Poster ID: 16238

Comparison of Different Sea State Measuring Techniques in Offshore Wind Farms

Marten Schmager, Kai Herklotz
Federal Maritime and Hydrographic Agency, Hamburg, Germany

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Motivation

Within the scope of the research project RAVE Offshore Service different sea state measuring techniques have been compared. Nowadays wave buoys are the standard tool to survey ocean waves. Nevertheless directional radar sea state measurements are a reliable, accurate and low-maintenance alternative to wave buoys.

Experimental Setup

The dataset includes two time series from two different locations. The first locations is the wind farm Nordsee One at the southern part of the North Sea, approx. 25 km north of the island Juist. The second location is the wind farm Butendiek at the western part of the North Sea, approx. 30 km west of island Sylt.

Sea State Measurements at Nordsee One

The wind farm Nordsee One is provided with a wave buoy and a directional radar gauge. The survey is fully established since February 2018 and is planned for two years.

Fig. 1: Directional wave rider buoy at the wind farm Nordsee One.

Sea State Measurements at Butendiek

The dataset of the wind farm Butendiek consists of three individual wave buoys and one directional radar gauge. The simultaneous survey started in July 2018 and should last for at least one year of operation.

Fig. 2: Directional sea state radar at wind farm Butendiek.

Results

To compare the two systems, the parameters significant wave height, maximum wave height and direction are investigated. Due to the fact, that the amount of data is higher in the radar gauge, the data have been down sampled to meet the sampling frequency of the wave buoy.

The results from both surveys indicate a good correlation among the two different systems.

Fig. 3 reveals that the results from the Significant Wave Height between the two systems are matching well. The correlation factor between the buoy and the radar gauge for the significant wave height is 0.99 for both surveys. The maximum wave height from the buoys is sometimes affected by spikes, so that thecorrelation factor is lower. The maximum wave height from the buoy is usually higher as the radar gauge.

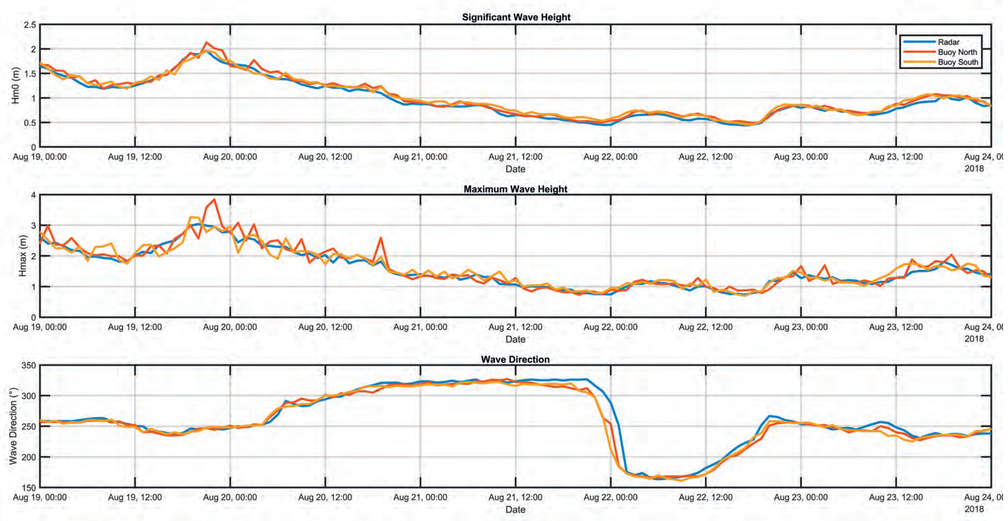

Fig. 3: Sea state measurements at wind farm Butendiek over a period of five days.

Based on two surveys the mean difference in significant wave height between the buoy and the radar gauge varies between 4.7 % in Nordsee One and 7.8 % in Butendiek. The statistic reveals that 60 % of all data are below 5 % of total differences between the two systems. Only 9 % of the data are above 10 % in total difference.

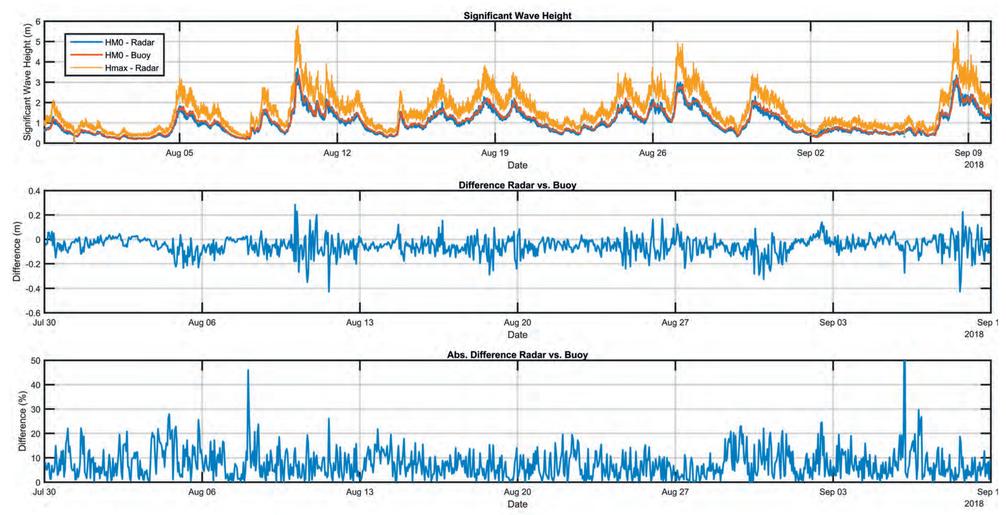

Fig. 4: Significant wave height and maximum wave height are shown in the top graph. The second and third graph shows the difference between the two systems in meters and percent.

Summary and Conclusion

Radar based sea state measuring techniques offering accurate and reliable sea state measurements but lacking of some features like surface temperature and currents. At situations, where an offshore structure is available, radar based measurements are well suited. Buoys have to be utilised where no platform is available since they send data via HF radio up to 50 km distance or worldwide per satellite. Therefore, a buoy can be optimally used to collect data at remote locations. Due to their nature of being anchored, the risk of loss remains. In areas with many offshore buildings, damage to the structures is still a risk. Since radar based measurements are maintenance free and same accurate than wave buoys, they offer a good alternative, if offshore structures are available.

The fact, that wind farms in the North Sea are more and more established, leads to the conclusion that the amount of sea state data generated will increase. By combining and centralising all those different surveys forecasts, planning of offshore activities and logistics can be enhanced. Scientific questing regarding climate change, detection and prediction of extreme waves and local effects can be addressed and furtherly investigated.

Acknowledgements

Founded by the Federal Ministry for Economic Affairs and Energy (BMWi)