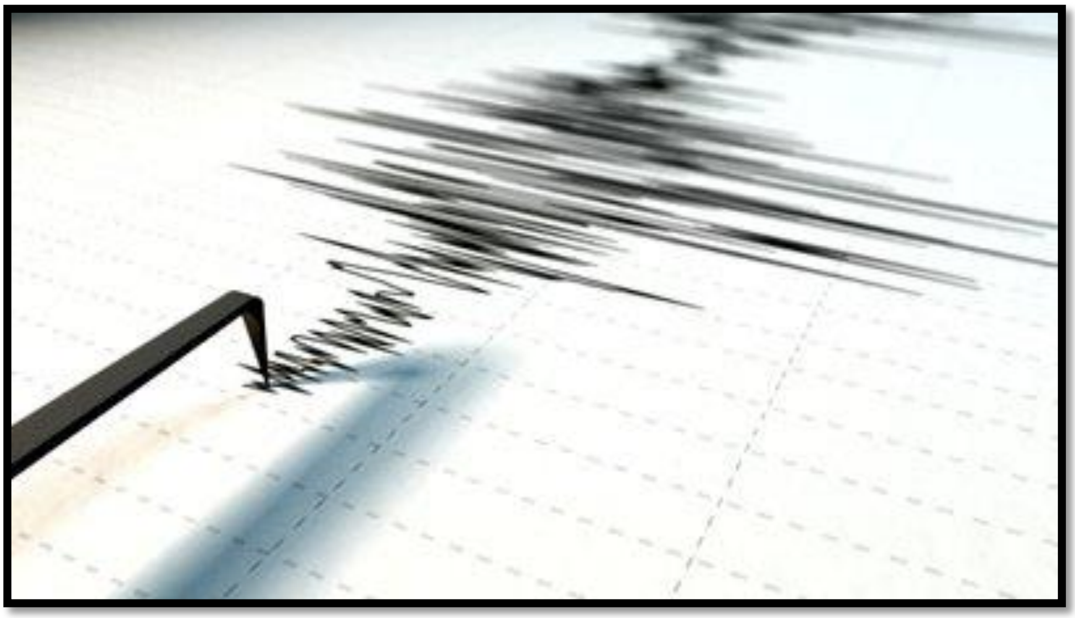
Early Warning Systems for Natural Disasters in Europe



Diliana Ivanova

10080074

ES3 3b

A. Grebner

9th October 2013

Academy of European Studies & Communication Management

The Hague University of Applied Science

Executive summary

The following dissertation examines the most common natural disasters in Europe and their Early Warning Systems as a countermeasure. The paper will attempt to answer to what extent these Early Warning Systems play a role in the reduction of deaths and damages caused by natural disasters in Europe. Considering that annually natural disasters generate significant financial losses and deaths; this question remains relevant. In addition, answering the question will allow for objective assessment on the available systems in Europe, as well as facilitating the identification of both the deficiencies and effectiveness of the techniques used to ensure financial, environmental, and personal safety in times of natural disasters.

The research methods used in the following dissertation consist of extensive preliminary research in the form of secondary sources, such as EU and national reports; in addition, the paper has an in-depth secondary data gathering which consists of books, articles, and academic papers; the dissertation also looks at quantitative data such as statistical reports relevant to disasters in Europe.

After carefully looking at different EWSs and trying to assess their effectiveness, the research has found that most of the real-time information gathered from satellites and radars is only made available to national authorities and academic circles. This fact becomes an obstacle to the public availability of this information, especially to people in risk who may make effective use of it. The availability of such data would lead to the better preparedness of communities and therefore the better counteraction to natural disasters.

Furthermore, one of the biggest gaps of EWSs is the lack of publicly available statistics and databases in which all natural disasters can be gathered together with the number of deaths, injuries, and financial losses so they can be later analyzed and compared. This will significantly increase the possible assessment based on official statistics and therefore give an objective picture of how effective EWSs are in reducing deaths and losses. The assessment of information would allow for the identification of current gaps in EWSs and therefore facilitate the justification for their improvement.

Table of Contents

Introduction

Climate change is considered to be one of the most dangerous phenomena we face today. As a result of global warming and other such imbalances, natural disasters have enlarged in scope, power, and frequency throughout the decades, generating the increasing need for improved ways to ensure the safety of communities, nations, and the environment.

The identification and implementation of techniques to ensure financial, environmental, and personal safety in times of natural hazards becomes as relevant and latent as ever.

The central question of the following paper is:

To what extend are Early Warning Systems helpful in reducing deaths and damages caused by natural disasters in Europe?

By answering the central question, the following paper intends to paint a general picture of just how effective Early Warning Systems (EWSs) have been in Europe throughout the last decades. By comparing the effectiveness of the systems, and based on the research findings, this dissertation will then try to formulate recommendations regarding future improvements and applications.

The methods used in the following dissertation consist of extensive preliminary research in the form of secondary sources, such as official documents concerning EWSs, EU, and National reports; as well as secondary data gathering, consisting of books, articles, academic papers regarding EWSs; and quantitative data such as statistical reports relevant to natural disasters in Europe.

The initial effort when writing this paper was centered on extensive preliminary research. This research helped identify the existence of an unanswered, yet relevant main question.

The analysis on the effectiveness of EWS is based upon collected secondary data over multiple events that changed the landscape of Europe. The comparison between the effectiveness of such systems in the past and today, will lay a platform for discussion about the recommended steps to take in order to ensure future improvements for more reliable EWSs.

The paper will introduce the readers to the most common natural disasters in Europe, giving account of historical circumstances which brought to attention the need for Early Warning Systems. Further in the dissertation a definition of EWSs and a brief history of EWSs and disaster reduction is provided.

Following are examples of such systems initiated in Europe, their stakeholders and a comparison to past events. This will later allow for the objective analysis of the central question. Furthermore the paper looks at the current gaps and needs of EWSs, the aspects which have to be improved and the future application of these systems. In the end there are recommendations, a final conclusion, appendixes and a glossary of terms used throughout the paper.

Chapter 1: Natural hazards

1.1: Introduction to the chapter

Natural hazards, also known as natural risks, are defined as "natural processes or phenomena that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage." (UNISDR, 2008).

The following chapter will examine the results of many common natural disasters in Europe, specifically looking at their influence on the improvement of EWSs.

Both natural hazards and natural disasters are concepts covered by this dissertation, yet they are not synonyms. A natural hazard holds a theoretical potential threat to peoples` lives, environment and property. However, this potential threat does not necessarily have to materialize into a disaster. On the other hand, a disaster is the result of a natural hazard which did occur. The clarification introduces the understanding that generally a hazard turns into a disaster if a certain situational vulnerability is met.

The concept of situational vulnerability is an essential guideline for the understanding and building of early warning systems as it provides a more accurate idea of the likelihood for a disaster to happen.

1.2: Natural hazards in Europe and their impact

Earthquakes

Earthquakes are seismic hazards which have high prevalence throughout Europe, even though it is not generally exposed to high magnitude events due to its rather stable geology. According to NatCatService 40% of all economic losses suffered by Europe in the last century were caused by some stronger magnitude earthquakes (n/a, Significant natural disasters since 1980, 2011). These stronger magnitude earthquakes are more prevalent in Southern Europe (Italy and Greece) and the Eastern parts of the continent (Turkey).

There are significant examples of destructive earthquakes throughout European history such as the Messina (Italy) earthquake of 1908 which, even today, continues to be remembered as the most cataclysmic earthquake in modern Europe. It resulted in 100,000 casualties (The Telegraph, 2011) which comprised around 40% of the city`s population at the time. The following tsunami claimed another 20,000 lives both in the city of Messina and a significant number of the population in the whole region (History, 2008).

Another historically relevant earthquake which capitalized on the need for efficient EWSs was the one in Izmit (Turkey) of 1999. According to the official statistics released by the Turkish government, 17,000 people died, 50,000 were injured and, almost half a million were left homeless (Science daily, 2011).

Storms

Storms are meteorological hazards. Commonly, strong destructive storms occur in the northern parts of Europe including the UK, Iceland, Ireland and Norway. Storms generally only appear in extreme weather conditions.

Worldwide, storms are thought to be the second largest contributing factor to economic losses due to natural disasters, after the hurricanes in the United States (Top Broker, 2013). This is a serious statement and it can be observed in the annual damages caused by storms in Europe, which are estimated to be around 1.9€ billion per year. In addition another 1.4€ billion are expended in the form of insurance claims (Insurance Journal, 2013).

Recent examples of destructive storms in Europe are windstorms Kyrill and Xynthia. The former took place in 2007 reaching the UK and Germany but also passing through France and The Netherlands. The storm is regarded as one of the most violent and destructive storms in over a century. It left behind a total of 32 deaths and in Germany alone the financial losses reached more than 4.1€ billion (Willis, 2007).

