SecurityResearch
Community of Users

CoU Brief
Geological Disasters

June 2018 / Issue 10

Summary statement

Summary statement

- The fragmentation that features initiatives in the landscape of geological disasters requires a comprehensive approach that allows for effective integration of the existing research infrastructures. This approach should foster synergies, encourage knowledge sharing, and promote the creation of a common understanding amongst different stakeholders and across different countries.
- In order for an effective European approach towards geological hazards to take off, standardisation of the definitions, methods, and processes used is required.
- Geological hazards should be perceived as transboundary events and, therefore, a multidisciplinary and multi-hazard approach should be applied. A geological hazard needs to be understood in terms of its effects on society, infrastructure and facilities. Furthermore, the potential after-events of geological hazards should be considered, too.
- There is a need for enhanced awareness of the risks that certain geological hazards pose to the general public. Hazards such as tsunamis are not well known to the European public and, therefore, efforts should be made to enhance the public's resilience and preparedness for such events.

Introduction

This CoU brief summarises the topic Geological Disasters and relevant EU-funded projects that participated in the 11th Meeting of the Community of Users (CoU) on Secure, Safe and Resilient Societies that took place 4-7 June 2018 at the BAO convention centre in Brussels.

The Community of Users is a DG HOME initiative that aims to improve information transfer of research outputs and their usability by different categories of stakeholders. During the meetings and thematic workshops, policy updates and information about H2020 projects are provided and interactive discussions facilitated to ensure that solutions and tools resulting from research will reach users.

European Commission

Scope & Relevance

Geological hazards, short 'geohazards', are conditions relating to geology that have the potential to cause harm or damage. [1] These hazards include fast-moving events such as landslides, tsunamis and volcanic eruptions but also slower-moving phenomena like the movement of tectonic plates that often remain unnoticed. Both types pose a serious threat to the European Union both in terms of financial losses, damaged property and affected societies. To illustrate, in 2016 the EU-28 Member States suffered for over 84 million Euros of damage as a result of geohazards. [2] In that same period, over 3 600 people in the EU lost their lives to events such as earthquakes and volcanic eruptions. [3]

Due to the high population density and high amount of financial assets, urban environments are particularly vulnerable to geohazards. [4] With the population living in urban areas growing, geohazards become an increasingly pressing issue. Therefore, it is urgent to invest not only in the forecasting of geohazards but also in the response strategies that are implemented after an event has taken place.

While geohazards pose a substantial threat to the European Union, information sharing on the topic remains limited and inefficient. On the one hand, measuring vulnerability and exposure to geohazards is a challenge as a comprehensive methodology for measurement is lacking. [5] National competent bodies apply different approaches, use different standards and produce data of varying quality, which makes comparisons between events and countries difficult. On the other hand, information and data are not generally available and accessible. [6]Therefore, the challenge in the realm of geohazards lies within the management of the currently existing initiatives and the urge to create linkages between the various national laboratories, experimental sites, and research centres. Data that is already available should be made more accessible and needs to be exchanged with scientists from other Member States in order to allow mutual learning. Moreover, data gathering processes in different Member States and across various initiatives need more streamlining in order for events to be compared. This ties in with Task 1 of the Sendai Framework which is aimed at improving knowledge on disasters.[7]

Supersites provide one way to facilitate such exchanges and enhanced accessibility and those were further explored during the 11th CoU High Level meeting. Supersites have proven to be beneficial for long-term monitoring of vulnerable areas and are a great illustration of knowledge exchange between Member States. Various supersites have shown that a multi-disciplinary approach is needed in order to effectively address risks on the national level. Once again, this requires collaboration between different Member States as well as between different types of stakeholders (researchers, practitioners, policymakers, civil society, industry).

In particular, earthquakes constitute a hazard that requires specific attention as they cause most harm (with close to 19 000 recorded fatalities and losses of 29 billion Euros between 1998 and 2009 in Europe). [8] Through more effective collaboration within the existing research infrastructure, early warning systems can be enhanced and, subsequently, human and financial losses can be reduced. Moreover, innovative technologies and novel solutions can contribute to improving the capabilities of the first responders and the search-and-rescue operations. Applying the multi-hazard perspective, earthquakes should no longer be addressed as demarcated events but, instead, they should be viewed in a broader context meaning that potential after events (i.e. tsunamis) and their effects on society (damage to vital infrastructure, facilities and communities) should be taken into account.

