Geophysical Research Abstracts
Vol. 17, EGU2015-10709, 2015
EGU General Assembly 2015


# Assessment by regional modelling of the impact of monopile foundations on the hydrodynamics and sediment transport: case of Courseulles-sur-Mer (France) wind farm

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Offshore monopile foundations of wind turbines modify hydrodynamics and sediment transport at local scale and also at regional scale. The aim of this work is to assess these changes and to parametrize them in a regional model. These modifications were previously evaluated using the regional circulation model MARS3D (Lazure and Dumas, 2008) in tests-cases (Rivier et al., 2014) using two approaches: in the first approach, monopiles are explicitly modelled in the mesh as dry cells and in the second approach a sub-grid parametrization which considers the drag force exerted by a monopile on the flow is used. The sub-grid parametrization is improved close to the bed in this paper by adding a drag force term in the momentum equations, source terms in the turbulence model and by increasing the bed shear stress at monopile location. Changes in hydrodynamics regime, especially near-bed, affect sediment transport regime and modifications due to monopiles on sediment dynamics is also investigated using the MARS3D sediment transport module (Le Hir et al., 2011) which solves the advection-diffusion equations.
Test-cases are run using hydrodynamical conditions and sediment grain sizes typical from the area located off Courseulles-sur-Mer (Normandy, France) where an offshore wind farm is planned to be built. Velocity, turbulent kinetic energy and bed thickness changes due to the monopile simulated by both approaches are compared to each other and to experimental measurements made in a flume at the University of Caen or to published data (e.g. Roulund et al., 2005; Dargahi,1989). Then the model is applied in a real configuration on an area including the future offshore wind farm of Courseulles-sur-Mer. Four monopiles are represented in the model using both approaches and modifications of the hydrodynamics and sediment transport are assessed along a tidal cycle. Currents increase at the side edge of the monopile and decrease in front of and downstream the monopile. Turbulent kinetic energy strongly increase as expected upstream the monopile. Resuspension and erosion occurs around the monopile in locations where current speeds increase due to the monopile presence and sediments deposit downstream where the bed shear stress is lower. The pattern of bed erosion is modified depending of current velocity.

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