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Pan-European stochastic flood event set

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Impact Forecasting (IF), the model development center of Aon Benfield, has been developing a large suite of catastrophe flood models on probabilistic bases for individual countries in Europe. Such natural catastrophes do not follow national boundaries: for example, the major flood in 2016 was responsible for the Europe's largest insured loss of USD3.4bn and affected Germany, France, Belgium, Austria and parts of several other countries. Reflecting such needs, IF initiated a pan-European flood event set development which combines cross-country exposures with country based loss distributions to provide more insightful data to re/insurers. Because the observed discharge data are not available across the whole Europe in sufficient quantity and quality to permit a detailed loss evaluation purposes, a top-down approach was chosen. This approach is based on simulating precipitation from a GCM/RCM model chain followed by a calculation of discharges using rainfall-runoff modelling. IF set up this project in a close collaboration with Karlsruhe Institute of Technology (KIT) regarding the precipitation estimates and with University of East Anglia (UEA) in terms of the rainfall-runoff modelling. KIT's main objective is to provide high resolution daily historical and stochastic time series of key meteorological variables. A purely dynamical downscaling approach with the regional climate model COSMO-CLM (CCLM) is used to generate the historical time series, using re-analysis data as boundary conditions. The resulting time series are validated against the gridded observational dataset E-OBS, and different bias-correction methods are employed. The generation of the stochastic time series requires transfer functions between large-scale atmospheric variables and regional temperature and precipitation fields. These transfer functions are developed for the historical time series using reanalysis data as predictors and bias-corrected CCLM simulated precipitation and temperature as predictands. Finally, the transfer functions are applied to a large ensemble of GCM simulations with forcing corresponding to present day climate conditions to generate highly resolved stochastic time series of precipitation and temperature for several thousand years. These time series form the input for the rainfall-runoff model developed by the UEA team. It is a spatially distributed model adapted from the HBV model and will be calibrated for individual basins using historical discharge data. The calibrated model will be driven by the precipitation time series generated by the KIT team to simulate discharges at a daily time step. The uncertainties in the simulated discharges will be analysed using multiple model parameter sets. A number of statistical methods will be used to assess return periods, changes in the magnitudes, changes in the characteristics of floods such as time base and time to peak, and spatial correlations of large flood events. The Pan-European flood stochastic event set will permit a better view of flood risk for market applications.