Finally, less frequently occurring events such as tsunamis require increased attention, in particular on the side of citizen awareness. Currently, the majority of the European population is unaware of the tsunami risk in Europe. However, the tsunami that struck Bodrum in July 2017 proves that such events can occur in Europe and that their impact can be substantial. [9] Therefore, there is a need to make citizens aware of the tsunami risk in Europe and to enhance their resilience by instructing them how to respond to such an event.

1 UNISDR definition
2 European Environmental Agency, Natural hazards in EU and EEA Member States, February 2017
3 European Environmental Agency, Natural hazards in EU and EEA Member States, February 2017
4 European Environment Agency, 2010
5 Capes, R. & Teeuw, R. (2017). On safe ground? Analysis of European urban geohazards using satellite radar interferometry. International Journal of Applied Earth Observation and Geoinformation, Vol. 58.
6 European Environment Agency, 2010
7 UN Sendai Framework, 2015
8 European Environment Agency, 2010
9 Astarte presentation, 11th CoU meeting, June 2018

Current debates and stakeholder perspectives

This section describes why the topic of geological hazards is particularly important for each stakeholder group.

Practitioners

Since geohazards are difficult to predict and virtually impossible to prevent, practitioners can benefit from accurate monitoring tools and models that help forecast a hazard as accurate as possible from innovative technologies that aid them in the response phase. Therefore, practitioners are particularly keen on enhancing international and interdisciplinary cooperation on geohazards as this would allow them to be better prepared and to build more resilient societies. Accurate early warning systems for geohazards provide practitioners with the ability and time to prepare for an event and, thereby, they are able to mitigate risks. Given the transboundary nature of geohazards, information sharing between countries is essential for practitioners. Establishing an effective framework for cooperation and knowledge sharing between different countries and stakeholders is, therefore, key to ensure the successful functioning of the practitioners on the ground.

Moreover, practitioners would benefit from strategies that make data more comprehensible. Due to the vast amount of available data, practitioners sometimes struggle to draw the right conclusions. Projects such as ARITSTOTLE[10] help to digest the data in order for the practitioners to be able to make accurate and timely assessments and decisions.

Industry

Industry can play a substantial role in enhancing the resilience of societies as well as in supporting practitioners in their work in the aftermath of a crisis. Tools and technologies that allow first responders to work more effectively, such as INACHUS[11], contribute to the overall safety and help to reduce the losses of an event. By enhancing the resilience and preparedness of societies and infrastructure, the total costs can be reduced. Therefore, industry can play a role in providing incentives for government and communities to invest in resilience.

Nevertheless, in order for the industry to be able to produce products that meet the needs of the geohazard community, it is essential to ensure an accurate and timely transformation of raw data into comprehensive analysis and conclusions. In the currently existing European research infrastructure on geohazards, efforts have been made already to speed up the process of transforming data into products. However, industry would benefit from further investment in this area to ensure a market for the developed products.[12]

Policymakers

Since countries experience different levels of vulnerability to geohazards, it can be challenging to create a common ground on the European level. However, due to the transboundary nature of geohazards, it is crucial for countries to collaborate to mitigate the risks and to coordinate efforts in the response phase. Therefore, policymakers would benefit from more standardised procedures across different states in order to be able to collaborate and cooperate more effectively and efficiently. In order to, ultimately, ensure better cooperation on the European level, policies on the national level need to be better aligned.

Policymakers would thrive by liaising more closely with the scientific community and the currently existing research infrastructures to ensure a faster uptake of research results into new policies.

Closer cooperation between those two stakeholder groups would also allow data generated by the research initiatives to be integrated into policies more rapidly. A shorter cycle between the data collection phase and the creation of new policies would strengthen the latter as they would be based on the most up to date research results.

