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A seamless approach to assessing modeluUncertainties in climate projections of severe European windstorms

Peter Knippertz[†]; Tomek Trzeciak; Jennifer Owen
[†] University of Leeds, United Kingdom
Leading author: p.knippertz@leeds.ac.uk

Despite the enormous advances made in climate change research, robust projections of the latitude and strength of the North Atlantic stormtrack are not yet possible, bearing enormous risks to European societies and the (re-)insurance industry. Previous studies have addressed the problem of climate model uncertainty through statistical comparisons for the current climate and found that there is large disagreement between different models, different single-model ensemble members and observed climatologies of intense cyclones. The use of different horizontal and vertical resolutions, and different metrics further exacerbate comparison between different studies. Generally such statistical evaluations have difficulties to separate influences of the climate model's basic state, which will be governed by slow processes such as ocean circulations or sea-ice transport, from the influence of fast processes such as energy fluxes from the ocean or latent heating on the development of the most intense storms. The former might generate a bias in storm counts through an incorrect occurrence frequency of storm-prone initial conditions, while the latter could generate a similar bias due to the lack of crucial dynamics of extreme cyclone intensification resulting from over-simplistic model physics or insufficient horizontal resolution. Compensating effects might conceal errors and suggest higher reliability than there really is. Therefore, separating sources of uncertainty is an important step towards a more reliable interpretation of climate projections and towards targeted improvements of future model generations. Systematic biases in fast processes, if they were known, could be used to develop calibration techniques to post-process climate model output. The way to separate influences of fast and slow processes in climate projections discussed here is through a cost-effective "seamless" approach of simulating historical severe storms with climate models in a numerical weather prediction mode with a common metric for storminess and predefined initial conditions on time-scales of several days.