EMERGENCY SERVICES REGULATORY SYSTEMS GREEN PAPER DEVELOPMENT

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Summary

The FIRESPILL overall objective is to enhance the capacity of Emergency Service Organizations to increase cross-border effectiveness in tackling natural and man-made disasters, decreasing the exposure of the populations to the impact of hazards and increasing the safety of the Croatian and Italian Adriatic basin by improving emergency prevention and management measures and instruments. In particular, with this report is developed the project line WP3 that aims at improving the level of uniformity of the current structures, procedures and legislation regarding Italian and Croatian Emergency Services Regulatory Systems (ESRS), as well as enhancing its overall efficiency, according to the EU principle of cooperation and subsidiarity (EU civil protection mechanism).

The main of this work outputs are standardized CBC procedures to tackle risks between Italy and Croatia, as well as improved cross border emergency management system.

The work main outputs will be further exploited through its adoption by relevant authorities, by means of which it becomes permanent guideline and set of rules to be consulted when implementing any future measures and actions aiming at homogenizing different legislations, procedures, platforms through stakeholder involvement in both countries. The knowledge, and experience integrated in the outputs, given the concerned territories and the plurality of addressed issues, have a value that is not limited to project duration since they remain at disposal to Stakeholders, Civil Protection and Coast Guard organizations and Citizens even after the end of the project.

This act aims at developing a series of policy recommendations for a more efficient, harmonized, homogeneous ESRS (legislation, operational rules, platforms and procedures) in both countries, in the form of a Green Paper.

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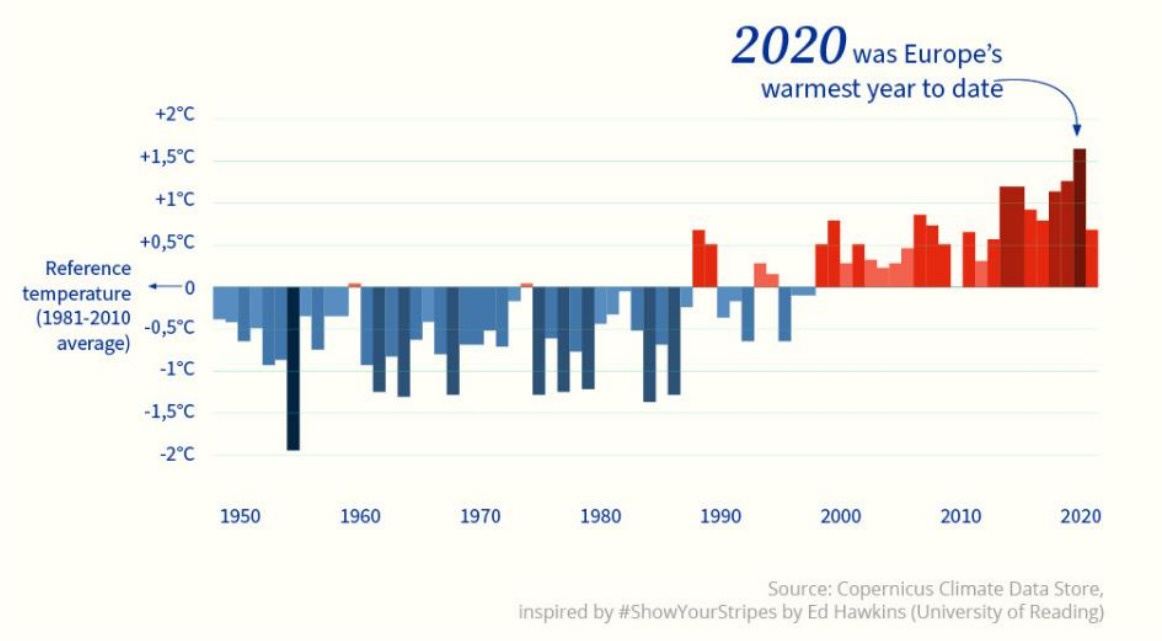
1. Introduction

Civil protection and climate change

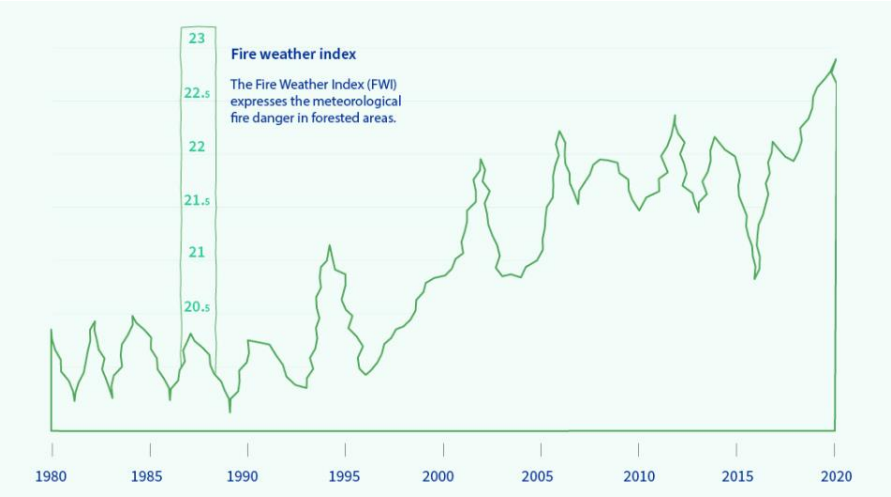
Over the past 40 years, Europe has seen a sharp increase in temperatures. Warmer temperatures have exacerbated extreme weather events across the continent, with dire consequences for large numbers of people and the economy. The average temperature has been 2.2°C higher over the last five years than it was at the end of 19th century. 2020 was Europe's warmest year to date[1].



Im. 1: Temperature trends in the 19th century[2].

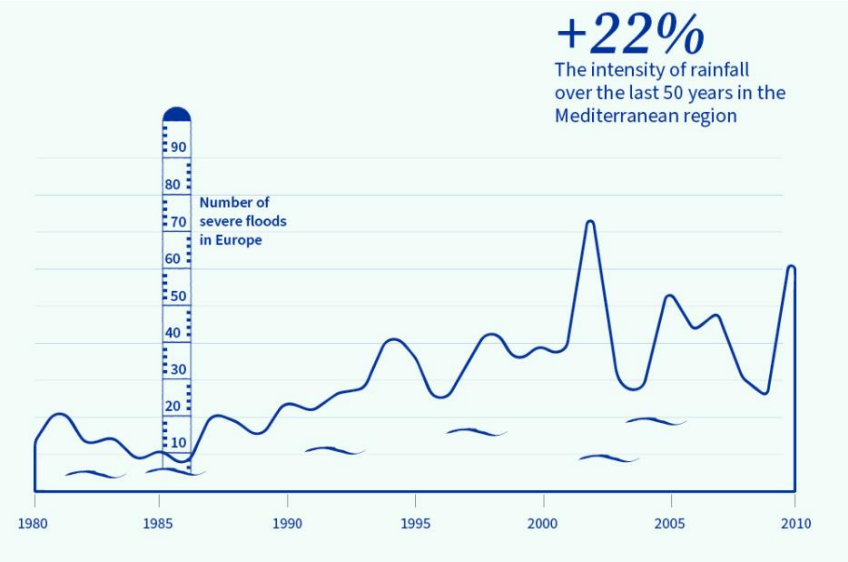
As temperatures rise, the phenomenon of forest fires increases. Since 1980, more than 190 000 km^2 of forests have gone up in smoke in Europe, with the involvement of central and northern Europe, regions that in the past were not typically affected.

[1] Civil protection and climate change in https://www.consilium.europa.eu/it/policies/civil-protection/
[2] Copernicus Climate Data Store.



Im. 2: Fire Weather Index trend in the 19th century[3].

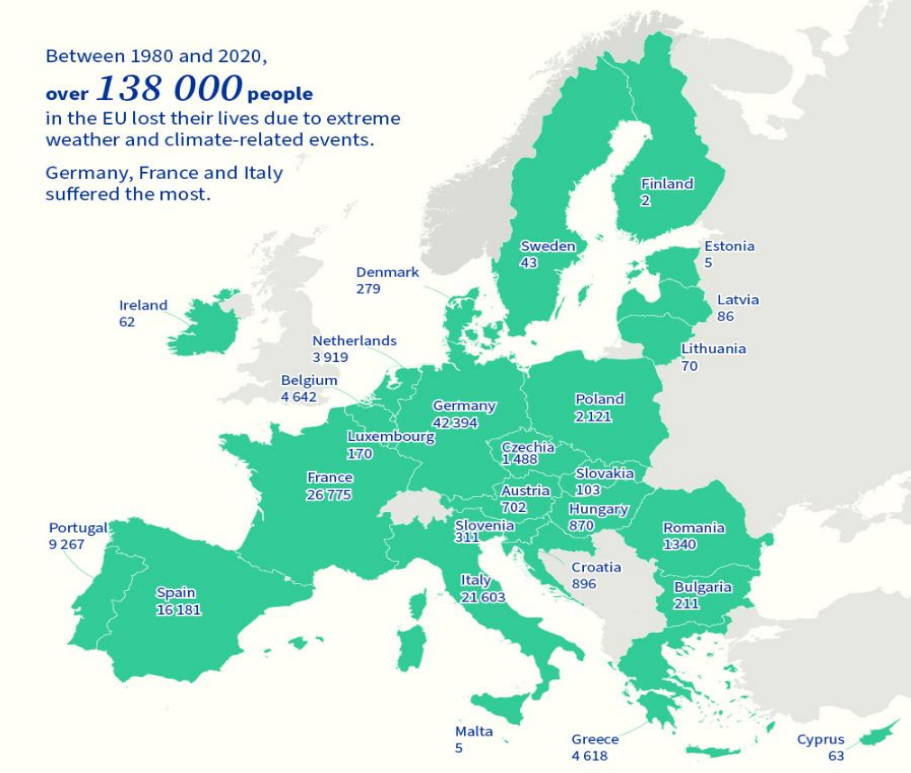
The extreme weather conditions generated by climate change have also caused an increase in the number of severe floods. In the Mediterranean region, in fact, there has been a 22% increase in the intensity of rainfall in the last 50 years.



Im. 3: Number of severe floods in Europe[4].

[3] European Environment Agency.
[4] Ibidem.

Unfortunately, extreme weather conditions are associated with significant losses both in terms of human lives and in economic terms. Between 1980 and 2020, over 138 000 people in the EU lost their lives due to extreme weather and climate-related events. Germany, France, and Italy suffered the most. The financial losses caused by extreme weather and climate-related events exceeded €487 billion in the EU27 over the last 40 years. This is significantly more than what the EU spends over two years on all its policies and programmes. The overall cost was the highest for Germany, Italy and France. Denmark, Austria and Luxemburg had the highest losses per capita[56].



Im. 4: Loss of life due to extreme weather and climate-related events in the EU between 1980 and 2020 [7].

[5] Civil protection and climate change in https://www.consilium.europa.eu/it/policies/civil-protection/
[6] The economic cost of river flooding in Europe exceeds €5 billion a year on average.
Forest fires cause about €2 billion of economic damage every year.
[7] European Environment Agency.

Data on climate change losses are worrying. Extreme weather events are becoming more frequent, intense and persistent. It is therefore essential to adapt civil protection systems to the consequences of climate change in terms of both prevention and preparedness, response and overcoming of the emergency.

To this end, investment should be made in research and innovation, including through the EU Civil Protection Knowledge Network, with the aim of better recognising and anticipating extreme weather risks and enhancing civil protection capabilities. Countries must develop appropriate actions to increase their resilience. Particular attention should be paid to the role of participation of citizens and volunteers in civil protection initiatives such as information, awareness raising, training and exercises.

Organizational framework of the Croatian and Italian Civil Protection System

The Croatian civil protection system

In the Republic of Croatia, civil protection is a system of organising stakeholders, operational forces and citizens in order to protect and rescue people, animals, material and cultural goods and the environment in the event of major accidents and disasters and to remedy the consequences of terrorism and war destruction.

The coordination of the system at the national level is within the competence of the Ministry of the Interior, whose organizational structure includes the Civil Protection Directorate. The Directorate covers the entire territory of Croatia through five regional civil protection offices (Zagreb, Rijeka, Varaždin, Osijek and Split) and 15 civil protection services, which are connected to zonal/regional offices in terms of organization and are located in the county centres, corresponding to a total of 20 separate locations in Croatia, including the 112 county centre.

Through the single European emergency number 112, the Civil Protection Directorate (competent 112 county centre) receives all types of emergency calls, forwards information to the competent services, coordinates their interaction and aggregates feedback on the activities carried out.

By-laws regulating all segments of the civil protection system (planning, prevention, preparedness and response) were adopted pursuant to the Act.

The Act requires the adoption of the following strategic documents:

- disaster risk assessment;
- disaster risk reduction strategy;
- civil protection system development strategy;
- national civil protection action plan.

The civil protection system provides a platform for the involvement of all relevant stakeholders (representatives of emergency services actively participate in the work of the civil protection headquarters). The civil protection system operates at all levels (state, regional and local) in order for all stakeholders and

operational forces to jointly implement measures and activities aimed at protecting the population, property and the environment in the event of emergencies.

Organization on state level

The Croatian Government has adopted decrees on the internal organisation of all state administration authorities. The Ministry of the Interior, the Ministry of Health, the Ministry of the Sea, Transport and Infrastructure and the Croatian Firefighters' Association are particularly important for the emergency services system. Operational and logistical support to the work of emergency services is also provided by other state administration authorities (e.g., the Ministry of Defence through the involvement of the Armed Forces in operational activities, the Ministry of Economy and Sustainable Development through environmental protection and commodity reserves, and other authorities within the scope of this Act and the decrees on the internal organization).

Ministry of the Interior

The Ministry of the Interior carries out administrative and other tasks relating to police and criminal police affairs, namely the protection of life and personal safety of people and property, and other tasks in accordance with the regulations defining police work. The Ministry of the Interior also carries out administrative and professional tasks relating to the establishment of the civil protection system, the rescue of citizens, material and other goods in the event of major accidents and disasters, and other tasks in accordance with the regulations defining the work of civil protection. The Ministry is headed by the minister of the interior, who is also the deputy prime minister of Croatia and the head of the Croatian Civil Protection Headquarters.

In accordance with the Decree on the Internal Organization, the following organizational units have been established at the headquarters of the Ministry of the Interior: cabinet of the minister, general secretariat, independent services/sectors (internal audit; cooperation with the Military Ordinariate of the Republic of Croatia, information security, supervision of personal data protection, information and communication systems), the Forensic Science Centre 'Ivan Vučetić', directorates (European affairs, international relations and European Union funds; human resources; material and financial affairs; immigration, citizenship and administrative affairs), as well as the General Police Directorate and the Civil Protection Directorate.

The Civil Protection Directorate was established by the Decree on the Internal Organization of the Ministry of the Interior, and started its work on 1 January 2019 for the purpose of performing administrative and professional tasks involving the establishment of the civil protection system, the rescue of citizens, providing for material and other goods in the event of major accidents and disasters; organizing stakeholders, operational forces and citizens in order to protect and rescue people, animals, material and cultural goods and the environment in the event of major accidents and disasters and to remedy the consequences of terrorism and war destruction; training and upskilling of protection and rescue stakeholders; carrying out civil protection tasks, measures and activities; managing the alert and notification system and conducting international cooperation in the field of civil protection; carrying out inspection tasks in the fields of civil protection, fire protection, production and trade of explosive substances and weapons, private protection and detective work, mine action; radiological and nuclear safety, tasks relating to the 112 system and tasks relating to demining and explosive atmospheres.

The objectives of the Civil Protection Directorate are to establish new capacities of the civil protection system through:

- consolidation of civil protection systems;
- uniform preparation, planning, procedures, equipping and training;
- establishing a system of clear powers and competence;
- uniform coordination of civil protection system operation;
- efficiency and rationalization of resource use;
- shortening response time;
- efficient preparedness supervision.

The following organisational units have been established at the Civil Protection Directorate:

- Civil Protection Directorate Office;
- Civil Protection Operations Centre;
- National Civil Protection Training Centre;
- Inspection Affairs Sector;
- Disaster Risk Reduction Sector;

- Radiological And Nuclear Safety Sector;
- Preparedness And Coordination Sector;
- 112 Sector;
- State Emergency Response Unit;
- Explosive Atmospheres Sector;
- Croatian Mine Action Centre.

The regional civil protection offices in Zagreb, Split, Rijeka, Osijek and Varaždin have been established as internal organisational units, outside the headquarters, to perform tasks within the scope of activities of the Civil Protection Directorate for the counties and the City of Zagreb. In order to perform tasks within the scope of activities of the Regional Civil Protection Office, the prevention and preparedness service, the 112 county centre, the inspection affairs service and the civil protection service have been established at county headquarters.

Croatian Firefighters' Association

The Croatian Firefighters' Association (CFA) performs administrative and professional tasks related to firefighting; conducts training of fire brigade members; provides technical assistance in the event of incidents and dangerous situations; performs inspection tasks in the field of firefighting and other tasks related to firefighting.

Among other things, the Croatian Firefighters' Association carries out the following activities:

- drafts the proposal of the national firefighting development strategy;
- models the Croatian firefighting system;
- encourages action to improve fire protection and the implementation of firefighting activities;
- develops a programme of activities in the implementation of special fire protection measures of interest to Croatia and refers it to the adoption procedure;
- coordinates activities relating to the inclusion of fire brigades in the civil protection system;
- organises the 193 state firefighting operations centre;
- organises firefighting activities;

- provides a central information and communication system;
- develops procurement plans for firefighting equipment and technology.

The central office of the Croatian Firefighters' Association in Zagreb consists of the following organisational units:

- Cabinet of the chief fire commander;
- The 193 state firefighting operations centre;
- General secretariat;
- Programme, Security and Support Sector;
- Firefighting Sector;
- Inspection Sector;
- Independent internal audit service.

The Croatian Firefighters' Association is the central state office competent for firefighting, headed by the chief fire commander. The chief fire commander is responsible to the Croatian Government for the legality of the work of the Croatian Firefighters' Association and for the equipment, organisation, training and response preparedness of fire organisations, fire brigades and firefighters in Croatia.
Of particular importance for the emergency services system, in addition to Croatian Firefighters' Association, are the Croatian Mountain Rescue Service and the Croatian Red Cross, which base their work on the Act on Associations, but also on separate acts and international obligations and guidelines.

Croatian Mountain Rescue Service

The Croatian Mountain Rescue Service (CMRS) is a national, vertically organised, voluntary, professional, humanitarian and non-partisan association of public importance whose main objectives are prevention of accidents, rescue training, rescue and provision of medical first aid in mountains and in other inaccessible areas and in emergencies requiring special expertise in rescuing and providing assistance and the use of technical mountain rescue equipment in order to preserve human lives, health and property. The CMRS is a non-profit association that performs activities of interest to Croatia.

Croatian Red Cross

The Croatian Red Cross (CRC) is a non-profit legal person and the national Red Cross society, which is active only in the territory of Croatia, is guided by the basic principles of the Red Cross and acts impartially and without discrimination. It is the largest humanitarian organisation in Croatia.

The activities of the Croatian Red Cross are aimed at helping all vulnerable social groups and at the continuous training of employees and volunteers. They include activities in the fields of first aid, voluntary blood donation, health protection and promotion, social welfare, crisis preparedness and response, water rescue and environmental protection of coastal areas, protection of migrants, search services, youth and volunteer services. The Croatian Red Cross programmes in local communities are aimed at helping all vulnerable groups in society and improving lives. The Croatian Red Cross is a fundamental operational force of the civil protection system for emergency response. The operational forces of the Croatian Red Cross consist of employees and volunteers of Red Cross societies organised into crisis headquarters, emergency response teams and support teams at the local, county and national levels.

Croatian Disaster risk assessment

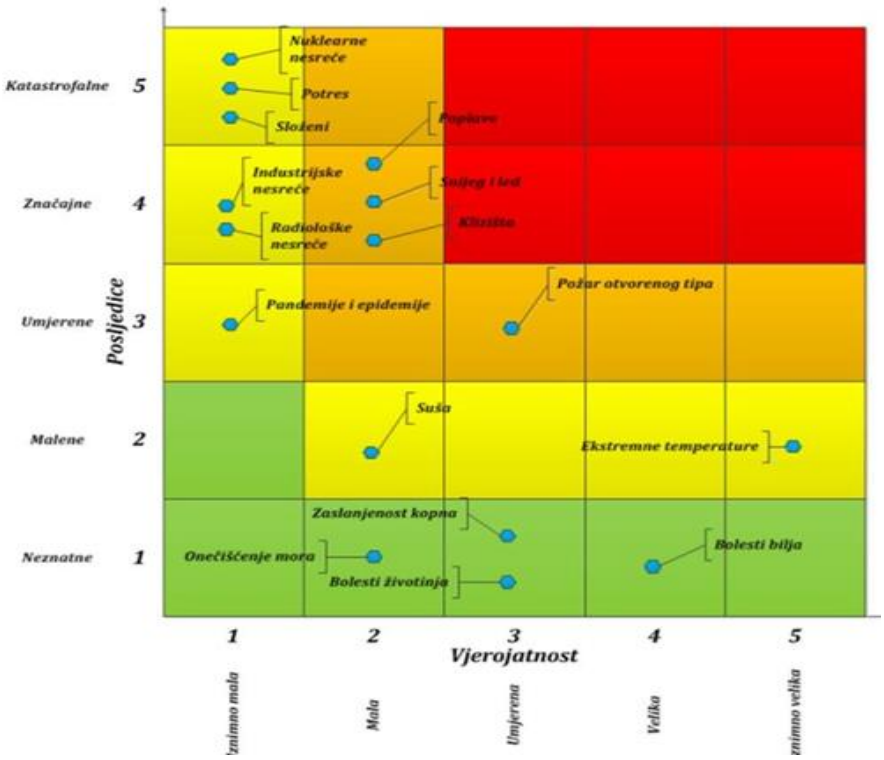
Pursuant to the Civil Protection System Act, in November 2019 the Croatian Government adopted the Disaster Risk Assessment for the Republic of Croatia.

In accordance with the Civil Protection System Act, major accident risk assessments in Croatia are drafted at the regional (counties and the City of Zagreb) and local level (cities, towns and municipalities) of the system. According to the national assessment, major accidents and disasters emerge from a wide range of natural phenomena and from technical and technological processes, posing a significant social and economic burden for Croatia.

The adoption of this risk assessment at a national level continues the process of changing the paradigm of the civil protection system by gradually shifting the focus of activities from the development of response capacities to strengthening risk management/reduction capacities (reducing the vulnerability of all categories of social values exposed to the adverse effects of threats).

When analysing each scenario, the assessment also considered the impacts of climate change on a particular risk. Given that the European Commission's guidelines highlighted these impacts as an important part of the risk assessment, a special task force was established to draft and analyse texts relating to climate change impacts on risks, gathering representatives of the Ministry of Environmental Protection and Energy, 3 the Croatian Meteorological and Hydrological Service and the Ministry of the Interior.

The assessment has identified and analysed a total of 15 risks (plus one complex risk: earthquake and flood in the City of Zagreb), providing an overview of the impact of climate change on 10 of them.



Im. 5: Risk matrix (events with worst possible consequences).

The Disaster Risk Assessment for the Republic of Croatia divides risks into three categories:

1. unacceptable risks: floods caused by overflow of inland water bodies, earthquakes and wildfires;
2. tolerable risks: landslides, extreme temperatures, epidemics and pandemics, snow and ice, nuclear accidents, radiation accidents, industrial accidents, drought and marine pollution;
3. acceptable risks: plant diseases, animal diseases and soil salinisation.

Unacceptable risks need to be reduced as soon as possible at the national level and using national and European Union funds. The assessment has defined investment priorities, primarily in scenario-specific areas and across the entire territory of Croatia. This is a strategic orientation for equipping and training emergency services in Croatia.

Of the 10 risks addressed in the Disaster Risk Assessment for the Republic of Croatia, for which the impact of climate change is presented, two have been identified as unacceptable risks (floods caused by overflow of inland water bodies, earthquakes, and wildfires), five as tolerable risks (landslides, extreme temperatures, epidemics and pandemics, snow and ice, drought) and three as acceptable risks (plant diseases, animal diseases and soil salinisation).

According to the above, climate change has a significant impact on the risks affecting human life and health, the economy and social stability and policies in Croatia.

The risk assessment does not include the risk of transport accidents (in road, rail, air and maritime transport), which is largely an important segment of emergency management by emergency services, especially those on the coast, and especially during the summer season.

Climate change trends in relation to emergencies in Croatia

According to the 'Climate change, impacts and vulnerability in Europe 2016' report, the observed climate change already has far-reaching consequences for ecosystems, the economy, human health and the well-being of Europe's citizens. The report states that all European regions are vulnerable to climate change, but some of them will be affected more than others. Southern and south-eastern Europe are projected to be climate change hotspots, as the most harmful effects are expected in these areas.

The situation in Croatia should also be considered in this context, and strategic documents should set climate change adaptation goals and activities and identify risks that may lead to emergencies.

On 7 April 2020, the Croatian Parliament adopted the Climate Change Adaptation Strategy in the Republic of Croatia until 2040, with an outlook to 2070 (hereinafter: the Strategy). This is the first national Adaptation Strategy to address the sectors most exposed and vulnerable to climate change, according to current knowledge.

The Strategy states that climate change adaptation requires the attention and involvement of all stakeholders, the economy and decision-makers at the national, regional and local levels of government. The measures need to be tailored to the estimated needs, implementation possibilities and available capacities.

The Strategy outlines the impacts and challenges of climate change adaptation in the field of disaster risk management:

- wildfires due to extended periods of high solar irradiance and extended periods of high air temperature;
- epidemics and pandemics due to the impact of changes in precipitation volume, humidity and evaporation on the mode of transmission of diseases or on the properties of disease agents;
- increased health and socio-economic burden on the community due to food contamination and environmental pollution following occurrences such as floods or landslides.

The Strategy also outlines possible responses to reduce high vulnerability as part of disaster risk management:

- strengthening the competencies of key stakeholders in climate change- related risk management;
- enhancing the capacities for management and recovery following major accidents and disasters relating to climate change;
- setting out multidisciplinary priority guidelines for climate change-related procedures;
- extending the monitoring and risk assessment system using the tools for monitoring climate change risk indicators;
- more efficient remediation of damage resulting from major accidents and disasters relating to climate change;
- modifying the burden borne by the community following exposure to climate change-related threats.

The Strategy defines disaster risk management as undertaking preventive and planning activities to reduce vulnerability and mitigate the adverse effects of disaster risks. Climate change can increase the likelihood and intensity of a disaster. The major expected impacts leading to a high or medium vulnerability in this sector are landslides, floods, wildfires due to extended periods of high solar irradiance and extended periods of high air temperature, extreme temperatures due to extended periods of high solar irradiance and extended periods of high air temperature, pandemics due to the impact of changes in precipitation volume, humidity and evaporation on the mode of transmission of diseases or on the properties of disease agents, as well as complex risks, especially in urban areas.

The above shows that Croatia is strategically focused on climate change adaptation and all emergency services should adapt their operation at all management stages (planning, prevention, preparedness, response and recovery) in order to contribute to the implementation of the Strategy and climate change adaptation, in particular to reduce the disaster risks presented in the risk assessment, but also to increase the operational capacity for rapid and efficient emergency response and recovery.

Croatia is currently harmonising the Disaster Risk Management Strategy until 2030, which aims to enhance a proactive approach to risk management, with the ultimate goal of achieving comprehensive, sustainable and, in the long-term, justified disaster risk management.

Particular account should be taken of so-called HILP emergencies caused by climate change (e.g., large volumes of precipitation in a small area – for example, the floods in Zadar in September 2017). These emergencies are characterised by low probability of occurrence, unacceptable effects, and rapid occurrence, while the remediation of their effects requires the involvement of local and regional emergency services, and possibly the involvement of state-level operational forces. The above shows that, due to the threats and risks Croatia is exposed to, there is an imperative to improve the management processes (planning, prevention, preparedness, response and recovery). They are the basis for developing a legislative framework and operational plans for the timely and efficient emergency service operation.

The Italian civil protection system

Italy is among the most exposed countries to natural risks and related human activities. This requires a system that ensures in each area the resources capable of intervening quickly and in a coordinated manner in case of emergency, but also of operating to prevent and, as far as possible, to foresee any disaster.

For this reason, in Italy, civil protection is not a task assigned to a single body, but a function attributed to an integrated system, made up of public and private, central and territorial structures: The National Service, established in 1992 with Law no. 225 and reformed in 2018 by the Civil Protection Code.

Within the system, the skills in the activities of forecasting, prevention, rescue and overcoming of emergency situations are entrusted to several bodies and operational structures as the complexity of the national risk landscape requires the coordinated use of all the professionals and resources available.

The components of the National Service are identified in Article 4 of the Civil Protection Code (Legislative Decree No. 1 of 2 January 2018):

- State administrations
- Regions
- Autonomous Provinces
- Local societies

In Article 13 of the aforementioned decree, however, the following are identified as operational structures of the National Service:

- The scientific community, it contributes to the National Civil Protection Service with a function of technical and scientific support, through monitoring, forecasting and prevention of the different risk hypotheses on the national territory, development projects and technological innovation of monitoring networks and studies and research. The activities are regulated through agreements with individual research institutes, in particular with the National Institute of Geophysics and Volcanology (INGV), the National Research Council (CNR) and the Agency for New Technologies, Energy and the Environment. (ENEA).

  The INGV deals with seismic and volcanic surveillance throughout the national territory, through technologically advanced monitoring networks distributed over the territory (National Seismic Network), or concentrated around volcanoes.

The CNR deals with developing knowledge, methodologies and technologies for national monitoring, forecasting and surveillance systems, in close collaboration with the Functional Centers of Civil Protection, which constitute the network of operational centers for the national alert system.
The ENEA deals mainly with the evaluation and prevention of seismic risk in the national territory, the monitoring of earthquakes, the analysis of the seismic hazard of selected sites and the development of modern anti-seismic technologies for civil, industrial and cultural structures and infrastructures.

- The National Fire Brigade intervenes in the protection of human life, in the protection of goods and the environment from damage or danger of damage caused by fires, accidental situations and industrial risks, including those arising from the use of nuclear energy. In case of calamitous events, the Corps can be immediately activated as an operational structure of the National Civil Protection System and ensures immediate and urgent technical interventions according to its competences and in compliance with the levels of coordination provided for by the current Civil Protection legislation. To best deal with disasters, firefighters operate through the regional mobile rescue columns, made up of men and vehicles employed. The National Fire Brigade, in addition to ensuring urgent technical assistance in the territory, provides information on the consequences of the event and determines an initial estimate of the victims, the injured and people in need of assistance. Furthermore, the Fire Brigades provide support with their mobile operational centers available, activate their staff to check and control the viability of the buildings intended to host the operational and coordination centers of the rescue system, provide operational and logistical support for the emergency housing assistance of the populations and intervene to secure structures, infrastructures and cultural heritage. In the event of forest fires, firefighters provide the Regions resources and staff for active fighting interventions and promote the study and testing of measures and regulations to avoid fires or limit their consequences.
- The Armed Forces participate in the National Civil Protection Service and contribute to the protection of the national community in case of damage or danger of serious damage to the safety of people and property. In case of emergency or critical events, the Italian Army, navy and air force provide logistical and operational support, qualified personnel, tools and means. The help of the

Armed Forces is ensured through the operational units located throughout the national territory, which is divided into areas of responsibility (military regions) and intervention zones (the military commands of the area). The relatio with the National Civil Protection Service is ensured by the Defense Staff at national level and by the Command of the Military Region at regional level.

- The Police Forces (State Police, Carabinieri, Finance Police, Coast Guard, Penitentiary Police, Local Police), are involved in civil protection interventions regarding safety and safety of people, each force according to its own logistical, instrumental and personnel possibilities.
- The organized civil protection volunteering registered in the national list of civil protection volunteering was born under the pressure of the great emergencies that have affected Italy in the last 60 years: above all, the flood of Florence in 1966 and the earthquakes in Friuli and Irpinia. A large spontaneous mobilization of citizens made it clear that it was not the solidarity of people that was lacking, but an organised public system that knew how to use and enhance it. Since then, civil protection volunteering has combined religious and secular pressures and guarantees the right to be rescued with professionalism. Today, it represents an extraordinary resource in terms of skills and operational capacity that has over 5,000 organizations throughout the country. To support this reality, a detailed regulatory model has been built to provide legal protections, training courses and to improve the ability to intervene. Legislative Decree No. 1 of 2018, Code of Civil Protection, includes organized civil protection volunteering registered in the national list of civil protection volunteering among the operational structures of the National Service. In particular, to verify and test the organizational models of emergency intervention, the Department and the Regions promote exercises that simulate risk situations in which voluntary organizations are involved. Civil protection volunteering is divided into national and local organizations throughout the national territory and is represented by the new National Committee, provided for in art. 42 of the Civil Protection Code.
- The Italian Red Cross (CRI) founded on June 15, 1864, is the National Society operating in Italy and related to the International Movement of Red Cross and Red Crescent. Auxiliary to the Public Authorities and Operational Structure of the National Civil Protection System, it aims at preventing

and alleviate human suffering impartially, regardless of nationality, race, sex, religious and political beliefs.

- The National Health Service - NHS is the set of functions and welfare activities that regional health services, the State, national institutions and institutions perform to ensure health protection. Health is in fact a fundamental right of the individual and an interest of the community, respecting the dignity and freedom of the human person (Article 1 of Legislative Decree No 502 of 30 December 1992). The Health Reform (Law No. 833 of 23 December 1978) introduced the term. The National Health Service is not a single administration, but is a public system composed of: Ministry of Health, national bodies and institutions (Higher Health Council, Higher Institute of Health, Higher Institute for Prevention and Safety at Work, Agency for Regional Health Services, Institutes of Hospitalization and Care of a Scientific Nature, Experimental Zoo-prophylactic Institutes, Italian Medicines Agency) and regional health services (which include regions and autonomous provinces, local health companies and hospital companies).
- The National Alpine and Speleological Rescue Corps - Cnsas is the central technical body of the Italian Alpine Club - Cai, which works for the protection of human life, deals with the rescue of the injured in the mountain territory, in the caves and in the impervious areas of the national territory and is engaged in the prevention and surveillance of accidents (Law of 21 March 2001, n. 74).

Art. 13 of the Code identifies the subjects that contribute to civil protection activities: professional orders and colleges (with their respective national councils), bodies, institutes, national agencies, companies, companies and other public or private organizations that perform civil protection functions.

Collegial bodies

During the construction process of the National Service, the need gradually emerged to create a connection between forecasting and risk prevention on the one hand and management of emergencies on the other. For this reason, as early as 1982, a technical-scientific Commission was established to give an authoritative opinion on scientific questions and to orient research towards risk prevention. With Law n. 225 of 1992, the Commission was configured as the link between the National Service and the scientific community. Since 2006, the National Commission for the Prediction and Prevention of Major Risks is an independent structure

from the Department of Civil Protection, as it is chaired and composed of qualified experts in civil protection matters (Article 20 of Legislative Decree 1/2018).

The body that ensures the unitary management and coordination of emergency activities is the Operational Committee (Article 14 of Legislative Decree 1/2018). It is chaired by the Head of Department and it is made up of representatives of Components and Operational Structures of the Civil Protection System. It aims at evaluating news, data and requests from the areas involved in the emergency, it defines intervention strategies and coordinates interventions of all administrations and bodies involved in rescue operations.

Department of National Civil Protection

The Department of Civil Protection is a structure of the Presidency of the Council of Ministers that carries out tasks of guidance, promotion and coordination of the entire National Civil Protection Service.

In close liaison with the Regions and Autonomous Provinces, it develops and coordinates National Plans for risk scenarios and tests their effectiveness through exercises, coordinates the Service's intervention when emergencies of national importance occur, promotes activities aimed at risk forecasting and prevention, defines general criteria for the identification of seismic zones, and develops general guidelines for civil protection training activities.

The Department also coordinates the National Service's participation in European Union civil protection policies and intervention in emergencies abroad.

Civil Protection Authorities

Part of the National Service are the civil protection authorities which, according to the principle of subsidiarity, differentiation and adequacy, guarantee the unity of the system by exercising, in relation to their respective spheres of government, the functions of policy-making in the field of civil protection and which are:

a. the President of the Council of Ministers, in his capacity as the national civil protection authority and holder of policies on the subject;
b. the Presidents of the Regions and Autonomous Provinces of Trento and Bolzano, in their capacity as territorial authorities of civil protection and on the basis of the legislative power attributed, limited to the articulations belonging to or dependent on their respective administrations;

c. mayors and metropolitan mayors, in their capacity as territorial civil protection authorities limited to the articulations belonging to or dependent on their respective administrations.

The President of the Council of Ministers, for the achievement of the purposes of the National Service, holds the powers of order in matters of civil protection, which he may exercise, unless otherwise determined by deliberation through the Head of the Department of Civil Protection, and determines civil protection policies for the promotion and coordination of the activities of state administrations, central and peripheral, regions, metropolitan cities, provinces, municipalities, national and territorial public bodies and any other public or private institutions and organizations in the national territory.

Activity of the National Service

Rescue of people in emergency is the activity that identifies the main function of civil protection, although over the years the competences of the System have extended to the development of knowledge of risks and actions to avoid or minimize the damage caused by disasters.
Law no. 225 of 1992 - establishing the National Service - defines civil protection activities: forecasting and prevention of risks, aid to the affected populations, contrasting and overcoming the emergency, and risk mitigation.

