Offshore wind power in the Aegean Sea

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The wind climate of the Mediterranean Sea has been estimated from atmospheric modeling (Cavali 2005, Largier et al. 2005) and QuikSCAT (Furevik et al. 2011). The latter shows the Aegean Sea as a promising area for offshore wind power development.

According to the Hellenic Wind Energy Association (HWEA), the sites of particular interest for offshore wind energy are located close to the shores of the Aegean Sea. See Figure 1. Wind farm developers aim to select local areas with favorable wind conditions to optimize the annual energy production and the economic profit.

In the Aegean Sea, where the spatial variations in wind speed are very high, accurate resource mapping is of great importance as the produced wind power is proportional to the cubed wind speed. It is challenging to model the wind resource and it is costly to measure from the ground at every place of interest.

Maps based on Synthetic Aperture Radar (SAR) are expected to prove their value as excellent resource maps of the Aegean, to the benefit of the national economy.

High-resolution SAR satellite data bring new information for pre-feasibility at the policy planning level. For accurate wind resource mapping from satellite it is necessary to collect many images to reduce the uncertainty.

The 10-year Envisat ASAR archive has been used for wind resource mapping. Figure 2 shows the number of overlapping scenes. Wind maps from satellite are retrieved at 10 m, a map of the mean wind speed for the Aegean Sea is shown in Figure 3. This is given as mean Equivalent Neutral Winds (ENW).

The offshore wind resource is also calculated from Sentinel-1 wind fields from 2014-16. Figure 4 shows the number of overlapping samples and Figure 5 the mean wind speed at 10 m.

For comparison, a map of the mean wind speed from ASCAT is presented for year 2015 (Figure 6).

The work on Sentinel-1 and ASCAT is done for the New European Wind Atlas. This project will run until 2019, so it is work in progress.

The Sentinel-1 images are processed at DTU Wind Energy in near-real-time and we have updated our wind resource software.

A service-based on satellite SAR-derived winds for wind resource estimation is available at DTU Wind Energy.

In order to predict the wind resource for the turbine hub height, DTU Wind Energy has developed a method for extrapolation of winds to around 100 m using a combination of satellite wind fields and the long-term climate of atmospheric stability from the mesoscale model (Badger et al. 2016).

Over time, as more Sentinel-1 scenes are acquired, a combination of wind maps from Envisat ASAR and Sentinel-1 will lead to a substantial improvement of the data coverage and the statistical robustness of satellite based wind resource maps.