Geophysical Research Abstracts, Vol. 8, 04538, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04538

Ecosystem engineering in benthic boundary layers: thresholds and trade-offs

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Coastal salt marshes are inhabited by unique vegetations that are able to cope with hydrodynamic forces originating from waves and tidal currents. By attenuating these hydrodynamic forces from waves and/or currents, some species are able to improve their environment by enhancing sediment accretion (i.e. reduce inundation stresses). Such modification of the abiotic environment via biological activity is often referred to as ecosystem engineering, which has been shown to play an important structuring role in a broad range of stressful environments. In this study we focus on so called autogenic ecosystem engineers that induce habitat changes by their own physical structures. Using Spartina anglica as model system, we try to clarify the importance of the number of physical structures for the engineering effect. Our flume studies demonstrated quantitatively that there is a both a minimum vegetation density threshold and a minimum patch size that needs to be exceeded before the engineer Spartina is able to improve its habitat by enhancing sediment accretion. The minimum vegetation density needed to trap sediment within a tussock, may however cause the formation of erosion troughs around a tussock, which may restrict lateral expansion These flume results agreed well with field observations and the results of hydrodynamic modelling. From our study we conclude that autogenic ecosystem engineers, that induce habitat changes by their own physical structures, may require a minimum investment in physical structures to improve their habitat, but that such thresholds may as a trade-off induce negative effects at the edge.