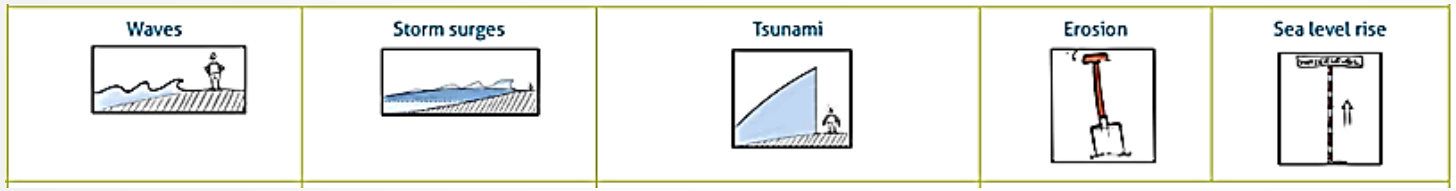




Marsh Mudflat Dynamics under Sea Level Rise (SLR)

Advancing fundamental understanding and adaptation



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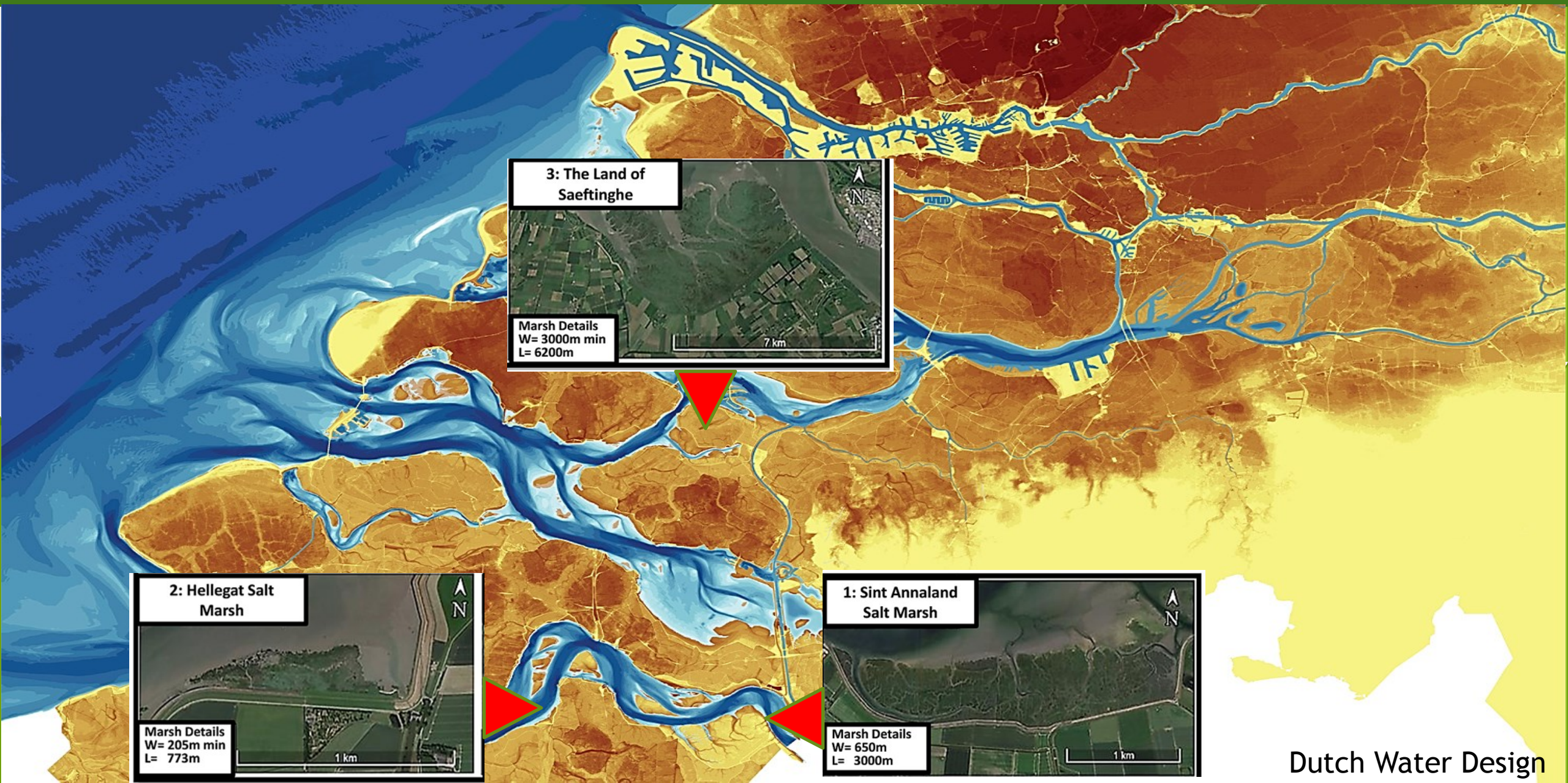
Overview of Salt Marshes in the South Western Delta



