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Seasonal streamflow forecasting - Which are the drivers controlling the forecast quality?

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Streamflow information for the months ahead is of great value to existing decision-making practices, particularly to those affected by the vagaries of the climate and who would benefit from better understanding and managing climate-related risks. Despite the large effort, there is still limited knowledge of the key drivers controlling the quality of the seasonal streamflow forecasts. In this investigation, we show that the seasonal streamflow predictability can be clustered, and hence regionalised, based on a priori knowledge of local hydro-climatic conditions. To reach these conclusions we analyse the seasonal forecasts of streamflow volumes across about 35400 basins in Europe, which vary in terms of climatology, scale and hydrological regime. We then link the forecast quality to various descriptors including physiography, hydro-climatic characteristics and meteorological biases. This allows the identification of the key drivers along a strong hydro-climatic gradient. Results show that, as expected, the seasonal streamflow predictability varies geographically and seasonally with acceptable values for the first lead months. In addition, the predictability deteriorates with increasing lead months particularly in the winter months. Nevertheless, we show that the forecast quality is well correlated to a set of drivers, which vary depending on the initialization month. The forecast quality of seasonal streamflow volumes is strongly dependent on the basin's hydrological regime, with quickly reacting basins (of low river memory) showing limited predictability. On the contrary, snow and/or baseflow dominated regions with long recessions (and hence high river memory) show high streamflow predictability. Finally, climatology and precipitation biases are also strongly related to streamflow predictability, highlighting the importance of developing robust bias-adjustment methods.