwards, the tweets are filtered to include only those relevant to fires and which location are close to Evia from July 1st until August 30. Then, a chart was created showing the tweets per date (Figure 2b). The chart indicates a notable increase in activity between 1st and 15th of August, aligning with a prolonged period of intense heatwave and dry weather in Greece. However, when specifically focusing on the Evia wildfire, it is evident that the peak of tweets corresponds to the day and the following one of the fire start (August 5th and 6th) and the tweet activity remains notably higher throughout the duration of the Evia wildfire.



(**a**) (**b**)

Figure 2: Visualization of social media posts in a Dashboard and a line chart for the region of Evia for a period of two months (July-August 2021): (a) Social media posts visualization in Dashboard; (b) Tweets per date in a line chart.

4. CONCLUSIONS & FUTURE STEPS

This work presents the Social Media Analysis Toolkit that aims at helping the involved stakeholders in case of a wildfire in terms of providing real-time and accurate information for making crucial decisions. The toolkit is presently undergoing testing to validate and enhance its functionality, with upcoming exercises expected to generate new requirements. Moving forward, stakeholders will be trained to understand how to use it, interpret its data, and know what to do if they encounter issues. The performance of the tool and its added value will be assessed with user surveys, interviews, and analysis of incident reports. Part of the process will also involve informing and educating the public on how to share useful information during wildfires and how to avoid spreading misinformation.

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KNOWLEDGE AND EFFECTIVENESS OF 112: THE CASE OF THE 2021 FOREST FIRE IN ANCIENT OLYMPIA

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ABSTRACT
In 2021, 9,514 fires occurred in Greece. The General Secretariat for Civil Protection, through the activation of 112, sent 76 forest fire warning messages, of which 66 for evacuations of settlements. The fire that broke out in Ancient Olympia on August 4, 2021, destroying 18,400 hectares of forest and agricultural land. Totally sent seven (7) messages 112 for evacuations which they involved residents of twenty-three (23) settlements in this municipality. This study, which was conducted using the methodology of synchronic studies, investigated the knowledge and effectiveness of the message in a sample of 126 residents of Ancient Olympia.
The results demonstrate that the 112 message, although largely understood and clear, did not motivate residents to leave the areas at risk and leave the areas at risk and flee to a safe place, attempting evacuation immediately, following the instructions of the message. As for what they would prefer the content of the 112 message to contain, almost everyone wanted it to have specific instructions on escape and safety routes.

Keywords: message 112, evacuations, forest fire , Ancient Olympia .

1. INTRODUCTION AND PURPOSE

Risk communication in emergency situations, with the aim of rapidly disseminating information and promoting preventive behavior among the public, can also be done by sending emergency messages, via text messages to all mobile phones, directly to a specific location. Successful communication is determined by how quickly a message can be disseminated, Having consistent, clear, secure and concrete information that can reduce the time citizens are indecisive and increase the likelihood of taking immediate drastic measures [1]. This information is: who is sending the message, what citizens should do and when they should act, the exact location of the natural disaster and why they should act [1], [2].
In Greece, the General Secretariat for Civil Protection is responsible for the implementation and operation of the Emergency Communications Service 112.
Forest fires are common in Greece. According to the data of the Hellenic Fire Brigade [3] In the summer of 2021, devastating forest fires that hit Greece resulted in over 125,000 (ha) of forest and agricultural land being burned and between July 28 and August 16, 2021, 76 alarm messages were issued using message 112. Of these, seven 112 evacuation messages were sent to residents of twenty-three settlements in the Municipality of Ancient Olympia in the Prefecture of Ilia, in the Region of Western Greece, due to the fire that occurred on the morning of August 4, 2021 and resulted in the burning of [4].
The aim of this research is to investigate the knowledge and effectiveness of the 112 message to the residents of the above area.

2. METHODOLOGY

The present study was carried out with the methodology of cross sectional studies and was conducted from 01 April to 31 May 2022. The study population was 126 residents of Ancient Olympia and its settlements, which were affected by the forest fire in the summer of 2021. Participants were selected using the method of non-random opportunity sampling and were invited to complete a questionnaire, with voluntary and anonymous participation. A total of 126 responses were received. The questionnaire included questions concerning: **a)** socio-demographic data: questions about: gender, age, place of residence, family status, level of education, profession, **b)** questions measuring perception and action behaviors in relation to message 112. They were also asked what they wish for the further development of the content and information they would like the emergency message 112 to provide. Quantitative variables were expressed as mean values (standard deviation), while qualitative variables were expressed as absolute and relative frequencies and analyses were conducted using SPSS statistical software (version 26.0).

3. RESULTS AND DISCUSSION

3.1 Socio-demographic characteristics of participants

The sample consisted of 126 participants, of whom 54% were men. Most of the participants were 40 years or older (43.7%) and employed (81.7%). Almost all participants had a mobile phone (99.2%), of which 80.8% had a smartphone.

3.2 Knowledge of 112

73.6% of respondents consider the 112 message to be an integrated emergency communications service, while 65.6% stated that they had been informed by an official body about the existence of 112. 68.3% knew that they can call 112 free of charge in any emergency, anywhere in Greece and the EU, while 64.3% knew that calling 112 provides the ability to locate the caller's location.

3.3 Help from 112

Respondents' opinion of the help offered by 112 ranges from 5% to 81%. More specifically, 81% of the sample agreed with the statement: "It helped me *understand which area is affected" and* 79.3% with the statement: "*It helped me understand what the risk is and how serious it is."* In addition, 24.8% of the sample agreed with the statement: "It *made me panic"* and 5.8% with the statement: *"It was indifferent".* The above results are consistent with other studies conducted in Australia in areas affected by large and destructive forest fires, such as Victoria, New South Wales, South Australia, Queensland and the Northern Territory [5] and in the USA such as California, New Mexico, Arizona and Colorado [6], [7].

3.4 Actions after receiving message 112

Almost all participants (N=113; 89.7%) received the emergency message 112 to evacuate, during a fire in summer 2021. More than half of the participants (57.0%) searched to find out if this was the case, 36.4% stayed at home to protect it, and 31.4% waited to see how the fire would develop and evacuated as soon as they thought it was too dangerous (Figure 1), findings similar to surveys in Australia [8]–[11]. Only 15.7% attempted evacuation immediately, following the instructions in the message. Our research confirms the claim of Wong and his colleagues by analyzing cases of 11 fires that occurred between 2017 and 2019 in California, namely that there are people who do not intend to leave the areas at risk [12].

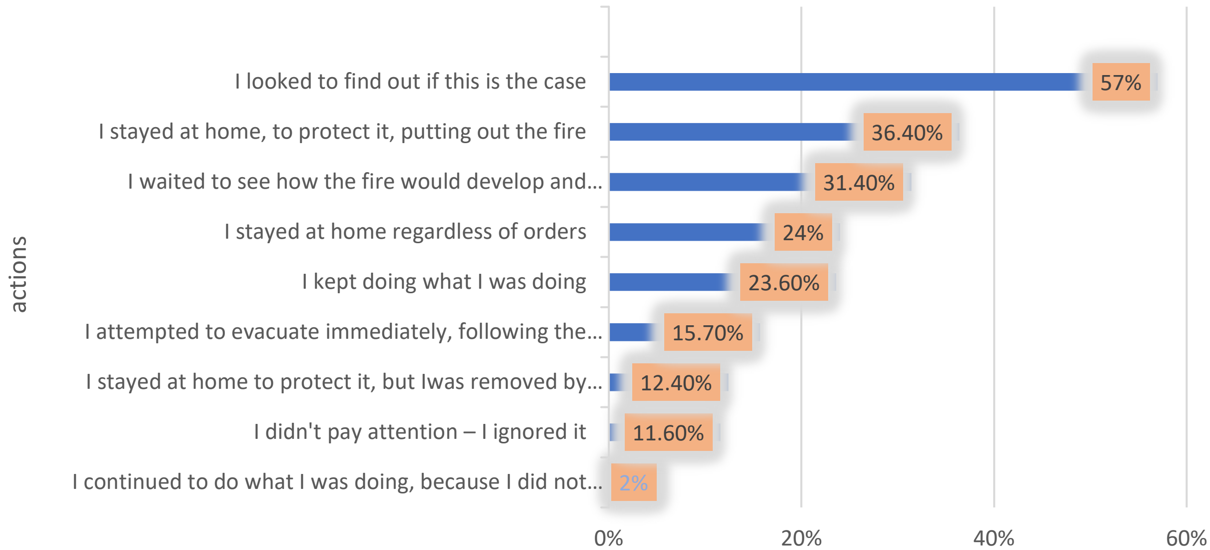

Figure 1. Actions after receiving the emergency message 112 to evacuate, during a fire in the summer of 2021, in descending order

3.5. Desirable features of 112

Participants' opinion on the desired characteristics of 112 is described in Figure 2.

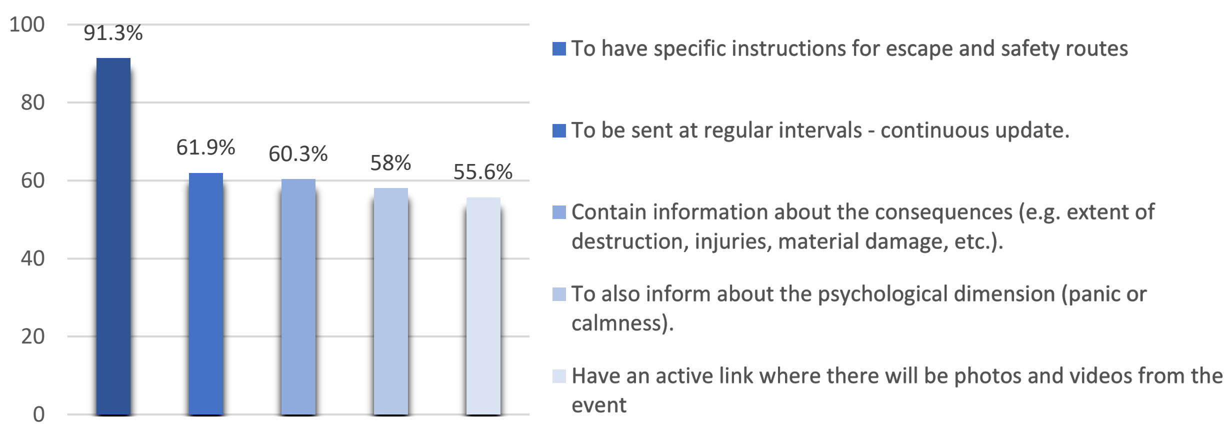

Figure 2. What participants would like the content of the 112 emergency message to have

4. CONCLUSIONS

This survey is the first that has been conducted in Greece and although it was conducted on a small sample of the population, a fact that should be taken into account in interpreting the results, it provides data on the trends of the general population regarding the knowledge and effectiveness of the 112 message to the residents of the Municipality of Ancient Olympia, after the large fire that occurred in the summer of 2021.

It was found that the majority of participants are aware of the existence of 112. But not everyone has been informed by an official body. The message was largely understandable and clear, although 1 in 4 of the participants said it caused them to panic. However, they did not attempt to leave the areas in danger and leave for a safe place, attempting to evacuate immediately, following the instructions in the message.

In our study, only 19 out of a total of 126 respondents left for a safe place and attempted evacuation immediately, following the instructions in the message.
The results of our research confirm that as in other countries (Australia, USA), affected by fires, so in our region most will try to be informed and confirm fire warnings. Some will wait until they are threatened immediately, before taking action and before taking protective measures, and others will stay to defend their property. As for what they would prefer the content of the message to have, almost all of them stated in order of priority that they would like it to have specific instructions on escape and safety routes, to be sent at reasonable intervals in order to have a continuous update, to contain information on the consequences (e.g. extent of destruction, injuries, property damage, etc.), be informed about the psychological dimension and have an active link to photos and videos of the incident. Further studies are needed nationwide, which will identify particular aspects of the use of 112 and clarify factors that favor its effectiveness.

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ESTIMATING THE POSSIBILITY OF DEBRIS FLOW OCCURRENCE IN A POST-FIRE ENVIRONMENT. THE CASE OF SCHINOS, GREECE

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ABSTRACT
In Mediterranean environments, post-fire geomorphic processes and associated risks pose a significant threat. Despite the prevalence of forest fires and landslide/debris flow disasters in the region, predicting the likelihood of post-fire mass movement phenomena remains limited. This study addresses the issue by implementing a debris flow likelihood model to assess the probability of mass movement events in various catchments of the Schinos area (Attica, Greece) following a catastrophic fire in summer 2021. The model's accuracy is validated through field observations of mass movement phenomena after intense rainfall. The findings demonstrate the model's success in determining debris flow probability, considering specific geo-environmental factors such as soil and vegetation types. This approach establishes the model's reliability in evaluating mass movement risks in Mediterranean regions abundant with post-fire hazards and disastrous events.

Keywords: debris flow, wildfires, post-fire, logistic regression, Mediterranean environments

1. INTRODUCTION

Despite the fact that forest fires are an integral part of the Mediterranean ecosystems, their occurrence affects, often heavily, the hydrologic and geomorphic processes inducing significant changes in the burnt landscape as well as important subsequent hazards, including increased erosion desertification and soil loss increased flood and mass movement phenomena frequency. One of the most common hazards of a post-fire environment is the occurrence of debris flows of various magnitudes, triggered by intense rainfall events mobilizing sediments of various grain sizes (from clay to boulders) which together with water, flow by gravity downstream causing severe impacts and posing a risk to the population. Despite their significance and frequency, there is no systematic diagnosis of debris flow risks after forest fires in the Mediterranean region

Over the past few years, the research and risk-professionals community has responded to the increasing occurrence of debris flow disasters worldwide by developing primarily empirical methods for predicting and warning about such events. These approaches often involve utilizing rainfall thresholds as a key component in the prediction process [1, 2].

In this study, we explore the suitability of a debris flow likelihood model initially applied in the Western U.S. and adapt it for the Eastern Mediterranean region. By utilizing European soil data, we estimate the probability of debris flow events in the post-fire environment of Schinos-Alepochori in Attica, Greece, following a catastrophic fire in 2021. To validate the model's performance, we monitored the area and conduct field observations, comparing the predicted results with actual occurrences of debris flows in the fire-affected region.

2. APPROACH

One of the commonly employed models to assess the likelihood of debris flow events is logistic regression, which involves a binary dependent variable representing the catchment's response to a storm [3]. This approach aims to characterize debris-flow hazard by examining the correlation between geospatial data related to catchment geomorphology, soil properties, burn severity, and storm intensity, and the occurrence or absence of debris flows. Within this framework, the statistical probability of debris-flow occurrence following a storm is calculated through binary logistic regression, employing the logistic curve, expressed by the following equation [3]:

$$P = e^x / (1+e^x) \quad (1)$$

where P represents the statistical likelihood number ranging from 0 to 1, (with higher values denoting higher likelihood of debris flow occurrence) and x is the link function (2), which is given through the following equation and e^x is the exponential function (e is constant and equal to 2.718). In this study we used Staley et al model [3] as shown in equation 2.

$$x = -3.63 + (0.41 \times X1R) + (0.67 \times X2R) + (0.7 \times X3R) \quad (2)$$

Where:

P denotes the statistical likelihood of debris-flow occurrence

X1R denotes the part of upslope area classified as high or moderate soil burn severity and with gradients ≥ 23°, multiplied by the peak 15-minute rainfall accumulation of the design storm (in millimeters [mm])

X2R denotes the average differenced normalized burn ratio (dNBR/1000) of the upstream area, multiplied by the peak 15-minute rainfall accumulation of the design storm (in millimeters [mm]),

X3R denotes the soil KF-Factor of the upslope area multiplied by the peak 15-minute rainfall accumulation of the design storm (in millimeters [mm]).

3. RESULTS

Based on the above equations we calculated the statistical likelihood of debris flow occurrence in 23 basins along the coastal road from Alepochori to Schinos, for a given maximum 15min design rainfall accumulation. The probability (P) ranged from 0.05 to 0.893, with an average of 0.485.

Subsequently, five classes of equal interval were defined for the probability P obtained for cartographic illustration purposes, a practice followed also in previous works (USGS, 2018), namely: (i) 0-0.199: slightly probable, (ii) 0.2-0.399: moderately probable, (iii) 0.4-0.599: probable, (iv) 0.6-0.799: very probable, (v) 0.8-1.0: highly probable. The following map (Figure 1), shows the probability in the study basins.

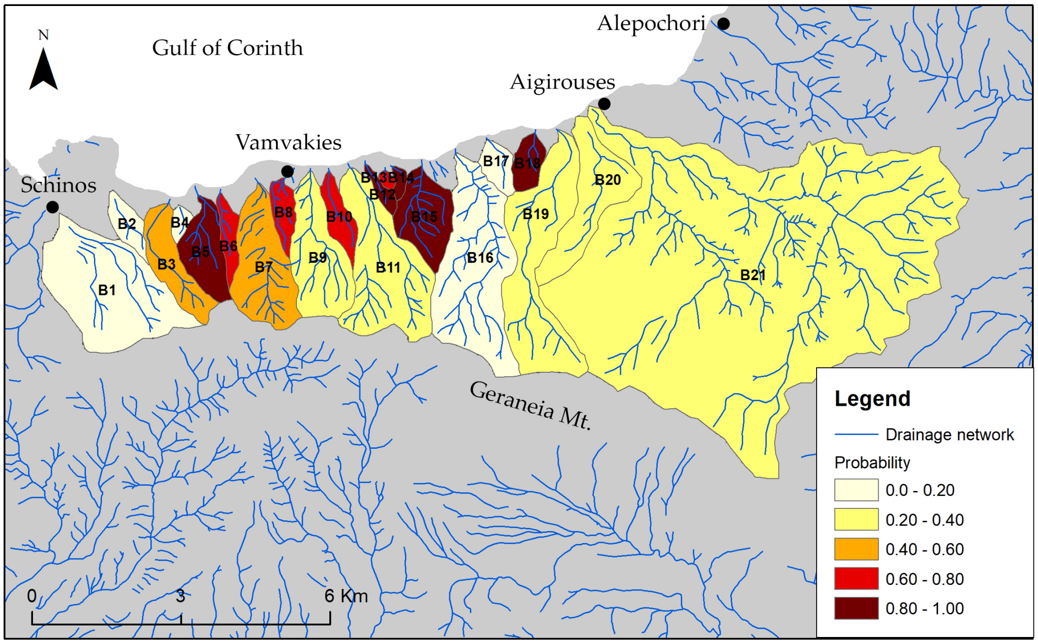

Figure 1. Map of the study area, with the values of the probability in each basin.

Comparing the occurrence of debris flows with the probabilities calculated from the above equations revealed an initial correlation. Debris flows were identified at the outlets of eight basins (namely: B5, B14, B12, B15, B6, B13, B8, B7) based on field observations, all of which were in basins with relatively high probabilities of debris-flow occurrence. To assess the statistical significance of this association, we conducted a Mann Whitney U test, examining the probability variable against the actual catchment binary response (i.e., debris flow generation or no debris flow generation). The test demonstrated a significant association between these variables (sig. = 0.001), indicating a notable difference in probability values between basins with recorded debris flow generation and those without. Additionally, we evaluated the model's predictive capability by testing it with actual debris flow occurrences (true positives) using Receiver Operating Characteristic (ROC) curves. The analysis revealed a reasonably good model prediction accuracy, with an AUC (area under the curve) value of 0.913. The ROC graph and AUC value were derived using the ArcSDM tools in ArcGIS 10.7 software for this study.

Overall, this study investigates the suitability of a binary regression model for assessing the statistical likelihood of debris flow generation in Greece, which serves as a representative example of the Eastern Mediterranean terrain. The findings, combined with field validation through observations of actual debris flow occurrences in the study area, demonstrate the method's effectiveness within the specific geo-environmental characteristics of the region. This suggests its potential for broader applications in the area it covers. The calculated probabilities ranged from 0.05 to 0.893, with an average probability of 0.485. Among the 21 basins studied, 11 exhibited relatively higher probabilities, and eight of these basins experienced debris flows during the study period, highlighting a statistically significant association (sig = 0.001) and a high AUC value (0.913) in the ROC analysis. The model's adaptability is noteworthy, given its modest data requirements and utilization of readily available geospatial data, along with the potential for using established European soil datasets (K-factor). These characteristics support its potential applicability across the region. Furthermore, employing this model aligns with the need for rapid assessment following fires, enabling informed decision-making for implementing measures or risk management initiatives in the limited time between the summer fire season and the subsequent autumn-winter rainfall period.

Utilizing such models offers the prospect of advancing hazard assessment and, consequently, enhancing risk management efforts. Improved prediction of debris flows is of utmost importance in the Mediterranean region and can lead to more informed resource management, prioritization, and intervention planning. Additionally, it facilitates the effective design of infrastructure and the prevention of high-risk situations, particularly those involving human lives. Consistent use of this tool can significantly contribute to reducing the vulnerability of people, infrastructure, and valuable natural, cultural, and economic resources to these hazardous events.

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FIRE UP THE TRANSDISCIPLINARY DIALOGUE FOR WILDFIRE RISK MANAGEMENT WORKING GROUP "INFRASTRUCTURE"

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ABSTRACT

In line with the respective demands for more public participation, transparency and fairness in wildfire risk management institutions and procedures, Firelogue as an EU Coordination and Support Action (CSA) aims to connect, coordinate and support three Innovation Actions (IAs - TREEADS, FIRE-RES, SILVANUS) granted under the H2020-LC-GD-1-1-2020 "Prevention and management of extreme forest fires through the integration and demonstration of innovative means" as well as the precursor project "firEUrisk" by integrating their results across stakeholder groups and Wildfire Risk Management phases (WFRM). It therefore relies on different formats to process the existing WFRM knowledge and innovations developed by the IAs and translate them into an online WFRM community platform named "Lessons on Fire powered by Firelogue" (LoF by Firelogue). This platform disseminates the knowledge of the entire WFRM community as well as technologies and measures developed by the IAs.
In addition, to structure the discussions in dialogue formats, five (5) Working Groups (WGs - Environmental/Ecology, Societal, Infrastructure, Insurance and Civil Protection) have been established, which will work along four horizontal thematic strands to ensure parallel processes and facilitate the exchange between WGs. More specifically, all WGs will address the following aspects of WFRM within and across their respective foci: socio-economic, climate policy (mitigation and adaptation), technology, and earth observation. The aim of this extended abstract is to provide an overview of Firelogue and more insights on its Infrastructure Working Group.

Keywords: Firelogue, Wildfire Risk Management, Dialogue, WG "Infrastructure", Online Platform.

1. INTRODUCTION

Wildfire risk management is characterised by complex interactions between human behaviour, socio-economic development, climate and vegetation resources, also known as fuel [1]. These interdependencies are closely linked to the interests and intentions of different stakeholders. These interests and activities can be synergistic, but they can also be contradictory or even conflicting. However, the interrelationships need to be discussed and assessed from different perspectives to ensure that they are understood and integrated in a meaningful way. Similarly, the views of citizens need to be included in preventive measures, such as perimeter cleaning, or response measures, such as evacuations, in order to be effective. Land and forest owners have a stake in certain land planning and management strategies, as do infrastructure operators. Last but not least, insurance schemes may be developed by private or public stakeholders and may, for example, be linked to building or information requirements. Nevertheless, the associated preconditions and implications from different WFRM perspectives need to be taken into account in order to develop sustainable approaches. Against this background, Firelogue considers that it is crucial to bring together the multitude of different WFRM actors to uncover their conflicting interests and objectives in order to design holistic policies that address them, including their synergies and trade-offs across different sectors and stakeholder groups.

