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Can we trust climate models to realistically represent severe European windstorms?

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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.

One weakness of such statistical evaluations lies in the difficulty to separate influences of the climate model's basic state from the influence of fast processes on the development of the most intense storms. Compensating effects between the two might conceal errors and suggest higher reliability than there really is. 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, has recently been undertaken in the SEAMSEW project at the University of Leeds funded by the AXA Research Fund.

Key results from this work focusing on 20 historical storms and using different lead times and horizontal and vertical resolutions include: (a) Tracks are represented reasonably well by most hindcasts. (b) Sensitivity to vertical resolution is low. (c) There is a systematic underprediction of cyclone depth for a coarse resolution of T63, but surprisingly no systematic bias is found for higher-resolution runs using T127, showing that climate models are in fact able to represent the storm dynamics well, if given the correct initial conditions. Combined with a too low number of deep cyclones in many climate models, this points too an insufficient number of storm-prone initial conditions in free-running climate runs. This question will be addressed in future work.