Topic: 6. Resource assessment and 9. Geology, waves & current measurements

Innovative measurement technologies for met-ocean and soil conditions

Bernhard Lange, Julia Gottschall, Claudia Rudolph, Gerrit Wolken-Möhlmann, Thomas Viergutz, Florian Meier, Volkhard Spieß*
Fraunhofer IWES, Am Seedeich 45, 27572 Bremerhaven, Germany
** University of Bremen, Bibliotheksstr. 1, 28359 Bremen, Germany*

Summary
The offshore wind industry requires detailed and specific knowledge about the met-ocean and soil conditions. This calls for new, dedicated measurement technology. Two examples for the successful development of such innovative technologies are presented and future needs are discussed.

1. Objective

The development, installation and operation of offshore wind farms require detailed knowledge about the met-ocean and soil conditions. Uncertainties in the knowledge of these conditions have large technical and financial implications and direct impact on the cost of electricity. In situ measurements of the met-ocean conditions and the soil conditions are therefore indispensable.

2. Methodology

The requirements to these measurements for offshore wind power differ from those for onshore wind farms and for other offshore industries like oil and gas. Therefore the offshore wind power industry needs new, innovative measurement technology well-suited for their specific needs.
The requirement to the accuracy of the wind measurement is a very obvious case: The accuracy of wind speed measurements performed for other purposes, e.g. the weather services, is clearly not sufficient for the wind industry. Offshore measurement masts as known from onshore wind, are not well suited for offshore measurements because of their high cost, limited flexibility and inherent limitations in deep waters. Today, the maturing offshore wind industry is utilising a new measurement technology based on wind LiDAR mounted on floating platforms.
A different case is the geophysical exploration. Here the need of offshore wind power is a geological survey showing the geological soil conditions of the first 10th of meters in relatively shallow waters. For this, a new multi-channel seismic measuring method has been developed which is particularly tailored to offshore wind energy requirements. It combines the strength of the multichannel seismic used in deep sea for oil and gas exploration with those of typical shallow water methods.

3. Results

The development of new, dedicated measurement technologies for offshore wind power will be presented for two examples:
Fraunhofer IWES has developed a wind LiDAR buoy for offshore wind measurements. Measurement errors induced by wave motion effects are mitigated by a motion correction algorithm. The buoy was validated extensively offshore against different fixed 100m met masts. Very high measurement accuracy and data availability were shown. The technology is now used commercially and currently 4 Fraunhofer IWES Wind LiDAR Buoys are performing measurements for future wind farms.
The digital multichannel seismic method has been successfully used for geophysical surveys of offshore wind farm areas. In comparison to standard state-of-the-art technologies, the resolution and signal penetration to a greater depth are drastically improved. Based on these results, the number of borings could be reduced e.g. in the wind farm Arkona Becken Südost, where based on Fraunhofer IWES seismic data the BSH approved a change of turbine locations without additional borings.

4. Conclusion

As shown in the two examples, the development of new measurement technology specifically tailored to the needs of the offshore wind industry can lead to important advantages and contributes to lowering the cost of offshore wind power. It will also be discussed which other topics could in the future benefit similarly from the development of new measurement technologies.