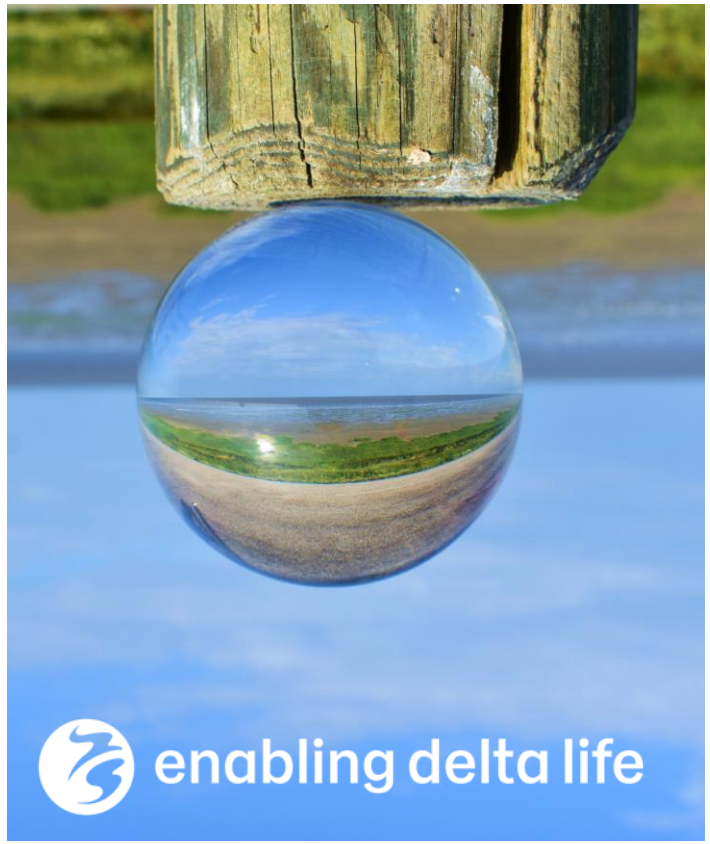
Asia Water Forum 2022
8–11 August 2022 • Online

Focus Area: 1: Water as a sustainable resource

Session Title: 1E: Nature-based solutions and integrated perspectives

Schedule: [11 August 2022 (Thu), 9:00 a.m. - 10:30 a.m. (GMT+08)]



Tools for the design and assessment of resilient mangrove coasts - and other Nature-based solutions

Jasper Dijkstra - Deltares
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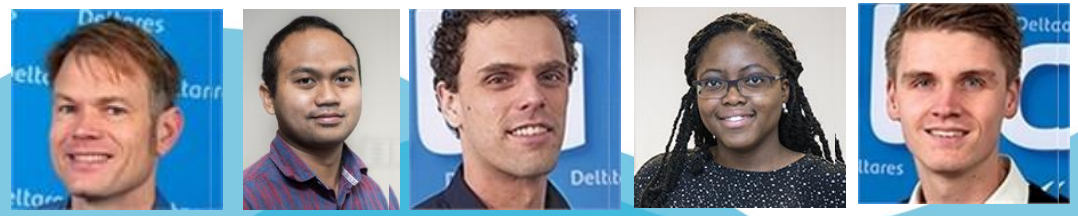
Pim Willemsen – Deltares, Twente University
Uwe Best – Deltares, IHE Delft
Bob Smits - Deltares



Rationale: managing NBS functions over design lifetime

Functions:

- Flood risk reduction
- Food provisioning
- Habitat
- Nutrient and carbon cycling
- Sediment sink
- Recreation/tourism

