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Offshore wake effect study from Earth Observation SAR

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Winds are derived from EO SAR scenes in order to determine the wake effect of a large offshore wind farm (80 2MW wind turbines) located at Horns Rev in the North Sea. Wind wakes are regions of reduced wind speed and high turbulence intensity found downstream of obstacles (e.g. offshore wind farms). The aim of the present study is to characterize wind wakes spatially thereby supporting wake models in the prediction of environmental impacts of large offshore wind farms. The study is based on 29 ERS-2 SAR scenes, 12 ENVISAT ASAR scenes and additionally on high resolution airborne ESAR data. Scenes have been collected continuously since the Horns Rev wind farm became operative in December 2002. Maps of wind speed are derived from the SAR data through geophysical model functions (CMOD-4/5 and CMOD-IFR2); *a priori* knowledge of the wind direction is required. The wind direction is obtained from streaks in the SAR images (FFT analysis) or from a meteorological mast at 60 m. The wind speed obtained within a region upstream of the wind farm is considered the free stream velocity. Wake effects are spatially identified through comparison of the mean wind speed downstream of the wind farm to free stream conditions. Further, turbulence intensities are mapped through the relation of standard deviation to mean wind speed.

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