Report on Current risks scenarios

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Summary

Foreword

This report is part of the E-CITIJENS project, funded by Italy –Croatia Inter-Reg program. The main aim of the project is to increase the safety of the Italian and Croatian Adriatic basin in relation to natural and man-made disasters by developing a cross-border model of an emergency management system integrating risk scenarios data from sensor networks and regulatory frameworks and the information voluntarily provided via social media by the public (citizen journalism). Three risk areas are primarily considered: floods, forest fires, and seismic.

Four main activities are planned to achieve this goal. The first, *Survey of current risks scenarios, management legislation and social media and crowdsourcing* (activity 3.1), consists of the survey and assessment, besides best practices, of knowledge and experience from previous projects in both countries concerning current risks scenarios, current civil protection management legislation and social media and crowdsourcing. For each of these three topics, a thematic task force (TTF) has been set up. In particular, TTF1 concerns risk scenarios, TTF2 concerns risk management legislation and TTF3 concerns social media and crowdsourcing.

This report presents and discusses the results obtained by the first thematic task force (TTF1), which has the main aim of analyzing and comparing the techniques and the metrics used in Italy and Croatia to model and represent risk scenarios for the selected target risks of the project (floods, forest fires, seismic). The present document was elaborated on the basis of the information collected in a survey that took place in July and August 2019, where all the recipients and the partners involved in TTF1 (University of Bologna - CIRI FRAME, Molise Region, Pescara Municipality) were asked to answer specific questions (that will be described later in the present document) in relation to their own knowledge and experience concerning the topics investigated.

The information obtained was then summarized and integrated in order to build an overview of the current methodologies used in Italy and Croatia to model and represent risk scenarios for the target risks of interest, considering both the trans-national/national and the regional/local approaches.

Introduction

Natural and man-made disasters are becoming progressively more extreme and complex, in Europe as all over the globe, due to many factors, also related to climate change. There is therefore a clear civil protection interest in reducing the related risks and in establishing appropriate feed-back mechanisms to minimize as much as possible their frequency of occurrence and their impacts.

Just for the sake of clarity in terminology, risk is defined, according to ISO31010:2009 [1], as the combination of the consequences of an event (hazard) and the associated probability of its occurrence while, according to the Food and Agriculture Organization of the United Nations [2], a disaster is any event, natural or man-made, that threatens human lives, damages private and public property and infrastructure and disrupts social and economic life. In this document, only natural risks will be considered. In particular attention will be paid to flooding, forest fires and earthquakes that can be classified respectively as meteorological, climatological and geo-physical natural disasters.

Risk management is a continuous process that requires a constant adaptation to changing circumstances and social requirements in order to prevent risks and reduce vulnerability in the risk-prone areas; it consists broadly in the following steps: prevision and prevention, preparedness, response and recovery. More in detail, it is characterised by the following cyclic activities: pre-assessment of risk, consideration of measures and policy instruments for risk reduction (e.g. early warning systems, land use regulations, etc.), policy decisions, implementation of measures and instruments, monitoring and assessment of their effectiveness, revision.

It is important to remark that the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* [3] emphasizes the necessity to shift from reactive emergency relief to a pro-active disaster risk reduction in the pre-disaster stages by strengthening prevention, mitigation and preparedness. Just for the sake of clarity, disaster risk reduction is, according to the United Nations Office for Disaster Risk Reduction [4], the concept and practice of reducing risks through systematic efforts to analyze and reduce the causal factors of disasters.

The *Sendai Framework for Disaster Risk Reduction 2015-2030* [5], adopted at the Third United Nations Word Conference in Sendai (Japan) in 2015, sets the understanding of disaster risk in all its dimensions as the first priority of action to reduce risk at global, national, regional and local level. Therefore, risk assessment, that according to ISO31000:2009 [6] is the overall process of risk identification, risk analysis and risk evaluation, plays a key role in strengthening a risk-informed approach in policy making. The identification of representative risk scenarios is of great importance in order to assess in more detail a particular type of risk. In fact, risk scenarios are representations of situations that can lead to significant impacts and they are generally identified in order to cover different magnitudes. It is moreover noteworthy that risk assessment allows the identification of the interrelations between different kinds of risk (cascading effects) and of climate change emerging risks and potential impacts.

While a coherent and consistent risk assessment methodology is still lacking across the EU it is fundamental, as stated in *Risk Assessment and Mapping Guidelines for Disaster Management* [7], to progressively define good practices; the comparison of the current methods and processes used in each Member State is an important part of this process.

Sensor networks are essential in evaluating the level of alert in relation to the target risk scenario analysed and, consequently, in activating Civil Protection prevention, warning and rescue measures. These networks provide real-time data (e.g. hydrometric levels) to the Civil Protection authorities, which process them in order to evaluate the possibility of occurrence of a defined risk scenario and its magnitude through the use of severity scales. The definition of specific indicators and severity scales for a target risks are crucial in order to ensure preparedness (i.e. in order to associate to a precise level of danger clear response actions). It is important to remark that, potentially, the authoritative data from national or regional sensor networks can be integrated with other sources as social media, as proposed in the project E-CITIJENS.

In EU, the Copernicus Emergency Management Centre [8] provides highly valuable information for disaster management in relation to different kind of risks, both natural and man-made. Its early warning and monitoring component include systems for floods (European & Global Flood Awareness System), forest fires (European & Global Forest Fire Information System) and droughts (European Drought Observatory) while its on-demand mapping component includes the provision of risk and recovery maps for prevention and planning and of rapid maps for emergency response.

As the main scope of the first thematic task force (TTF1) is to analyze the techniques and metrics used in Italy and Croatia to model and represent risk scenarios for the selected target risks (floods, forest fires, seismic), all the partners engaged in TTF1 (University of Bologna - CIRI FRAME, Molise Region, Pescara Municipality) and related organizations were asked to answer specific questions in relation to their own experience and knowledge concerning the topic investigated.

The structure of the survey that was submitted to all the partners involved will be now presented. For each of the three typologies of risk considered, the participants were asked to report on the following seven points:

1) current risk scenarios,
2) sensor networks,
3) indicators and parameters for defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures,
4) expected trend by climate change and anthropic activity,
5) interactions with technological outbreaks,
6) proposal for enhancement/adaptation of measures,
7) data sources.

More in detail, concerning the first request, the participants were asked to describe the criteria in use to identify and select the risk scenarios for emergency planning and management including current practices adopted. Secondly, regarding sensor networks, the participants were called to list the existing physical sensors (if any) related to the risk type analysed, their distribution and the technology adopted. In point three it was then requested to enumerate parameters, related indicators and measuring scales used to describe risk scenarios. As it is easily understandable, these first three points are crucial to build an overview of the techniques and metrics used in both Countries to model and represent risk scenarios for the selected target risks. In the following requests, the participants were asked to report their knowledge concerning the expected risk trend due to climate change and anthropic activity and about the possible interaction of natural disasters with technological outbreaks. Actually, it is well known that natural disasters can trigger a wide variety of secondary events (cascading effects). In the last request, the partners were asked to list general or specific proposals for enhancement regarding the previous points and finally to list relevant reference documents and national, regional and local institutions or agencies that may provide specific information related to the target risk considered.

1. Floods

1.1. Characterization of the hazard

Among natural hazards, flooding is the one that affects more people around the globe. These meteorological events can occur in many different ways (e.g. river floods, flash floods, urban floods, floods from the sea in coastal areas) and the damages that they can cause strongly depend on the specific vulnerabilities of the affected areas. According to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], flood risk is the main risk European emergency management authorities have to cope with. Due to the intensification of flood phenomena and the increase in their severity, ascribable to the continuous demographic and economic development and climate change, their impacts on people, infrastructure and the environment can be highly significant. Therefore, there is a considerable civil protection interest in reducing flood risk and in establishing appropriate feed-back mechanisms to minimize as much as possible their frequency of occurrence and their impacts.

In the EU, *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks* (Flood Directive)[10] establishes a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Union. The Directive requires Member States to produce:

- Preliminary Flood Risk Assessments (article 4) to identify the areas, more in particular river basin districts or other units of management, with significant flood risk;
- flood hazard maps and flood risk maps (article 6) at river basin level (or more generally at unit of management level) according to the following three scenarios:
  - floods with a low probability, or extreme event scenarios,
  - floods with a medium probability (likely return period > 100 years),
  - floods with high probability, where appropriate (flood risk maps are an essential and effective tool of information and a basis for priority setting in flood risk management);

- Flood risk management plans (article 7) at the river basin level (or more generally at the unit of management level) focusing primarily on prevention, protection and preparedness; these plans include the setting up of flood forecasts and early warning systems, and the promotion of sustainable land use practices;
- updates every six years to take into account the climate change impacts.

Flood forecasting and warning systems are obviously crucial flood risk management elements that need to be continuously operative in order to monitor the occurrence of dangerous hydro-meteorological conditions (the data coming from sensor networks are processed using also flood forecast models) and therefore the level of alert. In general, specific indicators and severity scales are defined in order to associate a precise level of danger with clear response actions to ensure preparedness. In the EU the European Flood Awareness System [11], which is part of the Emergency Management services of the Copernicus Programme, aims to support preparatory measures before major flood events strike, providing complementary information to the Member States' national and regional civil protection authorities and informing the European Emergency Response Coordination Centre about the possibility of upcoming floods.

1.2. Current risk scenarios

This section aims to describe the criteria in use in Italy and Croatia, focusing on the partner regions, to identify and select flood risk scenarios for emergency planning and management, including the practices adopted.

In Italy, the implementation of the Flood Directive in national legislation took place through the enactment of Legislative Decree 49 of 23/02/2010 (*Attuazione della direttiva 2007/60/CE relative alla valutazione e alla gestione dei rischi di alluvione*). According to this Decree, District Basin Authorities prepare coordinated flood management plans at the water district level, and it is the competence of the regions, in collaboration with the National Department of Civil Protection, the predisposition and the realization of state and regional alert systems for hydraulic risk for the purpose of civil protection. Annex I of the National Civil Protection Department operative indications *"Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico* *e idraulico e della risposta del sistema di protezione civile"* (10/02/2016) contains the basis for the definition of event scenarios by the Regional Authorities. More in detail, this document presents the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality" (*Tabella delle allerte e delle criticità meteo-idrogeologiche ed idrauliche)* that describes the reference event scenarios, which are marked with a colour code that represents the level of criticality (green, yellow, orange, red), and their related expected effects and damages.

