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Can precipitation modelled from Regional Climate Models really be used in studies of climate change impacts on flooding?

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This study evaluates the impacts on flood inundation of a changing climate within a probabilistic framework. Global and Regional Climate Models (GCM/RCM) are used to drive catchment hydrological and river hydraulic models within a cascaded framework. We consider three analytical steps that must be taken into account in order to successfully provide probabilistic projections of flood inundation: (i) downscaling of the driving variables from the GCM/RCM due to the scale mismatch between the model types; (ii) bias correction due to GCM/RCM deficiencies in modelling consistent seasonal and inter-annual climate variability and (iii) uncertainties in the cascade of models.

A probabilistic climatic-hydrologic-hydraulic cascade flood prediction system was set up to identify different sources of uncertainties and understand the way in which they propagate. Critical assessment regarding the ability of RCM model simulations to drive such a model cascade is particularly highlighted, proving a basis for discussion on our current ability to quantify climate impacts of extreme behaviour by such methodologies. Flood events can be caused by different mechanisms, such as high-intense rainfall events over a short period or intermediate precipitation over a longer time period and the spatial pattern of precipitation. It is therefore important that these mechanisms are sufficiently reproduced by RCMs in climate impact assessments. The study area was a meso-scale Upper Severn catchment located in the Midlands Region of England. Multiple RCM predictions were obtained from the ENSEMBLES project (16 ensembles) as well as the HadRM3 members of the UKCP09 (11 ensembles).