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# Hydrodynamic and suspended sediment patterns in the estuarine turbidity zone of a mesotidal estuary from cross-sectional ADCP measurements and numerical simulations

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Carefully assessing impacts of human interventions on hydrodynamics, salinity and sediment transport in estuaries has become increasingly important due to the high ecological importance of these systems. Quantifying these changes is commonly done by numerical modeling. However, model results highly rely on the applied model formulations and model parameters. Therefore, validation of the results with measurements is necessary. In case of suspended particulate matter, the use of stationary point measurements is limited due to the high spatial variability of sediments in the water column.

This study focusses on modeling the estuarine turbidity maximum of the Weser estuary (Germany), which is a mesotidal and well- to partially mixed estuary. The estuarine turbidity maximum evolves due to known physical effects such as the gravitational circulation, tidal velocity and tidal mixing asymmetries as well as vertical and lateral advection. Those effects also contribute to high lateral and vertical variations which may in nature superposed with secondary currents by local bathymetric features. To increase the understanding of the high spatial and temporal variability of the suspended particulate matter and to validate numerical simulations, 13-hour measurements of three cross-profiles within the estuarine turbidity maximum were carried out in three consecutive years (2009 – 2011). Those consisted of continuous measurements of two vessel-mounted acoustic doppler current profiler, one of which was tilted by 20°. Also, a movable unit (with conductivity, temperature and depth probes, a laser in-situ scattering transmitter and an optical backscatter sensor) was used, also taking a water sample for calibration every 30 minutes. The employed hydrodynamical modeling tool based on the 3D shallow water equations is UnTRIM, described by Casulli and Zanolli (2002), together with the SediMorph module for calculation of transport of suspended and bed load. The model domain has a size of about 2.000 square kilometers and reaches from beyond the limit of freshwater influence to the limit of tidal influence at the tidal weir.

Preliminary investigations of the measurements show an asymmetry of the tidal velocity with vertically homogeneous flood current and surface concentrated ebb current. This goes along with a higher suspended sediment transport during flood than during ebb, leading to a net sediment transport in the upstream direction. The validation of the simulated sediment budget with the measurements proves good general agreement between simulations and observations. This contribution focusses on investigating further aspects of lateral and vertical variations of the current and suspended matter, dealing with bathymetry based secondary currents as opposed to the variations due to lateral and vertical advection described in literature.