System Components

- Semi-diurnal tidal dynamics, mean tidal range ~ 3.9m with small waves
- Banks of active shipping channel have suffered major erosion
- Water levels have increased ~3mm (mouth) and ~15mm(inner sections) of the Estuary. (Temmerman, et al., 2005)
- Predominantly cohesive/fine sediments

Parameter	Value	Unit
Domain	2500 x 500	[m]
Cell Size	10 x10	[m]
Wave Height	2 -3 (Storms) & 0.7 (Normal)	[m]
Tidal Range Variations	4.49 to 5.93m	[m]

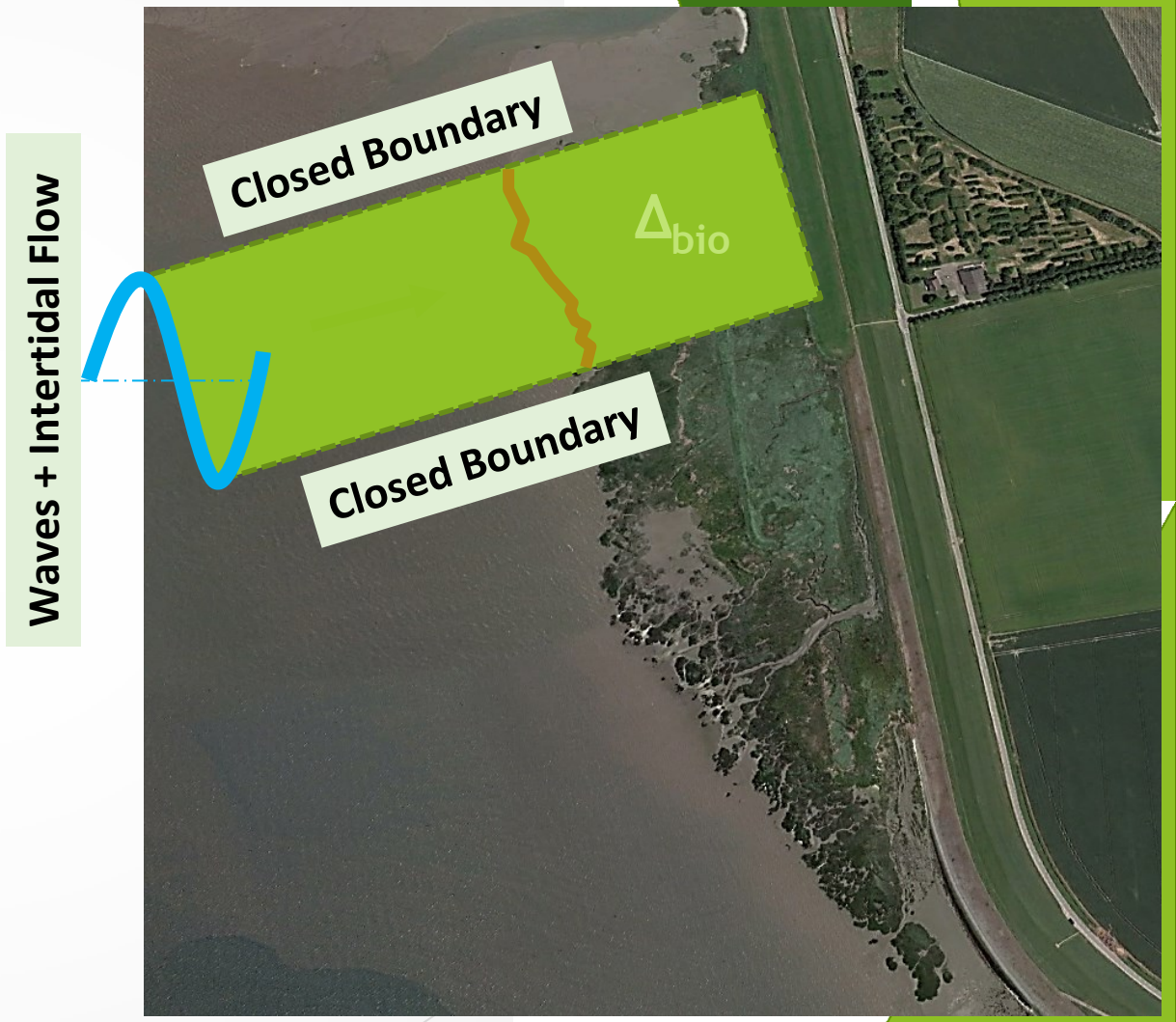
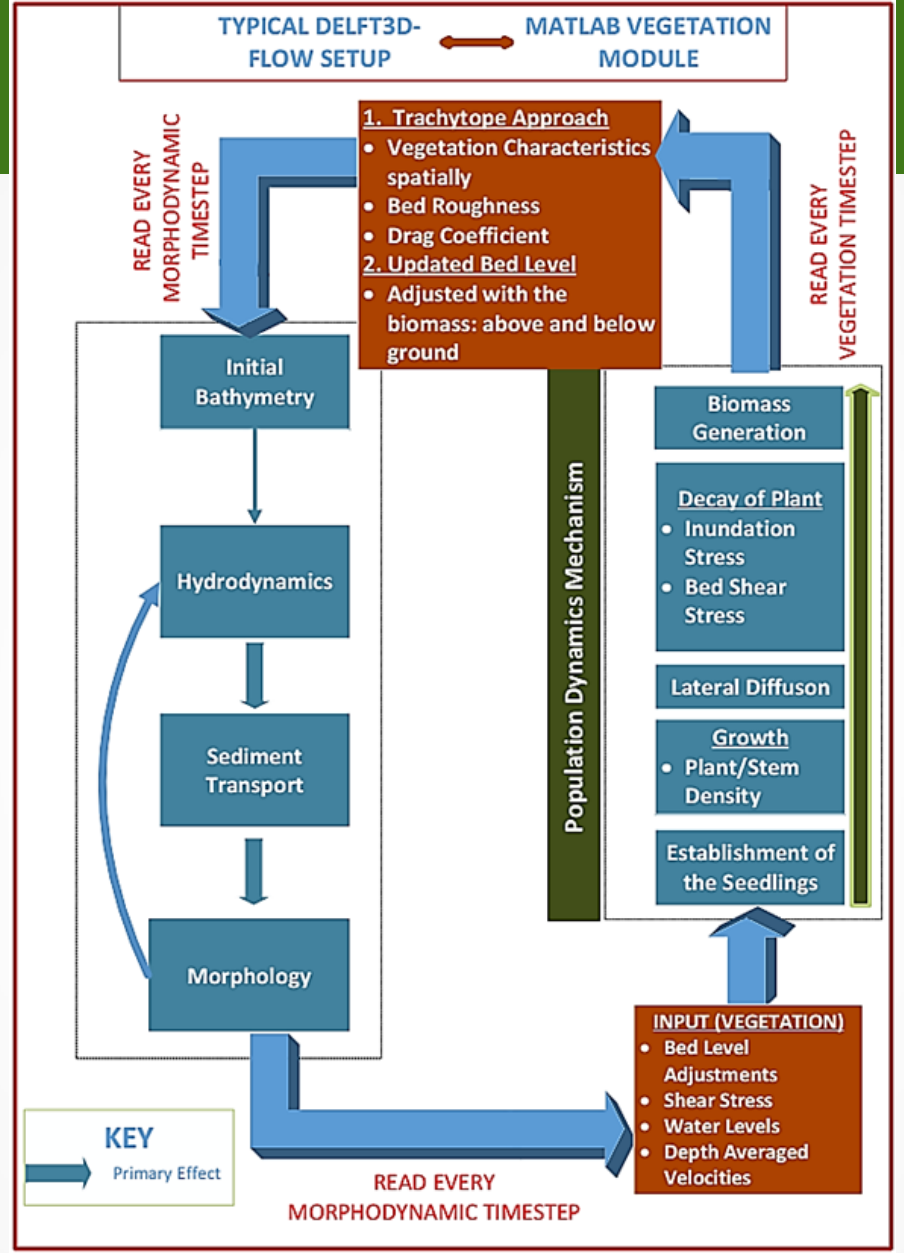


