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MOS correction of GCM- and RCM-simulated daily precipitation

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Understanding long-term changes in daily precipitation characteristics, particularly those associated with extreme events, is an important component of climate change science and impact assessment. Estimates of such changes are required at local scales where impacts are most keenly felt. However, the limited spatial resolution of General Circulation Models (GCMs) makes direct estimates of future daily precipitation unrealistic. A popular downscaling approach is to use GCMs to drive high-resolution Regional Climate Models (RCMs). Whilst able to simulate precipitation characteristics at smaller scales, RCMs do not represent local variables and remain limited by systematic errors and biases.

It is possible to apply statistical corrections, known as Model Output Statistics (MOS), to RCM-simulated precipitation. The simplest form of MOS (including bias correction) follows a 'distribution-wise' approach in which the statistical link is derived between long-term distributions of simulated and observed variables. However, more sophisticated MOS methods may be performed 'event-wise' using, for example, multiple linear regression to derive links between simulated and observed sequences of day-to-day weather. This approach requires a fitting period in which the simulated temporal evolution of large-scale weather states matches that of the real world and is thus limited to either reanalysis-driven RCMs or nudged GCM simulations.

It is unclear to what extent MOS can be used to correct daily precipitation directly from GCMs, thus removing the computationally challenging RCM step from the downscaling process. Here, we present and cross-validate a stochastic, event-wise MOS method for both GCM- and RCM-simulated precipitation. A 'mixture' model, combining gamma and generalised Pareto distributions, is used to represent the complete (extreme and non-extreme) precipitation distribution. This is combined with a vector generalised linear model (VGLM) in order to estimate the precipitation distribution based on one or more predictors. GCM-MOS models are fitted using an ECHAM5 simulation nudged to ERA-40 for the period 1958-2001.

Preliminary findings based on cross-validation suggest that, for this setup, precipitation from a nudged GCM performs better than RCM precipitation when used as a predictor for point-scale precipitation. Further work will focus on using the large-scale (frontal) and convective components of simulated precipitation as predictors.