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An offshore climatology of anomalous wind events

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The current emergence of large offshore wind farms calls for improved understanding of the offshore wind climate. Detailed knowledge of wind variability is required for turbine load computations, but traditional methods fail to represent the full suite of offshore wind conditions. This research addresses the question “how to improve the representation of wind variability in load assessment models?”

We first define categories of anomalous wind events (AWEs) as boundary-layer winds that cannot satisfactorily be characterized by the logarithmic or power-law wind profiles. Low-level jets are an illustrative example, but profiles with strong speed- or directional shear, strong turbulence and gusts, wind ramps and internal boundary layers are also highlighted. These AWEs can then be described in terms of their spatial and temporal characteristics and their relation to other (meteorological) variables. This methodology is applied to observations for the year 2012 from the IJmuiden meteomast located 85 km off the Dutch Coast, occasionally complemented with observations from other years or locations.

Preliminary results indicate that at least 20% of the 30-min averaged wind profiles should be classified as AWEs. Offshore low-level jets occur up to 10% of the total time, with more jets in stable conditions during spring and early summer. As many as 250 ramp events were identified for the year 2012.

The methodology can easily be applied to other datasets, and the resulting climatology can be used to complement the meteorological input for turbine load assessment models. Furthermore, the methodology can serve as a framework for model evaluation, and as a basis for in-depth physical analysis.