The latter rampaged through southern Europe (Madeira, the Canary Islands, Spain, Portugal and southern France) in 2010 causing significant losses of life and properties. The total deaths were reported to be more than fifty and the financial losses throughout the affected regions in terms of destroyed/damaged infrastructure were calculated to be more than 2.5€ billion (O`Donnell, 2010).

Extreme temperatures

As a result of global warming and constantly changing temperature amplitudes, one of the most frequently occurring natural disasters in Europe for the last fifteen years has been extreme temperatures, leading to heat waves in the summer and massive freezing during the winter.

Generally, during the summer it is no longer surprising to have extreme records of temperatures higher than 38 degrees in much of Europe, with high fluctuations in day to day temperatures. This wild change in temperatures often leads to massive sun strokes and heat waves which sometimes result in numerous deaths. In addition, it has been argued that extremely hot temperatures are responsible for causing massive forest fires all across Europe, which annually destroy thousands of hectares of flora and fauna.

An example of such a climate anomaly is the heat wave in Europe in the summer of 2003, reported to break records, being the hottest one since 1540 (Met Office Education, 2003). The results were temperatures reaching far above 35 degrees Celsius. This led to the death of nearly 70,000 people, mainly in Central and Western Europe. Moreover the heat waves not only brought the death of thousands, but also ended in massive floods (caused by high peaks mountain snows) and forest fires. One of the most affected regions with regards to fires was Portugal which suffered enormous losses, suffering more than 5% of its countryside and 10% of its forests (around 215,000 hectares) completely destroyed (European Commission, 2003).

On the other hand, Europe experiences extreme temperature changes during the winter which result in not only really low temperatures but, also, rather high ones.

An example of such atypically high temperatures during the winter took place in Italy, where due to a winter heat wave they reached 25 degrees in January 2013. A rather older example dates back to December 2010 when the temperatures in the Balkans, unlike the rest of Europe which was freezing, reached 20 degrees Celsius (Wikipedia, 2013).

In contrast to these winter heat waves, the opposite phenomena of really low temperatures during the winter is present, pointing to a colder winter atmosphere than in the the past. Annually the cold weather conditions Russia is predisposed to translate into severe winters with temperatures dropping -twenty degrees Celsius in some parts.

Unlike in Russia, anomalous winter temperatures are atypical for the most of Europe. Yet, in the beginning of 2012, which started with records in many countries, the temperatures in Scandinavia reached -forty degrees and, for much of the rest of Europe, around -twenty to -thirty degrees (boston, 2012). Many places were obstructed under huge masses of snow making them unreachable as well as leading to the shutdown of telephone and electricity connections. The impossibility for the buried regions to be reached, together with the lack of communication and the insufficient heating, (caused by the short cut of electricity), caused thousands of deaths and amputations as a result of frostbite all around the continent (Dankers & Hiederer, 2008).

Floods

One of the most common hydrological natural hazards in Europe – floods- is usually caused by heavy rains. Each year Europe is overwhelmed by floods, normally during the months of April and May which witness highest level of precipitations. Such rains can lead to raising water levels of rivers which constitute an additional danger especially in low-laying lands (Top Broker, 2013).

Most of the floods in Europe occur in the UK where over-floods coming from the ocean are relatively frequent. In the rest of Europe floods happen more commonly around the center of the continent, and are normally caused by major European rivers such as Danube and Elbe.

An exemplary illustration of such an event is the Great Central European flood from 1997, which affected Poland, Germany and the Czech Republic. It was caused by the over flood of Oder river, resulting in 110 deaths and 4.5€ billion in asset losses or damages (JOURNAL OF GEOPHYSICAL RESEARCH, 2004).

Another, more recent case of a disastrous flood in Europe dates to the spring of 2013. In this case, it was the Elbe`s and Danube`s water levels which increased significantly, causing extreme floods in Germany, and the Czech republic. The floods forced more than 100,000 people to leave their homes in an emergency evacuation (GRIESHABER, 2013). The disaster’s official report stated that around 10,000 people had to leave their homes, many of which couldn’t return. In addition twenty five people deceased. The financial losses in Germany alone exceeded 5.8€ billion (Newsdesk, 2013).

It is important to understand the commonalities of countries sharing water sources. For example, the Danube River is shared between 19 European countries, which leads to the need for a shared effort between countries in supervising the river`s activity (Joined Research Center, 2010).

1.3: Conclusion to the chapter

All of the above mentioned types of disasters and the applicable examples resulted billions of euros in losses, numerous deaths, while leaving thousands of people without a home. Preventive measures to these disasters and their results, attention to a better developed and communicated system was brought forth. The desire for substantial counteraction to these natural disasters brought the need and initial efforts for significant improvement in the performance of Early Warning Systems in Europe.

Chapter 2: Early Warning Systems

2.1: Introduction to the chapter

The following chapter will establish the definition of EWSs. Moreover it will go through the history of EWSs, their introduction and the factors which drove the need for them.

2.2: What is an Early Warning System?

An Early Warning System, as defined by the Free Dictionary, is “a system or procedure designed to warn of a potential or an impending problem; anything that gives advance notice of something” (The Free Dictionary, 2013).

The main components of such systems, often applied to the prevention of natural disasters, include radars, sensors, detectors, satellites and, last but not least, well assessed human decision making and sufficient communication system. All these components, together or individually, build a platform for EWSs and their networks. Early Warning Systems provide us with a warning that informs us about the proximity of a coming disaster. This warning, which can be of minutes, days or even months, can be inevitably precious for prompt and effective reaction to coming disasters, giving the chance to reduce damages, and more importantly, reduce fatalities and injuries. Because of this unique role, Early Warning Systems are considered to be a vital governmental tool towards the sustainable development of a stable and unthreatened social and economic environment (ESIG Alert, 2004).

According to UNISDR (2006) there are four steps in the building and successful implementation of an Early Warning System (Villagran de Leon & Bogradi, 2007) (see appendix 2). The four steps include knowledge of the risk of the natural hazard, monitoring for changes and anomalies in the behavior of the hazard, communication once a disaster occurs or is about to occur and, finally, response to the disaster and its damages. These four steps are important for running a successfully EWSs. If one of the steps is missing, neglected, or miscommunicated, then the whole system fails to fulfill its purpose.

2.3: History of Early Warning Systems

Throughout the last century the need for substantial efforts against natural disasters was brought forth to the attention of many nations. This need for a plan of action was shaped by response to large-scale disasters such as the Messina (Italy) earthquake of 1908 which killed 100,000 people, the North Sea Flood of 1953 which killed 2000 people in the Netherlands and the UK, and the earthquake in southern Campania (Naples region, Italy) of 1980 which killed nearly 3000 people (Bressan, 2012). Obviously, there are many more examples throughout European history which shaped the need for EWSs; but the ones mentioned above could be considered to have been key events.

The modern history of Early Warning Systems can be traced back to 1990. In this same year, on January 1st, the United Nations General Assembly proclaimed the period between 1990 and 2000 as the International Decade for Natural Disaster Reduction (IDNDR); its goal was to increase awareness on the global influence of natural disasters and to take actions in reducing deaths, asset losses, and social and economic disruption, by developing an agenda for disaster reduction (Time toast, 2010). Special attention was given to the establishment of EWSs through international cooperation. Later on, as a result of the programme, it had been agreed that all regional and national systems should be merged in a common database to accomplish a more detailed and global supervision on natural hazards. Throughout the years the project had the purpose to closely overlook all national and international initiatives concerning EWSs as to achieve standardization and general progress in the introduction of EWS programs.

The IDNDR focused on the correlation between national/international efforts and the reduction of deaths and damages during natural disasters, thus making EWSs a major investment for many countries. Moreover disaster reduction became a fundamental topic to many academic communities which operated around the question of how EWSs can possibly be improved so that they can become more reliable and, therefore, more successful in fulfilling their purpose (HPN, 1994).

Later, in 1998, the first International Conference on Early Warning Systems for the Reduction of Natural Disasters was launched in Germany; its aim was to become a place where accomplishments could be noted, and ideas and experiences regarding successful implementations of EWSs could be shared and discussed (Meteo world, 2011). This aided the establishment of better coordination between nations when introducing these systems.

During the second Early Warning Conference in Bonn (Germany) the International Early Warning Program (IEWP) was proposed; although the conference took place in 2003, the project was not adopted until January 2005 (ISDR, 2008). By adopting this program, the UN aimed to help improve prevention by using a comprehensive set of methods including rapid information sharing as well as training communities at risk.

2.4: Conclusion to the chapter

The historic events connected to the introduction and the successful implementation of EWSs significantly contributed to the development of the systems. Taking into consideration how important international cooperation is, the discussion surrounding disaster prevention became a priority on the agendas of many international summits. Moreover, international relations were effectively strengthened through common disaster reduction plans.