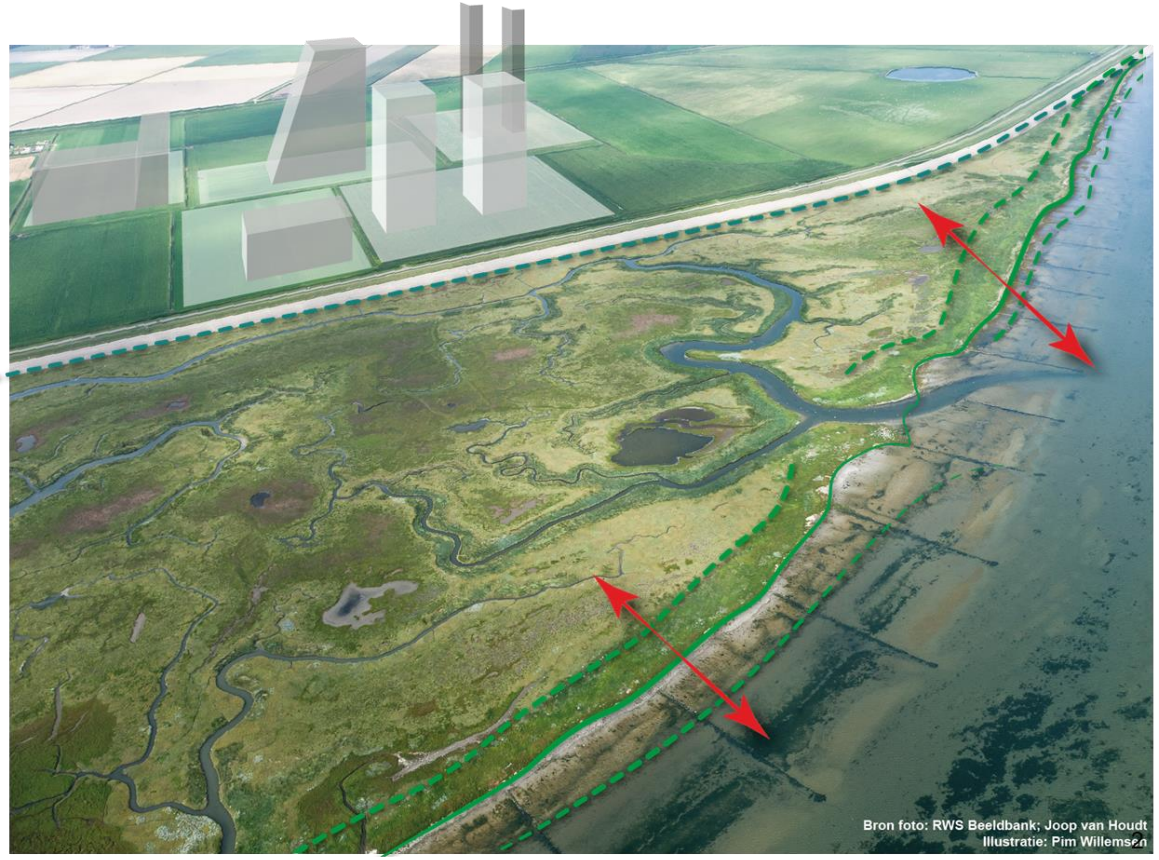
Performance / function

relate to wetland extent

Wetland extent is dynamic:

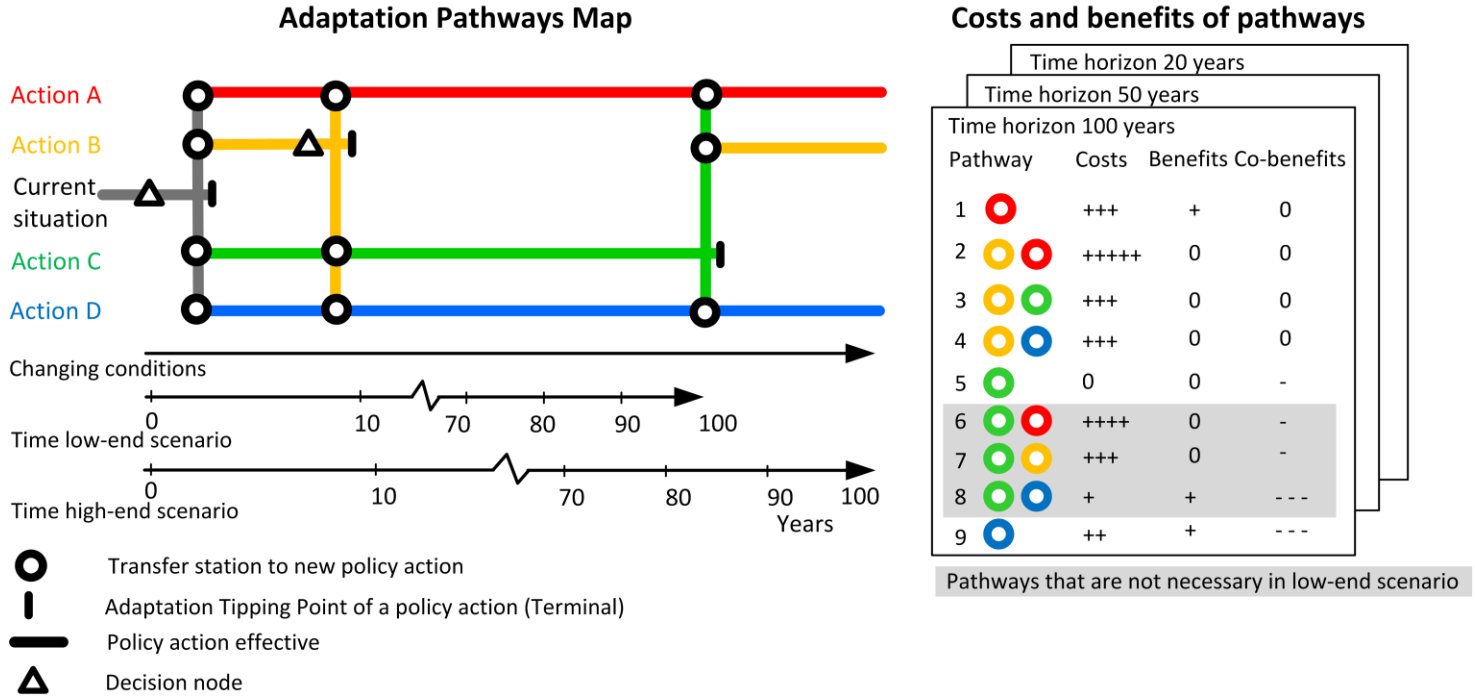
- rSLR
- Sediment supply
- Wave climate
- Vegetation cover

