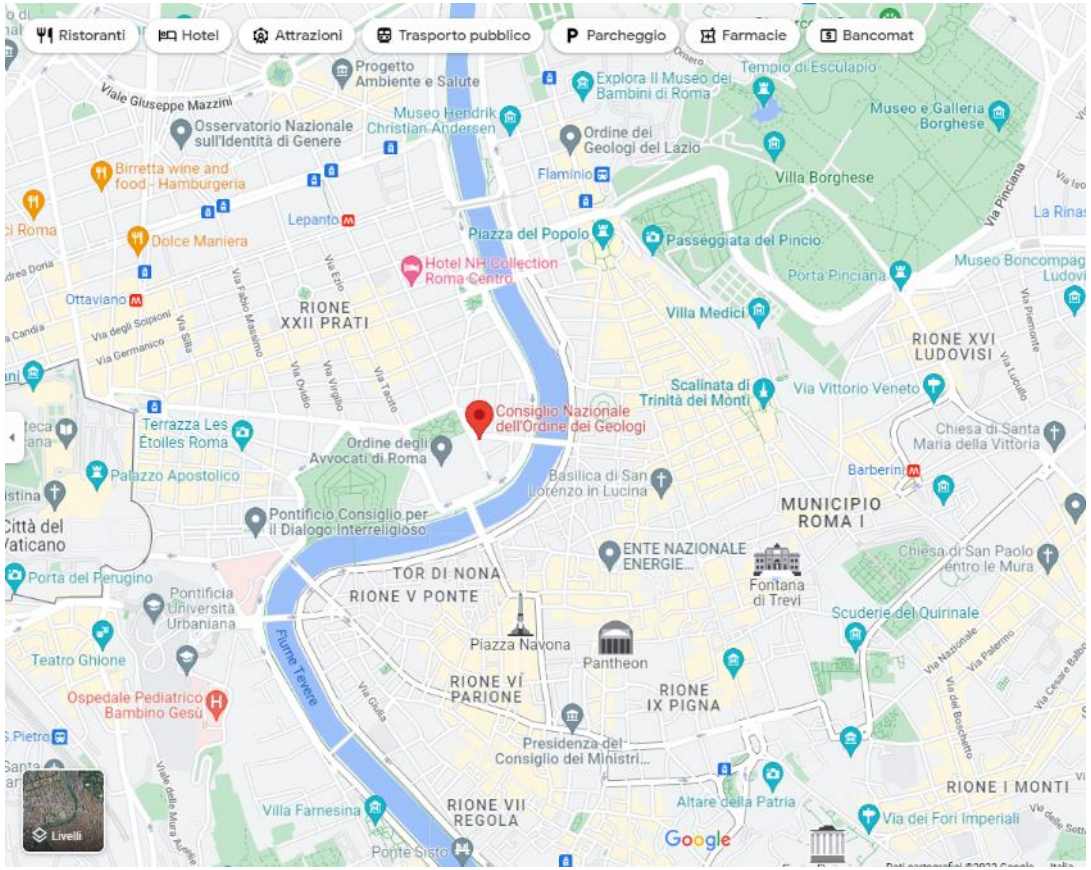
THE CONTRIBUTION OF GEOLOGY TO WATER MANAGEMENT IN THE ERA OF CLIMATE CHANGE

RUDI RUGGERI – CONSIGLIO NAZIONALE DEI GEOLOGI

CONSIGLIO NAZIONALE
DEI GEOLOGI

rudi.ruggeri@cngeologi.it **www.cngeologi.it**

Todi, 26 July 2024



CNG Introduction

The Italian National Council of Geologists, established in 1963, is the institutional representative body of the professional category of geologists. The task of the Council is to protect the profession, guarantee the quality of the activities carried out and encourage constant training. Alongside the institutional activities, the CNG is active in the training sector, constantly promoting and organizing conferences and seminars for updating and deepening on current issues related to the exercise of the profession. Very active also in terms of communication with its members, through constantly updated magazines, newsletters and press releases.

rudi.ruggeri@cngeologi.it

INSEDIATO IL CONSIGLIO NAZIONALE DEI GEOLOGI 2020-2025: IL NUOVO PRESIDENTE È ARCANGELO FRANCESCO VIOLO

rudi.ruggeri@cngeologi.it

Some facts

CONSIGLIO NAZIONALE DEI GEOLOGI

- Registered members are 12.256 (-233), EuroGeol 76 (IT) + 5 (GR), various webinars, F2F and Hybrid events with over 11.445 participants in total
- CNG is a member of EFG (European Federation of Geologists) supporting the execution of various EFG Projects (**CROWDTHERMAL, ENGIE, REFLECT, ROBOMINERS, CRM GEOTHERMAL, CEEGS**)
- Webinar/awareness workshop **PERC**: "**Mineral Standard Reporting**" role of the "Competent Person" into the Minerary Serctor, Future Sustainable Development and Standardization of the Mineral Industry in Europe - June 2021
- Italian (CNG team) and Spanish delegations (ICOG – Carlos García Royo) under the EFG umbrella/sponsorships represented by its secretary G. Ponzoni made a **visit in La Palma and on the Montana Vieja volcano** aiming to share with the local Authorities technical knowledge and aid procedures and offer aid to humanitarian in need for better facing the tragic situation on the island – from 5 to 9 November 2021

rudi.ruggeri@cngeologi.it

What is climate change?

- Climate change is a change in the pattern of weather, and related changes in oceans, land surfaces and ice sheets, that have come to define Earth's local, regional and global climates and occurring over time scales of decades or longer.

- Human activities, especially emissions of heat-trapping greenhouse gases from fossil fuel combustion, deforestation, and land-use change, are the primary driver of the climate changes observed in the industrial era.

rudi.ruggeri@cngeologi.it

Climate change impacts

As global temperatures climb, widespread shifts in weather systems occur, making events like **droughts, hurricanes, and floods more intense and unpredictable**.