Thanks to the introduction of the common disaster reduction goals, with particular attention on early warning, and the joint international efforts, EWSs have become more reliable and efficient. Since the introduction of IDNDR in 1990 EWSs continue to improve through international cooperation.

Chapter 3: Early Warning Systems in Europe

3.1: Introduction to the chapter

The following chapter will look at different disaster reduction programs initiated by the European Union which, in addition to the EWS programs, also include a number of networks aimed at communicating and acting on the information from the EWSs. Finally the chapter will present results, drawn from the comparison between past and current events in which EWSs were applied, used for the formulation of recommendations on the improvement and the future application of EWSs.

3.2: Early Warning Programs in Europe

In order to meet the need for safety and stability throughout Europe, the European Union has introduced a set of Early Warning programs in order to reduce the impact of natural disasters (see appendix 3).

KultuRisk

KultuRisk is an early warning program initiated by the European Commission and UNESCO-IHE (Institute for hydrologic education). The efforts in introducing the project are shared between six countries in Central and Western Europe. The project was scheduled to have duration of three years (finishing in 2013) and counts with an estimated capital of 4.5€ million (European Commission, 2011).

The need for such a program was brought to attention as a response to the catastrophic events happening around Europe since the beginning of the millennium. Events involved in the formation of the initiatives can be dated back to the heat waves from the summer of 2003 which resulted in many deaths and wild fires, the extremely destructive floods of 2002 which inflicted billions of euros damages on Central Europe, and the L`Aqila earthquake in Italy of 2009 which caused estimated damages of 16€ billion and nearly 300 deaths, thousands injured and many left homeless (Kington, 2012). The extreme consequences caused by natural disasters highlight the need for improvement in the risk prevention methods, including risk knowledge and preparedness among the communities.

The main idea of the project is to develop a culture of risk prevention and fast recovery from natural disasters which stems from the concept that instead of learning disaster avoidance people should learn about disaster management (Di Baldassarre, 2010).

KultuRisk aims to inform people about the actions that should be taken in times of a natural disaster, in order to teach them to react faster and more efficiently, which translates into reduced damages on their properties, as well as the disaster-related fatalities. The examples which the project uses as a base for its information are past disaster events which resulted in enormous calamities. The idea is to analyze each situation and to discuss what could have been done in order to diminish the losses. KultuRisk attracts attention to the importance of keeping a clear-head and well established procedures when in an emergency situation. These educational sessions take place in the form of presentations, open dialogues, and discussions (KultuRisk, 2011). The presentations are executed by partners of the project (local and international non-governmental organizations) to people in schools, the media, and local communities.

KultuRisk was a significant factor for decreasing the losses during the 2013 floods in Europe. Even though twenty five people died and the overall losses were estimated 12€ billion, the project had its importance in casualty reduction as people were better prepared for the disaster. Many of them guaranteed the shelter of documentation and important assets by moving them to the second floor or their houses, turning off gas and electricity, finding a safe place for themselves and their household. Simple but important actions like these guaranteed around 30% reduced asset loss; all thanks to the better timely preparedness and education of people (the weather channel, 2013).

Compared to the floods of 2013, the losses caused by the European floods of 2002, when KultuRisk was still not in action, were greater. The total damages or losses were estimated to be 15€ billion and total deaths amounted to 110 (abs consulting, 2002).

This comparison gives a positive preliminary overview of the KultuRisk as an Early Warning System. When comparing the two devastating European floods, the numbers of deaths and losses were significantly reduced since the introduction of the project.

REAKT

REAKT stands for Real Time Earthquake Risk Reduction and is an early warning system introduced by the European Commission in partnership with AMRA (analysis and monitoring of environmental risk). The project is scheduled to continue until 2014 when the final results from it will be evaluated. REAKT started as an early warning project in 2011 and its financial input was estimated to be around ten million euro (European Commission, 2010).

The project is focused on effective warning of earthquakes across Europe and is mainly targeted at the vulnerable regions in Southern Europe (Italy, France, Greece, etc.) which are closely monitored with seismic maps (see appendix 1). According to the project`s official website, its main goal to:

"The general objective of the Project is to improve the efficiency of real time earthquake risk mitigation methods and its capability of protecting structures, infrastructures and people. REAKT aims at establishing the best practice on how to use jointly all the information coming from earthquake forecast, early warning and real time vulnerability assessment. All this information needs to be combined in a fully probabilistic framework, including realistic uncertainties estimations, to be used for decision making in real time." (REAKT, 2011)

The project`s purpose is to critically assess all the existing procedures for risk reduction, identify timely response procedures to the earthquakes, and execute an analysis aimed to find the most cost-efficient and life-efficient way to improve the communication between the time when the danger is alerted and the actual occurrence of the earthquake (REAKT, 2011). REAKT aims to serve as a structural decision making body with the resources to introduce a better and more efficient response to sudden disasters like earthquakes. This is done by considering different regional, national and international systems for early warning and earthquake communication alerts. Later, the gathered information is assessed in order to compute a broader and more detailed picture of what is happening. In this fashion, REAKT aims to build a detailed methodology for timely warning and adequate reaction to earthquakes.

In order to gather sufficient and reliable information on real time dangers, REAKT maintains a 24/7 connection with a wide network of seismic centers all around Europe. In this way the system is able to gather and assess as much real time information on seismic activity as possible which is later put forward a model for the improvement guide.

In 2009, when the project had not been implemented, L`Aquila (Italy) was shaken by 5.9 Richter magnitude scale. The disaster killed nearly 300 people and resulted in 16€ billion in damages. The losses of the disaster could have been diminished as a month before the earthquake, Giampaolo Giulianim, Italian laboratory technician who was predicting earthquakes based on radon emissions, predicted the danger of a major earthquake. Unfortunately his alert was neglected (Dollar, 2010). He later joined the American

Geophysical Union in San Francisco with the vision of creating a worldwide seismic early warning system.

Another example studied by REAKT has been the 2011 earthquake in Van, Turkey. With its 7.1 magnitude, it claimed the life 604 people and amounted losses of over 700€ million (Daniell & Vervaeck, 2011).

The statistical comparison of the two earthquakes clearly shows a gap between the introduction of an early warning system and an early assessment of the danger. However there are more factors that could influence the destructive effects such as magnitude and specific architectural endurance and population density of the region. This contractual nuances, makes, it hard to assess whether the EWS showed actual results in terms of diminishing deaths and losses.

EFAS

EFAS stands for European Flood Awareness System, a project, aimed at providing early warning against floods which was introduced in 2003 as a joined initiative between the European Commission, the European Joined Research Center, and the Union`s member states (European Commission, 2012).

EFAS was created as a response to the innumerable floods in Europe’s history. Rivers, especially in their high-water period can be a latent danger to cities and countries situated around the rivers banks (Elhardt, 2007). Looking for solutions to threats of over-flooding, the European Union found itself in need of an effective Early Warning System which would be efficient in supporting affected communities, and shielding some of the financial losses caused by floods.

The project is the biggest Early Warning System of its kind in Europe. This is the result of a well-established cooperation between national meteorological centers and inter-European collaboration centers such as the European Centre for Medium-Range Weather Forecast (ECMWF), Global Monitoring of Environment and Security Emergency Management Service (GMES-EMS), and European Commission’s Monitoring and Information Centre (MIC) (Joint Research Center, 2013). As a result the system is supported by qualitative real time information on rivers around Europe as well as the chance for potential floods. EFAS runs 24/7 with information being periodically collected into data banks.

The greatest advantage of EFAS is the fact that it can predict imbalances up to ten days in advance. This provides ample for warning and provides extra time for preparative efforts (Alfieri & Thielen, 2008).

In 1997, in the early stages of development of EWSs, a large Central-European flood caused damages calculated upwards of 4€ billion and 115 fatalities (official report, 2002). Even though the post-actions were sufficient in the form of humanitarian aids from charities and organizations, the governments of involved nations were criticized for their inadequate decision-making and inappropriate response to previous warnings of a potential river over flood.

A recent example of a European flood can be found in the spring of 2013. The losses were estimated around 6€ billion in Germany alone, 25 people died and thousands were forced to live their homes (dw, 2013).

Even though the losses do differ and a considerable death toll, Germany was strongly criticized for its incompetence to learn from past events (the flood from 2002). Even though there were raising levels of all big Central-European rivers, clearly alerting a danger, the country found itself unprepared, starting with a lack of sand bags for the river banks, to being poorly prepared regarding evacuation plans (Rex, 2013). Even in cases when a reliable EWS is available, it might fail to fulfill its purpose if the communication is badly transferred or misunderstood.

EFFIS

The European Forest Fire Information system plays an important role in the early warning supervision of natural hazards throughout Europe. The project is a joined initiative of the Joined Research Center, the Directorate general for environment, and the European Commission. It was initiated in 2000 (Strobl, 2009).

