Estimation of turbulence intensity using rotor effective wind speed in Lillgrund and Horns Rev-I offshore wind farms

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Turbulence characteristics of the wind farm inflow have a significant impact on the energy production and the lifetime of a wind farm. The common approach is to use the meteorological mast measurements to estimate the turbulence intensity (TI) but they are not always available and the turbulence varies over the extent of the wind farm. This paper describes a method to estimate the TI at individual turbine locations by using the rotor effective wind speed calculated via high frequency turbine data.

The method is applied to Lillgrund and Horns Rev-I offshore wind farms and the results are compared with TI derived from the meteorological mast, nacelle mounted anemometer on the turbines and estimation based on the standard deviation of power. The results show that the proposed TI estimation method is in the best agreement with the meteorological mast. Therefore, the rotor effective wind speed is shown to be applicable for the TI assessment in real-time wind farm calculations under different operational conditions. Furthermore, the TI in the wake is seen to follow the same trend with the estimated wake deficit which enables to quantify the turbulence in terms of the wake loss locally inside the wind farm.

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