

Artificial Structures Steer Morphological Development of Salt Marshes: A Model Study

Authors: Rutger W. A. Siemes^{1,2}, Bas W. Borsj¹, Roy J. Daggenvoorde² and Suzanne J. M. H. Hulscher¹

¹ Water Engineering & Management, University of Twente, Enschede, The Netherlands

² HKV, Lelystad, The Netherlands

Abstract

Salt marshes are increasingly recognized as resilient and sustainable supplements to traditional engineering structures for protecting coasts against flooding. Nevertheless, many salt marshes face severe erosion. There is a consensus that providing structures that create sheltered conditions from high energetic conditions can improve the potential for salt marsh growth. However, little proof is provided on the explicit influence of structures to promote salt marsh growth. This paper investigates how artificial structures can be used to steer the morphological development of salt marshes. A morphological model (Delft3D Flexible Mesh) was applied, which enabled the analysis of various artificial structures with realistic representation. A salt marsh in the Wadden Sea which has seen heavy erosion (lateral retreat rate of 0.9 m/year) served as case study. We simulate both daily and storm conditions. Hereby, vegetation is represented by an increased bed roughness. The model is able to simulate the governing processes of salt marsh development. Results show that, without artificial structures, erosion of the salt marsh and tidal flat continues. With structures implemented, results indicate that there is potential for salt marsh growth in the study area. Moreover, traditional structures, which were widely implemented in the past, proved to be most effective to stimulate marsh growth. More broadly, the paper indicates how morphological development of a salt marsh can be steered by various configurations of artificial structures.

Keywords: salt marsh; Wadden Sea; nature-based coastal protection; artificial structures; coastal resilience; numerical modeling; process-based.

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