Throughout the last decades Europe has suffered numerous forest fires which caused not only deaths, but also damages calculated in the billions of euros. In addition, some species of flora and fauna have become endangered because of these fires. This alone is considered to be one of reasons why fires are one of the most dangerous hazards in Europe. Especially in the summer season, when extremely high temperatures occur, there are widespread probabilities of forest fires.

The programme provides a supervision of potential forest fires throughout the continent, as well as a common database with reliable and up-to-date information on past and potential fires around Europe (Ayanz, The European forest fire information system, 2010). This is done as a complementary effort to national and regional systems for detection of fire hazards. This supervision is achieved with the help of satellites as well as general analysis of the hazards depending on factors such as temperature and geographical position. The system consists of variety of components such as database storage, estimation of the potential danger of fires, as well as damage appraisal (EC Joint Research Center, 2013).

One of the most notable advantages of the program is that its database and mapping (of past, current and potential fire areas) are publicly available on the website of EFFIS. This allows for the information to reach a higher number of people who can better prepare themselves as well as take voluntary actions in case of fires. The available information consists of past fire events, information on how fires occur as well as effective ways to overcome them. In addition, and perhaps most importantly, it monitors the appearance of current fires including time of the fire occurrence, location, size, and cause for its appearance (Joint Research Center, 2011). In addition to EFFIS, two more divisions were introduced in order to deal with forest fires hazards. The first is EFFRFS (European Forest Fires Risk Forecasting System) which tries to estimate the risk for forest fires to occur around Europe. Its work depends on the gathered knowledge and information of all European local and regional supervising systems. The second one is EFFDAS (European Forest Fires Damages Assessment System) which aims at inspecting post disaster conditions and mainly assesses social, economic and financial damages caused by the fires (Ayanz, The European Forest Fire Information System: A European strategy towards forest fire management, 2007).

In 2003, Portugal was highly affected by forest fires caused by droughts. Nearly 10% of the forests (around 215,000 hectares) were completely destroyed. Such vast losses were caused by the slow assessment of information about the type and range of the fire. This, to certain extend, was driven by the lack of common European wild fire database (DIRECTORATE-GENERAL JOINT RESEARCH CENTRE, 2005).

Later, in 2004, EFFIS introduced EU fire database. It contained satellite mapping and real time information of fires and press releases.

In 2007 there were series of massive forest fires in Greece in which nearly 670.000 hectares were destroyed. The fires were supervised with mapping, the type and scope of the fires was assessed promptly, allowing for the faster response to the disaster. EFFIS was involved with the assessment of the Greek fires with real time information provided by its database. In addition, it provided a landscape of the region in order for further developments of the fire to be adequately predicted (Fire uni, 2010).

Even though the EWS did not diminish the losses or could not restrain the fire due to its massive scope, the EFFIS managed to support the event with real time information and mapping which were useful for the better understanding of the fire`s behavior and development. Later, the information gathered from the event, was used for future practices, assessments and case studies.

3.3: Distribution networks for information on early warning

In order for early warning to be correctly applied it is important to not only have reliable Early Warning Systems but also to have a trustworthy information channel and distribution networks. In addition to the well-known technological methods such as short messaging (sms), emails; radio and TV broadcasts; the internet and its search engines as a platform for information distribution, there are some specially developed information networks which are publicly available and give current information on natural hazards.

Global Telecommunication System (GTS)

As defined by the World Meteorological Organization, the Global telecommunication system is "the coordinated global system of telecommunication facilities and arrangements for the rapid collection, exchange and distribution of observations and processed information within the framework of the World Weather Watch" (World Meteorological Organization, 2009).

The main objective of GTS is to supervise and distribute the information regarding meteorological changes, achieved by a network of satellites.

The system is divided into three main levels (see appendix 4). The foundation of GTS lays in the importance for national meteorological telecommunication networks. This means that each country is responsible of supervising its territories regarding weather changes. Later the data and the gathered information are filtered through the regional meteorological telecommunication networks (Rainer, 2010). After the information is passed onto the regional networks it is sent to the main telecommunication centers which are responsible for gathering and analyzing the data, therefore being responsible for giving the signal in times of danger and possible disasters.

Shared Environmental Information System (SEIS)

SEIS is a collaborative initiative between the European Commission and the European Environment Agency. It was created as a result of the need for a single supervision system to gather and analyze the information regarding environmental changes throughout Europe (European Environment Agency, 2011).

The SEIS is a shared EU environmental information system and its main purpose is to make environmental information publicly available.

The main advantage of SEIS is that it simplifies the reporting of environmental changes as well as making the analysis easier, faster and therefore more reachable to the public.

3.4: Results

According to the Annual Disaster Statistics Review of 2010, deaths caused by natural disasters in Europe have increased compared to the past decades (Sapir, Vos, Below, & Ponserre, 2010). However, it should be mentioned that occurrence of natural disasters has increased nearly 20% compared to the beginning of the millennium. It can be argued that this increase is a result of global warming and the consequent changing climatological and meteorological conditions. The increase in the occurrence of natural disasters might be looked proportional to the number of deaths and damages. In addition it is a subjective problem whether an EWS influences the successful mitigation of disasters, due to the fact that there is no fully-objective base for comparison between disasters as they differ in scale and circumstances. This is a fundamentally important factor influencing the lack of clear information on whether Early Warning Systems have a positive or neutral impact socially and economically speaking.

3.5: Conclusion to the chapter

In order to reduce the impact of natural disasters, Europe has initiated a set of EWSs. These systems, combined with a working communication channel or network, are an intergovernmental tool for working towards a sustainable development of disaster reduction plans. EWSs, when well-built and complemented by effective communication channels, can be a strong asset for the European Union, in bringing stability and safety to its Member States.

Chapter 4: Future of Early Warning Systems

4.1: Introduction to the chapter

In order to objectively assess the accountability of Early Warning Systems and their possible future application it is important to first consider the current gaps and errors in the systems. Once this is done and the needs are fulfilled, early warning can become a fully reliable network of systems which will lead to a successful improvement of disaster management.

4.2: Current gaps and needs

Significant development of Early Warning Systems has been achieved through the last 20-30 years. Partially this has supported and stimulated great advances in technology and science. Therefore, a more sustainable and reliable environment for building early warning systems has been made possible having a positive impact onto the communities and their understanding of natural disasters (GAR, 2011).

Despite the positive development of early warning, the system still has many flaws and weaknesses which need to be strengthened and addressed in order to become a fully effective system of mitigation against natural disasters.

It is important to note that the currently available Early Warning Systems tend to have a narrow scope in the successful identification of natural disasters. This means that the systems available today are not capable of predicting many of the actual disasters which occur in Europe.

In addition many national initiatives are vague and badly structured plans for disaster management (Grasso, 2008). This includes not only the systems and projects themselves but also the coordination between the different actors and organizations in the national structure of Early Warning Systems and their application.

Generally speaking, a better organized and managed Early Warning System, coordinated correctly, with the introduction of specific national and international legislations for disaster management, and early warning, will strengthen the effectiveness of the systems and therefore will give better results in the reduction of casualties and damages caused by natural disasters around Europe.

4.3: Future application of Early Warning Systems

Early Warning Systems have a wide potential for development and improvement. Their future perspectives highly depend on the national disaster management plans as well as the well-structured cooperation on an international level. As the technological and scientific fields continue to develop it is likely that early warning will reach a stage of good, well-structured systematization which will allow the advanced and timely warning for disasters (UN Environment Programme, 2012). Furthermore these systems will allow for a multi-hazard analysis and supervision. This would be cost, time and data efficient.

4.4: Conclusion to the chapter

It has become crucial to analyze the gaps and current needs of Early Warning Systems in Europe. This will allow for the identification of specific areas for improvement, and the ability to address them so that EWSs can have a wider, more reliable application in the future.

Recommendations

A recurrent issue when talking about the implementation of Early Warning Systems is the fact that many countries lack efficient and clearly structured disaster management plans. The lack of such plans, affects the adequate reaction to a disaster, and it rather becomes an obstacle for an initiative on a EU level. The lack of a clear national plan of action affects not only its internal disaster reduction plans but also any international cooperation regarding its proper establishment and functioning.

There is, indeed, a multinational database which does gather real time knowledge from satellites and radars, and also provides valuable information not only on the specifications in a given region but on natural hazards and their vulnerability as well. However this information seems to be oriented for use of the academic circles rather than the public who could also make effective use of it.

Despite the aforementioned initiative, one of the largest gaps of EWSs is the lack of publicly available statistics where all natural disasters can be gathered together with the number of deaths, injuries, financial losses, etc., so that they can be later analyzed or compared. This dissertation hopes to be helpful in the development of future studies regarding pitfalls and needs for improvement of early warning systems in Europe. This will significantly increase the possible assessment based on official statistics and therefore will provide an objective and realistic information on how effective EWSs are in reducing casualties, economic losses, and other consequences of extreme environmental phenomena.

