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A DIGITAL RADIO NETWORK OF DMR TRUNKED TECHNOLOGY FOR ALL PUBLIC SAFETY SERVICES: A USECASE IN CORFU ISLAND

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ABSTRACT

Mission critical communications are the communications systems that are used by Public Safety Services in the field operations to support the mobility of the first responders. Professional Mobile Radios (PMR) are successful systems used for critical communications during the last years. Amongst the available PMR solutions on the market, the DMR Tier III technology also known as DMR trunked technology seems to be an attractive solution for the Public Safety Services. DMR trunked technology which is standardized by ETSI organization fulfills the demands of all critical services such as (fire brigade, police, health emergency, coast guard and other municipal services) and still constitutes a cost efficient solution. A complete system like trunked DMR is capable of replacing into one, all the old separate analog systems that are now used, which will keep the privacy of each Service and add the value of easy collaboration. This paper work illustrates a possible design of a DMR trunked radio network for all Public Services for the Corfu Island taking into account the different demands of each partner. Moreover, in our scenario we design the core network by using the *Radio Mobile* planning tool using VHF frequency band. The radio coverage and the amount of terminal radios are finally calculated to estimate the total cost of such a DMR trunked system for the Corfu region.

Keywords: Public Safety, Critical Communications, Digital Mobile Radio, Network planning , Radio coverage.

Notes: The views and the conclusions contained in this work express only the authors' research and should not be interpreted as representing the official positions of the Hellenic Fireservice.

1. INTRODUCTION

Public Safety Services and Government agencies use critical communications as the most secure and reliable radio systems for their missions. Mission critical communications refer to the PMR radio systems which they have unique features that stand out from commercial mobile broadband communication systems. For this reason, mission critical services still use the trusted PMR technologies such as (TETRA, Tetrapol, P25, DMR and dPMR) [1-4]. First Responders from each Public Safety authority offer valuable service to the society and have to deal effectively with critical situations, something impossible without communications. Critical Services are acting on high demanding environments such as urban domains, indoor areas, rural, forest and border regions [5,6]. Due to that fact, broader radio-communications are needed to fulfil extended coverage in every place of possible action.

The main idea of this work is evaluating the DMR trunked technology which completes the needs of all Mission Critical Services in Hellas territory (i.e police, fire brigade, health emergency, coast guard and civil protection) as the most attractive solution. Moreover, focusing on the network planning for the case Corfu, we simulate the radio coverage using five possible sites with star topology for the core network. In these simulations, we use the Radio Mobile software tool for VHF (150-174 MHz) frequency band. Furthermore, we try to calculate the total amount of equipment for all Public Services that acting in the Corfu region and estimate the total cost of this DMR trunked system for upgrading the old analog systems that currently exist.

2. MISSION CRITICAL COMMUNICATIONS TECHNOLOGIES

Communications on emergency situations that are used by first responders in the field are differently designed from the commercial communication systems, which are designed with different demands. Some of the characterization of the emergency system are presented as follows [1,2]:

- Robust with high communication availability at least 99.99% of the time per year.
- Secure communications from non-authorized users (AES encryption protocol)
- Several emergency features (i.e. man down, lone worker, integrated GPS)
- Radio terminals compatible with military standards (MIL-STD-810G, -D, -E, -F) and IP67
- Interoperability among different manufactures and operational efficiency.

Trunked technologies are mostly used as professional critical communication systems in the global market. These systems are computer controlled radio systems that provide a lot of features such as efficient spectrum usage, dynamic capacity of resources and plethora of radio channels for different groups of users. In Europe the most successful protocol standards are presented in Table 1 with some their basic features [1-4].

Table 1. Mission critical Communication standards in Europe

Technologies	Tetra	Tetrapol	P-25	DMR	dPMR
Frequency bands (MHz)	UHF	UHF	VHF,UHF, 700,800,900	VHF,UHF, 700,800	VHF, UHF
Modulation	TDMA (4-slots)	FDMA	FDMA, TDMA(2-slots)	TDMA (2-slots)	FDMA
Channel spacing	25 kHz	12.5 kHz	12.5 kHz	12.5 KHz	6.25 KHz
Data rates	28.8 Kb/s	8 Kb/s	12 Kb/s	9.6 Kb/s	4.8 Kb/s
Encryption	Yes	Yes	Yes	Yes	Yes
Compatible with analog systems	No	Yes	Yes	Yes	Yes
Implementation (system scales)	large	large	large	small to large	small to medium
Supported by different manufactures	Yes	limited equipment availability	Yes	Yes	limited equipment availability
System cost (per km ²)	€€€	€€€	€€€€	€€	€€

2.1. DMR standard

Digital Mobile Radio (DMR) is an open standard defined by ETSI in 2005. DMR is capable of satisfying the needs of mission critical communications with minimized cost, as a result is being trusted by many Public Safety authorities in the world. Tier III is a licensed trunked system with a controller function that automatically regulates the communications. Moreover, DMR Association has been established to support this protocol as an open standard and guarantee the interoperability functionality among different manufacturers. Ones, who want to join this technology with their radio products, have to pass some compatibility tests. DMR has found great acceptance from Public Safety authorities and nowadays is one of the most promising technology for PMR sector globally.

3. USE CASE FOR CORFU REGION

The main scope of this study is to design a digital radio network for the case of all Public Safety authorities that are acting in Corfu Island. Each one of these critical services has different responsibility region. Due to this we find out that the total acting area of all the above services is 4,006 km². The 638km² refer to land terrain and the rest of them, the 3,368 km² are sea area. The total territory of all Public authorities is presented with dotted area in Figure 1a.

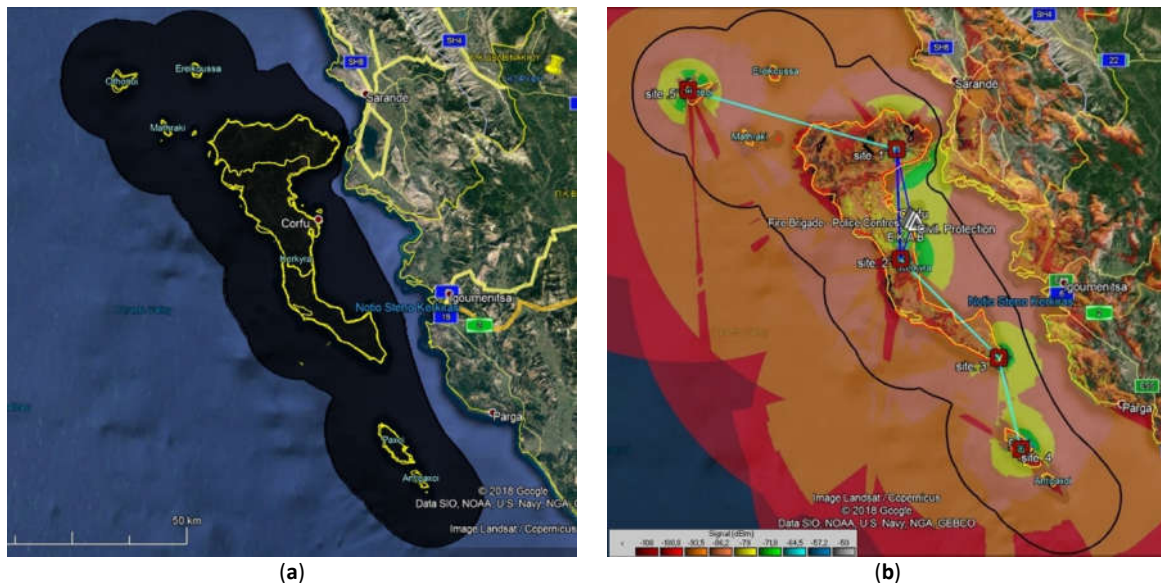


Figure 1. a) This map represents the responsibility regions of all public Safety Services in Corfu Island including the coast guard regions that are the Hellas national sea territorial limits at 10 nm (nautical mile) for research and rescue activities, b) The radio coverage map from five possible sites with star topology of the network architecture.

Figure 1a presents the total geographical area in which a 100% radio coverage is needed. In our simulations we propose five possible sites that we suggest that each one covers large terrain areas effectively. Moreover, in our link budget analysis we use parameters presented in Table 2. The simulation results are presented in Figure 1b.

Table 2. Link budget parameters of the system

System Parameters	Downlink	Uplink (mobile terminal)
Power transmitted Tx	45 W	25 W
Antenna height	7 m	2 m
Antenna Gain Tx	5 dBi	2 dBi
Additional Losses (cables, connectors,...)	1.5 dB	4 dB
EIRP	49.5 dBm	41.8 dBm
Dynamic sensitivity Rx faded (8 to 100) km/h	-104dBm	-108dBm

In our simulations, the software that we used is the Radio Mobile coverage tool that finds wide acceptance from the scientific community [7]. In Figure 1b the estimated coverage is illustrated on Google earth map tool, the result is a coverage of 98% for the terrain area and a 99.8 % on sea area. To improve further this coverage presence more infrastructure sites should be established.

3.1. Transceiver amounts and cost estimation of DMR trunked system

After the radio coverage simulations, we try to estimate the radio equipment for the needs of all the Public Safety Services in Corfu region. Firstly, by finding the departments of each authority, we calculate the manpower units and try to estimate the total amount of the terminal radios that presented in Table 3.

Table 3. Estimated needs for Public Safety communications on Corfu Island

Public Safety Services	Departments	Mobile units	Mobile radios	Portable radios
Fire Service	4	50	55	65
Police	10	33	44	80
Coast Guard	5	7	15	25
Civil Protection	6	15	22	10
Health emergency	2	7	10	10

Finding the total radio terminals also we can estimate the cost of the system by searching through manufacture leaflets [8]. The cost details of all the infrastructure system is presented in Table 4.

Table 4. Total cost estimation for Public Safety communications on Corfu Island.

Total Radios	units	Cost per unit	Total Cost
Mobile radio DMR Tier III	146	800 €	116,800 €
Portable radio DMR Tier III	190	850 €	161,500 €
medium size Base Stations	4	32,000 €	128,000 €
large size Base Stations	1	60,000 €	30,000 €
site infrastructure ¹	5	4,500 €	22,500 €
IP Microwave links	8 pairs	3,000 €	24,000 €
Mobile switching centre (MSC)	1	70,000 €	70,000 €
Dispatcher sites	5	25,000 €	125,000 €

¹ Site infrastructure includes: isobox containers (4m²), antenna pylons (7m), lighting protection, VHF antennas, cables, ect

4. CONCLUSION

In this work, we evaluate a DMR trunked radio system that is capable of supporting all Mission Critical Services in Corfu region. Moreover, we present the radio coverage analysis to estimate the total coverage of the Corfu region and calculate the total amount of terminals for all authorities to estimate the total cost of this DMR system.

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SEISMICITY MONITORING IN IONIAN ISLANDS

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ABSTRACT

The Central Ionian Islands area, including Kefalonia and Lefkada Islands, has been recognized as one of the most active zones in the Aegean and its surroundings. The 2003 Mw6.2 Lefkada earthquake has motivated the installation of a dense local seismological network which was progressively improved and is permanent nowadays. This permitted the manual picking and location of more than 3900 events with magnitudes of $M \geq 0.3$ from June 2018 until the end of June 2019. A noteworthy seismic excitation is observed during that period, which is processed through relocation of seismicity and statistical analysis of its aftershock sequence in order to get information regarding the geometric and kinematic properties of the activated structures.

Keywords: Microseismicity, Ionian Islands

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1. INTRODUCTION

The area of central Ionian Islands, comprising Lefkada and Kefalonia, is characterized by remarkably high seismic activity, with several strong ($M \geq 6.0$) earthquakes that have caused severe casualties and damage. The study area is located between the continental collision to the north (between Adriatic microplate and Eurasian) and the oceanic subduction of the eastern Mediterranean lithosphere under the Aegean microplate to the south [1]. The dominant tectonic feature is the dextral strike slip motion caused by the Kefalonia Transform Fault Zone (KTFZ) [2] along which the most disastrous events in Kefalonia and Lefkada Islands occur during the last six centuries.

The microseismicity monitoring was enabled because of a dense local seismological network that was installed and is in continuous operation in the study area [3]. Thus, in addition to the major fault segments associated with the occurrence of $M \geq 6.0$ earthquakes, the secondary structures efficient to accommodate moderate events ($5.0 \leq M \leq 5.9$) were investigated and their geometric and kinematic properties were identified [4, 5]. The aim of this study is to present the investigation of the recent microseismicity that took place in the time interval June 2018 – June 2019, in a continuous effort to detail as much as possible the complex seismotectonic regime of the study area.

2. SEISMICITY LOCATION AND SPATIAL DISTRIBUTION

The data set of our study includes all earthquakes that are recorded in the area from June 2018 until June 2019, which were manually picked and located. The earthquake catalog comprises 3759 events with magnitudes in the range [0, 5.4], and region defined by latitudes $37.7^\circ - 39.2^\circ$ and longitudes $20.0^\circ - 21.0^\circ$. The magnitude completeness was found $m_c = 1.5$, computed by goodness-of-fit (GOF) method [6] and their epicentral distribution is shown in Figure 1. The relocated seismicity is mainly associated with the known fault segments along the western coastlines of Lefkada and Kefalonia Islands, the ones that were activated in the 2003, 2014 and 1025 seismic sequences. Additional secondary active structures appear to accommodate

dense epicentral concentration, and the analysis for their geometrical and kinematic properties significantly contributes in detailing the fault network of the study area, and consequently to the improvement of the seismic hazard assessment.

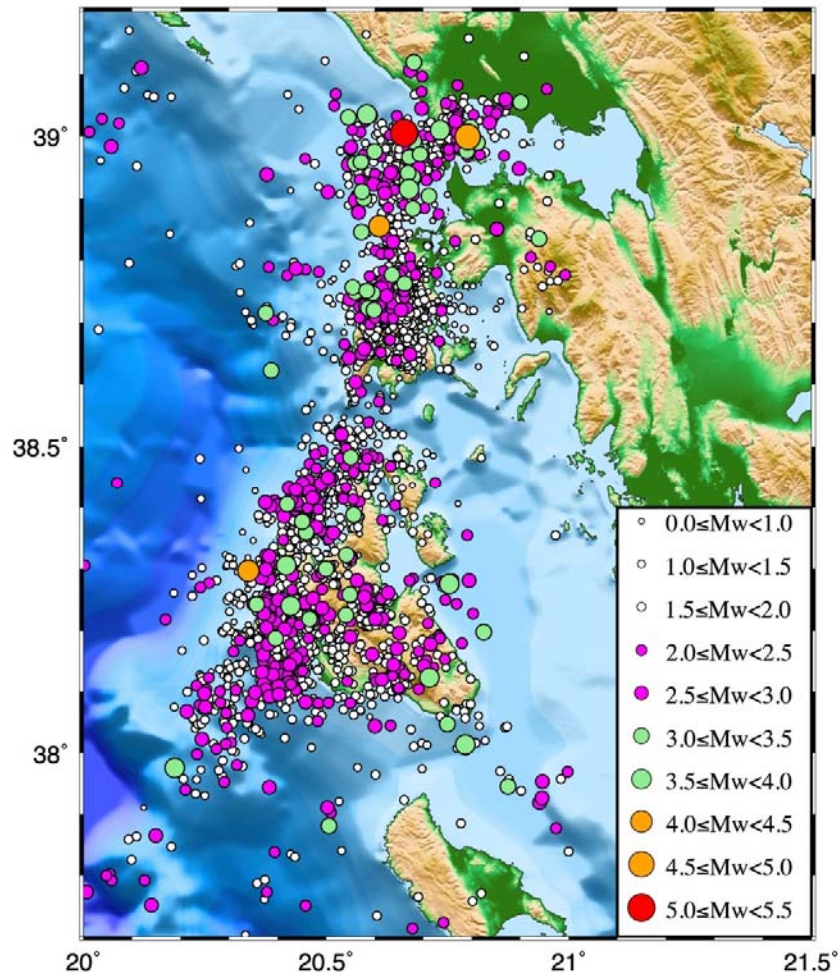


Figure 1. Epicentral distribution of earthquakes that occurred in the area of central Ionian Islands in the period June 2018 – June 2019.

3. THE 2019 SEISMIC EXCITATION

A noteworthy moderate magnitude Mw5.4 earthquake occurred on the 5th of February 2019 in the offshore area north of Lefkada Island, followed by a productive aftershock sequence. Relocation is then performed for the latter by manually picking the P and S arrivals using a 1-D velocity model [7] taking into account station time delays following a procedure described in [8] and the HYPOINVERSE [9] computer program.

The relocated earthquake set comprises approximately 370 earthquakes that were detected by an adequate number of seismological stations and were relocated. The statistical analysis includes the calculation of the completeness magnitude according to the GFT method (Figure 2). The temporal features of the earthquake sequence were performed by means of the modified Omori law and the estimated aftershock rate in comparison with the observations is presented in Figure 3. The overall decay rate is consistent with the modified Omori law.

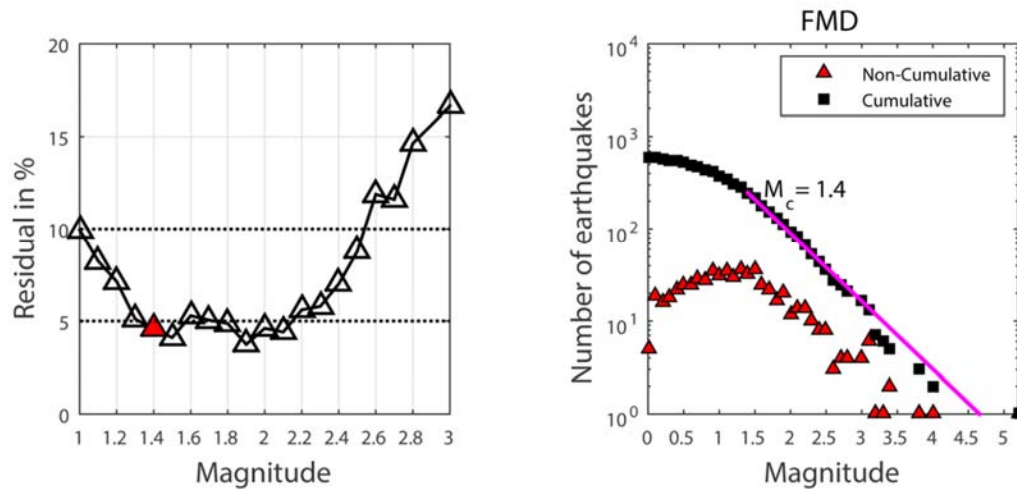


Figure 2. Frequency – Magnitude distribution calculated for the analyzed earthquakes after the mainshock. A magnitude of completeness of 1.4 was estimated for the relocated earthquakes.

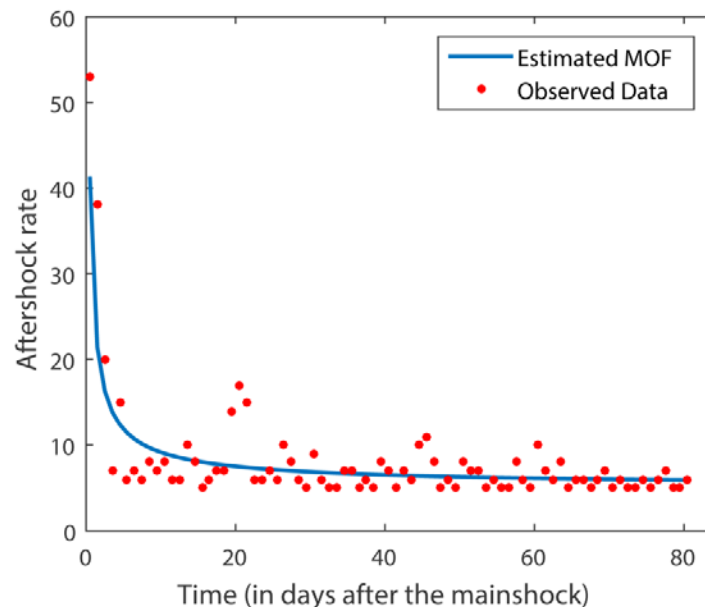


Figure 3. Estimated aftershock rate according to the modified Omori law in comparison with the observations. The decay rate is calculated for 247 earthquakes that followed the mainshock with a magnitude of completeness of 1.4.

4. CONCLUSIONS

Secondary active structures and their properties can be identified by means of analyzing the microseismicity recorded by the local network installed and operated in the area of the Ionian Islands. The study of complex earthquake sequences, which are common in the area, highlights the need for systematic maintenance and analysis of the seismicity, and then relocation with advanced methods and techniques for accomplishing a highly accurate earthquake catalog.

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INITIAL RESULTS FOR LOW COST SEISMIC SURVEY SYSTEM AND SOFTWARE DEVELOPMENT

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ABSTRACT

One of the biggest problems encountered in geophysical surveys is the correct selection of the first arrival times of seismic waves and then the creation of the best linear digression for the creation of the curves, whose slopes provide us with useful information about seismic wave propagation velocities. Current publication presents an automatic way of selecting the best travel time curves which minimizes the analysis time of the experimental data. The thickness of each layer is automatically calculated in accordance with the theory of seismic refracted rays and also the application provides the possibility of quickly estimating the geological composition of the subsoil for relatively shallow depths. Reference is also made to this applications extension in respect of early warning of a potential upcoming landslide when water saturation exceeds a specific threshold.

Keywords: Seismic Survey, Geophysical Surveys, Low Cost Sensors, Algorithm, Water Saturation, Travel – Time Curves, Seismic Velocities.

1. INTRODUCTION AND OBJECTIVE

Main purpose of geophysical research is the accurate identification of geological layers achieved by detecting different seismic wave propagation velocities [1]. Having determined each geological layer's velocity, we can then calculate each layer's thickness, as a preliminary evaluation of the geological formation that forms a specific area [2]. Specific equipment and special data collection programs were used during the experimental process, which then were analyzed and, in this way, the ex-post evaluation of the thickness of each layer was performed. The difficulty that we encounter each time was the subjective approach of the first arrival times whose correct localization is of great importance because the exact detection of each, gives the correct values of the velocities of each layer. A later arisen difficulty was the calculation of the best regression line to a travel time scatter plot where the points of first arrival times were previously marked. The slope of the incised lines results in the values of the seismic velocities of the layers from which the thickness of the layers is calculated indirectly. As far as investigation depth is concerned, it is also necessary to determine the cross-over distance (X_{co}) resulting from the intersection of the lines in the graphs of the travel t [3].

2. EXPERIMENTAL METHOD

2.1 Proposed Method

This article proposes to create an exe application that automates the above manual operation and defines objectively the choice of outbreaks according to which it is the same for all signals. Based on the selection of outbreaks and the insertion of the geophone distances into the program, all possible scatter plots are created with all possible Travel -Time curves. These plots show each layers' speed as well as calculating the R^2 value of each trendline. In this way we can rapidly estimate the seismic waves expected propagation speeds. By selecting the scatter plot that is most suitable, the image number corresponding to the scatter plot, is entered in the "best image" cell into the program. Then the program prints the useful values of X_{co} , X_{crit} , and h (layer's

thickness) whose equations have been entered in the program according to the theory³. A quick description of the application is shown in the flowchart of Figure 1.

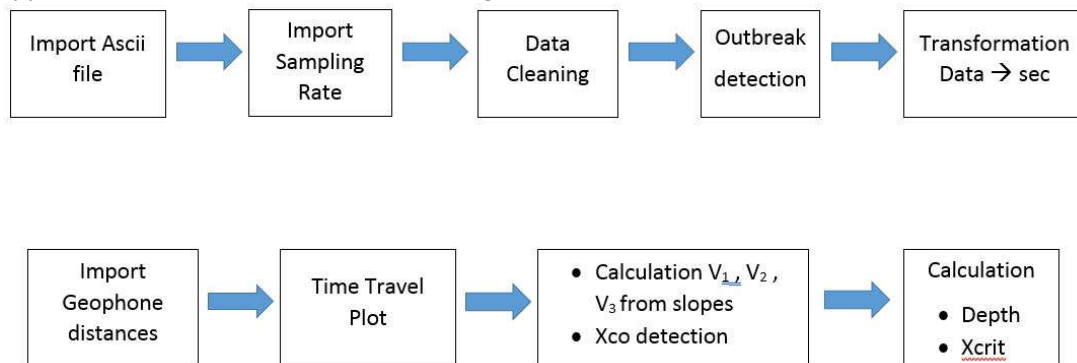


Figure 1: Program's operating steps diagram.

2.2 The Application

The application is designed to read ASCII format files, format which the commercial Grilla program used in the surveys, prints. After the program has read the file that must be in the same folder as the application, the program asks for the sampling rate to be entered. After the sampling rate is entered, a screen with outbreaks marks shows up, as shown in Figure 2. In a next step, the application asks for the geophone distances to be entered. Finally, the application, after calculating all the possible Travel Time scatter plots, stores them in the form of images in an image folder where the user chooses the best scatter plot, as the "best image", Figure 3. After the best image is inserted, the program prints the values for Xco, Xcrit, and h, Figure 4. It is distinguishable that the application also gives the possibility to compare the results of different Travel - Time diagrams without having to re-apply the application from the beginning but placing another number in the "Best Image". The main and most important points of the application are to find outbreaks and the best Travel Time Curve.

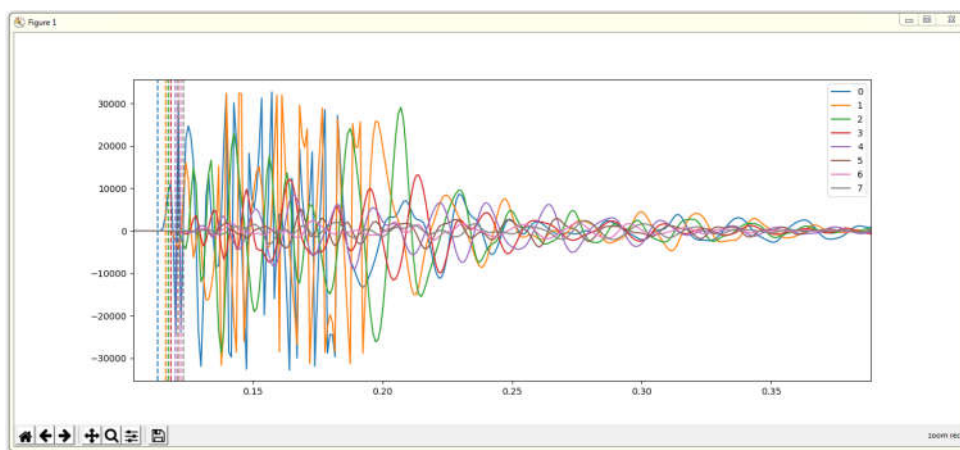


Figure 2: Signals are shown with the outbreaks located in dashed lines

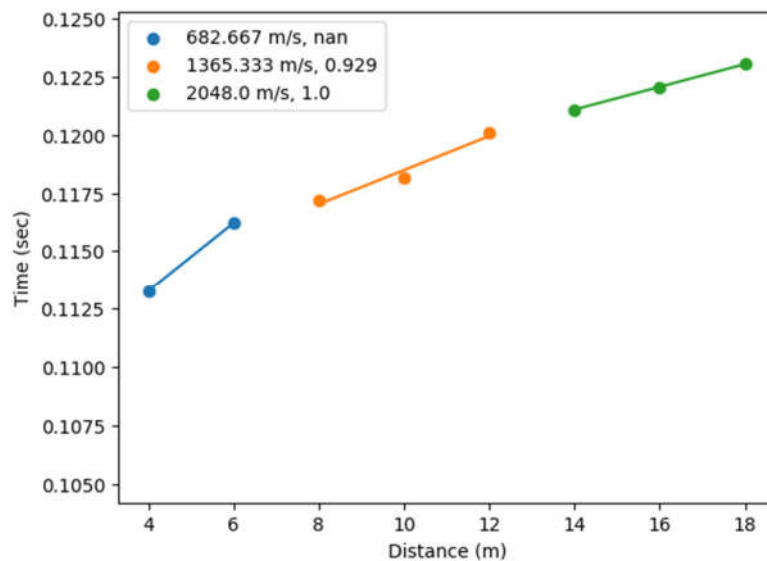


Figure 3: Depiction of chosen “best image” with the velocities and R² of linear digression

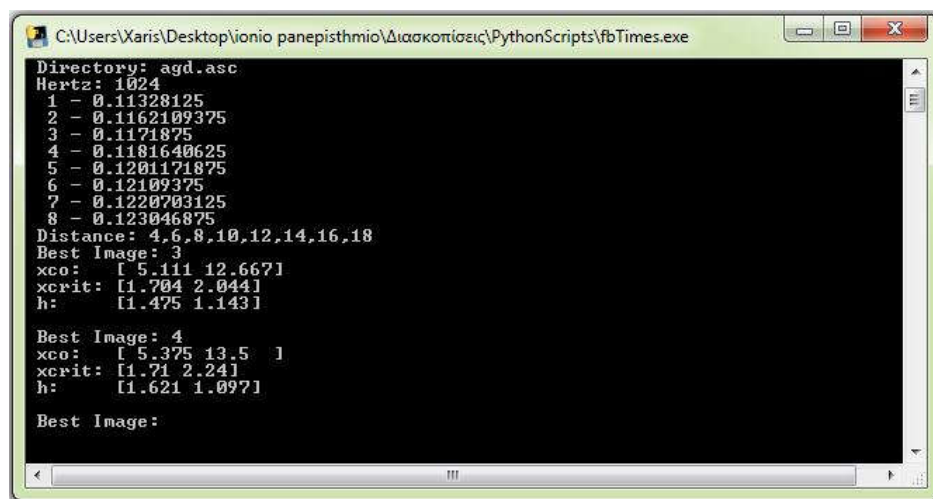


Figure 4: Prints of the Xco, Xcrit, and h values.

3. APPLICATIONS

This application can be used either directly by the geophysicist in the field of interest with his physical presence by performing the experiment, or indirectly by a remote control system from where a suitable sensor arrangement with a passive function sends a hazard alert detecting changes at the propagation velocities of the waves due to a change in the composition of the overlying soil layers, where the soil becomes more cohesive due to increased moisture [4,5]. In order to implement automatic alerting of dangerous landslides outside of the application that analyzes and extracts data, low cost mems type detectors are also needed which replace the more expensive geophysical systems that detect seismic waves in the same way as geophones.

4. CONCLUSION

The development of this application as we mentioned above is aimed at 2 points. One is the ability to objectively detect outbreaks and the other is the ability to select the appropriate scatter plot Travel Time Curve. This application optimizes the process of data analysis of the layers of the subsoil as well as the possibility to confirm the experimental measurements since between the experimental process and the data analysis the time is minimal. Using the above application, it is possible to execute a number of devices giving the field all the information needed for lithostratigraphy [6]. The application also has the capability for early warning of dangerous landslides, after installing an appropriate detector array. This could be a powerful civil protection tool due to the possibility of early warning of various seismic disasters. The development of such applications is very important in the field of geophysical research. It is a useful open source tool that can be optimized by any user and free to use by anyone working with geophysical surveys.

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SUSCEPTIBILITY AND HAZARD ASSESSMENT IN THE IONIAN ISLANDS FOR HIGHLIGHTING SITES OF SIGNIFICANT EARTHQUAKE-RELATED HAZARDS

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ABSTRACT

The identification of the earthquake environmental effects by using various methods has become significant in recent years due to the fact that among others it serves as a valuable tool for revealing and highlighting sites of significant earthquake-related hazards. In the frame of the project entitled "Tilemachos - Innovative Operational Seismic Risk Management System of the Ionian Islands" included in the Priority Axis "Environmental Protection and Sustainable Development" of the Operational Programme "Ionian Islands 2014-2020", the landslide, liquefaction and tsunami hazards in the Ionian Islands are analyzed and assessed by combining different methods. Landslide, liquefaction and tsunami inventories for all Ionian Islands were initially created. Along with the inventories, different thematic maps were used and combined in order to test the earthquake-induced landslide and liquefaction susceptibility and the tsunami hazard of the Ionian Islands. The main result is the identification of sites of significant earthquake-related hazards in the Ionian Islands. This study and its results could constitute a basic guide for the future urban design and planning and the sustainable local development since all scientists and agencies competent to the prevention and management of natural disasters can be informed and guided.

Keywords: earthquake environmental effects, hazard assessment, susceptibility assessment, Ionian Islands

1. INTRODUCTION

The Ionian Islands are located in the northwestern part of the Hellenic Arc and constitute one of the most seismically active areas in the Mediterranean region and worldwide [1]. The high seismicity is controlled by the occurrence of the Cephalonia Transform Fault Zone (CTFZ), which is the main active tectonic structure in the Ionian Islands. The high seismicity of the Ionian Islands comprises historical and recent shallow seismic events with moment magnitude up to 7.4, macroseismic intensities up to X+ in MM scale and significant impact on the population, on the natural environment as well as on buildings and infrastructures of the islands. The most recent episodes of the seismic activity in the Ionian Islands are the Cephalonia Isl. earthquakes of January 26, 2014 (Mw 6.0) and February 3, 2014 (Mw 5.9), the November 17, 2015 Mw 6.4 Lefkada earthquake and the October 26, 2018 Mw 6.8 Zakynthos earthquake. The 2014 Cephalonia earthquakes caused extensive environmental effects and damage on the building stock of the western Cephalonia [2, 3]. The 2015 Lefkada earthquake triggered mainly slope movements in the western and southern part of the island and building damage in its southwestern part [4]. The 2018 Zakynthos earthquake caused slight non-structural damage to buildings and infrastructures and limited environmental effects in the southern part of Zakynthos Island [5].

For the detailed reassessment of the seismic hazard in the Ionian Islands, the project titled "Tilemachos - Innovative Operational Seismic Risk Management System of the Ionian Islands" was included in the Priority Axis "Environmental Protection and Sustainable Development" of the Operational Program "Ionian Islands 2014-2020". Implementing partners are the Region of the Ionian Islands, the National and Kapodistrian

University of Athens (NKUA), the Ionian University, the Technological Educational Institute of the Ionian Islands, the Regional Union of Municipalities of Ionian Islands, the Earthquake Planning and Protection Organization and the National Observatory of Athens.

The contribution of NKUA to the implementation of this project comprises two subprojects entitled “Hazard analysis and assessment” and “Supply of specialized software”. The first scientific subproject has been organised in 12 work packages (WPs). This paper focuses on the WP 1.5 “Development of maps with earthquake-induced environmental effects”, which deals with the analysis and assessment of landslide, liquefaction and tsunami hazards in the Ionian Islands in order to reveal and highlight sites of significant earthquake-related hazards. The applied methodologies and the achieved results in the frame of the WP 1.5 are presented in this paper.

2. METHODOLOGY

The liquefaction susceptibility assessment included (a) inventory of liquefaction phenomena induced by historical and recent earthquakes, (b) geological and geotechnical reconnaissance of all areas prone to liquefaction phenomena and (c) application of a liquefaction hazard assessment in a Geographic Information Systems (GIS) environment.

The landslide susceptibility assessment included (a) inventory of slope movements induced by all known earthquakes in the Ionian Islands, (b) geological and geotechnical reconnaissance of all areas prone to landslide phenomena and (c) application of the Analytical Hierarchical Process (AHP) used along with the Weighted Linear Combination (WLC) method in the frame of a multi-criteria decision analysis.

The tsunami hazard assessment along the coastal areas of the Ionian Islands included (a) inventory of tsunamis induced by all known earthquakes in the Ionian Islands, (b) generation of a TanDEM-X elevation model of the Ionian Islands based on data produced by TanDEM-X and TerraSAR-X satellite pair, which was used in the next steps for the detail tsunami hazard assessment, (c) geological and geotechnical reconnaissance of all coastal areas exposed to tsunami effects, (d) assessment of the maximum tsunami run-up based on historically reported and instrumentally recorded maximum tsunami run-ups in the Ionian Islands (e.g. tsunami run-ups induced by the 1867, 1899, 1914, 1915 and 1948 earthquakes), (e) detailed definition of inundation zones based on different possible tsunami run-ups (0-5.0, 5.1-10, 10.1-15, 15.1-20 m) and (f) assessment of the building vulnerability and damage in case of tsunami generation.

3. RESULTS

Based on the methodology applied for the assessment of susceptible areas to liquefaction we reached at the next findings (Figure 1a):

- In Kerkyra Isl., the highly susceptible areas are composed of recent coastal deposits, recent and old dunes, while medium susceptibility is associated with recent alluvial deposits along river beds and river banks.
- In Paxoi, Antipaxoi and Meganissi islands the susceptibility of the geological formations is low.
- In Lefkada Isl., the highly susceptible areas consist of Holocene coastal and lagoonal deposits, while Holocene alluvial deposits, terra rossa and lake deposits are characterized by medium susceptibility.
- In Cephalonia Isl., the medium susceptible areas consist of Holocene alluvial deposits and alluvial fans.
- In Ithaci Isl., the medium susceptible areas comprise Holocene alluvial deposits.
- In Zakynthos Isl., the highly susceptible areas are composed of Holocene coastal deposits, while the medium susceptible areas of Holocene alluvial deposits.

Based on the results of the aforementioned methodology for the landslide susceptibility assessment we found that (Figure 1b):

- In Kerkyra Isl., the highly and very highly susceptible areas correspond mainly to the morphological discontinuities along active faults in the central and southern part of the island.
- In Paxoi and Antipaxoi islands, the values of LSI are very low and thus there are no susceptible areas.

- In Lefkada Isl., the highly and very highly susceptible areas are the abrupt coastal slopes and scarps in the western part of the island as well as along morphological discontinuities formed along the Ionian Thrust [4] and along active faults in the eastern and southeastern part of the island.
- In Cephalonia Isl., the highly and very highly susceptible areas are observed along morphological discontinuities formed by the Agia Efimia fault and the Kontogourata-Agonas fault in the northern part [2], the Aenos fault zone in its middle part and the Paliokastro fault [2] in its southeastern part.
- In Ithaci Isl., highly susceptible areas are observed along morphological discontinuities attributed to active faults and inactive tectonic structures in the northern part of the island.
- In Zakynthos Isl., high and very high values of the LSI are mainly presented along active and possible active faults and their morphological discontinuities. More specifically, along a possible active fault in the middle of the island, along the Kamaroti fault zone and the Keri faults [5] in the southern part of the island and along the slopes of Mt Skopos located in the eastern part of Zakynthos, where the majority of the slope movements induced by historical and recent earthquakes is observed [5]. High susceptibility is also observed along coastal slopes in the western Zakynthos such as in Navagio area.

Based on the methodology applied for the tsunami hazard assessment, inundation zones (Figure 1c) were defined based on the maximum tsunami run up along the coastal areas of the Ionian Islands:

- In Kerkyra Isl., significant inundation zones are observed in the northern part of the island (Sidari, Astrakeri, Agnos, Roda and Acharavi areas), along the entire central eastern and southeastern coastal areas (Kontokali, Kerkyra town, Messonghi, Lefkimmi, Kavos areas) and along the western coastal areas (Megas Choros, Palaeokastritsa, Agios Georgios bay and Afionitika-Agios Stephanos areas).
- In Paxoi Isl., the inundation zone with the maximum run up of 5 m extends along the perimeter of the island, while its maximum inland extend of 400m is observed in the southern part of the island.
- The maximum elevation of the Antipaxoi Island does not exceed 5 m. Thus, the entire island is expected to be attacked by a tsunami with maximum run-up of 5 m.
- In Lefkada Isl., the maximum inland extend of the inundation zone is observed in the northern part of the island and especially along the coastal part of Lefkada town. Inundation zones are also detected along the eastern coastal Lefkada (Nydri area) and in southern Lefkada (Vassiliki village). In Meganissi, inundation zones are observed in the eastern part of the island (east of Vathy Bay).
- In Cephalonia Isl., inundation zones with small inland extend are observed along the entire eastern coastal part. Inundation zone with large inland extend of about 300 m is observed in Sami coastal area. Inundation zones with smaller inland extends are also observed in Agia Efimia, Antisamos and Poros coastal areas. In southern Cephalonia, Lefkes port and Skala coastal areas are also exposed to tsunami hazard. In western Cephalonia, the coastal areas from Lixouri to Livadi swamp and from Argostoli bay to Platis Gialos beach constitute extensive inundation zones.
- In Ithaci Isl., its eastern coastal part (Vathy area) is characterized by a gentle morphology with low-angle slopes. Thus, it is highly susceptible to tsunami waves with inundation zones with maximum inland extend of 150 m for a maximum run-up of 5 m.
- In Zakynthos Isl., the coastal area from Zakynthos town to Argasi and the area around the cape Geraki form extensive inundation zones. The coastal zone of Laganas bay is another extensive inundation zone, while zones with smaller inland extend are also observed in western Zakynthos.

4. CONCLUSIONS – DISCUSSION

The mapping of the earthquake environmental effects by using various methods has become significant in recent years due to the fact that among others it serves as a valuable tool for revealing and highlighting sites of significant earthquake-related hazards. The abovementioned approach can contribute to the reduction of the vulnerability of island and mainland urban areas against earthquakes and the earthquake-induced effects on the natural environment and as a result to the reduction of the earthquake disaster risk and the

subsequent risks of the earthquake environmental effects. Many more island and mainland regions can benefit from this study as it could constitute a basic guide for the future urban design and planning and the sustainable local development since all competent to the prevention and management of natural disasters can be informed and guided. For developing modern and novel risk mitigation strategies, it is fundamental to emphasize the role and the contribution of the earthquake environmental effects on the assessment of the national and regional seismic hazard.

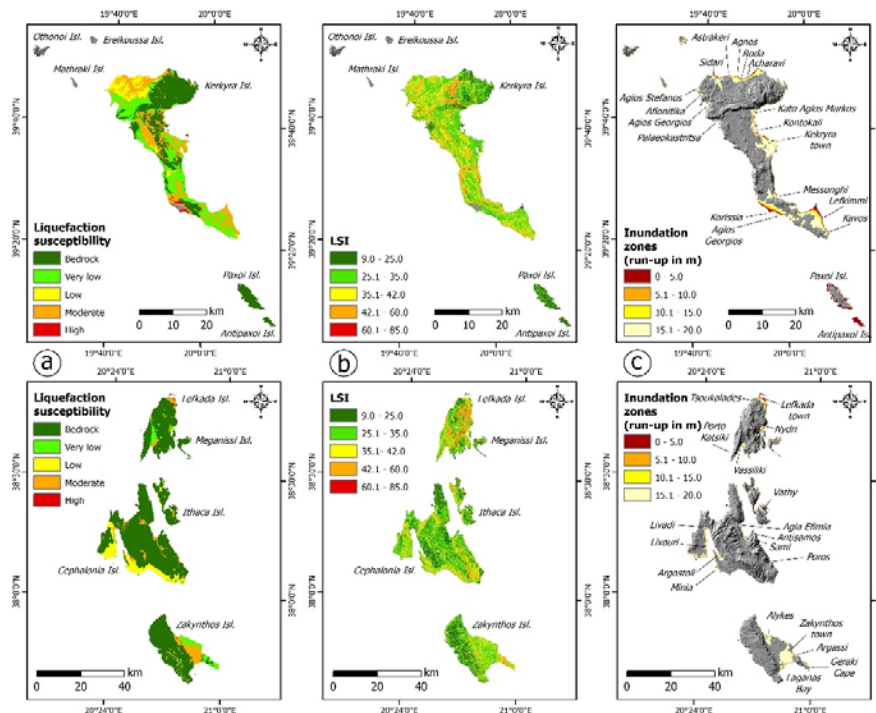


Figure 1. (a) The liquefaction susceptibility map, (b) the landslide susceptibility map and (c) the inundation zone map for the Ionian Islands.

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CONCEPTION DESIGN AND IMPLEMENTATION OF A LOW COST EFFECTIVE SEISMOGRAPH

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ABSTRACT

This paper is focused on the conception, design and implementation of a compact low cost open source hardware and software system that can detect local to regional seismicity and micro seismicity. The created instrument has been already installed in an area of high seismic activity (Lefkada Island – Village Evgiros) and the recordings are transmitted to the database continuously from the day of its installation up today. Thus have create an amount of data for more than 215 days and all of those data have been stored to our database. The recording signals come to the instrument from an accelerometer and a geophone in real time by using the time stamp data from a precision real time clock circuit in combination from the internet connection. The data are stored internally to the instrument and transmitted over internet to a database server every five minutes to inform us for any upcoming event.

Keywords: low cost systems, sensors, accelerometer, geophone, seismicity, real time clock.

1. INTRODUCTION

The aim of the present paper is to study local to regional seismicity and micro seismicity features in seismically active areas, as well as to define their seismotectonic [1] properties.

All the latest technological advancements provide us the opportunity to design and implement low cost ground motion detectors for indoor and outdoor survey. We can archive from microcontroller type electronic boards in combination with electronic components, acceleration sensors, velocity sensors, low noise high gain signal amplifiers, and additional functional electronic circuits.

Since low cost high accuracy seismographs do not exist in the market as instruments for scientific research, our low cost seismograph could be a unique instrument aiming to compete expensive market seismograph systems with cost of each one reaching the amount of fifteen to twenty thousand euro.

As we know there are lot of low cost [2] systems outside at the market. A low cost instrument designed and implemented here, in fully operational mode with connection through internet, capable to send the data to the remote server and almost in real time to the database platform. The instrument will not exceed in cost the amount of 300 Euros.

2. DESIGN AND IMPLEMENTATION

The system (instrument) consists of low cost [3] open source hardware and software microprocessor boards (Arduino Uno R3 and Raspberry Pi 3 B+), customized low noise design signal amplifiers, low power dissipation sophisticated power supply, two (2) kinds of earth ground shaking sensors a) Ceramic Accelerometer with cutoff frequency $f_c=0.08\text{Hz}$ and b) moving coil geophone with cutoff frequency $f_c=4.5\text{Hz}$ (one for acceleration and one for velocity).

The data from the two sensors (signals) have to be amplified independently, without changing their characteristics in frequency and phase and without importing any kind of external noise on it. To increase the sensitivity of the sensors (accelerometer and geophone) high amplification (gain) has to be archived in respect to the above topics. For all those reasons we design and implement two high gain low noise signal amplifiers using sophisticated tools for simulation and printed circuit board development software tools.

For each sensor we receive two rows of data from the digitization unit. The one row contains the sensor data that have been passed from an active second order low-pass anti-alias filter [4] and the second row the sensor data that have been passed for an 8th order active low-pass anti-alias filter [5].

A low cost microprocessor board (Arduino Uno R3) [6] is responsible for digitizing the analog data from the amplified signal of the sensors with a frequency sampling rate of 345Hz. Then the digitized data are imported to a low cost one board computer (Raspberry Pi 3 B+) [7] for adding timestamp from its real time clock. Also more options like internet connectivity, data transportation to the server and distance system maintenance are become possible.

System is powered from an uninterruptable power supply system using the grid and a circuit consisted from a changer and a battery for backup. Also the system can operate also off grid (outdoor operation) with the ad of a solar panel that charge the internal battery and make the system energy autonomous.

Data can be easily downloaded from our server for further processing as the picking of P and S waves [8] after any earthquake recording. System operates adequately in the field as a temporary station recorder in different applications as the recording of seismic noise or earthquake activity. The system can be also used indoor as a permanent seismological station.

It has been already tested in real time mode of indoor operation (because like this way we use test) at Evgiros village in Lefkada Island for more than 6 months of uninterruptable successful operation. All the time of its operation is properly transmitting packets contained of 5 minutes of data to the main server of our database in Kerkyra. The data packages contain five rows. Two rows for each sensor and one row for timestamp.

At each line we get a) timestamp [9] , b) accelerometer data (2nd order active LPF at 30Hz, c) geophone data (2nd order active LPF at 30Hz), d) accelerometer data (8th order Bessel LPF at 5Hz), and e) (8th order Bessel LPF at 5Hz). Although we are at the beginning of the design, the results that we already have obtained are encouraging.

3.SYSTEM AND REAL SEISMIC RESULTS

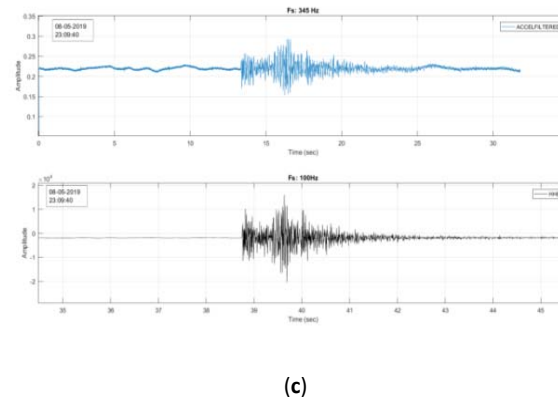
In the following images a short description of the system is provided. The system was installed in Evgiros village at Lefkada Island, a place with significant seismic activity. Collocated with a high resolution 24 bits digitizer equipped with a broad band seismometer (30 s – 100 Hz) [10] giving us the opportunity to compare the recording. Figure 1a, shows the block diagram of the low cost seismograph while in figure 1b, we see our low cost seismograph implemented with all its parts. Notice the box of our seismograph is a low cost plastic toolbox case.



(a)

(b)

KB12(VB)



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LANDSLIDE HAZARD IN CORFU ISLAND, GREECE

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ABSTRACT

Although Corfu Island is not considered one of the highest landslides susceptibility areas of Greece, up-to-date information reveals a long history of landslides, affecting both residential areas and infrastructure. The Hellenic Survey of Geology and Mineral Exploration (HSGME) has digitized existing landslide data from past reports have been conducted by the Survey (under any successive name) over the last 60 years in Corfu. It should be noted that updated data include only records of landslides examined by HSGME (former IGME) during this period and not any event, possibly not affecting the human environment. Historic archives constitute a valuable information source of delineating the landslide susceptibility to a given area. Along with landslide locations, the database contains information on the timing of landslide events, the type of landslide, the triggering factor, volume and area data, and impacts for each landslide, when this information is available. Database information is being evaluated by field reconnaissance survey, to prepare accurate and reliable inventory and landslide susceptibility maps of the island, which is the basic tool for managing a sustainable hazard and risk mitigation programs in landslide prone areas.

Keywords: Corfu, landslides, Database, hazard, assessment.

1. INTRODUCTION

A landslide is a downward or outward movement of soil or rock, under the influence of gravity, occurring when part of a natural slope is unable to support its own weight. This movement can occur in many ways. It can be a fall, topple, slide, spread or flow [1]. The speed of the movement may range from very slow to rapid. Although landslides usually occur to steep slopes, they may also occur to areas with low relief or slope gradient. They are complicated processes, because there are many factors involved in the manifestation of a landslide event. Landslide causative factors can be splitted into preparatory and triggering causal factors. Landslides may result in a number of direct losses in several ways, including 1) Loss of life or injury of people and animals, 2) loss of property by destroying houses and buildings, 3) loss of infrastructure and lifeline facilities such as roads, railway, bridges, telecommunication, electrical supply lines, etc., 4) losses of resources, 5) loss of productive farmland, being covered by debris, 6) loss of places of cultural heritage. Landslides may also result in indirect losses like 1) reduce of property values, 2) loss of productivity, transport break down, 3) increased investment costs of preventing or mitigating future landslide damage, 4) adverse effect on water quality, 5) reduction in quality of life of affected people. Finally, as any other disaster, serious landslides may have an impact on people's emotional well-being.

Landslides are common phenomena in Greece, constituting one of the main natural hazards associated with its complex morphology as well as its geological and tectonic structure. Landslides have been studied systematically by the Hellenic Survey of Geology and Mineral Exploration (HSGME, former IGME), to evaluate the nature of the hazard and the damages to human life, buildings, transportation systems, utilities and lifelines. The efficient management of this wealth of information imposed the creation of a digital database of landslides. In the frame of the ongoing OPYGEK – GEOKA project the landslide database of HSGME, designed a few years ago, is in updating process and will be included in the Integrated Geo-data System of the Survey. Updating process follows the relevant directives of the European Union and the United Nations for harmonization on the need to draw up a common policy on natural disaster management.

2. HISTORICAL RECORDS - UPDATED LANDSLIDE DATABASE FOR CORFU ISLAND

Corfu Island situated in the northern Ionian Sea, just off the coast of Epirus region, northwest Greece, covering an area of 593 sqs. Km is mountainous in the north, dominated by Pantokrator Mountain (906 m), becoming lower in the central and southern part, while the geological structure consists both of the Ionian and pre-Apulian geotectonic zones, as most of the Ionian Islands flow [2]. Along with adjacent small islands, they make up the municipality as well as the regional unit of Corfu.

Corfu is among the first regions in Greece, where landslide database has been fully updated. Landslide records comprise more than 45 landslides, derived from 23 technical reports that have been prepared for the last 60 years (1959 – 2019) by the Hellenic Survey of Geology and Mineral Exploration (in any successive form).

Although the Corfu island is not considered one of the highest landslide prone areas of Greece [2, 3, 4], updated information reveals a long history of landslides, affecting both residential areas and infrastructures. All landslides were digitized into a Geographical Information System (G.I.S.), which displays spatial information in the form of Points, Lines and Polygons, depending on the details given in the relevant technical report.

Recorded data include fields like geographic details (prefecture, municipality, year, season, coordinates), location (elevation, land use, slope gradient, erosion, geotectonic zone, geological formation, lithological composition, permeability, inclination of strata, thickness of weathered zone, precipitation, man-made impact, groundwater level, seismic risk zone), landslide data (history, type of movement, geometry, rate), landslide process (triggering factor, causes, consequences, structures affected, proposed mitigation measures, degree of effectuality of mitigation measures).

2.1. General pattern of landslide distribution in Corfu island

The general distribution pattern of recorded landslides within Corfu territory is given in figure 1. It can be seen that landslides are spread almost throughout the island, with a higher concentration around the northwestern and central part.

Landslides of any type and size have been mapped within the island, mostly comprising rotational or translational slides, some of the complex form, while soil creep and rock falls also occur. Additionally, ground subsidence due to dissolution of gypsum bearing formations appears in Corfu.

The vast majority (76%) of the recorded landslides is located within residential areas and road network, while the rest 24% within forests and cultivated lands. This selectivity is probably due to the fact that most of the recorded landslides were examined at the request for local authorities to address the impact on infrastructure and do not include the total number of events that had been occurring during the 60-year period. Referring to the favorable geological formation, almost 95% of the total recorded landslides are hosted in Neogene and Molassic sediments.

Precipitation and distance to drainage, in combination with the type of lithology are the main causes and triggering factors for the landslide occurrence in Corfu, since they cause erosion and saturation of materials as well as fluctuation of the ground water table. Human activities, particularly road construction and land-use, contribute also significantly to the slope instability and failure.

Landslides in Corfu usually cause serious damages to property such as cracks at walls or problems in foundation of ordinary buildings and destruction of farming land. In the early sixty's, relocation of settlements was imposed due to the instability of the site. Furthermore, destruction of road networks creates huge problems with transport and great financial remediation costs.

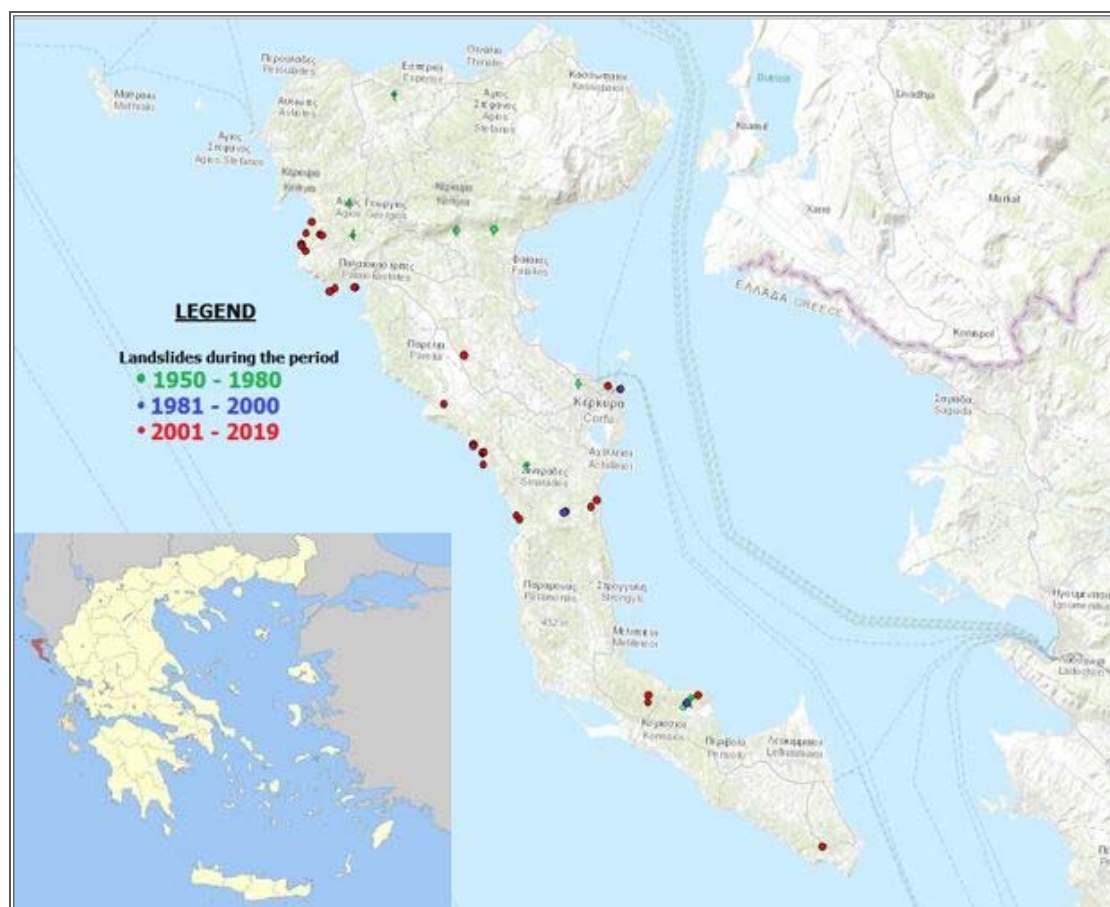


Figure 1. Distribution of landslides recorded by HSGME (IGME) in Corfu island within 60 years (1959-2019) period of time

2.2. Assessment of Landslide Hazard by HSGME (IGME)

During incidents of national significance caused by natural hazards, HSGME (IGME) has operated an Emergency Response Team, which provides consulting support to State and local government agencies. It serves the Nation by providing reliable scientific information and thus minimizing loss of life and property from natural disasters. It is ready to coordinate and respond when the General Secretariat for Civil Protection (G.S.C.P.) declares a disaster, and they ask for landslide expertise. HSGME (IGME) conducts landslide hazard assessments, pursues landslide investigations and forecasts, and provides technical assistance to respond to landslide emergencies.

Apart from consultancy, it provides also geospatial data and relevant site maps in support of emergency response requirements.

Depending on the quality and accuracy of data, landslide maps may range from simple reconnaissance inventories that only give an overview of the landslide hazard in an area and delineate sites where more detailed studies should be conducted, to detailed inventories, providing a better understanding of the different landslide processes operating in an area and can be used to regulate or prevent development in landslide areas and to aid the design of remedial measures. A landslide susceptibility map goes beyond an inventory map and depicts areas that have the potential for land sliding. These areas are determined by correlating some principal factors that contribute to land sliding, such as steep slopes, weak geologic units that lose strength when saturated, and poorly drained rock or soil, with the past distribution of landslides.

3. RESULTS AND CONCLUSION

Losses and risks associated with landslides can be reduced significantly if decision makers of all levels of government take well-informed actions before a disaster occurs and respond appropriately after a disaster. Unlike hazardous events that affect large areas, such as earthquakes or flooding, landslides are local complex phenomena, which have to be studied and described one by one, as each one might have different characteristics. Continually updating landslide database is by far the most important, as it gives insight into the frequency of the phenomena, the types involved, the volumes and the damage that has been caused. Historic archives, followed by field survey to increase data integration are essential to produce inventories and susceptibility landslide maps most useful to planners and the public. Based on the fully updated and confirmed landslide data in Corfu, HSGME is now ready to proceed, selecting the appropriate method [6, 7, 8] of data analysis and modelling and the compilation of medium scale reliable and accurate inventory and susceptibility maps of Corfu. In areas of increased susceptibility detailed hazard maps can be compiled. The effective management of landslide hazard implies a multistage approach, including prevention, mitigation, response and recovery.

The problem of landslides in Greece focuses far more on dealing with the impact and less on prevention. Prevention requires long-term planning of activities and initiatives, for forecasting and defining high landslide risk zones. Moreover, an open communication with society is needed, through knowledge transfer, awareness-raising, training, and educational activities to enable societies to develop effective policies and strategies for reducing landslide disaster.

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IMPACTS OF A POTENTIAL OIL SPILL ON THE WESTERN COAST OF CORFU ISLAND

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ABSTRACT

The "blocks" for future oil drilling in the sea have been demarcated in the Ionian Sea, to the west of Corfu. The same area is crossed by international shipping routes. An oil spill in this marine area is likely to occur. What are the possible impacts on the maritime and coastal area, e.g. on the west coast of the Corfu -hosting tourist activities- and the Diapontia Islands (Mathraki, Othoni, Erikousa)? Furthermore, how can the local authorities be adequately prepared to handle such a problem?

This work includes: (a) analysis of the possible trajectories of potential oil spills, taking into account winds and sea-currents in the area during the summer tourist season, (b) an estimation of the most-at risk parts of the western coastline of Corfu in the case of an oil spill spreading, (c) Environmental Sensitivity Index Map of the western coastline featuring the biological resources, the human activities and the typology of the coastline in relation to the oil (based on international classification standards and bibliography) was created. Based on points a,b,c, the environmental and other resources and parts of the western coastline at risk in the case of a possible oil spill can be estimated, in order to outline the content of a Contingency Plan to address the risk of a marine oil spill.

Keywords: Corfu, pollution, oil spill, drilling, hazard

1. INTRODUCTION

Marine pollution constitutes one of our planet's major environmental problems, especially the enclosed Seas such as the Mediterranean. An oil spillage in the sea is subjected to processes such as: spread, evaporation, emulsification, dispersion, dissolution, photo-oxidation, sedimentation, biodegradation, etc. These processes occur due to its stirring on the sea surface by the wind, the waves, the sea currents and the exposure of the oil to the sun. Factors affecting the oil spill response include: the oil type, the spill size, the rate of spillage in the sea, the location, the climate conditions, the clean-up operations response. Oil spill events could affect: (a) the social and economic activities: apart from the oil spill clean-up cost, there is serious economic damage for the "clean seas and coasts" economy sectors (tourism, fishery, shipping, coastal communities, cultural heritage sites, etc.) (b) the marine environment and the shoreline: oil pollution may have an impact on the populations of species related to the affected coasts, as well as on the people living close to the polluted coasts, thus affecting their conditions of living and their quality of life.

In Mediterranean Sea, large concentration of oil spills accidents is observed in the central Aegean Sea and at the Lebanon-Israel coasts, followed by the Ionian Sea, the South Aegean, the sea around Sicily, the Genoa and Venice gulfs. The accidents' majority have happened in territorial waters [1-9]. Corfu Island integrated in the broader Mediterranean context with a strong interaction between economic activities and protected areas. Throughout the Ionian Sea, the prevailing swell waves come from the NW while the next more frequent incident is that of the SE. The wind direction is usually from the West, N-NW and the intensity of the winds is around 4-5 m/s.

2. METHODS

Analysis of the possible trajectories of potential oil spills has been made using the NOAA GNOME software. The NOAA TAP (Trajectory Analysis Planner) software was used to estimate the most-at-risk areas. An “Environmental Sensitivity Index Map” of the western coastline featuring the biological resources (flora and fauna), the human activities (tourism, recreation areas, ports etc.) and the typology of the coastline in relation to the oil (based on international classification standards and bibliography) was created.

3. POSTULATED INCIDENT SCENARIO & METHODS

By the end of September 2018, a forecast for unusual extreme weather conditions which would primarily affect the Ionian Sea area (especially South Ionian). On Saturday 29 September 2018, at about 01:45, a leakage occurred off the western Corfu shoreline from a tanker sailing across the Otranto strait, estimated by 5% of its cargo (135 tones or about 1000 fuel oil barrels).

3.1 Forecast through the use of GNOME¹:

After 96 hours, the location and the form of the oil-spill as shown in the map (Figure 1).

