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The potential of a hybrid framework including data driven approaches for hydrological forecasting

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Ensemble hydrological forecasts are important for operational water management and near future planning, even more so in times of increased extreme events such as floods and droughts. Especially the latter requires a planning horizon of several weeks to months to optimize water availability. Having a flexible forecasting framework that can deliver this information in a fast and computational efficient manner is critical. In this study we are exploring a new hybrid framework, combining machine learning models with seasonal (re)forecasting information, in a hindcasting experiment to evaluate the potential of data driven approaches for seasonal forecasting purposes.

We focussed on 5 different ML methods, which are used to predict discharge and surface water levels of various stations at a national scale (the Netherlands). Input from the European Flood Awareness System and SEAS5 serve as boundary conditions. The ensemble hydrological hindcasts were then evaluated against climatological baseline hindcast with commonly used scores such as anomaly correlation coefficient (ACC), brier skill score (BSS) and continuously ranked probability score (CRPS).

We observed consistently skilful predictions for the first lead months throughout the year for all station and model combinations. Early spring and summer months show increased skill up to several months as a result of snow dynamics that were captured. Furthermore, we show that the choice of ML model only has a limited impact on the overall forecast performance.

With our study we show that a hybrid framework is able to bring location specific skilful seasonal forecast information with global seasonal forecast inputs. At the same time our hybrid approach is flexible and fast, and as such a hybrid framework could easily be adapted to make it even more interesting to water managers and their needs.