Figure: The Hellegat Salt marsh, Western Scheldt (Best, et al., 2018)

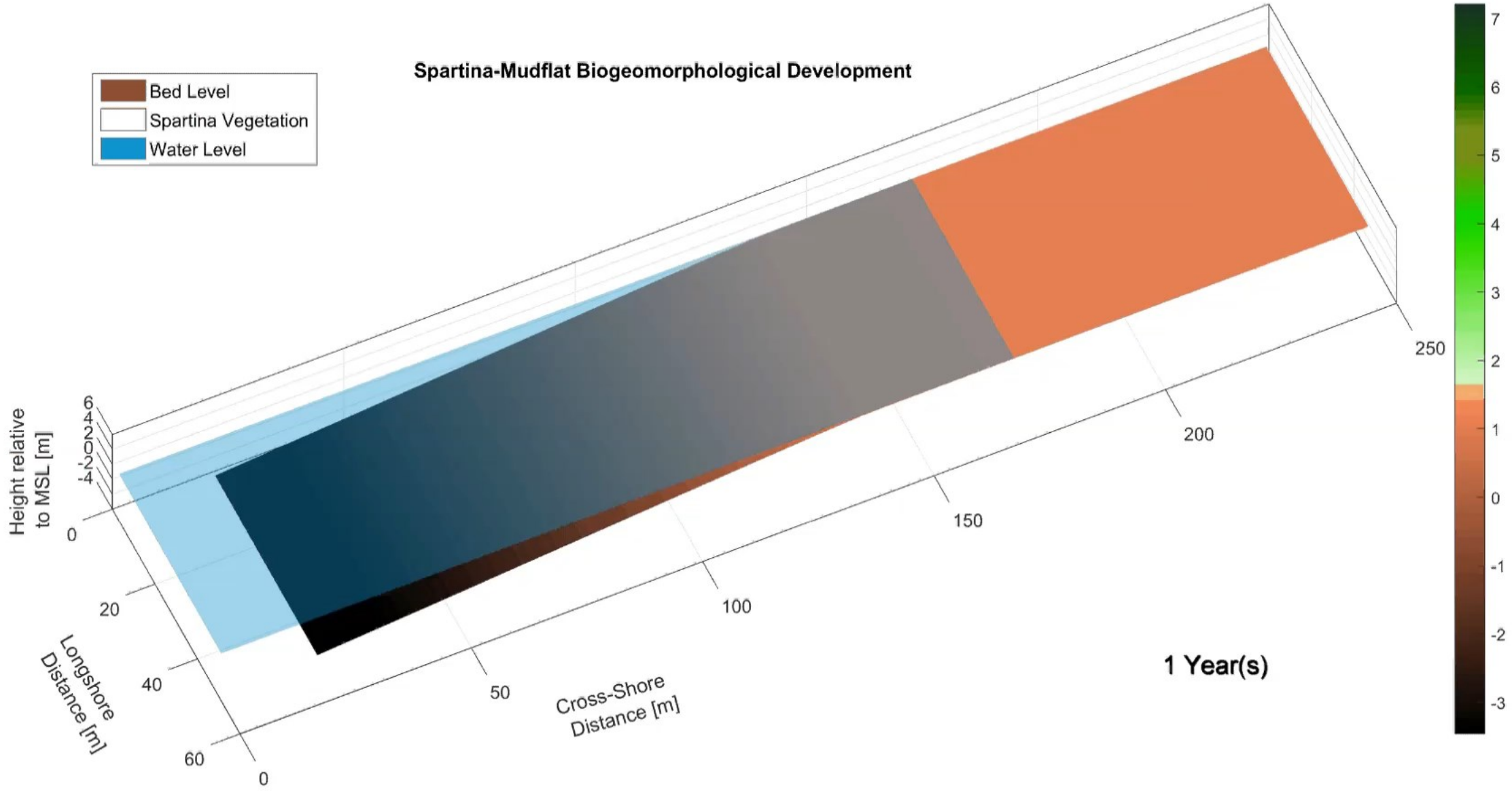
METHODOLOGY
Model Dynamics



For more information kindly see Best, et al., (2018)

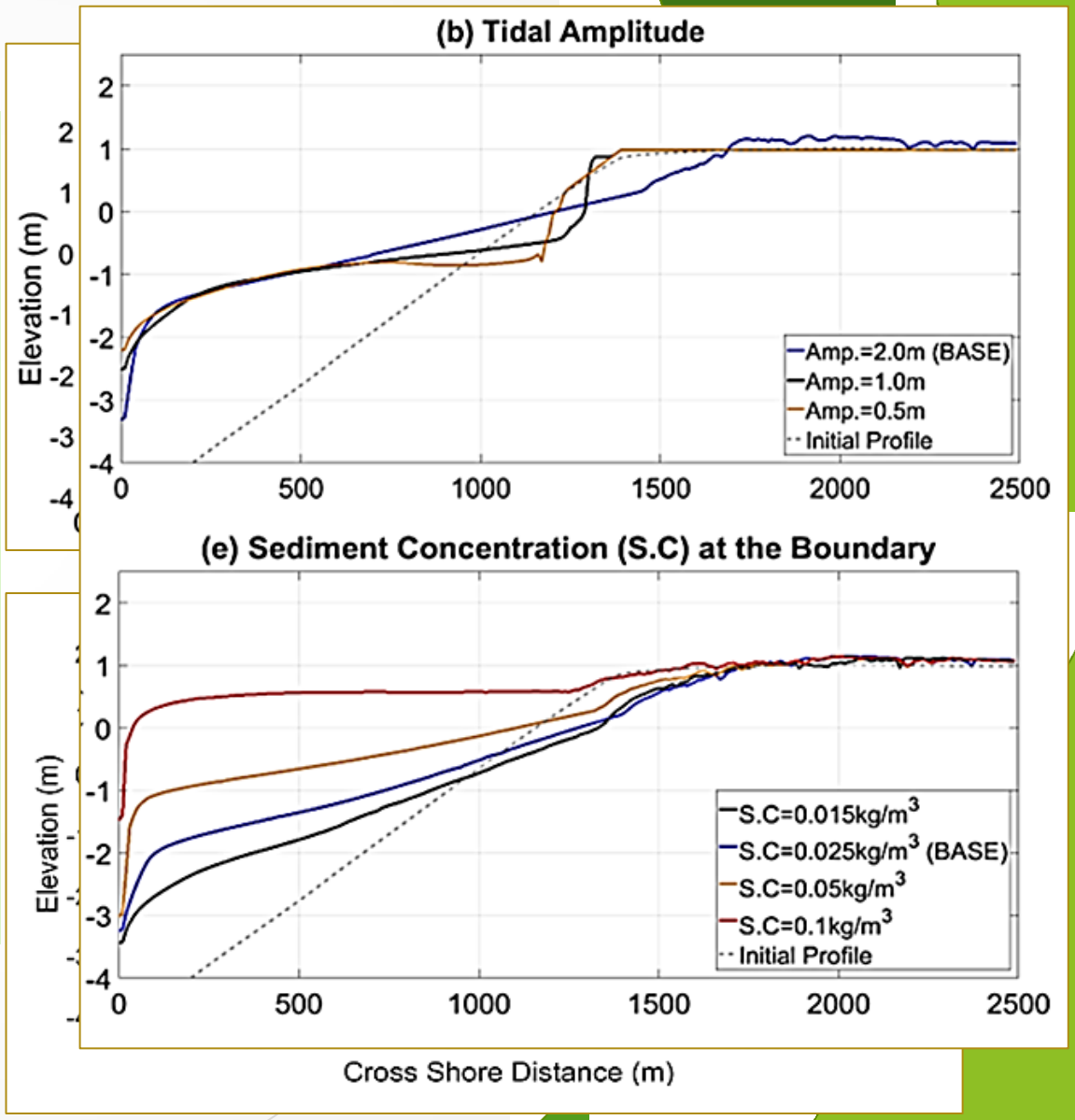
Best ÜS, van der Wegen M, Dijkstra J, Willemsen P, Borsje B, Roelvink D (2018) **Do salt marshes survive sea level rise? Modelling wave action, morphodynamics and vegetation dynamics.** Environmental Modelling & Software