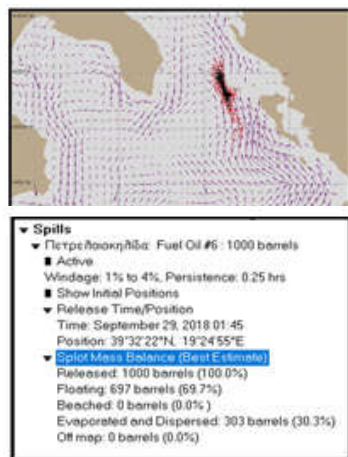


Figure 1. Location and form of the oil-spill created by the 29.09.2018 event

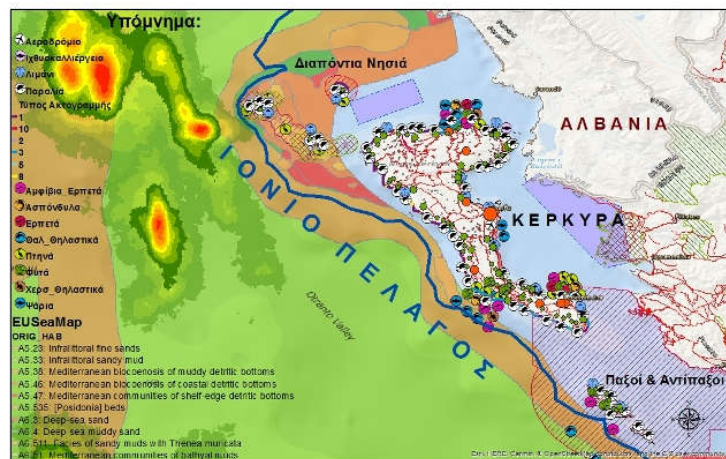


Figure 2. Oil spill threat to resources of S. & E. Corfu (29.09-03.10.2018) The areas in red color represent a possible intense oil concentration at the sea surface, which weakens in the yellow ones, and even more in the dark green areas. The possible hazard is extended out of the 200-meter depth line

Results indicate that, under given weather conditions and without any response measures taken, 96 hours later (3.10.2019, 1:00), the oil-spill had not affected Corfu and Diapontia islands shoreline. This is also confirmed by the results of the model, where the rate of the “Beached” parameter is zero. Some variations of the basic scenario were then tested, resulting in minor divergences [10-12].

3.2 Environmental Sensitivity Map

The shoreline at the West and North Corfu and at the Diapontia islands is segmented and characterized according to the “Environmental Sensitivity Index” (ESI) typology². Biological resources (flora, fauna), protected areas, beaches and underwater eco-systems as well as human activities at the shoreline and the sea (settlements, tourism & leisure, fishery-aquacultures, transport infrastructures) have been taken into account [13].

¹ A trajectory model of NOAA, which predicts the possible route of a specific oil-spill, using, among others, winds and currents data of the area.

² Among the aforesaid shoreline types, the most sensitive ones to oil are ranked as follows: -ESI 10 (Very High) and -ESI 8 (High) 18.6% of the total shoreline is classified under ESI-1 type (rocky shores, cliffs, etc). 15.4% is classified under ESI-3 type (sandy beaches), 7.0% is classified under ESI-2 type (steep slopes exposed to the waves), 2.8% is classified under ESI-8 type (coasts protected by man-made structures, etc), 1.7% is classified under ESI-10 type (salt and water marshes, swamps, etc). 53.8% (east coast) has not been classified

A Shoreline Description (NOAA) table for Corfu is filled giving priority to the human and biological resources large concentration, and to especially oil-sensitive shoreline type areas. The foreseen trajectory of the tested oil-spills Environmental Sensitivity Map (Figure 2), provides a sense of the potential hazard degree in areas north and west of Corfu.

3.3 T.A.P. Results Analysis - Pollution risk assessment

TAP³ was used to assess: (a) the possibilities for an oil spill to threaten specific shoreline locations at the W and N Corfu, (b) the time needed for the oil to reach it, the possibly severely affected areas and at what extent an oil spill could threaten a particular location.

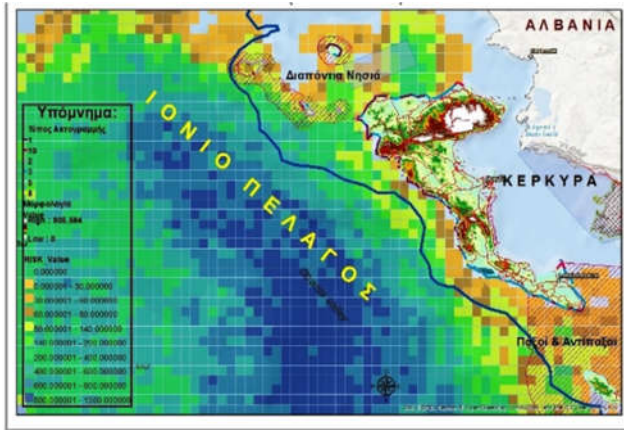


Figure 3. Oil spill risk affecting the shoreline in Summer 2018 (1000b LOC=5bb)

Data such as the shoreline, the surface sea currents and the winds blowing in the area on a daily basis over 9 months (5.2018 – 1.2019) were used. There has been an exploration of the sea area at the W & N of Corfu, defined by the “blocks” 1.2 and 3 (7036 km²), where hydrocarbon explorations are to be carried out, 75 sites of potential spills were determined within the area of the 3 blocks and, for each of the 75 potential spill sites, 5 dates of the 75 potential incident outbreak were randomly chosen (5x75=375 potential cases), per season.

The assumed spill quantity is 1000 barrels and (alternatively) 5000 oil barrels and the model “runs” for 5 days after the incident outbreak. [14-17]

Impact Analysis shows the cumulative impact of 5 trajectories per oil-spill. Results refer to percentages - not quantities of oil. By taken into account the aforementioned results for all 75 potential oil-spills cumulatively, an average rate of potential risk is illustrated (Figure 3).

Impact by Spill shows the particular impact of each of the 5 trajectories for each oil-spill.

Oiling Analysis focuses on specific sites (e.g., protected coastal areas, etc) aiming to answer the question: “How much quantity of oil will reach the sensitive area as a result of an oil spill?”; the quantities per oil spill (and its trajectory) which may reach the shoreline are relatively low for each particular area (Figure 4a)

Response Time Analysis (available response time) provides a forecast on how soon an oil spill will reach a sensitive area. For each selected cell/site, the foreseen time available to the competent authorities to develop locally resources before the oil reaches it is illustrated (Figure 4b).

Threat Analysis answers to the question “which oil-spills constitute a threat to a protected area?” When selecting a cell/protected area, the oil spills which are likely to “supply” oil to it (regardless of quantity) are illustrated in circles. (Figure 4c)

Resource Analysis provides data in respect with the quantity of a specific resource which is affected by the formed spills or the response level (combination and quantities of means) required for the appropriate handling of these oil spill impacts (Table1)

³ Trajectory Analysis Planner (TAP) is a tool (software) developed by NOAA. With the assistance of the NOAA officers, the code was adapted to the requirements of the present dissertation. The TAP, is a useful tool for the statistical approach of a potential oil-spill risk, using real data over time.

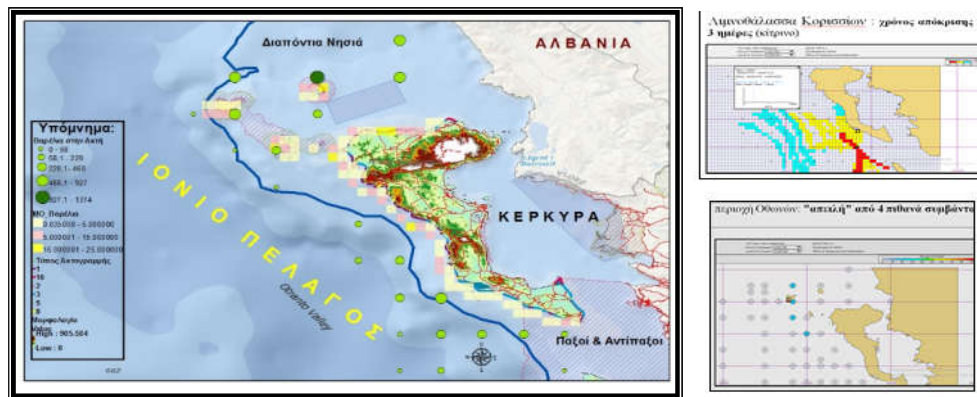


Figure 4. (a) The average oil quantity which is likely to reach each “cell” of the shoreline from all the sources of the incident. Average quantities per shoreline “cell” range from 0.03 to 21.6 oil barrels **(b)** The foreseen time available to the competent authorities to develop locally resources before the oil reaches it estimated to be 1 to 3 days (yellow) for the majority of cases studies. **(c)** Threat analysis: The circles color indicates the percentage of the 5 trajectories foreseen to supply at least 5 barrels (minimum limit fixed) to the selected cell within the 5 days.

Table 1. In the case of Corfu, the length per type (according to the Environmental Sensitivity Index-ESI), of the beach which is likely to be threatened at the shoreline of SW Corfu, around the Korissia lagoon, namely a very important biotope, by 3 potential oil spills

ID	OIL SPILL		TOTAL Shoreline Impact (m)	SHORELINE TYPE				
	X	Y		ESI 1	ESI 2	ESI 3	ESI 8	ESI 10
1	39°12'0"N	19°15'4"18"E	14.674	1.980	598	11.200	896	
2	39°12'0"N	20°10'00"E	16.901	4.070	727	12.000	104	
3	39°12'4'58"N	19°15'0"E	6.927	1.980		4.110	837	

4. CONCLUSIONS

The results from the TAP implementation may be valorized in coastal area oil-spill risk management planning and updating of a Contingency Plan, and specifically towards:

- the identification of areas in the coastal (and broader marine) space with relatively high possibility of an oil-spill threat in the future.
 - the calculation of the oil quantity which is likely to end up and affect these areas.
 - the marine and coastal resources potentially exposed to an eventual pollution risk
 - the location of potential spill incident sites may generate the pollution risk
 - the calculation of the local authorities and the competent services available response time
- The “Resources Analysis” provides data related to the specific resource quantity affected by spills or the response level required for their effective management and updating of an Emergency Plan.

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ARCHAEOLOGICAL AND GEOLOGICAL RECORDS OF EARTHQUAKES: BUTRINT (SW ALBANIA) AND THE NORTH CORFU ACTIVE FAULT AS A CASE STUDY

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ABSTRACT

In this review paper a possible seismic destruction occurred in the archaeological site of Butrinti (SE Albania) and the neotectonic fault pattern of the area, as well as the northern Corfu Island main active fault are presented. The catastrophes of the Theatre of Butrinti and the surrounding monuments dated earlier to the 4th century AD should be attributed to the seismic activity triggered by the reactivation of these faults during Roman time (imperial period 358 AD). A second seismic event affecting early Byzantine monuments is also probable (12th century AD).

Keywords: Archeoseismicity, Epirus, Pantokrator limestone, Seismic hazard.

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1. INTRODUCTION

Archeoseismology is the study of palaeo-earthquakes through indicators in the archaeological and human history records by a multidisciplinary research. It goes back to historical times, with the help of literature (sources), archaeology, and farther back to geological records, that is palaeoseismology. It goes back to geological time.

Butrint (or Butrinti, Βουθρυντό in Greek) was founded during the 7th to 6th centuries BC at the latest and continued to flourish until the Byzantine time, while it continued as a fortress until 19th century. Parts of the encircling walls, theatre, temple, promenade and churches are characterized as to Hellenistic, Roman, Byzantine and Venetian. Archaeological data are available, though often not published, and sometimes do not permit the clear reconstruction of the site's history. Additionally, written sources show that in the late 4th century AD, that Butrinti declined, not only due to the decline of productivity and occupation (post-Roman dark ages). Even though there are no historical or archaeological evidence linking the decline period and the destruction to invasions or to an earthquake disaster, which is also probable. The latter is under consideration.

2. FIELD DATA AND INTERPRETATION

The field study (Pavlides et al., 2001) shows that two fault sets exist surrounding and intersecting both the limestone hill on which the ancient town of Butrinti was built. The southern part of the hill is confined by a steep tectonic scarp, trending E-W to NE-SW, which represent the continuity of the right-lateral oblique -slip fault of Northern Corfu. Mount Pantokrator (Παντοκράτωρ in Greek) is a mountain located in north-eastern Corfu. At 906 m, it is the highest mountain on the island. The whole island, composed as it is of various limestone formations, presents great diversity of surface, as well as Neogene to Quaternary marls and other sedimentary deposits. This major fault of the Island trending almost E-W separates the northern Corfu "pantokrator" of late Triassic – early Jurassic carbonate rocks (metamorphosed hard limestone) from the southern Neogene sedimentary ones (hills and plains). The northeastern edge of Corfu lies off the coast of Ksamil (Butrinti) peninsula and Sarandë, Albania, separated by straits varying in width from 3 to 23 km (2 to 14 miles).

Inside the Butrinti archaeological site fault planes on the southern acropolis limestone hill cliff, cracks and subsidence parallel to this fault, especially in the lower land, have been observed, especially on the Amphitheatre and Dwelling house (3rd-2nd century BC), Nymphaeum (1-2 century AD) Lake gate (4th century BC), Lion gate (4th-3rd century BC), Asclepius's Temple (1-2nd century AD), Paleochristian Basilica (6 century AD). They are mainly diagonal fissures and open cracks. A secondary normal N-S trending fault is located along the NW of Butrinti hill with an observable length of 1 km and a maximum vertical displacement of 3 m. The continuous subsidence of part of the ancient city, the presence of evaporates (halokinesis or diapirism) and their continuous vertical movement allows us to conclude that these faults are still active and possible activated in historical period.



Figure 1. Photograph of the Butrinti Amphitheatre of the 3rd century BC. Deformed construction and especially open fissures are shown by arrows at the western side of the auditorium. Right down corner: the sketch of the diagonal shear cracks. They are typical evidence of seismic activity.

The destruction is widespread in the archaeological site of Butrinti (Buthrotos) especially on the flat lowland, but it cannot be correlated to similar findings over the broader area. The broader area was affected by many seismic events, and a hypothesis of seismic damage in the archaeological site as mentioned above, is very probable. But it does not agree satisfactory with the few historical data, because the historical seismicity of Albania is imperfectly known. The diagonal fissures and cracks with a NE-SW direction observed in the Hellenistic – Roman theater probably related to strong earthquake (s) and the activity on the known NE-SW trending active fault. The observable subsidence and dislocation could be considered as a reasonable consequence of seismic activity, as well as “aseismic” creep and geomorphologic changes, so a first hypothesis is that cracks surrounding the Acropolis along the margins of the basement with the soft Holocene sediments, where the Hellenistic, Roman and Byzantine towns mainly developed, they are due to creeping and other natural processes, e.g weathering, compaction, underground water fluctuation, that is gravity-driven phenomena mainly.

3. CONCLUSIONS

The observed destructions could also be the result of seismic shaking of a long or short distance earthquake and not of primary fault activity of the Corfu-Butrint fault, although it is clear that they systematically follow, more or less, pre-existing tectonic structures. A hypothesis of blind reverse fault reactivated by a historical seismic event is also probable.

Taking into account all the available information for Butrinti and the experience from other similar cases of Greece and the Mediterranean can be concluded that the subsidence of the theatre and surrounding area, as well as the most of the above described dislocations are associated with the co-seismic displacement of the Butrinti fault, passing through the southern/southeastern part of the town. Most probable is that they are due to a nearest locate strong seismic event, if not by the reactivation as seismic or sympathetic of the Butrint fault, that is epicentral area. The most distinctive evidence for rupture associated with the surface brake is the Theater and the Tower Gate. That seismic event was responsible for the destruction in Butrinti after the 3rd century AD. The oldest known event occurred around late 3rd and 4th centuries close to Butrinti is that of 358 AD. In this case Butrinti can be considered the macroseismic epicenter of the 358 AD strong earthquake, where primary destruction due to seismic fault damages are evident. The maximum Intensity of this event can then be reconsidered as IX to X, because of the seismic cracks affecting foundation mainly and the theater terraced seating on the ground. The epicenter of the poorly known seismic event of the 1153 AD could also can be considered in Butrinti, with a degree of uncertainty. Archaeological evidence suggests that at least two



major earthquakes struck the town of Butrinti, the first in late Roman-early Byzantine times and the second in the Byzantine period. These are valuable and useful information and quantitative data for Seismic Hazard Assessment of the broader region, including Corfu.

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SINKHOLES IN CORFU DUE TO GYPSUM DISSOLUTION

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ABSTRACT

A large part of Corfu consists of formations that incorporate gypsum, a mineral that suffers from high rates of dissolution, creating surface and underground cavities, that can lead to ground failures. The type of gypsum formation, bedded (mainly of Messinian age), domes or as bodies, fragments and cementing material in Triassic conglomerate formations, control the size and shape of ground failure. Consequences from ground failures could be serious; life or property loss, structural damages of buildings or infrastructure, underground water pollution. HSGME (former IGME) presents a case study of a sinkhole in Temploni area in an attempt to raise awareness of local authorities and citizens about the problem of sinkholes.

Keywords: sinkholes, Corfu, Gypsum, citizens awareness.

1. INTRODUCTION

In the Central Part of Corfu gypsiferous formations can be found, which are associated with “karst” geo-forms that are presented at the surface with dolines (closed hollows), empty or filled with water. It is well known that dissolution of gypsum many times causes serious ground failure problems, especially when occurring in urban areas. Some of the built up areas worldwide that are affected by gypsum geohazards are: Ripon and Darlington in UK [1], city of Zaragoza [2], and the town of Calatayud [3] in Spain, the outskirts of Paris [4] in France, Stuttgart and many towns peripheral to the Hartz Mountains in Germany [5,6], towns of Birzai and Pasvalys in Lithuania [7], and several areas in Cyprus and Greece [8]. The severity of the phenomena and the respecting protective measures depend on the generic mechanism of the sinkhole manifestation. A study in Cyprus distinguishes two types of genetic mechanisms, which result in different karstic forms and need different approach in mitigation measures [9].

2. THE TEMPLONI CASE

On May 2008, a sinkhole with an 11m diameter, developed North of the town of Corfu, in Temploni area (Fig.1a). The Institute of Geology and Mineral Exploration – IGME, now HSGME, conducted a hydrogeological, engineering geological and geophysical survey for the study of the phenomenon and proposed some protective measures (details in Discussion chapter). Ten years after, on January 2018, a second smaller sinkhole was developed at a distance of about 190m, while for the first one, there have been several attempts by the local authorities to fill, but the sinkhole was progressively increasing, reaching a 30m diameter (Fig.1b).

2.1. Geology

The area of Temploni is placed in the Ionian Geotectonic zone and consists mainly of Triassic breccia (limestone fragments with gypsum as cemented material) and Triassic gypsum that can be found as intrusion in breccia. At surface the area is mostly covered by a layer of alluvial and eluvial deposits.

The main tectonic feature in the region is the overthrust of Triassic formations (breccia) over the Mio-Pliocene sediments that represents one of the latest orogenic activities in Greece.



Figure 1. The sinkhole in Temploni area, Corfu (a) in 2008 and (b) in 2018.

2.2. Hydro-Geology

The region is a typical karstic area from the dissolution of gypsum with characteristic morphological features like dolines, karstic shafts and generally karstic geo-forms. The Triassic breccia is characterised as a permeable formation due to secondary porosity and as a hydro-lithological unit is characterised by anisotropy and heterogeneity both in the horizontal and vertical directions. The Triassic gypsum is a not permeable formation but it is highly soluble. Gypsum in general dissolves in flowing water about one hundred times more rapidly than limestone, but at only about one thousand the rate of halite.

A groundwater table develops in the Triassic breccia at depth between 12m and 50m from the surface.

2.3. Geophysical Investigation

The geophysical survey in the area conducted by IGME now HSGME [10], involved the measurement of 12 ERT lines in two different main orientations. Each ERT line had 48 electrodes with an inter-electrode spacing of 5 m or 10 m, and the electrodes are positioned relatively densely around the area of the developing sinkhole in an attempt to clarify its structure. The pole-dipole array was used (remote electrode was placed approximately 1 km away from the line), and each dataset had more than 1200 measurements, which were obtained using the ten-channel Syscal Pro (Iris Instruments) resistivity meter.

ERT data were inverted using a 2D smoothness constrained inversion program [11]. A high resistivity funnel shape anomaly was detected over the void but the resulting images of adjacent and intersecting lines were inconsistent and it was decided to adopt a 3D interpretation approach [10], in order to get a clearer picture of the studied targets. The two-dimensional ERT lines measured at the Temploni area were inverted using the 3D inversion approach for the centremost part of the research area around the existing sinkhole [10]. The 3D interpretation enabled the compilation of a clearer picture regarding the subsurface structure and its geometry by introducing various 2D slices at different elevations and cross-sectional images.

The results showed that funnel-like sinkhole is created within the Triassic breccia on the surface (elevation + 78 m) and is developing deeper towards the N-NE direction with decreasing diameter up to approximately 10-m depth (altitude + 68 m). From this depth, the sinkhole seems to be filled with soft sediments having a thickness of approximately 13m. At the elevation of 55m, a possible void is detected within the Triassic gypsum and is visible throughout the depth of geophysical prospecting.

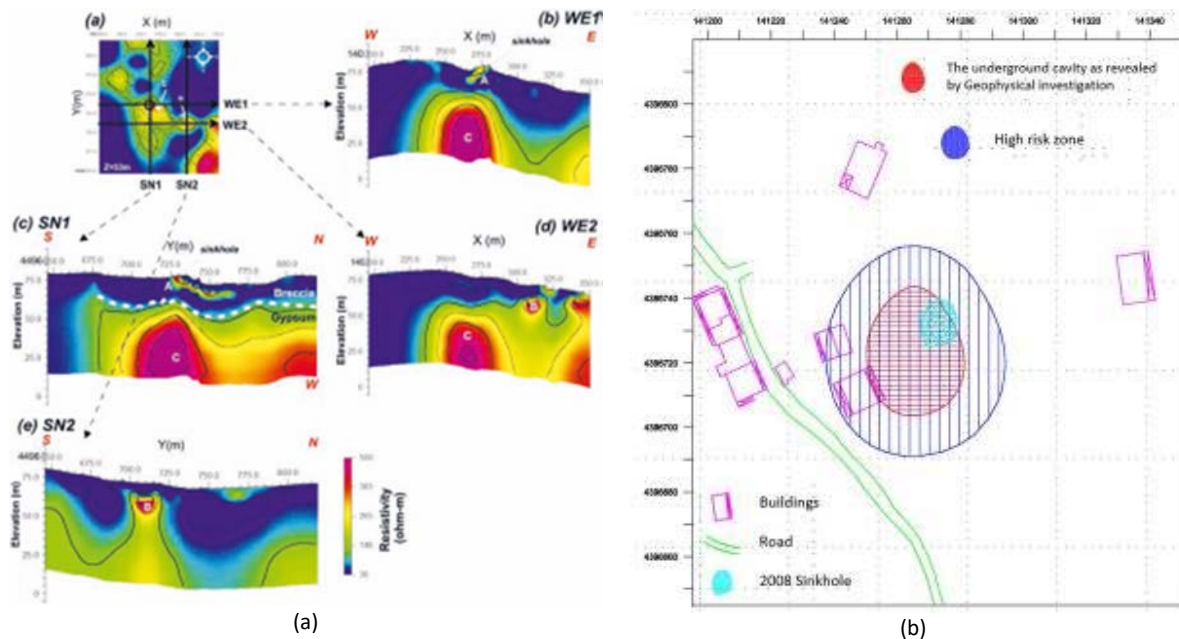


Figure 2. (a) Selected geoelectrical sectional images of the 3D inversion results of the ERT data from the Temploni area. A, B, and C are high-resistivity anomalies that can be interpreted as sinkholes or voids in this site. Profile lines SN1, SN2, WE1, and WE2 are depicted on the depth slice (53-m depth) image in (a). (b) Risk zone (2008).

2.4. Engineering geological judgment – Genetic mechanism

The results of the geophysical investigation in correlation with the hydro-geological and engineering geological findings from the research implemented in 2008, enabled the clarification of the genetic mechanism and the determination of the geometry of the underground cavities.

Summarising, it was concluded that under the sinkhole there was an underground cavity. The cavity, in 2008, was unfilled and was formed in gypsum formations. The elevation of upper part of cavity was estimated at absolute altitude +55 with overburden thickness 10m of rock formations (gypsum and Triassic breccias) and 13m of soil materials (clayey marly materials). The creation of the sinkhole was derived from the partial failure of the roof of the cavity, which created a passage for the overburden loose soil materials.

Taking into account that the dissolution of gypsum is a continuous and relatively rapid process and that the area is characterised by high seismicity rates, the probability of a total collapse is very high. Moreover, any attempt to fill the sinkhole would add weight to the roof increasing its instability. For these reasons a high-risk zone was determined, which resulted from the greater diameter of the cavity, the average thickness and the angle of friction of overburden loose soil materials (13m - 45°). The resulted zone outside the sinkhole had a width of 13m (Fig.2b).

Local authorities were informed about the results, alerting them about the buildings in the vicinity of high-risk zone and they were advised not to fill the cavity as this could initiate a total collapse of cavity roof [8].

3. LESSONS LEARNED - DISCUSSION

The findings and conclusions from the research carried out from IGME in 2008 at the vicinity of an 11m diameter sinkhole were confirmed. The estimation of the risk zone in 2008 was very accurate; actually, the size and shape of the underground cavity in fig.2b coincides with the present size and shape of the sinkhole. Although the local authorities were warned about the danger associated with the presence of the sinkhole, they underestimated the risk and they have attempted several times to fill the sinkhole. Unfortunately, the sinkhole generation mechanism is still active, the restored ground has collapsed repeatedly, developing to an



even larger sinkhole at the same location and a second sinkhole has recently developed nearby, that affected the local road. Local authorities must be aware of what could be the problems associated with gypsum dissolution in the area and the authorities must implement a corresponding hazard and risk assessment and accordingly take protective measures.

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INSTALLATION OF A LOW-COST EARLY WARNING MONITORING SYSTEM FOR LANDSLIDES – FIRST FIELD RESULTS

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ABSTRACT

This paper introduces the installation of a low-cost landslide monitoring system using MEMS (Microelectromechanical System) acceleration sensors, the possibility of using it as an early warning system, as well as retrieved first results obtained by its installation and usage on the field. New approach for landslide monitoring is likely to be of wide applicability to areas characterized by complex ground displacements. A significant interest of international research is therefore to deeply comprehend potential landslide triggering factors, through deployment of early warning systems. Moreover, there is an obvious need for low cost, fast and accurate way of landslide monitoring, based on the technological advances of recent years. The implementation of such a technique is the main objective of this proposal, aiming to exploit the innovative features of Internet of Things (IoT) on using low cost sensors, while dealing with landslide impacts.

Keywords: landslide monitoring, earthquake induced landslides, rain induced landslides, low cost sensors, early warning system

1. INTRODUCTION AND OBJECTIVE

Having the intention to measure ground acceleration and monitor the evolution of natural and artificial slopes, we developed a system consisting of low-cost sensors. Having successfully detected and recorded the slide's imprint through many small-scale laboratory conducted simulations, our next research stage was pilot testing under real conditions. Even though our laboratory findings were extremely short in a region of time (up to the level of few milliseconds), under real field conditions, the precursor activity time region is expected to be more intense and last longer, given that several factors have acted, so as the slope to reach marginal equilibrium state and consequently slide [1],[2]. Having installed it on either active landslide areas or prone-to-failure slopes, proposed system focuses on detecting possible landslide activity and generate warning when earth vibrations reach and exceed a specific threshold, covering this way earthquake induced landslide events[3]. Equipped also with a rain sensor is able for later failure causes definition of the monitored slope, such as an intense and prolonged rainfall, covering this way rain induced landslides[4]. Aiming at more accurate measurements compared to simulation stage, a better low-cost MEMS acceleration sensor was used. High sampling rate and almost complete energy autonomy are also included in the system's advantages, as it consists of a lead component battery, charged by a solar panel.

2. EXPERIMENTAL METHOD

Present monitoring system is capable of recording at sampling frequencies up to 35 Hz. Figure 1 illustrates the basic architecture. In its initial form it consists of two (2) units, one master unit (receiver system) and one slave (transmitter system), with the ability to add more than one slave units. Transmitter (slave) unit is made up of an Arduino Uno R3 single board microcontroller (Fig 2a), as well as a low-cost accelerometer sensor (ADXL335). The ADXL335 is a smart, low-power, analog triaxial MEMS (Microelectromechanical System) accelerometer with 12 bits of resolution (Fig 2b). Transmitter unit has also a rain sensor installed (FC-37) for later defining the failure causes of the monitored slope (prolonged / intense rainfall). Receiver unit is based on an Arduino DUE microcontroller and a Raspberry Pi 3B+ and has also a LCD display. Both communicate wirelessly through RF module. In more detail, the master unit (receiver system) stores

data from its sensor while accepts sent data from slave unit's sensor. All data are being stored in an SD memory card in daily files. Each file contains the acceleration values on the 3 axes (X, Y, Z) along with the rain sensor values and the timestamp (DD/MM/YYYY HH:mm:ss) to determine the exact failure start time. Raspberry Pi 3B+ compresses data into hourly records and sends them via mobile or Wi-Fi network (remote monitoring). As long as power is concerned, every unit is powered from a lead component internal battery (12V - 7Ah), which is charged by a solar panel for almost complete energy autonomy.

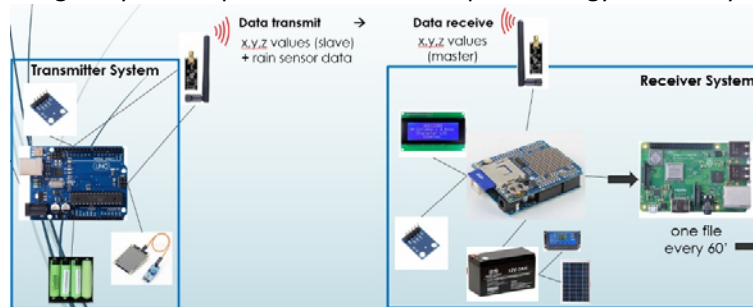


Figure 1. General architecture of our proposed landslide early warning system

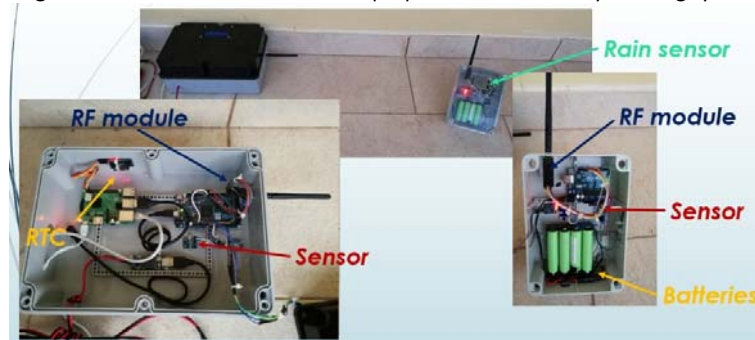


Figure 2. Basic components of proposed system

3. RESULTS AND DISCUSION

Analyzing the system's operation principle, it should be stated that the master unit (receiver) is installed outside of expected sliding mass, while the slave unit (transmitter) is installed inside. This way the operation principle is simple: When ground acceleration overcomes a critical predefined value (threshold) in both units, the system decides that is due to a non-landside external interference (e.g. car, human, animal etc). On the other hand, in case ground acceleration overcomes threshold value only in slave unit, which is inside sliding mass, then the system activates the buzzer and a warning shows-up on the LCD display. In figure 3 is presented a translational slide case, as threshold was exceeded in both x and y-axis. Figure 3 illustrates laboratory retrieved data where the threshold is clearly exccessed, during the experimental phase of proposed system, while Figure 4 illustrates field data comparison between transmitter and receiver, where is clearly shown the relation between master and slave noise in the 3 axes:

$$\text{Master Max noise} = 0.2 * \text{Slave Max noise}$$

The above relation is expected to be revised as field data processing continues. What is important in determining landslide risk is not so much the absolute value of the slope movement at a given time, but the movements increase rate. When the rate becomes strongly increasing then the risk of an upcoming landslide increases also in the near future. At the stage of landslide risk assessment, systematic monitoring will allow the development of reliable early warning systems[5],[6]. The systematic monitoring of such areas using low-cost sensors will give a clear picture of changes in terrestrial movements over time, allowing time probability to be determined as a function of movement rate.

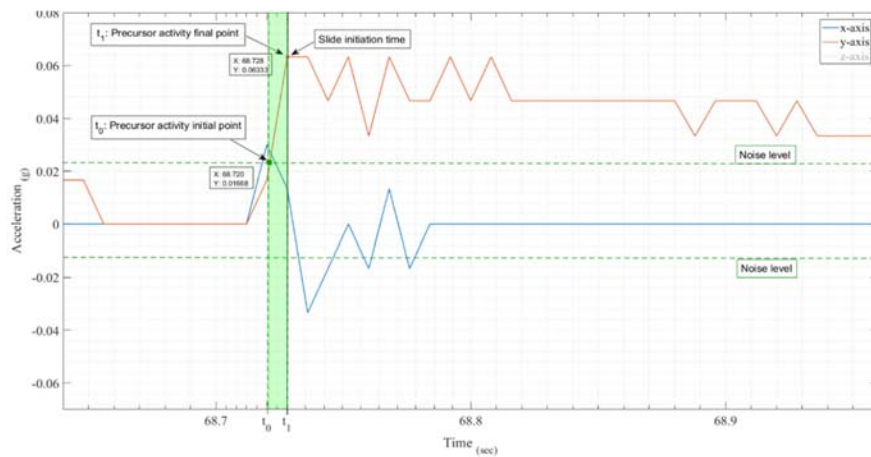


Figure 3. Laboratory retrieved data where the threshold is clearly exceeded, during the experimental phase of proposed system

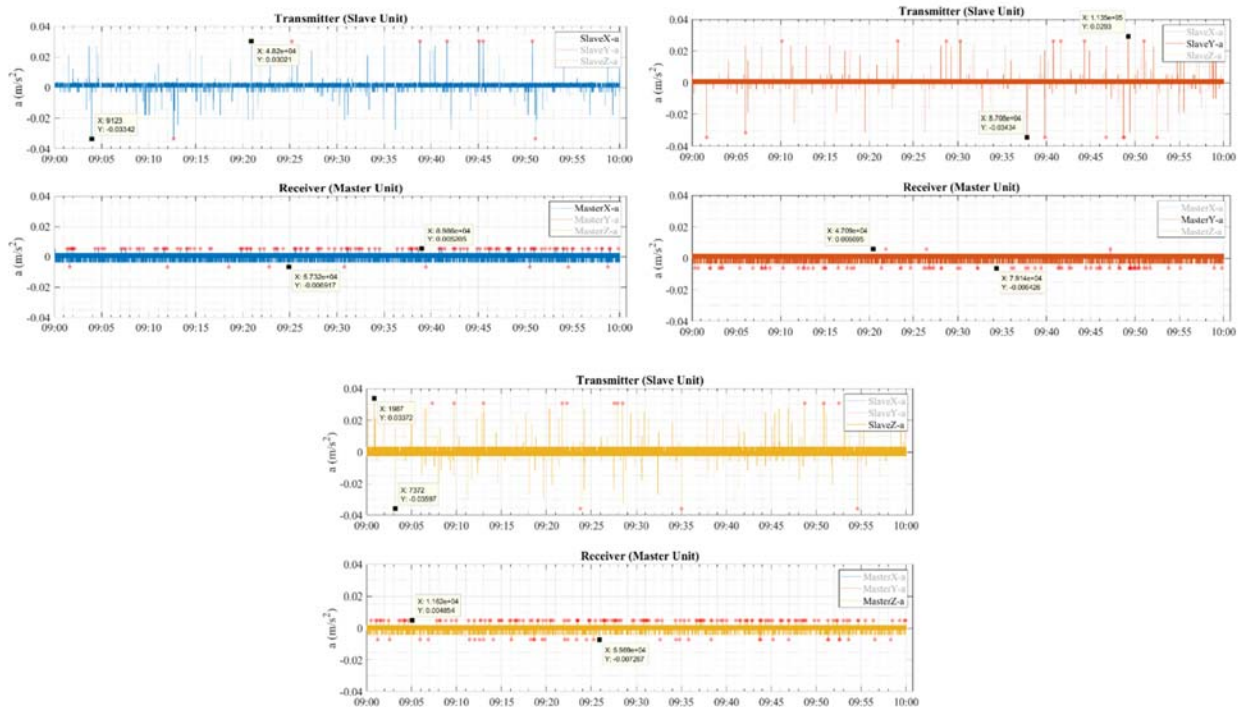


Figure 4. Pilot testing under real conditions -field retrieved data – a typical hourly data processing in each axis (up and left: x-axis, up and right: y-axis, down: z-axis)

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IMPACT OF LOW COST TOOLS IN EMERGENCY PLANNING

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ABSTRACT

This paper focuses on the impact of low cost tools in emergency planning and disaster risk management in general, with an emphasis on gathering large scale information on-site at a real time basis.

In our research project, the main objective is the development of an operational platform that is based on an extensive network for data collection, using sensors in multiple locations, that creates the preconditions for an ameliorated observation of extended geographical areas, faster data extraction, on-time intervention and better coordination of all operational resources.

An overview of the evolution of disaster management tools will take place where emphasis shall be put on the cost- effectiveness of such tools.

The research question is about how a low cost system covering a large geographical area will actually influence the existing emergency operational planning.

Keywords: disaster management, emergency planning, low cost system, sensors, remote sensing

1. INTRODUCTION

Natural disasters are extreme events that occur with high frequency during the last decades. The impact of such events in the environment has become very severe, adding up to the consequences of climate change. The number of people affected by natural disasters in relation to the costs to the global economy as well as to various national economies is immense [1]. The increased vulnerability of societies linked to natural hazards lead up to large economic losses and influences deeply the socio- economic system in general.

Research has shown that natural disasters are more destructive in countries where the living standards are low. Developed countries are also exposed to disasters and their impact at socio-economic level may be equally high. This is more likely to happen when there are economic turbulences and the country's vulnerability is increased [2]. It is obvious that economic factors play an important role not only in emergency planning and mitigation but also in the response phase and most importantly in the rehabilitation phase of the disaster.

Informed decision making in disaster risk management requires skills and tools for analyzing information that may be limited and when it does exist it is often either unused or underutilized. In areas with high risk of hazards it seems essential to invest more on emergency planning while the available finances are not sufficient in the field of civil protection. Local and regional authorities should have -and often renew- emergency plans by using effective and easy-to-use tools, taking into consideration that decision makers often do not have sufficient skills or expertise on crisis management and especially new technologies.

Our study is based on creating an easy-to-use platform based on a wide network of sensors that will facilitate the exchange of data between stakeholders and their processing in real time, leading to effective decision making.

2. LOW COST TOOLS IN EMERGENCY MANAGEMENT

Disaster risk reduction (DRR) has long been recognized in the literature for its role in mitigating the negative environmental, social and economic impacts of hazards. Disaster costs continue to rise and the demand has increased to demonstrate the economic benefit of disaster risk reduction (DRR) to policy makers [3].

During the last decades remote sensing has become an operational tool in the disaster preparedness and all phases of a natural hazard. The use of remote sensing data is not possible without a proper tool to handle the large amounts of data and combine it with data coming from other sources, such as maps or measurement stations. Therefore, together with the growth of the remote sensing applications, Geographic Information Systems have become increasingly important for disaster management. [1]

Remote sensing is the art and science of making measurements of the earth using sensors. These sensors collect data in the form of images and provide specialized capabilities for manipulating, analyzing, and visualizing those images [4].

Hazard maps are one of the final products that risk managers need during emergency planning. In order to produce hazard maps, scientists need various sensor data from varied sources including geological maps, databases of historical events, digital elevation models, as well as land-cover maps [5].

Our project TILEMACHOS, funded by the Regional Programme of Ionian Islands, focuses on developing a platform based on a network that has the possibility of contributing up to a significant level in all three first stages of an emergency, from early warning and activation of alert systems, to initial impact assessment and mobilization of all resources.

The development of such an extensive network for data collection creates the preconditions for an ameliorated observation of extended geographical areas, faster data extraction, on-time intervention and better coordination of all operational forces.

During the implementation phase of our research project, we have been confronted with the intention of a legislative change in the civil protection system (by the outgoing government). Having studied thoroughly the under public consultation draft law, we have started preparations adjusting the work being done in TILEMACHOS project platform. However, the voting on the proposed draft law has been cancelled due to national elections.

A possible change of the legislative framework is quite common in Greece and may cancel any time-built infrastructure. Our research project focuses on developing a customized platform linked to a tailor-made database. This will include all human resources and civil protection equipment and means that those responsible will be able to retrieve and use, in accordance with the legislative framework in force.

An observation that came up after having studied the national civil protection legislation (from 1974 till today) is that current legislation has multiple vulnerable points as far as coordination of resources is concerned, as well as the integration of complex protocols and plans. Complicated communication plans and multiple action plans in force create a suffocating environment for effective interaction. This leads up to being in lockstep with emergency plans as far as the main actors in civil protection are concerned.

3. ARCHITECTURE AND FEATURES OF THE PLATFORM

The proposed platform follows a modular architecture design, as shown in Figure 1. The key elements of the platform are the database (db) and the Application Programming Interface (API). Although a plethora of alternatives exist, our proposal is based on the opensource, high reliability and increased throughput database management system MySQL that manages relational, streaming and geospatial information. The API features detailed documentation, acts as an intermediary for all information exchange & service provision and additionally provides for organised extension of the proposed platform to accredited third-parties, should the need arise. The administration subsystem is for monitoring and setting of all parameters of the platform while the website portal serves as access point through the network, be that the internet or a localised closed network. Through the portal, public content is provided that may contain information presented via the Geo Informational System (GIS), i.e. on a map, as well as the Decision Support System (DSS). The low-cost sensory network (sensors' feeds) provides information that enables the DSS to support in real-time the decision process further than manually inserted information. The e-Info service is a two-way communication between the platform and the wide public through iOS/android smartphone applications, i.e. the platform administrator can broadcast information to all or selected such iOS/android smartphones, while users of

iOS/android smartphones may submit information to the platform (crowdsourcing). It should be noted that given the high probability of lack of networking (GSM or wi-fi) during natural disaster, the iOS/android smartphone application features some local content in order to provide for connectionless use.

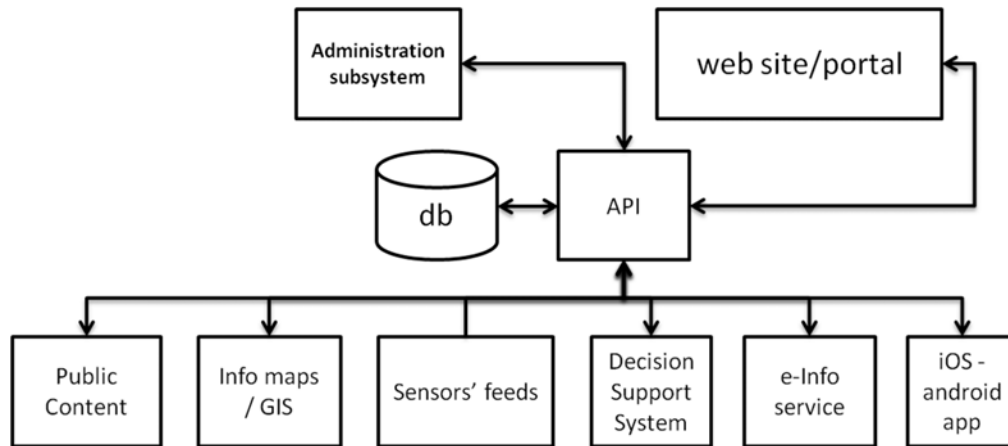


Figure 1: The architecture of the proposed platform.

4. CONCLUSION

To sum up, we should put an emphasis on the significance of updating regularly all the relative data that will absolutely secure operational effectiveness. In addition, good equipment maintenance, effective participation of all actors and will for inter-operational cooperation in managing a hazardous event are certainly key factors for success.

Ionian University, through its under construction TILEMACHOS platform attempts to bring together all operational plans from different stakeholders and actors, and become the first step of harmonization at institutional and operational level.

In emergencies, making the correct decision in a limited time with limited information is the ultimate challenge.

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NEW TECHNOLOGIES AND CIVIL PROTECTION: THE EXAMPLE OF THE REGION OF THE IONIAN ISLANDS. DIFFICULTIES AND PERSPECTIVE

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ABSTRACT

This paper focuses on the impact of low cost tools in emergency planning and disaster risk management in the concept of Civil Protection as a comprehensive risk management and management is a relatively recent institutionalized public policy in our country. Many steps forward have been made and there is still much to be done.

Our legislative framework foresees important responsibilities for Civil Protection, but their implementation faces several obstacles.

New technologies developed today can greatly contribute to the work of Civil Protection.

The Ionian Islands Region, an island region with tourist growth, is facing a series of natural catastrophic events such as fires, earthquakes, floods, landslides.

New technologies will make a significant contribution to managing these events.

The Ionian Islands Region implements two innovative programs, the "TELEMACHOS" and "LAERTIS", which include all the natural hazards mentioned above.

However, the difficulties that the Civil Protection Department must face are, inter alia, the incorporation of new technologies into its daily operations.

Keywords: Region of Ionian Islands, civil protection, new technologies

1. INTRODUCTION

The concept of disaster management as an integrated system of prevention, response and recovery is relatively recent in relation to other public policies.

At the academic level, significant advances were made in the field of disaster research in the 1950s, and research teams were established in US universities and research centers.

The first disaster research center was established in 1963 at the University of Ohio (Disaster Research Center) to study natural and man-made disasters at the level of prevention, response and rehabilitation.

The 1970s saw a significant change in the history of disasters as, for the first time, at the level of international organizations the need to address them was recognized. Thus, in 1972, a special agency was created within the United Nations, the UNDRP (United Nations Disaster Relief Organization) responsible for rescuing and providing humanitarian aid in cases of natural disasters, and at the same time the UN Conference in Stockholm was convened for the environment and sustainable development with a view to identifying joint action to conserve and improve the environment and activate efforts in this direction.

The development of new technologies with significant achievements, especially nowadays, is a key ally towards an integrated management of the Civil Protection system.

In Greece, civil protection was introduced in 1995. In 2002, the institution was upgraded, its purpose and objectives were redefined, in line with modern data, and a civil protection system was established in the country [1].

2. TECHNOLOGY & CIVIL PROTECTION IN REGION

To serve this purpose, the civil protection system of the country includes public administration units as civil protection planning and implementation bodies, specialized emergency management bodies and volunteers. Procedures for planning and implementing civil protection actions are also provided.

Meanwhile, the Decision of the Organization of the Ionian Islands Region, provides, inter alia, for the Directorate of Civil Protection:

- Coordinate and oversee civil protection work for disaster prevention, preparedness, response and disaster management within the territorial boundaries of the Region.
- Planning and organizing disaster prevention, information and emergency response issues, as well as allocating and co-ordinating the action needed and resources to do so.
- Coordinate all regional services, as well as public and private resources and resources to ensure preparedness, disaster response and damage recovery.
- Participation in the development of forest fire protection programs, in the design and study of methods and means of their prevention and suppression. The above competences in order to exercise them effectively and consistently it is now considered necessary to use new technologies, which are now available and adapted to the contemporary needs of Civil Protection.

P.I.N.'s initiatives have now been integrated into 2 innovative programs, co-funded by the EU (NSRF 2014-2020), named "TELEMACHOS" and "LAERTIS", which are run by the Civil Protection Department.

The "Telemachos" program focused on the creation of an innovative system for seismic risk management in the Ionian Islands and includes:

The elaboration of thematic maps (geological, geotechnical, seismic etc) and soil and vulnerability measurements of buildings, networks and infrastructures, as well as the development of a system to support the exchange of data between stakeholders and their processing in real time.

The "Laertis" program includes the risk assessment of fires, floods, erosion as well as the risk of landslides and the analysis of vulnerability for all the above risks using satellite images.

In the meantime, an Emergency Management System based on Wireless Sensor Network technologies is foreseen to provide emergency information to operators, as well as the production of special information material and the provision of the necessary equipment for the prevention and suppression of risks in natural disasters.

The key question here is which executives will manage the new technologies and with what infrastructure in a public administration that does not seem to have realized the need for immediate implementation of the new technologies in the critical area of Civil Protection.

For example, in each of the Regional Divisions of the PIN there is an employee who is even required to perform duties in two or three different services at the same time having to work part-time 24 hours a day for 365 days a year. Sundays and public holidays, participating in similar committees or regular or extraordinary exercises of other stakeholders and performing secretarial duties daily.

And the problem is not only the lack of staff, it is also the lack of mechanical equipment, since the P.I.N. does not have project machinery, trucks, aquifers, and if one of them has no operator and therefore the machine cannot be used.

Specialized programs or targeted seminars for learning new technologies are not available and the employee will have to look for ways to learn and become familiar with the various applications.

But even then, there is the problem of procuring software, installation and training and other services that work together in a Civil Protection context - a collaborative public policy. Service organization charts do not provide for the use of new technologies but, even if a service - usually at the initiative of some people - seeks it then it will encounter discontinuity or denial of other services or entities.

In addition, Region of Ionian Islands is an island Region and the Regional Units have the difficulty of geographical isolation. Moving from one island to another takes many hours and communication between



stakeholders is difficult. In severe weather conditions, things get even worse as there is traffic and communications disruptions.

In this context, the use of new technologies would greatly facilitate the task of Civil Protection.

3. CONCLUSION

To conclude, therefore, the use of new technologies in the field of Civil Protection requires a revision of the existing operating model and philosophy and consequently a redesign of the legislative framework with clear anticipation at all planning stages: responsibilities, continuous learning, installation and operation liaising with other agencies and bodies that are the implementing stakeholders of Civil Protection actions.

Specialized human resources already exist, new technologies are available and remain to be used effectively and in the right direction.

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THE FOREST FIRES IN WILDLAND-URBAN INTERFACE AREAS. ESTIMATION OF THE RISK. CASE STUDY: "ISLAND OF CORFU"

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ABSTRACT

The present paper deals with a major issue that has been of concern to the international community, namely forest fires in forest-urban interface zones. Wildfires in these areas can result in natural disasters as they occur in anthropogenic environments, with both infrastructure and human losses. Greece is one of the most afflicted Mediterranean countries and as a country with many islands has special features, and there are sensitive areas in the fires due to vegetation such as Corfu. The vulnerability of the island is high, as there is a homogeneous distribution of the settlements throughout. Prevention in combination with pre-firefighting are the main means that can prevent a disaster on the island. The presented method enables to fully understand the vulnerability of a house or a whole settlement to fire and specific measures and means are presented.

Keywords: Wildland-Urban Interface Area, Highly Risk Period, Mega-fires, Focused Firefighting

1. INTRODUCTION - OBJECTIVE

Forest fires are one of the major problems of the land's natural environment and they have impacts globally, as they are the main components of the three major global environmental problems - greenhouse effect, climate change, and desertification- in an endless and constantly repeating disastrous cycle. In Greece, this issue is complex and constantly worsening, attributed to climatic conditions, human activities, lack of institutional measures concerning inadequate equipment and organization of fire-fighting forces, as well as combinations of the above factors.

This topic was chosen because of its great importance, in that it relates in addition to the degradation of the natural environment in some cases to the degradation of the residential environment and the high risk of a particularly large number of human lives, especially if the fire is big and has the characteristics of the mega-fire.¹

The research field is the Corfu Wildland-Urban Interface Zones, which are examined at three geographical zones in the same way as reported by the local authorities involved, namely North Corfu, the Middle, and the South. The present study aims to contribute to the effective prevention and suppression of forest fires, mainly by identifying the fire vulnerability indices concerning the Corfu settlements while making the best possible use of the existing fire-fighting potential, but also of its active civilians. Vital installations protection on the island is another major issue.

It should be noted that according to the latest census of ELSTAT [1]. Corfu has the third-highest population density per km² in Greece with a homogeneous distribution of population throughout the island, except for Corfu Town which accounts for 37.20% of the population. This is also evidenced by the number of communities and settlements for which the first reaches one hundred three (103) and the latter referred two

¹ Mega-fire: It is one that has such dynamics that it cannot be counteracted by direct attack on its front by ground or aerial means. Its front is characterized by very high thermal intensity.

hundred fourteen (214). It is noted also, that according to the Presidential Decree 575/1980 about forest areas, Corfu island is classified as a very flammable vegetation zone.

The chart below presents collected data from the Fire Service of Corfu for the years 2009-2016 [2] and it can be shown that most of the burned areas were in high risk period.²

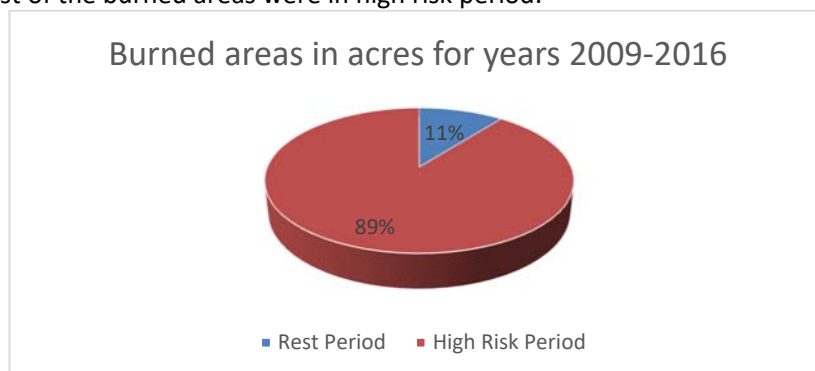


Image 1 – Burned areas in acres. Source: Fire Service of Corfu.

2. EXPERIMENTAL METHOD

In order to make a risk mapping the “Risk Assessment Form” was used. This form has been created using the Javascript language so that the necessary calculations can be made by any browser. It is available at URL: <http://www.fria.gr/prolipsi/files/Assessment-Form.html> which also contains instructions for its usage. [3] This form estimates the risk of the settlements near the forest vegetation. Two hundred (200) dwellings were selected for control that were near the forest areas and which were within the boundaries of the settlement or community.

2.1 Analysis of the calculation method of Risk Assessment

The form divides the risk into three parts: (a) the landscape and vegetation that it contains; (b) the specifications and the materials which the house is built; and (c) access to the site by the fire trucks as well as other factors that enhance the fire fighting.

The first part of the risk is 50% of the total risk and is calculated when completing the questionnaire in sections A and B. The second part of the risk is 30% of the total risk and is calculated when completing the questionnaire in Section C. And finally, the third part of the risk is the rest 20% of the total risk and is calculated at the completion of the questionnaires in Sections D and E. Because in the last part may calculate factors which enhance the firefighting, there are questions that give negative values, reducing the risk calculated in this location. The total risk is the sum of these three parts and the maximum value is the number 100. However, the author of the mathematical formula for values greater than 36 considers that there is an extreme risk. The following table presents the results given by the form for specific wildland-urban interfaces areas, in most cases villages next to wild vegetation, in Corfu island. [4]

² The “High Risk Period” extended from July to August and is characterized by high temperatures, low relative humidity, and strong winds.

Region	Location	Index A	Index B	Index C	Indices' Sum	Region Average
NORTH CORFU	SPARTYLAS	16,68	12,50	16,20	45,38	30,42
	PAGOI	2,14	13,30	10,90	26,34	
	PRINYLAS	4,50	13,70	11,10	29,30	
	STRINYLAS	4,16	11,30	10,50	25,96	
	PETALEIA	3,63	11,90	13,50	29,03	
	KAROUSADES	5,13	11,95	10,90	27,98	
	NYMFES	3,72	12,95	12,25	28,92	
MIDDLE CORFU	SINARADES	5,38	12,75	10,40	28,53	39,04
	AGIOI DEKA	19,14	12,75	17,35	49,54	
SOUTH CORFU	SPATERA	21,48	11,65	17,90	51,03	39,96
	AG. MATHAIOS	19,90	12,15	17,20	49,25	
	VASILATIKA	6,00	11,70	11,60	29,30	
	KOUSPADES	4,35	13,20	12,70	30,25	
	Average	8,94	12,47	13,27	34,68	
Risk Values						
Low Risk: <=16, Medium Risk: >16 & <=24, High Risk: >24 & <=36, Extreme Risk: >36						

Table 1 Field Values. Source: N. Kolovos MSc Thesis

3. RESULTS & DISCUSSION

Managing the fuel around the houses could be the best solution for protection against forest fires in wildland-urban interface zones. However, this measure is difficult to apply to the specific area, under current political and economic circumstances. It is becoming apparent, as has been shown from the compiled and cited data and their processing, that we must focus on those factors that maximize burned area and can cause disaster. So, in order to reduce the response time, we must arrive at the event location as quickly as possible and perceive this event as early as possible. Ideally, these can be achieved through preventive, pre-suppression and suppression measures as described below:

- Increase the number of firefighters by recruiting volunteers.
- Increase the number of afternoons patrols in selected areas. Focused Firefighting.³
- Use of UAV (Unmanned Aerial Vehicle) to cover the "blind areas" and monitor the trends of fire.
- Integration into the fire suppression system motorcycles or ATV equipped with a high-pressure sprinkler system, which by focused firefighting may be more effective.

By the first three suggestions, we achieve early detection of fires and immediate intervention. The last suggestion concerns newer means with motion flexibility in order to reduce the time of the first attack. It is important that by UAVs we can be identified with precise coordinates the fire locations, their trends and in real-time to identify in the fire locations the possible existence of human life.

4. CONCLUSION

Summarizing the above we can conclude that the risk level of fire hazard in the wildland-urban interface zones depends on the fuel, the meteorological conditions, and the regional topography. Generally, the vulnerability of buildings and infrastructures depends on the state's ability to perceive and act in a deterrent manner in order to avoid a catastrophe with both environmental and human consequences.

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³ This term means the involvement of current human resources and equipment available in the fire location in such a way as to achieve the optimum result with the least possible use.

THE WORLD TSUNAMI AWARENESS DAY/UNISDR: AN OVERVIEW AND THE CASE OF GREECE

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ABSTRACT

In December 2015, the UN General Assembly designated 5 November as World Tsunami Awareness Day (WTAD). Since then a variety of relevant activities take place every year around the globe and particularly in the tsunami-prone communities. This presentation aims to provide an overview summarizing the achievements of the WTAD initiative at the global scale as well as in Greece.

Keywords: Tsunami risk, tsunami awareness, tsunami risk reduction.

1. INTRODUCTION

Tsunamis are low-frequency but high-impact natural events. In the past 100 years, 58 of them have claimed more than 260,000 lives, or an average of 4,600 per disaster, surpassing any other natural hazard (<https://www.unisdr.org/tsunamiday>). The highest number of deaths in that period was in the Indian Ocean tsunami of December 2004. It caused an estimated 227,000 fatalities in 14 countries, with Indonesia, Sri Lanka, India and Thailand hardest-hit. Just three weeks after that the international community came together in Kobe, in Japan's Hyogo region. Governments adopted the 10-year Hyogo Framework for Action, the first comprehensive global agreement on disaster risk reduction. In addition to the Pacific Tsunami Warning System, already operating since 1965, three new regional Tsunami Warning and Mitigation Systems were created during 2005, namely in the Indian Ocean, in the Caribbean Sea as well as in the NE Atlantic, the Mediterranean and connected seas. These systems are based upon seismographic and sea-level monitoring stations and disseminate alerts to national tsunami information centres (e.g. [1]).

According to the descriptions and adoptions by UNISDR (<https://www.unisdr.org/tsunamiday>; <https://www.un.org/en/events/tsunamiday/>), rapid urbanization and growing tourism in tsunami-prone regions are putting ever-more people in harm's way. That makes the reduction of risk a key factor if the world is to achieve substantial reductions in disaster mortality – a primary goal of the Sendai Framework, the 15-year international agreement adopted in March 2015 to succeed the Hyogo Framework. World Tsunami Awareness Day was the brainchild of Japan, which due to its repeated, bitter experience has over the years built up major expertise in areas such as tsunami early warning, public action and building back better after a disaster to reduce future impacts. The date for the annual celebration was chosen in honour of the Japanese story of “Inamura-no-hi”, meaning the “burning of the rice sheaves” (e.g. [2]). During an 1854 earthquake a farmer saw the tide receding, a sign of a looming tsunami. He set fire to his entire harvest to warn villagers, who fled to high ground. Afterwards, he built an embankment and planted trees as a buffer against future tsunami waves.

The UN General Assembly has called on all countries, international bodies and civil society to observe the day, in order to raise tsunami awareness and share innovative approaches to risk reduction. It also asked the UN office for Disaster Risk Reduction (UNISDR) to facilitate the observance of WTAD in collaboration with the rest of the United Nations system, including UNESCO.

2. COMMUNITIES AT RISK – THE ROLE OF WTAD

According to the Ocean Conference convened at United Nations Headquarters in New York from 5 to 9 June 2017 (<https://oceanconference.un.org/about>), more than 600 million people (around 10 per cent of the world's population) live in coastal areas that are less than 10 meters above sea level. Oceans, coastal and marine resources are very important for people living in coastal communities, who represent 37 per cent of the global population in 2017. Shipping is responsible for more than 90 per cent of the trade between countries. The global oceans-based economy is estimated at \$US3 trillion a year, which is around 5 per cent of global GDP. Approximately 50 per cent of all international tourists travel to coastal areas. By the year 2030, an estimated 50 per cent of the world's population will live in coastal areas exposed to flooding, storms and tsunamis (<https://www.unisdr.org/tsunamiday>).

Investing in resilient infrastructure, early warning systems, and education is critical to saving people and protecting their assets against tsunami risk in the future. In 2019, the World Tsunami Awareness Day will promote Target (d) of the "Sendai Seven Campaign", which focuses on reducing disaster damage to critical infrastructure and disruption of basic services. In the website of the WTAD (<https://www.unisdr.org/tsunamiday>) one may find a variety of relevant educational material, including booklets (e.g. Get up to high ground booklet), animated educational videos (e.g. What is a tsunami? - which is an animated educational video describing the science behind the generation of tsunamis), various earthquake and tsunami textbooks and teacher guides produced by IOC/UNESCO, an animation-booklets-posters trio titled "Tsunami and you - Living more safely with natural hazards", and many others. It is worth noting, however, that tsunami awareness activities should not be only restricted around the day of 5th November every year, but should be rather performed all the year round.

3. TSUNAMI RISK AND TSUNAMI AWARENESS IN GREECE

In the Mediterranean and particularly in Greece, the tsunami risk is not negligible as it comes out from the geological, historical and instrumental records of past tsunami events (e.g. [3,4]). The tsunami threat was reminded several times in the last 10 years or so when at least five strong earthquakes were accompanied by small or moderate tsunamis: July 1st 2009, South Crete Isl. [5], Nov. 17th, 2015, Lefkada Isl. [6], June 12th, 2017, Lesvos Isl. [7], July 21st, 2017, Bodrum-Kos Isl. [8], Nov. 26th, 2018, Zakynthos Isl. [9]. The size of all these earthquakes fall in the magnitude range from 6.3 to 6.6. Should the magnitude increase the tsunami size will also increase which implies important risk.

After the official establishment of the Hellenic National Tsunami Warning Center (HL-NTWC) by governmental Law in September 2012, and its accreditation in the framework of IOC/UNESCO in September 2016, several activities contributing to the WTAD were developed in Greece, including the production of educational posters in the frame of the EC-FP7 project ASTARTE and the national project GEORISK, educational talks to groups of school children, as well as relevant demonstration activities during the 5-day Athens Science Festival (2016, 2018), the Researchers Night (2016) etc. A particular activity has been the organization of tsunami evacuation drills, e.g. in Heraklion coastal zone, Crete Isl., April 2016, in collaboration with local Red-Cross volunteers and in Lindos coastal zone, Rhodes Isl., in collaboration with the Civil Protection Office of the Municipality of Rhodes and the Post-Graduate Programme on "Environmental, Disaster, and Crisis Management Strategies" of the Department of Geology and Geoenvironment, National and Kapodistrian University of Athens. Of particular importance is the launch in 2018 for the first time in Greece of the informative web-site of the HL-NTWC (<http://hl-ntwc.gein.noa.gr/>) organized by the author of this paper.

4. CONCLUSIONS

Tsunami awareness activities are of crucial importance to prepare coastal communities against tsunami threats. Such activities started systematically in Greece in 2016. However, the effort should be intensified since most of the local people as well as of the millions that visit the country every year have ignorance about the tsunami risk. It would be particularly effective to run such efforts in the frame of the parallel international Tsunami Ready programme which is ongoing with the support of IOC/UNESCO.

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THE TSUNAMI READY PROGRAM AS A TSUNAMI RISK REDUCTION STRATEGY AND ITS POTENTIAL IMPLEMENTATION IN TWO TEST SITES OF GREECE (RHODES AND KOS ISLAND)

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ABSTRACT

The aim of the Tsunami Ready initiative is to promote the resilience of coastal communities exposed to tsunami risk through better planning and education. It was introduced in the US in 2001 as a voluntary community recognition program for the evaluation of coastal communities recognised as "TsunamiReady®". The evaluation is based on specific guidelines regarding preparedness, mitigation and response to tsunami risk. Specifically, communities need to have a plan for tsunami risk, to have hazard and evacuation maps, to provide tsunami signage in the area indicating safe areas that can be reached through the appropriate escape routes, to carry out systematic training activities and drills and to have developed early warning systems. "TsunamiReady®" provided the basis for "International Tsunami Ready", implemented in other tsunami prone areas worldwide, with the support of UNESCO.