Development



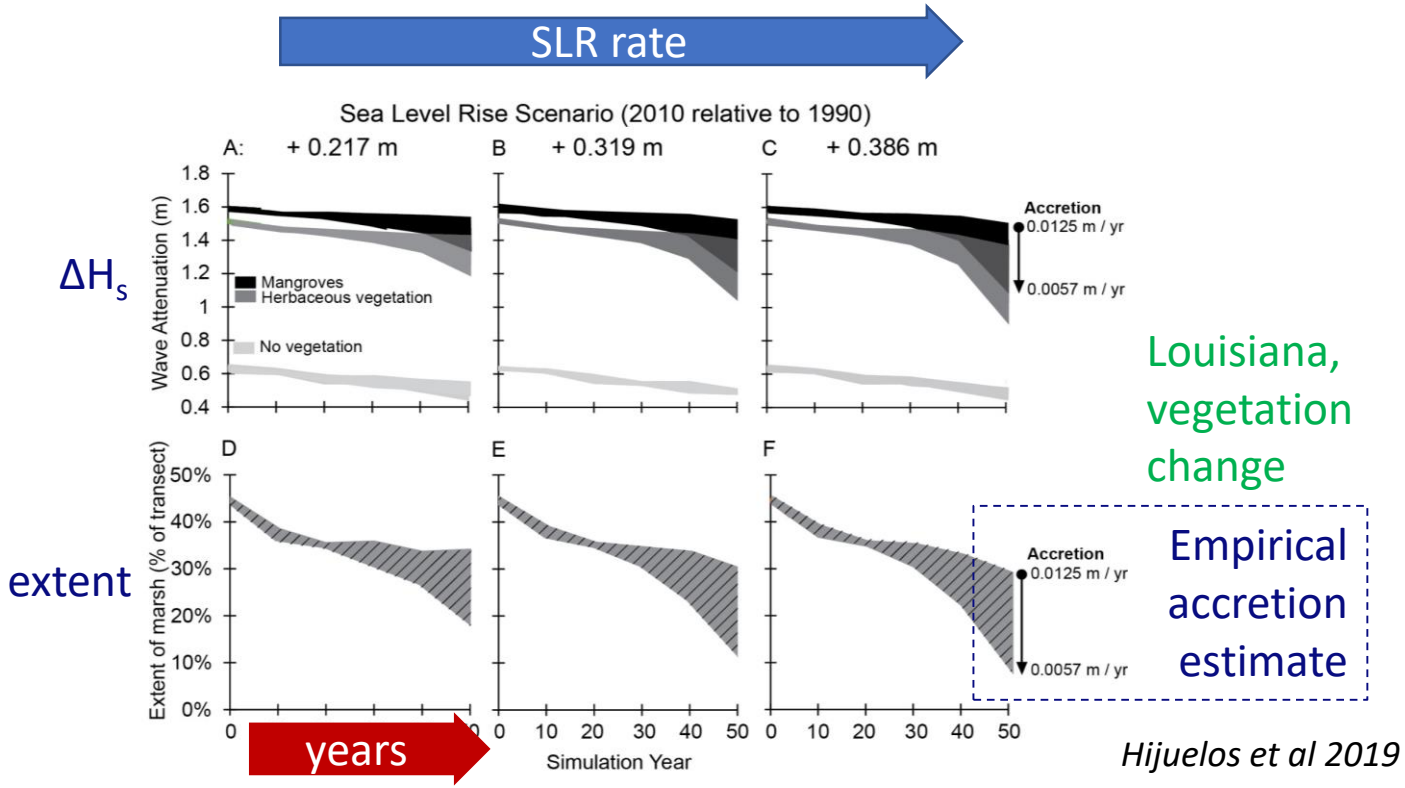
Managing NBS functions to enable implementation

- Management: Need to quantify the effects of integrated Nature-based solutions to inform cost-benefit analysis
- Stakeholders: Demand for insight, transparancy on benefits and consequences of solutions
- E.g., exploration of adaptation pathways (DAPP approach) requires quantification of services over time



Process-based dynamics in relation to (changing) environment

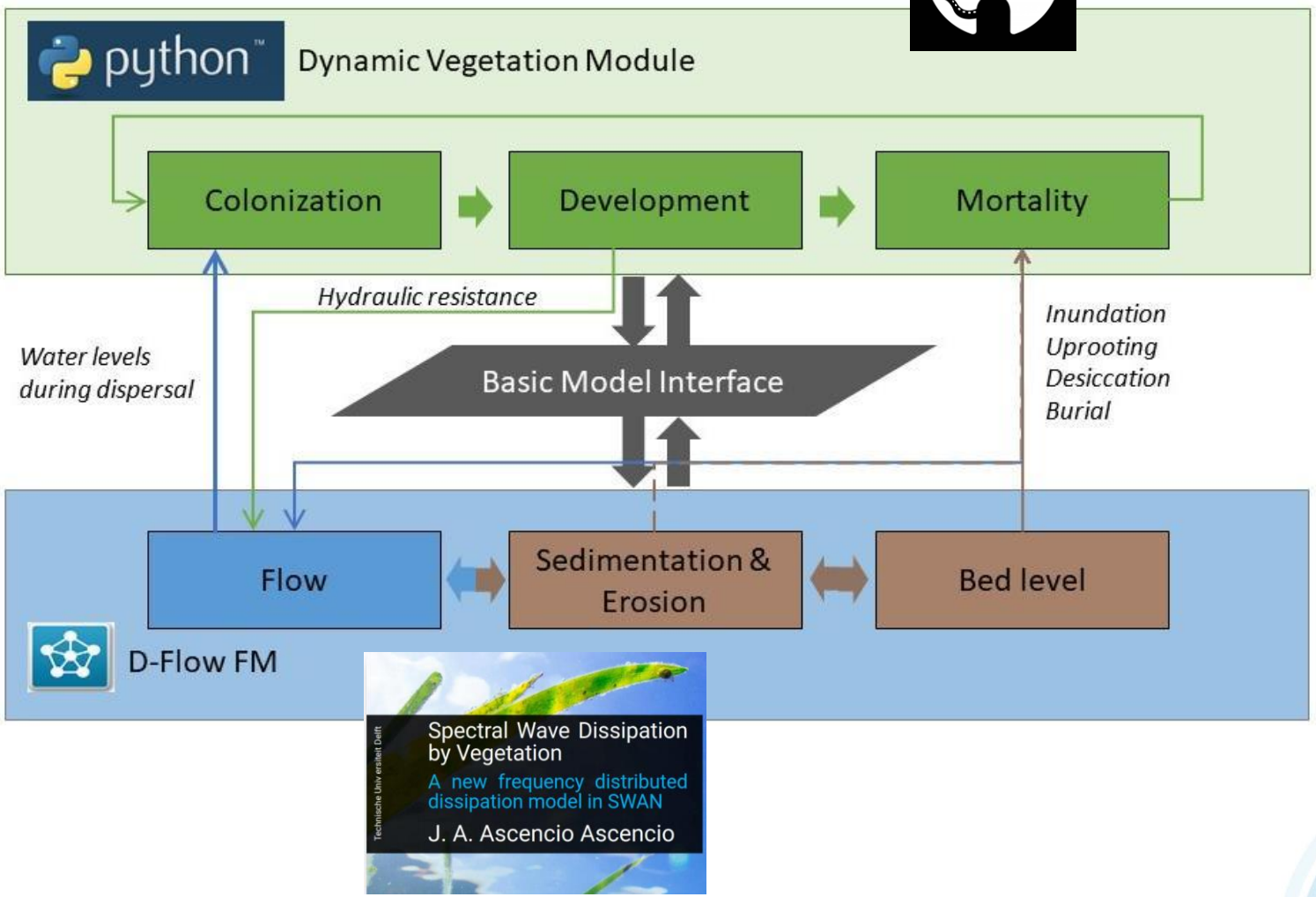
- Tool purpose: Quantifying spatial and functional change over time
- Not straightforward and not linear due to biophysical feedbacks involved
- How applicable are empirical models under scenarios of change?



