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Reconstructing storminess and storm surge conditions for Northern Europe since 1850 using the Analog method as nonlinear statistical upscaling tool

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Daily wind fields with high spatial resolution (25 km) are reconstructed from long historical SLP time series for Northern Europe since 1850. The ability of the analog method as a nonlinear statistical upscaling tool is evaluated. More specifically it is tested whether the general wind statistics, the frequency and magnitudes of extremes can be realistically reproduced.

In a first step, a regional climate model is used to numerically downscale global reanalysis data over Northern Europe, providing a pool of highly resolved homogenous and physically consistent atmospheric fields such as SLP, Zonal and Meridional winds. In a second step, the analog method is used to redistribute analogous fields of this pool (predictand) according to the highest similarity concerning the pool of observational time series (predictor). For the reference period of the analog pool, a leaf-one-out method is used, reconstructing all days from all other years of the pool except for the year of consideration. Outside the time span of the analog pool, the highest similarity to an atmospheric state in the reference period is used to find the analogous (most similar) atmospheric fields since 1850.

Besides the general wind statistics, the method is evaluated for realistically reproducing singular historical events related to storm surges. While storm floods at the North Sea are mostly caused by a single storm event, storm surges at the Baltic Sea are also influenced by the culminating effects of continuous extreme conditions over multiple days or weeks. It will be shown how the analog-method is able to reproduce these events despite the lack of the true event itself in the analog pool. Results also have implications on the general use of the analog-method as statistical upscaling tool for Paleoclimate reconstructions, i.e. using proxy data to reconstruct atmospheric fields on longer timescales. Although these reconstructions consist of lower spatial and temporal resolution, the main question is whether or how good the method is still able to reconstruct events in the past which are not present in the analog pool of the observational period by redistributing already known or simulated atmospheric states of a given reference period.