Although catastrophic tsunamis in Greece are rare, historical records and geological surveys have shown that tsunami risk is significant in several coastal areas. Thus, the cities of Rhodes and Kos were chosen as areas where the implementation of Tsunami Ready could be investigated, because of the high seismicity in the region that in some cases lead to a tsunami generation, and in addition, due to several tsunami mitigation activities that are ongoing. Evaluation of the current situation according to the "International Tsunami Ready" guidelines shows that neither of the two regions meets all the requirements. However, specific objectives for a successful integrated risk management operation have been identified. Finally, starting from a bottom-up approach it is possible to identify the needs and objectives to be set for emergency planning at national level, as planning for a risk is a matter of national policy.

Keywords: Tsunami Ready, tsunami risk mitigation, tsunami hazard, Rhodes Island, Kos Island

1. INTRODUCTION

The Tsunami Ready initiative aims to foster the resilience of local coastal communities in the threat caused by tsunamis, through better planning, education and awareness. Tsunami Ready was established as a voluntary program in the United States in 2001 by the National Weather Service (NWS) and the National Tsunami Hazard Mitigation Program (NTHMP). The coastal communities that wish to be recognized by the NWS as "TsunamiReady®" should meet the established guidelines for a standard level of capability to mitigate, prepare for, and respond to, tsunamis. The guidelines include the development of designated and mapped tsunami hazard zones and evacuation maps, public display of tsunami information, public education activities

supported by educational material, exercises, emergency operation planning for tsunami and reliable means for a 24-hour warning point for receiving and disseminating the official alerts. The "International Tsunami Ready" has been modeled after the US "Tsunami Ready®" under the auspices of the Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO), as a pilot project for coastal communities interested in strengthening their tsunami preparedness. The Intergovernmental Coordination Group for Tsunamis and other Coastal Hazards for the Caribbean and Adjacent Regions (ICG/CARIBE EWS) has already adopted the initiative and approved 10 indicators, which provide the basis for the International Tsunami Ready. The program has been piloted in the Pacific, adapted in the Indian Ocean, while it is under consideration for the Northeast Atlantic and Mediterranean (NEAM) region. A first approach for a probable implementation of the Tsunami Ready Program in two test sites of Greece has been attempted.

2. STUDY AREA

The cities of Rhodes and Kos were selected as test sites for a Tsunami ready indicators analysis, as they are located in a region of high seismicity, where several tsunamis have been observed in the past [1, 2]. In both islands several studies have been accomplished in fields relevant to the Tsunami ready guidelines (e.g. [3,4,5,6]). Moreover, during the last years in both islands several activities in the field of tsunami preparedness have taken place and effective collaboration between the scientific community and the local authorities is ongoing, with the aim of enhancing tsunami risk management. In Rhodes, a network of seismic early warning devices has been developed since 2013, in the frame of the NEARTOWARN project, with the purpose to meet the needs for a local early tsunami warning [7]. Furthermore, tsunami exercises are organized on an almost annual basis in collaboration with the National and Kapodistrian University of Athens. Recently, in the aftermath of the strong earthquake ($M_w=6.6$) in Kos Island (21 July 2017) and the local but strong tsunami that followed, a joint one-year project is ongoing coordinated by the Joint Research Centre (JRC)/EC with the collaboration of the Hellenic National Tsunami Warning Center (HL-NTWC), and the Municipality of Kos, with the support of DG-ECHO/EC for the development of a prototype local tsunami warning system, including the installation of tsunami evacuation signs, public awareness activities and an evacuation exercise.

3. OPERATIONAL MANAGEMENT OF TSUNAMI RISK IN GREECE

At national level in Greece the official tsunami warning provider is the Hellenic National Tsunami Warning Center (HL-NTWC), which was established by law (n.3879/2010, Government Gazette, Issue number A 163, Sept. 2010). It operates a 24-hour tsunami monitoring service for Greece and the eastern Mediterranean Sea, providing warning messages to the General Secretariat for Civil Protection in Greece and to a large number of subscribers beyond the country. Since 2016, HL-NTWC acts as an accredited Tsunami Service Provider (TSP) in the framework of the North-Eastern Atlantic, the Mediterranean and connected seas Tsunami Warning System (NEAMTWS) of the IOC/UNESCO.

Emergency planning in Greece is based on the National Emergency plan "Xenokratis" (Ministerial Decision 1299/03 – 423 B'/10-4-2003, Government Gazette) and there is no plan specifically for tsunamis because tsunamis are considered as a special type of flooding. Thus, for emergency management after a tsunami the National Emergency Management Plan for Floods will be implemented. Regarding early warning and prevention measures for tsunamis, there is a special reference in the National Emergency Management Plan for Earthquakes.

4. TSUNAMI READY APPLICATION IN GREECE-DISCUSSION

The assessment of the current situation on the basis of the indicators defined by the "International Tsunami Ready" initiative shows that none of the two regions meets all the guidelines. The following important issues have been defined:

- 1) The national policy support is necessary, even for the pilot implementation of the initiative. A crucial issue is that tsunami hazard is not identified in the emergency operation plan as a hazard, as tsunamis are considered only as a special type of flooding. In addition, although the national warning system is in place, it is doubtful whether it is end-to-end, and if the further procedures have been adequately developed to disseminate the warning to the public. The probable reasons for this situation are:
 - The tsunami warning messages content is difficult to be interpreted in operational terms.
 - Civil protection authorities deal with a large number of emergencies, such as wildfires, earthquakes and floods, which are quite frequent in Greece and as a result tsunami risk management is given less priority, due to the rare tsunami occurrence.
 - People involved in the whole chain of risk management are not always adequately trained in the field of tsunami risk, which is rather new.
 - A large number of warning messages that are not followed by a real event and the subsequent issue of a cancellation message will probably be considered as a weakness of the system, which may appear less reliable.
 - In some cases, different TSPs may send messages with a different alert level (for the same earthquake), due to small modifications adopted in the Decision Matrix for the Mediterranean. This fact may be confusing to the recipients.
 - Public awareness has not been developed enough in Greece and evacuation plans for tsunamis have not been determined at the moment, although some studies have been done (e.g. Lekkas et al., 2010). Even in the ideal situation that the public is warned, there is no evidence that people will know where to go and how to be protected.
- 2) The legal framework for such initiatives at local level should be further examined. According to the recommendation of Working Group 4 on Public Awareness, Preparedness and Mitigation of ICG/NEAMTWS, the legal implications of piloting Tsunami Ready-like initiatives in some test countries of the NEAM region, should be analyzed. It is necessary to ensure that laws provide support for such an implementation. For example, clear roles and responsibilities should be established for all relevant institutions.
- 3) Another important field that has to be considered is the tourism sector. Both Kos and Rhodes islands are popular touristic destinations and the acceptance of the relevant mitigation measures (e.g. signage) is highly desirable. Educational activities addressed specifically to tourist operators could provide a basis for a further engagement.
- 4) Finally, the most important goal that has to be achieved is to enhance public awareness. A good start would be school education as students can build a future, more resilient generation and furthermore they can communicate the safety behavior rules to their families, increasing protection to a wider community. Furthermore, in the Mediterranean region, where tsunami arrival times are very short, people should be aware of the natural warning signs and how to be protected, with or without official warnings.

5. CONCLUSIONS

The rare occurrence of tsunamis in Greece leads to the wrong perception that there is no tsunami risk. Although early warning systems have been already developed, the final goal, which is to alert the population and save lives in the case of a tsunami event is still under development and needs further efforts and improvements. Fortunately, the first steps have been already taken.

The purpose of the Tsunami Ready programme is to enhance the resilience of local coastal communities exposed at tsunami risk through better planning and education. Therefore, communities that can plan and produce hazard and evacuation maps, implement systematic training activities and drills, and develop early warning systems, are more likely to manage effectively an emergency. On the other hand, coastal communities that are unprepared will react without a strategy and the early warning, if any, most likely will



not be effective. Therefore, Tsunami Ready provides a tsunami risk reduction strategy, as the way to manage tsunami risk and maintain the preparedness in the long run is indicated.

Communities are the first responders in case of a disaster and a community-based approach could be effective, as its members have a better understanding on the local needs and their vulnerability. Moreover, starting from a bottom-up approach it is possible to identify the needs and objectives to be set for emergency planning at national level, as planning for a risk is a matter of national policy.

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TSUNAMI HAZARD AND SAND DUNE PROTECTION IN WEST NAXOS ISL., GREECE

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ABSTRACT

The west coast of Naxos Isl. was hit in 1956 by the Amorgos tsunami. This study aims to: a) determine the impact of a potential tsunami similar to the one that occurred in 1956, based on the island's contemporary residential and tourist development, and b) explore whether the natural geomorphs (sand dunes) in the 3 study areas (Glyfada, Agios Prokopios, Chora of Naxos) can reduce the tsunami risk.

Risk assessment was based on processing field data (differential GPS) and satellite images with GIS software. Furthermore, the dunes potential risk reduction has been evaluated.

Results show that taller sand dunes and vegetation provides better tsunami protection to the coast of Glyfada, than the one of Agios Prokopios. Uncontrolled tourism development without any sand dunes protection measures undermine their development and, consequently, increases the tsunami risk.

Keywords: Tsunami, Hazards, Naxos, Sand dunes, ITIS₂₀₁₂

1. INTRODUCTION

Naxos Isl. belongs to the island complex of Cyclades, located in central Aegean Sea. The island geomorphologically is divided into two parts: the east side is characterized by high altitudes and rocky steep coastlines, while the west side present slow and mostly sandy slopes along the coast. This geomorphic peculiarity along with the higher population concentration (both residents and tourist infrastructures) on the west side, increases the tsunami risk in the western coast of the island [3].

The present study focuses on three areas in western Naxos, for which 1956 run-up data are available. Historically recorded events in the wider area of the southern Aegean, proves that the tsunami risk is real and measurable [1], [6], [7]. The most recent tsunami inundation evidence (collected from a sufficient number of witnesses) are run-up values records (one from each study area) from the 1956 event [6], [7]. These past run-up values are projected in the present landscape, on island's current population and tourism infrastructure. In the west coastal zone, in the areas of Agios Prokopios and Glyfada the well-developed dune fields [2] are stabilized by vegetation, and could act as a natural barrier, limiting the tsunami impact [4] [8].

Because of the urban expansion and tourism development, sand dunes exist neither to the south of Naxos nor in the third study area (Chora of Naxos).

This study aims to: a) determine the impact of a potential tsunami similar to the one occurred in 1956, based on the island's contemporary residential and tourist development, and b) explore whether the natural landforms (sand dunes) can reduce the tsunami risk.

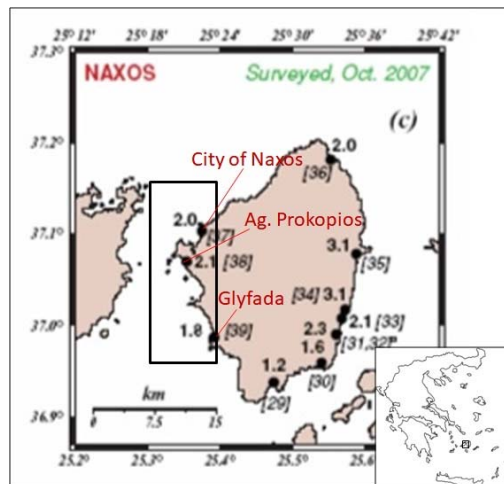


Fig. 1 Tsunami run up sites in Naxos, 1956. With red names are the three study areas in west Naxos. (Modified from Okal et al., 2009)

2. METHODOLOGY

Run-up records are by definition the boundary points of the inundation zone. Based on the historical run-up records, a contour line delimiting the potential inundation zone of each of the study areas has been mapped using GIS software. Satellite images were projected on the map. The resulting maps were compared with 1950s and 1960s aerial photographs.

The potential impacts of a near future event are analyzed based on the 6 main categories of the ITIS₂₀₁₂-Integrated Tsunami Intensity Scale [5].

In order to study the role of sand dunes as a natural tsunami wall, sand dunes heights, slopes and vegetation distribution were mapped using differential GPS.

Finally, using satellite imagery and GIS technology, the high-risk areas, in case of an event similar to the 1956 tsunami were located, mapped, evaluated and categorized against ITIS₂₀₁₂.

3. RESULTS

3.1. Projecting 1956's tsunami event, in Naxos, today

The contemporary satellite image projection on the run-up map shows a significant increase of tsunami risk, in case of a similar to 1956 event.

Given the past run-up measures and based on ITIS₂₀₁₂ criteria's complementary relationship, the impact of a similar to 1956 event is expected as follows:

Tsunami Hazard analyzed with ITIS₂₀₁₂

Impacts on Buildings: Inundation height up to 2 meters affects a significant number of buildings (homes, tourist accommodation and stores). Mainly in Chora of Naxos, tsunami waves could affect buildings located in a zone between 200 to 300 meters from the coast. The impact on buildings is limited to the area of Glyfada, which is clearly more sparsely populated. The vast majority of buildings are RC.

Impacts on Infrastructure: The main road to Chora of Naxos, in the area of Ag. Prokopios is coastal and located in the inundation zone. Power lines are exposed at an altitude of 2 to 5 meters in all three study areas. A public parking area located in Chora of Naxos could also be affected.

Mobile Objects: Mobile objects potentially displaced are small yachts and leisure boats, marine equipment off the coast, cars on the shore between the coast and the lagoon, as well as cars and machines off the coast, catering equipment, store merchandise, luggage, metal plates, protective wooden fences and other light constructions such as wooden kiosks etc.



Fig. 2 & 3 Ag. Prokopios back in 1960 and today (photos from agersaniotis.blogspot.com, protothema.com, Likouropoulos M.), Chora of Naxos and run up zoning

Impacts on Environment: Erosion at these run up values is limited. The impact on Chora of Naxos will be significantly limited as the sandy material along the coast has been covered by concrete in most zones. Higher level of erosion it is possible in Agios Prokopios, than in the Glyfada area. In all areas, finer sedimentation as well as flooding of agricultural areas are expected.

Impacts on Human: Clearly the number of residents and visitors is exponentially increasing throughout the years. Based on the current population density, about 1/7 of the Chora of Naxos population is estimated to be under the risk of injury or death in the inundated areas; that counts for about 1000 people (permanent residents), at any time of the year. This number is higher during the summer when the population on the coast is increased. In the other two study areas the impacts are seasonal, as resident's number is limited.

3.2. Natural Protection from sand dunes lines

The maximum height of the sand dunes along the Ag. Prokopios and Glyfada, exceed 4 and 5 meters respectively above mean sea level. However, in terms of sand dune vegetation there are significant differences between the two areas. In Glyfada, sand dunes vegetation in some places exceeds 2 meters in height, making this natural tsunami wall even more effective, having higher energy-absorption coefficients.

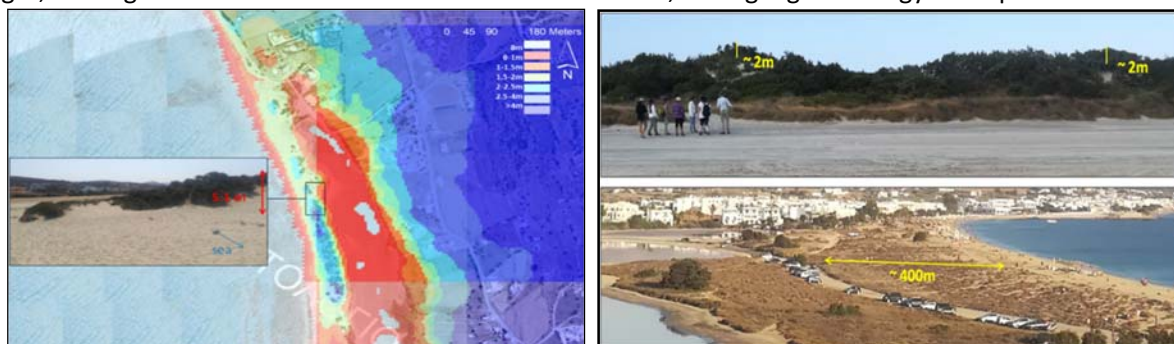


Fig. 4 & 5. Sand dunes in Glyfada area. The blue line (sand dunes line) near the coast is over than 4 meters high. The different vegetation heights and spreading in Glyfada area (top) and in Ag. Prokopios area (down).



In Agios Prokopios area the vegetation height is limited to a few centimeters (<0.60m), except for a few limited sites, where it reached around 1m heights. The width of the vegetation strip is greater than the one of Glyfada.

4. CONCLUSIONS

As expected, the increased presence of humans on the island and its activities increases the impact on all of the ITIS₂₀₁₂ categories. The impact of a potential small/medium tsunami on the West Naxos depends on seasonality. However, in any case it will be not as negligible as in 1956.

Sand dunes can reduce tsunami inundation, as they can partially absorb tsunami wave energy. This depends both on the height of the sand dunes and on the vegetation. In conclusion, the settlement behind the sand dunes in Glyfada is better protected than the one in Agios Prokopios, due to lack of restricting measures for the people and vehicles transition on the sand dunes. Uncontrolled tourism development, without any sand dunes protection measures, undermine their development and, consequently, increases the tsunami risk.

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PRELIMINARY RESULTS FROM SMALL AND LARGE SCALE TESTS FOR AN EARLY DETECTION SYSTEM OF WILDFIRES IN STROFYLIA FOREST

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ABSTRACT

In this paper, preliminary results of small and large scale experiments of an early wildfire detection system under development (THEASIS system) for the Strofyliya forest are presented. The THEASIS system was developed by integrating UAVs, a stationary vision system and a ground station with various software modules. In this paper, the small and large scale experiments and their corresponding results concerning the smoke detection and the coordinate extraction of the fire location algorithms, as well as range tests of the UAV in the Strofyliya forest are presented. The smoke detection method was successfully tested with controlled fires up to 500 m. The coordinate extraction algorithm tested up to 2000 m with a maximum error of 10%. Finally, the minimum flight altitude (35 m) and the maximum distance (4500 m) covered by the UAV in the Strofyliya forest was determined. The preliminary results are promising towards the development of a system for early detection of wildfires.

Keywords: Early detection, wildfires, UAV, smoke detection.

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1. INTRODUCTION AND OBJECTIVE

The effects from the large and reoccurring wildfires are devastating for both natural environment and human communities. Conventional forest monitoring systems based on manned watchtowers have been widely used for the early detection of wildfire starting points. More modern systems are based on satellite-based systems, wireless sensor network-based systems as well as optical and thermal-camera based systems [1, 2]. Towards this direction, the project "SFEDA-Forest Monitoring System for Early Fire Detection and Assessment in the Balkan-Med Area" funded by the Interreg Balkan-Mediterranean program is developing the THEASIS system for early detection of wildfires, which is going to be demonstrated in Strofyliya forest, based on UAVs as well as on ground static cameras. The purpose of the THEASIS system is to offer an early fire detection system,

capable of monitoring and notifying firefighters around the clock, minimizing incidents of fire or arson which could possibly were not suppressed adequately after a delayed mobilization.

The main components of the THEASIS system are the UAVs, a stationary vision system and a ground station that integrates the system and hosts the image processing algorithms, motion planning algorithms and the communication protocol of the components (Figure 1). The conceptual scheme of the THEASIS system was presented in [3] together with a method to evaluate UAV based schemes for early detection of fire monitoring systems. The integrated software modules are based on recent research results in image processing and motion planning of UAVs [4-9]. The image processing algorithms are used for the smoke detection and the coordinate extraction of the fire location while the motion planning algorithms are used to generate flight plans for the UAV. Although, all algorithms are verified by simulation, they must be tested by small and large scale experiments in order to deploy them in the THEASIS system.

In this paper, small and large scale experiments of the image processing algorithms as well as range tests of the UAVs in the Strofyliya forest are presented. The experimental methods and results of the smoke detection and the coordinate extraction algorithms up to 500 m and 2000 m respectively, are presented. Concerning motion planning, the minimum flight altitude as well as the maximum distance covered by the UAV in the Strofyliya forest are determined.

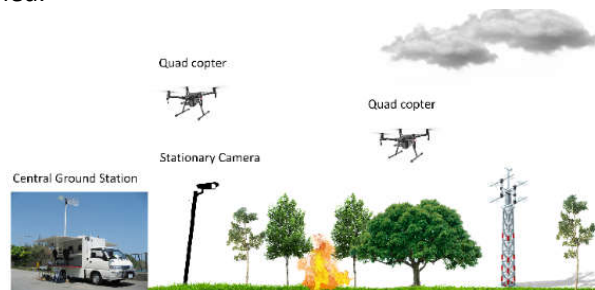


Figure 1. Conceptual design of THEASIS project

2. EXPERIMENTAL METHODS

The purpose of these experiments is to certify the capability of autonomous operation of the THEASIS system in a forest environment. In this paper, the results of the small and large scale testing are presented to indicate the capabilities of the proposed coordinate extraction, fire/smoke detection and UAV motion schemes. The experiments were conducted using the Tonbo EOD-100-IREX optical system, the DJI Matrice 210 quadcopter equipped with the Zenmuse X5s optical camera, the Zenmuse XT thermal camera and TB55 batteries and operated with the DJI Cendence GL800A remote controller. The main experiments that are presented are the following:

- Smoke detection by the stationary camera. The detection problem is based on a video-based technique that models smoke's motion making use of the temporal change of smoke's area and shape [11]. Small scale smoke detection experiments are conducted in quasi-operational conditions involving controlled fire scenarios in an urban tree area, under different weather conditions and combustible materials. The controlled fires and/or smoke generation locations were placed at distances ranging from 100 to 500 m away from the stationary camera to test the capability of the algorithm in identifying smoke and/or fire.
- The coordinate extraction of the fire location by the stationary camera is based on the following three assumptions: (a) The planarity of the scene, (b) the pin-hole camera model and (c) and the parallelism of the horizon and the horizontal field of view. A three parameters model for the mapping of the scene's depth onto the image plane is used to determine the coordinates [12]. The proposed coordinate estimation scheme was tested in Strofyliya forest with UAV estimated points for a range of distances (100 m, 500 m, 1000 m, 2000 m) and pan, tilt directions in real environmental conditions.

- Manual range tests. The purpose of this test was to evaluate the telemetry range in Strofyliya forest. Although the maximum range is limited in Greece to a maximum of 4.5 km, the telemetry depends on the location, the presence of electromagnetic fields on site, the weather and finally by the frequency of communication (2.4 & 5.8 GHz). The 2.4 GHz frequency was chosen for the experiments due to its strong penetration ability. Two autonomous flights above the largest forest canopy of Strofyliya at two different altitudes (25 m and 35 m) were executed. The initial point of the path was located near the fire tower of the Strofyliya forest (lat N 38.101738, long E 21.345660) and the UAV had moved along a straight line in a South-South West direction over the forest. The number of incidents concerning video or signal transmission interference are recorded during the mission. In case of communication loss, the mission is terminated, and the UAV returns to its home position (starting point of the mission) by default.

3. RESULTS AND DISCUSSION

Concerning the smoke detection the algorithm performed well, fully exploiting the increasing size of smoke's area, as well as the change of its shape as time evolved (Figure 2a). Concerning the coordinate extraction algorithm the worst relative estimation error was smaller than 10% (Figure 2b). With respect to the range tests, the results shown that the UAV was able to maximize its safe and controllable flight distance up to 4.5 km, when it flew at an altitude of 35 m (Table 1). The first signal interference was detected at 4.4 km that is very close to the maximum distance. The battery measurements showed that a fully charged drone can cover the longest distance path of 4.5 km, using 40% of the battery's capacity. The maximum battery temperature was 39 °C. According to measurements a fully charged drone will be able to execute 2 distant paths with safety. The UAV moved with the maximum horizontal speed (15 m/sec) reaching the maximum distance (4.5 km) in less than 6 min. During the 25 m altitude mission, the first interference occurred at 1.8 km and multiple interferences (low communication signal, low quality video stream) occurred at 3.2 km. Loss of communication occurred at 3.8 km where the return home function was activated.

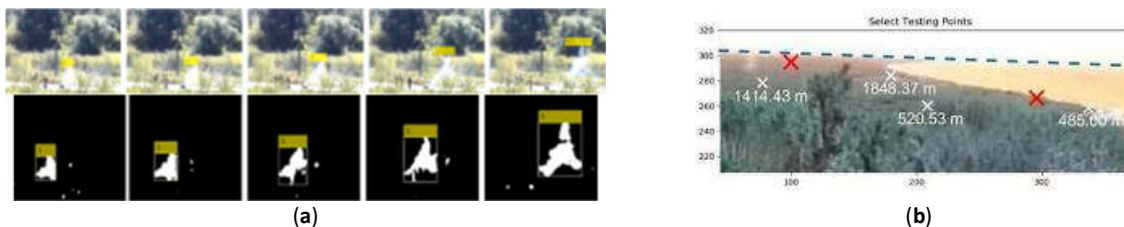


Figure 2. (a) Change in area of smoke's region as time evolves in successive video frames and the corresponding binary masks used for the detection of smoke (b) Coordinates estimation. Horizon (blue line), pair of corresponding points used for the fitting of model (red points) and estimated depth for four different points of the scene (white points)

4. CONCLUSIONS

In this paper, the preliminary results of small and large scale experiments of the THEASIS system were presented. Specifically, results from the smoke detection algorithm as well as coordinate extraction algorithm were presented. The smoke detection method was successfully tested with controlled fires located at distances ranging from 100 to 500 m away from the stationary camera. The coordinate extraction algorithm tested in the Strofyliya forest for distances up to 2000 m with a maximum error of 10%. Finally, the range test in the Strofyliya forest showed that the UAV can reach the maximum distance of 4.5 km by flying in 35 m altitude without significant signal interferences. The preliminary results were promising towards the development of the system for early detection of wildfires. Future work includes extensive tests in the Strofyliya forest of all components as well as complete performance tests of THEASIS system.

Table 1. Autonomous flight with height -5 and 15 m down of take-off point in hill

Flight Distance	Altitude	Signal Interference
1800 m	25 m	1
3200 m	25 m	Multiple
3800 m	25 m	Out-of-range
4400 m	35 m	1
4500 m	35 m	Out-of-range

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STUDY OF FLOOD VICTIMS' BEHAVIOR AGAINST FLOOD THREAT

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ABSTRACT

Floods are one of the most lethal natural hazards in the Mediterranean region and worldwide. Although previous works on flood mortality examine various situational and demographic factors, there is only sporadic evidence on the behaviour of victims. This work focuses on analysing this behaviour based on the victims' reported actions, to provide a better understanding on their overall stance and investigate potential correlation with other factors.

Results show that the majority of victims enter deliberately in floodwaters, while they are in an initial position of safety. There is a noteworthy percentage (although it is the minority of cases) in which victims exhibit a passive stance, mostly in incidents where they are trapped inside buildings. The victims' behavior presents statistically significant correlations with their demographic details, the use of vehicles, the surroundings (indoor or outdoor incidents). Overall, results indicate that additional efforts should be made to reduce the high percentage of risk-taking actions, especially concerning vehicle occupants.

Keywords: flood deaths, behavior, Greece, stance, mortality

1. INTRODUCTION

Flash floods are one of the most deadly flood types, inducing a large number of fatalities around the world on a yearly basis. Due to their nature (rapid onset), flash floods provide little time for individuals to react and take preventive actions to avoid danger, testing both individuals and authorities preparedness levels.

Flood mortality has been examined by several works, studying large numbers of fatalities caused by a single or a series of events, exploring a number of factors that affect the risk of individuals during floods [1], encompassing mostly situational and demographic variables. An important factor that has not been extensively explored is the behavior of individuals against the imminent risk. However, recent incidents have shown documentary evidence that individuals deliberately entered floodwaters.

In addition, there is multiple evidence of dangerous risk-taking behavior reported in previous studies [2], [3], [4] with reports of individuals ignoring or even removing relevant warning signs [5] or standing dangerously close to raging water to observe the phenomenon [4]. Staes et al. [6] reported cases of victims that decided to enter floodwaters despite warnings of bystanders and official personnel by removing or driving around roadblocks and barricades. Coates [7] reports incidents, during which individuals entered floodwaters pursuing recreational interests, suggesting that victims' behavior shows a lack of understanding of inherent dangers.

Although, the risk-taking stance has been acknowledged for over two decades in literature, there is very limited work focusing and analyzing this behavior.

In this context, this work aims to explore the stance of victims by developing a classification system based on their reported actions. The study aims to provide an objective definition of what is "active" and what is "passive" or "protective" behavior and to examine whether it is connected to any other situational, environmental or demographic variables.

2. MATERIALS

This work exploits the database of 216 flood fatalities in Greece, developed by Diakakis and Deligiannakis [3] covering the period 1970-2010 and extended in subsequent studies to 1970-2018. Each entry of the database corresponds to one fatality, with variables that are used to describe the circumstances, the environment and the actions of the victims at the time of the incidents, as well as their demographic characteristics as shown in detail in the above study.

The basic distinction made in previous works, follows a basic question set by multiple authors that is whether a fatal incident was caused by a careless or risk-taking behavior or under the formed circumstances the victim was left with no options to escape danger. Following this very division, this study divides the victims in 3 major groups:

- i) Group of Deliberate Active (DA) behavior: The victims who deliberately and/or voluntarily came in contact with floodwaters, while being in an initial position of safety. This category does not include individuals who came in contact with floodwaters because they were forced by someone, or they were fleeing from danger, but only the ones for whom this contact was the result of their decision.
- II) Group of Forced- Active (FA) behavior: This group comprises of victims that while in a position of reducing safety (e.g. their house is flooding), they refuse to evacuate while still possible and eventually die as a result of a deliberate contact with floodwaters.
- ii) Group P (stands for Passive): The victims that came in contact with floodwaters inadvertently, while at their initial position, safety was compromised or was in decline.

3. RESULTS

Amongst 173 fatalities for which information on their stance was available, a sum of 127 can be categorized in the spectrum of “deliberately active” stance, out of which a large part (74) consisted of people that voluntarily entered floodwaters to reach a destination. On the other hand, in 44 cases victims exhibited a passive stance, out of which a large portion 24 were unaware of the flood threat until it was impossible to evacuate.

With respect to the surroundings in which the studied incidents occurred, it was found that behaviors in the realm of active stances were exhibited mostly in outdoor environments (123 out of 129 cases). Examination of victims’ gender shows differences in the male/female ratio when considering different types of stances. In the active stances group, males are the vast majority of victims, with a ratio of 3.6 to 1. In the group of victims who exhibited behaviours that belong to the realm of passive stance, males are again the majority but with a much lower ratio (approximately 1.4 to 1).

With respect to the age of the victims, it was found that individuals that passed away as a result of an active stance were in average younger by a significant margin than the ones that died exhibiting a passive stance (44 years old against 63.2 respectively).

In relation to the use of vehicles, it was found that the majority of fatalities characterized by active stance was vehicle-related. On the contrary, only a small number of passive-stance fatalities incorporated a vehicle. As far as the mortality-magnitude of the flood event is concerned, it appears that high mortality events (>10 fatalities) are characterized by more passive-stance fatalities than smaller ones, leading to an impressively different ratio between the two categories.

Overall, results show that flood victims coming in contact deliberately with floodwaters is not the exception, but the majority of cases. For different reasons or with different motivations, a large percentage of related fatalities derives from individuals that while in an initial position of safety, or while having other safer options, decide to enter floodwaters probably underestimating the risks. Males, younger individuals and vehicle occupants exhibit higher percentages in these type of active-stance incidents, which mostly occur outdoors and outside the urban fabric. On the other hand, passive-stance incidents occur mostly indoors, with victims



being older by average. The findings indicate that additional efforts should be made to reduce the high percentage of risk-taking actions, especially concerning vehicle occupants and individuals who drive/walk near floodwaters or observe floods from what they think is a safe distance. Given the findings, educational programs should be used to strengthen people's awareness of the risks and warning signs should be posted in high-risk locations.

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PUBLIC AWARENESS, INFORMATION AND TRAINING FOR NATURAL AND TECHNOLOGICAL DISASTERS

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ABSTRACT

In this study, the level of public awareness and information and training on natural and technological disasters in Greece is examined as well as the challenges that arise in the new era. The study includes literature review and field research. A special research instrument (questionnaire) was formed for the purpose of conducting the field research. The field research and the literature review indicate the factors that contribute to the public awareness on natural and chemical disasters (previous experience of a disaster, general knowledge, house location etc). They also indicate low level of public information concerning issues of prevention and guidance for self-protection. The level of the training on related issues is even lower. A very small percentage of the respondents have participated in a regional evacuation drill. The subjective assessment of the respondents concerning the level of preparedness in case of natural and technological disasters shows that the majority believes that it is “not at all” or “little” prepared. A high percentage of the respondents consider that being informed through new technologies is important.

Keywords: Public awaireness, public information, emergency response, civil protection

1. INTRODUCTION

The natural disasters such as forest fires, earthquakes, floods, strong winds as well as major accidents involving dangerous substances (fires, explosions, toxic releases), can directly affect human health through injuries, death and disease outbreaks and they can cause severe environmental and infrastructural disruption [1,2,3,4]. Longer-term impacts may include noncommunicable diseases, psychiatric morbidity and disabilities. A significant aspect is a technological accident to be triggered by a natural hazard or disaster which is commonly referred to as NATECH accident [5,6].

In the framework of protection measures against similar technological or natural hazards, both the legislation and the international practice include the land use planning, some prevention measures in every area and industrial plant and also an emergency response plan [2,7,8]. One of the most important aspect of emergency planning and response decision-making is the assessment of protective actions for the population. Such actions are evacuation or sheltering in-place, provision to the population with protective equipment (respiratory protection, clothes) or with specific agent antidotes (e.g. iodine tablets in case of a nuclear accident). The best solution is not unique when multiple criteria are taken into consideration (e.g. health consequences, social disruption etc) [9,10].

In any case, informing people and preparing them for every emergency situation is of primary importance. In this context, some relevant legislative provisions are included, such as the information and participation of the public according to the Seveso III Directive [11,12,13,14]. Occupational safety and health procedures can contribute to the prevention of natural and technological disasters, as well as, to the preparation of emergency plans, by promoting training and safety culture policies to workers and the public [15,16,17].

In this study, the level of public awareness and information and training on natural and technological disasters in Greece is examined as well as the challenges that arise in the new era.

2. METHOD

This study includes literature review and field research. A special research tool (questionnaire) was formed in order to conduct the field study. This was established by a scientific team of two engineers, a sociologist and a statistician. Results from relevant researches were taken into consideration, while forming this research tool, regarding the investigation of the level of public awareness on emergency situations and on natural and technological disasters in particular [18,19,20,21,22,23]. With the use of the research tool, data was collected regarding the demographic characteristics of the examined sample.

A pilot questionnaire was introduced twice to a heterogeneous sample of 30 people so as to measure the level of comprehension, acceptance and interpretation. After doing all the necessary adjustments, the questionnaire was distributed to the public. The sample under study consists of adults of both sexes, all ages and education level. For the use of the research tool, all terms concerning the personal data protection were complied under the country's legislation. The questionnaire was distributed with two different ways, via a web platform and in person using printed forms. More than 1400 questionnaires were collected.

In this paper, the results of the study concerning the natural and technological disasters are presented. Certain parameters were examined such as the place of residence whether it is close to a forest or to industrial areas, the level of public awareness, the previous experience from natural and technological disasters, the information which was provided to the public from the authorities, the training needs, the way that people prefer to be informed etc.

The under study sample is considered to be a sample of the general population during time. Based on this condition statistical tests were conducted in the "sample". The confidence level used was $\alpha=0.05$ in order to prove the statistical significant differences.

3. RESULTS AND DISCUSSION

The literature review and the results from the field research show low level of the information provided to the public concerning issues of prevention and guidance for self-protection in case of natural and technological disasters. The level of the training on related issues is even lower. A very small percentage of the respondents have participated in a regional evacuation drill close to their residency.

Factors that affect the level of public awareness are the previous knowledge and information on related issues and especially the experience from a similar disaster (mainly incidents that occurred in Greece such as earthquakes, floods and strong winds).

The subjective assessment of the respondents concerning the level of preparedness in case of natural and technological disasters shows that the majority believes that it is "not at all" or "little" prepared. The issue of earthquake preparedness stands out, where the percentage of those who replied that they believe they have been "much" or "very much" prepared is higher, compared to other disasters such as forest fires, major industrial accidents, strong winds and floods. Despite that, the percentage of the respondents who believe that they are "not at all" or "little" prepared for earthquakes remains higher, compared to the percentage of the respondents who believe that they are "much" or "very much" prepared.

Regarding the way to receive information for being prepared in case of an emergency situation, all options are answered with high percentage, with the exception of the newspaper and the radio. The most popular way of being informed is via internet. Another significant finding is that a high percentage of the respondents consider that being informed through new technologies is important (training through visual reality, webinars, social networks, mobile applications). Nevertheless, the informative speeches as well as the training seminars also got high percentage according to the respondents' answers.

Depending on the house characteristics (location, type of building etc), different issues of emergency situations concern the respondents. It was initially proved that, as expected, the primary concern of those living close to forests was fire (statistically significant). Also, those who reported that their house was close

to an industrial zone they were “much” or “very much” worried about a potential major industrial accident. Furthermore, those whose house were in the first floor or higher in the building, had natural gas heating system and were close to an industrial area were “much” or “very much” worried about a potential earthquake.

Concerning the way of receiving information in real time while the natural or technological disaster is in progress, the majority of the respondents mentioned that they prefer to be alerted on their mobile device via sms. A significant percentage of the respondents prefer to be informed via internet and a warning siren sound, instead of alternative ways such as the TV, radio or fixed telephone.

4. CONCLUSIONS

The field research and the literature review indicate the factors that contribute to the public awareness on natural and chemical disasters (previous experience of a disaster, general knowledge, house location etc). They also indicate low level of public information concerning issues of prevention and guidance for self-protection. The level of the training on related issues is even lower. A very small percentage of the respondents have participated in a regional evacuation drill. The subjective assessment of the respondents concerning the level of preparedness in case of natural and technological disasters shows that the majority believes that it is “not at all” or “little” prepared. A high percentage of the respondents consider that being informed through new technologies is important.

The basic priorities of all the stakeholders in order to raise public awareness and provide relevant information and training on natural and technological disasters are indicated, especially by taking into account the technological changes and innovations.

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INTERRELATION BETWEEN OCCUPATIONAL HEALTH & SAFETY LEADING AND LAGGING INDICATORS IN GREEK MINING INDUSTRY. AN EMPIRICAL STUDY

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ABSTRACT

Mining industry, as any other industry, relies on indicators to measure health & safety performance. Organizations typically measure performance to determine whether objectives or targets are being met as well as the effectiveness of the implemented health & safety management system or program. In order to do so they involve either outcome measures (lagging indicators) and process indicators (leading indicators) of performance. Lagging or outcomes indicators have been used for some time in the mining industry to track when damage, injury or harm has occurred, in an attempt to introduce measures that will prevent future harm. Leading or activities indicators measure the direct and indirect precursors to harm, and give advance warning before an event occurs that might lead to an undesired outcome, providing an opportunity for preventative action to be taken. General models for measuring occupational health & safety performance using lagging and leading indicators have been developed worldwide. The longitudinal measurement of leading and lagging indicators will also provide a more robust understanding of the relationship between leading and lagging indicators which is often not known. Conducted researches demonstrated that positive performance indicators (leading indicators) are very well correlated with the rate of accidents at work (lagging indicators).

Keywords: leading indicators, lagging indicators, mining, trend, health & safety

1. INTRODUCTION

Occupational health and safety (OHS) performance measurement is an important part of the management of OHS. The measurement of OHS performance enables the detection and resolution of problems and provides information needed to evaluate the effectiveness of organizational OHS initiatives. This empirical study, based on published health & safety data of the Greek Mining Enterprises Association for the period 2009-2018 [1], investigates the correlation between leading and lagging indicators in Greek mining industry.



2. LEADING AND LAGGING INDICATORS

Leading indicators (also referred to as pro-active, positive or predictive indicators) [3], [5] focus on future health and safety performance with the intent of continuous improvement. They are indicators that can give advance warning about what might be going wrong. They can be used to measure activities undertaken to positively impact the performance in the workplace, and to identify problem areas where additional preventative action is required.

Lagging indicators (also referred to as re-active or outcome indicators) [5] measure the end result of OHS processes, policies and procedures. They document things that have already happened. Since they record things after the incident, they promote a reactive health and safety culture. They measure negative or unwanted outcomes such as injuries, illnesses or deaths [2]. They are also referred as outcomes indicators as they measure the final outcomes.

Using leading indicators, mining companies can identify whether proactive risk-lowering decisions and actions are being effective, and why a desired result has or has not been achieved (as measured by a lagging indicator). In this way, leading and lagging indicators together trace cause and effect pathways [3].

Many safety professionals argue that tracking leading indicators is a more effective way of improving safety performance than lagging indicators. Lagging indicators measure what has already happened (e.g. number of incidents, days away from work), while leading indicators measure proactive, preventative, and predictive initiatives before incidents happen (training, safety meetings, number of observations, etc). While leading indicators provide a better measure of safety performance, lagging indicators are also helpful because they can be used to evaluate leading indicators as well as health & safety management system effectiveness. A successful occupational health and safety management system needs them both. Without lagging indicators, it would be difficult to know whether leading indicators were effective. It is helpful to compare leading indicators to lagging indicators to determine their effectiveness, and see whether they're driving the right behaviour and reducing risk. If you keep achieving leading targets but lagging results are not improving, that means either you're measuring the wrong things or you have procedures issues. Correlations between leading and lagging indicators evaluates the effectiveness of the former. This can help determine if an organization's leading indicators are providing meaningful information that can lead Organization's informed decisions. The ideal situation is:

Leading indicators	UPWARD (Good input) 	Lagging indicators	DOWNWARD (Good output performance) 
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3. RELATIONSHIP BETWEEN LEADING & LAGGING INDICATORS OF GREEK MINING COMPANIES

For the purpose of this paper we are considering as leading indicators:

- Training hours per employee
- % of OHSAS-certified companies (members of the Greek Mining Enterprises Association)
- % of employees under predictive medical examinations
- safety climate & safety culture

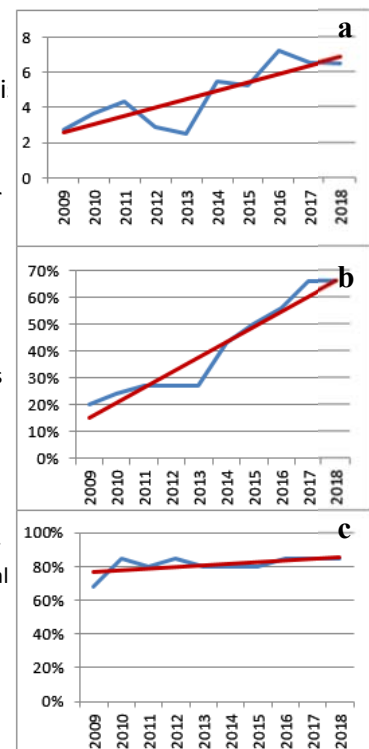
taken by the published data of the Greek Mining Enterprises Association for shown on Table 1.

The following diagrams presents the aforementioned data.

Table 1: Leading indicators of Greek mining companies [1]

	Training hours per employee	% of OHSAS-certified companies	% of employees that are periodically under medical supervision
2009	2,71	20%	68%
2010	3,66	24%	85%
2011	4,38	27%	80%
2012	2,88	27%	85%
2013	2,55	27%	80%
2014	5,49	43%	80%
2015	5,23	50%	80%
2016	7,27	56%	85%
2017	6,53	66%	85%
2018	6.5	66%	85%

Figure 1:
(a) Training hours per employee;
(b) Percentage of OHSAS-certified companies;
(c) Percentage of employees under periodical medical supervision



As it is obvious from the above diagrams the trend for leading indicators is "upward". Increase of percentage of OHSAS-certified companies indicates a shift to improved safety culture. Implementations of occupational health & safety management systems such as OHSAS 18001 creates a basis for a systematic approach in the area of OHS documented policies and procedures, detailed working instructions, audits at planned intervals, management reviews, explicit roles and responsibilities, preventive and corrective actions and measuring and monitoring of results. All the aforementioned combined with an increase in safety training hours per employee as well as periodical medical supervision of employees, leads in improved results in occupational health and safety as it is shown through the following lagging indicators.

For the purpose of this paper we are considering as lagging indicators:

- Accidents Frequency Rate Index
- Accidents Severity Rate Index
- Number of Fatal Accidents

taken by the published data of the Greek Mining Enterprises Association for the period 2009-2018 [1] as it is shown on Table 2. The diagrams present the aforementioned data.

Table 2: Lagging indicators of Greek mining companies [1]

	Frequency Rate Index	Severity Rate Index	Number of fatal accidents
2009	5,01	136,38	7
2010	5	99,52	0
2011	4,39	100,78	3
2012	3,07	69,81	2
2013	2,76	90,4	3
2014	3,81	156,69	5
2015	3,32	96,19	3
2016	3,25	99	3
2017	4,1	110,96	2
2018	3,26	114,66	0

As it is obvious from the diagrams the trend for lagging indicators is “downward”.

To summarize the results, we can use as a rule-of-thumb that when leading indicators increase, lagging indicators must decrease; or, in other words, if a company want to decrease lagging indicators, (OHS) management should take steps to increase the appropriate leading indicators.

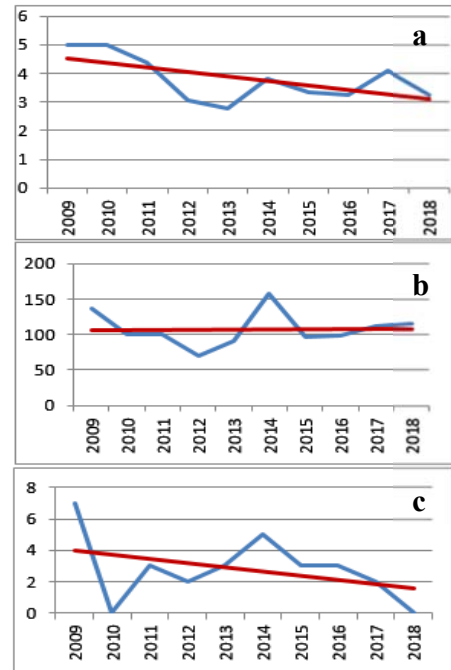


Figure 2: (a) Accidents Frequency Rate Index; (b) Accidents Severity Rate Index; (c) Number of fatal accidents

4. THE CASE OF A LARGE MINE

The above mentioned correlation between health & safety leading and lagging indicators, is confirmed in the case of a large open-pit mine operated by Public Power Corporation of Greece (the largest member of the Greek Mining Enterprises Association), which has been certified according to OHSAS 18001 requirements since the mid of 2014 and employed about 1.000 people [4]. Within that framework, leading indicators -such as safety training, number of safety audits contacted and number of employees that are periodically under

	Leading indicators			Lagging indicators		
	Training hours per employee	Safety audits	Number of employees that are periodically under medical supervision	Accident Frequency Indicator	Accident Seriousness Indicator	Number of accidents
2010	-	14	77	4,94	101	9
2011	-	12	44	4,46	91	8
2012	8,3	8	105	7,89	184	13
2013	10,8	20	52	4,85	97	8
2014	8,3	32	154	4,66	92	8
2015	9,7	42	364	2,19	58	4
2016	9,6	55	537	5,65	77	10
2017	11	55	424	1,88	46	3

medical supervision- through the period 2014-2017 had an “upward” trend as Figure 3 depicts, while lagging indicators - such as Accident Frequency Indicator, Accident Seriousness Indicator and number of accidents- had a “downward” trend as Figure 4 depicts [4].

The diagrams present the aforementioned data for leading indicators.

As it is obvious from the following diagrams the trend for leading indicators is “upward”. The diagrams present the aforementioned data for lagging indicators.

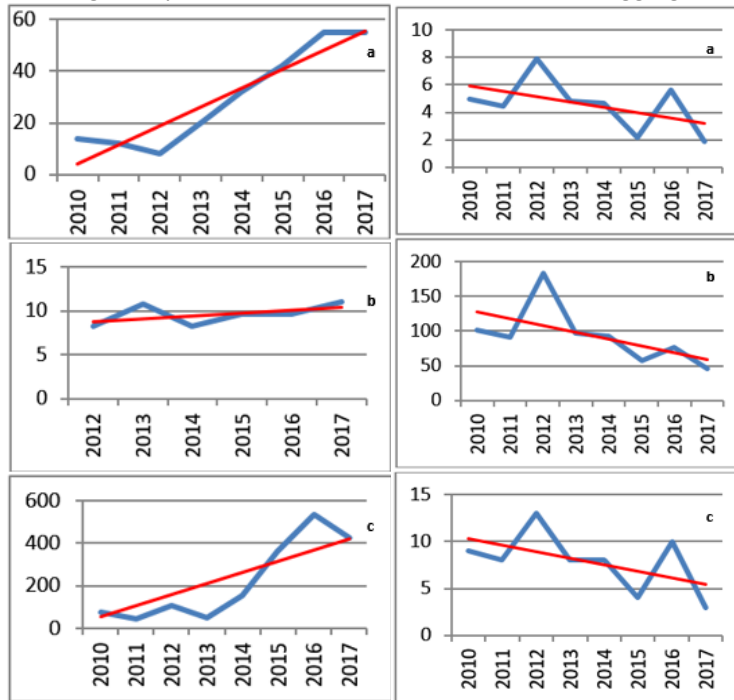


Figure 3: (a) Safety audits; (b) Training hours per employee; (c) Percentage of employees under periodical medical supervision

Figure 4: (a) Accident Frequency Indicator; (b) Accident Seriousness Indicator; (c) Number of Accidents

As it is obvious from the diagrams the trend for lagging indicators is “downward”. This strong relationship between lagging and leading indicators show that the proactive actions taken were at the right direction and considered as effective.

5. CONCLUSION

Setting as a target the continuous increase of appropriate leading indicators one can safely assume that lagging indicators will decrease in the long run. This paper is the threshold to a more extensive study of the correlation between leading and lagging indicators by using detailed data of leading indicators from mining companies and correlate them with historical data of lagging indicators through the use of appropriate statistical techniques. Management efforts should be focused on frequently used leading indicators of precursor circumstances. Leading indicators contribute to an organization's

ability to develop appropriate proactive action strategies to prevent harm while the results are measured through lagging indicators. Increased leading indicators targets should correlate, over time, with decreased lagging indicators values; this correlation best documents Organization's continuous improvement. The sensitivity of the outcomes (as measured through lagging indicators) to the various leading indicators can be difficult to determine. Thorough research among mining companies through the use of statistical techniques with appropriate data, warrants further studies in the future.

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U-Geohaz PROJECT, GEOHAZARD IMPACT ASSESSMENT FOR URBAN AREAS

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ABSTRACT

U-Geohaz (Geohazard impact assessment for urban areas) is a two-years project that is focused on monitoring geohazard-associated ground deformations, a key prevention action that will be specifically addressed to urban areas and critical infrastructures. The project will propose a procedure to produce maps to assess continuously the potential impact of geohazard activity. These maps will provide essential inputs to support early warning, giving information on the stability of the monitored areas and to evaluate the expected damage. In particular, the project will provide tools to support early warning (EW) systems for landslides and rock-falls, and an EW system for volcanic geohazard. The main output of the project will be the development of new products for multi-geohazard prevention purposes and the validation of its potentialities by implementing their use in the involved Civil Protection Authorities (CPAs). It is a project co-funded by the European Commission, Directorate-General Humanitarian Aid and Civil Protection (ECHO), under the call UCPM-2017-PP-AG - Prevention and preparedness in civil protection and marine pollution (UCPM-2017-PP-AG – 783169 U-Geohaz).

Keywords: Geohazards, monitoring, Sentinel 1.

1. INTRODUCTION

U-Geohaz project (UCPM-2017-PP-AG – 783169) is co-funded by the European Commission, Directorate-General Humanitarian Aid and Civil Protection (ECHO), under the call UCPM-2017-PP-AG started on January the 1st and now runs towards the end (31/12/2019). It is a two-years project that is focused on monitoring geohazard-associated ground deformations, a key prevention action that will be specifically addressed to urban areas and critical infrastructures. The project is led by Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) 18 beneficiaries that come from 11 countries. Twelve of them are Geological Surveys and three Civil Protection Agencies. Main target is to provide maps, based on Sentinel-1 / 6-days ground deformations monitoring, to assess continuously the potential impact of geohazard activity to urban areas and critical infrastructures and to be used as key inputs to support early warning.

2. U-Geohaz BACKGROUND

U-Geohaz is the natural extension of the previous ECHO project Safety. U-Geohaz goals will be achieved by fully exploiting the results obtained in SAFETY. In particular, U-Geohaz aims to advance with respect to SAFETY. The project will provide tools to support early warning (EW) systems for landslides and rock-falls, and an EW system for volcanic geohazard.



3. TARGETS

The 1st target is to provide maps, based on Sentinel-1 6-days ground deformations monitoring, to assess continuously the potential impact of geohazard activity to urban areas and critical infrastructures and to be used as key inputs to support early warning.

The 2nd target is to develop an early warning system for rockfall geohazard based on database and rainfall thresholds.

The 3rd target is to strengthen the interaction between CPAs and Geological Surveys in Europe, with the aim of contributing to improve their cooperation. To this purpose 12 geological surveys have been involved with direct relation with their corresponding CPAs and a survey has been implemented in order to provide a better understanding of the relations between GSs and the corresponding CPAs in the different European countries. U-Geohaz products performance will be demonstrated to the GSs and the CPAs from the participating countries. Moreover, a thorough evaluation of the integration of geohazard into urban planning to increase urban resilience in Europe will be contacted.

4. RESULTS

The U-Geohaz activities has been developed in two different test sites: (1) The Valle d'Aosta site, an area of the North-West Italy prone to landslides and with some active Deep seated gravitational Landslides affecting critical infrastructures and urban areas and (2) the Canary Islands, an active Volcanic archipelago located in the south west of Spain that also has areas with high susceptibility to rock falls. The main results of the project are reported on the web page of the project (<https://u-geohaz.cttc.cat/>). Among others, U-Geohaz has successfully reached the following goals:

- Improvement of the methodology developed in Safety to provide reliable 6-day updates of deformation activity maps bases on Sentinel-1 [1].
- Developed a methodology to produce risk maps based on deformation activity maps, exposure to active geohazards and vulnerability [2].
- Estimation of a Rainfall thresholds for Canary Islands area [3].
- Production of deformation activity maps, Active deformation areas map and Risk maps of different areas of Valle d'Aosta [1].

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ANALYSIS OF BLEVE SCENARIO IN THE LPG TANK: A CASE STUDY AT THE KAMENA VOURLA INCIDENT

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ABSTRACT

This paper studies the Consequence Analysis and the PROBIT Method over a BLEVE scenario. The procedures of analysis are included in design standards - safety codes and represent guidance to comply with the regulations on the control of major hazards in the USA and in the European Union (EU). A specific case study at the Greek Southern territory has been analyzed which corresponds to the Kamena Vourla LPG incident. At Kamena Vourla the BLEVE scenario took place on a tank truck filled 85% with 18 tons of LPG which is very close to 40000 liters. The results and conclusions are reported at this study.

Keywords: LPG, BLEVE, Risk, Consequence Analysis, PROBIT Method.

1. INTRODUCTION

There is no doubt that technology has played a major role in improving the processes in the transport of dangerous goods. However, technology also have led to the complexity on the transport processes[2]. With technological advances, the safety measurements have been increasing constantly in order to avoid accidents or be ready to face the risks in case an incident have occurred, in industrial terms we talk about incident reduction and accident prevention, but unfortunately, risk cannot be totally eliminated as it is always important to take into account the possibility of a human error to occur. So, an important safety measurement would be to use extreme caution when dealing with hazardous materials. A hazard is an intrinsic physical, chemical, societal, economic or political condition that has the potential to cause damage to a risk receptor (people, property or the environment). A hazardous event requires an initiating event or failure and then either failure of or lack of safeguards to prevent the realization of the hazardous event. A risk is a measure of human injury, environmental damage or economic loss in terms of both the frequency and the magnitude of the loss or injury.

On the eve of public holidays, it is customary that the Greek police ban traffic trucks on the entire road network. On the eve of April 30, the police arrested a truck tank containing 18 tons of LPG near the town of Kamena Vourla. Shortly after, a van comes to hit the truck to the rear, causing a leak of LPG which immediately ignites. Thirty minutes later, a vehicle fire just takes position 5 m from the tank, a BLEVE occurs. Witnesses reported the formation of a Fire Ball about 100 m radius and 150 m high. Large drops of liquid LPG fire showered over distances of 300 to 400 m. The tanker truck and firefighters completely disintegrated. Large fragments are found at distances of 200 to 300 m (driving the fire truck was found at 250 m). The LPG tank is projected into a one piece in a remote building of approximately 500 m, demolished the roof and landed 300 m away, or at a distance of 700 to 800 m from the explosion. The accident is four people, including a person beheaded by a fragment at 400 m from the explosion. People located 300 m from the accident injured by burns. In this paper we did an incident analysis of BLEVE Scenario in the LPG Tank using the method of consequence analysis. Moreover, we use the PROBIT Method for Estimating Consequence Level. Finally, we compare the theoretical results with the real ones.

2. METHODOLOGY

In this paper, we examine the methodology for evaluating the consequences of BLEVE events resulting from LPG vessels (with safety valves) that fail due to fire.[1, 2, 3,4, 5, 6, 7, 8, 9 & 14]

Moreover, we use PROBIT equations which are available for a specific health consequences as a function of exposure. These equations were developed primarily using animal toxicity data. It is important to acknowledge that when animal population are used for toxicity testing, the population is typically genetically homogeneous – this is unlike human population exposed during a chemical accident. This is a source of uncertainty when using PROBIT equations. In a hazard assessment which is taken to the point of determining the risk to the public it is necessary to estimate injury in the area around the hazard source. In order to do this it is necessary to be able to estimate first the intensity of the physical effect such as heat radiation, explosion overpressure or toxic dosage as a function of distance, and then the probability of injury as a function of this physical intensity. [10, 11, 12, 13 & 14]

3. RESULTS and DISCUSSIONS

Prevention of accidents through the utilization of appropriate technologies is required before any transportation of chemicals or other flammable materials. Such technologies can be applied computationally by experimental procedures, resulting to better and more accurate decisions, regarding the overall measures required to prevent fatalities. Still, human errors are always considered as an unmeasurable parameter able to lead to undesired events. Such incidents can have a minor impact to human life but occasionally can cause death. Boiling Liquid Expanding Vapor Explosion or BLEVE is a common phenomenon used to describe accidents caused by the explosion of Liquefied Petroleum Gas (LPG) tanks. These explosions are among the most fatal and can have visible effects up to a kilometer radius. In case of a BLEVE scenario, mathematical analysis and calculations of the consequences at various stages are necessary. Mathematical modeling of the BLEVE phenomena can calculate the Heat radiation from a fireball, the Overpressure of the blast wave and the Distances for vessel fragments thrown away.

Estimated results, that have been calculated in order to analyze a real BLEVE scenario, can differ greatly when are approached theoretically. Nevertheless, these calculations are apparently needed, considering the fate of future confrontation of such incidents. The usage of Probit method (or probability unit) was developed to provide a linear relationship between dose and response. This probabilistic method provides a link between the portions of the exposed population to a BLEVE scenario and the probability of occurrence regarding the dose of the liquid.

Considering Kamena Vourla accident, calculated probabilities regarding the overall effects of thermal radiation of the fireball and blast's overpressure, are compared with real results, to determine any ability to measure effects and define better prevention methods. Probit analysis was used to evaluate the effects of a BLEVE, especially distances over casualties and injuries probabilities.

3.1 Comparison of Theoretical and Real Results

The accident in Kamena Vourla had a devastating outcome in human life with both fatalities and injuries. The tanker truck that was hit by a van, blew up occurring a BLEVE. Considering the approximate time, a BLEVE can occur, corresponding firefighters were significantly late, approaching the area of the accident 30 minutes after the ignition of LPG. This resulted in 4 counted deaths including civil officers on-site and injuries to people located nearby.



Figure 1. : Map of the incident

Experimental calculations on BLEVE, by the use of Probit method, focus on two main parameters, the thermal Radiation Intensity of the fire, before and after the blowout, and Overpressure from the explosion and the consequences of the fireball and the projection of different sized fragments.

Probabilistic calculations show that there is 49 per cent for death in a 100 meters radius. Thermal radiation of that range was calculated to 2,629 kw/m². Radiation from such a fireball could overcome Probit theoretical results. In fact calculations indicated a 72 meters radius fireball, whereas real results did overcome 100 meters. Nevertheless, numbers tend to be more realistic in case of 50 meters radius. Real numbers show that people and equipment present in close range (firefighters, drivers and trucks) where completely disintegrated.

Comparing real and theoretical results of fire showered over longer distances of 300 to 400 meters do present similarities.

Calculated thermal radiation intensity indicates that injuries and burns from the blast can be equally significant in that range, as at a range of 500 meters, exceeding the radius of liquid expansion from the actual accident.

Considering the effects of an over-pressurized explosion, the blast of a BLEVE scenario shows an immediate reduction of the wave after the first 100 meters.

Probability of structural damage or fatal impact by fragments are approaching 100 per cent in a half a kilometer radius. However, the power of the explosion of Kamena Vourla accident, magnified by the abrupt release of significant amount of energy that could resulting damages up to a distance of 700 meters (the final position of the LPG tank). In closer range, the loss of life at 400 meters by fragment is actually accurate regarding the Probit method.

4. CONCLUSION

This study demonstrates the methodology for evaluating the consequences of BLEVE events resulting from LPG vessels (with safety valves) that fail due to fire. It provides a unique record of 10 risk factors at pressurized containers and also explains how these risk factors and fallacies must be examined in every container fire if we want to have desirable results and prevent possible injuries or deaths.

Furthermore, it provides mathematical models that will help to predict the damage of the explosion, thus equip us with better risk management. PHAST 6.7 software was used to analyze the data due to its validation of modeling and particular consideration for vessels' explosion.

Moreover, in the case of the accident in Kamena Vourla it is shown that the pressure was able to remain high for a distance until it became steady when it reached nearly 240 meter, which means that BLEVE had a huge impact in a large area.

Another parameter used in this study was the PROBIT Method for Estimating Consequence Level. This probabilistic method provides a link between the portions of the exposed population to a BLEVE scenario and the probability of occurrence regarding the dose of the liquid.

Considering Kamena Vourla accident, calculated probabilities are interpreted regarding the overall effects of thermal radiation of the fireball and blast's overpressure and they are compared with real results. Therefore, the data interpreted in the study indicates that the theoretical results can be taken in to accordance and be compared with the real ones. Finally, taking into consideration the theoretical results, accidents in the future can be easily avoided.

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PRIVATE – PUBLIC SECTORS PARTNERSHIP FOR DISASTER RISK REDUCTION IN ARMENIA: THE CASE OF ALTER PROJECT

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ABSTRACT

Effective and efficient disaster management calls for cooperation among public authorities, private entities, civil society actors, local communities and international organizations. European Commission (DG ECHO) financed ALTER project (2018 – 2020), to formulate private – public sectors partnership for disaster risk reduction in Armenia. The aim is to increase resilience in rural areas of Armenia that face floods risks originating in dams' failure due to earthquakes. Such broad alliances established upon transfer of good practices, methods, tools, knowhow and experience from Union Civil Protection Mechanism countries to Armenian government and key stakeholders. Assessment of current situation and future perspectives led to Joint preparatory work of EU and Armenian partners with private sector, foreign and Armenian companies that manage the hydro and tailing dams.

In close cooperation with Ministry of Emergencies, three tabletop, followed by three on field exercises took place, coupled with training activities for local stakeholders and communities. During exercises regional and local emergency plans were tested, together with best practices and lessons learned from other projects and initiatives such as the PPRD East II European Commission initiative for risk reduction in South Caucasus. All efforts capitalized on Armenian and international initiatives and projects' results as well as on work done by private companies to comply with international standards of safety and security. The agreements signed between public and private sector on disaster risk reduction, can become a cooperation model for the whole area of Caucasus and beyond, for major risks. Remaining ALTER activities focus on capacity building of local communities, regional / local operational authorities, and key stakeholders to build long-term fruitful cooperation.

Keywords: Disaster Risk Reduction, Dams' Failure, Floods, Public Private sectors partnership

INTRODUCTION AND OBJECTIVE

Mining sector in Armenia is very important for economic development and social cohesion. Rural areas' prosperity depends on mining activities of private companies; owned by foreign funds in most cases. ALTER pilot areas are:

- Pilot Area 1: Kapan and Kajaran cities in the southern Armenian region of Syunik, near the Iran – Armenian borders
- Pilot Area 2: Vorotan Cascade hydroelectric infrastructure in Syunik region near the city of Sisian
- Pilot Area 3: Akhtala community in the northern region of Lori, near the borders with Georgia.