Despite varying vulnerabilities at the national level, the EU has established a number of directives and programmes to enhance EU cooperation in the field of geohazards:

- **Directive 2007/60/EC on the assessment and management of flood risks** entered into force in 2007. The Directive requires Member States to assess the risk that their coast lines and water courses are exposed to and to map the assets and human lives that are at risks in these areas. This helps the Member States to take action to mitigate the risk and the reduce the potential harm. Moreover, the Directive allows the public to access information and to engage in the planning processes.
- **EU Adaptation Strategy Package (COM/2013/0216 final)** includes the EU Strategy on Adaption to Climate Change and facilitated the development of Climate-ADAPT, a platform where Member States can share knowledge on climate change and its impacts on environmental and social systems. Climate-ADAPT encourages knowledge exchange on climate change and allows Member States to learn from each other regarding resilience and preparedness for natural hazards and geological events.

10 http://aristotle.ingv.it
11 https://www.inachus.eu
12 EPOS presentation, 11th COU Meeting, June 2018

- **Seventh EU Environmental Action Programme (7the EAP)** was adapted in 2013 and intends to guide the EU actions regarding the environment and climate change up to 2020. The programme aims to encourage Member States to enhance their resilience and to mitigate the risks that come with climate change. Hereby, the Union's economy and society are better safeguarded.
- **Decision No. 1313/2013/EU** requires Member States to develop risks assessments at national and sub-national level regarding climate change and the hazards related to this development. This decision falls within the framework of the Union Civil Protection Mechanism.

Academia

Given the inability to prevent geohazards, the research community can play a significant role in monitoring and developing tools that allow for the prediction of such events to occur. Whereas many countries have established a national infrastructure of research initiatives and facilities related to geohazards, the academic community would benefit from building bridges between the various national infrastructures to create a pan-European network. Research on new technologies and tools would benefit from the exchange of knowledge at the international level and this would, in turn, enhance the resilience and preparedness of the EU as a whole.

The real challenge, however, lies within ensuring that the vast bulk of data that is currently available is analysed and becomes useful for research projects. The raw data generated by the various research facilities needs to be translated into findable and usable information upon which academia can build research. Academia can play a role in the analysis and interpretation of the data generated by the various research facilities. This processed data could than function as one of the inputs for policy to be built on.

Thirdly, academia can play a role in the dissemination and communication of risks and information. This ties in with the lack of awareness on certain risks among the general public. Accurately interpreting the cumulated data and translating this into policies and risk communication requires the scientific community to cooperate closely with policymakers. Hereby, academia could play a role in providing policymakers and (local) communities with data and evidence upon which (risk) communication can be based.

Civil society

During the 11th CoU meeting, it was identified that civil society is often insufficiently aware of the risks that geohazards can pose to them. Due to the fact that some geohazards are more likely to occur in certain regions than in others, individuals might lack knowledge on response strategies. This is particularly worrisome in the case of tsunamis since the awareness among civil society is considerably low whereas the ability to provide an early warning is little; often 15 minutes after a potential tsunami is detected, the first waves hit the shores.[13] Therefore, the resilience and preparedness of the general public would be substantially enhanced if they would be more adequately informed about the risks and required response at the time a tsunami strikes.

Relevant initiatives

EU research infrastructure

- **EPOS** (November 2010 – November 2014; closed) created a pan-European framework of national research infrastructures related to Earth Science in Europe. EPOS addressed the current fragmentation of Earth Science initiatives and Europe and created a single, sustainable, permanent and distributed infrastructure that encourages collaboration and cooperation between Member States. Through connecting monitoring networks, observatories, experimental laboratories, EPOS provides access to geophysical and geological data and modelling tools that allows scientific research in the field to further develop. EPOS enabled the European scientific community to study phenomena from a multidisciplinary point of view, at different temporal and spatial scales.
- **SERA** (May 2017 – May 2020; ongoing) is specifically concentrated on earthquake hazards and to that end, SERA aims to improve the access to data, services and research infrastructures in this field. Ultimately, SERA would deliver solutions based on R&D seismology and earthquake engineering which would help to reduce the risk posed by natural and anthropogenic earthquakes. To this end, SERA will, amongst others, involve communities of previous successful projects, provide access to experimental facilities for earthquake engineering worldwide, offer access to data and products across various domains of seismology, expand the access to seismological observations and create a network of infrastructures in the field of earthquake engineering. At the core of SERA lies the exchange of information and data and the fostering of a European research infrastructure on earthquake engineering and seismology.
- **ARISTOTLE** (February 2016 – February 2018; closed) was focused on providing expert advice to the Emergency Response Coordination Centre (ERCC) regarding situation assessment in crisis situations. By creating a collaborative network of scientific and operational experts across Europe, crisis situations can now be assessed more accurately as available data is evaluated

