Geophysical Research Abstracts
Vol. 20, EGU2018-7853, 2018
EGU General Assembly 2018

Sticky Coasts: Characterising the role of biological cohesion on modulating coastal erosion in soft sediment environments

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Previous studies have identified how the degree of cohesion within a sediment fabric may directly influence sediment erosion processes. This may result from physical cohesion caused by organic matter, and natural clays, or through biologically produced polysaccharides, originating from microbial mats and bacteria. Biologically cohesive extracellular polymeric substances (EPS) are commonly associated with the pervasive secretion of marine benthic and pelagic microorganisms, such as diatoms and microphytobenthos, where they are estimated to represent 40% of the total marine organic carbon pool. To date, EPS research has focussed on the fluvial-intertidal zones and deep marine processes where EPS is shown to contribute to bedform and seabed sediment stability through the formation of a cohesive matrix, where bonds between sediment particles are created when activated by moisture. However, the presence of these 'biopolymers' have not been investigated in subaerial coastal environments where soft cliff sediments and shorelines are exposed to diurnal wetting and drying cycles associated with tides and longer term climatic events. This study offers a novel, and timely insight, drawing in previous understanding of coastal erosion mechanisms with modern sedimentary processes through a series of field and laboratory based investigations. Here, we quantify the proportion of EPS from a variety of boulder clay, Kimmeridge clay and chalk geologies along the East Yorkshire coastline. We demonstrate how EPS quantity varies with cliff material grain-size and location on the cliff (active vs stable areas). Using historical LIDAR and satellite imagery from the study site areas, we then show how EPS content manifests itself in varying rates of coastal retreat. Furthermore, through the use of low temperature scanning electron microscopy (LTSEM) analysis we will develop a more detailed classification of EPS from a sedimentological perspective through the visual representation of the internal fabric within the sediment matrix. This work will inform a series of laboratory experiments, aimed at emphasising the spatial distribution of growth and decay of biopolymers along the shoreface. It is expected that the outcome of this study will have important implications for the understanding, and future modelling of coastal erosion under predicted climate variability.