DTU Library

SAR Wind Maps and Derived Products: New Pos sibilities for Offshore Wind Energy Exploitation

Badger, Merete

Link back to DTU Orbit

Abstract of Contribution 126

ID: 126
Oral presentation
Topics: Users Type and Category, Validation and Accuracy

SAR Wind Maps and Derived Products: New Possibilities for Offshore Wind Energy Exploitation

Merete Badger, Tobias Ahsbahs, Ioanna Karagali, Charlotte Hasager
Technical University of Denmark, Denmark

Unlimited access to L2 ocean wind fields from SAR opens up new possibilities for application of such wind products in connection with offshore wind energy exploitation. The European Space Agency (ESA) provides an Ocean Wind field component (OWI) retrieved from Sentinel-1 (S-1) observations. The Technical University of Denmark holds a comprehensive archive of SAR wind products for the European Seas generated in a systematic manner for both the Envisat and S-1 missions (see https://satwinds.windenergy.dtu.dk/). Institutions in the United States and Canada provide similar data offerings. End user's access to wind maps and derived products tailored to wind energy applications has thus eased significantly.

This presentation shall focus on the value of a long-lasting collection of SAR observations for mapping of wind resources offshore. We first investigate the compatibility of wind fields retrieved from different European SAR sensors (Envisat, S-1A, S-1B) through comparisons with in situ observations of the wind speed. Any wind speed biases must be eliminated before the SAR wind data sets can be merged to a single time series.

Based on the merged SAR wind time series, statistical analyses are performed to estimate the mean wind speed, the Weibull distribution, and the energy density within grid cells of the dimension 0.02° latitude and longitude. This leads to detailed wind resource maps over the European seas including coastal waters. The advantage of SAR winds for offshore wind energy exploitation lies partially in the resolved coastal wind speed gradient. Gradients calculated from SAR winds compare well with ground based remote sensing wind measurements from the shoreline up to 3 km offshore. Wind speed gradients from SAR in coastal areas may be influenced by an increased uncertainty in the modelled wind direction, which we use as input for the SAR wind speed retrieval. Preliminary results suggest that small-scale local changes in the wind direction can introduce changing biases with the distance to shore.

Wind speeds retrieved from SAR are valid at the standard height 10 m above sea level. Wind resource maps for higher levels in the atmosphere, where wind turbines operate, are calculated on the basis of long-term average wind profiles given by a Numerical Weather Prediction (NWP) model. Wind resource maps based on SAR and modeling are made available as part of a larger mapping effort called the Global Wind Atlas (http://science.globalwindatlas.info/science.html) for the heights 10, 50, 100 and 150 m. The maps are updated as new S-1 SAR data is collected.

Altogether, synergies between SAR winds and outputs from NWP models are promising for wind resource mapping and wind farm planning in coastal areas where other types of observations are difficult and costly to gather. The open access to SAR wind maps and derived products represents an attractive new opportunity for wind energy developers and the use of SAR winds for planning of offshore wind farms could become standard practice in the near future.