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Improving seasonal prediction of UK winter streamflow

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Winter (December-January-February, DJF) in the UK is a key season for water management. Drier than normal conditions can suppress recharge of reservoirs and groundwater levels that can be critical for the provision of water supplies through the following summer, but above normal soil moisture and river flows enhance flood risk. Skilful hydrological forecasts of season-ahead prospects for above or below normal streamflow volumes would be extremely beneficial for decision-making in operational water management and is an active area of research.

Recent work has shown that traditional Ensemble Streamflow Prediction (ESP) forecasts for DJF, with predictability from Initial Hydrologic Conditions (IHCs) alone, are skilful against climatology in many catchments in the south and east of the UK (higher catchment storage), but not for catchments in the north and west (lower catchment storage). However, there are several avenues that might improve upon the performance of traditional ESP that exploit the known influence of the North Atlantic Oscillation (NAO) on the hydroclimate of the north and west in winter: 1.) ESP_NAO – sub-sampling ESP members based on NAO+/NAO- years, and 2.) Dynamic_P – using a derived precipitation product from a 24-member ensemble of the UK Met Office's dynamical seasonal climate forecast system (GloSea5) based on atmospheric circulation downscaling, which has shown to give improved winter seasonal prediction skill over the direct precipitation forecast by GloSea5.

The ESP_NAO approach uses IHCs initialised on the 1st of December from the GR4J hydrological model forced with sub-sampled historic climate sequences based on NAO+/NAO- years. The Dynamic_P approach also uses the same IHCs generated on the 1st of December, but is instead forced with downscaled DJF average precipitation forecasts. The DJF averaged precipitation forecast values were temporally disaggregated to daily values for running though the hydrological model using a historic-sequence-correction method. Potential improvements of these two more complex forecasting approaches in overall performance, sharpness, and reliability is benchmarked against traditional ESP over a 20-year hindcast period (winters 1992/93 to 2011/12). This work is part of the Improving Predictions of Drought for User Decision Making (IMPETUS) project and provides insight to when and where scientific advancements in seasonal forecasting can be beneficial to water management.