Offshore winds from a new generation of European satellites

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Publication date:
2017

Document Version
Peer reviewed version

Offshore wind energy, Wind resources:

Offshore winds from a new generation of European satellites

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Offshore wind fields retrieved from satellite Synthetic Aperture Radar (SAR) observations can give valuable insight in the spatial wind variability over large areas. We can utilize this for mapping of wind farm wakes, wind resources, coastal wind speed gradients, storms, and other wind phenomena at sea. All are important for the planning, operation, and maintenance of offshore wind farms.

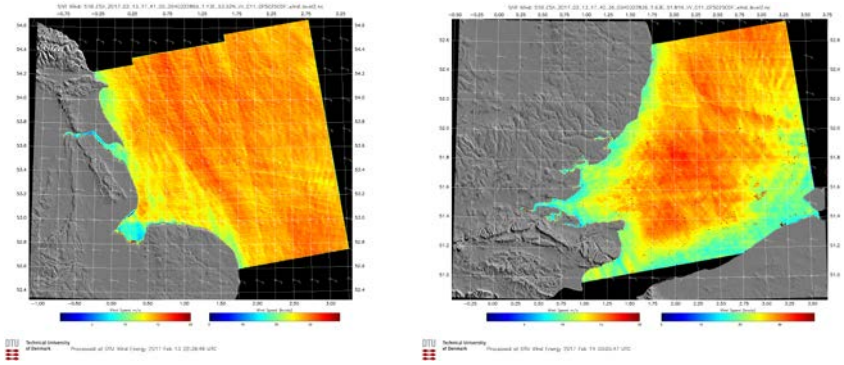

Figure 1: Example wind fields over the UK retrieved from Sentinel 1B. February 13, 2017 at 17:40 UTC.

Typical shortcomings of SAR-based wind fields include a low sampling frequency and a need for advanced data processing in order to retrieve the wind speed at 10 m above sea level. A new generation of European satellites and services could lower these barriers for applications in wind energy significantly.

The Sentinel-1 A/B missions by the European Space Agency (ESA) deliver C-band SAR observations at an unprecedented coverage and spatial resolution. Over the seas of Europe, approximately 200 new acquisitions take place every day. DTU Wind Energy operates a system for processing of the raw SAR data to wind fields in near-real-time. The wind fields are available for download; for example by users in the wind energy community. Comparisons with mast and lidar observations have shown RMS errors of 1.3-1.5 m/s as close as 1 km from the coastline.

ESA's Copernicus programme offers an Ocean Wind and Wave product (OWI), which allows users to bypass the processing of raw SAR data to wind and wave fields. The coverage is limited to the Mediterranean Sea at present but we can expect an expansion to other seas of Europe over time. The accuracy of this new product is currently under investigation.

TerraSAR-X is an X-band SAR mission by the German Aerospace Center (DLR). It offers very high-resolution imagery, which may be used for detailed studies of e.g. wind farm wakes. TerraSAR-X imagery is acquired on-demand and this requires payment of a fee. Because the most widely used algorithms for SAR wind retrieval are for C-band, further validation of wind retrieval algorithms for X-band is needed before it can be used routinely. Comparisons with mast and lidar observations are in progress at present.

This presentation will address the availability, the spatial coverage, and the accuracy of different wind products retrieved from SAR. We investigate the possibility of combining all available SAR-based wind fields into a single data series for wind resource assessment, which requires careful calibration of all sensors by the space agencies as well as consistent processing of historical and current satellite observations. Examples of the use of SAR-based wind fields for offshore wind energy applications will be given to illustrate their value.

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