Model Dynamics

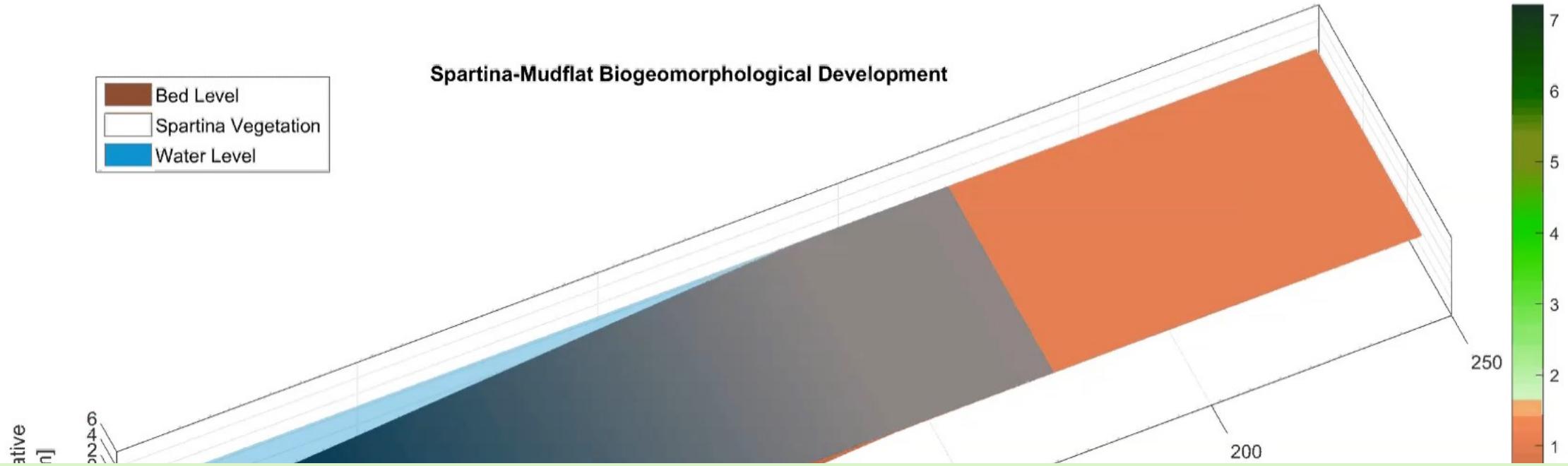


Wave, Tidal Range & Sediment Impact on Marsh-Mudflat Dynamics

- Tidal amplitude ≥ Marsh level, waves dissipate at MHWL = gentler transitions.
- Dredging may result in steep slope formations and instability with narrower marsh platforms.
- Restoration works which stir up the sediment offshore allow for greater deposition in the marsh.