Last but not least it is important to mention the significant progress of technology and science in the development of more accurate efficient warning systems. Technology and science can bring early warning to a new level, where disasters can be predicted long time before they happen. Of course the development of technology takes time. However its success lies within the foundations of and efficient early warning system

Conclusion

Many natural disasters throughout the modern human history have left marks on us as a society. Great-scale disasters, leaving destruction and deaths behind and the hope to be able to sustain ourselves through nature`s sprees, have introduces a new important concept within the way we govern our countries- it introduces the importance of disaster management and Early Warning Systems.

It is important to consider where we are in the development of this vital concept as a survival tool, to analyze it, and improve upon its gaps and needs in order to become a completely functioning, efficient and timely alarm.

Once the current mistakes and needs are analyzed we will be able to introduce new and better locally and internationally oriented early warning systems which will help us survive the changes of nature`s responses.

References

abs consulting. (2002). *central european flooding 2002.* Retrieved from http://www.absconsulting.com/resources/catastrophe_reports/flood_rept.pdf

Alfieri, L., & Thielen, J. (2008). *Learning from EFAS to develop European Flash Flood Early Warning Capacity.* Retrieved from http://www.imprints-fp7.eu/workshop-Salerno/images/stories/pdf/presentations/Alfieri_Salerno_2012_low.pdf

Ayanz, J. S. (2007). *The European Forest Fire Information System: A European strategy towards forest fire management.* Retrieved from http://www.fire.uni-freiburg.de/summit-2003/3-IWFC/Papers/3-IWFC-121-San-Miguel-Ayanz.pdf

Ayanz, J. S. (2010). *The European forest fire information system.* Retrieved from http://ec.europa.eu/dgs/jrc/downloads/20100602_infoday_madrid_san_miguel_ayanz.pdf

boston. (2012, February 3). *The big picture*. Retrieved from boston.com: http://www.boston.com/bigpicture/2012/02/extreme_cold_weather_hits_euro.html

Bradford, J., Hatcher, C., & Zilinskas, R. (1993). *Biological Hazards and Emergency Management.* Retrieved from http://www.colorado.edu/hazards/publications/wp/wp82.pdf

Bressan, D. (2012, December 28). *December 28, 1908: The Tsunami of Messina*. Retrieved from Scientific america: http://blogs.scientificamerican.com/history-of-geology/2012/12/28/december-28-1908-the-tsunami-of-messina/

Daniell, J., & Vervaeck, A. (2011, November 3). *New Insights into the October 2011 Van (Turkey) Earthquake – detailed analysis by the CEDIM Forensic Earthquake Analysis Group*. Retrieved from Earthquake report: http://earthquake-report.com/2011/10/25/new-insights-into-the-october-2011-van-turkey-earthquake-detailed-analysis-by-the-cedim-forensic-earthquake-analysis-group/

Dankers, R., & Hiederer, R. (2008). *Extreme temperatures and precipitation in Europe: Analysis of a high-resolution climate change scenario.* Retrieved from http://eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_docs/other/EUR_23291.pdf

Department of Regional Development and Environment Executive Secretariat for Economic and Social Affairs Organization of American States. (1991). *Primer on Natural Hazard Management in Integrated Regional Development Planning.* Retrieved from OAS: http://www.oas.org/dsd/publications/Unit/oea66e/ch11.htm

Di Baldassarre, G. (2010). KultuRisk risk prevention. Retrieved from http://www.preventionweb.net/files/22160_dibaldassarreevaluatingthebenefitso.pdf

DIRECTORATE-GENERAL JOINT RESEARCH CENTRE. (2005). *Forest fires in Europe 2005.* Retrieved from http://www.pedz.uni-mannheim.de/daten/edz-bn/gdu/06/EUR_22312_EN.pdf

Dollar, J. (2010, April 5). *The man who predicted an earthquake*. Retrieved from The guardian: http://www.theguardian.com/world/2010/apr/05/laquila-earthquake-prediction-giampaolo-giuliani

dw. (2013, June 13). *Germany fights back floods*. Retrieved from dw: http://www.dw.de/germany-fights-back-floods/a-16863586

EC Joint Research Center. (2013). *European forest fire information system.* Retrieved from http://www.efiatlantic.efi.int/files/attachments/efiatlantic/events/dfci/j_san_miguel_ayanzi_effis_fire_prevention_burdeaux_09.01.2013_v2.pdf

ECMWF. (2011). Knowledge-based approach to develop a cULTUre of Risk prevention (KULTURisk). Retrieved from http://www.ecmwf.int/research/EU_projects/KULTURisk/

Elhardt, F. (2007). *Danube Early warning system.* Retrieved from http://migratie.bics.nl/eri/hulldata/documents/background%20info/19B_DREWS_Hinson.pdf

ESIG Alert. (2004). *Early Warning Systems and Sustainable Development*. Retrieved from Environmental and Societal Impact Group: http://www.isse.ucar.edu/alerts/alert6.html

European Commission. (2003, August 26). *The European Forest Fires Information System results on the 2003 fire season in Portugal*. Retrieved from Relief Web: http://reliefweb.int/report/portugal/european-forest-fires-information-system-results-2003-fire-season-portugal

European Commission. (2010). *REAKT*. Retrieved from Community Research and Development Information Service: http://cordis.europa.eu/projects/rcn/99822_en.html

European Commission. (2011). KultuRisk. Retrieved from http://ec.europa.eu/research/environment/pdf/project_summaries/fp7/natural_hazards/kulturisk.pdf

European Commission. (2012). *European Flood Awareness System*. Retrieved from Institute for Environment and Sustainability: http://ies.jrc.ec.europa.eu/european-flood-alert-system

European Environment Agency. (2010). *Mapping the impact of natural hazards and technological accidents in Europe.* Copenhagen.

European Environment Agency. (2011). *Shared environmental information system*. Retrieved from EEA: http://www.eea.europa.eu/multimedia/shared-environmental-information-system-seis

FHWA Resource Center. (2008). *Seismic Hazards and Response Spectrum Fundamentals.* http://mceer.buffalo.edu/research/HighwayPrj/Workshops/Charleston/03Manceaux.pdf.

Fire uni. (2010). *Forest fires in Europe 1961-1998*. Retrieved from fire uni: http://www.fire.uni-freiburg.de/iffn/country/global/Europe_1.htm

GAR. (2011). *Gaps and challenges in early warning systems*. Retrieved from Global Assessment Report on Disaster Risk Reduction: http://www.preventionweb.net/english/hyogo/gar/2011/en/hfa/challenges.html

Grasso, V. (2008). *Early Warning Systems: State-of-Art Analysis and Future Directions.*

GRIESHABER, K. (2013, August 8). Central Europe Floods Are Most Dramatic In A Decade. *Huffington Post*. Retrieved from http://www.huffingtonpost.com/2013/06/08/central-europe-floods_n_3407949.html

History. (2008). *Worst European earthquakes*. Retrieved from History: http://www.history.com/this-day-in-history/worst-european-earthquake

HPN. (1994). *The IDNDR - for the uninitiated*. Retrieved from Humanitarian practice network: http://www.odihpn.org/humanitarian-exchange-magazine/issue-01/the-idndr-for-the-uninitiated

III International conference on early warning. (2006). *Developing early warning systems: a checklist.* Bonn. Retrieved from http://www.unisdr.org/2006/ppew/info-resources/ewc3/checklist/English.pdf

Insurance Journal. (2013). Aon Benfield Cat Report: Severe Winter Causes $1.8bn Econ. Loss in Europe. *Insurance Journal*. Retrieved from http://www.insurancejournal.com/news/international/2013/04/05/287357.htm

ISDR. (2008). *International early warning programme*. Retrieved from International Strategy for Disaster Reduction: http://www.unisdr.org/2006/ppew/iewp/about-iewp.htm

Joined Research Center. (2010). *From floods to forest fires: early warning systems.*

Joint Research Center. (2011). *EFFIS.* Retrieved from http://gofc-fire.umd.edu/meeting/static/Netherlands_2013/Fire_IT_Netherlands/sanMiguel_EFFIS_GOFC_FireIT_16.04.2013.pdf

Joint Research Center. (2013). *EFAS*. Retrieved from European Commission: http://www.efas.eu/

JOURNAL OF GEOPHYSICAL RESEARCH. (2004). *Extreme floods in central Europe over the past 500 years: Role of cyclone pathway ''Zugstrasse Vb''.* Retrieved from JOURNAL OF GEOPHYSICAL RESEARCH: http://www.manfredmudelsee.com/publ/pdf/Extreme_floods_in_central_Europe_over_the_past_500_years.pdf

Kington, T. (2012, October 27). *L'Aquila's earthquake-scarred streets see battle between science and politics*. Retrieved from the guardian: http://www.theguardian.com/world/2012/oct/27/laquila-earthquake-battle-science-politics

