Improved representation of European precipitation in a 25-km atmospheric global circulation model

Reinhard Schiemann[1], Alexander J. Baker[1], Marie-Estelle Demory[1], Kevin Hodges[1], Stephanie J. Johnson[1,3], Matthew S. Mizielinski[2], Malcolm J. Roberts[2], Len C. Shaffrey[1], Jane Strachan[1,2], Pier Luigi Vidale[1]

[1]National Centre of Atmospheric Science (Climate), University of Reading, UK, [2]MetOffice, Exeter, UK, [3]ECMWF, Reading, UK

Global Climate Models (GCMs) can nowadays be run at horizontal grid spacings of about 25km over decadal to centennial periods, thanks to an increase in computational and data handling resources as well as concerted development at different modelling centres over the past years. One such effort has been the UPSCALE project, a collaboration between the National Centre of Atmospheric Science at the University of Reading and the UK Met Office, where the resolution of the HadGEM3-GA3 GCM was progressively increased from about 135km grid spacing to about 25km, with minimal other changes to the model.

Here, we evaluate the representation of European precipitation in the UPSCALE model hierarchy for present-day climate conditions. We show that there is an improvement with resolution in the climatological-mean spatial precipitation distribution, particularly during autumn and winter, and throughout a wide range of spatial scales. Furthermore, we conduct Extreme Value Analysis of the daily precipitation aggregated over large European river basins (>50000 km^2) and show that the fitted extreme value distributions also agree better with the observed precipitation in the 25-km model. We investigate possible reasons for this improvement including (i) a more realistic representation of storm tracks, (ii) atmospheric blocking, and (iii) the influence of orography.

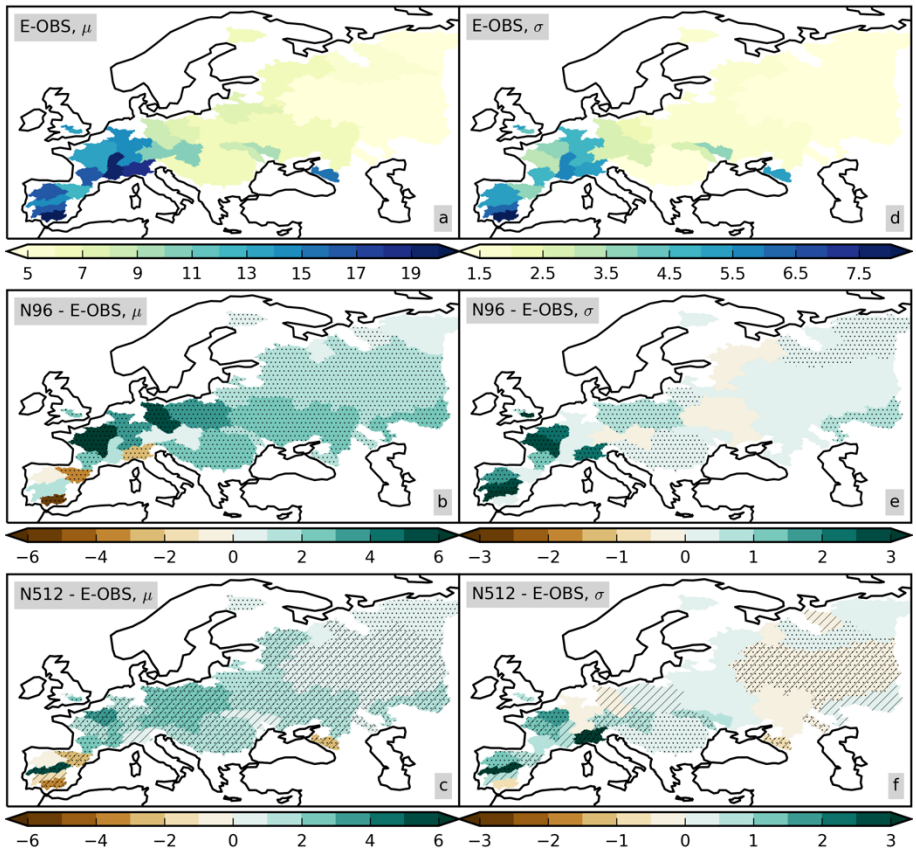

Fig. 1 Fitted extreme value distribution parameters for winter maximum daily precipitation over river basins (**left**: location parameter μ, **right**: scale parameter σ). **Top**: observational estimate, **middle**: bias for 135-km model, **bottom**: bias for 25-km model. Stippling (hatching) shows statistically significant model-observation (model-model) differences.