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Capturing spatial and temporal patterns of widespread, extreme flooding across Europe

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Statistical characterisation of physical hazards is an integral part of probabilistic catastrophe models used by the reinsurance industry to estimate losses from large scale events. Extreme flood events are not restricted by country boundaries which poses an issue for reinsurance companies as their exposures often extend beyond them. We discuss challenges and solutions that allow us to appropriately capture the spatial and temporal dependence of extreme hydrological events on a continental-scale, which in turn enables us to generate an industry-standard stochastic event set for estimating financial losses for widespread flooding.

By presenting our event set methodology, we focus on explaining how extreme value theory (EVT) and dependence modelling are used to account for short, inconsistent hydrological data from different countries, and how to make appropriate statistical decisions that best characterise the nature of flooding across Europe. The consistency of input data is of vital importance when identifying historical flood patterns. Collating data from numerous sources inherently causes inconsistencies and we demonstrate our robust approach to assessing the data and refining it to compile a single consistent dataset. This dataset is then extrapolated using a parameterised EVT distribution to estimate extremes. Our method then captures the dependence of flood events across countries using an advanced multivariate extreme value model. Throughout, important statistical decisions are explored including: (1) distribution choice; (2) the threshold to apply for extracting extreme data points; (3) a regional analysis; (4) the definition of a flood event, which is often linked with reinsurance industry's hour's clause; and (5) handling of missing values.

Finally, having modelled the historical patterns of flooding across Europe, we sample from this model to generate our stochastic event set comprising of thousands of events over thousands of years. We then briefly illustrate how this is applied within a probabilistic model to estimate catastrophic loss curves used by the reinsurance industry.