Process-based ‘Nature-based solutions’ modelling

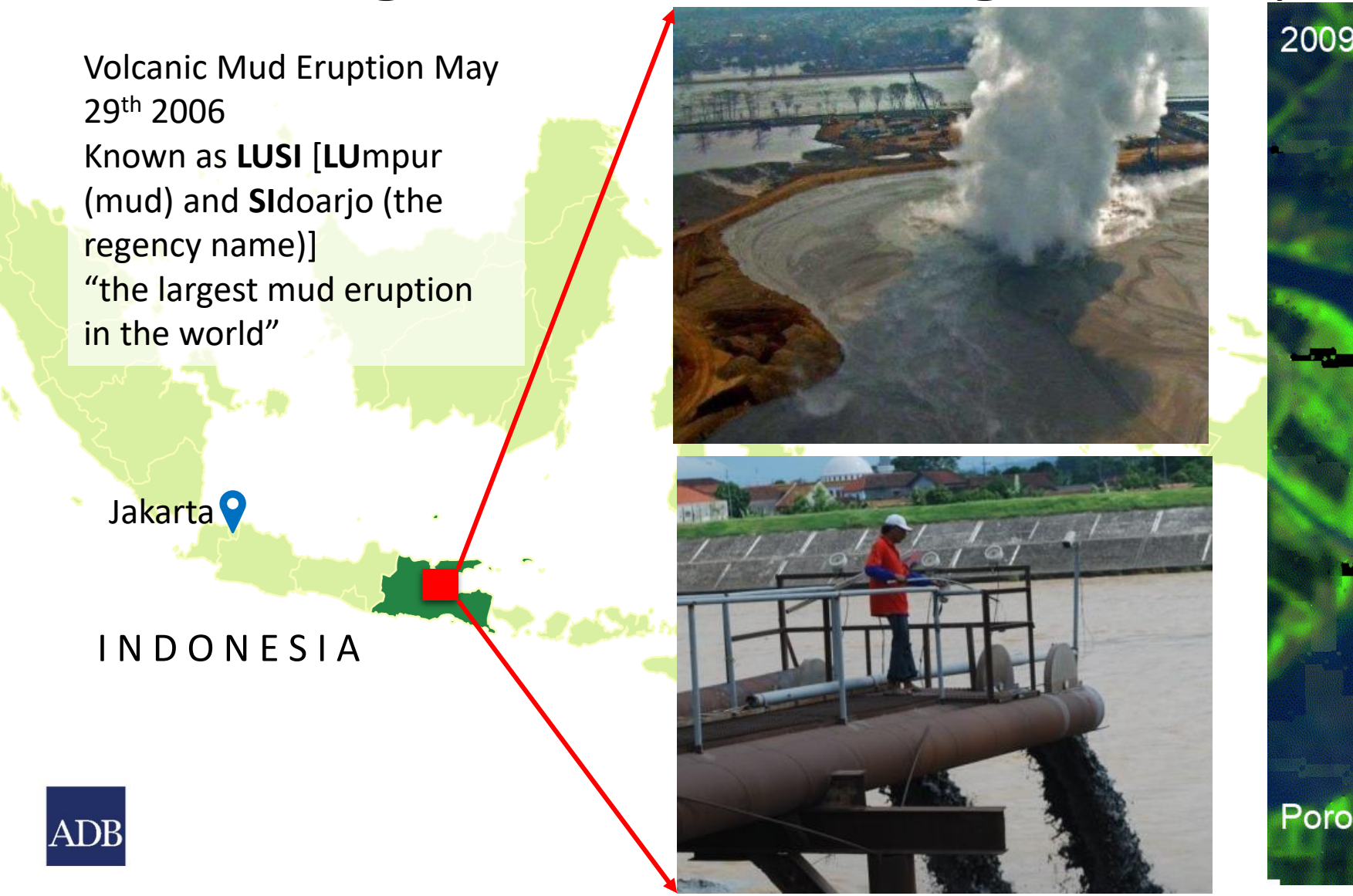
- Based on Delft3D – Flexible Mesh suite (Open Source) with realistic vegetation drag options
- Fast and flexible feedbacks with Dynamic Vegetation Module in Python via Basic Model Interface (BMI)