- Forecast: its objective is to identify risk scenarios and, when possible, to foretell, monitor supervise events and expected risk levels in real time;
- Prevention: aims at avoiding, or minimizing damage in the event of a disaster. Warning, emergency planning, training, dissemination of knowledge of civil protection, information to the population and application of technical regulations are tools for prevention;
- Relief: consists of first aid interventions for populations struck by disasters.
- Overcoming the emergency: set of initiatives necessary to remove obstacles for the resumption of normal living and working conditions of communities affected by the disaster.

In ordinary

The components and operational structures of the National Service are employed, according to competence and responsibility, in forecasting activities and planning of risk prevention and mitigation actions.

Central to this process is the involvement of the technical-scientific community, through the Network of Functional Centers - which carry out daily, at central and regional level, forecasting, monitoring, surveillance and alerting activities - and of Competence Centers, structures that carry out research and provide technical-scientific services for civil protection purposes. Municipalities, Provinces and Prefectures are also dedicated to updating emergency plans, essential for prevention, on the basis of regional and national guidelines. Even the individual citizen, as a member of the National Service, has a leading role in risk prevention activities. The objective of the ordinary activities of disseminating knowledge of civil protection and raising awareness of the population is precisely to train a more aware and prepared citizen.

Network of functional centres

The network of functional centers consists of the central functional center, at the Department of Civil Protection, and the decentralized functional centers in the regions and autonomous provinces. Each functional center carries out real-time forecasting, monitoring and surveillance of meteorological phenomena with the consequent assessment of the expected effects on people and things in a given territory, contributing, together with the Civil Protection Department and the Regions, to the management of the national alert.

The activity of the network of functional centers. Each functional center has the task of collecting and sharing with the entire network of Centers a series of data and information from different technological platforms and a dense network of sensors located throughout the country. In particular:

- Data collected by the meteorological-hydro-pluviometric networks, the national meteorological radar network and the various satellite platforms available for earth observation;
- Territorial hydrological, geological, geomorphological data and those deriving from the landslide monitoring system;
- Meteorological, hydrological, hydrogeological and hydraulic modeling.

Based on these data and modeling, the functional centers develop the probabilistic expected scenarios, also through the use of forecasting models of the effects on the territory. Based on these assessments, the functional centers issue bulletins and notices which report both the evolution of the phenomena and the levels of criticality expected in the area.

The Central Functional Center. The central functional center is located at the operational headquarters of the Civil Protection Department, and it is through it that the Department, together with the Regions, guarantees the coordination of the national alert system. Furthermore, consistently with the principle of subsidiarity, in cases where the decentralized functional centers are not active or are temporarily inoperative, the central functional center carries out all the operational tasks assigned to them.

Competence Centers

The Competence Centers provide services, information, data, processing and technical-scientific contributions in specific areas. They can coincide with the functional centers or be external, but participate in the network of functional centers through the stipulation of agreements that identify the areas of activity of each structure. The centers of expertise that collaborate with the network of functional centers include state administrations, agencies, research institutes, universities and basin authorities.

The subjects that can be identified as Centers of Competence are:

a. Operational structures and public entities appointed to carry out activities, services, studies and research in disciplinary areas of specific or exclusive competence, including territorial, attributed by laws, legislative and regulatory provisions, for the pursuit of institutional purposes;
b. Subjects participated by members of the National Civil Protection Service, established with the aim of promoting technological development and higher education. They carry out their activity primarily for the National Civil Protection Service and they are both subject to supervision of the Department of Civil Protection;
c. Universities, university departments, research centers that have exclusive technical scientific knowledge or proprietary rights in the use of intellectual rights, intellectual property and scientific research;
d. Universities, University Departments, Research Centers, on which the National Commission for the Forecasting and Prevention of Major Risks expresses its opinion of technical-scientific merit, based on a comparative assessment following specific needs formulated by the Department of Civil Protection for the various types of risk that the subjects referred to in the letters cannot face a), b) and c).

In emergency

The management of emergencies, as required by article 2 of legislative decree n. 1 of 2 January 2018 "Civil Protection Code", consists of a set of measures and interventions aimed at ensuring rescue and assistance to people and animals affected by disasters, reduction of the impact of the event and information activities to the population.

Emergency civil protection events related to natural disasters or human activity are divided into events that:

A. can be faced with interventions in the ordinary way by the individual bodies and competent administrations;
B. by nature, or extent, involve the coordinated intervention of several entities or administrations and must be faced with extraordinary means and powers;
C. in terms of intensity and extent have national importance and must be faced with extraordinary means and powers.

When an event hits a territory, the Mayor - the only civil protection authority within the National Service - has the task of ensuring first aid to the population, coordinating the local operational structures on the basis of the municipal emergency plan (type event "A"). If the means and resources available to the Municipality are not sufficient to deal with the emergency, the Province, the Prefecture (Territorial Office of the Government) and the Region intervene, activating the resources available in the territories under their jurisdiction (type event "B").

In the most serious situations, at the request of the regional government, the national level takes over, with the declaration of a state of emergency (type event "C"): the coordination of interventions is assumed directly by the President of the Council of Ministers, who operates through the Department of Civil Protection. It is in these cases that the National Service is engaged in all its components and operational structures.

Command and control chain

The regional model defines the roles and responsibilities of the various actors involved, with the related exchange of information and communications, and identifies the structures suitable for operational coordination.

At the various territorial and functional levels, the coordination follows the principles of the "Augustus Method", which consists of simple and flexible emergency management and allows representatives of each "operational function" to interact with each other at the so-called "decision tables" and in the Operating Rooms at various levels (COC, COM, CCS, COR, DI.COMA.C.), thus starting collaborative decision-making processes in real time.

- **Municipal level**. The first response of the civil protection system must be guaranteed by the local structure through the activation of Municipal Territorial Presidium (PT). This structure is responsible for the supervision of the territory, in order to guarantee inspection and monitoring of any current critical issues, in particular on those areas most exposed to the risk.

  It must be activated by the Municipal Civil Protection Manager in order to carry out an initial evaluation of the current event. If the intervention is not manageable by this structure, the COC (Municipal Operations Center) must be activated directly.

  The COC (Municipal Operations Center) is chaired by the Mayor, the highest civil protection authority at municipal level, or by one of its delegates, where the different components operating in the social context are represented.
- **Provincial level**. At this level they are activated the CCS (Rescue Coordination Center), at the Prefectures of the Provinces. Convened and chaired by the Prefect, or his delegate, by the Deputy Prefect, it is composed of the highest managers of all the operational components and structures present in the provincial territory, both civil and military, police forces, fire fighters, voluntary organizations and essential services related to civil protection, according to the institutional competences established by law. These authorities, while continuing to carry out their respective ordinary functions, act in the emergency under the coordination of the Prefect. The CCS therefore has the important task of identifying the strategies and operations of intervention to overcome the emergency and to connect with the local authorities of the affected areas. Depending on the severity of the emergency, the Prefect constitutes and coordinates the Mixed Operational Centers (COM) which are the direct outpost of the CCS in the affected area.

  The Mixed Operations Centers (COM) are the first emergency line in the event of a calamitous event. Each COM is the responsibility of a manager (usually an official of the Prefecture or the Department

of Civil Protection, or a Mayor of one of the municipalities concerned), appointed by the Prefect or the Head of the Department of Civil Protection. Representatives of municipalities and operational structures (Urban Fire Brigades, Fire Brigades, Volunteering, Municipal Police Forces) participate to this center. The tasks of the COM are to promote the coordination of the emergency services organized by the Prefect with the interventions of the Mayors belonging to the COM itself. Generally, the territorial composition of these emergency bodies is linked to various factors such as: population density, land size, geographical, orographic, hydrographic configuration. In view of these aspects, a COM may be composed of one or more municipalities. The location of the COM is usually barycentric compared to the relevant municipalities and is located in anti-seismic structures, not vulnerable to any type of risk.

- **Regional level**. At this level, on the other hand, we find the COR (Regional Operations Center), whose superior authority is the President of the Region. A strong point of the regional civil protection system, emergency management is based on the integration, coordination, sharing of knowledge and intervention procedures at the various institutional levels.

- **National level**. Finally, at this level, DI.COMA.C. (Command and Control Directorate), a mobile central structure activated only following major events and representing the decision-making level located throughout the territory that provides local coordination support directly in the area affected by the event. It has tasks and functions carried out by the various representatives of the institutions, both at central and local level, and of the world of volunteering which operates under the coordination of the National Department of Civil Protection.

The information, therefore, if previously known, allows all the components and operational structures, which intervene in the management of the emergency, to mobilize and deploy in a few hours (the first hours) men and vehicles in the areas affected by an event.

Classification of events and possibilities for international intervention

In the Italian legal system, the division of responsibilities for civil protection is determined on the basis of the nature of the event to be dealt with and the ability of the agencies involved to cope with it. The classification of disaster events is also reflected in international assistance. Specifically, the possibility of resorting to foreign

aid to cope with "natural or man-made events that can be dealt with through interventions that can be implemented by the individual entities and administrations responsible in the ordinary way" (type A events) is excluded. Conversely, it is possible to request international aid to respond to natural or man-made disasters that by reason of their intensity and extent must, with immediacy of intervention, be dealt with by extraordinary means and powers (type C events).

Where the event by its nature and extent cannot be coped with by the means available to the individual municipality, but extraordinary interventions are not indispensable (type B events), the Department of National Civil Protection considers that international assistance is not possible.

The state of emergency as a facilitator of international assistance

Recourse to international intervention to deal with calamitous events, in Italy, normally follow a declaration of a state of emergency. Where a disaster takes on the characteristics of a "type b" event, the activation of regional components useful for civil protection interventions may take place through a specific act, in the regions where it is envisaged, called a state of "crisis," "emergency" or "calamity" decree. This act may be adopted by regions according to regional rules, and may have partially different effects in different contexts. It delimits the duration and territorial extent of the crisis, and may allow a centralization of power over civil protection structures (in the head of the President of the Regional Council or his delegate). The state of crisis (or emergency or calamity) decree may also authorize the adoption of reasoned ordinances derogating from existing regional laws and regulations.

Where the calamitous event is such that it must be dealt with by extraordinary means ("type c" event), the Council of Ministers, at the proposal of the Prime Minister and having acquired the agreement of the region concerned, may resolve the national state of emergency, from which derives the possibility for the head of the DPC and the prefects to adopt ordinances in derogation of any existing provisions. Such ordinances must, however, comply with the general principles of the Italian legal system, as well as with EU and international standards directly applicable in Italy, and with the limits indicated in the decree declaring the state of emergency, including time limits.

In conclusion, for "type B" events, the conduct of international civil protection actions should generally be considered subordinate to the declaration of the state of crisis (or emergency or calamity) - where provided

for - having to comply with the guidelines and procedures indicated therein. International assistance in the case of "type c" events is necessarily subordinate to the adoption of a resolution on the state of emergency, which may allow the adoption of emergency ordinances.

The international early warning

Italian domestic law does not generally provide for early warning obligations to international actors, nor does it regulate the activation procedure. This gap is partially filled by some international agreements, which oblige Italy to alert states and international organizations in case of particular disasters. This is the case, first and foremost, with nuclear accidents. If such disasters occur, Italy is also required to inform the European Commission. In the case of disasters that result in pollution of the sea, Italy must alert the Mediterranean states under Article 9(2) of the Convention for the Protection of the Mediterranean (1976, amended 1995) and Article 8 of its Third Protocol. Additional early warning obligations relate to disasters related to the movement of hazardous wastes, as provided for in Article 13(3)(f) of the Basel Convention (1989). Finally, Italy must alert World Health Organization about any event occurring on its territory that may constitute a public health emergency of international concern. In cases not covered by the above instruments, Italy is not required to contact non-EU states, but on certain occasions it is obliged to alert other members of the Union. In fact, Article 14 of Decision 2013/1313 stipulates that EU member states must promptly inform each other in the event of an impending or occurred disaster with cross-border effects. The state affected, or potentially affected, by a major disaster must also inform the European Commission, especially where it is planned to activate the cooperation provided for in the Mechanism, so as to facilitate the Commission's own coordination activities.

The request for international assistance

It is unclear whether general international law requires states affected by disasters to seek international assistance. Italian domestic law, moreover, does not regulate the request for assistance in detail.
The absence of a precise discipline inherent in requesting and accepting international assistance means that the distribution of competencies and powers in this area is not entirely clear. The problem arises only relatively with reference to requesting aid to other international actors, i.e., EU member states, third states and international organizations.

The problem arises only relatively with reference to the request for aid to other international actors, i.e., EU member states, third states and international organizations.

In the case of "type c" events, it is clear that international assistance can only be requested, and possibly accepted, at the state level. Since the entire civil protection activity is subject to centralized government coordination and the Department of Civil Protection (DPC), it cannot be the case that territorial entities interfere with this coordination by requesting the intervention of foreign entities. Even in the case of "type b" events, the request for intervention must be verified at the state level, since Article 117 of the Constitution grants the state exclusive competence in foreign policy and international relations.

The request for international assistance and its eventual acceptance is evaluated by the Civil Protection Operational Committee. The DPC must then transmit the Italian position, as defined by the Operational Committee, to the foreign state or international organization (bilaterally) or to another EU state (through the EU Civil Protection Mechanism). Activation of the Mechanism by the Department is done through the Common Communication and Information System, CECIS, which ensures communication and exchange of information between the Emergency Response Coordination Centre and member states' contact points.

EU Civil Protection Mechanism

The most important international cooperation mechanisms in which the two countries participate are provided for in EU law. In particular, the Treaty on the Functioning of the European Union expressly provides for the "solidarity clause" in which it is stipulated that where an EU Member State is the victim of a disaster (natural or man-made), the Union and other Member States must provide assistance to it. To date, the most important instrument in this area remains the Civil Protection Mechanism, which has been in existence for more than a decade. In order to ensure higher protection in the event of disasters, in 2001 the Union legislature adopted a decision through which a "Community Mechanism to facilitate reinforced cooperation in civil protection assistance interventions" was established. The Mechanism was then amended by Decision 2007/779 establishing "a Community Civil Protection Mechanism" and finally replaced with the new "Union" Civil Protection Mechanism, adopted by Decision 2013/1313.

In addition to the EU countries, there are currently 7 states participating in the mechanism (Bosnia and Herzegovina, Iceland, Montenegro, North Macedonia, Norway, Serbia and Turkey).

The EU Mechanism has a rather broad scope. It covers any natural or man-made disaster, concerning people, the environment or property, inside or outside the EU. The actions allowed by the Mechanism are then related to different aspects of civil protection. The Mechanism deals primarily with disaster prevention and preparedness. States must identify the risks to which they are subject, and can determine in advance the human and material resources they could make available for civil protection activities, possibly pre-committing them within a voluntary pool (known as a European Emergency Response Capacity), which can be mobilized in the event of a disaster.

Information on prevention and preparedness should be provided to the European Commission, which coordinates the activities carried out by national authorities and contributes to the exchange of best practices. The EU and states, in fact, can implement training programs for response teams.

Second, the Mechanism regulates early warning for disasters that may affect the territory of member states. The state affected by a disaster must immediately notify the Commission and the member states that are likely to be affected by the disaster. The Commission then ensures the flow of information between countries participating in the Mechanism through the Emergency Response Coordination Centre (ERCC), an office of the Directorate-General for Humanitarian Aid and Civil Protection.

Third, the Mechanism governs the coordination of disaster response in the Union and other countries involved in the Mechanism. Within the Mechanism, the internationalist principles of sovereignty and non-interference prevail. This implies that the state affected by the disaster may request assistance, but is not obliged to do so. Where assistance is provided, the requesting state is competent, within its own territory, to direct relief efforts and to indicate guidelines and limits of the tasks entrusted to foreign teams. The state potentially offering assistance also retains a wide margin of discretion. Once it receives a request for relief, it is subject to a procedural obligation to decide in a timely manner whether to offer assistance, but it can determine for itself the scope and conditions of relief and can also deny assistance. The "intergovernmental" characterization of the Mechanism is tempered, however, by the activity from the Commission. In fact, the ERCC serves as a hub for inter-state communications and coordinates assistance operationally, if necessary by dispatching agents selected by it from among the Member States' experts trained for this purpose, who facilitate coordination among intervention teams and, where appropriate, liaise with the competent authorities of the requesting Member State.

Finally, the Mechanism regulates civil protection activities taking place outside the European Union. Where a third country requests assistance from the European Union, through the Emergency Response Coordination Centre (ERCC), the procedures inherent in disaster response within the EU will generally apply to such assistance. External assistance, however, presupposes a higher degree of coordination among European countries, since they must interact with a third state with which they do not, at least initially, share information and procedures. A key bridging function is therefore assigned to the Commission, which must maintain a constant dialogue with both member countries and the third country at all stages of the disaster response.

The provision of assistance through the Mechanism can be facilitated by national transposition of guidance contained in a non-binding instrument, the Host Nation Support Guidelines (HNSGs). The HNSGs are a document prepared by European Commission staff with input from member state experts (but not representing the official position of the institution), which contains recommendations designed to help states facilitate international assistance. The HNSGs are complementary to other tools, namely the IDRL Guidelines, and can be used to facilitate assistance from EU member states and non-member states.

European Civil Protection Pool

The EU established the European Civil Protection Pool to advance European cooperation in civil protection. It aims to enable a faster, better-coordinated and more effective European response to human-induced disasters and natural hazards.

The Pool currently brings together resources to respond to disasters from 25 Member States and participating states, ready for deployment to a disaster zone at short notice. These capacities cover a wide range of services, such as search and rescue, medical treatment, or forest fire fighting.

To ensure a better response to future challenges, in May 2021 the Council adopted a new regulation to strengthen the EU civil protection mechanism.

The new rules give the EU additional capacities to respond to new risks in the EU and beyond and boost the rescEU reserve.

Being well prepared to intervene immediately in a disaster is crucial in saving lives and minimising damage. The European Civil Protection Pool allows for better organised, more predictable and coherent EU operations.

To this end, the European Commission has set up a certification and registration process. It ensures that capacities (e.g. emergency response teams and equipment) provided by EU Member States and participating states meet high operational standards.

Certification includes the participation of emergency teams in disaster simulation exercises to train with peers. This ensures that they properly operate during international deployments.

The European Commission oversees and funds the EU certification process with the support of national experts.

As of June 2022, the Pool includes 81 registered resources offered by 25 Member States and participating states. These resources range from mountain rescue teams to the availability of mobile laboratories, medical air evacuation, water purification equipment, etc.

rescEU

The European Commission upgraded the EU Civil Protection Mechanism and created rescEU to protect citizens from disasters and manage emerging risks.

RescEU has established a new European reserve of resources (the 'rescEU reserve'). In 2019 the EU established the rescEU reserve, which includes:

- a fleet of firefighting planes and helicopters;
- medical evacuation planes;
- emergency medical teams and field hospitals;
- a stockpile of medical equipment and mobile laboratory capacities;
- detection, decontamination and stockpiling capacities to respond to chemical, biological, radiological and nuclear incidents;
- temporary shelters;
- transport and logistics.

Emergency Response Coordination Centre (ERCC)

The Emergency Response Coordination Centre (ERCC) is the heart of the EU Civil Protection Mechanism. It coordinates the delivery of assistance to disaster-stricken countries, such as relief items, expertise, civil protection teams and specialised equipment.

The centre ensures the rapid deployment of emergency support and acts as a coordination hub between all EU Member States, the 7 additional participating states, the affected country, and civil protection and humanitarian experts.

The ERCC operates 24/7 and can help any country inside or outside the EU affected by a major disaster upon request from the national authorities or a UN body.

A well-coordinated response to human-induced disasters and natural hazards at European level can avoid duplication of relief efforts. It can also ensure that assistance is tailored to the needs of those affected.

To lessen the burden on contributing states, the Emergency Response Coordination Centre can liaise directly with the national civil protection authorities of the country in need. The centre can also financially support the delivery of civil protection teams and assets to the affected country.

2. Different organizations of civil protection services

Analysis of Italian and Croatian Emergency Services Regulatory Systems

The first step for the purpose of closer cross-border cooperation between Italy and Croatia in case of fires, earthquakes, oil spills and other natural and man-made marine hazards by activating the EU CP mechanism, is to frame the organization of the two countries civil protection systems.

This provides an understanding of who is in charge of civil protection, how the system is organized, and what operational structures concur in civil protection activities to manage the above-mentioned hazards. The following chapter analyses the emergency management services of the Italian and Croatian states, highlighting the differences, uniformities and similarities.

Head of the civil protection service

- **In Italy, the National Civil Protection Service is headed by the Presidency of the Council of Ministers.** The Presidency of the Council of Ministers, in the person of the President, holds the powers of ordinance in matters of civil protection, which it can exercise, through the Head of the Civil Protection Department. The President of the Council of Ministers prepares the guidelines for carrying out, in a coordinated form, the civil protection activities referred, in order to ensure their unity while respecting the peculiarities of the territories.
- **In Croatia, the Civil Protection Service is headed by the Ministry of the Interior.** The Ministry of the Interior carries out administrative and professional tasks relating to the establishment of the civil protection system, the rescue of citizens, material and other goods in the event of major accidents and disasters, and other tasks in accordance with the regulations defining the work of civil protection. The Ministry is headed by the minister of the interior, who is also the deputy prime minister of Croatia and the head of the Croatian Civil Protection Headquarters.

Civil protection activities

- **In Italy, a preventive approach to risk management prevails. Civil protection, in addition to carrying out rescue activities and overcoming the emergency, carries out risk prediction, prevention and**

mitigation activities. The components and operational structures of the National Service are engaged, for the various ambitions of competence and responsibility. Central to this process is the involvement of the technical-scientific community, through the Network of Functional Centers - which carry out daily, at central and regional level, forecasting, monitoring, surveillance and alerting activities - and of Competence Centers, structures that carry out research or provide technical-scientific services for civil protection purposes. Municipalities, Provinces and Prefectures are also dedicated to updating emergency plans, essential for prevention, on the basis of regional and national guidelines and guidelines. Even the individual citizen, as a member of the National Service, has a leading role in risk prevention activities. The objective of the ordinary activities of disseminating knowledge of civil protection and raising awareness of the population is precisely to train a more aware and prepared citizen.

- **Risk management in Croatia focuses on an emergency approach**. The Minister of the Interior establishes the civil protection system in the event of a major accident and calamity, organizing rescue and assistance to the population. Ordinarily, the operational structures are limited to training activities.

Civil protection services at regional level (Country level)

- **In Italy, civil protection is a matter of concurrent legislation, so that, without prejudice to the determination of the fundamental principles, legislative power rests with the regional governments. Each Region has organized itself with its own civil protection system.** Therefore, each region has its own system that regulates the civil protection service, defining the tasks of the various operating structures for each area of competence and entering into agreements with other public and private entities, in order to effectively pursue the objectives of the performed activities.
- **In Croatia, civil protection responsibilities have not been delegated to the local level.** The regional civil protection offices have been established as internal organisational units, outside the headquarters, to perform tasks within the scope of activities of the Civil Protection Directorate for the counties and the City of Zagreb.

Operative structures

The operational structures of the two emergency services are similar to each other with the exception of the civil protection volunteering service present in Italy. Within the Italian National Service, Civil Protection volunteering is an operational structure and is divided into national organizations, local associations and municipal groups. A multifaceted reality both from an operational point of view and for the variety of professionalism and skills expressed that range from rescue to health care, from forest fire fighting to the protection of cultural heritage, from telecommunications to the preparation of reception areas. Volunteering works in an integrated way with the components and operational structures of the Italian National Service both in ordinary and emergency and regularly participates in exercise activities to ensure full synergy with all the players in the System.

3. Management of Wild Fires, Earthquake, Oil Spill and other marine natural and man-made hazards

Seismic risk

Italy and Croatia, due to their particular geographical position, located in the convergence area between the African and Eurasian plates, are countries at high seismic risk in the Mediterranean.

The entire Adriatic area is therefore at high seismic risk, and different inland regions may be active at different times. Unfortunately, the tectonic structure of the subsurface is not easily reproducible, and it is not possible to predict how and where the stored energy, a phenomenon that shakes the Earth's layer, will be released.

Best practices. Civil protection activities carried out for earthquake risk management.

Forecast

Current knowledge does not allow us to predict the exact time and place where the next earthquake will occur. Currently the only possible forecast is the statistical one, which is based on the knowledge of the frequency of the seismicity that affected the country. The areas of our country subject to high seismicity are known, in terms of frequency and intensity of earthquakes, or where a strong earthquake is more likely to occur, but it is not possible to establish exactly when this will happen. Probabilistic forecasting allows us to identify the most dangerous regions and to distinguish them based on the probability of strong earthquakes and the frequency with which they can be expected. It is possible to study more precisely the time interval in which in a given region an earthquake can be expected with a higher probability, but it is necessary to know how much energy is stored in the seismogenic structure capable of triggering an earthquake in that area and how the energy will be released. While studying seismogenic structures in depth, it is not yet possible to predict the exact moment in which the next seismic event will take place. The study of seismic precursors has made enormous progress and the possibility is not excluded that in the future it will be

possible to fix the initial instant of the earthquake. The study on the precursors of an earthquake concentrated on:

- geophysical precursors: irregularities in the velocities and characteristics of P and S seismic waves, changes in the magnetic and electrical characteristics of rocks and the atmosphere;
- seismological precursors: before a strong earthquake it is possible to detect a series of micro-tremors, perceptible only through instruments, or a change in the distribution of seismicity;
- geodetic precursors: variations in altitude, position, inclination of parts of the soil surface and in the speed of the calculated movements;
- geochemical precursors: modification of the concentration in groundwater and ground gases of some radioactive chemical elements, including radon gas;
- hydrological precursors: variation of the groundwater level in the subsoil, measured in the wells.

Seismologists have understood the phenomenon and hypothesized a valid genetic model of the earthquake but nevertheless the prediction of seismic events based on precursors has so far given contradictory results. None of the aforementioned precursors occur regularly before any major seismic event. To date, the only valid method to reduce the consequences of an earthquake is limiting the risk factors by intervening on the quality of buildings.

Emergency planning and damage scenarios

Specific emergency plans are required to organize the Civil Protection structures to deal with and manage an emergency. Contingency plans identify targets from reach out to plan an adequate civil protection response when the event occurs. The emergency plan defines the methods of intervention. In order to size the resources to be put in place in the event of an emergency, it is necessary to know the damage scenarios that are defined on the territorial data of exposure and vulnerability and on the basis of past reference events whose occurrence is considered more probable depending on the chosen time interval. The Department of Civil Protection deals with the assessment of these seismic scenarios, which are not limited to estimating the extent of the shaking, but are oriented towards assessing the losses immediately. Knowing the "damage scenario" allows you to reach a territorial picture of the area involved by the event by providing data of

significant importance regarding the location and extension of the most affected area, the functionality of transport networks, communication routes and of distribution lines, the expected losses in terms of human lives, injured people, homeless people, collapsed and damaged buildings and the corresponding damage in economic terms, with repercussions on Civil Protection activities also in emergency planning and management activities . With regard to planning, the data make it possible to identify and represent the reference event for sizing human resources, the materials to be used and their allocation to be foreseen in the plan. To do this, the Department of Civil Protection gives its support to the Regions during the planning and guidance process towards the minor local authorities, Provinces, Municipalities, Mountain Communities, providing data on information regarding their impact on the territory for one or more reference events in correspondence with which different levels of activation of the Civil Protection plans are associated. With regard to emergency management, the information immediately describes the real event and its impact on the territory, in support of the activities to overcome the emergency. The tools adopted by the Department of Civil Protection to assess the damage scenarios are Emergency Management Information System (Sige), territory framework (Quarter) and Municipal damage scenarios (Scecom). These devices are adopted by the Civil Protection Department to remedy the emergency and to support the Regions and local authorities. The methods for assessing the danger and vulnerability are based on the need to synthetically provide an answer that the protection operators civil can be adopted both locally and nationally and are the same for all instruments. However, assessing the uncertainty of the estimate and quantifying the confidence level of the loss predictions is not an easy task. The Service has carried out a series of studies that have led to "second generation" products to assess the damage scenario such as Faces (Fault Controlled Earthquake Scenario) and Espas (Earthquake Scenario Probabilistic Assessment).

Prevention

The study of prevention is managed by the Seismic Risk Service of the Department which deals with the elaboration of the criteria and techniques to be applied for the assessment and reduction of seismic risk, expands the technical-scientific skills for the prediction of the impact of the earthquake on territory and is committed to optimizing interventions in emergency conditions and post-earthquake reconstruction. The Risk Service also provides technical support and assistance to other central and peripheral administrations of the State with which it collaborates closely, monitors the territory to determine the characteristics and

effects of earthquakes, organizes and manages awareness-raising initiatives on prevention and particular on the seismic risk. The scientific and operational contribution of the centers of competence for seismic risk such as the INGV (Istituto Nazionale di Geofisica e Vulcanologia) for the seismological aspects, the ReLUIS (Rete dei Laboratori Universitari di Ingegneria Sismica) and the Eucentre (Centro Europeo per la formazione e la ricerca in ingegneria sismica) for the engineering aspects are fundamental for the performance of these tasks. To appropriately mitigate the seismic risk, a constant effort is required to improve knowledge on the causes of the phenomenon, an in-depth study of the behavior of structures subjected to seismic actions and optimization of emergency interventions. The seismic risk is closely linked to the presence of man and due to the unpredictability of the occurrence of an earthquake, to limit its effects on the man-made environment it is necessary to intervene by adopting appropriate seismic risk prevention and reduction policies such as:

- improve knowledge of the phenomenon by monitoring the territory and adequately assessing the danger to which citizens, housing assets and infrastructural systems are exposed;
- implement policies to reduce the vulnerability of older buildings, relevant buildings (eg schools, monumental assets) and strategic buildings (eg hospitals, structures used for emergency management), optimizing the resources used for the recovery and the requalification of the building stock;
- update the seismic classification and legislation;
- broaden knowledge on the consistency and quality of assets exposed to risk;
- develop seismic micro-zonation studies for the correct use of ordinary planning tools, to obtain over time a reorganization of the territory that takes into account the seismic risk and to improve the efficiency of emergency management following an earthquake;
- intervene on the population by constantly informing and raising awareness among citizens.

Seismic classification

To reduce the effects of the earthquake, state action has focused on the classification of the territory, based on the intensity and frequency of past earthquakes, and on the application of special construction regulations in areas classified as seismic.

The Italian anti-seismic legislation, aligned with the most modern international regulations, prescribes technical standards on the basis of which a building must withstand the weakest earthquakes without serious damage and without collapsing the strongest earthquakes, first of all safeguarding human lives.

Until 2003 the national territory was classified into three seismic categories of different severity. In 2003 the criteria for the new seismic classification of the national territory were issued, based on the most recent studies and elaborations relating to the seismic hazard of the territory, i.e. on the analysis of the probability that the territory will be affected in a certain time interval (generally 50 years) from an event that exceeds a certain threshold of intensity or magnitude. To this end, the Ordinance of the President of the Council of Ministers no. 3274 of 20 March 2003, in the Official Gazette no. 105 of 8 May 2003.

The provision dictates the general principles on the basis of which the Regions, to which the State has delegated the adoption of the seismic classification of the territory (Legislative Decree no. 112 of 1998 and Decree of the President of the Republic no. 380 of 2001 - "Consolidated Law of the Building Regulations "), have compiled the list of municipalities with the relative attribution to one of the four areas, with decreasing danger, in which the national territory has been reclassified.

Zone 1 - It is the most dangerous area. The likelihood of a major earthquake is high

Zone 2 - In this area strong earthquakes are possible

Zone 3 - In this zone, strong earthquakes are less likely than in zone 1 and 2

Zone 4 - It is the least dangerous area: the probability of an earthquake is very low

In fact, the "unclassified" territory disappears, and zone 4 is introduced, in which the Regions have the right to prescribe the obligation of anti-seismic design. Furthermore, each zone is assigned a value of the seismic action useful for the design, expressed in terms of maximum acceleration on rock (zone 1 = 0.35 g, zone 2 = 0.25 g. Zone 3 = 0.15 g, zone 4 = 0.05 g).

The implementation of the ordinance n.3274 of 2003 has made it possible to significantly reduce the distance between consolidated scientific knowledge and its translation into regulatory instruments and has led to the design and construction of new buildings, safer and open to the use of innovative technologies.

The innovations introduced with the ordinance have been fully implemented and further refined, thanks also to the studies carried out by the centers of competence (Ingv, Reluis, Eucentre). An update of the national

reference hazard study (Working Group, 2004), provided for by OPCM 3274/03, was adopted with the Order of the President of the Council of Ministers no. 3519 of 28 April 2006.

The new hazard study, attached to the OPCM no. 3519, provided the Regions with an updated tool for the classification of their territory, introducing acceleration intervals (ag), with a probability of exceeding 10% in 50 years, to be attributed to the 4 seismic zones.

In compliance with the guidelines and criteria established at national level, some Regions have classified the territory in the four proposed zones, other Regions have classified their territory differently, for example by adopting only three zones (zone 1, 2 and 3) and introducing, in some cases, subzones to better adapt the standards to the seismic characteristics.

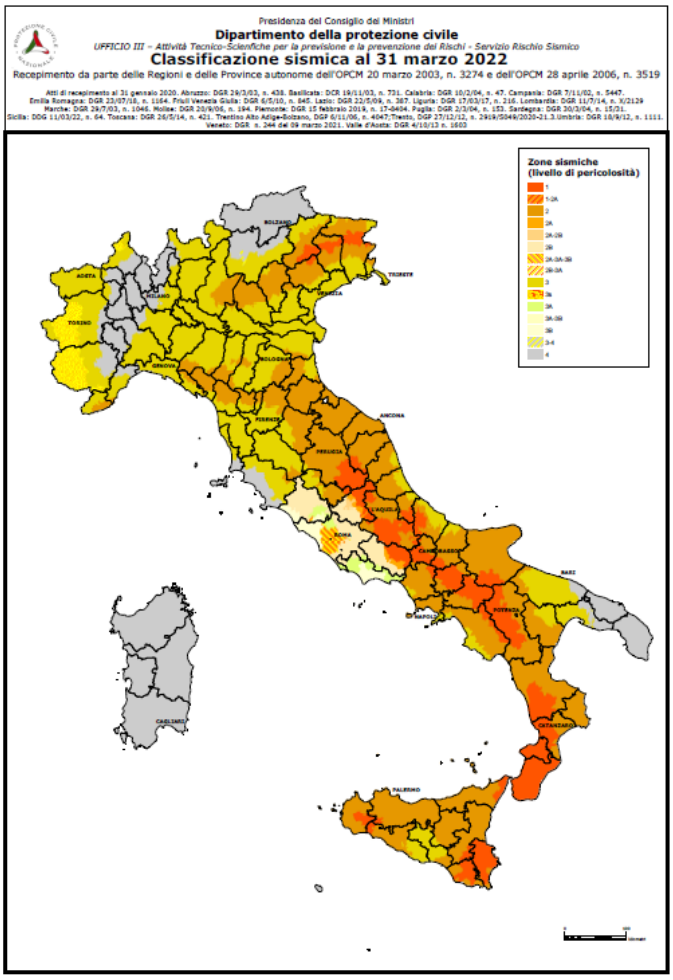
For the details and meaning of the zoning of each Region, please refer to the regional regulatory provisions.

Whatever the regional choice, each zone or sub-zone is assigned a basic hazard value, expressed in terms of maximum acceleration on rigid ground (ag). However, this basic hazard value has no influence on the design.

The current Technical Regulations for Constructions (Ministerial Decree of 14 January 2008), in fact, have changed the role that the seismic classification had for design purposes: for each area - and therefore the municipal area - a peak acceleration value was previously provided and hence the elastic response spectrum to be used for the calculation of seismic actions.

From 1 July 2009 with the entry into force of the Technical Regulations for Construction of 2008, for each construction we must refer to an "own" reference acceleration identified on the basis of the geographical coordinates of the project area and according to life nominal of the work. A basic hazard value, therefore, defined for each point of the national territory, on a square grid of 5 km on each side, regardless of the municipal administrative boundaries.

The seismic classification (seismic area to which the municipality belongs) remains useful only for planning management and for the control of the territory by the responsible bodies (Region, Civil engineering, etc.).



Im. 6: Map seismic classification Italy[8].

Anti-seismic regulations

Seismic prevention can be achieved through the use of two tools: the seismic classification and the anti-seismic legislation. The anti-seismic legislation refers to the criteria for constructing a building in order to reduce its tendency to suffer damage following an earthquake. Currently, reference is made to the Technical Standards for Construction (NTC 2018). The 2018 NTCs identify the minimum indices of seismic vulnerability

[8] https://rischi.protezionecivile.gov.it/static/c7650fa8eac014a28ef074236bb234f7/mappa-classificazione-sismica-aggiornata-al-31-marzo-2022-provincia.pdf

that must be achieved in the event of the improvement of historic buildings and the adaptation of existing school buildings. The NTC 2018 also contain the general technical construction criteria for the design, execution and testing of buildings and for their consolidation, general criteria for the verification of the safety of buildings, investigations on soils and rocks and indications on the techniques for the design, execution and testing of land support works and foundation works; general criteria and technical specifications for the design, execution and testing of special works and the protection of buildings from fires. The 2018 NTCs also identify the minimum indices of seismic vulnerability that must be achieved in case of improvement of historic buildings and adaptation of existing school buildings. Minimal impact they must be achieved in the event of an "improvement" reserved for historic buildings (minimum vulnerability index: 0.6) or "adaptation" of existing school buildings (minimum vulnerability index: 0.6). The adaptation may also include local improvement and repair. As regards the management of the results of the seismic vulnerability checks, the Civil Protection provided clarifications on the matter with the circular of 4 November 2010, n. DPC / SISM / 0083283. Unlike the intervention, the verification is mandatory: the need for seismic adaptation of buildings and works will be taken into consideration when drafting the three-year and annual plans and for the preparation of the extraordinary plan for earthquake safety.

