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Ensemble hydrological forecast efficiency evolution over various issue dates and lead-time: case study for the Cheboksary reservoir (Volga River)

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Ensemble hydrological forecasting allows for describing uncertainty caused by variability of meteorological conditions in the river basin for the forecast lead-time. At the same time, in snowmelt-dependent river basins another significant source of uncertainty relates to variability of initial conditions of the basin (snow water equivalent, soil moisture content, etc.) prior to forecast issue. Accurate long-term hydrological forecast is most crucial for large water management systems, such as the Cheboksary reservoir (the catchment area is 374 000 sq.km) located in the Middle Volga river in Russia. Accurate forecasts of water inflow volume, maximum discharge and other flow characteristics are of great value for this basin, especially before the beginning of the spring freshet season that lasts here from April to June.

The semi-distributed hydrological model ECOMAG was used to develop long-term ensemble forecast of daily water inflow into the Cheboksary reservoir. To describe variability of the meteorological conditions and construct ensemble of possible weather scenarios for the lead-time of the forecast, two approaches were applied. The first one utilizes 50 weather scenarios observed in the previous years (similar to the ensemble streamflow prediction (ESP) procedure), the second one uses 1000 synthetic scenarios simulated by a stochastic weather generator.

We investigated the evolution of forecast uncertainty reduction, expressed as forecast efficiency, over various consequent forecast issue dates and lead time. We analyzed the Nash-Sutcliffe efficiency of inflow hindcasts for the period 1982 to 2016 starting from 1st of March with 15 days frequency for lead-time of 1 to 6 months. This resulted in the forecast efficiency matrix with issue dates versus lead-time that allows for predictability identification of the basin. The matrix was constructed separately for observed and synthetic weather ensembles.