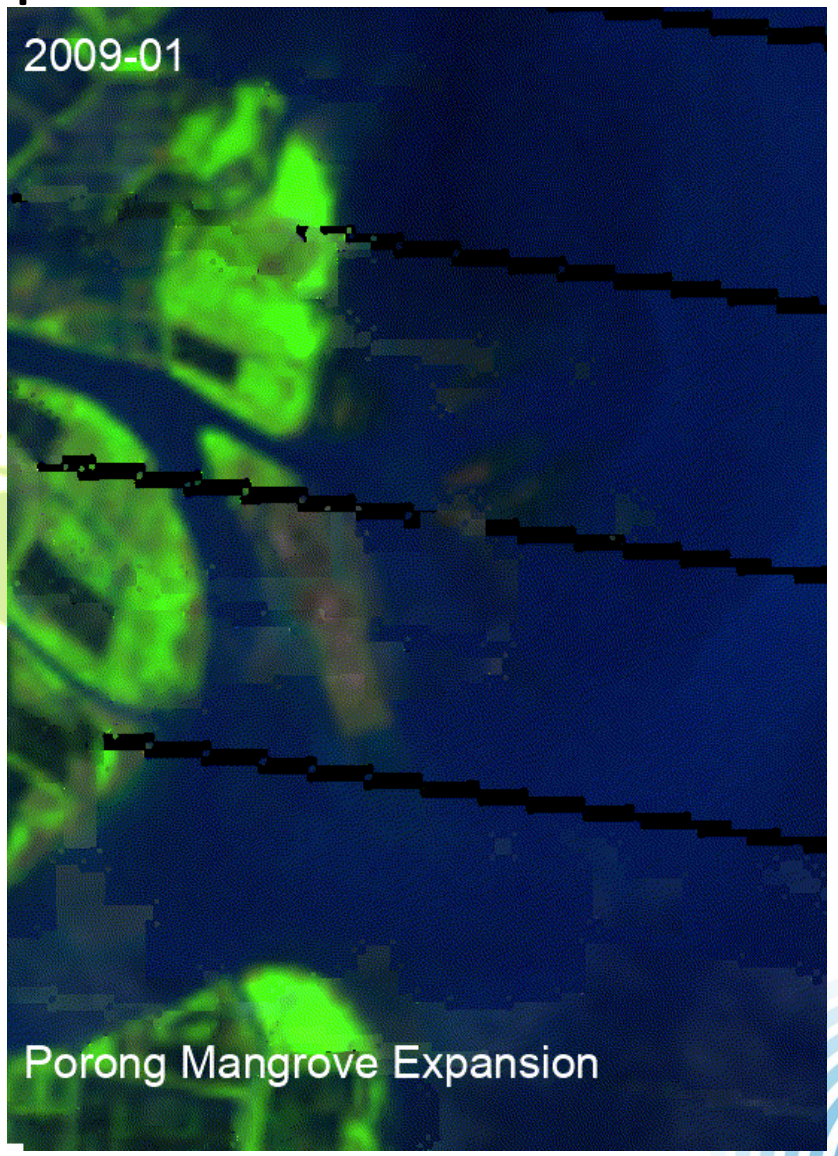
On Github



Porong Delta and Mangrove Expansion

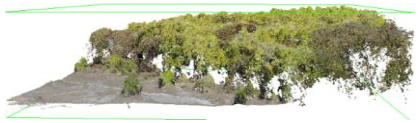
Volcanic Mud Eruption May 29th 2006
Known as **LUSI** [**LU**mpur (mud) and **SI**doarjo (the regency name)]
"the largest mud eruption in the world"



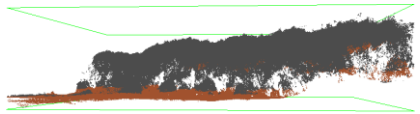


Retrieving Mangrove Biophysical Properties from Sky

UAV-based SfM Photogrammetry

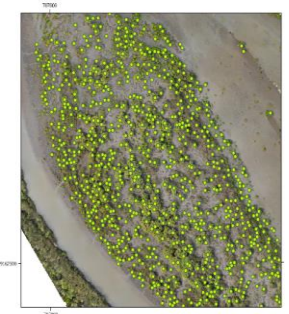


cleaned point clouds



ground classification

height-normalised



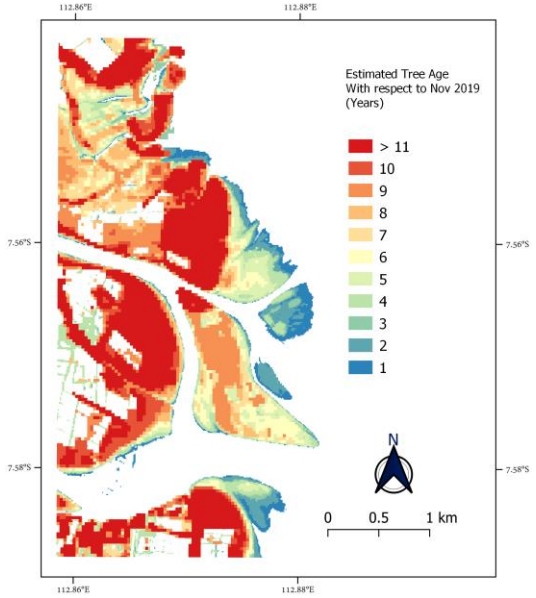
individual tree detection and very high resolution orthomosaic

