PANTHEON

Community-Based Smart City Digital Twin Platform for Optimised DRM operations and Enhanced Community Disaster Resilience

D2.2

MULTI-HAZARDS/RISK DATA AND ASSESSMENT REPORT

DOCUMENT INFO

Deliverable Number	D.2.2
Work Package Number and Title	WP2 – PANTHEON Approach for Building Disaster – Resilient Communities
Lead Beneficiary	KEMEA
Due date of deliverable	30/04/2023 (M04)
Deliverable type[1]	R – Document, report
Dissemination level[2]	PU - Public
Author(s)	Ioanna Triantafyllou (KEMEA), Vassiliki Apostolopoulou (PRACTIN)
Internal reviewer(s)	Fanourios Fakoukakis (FINT), Daoiz Zamora (MION), Sarah Kainz and Constanze Geyer (JOAFG), Marianthi Stefouli and Dimitris Petridis (EPSILON), Mike Karamousadakis and George Stergiopoulos (THL), Otilia Bularca and Ana-Maria Dumitrescu (SIMAVI)
Version - Status	V.1.7 – Final Document

TASK ABSTRACT

The deliverable D2.2 is focusing on the existing environmental multi-hazard approaches based on a literature review as well as on a participatory process that has been performed for Île-de-France (France) and Attica (Greece) regions. The objective of this report is to identify what is the existing knowledge to advance our understanding of multi-hazard events, their impact, as well as the methods and approaches available for assessing and mapping of multi-hazard risks in the frame of Smart cities with digital twins' technology (SCDT).

[1] **Please indicate the type of the deliverable using one of the following codes**:
R = Document, report
DEM = Demonstrator, pilot, prototype, plan designs
DEC = Websites, patents filing, press & media actions, videos
DATA = data sets, microdata
DMP = Data Management Plan
ETHICS: Deliverables related to ethics issues.
OTHER: Software, technical diagram, algorithms, models, etc.

[2] **Please indicate the dissemination level using one of the following codes**:
PU = Public
SEN = Sensitive

Review History

Version	Date	Modifications	Editor(s)
1.0	30/05/2023	First draft	Ioanna Triantafyllou (KEMEA) Vassiliki Apostolopoulou (PRACTIN)
1.1	01/06/2023	FINT Review	Fanourios Fakoukakis
1.2	04/06/2023	MION Review	Daoiz Zamora
1.3	07/06/2023	JOAFG Review	Sarah Kainz, Constanze Geyer
1.4	09/06/2023	EPSILON Review	Dimitris Petridis, Marianthi Stefouli, Lilly Christoforidou, Odysseas Katsaitis, Marc Bonazountas, Julie Auerbach
1.5	13/06/2023	THL Review	Mike Karamousadakis, George Stergiopoulos
1.6	20/06/2023	SIMAVI Review	Otilia Bularca, Ana-Maria Dumitrescu
1.7	14/07/2023	Final Document	Ioanna Triantafyllou (KEMEA)

DISCLAIMER

Funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CBDRM	Community-Based Disaster Risk Management
CPA	Civil Protection Agencies
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EEA	European Environmental Agency
EPPO	Earthquake Planning and Protection Organization
ESA	European Space Agency
EWS(s)	Early Warning System(s)
GEM	Global Earthquake Model
GIS	Geographical Information System(S)
NGO	Non-Governmental Organization
NOA	National Observatory of Athens
PGA	Peak Ground Acceleration
PM	Particulate Matter
SCDT	Smart City Digital Twin
SSH	Social Sciences and Humanities
UNDRR	United Nations Office for Disaster Risk Reduction

Executive Summary

The objective of this report is to review the existing environmental multi-hazard approaches, projects and associated literature that have been undertaken across academia and industry, from the perspectives of both policy and practice, mainly within the regions of Île-de-France (France) and Attica (Greece). This aims to identify the existing or new knowledge required to advance the understanding of multi-hazard events, their impact, as well as the methods and approaches available to assess multi-hazard risk mapping in policy and practice. The report was compiled and led by KEMEA and supported by PRACTIN.

Different approaches of multi-hazard events exist. However, throughout the present report the approach of multi-hazard is assumed as (1) the selection of multiple major hazards that the regions face, and (2) the specific context where hazardous events may occur simultaneously or cumulatively over time, by considering the potential for interrelated effects (UNDRR, 2020). Multi-hazard assessment approaches are often more qualitative than quantitative and do not incorporate temporal changes in the vulnerability of assets over time, for example during successive hazards.

Multi-hazard approaches are mainly based on the application of quantitative and qualitative methods. The review performed highlighted that the governments of the selected regions make efforts to move from recognising to assessing interdependencies and interactions between hazards. This approach is in line with the respective holistic national perspectives on assessing hazards. As part of the review of practice, interviews were carried out with seven (7) key stakeholders representing seven respective stakeholder organisations. Systematic data collection about exposure, vulnerability and impact was highlighted by several stakeholders as a key barrier for advancing the state-of-the-art of multi-hazard disaster risk management approaches. They also underlined the lack of maintenance and/or upgrading of equipment as well as the need for interoperability and coordination between the relevant sectors.

The next step of the analysis has been the development of a questionnaire with the aim to gather information about the identification of major hazards that could affect the selected regions and the measures relevant authorities undertake to respond to disasters and how the risk could be reduced. There are various types of disasters that can occur in the regions under study, namely, floods, droughts, storms, heatwaves, wildfires, earthquakes, tsunamis, volcanic eruptions, epidemics, etc. The survey procedure seeks to identify the main gaps and needs during all the stages involved in the risk management process, i.e. prevention, preparedness, response and recovery, with the aim to enhance the Civil Protection capabilities in emergency situations. The purpose of the questionnaire is to identify public knowledge about such disasters and what are the most appropriate procedures to respond to disasters. The questions refer to the procedures a community can carry out to protect and preserve life and property. Such a survey can be helpful to understand how many people are aware of disaster management and how they can be trained for coping with different types of disasters.

1. Introduction

1.1 SCOPE OF THE DELIVERABLE

PANTHEON will design and develop a Community-based Digital Ecosystem for Disaster Resilience. In more detail, the aim is to improve risk assessment, reduce vulnerability, and strengthen community disaster resilience. Part of this is the enhancement of operational capabilities of Community Based Disaster Resilient Management (CBDRM) teams. To this end, it will use Smart City Digital Twin (SCDT) technology and leverage new and emerging technologies and innovations. For the specific developments in the project, our research focuses on France (Île-de-France) and Greece (Attica) as pilot regions.Bridging the (CBDRM) could play a significant role in increasing the resilience of the case study areas involved in the project.

The above issues will be addressed in PANTHEON through desk-based and primary research, as well as co-creation activities and framework development that will involve both stakeholders and citizen groups from the case-study areas. PANTHEON will also draw on different understandings of new technologies and new forms of media used for communication by both stakeholders and citizens. Finally, the scope of the deliverable will be combined into a framework and a methodology to perform a multi-hazard/risk mapping of the aforementioned regions that can be used in communities to bridge the Smart City Digital Twin (SCDT). The project consists of ten (10) work packages (WP), with this deliverable being the second part of WP2 “Regional Multi-Hazards/risk data and assessment.” The scope of WP2 is to analyse and detail the overall PANTHEON ecosystem and provide an approach for the required design considerations in order to build a Community based Operational Resilient system. This work is based on: analysis of EU and regional CBDRM environment and stakeholders as well as on the analysis of disaster models based on historical data and regional features.

The objectives of WP2 that are relevant to Task 2.2 are the following:

- Analyse the identified approaches and existing knowledge through surveys and interview groups with Civil Protection Agencies (CPA) with the aim to build a community of users for the following phases of the project.
- Combine a wide literature review with interdisciplinary knowledge,emergency responders, responsible bodies and other key stakeholders represented in the project.

The WP2, “Approach for Building Disaster-Resilient Communities” will provide the foundational knowledge needed to feed into the other WPs. The outputs and deliverables of WP2 will feed into both the baseline information required for WP3 “Requirements, Participatory Design Process and Pilot Use-Cases Specifications,” and the development of the framework required for WP6 “Remote sensing for multi-hazards and Data Delivery Scheme Implementation”, while also forming the baseline understanding of the terms disaster resilience, vulnerability, and risk perception and analysis of CPAs gaps and challenges that will be addressed and further analysed throughout the project.

1.2 PROPOSED APPROACH

The deliverable D2.2, "Regional Multi-Hazards/risk data and assessment", is based on desk research, targeted surveys as well as interviews with various stakeholders were applied to identify the hazards involved as well the various approaches and practices used to mitigate the impact. Desk-based research includes a literature review of Disaster Risk Management (DRM) and risk mapping for all major hazards for the selected regions (Île-de-France and Attica).

This desk-based research was integrated with information from interviews with CPAs at regional and national level in both countries. These interviews were used to determine diverse policies aspects that are taking place in PANTHEON case study areas.The aim of this report is to establish some of the current regional multi-hazards/risks assessments that are taking place among CPAs in different administration levels and determine how disaster management and risk perception relate to them, their organizations, and the communities that they work in. Specifically, this report will outline the current resilience methods, establish the current needs to CPAs and their plans for future resilience activities. Interviews, surveys and desk-based research aim to identify the current DRM approaches in the selected regions.

In addition, the interviews conducted at national and regional level, will provide an additional level of insight, from the CPAs' perspectives, into their DRM practices,the relationships between them and with the communities, their potential gaps and challenges and suggestions for future disaster risk resilience activities. This report provides comprehensive background knowledge necessary for PANTHEON, which will be used for future tasks of the project.

1.3 STRUCTURE OF THE DELIVERABLE

This document is comprised of six sections:

- ✓ The Introduction section (current section 1) includes the overview of the deliverable and describes how it will be integrated into the overall PANTHEON project.
- ✓ Section 2 presents the methodology used to identify hazard impacts in the selected regions.
- ✓ Section 3 dedicates the hazards impact methodology followed for the region of Île-de-France based on the description and identification of major hazards and their interactions, as well as the multi-hazards risk assessment and mapping.
- ✓ Section 4, similar to section 3, focuses on the methodology for hazard impacts followed for the region of Attica based on the description and identification of major hazards and their interactions, as well as the multi-hazards risk assessment and mapping.
- ✓ Section 5 refers to the structure and the analysis of the interview with stakeholders and of the questionnaire replies received.
- ✓ Section 6 refers to the main concluding remarks.

2. PANTHEON Multi-Hazard Impact and Risk Assessment Methodology

The Multi-Hazard Impact Methodology (MHIM) is an approach used to assess the potential impacts of multiple hazards, both natural and human-induced, on a specific area or region (Diaz-Granados and Wachtendorf, 2014). The methodology is commonly used by researchers, disaster risk reduction practitioners and policymakers to better understand the complexity and interaction of hazards and their potential impacts on communities and infrastructures.

The types of hazards examined in the two regions have been selected after extensive desk research. Our selections have been verified by the replies received from the interviews and questionnaire surveys with stakeholders. These types of hazards include earthquakes, floods, wildfires, landslides, severe weather, and human-induced hazards, such as industrial accidents or terrorism, when relevant. PANTHEON MHIM is in general, but not explicitly, based on a multi-disciplinary approach suggested by Liu and Siu (2017).

The PANTHEON MHIM process involves the following key steps for each one of the regions examined, i.e. the Île-de-France and Attica:

- Hazard identification and characterization: The hazard identification process involves the determination of the sources and causes of potential hazards, as well as the likelihood and severity of their occurrence. Once potential major hazards are identified, they will be characterized in terms of their nature, magnitude, and potential impact. This involves the determination of the properties and behavior of the hazard, as well as the potential consequences of exposure. Characterization of hazards is important for developing appropriate risk management strategies and measures to control or mitigate the risks associated with the respective hazards.
- Exposure assessment: This includes examination of several factors, such as infrastructure, social and economic conditions, and demographic characteristics, which are exposed to hazards.
- Multi-hazard impact analysis: This is focusing on an overall assessment of the compounding effects of multiple hazards and semi-quantitative analysis for each region for any major hazard that was analysed.

The above methodology represents a general approach with appropriate adjustments to the region examined, to the features of each hazard type analysed and to the data available. In general, the methodology relies on the use of both quantitative data and qualitative information, including historical records, existing knowledge, and consultations based on stakeholder interviews and questionnaires. The main goal of the PANTHEON MHIM approach is to provide comprehensive and integrated information for each region under study that can help PANTHEON stakeholders and partners to design and develop Disaster-Resilient Communities and Conceptual Models aiming to reduce the risks and increase the resilience of the selected communities and infrastructures to multiple hazards. Therefore, a holistic and systematic approach is needed to manage multiple hazards and their potential impacts effectively.

2.1 IDENTIFICATION OF MAJOR HAZARDS AND THEIR INTERACTIONS

Identification of major hazards and their interactions is a crucial step in understanding the potential risks and impacts of natural and human-induced hazards on a particular area or region. The process involves determination and characterization of various hazards as well as analysis of their potential interactions and interdependencies.

The following are some of the major categories of hazards and the respective interactions that have been analysed for hazard identification and characterization in each region (e.g. Walia et al. 2020). The terms and definitions referring to the various types of hazards can be found in the glossary of basic terminology on disaster risk reduction organized by UNESCO (2010):

Geological Hazards: These include hazards related to earthquakes, landslides, and volcanic eruptions. These types of hazards can cause other types of associated hazards such as floods, tsunamis, and droughts. For example, a landslide triggered by heavy rainfall can dam a river and cause flooding, while a strong earthquake can generate a tsunami causing significant damage to coastal infrastructure and communities.

Meteorological Hazards: These include hurricanes, tornadoes, thunderstorms, blizzards, and floods, and they can trigger other types of hazard such as landslides and wildfires. For example, heavy rainfall from a storm can trigger landslides in areas with steep slopes, while strong winds from a tornado can exacerbate a wildfire by spreading embers.

Hydrological Hazards: These include floods, flash floods, and droughts, and they can interact with other hazards such as landslides and wildfires. For example, a landslide or wildfire can reduce vegetation cover and increase runoff, leading to increased flood risk downstream, while a drought can exacerbate wildfire risk by drying out vegetation.

Technological Hazards: These include industrial accidents, transportation accidents, and terrorist attacks. They can interact with other hazards such as earthquakes and floods. For example, an industrial accident can release hazardous chemicals into a river, exacerbating the impact of a flood downstream, while a terrorist attack on a critical infrastructure facility such as a power plant can have cascading effects on the surrounding area.

Major hazards for each region and their interactions are identified on the basis of a multi-disciplinary approach that combines data analysis, national and historical data and stakeholder consultations to understand the potential risks and interdependencies of hazards. The following steps have been undertaken to identify major hazards and their interactions in each region under study. Figure 1 shows a general methodological framework:

Conduct a hazard inventory: The first step is to create an inventory of potential hazards in the region. This includes natural hazards like earthquakes, tsunamis, floods, and landslides, as well as human-caused hazards like industrial accidents and terrorist attacks.

Assess potential interactions: After characterizing individual hazards, the next step is to assess their potential interactions. This includes an evaluation of how different hazards might affect each other, as well as how the impacts of one hazard might be amplified or mitigated by the presence of other hazards.

Hazard categorisation: Once the hazards have been identified, the next step is to characterise them in terms of their frequency, likelihood, and potential impact. This can be done by analysing historical data, risk assessment, and consulting with experts.

Figure 1- Framework used for the analysis in the present deliverable.

2.2 MULTI-HAZARD RISK ASSESSMENT AND RISK MAPPING

The impact analysis from the multi-hazard perspective in a region is usually complex. For example, when multiple hazards occur simultaneously or in rapid succession, their impacts can be compounded, resulting in significant amplification of damage and loss of life.

The general matrix shown in Figure 2, which sometimes is called a risk control matrix, has been suggested by OECD (2012) for the analysis of hazards and their potential impact. However, such a matrix represents only a general scheme and its application depends on several factors. In our analysis an effort has been made to take it into account but not in *stricto sensu*.

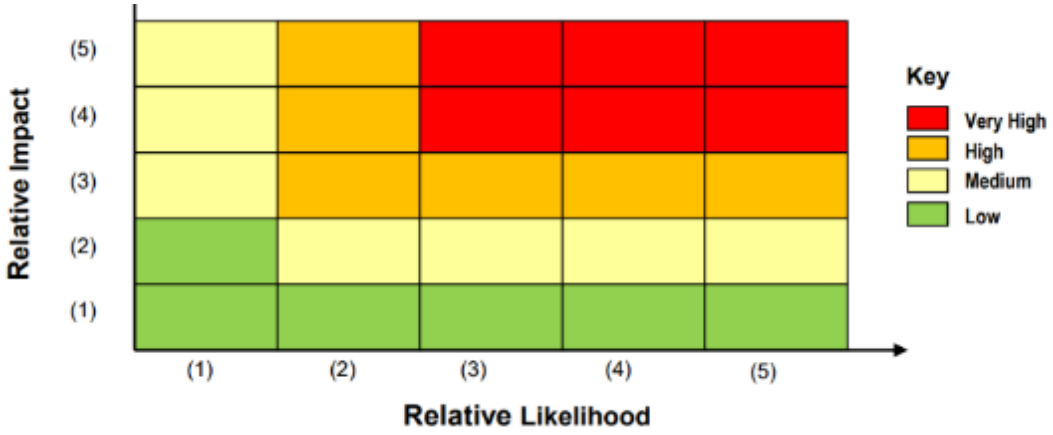

Figure 2- Risk matrix representation on a two-dimensional diagram (extracted from OECD 2012).

The main impacts from multi-hazards can be classified as follows (UNDRR, 2020):

Physical damage to infrastructure: Multi-hazards can cause significant physical damage to infrastructure, such as buildings, roads, bridges, and utility systems. For example, an earthquake can cause various damages to such infrastructures. However, an earthquake followed by heavy rainfall can also result in landslides and flooding that may cause further damage to roads and bridges, thus disrupting transportation and communication systems.

Displacement of populations: Multi-hazards can cause temporary or permanent displacement of populations. Displacement can be caused by physical damage to homes and buildings, or by the need to evacuate due to the potential for further hazards, such as aftershocks after a strong main shock.

Loss of life: Multi-hazards can result in the loss of life due to physical trauma or because of exposure to hazardous materials or conditions. For example, an earthquake followed by a tsunami can result in significant loss of life due to drowning or exposure to hazardous materials.

Economic impacts: Multi-hazards can have significant economic impacts on a region, including loss of income, damage to businesses, loss of insured property, and disruptions to supply chains. These impacts can be long-lasting, affecting the region's economic development and stability for several years.

Social impacts: Multi-hazards can also have significant social impacts on a region, including loss of community cohesion, increased stress and trauma, and disruption to social and cultural norms. These impacts can be particularly pronounced among vulnerable populations, such as low-income households or ethnic and racial minorities.

Environmental impacts: Multi-hazards can also have significant environmental impacts on a region, including contamination of water and soil, loss of biodiversity, and disruption to natural ecosystems. These impacts can be long-lasting and can have broader implications for global climate change and sustainability.

Overall, the impact from multi-hazards in the regions under study can be severe and long-lasting, highlighting the importance of comprehensive disaster risk reduction strategies that consider the potential interactions between different hazards and their impacts on vulnerable populations and the environment (Figure 3). PANTHEON follows a comprehensive approach that considers the characteristics of each region, the potential compounding effects of multiple hazards, and the need to build resilience in local communities.

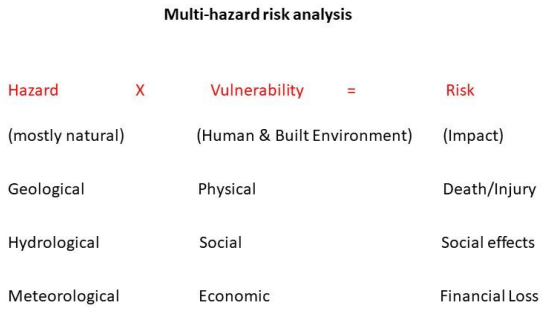

Figure 3- Multi-hazard risk analysis of the present deliverable.

3. Application of the Multi-Hazard Impact Methodology to Île-de-France Region

The Île-de-France is a region (Figure 4a) in the north-central part of France, encompassing the city of Paris and its surrounding suburbs. It is the most populous region in France, with a population of over 12 million people, and covers an area of 12,011 square kilometers[3].

The region is divided into eight administrative departments (Figure 4b): Paris, Seine-et-Marne, Yvelines, Essonne, Hauts-de-Seine, Seine-Saint-Denis, Val-de-Marne, and Val-d'Oise. It is bordered by the regions of Hauts-de-France to the north, Grand Est to the east, Bourgogne-Franche-Comté to the southeast, Centre-Val de Loire to the southwest, and Normandy to the northwest.

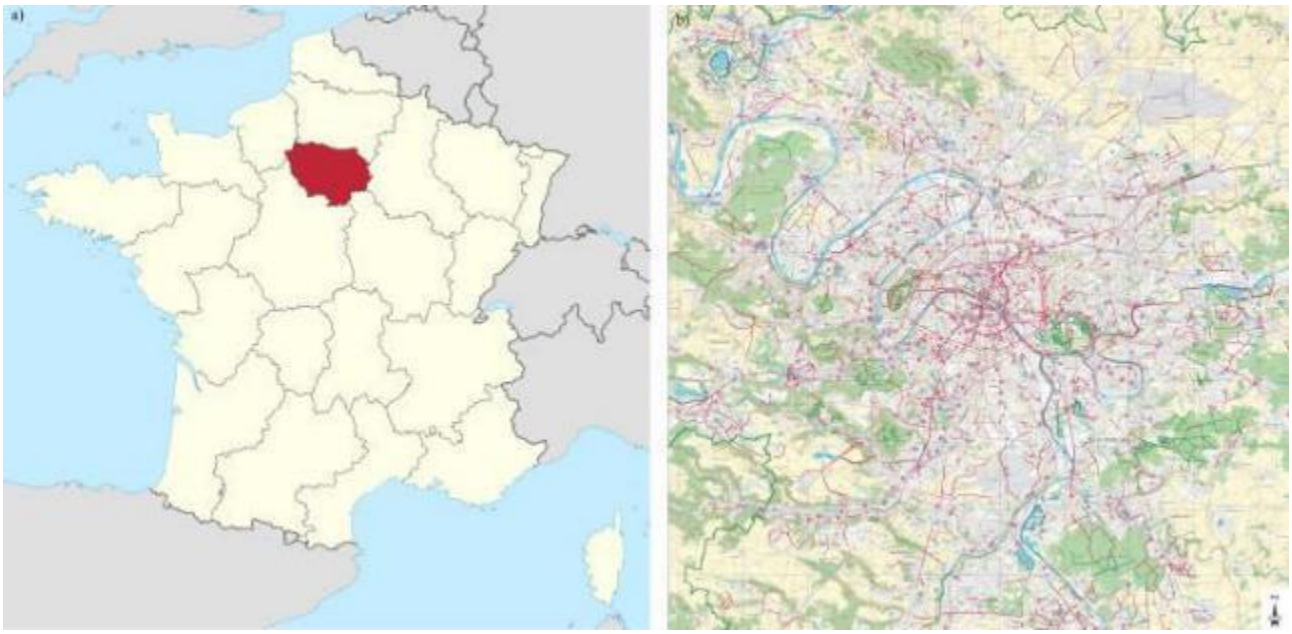

Figure 3- Map of France (a) and the region of Île-de-France (b) (extracted from Pescaroli and Nones, 2016).

The Île-de-France region is the economic and cultural center of France, with many of the country's major industries and businesses based there. It is also a major tourist destination, with numerous historic and cultural landmarks, museums, and art galleries. The region is served by an extensive transportation network, including multiple airports, train stations, and a comprehensive metro and bus system.

Due to its location and importance, the Île-de-France region is vulnerable to a range of hazards, including natural disasters such as flooding and earthquakes, technological accidents such as transportation accidents and chemical spills, and security threats such as terrorist attacks. As such, it is essential to have

[3] Île-de-France, https://en.wikipedia.org/wiki/%C3%8Ele-de-France; last access 04 May 2023

effective disaster risk reduction policies and emergency preparedness measures in place to minimise the potential impact of these hazards on the region and its population.

To address these challenges, the Île-de-France region has developed various initiatives and policies to enhance its resilience to hazards. For the purposes of this deliverable, the MHIM methodology will be applied to the first part of the assessment methodology for the case of the Île-de-France region (and not on mitigation measures and procedures), and focus on mapping the exposure of the region to various hazards along with assessing the potential impacts of these hazards, including floods, earthquakes, heatwaves, and terrorist attacks.

The MHIM will be broken down into the following steps:

Identification of Hazards: The first step in the MHIM methodology is to identify the hazards that could potentially impact the Île-de-France region. These hazards may include natural disasters such as floods and earthquakes, technological accidents such as chemical spills, and security threats such as terrorist attacks.

Assessment of Exposure**:** The next step is to assess the vulnerability of the region to the identified hazards. This involves the exposure of the population, infrastructure, and the environment to the identified hazards. For example, in the case of flooding, the assets that are exposed to flooding are people, property, infrastructures

Risk analysis: The final step is to assess the impact of the region based on the characteristics of hazards and the assets that are under threat in a potential hazard. The impact may be quantitative, qualitative or semi-quantitative. The analysis will have based on the risk assessment of each hazard that is analysed as well as on the studies that have been performed.

3.1 MULTI-HAZARD DESCRIPTION, IDENTIFICATION AND INTERACTIONS

In this subsection, the first part of the aforementioned MHIM assessment methodology will be applied for the case of the Île-de-France region, for all hazards identified through previous deliverables.

3.1.1 EARTHQUAKES

Identification of Hazards

Although relatively rare, earthquakes can occur in the Île-de-France region mostly triggered by activity in nearby regions or by human-made activities such as mining (Figure 5). Historically, the region has experienced several small to moderate earthquakes. For example, in 1716, and in 1984, an earthquake with a magnitude of around 4.5 and a 5.4 magnitude earthquake respectively were felt in the area of Paris[4].

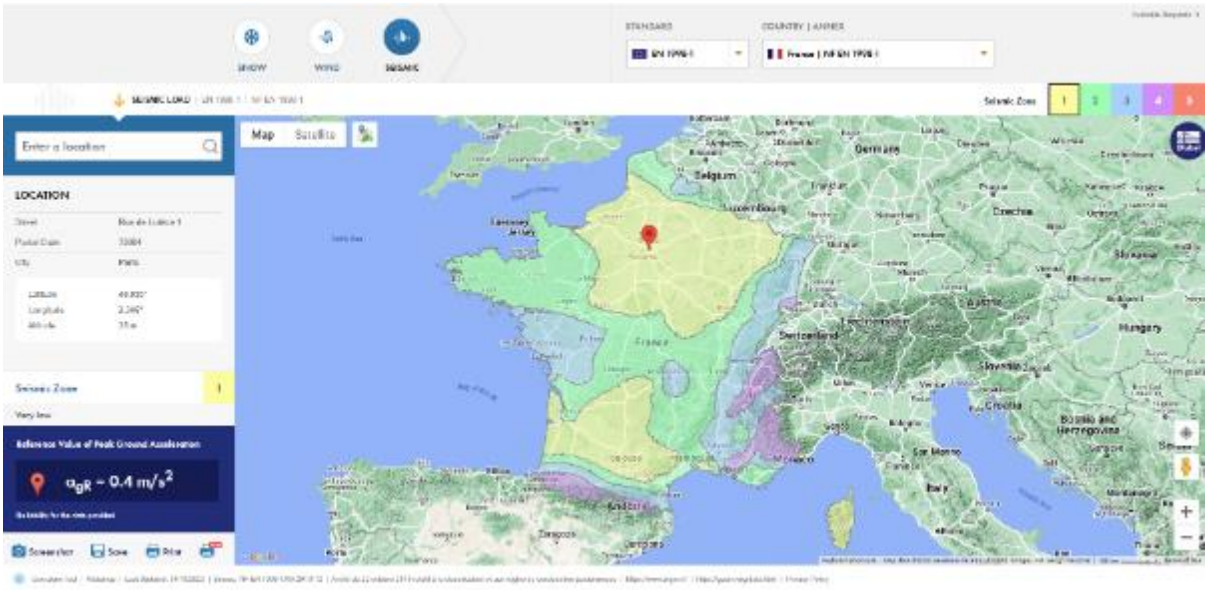

Figure 4- Map of main seismic zones in France[5]

[4] Earthquakes in France, https://www.worlddata.info/europe/france/earthquakes.php, last access 30 June 2023

[5] Classification of seismic zones in France, (https://www.dlubal.com/en/load-zones-for-snow-wind-earthquake/seismic-nf-en-1998-1.html), last access 29 May 2023

3.1.2 FLOODS

Description and Identification

The Île-de-France region is at high risk of flooding due[6] to its location along the Seine River and its tributaries, which can overflow their banks during heavy rainfall, snowmelt, or storm surge. The Île-de-France region, which includes the capital city of Paris, has experienced several significant flooding events throughout history. Here are a few notable events[7]:

1910. It was one of the most devastating floods in the region's history, which affected not only Paris but also many surrounding areas. The Seine River reached its highest level in over 200 years, flooding much of the city and causing widespread damage. It took several weeks for the water to recede, and many people were left homeless.

