Proposal of single risk management plans in the IT test site

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1. Introduction

The available Italian single risk management plans as for the Ferrara test site have been described in the relevant deliverables and they are quite detailed and accurately consider the pertinent EC directives on risks induced by natural hazards. However, to the purpose of formulating a proposal for a possible improvement or the update of the existing Italian risk management planes, we suggest here that the existing single risk management plans could integrate digital tools and big data analytics. Besides the usefulness of digitalized automatic procedures capable of processing big data in risk management, the necessity of digitalization of the alert systems is nowadays particularly evident based on the pandemics experience that has shown the crucial role operated by social media, and apps for sharing information in a virtual modality i.e. without requiring in-presence contacts. It is suggested that the great challenge as for the proposal of possible updates of existing risk management plans relies upon finding the optimal way for storage and integration of big data information in well integrated plans dealing with natural disasters (see also Rocchi et al., Applied Sciences, 2022).

2. Capacity for Disaster Reduction Initiative (CADRI)

The Capacity for Disaster Reduction Initiative (CADRI) is a global partnership that helps countries reduce disaster and climate risks through providing access to a unique pool of multidisciplinary expertise in various socio-economic sectors to achieve the 2030 Agenda and leave no one behind. CADRI Partners are a group of like-minded actors in humanitarian assistance and development cooperation who join forces to provide a coherent offer of services to countries to help them reduce their exposure and vulnerability to disaster and climate risk. Some of the members are: The Food and Agriculture Organization (FAO), The International Organization for Migration (IOM), The United Nations Educational, Scientific and Cultural Organization (UNESCO), The World Meteorological Organization (WMO).

The CADRI Digital Tool has been designed to support countries in their efforts to strengthening their national and local capacities to reduce disaster and climate related risks. Registered users can have access to the tool functionalities that allow for the design, planning and implementation capacity diagnosis missions, which can be comprehensive or focused on specific sectors and hazards. Registered users can use the tool to conduct sector specific analysis, independently of a CADRI mission Non-registered users can have access to the complete question data bank. They can customize their search for guidance on the key issues to consider when build DRR and CCA capacities at national and local level. The CADRI Digital Tool can be used in both development and humanitarian contexts.

2.1 Preliminary definitions

"Disaster" and "disaster risk" are connected but different – the former being the event and the latter being the probability of occurrence of that event, and hence the two call for different types of information.

Disaster risk information refers to comprehensive information on all dimensions of disaster risk, including hazards, exposure, vulnerability and capacity, related to persons, communities, organizations and countries and their assets. Disaster risk information includes all studies, information and mapping required to understand the disaster risk drivers and underlying risk factors (for instance land use, food insecurity maps, forest coverage, drainage network, etc.). Disaster information refers to information on the disaster event, its effects, response operations and resources involved, and impacts in a society. Disaster information, commonly managed through historic (extreme) event catalogues and disaster loss databases, encompasses information on the hazard event's intensity, location and time of occurrence and the disaster's damages, losses and their impacts across human, material, economic and environmental dimensions (e.g. disruption of education services, livelihoods destruction, etc.). Information on disaster/emergency response is often captured in emergency response operational information systems linked with telecommunication systems, disaster/emergency response resource database and resource allocation. An information system is understood as an organizational system designed to collect, store, and process data, for distributing information, knowledge, and for providing information products to support decision-making, coordination, analysis and visualization. It is composed of four components: people, structures (or roles), processes and technology (including software and hardware). An integrated information system can be understood as combination of interconnected information systems from various sources, system mechanisms (interfaces and networks) and system operations (control and management) for data integration, visualization, and modelling.

2.2 Relevance

Disaster risk reduction is about decisions, choices, and development pathways, to prevent new risks, reduce existing ones and strengthen resilience. Key to making informed decision is developing an understanding of risk, including its root causes and drivers, which requires both disaster information and disaster risk information to understand the past and projected future risks. Access to information from a variety of sources can facilitate the transformation of raw data regarding the risks at hand into actionable insights and wisdom to inform the mitigation, prevention, and recovery efforts. Information on risk and disaster risks is relevant for different purposes and applications:

• Risk prevention: hazard information is essential to decide on construction locations and to design resilient critical infrastructure and development of nature-based solutions. Mitigation: Retrofitting weak building structures, developing disaster resilient building codes and designing flood and storm surge protection measures.

