Bio-geomorphic interactions between sedimentation and vegetation dynamics at the transition from intertidal mudflats to marshes

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Alternative stable state theory has been applied increasingly to marsh ecosystems in the past few years (e.g. van de Koppel *et al*., 2005; Marani *et al*., 2010; Wang & Temmerman, 2013). While the intertidal mudflat is a highly dynamic environment, with alternation of sedimentation and erosion, marshes or vegetation patches on the mudflat have been proved to enhance stability through sedimentation which is initiated through flow attenuation within the vegetation. In this way they improve their own environmental conditions, leading to enhanced growth of plants. This leads to the two alternative stable states: the positive feedbacks between vegetation and sedimentation lead to a high-elevated, vegetated stable state, while in the absence of vegetation, the alternation of sedimentation and erosion sustains a lower-elevated, non-vegetated state.

While these contrasting effects are known, there has been no investigation on what patterns occur in the transition zone from mudflat to marsh: how does the transition from the highly dynamic mudflat occur towards the stable marsh? How will sedimentation-erosion patterns be at the edge? In order to study this, 10 cross-shore transects of lengths of up to 15m were set up at two locations in the brackish marshes of the Scheldt Estuary, where *Scirpus maritimus*, a clonal plant, is the dominant pioneer species. Along those transects changes in elevation, plant size and shoot density as well as the position of the marsh edge have been monitored monthly over three growing seasons, from spring 2011 to December 2013. During the observation period the marshes were expanding clonally onto the mudflat along all transects with rates of up to 2m per year. Our results show correlations between the seasonal variations in plant outgrowth and sediment surface elevation, indicating that bio-geomorphic feedbacks between vegetation dynamics and sedimentation drive the evolution of the mudflat-marsh transition zone.

References

Marani M., A.D. Alpaos, S. Lanzoni, L. Carniello, and A. Rinaldo. 2010. The importance of being coupled: stable states and catastrophic shifts in tidal biomorphodynamics. Journal of Geophysical Research 115:1-15.

Van de Koppel J., D. van der Wal, J.P. Bakker, and P.M.J. Herman. 2005. Self-organization and vegetation collapse in salt marsh ecosystems. American Naturalist 165(1):E1-E12.

Wang C. and S. Temmerman. 2013. Does biogeomorphic feedback lead to abrupt shifts between alternative landscape states? An empirical study on intertidal flats and marshes. Journal of Geophysical Research: Earth Surface 118:229-240.