Validation of the dynamic wake meander model for loads and power production in the Egmond aan Zee wind farm

This paper investigates wake effects on load and power production by using the dynamic wake meander (DWM) model implemented in the aeroelastic code HAWC2. The instationary wind farm flow characteristics are modeled by treating the wind turbine wakes as passive tracers transported downstream using a meandering process driven by the low frequent cross-wind turbulence components. The model complex is validated by comparing simulated and measured loads for the Dutch Egmond aan Zee wind farm consisting of 36 Vestas V90 turbine located outside the coast of the Netherlands. Loads and production are compared for two distinct wind directions—a free wind situation from the dominating southwest and a full wake situation from northwest, where the observed turbine is operating in wake from five turbines in a row with 7D spacing. The measurements have a very high quality, allowing for detailed comparison of both fatigue and min–mean–max loads for blade root flap, tower yaw and tower bottom bending moments, respectively. Since the observed turbine is located deep inside a row of turbines, a new method on how to handle multiple wakes interaction is proposed. The agreement between measurements and simulations is excellent regarding power production in both free and wake sector, and a very good agreement is seen for the load comparisons too. This enables the conclusion that wake meandering, caused by large scale ambient turbulence, is indeed an important contribution to wake loading in wind farms.

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