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Ensemble-Based Seasonal Predictions for Supporting Water Management in Semi-Arid Regions – From Global to Regional Information

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While weather forecasts are used for the warning of flood events and climate projections for long-term climate adaptation measures, it is the knowledge of the coming months that is crucial for the management and control of water reservoirs, e.g. for power generation or for irrigation. This is particularly relevant in regions characterized by dry seasons, i.e. semi-arid areas. In semi-arid regions, unlike in arid regions, much can be achieved with sustainable and science-based water resources management.

Our study addresses the regionalization of globally available seasonal forecasts to support local water resources management and decision-makers in semi-arid regions. We investigate the performance of the global seasonal predictions of the European Centre for Medium-Range Weather Forecasts (ECMWF SEAS5) with forecast horizons up to 7 months in advance for selected semi-arid target regions. These include the catchments of the Rio Sao Francisco in northeastern Brazil, the Rio Chira in Ecuador / Peru and the Karun in Iran. The uncertainties in the global seasonal forecasting system are covered by ensemble predictions. As a measure of the quality of the seasonal ensemble predictions of precipitation and temperature, we analyze accuracy (mean absolute error skill score), overall performance (continuous ranked probability skill score), sharpness (interquantile range skill score) and reliability. The ensemble forecasts are bias corrected with a quantile-quantile transformation and compared with global gridded satellite data (GPM) and station observation data. Results generally show higher performance measures for the retrospective precipitation forecasts of the Rio Sao Francisco area than for the Rio Chira or the Karun area. For the Rio Sao Francisco area, the seasonal predictions of the rainfall over the four main months of the rainy season are even more efficient than statistical reference forecasts up to two months ahead.

One reason for the limited performance of the global seasonal forecasts in the catchment areas of the Rio Chira and the Karun can be the complex topography and the inadequate horizontal resolution of 35 km of the global forecasting system for regional applications. We therefore use the Weather Research and Forecasting (WRF) model to dynamically downscale the global forecasts. Our dynamical downscaling is progressively nesting from 35 km to 9 km and finally to 3 km. Finally, these refined seasonal predictions will not only serve for hydrometeorological drought forecasts in the catchment areas, but also serve as driving data in further subsequent impact modelling for hydrological-, sediment- and ecosystem modeling within the international framework of this study.