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Global bias-corrected seasonal forecasts: Towards efficient and near real-time solutions

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Droughts, prolonged heat-waves, heavy precipitation events and large-scale flooding - the last years have demonstrated that global climate change is already hitting hard in many places of the Earth. This, inevitably, leads to increased water stress that requires a more sustainable and timely water management across scales. In particular, for optimized use of water resources for irrigation or hydropower generation, it is essential to know their expected availability in the coming months all over the world. This sub-seasonal to seasonal temporal domain, from weeks to months ahead, is addressed by seasonal forecasting systems such as SEAS5, developed by the European Centre for Medium-Range Weather Forecasts (ECMWF). These systems have the potential to provide essential data for enhancing water management practices. Without a bias correction though, the data exhibit a notable deficiency in skill. We have shown for several regions of the world that the “Bias Correction and Spatial Disaggregation” method (BCSD) can improve the forecasting skill substantially. Our next step is now to expand our efforts from the regional to the global scale, i.e., to provide the BCSD-forecasts for the entire globe. Here, the challenge lies in significantly reducing the computational demand for the bias correction: Presently, the BCSD requires several days to execute on a global scale. However, if such forecasts should be used as decision support, a timely provision is crucial.

We therefore present a method to achieve this task: The utilization of fixed Cumulative Distribution Functions (CDFs) rather than their recalculation for each pixel has the potential to enhance the computational efficiency of the bias correction. This approach not only significantly reduces the required data volume but also improves accessibility. To further achieve transferability of the system, we also demonstrate the performance of this system in a containerized environment. Our goal is to achieve a globally corrected SEAS5 forecasts within a time frame of ideally less than one day. With the provision of these bias-corrected data in near-real time, better estimations become available for direct utilization by water managers or as input for subsequent modeling processes.