Private companies that own the dams (hydroelectric and tailing ones) in these areas frequently change ownership and management, while at the same time try to comply with the international standards of safety and security, bringing expertise from abroad. The geomorphological and geographical characteristics of pilot areas reveal a high-risk prone profile to floods caused by dams' failure. Disaster risk reduction activities are in place both by Armenian public authorities (Ministry of Emergencies – MES, and National Platform for Disaster Risk Reduction – ARNAP), and private companies in the framework of Corporate Social Responsibility. Sometimes, international organizations such as World Bank and UNISDR finance studies or activities in disaster resilience.

However, a coherent framework for establishing permanent public private - sectors partnerships for disaster risk reduction is lacking. ALTER works on filling that gap.

EXPERIMENTAL METHODS

ALTER implementation structured as presented below:

- Initially an assessment of existing situation took place. Related reports (such of World Bank on Mining Sector in Armenia) have been thoroughly reviewed with the support of American University of Armenia (ALTER partner). Study visits at pilot areas to mining activities, hydroelectric and tailing dams and local authorities took place. Joint working teams were established.
- Cooperation established with foreign companies that consult mining ones in Armenia on safety and security issues (i.e. dams' failure impact studies).
- Educating and training activities have been organized both in Yerevan and pilot areas.
- Tabletop and field-test exercises organized under the auspices and full engagement of Armenian Ministry of Emergencies. The exercises coupled with training of participating actors. Improvements in regional/local emergency plans made, as well as establishment of real time early warning systems in the area of Kapan, achieving synergies with other initiatives / projects. Good practices from abroad selected and tested.
- MOUs and Specific cooperation agreements signed between Armenian state and private companies for long-term cooperation in disaster risk reduction, beyond the demands of national legislation and commitment to reach international standards.
- MOUs signed between EU partners and Armenian state in Disaster Risk Reduction.
- MOUs signed between EU partners and American University of Armenia on staff exchange (ERASMUS+).
- Mainstreaming of project results by Armenian Government (in exercises governmental policies and risk reduction initiatives have been also tested).

RESULTS AND DISCUSSION

The results are very promising, as all pre-mentioned activities implemented successfully, especially since core project activities tackled serious weaknesses and challenging issues of emergency management such as: Issues considered within the frame of tabletop and on field exercises for Sisian, Kapan and Akhtala target communities and their participants:

1. Testing the DRM plans of local / regional authorities or accelerating their creation where absent (Akhtala case) and the good practices selected by Armenian partners from abroad.
2. Elaboration of complete, realistic scenario for target communities. The responsibilities and authority assigned to the 'players' (stakeholders), also with consideration of Emergency Response Plan, which includes public awareness, evacuation, information exchange and other urgent measures to be taken for population protection.

3. Discussion and review of the existing Disaster Preparedness and Response Mechanisms including public-private partnerships policy in the DRM field at regional, national and cross border fields.
4. Challenging consideration of the available mechanisms of cooperation which existing between the regional state-government bodies, governmental and non-governmental organizations, international and local humanitarian organizations in the field of risk reduction, disaster preparedness and response, post-disaster rehabilitation.



Pictures 1, 2: tabletop exercise in Kapan, operational center in Kapan)

ALTER achieved wide participation to activities. Participants (indicative pictures above):

- Staff of MES Population Protection and Elimination of Disaster Consequences Department,
- MES Syunik and Lori Regional Rescue Service Departments,
- ALTER project partners from Greece, Cyprus and Bulgaria,
- ALTER project teams from ARNAP and AUA,
- Representatives of Sisian (as well as Balak, Uyts, Vorotnavan and Shaghat villages), Kapan and Akhtala Community Offices and other livelihood structures (Syunik Regional Police Department, Sisian Electric Network, etc.),
- Representatives of private companies managing /operating the dams: ContourGlobal Hydro Cascade, CJSC; Zangezur-Copper Molibdenum, NGOs involved in DRR activities.

CONCLUSION AND REFERENCES

Trust, coordination, guidance and sincere willingness to transfer know how from EU to Armenia building on existing work done in the country, was the key factors to ALTER successful implementation. Operational Centers in Armenia are modern and functional (in Yerevan and regions' capital cities). Exercises are being conducted frequently (at least one per year in every region and Disaster Risk Reduction activities are present throughout Armenia. Private companies invest in local societies' resilience. Bilateral agreements, national and international projects, as well as countries and international organizations offered and continue to do so in the disaster reduction in Armenia.

ALTER offered the coherent framework for exploiting all these efforts, capitalizing on them, mainstreaming their results and create permanent public private sectors partnerships on disaster risk reduction in mining sector. European partners indicated effective and efficient ways for bringing best practices and knowhow from abroad to Armenia. The newly elected Armenian government intends to expand the "ALTER" cooperation model to other important sectors of Armenia and opportunities to export it to other countries in Caucasus seem promising.

Below we present some links. The first one is the ALTER project web page. The others refer to good practices on resilience from disasters from which ALTER partners selected some, analysed, adapted and tested during field exercises to include them into their policies.



<http://alter-project.eu/>
<http://www.preventionweb.net/arise/good-practices>
<http://www.oecd.org/cfe/regional-policy/resilient-cities.htm>
<http://www.100resilientcities.org/resources/>
<http://www.unisdr.org/we/campaign/cities>



THE CHANGING RISK AND DISASTER LANDSCAPE IN THE ECONOMIC CRISIS ERA

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ABSTRACT

The landscape of vulnerability and risk is changing in times of economic crisis. New risks emerge and previous risks reappear. Equally important, risk perception and acceptability change. Real and fictional risks create the framework in which adaptation efforts of individuals, social groups, and the society at large unfold, which in turn shapes risk geography. Urgency prevails over a long term outlook and individual reactions over collective efforts. Besides, perception of risks associated with natural hazards fades against socio-economic risks. In the crisis milieu and in conditions of uncertainty, emergency management prevails in adaptation efforts; priorities relating with issues that are believed to have no immediate impact such as climate change, risk prevention and mitigation, retreat in the agenda of individual and social strategies, and so do long-term disaster risk reduction policies.

The paper discusses risk and disaster management in the economic crisis era. More specifically, first it presents conceptual approaches to disaster, crisis and risk, then explores the new landscape of risks and disaster in an environment of economic crisis, and identifies changes in policies, strategies and management approaches. Finally, it announces the volume "Contemporary issues on natural and manmade disasters: The new agenda of crisis" edited by the authors, with contributions concerning facets of disaster risk reduction in the context of economic crisis in Greece and other countries.

Keywords: economic crisis, risk, disaster, risk perception, knowledge

1. APPROACH TO RISK, DISASTER AND CRISIS IN THE CONTEXT OF FINANCIAL CRISIS

The conceptual relationship between disaster, risk and crisis is unclear. As early as 1989, Rosenthal et al., in an attempt to decipher the concept of crisis, introduced crisis as a situation in which coexist: a threat to elements deemed by society as significant and may suffer serious implications, a perceived urgency in planning and action to prevent the threat and / the impacts, and uncertainty due to inadequate information, lack of knowledge and other external factors [1].

The concept of risk also has quite a few meanings. In the common language the emphasis is on the likelihood of an adverse event, whereas in the technical language the focus shifts to the impact as 'potential' losses, from a specific cause, to a particular place or sector over a given period of time [2]. No matter the scientific and discipline silos, it is important to bear in mind that risks are related to a range of conditions and scales and fall into a number of categories (Table 1).

The outbreak of the more recent global financial crisis has highlighted the complexity of risks and their management in crisis situations. The effects on risks were devastating in all conceptual, institutional and management levels. Already by the end of 2007, there have been significant cuts in public spending and public investment in all countries in the global North. At the same time, drastic reductions in the earnings of employees and retirees and the increase of the numbers of the unemployed led to significant reductions in purchasing power and an increase in vulnerable low-income groups. Moreover, the decline of the welfare state and the significant reduction in social spending, in the context of rigorous austerity policies, exacerbated existing economic and social risks [3]. Alongside the known risks, new risks arose from reduced incomes, rising unemployment and insecurity. Old and new risks are very difficult to deal with the degraded health and

welfare systems inflected by restrictive policies.

Table 1. Indicative risk categories and risk sources.

RISKS	Micro-level	Meso-level	Macro-level
Natural		Landslides, Volcanic eruption	Earthquakes, Typhoons, Floods, Draught
Health	Sickness, Injury, Disability	Epidemic	Pandemic
Life cycle	Birth, Old Age, Death	Population ageing	
Social	Crime, Loss of shelter, Domestic violence	Terrorism, Gangs	Organised crime, War, Civil strife
Economic	Unemployment, Poverty, Malnutrition, Business failure	Displacement, Food insecurity	Financial or currency crisis, Trade shocks Technology shocks
Cultural/ Political	Discrimination (racial, gender etc.)	Riots	Coup d'état, Failed states
Environmental	Heat islands	Pollution, Deforestation	Climate change, Biodiversity loss

¹ Adjusted by the authors from R. Holzmann, S. Jørgensen (2000) Social Risk Management: A New Conceptual Framework for Social Protection and Beyond, Social Protection Discussion Paper Series, N. 006.

2. THE FLUCTUATING LANDSCAPE OF RISK AND DISASTER IN CRISIS HIT GREECE

By the end of 2009 the Greek economy was hit by a deep and prolonged crisis. At the start of the crisis, GDP per capita accounted for 85.7% of the EU average and a few years later, in 2015, it had sunk to 64.0%. Unemployment was estimated to 27.5% in 2013 and is slowly decreasing since. The risk of long-term unemployment, poverty and degradation of housing, nutrition, health, education and loss of opportunities made the future uncertain and disconsolate for large sections of the population.

Although it is still very challenging to accurately assess the impact of the crisis on nutrition and population health, there is strong evidence that economic adjustment policies have had an impact. It is noteworthy that the domestic food market decreased by 13.0% in the period 2008-13. In addition, data show that access to health services has become difficult, while the diet of a large part of the population had degraded. Furthermore, at the time of the crisis the risks deriving from criminal acts have come to the fore both by the media and the scientific community. Although the analysis of crime data reveals a mixed picture, the impression many citizens have is that the crime rate is rising. In the crisis era, the risk of criminal activity rises in the hierarchy of risks. As an indication, there is a general tendency to lock the front door of an apartment building, as it is believed to hinder access by dangerous persons, although this impedes emergency evacuation of the building and is of course prohibited by law.

A new threat to public health in economic crisis is energy poverty. A European Parliament study showed that in 2013 around 36.0% of Greek households were faced with energy poverty. Relating to energy poverty was an increase in air pollution due to the use of inappropriate 'fuels', and also fluctuations in power demand leading to instabilities of the energy system.

Regarding the impact of crisis on typical natural and technological risks in the field of civil protection there are very few studies [3, 4, 5]. Even so, vulnerability of the built environment is expected to increase due to the effects of crisis on renewal and maintenance of buildings and infrastructure. Private investment in housing has decreased dramatically during the crisis from 12.4% of GDP in 2007 to 2.3% in 2013. In some areas, the sharp drop in property prices and complex ownership make maintenance and upgrading of existing buildings unattainable without the still scarce public investment. Moreover, due to its low energy efficiency, buildings are vulnerable to heat and cold waves. Around 46% of existing housing lacks heat insulation and has low energy efficiency. What is more, public space has been also undergoing a downturn in crisis even though its use has increased [6].

Last but not least, reduction in public spending hampers even regular and needed emergency preparedness actions, such as clearing of streams and cutting vegetation along the road network, let alone long term capacity building and training. Underfunding and understaffing of public services worsens the situation; for example, in 2016 Forest Service received only about 13.0% of the amount required for fire prevention, while the recruitment of seasonal forestry personnel was limited [7].

3. INTRODUCING A JOINT EFFORT TO UNDERSTAND RISK AND DISASTER IN THE CRISIS ERA

How the recent crisis affects risks and their management is an open central issue to be addressed? To this end, stemming from a joint effort a book was published in 2018 focusing on current risks (natural, technological, anthropogenic) and their management in the context of the economic and social crisis [8]. It refers to a wide range of risks and disasters. First, it examines the natural dangers that are subject of civil protection in Greece, such as earthquakes and forest fires. It also refers to the global issue of climate change and its associated risks, focusing on Greece. It also highlights major socio-economic risks, such as food poverty and immigration.

The volume is a follow-up to the European Support Action "Enhancing Knowledge on Disaster Risk Reduction and Adaptation to Climate Change", acronym: KNOW-4-DRR (website: www.know4drd.polimi.it/) funded by the 7th Framework Program (FP7) for Research in the EU, implemented from June 2013 to May 2015 coordinated by the Technical University of Milan (POLIMI). The project looked at the complex interplay between knowledge, decision making and action in order to identify and understand the factors that impede / hinder the use of knowledge to reduce the risk of disaster and adapt to climate change. The Department of Geography of Harokopio University, as the Greek project partner, organized on April 7, 2014 in Athens a workshop on disaster risk reduction in times of crisis. All the authors of the book participated in this workshop as members of the research team or invited experts.

There are nine chapters that attempt to answer the book's central questions from different, often complementary, aspects. Two-chapters deal with general issues, namely the utilization of knowledge to reduce disasters and the issue of malnutrition. The remaining seven chapters focus on case studies that comment on aspects of preventing and managing risks in different national contexts. Of those, four chapters focus on Greece in the context of the prolonged crisis and examine risk management in relation to forest fires, risks to coastal areas due to climate change, infrastructure degradation and refugee shelter. The remaining three-chapters comment on risk management against significant hazards in other countries, such as earthquakes in Turkey, floods in France and tropical storms in Vietnam

4. CONCLUDING REMARKS

The landscape of vulnerability and risk is changing in economic crisis. New risks emerge and older risks reappear. Equally important, risk perception and acceptability change. Urgency prevails over a long term outlook and individual reactions over collective efforts. Besides, perception of risks associated with natural hazards recedes against socio-economic risks.

In the crisis milieu and in conditions of uncertainty, emergency management prevails in adaptation efforts; issues that are believed to have no immediate impact such as climate change recede in the agenda of individual and social strategies, and so do long-term disaster risk reduction policies. Public policies shift towards emergency response [9] leaving aside long term disaster risk reduction. Furthermore, there is a growing separation of the already distinct fields of disaster management and spatial planning [10]. Recent disasters (such as floods in West Attica in 2017 and forest fires in East Attica in 2018) demonstrated most tragically the limitations of focusing solely on emergency response; neglecting comprehensive disaster risk reduction nurtures the underline causes of vulnerability and the outbreak of future disasters.

Last but not least, in the crisis feelings of anxiety and uncertainty of the population became more pronounced while threat of destruction and fear management became tools of power on citizens who already felt insecure [11]. According to Portaliou (2014) [12], "Fear, insecurity, the future as a disaster, lock people in a state of



introversion". Consequently, there is a retreat to individual crisis adjustment strategies, based on a sense of urgency and present perception of real or imaginary risks. Such individual adaptability to the crisis is likely to increase risk, and also to transfer vulnerability between social groups and places and even to future generations who will have to pay the high toll of future disasters.

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THE GREEK OMBUDSMAN'S EXPERIENCE WHEN INTERVENING IN CASES RELATED TO MANAGEMENT OF NATURAL DISASTERS BY THE PUBLIC ADMINISTRATION

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ABSTRACT

The scope of this paper is to briefly present the experience obtained through the Greek Ombudsman's operation during the last 21 years [established in October 1998, located in Athens] on natural disaster issues handled by the Greek Public Administration. The Ombudsman is a constitutionally recognised Independent Authority which monitors the entire function of the Greek Administration. The mediation findings between public services and citizens, indicate many types of maladministration, either before or after a natural disaster. Problems noted, with respect to maladministration, are the inaccurate application of the various, existing law provisions, legislative gaps and overlap of authorities' competences. In addition, the presence of precautionary measures and management of the in-situ crisis and the aftermath consequences was found poor in many cases. These maladministration acts [at least they can be described as such] lead to time-consuming problem solving and occasionally to tragic events like human losses. During the last years there is an increase of complaints related to natural disasters and their impact on anthropogenic environment i.e. infrastructure etc. This increase leads to enhanced "maladministration issues", that have been lately "more visible", and may lead to an appreciation that due to climate change more disasters occur, thus affecting a higher percentage of the population. The Independent Authority is constantly proposing solutions for problems reported by citizens, as well as legislative and operational amendments. In this paper indicative cases examined by the Authority are presented, the administrative policies and the optimization of the legislation framework is discussed.

Keywords: Greek Ombudsman, citizens reports, mediation, legislative framework, maladministration, precautionary measures & policies, natural disasters, climate change, infrastructure damage

1. INTRODUCTION - ROLE OF THE GREEK OMBUDSMAN

The Authority was firstly divided in four "cycles" which are: **a)** Human Rights, **b)** Social Protection, **c)** Quality of Life and **d)** State–Citizen Relations. Nowadays the Authority includes two more cycles the Children's Rights and Equal Treatment. Via recent legislation it is the National Mechanism for the Investigation of Arbitrary Incidents [1-3]. The Greek Ombudsman is the Authority's Head, assisted by six deputies. The submitted citizen's requests (cases) are initially examined to verify if they fall within the Ombudsman's jurisdiction, based on relative legislation provisions. If the cases can be examined and "founded", a preliminary investigation is conducted. It is evaluated if there are maladministration acts, "bad administrative practices" or legislation violations by the public services - authorities i.e. ministries, 1st & 2nd degree local authorities, tax offices,

customs, city plan offices, police stations, prisons, schools, etc. The Authority as a *mediator*, makes recommendations and proposals to all levels of the public administration. Furthermore, findings, conclusions, annual and special reports of the Authority are submitted to the Greek Prime Minister, the parliaments President, competent ministries, parliamentary committees and government bodies, in order for new policies and good practices to be instituted. A significant amount of the proposals and recommendations are accepted by administration thus resolving citizens requests (approximately 85% of the cases, within its jurisdiction, are resolved). It is noticed that the Ombudsman does not impose sanctions or annul public administration's illegal actions. Therefore, *its aim is to convince administration to act legally and within the good practices framework. All public services have an obligation to facilitate the investigation in every possible way.* Non-cooperation during an investigation by a public service (or public servant) may be the subject of a special report from the Ombudsman to his/her supervisor or the competent Minister and a disciplinary action may be taken. If there are indications that a public official, civil servant, or member of the administration has committed an illegal act, the Ombudsman shall also communicate the report to the competent public prosecutor. The Ombudsman has competence over the private sector or specific individuals, *in case of violation of children's rights or the principle of equal treatment and non-discrimination provisions.*

2. ISSUES EXAMINED BY THE AUTHORITY

The Quality of Life Dpt. examines cases related to the natural and anthropogenic environment. It consists of Senior Investigators of all expertise i.e. lawyers, environmental scientists - geologists, chemical and structural engineers, topographers, architects, archaeologists, etc. Most complaints, that fall within the interest of this paper, are mainly related to "poor handling" of natural disasters aftermath consequences by the public administration. Especially, the time-consuming procedures for aid benefits handed to citizens, infrastructure damage repairs after a disaster, absence of coordination and competence overlap of the public services are examined. The Authority, also, conducts on-site researches and publishes special reports for issues affecting a large number of citizens. It describes the administration's resilience after the disasters and some causes of them. It appears that the consequences of climate change [*widely accepted nowadays by the scientific community*] which affect a large number of citizens, lead to an increase of incoming complaints the last years not only about the damages of the infrastructure, but also about the lack of precautionary actions by public administration. Indeed, after the tremendous flashflood in "Mandra" and the "Mati" forestfire in 2018 which caused numerous human losses, citizens appear to be more concerned about the precautionary measures & policies of the State. Citizens ask from state services to act timely against natural disasters, but those seem to be unprepared. Other parameters, such as the illegal constructions in forests, coastlines, rivers etc. or inappropriate municipal waste management are related to enlargement of natural disasters consequences. Public services are divided on the central administration (Ministries) and two grades of self-dependent local administration (Prefectures and Municipalities). Both grades are in cooperation and supervised by the Decentralized Administrations of the Ministry of Internal Affairs. The central administration arranges the main – general policies to confront high importance problems while the other public services execute them.

2.1. Flood protection

After the increasing rate of flashfloods, citizens request from the local government to take flood protection measures. The inadequate flood protection infrastructure, the embankment (backfilling) of streams, the coverage and rechanneling of creeks by utilizing inappropriate rainwater drain pipes (small diameter), the constructions which decrease river's flow capacity in combination with illegal construction and lack of cleaning actions on river areas, lead to an obvious higher possibility of flood events. The competence of river cleaning dictated by Law 3852/2010 belonged mainly to the Prefectural Government and by way of exception to the Municipalities for islands or mountainous regions. After the institution of Law 4555/2018 the Prefectures (technical services) are the only competent authorities. Moreover, the protection of rivers from illegal construction is exercised by the local planning offices supervised by the Municipality or by the

Decentralized Administration. According to Law 4258/14 the competence for the study, construction and maintenance of flood protection structures at river areas [i.e. retaining walls, river & stream arrangement works] can be performed, fragmented, by municipalities, prefectures or other administration bodies. This leads to a vague competence and hence inaction of all relative public services. The design and construction of rainwater drain structures is usually related to transportation infrastructures, so according to numerous decisions of the central government, the respective competence belongs to plenty of public services or private operators. The design, construction, operation and maintenance of irrigation canals is assigned usually to local or general organisations for land improvements which are supervised from the Prefectures. Issues mattered with the operation of those organisations such as the wide spatial distribution (430 organisations), poor finance, obsolete and fragmented legislative framework are investigated by the Authority. According to citizen's complaints [4-5], the above mentioned competed services all over Greece fail to exercise their responsibilities on time, so the flood hazard has increased. From the findings of the Authority most common causes of this type of maladministration, are the lack of appropriate machines, personnel or financing especially due to previous public debt crisis. Moreover, from the handling of some cases, it was found that public services denied to recognise their responsibilities due to the controversial law provisions. Unfortunately, in the case of flood protection structures there isn't still a "clear" plan or a technical tool to distribute specifically the competences among the services. To comply with European Directives 2000/60/EC & 2007/60/EC, Greece has proceeded to the registration of all water bodies and the assessment of flood hazard during the 2013-2017 period [6-7]. However, the achievement of set goals, alongside with the absorption of respective necessary European funds is considered extremely limited while updated adequate data are absent (i.e. continuous monitoring and analyzing soil and surface and groundwater samples).

2.2. Forest-fire protection

The competence of waste handling and cleaning of dry plants, in urban & suburban areas, according to Law 3852/2010, belongs to the Municipalities. Citizens are obliged to maintain their own places clean from flammable materials, but in case of lack of action Municipalities are assigned to clean private properties. According to Law 998/79 (as amended) the protection of forests is exercised by the Forest Service which is supervised by the Decentralized Administration. The Authority has examined plenty of complaints referring to the absence of timely cleaning of free spaces near or in forests [8]. During an on site visit by the Authority in 2007, after the forestfire in Evoia, it was found, except the above mentioned problem, that emergency roads and safety zones inside forests were poorly maintained. Also the electrical distribution network was not properly "cleaned" by the public power company leading to a higher possibility of fires originating from sparks [9]. Moreover the Authority has examined plenty of cases related to illegal waste disposal, a very possible reason for forest fires, beyond other environmental impacts i.e air, soil, surface and underground (aquifer) pollution etc. Waste fires occur when decomposition of the uncovered waste, leads to substantial heat and can cause material in the landfills to spontaneously combust. Also fires are attributed to arson in order to reduce volume of waste or to collect valued material i.e metals etc. Fortunately, Greece has adopted a series of European Directives provisions i.e 1999/31/EC, 2008/98/EC, etc for waste disposal methodologies. According to them, a National Plan for Waste Management is instituted alongside with the respective Prefectural Plans during 2015-2016 period. Nevertheless achievement of the goals is limited, leading to serious waste management problems, thus EU imposes fines to Greece.

2.3. Infrastructure repair – Public procurement

The retrofit and repair of different types of infrastructure after a disaster requires special experience, knowledge and equipment. Thus, with this excuse, public services usually assign the construction and sometimes the operation of infrastructure to the private sector. Law 4412/16, in compliance with European Directive 2014/24/EU for public procurement, sets out the regulations to commit contracts between public services and private companies for design and construction of infrastructure. The application of this legislation framework is very time-consuming, so the use of the negotiation procedure without prior

publication is proposed by law in some emergency and unpredicted cases (Articles 32 & 32A). The Ministry of Infrastructure & Transportations clarified that use of the above procedure is permitted in cases of natural disasters without a finance limit [10]. Complaint handling revealed a limited [or none] usage of this direction from Prefectures, Municipalities and public services. An excuse mentioned by Municipalities and Prefectures is that they don't have the appropriate technical or financing background to exercise that procedure, so they are forwarding the problem to the central administration. As a result, after a disaster, critical infrastructure i.e. retaining walls, bridges, ports etc. are not repaired on time and as usual the competent Ministry has to manage problems from the entire country. For example, the Authority is examining a representative case that deals with a landslide, first observed during the year 2000, a problem never solved! After extreme weather conditions in 2018, the landslide extended and destroyed a significant road and now threatens numerous households leading to a major natural disaster. The initial, smaller extent, landslide was possibly triggered from the construction of a road without the appropriate geological and ground stability studies. However, an inappropriate, poorly studied and built, retaining wall was constructed to prevent the landslide from growing. For many years the Municipality denied to address the problem and take measures to protect citizens and the environment from a possible serious landslide. The excuse was (is) that the road was not its responsibility since the (so called then) Ministry of Public Works supervised and funded the initial road construction. According to the Municipality their competence was limited only on cleaning or minor maintenance of the road. Eventually, after the Authority's mediation, the Municipality accepted to resolve the problem without using the Ministry's Guideline (did not explain the reason). Thus the whole procedure is lengthy and danger still threatens the surrounding areas and the citizens.

3. DISCUSSION – CONCLUSIONS

Problems, in natural disaster handling issues by administration, are the inaccurate application of the, various, existing law provisions, legislative gaps and overlap of authorities' competences. The application of precautionary measures, management of the in-situ crisis and the aftermath consequences was found poor in many cases. Public services do not recognize their responsibilities, using as an excuse the controversial law provisions. Legislation has not set a "clear" plan or technical tools to distribute specifically the competences among the services for the study and construction of flood protection structures. Also the use of the faster negotiation procedure for financing public works, related to rehabilitation after natural disasters is proposed by law in some emergency and unpredicted cases. The competent Ministry has clarified that use of the above procedure is permitted in cases of natural disasters without a financing limit. However, this provision is not utilized by local authorities hence infrastructures are not repaired on time and usually the Ministry has to manage problems from the entire country. The findings from the above indicative cases expressed in the following equation: *Extreme weather conditions + natural disasters of various sources + unprepared public services + unwillingness to adjust to new conditions + legislation gaps + lack of adopting good practices = poor crisis management + tragic losses + infrastructure destructions + very slow repair + lack of resilience of society + economic loss.*

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GEOLOGICAL PAST CLIMATE VARIATIONS AND CHANGES

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ABSTRACT

In this review paper are given new accurate published geological data of global warming and large-scale geological climatic changes and sea level changes, as well for the Phanerozoic era and especially the Quaternary period, with special emphasis on the last interglacial period (Eemian warm epoch ~125,000, +1 to 2.5 to 5 degrees Celsius higher temperature, and the short Younger Dryas cold period (~12,900 to 11,700 decline of 2 to 6 degrees Celsius). The temperatures of the past are continuously changing. The data are discussed, evaluated and compared with current climate variations of the historic period. In this context they are also compared to current climate change scenarios for the future, which are associated with State policies or political groups, as well as economic interests.

Keywords: Paleoclimatology, atmosphere, CO₂, sea level.

1. INTRODUCTION

“Climate change” means a large-scale, global change of dramatic dimensions of Earth’s climate, with serious environmental impacts. This marks a significant and lasting change in the statistical distribution of weather for periods ranging from thousands to millions of years. It has always been a natural part in Earth’s evolution. This simple fact is so obvious to all scientists studying Earth’s history. There is nothing new today, compared to the past. However local climatic variations rather than changes may be important for human societies, included in some five, ten to thirty year cycles, or thousands of years during historical period and the Holocene (10,700 yrs). The driving forces that cause such changes are yet unclear (Astronomical, geological etc). Natural Science is ruled by observational facts, long enough in geological terms and measurements tested by experiments, not only by ephemeral models out-puts. Earth is a thermodynamic system that constantly reheats and changes, in the geological time, especially its surface and atmosphere. Earth as a Complex System of Systems follows the non-linear laws of Chaos and Complexity. At present time a new Global Warming is in progress. This is a scientific fact, while the anthropogenic contribution is either the main reason or only a component. It is not yet proved clearly.

2. EARTH’S ATMOSPHERE

The evolution of the atmosphere is related mainly to the balances of two basic elements, the carbon and the oxygen. These elements are fundamental, for the living organisms and for the earth crust. So, the atmosphere’s evolution is tightly connected with life itself and the lithosphere. Carbon, as an element of the cosmic methane of the primitive earth atmosphere and rocks, slipped first to the atmosphere in the form of carbon dioxide (CO₂) and later to the plants’ and to the animals’ tissues as “food” for the bacteria. Apart from the animal organisms, large quantities of carbon are storage in the rocks of the upper earth’s crust. This carbon constitutes a structural element of our organisms; it originates from the Earth’s cosmic matter as well as its rocky and liquid body and it is destined to return to the “inorganic” world where it will continue its recycling procedure. Has the Earth’s atmosphere always been the same? The reconstruction of the atmosphere constitutes a very difficult geological problem because actually there are not enough fossils in order to do the necessary calculations and estimations with regard to its composition. Still, the rocks have some characteristic features, which help scientists towards this direction. The solar radiation influences mainly the atmospheric air, as it constantly stimulates and agitates it; it keeps it almost constantly in a condition far from the state of equilibrium. The systems which are in a state of equilibrium are considered to

be relatively simple from the viewpoint of physics and are described by simple laws. But, the systems which are far from the state of equilibrium become with no doubt more complicated.

3. HOW UNIQUE IS OUR PLANET'S CLIMATE?

Climatology is a scientific branch which uses the contemporary meteorological instrument measurements in order to classify the planet's present-day climate. Still, the main information about the earth's climate dynamics and change is deducted from the ancient climates study, as these are recorded in the geological archive. The ancient climates study developed in its present-day form during the 60's, when scientists started to use the planktonic foraminifers' shells with the proportions of oxygen isotopes (O^{16}/O^{18}) in order to deduce the ancient oceanic temperatures. *Palaeoclimatology* is actually the study of the past state of the climate with the use of geological data. It offers a different dimension to this study and contributes to the real, historical understanding of the climate changes and variations. The earth climate has not undergone any extremities during the recent geological past, like the ones we suppose that happened during the initial phases of the earth's evolution, when life was still limited. The more life developed on this planet, the more complicated and organized it became, the smaller in number and intense did the big and dangerous climate changes become. Earth's climate changes are not as extreme as the ones measured on other planets of our solar system, like Venus. Our climate is considered to be invariable on time scales of the order of thousand years and partially variable on larger time scales, for various reasons.

"The inner part of the Earth cools mainly through the tectonic plates transport zone, while its constant gas recycling procedure has had a stabilizing impact on the earth climate. While volcanoes feed the atmosphere with gases, the diving of the lithospheric plates turn the gases back to the Earth's interior", (Bullock and Grinspoon 2000). What a fabulous discovery! Eventually, climate is not only a matter of the atmosphere but a matter of the whole planet, Gaia. It is not only for the solar radiation that influences the atmosphere's gases, neither for the oceanic masses nor the hot or cold land. It cannot be the most important biological factor, as the founder of the Gaia hypothesis (Lovelock 2000), aptly emphasizes, among many other factors that influence the earth climate are its bowels. These slow –in terms of our time experience- movements of the tectonic plates, act, millions of years now, in such a way, that keep climate in some limits, which favor the maintenance of life. The earth climate intertwines with the soil, the water, life and the geologic processes. The climate changes happen often and constitute a natural phenomenon. It would be rather strange not to have any climate changes on a planet where everything changes in time. Over many millions of years, the climate conditions on Earth were much warmer and watery than what we experience today. The global warming, is a common phenomenon as revealed by the fossil archives. Over the last 2.55 million years –during which climate changes are more familiar to us - only 10% of the total time span was under the same climate conditions with the ones we enjoy today. The rest 90% of the total time span was different; the climate was usually cooler (ice ages) in alteration only for some very short periods warmer (interglacier). The climate changes have always marked changes in the living world, which was forced to adjust to these. Concerning the climate changes of the geological past in comparison to recent climate variation and the proposed models of the near future we could give emphasis to the following:

1. Recent data show that CO_2 concentration of the past was as much as 5 to 10 times when the life eruption occurred on land (Paleozoic, 550-250 million yrs). The primary carbon cycle has a major source, such as volcanism, soil exhalation, ocean fauna and flora, "rock's residence time" and erosion. Today, ice-core analyses enable scientists to determine the CO_2 in the tiny air bubbles back as far as 800,000 years ago. Would the 150 million-year steady decline in CO_2 have continued? Is it a "natural" feedback loop? In fact, CO_2 concentrations constantly vary, from one place to another and from one time to another, just as temperatures do. The increase of CO_2 is the unprecedented recently.
2. Water vapour, methane and other gasses are also greenhouse factors.
3. Temperatures of the past is changeable, rapid or gradual, but always in specific limits to keep life (not species) alive, while the atmospheric chemical synthesis varies. Temperature changes ± 2 and up to ± 6 degrees centigrade is a common phenomenon occurred in the near geological time at least. An important question is what scientific evidence

of the past do we have that abrupt climate change has happened in the past? and will it be happening in the near future?

4. Ice covers extended and shrink during the history of the Earth and especially the recent one, while the life flourished without glacier on the planet, many long warm periods, such as Miocene. Time is over according to paleoclimatological data and Milankonitch cycles for our recent Interglacial period. How we will stave off the next ice age?
5. Until the middle of the 20th century, geoscientists possessed only little information, which they gained from the study of the volcanoes. The volcanoes were considered to be the most likely sources of oxygen, water CO and CO₂ for the primary atmosphere. During eruptions, big quantities of gas escape in the atmosphere. Furthermore, the volcanic rocks include magma gases in a proportion of 1 to 2% of their total weight, which also escape slowly in the atmosphere. This scientific assumption seemed appealing to scientists. Almost in all volcanic eruptions is revealed that water, in the form of superheated vapor, covers the largest percentage among all attracting gases. The gaseous element nitrogen is found in relatively abundant quantities, i.e. at a percentage of 4-5% average. This is enough to justify nitrogen's proportion in today's atmosphere. The justification of the oxygen's percentage in today's atmospheric composition has puzzled scientists for a long.
6. Another issue of IPCC (2007) is the threat of a rapidly rising sea level to low-lying coastal areas. In Earth's history It is known clearly that sea level is always changing, mostly to lower, e.g. 40 to 130 m (Caputo 2007; Möner 2013). The idea that the present should represent something new and threatening looks very strange to a geoscientist. There are physical laws that cannot be ignored and which set the frames of the amounts and rates of possible sea level changes, such as the time required for ice melting, the ultimate rate of sea level rise, and the relation between ocean heating and water column expansion. Therefore, it is out of scientific possibility to have sea level changes in the year 2050 or 2100 amounting to 2 to 10m or more. A +20 cm to 1 m appear more realistic.

4. EPILOGUE; CLIMATE CHANGES: THE LITTLE WE KNOW, THE BIG WE AFRAID.

The Earth's atmosphere is a dynamic system, which is in constant motion and change.

The static view of the atmosphere's structure can be simulated with an instant "photo" of its endless "cinematic" motion. The geological data we possess show that the oxygen's, the carbon dioxide's and the ozone's quantities and relative proportions in the atmosphere have not always been the same. These fluctuations were much bigger in the distant geological past and much smaller over the latest 500 million years, when life stabilized on land. Changes in their proportions are more sensitive because they are directly connected with the evolution of life. These changes influence life and they are influenced by life. Severe climate changes, like the ones prevailing on our neighbor planets, are not met on Earth. Earth cannot become a glacial planet like Mars. Neither can it become hot like the neighboring Venus. The few, though extreme circumstances, cannot lead the whole system to non-biotic conditions. There is evidence for this in our geological archives. Life has never been interrupted since it started, four billion years ago. Life has only undergone a lot of changes in forms and it is expected to experience more changes in the future. The extreme climate conditions might discomfort the biogeosystem with some extreme fluctuations, but the climate remains always life friendly in the thin biosphere, near the "warmth" of Earth's surface. If we consider how limited this is-only 4-5 km above us- and how many earth subsystems cooperate in order to keep the climate in a state of incubator for life, we would certainly value more our biosphere, that is our home. We live inside a very small incubator indeed that is surrounded by environments either very unfavorable or totally destructive for any form of life.

More than a century from now, on current trends, today's concentration of CO₂ will have doubled. How much warming will that cause? The official prediction, 1.5-4.5 C° per CO₂ doubling, is proving a substantial exaggeration. When modern life evolved 500 million years ago, CO₂ was more than 10 times higher than today, yet life flourished at that time. As if that were not bad enough, the official story is that feedbacks triggered by direct warming roughly triple it, causing not 1 but 3 degrees' warming per CO₂ doubling. CO₂, even if it is traced in much smaller proportions (0,039% or 390 ppm), plays a significant role in the balance

which is related among others to the temperature. It also participates in the composition of the atmosphere with a small, though ideal proportional ratio. Its quantity is enough for trapping through the greenhouse effect, as much infrared solar radiation as required for the organisms' temperature needs. That means, temperatures that do not threaten life; neither more, nor less heat than needed. Any distortion in this CO₂ proportion, no matter how small it might be, would have great impact on the biosphere's temperatures. This gas is associated with life on a direct and daily basis but also in terms of geological time. The plants are directly fed by CO₂ through solar energy and release oxygen in the atmosphere. Indeed, many plants are very selective as far as the carbon dioxide molecules they take in are concerned. Nature's complexity is much bigger than we can imagine and understand. The estimated date models for projected climate changes over the next 50 or 100 years, extreme or not, are hazard assessments, not predictions, which is why all serious scientists, not never limited to a prediction model, but in a number of considerations. Just these estimates are "sounding the alarm" for a possible permanent and total change, weak or stronger, nothing more. The complexity of the Earth's System and global climate system as well, marks the weakness accurate prediction of the future development. Estimates show that there are factors that make certain future situations more likely than others. Mankind has always made great evolutionary and cultural leaps when the environment was changing, usually for the worse. It can become a springboard for further development and be turned into advantage. Humanity must be prepared to adapt to new climatic conditions created on the planet, as they would change, big or small.

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GREEK SCHOOL COMMUNITY IS COPING WITH EARTHQUAKE

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ABSTRACT

Communities around the world are faced with natural disasters, such as earthquakes. It is well known that Greece occupies the first place in seismic activity in Europe and has been affected by a lot of seismic events. Worldwide the individual and community mitigation of earthquake disasters through the prevention and preparedness actions is a vital issue, and schools play a great role to these efforts. School earthquake management mirrors family disaster prevention, and national disaster prevention policy.

In Greece, Earthquake Planning and Protection Organization (EPPO), is a State Organization and the competent authority to process and design the national policy on earthquake protection. The EPPO's School Earthquake Safety Initiative is aiming to strengthen risk awareness in Primary and Secondary Schools and to prepare the school community to act in a proper way in case disaster strikes.

This study aims to assess the contribution of EPPO's Initiative to the improvement of level of school preparedness in Greece the last decade. In this framework a survey has been implemented by specific questionnaire. This questionnaire was answered by Schools' Directors and teachers from 48 Prefectures of all Regions of the country, during 7 school periods (from 2012-2013 to 2018-2019). The results of the analyzed questionnaire indicate that the actions of EPPO, such as the implementation of training seminars and the development of a specific Handbook on School Earthquake Planning, have decisively contributed to change the prevailing mentality, to improve the schools earthquake preparedness and to foster a culture of safety. This research is part of the evaluation of EPPO's strategy for earthquake school management at national level and constitutes a basic input for the planning of this strategy in the future.

Keywords: Earthquake, Schools, Emergency Planning, Seismic Risk Reducton, Drills

1. INTRODUCTION

"Worldwide, approximately 1.2 billion students are enrolled in primary and secondary school; of these, 75 million school children live in high seismic risk zones and hundreds of millions more face regular floods, landslides, extreme winds and fire hazards" [1]. "Children spend up to 50 per cent of their waking hours in school facilities, yet all too often schools are not constructed or maintained to be disaster resilient. The deaths of children and adults in schools cause irreplaceable losses to families, communities and countries. Millions of children also suffer lifelong injuries and disabilities through disasters" [2].

Needless to say, the lessons learned from previous disasters show that the role of schools in seismic risk reduction is vital. Schools are appropriate for facilitating disaster risk reduction because the typical school includes a policy framework, environmental arrangement, health services, and health education, which includes basic evacuation training and capacity development for students, and professional education for teachers, including hazard map development, evacuation planning, and school policy development [3].



Earthquake Planning and Protection Organization (EPPO) is a State Organization and the competent authority in Greece to process and design the national policy on earthquake protection. The last two decades EPPO contributes substantially to build an earthquake safety culture at school community [4].

2. METHODOLOGY

This survey is aiming to assess the contribution of EPPO's School Earthquake Safety Initiative to the improvement of level of school preparedness in Greece the last decade.

A closed-form questionnaire was developed for the research, which contained 20 questions concerning protective earthquake measures at family and workplace level. The participants of this research are School Directors and teachers from 48 Prefectures of all Regions of the country. The questionnaires were administered to responders before the beginning of EPPO's seminars entitled "Seismic Risk Reduction Actions at School Community".

6279 questionnaires were gathered from September 2012 to June 2019, and analyzed by EPPO's Department of Education.

It is important to mention that the last seven years EPPO implements a specific Initiative addressed to school environment, in collaboration with the Ministry of Education. More specifically, EPPO's main actions are the following:

- a. Implementation of seminars at prefecture level, in order to be appropriately educated and adequately trained the School's Directors and teachers responsible for school earthquake planning. These seminars take place in collaboration with the local Divisions of Ministry of Education and other competent authorities. This EPPO's School Earthquake Safety Initiative is an innovative approach to today's earthquake-risk environment, recognizing the importance of transforming schools into centres for earthquake knowledge through participatory prevention and preparedness actions. During these seminars the teachers are trained to be ready, to remain calm and in control of the students in case of an earthquake and to follow specific documented preparedness and evacuation procedures. Furthermore, teachers are trained to teach basic safety concepts to students, including drills and learning activities (using EPPO leaflets, educational kit) that can be incorporated into lesson plans in a fun and fear-free way.
- b. Development of educational material (guidelines, brochures, posters, presentations etc.) specifically targeted to schools' staff. In terms of improvement of knowledge and skills for school seismic risk reduction, seven years ago (in 2012) EPPO prepared and published a Handbook on School Earthquake Emergency Planning [5]. It is well known that each School Earthquake Plan is always a work-in-progress, and never a finished document. Thus, EPPO has updated the specific Handbook three times till today. This Handbook is written for administrators, teachers and support staff involved in earthquake preparedness at school. Its purposes are:
 - To guide administrators and teachers in assessing risks and planning and carrying out protection measures;
 - To develop skills and provisions for earthquake preparedness, response, and rapid recovery;
 - To support schools in developing or revising emergency plans specific to their local needs.

3. RESULTS OF SURVEY

As already mentioned, EPPO prepared the first version of Handbook at 2012. In the framework of this survey the researchers checked if there is any improvement to school preparedness level related with the EPPO's Handbook publication. Thus, it is noticed that from the school period 2012-2013 till 2018- 2019 the collected results regarding the school readiness are varied considerably.

These data have been analyzed and have been divided into two main periods, 2012 – 2014 and 2014 – 2019. The researchers decided the abovementioned two chronological frames because the data processing has shown that there is a decisive point in changing attitudes and behaviors at school community. This reference



point is the school year 2014-2015. The most possible explanation is that EPPO's Handbook was sent by the Ministry of Education to school units at school period 2012-2013, but the schools needed almost two years to adopt the safety procedure and the standards of EPPO. The Figures 1 and 2 show the frequencies of the respondents' responses to each qualitative feature, rating their performance on the basis of the options "Yes", "No", "I do not know / I do not answer".

3.1. Emergency Plan

Regarding the question "Is there an Earthquake Emergency Plan at your school?", the participants claimed the following:

- Period 2012-2014: 1735 of the 2041 participants responded "Yes", while the minority, 69 out of 2041 responded "No". Also, 87 out of 2041 responders answered "I do not know" and 150 out of 2041 "No answer".
- Period 2014-2019: 4752 of the 5090 participants gave affirmative answer, while 102 out of 5090 answered negatively. However, 112 out of 5090 responders answered "I do not know" and 124 out of 5090 "No answer" (Figure 1).

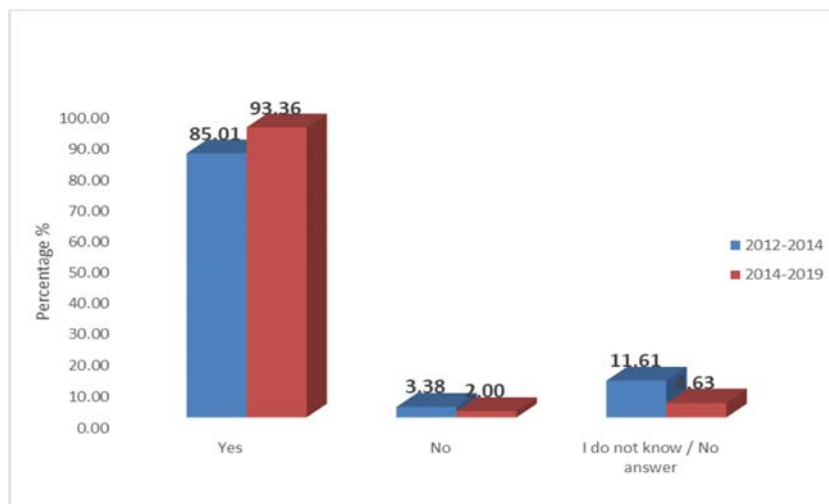


Figure 1. Answers to the question: Is there an Earthquake Emergency Plan at your school?

3.2. Earthquake drills

In Greece every school should conduct at least two earthquake drills per year. Drills are a vital experiential learning process, providing an opportunity to train students, remember procedures, check on provisions and, evaluate the emergency plan of the school. According to the results the participants answered the following:

- Period 2012-2014: The 80,45% of the participants responded "Yes", the 10,83% responded "No" and the 8,72% didn't answer.
- Period 2014-2019: The 91,61% of the participants responded "Yes", the 4,13% responded "No" and the 4,26% didn't answer (Figure 2).

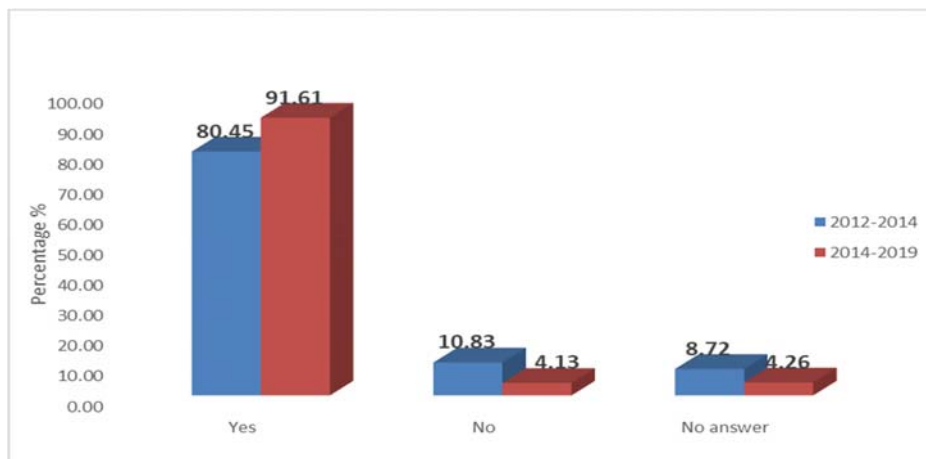


Figure 2. Answers to the question: Do you hold earthquake drills at your school each year?

4. CONCLUSIONS

Proper risk assessment, including seismic risk, is crucial to create a safe environment. It is generally accepted that earthquake emergency planning requires collective efforts on implementation, evaluation and continuous improvement, mainly at places that host children, such as school units.

This research is aiming to assess the contribution of EPPO's School Earthquake Safety Initiative to the improvement of level of school preparedness in Greece the last decade. The participants of this research are School Directors and teachers from 48 Prefectures of all Regions of the country. According to the analysis of the survey's results it is concluded that the development of EPPO's Handbook on Earthquake Emergency Planning, as well as the implementation of training seminars at each prefecture of the country, have decisively contributed to improve the schools' earthquake preparedness and to foster a culture of safety.

This research is part of the evaluation of EPPO's strategy for earthquake school management at national level and constitutes a basic input for the planning of this strategy in the future.

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ESTABLISHING CROSS BORDER COOPERATION IN DISASTER MANAGEMENT: THE ROLE OF EMERGENCY LOGISTICS

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ABSTRACT

Recent disasters around globe indicate that most challenging territories for managing emergencies are the cross border territories. Various reasons (economic, historic, social, political, cultural) make difficult to agree, establish and implement joint strategies and policies dealing with climate change impacts, societies' resilience and emergency management at cross border areas. The already identified deficit in exploitation of research and projects' outputs to strengthen the civil protection system at national, regional and local levels becomes worse at the borders. Technological advancements and innovations available cannot be used appropriately due to reluctance by civil protection authorities to invest in new technologies, lack of personnel, high rigidity in existing plans and procedures, inability to create cross border standard operation procedures and most important to identify the cross border area as a single area of intervention prior to and during an emergency. Through the The Joint Cross Border Cooperation for Securing Societies Against Natural and Man-Made Disasters (J-CROSS) project of Interreg IPA Cross Border Cooperation Programme (CCI 2014 TC 16 I5CB 009) specific set of activities tackle such deficiencies. Pilot area is the cross border one of Western Macedonia and Pelagonia Regions. Joint teams work on risk assessment, early warning systems mapping and specifications for establishing at risk areas and critical infrastructures, improvement of emergency plans, joint training and common organization of tabletop and field exercises. Following the EU host nation support guidelines, for receiving support by Union Civil Protection Mechanism and rescEU initiative, special attention has been given to emergency logistics at cross border area, a field that helps authorities optimize the entire civil protection system to enable joint cooperation between the two countries. Such efforts will lead to joint action plans by the two regional authorities and long-term cooperation in civil protection.

Keywords: Cross border disaster management, emergency logistics

1. INTRODUCTION AND OBJECTIVE

Cross-border emergency logistics research includes the review of worldwide good practices on the field as well as algorithmic tools and methods applied to the same field, best practices aimed at optimizing emergency logistics at a cross-border level under various scenarios to be developed. Finally identifies specific measures for facilitating the intervention and support of the Union Civil Protection Mechanism in the cross border area of Western Macedonia and Pelagonia regions.

According to Thomas and Kopczak (as cited in Overstreet et al., 2011), Humanitarian Logistics is "the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people. The function encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking and tracing, and customs clearance". Moreover, according to USAID (2019), the scope of Emergency Supply Chain Management is the establishment of a system ahead of an emergency that manages all the commodities necessary to respond to a crisis and ensure that they will get to point of interest as efficiently as possible. Figure 1 provides a schematic representation of the research framework proposed by Overstreet et al. (2011).

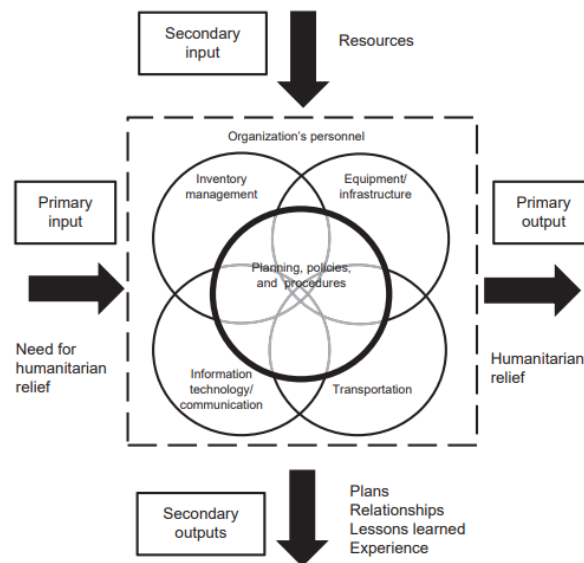


Figure 1: Humanitarian Logistics framework [Source: Overstreet et al., 2011]

Objectives and logistical needs of different phases and stages inside phases of the disaster management cycle vary. It has been argued (Patel et al., 2016) that a high concentration of efforts in terms of Humanitarian Logistics is associated with the response and the recovery phases (Figure 2). The response and recovery phases require an agile supply chain as well as integrated logistics solutions. In this context, agility is defined as the ability to respond to unexpected changes when demand is unpredictable, an attribute that could be vital during the response and recovery phases. On the other hand, at further stages of the cycle, the need for agility is lessened and supply chains become more conventional. Specifically, Figure 3 displays a change from an agile approach with effectiveness as main objective (response phase) to a lean approach with efficiency as the main objective (reconstruction phase).

Cross border factors make more challenging the already complicated situation. The solution is to use emergency logistics –usually described in one line at emergency plans- as the catalyst for optimizing the entire civil protection system at both bordering regions.

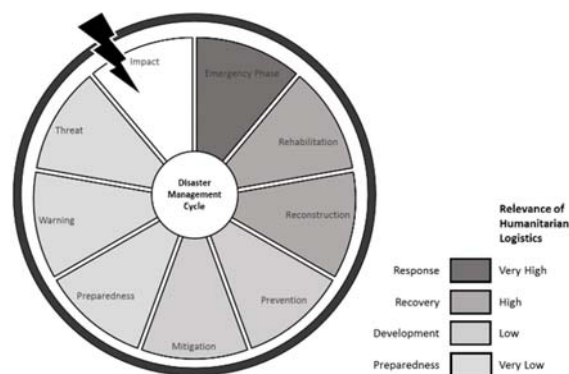


Figure 2: Stages in the disaster management cycle and their relevance with Humanitarian Logistics [Adapted from: Patel et al., 2016]

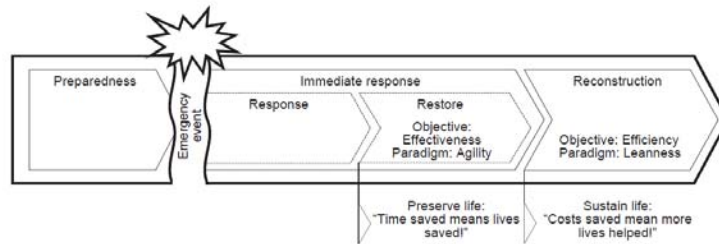


Figure 3: The need for agility and leanness during Humanitarian Logistics process [Source: Cozzolino, A., Rossi, S., & Conforti, A. (2012).]

2. EXPERIMENTAL METHODS

In our approach best practices identification for emergency logistics and especially at cross border areas is the base for further activities. User needs in both areas and the analysis of existing situation and already foreseen interventions in civil protection systems near the borders identified and analyzed. Successful examples from projects and other cross border described and critical factors for successful adaptation and adoption stressed and presented to civil protection authorities. Research focus on decision support procedures and the restrictions imposed by political, cultural, technological and procedural reasons. Available tools, algorithms and methods to support, facilitate and optimize decision-making presented (for facility location, inventory management, relief distribution, and mass evacuation) together with realistic scenarios on potential disasters in the area. For example, the earthquake in Bitola in 1963 that let to over 1000 fatalities and 4000 injured, while 80% of the city was demolished and 200.000 people left homeless. Joint training and a cross border field exercise is planned for spring 2020. All aforementioned activities lead the authorities to revise all key elements of regional local and cross border civil protection system to optimize benefits of interventions planned both individually by themselves as well as jointly with their neighbours.

3. RESULTS AND DISCUSSION

Work done so far and especially in emergency logistics, confirms as obstacles to cross-border in disaster management those identified by Becking (2017):

1. Different administrative and civil protection structures in the neighboring countries.
2. Legal differences on which actors have the competence to sign cross-border agreements based on existing conflicting legislation and bilateral agreements
3. Different in communication, mobilization and emergency logistics support systems
4. Language (less since Greek is a dominating language at border area) and cultural barriers
5. Different prioritization in neighboring countries concerning disaster management

4. CONCLUSION AND REFERENCES

The analysis and the work done in emergency logistics field with civil protection actors in both countries identifies as critical the following aspects of cross-border disaster management:

- Organizing disaster management actors in a clearly identifiable structure and with a clear overview of individual responsibilities
- Negotiation and signing of bilateral and ideally multi-national agreements that provide the framework for joint response to and recovery from disasters
- Creation of a knowledge and experience sharing culture for achieving a shared-level of preparedness among neighbours



Detailed analysis of challenges, adaptation and adoption of well-proven best practices, use of scientific methods for supporting operational authorities together joint training activities as well as exercises create the base for successful joint activities in emergency management at the cross border area. Such cooperation can be an example for the whole area of Western Balkans and beyond.

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INGENIOUS: THE FIRST RESPONDER OF THE FUTURE – A NEXT GENERATION INTEGRATED TOOLKIT FOR COLLABORATIVE RESPONSE, INCREASING PROTECTION AND AUGMENTING OPERATIONAL CAPACITY

Consortium: Institute of Communications and Computer Systems – ICCS (Greece), Universiteit Twente (Netherlands), Deutsches Zentrum fuer Luft – Und Raumfahrt EV (Germany), Diginext (France), Fundacion Tekniker (Spain), Exus S.A. (Greece), SINTEF AS (Norway), Center for Research & Technology Hellas – CERTH (Greece), Totalforvarets Forskningsinstitut (Sweden), SATWAYS Ltd (Greece), Alpes Lasers S.A. (Switzerland), Technische Universitaet Wien – TUW (Austria), CY.R.I.C Cyprus Research & Innovation Center Ltd – CYRIC (Cyprus), Universitat Pompeu Fabra (Spain), SingularLogic S.A. (Greece), Korea Institute of Robot & Convergence (S. Korea), Gobierno Vasco – Dept. Seguridad (Spain), Assistance Publique – Hopitaux de Paris (France), Sodertorns Branforsvarsforbund (Sweden), I.S.A.R. Stiftung Gemeinnutzige UG – Haftungsbeschränkt GMBH (Germany), Police Service of Northern Ireland (UK), Hellenic Rescue Team of Attica – HRTA (Greece), Trilateral Research Ltd (Ireland).

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ABSTRACT

The INGENIOUS project (EU Horizon 2020) aims to develop, integrate, test, deploy, demonstrate and validate a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, which ensures high level of Protection & Augmented Operational Capacity to respond to the disaster scene. This will comprise a multitude of the tools and services required: 1) for enabling protection of the first responders with respect to their health, safety and security; 2) for enhancing their operational capacities by offering them with means to conduct various response tasks and missions boosted with autonomy, automation, precise positioning, optimal utilisation of available resources and upgraded awareness and sense-making; 3) for allowing shared response across first responders teams and disciplines by augmenting their field of view, information sharing and communications between teams and with victims. The NGIT armours the FRs at all fronts, by delivering novel, affordable, accepted and customised response tools and services as part of their uniform and as part of their operational assets. The NGIT will be provided at the service of the FRs for extensive testing and validation (at component and Toolkit levels) in the framework of a rich Training, Testing and Validation Programme – of Lab Tests (LSTs), Small-Scale Field Tests (SSTs) and Full-Scale Field Validations (FSXs) – towards powering the FR of the future being fully aware, fully connected and fully integrated.

Keywords: search and rescue, crisis management, security, wearables, UAVs.

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1. INTRODUCTION

Today's First Responders (FR) are using technology of the past. During their primary mission of saving lives and preserving society's safety and security, FRs face a multitude of challenges. In both small scale emergencies and large scale disasters, they often deal with life-threatening situations, hazardous environments, uncharted surroundings and limited awareness. Threats and hazards evolve rapidly, crossing municipalities, regions and nations with speed and ease. Armouring public safety services with all the tools that modern technology has to offer is critical. Such tools holistically enhance their protection and augment their operational capacities, assisting them in saving lives as well as ensuring their safe return from the disaster scene. However, "more technology and tools" is not necessarily a solution towards empowering FRs.



When firefighters, police officers and emergency medical services work in the field, they are often faced with “silo-ed” operations and overwhelming information flows. This should be dramatically reduced. What they need instead are intelligent, integrated, interconnected and seamless tools & services that add layers of protection against the dangers of their working environment and augment their situational awareness rather than distracting them from their mission.

Now more than ever, first responders confront at a global level, an increasing exposure to natural and manmade disasters due to climate change, rapid and unplanned urbanisation, demographic pressure, construction and more intensive land-use in hazard prone areas, eco-system degradation [1], radicalisation and extremism as well as economic crisis. Notably, the World Economic Forum identified major disasters as one of the top five global risks in 2017 [2]. Europe remains vulnerable to a wide range of natural and manmade hazards (such as flood, earthquake, industrial accidents, terrorism, critical infrastructure losses, etc.) [3], with disasters causing tremendous repercussions in human life and financial losses [4].

INGENIOUS [5] will develop, integrate, test, deploy and validate a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, which ensures high level of Protection & Augmented Operational Capacity to respond to the disaster scene. This will comprise a multitude of the tools and services required: 1) for enabling protection of the FRs with respect to their health, safety and security; 2) for enhancing their operational capacities by offering them with means to conduct various response tasks and missions boosted with autonomy, automation, precise positioning, optimal utilisation of available resources and upgraded awareness and sense-making; 3) for allowing shared response across FR teams and disciplines by augmenting their field of view, information sharing and communications between teams and with victims. The NGIT armours the FRs at all fronts. The NGIT will be provided at the service of the FRs for extensive testing and validation in the framework of a rich Training, Testing and Validation Programme – of Lab Tests (LSTs), Small-Scale Field Tests (SSTs) and Full-Scale Field Validations (FSXs) – towards powering the FR of the future being fully aware, fully connected and fully integrated.

2. METHODS

2.1 Operations

NGIT is directly utilised during response activities and upgrades protection and operational capabilities of the first responders whilst enabling collaboration and coordination among team members, agencies and between victims and infrastructure owners. From an operational perspective, NGIT supports and improves the following response activities: 1) Improving situational awareness by allowing local and remote detection, monitoring and analysis of passive and active threats and hazards at incident scenes in real time as well as empowering responders’ movements by accurately specifying their location and their proximity to team members, victims, assets, risks and hazards; 2) Delivering resilient data and voice communications between teams and with victims by interconnecting the HQ with the worksite crews and sensorial components deployed, exploiting the merits of edge/fog networking; 3) Augmenting command, control and coordination over a novel C3 and Common Operational Picture platform that allows collaborative incident management, monitors responders’ actions in real time whilst coupling with an expert reasoning system for all-source information fusion and analysis conveyed and intuitively visualised at those operating via traditional (mobile voice, data and app) and novel (augmented reality glasses, fully interoperable) interfaces; 4) Preserving responders’ health and safety and boosting performance by upgrading their uniform and body gear with resistive materials and wearable sensing, communication and positioning components; 5) Enhancing logistics and resource management by tracking and tracing first responders and their assets across the operational scene, enabling effective sectorisation and optimal utilisation of resources based on the analysis of hazard-specific needs; 6) Improving casualty management by the use of novel applications for triaging and victim classification at a prehospital support level and for suspect/victim face recognition; 7) Upgrading Training and Exercises of the first responders’ community delivering a rich programme of Command-Post, Small-Scale and Full Scale Exercises during which diverse teams of responders covering the entire range of disciplines (civil



protection, fire brigades, emergency medical services and police services) shall synergistically test, evaluate and validate the full extent of capabilities offered by the NGIT.

2.2 Technology

NGIT armours the first responders with novel, affordable and reliable tools and services as part of their uniform and as part of their operational assets in an integrated manner, facilitating seamless and resilient interconnectivity and boosting awareness. More specifically, 1) the NGIT builds upon the concept of “smart” first responders by holistically equipping them to protect them and assist in conducting their response duties, empowering and enhancing their helmet, uniform, boots and accompanying K9 units with wearables, communication and localisation components, sensors and addons delivering augmented reality functions. 2) Moreover, the NGIT comprises of smart devices in the air and on the ground, that are essentially external response modules operated by first responders to monitor, map, analyse and assess the incident scene. These are: the fully customisable self-exploring drones perceived as FRs’ companions, the standalone components for delivering worksite communications (interconnecting tools/sensors with FRs, among FR teams, FRs with HQ and FRs with citizens/victims) and the indoor and outdoor localisation modules used to track and trace FRs and their proximity to team members, victims, assets, risks and hazards in real time. 3) Ultimately, the NGIT supports first responders with multi-fusion and expert reasoning modules for improving situational awareness and threat and hazard detection, a C3 and a COP platform with augmented reality capabilities as addons for Command, Control and Coordination and with mobile applications to improve response activities (such as worksite declassification, victim triaging, victim/suspect recognition and identification, multilingual speech support across multinational teams and social media “push” & “pull” messaging).

