Impact of Diverse Configuration in Multivariate Bias Correction Methods on Large-Scale Climate Variable Simulations under Climate Change

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Abstract

Bias correction of values is a necessary step in downscaling coarse and systematically biased global climate models for use in local climate change impact studies. In addition to univariate bias correction methods, many multivariate methods which correct multiple variables jointly — each with their own mathematical designs — have been developed recently. While some literature have focused on the inter-comparison of these multivariate bias correction methods, none have focused extensively on the effect of diverse configurations (i.e., different combinations of input variables to be corrected) of climate variables, particularly high-dimensional ones, on the ability of the different methods to remove biases in uni- and multivariate statistics. This study evaluates the impact of three configurations (inter-variable, inter-spatial, and full dimensional dependence configurations) on four state-of-the-art multivariate bias correction methods in a national-scale domain over South Korea using a gridded approach. An inter-comparison framework evaluating the performance of the different combinations of configurations and bias correction methods in adjusting various climate variable statistics was created. Precipitation, maximum, and minimum temperatures were corrected across 306 high-resolution (0.2°) grid cells and were evaluated. Results show improvements in most methods in correcting various statistics when implementing high-dimensional configurations. However, some instabilities were observed, likely tied to the mathematical designs of the methods, informing that some multivariate bias correction methods are incompatible with high-dimensional configurations highlighting the potential for further improvements in the field, as well as the importance of proper selection of the correction method specific to the needs of the user.

Keywords : Multivariate Bias Correction, High-dimensional Configuration, Downscaling, Climate Change

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