1955. In that year, heavy rainfalls caused significant flooding in several parts of France, including Île-de-France. The Seine River overflowed its banks once again, and many people were evacuated from their homes. This flood also caused significant damage to the city's infrastructure, including roads and bridges.

2016. In June 2016, Île-de-France experienced another episode of heavy rainfall, which caused flooding in several areas of the region. This flood was not as severe as the previous two but still caused significant damage, particularly in the suburbs of Paris. The Seine River once again rose to a dangerous level, prompting the closure of several tourist attractions.

2018. In January 2018[8], the Seine River once again overflowed its banks due to heavy rainfall. Several suburbs of Paris were affected, and many people were forced to evacuate their homes. This flood also caused significant transportation disruptions, with several train lines being closed due to flooding.

Interaction

Floods can interact with these hazards in several ways, leading to increased risks and potential impacts.

Landslides: Floods can increase the risk of landslides in areas with steep slopes or unstable soil. The saturation of soil with water can cause the ground to become unstable, leading to landslides that can damage infrastructure, buildings, and homes, and pose a significant threat to human life.

Technological Hazards: Floods can damage critical infrastructure such as roads, bridges, and buildings. This damage can be particularly severe when combined with other hazards, such as earthquakes or high winds. The loss of infrastructure can hinder emergency response efforts and cause significant economic losses. The interaction between floods and technological hazards may lead to significant impacts on both

[6] INSEE. (2021). Risks and hazards in Île-de-France, https://www.insee.fr/fr/statistiques/fichier/1559415/aval_decembre_2010_art1_101.pdf, last access 04 July 2023

[7] Seine Basin, Île-de-France: Resilience to Major Floods, https://www.oecd.org/gov/risk/Flood-risk-management-seine-river-executive-summary.pdf, last access, 11 June 2023

[8] Agence Parisienne du Climat. (2021). Floods in Paris and the Île-de-France region, https://www.apc-paris.com/actualite/crue-seine-janvier-consequence-changement-climatique, last access 30 June 2023

human life and infrastructure. In the context of the Île-de-France region, floods can interact with technological hazards, such as chemical spills.

Contamination of water sources: Floods can lead to the contamination of water sources with pollutants, such as sewage or chemicals. This can pose a significant threat to public health and the environment.

Urban flooding: Urban flooding, which occurs when rainfall overwhelms the drainage system in urban areas, can lead to inundation of buildings, homes, and roads. This can be worsened by the occurrence of other hazardous events, such as landslides and ground subsidence, which can exacerbate the effects of flooding and increase the risk of structural damage.

3.1.3 HEATWAVES

Description and Identification

The Île-de-France region is prone to heatwaves, particularly during the summer season and lately, more often due to the climate change effects. Heatwaves can be dangerous, especially for vulnerable populations such as the elderly, young people and those with pre-existing medical conditions. In recent years, the region has experienced several heatwaves, with temperatures reaching well above 30°C (86°F). The diagram in Figure 6 shows that in France heatwaves cause the highest number of fatalities among the various natural disasters in the country.

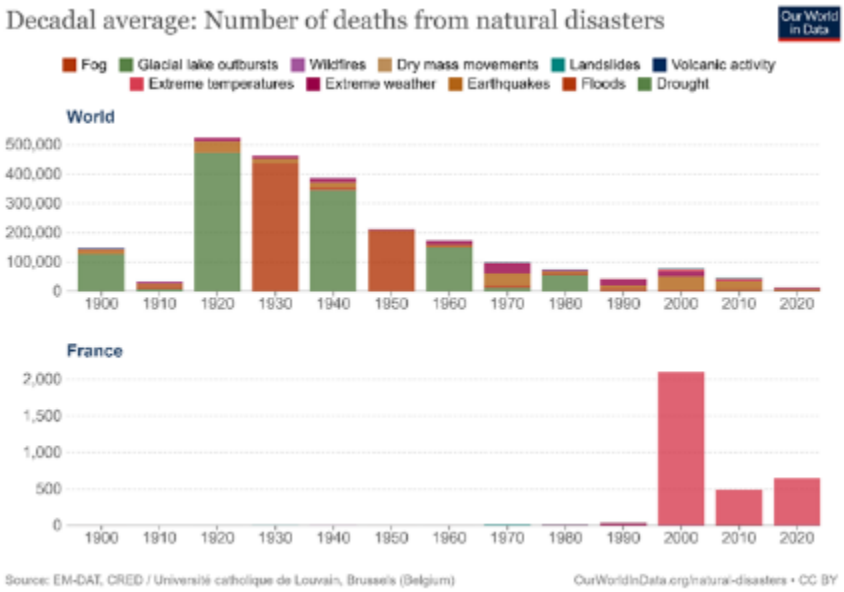

Figure 5- Disasters caused by natural hazards worldwide and in France in the time interval 1900–2020[9].

3.1.4 TECHNOLOGICAL HAZARDS

Description and Identification

The Île-de-France region is home to several large industrial sites, including chemical plants, oil refineries, and storage facilities, which can pose a risk of accidents or spills. Additionally, the region's extensive transportation networks, including highways, railways, and airports, can also pose a risk of accidents. Some examples of technological hazards that occurred in Île-de-France are briefly described below:

Industrial accidents: In 2019, a fire broke out at a lubricant factory in the town of Aubervilliers, causing the release of toxic smoke into the air. The incident led to the evacuation of nearby residents and a closure of schools and public transportation.

Transportation accidents: In 2013, a train derailment and explosion occurred in the town of Bretigny-sur-Orge, killing seven people and injuring dozens more. The incident resulted in the suspension of train services in the region and caused significant disruptions to transportation.

[9] Natural Disasters in France, https://ourworldindata.org/natural-disasters, last access 29 May 2023

Cyberattacks: In 2021, a cyberattack on the French health insurance system resulted in the theft of personal information of millions of people, including their social security numbers and health records. The incident raised concerns about the security of personal data and led to calls for greater cybersecurity measures.

Chemical spills: In 2019, a chemical spill occurred in the Seine River near Rouen, resulting in the closure of several water treatment plants and disruptions to the water supply for millions of people in Île-de-France.

These examples demonstrate the potential impacts of technological hazards on the region and highlight the importance of emergency preparedness and response planning.

Interaction

Technological hazards can interact with other hazards in the Île-de-France region in various ways. Some of these interactions are:

Flooding: Heavy rainfall or other natural disasters can cause flooding that may damage or disrupt industrial facilities, leading to potential technological hazards, such as chemical spills, gas leaks, or explosions.

Heatwaves: High temperatures can increase the risk of technological hazards, such as electrical fires, transformer explosions, or overheating of industrial equipment.

Transportation accidents: Accidents involving transportation of hazardous materials by road, rail, or waterways can pose a significant risk to public safety and the environment, especially if they occur during natural disasters or extreme weather conditions.

Power outages: Power outages caused by natural disasters, infrastructure failures, or cyber-attacks can disrupt critical infrastructure and increase the risk of technological hazards such as nuclear power plant malfunctions, chemical plant explosions, or oil refinery fires.

Cyber-attacks: Cyber-attacks on industrial control systems or other critical infrastructure can cause significant disruptions and increase the risk of technological hazards, such as equipment failure, explosions, or toxic compounds releases.

3.1.5 TERRORISM

Description and Identification

The Île-de-France region has been the target of several terrorist attacks in recent years[10]. These attacks have targeted various locations, including public spaces, transportation networks, and cultural sites. Some

[10] OECD. (2020). Resilience to terrorist attacks and other disasters: Lessons from Paris, https://www.oecd-ilibrary.org/docserver/8af4ab29-en.pdf?expires=1688467964&id=id&accname=guest&checksum=E5F66E327E47D60D2D3ED50F68147CFD, last access 04 July 2023

of the most notable attacks include the November 2015 Paris attacks, which resulted in the deaths of 130 people and hundreds of injuries, and the July 2016 truck attack in Nice, which killed 86 people and injured over 400 others. Some characteristic examples are briefly described below:

Charlie Hebdo attack: In January 2015, terrorists attacked the offices of the satirical magazine Charlie Hebdo in Paris, killing 12 people and injuring many more. The attack had a profound impact on French society and led to debates about freedom of expression and the integration of immigrant communities.

Bataclan attack: In November 2015, terrorists attacked the Bataclan theatre in Paris during a concert, killing 90 people and injuring many more. The attack had a significant impact on the tourism industry and led to increased security measures in public spaces throughout the city.

Nice truck attack: In July 2016, a terrorist drove a truck into a crowd celebrating Bastille Day in Nice, killing 86 people and injuring many more. The attack led to increased security measures at public events throughout France and had a significant impact on tourism in the region.

Notre-Dame attack: In June 2021, a man attacked police officers with a knife near the Notre-Dame cathedral in Paris, injuring several people. The attack raised concerns about the security of public spaces and led to increased police presence in the area.

Interaction

Terrorism can interact with other hazards in the Île-de-France region in various ways. Some of these interactions are:

Natural disasters: Terrorist attacks may occur during or immediately after natural disasters, such as earthquakes or floods, when emergency services and infrastructure are already stretched, leading to increased casualties and damage.

Cyber-attacks: Cyber-attacks on critical infrastructure, such as transportation or energy networks, can create increased vulnerabilities that terrorist groups may exploit to launch physical attacks, such as bombings or shootings.

Transportation accidents: Accidents involving transportation infrastructure, such as bridges or tunnels, may create opportunities for terrorists to launch attacks or cause disruption to transportation networks.

Chemical or biological incidents: Terrorist groups may use chemical or biological agents as weapons, causing significant harm to human health and the environment.

3.2 DETERMINATION OF IMPACTS, MULTI-HAZARD RISK ASSESSMENT AND RISK MAPPING

Identification of impacts from hazards is a critical step in the disaster risk management process. It involves assessing the potential effects of a hazard on the environment, society, and economy. Here are some impacts that may result from various hazards:

Physical impacts: Physical impacts can include damage to buildings, infrastructure, and natural resources, such as waterways and forests. For example, earthquakes can cause structural damage to buildings and bridges, while hurricanes can lead to flooding and wind damage.

Health impacts: Hazards can also have adverse effects on human health. For example, exposure to hazardous chemicals or pollutants can cause respiratory problems or other illnesses. Natural disasters such as floods and hurricanes can also result in injuries or fatalities.

Economic impacts: Hazards can have significant economic impacts, including damage to property, lost productivity, and disruptions to supply chains. In some cases, businesses may be forced to close temporarily or permanently, resulting in job losses, and reduced economic activity.

Social impacts: Hazards can also have social impacts, such as displacement of communities, loss of cultural heritage, and psychological diseases. For example, residents may experience stress, anxiety, and depression following a natural disaster.

Environmental impacts: Hazards can also have adverse effects on the environment, including damage to ecosystems and wildlife habitats. For example, oil spills can have long-term effects on marine life and the ocean environment.

In this section the focus is on the major impacts coming from the analysis of the previous chapter, i.e. the major impacts of floods, heatwaves, technological hazards and terrorism in the Île-de-France region.

3.2.1 EARTHQUAKES

Impacts

The effects of earthquakes are multifold. Key impacts are summarised as damage to buildings and infrastructures, cut-off to lifelines, such as energy and water supply and telecommunications, disruption to transportation, economic losses as well as a variety of social and psychological impacts. Such kinds of earthquake impacts are analysed in more detail in the case of Attica region, Greece, since earthquake risk in that region is much higher than in Île-de-France region.

Risk Assessment

The French government has taken steps to prepare for potential earthquakes in the region, including the conduct of seismic surveys and implementation of building codes to ensure that structures are earthquake-resistant. However, the risk of a large earthquake occurring in Île-de-France is considered low.

It is important to note that earthquake preparedness is still important, even in regions where earthquakes are rare. It is recommended that residents should familiarize themselves with earthquake safety procedures, such as drop, cover, and hold on, and have emergency supplies on hand in case of an earthquake or other disaster (Beauval and Bard, 2022).

3.2.2 FLOODS

Impact

There are just a few examples of significant flooding events that have occurred in Île-de-France over the years. The 2018 impacts of the floods were significant and widespread. Here are some of the key impacts:

Damage to the infrastructure: The floods caused damage to roads, bridges and buildings, including residential homes and businesses. In some cases, entire neighbourhoods were submerged under water.

Disruption to the transportation system: The floods disrupted transportation systems, including trains, buses, and metro lines. Some roads were also closed due to flooding, causing traffic jams and delays.

Economic losses: The floods had a significant impact on the local economy, with many businesses forced to close temporarily or permanently. The cost of the damage was estimated to be in the order of hundreds of millions of euros.

Health risks: The floods posed health risks to residents, as floodwaters can be contaminated with sewage and other hazardous materials. There were concerns about the spread of diseases such as leptospirosis, a bacterial infection that can be transmitted through contact with contaminated water.

Psychological impacts: The floods also had a significant psychological impact on residents, many of whom lost their homes and belongings. The stress and trauma associated with such events can have long-lasting effects on mental health.

Risk Assessment

While the region has taken steps to mitigate the effects of future floods, including building flood walls and improvement of the drainage systems, the threat of flooding remains a concern for residents and authorities alike. To address this risk, the region has developed a Flood Risk Management Plan[11], which includes various countermeasures, such as the construction of flood protection infrastructure, the establishment of emergency response teams, and the development of early warning systems to help mitigate the impact of future flooding events.

In response to the 2018 floods, the French government declared a state plan and implementation of measures against natural disaster to support those affected. This included financial assistance for homeowners and businesses, as well as support for the reconstruction of damaged infrastructure.

[11]Flood in Seine River, https://www.oecd.org/gov/risk/preventing-the-flooding-of-the-seine-2018.pdf, last access 30 June 2023

There have been several existing risk and impact assessments conducted on floods in Île-de-France region. The period of the floods extends normally from November to March. Outside this period, storms with heavy rainfall can also cause flooding. Here are some of the key results from these assessments:

Flood-prone areas: According to a study conducted by the French Ministry of Ecology, Sustainable Development, and Energy in 2011[12], the areas at highest risk of flooding in Île-de-France are located along the Seine River (Figure 7) and its tributaries. The study identified several flood-prone zones within the region, including the Val-de-Marne, Essonne, and Yvelines departments.

Figure 6- Great flood of Île-de-France in Paris, 2018[13].

Evaluation of critical infrastructure: Another study conducted by the French Ministry of Ecology in 2018[14] evaluated the potential impacts of flooding on critical infrastructure in Île-de-France. The study identified several critical infrastructure systems that are vulnerable to flooding, including transportation networks, water treatment plants, and healthcare facilities. The study also noted that disruption to transportation networks could have significant economic impacts on the region.

Potential impacts: The French Ministry of Ecology study noted that floods in Île-de-France could have significant impacts on public health, including an increase in waterborne diseases and other health risks. The study also noted the potential for significant economic impacts, including damage to infrastructure and disruption to businesses. In the event of a 100-year flood, it is estimated that 350,000 people are likely to be flooded and more than 850,000 people will be affected, for example by electricity cut off and flooded cellars.

Mitigation strategies: The French government has implemented several mitigation strategies to reduce the risk and potential impacts of floods in Île-de-France. These strategies include the construction of new

[13] Photo courtesy, (https://www.preventionweb.net/news/further-improvements-needed-manage-major-flood-risk-paris-and-seine-basin), last access 30 May 2023

flood protection infrastructure, such as levees and dams, and the implementation of flood warning systems to improve emergency response.

Cost-benefit analysis: A cost-benefit analysis from Bouleau, et al. (2020) found that the implementation of flood protection measures in Île-de-France would result in significant economic benefits, including reduced damage to infrastructure and improved public safety.

Risk Mapping

Météo-France is a public service, attached to the Ministry of Transport. The central office has been located in Paris since 1887, but the services are now highly decentralized. The National School for Meteorology (Ecole Nationale de Meteorologie, ENM) and the National Centre for Meteorological Researches (Centre National de Recherches Météorologiques CNRM) are in Toulouse. Each department has its local meteorological centre (Centre départemental météorologique Cdm), gathered in seven regional directorates.

The main mission of Météo-France consists in surveying and forecasting the state of the atmosphere, the snow mantel, and the superficial ocean, and to ensure security of individuals and goods. It is also in charge of studying the climate and its evolution (CNRM, with three specialized units – snow, ocean and aviation).

Météo-France provides meteorological bulletins for weather forecasts, which are available at any time by phone or internet. It also offers a vigilance map.

Vigilance was set up by Météo-France to inform both the public and the authorities about hazardous weather conditions in metropolitan France. The aim is to alert the public to any situation which might become dangerous in a time frame of 24 hours.

It consists of a map of metropolitan France which indicates any climatic danger threatening one or more departments in the next 24-hour period. Seven types of threats are considered: high winds, heavy rainfalls, thunderstorms, snow/ice, avalanches, heat waves and cold waves. Each department is coloured in a threat level, green, yellow, orange, or red, depending on the meteorological situation and the level of alert required as described below.

Level 1: Green: No need to take any special precautions.

Level 2: Yellow: Occasionally hazardous weather events which are nonetheless quite normal in this area (e.g. mistral, thunderstorms) are forecasted.

Level 3: Orange: hazardous weather events of great severity are forecasted.

Level 4: Red: hazardous weather events of exceptional severity are forecasted.

The map is updated twice a day, at 6 a.m. and 4 p.m. In the event of a significant change, it can be updated at any time. When the map contains an orange or red area, a pictogram shows the type of event forecast; it is also accompanied by follow-up reports which are updated as often as necessary. The reports specify

the event's development, trajectory, severity, and duration, as well as the possible consequences of the event, and offer advice from the authorities about what one should do.

The purpose of vigilance is to inform the public and the professionals in a clear and easy to use way. Moreover, addresses the authorities whose job is to alert and mobilise the emergency services. It has replaced the alert system in operation since 1993, which was specifically designed for the emergency services.

As for floods, their causes are not only atmospheric. They are predicted by the Flood forecast Service (Service de Prévision des Crues), whose results are transmitted into the Météo-France website. Rainfalls are included in the meteorological vigilance; their duration and intensity are forecasted.

The scope of flood monitoring includes the main metropolitan waterways. On these rivers, the State takes charge of the regulatory mission of monitoring, forecasting and transmitting information on floods, in application of Articles L. 564-1, L. 564-2 and L. 564-3 of the environment code15.

The master plans for flood forecasting define the conditions for this responsibility by the State. These watercourses are those for which the importance of the stakes (people and goods exposed to danger) justify the intervention of the State and for which the forecast of the risk of flooding by overflow of watercourses is technically possible at an economically acceptable cost.

On other rivers, local authorities can set up their own surveillance systems, in addition to those set up by the State.

Outside of these waterways there is a risk of flooding caused directly by local runoff from heavy rains. Information relating to this risk is provided by the meteorological vigilance set up by Météo-France, which you can be accessed using the link provided on the flood vigilance map (Figure 8).

[15] Weather in France, https://meteofrance.fr/actualite/actualite-de-meteo-france/la-vigilance-de-meteo-france-etendue-au-lendemain-pour-mieux-se-preparer-aux-dangers, last access 14 June 2023

Figure 7- Flood forecasting for Paris region[16].

Overall, these assessments provide important insights into the risks and potential impacts of floods in Île-de-France, as well as the strategies that can be implemented to mitigate these risks and improve public safety and resilience.

ThinkHazard! – A multi-hazard tool

An important multi-hazard tool developed in the last years is the one called "ThinkHazard!". This is an analytical tool dedicated to improving knowledge and understanding of natural hazards. The primary users are development sector professionals, who need to gather hazard information while planning projects. However, the benefits of ThinkHazard! stretch beyond the development sector, into general education about global distribution of multiple hazards and how to manage them.

ThinkHazard! is developed and maintained by the Global Facility for Disaster Reduction and Recovery (GFDRR Labs). Version 1 of the tool was used over 140,000 times in 200 countries and has been adopted into the World Bank Operations Portal for core use in project planning.

ThinkHazard! is a web-based tool enabling non-specialists to consider the impacts of disasters on new development projects. Users can quickly and robustly assess the level of river flood, earthquake, drought,

[16] Vigicrues platform, https://www.vigicrues.gouv.fr/faq.php, last access 30 May 2023

cyclone, flood, tsunami, volcano, and landslide hazard within their project area to assist with project planning and design (Figure 9).

ThinkHazard! is a simple flag-based system to highlight the hazards present in a project area. As such, a user is only required to enter their project location – national, provincial or district name. The results interface shows a user whether they require high, medium, or low awareness of each hazard when planning their project.

ThinkHazard! also provides recommendations and guidance on how to reduce the risk from each hazard within the project area and provides links to additional resources such as country risk assessments, best practice guidance and additional websites. In addition, the tool shows how each hazard may change in the future because of climate change.

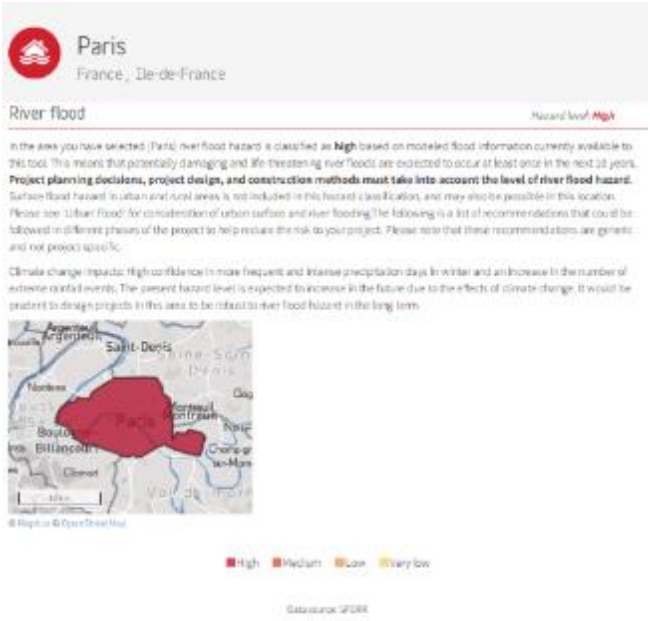

Figure 8- Flood risk map for the Île-de-France region[17].

[17] ThinkHazard platform, https://thinkhazard.org/en/report/16280-france-ile-de-france-paris/FL, last access 30 May 2023.

3.2.3 HEATWAVES

Impacts

Heatwaves can have significant impacts on the environment, society, and economy of Île-de-France. Here are some of the major impacts of heatwaves:

Health impacts: Heatwaves can cause heat exhaustion and heatstroke, particularly among vulnerable populations such as the elderly, children, and those with pre-existing health conditions. In Île-de-France, heatwaves have been associated with an increase in hospital admissions and deaths (Hong et al., 2022) .

Economic impacts: In the study[18] was found that heatwaves can have significant economic impacts, including reduced productivity in the construction and agricultural sectors, increased healthcare costs and increased energy consumption for air conditioning, which is directly translated to reduced productivity.

Environmental impacts: Heatwaves can have adverse effects on the environment, including reduced water quality and increased air pollution. For example, during heatwaves, the concentration of pollutants, such as ozone and particulate matter (PM), can increase, thus leading to respiratory or cardio problems.

Infrastructure impacts: Heatwaves can also affect infrastructure, particularly transportation systems. For example, during a heatwave in 2019, the heat caused rail tracks to buckle, resulting in train cancellations and delays.

Social impacts: Heatwaves can also have social impacts, such as increased social isolation and reduced participation in outdoor activities. In Île-de-France, heatwaves have been associated with a decrease in attendance at cultural events and outdoor festivals with a direct economic impact. A study conducted by the French National Institute of Health and Medical Research (INSERM) in 2018[19] found that vulnerable populations, such as the elderly and those with pre-existing health conditions, are at higher risk of heat-related illness and death during heatwaves. The study also noted that social isolation and lack of access to air conditioning can exacerbate these risks.

Future risks: A study conducted by the French Environment and Energy Management Agency in 2018 evaluated the potential impacts of climate change on heatwaves in Île-de-France[20]. The study found that climate change is likely to increase the frequency and intensity of heatwaves in the region, highlighting the need for continued investment in mitigation and adaptation strategies.

[18] Economic losses from climate-related extremes in Europe (8th EAP), https://www.eea.europa.eu/ims/economic-losses-from-climate-related, last access 30 June 2023

[19] INSEE. (2018). Évolution de l'espérance de vie à la naissance, https://www.insee.fr/fr/statistiques/3676610?sommaire=3696937, last access 04 July 2023

[20] ADEME. (2018). Évaluation des impacts potentiels du changement climatique sur les épisodes de canicule en Île-de-France, https://www.arec-idf.fr/fileadmin/NewEtudes/000pack3/Etude_2851/20221115_diag_PRACC.pdf, last access 04 July 2023

Risk mapping

The basic climate change scenarios for this plan, communicated through regular reports (Ouzeau et al., 2014) include a state-of-the-art of the projection of heat wave occurrence and intensity over the 21st century in France (Figure 10).

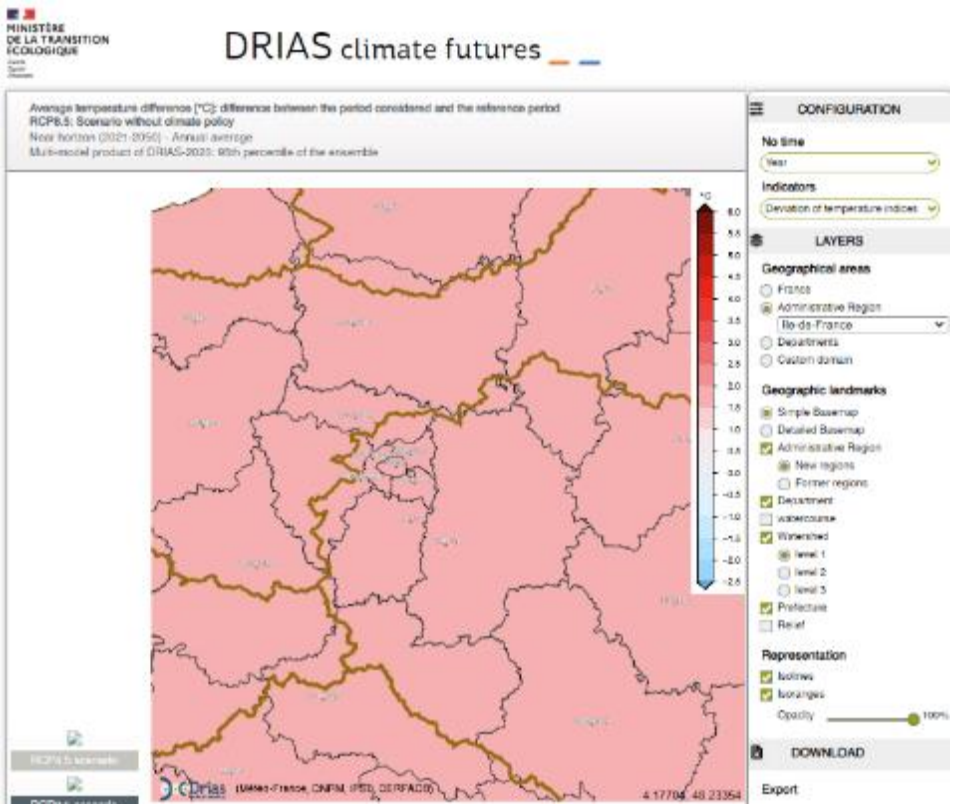

Figure 9- Climate simulations for the metropolis of Île-de-France[21].