Landsat 7

Landsat 8

Sentinel 1 and 2

age map



mangrove extent development

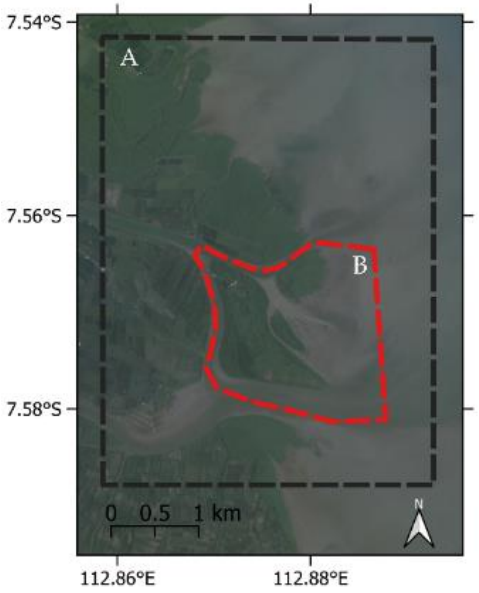
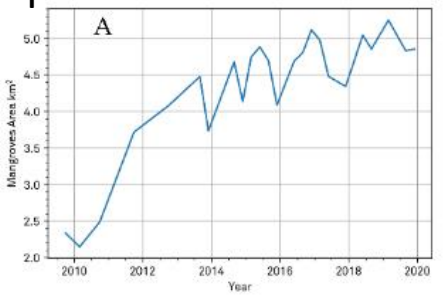
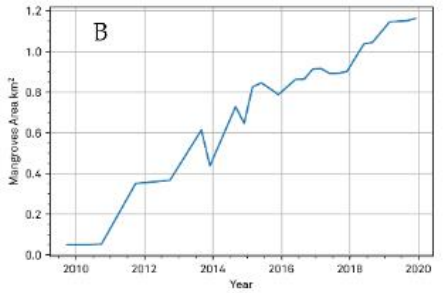
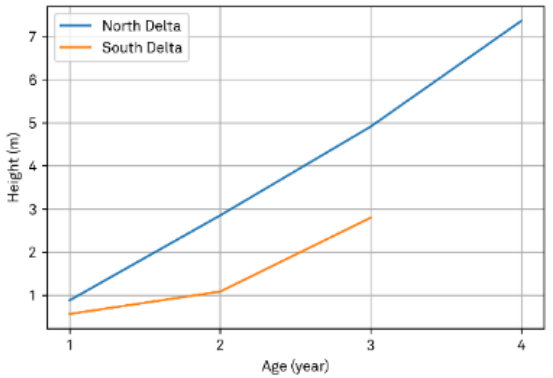


Image Source: Planet Tropical Analyzed Analytic Monthly October 2020





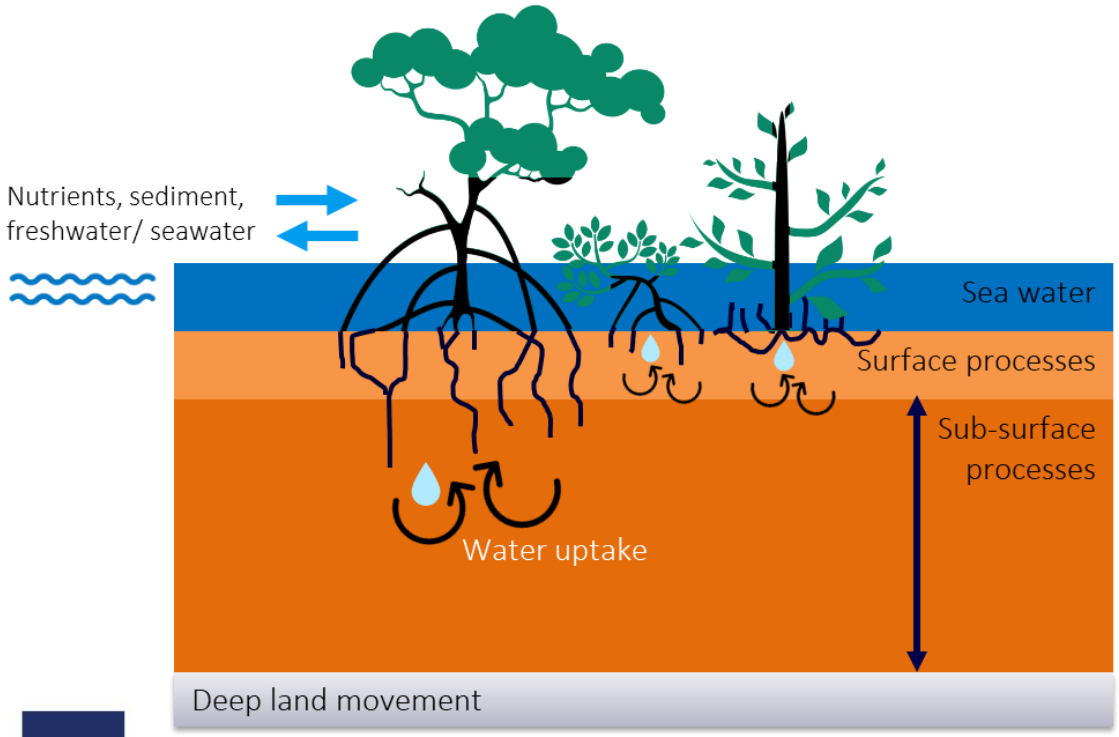
age-height relationship



Beselly, et.al. (2021) Eleven Years of Mangrove–Mudflat Dynamics on the Mud Volcano-Induced Prograding Delta in East Java, Indonesia: Integrating UAV and Satellite Imagery.