KultuRisk. (2011). *About KultuRisk*. Retrieved from KultuRisk: http://www.kulturisk.eu/project-definition

Met Office Education. (2003, August). *The Heatwave of 2003*. Retrieved from Met office education: http://www.metoffice.gov.uk/education/teens/case-studies/heatwave

Meteo world. (2011, October). *Good practices for multi-hazard Early Warning Systems (EWS)*. Retrieved from Meteo world: http://www.wmo.int/pages/publications/meteoworld/archive/oct11/mhew_en.html n/a. (2006). *Explain the causes of hydrological hazards*. Retrieved from Market by Teachers: http://www.markedbyteachers.com/university-degree/physical-sciences/explain-the-causes-of-hydrological-hazards.html

n/a. (2007). Flash flood early warning systems reference guide. Retrieved from http://www.meted.ucar.edu/communities/hazwarnsys/ffewsrg/FF_EWS.Chap.6.pdf

n/a. (2010). *Earthquake Concept of Operations Plan.* Retrieved from http://ca-contracostacounty.civicplus.com/DocumentCenter/Home/View/4317

n/a. (2011). *Significant natural disasters since 1980*. Retrieved from Munich RE: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/significant_natural_catastrophes.aspx

Newsdesk. (2013). *European flood loss creep begins*. Retrieved from International Reinsurance intelligence: http://www.globalreinsurance.com/european-flood-loss-creep-begins/1403135.article

O`Donnell, A. (2010). European Windstorm Xynthia Causes at Least 50 Deaths. *Insurance&Technology*. Retrieved from http://www.insurancetech.com/claims/european-windstorm-xynthia-causes-at-lea/223101010

official report. (2002). *Central European flooding, August 2002.* Retrieved from https://support.rms.com/publications/Central%20Europe%20Floods%20Whitepaper_final.pdf

Pearson, L. (2012). *Early warning of disasters: facts and figures*. Retrieved from SciDevNet: http://www.scidev.net/global/communication/feature/early-warning-of-disasters-facts-and-figures-1.html

Rainer, J.-M. (2010). *The global telecommunication system.* Retrieved from http://www.itu.int/ITU-D/emergencytelecoms/events/Yaounde/Presentations/omm_uit.pdf

REAKT. (2011). *Objectives*. Retrieved from REAKT: http://www.reaktproject.eu/index.php?option=com_content&view=article&id=48&Itemid=55

REAKT. (2011). *W1*. Retrieved from REAKT: http://www.reaktproject.eu/index.php?option=com_content&view=article&id=58&Itemid=68

Rex, E. (2013, July 5). *EXTREME WEATHER: How will Europe prepare for the next flood?* Retrieved from E&E news: http://www.eenews.net/stories/1059983884

Rogers, D., & Tsirkunov, V. (2011). *Global Assessment Report on Disaster Risk Reduction.* Retrieved from http://www.preventionweb.net/english/hyogo/gar/2011/en/bgdocs/Rogers_&_Tsirkunov_2011.pdf

Sapir, D.-G., Vos, F., Below, R., & Ponserre, S. (2010). *Annual Disaster Statistical Review 2010.* Retrieved from http://cip.management.dal.ca/publications/ADSR_2010.pdf

Science daily. (2011, February 18). *Izmit Earthquake (Turkey): Early Warning Signals Detected for the First Time*. Retrieved from Science daily: http://www.sciencedaily.com/releases/2011/02/110218083606.htm

Strobl, P. (2009). *European Fores Fire Information System and other early warning activities.* Retrieved from http://www.un-spider.org/sites/default/files/strobl_3rd_ws-bonn_22_10_09.pdf

TakeOneStep. (2009). *Biological Hazards*. Retrieved from TakeOneStep: http://www.takeonestep.org/pages/yoursafety/safenotsorry/biologicalhazards.aspx

The Free Dictionary. (2013). The Free Dictionary. Retrieved from http://www.thefreedictionary.com/early+warning+system

The Telegraph. (2011). Europe`s deadliest earthquakes. *The Telegraph*. Retrieved from http://www.telegraph.co.uk/news/worldnews/europe/spain/8508553/Europes-deadliest-earthquakes.html

the weather channel. (2013, July 9). *Europe Floods 2013's Costliest Natural Disaster*. Retrieved from The weather channel: http://www.weather.com/news/europe-floods-2013s-costliest-natural-disaster-20130709

Time toast. (2010). *Early Warning Systems through history*. Retrieved from Time toast: http://www.timetoast.com/timelines/early-warning-systems-through-history

Top Broker. (2013). Economic losses from Central European floods to exceed insured losses. *Top Broker*. Retrieved from http://www.citopbroker.com/news/economic-losses-of-central-european-floods-to-exceed-insured-losses-5301

Top Broker. (2013). *European winter storms cause $1.8 billion in economic losses*. Retrieved from Top Broker: http://www.citopbroker.com/news/european-winter-storms-cause-1-8-billion-in-economic-losses-4947

UN Environment Programme. (2012). *Early Warning Systems: A State of the Art Analysis and Future Directions.* Nairobi. Retrieved from https://na.unep.net/siouxfalls/publications/Early_Warning.pdf

UN Office for outer space affairs. (2013). *UN-SPIDER Bonn Expert Meeting on the Use of Space-Based Information for Early Warning Systems*. Retrieved from Secure World Foundation: http://swfound.org/events/2013/un-spider-bonn-expert-meeting-on-the-use-of-space-based-information-for-early-warning-systems/

UNESCO. (2007). *Hydro-meteorological Hazards*. Retrieved from UNESCO: http://www.unesco.org/new/en/natural-sciences/special-themes/disaster-preparedness-and-mitigation/natural-hazards/hydro-meteorological-hazards/

UNISDR. (2008). *Terminology*. Retrieved from The United Nations Office for Disaster Risk Reduction: http://www.unisdr.org/we/inform/terminology

Villagran de Leon, J. C., & Bogradi, J. (2007). *Early warning systems in the context od disaster risk management.* Bonn: United Nations University. Retrieved from http://www.unisdr.org/2006/ppew/info-resources/docs/ELR_dt_23-25.pdf

White, I., & Bullman, P. (2010). *Establishing a community based early warning system and response mechanism* . Retrieved from http://www.glencree.ie/site/documents/ews_final.pdf

Wikipedia. (2013, September 22). *2013 extreme weather events*. Retrieved from Wikipedia: http://en.wikipedia.org/wiki/2013_extreme_weather_events

Willis. (2007). *Windstorm Kyrill.* Retrieved from http://www.willisresearchnetwork.com/assets/templates/wrn/files/Willis%20Windstorm%20Kyrill%20Report%2001%20Feb%202007.pdf

World Meteorological Organization. (2009). The Global Telecommunication System. Retrieved from http://www.wmo.int/pages/prog/www/TEM/index_en.html

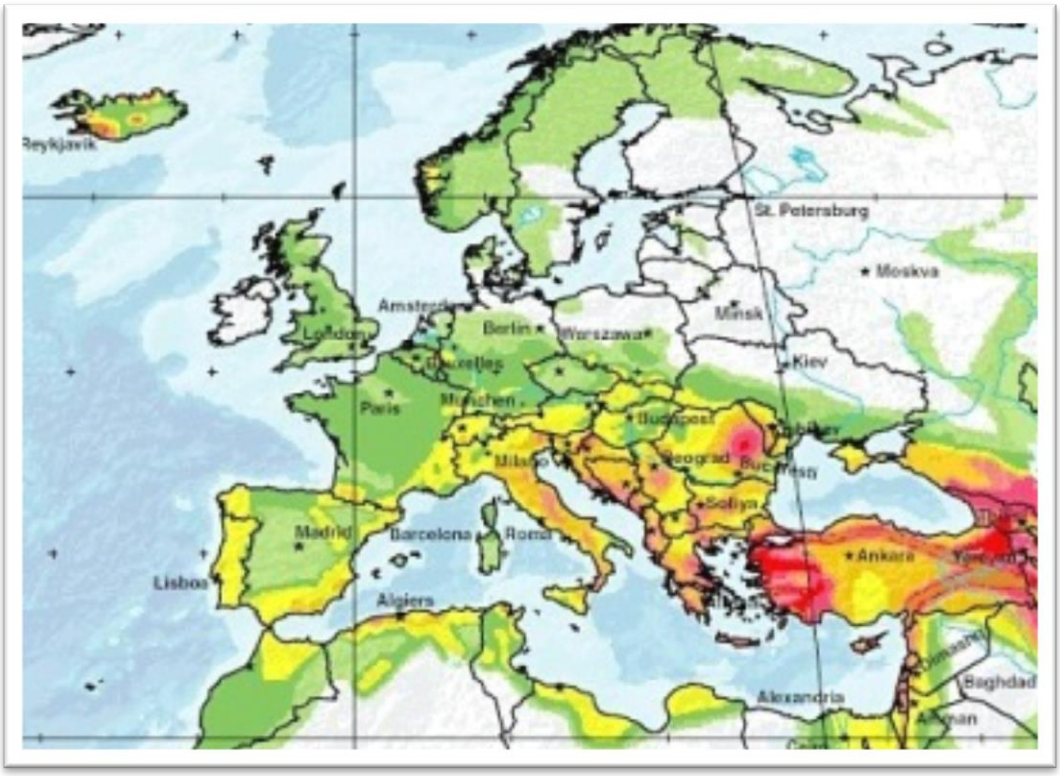
Appendixes

Below is a list of appendixes mentioned in the up-written document.