National Accelerometric Network

The National Accelerometric Network (Ran) is a monitoring network whose task is to record the response of the Italian territory to the earthquake, in terms of ground accelerations. The data generated by the system allow to describe in detail the seismic shaking in the epicenter area and to estimate the expected effects on buildings and infrastructures, they are suitable for seismology and seismic engineering studies and participate in defining the seismic action to be used in structural calculations for reconstruction. The RAN is distributed throughout the country, with particular attention to areas of high seismicity and is managed by qualified personnel from the Seismic Risk Service - Technical - Scientific Activities Office for the prediction and prevention of risks of the Civil Protection Department. To date, the National Accelerometric Network is made up of 647 digital stations, both permanent and temporary, which include an accelerometer, a digitizer, a modem / router with an antenna to transmit digitized data via GPRS and a GPS receiver to link the time to information universal UTC and to evaluate the latitude and longitude of the location.

The data flows into the central server of the National Accelerometric Network within the Department of Civil Protection which deals with their processing automatically to obtain an estimate of the descriptive parameters of the earthquake.

Seismic Observatory of Structures

The Seismic Observatory of Structures (OSS) was conceived and is directed by the technicians of the Department's Seismic Risk Service. The structures of the permanent OSS network and the temporary emergency network are identified by the Ministry of Infrastructure and Transport, the Regions, local authorities and other public bodies. The efficiency of the network is guaranteed through an appropriate maintenance service, a high efficiency rate of the network is maintained (about 97%). The Civil Protection Department monitors the oscillations caused by the earthquake thanks to the national network of the Seismic Observatory of the structures. The OSS allows you to estimate the damage caused by an earthquake to the monitored structures, which can be extended to structures with similar characteristics located in the affected region, thus providing useful data for civil protection activities immediately after a seismic event. The Seismic Observatory of Structures allows check strategic structures for the management of a seismic emergency and estimate damage, as well as make information available to the technical-scientific community to understand the response of buildings to a seismic event. These data also represent useful baggage for updating the technical standards regarding construction in seismic areas. If one of the OSS structures is affected by a major earthquake, the monitoring system detects the displacement of the ground and the structure and immediately afterwards transmits the recorded data to the central OSS server in Rome. The server is able to automatically process the recordings merged from all the structures affected by processing a summary report that includes the maximum recorded values as well as some descriptive parameters useful in evaluating the incoming earthquake, the vibrations of the structure and the state of damage. This report is also automatically published on the public site of the OSS. Immediately after a strong earthquake, a temporary network consisting of at least 4 simplified monitoring systems immediately integrated into the OSS is installed in the epicentral area. The monitored structures are above all the structures intended for the organization of actions for emergency management, such as the headquarters of the Mixed Operations Centers and Di.Coma.C. The OSS monitoring system consists of sensors distributed on all floors of the building

as well as on the ground, for an average of 20 acceleration measurements that allow you to analyze the vibrations of the structure for a consequent estimate of the damage. The sensors are connected by cable to a seismic control unit, connected via ADSL with the OSS server in Rome. The OSS consists of 131 OSS systems of this type and 29 other simplified permanent systems, similar to those of the temporary network installed in an emergency. This configuration provides only independent sensors connected to each other in a Wi-Fi network, for about 7 measurements, on the ground and on the top floor of the building. It is a cheaper system but it is less accurate. To better understand the earthquake observed experimentally with OSS systems, firstly, the available technical documentation is collected, then in situ investigations are carried out on the monitored structure. Thanks to this information, a mathematical model is developed that allows to simulate its behavior under earthquakes of increasing intensity and to estimate the damage. It is possible to consult all the documentation found, the description of the monitoring system, the surveys, the models and all the data produced by the systems since 1999 on the ISS-Fact-finding and monitoring site within the OSS (after registration).

Seismic micro-zonation

Buildings and infrastructures do not always respond in the same way following a seismic event. It is not infrequently possible to observe extensive damage even in places far from the epicenter. The earthquake that struck L'Aquila on 6 April 2009, for example, showed that in some municipalities far from the epicenter (eg S. Pio delle Camere, 30 km from the epicenter), there was considerable damage to the structures. Factors that influence the response of the structures to seismic stresses are both the quality of the buildings and the different local seismic hazard, conditioned by the different way in which the earthquake propagates and by the instability of the soil. Seismic micro-zonation (MS) studies allow to identify stable areas, stable areas that could be subject to local amplification and unstable areas, (e.g. landslides, surface ruptures due to faults and dynamic soil liquefaction) with objective to improve the skills on the alterations that the seismic shaking can undergo on the surface in order to provide useful information for the government of the territory, for the design, for the planning, for the emergency and for the post-earthquake reconstruction. With regard to spatial planning, the seismic micronation studies in relation to the various scales and levels of intervention, are directed to the areas for which the regulatory framework provides for use for building purposes, their

potential transformation for these purposes, or use for civil protection purposes. Seismic micro-zonation allows you to guide the choice of areas for new settlements, define reliable interventions in a given area, plan investigations and levels of detail, establish guidelines and rules for intervention in urbanized areas, define intervention priorities. MS studies are useful in the construction of new works or interventions on existing buildings as they highlight the possibility that some shaking phenomena linked to the lithostratigraphic and morphological characteristics of the area may be subject to amplification as well as to phenomena of instability and permanent deformation triggered by the earthquake. Based on the level of in-depth analysis to be achieved, Seismic Micro-zonation assumes different costs.

- level 1: consists of a collection of pre-existing data, processed to distinguish the territory into qualitatively homogeneous micro-zones. Preparatory to real seismic micro-zonation studies;
- level 2: defines a real map of zoning thanks to the introduction of the associated element associated with the homogeneous areas, using further and targeted surveys (where necessary);
- level 3: indicates a seismic micro-zonation map with in-depth information on particular themes or areas.

To establish the level of in-depth study to be adopted in the study of MS, it is necessary to evaluate its actual usefulness in order to compare it with the costs to be faced. To intervene on risk mitigation, it is appropriate to improve knowledge on the seismic phenomenon thanks to MS studies, assess vulnerability and exposure and optimize the resources available to carry out targeted interventions. The techniques of execution and application of seismic micro-zonation on the Italian territory are regulated by the "Guidelines and Criteria for Seismic Micro-zonation".

Damage scenarios

The first essential information to intervene immediately following an earthquake are the size, extent and location of the damage. In this regard, it is necessary to use assessment tools built on the basis of simulations of damage scenarios that allow employees to plan and manage emergency response in real time, even before inspections. These tools are associated with rapid damage assessment activities in order to consolidate the preliminary analyzes and projections identified thanks to the first instrumental data collected by the seismic monitoring network. In the event of seismic events exceeding the damage threshold, a rapid macro seismic

survey is carried out with the aim of directing and coordinating relief and resources in the emergency phase. The survey consists in observing the level of damage and how it is distributed in the various affected locations by assigning to each of them a value of macro seismic intensity expressed in degrees on the Mercalli Cancani Sieberg (MCS) scale. In the moments following an earthquake, it is extremely important to identify its size, its impact on the territory and on the population as soon as possible in order to be able to size the aid and organize it appropriately. The Civil Protection Department has taken advantage of the negative experience gained during the 1980 Irpinia earthquake and in this sense has set up a territorial information system (GIS) capable of generating in semi-real time a scenario for simulating the consequences of seismic event. If the earthquake is of significant magnitude, the National Institute of Geophysics and Volcanology transmits the focal parameters (magnitude and coordinates) of the event to the Department. Immediately after, an automatic procedure is activated for the generation of a report which is made available to the Civil Protection within just 10 minutes of the event.

The report contains data, maps and other information about the municipalities within a radius of 100 km around the epicenter. In particular, data are provided on:

- description of the territory (anthropogenic, physical and administrative aspects; characteristics of buildings and infrastructures; seismic monitoring networks);
- danger (seismogenic zones, historical earthquakes, isosist and elevated planes, attenuation of the ground motion);
- vulnerability (building stock, schools, hospitals, road and rail networks);
- exposure (characteristics and distribution of the resident population in each census section);
- preliminary assessment of damages and losses (damaged and unusable houses, estimate of dead and injured, estimate of economic damage).

Limit Condition for Emergency (CLE)

Following an earthquake of significant intensity and simultaneously with the occurrence of physical and functional damages that almost completely interrupt the urban functions present (including the residence), the Limit Condition for Emergency (CLE) is defined as the condition for which the settlement urban still retains, as a whole, the operation of most of the strategic functions for the emergency, their accessibility and

connection with the territorial context. CLE is performed at the municipal level, but it is also possible to carry it out at the inter-municipal level. The CLE analysis was introduced starting from OPCM no. 4007/2012 which regulates the use of the funds provided for by art. 11 of the DL n. 39/2009 for the year 2011 and is performed in parallel with the seismic micro-zonation studies according to the national standards adopted by the Department of Civil Protection (CLE standard).

Standard of representation and computer storage of the CLE analysis

The information is assembled through specific survey forms, approved by the Technical Commission for MS studies and issued with the decree of 27 April 2012 of the Head of the Civil Protection Department. The document describing the standards in detail consists of two parts: the first part contains the description of the representation system of the "Charter of elements for the analysis of CLE" while the second part describes the filing system. The legend used for the "Map of elements for CLE analysis" and the layout of the title block are defined in the representation system. Within the Charter are shown the elements that identify, within the urban settlement, the emergency management system (strategic buildings, emergency areas, accessibility infrastructures and connection, interfering structural aggregates and related structural units). To facilitate the work of entering alphanumeric data, SofCLE has been prepared, a software freely distributed which reproduces all the survey cards.

Usability surveys

To effectively manage a post-earthquake emergency, the expeditious activities of assessing the damage and usability on public and private buildings and buildings of cultural interest play a fundamental role. In fact, these activities have the objective of safeguarding public safety, guaranteeing, if possible, the timely return of the population to their homes and carrying out the first urgent measures to make buildings safe to reduce the inconvenience of those affected and any further possible damage.

In these contexts, on the one hand, the Fire Brigade are called upon to work who, within the scope of their competences and attributions, among their activities, carry out expeditious surveys to verify and facilitate the practicability of the roads, check the usability of the buildings and perimeter the areas to be subjected to preventive interdiction. On the other hand, at the same time, technicians of the National Civil Protection

Service act who, equipped with adequate professional skills and suitably trained, have the task of carrying out a timely, albeit expeditious, analysis of the buildings, carrying out inspections with the help of technical evaluation sheets (Aedes and GL-Aedes data sheets). For this purpose, with the Decree of the President of the Council of Ministers of 8 July 2014, the National Technical Unit was established which goes in the direction of rationalizing, according to a predefined scheme in peacetime, the mobilization of expert technicians for post-seismic emergency usability checks.

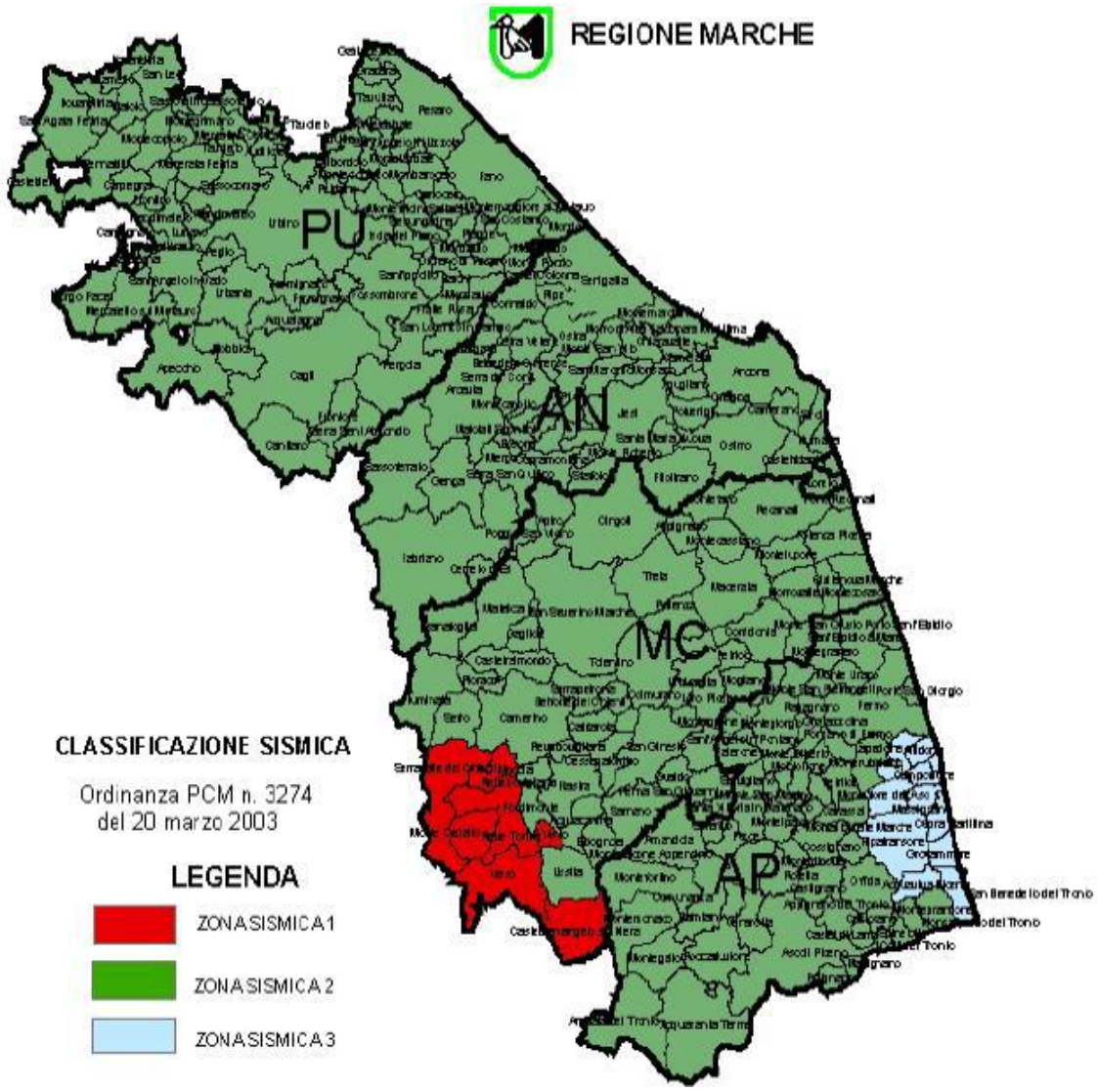
The technicians to be enrolled in the National Technical Nucleus, coming from the Public Administration, voluntary organizations and professional Orders and Colleges, are addressed the operational indications of October 29, 2020, aimed at integrating their previous skills and professional experiences with knowledge that allows them use in post-seismic emergencies.

These expeditious post-seismic emergency activities require a considerable degree of standardization of procedures and constant quality control in the management and organization of surveys and inspections. With the aim of defining coordinated and integrated ways of organizing and implementing these activities, on February 12, 2021, the Department issued the Operational Guidelines for the connection and coordination of the activities of a quick post-earthquake technical inspection.

Marche Region's experience

After the issue of OPCM no. 3274/2003, also the Marche Region, with the DGR n. 1046 of 29/07/2003 "General guidelines for the first application of the Ordinance of the President of the Council of Ministers no. 3274 of 20 March 2003. Identification and formation of the list of seismic zones in the Marche Region ", adapts the design to the new standards and proceeds with a seismic reclassification of the municipalities of its territory.

With the DGR 1046/2003 (subsequently modified by DGR 136/2004) the seismic zones of the Marche Region are thus identified; in light of this classification, 6 municipalities in the Province of Macerata were included in Zone 1 (high danger), 12 municipalities in the Provinces of Ascoli Piceno and Fermo were classified in Zone 3 (medium-low danger) while most of the remainder territory was included in Zone 2 (medium-high danger) (Im. 6).

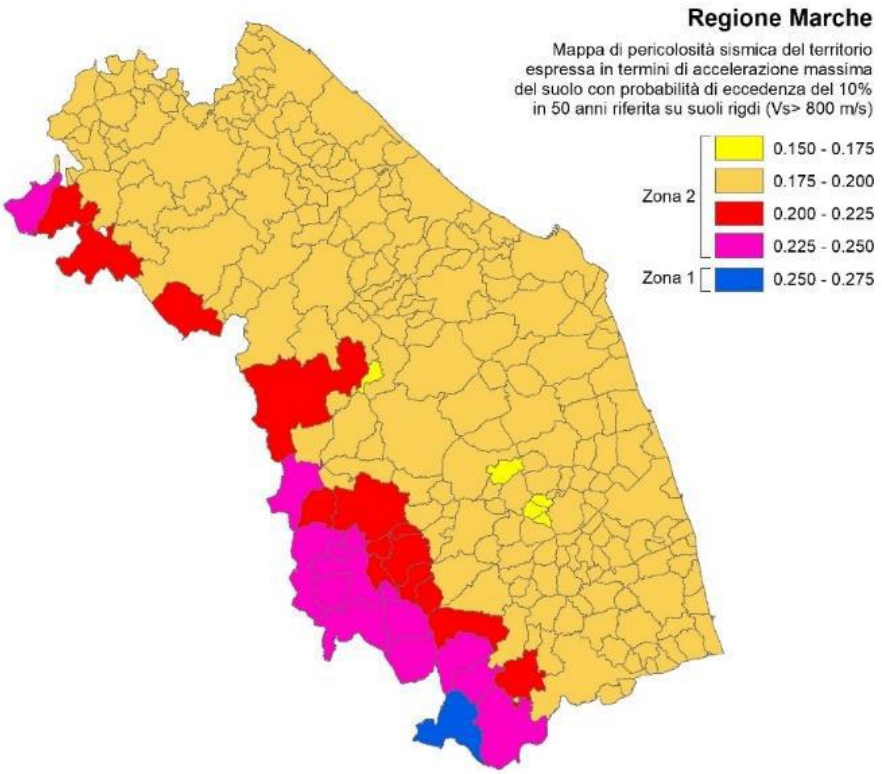


Im. 7: The seismic classification of the Municipalities of the Marche Region according to DGR 1046/2003.

Subsequently, with the OPCM no. 3519 of 29/04/2006, the national seismic hazard map was approved and, in Annex 1, the new criteria were established through which to identify, for each municipality, the 4 seismic zones, by means of the maximum acceleration values of the soil "ag".

These values of "ag" are provided, for all Italian municipalities, in Annex 7 of OPCM no. 3907 of 13/11/2010, which governs the contributions for the prevention of seismic risk provided for by art. 11 of Law 77 of

24/06/2009; using these values it is clear that all the current 225 Municipalities of the Marche Region fall into Zone 2, except the Municipality of Arquata del Tronto, which is located in Zone 1 (Im. 7).

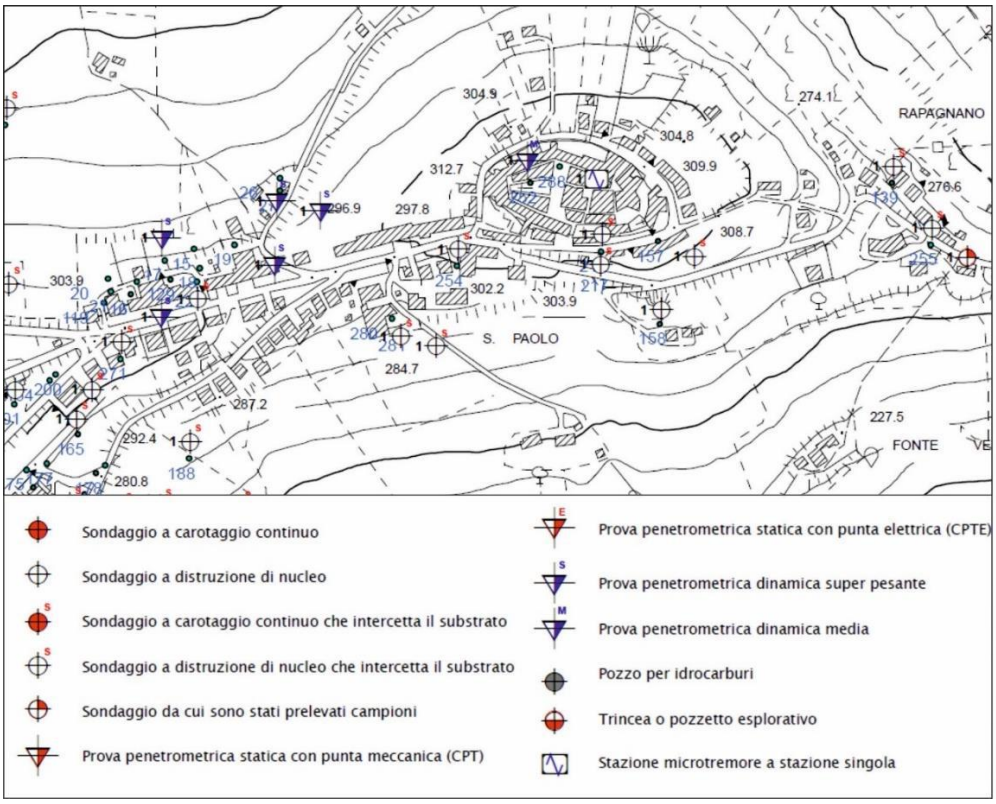


Im. 8: The classification of the Municipalities of the Marche Region based on the ag values contained in OPCM 3907/10.

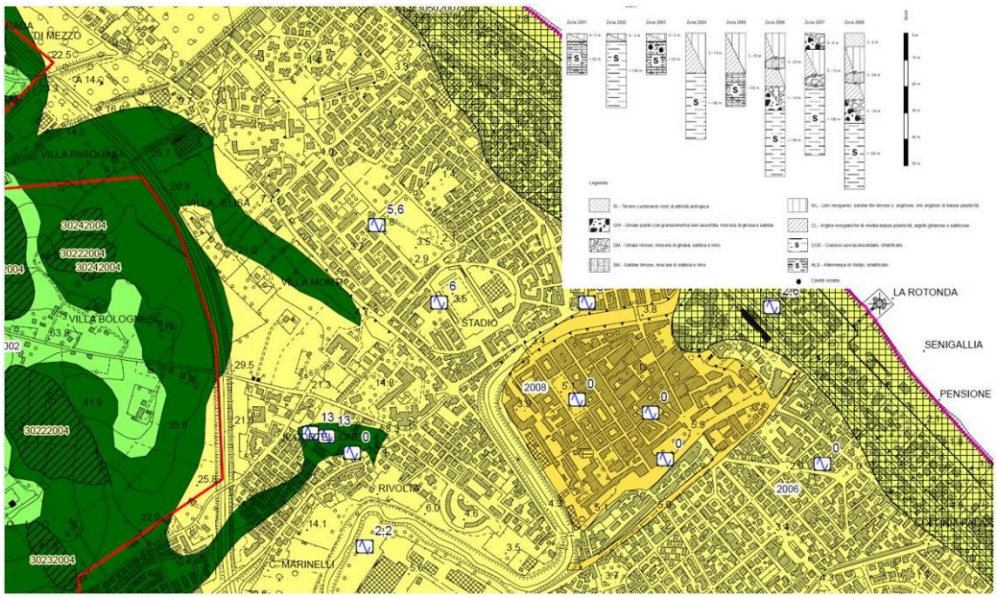
The whole regional territory is therefore characterized by medium-high values of seismic hazard.

Seismic Microzonation in the Marche Region

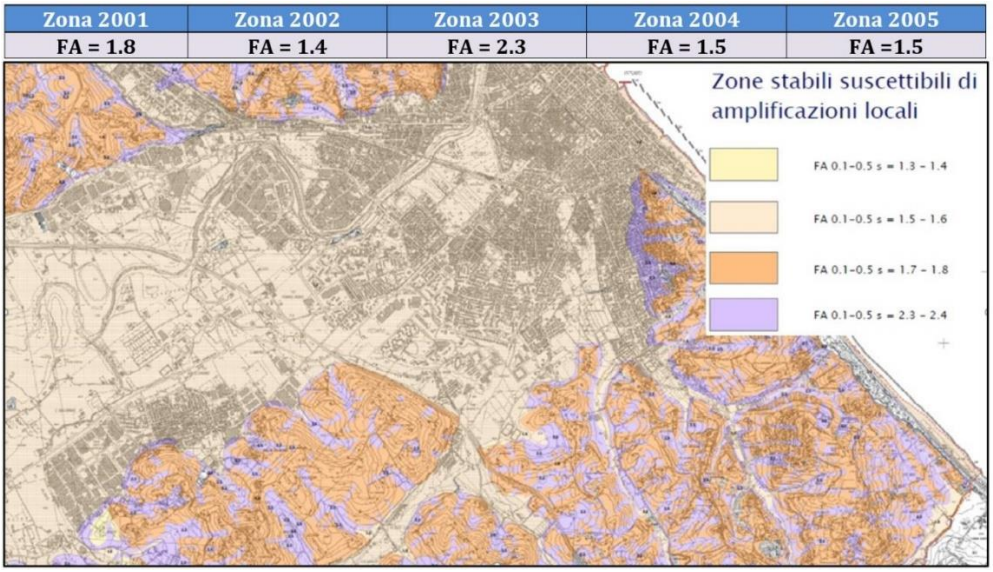
To date, all the municipalities of the Marche have a microzonation of at least level 2. Furthermore, on 89 municipalities, there are level 3 MS studies (85 of which studied following the Ordinance of the Extraordinary Commissioner for Reconstruction 24/17 following the earthquake that hit central Italy in 2016).
Below are some excerpts of the maps produced by regional seismic microzonation studies.



Im. 9: Extract from the Investigation Charter of the Municipality of Rapagnano (FM).



Im. 10: Extract from the MOPS Charter of the municipality of Senigallia (AN).

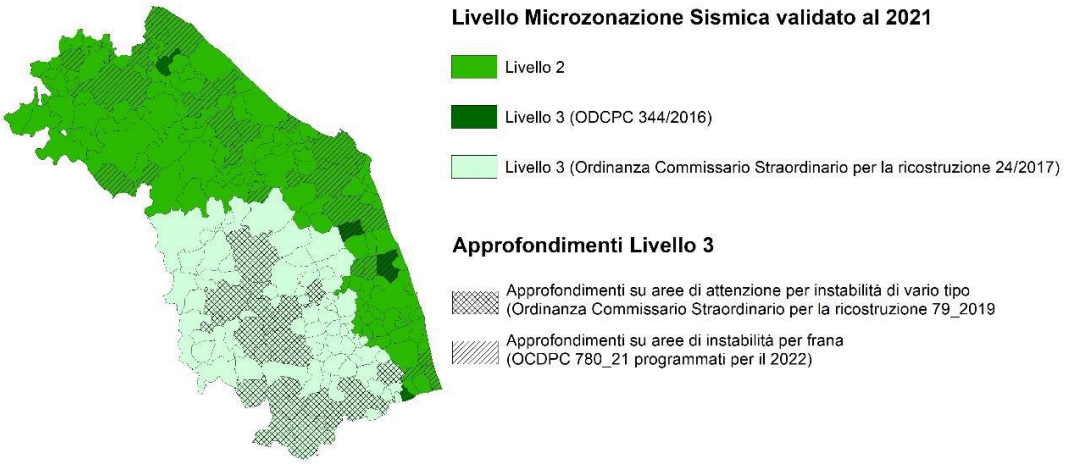


Im. 11: Extract from the Level II Seismic Microzonation Card (FA 0.1 - 0.5 s) of the municipality of Pesaro (PU).

Future prospects of Seismic Microzonation in the Marche Region

With the OPCM no. 780 of May 20, 2021, new funds have been allocated for MS and CLE.

The Marche Region has decided to use these state funds, supplemented by regional co-financing, to carry out Level 3 in-depth studies on some areas of attention due to slope instability (as identified and defined in the level 1 studies and updated by level 2 studies) in 31 municipalities in the Marche region (Im. 11).



Im. 12: The current state and planning for the future of microzonation in the Marche Region.

The process for selecting the first municipalities that will benefit from state funds and regional co-financing was initiated with Decree no. 456 / SPC of 13 December 2021 and the studies will be carried out in 2022.
The choice of Municipalities to be included in the new studies was carried out in collaboration with CNR-IGAG, selecting them from those that have already carried out MS level 2 studies, i.e. the Municipalities for which it was possible to establish, in correspondence with the urbanized areas or development, a true quantitative estimate of the local amplifications of the seismic impulse.

The analysis of the Limit Condition for the Emergency in the Marche Region

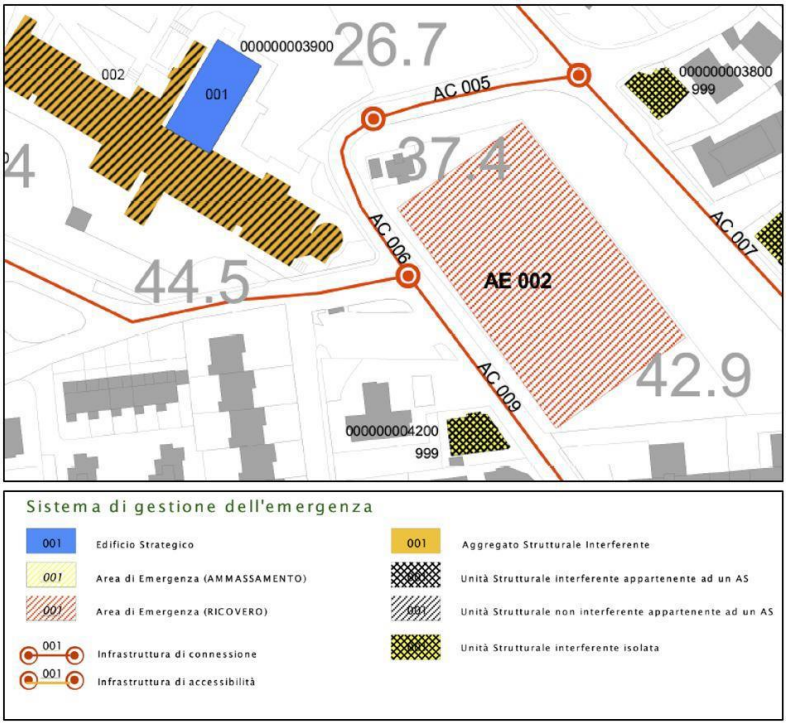
The analysis of the Limit Condition constitutes a first tool aimed at the integration of interventions on the territory for the mitigation of seismic risk on a municipal scale and concerns the verification of emergency management systems, understood as sets of physical elements (buildings strategic areas, emergency areas, connection and accessibility infrastructures).
For the analysis of the CLE of a specific settlement it is essential to identify:

a. the buildings and areas that guarantee the strategic functions for the emergency;
b. the infrastructures of accessibility and connection with the territorial context, of the buildings and areas referred to in point a) and any critical elements;
c. the structural aggregates and individual structural units that may interfere with the accessibility and connection infrastructures with the territorial context.

Operationally, we proceed by identifying, in each context, the elements of the emergency management system, which are detected using five specific detection cards specially prepared, in which to collect the information:

- Strategic Buildings (ES)
- Emergency Areas (AE)
- Accessibility / Connection Infrastructures (AC)
- Interfering Structural Aggregates (AS)
- Interfering Structural Units (US)

The information collected is entered in a database and represented in the GIS environment on the base cartography (Im. 12).

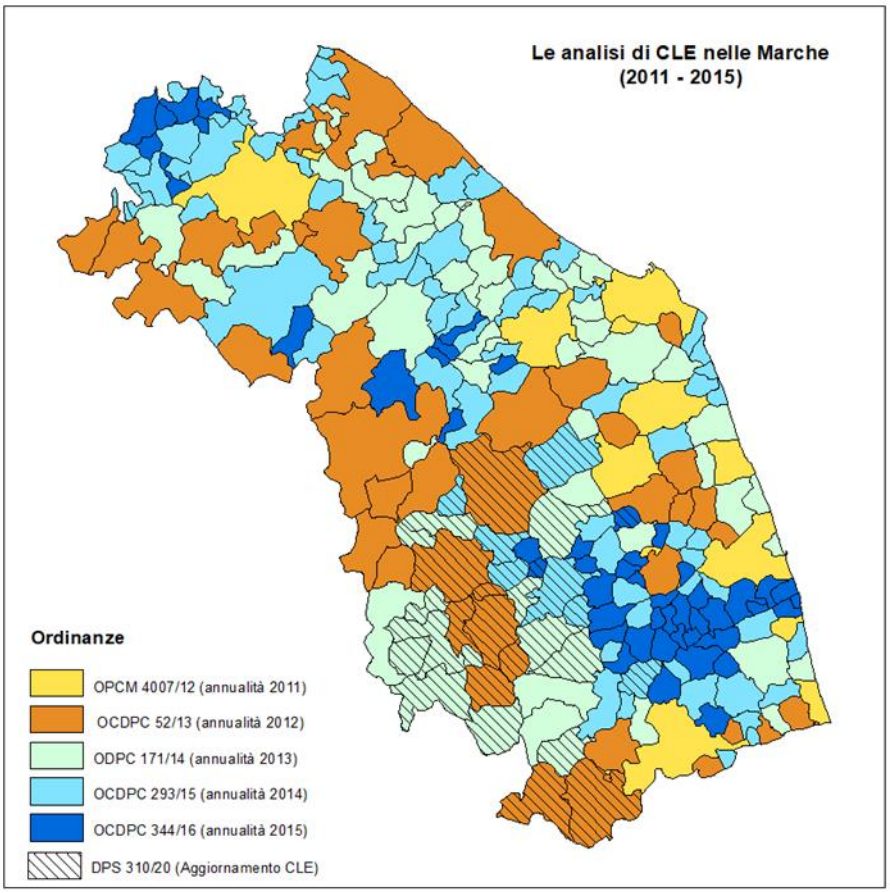


Im. 13: The analysis of the Limit Condition in the Marche Region.

In practice, the preparation of the cards allows the implicit verification of the emergency management system, since it identifies on the one hand the artifacts or areas with management functions (strategic functions) and on the other the accessibility to the system composed of these elements, also identifying the main potential critical factors that can affect performance.

All the municipalities of the Marche have analyzes on the limit condition for the emergency.

Furthermore, with Decree no. 310 / SPC1 of 12 November 2020, the Marche Region has launched an update of the CLE for 29 municipalities most affected by the 2016 earthquake.



Im. 14: The analysis of the Limit Condition in the Marche Region.

This choice arose from the consideration that in the capitals of the aforementioned municipalities the urban fabric has undergone evident transformations as a result of the aforementioned seismic events, with the construction of new residential settlements (see the "SAE" Emergency Housing Solutions and replacement houses) , and very often the relocation of strategic buildings functional to emergency management. All these elements logically went to affect the elaboration of the CLE Analysis and the drafting of the Municipal Civil Protection Emergency Plan.

The strengths of the experience of the Marche Region

Seismic Microzonation studies and the analysis of the Limit Condition for Emergency in the Marche Region have been made possible for over a decade now, thanks to the precious and indispensable collaboration between local authorities, national research institutes, the academic and professional world (both Technical orders, both freelancers).

This "model" adopted of "team play" is described below which, through a series of regulatory acts by the Marche Region, has made it possible to carry out these studies throughout the region.

Regional legislation

The Marche Region, through the Regional Council Resolution (DGR) 967 of 5 July 2011 "First Provisions for carrying out Seismic Microzonation surveys", acknowledges the provisions at national level of Law 77/09 and OPCM 3907/10.

With the DPS2 Decree n. 53/2011, the first Municipalities in which to carry out the Microzonation studies are identified (selected on the basis of population and ag value) and the share of regional co-financing for the studies is established.

In the document, which is the deed of departure for MS in the Region, it also resolves:

- the approval of a protocol between the Marche Region, ANCI Marche and the Order of Geologists to ensure the best execution of the MS studies (protocol that will be integrated in 2012 following the inclusion of the CLE studies, including the Orders of Engineers, Architects and Surveyors);
- the incorporation of MS studies into urban planning tools;
- the establishment of a Regional Technical Commission on Seismic Microzonation, made up of 5 experts with proven experience in the sector to support the studies;
- the decision that it is the Municipalities that directly assign the task to a duly selected implementing entity.

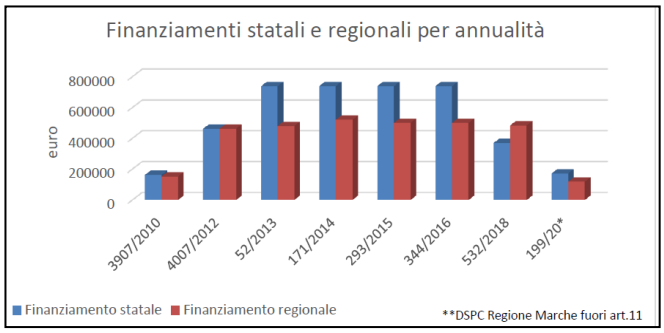
To implement this last point, the Marche Region has provided to regulate the procedures for conferring the assignments, indicating a series of principles aimed at favoring the best and most correct carrying out of studies and the adequate selection of the persons in charge, contained in the disciplinary scheme assignment to be provided to the Municipalities (Decree DPS 163/2011), within which it also provided for:

- the obligation to identify the figure of a young collaborator (with less than 5 years of membership in the professional order) who supports the geologist in charge;
- the obligation to participate during the performance of the assignment in the technical coordination meetings with the Regional Commission, in order to evaluate the progress of the studies and support the appointees;
- starting from 2012, the collaboration with the persons in charge of the parallel studies of CLE.

With the introduction of the CLE analyzes starting from 2012, the DGR 1470 of 13/10/2012 extends the selection criteria of the Municipalities also to the CLE, deciding that every year the Regional Civil Protection identifies the Municipalities on which to carry out the MS and the CLE analysis based on the demographic dimension, the anthropization of the territory and the presence of infrastructures of strategic interest and the possible drafting or adaptation of the PRG.