According to this document, Molise, Abruzzo and Emilia Romagna, as the other Italian Regions, defined flood risk scenarios. As the differences in the procedures and risk scenario identification between the Regions are not substantial, the event scenarios concerning flood risk defined in Emilia Romagna will now be presented:

- green colour code - absence of significant predictable phenomena;
- yellow colour code - localized phenomena of:
  - increase in hydrometric levels in the mayor watercourses above hydrometric threshold 1,
  - increase in hydrometric levels in the reclamation network,

  even in the absence of rainfall, the passage of river floods in large watercourses can cause hydraulic criticalities;
- orange colour code - possible widespread phenomena of:
  - significant increase in hydrometric levels in the mayor watercourses above hydrometric threshold 2, with flooding of neighbouring areas and floodplain areas including the banks,
  - significant increase in hydrometric levels in the reclamation network, with difficulties in water disposal and possible flooding phenomena in the surrounding areas,
  - erosion of the banks, solid transport and rambling of the riverbed,
  - partial or total obstructions of the spans of the bridges of the major watercourses,

  even in the absence of rainfall, the passage of river floods in large watercourses can cause hydraulic criticalities;
- red colour code - Numerous and/or extensive phenomena can occur, such as:

- river floods of the major watercourses with: exceeding the hydrometric threshold 3, extensive flooding phenomena also of areas distant from the river, widespread erosion of the banks, solid transport and rambling of the riverbed,
- overflow of the reclamation network with flooding of the neighbouring areas,
- levee overtopping, siphoning, levee failure, outflow, overtopping of bridges and other crossing structures, meander cut-off,
- partial or total obstructions of bridges spans in major watercourses,

even in the absence of rainfall, the passage of river floods into larger watercourses can cause criticalities.

The threshold values referred to are defined by the Region for each instrumented river section and they generally identify the following situations:

- threshold 1: water levels corresponding to the complete occupation of the lean riverbed, significantly below the ground level. It indicates the passage of a not very significant flood, which could however require some hydraulic manoeuvres or preventive actions on the water courses;
- threshold 2: water levels corresponding to the occupation of the floodplain areas or of natural expansion of the watercourse, which involve embankments where present, and may exceed the terrain level. It indicates the passage of a significant flood, with widespread phenomena of erosion and solid transport;
- threshold 3: water levels corresponding to the occupation of the entire river section, close to the maximum recorded or to the bank heights. It indicates the passage of an exceptional flood, with huge and extensive erosion and solid transport phenomena.

In the case of Croatia, data were not collected through the survey; thus, data were obtained using the project network and from documental and literature sources.

In Croatia, flood defence is managed by Croatian Waters (*Hrvatkske Vode*), a government agency founded by the Republic of Croatia and run by the Management Board and General Managers, as regulated by the Water Act. River basin districts are the flood risk management reference territorial units; for each river basin district, flood risk is evaluated and flood risk management plans are prepared.

In the definition of the scenarios, there is a difference between north and south Croatia. In fact, inland floods are more frequent, and in coastal areas floods are very rare and depend mainly on sea tides. Every year scenarios are revised before the critical season. Concerning the methods used for national risk assessment in the country, according to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], for every event identified, two types of scenarios need to be developed: the most likely adverse event and the event with the worst consequences. The scenario addressed in the Croatian national risk assessment for floods is the spill of inland water bodies in the Danube (while in Italy is fluvial floods).

1.3. Sensor networks

This section aims to give an overview of the existing physical sensor networks related to floods in Italy and Croatia, focusing on the partner regions.

In Italy, the hydro-meteo-pluviometric observation networks have been assigned by the state to the regions together with the transfer of the competences foreseen in art. 92 of Legislative Decree 112/1998. Therefore, all the regions have their own hydro-meteo-pluviometric observation network. These networks carry out numerous and different monitoring functions, which can be classified into two large groups: 1) real-time use of precipitation and hydrometric level data for watercourses for the assessment of emergency situations for civil protection and land security; 2) information support functions for hydrological and climatological studies for the many aspects relating to land planning and water resource management.

A brief summary of the information collected in the survey for Emilia Romagna, Molise and Pescara Municipality will be presented.

In Emilia Romagna, hydro-meteo-pluviometric monitoring has been active for over a century. The current regional network is the result of the integration of networks belonging to several bodies operating in the territory with different purposes. With regional Law 7/2004, the region assigned to the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (ARPAE) the task of managing the Integrated Hydropluviometric Monitoring Network. The stations of the hydrometeorological network transmit the data via radio, which are stored in a database; each station is associated with metadata that identifies and qualifies it (registry, type of sensors etc.). The data of the hydrometeopluviometric stations, in addition to the use inside ARPAE, have always been utilized for requests coming both from public institutions and from the private sector. The number of sensors in the hydrometeorological monitoring network is 582, divided into the various provinces.

In Molise, the sensors of the monitoring network are located throughout the region, and they measure rain, temperature, river and lake levels, atmospheric pressure, relative humidity, wind and snow level. The data transmission system takes place with a radio network with dedicated frequencies. The data acquisition centre is at the Civil Protection Service of Molise Region in Campochiaro (CB). This data centre has hardware and software equipment that is useful for specific purposes.

Finally, on the municipal territory of Pescara, numerous physical sensors have been installed to constantly measure the water levels in the road underpasses and along the banks of the Pescara River. When the water level reaches a critical threshold, traffic lights are activated to warn of danger. All the physical sensors are associated with cameras that allow a real-time visual check.

In Croatia, the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod*) is the governmental body that manages the meteorological and hydrological infrastructure as well as the national archives of meteorological and hydrological relevant data. This Service is connected with the 112 centre (the coordination body for all emergencies).

1.4. Indicators and parameters defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures

This section aims to describe the indicators and parameters adopted in Italy and Croatia, focusing on the Regions directly involved in the project, used to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures.

In Italy, fundamental reference documents concerning flood alerting systems are:

- Direttiva del Presidente del Consiglio dei Ministri del 27/02/2004 *"Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico e idraulico ai fini di protezione civile"* e s.m.i.;
- *Indicazioni operative del Dipartimento di Protezione Civile Nazionale del 10 febbraio 2016 recanti "Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile";*
- *Direttiva Alluvioni* (D.Lgs 49/2010).

Moreover, Annex I of the National Civil Protection Department operative indications*"Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"* (10/02/2016) contains the "Table of meteo-hydrogeological and hydraulic alerts and levels of criticality". This document describes the reference flood event scenarios (section 1.1) which are marked with a colour code representing the level of criticality (green, yellow, orange, red) and their related expected effects and damages. Each event scenario/colour corresponds to the activation of a precise operational response (yellow-attention, orange-warning, red-alarm).

Concerning flooding phenomena, the primary indicator for evaluating the hazard is the hydrometric level in the major watercourses. It is assumed that the gravity of the possible effects induced by the flood on the surrounding territories can be considered proportional to the level reached by the water, as it is impossible to know and foresee on a regional scale the criticalities of the hydrographic network and of the crossed territories that can occur during the passage of the floods (these criticalities can be found only on a local scale and through direct observation).

Molise, Emilia Romagna and Abruzzo regions, as the other Italian Regions, have defined, on the basis of these operative indications, the severity scales for flood risk in function of the hydrometric threshold specifics defined for each regional territory. The emergency severity scales are evaluated daily by the regional Functional Centres. This evaluation is based on data recorded by the monitoring network and weather forecasting models.

In the case of Croatia, Croatian Waters defines thresholds and activates warnings and emergency responses. More in detail, operational flood risk management is regulated by the National Flood Defence

Plan, the Master Flood Defence Implementation Plan and the Flood Defence Implementation Plan. In particular, the National Flood Defence Plan regulates the early warning and the communication system, while the Master Flood Defence Implementation Plan defines the four stages of flood defence depending on section-specific hydrometric levels (the criteria for their identification are contained in the same document) and the operative actions to be taken in each case. The four stages are state of alert, regular flood defence, emergency flood defence, and state of emergency.

1.5. Expected trend by climate change and anthropic activity

This section aims to summarize the inputs sent by the partners concerning the expected trend for flooding, in particular considering the possible effects of climate change. No relevant information was obtained in the survey concerning the direct effects of anthropic activity on the occurrence and the severity of floods. In general, the knowledge of the current meteo-climatic, hydrological and marine variability and the respective future scenarios is one of the starting points necessary for climate change adaptation strategies. In Molise Region, the Civil Protection Service is taking an interest in the subject and has nominated a technical study detailing extreme weather events. Currently, at the occurrence of a severe flood event, the Functional Centre of Molise Region drafts a technical document reporting a meteorological analysis of the conditions that lead to the event and its effects on the ground. Some interesting information concerning this topic can be extrapolated from the European project “Life PRIMES-Preventing flooding risk by making resilient communities”, approved under the 2014-2020 LIFE program on climate change adaptation strategies and concluded in December 2018. During this project, the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (ARPAE) defined and analyzed a dataset of climatic, hydrological and marine indicators for the period 1961-2014, including the seasonal pattern of precipitation and the number of days with precipitation greater than 50 mm /24 hours on alert areas of Emilia-Romagna. It is also interesting to report that the LIFE IRIS project "Improve resilience of industry sector" which has developed several useful tools for companies that intend to deal with the threats of climate change through risk analysis and the definition of climate adaptation actions to increase resilience.

1.6. Interactions with technological outbreaks

No information for this request was collected from the survey. It is anyway interesting to remark that potential cascading effects of a flood event, according to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], may include the loss of vital infrastructure, the outbreak of epidemic or epizootic events, damage to industrial facilities causing the release of chemical or radioactive substances. The latter events are named "NaTech" accidents (Natural events triggering Technological disasters). A review of NaTech accidents caused by floods is reported by Cozzani et al. (2010) [12] and by Krausmann et al. (2016) [13]. Directive 2012/18/UE ("Seveso-III" Directive), addressing the control of major accidents caused by dangerous substances, requires that NaTech scenarios involving the release of hazardous substances caused by floods in chemical and process facilities identified. The safety reports issued for the industrial sites falling under the obligation of the Directive also require the control and management of the risk deriving from such events. The "Seveso-III" Directive was implemented in the Italian and Croatian national legislation in 2015. In Italy, the Ministry Decree 105 of 26th June 2015 came into force to implement the obligations of the Directive, with Regional Committees (CTR, *Comitato Tecnico Regionale*) having the responsibility to assess and approve the safety reports issued by the operators. In Croatia OG no. 80/13, 153/13, 78/15, 12/18, 44/14, 31/17, and 45/17 were emitted.

1.7. Proposals for enhancement

This section aims to summarize the inputs sent by the partners concerning possible improvements of the practices in use in flood risk management.

Molise Region reported that its flood risk management plans provide for measures, which are specific to civil protection activities and are referred to art.2 of D.Lgs. 1/2018, aimed at improving flood forecasting and alerting, disaster and response planning during the event as well as supporting activities to restore pre-event conditions. These measures are subject to periodic revision. Moreover, it is reported that, due to the ongoing climate change and the severe events reported in the Molise area, an urgent and detailed study of regional climatology to better assess the possible effects on the ground and define appropriate safeguards is highly necessary. The Pescara Municipality, instead, has implemented various activities and initiatives to inform the population on risk scenarios; it is in fact well know that this can significantly increase the resilience of a community. Some interesting information on the same aspect can be extrapolated from the European project “Life PRIMES” (section 1.4), in which both Emilia Romagna and Abruzzo were partners. The main aim of this project was the creation of resilient communities increasingly active part in the construction of adaptation strategies and effective warning systems. The objectives have been achieved through a series of activities, inter alia, the implementation of a shared web space, the development of a process of dialogue and empowerment of the community through the preparation of local development plans for adaptation actions and the assessment of risk perception and resilience analysis. The project's added value is the "PRIMES Guidelines" for developing the Civic Adapt Action Plan for Communities, designed to support other local communities in developing a participatory processes aimed at improving territorial resilience with respect to flood risk.