Overall, these assessments provide important insights into the risks and potential impacts of heatwaves in Île-de-France, as well as the strategies that can be implemented to mitigate these risks and improve public safety and resilience. During heatwaves, the French government has implemented various measures to protect public health. Such measures include opening cooling centers, distributing information on how to stay cool and hydrated, and limiting outdoor activities during the hottest parts of the day. The French government has also taken steps to mitigate the effects of heatwaves, including the implementation of green infrastructures, such as green roofs and walls, aiming to help reduction of urban heat island effects. Additionally, the government has established a heatwave warning system, to warn residents of potential risks and give advice for protection measures.

[21] DRIAS Climate scenarios, http://www.drias-climat.fr/decouverte/ cartezoom/ scenario/EUROCORDEX2020_DISTRIBUTION_ELAB/Q95/RCP8.5/RCP8.5/H1/ATAV/ATAV/A1, last access 30 May 2023

3.2.4 TECHNOLOGICAL HAZARDS

Impacts

Technological hazards can have significant impacts on the environment, society, and economy of Île-de-France. Here are some of the major impacts of technological hazards:

Health impacts: Technological hazards can cause acute or chronic health effects, depending on the type and severity of the hazard. For example, industrial accidents can release toxic chemicals into the air or water, leading to respiratory problems, cancer, or other illnesses.

Economic impacts: Technological hazards can also have economic impacts, including damage to property and infrastructure, loss of productivity, and disruptions to supply chains. For example, a chemical spill in a major transportation hub could result in significant economic losses due to delays and cancellations.

Environmental impacts: Technological hazards can have adverse effects on the environment, including pollution of air, water, and soil. For example, industrial accidents or oil spills can result in long-term environmental damage and harm to wildlife.

Infrastructure impacts: Technological hazards can also affect infrastructure, particularly transportation systems. For example, a major accident or incident at an airport or train station could result in disruptions to travel and economic activity.

Social impacts: Technological hazards can also have social impacts, such as increased social isolation and reduced trust in institutions. For example, a major incident at a nuclear power plant could lead to widespread fear and anxiety among the population.

Risk Assessment

Île-de-France is the most populous region in France and is home to numerous industrial sites, transportation networks, and other critical infrastructure. As a result, it is vulnerable to various technological hazards, such as chemical spills, industrial accidents, and transportation accidents.

The French government has implemented several measures to mitigate these risks, including strict regulations for industrial sites, emergency response plans, and regular safety inspections. The government has also established specialized response teams to deal with potential accidents or spills, such as the Sécurité Civile, which is responsible for responding to large-scale disasters and emergencies.

Despite these measures, accidents can still occur, as was the case in the 2019 Lubrizol chemical plant fire in Rouen, which caused widespread concern in the region. The incident highlighted the need for continued vigilance and improvement of safety measures in the region.

It is important for residents and businesses in the Île-de-France region to be aware of the potential risks posed by industrial sites and transportation networks and to take appropriate precautions. This includes following emergency instructions in the event of an accident or spill and being prepared with emergency supplies and evacuation plans.

Figure 10- Industrial accident: Lubrizol Factory[22].

One study conducted by the French Environment and Energy Management Agency (ADEME) in 2016[23] focused on the risks of technological hazards in the Île-de-France region. The study assessed the potential impacts of various technological hazards, including transportation accidents, industrial accidents, and terrorist attacks. The study also evaluated the vulnerabilities of different areas of the region and identified priority areas for risk reduction and emergency planning.

A major industrial hazard (Figure 11) is an accidental event occurring on an industrial site and leading to immediate serious consequences for the personnel, the neighbouring populations, property and/or the environment. Establishments deemed to be hazardous are subject to a specific regulation. The regulations governing facilities classified for the protection of the environment which are the most dangerous ones are listed as "Seveso" establishments.

Another study conducted by the French National Institute for Industrial Environment and Risks (INERIS)[24] in 2018 focused on the risks of chemical accidents in the Île-de-France region. The study identified areas of the region with a high density of chemical facilities and assessed the potential consequences of different types of chemical accidents. The study also proposed recommendations for improving the safety of chemical facilities and emergency response measures.

The assessment of potential technological hazards in the Île-de-France region has resulted in several key findings. These include:

[22] Photo courtesy, https://www.itgagroup.com/industrial-accident-lubrizol-factory/), last access 30 May 2023
[23] ADEME. (2016). Évaluation des risques technologiques en Île-de-France. https://ile-de-france.ademe.fr/sites/default/files/guide-pratique-pcaet-ile-de-france.pdf, last access 04 July 2023
[24] INERIS. (2018). Évaluation des risques d'accidents industriels impliquant des substances chimiques en Île-de-France. https://www.ineris.fr/sites/ineris.fr/files/contribution/Documents/INERIS_RS_2019-BDissuHD2.pdf, last access 04 July 2023

High density of critical infrastructure: The region has a high density of critical infrastructure, including chemical plants, oil refineries, and transportation networks. This concentration increases the risk of technological hazards and their potential impact.

Transportation accidents: Transportation accidents, such as train derailments and plane crashes, are a significant hazard in the region due to its large airport and extensive rail network. These accidents can cause significant damage to infrastructure and pose a threat to human safety.

Industrial accidents: The region has many industrial facilities, which can pose a risk of accidents such as fires, explosions, and chemical spills. These accidents can cause significant damage to the environment and pose a threat to human safety (Figure 12).

The ARIA (Analysis, Research and Information on Accidents) database lists incidents or accidents that were, or could have been, deleterious to human health, to public safety or to the environment. These events stem from: activities carried out at plants, workshops, warehouses, construction sites, quarries, breeding farms, etc., cited in legislation specific to Classified Facilities;

- transport of hazardous materials by rail, road, river/canal or sea;
- gas distribution and use;
- operations of pressurised equipment;
- mines and underground storage facilities;
- dykes and dams.

ARIA has an inventory of over 46,000 accidents and incidents occurring in France or abroad. Some 1,200 new events are added to the data base each year[25]. It is always possible to enhance this database thanks to fresh information obtained on the accident records. In the ARIA website one may find the following *Note* and *Advisory*.

Note: The ARIA database is not intended to be exhaustive: only those accidents / incidents that showcase experience feedback as a risk prevention and mitigation tool are compiled in ARIA. The criteria used to select the events to catalogue are continuously being updated, in keeping up with new technologies. Nonetheless, it became standard practice a few years ago to systematically inventory accidents occurring at high-risk facilities or with fatalities at any classified facility.

Advisory: The website presents a catalogue of industrial / technological accidents and incidents occurring in France and abroad. Its basic objective is to showcase experience feedback as a risk prevention tool. It is not intended to be exhaustive. Should you notice any important inaccuracies, errors or omissions despite the care taken during data recording and analysis, please feel free to notify us of complementary details or point out possible anomalies at the following address: mailto:barpi@developpement-durable.gouv.fr; be sure to indicate your sources.

[25] ARIA Database, https://www.aria.developpement-durable.gouv.fr/the-barpi/the-aria-database/?lang=en/ last access 09 May 2023

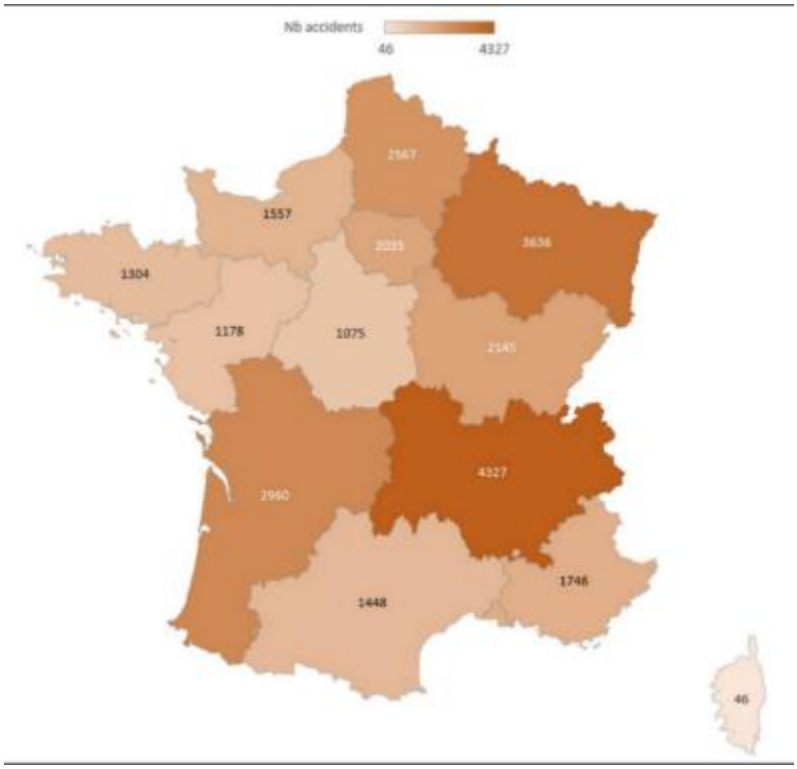

Figure 11-Geographical distribution of industrial accidents in FRANCE (ARIA Database).

Chemical spills: The region's high concentration of chemical plants and storage facilities increases the risk of chemical spills. These spills can have significant impacts on human health and the environment.

Air pollution: Air pollution is an alteration of the air quality by one or more substances or particles present at concentrations and for a significant period to create negative health effect.

Due to its high urban density, Paris has a continuous high concentration of pollutant emissions concentration[26] and is chronically polluted with nitrogen dioxide and fine a Particulate Matter PM_{10} and $PM_{2.5}$ (Figure 13). Exceedance of the regulatory thresholds defined at the European level are frequently recorded.

In Paris, the pollution level is globally homogeneous. However, a much higher level can be observed near the main roads with heavy automobile traffic. Appliances used for combustion in homes, motor vehicles, industrial plants and cooling towers are frequent sources of air pollution, and their use increases the risk.

[26] European Environment Agency. (2022). Air quality in Europe — 2022 report https://www.eea.europa.eu/publications/air-quality-in-europe-2022, last access 30 June 2023

Climatic conditions, with high temperatures and a lack of wind, can increase the concentration of various particles in the air. Each pollutant has its own impact on human health: irritation of mucous membranes, skin, eyes, respiratory tract, reduction in respiratory capacity and asthma attacks. The most sensitive people, such as children, the elderly, heavy smokers, people with heart disease or smokers, people with heart or lung disease are the most affected by air pollution. For them, pollution can promote illnesses, aggravate some of them and sometimes even accelerate death.

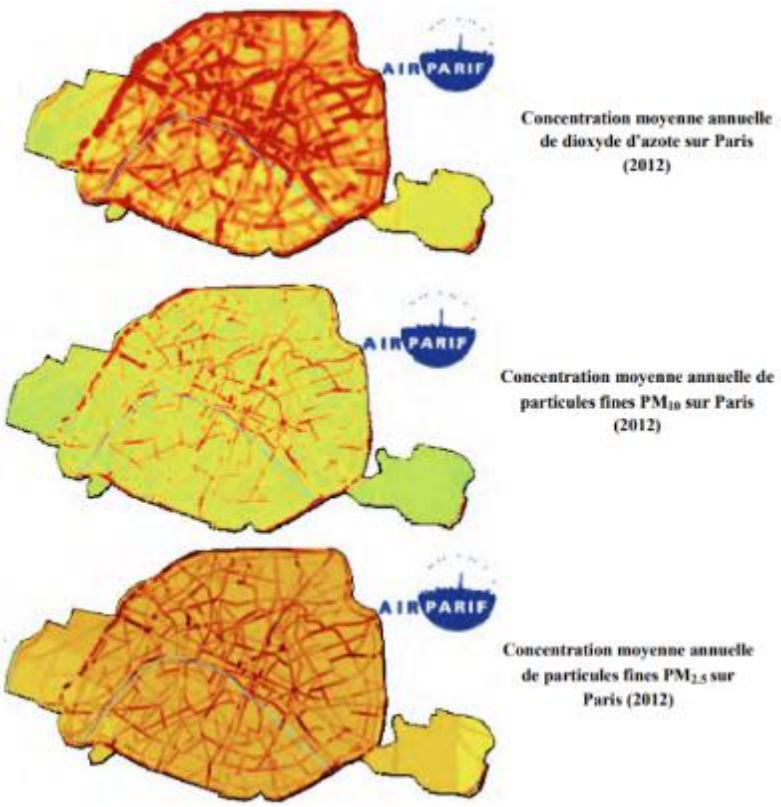

Figure 12- Maps of annual concentration of various particles in Paris, with red indicating high concentration and green indicating low concentration.

Risk mapping

Copernicus is an EU programme to develop European information services based on satellite Earth Observation and in-situ (no space) data. Copernicus is implemented by the European Commission (EC) with the support from the European Space Agency (ESA) for the Space component and the European Environment Agency (EEA) for the in-situ component.

The objective of Copernicus is to monitor and forecast the state of the environment on land, sea and in the atmosphere, to support climate change mitigation and adaptation strategies, the efficient management of emergency situations and the improvement of the security of every citizen. Information provided by Copernicus improves people's safety, e.g. by providing information on natural disasters such as forest fires or floods, and thus help to prevent the loss of lives and property as well as damages to the environment.

Copernicus is a user driven programme and the information services provided are available to the Users, mostly public authorities, on a full, open, and free-of-charge basis. The Copernicus Programme is served by dedicated satellites (the Copernicus Sentinel families) and a set of additional Contributing Missions (satellites run by various commercial and national agencies). Since the launch of Sentinel-1A in 2014, the European Union set in motion a process to place a constellation of almost 20 more satellites in orbit before 2030. This satellite data is complemented by and validated with in situ data. For example, the area of the 2019 industrial accident in Rouen is illustrated in Figure 14.

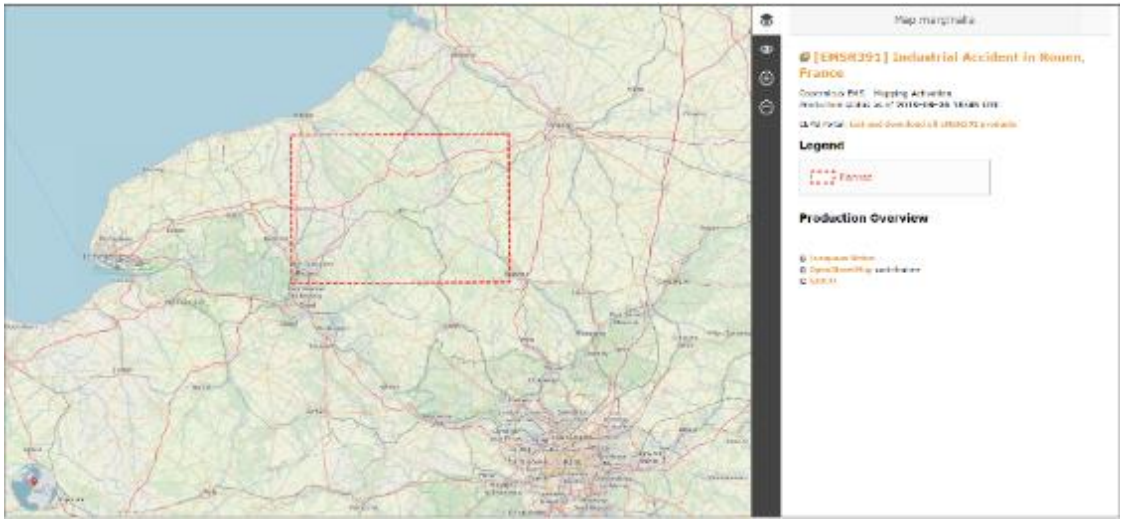

Figure 13- The area of 2019 industrial accident in Rouen[27].

[27] Copernicus risk mapping, https://emergency.copernicus.eu/mapping/sites/all/scripts/show_feed.php?url=https://emergency.copernicus.eu/mapping/list-of-components/EMSR391/aemfeed, last access 30 May 2023.

3.2.5 TERRORISM

Impact

Terrorism can have significant impacts on the environment, society, and economy of Île-de-France. Here are some of the major impacts of terrorism[28]:

Human impact: Terrorism can cause death, injury, and trauma to individuals and communities. In Île-de-France, terrorist attacks have resulted in the loss of life and injuries to many people, as well as to long-lasting psychological effects.

Economic impact: Terrorism can have a significant impact on the economy, including damage to infrastructure and property, disruption of trade and commerce, and decreased tourism. In Île-de-France, the tourism industry has been particularly affected by terrorist attacks, resulting in significant losses for businesses and the economy (Figure 15).

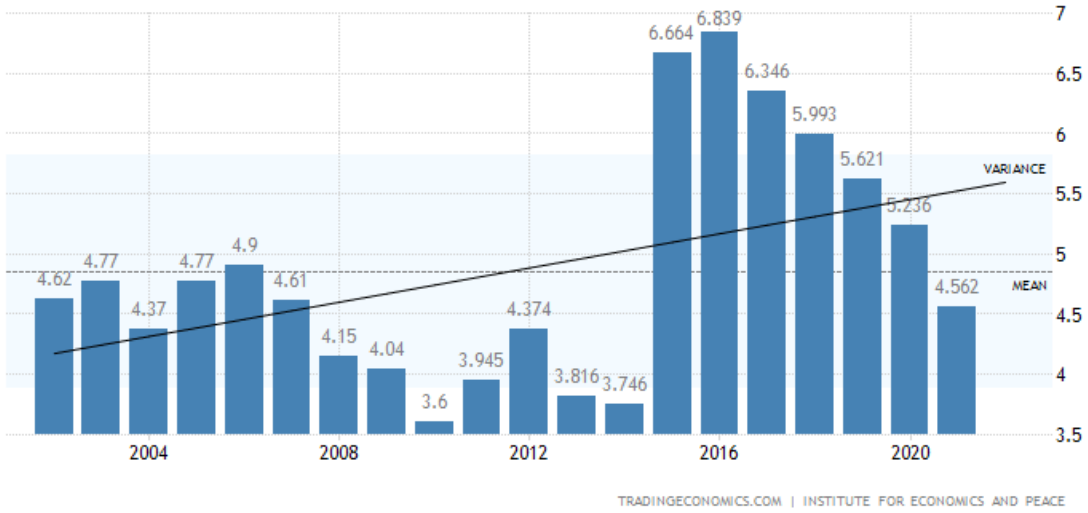

Figure 14- Terrorism index in France from 2002 to 2023[29].

Social impact: Terrorism can create fear and anxiety in communities, leading to increased social isolation and decreased trust in institutions. In Île-de-France, terrorist attacks have led to a sense of insecurity and fear among the population, particularly in public spaces such as transportation hubs and tourist attractions.

[28]Terrorist Attacks in Paris, November 2015: Critical Infrastructure Impacts and Responses, https://fra.europa.eu/sites/default/files/fra-2015-paper-01-2015-post-paris-attacks-fundamental-rights-considerations-0_en.pdf, last access 29 May 2023

[29] France Terrorism Index, https://tradingeconomics.com/france/terrorism-index, last access 6 June 2023

Political impact: Terrorism can also have a significant impact on the political landscape, including changes in government policies and regulations, increased surveillance and security measures, and changes in public opinion. In Île-de-France, terrorist attacks have led to debates about the balance between security and individual liberties, as well as discussions about immigration and social integration.

Environmental impact: While the environmental impact of terrorism is less significant than other hazards, terrorist attacks can lead to environmental damage, particularly in the case of attacks on industrial or infrastructure targets. For example, an attack on a chemical plant could result in the release of toxic chemicals in the environment.

The examples of terrorist attacks on Île-de-France briefly described in section 3.1.5 demonstrate the impact of terrorist attacks on the region and highlight the need for ongoing efforts to prevent and respond to such incidents.

Risk Assessment

Key findings from Terrorism Multi-Hazard Risk and Impact Assessment initiatives include:

Potential Targets: A study conducted by the French Institute of International Relations[30] identified potential targets of terrorist attacks in the Île-de-France region. These included transportation systems, public spaces, such as tourist attractions and stadiums, and critical infrastructure, e.g. power plants, water treatment facilities, and communication networks.

Potential Impacts: Another study conducted by the French National Assembly[31] evaluated the potential impacts of terrorist attacks in the Île-de-France region. It has been found that the most likely scenarios for terrorist attacks were suicide bombings, shootings, and vehicle attacks. The study also estimated the number of casualties and economic losses that could result from these scenarios.

Vulnerable Areas: A report by the French Ministry of the Interior[32] identified vulnerable areas in the Île-de-France region where the risk of terrorist attacks is higher. These areas included densely populated neighborhoods with high unemployment rates and a lack of social cohesion.

Recommendations for Risk Reduction: The same report by the French Ministry of the Interior also made recommendations for reducing the risk of terrorist attacks in the Île-de-France region. These included

[30]Institut Français des Relations Internationales. (2016). Les cibles de l'Île-de-France : comprendre la menace terroriste. https://www.un.org/counterterrorism/sites/www.un.org.counterterrorism/files/2118451_f_oct_vulnerable_targets_module_1_web.pdf, last access 04 July 2023

[31] Assemblée Nationale. (2016). Les conséquences économiques et financières des attentats du 13 novembre 2015, https://www.vbo-feb.be/globalassets/actiedomeinen/economie--conjunctuur/economie--conjunctuur/economische-impact-terroristische-aanslagen-bedraagt-bijna-06-van-het-bbp/analyse-feb---limpact-economique-des-attentats-terroristes.pdf, last access 04 July 2023

[32] Ministère de l'Intérieur. (2018). Lutte contre les violences et les incivilités dans les quartiers prioritaires de la politique de la ville., https://www.revistamisionjuridica.com/wp-content/uploads/2020/09/art5-2.pdf, last access 04 July 2023

improving the integration of immigrant communities, increasing the presence of security forces in vulnerable areas, and improving intelligence gathering and analysis.

Figure 15- This picture, taken on Nov. 13, 2017, shows lightened candles, flowers and messages at a makeshift memorial around the commemorative plaque outside the Bataclan concert hall in tribute of the victims of the attack on the Bataclan in which 90 people were killed on that date[33].

Emergency Response Planning: A study conducted by the French Ministry of Defense evaluated the emergency response planning efforts in the Île-de-France region. It found that while emergency response plans were in place, there were gaps in communication and coordination between different agencies, which could hamper the effectiveness of the response in the event of a terrorist attack (Figure 16).

[33] Photo courtesy, https://time.com/5910960/paris-attack-anniversary-bataclan/, last access 30 May 2023

Figure 16- Terrorist incidents map of France 1970-2015[34].

Following these attacks, the French government has implemented heightened security measures throughout the country, including the Île-de-France region. These measures include increased police and military presence in public spaces and transportation networks, as well as the establishment of security checkpoints at certain locations.

It is important for residents and visitors in the region to remain vigilant and to report any suspicious activity to the authorities. Additionally, it is recommended to follow the advice of local authorities in the event of a security threat or emergency. While the risk of a terrorist attack cannot be eliminated, taking precautions, and staying informed can help to minimize the potential impact.

Overall, these findings highlight the need for ongoing terrorism multi-hazard risk and impact assessment studies in the Île-de-France region to identify new risks and inform efforts to improve public safety and emergency response (Figure 17).

[34] Photo courtesy https://commons.wikimedia.org/wiki/File:Terrorist_incidents_map_of_France_1970-2015.svg, last access 30 May 2023

3.3 RISK ASSESSMENT ANALYSIS FOR THE ÎLE-DE-FRANCE REGION

Risk analysis is a complex field requiring specific knowledge and expertise. Currently, there is no universally agreed risk analysis method applicable to all types of hazards. For example, a method adopted for industrial hazards may not be suitable in the field of natural hazards. Legal requirements may also determine issues such as 'allowable' threat or risk to the community and, consequently, how to perform them. From the identification of major hazards and their interactions and the desk-based research, including the collected opinions of stakeholders, it is obvious that the Île-de-France region mostly is mostly threatened by earthquakes, floods, heatwaves, technological accidents and terrorist attacks. Due to the lack of fully quantitative data our analysis has been based on semi-quantitative approach. In this prospect, for each hazard type the levels of exposure of the several assets and the respective impact levels are highlighted according to the general risk matrix illustrated in Figure 2. The result is summarized in Table 1.

Table 1: Matrix of semi-quantitative risk assessment for natural and human-made in the Île-de-France region.

	Earthquakes	Floods	Heatwaves	Technological Accidents	Terrorist Attack
Exposure to hazard	Low	Medium	High	Medium	High
Impact from hazard	Low	High	Medium	Medium	High

The above risk assessment matrix categorises and captures the relative likelihood of the potential impact expected for each hazard type examined. This is an effective way to get a holistic view of the identified risks for all relevant stakeholders. Table 1 shows that the earthquake risk is relatively low but the risk from terrorist attacks is relatively high. The relative risk associated to other hazard types, such as floods, heatwaves and technological accidents, varies from medium to medium-to-high.

From the above matrix comes out that the Île-de-France region is threatened by more than one hazard types with variable impact level. The above generalised matrix provides information which is necessary to relevant stakeholders to prepare the community in emergency cases. In addition, this risk assessment matrix helps to the prioritisation of mitigation measures. The mitigation measures will depend on the specific characteristics of each region and the hazards that are most likely to occur. In general, measures that can reduce the physical damage caused by hazards and aim to maintain critical infrastructure and services should be a priority. Additionally, such measures not only promote public education and awareness but also support building community resilience for the reduction of the social and economic impacts of multi-hazard events.

4. Application of the Multi-Hazard Impact Methodology to Attica Region

The Region of Attica[35] (Figure 18) is located in the central part of Greece. It contains a territory of 3,808 km^2 and covers 2.9% of the total territory of Greece. Athens is the capital city of Greece as well as of the Regional Administration of Attica and of the Decentralized Administration of Attica. The Region is divided into 66 municipalities. Athens is one of the world's oldest cities and its recorded history spans around 3,400 years. The population of Attica Region is about 4 million.

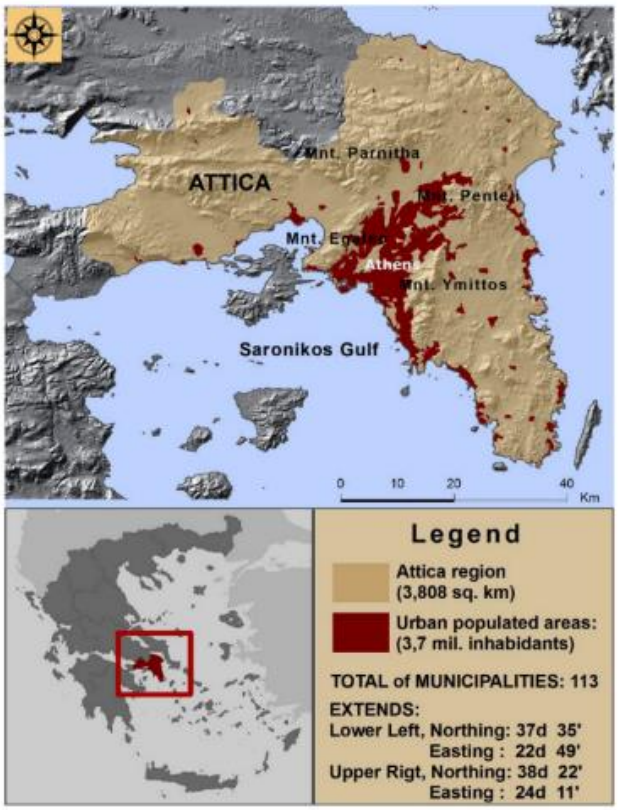

Figure 17- The study area of Attica region (from Iliopoulou et al. 2018).

Attica region is the economic and cultural center of Greece, with many of the country's major industries and businesses based there. It is also a major tourist destination, with numerous historic and cultural

[35] OECD (2020), Regional Policy for Greece Post-2020, OECD Territorial Reviews, OECD Publishing, Paris, https://doi.org/10.1787/cedf09a5-en , last access 30 June 2023

landmarks, museums, and art galleries. The region is served by an extensive transportation network with a comprehensive metro and bus system.

Due to its location and importance, the Attica region is vulnerable mainly to natural hazards, such as earthquakes, floods, wildfires, heatwaves, and landslides. As such, it is essential to have in place effective disaster risk reduction policies and emergency preparedness measures aiming to minimize the potential impact of these hazards on the region and its population.

To address these challenges, the Attica region has developed various initiatives and policies to enhance its resilience to hazards.

4.1 MULTI-HAZARD DESCRIPTION, IDENTIFICATION, AND INTERACTIONS

To identify the hazards that could potentially impact Attica region, a comprehensive hazard assessment was conducted using a range of data sources and methodologies.

