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Testing the Joint UK Land Environment Simulator (JULES) for flood forecasting

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Land Surface Models (LSM) are based on physics principles and simulate the exchanges of energy, water and biogeochemical cycles between the land surface and lower atmosphere. Such models are typically applied for climate studies or effects of land use changes but as the resolution of LSMs and supporting observations are continuously increasing, its representation of hydrological processes need to be addressed adequately. For example, changes in climate and land use can alter the hydrology of a region, for instance, by altering its flooding regime. LSMs can be a powerful tool because of their ability to spatially represent a region with much finer resolution. However, despite such advantages, its performance has not been extensively assessed for flood forecasting simply because its representation of typical hydrological processes, such as overland flow and river routing, are still either ignored or roughly represented. In this study, we initially test the Joint UK Land Environment Simulator (JULES) as a flood forecast tool focusing on its river routing scheme. In particular, JULES river routing parameterization is based on the Rapid Flow Model (RFM) which relies on six prescribed parameters (two surface and two subsurface wave celerities, and two return flow fractions). Although this routing scheme is simple, the prescription of its six default parameters is still too generalized. Our aim is to understand the importance of each RFM parameter in a series of JULES simulations at a number of catchments in the UK for the 2006-2015 period. This is carried out, for instance, by making a number of assumptions of parameter behaviour (e.g., spatially uniform versus varying and/or temporally constant or time-varying parameters within each catchment). Hourly rainfall radar in combination with the CHESS (Climate, Hydrological and Ecological research Support System) meteorological daily data both at 1 km2 resolution are used. The evaluation of the model is based on hourly runoff data provided by the National River Flood Archive using a number of model performance metrics. We use a calibrated conceptually-based lumped model, more typically applied in flood studies, as a benchmark for our analysis.