MYRIAD-EU: **M**ulti-hazard and s**Y**stemic framework for enhancing **R**isk-**I**nformed m**A**nagement and **D**ecision-making in the **E.U.**

Background and Challenge

In the Netherlands in 2012, moderate rainfall over five days combined with moderate storm surges over five tidal cycles caused extreme inland water levels that led to evacuations and the use of emergency overflow areas. Despite an advanced water management system, the interaction of the two hazard drivers of storm surge and rainfall in space and time was not explicitly considered in its design. In Serbia and Bosnia and Herzegovina in 2014, intense rainfall from Cyclone Tamara combined with saturated soils, triggered massive landslides that also had knock-on effects such as power outages. Despite post-war investments in flood early warning systems and physical flood protection infrastructures, the standards of these systems did not meet the gravity of the cascading impacts.

These examples show ways in which multiple hazards can have *interrelated effects* on risk. Three key kinds of interrelated effects on risks are through *triggering*, *amplification*, and *compound* events. Triggering events occur where one hazard causes another hazard to occur. Amplification events occur where the occurrence of one hazard can change the likelihood and/or magnitude of additional hazards in the future. Compound events are of hazards coinciding in space and/or time with impacts greater than the sum of the two. **A key question is how could natural hazard risks be better managed by considering those interrelated effects?** This is at the core of the rapidly growing policy and scientific dialogue on multi-hazard risk assessment, as exemplified by high-level discussions at the UNDRR Global Platform 2019 and the aims of the Sendai Framework for Disaster Risk Reduction. There is a recognised need for a paradigm shift to a multi-hazard approach that includes these interrelated and systemic risks.

Aims and objectives

MYRIAD-EU aims to improve risk-informed decision-making in Europe by co-developing a harmonised and standardised framework for multi-hazard risk management that allows stakeholders to assess dynamic multi-hazard risks and DRR solutions across multiple hazards, sectors, scales, and goals, and provides flexibility to integrate new developments in innovative risk science. This will be achieved through a four-year project with the following objectives:

- Enhance interdisciplinary collaboration to facilitate consensus on multi-hazard risk definitions and indicators
- Identify regions and sectors in Europe most at risk from multi-hazards now and in the future;
- Co-develop, co-test and co-refine a harmonised and standardised framework in five multi-scale system case-studies between science and practice;
- Improve our understanding of dynamic feedbacks between risk drivers, including systemic vulnerability, especially through the use of innovative new methods (e.g. machine learning, big data analytics, disaster forensics);
- Develop and assess the applicability of novel methods to generate dynamic multi-hazard risk scenarios;
- Develop multi-risk decision making approaches that allow for the development of forward looking risk reduction pathways and account for synergies and trade-offs between hazards, sectors, scales, and decision and policy goals;
- Develop new mapping tools and open interfaces for exploring dynamics of risk drivers, multi-hazard risk scenarios, and DRR pathways and solutions;
- Improve knowledge exchange on multi-hazard risk assessment and reduction.

General approach

Given the complexity of the challenges surrounding multi-hazard risk assessment and management, it is our conviction that there is no single tool, model, or approach. In fact, there are countless tools, models, and approaches that could be used depending on the stakeholder's involved, their questions, the geographical setting, spatiotemporal scale of study, and so forth. However, a **harmonised and standardised framework** can be developed that provides a set of procedures and guidance for carrying out multi-hazard risk assessment and management. This framework should provide users with **generic tools and open interfaces** to help them develop dynamic multi-hazard risk scenarios and prioritise actions and resilient development pathways. These tools and interfaces should not be over-prescriptive in the data and models that they use as input. For example, if a given user already has hazard scenarios for their own region, the tools and interfaces should allow these to be used as input, thereby increasing the utility of the tools for potential

users. Therefore, we believe that the tools and interfaces should provide generic information but also the ability to plug and play with other data and models.

To address this complexity, we believe that the harmonised and standardised framework, the innovative methodological development to operationalise the framework, and the implementation and testing of the framework should all be carried out in an experimental setting between researchers, decision-makers, and other key actors. Therefore, at the core of MYRIAD-EU is the concept of a **laboratory of systemic multi-hazard risk assessment and management. The foundation of the laboratory is the common framework**, in which the overall conceptual approach is co-developed. **The heart of the laboratory is five multi-scale system case studies**. These are fed by **innovative methodological development** relating to the dynamics and feedbacks of risk drivers, risk scenarios, and risk-informed decision-making. The framework and innovative methodological development is co-designed between researchers and decision-makers, implemented and tested in the multi-scale system case studies, and refined based on the findings of these case studies.

Case studies

The multi-scale systems case studies form the heart of our laboratory approach, They are the experimental implementation and testing grounds for the overall framework for multi-hazard risk management and the MYRIAD-EU innovative methodological developments. An initial tentative set of case studies for discussion is summarized in Figure 1.

The case studies are carefully selected to provide a spread of different spatial scales, geographical locations, and institutional settings across the E.U., combinations of hazards (geological, hydrological, meteorological, biological), and a combination of sectors (for example: tourism, food, energy, infrastructure, ecosystems, and finance). For each case study, impacts will be identified that may occur within the region, but also outside the region across the rest of Europe.

