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Predictions of river flow in NW Europe using a coupled hydrological and regional climate model

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Regional Climate Models (RCMs) offer significant improvements over Global Climate Models in terms of their representation of rainfall at the spatial and temporal scales required for hydrological modelling. Here we test a new implementation of a grid-based hydrological model embedded in a model of land-surface climatology (the Joint UK Land Exchange Scheme; JULES) against observed river flows in several major NW European rivers, including the Rhine, Maas, Elbe, Danube, Loire, and Seine.

Our hydrological model comprises a probability-distributed model of soil moisture and runoff production (PDM) coupled with a discrete approximation to the 1D kinematic wave equation to route surface and subsurface water downslope (G2G). The model was driven with hourly output from the Hadley Centre regional climate model, which itself was driven using results from the ERA-40 reanalysis experiment (1961-2000). The results of simulations for river catchments in northwest Europe are presented and compared with measured river flows over the same time period, for the same locations.

The success with which the runoff production and flow routing components of the land-surface model match observed flow data is evaluated. We demonstrate that model performance is considerably improved by: (i) the use of 25 km resolution ancillary data sets for soil hydraulic and thermal properties derived from IGBP data, and (ii) by accounting for spatially-variable soil depth using soils data derived from the European Soil Database.