13 CENALT presentation, 11th COU Meeting, June 2018

critically. Based on a multi-hazard approach, the vast amount of data available in times of crisis is analysed and translated into authoritative information. ARTISTOTLE created a multi-hazard early-warning service, provides comprehensive reporting of the information gathered by the 24/7 operational centres and provides experts analysis when requested. ARTISTOTLE builds upon the expertise available within the Member States to come to accurate assessments of crisis situations.

Projects related to GEO Supersites:

- **GEO Geohazards Supersites and Natural Laboratories** (since 2010) is structured around six supersites around the world that allow for improved scientific research and geohazard assessment. With sites in Congo, Ecuador, Greece, Iceland, Italy, Turkey and the US, GSNL aims to enhance international capacity building and contributes to Task 1 in the Sendai Framework, namely to understand disaster risk. GSNL is a voluntary international partnership and is concentrated on important scientific problems and high-risk levels. Ultimately, GSNL attempts to provide open, full and easy access to data from the supersites and national laboratories. Furthermore, GSNL promotes advancements in geohazards science and the fast uptake of scientific results by DRR stakeholders and decision makers. Finally, GSNL encourages global scientific collaboration, capacity building, and data sharing.
- **FUTUREVOLC** (October 2010 – April 2016; closed) created a procedure for vulcanological monitoring through European collaboration and, thereby, developed new models to assess volcanic crises. Furthermore, FUTUREVOLC has improved the transfer of relevant information on volcanic risks to civil protection and relevant authorities. A supersite in Iceland has functioned as a demonstration site and allowed the consortium to identify current gaps and to develop strategies accordingly. FUTUREVOLC developed models and tools that allow for better response during eruptions and, thereby, reduce the impact on societies.
- **RECONASS** (December 2013 – June 2017; closed) established a monitoring system for constructed facilities that allows for continuous updates of the conditions of the structure after a disaster. The system can assess the physical damage, loss of functionality and economic loss of such facilities and is particularly useful when analysing structures that are crucial in the response and recovery phase. Hereby, RECONASS contributes to the recovery phase after a disaster strikes.
- **INACHUS** (January 2015 – January 2019; ongoing) aims to create a tool that supports the Search-and-Rescue (SaR) crews. The robot that INACHUS creates allows for time reduction and increased efficiency in the recovery phase after a disaster has occurred. It allows for localizing survival spaces and to identify the location of survivors in facilities. Through the use of sensors, it is able to detect trapped humans in various situations and, using these sensors, information can rapidly be communicated to a command centre. Using 3D visualization techniques, INACHUS creates an accurate decision support system that helps to plan an manage SaR operations.

Projects related to tsunamis in Europe:

- **ASTARTE** (November 2013 – April 2017; closed) was established following the 2011 tsunami in Japan and was aimed at mitigating the tsunami risk in the NEAM region. ASTARTE was aimed at improving knowledge of tsunami generation and recurrence, establishing statistical emulation approaches for tsunami simulation and creating methods for the assessment of hazards, vulnerability and risk. Furthermore, ASTARTE invested in guidelines for decision makers to increase the resilience and awareness of coastal communities.
- **TSUMAPS-NEAM** (January 2016 – July 2017; closed) has created a long-term Probabilistic Tsunami Hazard Assessment (PTHA) for coastlines of the NEAM region. TSUMAPS-NEAM collaborated closely with ASTARTE and national PTHAs. The project established an encouraged outreach, guidelines and capacity building initiatives and aimed to foster stronger linkages between Tsunami Service Providers and the ERCC to enhance effectiveness in the response phase. TSUMAPS-NEAM has, in its regional approach, developed standardised PTHA products and build a common understanding of the best practices.
- **CELNAT** (since 2009) is a project by the French Ministry of Interior and functions as the national tsunami warning centre of France. CELNAT warns the French civil protection authorities within fifteen minutes after a potentially tsunami genic event occurred in the Western and Eastern Mediterranean Sea or in the North Eastern Atlantic Ocean, transmitting pertinent parameters of the quake and tsunami. CELNAT advises NEAM tsunami service providers and national tsunami warning centres and provides them with timely data and updates.
- **ICG NEAMTWS** (since 2005) is a body of UNESCO concentrated on oceanography. The IOC-UNESCO has established the ICG NEAMTWS, a body specifically dedicated to tsunami warning and mitigation. The goal of the ICG NEAMTWS is to coordinate the establishment and performance of the tsunami early warning system in the NEAM region. ICG NEAMTWS contributes by providing technical support, investing in risk assessment and mitigation and by enhancing public awareness.