Extreme weather events that may have hit just once in our grandparents' lifetimes are becoming more common in ours. However, not every place will experience the same effects: Climate change may cause severe drought in one region while making floods more likely in another.

rudi.ruggeri@cngeologi.it

Climate Risk Assessment

Climate Change

- Climate change represents an urgent and potentially irreversible threat to human societies. The overwhelming majority of countries around the world adopted the Paris Agreement, which includes to limit global temperature rise to 1.5°C
- The Intergovernmental Panel on Climate Change concluded that observed warming of the climate system is ***unequivocal***, and impacts are recognised at regional and local scales
- The 2021 IPCC's Sixth Assessment Report confirmed that observed warming is driven by emissions from human activities.

Asset Exposure and Vulnerability

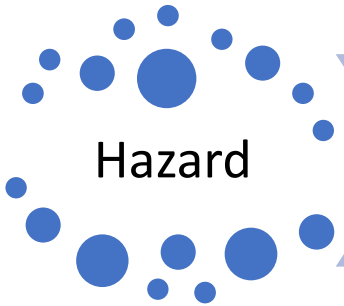
- Climate change is associated with increasingly frequent and intense natural disasters, from droughts and wildfires to hurricanes and coastal flooding
- This increases the risks for infrastructure failure with significant impacts that will require long-term adaptation measures and considerable investments
- Understanding the level of vulnerability contributes to better, more informed decision-making and priority setting

Impacts and Adaptation

- The complexities and dynamics of a changing climate, interacting with a multitude socio-economic factors at local to national and global scales, make impacts difficult to anticipate
- Complex models are elaborated to process large number of data (land use, weather forecasts, sea levels, rainfalls, temperature, GHG emissions, etc.)
- Models produce an overview of possible futures within a probabilistic manner, and provide a tool for assessing possible impacts and for sensitivity testing of adaptation options

rudi.ruggeri@cngeologi.it

Climate Risk Assessment



Hazard

- Magnitude (severity)
- Likelihood (probability)

Exposure

- Spatial extent
- Number of assets or people affected

Vulnerability

- Sensitivity of assets
- Sensitivity of people

Risk

- Assess the risk
- Define proportionate measures to mitigate it

Definition of natural hazard risk

$$\frac{Hazard\ x\ Expsosure\ x\ Vulnerability}{Resilience\ or\ coping\ capacity} = Natural\ hazard\ risk$$

Hazard, Exposure, Vulnerability

- These three factors are not static and, in some cases, can be impacted by other externalities

Mitigation/Adaptation

- limit the potential exposure to a natural hazard event and/or;
- decrease the vulnerability of assets through additional engineering;
- Increasing the system capacity to cope and/or act to reduce the risk

rudi.ruggeri@cngeologi.it

NATURAL HAZARD RISK MANAGEMENT PLANNING

Based on the recent publication : Science for Disaster Risk Management 2020: acting today, protecting tomorrow, EUR 30183 EN A. Casajus Valles, Marin Ferrer, M., Poljanšek, K., Clark, I. ed. Publications Office of the European Union 2020 , DOI: 0.2760/438998, that the EFG Panel of Experts on Natural Hazards and Climate Change has contributed.

rudi.ruggeri@cngeologi.it

DEFINITIONS

Understanding Risk

risk is defined as "a measure of the probability and severity of an adverse effect to health, property of the environment"

Risks & vulnerabilities

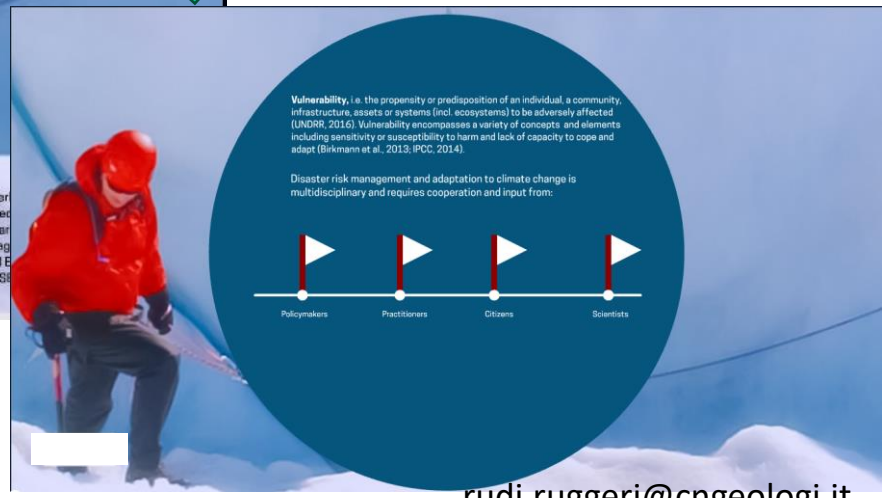
image source: https://www.ochaopt.org/content/emergency-response-preparedness-erp-and-disaster-risk-management-drm

Hazard, is the process, phenomenon or human activity that carries the potential to cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

Hazards can be natural (e.g. earthquakes, droughts, floods) or anthropogenic (e.g. oil spills, terrorist attacks) in origin and can be characterised by their location, likelihood of occurrence, intensity or magnitude, duration, and extent.

Hazards can be sudden onset events (e.g. flash floods, storms, mudflows, landslides, earthquakes) or creeping processes (e.g. droughts, salinisation) (IPCC, 2014; UNDRR, 2016).

Exposure, i.e. the presence of people, infrastructure, housing, production capacities, species or ecosystems, and other tangible human assets in places and settings that could be adversely affected by one or multiple hazards (IPCC, 2014; UNDRR, 2016).



Hagenlocher, M., Thieken, A., Schneider P., Donovan, A., Morsut, C., Paris, N., Pe Assessment', in: Casajus Valles, A., Mar (eds.), Science for Disaster Risk Manag day, protecting tomorrow, EUR 30183 E European Union, Luxembourg, 2020, IS doi:10.2760/571085, JRC114026.

