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The concept of spectrally nudged storylines for extreme event attribution

Article

Supplemental Material

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Supplementary for 'The concept of spectrally nudged storylines for extreme event attribution'

by Frauke Feser and Theodore G. Shepherd

Key parameters for spectral nudging in storyline realization

When simulating Spectrally Nudged Storylines, care should be taken in choosing the right settings for spectral nudging. The model should be disturbed as little as possible, so that it can develop its own regional features and extreme events while staying close to observed large-scale weather phenomena like high and low pressure systems[1]. This is a tradeoff between nudging too strongly and thereby inhibiting or dampening the generation of regional atmospheric processes, and nudging too weakly which would lead to unacceptably large deviations from observed large weather patterns[2] by insufficiently constraining the butterfly effect. When selecting the spatiotemporal scales to be nudged, this depends on the reanalysis or general circulation model (GCM) data to nudge to. The amount of grid points or wave numbers should be chosen in a way that large-scale patterns like pressure systems can be resolved. Also, the vertical profile will depend on the reference data to nudge to. The most important point is not to nudge close to the surface, as regional and small-scale processes mostly take place there. Starting to nudge above a height of about 700 or 750 hPa in order not to disturb these small-scale processes is recommended. References [3,4] use a plateau-shaped profile as the reanalysis data which is used for the nudging does not provide data for the highest model levels of the chosen GCM. If reanalysis data for all model levels is available, a parabolic profile could also be suitable. For the nudged variables the idea is to use as few as possible in order to limit the disturbance of the model. These variables should have a sufficient level of quality in the reanalysis data. Earlier tests of the first author when developing spectral nudging for regional climate models showed that there is no added value in nudging temperature, pressure or humidity in addition to nudging the horizontal flow (horizontal wind components or vorticity and divergence). As humidity is often of lower data quality in reanalysis data, it may be less optimal to use it for nudging. And for spectrally nudged storylines, it is essential to allow the thermodynamic fields to respond to the counterfactual perturbations through the model physics. More details on the tests to find the optimal settings for the spectral nudging can be found in References [3,4].

References

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