4.1.1 EARTHQUAKES

Description and Identification

During the historical period of seismicity, i.e. before 1900, only a few earthquake events are known to have occurred in the region of Attica. For example, on 3 September 1705, a strong earthquake shook Athens. However, at that time Athens was only a small town. Some building damage was reported but it has not been possible to identify the seismic fault that generated the earthquake. On the other hand, only little macroseismic information is available to determine the earthquake magnitude event (Ambraseys and Jackson 1997). Therefore, Papazachos and Papazachou (2003) tentatively suggested a magnitude around 6.3.

In the instrumental period of seismicity, i.e. after 1900, four are the most important earthquake events that hit the region of Attica.

1938. The 20 July 1938 strong earthquake, measuring surface-wave magnitude Ms=6.0, hit the eastern side of Attica Region. In the area of Oropos town three villages were destroyed, 18 people killed, 107 injured and about 8,000 rendered homeless (Papazachos and Papazachou, 2003). This earthquake probably ruptured either part of the Oropos offshore fault or the shorter on land Milesi fault, numbered 12 and 11 in the map of Figure 19, respectively. No seismic surface ruptures were observed, but several landslides occurred particularly in the area of Malakasa town near the epicenter.

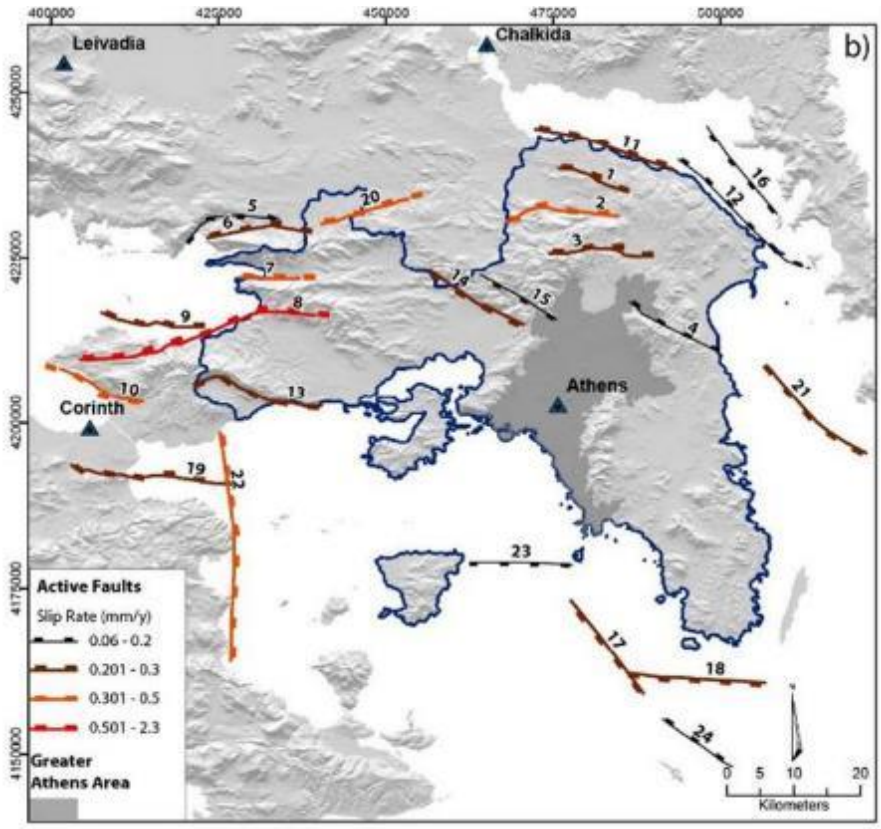

Figure 18- Map of active faults that can cause damaging earthquakes within the region of Attica. Different fault symbols represent different slip-rate categories. Slip rates govern earthquake recurrence. As slip rates increase, the average earthquake intervals recurrence tends to decrease (from Deligiannakis et al., 2018).

1953. On 5 September 1953, a strong earthquake measuring magnitude 5.9 (ISC-GEM, 2022) occurred in the western side of the Attica Region and caused some building damage but no casualties. This earthquake was perhaps associated with the seismic fault numbered 13 in the map shown in Figure 19.

1981. A series of three strong earthquakes ruptured the eastern Corinth Gulf on 24 and 25 February and on 4 March 1981, with magnitudes 6.7, 6.4 and 6.3, respectively. These earthquakes were very likely associated with the seismic faults numbered 7, 8 and 9 illustrated in the map of Figure 19. The epicenters of these earthquakes fall outside the administrative boundaries of the Attica Region and are located at distances of about 70 km from the center of the capital city of Athens. The so-called "earthquake sequence of Alkyonides" caused extensive damage in many places around the epicentral area, mainly in the Prefectures of Corinthia and Voiotia. The cumulative effect of the earthquakes included 22,554 buildings that were either destroyed completely or beyond repair, 11,745 buildings seriously damaged and 50,222 buildings lightly damaged (Papazachos and Papazachou, 2003). The death toll was 20 while about 500 persons were injured. In the Attica region, seismic shaking was felt. Damage was caused to buildings in

several geographical spots but mainly in two suburbs of Athens, namely Chalandri and Aghios Ioannis Rentis. In these areas damage was favoured by the seismic ground motion amplification due to local site conditions.

1999. On 7 September 1999, a strong earthquake measuring magnitude 6.0 ruptured the southwestern foothills of Parnitha mountain in association with the seismic fault numbered 15 in the map of Figure 19. Extensive destruction was caused mainly in the western suburbs of the capital city of Athens (Figure 20). About 110 buildings collapsed, 5,222 were damaged beyond repair and 38,165 rendered beyond any use temporarily (Papazachos and Papazachou, 2003). The death toll was as high as 143, the number of injuries was 1,600 while 50,000 people were rendered homeless.

Figure 19- Collapse of a factory building (top) and of residential building (bottom) in the west side of Attica Region resulting from the 1999 strong earthquake (from Papadopoulos, 2000).

Interaction

Apart from damage caused directly by the seismic shaking, strong earthquakes may also cause a variety of ground failures, i.e. several types of permanent ground deformation. These include surface fault breaks, soil liquefaction and landslides all being secondary earthquake hazards. In the next lines we briefly review this topic in relation to earthquakes that hit the Region of Attica.

Surface Fault Breaks

Strong shallow earthquakes may cause permanent ground displacements along fault lines. This can lead to the destruction of buildings, roads, pipelines, railway tracks and of other infrastructures. Such surface displacements can also affect natural features by diverting streams and rivers and affecting groundwater in aquifers, which turn to serious implications for public water supplies. Surface fault breaks were caused by the 1981 eastern Corinth Gulf earthquakes (Papazachos and Papazachou, 2003). These fault displacements were observed in the Prefectures of Corinthia and Voiotia but didn't affect the territory of Attica Region.

Soil Liquefaction

Sites characterized by very shallow water table with saturated soft material are quite susceptible to soil liquefaction, which is a hazardous secondary effect of the earthquakes. Soil liquefaction happens when under seismic loading the soil loose its strength and cohesion and temporarily behaves as liquid. Soft material prone to soil liquefaction includes fine-grained sands, alluvium or compacted soil. Soil liquefaction may lead to the collapse or overturn of buildings and other infrastructures including roads and bridges. Local phenomena of soil liquefaction were observed in the eastern Attica Region in association with the 1938 Oropos earthquake. Similar phenomena occurred after the 1981 Alkyonides earthquakes in areas beyond the western administrative boundary of the Attica Region (Papazachos and Papazachou, 2003).

Landslides

Unstable slopes are quite prone to landslides and rock falls. Earthquakes may cause landslides and rock falls either on land or on the sea floor. On land landslides were triggered by the 1981 Alkyonides earthquakes in areas beyond the western administrative boundary of the Attica Region. However, such landslides and rock falls occurred in the southwestern slopes of Parnitha mountain, within Attica Region, because of the 1999 strong earthquake. Provisional roads were blocked for several hours after the earthquake occurrence (Pavlides et al., 2002) (Figure 21).

Rivers can also be blocked by landslides, creating temporary dams. When dams fail this can lead to widespread flooding downstream. Artificial reservoirs are often constructed in upland areas. If an earthquake causes a landslide in such an area it can lead to the displacement of water and the waves generated could weaken the dam and overtop it, causing flooding. Such phenomena have not been reported in the Region of Attica.

Figure 20- Landslide caused by the 1999 strong earthquake uphill Aspropyrgos town, west side of Attica Region (from Pavlides et al., 2002).

Tsunamis

Strong earthquakes occurring underwater can cause seabed deformation due to fault displacement in the sea floor. Since water is not compressible the fault displacement causes water displacement producing gravity waves called tsunamis. In the open ocean tsunamis are of small amplitude (usually <1m) and have long wavelength (up to 200km or more) depending on the dimensions of the seismic source. However, wave height increases rapidly when the wave arrives and propagates in the shallow water domain. Therefore, large tsunamis may take wave height (amplitude) of several meters close and along the coast. The first 1981 Alkyonides earthquake caused a local tsunami which was measured as high as 1m in the coast of eastern Corinth Gulf (Papazachos and Papazachou, 2003). It is not clear, however, if this tsunami was caused by co-seismic fault displacement in the sea floor or by an underwater landslide triggered by the earthquake.

4.1.2 FLOODS

Description and Identification

The Attica Region is mostly dry (Mimikou et al. 2002) with a mean annual rainfall of approximately 390 mm (Koutsoyiannis and Baloutsos, 2000). The river network is dominated by streams, with small amounts of water for most of the year. However, the region is at high risk of flooding due to its gradual urbanization, in terms of both population and spatial expansion, which caused drastic increase of the region's exposure to flash floods. Therefore, the Attica Region, including the capital city of Athens, has experienced several significant flooding events throughout history. Here are a few recent remarkable episodes:

1977[36]. Torrential rains swept down hills and overflowed rivers. 25 people lost their lives while the damage cost was estimated in the order of millions of dollars. One major highway within the urban area and hundreds of cars were abandoned after 6.9 cm of rain fall during a 15-hour period. Sewer systems were blocked by large amounts of debris and some historical monuments at the foothill of the Acropolis had to be pumped out.

2017[37]. This was one of the most devastating floods in the region's history. This episode affected the areas of Mandra, Nea Peramos and Megara in the western section of Attica region on Wednesday, 15 November 2017. Twenty-three (23) people lost their lives due to the strong flooding. Extensive damage was caused, and severe impact occurred in buildings and other infrastructures, e.g. roads and transportation. The Greek Civil Protection Authority described the situation as unprecedented. The General Secretary for Civil Protection declared the Region in an emergency state.

4.1.3 WILDFIRES

Description and Identification

Wildfires are a frequent hazard in Greece, like in all southern European countries. The region of Attica has been hit by wildfires many times. Mitsopoulos et al. (2015) reported that several large fires affected the area during the last 20 years (1995, 1997, 1998, 2005, 2007, and 2009), which have destroyed hundreds of residential structures and settlements in the area of the Penteli, NE of Athens. According to Colantoni et al. (2021), Attica region is typically the case of peri-urban areas where pastoralism declines due to competition from more profitable agricultural activities (e.g., vineyards, garden crops, flowers) and other land-use (conversion of pastures into low-density settlements or fragmentation of a rural landscape matrix with pastures intermixed with cropland and woodlands). In this context, an intense decline in livestock farms was associated with (i) more severe wildfires, (ii) a higher incidence of fires burning woodlands, and (iii) a higher spatial heterogeneity of fire events, being motivated by multiple causes that include a lack of subsidies for livestock, conversion of forest and non-forest natural areas to urban

[36] 25 Die as Heavy Rains Flood Athens and Piraeus, https://www.nytimes.com/1977/11/04/archives/25-die-as-heavy-rains-flood-athens-and-piraeus.html, last access 30 June 2023
[37] Case study: Floods in the Attica Region, Greece, November 2017 https://www.efas.eu/en/news/case-study-floods-attica-region-greece-november-2017

settlements, poor forest management, and land abandonment. On 23 July 2018 a high-level fire hazard was officially forecasted (Figure 22). On the next day, two large fires broke out in the central-southern mainland of Greece. In the Attica region the fires caused evacuations of towns and villages, damage to property and 104 casualties. The burning of thousands of hectares of forestry was noted. Regional Greek authorities declared an emergency state in the eastern and western parts of Attica region, and the EU Civil Protection Mechanism was activated to request for aerial and ground firefighting assets.

Figure 21- Map of next-day fire hazard forecasting issued on 22 July 2018 by the General Secretary of Civil Protection, Greece[38]. Legend explanation for hazard level: 1. Low, 2. Intermediate, 3. High, 4. Very high and 5. Alert level.

4.1.4 HEATWAVES

Description and Identification

The Attica Region is prone to heatwaves, particularly during the summer season. In recent years, the Region of Attica experienced several heatwave episodes with temperatures reaching well above 40°C. In 1987[39] a prolonged heatwave took place in Greece from July 20 to 31, causing at least 700 deaths in the country, most of them occurring in the Athens area (Papadopoulos, 2000). This has been the deadliest heatwave to hit the country in modern times. The death toll nearly doubled that of the second largest, which was an extremely powerful heatwave that hit central Greece in August 1958 killing 600 people.

[38] Map of fire hazard forecasting https://civilprotection.gov.gr/arxeio-imerision xartwn?field_imerominia_harti_value=07%2F23%2F2018, last access 29 May 2023
[39] Heatwave in 1987 in Greece, https://el.wikipedia.org/wiki/%CE%9A%CE%B1%CF%8D%CF%83%CF%89%CE%BD%CE%B1%CF%82_%CF%83%CF%84%CE%B7%CE%BD_%CE%95%CE%BB%CE%BB%CE%AC%CE%B4%CE%B1_%CF%84%CE%BF_1987, last access 20 May 2023

4.1.5 LANDSLIDES

Description and Identification

Landslides are natural disasters that occur when masses of soil, rock, and debris slide downhill a slope. Landslides may occur anywhere in the world, but they are particularly common in mountainous regions and areas with steep slopes. The causes of landslides[40] include:

Earthquakes: Earthquakes can cause landslides by shaking the ground and destabilizing slopes.

Heavy Rainfall: Heavy rainfall can saturate the soil and cause it to become unstable, leading to landslides. This is particularly common in areas with poor drainage systems.

Human Activities: Human activities such as construction, mining, and deforestation can weaken the soil and cause landslides. Excavation of slopes can also destabilize the soil and trigger landslides.

Landslides can have devastating effects on human lives and infrastructure, causing fatalities, injuries, and significant economic losses. In Greece the western part of Greece is particularly prone to landslides. However, important landslides are infrequent in the Attica region.

4.1.6. HUMAN-MADE HAZARDS

Multi-hazards related to human activity such as terrorism, cyber-attacks, industrial accidents, and transportation incidents are of low priority according to the opinions received from the interview and questionnaire replies. Therefore, only a brief overview is included in this subsection and no further analysis is made below.

Terrorism

In the time interval from 1975 to 2002 Greece experienced a long-standing period of terrorism represented mainly by the self-called “Revolutionary Organization 17 November-RO17N”, an ultra-left-oriented extra parliamentary armed group. Although relevant information can be collected from mass media, we have reached to some conclusions based on a few specific studies such as those by Bossi (1996) and Chantzi (2009).

The terroristic organisation RO17N performed a series of attacks by either executing or trying to execute political persons as well as persons of the enterprises world, the police, officers of foreign Embassies and others. Most of the attacks took place within the Attica region. No massive attacks have been reported. During 2002 the Greek state authorities were able to identify the persons involved in the RO17N and to terminate their terroristic activity. At the same period, but also after 2002, many other organizations but minor as compared to RO17N, undertook the responsibility of a long number of terroristic attacks

[40] Effects of Landslides, https://www.linkedin.com/pulse/causes-effects-landslide-abid-jahan/, last access 30 June 2023

executed in Greece and mainly in the Attica region[41]. In the last years the terrorism in the Attica region and generally in Greece is abating.

Cyber-attacks

Various episodes of cyber-attacks have been reported in the last years in various Greek organisations, which are mainly public. A recent episode of cyber-attack at national level in Greece was reported by the end of May 2023, when a platform of the Institute for Educational Policy collapsed. This platform is dedicated to a bank of examination topics for the national examinations that graduates of secondary schools have to undergo for getting a position at the universities of the country. The collapse of the platform created a major social issue in the country, including the Attica region, for the reason that the examinees number was around 90,000. Although the case is still under investigation, public information says that it is attributed to distributed denial-of-service (DDoS) attack[42]. DDoS attack is a malicious attempt to disrupt the normal traffic of a targeted server, service or network by overwhelming the target or its surrounding infrastructure with a flood of Internet traffic.

In Greece, the prevention, investigation and suppression of crime and antisocial behavior, committed through the Internet or other electronic media is the responsibility of the Cyber Crime Division, Hellenic Police, Ministry of Citizen Protection. The Cyber Crime Division is an independent central service, which reports directly to the Chief of the Hellenic Police. Statistics from the Cybercrime Division regarding cybercrime show that the total number of new criminal cases handled during the year 2020 rose to 5,148 into different types of crime (e.g. fraud conducted via internet / e-commerce, personal data legislation / threat / defamation, Illegal access and obstruction of information systems / data interception / violation of electronic communication privacy, etc.)

[41] Terrorism in Greece, https://en.wikipedia.org/wiki/Terrorism_in_Greece, last access 14 June 2023
[42] Cyber-attack in Attica, https://www.tanea.gr/2023/05/31/greece/ti-deixnoun-ta-stoixeia-gia-tin-kyvernoepithesi-stin-trapeza-thematon-poioi-mporei-na-vriskontai-piso-apo-ta-xtypimata/, last access 14 June 2023

4.2 DETERMINATION OF IMPACTS, MULTI-HAZARD RISK ASSESSMENT AND RISK MAPPING

4.2.1 EARTHQUAKES

Impacts

The impact of earthquakes is multifold. Below we comment on some of the key impacts:

Damage to infrastructure: Earthquakes may cause damage to roads and buildings, including residential homes and businesses.

Cut-off to lifelines, Earthquakes may cut off energy and water supply as well as telecommunications networks.

Disruption to transportation: Earthquakes may disrupt transportation systems, including trains, buses, and metro lines. Some roads are also closed due to damage or obstacles, causing traffic jams and delays.

Economic losses: Earthquakes have a significant impact on the economy, with many businesses forced to close temporarily or permanently. For instance, the cost of the losses may be hundreds of millions of euros.

Social and psychological impacts: Earthquakes also cause social disruption and significant psychological impact on residents, many of whom lost their homes and belongings. The stress and trauma associated with such events can have long-lasting effects on mental health (Trichopoulos et al. 1983).

Risk Assessment

The region of Attica is characterized by low seismic hazard as compared to other seismogenic areas of Greece. This is illustrated in the official seismic hazard zonation in terms of the expected Peak Ground Acceleration (Figure 23). However, it has been estimated that it occupies the top position in the country from the seismic risk point of view (Papadopoulos and Arvanitides, 1996). This estimation was based on that the Region of Attica, where the capital city of Athens is situated, is characterized by high vulnerability of several assets and by high concentration of population as well as of various commercial and economic activities. This estimation was confirmed by the occurrence of the September 7, 1999 earthquake. Although it was of moderate physical size (magnitude only 6.0), it caused 143 casualties, extensive damage and the highest costly impact ever were reported from earthquakes in modern Greece. This cost has been estimated to be as high as 3 billion USD (Papadopoulos, 2000). In a more recent and independent approach performed by GEM (Global Earthquake Model)[43], the Attica Region is again characterised as having the highest earthquake risk in Greece (Figure 24).

[43] Global Earthquake Hazard and Risk Model, https://www.globalquakemodel.org/gem, last access 29 May 2023

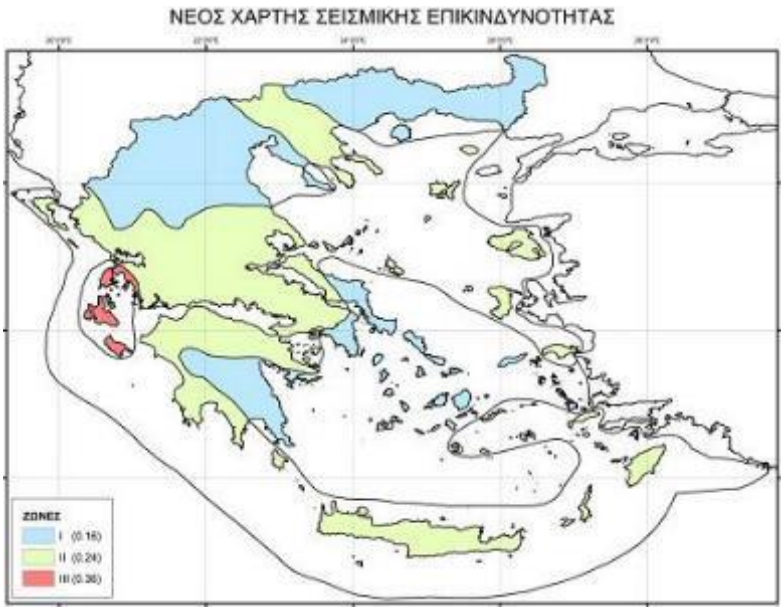

Figure 22- Map of seismic hazard zonation in Greece introduced in the current Building Code of Greece. One may observe that the eastern and western parts of the region of Attica belong to the low and intermediate hazard zones, respectively.

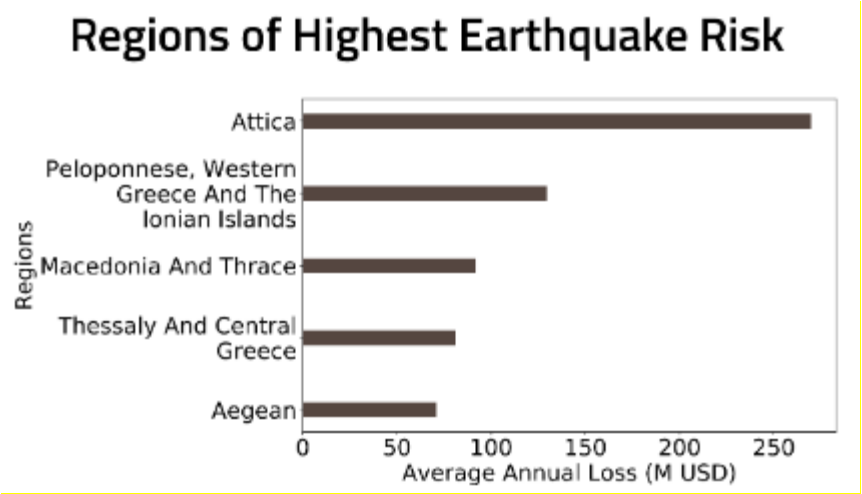

Figure 23- Earthquake risk ranking in several Greek Regions.

In the frame of PAFSANIAS[44] project the earthquake risk assessment for Attica Region included a series of methodological steps to determine the potential impact of future strong earthquakes in the region (Figure 25):

(a) Calculation of the maximum expected earthquake magnitude from several individual fault models based on the rupture of the entire length of active faults (Figure 19).
(b) Classification of geological conditions to seek the dependence of the macroseismic intensity on such conditions.
(c) Calculation and mapping of the expected Peak Ground Acceleration (PGA) field for each one of the individual fault models.
(d) Translation of PGA to expected seismic intensity maps. For each individual fault model two alternatives have been considered. In the first, expected intensity has been calculated without considering local geological conditions, while in the second such conditions have been considered.

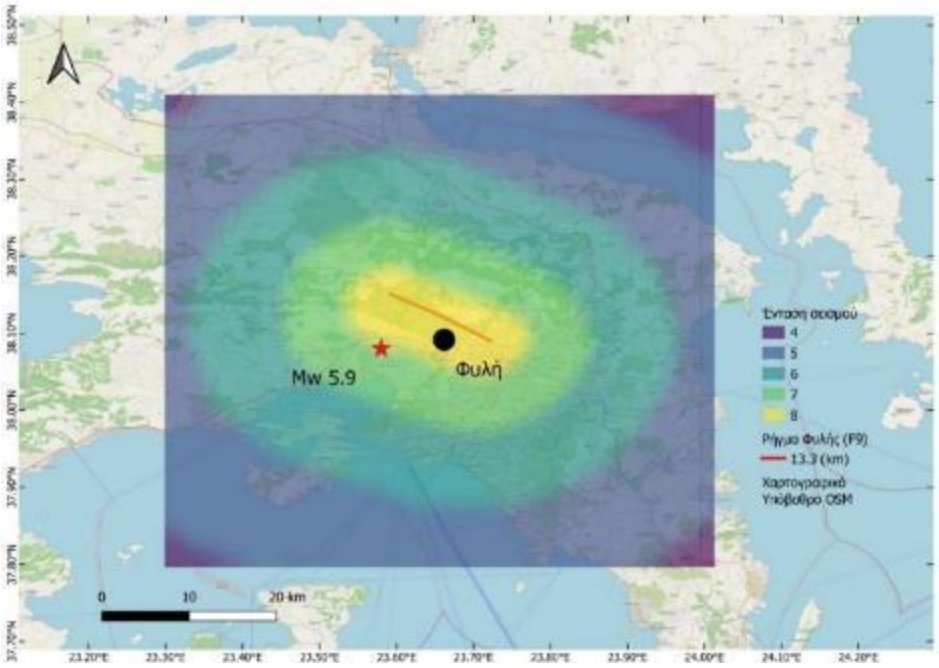

Figure 24- Geographical distribution of seismic intensities for a future earthquake scenario without considering local soil conditions. The red line shows the seismogenic fault of Parnitha earthquake on 7 September 1999. The red star shows the earthquake epicenter and the black point Fyli location that affected significantly.

[44] PAFSANIAS project, https://pafsaniasportal.geol.uoa.gr/atlas_platform/, last access 6 June 2023.

4.2.2 FLOODS

Impact

Floods[45] cause damage to businesses and infrastructure, such as transport or utilities, like electricity, gas, and water supply. In addition, they can have significant detrimental impacts on individuals as well as in local and regional economies. Flooding of primary roads or railways can deny access to large areas beyond those directly affected by the flooding for the duration of the flood event. Flooding of water distribution infrastructure, such as pumping stations or of electricity sub-stations, can result in loss of water or power supply over large areas. This can magnify the impact of flooding well beyond the immediate community.

Floods are the leading cause of weather-related infectious disease outbreaks. Flooding events increase the chance of spreading waterborne diseases, such as hepatitis A and cholera. Receding floodwater can create stagnant pools of water, which provide the perfect breeding ground for mosquitoes, thus increasing the potential to transmit malaria and other diseases. Flood events also lead to an increase in some forms of zoonosis, such as leptospirosis. Flooding can also have a negative effect on wildlife, causing drowning, disease proliferation, and habitat destruction. Unpredictable floods can be harmful even to aquatic life. For example, fish can be displaced from their original place and their nests destroyed.

According to Diakakis et al. (2013), floods in the Attica Region had significant impacts on human environment. These authors listed the fatal flood episodes that occurred in the Athens area from late 19th century up to 2003 (Figure 26).

[23] Impact of flooding, https://www.floodinfo.ie/about_frm/impacts_of_flooding/, last access 20 May 2023

Date	Locations in summary	Deaths	Date	Locations in summary	Deaths
05-11-1896	City centre	1	14-10-1955	Tzitzifies, Chalandri	2
14-11-1896	Piraeus, Moschato	62	06-11-1961	Peristeri, Ilion	33
05-11-1899	Piraeus, City centre	7	02-11-1977	Ilion, Peristeri	36
23-11-1925	Nea Ionia, Fahlero	13	10-12-1977	Chalandri, Nea Ionia	3
22-02-1930	City centre	1	30-5-1979	Argiroupoli, Glyfada	1
27-10-1930	City centre, Fahlero	2	15-1-1991	Ilioupoli, Alimos	1
02-12-1933	City centre, Fahlero	2	31-1-1994	A. Liosia, Acharnes	2
22-11-1934	Nea Ionia, Fahlero	7	21-10-1994	Nea Ionia, Glyfada	5
05-11-1936	Kallithea, Moschato	2	08-7-2002	Moschato	1
30-09-1951	Petroupoli, Nikaia	1			

Figure 25- Catalogue of fatal flood events in the Athens area between 1880 and 2010, their locations across the study area and the number of fatalities that they induced (Diakakis et al. 2013).