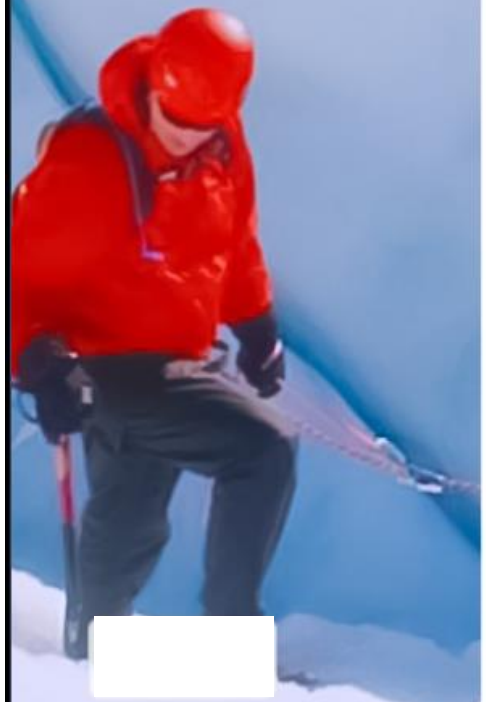
rudi.ruggeri@cngeologi.it

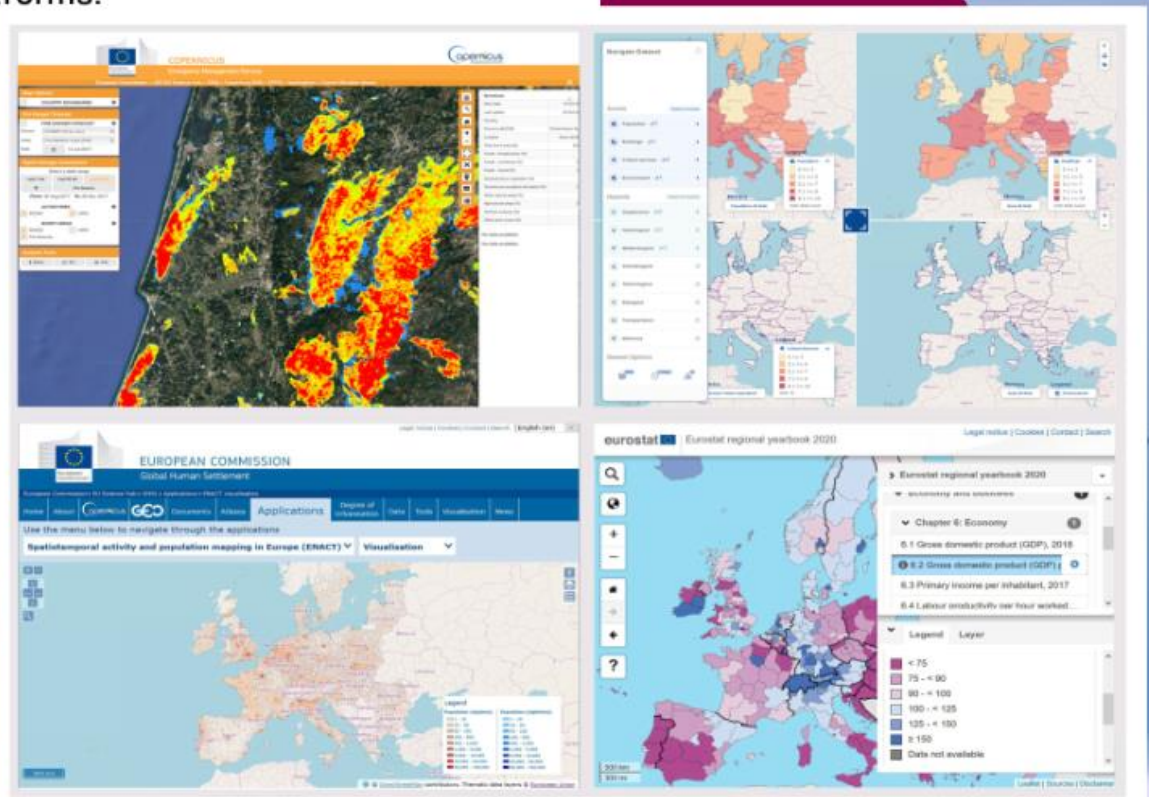
ASSESSMENT

Visualise Risk

Risk Assessment:
(1) risk identification, (2) risk analysis and (3) risk evaluation (ISO 31000:2009).

Development and use of risk data platforms.



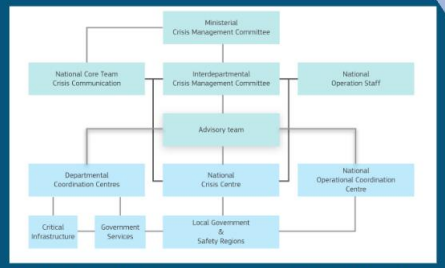


Hagenlocher, M., Thieken, A., Schneiderbauer, S., Aguirre Ayerbe, I., Dabes, P., Donovan, A., Morsut, C., Paris, N., Pedoth, L., Tonmoy, F., 'Risk Assessment', in: Casajus Valles, A., Marin Ferrer, M., Poljanšek, K., Clark, I. (eds.), Science for Disaster Risk Management 2020: acting today, protecting tomorrow, EUR 30183 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18182-8, doi:10.2760/571085, JRC114026.

rudi.ruggeri@cngeologi.it

MANAGEMENT PLANNING

The risks confronting European states and communities are highly diverse in nature, intensity, scale and extent. Therefore, DRMP necessarily involves the integration of risk management activities both vertically (i.e. between multiple actors from local to European and even through to global level via various international initiatives, e.g. UN agreements and frameworks) and horizontally (i.e. between actors working at similar levels).



The Netherlands civil security system (Figure) shows how vertical a… …ty and security issues is… …l other bodies

14/27

Vertical and horizontal integration in disaster risk management planning

Disaster risk management planning (DRMP)

DRMP refers to the application of processes developed and adopted by institutions to prepare for, and implement measures to reduce the risk of the impact of, disasters of various kinds.

