Geophysical Research Abstracts
Vol. 19, EGU2017-17716, 2017
EGU General Assembly 2017

Benchmarking Ensemble Streamflow Prediction Skill in the UK

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Skilful hydrological forecasts at weekly to seasonal lead times would be extremely beneficial for decision-making in operational water management, especially during drought conditions. Hydro-meteorological ensemble forecasting systems are an attractive approach as they use two sources of streamflow predictability: (i) initial hydrologic conditions (IHCs), where soil moisture, groundwater and snow storage states can provide an estimate of future streamflow situations, and (ii) atmospheric predictability, where skilful forecasts of weather and climate variables can be used to force hydrological models. In the UK, prediction of rainfall at long lead times and for summer months in particular is notoriously difficult given the large degree of natural climate variability in ocean influenced mid-latitude regions, but recent research has uncovered exciting prospects for improved rainfall skill at seasonal lead times due to improved prediction of the North Atlantic Oscillation. However, before we fully understand what this improved atmospheric predictability might mean in terms of improved hydrological forecasts, we must first evaluate how much skill can be gained from IHCs alone. Ensemble Streamflow Prediction (ESP) is a well-established method for generating an ensemble of streamflow forecasts in the absence of skilful future meteorological predictions. The aim of this study is therefore to benchmark when (lead time/forecast initialisation month) and where (spatial pattern/catchment characteristics) ESP is skilful across a diverse set of catchments in the UK. Forecast skill was evaluated seamlessly from lead times of 1-day to 12-months and forecasts were initialised at the first of each month over the 1965-2015 hindcast period. This ESP output also provides a robust benchmark against which to assess how much improvement in skill can be achieved when meteorological forecasts are incorporated (next steps). To provide a 'tough to beat' benchmark, several variants of ESP with increasing complexity were produced, including better model representation of hydrological processes and sub-sampling of historic climate sequences (e.g. NAO+/NAO- years). This work is part of the Improving Predictions of Drought for User Decision Making (IMPETUS) project and provides insight to where advancements in atmospheric predictability is most needed in the UK in the context of water management.