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Comparison of stochastic MOS corrections for GCM and RCM simulated precipitation

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We present the application of a stochastic Model Output Statistics (MOS) method to estimate daily precipitation at 465 UK stations between 1961-2000 using simulated precipitation from the $RACMO_2$ and CCLM RCMs and from the ECHAM5 GCM as predictors. The MOS method uses logistic regression to model rainfall occurrence and a Gamma distribution for the wet-day distribution. All model parameters are made linearly dependent on the predictors, i.e. the simulated precipitation, and the regression coefficients are determined separately for each station using maximum likelihood estimation. This approach is an example for a Vector Generalized Linear Model and in our application combines a model correction and a downscaling step.

The fitting and validation of the statistical model requires the daily, large-scale weather states in the RCM and GCM to represent the actual, historic weather situation. For the RCMs this is achieved by using simulations driven by ERA40 reanalysis data; $RACMO_2$ is just driven at the boundaries, whereas in CCLM the circulation within the model domain is additionally kept close to ERA40 through spectral nudging. For the GCM we have used a simulation nudged towards ERA40. The model validation is done in a cross-validation setup and is based on Brier scores for occurrence and quantile scores for the estimated probability distributions.

The comparison of the validation skills for the two RCM cases shows some improved skill if spectral nudging is used, indicating that on daily timescales RCMs can generate internal variability that needs to be kept in mind when designing and validation downscaling methods. A major outcome of the study is that the corrected GCM-simulated precipitation yields consistently higher validation scores than the corrected RCM-simulated precipitation. Taken at face value this seems to suggest that in a setup where the simulated precipitation is post-processed there is no clear added value of using an RCM. However, due to the different ways of controlling the atmospheric circulation in the RCM and the GCM simulations, such a strong conclusion cannot be drawn. Yet, the study demonstrates how challenging it is to demonstrate the value added by RCMs in this setup.