The goal of DRMP is to ensure that societies and their communities are able to enhance their levels of resilience in relation to disasters with which they can reasonably expect to be confronted, within a specified time frame.

DRMP aims to develop clear procedures, protocols and capabilities to significantly reduce or eliminate risks through systematic, well-coordinated actions from public, private and civic groups and individuals.

Generation and analysis of alternatives

Sliuzas, R., Jackovics, P., Thorvaldsdóttir, S., Kalinowska, K., Tyrologou, P., Resch, C., Castellari, S., Greiving, S., 'Risk management planning', in: Casajus Valles, A., Marin Ferrer, M., Poljanšek, K., Clark, I. (eds.), Science for Disaster Risk Management 2020: acting today, protecting tomorrow, EUR 30183 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18182-8, doi:10.2760/571085, JRC114026.

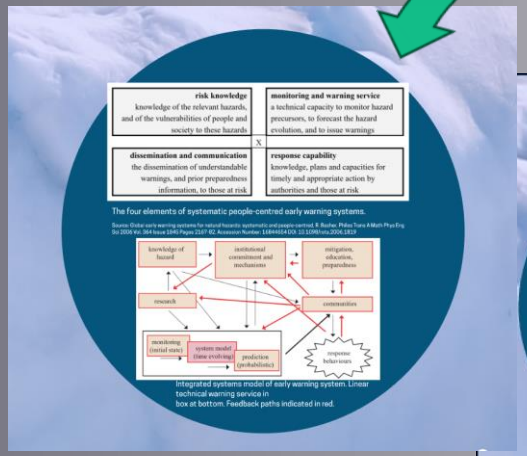
Key impact indicators

	VITAL SAFETY OR SECURITY INTEREST	IMPACT CRITERIA AND INDICATOR
1	Territorial	Encroachment on the national territory
		Infringement of the international position of the nation
2	Physical	Fatalities
		Seriously injured and chronically ill
		Physical suffering (lack of basic life necessities)
		Loss and damage to buildings and infrastructures
3	Economic	Costs of impairment of the economy
4	Ecological	Long-term effects on the environment and nature, including flora and fauna
5	Social and political	Disruption of everyday life
		Damage to the democratic legal order
		Social psychological impact and social unrest

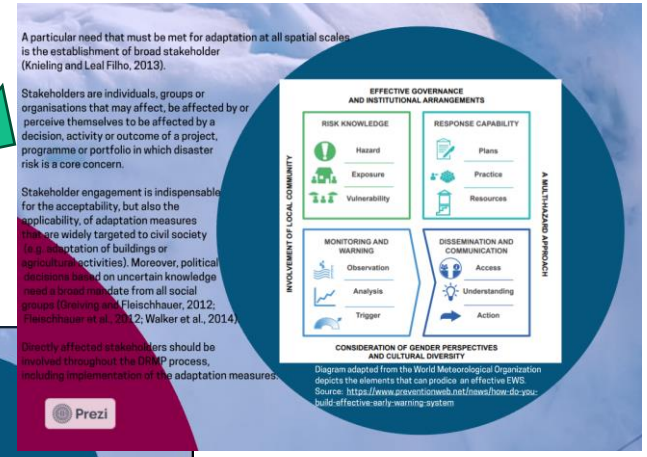
Examples of impact indicators for vital safety or security interests in the Netherlands.
Source: adapted from Ministry of Security and Justice of the Netherlands, 2014.

rudi.ruggeri@cngeologi.it

POLICY INSTRUMENTS AND PRODUCTS FOR DISASTER RISK MANAGMENT PLANNING

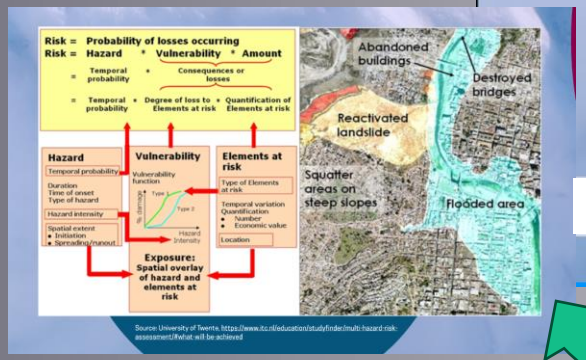


Early Warming Systems



Stakeholders

Adopting a risk-informed planning approach can assist nations and their communities to increase their disaster resilience by reducing risk and being better prepared for response and recovery processes should a disaster occur.



