Geophysical Research Abstracts
Vol. 13, EGU2011-11375, 2011
EGU General Assembly 2011

Observed runoff trends across Europe - a benchmark for land surface and global hydrological model simulations

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Runoff from river basins in Europe has been found to exhibit trends over the twentieth century that have some parallels with climatic changes, i.e. to warmer winters in the north, a stronger seasonality in central Europe and overall drier conditions in the south. Such changes can provide a benchmark, against which the performance of models that are used to project future hydrological change can be evaluated. Within the EU WATCH project, several land surface and global hydrological models have taken part in a model intercomparison project (WaterMIP) to compare global water balance simulations in a consistent way. Eight of the models were run for a longer time period (1964-2001) using the same climate database, i.e. the bias-corrected WATCH Forcing Data. These simulations were used in this study to investigate how modelled runoff trends compare to trends in observations from over 400 small basins with near-natural flow conditions, drawn from across Europe. While the main aim was to test trends as a benchmark, the comparison across models (having different model structure and parameterization) can also assist attribution of trends and elucidate which process descriptions models may need to improve. The results show that overall regional patterns of trends in annual runoff are well reproduced, which suggests that the quality of the common forcing data is satisfactory. However, trends in monthly runoff and trends in extremes are not well represented and differ substantially among the models. WaterMIP has already described the major differences among the models, such as in the simulation of snow accumulation and melt. We show that these differences can have a transient effect, i.e. they cause differences in the long-term trends of seasonal runoff and hydrological extremes. Consequently, the sensitivity of streamflow to climate variability in a particular region may be difficult to judge for some of the models. In this presentation such model-specific differences are demonstrated and it is further illustrated how validating models for trends or long-term variability can reduce uncertainty in the interpretation of model projections of the hydrological response to climate change.