Following the resolution with DGR 967 of 5 July 2011, in 2012, through the Regional Law of 26 November 2012 No. 35 "Provisions on seismic microzonation", the Region formalizes in its legislation the introduction of Seismic Microzonation studies , defining that the Municipalities must carry out the MS studies, which areas will concern these studies in particular (Art. 1) and that the urban planning tools must be adapted to such studies after their certification of conformity (Art. 2 and 4); currently the law is still awaiting the publication of the implementing rules.

The regional curriculum starts in 2011 and; over the years, through the various acts by the Regional Civil Protection, state funding, provided through art. 11 in the 7 years foreseen, were integrated by the Marche Region with a regional co-financing and transferred to the Municipalities identified from time to time (according to the procedures provided for in the Ordinances), so that they directly entrusted the professionals selected by them to carry out the MS studies (and CLE analyzes since 2013) (Im. 14).



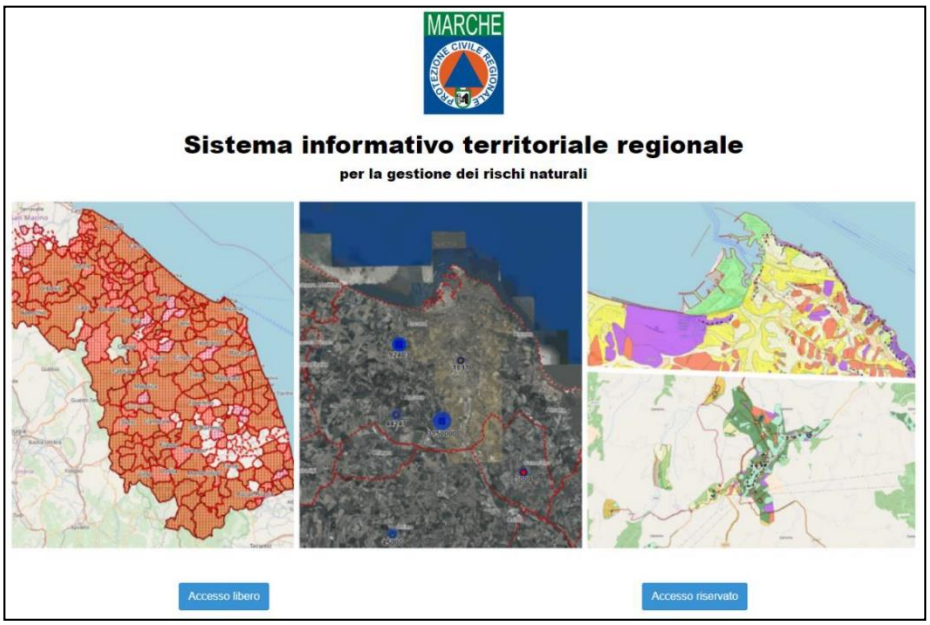
Im. 15: The composition of the loans disbursed by the Region for the various years.

In 2015, through an agreement between the Experimental Geophysical Observatory of Trieste and the Marche Region, the "Regional abacuses for lithostratigraphic amplifications aimed at drawing up level II seismic microzonation maps" were developed, thus implementing the indications present in the Guidelines and Criteria for MS (DPC-CRPA 2008), which advise individual Regions to develop their own abacuses for the quantitative characterization of the amplification phenomena expected in the "stable susceptible to amplification" areas for which a simplified approach may have significance (objective of level 2 MS studies). The schedules, after a series of reviews and tests, were made available and used for level 2 studies starting in 2018. In the same year, pursuant to Regional Law no. 35/2012, an agreement (renewed and still in place) was stipulated between the Marche Region - Civil Protection Service and the C.N.R. - Institute of Environmental Geology and Geoengineering (IGAG) so that it provides support activities to the Region through various actions, such as the supervision of the preparation of the level 2 studies that were about to be carried out and the indications to the Municipalities for a correct application of Article 2 of Regional Law 35/2012, which provides that the Municipalities adapt their urban planning tools to the studies of MS.

The Regional Territorial Information System for the management of natural risks

The Civil Protection Service of the Marche Region has created an online "Regional Territorial Information System for the management of natural risks", in which to archive and make accessible in an open form, all the regional MS and CLE studies validated each year by the National Commission for the MS.

The portal, available at https://qmap-protciv.regione.marche.it/, has a WebGis section in which it is possible to interactively browse the maps produced and a section where it is possible to view and download all the data present, both in documentary and vector format.



Im. 16: The home page of the regional site for the management of natural risks.

In addition to the information relating to the MS studies and the CLE analyzes, the portal has been perfected, implemented and expanded over the years: one section contains links to the Civil Protection Plans of the Municipalities of the Marche, while in another the information has been entered relating to the safety measures carried out in the area with resources made available from time to time following various declarations of a state of emergency.

To date, the portal has become a very important archive and an easy and quick consultation tool by Prefectures, Professional Orders, Provincial and Municipal Administrations as well as individual citizens.

Forest fires risk

More than 4,000 km2 of vegetation burns down every year in the European Union, 85% of it in southern Europe. The consequences for the natural balance are very serious and the time for forest and environmental ecosystem restoration very long. The alterations of natural soil conditions caused by fires also promote slope failures. In the current context of climate change, forest fires are a problem that is bound to complicate and worsen in the coming years. Indeed, in Europe, global warming is leading to an increase in the number of danger days and consequently an extension of the fire season, making our forests increasingly vulnerable.

At the same time, certain socio-demographic phenomena have also influenced the intensity of forest fires, particularly rural abandonment and changes in agricultural practices and land use. The gradual abandonment of the countryside and thus of agricultural, pastoral and forest management practices, which has been ongoing since the 1960s in most of Europe, has led to a consequent decrease in land management. Less management also means uncontrolled increase in vegetation and forest area, making more material available for burning and thus facilitating fire spread. In fact, one of the determining factors for the spread of a forest fire is the availability and continuity of surface forest combustible material, i.e., shrubs and plants that grow uncontrolled. In short, lack of management increases the vulnerability of the land to fire. Another consequence of the lack of rural land management is the displacement of the urban-forest interface, i.e., bringing the forest closer to urban centers, which puts homes at greater risk should a fire occur.

Best practices. Civil protection activities carried out for forest fires risk management.

Forecast

The forecasting activity consists in identifying the areas and periods at risk of forest fire, as well as the hazard indices elaborated on the basis of climatic and vegetation variables, the application of which is crucial for the planning of prevention and extinguishing interventions.

The forecasting activity, but more generally the warning system, makes use of the forecasts of the dangerous conditions of possible forest fires and the resulting risk scenarios not only in wooded and rural areas, but above all in peri-urban areas. These activities, implemented by the Department and the regions through the

network of functional centers, are therefore fundamental in view of the activation of the interventions that take place on the basis of the needs expressed by the individual territories.

The management of the alert system is ensured by the Civil Protection Department through the Central Functional Center and the Forest Fire Risk and Interface Service, which issues a daily bulletin of susceptibility to the initiation of forest fires throughout the national territory, identifying for each province three levels of danger (low - medium - high). Three different situations correspond to the three levels of danger:

- low danger: the event can be faced with ordinary means only and without particular use of forces;
- average danger: the event must be faced with a rapid and efficient response from the active control system;
- high danger: the event can reach such dimensions as to almost certainly require the participation of the state air fleet.

The forecasts are prepared not only on the basis of weather and climatic conditions, but also on the basis of vegetation, physical state and land use, as well as the morphology and organization of the territory. The bulletin is limited to a provincial-scale forecast, estimating the average value of the susceptibility to triggering over a period of time useful for the next 24 hours and a trend for the next 48.

The bulletin is made available to Regions and Autonomous Provinces, Prefectures, Forestry Carabinieri and Fire Brigade. The decentralized functional centers, in the Regions where the alert system is active, can in turn issue a fire susceptibility bulletin.

National forest fire forecast bulletin

As required by the Directive on the active fight against forest fires of 1 July 2011 signed by the President of the Council of Ministers, the Department of Civil Protection prepares a national forest fire forecast bulletin on a daily basis, taking into account the weather and climate conditions, vegetation, the physical state and use of the land, the morphology and organization of the territory.

The Bulletin reports the probabilistic forecasting scenario of the susceptibility conditions to the initiation and propagation of forest fires, articulated on three levels (low, medium, high), with an estimate of up to 24 hours and a representation of their trend up to at the most appropriate time scale.

This forecasting tool aims to provide the Department Offices with information to support the activities of the State air fleet so as to modulate organizational management in terms of maximum profitability.
The Bulletin is also made available to the competent Administrations on the subject for an exchange of information aimed at promoting a synergistic framework of initiatives and interventions to combat forest fires.

Prevention

Prevention activities aim to counteract the factors and causes that determine the initiation and development of fires. Prevention is divided into activities that vary according to the methods, timing and intensity of the interventions to be carried out. Generally, these interventions are classified into:

- cultural interventions: they act on the distribution and quality of the fuels present in the space in the form of biomass and include:
    a. reduction of combustible biomass with high propagation potential;
    b. collection of woodworking residues;
    c. pruning;
    d. thinning;
    e. re-naturalization of formations;
    f. elimination of highly flammable species.
- infrastructural interventions: they serve to limit difficulties or shortcomings connected with the physical nature of the territory to be defended. They include construction, restoration and maintenance activities for:
    a. service roads;
    b. fire-break avenues;
    c. water supply points;
    d. stands for helicopters.

In cases where cultivation interventions cannot be applied due to the poor accessibility of the sites or due to excessive costs, infrastructural interventions are the only possible interventions. Alongside these preventive

interventions, which can be defined as direct, those of indirect prevention must be identified which have an impact on the whole territory. They are divided into:

- short-term interventions that include the set of activities aimed at raising awareness among citizens, in order to avoid behaviors that can trigger fires, such as for example the posting of signs or the distribution of brochures illustrating the behavior to be adopted in the event of fire.
- long-term interventions based on information campaigns, awareness raising in schools, AIB training courses for volunteers, etc.

Among the preventive measures to deal with the risk of forest fires there are:

- Forestry prevention: includes the set of operations that tend to reduce the impact of any passage of fire on the wooded surface or to reduce the possibility of ignition;
- Fire-resistant avenues: these consist of open roads or tracks created to prevent the spread of fires in wooded areas;
- Fire protection strips in wooded areas: these are areas with a lower density of vegetation between the forest and areas with different destinations, the aim of which is to reduce the forest fire risk and, at the same time, allow the extinguishing operations to take place in safe conditions and in a short time;
- Prescribed fire: it is a technique of expert and authorized application of fire to vegetation, on planned surfaces, with the aim of eliminating some particularly flammable parts of the vegetation, such as litter and dry grasses, in order to reduce the impact of the passage of fire in specific areas and facilitate fire-fighting interventions;
- Water supply: the water supply network is composed of large basins and water supply points, both natural such as streams and lakes, and artificial ones, such as artificial reservoirs, hydrants and pipelines, for land vehicles and for helicopters operating in extinguishing;
- Forest road system: it has the purpose of allowing the access of AIB operators and vehicles in the wooded complexes;
- Helicopter stands: serve to increase the operational capacity of the helicopter service, reducing intervention times by locating landing stands in areas where fire is likely to develop. These landing points are useful both for refueling the aircraft and for boarding people, materials and water.

Active fight against forest fires

The fight against forest fires aims to reduce economic damage and mitigate the consequences on the environmental and socio-cultural heritage. It is based on the identification of the main objectives to be defended. Among these, the Park Areas, as established by law 353/2000, are of absolute priority.

Excluding housing structures, such as urban centers, farmhouses etc., which differ from this planning as they are the responsibility of other Bodies, the following elements of evaluation are considered:

- vegetational and environmental value: protected natural areas;
- wooded and / or non-wooded areas adjacent to inhabited centers;
- young reforestation and / or coniferous forests;
- difficult accessibility from the ground to the areas referred to in the previous points;
- extension of the area to which the fire can spread;

The interventions of active fight against forest fires include reconnaissance, surveillance, sighting and extinguishing activities by air and land vehicles.

The regions organize the aforementioned activities through the regional plan, ensuring the coordination of their fire-fighting structures with the state ones through the Permanent Unified Operations Room (S.O.U.P). The S.O.U.P. ensures the connection and coordination between the regional and local levels, manages the intervention of regional air vehicles and the request for air competition from the state vehicles.

The Department of Civil Protection guarantees and coordinates on the national territory, through the Unified Air Operational Center (C.O.A.U.), the aerial firefighting activities with the State firefighting fleet.

The C.O.A.U., is continuously active within 24 hours throughout the year. Command and control center for all aircraft made available for competition in civil protection activities, the C.O.A.U plans and coordinates flight activities both nationally and internationally. In the forest firefighting activity he is in constant contact with the Regional Operational Centers and Soups of all the Regions. To minimize the time required to arrive at the site of operations, the planning of the ground dislocations of the available air vehicles is essential. The firefighting planes and helicopters of the state's air fleet are deployed on the territory taking into account the areas at risk and the weather conditions that make forest fires more likely to ignite. Any point in the country can be reached within 60/90 minutes of take-off.

Puglia Region's experience.

The Puglia forest heritage, based on data produced by the National Inventory of Forests and Forest Carbon Tanks (INFC, 2005), amounts to 179,040 hectares and specifically the regional forest area is divided into:

- 145,889 hectares of "Woods" (81.48%)
- 33,151 hectares of "Other wooded lands" (18.52%).

The provincial distribution of the forest heritage indicates the province of Foggia as the one with the greatest forest resources, followed by Taranto, Bari, Lecce and finally Brindisi.

Province	Superficie territoriale (ha)	Superficie boscata (ha)	Altre terre boscate (ha)
BARI	513.831	26.333	1.902
BRINDISI	183.717	2.719	388
FOGGIA	718.460	91.188	20.024
TARANTO	243.677	21.363	9.671
LECCE	275.940	4.293	1.165
PUGLIA	**1.935.625**	**145.896**	**33.150**

Im. 17: Source C.F.S. - INFC, 2005.

Still according to the INFC 2005, with respect to the degree of mixture of the topsoil, in Puglia as in almost the whole national territory, the pure deciduous forest prevails followed by the pure coniferous forest.
Furthermore, it is important to report from the IFNC 2005 survey that the naturalistic constraint is triggered on forest surface falling within national or regional protected areas and Natura 2000 sites and concerns as much as 62% of the regional forest area (of which 44.8% falls in SIC and SPA areas).
In the Puglia Region, the forest fire risk assessment is described in the 2018-2020 AIB Plan, approved with Regional Council Resolution no. 585/2018, the validity of which was extended to the year 2021 pursuant to and for the purposes of the Regional Council Resolution no. 388/2021.
The zoning of the risk, carried out at the municipal level, arises from a methodological procedure that takes into consideration some basic components: woodiness, potential risk, real risk, density of roads, presence of pastures.

The linear combination of indices, appropriately weighted and normalized on a regional basis, leads to the definition of an Overall Risk Index (IR) at the municipal level and, therefore, to a classification of the territory by risk bands.

The components were expressed in indices defined as follows:

1. Woodiness index (IB): based on the previous information on the regional forest heritage, the woodiness index was calculated for all the Apulian municipalities. The index was calculated as the ratio between the forest area and the overall area of the municipality in question. In essence, it is an index that identifies the overall and undifferentiated exposure, in terms of surface area, of each individual municipality to the risk of forest fire;
2. Stain index (IM): based on the most updated UDS (Land Use) of the Puglia Region (2011), the presence index of sclerophyll vegetation was calculated, attributable to the associative plant formation defined as Mediterranean Macchia. For all the Apulian municipalities, the index was calculated as the ratio between the surface with the presence of scrub and the overall area of the municipality in question;
3. Potential Risk Index (IRP): it is calculated by attributing a different weight to the plant formations present, based on the definition of the hazard exclusively linked to the fuel model attributable to each phytocoenosis present and its load, according to the proposed method by Vicente et al. (2000);
4. Real Risk Index (IRR): it is based on the real incidence of the phenomenon, both in terms of the area actually covered by the fire, and in terms of the number of fires that developed in each municipality in the period between 2008 and 2015;
5. Climate Risk (RC): determined on the basis of the maximum temperature and minimum precipitation variables, analyzed individually for the elaboration of the index. The starting information layers, in raster format (1km2 cell), are represented by the monthly average of the maximum temperatures and minimum rainfall recorded in the period 1976-2005 for the whole regional territory;
6. Density of Roads: indicates the distribution of road networks and accessory spaces, railway networks including the adjoining surfaces of the Region. The density was calculated using the "Kernel density" method. Each municipality was then assigned the average density value over the entire municipal area;

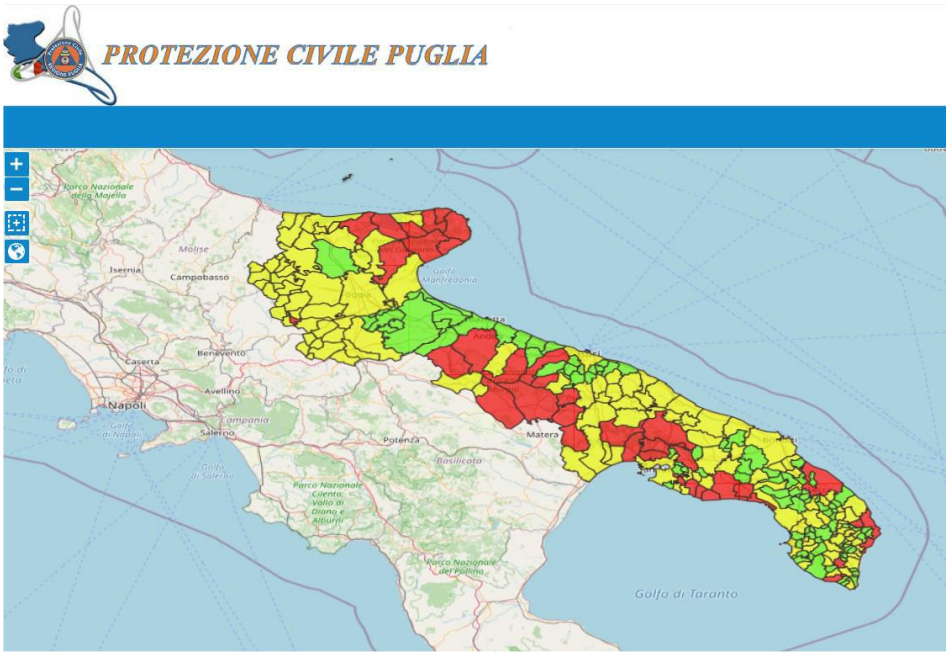
7. Presence of pastures (IPAS): it is based on the real presence of pastures present on the regional territory. For this estimate, information on the land use of the Puglia Region was used.

The seven basic indices have very different values and ranges of variation; in order to make them comparable and aggregable in an overall index, they have all been rationalized so as to obtain an interval between 0 and 1 for each variable.

Furthermore, taking into consideration the great variety of ecosystems and vegetation formations that the Puglia Region possesses, immersed in a predominant agricultural and anthropic matrix, it was considered appropriate to diversify the contribution of each variable in the calculation of the overall index.

The overall risk index is therefore calculated on a municipal basis as follows:

$$IR = 4 * (IB) + 4 * (IM) + 3 * (IRP) + RC + DS + IPAS$$



Im. 18: forest fire risk map on a municipal scale.

Activities carried out for risk management

The forest firefighting (A.I.B.) activities carried out by the regional civil protection system have the purpose of protecting the forest environment, reducing the areas affected by fire and related negative impacts (landscape degradation, habitat loss, greater susceptibility to soil erosion, etc.).

The aforementioned purpose is pursued through civil protection planning, the daily forecast of fire criticality levels, the training of A.I.B. operators, information to the population, territorial protection and active fight against forest fires. In the following we will focus on these last two actions, which contribute to the management of risk in real time.

The monitoring of the territory allows the early detection of forest fires by the staff in the field and in the room, also thanks to the views provided by the detection cameras. The latter, equipped with appropriate sensors, were installed in strategic points of the area, characterized by a high naturalistic value and large viewing areas. Furthermore, special patrol services are activated for the territorial control, the intensity of which is linked to the level of fire criticality defined daily in special bulletins issued by the decentralized functional center of the Puglia region.

Active fighting actions, on the other hand, make it possible to reduce the spread of fires and contain the areas affected by the fire. These actions are coordinated by the Unified Permanent Operations Room of the Puglia Region (S.O.U.P.), which avails itself of the active support of the National Fire Brigade, the Forestry Carabinieri, the Regional Agency for Irrigation and Forestry Activities (A.R.I.F.), the fleet regional and national air, of the Organized Volunteer Organizations of Civil Protection duly registered in the Regional List and of the other Local or Functional Bodies.

The SOUP, hinged in the Regional Operational Center (C.O.R.) of the Civil Protection Section, guarantees 24-hour operation in the period of maximum danger of forest fires (15 June - 15 September with possible extension depending on weather-climatic and environmental conditions), defined every year by decree of the President of the Regional Council.

The difficulties encountered due to the regulatory and organizational limits of the structure

The difficulties encountered in the management of forest fires are mainly linked to the organizational limits of some components of the civil protection system, which are sometimes undersized in terms of staff and

the equipment available. These criticalities do not allow the orderly performance of territorial protection and support activities in the phase of active struggle, especially at the municipal level.

Further organizational criticality is linked to the failure to activate the so-called "Optimal territorial and organizational areas", defined by Legislative Decree 1/2018. These structures would make it possible to plan and deliver civil protection activities at a supra-municipal level, overcoming the criticalities connected to the reduced capacity of small municipalities to cope with the workloads for managing forest fire risk with their own men and means.

To the above must be added a criticality linked to the lack of interoperability of the data contained in the civil protection plans, useful for the timeliness of active control actions. In fact, one of the main operational limitations encountered during the event phase, in addition to the lack of human resources, is the reduced knowledge of the water withdrawal points and forest roads to reach the sites affected by the fires.

As regards the difficulties due to regulatory limits, it is worth highlighting the absence of a shared methodology for assessing the risk of forest fires in urban-forest interface areas as well as for the definition of an intervention model that defines the distribution of competences between the different structures that participate in the management of such events.

The solutions identified to overcome the difficulties referred to in the previous point

To overcome the difficulties described in the previous paragraph, the Puglia Region has activated various initiatives. Notably:

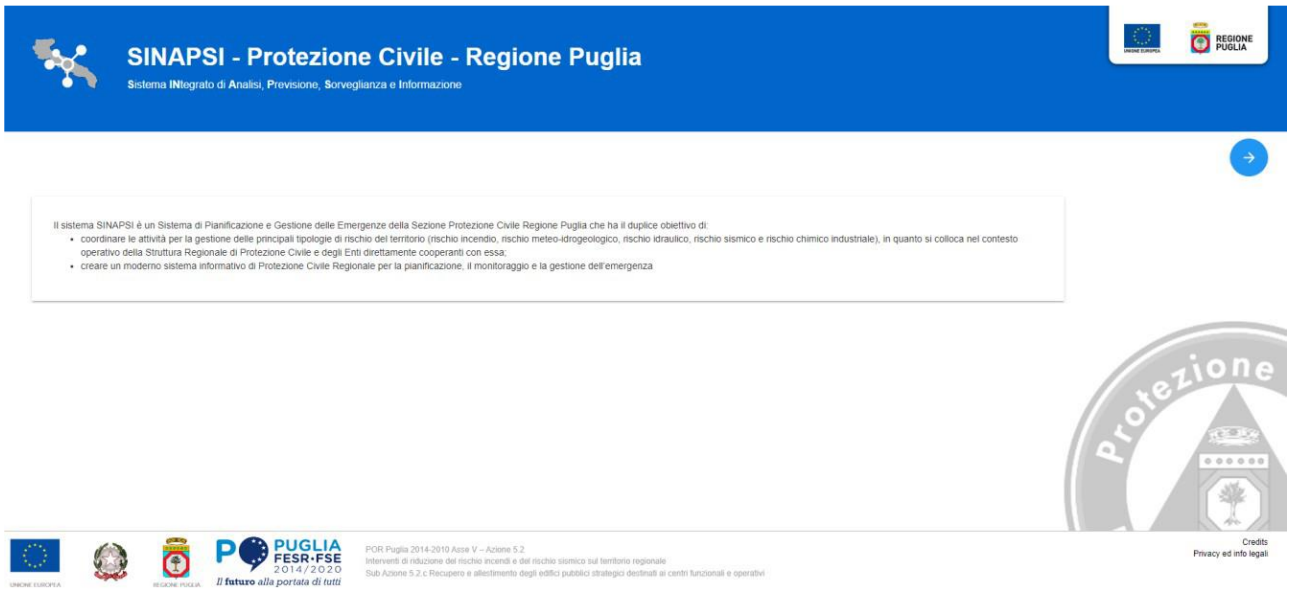
- development of an IT platform for the management of civil protection risks (Integrated System of Analysis, Forecasting, Surveillance and Information - S.IN.A.P.S.I.), which also allows the collection of the contents of civil protection plans and the data that compose them;
- implementation, based on the INTERREG project "Ofidia 2 - Operational FIre Danger preventIon plAtform2", of a highly innovative and cutting-edge system, consisting of a network of wireless sensors, high-resolution cameras and drones useful for detecting fires in wooded areas or in the immediate vicinity of the same;
- financing, under the POR Puglia 2014-2020, in favor of n. 140 Apulian municipalities for the implementation of municipal civil protection plans;

- funding, under the POR Puglia 2014-2020, in favor of the Regional Agency for Irrigation and Forestry Activities (A.R.I.F. Puglia) for the implementation and activation of the territorial civil protection unit;
- funding, under the POR Puglia 2014-2020, in favor of the University of Bari for the development of fuel models and for the identification of forest roads;
- provision, under the INTERREG project "TO BE READY - The flOod and Big firE foREst, prediction, forecAst anD emergencY management", of training courses in favor of personnel involved in various capacities in forest fire prevention activities (Director of Shutdown, Operations Room Manager, Room Workers, Safety and coordination of AIB teams, etc.);
- agreements with the Regional Fire Department and the Regional Command of the Forestry Police to support the management of the AIB campaign in the period of serious danger through the presence of its own personnel in S.O.U.P. and additional teams in the area;
- identification of a company for the extinguishing service of forest and non-forest fires with the launch of water and / or extinguishing / retardant products, or other compatible additives, through the use of two fixed-wing aircraft;
- approval of the territorial contexts identified as a result of the activities of the PON Governance for the subsequent perimeter of the optimal territorial and organizational areas, useful for their organization.

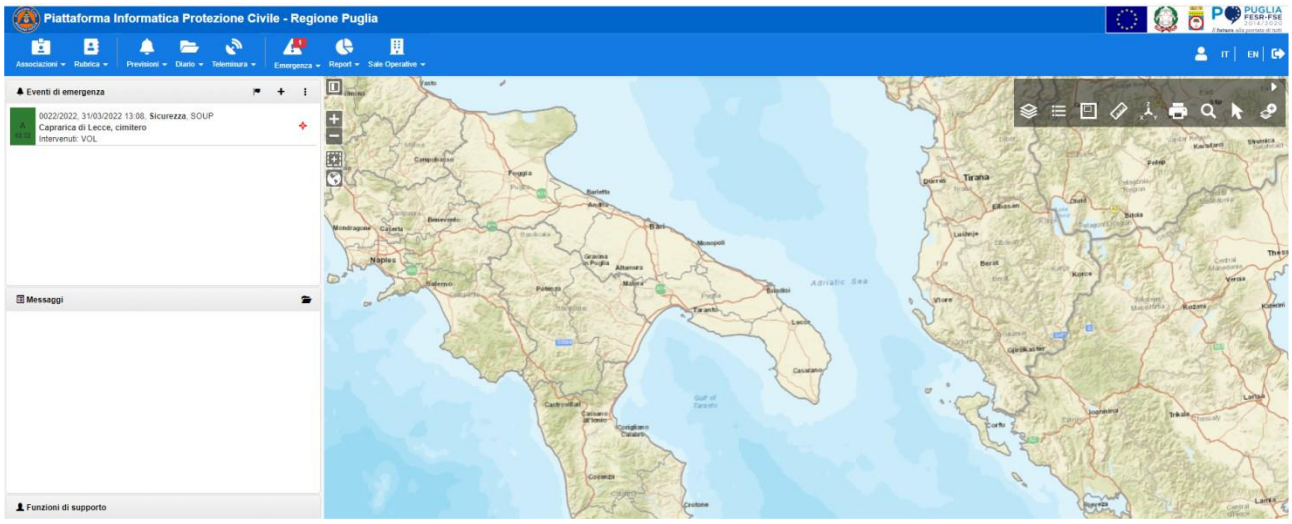
Proposals to adapt the regulations or the structure

For the constant adaptation of the regulations and the structure, the updating of the AIB operational program is proposed annually. In this sense, the Puglia Region annually draws up and approves this program, as part of which the procedures for managing fires are updated. These updates make it possible to take into account the current knowledge of the territory and any changes in the organization of the regional civil protection system. In addition, for the constant updating of geographic information layers and planning tools, it is proposed to use a common platform accessible by all entities involved in the management of civil protection risks, both in deferred time and in the event phase.

In this sense, the Puglia Region has activated the S.IN.A.P.S.I. platform, currently under development and continuous adaptation, to collect, in a systematic and readily accessible way, any information useful for risk management.



Im. 19: S.IN.A.P.S.I. platform interface.



Im. 20: S.IN.A.P.S.I. platform interface.

Oil spill risk

Oil spill risk refers to the likelihood of an accidental or deliberate release of oil into the environment, typically from oil tankers, pipelines, offshore drilling operations, or oil storage facilities. These spills can have significant ecological, economic, and social impacts on marine and coastal environments.

Several factors contribute to oil spill risk:

- Transportation: The transportation of oil by sea, land, or pipeline increases the potential for spills. Tanker accidents, pipeline leaks, or derailments can result in oil spills.
- Offshore drilling: Exploration and production activities in offshore oil and gas fields pose a risk of spills due to equipment failure, blowouts, or accidents during drilling, well construction, or platform operations.
- Aging infrastructure: Aging pipelines, storage tanks, and other infrastructure increase the likelihood of leaks or failures that can lead to spills.
- Human error: Human mistakes, such as improper handling, equipment operation, or inadequate safety measures, can result in oil spills. These errors can occur during oil transfer, vessel navigation, or maintenance activities.
- Natural disasters: Severe weather events, such as hurricanes, storms, or earthquakes, can damage infrastructure or vessels and cause oil spills. These events can make containment and cleanup efforts more challenging.
- Environmental sensitivity: Areas with high ecological or environmental significance, such as coral reefs, sensitive habitats, or protected areas, face greater risks from oil spills due to the potential for severe ecological damage.
- Regulatory compliance: The effectiveness of regulations and enforcement in place to prevent spills and ensure proper response and cleanup plays a significant role in spill risk. Weaker regulations or non-compliance increase the risk of spills.
- Response capabilities: The availability of resources, technologies, and trained personnel to respond to and contain oil spills affects the overall risk. Adequate response capabilities can mitigate the impact of spills.

Efforts to mitigate oil spill risk should include analysis of the event and use of specific models and monitoring actions combined in emergency plans based on the Early Warning Early Action paradigm, to reduce the environmental damage.

The Mediterranean is one of the areas more exposed to the risk of oil pollution. In the waters of the Mare Nostrum passes 20% of all worldwide product traffic petroleum: approximately 360 million tons per year. In the Mediterranean they operate every day 2000 ferries, 1500 cargo, 300 ships tank. It is estimated that every year they end up in Mediterranean waters between 100 thousand e the 150 thousand tons of petroleum products. It is estimated that every year they end up in Mediterranean waters between 100 thousand ends the 150 thousand tons of petroleum products. Over 40% of the hydrocarbon is caused by the activity operational and routine.

Best practices. Civil protection activities carried out for oil spill risk management.

In Italy, the National Service of Civil Protection participates in activities for the defense of the sea and coastal areas from hydrocarbon pollution caused as a result of an accident, if the danger of pollution or the pollution in progress is such as to result in an emergency situation that cannot be coped with by the means available to the Ministry of the Marine Mercantines. In such a case, the Civil Protection Department shall assume the direction of all operations on the basis of the national emergency response plan adopted by the organs of the National Civil Protection Service.

The National Emergency Response Plan for the defense of the sea and coasts from pollution by hydrocarbons or other dangerous and noxious substances.

The Italian response activities to marine and coastal pollution by hydrocarbons and HNS are organized on three management levels which correspond to three planning levels. Level 1 - pollution of light or medium severity, is regulated by the Local Operational Plans (POL) of the maritime compartments and by the coordination plans of the Maritime Departments; level 2 - severe pollution, is subject to regulation in the MiTE Plan; while level 3 - very serious pollution, is regulated by this Plan.

As part of the activities implemented pursuant to this Plan, it is understood that search and rescue operations (SAR), for the safeguarding of human life at sea, have priority over any other type of intervention.

Response systems.

Management at national level

The Department of Civil Protection (DPC), following the resolution of the state of emergency implements the coordination of the activities aimed at defending against hydrocarbon or HNS pollution of the sea and coasts, carried out by the Administrations and Bodies, as well as by the operational structures involved at national, territorial and peripheral level. The following contribute to emergency management:

- the Ministry of Ecological Transition (MiTE) through:
  - the General Management (DGPNM);
  - the Marine Environmental Department of the Port Authority Corps - Coast Guard (RAM);
  - the Directorate-General for infrastructures and safety (DG IS) - exclusively in the event of accidents deriving from mining activities for the exploration and cultivation of hydrocarbons, with the coordination of its branch offices (UNMIG) competent for the territory;
- the Higher Institute of Environmental Protection and Research (ISPRA) following activation by the MiTE in the local emergency phase or directly by the DPC as a Center of Competence, for technical and scientific support for emergency management;
- the Ministry of Infrastructure and Sustainable Mobility (MIMS) through the central and territorial organization of the Port Authority Corps - Coast Guard, which is assigned the operational direction of operations at sea through its National Operational Center of the Coast Guard (CONGUARCOST) and / or the Designated Maritime Authority, if delegated for the exercise of operational management;
- the Ministry of the Interior by activating:
  - the Department of Firefighters, Public Rescue and Civil Defense which provides, also through the territorial divisions, the technical contribution in order to ensure public safety both from the point of view of fire risk and from that of exposure to HNS, as well as to contribute to instrumental monitoring procedures and fire surveillance activities, to make the places affected by the event safe;

- the Prefectures - Territorial Offices of the Government (UTG) territorially affected by the event which in consideration of the nature of the events and the consistent involvement of the state forces, assume the unitary direction of the emergency services at the provincial level, in coordination with the regional structure of civil protection;

- the Ministry of Defense, through the Operational Command of the Joint Forces Summit (COVI), which activates the use of its resources for anti-pollution operations;
- the Ministry of Agricultural, Food and Forestry Policies (MIPAAF) contributes to the management of the emergency, with particular reference to protected areas, activating the central and peripheral organization of the Carabinieri Forestry, Environmental and Agri-food Unit Command;
- the Ministry of Health makes use of the network of experimental zoo-prophylactic institutes;
- the Customs Agency which favors the administrative procedures connected both with any problems of provisional storage and initiation of disposal of the collected oils and other polluting or polluted products or materials, and to facilitate the eventual arrival and use, in the territory national, of means and materials from foreign countries to face the emergency.
- Volunteer Organizations, previously formed for the specific type of intervention and the use of the equipment provided.

Management in the territorial and peripheral areas

- the competent Maritime Authority or, where appropriate, the designated one exercises the operational direction of the activities at sea for the defense against oil pollution or HNS. To carry out these tasks, it appoints and makes use of the Area Coordinator (OSC) who exercises tactical direction, maintaining control of the naval units at sea. The Designated Maritime Authority maintains contact with the Judicial Authority;
- the Prefecture - Territorial Office of the Government competent for the territory which, in the event that the pollution reaches the coast, assumes, in conjunction with the President of the Regional Council and in coordination with the regional civil protection structure, the operational management on land of all emergency services to be activated at the provincial level provided for by the specific

Provincial Civil Protection Plan, in order to guarantee public safety, environmental protection, as well as the removal, collection and start of disposal and / or recovery of polluting materials;

- the Regions ensure, the carrying out of the related civil protection activities in the regional context;
- the Environmental Protection Agencies that operate, in conjunction with ISPRA, within the National Network System for Environmental Protection (SNPA), with expertise in the characterization of pollutants and in the monitoring and evaluation of level of contamination and environmental risk;
- Municipalities whose coast has been directly affected by pollution, or is threatened by it, guarantee the implementation of information and assistance measures to the population by taking any further actions, also in consideration of the principles of adequacy and differentiation;
- the Peripheral Territorial Commands of the Armed Forces that intervene with operational and logistical functions with territorial competence, operating in the area affected by the emergency, make their organizations available according to the directives issued by COVI;
- the Carabinieri Forestry Departments, operating in the protected area affected by the emergency, make available the human and instrumental resources available, in accordance with the directives issued by the Carabinieri Forestry, Environmental and Agri-food Unit Command;
- the peripheral UNMIG offices, in conjunction with the Directorate General for Infrastructure and Safety (DG IS) of the MiTE, operate as supervisory authorities and mining police in matters of safety and health of workers in onshore and offshore activities for research, cultivation and storage of hydrocarbons, also providing technical-logistical and administrative support to the peripheral Committee for the analysis and evaluation of major hazard reports, major accident prevention and design communications and other related technical documents for all offshore activities;
- the regional health services, through the local health authorities (departments of prevention / public health) ensure the hygiene control activities of fishery and aquaculture products from the area affected by the event.
- Volunteer Organizations, previously formed for the specific type of intervention and the use of the equipment provided.