2. FIRELOGUE PROJECT

Firelogue, is a Coordination and Support Action (CSA) granted under the H2020-LC-GD-1-1-2020 "Prevention and management of extreme forest fires through the integration and demonstration of innovative means". It aims to create a dialogue and empower the WFRM community to address current and future wildfire challenges by acting as a knowledge exchange facilitator, aggregating the experiences and best practices of all engaged stakeholders. Its objectives also include to connect, coordinate and support three Innovation Actions (IAs - TREEADS, FIRE-RES, SILVANUS) and other closely related research projects in the field, such as FirEUrisk and integrate their results across stakeholder groups and fire management phases (Prevention and Preparedness; Detection and Response; Restoration and Adaptation).

More specifically, Firelogue aims to:

- Stimulate and provoke cooperation and synergies between the various actors within the WFRM community;
- Empower the WFRM community to effectively address the present and future challenges associated with wildfires;
- Engage all relevant audiences to actively participate, contribute their input and learn from each other's best practices and expertise;
- Raise awareness among practitioners, civil society and beyond regarding the significant progress made by Firelogue and its crucial role in fostering a seamless and productive dialogue within the wildfire sector;
- Provide support to policy makers by offering comprehensive knowledge and certainty to civil society, aiding in the formulation of informed policies related to wildfire management.

2.1. Firelogue Working Groups (WGs)

Firelogue proposes to cluster a variety of different WFRM actors/stakeholders and bring together experts in five thematic Working Groups (WGs) on (i) Environmental/Ecology, (ii) Society, (iii) Infrastructure, (iv) Insurance and (v) Civil Protection into exploring different aspects of WildFire Risk Management (WFRM) (Fig. 1).

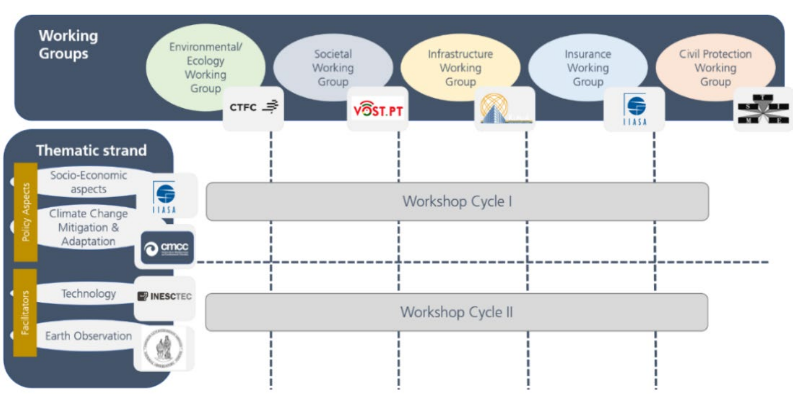

Figure 1: Firelogue Working Groups

More specifically the purpose of the Working Groups are to:

- Ensure the integration of innovative technologies, measures, strategies and governance approaches across the projects into holistic recommendations and to identify their synergies and trade-offs across different sectors and stakeholder groups.
- Exchange about remaining challenges and innovative opportunities within each WG theme and to reflect about integrating them into holistic WFRM strategies
- During Workshop Cycle I, focus will be given to the thematic strands that will reflect main policy aspects (socio-economic and climate policy).
- During Workshop Cycle II, technologies and Earth Observations services will be majorly discussed as means to facilitate integrated WFRM approaches.
- Each WG aims to create a policy recommendations document on the specific field of WFRM.
- Cross-thematic working groups will enable the exchange on relevant measures and solutions at cross-sectoral level, taking into consideration that integrated WFRM encompasses multiple dimensions, stakeholders and approaches.

2.1.1. Working Group “ Infrastructure”

Critical infrastructure is an asset, a facility, equipment, a network or a system, or part thereof, which is necessary for the provision of an essential service (Dir.2022/2557). Experiences from recent disasters affecting critical service assets have provided evidence of the interdependencies between infrastructures and societal function and resilience in different dimensions (e.g. power outages in areas affected by forest fires and transport disruptions) [2]. On the other hand, the operation of inadequate or failing infrastructures has often been shown to be a driving factor for wildfires, especially in the Wildland-Urban Interface (WUI) (e.g. wildfires caused by power lines). In this respect, the working group will discuss, generate insights and recommendations on the following topics, lying under the overarching theme of the interaction of infrastructure with its surrounding natural environment and their exposure to wildfires:

- **Infrastructure as a driving factor in fire regime.** Infrastructure’s malfunction, failure or misuse may lead to wildfire ignition. Prevention measures for the assets upgrade and/or vegetation management of the surrounding areas are deemed necessary. Additionally, the positive involvement of different infrastructures in wildfire management should be further exploited (e.g. role of road network as fire break).
- **Impact of wildfires to infrastructure.** Wildfires can adversely affect the operation of infrastructure assets and networks exposed due to their geographic location, causing disruption of the service provided. This tendency has increased due to the expansion of human settlements and industrial activity into the wildland.
- **Cross-cutting topics with other WGs** have become evident, such as (i) the nature-based solutions infrastructures may adopt for their protection against wildfires; (ii) the necessary societal awareness and preparedness in case of an emergency caused by service disruption; (iii) the insurance claims in case of an infrastructure-ignited fire and vice versa; (iv) the role of civil protection agencies in ensuring resilience planning and emergency training on behalf of critical infrastructure operators, (v) climate change projections and EU climate change adaptation policies regarding infrastructures and WFRM .

2.1.2 Future Steps

The next steps for the Infrastructure WG are to create a “White Paper” with policy recommendations for improving the protection and resilience of infrastructure systems and wildlands and forests exposed to infrastructure-ignited wildfires, aiming to reduce socio-economic and environmental impacts due to service disruption.

3. LESSONS ON FIRE POWERED BY FIRELOGUE PLATFORM

In order to achieve the aformentioned objectives, and with a view to create an online WFRM community, Firelogue has developed a platform called "Lessons on Fire powered by Firelogue" (LoF by Firelogue). "LoF by Firelogue" platform built upon the Lessons on Fire platform established by the Pau Costa Foundation (PCF) in 2015, thereby leveraging the valuable insights and experiences gained from their prior endeavors. Upon the completion of the project, Firelogue's platform will be entrusted to PCF to undertake the responsibility of its continuous maintenance and updates.

The LoF by Firelogue platform serves as a highly valuable resource for the WFRM community. It functions as a centralised hub for sharing of knowledge, dissemination of news and events, promotion of EU platforms dedicated to dissemination of activities, as well as access to various existing platforms related to WFRM. One of the notable features of the platform is its ability to facilitate connections between professionals within the field. It ensures that users remain informed about the latest fire-related events and news, while also granting them access to technical publications, best practices in WFRM, case studies, and a range of fire-related documents. The platform along with its associated context, remains open to all, enabling registered users to contribute their own content. Registered users are given the opportunity to upload their own fire-related contentthrough uploading their results, documents, events and news. This collaborative effort enhances and empowers the WFRM sector.

4. CONCLUSION

Overall, the Firelogue WGs and the LoF powered by Firelogue Platform's are critical resources for the WFRM community, policy makers and civil society to address current and future wildfire challenges. By creating dialogue and empowering the community, Firelogue makes a significant contribution to mitigating the impacts of wildfire. Infrastructure WG strives to better understand the interaction of infrastructure with wildlands and forests, and to incorporate wildfire risk reduction and response measures for both the infrastructure and the surrounding areas, to improve the protection and resilience of infrastructure systems and wildlands and forests exposed to wildfire.

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THE ROLE OF REMOTE SENSING IN THE ASSESSMENT OF A POST FIRE EVENT. CASE STUDY: WILDFIRE IN ANCIENT OLYMPIA 2021

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ABSTRACT
Wildfires significantly affect and change the structure, composition and functioning of a local ecosystem. Due to recent climate change, the temperatures every summer are higher thus the fire probability. Monitoring and assess a post fire event is important for evaluating resilience and securing all the significant data that will increase management and support for the restoration of the burned area from the responsible authorities. In contrast to the time consuming and expensive field work, remote sensing provides a time and cost effective tool to monitor and evaluate a post fire event. In this study, remote sensing techniques are used like the Normalized Burn Ratio (NBR) and difference Normalized Burn Ratio (dNBR) in order to monitor, assess and evaluate the fire severity of the study area. The results showed: low severity in 5078ha, moderate severity in 8505ha and high severity to 4381ha. The effect of the fire severity depicted in the damage to not only vegetation but to build up areas with total 18000ha area burned. Specifically, 46 out of 616 houses affected by the fire, 11247ha out of 49000ha of agriculture was burned, 2716ha out of 10029ha of forests, and 3879ha out of 10711ha of shrubs were burned during the fire.

Keywords: Wildfire, remote sensing, NBR, fire severity

1. INTRODUCTION
Forest fires have been increasing in Greece and every summer during fire season, forests have fire problems [1,2,3]. Many of the fires are due to arson and the hot weather condition make the situation even worse [4]. The climatic conditions of Peloponnese, the high temperatures and the long drought season, increase the fire risk in the area [5,6].Mapping the spatial extent of burned areas is vital for the evaluation of ecological impacts and economical losses of the area [7,8]. Remote sensing is essential for the forest fire area identification and post fire assessment of the burned area, using high resolution multi-spectral bands from optical sensors like Sentinel 2 [9]. In this study, the method that will be applied in order to map burnt areas is based on the use of remote sensing and the Normalized Burn Ratio (NBR) which is used to identify burnt areas and estimate the burn severity. Burn severity refers to how fire intensity affects the surrounding ecosystem and shows the degree to which the burnt area has been changed by the fire [10].

The preparation of maps that depicts and give information for:
-Land use/cover that were burned
-The actual area of the burned forest and non-forest
-Identification and classification of the severity of the burnt areas
All the above will assist and help the authorities in understanding the area of the damage and take the measures for the reconstruction of the forest and whatever was destroyed.

2. STUDY AREA

A wildfire started in August 4th 2021 in Ancient Olympia Municipality at Peloponnese, Greece. Large pine forests were burned and rural areas. The fire had several active spots and the wind was moderate with high temperatures thus the flammability of the forests was high. Many villages and locations was ordered to be evacuated and in the area came 174 firefighters, 52 vehicles, 4 helicopters and 2 airplanes.

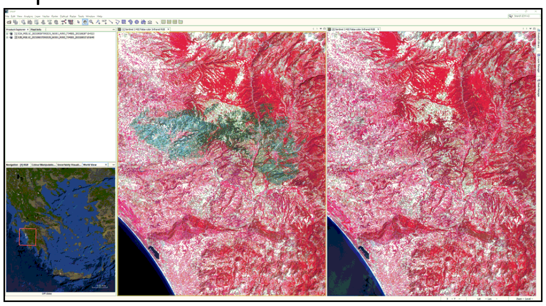

Figure 1: Location of the study area. Ancient Olympia location depicted (left) after fire and (right) before fire, in the Near Infrared spectrum

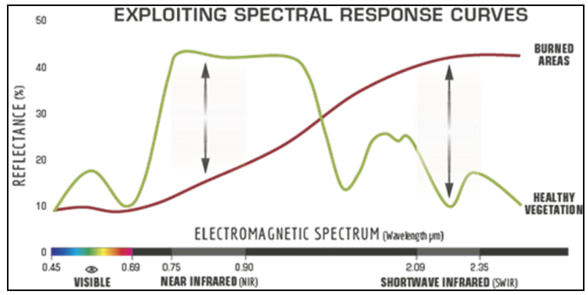

Figure 2: Response of the healthy vegetation and the burned area in the electromagnetic spectrum. Source: U.S. Forest service

3. DATA

In order to fulfill the above tasks pre-event and post-event satellite images were used. Specifically, Sentinel-2A acquired on 01/08/2021 with 0% cloud coverage which was used as before fire image. Sentinel-2B acquired on 26/08/2021 with 0% cloud coverage which was used as after fire image. They both were available under Copernicus hub by the European Union and ESA.

Moreover, several vector data were used, like the transportation data, hydrography data, land use data and built up areas. All of them were acquired from the OpenStreetMap, and the Copernicus Global Land Service. Also, statistical data received from the Emergency Management Service (EMS).

4. METHODOLOGY

The processing of the satellite imagery was done by preprocessing techniques related with corrections, orthorectification and image enhancements in order to contribute to the post analysis of the fire in the study area. The satellite images from ESA's Sentinel 2 were used in order to identify the burned area and classify it. Also, based on the analysis, the land cover and the area that was burned was calculated. The resulted map for the study area, shows the extent of the fire damage and was analyzed and showed information about the forest damage.

4.1 NORMALIZED BURN RATIO

The Normalized Burn Ratio (NBR) was created to help analysts identify the burned areas and to assess the severity of the fire in the study area. It uses the wavelengths of the near Infrared (NIR) and the shortwave Infrared (SWIR) in the electromagnetic spectrum.

Normalized Burn Ratio (NBR) calculation method: **NBR = NIR-SWIR/ NIR+SWIR**

Before the fire, the healthy vegetation reflects highly in Near Infrared and low in the shortwave Infrared spectrum. The reflectance of a burned area is low in the NIR and high in the SWIR band. High values of NBR show healthy or unburned vegetation while low values show no vegetation and burned areas (US forest service).

4.1.1. BURN SEVERITY

The difference of pre-fire and post-fire NBR was used to estimate the delta NBR which is used to estimate the severity of the fire. Higher dNBR indicate more severe damage. Areas with negative dNBR values may indicate increased vegetation productivity following a fire.

Burn severity calculation method: **dNBR or ΔNBR = PrefireNBR – Postfire NBR**

By using the classification recommended by the United States Geological Survey (USGS) authority, the (Table 1) severity thematic layers were classified and created.

Table 1: Burn severity levelling estimated from the dNBR and recommended by USGS.

ΔNBR	Burn Severity
< -0.25	High post-fire regrowth
-0.25 to -0.1	Low post-fire regrowth
-0.1 to +0.1	Unburned
0.1 to 0.27	Low-severity burn
0.27 to 0.66	Moderate-severity burn
> 0.66	High-severity burn

5. RESULTS AND DISCUSSION

Difference Normalized Burn Ratio (dNBR) map was produced for the fire event around the location of Ancient Olympia (Figure 5). The spatial distribution of the dNBR is categorized in levels according to table 1. The severity map that, reclassified in order to show the different severity levels in the study area. The classification has been done similar to the classification of US Geological Survey and used to create a thematic burn severity layer depicting severity as unburned to low, moderate, high severity and potential regrowth. Specifically, the fire severity analysis showed: low severity in 5078ha, moderate severity in 8505ha and high severity to 4381ha. This shows that the fire had devastated results in the area affected the whole area and not just parts.

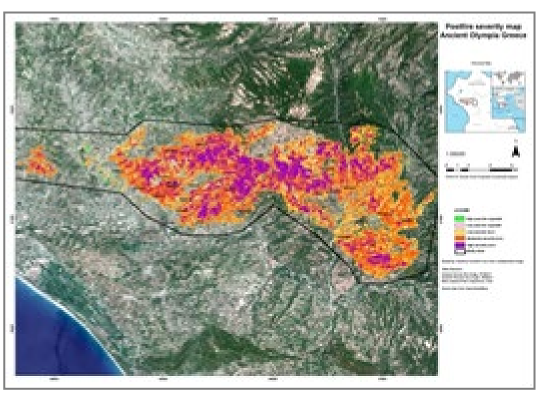

Figure 3: Burn severity map for the post fire assessment in the study area classified based on the Table 1

The NBR and dNBR maps are generally created after the fire in order to make a first assessment of the burn severity in the area and to help firefighters in their field work. After a while they usually calculated again so as to assess the vegetation that was burned. The products that are created are maps and data that can help the local authorities identify what has been burned and what can be restored after the fire. Also, they used for estimation of the burn severity of the soil and how the level of severity can cause even more severe results due to floods, landslides and soil erosion.

Table 2: Land use and built up areas that were affected and burn by the fire in contrast to the total hectares of each in the study area.

Consequences within the study area				
		Unit of measurement	Affected	Total in
Burnt area		ha		17,861.8
Estimated population	Number of inhabitants		2,106	33,393
Built-up	Residential Buildings	ha	46.7	616.1
Land use	Arable land	ha	734.8	5,846.1
	Permanent crops	ha	2,655.9	15,062.5
	Heterogeneous agricultural areas	ha	7,858.7	28,723.2
	Forests	ha	2,716.3	10,029.0
	Shrub and/or herbaceous vegetation association	ha	3,879.7	10,711.7
	Other	ha	16.4	1,556.9

From the analysis that was performed, information related to the area and land use that was burned was calculated, based on the satellite images and remote sensing. Table 2 shows the areas in hectares affected by the fire. As can be seen in the table 2, the fire caused damaged to not only vegetation but to build up areas with total 17861ha burned. Specifically, 46 out of 616 houses affected by the fire, 11247ha out of 49000ha of agriculture was burned, 2716ha out of 10029ha of forests, and 3879ha out of 10711ha of shrubs were burned by the fire.

6. CONCLUSION

Forest fires regularly damage whatever they find in their way from buildings to forests and agricultural lands. Disaster management activities have to be concentrated to the preparation of actual risk maps that make disaster management fast and sustainable. In this way, remote sensing is a very effective tool to monitor, identify and assess the vegetation in the study area. In this study, the role of remote sensing in the assessment of a post fire event was analyzed by creating fire severity map. This analysis can help the local authorities identify what has been burned and what can be restored after the fire. Also, they can be used for estimation of the burn severity of the soil and how the level of severity can cause even more severe results due to floods, landslides and soil erosion.

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EVALUATION OF NEW TECHNOLOGIES IN DISASTER MANAGEMENT STRATEGIES FROM DESIGN TO IMPLEMENTATION. FIRE MANAGEMENT IN GREECE

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ABSTRACT
Natural disasters are an increasing parameter globally. An important fact of this trend appears to be climate crisis, which has dramatically worsened in recent years. Unfortunately, forest fires belong to the category of natural disasters that are affected by climate change and destroy valuable parts of forest land. Therefore, the existence of effective plans to deal with these fires is a vital achievement on a global scale but also in the Greek area. For this purpose, this work is an attempt to investigate the results of the application of new technologies in fire management as they have dynamically entered the struggle of fire management and contribute the most in effective intervention in wildfires. In Greece, new technologies have been introduced in this effort and the evaluation of their application can be a trigger for further improvement of the failures that can be detected in practice. The effort is focused on the degree of application of these technologies in fire management but also on the degree of effectiveness they present in the different stages of intervention. The research uses data based on questionnaires answered by personnel involved in fire management. Finally, the experience shows that although new technologies are used sufficiently in the Greek area, there is also space for improvement according to those responsible and the application of those technologies can be induced in even more areas.

Keywords: Wildfires, Climate crisis, Fire management, Natural disasters, Geographic Information Systems.

1. INTRODUCTION

Natural disasters represent a negative aspect globally. Climate crisis combined with man made factors result in extreme natural phenomena in the urban environment which cause extensive disasters and massive migration flows [1]. Within the above framework, the phenomenon of forest fires is a case that presents an increasing trend and poses a threat in ecosystems [2,3]. Therefore, there is a strong need to apply new technologies in fire management and evaluate their effectiveness [4]. Nowadays there are various systems which help in the above direction. Drones, Gis, other satellite systems such as MODIS, VIIRS, FireSat are same examples of the technology implied in fire management [5,6,7,8]. In Greece, the use of new technologies also includes two programs, DeepBlue and SeasFire that are held by National Observatory of Athens [9.10]. The research tries to point out the fields that the application of new technological systems may show limited effectiveness in Greece and how the design of new practices must be differentiated to overcome obstacles.

2. METHODOLOGY

2.1. Stage I: Defining the type of research and data selection

Quantitative research was conducted through questionnaires that included 14 close type questions and 78 people answered them. This type of research aimed to show the percentage of application and effectiveness of new technologies in fire management in Greece. The choice of this specific type of research was inevitable due to the characteristics of the subject under discussion. The sample of the research consists of professionals who have experience in forest fires in Greece. Most of the answers were from firefighters, civil protection officers, civil servants occupied in local authorities and personnel in forestry services. The first part of the questions is related to demographic information such as age, education, professional status, and experience in forest fires. Subsequently, the questions are formulated to investigate the degree of application and efficiency that new technological methods have in wildfires. The responders had to select an answer from a graduated scale numbered from 1 (none) to 5 (a lot).

2.2. Stage II: Data analysis

According to the data selected, the percentages of women and men, who answered the servey, are 28,2% and 71,8% accordingly. In addition, the majority of the responces have university and postqraduate diplomas in the percentages of 28,2% and 35,9% accordingly. Moreover, a great percentage (above 60%)of the answers were from high experienced profesionals. The majority of the answers were from the fire department and from civil protecton officers while there were others from foresty services and civil servants.

The other part of the research referred to questions that tried to point out the progress Greek frame has made in incorporation of new systems in fire managemnt nowadays.

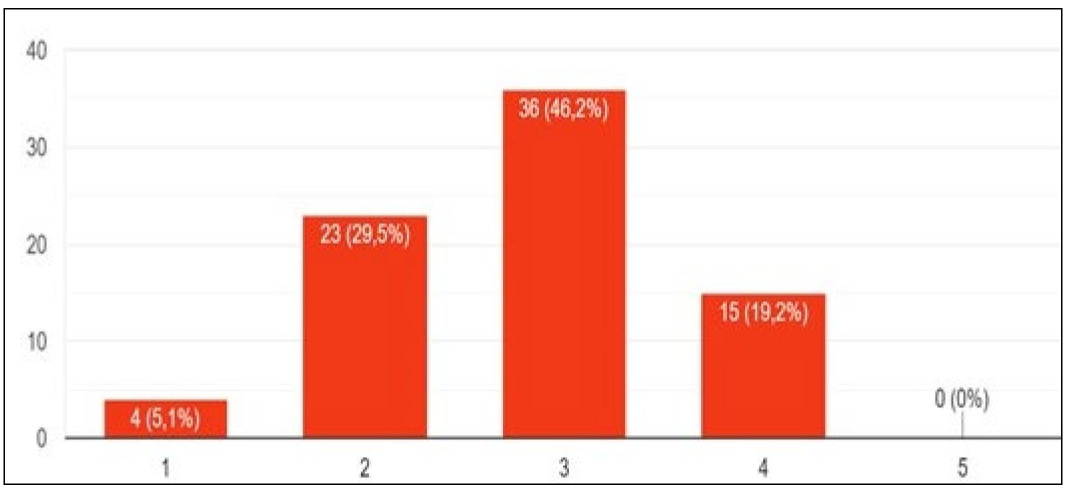

Figure 1. The extend that Greek practice in fire management has incorporate new technologies.

According to figure 1, 29,2% answered that there is little progress in the issue under discussion and 46,2% thinks that some steps have been made. Only 19,2% has the opinion that Greece has made positive changes in adapting new technology.

When it comes to experience Figure 2 shows that highly experienced professionals are of the opinion that new technologies are not as much used as they should. Analytically, 32 answers fluctuate below the middle which means that in Greek fire management there are still a lot to be done.

