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Evaluating a Combined Bias Correction and Stochastic Downscaling Method

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Much of our knowledge about future changes in precipitation relies on global (GCM) and/or regional climate models (RCM) that have resolutions which are much coarser than typical spatial scales of extreme precipitation. The major problems with these projections are both climate model biases and the scale gap between grid box and point scale. Wong et al. presented a first attempt to jointly bias correct and downscale precipitation at daily scales. This approach however relied on spectrally nudged RCM simulations and was not able to post-process GCM biases.

Previously, we have presented an extension of this approach that separates the downscaling from the bias correction and in principle is applicable to free running RCMs, such as those available from ENSEMBLES or CORDEX. In a first step, we bias correct the RCMs (EURO-CORDEX) against gridded observational datasets (e.g., E-OBS) at the same scale using a quantile mapping approach that relies on distribution transformation. To correct the whole precipitation distribution including extreme tails we apply a mixture distribution of a gamma distribution for the precipitation mass and a generalized Pareto distribution for the extreme tail. In a second step, we bridge the scale gap: we add small scale variability to the bias corrected precipitation time series using a vector generalized linear gamma model (VGLM gamma). To calibrate the VGLM gamma model we determine the statistical relationship between precipitation observations on different scales, i.e. between gridded (e.g., E-OBS) and station (ECA&D) observations. Here we present a comprehensive evaluation of this approach against 86 weather stations in Europe based on the VALUE perfect predictor experiment, including a comparison with standard bias correction techniques.