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M3: Anholt Offshore Wind Farm Wake Studies

Simulating coastal effects on an offshore wind farm

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Wind turbine wakes can cause energy losses in wind farms[1] and their effect needs to be modeled in order to design energy efficient wind farm layouts. Wake losses in offshore wind farms are often modeled by assuming offshore conditions for all wind directions; however, many offshore wind farms are build in the vicinity of a coastline. In this study, we simulate the effect of the Danish Peninsula Djursland on the Anholt offshore wind farm, using a Reynolds-averaged Navier-Stokes (RANS) setup.[2] The coastline is modeled as a roughness change, the wind turbines are represented by actuator disks and a neutral atmospheric boundary layer including Coriolis forces is employed. For westerly and south westerly winds, the distance from the coastline to the Anholt wind farm varies between 15 and 50 km, which causes a horizontal wind speed gradient that results in a variation in wind turbine power along the north-south oriented rows. This effect is visible in RANS, as plotted in Figure 1 and is also observed in SCADA data provided by DONG Energy. The wind resources at the wind farm and the power deficits, calculated by RANS, are compared with mesoscale simulations and SCADA data, respectively.

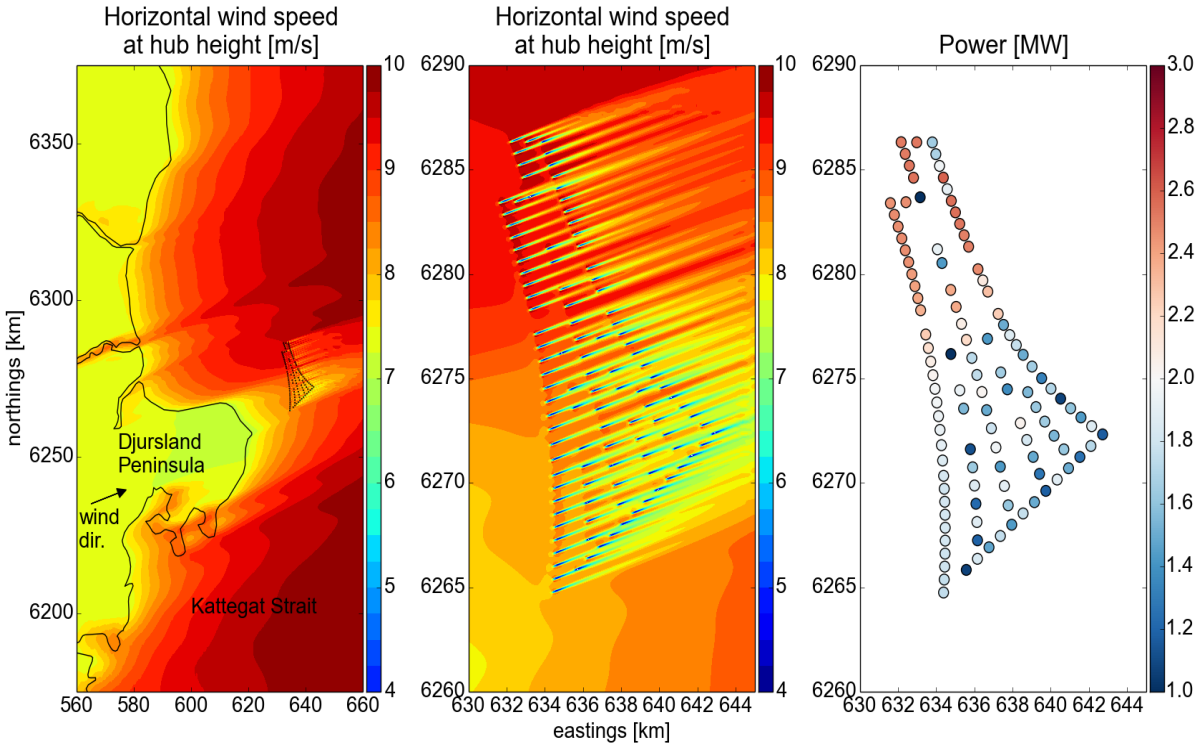

Figure 1: Horizontal wind speed at hub height and wind turbine power at the Anholt offshore wind farm, for a wind direction of 250º, using RANS actuator disk simulations. Coastline and wind farm layout are shown as a black contour and black dots in the most left figure.

[a] DTU Wind Energy, Roskilde and Lyngby, Denmark

[1] Barthelmie R. J. et al., Wind Energy **10,** 217 (2007)

[2] van der Laan, M. P et al. Dabbs et al., Journal of Physics: Conference Series **524,** 1 (2015)