EGU22-10396
https://doi.org/10.5194/egusphere-egu22-10396
EGU General Assembly 2022

Bias adjustment of RCM simulations in high-latitude catchments: complexity versus skill in a changing climate

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For climate-change impact studies at the catchment scale, meteorological variables are typically extracted from ensemble simulations provided by global (GCMs) and regional climate models (RCMs), which are then downscaled and bias-adjusted for each study site. For bias adjustment, different statistical methods that re-scale climate model outputs have been suggested in the scientific literature. They range from simple univariate methods that adjust each meteorological variable individually to more complex and statistically as well as computationally more demanding multivariate methods that take existing relationships between meteorological variables into consideration. While several attempts have been made over the past decade to evaluate such methods in various regions, there is no guidance for choosing an appropriate bias adjustment method in relation to the study question at hand. In particular, the question whether more complex multivariate methods are worth the effort by resulting in better adjustments of a wide range of univariate, multivariate and temporal features, remains unanswered.
We here present an approach to systematically assess the performance of the most commonly used univariate and multivariate bias adjustment methods at different catchment scales in Sweden. Based on a multi-catchment and multi-model approach, we evaluated numerous univariate, multivariate and temporal features of precipitation, temperature and streamflow. Finally, we discuss potential benefits (skills and added value) and trade-offs (complexity and computational demand) of each method, in particular for hydrological climate-change impact studies in high latitudes.