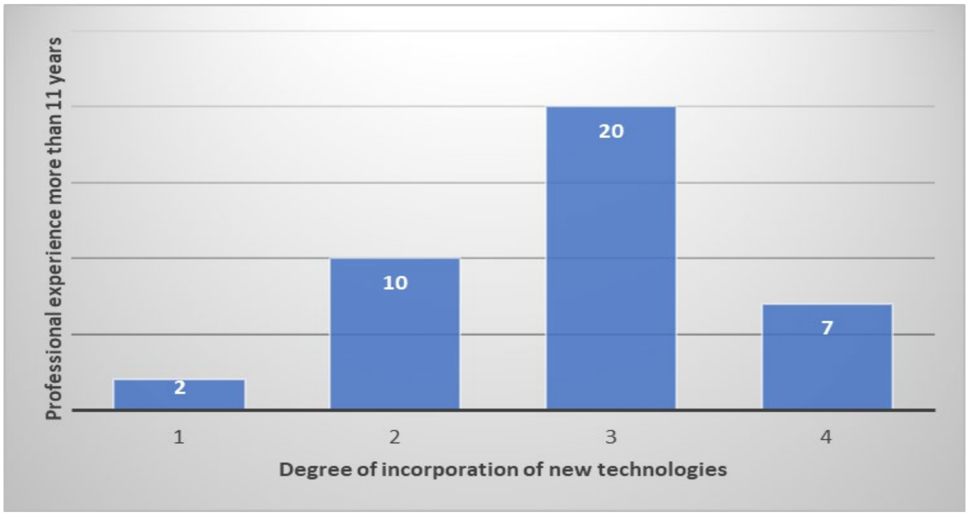

Figure 2. The extend that Greek practice in fire management has incorporate new technologies.

Also in almost all stages (prediction, detection, coordination, restoration), the answers showed that Greece uses new technology effectivelly. On the other hand the only stage that may presents a slight setback is intervation. As figure 3 above shows a great number of answers (in total 46,2%) thinks that in intervention there are practices to reconcider.

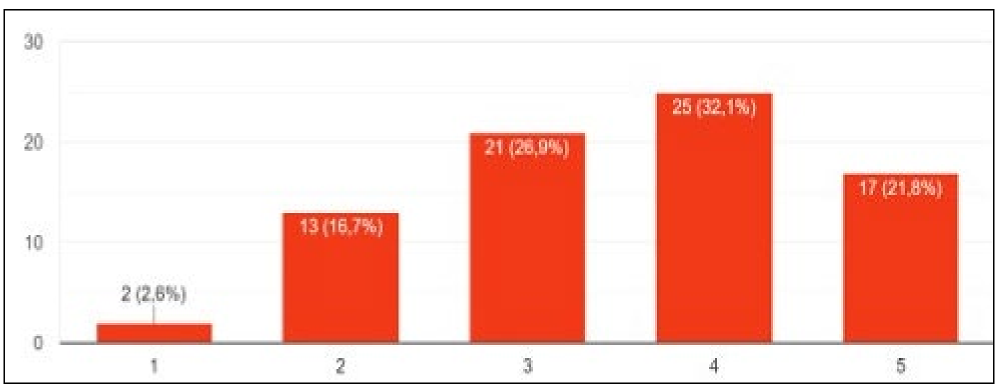

Figure 3. New technologies in the intervention stage

3. CONCLUSİON

3.1. Results

Although it is still at the beginning, the effort to integrate new technologies into Greek practice has revealed many interesting elements. The research showed that the Greek fire management framework has incorporated new technologies to a limited extent, less than expected, despite the fact that in recent years there has been made a significant improvement in general.

An important parameter in Greek reality is that new technologies have improved the efficiency in dealing with fires. But in intervention, the percentages show that the technological inventions are not applied as they should, which demonstrates the need to improve the application of the new systems in practice. Intervention in forest fire events is the sector that in Greece according to the opinion of the involved parties may need a new approach.

3.2. Sugestions

- Extensive usage of new technologies in fire management
- Mandatory educational training programs in new technologies for the personel involved in fire management.
- Development of an international and local network to communicate knowledge and experience.
- Development of a research center in order to evaluate new technologies in practice and detect any failures.
- The organizational base should keep a central focus but also emphasis should be given to decentralize some authorities to detect failures and act accordingly.

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TRAINING NEEDS ANALYSIS FOR CIVIL PROTECTION IN GREECE

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ABSTRACT

Today's hazards, such as biological, environmental, geological, hydro meteorological and technological processes and phenomena, pose a major threat to humans and the environment. Training constitutes an important factor in preventing and responding to such risks. The SETOFF Project aims to improve the readiness and occupational safety of both civil protection and private sector safety and security personnel against future crises and emergencies, by developing an innovative e-training curriculum. An assessment and analysis of the training needs was carried out for the preparation of the curriculum. In this paper the main results of the quantitative survey for training needs in Greece are presented. An online questionnaire was established which was distributed in employees in various services and organizations related to civil protection. Overall, 347 respondents participated. The training needs analysis highlighted the significant lack in terms of the existing level of training for civil protection issues in Greece, particularly for some groups, such as municipal and regional staff, safety engineers, volunteers etc. Issues such as preferences regarding certain features of an asynchronous training program and the duration of each training course were investigated. Based on the results of the analysis of training needs, the topics to be included in the training program of the SETOFF project were chosen. These are introduction to risk, risk management process, risk perception, risk communication, weather phenomena, floods, fires (urban, wildfires), earthquakes, volcanoes, industrial accidents, epidemics, security, occupational safety and health (for first responders) and first aid.

Keywords: training, e-learning, civil protection, distant asynchronous learning, disaster preparedness

1. INTRODUCTION - OBJECTIVE

Natural and man-made disasters can have very serious effects on the lives and health of workers, citizens and the environment. The importance of training for civil protection personnel and first responders for disaster risk reduction in relation to natural or man-made disasters is underlined by a number of studies and reports [1,2,3]. However, the weaknesses that still exist at the level of training and the large differences between countries are pointed out [2,4,5]. Training that includes participants from different countries gives the possibility of exchanging knowledge and approaches and contributes to the increase of preparedness of those involved in civil protection [6]. It is also mentioned that there is a wider audience in need of targeted training at the European level than the target audience of the European Civil Protection Mechanism (UCPM) training programme (firefighters, military or paramilitary from command levels to tactical and operational levels). For example, it is mentioned that training should include foresters and landscape management practitioners (e.g., behavioral experts, meteorological forecast engineers), trainers, government actors and other stakeholders [6].

The importance of emergency preparedness training for natural and technological disasters as well as epidemics is highlighted by studies that have been carried out in Greece regarding emergency situations in the place of residence and in the workplace [7,8,9].

One project which focuses on training on civil protection by taking into consideration differences among countries, is the SETOFF (Smart Education and Training PrOgram For central and local government servants: Embrace vulnerability as our greatest strength and innovative tools For risk management). The SETOFF Project aims to improve the readiness and occupational safety of both civil protection and private sector safety and security personnel against future crises and emergencies by developing an innovative e-training curriculum. In this context an e-training platform will be developed including several topics related to natural and technological emergencies, as well as epidemics, based on the cooperation of universities, research institutes and other organizations from four European countries including Greece. The results of the project will be useful for all those involved on emergency preparedness and response in the workplace and in local, regional and national level.

Based on the SETOFF project objectives, an assessment and analysis of the training needs was carried out for the preparation of the training program [10,11]. The training needs study was carried out based on research questions such as: What topics should the training program include? How long should each training module be? What are the particularities that must be taken into account to cover the training needs (e.g. different beneficiaries, differences in each country)? What are the best methods, tools, best practices for distance learning?

The methodology of the training needs study in the context of the SETOFF project included a literature review, online anonymous surveys via electronic questionnaires in four countries (Greece, Belgium, the Republic of North Macedonia and Spain) and qualitative research through the formation of focus groups and the analysis of interviews with individuals from each of the 4 reference countries. In this paper the results of the quantitative survey in Greece are presented.

2. METHOD

An online questionnaire was established according to the objectives of the SETOFF project, the results of the qualitative field research carried out through interviews with stakeholders and research tools mentioned in the literature [e.g. 12,13,14,15,16,17,18].

The Greek version of the questionnaire was distributed through an online platform in Greece, for the period from June - August 2022. Recipients of the questionnaire were employees in various services and organizations such as civil protection organizations (municipality, regional unity, central government), Fire service, Police, Emergency medical service, Coast guard, Security service, as well as individuals with Safety Engineer duties, trainers in training programs, civil protection experts, volunteers etc. To use the research tool, all the terms related to the protection of personal data complied with the legislation. In total 347 participants filled in the questionnaire in Greece. Statistical tests were performed on the "sample". The confidence level was a=0.05.

3. RESULTS AND DISCUSSION

According to the objectives of the SETOFF project and the qualitative field research through interviews with various beneficiaries, it emerged that the training program should be better implemented as an asynchronous distance training program. Attendees are people with an unstable time schedule since some of them work in shifts or either adapt their work or are kept in readiness, according to emergencies.

Among the main advantages of asynchronous training, mentioned in literature, is the flexibility to carry out each course at the time and place that serves the student [19].

The online survey investigated the level of existing training of the participants and their needs regarding an asynchronous training program. The participants' level of training was investigated by asking them whether they had attended training seminars on specific topics and whether the seminars included simulation. The most frequently reported training program attended in the past was the one with subject “First aid” (52%) which in fact was attended by the majority with simulation. More than 30% of the participants (but less than 45%) reported that they have been trained for “Risk assessment and management”, “Occupational safety and health”, “Earthquakes” and “Fires”. Less than 30% of the participants reported that they have been trained for other topics such as “Floods”, “Windstorms”, “Disaster recovery”, “Epidemics”, “Risk communication”, “Major industrial accidents” etc. Of less attendance were the training programs of “Organised crime – Terrorism” and “Energy/power/utility failure – Fuel resource shortage”. The results show that there is a significant lack of training on issues related to civil protection. These results are consistent with the results of the qualitative interview research carried out in the context of the SETOFF project, as well as with the relevant literature [10,11].

Participants were also asked about their preferences regarding certain features of an asynchronous training program. Most participants consider very important to be able to re-attend courses that they have already attended, to be able to attend each course independently and to be informed for additional resources of information for each topic. They also reported that it is important for them to have access to guidelines for attending the training program.

The participants answered, based on their preferences, for the duration of each course depending on the topic. Topics for which participants reported requiring more training time than others, were for example “Risk assessment and management”, “Occupational safety and health”, “Fires (Urban, forest)”, “First aid” and “Major Technological accidents (explosion, fire, hazardous material releases etc.)”.

Based on the results of the quantitative and qualitative analysis of training needs for Greece and the other countries, as well as the literature review, the training program that will be implemented on the SETOFF project on-line platform was designed. The topics chosen are: Introduction to risk, Risk management process, Risk perception, Risk communication, Weather phenomena, Floods, Fire (Urban, Wildfires), Earthquakes, Volcanoes, Industrial accidents, Epidemics, Security, Health and safety of first responders and First aid.

4. CONCLUSIONS

The training needs analysis in Greece highlighted the significant lack in terms of the existing level of training for civil protection issues, particularly for some groups, such as municipal and regional staff, safety engineers, volunteers etc. The completion of the set-off will contribute to the strengthening of training on these subjects through a user-friendly asynchronous training platform that will be designed based on the analysis of training needs.

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EMERGENCY MANAGEMENT BY COMMUNITIES' INTERACTION THROUGH YOUTH (EM-CITY)

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ABSTRACT
This study is part of an ERASMUS+ KA2 project with partners from Italy, Greece, Cyprus and Turkey. The EM-CITY Project is aiming to promote social cohesion among different groups in the local communities in the case of an emergency, recognizing that Young People, if properly sensitized and involved, can play a pivotal role in facilitating these relations. EM-CITY project follows an Anthropological Approach and specifically Action Research. Following the known cycle of Action Research, desktop research has been performed along with two Focus Groups in all four partner countries (16 in total). The 1st one involved (N= 54) Civil Protection (CP) stakeholders and Young People, the 2nd (N=60) from the same target group. Additional data was collected from semi-structured questionnaire with N=234. Findings show that most of the stakeholders (organizations/associations, public and private institutions working with Young People) are not aware of the CP system in their local community. The general population does not normally, actively participate in exercises and/or trainings nor informative events about CP. The voluntary organizations and public organizations in CP need to acknowledge each other more and collaborate; Young People can be an asset in helping themselves and their families in such situations. The results from the semi-structured questionnaire have revealed that whilst there is a highly positive and significant relationship between Youth Role and Training Modules.

Keywords: youth engagement, emergency management, non formal training.

1. INTRODUCTION

This study is part of an ERASMUS+ KA2 project approved in Round 1 of the Youth Call, 2021. The coordinating party is from Italy namely European Project Consulting 'EPC', partnering with Community Crisis Intervention 'CCI' Greece, the Centre of Excellence in Risk and Decision Sciences 'CERIDES' of the European University Cyprus (EUC), and 'INNOGO' from Turkey. The projects has started from February 2022 whilst its bound by the grant agreement to accomplish its main, tangible and intangible goals by April 2024. Thus, the project is thus far within the month 18 of 26 of its total duration.

The world is plagued by an increasing number and variety of types of emergencies, an impression that is certainly heightened by what seems to be frequent, very-largescale natural phenomena, including earthquakes, floods, hurricanes, volcanic eruptions, epidemics and wildfires all over the globe. In addition to this; is the rising level in political tensions enumarating to the increased effects of climate crisis [1]. For example, the EU Science Hub reports that EU 2021 wildfire season was the second worst on record since 2000 [2]. Adding these events a wide range of severe storms, mudslides, lightning strikes, tornadoes, and other hazard agents affecting smaller numbers of people, one will conclude that natural phenomena are increasing [3]. However, most studies evaluating youth´s emergency and crisis preparedness are descriptive and end up as a case description in handbooks, recommendations, and lectures [4]. A similar perspective is also highlighted in the Sendai Framework for Disaster Risk Reduction

2015-2030 [5], claiming that beyond descriptions and handbooks, meaningful engagement is critical to strengthen the agency of youth so they can make the right, informed and safe decisions for themselves, the community and the wider society; eventually affecting the quality of life for all. Although youth are considered themselves as a risk group in a disaster -since they may not know how to deal with it-, an educational initiative incorporating training may allow them to be an important resource for the future emergency preparedness [6]. This is indeed one of the needs EM-CITY is tackling by using Anthropological Action Research for eventually creating with and for Young People, online training modules and Learning Teaching Training Activities investing in Youth Engagement in Disaster Risk Management (DRM) and Disaster Risk Reduction (DRR) and preparedness; covering the cycle of Prevention, Preparedness, Response and Recovery along with the Youth role as volunteers within an multicultural community.

2. OBJECTIVES

The general objectives of the project are: a) to promote interactive processes between local authorities, civil protection operators, young people, key community representatives, and people who are involved in emergency situations. b) to foster the role of young people as "interactive bridges" between Civil Protection operators, Local Authorities, Culturally and Linguistically Diverse (CALD) and non-CALD communities, citizens groups, and other key actors in the local area. c) to promote civic engagement, active citizenship, civil protection values, emergency management skills for youth among the local community; d) to promote awareness of emergency communication issues (and creating solutions) among the stakeholders and the local community.

3. METHODOLOGY

The project is based on a social constructivism approach, which emphasises the need to understand the importance of culture and context for what occurs in society and construct knowledge based on this understanding [7]. The methodology that was followed for this project was Anthropological. Generally, Anthropological research adopts a comparative, historical, or ethnographic research to the study of society and culture [8].

For EM-CITY Ethnographic research was adopted first so as to learn more in terms of depth and complexity of the relationships between the public Civil Protection Authorities but also their relationship with other organisations. Typically, an anthropological approach uses multiple qualitative methods to collect data that are useful on their own as well as complementary to quantitative data in a mixed-methods approach which can include (amongst others) participant observation, individual interviews, focus groups, textual analysis [9]. Albeit researches dividing and differentiating between topical ethnographic research and Action Research [10], in order for the project to develop its tangible results the process and cycle of Action Research was followed based on its well known 7 steps.

Project activities started with a mapping/ understanding (and future plans) of group dynamics and interactions in the local area in an emergency, the areα of Vizenza was studies by the Italian team, Crete by the Greek team and specifically the region of Malevizi, Erzurum main area for Turkey and the municipality of Nicosia for Cyprus. The main hazards and likelihood of emergencies was studied as well as the composition of the community (in terms of local and non-local people); well as the public and private authorities and organizations responsible for the indicated hazards and emergency situations determined. All partners have investigated also on recent, best practices from all around the world, in order to get inspired of how to develop the tangible results (mainly the Module Trainings) for the EM-CITY project. Further data was also collected via Focus Groups, one in each country, early in the project, with a total of 54 people composed of Young Local People, non-CALD (volunteers, interested on the topic); young People CALD (volunteers interested on the topic); Representatives of local Civil Protection; Representatives of local NGOs; Politicians, representative of Municipality; Representatives of Civil Protection from to answer the specific questions:

1. What are the group dynamics in local area during emergency situations, 2. What are the needs of local stakeholders (especially CALD groups during emergency situations), 3. What are the needs and positioning of young people in local area regarding emergency situations.

After the finalization of the first focus groups, a questionnaire was prepared based on the above themes. Likert scale type and open questions were used for the questionnaire. The aim of the questionnaire was to provide the input information for the design of the EM-CITY training modules. The semi-structured questionnaire was responded by 87 young people from Greece, 32 from Cyprus, 36 Italy, 77 from Turkey. In total, 232 young people responded to the semi-structured questionnaire. A 2nd Focus Group also took place, one in each country with a total of 60 people with the same background as the 1st Focus Group; for the collecting data in order to shape the training modules.

In addition, on March 2023 15 Young People from all partner countries met in Cyprus for an intensive four-day Learning Teaching Training Activity (LTTA) hosted by the European University Cyprus_CERIDES, constructed by an expert in the field Dr. Christos Dimopoulos. The Training covered the basics of emergency management and the four stages of the emergency management process; Preparedness, Response, Recovery, Prevention (Mitigation. The young volunteers involved in the mobility, shared their prior experiences in similar situations, especially the young people from Turkey had shared their recent experience from the large scale earthquake in Turkiye - Syria on the 6th of February 2023.

4. RESULTS

Results of the 1st Focus Group are: Young people stated that focus must be in prevention, especially when considering fires. They opt for educative material, e.g short videos or microlearning easily accessible and free online for refreshing the memory even if they have received prior, extensive training. To reach conclusions from the semi-structured questionnaire, SPSS 20 program was used; for descriptive statistics, along with factor analysis, and correlation analysis to understand the level of relationship between dimensions. One-way ANOVA analysis applied to analyze whether the sub-dimensions used in the study differ according to the countries. The averages and standard deviations of the answers given by the 234 participants can be provided in the form of Annexes if needed. The scales used in the study consist of 3 sub-dimensions in total: Youth role, Training Module and Cultural and Linguistic Diversity in Case of Emergency. Correlation analysis determined that there was a significant and positive relationship between all the sub-dimensions. While there is a highly positive and significant relationship between Youth Role and Training Module sub-dimensions; there is a moderately positive and significant relationship between Youth Role and Cultural and Linguistic Diversity and between Training Module and Cultural and Linguistic Diversity. So the Youth Role size is more likely to act and affect with the Training Module. Also, a one-way ANOVA analysis was applied to analyze whether the sub-dimensions used in the study differ according to the countries. As a result of the analysis, Greece's Youth Role dimension score is 0.26 higher compared to Italy; and compared to Turkey, it is 0.98 higher. Italy's Youth Role dimension score is 0.71 higher than Turkey's. The Youth Role size of Cyprus is 0.90 higher than that of

Turkey. Accordingly, Greece attaches more importance to Youth Role than Italy and Turkey; again, it is seen that Italy and Cyprus attach more importance than Turkey.

The answers from each country highlight the significance of education, training, and community involvement to engage young people in civil protection and emergency management. In Italy, promoting a sense of belonging and responsibility within the community is emphasized. Cyprus stresses informal education and starting at a young age, while Greece emphasizes training and information campaigns. In Turkey, policies are needed to increase the active role of young people in emergency situations, as their current involvement is comparatively low. The awareness of youth's importance in emergencies needs to be disseminated. The significant answers from each country highlight the importance of training and effective communication for engaging CALD (Culturally and Linguistically Diverse) young people in civil protection.

5. DISCUSSION

So far, the project has indicated the large acceptance of such initiatives from Young People and the Local Authorities. We believe that it is a valuable research, following a specific methodological approach and involving its target group to accomplish its main aspirations which can be summarized as to increase the involvement of youth in the local communities in the case of an emergency and being able to act as interactive bridges between local CP operators and authorities in such an occasion. Further discussion is needed.

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TOURIST PERCEPTIONS AND DISASTER PREPAREDNESS: THE CASE STUDY OF CRETA MARIS RESORT HOTEL UNIT IN CRETE

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ABSTRACT
Tourism is a significant economic sector in Greece that contributes to the development of the country. However, the vulnerability of tourist destinations to natural and man-made disasters poses a considerable risk to the sustainability and resilience of the tourism industry. Understanding tourists' risk perceptions is crucial for effective disaster risk management in tourism destinations. This includes investigating how tourists perceive and interpret various hazards, their level of concern regarding potential risks, and the demographic factors that shape risk perceptions and preparedness actions. The study explores the role of demographic factors in shaping tourists' risk perceptions and disaster prepardness actions. This study examined tourists' perceptions of disasters and disaster preparedness actions. 107 hotel guests in a hotel in Crete completed a self-report questionnaire, immediately after a large-scale disaster exercise took place. Results indicated a low level of disaster preparedness actions, prior to visiting the country. Implications for disaster preparedness and resilience are discussed. By gaining insights into tourists' perceptions, tourism stakeholders can develop effective risk communication strategies and enhance destination resilience, ensuring the safety and satisfaction of visitors.

Keywords: Tourism, disaster risk reduction.

1. INTRODUCTION

Tourist destinations are susceptible to various natural and man-made disasters, making disaster perceptions and preparedness critical for ensuring the safety and resilience of both tourists and the destination. Safety and security are essential conditions for the development of the tourism industry, and fundamental determinants of its growth [1].
Tourists are often more vulnerable than locals in disaster situations because they are less familiar with local hazards, less access to resources on which they can rely on to avoid risk, and they are less independent, when in a foreign country [2].
Relatively little research has been conducted on tourists' perception of risk. The outcomes of this study are expected to contribute to the tourism industry by providing knowledge of tourists' risk perception and improving planning and risk communication for future crisis management.
Tourists perceive different types of risk and/or a combination of these risks, which make tourists perceive a global level of risk [3].

This research proposal aims to investigate tourists' disaster perceptions, their influence on preparedness behaviors, and the implications for enhancing destination resilience. By understanding tourists' perceptions and developing effective preparedness strategies, tourist destinations can mitigate risks, improve visitor safety, and enhance long-term resilience.

2. OBJECTIVES

a. To assess tourists' disaster perceptions, including their understanding of local hazards, risk perceptions, and knowledge/undertaking of preparedness measures.
b. To examine the relationship between tourists' disaster perceptions and their preparedness behaviors, such as acquiring travel insurance, seeking safety information, and adhering to safety guidelines.
c. To identify the key demographic factors influencing tourists' disaster perceptions and preparedness behaviors.
d. To develop evidence-based recommendations and guidelines for enhancing disaster preparedness and resilience in tourist destinations.

3. METHODOLOGY

A quantitative approach was employed, involving a self-report questionnaire completed by tourists staying in a hotel in Crete, where a large scale disaster preperdness exercise took place.
The questionnaire was developed so as to assess tourists' disaster perceptions, preparedness behaviors, and demographic information.
Descriptive statistics were utilized to analyze survey responses, providing insights into disaster perceptions, preparedness behaviors, and demographic trends.
Ethical guidelines were followed, ensuring informed consent, anonymity, and confidentiality of participants.

4. RESULTS AND DISCUSSION

Results from the study indicate that participants rate earthquakes (80.6%) as the most likely crisis event to occur in this destination, followed by wildfires (44.4%) and extreme temperatures (40.7%). The most common preparedness actions undertaken prior to travelling were Carrying a travel health kit, including prescription and over-the-counter medication (52.6) and secondly consulting appropriate sources of information in their country of origin for travel warnings and travel health notices regarding the country of destination (40.8%). Regarding the perceived importance of the disaster preparedness exercise that took place in the specific hotel, 75.2% rated the exercise as very/extremely important. This research aims to provide a comprehensive understanding of tourists' disaster perceptions and preparedness behaviors. The findings will contribute to developing targeted interventions to enhance disaster preparedness and resilience in tourist destinations.

