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Atmospheric-hydrologic ensemble prediction and interpretation in the upper Rhine catchment

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Appropriate dispositions in the case of flood occurrences require longer lead times in hydrological forecasting. This in turn implies an increased uncertainty, which cannot be accounted for by a deterministic simulation. A possibility to address this issue is the use of probabilistic forecasts driven by meteorological ensemble prediction systems (EPS), as the meteorological input is considered to represent a main source of uncertainty.

In our setup, an operational global atmospheric EPS (ECMWF EPS), dynamically downscaled with a limited-area atmospheric EPS (COSMO-LEPS), is used to drive a semi-distributed hydrological model (PREVAH). PREVAH runs at a spatial resolution of 500 meters and with hourly time steps. The study area covers the Rhine catchment till Rheinfelden and is further divided into 23 subcatchments, covering a total of 34,550 km2. Using a subsample of 10 ECMWF ensemble members selected by the COSMO-LEPS cluster analysis, a daily hindcast for the year 2005 was carried out with a forecast range of 120 h. For the period of the extreme flood event in August 2005, the full ECMWF EPS (51 members) was additionally downscaled and applied.

Results from this hindcast-experiment show potential benefits of the additional probabilistic information. The verification of the model system indicates a very notable performance for the selected case study (August 2005) as well as for the continuous long-term hindcast period (the full year 2005). A further analysis of the representativeness of the reduced ensemble shows, that the loss of information compared to the full ensemble seems acceptable.