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Vertical suspsended sediment fluxes observed from ocean gliders

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Many studies trying to understand a coastal system in terms of sediment transport paths resort to numerical modelling – combining circulation models with sediment transport models. Two aspects herein are crucial: sediment fluxes across the sea bed–water column interface, and the subsequent vertical mixing by turbulence. Both aspects are highly complex and have relatively short time scales, so that the processes involved are implemented in numerical models as parameterisations. Due to the effort required to obtain field observations of suspended sediment concentrations (and other parameters), measurements are scarce, which makes the development and tuning of parameterisations a difficult task.

Ocean gliders (autonomous underwater vehicles propelled by a buoyancy engine) provide a platform complementing more traditional methods of sampling. In this work we present observations of suspended sediment concentration (SSC) and dissipation rate taken by two gliders, each equipped with optical sensors and a microstructure sensor, along with current observations from a bottom mounted ADCP, all operated in the German Bight sector of the North Sea in Summer 2014.

For about two weeks of a four-week experiment, the gliders were programmed to fly in a novel way as Lagrangian profilers to water depths of about 40 m. The benefit of this approach is that the rate of change of SSC – and other parameters – is local to the water column, as opposed to an unknown composition of temporal and spatial variability when gliders are operated in the usual way. Therefore, vertical sediment fluxes can be calculated without the need of the – often dubious – assumption that spatial variability can be neglected.

During the experiment the water column was initially thermally stratified, with a cross-pycnocline diffusion coefficient estimated at $7 \cdot 10^{-5}$ m^2 s^{-1}. Halfway through the experiment the remnants of tropical storm Bertha arrived at the study site and caused a complete mixing of the water column. An analysis of the data showed that resuspension and deposition were solely tidally-driven and in equilibrium prior to the arrival of the storm, with an averaged resuspension rate of 3-4 g m^{-2} s^{-1}. During the storm the effect of surface waves increased the resuspension rate by an order of magnitude. The data suggest that after the passing of the storm, when the tide was the main driver again, resuspension rates are generally higher than before the storm. This provides a further indication that although a (Summer) storm might be a short-term event, its effects on sediment transport may be felt on much longer time scales.