5. CONCLUSION

By understanding tourists' disaster perceptions and their impact on preparedness behaviors, tourist destinations can develop effective strategies to enhance resilience and mitigate risks. This research sets the foundation for further research, emphasizing the importance of collaboration among researchers, tourism professionals, and policymakers to promote the safety and resilience of tourist destinations in the face of disasters.

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UTILIZING EDUCATIONAL INSTITUTIONS' SYSTEMS AS A FOCAL POINT FOR THE MANAGEMENT OF RISKS AND DISASTERS

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ABSTRACT
The correlation between climate change and the escalation of poverty rates amplifies the susceptibility of communities to catastrophes, hence compromising their capacity to withstand and recover from the consequences of such events. In the given scenario, it is imperative for developers, planners, and researchers to devise novel strategies aimed at enhancing the resilience of communities in response to escalating risks. This research investigated the most effective strategies for school systems, which are significant social institutions, to mitigate catastrophe risk within their communities. Social institutions have a significant effect on individuals' conventions, beliefs, and behaviors. School, after the family environment, has significant importance as a socialization institution. It assumes the responsibility of cultivating individuals' attitudes, knowledge, actions, abilities, and values, so ensuring their adherence to societal norms. The present research investigates the potential of leveraging the school system as a means to enhance catastrophe risk reduction efforts in socioeconomically deprived areas of Greece. The integration of catastrophe risk reduction into Greece's educational systems would provide several advantages, as shown by the findings of the research. The inclusion of disaster risk management in school curriculum and the incorporation of ideas related to emergency preparation are widely recognized as crucial measures for enhancing disaster risk management.

Keywords: Disaster Risk Reduction, School Systems, Civil Protection

1. PROBLEM STATEMENT
Similar to several other geographical areas around the globe, Greece is confronted with a multitude of hazards [1]. There are a multitude of causes that might give rise to these dangers, which can be broadly categorized into two distinct groups: natural threats and man-made threats. Nevertheless, there is room for debate over the underlying reason. The essay examines the many threats posed by natural phenomena and draws the conclusion that human beings have responsibility for these occurrences. Nevertheless, the subject matter at hand warrants a distinct discussion in a subsequent article. If the risks associated with a situation are not effectively handled and proper containment measures are not implemented, there is a significant potential for a catastrophe to occur. Furthermore, if no action is done in response to an emerging danger, the likelihood of a negative outcome increases[2] [3]. Hence, it is important to comprehend the optimal methodology for mitigating these hazards and, if feasible, preventing or reducing catastrophic events [4] [5]. The removal of the fundamental driver of community development from the catastrophe risk reduction equation results in a gap between global and local activity, which in turn compromises community resilience. Papaevangelou [6] asserts that education and the educational system play a major role in fostering socio-economic development within communities.

Purpose of the study

The major objective of the study is to assess leveraging schools systems as a locus for risks and disaster management using Greece as a case study. The study is also based on different specific objectives that include;

- To establish the effect of school curriculum on disaster risks management school.
- To explore the effect of civil protection knowledge acquisition on disaster risks management school.

Research Questions

1. What is the effect of school curriculum on disaster risks management school?
2. What is the effect of civil protection knowledge acquisition on disaster risks management schools?

Research hypothesis

H1: School curriculum has a positive effect on disaster risks management school

H2: Civil protection knowledge acquisition has a positive effect on disaster risks management schools.

Theoretical review

This study is guided by the Hyogo Framework for Action (2005-2015) and the Sendai Framework for Disaster Risk Reduction (2015-2030). The Sendai Framework for Disasters was officially endorsed in March 2015 in Japan as a successor to the Hyogo Japan Framework for Action, which was in effect from 2005 to 2015 [7] [8]. The primary objective of this initiative is to enhance the resilience of nations and localities in the face of natural or man-made calamities. The Sendai Framework for Action guarantees the perpetuation of endeavors begun under the Hyogo Framework for Action. The significance of the Sendai framework lies in its emphasis on the resilience of communities in the face of catastrophes. In the context of Greece, schools serve as essential centers for community development. Furthermore, within any particular community, students serve as a crucial and primary source of knowledge pertaining to catastrophes [9] [10] .

2. METHODOLOGY RESEARCH DESIGN

The study used a quantitative approach and a descriptive research design. Descriptive research is an inquiry in which quantitative data is gathered and evaluated to characterize a particular phenomenon in terms of current trends, current occurrences, and current connections between various variables.

3. RESULTS

This section presents the interpretation of the different results obtained after analyzing data collected from the selected teachers in Kozani, Greece.

Regression analysis

The relationship between school systems (school curriculum and knowledge acquisition) and disaster risk management was established using regression analysis as presented in the subsequent tables.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.831[a]	0.573	0.484	0.71437
a. Predictors: (Constant), School curriculum, Knowledge acquisition				

The dependent variable is disaster risk management. The independent variable is regressed against the dependent variable obtaining R2 value of 0.573. This indicates that the independent variables jointly explain 57.3 % of the variation in the dependent variable (disaster risk management). The regression results also confirm that the study's independent variables do not influence 42.7% of the changes.

ANOVA						
S		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	79.216	3	28.031	71.241	0.021
	Residual	71.878	150	0.413		
	Total	143.082	159			
a. Dependent Variable: Disaster risk management						
b. Predictors: (Constant), School curriculum, Knowledge acquisition						

The F-statistic of 71.241 at prob. (Sig) = 0.021 conducted at 5% level of significance is used to determine the significance of the regression model. This means a statistically significant linear relationship between the independent variables (School curriculum and Knowledge acquisition) and the dependent variable (Disaster risk management) as a whole.

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.617	0.315		1.259	0.210
	School curriculum	0.361	0.065	0.491	11.024	0.000
	Knowledge acquisition	0.052	0.097	0.042	0.628	0.031
a. Dependent Variable: Disaster risk management						

The results in the table above confirm a relationship between school systems (school curriculum and knowledge acquisition) and disaster risk management since $p<0.05$.

4. CONCLUSION

Extensive research substantiates the significance of educational institutions in enhancing the efficacy of catastrophe risk management. In the present situation, it is essential to persist in the advancement of Disaster Risk Reduction (DRR) education throughout all levels of the educational continuum, starting with basic schools. It is essential that the school curriculum include both theoretical instruction and practical exposure in many areas of health protection, first aid, fire prevention, emergency response, natural disaster management, and residential protection duties. The dissemination of knowledge on disaster risk reduction among students in Greece assumes a crucial role in enhancing the capacity of ordinary people to withstand and recover from various forms of catastrophes. In order to provide a comprehensive education including both theoretical knowledge and practical skills, it is essential to prioritize the appropriate education of students within the faculties of education. These kids serve as the custodians of information and facilitators for their peers. The school education system has several avenues for expanding the implementation of catastrophe risk reduction measures. The Greek education system provides avenues for the incorporation of catastrophe risk reduction within educational establishments. Educational institutions function as social entities with the capacity to receive and allocate financial resources from the community towards the advancement of communal progress.

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FIRE RISK LEVEL AND TRENDS IN ATTICA REGION, 2014-2022

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ABSTRACT

Fire Risk Maps are published daily for Greece by the General Secretariat of Civil Protection, for the period from June 1st to October 31st, depicting Fire Risk level from 1 (Low) to 5 (Alarm) for every forest department area,. These indicators are based mainly on the calculation of Fire Weather Index and a series of other factors integrated by experts. In this work, these indicatiors are used as risk score ponits, in order to provide a quantitative approach to fire risk through the time series of available maps since 2014 for the region of Attica. Consequently, four main parameters are extracted for every forest department: (a) a total score as a sum of points for each period of 153 days is calculated for every year, (b) the average risk score for all years, (c) the trend of the total risk score for all years, and (d) the average daily risk score for every day of the period. Moreover, the number of consecutive days with high and very high risk was calculated for all areas. Results show that Parnitha forest department has the greatest risk score followed by Lavrion and Penteli, all areas show increasing fire risk trend, the highest being that of the city of Athens, with 2021 showing the greatest fire risk for all departments. Results were compared to fire incidents (data from the Fire Service of Greece)where Egaleo, Parnitha and Penteli show the highest burnt area, and Lavrion, Penteli and Egaleo show the highest number of incidents.

Keywords: Fire Risk Maps, risk score points, high risk, fire incidents

1. INTRODUCTION

Fire Risk Maps are daily published by the General Secretariat of Civil Protection for every Forest Department domain area of Greece [1]. It is indicated as a level of risk from 1 to 5 (1:Low, 2:Medium, 3:High, 4:Very High, 5:Alarm) and the map is accordingly color coded. Estimation is based on Fire Weather Index [2]–[4] calculation and other supplementary factors contributed by the expert group of the GSCP. Daily maps cover the period of 153 days from June 1st to October 31st for every year since 2014 and they are available online. This work studies the spatial and temporal variation of Fire Risk for the region of Attica, assuming the Risk Level as a number of risk score from 1 to 5 points on a daily basis, for the sake of meta-processing qualitative indicators into a new quantification. Fire incident data have also been collected and processed for the same area, according to data published online by the Hellenic Fire Service.

2. METHODOLOGY

2.1. Fire Risk

All daily Fire Risk maps (Fig. 1) were downloaded and tables containing the Fire Risk level for each day of the time series period were constructed. The daily Fire Risk level was plotted against time for every year of each Forest Department, and the daily average was calculated and plotted accordingly (Fig. 2).

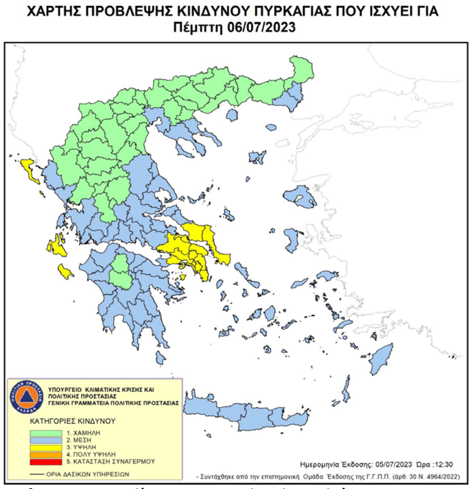

Figure 1. Daily prognostic Fire Risk map from published by the General Secretariat of Civil Protection [1].

The total sum of Fire Risk points was calculated for every year of each Forest Department, and the average Fire Risk score was calculated accordingly, for the time series. Total Fire Risk score was plotted against years and the slope of linear regression was calculated (Fig. 3), along with the according correlation coefficient. Values of yearly Fire Risk score, average Fire Risk score and Fire Risk trend slope were attributed to Forest Department polygons in ESRI ArcGIS Pro, and respective thematic maps were produced (Fig. 4). Moreover, for every year of each Fire Department, the total number of consecutive days of high/very high/alarm risk level (Table 1) were calculated and are shown in the form of absolute numbers and percentage of the wildfire period (% of days from June 1st to October 31st).

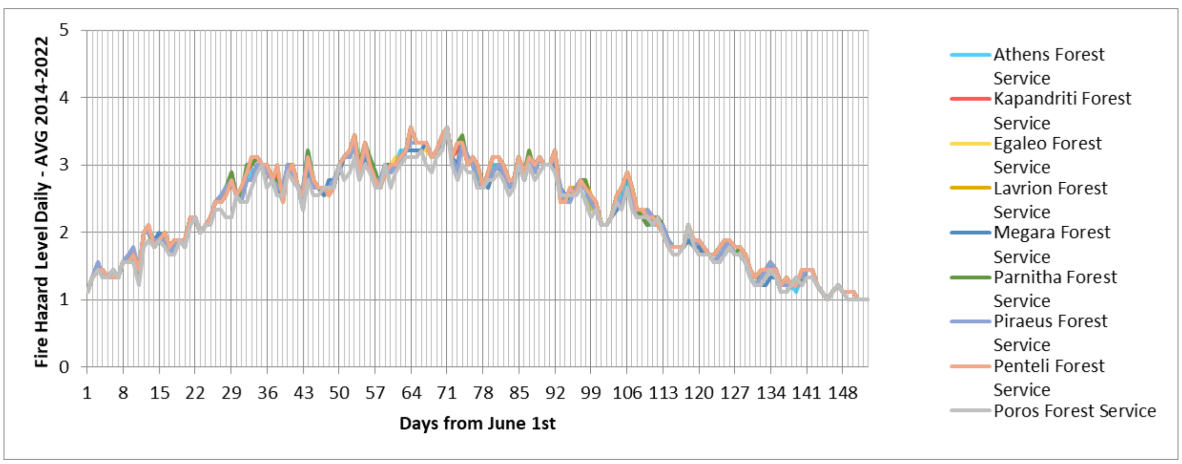

Figure 2. Average (2014-2022) daily fire risk level throughout the period June 1st to October 31st for every forest department of Attica. Third week of July and first two weeks of August show the highest average fire risk, followed by end June and mid-September, the highest of all being in August at Penteli and Lavrion, followed by Parnitha. During August, all areas except Poros average scores above 3 (high risk).

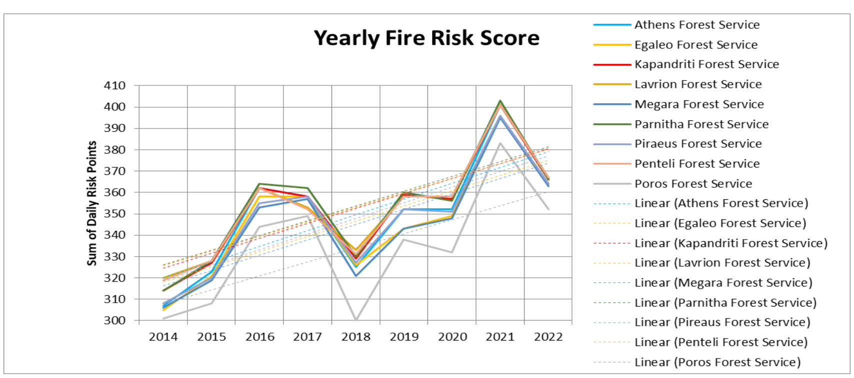

Figure 3. Yearly Fire Risk Scores of all forest departments of Attica present a generally increasing trend.

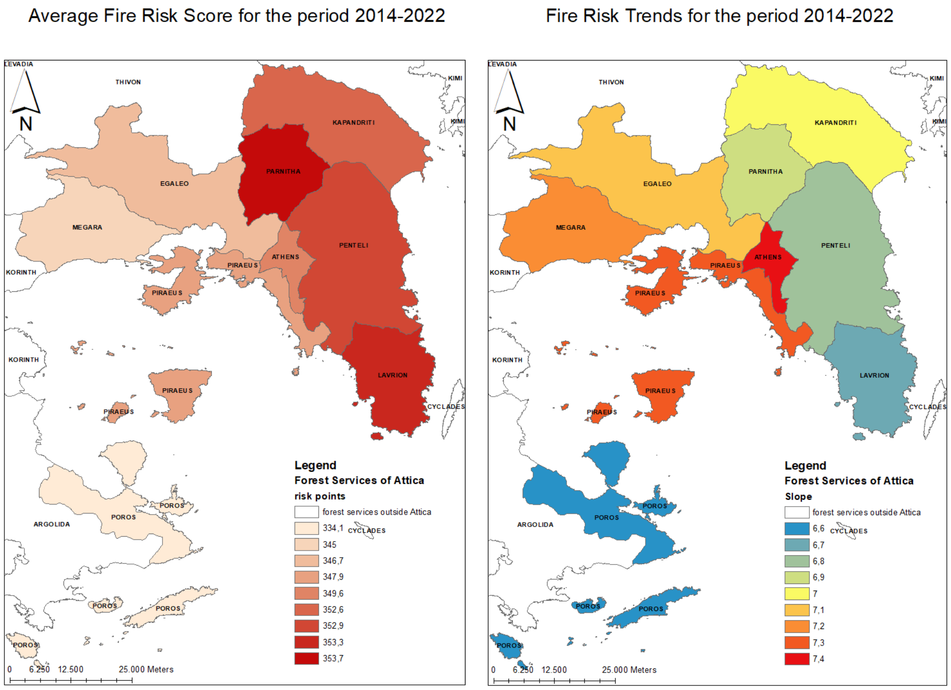

Figure 4. Average total fire risk score for each forest department of the region of Attica (left). Trends of total fire risk score for each forest department (right).

2.2. Fire Incidents

Fire incident data for the areas of the Forest Departments of Attica were collected from the Hellenic Fire Service website. For every Forest Department, the total number of incidents and the total burned area were calculated, and then sums and averages were calculated accordingly. Likewise, data were attributed to polygons of Forest Departments and respective thematic maps were constructed (Fig. 5).

Table 1. Maximum number of consecutive days with fire risk level 3 or above for every forest department.

	CONSECUTIVE DAYS WITH RISK LEVEL ≥ 3																	
Year	Athens Forest Service		Egaleo Forest Service		Kapandriti Forest Service		Lavrion Forest Service		Megara Forest Service		Parnitha Forest Service		Piraeus Forest Service		Penteli Forest Service		Poros Forest Service	
2014	7	5%	16	10%	15	10%	43	28%	40	26%	44	29%	41	27%	43	28%	39	25%
2015	6	4%	18	12%	14	9%	57	37%	51	33%	57	37%	53	35%	57	37%	48	31%
2016	1	1%	17	11%	13	8%	66	43%	63	41%	67	44%	62	41%	66	43%	55	36%
2017	15	10%	32	21%	26	17%	57	37%	61	40%	61	40%	62	41%	57	37%	55	36%
2018	6	4%	14	9%	13	8%	45	29%	49	32%	45	29%	49	32%	44	29%	39	25%
2019	9	6%	31	20%	27	18%	66	43%	55	36%	67	44%	59	39%	66	43%	55	36%
2020	4	3%	21	14%	12	8%	64	42%	55	36%	63	41%	57	37%	64	42%	51	33%
2021	25	16%	43	28%	40	26%	88	58%	85	56%	89	58%	87	57%	88	58%	84	55%
2022	58	38%	57	37%	58	38%	59	39%	56	37%	58	38%	57	37%	59	39%	54	35%

3. RESULTS - DISCUSSION

Fire Risk Score maps for the period of 2014 to 2022 during the fire season indicate that Parnitha is the forest service with the highest average yearly risk. Lavrion, Penteli and Kapandriti forest department areas have also reached a high score of risk points close to Parnitha's score.

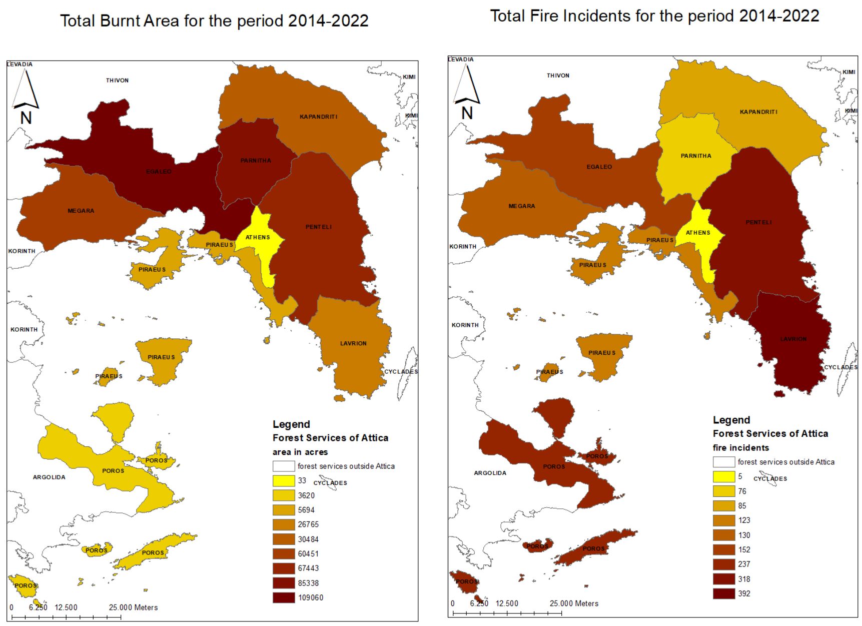

Figure 5. Total burnt area per forest department domain for the period 2014-2022 (left) and total number of fire incidents, respectively (right).

Fire Risk Trends map for the period 2014-2022 shows that Athens Forest service is the one with the greater increasing trend. This observation might be explained by the urban heat island effect, a phenomenon that affects urban regions and is linked to the FWI as a meteorological influence. High trends are also observed in fire services with intense urbanization like Piraeus, Megara and Egaleo.
The table containing the total number of consecutive days with risk level ≥3 during the fire season for each fire service shows that 2021 was the year with the most consecutive days with risk level ≥3, especially for Lavrion, Megara, Parnitha, Piraeus, Penteli and Poros fire services which had a percentage of more than 50%.
It has to be noted that impact and frequency of wildfires for Attica region depicted in maps with data from the Greek Fire Service comprise incident data not only during the fire season but for the whole year. Lavrion forest department has the most incidents and this fact can be correlated with the table of consecutive days with risk level ≥3. The map showing the Total Burnt Area for the period 2014-2022 indicates Egaleo fire department area at the top, something that does not align with the incident map. In West Attica, less fire incidents lead to more burnt area, while in East Attica, more fire incidents result in less burnt area.

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MECHANISM DIRECT RESPONSE AND SUPPORT OF LOCAL GOVERNMENT ORGANIZATIONS FOR THE MANAGEMENT OF RISKS, DISASTERS, AND CRISIS

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ABSTRACT

A proposal for the creation and operation of the Direct Response and Support Mechanism of the Local Government Organizations is described for the management of risks, disasters, and crises that will operate within the framework of the Central Union of Municipalities of Greece. The mechanism intervenes supportively in Local Government Organizations when they face emergency needs from the occurrence of natural and technological disasters and crises. The Mechanism aims to assist the Local Government Organizations that are affected and do not have the possibility of effective actions due to losses of their executives and means. The Mechanism does not replace the role but acts in support of the Local structures of the Local Government Organizations.

Keywords: Mechanism, Management, Risks, Crises, Local Government Organizations

1. INTRODUCTION

Local Government Agencies are called upon to manage with increasing frequency emergency needs arising from the combination of natural and technological disasters and crises.

The main characteristic problems of emergency management by the Local Government Organizations who bear the brunt are:

a. The immediate response and many decisions, urgent actions, and initiatives that they must undertake in all areas within a minimal period.

b. The losses suffered by the operational and service structures of the Local Government Organizations themselves. but also, all kinds of supporting structures in the area due to the disaster.

c. The minimal time margins that exist in the emergency and in dealing with the consequences of a disaster as well as the speed of development of events.

d. The justifiable lack of experience of the elected officials, executives, and services of the Local Government Organizations especially in risks that appear for the first time in the region.

e. The complex Institutional Framework creates confusion and does not facilitate the immediate resolution of problems.

From the recent major disasters, such as for example in Mandra, Mati, Chania, Kineta, Evia, Karditsa, Kefalonia, Samos, Hersonissos, Tyrnavos, Arkalochori, Heraklion, and Agia Pelagia, Heraklion, Crete, as well as from the experience of involvement in numerous other events in Greece and abroad, the necessity of supporting the Local Government Organizations has been established. and in the Pre-Catastrophe Stage of the formation of a Central Mechanism by KEDE, which will respond immediately, go to the affected area, and guide - scientifically, technically, administratively, and operationally support the Local Government Organizations, which were affected in a co-catastrophic stage [1-7].

