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Operational Hydrologic Ensemble Forecasts in Small Catchments –Implementing New Products for Precipitation Estimation and Seamless Predictions

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Flood forecasting and warning for small catchments are challenging due to the short response time of the catchments on heavy rainfall events. Thus, disaster managers are interested in extended lead times to initiate flood defense measures, which can be obtained by employing forecasts of numerical weather models as driving data for hydrological models. To portray the inherent uncertainty of weather model output, ensemble hydro-meteorological forecasts can be used.
Within the scope of the project HoWa-PRO (funded by the Federal Ministry of Education and Research, Germany) we develop a hydrologic ensemble forecasting system for flood early warning in small catchments with lead times up to 48 hours. The so-called sentinel watches meteorological ensemble forecasts of the German Weather Service (DWD). If a specific precipitation criterion is surpassed, the sentinel starts collecting and concatenating various established precipitation products for precipitation estimation based on radar (Radolan-RW), nowcast (Radolan-RV), and ensemble forecast (Icon-D2-EPS, Icon-EU) to initiate a hydrologic ensemble flood forecast. The results can be followed via the web platform howapro.de.
Besides this renowned precipitation products, we set up a second hydrologic ensemble forecasting system using prototypic data of upcoming products for precipitation estimation and forecasting to explore their capabilities. Here we combine (1) observed radar data assimilated to precipitation gauges and commercial microwave links (pyRADMAN), and (2) the seamless prediction data SINFONY-INTENSE. The latter is a combination of nowcasting and numerical forecast ensembles. Both data products are delivered some minutes earlier than the established products which offer benefits for disaster managers.
The sentinel system scales well with additional catchments which can be simulated in parallel. Currently, the sentinels for both data versions (established and upcoming precipitation products) are invoked each 30 min, shortly after new observed data is delivered. The used WeatherDataHarmonizer library (Wagner and Grundmann, 2023) ensures a temporally, spatially, and formally homogeneous precipitation data set with a lead time of maximum 180 h, a time resolution of 15 min, and a spatial resolution of about 1 km. Each component of the sentinel is robust in a sense of handling missing operational data or machine faults. Additionally to the technical aspects, we present results of operational hydrologic ensemble forecasts for selected events and catchments in Saxony, Germany, and compare the performance of both systems.

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