Individual-Based Mangrove Model Coupled with Delft3D-FM (Spatially Explicit)

Mangrove plant-soil feedbacks
Require tree-to-tree interactions model (individual-based)



Hydro-period

Soil Elevation

Regulators

Porewater Salinity

Resources

Nutrient (chemical/ biochemical) *

* Assume always in optimum condition (not yet implemented)

Complete with full life cycle of mangroves and tree recruitment

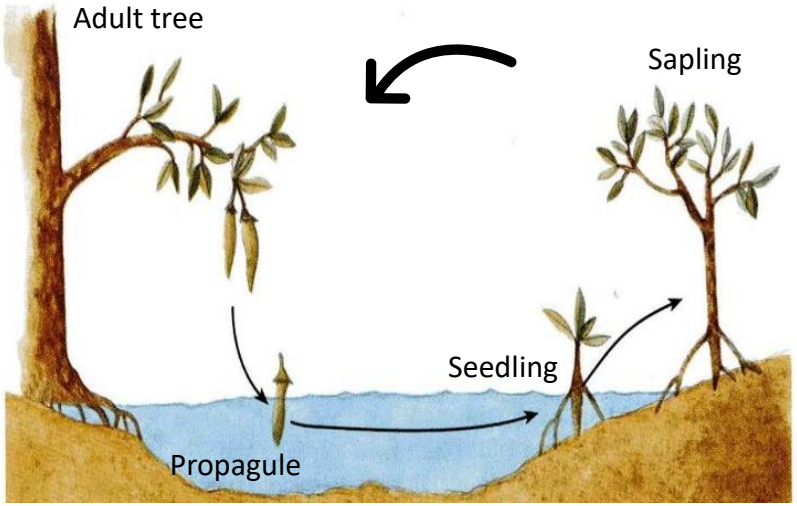
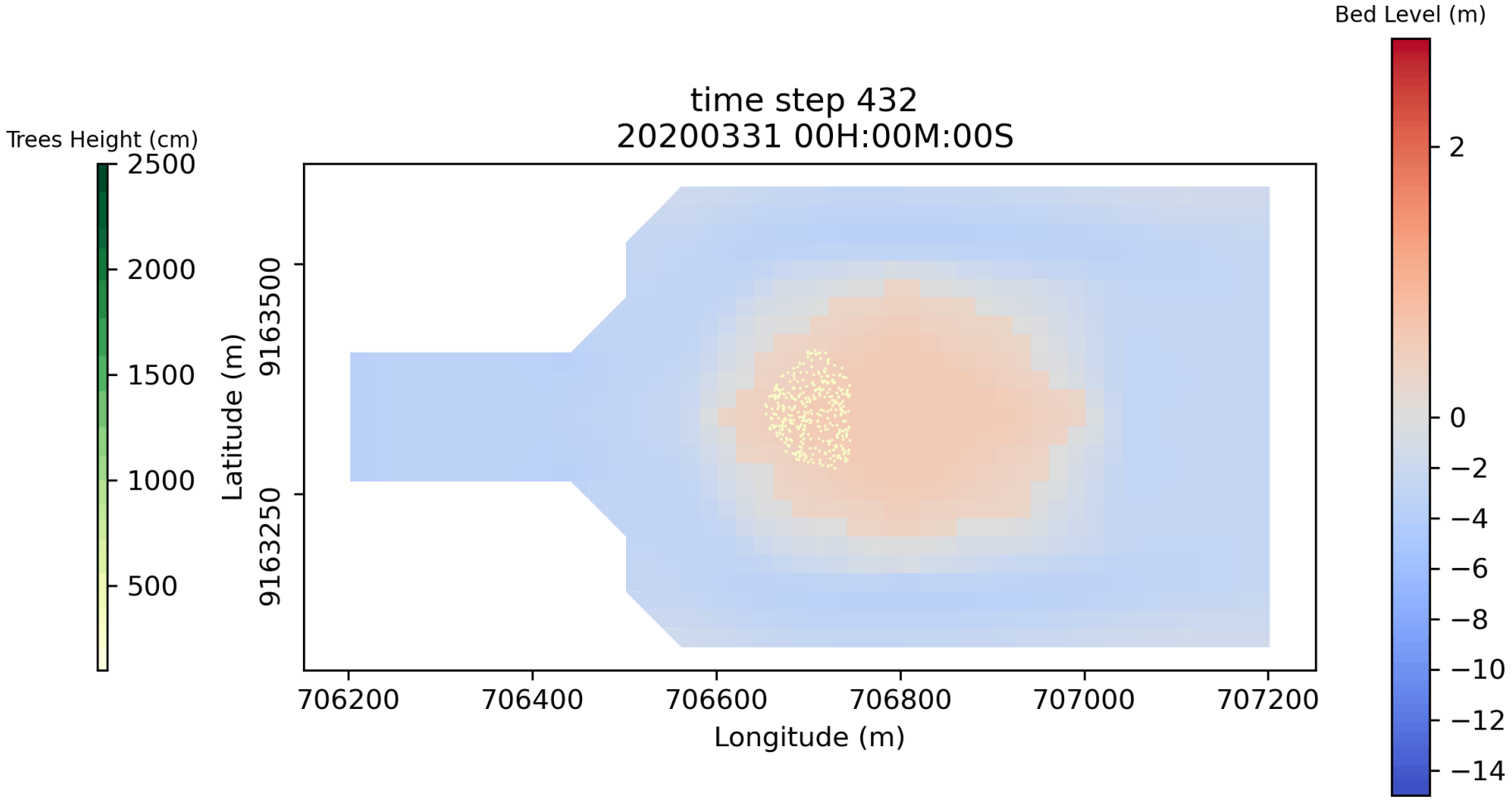


Fig: https://mangroveforest10.blogspot.com/2019/04/life-cycle-of-mangrove-tree.html

