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Power losses from wakes in large offshore wind farms

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The paper will draw together results from a number of projects which have been conducted over the last few years which aim to identify why state of the art models significantly under-estimate power losses due to wind turbine wakes in large offshore windfarms. Since power losses in large arrays are estimated to be 10-20% on average, accurate modelling is important to the economic success of future wind farm developments. This research is part of the EC funded UPWIND project which aims to radically improve wind turbine and wind farm models in order to continue to reduce the costs of wind energy. The FLOW workpackage focuses on external conditions (wind and turbulence) and wakes within and downwind of wind farms. Here we will present results for offshore wind farms. The main issues are low ambient turbulence, atmospheric stability, the interaction of multiple wakes and wake recovery downstream which needs to be estimated in order to optimally site multiple large clusters. The approach used is to develop an understanding of issues relating to flow by analysis of data from offshore wind farms. These are used to develop scenarios which will then be the subject of simulations by a range of models from the state of the art models currently used by wind energy developers through analytical solutions to CFD codes. The results will be compared to identify which are the key issues in developing more accurate models for use in wind energy planning.

Results from the data analysis will be given including an assessment of the role of atmospheric stability in the development of wakes in large offshore wind farms. We will present an assessment of the state of the art in wake and flow modelling for offshore wind farms and results from the wake model benchmarking exercise. Significant attention will be paid to addressing uncertainties in wake modelling and in wake data analysis.