2. OBJECTS OF THE DIRECT RESPONSE AND SUPPORT MECHANISM OF LOCAL GOVERNMENT ORGANIZATIONS. FOR THE MANAGEMENT OF RISKS, DISASTERS AND CRISIS

The aim is to support the Local Government Organizations and the establishment of a mechanism to guide them by the Central Union of Greek Municipalities so that the Municipalities can respond effectively and achieve the maximum possible protection, as well as the minimization of losses and the reduction of economic, social, and environmental impacts.
According to the basic principle of Risk, Disaster, and Crisis Management Theory, all the support actions of the Immediate Response - Emergency Support Mechanism are included in the three main stages: Pre-Catastrophe Stage, Co-Catastrophe Stage, Post-Catastrophe Stage.

A. PRE-DISASTERS STAGE

A1. Establishment of Organ. Members of the Board of Directors participate of the Central Union of Greek Municipalities, elected and specialized scientists and technicians, with extensive operational experience, who will cover all the individual objects of Immediate Response Support.
A2. Equipment and Media. Proposals for emergency equipment and means of the Mechanism, which will allow the self-reliance of actions of the members of the Mechanism in an area that has suffered disasters, and which is unable to offer any support.
A3. Institutional framework. General and Special Designs. Unification of the actions that, based on the existing Institutional framework, correspond to actions of the Local Government Organization.
A4. Memoranda of Activities of the Immediate Response and Support Mechanism of Central Union of Greek Municipalities.
A5. Engagement process. Drafting of the Mechanism's involvement protocols for each risk or for a combination of risks.
A6. Action Memoranda of the affected Municipalities based on the existing Institutional framework and for each risk or combination of risks.
A7. Operational Exercises. Participation in Operational Exercises and Actions on the map and in the field, which is organized by Central and Regional Bodies and Local Government Organizations of the A and ΄B degree.
A8. Instruction forms in a digital format suitable for reproduction.
A9. Recording of Operational and Institutional Problems faced by the Municipalities in which disasters have recently occurred. Proposals for Improvements in the Institutional Framework

B. CO-CATASTROPHIC STAGE

B1. Immediate transition to the affected area and urgent actions. Guidance, participation, and support of rescue operations. Selection of Intervention Sites, Extrication, Penetration and Rescue Techniques, Operator Safety, and Technical interventions in infrastructure and construction.
B2. Demarcation of the affected area. Distinguishing impact zones (Zone of Total Destruction, Infiltration Zone, Peripheral Zone) with modern means and applications (Remote Monitoring, Drone). Impact Assessment, Organ Mobilization. Initial impact assessment and perceived risks.
B3. Escape, Refuge, Population Concentration. Selection of escape axes, places of refuge, areas of population concentration, etc., taking into account the existing physical-geographical, geodynamic, hydrometeorological, urban planning, spatial planning, and environmental characteristics of the affected area.

B4. Analysis and Risk Assessment of Catastrophic Phenomena and Crises. Assessment of occurrence of accompanying risks and accompanying catastrophic phenomena. (Fires, Tsunamis, Landslides, Liquefaction, Floods, etc.). Demarcation of potentially hazardous areas.
B5. Instructions to those affected, media contact, Social Media, etc. They are made based on Greek and International experience by specialized and experienced scientists.
B6. Coordination and Management of Foreign Aid. Technical support for the coordination of services and the provision of immediate assistance to those affected (food, emergency items, gathering and distribution areas, etc.).
B7. Psychological support. Organization of psychological support for victims according to international standards and existing conditions.

C. POST-DISASTER STAGE

C1. Immediate Assistance. Support actions to provide assistance to those affected. Organization, collection, and distribution of immediate aid.
C2. Impact Recording Technical Support. Impact Recording Technical Support and impact recording actions in residences, businesses, and infrastructures.
C3. Technical assistance. Technical support for infrastructure and lifeline restoration actions (electricity, water supply, communication networks, etc.)
C4. Special Psychological Support. Action support, assistance to special population groups as well as psychological support from scientists specializing in the psychology of disasters and crises.
C5. Communication management. Media updates, Social Media, etc. It is carried out according to National and International practices by specialized, experienced scientists and is adapted to the particularities of the region.
C6. Education - Information. Informing teachers, students, the disabled and in general special groups, and the general population about protection during the post-disaster period.

3. DISCUSS

The main Institutional Framework of the National Mechanism for Crisis Management and Risk Management, which governs this project, is Law 4662/2020.
The proposed mechanism is fully compatible and follows the instructions of the Emergency Response and Immediate/Short Consequence Management Plans from the Event of Natural Disasters of the General Secretariat of Civil Protection [8,9].

It should be pointed out that the Immediate Response and Support Mechanism does not replace the competent Institutional Bodies involved in the management of risks and crises but acts as a support for the provision of scientific, technical, administrative, and humanitarian assistance.

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SIMULATING TERRORIST ATTACKS ON CROWDS – THE matEXODUS MODEL

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ABSTRACT
The rising frequency of Marauding Terrorist Attacks (MTA) or active shooters, has increased the need to consider the impact of possible terrorist and active shooter activities in emergency response protocols. The civil defiance community has shown significant interest in a tool that can quantify risks and enables mitigation against active shooter scenarios and similar threats. This work outlines the developments and enhancements made to a micro-simulation pedestrian evacuation model that represents a significant advancement towards fulfilling this analytical need. The novelty of this work lies in the explicit representation of active shooters and the effect that their actions may have on a population that attempts to protect itself by hiding, escaping, and fleeing the scene. Furthermore, a novel vision model has been incorporated into the evacuation simulation tool reflecting the shooters' vision capabilities and using this information to visually target the civilian population.

Keywords: marauding terrorist attacks, human behaviour, evacuation modelling, active shooter

1. METHODOLOGY – INTRODUCTION
The matEXODUS evacuation simulation model is used for this study. This model is a variant of the EXODUS Agent Based Model (ABM) which incorporates specific features that attempt to capture events and behaviours that take place during MTA incidents (see Figure 1) for example, allowing a crowd to circulate, be affected by actions of active shooters, evade the active shooter, incur injuries, permit agents to potentially counter attack shooters under certain conditions, and evacuate from the incident area [1]. Both the crowd (i.e., civilian population) and the marauding terrorists are simulated by matEXODUS on an individual level.

(a) (b) (c)

Figure 1: Example of marauding terrorist attack (MTA), Westgate Mall, Nairobi, Kenya, 2013 showing (a) shooters within mall, (b) civilians fleeing from scene and hiding from the attackers, (c) civilian attempting to assist child.

Within matEXODUS each agent is defined by a set of physical (e.g., age, gender, agility, mobility, etc.), psychological (e.g., response time, patience, drive, urgency, etc.), physiological (e.g., respiratory rate, impact of heat, narcotic and irritant gasses, smoke obscuration, etc.) and experiential (e.g., distance travelled, travelling time, time wasted in congestion, etc.) attributes. The development of matEXODUS began as part of the EU 2020 AUGGMED project [2,3,4] (see Figure 2) and it continues with support from DSTL, DASA, UK Home Office and the UK Department of Transport.

(a) (b)

Figure 2: (a) members of the Greek Coast Guard, representing the blue team, training using immersive VR during Pilot 3 of the AUGGMED system in a scenario involving a marauding terrorist attack on the port of Pereaus, Greece, (b) VR training platform based on standard desktop PC hardware involving real players representing the red team and attacking the simulated civilians within the port of Pereaus, Greece. The blue team in (a) must apprehend and eliminate the threat posed by the red team in (b).

The purpose of the tool is to enable:

a) Training of first responders (e.g., police, anti-terrorist staff, fire services, medics) in the effects of marauding terrorists and the impact that their actions are likely to have on large crowds by visualising the effects of shooters on a population.
b) Policy evaluation in mitigating terrorist incident risk
c) Assessing vulnerability levels of the civilian population due to criminal action (e.g., number and locations of injuries/fatalities) and due to spatial constraints (e.g., lack of hiding locations, congestion bottlenecks).

2. MODELLING – ATTACKERS

Within the matEXODUS model all agents are represented individually. This is also the case for the simulated attacker agents. Attackers are assumed to be able to hold firearm weapons. Each attacker has their own distinct characteristics related to their attacking capabilities that include fire rate, number and size of magazines, competency and accuracy level, target acquisition strategy (e.g., maximising kills or injuries), etc.

Each attacker can utilise their own field of view (FoV) to determine and select the largest or most visible target. The attacker can then prioritise targets in their central FoV or even identify targets in their peripheral view (see Figure 3 and Figure 4). During the attack an agent may deviate from their assumed route to chase civilian agents that they have identified. As an optimisation strategy attackers can target areas with the greatest number of viable targets utilising a 360o visibility search methodology. As the attacker aims and shoots at civilians each bullet fired is assigned an error in accordance with the shooter's firearms' proficiency. In the case when a shooter misses their target, then they may potentially hit another civilian agent or another terrorist.

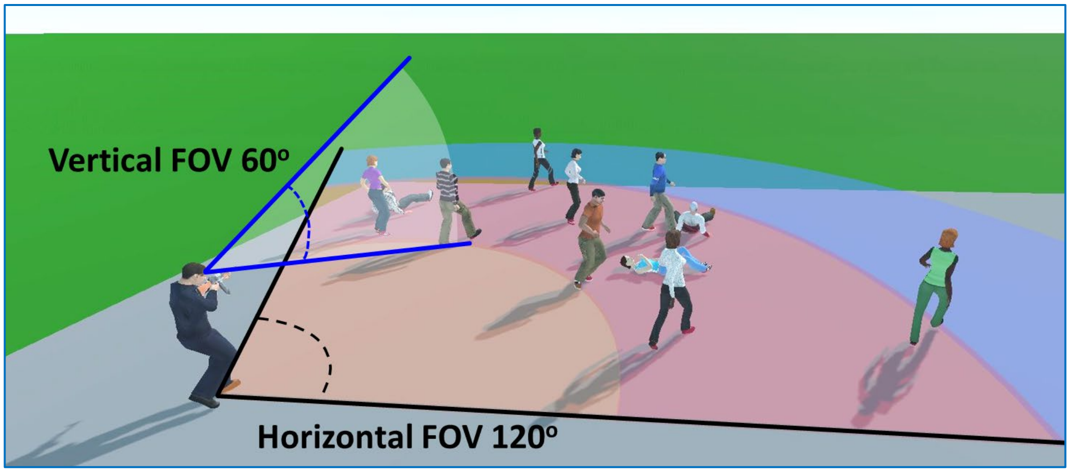

Figure 3: Shooter aiming at civilians present in their field of view (FoV)

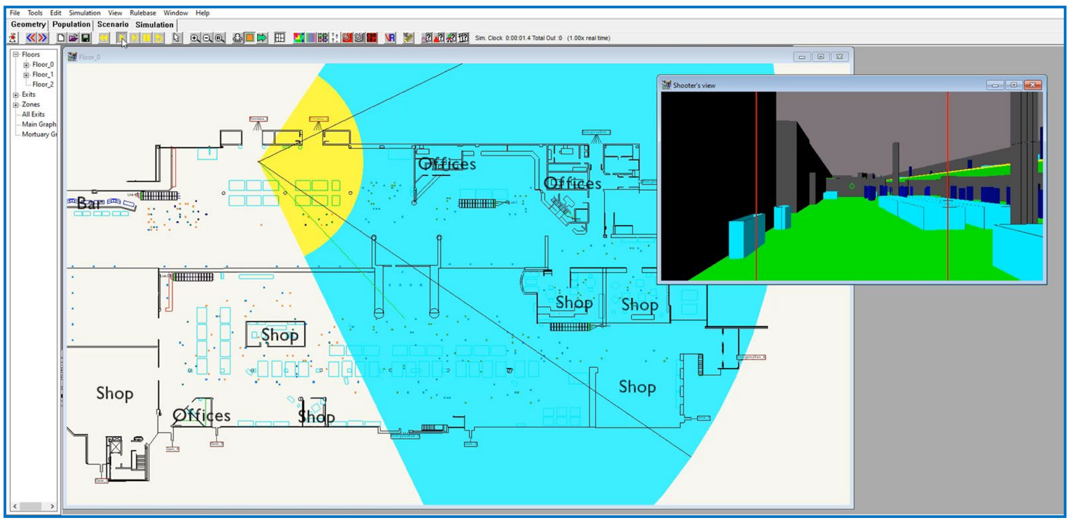

Figure 4: matEXODUS showing top view of shooter's FoV and FoV from a first-person perspective.

3. MODELLING – CIVILIANS

Prior to the commencement of the attack the civilians are considered to circulate within the environment, performing their routine actions. However, once the attack starts the civilian agents are able to respond to the threats by being either directly exposed to the threat or being informed by other civilian agents of the existence of the threat. Once a civilian agent becomes aware of a threat their urgency attribute increases at which point, they start running away from the threat. The civilian agent can assume several behaviours to minimise their vulnerability and can respond in various ways to a threat based upon their exposure to the shooters. For example, they may seek for the nearest hiding location, or may move towards a safe exit without moving closer to a shooter. In the case when civilian agents become trapped and are seen by the shooter, for example, while hiding, they may choose to flee or attempt a counterattack. As the scenario evolves and new threat information is received, the civilian agents, may re-assess the conditions and determine a more optimal course of action.

4. MODELLING – INJURIES

A novel injury model has been developed and agents who are shot can incur one of five injury levels: minor, moderate, serious, very serious, and fatal. The probability of civilian agents sustaining a given injury level can be defined by the user for each shooter. This injury level can degrade over time, and it can escalate if they are hit multiple times.

Minor Moderate Serious Very serious or fatal

Figure 5: The injury levels represented within matEXODUS.

5. CONCLUSIONS

A novel methodology has been developed that allows a pedestrian evacuation model, namely matEXODUS, to represent active shooter scenarios. The tool can simulate the actions of active shooters capable of target acquisition, aiming and injury, using 3D vision modelling, a civilian population that is capable of taking several protective measures as a response to the posed threat. The model can thus simulate likely shooter actions and strategies and people's behavioural response to such events. The tool can enhance existing threat vulnerability analysis by providing additional insights into the outcomes of possible MTA incidents and provide the means to train first responders in such scenarios by quantifying the number, type, and location in which injuries are likely to occur.

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CHEMICAL RISK PERCEPTION AND AUGMENTED REALITY

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ABSTRACT

In the framework of the FET Open project GIDPROVIS that investigates technologies used to detect and identify chemicals present in the environment, chemical risk perception is examined in order to better representing chemical information to the users of the GIDPROVIS technologies. The measured chemical data are transferred and interpreted in a data hub and displayed on graphical interface of augmented reality. The chemical vapors data from the natural (ambient) environment, outdoors or indoors, are continuously transferred to the data hub via wireless transmission with the aim of making the unseen molecular world of human surroundings "visible" as molecular auroras. Chemical risk perception is examined in the framework of the various stages of perception in order to provide better ways to display data, information and chemical knowledge to the users of the GIDPROVIS technologies in an efficient and productive way. The augmented reality-based software developed in the framework of the project took into consideration the research carried out in chemical risk perception in order to represent chemical plumes, sources of emissions, information regarding types, concentrations and toxicity of chemical compounds. Empirical research in the project has shown limitation of GHS symbols to represent chemical information. Alarms and awareness regarding the natural, chemical environment monitored by the project technologies were represented on various displays in ways strongly depending on the different types of users and in various information layers.

Keywords: Chemical risk, chemical vapors, chemical information, toxicity, augmented reality.

1. INTRODUCTION

Project GIDPROVIS [1, 2] investigates technologies that can be used to detect and identify chemicals present in the human environment (surroundings).

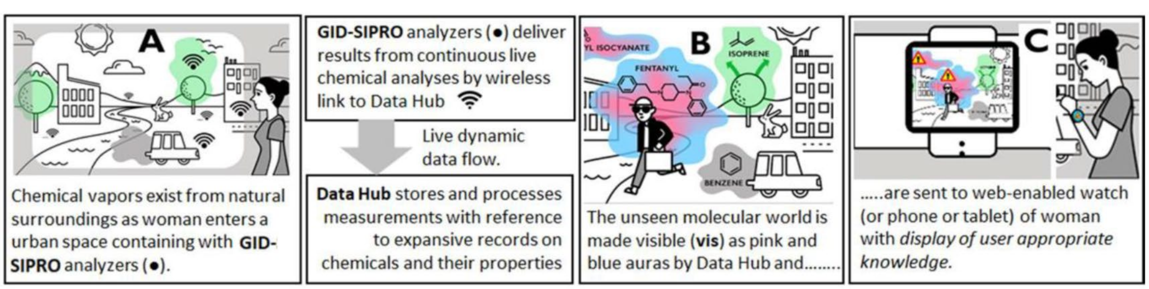

Figure 1: Schematic approach of the GIDPROvis project

In the project social, empirical and literature research is carried out to study chemical risk perception [3, 4] with the aim to better representing chemical data, information and knowledge to the users of the GIDPROVIS technologies. The selection of augmented reality as the framework for presenting the chemical information introduces another level of complexity for the necessary GUI.

2. METHOD AND DATA

Fifteen focus group interviews were organized in 2021 with in total of 40 participants in Finland and four focus group interviews with in total of 11 participants in Germany. Focus groups offer a means of obtaining rich information about understandings, thoughts and feelings in people's own words as well as a possibility for discussion among participants. Additionally, 23 interviews with individual participants organized in Greece. All interviews in different countries lasted between 45 and 90 minutes offering a space for an intellectually intensive discussion on chemical hazards and risks. In total, 74 people named in the project as non-experts, at the age of 18 to 84, participated in interviews in the three countries. The interviewees represented different professions and most of them had only a general knowledge of chemistry. This means that they were not educated or trained to deal with chemicals, chemical risks and hazards, or chemical communication in their everyday occupational activities. In Finland, five focus group interviews were organized with second and third-year university students who studied to become science teachers in high schools. All interviews were organized online and in native language. All interviews were recorded and transcribed verbatim. Semi-structured interviews were also organized in the three countries with experts this time; five in Finland, five in Germany and seven in Greece. All interviewed firefighters had several years of experience and knowledge of chemical toxics. Additionally, we also interviewed ten other experts in Finland and three in Greece that were police officers, chemists, medical professionals, civil servants to gain more understanding or how chemical risk is perceived by various professionals.
All interviewed firefighters had several years of experience and knowledge also in CBRN (chemical, biological, radiological, nuclear) dangers. The issue of privacy and data protection has been kept through various documents, notices and information.

3. RESULTS AND DISCUSSION

Experts need verification of assumptions made at the beginning of chemical event and take notice of all kinds of cues available. They try to find the potential sources of chemical vapors in emergency scenes by using the GHS warning symbols. GHS warning symbols do not give to experts all the information they need. They also try to know the name of the chemical to find product information. Googling the name of the chemical substance for non-chemists does not lead to the necessary information. UN number can give identification for dangerous material. They need to search to find these numbers in the scene. Symbols, names and numbers are the only clues for the firefighters and careful use of databases is required for correct risk assessment. The chemical detectors are providing additional data and information if it is available and can be used effectively.

4. CONCLUSIONS

In the project the chemical risk perception was investigated. This investigation is polar; experts, non-experts. The study takes into consideration that overload of the user with information and risks (symbols, advice) might have some adverse effects: make users indifferent to the system and even reduce the risk perception. In the context of Human Machine Interface(HMI) and Augmented

Reality(AR), the extend of data(numbers, names), information(e.g concentrations, toxicity, sources of emissions(AR), direction of chemical plume(AR), knowledge(e.g personal protective equipments) that will be displayed in GIDPROVIS screen are examined in the context of operational impacts. The capability of access to more information by the user through the HMI is also possible. In the project, HMI is governed on the principles of fair, direct, open information to the public.

Figure 2. Visualization of results of chemical risk by the augmented reality approach

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THE IMPORTANCE OF ENVIRONMENTAL AWARENESS AND PROTECTION FROM NATURAL DISASTERS, THROUGH THE EDUCATIONAL PROCESS

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ABSTRACT

This research refers to climate change, in terms of its definition, its rapid evolution, as well as the changes that occur to everyday life, both in the social and economic field, in Greece and in the rest countries of the European Union (NASA, 2022) [1]. Additionally, reference is made to natural disasters, as phenomena that are triggered and strengthened by climate change [World Meteorological Organization, 2021) [2], correlated with the knowledge provided, which aims to protect against similar risks (Muttarak, R. and Lutz W, 2014) [3]. Then, thoroughly examined is the existing society's system, which is responsible for the protection of citizens and their properties, starting from the educational system, up to the higher executive heads. Conclusively, the research is conducted by the help of scientific sources, as well as from the testimonies of people from the field of every level of education and social/civil protection, to emphasize the need of a holistic policy approach, regarding the environment, starting from the quality information, clarifying the role of the educational system.

Keywords: Climate Change, Natural Disasters, Environment, Educational System, Protection, Greece

1. INTRODUCTION/OBJECTIVE

In the present thesis, our comprehensive examination is whether the existing educational Greek system (environmentally wise) could achieve an interactive relation between its civils and the people who are occupied in the civil protection sectors, leading to optimized cooperation, in case of an emergency by collecting professional interpretations. Finally, we put out the analysis of the results that are collected, as well as conclusions and recommendations for an effective implementation on Greece's system.

CLIMATE CHANGE, NATURAL DISASTERS, AND IMPACTS

According to Bednar-Friedl B. et al. (2022) [4] the average global temperature has already increased by more than 1°C compared to pre-industrial temperatures, while scientists from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019) [5] warn that the increase in the average temperature of the planet by 1.5°C will bring about devastating effects, both for the environment and for societies. Climate change is affecting regions around the world and its effects are expected to increase in the coming decades, specifically related to natural disasters.

Natural disasters are the potential effects of natural hazards (hydro-meteorological, geological, biological, which man is unable to manage, given the resources available to him. Natural disasters occur when a natural hazard ends up being destructive. Therefore, natural disasters include coastal and urban floods, hurricanes and cyclones, wildfires, landslides, earthquakes, tsunamis, volcanoes, droughts, while this category includes the emergence of viruses and bacteria that threaten human health and the balance of the environment.

In addition, the population is disproportionately affected, with an emphasis on vulnerable households and systems. Widespread impacts on ecosystems, people and infrastructure appear to be increasingly attributed to the increased intensity and frequency of extreme weather events, with an emphasis on rising air temperatures, subsequent drought and wildfires, and heavy rainfall (Lindell, (2013) [6].

EDUCATIONAL SYSTEM IN GREECE

When the climatic circumstances are dangerous as such, it is expected that each country, no matter how affected it is, should be well prepared, starting from the educational system, which provides easily and equally all the necessary information regarding the protection and the prevention of a potential disaster. After thoroughly examining the Greek educational system and comparing it to the EU's (European Commission, 2022) [7], we've concluded that it is highly lacking updated, continuous, and concentrated information regarding the environment. It is mainly focused on theoretical information, without significant practice, mostly related to the formal rather than substantive way of learning.

2. METHODOLOGY AND DATA OF THE RESEARCH

A representative sample for this subject would be possible, after its delivery to every educational unit, as well as to every civil protection service, all throughout Greece. Therefore, the questionnaire was sent to all public educational structures as well as to all Civil Protection/Disaster and Crisis Management structures. The research methodology is a combination of a literature review (official sources found on the internet) as well as a mixed questionnaire (closed-ended questions: yes or no or scale, plus an idea/suggestion framework). The total sample amounts to 1,821 responses. EXCEL spreadsheets were used, during the processing of the survey results, as well as statistical data, automatically generated by the Google Forms service, which was a key tool for collecting responses.

