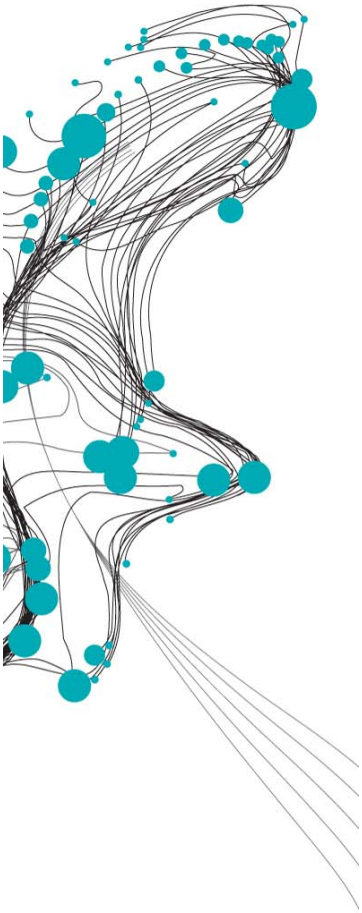
Tynke Siegersma

Graduation Date:
8 February 2022

Graduation committee:
University of Twente
Dr.ir. B.Borsje
Dr.ir. E.Horstman
Dr.ir. P.W.J.M. Willemsen

MODELLING PIONEER VEGETATION ESTABLISHMENT AT CONSTRUCTED SALT MARSHES FROM SEASONS TO DECADES

Nature-based Solutions that combine salt marshes with traditional coastal protection structures are gaining popularity in the face of ongoing climate change. Vegetation establishment is of major importance herein as it facilitates salt marsh growth in lateral and vertical direction. However, the effects of marsh-supporting management measures (e.g. brushwood dams) on the establishment of pioneer vegetation on salt marshes are still understudied. To that end, this study quantifies hydrodynamic and morphodynamic thresholds for vegetation establishment based on observations from a constructed salt marsh. Bed level changes, inundation, and vegetation characteristics of the dominant pioneer species Salicornia were monitored during growing season 2021. Subsequently, the existing hydromorphodynamic DET-ESTMORF model was extended with the ability to predict vegetation establishment based on these thresholds. This extended model was then used to predict pioneer vegetation establishment on the short-term under different dam heights and on the long-term under expected sea level rise the coming 80 years.



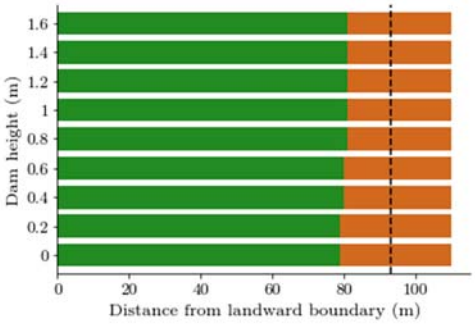


Figure 1: Vegetation establishment after one growing season with different dam heights. Green represents vegetated, whereas brown represents bare areas. The dotted line depicts the location of the dam.

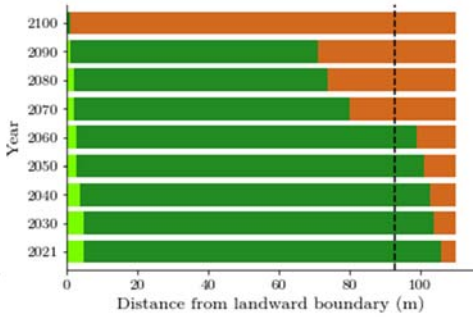


Figure 2: Long-term vegetation establishment when 7.6 mm sea level rise per year was taken into consideration. Light green represents the predicted establishment before the bed was elevated in 2017 to facilitate salt marsh formation.

Increased dam height does not result in a significant increase in vegetation establishment boundary at this specific location (Figure 1), due to the relatively high bed level already present. The vegetation boundary moves only 2 m towards the sea when the dam height increases from 0 to 0.8 m (Figure 1). However, higher dam heights do result in higher sedimentation rates at the area landward of the dam. Predicted sea level rise caused the vegetation boundary to retreat landward each decade until almost no vegetation was present anymore in the year 2100 (Figure 2). In summary, the exceeding of the vegetation establishment thresholds each growing season results in the vegetation boundary moving towards the coast on the long run. All in all, the extended DET-ESTMORF model can hence be used to simulate the effects of different management measures on vegetation establishment on a constructed salt marsh per growing season or over a prolonged period.

Hu, Z., Wang, Z. B., Zitman, T., Stive, M, Bouma, T. (2015). Predicting long-term and short-term tidal flat morphodynamics using a dynamic equilibrium theory. *JGR: Earth Surface*. 120. 10.1002/2015JF003486.

UNIVERSITY OF TWENTE.