Risk Assessment

In the Region of Attica, after the experiences of destructive flooding episodes, such as the 2017 deadly one in Mandra (Figure 27), west side of the region, the need for the development of an efficient early warning system for flash floods became significant. Many authors have proposed relevant actions towards such a prospect, based on the international experience. In the meantime, a flood risk management plan for river basins in the Attica Region was elaborated (Figure 28).

Figure 26- Building damage caused by flash flooding on 16 November 2017 in several locations of Mandra area, west side of Attica region[46].

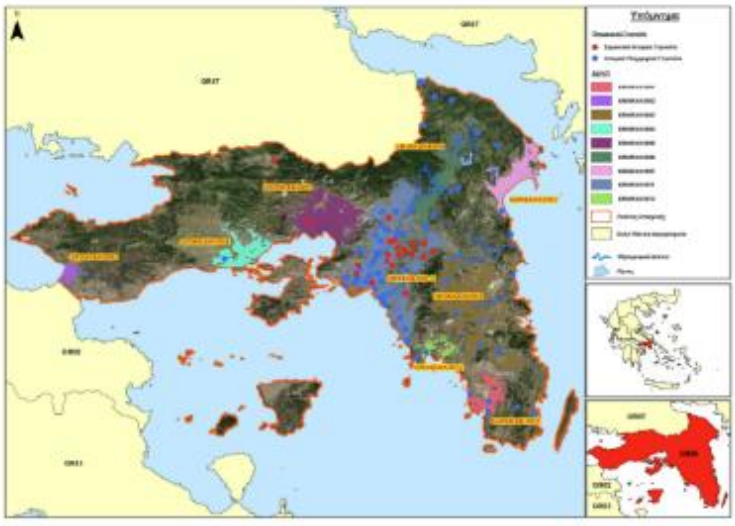

Figure 27- Potentially High Flood Risk Zones in the Attica region. Blue and red dots illustrate historical floods and significant floods, respectively, that occurred from 1930 up to 2012.

[46] Environmental, Disasters and Crises Management (EDCM). Flash Flood in West Attica (Mandra, Nea Peramos) Newsletter #5. 15 November 2017, https://edcm.edu.gr/images/docs/newsletters/Newsletter201705_Mandra-Floods-eng.pdf, last access 25 May 2023.

Risk Mapping

According to a study conducted by the Ministry of Environment and Energy in 2016[47], the areas at highest risk of flooding in Attica region for return period 1000 years are illustrated in Figure 29.

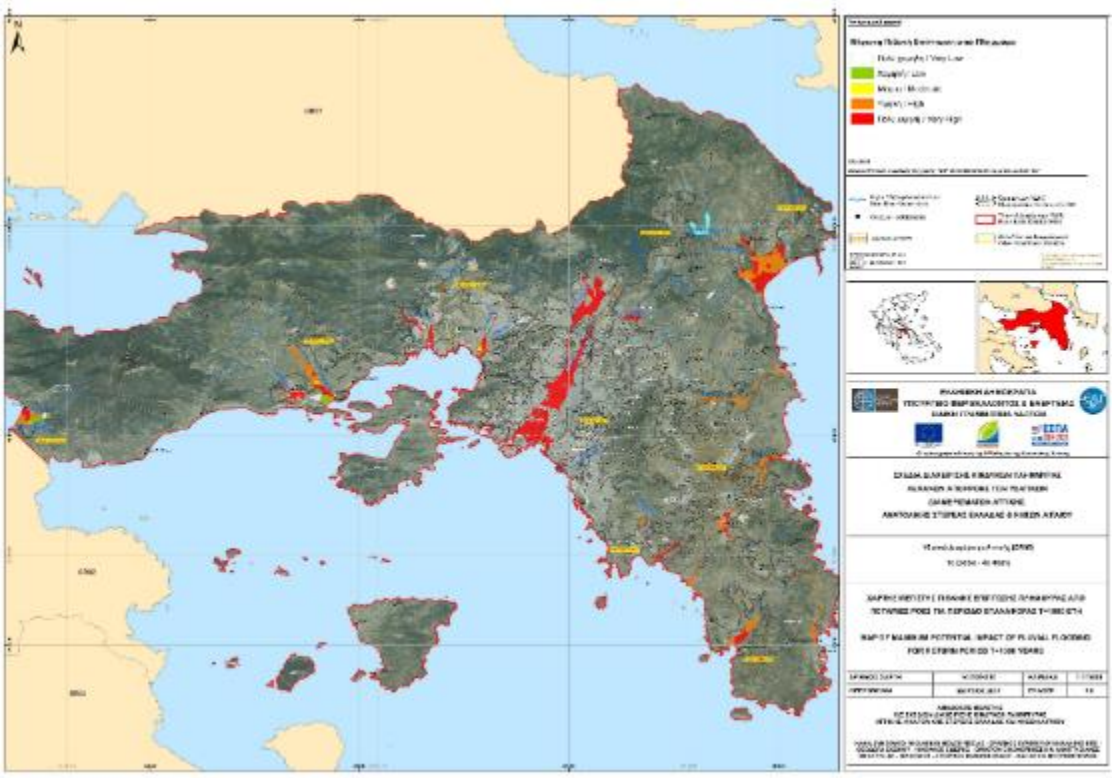

Figure 28- Map of maximum potential impact of fluvial flooding for return period T=1000 years (from Ministry of Environment and Energy, 2016).

The Greek government through the Ministry of Environment and Energy has implemented several mitigation strategies to reduce the risk and potential impacts of floods in the Attica Region. These strategies include the construction of new flood protection infrastructure and policies (Figure 30).

[47] Special Secretariat for Water. (2019). 1st Revision of the Preliminary Flood Risk Assessment of Attica (EL06), https://floods.ypeka.gr/index.php?option=com_content&view=article&id=215&Itemid=948, last access 30 June 2023

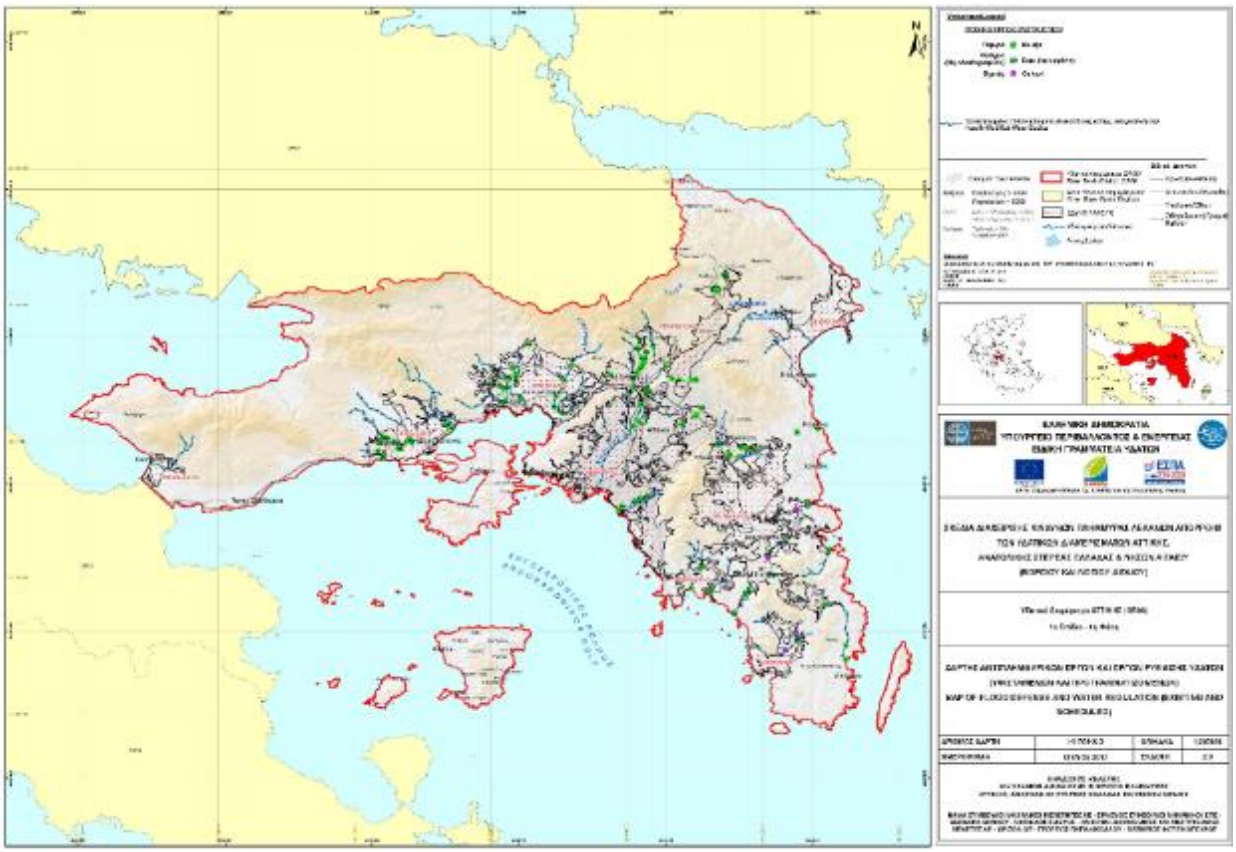

Figure 29- Map of flood defense and water regulations (existing and scheduled)[48].

More recently, Feloni et al. (2020) identified the flood-prone areas in Attica region using geographical information systems techniques and decision-making, based on a comparative evaluation for various scenarios (Figure 31). The same authors underlined that human activities and urbanization of recent years play a significant role in flood occurrence. In their approach, it is considered mainly static data that are linked to flooding, such as the topography and land cover distribution and it can be easily customized in ungauged catchments. They investigated various scenarios regarding criteria standardization, hierarchy, and factors' weighting estimation. Each scenario was evaluated using a dataset of point features that correspond to the position of flood affected properties recorded within the period 2005–2016. The purpose of this study was to identify potentially flood prone areas by adopting the least subjective and most reliable approach, as a framework that can be applied to other ungauged catchments, toward an integrated flood risk assessment and management.

[48] Flood Risk Management Plan of River Basins of Attica region, Water Department of Attica, https://floods.ypeka.gr/egyFloods/gr06/report/I_3_P06_EL06.pdf/ last access 18 May 2023

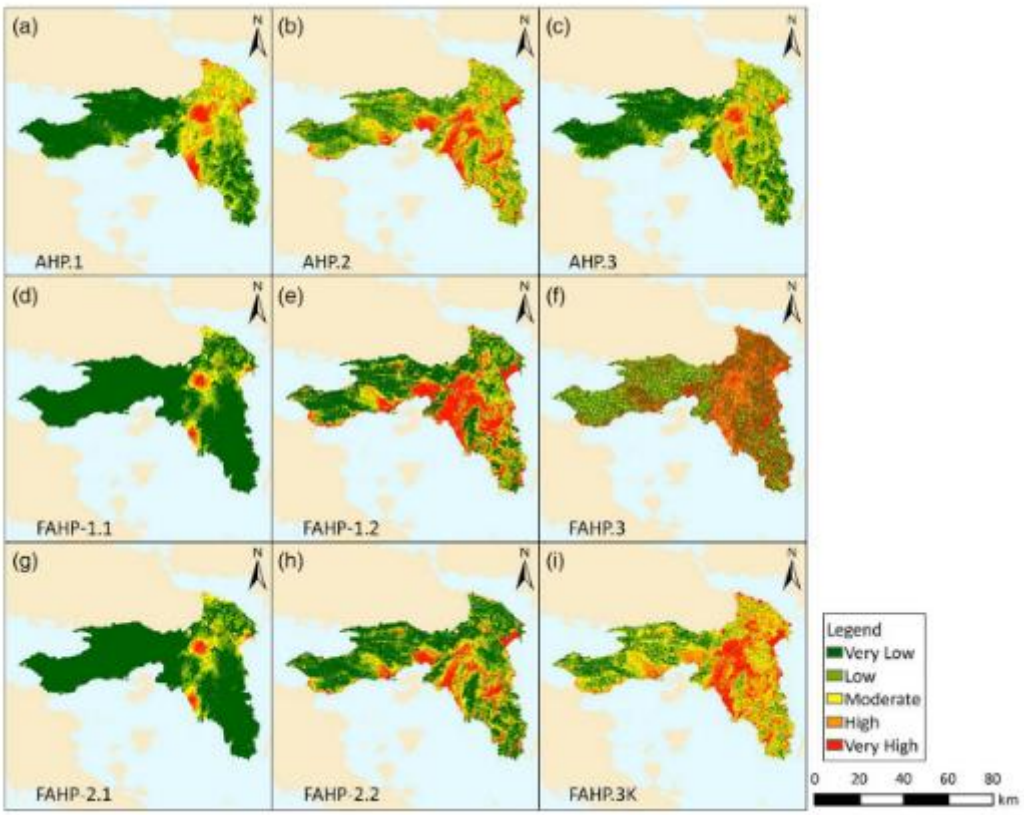

Figure 30- Flood vulnerability map according to the suggested scenarios (from Feloni et al., 2020).

4.2.3 WILDFIRES

Impact

A variety of major impacts is associated with wildfires (Figure 32). Among others, these include the following[49]:

Health Issues and air pollution: Wildfires or forest fires can have important impact on mortality and morbidity depending on the size, speed of, and proximity to, the fire, and whether the population has advanced warning to evacuate. Beyond fatalities, wildfires and the resulting smoke and ashes can cause burns and injuries and other health issues.

Ecosystem Damage: A healthy forest constitutes a generous and elegant system that recycles nutrients, purifies the air, retains water, builds soil, and supports an abundance of life. Strong enough wildfires can

[49] Impact of wildfires, https://www.who.int/health-topics/wildfires#tab=tab_2, last access 30 June 2023

interrupt many of these processes by damaging or even destroying plants and soil and by killing or displacing wildlife.

Soil Erosion: Once a wildfire leaves an area, root stabilization provided by plants may no longer be viable depending on the level of destruction. In such cases, erosion problems can affect the land and local water sources. Unstable soil can contribute to mudslides, flooding events, and land degradation.

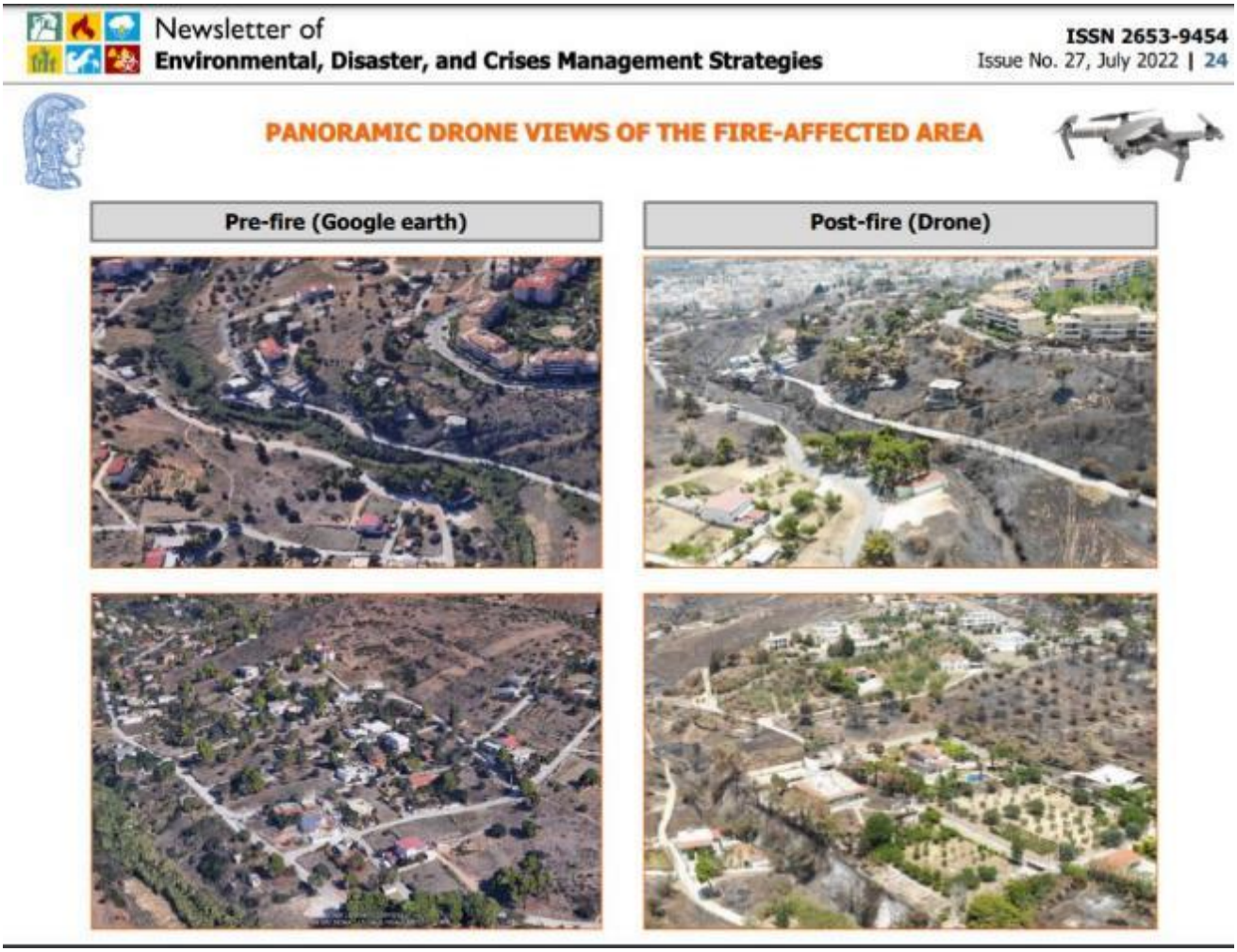

Figure 31- Pre-and post-fire configuration of the affected areas from the fire of 22 July 2018 in eastern Attica region[50].

[50] Environmental, Disasters and Crises Management (EDCM). The July 19-20, 2022, Penteli (Attica, Greece) Wildfire. Newsletter #27. 15 July 2018, https://edcm.edu.gr/images/docs/newsletters/Newsletter_27_2022_Penteli_Wildfire.pdf, last access 25 May 2023.

Risk Assessment and Mapping

An important initiative of the wildfires monitoring is the FireHub of BEYOND[51] established at the National Observatory of Athens. The objective of this initiative is to facilitate early warning and decision making in support of emergency response and evacuation processes, as well as to address diachronic and near real-time Burnt Scar Mapping needs, at various spatial resolutions. Active-fire services are offered online and are publicly open, and cover Greece, including the Attica region (Figure 33), the wider Mediterranean, the North Africa, the Balkans, the Middle East, and the Black Sea territories. The service is totally open to the public and user authorities for accessing the fire detection information in real time. FireHUB system is used by many operational users namely Fire Brigades Authorities, Copernicus EMS Risk and Recovery, Ministerial Services and Organizations for Forest Protection and Territorial Recovery and Planning, WWF, private sector entities, and National, Regional, and Local Authorities. From 2018 the FireHUB was integrated to the European Forest Fire Information System (EFFIS), and to the web system of the Global Fire Monitoring Center of the International Strategy of UN for Disaster Risk Reduction (UNDRR).

A new service known as Forest Fire Information System provides daily near real-time information on active fires and burned areas, as well as statistics on the affected areas per time period and country over the large area covering Europe, North Africa, Middle East, Balkans, and Black Sea. The FIREHUB system uses a multitude of daily acquisitions of satellite images gathered by the antennas of the BEYOND Center.

Figure 32- An excerpt from the FireHub-WebGIS platform for Attica region, Greece (http://195.251.203.238/seviri/).

[51] Beyond-Fire Hub, http://beyond-eocenter.eu/index.php/web-services/firehub, last access 29 May 2023

4.2.4 HEATWAVES

Impact

Heatwaves can be dangerous, especially for vulnerable population groups, such as the elderly, young people, and those with pre-existing medical conditions. Raising temperatures lead to a dramatic increase in energy consumption, cause poor air quality and may cause increased potential for flash floods.

During such heatwaves, the Greek government implemented various countermeasures to protect public health, including opening cooling centers, distributing information on how to stay cool and hydrated, and limiting outdoor activities during the hottest hours of the day to mitigate risks.

In the frame of climate change, the Attica Region plans to implement further countermeasures that aim at increasing the region's resilience and protecting the citizens from the repercussions of increasing urban temperatures. In such situations, the city mayors have an important role to play. The City of Athens[52], in collaboration with the National Observatory of Athens (NOA), will further develop the already existing framework of collaboration with NOA in order to confront heatwaves and protect the most vulnerable population in the capital city.

Heatwaves have significant impacts on both ecosystems and human beings. This is compounded by future climate scenarios which indicate more frequent and severe heat waves in certain locations. There are members of communities that are more vulnerable to the effects of heat waves such as the elderly and infants and this presents particular challenges for the future (Zuo et al. 2015).

Energy consumption: There are significant implications associated with heat waves such as extra power consumption, community health, water consumption and quality, and additional costs within the natural and built environments. One of the critical issues is peak electricity demand which is closely linked with factors such as building occupant health and costs to consumers. Utilization of renewable and sustainable energy helps to mitigate this specific issue. Common policy instruments to deal with risks associated with heat waves include heat impact assessment and heat warning system. Similarly, building design should take impacts of heat waves into consideration such as dwelling adaptation (Zuo et al. 2015).

Social Impact: Extreme heat may cause heat-related illness and death, particularly in elderly populations, the poor, outdoor workers or other vulnerable people.

Heatwaves can have significant impacts on the environment, society, and economy of Attica region. Here are some of the major impacts of heatwaves:

Health impacts: Heatwaves can cause heat exhaustion and heatstroke, particularly among vulnerable populations such as the elderly, children, and those with pre-existing health conditions.

[52] Athens Resilience Strategy For 2030, https://www.citiesoftomorrow.eu/resources/toolbox/roadmaps/athens-resilience-strategy-2030/, last access 18 May 2023

Economic impacts: Heatwaves can also have economic impacts, including reduced productivity and increased energy consumption for air conditioning.

Environmental impacts: Heatwaves can have adverse effects on the environment, including reduced water quality and quantity increased air pollution. For example, during heatwaves, the concentration of pollutants such as ozone and particulate matter can increase, leading to respiratory problems.

Infrastructure impacts: Heatwaves can also affect infrastructure, particularly transportation systems. For example, during a heatwave in 1987, the heat caused rail tracks to buckle, resulting in train cancellations and delays.

Social impacts: Heatwaves can also have social impacts, such as increased social isolation and reduced participation in outdoor activities. In Attica, heatwaves have been associated with a decrease in attendance at cultural events and outdoor festivals.

Risk Assessment and Mapping

To mitigate the impacts of heatwaves, emergency managers and policymakers can implement strategies such as public health campaigns to raise awareness of the risks, cooling centers for vulnerable populations, and urban planning measures to reduce the urban heat island effect.

Extreme temperatures are the cause of excess morbidity and mortality in societies. Real time condition updates during the ongoing event could help prevent the consequences. EXTREMA[53] (Figure 34) aims to improve the resilience of the European population to extreme temperature events (heatwaves and cold spells). To maintain an acceptable quality of life for the foreseeable future, Europe should increase the population's resilience to extreme temperatures. Increased awareness induces self-protective behaviors that in turn reduce the loss of life. To that end, EXTREMA suggest a new innovative and effective approach that aims to exploit the high penetration of smartphones in Europe in the form of a mobile application for the public, and an administration web hub for the local authorities. The mobile app will evaluate the real-time personalized health risk of the user at his/her location, and if high, it will alert him/her and provide recommendations. The web hub will provide information and tools to the authorities to help them manage the disaster: next day alerts, current hazard maps, and an information management tool for the open centers. EXTREMA, through its beneficiaries, has secured access to several important international city EXTREMA application is a tool that can spot-out in real time the city areas that suffer most during the ongoing event, indicating thus where the victims are to be expected. EXTREMA use real-time satellite data, along with other models and city-specific data to estimate the temperature, humidity, and discomfort index for every square kilometer in the city. Temperature estimates are updated every 5 minutes, providing data at a spatial and temporal resolution that is not available from any other service.

[53]EXTREMA App, https://extrema.space/, last access 20 May 2023

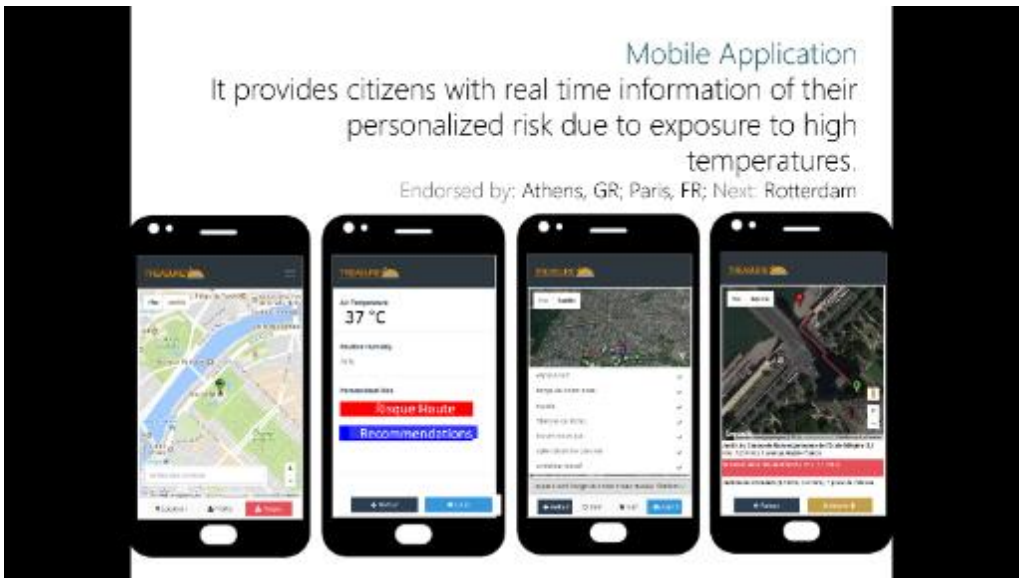

Figure 33- An excerpt from the mobile application (EXTREMA) for Athens and Paris.

4.2.5 LANDSLIDES

Impact

The impact of landslides is multifold, which is briefly summarized below:

Loss of Life and Property: Landslides can cause significant loss of life and property. They can bury houses, roads, and other infrastructure, causing fatalities and injuries. In some cases, landslides can destroy entire communities (Sidle and Ochiai, 2006).

Environmental Damage: Landslides can also cause significant environmental damage. They can alter natural water courses, leading to flooding and erosion. Landslides can also damage ecosystems by destroying vegetation and wildlife habitats.

Economic Impacts: Landslides can have significant economic impact. They can disrupt transportation systems, causing delays and increased transportation costs. They can also damage buildings and infrastructure, leading to costly repairs.

Social Impact: Landslides can have significant social impact. They can displace communities, leading to negative economic consequences, social disruption, and psychological stress. Landslides can also disrupt access to healthcare and education, leading to long-term social consequences.

Risk Assessment and Mapping

Tavoularis et al. (2021) developed on a regional scale (1:100,000), a landslide susceptibility map for the entire area of the Attica Region. To this aim a database was created for slope failures triggered in the Attica region from 1961 to 2020. In addition, a semi-quantitative heuristic methodology, called Rock

Engineering System (RES), was applied through an interaction matrix, where ten parameters, selected as controlling factors for the landslide occurrence, were statistically correlated with the spatial distribution of slope failures. The model produced was validated by using historical landslide data, field-verified slope failures and a methodology developed by the Oregon Department of Geology and Mineral Industries. Having compiled the landslide susceptibility map, studies focusing on landslide risk assessment can be realized in the Attica Region.

DIAS[54] geodatabase shows the spatial distribution of over 300 landslides, including rockfalls, slope falls and erosion lines, based on published and unpublished information, field observations and remote sensing techniques. The outcome of the DIAS project will be accessible to the public, through a web-based platform using an open-source GIS software to aid awareness of landslides among different stakeholders, e.g., landslide experts, government agencies, planners, citizens. Moreover, the DIAS project can facilitate the role of Civil Protection Authorities, by providing input for prevention and preparedness.

Taking into consideration the previous outcomes, the upcoming steps of DIAS research project will be the generation of hazard and risk maps using triggering dynamic factors, like earthquake and rainfall data, as well as different elements of risk in specific areas (Figure 35).

