Long-term biogeomorphological behavior of coupled bare intertidal flats and vegetated foreshores

Willemsen, P.W.J.M; Borsje, B.W.; Vuik, Vincent; Janssen, Stephanie; Bouma, T. J.; Hulscher, SJMH

Publication date
2016

Document Version
Final published version

Citation (APA)
Willemsen, P. W. J. M., Borsje, B. W., Vuik, V., Janssen, S., Bouma, T. J., & Hulscher, SJMH. (2016). *Long-term biogeomorphological behavior of coupled bare intertidal flats and vegetated foreshores*. 68. Abstract from NCK-days 2016, Ouddorp, Netherlands.

LONG-TERM BIOGEOMORPHOLOGICAL BEHAVIOR OF COUPLED BARE INTERTIDAL FLATS AND VEGETATED FORESHORES

P.W.J.M. Willemsen[1]*, B.W. Borsje[1,2], V. Vuik[3,4], S.K.H. Janssen[2,3], T.J. Bouma[5], S.J.M.H. Hulscher[1]
[1] University of Twente, p.willemsen@utwente.nl, [2] Deltares, [3] Delft University of Technology, [4] HKV, [5] NIOZ

Over the last decades, the development of coastal areas shows a growing paradox. The majority of the world population has settled in coastal areas, while coastal flood risks are likely to increase due to global and regional changes, including storm intensity, accelerating sea level rise (SLR) and land subsidence (Bouma et al., 2014 and references herein). Conventional coastal engineering solutions are increasingly challenged by these changes and become unsustainable. Ecological engineering can serve as an alternative or add-on to conventional coastal defences, such as groins, breakwaters, dams and revetments (Temmerman et al., 2013 and references herein). The main knowledge gap hampering application of intertidal ecosystems within coastal defense schemes is lack in ability to account quantitatively for long-term ecosystem dynamics (Bouma et al., 2014). Borsje et al. (2011) indicated that the dynamic foreshore can conceptually be related to SLR and that the bed level decreases after an extreme event. More recently Möller et al. (2014) showed a stable bed in the vegetated marsh during extreme weather events, while the tidal flat in front of the marsh is more dynamic and affecting the long-term sustainability of the intertidal ecosystem (e.g. Bouma et al., 2014; Hu et al., 2015).
The overall aim of this study is to quantify the long-term (50 – 100 year) biogeomorphological behavior of the coupled bare intertidal flat and vegetated foreshore. Hypothesized is that the long-term safety level of foreshore behaves within a cyclic pattern with short term fluctuations (fig. 1). In the presentation the research outline for the coming years will be presented, focusing on different aspects. The thriving processes for the dynamic behavior will be studied. The morphologic changes of study sites in the Dutch Southwest delta will be analyzed. These changes are collected since 2014, using SED sensors collecting point data of sedimentation and erosion. The behavior of the bare intertidal flat will be assessed using the line model (DET-ESTMORF) of Hu et al. (2015), calculating long-term morphodynamics using the dynamic equilibrium theory. The foreshore as a whole will be studied using a biogeomorphological landscape model (e.g. Delft3D, XBeach). Finally, an interactive design tool will be developed to increase the practical applicability of vegetated foreshores as natural coastal defence, by parameterizing and converting the applied models.

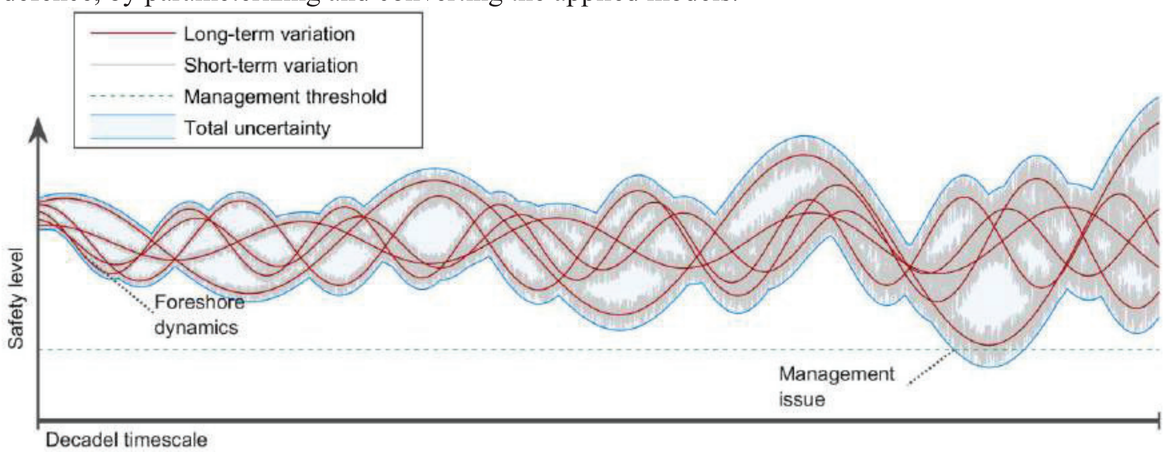

Figure 32. short- and long-term variability of the foreshore safety level (influenced by e.g. foreshore width, season, climate), that can contribute to the safety level of the dike at the back. Including a management threshold in case the ecosystem is functioning as natural coastal defence.

Borsje, B. W., van Wesenbeeck, B. K., Dekker, F., Paalvast, P., Bouma, T. J., van Katwijk, M. M., & de Vries, M. B. (2011). How ecological engineering can serve in coastal protection. *Ecological Engineering, 37*(2), 113-122.
Bouma, T. J., van Belzen, J., Balke, T., Zhu, Z., Airoldi, L., Blight, A. J., . . . Herman, P. M. J. (2014). Identifying knowledge gaps hampering application of intertidal habitats in coastal protection: Opportunities & steps to take. *Coastal Engineering, 87*, 147-157.
Hu, Z., Lenting, W., van der Wal, D., & Bouma, T. J. (2015). Continuous monitoring bed-level dynamics on an intertidal flat: Introducing novel, stand-alone high-resolution SED-sensors. *Geomorphology, 245*, 223-230.
Möller, I., Kudella, M., Rupprecht, F., Spencer, T., Paul, M., van Wesenbeeck, B. K., . . . Schimmels, S. (2014). Wave attenuation over coastal salt marshes under storm surge conditions. *Nature Geosci, 7*(10), 727-731.
Temmerman, S., Meire, P., Bouma, T. J., Herman, P. M. J., Ysebaert, T., & De Vriend, H. J. (2013). Ecosystem-based coastal defence in the face of global change. *Nature, 504*(7478), 79-83.