Coastal Ecosystems I & II

COESSING
University of Ghana
August 3, 2018

Coastal Zone

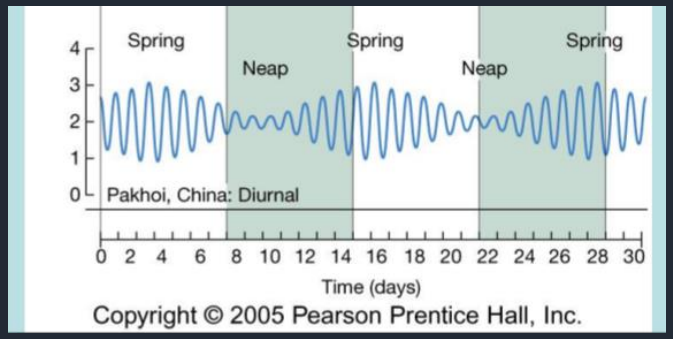
Coastal Zone

Coastal Zone

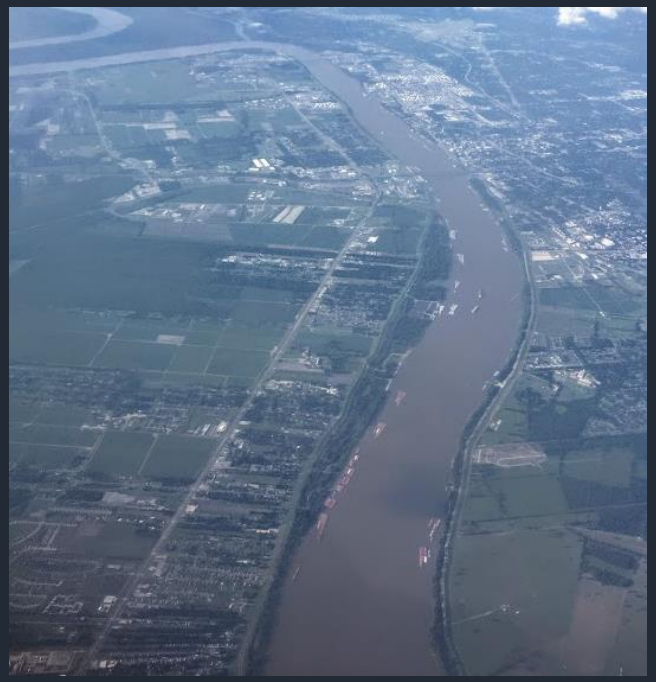
Three main classifications

Wave dominated

Tidally dominated



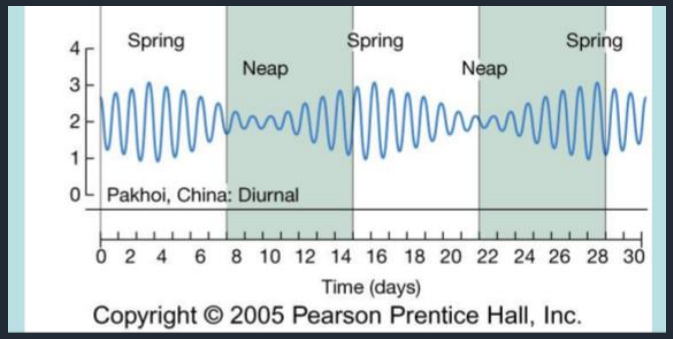
