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A generic gust definition and detection method based on wavelet-analysis

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Gust prediction quality heavily depends on the actual definition of what a gust is. This is the case, as the major concern about gusts is their possibly destructive effect on structures or objects exposed to the gust. This effect is proportional to the energy that is contained in a specific gust. Existing gust definitions, however, do not represent the physical impact a gust has on structures or objects and are rather arbitrarily choosen and often developed for specific use cases (e.g. aviation or wind comfort of pedestrians). Fourier-Analysis is a common way of investigation the spectral energy contained in a fluctuating signal. Unfortunately Fourier-Analysis does not provide energy localization in time, which is required in order to identify specific gusty sections within a wind velocity dataset. Performing a Wavelet-Analysis rather than a Fourier-Analysis on wind velocity data, however, has major informational advantages, as the energy contained in the data can be located not only in frequency but also in time. This leads to a strait-forward method of deriving information about gusts from high-resolution wind velocity data. In order to define, what a gust in the context of this analysis might be, we suggest the specification of a relevant frequency as well as a threshold for the detected energy content. We therefore define a generic gust as a section of the data, where within a specific frequency a specific threshold for the detected energy content is surpassed. This approach creates a two-dimensional space (frequency, energy) of possible gust definitions. Both dimensions can easily be limited, in order to fit the sensitivity region custom to a specific problem in general or a specific structure or object in particular. The method can easily be applied to turbulence resolving simulation data as well as high-resolution wind velocity measurement data. We will present and compare results derived by this method using data from the LES model PALM of Leibniz Universität Hannover as well as high resolution wind velocity measurement data from the Hamburg Weather Mast of Universität Hamburg and Max Planck Institute for Meteorology.