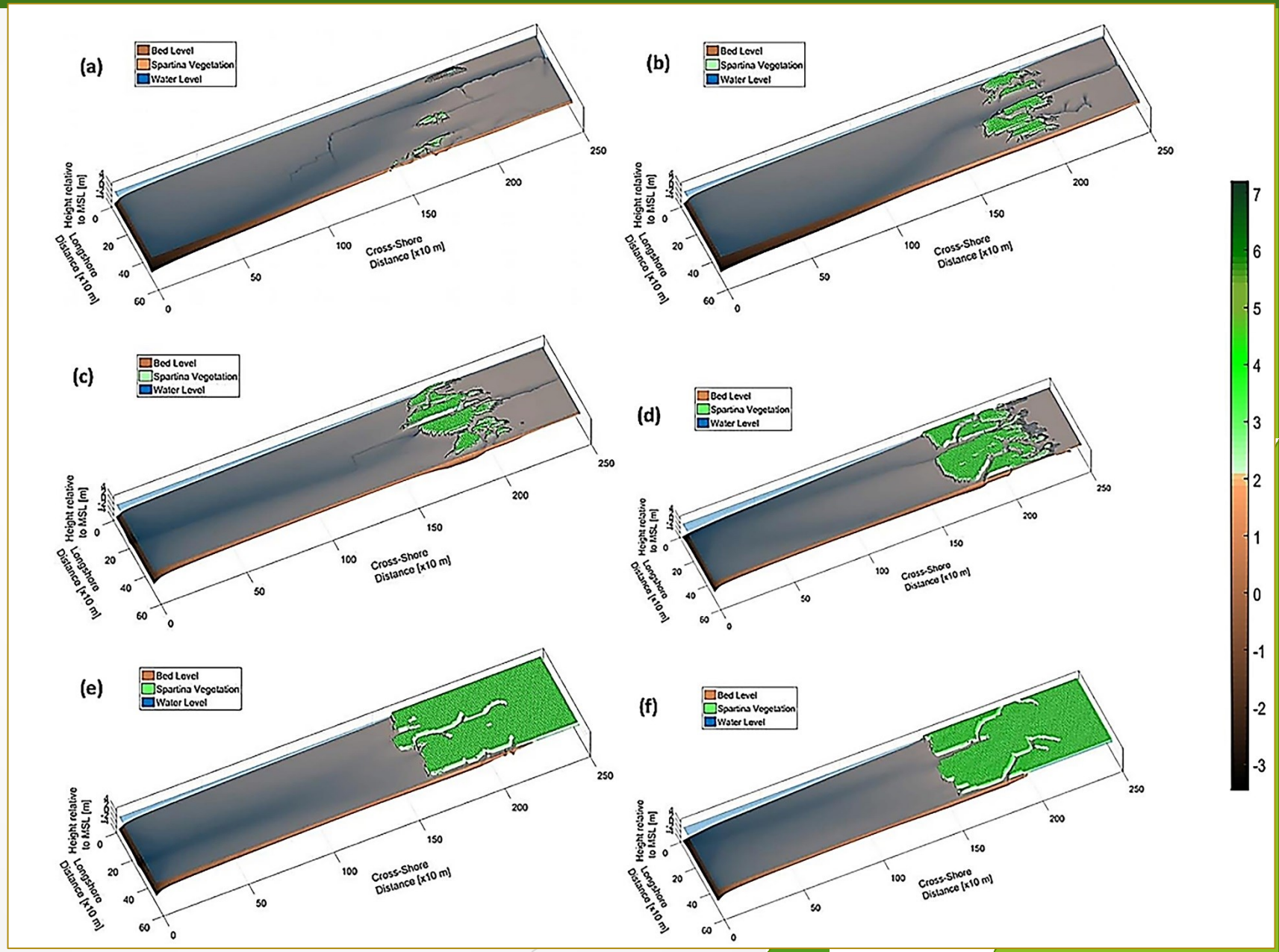
Sea Level Rise, Linear & Scenario-based (IPCC, NOAA) Rates