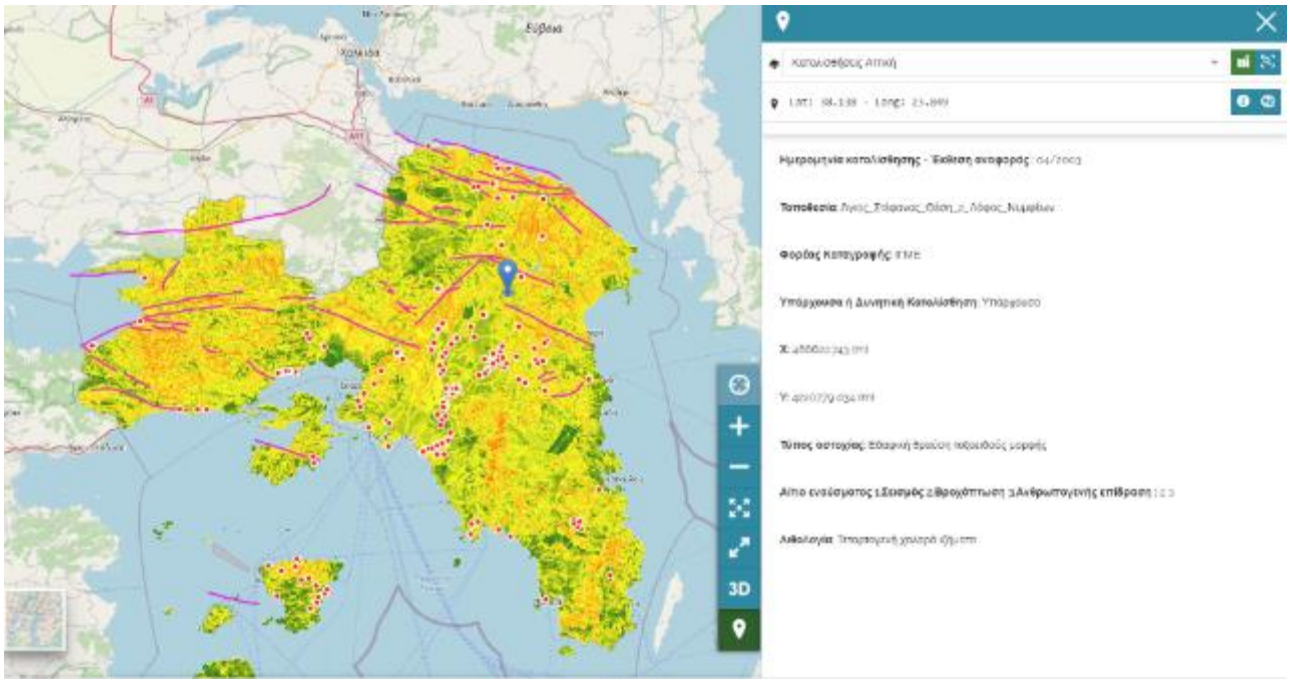

Figure 34- An excerpt from the landslide WebGIS platform (DIAS project) for Attica Region.

[54] Landslide application, http://dias-proj.civil.duth.gr/mapstore/#/context/Dias_Landslides/40, last access 21 May 2023

4.3 RISK ASSESSMENT ANALYSIS FOR THE ATTICA REGION

For the risk assessment analysis in the Attica region we followed the steps performed for the risk analysis in Île-de-France region. The result is illustrated in Table 2, which shows that the risk from earthquakes and heatwaves is relatively the highest among the various risks examined. On the other hand, the risk associated with wildfires is relatively of medium level. The risk which are caused by landslides, terrorist attacks and cyber-attacks are relatively low. Our results are consistent with the conclusions of other researchers (Galderisi et al., 2020) who found that the Attica region is mainly exposed to natural hazards, particularly earthquakes, floods, heat waves and wildfires than to human-made hazards. The relatively high exposure of Attica to natural hazards is due to that it is characterized by high concentration of population, industrial and economic activities and infrastructures.

Table 2: Matrix of semi-quantitative risk assessment for natural and human-made in the Attica region.

	Earthquakes	Floods	Wildfires	Heatwaves	Landslides	Terrorist Attack	Cyber Attack
Exposure to hazard	Medium	Medium	High	High	Low	Low	Medium
Impact from hazard	High	Medium	High	Medium	Low	Low	Low

5. Interaction with Key Stakeholders

5.1 ANALYSIS OF THE INTERVIEW

5.1.1 INTRODUCTION

KEMEA performed its interview study with Civil Protection Agencies (CPAs) stakeholders, from 5 to 31 May 2023. The interview process included seven (7) stakeholders which are authorities relevant to civil protection and disaster risk management from both Greece and France. All stakeholders were identified based on a stakeholder expertise, i.e., their qualifications and experience. Stakeholders represent governmental sectors at various scale/levels of operation (national, sub-national, regional).

The interview study aims to understand different expectations and influencing factors towards CPA's contribution in the current context. With that objective in mind, for recruiting the focus was on their roles, their involvements, their activeness as well as their influence and impacts regarding CPA's areas of intervention. During the interview process we experienced a variety of backgrounds, understanding and focus of interviewees, which required a flexible approach towards the questionnaires and methodology adjusted to the flow of the discussion.

In this section the viewpoints of the interviewed stakeholders are reflected.

5.1.2 INTERVIEW PROCEDURE

The relevant questions addressed to stakeholders can be found in Annex 1. We have tried to document all suggestions and perspectives that will contribute to the strengthening of the relevance, effectiveness, and efficiency of CPAs, as ways to enhance CPA's roles and contribution in facilitating disaster risk management as well as its stakeholder engagement process. The data collection, handling and storage is compliant to the GDPR standards, and data is collected in an anonymous manner to avoid privacy issues, however the name of the organizations is included in the present report (see Table 3). Following the rules of ethics and confidentiality, the participants signed the relevant consent form of participation (Annex 2).

In sum seven persons were interviewed who service at seven different organizations in both France and Greece (Table 3). Interviewees were selected from the perspective of covering a variety of natural human-made risks. The objective has been to obtain insights from the *status quo* of national hazards, risk assessment and disaster management tools used in the two countries, as well as from the potential approaches for improvements and recommendations for community outreach. Furthermore, the objective included identification of gaps and challenges to be considered during the risk assessment and planning process to enhance Civil Protection and emergency management capabilities to face single and multi-hazard events. An attempt has been made to extract and organize the most relevant ideas in a comprehensive way.
The issues addressed have been organized in the next groups:

- Risk perception and policy
- Tools for risk assessment, mapping, and planning
- Emergency management and response capacity
- Early Warning Systems (EWSs) and their potential applications
- Risk culture and communication
- Challenges in national legislation
- Enhancement and improvement of the capacity in Disaster Risk Management (DRM).

5.1.3 RESPONSE RECEIVED

The response received from the interviewed stakeholders is summarized in Table 4. In the next lines the main outcomes are shortly reviewed.
An important issue raised by the experts is the need for strengthening risk assessment and planning with more resources and educational actions. In association to these suggestions, the need to improve risk analysis based on either scenario or probabilistic tools have also been underlined. Such improvements are seen from the point of view of technological progress but also from the perspective of better knowledge of more information and research outcomes.
Forecasting, which is an essential part of the risk assessment, the overall opinion is that it is one of the most important tools in the emergency management. Therefore, there is room for improvements, as regards forecasting accuracy, reliability, resolution (e.g., wildfire daily map) and the time which is adequate for advance forecasting of a potentially impactful event.
Deeply related to the EWS issue is the common sense that the emergency phone number 112 is a tool of early warning. Within this frame, 112 SMS notifications prior to meteorological hazards (e.g., severe weather, floods, wildfires) are effective awareness tools for taking countermeasures.

Regarding the challenges in national legislation, some stakeholders pointed out the need for increasing the interoperability between all the relevant stakeholders and organizations. To reinforce the capacity in Disaster Risk Management (DRM) to face multi-hazard events some suggestions underlined the next:
• Enhancement of the involvement of citizens in the emergency management in a proactive way, e.g., through training and awareness activities. This is especially relevant in events affecting a large group of population, when self-protection and the use of their own capabilities to manage the situations are essential.
• The need for the improvement of forecasting tools with a better integration of climate change challenges by considering the severity and the recurrence of unprecedented hazardous events.
• Clear planning per hazard type with distinct responsibilities and liabilities for each organization involved.

5.1.4 SUGGESTIONS AND RECOMMENDATIONS

For sustainable development in the disaster risk management, stakeholders expect to see a stronger research and technical influence to support CPAs in the management of risks in their regions. Various strategies are needed with both top-down and bottom-up approaches that can be used depending on the context. CPAs need to expand their partnerships in the region in a strategic manner. The outcomes of research studies need to be better disseminated and relevant tools should be utilized for a wider benefit sharing. Some of the suggestions supported that DRM could include several actions such as maintenance of regional approaches, but with consideration to the local context through high-quality procedures and increase the harmonization of guidelines and tools at the national level. In addition, other actions suggested focus on better implementation management plan and strategy and that for the improvement of the capacity in the DRM of importance are to strengthen partnerships, to broaden the engagement among the various stakeholders but also to better clarify responsibilities and roles.

Table 3: List of organizations and services mentioned in the response received by the interviewed stakeholders. Organizations in which the interviewees are servicing on are marked with *.

Names of organizations and services	Web Link
Greece	
Earthquake Planning and Protection Organization-EPPO*	https://www.oasp.gr/en
General Secretariat for Civil Protection, Ministry for Climate Crisis and Civil Protection*	https://civilprotection.gov.gr/odigies-prostasias
Region of Attica*	https://www.patt.gov.gr/en/
Directorate of Natural Disaster Impact Restoration, Ministry of Infrastructure and Transports*	https://www.yme.gov.gr/ypoyrgeio/organosi-ypiresion/geniki-grammateia-ypodomon/item/7141-%CE%B3%CE%B5%CE%BD%CE%B9%CE%BA-391608
Hellenic National Meteorological Service (HNMS)	http://emy.gr/emy/en
Geodynamic Institute-National Observatory of Athens (GEIN-NOA)	http://bbnet.gein.noa.gr/HL/seismicity/real-time-seismicity/last-24-hours
ENCELADUS supersite	https://greeksupersite.eu/
Institute of Engineering Seismology and Earthquake Engineering (ITSAK)	http://www.itsak.gr/en/page/acc_network
Hellenic Survey of Geology and Mineral Exploration (HSGME)	https://www.eagme.gr/
Hellenic National Tsunami Warning Center (HL-NTWC)	http://hl-ntwc.gein.noa.gr/en/index.html
Copernicus-Beyond-NOA	http://beyond-eocenter.eu/index.php/web-services/hellenic-mirror-site
France	
French Ministry of Home Affairs/ Résif-BCSF*	https://recipe.ctfc.cat/results/
Délégation Ministérielle pour l'Intelligence Artificielle (DMIA)- Ministry of the Interior*	https://www.dmia.eu/index.php/qui-sommes-nous-a-la-dmia/
Military Applications Division (CEA-DAM)*	https://www-dase.cea.fr/commun/mentions_en.htm
Safe Cluster*	https://www.safecluster.com/
Georisques	https://www.georisques.gouv.fr/
Vigicrues	https://www.vigicrues.gouv.fr/

Météo France	https://meteofrance.fr/
Institut de physique du globe de Paris (IPGP)	https://www.ipgp.fr/en/
EU and International	
INFORM- Joint Research Centre (JRC)	https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk
COPERNICUS- Emergency Management Service	https://emergency.copernicus.eu/
EFAS-European Flood Awareness Service	https://www.efas.eu/en
GEM-Global Earthquake Model	https://www.globalquakemodel.org/gem
European-Mediterranean Seismological Centre (EMSC)	https://www.emsc-csem.org/#2

Table 4: Response received from the interviewed stakeholders.

Organization	Earthquake Planning and Protection Organization (EPPO)	General Secretariat for Civil Protection, Ministry for Climate Crisis and Civil Protection	Deputy Head of Civil Protection of the Attica Region	General Directorate Impact Disaster Recovery	Senior advisor of Safe Cluster	Prefect – French Ministry of Home Affairs/ Secretary general of the DMIA	Military applications division (Direction des applications militaires, DAM)
Role in Organization	Department of Emergency Planning and Prevention of EPPO	Head of Natural Disasters Department	Autonomous Directorate of Civil Protection of the Attica Region	General Director at Ministry of Infrastructures & Transports	Project coordinator of EU projects	Director	Senior researcher
Years active in organization	12	13	2.5	37	2	40	20
Management Phase	Prevention Preparedness, Response (limited)	Preparedness, Response	Prevention Preparedness, Response, Recovery	Response, Recovery	Prevention Preparedness, Response, Recovery	Global responsibility on artificial intelligence and are working on information systems with all the general directions.	Prevention

High probability natural hazards	Earthquakes, wildfires, floods, heatwaves	Wildfires, blizzards, landslides, earthquakes, tsunamis, droughts	Floods, wildfires, earthquakes	Earthquakes, landslides, floods, wildfires	Earthquakes, landslides, wildfires, heatwaves, storms, floods, heatwaves	Earthquakes, volcanic eruptions, tsunamis, landslides, heatwaves, storms, blizzards, floods, droughts, wildfires epidemics/pandemics	Earthquakes, volcanic eruptions, tsunamis, landslides, heatwaves, storms, floods, droughts, wildfires epidemics/pandemics
High probability man-made hazards	Technological accidents, CBRNe malicious acts	Technological accidents, cyber threats, terrorist attacks, CBRNe malicious acts	Technological accidents	No response	Technological accidents, cyber threats, terrorist attacks	Technological accidents, cyber threats, terrorist attacks, CBRNe malicious acts	Technological accidents, cyber threats
Hazard with highest impact	-Earthquakes are caused in Greece produced the highest seismicity. -Wildfires are associated with climate change. - Floods are associated with high vulnerability built environment	Wildfires are caused very frequently. 1500 events occurred in Greece in 2022. Earthquakes and floods have the highest impact in built and human environment	Floods and wildfires affect the Attica region due to high vulnerability. It is observed mixed zone of built and natural environment.	Earthquakes cause significant built damage	Mainly terrorist attacks, cyberthreats and technological accidents. Following the wildfires, flash floods, pandemics and heatwaves.	Mainly natural hazards, such as wildfires, storms. The human-made hazards such as CBRNe malicious acts and terrorist attacks are under control.	Mostly due to population increase in cities, coastlines, tech accidents, met and natural hazards can produce high impact
Impact categories (order of importance)	-Human loss -Economic loss -Built environment	-Human loss -Critical service disruption -Built environment -Natural environment -Economic loss	-Human loss -Critical service disruption -Built environment -Economic loss -Natural environment	Built environment is the highest impact category	-Human loss -Built environment -Natural environment -Economic loss	Human loss	Natural environment Critical service disruption

Risk assessment	Several risk assessment plans are available for all major hazards. As regards the management of seismic risk, particular is the role that permanent scientific committees play, e.g. the Committee on Seismic Hazard and Risk Evaluation.	Several risk assessment plans are available for all major hazards (floods and earthquakes)	Flood risk assessment has been performed flood extent zones in regional coverage	No	Available for the flash floods. Prevention for technological and natural risks.	The risk assessment is done at the provincial level, the regional level with civil security zones, and at national level	Seismic hazard assessment is performed, volcano as well (overseas)

Risk assessment tool	Quantitative risk assessment(ENCELADUS supersite, National Accelerograph and Seismograph Network)	-Qualitative risk assessment/hazard identification tools HSGME (Landslides) -HL-NTWC (Tsunami) -GEM (Earthquakes-advisory only)	Qualitative risk assessment/hazard identification tools	Regulations exists as regards the building inspection after destructive events (e.g., earthquakes, floods, wildfires, landslides).	-Qualitative risk assessment/hazard identification tools -Quantitative risk assessment	-Qualitative risk assessment/hazard identification tools -Quantitative risk assessment / Analyse and evaluate level of impact, severity of exposure. -Inventory of assets with information related to disaster risk. -Tools for security management / controls implementation for risk mitigation tools. -France has a very good tradition of cooperation between civil and military tools. The prefect can be at the territorial level the person that brings all the resources together in a crisis.	-Quantitative risk assessment - Analyse and evaluate level of impact, severity of exposure.
Scenario based/ Probabilistic approach	Probabilistic approach	Probabilistic approach	Both	No	Scenario based mainly	The probability analysis is often used with scenarios	Both, depending on the regulation concerned

Level of geographical coverage of risk assessment tools	National	National for all major hazards Regional for floods and earthquakes	Regional	National	National, but each municipality uses its own tools	All the plans have the 3 levels	Mediterranean and NE Atlantic
Public domain data platform(s)	Copernicus, Beyond-NOA, GEIN-NOA, HNMS	INFORM (JRC)	no	No	Georisque governmental platform, Copernicus satellite imagery	-Georisques of the ministry of ecological transitions and territorial cohesion - Vigicrues for floods and water risks	Yes, there are several of them, for seismic data for instance
Real-time observation	Real time seismicity (GEIN-NOA), Real time strong motion records ITSAK	HNMS (meteorological forecasting)	HNMS (meteorological forecasting)	Real time seismicity (GEIN-NOA)	no	France has a good control on real time observation.	For earthquakes and tsunamis, from CEA (Cenalt), EMSC, Résif-BCSF, and for volcanoes (IPGP Paris)
Early Warning System(s) (EWSs)	112 emergency number	-112 emergency number -HL-NTWC (tsunami warning), -European Flood Awareness System (EFAS)- advisory	no	112 emergency number	New app FR-Alert, radio and sirens for technological accidents	France has early warning systems to measure risks on rivers, on tsunamis, on fire, on earthquakes. Météo France gives many alerts and early warning for storms.	
Hazard forecasting/ risk estimation	Earthquake intensity maps	-Daily Wildfire Risk Mapping -Weather forecasting	no	After the earthquake go first to the affected location	Not directly	Yes	

Risk communication	EPPO site	-Civil protection site, -twitter -Facebook, -112 (guidelines)	Social media, site of civil protection directorate of Attica	No interaction with the public. The protocol activated internally.	Sirens, radio, specific message to neighboring countries	The Home Ministry has about 500 staffs in different communication services on territorial or national level.The traditional way with a fire siren is still used in the rural areas.	This is the job of Civil security. So for mostly through sirens, but some other approach are underway (FR-Alert)
Gaps in monitoring/forecasting	Maintenance and/or upgrade of equipment Interoperability and coordination needs improvement	-Maintenance and/or upgrade of equipment -Improved coordination at national and cross-border level -Research and development	Unified platform for awareness and information between the relevant authorities	The organization is not entitled to the above mentioned procedures.	-Maintenance and/or upgrade of equipment -Improved coordination at national and cross-border level -Research and development	We don't have too many gaps, but the citizens are changing. The traditional way of behavior with resilient people in rural areas and a high level of solidarity and knowledge of each other is not working too much in the big cities. The protection systems are completely different in densified urban areas.	-Improved coordination at a national and cross-border -level Research and development
Specific DRR policies/plans	National risk assessment for various hazards from climate crisis and civil protection ministry	Involvement of the policy and the governance of the plans.	No specific policies.	Specific regulations are in place for strengthening buildings against earthquakes.	General plan from the ministry	France has what is called the "Zone de défense et de sécurité" that counts between 1 and 4 regions.	Mostly prevention (partially), warning (effective). Preparedness is quite low

DRM and international standards	Guidelines for earthquake risk are harmonized with FEMA	Regulations and recommendations from -Sendai Framework, -EU -UNDRR	Follow the policies from the ministry	Follow the policies from the ministry	Follow the EU and UN standards for their guidelines		
Gaps/challenges in legislation	Overlap responsibilities and duties between the relevant organizations and authorities	Interoperability and coordination need improvement	Interoperability and coordination need improvement			The French legislation is sufficient in 2023 and has a high capacity to solve the problems that we encounter.	Further effort is mostly needed on preparedness and training, plus cooperation between stakeholders, researchers

Improvement of the capacity in the DRM (order of importance)	-Train the public and increase its level of awareness regarding risks with the highest probability of occurrence. -Adequate training of first responders both in terms of new technologies and of operational procedures	-Train the public and increase its level of awareness regarding risks with the highest probability of occurrence -Maintenance and upgrade of technological equipment -Clear planning per hazard with distinct responsibilities and liabilities for each organization	-Clear planning per hazard with distinct responsibilities and liabilities for each organization -Train the public and increase its level of awareness regarding risks with the highest probability of occurrence -Maintenance and upgrade of technological equipment -Adequate training of first responders both in terms of new technologies and of operational procedures	The national legislation needs improvement	-Train the public and increase its level of awareness regarding risks with the highest probability of occurrence. -Adequate training of first responders both in terms of new technologies and of operational procedures	-Train the public and increase its level of awareness regarding risks with the highest probability of occurrence. -Adequate training of first responders both in terms of new technologies and of operational procedures. -Clear planning per hazard with distinct responsibilities and liabilities for each organization -Maintenance and upgrade of technological equipment. -To work with more artificial intelligence to help the maintenance of the plans, the building of scenarios for risks assessments and to develop predictive systems	- Train the public and increase its level of awareness regarding risks with the highest probability of occurrence - Clear planning per hazard with distinct responsibilities and liabilities for each organization

5.2 ANALYSIS OF THE QUESTIONNAIRE

In this research the opinions of persons (respondents) affiliated with several operational organizations in both France and Greece were collected. The investigation focused on a variety of risk management issues. We organized a series of relevant questions of multiple-choice mode and the respondents were requested to reply through a procedure of interviews. The respondents were able to select only one of the various choices. The respondents are with public organizations involved in risk management and first response during emergency situations of a variety of types. Although the number of respondents (39) involved in this investigation is limited, their feedback could be considered as a first approach to the risk perception issue. From this point of view the results received are of importance for scheduling similar investigations in the future.

The questionnaire prepared for this investigation can be found in Annex 3. The next lines we present the results for each one of the 19 questions based on the replies received from the experts.

1. ***What are the top 5 hazards/risks that affect or could affect your area? Please place the hazard with the highest relevance at the top?***

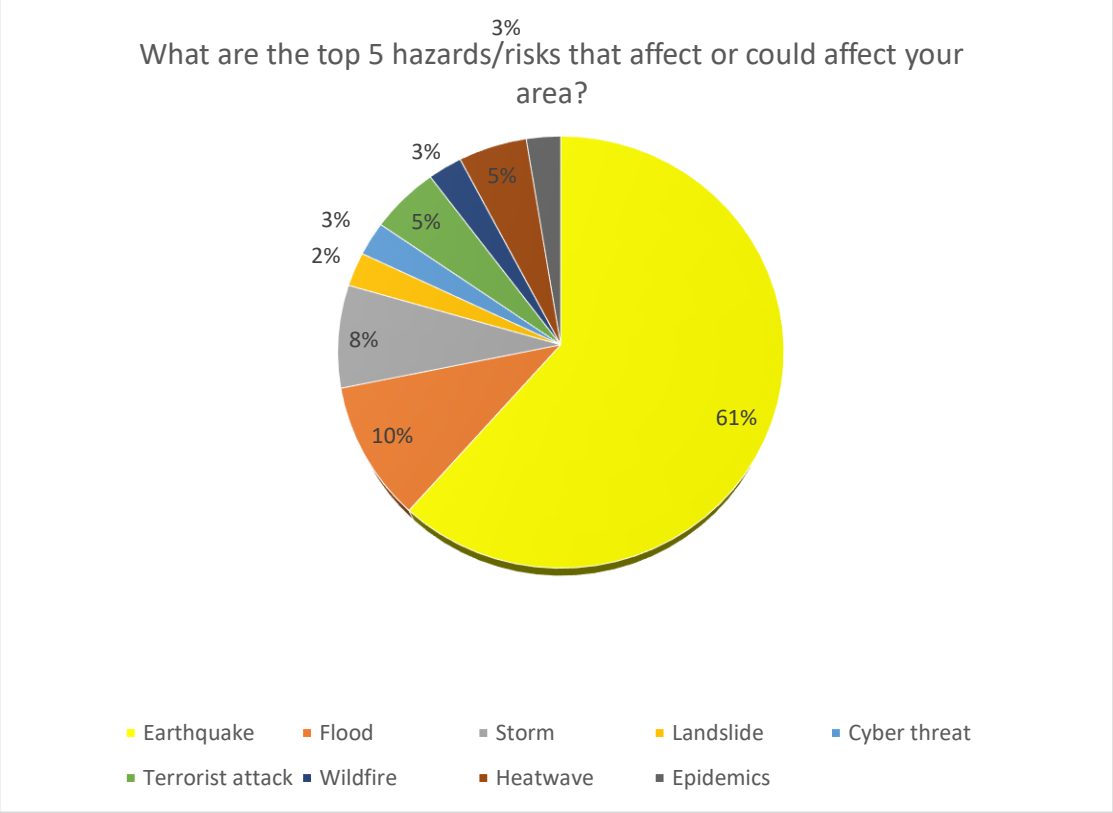

Figure 35- Distribution of responses received to question 1.

Following the order of importance, the majority of the 39 respondents replied at the percentage of 61% that earthquakes are at the top of risks. Although France is a country of relatively low seismicity

in Europe, the earthquake risk is considered as the risk that could significantly affect the country (Figure 36).

2. ***Does your organization use risk assessment/hazard analysis tools?***

Only 23 out of 39 respondents answered this question. The result was that out of these 23 experts 10 replied with "Yes", 8 with "No", while 5 replied "Not Aware" about the usage of risk assessment or hazard analysis tools in their organisation.

3. ***If yes, which tools?***

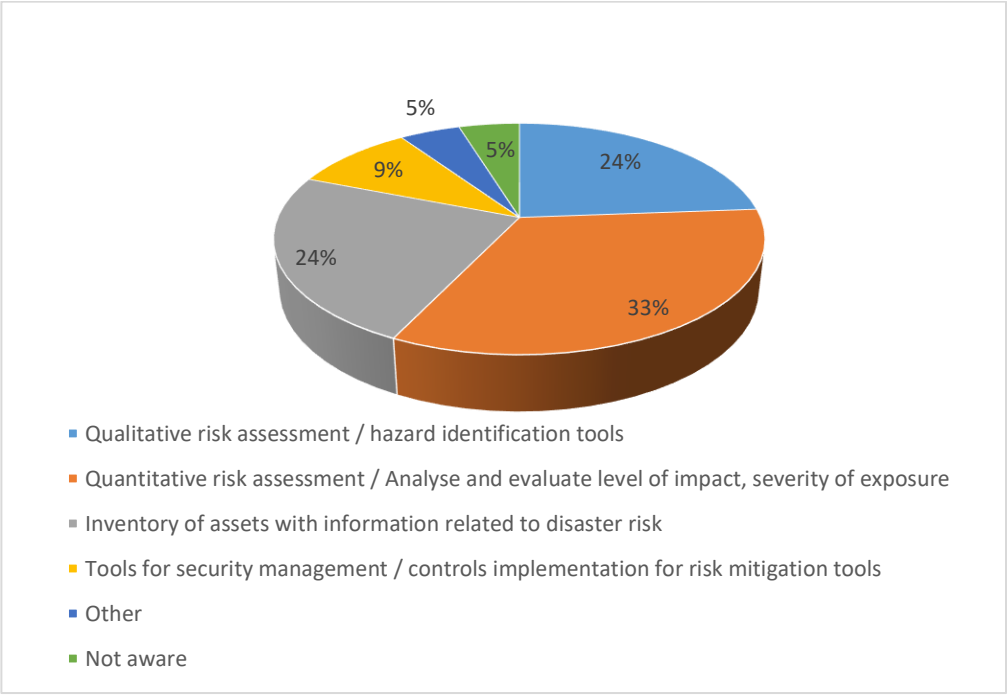

Figure 36- Distribution of responses received to question 3.

33% of the respondents answered that quantitative risk assessment through analysis and evaluation of the level of impact and the severity of exposure is available (Figure 37). However, 24% of the respondents replied that they are aware about qualitative risk assessment through hazard identification tools. Another 24% replied to be aware through an inventory of assets with information related to disaster risk.

4. ***Does your organization use risk information to fulfil its mandate?***

Regarding the usage risk information 16 out of 23 respondents answered with "Yes", 2 with replied "No", while 5 declared to be "Not Aware".