• Preparedness: Disaster impact information reveals hotspots of vulnerability, combined with risk information and hazard monitoring make possible to develop impact-based forecasting and early warning, scenarios, plan evacuation routes and mechanisms, designate shelters, and run drills and simulation exercises.

• Response: Risk information, especially exposure and vulnerability of population and assets, can help provide initial and rapid estimates of human, physical damage and losses to support emergency relief and initial rehabilitation. Disaster information can shed a light on hotspots where response efforts should be concentrated

• Recovery: Risk information on hazard and vulnerabilities is essential to ensure the recovery process mitigates pre-existing risk and avoids creating new risk by following the 'building back better' principles. Disaster information on the level of disruption, damage and economic losses is essential to assess the impacts of disasters, identify recovery needs, plan, and manage a more resilient recovery.

• Risk financing and financial protection: Reliable disaster and risk information can aid in the development of risk transfer mechanisms such as insurance, reinsurance, and capital market solutions (e.g. disaster bonds) and build the case for investments in disaster risk reduction. Integrated risk information systems are meant to make selected information on prevailing hazards (hydro-meteorological, geological, biological, technological etc.) and vulnerability (people, infrastructure, livelihoods etc.), including census and socio-economic data, available to help planners understand disaster and climate risk vulnerabilities, as well as to produce impact-based warning information relevant to those exposed. Understanding the interconnectedness and interdependences of systems is essential to minimize cascading disaster impacts. Integrated disaster and disaster risk information systems can enable the applications listed above if access to relevant information products and data is given to multiple users: public and private sector, communities, households. An integrated information system can also solve many of the common complaints caused by fragmented systems such as limited sharing of data, lack of standardization, lack of cross-analysis and limited coordination and cooperation between agencies and sectors. Integration of information systems does not necessarily imply a super-system should be developed to encompass all pre-existing systems but rather points at the need to ensure system-to-system communication and interoperability for seamless and timely communication, secured data access, exchange, interpretation and reuse.

3. Good Practices on Integrated Risk Information Systems

3.1 CADRI Key principles emerging from the review of good practices

3.1.1 Digital development principles:

Thse principle provide insightful guidance derived on applying technologies to development programs. These nine living guidelines designed to help integrate best practices into technology-enabled development programs encompass:

1) design with the user;

2) understand the existing ecosystem;

3) design for scale;

4) build for sustainability;

5) be data driven;

6) Use Open Standards, Open Data, Open Source, and Open Innovation;

7) Reuse and Improve;

8) Address Privacy and Security;

9) Be collaborative.

3.1.2 User-centric

The first step prior to defining the parameters of a risk information system is to understand user needs. A risk information system should be designed to meet the needs and 3 requirements of the users to support operational and strategic decision-making. This includes developing clear and intuitive visualization options with simple icons and user-friendly interfaces.

3.1.3 Disaggregation.

The collection of geographic, income group, sex, age and disability disaggregated risk and disaster impact data is essential to design inclusive disaster risk management policies and programs that address the inequalities and disproportionate impact of disasters on the most vulnerable.

3.1.4 Data Standards.

Data standards for risk and disaster information are essential for systems interoperability. Existing data are usually heterogeneous, sometimes not comparable, and in many cases not digitized or available/accessible to partners and third parties. API (Application programming interfaces) first design approach should be considered. Building APIs which are consistent, and reusable allows data to be consumed by different applications and maintained efficiently for all device, platforms and operating systems enabling information systems to connect to each other efficiently.

3.1.5 National Spatial Data Infrastructure

It is known as NSDI - offer an opportunity for the enforcement of metadata standards which is key to enable exchange and sharing of geographic information and services.

3.1.6 Data ecosystems for risk-informed development:

Integrated information systems need to consider governance aspects (policies, regulations and processes such as information sharing protocols and access rights) which are essential for interoperability among information systems and to ensure end-users can access the information services and products they need to make decisions.

3.1.7 Connecting resources:

Linking risk information systems with the larger data and information management systems of government line agencies (and non-government institutions such as academia when relevant) is essential. To enable a better understanding of the sectorial impact of disasters and sector-specific vulnerabilities, the capacities of line agencies need to be strengthened to collect and analyse risk and disaster information. Sector-specific information systems should incorporate relevant information on risk and disasters, while risk and disaster information systems require up to date baseline information on the sector assets and systems exposed, vulnerabilities, replacement costs, etc.

