Findings on scouring and wind-wave correlation for OWEC design recommendations and offshore operations

Hildebrandt A., Schendel A., Welzel M., Schlurmann T.
Leibniz Universität Hannover, Ludwig-Franzius-Institute, Hannover, Germany,
Tel: +49 (0)511 762-2582, hildebrandt@lufi.uni-hannover.de;

Summary
New findings on scour processes around monopoles and jacket foundations will be presented. The results are based on experimental studies in the 3D wave and current basin of the LuFI in Hanover including combined multidirectional waves and currents. In connection to the environmental conditions wind-wave misalignments and correlation will be shown for normal and extreme conditions.

1. Background & Objectives

1.1 Scouring

The progression of scour in unidirectional, random waves is already addressed by several studies, however, experimental studies on the scour progression induced by multidirectional waves are still very limited. Thus, a novel experimental study was carried out in the 3D wave and current basin to advance the understanding of scouring processes induced by multidirectional waves and systematically investigate the influence of wave spreading on the scouring process.
The dependency of scour depth on wave spreading is particularly prominent for small Keulegan-Carpenter (KC) numbers. The scour depth shows a growing dependency on KC numbers for increasing wave spreading. In addition to monopile structures, processes and results for jacket-type platforms will be presented and induced local scouring and near-field erosion/accretion processes for different wave and current conditions will be shown. The state-of-the-art 3D laser scanner topographies enable to effectively assess the underlying driving mechanisms of different scour developments and insights on the scouring processes will be presented.

1.2 Wind-Wave Correlation

A database of 10 years recorded wind speed and –direction, significant wave height and direction was created from FINO 1 data. In addition to the analysis of the wind wave characteristics of the whole 10 years, 83 storms were identified. Figure 1 shows the identified storms arranged on the abscissa by decreasing mean wind direction of the whole storm duration. The top ordinate shows the frequency of occurrence of the wind directions for each storm by the colorbar. The directional frequencies for each storm sum up to 100% and each vertical data set shows the distribution of wind directions in comparison to the simultaneous wave directions in the middle plot. The undermost plot shows the frequency of the misalignment of wind and wave directions for each storm, which tends to increase with shifting mean wind directions towards SSW (200 degrees).
Based on further details the characteristics and causes for varying misalignments and correlation of wind and wave incidents will be shown in connection to former studies [1] and locations in the North Sea.

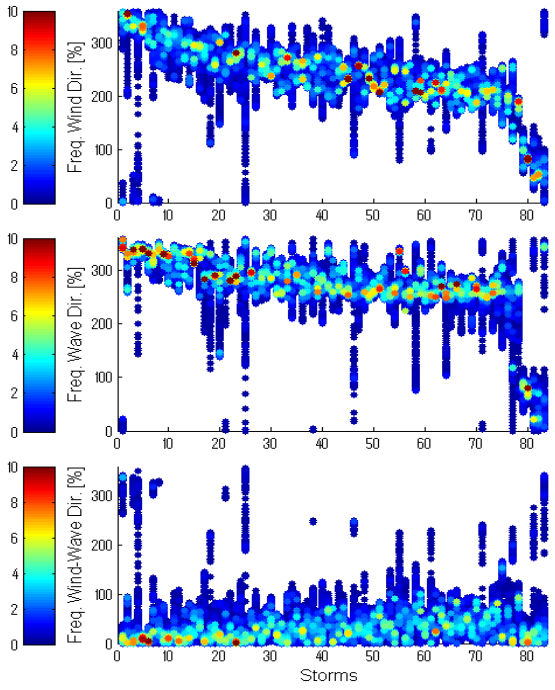

Fig. 1: Storms arranged by decreasing mean wind direction versus directional frequency of wind (top), wave (mid) and the misalignment of wind and waves (bottom).

3. References

[1] Fischer, Rainey, Bossanyi, Kühn (2011): Study on Control Concepts suitable for Mitigation of Loads from Misaligned Wind and Waves on OWT supported on Monopiles, Wind Eng., Vol. 35, No. 5, pp. 561-574