5. ***If yes, what kind?***

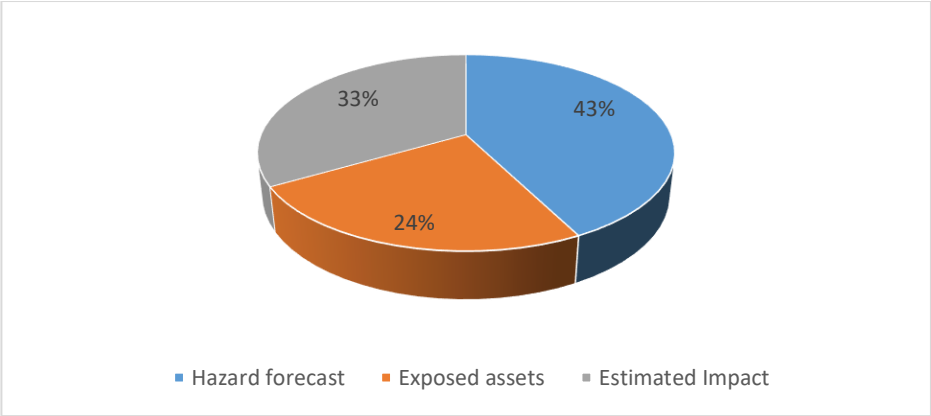

Figure 37- Distribution of responses received to question 5.

Regarding the risk information in use, 43%, confirmed the usage of hazard forecast, 33% of the estimated impact and 24% indicated to use exposed assets, respectively (Figure 38).

6. ***Does your organization have an up-to-date disaster management plan/strategy?***

According to the 39 replies received, 15 respondents answered with "Yes", 12 answered with "No" and 5 declared to be"Not Aware". On the other hand, 5 answered "Under Development".

7. ***If yes, how often is the disaster management plan/strategy updated***?

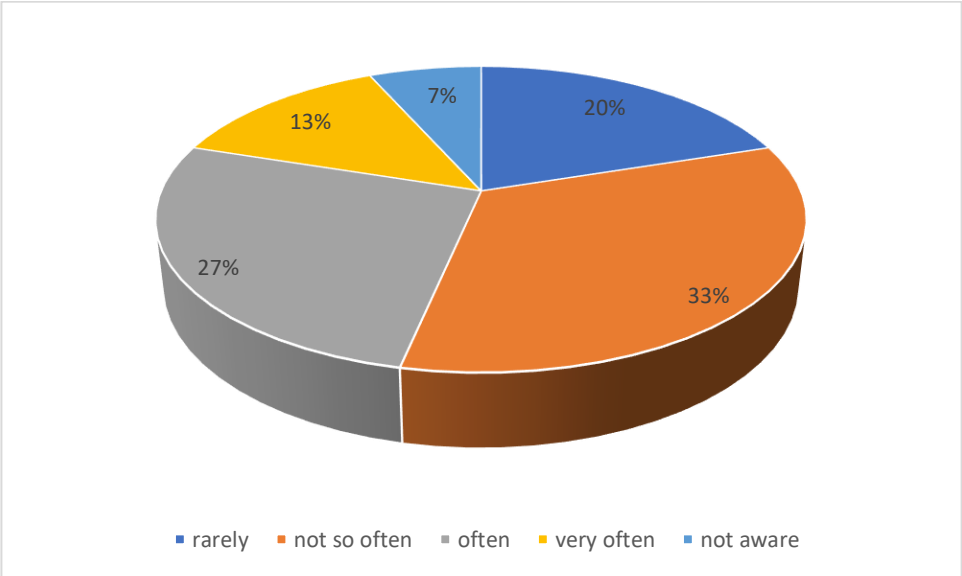

Figure 38-Frequency of management plan/strategy update; n=15

Among the 15 “Yes” replies received, 33% of the respondents stated that they management plan and/or strategy is updated “Not so often”, 27% said “Often” and 20% chose the option “Rarely”. correspond to “Not so often”, “Often” and “Rarely”, respectively. However, the category “Very often” received only 13% (Figure 39).

8. ***If not, is a disaster management plan/strategy planned to be implemented in the future?***

Among 12 out of 37 respondents who answered “No” in question 6, only 1 replied “Yes”, 5 replied “No” and 6 declared to be “Not Aware” about plans for a disaster management plan/strategy in their organization.

9. ***What are the main actions that your organization has taken to minimize future disaster impact and losses?***

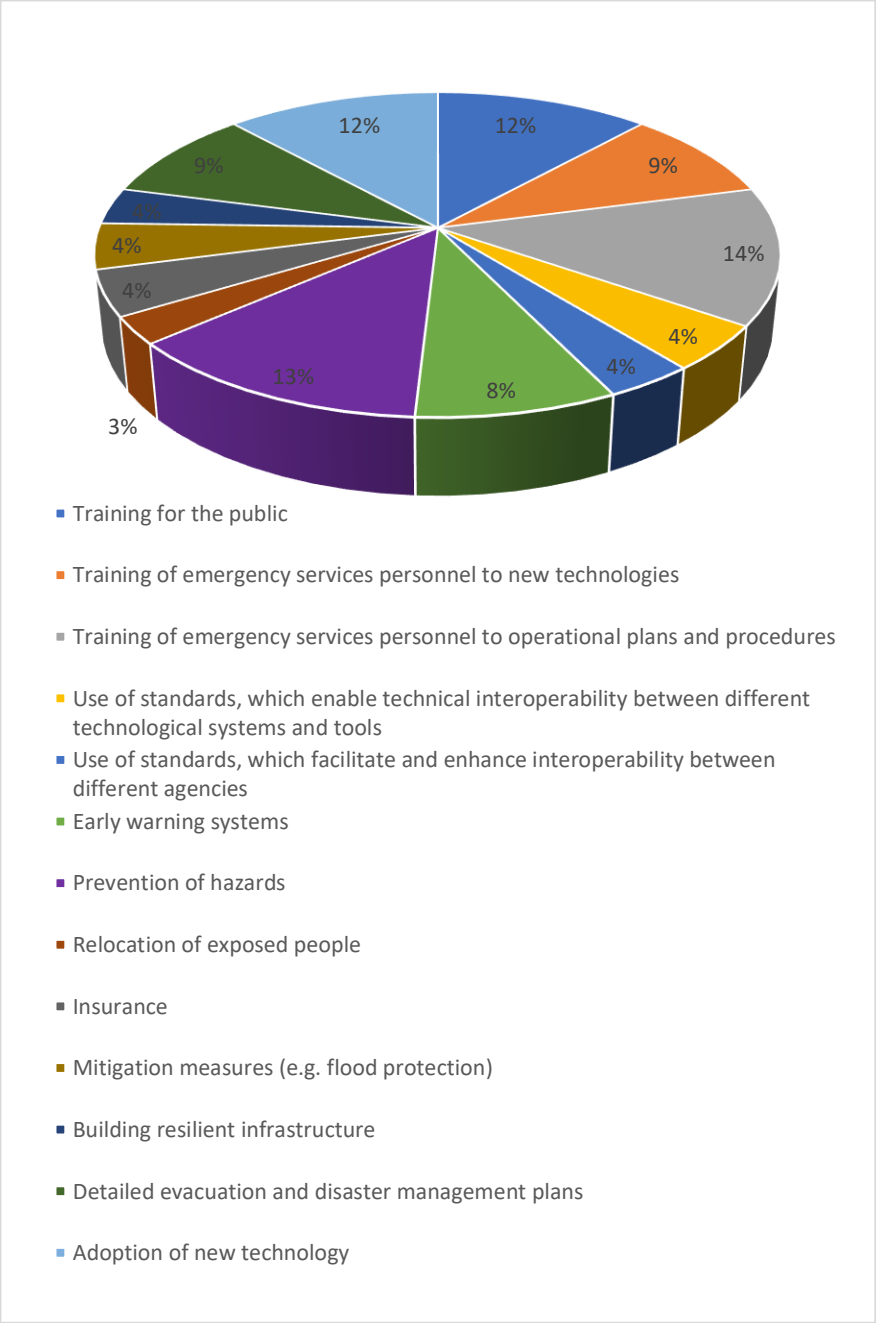

Figure 39- Distribution of responses received to question 9.

14% of the respondents stated that "Training of the emergency services personnel to operational plans and procedures" was conducted in their organization. Actions regarding "Prevention of hazards" follow very closely with 13% (Figure 40). A percentage of 12% is equally shared by the actions "Training of public" and the "Adoption of new technology". It is obvious that training actions regarding both the public and the emergency services personnel concentrate significant percentage (total=26%).

10. To what extent does your organization integrate international/EU standards in its operational procedures?

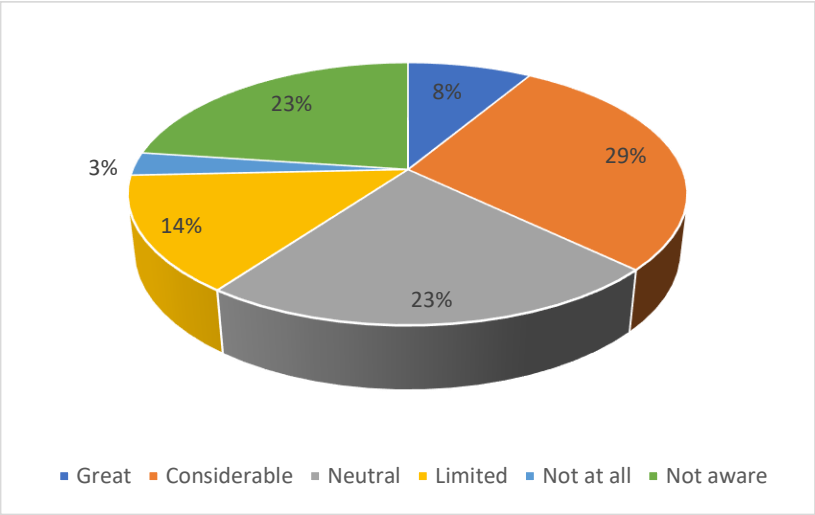

Figure 40- Distribution of responses received to question 10.

A percentage of 29% answered "Considerable". However, a relatively high percentage (23%) declared "Neutral" and another 23% declared "Not aware". A percentage of 14% replied "Limited", while only 8% believe the appropriate reply is "Great". Considering these results one may conclude that less than 40% of the respondents believe that their organization integrate international/EU standards in its operational procedures (Figure 41).

11. In your opinion, to what extent are the four disaster management phases addressed by national policies and initiatives? [Prevention phase]

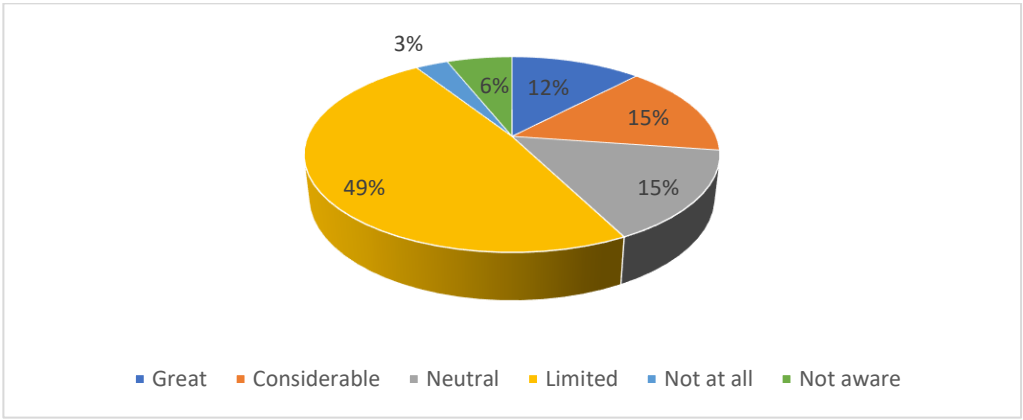

Figure 41- Distribution of responses received to question 11.

According to the replies received, the prevention phase is "Greatly" or "Considerably" addressed by national policies and initiatives at percentages of 12% and 15%, respectively. However, 49% of the respondents replied it is addressed only "Limited" (Figure 42).

12. ***In your opinion, to what extent are the four disaster management phases addressed by national policies and initiatives? [Preparedness phase]***

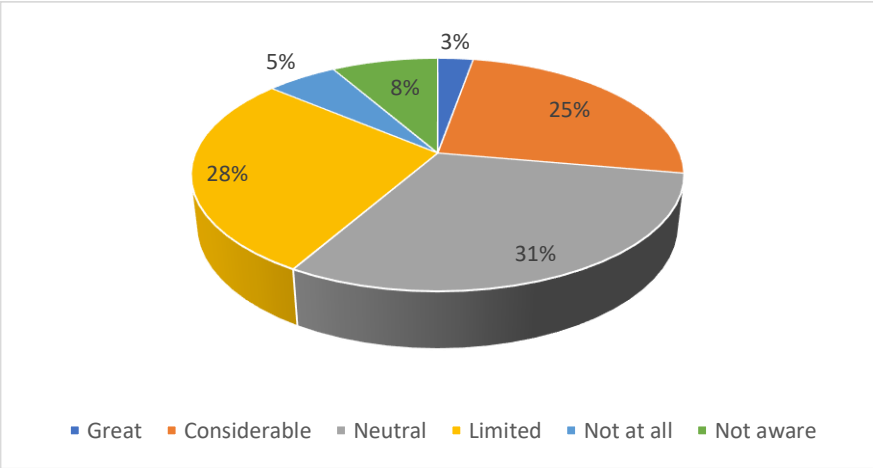

Figure 42- Distribution of responses received to question 12.

The statements of the participants show, that only 3% would evaluate that, the preparedness phase is "Greatly" addressed by national policies and initiatives at percentage of only 3% but 25% say it is "Considerably" addressed (Figure 43). The main conclusion is that the majority of respondents did not reply quite positive given that a percentage of 28% declared that this issue is only "Limited" addressed. In addition, the highest percentage of respondents (31%) declared "Neutral", while 8% replied "Not aware".

13. ***To what extent are the four disaster management phases, in your opinion, addressed by national policies and initiatives? [Response phase]***

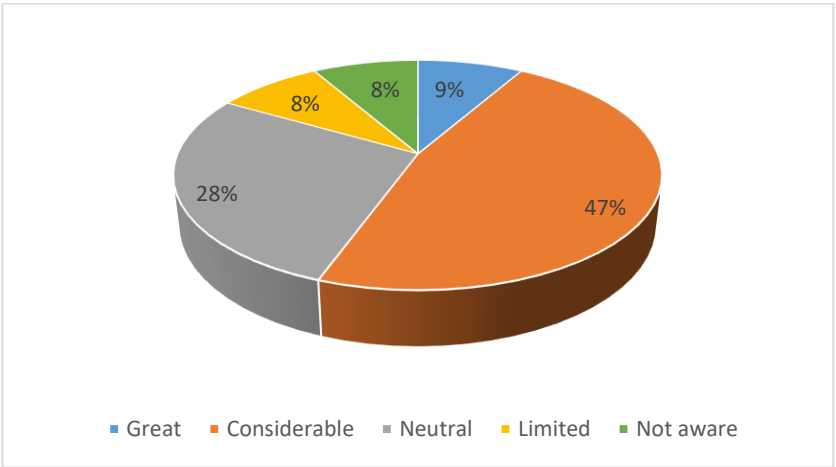

Figure 43- Distribution of responses received to question 13.

As regards the response phase, more than half of the respondents replied positively, given that 9% and 47% of them believe that this issue is addressed at “Great” and “Considerable” level, respectively (Figure 44). However, a remarkable percentage of 28% declared “Neutral”.

14. To what extent are the four disaster management phases, in your opinion, addressed by national policies and initiatives? [Recovery phase]

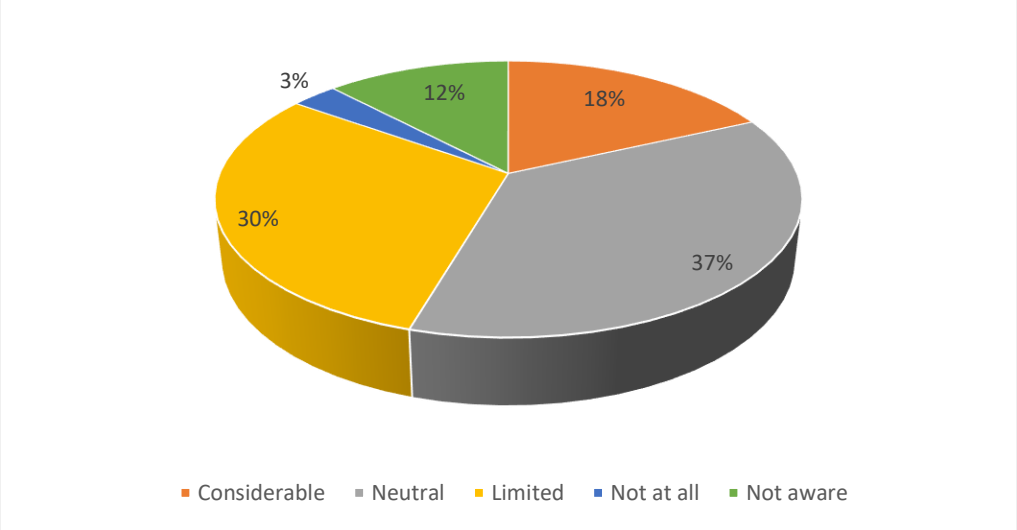

Figure 44- Distribution of responses received to question 14.

A percentage of 37% of the respondents declared “Neutral” about the issue of recovery phase. It is noticeable that no participant chose the category “Great”, while only 18% of the respondents believe this issue is “Considerably” addressed and another 30% replied that it is “Limited” addressed (Figure 45).

15. What do you think are the main gaps in disaster management preparation and mitigation?

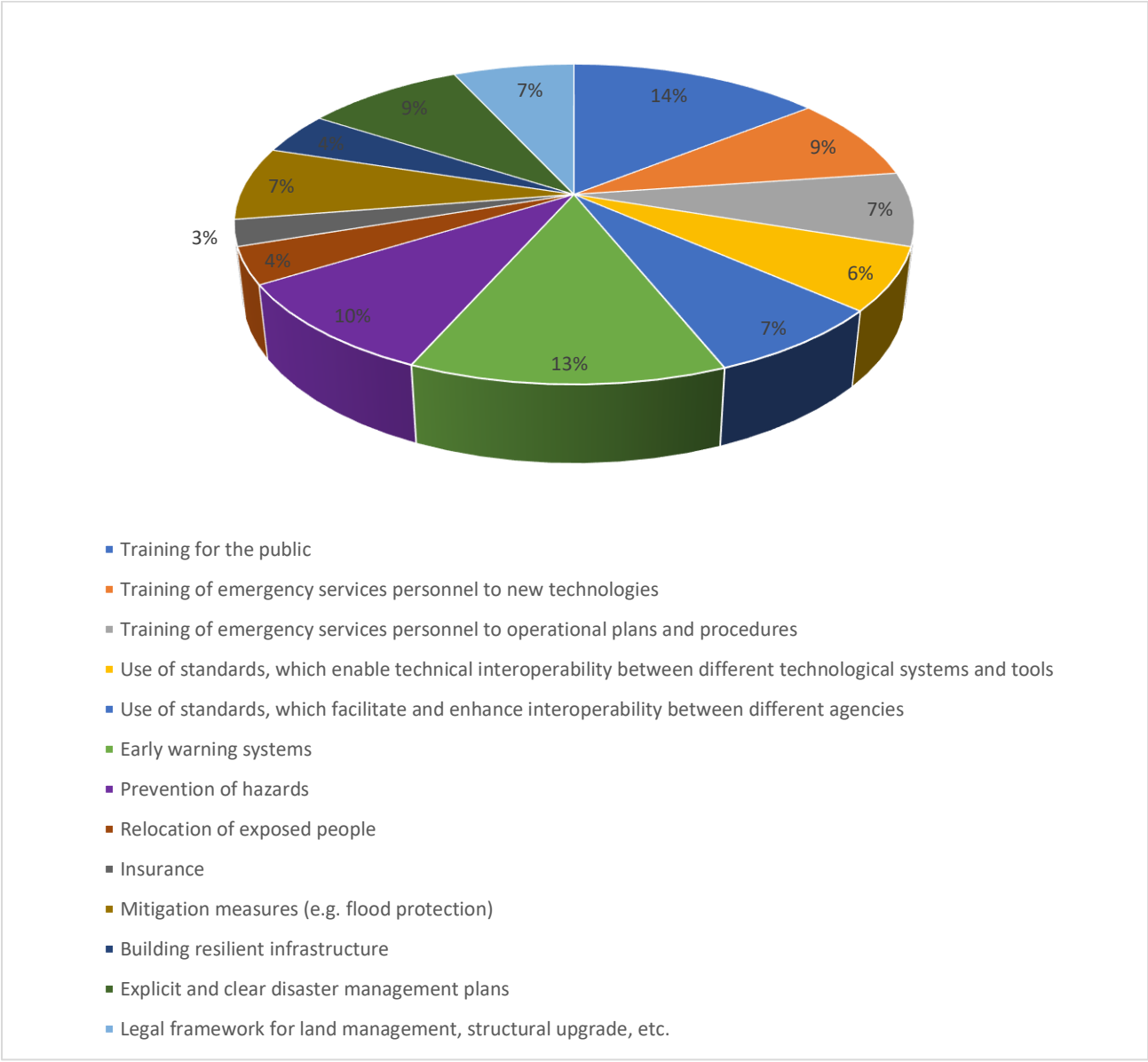

Figure 45- Distribution of responses received to question 15.

The replies received in this question are quite fragmented given that no predominant reply has been received and the replies are distributed in 13 different options with percentages ranging from 14% to 3% (Figure 46). The respondents expressed the opinion that the main gaps in disaster management preparation and mitigation can be recognized in the issues of “Training of the public” (14%), “Early warning systems” (13%) and “Prevention of the hazards” (10%).

16. Is there any available Early Warning System in your region?

A number of 34 out of 39 respondents answered this question. The most important result is that 18 replied “Yes”, 5 replied “No” and 11 declared “Not aware”.

17. If yes, for which risks?

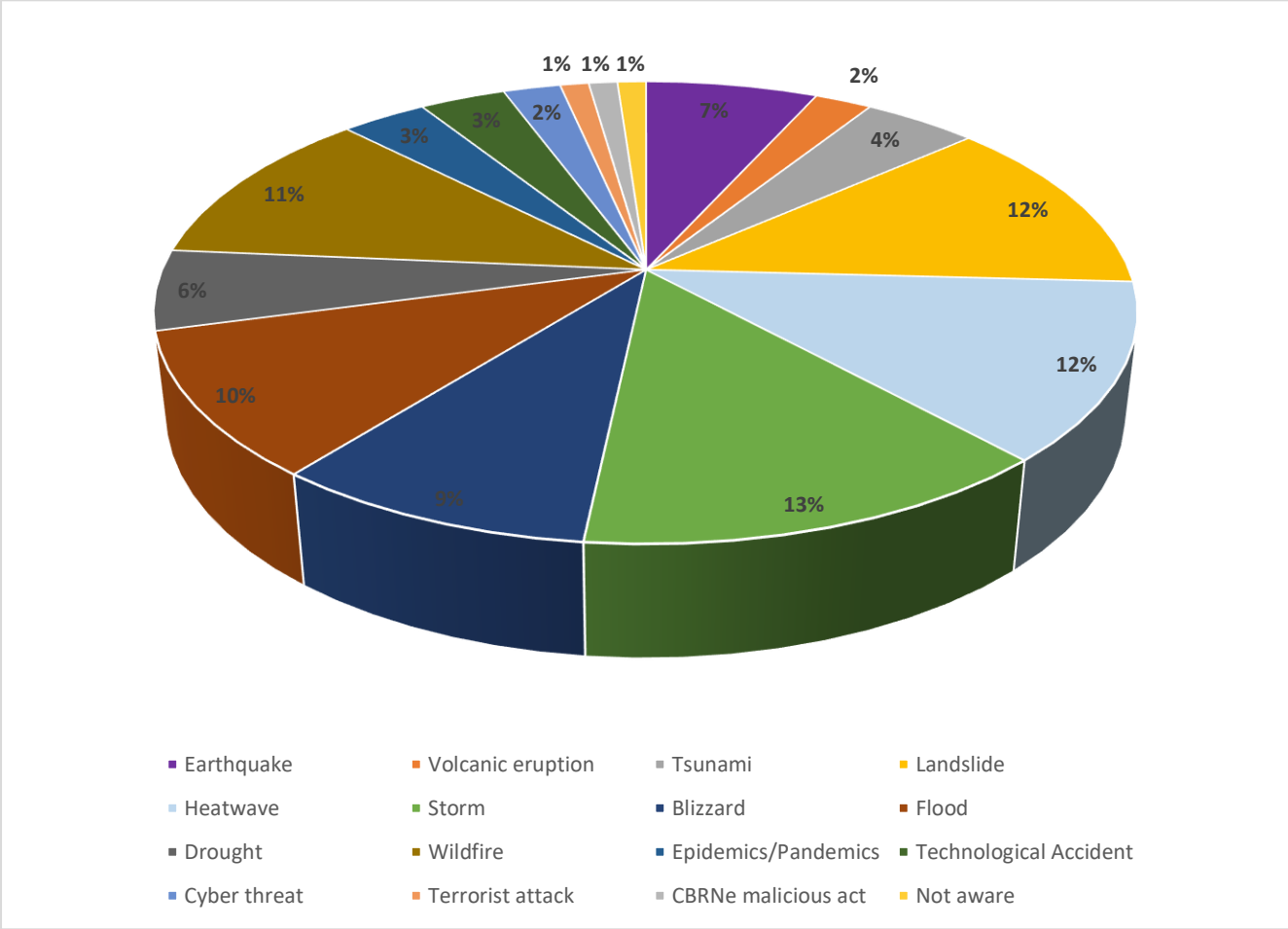

Figure 46- Distribution of responses received to question 17.

Once more the replies received appear quite fragmented. Among 18 respondents who answered “Yes”, a percentage of 13%, 12% and 9% replied that early warning systems are available for storms, heatwaves and blizzards, respectively (Figure 47).

18. Does your organization receive notifications for upcoming events as result of early warning?

In this question 18 out of 34 respondents answered “Yes”, only 5 out 34 answered “No” but 11 out of 34 declared “Not aware”.

19. If yes, which is the main dissemination system for the warning issued?

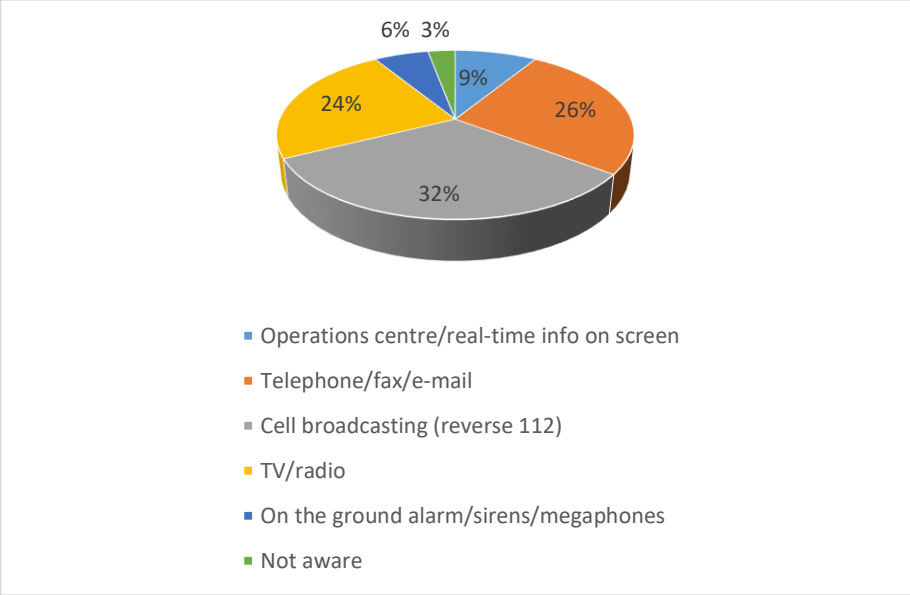

Figure 47- Distribution of responses received to question 19.

From 18 respondents who answered “Yes”, a percentage of 32% replied that the 112 emergency phone number is the main dissemination system, while 26% declared communication via regular phone, fax or email. Another 24% declared communication via TV and or radio (Figure 48).