3. RESULTS

Demographic-related data (a to d):

a) Gender:
- 1,029 (56.5%) women
- 777 (42.7%) men
- 15 (0.8%) unspecified

b) Age group:
- 50 to 59 years: 663 people (36.4%)
- 40 to 49 years: 529 people (28.9%)
- 30 to 39 years: 314 people (17.2%)
- 60 to 69 years: 165 people (9.1%)
- 18 to 29 years old: 153 people (8.4%)

c) Complete level of education:
- Master's degree: 785 people
- Undergraduate degree: 677 people
- Doctoral degree: 359 people

d) State of Residence:
- Attica: 478 responses (26.2%),
- Thessaloniki: 114 responses (6.3%)
- Heraklion, Crete: 109 responses (6.0%)
- Larissa: 77 responses (4.2%)
- Achaia: 73 responses (4.0%)
- 4.0%<Rest regions

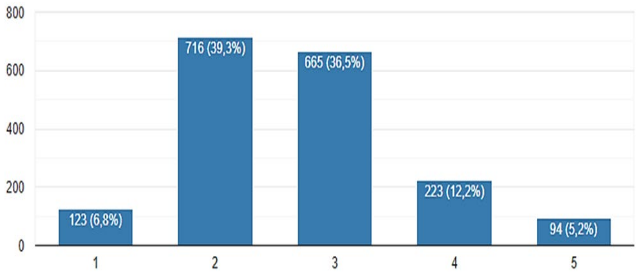
e) Occupation:

- Primary Education Teacher: **535** responses (29.4%) | Secondary Education Teacher: **666** responses (36.6%) | Higher Education Teacher: **309** responses (17%) | Civil Protection/Disaster and Crisis Management Services: **311** responses (17.1%)

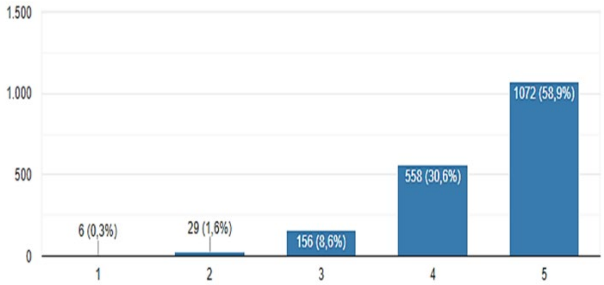
f) Have you ever received environmental training (whenever and however that happened)?

Yes: **1,013** people (55.6%) | No**: 808** people (44.4%)

g) **Do you consider sufficient the access that children and young people about environment, through the educational system?**



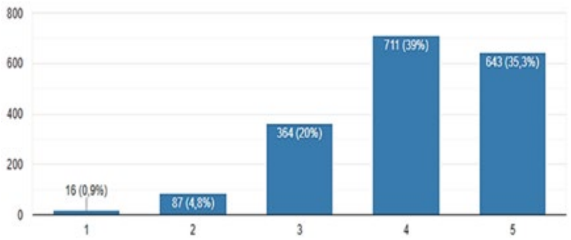
h) **To what extent do you think that environmental education is an important addition to the educational program?**



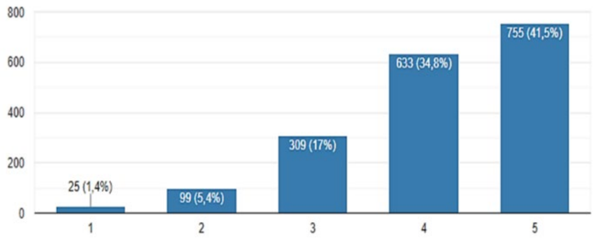
i) **Do you think that environmental education should exist at all educational levels?**

- Yes: **1,606** people (88.2%) |Maybe: **139** people (7.7%) | No: **75** people (4.1%)

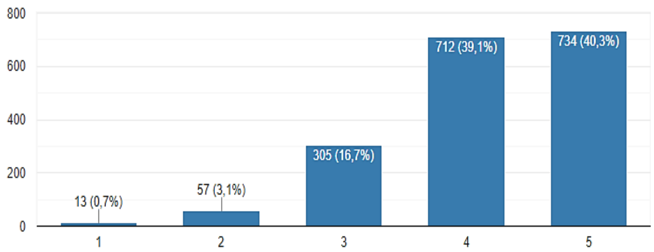
j) **Do you think that environmental awareness, in the context of the formal educational process, could work as a preventive measure for climate crisis and the effects of natural disasters?**



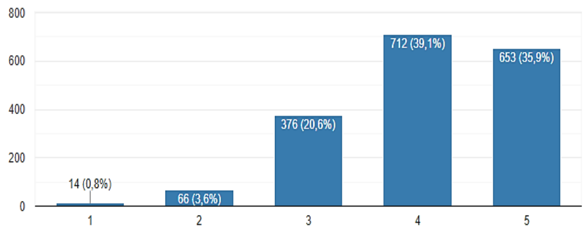
h) **Would information about climate change and natural disasters be disasters be more effective, if it were addressed both to parents and children?**



k) **How important do you think it is to dedicate teaching hours on how to deal with natural disasters, both theoretically and practically?**



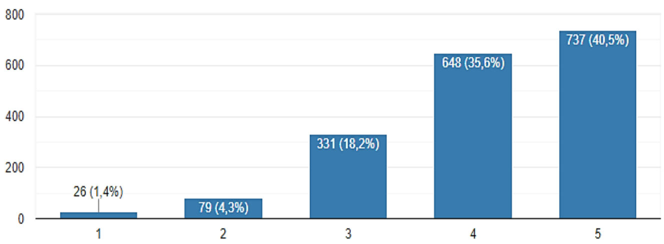
l) To what extent do you think that dedicating time to the teaching of natural disaster response will facilitate the work of those working in the fields of crisis and disaster management?



m) **Do you think that the rest of Europe provides more knowledge regarding environmental awareness and natural disasters?**

Yes: **701** (38.5%) | No: **102** (5.6%) | Don't know: **1.018** (55.9%)

n) **To what extent do you think that the passing of Ministerial Decision 66152/GD4/2022 (Government Gazette 2820/B/6-6-2022) which provides the inclusion of environmental education in primary and secondary schools in Greece, is a positive development?**



4. CONCLUSION AND RECOMMENDATIONS

- Free, equal, and updated information about the environment, which should not be limited within a book. Environment is all around and it would be more useful to proceed to a direct connection with nature (organization of educational trips to nature/environmental centers, environmental actions, benefits of the circular economy etc.), adding interactivity to the educational process.
- Direct Childrens' connection with civil protection/crisis and disaster management services personnel, to provide basic disaster prevention methods, during the teaching hours, achieving hybrid learning conditions (theoretical and practical approach) [visiting burned areas, perform safety practices etc.].
- Closer cooperation of parents with the school, to achieve a unified attitude towards the environment. At the same time, it is considered necessary to add a vulnerability study of the area to natural disasters for both age groups, for optimal prevention and protection.
- Start environmental education, as young as possible, keeping a relevant momentum throughout formal education.

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MUNICIPAL AUTHORITIES AND CLIMATE CHANGE

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ABSTRACT

Climate change now affects every country on every continent. It disrupts national economies and affects lives while having significant impacts on the people, communities and countries of today and even more so tomorrow. Humans are faced with the serious effects of climate change, such as changing weather conditions, rising sea levels and other even more extreme weather events. The paper discusses the significance of transitioning to renewable energy sources, enhancing energy efficiency, and promoting sustainable transportation to reduce greenhouse gas emissions. Additionally, the paper emphasizes the value of public awareness and education in fostering a culture of climate action and driving individual behavioral changes. Furthermore, the paper explores the critical role of municipalities climate policies, regulations, and international cooperation in coordinating global efforts to combat climate change with special reference to the case of Athens, capital of Attica, which as a large urban center faces a significant problem. It underscores the need for climate resilience and adaptation strategies to cope with the increasing frequency of extreme weather events and changing environmental conditions. In conclusion, this abstract serves as a concise introduction to the multifaceted nature of climate change work. It underscores the critical need for immediate action and collaboration at local, national, and international levels to mitigate the impacts of climate change and build a sustainable future for generations to come.

Keywords: Climate, change, municipalities, policies, Athens

1. INTRODUCTION

Climate change is now indisputable. The effects of climate change, already evident across the world, vary from region to region depending on climatic, geographic, social and economic conditions. Some of the manifestations of climate change are the following [1]:

- The temperature of the atmosphere and oceans is increasing,
- The distribution of rainfall is changing,
- Snow and glaciers decrease,
- Sea level is rising and
- Extreme weather events such as floods and droughts are increasing in intensity and frequency.

TRANSITIONING TO RENEWABLE ENERGY SOURCES IS SIGNIFICANT IMPORTANCE

Here are some key reasons why this transition is crucial:

- Mitigating Climate Change
- Reducing Air Pollution
- Energy Security and Independence
- Sustainable Resource Use
- Job Creation and Economic Growth

- Energy Diversity and Resilience
- Mitigating Environmental Degradation
- Long-Term Cost Savings
- Global Cooperation and Sustainability

Overall, transitioning to renewable energy sources is a vital step in building a more sustainable, resilient, and climate-friendly energy system. It can significantly contribute to reducing greenhouse gas emissions, curbing climate change, and fostering a cleaner, healthier, and more prosperous world.

PUBLIC AWARENESS AND EDUCATION ARE INVALUABLE TOOLS IN FOSTERING A CULTURE OF CLIMATE ACTION

Here are some key aspects highlighting the value of public awareness and education in addressing climate change [2]:

- Understanding the Issue
- Motivating Behavior Change
- Support for Policy Initiatives
- Empowering Advocacy and Activism
- Building Climate Resilience
- Encouraging Corporate Responsibility
- Leveraging Social Norms
- Educating Future Generations
- Fostering Global Cooperation
- Creating a Sense of Agency

In summary, public awareness and education play a pivotal role in fostering a culture of climate action. They lay the foundation for informed decision-making, behavior change, policy support, and collective efforts to address climate change effectively. By raising awareness and inspiring action, we can create a more sustainable and resilient future for the planet and its inhabitants.

2. THE CRITICAL ROLE OF MUNICIPALITIES CLIMATE POLICIES, REGULATIONS, AND INTERNATIONAL COOPERATION

Climate change requires collective efforts and actions by governments, local authorities, businesses and citizens. Below are some of the main actions that can be taken to tackle climate change [3-4]:

- Reducing greenhouse gas emissions: Limiting the burning of fossil fuels, promoting renewable energy sources (such as solar and wind energy), upgrading infrastructure for energy efficiency and promoting public transport are critical measures [5].
- Forest protection and forest reforestation: Forests are natural carbon stores and contribute to the absorption of greenhouse gases. Preservation of existing forests and reforestation of deforested areas are necessary actions [6].
- Encourage sustainable agriculture: Investing in organic farming and growing crops that require less use of fertilizers and pesticides can reduce gas emissions and deforestation for agricultural use [7].
- Promoting sustainable building and urban development: Incorporating sustainable practices in building and urban development, such as the use of green roofs, solar

panels, and promoting environmental sustainability in cities, can reduce dependence on fossil fuels.

- Promoting sustainable transport: Promoting the use of public transport, cycling and walking can reduce road transport emissions.
- Awareness and education: Raising public awareness and providing education about the consequences of climate change and best practices for climate protection can lead to more sustainable lifestyle and consumption choices.

3. THE CASE OF ATHENS

Athens, like many cities around the world, has been taking various public actions to combat climate change. These actions are aimed at reducing greenhouse gas emissions, promoting sustainable practices, and building resilience to climate impacts. Some of the initiatives undertaken by the city include:

- Renewable Energy Projects
- Public Transportation Improvements
- Active Transport and Cycling Infrastructure
- Energy Efficiency in Buildings
- Waste Management and Recycling
- Green Spaces and Urban Parks
- Climate Action Plans and Strategies
- Public Awareness and Engagement
- Partnerships and Collaboration

At this moment there is a discussion around the world about a "Green and Fair Recovery" from the Pandemic. Athens is heading full speed in this direction, and in the meantime, like many other cities, it is updating its Climate Action Plan with a horizon of 2050.

The axes and general objectives of the Action Plan are as follows:

- Axis 1: Energy Production from RES and Energy Upgrade of the Built Environment.
- Axis 2: Accelerating the Transition to Sustainable and Smart Mobility
- It concerns the reduction of greenhouse gas emissions and the adaptation to climate change and the support of the city's resilience (Adaptation and Resilience)
- Axis 3: Urban Revitalization. It concerns Adaptation to Climate Change and the Support of the City's Resistance (Adaptation and Resilience).
- Axis 4: Management and Restoration of Ecosystems and Biodiversity
- It concerns Adaptation to Climate Change and the Support of the City's Resistance (Adaptation and Resilience).
- Axis 5: Prevention and response to climate risks. It concerns Adaptation to Climate Change and the Support of the City's Resistance (Adaptation and Resilience).
- Axis 6: Circularity and sustainable water and waste managementIt concerns the reduction of greenhouse gas emissions, the adaptation to climate change and the support of the resilience of the city (Mitigation, Adaptation and Resilience).
- Axis 7: Transition to a Green and Digital City. It concerns the reduction of greenhouse gas emissions, the adaptation to climate change and the support of the resilience of the city (Mitigation, Adaptation and Resilience).

In addition, in the recent updated Climate Action Plan, which was made after a consultation between the services of the Municipality of Athens, academic institutions, representatives of the city's population groups, Non-Governmental Organizations, climate experts and representatives of the private sector active in the environmental sector, are included:

- Energy production from Renewable Energy Sources (RES) and energy upgrading of the built environment.
- Accelerating the transition to sustainable and smart mobility.
- Urban revitalization incorporating green and blue infrastructure.
- Management and restoration of ecosystems and biodiversity.
- Prevention and response to climate risks.
- Circularity and sustainable water and waste management.
- Transition to a green and digital city. [8]

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CRISES MANAGEMENT IN HIGHWAY TUNNELS. THE CASE OF TUNNELS ON "EGNATIA MOTORWAY SA" ROAD NETWORK

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ABSTRACT

This thesis discusses management of emergency situations in highway tunnels on Greek territory, focusing mainly on the highway tunnels of "Egnatia Motorway S.A.". In order to understand this management, reference will be made to the legislative framework concerning basic road safety requirements in tunnels, both in the pre-construction phase and the already existent ones.

The data collected from highways in countries excluding Greece has shown a similar ratio of records on open roads and tunnels. Even though accidents in tunnels are fewer, the consequences are more serious compared to other locations on the highway.

Following this, examples of how to manage an emergency situation were given in simulations in two highway tunnels of "Egnatia Motorway S.A.". The management procedure that should have been followed by the centre managers is the same as the one in the United Kingdom.

Even though the tunnels of Egnatia Motorway are relatively new and their management system in accordance with EU directives, some suggestions of further improvement are offered at the end of this thesis. Firstly, technology can assist in the surveillance of these tunnels and even foresee accidents and secondly every driver must be informed about the conditions in the tunnels.

The aim of this dissertation is to make the importance of highway tunnels clear. Their existence does not only facilitate the commute of civilians but it can also be a potential source of danger; something that both those managing them and drivers using them should be aware of.

Key words: tunnels, Egnatia Motorway S.A, accidents

1. INTRODUCTION

Many fatal accidents in road tunnels have been the reason for a change in the legislative framework in the European Union. Due to this, the mandatory existence of an emergency lane and the existence of emergency exits to a safe external area were established. In addition, lighting, monitoring systems from control centers and signage needed to be adapted to the new regulations as they play a key role in the smooth operation of the road.

2. METHODOLOGY & DATA

In order to understand the importance of incident management in road tunnels, this paper first discusses the statistics of incidents [11, 12]. Thus, road accident data was collected on three motorways, the "Egnatia Odos SA", the AISCAT motorway and the BRENNER motorway [1,4]. Taking into account this data, it can be concluded that a considerable proportion of all accidents occur in road tunnels and that there is no difference in the types of incidents on the open road and in tunnels [16].

Table 1. Total data studied from motorways.

	Egnatia motorway S.A.	AISCAT	BRENNER
Total length	658 km	5,590 km	314 km
Number/percentage of tunnels	72	0,45% (25.4 km)	17
Time of data collection	2012-2014	2001	1995-2003
Number of accidents	-	41,251	15,744
Number of accidents in tunnels	96	1,897	299

Bearing in mind the management protocols followed by the United Kingdom [2, 3] and the General Emergency Plan of Greece [13, 14, 15], an analysis of the steps followed the managers of the Egnatia Odos SA Control Centre are to take ensued [7, 8, 9, 10]. At the same time, reference was made to the safety exercises carried out by Egnatia Odos SA in road tunnels [5, 6]. Through these, we can check the response times to a critical situation, the actors involved and the alternative routes given.

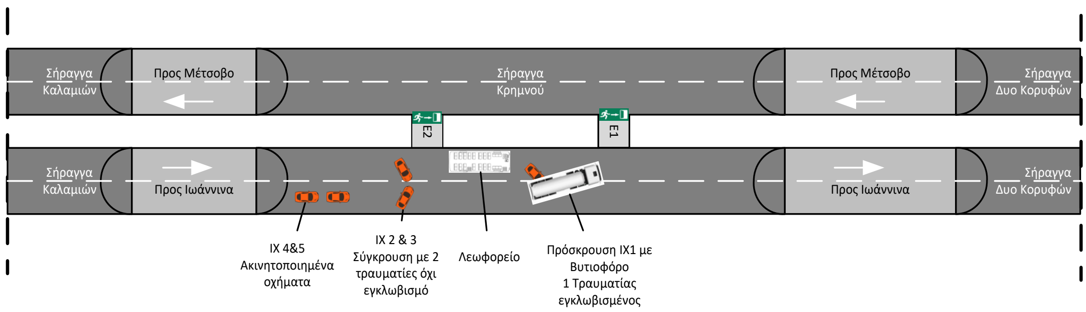

Figure 1. Scenario sketch of safety exercise in the tunnel of Krimnou.

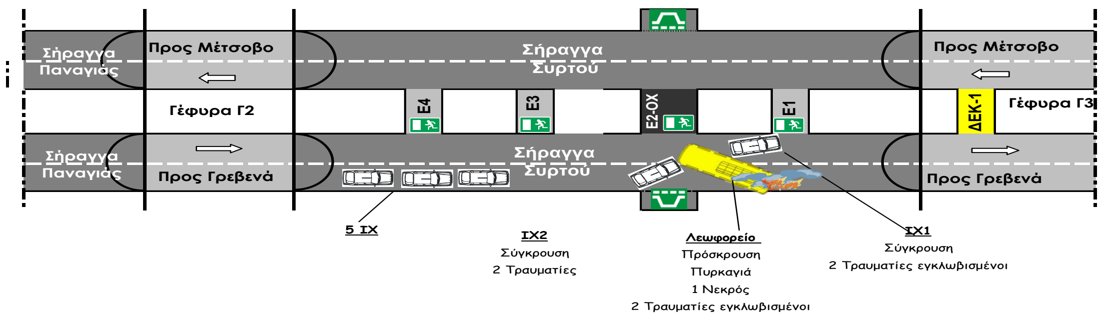

Figure 2. Scenario sketch of safety exercise in the tunnel of Sirtou.

3. DISCUSSION

At the end of the paper, some suggestions on how to prevent the situation were made. First of all, we referred to the road education of highway users which is of major importance to avoid accidents. In addition, the signage within the tunnels for emergency exits, emergency telephone or fire extinguisher points should be in bright colors for immediate recognition by citizens.

Most importantly, however, is to minimize serious accidents caused by vehicles with hazardous materials or by spontaneous combustion of accidents. In the former case, a GPS system that will track the vehicle's path will save reaction time in case of a problem or accident with the vehicle. Similarly, in the second case, thermal imaging of vehicles entering the tunnel would make it easier for managers to check the temperatures of accidents and inform drivers in case they witness something suspicious.

Figure 3. Inside of a tunnel outside of Greece (Source: revistaitransporte.com)

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ACTIONS TO INFORM AND RAISE AWARENESS HUMANS ABOUT ENVIRONMENTAL RISKS AND CIVIL PROTECTION

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ABSTRACT
The actions, that aim to inform-raise awareness humans about environmental risks and civil protection, became part of Sustainable Urban Development Strategies of Municipality of Chania and funded by Business Plan of Crete 2014-2020, with amount of 72000€. The actions refer to the creation of printed material, with instructions about self-protection, the production and distribution of emergency purpose bag in the schools of town, the place of informative board with the places of evacuate, after earthquake and the organization of seminars about Firsts Aids to humans.

Keywords: emergency bag, seminars of First Aids, volunteers, Greek Red Cross, open evacuation areas after earthquake

1. INTRODUCTION

The emergency bag (Figure 1a) consists of the printed instructions of self-protection and the family action plan [1, 2], that are created in regard to the information of General Secretariat of Civil Protection and the integration of regionals information's, too. Also, it contains a lens, which is rechargeable with hand dynamo, a magnet (Figure 1b) with the phones of emergency services and a whistle. It has been distributed, with the aid of volunteers, from the Regional Department of Greek Red Cross in Chania, to 4000 students of 19 Primary Schools of Chania.

(a)

(b)

Figure 1. **(a)** The emergency bag; **(b)** Magnet with emergency phones.

2. METHOD AND DATA

The distribution of the emergency backpacks took place between October and December 2022 with the contribution of the volunteers of the Chania branch of the Hellenic Red Cross. The engineer of the technical service of the Municipality of Chania, in collaboration with volunteers of the Hellenic Red Cross of the Chania Department, visited the 19 primary schools, distributed the backpacks to the students and talked about volunteering and self-protection rules.

For the first aid seminars, the Municipality issued press releases and invited citizens to apply. The training is carried out by certified volunteer trainers of the regional department of Chania of the Hellenic Red Cross.

3. RESULTS AND DISCUSSION

During the distribution of the emergency backpacks and presentation about volunteering and self-protection rules, the students asked the volunteers many questions. The students query more details about how to be protected and the all action gathered positive comments and was considered very interesting by the student community.

The first aid seminars had a great appeal to the humans. From the beginning, the participation of the citizens was very large. The seminars (Figure 2) of Firsts Aids organized with the collaboration of Regional Department of Greek Red Cross in Chania in the period of February - September 2023. About 1100 residents educated about the Firsts Aids from the certified teachers-volunteers of Greek Red Cross until the end of July 2023.

Figure 2. Poster announcing the seminars of first aids to the citizens.

As part of informing the humans about prevention from physical hazards, there were established and placed informational boards (Figure 3) announcing the 22 open evacuation areas in Municipality of Chania (B.A.A. Section) after earthquake.