3.1.8 Open data and open standards:

Open data principles refer to technically and legally open data, accessible, interoperable, and reusable data. Adherence to this can promote civil society use of public data, as well as to facilitate the interoperability of government information systems. Source: GFDRR. World Bank. 2014. Open Data for Resilience Field Guide. Washington, DC:

3.1.9 Institutionalization and sustainability

Availability of risk information is necessary but not sufficient to build an integrated risk information system. Moving from a platform to share information to a system that is sustainable would require extensive regulations and governance related standard operation procedures (SOP) and workflows. Policy incentives are needed to institutionalize data 4 collection and motivate planners at all levels to apply the information and consider impact of development initiatives on risk generation or mitigation.

3.1.10 Advanced data querying and analytics

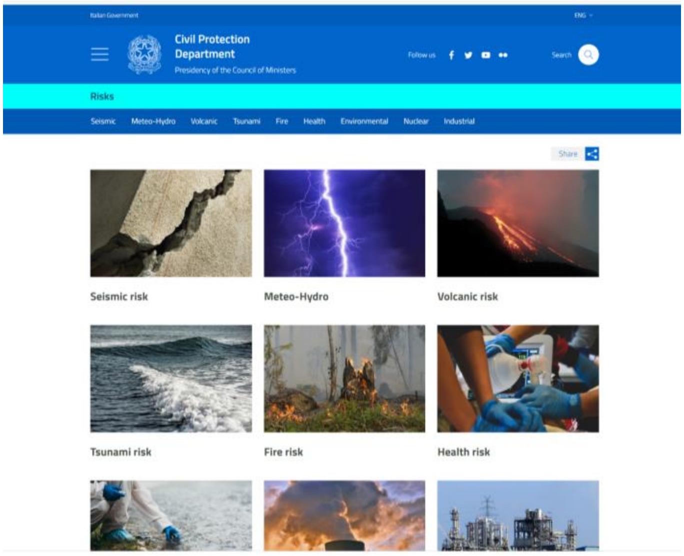
Advanced data querying and analytics such as machine learning techniques are recommended to process the vast amount of available data and highlight what is significant. Crowdsourcing is an important development, where digital volunteers offer their time and expertise to complete microtasks such as micro-mapping in order to analyse big data

4. Digital alert and information tools developed by the Italian Civil Protection Agency

At the website: https://rischi.protezionecivile.gov.it/en/ it the civil Protection Department gathers a series of reports about the following single risks:

- Seismic risk
- Meteo-Hydro risk

- Volcanic risk
- Tsunami risk
- Fire risk
- Health risk
- Environmental risk
- Nuclear risk
- Industrial risk



4.1 The challenge of unified worldwide monitoring systems for single risk management

The 7th edition of the Global Platform for Disaster Risk Reduction - GP2022 has been held in 2022, organized by the Government of Indonesia and the United Nations Office for Disaster Risk Reduction (UNDRR). It consisted of six days focused on disaster risk governance, considering the global COVID-19 crisis, the progress in the implementation of the Sendai Framework (2015-2030), and the goals set by the 2030 Agenda for Sustainable Development (see https://www.protezionecivile.gov.it/en/notizia/global-platform-disaster-risk-reduction-gp2022)

The main topic that names the event "From Risk to Resilience: towards sustainable development for all in a COVID-19 transformed world" has targeted different audiences, regional and political levels, with the joint engagement of representatives from Governments, the United Nations, and many stakeholders in the two Ministerial Roundtables, four High-Level Meetings, and fourteen thematic sessions.

For the GP2022 edition, the Head of the Civil Protection Department, Fabrizio Curcio, has spoken at the Roundtable on May 25, with a video message dedicated to climate change and the commitment of the National Civil Protection System.