2. Forest fires

2.1. Characterization of the hazard

Forest fires are recurrent phenomena in the EU, and they can tremendously impact human health, the environment, infrastructure and the economy, causing significant damages also due to cascading effects. Because of this, they are considered by national emergency authorities, even for non-Mediterranean countries, a substantial disaster risk. According to the *factsheet of the European Civil Protection and Aid Operations on forest fires* [14], 31% of all requests for assistance throughout the European Union Civil Protection Mechanism between 2007 and 2018 were in response to forest fires.

Forest fires' likelihood and severity depend mainly on climatic conditions (e.g. humidity, wind, temperature), vegetation characteristics (e.g. flammability and water content of plant species) and terrain morphology. At the same time, it is also remarkable that the majority of the fires in Europe are human-induced.

According to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], the area at risk and the probability of large fires are expected to grow because of climate change. As stated in the European Commission *PESETA II study (Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis)*[15], the total burned area in southern Europe could more than double during the 21st century, and the temperature increases in central and northern latitudes could expand northward the areas prone to forest fires. Therefore, the civil protection interest in reducing forest fire risk and in establishing appropriate feedback mechanisms to minimize as much as possible their frequency of occurrence and their impacts is unquestionable.

It is essential, also for this hazard, to focus on a proactive disaster risk reduction in the pre-disaster stages by strengthening prevision, prevention and preparedness, which basically means improving the assessments of the risk, reinforcing forecasting and early warning tools and promoting the resilience of territories.

At the European Union level, it is interesting to remark that the *Forest Strategy 2014-2020* [16] provides a framework for national forestry and forest-related policies promoting sustainable forest management and identifying the protection of forests from different threats, including fires, as a priority. Concerning forest fire forecasting and monitoring, the European Forest Fire Information System [17] (which is part of the Emergency Management services of the Copernicus Programme) is a modular web geographic information system that provides real-time and historical information on forest fires to national, regional and local Civil Protection authorities across the European Union. It includes the following modules: Fire Danger Assessment, Rapid Damage Assessment (which includes Active fire detection, Fire severity assessment and Land cover damage assessment), Emissions Assessment and Smoke Dispersion, Potential Soil Loss Assessment and Vegetation Regeneration. Since 1998, the European Forest Fire Information System has been supported by a network of experts from the Member States, the Expert Group on Forest Fires.

2.2. Current risk scenarios

This section aims to describe the criteria in use in Italy and Croatia, focusing on the partner regions, to identify and select forest fire risk scenarios for emergency planning and management, including the practices adopted.

In Italy, the Framework Law on forest fires is L.353/2000. Article 3 attributes the task to draw up regional plans of prevision, prevention and active fight against forest fires to regions (*Piani regionali di previsione, prevenzione e lotta attiva contro gli incendi boschivi*), while article 4 assigns the implementation of prevision and prevention activities to provinces, mountain communities and municipalities. The regions therefore define the forest fire risk scenarios (more specifically, each region produces specific danger maps based on the defined danger levels).

The basis for evaluating forest fire risk is the analysis of predisposing factors such as: features of vegetation, climatic conditions, humidity, wind, temperature and morphology of the soil. Concerning the Italian participants in this task force, Molise Region approved the update and revision of the *Regional Plan for Forecasting, Prevention and Active Fire Fighting* (AIB Plan) for 2018 – 2020 in 2018. This AIB Plan defines the scenarios of danger and risk for forest fires in the regional territory. More in detail, in this document, forest fire risk is defined as the sum of the variables that represent the propensity of plant species to be crossed more or less easily by fire, and the risk prediction algorithm is based on a weighted additive model. The procedure performed is similar to that used in the multi-criteria analysis, in which it is necessary to solve the problem of determining a single evaluation index starting from several factors, both limiting and predisposing. Two large groups or events identify the main event scenarios: summer fires and winter fires. This choice is based on the spatial and seasonal distributions of these events. Depending on the season, different predisposing factors are considered: in summer, bio-climate, slope, exposure, coverage and use of the land are the parameters considered, while to calculate the winter risk, the altitude is also used.

Concerning Pescara Municipality, the hazard scenarios for forest fires are defined by the Abruzzo Region. Also in this case, a weighted additive model is used to calculate the risk, and a distinction between summer and winter forest fire events is made (distinct risk values were calculated). Veneto Region uses a fire propagation model to produce dynamic risk maps.

In Emilia Romagna, the calculation of the risk for forest fires on a municipal basis is done by combining the values of potential danger attributed considering the use of soil and phytoclimatic regions with the values obtained from the analysis of the trigger points and deriving from the elaboration of the statistics of the events of each municipality. The parameters used are, among those available, the ones that best represent the two components of the "risk" value: 1) the probability that the "fire" event will occur and 2) the severity of the damage that the fire itself can cause. In the case of forest fires, the damage can be described and quantified as the combination of two fundamental components: the quality of what burns and the extent of the fire. Weighted values are obtained from the combination of these data, leading to the representation of risk in the following classes: negligible, weak, moderate, and marked. In Emilia-Romagna, no municipality has environmental characteristics or statistical data typical of areas that at a national level would be considered at a "strong" risk of fires. By applying the methodology described above, it is possible to update the calculation of the risk indices in relation to the number, extent and distribution of the fires.

For Croatia, no data were collected in the survey, but the information was retrieved from the open technical and scientific literature and using the project network.

Interactive fire hazard maps are produced by the Croatian Association for Crisis Management HUKM (*Hrvatska Udruga Kriznog Menadžmenta*), gathering a large group of information. The primary sources of data are the Croatian Meteorological and Hydrological Service (*Državni Hidro Meteorološki Zavod*, the European Copernicus Emergency Management Service (EMS) and Croatian Forests (*Hrvatske Šume*). These hazard maps are used by fire departments in coordination with 112.

Concerning the methods used for national risk assessment in the country, according to the working document of the European Commission *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], for every event identified, two types of scenarios need to be developed: the most likely adverse event and the event with the worst consequences. For forest fire risk, according to the above-cited document, the most likely scenario is described as a situation that usually occurs in summer, where there are forest fires that occasionally threaten people and properties, and that can be handled relatively quickly (from hours to some days). The worst possible scenario, instead, is described as a situation with extreme weather conditions (strong wind, high temperatures, lightning strikes and drought), which favours the development of multiple and simultaneous forest fires of considerable size in the coastal area of the country. These events may threaten critical infrastructures and lead to road, rail and maritime transport congestion. Many resources from all over the country are usually engaged, and a large amount of the population may need to be evacuated.

2.3. Sensor networks

This section aims to give an overview of the existing physical sensor networks related to forest fires in Italy and Croatia, focusing on the partner regions.

Regarding the Italian partner regions, there are no specific sensors for forest fires in the Molise and Emilia Romagna regions as in the municipal territory of Pescara. In Molise Region, with the European cooperation project “To Be Ready” (IT-AL-ME), an experimental network for the evaluation of phenology and for the improvement of analyses is planned. This network includes some cameras with images in the visible for the monitoring of sensitive areas and the acquisition of satellite images to predict the danger of forest fires.

For Croatia, no data were collected in the survey, but the information was retrieved using the project network and from the open technical and scientific literature.

In Croatia, human wildfire surveillance is mainly organized by Croatian Forests (*Hrvatske Šume*), the governmental organization responsible for protecting and exploiting forests in state ownership. Twelve experimental cameras were installed in four counties for fire detection, and now there are 140 cameras installed in the country. Relevant support tools are "Adriafire Propagator" (it gives live information when a fire is detected in a precise area) and "Adriafire Risk" (for smoke detection).

2.4. Indicators and parameters to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures

This section aims to describe the indicators and parameters adopted in Italy and Croatia, focusing on the partner regions, to define emergency severity scales to activate Civil Protection prevention, warning and rescue measures.

In Italy, the Prime Minister defines every year the timing of the AIB campaign (*Campagna Anti Incendio Boschivo*) and gives operational guidelines to the Regions and to the competent Ministries for the prevention and management of forest fires. As already reported, and just for the sake of clarity, the Framework Law on forest fires is L.353/2000. Article 3 attributes the task to draw up regional plans of prevision, prevention and active fight against forest fires (*Piani regionali di previsione, prevenzione e lotta attiva contro gli incendi boschivi*) to Regions, while article 4 assigns the implementation of prevision and prevention activities to provinces, mountain communities and municipalities. Regarding the Italian participants in this task force, Molise has defined the scale of severity for forest fire risk articulated in 4 levels: green, yellow, orange and red, depending on the specifics defined for the regional territory and with the support of numerical modelling (RISICO) made available by the National Department of Civil Protection. The emergency severity scale is evaluated in the period from June to September by the Functional Centre of Molise Region, which is responsible for monitoring and alerting activity.

The Municipality of Pescara, located in the Abruzzo Region, defined forest fire parameters on the basis of the presence of areas that have already been involved in fires, according to national and regional legislation. Concerning the intervention model, the example of Emilia Romagna will be reported. The

intervention model is divided into successive phases in relation to the level of danger, which timely marks the growth of the level of attention and use of the tools, human and financial resources that are put in place. Two periods are defined:
1) an ordinary period (during which the danger of fires is limited or non-existent);
2) a period of intervention (during which the danger of forest fires is high).
During the intervention period, increasing operational phases are activated, proportionate to the forecasting aspects, divided into the following:

- attention phase (indicatively from February to April and from June to September);
- pre-alarm phase (which coincides with the state of serious danger);
- alarm phase (reporting of fire sighting);
- containment, extinguishing and reclamation phase (fire extinction).

For Croatia, no data were collected in the survey, but the information was retrieved using the project network. Traditional communication related to forest fires is quite effective in the country. It is interesting to report that in the coastal cities, interactive panels give continuously, during the critical season, an indication of the level of risk (they take the data directly from competent institutions such as DHMZ). Moreover, information is given through the official social media pages of DHMZ and some fire departments.

2.5. Expected trend by climate change and anthropic activity

No information concerning this request was obtained from the survey. Only a note from Molise Region (Italy) was provided, asserting that a report is carried out periodically concerning the trend and frequency of forest fires. Moreover, according to the working document of the European *Commission Overview of Natural and Man-made Disaster Risks the European Union may face* [9], climate projections suggest substantial changes in precipitation and temperature patterns. As a result, the length and severity of the fire season, the area at risk and the probability of large fires and greenhouse gas emissions are projected to grow with respect to the actual conditions.