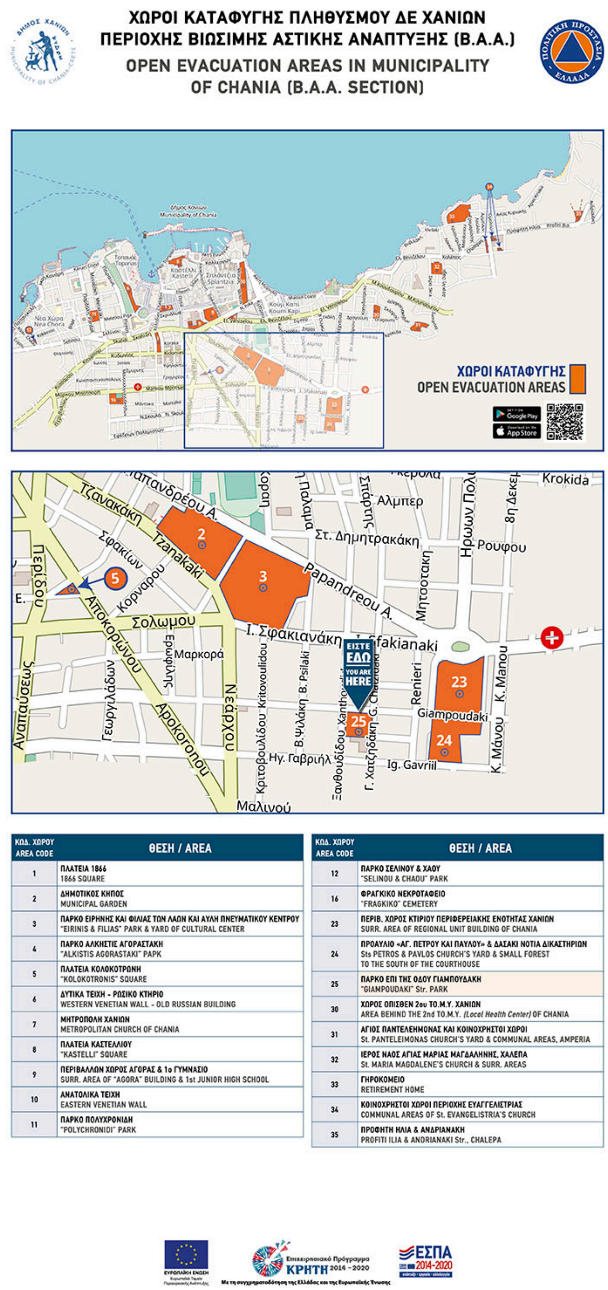

Figure 3. 22 signs are placed with information's about open evacuation areas after earthquake in city of Chania.

CONCLUSION

The action aims to inform humans about the instructions of self-protection from natural risks and the trigger to adopt good strategies to manage the emergency purposes, due to the physical hazards.

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MEDITERRANEAN AND PAN-EUROPEAN FORECAST AND EARLY WARNING SYSTEM AGAINST NATURAL HAZARDS

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ABSTRACT

Natural hazards are worsened by climate change, leading to increased costs, frequency, and strain on limited resources for emergency responses. This is particularly evident in rapidly warming regions. MedEWSa aims to address these challenges by offering innovative solutions that enable timely and accurate impact and finance forecasting, as well as early warning systems (EWS) to support the swift deployment of first responders to vulnerable areas. MedEWSa will develop a comprehensive pan-European–Mediterranean–African solution, integrating various services to create a sophisticated multi-hazard EWS based on the assessment of impacts. Led by the World Meteorological Organization (WMO), MedEWSa aligns with the UN Secretary General's call to ensure global protection from extreme weather and climate-related hazards through EWS within five years. Through eight carefully chosen pilot sites, four twin partnerships will be established, connecting areas in Europe, the southern Mediterranean, and Africa that have experienced natural hazards and cascading effects. These twins will focus on wildfires, extreme weather events, coastal floods, storm surges, floods, landslides, heatwaves, droughts, and wildfires. By demonstrating knowledge transfer between areas with varying climatic conditions, MedEWSa will showcase the adaptability and versatility of its tools.

Keywords: Civil Protection, Disaster, Resilience, Crisis Management, Early Warning System (EWS), Multi-Hazard Early Warning System (MHEWS)

1. INTRODUCTION

The MedEWSa project aims to leverage the expertise and synergy of its partners to address the expected outcomes outlined in this specific call (DRS-01-05). Its goal is to establish long-term capacities in climate risk reduction, climate change adaptation (CCA), and multi-hazard early warning systems (MHEWS). MedEWSa will utilize existing operational tools across Europe to create a scalable and modular multi-hazard platform. The MedEWSa project encompasses a set of five distinct objectives:

Objective No1 focuses on introducing a standardized Decision Support Dissemination System (DSDS) for risk and vulnerability assessment. This will enhance existing capabilities, enable accurate identification of natural hazards, and facilitate improved science communication and information dissemination.

Objective No2 involves developing comprehensive AI-based products based on insights from four twin pilot sites. These products will provide innovative forecasting and impact assessment services, improving response capacities to extreme weather events and geological hazards. MedEWSa will integrate its early warning systems (EWS) into existing decision-making tools.

Objective No3 aims to deliver a EuMeA service, continuously assessing multiple hazards in vulnerable Mediterranean and African areas. This service will be validated and operational at a TRL of 6 to 8 by the project's end. MedEWSa will explore hybrid approaches to enable timely operational forecasts and lessons learned packages for planning authorities and civil protection agencies.

Objective No4 focuses on technological breakthroughs in Big Data, incorporating advanced AI techniques, mapping methods, and risk transfer solutions. These innovations will enhance decision-making capabilities and improve the security of people and assets.

Objective No5 aims to effectively disseminate critical information on climate-related hazards and risks to a wider audience. MedEWSa will prioritize societal support, outreach, and early warning, deploying validated interventions and risk reduction strategies at regional, national, and international levels. Collaboration with the Red Cross and Red Crescent national teams will strengthen communication and response systems for citizens in vulnerable areas.

In conclusion, MedEWSa strives to integrate existing tools, develop innovative technologies, and foster societal engagement to enhance early warning and response systems. The project aims to reduce risks, build resilience, and effectively address climate-related hazards and extreme events.

Figure 1.: *Graphical presentation of a Multi-Hazard Early Warning System (MHEWS) [1].*

2. METHOD

MedEWSa's main objective is to implement an innovative solution comprising a multi-hazard early warning system (MHEWS) and an intelligent Decision Support and Dissemination System (DSDS). By building on existing systems, MedEWSa aims to enhance their capabilities and establish connections with the South-East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A) and the African Multi-Hazard Early Warning and Early Action System (AMHEWAS) [2].

MHEWAS, a program developed by the African Union Commission, focuses on reducing disaster losses and enhancing resilience by establishing interoperable early warning systems (EWSs) for transboundary disaster risk management. MedEWSa will collaborate with SEE-MHEWS-A and AMHEWAS to refine existing information channels and improve communication and information dissemination [2].

To deliver DSDS services, MedEWSa will adopt a co-designing process, incorporating cascading risk assessments and feedback from users and stakeholders. This iterative approach ensures the clear and effective dissemination of information, using accessible language tailored to different audiences.

Usability is a crucial aspect of MedEWSa's approach, particularly in bridging the communication gap. The consortium includes partners such as the Red Cross Red Crescent (RCCC), ACMAD, AMHEWAS, CONV, and national Red Cross and Red Crescent organizations. Their expertise, local knowledge, and networks contribute to delivering information that effectively communicates risk levels and appropriate actions.

MedEWSa's focus extends to addressing multi-hazards with cascading effects, including meteorological and hydrological events, wildfires, hydrometeorologically induced geo-hazards, and volcanic hazards. The DSDS operates on multiple levels, catering to different users and specific event scales.

Collaboration with existing systems at national, regional, and EuMeA levels, as well as participation in international standardization initiatives, are key elements of MedEWSa's strategy. The project aims to boost interdisciplinary collaboration in utilizing artificial intelligence (AI) for natural disaster management.

MedEWSa will establish synergy-building clustering initiatives and partner with stakeholders such as national meteorological and hydrological services, civil protection authorities, and the AMHEWAS situation room at the African Union Commission [2].

With a focus on efficiency, MedEWSa will establish four pillars and eight pilot sites, integrating cutting-edge technology and research to provide complementary services for different users, including first responders, crisis planners, and authorities responsible for issuing warnings [2].

In summary, MedEWSa strives to implement an innovative and comprehensive solution that enhances early warning systems, improves communication, and strengthens resilience to multiple hazards.

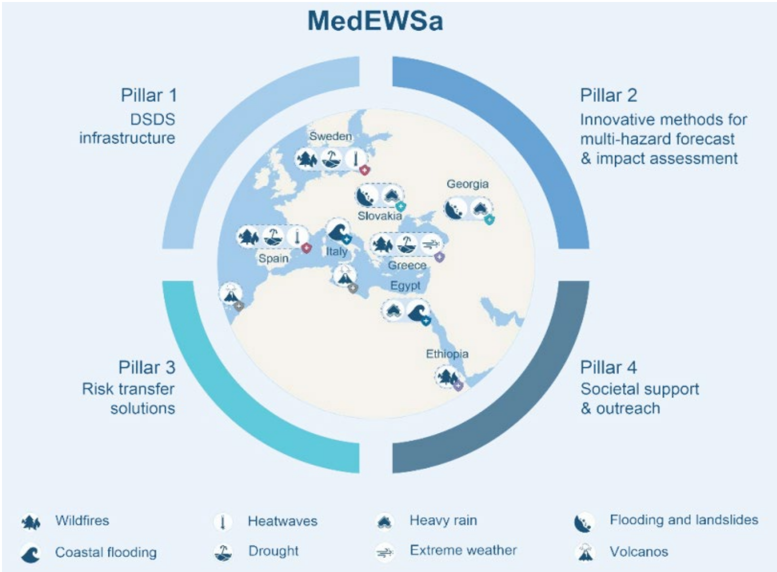

Figure 2.: *The MedEWSa concept and offering [2].*

3. RESULTS AND DISCUSSION

MedEWSa aims to go beyond the current state-of-the-art [3,4,5,6,7,8,9,10] by advancing AI-based decision support, impact forecasting, and modeling of multiple hazard dynamics and interdependencies (MHEWS). This will empower first responders (FRs) with data-driven insights for informed decision-making.

The consortium has developed machine learning (ML) solutions addressing health, environment, and climate challenges, providing real-time alerts, accurate predictions, and disaster simulations. These solutions benefit FRs, civil protection authorities, and decision-makers.

Bridging the gap between local assessments and transnational conditions is crucial for effective disaster risk reduction and EU policymaking. MedEWSa will focus on understanding hazard interdependencies, considering the rarity of concurrent extreme events, uncertainty, and potential impact magnitude. Conditional probability assessments will determine the likelihood of one co-variable being extreme given another.

By addressing research gaps and employing innovative methodologies, MedEWSa enhances early warning systems and provides insights for FRs, authorities, and stakeholders. The project combines data-driven approaches with physics-based models, exploring hybrid methods for improved early warnings. The EuMeA analysis facilitates integrated and rapid global warnings with support from the AUC and UMA. This aligns with COP27's commitment to regional climate security leadership.

Understanding physical drivers, spatial-temporal dependencies, and uncertainties in extreme event predictions is crucial for effective weather-sensitive sector actions and disaster risk management. Cross-scale assessments and knowledge sharing improve emergency responses and responder expertise. MedEWSa assesses hazard interdependencies, visualizes connections, and communicates potential impacts to FRs, operators, policymakers, communities, and the public.

In summary, MedEWSa ambitiously advances AI-based decision support, impact forecasting, and hazard modeling to enhance early warning systems. By leveraging innovative methodologies and fostering collaboration, MedEWSa strengthens FR resilience and community safety in the face of multiple hazards.

4. CONCLUSION

MedEWSa is an ambitious project, aiming to advance the state-of-the-art in early warning systems. By integrating AI-based decision support, impact forecasting, and hazard modeling, MedEWSa provides data-driven insights for informed decision-making. Machine learning solutions offer real-time alerts and accurate predictions, benefiting first responders and decision-makers. Bridging the gap between local and transnational conditions, MedEWSa improves risk reduction and informs EU policymaking. Understanding hazard interdependencies and uncertainties enhances early warning systems and strengthens resilience. Despite being in the implementation phase, MedEWSa remains committed to its ambition, combining data-driven approaches with physics-based models and fostering collaboration. MedEWSa strives to enhance early warning systems, ensuring the safety of communities facing multiple hazards. In conclusion, MedEWSa's ongoing implementation reflects its ambition and progress beyond the state-of-the-art, making a significant impact in early warning systems and community resilience.

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GOBEYOND: ADVANCING GEO AND WEATHER MULTI-RISK IMPACT-BASED EARLY WARNING AND RESPONSE SYSTEMS FOR RAPID DEPLOYMENT OF FIRST RESPONDERS IN THE EU AND BEYOND

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ABSTRACT

GOBEYOND is an innovation action focused on developing Multi-Risk Impact-based Early Warning System (MR-IEWS) platforms for geohazards and weather/climate events. These platforms will support Civil Protection Authorities and first responders in Europe, the Union for Mediterranean (UfM) countries, and beyond. GOBEYOND leverages existing Early Warning Systems and forecasting algorithms to integrate innovative algorithms for geohazards and weather/climate events into a comprehensive MR-IEWS. The platforms incorporate high-resolution vulnerability, exposure, and risk information to assess the severity of hazards in terms of socio-economic impacts. A participatory framework ensures authorities, citizens, and civil society representatives are actively engaged in co-design. The MR-IEWS platforms will be tested in international, regional, and municipal environments through demonstrations in Andalusia (Spain), Attica (Greece), Campania (Italy), a Canton in Switzerland, the Al Hoceima province (Morocco), and four EU municipalities. Advanced capabilities, including communication services, crowdsourcing, and artificial intelligence, will be assessed. Operational testing over 24 months aims to achieve Technology Readiness, validating the effectiveness and practicality of the platforms for real-time use. GOBEYOND seeks to enhance early warning and response capabilities for multi-risk events.

Keywords: Civil Protection, Early Warning Systems, Artificial Intelligence, Multi-Risk Events, Disaster Risk Management, Multi-Risk Decision Support System (DSS), Multi-Risk Impact-based Early Warning System (IEWS)

1. INTRODUCTION

The GOBEYOND project, aims to develop and test a Multi-Risk Impact-based Early Warning System (IEWS) to support Civil Protection Authorities (CPAs) and first responders during weather, climate, and geophysical emergencies in Europe and beyond [1]. The project builds upon the legacy of the Multi Hazards-IEWS developed in the ANYWHERE initiative [2] and leverages existing services offered by organizations such as Copernicus Emergency Management Services, European Flood Awareness System, European Forest Fire Information System, and European Drought Observatory.

The main objective of GOBEYOND is to go beyond the current state of the art by developing and testing a comprehensive Multi-Risk IEWS that enhances situational awareness and enables rapid deployment of responders. To achieve this, the project outlines six specific objectives:

Integration of Data and Information: The project will develop mechanisms to integrate diverse data sources, including climate projections, meteorological forecasts, geohazard physical data, and impact forecasting products, into the Multi-Risk IEWS. Enhanced Risk Assessment: The project will enhance the risk assessment capabilities of the IEWS by incorporating advanced methodologies and tools to analyze and evaluate risks associated with weather, climate, and geophysical hazards. Strengthened Early Warning Mechanisms: The IEWS will be designed to trigger timely and effective early warnings by improving the integration of scientific and technical advancements into real-life protocols of authorities and first responders. Tailored Services for Local Needs: The project will focus on developing IEWS services that are adapted to the specific requirements and context of local authorities, first responders, and the population, thereby ensuring their effectiveness and relevance. Testing and Validation: The developed Multi-Risk IEWS will undergo rigorous testing and validation processes to assess its performance and reliability in operational environments. Maximizing Impact and Dissemination: The project aims to maximize the impact of the Multi-Risk IEWS by actively disseminating its results, promoting knowledge transfer, and fostering collaboration with relevant stakeholders at regional, national, and international levels.

By addressing these specific objectives, GOBEYOND aims to advance the capabilities of early warning systems, improve disaster risk management, and ultimately reduce the impacts of weather, climate, and geophysical emergencies on vulnerable communities [1].

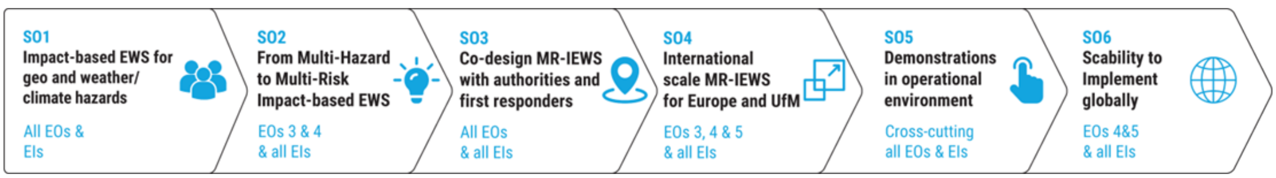


Figure 1.: Specific Objectives and their contribution to Topic Expected Outcomes and Destination Expected Impacts [1]

2. METHOD

GOBEYOND a scientific program funded by the European Union, aims to develop and test an advanced Multi-Risk Impact-based Early Warning System (IEWS). The program focuses on enhancing the capabilities of Emergency Management Centers (EMCs) to effectively respond to geo and weather/climate emergencies. It involves the integration of innovative methodologies and algorithms into existing platforms to provide accurate impact forecasts.

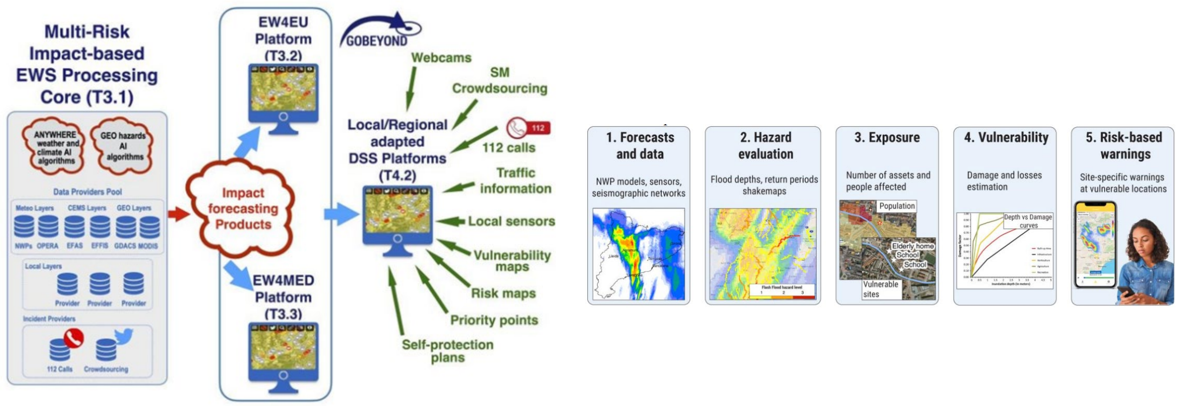
The program follows a participatory approach, engaging first/second responders, regional/local authorities, and key communities in the co-design, co-creation, and co-evaluation of the methodologies and platforms. This collaborative framework ensures that user needs and requirements are considered from the beginning of the innovation process.

GOBEYOND proposes the development of a Multi-Risk IEWS platform, which goes beyond the current standard by providing impact forecasting for a wide range of hazards. The platform consists of a common Processing Core that runs selected A.I. algorithms and generates impact forecasts. These forecasts are then fed into various user interfaces, catering to the different needs of international, national, regional, and local Civil Protection Authorities (CPAs) and first responders.

The program includes the development of a European-scale Impact-based Multi-Risk Decision Support System (DSS) called EW4Europe, which integrates products from various sources and facilitates coordination among CPAs. Regional and local DSS platforms will also be developed to support decision-making at lower levels. These platforms will have advanced features such as identifying vulnerable areas, advanced communication services, and integration with emergency and self-protection plans.

GOBEYOND will also adapt the Multi-Risk IEWS [2,3,4,5,6,7,8,9,10] for countries in the Union for the Mediterranean, creating a version called EW4MED. The program will demonstrate its developments in operational environments through pilot sites in Europe and the Union for the Mediterranean, involving early adopter CPAs and responders in areas prone to major emergencies.

Overall, GOBEYOND aims to advance the capabilities of early warning systems, improve disaster management, and minimize the impacts of geo and weather/climate emergencies by providing timely and accurate information to authorities and responders [1].



(a) (b)

Figure 2. (**a**): Scheme of the GOBEYOND weather, climate and geo Multi-Risk Impact- based Early Warning system (MR-IEWS), composed of a common Processing Core and three types of DSS platforms adapted to the needs of the different use cases (international/national, regional and local). (**b**): MR-IEWS: Scheme of the methodological approach to transform MHIEWS into **MultiRisk Impact-based EWS [1].**

3. RESULTS AND DISCUSSION

Results of the GOBEYOND project demonstrate a significant leap forward in early warning systems for geohazards and weather events. By harnessing state-of-the-art artificial intelligence algorithms and advanced impact forecasting techniques, the project has successfully developed and tested the Multi-Risk Impact-based Early Warning System (MR-IEWS) platforms.

Compared to the current state of the art, the GOBEYOND MR-IEWS platforms provide real-time assessments of socio-economic impacts with unprecedented accuracy and efficiency. The integration of advanced artificial intelligence capabilities, such as crowdsourcing and Site-Specific Warnings, further enhances the system's effectiveness.

A key aspect of the project is its participatory approach, involving authorities, citizens, and civil society representatives in the co-design and co-creation of the MR-IEWS platforms. This inclusive process ensures that the platforms are tailored to meet the specific needs of different regions and promote community engagement.

Through extensive demonstrations in various regions, including Andalusia, Attica, Campania, Switzerland, and the Al Hoceima province in Morocco, the MR-IEWS platforms have been rigorously tested and proven to be reliable for operational use. The 24/7 operational testing over a span of 24 months further validates the platforms' effectiveness in real-time emergency situations.The results of the GOBEYOND project highlight the significant advancements made in early warning systems, providing decision-makers and first responders with invaluable tools to effectively manage geohazards and weather events. The successful integration of artificial intelligence and stakeholder involvement sets a new benchmark for the field and paves the way for more accurate, efficient, and inclusive early warning systems in the future.

4. CONCLUSION

GOBEYOND is an innovative project revolutionizing early warning systems for geohazards and weather events. It utilizes cutting-edge artificial intelligence algorithms and advanced impact forecasting techniques to develop Multi-Risk Impact-based Early Warning System (MR-IEWS) platforms. These platforms provide real-time assessments of socio-economic impacts, surpassing the current state of the art. What sets GOBEYOND apart is its participatory approach, involving authorities, citizens, and civil society representatives in the co-design and co-creation process. This ensures that the MR-IEWS platforms cater to specific needs and promote inclusivity. Demonstrations take place in various regions, including Andalusia, Attica, Campania, Switzerland, and the Al Hoceima province in Morocco. Advanced features such as artificial intelligence, crowdsourcing, and Site-Specific Warnings are tested in EU municipalities, integrating with regional emergency plans for prompt response actions. With 24/7 operational testing over 24 months, the MR-IEWS platforms are proven reliable for operational use, surpassing existing early warning systems. GOBEYOND's use of artificial intelligence and stakeholder involvement pushes the boundaries of early warning systems, providing accurate, efficient, and inclusive tools for managing geohazards and weather events.

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WEATHER CONDITIONS DURING PASSENGER SUNK SHIPS (TECHNOLOGICAL DISASTERS) IN THE AEGEAN SEA

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ABSTRACT
The purpose of this short note is to explore the weather conditions during passenger ship sunks in Aegean Sea. For this purpose unregistered in the EM-DAT database, passenger ships sunks cases were examined, which fulfilled the criteria for technological disasters. Eight (8) cases were found.
Weather reanalysis data regarding sea level pressure and wind speed were adopted from datasets of The NOAA Physical Sciences Laboratory (PSL) – 20th Century Reanalysis Daily Composites.
Results indicate that not in all cases weather conditions contribute to those technological disasters.
The not existing records contribute to the lack of the database for Greece, which can be a guide for the implementation of prevention and mitigation policies.

Keywords: Hazards, registered natural and technological disasters, international databases.