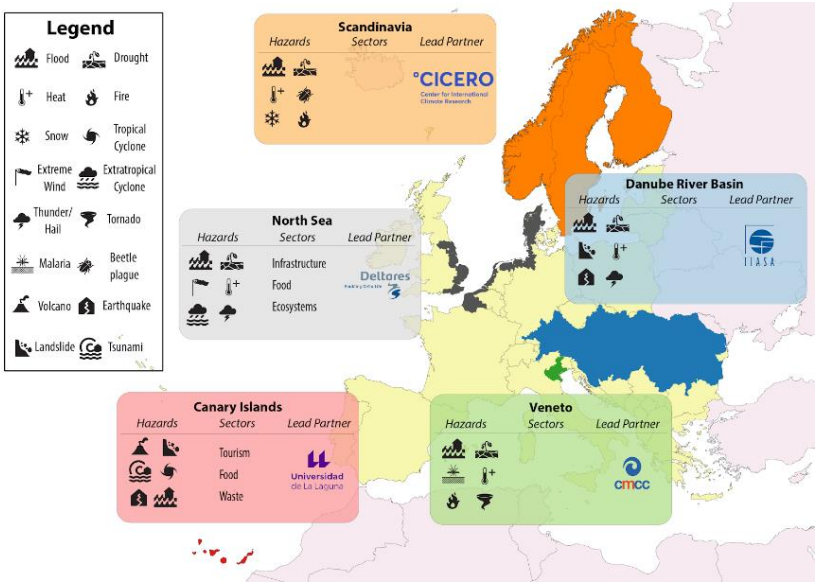

Figure 1: Tentative overview of potential case studies (NB: sectors are indicative only at this stage

Current consortium

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Other consortium institutes: British Geological Survey, CICERO, CMCC, RiskLayer, Deltares, IIASA, Max Planck Institute for Biogeochemistry, Arctik, Universidad de la Laguna

Role of sectoral stakeholders

The co-development of the framework with stakeholders and the use of a laboratory approach with the case studies at the heart is expressly designed to ensure a full engagement between science and practice. We are therefore now approaching potential stakeholders to become involved in the consortium. We would like to engage institutes who can represent various sectors within the different case studies, as partners of the consortium. The envisaged role is to help us connect to relevant stakeholders from the policy and practice communities, facilitate workshops, and bridge the gap between science and practice.

Call text

LC-CLA-16-2020: Multi-hazard risk management for risk-informed decision-making in the E.U.
Risks due to natural hazards have increased dramatically in Europe, due to deep changes in climate, land use and socio-economic evolution since the 20th century. Improved disaster risk management and reduction requires an integrated approach to better forecast, prevent and adapt to multiple hazards, their interactions and impacts. Innovative and comprehensive methodologies, models and tools that assess multi-hazard risks and associated cascading effects and take due account of future drivers (such as climate change), have the potential to represent the leverage to help risk managers and decision-makers prioritise mitigation/adaptation actions, resilient preparedness and response, and develop sustainable and resilient development pathways.

Scope

Actions are encouraged to capitalise on and assess existing methodologies, models and tools for disaster risk management available at EU and national levels in order to define a common framework for risk and vulnerability assessments for areas exposed to multiple natural hazards. Based on the diagnosis of multi-hazards and multi-risk assessments, innovative decision-making tools that help planners to make effective and future proofed risk management choices need to be developed (e.g., dynamic adaptation pathways to address future and emerging threats). Sustainable adaptation options including ecosystem-based approaches such as Nature-Based Solutions – that are cost-effective and provide multiple co-benefits should be prioritised where appropriate.

Research actions should aim to develop a harmonized and standardised multi-hazard risk management approach in order to compare the threats and combined effects posed by several natural hazards (geological, hydrological, meteorological and biological), including hazards from compounded events, and evaluate the risks related to their interactions and cascade/simultaneous effects on the socio-ecological systems. A forward looking perspective, paying due attention to future trends and drivers (such as climate change) should be ensured. In this perspective, quantitative scenarios on present and future risks, on potential direct and indirect effects, in a multi risk environment need further developments. In order to be more operational, such a framework should be developed in close cooperation and dialogue between science and practice with the key actors and end-users to take into account their needs in the scientific development of multi hazard/multi risk assessment methods and enable feasible solutions for more practical use.

In light of the above, actions should also seek to develop mapping tools and user-friendly ICT open interfaces to better understand the model scenarios and outputs. Emphasis on systemic vulnerability of different sectors exposed to multi-hazard risk (e.g. agriculture, forests and other economic sectors, land use, infrastructure, ecosystems) will require particular attention in building the risk analysis. Similarly, uncertainty should be more consistently addressed to provide reliable estimates of vulnerability and risks. Action should take advantage of data and information provided by the Copernicus programme, in particular the Copernicus Emergency Service, and the European Research Infrastructure Consortiums (ERIC) such as the European Plate Observing System (EPOS) and the European Multidisciplinary Seafloor and Water Column Observatory (EMSO). Actions should also build upon and seek collaboration with the projects funded under the relevant SC7 DRS topics.

The Commission considers that proposals requesting a contribution from the EU in the range of EUR 3-5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impacts:

The project results are expected to contribute to:

- a consensus in better definitions, indicators and functions to characterise multi-hazard risk through enhanced inter-disciplinary collaboration between the different science and practice communities addressing various types of hazards, disaster risk and sustainable development;
- prioritisation of investments and pertinent selection of effective risk reduction management options;
- enhanced capacity for identification of vulnerable, threatened areas and infrastructures most at risk from multi hazards in Europe;
- better informed forward-looking national risk assessments that also take into account long-term drivers such as climate change, and enhanced implementation of existing legislation and streamlining of policies;
- enhanced risk-informed decisions on land-use planning addressing trade-offs between differing prioritized adaptation options and competing policy goals;
- enhanced understanding of the relationships and interactions of multiple hazard, including compound events and cascading risks and risk related processes driven by environmental and societal changes on different time and spatial scales;
- better knowledge exchange through platforms such as Disaster Risk Management Knowledge Centre, and stakeholder networks on emergent risks and extreme events (e.g., Community of Users, Risk Knowledge-Action Network).

Type of Action:

Research and Innovation action

Project size (as EU contribution) in the range of:
EUR 3 to 5 million