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The Impact of Wind Characteristics on Power Production on the Scale of a Single Offshore Windfarm

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In the UK, the proportion of electricity produced by wind power is expected to increase to approximately 20% by 2020. However, the increase in spatially dispersed, and variable generation is making the management of the power system on a national and regional scale increasingly complex. During the early integration of wind power into energy systems the increasing geographic spread of wind generation was anticipated to lead to a smoothing of the variability of power generation. However, the recent trends towards larger single turbines and ever larger offshore wind farms are bringing new concerns for power system operators. There is a need to understand the potential for significant local power swings that could lead to local disruption and/or rolling impacts on power systems.

Typically operational estimates of the power output of a wind farm are based on the mean wind speed at the average hub height. However, this approximation leads to varying degrees of error. This study is investigating whether the wind power forecast error could be reduced by incorporating more detail of the nature of the flow across a single offshore wind farm. Specifically, the impact of turbulence caused by wakes from neighbouring wind turbines, and the effect of wind shear across the wind farm is being considered. A relatively simple modelling approach is being used, i.e. a mean flow canopy model, previously applied to flows around buildings in urban areas, to estimate the spatial variability in mean wind speed across a single wind farm for different meteorological conditions and turbine configurations. This presentation will provide results of the model compared with observations from an operational wind farm in the UK.