1. INTRODUCTION

A disaster is a sudden event that disrupts the function of a community and causes human, material, economic and environmental losses. Disasters are mainly caused by nature, but sometimes they can have a human origin. According to the EM-DAT clasification, those man made disasters, also called Technological Disasters, include: Industrial accidents, such as Chemical spill, Collapse, Explosion, Fire, Gas leak, Poisoning, Radiation, Oil spill, Other; Transport accident, such as Air, Road, Rail, Water; Miscelleanous accident, such as Collapse, Explosion, Fire, Other. So a transort accident in water (a ship sunk), can be characterized as a technological disaster, if specific criteria are fulfilled

EM-DAT is an effort undertaken by the Centre for Research on the Epidemiology of Disasters, Louvain (Belgium), providing a unified platform for events' registration [1]. Registered disasters on EM-DAT platform offers a relevant information base for vulnerability assessment and rational decision-making in disaster situations. In Greece, the Hellenic General Secretariat for Civil Protection (GSCP) has been responsible for the registration of natural or technological disasters to EM-DAT database, following the norms, classifications, and thresholds adopted by the same organization.

The purpose of this short note is to explore the weather conditions during ships sunks in Aegean Sea and if those conditions were favorable for those events.

2. DATA AND METHOD
Weather reanalysis data regarding sea level pressure (SLP) in hPa and wind speed (WS) in m/s were adopted from datasets of The NOAA Physical Sciences Laboratory (PSL) – 20th Century Reanalysis Daily Composites, Version 20CRV3 [2]. Plots were made using the reanalysis data of the day registered as day of the sunk.

For the afforementioned purpose the criteria of the EM-DAT international database have been used. All disasters included in the Table, conform to the first of the following criteria:

1. 10 or more people dead;
2. 100 or more people affected;
3. The declaration of a state of emergency
4. A call for international assistance.

All events included in the Table, were adopted from web sources and archive daily press material.

3. RESULTS

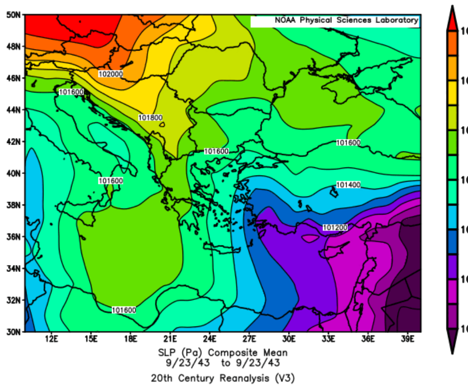
Table 1 shows the 8 cases that fulfill the criteria. Seven (7) of the cases are passenger ships sunk, while one (1) is a lake boat sunk. For the time period 1943 – 1944 (during WWII) the site Invisible Graves claims a total of at least twelve cases of ships sunks with Italian soldiers as passengers (or prisoners), which sank to the Aegean Sea. At least 7 of them sank due to military actions and are not referred to the Table. Three of them, namely DONIZETTI, SINFRA and PETRELLA sunk possibly due to military actions and are referred to the table because the number of passengers (or prisoners) was significant.
The meteorological analysis using reanalysis data, shows that at least four cases of the ships: ORIA, CHIMARA, CHRYSI AYGI and the Megdova' lake boat, the weather conditions have contributed significantly to the disaster. Especially for the late case, as archive daily press claims, a storm or tornado appeared
In Figure 1, five (5) of the eight graphs regarding SLP and WS are presented. As it can be clearly shown in 3 of the 4 sunks with more than 1000 fatalities, weather conditions seem not to contribute to those events. We must notice that the ORIA sunk is the deadliest ship sunk in the Mediterannean.sea
Also,it is very interesting that the sinking of POPI became in colloquial language the synonym to persons or services that they did not know how to react in an emergency case.

Table 1. Unregistered in EM-DAT, Transport Accidents (Water) for the Aegean Sea, regarding only passenger sunk ships. Category 2 is for technological disasters. References are included in brackets.

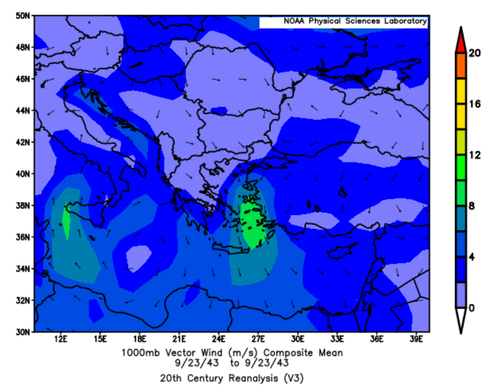
Disaster	EM-DAT Category	EM-DAT Criterion	Date	Place	Deaths	SLP	WS	Comments	Reference
POPI	2 – Sunk	1	27/11/1934	Fleves isl.	11	Low	Medium		[3, 5, 6]
DONIZETTI	2 – Sunk	1	23/9/1943	Rhodes	2670	High	Low	Possibly due to military action	[3, 4]
SINFRA	2 – Sunk	1	19/10/1943	Herakleion	2000	High	Low	-//-	[3, 4]
PETRELLA	2 – Sunk	1	8/2/1944	Souda Bay	1584	Low	Low	-//-	[3, 4]
ORIA	2 – Sunk	1	12/2/1944	Patroklos	4115	Low	High		[3, 4, 7]
CHIMARA	2 – Sunk	1	19/1/1947	South Evoikos	383	Low	High		[3, 5]
Megdova' lake boat	2 – Sunk	1	5/12/1959	Plastira's Lake	25	Low	Medium	(Tornado?)	[5, 6]
CHRYSI AVGI	2 – Sunk	1	23/2/1983	Karystos	28	Low	High		[3, 5]

4. CONCLUSIONS

In recent times a lot of marine transport disasters are registered, most of them regarding immigrant boats carrying ilegally a lot of persons. An effort must be taken, all of those marine transport disasters to be recorded. Those records can be used as an educational tool. The need for action and protection measures regarding all kind of transport accidents is a necessity. The contribution of education and preparedness drills, as part of the precaution measures, is considered crucial. In situ drills and formal education is one of the means that are used by modern states for informing, training and raising the awareness of personel, services, but also and for pupils (i.e., future adults) about natural disaster. Therefore, updating the natural disasters curriculum, enriching education and training, on a regular basis, may ensure the validity of training [8, 9].

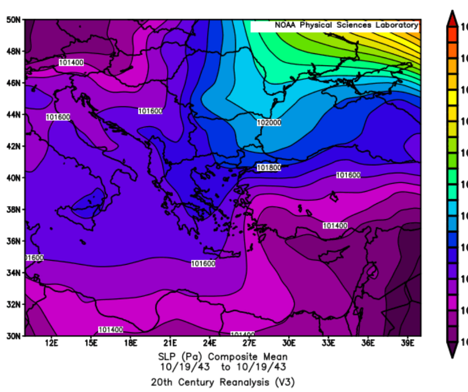


(**a**)

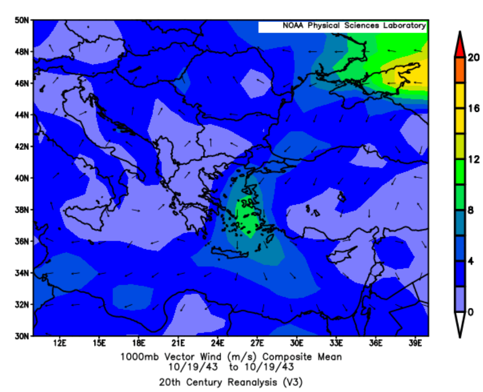


(**b**)

DONIZETTI

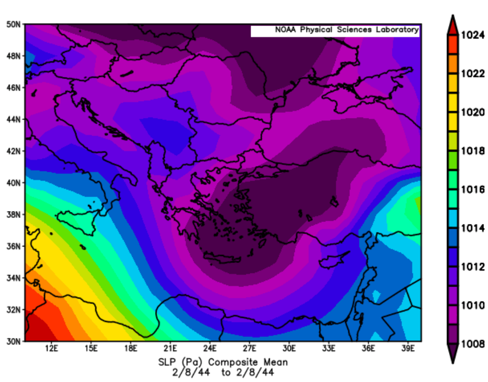


(c)

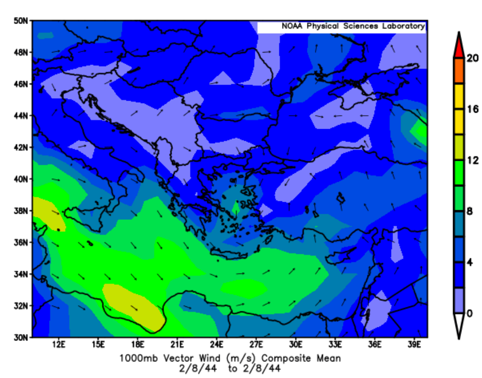


(d)

SINFRA

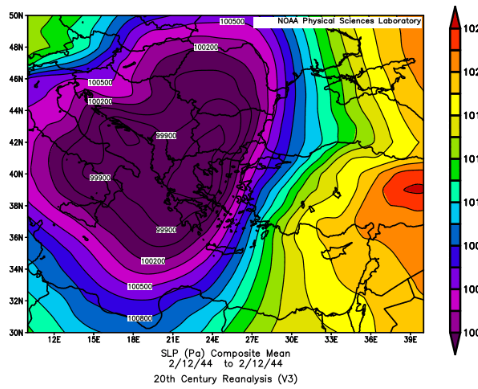


(e)

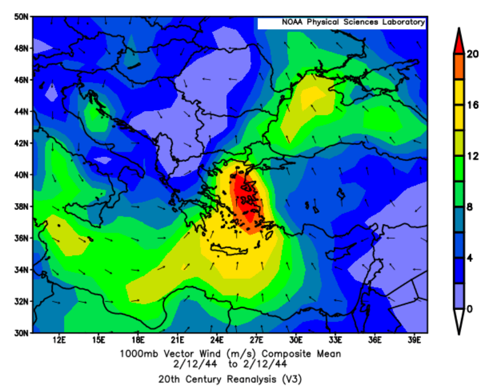


(f)

PETRELLA

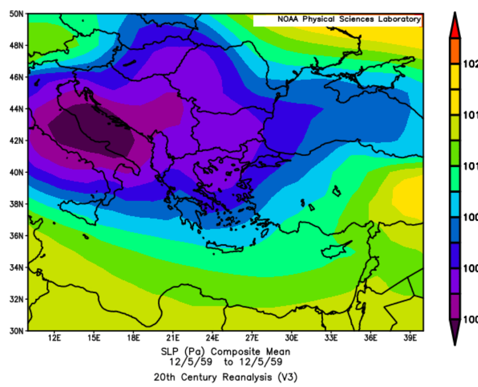


(g)

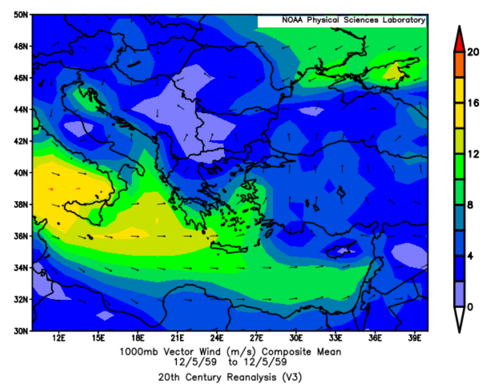


(h)

ORIA



(i)



(j)

Megdova' boat sunk

Figure 1. Sea Level Pressure (SLP) in hPa on left panels, and Wind Speed in m/s on right panels. Names of passenger ships sunk is given below each pair of graphs.

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COMPLETION EM-DAT DATABASE RECORDS REGARDING NATURAL AND TECHNOLOGICAL DISASTERS IN GREECE

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ABSTRACT
This short note is about the lack of Greek registered natural and technological disasters in EM-DAT international database. This database use specific criteria for the registration of an event as a disaster. The not existing records contribute to the lack of the database for Greece which can be a guide for the implementation of prevention and mitigation policies.

Keywords: registered / unregistered natural and technological disasters, international databases.

1. INTRODUCTION

A disaster is a sudden event that disrupts the functioning of a community and causes human, material, economic and environmental losses. In all cases, for the hazards categories, the Emergency Database (EM-DAT) classification was used. EM-DAT is an effort undertaken by the Centre for Research on the Epidemiology of Disasters, Louvain (Belgium), providing a unified platform for events' registration [1]. Registered disasters on EM-DAT platform offers a relevant information base for vulnerability assessment and rational decision-making in disaster situations. In Greece, the Hellenic General Secretariat for Civil Protection (GSCP) has been responsible for the registration of natural or technological disasters to EM-DAT database, following the norms, classifications, and thresholds adopted by the same organization.

2. DATA AND METHOD

For the afforementioned purpose the criteria of the EM-DAT international database have been used. Web pages [2], a database from ELINYAE [3] and some published papers in peer reviewed journals. All disasters included in the Table, conforming to at least one of the following criteria:
1. 10 or more people dead;
2. 100 or more people affected;
3. The declaration of a state of emergency
4. A call for international assistance.

All events included in the Table, were adopted from published papers, web sources and archive daily press material.

3. RESULTS

The results with candidate disasters and associated references [4 – 21] are shown in Table 1. According to the results, there is a lack in the registration procedures regarding the events that could included in the EM-DAT. Even more there are unregistered events that received a lot of publicity from media.
Technological and industrial disasters usually cause a series of long lasting detrimental problems (environmental; health; planning; etc) which need long term monitoring. It is important to record and register on international databases all available data for technological disasters in Greece. The lack of data due to unregistered disasters, as well as the incomplete international databases, affect decision making policy issues [22].
Educational initiaves in general [22] and especially in industries can promoting a culture of risk prevention and well-being in the workplace. There is a question on the proper handling of multiple disasters, happening in the same place at (almost) the same time [23].

Table 1. Candidate events for possible inclusion in EM-DAT which fulfill the criteria of the database. Categories (1 – for natural disasters and 2 – for technological ones). References are included. Dates in brackets are for new calendar.

Disaster	EM-DAT Category	EM-DAT Criterion	Date	Place	Deaths	Injuries	Homeless	Infrastructures	Comments	Reference
Kythira' Earthquake	1 – Erthquake	1	11/8/1903	Kythira	14					[10, 11]
"Litheos" Flood	1 – Convective Storm	1	17/6/1907 (4/6/1907)	Litheos river – Trikala	300			1200–2000 houses with damages		[2]
Cholera epidemic	1 – Biological	1	1912–1913	Greece	"Hundreds of deaths"					[17]
Lefkada' Earthquake	1 – Erthquake	1	27/11/1914	Lefkada	16					[10, 11]
Thessaloniki' Fire	2 – Fire	2	5/8/1917 (18/8/1917)	Thessaloniki			70000	9500 houses burned		[12]
"Spanish flu"	1 – Biological	1	1918	Greece	"thousands"					[14, 15, 20]
Cine "PANORAMA"	2 – "Fire"	1	19/10/1924	Athens	26	18			All teenagers	[12]
Plague appeared	1 – Biological	1	1923–1926 (1924)	Athens / Piraeus	55					[19]
Plague appeared	1 – Biological	1	1923–1926 (1926)	Athens / Piraeus	63					[19]
Rhodes' Earthquake	Earthquake	1	26/6/1926	Rhodes isl.	12	>10				[10, 11]
Corinth' Earthquake	1 – Earthquake	1	22/4/1928	Corinth	20					[10, 11]
Kos' Earthquake	1 – Earthquake	1	23/4/1933	Kos isl.	178					[10, 11]
Piraeus' Flood	1 – Storm		22/11/1934	Piraeus	6			Yes		[2]
POPI	2 – Sunk	1	27/11/1934	Fleves isl.	11					[8, 9]
Chalastra' Storm	1 – Convective Storm	1	1/8/1935	Thessaloniki – Chalastra	50			Yes	Most of them fisherman'	[2]
Crete' Flood	Storm	1	18/10/1937	Herakleion – Crete	16					[2]
Oropos' Earthquake	1 – Earthquake	1	22/7/1938	Oropos	18					[10, 11]
Larissa' Earthquake	1 – Earthquake	1	1/3/1941	Larissa	40					[10, 11]

DONIZETTI	2 – Sunk	1	23/9/1943	Rhodes	2670			Possibly due to military action	[8, 9]
SINFRA	2 – Sunk	1	19/10/1943	Herakleion	2000			-//-	[8, 9]
PETRELLA	2 – Sunk	1	8/2/1944	Souda Bay	1584			-//-	[8, 9]
ORIA	2 – Sunk	1	12/2/1944	Patroklos isl.	4115				[8]
CHIMARA	2 – Sunk	1	19/1/1947	South Evoikos	383				[9, 10]
Rhodes' Earthquake	1 – Earthquake	1	25/4/1957	Rhodes isl.	18				[11, 12]
Heat Wave	1 – Heat Wave	1	20-26/8/1958	Greece	600				[2]
Volos' Flood	1 – Flood	1	13/10/1959	Volos	27	23			[2]
Megdova' lake boat	2 – Sunk	1	5/12/1959	Plastira's Lake	25		Due to Tornado?		[2]
Corinthian Gulf	1 – Tsunami	2	7/2/1963	Aigio - Selianitika	2	12	Boats with damages		[2]
OA954	Airplane crash	1	8/12/1969	Keratea	90				[2]
Flash Flood	1 – Storm	1	2/11/1977	West Attica	39				[2]
CHRYSI AVGI	2 – Sunk	1	23/2/1983	Karystos	28				[9, 10]
Thessaloniki storm	1 – Convective Storm	1	21/7/1983	Thessaloniki	9		Yes		[2]
Jet Oil	2 – Fire – Explosion	2	24/2/1986	Thessaloniki		11			[3, 4]
Drapetsona' Fertilizer Industry	2 – Explosion	2	16/1/1992	Drapetsona – Piraeus					[3, 4]
PETROLA Refinery	2 – Explosion – Fire	1	1/9/1992	Elefsina	14	20			[3, 4]
Drought	1 – Drought	2	5/6/1993 to 4/11/1993	Greece					[2]
Podonifti's Flood	1 – Storm	1	21/10/1994	GAA	10				[2]
PYRKAL	2 – Explosion	2	3/8/1997	Elefsina	1	6			[3, 4]
EKO Refinery	2 – Explosion	2	23/11/1998	Thessaloniki	4				[3, 4]
Kamena Vourla	2 – Fire / BLEVE	2	30/4/1999	Kamena Vourla	5	14			[3, 4]
CHYMA	2 – Fire / BLEVE	2	26/7/2006	Lavrio					[3, 4, 5]
H1N1 Influenza	1 – Biological	1	2009–2010	Greece	140				[16, 17]
ELPE	2 – Fire	2	8/5/2015	Aspropyrgos	5	1			[3, 4]
West Nile Virus	1 – Biological	1	June to October 2018	West Attica	44				[6, 7]
Covid-19 pandemic	1 – Biological	1	March 2020 – now	Greece	3988				[21]

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A REVIEW OF FREE AVAILABLE GREEK WEB TOOLS CONCERNING PRECAUTION MEASURES FOR SECONDARY EDUCATION STUDENTS

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ABSTRACT

For the prevention and confrontation of varius hazards there is a need for an educational subject usually provided by organizations such as Greek General Secretariat of Civil Protection (GSCP), The Earthquake Planning and Protection Organization (EPPO – OASP), etc. In such actions, Information and Communication Technologies (ICT) have a dominant role, since students use them widely, not only in the educational process but also in their daily lives. A modern approach to the pedagogical use of ICT is the use of mass media, social networks and digital learning objects. Those are described as self-standing resources of learning content that include or indicate learning objectives. The objects include interactive virtual and multimedia environments, as well as educational games. In this paper we evaluate material provided from Deucalion project, GSCP, EPPO and Memorandum of Acts for secondary education school units. The evaluation uses the same classification of hazards as the EM-DAT. The results indicate that not all type of hazards are included in the material. There is a need to update and develop such material and applications.

Keywords: web tools, Information and Communication Technologies, Natural Disasters, precaution measures.

1. SCOPE OF THE PAPER

Educating students on prevention and precaution issues coming from natural disasters is an important factor at decreasing the impact of natural disasters. Students who have participated in relevant training programs are likely to have better knowledge of safety behaviors and their families show greater readiness and awareness [1]. In Greece this is the role of coordinators for Environmental Education and for Physical and Mental Health. Those two coordinators suggest various activities and programs for secondary education students and teachers. In cooperation with them those activities are supported from Centers of Environmental Education (50 in total in the Greek State) [2, 3, 4, 5].

The aim is for students to acquire the necessary knowledge, skills and practical addressing of the hazards. Apart from the importance of self-protection, the education for the risk of disasters at all levels of education contributes so students have an important role in the diffusion of relevant knowledge to local communities.

The scope of the paper is to evaluate those tools using the EM-DAT classification for Hazards [6].

2. METHOD USED

In 1988, the Centre for Research on the Epidemiology of Disasters (CRED) launched the Emergency Events Database (EM-DAT). The main objective of the database is to serve the purposes of humanitarian action at national and international levels. The initiative aims to rationalise decision making for disaster preparedness, as well as provide an objective base for vulnerability assessment and priority setting. Using this classification, we match learning objectives with hazards type [6].

In this study, for the prevention and confrontation of various hazards, we evaluate educational subjects (guidelines, brochures, interactive sections, interactive tools) provided by following organizations: University of Ioannina (http://deucalion.edu.gr/objects.php), Greek General Secretariat of Civil Protection (GSCP), EPPO educational material and material for volcanoes (RACCE Museum), Memorandum of Acts (for schools) official document provided by Ministry of Education and the educational program TAME (greek acronyms for: I'm scared – I am struggling – I'm learning – I'm training) which is an educational initiative of Beurau for Civil Protection of the Municipality of Aspropyrgos [7, 8, 9].

3. RESULTS

Table 1, shows the comparison of EM-DAT classification for hazards with learning objectives associated with education on the prevention and precautionary measures. The results indicate that not all type of hazards were included in the material and is not up to date.
The growing number of all kind natural and technological hazards and their consequences must alert the educational community [10]. It is necessary to summarize the educational material and also to inform and train teachers and students using educational tools, both traditional and web based / Information and Communication Tools, social media, etg.

Table 1. Evaluation of free available Greek web tools concerning precaution measures for disasters and hazards classification as provided from EM-DAT.

Disaster Group	Disaster Subgroup	Definition	Disaster Main Type	Deucal ion	EPPO	GSCP	Memorandum of Acts (For schools)	TAME
Natural	Geophysical	A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.	Earthquake	√	√	√	√	
			Mass Movement (dry)	√				
			Volcanic activity	√	√	√		
	Meteorological	A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.	Extreme Temperature	√		√	√	
			Fog	√		√		
			Storm	√		v	√	
	Hydrological	A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater and saltwater.	Flood	√		v	√	
			Landslide	√		v	√	
			Wave action	√		v		

	Climatological	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability	Drought		v		
			Glacial Lake Outburst	√		√	
			Wildfire	√	v	√	
	Biological	A hazard caused by the exposure to living organisms and their toxic substances (e.g. venom, mold) or vector-borne diseases that they may carry. Examples are venomous wildlife and insects, poisonous plants, and mosquitoes carrying disease-causing agents such as parasites, bacteria, or viruses (e.g. malaria).	Epidemic	√	v	√	
			Insect infestation	√			
			Animal Accident	√			
	Extraterrestrial	A hazard caused by asteroids, meteoroids, and comets as they pass near-earth, enter the Earth's atmosphere, and/or strike the Earth, and by changes in interplanetary conditions that effect the Earth's magnetosphere, ionosphere, and thermosphere.	Impact				
			Space weather	√			
Technological	**Industrial accident**		Chemical spill			√	
			Collapse				
			Explosion		v		√
			Fire				√
			Gas leak				√
			Poisoning				
			Radiation	√			
			Oil spill				
			Other				

Transport accident	Air		
	Road	**v**	**√**
	Rail		**√**
	Water		
Miscelleanous accident	Collapse		
	Explosion	**v**	**√**
	Fire	**v**	**√**
	Other		

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