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Vertical suspended sediment fluxes observed from a formation of underwater gliders

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In order to understand and predict the pathways and deposition of fine sediments in coastal regions valid parameterisations of the fluxes across interfaces (sea bed - water column or a pycnocline) are paramount. Traditionally, these parameterisations are based on the concept of a critical shear stress, but more recently a probabilistic approach has been proposed, in which the resuspension of sediment is assumed to have a certain likelihood, depending on the external forcing. Both approaches find their justification, to some extent, from the results of laboratory experiments, however, *in-situ* data, essential for model validation, are scarce.

In this study we develop a field method to estimate the (fine) sediment fluxes between the seabed and the water column, and across the pycnocline. The method is applied to a stratified shallow sea (the North Sea in Summer). In order to assess the results, these fluxes are interpreted in terms of bottom shear stress and current shear between upper and lower layer, respectively.

The method was tested in an experiment with two underwater gliders in Summer 2013 in the German Bight. Both gliders were equipped with optical backscatter sensors, the measurements of which serve as a proxy for suspended sediment concentration. The profiling character of the gliders allows to calculate the rate of change of the layer-averaged sediment concentration, as observed by the platform. The local, Lagrangian rate of change of sediment concentration is the balance between the fluxes across the layer's interfaces. Due to a horizontal speed of the glider of about 0.5 m/s, horizontal gradients in sediment concentration cause the observed and the local rate of change of sediment concentration to be significantly different.

The novelty of this experiment was that the two gliders were flown in a rigid formation, where one glider trailed the other at a more or less constant distance of 5 km, controlled by an algorithm. This allowed the local rate of change to be quantified – and therefore the net fluxes across the interfaces – by accounting for the effects of horizontal gradients.

The validity of this method was assessed by comparing the settling and resuspension/entrainment fluxes with physical drivers: current shear near the pycnocline and bottom shear, with wind effects and tidal motion as proxies, respectively.