

Comparing WindPRO and Windfarmer wake loss calculation

By Per Nielsen, November 2002 – Updated June 2003

Wake loss for to different sets of wind data has been calculated wake loss with the WindPRO model (same as in WAsP, the *N.O.Jensen* model) and the Windfarmer “Eddy viscosity model”, based on the *Ainslie* model.

Here are the results, but please note:

- Not all adjustable parameters in Wind Farmer have been tested.
- The “real” array lost cannot be measured – only the variation from WTG to WTG, so the absolute Wake loss will always to some degree be unknown – but based on guidelines such as that the least reduced can minimum have 0% loss, gives a fairly good estimate of real losses.
- The changes in distance to coastline can in combination with insufficient handling of this from WAsP also be a part of explanation for mistakes

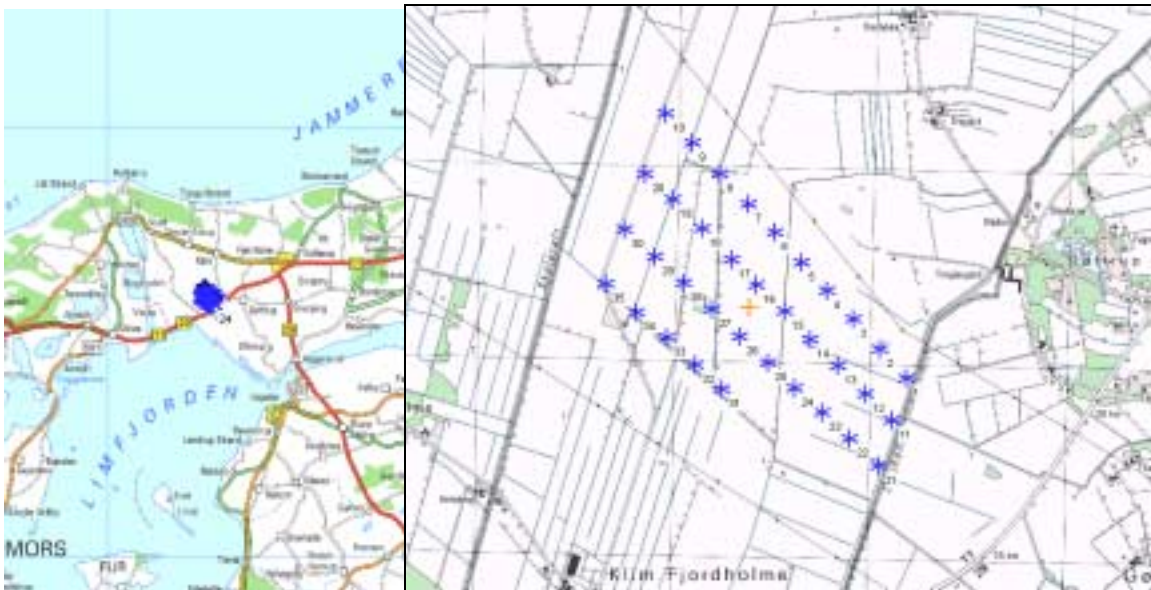


Figure 1 The wind farm site in northwest Denmark and the layout.

The difference between the two models is very small. Using a Turbulence Intensity (TI) of 10%, the WindFarmer seem to underestimate the array losses around 2% relative to WindPRO – and especially for the two “back rows” (WTG 1-20), where Windfarmer has up to 6 percent point to low calculated array loss, where WindPRO has up to 4 percent point to low. But using a TI of 5%, Windfarmer seems to overestimate slightly. So by adjusting the TI it seem that the difference in the 2 models is almost none. The TI is indirectly adjustable in the WindPRO model by adjusting the Wake Decay constant (WDC) – this has been tested also see full case study report 01_Klim, available at:

In the case study report, there are made different parameter variations in the WindPRO calculation showing that the “right patterns” for the back rows can be reached by changing the Wake Decay Constant (WDC) or the used Ct curve – but then there is no good match for the front rows. So a revised model seems to be the solution – this we will work on in the “Large-Park” project together with Risø. The project was just started in November 2002 and will be finalized 2004 – but hopefully some good “repair tools” will be available before.

