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Characterisation of impacts on the environment of an idealised offshore wind farm foundation, under waves and the combination of waves and currents

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Offshore wind technology is currently the most widespread and advanced source of marine renewable energy. Offshore wind farms populate waters through the North Sea and the English Channel. The UK and French governments devised deadlines to achieve percentages of electricity from renewable sources by 2020, these deadlines and the direct translation of land based wind farm technology to the offshore environment resulted in the rapid expansion of the offshore wind energy. New wind farms have been designed with a larger number of masts and are moving from shallow offshore banks to deeper waters and in order to produce more power the diameters of monopoles masts are becoming larger to support larger turbines.

The three-partner EU INTERREG funded project OFELIA (http://www.interreg-ofelia.eu/) aims to establish a cross-channel (between the UK and France) research collaboration to improve understanding of the environmental impacts of offshore wind farm foundations.

The objective of the present study is to characterise changes in the hydrodynamics and sea bed in the vicinity of an offshore wind farm mast and in the wake area under wave and wave-current conditions corresponding to events in the French wind farm site of Courseulles-sur-mer (offshore of Lower Normandy, in the English Channel).

Experiments were carried out in two laboratory facilities: a wave flume of 35 m long, 0.9 m wide and 1.2 m in depth with regular and irregular waves (García-Hermosa *et al.*, 2014); and a wave and current flume of 17 m long, 0.5 m wide and 0.4 m depth with regular waves, currents from 180º to the waves and a mobile bed (*Gunnoo et al.*, 2014). Flow velocity measurements were taken with an Acoustic Dopple Velocimeter (ADV) at various points around the cylinder and Particle Image Velocitmetry (PIV) techniques were applied to larger areas upstream and downstream of the cylinder. During the assessment of waves and currents' effects on the bed evolution were assessed using a laser and camera system photographing the bed (Marin & Ezersky, 2007, and Jarno-Druaux *et al.*, 2004).

Velocity fields, and flow structures around the cylinder at low KC numbers (KC∼1) were characterised and parameters such as vorticity, turbulent kinetic energy and bed shear stresses derived where possible. During the experiments vortex structures with a horizontal axis were observed in the vicinity of the cylinder and the bed even at low KC. The Keulegan-Carpenter number (KC) is defined as: $KC = \frac{U_m T}{D}$, where U_m is the bottom orbital velocity, T the peak period and D the pile diameter.

As part of the project, the findings from the experiments fed into a regional numerical modelling (Rivier *et al.*, 2014) to improve parametrisation of the representation of the within-cell processes (local to the mast).

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