River dominated



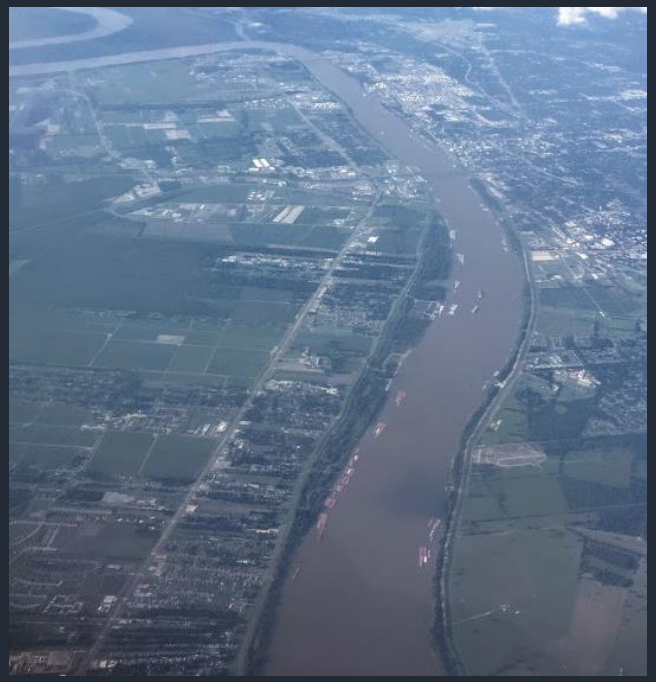
Parameters and processes of interest

Wave dominated

Tidally dominated



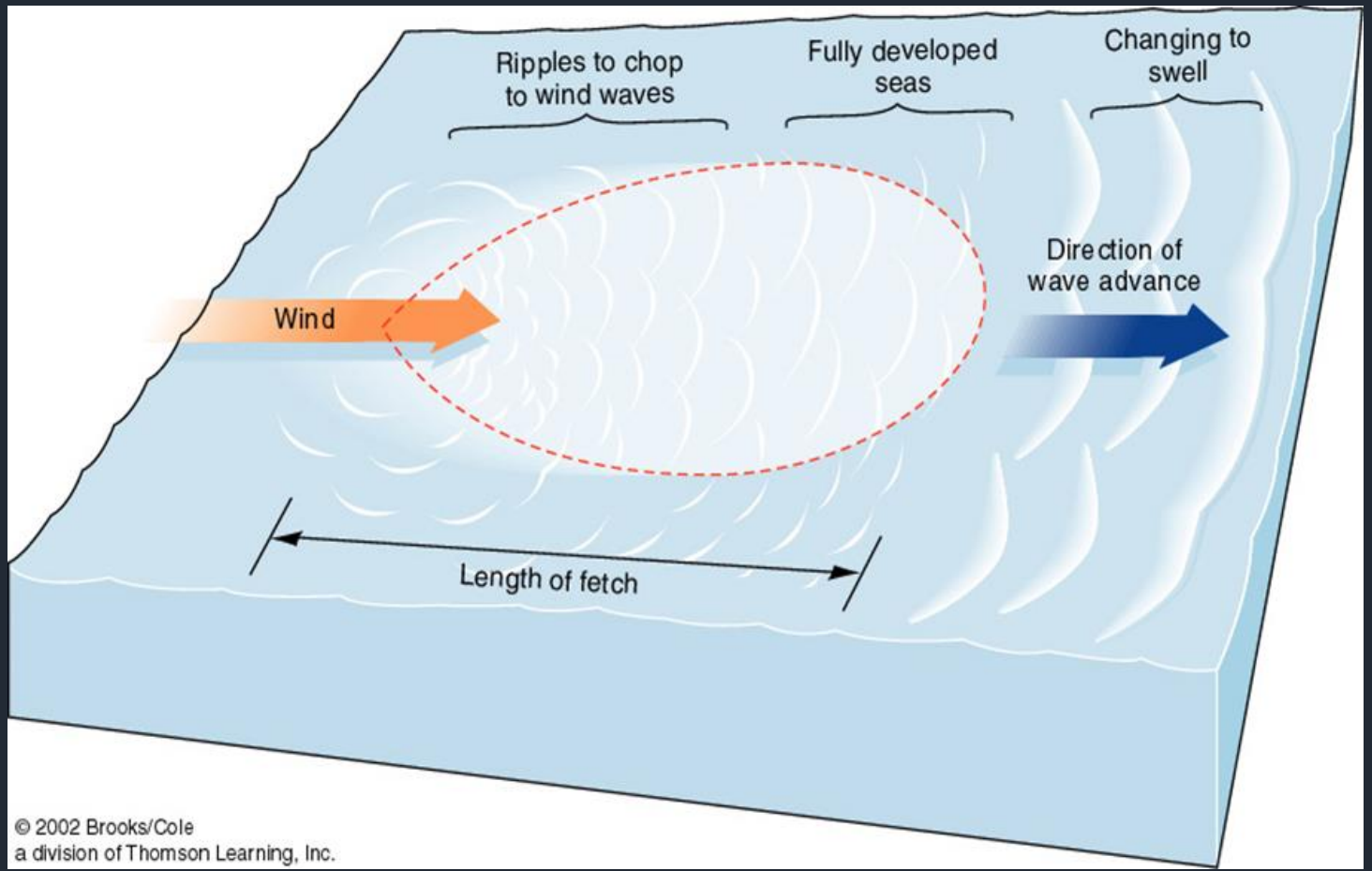
River dominated



Wave-dominated Coasts

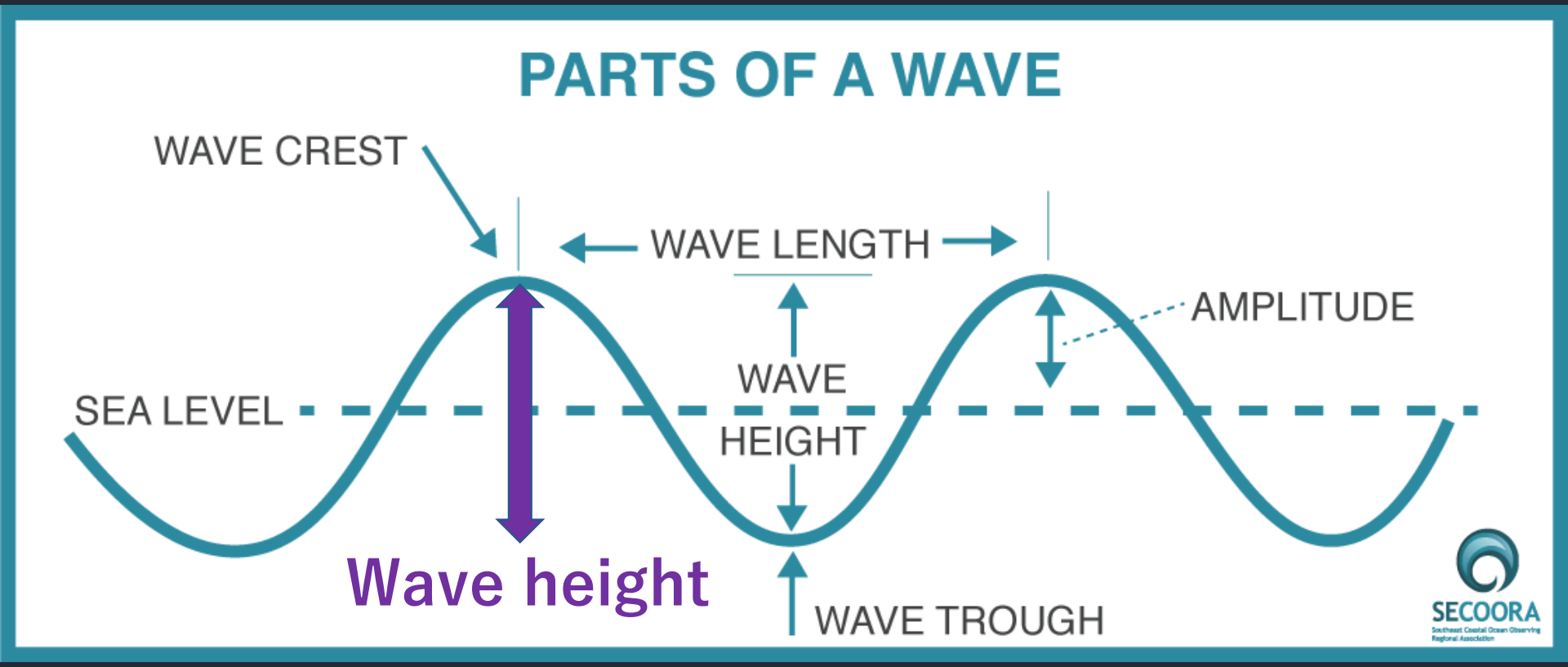
Wave-dominated coasts

