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Parametric bias correction and high-resolution downscaling of climate model rainfall

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Distribution mapping has been identified as the most efficient approach to bias correct climate model rainfall, while reproducing its statistics at spatial and temporal resolutions suitable to run hydrologic models. Yet, its implementation based on empirical distributions derived from control samples (referred to as non-parametric distribution mapping), makes the method's performance sensitive to sample length variations, the presence of outliers, the spatial resolution of climate model results, and may lead to biases, especially in extreme rainfall estimation. To address these shortcomings, we propose a methodology for simultaneous bias correction and high resolution downscaling of climate model rainfall products that uses: a) a two component theoretical distribution model (i.e. a generalized Pareto (GP) model for rainfall intensities above a specified threshold u*, and an exponential model for lower rainrates), and b) proper interpolation of the corresponding distribution parameters on a user-defined high-resolution grid, using kriging for uncertain data. We assess the performance of the suggested parametric approach relative to the non-parametric one, using daily raingauge measurements from a dense network in the island of Sardinia (Italy), and rainfall data from 4 GCM/RCM model chains of the ENSEMBLES project. The obtained results shed light on the competitive advantages of the parametric approach, which is proved more accurate and considerably less sensitive to the characteristics of the calibration period, independent of the GCM/RCM combination used. This is especially the case for extreme rainfall estimation, where the GP assumption allows for more accurate and robust estimates, also beyond the range of the available data.

Reference:
Mamalakis, A., A. Langousis, R. Deidda and M. Marrocu (2017) A parametric approach for simultaneous bias correction and high-resolution downscaling of climate model rainfall, Water Resour. Res., WRCR22499, doi: 10.1002/2016WR019578