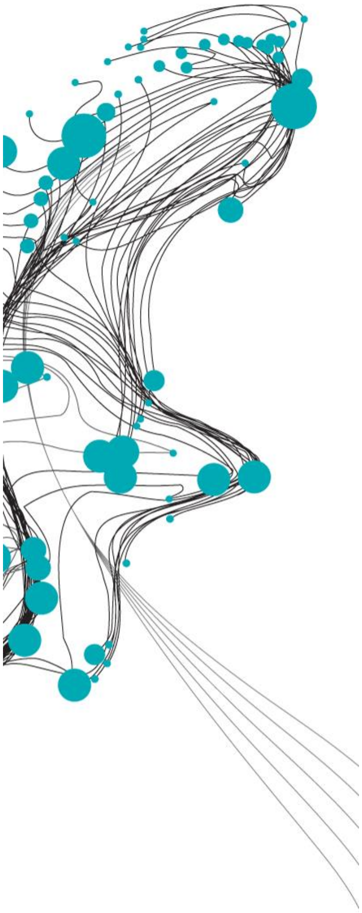
PERFORMANCE AND LIMITATIONS OF ENSEMBLE RIVER FLOW FORECASTS



High and low flows may cause several problems to society. Ensemble prediction systems are increasingly used for hydrological forecasting. These systems provide an ensemble of forecasts for each forecast period instead of a single, deterministic forecast. The objective of this study is to develop an ensemble flow forecasting system for the Biała Tarnowska catchment (~1000 km^2) in Poland and to investigate the performance of this system for lead times from 1 to 10 days, for low, medium and high flows and for different hydrological circumstances.

The ensemble flow forecasting system consists of a deterministic lumped hydrological model (HBV model) with input data in the form of ensemble precipitation and temperature forecasts (51 ensemble members) from the European Centre for Medium-Range Weather Forecasts. The deterministic calibration of the hydrological model has been based on observation data. No pre- or post-processing with Quantile Mapping has been applied, because this resulted in the best flow forecasts. To improve the representation of the current situation in the catchment at the forecast day, the initial conditions in the hydrological model are updated based on discharge observations at one day before the forecast day.

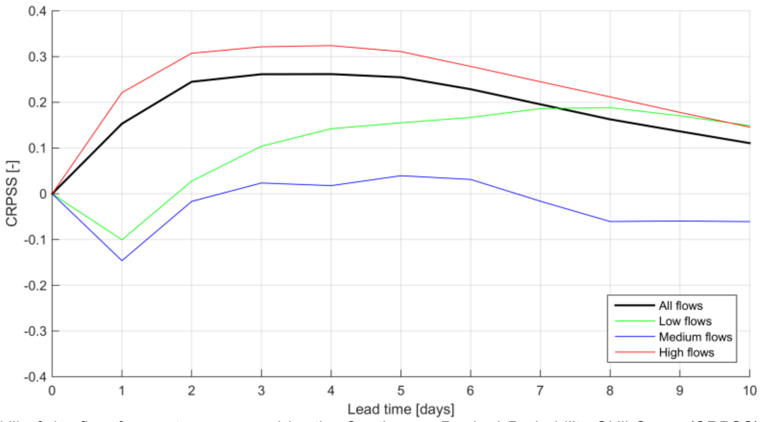


Figure 1: Skill of the flow forecasts, expressed by the Continuous Ranked Probability Skill Score (CRPSS). The skill is obtained by comparing the performance of the flow forecasts against reference forecasts (based on historical observations of precipitation and temperature). Systems with perfect skill give scores of 1 and values below 0 indicate no skill.

The performance of the flow forecasts deteriorates with lead time. In Figure 1 the skill of the flow forecasts relative to reference forecasts is presented. The skill is very different for the low, medium and high flow forecasts. The low flow forecasts do not have skill until a lead time of 2 days and after that they show a small positive skill. The medium flow forecasts do not provide skill for all lead times. The highest skills are obtained for the high flow forecasts. The forecast skill is very different for different high flow and low flow producing processes. Regarding high flow forecasts the highest skill is obtained for short-rain floods, but the skill decreases considerably after a lead time of 5 days. From a lead time of respectively 3 days and 2 days also long-rain floods and snowmelt floods are skilfully forecasted. The low skill of low flow forecasts is mainly caused by low rainfall/high evapotranspiration generated low flow forecasts, while the skill of snow accumulation generated low flow forecasts is relatively high.

The results provide information about the system and in which situations it can be used. To further improve the flow forecasts it is recommended to look at the relative contribution of meteorological errors and hydrological model errors. In low flow forecasts, errors from the hydrological model (including initial conditions) are relatively more important, while in high flow forecasts errors from the meteorological forecasts are relatively more important. It is also recommended to do further research to improve the reliability (dispersion) of the ensemble flow forecasts. After all, it is recommended to extend the research to other catchments, (if possible) with a longer period of data and with statistical tests, before the system is potentially applied operationally.

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