Comparison of different sea state measuring techniques in offshore wind parks

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Summary
Within the scope of the research project *RAVE Offshoreservice*, funded by the *Federal Ministry for Economic Affairs and Energy (BMWi)*, different sea state measuring techniques are compared to each other. Directional radar sea state measurements can be a reliable, accurate and maintenance free alternative to wave buoys. Nevertheless, it still needs to be investigated how accurate the systems from different manufactures are.

1. Motivation

When running an offshore wind park, it is necessary to know the exact weather- und sea conditions during all stages of construction and operation. Therefore a set of different environmental measurements needs to be evaluated. One way to measure the sea state is to measure the movement of the waves directly by using wave rider buoys. Another approach is to measure the height of the waves from a fixed platform by using radar techniques. In the German wind parks *NordseeOne* and *Butendiek* wave buoys and directional radar measurement systems are installed, as part of the research project *RAVE Offshoreservice* [1]. By comparing both systems, the strength and weaknesses can be evaluated and suggestions about sea state measurements on future wind park projects can be made.

2. Sea state measurements in general

Wave buoys use three accelerometers, one for each direction, to measure the orbital movement of the buoy. Over a distinct period of time, e.g. 30 mins, the waves are measured and the statistical parameters are calculated. Radar gauges measure the distance between the transducer and the sea surface by sending and receiving a radar pulse. By combining three transducers, the slope of the surface can be calculated and therefore the wave direction computed.

3. Data investigation and results

To compare the two datasets the parameters significant and maximum wave height, wave frequency and period, and wave direction are used. The comparison of the five parameters shows generally a good correlation between the two systems, see Fig. 1. Though in a more detailed view, some differences in a range of one up to ten percent in height and similar differences degree in direction still exist. The reason for those differences is still under investigation.

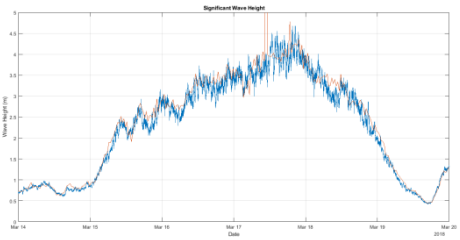

Fig. 1: Radar vs. Buoy Measurements - Significant Wave Height (image is still a dummy, need better one)

Another main difference, despite the measurement principle itself, is the amount of data generated, which is significantly higher for the radar system. This is due to the different sampling frequencies, power requirements, and physical limitations, see Tab. 1.

Tab. 1: Size of Datasets

System	Samples/Hour	Window
Radar	30000	20 min
Buoy	4610	30 min

Radar based sea state measuring techniques offering accurate and reliable sea state measurements but lacking of some features like surface temperature and currents. Nevertheless, it still needs to be further investigated, how accurate the results from different manufactures and systems are. Therefore further comparison campaigns should be run and evaluated.

4. References

[1] The research at alpha ventus (rave) project website. [Online]. Available: http://www.rave-offshore.de.