Appendix 1: Hazard maps

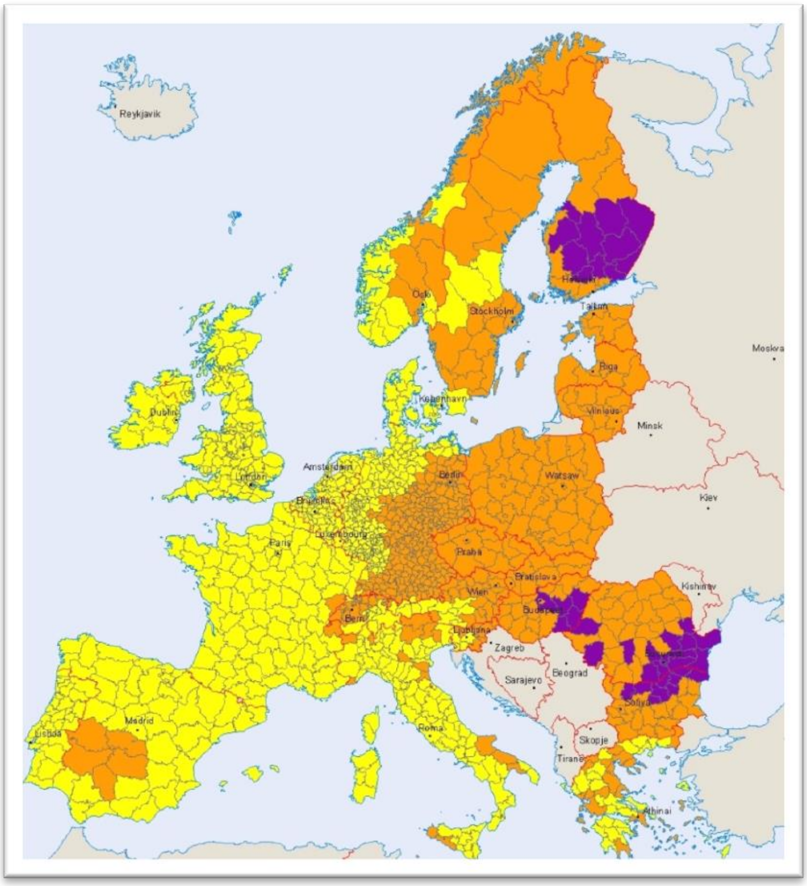
Natural hazards are usually supervised and analyzed with the help of hazard maps which are different depending on the natural hazards they aim to study and analyze.

As follow there are two examples of hazard maps. The general pattern is the darker the color on the map, the bigger the danger of the given hazard is.



Picture 1: Seismic hazard map

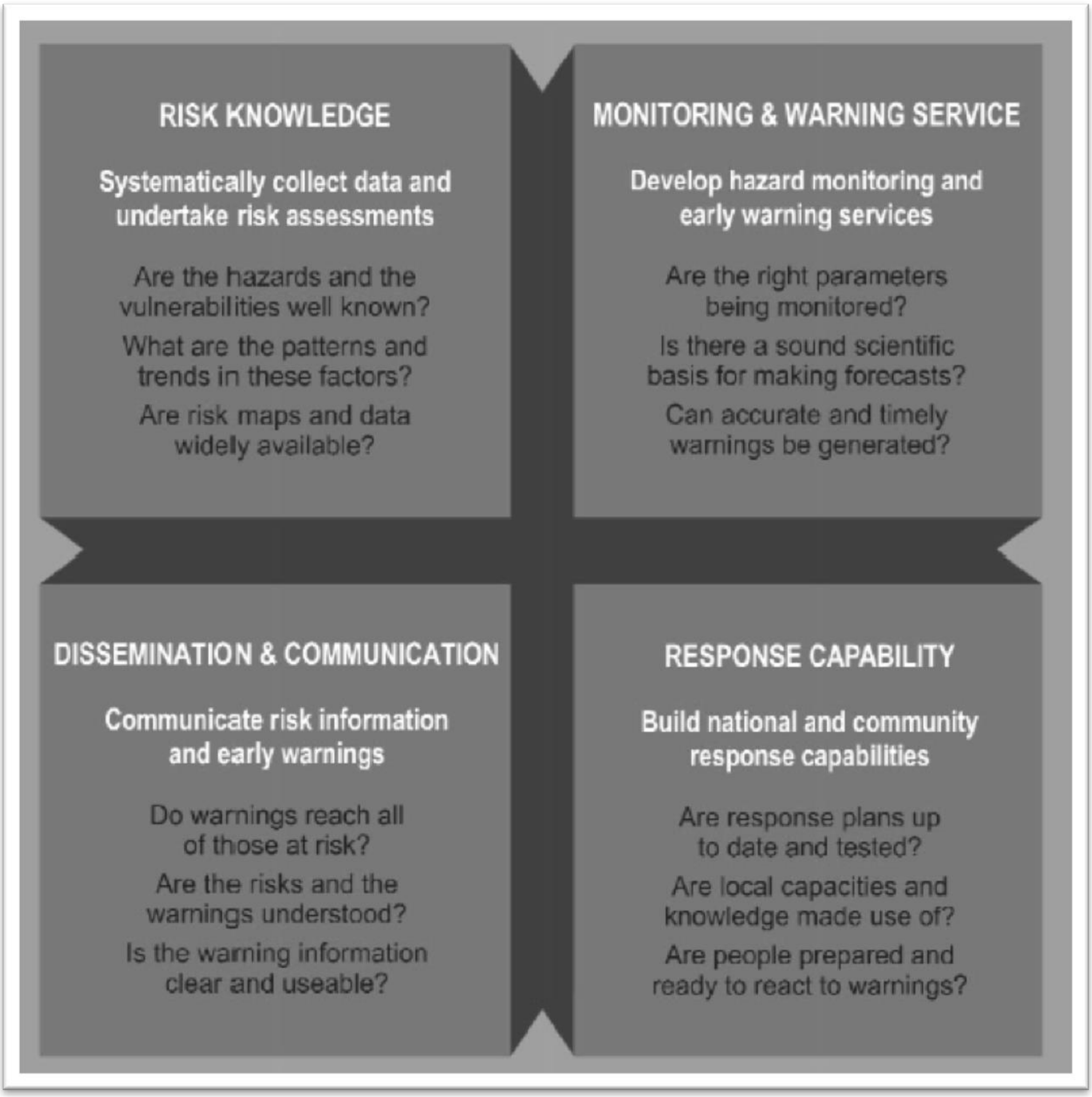
The seismic hazard map shows the more vulnerable parts of Europe, exposed to bigger chance of earthquakes. Generally the South-Eastern parts of the continent (Italy, Greece and Turkey) are the sensible spots which hold a bigger chance of suffering from an earthquake. Therefore such hazard maps allow for the permanent supervision and the timely analysis of the possible occurrence of an earthquake.