Event scenarios

The event scenario, both for hydrocarbon and HNS pollution, is defined on the basis of the type of accident, pollution, even potential, and its severity.

- Level 1, pollution of light or medium severity, or potentially such, which by extent and / or extent and / or type of pollutant can be managed with locally available personnel, equipment and equipment, without representing a direct, immediate and substantial threat to the it costs. This situation also includes accidental spills occurring at or near an identified structure / ship, which have a slight or low environmental impact;
- Level 2, severe pollution, or potentially such, which due to extent and / or extent and / or type of pollutant cannot be managed with locally available personnel, equipment and equipment and represents a serious threat to the coast. This situation includes pollution that requires assistance and additional local, regional, state or in compliance with international agreements;
- Level 3, very serious pollution, or potentially such, which by extent and / or extension and / or type of pollutant and the areas concerned, requires the resolution of the state of emergency of national importance. This includes pollution that requires additional state or international assistance and resources.

Intervention model

The intervention model defines the actions that the various peripheral, territorial and national bodies must take to deal with the emergency both for the pollution of the sea and the coast by hydrocarbons, and for that relating to HNS.

Level 1 - Light or medium-severity pollution

The intervention, in cases of pollution scenarios, even potential, of Level 1, is regulated by the Local Operational Plans (POL) of the maritime compartments and by the Coordination Plans of the Maritime Departments. This is a situation that can be managed locally with the resources available there.

Level 2 - Severe Pollution, Local Emergency

The intervention, in the cases of pollution scenarios, even potential, of Level 2, is regulated by the MiTE operational plan both as regards the choice of operational strategies and their management. This is a more complex situation than Level 1 and requires the declaration of the status of Local Emergency by the Head of the Maritime Department with the implementation of the actions provided for by the alert phase and the measures provided for by the Provincial Plans if the pollution reaches the coast. This Level also includes pollution that is managed under international agreements and that which by extension and / or entity involves several Maritime Compartments, until the national emergency declaration intervenes. If the pollution is no longer compatible with the territorial resources used, the state of mobilization of the National Civil Protection Service may be ordered pursuant to art. 23 of the Civil Protection Code.

Alert phase during the level 2 emergency

This phase begins with the declaration of the Level 2 Local Emergency status, following which the General Command of the Port Authority Corps - Coast Guard and the Ministry of Ecological Transition alert and keep the Civil Protection Department constantly updated.

Actions of territorial and peripheral bodies in the Level 2 emergency

During the alert phase in a Level 2 emergency, the following actions will be ensured by the local and peripheral bodies:

- the Head of the Maritime Department who implemented the POL and declared the Local Emergency (Level 2) complies with the MiTE operational plan, ensuring a continuous flow of data and information that allows to have the real situation of the event as well as its evolution, keeping the MiTE - COIMAR and RAM, the DPC - COEMM, the CONGUARCOST, the Prefecture - U.T.G., the Region and the Mayors involved in the emergency;
- the Prefect, in agreement with the Head of the Maritime Department, takes action to prepare and implement, where necessary, all the measures on the threatened stretches of coast, based on the specific Provincial Plan, liaising with the Mayors involved in the emergency. The Prefect keeps the MiTE - COIMAR and RAM, the DPC - COEMM, CONGUARCOST and the Region constantly updated on this activity and the evolution of the situation;

- the Region, in conjunction with the Prefect, ensures the use of regional resources to deal with the emergency in progress by activating, where necessary, the Crisis Unit. In relation to the evolution of the scenario, if the means and forces in the field at their disposal are not sufficient, they evaluate the need to make a specific request for additional means and resources to the DPC;
- the Mayor ensures information and assistance to the population, also contributing to emergency management, also in relation to the provisions of the Provincial Plan.

Actions of the Civil Protection Department in the Level 2 emergency

The Civil Protection Department, as soon as it receives the news of the local emergency declaration, through the Italy Situation Room and the Maritime Emergency Operations Center, helps to ensure a constant flow of information with:

- the Ministry of Ecological Transition;
- Directorate-General for naturalistic heritage and the sea (DG PNM);
- Marine Environmental Department of the Port Authority-Coast Guard Corps (RAM); - Directorate General Infrastructure Security (DG IS);
- the General Command of the Port Authorities - Coast Guard - National Operations Center (CONGUARCOST);
- the Higher Institute of Environmental Protection and Research (ISPRA);
- the Ministry of the Interior - National Fire Brigade Operations Center (CONVVF);
- the Ministry of Defense - Operational Command of Vertice Interforze (COVI) if naval vessels of the M.M. with adequate command, control and logistical support capabilities or with specific anti-pollution capabilities, as well as other resources of the Armed Forces;
- the Ministry of Agricultural, Food and Forestry Policies Forestry, Environmental and Agri-food Unit Command of the Carabinieri.

In particular, in relation to the evolution of the scenario, it provides:

- make contact with the Region and the Prefecture - Territorial Office of the Government concerned, in order to ascertain that the measures of their respective competence have been prepared;
- alert the national voluntary organizations formed and equipped to deal with any beaching of hydrocarbons and the specialized centers for the care of avifauna, mammals and marine reptiles;

- activate any air competition, in addition to the one already put in place by the aircraft of the Port Authority - Coast Guard, of other structures of the Defense Administration and / or other Bodies / Administrations of the State in support of monitoring activities environmental.

Furthermore, again through the Italy Situation Room and the Maritime Emergency Operations Center:

- maintains operational communications with the MiTE - COIMAR and RAM, CONGUARCOST, with the Prefecture - U.T.G., the Region and the Mayors interested in the emergency to acquire any useful information on the evolution of the event;
- follows the situation to acquire and process any useful information;
- follows any activations requested by the MiTE for emergencies in execution of national and international Agreements and Conventions for cooperation and fight against accidental marine pollution; - follows through the MiTE the alerting of the industrial sector of the research and cultivation of hydrocarbons at sea for the possible provision of its anti-pollution resources;
- activates, as a national focal point for the CECIS marine pollution telematics platform, any requests for help from the Participants of the Union Civil Protection Mechanism and EMSA and at the same time, sends requests for help if necessary.

Level 3 - Very serious pollution, National Emergency

The intervention, in cases of pollution scenarios, even potential, of Level 3 is regulated by this Plan.

This is a situation that, due to its size or gravity, requires the use of extraordinary resources even in the imminence of the event, through the resolution of the national state of emergency (Article 24 of the Code).

This level follows the alert phase and provides for the implementation of the actions of the national emergency phase.

Following the alert phase initiated for Level 2, when the pollution is no longer faceable with the means and resources deployed by the MiTE, the Council of Ministers resolves the state of National Emergency pursuant to art. 24 of the Civil Protection Code.

Actions of the Department of Civil Protection in Level 3

The Head of the Department, in relation to the news and information flowing into the Italy Situation Room and the Maritime Emergency Operations Center, orders the convocation of the National Civil Protection Operational Committee which ensures the coordination of emergency activities.

The DPC assumes the strategic direction of all operations on the basis of this Plan, in particular, through the Italy Situation Room and the Maritime Emergency Operations Center, requires:

- to the CONGUARCOST the dispatch of the personnel of the Corps to ensure the continuous service 24 hours a day at the COEMM;
- COIMAR to designate its own personnel for the function of liaison with the MiTE;
- to COVI the dispatch of the personnel designated for the liaison function in the case of use of naval units of the M.M.;

Furthermore, the DPC ensures the unitary direction of all the forces employed and specifically it:

- issues civil protection ordinances for the coordination of the implementation of the interventions to be carried out during the state of emergency;
- activates, where necessary, a technical-scientific table to support decisions, composed of representatives of Bodies / Administrations / Organizations deemed appropriate to deal with the emergency, making use, if activated by the MiTE during the Level 2 Emergency, also of the results produced within the "Emergency Coordination Committee";
- establishes the intervention strategies also on the basis of the proposals arising from the technical table;
- coordinates the operations necessary for the assessment of pollution on the coast (SCAT) and the consequent clean-up activities on land and at sea, respectively through the Prefect responsible for the territory to whom the operational management of the state forces on land is assigned, and through the Competent or designated maritime authority to which the operational management of the interventions at sea is assigned, making use of the contribution of the Regions concerned;
- asks the Ministry of Defense, through the COVI, for any other resources and assets of the Armed Forces;

- activates and coordinates the intervention of all available national resources, both of a scientific and operational nature, including those of the national industry in the sector of competition in the clean-up activities and, if necessary, it provides purchase, rental of materials, means and anything else necessary in relation to the type of intervention;
- requests, if necessary, through the CECIS - marine pollution telematics platform at the ERCC, additional resources from participating countries and EMSA;
- coordinates the request for international aid, in conjunction with the Ministry of Ecological Transition and, if necessary, with the Ministry of Foreign Affairs and International Cooperation, on the basis of cooperation agreements and the fight against accidental marine pollution (RAMOGE and others), or in the framework of international conventions also from non-neighboring foreign countries, as well as from both operational and scientific collaborations from international organizations such as the IMO, REMPEC;
- activates and coordinates the use of national voluntary organizations formed and equipped to deal with any beaching of hydrocarbons and specialized centers for the care of avifauna, mammals and marine reptiles;
- maintains the link with the Regions with the purpose of involving territorial voluntary organizations;
- evaluates the possible activation of the Di.Coma.C. in relation to the evolution of the emergency;
- coordinates relations with the press and / or public information media in a unified form.

Actions of peripheral and territorial bodies in National Emergency, Level 3

The peripheral and territorial bodies continue with the activities already put in place in the alert phase (Level 1 and 2), implementing the provisions issued at national level by the DPC and ensuring further measures on the stretches of coast affected by pollution, based on the provisions of the Provincial Plan. In particular:

- the Prefect, in agreement with the Head of the Maritime Department, in conjunction with the Region, continues to implement the measures already put in place on the stretches of the concerned coast, implementing in conjunction with the DPC, the coordination of state forces and related peripheral structures used in the emergency to support the municipalities concerned. It ensures a constant flow of information with the DPC and draws up a daily report on the evolution of the operations in progress and on the evolution of the situation;

- the Region ensures the contribution of the competent regional departments to the regional civil protection structure and, in conjunction with the Prefect, continues to ensure the use of regional resources by implementing the provisions of the Provincial Plan;
- the Mayor ensures information and assistance to the population, also contributing to emergency management, also in relation to the provisions of municipal planning and the Provincial Plan.

Union Cooperation

European Civil Protection is based on the Directorate General for Humanitarian Aid and Civil Protection (DG-ECHO) of the European Commission.

In case of pollution of the sea and coasts by hydrocarbons and by HNS, when its size exceeds the national reaction capacities, the country where the accident occurred can appeal to the EU civil protection mechanism and in particular to the ERCC.

DG-ECHO has set up a 24/7 system capable of:

- providing assistance in civil protection operations including marine pollution;
- intervening specifically on the issue of marine pollution through EMSA whose personnel, specialized naval units, equipment and services can be activated through requests from Member States formulated through the ERCC. The Agency also provides a satellite service for monitoring oil spills through the CleanSeaNet system.

Communications on current emergencies and requests for help from Member States are the responsibility of the DPC, with the use of the CECIS Marine Pollution telematics system via the COEMM.

If there is a need to acquire specific information on the characteristics and behavior in the marine environment of chemical and noxious substances that cause pollution, it is also possible to contact the MAR-ICE Network (MARine Intervention in Chemical Transport Emergencies), activated by the '' EMSA in close collaboration with the CEDRE (Center of Documentation, Research and Experimentation on Accidental Water Pollution) and the CEFIC (European Chemical Industry Council) and to consult databases and guidelines developed internationally and available on the institutional websites of EMSA and REMPEC.

International Agreements

The MiTE is the national authority authorized to act on behalf of the State for the signing of international agreements for cooperation and fight against accidental marine pollution (RAMOGE, etc.), as well as for both operational and scientific collaborations from organizations of an international such as IMO, REMPEC, EMSA, etc. In the event of events falling within the scope of the aforementioned Agreements, it will be the responsibility of the MiTE to request / offer aid to the co-signatory countries of the Agreement and, in the event of a national emergency, in close coordination with the DPC.

ARPA FVG's experience.

Firespill oil risk management is one of the main activity goals defined by ARPA FVG as part of the firespill project, with a specific focus on firespill emergency response planning. Arpa is accordingly conducting a hazard analysis aimed at a subsequent oil spill risk analysis for subjects exposed in the pilot area.

Massive numerical simulations are used for this analysis through the PyGNOME model of NOAA; for each potential identified source, a spill is simulated every hour for a whole year and the trajectory of the pollutant is then followed for the next 48/72 hours.

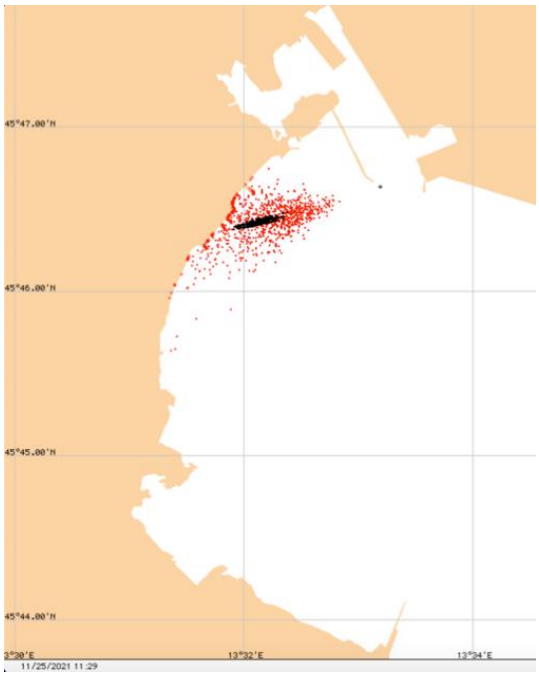
Once the numerical simulations completed and the exposed areas identified, statistics are subsequently produced, differentiated according to weather conditions concerning the quantity of pollutant poured into the observed areas. Moreover, ARPA FVG will conduct a proper risk analysis, thus evaluating, in addition to danger, vulnerability and exposure of the studied subjects.

The ultimate purpose of these activities is to provide stakeholders, specifically the Regional Civil Protection and the Port Authorities in the pilot area, with various tools, such as statistical data and hazard maps, as well as, at a later stage, risk maps, useful for preparing responses to any oil spill emergencies, therefore for a more effective risk management by the bodies in charge.

ARPA FVG has a Prompt Availability service which provides for the activation of multiple specialist teams depending on the need and type of intervention.

Modeling specialists need both context information relating to the area environmental conditions at the time of the accident and information relating to the source to set up the models.

Pointedly, marine modeling requires wind and surface current fields relating to the precise moment in which the accident occurred and information relating to the type and amount of the spilled pollutant.



Im. 21: Numerical simulation with the GNOME Oil Spill model carried out during the exercise.

The information obtained from the simulation models guide the intervention operations for damage containment. Actually, information is provided on the development of the pollutant spot, on the drift times of the spot itself and on the probability of stranding.

Based on previous experiences, some sensitive points emerged in the provision of technical support offered by the Agency to the competent authority for emergency management.

These points risk generating critical issues if not adequately strengthened in the preventive phase.

These aspects are related to the use of simulation models and particularly: the availability of use of a reliable simulation model to describe the area involved in the spill, the availability of environmental data input to the model, the availability of frequent updates of the meteo-marine conditions determining the dispersion of the spill, the use of modeling outputs for a prompt and correct planning of the emergency containment intervention.

Solutions identified to overcome regulatory and structure limits

Environmental data Availability in input to the model

In the context of emergency management, ARPA FVG is developing and implementing some forecasting tools for simulating the dispersion of oily pollutants in the sea. These modeling tools act as a support to the bodies in charge of the effective emergencies management at sea, providing useful information for the activities related to the pollutant containment.

Specifically, the oil spill model currently used in this area is GNOME. Moreover, ARPA FVG prepares and makes available the environmental data which act as input for this model on a daily basis, so that they are available in the event of a spill of hydrocarbons; starting from these input data, it is then possible to conduct simulations and view the outputs through the GNOME desktop version. To improve the quality of the service offered, ARPA FVG works to diversify the sources of these environmental data, in order to guarantee their redundancy in case of absence of data from one of the them as well as to improve adherence to reality of the same sources, through the use of meteorological and hydrodynamic models with suitable resolution for the pilot area.

Currently, ARPA FVG is also implementing the MEDSLIK-II oil spill model in operational mode, to provide stakeholders with an additional forecasting tool in case of emergencies.

Use of modeling outputs for prompt and correct planning of emergency containment intervention

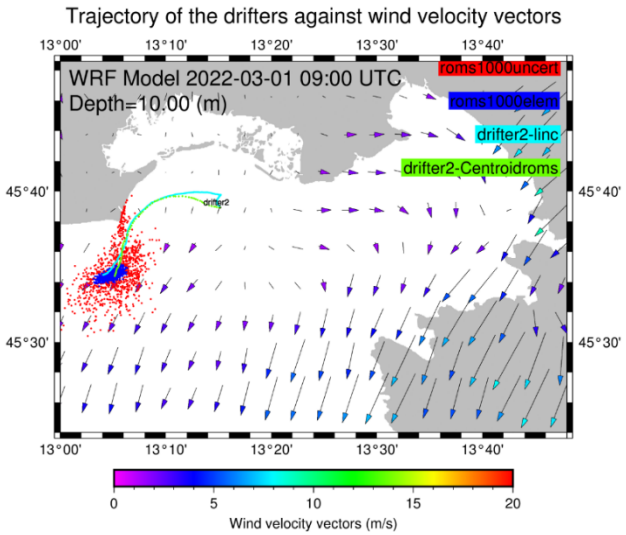
As part of the response planning to oil spill events, ARPA FVG is carrying out, as previously mentioned, hazard and risk analyzes in the pilot area, with the aim of providing those in charge of emergency interventions with statistics and risk maps, useful for improving the planning of such interventions, thus overcoming the limits currently found.

Use of a reliable simulation model to describe the area affected by the spill

The numerical models currently used by ARPA FVG in response to emergencies have demonstrated so far their effectiveness in providing in a clear and timely manner the displacement of an oily pollutant in the event of a spill into the sea. To guarantee a continuous and always operational service, it is necessary that the input data for the functioning of the numerical models, are always available.

For this purpose it is fundamental to have multiple providers of this data. This redundancy on the input data, as well as guaranteeing the service in case of malfunction, allows a comparison of the results obtained from the numerical models with the different data input. It may happen that different numerical models or different input data provide different predictions. Understanding which is the most reliable model for a given environmental situation is one of ARPA FVG tasks. In order to extract this information, a continuous validation campaign of the used codes is needed. Currently, the codes in use are constantly updated and subsequently validated through the use of "Stokes Drifters". The release of these tracing devices must be carried out on an almost regular basis in order to collect a database that is gradually increasing in size to cover all the possible environmental scenarios in the region of interest of ARPA FVG.

Since its introduction, this validation campaign highlighted the operational limits of some models, especially in cases of spills in the lagoon and / or inside ports.



Im. 22: Validation of the GNOME oil spill model with a Stokes Drifter.

Availability of frequent updates of weather and sea conditions determing spill dispersion

The experience gained during the exercises on the response to oil spill emergencies, in the Gulf of Trieste, and deriving from the training courses of the personnel in charge of interventions clearly indicates that the

monitoring, in real time, of the dispersion of the pollutant, is an essential element of the set of information necessary for an effective intervention to contain the environmental impact.

Knowledge of the impacted area, to be considered as an initial condition for the evaluation of the subsequent evolution, and of the physical and chemical characteristics of the pollutant,together with the forecast modeling of the hydrocarbon dispersion, are essential information on which decisions for emergency intervention are taken. Furthermore, the frequent updating on the evolution of the meteo-marine conditions determining spill dispersion, also allows attributing and keeping the quality level of the modeling forecasts, which are used to estimate the areas that are likely to be impacted by the pollutant in the following hours, updated. In light of this, to overcome the current limits in monitoring the very early stages of an oil spill emergency in the Gulf of Trieste, goals have been set to be achieved, also thanks to the resources and collaborative environment of the INTERREG IT-HR FIRESPILL project

Limits can be overcome according to two complementary approaches to improving environmental monitoring, which can be adopted through investments in latest generation technological systems.

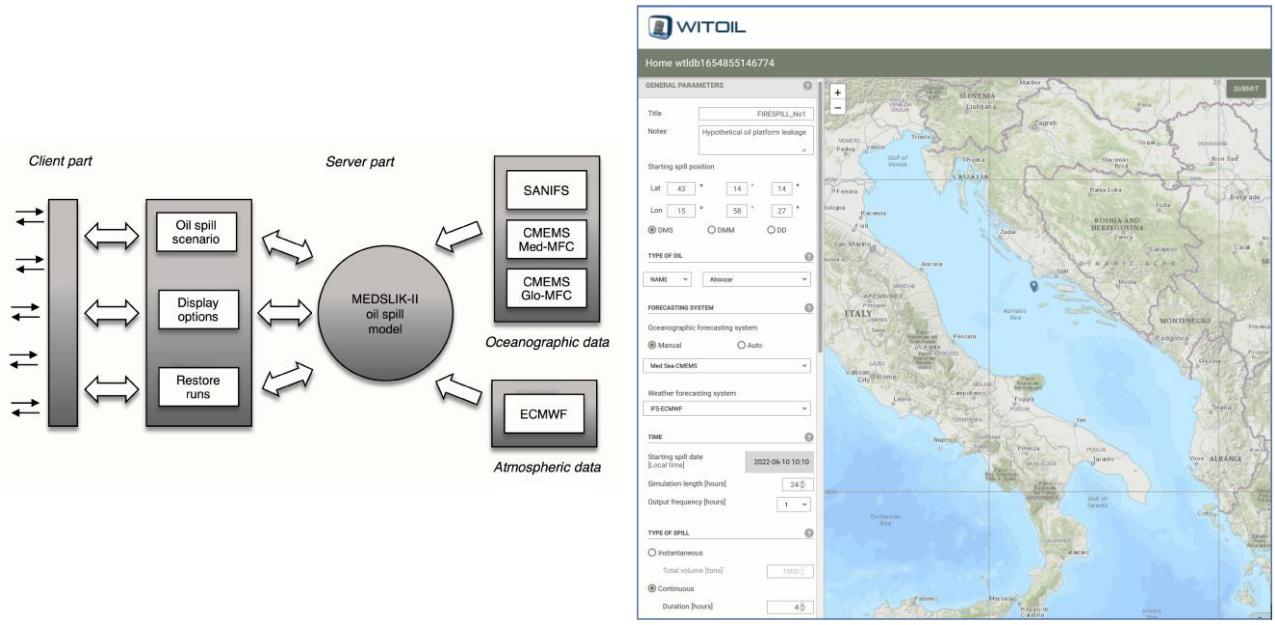
The first approach involves the continuous detection of environmental conditions on the marine and coastal area at risk of oil spills; the second concerns the rapid deployment of a high-resolution monitoring, focused on the specific place where the release takes place. More specifically, ARPA FVG, has identified in the installation of a HF marine RADAR for the continuous detection of surface currents and wave height, which completes and increases the observational quality of the current coastal RADAR network, present on the Gulf of Trieste, the substantial contribution to continuous environmental monitoring.

In addition to the information available in the event of an emergency, the marine RADAR will make it possible to create a database that gradually grows over time and is very useful for the validation of dispersive models and for the updating of the factors contributing to the environmental impact risk analysis, in the event of a release of hydrocarbons into the sea. As for the increase in spatial resolution and number and type of information to be acquired with monitoring activated only in case of emergencies, ARPA FVG is organizing a fleet of drones, specially equipped with multispectral cameras, and a team of pilots able to overflight and reduce the acquired data into useful information for defining the area concerned and the physical characteristics of the hydrocarbon present on the sea surface.

Results of the Puglia Region-CMCC collaboration on the forecast of oil spill transport and fate

Web-based platform for operational application to oil spill accidents

To increase cross-border effectiveness in tackling accidental and operational oil spills, the oil detection and monitoring services should be combined with modeling tools and products that predict the transport and consequences of the spills. To this end, an innovative operational web-based platform has been developed in the FIRESPILL Project. The platform consists of the client and server parts. The client part is represented by Graphical User Interface (GUI) to configure and trigger the system, as well as to visualize, manage the results using Google Maps, and disseminate them in digital format.



Im. 23: Scheme of the oil drift forecasting platform functioning (on the left) and GUI (on the right).

The core of the server part is the Lagrangian oil spill model MEDSLIK-II[9] which produces oil concentration maps at the sea surface, on the coastlines, and in the water column as well as oil transformation time series

[9] http://medslik-ii.org

that describe the oil weathering: evaporation, viscous-gravity spreading, natural dispersion, and emulsification.

MEDSLIK-II has been successfully used for more than 10 years to simulate the transport and fate of oil spills in deterministic and stochastic mode. The model was validated with real spill cases including the *Jiyeh* power station oil spill (Lebanon, 2006); the *Costa Concordia* accident and parbuckling (the Tyrrhenian Sea, 2012, 2013); the *Agia Zoni-II* oil spill (the Saronic Gulf, Greece, 2017); the *Ulysse-Virginia* oil spill (the Ligurian Sea, 2018); the Mediterranean oil spill (the Levantine, 2021); the *Baniyas* power station oil spill (Syria, 2021); as well as with various drifter trajectories.

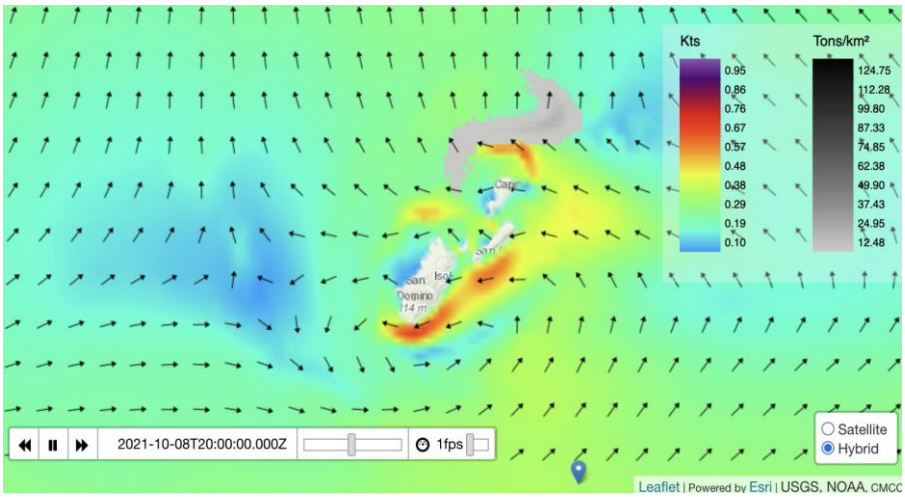
The information about the spilled oil can come from direct communications following the accident or from overflight/satellite data. User should specify oil simulation scenario, customize the display options, and manage individual runs.

The model is forced by data about sea currents, waves, sea surface temperature and wind represented in the server part. The data include a set of outputs from the predefined operational meteo-ocean forecasting systems.

The platform is governed by Graphical User Interface (GUI) that allows users to execute the simulations, visualize and temporary store the results, and then, obtain them in digital formats compatible with widely used GIS software.

GUI is designed in a user-friendly way (Im. 23), which means it is easy to read and interact with without having to get lost, confused, experimenting, or studying a manual book. The GUI elements include a sidebar (on the left) devoted to the client part and viewport (on the right) that displays the results of simulation on map. To force oil spill modeling, the platform uses input data on sea currents, sea surface temperature, and 10-m wind from the forecasting systems available. After accomplishing a simulation, the surface oil concentration automatically appears on the map. Individual simulation frames can be displayed by means of the animation player control bar. The results of simulations can be downloaded in common GIS format.

The platform allows separated or combined rendering the surface oil concentration together with the predefined environmental fields and underlying meteo-oceanographic data. In Im. 24, a snapshot of the oil spill forecast is displayed for a virtual oil spill run near the Isole Tremiti on 8th October 2021.



Im. 24: Virtual spill simulation. Oil concentration (tons/km2) in grayscale and the sea surface currents (knots) in color scale.

Oil spill hazard from dispersal of oil along shipping lanes in Adriatic Sea

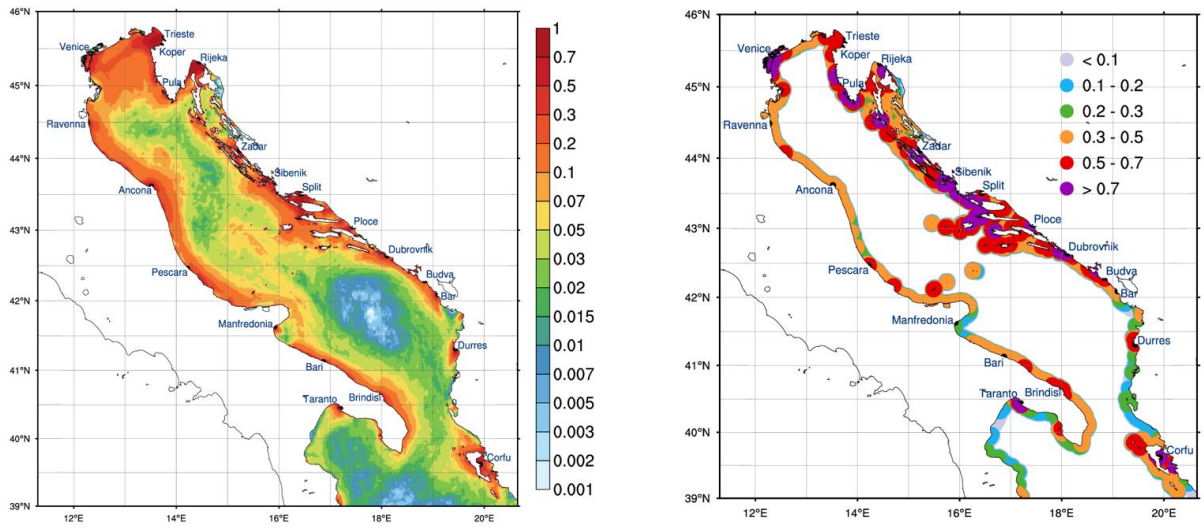
Over the past decade, maritime traffic has shown permanent growth, thus increasing the risk of pollution caused by shipping activities. In the framework of the FIRESPILL Project, we focused on chronic oil pollution from ships, which is of particular concern since operationally released hydrocarbons tend to cumulatively exceed the volumes of the largest historical oil spills.

Usually, operational spills are related to unintended or deliberate releases through routine ship activities, including oily ballast water from fuel tanks, bilge water dumping, engine effluent discharges (sludge), heavy residuals, lubrications, etc. Although the quantity of oil in an operational release is rather small (from a few liters for a small leisure craft to a few cubic meters for larger ships) some toxic oil compounds and residuals have immediate adverse biological effects, and long-term exposure to chronic oil pollution threatens life in marine and coastal environments.

Stochastic simulations of virtual oil spills from ships were performed for the Adriatic Sea over 2017–2020, applying the European Marine Observation and Data Network (EMODnet) vessel densities as a proxy for starting locations of operational spillage. The MEDSLIK-II oil spill model was run using high-resolution currents provided by the Copernicus Marine Service and the European Centre for Medium-Range Weather

Forecasts winds. Chronic exposure to operational oil spills was reported in terms of hazard indices for five vessel groups: pleasure and passenger ships, cargo and service vessels, the fishing fleet, tankers, and other ships.

More than 1,000,000 virtual spills were seeded separately for these groups The obtained results are likely representative of future events since the vessel density distribution and the amount of operationally spilled oil were assumed to be typical of the present state, which is not expected to change significantly in the future. As shown in Im. 25, the highest hazard indices from all ships were located in the northernmost part of the basin and along the coastlines of Italy, Croatia, and Slovenia. In the vicinities of several major ports (e.g., Trieste and Koper, Venice, Split, Rijeka, Pescara, Brindisi, Durres, Zadar, Šibenik, and Dubrovnik), hazard indices were also elevated at the sea surface and on the coastlines. Conversely, the southern Adriatic exhibited the lowest hazard indices.

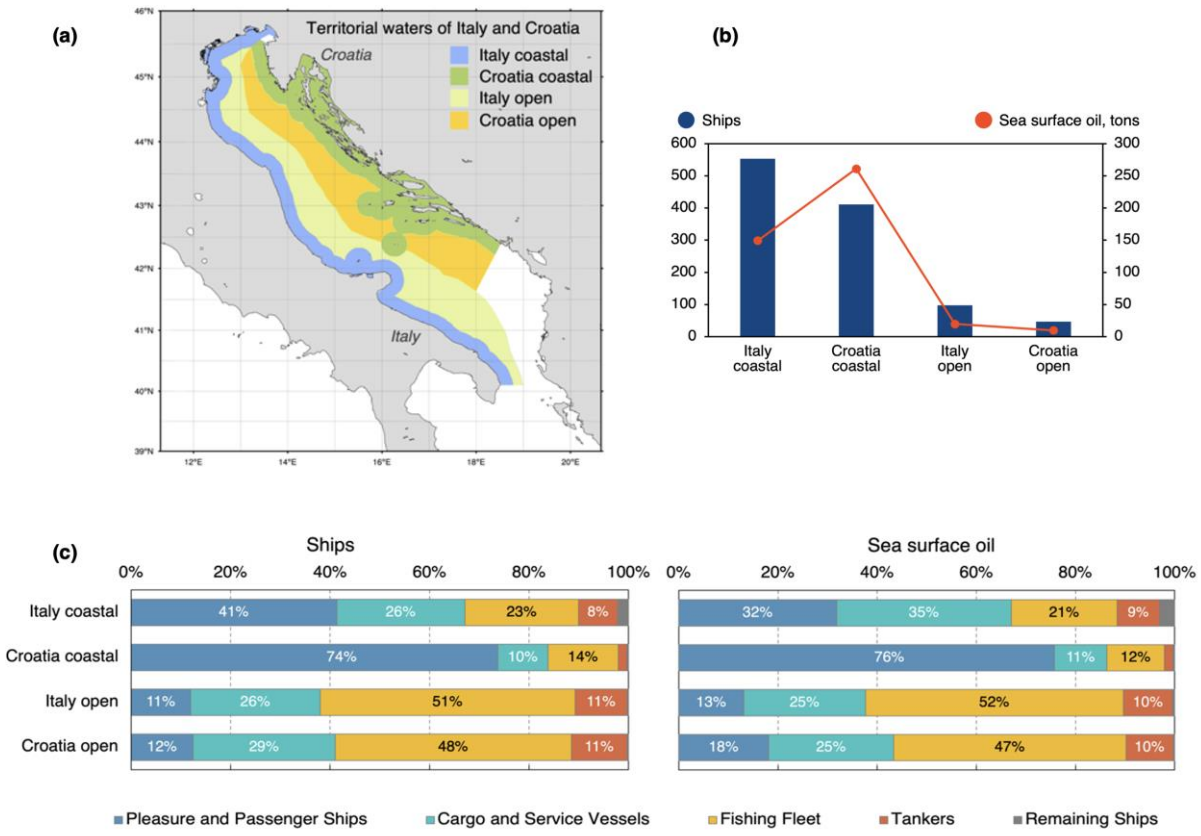


Im. 25: Averaged hazard maps for 2017–2020 at the sea surface (left) and on the coastlines (right) for all ships.

The geographic distributions of hazard indices differed substantially for various ship groups, demonstrating a close relationship with corresponding vessel density patterns. Virtual spills from pleasure and passenger ships, which dominated in the Adriatic, caused the elevated hazard indices in the Croatian territorial waters. In this area, coastwise shipping might be the key polluter. Cargo and service ships mainly influenced the areas associated with large ports with bulk cargo terminals. The transport corridor located along the main Adriatic

axis was also visible in terms of hazards. The fishing fleet formed a wide, diffuse zone of elevated hazards that mainly shifted toward the Italian coastline. Tankers showed hazard distributions similar to those of cargo and service ships; if the focus was not oil pollution, these two groups would have been merged. The influence of remaining ships was local and minor.

Comparative analysis of the ship and sea surface oil integrals over the Croatian and Italian territorial waters (Im. 26) showed that the Croatian coastal waters were more chronically polluted than the Italian coastal waters, despite hosting fewer ships.



Im. 26: (a) Domains of integration. (b) Averaged monthly numbers of ships and sea surface oil (tons) for 2017–2020. (c) Breakdown of ship numbers and sea surface oil into five vessel groups.

This is likely due to differences in circulation efficiency; pollution dissipates quickly along the Italian coast but tends to stagnate near the Croatian coast. Cargo and service ships were identified as the main polluters in

Italian coastal waters, while most of the oil in Croatian coastal waters was from pleasure and passenger ships, coastwise shipping in particular. Both the Italian and Croatian offshore waters were significantly less polluted, with the main contributions from the fishing fleet, and cargo and service vessels.

In conclusion, the web-based operational platform was designed to enhance Emergency Management Systems (EMS) in the case of oil spill accidents in the Adriatic Sea. The hazard maps obtained can be used for guiding the detection of operational spills in the impacted areas and for coastal management in the context of chronic oil pollution from ships.

The developed approach can be adopted for the implementation of common monitoring strategies and a disaster management system, through strengthening administrative and technical capacities, raising awareness, educating, equipping, and preparing citizen and rescue teams. In this respect, the Puglia Region-CMCC collaboration may now be seen as representing best practice implemented within the FIRESPILL Project.