2.6. Interactions with technological outbreaks

No information for this request was collected from the survey. According to the working document of the European *Commission Overview of Natural and Man-made Disaster Risks the European Union may face* [9], forest fires can have major disruptive impacts on the environment, human health and the economy, taking into consideration the particularly relevant environmental, financial and well-being value of forest areas and woods, as well as of wildland-urban interfaces (WUI). Under extreme climatic conditions, forest fires impact ecosystem health and functions, and can cause extensive damage to life and property through the disruption of transport systems and of critical infrastructures (airports, power lines, etc.), industrial facilities and private assets. While casualties can usually be avoided, fires originate significant distress and fumes that can severely affect human health and contribute to global warming. Interactions with artificial fuels (e.g. domestic LPG tanks) and natural fuels (bushes, ornamental vegetation, wooden structures) at WUI may escalate such consequences.

2.7. Proposal for enhancement

This section aims to summarize the inputs sent by the partners concerning possible improvements of the practices in use in forest fire risk management. A note of Molise Region suggests that practical actions for enhancing the protection of citizens and assets could be the improvement of the forecasting of vegetation status and the boost of forest fire risk awareness in the population since the phenomenon of forest fires is strongly influenced by human activity and weather conditions. Moreover, it would be important to homogenise land and air active firefighting.

Concerning the increase in forest fire risk awareness, the municipality of Pescara has started various activities and initiatives to communicate with the population, aiming to raise the knowledge of risk scenarios.

The University of Bologna-CIRI FRAME proposes to further evaluate, mainly for potential early fire detection and damage assessment, the use of multispectral images periodically taken from satellites or from planned UAV flights over sensible areas.

3. Earthquakes

3.1. Hazard characterization

Earthquakes are geological phenomena that occur without warning, with consequences that can be highly dramatic. Seismic risk is particularly significant in Southern Europe countries and in general at plate boundaries, where more than 90% of earthquakes take place. It is also important to remark that earthquakes can trigger various cascading effects such as landslides, tsunamis, and debris avalanches. They can also damage critical infrastructures or lead to severe accidents in the chemical and process industry due to the loss of containment of hazardous substances.

Earthquakes are unpredictable events. In fact, it is impossible with the current scientific tools to determine when and where the next earthquake will occur and how large its magnitude will be. Nowadays, the only possible seismic previsions are statistical and based on past seismicity.

The identification of earthquake-prone areas and of damage scenarios is of great importance for seismic risk management. Moreover, since seismicity is a feature of the site and therefore cannot be changed, it is crucial to strengthen preparedness, act on the vulnerability of buildings, improve their resilience, and plan appropriate response operations in order to reduce the severity of damages on communities, infrastructures, economy and the environment.

The reference document for seismic prevention concerning the vulnerability of buildings in the EU is Eurocode 8 (*EN 1998: "Design of structures for earthquake resistance"* [18]). Its provisions apply, as stated in the document, to the design and the construction of buildings and civil engineering works in seismic regions, and its purpose it to ensure in the event of earthquakes that human lives are protected, that damage is limited and that structures important for civil protection remain operational. Eurocode 8 is composed by six parts, dealing with different types of constructions or subjects:

- EN1998-1: General rules, seismic actions and rules for buildings
- EN1998-2: Bridges
- EN1998-3: Assessment and retrofitting of buildings
- EN1998-4: Silos, tanks and pipelines
- EN1998-5: Foundations, retaining structures and geotechnical aspects

- EN1998-6: Towers, masts and chimneys.

3.2. Current risk scenarios

This section aims to describe the criteria currently applied in Italy and in Croatia, focusing on the partner Regions, to identify and select seismic risk scenarios for emergency planning and management, including the practices adopted.

In Italy, the national territory is classified into four risk zones (O.P.C.M. n.3274 / 2003, *Primi elementi in materia di criteri generali per la classificazione sismica del territorio nazionale e di normative tecniche per le costruzioni in zona sismica*), including in area 4 (the least dangerous) all those territories that had been excluded from any seismic classification. Each zone is given a value of the seismic action useful for the planning of preventive and response measures in case of earthquake, expressed in terms of maximum acceleration on rock (‘a_g’). More in detail, the zones are defined as follows

- seismic zone 1: $a_g > 0,25$;
- seismic zone 2: $0,15 < a_g < 0,25$;
- seismic zone 3: $0,05 < a_g < 0,15$;
- seismic zone 4: $a_g < 0,05$.

O.P.C.M. 3274/2003 states the general principles according to which the regions compile the list of municipalities with the relative attribution to one of the 4 zones.

Concerning the Italian partners of the project, Molise Region, with the R.L.13/2004 "Seismic reclassification of the regional territory and new seismic legislation", has adopted the national law on seismic classification, and all the municipalities of the region are classified as seismic.

In Emilia Romagna, there are 107 municipalities in seismic area 2 and 224 municipalities in seismic area 3 based on the seismic classification approved by the DGR 1164/2018. It is to remark that an actual estimate of the seismic risk on a regional scale is not yet possible as vulnerability estimates of urban centres and infrastructural networks at a wide area scale are not yet available. In the region, the seismic action necessary for the design and the implementation of interventions to prevent seismic risk is defined for each site starting from the seismic hazard parameters provided by the technical standards for buildings. Alternatively, the use of accelerograms is permitted, provided that they are correctly commensurate with the local seismic hazard of the build area considered. During the seismic event, the scenario is obtained through the quick definition of the exposed elements falling within the affected area, which is determined with various techniques as the elaboration of the instrumental measurements of the seismic shaking and its effects on the buildings, fundamental are also the damage communications from the operating structures of the regional Civil Protection system.

The Municipality of Pescara based its emergency planning concerning earthquakes on the values defined at the national level and on the regional studies of seismic microzonation.

For Croatia, no data were collected in the survey, but the information was retrieved using the project network and from the open technical and scientific literature.

Concerning the methods generally used for national risk assessment in the country, according to the working document of the European Commission, *Overview of Natural and Man-made Disaster Risks the European Union may face* [9], for every event identified, two types of scenarios need to be developed: the most likely adverse event and the event with the worst consequences. The risk type/scenario addressed in the Croatian national risk assessment for seismic risk is an earthquake in the city of Zagreb. The likelihood of this risk is small, while the possible impacts are catastrophic. In the assessment, climate change is not considered. Concerning cascading effects, flooding is part of a composite risk scenario.

3.3. Sensor networks

This section aims to give an overview of the existing physical sensor networks related to earthquakes in Italy and Croatia, focusing on the partner regions.

In Italy, the expertise in seismic monitoring is attached to the National Institute of Geophysics and Vulcanology (*INGV, Istituto Nazionale di Geofisica e Vulcanologia*) and to the National Department of Civil Protection. The main sensor networks, taken as a reference from the Regional Operational Centres (therefore also from the operational centres of Molise, Abruzzo and Emilia Romagna regions) for the definition of seismic scenarios, are the National Accelerometric Network (RAN, *Rete Accelerometrica Nazionale*) and the Network of the Seismic Observatory of Structures (OSS, *Osservatorio Sismico delle Strutture*), both managed by the Civil Protection Department.

RAN is a monitoring network that records the effects of an earthquake in terms of soil accelerations, and it consists of 580 digital stations, permanent and temporary. Each station is equipped with a triaxial accelerometer that allows the acquisition of accelerometric measurements in the north-south, east-west and vertical directions, a digitizer, a modem/router with an antenna to transmit the digitized data via GPRS and a GPS receiver to associate the data with the universal UTC time and to measure the latitude and longitude of the station. The data flow to the central server of the headquarters of the Department of Civil Protection, where they are acquired and processed automatically to obtain an estimate of the main parameters that describe the seismic shock.

Instead, the national OSS network comprises 160 publicly owned buildings falling into municipalities classified mostly in seismic zones 1 and 2. The OSS allows the assessment of the damage caused by an earthquake to the monitored structures; this assessment can also be extended to similar structures that fall within the affected area, thus providing helpful information for the civil protection activity immediately after an earthquake. This monitoring system records the movements of the terrain and of the structures and immediately sends the recorded data to the central OSS server in Rome. The server automatically processes the entries flowing from all the affected structures, producing a summary report with the maximum values and some descriptive parameters which allow to evaluate the incoming earthquake, the vibrations of the structure and the relative state of damage. Furthermore, in the hours immediately following a severe earthquake, a temporary network consisting of simplified monitoring systems is installed in the epicentre area. In this case, the monitored structures are mainly the buildings designated for coordinating emergency management interventions.

For Croatia, no data were obtained from the survey, but the information was retrieved using the project network. The Croatian Seismograph Network is operated by the University of Zagreb, in particular by the Department of Geophysics (*Seizmološka Služba*). In the country, there are two seismological stations (Zagreb and Makarska).

3.4. Indicators and parameters for defining emergency severity scales to activate Civil Protection prevention, warning and rescue measures

As seismic events are not predictable with current technologies, the definition of effective emergency response actions is a crucial aspect in seismic risk management. Upon the occurrence of an earthquake, the assessment of damage (size, extension and localization) is immediately necessary to provide proper assistance to the affected population. Tools to assess the damage are thus essential.

In Italy, the parameters that define the physical intensity (magnitude) and the macroseismic intensity of an earthquake are elaborated and defined by INGV and by the Civil Protection Department. It should also be remarked that the activation threshold for a detailed study of the seismic phenomenon is set at magnitude 4. Furthermore, a great effort was made for the seismic classification of the national territory (section 1.1). This classification is based on historical data (intensity, frequency and location of past earthquakes) and is the natural basis for the planning of emergency responses.

It is interesting to report that in Emilia Romagna, as part of the agreement with CIRI Edilizia e Costruzioni, the “Ground Motion Analysis Toolbox” software was developed. This software allows the calculation of the main intensity indices of a seismic event and the response spectra and the evaluation of the presence of impulsive characteristics in the recordings. This Toolbox is used at the Emilia Romagna Regional Operative Centre to define emergency seismic scenarios. Among the intensity measurements taken into consideration, there are: PGA (peak ground acceleration), EPA (effective peak acceleration), I_c (characteristic intensity), EPV (effective peak speed), SI_H (Housner spectral intensity), PGV (peak ground velocity), PGD (peak ground displacement). Further assessments, which allow the evaluation of the severity of the effects of an earthquake on structures, are conducted in the region by analysing, for the buildings of the seismic observatory of structures, the extent of inter-floor displacements, which constitute a particularly reliable index of damage.

3.5. Expected trend by climate change and anthropic activity

While climate change does not affect directly the occurrence and the severity of seismic risk, anthropic activity is obviously related to exposure and to vulnerability. Therefore, for the reduction of seismic risk, it is highly important to strictly regulate urbanization, especially in earthquake prone areas, and to follow the provision of Eurocode 8 for the design and construction of new buildings.

3.6. Interactions with technological outbreaks

Earthquakes' possible cascading effects may strongly affect the built environment. As the disruption of strategic infrastructure can seriously aggravate emergency situations, it is crucial to assess their vulnerability.

Molise Region reported, in response to the survey, that during the European Cooperation project "Readiness, Resilience enhancement of Adriatic basin from fire and seismic hazards" (IT-HR), strategic public buildings were briefly monitored in order to define a better response in case of an earthquake. Also Dalmatia County participated in this project and 15 schools were evaluated in the county. The results of this monitoring also led to possible proposals for structural improvement of buildings.

