Geophysical Research Abstracts
Vol. 20, EGU2018-5112, 2018
EGU General Assembly 2018

Implications of bio-flocculation on fine estuarine particle transport

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The settling velocity of suspended particulate matter (SPM) is a crucial parameter for predicting SPM transport and morphological development in coastal environments, such as estuaries.
While settling velocities of non-cohesive particles (for instance quartz) can be determined from their size and density, this becomes more difficult for fine cohesive particles which tend to change the size and density through undergoing dynamic flocculation processes. Previous studies have characterized flocculation as an ephemeral process governed by SPM concentration, turbulence, organic matter and TEPs suggesting strong variations over space and time.
Transparent exopolymer particles (TEPs) are polysaccharidic exopolymers produced by phytoplankton and bacterioplankton. Because of their "stickiness" TEPs can facilitate aggregation of suspended particles and existing flocs resulting in mixed bio-flocs consisting of biotic and abiotic components, which makes them important agents for bio-geochemical cycling.
In estuaries concentrations of TEPs vary over space and time which makes their influence on flocculation and particle transport difficult to assess. Despite the recognition that biological substances such as TEPs are important factors influencing flocculation dynamics and potentially estuarine fine sediment transport detailed knowledge is still lacking.
We present a coupled experimental and modelling study investigating the importance of TEPs on flocculation and transport dynamics of fine natural estuarine sediments (sampled in the Western Scheldt estuary, the Netherlands). Our experiments are conducted in a rotational flume, where sediment concentration and floc size distribution is continuously monitored using an OBS (Optical Backscatter) and LISST-200X sensor (Laser in-situ Scattering and Transmissometry). The rotational flume is used to simulate idealized tidal cycles alternating periods of high turbulence (representing flood or ebb) with periods of low turbulence (representing high- or low water slack). Equilibrium floc sizes during these experimental stages are compared for different concentrations of SPM and TEPs representing natural ranges found in estuarine ecosystems. Although in nature TEPs can represent a variety of different polysaccharides, we mimic TEP in our experiments through the addition of Guar Gum a high molecular weight polysaccharide. Finally to assess the potential impact on fine estuarine sediment transport we add the found relationships between settling velocities, SPM and turbulence at various TEP concentrations into an existing 1D estuarine transport model.
Our results show that TEPs have a significant impact on flocculation dynamics of fine estuarine sediments, which shown by our 1d simulation can also influence large scale transport behavior of SPM.