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From seasonal forecasting to water management decisions: challenges and opportunities

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To support the decision-making process at seasonal time scales, hydrological forecasts with a high temporal and spatial resolution are required to provide the level of information needed by water managers. Following the 2018 Northwest European drought, seasonal forecasting became one of the major focus points of European water managers.
As part of the EDgE (End-to-end Demonstrator for improved decision making in the water sector in Europe) project commissioned by ECMWF (C3S), we have created a unique dataset of hydrological seasonal forecasts derived from four global climate models (CanCM4, FLOR-B01, ECMF, LFPW) in combination with four global hydrological models (GHMs: PCR-GLOBWB, VIC, mHM, Noah-MP). The forecasts are provided at a daily temporal resolution and 5-km spatial resolution and are bias corrected against E-OBS meteorological observations.
Results show that skillful discharge forecasts can be made throughout Europe 3 months in advance, with predictability up to 6 months for Northern Europe due to the impact of snow. Drought forecasts have high skill over Europe due to the large spatial and temporal extent of drought events that is picked up by the seasonal forecasts. The model forecast skill is model dependent, where some GHMs show high skill for high flows, whereas other GHMs have a superior performance with regard to seasonal forecasting of low flows. Finally, the results indicate that the initial model conditions can dominate the forecast skill for multiple months.
Even though multi-model seasonal forecast systems like EDgE show a great potential, the communication of the skills of these multi-model systems remains challenging. For drought mitigation, water managers indicated that long lead times are required to deploy low cost, low regret mitigation strategies. Flood mitigation was not helped by the use of seasonal forecast, because the costs of preventive actions are high and the high uncertainty in the forecast made it unsuitable to support decision making. In the end, water managers indicated that they are helped by simplified metrics of uncertainty rather than getting the full uncertainty information for the forecast system.
Overall, we conclude that multi-model systems have an advantage as they are better capable of capturing the uncertainty of a forecast, but are challenging when it comes to real-time decision making and operational applications.