3. CONSORTIUM

INGENIOUS consortium has a rich diversity of organisation types: “typical” End-users/Practitioners (6) (first responders teams of all disciplines, fire brigades, emergency medical services, civil protection, K9 units and law enforcement agencies) comprise 26% of the Consortium, followed by specialised SMEs and Industries (7) representing 30% of the Consortium providing focused solutions on sensors embedded on FRs, data fusion platforms, Augmented reality services and Common Operating Picture and C3 systems, coupled with the important legal, privacy, ethical and social, human and security factors dimension (TRI expert partner). The consortium is complemented and showcases a multi-disciplinary and prominent research, innovation and scientific dimension for the final solution with the participation of EU’s finest RTOs and Universities as well as of. KIRO (pioneer research institute on disaster response robotics in Korea) (10) representing 44% of INGENIOUS.

4. PROJECT TIMELINE

INGENIOUS is part of the initiative “H2020-EU.3.7.5: Increase Europe’s resilience to crises and disasters” and specifically the topic “SU-DRS02-2018-2019-2020: Technologies for first responders” (H2020-SU-SEC2018). It is a Research and Innovation Action (RIA) with a total budget of €8.9 million and duration of 36 months, starting from September 2019.



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CURSOR: COORDINATED USE OF MINIATURIZED ROBOTIC EQUIPMENT AND ADVANCED SENSORS FOR SEARCH AND RESCUE OPERATIONS

Consortium: Bundesministerium des Innern – THW (Germany), Entente pour la Forêt Méditerranéenne – EPLFM (France), Merseyside Fire and Rescue Authority – MFRA (UK), Service Départemental d'Incendie et de Secours de la SAVOIE – SDIS73 (France), Hellenic Rescue Team of Attica – HRTA (Greece), Institute of Communications and Computer Systems – ICCS (Greece), EXUS Software Ltd. (Greece), C4CONTROLS – C4C (UK), International Security Competence Centre GmbH – ISCC (Austria), Tohoku University (Japan), SINTEF AS (Norway), Commissariat à l'énergie atomique et aux énergies alternatives – CEA (France), The University of Manchester – UNIMAN (UK), German Institute for Standardisation – DIN (Germany), Trilateral Research Ltd (Ireland), ARTTIC S.A.S. (France).

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ABSTRACT

The CURSOR project aims at developing new and innovative ways of detecting victims under debris. This includes the coordinated use of miniaturized robotic equipment and advanced sensors for achieving significant improvements in Search and Rescue (SAR) operations with respect to: (a) the time used to detect trapped victims after a building structure has collapsed, and (b) an informed and accelerated decisionmaking by first responders during rescue operations allowing for the deployment of expert personnel and, in particular for operations in hazardous environments, suitable equipment at prioritized locations. CURSOR is proposing a system consisting of several integrated technological components. It includes Unmanned Aerial Vehicles (UAVs) for command & control, 3D modelling and transportation of disposable miniaturized robots, that are equipped with advanced sensors for the sensitive detection of volatile chemical signatures of human beings. Information and data collected are transferred in real time to a handheld device operated by first responders at the disaster site.

Keywords: search and rescue, crisis management, security, robotics, UAVs.

Acknowledgements: This work is supported by the project CURSOR, which has received funding from the European Union's Horizon 2020 (H2020) programme under grant agreement No:832790.

1. INTRODUCTION

Due to climate change, global society will have to face a severe increase of natural disasters in the future. Therefore, strengthening societal resilience against disasters like flooding, droughts, forest fires but also earthquakes has been declared as a priority also for the European Union, which became evident in recent years through the adoption of a new Civil Protection legislation with a strong focus on disaster resilience and response and the reinforcement of the Emergency Response Coordination Centre (ERCC). In May 2018, the European Parliament decided to upgrade the EU civil protection capacity by establishing RescEU, a reserve at European level of civil protection capabilities, including urban search and rescue [1]. At international level, the International Search and Rescue Advisory Group [2] facilitates the coordination between the various international USaR teams who make themselves available for deployment to countries experiencing devastating events of structural collapse due primarily to earthquakes.

In a disaster situation, the goal of SaR operations is to find the greatest number of people in short time, while minimizing the risk to rescuers. Natural or man-made disasters often result in difficult working conditions for Urban Search and Rescue (USaR) teams [3] and other First Responders (FR), such as police, medical services and civil protection units not specialized in SaR. FRs are often exposed to high risks during response due to

structural instability of the disaster site and/or because of hazardous environments. Under such conditions FRs must take quick decisions to determine the location of trapped victims as swiftly and as accurately as possible.

Today, FRs still rely on technologies of the past in conducting their USaR tasks in search of victims. They face the (current) limitations of conventional telescopic-pole visual and IR cameras, time-consuming laser scanners for detecting removable structural elements without causing cascading collapses, the limited use of UAVs in the field as well as heavy and difficult to move THz/GPR scanners for detecting voids. Therefore, they prefer to trust their senses and those of their SAR companions, i.e. the K9 (canine) units. Even though, more technology and tools are not by default the solution, the field of USaR activities requires modernisation, exploiting technological advances to its fullest as human life is at stake. CURSOR builds strongly upon previous and connects to ongoing research into rescue technologies for FRs.

CURSOR [4] will develop and promote the use of novel technologies by USaR teams reducing the time for detecting survivors trapped in damaged and collapsed buildings. The project will deliver the innovative CURSOR SaR Kit, an integrated system of various technological components and platforms, that allows USaR teams to a) work efficiently and safely on the disaster site, while detecting and locating survivors and b) enable collaborative response, by sharing information and accurately visualizing the disaster scene and associated notifications across all levels of command.

2. METHODS

The main operational challenges for USAR teams include insufficient situational awareness causes lengthy SAR processes, while working in hostile and uncharted environments. According to statistics, uninjured survivors can survive up to around 72 hours, which is called the Golden 72 hours. As losing time in USAR operations costs lives, it is essential to quickly detect and localise trapped victims. To do so and to use the available, often scarce resources for search and rescue most efficiently, it is of utmost importance to have an accurate overview of the current disaster scene at any point in time during the operation and to efficiently manage the information exchange between responders in the field and the team command, UCC (USAR Coordination Cell) or OSOCC (On-site Operations Coordination Centre).

In addition, CURSOR [4] will deepen the shared understanding between First Responders and (technological) solution providers on the operational needs, along with requirements during USaR operations and the technological possibilities and features matching them. During complex and challenging disaster situations CURSOR will reduce the time needed for deployment of Search and Rescue personnel with their equipment by developing an USaR Kit that is highly mobile, easy to set up and user friendly. CURSOR technologies will also reduce the time needed for Situational Assessment (SA) during USaR operations, where an improved collaborative and shared operational picture of the affected area is needed to allow a more efficient triage, e.g. through faster identification of confined spaces with potential for trapped survivors. Decreasing the time needed for onsite disaster response, where the exact position of victims within the debris cone must be determined most accurately and by considering safety and security aspects for the victim and the First Responders to take informed decisions for the rescue operation. Improving the protection of First Responders' health and safety during USaR operations, by developing a system with unmanned robotic platforms allowing for highly remote operations.

Finally, CURSOR technologies will ensure the uptake and sustainability by transfer of results and lessons learnt collected during specification, development and (field-)validation of the CURSOR SaR Kit. Through close collaboration with other practitioner organisations and networks (such as INSARAG) through CURSOR's First Responder Board, the project will not only be guided with respect to hands on experience from past missions and policy requirements currently relevant to the development of the CURSOR SaR Kit, but also allow the project to contribute to standardisation activities and the improvement of guidelines and Standard Operating Procedures (SOP) for USaR teams.



3. CONSORTIUM

Coordinated by THW, CURSOR involves four more FR organisations from France, UK and Greece; their operational know-how and network will guide the development and sustainability of results. Leading edge technologies will be provided by research partners, whereas key innovative components will be developed by SMEs, which will commercialise CURSOR SaR Kit. Other practitioners will participate throughout the development process, during technology validation and in standardisation activities as members of the project's FR Board (INSARAG secretariat, Regione Liguria, USaR NL, Japan NRIFD).

4. PROJECT TIMELINE

CURSOR is part of the initiative "H2020-EU.3.7.5: Increase Europe's resilience to crises and disasters" and specifically the topic "SU-DRS02-2018-2019-2020: Technologies for first responders" (H2020-SU-SEC2018). It is a Research and Innovation Action (RIA) with a total budget of €7.4 mn and duration of 36 months, starting from September 2019.

5. CONCLUSION

The overall aim of CURSOR is to provide search and rescue teams with an easy and fast deployable system (CURSOR SaR Kit) which significantly reduces the time to detect trapped people and to provide sufficient information for prioritisation of actions during search and rescue operations according to the operational needs of the First Responders (FRs). CURSOR's mission and objectives address this directly by proposing the specification, the development, the evaluation, and validation of the CURSOR SaR Kit. Developing such a system requires the development of technological challenges that achieve very specific results.

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FASTER: FIRST RESPONDER ADVANCED TECHNOLOGIES FOR SAFE AND EFFICIENT EMERGENCY RESPONSE

Consortium: Center for Research & Technology Hellas – CERTH (Greece), Engineering Ingegneria Informatica SPA – ENG (Italy), Hellenic Telecommunications Organization S.A. – OTE (Greece), DIGINEXT (France), Crisisplan B.V. – CPLAN (Netherlands), Drone Hopper SL (Spain), Robotnik Automation SLL (Spain), Synelixis (Greece), Instituto de Novas Tecnologias – INOV (Portugal), FONDAZIONE LINKS (Italy), Kpeople Research Foundation – KPRF (Malta), Kajaanin AMMATTIKORKEAKOULU OY – KAMK (Finland), VRIJE Universiteit Brussel – VUB (Belgium), University of West Attica (Greece), Ayuntamiento de Madrid – ADM-POL (Spain), Servicio Madrilenio de Salud – SUMMA (Spain), ECOLE Nationale Supérieure des Officiers de Sapeurs-Pompiers – ENSOSP (Spain), Wyższa Szkoła Policji w Szczytnie – WSPOL (Poland), Kajaanin Kaupunki (Finland), Hellenic Rescue Team of Attica – HRTA (Greece), Municipio de Grandola (Portugal), Consorzio per il Sistema Informativo – CSI PIEMONTE (Italy), Kwansei Gakuin Educational Foundation – KGU (Japan)

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ABSTRACT

The FASTER project (EU Horizon 2020) aims to establish a new approach for disaster response in order to improve Europe's overall disaster resilience. This will be accomplished by the targeted employment and synergistic deployment of a set of appropriate and complementary technologies. Immediate response is the second phase of the disaster management cycle and is a very important aspect for dealing effectively with disasters. Consequently, FASTER will improve the disaster response and monitoring capabilities by providing first responders with a suite of core and supplementary tools to augment their situational awareness and, as a result, improve their safety as well as enhance their operational capacity. The focus of disaster response is mitigating the impact of the disaster and ensuring the safety of those in immediate risk. However, as this takes place during the emergency, it also includes the safety of first responders who provide the means and resources for effective disaster mitigation and protection of life. Their in-field effectiveness is critical to mitigation and ensuring a short and smooth recovery phase.

Keywords: search and rescue, crisis management, security.

Acknowledgements: This work has received funding from the European Union's Horizon 2020 (H2020) programme under grant agreement No:833507.

1. INTRODUCTION

The European Environment Agency (EEA) reports that Europe is experiencing an increasing number of disasters, derived either from natural phenomena, technological accidents or human actions [1]. These disasters affect EU citizens, the EU economy and the environment every year [2]. Over the period 1980-2016, the total reported losses caused by weather and climate-related extremes in the EEA member countries amounted to 436 billion EUR. The economic and societal impact will continue to escalate, as weather-related disasters alone could affect about two-thirds of the EU population annually by the year 2100, according to a recent data-driven forecast study [3]. First responders (FRs) are the people who are among the first to arrive and provide assistance at the disaster scene. They are typically professionals with specialized training, including law enforcement officers, firefighters, emergency medical personnel, rescuers, K9 units, civil protection authorities and other related organizations.

Due to the nature of their work, FRs are often operating in risky and hazardous environments, including collapsed, burning or flooded buildings, darkness, smoke, heat, and broken communications. Furthermore,



FRs may experience health incidents (e.g. sudden illness, dizziness or exhaustion strokes) during operations, which can prevent them from completing their mission, and, more importantly, put their own life at risk. FRs may often not notice early signs or choose to ignore them in favour of accomplishing their mission, which can lead to become additional casualties of the disaster [4].

Despite their commitment and proper training, FRs' capabilities are often limited by the chaotic environments they operate in, making it extremely difficult for them to estimate the exact position of the victims, dangerous areas, or other FR teams. Though modern technology has played an important role in aiding FRs, it is often geared towards everyday or commercial use, and difficult to realize its full potential during a crisis. Autonomous vehicles are useful in disaster scenes, according to a member of the Reykjavik Search and Rescue (SAR) Team, who claims that using drones has enabled them to respond faster and more accurately [5], but they lack in operational autonomy. Cameras and other sensors can enhance situational awareness; however, an overwhelming amount of information may achieve the opposite. Multiple displays and devices, though useful on their own, can quickly add clutter and weight to carried equipment. Drones can permit faster and more accurate responses but lack operational autonomy. Communication between FRs and the Command and Control center is often hindered by broken, overloaded or non-existent network infrastructure [6]. Multiple FRs agencies and community volunteers, operating on the same scene need, need proper coordination. Often the problem lies not so much in the lack of resources and willingness to provide help, but in the logistics to efficiently direct and deliver assistance to the right places where and when it is most needed. These problems raise the need to harness the rapidly evolving technology towards protecting FRs from multiple and unexpected dangers, and to provide solutions enabling them to operate in a seamless and efficient way in any environment and in cooperation with the community.

2. IDENTITY AND VISION

FASTER [7] is a research and innovation project, funded by the European Commission, that aims to address the challenges associated with the protection of FRs in hazardous environments, while at the same time enhancing their capabilities in terms of situational awareness and communication.

FASTER is a joint, interdisciplinary endeavour, which started in May 2019 and has a planned duration of 3 years. It is undertaken by a consortium of 23 member organizations coordinated by CERTH, consisting of 8 research institutes, 3 leading industries, 4 SMEs, and 8 First Responder agencies including law enforcement agencies, firefighters, medical emergency services, K9 units, disaster response teams and civil protection organizations. Funded by the European Commission under the Horizon 2020 program, it spans much of the EU (Belgium, Finland, France, Greece, Italy, Malta, the Netherlands, Poland, Portugal, and Spain), as well as Japan.

FASTER acknowledges the development of a diverse range of tools which partially address some of the identified issues that FRs are facing, and intends to improve, extend and adapt them, developing integrated solutions for FRs that will be validated on the field.

3. METHODS

FASTER has a clear vision of going well beyond the state of the art providing cross-discipline tools to assist FRs in all aspects of their work and more importantly to increase their safety while operating. More specifically, FASTER aims at improving FRs' situational awareness by creating a secure IoT network for real-time data collection, including environmental (e.g. ambient temperature) and biometric measurements, from sensors, wearables and smart textiles, fitted on FRs' gear. Additionally, in FASTER, text analysis techniques will be coupled with deep learning algorithms to eventually implement a classifier for social media posts and an event detection algorithm. Algorithms will be able to recognize emergency situations such as floods, fires, extreme weather events, and damaged infrastructure by simply scrapping the web.

The retrieved data will be then provided to both individual FRs through AR-enabled devices and operation leaders creating a Common Operational Picture with an innovative interface for portable devices. Especially,

the AR interface will be developed to handle operations in any environment, seamlessly switching from registered to unregistered modes without misleading the user allowing FRs to digitally annotate the incident scene, and navigate them in complex environments. Similarly, FASTER's Portable Common Operational Picture tool will be carefully designed for enabling FRs to understand critical information at a glance and to acquire an overall and continuously up-to-date situation awareness.

Additionally, multi-functional autonomous vehicles equipped with vision sensors will be employed in order to enhance the operational capabilities of the FRs and at the same time allow them to see beyond obstacles and inspect unreachable or dangerous areas. In detail, each FR will be equipped with a small lightweight UAV ready to be utilised on demand assisting in visually inspecting otherwise inaccessible areas. Drones will be combined with AR technology for eventually offering an X-Ray like view to the FRs. In parallel, hand gesture recognition methods will be developed within FASTER allowing navigation of autonomous vehicles including drones in the disaster scene, mobile mission management (e.g. accepting mission tasks, reporting a problem, etc.), and haptic communication (e.g. by identifying gestures as messages and transmitting them as Morse code vibrations) between the FRs.

FASTER will also provide the technology for enhancing the communication between FRs and K9s. Wearables will be fitted on K9s' collar or body in order to collect data that will be later fed into Deep Learning (DL) algorithms for automatically classify the K9s' behaviour enabling FRs to easily understand the information when the dog is out-of-sight.

UaVs and 5G technologies will be also employed in order to achieve resilient and reliable connection. More explicitly, FASTER will address resilient communications in multiple levels. Firstly, in extending the communication network beyond the last operational point of communication by using a drone or swarm of drones as a relay service. Secondly, in emergency messages broadcasting to both civilians and FRs, considering safety processes and operational commands respectively. Towards that end, FASTER will introduce the Emergency Communication Box for broadcasting the aforementioned messages, where a mobile application will accompany it and will be able to receive and read the transmitted messages. Lastly, in managing and orchestrating of applications for FRs, including technologies related from IoT to AR/VR in a 5G infrastructure. Available tools and techniques for managing network services and properly extending them to meet FRs' needs will be also employed within FASTER and the application of blockchain and smart contract technologies to coordinate transparent interactions between FRs and all other parties involved in the relief effort will be also explored.

Finally, particular emphasis will be put on the engagement and involvement of the FRs in the development of tools ensuring that they will be compliant with their requirements and needs.

4. PILOTS AND VALIDATION

The FASTER solution will be demonstrated in three carefully selected scenarios that cover a diverse range of disaster scenarios. Firstly, FASTER will be piloted in Madrid, in a multi-storey building collapse case where a structural failure triggers a complete collapse. The second use case concerns a major flood in a high-density urban environment and will be realised in Alessandria area in Italy. The final use case refers to an indoor disaster scenario, where an explosion occurs in a populated building and will be demonstrated in Kajaani, Finland. All FASTER tools will be validated in at least one of the above pilots, giving the researchers, integrators, and FRs the opportunity to examine their usefulness and interoperability in different use cases.



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NOVEL INTEGRATED SOLUTION OF OPERATING A FLEET OF DRONES WITH MULTIPLE SYNCHRONIZED MISSIONS FOR DISASTER RESPONSES: HORIZON 2020 PROJECT RESPONDRONE

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ABSTRACT

Region of Western Macedonia, supported by the newly established Department of Regional and Cross Border Development of Western Macedonia University participates in the HORIZON 2020 project RESPONDRONE. It will develop and validate an integrated solution for first responders to easily operate a fleet of drones with multiple synchronized missions to enhance their situation assessment capacity and own protection. This System of Systems will simplify and accelerate situation assessment and sharing, decision making and operations management, while requiring a small crew to operate it. Moreover, it will deliver high-level information to any involved control centre through an intelligent web-based system that can be operated and accessed from a remote site as well as serving as on-demand airborne communications network to allow people on the ground to communicate with the command centre in case of cellular coverage collapse.

With these situational-awareness enhancing tools, emergency response teams will be able to more rapidly, effectively and efficiently respond to an emergency or disaster and therefore save more lives. The fleet of drones will provide enhanced capabilities to support assessment missions, search and rescue operations, as well as forest fire fighting. Each fleet or unit of drones will be able to operate by a single pilot and few observers. To ensure seamless uptake and adaption by first responder organizations, RESPONDRONE will be fully integrated and embedded within the current processes and procedures of real emergency response agencies and teams. Therefore, RESPONDRONE will increase the effectiveness and efficiency of civil protection operations as it will consider the first responder total mission time, cost, and effectiveness (and not just considering the deployment time). The RESPONDRONE system will be demonstrated under full operational settings in a demonstration in Corsica, while smaller pilots will be conducted in end users areas. Region of Western Macedonia will prepare a pilot testing for the cross border area.

Keywords: Drones, Disaster management, Cross border operations, situational awareness

1. INTRODUCTION AND OBJECTIVE

The most critical part of responding to any (large-scale) disaster when the very first report of it has been received is the immediate response to obtain a comprehensive situational awareness of the disaster. If a disaster occurs in a large area, emergency response teams require an extensive understanding of the area struck by the disaster as fast as possible and real time information on, among others, the status of critical structures, the power grid, road access, the exact location of victims and environmental threats. Collecting, processing, sharing and displaying this information as fast as possible after a disaster has occurred is challenging, especially when no reliable communications infrastructure is available. Quickly gaining an understanding of the situation in the disaster area, including the location of survivors, deployment and direction of first responder teams, and monitoring of mission progress resources is difficult for decision

makers. Therefore, the more quickly a comprehensive overview of the area of disaster can be provided and a communications network be established, the faster first responders indeed can provide a coordinated response.

The novel technologies and methodologies of RESPONDRONE will be integrated into the organisational processes of the civil protection operations through advanced training programs, while ensuring the highest civil liberty standards. The proposed solution will be demonstrated through participation in actual civil protection exercises on Corsica, involving several agencies simultaneously. It will contribute to the enhancement of inter-agency collaboration in disaster preparedness in order to prepare first response teams and emergency centres to react in a fast, coordinated manner when disasters occur. Cross-border capabilities will be demonstrated as 9 public bodies responsible for civil defence and emergency response from 8 different countries (all full partners of the RESPONDRONE Consortium) will participate in the exercises as well.

RESPONDRONE will develop an integrated multi-drone emergency solution with field-proven procedures to integrate it into the current first responders' operational workflow. This objective will require:

- (A) An integrated set of processes and procedures for increased effectiveness and efficiency of emergency responses;
- (B) Cutting-edge technologies mandatory to operate simply and autonomously a fleet of drones equipped with a variety of payloads to provide high-level situation awareness; and
- (C) Advanced training programs for first responder agencies and drone operators to operate these cutting-edge technologies.

These measures and tools will facilitate the full integration of the use of fleets of drones into the processes of first responders in order to improve the effectiveness and efficiency of any emergency response. Therefore, RESPONDRONE will significantly contribute to the European Emergency Response Capacity.

2. EXPERIMENTAL METHODS

To achieve the project's objectives, a 36-month work plan has been designed. This work plan foresees 14 Work Packages ("WP") in four building blocks, namely (A) Preparatory Actions, (B) System Integration and Validation, (C) Improving Operations and (D) Impact generating Actions) and it accommodates for the interaction between the WPs.

RESPONDRONE will follow the *System of Systems (SoS)* approach. A SoS is defined as a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities. Both individual systems and SoS conform to the accepted definition of a system in that each consists of parts, relationships, and a whole that is greater than the sum of the parts; however, although an SoS is a system, not all systems are SoS. As for integration – in SoS the recommendation is integration of each systems Stand Alone, and afterwards will be the stage of the SoS integration.

End-user Involvement: One of the most important features of RESPONDRONE, which makes it potentially more sustainable and unique, is its *user-centred approach*. In this approach, all end-users and stakeholders will be involved from Day 1 project in the design, development, operation and maintenance of the RESPONDRONE system. In addition, in order to increase the user-friendliness of the system, a set of interactive web tools will be developed for the system front-ends to allow the user to visualise both the location of the data points (using maps) and the data values (using plots / data visualisation layers). A review of use cases, existing tools and consultation with end users will be carried out to identify the most appropriate data visualisation tools to be integrated into the platform within project scope.

Preliminary Actions: The project will start with two preparatory actions that will form the base of the project and the outcomes will be used subsequently in the rest of the project: WP1 Survey of Disaster Response Operations and WP2 Risk Assessment and Management Methodologies for purposes of establishing the base lines.

3. RESULTS AND DISCUSSION

A multitude of innovative and efficient systems and solutions for CM are currently being developed. A variety of gaps exist when examining not only crisis management processes, but also technological capabilities. DRIVER+ (partner of RESPONDRONE) has conducted a gap assessment study and the major aspects stated in the final report were Category:

- Decision support: a) “Lack of a “Common Operational Picture” environment to integrate data sources and calculation results from different sources crucial for decision making process” b) “Limits in the ability to merge and synthesize disparate data sources and models in real time (historic events, spreading models, tactical situation, critical assets map) to support incident commander decision making”
- Information sharing and coordination: a) “Shortcomings in the ability to exchange crisis-related information among agencies and organizations (also related to interoperability)”, b) “Lack of common doctrines and procedures supporting international cooperation in aerial firefighting” and probably other aerial system operations
- Resource planning: a) “Shortcomings in the use of virtual reality to enhance preparedness of first responders in case of large scale evacuation, as a support for training and exercise”
- Casualty management: a) “Limited ability to identify the location of injured/trapped/deceased casualties in large forest fires”, and possibly other crisis situations, b) “Barriers in capability to provide medical assistance to casualties either by transporting them to a safe place or bringing emergency medical service to the scene”

First responders and crisis managers still see shortcomings in getting an overall situational awareness (common operational picture), combining different data sources for effective decision making, collaborating with different responder teams (especially cross-border) and providing virtual reality training to optimally prepare responders to complex crisis situations.

4. CONCLUSION

Within CM it is necessary to have the right information at the right time. By adding a layer of trustworthy information, both live at the user's fingertips as well as integrated into existing information, RESPONDRONE will add to the decisiveness. To be able to add a large amount of data with limited staffing RESPONDRONE will use a multi-drone solution. RESPONDRONE will therefore significantly influence crisis management on two axes:

1. *Improve the situational awareness of first responders compared to existing operations (even with drones).* RESPONDRONE will add much more information in real time for the situational awareness and the decision process, integrating this information (both live and analysed information) fully within existing CM procedures. A solution that can be used at cross-border and/or cross-agency level. Based on the expressed needs and requirements of end-users, this system of systems will allow collaboration across borders due to its distributed nature, thus effectively connecting the critical pieces that are all needed to provide for an effective crisis response.
2. *Keep the drone fleet operating crew reduced in size, in order to contain the training and expertise costs, while ensuring the compliance with flight regulations.* The multi-drone capability, by being able to fly a fleet of drones by few pilots and operators significantly reduces the required staff of the first responders. Moving the flight planning and data analysis to a centralized platform reduces the need for experts to be near the emergency. Experts from all over the world can be given access, and in this way add their expertise nearly immediately. Moving parts of flight planning into a centralized platform also means the operators on the ground have fewer direct responsibilities for the drone flights. This makes it easier to always have the right operators in the right location.

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ASSESSMENT OF STRUCTURAL AND NON-STRUCTURAL VULNERABILITY OF SEWAGE TREATMENT PLANTS, THROUGH A QUESTIONNAIRE

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ABSTRACT

The priority given to the health and safety of the population is unquestionable, worldwide. Statistically, the impacts of natural disasters increase over time. Critical Infrastructures such as Wastewater Treatment Plants (WTP) are in immediate risk (seismic, sanitary etc) with significant impacts on the community, especially in seismic countries (as Greece). Assessment of these vulnerabilities is imperative, as the investigation is poor at this direction, so far.

The ultimate goal is to mitigate the effects of an earthquake disaster, such as injuries, deaths, property damage, disruption of facilities, loss of "customers", financial losses, environmental impact, reduced confidence in business and the state, fines and penalties, and legal actions.

The present work aims at the creation of a Structural and Non-Structural Vulnerability Questionnaire (SV-NSV) for Sewage Treatment Plants (STP), particularly referring to Primary Mechanical Cleaning (sand collectors, primary settling tanks etc) and Secondary Biological Cleaning (gravel-refinery etc). It is addressed to the Managers of STP, and especially to its Security Department. Through this questionnaire, the variables that contribute to each vulnerability factor (SV and NSV) are identified and recorded. Such variables related to SV are the structural type of the constructions, their Anti-Seismic Regulation etc. The variables related to NSV are Electro-mechanical installations, pumps, pipelines, generators etc. Totally 265 variables are examined.

According to the methodology, existing questionnaire about the "Primary Pre-earthquake Assessment of Public Buildings and Public Welfare Institutions" is utilized and adjusted accordingly. Bibliographic characteristics of WTP are examined and included in the questionnaire.

The creation of the questionnaire is an easy-to-use "tool" for assessing the main factors of Structural and Non-Structural Vulnerability of STPs (after distribution and statistical processing). Future documentation of the reliability and validity of the questionnaire as well as the contribution and importance of their variables in assessing vulnerability are necessary.

Keywords: Vulnerability, Safety, Sewage, Sanitary Engineering, Questionnaire

1. INTRODUCTION

Our society is suffering from increasing natural disasters, especially because of the urbanization of big cities in recent decades [1] and the increase in population. [2] The Impacts of Earthquakes on Wastewater Treatment Plants (WTP), as a subset of Life Lines and Critical Infrastructures are significant as the harmful effects on building infrastructure, functionality etc affect a large proportion of the population. Internationally, emphasis is placed on the prevention and evaluation of vulnerability "Sendai Framework for Disaster Risk Reduction 2015-2030". [3] Health and safety issues have already been incorporated into Greek law. [4] The only ambitious European Program called as "Syner-G" about Seismic Vulnerability and Risk Analysis for Buildings, Infrastructure etc in a systematic way (eg incorporating social parameters) is over by 31/3/2013, but its utility requires investigation as it has not been widely applied to Wastewater Treatment Plants or especially to Sewage Treatment Plants (due to its multi-parametricity). [5,6,7,8] Other efforts to investigate the vulnerability of critical infrastructures, about natural disasters, have been made by other researchers. [9,10,11,12]

2. EXPERIMENTAL METHOD

The purpose of this work is to evaluate the structural and non-structural vulnerability of Sewage Treatment Plants (STP). The method used to investigate seismic vulnerability of STP is bibliographic. FEMA makes Macroscopic Assessment and Calibration of Risk Assessment Variables through recordings at Business Bulletins. [13]

The function of STP is described by researchers such as Markantonatos, Traganitis, Alexandros, Tsekouras and others. [14,15,16,17] Terms and conditions for wastewater treatment especially in small systems determine their proper operation. [18,19]

In Greece, Technical Services or operating agencies of Public buildings and Public Welfare Institutions owe to participate and perform the Pannelinic Programme of the Primary Stage of Pre-Earthquake Assessment. The autopsy reports of structural and non-structural vulnerabilities are sent to the Earthquake Planning and Protection Organization (EPPO) for further calibration. [20,21]

Respectively, a Questionnaire (autopsy report) was developed for STP about their Structural and Non-Structural Vulnerabilities, for the needs of the present work. EPPO autopsy reports were a guide to this effort and obviously, there were variations and appropriate adjustments to the particularities of these facilities. The variables listed in the Questionnaire need further investigation about their reliability and validity. It has been assumed that the reference issues are only the Primary and Secondary Treatment Plants, which constitute the STP, as well as the “control building” place. The questions were attempted to be closed-ended for easier handling of the results.

The questionnaire refers to Primary Wastewater Treatment Plants and to Secondary Biological Purification. Its usefulness is clear for Regions and Municipalities, as after assessing the vulnerability of STPs, they can make interventions for greater durability of constructions so as to have less impact on people, infrastructure, economy, etc. The questionnaire was created to record 25 structural vulnerability variables such as STP identity, technical characteristics, seismological and geotechnical features of the area, and the STP structural type. Accordingly, the questionnaire includes 96 variables related to non-structural vulnerability in sewage treatment plants (walls and long-length walls, electromechanical installations, fuel tanks, pipelines, electrical equipment, lighting) but also in “control building” places (doors and exits, windows, parapets, protecting railings – cladding – plates - other decorative elements, fences and walls, attachments, escalators, elevators, PCs, stored materials, fire detection and fire firefighting). Variables on the connection of STP to city networks are also included. The questionnaire also includes 144 variables about the Units that constitute the STP. These variables are a) General characteristics, b) preliminary treatment (bar racks, pulping, grit chamber, skimming tank), c) primary sewage treatment plant (primary sedimentation tank), d) secondary sedimentation treatment purification (biological filter, tank of activated sludge, tank of secondary sedimentation, stabilization tanks, chemical precipitation, treatment of the sludge (hopper-concentration- digestion-conditioning- dewatering and drying- stabilization- final disposal), and e) the STP pipes.

3. RESULTS AND DISCUSSION

The Structural and Non-Structural Vulnerability Assessment Questionnaire of STP is a handy “tool” for its immediate use by safety technicians, administrators of these places and others. It consists of a total of 265 variables related to Structural Vulnerability and Non Structural Vulnerability. It is interesting that variables as grit chamber, biological filters etc have been incorporated at non-structural vulnerabilities. The questionnaire is a coherent mean of recording all the variables that tend to be risk for workers, operators, citizens, facilities themselves, etc. Possible STP failure can have a wider impact on humans, on building infrastructure, on the environment. Future research may focus on the reliability and validity of the proposed questionnaire. Proposed actions are to distribute the questionnaire to the recipients and the subsequent statistical processing of the results.

4. CONCLUSION

Our society, having as its priority the prevention of natural disasters and the mitigation of their harmful effects, must record and strengthen critical infrastructures such as STPs. Possible structural or non-structural failures will have a significant impact not only locally but also on people, constructions and the environment. The globalization of the effects of natural disasters creates much greater effects than ever before in systemic-operated environments on our planet.

In this direction of recording the vulnerability of STP, the present work is moving. This effort is identified in the creation of a Structural and Non-Structural Vulnerability Assessment Questionnaire, incorporating the specificities of these sites. The questionnaire is user-friendly and contributes most positive to social security.

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LOCAL SEISMICITY IN THE BROADER FLORINA AND PELAGONIAN BASINS

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ABSTRACT

We study the seismicity of the Florina and Pelagonian basins, which is important for the safety of some critical infrastructures (e.g. power plants, dams, etc.) which are around the area under concern. A detailed study of earthquakes in the broader area of Florina and Pelagonian basins was undertaken. The basic reason is to evaluate the seismicity of the area and provide useful information to engineers, regulators and planners in order to mitigate adverse social and/or economic effects of an earthquake and allows them to plan earthquake-resistant designs.

Keywords: earthquakes, seismicity, critical infrastructures, mean return period, probability

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1. INTRODUCTION

The Florina and Pelagonian basins are similar as far as their deformation and sedimentation history is concerned. They are both sub-basins of a long (more than 150 km) generally NW-SE trending sedimentary basin, which is a graben bounded by NW-SE to NNW-SSE striking normal faults. These faults were formed during an extensional stage following the main alpine orogenetic event, probably due to orogen collapse [1,2]. The area covered in the present study (cross border between Greece and North Macedonia) is bounded between latitudes $\phi = 40.24-41.24^\circ$ and longitudes $\lambda = 20.24 - 22.00^\circ$. The area almost extends 100 Km from South to North and 200 Km from West to East. Earthquakes of broad magnitude spectrum (small, medium, large) were reported or they were recorded since historical era up to the present. In Figure (1) the seismicity map of the whole region is demonstrated and covers the time span 552 A.D. – 2018. The shocks are marked by different symbols and different colours (specially the large ones). The earthquakes used in this work are restricted to shallow depths only, given that an absence of deep events in the study area.

Almost 95% of shocks generated are limited in depths lower than 20 km, as it is depicted in Figure (2), where one can see a 3D North-South section.

Florina and the surrounding region considered as an area of low-to-middle seismicity. On the other hand this area experienced large earthquakes that occurred in the past. Magnitudes reach the size of 6.7 which is the highest observed. Such earthquakes can cause of course heavy damages to infrastructures and to environment, injuries, homeless people and possibly human victims. We study the seismicity of the considered area which is important for the safety of some important infrastructures (e.g. power plants, dams, etc.) installed in the area.

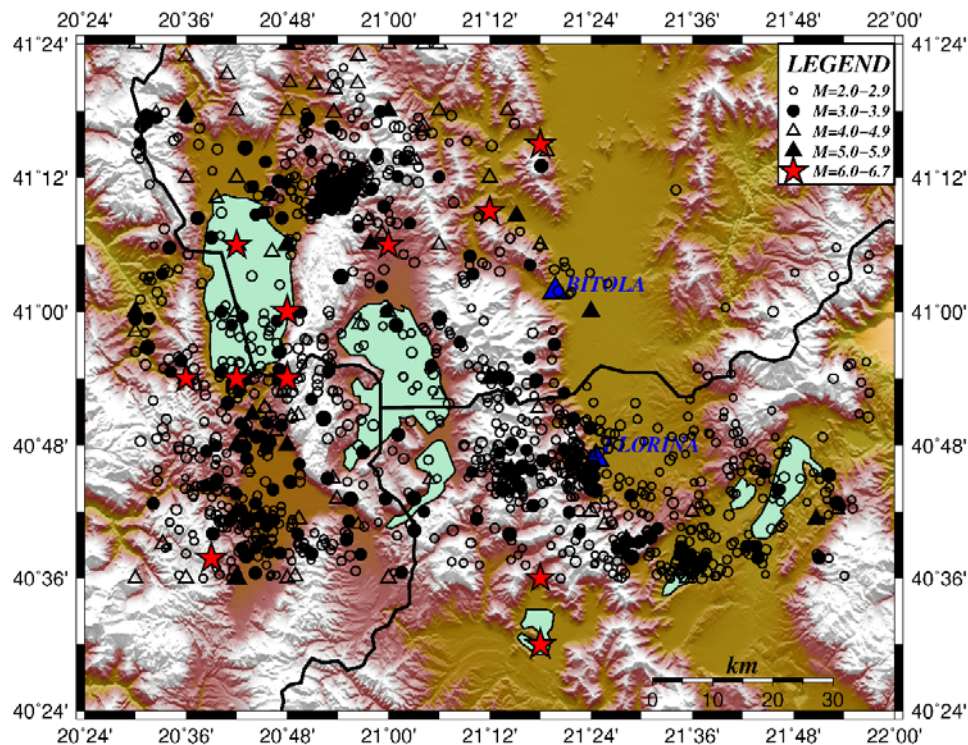


Figure 1. The earthquake epicentres with magnitude $M \geq 2.0$ which occurred in the region, during the time period 552 A.D. – 2018. All the magnitude symbols are illustrated in the legend. The position of Florina and Bitola is also appeared with a blue triangle.

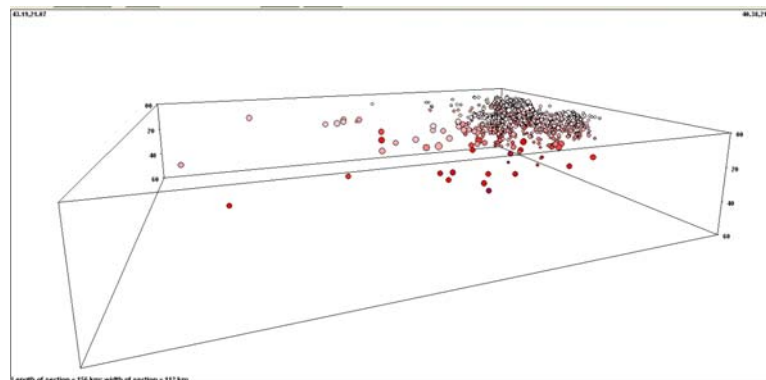


Figure 2. The 3D cross section (of North – South direction) of the events occurred in the area. Their depths lower than 20 Km are obvious for the majority of them.

2. METHOD

Besides the seismological stations of the permanent Hellenic Unified Seismological Network (HUSN) (Florina, Kozani, etc.) that are already installed, a portable seismological network, consisting from 5 portable stations, were installed and are in operation for a time period of 8 months, in order to record the present earthquake activity. All seismographs of the permanent National Hellenic network as well as the portable ones installed for the purpose of this work are of digital technology with broad-band seismometers (with periods between

~50000sec and ~0.1 sec), which recorded in real time the seismic waves from earthquakes occurred in various regions of Greece and the surrounding area.

3. RESULTS AND DISCUSSION

Based on the seismic activity recorded from the HUSN as well as by the portable network installed we calculated some useful seismicity quantities characterizing the study area, such. A commonly used measure of seismicity is the mean return period of earthquakes, T_m . The calculated mean return period of earthquakes with moment-magnitudes, M_w , or larger occurring in the study area is given in Table 1.

Table 1. Mean return period of earthquakes with magnitude equal to or larger than M_w in the study area.

Magnitude (M_w)	Mean Return Period (T_m , in yrs)
4.0	2.3
4.5	5.9
5.0	15.5
5.5	40.2
6.0	104.7
6.5	282.3

It is obvious from Table 1 that the mean return period for an earthquake with magnitude $M_w 6.5$ is in the order of 282 years, while smaller mean return periods are expected for lower earthquake magnitudes.

Another popular seismicity measure is the probability, P_t , that an earthquake with magnitude M_w or larger occurs during a time span, t , supposing a Poissonian probability distribution. The results for the study area are given below in Table 2.

Table 2. Probability of occurrence of an earthquake of magnitude equal to or larger than M_w during a time span T (in yrs) in the study area.

T	1	10	20	25	50	75	100	300
M_w	P_1	P_{10}	P_{20}	P_{25}	P_{50}	P_{75}	P_{100}	P_{300}
4.0	0.899	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4.5	0.569	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5.0	0.266	0.955	0.998	1.000	1.000	1.000	1.000	1.000
5.5	0.107	0.679	0.897	0.941	0.997	1.000	1.000	1.000
6.0	0.041	0.341	0.566	0.647	0.876	0.956	0.985	1.000
6.5	0.015	0.142	0.264	0.318	0.535	0.683	0.784	0.990

It is obvious from the above results (Table 2) that an earthquake with magnitude equal to or larger than $M_w 6.5$ is expected to occur in the study area every 300 years with very high level of probability (0.99). The broader region experienced an earthquake with such a magnitude ($M_w 6.6$) during the large event of Kozani-Grevena on 13 May 1995.

4. CONCLUSIONS

In the area considered in our study some critical infrastructures are situated. These include the two power plants of Meliti and Novatsi, as well as five water dams. Strezevo dam exists in the Pelagonia region and the rest four dams (Parori, Triantafyllia, Kolchiki and Papadias) are situated in the area of Florina. Therefore, seismicity studies, like the present one, are important for understanding the level of seismicity threatening such infrastructures. From the results of (Table 2) we can see clearly that the probability for an earthquake with magnitude 6.5 occurring in a time span of 300 years is very high. On the other hand the mean return



period for such a magnitude (M6.5) is 282 years very close to the 300 years (Table 1). This observation verifies the good quality of data used for this study. Using different data, during 2005 [3], defined 272 yrs of mean return period in an extended area of region. The probability that the large earthquakes of magnitudes 6.0 and 6.5 which are going to be generated during the next 100 years in the region is 98% and 75%, respectively.

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1999 – 2019: 20 YEARS AFTER THE 1999 ATHENS EARTHQUAKE E.P.P.O.'s RESPONSE AND ACTIONS

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ABSTRACT

On September 7 1999 a strong earthquake occurred in Athens resulting 143 deaths, hundreds of injuries and severe damages to buildings and constructions in Attica Region and Viotia Prefecture. The goal of this paper is to present the response, actions and operations of the Earthquake Planning and Protection Organization (E.P.P.O.), during and after the 1999 Athens Earthquake.

E.P.P.O. is responsible for planning and implementing earthquake policies in Greece. As such, the Organization, within its responsibilities, affectively and successfully responded during and after the event, and presented very productive scientific and operational work throughout the last 20 years.

The research performed for the purposes of this project was based on interviews and an extended literature and desk research. Interviews were conducted with the past and present E.P.P.O.'s high rank officials and employees.

Keywords: 1999 Athens Earthquake, Response, Inspections, Seismic Codes, Regulations.

1. INTRODUCTION

Earthquake Planning and Protection Organization (E.P.P.O.) is a Legal Entity of Public Law and operates under the supervision of the Ministry of Infrastructure and Transport. E.P.P.O. was founded in 1983 with the responsibility of planning and implementing seismic policies in Greece coordinating public and private resources. On 2011, Institute of Engineering Seismology and Earthquake Engineering (ITSAK) was merged with E.P.P.O. as a research unit.

E.P.P.O. acts on three operational levels: Prevention, Preparedness and Response - Recovery and produces significant scientific work throughout its expert staff (Engineers and Geologists) with the support and advice of Scientific Committees. The 6 Scientific Committees operating in the Organization deal with the assessment of short-term Seismicity, Seismotectonics, the design and support of Seismic Codes and Regulations, Civil Protection and Public Awareness and the Monitoring of the volcano in Santorini island. Apart of its scientific work, E.P.P.O. also acts on Applied Research and co-finances the European Centre on Prevention and Forecasting of Earthquakes (E.C.P.F.E.) which, in Greece, is based in the Organization's headquarters. After an event, the Organization acts, in and out of the country, on a detailed Operational Plan which includes deployment to the affected areas, direct Governmental briefing and installation of a portable ground motion network. E.P.P.O.'s Engineers participate to the operations of the Urban Search and Rescue Teams (MUSAR 1 and MUSAR 2).

To communicate its work E.P.P.O. organizes, funds, and participates in National and International Scientific Events, Symposiums, Conferences, etc.

2. THE 1999 ATHENS EARTHQUAKE

A strong earthquake of magnitude $M_W=5.9$ occurred in Athens on September 7 1999 at 14:56:50 local time (11:56:50 UTC) [1]. The earthquake was felt in most of the country (Intensity: IX), resulting 143 deaths, more than 1,000 injured people, over 90,000 homeless and severe damages to residential, commercial and industrial establishments and constructions at the Attica Region and Viotia Prefecture. Many historical buildings, monuments and structures of cultural value were severely damaged or even collapsed [1].

2.1. E.P.P.O.'s Response and Actions

E.P.P.O. responded immediately after the first shock. The Organization's Operational Centre was activated (as planned), for the first assessment of the situation, in collaboration with the General Secretariat of Civil Protection, the Police Force, the Fire Service and the National Center for Emergency Assistance. Since telecommunications were off during the first hours, satellite phones were used to communicate with all the Municipalities and the local Police Stations in the affected areas. Right after the earthquake, committees of Engineers were deployed in the affected areas to estimate the scale of the damages and to assist the National Urban Search and Rescue Teams and the National Center for Emergency Assistance Teams. E.P.P.O.'s Engineers were involved in 32 different search and rescue operations for people trapped under the debris of collapsed buildings.

E.P.P.O.'s Geologists and Geophysicists went to the affected area to trace and identify the seismic fault. The work included geological mapping and collection of microtectonic information [2].

E.P.P.O.'s Engineers also participated to the First and Second Degree Post-Earthquake Inspection Committees and to the risk elements removal and temporal support and propping teams. The First Degree Post-Earthquake Inspections were carried out using the Forms and Guidelines provided in a Special Technical Issue published by Earthquake Planning and Protection Organization in 1997 [3].

For the homeless, the Organization published immediately after the earthquake, a Special Issue providing all information about safe living in tent camps, rent subsidies and contact details with all competent Public Services and relevant stakeholders [4]. The Issue was distributed by E.P.P.O.'s Engineers in all tent camps.

2.1.2. Training Programs, Conferences and Publications

Until the end of 1999, 300 Engineers were trained by the Organization on the ways and procedures of the Post-Earthquake Inspections and the repairs and retrofit of damaged constructions, while three major relevant conventions were financed and co-organized with the Technical Chamber and the Civil Engineering Association of Greece [2].

E.P.P.O.'s Engineers and Geologists performed informational and training events and exercises for scholars and students all over the affected areas.

Several special Issues and Booklets were published regarding terms and measures of protection, compensation for the damaged buildings and constructions and technical details and information on the repairs. With the collaboration of the E.C.P.F.E., E.P.P.O. published Technical Handbooks on Search & Rescue Operations in Earthquakes and Risk Elements Removal - Temporal Support and Propping [2].

3. 2000 – 2019: ACTIONS AND OPERATIONS

3.1. Applied Research

In February 2000 E.P.P.O. funded an Applied Research Joint Program in the fields of Seismic Engineering, Seismotectonics and Civil Protection. Totally 74 Research Programs and Studies were assigned to Universities, Technological Institutes, Research Centers, Groups of Scientists and Private Companies with the total cost of more than 1.35 billion drachmas (€3.98 million) [2].

From 2000 to 2019, the Organization also participated in a series of European Union Research Programs such as FORMIDABLE, PEADAB, LOCCATEC, IDIRA, RACCE, E-PreS, EVANDE, PACES, etc. LODE and TILEMACHOS Programs are currently in progress [5].

3.2. Codes and Regulations

On November 2000 E.P.P.O. revised the Hellenic Regulation of Reinforced Concrete - 2000 (E.K.O.S. - 2000), which was officially applied on July 2001 (latest amendment on 2010).

The Greek Seismic Code (E.A.K. – 2000), was issued on 2001 and enforced on January 1st 2004 (latest amendment on 2010).

The Code of Structural Interventions on Reinforced Concrete buildings (KAN.EPE.) was introduced on March 2001 and implemented on 2012 (latest amendment on 2017).

The 1st draft of Regulation for Assessment of Interventions on Masonry Constructions (K.A.D.E.T.) was finalized on March 2019 and presented to the public on September 4 2019. Discussion on the Regulation is open until November 15 2019 [5].

3.3. Pre-Earthquake Inspection

In 2001 E.P.P.O. implemented the First Degree Pre- Earthquake Inspection Program for buildings of public use which is still in progress. The vulnerability assessment of buildings is carried out at national level in Greece and includes three steps: a.First degree inspection (Rapid Visual Screening Procedure), b.Second degree inspection (approximate Seismic Evaluation for insufficient buildings from the first degree inspection), c.Third degree inspection (detailed assessment of seismic performance of buildings with local or general inefficient seismic performance). In order to communicate the necessity of the Program, Earthquake Engineering Department initiated, on 2015, a Training Program/Seminar for Engineers all over the country [5, 6].

A First Degree Pre-Earthquake Inspection Methodology for bridges was firstly introduced in 1999 (under revision). The Second Degree Pre-Earthquake Inspection Methodology is currently being drafted.

3.4. Seismic Risk Assessment

The new Seismic Hazard Map was introduced in 2003 throughout a series of Research Programs and Studies assigned by E.P.P.O. to all Seismological Bodies of Greece [5].

E.P.P.O. contributed to the creation and funds the National Seismographic Network and continuously develops and improves the National Accelerometric Network. During 2008-2010 the Organization funded the acquisition and installation of 185 new digital accelerometers giving 65 of them to the Institute of Geodynamics. E.P.P.O.'s Accelerometric Network consists of 250 accelerometers installed in all major Greek cities and is a member of the International Federation of Digital Seismograph Networks (FDSN) [5, 7].

3.5. Operational Plan, Communication and Public Awareness

E.P.P.O. provides the necessary guidelines and proper assistance to Public and Private Sector Services and Units for the design and application of their own affective Operational Plan. Workshops and Exercises are organized all over the country and special multilingual editions and publications are released for this purpose. During 2013 -2015 E.P.P.O. designed the Operational Plan for the Ministry of Infrastructure and Transport concerning all Civil Protection risks and hazards.

Extensively informative and educational campaigns have been created and publicized to educational institutes, mass media, public transportation and internet. Especially for 1999 Athens Earthquake E.P.P.O. organized Scientific Events (2000, 2001 and 2019) and issued Special Reviews on the actions and operations of the Ministry [5].

The Organization holds a very informative web site (www.oasp.gr), accessible to the public and also a Facebook page for the communication of its actions, events and operations. E.P.P.O. has also developed a spatial data infrastructure system (SDI) in order to support its main priority actions. Two applications were developed in (a) Vulnerability assessment of buildings (b) GIS Hellenic Accelerograms Database.

3.6. European Civil Protection Mechanism

E.P.P.O. actively participates to the European Civil Protection Mechanism. E.P.P.O.'s Engineers and Geologists are continuously trained by the Mechanism, participate to Exercises, to the Exchange of Experts Program and to mission inside and outside European Union Countries. In 2016 Engineers participated to the Amatrice (Italy) Mission (24.08.2016 Earthquake) and to the 1st Advisory Mission to Solotvyno (Ukraine) for the impact assessment of the salt mines collapse to the built and surrounding environment.

3.7. European Centre on Prevention and Forecasting of Earthquakes



For the past 20 years, E.C.P.F.E. designed and implemented a series of Research Programs co-funded and supported by the European Council and E.P.P.O. such as the Draft Framework Regulatory Document for Structural Interventions and Seismic Protection of Monuments, the Pre-Earthquake Assessment of Monuments, the draft of the Seismic Code for the Non-Structural Components, the translation of the Code of Structural Interventions on Reinforced Concrete buildings (KAN.EPE.), etc.

Technical Handbooks, posters, special editions for people with disabilities (including easy-to-read and MAKATON) were issued in Greek and English [8].

4. CONCLUSIONS

The Organization's Response was immediate, accurate and crucial during the 1999 Athens Earthquake. E.P.P.O.'s scientific and research work is extremely successful since all published issues (handbooks, guidelines, etc.), are still in use by all involved stakeholders facilitating their efforts during crisis.

The upgrade of the Codes and Regulations improved significantly the seismic behavior of the constructions which is proven at every seismic event over the past years.

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THE 1999 ATHENS EARTHQUAKE - EXPERIENCE AND IMPROVEMENTS

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ABSTRACT

This paper presents all the work brought about, as well as the measures taken by the Directorate General for Natural Disaster Rehabilitation (GDAEFK) and the Ministry of Infrastructure and Transport, after the September 7th, 1999 earthquake in Attica. An overview of the project of rehabilitation is presented, with reference to the methods used and the measures taken by the state, in order to remedy the effects of the earthquake, referring to the problems and the given solutions. The registry starts with the immediate mobilization of the Ministry after the earthquake and the building damage assessment and continues with the recording of temporary housing measures for the affected people, as well as the measures taken until the final restoration of the affected buildings. Conclusions, in order to turn GDAEFK more effective, are drawn from the comparison of the post-earthquake rehabilitation work after the September 7th 1999 incident with that of earlier and subsequent earthquakes.

Keywords: September 7th 1999 earthquake, action plan, temporary shelter, rehabilitation, improvements

1. INTRODUCTION AND OBJECTIVE

The M 5.9 earthquake, known as the 1999 Athens earthquake, occurred on September 7th, 1999, at 14:56 local time. It has been the deadliest earthquake in the last 50 years in Greece, causing 143 deaths, thousands of homeless people, and in total more than 115,000 people affected. The entire state apparatus was immediately mobilized to deal with the effects of the devastating earthquake, also helping those affected, restoring the normal order of society and taking all necessary measures to house the affected and help them financially to repair their damaged buildings.

In July 19th, a new earthquake in Attica, twenty years after the devastating earthquake, highlighted all the problems of the latter earthquake.

This manuscript reviews all actions and measures taken by the Ministry of Infrastructure and Transport, from the first hours after the earthquake to the restoration, as also indicates the consequences of those that were not done or done with a wrong way.

2. ANALYSIS METHODS

Quantitative and qualitative analysis of data from GDAEFK Archive, of all the measures taken using comparative tables, and diagrams.

3. RESULTS AND DISCUSSION

Ministry of Infrastructure and Transport, in charge of Damage Assessments, using all the experience so far and all available human resources, ordered immediately the commencement of 'Rapid Damage Assessment' of buildings in order to record the affected buildings, to demolish danger buildings, to plan housing of the affected and to take remedial measures [2,3].

- i. On September 8th, 1999, '**Rapid Damage Assessments**' (first evaluation) of the buildings began and a week later, along with the Rapid Inspection, started the **Re-evaluation of Damaged Buildings** (marked yellow and red at the primary level inspection), in order to inform citizens whether their houses can be used, to identify and register dangerous high-risk buildings, in order to demolish them

and also to evaluate the extent of the incident, make an estimation of the cost of repairs of the damages and take the necessary measures. Primary and secondary inspections lasted approximately four (4) months and were carried out by more than 2,000 Engineers.

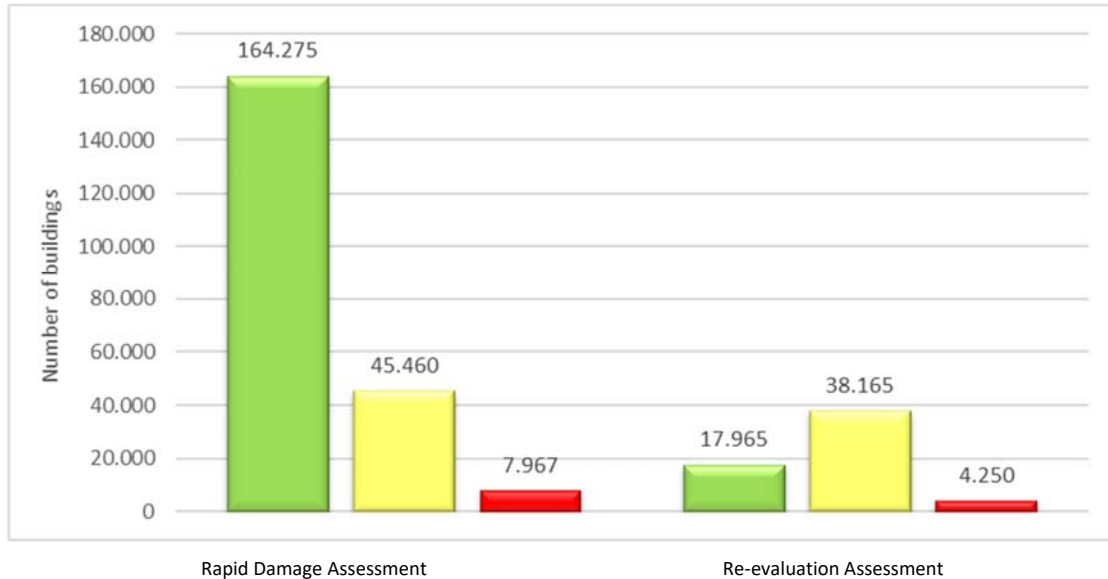


Figure 1: Damage Building Assessment

- The recognition of the coordination problems of the actions of all parts combined with the need for response and recovery from seismic impacts, led to the establishment of civil protection plans and the 2003 Civil Protection Master Plan, under the code-name XENOKRATIS, defining the actions based on the responsibilities of all parts. Subsequently individual plans for each type of event (earthquake, fire etc.) are gradually adopted, clarifying the roles of the parts involved after the event, in order to respond to emergencies urgently and effectively [2,3].
- ii. The demolition and removal of buildings which collapsed during the earthquake of September 7, 1999 was progressively carried out, in 15 phases, by the Ministry of Infrastructure and Transport, with the assignment of the project to companies and the disposal of € 11,075,569 a scientific research was ordered to identify the cause of collapses where there were human victims.
- Useful conclusions of the structural problems of damaged buildings and the causes of collapses were drawn.
- iii. Ministry disposed credits to Prefectures for the demolition of danger buildings and the underpinning of damaged, temporary non-residential buildings (€ 30,882,279) and for infrastructure works due to earthquake damages € 54,827,156. Moreover, experienced Civil Engineers of Ministry assisted and gave technical support to Prefectures for that purpose [1].
- As a consequence, the whole plan/work was soon completed.
- iv. Gradually, after the incident (on September 10th, 1999), new services were established; eight (8) Sections and sixteen (16) Seismic Recovery Offices (TAS & GAS respectively), with spatial competence.
- A large number of new employees helped the understaffed Ministry to carry out the project of rehabilitation.
- The Ministry has today a very experienced staff dealing with the consequences of natural disasters.
- v. To cover the housing needs of the affected:

- a. The cost of renting or co-housing for homeowners or tenants, whose houses were damaged, was granted. The amount approved, per month, for rent or cohabitation subsidy, depended on the number of family members living in the affected dwelling and the maximum period for rent subsidy was, for the owners up to two (2) years and for tenants up to six (6) months. The total cost of rent subsidy was **€ 113,899,233.00**, for 29,510 beneficiaries.
- b. Or containers, either in organized camps in public or in private areas, were disposed for the affected. In a short period of time, 101 camps were established in 28 Municipalities, **5.673** houses were granted and by December 1999, all people had a place to live in.
- After each event, the disadvantages and advantages of the temporary housing of the affected people are taken into account and depending on the type and the consequences of disaster and on other elements, such as geographical location, area, tourism etc. of the affected area, decisions are made about how to deal with the temporary housing of the affected.
- vi. Within a very short time, credit facilities related to the restoration of damaged buildings were carried out. Mortgage assistance consisting of free government assistance and a 100% interest rate subsidized loan by the Greek State. The ratio of state aid and loan was 1/3 state aid and 2/3 loan. Depending on the usage of the building, as well as on the damages occurred, relevant fixed prices per square meter, had been settled.
- In conclusion, the experience of all these years is effectively utilized depending on the event, so that the restoration of buildings is quick and the process flexible, simplified and favorable to those affected.
- In spite the fact that Greek state disposed money to help people to restore their properties, a lot of houses were never restored, or were restored with a wrong way, and this was noted during the building damage assessments, after the July 19th 2019 earthquake in Attica.
- vii. Owners who did not wish to receive financial assistance for the restoration of their damaged houses, could declassify their “yellow” marked buildings, with light damages, after repairing them without taking the legal license.
- This was a rather wrong decision as it was misused.

4. COCNLUSION

A lot of difficult problems occurred when managing the effects of the earthquake of 1999, which provided a great deal of experience to engineers, as also to the Ministry. Dealing with emergencies and the effects of earthquakes or other natural disasters, contributed to draw useful conclusions from the decisions made, relate to both positive and negative results.

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SUSTAINABLE DISASTER RECOVERY PROCESS AFTER EARTHQUAKE. OPPORTUNITIES AND CONSTRAINTS: THE ROLE OF COMMUNITY INVOLVEMENT

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ABSTRACT

The research field of this paper is the sustainable recovery process of a traditional settlement after an earthquake and the role of community involvement into the recovery process. Disaster is defined as complicated, while its effects are multi-dimensional and influence both natural and human environment. Several scientists attempted to identify the various risk management steps and concluded that four phases of disaster management exist. These phases are the following: prevention-mitigation, preparedness, emergency-response and recovery. In the recovery phase, all necessary long-term actions are implemented for the rehabilitation of society and reconstruction of the infrastructure, so the affected people have the same quality of life as they had before the disaster or even better.

This paper will attempt to examine if the recovery process is a “window of opportunity” for the city to reduce its vulnerability to up-coming hazards and if it’s possible to improve the preimpact level. Moreover, we will try to analyse the recovery process in traditional settlements, in which severe earthquakes have occurred with serious effects in the urban environment. One of them took place in Italy (L’ Aquila) and the other occurred in Greece (Konitsa). Through the analysis of their recovery process we will attempt to find out which were the challenges that each city/village had to face. The analysis of these case studies will focus on the role of community involvement into the recovery process. In the case study of Vrissa, Lesvos, where a strong earthquake occurred in 2017, the recovery process is still in early stages. Because of this, after the literature review and the analysis of the case studies, we will attempt to analyse the challenges that Vrissa has to face and recommend some specific points in order to have a sustainable recovery.

Keywords: Earthquake, Sustainable Recovery process, Seismic Risk Assessment, Community Involvement, Vrissa.

1. INTRODUCTION

During the course of human history, disasters have been the subject of various interpretations. Labelling them at first as “Acts of Gods”, to purely innate natural phenomena and finally to phenomena/events caused by both human and nature’s actions, disasters have harmful consequences to human lives as much as to the physical and built environment.

Before the 1980s, there was limited research material about the Disaster Recovery process. Among the other three phases of the disaster management cycle, recovery is the least discovered. Undoubtedly, there is an overlap among these four phases [1]. Actions on mitigation, preparedness and response phases are crucial for the success that these activities will have on the recovery phase.

According to the literature review, the post-disaster recovery is described as a particularly multidimensional long-term process, which is defined as nonlinear and has no clear boundaries. In research studies there is no consensus on the term of Recovery. The various definitions attributed to Recovery give away the researcher’s academic background and vary according to the perspective that each researcher analyses. A range of terminologies such as **Restoration, Reconstruction, Rehabilitation and Restitution** usually appear as synonyms to Recovery, but their meaning varies quite much because they focus on diverse elements of the

Disaster Recovery that come from different angles [2]. For instance, Smith and Wenger (2007) [3] defined recovery as *“the differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre-event planning and post-event actions.”* This definition of recovery includes the various ways of the challenges that people are called to face. Furthermore, according to Edgington (2010) [4], the recovery process should be conceived by planners but also by the community as *“a window of opportunity to incorporate sustainable development principles and apply holistic management approaches to rebuilding cities”*. Consequently, United Nations International Strategy for Disaster Reduction (UNISDR) [5] gives a well-rounded definition, integrated by the various aspects of recovery, considering that *“recovery needs to be viewed holistically – as part of a continuum, inseparable from preparedness, response, mitigation and sustainable development. Moreover, recovery must be approached in a cyclical nature wherein actions to strengthen resilience are taken both before and after disasters occur – rather than a linear approach that limits recovery action to the aftermath of event”*.