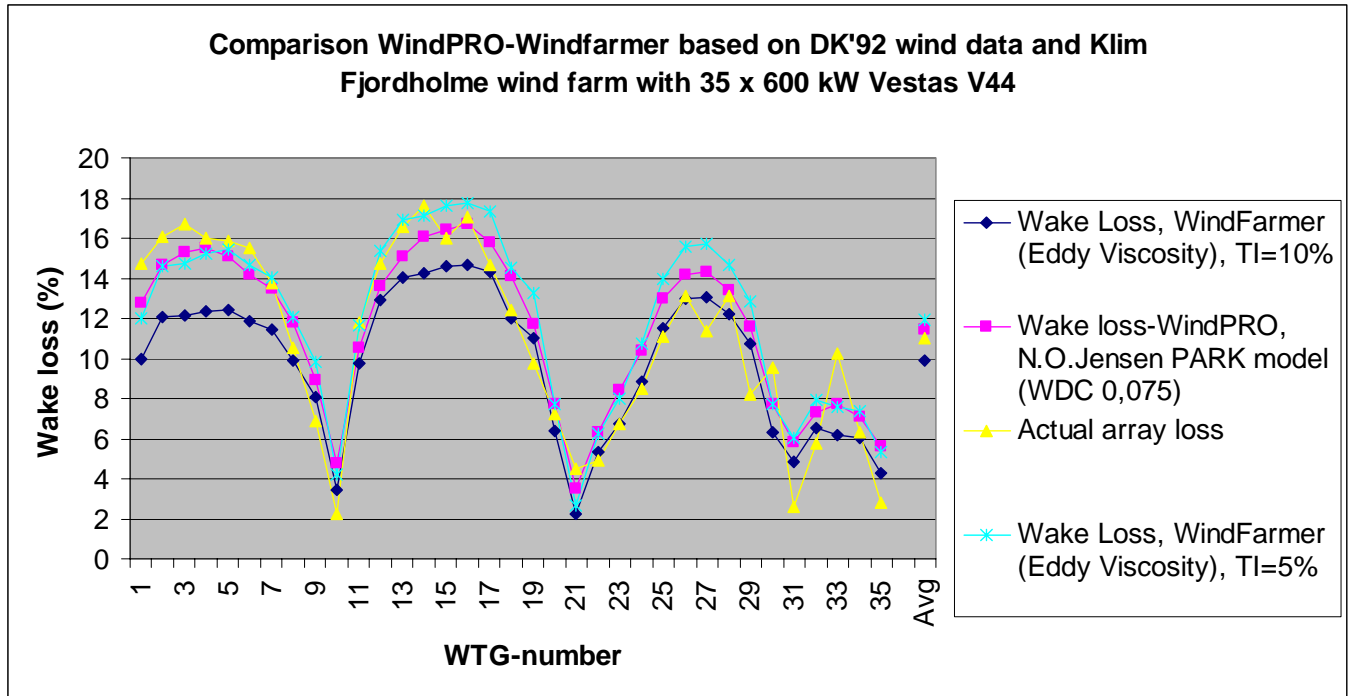


Figure 2 Based on all available production data and the normally used long-term wind data for Denmark.

Conclusion:

There are only very little difference between the 2 models. Choose of TI (WindFarmer) and WDC (WindPRO) is important to get good performance. None of the models seem to make a “perfect” modeling – they both seem to overestimate slightly for the first rows (seen from main wind direction and underestimate slightly for the back rows. This could be critically for wind farms with more than 5 rows.

