**Abstract**

We show the steps undertaken in the development, validation and application of a real-time wind farm simulator. An accurate real-time simulation is an enabling technology for several purposes: Energy production assessment; performance monitoring; wind farm control; short term forecasting.

**Improving Wake Model Accuracy**

The new model is being validated against a wide range of validation cases. Validation cases from a number of wind farms covering a range of distances, turbulence levels and stability conditions are used. The examples displayed in Fig 1&2 shows the process for moderate wind speed and strong wakes.

**Real Time Wind Farm Simulator**

The 3D RANS model of the waked flow is then integrated in WakeBlaster, a real-time wind farm simulator software. The tool models for each step the state of the wind farm and reports simulation results such as power and rotor equivalent wind speed due to wakes. In Fig. 4 the output is compared to SCADA data.

**3D RANS Solver with Eddy Viscosity Turbulence Closure**

Both 2D and 3D Reynolds-averaged Navier-Stokes (RANS) models have been developed for use in a real time wind farm model, taking account of local and temporal environmental conditions. The 3D model allows modelling of significant 3D effects, such as the interaction between multiple wakes or between a wake and the boundary layer.

**Conclusions**

We have developed a new wind farm simulation software component that features improved accuracy and higher level of detail compared to statistical models. Analytical approximations for 3D flow effects are replaced by numerical modelling. The wind farm simulation allows detailed modelling of time variant and hysteresis effects.

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