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Stochastic bias correction for mean and extreme precipitation

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Extreme precipitation is a major hazard, which can cause serious environmental and economic impacts. Projections of future changes in precipitation variability are required for modelling these extreme events throughout the world. However, the large-scale simulations obtained using GCMs are inadequate for this purpose since they do not capture the local-scale variability. Robust knowledge about future extreme precipitation on the local scales is imperative for water resources management and planning. Hence, dynamical or statistical downscaling of GCMs are necessary. Different methods of downscaling exist, namely dynamical downscaling and statistical downscaling which includes perfect prognosis and model-output statistics (MOS). Each of these approaches presents both advantages and disadvantages. Dynamical downscaling is biased and cannot be directly applied to grid scales and because it produces grid box averages, it is unable to explain precipitation variability at point scales. While statistical downscaling only allows for large-scale predictors and ignores any physical mechanisms at mesoscales. The aim is then to improve existing methods by incorporating both statistical and dynamical downscaling approaches. Using data from the United Kingdom, a univariate mixture model is employed to introduce stochastic variability at local scales, which is not resolved by the RCM. This mixture model combines two distributions, one for the bulk of the data and another for the upper tails. Vector generalised linear models (VGLM) are then employed to include the modelled precipitation from the RCM as a predictor for observed precipitation. This statistical model essentially presents a new bias correction approach within a regression framework, where the addition of stochastic noise is included so as to downscale to point scales. This statistical model will then be able to generate entire precipitation distributions and act as a precipitation generator, and hence better represent local variability and extremes.