2. SCOPE OF RESEARCH & METHODOLOGY

2.1. Motivation & Research Questions

The stimulus for this paper is a major earthquake that took place in 2017 in Lesvos, Greece. Particularly, in June 12, 2017 a severe earthquake of 6.3 Mw magnitude caused serious damages on the physical and built environment of a village named Vrissa. The damages and effects of the earthquake are localized at Vrissa, while in the surrounding area and settlements they are scattered and smaller in scale. The impact on the village of Vrissa was so extensive that 80% of the buildings were destroyed. However, the Disaster Recovery in the case of Vrissa is yet in early stage. In this paper, we will raise the hypothesis that Recovery process is a “window of opportunity” to incorporate sustainable development principles to rebuilding/reshaping the city. The main research question is to find out how the community involvement can influence the recovery process of a traditional area. Especially, we will examine if there was community involvement into the decision-making process of the recovery and if it influences the disaster recovery process negatively or positively. So, the research questions of this paper are: 1. How the community involvement can influence the disaster recovery process of a traditional area? 2. Should the disaster recovery process take in consideration the community involvement?

2.2. Methodology

To be able to answer the main research questions, we will analyse the recovery process of few case studies in Italy and Greece. In these case studies, we will attempt to find out how these traditional settlements responded to their disaster recovery process. The chosen case study in Italy is L’ Aquila in 2009. Although L’ Aquila is bigger than Vrissa, it was chosen because the most damages happened in the city center, in which old masonry buildings were also built. The chosen case study in Greece is Konitsa in 1996. Konitsa had similar geological characteristics with Vrissa and its historical center consisted of old buildings with masonry. Moreover, a critical review is considered necessary of the policy/plans/programme documents of the case study produced by the local authorities. Valuable tool and method for this paper is considered the interaction of qualitative and quantitative analysis for the case study of Lesvos. Semi-structured interviews with officeholders in the Bureau of Recovery on Natural Disasters and with the coordinator of the Recovery process in Vrissa had been held. Consequently, recommendations for sustainable recovery process will be given.

3. CONCLUSIONS & RECOMMENDATIONS

For the review of the case studies we comprehend that the debris management plays significant role in the recovery process. Extremely helpful asset for the recovery is an existing urban plan based on sustainable principles and including mitigation measures. Additionally, if there is a sustainable emergency action and recovery plan, in which the strengths and the weaknesses of the area are included, the damage assessment will be focused in the problematic and more vulnerable points of the area, saving significant time in the phase

of response and emergency [7, 8, 9, 10, 11]. Moreover, fragility curves could be used in order to evaluate the implemented disaster urban plan in terms of resiliency. Also, they can be used to organize the emergency response and facilitate the economic losses for a future event that might exceed the one that occurred and caused the disaster in the first place [12, 13, 14].

The strong community involvement is necessary for all the phase of disaster management. The continuous education and participation of citizens on the disaster management will give the advantage on the community to be more prepared, less vulnerable and unflappable, and citizens will contemplate the disaster as an opportunity for change rather than focus on the its destructive power. The bigger the community involvement is, the bigger chances exist for a successful recovery plan. Additionally, when various groups of society participate in the decision-making process, then social inequalities are appeased. Specifically, in the selected cases studies, we tried to categorise the level of community participation in recovery process according to the ladder of participation by Arnstein (1969) and by Davidson et al (2006) as depicted in the figure 1 below [15, 16, 17].

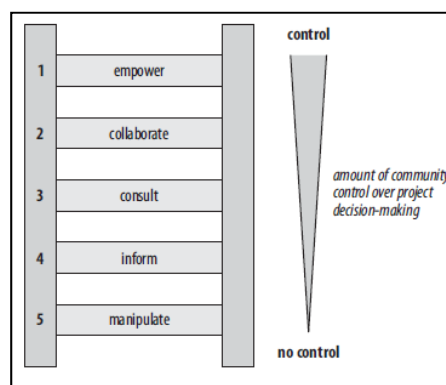


Figure 1. Ladder of Community Involvement, Davidson et al, 2006

For the protection and preservation of traditional settlements, there are specific procedures and policies. The process of buildings' demolition is very complicated and time-consuming. In particular, if the owners choose to purchase a new building or reconstruct their buildings in a location outside the traditional settlement, the interest-free loans rise to 60% of the funding, while the state-funding decreases from 80% to the 40%. Furthermore, if the building is located in a traditional settlement, it should be rebuilt or repaired with the same or similar materials wherever is possible, in order to preserve the historical and traditional character of the settlement. If the affected area is borderland, as in the case of Vrissa, then housing assistance is increased by 10% for normal buildings, 20% for buildings in a traditional settlement, 30% for preservatives buildings. Moreover, pioneering is the fact that while in the other settlements state aid is given for the reconstruction of only one home of the beneficiary, in the case of traditional settlements it is granted for more than one [18, 19].

In the case of Vrissa, there is no organized and targeted recovery plan. The reconstruction process is defined and shaped by the willingness of the owners to repair or reconstruct their houses rather than the guidance or the encouragement of the state for sustainable reconstruction solutions. Especially, during the inspections after the earthquake, it was found that the inhabitants had placed several arbitrary enclosures e.g. warehouses. But, the squares to determine the state subsidy are determined by the post-earthquake inspections, with the result that, within the state subsidy, the arbitrary buildings constructed by the inhabitants are included. In addition, the state subsidy finances the residents based on the standards that their house had before the earthquake and does not encourage them for improvements on their reconstruction based on new materials and technologies [18, 19].



So, we understand that the “bounce back” policy is being pursued and there is no political will for a holistic recovery based on social equity and sustainability. Basically, all members of society must unite and decide together which will be the goal of the recovery of Vrissa. So far, few bottom up-initiatives and grassroots have been created but they mostly aimed to spread the information and to cover the basic needs of the affected people. Thus, it is essential to develop and implement a sustainable recovery plan, which will be attuned with the urban plan. In this particular plan the opportunities, constraints and the challenges that the community of Vrissa needs to face should be included in order to recover.

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VRISA 2017 – 2019, DISASTER – RESPONSE – RECOVERY PROCESS

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ABSTRACT

On the 12th of June 2017 at 15:28, local time, an earthquake of magnitude Mw6.3, shook the island of Lesbos. The incident is well known for the devastating impact it had over the village of Vrisa, a small community of, just over, 600 residents. For a plethora of reasons, portion of its buildings were utterly or partially collapsed and as a result the village has been evacuated, an order which stands till today. Since it was marked as a traditional settlement, several peculiarities were considered in order to keep the morphology of the buildings facades, a process which had to work in parallel with the restoration process. It had as a result the involution of many public sectors, forcing a cooperation between them in order to pare any delays down. Through legal and regulatory framework involving the incident as well as an experiential report of the authors, is tried to be presented an evaluation of the restoration process so far.

Keywords: earthquake, natural disaster, Vrisa, response, recovery

1. INTRODUCTION AND OBJECTIVE

On the 12th of June 2017 (12:28 GMT) an offshore destructive earthquake occurred approximately 15 km south of the SE coast of Lesbos island [1]. Its magnitude was recorded Mw6.3 and focal depth of 13.5 km (shallow). Preliminary estimates of maximum horizontal on ground acceleration in the area were around 0.2g [2]. These readings, as recorded by ITSAC accelerographs, were too small for an earthquake with a magnitude of this size and the first calculations showed that the actual values were much higher. It looks like Vrisa resides in a wider area of high seismic acceleration. However, having as fact that Vrisa stands over the near field of the seismic fault, possible supplementary factors bear down on it [3]. (Figure 1)



Figure 1: (a), (b) Vrisa 06/14/2017, from the personal files of the authors

The next day, over 100 engineers, under the supervision of the Directorate of Natural Disaster Rehabilitation (D.A.E.F.K.), commenced inspections asserting that a building was habitable or not but also to assess any direct threat it could pose to its surroundings. The biggest concentration of damages was noticed at the village

of Vrisa which was evacuated right after the incident. All of the above lasted for, approximately, a month and a half.

Afterwards and according to the data gathered every day, a decree [4] was issued for the demarcation of the affected area in order to, primarily, set the budget and, secondarily, to specify those who were entitled to any state aid but also the way it is meant to be granted. But in this case there were several differences, compared to the norm. For traditional settlements, such as Vrisa, the owners of the damaged buildings are entitled to state aid for the totality of their holdings and not just for a single one, and the amount of state aid is marked up by 20%. This, among others was the leading idea in order to persuade the house owners of Vrisa to stay there and restore their once beautiful village.

A month later, with another decree [5], another grant was issued, but this time it had to do with subsidization for rent or joint tenancy for those whose home, when the earthquake struck, was marked either “yellow” or “red” but also was their main residence, and for the next two years after the incident (was recently extended for one more year). For the residents of Vrisa, the decree extends for everyone whose main residence was in the excluded area and for as long as the exclusion is in effect.

Furthermore, by decree of the Minister of Infrastructure and Transport, the granting of a subsidy for the demolition of dangerously crumbling buildings was approved [4]. The beneficiaries of the grant are the owners of the buildings, for all their properties, and for which Protocols for Demolition (P.A.E.E.K.) had been issued, provided that the affected building is demolished within specified deadlines. Finally, for the minimization of bureaucracy a funding was given to the Municipality of Lesvos for the management and removal of demolitions products as well as the retention of reusable facade elements.

The purpose is to see how immediate response actions and the statutory framework worked in the process of restoration on the island of Lesvos, and in particular in Vrisa, up to now.

2. ANALYSIS METHOD

Comparative quantitative analysis over absolute numbers.

3. RESULTS AND DISCUSSION

During inspections all over the island of Lesvos, 2252 buildings were checked 1205 of which were marked to have serious damages and to be practically uninhabitable or in the brink of imminent collapse [6]. The percentage of these is 47.8% while at Vrisa the same percentage approaches 78%! (Figure 2)

Of the 338 buildings marked for demolition, over 250 have been demolished so far [6] and concerning the subsidization for rent or joint tenancy, the resident families of Vrisa who are temporarily relocated are approximately 60% of the beneficiaries [6]. (Figure 3)

The results of the sheer numbers of actions so far and how and where the institutional framework facilitated or hindered the work of rehabilitation will be discussed.

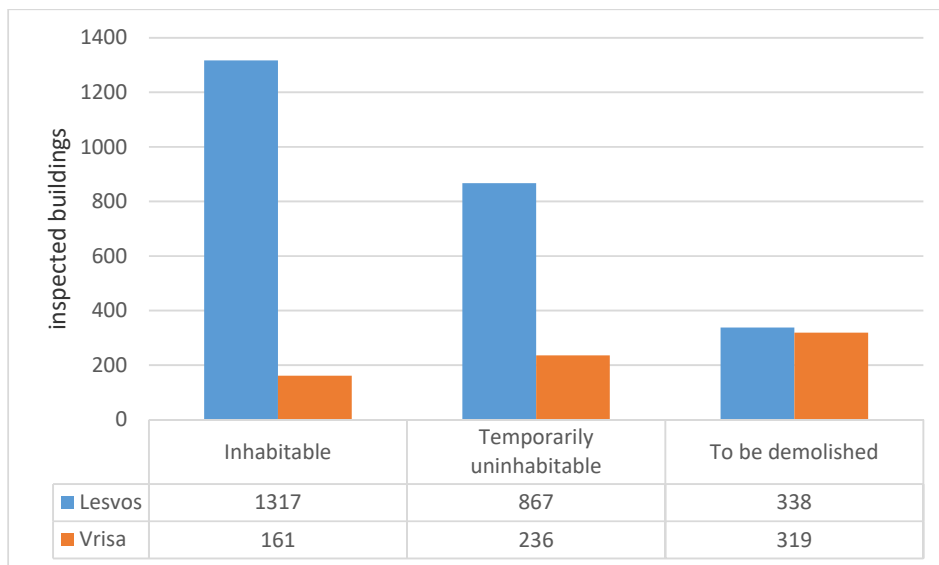


Figure 2: Habitability of buildings comparative data, between Vrisa and the entire island of Lesvos (including Vrisa)

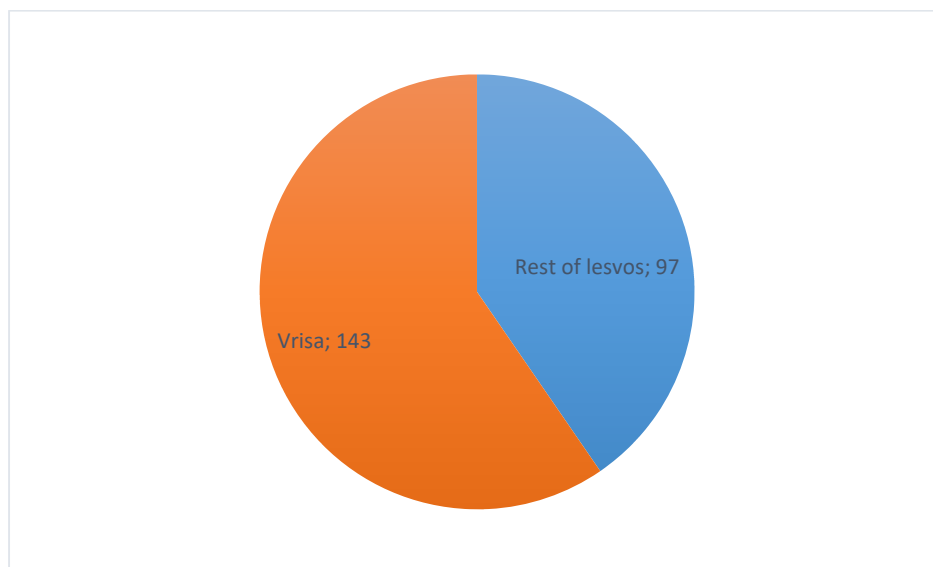


Figure 3: Subsidization for rent or joint tenancy comparative data, between Vrisa and the rest of Lesvos

4. CONCLUSION

The process of restoration is either way time consuming. In the case of Vrisa, the morphology which by its self includes unregulated placed buildings, narrow streets, many collapsed buildings, all localized in a specific part of the village makes it even more difficult. Adding up the fact that, for the restoration procedures, the approval of jointly competent authorities (Council of Architecture, Ministry of Culture) is required, leads to further delays. Nonetheless and bearing in mind that most demolitions have been completed and for the majority of repair license issuances the necessary inspection has been carried out by the engineers of D.A.E.F.K. (also the method of repair has been agreed) and only the approval by the co-competent Services remains, we can say with certainty that we are back on track.

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EMERGENCY EVACUATIONS

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ABSTRACT

In the event of an emergency, evacuation is a measure for every person to remove it from the hearth of danger from which it is at risk. The speed of evolution of any natural or technological disaster depends on many factors, while in the context of self-protection and civil protection spontaneous removal is applied but organized removal can also be applied. The result of all this is the need to design and draft plans on the part of the State, which has the responsibility of protecting citizens, and in particular at the municipal level.

In each case of danger and for each settlement, a Plan should provide answers to a number of questions, such as who proposes, who decides, who is at risk, what its stages are, what its different times, how people will be informed, who the place what actions need to be taken to implement it, how long it will take, etc.

Keywords: emergency, evacuation, good practices

1. INTRODUCTION

Following the disasters of forest fires in 2007, paragraph 2 of section 18 of Law 3613 instituted Organized Displacement (PLO) and was updated in 2014 with the subparagraph 5 of section 108 of Law 4249, which states the liability of Mayors and Regional Governors to take its Implementation Decision. The article also raises many questions on good and bad practices.

2. ANALYSIS METHOD

Comparative analysis over destructive or emergency events taken place in Greece and worldwide.

3. RESULTS AND DISCUSSION

Presentation refers to successful evacuation cases (23/7/2018 - Mati - evacuation of child camp of Athens Municipality due to forest fire, 12/2/2012 - Thessaloniki - evacuation of 72,000 inhabitants due to World War II bomb removal, 22/2/2007 - Thessaloniki - evacuation of schools due to gas leak) and international events (28/8/2005 - N. Orleans - Hurricane Katrina, 7/12/1941 Pearl Harbor - Japanese bombing of US fleet, 20/1/2019 - Chile - evacuation due Upcoming Tsunami, 11/9/2001 - New York Twin Towers - Evacuation after terrorist attack, 22/8/1985 - Manchester (video) - fire at BOEING 737, 11/3/2011 Japan - tsunami).

Indicative examples of good practice in informing and planning both in Greece and abroad (Komotini Municipality for concentration areas, Municipality of Thessaloniki for refugees and camps, Municipality of Chania for escape routes, Municipality of Elliniko - Argyroupoli for registration of persons will be required to transport them, Germany (video) for the transfer from a man to a hospital with his mattress, Australia for mobile information updating), but also examples of incorrect planning by Ministries (Ministry of Education for Schools, Ministry of Health for Hospitals).

Designers need proper planning for applicable Organized Population Removal Plan to be. History teaches.

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1. Law 3613
2. Law 4249

CRISIS MANAGEMENT DUE TO FOOD POISONING IN HOTELS AND HOSPITALITY UNITS

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ABSTRACT

Tourist industry is particularly sensitive because can be affected from a number of factors like: political crisis, economic crisis, strikes of transportation, air strikes, earthquakes, terrorist actions, etc.

With the term “crisis” we describe one unforeseen event that is characterized from tension and insecurity. It demands immediate decisions and application of measures so that will reduce the negative effects as soon as possible. There are three main types of crisis:

A. Natural Disasters (earthquakes, floods, tsunami, fires etc).

B. Technological Disasters (failure: of informatics systems, electricity, communications. water supplies, etc.)

C. Man Made Disasters (terrorist actions, food poisoning, strikes of the personnel etc.) For the management of the crisis is required an order center and a team of management crisis both with distinct and specified duties. The case of a food poisoning in a hotel is presented.

Keywords: crisis, management, food, poisoning, hotel

1. INTRODUCTION

The development of the tourist industry is threatened from a number of negative events. Tourist industry is particularly sensitive because can be affected from a number of factors like: political crisis, economic crisis, strikes of transportation, air strikes, earthquakes, terrorist actions, etc. These are only some characteristic examples that caused losses of millions of euros in the tourist industry.

With the term “crisis” we describe one unforeseen event that is characterized from tension and insecurity. It demands immediate decisions and application of measures so that will reduce the negative effects as soon as possible. A crisis situation is determined from the evaluation of the negative effects that threatened the enterprise. [1]

2. ANALYSIS

1.1. CHARACTERISTICS OF THE CRISIS

The main characteristics of the crisis are:

- The tension is increasing with time.
- It dominates a feeling of insecurity and danger.
- It affects ordinary functions.
- It affects the public image of the enterprise.
- It causes damage of the moral of the administration and the personnel and number material damages. [2]

1.2. ORDER CENTER

During the crisis an order center must exist that will coordinate all activities. The order center will be the focal point for the management and evaluation of all information that will get from the hotel. The main goal of the order center is the decision making and the materialization all the necessary actions so that will have a positive control during the entire crisis.

The team of management crisis will inform the order center when there is an alarm for fire, bomb threat,

blackout, earthquake, massive food poisoning, or other serious events that will affect the well-being of customers and personnel. The decision for the activation of the order center will be based on the seriousness of the situation. [3]

The order center must have a telephone line and an alternative one for the case that the main tel line does not function.

1.3. MINIMUM FACILITIES AND UTILITIES OF THE ORDER CENTER

- Communication facilities.
- Keys for all the places of the hotel.
- Light for emergency case of all places of the hotel, inside and outside.
- Phones e.g. police, fire dept. hospitals, health centers, travel agencies etc.
- Manual of crisis management.
- Maps for all places of the hotel with all information of the technical office.
- Mobile First Aid Kit
- Protective masks
- Oxygen
- Wheel Chair
- Four big flash lights, 4 whistles and a loud speaker.

The order center has lists of all the information of the hotel, lists of all medical facilities nearby and lists of nearby hotels.

1.4. THE TEAM OF MANAGEMENT CRISIS

The team of management crisis is made by the General Manager and refers to him about the emergency of the situation and then to the order center. The team of management crisis has the following responsibilities:

- Informs the order center if the situation is serious
- Evaluates continuously the health and the safety of the customers and the personnel.
- Organizes groups of the personnel for urgent help and makes plans for emergency situations e.g. fire, blackout, demonstrations, etc.
- Keeps a record afterwards of all the activities taken place during the crisis, for evaluation afterwards.
- Organizes the training of the personnel.

The team of management crisis is the leadership team during the crisis and is having the following composition: the leader, the lawyer, the financial representative, the human resources person and an external advisor. [4]

1.5. THE CASE OF FOOD POISONING

The case of food poisoning is having three steps:

- Preparation before the crisis
- Management of the crisis
- External communication.

1.5.1. Preparation before the crisis

Every department of the hotel must have certain definitive functions that are communicated to all present and future employees of the hotel.

- One person has the responsibility of the management crisis during the food poisoning. He must have an alternative person.
- All telephone numbers for emergency situations, health centers, hospitals, police etc).
- Training of all the personnel that is involved with the food poisoning and the procedures that accompany the event. The F&B manager is also involved.

1.5.2. Operational Procedure

When we have a case of food poisoning is of outmost importance that all personnel involved knows the

procedures and follows them to the point.

The employee that receives the complaint:

- Follows the formal procedures for emergency situations.
- Communicates immediately with the director of the hotel or an alternative person e.g. the F&B manager.
- He should not have an extensive conversation with the person that makes the complaint.

The Director or the person responsible for management of the situation: He receives the complaint in a written form with all the necessary information in detail from the person involved with the food poisoning.

Is required the following information:

- Name, address and tel. of the person involved.
- The symptoms that appear and when and where.
- The names, addresses etc of other customers that were there.
- Date and time of the event.
- Duration of the illness.
- The details of the suspicious foods or drinks that were consumed or drugs that he or she took before or after the event.
- Name of the doctor or the hospital that examined the person involved.
- All the known allergies that the person involved might had.

During the conversation with the person involved the representative of the hospital shows an understanding and expresses his concern about the situation. Also he says that he will further investigate the event and requests further information that will contribute the investigation.

- The representative of the hotel pays special attention not to intervene with the personal affairs.
- He emphasizes that all personal information will remain private.
- If the person involved refuses some information the representative does not press him.
- He remains gentle even if he has doubts about the case. Does not disagree but he also does not accept the responsibility. He lets the person involved to tell his story but without suggesting to him any ill symptoms.
- The representative of the hospital does not give any medical advice. He simply collects all the information.
- He reads all the information to the management crisis director for further procedures.

1.5.3. Press Communication

The administration of the hospital it will handle the press release and mass media.

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COMMUNITY PREPARATION AND REACTION DURING THE FOREST FIRE ON JULY 23, 2018 IN EASTERN ATTICA. THE ROLE OF RISK COMMUNICATION

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ABSTRACT

On July 23, 2018, Greece was affected by the deadliest wildfire in its modern history, which claimed the lives of more than 100 people, while several others suffered health and property damages. This research examines individual risk perception and the rational decision-making during a wildfire. To achieve this goal, the affected people experience in this catastrophic event was evaluated through a systematic process, demonstrating the failure of existing disaster risk communication techniques.

Keywords: Risk Communication, Risk Perceptions, Wildfire, Community Involvement, Mati

1. INTRODUCTION

On July 23, 2018, Greece was affected by the deadliest wildfire in its modern history, which claimed the lives of more than 100 people, while several others suffered health and property damage. The wildfire that affected the settlements at Neo Voutza and Mati in East Attica is the deadliest in the history of the modern Greek state and the second deadliest wildfire in the world in the 21st century, after the wildfires in Australia on 7 February 2009, which claimed the lives of 180 people.

Due to the large number of lost lives and health damages, fundamental questions have been raised about wildfires safety. Few studies have investigated the impact of risk communication on the preparedness and responses of citizens recently affected by wildfire. Furthermore, when investigating past experience, studies tend to focus on risk and its consequences disregarding the social context in this process. This research aims to fill in the incomplete literature by examining the experiences of people affected by a catastrophic event by assessing their reactions as guided by their individualized perceptions and existing risk communication policies.

2. THE FIRE OF JULY 23

The July 23 wildfire was characterized as an extreme phenomenon. The environmental conditions that prevailed on that day (fire characteristics, climatic factors, etc.) put the civil protection system to the test. The majority of residents in Neo Voutza and Mati settlements faced the disastrous intensity of the wildfire, without adequate warning and effective assistance was provided by the emergency services. [1]

3. METHODOLOGY

In order to evaluate the experiences of the affected people of the devastating wildfire and examine how their preparedness and the available to them information influenced decision-making during the wildfire, a representative sample of the affected population was studied (according to the sampling rules). In the selected sample (90 people) have been included mainly those who have experienced the devastating fire having suffered personal injuries and / or loss of their loved ones.

The data used for the evaluation were derived from personal semi-structured interviews, written depositions, visual evidence and audio documents. The collected data were analyzed with the grounded theory techniques, using the freeware AQUAD 7 quality analysis software. The grounded theory is best suited for the

study of individual processes and interactions between individuals and the wider social processes, offering systematic approaches to discovering important aspects of human experience that often remain inaccessible by traditional methods of verification [2].

Two key questions were asked: a) What were the perceptions of the affected people about the risk that threatened them (risk knowledge, understanding, awareness). b) How did their access to information take place and how significant was the information in regard to its validity and timeliness and their actions. Furthermore, given the situation the residents of the affected area had to face, significant conclusions were drawn on risk communication in crisis situations, attempting to link them to the findings of international literature.

The analysis found significant relationships between information and preparedness for fire and showed variability in the application of the available risk information. Also detected schematic interactions between information, experience and expected outcome.

4. RESEARCH FINDINGS

The analysis of the July 23 wildfire survey data revealed several key findings regarding the parameters that influenced rational decision-making during the wildfire, which were discussed in combination with existing bibliographic findings, like the past experiences with risk [3,4,5], the confidence in the source of risk information [6,7] and the social influence of others [8,9], the people's perceptions of risk, varying according to their personal beliefs and value systems [10,11], the fact that even if people think they are in danger of fire or this perception is not correlated with taking protective measures [12,13,14], etc.

The narration of the personal experiences of those affected provided valuable information on: their preparedness; their expectations from the emergency system; their risk perception and their reactions to a situation that was considered life threatening and their survival mechanisms; their beliefs about the risk and their awareness; their sense of control; their confidence in emergency services; how to evaluate and interpret emergency and warning messages and what exactly were these; their past experiences and behavior patterns, etc. People's knowledge, experiences, memories and beliefs influenced awareness levels of wildfire risk and levels of preparedness. Reactions varied according to age, physical well-being, responsibility for the most vulnerable family members or pets.

The majority of the people chose to evacuate their home rather than stay and defend their property. Despite the severity and speed of wildfire spreading, which dramatically reduced their reaction time, people seemed to wait until they decide whether to evacuate their homes. Delayed evacuation is a dangerous response to wildfire [15,16,17], while emergency communication is the fastest, most immediate and perhaps the only available resource that can be offered to the people who are facing a life threatening situation and they need to react immediately.

5. DISCUSSION AND CONCLUSIONS

The concept of 'risk perception' is commonly used in relation to natural risks and threats to the environment and health. Scientists' research, based on psychometric model, has shown that people tend to identify natural risks through various subjective perceptions and beliefs in a multi-dimensional way of thinking. In other words, human risk perception works as a filter through which the various types of threats are identified [18]. Ignoring the probability theory, people construct societal risks or disregard others, resulting in reactions and behaviors which do not always comply with the relevant recommendations. Despite the self-image that dealing with a catastrophic event is a conscious and rational endeavor, individuals' misconceptions about risk often act as an important vulnerability factor, increasing dramatically the impact of the disaster [19,20,21]. Many factors influence the way people perceive the risks that threaten them. These factors can alter risk perception to varying degrees [21,22,23]. To date, at least 15 risk factors directly related to risk communication have been identified [24,25].

Risk communication is closely linked to threat and threat assessment. Information and education are the main mechanisms used by competent authorities to improve the preparedness of the population. However, it is not the information that determines emergency preparedness and response actions. The basic purpose of risk communication is more than just transmitting a message. The concept of "risk communication" is directly intertwined with: preparedness; informing and educating the public about disaster risk reduction (rational understanding, detection, management); protecting public health and safety; protecting property and environment; providing information; warning of threats; modifying public attitudes, in order to adopt healthier and less risky behaviors; giving public the opportunity to make better choices and make better decisions in emergencies where there is a regime of uncertainty and time constraints; restoring public legitimacy and trust in the authorities who are responsible for managing an incident etc [26]. Various theoretical models have been developed describing how a message or information about risk evolves, how public perceptions are shaped and how decisions are made, providing the foundation for coordination and effective emergency risk communication [27,28,29].

The diversity in the experiences, background and composition of communities exposed to the wildfire risk is enormous. The persistence of traditional and often fragmented and outdated risk communication techniques not only fails to achieve its original purpose, but can lead to serious errors during a crisis.

If the responsible decision makers do not recognize the diverse influences and the idiosyncratic nature of the public, then the message of the relevant recommendations eventually loses its effectiveness [30].

Emergency Risk Communication should be integrated into strategic planning to become a functional "pillar" of preparedness and response. Further development of relevant laws, regulations and support frameworks with defined professional roles and responsibilities is needed. This will contribute to timely release relevant information, enhance the collection and the exchange of information through a collaborative approach in order to facilitate communication and encourage public support, cooperation and interaction between community members.

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FLOOD MORTALITY IN GREECE: WHAT WE KNOW SO FAR

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ABSTRACT

Floods are one of the most lethal natural hazards on a global scale. Greece is no exception to this regime, with recent extreme events showing how deadly floods can be (e.g. Mandra flood in 2017). This work focuses on reviewing the knowledge around flood mortality and specifically our understanding of the conditions under which these deaths occur, by exploiting an inventory of flood fatalities in Greece for the period 1960–2018. Results show a slight increase in deaths. Demographic analysis indicates that males and older individuals are more vulnerable. Most incidents occur outdoors and a large portion of them involves a vehicle. Examination of the stance of victims indicates that in a large number of these incidents, the victim deliberately enters floodwaters underestimating the risk. The immediate surroundings and the environment in which incidents occur play a role in how the risk situations develop. Results to this day point to specific circumstances and a profile of victims that exhibits higher vulnerability. High-risk situations and new challenges arising are apparent as well, indicating specific actions that should be undertaken to reduce flood risk to human life.

Keywords: flood deaths, fatalities, Greece, flash floods, mortality

1. INTRODUCTION

Floods are one of the most lethal natural hazards, inducing significant damages on property and infrastructure as well as a noteworthy number of fatalities.

Several studies analyze the consequences of flooding to human health [1] and focus on direct mortality, examining specific factors that affect the vulnerability of individuals to flooding, in an effort to provide an understanding of risk situations and how they develop. To this end, previous works study the victims' gender and age [2], their activity at the time of the incident and the use of motor vehicles [3], the victim's behaviour and surroundings [4] and others [5].

Despite the significant improvements in early warning, flood forecasting, risk management, structural flood-protection measures and other risk mitigation initiatives, flash floods continue to induce a large number of victims in the Mediterranean region [6], [4], [7] and around the world [8]. In Greece, despite the advances in various aspects of human life protection [9], recently both major and minor flood events have shown a potential for causing a large number of fatalities (e.g. 24 deaths in the 2017 Mandra flood – [10]) and there are even indications of an increase in annual numbers [4].

In this context and given the looming threat of climate change, this work aims to review our understanding of the conditions under which these deaths occur by exploiting an inventory of flood fatalities in Greece for the period 1960–2018. Results present key influencing factors of flood mortality and describe relationships between them while highlighting how risk situations can develop.

2. MATERIALS

This work exploits the database of flood fatalities created by Diakakis and Deligiannakis [11] for Greece for the period 1960 and 2010 and extends it to the period 2010–2018, using fatal incident descriptions included in scientific publications and flood databases [12] [13], as well as press articles and various other sources described in the above articles.

Each entry of the database corresponded to one fatality and consisted of several variables that provided an objective description of each fatal incident. All deaths included were directly or indirectly attributable to a flood event. Long-term health effects caused by flood disasters were not examined in this work due to lack of data. Each fatality was given a classification in each of the following variables:

- (1) Name, age, and gender of the victim
- (2) Exact location of the incident
- (3) Date
- (4) Activity of the victim
- (5) Cause of death
- (6) Type of surrounding environment (urban/rural and indoors/outdoors depending on the surroundings in which the incident took place).
- (7) Time of day (daytime or nighttime)
- (8) Stance of the victim (active or passive)
- (9) Use of vehicle (yes/no)

The data were analyzed using different statistical tests, selected to quantify the findings and to examine possible statistical relationships between the variables of interest, depending on theoretical conditions. Univariate and bivariate statistical analyses were conducted depending each time from the factors examined. To ensure data accuracy, information on the incidents was cross-checked between at least two independent sources mentioned above, including in some cases, press article descriptions.

3. RESULTS

Overall, fatalities show a slight increase with a slope of 0.045, although significant variations and outlier values can be identified especially in the three most lethal events of the period of study (namely in 1961, 1977 and 2017) (Figure 1).

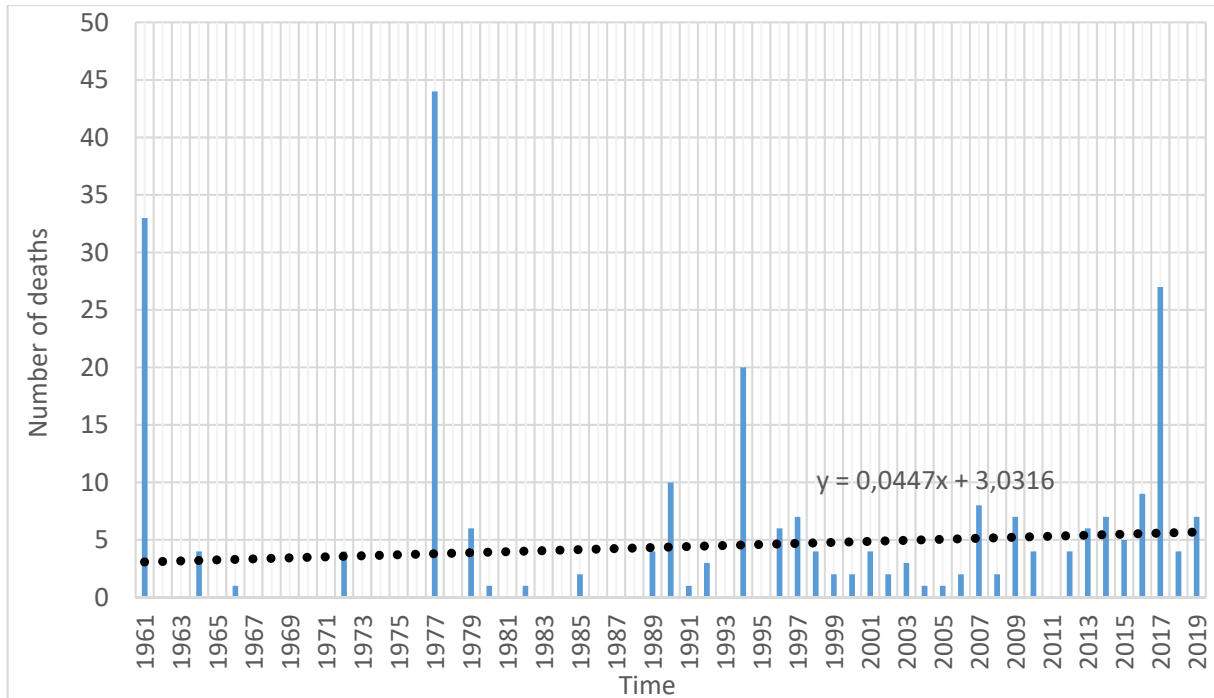


Figure 1. Temporal evolution of flood fatalities in Greece (1960-2018). The dotted line denotes

Flood deaths follow as expected the seasonality of flood occurrence in the country. The analysis shows an overrepresentation of older individuals and of males against the country's general population, indicating that these two groups are more vulnerable. With regard to gender, this pattern is most probably attributed to risk-taking propensity on behalf of males in comparison to females acknowledged in the relevant literature multiple times. Regarding the age of the victims, the pattern is attributed to the inability of older individuals to flee due to a physical condition and/or a reluctance to evacuate before retrieving some belongings.

Furthermore, there is sporadic evidence of qualitative changes in flood mortality. For instance, there are indications of a gradual increase of vehicle-related fatalities especially against indoor incidents, as buildings have become structurally more resilient. These qualitative changes could lead to new challenges when it comes to human life protection. A large portion of the decedents was killed in urban areas (especially in Athens). However, in more recent decades, there is an increase of rural area incidents as a percentage, probably attributed to improvements in urban infrastructure during the period of study. Outdoor deaths are the majority of the total, in many cases involving the use of a vehicle.

Statistically significant correlations were found between several of the factors analyzed. For example, fatalities that occurred in urban environments, have a higher probability to occur indoors, while the victims are generally older than the average. On the contrary, incidents that occur in rural areas tend to occur to younger victims, a large portion of which uses a vehicle to enter floodwaters. The stance of victims in outdoor incidents is mostly active (i.e. entering floodwaters deliberately), whereas indoor incidents are characterized by more passive behaviors. Events of high mortality (>10 deaths) tend to include both environments (urban and rural) and surroundings (indoor and outdoor deaths) in their incidents, while smaller events are mostly limited to outdoor fatalities and more active behaviors.

Overall, the insights offered by the present analysis provide a better understanding of the conditions and circumstances under which fatal incidents occur in Greece. They highlight that risk is increased due to inappropriate (active) behaviors, especially involving vehicles, with victims deliberately entering floodwaters, sometimes using faulty or dangerous infrastructure. These incidents occur mostly outdoors mostly to younger individuals and males. On the contrary urban incidents happen mostly indoors, involving most of the time older individuals that fail to evacuate the flooded buildings. Based on these findings, authorities should increase appropriate signage warning drivers of flooding risks, especially in locations where the road network crosses watercourses. In addition, special awareness and education campaigns should target drivers and older individuals (and their close relatives) of the dangers of flooding outdoors and indoors. Citizens living in high flood risk zones, especially ones living in basements and ground floors should be a priority in these campaigns.

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THE UTILISATION OF MOBILE APPLICATIONS AND SOCIAL MEDIA AT CRISIS PREVENTION AND MANAGEMENT. GOOD PRACTICES FROM HISTORIC EVENTS

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ABSTRACT

The aim of the paper is to analyze the possibilities for the use of social media in the management of natural disasters and to propose basic guidelines for organizing communications and data exchange between the participants in such events. Social media might well enhance systems of communication, thereby substantially increasing the ability to prepare for, respond to, and recover from events that threaten people and infrastructure. Social media cannot and should not supersede current approaches to disaster management communication or replace existing infrastructure, but if managed strategically, they can be used to bolster current systems. Therefore, the utilization of the social media by first responders and governmental agencies prior to and during disasters, are highly recommended

Keywords: social media, crisis management, mobile apps

1. INTRODUCTION

A natural disaster is the effect of a natural hazard (e.g., flood, tornado, hurricane, volcanic eruption, earthquake, heatwave or landslide). It leads to financial, environmental or human losses. Natural disasters come without warning and they take lives of tens, hundreds and thousands of people. The resulting loss depends on the vulnerability of the affected population to resist the hazard, also called their resilience. If these disasters continue it would be a great danger for the earth. This understanding is concentrated in the formulation that disasters occur when hazards meet vulnerability.

The term “social media” refers to Internet-based applications that enable people to communicate and share resources and information. The emergence of this new communication channels represents an opportunity to broaden warnings to diverse segments of the population in times of emergency. These technologies have the potential to prevent communication breakdown through reliance on just one platform and thereby to reinforce the diffusion of warning messages but also present policy makers with new challenges.

2. MAIN PART

The use of social media for emergencies and disasters on an organizational level may be conceived of as two broad categories. First, social media can be used somewhat passively to disseminate information and receive user feedback via incoming messages, wall posts, and polls. A second approach involves the systematic use of social media as an emergency management tool. Systematic usage might include: 1) using the medium to conduct emergency communications and issue warnings; 2) using social media to receive victim requests for assistance; 3) monitoring user activities and postings to establish situational awareness; and 4) using uploaded images to create damage estimates, among others.

Research and reviews of different cases has identified the four primary ways that citizens use social media technologies during natural disasters:

- Family and Friends Communication - To connect with family members between affected and unaffected communities/areas (or within affected communities) for situation updates and planning responses. This is the most popular use. Primary tools used are Twitter, Facebook and/or a blog.

- Situation Updates - Neighbours and communities share critical information between each other such as; road closures, power outages, fires, accidents and other related damages.
- Situational/Supplemental Awareness - in a number of cases citizens rely less and less on authority communication, especially through traditional channels (television, radio, phone.)
- Services Access Assistance - Citizens would use social media channels to provide each other with ways and means to contact different services they may need after a crisis.

Before a disaster social media can help people better prepare for a disaster and understand which organizations will help their communities [1]. During the disaster social media helps users communicate directly to their families, reporters, volunteer organizations and other residents and immediately share information. It also controls rumours because it's easier for organizations to validate facts. After the disaster, social media helps bring the community together to discuss the event and share information, coordinate recovery efforts and get information about aid. The use of social media for disaster preparedness has two components:

- As an effective means for providing updated information about a crisis, proactive steps must be taken prior to disasters in order for effective communications to occur.
- As a part of crisis observation, managers should be monitoring social media platforms and channels that may be relevant to their organization. Observing can be as simple as conducting regular searches and analyses of media platforms for keywords and phrases that may imply an emerging crisis or disaster. Monitoring of social media should extend into the crisis response and post-crisis phases to check how crisis management efforts are being received. Many researchers propose three ways to use social media during natural disasters:
 - Preparing for a natural disaster - though no one can predict an earthquake day in advance, social networks such, email and text messaging could help people prepare for the emergency.
 - Responding during and immediately after the natural disaster - this is especially the case for SMS messages and other communications that can be received through cellphones.
 - Recovering from the natural - communication is done through social media.

During recent historical events the use of mobile applications and social media networks is characterised by extremely remarkable features, as in following cases:

1. During the Boston Marathon Bombings, the Boston Police Department made terrific use of hashtags [2]. They clearly had a hashtag strategic plan in place, and used social media for media alerts, news conferences, as well as information request from the Boston community.
2. Following the Boston Marathon bombings, one quarter of Americans [3] reportedly looked to Facebook, Twitter and other social networking sites for information, according to The Pew Research Center. The sites also formed a key part of the information cycle: when the Boston Police Department posted its final "CAPTURED!!!" tweet [4] of the manhunt, more than 140,000 people retweeted it. Community members via a simple Google document [5] offered strangers lodging, food or a hot shower when roads and hotels were closed. Google also adapted its Person Finder [6] from previous use with natural disasters.
3. During the hurricanes that have hit the U.S. the use the application Zello (free push-to-talk walkie talkie app) has risen in popularity among emergency responders in the wake of the number of hurricanes that have hit the U.S. the last several years. As Hurricane Florence battered the Carolinas, several emergency channels were set up on Zello to allow people to request help. One of the channels was being operated by the Cajun Navy, a group of civilian rescuers that often travels to disaster areas to help execute rescue and recovery operations.

Drawing up an effective social media strategy and tweaking it to fit an emergency, however, is a crucial part of preparedness planning.

For the Boston Marathon incident, no consistent hashtag on Twitter could be found, which can make tracking relevant information difficult. Even searching for the word "Boston" would have fallen short, because it could

lead to unrelated matter like Boston tourism or fail to capture relevant tweets that did not include the word Boston.

Nevertheless, the tendency to sensationalize news that is inherent in human nature, basic information may get disproportionately misconstrued as a result of which rumours are created, misleading people with regard to ongoing activities. In the process, there is a loss of confidential information and victims may fail to be notified about revised safety measures. Eventually the lack of constant flow of communication can result in chaos and confusion. Critical tasks that can be implemented by social media include:

- Prepare citizens in areas likely to be affected by a disaster;
 - Broadcast real-time information both for affected areas and interested people;
 - Receive real-time data from affected areas;
1. Mobilize and coordinating immediate relief efforts; and
 2. Optimize recovery activities.

Concerns such as the threat of technology failure, hackers, stalkers, viruses, flaming, and usability issues will have to be addressed in the development of emergency online networks. Current social networks have limitations in terms of the collaborative tools available to users that might be repurposed for emergency use, especially given as they were generally designed with socializing rather than emergency efforts in mind. Nevertheless, within a short time, even the most enhanced system will seem primitive as user requirements mature and develop in all areas. Systems will ultimately emerge that allow true collaboration and have complete user control. When developing the use of online social networks, it is essential to engage emergency management personnel and their organizations in dialog to determine their concerns, needs and how to serve them in the best feasible manner.

3. CONCLUSIONS

Social media has re-defined communication in today's modern world. Text messaging, the internet and social networking sites have made it possible to communicate with a large number of people anywhere on earth. It is an efficient and easy way to keep in touch and impart information, particularly in a time of crisis. The Internet has become an essential communication network during this time. With thousands displaced from their homes and many having fled the disaster zone, people turned to social networking sites to contact friends, post photos and share stories. Social Media has become a valuable means of communication in many places affected by a natural disaster [7], which allows people to keep in touch with family and friends and access important information. Social media cannot and should not supersede current approaches to disaster management communication or replace existing infrastructure, but if managed strategically, they can be used to bolster current systems. Now is the time to begin deploying these innovative technologies while developing meaningful metrics of their effectiveness and of the accuracy and usefulness of the information they provide. The present paper illustrated how combining social media applications with voice applications such as Zello has been proven to help disaster management. Additionally, the possibility of automating IoT devices by updating groups on social media is highlighted.

Social media might well enhance systems of communication, thereby substantially increasing the ability to prepare for, respond to, and recover from events that threaten people and infrastructure. Therefore, the utilization of the social media by first responders and governmental agencies prior to and during disasters, are highly recommended.

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MULTIDISCIPLINARY GEOMORPHOLOGIC ANALYSIS OF GEOHAZARDS

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ABSTRACT

Challenges in current geomorphological processes demand constant monitoring achieved with low cost and highly accurate methods. The rapid development of remote sensing techniques in synergy with classical geomorphological surveys, like field and structural geology, can provide both the necessary resolution and precision that modern geomorphological studies require. However, the use of independent photogrammetric products can lead to fragmentary knowledge due to incorporated errors of each product. As an alternative, the use of multisourced data for different time periods secures the accuracy of the derived results and facilitates the conduct of indisputable conclusions on the evolution of the impact of the geomorphological process on the modern society. Our methodology is based on a synergistic approach between different multitemporal and multisourced data and field geology mainly applied in areas affected by mass wasting events (landslides). The use of this type of methodology enhanced by the low cost technology of UAVs allows the fast mapping and detection of geohazard areas.

Keywords: geomorphological changes, remote sensing techniques, field geology, geohazard mitigation.

1. INTRODUCTION

While planet transmits vital signs of its survival, new technologies are claimed in order to achieve effective management of the recorded changes. Predicting and mitigating changes in Earth Systems requires the collection, analysis, management and use of relevant data. Especially, geomorphological changes that can lead to natural hazards in an area of interest are characterized as complex issues by a modern geoscientist. These active changes involve many earth disciplines such as active tectonics, geomorphic indices measurement methodology [1, 2, 3], sedimentology, hydrology etc. The result of these processes strongly influence economic, societal and politic status of the affected area. Since the development of remote sensing techniques after World War I geoscientists had to manage a large number of new data in areas of previous low accessibility and nowadays they actually have full potential to compare them through different time periods [4]. For example an active landslide can be monitored using many different methods like inclinometers, topographical surveys measurements [5] or photogrammetric techniques [6]. The advantages and drawbacks of each methodology can extensively vary, however a turn in the Earth Sciences methodologies is recorded nowadays, combining other techniques with remote sensing or UAV applications [6, 7]. Precise mapping and monitoring are prerequisites for the analysis of a geomorphological process in order to predict its evolution over time. As described in the next paragraphs, we present a multisensored data methodology that can be used in order to designate changes in hazard areas due to climatic, tectonics or man made causes. Our team has long experience on a robust and innovative methodology using both classic geomorphological techniques and cutting edge image technologies (UAV, GPS, GNSS, SfM) that can describe a geomorphological process over time. These new technologies enable qualitatively and quantitatively analysis of geohazards that can set in danger human lives and activities. The aim of this paper is to highlight a methodology based on multiple sensed data integration applied in Geographic Information Systems that can successfully improve our knowledge upon the geomorphological risk of a specific area.

2. METHODOLOGY

For years geomorphological studies were relied on qualitative methodologies based mainly on field surveys. However, the high cost of a field expedition and the problems of accessibility or the increasing frequency of the natural hazard expression led to the seeking of new methods in deriving quantitative data from the field. The constant evolution of satellite radar sensors has led to the development of ground surface deformation maps with millimeter precision. The newest method for monitoring such changes is the use of ultrahigh resolution imagery captured from UAVs. Research needs for easy accessibility and low cost technology are fully satisfied in UAV technology by using autopilot systems, miniature GPS-GNSS, and light weight cameras. At the same time new processing methodologies like the SfM [6] are developed and offer detection and bestfit matching between derived photographs. However, a single used technique is not always sufficient for the study of a complex geomorphological process, thus the adoption of synergistic approach is required (Figure 1). Photogrammetric and inteferometric processing is based on the application of remote sensing data such as high resolution satellite images, digital airphotos, aerial photos captured from UAV and radar data. The coexistence of raster and vector data, polylines, polygons, and field measurements are crucial in producing comprehensible maps for understanding and mitigation of geohazards.

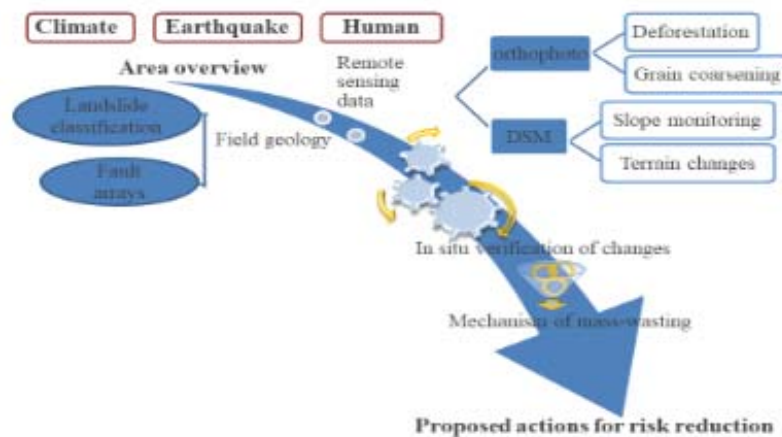


Figure 1. Flow chart showing a multidisciplinary landslide study.

2.1. Application of the synergistic method in mass wasting areas

Extensive slope failures, rock falls and periodically triggered landslides consist a common risk in the Greek territory. The landslides can be divided in slow and short- moving mass movements or fast and sudden mass movements that incorporate hundreds of cubic meters of rock or soft lithologies. The main reason of these movements are the extreme climatic conditions or the earthquake activity. Especially the last 50 years with the results of climate change being increasingly recognizable, mass wasting failures are more frequent and involve existed failures or cause new ones (Figure 2a). The landslide effect can be maximized in the case of a strong earthquake (Figure 2b), and in areas of unsupervised human intervention (Figure 2c). The mitigation of those failures can be quite expensive or can lead to protests and political crisis when affect populated areas. The synergy of multifunctional geoscientific technologies for monitoring at least active landslides in Western Greece that is more vulnerable in such events because of its lithological properties and earthquake activity is an absolute necessity. The results of these geoscientific technologies can produce a complete database for the failures over the last 70 years. Through this database useful results can be showed concerning the time that a failure is active [8], the direction of the movement [9, 10], the density of the failures [11] etc. The easiest way to collect updated data of affected areas are the UAV technology. UAVs benefit from their easy handling, their low cost application, their flight below the clouds and their capability

of collecting dense point clouds data in short time. Their comparison to digital airphotos, or satellite imagery illustrates the way that a landslide site can change through time (Figure 3).



Figure 2. (a) The Analipsi landslide (Ilia prefecture) triggered after rainfall [8]. (b) Airphoto of a characteristic earthquake induced landslide (Skolis Mtn) [11]. (c) Human intervention landslide (road construction) in Lefkada.

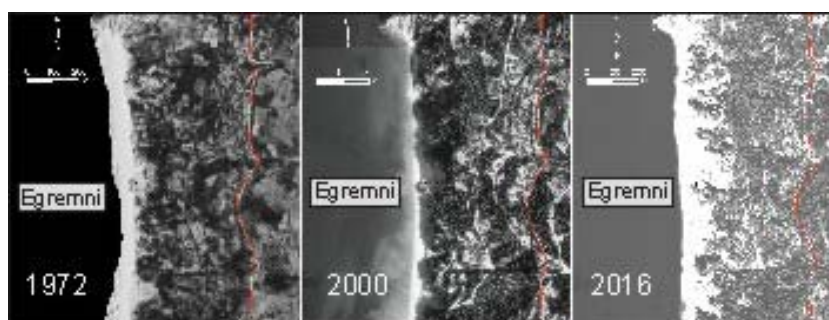


Figure 3. Diachronic changes of the coastal area in Lefkada derived from digital airphotos, satellite data and UAV imagery.

3. CONCLUSIONS

Reliable methods for collecting terrestrial data that concern geomorphological changes were developed over the last decade. These methods are based on collecting and managing dense point data which is the main advantage compared to classical methods. Even if such methodology can encounter many types of geomorphological changes the mass wasting field appears as most prominent as it concerns many areas of different climate and different grades of human interaction. However, the independent use of each methodology provides poor results in order to fully comprehend and record the parameters of a landslide failure. For this reason, our team developed a synergistic approach based on multitemporal and multisourced data to answer and understand the evolution and the possible geohazards that are encrypted in a landslide manifestation. Especially, for safety reasons the preemptive inspection of a hazard area and ex-post annual investigation are strongly suggested.

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UAS-BASED PHOTOGRAMMETRY FOR 3D-MAPPING AND REDUCTION OF LANDSLIDE RISK IN TECTONICALLY ACTIVE AREAS: THE CASE OF CHIOS ISLAND (GREECE)

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ABSTRACT

The North Aegean islands are characterized by particular geodynamic and seismotectonic regime and by great amount of natural disasters. Recent earthquakes in Greece, testify that North Aegean region is seismically active. An earthquake can increase the chances and the frequency of landslides for an area. On Chios island, along the Chios-Kardamyla Road, and specifically in the region from Mersinidi to Myliga area, there is a significant thrust between Paleozoic clastic and Triassic carbonaceous formations. In this area many landslides have occurred. The regime, the crucial differentiations of the environment and human activities can lead to extensive damage. Thus, it was necessary to identify the hazardous areas and the specific places aggravated by earthquakes or considered as dangerous to landslides. This study presents the procedure followed for: (a) Evaluation of existing geological, geotectonic, hydrogeological, seismotectonic and geotechnical data, (b) UAV mapping and creation of Digital Surface Models (DSM); (c) Geological-Tectonic mapping for the wider area; (d) Research of discontinuous tectonic deformation that the formations have undergone; (e) Research of the hydrogeological conditions of the area and determination of the role of groundwater in rock and soil movements; (f) Geotechnical mapping of the formations; (g) Recording and processing of the measurements of the geometrical features of the structures in the area. All the data above in combination with the extracted plans for rockfall and rock slides, the simulation models of rockfalls, the results of drillings along the specific section of the road and the causes of slidings, led to the suggestion of appropriate countermeasures for landslides.

Keywords: SfM, landslides, rockfalls, 3D-modeling, tectonics.

1. INTRODUCTION

Chios is a semi-mountainous greek island with 51.320 inhabitants, a coastline of 215 km, a few nautical miles from the west coast of Turkey. The study area is a coastal zone along the provincial road of Chios-Kardamyla and particularly its part from Mersinidi to Myliga, in the northeast part of the island (Figure 1a). The area is characterized by slopes and rotational slides, in which, the upper segment of the moving mass moves downwards, while at its base there is elevation. UAS have been increasingly utilized for research in Natural Hazards and Risk Management. The largest part of the study area was inaccessible, so the thorough examination and mapping of existing geological-tectonic structures necessitated the use of UAV. The use of SfM (Structure for Motion) techniques to obtain data from inaccessible areas has led to the development of methodologies, such as geological mapping, boundary and surface tectonic mapping and high-accuracy structural analysis in 3D environments [1,2,3,4].

2. METHODOLOGY

At first, the aerial mapping project was planned according to: a) technical capabilities and the equipment, b) the needs of visual analysis and the extent of the area, c) the peculiarities and weather conditions. The factors adjusted were: a) The flight above the takeoff position altitude. According to the morphology and the altitude

of the area and the required analysis, heights of 100 m and 150 m were selected with GSD 3.94 cm/pixel and 4.64cm/pixel in southern and northern part respectively, below 5cm/pixel in γ^6 cases; b) The orbital of UAS. The area was scanned in two directions perpendicular to each other to create 3D maps; c) The pitch angle of the camera ($60^\circ - 70^\circ$) and d) The overlap rate (above 80% so to maximize the number of confirmed tie points and increase the accuracy of the result). The geological structures and the geomorphology of the study area were examined. This was achieved by field mapping and by 3D-mapping on the models produced, in combination with the study of the existing references. Visual data and metadata from UAV photogrammetry flights were obtained, by using the DJI Mavic Pro drone. Static RGB images and high-resolution videos were captured. The photogrammetry data was first processed using Pix4Dmapper (v. 4.2.25) and the derivatives were exported for further processing and analysis in all software environments used in geographic, geological and design applications (GIS, Modeling, CAD) in appropriate format (shp, dxf, ascii, pdf, etc.). After initial data processing, orthomosaics, DSM (Figure 1c) and 3D models (Figure 1b) were produced via Pix4D.

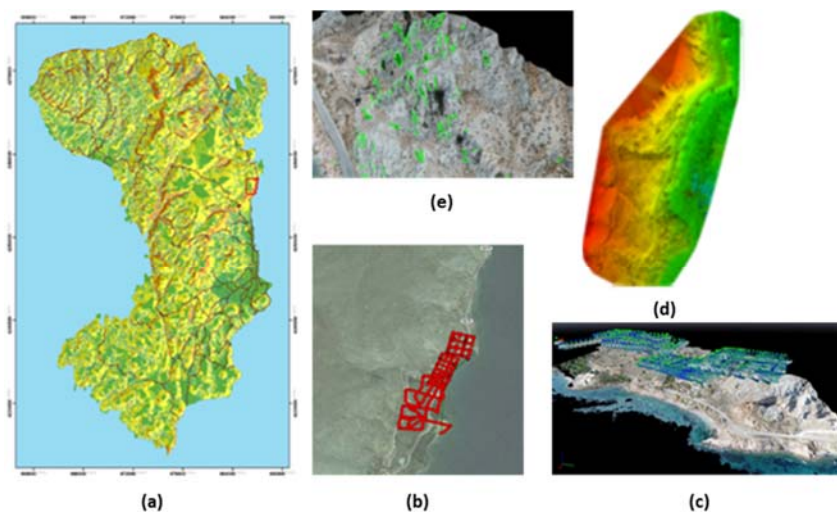


Figure 1. (a) The study area (red framework) on morphological map of Chios; (b) Flight plan for the southern part; (c) 3D model of point cloud and grid of photorealistic surfaces in the northern region. The positions of the camera, when taking photos, are noted; (d) DSM; (e) Digitization of tectonic structures on the 3D model (Pix4Dmapper).

SfM photogeological and phototechnical mapping was carried out in Pix4Dmapper and ArcGIS, with simultaneous second-time video overview in order for interpretation problems to be resolved. The tectonic lines and surfaces were digitized directly on 3D relief on the anchor points of the model (Figure 1d). The surface and line data were imported individually and in total into AutoCAD and GIS. The overlap of lines and surfaces on the orthomosaic greatly guided geological mapping. The boundaries of the geological formations were digitized in a GIS environment. Then, polygons and 3D complex lines were imported into ArcGIS. The polygons were transformed into triangular irregular networks (TIN), points were created on the surfaces and the dip and dip-direction values were calculated for them.

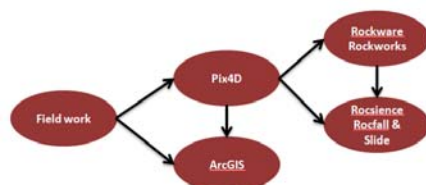


Figure 2. The workflow concerning the software used in the study.

The statistical analysis of the tectonic data was carried out in Rockware Rockworks 17 software. Stereographic projections were made on Schmidt networks. Circular projections and planar poles density diagrams were

also made. Rose diagrams were made for the lines, according to the strike measurements of the segments. Then, the coordinates of the start and the end of each segment were calculated. Finally, each rose diagram was made by calculating the frequency of measurements' occurrence and by weighing the length of each line. The derivatives of the process described above, are presented in Table 1.

Table 1. The derivatives from the software used during the process in the study.

Field work	Pix4D	ArcGIS	Rockware Rockworks	Rocsience Rocfall	Rocsience Slide
Field mapping	UAV flight planning, Point cloud and Mesh	Tectonic data synthesis and analysis	Tectonic data analysis	Landslides simulation risk	Slope stability calculations
Field tectonic data analysis	DTM, Orthomosaic, DSM	Topographic & Morphological-Tectonic maps	Density diagrams		
UAV-captured video	3D model	Geotechnical map	Rose diagrams		
	3D mapping	Geological-Tectonic map	Final statistics		
	Tectonic data analysis				

3. RESULTS

In total, 23 surfaces and 99 lines were digitized and measured in the southern region, while 292 surfaces and 423 lines were digitized in the northern one. The lines were divided into 6968 segments of unique orientations. Generally, the area is characterized by high slope surfaces mainly on the rocky carbonate basement. The morphology of the terrestrial area and the coastline is directly influenced by these faults and discontinuities, which generally have a NNE-SSW direction, they are combined with N-S and NW-SE secondary directions and they form the boundary detachment surfaces of segments of the rock mass and their sliding or turning over lithological or tectonic boundaries with the overlying formations. The diagrams confirm the results of the measurements on the surfaces, except that the N-S directions have a higher frequency and length percentages than the N-E ones.

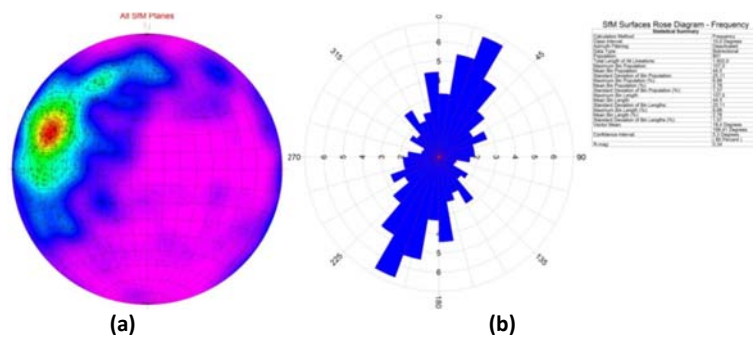


Figure 3. (a) View of SfM surfaces' poles and density diagram for the whole region; (b) Rose diagram of surfaces directions for the whole region.

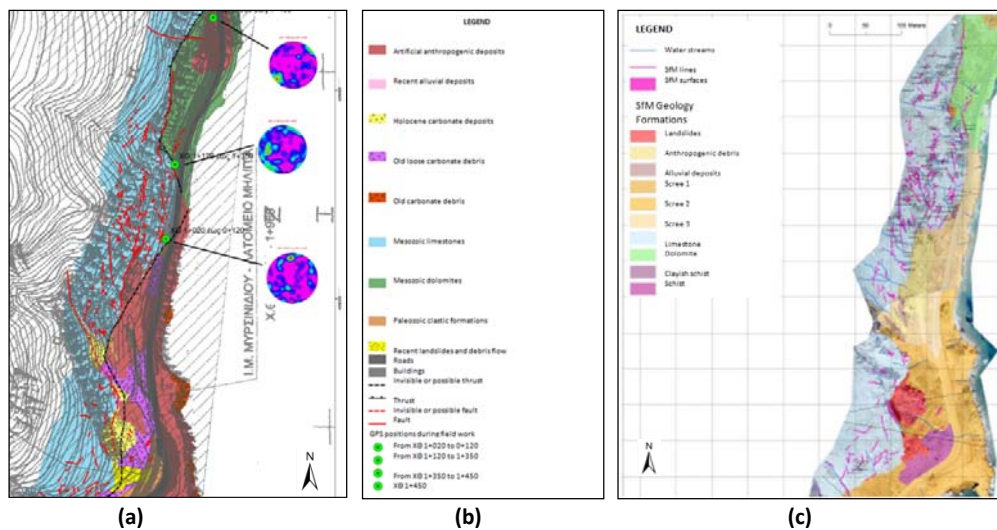


Figure 4. (a) Geological-
tectonic map: SfM lines,
density diagrams, field
and SfM data; (b)
Simplified legend of the
geological-tectonic map;
(c) Photogeological-
phototectonic map: SfM
lines and surfaces on
the original geological
map that was derived
from mapping,
according to the
orthomosaic and the
model.