Spatial plans

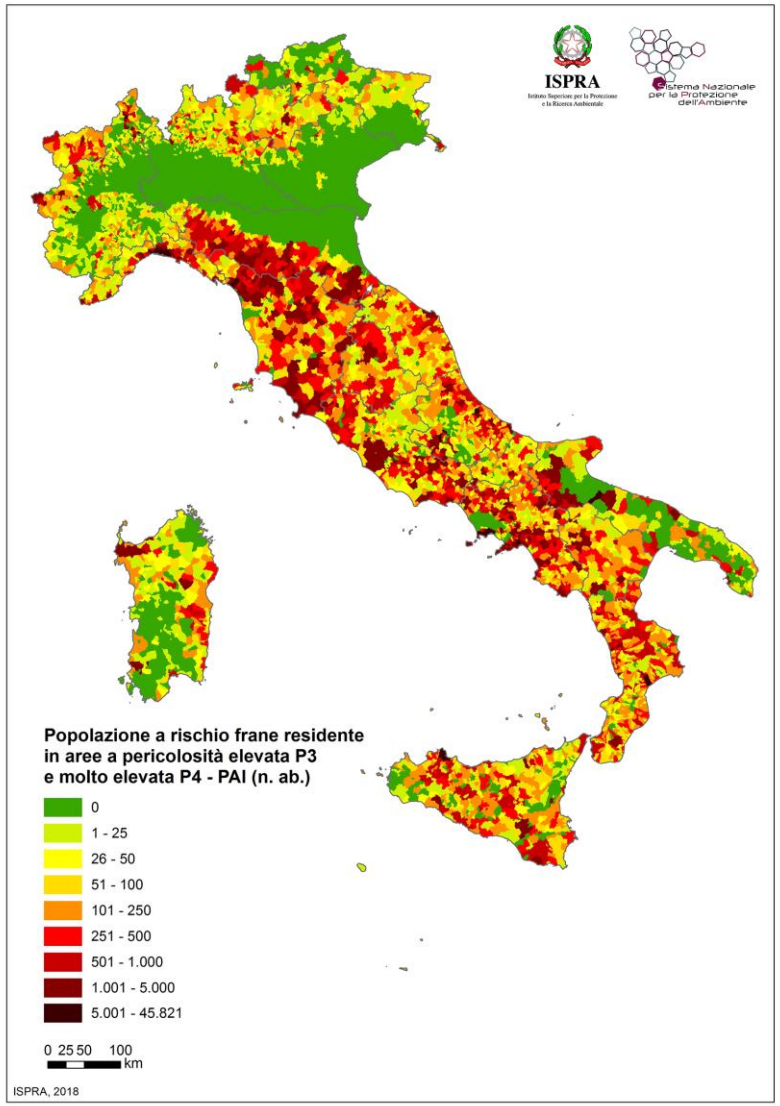
Conclusions

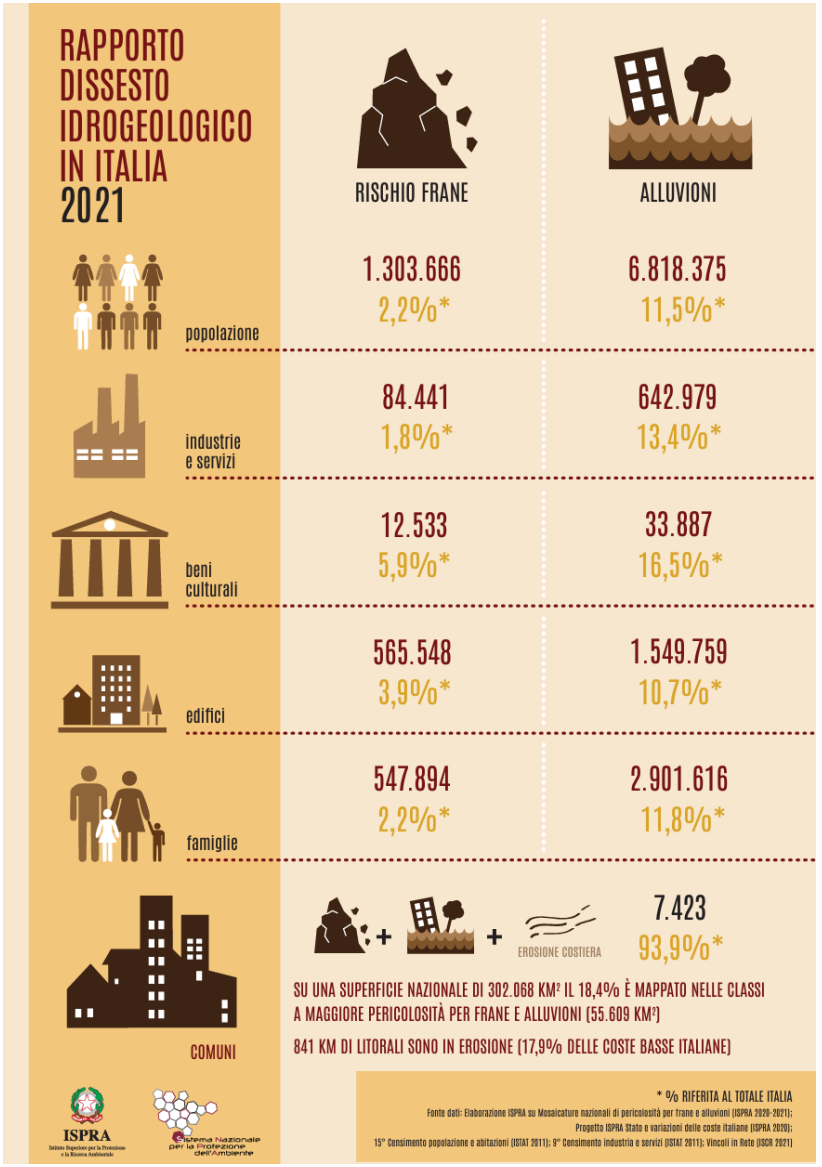
Effective DRMP requires well-conceived and coordinated strategies and actions between a diverse range of actors, including citizens, at multiple levels and integrating a large number of disciplines in order to ensure that adequate capacity and capability exists to execute major crisis management functions (Tagarev et al., 2017) in a competent and efficient manner.

Thank you , for more information, visit: https://eurogeologists.eu/european-network/ under Panel of Experts on Natural Hazards and Climate Change