4. Improvement proposals

Recommendations and guidelines

Italy and Croatia are two countries characterized by territories exposed to natural risks and linked to human activities. This requires a system that ensures in each area the presence of resources able to intervene quickly and in a coordinated way in emergency, but also to operate to prevent and, as far as possible, predict disasters. The aim of the following paragraph is to briefly and comprehensively illustrate the Disaster Risk Reduction policy, the aim of which is to prevent new disasters and reduce the risk of existing ones managing residual risk, all of which contribute to strengthening resilience and thus to achieving sustainable development. In particular, two key elements of Resilience will be analyzed, the Crisis and the Emergency, and the factors to intervene to reduce the Risk or the degree of Emergency.

To be able to enter into this topic it is necessary to start from the definition of Security. Among the many existing definitions, all closely related to the context in which it operates, an extremely general statement could be that which sees safety as the condition (or perception) of absence of possible negative events. When we are in a situation of high security it will mean that the level of risk will be low, or at least perceived as such. The Disaster Risk Reduction, UN-branded philosophy to address civil protection issues, embraces this conceptual approach: if security is the opposite and complementary term of risk, or if the absence of Security necessarily entails a high Risk value, It is also true that the new concept of Resilience can be seen as the set of actions aimed at increasing the level of Security and drastically reducing that of Risk. At this point, in order to understand the boundaries within which the Disaster Risk Reduction moves, it is necessary to have clear elements such as Crisis and Emergency, key factors of Resilience.

Without a doubt, it is not difficult to understand a crisis situation or an emergency context, but to identify the precise boundaries. In other words, it is not at all easy to focus, in space and time, when a state of crisis occurs in a given context, or even when from a condition of crisis there is a transition to a state of emergency. One thing is certain: in both situations external agents contribute to determine the two contexts and the time factor plays a central role. In general it can be said that, in the event that a given event, anthropic or natural,

occurs in a given territory, we will have a crisis condition, with the possibility that it can degenerate into an emergency situation. We will talk about crisis when: "a system in equilibrium (static or dynamic, natural or anthropic) is upset by one or more factors internal or external to the system itself"[10]. If the system, as a result of this imbalance, fails with its own strength, to return to the original situation, or to reach a new equilibrium condition, the preconditions for an emergency condition will occur.

The emergency occurs when "as a result of a certain event (natural or anthropic, predictable or unpredictable) its overcoming, aimed at addressing and solving the problems that occurred, or avoiding further situations of danger, crisis or discomfort, is strongly linked to the time and resource factors available"[11].

$$E = \frac{R}{t * Re}$$

An emergency will depend on the value of the Risk (R)[12], obviously no longer considered in probabilistic terms, since the event took place, and the factors Time (t) and Resources (Re). These two factors are typical and characteristic of an emergency state. There would not be an emergency situation if there were not a context in which "something needs to be done and done in a short time". Therefore, the Time factor has a crucial position. If we had considerable time to deal with a situation, we would not be faced with an emergency situation. Linking the concept of Time to the action of "accomplishing something", that is, of reaching a goal through a sequence of steps, means introducing the concept of Timing. The other factor is Resources, which is "something that we need to do things" in a short time, of course, to achieve our goal or avoid a situation. Possessing huge resources means that a context is not immediately and necessarily emergential, on the contrary, the scarcity of resources or the performance poverty of these, can bring in a short time an event, otherwise simple, to be extremely complex in its resolution. From these reflections follows that Timing and Resources are the reference points of an Emergency. These elements can be represented by the concept of Organization:

[10] Toseroni F. (2009), Protezione e Difesa Civile: storia, organizzazione, pianificazione ed analisi delle minacce future, EPC Libri, Roma., p. 310.
[11] Ibidem
[12] Risk can be defined as the product of Danger (D), Vulnerability (V) and Exposure (E): $[R = D * V * E]$.

$$Organization\ (O) = Timing\ (T) * Resources\ (Re)$$

Timing depends, in turn, on two factors: coordination and communication

$$Timing\ (T) = Coordination\ (C) * Communication\ (Com)$$

This means that the success of a given action is strongly linked to the ability to coordinate resources (men, means, materials...).

This is only possible if you have an effective communication system. A good Organization is based, without doubt, on the Resources that are possessed, but these if not properly used, through an effective action of Coordination, will surely be poorly used with respect to their potentialities. The greater the Resources, the more complex will be the Coordination function, which cannot be separated, for its correct functioning, from an effective Communication system (internal and external). Knowing how to manage the available resources (men, means, materials...) and optimize the time, both of finding them as well as of their harmonious use, means having a good organizational level, which can not, in any way, not be considered a feature of emergency planning.

$$Emergency\ (E) = \frac{Risk\ (R)}{Organization\ (O)}$$

Therefore, in order to reduce the Risk or the degree of Emergency, it is possible to intervene on all the factors described in this report. The actions carried out in order to operate in particular on the Organization factor, are called Resilience.

Resilience

In the field of Security and Civil Protection, Resilience is understood as "the ability of a System to absorb, in order to prevent or delay, the transition from a Crisis State to an Emergency State, a negative, expected or

unexpected event, reacting and shaping the response of its structure in order to overcome the adverse event, restoring a new balance in the System"[13].

The concept of Resilience then comes to indicate a set of possible actions that can affect any, or all the elements characterizing an emergency.

$$Emergency\ (E) = \frac{Dangerousness\ (D) * Vulnerability\ (V) * Exposure\ (E)}{Coordination\ (C) * Communication\ (Com) * Resources\ (Re)}$$

If it is true that an Emergency is: directly proportional to the event occurred (D), the level of destruction caused (V) and the value of the destroyed object (E), and inversely proportional to the ability to coordinate the forces in the field (C), the level of communication between forces (Com) and the quantity and quality of available resources (Re); We can also say that, at the same time, a Resilience activity with a view to lowering the level of an Emergency, will be more effective the lower the factors attributable to strategic or programmatic actions, activities for the reduction of Dangerousness (D), Vulnerability (V) and Exposure (E), and the higher the factors attributable, with project-training-training actions in the areas of Coordination (C), Communications (Com) and Resources (Re).

It is therefore possible to say that Emergency and Resilience are nothing more than the two sides of the same coin. The only way to reduce the magnitude of an Emergency is to operate in a Resilience perspective, The latter may be a prevalent preventive action (prediction) operating on the factors D and V and E, or a prevalent defensive action (rescue) operating on the factors C, Com and Re or, finally, both. A balanced set of such actions is able to make a Community "resistant to the impact of an event". In other words, a community, a Civil Protection Agency or a Nation, is all the more "protected" against an emergency, the higher its degree of resilience. This means that the capacity of absorption and response, compared to an adverse event, is strongly linked to the management of the territory, the degree of vulnerability, the attitude and the preparation of the population and its administrators, as well as the level of professionalism, resources, communication skills and skills of the structures (public, private, professional or voluntary) used for rescue.

[13] Toseroni F. (2009), *Protezione e Difesa Civile: storia, organizzazione, pianificazione ed analisi delle minacce future*, EPC Libri, Roma.

The importance of risk forecasting and prevention activities

For the purposes of Civil Protection, the risk is represented by the probability that a natural phenomenon or induced by human activities could cause harmful effects on the population, on the settlements and the infrastructures, within a particular area, in each period of time. Risk and danger are therefore not the same thing: the danger is represented by the calamitous event that can hit a certain area (the cause), the risk is represented by its possible consequences, that is, by the damage that can be expected (the effect). It is known that the territory in which we live is exposed to various kinds of risks, as it is not always possible to eliminate the hazard, it is important to reduce the impact this causes as much as possible.

In this perspective, the forecasting and prevention activities play a very important role:

- Forecast consists in the identification and study, even dynamic, of the possible risk scenarios for alerting needs (where possible) and civil protection planning;
- Prevention consists of the set of activities of a structural and non-structural nature, also carried out in an integrated form, aimed at avoiding or reducing the possibility of damage resulting from calamitous events also on the basis of the knowledge acquired as a result of forecasting activities.

To pursue the objectives of forecasting and prevention activities, the scientific community should also be involved.

Civil Protection Planning

Emergency plans are necessary to prepare Civil Protection Service facilities to deal with and manage an emergency. These identify the objectives to be achieved in order to organize an adequate civil protection response when the event occurs. The Civil Protection Plan must contain the forecasting activities and identification of possible risk scenarios in the considered territory, the operational strategies and intervention models for each risk considered, and the operational structures and resources available to cope with the current event. The Civil Protection Plan should be prepared by the competent bodies of the various territorial levels, starting with the municipal level.

Active citizenship

To mitigate risks, it is important to increase the resilience of communities. In the management of all the phases that precede and follow the occurrence of an event in the territory, the individual citizen plays a leading role. In fact, the objective of the ordinary activities of disseminating knowledge of civil protection and raising awareness of the population is precisely to train a more aware and prepared citizen. Involving the population, informing them about the risks present in the territory and about the best practices to be adopted in the event of an emergency is fundamental in order to optimize the times and methods of rescue, concentrating all resources especially towards the most fragile subjects. It is important to promote initiatives aimed at increasing the resilience of communities, encouraging the participation of citizens, individuals and associates, also through training of a professional nature, in civil protection planning and the dissemination of knowledge and culture of civil protection.

Active citizenship must not limit itself to making the population aware of the risks present in the territory and on the best practices to be adopted in an emergency but must give citizens the opportunity to provide their service, free of charge, in civil protection activities. Citizens, after having acquired the necessary knowledge to be able to operate effectively, must be able to participate in carrying out civil protection activities by joining organized volunteering operating in the sector.

Therefore, it is appropriate to regulate the participation of organized volunteers in civil protection activities:

- protecting the health and safety of volunteers;
- defining the activation modalities and the activities that the volunteers can carry out;
- providing for contributions aimed at strengthening operational capacity, improving technical preparation as well as developing the resilience of communities.

Institutions must enhance organized civil protection volunteering, guaranteeing its autonomy and promoting its development.

Proposals to improve forest fire risk management

According to the EFFIS Annual Report on Forest Fires in Europe, Middle East and North Africa, in the European Union, over 3400 km2 of land were burned in 2020. Around 40% of the burned area was part of the EU's Natura 2000 network, that is, the European coordinated network of protected areas, focused on ensuring the long-term survival of Europe's most valuable and threatened habitats and species. The damage caused in many of these ecosystems will likely take many years to be restored. Moreover, the summer wildfire season of 2021 ravaged Mediterranean countries, with more than half a million burnt hectares, and took a high toll on firefighter and civilian lives[14].

Studies on climate change[15] demonstrate that there is a clear trend showing increasing levels of fire danger, longer fire seasons, and more frequent fast spreading 'mega fires'. Within this already complex scenario, the detailed analysis at regional level of land management, the continuous process of abandonment of agricultural, silvicultural and grazing areas, are all indexes that the coming years will pose an increasing threat in the management of wildfires. This increased territorial vulnerability, higher presence of combustible fuel in forested areas and extreme weather conditions are already characterizing wildfires with higher propagation speeds, increased spotting phenomena and intensities higher than the available coping capacity.

The following recommendations are advanced to improve wildfire management in the project area:

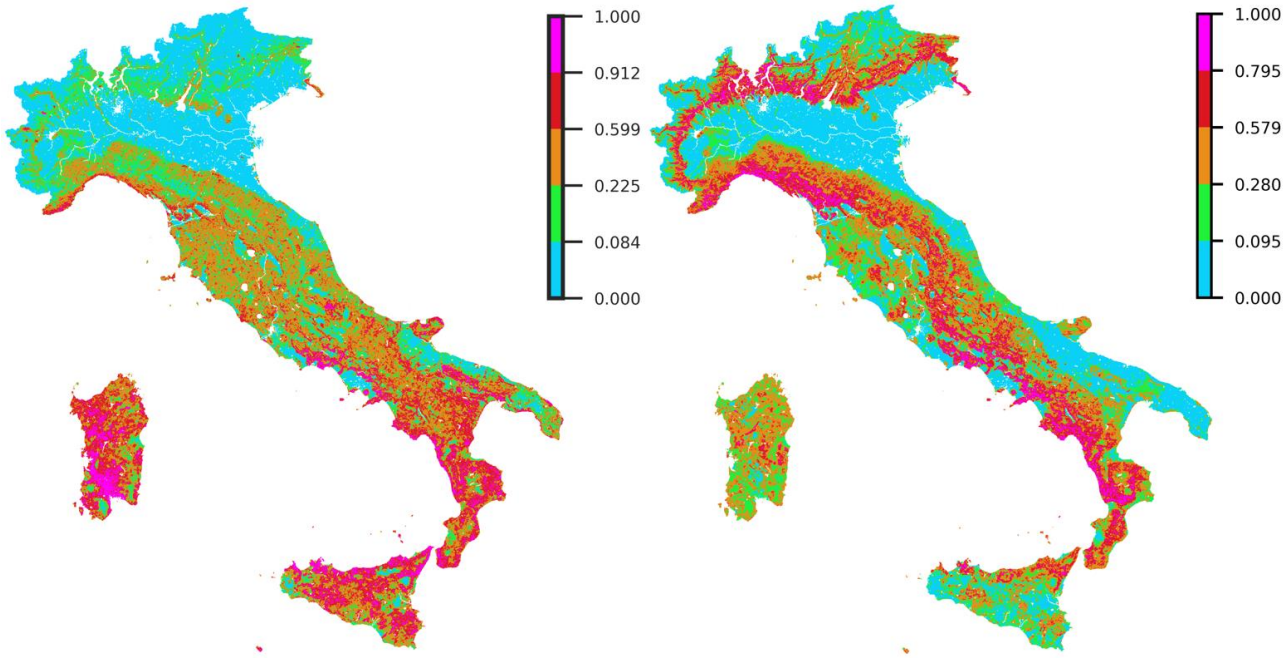
1) Hazard mapping as pillar of Early Warning Systems

To strengthen the coping capacity of the overall system, over the past decade the Italian Civil Protection department has conducted a comprehensive analysis of wildfire hazards by mapping the whole territory and developing tools to allow the exertion of anticipatory actions on the basis of state-of-the-art wildfire forecasting models.

[14] Trucchia A. et al, *Defining Wildfire Susceptibility Maps in Italy for Understanding Seasonal Wildfire Regimes at the National Level*. Fire 2022, 5, 30. https://doi.org/10.3390/fire5010030.

[15] San-Miguel-Ayanz J., Durrant T., Boca R., Maianti P., Libertà G., Artes Vivancos T., Jacome Felix Oom D., Branco A., De Rigo D., Ferrari D., Pfeiffer H., Grecchi R. and Nuijten D., *Advance report on wildfires in Europe, Middle East and North Africa 2021*, EUR 31028 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-49633-5, doi:10.2760/039729, JRC128678.

Mapping represents the basis of the hazard knowledge which is the first step and core for the implementation of any effective Early Warning and Early Warning to Early Action system.



Im. 27: Susceptibility map for the summer (left) and winter fire season developed by CIMA Research Foundation and the Italian Department of Civil Protection[16].

Image 22 for example depicts wildfire susceptibility[17] during the summer and winter seasons. After evaluating the very low susceptibility to wildfires in the winter period, Regione Puglia, has for example decided not to issue fire forecasts during the winter season. Given the intrinsic resource limits of any Civil Protection authority, these strategic evaluations are a good example of how scientific approaches can be used by policy makers and disaster risk managers. Aside from national studies the Region has also developed over the past years ad hoc tools with higher resolution than those done at national level.

[16] Trucchia A. et al, *Defining Wildfire Susceptibility Maps in Italy for Understanding Seasonal Wildfire Regimes at the National Level*. Fire 2022, 5, 30. https://doi.org/10.3390/fire5010030

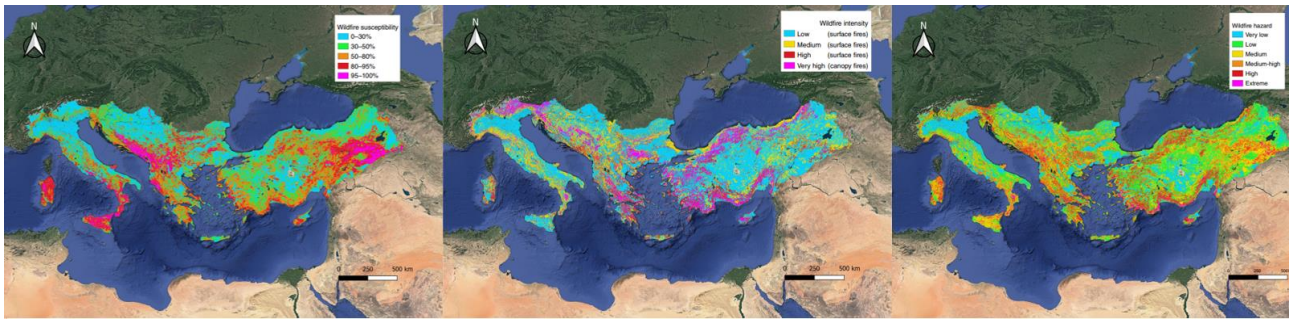
[17] Wildfire susceptibility is defined as the static probability of experiencing wildfires in a certain area, depending on the intrinsic characteristics of the terrain. This can be achieved by adopting several approaches, ranging from statistical hierarchical ones to ML-based algorithms.

This long-lasting work has provided the possibility to structure the service in a flexible way, and to enhance the forecasting capacity in the short, medium and long term by adopting Early Warning to Early Action strategies, however still much needs to be done to further strengthen the mechanism.

2) Develop active synergies with existing European projects in the area of wildfires

The EU has financed several programmes over the years that have focused on Wildfires. Many of them have developed tools, data, models, and methodologies which could be adopted and adapted according to national frameworks.

For what concerns wildfire hazard mapping for example the IPA Floods and Fires project (https://www.ipaff.eu/) has for developed a preliminary version of susceptibility, fireline intensity and hazard maps for Italy and the western Balkans[18].



Im. 28: From the left: Wildfire susceptibility, Wildfire potential intensity and wildfire hazard.

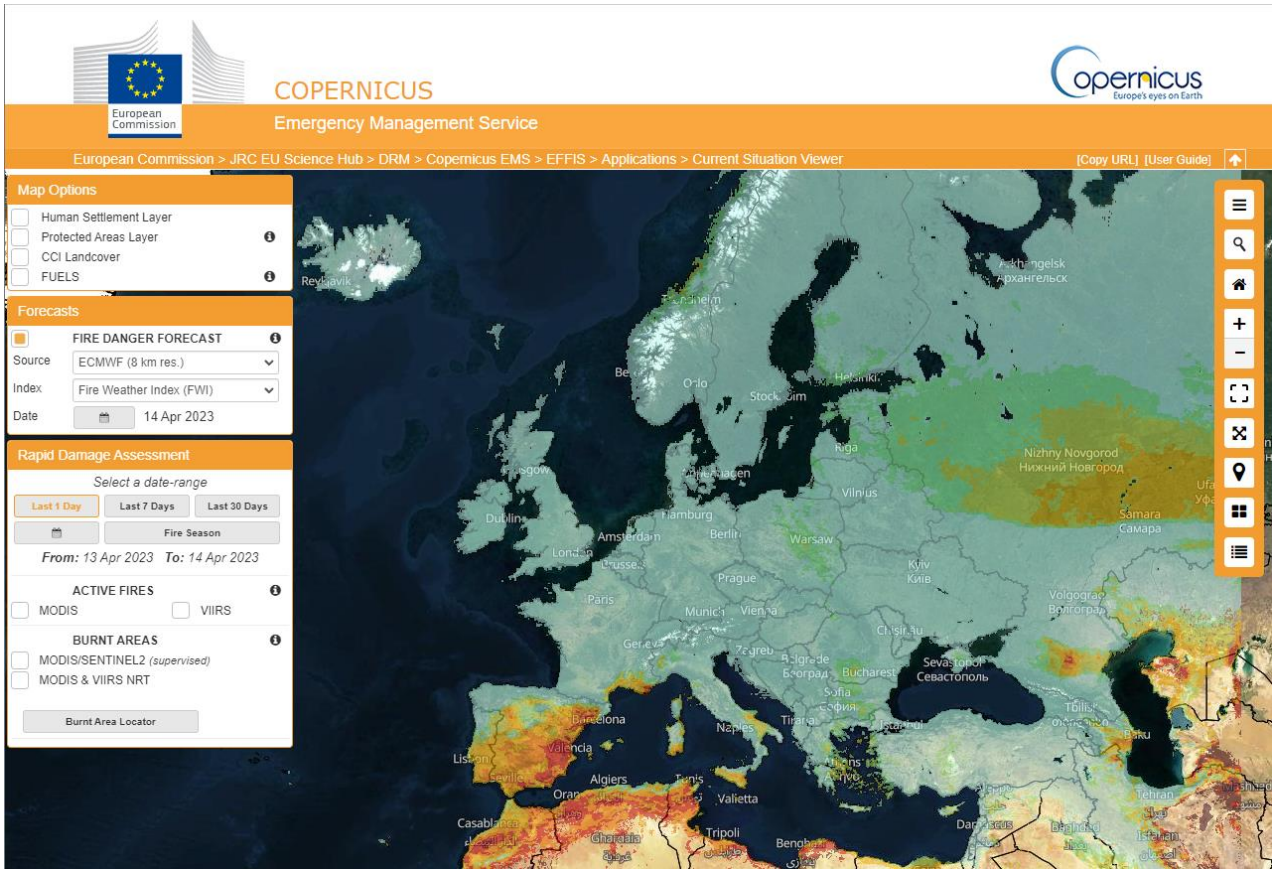
Developing synergies with such initiatives can provide the needed baseline to foster regional, national and supranational capacities.

3) Adopt state of the art forecasting models

There are several forecasting tools available that provide data and services that are needed to inform national and regional wildfire early warning systems. At European level the European Forest Fire Information System[19] provides accurate and timely information on forest fires to support decision-making processes

[18] Trucchia Andrea, et al., (2023) *Wildfire hazard mapping in the eastern Mediterranean landscape*. International Journal of Wildland Fire 32, 417-434.
[19] https://effis.jrc.ec.europa.eu/

related to fire prevention, preparedness, and response. The system collects and analyses data from various sources, including satellite imagery, weather forecasts, and ground observations, to provide a comprehensive overview of forest fires.

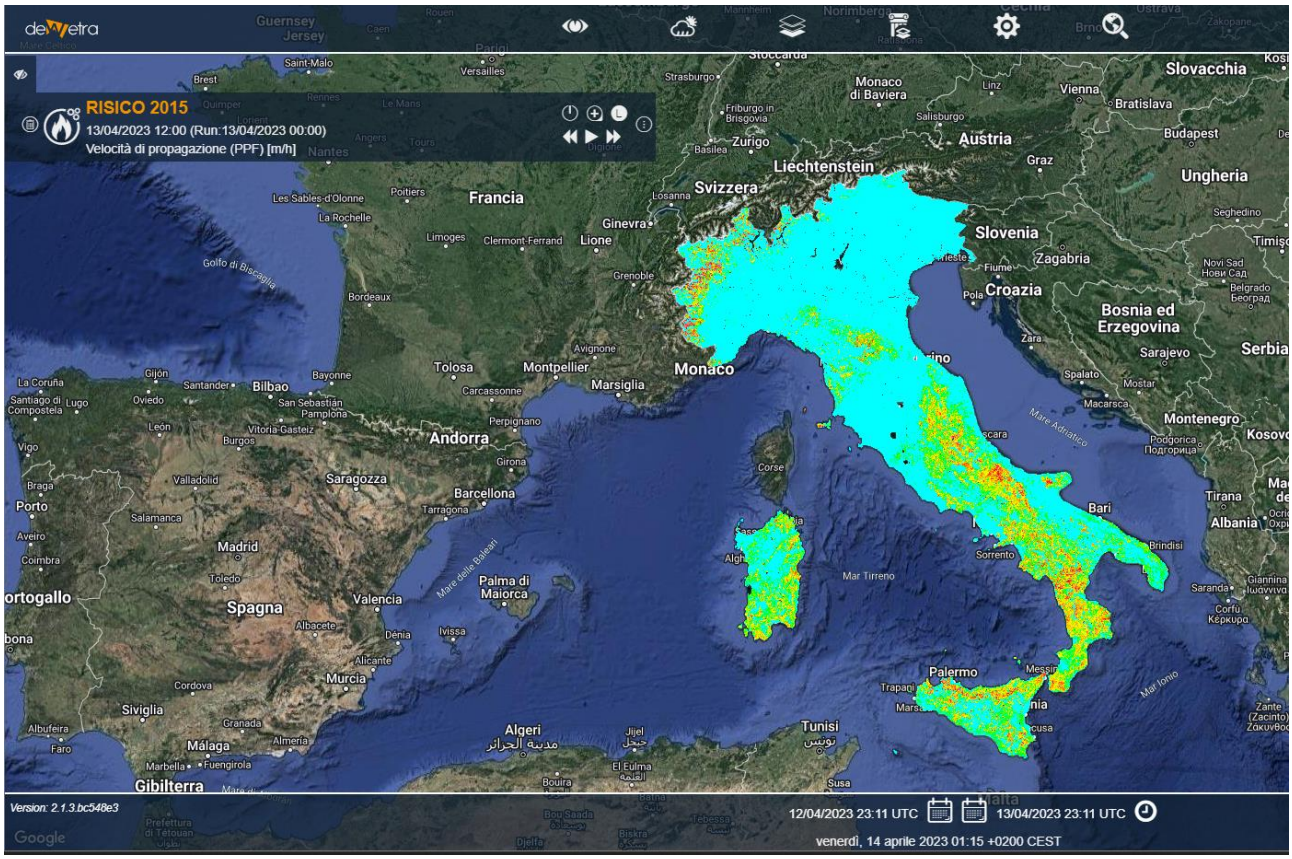


Im. 29: the EFFIS situation viewer.

Additionally EFFIS also provides fundamental services such us the provision of burnt areas and number of registered fires within a given area. This information does not substitute precise and verified cadasters of burnt area but are of great help for scientific and analytic purposes in areas which have not yest established institutional Disaster Loss Databases or where the datasets are too scarce.

The Italian Civil Protection Department also uses for the issuance of the daily wildfire danger index the RISICO model. This model, unlike FWI, has been adapted to the vegetation cover and the fire regimes of the Mediterranean basin (Fiorucci et al., 2005; 2007; 2008; 2011). RISICO integrates meteorological observations

and forecasts with vegetation cover and topography data. Modules describe dead fine fuel moisture conditions, the potential rate of spread, and the potential fire line Intensity. The forecasts are adjusted using susceptibility maps which provides a corrective value to the forecast enhancing their precision.



Im. 30: the RISICO wildfire model.

These tools are examples of forecasting models which are at the basis of functional Early Warning Systems. These models allow for the identification of most affected areas and period of highest wildfire danger for each macro-area. Associated to detailed risk scenarios it is also possible to estimate potential impact to facilitate the planning of preventive interventions and to optimize active control strategies.

4) Use of propagation models for risk scenario and enhanced situational awareness

Wildfire simulators are essential tools for creating scenarios in planning and response efforts. With fast and reliable simulations, it becomes possible to generate realistic scenarios that can help predict the spread of

fires and aid in the development of effective firefighting strategies. Simulators can be chosen based on the trade-off between physical realism and ease of use, as well as the rapidity of the code. When a fire is ignited, having access to hourly forecasts of the burned area shape after just a few minutes can be incredibly valuable for firefighters on the ground. By leveraging the power of wildfire simulators, it is possible to develop effective strategies for mitigating the impact of wildfires and reducing the risk to lives and property.

Knowing the characteristics of the behaviour of fire allows to determine propagation dynamics and evaluate the limits beyond which the fire exceeds the suppression capabilities. Propagation models[20] that allow strategic land management, evaluating the effectiveness of the preventive measures and anticipating the most appropriate strategies to be adopted during the quenching activities to optimize the effectiveness of the available resources.

The short-term forecast, that is the interpretation and the valorization of the meteorological data, provides useful indications to the monitoring of the operating room, and guarantees the recognition of the environmental conditions that favors intense phenomena, as well as the appropriate spatial deployment of resources with a view to the most efficient operational planning.

As the regional territories are very large and, in some cases, characterized by complex morphology, with road infrastructure that does not facilitate transfers quickly and with a limited availability of ground teams, their relocation must be strategic to intervene promptly on a possible fire, preventing it from expanding. Choices should therefore be made based on a comprehensive information framework which is useful for taking appropriate decisions.

5) Adopt Early Warning to Early Action Strategies

Alerting procedures are a fundamental part of Early Warning Systems. The Civil Protection system should be gradually activated based on thresholds, derived from forecasts, automated monitoring networks or from

[20] There are several propagation models available for example:
WRF-Sfire: Mandel J., Amram S., Beezley J. D., Kelman G., Kochanski A. K., Kondratenko V. Y., Lynn B. H., Regev B., and Vejmelka M.: *Recent advances and applications of WRF–SFIRE, Nat. Hazards Earth Syst*. Sci., 14, 2829–2845, https://doi.org/10.5194/nhess-14-2829-2014, 2014.
Also present on GithHub: https://github.com/openwfm/WRF-SFIRE.
Trucchia A., D'Andrea M., Baghino F., Fiorucci P., Ferraris, L., Negro D., Gollini A., Severino M., *PROPAGATOR: An Operational Cellular-Automata Based Wildfire Simulator*. Fire 2020, 3, 26. https://doi.org/10.3390/fire3030026

assessment teams that monitor areas at risk. Planning at all levels should focus on the creation of mechanisms which activate operative phases based upon predetermined thresholds or indicators. The conceptual scheme thus needs to shift the attention from response-oriented systems to preventive and anticipatory actions such as active monitoring of hotspots identified through local risk assessments or inhibiting activities which might ignite wildfires.

6) Adoption of innovative response techniques

In addition to systematic management that takes into account risk indices, in order to limit damage by reducing the area covered by fire and the costs of quenching operations, it is appropriate to optimise the available terrestrial resources. Even today, unfortunately, in many realities prevails the idea and the awareness that fires can be extinguished by coordinating the aircrafts, which are not always available in the immediate and which involve huge costs. This strategy is very often insufficient to face the phenomenon effectively. The activity of aircraft must necessarily be accompanied by ground work, especially during the reclamation phase. It is known that in case of transfers not made or made badly, the fire can be reactivated even after days. Therefore, it is appropriate that A.I.B. organizations work on assisted coordination, forming specialized figures that interact in order to develop a strategy that leads to a comprehensive attack plan. An effective approach to fighting forest fires can be one that takes into account a coordinated management aero-terrestrial, such as the use of Mobile Modules for Complex Fires (M.E.I.C.) which has suitable equipment to bring water to the fire front using the Canadian method.

Im. 31: Example Forest fire in extreme area: Molina Aterno (1200 m elevation) - Abruzzo, 2022.

The Canadian method consists in the transport of water on fires that develop on surfaces characterized by a complex morphology, not reachable with off-road vehicles and tankers, through the construction of hydraulic lines. These systems consist of tanks, pumps and hoses, limit, or in some cases avoid, the air intervention. In fact, the use of high-pressure impeller pumps allows sufficient water flows to be dispensed to intervene on flame fronts having a significant intensity.

The helicopter refills the tank that feeds the hydraulic line that conducts water over the fire.

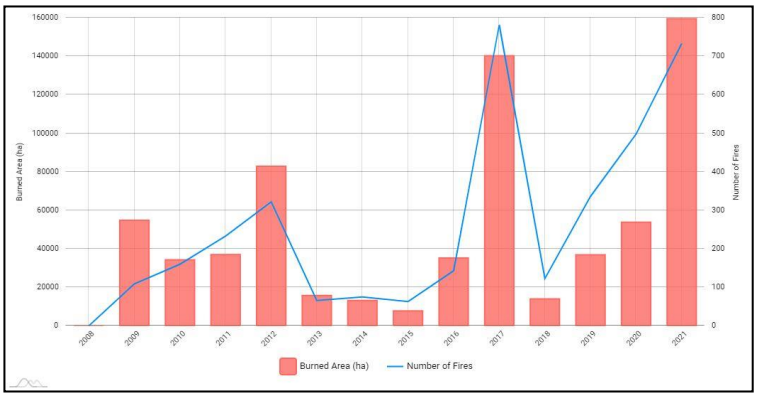
The operators, helicoptered to altitude, set up the hydraulic line that conducts water over the fire.

Im. 32: Example of coordinated air-ground forest fire management. Molina Aterno forest fire - Abruzzo, 2022

This methodology was introduced in Abruzzo during the Arischia and L'Aquila fires of 2020, where the density of the vegetation prevented the water released by the aircraft from reaching the surface layers of the forest, and proved decisive in the summer of 2021.

Im. 33: Application Canadian Method fires Abruzzo.

In fact, in the season of 2021, comparable to those of 2007 and 2017, the phenomenon of forest and interface fires, favoured by the particularly critical weather and climate trend, assumed a significant scale in many regions of our country.



Im. 34: EFFIS estimates and seasonal trend of forest fires in Italy[21].

[21] https://effis.jrc.ec.europa.eu/apps/effis.statistics/effisestimates.

The emergency situation in Sardinia, Sicily, Calabria and Molise, exceptional for its intensity and extension, has massively committed the aerial fire-fighting systems, making also required the activation of the European Civil Protection Mechanism.

Therefore, since there have been numerous requests for assistance to the State's air fleet and the assignment criteria relate to the environment affected by the fire, the resources available and the type of mission, considering the safeguarding of human life and the protection of the natural environment as a priority, the Abruzzo regional civil protection structure has very often found itself managing fires on its territory with only the regional helicopter, which is insufficient to meet the various needs.

It is precisely the use of the Canadian method that has made it possible to manage most events with the intervention of land resources alone, limiting the damage to such a level that it did not qualify for the declaration of a state of emergency by the Council of Ministers, unlike the aforementioned regions, and in particular neighbouring Molise, where the meteo-climatic conditions and the morphology of the territory is similar to that of Abruzzo.

The hope is that there will be greater political attention to the issue with knowledge and awareness of the problems. At this point it is hoped that the new national plan will be a visionary plan that includes integrated risk management, which speaks of land management, integration with agricultural policies, that dialogues with the urban component and that is approached in a way not emergency, but preventive.

Proposals to improve Oil Spill risk management

Managing oil spills is a complex process that requires a multi-faceted approach. Effective oil spill disaster risk management involves a combination of early warning and early detection measures to identify and respond to oil spills as quickly as possible. This is of high importance especially in the Mediterranean Sea being a semi-enclosed sea with limited water exchange with the Atlantic Ocean and the Black and Red Seas. The potential damage of oil spills in this area is difficult to quantify but according to research conducted by the EU Parliament has significant impacts[22]. Furthermore, the frequency of spills takes place daily on heavily concentrated traffic routes[23].

Spills are thus not only a hazard that has demonstrated damage to the economy and ecosystems but also happen very frequently in defined areas. The combination of high potential damage, high frequency, the vulnerability of the exposed elements (i.e. maritime ecosystems, blue economy, etc.), and low coping capacity at the supranational level provides the basis for a very high-risk scenario.

The importance of this topic is such that one of the UN Sustainable Development Goals (SDGs) focuses on the conservation and sustainability of marine resources (Goal 14. Conserve and sustainably use the oceans, seas, and marine resources for sustainable development)[24]. In this respect, Italy has identified SDG 14 as one of the priority themes of its agenda[25]. Within the mentioned framework, an analysis of the existing "National Emergency Response Plan for the defense of the sea and coasts from pollution by hydrocarbons or other dangerous and noxious substances" was conducted. The plan shows a good level of description of

[22] A report published by the European Parliament in 2017 estimated that the cost of an average oil spill in the Mediterranean could range from €600 million to €4.4 billion, depending on the size and location of the spill (European Parliament, 2017). The report also noted that oil spills in the Mediterranean have caused significant damage to marine ecosystems and the region's economies, particularly its fishing and tourism industries. On the same topic, a study published in the journal Marine Pollution Bulletin in 2017 estimated the economic impacts of oil spills on the Mediterranean's fishing industry. The study found that a major oil spill could lead to losses of up to €2.2 billion in the Mediterranean's fisheries sector, with smaller spills also causing significant economic damage (Abbott et al., 2017).

[23] Girin M. and Daniel P. (2018). Oil pollution in French waters. – In: A. Carpenter and A.G. Kostianoy (eds.), Oil Pollution in the Mediterranean Sea: Part II – National Case Studies. Hdb Env Chem., Springer.
Girin, M. and Carpenter, A. (2017). Shipping and oil transportation in the Mediterranean Sea. - In: A. Carpenter and A.G. Kostianoy (eds.), Oil Pollution in the Mediterranean Sea: Part I – The International Context. Hdb Env Chem.

[24] Target 14.1 of the SDGs calls for ratifying countries to "*prevent and significantly reduce marine pollution of all kinds* […]" by 2025.

[25] IMELS, "*La Strategia Nazionale per lo Sviluppo Sostenibile*", Ministry for the Environment Land and Sea, Rome, Italy, 2017.

intervention models and clearly defines overarching responsibilities amongst stakeholders. However, albeit defining possible event scenarios (chapter 4 of the plan), the plan shows less attention to the establishment of a system centered on Early Warning to Early Action strategies than to the response-oriented parts. The weakness of such an approach is made also more relevant by the lack of transboundary agreements and protocols within the project region which also make response activities more cumbersome and slower by not providing an adequate framework for the establishment of early warning and early detection practices. These can play a crucial role in minimizing the impact of oil spills on the environment and human health.

The implementation of an effective Early warning system for oil spills is thus of paramount importance. A functional EWS can predict the likelihood of an oil spill occurring in a particular area by using a variety of available data sources (i.e., weather forecasts, marine currents, commercial routes, historical data, etc.) to assess associated scenarios and plan accordingly. Identifying the areas at higher risk allows to prioritize interventions and focus available resources on limited portions of the sea where preventative measures, such as increased monitoring or additional safety measures, are needed to reduce the risk of an oil spill and, in case of the event, to rapidly respond and contain the spread.