4. CONCLUSION

The high-resolution videos captured, transport the researcher to the field at any time during processing data, resolving image quality or bad illumination issues during mapping. The largest part of the study area was inaccessible, so using UAV gave the ability for complete and detailed mapping. As a result, the statistics and the analysis were thorough and reliable. Concerning the structural analysis of the carbonate rocks in the area, they have undergone tectonic strain both by the activity of the nearly vertical tectonic surfaces crossing their mass and by the activity of the significant thrust surface at shallow depth below the ground, above the Paleozoic clastic formations. As a result, these carbonate rocks are fragmented on the one hand and geotechnically they begin to look like debris, but on the other hand they are broken into blocks and boulders that are easily detached from the main rock mass and overturned or slid over the schist. This behavior is also associated with the water activity, which reduces the shear strength of the discontinuities, the friction between the carbonate blocks and the friction between them and the clastic basement.

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ANALOGUE TO DIGITAL MAPPING OF PROTECTED AREAS

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ABSTRACT

In recent years the collection, management, analysis, modeling and visualization of spatial data (geodata) using databases, geographic information systems, image processing systems, etc., has become a very important field of research and practice. The EU has set itself an ambitious target of halting the loss of biodiversity in Europe by 2020. At the heart of its efforts is the establishment of an EU-wide network of protected areas spanning all over 28 EU countries. Natura 2000 lies at the very core of Europe's Green Infrastructure. It not only acts as an important reservoir for biodiversity and healthy ecosystems, which can be drawn upon to revitalize degraded environments across the broader landscape but also delivers many ecosystem services to society. In this paper, we dealt with the digitization and mapping of the protected areas in a prefecture of Greece, using GPS and computer programs after the digitization of analogue maps. This was done by input the data collected by GPS, in the program AutoCADMap, and export them in shape form. Then was processed with the program ArcGIS and the drawn out digitally the protected areas. Integrated G.I.S software enabling the establishing of nationwide geodatabase, including vector and raster data, digital elevation models and attributes attached to the geometric features. AutoCAD Map software, ArcGIS and Google Earth contain all necessary tools to perform the above-mentioned tasks: built-in thematic mapper, map editor, analyzing tools, digital image processor, digital surface modeler, relation database manager and report writer. There is a strong relationship between Green Infrastructure and protected areas (Natura 2000) as they provide a strategic focus for improving our natural environment and enhancing the quality of our lives with the offer of practical examples of how can be used in a way that provides multiple socio-economic benefits to people as well as to nature.

Keywords: AutoCAD, Data, Digitization, Geographic Information Systems (GIS), G.P.S.

1. INTRODUCTION

The first protected area was established as the Yellowstone national park in 1872. Since 1937 in our country, areas of high ecological interest have begun to be recognized and protected. It is therefore understood that our country has huge natural wealth and is one of the first in Europe in this field. . The designation and expansion of protected areas has also brought associated social and ecological costs. Unfortunately, the environment in Greece is facing multiple risks of degradation, even disasters.

The approach that has been put into practice in the first stages of the protected areas establishment was the absolute protection of natural areas and the elimination of human activities. In the industrializing countries, governments began to set aside areas of particular scenic beauty or uniqueness exclusively for conservation. But the creation of most of these protected areas involved the exclusion of local people [1]. The leading conservationists were foresters from the Imperial Institute of Forestry at Oxford (UK). Their management philosophy emphasized that "the public good was best served through the protection of forests and water resources, even if this meant the displacement of local communities" [2]. Along the way, this approach was

abandoned and gave way to the concept of the integration of the protected area into the surrounding area and the close connection of protection to the sustainable use of natural resources.

In recent years the collection, management, analysis, modeling and visualization of spatial data (geodata) using databases, geographic information systems, image processing systems, etc., has become a very important field of research and practice [3].

The EU has set itself an ambitious target of halting the loss of biodiversity in Europe by 2020. At the heart of its efforts is the establishment of an EU-wide network of protected areas spanning all over 28 EU countries. Natura 2000 lies at the very core of Europe's Green Infrastructure. It not only acts as an important reservoir for biodiversity and healthy ecosystems, which can be drawn upon to revitalize degraded environments across the broader landscape but also delivers many ecosystem services to society.

The purpose of the paper is to create digital maps by digitize the Protected Areas of P. Rodopi using modern tools and methods (GPS, AutoCAD programs, GIS) based on existing analogue maps used by the forestry service to date. This will enable these areas to be accessed quickly and accurately, and precisely, which will be imprinted on digital mapping backgrounds and there will be a wealth of information on each.

2. MATERIAL AND METHODS

In the prefecture of Rodopi, there are a few scientific identified, protected areas, which are classified in different categories such as: National Park, Areas of nature protection, Wetlands and European Ecological Net Natura 2000. The georeferenced maps 1:50.000 of Hellenic Military Geographical Service (HMGS) (Raster) in the projected system Hellenic Geographical Reference System 87 (HGRS '87) input in Autodesk Map Software with the help of Autodesk Raster Design Software. The commands "Rubbersheet" and "Triangular" used for hitching each map. Most of the protected areas were digitized from analogue maps with the help of ArcMap's Arc Editor and the Autodesk Map program. The total area of each region in km² was calculated in each of the above two software. Conversion from DXF data to GPX format. The remaining protected areas were captured using geodetical GPS Viva of Leica. The GPX files created with G.P.S. were later input in the ArcMap file. The shape files of ArcGIS are converted and transformed into KML. files, which can be input in Google Earth. All the maps have been created in ArcMap software of the ArcGIS platform and particularly in .mxd file of the above software. The grid defined in this project shall be used as a geo-referencing framework where grids with fixed and unambiguously defined locations of equal-area grid cells are required.

3. RESULTS

Through the AutoCAD and ArcGIS programs, we have been able to produce the final digital maps, which concern the protected areas in the prefecture of Rodopi. In figure 1 is shown the map of protected areas in Rodopi Prefecture. In figure 2 is shown the KML file of Wildlife Refuges in Rodopi Prefecture.

4. CONCLUSION AND DISCUSSION

Integrated G.I.S software enabling the establishing of nationwide geodatabase, including vector and raster data, digital elevation models and attributes attached to the geometric features. AutoCAD Map software, ArcGIS and Google Earth contain all necessary tools to perform the above-mentioned tasks: built-in thematic mapper, map editor, analyzing tools, digital image processor, digital surface modeler, relation database manager and report writer.

The rapid development of technology and the increasing use of digital spatial data bases multiplied portability and exchange of information between users. These data are now addressed in several extended circle of potential users who in order to assess whether and how the available data meet their needs require longer recording quality of the information provided. From the perspective of the producer of information essentially "required" to perform record and publish the results of a number of checks and other important issues related to information in order to enable the potential user to evaluate and assess the suitability use.

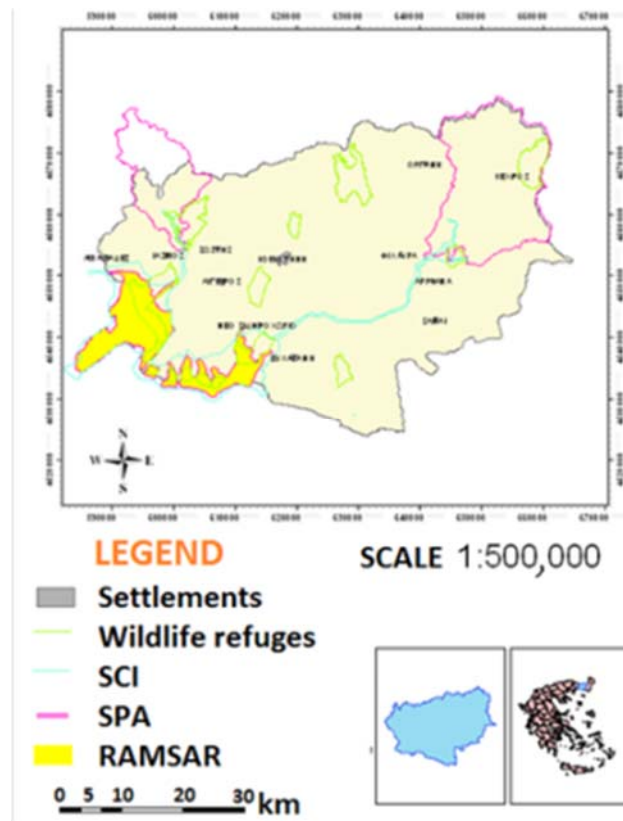


Figure 1. Map of protected areas in Rodopi Prefecture.

There is a strong relationship between Green Infrastructure and protected areas (Natura 2000) as they provide a strategic focus for improving our natural environment and enhancing the quality of our lives with the offer of practical examples of how can be used in a way that provides multiple socio-economic benefits to people as well as to nature.

The above statement is proved by the advantages that are obvious from the creation in every prefecture of a Completed Geographical Information System (G.I.S), for the whole prefecture, the following:

- The creation of necessary foundation, for the seamless and digital record of all the spatial data that use the prefecture's services and especially the forest services,
- The automation of update and transfer proceedings of any files between services – sections,
- The possibility of instant search, view and management of any spatial data for any spot or location of the prefecture,
- The disposal and the use of this information of all the services, which are likely needed (i.e. spatial design, design of foundation projects, etc.) or other purposes (creation of thematic maps, acts of administration etc.)
- The substantial optimization of the provided services towards the citizens and
- The efficient protection and management of natural, terrestrial ecosystems of the prefecture.

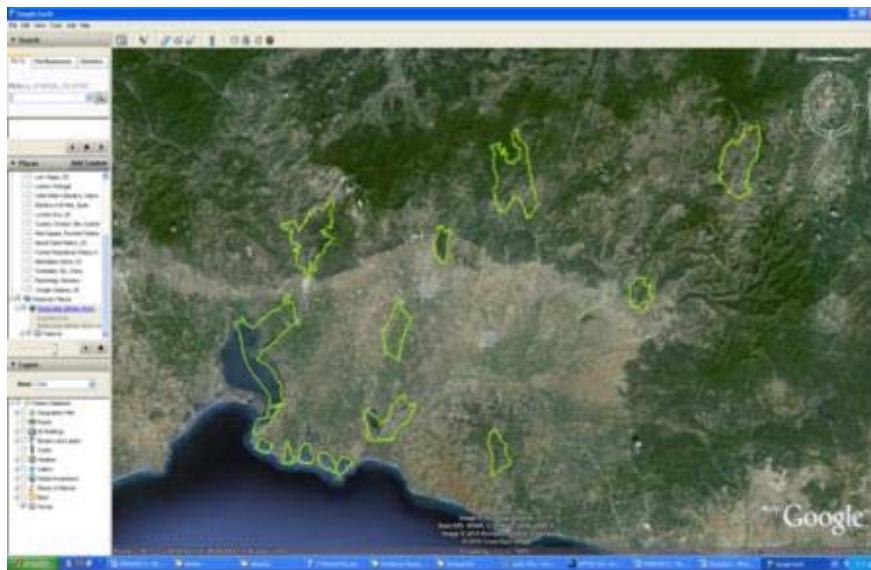


Figure 2. KML file of Wildlife Refuges in Rodopi Prefecture.

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THE ROLE OF TRAFFIC CONTROL CENTERS AND INTELLIGENT TRANSPORTATION SYSTEMS IN RISK AND EMERGENCY SITUATION MANAGEMENT

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ABSTRACT

Emergency situations require extensive cooperative and coordinative actions between several actors. This paper highlights the key role of Traffic Control Centers and Intelligent Transportation Systems in managing information for public response during the management of risk and emergency situations.

Keywords: Emergency management, Traffic Control Centers, Intelligent Transportation Systems, Business continuity

1. INTRODUCTION

Cooperative and coordinative actions before, during, and after emergency situations are vital in addressing and managing these, thus ensuring business continuity. This paper highlights the key role of Traffic Control Centers (TCCs) and Intelligent Transportation Systems (ITS) in emergency information management, a vital process in directing public response during all phases of emergency management. The findings are based on review of relevant literature and technical reports from the World Road Association (PIARC).

In Section 2 risk management, business continuity and emergency management are put in context and their interrelation for the different phases of the emergency management is discussed. Section 3 presents the role of TCCs and ITS in emergency information management for public response and includes examples of good practices in cooperative systems. Section 4 summarizes the findings and provides conclusions.

2. RISK, BUSINESS CONTINUITY AND EMERGENCY MANAGEMENT

Risk is defined as the effect of uncertainties on objectives and may be regarded as a threat or an opportunity. Risk management (RM) addresses risks through a systematic process which includes setting the context, assessing the risks through identification, analysis and evaluation, treating these by influencing their likelihood of occurrence, their consequences, or both, and monitoring and reviewing the different stages of the process. Throughout the process, clear, effective and efficient communication with stakeholders is vital for maximizing benefits and mitigating losses in a cooperative way for the benefit of the community.

Business continuity management (BCM) aims at ensuring that the organization will be able to continue its operations at desired level of operability after the occurrence of an emergency situation (e.g. natural disaster).

Emergency management involves both addressing a risk and ensuring the continuity of the functions of an organization. Emergency management focuses on threats and may also consider disasters that far exceed the capabilities of an organization to withstand these and conventional risk management may prove insufficient. Traditionally, the emergency management process considered three stages in the timeline of the evolution of an incident: preparedness, response and recovery, though other framework tend to also include a fourth stage at the beginning of the process, the mitigation stage, which involves taking sustained actions to reduce or eliminate long-term risk to people and property from hazards and their effects. This is performed throughout the risk management process by making use of Business Continuity Plans (BCPs)⁴ and Emergency Management Plans (EMPs) that may be devised at three levels of emergency planning: the national level, the

regional level and the local level that may be further refined into three tiers of planning: strategic, operational and tactical.

In the aforementioned context, business continuity is rather focused on the response and recovery stages of the emergency management process. Appropriate communication with the public is vital in managing risks and emergency situations, which eventually relies upon proper cooperation and information sharing within and across all processes.

3. THE ROLE OF TCCs AND ITS IN EMERGENCY INFORMATION MANAGEMENT

Technological advances and Big Data capabilities resulted in making TCCs an integrated part of any emergency management process involving the road network. TCCs are the core of traffic / mobility management and rely on the use of ITS for the collection, analysis, processing and dissemination of data in support to the emergency management process (e.g. traffic composition, routing, incident location) from and to the road users and emergency response units (e.g. Civil Protection, Fire Department, Police, Medics, etc.).

Modern ITS (e.g. VMS, CCTVs, V2X communication, traffic signal control systems, automatic plate recognition, laser and Doppler speed detectors, loop detectors) are able to effectively address safety, mobility, and environmental impacts by preventing traffic accidents, reducing traffic congestions and decreasing emissions, respectively. Use of ITS results in better management and control of the road network as well as in more reliable and updated user information, therefore allowing for informed travel decisions, modal choice, reduced energy consumption, increased road capacity and enforcement.

In emergency management, their role in traffic monitoring, incident detection and data acquisition and dissemination is unparalleled. ITS contribute in shortening the response time and routing necessary resources by enabling emergency response units to coordinate and act more efficiently in case of incidents and emergency situations. This enables faster, safer and more effective access of rescue services to the affected area resulting in quicker evacuation of road users and/or victims. In this respect, Traffic Management Plans (TMPs) are valuable tools by optimizing resources and guiding the use of ITS, thus ensuring that mobility and safety concerns are met .

Therefore, TCCs and ITS are integrated components in Coordinated Incident Management Systems (CIMS) that provide holistic framework for managing emergency situations . Efficient TCC design should facilitate management of traffic operation and interoperability with other systems and road/emergency stakeholders. Contrary to Emergency Operation Centers (EOCs), TCCs are permanent structures, therefore well suited for responding to a variety of situations. They are enablers of greater and more efficient cooperation between transport and emergency response personnel. In emergency management TCCs may adopt measures that can be broadly classified into preventive and operational. Examples of such measures are provided below:

- Emergency service routes and routing to safer and less congested routes.
- Real time information to road users and rescue services.
- Control and monitoring through UAVs or CCTVs.
- VMS for reliable and updated on-trip.

It must be noted though that effective decision-making relies on the availability of information and the quality of the integrated ITS data, such as9:

- Weather forecasts
- Traffic forecasts
- Speed management
- Automatic traffic enforcement
- Vehicle to vehicle (V2V) communication
- Vehicle to infrastructure (V2I) communication

3.1. Indicative examples of good practices

In **Australia, Fusion Centres** are created in order to provide interdisciplinary expertise and coordinate the information exchange between TCCs and EOCs to inform decision-making at all levels of government. These conduct analysis and facilitate information sharing and situational awareness during emergency situations while assisting law enforcement and homeland security partners in preventing, protecting against, and responding to crime and terrorism to better serve communities.

Road weather Information Systems

In Spain and Australia, National Weather Stations provide real-time information to Road Weather Information System Stations (RWIS) to generate 72-hour forecast reports on pavement temperature. These reports are delivered to road stakeholders and Traffic Management Centers to foster coordination between transport and emergency response units responsible for traffic safety and roadway infrastructure maintenance. For emergency situations, preparedness is facilitated through the development of scenario-based concept of operations.

e-Call

In case of severe car accident, a vehicle equipped with e-Call will automatically trigger an emergency call. Even if passengers cannot speak a Minimum Set of Data with information on the incident is sent including the exact location of the incident. Emergency response units are promptly notified and assisted through TCCs or other cooperative systems in accessing the incident site faster.

4. CONCLUSION AND FURTHER DEVELOPMENTS

This paper highlights the key role that TCCs and ITS may potentially have in risk and emergency situation management. Integration of ITS and TCCs in the management of emergency situations may result in improved situational awareness, advanced capabilities for information sharing, dissemination and communication among road and emergency response stakeholders by inducing a more effective decision-making in all phases of the emergency management process and more efficient response and recovery.

Nevertheless, further research is needed in developing guidelines for ITS deployment in emergency traffic situations, with respect to its reliability and supporting real-time user guidance. Moreover, the development of highly automated and autonomous vehicles and their foreseeable introduction in traffic, raise additional issues to be considered. These relate to the following:

- The capabilities of existing ITS and TCCs to handle the complexities that arise by the inclusion of highly automated or autonomous vehicles in relation to the required interfaces for data exchange, reliability and security levels.
- Lack of financial resources for replacing existing ITS and TCC infrastructure may affect the way collaborative ITS (C-ITS) is introduced by transport authorities.
- Operative, portability and interoperability issues that may arise due to the absence of a comprehensive regulatory framework.
- The future integration of Autonomous vehicle fleets tele-operation centers in the Traffic Management schemes and the subsequent risk and emergency management tasks they will bring

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BRIDGE POTENTIAL DEFORMATIONS MONITORING USING MTINSARSENTINEL-1 : THE CASE OF POLYFETOU BRIDGE (NORTHERN GREECE), PRELIMINARY RESULTS

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ABSTRACT

Large-scale civil engineering projects such as bridges, roads and dams, are critical infrastructure projects and their loss translates to a loss of movement and transportation, trade and commerce, among others. The use of remote sensing technologies (non-invasive) is an efficient solution to enhancing the condition assessment of bridges supporting improved decision making. Current study's main objective is to explore the use of space-born open SAR Copernicus data (Sentinel-1) in monitoring the condition of bridge infrastructure, improving the efficiency of inspection, repair, and rehabilitation efforts and developing unique signatures of bridge condition at low cost. In this research work, a long curved prestressed reinforced concrete bridge located in Western Macedonia, Greece (Fig. 1), has been selected as the case study for monitoring deflections using SAR interferometry. The so called "Polyfetou Bridge" crosses an artificial lake created by a hydroelectric dam in Aliakmonas river located a few kilometers away from the bridge. In this preliminary study the last five years have been investigated and cumulative deformations have been derived. The study's results demonstrate bridge locations where settlements appear and need further attention. The application has shown that the proposed method can be successfully used to remotely monitor bridge deformations that are indicators of the structural health of the bridge.

Keywords: MTInSAR, Sentinel-1, Bridge, structural health monitoring, Lake Polyfytyou

1. INTRODUCTION

Large-scale civil engineering projects such as bridges, roads and dams, are critical infrastructure projects that were realized a few decades ago and since then they unceasingly provide their services. The loss of these different infrastructure elements translates to a loss of movement and transportation, trade and commerce, communication across great distances, energy generation and transmission, organized healthcare, among others. Investments in infrastructure are directly related to great improvement in development indices and in the quality of life.

According to the Intergovernmental Panel on Climate Change (IPCC), changes in global climate in the 20th century, whether from human or natural causes, are already reflected in numerous indicators. The implications of these changes and their impacts for the planning, design and operation of transportation infrastructure are profound because of the pervasiveness of this infrastructure, its centrality in our everyday lives and culture, its interdependencies with other infrastructure, and its historical location in areas vulnerable to global warming effects. The estimated impacts are in many cases pronounced and the ability to cope with these impacts varies considerably depending upon the capacity to adapt. The use of remote sensing technologies (non-invasive) is an efficient solution to enhancing the condition assessment of bridges supporting improved decision making. The concept of remote sensing is often associated with satellite imagery for applications in the environmental and earth sciences; however, various remote sensing techniques have been used in infrastructure applications without being specifically labeled as such. Remote sensing is traditionally defined as the collection and measurement of spatial information at a distance from

the data source, without direct contact. To the bridge engineer, remote sensing can mean the ability to assess the condition of the bridge at a distance, enhancement of the inspection process, all without traffic disruption. No single Structural Health Monitoring SHM method exists that is capable of completely determining the condition of a bridge.

Over the past 20 years Interferometric Synthetic Aperture Radar (InSAR) [1] and Persistent Scatterer Interferometry (PSI) [2] have established themselves as a methodology capable of monitoring surface deformations in urban environments, thanks to the presence and density of coherent radar targets. Satellite SAR interferometry (InSAR) is proven as effective method for monitoring of deformations of both terrain and urban structures. With satellite SAR Interferometry specific bridges can be monitored to identify and investigate targets with suspicious displacement on a monthly (ERS, Envisat and Radarsat data) or/and weekly (TerraSAR-X and COSMO-SkyMed, Sentinel-1) time-scale. In the near future this will be possible on a daily basis (microsatellites next generation) [3-7]. Earth Observation technologies combined with a decision support system, which fuses data from multiple sources, offers several advantages compared to current bridge inspection and monitoring methods.

Current study's main objective is to explore the use of space-born open SAR Copernicus data (Sentinel-1) in monitoring the condition of bridge infrastructure, improving the efficiency of inspection, repair, and rehabilitation efforts and developing unique signatures of bridge condition at low cost. The case study is focused on Polyfytou Bridge in Northern Greece.

2. THE POLYFYTOU BRIDGE

In this research work, a long curved prestressed reinforced concrete bridge located in Western Macedonia, Greece (Fig. 1), has been selected as the case study for monitoring deflections using SAR interferometry. The so called “Polyfytou” bridge crosses an artificial lake created by a hydroelectric dam in Aliakmonas river located a few kilometers away from the bridge. The bridge was built in the beginning of 1970’s to connect Kozani and Servia Regions after the construction of the dam and it is part of the Kozani-Larisa National Road having often heavy vehicle traffic. It has a length of 1372 m and the total width is 13 m. Interestingly, the bridge has a combined structural system consisting mainly of simply supported I-Girder spans and monolithic cantilevers on either side of the three tallest piers. The total number of piers is 27 and all of them are founded at the bottom of the artificial lake. Considering the age of the bridge there are concerns regarding deck deformations or differential settlements that may need attention and require actions for repair.



Figure 1. Location map

3. DATA AND METHODS

The data used were acquired from the ESA Copernicus Hub Sentinel 1A & 1B SAR SLC images.

95 SAR SLC Sentinel-1 (56 S1A & 39 S1B) - Relative orbit 102 - Geometry of acquisition: Ascending. First image 12/10/2014 – Last image 07/01/2019 - The study area is located on Swath 1. The PSI technique implemented

at SARPROZ® [8] software was applied on the up mentioned dataset. The SAR images were: TOPS coregistration of N+1 SAR.SLC images (using SRTM DEM), Generation of N interferograms (single reference), Removal of atmospheric phase screens (stochastic model), Estimation of non-linear deformation (non a priori velocity info, cumulative deformation results)

4. RESULTS

In Figure 2 bridge cumulative deformations are shown for the time period from October 2014 to January 2019 in a chromatic scale from blue to red. The colors in the chromatic are classified based on the direction of cumulative deformations: cold colors, from dark blue to green, indicate uplift which means the reduction of the displacement towards the satellite sensor; hot colors, from green to red, indicate settlement which is interpreted as an increasing distance from the satellite sensor, while the green color (± 1.5 mm) indicates the stable areas. Some settlements are observed at the northern part of the bridge, while the southern is more stable.



Figure 2. PSI deformation map (Non-Linear deformation, cumulative in mm)

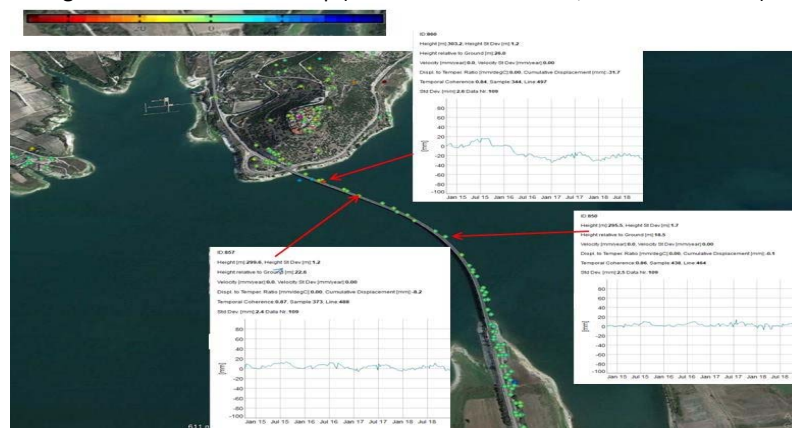


Figure 3. Deformation and time series analysis for specific scatterers.

The results are in accordance with recent inspections on the bridge. More specifically, the largest settlement demonstrated in Figure 2 is equal to 40 mm. In Figure 3 the evolution of the deformations indicates a correlation with the seasonal change (related to temperature or water level of the lake). The settlements in these locations should be further investigated to determine their cause which may be related to partial loss

of prestress of the deck, scour effects on the piers or bearing deterioration and proceed with appropriate repair actions.

5. CONCLUSIONS

In this paper, SAR interferometry has been proposed to be used as means to monitor the evolution of bridge deformations. Along curved old bridge in Northern Greece, named as Polyfetou, has been investigated with the remote sensing techniques. The results have demonstrated the bridge locations where large settlements appear and need further attention. The application has shown that the proposed method can be successfully used to remotely monitor bridge deformations that are indicators of the structural health of the bridge. Conclusions could be summarized as following:

- Excellent performance of Sentinel 1 SAR data to map motion over a bridge.
- Sufficient number of PS on a curved bridge showing locally patterns of deformation especially in the northern part.
- From historical motion diagrams (Time series analysis) it is almost clear the seasonal impact in the case of deformed scatterers.
- Produce deformation maps using both ascending and descending orbits of acquisition

Future work includes: a. Motion monitoring since 1993 to include the 1995 seismic event occurred in the area until today. b. Validation (lakes water levels changes, seismicity, slope instabilities). c. An interferometric processing using high resolution SAR images (TSX or CosmoSkyMED) in order to increase the number of scatterers.

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ANALOGUE TO DIGITAL MAPPING OF PROTECTED AREAS

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ABSTRACT

In recent years the collection, management, analysis, modeling and visualization of spatial data (geodata) using databases, geographic information systems, image processing systems, etc., has become a very important field of research and practice. The EU has set itself an ambitious target of halting the loss of biodiversity in Europe by 2020. At the heart of its efforts is the establishment of an EU-wide network of protected areas spanning all over 28 EU countries. Natura 2000 lies at the very core of Europe's Green Infrastructure. It not only acts as an important reservoir for biodiversity and healthy ecosystems, which can be drawn upon to revitalize degraded environments across the broader landscape but also delivers many ecosystem services to society. In this paper, we dealt with the digitization and mapping of the protected areas in a prefecture of Greece, using GPS and computer programs after the digitization of analogue maps. This was done by input the data collected by GPS, in the program AutoCADMap, and export them in shape form. Then was processed with the program ArcGIS and the drawn out digitally the protected areas. Integrated G.I.S software enabling the establishing of nationwide geodatabase, including vector and raster data, digital elevation models and attributes attached to the geometric features. AutoCAD Map software, ArcGIS and Google Earth contain all necessary tools to perform the above-mentioned tasks: built-in thematic mapper, map editor, analyzing tools, digital image processor, digital surface modeler, relation database manager and report writer. There is a strong relationship between Green Infrastructure and protected areas (Natura 2000) as they provide a strategic focus for improving our natural environment and enhancing the quality of our lives with the offer of practical examples of how can be used in a way that provides multiple socio-economic benefits to people as well as to nature.

Keywords: AutoCAD, Data, Digitization, Geographic Information Systems (GIS), G.P.S.

1. INTRODUCTION

The first protected area was established as the Yellowstone national park in 1872. Since 1937 in our country, areas of high ecological interest have begun to be recognized and protected. It is therefore understood that our country has huge natural wealth and is one of the first in Europe in this field. . The designation and expansion of protected areas has also brought associated social and ecological costs. Unfortunately, the environment in Greece is facing multiple risks of degradation, even disasters.

The approach that has been put into practice in the first stages of the protected areas establishment was the absolute protection of natural areas and the elimination of human activities. In the industrializing countries, governments began to set aside areas of particular scenic beauty or uniqueness exclusively for conservation. But the creation of most of these protected areas involved the exclusion of local people [1]. The leading conservationists were foresters from the Imperial Institute of Forestry at Oxford (UK). Their management philosophy emphasized that "the public good was best served through the protection of forests and water resources, even if this meant the displacement of local communities" [2]. Along the way, this approach was

abandoned and gave way to the concept of the integration of the protected area into the surrounding area and the close connection of protection to the sustainable use of natural resources.

In recent years the collection, management, analysis, modeling and visualization of spatial data (geodata) using databases, geographic information systems, image processing systems, etc., has become a very important field of research and practice [3].

The EU has set itself an ambitious target of halting the loss of biodiversity in Europe by 2020. At the heart of its efforts is the establishment of an EU-wide network of protected areas spanning all over 28 EU countries. Natura 2000 lies at the very core of Europe's Green Infrastructure. It not only acts as an important reservoir for biodiversity and healthy ecosystems, which can be drawn upon to revitalize degraded environments across the broader landscape but also delivers many ecosystem services to society.

The purpose of the paper is to create digital maps by digitize the Protected Areas of P. Rodopi using modern tools and methods (GPS, AutoCAD programs, GIS) based on existing analogue maps used by the forestry service to date. This will enable these areas to be accessed quickly and accurately, and precisely, which will be imprinted on digital mapping backgrounds and there will be a wealth of information on each.

2. MATERIAL AND METHODS

In the prefecture of Rodopi, there are a few scientific identified, protected areas, which are classified in different categories such as: National Park, Areas of nature protection, Wetlands and European Ecological Net Natura 2000. The georeferenced maps 1:50.000 of Hellenic Military Geographical Service (HMGS) (Raster) in the projected system Hellenic Geographical Reference System 87 (HGRS '87) input in Autodesk Map Software with the help of Autodesk Raster Design Software. The commands "Rubbersheet" and "Triangular" used for hitching each map. Most of the protected areas were digitized from analogue maps with the help of ArcMap's Arc Editor and the Autodesk Map program. The total area of each region in km² was calculated in each of the above two software. Conversion from DXF data to GPX format. The remaining protected areas were captured using geodetical GPS Viva of Leica. The GPX files created with G.P.S. were later input in the ArcMap file. The shape files of ArcGIS are converted and transformed into KML. files, which can be input in Google Earth. All the maps have been created in ArcMap software of the ArcGIS platform and particularly in .mxd file of the above software. The grid defined in this project shall be used as a geo-referencing framework where grids with fixed and unambiguously defined locations of equal-area grid cells are required.

3. RESULTS

Through the AutoCAD and ArcGIS programs, we have been able to produce the final digital maps, which concern the protected areas in the prefecture of Rodopi. In figure 1 is shown the map of protected areas in Rodopi Prefecture. In figure 2 is shown the KML file of Wildlife Refuges in Rodopi Prefecture.

4. CONCLUSION AND DISCUSSION

Integrated G.I.S software enabling the establishing of nationwide geodatabase, including vector and raster data, digital elevation models and attributes attached to the geometric features. AutoCAD Map software, ArcGIS and Google Earth contain all necessary tools to perform the above-mentioned tasks: built-in thematic mapper, map editor, analyzing tools, digital image processor, digital surface modeler, relation database manager and report writer.

The rapid development of technology and the increasing use of digital spatial data bases multiplied portability and exchange of information between users. These data are now addressed in several extended circle of potential users who in order to assess whether and how the available data meet their needs require longer recording quality of the information provided. From the perspective of the producer of information essentially "required" to perform record and publish the results of a number of checks and other important issues related to information in order to enable the potential user to evaluate and assess the suitability use.

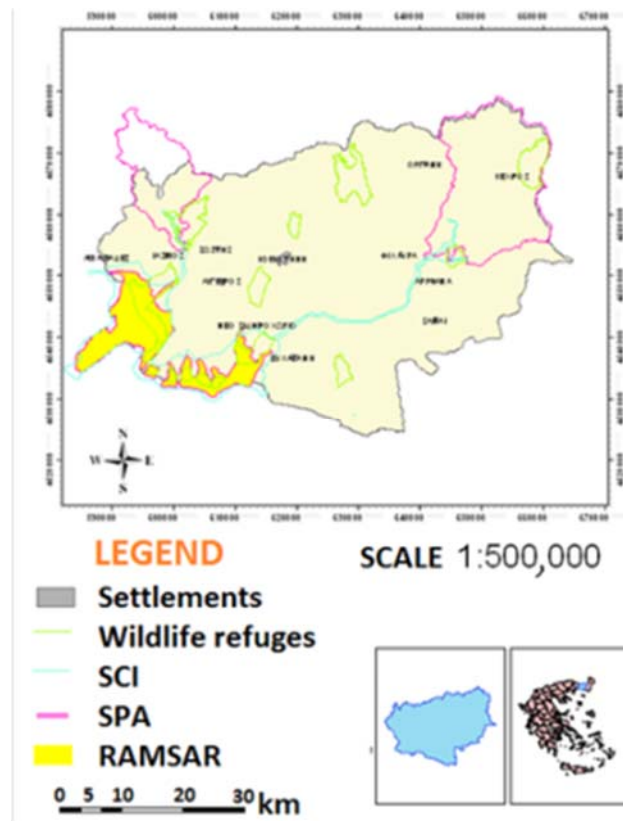


Figure 1. Map of protected areas in Rodopi Prefecture.

There is a strong relationship between Green Infrastructure and protected areas (Natura 2000) as they provide a strategic focus for improving our natural environment and enhancing the quality of our lives with the offer of practical examples of how can be used in a way that provides multiple socio-economic benefits to people as well as to nature.

The above statement is proved by the advantages that are obvious from the creation in every prefecture of a Completed Geographical Information System (G.I.S), for the whole prefecture, the following:

- The creation of necessary foundation, for the seamless and digital record of all the spatial data that use the prefecture's services and especially the forest services,
- The automation of update and transfer proceedings of any files between services – sections,
- The possibility of instant search, view and management of any spatial data for any spot or location of the prefecture,
- The disposal and the use of this information of all the services, which are likely needed (i.e. spatial design, design of foundation projects, etc.) or other purposes (creation of thematic maps, acts of administration etc.)
- The substantial optimization of the provided services towards the citizens and
- The efficient protection and management of natural, terrestrial ecosystems of the prefecture.

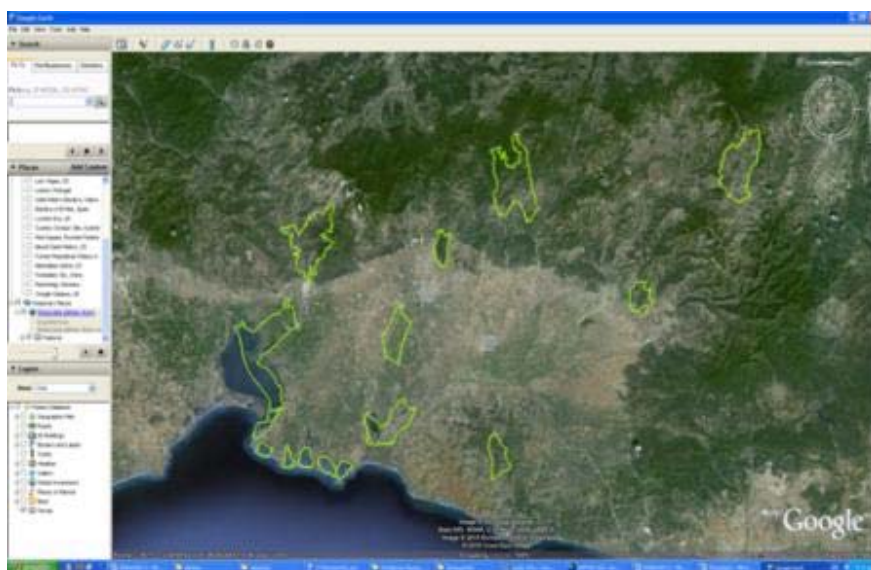


Figure 2. KML file of Wildlife Refuges in Rodopi Prefecture.

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BUILDING AN INTEGRATED FLOOD FORECASTING WARNING SYSTEM IN KILKIS-NORTHERN GREECE

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ABSTRACT

The project aims at optimally protecting the area of Kilkis from flood events, based on the use of meteorological and hydrological stations, in combination with satellite observations and numerical weather prediction forecasts. All information will feed the Integrated Flood Forecasting Warning System and will be made available on a digital platform (accessible from personal computers, tablets and mobile phones). The project will be carried out by the Institute of Environmental Research and Sustainable Development of the National Observatory of Athens (NOA, in close collaboration with the Kilkis Municipal Water Supply and Sewage Company. (DEYAK)

Keywords: Flood forecasting, observational network, early warning system.

1. INTRODUCTION

The project ultimate goal is to protect the area of Kilkis from flood events, based on the use of meteorological and hydrological stations, in combination with satellite observations and numerical weather prediction forecasts. For that purpose, two distinct phases of the project are foreseen:

- a) Extending the existing network of surface weather observations in the area [1], by installing a set of 15 new weather stations in Kilkis Prefecture, together with the installation of two level meters in Gallikos River.
- b) Developing the necessary tools for the observation of severe/adverse weather events, based on satellite observations, lightning measurements by ZEUS lightning detection system [2] as well as outputs from high-resolution numerical weather prediction models

All information will feed the Integrated Flood Forecasting Warning System and will be made available on a digital platform (accessible from computers, tablets and mobile phones), for use by the relevant authorities as well as the general public.

2. OBSERVATIONAL PLATFORM (IN SITU)

To better capture the meteorological conditions of the area, it is necessary to supplement the existing network of surface weather stations operating in the area (e.g. National Observatory of Athens, <http://www.meteo.gr/gmap.cfm>) with additional meteorological stations. Specifically, it is proposed to install 15 new stations in selected places across the Kilkis Prefecture, in close collaboration with the local authorities (Figure 1). At the same time, for the monitoring of the river level, it is foreseen to install two level meters at two locations to be selected along Gallikos River.



Figure 1. Map of proposed new meteorological stations (green dots) and level meters in Gallikos River (blue dots). The orange dots indicate the positions of the existing stations of the National Observatory of Athens.

3. REMOTE SENSING OBSERVATIONS AND HIGH-RESOLUTION WEATHER FORECASTS

The National Observatory of Athens (NOA) will design and develop the Integrated Flood Forecasting Warning System that will collect all the information provided by both existing stations operated by NOA and all measurements that will be collected from the in-situ observing network that will be implemented in the frame of the project.

NOA will provide in the context of the second phase of the project:

- Selection and installation services of stations / level meters and cameras, as well as integration of stations into the NOA database
- Day-to-day monitoring of the prompt operation of the in-situ observations in Kilikis area.
- Operational high-resolution weather forecasts,
- Satellite data provision (including snow cover maps) and lightning activity from the NOA's ZEUS lightning detection network.
- Design and implementation of the Integrated Flood Forecasting Warning System, with all information visualized on an online platform as well as implementation of a mobile application for use by citizens/general public.

Figure 2 shows schematically the Integrated Flood Forecasting Warning System.

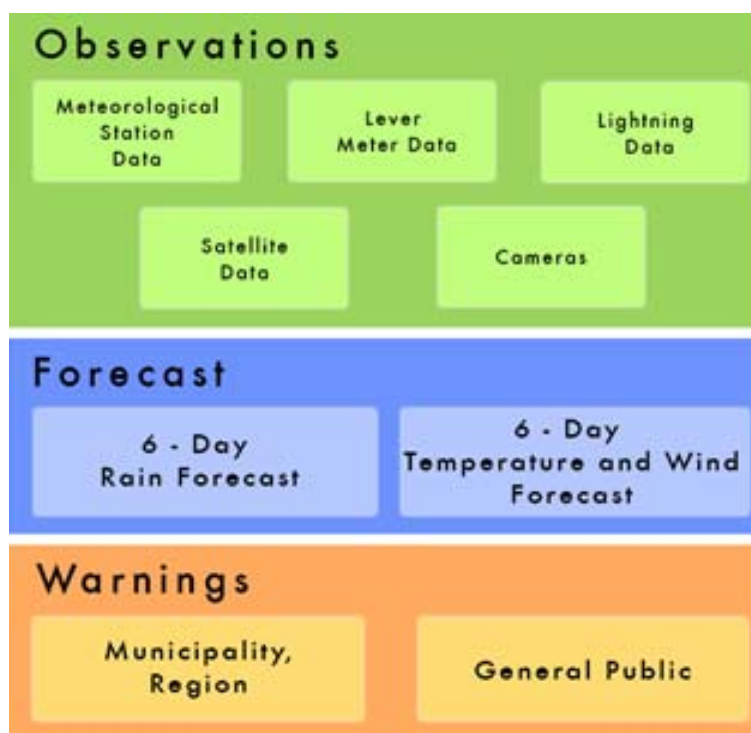


Figure 2. Schematic representation of the Integrated Flood Forecasting Warning System

4. CONCLUDING REMARKS

The realization of the Integrated Flood Forecasting Warning System in Kilis Prefecture will be the first attempt in Greece to build and operate a fully integrated system for the prompt warning of local authorities and local population about an incoming adverse weather event. Apart from its obvious use for flood monitoring, forecasting and early warning, the measurements gathered by the System will also be beneficial for other purposes such as agricultural, recreational/touristic activities, etc.

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IRIS: A RAPID RESPONSE FIRE SPREAD FORECASTING SYSTEM FOR GREECE

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ABSTRACT

The paper summarizes the development and application of a rapid response fire spread forecasting system for Greece. Named IRIS, under a messenger goddess in Greek mythology, the forecasting system was primarily developed to support the operational fire suppression activities of the Greek Fire Service. It employs a coupled atmosphere-fire modeling system, comprised of a state-of-the-art numerical weather prediction model and an advanced fire spread model. For the implementation of IRIS, a prototype geospatial dataset for the representation of fuels was constructed, using ultra-high-resolution open-source datasets provided by the Copernicus Land Monitoring Service. The forecasting system was calibrated and tested over 12 wildfires in total; 8 wildfires were used for the calibration of IRIS and 4 were used for independent testing of the calibrated system. Our overarching goal was to assess the capacity of IRIS in terms of providing accurate real-time wildfire spread forecasts. Results clearly highlight that reasonably accurate fire spread predictions can be obtained by proper calibration of the fire spread component. IRIS was operationally deployed in Greece during the 2019 fire season, providing 6 h and 24 h wildfire spread forecasts for 14 events (up to September 13 2019). To our best knowledge, IRIS is one of the few operational fire spread forecasting systems based on coupled atmosphere-fire modeling, operationally deployed on the EU level.

Keywords: fire spread, rapid response, operational forecast, WRF-SFIRE, coupled fire-atmosphere, IRIS.

1. INTRODUCTION

This work summarizes the development of a rapid response fire spread forecasting system for Greece. Named IRIS, under a messenger goddess in Greek mythology, the forecasting system is built around WRF-SFIRE, a coupled fire-atmosphere modelling system [1] that has been increasingly employed in recent years [2, 3, 4, 5, 6]. IRIS was primarily designed and developed with the aim to provide operational support to the fire suppression activities of the Greek Fire Service. Considering this, WRF-SFIRE was properly adapted to the Mediterranean environment of Greece. A prototype geospatial database of fuel models was first constructed, exploiting open-source databases of the Copernicus Land Monitoring Service. The modelling system was consequently implemented for several past wildfires in order to calibrate the fire spread algorithm, and tested during the 2018 fire season in order to evaluate its performance. Results indicate that WRF-SFIRE has considerable capacity with respect to predicting fire spread, thus establishing itself as a numerical tool of high applicability potential. To our best knowledge, IRIS is the first coupled modelling system implemented in the European Union (EU) for operationally forecasting fire spread and one of the few such systems implemented worldwide [7, 8]. Its entire design and calibration methodology followed are highly replicable, maximizing the robustness and porting potential of the forecasting system outside of the target area for which it was originally developed and tested.

It should be noted that the present work aims at providing an overview summary of IRIS. For the detailed description of the forecasting system, its calibration and testing, the interested reader should refer to the recently published paper of [9].

2. STUDY AREA, SELECTED WILDFIRES AND DATA

The target area of IRIS is Greece. For the development of the system, 8 wildfires that took place in 2016-2017 in Greece were first selected in order to calibrate the fire spread algorithm. The calibrated algorithm was then tested in 4 major wildfires of the 2018 fire season. For all events, fire duration does not include the time spent for mop up operations, considering only the time between fire ignition and the end of active fire suppression activities. Fire perimeter data, used for the validation of IRIS, were retrieved from the Copernicus Emergency Mapping Service (<https://emergency.copernicus.eu/mapping/>) and the National Observatory of Forest Fires of Greece (<http://epadap.web.auth.gr/?lang=en>).

3. DESCRIPTION OF IRIS

IRIS is built around the WRF-SFIRE coupled fire-atmosphere modeling system. Two different types of data are employed for driving WRF-SFIRE, related to the meteorology and the wildfire. The meteorological data include the mesoscale analysis and forecast data, and the high-resolution terrestrial data (e.g. topography, land use) that are used for initializing and driving the meteorological component of WRF-SFIRE (i.e. WRF). The wildfire data encompass the ultra-high-resolution fuel and topography data, and data regarding the location and time of fire ignition, which are used for driving the fire spread component of WRF-SFIRE (i.e. SFIRE). In terms of output, this includes a forecast for (a) weather-related fields (e.g. temperature, humidity, wind) at high-resolution, and (b) wildfire-related fields (e.g. rate of spread, fire line intensity, fire heat flux) at ultra-high-resolution.

Within the context of IRIS, 15 standard and custom fuel models were selected. The mapping of the selected fuel models was carried out using geospatial datasets provided by the Copernicus Land Monitoring Service (CLMS; <https://land.copernicus.eu>). In particular, the employed datasets include the high-resolution (100 m) layers for forests (<https://land.copernicus.eu/pan-european/high-resolution-layers/forests>) and grasslands (<https://land.copernicus.eu/pan-european/high-resolution-layers/grassland>), and CORINE land cover (<https://land.copernicus.eu/pan-european/corine-land-cover>). The forests geospatial dataset was used for defining fuel models related to the different forest types, while the grasslands dataset was used for defining the fuel model for Mediterranean grasslands. The remaining fuel models were defined by means of remapping from CORINE land cover.

A simple web application was developed for managing the on-demand operational deployment of IRIS. Access to this application is restricted to the officers of the Greek Fire Service, who can trigger the implementation of IRIS by clicking on a map to enter the coordinates and time of fire ignition.

4. RESULTS

Table 1 summarizes the statistical analysis of the fire spread simulations of WF1-WF8, which were used for the calibration of the IRIS. All simulations reproduced the spatial extent of the burnt areas better than random chance ($p < 0.05$). In almost all cases, the calibration of IRIS yielded improved accuracy with respect to fire spread simulation. In particular, the calibrated simulations resulted in statistically significant ($p < 0.01$) improvements in terms of both KC and SC. The largest improvements ($>90\%$ for KC and $>70\%$ for SC) were found for the three wildfires that originally showed the worst performance, namely WF4, WF5 and WF8. Overall, the calibration of IRIS allowed for reducing the model's tendency to overestimate burnt areas. As shown in Table 1, OI exceeded 0.90 in 5 of 8 cases when fire spread was simulated with the uncalibrated model. Using the calibrated model, OI was reduced and did not exceed 0.70 in 6 of 8 cases, showing negative values (burnt area underestimation) in two cases (WF1, WF7).

Table 1. Statistical evaluation (KC: Kappa coefficient; SC: Sorensen coefficient; OI: Overestimation index; BAA: burnt area agreement in ha; BAO: Burnt area overestimation in ha; BAU: Burnt area underestimation in ha) of the fire spread forecasts for WF1-WF8 before and after the calibration of WRF-SFIRE. Values of followed by * and ** indicate statistically significant accuracy (Z-test) at $p < 0.05$ and $p < 0.01$, respectively. Values of KC followed by ++ indicate statistically significant differences between calibrated and uncalibrated model simulations at $p < 0.01$.

ID	Uncalibrated						Calibrated					
	KC	SC	OI	BAA	BAO	BAU	KC	SC	OI	BAA	BAO	BAU
WF1	0.65**	0.69	0.85	4099	3462	208	0.70***	0.75	-0.45	2888	540	1419
WF2	0.47*	0.54	0.84	2203	3527	297	0.67**	0.72	0.58	2157	1294	343
WF3	0.52*	0.61	0.90	441	543	29	0.65**	0.70	0.56	396	266	74
WF4	0.17**	0.21	0.95	2394	17589	486	0.51***	0.58	0.62	2263	2612	617
WF5	0.28*	0.33	0.94	1317	5241	162	0.56**	0.60	0.66	1205	1328	274
WF6	0.39*	0.46	0.98	582	1359	12	0.48**	0.53	0.78	496	781	98
WF7	0.56*	0.60	0.54	1342	1404	414	0.62**	0.65	-0.62	943	188	812
WF8	0.24*	0.27	0.99	242	1307	7	0.49**	0.54	0.71	199	290	50

Table 2. Same as Table 1 but for wildfires WF9-WF12, using the calibrated IRIS.

Wildfire	KC	SC	OI	BAA ¹	BAO ²	BAU ³
WF9	0.60**	0.65	0.64	4664	4129	907
WF10	0.72*	0.77	0.23	1087	402	250
WF11	0.52*	0.56	0.87	519	776	56
WF12	0.53*	0.57	0.78	560	764	93

Table 2 summarizes the statistical analysis of the fire spread simulations of WF9-WF12, which were used for the testing of the calibrated IRIS. Results indicate that the model reproduced the spatial extent of burnt areas better than random chance ($p < 0.01$ for WF9 and $p < 0.05$ for WF10-WF12) in all simulations (Table 7). Clearly, the two largest wildfires of 2018 fire season, WF9 and WF10, were simulated better than the smaller ones, WF11 and WF12. In particular, the computed KC and SC values indicate substantial agreement between the actual and simulated final fire perimeters for WF9 and WF10, and moderate agreement for WF11 and WF12. Overall, however, the statistical analysis of the fire spread simulations for WF9-WF12 seems to confirm the robustness of the calibrated modeling system.

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A LOW-COST MULTI-PLATFORM SYSTEM FOR EARLY WARNING OF EXTREME HYDROMETEOROLOGICAL EVENTS

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ABSTRACT

Extreme weather events, such as severe precipitation, windstorms and heatwaves threaten lives and property, inducing hazards such as coastal floods, large-scale river floods, flash floods and fires, often leading to cascading effects and causing extensive damage and disruption. The intensification of weather extremes in future climate projections combined with the increase of people living in hazardous areas will increase the impacts of extreme weather events. To increase the resilience of societies, improved crisis management related to extreme weather events is needed. In this respect, hydro-meteorological hazards, like convective outbreaks affecting the Ionian-Adriatic areas mainly due to scirocco and easterly propagating fronts, leading to torrential winds, rain and flooding, represent a dramatic threat which needs to be faced by improving forecasts and timely warnings of such hazards in order to protect lives and properties. The main difficulty to disseminate prompt information about hydro-meteorological severe events to the end-users, is to set up near-real time monitoring integrated system, able to ingest precipitation data from distributed sensors and models and to perform forecasting of the evolving hydro-meteorological scenario. To this aspect, under the Interreg IPA-II Greece-Albania call "i-ALARM" project propose the development of an operational tool and the assessment of a unique state-of-the-art early warning system (EWS) organized according to type of natural hazards, based on a hydro-meteorological observation and modelling system. The advanced tool based on low-power/low-cost mobile x-band polarimetric weather radar, regional high reliable and robust characterization, prevention and danger of fire hazard, and coupled hydro-meteorological numerical modelling and observational data assimilation, tuned to the local territory.

Keywords: XPOL radar, i-ALARM; WRF-Hydro, LAPS, real-time, flash-flood/flood, early warning system

1. INTRODUCTION

Climate change especially in the last decade are accompanied by major hydro-meteorological and fire hazards, like wildland fires, intense convective storms, with global occurrence and in a more regional basis in the Adriatic and Ionian area. The increase of climate change variability in the region of Ionian and south-Adriatic Sea, has increased the frequency and precipitation magnitude of weather fronts propagating from west or south directions characterized by heavy rain with extreme winds, which sometimes lead to flooding

and tornados with catastrophic impacts including loss of lives particularly in coastal areas with complex terrain (UNEP, 2012). These areas are not fully monitored by weather radars which could improve significantly the forecasting ability of a numerical weather prediction (up to 5 days ahead) model and the nowcasting (short-term forecast of about 3 hrs ahead) of water discharge with a hydrological model in areas of high flood risk. The rainfall accumulation in this area is very high, and the frequency of floods and the tornados increases continuously as well as their intensity and the disasters that they cause. The concept behind Early Warning (EW) is that the earlier and more accurately we are able to predict short- and long term potential risks associated with natural and human induced hazards, the more likely we will be able to manage and mitigate a disaster's impact on society, economies, and environment.

2. METHODOLOGY

Monitoring and predicting is only one part of the early warning process. This step provides the input information for the early warning process that needs to be disseminated to those whose responsibility is to respond. Early warnings systems may be disseminated to targeted users (local early warning applications) or broadly to communities, regions or to media (regional or global early warning applications). When monitoring and predicting systems are associated with communication systems and response plans (Glantz 2003).

2.1. Aim of the i-ALARM project

The main aim of the proposed project is to assist local authorities in decision making and the general public to minimize the impact of extreme weather and fire events in inhabited and agricultural areas as well as to manage protected areas (UNESCO, NATURA). This will be achieved using accurate weather and fire danger forecast information provided by four high resolution numerical weather prediction (NWP) models and the supply of special technical fire protection and fighting resources. The NWPs will be based on stochastic forecasts in the form of ensemble forecasting instead of the conventional deterministic forecasts. The system will be deployed and tested in the bilateral region of NW Greece and S Albania. Enrichment of the border-crossing cooperation between Greece and Albania is a key element of the project on system deployment, training/education and data sharing. Moreover, the results will be immediately available to the local authorities and the public via a user friendly web page. The high-resolution precipitation observations are used to assimilate in the models (atmospheric and hydrological) to improve the forecasting. The forecast from atmospheric model (like WRF) can be used in hydrological models (like WRF-Hydro) to increase the time of reliable flood forecasting. The assimilation of the measurements will significantly improve the spatial and temporal accuracy of forecasting in the area of interest, which are crucial factors in a warning system of intense weather events.

2.1.1. The example of Mandra flash flood event on 15th of November 2017

In order to test the validity of our methodology the atmospheric and hydrological model output are tested simulating a high impact storm with extreme precipitation rates during the morning of the 15th of November 2017 around Mandra resulted in a flash flood that caused 24 fatalities and extensive damages. The simulation results demonstrate the potential benefit of using high-resolution observations from a X-band dual-polarization radar as an additional forcing component in model precipitation and hydrological simulations. The results of this study are analytically presented in the recent published manuscript of Varlas et al. (2019).

2.1.2. Radar data assimilation

NOAA's Local Analysis and Prediction System (LAPS) is a mesoscale assimilation system that combines diverse observations (in-situ measurements, remote sensing estimations and others) with background data to generate a spatially distributed, three-dimensional representation of atmospheric conditions. Latest developments expand LAPS nowcast capabilities by utilizing a flexible forward-in-time advection scheme (Figure 1). LAPS is applied in nowcasting mode for the case study of Mandra, assimilating XPOL radar data with regional surface and upper-air observations on gridded model data to produce objective analyses alongside with their nowcasts in a forecast window of 3 hours (Katsafados et al. 2019).

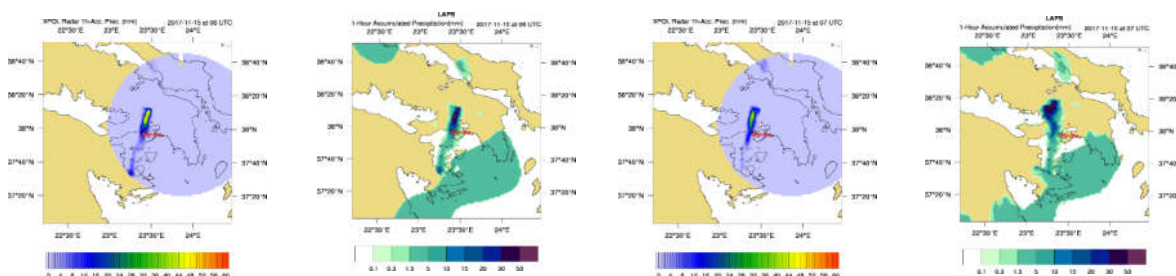


Figure 1. Nowcasting using the LAPS showing the evolution of the storm (in intensity and projection) at (b) 06 UTC compared to (a) the radar observation at the same time and (d) 07 UTC compared to (c) the radar observations again at the same time, during the 15 November flash flood event.

Figure 2, shows an application of assimilation of the radar data to state-of-the-art weather forecast models like WRF. The convection parameterization scheme of the model has been set to low level in order to show more clearly the effect of assimilation. The radar data has been assimilated as humidity mixing ratio in the model with its 4DVAR assimilation model (WRF-DA) for the period 00:00 to 02:30 UTC and then a short time forecast (nowcast) has been made for the time period 03:00 to 06:00 UTC. Without data assimilation there is even no rain in the area of Mandra, while with radar data assimilation the model is triggered by the radar data to produce significant rain in this area in the forecasting time period.

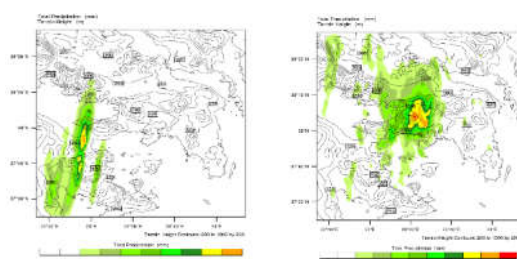


Figure 2. Short term forecasting (00:00 to 06:00UTC) with WRF (a) without and (b) with radar data assimilation for the flood event of Mandra 15/11/2017.

The range of available data can be extended to longer ranges than the maximum range of radar data using lightning detection data. A lightning detection network with high accuracy in Greece is under development from the National Observatory of Athens.

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THE IMPACT OF CLIMATE CHANGE ON PUBLIC HEALTH

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ABSTRACT

Climate change and its impact on human health have been at the heart of research and governments agenda for quite some time. Although local warming could partly have a positive impact, most of the impacts are considered negative. Not only exist the risk of increased air pollution and ozone pollution, the greater spread of pollen and therefore the more frequent occurrence of allergies and respiratory diseases, but also an increase in deaths due to heat waves, floods, drought, fires, decreased availability and cleanliness of drinking water, reduced food security and reduced availability of health services. High temperatures will also change the distribution and increase the overall burden for certain diseases that are transmitted through vectors, food and water.

The aim of this work is to critically study and present the impacts of climate change on public health and the presentation of trends and policies developed to mitigate these impacts.

Keywords: climate change, impact on human health, Infectious diseases, vectors, pollen, food safety, water and food related diseases, extreme weather events, mitigation, adaptation.

1. INTRODUCTION

Human activities have almost certainly begun to change the climate of the planet, mainly through the accumulation of greenhouse gas concentrations in the lower atmosphere. This reflects the escalation of the size and intensity of modern human entrepreneurship. During the 20th century, the size of the human population quadrupled and the average per person economic activity tripled. The overall demand for materials, energy and waste disposal now seems to be higher than the planet can afford - recent estimates show that we have been living beyond Earth's biological capacity for the last three decades. Globally, our ecological exceedance now stands at 30% above estimated sustainable natural limits - and the gap is widening. Climate change is currently on a clear continuous upward trend (with normal physics fluctuating year-on-year), and the average temperature on Earth's surface is now well above the threshold of natural temporal variation over the last thousand years. The nature of the ecological effects on human health must be understood. Without this knowledge, in turn, it is not possible to understand the changes that climate change will bring to people and communities of living organisms [1].

2. IMPACT OF CLIMATIC CONDITIONS ON HUMAN HEALTH AND WELL-BEING

Climate change operates at many levels and with a different relative impact on health. In general, it plays a multiplier role, usually enhancing or extending the existing health risks or problems of the population. Observations of the effects of climate change fluctuations on human health are now very important, in particular as regards heat exposure and cooling [2]. The effects of heat on health had already been a concern since the 19th century - particularly among European colonists, military personnel and other workers [3] - and the mechanistic physiological research has clarified the negative effects of excessive heat [2]. Thermal physiology, environmental ergonomics, biometeorology, and other disciplines continue to accumulate evidence of the impact of heat and cold on human health and labour productivity. Excessive daily exposure to heat causes stroke that can lead to deaths [4], heat exhaustion reduces work productivity [5] and heat stress interferes with daily household activities [6]. Other extreme weather events, such as thunderstorms

and droughts, create immediate risks of injuries and subsequent manifestations of infectious diseases, lack of nutrition and mental stress [7]. Any decrease in the ability to perform daily activities in relation to heat, cold or weather conditions should be considered as an 'impact on health' given the World Health Organization's definition of health ("Health is a complete condition of physical, mental and social well-being and not just the absence of illness or disability.") [8]. In addition, if the actions who are been taken to prevent the adverse effects of extreme weather conditions harm unintentionally health or well-being, this should also be considered as a 'health impact' related to climate.

The indirect effects of changes in climatic conditions are many and they varied. Changes in access to clean drinking water, especially in conditions of overcrowding and poverty, can cause diarrhea and other water-related diseases, including cholera. Other important examples are malnutrition and poor diet and degraded childhood development due to the decline in local agriculture [9], fluctuations in the levels and range of various diseases transmitted through vectors and other infectious diseases and [10] the tensions caused by the forced migration from affected homes and workplaces [11]. Of course, a variety of other factors affect these health problems and can have a far greater impact than climate change. Examples of systemic impacts include food crises (sometimes causing hunger and starvation//famine), water access conflicts / wars, and serious adverse economic impacts due to reduced human and environmental productivity [12].

3. CLIMATE CHANGE AND PUBLIC HEALTH

Climate change strategies are usually framed by two broad approaches: mitigation, which includes efforts to mitigate climate change itself, while adaptation includes actions to manage the effects of climate change, which are unavoidable despite mitigation efforts. Climate change mitigation is a critical task for the world. However, while governments continue to struggle with this unprecedented, complex political and ethical task, the most immediate challenge for the health sector is to identify the key regional health threats posed by climate change and ensure that strategies are developed.

A favourable aspect of efforts to mitigate climate change is that local health benefits will emerge rapidly in populations undertaking such efforts [13]. The health benefits will derive from mitigation measures addressing transportation and transport patterns, housing design standards, energy production, and agricultural systems (including livestock production). In many poorer populations, improvements in environmental technologies will help to replace the polluting fuels used in cooking with low carbon fuels, while improving information on reproductive health will lead to better nutrition and better health, with both types of improvements reducing stress on the climate system [14]. All of these actions will immediately reduce known risk factors for disease and premature death (e.g. air pollution, sedentary life, and dietary excesses). Innovative urban planning can have a wide range of positive effects on energy use, greenhouse gas emissions, urban thermal island impacts, patterns of physical activity, social relationships, and community cohesion [13].