rudi.ruggeri@cngeologi.it

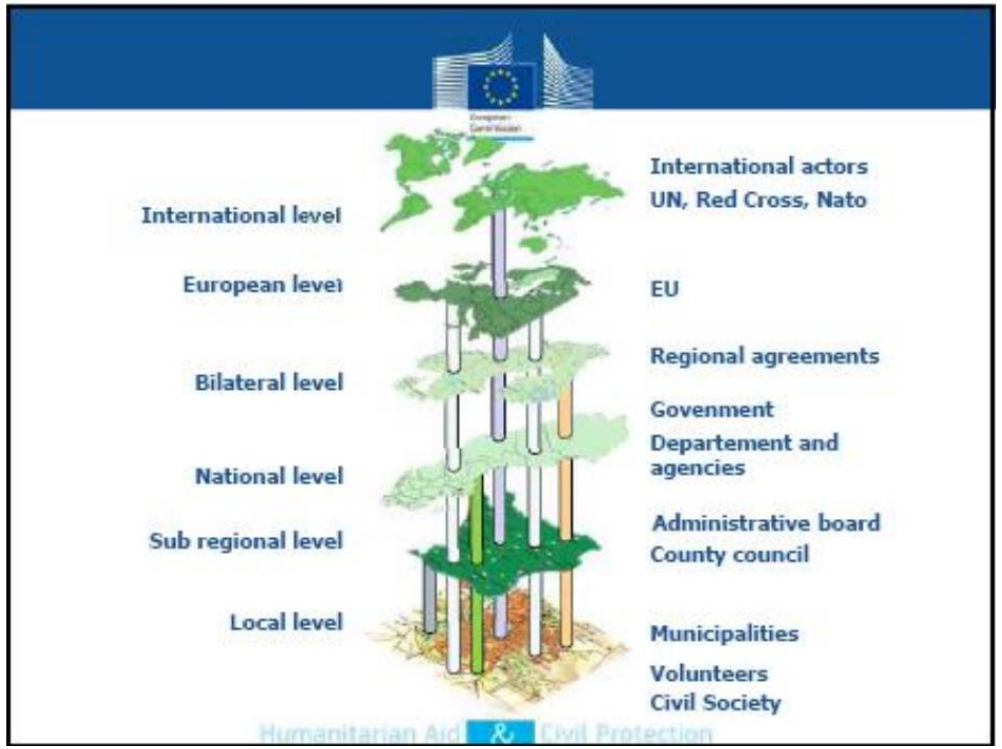
ITALY: A COUNTRY HIGHLY DISASTERS PRONE





rudi.ruggeri@cngeologi.it

DIPARTIMENTO DELLA PROTEZIONE CIVILE



In Italy, civil protection is a function attributed to an integrated system: the National Civil Protection Service, established in 1992 by Law no. 225 and reformed in 2018 by the Civil Protection Code.
It provides for implementing all activities to protect lives, property, settlements, animals and the environment from disasters and their damaging effects.
All levels of government are part of the National Civil Protection Service: the State, the Regions, the Autonomous Provinces, and the Local Authorities.
The operating structures working in coordination with such components are:

- the National Fire and Rescue Service
- the Armed Forces, the Police Forces
- the scientific community, the National Health Service
- the organised civil protection volunteer service
- the Italian Red Cross
- the National Corps of Alpine and Speleological Rescue
- the National System for Environmental Protection
- the structures responsible for meteorological services at national level.

rudi.ruggeri@cngeologi.it

NATIONAL CIVIL PROTECTION SERVICE: how it works in Italy

The Italian civil protection is a structure composed by various entities and public departments, scientific teams and volunteers that operate at various levels (state, regional, province and local) in a coordinated way.

Integrated system

Coordination

Main tasks

rudi.ruggeri@cngeologi.it

Role of Geologists in the context of natural and anthropogenic risks management

- Initial disaster notification;
- First assessment of the impact, followed by mobilization of and coordination by the Civil Protection authorities;
- Civil Protection guidelines through emergency communications services;
- Search and rescue (SAR) operations, first-aid administration and medical care if trained for that purpose;
- Mobilization and contribution of volunteers;
- Set up of emergency shelters;
- Risks scenario evaluation and planning (PEC – Piano di Emergenza Comunale);
- Raising awareness and education for protective measures to successfully deal with the continuous aftershock sequence;
- Post-event hazard mitigation and building inspections/assessments;
- Immediate financial evaluation of the impact plus relief measures;
- Communication with Authorities, population and public middles.

rudi.ruggeri@cngeologi.it

Italy: Ready to see water differently?

- Italy has 8 river basin districts, which supply much of the country's energy through hydropower and are crucial for agriculture and transportation. One of these is the Po Valley, a fertile area in the north of the country, which relies on a complex network of rivers and irrigation canals for water. It is one of the most productive agricultural regions in Europe.
- However, the same valley is also increasingly facing water scarcity in the summer, together with other parts of the country. This is due mainly to rising temperatures and reduced snowmelt. While in the south of the country, regions are grappling with the high-water consumption needed for agriculture and pollution causing poor marine health.
- These are all signs that water cycle is spinning out of balance and action is needed.

rudi.ruggeri@cngeologi.it

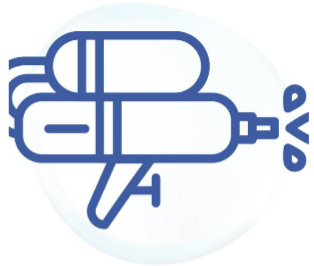
The issues affecting Italy's waters

42%

of drinking water lost due to leaky pipes in 2022

78% of Italians

agree that the EU should propose additional measures to address water problems



4,646

Italian hydropower plants were active in 2021

42%

less water contributed to rivers from melted snow this year

Over 40%

of public water supply lost due to leaks in the system

11%

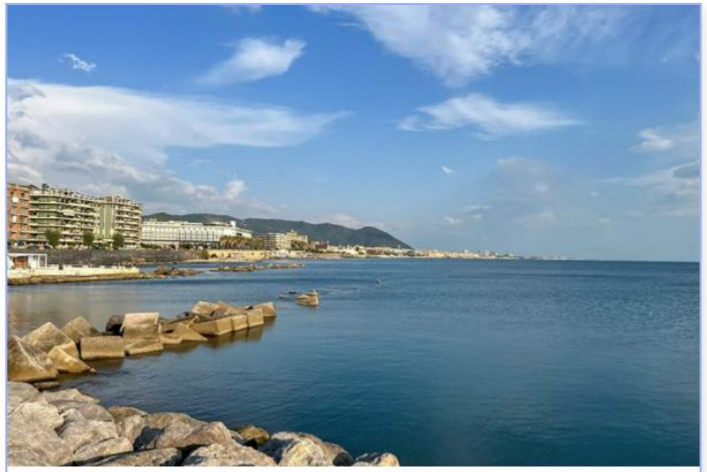
of wastewater is not treated in line with EU legislation

rudi.ruggeri@cngeologi.it

SOME water projects in Italy

GREAT LIFE brings great food to the table

Exploring more drought-and flood-resilient crops in response to temperature rises and water scarcity.



Combatting leaks through innovative solutions

Fixing the leaks in the water system will take time – and this project in the Municipality of Salerno is leading the charge.

