Geophysical Research Abstracts
Vol. 17, EGU2015-13585, 2015
EGU General Assembly 2015

The influence of biogenic stabilisation on the stability and transport of cohesive and mixed sediments.

Julie Hope (1,2), Rebecca Aspden (1), Jaco Baas (2), and David Paterson (1)

(1) Sediment Ecology Research Group, School of Biology, University of St Andrews. jah23@st-andrews.ac.uk,, (2) School of Ocean Sciences, Bangor University.

Recent decades have highlighted key interactions occurring at the sediment-water interface between the physical, chemical and biological properties of intertidal systems. With increased storm events and impending sea level rise, understanding these interactions is increasingly important. One key interaction, which has to be considered when investigating sediment erosion and transport, is the effect that microbial algae and their secreted extracellular polymeric substances (EPS) have on the erosion resistance cohesive and mixed sediment. Despite evidence that biofilms can increasing the stability of fine sediments by up to 10 times, sediment transport predictions have still been largely based on abiotic models (e,g Yallin parameter and Shield's model). The manner in which biological processes affect the behaviour of intertidal sediment remains a contentious topic in several disciplines, largely due to a lack of knowledge and difficulty in adequately representing these variable effects in a predictive model.

The mechanical protection provided by biofilms and the associated EPS has been investigated as part of a long-term field campaign in the Eden estuary, Scotland. This study incorporates the measurement of multiple physical (including particle size distribution (PSD), water content, flow velocity, salinity,) and biochemical (EPS content and microbial biomass) properties and the relative influence of these properties on the erosion and transport of various sediment types. Measurements were collected both within and between seasons and over tidal cycles to account for a multitude of environmental variables such as temperature, tidal input, flow velocities, weather etc. Intertidal sites were selected within the upper estuary encompassing varied bed structure (particle size distributions) within a relatively limited spatial scale to minimise the effects of salinity gradients and fluvial input across the sites.

Results indicate EPS content was significantly different between sites and seasons with a significant interaction between these variables ($P<0.001$). EPS content on the sandier site was significant higher in the summer than any other season ($P<0.001$) providing the greatest mechanical protection to the sediment, resulting in increased sediment stability whereas the mixed and muddier sites had higher EPS contents in spring ($P<0.001$ and $P<0.001$ respectively). The coefficient of variation was larger during the peak seasons than winter and autumn for EPS content, microbial biomass and sediment stability measurements, this is probably associated with the patchy distribution of biofilms on the sediment surface. PSD analysis reveals there were bimodal sediments deposited and accumulating at each site on the sediment bed, throughout the sampling period. Despite the percentage of depositing fines captured in sediment traps varying temporally at all sites, there was no significant spatial difference in sediments size classes between sites whereas the bed sediments changed both spatially and temporally suggesting variation in resuspension dynamics between sites. Significant effects, relative influence and correlations between controlling biological and physical factors at each site are explained and highlight the complexity of estuarine systems and the need for greater understanding in the face of sea level rise and increased storm events.