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Extreme Wind Gusts within European Winter Storms estimated from Dynamical and Statistical Downscaling

T. Kruschke (1), P. Lorenz (1), R. Osinski (1), M. Voigt (1), G.C. Leckebusch (1,2), and U. Ulbrich (1)

(1) Freie Universitaet Berlin, Institute of Meteorology, Berlin, Germany (tim.kruschke@met.fu-berlin.de), (2) School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK

Extreme winter wind storms are major natural catastrophes leading to enormous socio-economic impacts in Europe. The impact of a single events depends on the severity and extent of the event itself but also on the region hit by the storm, combined with its specific exposure of values and vulnerability. The spatial distribution of exposed values and their vulnerability is highly heterogeneous. Therefore, it is necessary to analyze extremes of surface wind speeds within winter wind storms with high spatial resolution.

This study analyzes if rather simple linear regression methods are suitable for estimating extreme surface wind gusts of high spatial resolution, using different coarse resolution predictors. The statistical relationships between coarse resolution predictors from ECMWF reanalysis data and high resolution (∼7km x 7km) predictands, i.e. the maximum gusts, are derived from dynamical simulations of extreme historical events performed with the German Weather Service (DWD) model chain GME—COSMO-EU.

Validation of the results of the statistical downscaling confirms the high skill of linear regressions for different European sub-regions. Hence, the application of these methods to more extensive datasets in order to estimate extreme wind gusts and their exceedance probabilities or return periods is justified.