Veritas gets €50 million boost to treat wastewater

Funding from the European Investment Bank (EIB) to improve the efficiency of wastewater collection and treatment systems across Italy.

rudi.ruggeri@cngeologi.it

WATER MANAGEMENT

Increasing water demand in the last years:

- Intensive agriculture
- Anti-freeze protection systems on mountains
- Artificial snowmaking on mountains
- Hydroelectric use

MITIGATION AND ADAPTATION

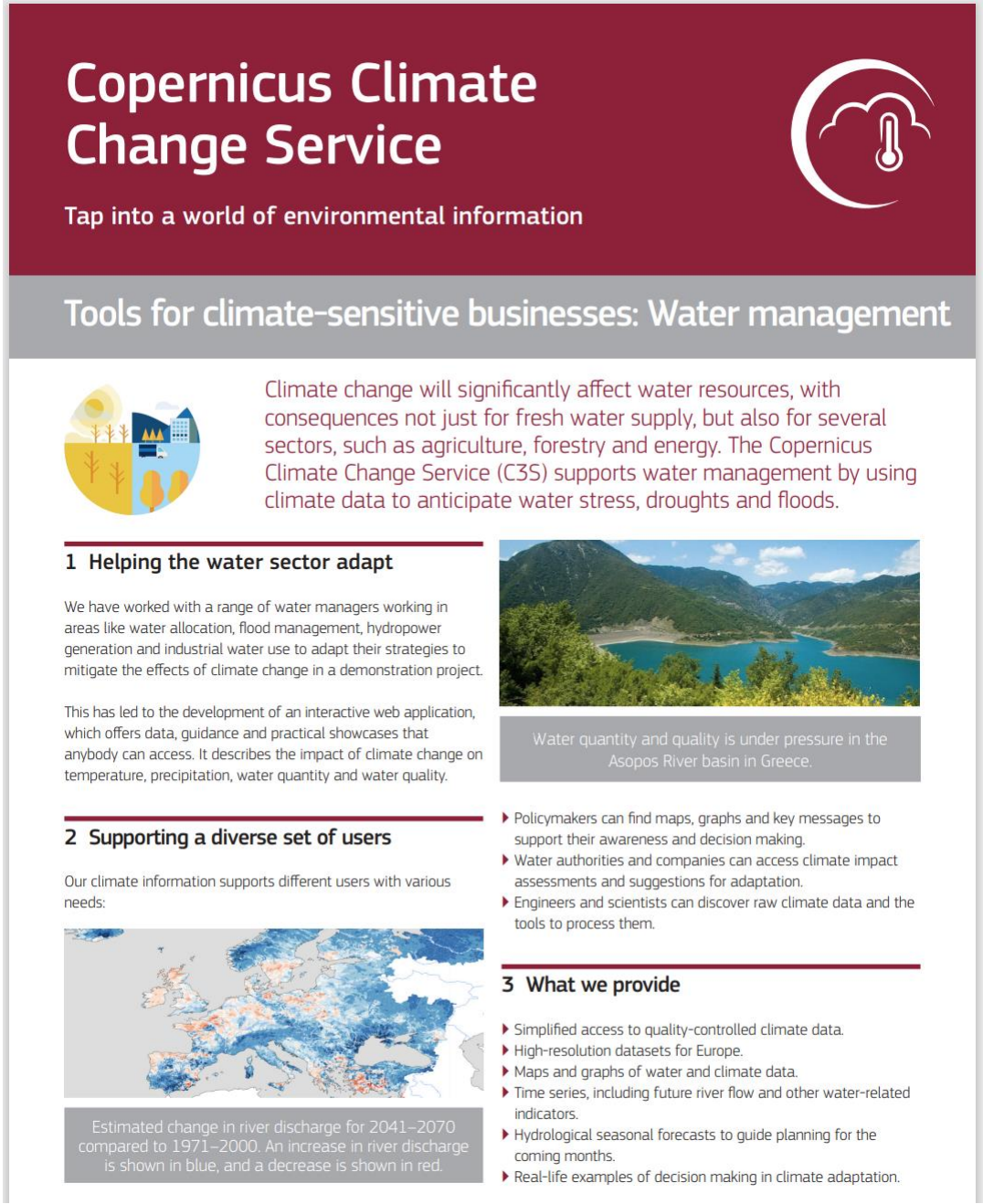
- More efficient irrigation systems
- Larger irrigation consortia
- Adapt the management of the reservoirs to the new flow regimes and for irrigation purposes
- Consider shorter return times of extreme events
- Consider climate change scenarios in the renewal of concessions

rudi.ruggeri@cngeologi.it

Copernicus Climate Change Service

Climate change will significantly affect water resources, with consequences not just for fresh water supply, but also for several sectors, such as agriculture, forestry and energy.

The Copernicus Climate Change Service (C3S) supports water management by using climate data to anticipate water stress, droughts and floods.



Copernicus Climate Change Service

Tap into a world of environmental information

Tools for climate-sensitive businesses: Water management

Climate change will significantly affect water resources, with consequences not just for fresh water supply, but also for several sectors, such as agriculture, forestry and energy. The Copernicus Climate Change Service (C3S) supports water management by using climate data to anticipate water stress, droughts and floods.

1 Helping the water sector adapt

We have worked with a range of water managers working in areas like water allocation, flood management, hydropower generation and industrial water use to adapt their strategies to mitigate the effects of climate change in a demonstration project.

This has led to the development of an interactive web application, which offers data, guidance and practical showcases that anybody can access. It describes the impact of climate change on temperature, precipitation, water quantity and water quality.

Water quantity and quality is under pressure in the Asopos River basin in Greece.

2 Supporting a diverse set of users

Our climate information supports different users with various needs:

- Policymakers can find maps, graphs and key messages to support their awareness and decision making.
- Water authorities and companies can access climate impact assessments and suggestions for adaptation.
- Engineers and scientists can discover raw climate data and the tools to process them.

Estimated change in river discharge for 2041–2070 compared to 1971–2000. An increase in river discharge is shown in blue, and a decrease is shown in red.