Key challenges

One of the key challenges is to reduce the fragmentation that currently exists in the landscape of geological hazards. The different national initiatives need to collaborate more intensively and more effectively. The existing research infrastructures need to be integrated more effectively to avoid duplication and to effectively develop policy concerns. Furthermore, to truly help the European scientific community on geohazards flourish, it is essential for different bodies to collaborate.

This challenge ties in with the need to approach geohazards from a multidisciplinary perspective. As the research from the supersites has shown, it is essential to approach hazards such as volcanic eruptions from a broader perspective considering the implications an eruption can have for a region. Therefore, systemic vulnerabilities in infrastructure, facilities and other structures should be assessed and evaluated in order to establish an effective response strategy. Research should be more focused on understanding the driving factors of the vulnerabilities in order to effectively mitigate them. Moreover, a multidisciplinary approach would allow societies to better prepare for geohazards and to, thereby, reduce the damage.

Furthermore, geohazards need to be understood from a multi-hazard angle, too. Hazards should not be perceived as demarcated events but rather, they should be viewed from a more holistic perspective taking into account potential after effects. This relates to the need for a multidisciplinary approach to geohazards as such events are not to be perceived as isolated occurrences. Nevertheless, in order to effectively apply a multi-hazard approach, methods and responses throughout different Member States needs to be harmonized. Knowledge and strategies regarding the prediction and monitoring of geohazards should be standardised in order for different disciplines, stakeholders, and countries to collaborate.

Besides, the need to share and enhance the accessibility of data brings along a number of challenges. Firstly, openly sharing data leads to the question of privacy and security. The degree of openness of certain types of data should be carefully considered since the data might be extracted and used to do harm. Depending on the type of data and the envisaged audience, the degree of confidentiality should be determined. Secondly, the reliability of data provided by citizens should be critically reflected upon at all times. While it is only experts who ultimately assess the data, citizens can provide input. However, it is important to not blur the line between citizens and scientists.

Related to tsunamis in Europe, a major challenge identified is the lack of awareness among coastal communities and those visiting coastal areas (i.e. tourists). Many people do not understand the risk of tsunamis in Europe and have never experienced such an event and, therefore, are unaware of the risks and the required response. In order to effectively reduce the potential damage and to enhance the resilience of societies and individuals, the risks of tsunamis should be more openly communicated.
Finally, a challenge that is specifically related to the supersites is the sustainability of the physical sites. The infrastructure that was designed especially for the supersites is often high maintenance and in order to sustain the functionality of the sites, solid sustainability plans need to be developed.

Possible synergies

During the 11th CoU Meeting, it became evident that in the field of geological hazards, more interaction and cooperation between national research infrastructures is required. The broad array of initiatives that currently exists should become more interwoven and integrated in order for relevant stakeholder groups to be able to build upon each other's work. Moreover, more cooperation would allow the European research community to answer needs identified by policymakers more effectively. Synergies between EPOS and national research infrastructures or targeted infrastructures such as SERA are encouraged.

In particular, the need for synergy building between outputs of various projects was emphasized. Methodologies, deliverables and solutions of projects should be compared and overlaps need to be identified in order for future projects to build upon the outputs of the current project cycle. Since the European security research landscape is featured by a broad variety of initiatives, it is essential that projects collaborate with each other to avoid duplication and to ensure faster progress. For example, projects could exchange deliverables more often to see in which areas these outputs overlap and where, subsequently, synergies could be established.

