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Residual circulation and suspended sediment transport in the Dutch Wadden Sea

Matias Duran-Matute (1), Maximiliano Sassi (1), Gerben de Boer (2), Ulf Grawë (3), Theo Gerkema (1), Thijs van Kessel (2), and Katherine Cronin (2)

(1) NIOZ, Royal Netherlands Institute for Sea Research, Texel, Netherlands, (2) Deltares, Delft, Netherlands, (3) IOW, Leibniz Institute for Baltic Sea Research, Warnemünde, Germany

The Dutch Wadden Sea (DWS), situated between continental Europe and the Dutch Wadden Islands, is a semi enclosed basin connected to the North Sea by a series of tidal inlets and composed mainly of tidal flats and sea gullies. The DWS is of high ecological importance due to its biodiversity and has been declared a World Heritage site by UNESCO. It is a dynamic area subject to regional relative sea level rise due to global sea level rise, postglacial rebound and gas exploitation. For intertidal areas to continue to serve as feeding ground for migratory birds, a net import of sediment is required. Observations are crucial but provide only scarce information in space and time. Hence, to estimate the net influx of suspended sediment into the DWS, realistic high resolution three-dimensional numerical simulations have been carried out using the General Estuarine Transport Model (GETM). The hydrodynamics are mainly governed by the tides, the fresh water discharge from several sluices into the DWS and wind variability. It is expected that the transport of suspended particulate matter (SPM) is governed by the same factors, too, in combination with sediment sink and source terms. For validation, the results are compared against different observational data sets, such as tidal gauges, temperature and salinity at a fixed station, and the volumetric flux rate through one of the inlets obtained from an acoustic Doppler current profiler (ADCP) attached to a ferry. SPM transport is modeled for four different sediment classes each of which is defined by the critical shear stress and the settling velocity. Results show a clear net import of SPM through one of the inlets, which is in agreement with the observations. First estimates of the total sediment fluxes through the different inlets are presented together with an analysis on their variability and sensibility to the external forcing. Of particular importance is the net export of SPM during storms as well as the role of storms on sub-tidal variability.