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

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Wind and gust statistics at the hub height of a wind turbine are important parameters for the planning in the renewable energy sector. However, reanalyses based on numerical weather prediction models typically only give estimates for wind gusts at the standard measurement height of 10 m above the land surface. We present here a statistical post-processing that gives a conditional distribution for hourly peak wind speeds as a function of height. The conditioning variables are provided by the regional reanalysis COSMO-REA6. The post-processing is developed on the basis of observations of the peak wind speed in five vertical layers between 10 m and 250 m of the Hamburg Weather Mast. The statistical post-processing is based on a censored generalized extreme value (cGEV) distribution with non-stationary parameters. To select the most meaningful variables we use a least absolute shrinkage and selection operator. The vertical variation of the cGEV parameters is approximated using Legendre polynomials, allowing gust prediction at any desired height within the training range. Furthermore, the Pickands dependence function is used to investigate dependencies between gusts at different heights. The main predictors are the 10 m gust diagnosis, the barotropic and baroclinic modes of absolute horizontal wind speed, the mean absolute horizontal wind in 700 hPa, the surface pressure tendency and the lifted index. Proper scores show improvements of up to 60 %, especially at higher vertical levels when compared to climatology. The post-processing model with a Legendre approximation is able to provide reliable predictions of gust statistics at unobserved intermediate levels. The strength of the dependence between the gusts at different levels is not stationary and strongly modulated by the vertical stability of the atmosphere.