4.2 MyDewetra platform

The Department of Civil Protection also contributed to the realization of the Sendai Framework with the Mydewetra.world platform accessible at the website https://www.mydewetra.org/, presented for the occasion at the stand set up by the CIMA Foundation, which represents the evolution of the Mydewetra application already used by the Central Functional Center of the Department for forecasting, monitoring and surveillance in real-time of all environmental risks. Mydewetra.world is a new open-source integrated system, that has been designed to be a single point of access to information and data available on a global, regional and local scale, provided by authoritative Institutions and Agencies in the field. Dewetra 2.0 (31/12/2015) is an integrated system of the Central Functional Center of the Department of National Civil Protection (DPC)- Presidency of the Council of Ministers, for the prediction, monitoring and surveillance, in real time, of all environmental risks. The system is technically and operationally certified. The system is the object of one of the lines of the convention for the development of knowledge, methodologies and technologies useful for the implementation of civil protection actions on the national territory and civil protection cooperation actions in the countries subject to Italian intervention, to which DPC and CIMA Foundation compete as a center of competence.

The scientific knowledge, the methodologies defined and formalized in rules and procedures, the experimentation of new technologies designed for the needs of the civil protection operators constitute the main characteristics of Dewetra which in this sense defines itself as a "compliance platform", in seamless evolution and development. The application developed by the Department is the result of the Agreement with the CIMA Foundation for scientific methodologies and technologies for disaster risk management in Italy and the countries cooperating with Italy.

myDEWETRA.world is also the subject of the Agreement between the Civil Protection Department and the World Meteorological Organization.

4.3 The role of BIG DATA

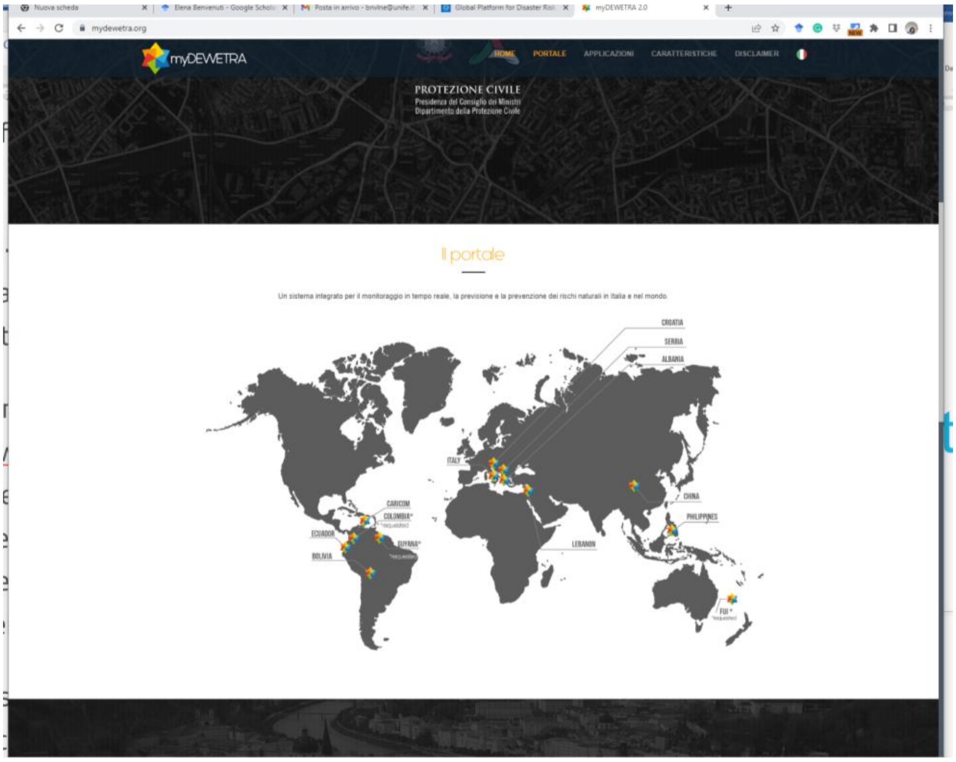
Rocchi et al.(2022) proposed a sound qualitative multi-hazard risk analysis methodology for the assessment of combined seismic and hydraulic risk at the regional scale, which can assist governments and stakeholders in decision making and prioritization of interventions. The method is based on the use of machine learning techniques to aggregate large datasets taken from the ISTAT database made of many variables different in nature each of which carries information related to specific risk components and clusterize observations. The framework was applied to the case study of the Emilia Romagna region, for which the different municipalities are grouped into four homogeneous clusters ranked in terms of relative levels of combined risk. The proposed approach proves to be robust and delivers a very useful tool for hazard management and disaster mitigation, particularly for multi-hazard modeling at the regional scale In Table 1 below possible other sources of databases are shown..