3 What we provide

- Simplified access to quality-controlled climate data.
- High-resolution datasets for Europe.
- Maps and graphs of water and climate data.
- Time series, including future river flow and other water-related indicators.
- Hydrological seasonal forecasts to guide planning for the coming months.
- Real-life examples of decision making in climate adaptation.

rudi.ruggeri@cngeologi.it

BEING GEOLOGISTS TRYING TO SOLVE WATER RESOURCE MANAGEMENT ISSUES

1 Assess water resources

- One of the main tasks of a geologist is to assess the quantity and quality of water resources, both surface and groundwater. This involves collecting and analyzing data from various sources, such as wells, springs, rivers, lakes, glaciers, and aquifers. A geologist can use techniques such as hydrogeology, hydrochemistry, hydrology, and geophysics to measure and model the water cycle, the flow and storage of water, the interaction between water and rocks, and the impact of human activities on water resources.

2 Plan water projects

- Another important role of a geologist is to plan and design water projects, such as dams, reservoirs, irrigation systems, water supply networks, wastewater treatment plants, and stormwater management systems. A geologist can provide valuable input on the feasibility, safety, efficiency, and environmental impact of these projects, by evaluating the geological conditions, the hydrological characteristics, the potential hazards, and the social and economic factors. A geologist can also collaborate with other professionals, such as engineers, hydrologists, ecologists, and planners, to ensure the optimal use of water resources.

rudi.ruggeri@cngeologi.it

3 Monitor water quality

- A geologist can also contribute to the monitoring and protection of water quality, by identifying and assessing the sources and effects of water pollution, such as chemicals, nutrients, pathogens, sediments, and thermal changes. A geologist can use tools such as water sampling, laboratory analysis, remote sensing, and geographic information systems (GIS) to detect and map the spatial and temporal distribution of water quality parameters, such as pH, conductivity, dissolved oxygen, and contaminants. A geologist can also propose and implement measures to prevent or mitigate water pollution, such as groundwater recharge, remediation, regulation, and education.

4 Manage water risks

- A geologist can also help to manage the risks associated with water resources, such as floods, droughts, landslides, erosion, and saltwater intrusion. A geologist can use methods such as hazard assessment, risk analysis, vulnerability mapping, and scenario planning to estimate and communicate the likelihood and impact of these events, and to identify the exposed and affected populations and assets. A geologist can also suggest and support strategies to reduce or adapt to water risks, such as early warning systems, emergency response plans, structural measures, and insurance schemes.

rudi.ruggeri@cngeologi.it

5 Research water issues

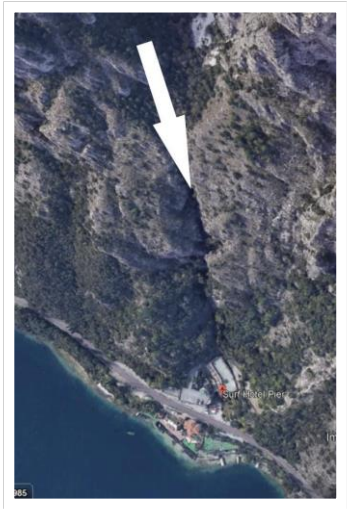
- A geologist can also conduct research on various water issues, such as climate change, water scarcity, water security, water governance, and water innovation. A geologist can use approaches such as fieldwork, experiments, modelling, simulation, and literature review to generate and test hypotheses, to collect and interpret data, and to produce and disseminate knowledge. A geologist can also participate in multidisciplinary and transdisciplinary research projects, involving other scientists, stakeholders, and decision-makers, to address complex and emerging water challenges.

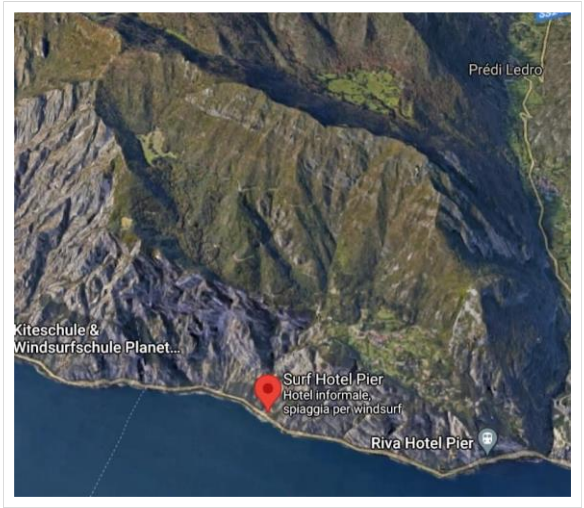
6 Educate water users

- A geologist can also educate and inform water users, such as communities, industries, governments, and the public, about the importance and value of water resources, and the need and benefits of water conservation, efficiency, and stewardship. A geologist can use methods such as outreach, communication, training, and advocacy to raise awareness, to share information, to provide guidance, and to influence behavior. A geologist can also inspire and engage water users, by showcasing best practices, success stories, and innovative solutions.

rudi.ruggeri@cngeologi.it

Role of Geologists in a context of an extreme meteo events risk managment





Limone sul Garda (August 2021): a mudflow overwhelmed the Hotel Pier. The flow broke through the kitchen door, overwhelming all the equipment and then going on to hit the entire dining room, reception and hotel lobby, affecting approximately 500 square meters of structure produced by the heavy rains that fell in a short time (>100 mm in a few hours) on a catchment area of approximately 3 sq km having the basin point (closing section) practically corresponding to the hotel.

We need correct urban planning from a geological point of view and a design that takes into account rainfall regimes with return times of over a century. Rainfall simulations related to climate change.

rudi.ruggeri@cngeologi.it

Role of Geologists in this modern world

Traditional role

Future role

rudi.ruggeri@cngeologi.it

Speaker: Rudi Ruggeri

CONSIGLIO NAZIONALE
DEI GEOLOGI

www.cngeologi.it

Thank you for your attention

rudi.ruggeri@cngeologi.it