Concluding remarks

Most of the respondents in both Greece and France considered that the earthquake is at the top of risks. This result is consistent with the very high seismicity in Greece. On the other hand, it is surprising enough since France is a country of relatively low seismicity in Europe.

About half of respondents replied that in their organisation an up-to-date disaster management plan/strategy either exist or is under development. However, such plans, if exist, are not updated very often. For minimizing future disaster impact and losses the organizations focus mainly to training actions for both the public and the emergency services personnel. However, less than 40% of the respondents believe that their organization integrate international/EU standards in its operational procedures.

Important findings were received regarding the extent to which the four disaster management phases are addressed by national policies and initiatives. About half of the respondents declared that the

prevention phase is addressed only at a “Limited” degree. Furthermore, only one third of the respondents declared that the preparedness phase is addressed at a satisfactory degree by national policies and initiatives. As regards the response phase, more than half of the respondents replied positively to this issue. However, the results about the recovery phase are not encouraging since a percentage of 37% of the respondents remained “Neutral”. In addition, no

respondent chose the degree “Great”, while about one third of them replied that this issue is addressed only at a “Limited” degree.

The replies received to the question about the main gaps in disaster management preparation and mitigation are quite fragmented given that no predominant reply has been received and the replies are distributed in 13 different options with percentages ranging from 14% to 3%. The participating experts expressed the opinion that the main gaps in disaster management preparation and mitigation can be recognized in the “Training of the public”, in the “Early warning systems” as well as in the “Prevention of the hazards”. About half of the respondents replied that Early Warning System(s) are available in their region. This is consistent with the fact that about half of the respondents indicated that their organization receive notifications for upcoming events through early warning mechanisms, mainly via the 112 emergency number but also via other means of communication including regular phone, fax, email, television and radio.

6. Conclusions

The correct interpretation of any hazard information to determine the potential impacts, and thus implement a robust risk management strategy, often requires specific data knowledge and technical skills. Additionally, hazard data are generated in many different formats from different sources and are available through a growing stream of online sources and data portals. As a result, DRM projects do not always cover the full range of hazard categories and intensities.

Various sectors, institutions and organizations need to work together for the development and implementation of disaster risk management plans. This report deals with hazards of different origin, highlighting the many links existing between hazards, vulnerabilities, and risk mapping to support resilient communities. The various chapters and subchapters provide specific information for the risk mapping platforms that can actively contribute to reducing disaster risk with involvement of policymakers, civil protection, critical infrastructure operators, scientists, and citizens. This study focuses on the regions of Île-de-France, France, and of Attica, Greece. The outputs collected in this study support substantially conclusions towards providing guidance to the stakeholders on working together across sectors, disciplines, and organisations with the aim to strengthen the identification and classification of disaster impacts for managing disaster risks effectively.

By reviewing several studies, we found that in both regions single events may have not only one single cause. The Île-de-France region is prone to several natural risks, such as mainly floods and heatwaves, as well as to human-made risks including technological accidents and terrorist attacks. For example, the disastrous major flood event of 2018 in Seine River, Paris, was caused by a combination of more than one heavy rain episodes. Another example is the 2015 terrorist attack in Bataclan, which caused multiple severe impacts. Apart from causing many fatalities, this event was of high impact mainly at social level.

On the other hand, the Attica region is highly prone to natural risks related mainly to earthquakes, floods, wildfires, and heatwaves. The earthquake of 7 September 1999 in western Attica, measuring moment magnitude 5.9, caused multiple consequences in many levels; 143 fatalities, hundreds of injuries, landslides and rockfalls that blocked territorial roads, as well as high economic and social impact. The same happened with the 15 November 2017 flood of Mandra-Megara in western Attica area, which caused 23 fatalities and important economic, social, and environmental impacts. Another example is the extreme wildfire in Mati area, eastern Attica, on 23 July 2018. This event caused 104 fatalities and many other economic, socials and environmental consequences. The two last events have been the deadliest that occurred in Attica region in recent years after the earthquake of 7 September 1999. However, the risks related to human-made hazards are very low in the Region of Attica.

In both Île-de-France and Attica regions several initiatives have been undertaken and several technological tools have been implemented for the assessment and mapping of risks that threaten the two regions. Through the participatory process of stakeholders' interviews and questionnaire survey, significant outcomes were reached for the improvement of the community disaster management.

7. References

Ambraseys N. N. & Jackson J.A. (1998). Faulting associated with historical and recent earthquakes in the Eastern Mediterranean region, Geophysical J. International, 133, 390-406.

Beauval, C. & Bard, P.Y. (2022). History of probabilistic seismic hazard assessment studies and seismic zonations in mainland France. Comptes Rendus de l'Académie des Sciences - Géosciences, Seismicity in France, 353 (S1), pp.413-440. ff10.5802/crgeos.95ff. ffhal-03608693f

Bossi, M. (1996). Ellada & Tromokratia- Ethnikes & Diethneis Diastaseis/ Greece & Terrorism- National and International Perspectives, Athens: Sakkoula Publ.

Bouleau, G., Barbier, R., Halm-Lemeille, M.P., Tassin, B., Buchs, A. et al. (2020). Despite great expectations in the Seine River Basin, the WFD did not reduce diffuse pollution. Water alternatives, 13 (3), pp.534-555. ffhalshs-02957812f

Chantzi, G. (2009). The evolution of terrorism in Greece from 1975 to 2009. Research Institute for European and American Studies (RIEAS), Research Paper No. 158, pp. 63.

Colantoni, A., Egidi, G., Quaranta, G., D'Alessandro, R., Vinci, S., Turco, R., Salvati, L. (2020). Sustainable Land Management, Wildfire Risk and the Role of Grazing in Mediterranean Urban-Rural Interfaces: A Regional Approach from Greece. Land, 9, 21. https://doi.org/10.3390/land9010021

Deligiannakis, G., Papanikolaou, I.D. & Roberts, G. (2018). Fault Specific GIS Based Seismic Hazard Maps for the Attica Region, Greece. Geomorphology, DOI: 10.1016/j.geomorph.2016.12.005.

Diakakis, M., Katsetsiadou, K. & Pallikarakis, A. (2013). Flood fatalities in Athens, Greece: 1880- 2010. Bulletin of the Geological Society of Greece, 47(3), 1407–1416. https://doi.org/10.12681/bgsg.10962

Diaz-Granados, M. A. & Wachtendorf, T. (2014). Multi-Hazard impact assessment and modeling: a review of the state of the art. International Journal of Disaster Risk Reduction, 10, 177-194. https://doi.org/10.1016/j.ijdrr.2014.07.006

Feloni, E., Mousadis, I. & Baltas, E. (2020). Flood vulnerability assessment using a GIS-based multi-criteria approach—The case of Attica region J. Flood Risk Manage., 13, Article e12563, 10.1111/jfr3.12563

Galderisi, A., Limongi, G. & Salata, K.D. (2020). Strengths and weaknesses of the 100 Resilient Cities Initiative in Southern Europe: Rome and Athens' experiences. City Territ Archit 7, 16. https://doi.org/10.1186/s40410-020-00123-w

Gill, J. C. & Malamud, B. D. (2014). Reviewing and visualizing the interactions of natural hazards. Reviews of Geophysics, 52(4), 680–722

Hong, Y. J., Min, Y. K., Lee, S., & Choi, S. (2022). Expanded Orientation of Urban Public Health Policy in the Climate Change Era: Response to and Prevention of Heat Wave in Paris and Seoul: A Brief Review. Iranian journal of public health, 51(7), 1461–1468. https://doi.org/10.18502/ijph.v51i7.10080

Iliopoulou, P., Tsatsaris, A. & Katsios, I., Panagiotopoulou, A., Romaliades, S., Papadopoulos, B., & Tselentis, Y. (2018). Risk Mapping of Visceral Leishmaniasis: A Spatial Regression Model for Attica Region, Greece. Tropical Medicine and Infectious Disease, 3(3):83. https://doi.org/10.3390/tropicalmed3030083

ISC-GEM (2022). The ISC-GEM Global Instrumental Earthquake Catalogue, Version 9.1 (http://doi.org/10.31905/D808B825).

Kontoes, C., Herekakis, T., Ieronymidi, E. Keramitsoglou, I., Fokaefs, A., Papadopoulos, G.A., Paralikidis, S., Aifantopoulou, D., Deflorio, A. & Kiranoudis, C. (2012). Mapping Seismic Vulnerability and Risk of Cities: The MASSIVE Project. Journal of Earth Science and Engineering. Vol. 2. 496-513.

Koutsoyiannis D. & Baloutsos G. (2000). Analysis of a long record of annual maximum rainfall in Athens, Greece, and design rainfall inferences, Nat. Hazards 29, 29-48.

Liu, B. & Siu, Y. L. (2017). Multi-Hazard Impact Assessment: A Review Of Methodologies And Applications. Natural Hazards, 88(2), 617-641. HTTPS://DOI.ORG/10.1007/S11069-017-2856-1

Liu, B., Han, X., Qin, L., Xu, W. & Jie Fan (2021). Multi-hazard risk mapping for coupling of natural and technological hazards, Geomatics, Natural Hazards and Risk, 12:1, 2544-2560, DOI: 10.1080/19475705.2021.1969451.

Mimikou M., Baltas E. & Varanou E. (2002). A study of extreme storm events in the Greater Athens area, Greece, IAHS-AISH Publication, No 271, The Extremes of the Extremes; Extraordinary Floods, 161-166.

Mitsopoulos, I., Mallinis, G. & Arianoutsou, M. (2015). Wildfire Risk Assessment in a Typical Mediterranean Wildland–Urban Interface of Greece. Environmental Management 55, 900–915 https://doi.org/10.1007/s00267-014-0432-6

UNDRR, (2020). Hazard Definition & classification review: Technical Report. https://www.undrr.org/publication/hazard-definition-and-classification-reviewFdi.

UNESCO (2010). Glossary of basic terminology on disaster risk reduction, Technical report, https://unesdoc.unesco.org/ark:/48223/pf0000225784 , 10 p.

OECD, (2012). Methodological Framework for Disaster Risk Assessment and Risk Financing, https://www.oecd.org/gov/risk/G20disasterriskmanagement.pdf

Ouzeau, G., Soubeyroux, J.-M., Schneider, M., Vautard, R. & Planton, S. (2016).Heat waves analysis over France in present and future climate: Application of a new method on the EURO-CORDEX ensemble. Clim. Serv. 4, 1–12.

Papadopoulos, G.A. & Arvanitides, A. (1996). Earthquake risk assessment in Greece. In: Schenk V. (Ed.), Earthquake Hazard and Risk-Advances in Natural and Technological Hazards Research, Kluwer, 221-229.

Papadopoulos, G.A. (2000). The Civil Protection in Greece-Mitigation of Natural and Technological Hazards. ION Publications, Athens, pp. 157, (in Greek).

Papazachos B. & Papazachou C. (2003). The earthquakes of Greece, Ziti Editions, Thessaloniki, 302 p.

Pavlides S.B, Papadopoulos G. & Ganas A. (2002). The fault that caused the Athens September 1999 Ms=5.9 earthquake: Field observations, Nat. Hazards, 27 (1-2), 61-84.
Pescaroli, G. & Nones, M. (2016). Cascading Events, Technology and the Floods Directive: future challenges. E3S Web of Conferences. 7. 07003. 10.1051/e3sconf/20160707003.

Sidle, R. & Ochiai, H. (2006). Landslides: Processes, Prediction, and Land Use. AGU Books, Water Resources Monograph 18, pp 312.

Simons, D., et al. (2017). Qualitative and quantitative approaches to risk assessment In: Poljanšek, K., Marin Ferrer, M., De Groeve, T., Clark, I., (Eds.), 2017. Science for disaster risk management 2017: knowing better and losing less. EUR 28034 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-60679-3, doi:10.2788/842809, JRC102482, 48-130.

Tavoularis, N., Papathanassiou, G., Ganas, A., & Argyrakis, P. (2021). Development of the Landslide Susceptibility Map of Attica Region, Greece, Based on the Method of Rock Engineering System. Land, 10, 148. https://doi.org/10.3390/land10020148.

Trichopoulos, D., Zavitsanos, X., Katsouyanni, K., Tzonou, A. & DallaVorgia, P. (1983). Psychological stress and fatal heart attack: the Athens (1981) earthquake natural experiment. Lancet 321(8322):441–444.

Walia, A., et al. (2020). Methodologies for disaster impact assessment In: Casajus Valles, A., Marin Ferrer, M., Poljanšek, K., Clark, I. (eds.), Science for Disaster Risk Management 2020: acting today, protecting tomorrow, EUR 30183 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18182-8, doi:10.2760/571085, JRC 114026, 112-129.

Zuo, J., Pullen, S., Palmer, J., Bennetts, H., Chileshe, N. & Ma, T. (2015). Impacts of heat waves and corresponding measures: a review. J Clean Prod 92:1–12. https://doi.org/10.1016/j.jclepro.2014.12.078.

8. Annex 1

INTERVIEW GUIDELINE FOR STAKEHOLDER

Date and Time:	
Place:	
Interviewer (name and organisation):	
Name of interview partner and organisation:	
Gender of participant:	☐ female ☐ male ☐ diverse ☐ no answer
Age of participant:	____years
Role in the organisation:	
Years active in organisation:	_____ years
Country and region active:	

1. What is your role inside your organization?

2. In which of the four (4) **disaster management phases** i.e., prevention, preparedness, response, recovery, is your organization active?

3. In your opinion, which are the **natural hazards** with the **highest probability** of occurrence in your country (and region)?
   ☐ earthquakes ☐ volcanic eruptions ☐ tsunamis ☐ landslides ☐ heatwaves ☐ storms ☐ blizzards ☐ floods ☐ droughts ☐ wildfires ☐ epidemics/pandemics

4. In addition to the natural hazards, which are, according to you, the **human-made hazards** with the **highest probability** of occurrence in your country (region)?
   ☐ Technological accidents ☐ cyber threats ☐ terrorist attacks ☐ CBRNe malicious acts.

5. Which are the hazards, regardless of whether they are **natural or human-made**, **with the highest impact to the community**?
   Please, explain the reasons.

6. About which of the **following impact categories** are you mostly concerned?

   Human loss
   Built environment
   Natural environment
   Critical service disruption
   Economic loss

7. Are you aware of any risk assessment performed in your country/region? If yes, for which **hazard and impact is it** and in which terms?

8. Do you, in your organization, make use of any **risk assessment tools**?
    a. If yes, please name the tool.

    ☐ Qualitative risk assessment/hazard identification tools

    ☐ Quantitative risk assessment / Analyse and evaluate level of impact, severity of exposure.

    ☐ Inventory of assets with information related to disaster risk.

    ☐ Tools for security management / controls implementation for risk mitigation tools.

    ☐ Other: _____

    b. If no, is it planned to use risk assessment tools in the future?

9. What is the level of geographical coverage (local, regional, national) of these risk assessment tools?

10. Are you aware of any **public domain data platform** providing access to risk data in your country? Does your organization make use of such platforms?

11. Are you aware of whether these **risk assessment tools** are developed with a **scenario based or a probabilistic analysis**?

12. Do you receive **real-time observations** for specific hazards? If yes, for which hazards? Who is the **provider** of these observations and data?

13. Do you use of **early warning systems** to receive and notifications? If yes, for which hazards and for which purpose?

14. Do you provide notifications as a result of your **hazard forecasting or risk estimation**? Are these hazard or risk driven (i.e. do you take into account the impact and probability of its occurrence)?

15. In which ways (social media, 112 notifications etc.) do you **communicate the hazard/risk to the public**?

16. Could you name **gaps that exist** in the **monitoring** and **forecasting of hazards**, the coverage of which will improve early warning systems?
    ☐ Maintenance and/or upgrade of equipment
    ☐ Improved coordination at a national and cross-border level
    ☐ Research and development
    ☐ Other: _____

17. Could you name **specific DRR policies/plans** followed at **national and/or regional** level?

18. Which of the **four disaster management phases** i.e., prevention, preparedness, response, recovery is **most addressed** by national policies/plans/regulations?

19. Do you use any, **disaster management** related, international standards (e.g. ISO, CEN) and/or guidelines (e.g. WHO/FEMA)?
    a. If yes, could you name them?
    b. If no, is your organization planning to use any standards in the future?

20. Are **there gaps and challenges** in the national legislation, that need to be **addressed and covered in the short-term** in order to increase capacity at a national and/or regional level?

21. According to your opinion, which are the best ways to be followed at national level, in order to enhance and improve the capacity in disaster management?

☐ Train the public and increase its level of awareness regarding risks with the highest probability of occurrence.

☐ Adequate training of first responders both in terms of new technologies and of operational procedures.

☐ Clear planning per hazard with distinct responsibilities and liabilities for each organization

☐ Maintenance and upgrade of technological equipment.

☐ Other: _____

9. Annex 2

PARTICIPANT CONSENT FORM

Project: PANTHEON Community-Based Smart City Digital Twin Platform for Optimised DRM operations and Enhanced Community Disaster Resilience
Topic: Approach for Building Disaster Resilient CommunitiesParticipation: Interview/questionnaire

PARTICIPANT CONSENT FORM

Before we start with the study, we would like to inform you about the data processing and ask for your consent. You need not worry about privacy as we will not share the information, we have gathered from this study other than statistical and non-identifiable personal information in the report. Please tick the following:

- ☐ I am aware of the main aspects of the participation for the above PANTHEON project.
- ☐ I confirm that I have had the opportunity to ask questions.
- ☐ I understand that my participation is voluntary.
- ☐ I understand that my answers to any questionnaire will remain anonymous.
- ☐ I understand that if I don't wish to answer any questions, I am free to decline.
- ☐ I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified of identifiable in the outputs that result from the research without my agreement.
- ☐ I agree to take part in the above-mentioned activity.
- ☐ I give my consent to audio footage.
- ☐ I understand that I can revoke my consent at any time with effect for the future, whereby the lawfulness of the processing carried out based on the consent until revocation is not affected. A revocation has the consequence that my data will no longer be processed for the above-mentioned purposes from that point on.
- ☐ I hereby confirm that I have read and understood this declaration of consent and that my questions were addressed properly.

Location and date:

……

Name of the participant: Signature participant:

…… ……

This form should be signed and dated. A copy should be saved by the participant and one for the project documentation.

This project has received funding from the European Union's Horizon Europe programme under Grant Agreement No 101074008.

PROJECT INFORMATION

The EU-funded project PANTHEON will design and develop a Community based Digital Ecosystem for Disaster Resilience. In more detail, the aim is to improve risk assessment, reduce vulnerability, and strengthen community disaster resilience. Part of this is the enhancement of operational capabilities of Community Based Disaster Resilient Management (CBDRM) teams. To this end, it will use Smart City Digital Twin (SCDT) technology and leverage new and emerging technologies and innovations. For the specific developments in the project, our research focuses on Greece (Athens) and France (Paris) as pilot regions. Input from other areas will also be welcome to broaden the scope.

To find out what can contribute to the improvement of community-based disaster resilience, the first step is to systematically elaborate the application-oriented approach. This includes:

- ⇨ Analyzing existing legal and regulatory environment, i.e., platforms and decision-making systems for community-based DRM and Human, technical, material and financial resources
- ⇨ Mapping of regional multi-hazard/risk assessments of all major hazards and risks
- ⇨ Develop indicators for community vulnerability and capacity for all social, economic, physical, and environmental, political, cultural factors.

To include the needs of individuals, recommendations for outreach are also asked. It should also be noted here that information on individuals must be clarified with them to protect their rights as well.

Methods: Conduction of surveys (interview and questionnaire) with members of community organisations and stakeholders in the pilot areas of Greece/Athens and France/Paris to get insights into the status quo of national hazards, risk assessment and disaster management tools used, potential approaches for improvements as well as recommendations for community outreach. The recorded interview will be transcribed and summarized using content analysis to address the research questions. The collected data in the questionnaire will be analysed statistically descriptively.

Project Partners:

1 TWI ELLAS ASTIKI MI KERDOSKOPIKI ETAIREIA (Greece)
2 AIRBUS DEFENCE AND SPACE SAS (France)
3 M3 SYSTEMS BELGIUM (Belgium)
4 SOFTWARE IMAGINATION & VISION SRL (Romania)
5 Mobility Ion Technologies SL (Spain)
6 FUTURE INTELLIGENCE EREVNA TILEPIKINONIAKON KE PLIROFORIAKON SYSTIMATON EPE (Greece)
7 ECOLE NATIONALE DE L AVIATION CIVILE (France)
8 UNIVERSITAT POLITECNICA DE CATALUNYA (Spain)
9 PRACTIN IKE (Greece)
10 ISEM-INSTITUT PRE MEDZINARODNU BEZPECNOST A KRIZOVE RIADENIE, NO (Slovakia)
11 INTEROPTICS S.A. (Greece)
12 JOHANNITER OSTERREICH AUSBILDUNG UND FORSCHUNG GEMEINNUTZIGE GMBH (Austria)
13 EPSILON MALTA LIMITED (Malta)
14 INSTITUT DE SEGURETAT PUBLICA DE CATALUNYA (Spain)
15 HELLENIC POLICE (Greece)
16 KENTRO MELETON ASFALEIAS (Greece)
17 Crisis Management State Academy (Armenia)

This project has received funding from the European Union's Horizon Europe programme under Grant Agreement No 101074008.

INFORMATION ABOUT GENERATED DATA

Processing of data

All data collected during the survey will be treated confidentially and will only be viewed or processed by the project-involved employees of KEMEA (Center for Security Studies, Athens, Greece) who stores the collected data material (in the role of data processor according to GDPR) and who works with the data material (in the role of data controller according to GDPR). Information that could lead to an identification of the person will be changed (anonymisation / pseudonymisation) or removed. In scientific publications, the data is post-processed accordingly, so that the resulting overall context of events cannot lead to an identification of the person by third parties. The results will be further processed in the form of a report and possibly further scientific publications.

Voluntary nature of participation

Participation in this survey is voluntary. Participants may withdraw at any time without giving reasons and without incurring any disadvantages. For this purpose, please keep this document with the contact: dpo@pantheon.eu

Confidentiality and anonymity

Your information will be used solely by researchers for research purposes in the context of the above research project. Personal information will not be shared with anyone outside the research team of this project. The published research results (publications, research reports) have no personal reference and therefore do not allow any conclusions to be drawn about your identity.

Data protection

The data will be processed based on your consent for the purpose of carrying out the above-mentioned research project (collection, evaluation, generation of results, publications). The legal basis for this is the EU General Data Protection Regulation (GDPR), namely in particular Art 6(1)(a) (consent) and Art 9(2)(j) (research purposes in the public interest) in conjunction with the Austrian Research Organization Act (FOG). Your personal data (name, contact, age, gender, duration in working area, role in disaster management, allocation of organisation and information about the disaster management plan) will be encrypted and stored for up to 10 years after the end of the project period (i.e., until 31.12.2032) and then deleted. The collected questionnaire ("raw data") will be kept for 10 years from the date of publication of the results of the project to demonstrate compliance with good scientific practice and then destroyed. Data required for the assertion, exercise and defence of legal claims will be stored for up to 30 years and subsequently deleted. You have the right to information, correction, deletion, restriction of processing, data portability, objection, and a right of appeal to the data protection authority at any time in accordance with legal provisions (in particular Art 15 to 22 DSGVO with the restrictions in § 2d paragraph 6 FOG).

Right of withdrawal

In order to be able to fulfil your right of withdrawal and to enable assignment of the correct record for this purpose, we urgently recommend saving this informed consent with the following contact address, to be able to contact us: dpo@pantheon.eu

This project has received funding from the European Union's Horizon Europe programme under Grant Agreement No 101074008.

10. Annex 3

QUESTIONNAIRE FOR COMMUNITY REPRESENTATIVES/STAKEHOLDERS

GENERAL QUESTIONS

1. Gender: □ Female □ Male □ Diverse □ No answer

2. Age: ____years

3. Country: _____

4. Which city are you active in? ……..

5. What organisation are you a part of? ……

6. For how long have you been a part of this organisation? ___years
7. Does your organization play a role in disaster management? □ Yes □ No

8. What role does your organization play in disaster management?.....

First responder; paramedic	☐
First responder; firefighter	☐
Municipal services/providing food, shelter	☐
Overall management	☐
Other……	☐

9. What is your position in the organization?

Social worker	☐
Councelor (e.g. for finances or mental health)	☐
Community and social service specialist	☐
Researcher (social sciences, humanities…)	☐
Researcher (natural sciences, technology, IT…)	☐
Engineer/Technician/Software Developer or similar	☐
Civil servant	☐
Management	☐
Other……	☐

10. Do you have any professional experience with disasters/disaster management?

□ Yes □ No

a. If, yes, in how far?.....

HAZARDS

11. What are the top 5 hazards/risks that affect or could affect your region/country? Please place the hazard with the highest relevance at the top, continue with the second most relevant etc.

□ Earthquake □ Volcanic eruption □ Tsunami □ Landslide □ Heatwave

□ Storm □ Blizzard □ Flood □ Drought □ Wildfire

□ Epidemics/Pandemics □ Technological Accident □ Cyber threat

□ CBRNe malicious act □ Terrorism attack □ Other……

12. Does your organization have any risk assessment/hazard analysis tools?

□ Yes □ No □ Not aware

a. If yes, which tools?

□ Qualitative risk assessment / hazard identification tools,

□ Quantitative risk assessment / Analyse and evaluate level of impact, severity of exposure,

□ Inventory of assets with information related to disaster risk

□ Tools for security management / controls implementation for risk mitigation tools

□ Other……

□ Not aware

13. Does your organization use risk information to fulfil its mandate? If yes, what kind?

□ Yes □ No □ Not aware

If yes, what kind?

□ Hazard forecast
□ Exposed assets
□ Estimated Impact
□ Other……
□ Not aware

14. Does your organization have an up-to-date disaster management plan/strategy?

□ Yes □ No □ Under development □ Is being planned for the future □ Not aware

15. If yes, how often is the disaster management plan/strategy updated?

□ Very often
□ Often
□ Not so often
□ Rarely
□ Never
□ Not aware

16. If not, is a disaster management plan/strategy planned to be implanted in the future?

□ Yes □ No □ Not aware

17. What are the main actions that your organisation has taken to minimize future disaster impact and losses?

□ Training for the public □ Training for emergency services personnel to new technologies

□ Training for emergency services personnel to operational plans and procedures

□ Use of standards, which enable technical interoperability between different technological systems and tools

□ Use of standards, which facilitate and enhance interoperability between different agencies

□ Early warning systems

□ Prevention of hazards □ Relocation of exposed people □ Insurance

□ Mitigation (e.g., flood protection) □ Building resilient infrastructure

□ Detailed evacuation and disaster management plans □ Adoption of new technology

□ Other: _____ □ None

18. To what extent does your organization integrate international/EU standards in its operational procedures?

Great	Considerable	Neutral	Limited	Not at all

19. To what extent are the four disaster management phases is, in your opinion, addressed by national policies and initiatives?

DM Phase	Great	Considerable	Neutral	LImited	Not at all	I do not know
Prevention						
Preparedness						
Response						
Recovery						

20. What do you think are the main gaps in disaster management preparation and mitigation?

□ Training for the public □ Training for emergency services personnel to new technologies

□ Training for emergency services personnel to operational plans and procedures

□ Use of standards, which enable technical interoperability between different technological systems and tools

□ Use of standards, which facilitate and enhance interoperability between different agencies

□ Early warning systems

□ Prevention of hazards □ Relocation of exposed people □ Insurance

□ Mitigation (e.g., flood protection) □ Building resilient infrastructure

□ Explicit and clear disaster management plans □ Legal framework for land management structural upgrade, etc.

□ Other ……□ Not aware

21. Is there any available Early Warning System?

□ Yes □ No □ Not aware

If yes, for which risks?

□ Earthquake □ Volcanic eruption □ Tsunami □ Landslide □ Heatwave

□ Storm □ Blizzard □ Flood □ Drought □ Wildfire

□ Epidemics/Pandemics □ Technological Accident □ Cyber threat

□ CBRNe malicious act □ Terrorism attack □ Other……..

□ Not aware

22. Does your organization receive notifications for upcoming events as result of early warning?

□ Yes □ No □ Not aware

23. If yes, which is the main dissemination system for the warning issued?

□ operations center/real-time info on screen

□ telephone/fax/e-mail

□ cell broadcasting (reverse 112)

□ TV/radio

□ on the ground alarm/sirens/megaphones

□ Other……

□ Not aware