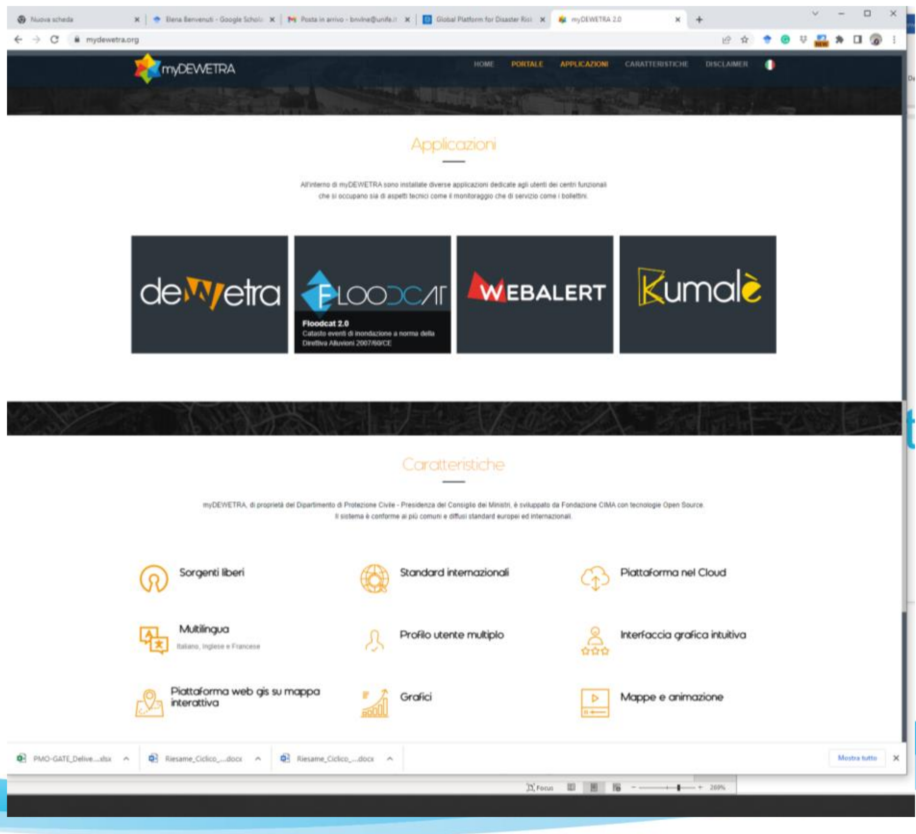
Table 1. Mapping disaster management phases with major data sources and application fields.

Disaster Management Phase	Data Source	Reviewed Application Fields
	1. Mitigation/Prevention	
Long-term risk assessment and reduction	Satellite, 33% Crowdsourcing, 17% Sensor web and IoT, 17% Social media, 13% Mobile GPS and CDR, 12% Simulation, 8%	General natural disaster [10] Earthquake [88,91] Oil spill [92] Flood [15,93,94]
Forecasting and Predicting	Simulation, 50% Satellite, 25% Sensor web and IoT, 13% Social media, 12%	Hurricane [52,54,95–100] Flood [101–103]
	2. Preparedness	
Monitoring and detection	Social Media, 31% Sensor web and IoT, 31% Satellite, 13% Combination of various data types, 9% Spatial data, 4% Lidar, 4% Mobile GPS and CDR, 4% Crowdsourcing, 4%	Wildfire [104] Flood [105–109] Earthquake [108,110] Landslide [111] Volcano [45,46]
Early warning	Social media, 29% Sensor web and IoT, 29% Simulation 14% Crowdsourcing 14% Satellite, 14%	Flood [112] Tsunami [76,112]
	3. Response	
Damage Assessment	Satellite, 53% UAV, 21% Social media, 16% Sensor web and IoT, 5% Crowdsourcing, 5%	Earthquake [19,20,113–115] Flood [116] Typhoon [117] Hurricane [118]
Post-disaster Coordination and Response	Social media, 25% Satellite, 16% Sensor web and IoT, 16% Crowdsourcing, 10% UAV, 9% Simulation, 6% Spatial data, 6% Lidar, 6% Mobile GPS and CDR, 3% Combination of various data types, 3%	General natural disaster [117–119] Flood [89,108] Earthquake [19,83–85,120]
	4. Recovery	
	Combination of various data types, 60% Crowdsourcing, 30% Satellite, 10%	Earthquake [121–123] Hurricane [124] Typhoon [125]

5.