In Emilia-Romagna, in application to the Regional law 1661/09 ("Delibera di Giunta Regionale"), requires that several categories of structures, including industrial facilities and storages of hazardous chemical substances and hazardous fuels, should be inspected and verified in order to assess their resistance to seismic action and their safety in the case of an earthquake. Provincial Civil Protection Plans (PPPC, *Piani Provinciali di Protezione Civile*) were prepared, indicating the specific structures in each category that should be verified. As an example, in the province of Ravenna, 35 sites where relevant quantities of hazardous substances are stored or processed were identified and included in the list provided by the PPPC. Also, in this case, the interaction of seismic hazard with chemical hazard may result in NaTech scenarios. A characterization of technological accidents that may follow the impact of earthquakes on industrial facilities where relevant quantities of hazardous chemicals are stored or processed is provided by Kraumann et al. (2016) [13]. Also, with respect to NaTech scenarios triggered by earthquakes, Directive 2012/18/UE ("Seveso-III" Directive), addressing the control of major accidents caused by dangerous substances, requires that such scenarios are identified and characterized. The safety reports issued for the industrial sites falling under the obligation of the Directive also require the control and management of the risk deriving from such events. The "Seveso-III" Directive was implemented in the Italian and Croatian national legislation in 2015. In Italy the Ministry Decree 105 of 26th June 2015 came into force to implement the obligations of the Directive, with Regional Committees (CTR, *Comitato Tecnico Regionale*) having the responsibility to assess and approve the safety reports issued by the operators. In Croatia OG no. 80/13, 153/13, 78/15, 12/18, 44/14, 31/17, and 45/17 were emitted.

3.7. Proposal for enhancement

This section aims to summarize the inputs sent by the partners concerning possible improvements to the practices in use in seismic risk management.

Molise Region highlighted the importance of the studies of Seismic Microzonation, which allows dividing the territory into zones with different behaviour in the event of an earthquake (local seismic response), with the aim of identifying the local conditions on a sufficiently large scale (municipal or sub-municipal). With the results of these studies, emergency planning at the local level can be improved. It is also interesting to report that Molise Region is participating in the draft of a project to be submitted to the H2020 program (MOSIS) which aims to create a DSS platform to centralize information from conventional sensors (e.g., accelerometers) and unconventional (e.g., images from drones, accelerometers on smartphones) for the assessment of the damage scenario following a seismic event.

As the seismic event is not predictable with current technologies, the optimization of emergency management and the improving of communication in the immediacy of the event is of great importance. Concerning the increase in earthquake risk awareness, the municipality of Pescara has started various activities and initiatives to inform the population about the earthquake risk scenarios. Finally, Veneto Region is developing an app to allow the CP volunteers to send prompt alerts in case of an earthquake (Interreg Project “Armonia”).

Conclusions

In this report, the information collected from the partners engaged in TTF1 (University of Bologna - CIRI FRAME, Molise Region, Pescara Municipality) regarding the techniques and metrics to model and represent risk scenarios for the selected target risks (floods, forest fires, seismic) were evaluated and summarized.

This document provides an overview of the methods and practices adopted in Italy and Croatia, giving also some suggestions for the enhancement of current practices, and aims to be a starting point to pursue the goals of the E-CITIJENS project.

From the information collected, it is clear that integrating risk scenario data from traditional sensor networks with the information provided by the public through social media can significantly improve all disaster risk management stages. In particular, the prevision, prevention and preparedness stages, which were mainly addressed in this document, would greatly benefit from such tools and innovative practices. In fact, social media can act as a "living sensor network" and provide a wide variety of data that, properly sorted and processed, can complement authoritative ones and be used to detect hazardous events and to assess the damage. Moreover, the upsurge of social media usage in the last decade has made it a powerful communication channel that can help Civil Protection authorities to inform citizens, before and during emergencies, on risk scenarios and on the evolution of disastrous events, improving preparedness and, in general, the resilience of communities.

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Appendix 'A1' – Unedited results of the TTF1surveyon current risk scenarios – FLOODS

PP5- University of Bologna – CIRI FRAME

1. Current risk scenarios

Per i fenomeni oggetto del Sistema di Allertamento dell'Emilia Romagna vengono definiti degli scenari di evento a cui corrispondono degli effetti e danni. Gli scenari vengono contraddistinti da una codice colore (verde, giallo, arancione e rosso) a cui corrisponde l'attivazione di una fase operativa: giallo-attenzione, arancione-preallarme, rosso-allarme e conseguenti azioni del modello di intervento.

Nella fattispecie del rischio alluvioni gli scenari sono così definiti:

Codice colore verde: Assenza di fenomeni significativi prevedibili

Codice colore giallo: Si possono verificare fenomeni localizzati di innalzamenti dei livelli idrometrici nei corsi d'acqua maggiori, al di sopra della soglia 1.

Si possono verificare innalzamenti dei livelli idrometrici nella rete di bonifica.

Anche in assenza di precipitazioni, il transito di piene fluviali nei corsi d'acqua maggiori può determinare criticità idraulica.

Codice colore arancione: Si possono verificare fenomeni diffusi di:

- significativi innalzamenti dei livelli idrometrici dei corsi d'acqua maggiori, al di sopra della soglia 2, con fenomeni di inondazione delle aree limitrofe e delle zone golenali ed interessamento degli argini;
- significativi innalzamenti dei livelli idrometrici nella rete di bonifica, con difficoltà di smaltimento delle acque, e possibili fenomeni di inondazione delle aree limitrofe;
- fenomeni di erosione delle sponde, trasporto solido, divagazione dell'alveo;
- occlusioni, parziali o totali, delle luci dei ponti dei corsi d'acqua maggiori.

Anche in assenza di precipitazioni, il transito di piene fluviali nei corsi d'acqua maggiori può determinare criticità.

Codice colore rosso: Si possono verificare numerosi e/o estesi fenomeni, quali:

- piene fluviali dei corsi d'acqua maggiori con: superamenti della soglia 3, estesi fenomeni di inondazione anche di aree distanti dal fiume, diffusi fenomeni di erosione delle sponde, trasporto solido e divagazione dell'alveo;
- tracimazione della rete di bonifica con inondazione delle aree limitrofe;
- sormonto, sifonamento, rottura degli argini, fontanazzi, sormonto dei ponti e di altre opere di attraversamento, nonché salti di meandro;
- occlusioni, parziali o totali, delle luci dei ponti dei corsi d'acqua maggiori.

Anche in assenza di precipitazioni, il transito di piene fluviali nei corsi d'acqua maggiori può determinare criticità.

La tabella completa degli scenari si può consultare e scaricare al link https://allertameteo.regione.emilia-romagna.it/weballerte-theme/guide_mappa/TABELLE_SCENARI.pdf

2. Sensor networks

Il monitoraggio idro-meteo-pluviometrico è attivo in Emilia-Romagna da oltre un secolo, ma con gestione centralizzata a livello nazionale.

Le reti osservative idro-meteo-pluviometriche sono state assegnate dallo Stato alle Regioni assieme al trasferimento delle competenze previste all´art. 92 del DLgs 112/98. L´attuale rete regionale è il risultato dell´integrazione di reti appartenenti a più enti operanti sul territorio con finalità differenti.

Con la LR 7/2004 la Regione ha assegnato ad ARPAE il compito di gestire la Rete Integrata di monitoraggio idropluviometrico (https://www.arpae.it/dettaglio_generale.asp?id=229&idlivello=32)

La rete svolge numerose e diverse funzioni di monitoraggio, catalogabili in due grandi gruppi:

- utilizzo in tempo reale dei dati di precipitazione e di livello idrometrico dei corsi d´acqua per la valutazione delle situazioni di emergenza ai fini di protezione civile e sicurezza del territorio;
- funzioni di supporto informativo a studi idrologici e climatologici per i molteplici aspetti afferenti la pianificazione del territorio e la gestione della risorsa idrica.

Le stazioni della rete idrometeorologica trasmettono i dati via radio.

I dati sono archiviati in un database; per ciascuna stazione sono associati i cosiddetti metadati, che identificano e qualificano la stazione (anagrafica, tipo di sensori ecc.). I dati delle stazioni idrometeopluviometriche, oltre all´uso interno ad ARPAE, sono sempre stati utilizzati per richieste provenienti dall´esterno, sia da istituzioni pubbliche che da privati.

Il numero di sensori presenti nella rete di monitoraggio idrometeorologico è pari a 582, suddiviso nelle varie province.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

La Regione Emilia-Romagna ha adottato il proprio sistema di allertamento ai sensi della Direttiva del Presidente del Consiglio dei Ministri 27/02/2004 “Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico e idraulico ai fini di protezione civile” e s.m.i. e delle indicazioni operative del Dipartimento di Protezione Civile Nazionale del 10 febbraio 2016 recanti "Metodi e criteri per l’omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"; recepisce inoltre le indicazioni della Direttiva Alluvioni (D.Lgs 49/2010) che, tra le diverse tipologie di criticità idraulica, ha inserito quella costiera, da inondazione marina.

Il Sistema di Allertamento prevede una fase di previsione, caratterizzata dall’emissione di allerte meteo idrogeologico idrauliche e una fase di evento in cui vengono emesse notifiche di superamento di soglie pluviometriche e/o idrometriche:

- fase di previsione: prima che l’evento si verifichi, a cui corrisponde l’attivazione di azioni di prevenzione volte alla riduzione/mitigazione del possibile danno sul territorio ed alla preparazione alla gestione di eventuali situazioni di emergenza, in riferimento alla pianificazione di protezione civile;
- fase di evento: al manifestarsi dell’evento, a cui corrisponde l’attivazione di azioni di monitoraggio, di contrasto e di gestione dell’emergenza in atto

Per quanto riguarda i fenomeni di piena il principale indicatore per la valutazione della pericolosità è il livello idrometrico nei corsi d'acqua maggiori. Si presume infatti che la gravità dei possibili effetti indotti dalla piena sui territori circostanti possa considerarsi generalmente proporzionale al livello raggiunto dall'acqua, essendo comunque impossibile conoscere e prevedere su scala regionale le criticità della rete idrografica e dei territori attraversati che possono manifestarsi durante il passaggio delle piene, riscontrabili solo su scala locale e tramite osservazione diretta.

Per ciascuna sezione fluviale strumentata viene definito un sistema di tre soglie idrometriche, che discriminano quattro livelli di criticità idraulica sul territorio, corrispondenti ai codici colore dal verde al rosso, e che individuano in linea generale le seguenti situazioni:

- Soglia 1: livelli idrometrici corrispondenti alla completa occupazione dell'alveo di magra, sensibilmente al di sotto del piano di campagna. Indica il passaggio di una piena poco significativa, che potrebbe però necessitare di alcune manovre idrauliche o azioni preventive sui corsi d'acqua.
- Soglia 2: livelli idrometrici corrispondenti all'occupazione delle aree golenali o di espansione naturale del corso d'acqua, che interessano degli argini ove presenti, e possono superare il piano di campagna. Indica il passaggio di una piena significativa, con diffusi fenomeni di erosione e trasporto solido.
- Soglia 3: livelli idrometrici corrispondenti all'occupazione dell'intera sezione fluviale, prossimi ai massimi registrati o ai franchi arginali. Indica il passaggio di una piena eccezionale, con ingenti ed estesi fenomeni di erosione e trasporto solido.