- Fetch = the distance over which wind blows on the sea surface, generating and propagating waves



Wave-dominated coasts

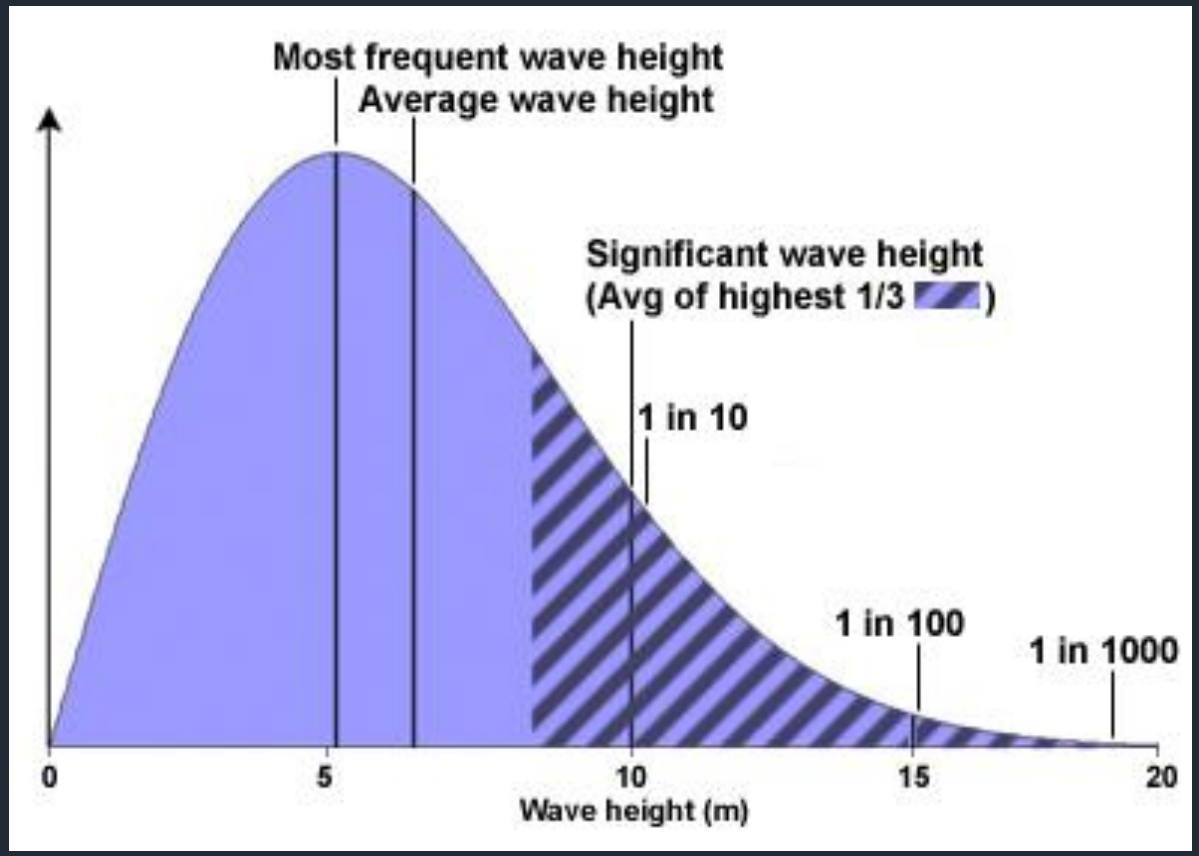
- Wave height (H) =
  distance from crest to trough



Wave-dominated coasts

- Significant wave height (H_S) = average height of the largest 1/3 of waves

Rayleigh Distribution:

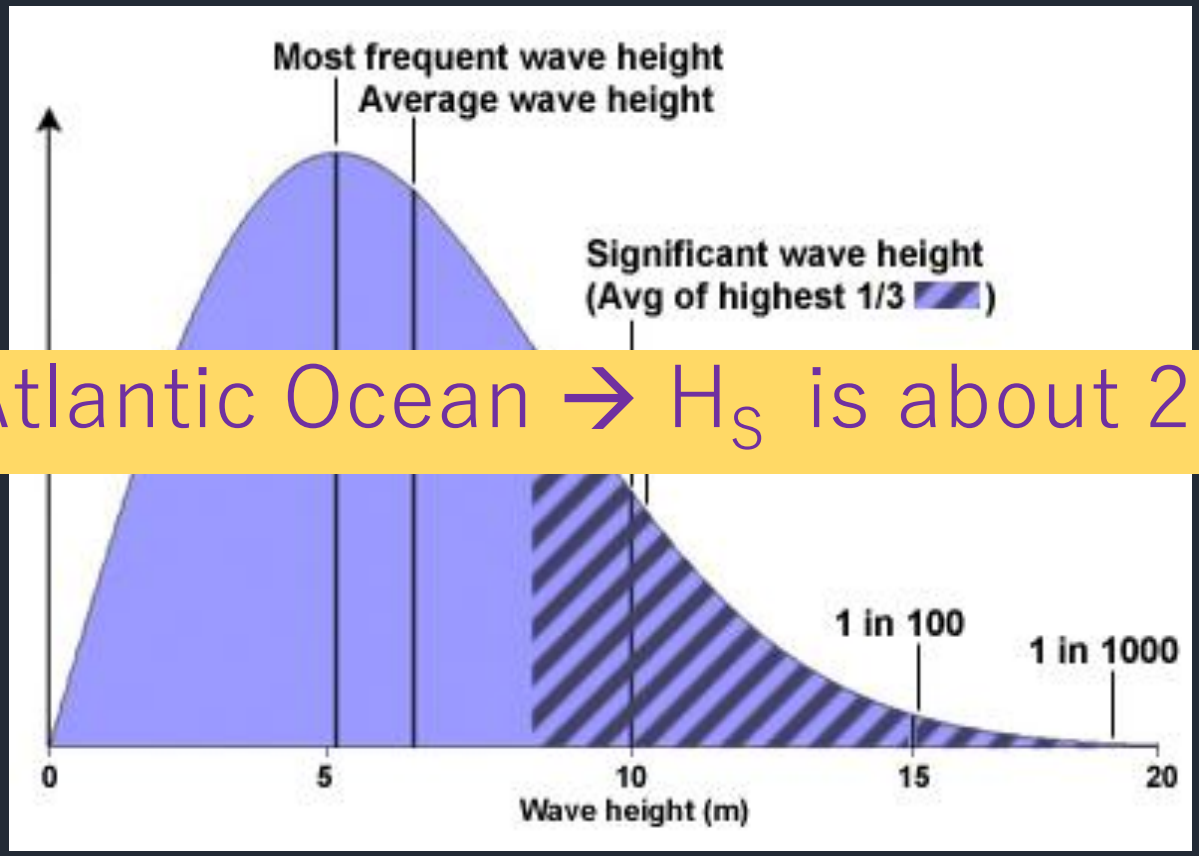


NOAA

Wave-dominated coasts

- Significant wave height (H_S) = average height of the largest 1/3 of waves

Rayleigh Distribution:

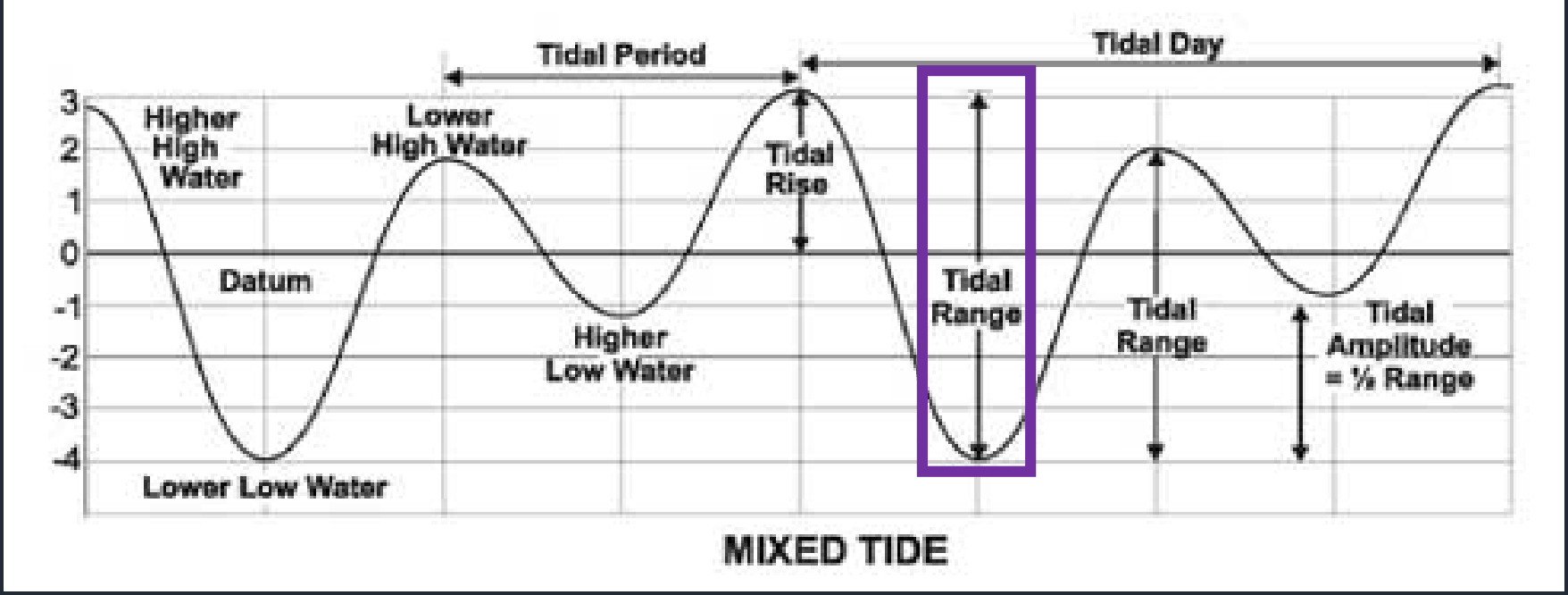


Atlantic Ocean → H_S is about 2 m

NOAA

Tidally-dominated coasts

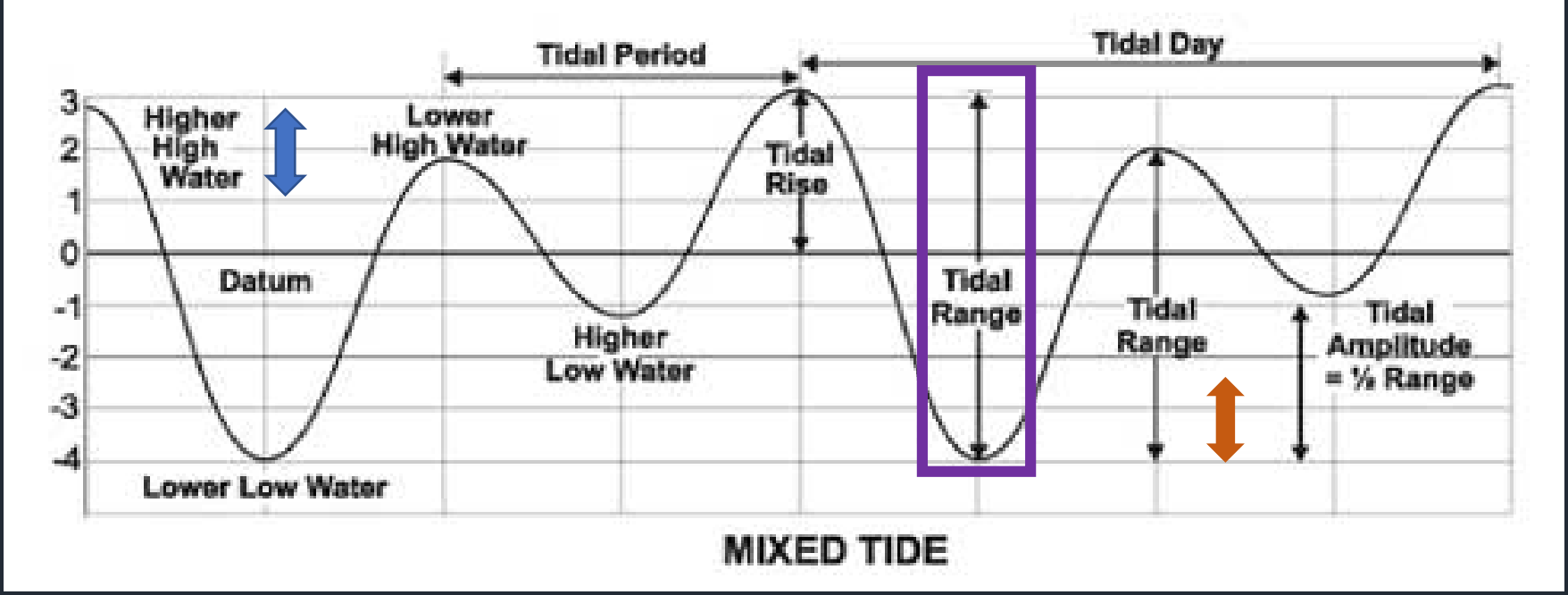
Tidally-dominated coasts



NOS Tidal Datums pub

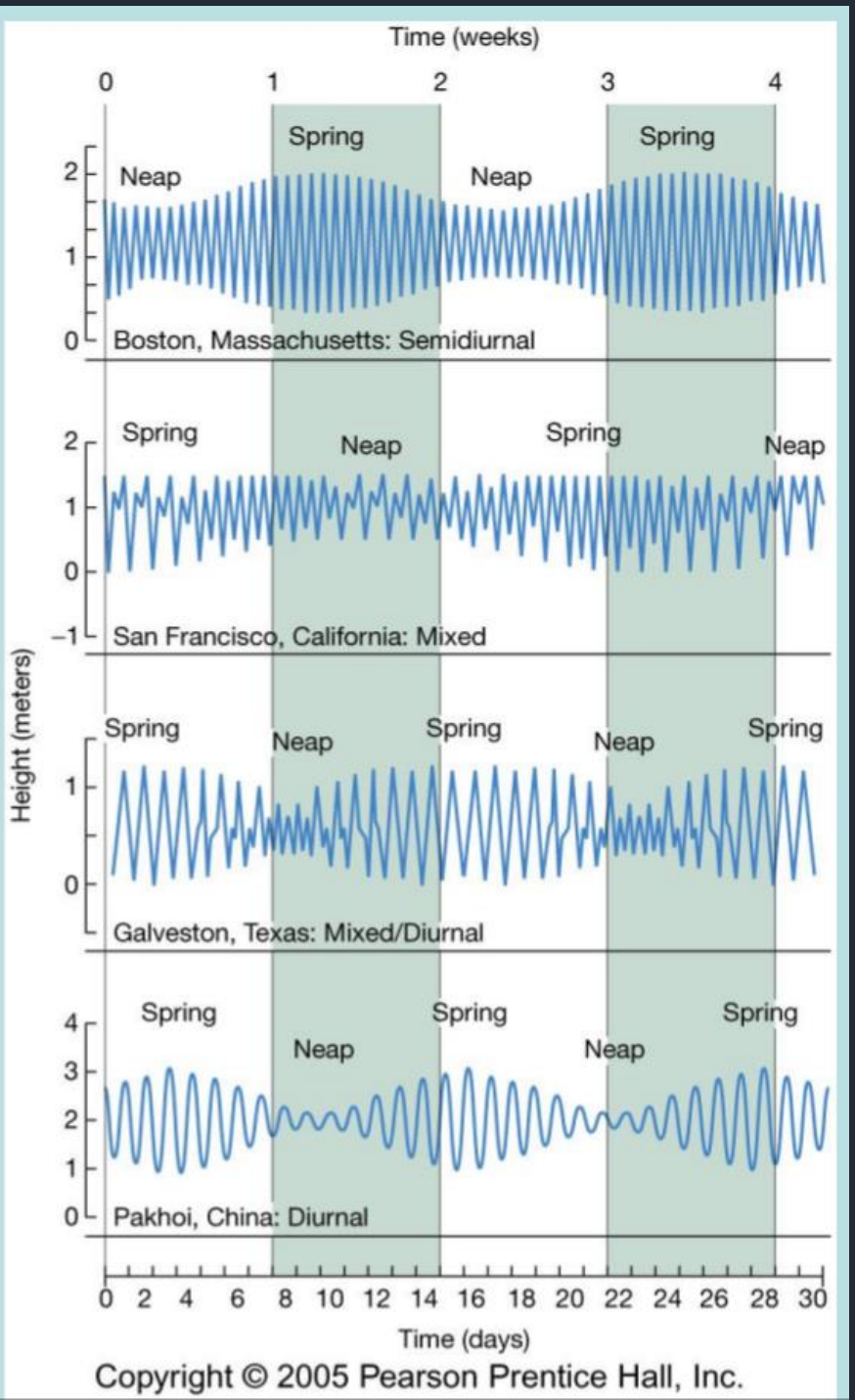
Tidally-dominated coasts

High in the tidal frame



