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Wake Models in WindPRO 2.5

Introduction

With the upcoming release of WindPRO 2.5 - additional wake models have been added into the WindPRO/PARK module. These new models allow the user to test different wake models on either new wind farms and/or using data from existing wind farms. The models implemented range from empirical engineering models to CFD-models – the latter requiring some increased calculation time when compared to engineering models. All new models can be run in connection to a raw meteorological data (METEO data), a WASP calculation, an ATLAS calculation or through wind resource files (e.g. generated with WASP, WindSim or another flow model). The online or printed documentation holds details on the included models.

Wake models

The following wake-models are released with WindPRO 2.5:

- PARK model: 1996 (N.O. Jensen)
- Eddy viscosity model: 1988 (J.F. Ainslie)
- G.C. Larsen: 1998 (European Wind Turbine Standards II)

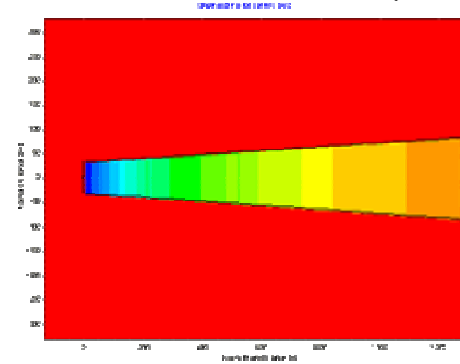
Single wake combination models

Today, most wake models are single wake models. Thus, in order to obtain usable results for wind farms with many turbines, these single wakes must be combined into a summed effect. This is done by empirical means, using different wake combination models. The most common method used is the 'squared velocity deficit method' – a method is also implemented and recommended for use in WindPRO. Note, all important wake model parameters are user configurable in WindPRO – but defaults settings applied.

Wake calculations in WindPRO:

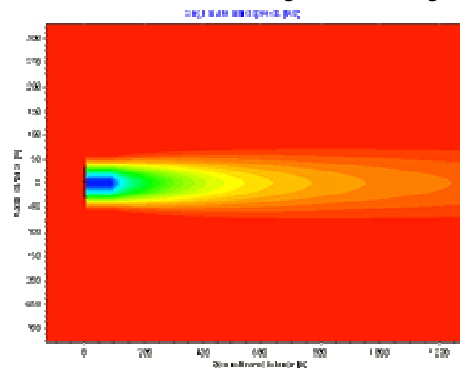
Include energy reductions, RIX and reduced wind speeds in the wind farms. Output is available as WindPRO print-outs and/or text files. Text file may be copied into spread-sheets or other third party programs.

N.O. Jensen Wake Model (PARK)



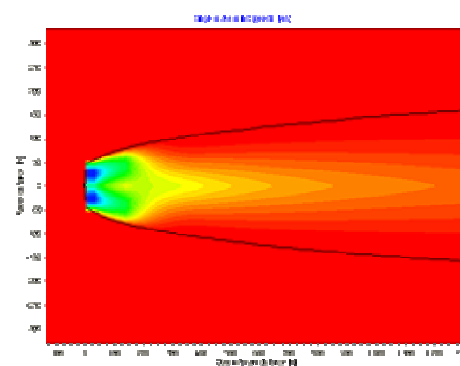
The N.O. Jensen wake model is a simple single wake model. The model is documented in the paper 'A Simple Model for Cluster Efficiency' by I. Katić et al and is based on the assumption of a linearly expanding wake diameter.

Ainslie Model (Eddy Viscosity Wake Model)



The wind turbine wake application of an axis-symmetric formulation of the time averaged Navier Stokes equations with an eddy viscosity closure was initially made by Ainsley. The application uses cylindrical coordinates and an assumption of incompressible fluid.

Larsen Wake Model



This model is a semi analytical model – derived from asymptotic expressions from Prandtl's rotational symmetric turbulent boundary layer equations. The model was proposed by G.C.Larsen, Risø. The model includes an option of adding an empirical bi-modal near wake description.