Furthermore, during the meetings the need for a multi hazard, multidisciplinary approach to geological hazards was voiced. This requires stakeholders from different types of backgrounds to collaborate and to develop more integrated approaches to geohazard responses. Supersites provide, in that regard, fertile ground for the creation of new partnerships and collaborations and can be perceived as a successful strategy to foster multidisciplinary cooperation.

Key Contacts

CoU website:
http://www.securityresearch-cou.eu/

EC DG HOME
Philippe Quevauviller
Philippe.Quevauviller@ec.europa.eu

EC DG RTD
Gilles Ollier
Gilles.Ollier@ec.europa.eu
Agnes Robin
Agnes.ROBIN@ec.europa.eu

JRC
https://ec.europa.eu/jrc/en
Ian Clark
Ian.Clark@ec.europa.eu

EPOS Project
https://www.epos-ip.org/
Massimo Cocco
cocco@ingv.it

SERA Project
http://www.sera-eu.org/en/home/
Domenico Giardini
domenico.giardini@erdw.ethz.ch

ARISTOTLE Project
http://aristotle.ingv.it/
Rémy Bossu
bossu@emsc-csem.org

GEO Geohazard Supersites and Natural Laboratories
https://geo-gsnl.org/
Stefano Salvi
stefano.salvi@ingv.it

FUTUREVOLC
http://futurevolc.hi.is/
Ágúst Gunnar Gylfason

For an overview of DRR-related projects funded under the Horizon 2020 (H2020) framework prior to 2016, see section 7.2.2 (Geological Hazards) of ***DG HOME, "Community of Users on Secure, Safe and Resilient Societies - Mapping H2020 and ISF Projects Funded under 2014-2015 Programmes," Working Paper (Brussels: European Commission, forthcoming***). The projects referenced within this section of the aforementioned document are universally geared towards tackling similar subjects as those discussed in this brief, and thus have the potential of exhibiting synergies with them

Way forward

Moving onwards, efforts should be made to enhance cooperation and collaboration between existing initiatives and across countries on the topic of geohazards. The field of geohazards would thrive by increased interconnectedness and the building of synergies. This would reduce the amount of valuable knowledge getting lost and lessens the risk of duplication of (research) efforts in the field. Moreover, effective collaboration in the geohazard domain would strengthen the ability to meet the needs of the community and the gaps identified by the policymakers. Furthermore, future initiatives should apply a multi-disciplinary perspective more often and effectively as well as they should shift focus to a multi-hazard approach. Geological hazards are not to be perceived as demarcated events. Instead, their impact on society in the broadest sense should be considered.

However, in order to effectively work together, standardisation across different disciplines and Member States is required. A common understanding of the procedure of identification, assessment, and evaluation of geological risks and hazards is needed to be able to exchange knowledge and to make cooperation in the response phase take off. In the future, research initiatives should invest in establishing a common understanding on definitions, methodologies, and processes in the field of geohazards in order for research data and outcomes to be transferable to other contexts. It is particularly important to implement similar strategies for data digestion and analysis as data will play an increasingly important role in the forecasting of events.

Finally, awareness raising activities need to be enhanced to ensure the general public understands the risks that less frequent geological threats, such as tsunamis, pose. Risk communication should be tailored to the envisaged audience as well as to the area which is at risk since the risk of geohazards differs in degree and across different regions.

RECONASS & INACHUS
http://www.reconass.eu/
https://www.inachus.eu/
Evangelos Sdongos
evangelos.sdongos@iccs.gr

ASTARTE
http://www.astarte-project.eu/
Maria Ana Baptista
mavbaptista@gmail.com

TSUMAPS-NEAM Project
http://www.tsumaps-neam.eu/
Roberto Basili
roberto.basili@ingv.it

CELNAT
François Schindele

IOC-UNESCO
http://www.ioc-unesco.org/
Gerassimos Papadopoulo

Related readings/publications

- Mapping the Impacts of natural hazards and technological incidents in Europe, EEA
- On safe ground? Analysis of European urban geohazards using satellite radar interferometry (Capes & Teeuw, 2017)

Forthcoming CoU events & other related events

- 12th CoU Meeting, 3 – 4 December 2018, Brussels
- Security Research Event (SRE) 2018, 5 – 6 December 2018, Brussels

European Commission