Quantifying windfarm-windfarm interactions using a modified RANS canopy model

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Background:

The role of wind energy in the electricity generation is expanding, with more and more offshore wind farms becoming operational. Many more are planned in the North Sea alone. With the number of wind farms increasing, they are becoming more and more closely spaced. This close spacing impacts the performance of the wind farms due to the wake they produce. These wakes can extend for many kilometres, as seen in Figure 1, which shows a wake extending for 20 km (250 rotor diameters). A different study employing both SAR and Doppler imaging shows a 4-8% velocity deficit at a distance of 65 rotor diameters [2].

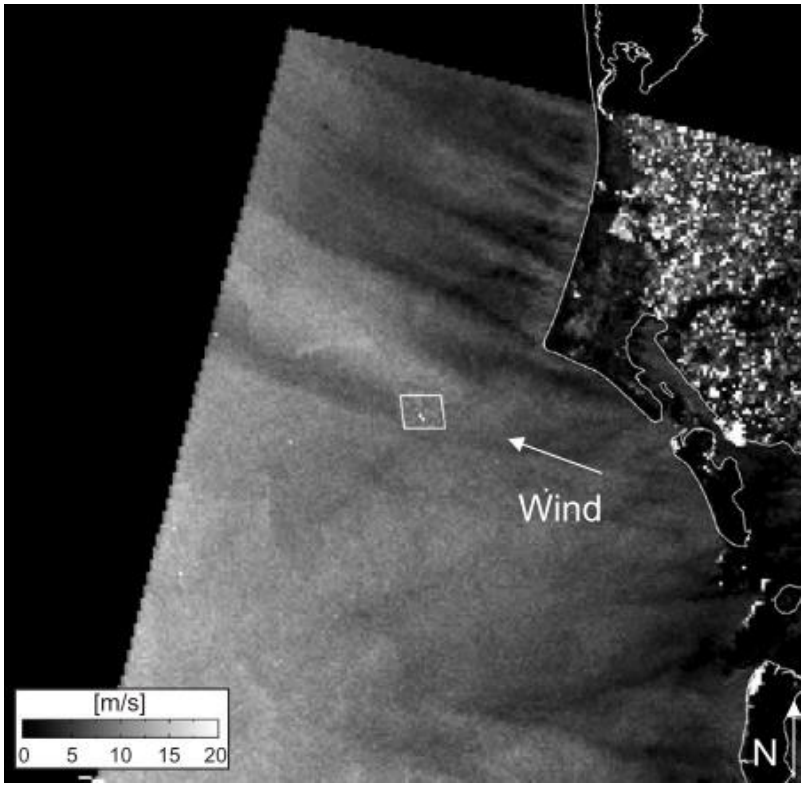

Figure 1: Windfarm wake of the Horns Rev wind farm captured by Synthetic Aperture Radar (SAR) satellite imaging. The images shows a significant velocity deficit at the image boundary, located 20km from the wind farm. [1]

Objective

The objective of this thesis is to model windfarm-windfarm interactions using a modified RANS canopy model. The canopy model is modified by incorporating fundamental wind farm parameters such as spacing, height and thrust to accurately capture the far-wake effects of a windfarm.

References

[1] Christiansen, M. B., & Hasager, C. B. (2005). Wake effects of large offshore wind farms identified from satellite SAR. *Remote Sensing of Environment*, *98*(2–3), 251–268. https://doi.org/10.1016/J.RSE.2005.07.009

[2] Ahsbahs, T., Nygaard, N. G., Newcombe, A., & Badger, M. (2020). Wind Farm Wakes from SAR and Doppler Radar. *Remote Sensing 2020, Vol. 12, Page 462*, *12*(3), 462. https://doi.org/10.3390/RS12030462