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Conceptualizing an adaptation pathway model for multi-hazard, multi-stakeholder systems

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While current adaptation planning approaches commonly focus on single hazards and individual sectors, a paradigm shift in decision-making is required to account for the increasingly interconnected world. Decision making support tools are needed to enable fair distribution of support and (increasingly) limited resources (i.e. space, financial means). No such integrated tools exist yet that account for dependencies, conflicts, and co-benefits between various stakeholders as well as the knowledge regarding dependencies and co-existence of various hazards and their joint impacts. This work provides a first conceptual framework of a decision-support tool in the context of adaptation planning in a multi-hazard, multi-stakeholder setting.

Decision-making processes for adaptation planning need to follow dynamically robust plans instead of a static optimal strategy to account for the deeply uncertain future. In fact, a myriad of uncertain or even unknown factors (i.e. climate change, socio-economic developments, technology advancement) might lead to very different future developments. Dynamic Adaptation Policy Pathways (DAPP) is a widely used systematic and practical approach for decision-making over time and strategic planning under uncertain conditions to design dynamic, adaptive plans covering short-term no-regret actions, long-term options, and adaptation signals to take actions.

A systematic literature review was undertaken to analyze adaptation planning concepts across various (multi-)sectors and (multi-)hazard contexts. This literature review was used to identify underlying paradigms and relevant concepts in the field of scenario analysis, pathway modelling, and multi-objective decision-making useful for advancing the existing DAPP approach. Using a simple, synthetic multi-hazard, multi-sector case study, the tailored adaptation planning framework was tested for its robustness.

As a result, an advanced DAPP framework was developed. It accounts for several different physical processes playing a role in natural hazard impacts on human systems (i.e., different hazard types). Moreover, it accounts for spatial and temporal dependence of (different) hazards influencing coping capacities and the triggering space to take adaptation actions (compound, consecutive, aggregating impacts). Furthermore, the framework acknowledges 1) the diversity of stakeholders in an exposed system in terms of their vulnerability, objectives, coping capacities and contesting interests (e.g., limited resources or space), and 2) the diversity of driving actors of adaptation action within a system and the connectedness of decisions and implications on the system

development. The framework uses information about the system and its boundaries, along with information about the available adaptation actions, information about the decision making process / motivation to take adaptation action, information about possible conflicts / dependencies within the decision space (with regards to objectives, adaptation actions, and other system elements) and implicit assumptions used to define the system (of systems). Using this framework, adaptation pathways – meaning sequence of adaptation actions – can be created and evaluated with regards to their robustness and performance in comparison to long-term visions.