



Wakes in large wind farms

Rebecca Barthelmie(1), Sten Frandsen (1), Martin Mechali (2), Leo Jensen (2), Paul Sørensen (2), Pierre-Elouan Rethore (1) and Jakob Mann (1)

(1)Risø National Laboratory, DK 4000 Roskilde, Denmark, Email: R.Barthelmie@risoe.dk; sten.frandsen@risoe.dk, (2) Elsam Engineering, Kraftværksvej 53,7000 Fredericia, Denmark

Wake losses in large offshore wind farms are predicted by state-of-the-art models to be of the order 10-20% and are hence a significant component of the overall economics of these wind farms. In recent years a number of projects have been carried out with the purpose of investigating wake effects at Horns Rev and Nysted offshore wind farms, both approximately 160 MW in size. The datasets are being used to map the downstream effect of large wind farms, and monitor the in-park wake effects. Initial analyses focuses on direct wakes (where flow is directly down the row of wind turbines). These are the most extreme in terms of the loss of power output but occur a relatively small fraction of the time. Supplemental data from the 40 MW Middelgrunden offshore wind farm and from a large onshore wind farm Nørrekær Enge are also being analysed.

Part of the project involves development of a model based on the analytical solutions of wake development described by Frandsen et al. (2004). This model has been operationalised for Horns Rev and Middelgrunden. Results from the modelling will be compared with the data analysis. The objective is to illustrate whether the merging of wakes within large wind farms can be described by simple linear models or whether the inclusion of the two-way interaction between the wind turbines and the boundary-layer is a necessary prerequisite for accurate models of wakes to be used in future wind farm design. A comparison of the model performance will also be made with the WASP model for each wind farm.