In situ observations of turbidity plumes at an offshore wind farm

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The development of offshore wind farms (OWFs) is increasing in Europe, as is its impact on the marine environment (Punt *et al*., 2009). The increase of the Suspended Particulate Matter (SPM) concentration during the construction phase by activities such as drilling of turbine foundations, scouring of the foundations and trenching of inter-platform cables and export cable is considered as an adverse effect (Degraer *et al*., 2013). However, these construction activities are not of major concern, since the entrained SPM has a local extent and remains close to the seabed. Regarding the potential impacts during the exploitation phase of the OWF, recent satellite observations of SPM plumes at individual turbines (Vanhellemont & Ruddick, 2014) and aerial photographs in a Belgian OWF have indicated that wind turbines generate SPM plumes that may have a significant impact on the seafloor and in the water column in a larger area. The influence of OWF on the turbidity during exploitation is a recent environmental topic and the subject of the present study. *In situ* measurements after the construction of the OWF Belwind in the southern North Sea have been carried out to characterize the SPM plumes and exploring their origin. These measurements were carried out with optical (OBS) and acoustic (ADV) backscatter sensors attached to a bottom lander, and with the hull-mounted ADCP from the RV Belgica. To our knowledge, the presented measurements are the first *in situ* water column observations of SPM plumes associated with monopile foundations.

The measurements correspond well with the findings derived from satellite imagery regarding plume dimensions and concentrations. The vessel-based measurement profiled the plumes during different current speeds, from slack tide to maximal flood and for different distances from the OWF. The fixed station measurement included a co-location of an acoustic and optical backscatter sensor attached to a bottom lander. These sensors exhibit the same quarter-diurnal variations in SPM concentration over the course of the spring neap cycle, except for a few days when SPM originating from an OWF turbine was advected towards the lander. This lack in coherence between the two sensors reveals a change in SPM size and/or type, most probably triggered by the massive fouling of the hard substrates (De Mesel *et al*., 2013; Coates *et al*., 2014). The epifaunal species trap and filter SPM out of the water resulting in organic matter enrichment around the monopiles, fining of the seabed in the depositional areas downstream of the monopiles, entrainment of faecal and degraded pseudo-faecal pellets by tides, and formation of SPM plumes. The long-term impacts on the ecosystem by these biologically induced physical changes of the water column turbidity and on the seabed integrity are still vague, and need therefore special attention in future environmental impact studies.

References

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