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Bayesian Network Approach for Assessing Probability of Multi-Hazard Climate Driven Events

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With the intensity and frequency of climate driven disasters increasing as result of climate change, there is ever more need to plan for such events and develop means to mitigate against them (UNDRR, 2015). Traditionally, the assessment of risks and impacts to regions posed by climate extreme events have been carried out in a “one at a time” approach, where the effects of each hazard, are assessed individually (Russo et al., 2023). However, it is recognised that a transition to a more multi-hazard and multisectoral approach is needed to be more efficient and effective in mitigating the risks/impacts posed to society, infrastructures, or the environment (Sendai Framework, 2015), (Russo et al. 2023). Whilst risk/impact assessment modelling can be complex, the derivation of risk/impacts is complicated further within a multi-hazard assessment due to the interdependent relationships between hazard, exposure and vulnerability, and that these vary over time in response to a preceding hazard (Gill et al. 2021).

The European Funded ICARIA project seeks to create an asset level modelling framework for understanding the potential risks/impacts posed by multi-hazard climate driven hazards, whilst also providing insight into cost-effective means of mitigating against them through the application of suitable adaptation measures. Two of the key challenges when transitioning from a single to a multi-hazard modelling approach are that (1) hazards are not directly comparable due differences in their processes and metrics, and (2) the effects of one hazard can influence the behaviour/characteristics of another hazard (Forzieri et al., 2016). To simulate the potential risks/impacts that could result from the modelled range of compound and consecutive hazards, a two-stage approach is being adopted that consists of (1) a deterministic physical modelling approach for quantifying the risks/impacts that can arise through simulation of various compound and consecutive hazard scenarios, along with (2) a stochastic Bayesian Network (BN) method for defining the probability distribution of such events. The BN will consider historical data for defining the probability distribution of modelled, multi-hazard scenarios for both current and future scenarios whilst data from the physical modelling will be used for defining the distribution of parameters relating to exposure, vulnerability, and impacts for the business as usual (no adaptation) and future adaptation scenarios.

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