Per loro stessa definizione le soglie idrometriche costituiscono un indicatore della pericolosità della piena soprattutto nei tratti di valle dei corsi d'acqua maggiori, dove sono presenti aree golenali e argini di difesa e dove viene effettuato il servizio di piena. Nei tratti non arginati dei corsi d'acqua maggiori, appartenenti alle zone di allerta montane, le soglie idrometriche possono rappresentare, oltre che un indicatore di pericolosità locale, anche un indicatore di preannuncio dei corrispondenti superamenti di soglia nei tratti di valle, per le tipologie di piene più frequenti.

Sono state individuate in via sperimentale anche soglie pluviometriche, che possono essere considerate precursori dell'insorgenza di un temporale forte e persistente e sono pari a 30mm/h e 70mm/3h di pioggia cumulata. In alcuni casi possono essere considerate anche come precursori di eventi che possono causare innalzamenti rapidi in corsi d'acqua del reticolo idrografico minore con tempi di corrivazione molto rapidi.

L'emissione dell'Allerta meteo idrogeologica idraulica e la ricezione delle notifiche del superamento di soglia idro/pluviometriche costituiscono per gli enti e le strutture operative interessate il riferimento per dare corso alle azioni di cui alla pianificazione di protezione civile, in riferimento agli scenari previsti e all'evoluzione puntuale degli stessi.

Per approfondimenti https://allertameteo.regione.emilia-romagna.it/homepage/

4. Expected trend by climate change and anthropic activity

La conoscenza della variabilità meteo-climatica, idrologica e marina presente e i rispettivi scenari futuri è uno dei punti di partenza necessari per le strategie di adattamento ai cambiamenti climatici. Durante il progetto Life Primes, Arpae ha definito e analizzato un dataset di indicatori climatici, idrologici e marini sul periodo 1961-2014, tra i quali l'andamento stagionale delle precipitazioni e del numero di giorni con precipitazione maggiore di 50 mm/24 ore sulle aree di allertamento dell'Emilia-Romagna. La variabilità climatica ha evidenziato una tendenza alla diminuzione delle precipitazioni durante l'inverno, all'aumento in estate e leggermente in primavera e in autunno. Focalizzando lo studio sugli eventi intensi, si è osservato che in autunno si concentrano oltre il 50% dei casi annui. L'analisi idrologica delle piene fluviali è stata condotta individuando gli eventi di piena principali su un periodo di 35 anni. Il data set di eventi è stato classificato in base ai livelli massimi raggiunti, confrontati con un sistema di 3 soglie idrometriche, evidenziando le piene che occupano l'area golenale e coinvolgono gli argini (> soglia 2) e quelle eccezionali, prossime all'esondazione (> soglia 3). L'analisi delle piene per ciascun bacino mostra un aumento nel tempo sia del numero degli eventi, sia del numero di superamenti delle soglie 2 e 3, in tutta l'area di analisi. Il trend crescente di numero e magnitudo delle piene è più marcato negli ultimi 10 anni, a conferma dell'aumento della frequenza delle precipitazioni intense sulla zona appenninica, evidenziato dall'analisi meteo-climatica delle precipitazioni. Lo studio dell'andamento della temperatura ha evidenziato un aumento medio di 0.4 gradi a decade. E' stata condotta anche un'analisi relativa al mare e alla costa, utilizzando analisi differenziate per periodo, tipologia di variabile e area geografica, a seconda delle banche dati disponibili per tenere conto della carenza di serie temporali lunghe ed omogenee di misurazioni meteo-marine.

5. Interactions with technological outbreaks

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6. Proposal for enhancement/adaptation of measures

Un percorso di adattamento è stato sviluppato con il progetto europeo LIFE PRIMES "Preventing flooding risk by making resilient communities" ovvero prevenire il rischio alluvioni rendendo le comunità resilienti, approvato nell'ambito del programma LIFE 2014-2020 sulle strategie di adattamento ai cambiamenti del clima, concluso a dicembre 2018 (http://www.lifeprimes.eu/).

Negli ultimi decenni, gli eventi alluvionali legati ai cambiamenti climatici, in costante aumento, hanno comportato pesanti costi in termini di perdita di vite umane, danni all'ambiente, ai centri abitati, alle attività produttive, ai beni culturali, all'agricoltura. Le comunità locali, per far fronte ad eventi sempre più frequenti, spesso estremi ed improvvisi, si trovano davanti una grande sfida: diventare parte sempre più attiva nella costruzione di strategie di adattamento e di sistemi di allertamento efficaci. Il progetto mira a creare comunità resilienti in grado di partecipare attivamente alle politiche di prevenzione del rischio da alluvione.

Gli obiettivi del progetto Life Primes sono stati raggiunti attraverso una serie di attività: definizione di scenari di riferimento di cambiamento climatico e del relativo impatto in modo integrato per le tre regioni partner; omogeneizzazione dei sistemi di allertamento; implementazione di uno spazio web condiviso; sviluppo di un percorso di dialogo e responsabilizzazione della comunità attraverso la predisponzone di piani di sviluppo locale per le azioni di adattamento; valutazione della percezione del rischio e dell'analisi della resilienza e analisi degli impatti attesi sull'economia locale e l'ambiente.

Valore aggiunto del progetto sono le "Linee guida PRIMES" per lo sviluppo di Civic Adapt Action Plan for Community, ideate per supportare altre comunità locali nello sviluppo di processi partecipati funzionali al miglioramento della resilienza dei territori rispetto al rischio alluvioni. La metodologia PRIMES è una metodologia di processo, mutuata dall'esperienza maturata durante il progetto che ha consentito di realizzare i Piani Civici di Adattamento e mitigazione del rischio alluvioni introducendo una serie di strumenti, denominati PRIMES tool-kit, funzionali ad incrementare la percezione del rischio delle comunità locali, rafforzando al contempo la collaborazione tra cittadini,istituzioni e Protezione Civile.

A livello di industria produttiva si segnala il progetto LIFE IRIS "Improve resilience of industry sector" (http://www.lifeiris.eu/) che ha sviluppato diversi strumenti utili alle imprese che intendono far fronte alle minacce del cambiamento climatico attraverso l'analisi del rischio e la definizione di azioni di adattamento climatico che permettano di aumentare la resilienza.

7. Data Sources

- "Codice della protezione civile", emanato con D. Lgs. n. 1/2018
- Direttiva del Presidente del Consiglio dei Ministri 27/02/2004 "Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico e idraulico ai fini di protezione civile" e s.m.i.
- Indicazioni operative del Dipartimento di Protezione Civile Nazionale del 10 febbraio 2016 recanti "Metodi e criteri per l'omogeneizzazione dei messaggi del Sistema di allertamento nazionale per il rischio meteo-idrogeologico e idraulico e della risposta del sistema di protezione civile"
- LR 1/2005 "Nuove norme in materia di *Protezione Civile* e Volontariato. Istituzione dell'Agenzia Regionale di Protezione Civile"

- DGR n. 962/2018 “Documento per la gestione organizzativa e funzionale del sistema regionale di allertamento per il rischio meteo idrogeologico, idraulico, costiero ed il rischio valanghe, ai fini di protezione civile”

LP- Molise Region

1. Current risk scenarios

On 23 October 2007, the 2007/60/CE Directive on flood risk assessment and management (Flood Directive) was adopted. The implementation of the Flood Directive in national legislation took place through the enactment of D.Lgs. 23 February 2010 No. 49.

The Molise Region, for the territory in the Sangro River basin, is included in the Central Apennine Hydrographic District, whose coordination is entrusted to the Tiber River Basin Authority, while, for the remaining territory, it is included in the Hydrographic district of the Southern Apennine, whose coordination is entrusted to the Liri, Garigliano and Volturno River Basin Authority.

District Basin Authorities prepare coordinated management plans at the water district level.

The Flood Risk Management Plan (PGRA) integrates all aspects of flood risk management and, specifically, prevention, protection and preparedness (including flood forecasts and the warning system) into a single framework taking into account the characteristics of the receptive catchments in the District.

The PGRA of the South Apennine Hydrographic District, in the Institutional Committee was adopted at the meeting of 17 December 2015, with deliberation No. 1/2015, and approved at the meeting of 3 March 2016, with deliberation No. 2/2016, obtaining 27 October 2016 with DPCM published on G.U. 28 of 03 February 2017.

The PGRA of the Central Apennine Hydrographic District, in the Institutional Committee was adopted at the meeting of 17 December 2015, with deliberation no. 6/2015 and approved at the meeting of 3 March 2016, with deliberation No.9/2016, obtaining 27 October 2016 with DPCM published on G.U. 28 of 03 February 2017.

The Molise Region, in coordination with the Department of Civil Protection, has prepared the part of the management plans related to the national, state and regional alert system, for hydraulic risk for the purpose of civil protection.

In 2018 it issued the document regulating the warning system and the regional flood risk intervention model, based on the guidance provided by the National Department of Civil Protection.

The agency that is responsible for monitoring and alerting activity is the Functional Center of the Molise Region, which is part of the Regional Civil Protection Service located in Campochiaro (Cb).

2. Sensor networks

The Molise Region has its own network of monitoring in real time and continuously with sensors located throughout the region and useful to the flood risk alert system. Sensors measure rain, temperature, river and lake level, atmospheric pressure, relative humidity, wind and snow level. The data transmission system takes place with a radio network with dedicated frequencies.
The data acquisition centre is at the Civil Protection Service of the Molise Region in Campochiaro (CB). The data center has hardware and software equipment that is useful for specific purposes.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

The Molise Region has defined on the basis of the indications of the National Department of Civil Protection, as on the rest of the national land, the scale of severity for flood risk articulated in 4 levels: green, yellow, orange and red, depending on the heights specifics defined for the regional territory.

The emergency severity scale is evaluated daily by the Functional Centre of Molise Region based on data recorded by the monitoring network and weather forecasting models.

4. Expected trend by climate change and anthropic activity

In the Molise Region there is no reference document, but the Civil Protection Service is taking an interest in the subject, nominating a technical study detailing extreme weather events, as it considers this analysis fundamental.

Currently, at the occurrence of an severe flood event, the Functional Centre of Molise Region drafts a technical document of meteorological analysis and its effects on the ground.

5. Interactions with technological outbreaks

In the Molise Region there is no reference document, except for the technology used for the monitoring and alerting system.

6. Proposal for enhancement/adaptation of measures

The PGRA described in Paragraph 1 provides for measures, which are specific to civil protection activities, referred to in art. 2 of D.Lgs No. 1/2018, aimed at improving flood forecasting and alerting, disaster and response planning during the event, as well as support activities to restore pre-event conditions.

These measures are subject to periodic revisions.