Proof of Concept

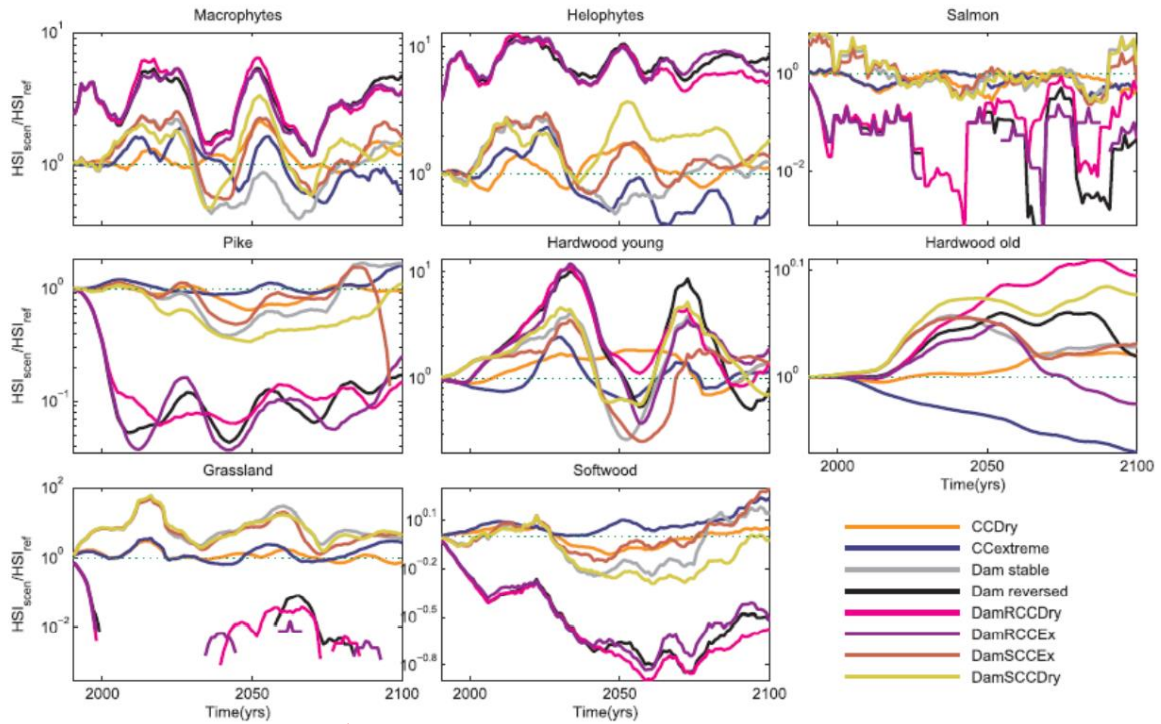
Plot Scenario B2 Coupling 1 Year 2020



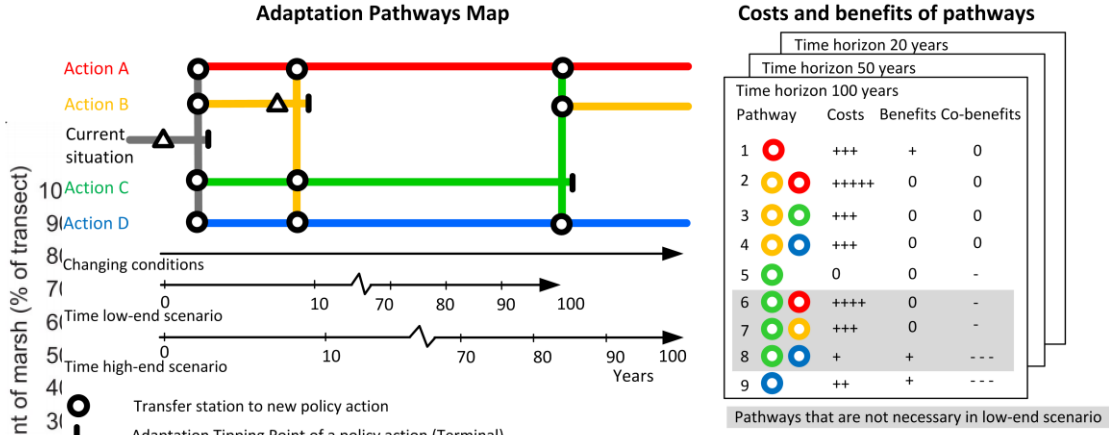
Animation…

From model output/landscape to Insight in NBS functions over time

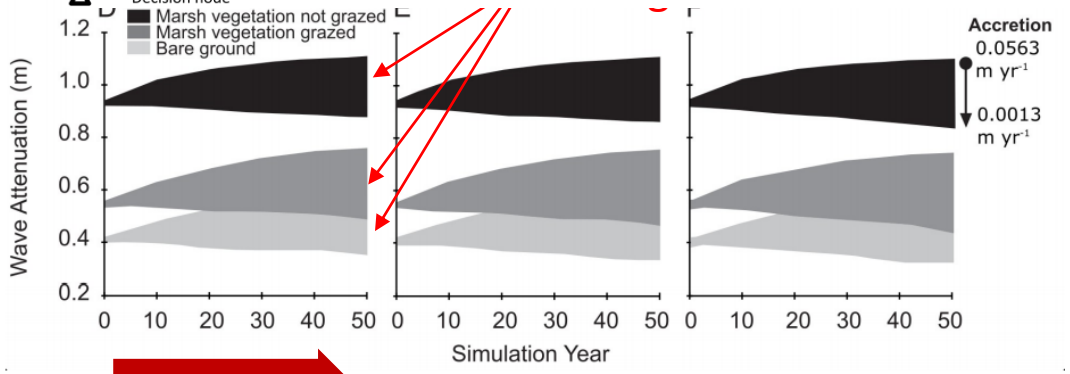
Habitat area



years



Wave attenuation



years

Fig 3. Change … enuation in a prograding wetland (Wadden Sea) under a range of sea-level rise and accretion scenarios and management actions. Extent of marsh and wave attenuation reported as a range across the three accretion rates (Table 1) and for three sea level rise scenarios: (A,D) 0.217 m of SLR, (B,E) 0.319 m of SLR, and (C,F) 0.386 m of SLR.

- Combined effect of Climate change and dam construction on riverine ecosystems (Van Oorschot et al., 2018): Decadal Habitat suitability change

- Effects of accretion rates and salt marsh management on wave attenuating function under SLR (Hijuelos et al. 2019)

Thank you

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