Long-term bio-geomorphological modelling of the formation and succession of salt marshes

Ype Attema[1], Gerard Dam[2], Bram van Prooijen[3], Robert-Jan Labeur[4], Dano Roelvink[5],

[1] TU-Delft, Svasek Hydraulics; y_h_attema@hotmail.com
[2]Svasek Hydraulics, UNESCO-IHE, Dam Enginering; gerard.dam@damengineering.no
[3]TU-Delft; b.c.van.prooijen@tudelft.nl
[4]TU-Delft; r.j.labeur@tudelft.nl
[5]TU-Delft, UNESCO-IHE, Deltares; d.roelvink@unesco-ihe.org

1. Introduction

The interaction between vegetation and the morphodynamics is considered to be an important process in salt marsh formation and succession. Therefore, the inclusion of vegetation modelling on the long-term morphological development of salt marshes is assessed by implementing a vegetation growth model in the morphodynamic modelling software FINEL2d.

2. Approach

The vegetation growth model as proposed in Temmerman et al (2007) was implemented in the package FINEL2d. This allows for the simulation of the interaction between vegetation, hydrodynamics, sediment transport and morphology. The vegetation growth model of Temmerman is based on an increase of vegetation stem density by means of a random possibility of establishment in combination with reduction of stem density for severe flow conditions or too much inundation. A modification of this concept was made, following the Windows-of-Opportunity concept as proposed in Balke et al. (2011). By this modification, the establishment of vegetation depends on the inundation time and maximum bed shear stress.

The vegetation-growth models have been tested on a simplified small tidal basin to assess the performance and the sensitivity. Subsequently, these models have been employed to hindcast the formation and succession of "The drowned land of Saeftinghe".

The Saeftinghe case study results demonstrate that the proposed method can reproduce the development of channels, tidal creeks and tidal flats over a 100 year period, see Figure 1.

3. Conclusions

Two types of systems have been identified: In Type 1 vegetation is leading and morphological development follow, whereas in Type 2 the morphological development is leading and the vegetation follows. For Type 1, the exact development of vegetation growth is essential. In this type of system the vegetation growth determines the tidal creek pattern. On the other hand, for Type 2, as in the 'Saeftinghe' case, the contribution is less significant. This is reflected in the fact that there are minor differences in channel and tidal creek patterns between the bio-geomorphological simulations and the purely morphological model results.

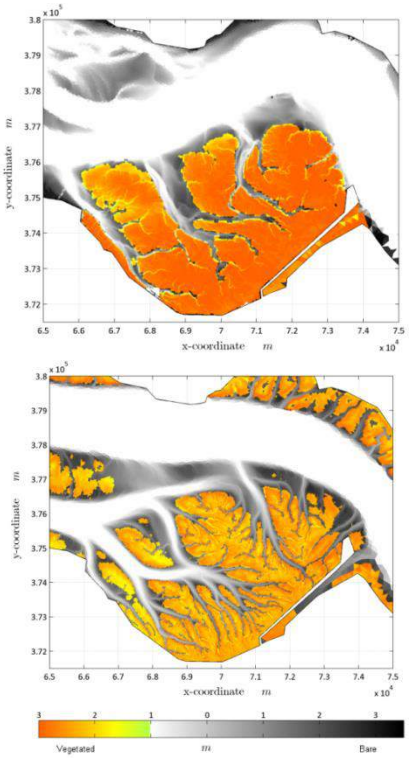

Figure 1: Bed level elevation and vegetation patterns for "Saeftinghe". *Upper:* Measured *Lower:* Modelled

References

Temmerman, S., et al. (2007). Vegetation causes channel erosion in a tidal landscape. *The Geological Society of America*, 35(7), 631-634.

Balke, T., et al., (2011). Windows of opportunity: thresholds to mangrove seedling establishment on tidal flats. *Marine Ecol. Progress Series*, 440, 1-9.