EMS Annual Meeting Abstracts
Vol. 16, EMS2019-515, 2019

Vertical profiles of wind gust statistics from a regional reanalysis using multivariate extreme value theory

Julian Steinheuer (1,2), Sabrina Wahl (2,3), and Petra Friederichs (3)

(1) Institute for Geophysics and Meteorology, University of Cologne, Germany (Julian.Steinheuer@uni-koeln.de), (2) Hans-Ertel Centre for Weather Research, (3) Institute of Geoscience and Meteorology, University of Bonn, Germany

Typical model forecasts and observations of wind gusts are predicted for a standard measurement height of 10 m above the land surface. However, many applications require wind gust estimates at higher levels, e.g., the renewable energy sector is requesting wind gusts at wind power plant hub height. We present a statistical post-processing for the regional reanalysis COSMO-REA6 of the German Weather Service DWD with 6 km grid spacing that targets hourly wind peaks for the location of the Hamburg Weather Mast. The weather mast data comprise peak wind speed observations at five vertical levels between 10 m and 250 m for 2004 until 2014. The post-processing realized a stochastic model for wind gusts using a generalized extreme value (GEV) distribution with non-stationary parameters. The parameters are conditioned on COSMO-REA6 and inferred in a censored maximum likelihood method. To select the most informative variables, we use a least absolute shrinkage and selection operator (LASSO). The most important predictors are the 10 m gust diagnostic, the barotropic and the baroclinic mode of absolute horizontal wind speed in the lowest six reanalysis heights, the mean absolute horizontal wind in 700 hPa, the surface pressure tendency, and the Lifted Index. Proper scores support our model and show especially in higher altitudes up to 60% improvement towards the climatology. Extremal dependencies between wind gusts in different heights are modeled by a multivariate GEV distribution. It is shown that the dependency between gusts is conditioned by the vertical stability of the atmosphere.