

Estimation of Vertical Wind Gust Profiles from Regional Reanalysis Using Extreme Value Theory

Julian Steinheuer (1), Sabrina Wahl (1,2), and Petra Friederichs (1)

(1) Institut für Geowissenschaften und Meteorologie, Universität Bonn, (2) Hans-Ertel Centre for Weather Research, Bonn

Typical model forecasts and observations of wind gusts are provided for a standard measurement height of 10 m above the surface. However, for many applications wind gusts on higher levels are of increasing relevance, e.g., for the renewable energy sector, wind gusts at hub height are important. We present a statistical model for the vertical profile of hourly wind gusts as measured at the Hamburg Weather Mast. The data comprise peak wind speed observations at five vertical levels between 10 m and 250 m for the time period from 2004 to 2014. We further dispose of hourly atmospheric data from the regional reanalysis COSMO-REA6 which covers Europe with a horizontal grid spacing of 6 km. The gust distribution is a generalized extreme value distribution, with non-stationary parameters. The parameters are conditioned on COSMO-REA6 and height. To select the most informative variables we use a LASSO approach. Most informative predictors are the 10 m gust diagnostic, the barotropic mode of absolute horizontal wind speed in the lowest six reanalysis heights, the mean absolute horizontal wind in 700 hPa and the surface pressure tendency. Proper scores, like the CRPS, support the usefulness of the variables. In a second step, we investigate the connection of wind gusts in different heights using Pickands dependence function and show its dependence on the stability of the atmosphere.