Picture 2: Extreme temperatures hazard map

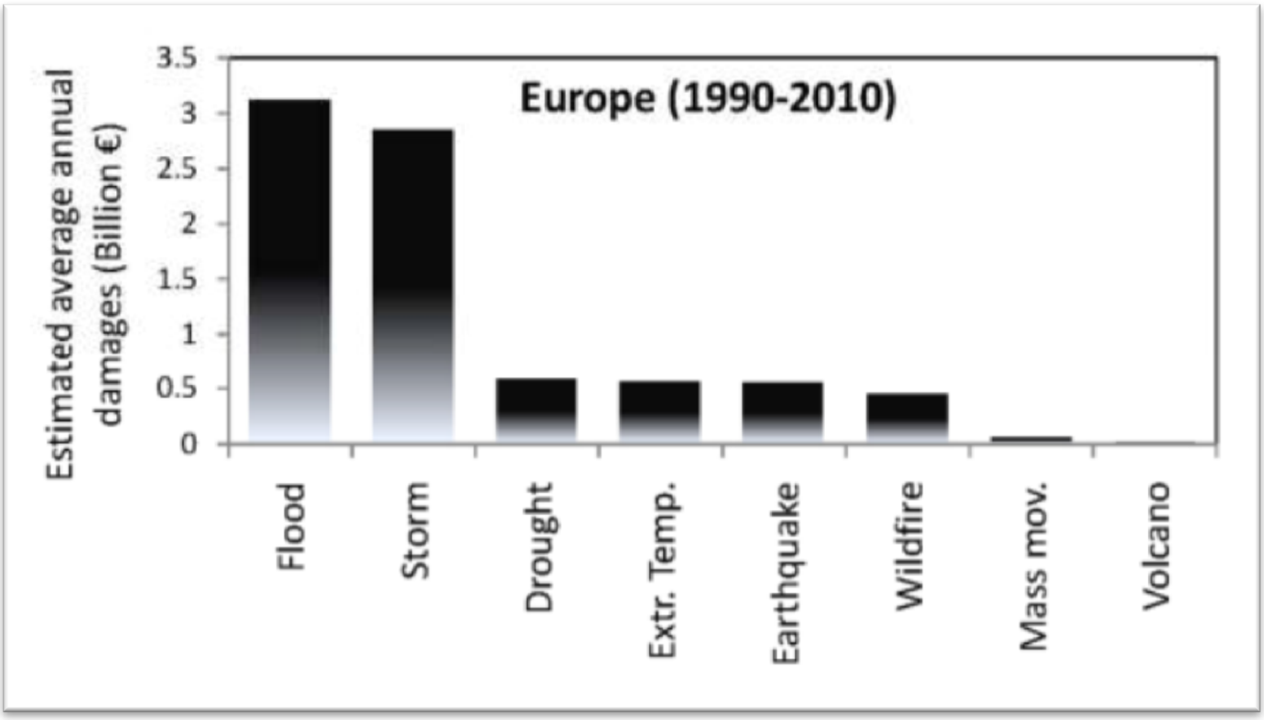
This extreme temperatures hazard map shows the estimated meteorological possibility of extreme temperatures to occur around the continent. The map is built on the bases of four factors: hot days, heat waves, cold days and cold waves. The existence of such maps helps for the general supervision of the temperature amplitudes around Europe and can significantly help the preparedness against too hot/too cold days.

Appendix 2: 4 steps for building an Early Warning System



Picture 3: 4 steps for building an Early Warning System

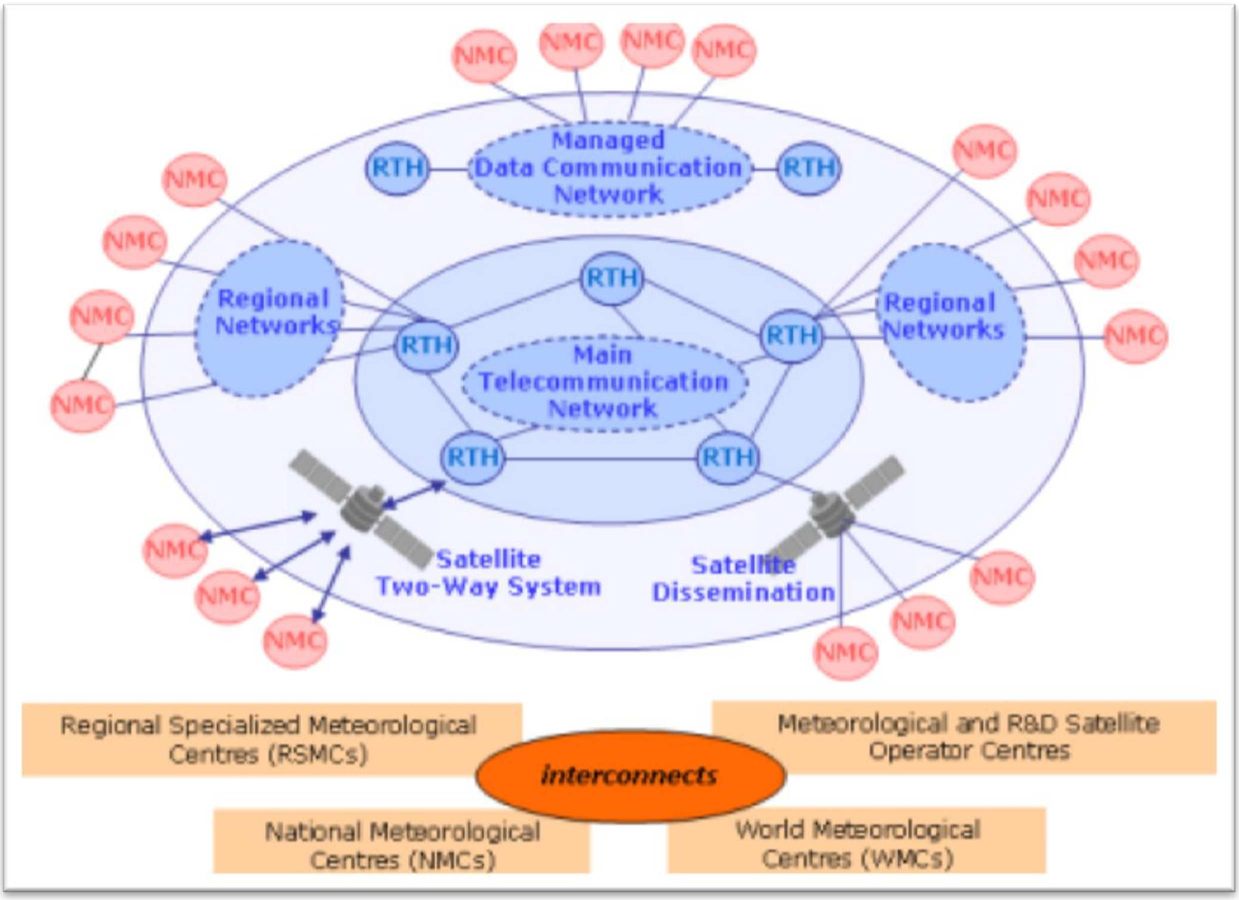
Appendix 3: Disasters in Europe and their financial estimation



Picture 4: Hazards and their financial estimation

This graph shows the analyzed occurring natural disasters in Europe and their financial estimation relying on data from past periods. By using the help of such graphs and data it is easy to estimate the most destructive natural disasters in Europe regarding the amount of financial aid needed to recover from the disaster.

Appendix 4: Global telecommunication system



Picture 5: Global telecommunication system

The visual representation of the Global telecommunication system clearly shows how the information is distributed from the national meteorological centers (with the help of satellites) to the regional centers and from there the information is gathered in a joined database at the Main telecommunication centers.

Glossary of terms

Biological hazards: This type of hazard refers to biological matter which poses a threat to any living creature. This threat can include microorganisms, viruses and toxins (TakeOneStep, 2009). Biohazards are dangerous not only because of their potential to spread, but more importantly the danger of some viruses and diseases to mutate into new ones, not yet known. The spread of biohazards is usually caused by big natural disasters such as tsunamis or earthquakes which might result in a poor, dangerous and unhealthy living environment such as lack of shelter, scarcity of clean water and lack of sanitation (Bradford, Hatcher, & Zilinskas, 1993).

Hydrological hazards: Hydrological hazards describe any danger driven from the changes in the water levels caused by rain. This might include river and coastal flooding (usually caused by heavy rains) as well as tsunamis and tropical cyclones (n/a, Explain the causes of hydrological hazards, 2006). The danger which the hydrological hazards hold is a direct menace for any area which can be affected in times of heavy rains. In addition many people live in areas around coastal line such as seas and rivers. This holds an additional danger as the water levels can easily rise. Furthermore this type of hazards can hold and indirect threat to people`s lives. Imputedly floods and rains can cause losses of crops and agricultural plantations which might lead to scarcity of food and even famine.

Meteorological hazards: Meteorological disasters are connected to the weather forming processes and are caused by extreme changes in weather (UNESCO, 2007). Such hazards can be tornadoes, floods, heavy rains, hailstorms and hurricanes. A specific characteristic of this type of hazards is that they are intrinsically dependent on the region and its specific weather conditions. A clear example of this is the USA which often suffers from highly destructive tornados. In comparison in Europe, for example, the level of tornados is extremely low and the ones that appear are generally weak and cause little to no damage. Summarizing the character of meteorological hazards it should be said that they are really dependent on the region. This makes it easier for specific continents or countries to have a better idea of the chances for a given meteorological hazard to happen.

Seismic hazards: Seismic hazards are connected to the appearance of earthquakes. They are supervised on regional, national and international level with the help of hazard maps (FHWA Resource Center, 2008). These maps help in the examination and study of the earth movements throughout regions and continents. After the most sensitive regions are determined, their risks are assessed. Later this allows the adequate construction of buildings with a possible angle of slope. Additionally, seismic maps can be used in planning and determining insurance rates in more or less seismically active regions (n/a, Earthquake Concept of Operations Plan, 2010).