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SHAKEMAPS USING A DENSE STRONG GROUND MOTION NETWORK IN AN URBAN ENVIRONMENT

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ABSTRACT

The immediately fast decisions-actions after the large events should be carried out with the information provided by shakemaps. In the framework of the post-earthquake countersteps and to provide more knowledge-information to citizens the Hellenic Seismological Network of Crete (HSNC) started operating as a study case a permanent strong ground motion (SGM) network in the urban environment of Chania and its southern basin. The initial motivation of this project was to monitor the ground shaking in a complex urban geological environment where the city's infrastructures exist, with some of them considered as of high economic interest, along with the existence of important cultural heritage monuments. The SGM network is mainly relay on the robust REF TEK 130 SM 24bit triaxial accelerometers but there are some 16bit low-cost Satways' GSense that have been deployed for supplementary information. In the first stage of our research, to investigate the seismic amplification and to provide supplementary information for the local site conditions, spectral ratio H/V measurements have been carried out. The available peak ground acceleration values are integrated in a GIS environment in order to provide detailed shakemaps. In the map generation procedure, different interpolation techniques have been tested with past event data and the adopted one takes the local site geological parameters into account.

Keywords: Strong Ground Motion network, Peak Ground Acceleration, shakemaps.

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1. INTRODUCTION

The last couple decades there is an increasing trend to invest in Earthquake Early Warning System. The basic concept of these systems is to create an alert before the strong shock for the public and the industries aiming to have a response time which is usually than less one minute [1]. Regardless the successfulness of the EEWS the immediately fast decisions-actions after the large events should be carried out with the information provided by shakemaps. These kind of map displays the distribution of ground acceleration within few minutes after an earthquake so the civil protection and emergency services may be deployed to those locations [2]. The idea is to provide a quick look at the affected area, examined which locations has potentially affected with severe damage and start the post earthquake recovery processes. This method could rapidly inform a wide audience about the possible effects caused by the large earthquake. Having a dense Strong Ground Motion (SGM) network helps to have an enhanced detail shakemap which will provide a clear view of the affected area. Having shakemaps with one or two instruments and relay on a generic ground-motion attenuation

relationship for a wide city could give a misleading picture. The dense SGM network that operates in Chania city produce high resolution Peak Ground Acceleration maps and the good results of this case study could inspire other municipalities to consolidate the monitoring of their infrastructures.

2. OBJECTIVE

The geology of Crete, as described by [3,4,5] is characterized by continuous nappe units produced by different stress fields that acted since upper Oligocene-Miocene. There are extensive tectonic nappes placed on the Plattenkalk limestone of the Talea Ori unit which are considered as the lowest units of Crete. More specific, in the Chania region the bedrock formations are the Plattenkalk and the Tripalio limestones and marbles. The extensional forces on Neogene formed the Chania basin which is covered with Neogene sediments and loose Quaternary alluvial deposits. On the figure 1(a) the Quaternary deposits are denoted with white and pink color; the beige and orange ones are the Neogene sediments while the others are Pre-Neogene formations. The Chania basin is filled with an extensive mass of alluvial loose sediments with an estimated maximum thickness about 150 meters on the western part of the Quaternary deposits [6].

The dense SGM network idea was to install the strong ground motion instruments on the different geological formations in the Chania basin as well as the crucial part of old town (figure 1b). The utilized sensors in the research area are set to record in continuous mode with sampling rate at 250Hz. The SGM network is equipped with the REF TEK 130 SM (<https://www.reftek.com>). The triaxial sensor is equipped which is a low-noise force-feedback model works on full scale in range $\pm 3.5g$ with $\pm 10V$ full scale voltage. The data are transferred with the RTPD's error correction protocol to the dedicated server. In the SGM network there are few supplementary accelerometers are the Gsense from the Satways Ltd. (<http://www.satways.net>). They are low cost 16bit tri-axial accelerometer that works on full scale range $\pm 2g$ with typical 3.3V. The connection with the data collection servers is achieved with the Seiscomp3 seedlink service (<https://www.seiscomp3.org>) while there is the OpenVPN option for networks with dynamic IP settings (<https://openvpn.net/>).

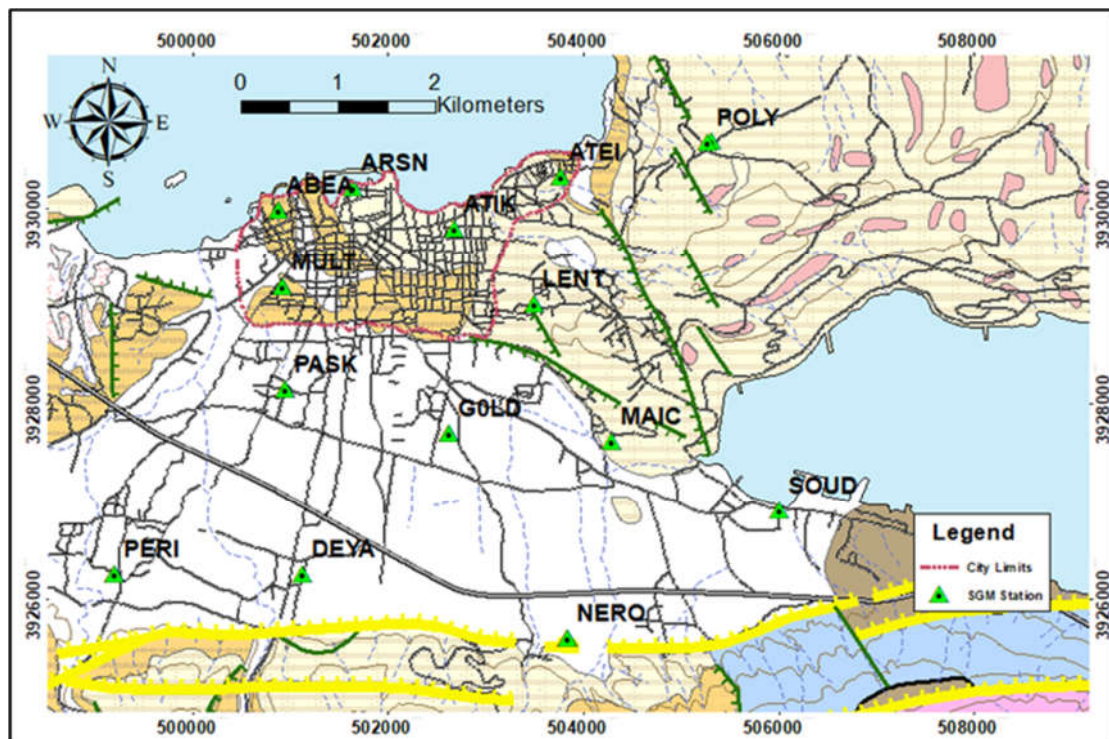


Figure 1. (a) The geological formation of Chania city and the SGM station locations in the different geological formation. The geology map is obtained by [5] work.

3. EXPERIMENTAL METHOD

To present the recorded peak ground acceleration values, PGA distribution maps were created in ArcGIS environment. Some of the popular interpolation techniques that have been tried are the Spline, the Inverse Distance Weight, the Natural Neighbor and the Kriging. Choosing the appropriate interpolation technique is an important job that is much depended on the dataset. The adopted method to create the shakemaps are the Ordinary co- Kriging. The Ordinary Kriging uses a linear combination of weighted measured values aiming to estimate the missing value at a point where no data are available [7]. The Ordinary Co-kriging is much alike the Ordinary Kriging, except that it incorporates additional covariates and the correlations among different variables. The use of the Co-kriging interpolators could be effective for datasets with significant intervariable correlations [8]. To give a trend to the interpolation based on the local site conditions, the well-known single station Horizontal versus Vertical Spectral Ratio (HVSr) of ambient noise [9] has been used to perform measurements at the locations of the strong ground motion network stations. The collected microtremor data have been processed with the Geopsy (<http://geopsy.org>) software. The results of the HVSr survey are illustrated in table 1.

Table 1. The predominant frequency and amplitude peaks for the SGM station locations.

Station	f_0	A_0	Station	f_0	A_0
ABEA	0.46	2.44	MAIC	0.35	2.10
ARSN	0.34	2.50	MULT	0.36	2.27
ATEI	0.4	2.27	NERO	0.63	1.99
ATIK	0.4	2.49	PASK	0.33	3.00
DEYA	0.44	2.72	PERI	0.46	3.51
GOLD	0.42	4.08	POLY	0.55	2.50
LENT	0.4	2.44	SOUD	0.36	2.26

The predominant frequency and amplitude f_0 , A_0 obtained from the HVSr measurements, have been used as variables to give a trend in Ordinary co- Kriging. The recorded PGA values along with f_0 and A_0 variables are fitted in empirical semivariograms to examine the statistical correlation of the PGA values versus the distance between all location pairs. Different semivariogram model equations (stable, spherical, tetraspherical, exponential to name a few) are used, aiming to find the optimal fitting between observed and empirical values [10]. The results are checked with a cross-validation analysis which can compare the results between different prediction methods.

4. RESULTS

To demonstrate the operation of the SGM network, we present the interpolation case from the event that took place in 2019/07/31 04:40 UTC with noticeable different results (figure 2a) obtained with the use of f_0 and A_0 variables in Ordinary co- Kriging. The Ordinary co- Kriging method influenced by the geological parameters improves the interpolation results.

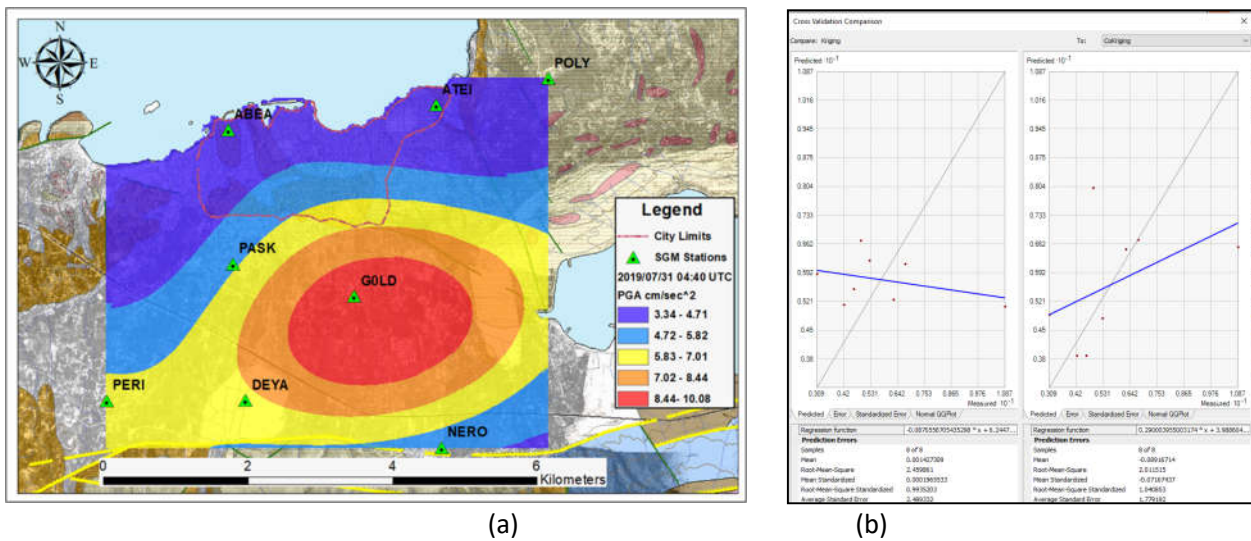


Figure 2. (a) The ML=5.3 event took place in 31/07/2019 shakemap; (b) The cross-validation analysis between the Ordinary co-Kriging and the Ordinary Kriging.

On the cross-validation analysis (figure 2b), the slope of the regression function between predicted and measured data presents higher values for the Ordinary co-Kriging rather than other interpolators such as the Ordinary Kriging. The additional variables in model explain better the ground acceleration distribution. At the same time all or most of the prediction errors such as the RMS, mean standardized and average standard error are presenting a noticeable decrease, while the root mean square standardized is close to 1 as it should be.

5. CONCLUSION

Aiming to perform a detailed monitoring of the ground shaking in a basin which is covered with weak and medium in term of stiffness materials, the SGM accelerometers have been installed in the different geological formation of the research area. In the shakemaps the estimation of the PGA values in location between the installed sensors has been achieved with the use of interpolation techniques. The ground related parameters f_0 and A_0 that reflect the geological attributes of area have been used to improve the interpolation method. The high-resolution PGA maps and the good results produced by the SGM network shows that the dense networks provide better shakemaps with detailed information that could be an important asset for civil protection agencies after a strong event.

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USING HISTORICAL RECORDS AND GEOGRAPHICAL INFORMATION SYSTEMS (GIS) TO IDENTIFY AREAS OF HIGH FLOOD RISK IN ATTICA, GREECE.

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ABSTRACT

Floods are natural phenomena but anthropogenic activities have accelerated their frequency, magnitude and impacts. This is particularly true for Greece that due its topography and climate conditions have many torrents that experience flash flood events. In this study historical records and Geographic Information Systems (GIS) were used to identify the areas that have experienced most floods in the past. The study area was the Prefecture of Attica of Greece that includes Athens and its population has exponentially increase in the last decades. This increase in population has led to unorganized development of roads, housing etc. In many cases, roads and house have developed in and adjacent to torrents. The first step of this study was to gather and analyze water pumping event data conducted by the Fire Brigade from 2012-2018 due to flooding in houses and stores in the different municipalities of Attica. Then based on these data, maps within GIS were developed. In Attica there is a total of 61 municipalities and these were categorized based on the number of pumping events as: a) high flooding risk, b) Medium flooding risk and c) low flooding risk. Sixteen municipalities had high flooding risk, 18 medium and the rest low. Overall, it was clear that some municipalities were more prone to flooding. This simple way of presenting the historical data in the form of maps can be utilized as a tool for the Fire Brigade and Civil Protection during rainfall events.

Keywords: new technologies, potential flood risk, water pumping, historical records, flood risk maps

1. INTRODUCTION

Floods are natural phenomena that are part of many ecosystem processes and can be vital for their conservation (e.g. regenerative mechanism for riparian areas) [1]. Many anthropogenic activities such as the increase in the world's population, changes in land-use, urbanization, river regulation have accelerated their frequency, magnitude and impacts [2, 3]. Many efforts are made worldwide to minimize their negative since they are considered as one of the most frequent and dangerous natural disasters [4]. With proper management plans floodwaters could actually be utilized especially in water scarce regions [5].

There are many different types of floods depending on the area they happen, the water velocity and quantity or the reasons that cause them [6, 7]. Of major interest are flash floods that are a direct response to rainfall with a very high intensity or sudden massive snow melting and are characterized by their episodic nature high velocities and the many damages they cause [8, 9].

The Mediterranean is especially prone to flash floods because of its rough orography near its coastline, the hypsometric variation from mountain peak to the coastline and the frequent intense rainfall events [10]. These conditions are also the reason that most running water bodies are "torrents" and wadis; ephemeral and intermittent streams with an episodic hydrologic regime that experience frequent flash floods [11]. Finally, climate change impacts of the region will affect the frequency and magnitude of flood events. With

more intense rainfall events expected [12] and more frequent wildfires [13] flash flood potential will increase in the Mediterranean.

The objective of this study was to evaluate the potential risk that different municipalities in the Prefecture of Attica have in regard to flooding events. To meet the objective, past historical events along with new technologies were utilized to develop these maps. Developing such maps is a requirement of the European Union Flood Directive 2007/60/EC for all partner countries.

2. METHODS

2.1. Study Area

Greece due its mountainous topography and Mediterranean climate conditions have many torrents that experience frequent flash flood events [11, 14]. In addition, many cities have been built along and in torrents. During flash floods, water flows, especially in urban environments, have very high speeds and can cause very catastrophic damages and even lead to loss of lives. A recent example is the flash flood of Mandra, outside of Athens, where 24 lives lost [15].

This study focused on Attica Region that includes the entire metropolitan area of Athens. Athens is Greece's capital and largest city. The total population is 3,828,434 people but in addition it also has a very high population density with 1,000 people per squared kilometer. The exponential increase in the population after the seventies led to the alternation of natural land-uses to urban impermeable areas, unorganized urban developments that include roads, house and other infrastructure, and along with the frequent wildfires that occur in its surrounding mountains is an area of major concern for flash floods [16].

2.2. Analysis of Historical Records and Development of Maps

The first step of this study was to gather the data from water pumping events conducted by the Fire Brigade from 2012-2018. Specifically, an official request was made to Fire Brigade Service regarding water pumping events. The additional information requested on the event were: a) location, b) number of pumping events, c) number of assistances provide, d) number of injured and e) number of deaths. The second step was to identify and analyze the pumping events caused by rainfall events in each municipality. These were the vents that we were interested in. Once the pumping events due to rainfall events were identified, with use of Geographic Information Systems (GIS) maps were developed based on the number of events that occurred in each municipality.

RESULTS

In Attica there is a total of 61 municipalities. These were categorized based on the number of pumping events as: a) high flooding risk, when they 101-530 events; b) Medium flooding risk, when they had 51-100 events and c) low flooding risk when the had 1-50 events. For Figure 1 it is clear that the number of water pumping events greatly differed from municipality to municipality. Specifically, 16 municipalities had high flooding risk, 18 medium and the rest low. The top 10 municipalities in regard to water pumping events were: 1) Megaron, 2) Marathonos, 3) Aharnon, 4) Mandras-Idyllias, 5) Piraios 6) Kifisias, 7) Peristeriou, 8) Ag. Paraskeyis, 9) Illioy, 10) Athinaion.

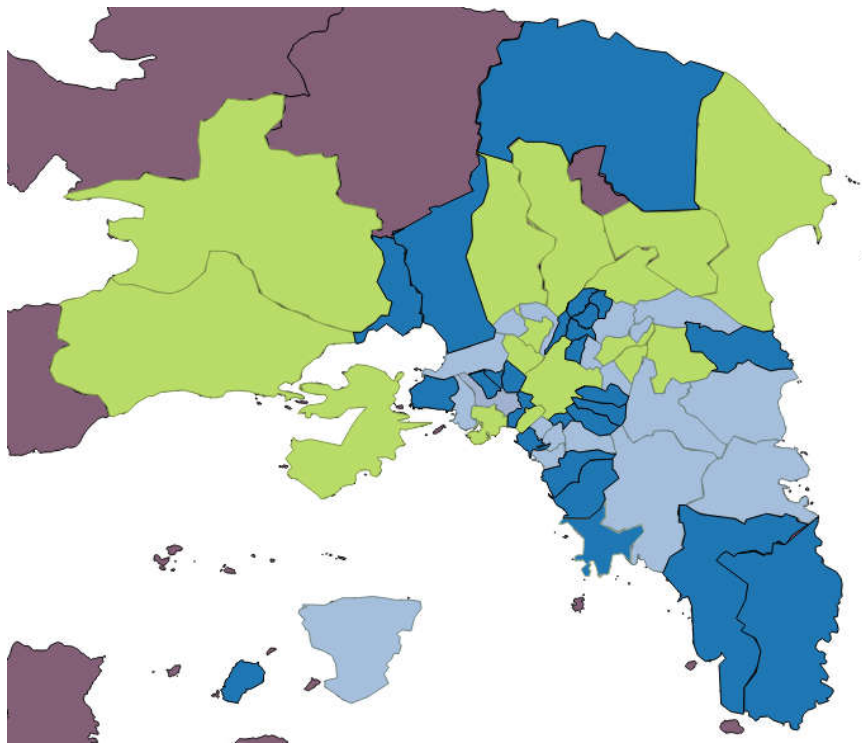


Figure 1. Municipalities had different risk to flooding events. Specifically, 16 municipalities had high risk (green color), 18 medium (light blue color) and 26 low (blue color).

3. CONCLUSION

Utilizing historical records and GIS allowed to evaluate the frequency of water pumping events and consequently (flood risk) for the different municipalities of Attica Region in a user-friendly form of a map. Some municipalities were more prone to flooding and special mitigation measures should be taken for them. These results that were presented in the form of maps can be utilized as a tool that could be used the Fire Brigade and Civil Protection during flooding events. The next step would be to enter the exact point of each pumping event in order to more accurately find the spatial location of where the flooding events occur.

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EUROPEAN PROJECT “LODE” (LOSS DATA ENHANCEMENT FOR DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION MANAGEMENT): CASE STUDY KEFALONIA, GREECE

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ABSTRACT

LODE is a project funded by DG-ECHO aimed at improving post disaster damage data collection and analysis to support a variety of local, regional, national and European stakeholders to develop more evidence based disaster risk reduction policies and measures. Ten partners from seven countries are committed to the project.

Using a cyclical and adaptive approach to learning from past events, the project will develop a system for collection, storage and organization of post-disaster damage and loss data from multiple sectors at relevant spatial and temporal scales so as to support a variety of applications, ranging from accounting to forensic analysis of disasters to enhancement of risk modelling capacity.

The baseline of LODE is a set of showcases where damage data collection and storage will follow the methodology and the approach that the project develops. The showcases will carry out applications involving different scales, hazard types, affected sectors and territories in order to show in practice the added value of the proposed system.

EPPO is the Greek partner of LODE and is responsible for the showcase of 2014 Kefalonia earthquakes which focuses on the usefulness and use of pre-disaster data. In an effort to enhance cross-fertilisation between pre- and post- data management, EPPO attempts a comparison of the data collected in pre-earthquake vulnerability assessment of public buildings in Kefalonia with the post-earthquake damage assessment of the same buildings.

Keywords: loss, risk, stakeholders, information system.

1. INTRODUCTION

LODE (<https://www.lodeproject.polimi.it/>) is a project funded by the European Commission- DG-ECHO – Directorate General for European Civil protection and Humanitarian Aid Operations, under the Program: Union Civil Protection Mechanism Prevention and Preparedness Projects in Civil Protection and Marine Pollution 2018-2020. It is addressing one of the priority under the call, that is enhancement of Post-disaster loss and damage assessment to support risk mitigation measures and climate change adaptation. The duration of the project is 24 months (starting date 15/1/19).

Ten partners are committed to the project from seven countries: Politecnico di Milano (Italy), Catalunya Regional Civil Protection (Spain), Finnish Meteorological Institute (Finland), Euro-Mediterranean Centre for Climate Change (Italy), National Scientific Research Council (France), Umbria Regional Civil Protection (Italy), Earthquake Planning and Protection Organization (Greece), University of Porto (Portugal), Forestry Institute (Serbia), Scientific Investigation Agency (Spain). Partners represent both scientific research centres and universities as well as public administrations that are active in different fields of risk management and mitigation.

The project will develop an inclusive damage and loss data model, which will result in an information infrastructure for recording damage from multiple sectors at relevant spatial and temporal scales.

Evidence-based, effective and efficient disaster risk reduction (DRR) and climate change adaptation (CCA) assessments, policies and strategies require knowledge and data. In the framework of the project a network of stakeholders was created in order to reach the maximal level of inclusion and participation of those who are perceived as holders of relevant knowledge and end users of the project. The novelty of this project is to share both data and uses, which will provide added value for all stakeholders involved.

The baseline of LODE is a set of ten showcases from participating countries where in each case one or two types of applications will be carried out in order to show in practice the added value of enhanced damage and loss data and the utilities provided by the information system that will be developed.

2. THE GREEK CASE STUDY IN LODE PROJECT - METHODOLOGY

As the seismicity of Greece is the highest in Europe and the 6th globally, EPPO chose as case study for the project the 2014 Kefalonia earthquakes (January 26 (15:55 local time) and February 3 (05:08 local time) with Magnitudes M6.1 and M6.0 respectively) [1]. Among EPPO's main activities in LODE project is to compare the data collected in pre-earthquake assessment of public buildings in Kefalonia with the post-earthquake damage assessment of the same buildings.

2.1. Pre-earthquake vulnerability assessment of buildings in Kefalonia

First degree inspections (rapid visual screening) for vulnerability assessment of existing buildings of public use were carried out in the island of Kefalonia before the earthquake of 2014.

The vulnerability assessment of buildings is carried out at national level in Greece and includes three steps of inspection. The Earthquake Planning and Protection Organization was assigned the preparation of the above framework and is responsible for the implementation and validation of the vulnerability assessment procedure. The three steps are: a. First degree inspection which is a Rapid Visual Screening Procedure, b. Second degree inspection which is an approximate Seismic Evaluation based on simplified calculations and non destructive methods for insufficient buildings from the first degree inspection, c. Third degree inspection which is a detailed assessment of seismic performance of buildings with local or general inefficient seismic performance (according to KAN.EPE, KADET or EC8-3) [2].

The first degree inspection is implemented in order to identify priorities at national level. The buildings are classified in three categories A, B, Γ.

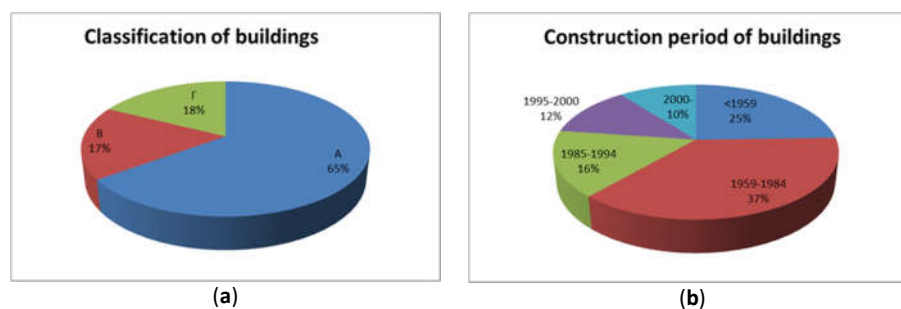


Figure 1. Statistical data from the first degree inspection of pre-earthquake assessment in Kefalonia from EPPO's data base (a) Classification of public buildings in three categories A, B, Γ according to their seismic performance (A: higher priority for further inspection, Γ: expected better seismic performance) (b) Classification of public buildings according to their period of construction

Higher scores (category A) correspond to buildings of higher priority for second degree inspection, whereas lower scores (category Γ) correspond to buildings with an expected better seismic performance. The results of building scoring, that determined the priority for the second degree inspection, are forwarded in the form of classified documents to the higher levels of administration (Prefecture Director, General Secretary of Decentralized Administration). The inspection of each building is carried out by the authority that is

responsible for the operation and the safety of the building. The national data base concerning pre-earthquake rapid vulnerability assessment of public buildings, which includes data of public buildings of Kefalonia is managed by EPPO.

2.2. Damages after the 2014 earthquakes in Kefalonia

Due to the two main seismic events, damage occurred to a number of structures. Most of the structural damage was observed during the 2nd event and was primarily concentrated in the Paliki peninsula area, on the western part of the island. In general, the buildings on the island behaved well, considering the intensity of the earthquake which had ground accelerations of up to 0.75 g which can be attributed to good construction quality [3].

The earthquake, on February 3rd 2014, caused significant problems in the water supply network. The majority of the damage was concentrated in the town of Lixouri. Large scale repairs and replacements took place until full functionality was achieved [3].

Unlike the residential and public buildings, the Kefalonia churches exhibited extensive structural damage (even partial collapse), and severe nonstructural damage. This can be attributed to their construction type, retrofit history. Most of the churches are very old, tracing back to the 17th century. Damage of nonstructural components was extensive. The impact of this damage was substantial in the function and the economy of the island. Nonstructural damage caused business to stop operating, including banks, restaurants, and stores and shut down the only airport in the island for more than 10 days. Also damage observed in Ports and Waterfront, in the road network in earth retaining structures.

After the Kefalonia earthquake, an operation of emergency inspection of buildings was carried out (post-earthquake inspection procedure) and included two degrees of inspection. The buildings were inspected in order to be classified in categories regarding their usability and damages [3].

The first degree post earthquake inspection is a rapid usability evaluation and the buildings were classified into two categories: usable (use of these buildings is allowed) or unusable (these buildings should not be used until the second degree inspection is performed).

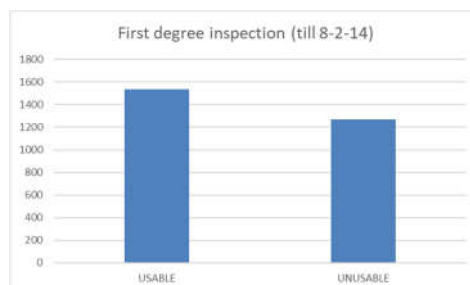


Figure 2. First degree post-earthquake damage assessment of buildings from the 2014 Kefalonia earthquake Source of data: Kefalonia Department of Rehabilitation from Earthquakes.

The second degree post earthquake inspection was performed only on the buildings characterized unusable during the first degree inspection [4].

Responsible for the organization of the safety assessment of individual buildings was the General Division of Rehabilitation from Natural Disasters (DAEFK), with the support of the local authorities (Engineering Departments of the municipality and prefecture) [5].

In our visit in Kefalonia island in 2019, we had meetings with regional and local authorities responsible for earthquake disaster management. We were informed about the procedure of rehabilitation of buildings and infrastructure and data was given about damages of buildings and road network. During our visit in Kefalonia we also inspected buildings damaged from 2014 earthquake.



(a)



(b)

Figure 3. Building damages after the 2014 Kefalonia earthquake (a) Photo from subsidized housing area taken on January 2014 (b) Photo from subsidized housing area taken on June 2019. The building damages got worse due to earthquakes that struck the island after Jan and Feb 2014 earthquakes.

3. CONCLUSIONS

The LODE project is going to use the experience of all partners in collecting, organizing, and using disaster damage and loss data at different levels of government. The information infrastructure that will be implemented will support a variety of analytical applications, such as the identification of post-disaster needs and compensation requests and forensic investigation of the damages and losses to improve recovery and reconstruction plans. The project will show how knowledge acquired from analysing a real event can improve risk models particularly in terms of indirect damage, which is necessary for developing and rendering science-based national risk assessments as required by the EU Community Mechanism and by national legislation.

Through the project we aim at raising awareness of the benefits of improving current ways of collecting and managing damage data, so as to develop a more coordinated approach to data management. Strong emphasis is put on exchange of current good practices and on the discussions regarding existing gaps and challenges that have been encountered or are still in place even in successful experiences.

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ILLEGAL IMMIGRATION AS A NATIONAL SECURITY PROBLEM. THE GREEK EXPERIENCE

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ABSTRACT

This paper aims to research the main options of illegal immigration that move to the European Union, with Greece to support a determinant role. Illegal immigration takes place as a consequence of immigration, in order to improve the living standards and the departure from uncertainty. The waves of illegal immigrants that go-ahead to the E.U. pass through Greece and often select our country as a permanent place to stay. Turkey does not cooperate and at least adopt a moderate strategy. On the other hand, the basic measures and policies from the E.U. are the Schengen Treaty and its information system, the coordination in the visas circulation and the operation of FRONTEX. Illegal immigration impacts economic, social and political levels. It is necessary however that the phenomenon combat presumes the more efficient operation of the Greek services and especially the Turkey coercion for cooperation.

Keywords: Illegal immigration, National Security

1. INTRODUCTION

In today's ever-changing international environment, migration is emerging as an important and increasingly complex phenomenon that affects the political, economic and social reality in many different ways and requires diverse responses from governments, societies, and individuals. Stereotypical and often incorrect views on the subject tend to focus solely on certain types of migration flows while overlooking the inherent complexity of the phenomenon. Economic migrants are persons who leave their country of origin purely for economic reasons in order to seek for better working and living conditions in the country of final destination. Refugees, on the other hand, are persons who are outside their country of origin, owing to a well-founded fear of persecution for reasons of race, religion, nationality, membership to a particular social group, or political opinion, and due to that fear, are unable or unwilling to return to that country. "Persecution" is considered to be the violation of a person's fundamental rights, such as torture, arbitrary detention, discriminatory treatment endangering the survival of the persecuted person, etc. While economic migrants have the possibility to return to their country of origin whenever they want, refugees cannot return until the situation in their country changes and is considered a safe place for them to go back to, as prescribed by the Geneva Convention relating to the Status of Refugees, as well as other international and European instruments and national laws. In other words, only persons that are not considered refugees can be sent back to their country of origin. Lately, an attempt has been made to swap the word 'illegal' with the word 'irregular' when referring to undocumented migrants, since the term 'illegal' contains some element of de facto illegality, while the term 'irregular' seems more appropriate and is less degrading of a person's personality.

The massive and increasing influx of irregular migrants from Asia and Africa, who in their attempt to reach Europe, find themselves stuck in the transit countries while waiting to move to the countries of final destination, is creating a potentially explosive situation with unforeseeable consequences. The reasons why these people are struggling to reach new destinations as well as the channels used to achieve that, vary widely. In some cases, they are looking for legal immigration routes while in others, they are risking their lives

in an attempt to flee political oppression, war and extreme poverty. International treaties and regulations applicable to refugees and migrants combined with EU Treaties in force, create a complex and problematic legal framework, which essentially prohibits transit and host countries to find a way to successfully manage the migration flows internally as well as at their borders. Illegal migration is becoming an increasingly acute and pressing international security problem. People that are forced to migrate to other countries, particularly to Western countries, are coming mostly from economically unstable or war-affected areas. The attempts of these people to enter into the Western countries illegally, given the fact that the legal migration channels are strictly controlled, gives rise to a series of security problems to the border crossings of each country. This situation is reflected by the fact that in 1960, there were some 1.4 million refugees worldwide, while that number raised to 8.3 million in 1980 and to 15 million in 1995. In recent years, the waves of refugees have increased to an alarming extent, not only in terms of size but also in terms of frequency and complexity. A number of striking examples, such as the recent one of Syria, and the older ones of Bosnia and Herzegovina and Rwanda, demonstrate the degree of exploitation incurred on populations as a result of the use of their ethnic, racial, religious and linguistic differences by political leaders on the one hand, and by organized crime traffickers on the other, as a means of obtaining economic benefits through the trafficking of these people to other countries. The result of the mass movement of people, be they economic migrants or refugees, is the mobilization of security forces and, where appropriate, of armed forces, to assist with measures such as border guards, in the host country. In short, this particular social issue with its humanitarian dimension is directly implicated in national security issues. The aim of this paper is to study and analyze the phenomenon of irregular immigration, particularly with respect to its causes and to potential security issues arising from its rapid growth. Are irregular migrants a possible threat to national security and cohesion based on the Greek experience? This question proves quite hard to answer given the fact that irregular migrants should definitely be looked at from a humanitarian perspective, since they are risking their lives to reach a safe place, but, at the same time, could also be considered as a security threat to the host countries, especially if their identity, cultural and religious beliefs are taken into consideration. [1-13].

2. ANALYSIS AND CONCLUDING REMARKS

Building walls or fences to ban illegal entry into a country cannot be the answer to migration. Illegal migration, nowadays, is a complex phenomenon that follows the same development path as legal migration. Migration happens primarily as a result of a process of economic development rather than due to social or political conditions in the country of origin. Economic reasons act as the main push factor driving migrants to seek work in countries other than their counties of origin, with a view to improving their standard of living. However, there are also social and political factors such as political instability caused by cultural diversity within the country of origin that causes people of a certain cultural affiliation, to move away from their home country. Illegal migration may follow the same development path as legal migration, but it does not follow legal routes. And with the exception of certain areas of illegal migration activity which are aimed solely at the maximization of profits deriving from criminal activities (such as smuggling or trafficking), the majority of irregular migrants hope that the time for their legalization will come sooner or later. Nevertheless, their stay in a host country may often prove to be problematic and a source of social disapproval, especially in those Member States which have been hit the most by the financial crisis. A typical example is Greece which sees illegal immigrants entering the country, enjoying full care services for free, without having contributed, not a single euro to the state budget, while its inhabitants are intimidated by the economic crisis, are increasingly sinking into poverty and are overburdened by debt. And not only that but both the socioeconomic cost relating to the degradation and ghettoization of specific city areas that were once thriving and the fact that the delinquent behavior of many of these irregular migrants is seriously affecting tourism should be also considered. Illegal migration introduces distortions at the social, economic and political levels. At the economic level, the employment of illegal immigrants leads to an informal reduction in wages in the areas of economic activity, where they are employed, which at the same time is accompanied by an increase in the

business profits stemming from this reduction in wage costs. At the social level, the main impact of illegal immigration is mainly reflected in encourages the spread of organized crime and terrorist networks and, possibly, in the deterioration of the population's health. Last but not least, at the political level, the impact of illegal migration is basically reflected in the emergence of a great variety of political viewpoints and attitudes ranging from racism and xenophobia to the granting of asylum to all migrants. The European Union, as a supranational institution in the fight against illegal immigration, is based both on the existing legislative framework which prevails over the corresponding national ones and on the development of specific strategies. The basis of EU legislation to combat illegal immigration is the Schengen Convention, the information system it contains and the system for monitoring visa approvals. On top of that, the European Border and Coast Guard Agency (FRONTEX) is used by the EU as its battering ram in the fight against illegal immigration. Frontex helps EU countries and Schengen associated countries manage their external borders. The activation of FRONTEX in the sea borders of Greece with Turkey is a guarantee to effectively addressing the phenomenon. Greece faces a major problem with the growing flows of illegal immigrants attempting to enter the territory of the European Union through its borders. It's currently running the risk of transforming from a transit hub into a zone of permanent illegal residence for migrants and Turkey has played a significant role in this negative development with its modest and often indifferent attitude to the fight against illegal immigration. This is evident both in the number of irregular migrants attempting to enter the country on a regular basis and on the number of refusals of entry, removal or even arrests. In conclusion, it should be noted that there is no such thing as a miracle formula for tackling illegal immigration and that the only way to limit this phenomenon is the close cooperation of all the countries involved. It would be also unrealistic to assume that it is possible to derail and barrier the borders from the influx of immigrants. And this is true not only in the case of small states with limited capabilities but also in the case of larger states or even the EU as a whole. But what can be achieved is the highest possible return on the resources available to combat and, combined with an appropriate policy, to eliminate the problem. Both the cooperation on combating irregular migration and the acceptance by neighboring countries of the readmission of persons illegally crossing the borders of one of the contracting countries, whether they are nationals or third-country nationals, are measures that can lead to limiting and, to some extent, resolving this phenomenon. [14-26].

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MANDRA, TWO YEARS AFTER. THE CONTRIBUTION OF D.A.E.F.K – K.E. IN THE RESTORATION OF BUILDINGS AFFECTED BY THE FLOOD

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ABSTRACT

The most devastating flood of recent years hit Western Attica on November 15th 2017, leaving behind 24 dead and huge disasters in infrastructure, buildings and the environment. According to Athens National Observatory, the rainfall that caused the flood was considered very strong and with relatively short duration, as the total rainfall a time period of three hours (between 3:00 a.m. and 6:00 a.m., local time), was estimated at 200 mm, 3.5 times above region's monthly average.

The day after the flood, engineers, employees of Central Greece's Directorate of Natural Disaster Impact Rehabilitation (D.A.E.F.K. – K.E.) commenced the inspections of the damaged, buildings. By a simple and straightforward procedure and in order to meet the necessities of the affected people, a one-off allowance was granted to residents and to businesses whose movable assets were destroyed. The work of the restoration was undertaken by D.A.E.F.K. – K.E., following the adoption of a Joint Ministerial Decree referring to the demarcation of the affected area. Other related Decrees further established the terms, conditions and procedures for the restoration of damaged buildings.

The purpose of this paper is to present the results of the restoration of buildings, two years after the incident, by studying the legislative framework and analyzing the implementation processes.

Keywords: West Attica, 2017 flood, Buildings rehabilitation, Central Greece's Directorate of Natural Disaster Impact Rehabilitation (D.A.E.F.K – K.E.).

1. INTRODUCTION

In recent years, due to climate change, we are confronted with increasingly serious flood events. By the recent flood in the wider area of Mandra, the toll for the state, besides damages to infrastructure, movable assets and real estate, includes human lives. The Ministry of Infrastructure is in charge of the state compensation for damages to buildings, through the organizational structure of the Directorate General of Natural Disaster Impact Rehabilitation.

The work of this Directorate begins immediately after the incident with the inspections of the damaged buildings. Restoration procedures are defined, and state aid is provided for the repair and reconstruction of affected buildings. The state aid implemented in phases in order to monitor the completion of each case. Damage recovery usually lasts longer than one year, as it not only concerns the distribution of funds, but also their proper use, as it sets out to limit similar damages in case of a new incident. The quest for more effective and faster relief for those affected is ongoing.

2. OBJECTIVE-PROCESSES FOLLOWED AFTER A FLOOD

As with all natural disasters, in the case of floods, specific procedures are followed and actions taken which are defined by specific action plan and the legislative framework.

2.1 THE INCIDENT

On November 15th of 2017, flash floods hit Mandra – Idyllia, Megara and Elefsina Municipalities in the wider region of West Attica. The flash flood is a sudden, localized flood, with high water volume and short duration, and comes as a result either after several (usually less than 6) hours of intense or excessive rainfall, or of a

dam or floodplain disaster [1]. After a night of heavy rainfall over Mount “Pateras” which resides above the affected regions, through the catchment area and due to soil erosion, large volumes of mud ended up draining within the residential areas of the above Municipalities. In a very short time period, huge amounts of water engulfed these regions.

According to Hellenic National Meteorological Service (HNMS) measurements, regarding precipitation of the specific region, the average monthly rainfall in Elefsina is 56 mm [2], while according to the Athens National Observatory, the mean annual total rainfall is 373 mm, while, for the month of November is 59 mm [3]. The intensity of the phenomenon can be seen from Figure (1), which depicts the evolution of the rainfall rate (mm/hr) on the 11.15.2017, within the affected area, where the average hourly rate of precipitation for the time period 3:00 to 6:00 a.m. was estimated to be approximately equal to the whole November’s monthly average in the region. We can conclude that it was a very strong and relatively rapidly rainfall. Total precipitation for that time period was estimated at 200 mm, 3.5 times above the total average for November in the region, as shown in Figure 2 [4].

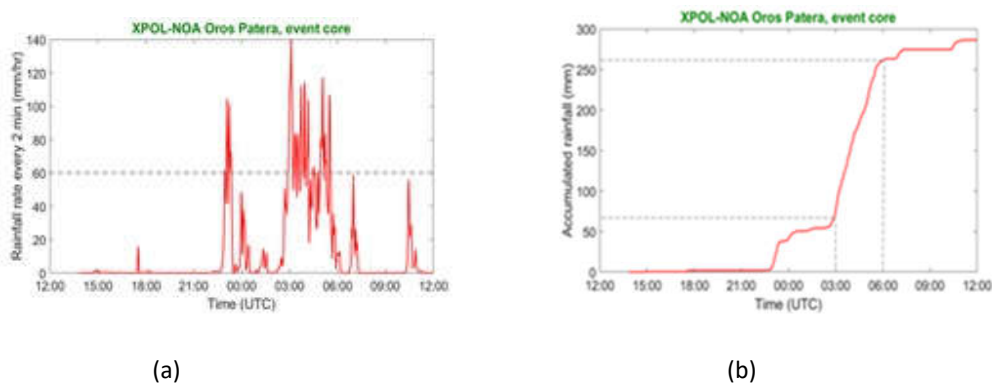


Figure 1: (a) Rainfall rate, 11.15.2017, (b) Rainfall accumulation, 11.15.2017

Specifically, the flood affected the Mandra, Nea Peramos, Megara, Elefsina and Magoula Municipalities, as well as the Inoi village, leaving behind 24 dead and incalculable damage to infrastructure, buildings, agricultures and properties. Mandra and Nea Peramos suffered the most damage. This is the third largest flood in Attica, accounting only the number of the dead.

2.2 RESPONSE

Immediately after the incident, D.A.E.F.K. – K.E. engineer groups (with the assistance of fellow engineers, employees of other Directorates of the Ministry of Infrastructure and Transport) began recording the damages over the buildings which were affected by the flood by performing, on the field, inspections (Fig 2. a, b). In less than a month, 2.153 inspections were done, of which 1,566 were located in the Municipality of Mandra - Idyllia and 587 in the rest of the affected areas (Elefsina and Megareon Municipalities). The administration of each borough assisted, by providing both the workplace (office space) and human resources.



Figure 2: (a,b) Mandra, Damages caused by the flood of 2017

2.3 DIRECT RELIEF MEASURES

For the reparation of the affected people, through regulatory framework, a lump-sum allowance, not only to residents but also to businesses, of EUR 5,000 and EUR 8,000 was respectively granted. Specifically on 11.28.2017 a Joint Ministerial Decree was issued (Government Gazette 4155/B/28.11.2017) according to which beneficiaries were: a) the tenants whose dwellings on the day of the incident were flooded and their movable assets destroyed and b) the businesses affected by the incident [5].

Those concerned, were informed about the above through continuous announcements by the Directorate General of Natural Disaster Impact Rehabilitation (G.D.A.E.F.K.) of the Ministry of Infrastructure and Transport. The procedure was simple and straightforward. It involved a submission of an application with four supporting documents (police ID, photos depicting damages on the building, a Public Utility Organization bill and a Solemn Declaration) followed by the inspection census. Of all the applications lodged, 1.204 citizens, related to residential use, were identified as beneficiaries of financial assistance, and 264 due to professional use.

2.4 PROCESS OF BUILDINGS REHABILITATION

The first step towards restoring damaged buildings is the issuing of a joint ministerial decree where the affected area is demarcated. Afterwards, deadlines, terms and conditions and the procedure for granting state compensation for owners of damaged buildings are set out in a series of decrees by the Minister of Infrastructure and Transportation. According to regulatory framework, state aid is composed of 60% Free State Assistance granted by the competent authority and 40%, interest free, loan granted by credit institutions [6].

For the buildings which deemed as repairable, repair license issuances can be issued by D.A.E.F.K. – K.E. after the owner (or owners) of the building submits a relevant application and the given supporting documents. In the event that the damages relate only to non-load bearing components, the building repair survey can be carried out by D.A.E.F.K. – K.E. engineers, free of any survey cost, at a fixed backing price per m² of the affected level of the building but also its use. Otherwise with load and non-load bearing components damaged, the repair survey must be compiled by a freelance engineer and the D.A.E.F.K. – K.E. repair invoice must be used [7].

For buildings that have been deemed to demolition, state aid is provided either for their reconstruction or the purchase of another (it can also be under construction), and depending on their previous use the benefits vary from EUR 300 to EUR 1.000 per m². In this case, funding is given in lots depending the advancements of each project.

3. ANALYSIS METHOD

The methodology is based on reports over the presentation of the incident and the legal framework for the rehabilitation of damaged buildings. It also presents quantitative and financial data from D.A.E.F.K. – K.E. archive.

4. RESULTS

To date, 516 applications have been filed with D.A.E.F.K. – K.E., for state aid, and 332 repair permits have been issued. Regarding demolished buildings, 6 applications have been submitted for the issuance of a provisional beneficiary designation (first phase of reconstruction) and 4 have been issued. For both the grant of the lump sum allowance and the total amount of state aid for the rehabilitation following the 2017 flood damages in the West Attica area, the reaction of the state mechanism over a two-year period can be reflected as effective.

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SMART CITIES: THEIR ROLE IN PROTECTION FROM NATURAL AND MAN-MADE DISASTERS

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ABSTRACT

The development of smart cities aims to modernize traditional cities, combining the expertise of all sectors initiative under the supervision of public services, enriching them with the results of the scientific community. Initially, in this paper, the definitions and the characteristics of smart cities will be analyzed and formulated according to numerous formulated surveys. After that we will refer to the natural and man-made disasters that affect a city, and how we can minimize the vulnerabilities of a city in order to be resilient and safe. Moreover, we will try to delineate some of the key resilience strategies and actions that need to be implemented so that a city can adapt and evolve to smart. The smart cities 'verticals' are diverse, including water, waste, energy, transportation, finance, and payments, health, safety, and security, agriculture and more. Finally, these critical factors must in service regardless of the pressures and emergency situations that may arise.

Keywords: Smart City, Disasters, Vulnerability, Urban Resilience.

1. INTRODUCTION

Smart city is one the one that uses Technology, data and intelligent design to enhance the City's livability, workability, resilience and sustainability. Cities are engines of growth for the economy of every nation. A serious proportion of the Greece current population lives in urban areas and contributes a huge amount of regional GDP. [1].

Urbanization accompanies economic development. As countries move from being primarily agrarian economies to industrial and service sectors, they also urbanize. This is because urban areas provide the agglomerations that the industrial and service sectors need.

Enhance livability means a better quality of life for all. In the smart city, people have access to comfortable, clean, engaged, healthy and safe lifestyle. Some of the most highly valued aspects include sustainable energy, convenient mass transit. Good schools, faster emergency responses, clean water and air, reduced crime, enhanced security and access to diverse urban amenities ranging from entertainment and cultural options to recreation, healthcare and community facilities.[2]

Enhance Sustainability means giving people access to the resources they need without compromising the ability of future generations to meet their own needs. Smart cities enable the efficient use of natural, human and economic resources and promote cost savings. [3]

It isn't necessarily about investing large sums of money into new infrastructure, but at times more about making infrastructure do more and last longer less, whilst aiming to reduce waste and negative environmental impacts.

Moreover, enhance workability means more and better jobs and increased local GDP. In the smart city, people have access to the foundations of prosperity-the fundamental infrastructure services that let them compete in the world economy. This paper highlights for smart cities the factors concepts of them, the core function

and the reference document of the code for smart communities. And we conclude with the key steps forward. [4]

2. SMART CITIES CONCEPTS

Smart cities concepts include several factors/parameters/ aspects as follows [4]:

- Measuring the impact on the natural environment and increasing capacity to reduce the impact,
- Increasing the effectiveness and reducing costs of providing city services and other government operations,
- Establish strong connections through networks that support learning and collaboration on regional, national and global scale,
- Improving two-way communication with the public and empowering residents to inform the city's future,
- Attaching and retaining talented and creative individuals by improving quality of life and developing a reputation for open innovation,
- Resolving local problems through collective action, open data and other means of collaboration by building new forms connection, discovering shared values, framing and understanding challenges and strengthening a sense of responsibility,
- Addressing issues of social inclusion by empowering and connecting groups inside and outside government, especially marginalized groups,
- Increasing the city's capacity to recover from economic disruption.

2.1. Core function of smart cities

The core function for smart cities are as follows[2,3, 4]:

- (a) Collecting data. Smart devices are located throughout the city to measure and monitor conditions. For instance, smart meters can measure electricity, gas and water usage with great accuracy. Smart traffic sensors can report on road conditions and congestion. Smart GPS gear can pinpoint the exact locations of vehicles or whereabouts of emergency crews. Automated weather stations can report conditions, and mobile devices can collect the position and speed of people, where they cluster at different times of the day and the environmental conditions around them.
- (b) Communication data. Once you've collected the data, you need to send it along. Smart cities typically mix and match a variety of wired and wireless communications pathways, from fibre-optic to cellular to cable.
- (c) Crunching data. After collecting and communicating the data, you analyze it for one three purposes: (i) presenting, (ii) perfecting or (iii) predicting.

Importantly, analyzing data turns information into intelligence that helps people and machines to act and make better decisions. This begins a virtual cycle wherein data is made useful, people make use of that data to improve decisions and behavior, which in turn means more and better data is collected, further improving decisions, behavior and project performance.

2.2. Smart cities code

The code for smart communities is a reference document for local government and urban development industry, first and foremost. It is also a resource for those who have significant influence over the outcomes of how we develop our communities, and what we develop. This includes state government planners, designers and policy makers, developers of all sectors (public, private and non-profit), and the deep value chain of product and service providers that are engaged in urban development.

This ecosystem of stakeholders shapes the investments we make in vertical and horizontal infrastructure, and the places and spaces in between. They are responsible for service and program delivery, and asset management. They help create the conditions for human development. Ultimately, and most importantly, citizens will be the beneficiary of the code. And having a common language for smart communities is therefore

important if we are to shape the best possible communities for our citizens, both now and next. Documents of this kind often provide an overall framework for the subject matter, along with a more detailed level of definition. The code will provide this for the concept of a smart community. The main Code components are (i) Urban Management, (ii) e-Governance, (iii) Transportation and e-Mobility, (iv) ICT, (v) Portable and waste water, (vi) Energy, (vii) Solid waste Collection and Disposal, and (viii) Economy.

3. Conclusions

The key steps forward are:

- (a) Identify need first, technology second. Take the time to define the problem you're trying to solve. Only with this understanding in place can the right approach to technology be selected.
- (b) Design for inclusion. Pay special consideration to communities who might get left behind when you adopt new technologies.
- (c) Let community in. Provide tangible support to unlock the full potential of local residents, and then tap into it.
- (d) Look outside for new solutions. Harness the combined power of public service champions, community-driven networks, and private sector innovations.
- (e) Think beyond city boundaries. Collaborate and share learned with other cities.
- (f) Enable and empower public servants. Identify city staff and community members who are pushing an innovative agenda, celebrate them, and provide support in scaling up their work.
- (g) Invest in the fundamentals. Focus on fundamental service delivery and capacity building through small-scale projects before taking on ambitious technology projects.
- (h) Integrate to implement. Integrate technology and data into your planning processes and resource-based decision making to ensure projects move forward.
- (i) Brand to build buy-in. Invest in the image and communications of the city as a vibrant place for technology-related opportunities with a high quality of living.

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THE ROLE OF LOCAL GOVERNMENT IN CIVIL PROTECTION NATURAL DISASTER MANAGEMENT ASSESSMENT OF THE FORMER MUNICIPALITY OF KEFALLONIA

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ABSTRACT

In the context of the general planning of Civil Protection and in terms of its responsibilities and obligations to the citizens living within its limits of responsibility, the Municipality of Kefallonia formed a management system by taking all necessary measures and actions to respond to emergencies from any kind of natural disaster. The system included action plans, prevention tasks, preparation drills, personnel organization, technology upgrading, enhancement of stakeholder's coordination.

The implementation of the system indicated that it can provide a valuable tool for assisting emergency decisions to local governments.

Keywords: civil protection, municipality, natural disaster, prevention, action plan, response.

1. INTRODUCTION

Civil Protection relates to actions and policies aimed at assessing the risk of a catastrophic event, taking measures to limit its likelihood of occurrence, and mitigating its consequences.

The general planning of Greece defines at all levels of administration, the Services and Agencies involved that coordinate the Civil Protection actions through their specific action plan [1].

The Civil Protection Planning in the Municipality of Kefallonia included measures and actions that are generally characteristic of all emergencies and additional specific measures and actions for each risk separately. Measures and actions are scaled up in the all phases of natural disaster management and relate to preparedness, crisis management and the recovering from consequences.

All of this planning has greatly helped in responding more effectively to emergencies from natural disasters in Municipality's jurisdiction.

2. THE CIVIL PROTECTION STRUCTURE OF THE MUNICIPALITY OF KEFALONIA

The Civil Protection Directorate of the Municipality of Kefallonia was responsible for supporting the coordination and supervision of the civil protection work for prevention and preparedness as well as for the disaster management and rehabilitation in the area of the Municipality.

2.1. Operational planning

In December 2013, the general response plan of the Municipality of Kefallonia and its annexes were created. Following the earthquakes of 2014, this plan was revised and supplemented by three specific plans relating to forest fires, floods and earthquakes, the annexes were enriched and operational maps were drawn up [3]. The Municipality's special plan for forest fires was complemented by the evacuation plan implemented in two cases.

For the most effective utilization of the human resources and means of the Municipality of Kefallonia, all the employees of the Municipality were assigned to groups and committees, and additional resources were provided annually by private contractors.

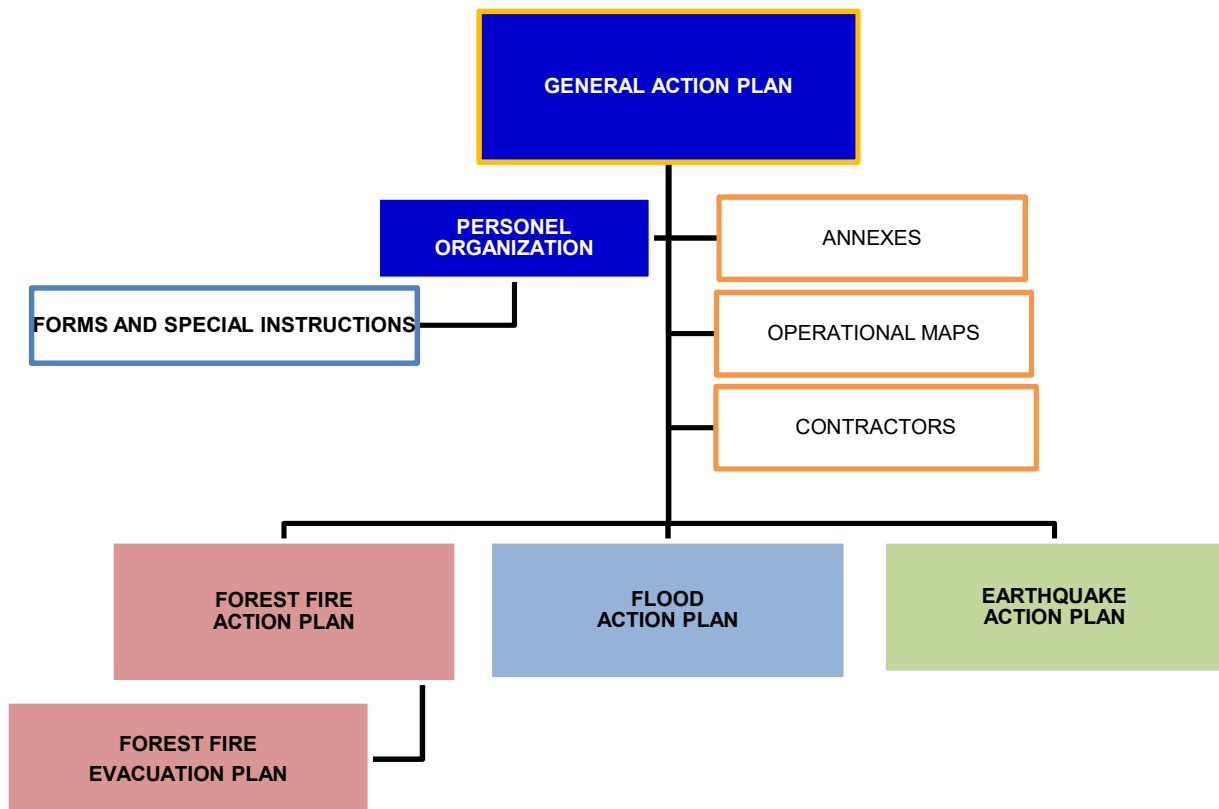


Figure 1. The structure of the Emergency Response Plan of the Municipality of Kefallonia

2.2. Preparation and prevention

The sector of prevention and mitigation of the effects of natural disasters was strengthened by performing tasks of fire protection, flood protection and extreme weather protection and upgrading of technological equipments.

The readiness of the Municipality's operational mechanism was improved by the enhancement of cooperation with the other stakeholders through preparation drills related to forest fires, marine pollution and earthquakes.

For better coordination of the stakeholders involved, the Directorate organized and participated in the meetings of the Civil Protection Local Committees.

Particularly during the forest fire season, when the fire risk was high, and in cases of emergency weather alerts the Municipality was on alert or patrolling.

For the purposes of informing citizens on civil protection issues, a website [3] of the Directorate was operated.

2.3. Response and recover

All this planning provided us an immediate and coordinates response and rehabilitation capability for dealing with natural disasters. In these few years, the Municipality of Kefallonia had to manage the consequences of a hundred and forty six disasters covering the entire spectrum of natural risk, whenever and wherever there was a need by providing many hours of overworking.

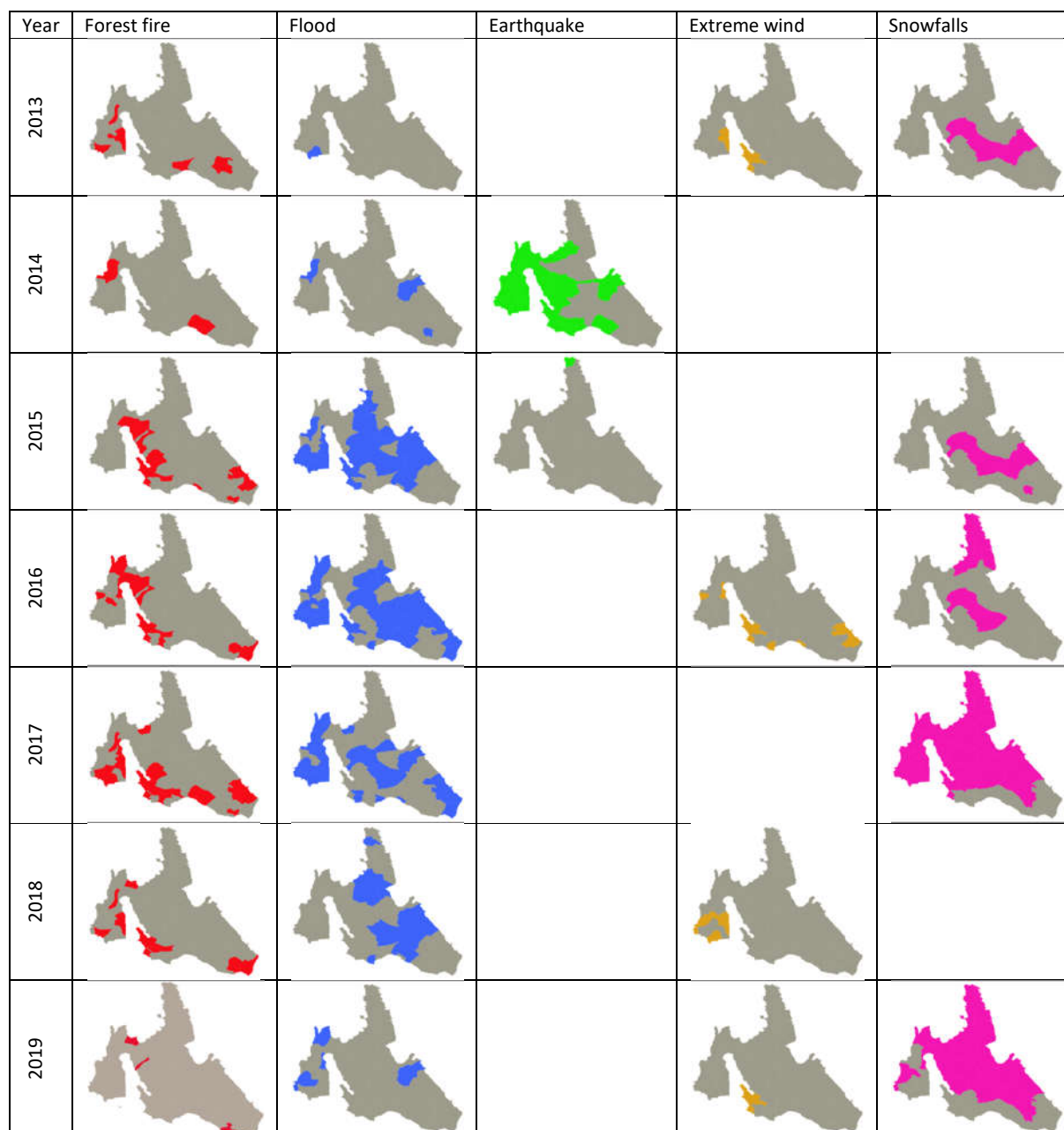


Figure 2. Geographical distribution of natural disasters by year faced by the Municipality of Kefalonia (2013 - June 2019)

In particular, the durability of the coping mechanism was tested with the earthquakes of 2014, the snowfalls of 2017, the floods of 2015 and 2016 and the forest fires of 2018 [2].

For the decision-making of actions, a civil protection operations centre was organised to address the emergency, and communications for the information collection and dissemination were ensured.

The human resources were organized in order to carry out all the actions concerning both the assistance of the affected, as well as and the short and long term restoration of the damage.

3. CONCLUSIONS AND SUGGESTIONS

Under current legislation, Municipalities are part of civil protection planning and are limited to a role complementary to that of the Region. They compose a memorandum of describing the responsibilities and available operational resources for the implementation of civil protection actions.

However, the role mainly of a local government that is in daily and more direct contact with the citizen, necessarily requires the design and implementation of a system of actions and procedures of the operational available personnel and equipment in order to improve as far as possible the protection and support of all those at risk of natural disasters.

The natural disaster management system of Municipality of Kefallonia included equivalently five stages:

- 1) Risk diagnosis
- 2) Preventive actions
- 3) Readiness-Immediate Response-Management-Assistance
- 4) Immediate and Long-term Impact Management and Rehabilitation Actions-Recovery
- 5) Plan improvements.

It is a fact that this implementation of the system and the acquired experience has helped us significantly in the most effective responding and short-recovery from natural disasters.

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Thanks to:

