Coastal
Ecology and
Bio-morphodynamics
Group

Resilience of coastal ecosystems, a tale of organisms and sediment

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Christian Schwarz

Ecologist, "Bio-geomorphologist"

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Experience

Assistant Professor	**Bio-geomorphology of Coastal Wetlands** University of Delaware, School of Marine Science and Policy	2020 -
Assistant Professor	**Bio-geomorphology of Coastal Barrier Systems** Utrecht University, Department of Physical Geography	2016 - 2019
Post-doctoral research	**Spatial ecology and Geomorphology** University of Antwerp, Ecosystem Management Group	2014 – 2016

Academic degrees

PhD.	**Spatial ecology and Geomorphology** Radboud University Nijmegen, the Netherlands (finishing date: March 2014) Royal Netherlands Institute for Sea Research (NIOZ) Title: "Implications of biogeomorphic feedbacks on tidal landscape development"	2013
MSc.	**Aquatic Ecology** University of Vienna, Austria Title: "Resource stoichiometry and the growth rate hypothesis in *Verrucomicrobium spinosum*"	2008
BSc.	**Environmental Biology specialization** University of Vienna, Austria	2007
BSc.	**Chinese Studies** University of Vienna, Austria	2006

UNIVERSITY OF DELAWARE

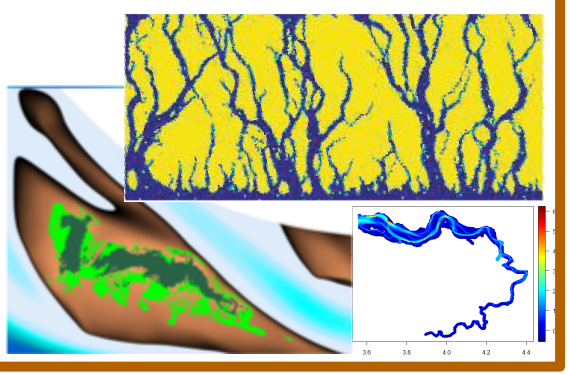
Research Aim

I study bio-morphodynamic interactions between **organisms** (e.g. plants or worms) and their **environment** (e.g. tides, waves, sediment transport), linking the field of **hydrodynamics, geomorphology and ecology**.

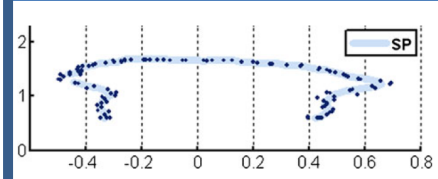
I'm interested in obtaining a better understanding of how bio-morphodynamic interactions influence ecosystem functioning by altering resource fluxes, biodiversity, landscape evolution and ecosystem resilience.

Research approach

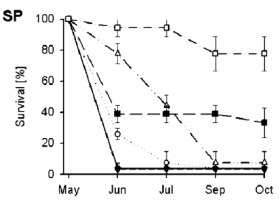
1. Numerical modelling

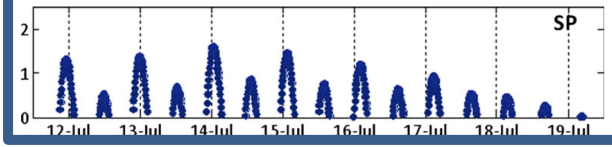


2. Empirical field measurements

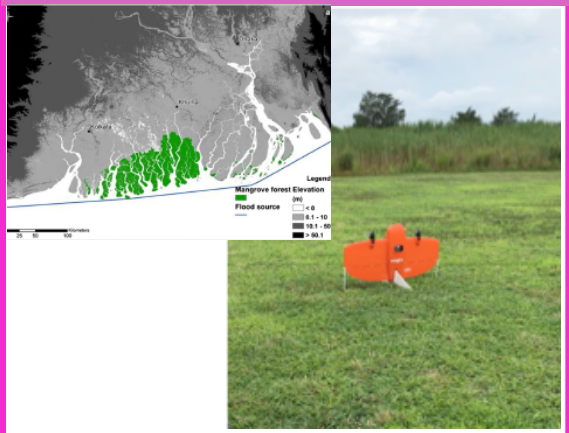


flow velocity [m s^{-1}]

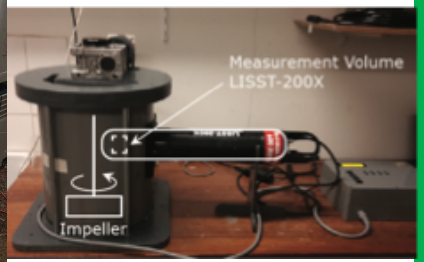




3. Remote sensing and UAV



4. Laboratory experiments



CEBG recent and ongoing Projects

1. **Recent projects:**

   - How do species traits influence the structure and resilience of coastal ecosystems

2. **Ongoing projects with Relevance to the Inland Bays:**

   a. Flocculation and Bio-flocculation in coastal waters
   b. Shallow subsidence and ponds

CEBG recent and ongoing Projects

1. **Recent projects:**

Focus on the impact of species traits on landscape dynamics and resilience, in particular:

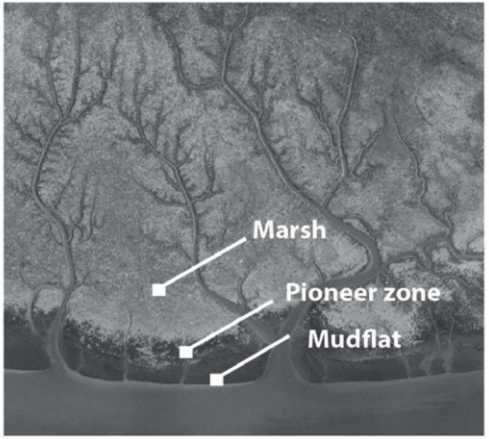
a. Salt marsh species traits

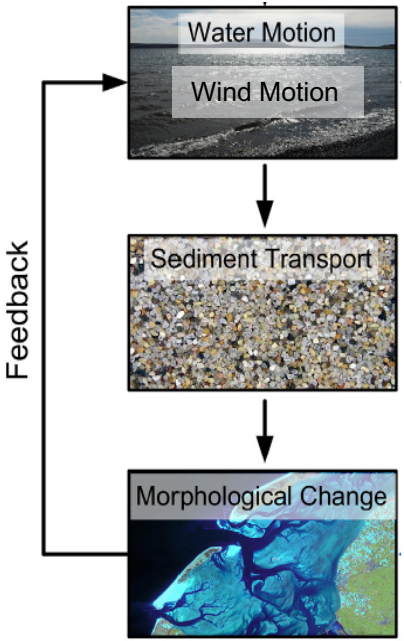
b. “Wetland species” traits

c. Dune vegetation

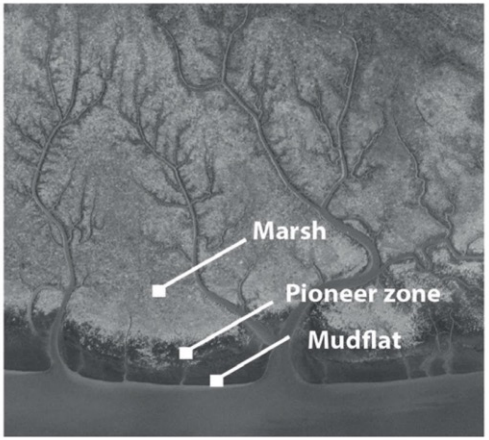
d. Multiple species assemblages of plants and benthic invertebrates

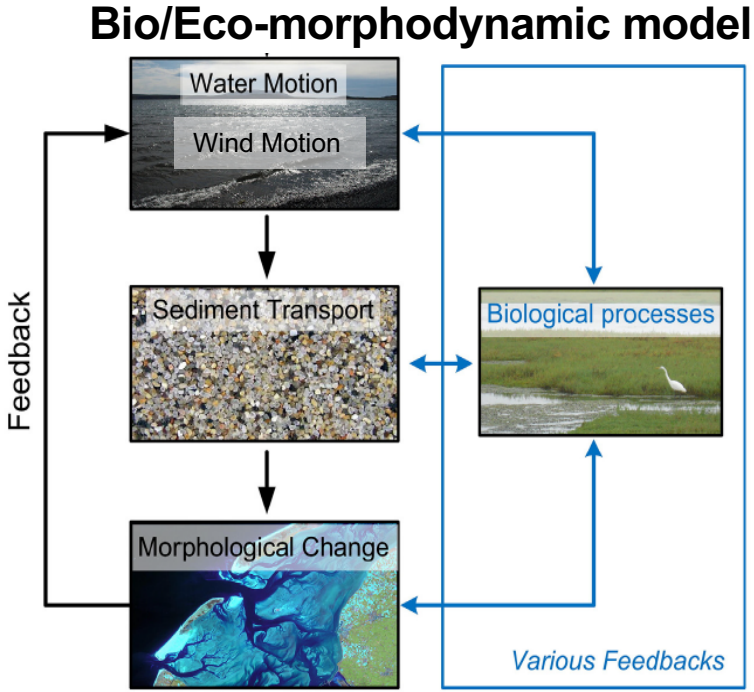
How do biophysical interactions control landscape evolution and resilience?



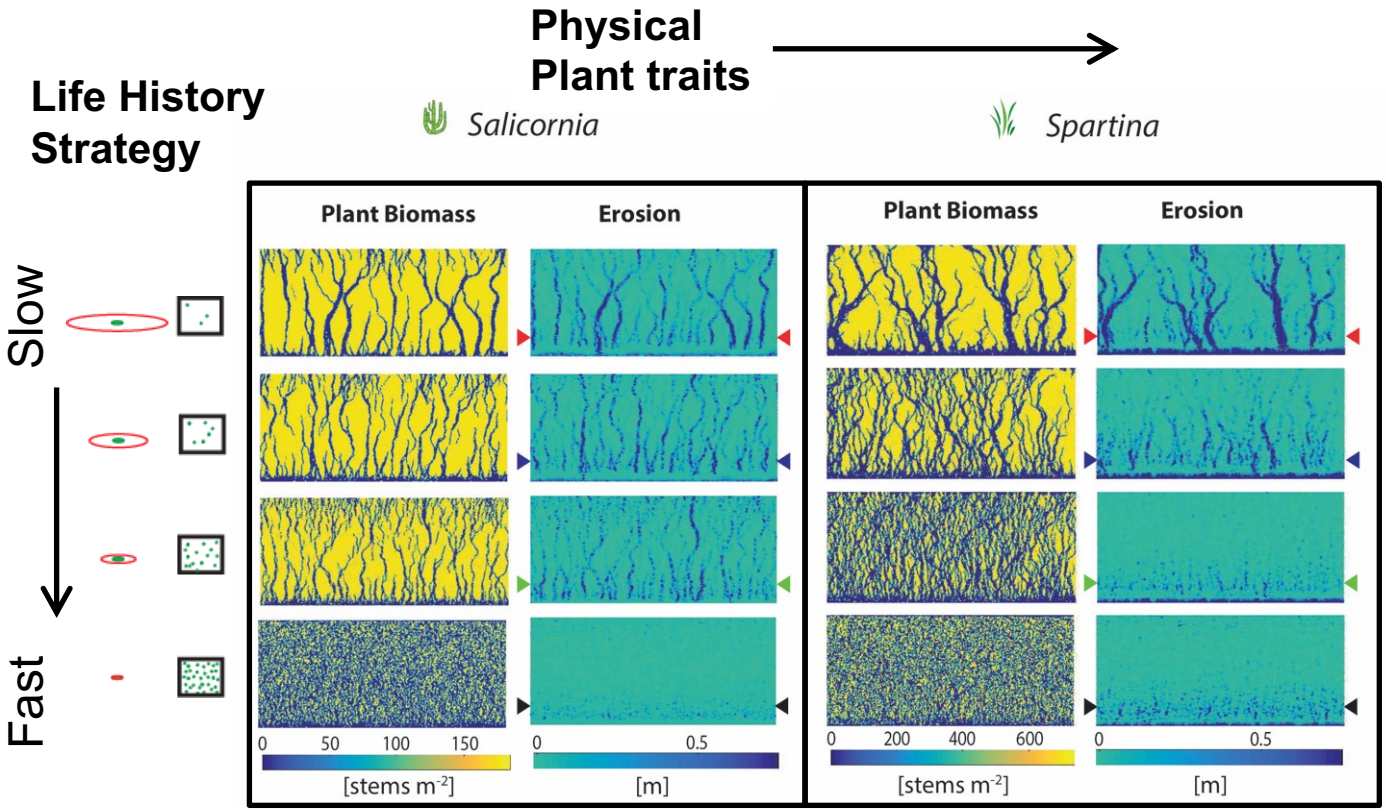


How do biophysical interactions control landscape evolution and resilience?



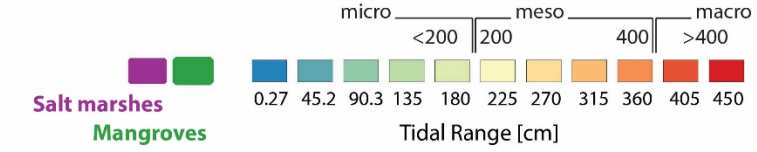


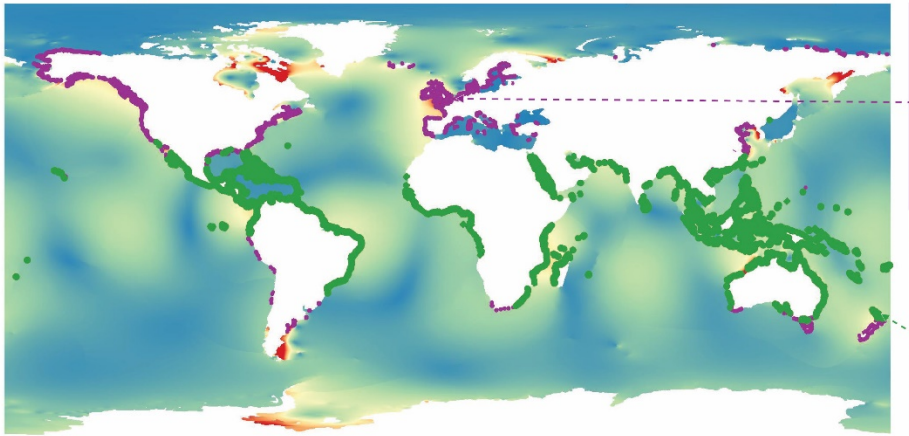
a. Salt marsh species traits shape landscape dynamics

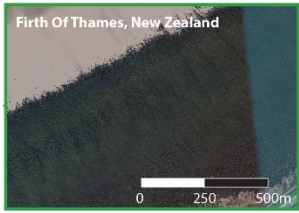


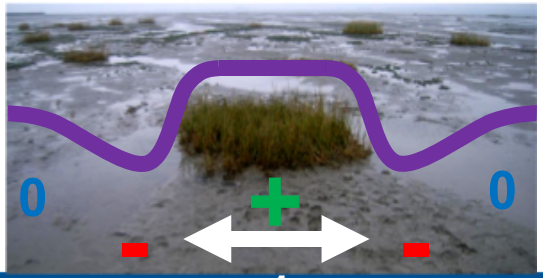
Schwarz et al., 2018

b. Wetland species traits shape wetland structure







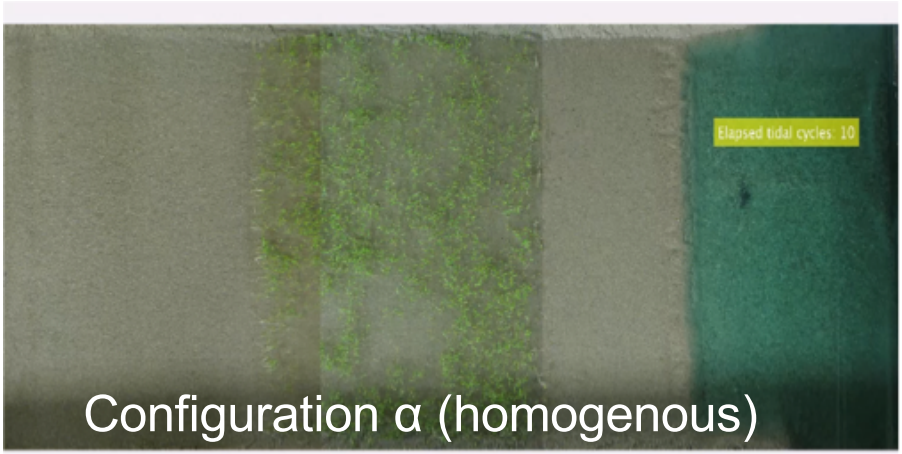


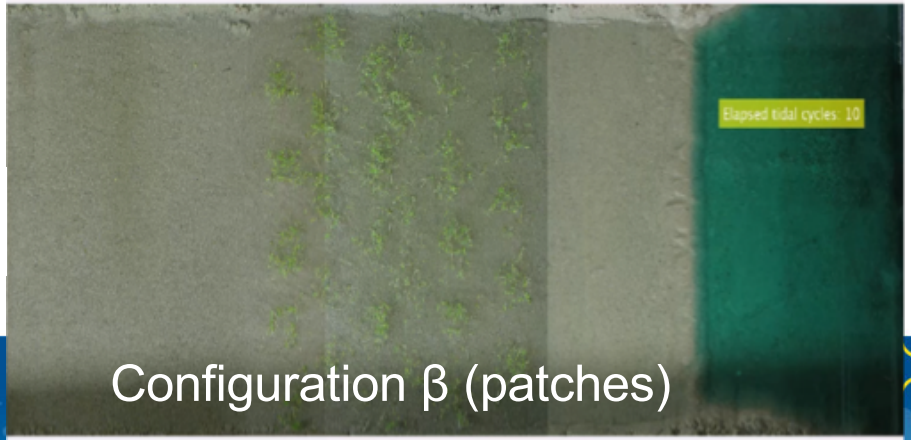
Scale-dependent feedbacks

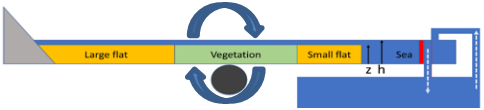
Schwarz et al., in review

b. Wetland species traits shape wetland structure

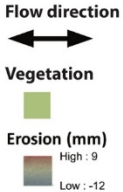
Impact of plant colonization patterns on channel emergence

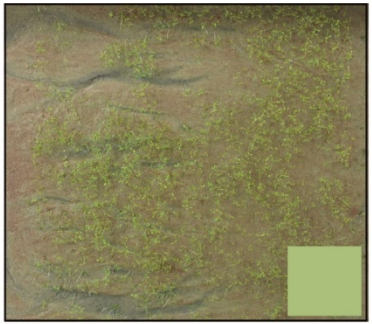




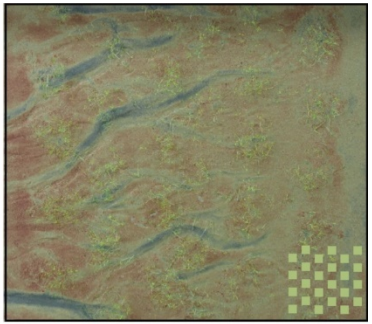


b. Salt marshes and mangroves facilitate different channel networks

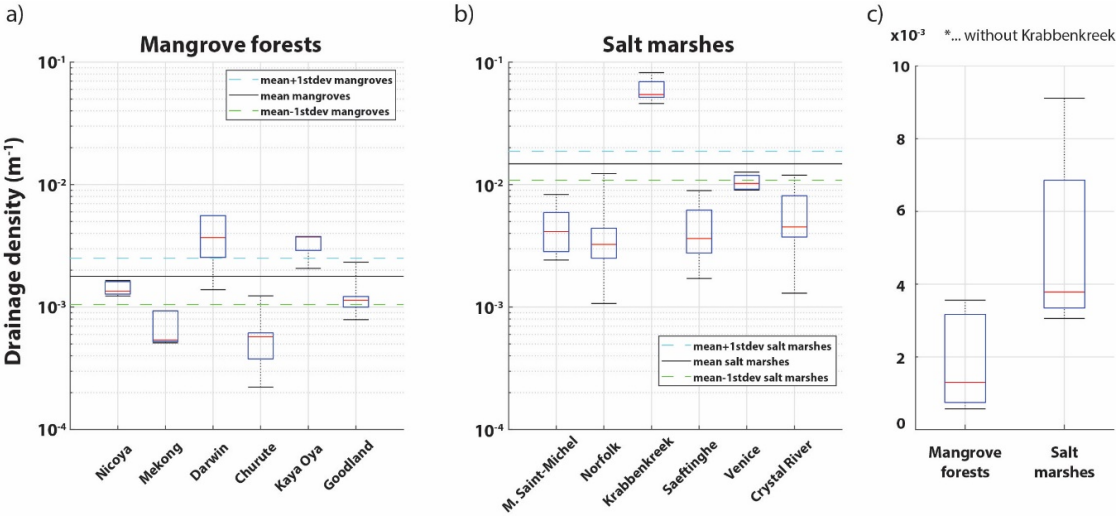




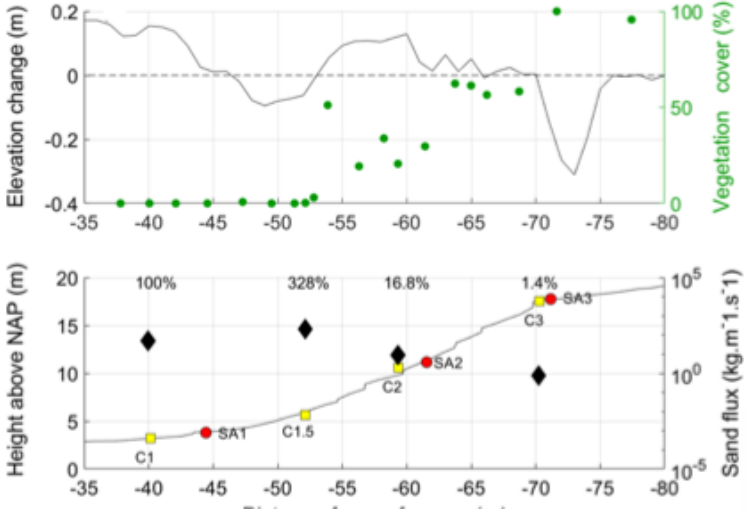
Homogenous

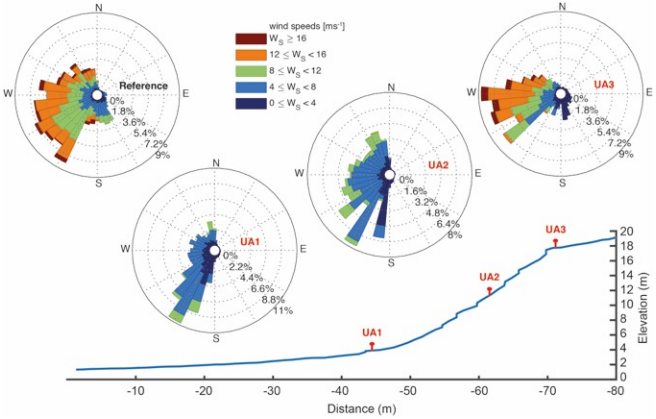


Patches



c. Dune vegetation shapes foredune dynamics



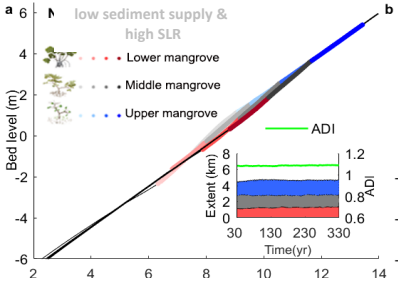


Vegetated coastal foredunes

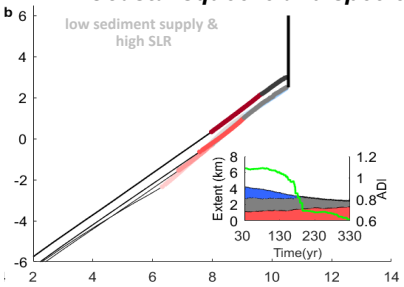
d. Multi-species mangrove assemblages

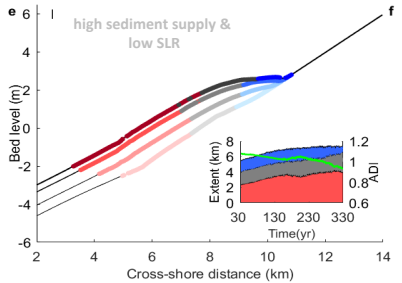
Utrecht University

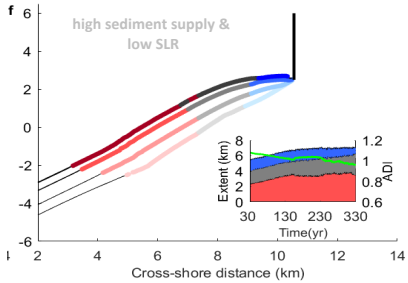
1. Landward migration



2. Coastal squeeze and species loss

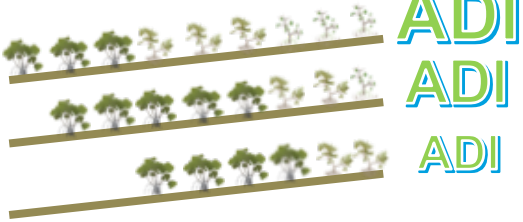




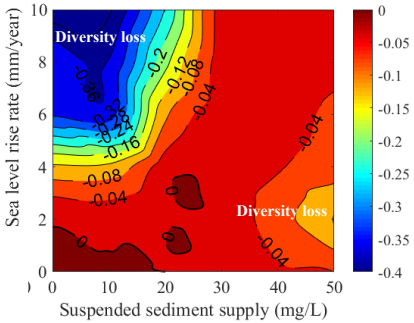


3. Double expansion and diversity loss

4. Seaward expansion and diversity lo

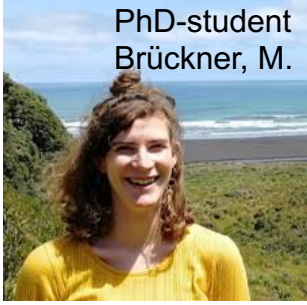


With coastal barriers

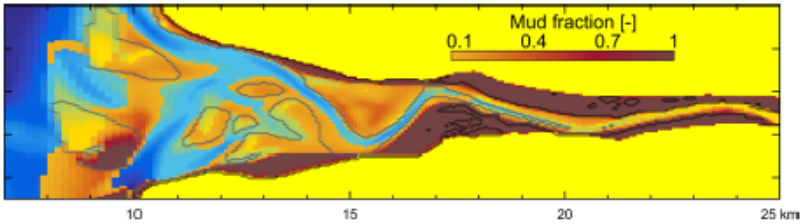


Xie et al., 2020

d. Multi-species benthic assemblages

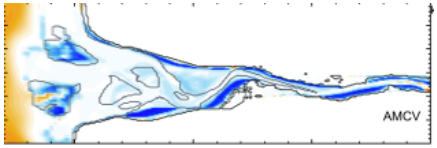


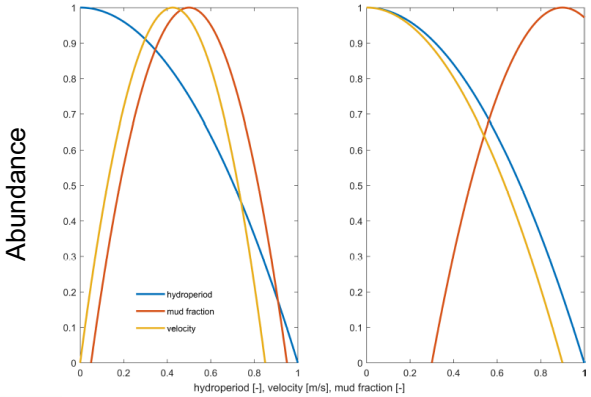
Utrecht University



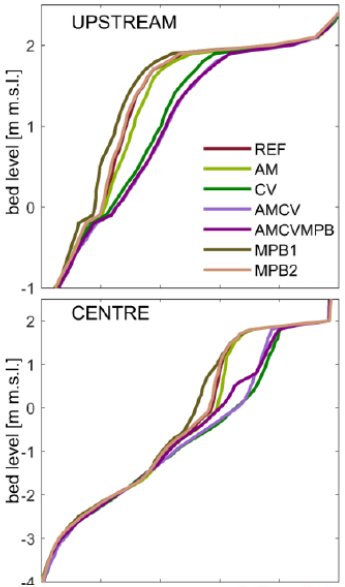
Arenicola marina

Corophium volutator





Benthic organisms alter mud distribution and large scale morphology



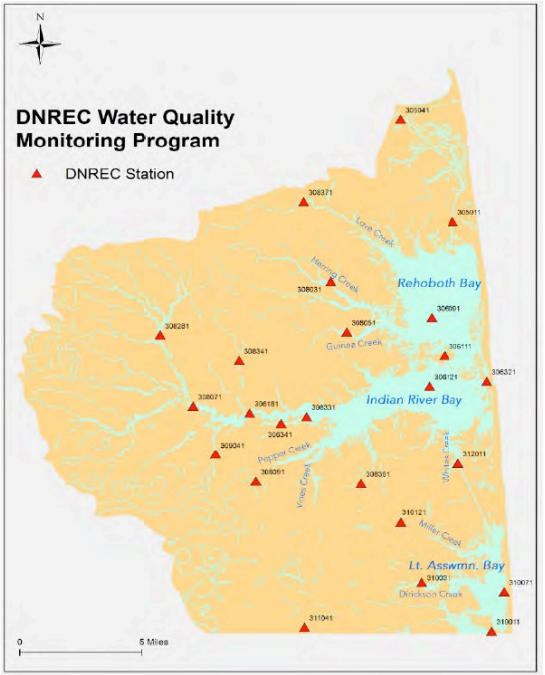
Brückner et al., 2021

CEBG recent and ongoing Projects

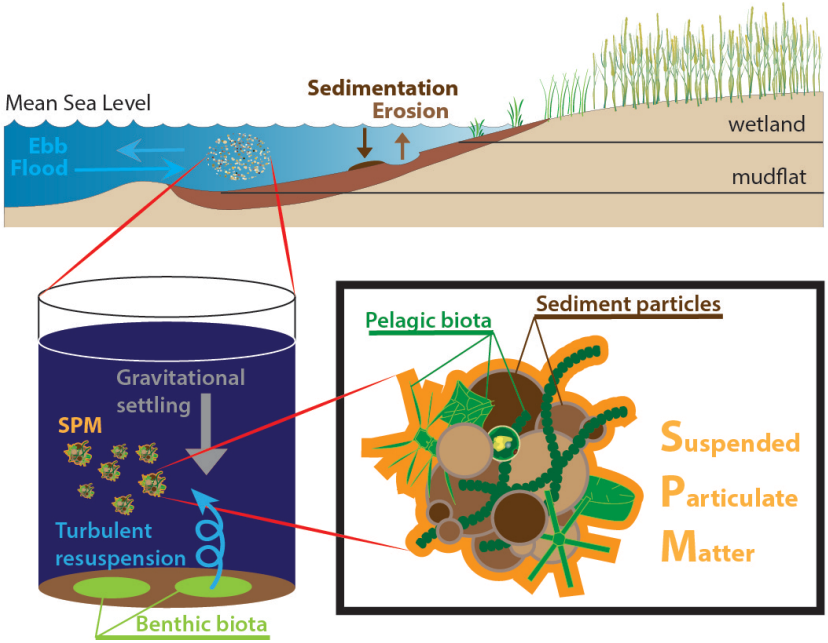
2. Ongoing projects:

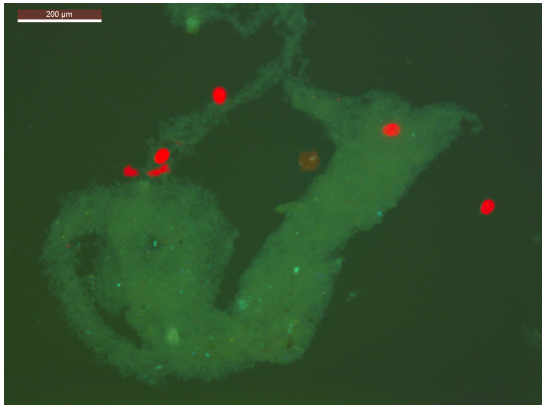
Sediment flocculation and Bio-flocculation

Salt marsh subsidence and ponding



Flocculation and Bio - flocculation

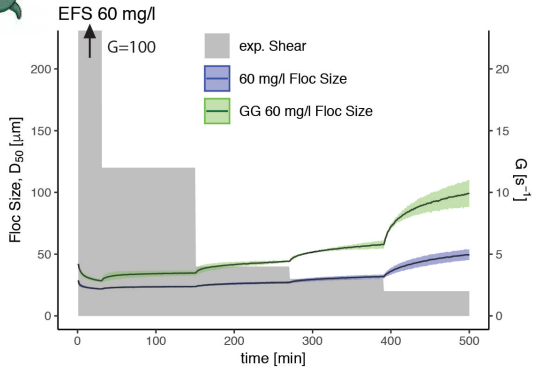


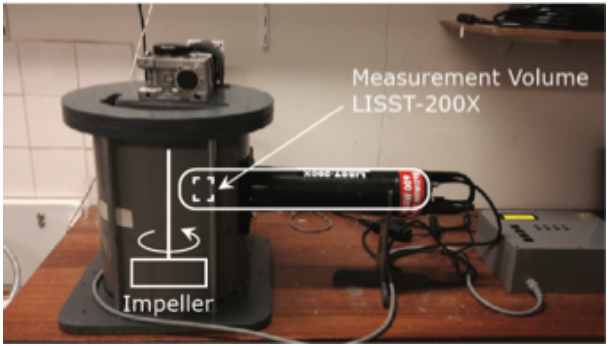


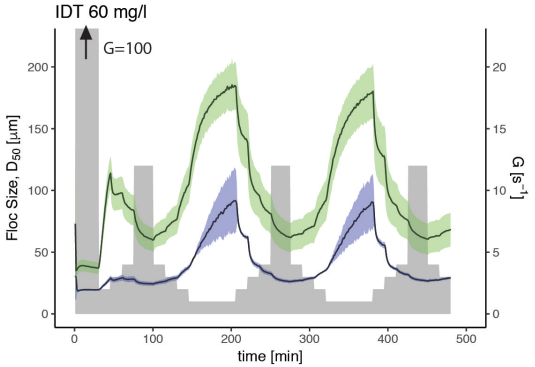
Collaboration with

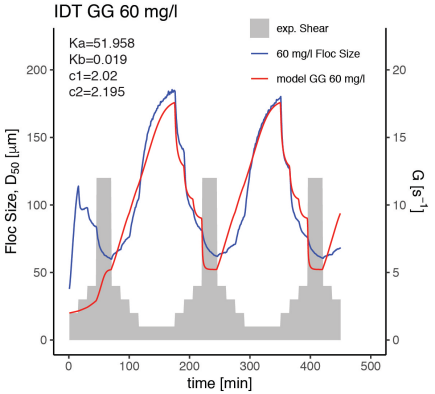
NIOZ

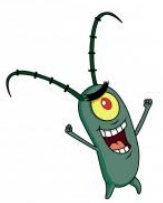
Flocculation and Bio - flocculation



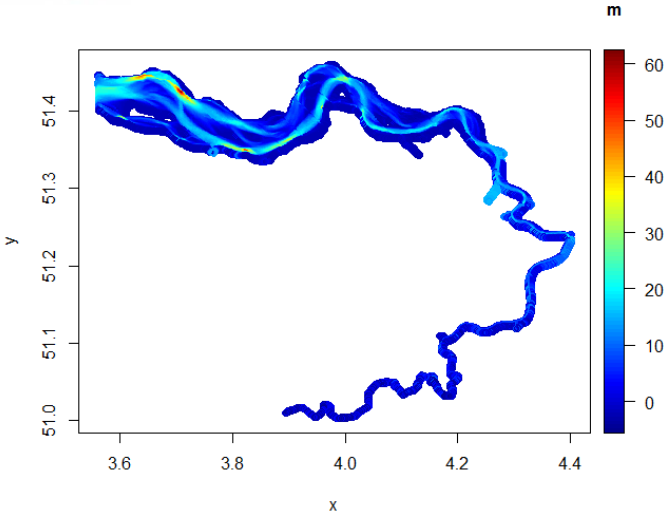


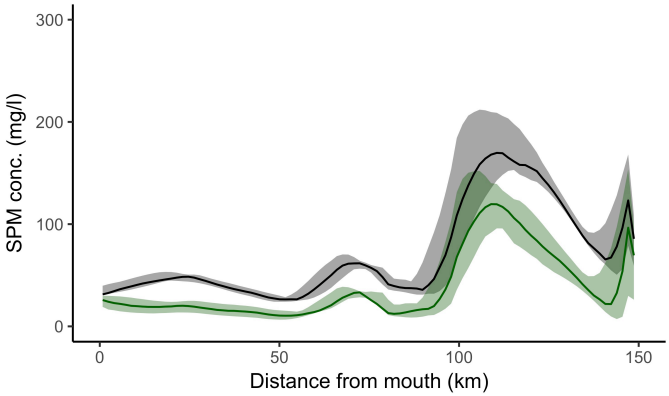


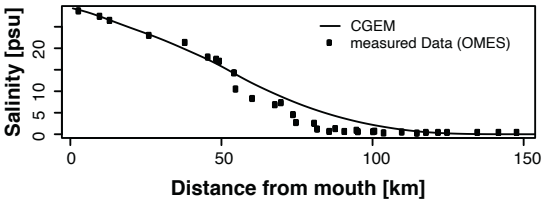


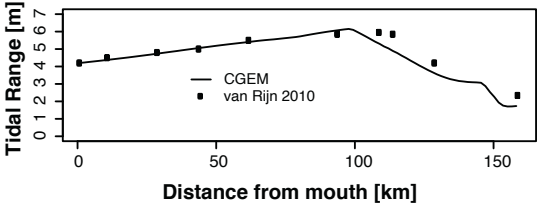


Flocculation and Bio - flocculation

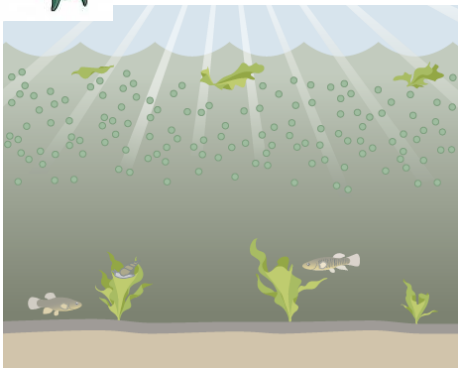


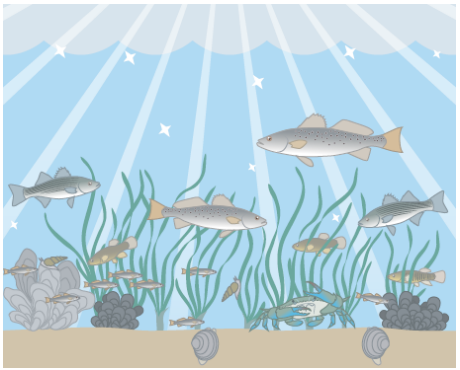






Relevance for the Center of Inland Bays



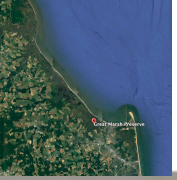


Excess nutrients from fertilizers, wastewater, and runoff cause blooms of microscopic algae. These, along with sediments in runoff, reduce water clarity which inhibits growth of bay grasses.

Bio-flocculation might help understand the influences of hydrodynamics and sediment settling on turbidity

In a **healthy bay,** there is little algae, light reaches the bottom allowing bay grasses to grow, a greater diversity of fish and shellfish are present

State of the Bays 2016

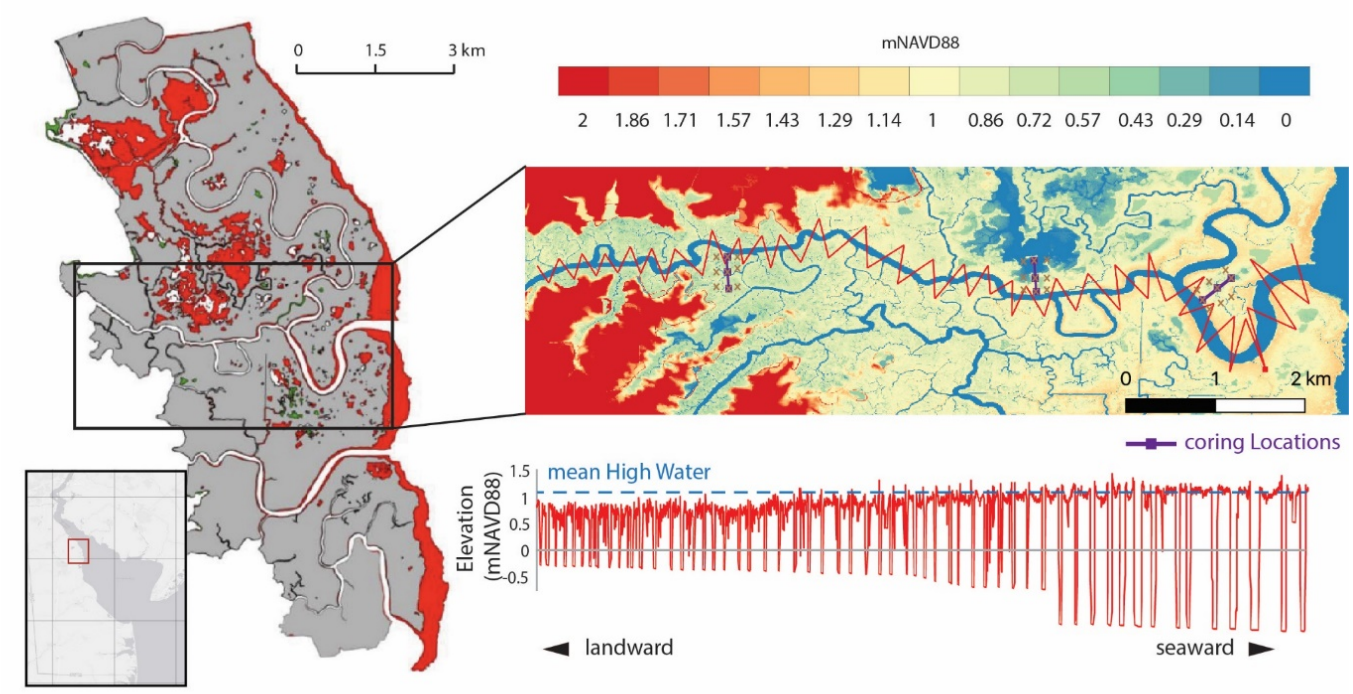


Shallow subsidence and interior ponding

What does a pond look like ?

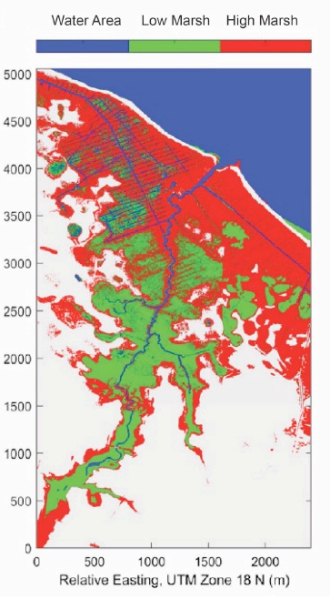
Angola Neck Delaware Inland Bays

What is its contribution to marsh area loss ?

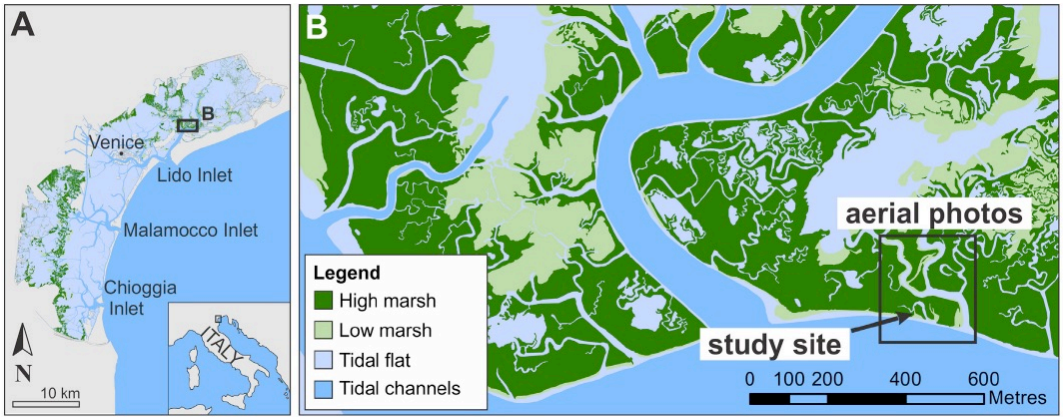


Literature hints to soil composition and plant species distribution

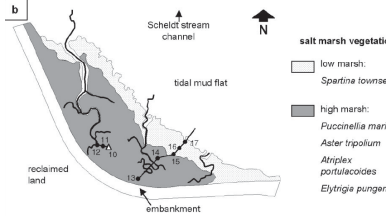
Plant distribution
Delaware Bay
Chen et al. 2017

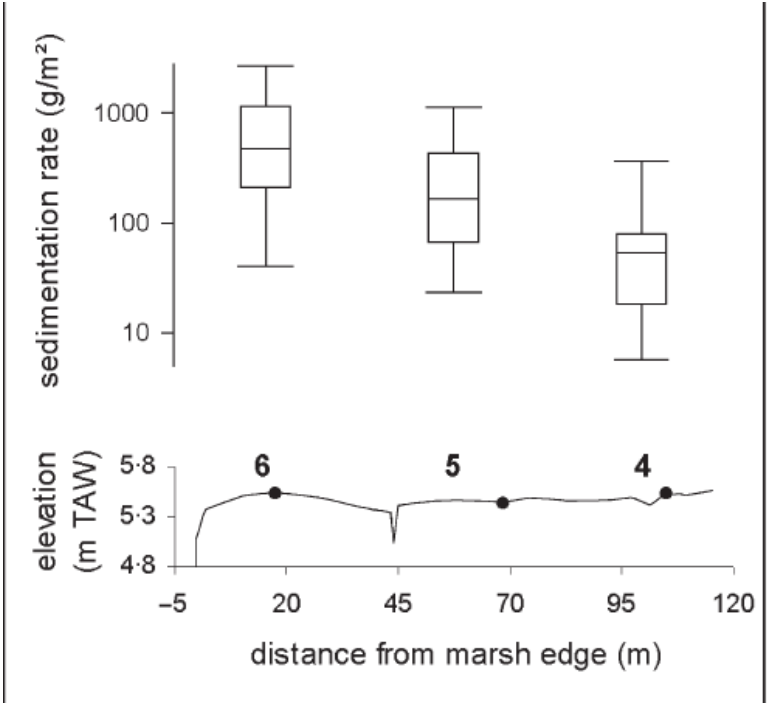


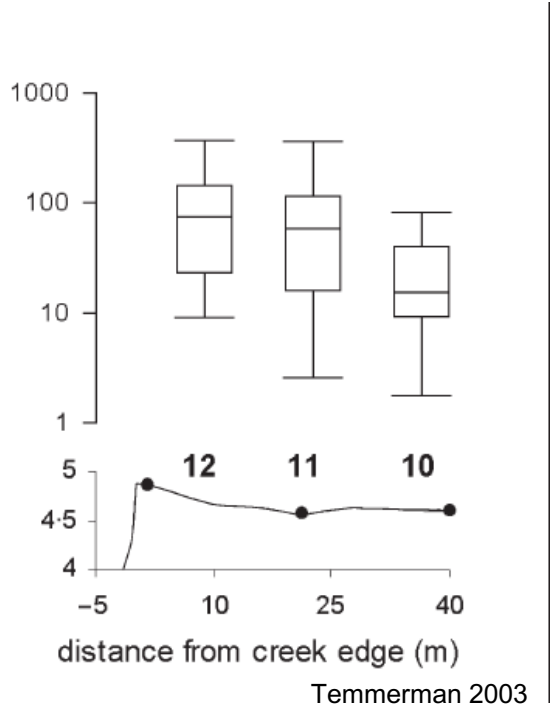
Plant distribution
Venice Lagoon
Cosma et al. 2017



The role of spatial sedimentation



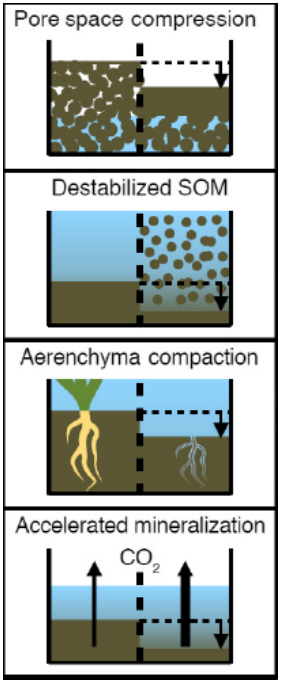




Temmerman 2003

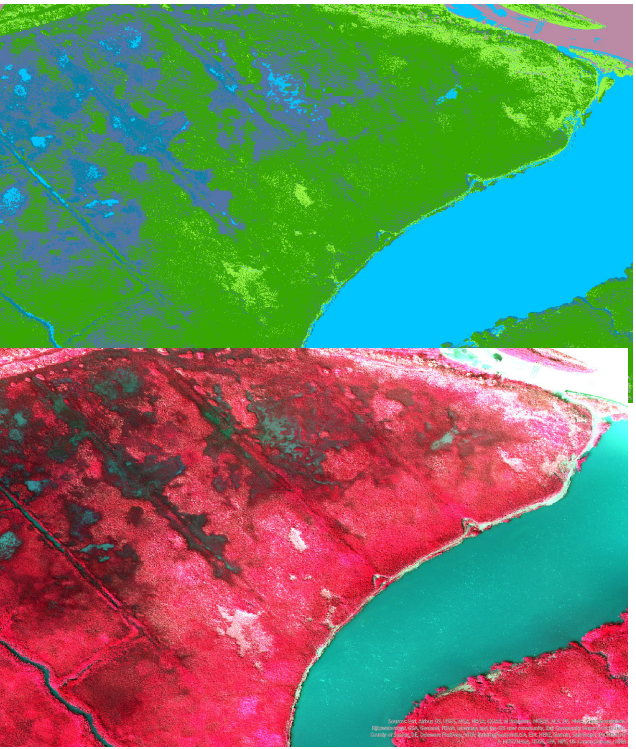
The role of compaction and plants

b



Chambers 2017

Our approach:



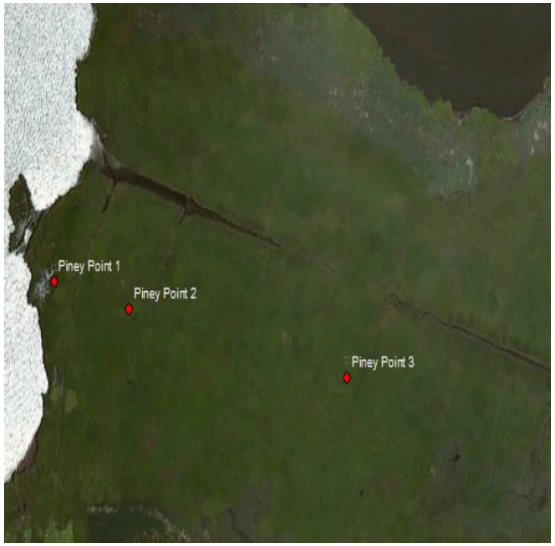
- Utilize UAV surveys and historical remote sensing products
- Identify ponds and their development through Artificial Neural Networks and Deep Learning
- Investigate mechanisms for ponding through geo-technical sediment analysis
- Quantify sediment characteristics

Relevance for the Center of Inland Bays

Piney Point

SLR : 3.4mm/year

- Non degraded (No ponding visible)
- Average net elevation change: **5.14** mm/year (2017)



McGowen 2017

Relevance for the Center of Inland Bays

Slough's Gut SLR : 3.4mm/year

- Visible degradation (visible ponding)
- Average net elevation change: **6.12** mm/year (2017)

McGowen 2017

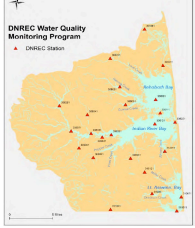
Relevance for the Center of Inland Bays

Angola Neck SLR : 3.4mm/year

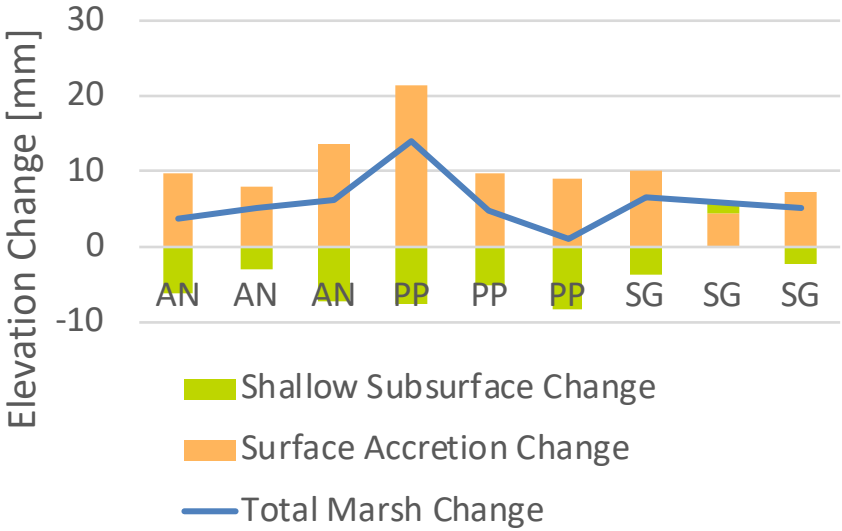
- Heavily degraded (extensive ponding)
- Average net elevation change: **3.28** mm/year (2017)

McGowen 2017

Relevance for the Center of Inland Bays



It is still unclear what factors influence ponding in salt marshes of the Delaware Inlands Bays



Preliminary Dataset 2020 (McGowen 2020)


Thank you for
your attention