Early detection systems are used to identify oil spills as quickly as possible after they occur. These systems use a variety of technologies, including satellite imagery, aerial surveillance, and on-site sensors, to detect and monitor the presence of oil spills. Early detection systems can help to reduce the impact of an oil spill by allowing for a rapid response that can contain and clean up the spill before it spreads.

The implementation of prevention and preparedness actions also goes in the direction of the Sendai framework for action Target G “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030”.

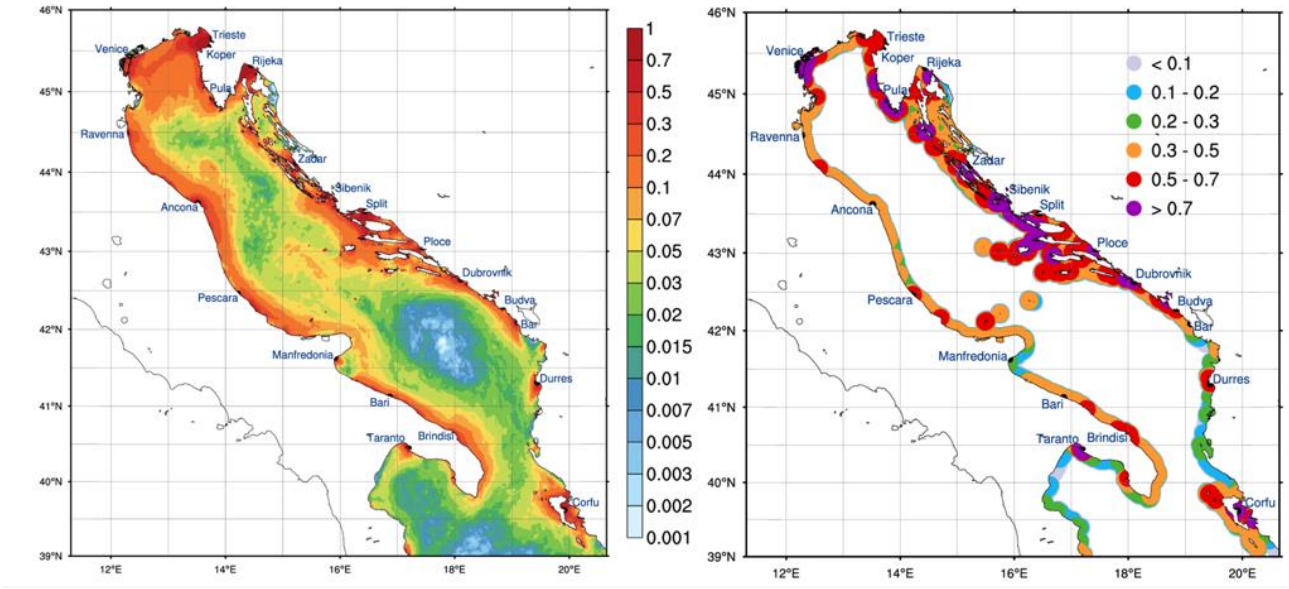
To establish a functional Early Warning system several steps, need to be implemented. For this, the use of the World Meteorological Organization and UNDRR checklist for Multi-Hazard Early Warning Systems[26] is suggested.

[26] WMO, UNDRR, *Multi-hazard Early Warning Systems: A Checklist*, Cancun, 2017.

The following recommendations are advanced to improve oil spill management in the project area:

1) Make use of the increased disaster risk knowledge data developed in the FIRESPILL project

The work done by CMCC, within the FIRESPILL framework, provides a great basis for the identification of areas where to prioritize active monitoring and early detection actions.



Im. 35: Hazard maps developed by CMCC.

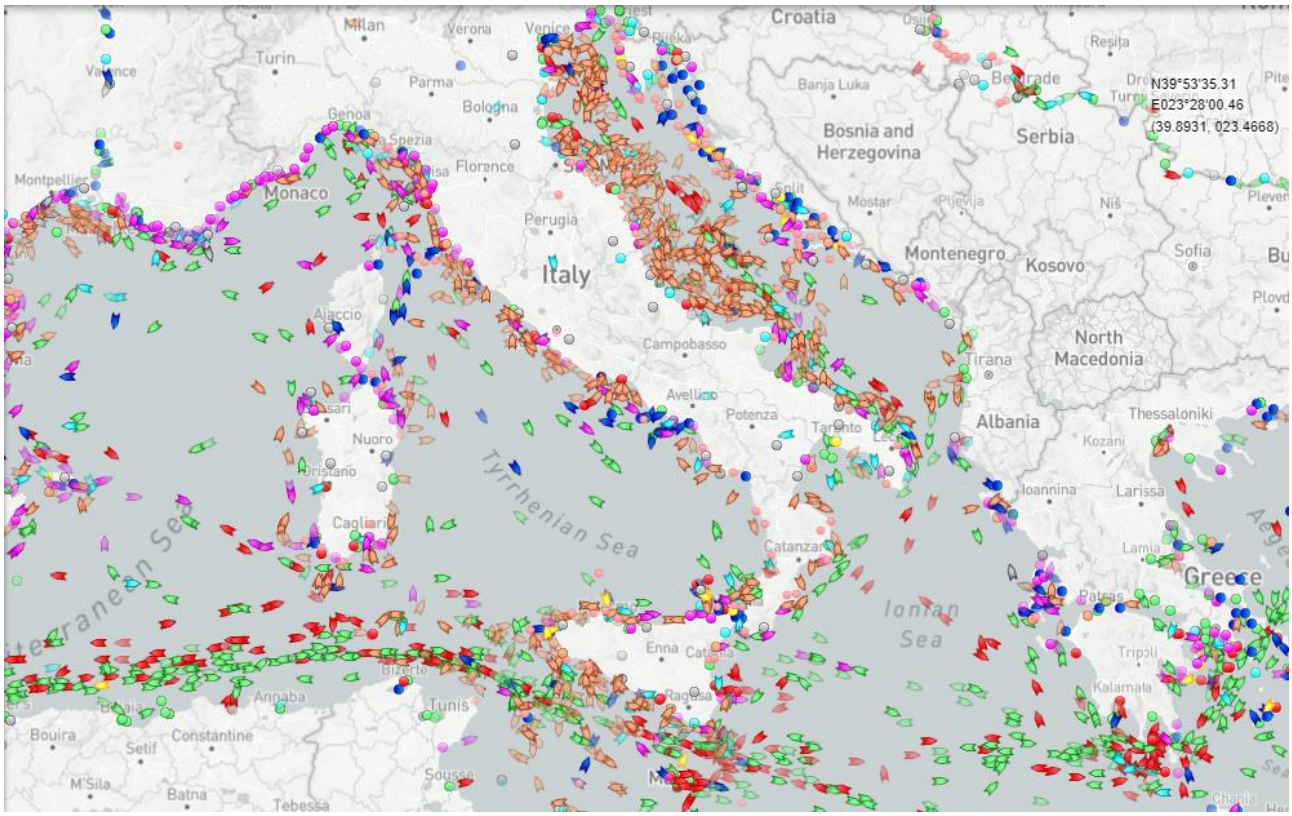
This first step provides for a localization of the area which is likely to be affected by an oil spill. No Civil Protection authority in the world would be able to always monitor the entire coast of its country, thus being able to reduce such an area represents a strategic advantage for the development of emergency plans.

It is thus recommended to revise existing plans or adopt new ones including data provided by scientific organizations and/or academia to foster the coping capacity of involved institutions.

2) Strengthen Detection, monitoring, analysis, and forecasting of oil spills

The oil spill is an anthropogenic hazard that is greatly affected by meteorological conditions (wind direction, speed, marine currents, etc.). Numerical Prediction Models are already in place and all project countries have access to high-resolution data.

While environmental conditions provide a part of the equation, there are several other pieces of information that are available and that can be used to evaluate the susceptibility of an oil spill. Marine tracker live to map for instance can provide great information on the possibility of an oil spill by simply quantifying the number of ships presence in an area previously defined as highly hazardous (see point 1).



Im. 36: Marine tracker live map. Live position of ships.

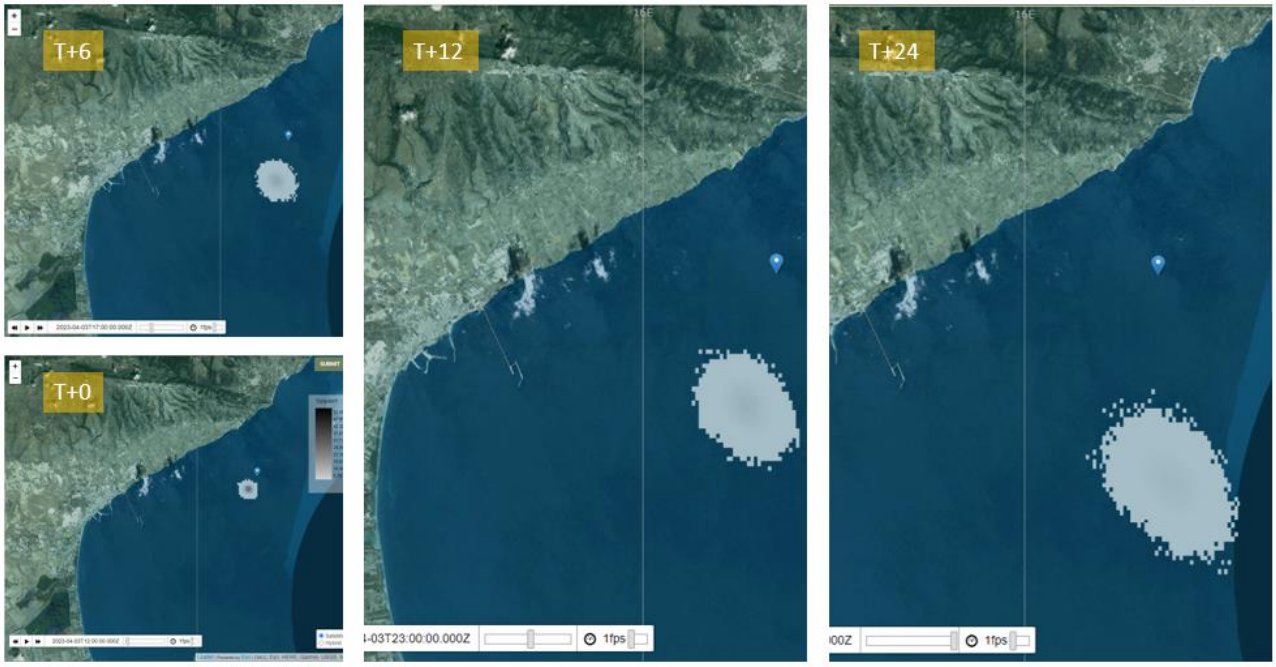
Combining these with dynamic information creates the basis to an alert system based on thresholds that could activate specific monitoring protocols based upon the surpassing of predetermined indicators.

3) Make operative use of the oil spill simulation platform

The availability of oil spill simulation data is of great importance for both the determination of possible risk scenarios (most probable or worse case) and for the evaluation of the intervention of an active spill.

Disaster risk managers can use such tools, in combination with hazard maps, to simulate possible and realistic scenarios. Once developed and approved those scenarios provide the basis for early detection procedures which should be determined a priori.

Moreover, the possibility of having a possible oil spill spread simulation available for responders during an event can allow the exertion of the most adequate containment procedures allowing to minimize the impact of a spill.



Im. 37: The Witoil platform developed in the FIRESPILL project. 1000t oil spill simulation using current forecasting models (IFS – ECMWF and Med Sea – CMEMS). The model determines the spread, the density (tons/km2), and the movement of the oil.

4) Apply an integrated (Early) Warning to (Early) Action approach

A coordinated response involving all stakeholders is essential. Effective communication between responders, authorities, and the public is critical to ensure a timely and effective response. The different stakeholders should be part of a constant communication and coordination flow in all the emergency phases, from the analysis to the closure of the operations.

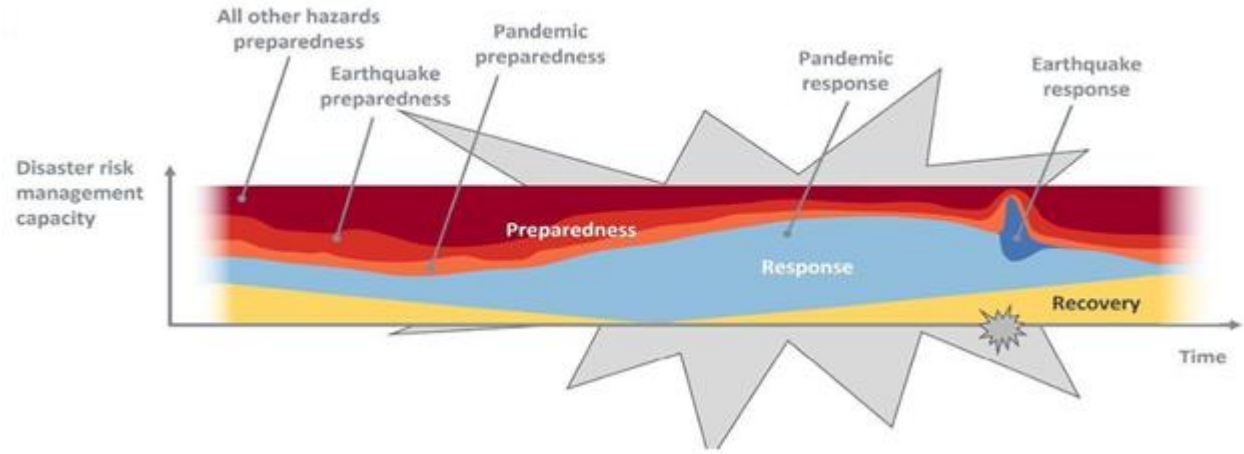
The suggested approach is a classic Warning-Action structure, where the monitoring organization should act in a proactive mode during the preparedness phase, supporting a quick mobilization by providing constant

communication flow and, more than that, linking the different status, sharing it with the relevant stakeholders asking a reaction to the status provided.

The suggested approach focuses on a series of main elements:

- it is structured to include a multi-hazard approach (e.g., a collision at sea, or the sinking of the tanker; the casual time coincidence with a forest fire or another event…);
- is structured to ensure an active monitoring action and a fast response.

To better understand the suggested approach, a parallel analysis with the classic DRM phases should be structured considering the DRM phases as continuous and simultaneous parallel lanes[27].



Im. 38: parallel phases DRM with split strands for multi-hazard risk management[28].

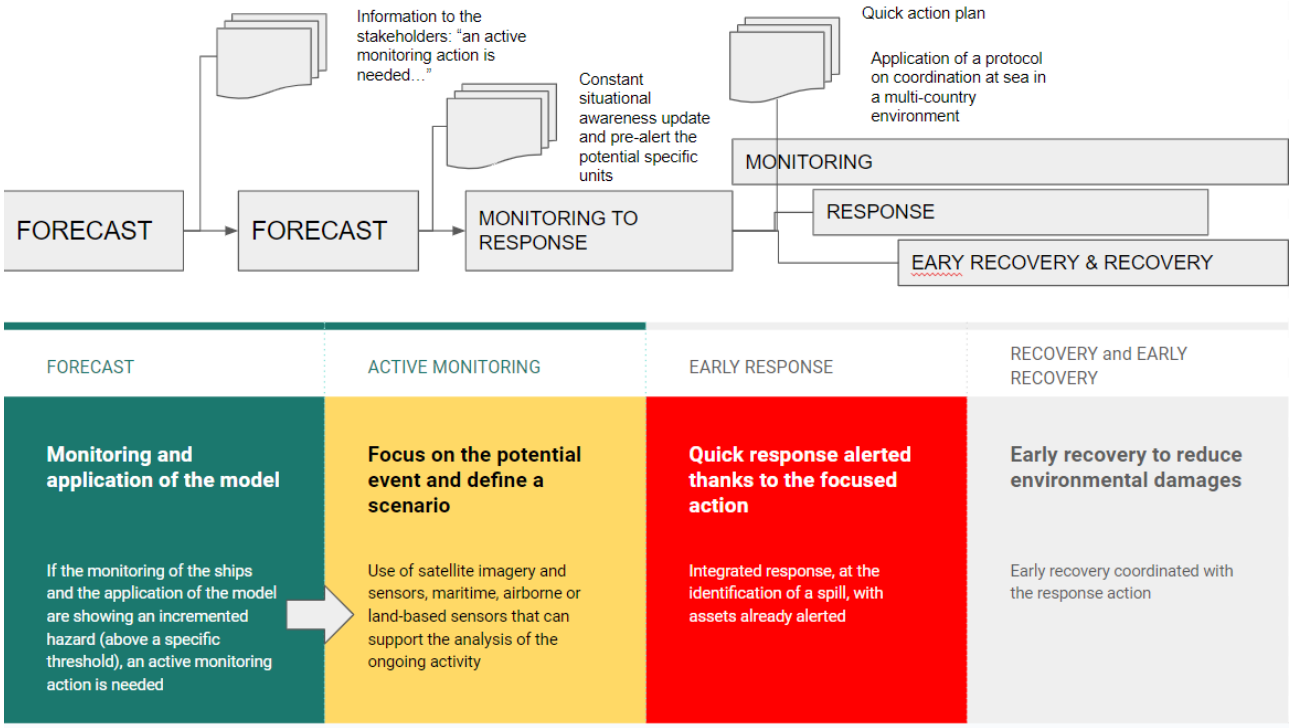
Using DRM phases, there is the need to consider that he Country and Regional Civil Protection organizations have to operate on a wider number of elements, on mitigation and preparedness, response and recovery/rehabilitation.

The picture above provides a possible framework of the activities carried on by the CP systems, with specific consideration of the main event and a potential second event (linked or not with the main one). To ensure

[27] Terzi S., De Angeli S., Miozzo D., Massucchielli L.S., Szarzynski J., Carturan F., Boni G., Learning from the COVID-19 pandemic in Italy to advance multi-hazard disaster risk management, Progress in Disaster Science, Volume 16, 2022,100268,ISSN 2590-0617,https://doi.org/10.1016/j.pdisas.2022.100268.
[28] Ibidem

being able to cope with the spill and other hazards, as well as to mitigate the damage, the advice is to react on the risk analysis by integrating active monitoring actions in the preparedness phase.

The application of the advice n.1 is paramount and is the initial key to the EWEA approach, as per the following flow:



Im. 39: EWEA approach.

Using the Abruzzo-Puglia region contribution on integrating National Shores Anti-Pollution Plan, it is possible to understand the classic response phase is very structured. The application of the EWS should be considered to cover the Forecast (through additional monitoring system) and the Active Monitoring (implementation of a planning and imagery action, according to specific requests and in a coordinate way)

5) Apply an integrated (Early) Warning to (Early) Action approach

Focusing on the response phase, it is of paramount importance to have a valid understanding of the following elements:

- The institution leading the at-sea rescue.

- Which countries will be directly touched by the event?
- Structuring specific support based on the event which is by nature dynamic.
- Transboundary plans to support both mobilizations and to facilitate communication flow and information exchange.

To do so in an effective way, an intergovernmental agreement is the best option. Such an agreement provides the basis for the cooperation between states while identifying and building up specific soft laws and SOPs to drastically reduce improvisation and thus improve reaction time[29]. Integrated systems for both offer and acceptance of international aid (including the activation of host nation support or similar systems) should be linked with the emergency plan and considered as part of the Early (or Anticipatory) Action scheme.

6) Awareness raising

A general, but fundamental, pillar of the Early Warning System is to share risk awareness and structure a culture of prevention and safety. This action can and should be enhanced as a parallel element, to support both Early Warning, Early Action, but particularly to reduce the damage by having owners, crews, authorities working together to support oil spill prevention in different ways:

- avoidance of dangerous manouvers,
- immediate alert of the relevant civil protection authorities
- definition of specific SOPs

The risk awareness aimed to the members of the public, however, could be focussed more on environmental protection and support to the relevant authorities at sea (for natants) and relevant monitoring and alerting action at land.

[29] See as example the agreement RAMOGE between France, Italy and the Principate of Monaco: https://ramoge.org/

Common training path

The health and safety of personnel involved in pollution control and depollution operations must be of primary importance. In particular, the crew of small boats and the members of the depollution teams operating on coastal formations of poor accessibility will be exposed to risk. In order to increase the level of health and safety of operators, it is essential to provide adequate training, information and training to enable them to identify the hazards involved and to manage the risks associated with the activities carried out. Since operators can be used in cross-border emergencies, it is essential that these activities are common to all countries participating in the European Civil Protection Mechanism.

In this document it is proposed a possible training program for both the staff of the administrations and the Marine Protected Areas and the resources of the civil protection volunteer who participate in emergency activities.

The theoretical/practical course examines in depth all the issues related to the intervention in case of oil spill, according to the program illustrated below. This will be the organisation of the civil protection system, with particular reference to the use of organised civil protection volunteering at territorial level; the environmental impact of oil pollution at sea; of the intervention model for the cleaning of the coasts and the different operating procedures depending on the various scenarios: interventions on sandy, pebble and rocky coasts. In addition, it will address the national and international regulatory framework for the mitigation of the risk of oil pollution, the rules on the possibility of compensation, the rules on the storage and delivery of the recovered product.

The classroom training program, with a minimum duration of 20 hours, includes the following modules:

Modules	Topic
1	The organization of the civil protection system and voluntary activities in emergencies resulting from the stranding of petroleum products along the coast.
2	Intervention at sea: subjects, skills, organization. Coordination between anti-pollution activities at sea and on land.
3	Characteristics and vulnerabilities of the marine and coastal ecosystem.
4	The main emergencies at sea and environmental damage: outline of agreements and national and international legislation for the prevention of pollution and the possibilities of compensation
5	The model of intervention on the coast: work organization, contacts and tasks, logistical needs related to the intervention on the coast of cleaning from the polluting product.
6	Operating procedures: roles, equipment, means for coastal cleaning activities
7	Safety: risk scenarios in the activities of hydrocarbon removal from the coast; personal protective equipment; deepening on the path for the safety of civil protection volunteers.
8	The effect of oil pollution on marine and coastal habitats and the main intervention techniques for the removal of pollutants along sandy, pebble and rocky coasts.
9	The temporary storage and disposal of the collected product: regulations, skills and possible solutions to the problems encountered in case of emergency.

The exercise moment foreseen at the end of the classroom training is essential to test the real potential of intervention in case of stranding of hydrocarbons on the coast by the groups formed through the course, both in relation to organisational and operational procedures (including in relation to cooperation between the different actors that need to coordinate) and in relation to the safety and proper use of personal protective equipment.

The day of exercise can also include a simulation of the classroom, designed to test the organizational phase of the intervention, the relationship between the different institutional subjects, and the different steps related to the identification of the most appropriate operating procedures in relation to different scenarios of emergency.

The practical outdoor exercise, on the other hand, involves a simulated intervention along the coast, with the setting up of the necessary structures and equipment to carry out the intervention and the testing of personal protective equipment for operators. In this sense, the exercise will focus on all the emergency phases: from the identification of a hypothetical scenario of intervention, to the coordination and transfer of information among all involved, to the involvement of volunteers, the definition and organization of the intervention procedures (inspection, initial briefing, retrieval of materials and equipment and preparation of the operational module, etc.) up to the identification of the storage of the recovered product.

Techniques of decontamination of the coast

Most coastal decontamination equipment and techniques are designed to perform treatment in water. Unfortunately, in case of major spills near the coast, the pollutant will reach it. While offshore equipment can generally be used anywhere on the water, the selection of treatment type on the coast depends on:

- Sea weather conditions at 72 hours;
- The type and amount of pollutant on the coast;
- The nature of the coast;
- The depth of penetration of hydrocarbon into sediments;
- The accessibility and transitability of the coastline;
- The possible environmental damage of treatment to the coastal environment

The removal of hydrocarbons from beaches is often done by mechanical raking using agricultural or road equipment. However, when the beaches are inaccessible to vehicles and when oil covers rocks and stones or is trapped in rock formations, crevasses or cavities, the collection by hand will be the only solution. Land raking consists in the collection of the oil using brushes and collecting with shovels within buckets, with subsequent transfer of the hydrocarbon collected in sealed holes.

To remove oil from hard surfaces (rocks, docks, etc.) it is possible to use the technique of sandblasting or high or low pressure hydraulic cleaning. Care should be taken in this case as the flora and fauna of the tidal zone may be damaged, although to a limited extent, by these techniques.

In certain circumstances non-intervention may be the best solution. In very sensitive areas, mechanical or, worse, chemical treatment can cause more damage than hydrocarbon itself. In some cases, after the expert opinion has been obtained, it will be better to leave the oil alone so that it degrades naturally, possibly limiting itself to preventing its dispersion in other sensitive areas.

Introduction of innovative equipment

Among the above mentioned activities, today there are particular difficulties in implementing the hydraulic cleaning of hard surfaces located in areas not accessible by land (pickup or truck).

Im. 40: Riserva Naturale di Punta Aderci - Abruzzo. Example of coasts not reachable by pickups and trucks[30].

[30] https://www.goodtrekking.it/trekking-abruzzo/punta-aderci-spiaggia/

To meet this need, one possible solution can be the use of Heliskid modules.

Im. 41: Intervention on spill[31].

It is a compact, versatile and transportable kit that allows you to make available with maximum speed, exactly where you need, a deployment of tank-structure, to be supplied with water and dispersants, pump, pipes and nozzles.

Im. 42: Heliskid modules[32].

[31] https://www.generazionezero.org/blog/2019/11/11/fuoriuscita-di-petrolio-in-brasile-2-500-km-di-costa-inquinati/
[32] https://www.vallfirest.com/it/vft-aerial/heliskid/

Proposals to improve earthquake risk management

This chapter has been drafted with the intention to contribute to the Green Paper on the development of Emergency Services Regulatory System (ESRS), adopting an "evaluative approach" of the management methods of Emilia-Romagna's and some other post-earthquake reconstruction processes, aimed at understanding its positive characteristics as well as criticalities, in view to systematize the knowledge raised from these experiences and better understanding the learnings and their overall replicability.

After summarizing the state of the art of reconstruction in the various sectors - private residential, private industrial and public - along with as exhaustive as possible a picture of the "toolbox" of regulatory, technical, planning and economic tools that supported the reconstruction management, the case of Emilia-Romagna has been analysed in comparison with other Italian earthquakes. A synoptic reading of the management of each one is attempted, deriving useful elements for the design of a governance model and of its "pillars" which, although it has many common features between events, shows a substantial level of dependence on the political-administrative, social and geographical context in which the event itself occurs.

Also, an attempt is made to draw some elements for reflection from the experience of "earthquake governance," to define effective strategies for the relaunch of the territory affected by the disaster, also considering the new crisis factors that have heavily complicated the situation in the territory, starting with the increasingly critical effects and impacts of climate change.

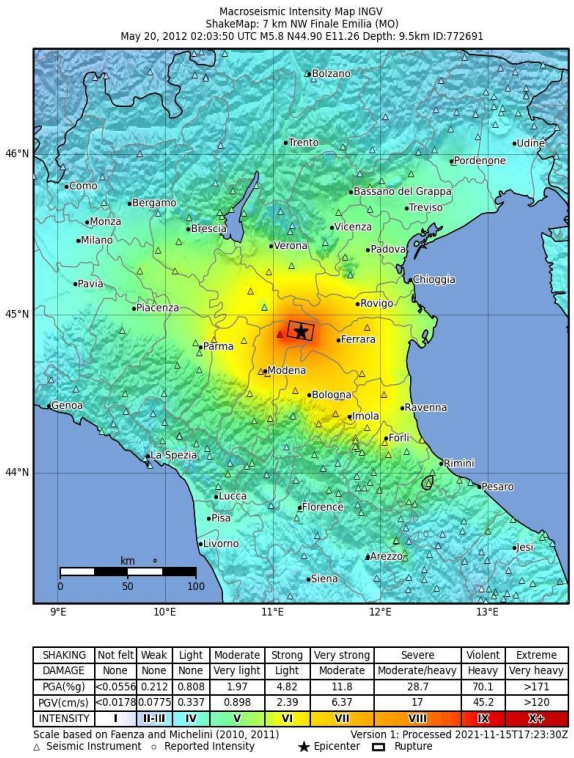
This is in view to increase that "adaptability"[33] of regions facing those crisis factors and real shocks (as an earthquake), as the capacity to reinforce the ability to change, innovate social behaviours, governance methods, characteristics of the production systems, etc., which over time can made a territory a leading region in terms of attractiveness and competitiveness in the national and European context.

[33] Bianchi P., Labory S.: *The role of governance and government in the resilience of regions: the case of the 2012 earthquake in the Emilia-Romagna region in Italy*; HAL, 2015, and Pike A., Dawley S. and Tomaney J., "*Resilience, adaptation and adaptability*", Cambridge Journal of Regions, Economy and Society, 4 – 2010. "*Adaptation*" and "*adaptability*" area understood the former as the capacity for immediate response to a shock, aimed at restoring previous conditions, and the latter as the capacity to proactively use the shock itself as an opportunity to take innovative paths.

A resilient land facing a catastrophe

The earthquake of May 2012 severely hit the regions of northern Italy and in particular a large area of Emilia, in the provinces of Ferrara, Modena, Reggio Emilia and Bologna, as well as the Lombardy province of Mantua and the Veneto province of Rovigo. The earthquake came unexpected to most people, as the collective memory had forgotten the 1570 earthquake in the Ferrara area, in which the city of Ferrara itself was half destroyed. That event during the Renaissance caused, among other things, the first documented episode of soil liquefaction phenomena and one of the oldest known occurrences of similar events. This liquefaction, in the areas of river humps in the plain, was again in 2012 among the causes of significant damage to buildings. The seismic swarm that began on the 20th of May contained 8 tremors of a magnitude of at least 5 on the Richter scale and reached its maximum intensity with the tremors of May 20th and 29th 2012, respectively at 5.9 and 5.8. They hit a large territory, with a population of about 550,000 inhabitants (excluding the capital municipalities of the four provinces hit, Ferrara, Modena, Reggio Emilia and Bologna), highly industrialised. 59 municipalities were involved, concentrated in an area with a high density of agricultural, artisan and industrial production activities and the presence of highly internationalised production districts (such as the biomedical sector in the Mirandola area), where 2% of the national GDP is produced[34], with exports amounting to 12.2 billion euros and 19.6 billion euros of added value.

[34] Excluding the contribution of Bologna.



Im. 43: Map of the area hit by the 2012 earthquake[35]

The damage - often collapses or serious destruction - affected historical centres, especially public and private buildings of historical and cultural value, as well as industrial and artisan buildings in suburban and industrial areas. The final toll of the disaster was 28 victims, with about 300 people injured, almost 21,000 homes damaged, and 45,000 people - 19,000 families - forced to temporarily leave their homes, 16,000 of whom were accommodated in tent camps set up by the Civil Protection. 72 municipal buildings, 653 schools and university buildings, 27 libraries, 102 health facilities, and 456 churches and places of worship were damaged. A further 754 public buildings, including 33 theatres, as well as numerous structures from the land reclamation system, suffered serious damage.

In addition to this, 10,000 companies also very serious damage, with widespread collapses, and 3,748 of them had to lay off more than 40,000 workers; there were also almost 14,000 farms and livestock holdings affected, covering an area of more than 200,000 hectares. The overall damage estimate certified by the

[35] Source: http://terremoti.ingv.it/event/772691

European Commission reaches 12.2 billion euros. When faced with a disaster of this magnitude, the public and private actors in the territory become - all together - protagonists of the reconstruction. Attention is immediately focused on social cohesion: schools and the industrial sector resumed their functionality in a short time, avoiding the displacement and depopulation characterising other events in Italy's long seismic history. From this standpoint, the leadership exercised by the Region in the Inter-Institutional Committee[36] – established specially for the purpose and composed of members of the local and regional governments, under the leadership of the regional President, appointed Deputy Commissioner of the Government - allowed the region to prepare a plan for the reconstruction in a short space of time that relied on the involvement of local communities.

Given the strategic need to ensure the maintenance of social cohesion, the focus was immediately placed on reducing as much as possible the precarious conditions that the community would have to face. In agreement with the national government, legislative decree 74/2012[37] was drafted, with the objective of ensuring the functionality of schools, services to citizens and the agricultural and industrial sectors as soon as possible.

The programming approach to emergency and reconstruction management

The centralisation of decision-making functions in the figure of the President, as Deputy Commissioner of the Government, allowed the Region to ensure a continuous connection with the national level, and at the same time to exercise strong leadership within the Inter-Institutional Committee. This led to the preparation, in a very short space of time, of a path articulated in operational plans for reconstruction, adopted by means of the *Commissioner's ordinances*[38], with the direct participation and consensus of the local communities. This

[36] Established by ordinance n°. 1, June 8, 2012, *the Institutional and Steering Committee for Reconstruction*, established by order of the Deputy Commissioner, which represented the pivot of the governance system and was aimed at ensuring assistance to the population, the full resumption of economic activities and the restoration of essential public services. Chaired by the President of the Region and made up of the Presidents of the Provinces of Bologna, Modena, Ferrara and Reggio Emilia and the Mayors of the affected municipalities, the Committee meets periodically to plan guidelines, activities and intervention choices

[37] Legislative decree n° 74, June 6 "*Urgent measures in favour of the populations affected by the earthquakes that hit the territory of the provinces of Bologna, Modena, Ferrara, Mantua, Reggio Emilia and Rovigo on 20 and 29 May 2012*".

[38] The operational framework set allowed the Deputy Commissioner to manage the process agilely, ensuring rapid responses to the issues emerging within the Inter-Institutional Committee, outlining priorities and respecting the criteria of legality, transparency, equity and safety in reconstruction. This aimed as far as possible to reduce the time and administrative procedures necessary to concretely implement such a process.

led to the main strategic choices for the immediate future, e.g. from the adoption - as early as 5th July 2012 - of the Schools Operational Programme, enabling timely reopening on 17th September, and the adoption of clear rules for starting and managing reconstruction in a transparent manner.

The governance of the emergency was therefore based on the convergent action of local democratic institutions and citizens, based on the principle that the vision, objectives and rules for the reconstruction must be built together, ensuring consensus, common mobilisation towards the objectives, efficiency of management, capacity for control, and transparency of processes. All this while the direct involvement of local administrators guaranteed a closeness to the community that was the only way to ensure the rapid identification of immediate priorities. With the awareness that only such an approach could ensure that local identities were not rigidly conservative but open, and used as a resource - the key to innovation aimed at guaranteeing more security and better preparation for possible future events.

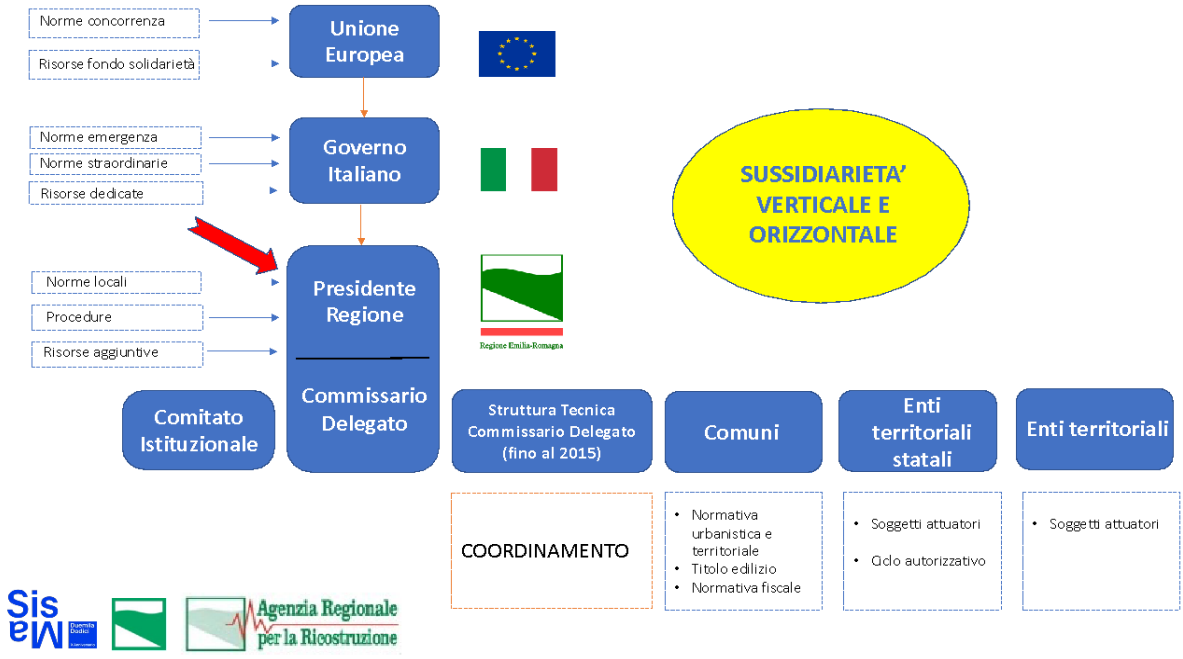
From this point of view, a fundamental choice coincided with the allocation - by means of Decree Law 74 - of the decision-making to a "medium" institutional level - the Region, with its President as Deputy Commissioner (Im. 27), endowed with a *Technical Structure set up ad hoc*[39], to carry out the temporary public works (schools, town halls, temporary housing, etc.) so that the population affected by the earthquakes of May 2012 could continue to enjoy the necessary public services.

As of 2015, the Technical Structure merged into the Agency for Reconstruction - Earthquake 2012, established for the purpose of managing the completion of the reconstruction[40]. The Joint Technical Commission, chaired and coordinated by the Regional Agency for Reconstruction and involving the Regional Geological, Seismic and Soil Service (for aspects related to seismic authorisation), the Regional Directorate for Cultural and Landscape Heritage, has been put in charge of providing advisory functions to support the Deputy Commissioner and the Institutional Committee, and supporting with to provide technical assistance Municipalities, Dioceses and other implementing bodies.

