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Downscaling for extreme and non-extreme daily precipitation using GCM model output statistics

Jonathan Eden (1), Martin Widmann (1), Douglas Maraun (2), and Mathieu Vrac (3)

(1) University of Birmingham, School of Geography, Earth and Environmental Sciences, Birmingham, United Kingdom (j.m.eden@bham.ac.uk), (2) Helmholtz Centre for Ocean Research Kiel (GEOMAR), Kiel, Germany, (3) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France

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. The limited spatial resolution of General Circulation Models (GCMs) makes direct estimates of future daily precipitation unrealistic and higher-resolution estimates are often made using GCM-driven 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.

Previous work has demonstrated that it is possible to downscale medium-to-heavy precipitation simulated by GCMs using stochastic bias correction, also known as model output statistics (MOS). Here, we extend upon this approach and apply a stochastic MOS correction for downscaling the full distribution of European precipitation (extreme and non-extreme) simulated by two GCMs. A mixture model, combining gamma and generalised Pareto distributions, is used to represent the complete precipitation distribution. This is combined with a logistic regression model and a vector generalised linear model (VGLM) in order to estimate the precipitation distribution based on simulated precipitation. GCM-MOS models are fitted using simulations of ECHAM5 and HadGEM3 nudged to ERA-interim for the period 1979-2010.

Preliminary findings based on cross-validation and appropriate skill scores suggest that the stochastic MOS method performs favourably compared to stationary models and particularly so in estimating high quantiles. Additionally, we will present downscaled scenarios from each GCM for European precipitation characteristics over the twenty-first century.