Geophysical Research Abstracts, Vol. 8, 00036, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00036

Downscaling heavy precipitation over the UK: a comparison of dynamical and statistical methods and their future scenarios

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Six statistical and two dynamical downscaling models were compared in their ability to downscale seven seasonal indices of heavy precipitation for two station networks in northwest and southeast England. The skill amongst the eight downscaling models was high for those indices and seasons that had greater spatial coherence. Generally winter showed the highest downscaling skill and summer the lowest. The rainfall indices that were indicative of rainfall occurrence were better modelled than those indicative of intensity. Models based on non-linear artificial neural networks were found to be the best at modelling the interannual variability of the indices, however their strong negative biases implied a tendency to underestimate extremes. A novel approach used in one of the neural network models to output the rainfall probability and the gamma distribution scale and shape parameters for each day meant that resampling methods could be used to circumvent the underestimation of extremes. Six of the models were applied to the Hadley Centre global circulation model HadAM3P forced by emissions according to two SRES scenarios. This revealed that the inter-model differences between the future changes in the downscaled precipitation indices were at least as large as the differences between the emissions scenarios for a single model. This implies caution when interpreting the output from a single model or a single type of model (e.g. regional climate models) and the advantage of including as many different types of downscaling models, global models and emissions scenarios as possible when developing climate change projections at the local scale.