Model appropriateness with respect to the impact of climate change on river flooding

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Extended abstract

How good should a river basin model be to assess the impact of climate change on river flooding for a specific geographical area? The determination of such an appropriate model should reveal which physical processes should be incorporated and which data and mathematical process descriptions should be used at which spatial and temporal scales. It should be based on sensitivities and a right balance between uncertainties of inputs, parameters and process descriptions resulting in an output uncertainty acceptable for the model user and feasible in view of data availability and computational possibilities.

An appropriate model will be determined for the river Meuse basin in Western Europe. First step is an analysis of climate data (stations, RCMs and GCMs) and river basin data (land use, topography, soils etc.) to determine important statistics such as correlation lengths and extreme values and associated uncertainties. These statistics and uncertainties are used to derive guidelines with respect to the physical processes to be incorporated in the river basin model, the spatial and temporal scales to be used and the mathematical process descriptions to be employed. Moreover, a preliminary scale analysis gives additional directives. The resulting characteristics are used in an existing modelling framework (IHMS) to build an appropriate river basin model for our research objective. Furthermore, two additional models (one more simple and one more complex model) are constructed to assess the sensitivity of the results to the model structure.

The three models differing in complexity with observed rainfall input are used to simulate discharge series to derive extreme value distributions (EVDs). Comparison with the corresponding observed EVD reveals the goodness-of-fit and the sensitivity of the results to model complexity. A stochastic rainfall model is used to generate rainfall input for the current and changed climate. These rainfall inputs are used in the three river basin models to simulate discharge series and derive EVDs for the different climates.

The climate data analysis showed large errors in RCM and GCM simulated rainfall although corrected for averaging effects. In particular, variability and extremes were simulated rather poorly. Large spatial correlation lengths seem to support relative large spatial scales. As expected the river basin analysis revealed different appropriate scales for different processes. However, the previous scale analysis showed that relative large spatial scales for a few important processes were appropriate to simulate extreme discharges in an acceptable way.