

Gustiness parametrization in the atmospheric boundary layer

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Wind gusts represent extreme wind conditions which can have large societal impacts. Gustiness must also be taken into account in construction planning and for example is an essential parameter in the design of modern wind turbines. Traditionally wind gusts are observed and reported at the surface layer of the atmospheric boundary layer. Most gustiness parametrization methods have been developed for the surface layer only. In many applications, however, there is a need for information from higher altitudes too. In this study we test the validity of four different gustiness parametrization methods – originally developed for surface layer – and propose a new gustiness parametrization method. The parametrizations are evaluated against almost a full year of observations, covering height levels from 16 to 143 m from three weather masts and one synoptic weather station at the Finnish southern coast. All stations are located over fairly flat terrain, but differences exist between the stations in surface roughness and the thermal environment. Results show that the new method captures quite well the reduction of gust factor (ratio of gust and mean wind speed) in stable cases, but it is sensitive to the quality of turbulent surface flux data. Additionally the five gustiness parametrization methods were tested against simulations from the meso-scale model AROME (Applications of Research to Operations at Mesoscale). All parametrization methods had difficulties in reproducing vertical profiles of gust factor when compared to AROME output.