The ongoing climate change, the severe events and European standards in this area, impose an urgent detailed study of regional climatology to better assess the possible effects on the ground and define appropriate safeguards.

7. Data Sources

www.protezionecivile.it

www.protezionecivile.molise.it

www.ildistrettoidrograficodellappenninomeridionale.it

www.abtevere.it/node/718?q=node/718

PP6 –Pescara Municipality

1. Current risk scenarios

On the basis of the hydraulic or flood criticality notices issued by the "Centro Funzionale – Regione Abruzzo", the Municipality of Pescara starts all the activities expected by the relative emergency plan: closure of the most exposed areas, activation of aids for monitoring the flood in the most critical points, activation of volunteer teams etc.).

2. Sensor networks

On the municipal territory numerous physical sensors have been installed to measure constantly the water levels in the road underpasses and along the banks of the Pescara River. When the water level reaches a critical threshold, traffic lights are activated to warn of danger; all the physical sensors are associated with cameras that allow a visual check in real time.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

According to national and regional legislation, the severity scale is defined and officially communicated by the "Centro Funzionale – Regione Abruzzo". The gravity scale is associated with color codes (green, yellow, orange and red) based on the forecasts and the intensity of the occurring events.

4. Expected trend by climate change and anthropic activity

No activity planned for climate change.

5. Interactions with technological outbreaks

No activity planned.

6. Proposal for enhancement/adaptation of measures

The municipality of Pescara has started various activities and initiatives for communicating to the population the knowledge of risk scenarios.

7. Data Sources

All the documents concerning the flood risks are elaborated by the Abruzzo Region through the mapping of areas subject to river flooding, named "PSDA". Instead the Municipality of Pescara has elaborated maps about the areas of the city that are subject to flooding due to the rains.

Appendix 'A2' – Unedited results of the TTF1 survey on current risk scenarios – FOREST FIRES

PP5- University of Bologna – CIRI FRAME

1. Current risk scenarios

Il calcolo del rischio per gli incendi boschivi su base comunale avviene combinando i valori di pericolosità potenziale attribuiti considerando l'uso del suolo e regioni fitoclimatiche con i valori ricavati dall'analisi dei punti di innesco e con i valori derivanti dalle elaborazioni delle statistiche degli eventi di ciascun comune.

I parametri utilizzati sono, tra quelli disponibili, quelli che meglio rappresentano le due componenti del valore "rischio":

1. la probabilità che l'evento "incendio" si verifichi
2. la gravità del danno che l'incendio stesso può provocare.

Nel caso degli incendi boschivi il danno può essere inteso a sua volta come la combinazione di due componenti fondamentali: la qualità di ciò che brucia e l'estensione dell'incendio.

Dalla combinazione dei dati si hanno valori ponderati che portano alla rappresentazione del rischio nelle seguenti classi:trascurabile, debole, moderato, marcato.

La scala dei valori di rischio si ferma al grado "marcato": in regione Emilia-Romagna nessun comune ha caratteristiche ambientali e/o dati statistici tipici di ambiti che a livello nazionale verrebbero considerati a "forte" rischio di incendi.

Applicando la metodologia sopra descritta, è possibile aggiornare il calcolo degli indici di rischiocon i dati che vengono rilevati relativamente a numerosità, estensione e distribuzione degli incendi. Analogamente potranno essere ricalcolati i parametri derivanti dalla Carta dell'Uso del Suolo qualora siano disponibili aggiornamenti significativi di tale tematismo.

Relativamente al rischio da incendio di interfaccia, ovvero di un fuoco di vegetazione che si diffonde o può diffondersi su linee, superfici o zone ove costruzioni o altre strutture create dall'uomo si incontrano o si

compenetrano con aree vegetate creando condizioni di pericolosità particolari, si fa riferimento alla relativa carta della pericolosità che si ottiene attraverso
l'elaborazione di informazioni di diverso genere, come la carta forestale e quella di uso del suolo, e può essere sovrapposta ad una copertura cartografica riguardante l'individuazione dei nuclei urbani e delle strutture ricettive/ricreative; particolare attenzione va posta infatti verso quelle infrastrutture che, per propria vocazione, risultano interconnesse con gli elementi forestali (campeggi, case di cura, parchi e zone dedicate alla ricreazione, parchi tematici, zone verdi urbane, giardini, ecc…)
Ai fini della rappresentazione le aree a rischio di incendio di interfaccia sono suddivise in
due sottoaree rappresentabili distintamente in cartografia:
1. La fascia di interfaccia vera e propria che è individuata all'interno delle aree antropizzate (abitati,infrastrutture, strutture ricettive, ecc.), di larghezza variabile in funzione della tipologia delle strutture e di altri parametri ambientali.
2. La fascia perimetrale ovvero una superficie esterna alla precedente e individuata sul territorio non antropizzato avente una larghezza indicativa di 100 - 200 metri.

2. Sensor networks

no

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

Il modello di intervento è articolato in fasi successive in relazione al livello di pericolosità, che servono a scandire temporalmente il crescere del livello di attenzione e di impiego degli strumenti e delle risorse umane e finanziarie che vengono messi in campo; si distinguono:
• un periodo ordinario (durante il quale la pericolosità di incendi è limitata o inesistente);
• un periodo di intervento (durante il quale la pericolosità di incendi boschivi è alta).

Nel periodo di intervento si attivano fasi di operatività crescente, proporzionata agli aspetti previsionali, articolate nell'ambito delle seguenti fasi:

1. fase di attenzione (indicativamente da febbraio ad aprile e da giugno a settembre);
2. fase di preallarme (che coincide con lo stato di grave pericolosità);
3. fase di allarme (segnalazione di avvistamento incendio);
4. fase di contenimento, spegnimento e bonifica (estinzione dell'incendio).

4. Expected trend by climate change and anthropic activity

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5. Interactions with technological outbreaks

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6. Proposal for enhancement/adaptation of measures

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7. Data Sources

- L 21 novembre 2000, n. 353 "Legge-quadro in materia di incendi boschivi",
- DGR 2 AGOSTO2017, N. 1172Approvazione del Piano regionale di previsione, prevenzionee lotta attiva contro gli incendi boschivi ex L.353/00. Periodo2017-2021

LP- Molise Region

1. Current risk scenarios

The D.lgs. 1 of 2.1.2018, "Code of Civil Protection, yes to art. 11,c. 1, lett. (m) gives the Autonomous Regions and Provinces the functions for "extinguishing forest fires, subject to state powers in this area, in accordance with the provisions of law 21 November 2000, No 353, and subsequent modifications and by decree August 19, 2016, No 177.

The Molise Region with the Regional Law 17 February 2000, No 10 established the Regional Civil Protection System, which has been entrusted with the exercise of regional civil protection responsibilities, including the active fight against forest fires (Article 3).

The Framework Law on forest fires, Law 353/2000, provides for the Regions to plan the active fight against forest fires, through the coordination of their fire-fighting facilities with the state.
As a result of this last

- of security in activities, including through the efficiency of communication channels;

In the context of the risk rule, a number of regional and national acts have outlined the framework for action and activities in charge of the Regional Civil Protection Service.
The main actions are:

- The specific training and training of personnel, in various ways involved in the management of the active fight against forest fires;
- The increase in the level of forest fires and the preventive warning of the civil protection system, the risk-to-forest is expected.
- Regional operational coordination under the Civil Protection Service, including through the use of a computer platform (Pythagoras) for event management, reporting and investigation by the PG authorities;
- The coordination of active combat units in the territory;

- Shutdown;
- The clean-up activities, perimeter of the areas covered by fire.

Law 353/2000 obliges each region to draw up the Regional Plan for the planning of the activity of forecasting, prevention and combating forest fires, on the basis of guidelines and directives of the Council of Ministers.

The Molise Region, in 2018, approved the update and revision of the Regional Plan for Forecasting, Prevention and Active Fire Fighting (AIB Plan) for the period 2018 – 2020.

The AIB Plan defines the scenarios of danger and risk forest fires in the regional territory.

The agency that is responsible for monitoring and alerting activity is the Functional Center of the Molise Region, which is part of the Regional Civil Protection Service located in Campochiaro (Cb).

2. Sensor networks

Currently there are no specific sensors for forest fires, but with the European cooperation project 'To Be Ready' (IT-AL-ME), an experimental network for the evaluation of phenology and for the improvement of analyses is planned. Satellite images, used to predict the danger of forest fires.

There are some cameras with images in the visible for monitoring sensitive areas.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

The Molise Region has defined the scale of severity for forest fire risk articulated in 4 levels: green, yellow, orange and red, depending on the heights specifics defined for the regional territory, with the support of numerical modelling (RISICO) made available by the National Department of Civil Protection.

The emergency severity scale is evaluated, in the period from June to September, by the Functional Centre of Molise Region.

4. Expected trend by climate change and anthropic activity

In the Molise Region there is no reference document. Periodically a report is carried out on the trend and frequency of forest fires.

5. Interactions with technological outbreaks

In the Molise Region there is no reference document.

6. Proposal for enhancement/adaptation of measures

The phenomenon of forest fires is strongly influenced by human activity, as well as weather conditions. For these reasons, effective actions consist of improving the forecasting of vegetation status and raising awareness of the population.

In addition, active combat action by land and air means should be homogenized.

7. Data Sources

www.protezionecivile.it

www.protezionecivile.molise.it

www.regione.molise.it

PP6 – Pescara Municipality

1. Current risk scenarios

The hazard scenarios for forest fires are defined by the Abruzzo Region which annually opens campaigns aimed at reducing the risk of fires inside the woods and parks, named “A.I.B.”.

2. Sensor networks

As far as the forest fire risk is concerned, there are no physical sensors on the municipal territory.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

According to national and regional legislation the hazard parameters are defined by the presence of soils that have already been involved by fire. Moreover, in the summer period (15 June - 15 September), the Regione Abruzzo issues a susceptibility report based on the expected temperatures at ground.

4. Expected trend by climate change and anthropic activity

No activity planned for climate change.

5. Interactions with technological outbreaks

No activity planned.

6. Proposal for enhancement/adaptation of measures

The municipality of Pescara has started various activities and initiatives for communicating to the population the knowledge of risk scenarios.

7. Data Sources

Civil Protection Department and Abruzzo Region: fire risk, named "AIB".

Appendix 'A3' – Unedited results of the TTF1 survey on current risk scenarios – SEISMIC RISK

PP5- University of Bologna – CIRI FRAME

1. Current risk scenarios

La storia sismica e le registrazioni strumentali indicano che in vari settori della regione si sonoverificati terremoti di magnitudo maggiore di 5.5 che hanno causato dannidi intensita macrosismica anche maggiori dell'VIII grado della scala MCS.

Pur essendo il territorio dell'Emilia-Romagna caratterizzato da una sismicità nonparticolarmente elevata, il rischio sismico e invece elevato.Occorre, infatti, considerare che il rischio dipende, oltre che dalla pericolosità, anche dalladistribuzione e dalla vulnerabilità degli insediamenti, delle attività e dei beni artistici, delle vie dicomunicazione e delle reti infrastrutturali.

