Geophysical Research Abstracts
Vol. 18, EGU2016-7934, 2016
EGU General Assembly 2016

Bias correcting precipitation forecasts for extended-range skilful seasonal streamflow predictions

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Meteorological centres make sustained efforts to provide seasonal forecasts that are increasingly skilful, which has the potential to also benefit streamflow forecasting. Seasonal streamflow forecasts can help to take anticipatory measures for a range of applications, such as water supply or hydropower reservoir operation and drought risk management. This study assesses the skill of seasonal precipitation and streamflow forecasts in France in order to provide insights into the way bias correcting seasonal precipitation forecasts can contribute to maintain skill of seasonal flow predictions at extended lead times. First, we evaluate the skill of raw (i.e. without bias correction) seasonal precipitation ensemble forecasts for streamflow forecasting in sixteen French catchments. A lumped daily hydrological model is applied at the catchment scale to transform precipitation into streamflow. A reference prediction system based on historic observed precipitation and watershed initial conditions at the time of forecast (i.e. ESP method) is used as benchmark. In a second step, we apply eight variants of bias correction approaches to the precipitation forecasts prior to generating the flow forecasts. The approaches were based on the linear scaling and the distribution mapping methods. The skill of the ensemble forecasts is assessed in reliability, sharpness, accuracy, and overall performance. The results show that, in most catchments, raw seasonal precipitation and streamflow forecasts are often more skilful than the conventional ESP method in terms of sharpness. However, reliability is an attribute that is not significantly improved. Forecast skill is generally improved when applying bias correction. Two bias correction methods showed the best performance for the studied catchments, with, however, each method being more successful in improving specific attributes of forecast quality: the simple linear scaling of monthly values contributed mainly to increase forecast sharpness and accuracy, while the empirical distribution mapping of daily values was successful in improving forecast reliability.