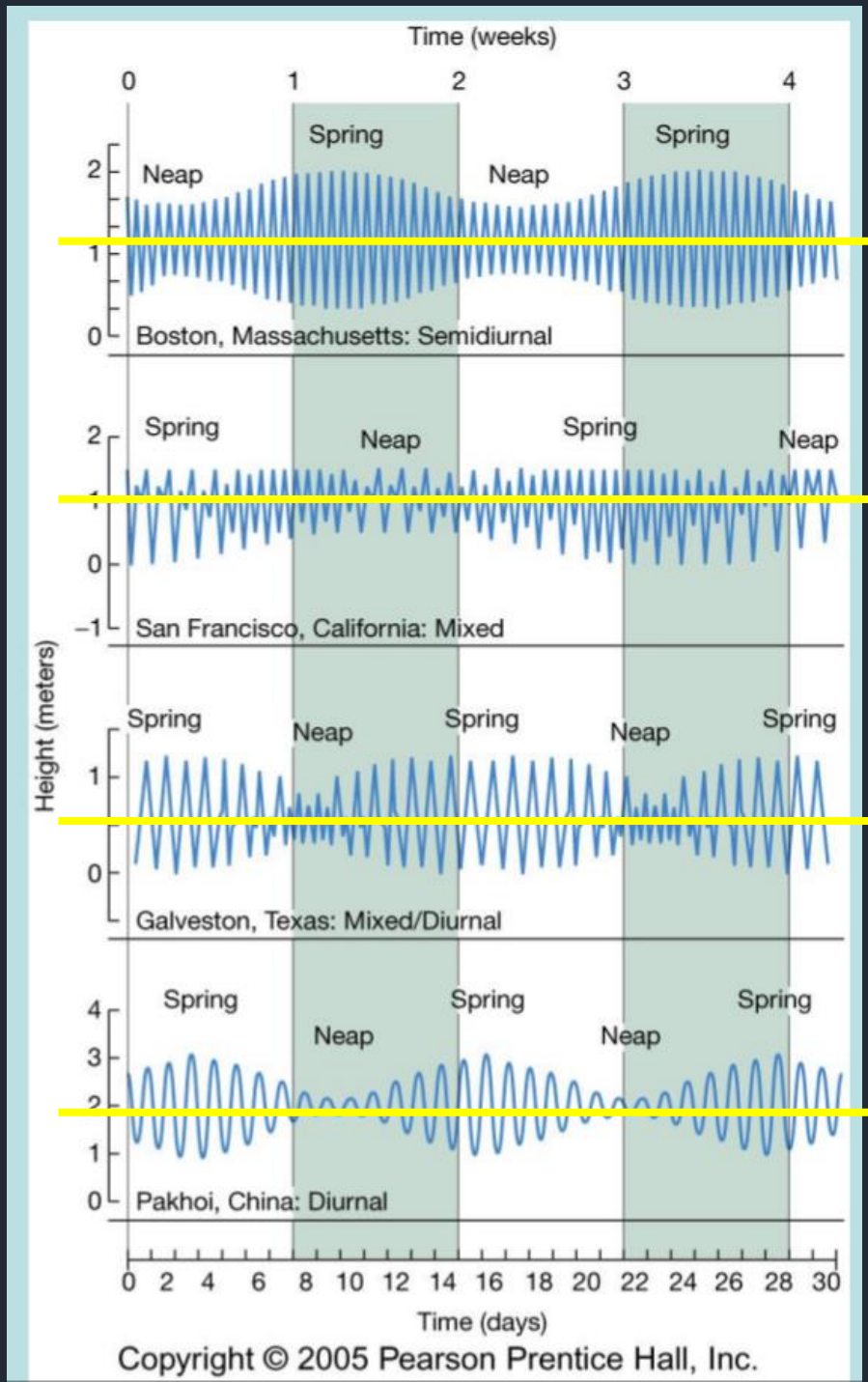
Low in the tidal frame

NOS Tidal Datums pub

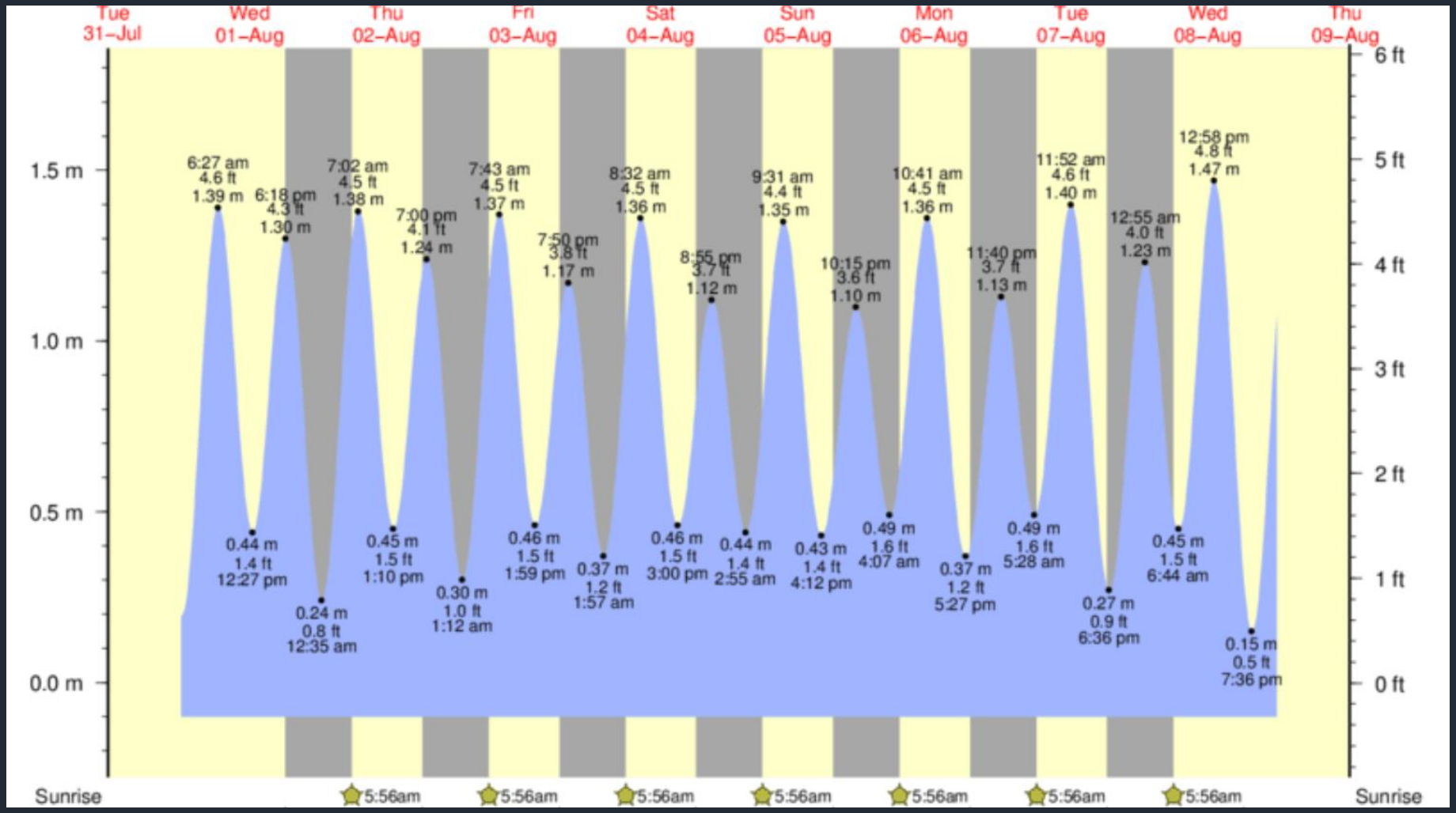


What would you feel if you were a plant?

