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Uncertainty quantification and attribution in flood risk assessment using Global Flood Models: an application to the river Rhine basin

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Floods are extreme hydro-meteorological hazards that pose significant risks to the economy and society. Reducing the risk associated with floods and better adapting to them is a daunting task because flood risk dynamics are influenced by different factors. Flood risk is usually defined as the product of three components: hazard, exposure and vulnerability. Global Flood Risk Models (GFRM) represent the underlying physical hazard, the exposure of people, properties or other assets to the hazard, and the losses that may occur following a flood event. Consequently, they are used by governmental agencies, risk reduction organisations, global investors and the (re)insurance industry to help manage the societal and financial risks associated with floods. GFRMs are subject to many sources of uncertainty, including uncertainty in processes representation, model parameters and input data; however, the relative importance of these different sources is poorly understood. Currently, no evidence exists on which uncertain input factor mostly control the final uncertainty in predicted losses in different places and circumstances. In this project, we use JBA's (a leading flood risk modelling company) Global Flood Model and Open Exposure Data (OED) to develop an appropriate methodological approach to analyse the sensitivity of loss predictions in a structured way. This is particularly challenging as input uncertainties exhibit complex spatially distributed and spatially-structured (correlated) patterns. We apply the methodology to the Rhine river basin, covering regions with different physical and socio-economic characteristics. We pursue the following objectives; (1) Identify and quantify the various sources of uncertainty e.g. associated to rainfall data, extraction of flood events sets, defence database, vulnerability curves, exposure portfolios (2) Analyse their relative importance on flood losses predictions across places along the river (3) Understand which of them are most important at each place. We aim to produce scientifically robust evidence about the importance of different sources of uncertainty across places with different climate, hydrology and socio-economic characteristics and try to address questions related to exposure and vulnerability dynamics, flood losses modelling and adaptation strategies. Such evidence base will help prioritise

efforts for uncertainty reduction of the case study model, as well as other flood risk models used by (re)insurers and government agencies, ultimately contributing to more informed decisions for flood risk mitigation.