Una vera stima del rischio sismico a scala regionale non è pero ancora possibile in quanto non sono ancora disponibili stime di vulnerabilità dei centri urbani e delle reti infrastrutturali a scala di area vasta. In Emilia Romagna, in base alla classificazione sismica approvata con la DGR 1164/2018, risultano 107 comuni in zona sismica 2 e 224 comuni in zona sismica 3.

La classificazione sismica costituisce un riferimento tecnico-amministrativo per graduare l'attività di controllo dei progetti e la priorità delle azioni e misure di prevenzione e mitigazione del rischio sismico.

La classificazione sismica non interferisce con la determinazione dell'azione sismica, necessaria per la progettazione e la realizzazione degli interventi di prevenzione del rischio sismico.

L'azione sismica è definita per ogni sito a partire dai parametri di pericolosità sismica previsti dalle norme tecniche per le costruzioni. La pericolosità è descritta in termini di accelerazione orizzontale massima attesa a_g in condizioni di campo libero, su sito diriferimento rigido con superficie topografica orizzontale (di categoria A come definita al §3.2.2), nonché di ordinate dello spettro di risposta elastico in accelerazione ad essa corrispondente Se(T), con riferimento a prefissate probabilità di eccedenza PVR, nel periodo di riferimento VR. In alternativa è ammesso l'uso di accelerogrammi, purché correttamente commisurati alla pericolosità sismica locale dell'area della costruzione.

In corso di evento lo scenario è ottenuto attraverso la definizione speditiva degli elementi esposti ricadenti all'interno della zona colpita, che viene determinata, attraverso varie tecniche, a partire dall'elaborazione delle misure strumentali dello scuotimento sismico e dei suoi effetti sulle costruzioni (Mappe di scuotimento, Rete accelerometrica nazionale e osservatorio sismico delle strutture), nonché dalle comunicazioni di danno provenienti dalle componenti e dalle strutture operative del sistema regionale di protezione civile.

2. Sensor networks

Le principali reti di sensori, prese come riferimentopresso il Centro Operativo Regionale per la definizione di scenari sismici, risultano la rete accelerometrica nazionale (RAN) e la rete dell'osservatorio sismcio delle strutture (OSS), entrambe gestite dal Dipartimento di protezione civile.

La RAN è una rete di monitoraggio che registra gli effetti di un terremoto in termini di accelerazioni del suolo. Risulta costituita da 580 postazioni digitali (dati riferiti a settembre 2018), permanenti e temporanee, provviste di un accelerometro triassiale che consente di acquisire le misure accelerometriche secondo le direzioni nord-sud, est-ovest e verticale, un digitalizzatore, un modem/router con un'antenna per trasmettere i dati digitalizzati via GPRS e un ricevitore GPS per associare al dato il tempo universale UTC e per misurare la latitudine e longitudine della postazione. 204 postazioni sono inserite all'interno di cabine di trasformazione elettrica di Enel Distribuzione e 376 sono posizionate su terreni di proprietà pubblica. I dati affluiscono al server centrale nella sede del Dipartimento di Protezione Civile, dove vengono acquisiti ed elaborati in maniera automatica per ottenere una stima dei principali parametri descrittivi della scossa sismica. L'Agenzia per la sicurezza territoriale e la protezione civile ha sviluppato, in collaborazione con il CIRI Edilizia e Costruzioni, l'applicativo Ground Motion Toolbox che consente, partendo dai dati accelerometrici della RAN, il calcolo dei principali indici di intensità dello scuotimento sismico e la valutazione della loro efficienza. La rete nazionale dell'OSS è costituita da 160 costruzioni di proprietà pubblica ricadenti in comuni classificati per lo più in zona sismica 1 e 2. L'OSS permette di valutare il danno causato da un terremoto alle strutture monitorate, estendibile a quelle ad esse simili che ricadono nell'area colpita, fornendo in tal modo informazioni utili all'attività di protezione civile immediatamente dopo un terremoto. Il sistema di monitoraggio registra il movimento del terreno e quello della struttura, e invia immediatamente i dati registrati al server centrale OSS di Roma.Il server elabora in automatico le registrazioni affluite da tutte le strutture colpite, producendo un rapporto sintetico con i valori massimi ed alcuni parametri descrittivi, che permettono di valutare sia il terremoto in arrivo, sia le vibrazioni della struttura, sia il relativo stato di danneggiamento. Inoltre, nelle ore immediatamente successivea un sisma grave, viene installata in area epicentrale una rete temporanea costituita da sitemi di monitoraggio semplificati. In questo caso le strutture monitorate sono prevalentemente gli edifici adibiti al coordinamento degli interventi per la gestione dell'emergenza, come le sedi dei Centri Operativi Misti e della DiComaC.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

Per definire la severità di un evento sismico, con particolare riferimento agli effetti sulle costruzioni, il Centro Operativo Regionale analizzale misure di intensità dello scuotimento ottenute a partire dalle misure accelerometriche acquisite dalla rete accelerometrica nazionale.

Le misure di intensità dello scuotimento sismico costituiscono dei parametri che descrivono sinteticamente l'intensità del moto del terreno, con particolare riferimento ai loro effetti sulle strutture. Le misure di intensità possono essere definite direttamente a partire da registrazioni di stazioni accelerometriche, come ad esempio l'accelerazione di picco del terreno, oppure sulla base della risposta, sia lineare che non, di strutture di riferimento.

Nell'ambito della convenzione con il CIRI Edilizia e Costruzioni è stato realizzato il software Ground Motion Analysis Toolbox che consente di calcolare i principali indici di intensità di un evento sismico e gli spettri di risposta. Inoltre il software valuta la presenza di caratteristiche di impulsività nelle registrazioni. GMToolbox è utilizzato presso il Centro Operativo Regionale per la definizione di scenari sismici in emergenza.Tra le misure di intensità prese in considerazione risultano: PGA (peak ground acceleration), EPA (accelerazione di picco effettiva), Ic (characteristicintensity), EPV (velocità effettiva di picco), SIH (intensità spettrale di Housner), PGV (peak ground velocity), PGD (peak ground displacement).

Ulteriori valutazioni, che consentono di valutare la severità degli effetti di un terremoto sulle costruzioni, sono condotte analizzando, per gli edifici dell'osservatorio sismico delle strutture, l'entità deglispostamenti di interpiano,che costituiscono un indice di danno particolarmente affidabile.

4. Expected trend by climate change and anthropic activity

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5. Interactions with technological outbreaks

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6. Proposal for enhancement/adaptation of measures

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7. Data Sources

- "Codice della protezione civile", emanato con D. Lgs. n. 1/2018
- "Aggiornamento della classificazione sismica di prima applicazione dei comuni dell' Emilia Romagna", approvata con DGR 1164/2018
- "Prime disposizioni di attuazione dell'Ordinanza PCM 3274/2003 recante *Primi elementi in materia di criteri generali per la classificazione sismica del territorio nazionale e di normative tecniche per le costruzioni in zona sismica*", di cui alla DGR 1435/2003

- Nuove norme tecniche per le costruzioni

LP- Molise Region

1. Current risk scenarios

The Molise Region falls into an area characterized by significant seismicity, which in the past has released earthquakes of high magnitude.

The maximum local intensity, between the 8th and 9th MCS (Mercalli-Cancani-Sieberg), would have been reached in San Giuliano di Puglia on the occasion of the earthquake of 5 December 1456, one of the most important and ruinous of the last thousand years in the South Central Italy.
Other major earthquakes in the Molise area in a time window that extends from the year 217 BC at 2002 it shows how the territory was characterized by a widespread regional seismicity with the presence of earthquakes with surface magnitude (Ms) > 6.0.

The national territory is classified into four risk zones (O.P.C.M. n.3274 / 2003), including in area 4 (the least dangerous) all those territories that had been excluded from any seismic classification.
Each zone is given a value of the seismic action useful for the design, expressed in terms of maximum acceleration on rock. The provision dictates the general principles, according to which the regions, to which the State has delegated the adoption of the seismic classification of the territory, compile the list of municipalities with the relative attribution to one of the 4 zones.

The Molise Region, with the law n.13 /2004 "Seismic reclassification of the regional territory and new seismic legislation", has implemented this provision. All the municipalities of the Region are classified as seismic.

2. Sensory networks

In Italy, the expertise on seismic monitoring is attached to the INGV (National Institute of Geophysics and Vulcanology) and the National Department of Civil Protection.

In Molise Region, Molise does not have sensors for seismic warning.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

The seismic event is not predictable with current technologies.
Therefore, upon the occurrence of an earthquake, there is only one emergency response action, which involves the assessment of damage and assistance to the affected population.
The activation threshold for a detailed study of the seismic phenomenon is set at M> 4.
The evaluation of the intensity and location of the seismic phenomenon is carried out throughout the national territory by INGV.

4. Expected trend by climate change and anthropic activity

In the Molise Region there is no reference document.

5. Interactions with technological outbreaks

Strategic public buildings were briefly monitored with the Readiness European Cooperation (IT-HR) project in order to define behaviour in the event of a seismic event. The results of the monitoring also led to possible proposals for structural improvement of buildings

At the moment the Molise Region is participating in the drafting of a project to be nominated on H2020 (MOSIS) which aims to create a DSS platform to centralize information from conventional sensors (accelerometers, etc.) and unconventional (images from drones, accelerometers on smartphones, etc.) for the assessment of the damage scenario following a seismic event.

6. Proposal for enhancement/adaptation of measures

The studies of Seismic Microzonation allow to divide the territory into zones with different behaviour in the event of an earthquake (local seismic response) with the aim of identifying the local conditions on a sufficiently large scale (municipal or sub-municipal) that can significantly modify the characteristics of the movement expected seismic or can produce significant permanent deformations for buildings and infrastructures.

With the results of the study, emergency planning at the local level can be improved.

The seismic event is not predictable with current technologies, the only actions should be directed towards optimizing emergency management and better dissemination of information in the immediacy of the event.

7. Data Sources

www.protezionecivile.it

www.protezionecivile.molise.it

www.ingv.it

PP6 –Pescara Municipality

1. Current risk scenarios

On the basis of the seismic hazard values elaborated by the INGV, the Municipality of Pescara has planned the sismic hazard at municipal scale through the study of "Microzonazione sismica".

2. Sensory networks

As far as the seismic risk is concerned, there are no physical sensors on the municipal territory.

3. Indicators and parameters for defining emergency severity scales to activate CP prevention, warning and rescue measures

The parameters that define the physical intensity (magnitude) and macroseismic intensity are elaborated and defined by the INGV and the Civil Protection Department.

4. Expected trend by climate change and anthropic activity

Not present.

5. Interactions with technological outbreaks

No activity planned.

6. Proposal for enhancement/adaptation of measures

The municipality of Pescara has started various activities and initiatives for communicating to the population the knowledge of risk scenarios.

7. Data Sources

INGV: mapping of seismic hazard whole the national territory

Abruzzo Regione: seismic risk (Seismic microzonation)