Geophysical Research Abstracts
Vol. 16, EGU2014-12837, 2014
EGU General Assembly 2014

Exploring the use of a deconvolution algorithm to 'unsmooth' climate model data and evaluate extremes

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Output from climate models is unavoidably smoothed (or convolved) by the way in which the physical equations are discretised and integrated. This implicit smoothing occurs at each timestep and can lead to the accumulation of errors, and also modifies the statistical properties of the model data (e.g. the shape of probability distributions for model variables, and spatial/temporal correlations). A direct consequence is that models are unlikely to reproduce the full range of extremes seen in observations. Dynamical and statistical downscaling methods can be used to replace some of the high-frequency information filtered out in the process of solving the model equations; however, there are alternative approaches which provide complimentary information. Here, we describe the use of deconvolution to directly 'unsmooth' the model output, thereby providing an indication of the extent to which smoothing affects the model output. The key obstacle in this approach is that the shape of the smoothing function is unknown, meaning that standard deconvolution algorithms cannot be used with confidence. For this reason, we have employed a 'blind' deconvolution algorithm which requires no prior knowledge of the properties of the smoothing function. We will describe the uses and accuracy of this technique, followed by a comparison of return levels for extreme wave heights calculated from raw and deconvolved Wave Watch III model data, driven by the UK Met Office QUMP (Quantifying Uncertainty in Model Predictions) regional climate model ensemble.