Table taken from Big Data in Natural Disaster Management: A Review, Yu et al. Geosciences, 2018





4.4 Example: Flood risk on DMETRA

The VFDM project entitled ' Integrating Flood and Drought management and Early Warning for climate change adaptation in the Volta Basin' has the ambition to provide the first large scale and transboundary implementation of Integrated Flood and Drought Management strategies through the complete chain of End-to-End Early Warning System for Flood Forecasting and Drought Prediction. The project will empower the National Meteorological and Hydrological Services (NMHSs) and other competent authorities of the six riparian countries (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali and Togo) with robust and innovative solutions for disaster risk reduction and climate change adaptation, including capacity development for nature-based solutions and gender sensitive participatory approaches. The VFDM project is aligned with the Adaptation Fund objective to ''reduce vulnerability and increase adaptive capacity of communities to respond to the impacts of climate change at the local, national and regional levels.'' Project Implementation Period: June 2019-June 2023

4 Conclusions

Developed by CIMA Foundation and currently in use in 13 countries, including Italian Department of Civil Protection, myDEWETRA is a real-time system for hydro-meteorological forecasting and monitoring. A web based platform that systematically organizes data and information produced by multiple institutions and agencies, from local to national and international levels. MyDEWETRA is the link between data producers and civil protection operators while assisting users to prepare real time risk scenarios based on the available data.

Beased on CADRI recommendations, it is suggested to integrate and leverage available databases pertaining to natural risks, such as ISTAT database into MyDEWETRA by means of machine learning algorithms following the methodology set by the contribution Rocchi et al. 2022. The aim is to further improve prioritization of interventions, reduce the reaction time and have all the information available in one unique system-platform.

References

Please refer to the referenced documents to have a detailed insight on the topic. They are all open access documents. We hereby declare that what reported below is entirely drawn from the above sources and that this deliverable is not in the position of proposing reliable multirisk plans, rather it intends to contribute to the discussion about the topic.

CADRI Compendium of Good Practices on Integrated Risk Information Systems, https://www.cadri.net/system/files/2021-09/CADRI%20-%20Good%20Practices%20-%20Integrated%20risk%20information%20systems_2020.pdf

UN, 2002, Johannesburg Plan of Implementation of the World Summit on Sustainable Development. Tech. rep. United Nations. UNEP, 1992. Agenda 21. Tech. rep. United Nations Environment Programme.

UNISDR, 2005. Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters. http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf.

UNISDR, 2015. Sendai framework for disaster risk reduction 2015–2030. United Nations International Strategy for Disaster Reduction. http://www.wcdrr.org/uploads/Sendai_Framework_for_Disaster_Risk_Reduction_2015-2030.pdf.

UNISDR, 2015. Multi-Risk Governance: Recommendations for Future Directions. Chapter prepared for the Global Assessment Report on Disaster Risk Reduction.

Zschau, J., Fleming, K., (2012). Natural Hazards: Meeting the Challenges of Risk Dynamics and Globalisation, in ‘ Improving the Assessment of Disaster Risks to Strengthen Financial Resilience’, World Bank and Government of Mexico, Editors, Chapter 9,

J. Zschau, Where are we with multihazards, multirisks assessment capacities? https://drmkc.jrc.ec.europa.eu/portals/0/Knowledge/ScienceforDRM/ch02/ch02_subch0205.pdf

https://www.preventionweb.net/understanding-disaster-risk/component-risk/disaster-risk

Rocchi, A.; Chiozzi, A.; Nale, M.; Nikolic, Z.; Riguzzi, F.; Mantovan, L.; Gilli, A.; Benvenuti, E. A Machine Learning Framework for Multi-Hazard Risk Assessment at the Regional Scale in Earthquake and Flood-Prone Areas. Appl. Sci. 2022, 12, 583. https://doi.org/10.3390/app12020583

Yu, M.; Yang, C.; Li, Y. Big Data in Natural Disaster Management: A Review. Geosciences 2018, 8, 165. https://doi.org/10.3390/geosciences8050165