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Assessing model uncertainties in climate projections of severe, mid-latitude windstorms using seamless approach

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Despite the enormous advances made in climate change research, robust projections of the position and the strength of the North Atlantic stormtrack are not yet possible. In particular with respect to damaging windstorms, this incertitude bears enormous risks to European societies and the (re-)insurance industry. Previous studies have addressed the problem of climate model uncertainty through statistical comparisons of simulations of the current climate with (re-)analysis data and found that there is large disagreement between different climate models, different ensemble members of the same model and observed climatologies of intense cyclones. The use of different horizontal and vertical resolutions, as well as different approaches to measure storminess further complicate comparison between the results from different studies.

One weakness of such statistical evaluations lies in the difficulty 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 due to over-simplistic model physics or insufficient horizontal resolution. Compensating effects between the two 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.

A possible way to separate influences of fast and slow processes in climate projections is through a "seamless" approach of hindcasting historical, severe storms with climate models started from predefined initial conditions and run in a numerical weather prediction mode on the time-scale of several days. Such a cost-effective case-study approach, which draws from and expands on the concepts from the Transpose-AMIP initiative, is currently undertaken in a recent project at the University of Leeds funded by the AXA Research Fund. Main aspects of interest are the overall quality of the climate model hindcasts, as compared to operational forecasts and reanalysis data, and the identification of systematic biases, which if known could be potentially used to develop calibration techniques for post-processing climate model output from longer simulations. The general concept of the numerical experiments conducted in this project and some first results will be presented at the conference.