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Publication date:
2008

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Ejsing Jørgensen, H., Frandsen, S. T., Mann, J., & Wagner, R. (2008). *Evaluation of different turbulence models with respect to coherences, spectras and lengthscales*. Abstract from 2008 European Wind Energy Conference and Exhibition, Brussels, Belgium. http://www.risoe.dk/rispubl/art/2008_60.pdf

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Session: Loads and control (BT4.1)
Track: Technical

EVALUATION OF DIFFERENT TURBULENCE MODELS WITH RESPECT TO COHERENCES, SPECTRAS AND LENGTHSCALES (abstract-ID: 98)

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The international standard IEC61400-1 prescribes requirement to various features of design turbulence and offers suggestions to which models to use calculating the external load. Thus, the quality of the calculations depends on the turbulence model. In the present paper we have reviewed the different models for coherences and spectra's and tested them up till heights of 160 m and crosswind distances of 80 m. In this paper we have shown that the model of Mann is superior to the model of Kaimal when estimating the coherences for larger scales and thereby the loads on the tower.

The paper describes characteristics of turbulence measured up till 160m met from the mast in at Høvsøre, Denmark, which is one of the few fully instrumented towers reaching above the height of the largest wind turbines on the market in 2007. The measurements are used to evaluate to the different turbulence models including the ones proposed in IEC61400-1 i.e. the Mann and Kaimal model.

The work is based on the analysis of four years of turbulence data with respect to turbulence, U power spectra's, length scales and coherences from the met tower at Høvsøre instrumented at 8 different levels.

The analysis of the peak in turbulence spectra's of U shows that the Length scale of turbulence for large turbines can be assumed approximately constant with height. But the analysis also shows that the Length scale is a function of Wind speed which is in accordance with ESDU. Furthermore, have the analysis of the measured coherences shown that the Mann model performs better than the proposed Kaimal/Davenport model especial for the larger separations.

Results of the analysis of turbulence are then combined with the response of the turbines by using two different calculation methods. The first method consists of integration over a simple actuator disk model, and the other more complicated method consists of a detailed HAWC simulation. Both methods are showing nearly the same results.

The investigations have shown that the response on the wind turbines are deferring up to 20-30% depending on the rotor diameter, with the model of Mann giving lesser loads than the adjusted Davenport approximation.

Finally, based on the data analysis and model simulations some recommendations on specifications on future turbulence models are offered with respect choice of Length scales and model specifications.