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Assessment of changes in extreme wind speeds from regional climate models

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Extratropical cyclones that usually develop and amplify over the Northern Atlantic are characteristic compartments of Europeans climate. Associated destructive wind speeds along with a large horizontal extent may cause substantial amount of damage. In Central Europe, winter storms are responsible for more than the half of the total economic loss caused by natural hazards. In light of global warming it is an important and still open question to what extent the frequency and/or intensity of severe winter storms may change by greenhouse gas forcing conditions (IPCC, 2007).

To study regional impacts of climate change on the local storm climatology in Central Europe, different scenarios from two regional climate models (RCM) with a horizontal resolution of 10 and 18 km, respectively, are used. We considered three emission scenarios (A1B, B1, A2) and two RCMs, the Regional Model (REMO) and the Consortium for Small-scale Modelling (CCLM), where the latter is initialized by two different runs of the global climate model ECHAM5/MPI-OM. Extreme value statistics are applied to calculate gust wind speeds for a specific return period at each grid point. Changes in the regional storm climate are quantified by differences in the gusts between a projection period (2021-2050) and a control period (1971-2000).

The evaluation of extreme wind speeds for a 10-year return period within the control period show that the spatial patterns as well as the characteristics of extremes are quite well reproduced by the models. The magnitude of the gusts, however, are significantly underestimated by 10 to 30%. This can be attributed to deficiencies in the gust parameterization schemes and the coarse resolution of the model chain which is unable to reproduce strong pressure gradients. These effects, however, will vanish when considering relative differences between two different time periods. Expected changes in extreme wind speeds for the future show a high variability both between the grid points and the different scenarios. It is found that the spatial patterns of relative changes are mostly controlled by the global model, whereas differences between the emission scenarios A1B and B1 as well as the RCMs are of minor importance. For Northern Germany, the RCMs suggest an increase in extreme wind speed for a 10-year return period between +2 and +6%, whereas for Southern Germany a decrease between 0 and -4% is expected.