[39] The Delegate Commissioner's Technical Structure, established by legislative decree No. 74/2012, was then regulated by Commissioner's Ordinance No. 31 of 30 August 2012.

[40] The Agency for Recostruction – Earthquake 2012, established in 2015 according Regional Law No. 6/2004, an operational body with managerial and organisational autonomy, within the framework of the guidelines of the Council, with the task of overseeing the "*complex of activities related to the earthquake, realising all possible synergies, coordinating the activities of external professional contributions and ensuring support for the network of local authorities involved*".

This was based on the conviction that, by consistently applying a criterion of *vertical and horizontal subsidiarity*, this was the best option among the alternatives of an all-national direction "far" from the territory, or of a management potentially too close to the local dimension of the territory, to ensure balance in the choice of priorities and effectiveness in the implementation of interventions. Under this profile, the three regions affected - and Emilia-Romagna in particular - had already shown a significant capacity to adapt to the challenges of change, especially if we look at the history of its industrial districts and their progressive integration into a regional innovation system.



Im. 44: The President of the Region, Deputy Commissioner for Reconstruction.

In the event of a disaster, the ability to respond is largely linked to the magnitude of the destruction and the size of the financial resources needed to rebuild: in the case of the Emilian earthquake, this could rely upon the choice to self-manage the emergency and the reconstruction, reacting with immediacy and aiming for a better building quality especially in terms of seismic safety and energy performance.

The approach proved effective and several companies - both multinational and local - located in the area of the epicentre (first and foremost the companies in the biomedical district), rather than relocating their plants to other countries, looked at the event as an opportunity to develop plant and organisational innovations and increase their production capacity.

Several researchers, in analysing the history of the event, developed the conviction that the ability of the regional government to define together the objectives and the path of reconstruction and to share it with its own institutional interlocutors and those in civil society, has not only favoured reconstruction in the strict sense of the word (as a reaction of "adaptation" to the shock of the earthquake) but also allowed them to strengthen the basis for a new evolutionary model of sustainable development of the territory. In other words, it reinforced the "*adaptability*" of the territory, by understanding how to seize, even in dramatic conditions, the opportunity to reinvent itself, favouring the principle of "*where it was, how it will be*" that is needed for a new development path.

Elements for a disaster governance model

This section attempts to systematise the elements which emerged from the Emilia-Romagna case, whose convergence can facilitate the implementation of an effective post-disaster governance system; these are also put in relation to the other reconstruction experiences in our country. The reconstruction process is considered from the point of view of both the strengths making its positive outcome possible, and the problems that emerged, some of which preceded the event and others during the past decade.

A comparative reading of Italian reconstructions

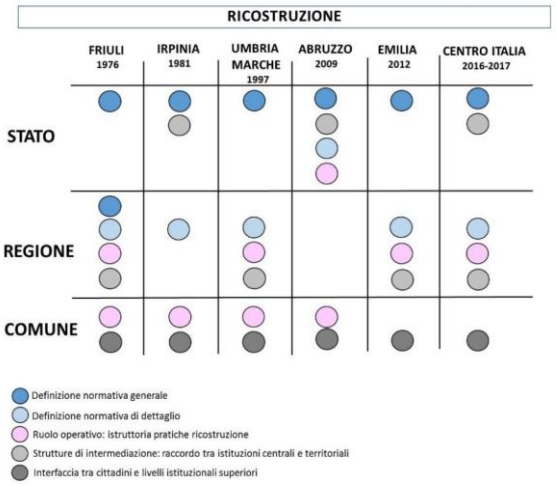
A recent document produced by the Special Office for the Reconstruction of the Earthquake Area Municipalities (URSC, linked to the 2009 L'Aquila earthquake)[41] proposes - among other things - a comparative reading of the governance models adopted in the event of the earthquakes hitting Italy from 1976 to 2016, identifying the actors and subjects involved in various capacities in the reconstruction processes, within the framework of their relationship with the respective territorial communities.

[41] See: Ufficio Speciale per la Ricostruzione dei Comuni del Cratere (L'Aquila 2009 earthquake), *Diritti dei cittadini a confronto in alcune ricostruzioni post sisma in Italia*, L'Aquila, 2018.

In general, the key evaluation question appears to be linked to the *consideration of the effective weight of the "governance"* of emergencies and reconstructions, compared to the results actually achieved. What is proposed is an analysis of the organisational models implemented in the different contexts to manage the respective reconstructions, highlighting differences in the actors involved, their responsibilities and functions. Image 28 accounts of some substantial differences in the responses to different events, also highlighting their evolution over time.

In particular, for the various seismic events, multiple aspects of the regulatory and management methods are identified, some of which, although they cannot be interpreted univocally, allow a useful comparison of:

- the "actors" involved in various capacities (authorities, entities, structures delegated to define and implement regulations)
- the “roles”, responsibilities and functions exercised by these actors in the processes carried out.



Im. 45: Responsibilities and functions in the Italian earthquakes 1976 - 2016.

In all circumstances, the organisational models for managing these events make it possible to identify *two macro phases*, one linked to *the emergency in the strict sense* (immediately following the event), and the other to *reconstruction in the broader sense*. They are characterised by different temporal articulation, each time aimed at housing reconstruction, recovery of production, and settlement development.

In general, a standard subsidiarity scheme in the distribution of responsibilities should envisage

- *centralised State management of the first phase of the emergency, corresponding to the passing of general legislation*;
- *involvement of the Regions in the reconstruction phase, with the issuing of detailed regulations and the preparation of organic programmes for the processes*;
- *implementation of operational interventions, delegated to the municipalities, regulated by urban planning instruments*.

In the reality of the events considered, the different "*models*" diversify where the "*standard*" phases of this scheme intersect, overlap, integrate or alternate. Indeed, we observe, for example, when compared against the very decentralised method that characterised the Friuli earthquake (certainly also linked to the Region's special statute), the very strong centralisation from the state authority in the case of the L'Aquila earthquake, which literally "skips" the regional level (although with a partial overlap with the municipalities, in terms of the operational functions connected to reconstruction practices). On the contrary - and taking into account the ordinary statutory character of the Regions in question - in the cases of Umbria - Marche 1997, Emilia 2012 and Central Italy 2016 - 2017, the central role exercised by the regional level clearly appears, only partially "mitigated", in the case of Central Italy, by the inter-regional character of the earthquakes and the need for the central State to exercise stronger coordination.

Below, we attempt to identify some key points.

a. Governance structures related to the same type of calamitous events (earthquakes, in this case) have changed over time as the reconstruction phase has progressed, differentiating themselves. Generally speaking, there seems to be a sort of "*path dependency*" *of governance schemes from the management choices made in the immediacy of the event*, linked to the specific conditions of the context, e.g. the actual extent of the event in terms of extension and damage, the organisational capacity of the regional and local administrative levels, the degree of proactivity of the actors in the economic system, etc.
b. However, the comparative reading of the choices that accompanied the different events seems to give account of *an evolution of management models in the direction of a gradually stronger role played by the regional level*, at a "meso" scale corrected if necessary by greater involvement from the State level when the supra-regional scale of the events requires stronger coordination: this is the case of the Institutional Committees set up in the four regions of the 2016 - 2017 Central Italy earthquake, whose function is to

support the strategic choices of the respective presidencies, in their function as Vice-Deputy Commissioners of the Government.

c. In general, there is a *growing consistency between the functions exercised at the various levels and the distribution of responsibilities dictated by the Constitution*, at least as far as the Regions with ordinary statutes are concerned, taking into account the progressive evolution of the structure and operations of the Regions themselves, starting from their effective establishment in 1970.

d. With the definition of a *Technical Mission Structure* of the Presidency of the Council of Ministers, the case of the *2009 L'Aquila earthquake appears to be in contrast, with the almost exclusive role of the central State, to the opposite extreme of the 1976 Friuli earthquake*, in which the Region played a leading role even at the level of defining the legislation, both general and detailed.

e. With the *2012 Emilia-Veneto-Lombardy earthquake*, precise choices were made, of both a strategic and operational nature. On the one hand, there was *the leadership of the Presidents of the Regions as Deputy Commissioners of the Government for the management of the emergency and reconstruction*, and on the other, the *positioning of the operational functions inherent to reconstruction practices to the regional level* and no longer delegated to the municipal level, with all the positive implications in terms of a organic unity in the governance of the actors, definition of policy priorities for the emergency and the reconstruction, creation of simplifying tools for its implementation (e.g. telematic tools), monitoring of processes.

f. The *2016 - 2017 Central Italy earthquake adapted the overall organisational approach of the Emilia-Veneto-Lombardy experience to the more markedly multi-regional scale of the event*, establishing the figure of the *Deputy Commissioner*, delegated by the Government for the reconstruction, *who is reported to by the Presidents of the regions involved, as Vice-Commissioners, who are in turn supported by Special Offices for Reconstruction, decentralised regionally* and organized in various provincial offices.

g. What is naturally common to all the events is the "*interface*" *role played by municipal administrations, as a connection between citizens and higher institutional levels*, but where the additional attribution of an operational role in the management of reconstruction practices must reckon with the frequent weakness of technical structures, which are not always accompanied by technical-managerial "*coverage*"

from the regional administrative level (except for the last two earthquakes, in which the municipalities were not called upon to directly carry out the management of reconstruction practices).

h. With regard to this last aspect, *the degree of integration of local actors and communities differed in the various circumstances* considered: whereas in the case of Friuli the strong focus on the local social context was undoubtedly favoured by the territorial decentralisation of the reconstruction, which made it possible to enhance the self-organising capacity of citizens and local administrations, on the opposite front, in the case of L'Aquila 2009, the predominance of the national level resulted in poor cooperation with the Region and Local Authorities, which were only able to enjoy very limited space, e.g. in the definition of regulations, only partially mitigated - in 2012 - with the establishment of the Special Office for the Reconstruction (USRC), allowing better coordination between central structures and municipalities.

i. Equally interesting is the comparison between the case of Irpinia in 1980 and that of the Emilia-Veneto-Lombardy in 2012: in the first case, great decision-making autonomy was granted to municipalities and communities in the management of the reconstruction: a process which, however, in the absence of an effective strategic direction, led to frequent relocations of destroyed settlements and great difficulties in activating an effective recovery. In the 2012 earthquake, on the other hand, in addition to the organisational and technological choices (certainly also made possible by the very different technological conditions that characterised the time when the events occurred[42]), the role of strategic direction played by the regional level, together with the cooperative capacity of local actors, became a keystone of the positive results achieved so far. Thus, in the context of the emergency, and with the support of the *Joint Technical Commission*, consistent collaboration was established between professionals in charge of damage assessment Unit, the Deputy Commissioner's Technical Structure and the Region.

In terms of ongoing trends, recent regulatory developments seem to be taking steps in the direction of greater standardisation in governance methods: the so-called *Reconstruction Decree*[43] assigns to the Presidency of the Council of Ministers the functions of guiding and coordinating the activities carried out by

[42] It was only from the earthquake of Umbria – Marche 1997 that it became possible to establish an online Observatory on reconstruction.
[43] Law No. 156/2019.

the competent institutional authorities on the subject of restoration and reconstruction in the territories affected by calamitous events of natural origin, i.e., not resulting from human activity. Added to this was the Prime Ministerial Decree of 4 April 2020, where the *Department of Casa Italia*[44] was assigned the additional responsibilities of "*coordinating the work of the competent institutional authorities for the activities of restoration and reconstruction of territories affected by calamitous events of natural origin or resulting from human activity, following civil protection interventions*", in continuity with its original mission aimed at increasing the seismic safety of the national housing stock[45].

Finally, at the time of writing this report, it is worth mentioning the Draft Law delegating the adoption of the "*Reconstruction Code*" to the Government, which is aimed at defining a uniform regulatory framework to coordinate the procedures and activities for reconstruction and economic recovery in the territories affected by seismic events, without prejudice to the responsibilities and activities attributed to the National Civil Protection Service[46].

Strengths and weaknesses in the Emilian experience

Understanding the replicability, or at least the transferability of the Emilia-Romagna case certainly implies considering the specific conditions whose occurrence, at different territorial scales, enabled its realisation. This leads us to return to a consideration of our initial conceptualisation regarding the territorial system's properties of "*capacity to adapt*" and "*adaptability*"[47].

This is an interpretation of the concept of "resilience" with strong territorial connotations, in which context-specific conditions weigh heavily on the definition of possible solutions to emerging problems. In this sense, the effectiveness of any decision-making process in responding to an immediate and critical emergency (an earthquake, in our case, but also a flood or an environmental or social emergency), depends significantly on

[44] Directly afferent to the Presidency of the Council of Ministers, the Department Casa Italia has the task of "*developing, optimising and integrating instruments aimed at the care and enhancement of the territory and urban areas as well as of the housing stock, also with reference to the safety and energy efficiency of buildings*".
[45] However, the subject matter needs to be reviewed to define clear governance, overcoming legislative fragmentation in order to create a structure with clear, standardised powers and tasks that can implement long-term interventions.
[46] The Code remained on standby due to the national political change occurred on September 2022.
[47] See *Bianchi P. and Labory S.*, cit.

the ability of decision-makers to make appropriate decisions according to the conditions of the context, with an approach that can be likened to the concept of "*place-based*" local development[48].

Placed in relation to the case of Emilia-Romagna faced with the effects of the earthquake, this approach leads us to highlight the *pillars of regional development*, namely:

- the *high administrative and institutional capacity* at the level of the regional government, capable of producing choices designed on the basis of a strategic vision of the territory;
- the *capacity for collaboration between institutional, economic and civil society actors*, which has grown at all levels within the framework of a strong aptitude for participation and cooperation between actors with different characteristics and even potentially conflicting interests;
- the *prior availability of programmatic and territorial planning* tools (at least to a certain extent the "offspring" of the above-mentioned aspects) that have made it possible to delegate choices to the territory, first relating to the management of the immediate emergency, and then to reconstruction.

It is in this context the great choices of governance are made, starting with the fundamental assignment of the President of the Region as the government's Deputy Commissioner for reconstruction, in fact identifying the meso-institutional level, "*not too far, not too close*" to the territory, as the most appropriate for making fast and effective decisions, starting with programmes dedicated to restoration of schools, municipal services, etc. as well as with the public-private cooperation leading to a rapid economic and jobs recovery.

It is again this context that makes it possible to express important innovations in the management of the reconstruction process, both on the planning side and on the social innovation side. On the first front is the use of a consolidated tool such as the *Special Area Programme*[49], used here to manage public resources for reconstruction in an integrated way with those from private investment, bringing the interventions of both

[48] There is extensive literature on the "*place-based*" approach to local development. As an example, see: Barca F., Carrosio G. (2020) "*Un modello di policy place-based: la Strategia Nazionale per le Aree Interne*", in Osti G., Jachia E. In "*Attivaree. Un disegno di rinascita delle aree interne*", Il Mulino, Bologna.

[49] Introduced by Regional Law 30/1996, the Special Area Programme supplemented the regional resources available under Sector Laws 41/1997 (on trade and the qualification of minor enterprises), 19/1998 (on urban regeneration) and 16/2002 (on the recovery of historical-artistic heritage and the promotion of architectural and landscape quality). Regional Law 30/1996 was subsequently repealed by Regional Law 5/2018 on territorial interventions for the integrated development of local areas.

parties into a system, within the framework of the *Organic Plans*[50]; on the second, the use of participatory methods to channel and organise citizens' contributions to the definition of reconstruction choices, in particular with regard to the recovery and revitalisation of historical centres[51].

On another front, and with a view to the need to consider which development path to choose once reconstruction is complete, it seems equally important to identify the territorial and economic limits and gaps that an area hit by an earthquake comes to show during the reconstruction phase, e.g. the presence or lacking of a spatial urban fabric, institutional capacity and decentralisation, the degree of resilience of enterprises in terms of investment capacity, the capacity of the actors of the civil society to cooperate. Limits and gaps that may differ from a place to another[52].

[50] The 2014 national Budget Law intervened opening up interesting fronts for the policy on historical centres, asking municipalities for an approach that was consistent with urban planning and integrated with other economic policies; one aspect going in this direction was the "*Organic Plans*", aimed at restoring living conditions, resuming economic activities and reducing the vulnerability of buildings and the urban landscape, on the basis of the provisions issued by the Region.

[51] As an example, it is worth mentioning the practices of Novi di Modena ("*Fatti il centro tuo*" - https://www.osservatoriopartecipazione.it/scheda-processo/562); San Felice sul Panaro ("*piùSanFelice*"- https://www.osservatoriopartecipazione.it/scheda-processo/560); nReggiolo ("Facciamo centro").

[52] Without prejudice to the natural drop in turnover in relation to the extent of the damage, which occurred in the immediate aftermath of the earthquake, if we look at the dynamics of investments, it is the companies with the highest level damage that, in the years from 2012 to 2015, invested the most, showing not only a different propensity to invest, but above all their focus on the new drivers of growth, from digital technology to all aspects related to sustainability. This phenomenon is confirmed by the economic data from the following years: companies with limited damage and low investment in the 2015-2019 period increased their turnover by 3 per cent, while those with medium or high levels of damage grew by 34 per cent.

5. Towards a common governance approach

Strategies and tools adopted by partners: a SWOT analysis

Disaster risk assessment is a qualitative and quantitative approach aimed at determining the nature and extent of disaster risk analysing potential hazards, and evaluating existing conditions of exposure and vulnerability that could harm people, property, services, livelihoods, and the environment. This section (Tab. 1) provides an analysis of the strategies and instruments adopted by partners for disaster management, according to the SWOT (strengths/Weaknesses/Opportunities/Threats). Strengths and weaknesses are analysed according to a "country approach", in view to give evidence to the main aspects identified by partners as core topics to be addressed in view to develop a shared and progressively convergent governance scheme. On the other hand, the external factors corresponding to opportunities and threats that may positively or negatively affect the achievement of the stated objective (e.g. the different approaches, forms of organisation, capacities available in the different contexts), are addressed jointly.

Strengths	**Weaknesses**
On the Italian side	
• General capacity for multi-level governance, esp. in coordination with all the agencies holding specific functions (emergency management; social protection; economic relaunch); • In Emilia-Romagna (ER), also: - strong capacity to cooperate with civil society; - accurate Territorial Planning facilitates immediate emergency infrastructure decision making; • Robust public policy (particularly in ER and Marche Region) to promote post disaster economic relaunch;	• Absence of a widespread and capillary specialised media network; • Regional differences in institutional organization, may lead to overlapping of actors and functions in the decision-making process; • Preservation of several cultural assets on Italian territory; • Regional lack of regulated intervention procedures for specific risks. (e. g. Puglia region); • Frequent undersized staff and equipment for managing emergencies.

• Multilevel governance mode ensures avoiding risks of economic/demographic desertification post-disaster; • Training of volunteers and the financing in favour of the municipalities for the planning; • Strong role of ICT tools in supporting decentralized management of applications for financial support to private/enterprise reconstruction (regional); • Regional authorities support vulnerable groups in case of disaster; • Centrality of the risk prediction networks in case of disaster; • Centrality of risk awareness campaigns.	
On the Croatian side	
• Quick response capacity and highly skilled human resources; • Equipment and training of central civil protection units, such as firefighters, protection and rescue services, and Red Cross units; • Centrality of effective risk prediction / communication networks in case of disaster; • Centralized management of applications for financial support to private/enterprise reconstruction (national); • National authorities/Civil Protection support vulnerable groups in case of disaster; • Centrality of risk awareness campaigns.	• Complex coordination of civil protection units • Frquent lack of specialised equipment; • Infrastructures non seismic-resistant; • Need for harmonization between different legislative levels, avoiding “over-planning” due to bad legislative coordination.
Opportunities and threats, on both Italian and Croatian sides	
Opportunities	**Threats**
• Implementing risk monitoring procedures; • Invest in awareness and prevention.	• Cultural heritage preservation and management at the national scale can become a bottleneck, due to the stricter restoration rules;

	• The delay in legislative harmonisation across different levels of government may affect the timely management of risk; • At the legislative level, specific procedures on risk assessment often aren't mandatory while for issuing building permits, the opinion of Civil Protection representatives should be binding, at least for critical infrastructure.

Tab. 1: SWOT analysis of strategies and tools for risk and disaster management adopted by Firespill partners.

Observations and considerations

Over the basis of the results provided by the survey, we can stress some relevant elements:

a. both countries show the presence of a widespread risk management planning, regulating and reducing hazards;
b. the organizational form (and subsequent process governance) depends upon different factors, locally relevant:
    - the level of centralization/decentralization of powers and functions, that influence the grade of authonomy both in risk management planning (although according to common norms, that maybe established also at EU level, as in the case of floods);
    - the capacity in self-organization and coordination of Public Administrations, in particular at interregional, regional and local level (regions, counties/provinces, municipalities);
    - the level of training of Civil Protection and in general of the professionals involved in risk management activities;
    - the level of equipment (including autonomous, effective and long-range communication tools);
    - the grade of sensitization and awareness of citizens, their capacity to safely behave in case of an emergency and to collaborate in its management.

c. apart of the immediate relief intervention, an “effective” response to the disaster implies the capacity to ensure as short as possible the maintenance or restoration of services to citizens and the support to economic activities, avoiding migrations, urban centres desertification, job losses;
d. damage assessment is still slow and rather “handmade”, in particular about historic and cultural heritage; this calls for technological innovation to speed up processes and standardize assessment results;
e. the more powers and functions are clearly allocated, the higher the potential effectiveness of governance schemes based upon a centre-periphery coordination and integration;
f. the Italian experience of the Regional Presidents appointed as Government Deputy Commissioners, with the power to operate by ordnances proved very effective in providing a timely decision making vs. ordinary legislative processes that are mostly very time consuming;
g. the best performances in post disaster management are observed in the territories in which public-private and institution-civil society cooperation has become the recognition code of territorial networks relationships;
h. updated territorial planning can be a highly important resource when a rapid decision making is required (e.g. where to locate refugee camps and/or provisional service infrastructures); on the contrary, over-planning and/or non coordinated and integrated multi-level planning may become an obstacle for effective decisions;
i. in general terms, in case of a disaster citizens remains primarily “victims”, as communication and sensitization campaingn, although growing in scale, are still not experience and practice-based (safety drills are still few and non continuous).

From disaster experiences, can we outline a possible “common model”?

With regard to the factors conditioning the implementation of effective responses to emergencies, the cases and experiences of different types of disasters, as emerging from the questionnaire, leads us to consider "*local conditions*" as the variable that most of all conditions the ability to respond to a disaster of any origin. And it is also the main factor in what makes true “modelling” difficult.

Paraphrasing the scholars Okuyama and Sahin[53], we can affirm that, although at different levels according to the scale of the event, "*a natural disaster throws the entire society against the wall. How much the territorial system economy manages to bounce back depends on the elasticity of the ball, i.e. the resilience of same territory. In this metaphor, the assessment of the impact of a disaster is to measure how hard the ball is smashed against the wall*”[54]. In this sense, the “*crushing of the ball*” concerns the territorial system in all its aspects: it is also what makes “*governance*” indispensable as the capacity to implement decision-making processes that involve all stakeholders, ensuring a transparent response to their needs and respect for everyone’s rights. According to this conceptualisation, summarised in the diagram in image 32, all levels of governance must work together, coordinating their actions so that the management of an emergency is successful.

<table>
<tr><th></th><th></th><th></th><th>National level</th><th>Regional level</th><th>Local level</th><th>Other actors</th></tr>
<tr><td rowspan="4">Phases: from the disaster to the management of the emergency and reconstruction</td><td rowspan="2">Before</td><td>Prevention / mitigation</td><td colspan="4" rowspan="4">Attribution of roles and responsibilities
Coordination</td></tr>
<tr><td>Preparation / planning / early warning</td></tr>
<tr><td rowspan="2">After</td><td>Response</td></tr>
<tr><td>Reconstruction</td></tr>
</table>

Im. 46: Emergency and reconstruction management[55].

[53] Okuyama S., Sahin S., *Impact estimation of disasters*, World Bank, 2009: in reality, the scholars refer only to the economy and not to the overall society. Nevertheless, we think that more properly we should refer to the whole territorial system, made of complex relationships, thrown in crisis by the event of a disaster.
[54] In Labory S., cit.
[55] Petak W.J., *Emergency management: a challenge for public administration*, Public Administration Review, pp. 3 – 7, 1985.

According to the UNDP (United Nations Development Programme)[56], generally speaking, good governance is characterised by a series of criteria that distinguish effectiveness and sustainability, and can be traced back to the following aspects:

1. subsidiarity in the allocation of functions and responsibilities;
2. equity, both in preparedness policies and in access to reconstruction resources;
3. accountability and transparency in decision-making processes;
4. civil commitment of citizens, with much emphasis on democratic participatory processes, as creators of consensus around choices,

to which, according to partners' experience, we may add two more criteria:

5. efficiency of the administrative apparatus, avoiding the creation of new institutions[57];
6. capacity for leadership.

We can thus affirm that, on the whole, this "package" of criteria, if well balanced within the local/regional institutional setting, can lead to a good degree of efficiency and effectiveness in managing emergency and reconstruction/reclamation processes, by organising cooperation among the existing institutions, from the central to the local level, and with the actors in the affected communities.

Apparently, the most effective operational framework corresponds to the form of a network, rather than strictly hierarchical relations, in which the decision-maker first of all listens, gathers information from all the relevant actors and together with the local communities, creates the synthesis that can best convey information on the damage suffered and on the needs upon which to base adequate decisions[58].

Therefore and as an example, all things being equal, *the disaster stories – e.g the earthquakes and floods hitting Emilia-Romagna, Marche, Friuli Venezia-Giulia and Zadar or the fires in the Dubrovnik – Neretva region or in Split – Dalmatja county*[59] *- can actually be considered, rather than governance "models", as a proposals*

[56] UNDP, "*Strengthening disaster risk governance*", 2015, in Labory S., no date.
[57] Generallyn speaking, the establishment of brand new institutions imply a running-in time of variable length that may compromise effieciency and effectiveness during a more or less long phase.
[58] This - we believe - was the real added value of the role played by the Institutional Committee and its President / Deputy Commissioner and by the technical structure that operated under their steering.
[59] Earthquakes of Emilia-Romagna (2012) and Marche-Umbria-Lazio (2016 – 2017), Zagreb and Petrinja (2020); floods in Friuli – Venezia Giulia (2003), Emilia-Romagna (2014), Zadar (2017); fires in Dubrovnik – Neretva region (2015 and 2018) and Split – Dalmatjia county (2022).

for a method. This comes about as a need to create a path capable of providing answers even to the most complex aspects of the emergency and the reconstruction or reclamation management, with an open approach. In other terms, a concrete approach based upon a "*learning by doing*" attitude, accumulating experience that will be valuable from the point of view of future prevention.

In particular in Italy, if we consider the problems of religious and monumental buildings so hardly hit by the earthquakes of L'Aquila (2009), Emilia-Lombardy-Veneto (2012) and Central Italy (2016 – 2017), this approach and model of intervention on such delicate structures may be probably replicable in the rest of the country and in Croatia as well.

In this regard, however, if we focus in particular the earthquake experiences, it should always be remembered that on one hand, as in the case of Emilia-Romagna (2012), a regional community's "*discovery of its vulnerability*"[60] may be linked to the under-consideration of the actual extent of the seismic risk, in relation to its history; on the other, the huge endowment in cultural and historical heritage, although bringing a very relevant contribution to the so-called "territorial capital", is also hardly exposed to risk of collapsing, in the case of an earthquake. Indeed, in terms of prevention this claims for opportune seismic re-classification and for better seismic engineering of the buildings.

In the same way, today, common experience suggests that we should also work on significantly increasing citizens' awareness, so that when a risk turns into a real event, their "role" is less and less that of "victims" and more and more that of proactive actors, making the principle of damage minimisation more concrete. From this point of view, Firespill project is providing relevant examples.

Ultimately, the analysis of more than a decade of disastrous events hitting the two countries and in particular the Firespill project area, tells us how complex it can be to have a prepared emergency management structure in place before an emergency occurs, as disasters are mostly unpredictable in terms of probability of occurrence and actual magnitude.

This is for the many reasons mentioned, and also because preparing for the worst is expensive, as it necessarily requires adopting a multi-risk approach. However, we know from experience that this is an approach that "pays off", as good management capacity on the part of a functioning institutional and social context reduces the scale of impact, including in terms of costs. This is even more the case in a context in

[60] See: Regione Emilia-Romagna, Sisma 2012 – *Emilia più di prima*, 2022.

which the capacities for both monitoring and forecasting, and emergency management in the strict sense, are improving considerably.

Securing the territory, once again, must be considered a political priority, an investment made in the present with an eye to the future of a country and its community. In this sense, the human capital and the legacy of knowledge and skills accumulated in the reconstruction processes must be put to good use, precisely because of the opportunity to structure a stable form of governance from this, reducing fragmentation, maximising resources and public investment, and guaranteeing community participation.

It is therefore good to remember that *even "models", if any, need to learn from experience*, especially at a time when, once the emergency has been resolved, services restored, homes and factories rebuilt, it becomes necessary to think in the future in an innovative way, seizing the opportunity to change what is useful to change, e. g. abandoning obsolete spatial planning choices and preparing for the new weaknesses and criticalities that the territory poses by today, especially those linked to local effects of global warming, on energy, water, food production, civil protection, public health, which has proved more vulnerable than expected. This is the real field of the new challenge of how to concretely decline the mission of increasing what presently we use to call "territorial resilience".

What resilience and for whom: new governance challenges for territorial sustainability

In general, post-disaster reconstructions can be seen as opportunities for urban and territorial regeneration, in the broadest sense of the term: in this regard, we can consider the famous example of the reconstruction of south-eastern Sicily following the violent earthquake of 1693, which gave rise to the splendid "*Sicilian Baroque*". Today, in the territories hit by some kind of disaster this opportunity finds the ideal grounds for experimentation and innovation, giving concrete form to the principle of a reconstruction/restoration process that, while safeguarding its historical-cultural, economic and social heritage and identity, looks ahead, trying to outline progressively what and how the "*future territory*" will be.

The historical centres, the productive settlement systems, the open spaces of agricultural production in the setting of the reclaimed land, represent not only the history of the communities that created them, but each piece of territory to be returned to the productive and reproductive processes of local systems and their actors. In this sense, the role of communities in the processes of rebuilding their own spaces emphasises the importance of *social capital*, of the role of networks of cooperation, reciprocity and trust which enable individuals and groups to carry out actions that would not be possible on their own[61].

It is a "*property*" of any territorial context that also constitutes the cornerstone of the "*identity*" of places and communities, which has allowed them to become what they are today. It is not, however, a property with univocal characteristics: it can produce positive effects when used as a basis for innovation and building a territory of better quality, but also negative effects, when it results in a localist defence of assets and interests pre-existing pre-existing to the disaster and in some cases obsolete.

This makes the discussion on the choice between "*adaptation*" (as the capacity to absorb a shock, getting back the the previous state) and "*adaptability*" (as the capacity to "use" the shock to re-engineer the system) - and thus on the concept of "*resilience*" - anything but academic.

Large disasters often represent an epochal rupture, including the potential triggering of important migrations[62], for the mending of which in several situations important participation processes were carried out, centred on the direction and objectives of local reconstructions. In these, the needs for immediate

[61] Putnam R., *La tradizione civica delle regioni italiane*, 1993.
[62] As it occurs in these days in Turkey and Syria, after the catastrophic earthquakes of February 6, 2023.

physical restoration were superimposed on the objectives of regenerating wounded identity and social cohesion.

But today's framework more and more speaks of other challenges, which in themselves transcend the choices of reconstruction and re-functionalisation of structures damaged by a flood or an earthquake or a large fire, pointing out new risks, linked to the issues of territorial "*sustainability*" (although this term appears to be largely worn out). For example, the quality of the landscape as a paradigm of a territory's attractiveness, the energy mix and models to support communities, and - last but certainly not least - how to manage water, hitherto treated in the purely emergency-based terms of its seasonal scarcity in relation to a growing demand or of its excess, due to highly concentrated and alluvional rainfalls, and not as the structural problem that – exactly like energy - characterises the present and for most of the year, rather than a more or less far future.

In all contexts in which there is a scarcity of strategic resources, whether of a quantitative nature or more linked to cost factors (maximally in contetxts hit by relevant disasters, e.g. a long lasting drought), there is a signifcant risk of the emergence of competition over access to the resources themselves (e.g. water, energy, woods, a clean sea, etc.) both among the actors in a specific territorial community (e.g. agriculture vs. industry and/or vs. standard civil uses), and between distinct and sometimes distant territories. And it goes without saying that patterns of use considered as "sustainable" within a given territory can produce unsustainable externalities in others, even not nearby. An example is the summer 2022 water crisis in the Po River, linked not only to a rainfall deficit, but also to excessive water use in the whole basin in relation to supply, by the production systems located upstream: a negative dynamic determining the rising of the so-called "*salt wedge*" in the entire delta area.

Even if potentially, the practices of multi-level governance put in place for the management of an emergency and a post-disaster reconstructions or reclamation, represents an important legacy and experience to support new collective actions for the so-called "*ecological transition*" of territories. By enhancing the capacity for interaction between social and economic actors and the different levels of government, it may also be possible to design new solutions for the strategic problems linked to today's interlinked risks – social, ecologic, economic - which are more than ever characterised by unpredictability and uncertainty, also because of their possible synergic effects.

Faced with the onset of a crisis, communities often demand speed in decision-making, but just as often, the improvement of environmental sustainability conditions, requires more knowledge and thus more time; this is, policies pretending to support social and economic "*resilience*" claim a much shorter time than ecosystems', being also, at least potentially, conflictive (e.g. the recent energy policies to support demand vs. the negative effects of the Ukranian war, that in fact re-stimulated the use of fossil fuels).

Crisis process governance is thus the right terrain for more robust horizontal and vertical coordination and integration of the different sectors and levels of public policies - including research - and the of actors that contribute to their design, which ensures territorial equity in the distribution of the effects of mitigation and adaptation policies.

For instance, in the case of the climate crisis, unlike an earthquake or flood or other on-the-spot shocks, its effects represent a "*slow burn*" that, tends to corrode slowly but constantly territorial cohesion, exacerbating divisions when, it is perceived that the allocation of resources creates winners and losers, especially when availability and supply does not keep pace with demand. This is the case e.g. of over-utilisation of the water (for civil and other purposes) upstreams in a water basin, penalising all the other users (civil and productive) located downstream This brings with it the risk of flight for those missing sufficient resources to keep up in the competition for resources (e.g. weaker companies, with less funds to invest in water saving technologies), tensions in the fabric of institutions and organisations, between generations and social and political factions, and between different geographical areas.

Therefore, addressing the question of *what kind of resilience and for whom* highlights the importance of understanding what kind of territorial system adaptability a community wants actually to pursue, according to what time perspective and with what externalities. Pursuing a higher level of resilience encourages consideration of both short-term, reactive responses to shocks, and long-term, proactive strategies.

The short-term necessarily addresses the quantitative aspects of immediate emergencies, such as post-disaster reconstruction or the crisis of production systems with possible job losses, caused by cost overruns related to energy and/or water shortages, with "fire-fighting" measures aimed at mitigating their negative effects. A longer-term vision can instead better address the qualitative aspects, drawing possible structural exit routes from the immediate crisis situations, with more suitable paths to respond appropriately to the recurrence of the manifestations of the crisis itself and minimising externalities. Following our example,

promoting an ecological transition that secures the territory not only seismically or hydrologically but also, e.g., reducing in absolute terms the demand for energy and water from the entire territorial system.

The pursuit of a more crisis-resilient territory, in the above-mentioned sense, emphasises the need for intelligent institutional leadership, with the sensitivity and preparedness to manage rapid and pervasive changes, capable of contextualising the nature of events and constructing a narrative of strategic adaptation involving regional and local actors. This is a need for which the relative "*institutional memory*" of having managed a disaster[63], if properly taken advantage of, can be very valuable. Exactly as it is the "*social memory*", for which continuous sensitisation and capacity building can mould citizens from simple potential "victims" to proactive actors in managing emergencies.

"Resilient" and effective disaster management have a lot to do with the *ecological transition*, today largely pursued by EU and international policies; and this paradigm poses a central question to governance: how to ensure that "sustainability" - understood as the capacity to preserve and improve the shaky equilibrium of a territorial (eco)system - does not become a mere "*compensation for the damage*" produced by a disaster, "patching up" local systems with short-term emergency measures and without questioning the structures that stand at the roots of the disaster itself (be it an instant shock or a *slow burn*)[64].

On the contrary, for any area hit by catastrophic events, a disaster should represent a real testing ground for a new season of development and transformation of the territory, in which the recovery of places of identity and the need to relocate functions, to define new and less risk-vulnerable urban polarities with better quality public spaces and better connections with the rural space, to relaunch and innovate production activities and services, will have to measure themselves not only against the challenges of the digital and technological transition, but also, and perhaps above all, against ecological challenges and the threat they represent to citizens' safety. This is a scenario that today also implies greater territorial "*attractiveness*", for citizens as a place to live and work, for businesses as a place to maintain and multiply their investments, for everyone as a place to discover. Definitely, for a territorial system open to change, although when considered a "model" in risk management, an unforeseen catastrophic event may represent a challenge also in terms of lessons learnt to improve the model itself.

[63] See: Pike A., Dawley S., Tomaney J., cit.

[64] See: "*Sustainable governance – reclaiming the political sphere – reflections on sustainability, globalization and democracy*", Wuppertal Institut fur Klima, Umwelt und Energie, 2005.