Geophysical Research Abstracts
Vol. 13, EGU2011-8123, 2011
EGU General Assembly 2011

How well do large-scale models reproduce hydrological extremes in Europe?

Simon Parry, Christel Prudhomme, and Jamie Hannaford
Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8BB, United Kingdom (spar@ceh.ac.uk)

There are inherent uncertainties involved in large-scale hydrological modelling and as such it is necessary to corroborate modelled output with observational data, which can act as a benchmark against which to compare model results. Hydrological extremes are often the most important range of the hydrological regime given their impact as natural hazards, on the economy and on society, although extremes are subject to the most uncertainty both in observed and modelled hydrological data. The increased uncertainty at high and low flows necessitates a specific focus on corroboration of modelled output at these extremes, a philosophy that has not often been applied in model intercomparison. Historical regional catalogues of drought and of high flows were produced from a large dataset of European streamflow records sourced from the Friend European Water Archive (EWA) and supplemented with additional timeseries from the National River Flow Archive (UK) and Banque Hydro (France). The catalogues demonstrate the spatial coherence and spatial variability in high and low flow characteristics across the continent. The extent to which large-scale hydrological models can reproduce the observed patterns of hydrological extremes is investigated in this paper.

The low and high flow catalogues were produced using the Regional Deficiency Index (RDI) and the Regional Flood Index (RFI), respectively. The same methods were applied in this paper to total runoff model output from five large-scale hydrological models (Jules, Htessel, MPI-HM, GWAVA and WaterGap), incorporating both land-surface schemes and global hydrological models. The model simulations were generated from consistent climatic driving data (Watch Forcing Data; WFD) spanning the period 1963-2001, and output at a 0.5° spatial resolution and on a daily timestep. The RDI and the RFI were then applied to these total runoff data, readily allowing comparisons to be made between observed and modelled reproductions of hydrological extremes.

Intercomparison of observed and modelled data suggests that large-scale models are generally able to reproduce the distribution of ‘rich’ and ‘poor’ periods of hydrological extremes, as well as individual high and low flow episodes. Nevertheless, the extent to which the three models can adequately represent the spatio-temporal evolution of hydrological extreme events varies regionally throughout Europe, temporally during episodes, and between high and low flows. High flows are generally less well reproduced by the models than low flows, potentially owing to reduced regional coherence of high flow response, but also perhaps proving sensitive to the spatial and temporal resolution of climatic input data and to elevation. Additional variability in the reproduction of hydrological extremes arises from the contrasting process base and conceptual underpinnings of the five large-scale models.

The RDI and the RFI have been shown to be useful techniques for providing benchmark data, as well as successful methods for corroborating modelled output for hydrological extremes. Following the generally successful reproduction of hydrological extremes by the five large-scale models presented in this paper, future research will focus on multi-model and multi-scenario projection of the potentially changing characteristics of hydrological extremes during the remainder of the 21st century.