- Salt marshes were shown to unable to adapt under SLR (IPCC RCP 8.5, 1.14m/century and NOAA 2.0m/century). Distinct tipping points do exist.
- Larger tidal prism increases the flow velocities thereby enhancing seaward erosion and landward deposition.
- Critical rate of increase, 4mm/yr where channels completely incise platform.

Below Ground Biomass

- Higher bio/accumulation rates = marsh heightening +progradation under SLR
- Initial conditions are critical e.g bed elevation
- Biomass production not sufficient in low production marshes.
- Survival is gained by increasing the system's overall accretion rate > 5mm-yr.



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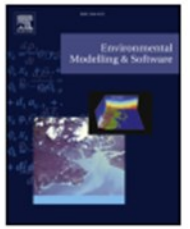

Do salt marshes survive sea level rise? Modelling wave action, morphodynamics and vegetation dynamics

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ABSTRACT

This paper aims to fundamentally assess the resilience of salt marsh-mudflat systems under sea level rise. We applied an open-source schematized 2D area model (Delft3D) that couples intertidal flow, wave-action, sediment transport, geomorphological development with a population dynamics approach including temporal and spatial growth of vegetation and bio-accumulation. Wave-action maintains a high sediment concentration on the mudflat while the tidal motion transports the sediments within the vegetated marsh areas during flood. The marsh-mudflat system attained dynamic equilibrium within 120 years. Sediment deposition and bio-accumulation within the marsh make the system initially resilient to sea level rise scenarios. However, after 50–60 years the marsh system starts to drown with vegetated-levees being the last surviving features. Biomass accumulation and sediment supply are critical determinants for the marsh drowning rate and survival. Our model methodology can be applied to assess the resilience of vegetated coast lines and combined engineering solutions for long-term sustainability.

- The marsh
- Drowning c
- Further wo
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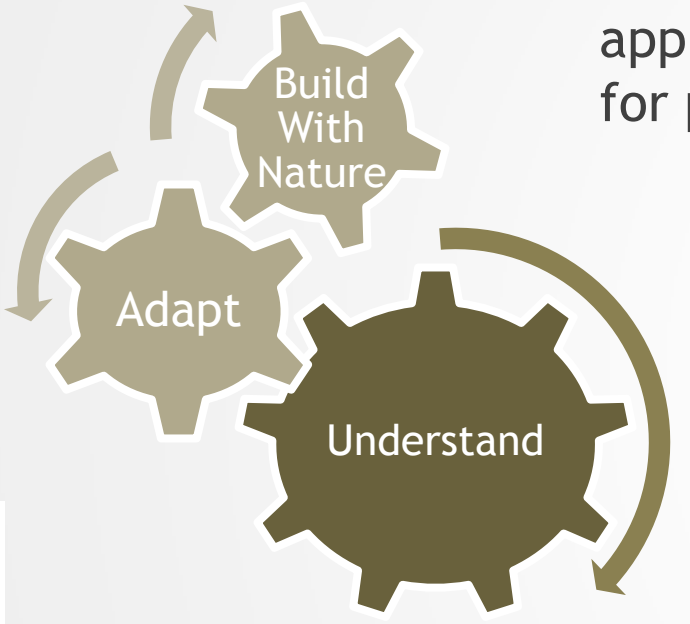
Closing Remarks



- Future research may utilize process-based approaches to evaluate engineering solutions for protection and restoration strategies.

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