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Towards improving model schematisations for the burial of fines within a sandy seabed

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Abstract

Fine sediments play an important role in the ecological functioning of coastal ecosystems, even when the seabed is predominantly sandy. Once fines are mobilized from the seabed, for instance by human activities, turbidity increases. The associated negative effects on both pelagic and benthic fauna are often estimated by using sediment transport models. These models are hampered by limited knowledge on the fluxes of fines into and from the seabed, which largely determine the affected area and residence time of fines. It is hypothesized migration of small-scale bedforms governs the burial of fines, i.e., the flux into the seabed.

To study this, we developed a conceptual model describing the temporal development of bed elevation as a function of near-bed hydrodynamics. Furthermore, the model estimates the location and mass of buried fines by linking deposition of fines to local sedimentation of sand. We validated this model with data collected during two field campaigns, situated nearshore of Egmond aan Zee, the Netherlands. As inputs for the model, we measured near-bed hydrodynamics using instrumented landers. Bed elevation was measured with multibeam echosounding, sidescan sonar and a small-scale ripple profiling sonar. Upper seabed structure was assessed by combining seabed sediment sampling with sediment profiling imagery.

The model shows that flattening of storm-induced megaripples by current-induced ripples is the dominant process for burial of fines within a sandy seabed. This process leads to a large horizontal variability in the presence of fines, with fines percentages varying an order of magnitude within meters. Model outcome agrees qualitatively with observations of upper seabed structure.

We identified the governing physical process for burial of fines in a sandy seabed and validated this with measured field data. As small-scale variability is inherent to this process, this should be explicitly accounted for in model schematisations of the seabed.

Keywords

fine sediment, North Sea, sediment transport, modelling