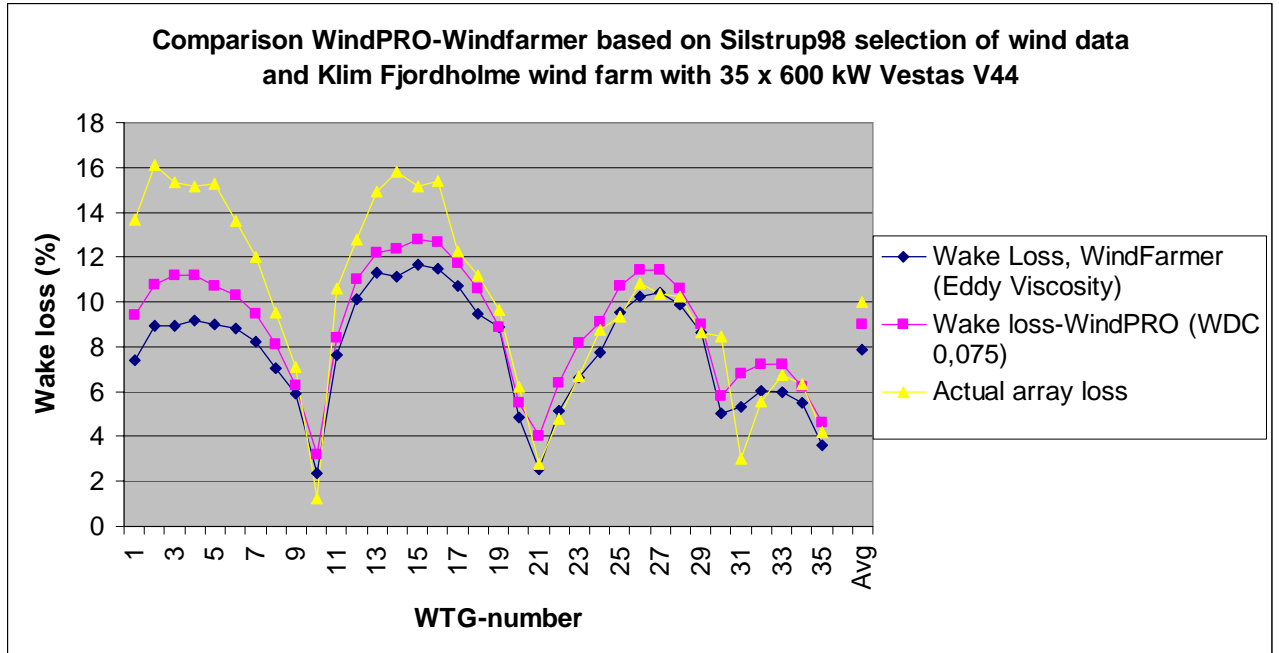


Figure 3 Based on a selection of days, where availability seem to be 100% and parallel measurements are available. Here the wind is more concentrated from the western directions. NOTE: Only TI = 10% is tested for WindFarmer here – using a TI of 5% will improve results, see previous figure.

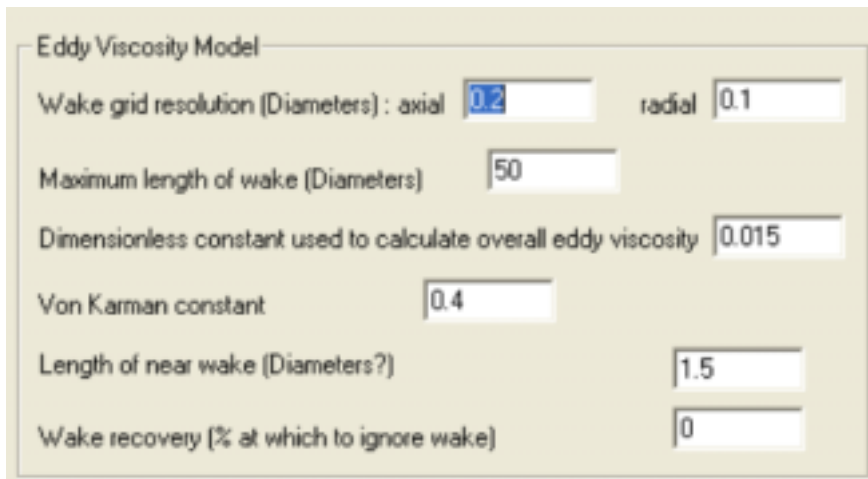


Figure 4 The used set-up of the Eddy Viscosity model in Windfarmer. Only variation of the TI has been tested.

Thanks to Kevin Romuld, EAPC, North Dakota for helping with Windfarmer calculations for comparison.

Thanks to Vestas for helping with the production data.