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Seamless hydrological predictions for a monsoon driven catchment in North-East India

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Improving hydrological forecasting systems on different time scales is interesting and challenging with regards to humanitarian as well as scientific aspects. In meteorological research, short-, medium-, and long-term forecasts are now being merged to form a system of seamless weather and climate predictions. Coupling of these meteorological forecasts with a hydrological model leads to seamless predictions of streamflow, ranging from one day to a season. While there are big efforts made to analyse the uncertainties of probabilistic streamflow forecasts, knowledge of the single uncertainty contributions from meteorological and hydrological modeling is still limited. The overarching goal of this project is to gain knowledge in this subject by decomposing and quantifying the overall predictive uncertainty into its single factors for the entire seamless forecast horizon.
Our study area is the Mahanadi River Basin in North-East India, which is prone to severe floods and droughts. Improved streamflow forecasts on different time scales would contribute to early flood warning as well as better water management operations in the agricultural sector. Because of strong inter-annual monsoon variations in this region, which are, unlike the mid-latitudes, partly predictable from long-term atmospheric-oceanic oscillations, the Mahanadi catchment represents an ideal study site. Regionalized precipitation forecasts are obtained by applying the method of expanded downscaling to the ensemble prediction systems of ECMWF and NCEP. The semi-distributed hydrological model HYPSO-RR, which was developed in the Eco-Hydrological Simulation Environment ECHSE, is set up for several sub-catchments of the Mahanadi River Basin. The model is calibrated automatically using the Dynamically Dimensioned Search algorithm, with a modified Nash-Sutcliff efficiency as objective function. Meteorological uncertainty is estimated from the existing ensemble simulations, while the hydrological uncertainty is derived from a statistical post-processor. After running the hydrological model with the precipitation forecasts and applying the hydrological post-processor, the predictive uncertainty of the streamflow forecast can be analysed. The decomposition of total uncertainty is done using a two-way analysis of variance.
In this contribution we present the model set-up and the first results of our hydrological forecasts with up to a 180 days lead time, which are derived by using 15 downscaled members of the ECMWF multi-model seasonal forecast ensemble as model input.