Short Project Summary

Development of a regionalized operational hydrometeorological seasonal forecasting system

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Increasing demands for water in a wide range of fields will enhance the amount of people suffering from water scarcity in the near future. Particularly semi-arid regions are lacking of reliable knowledge about the available freshwater resources and the occurrence of extreme events for the next season. While climate information from globally available seasonal forecast models is too coarse for direct application in decision making or for climate impact models, and further often suffers from biases, regionalization and correction of the global forecasts are indispensable for sustainable regional water resources management. Within the Seasonal Water Management for Semiarid Areas (SaWaM) project, we therefore developed a regional hydrometeorological seasonal forecasting system applying a regionalization and bias-correction approach to global seasonal forecasts.

Methods and Data

In data-scarce regions, the definition of the suitable reference data set for bias-correction is already challenging. In some regions, like in Iran or Sudan, the uncertainty of different reference data sets with respect to precipitation is large. In other regions, like Northeast Brazil, a higher level of agreement is evident. Regarding the necessity of a comprehensive reference data set also for impact modelling, a reference is required including different hydrometeorological variables like precipitation, temperature and incoming radiation. Therefore, we use the high resolution (0.1°) surface replay of the ECMWF reanalysis system ERA5 as a comprehensive reference data set, providing the required consistent hydrometeorological information. With

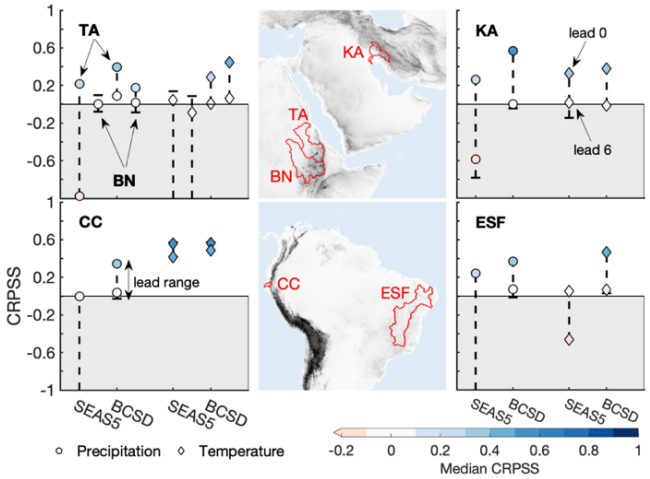

Figure 1: Overall performance evaluated by the Continuous Ranked Probability Skill Score (CRPSS) for precipitation and temperature forecasts of one month during the basins' rainy season of SEAS5 raw forecasts and bias-corrected and spatially disaggregated (BSCD) SEAS5. CRPSS is shown for lead 0 to lead 6 forecasts for July for the basins of Tekeze-Atbara/ Blue Nile (TABN), and for February for the Karun (KA), Catamayo-Chira (CC) and Extended São Francisco (ESF) basins. A CRPSS > 0 defines an on median (1981-2016) better seasonal forecast than a simple climatological forecast.

ERA5-Land, both a bias-correction and spatial disaggregation (BCSD) to 0.1° of the global seasonal forecasts is performed.

The latest seasonal forecasting system SEAS5 of ECMWF is used in the SaWaM project. Global forecasts at a resolution of around 36 km are available each month with a forecast horizon of 215 days. In the BCSD-approach, we correct the daily data of the SEAS5 forecasts with the ERA5-Land reference through empirical quantile mapping of the cumulative distribution functions including a moving 15-day-window aligned around the current forecast day. In the bias-correction, both the correction of values above or below the reference range of quantiles, and the correction of wet- and

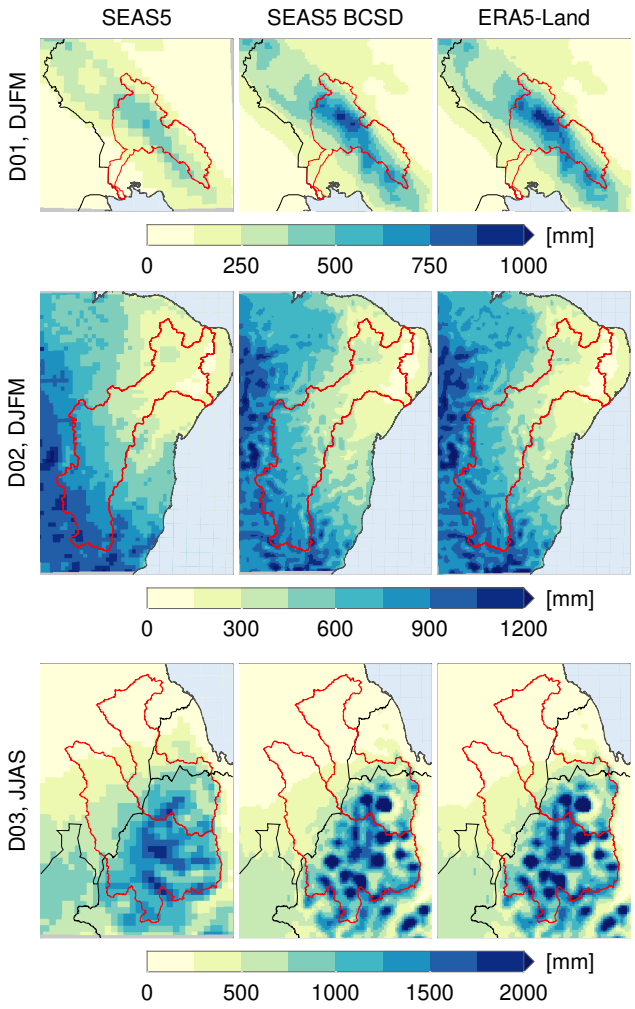

Figure 2: Total precipitation during the four main months of the rainy season for the (from top to bottom) Karun, Extended São Francisco, and Tekeze-Atbara/Blue Nile domains for SEAS5 (lead 0), SEAS5-BCSD (lead 0) and ERA5-Land averaged over the period 1981 to 2016.

dry day frequencies are accounted for. Spatial disaggregation is performed through bilinear interpolation. The BCSD-based SEAS5-forecasts, produced in SaWaM, are freely available via the World Data Center for Climate (WDCC) from the German Climate Computing Center (DKRZ).

Results and Conclusions

A fully operationalized regionalization and bias-correction system produces seasonal forecasts after each release of the global seasonal forecasts SEAS5 for the regional hydrometeorology at 0.1° horizontal resolution and with forecast horizons up to seven months ahead. The BSCD approach produces skilful seasonal forecasts over the SaWaM target regions (Fig. 1). With respect to a simple climatological forecast, raw SEAS5 forecasts show limited forecast skill at higher forecast lead times. SEAS5-BCSD forecasts, on the contrary, provide good overall performance even up to seven months ahead for precipitation and temperature forecasts in the study regions. The BCSD approach further allows for spatial correction of the hydrometeological fields, providing high agreement with the reference data ERA5-Land (Fig. 2).

SEAS5-BCSD currently is the first publicly available daily high-resolution seasonal forecast product that covers multiple regions and variables for such a long period. It hence provides a unique test-bed as driving data for hydrological, ecosystem or climate impact models. Being further visualized in the SaWaM online tool (https://sawam.gaf.de/), our forecasts provide a crucial contribution for the disaster preparedness and, finally, climate proofing of the regional water management in climatically sensitive semi-arid regions.

References

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