https://pfaf.org/user/Plant.aspx?LatinName=Juncus+conglomeratus

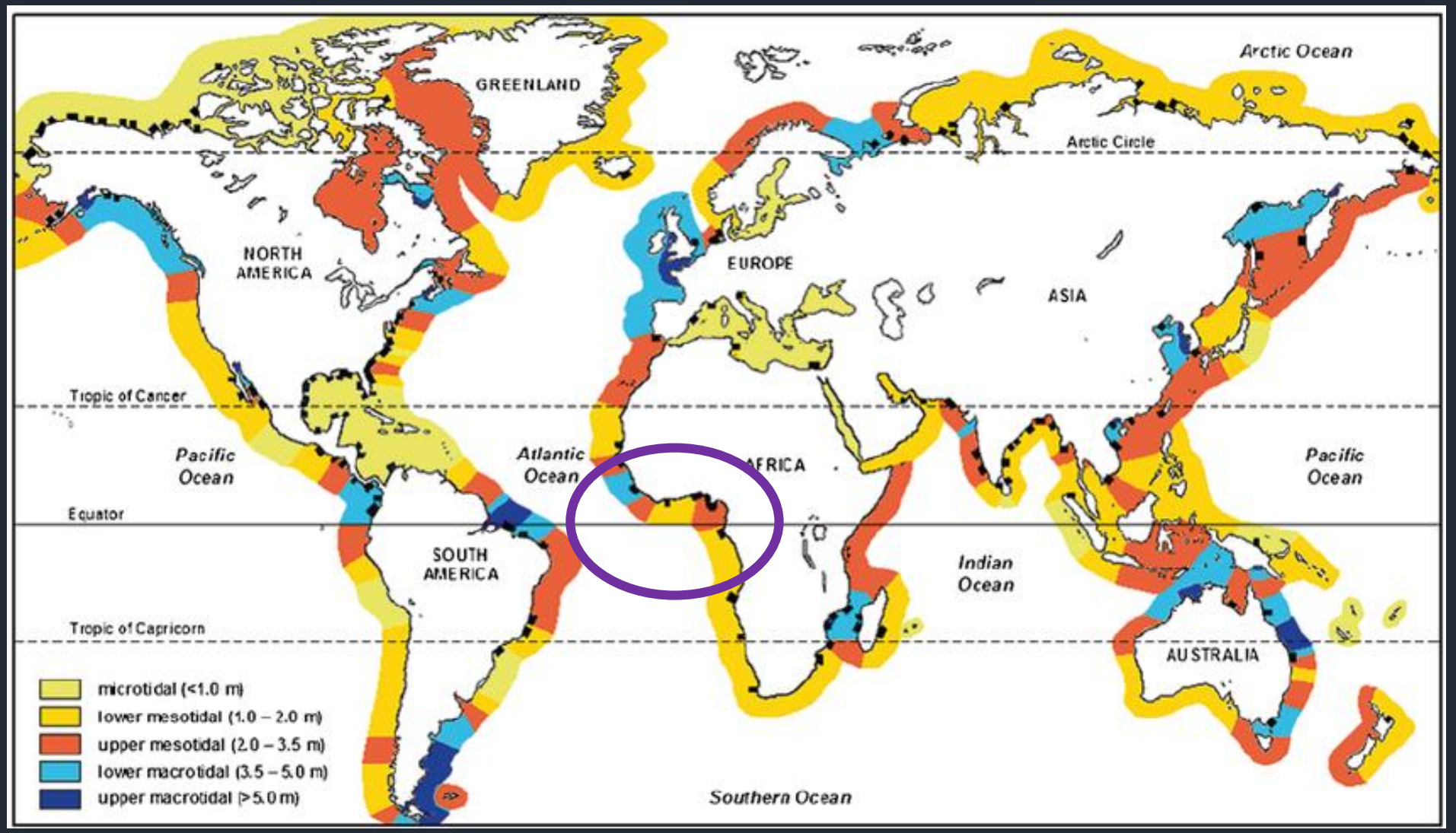


What about in Accra?



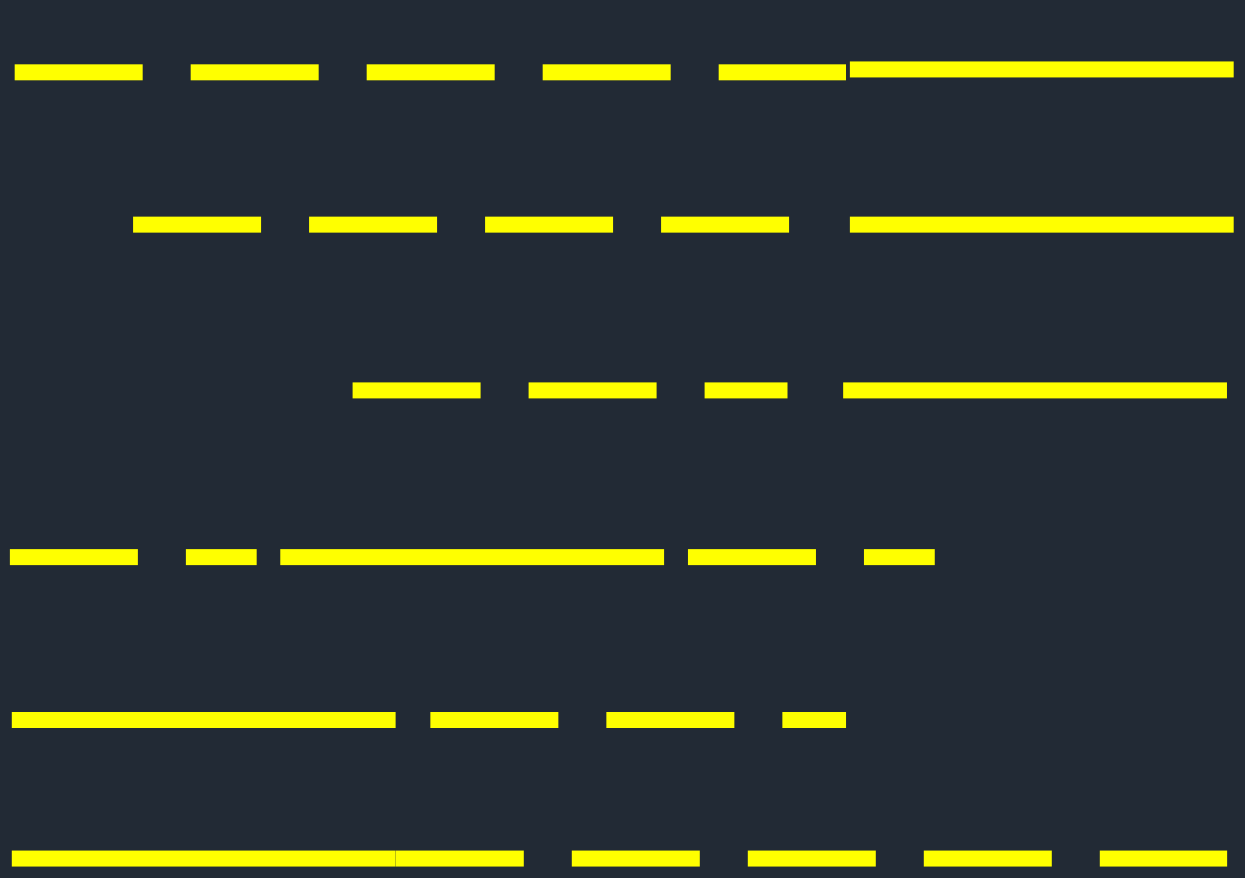
https://www.tide-forecast.com/locations/Accra/tides/latest

Size of the tide range: Macro-, Meso-, Microtidal



Flemming, Siliciclastic Back-Barrier Tidal Flats

Vegetation and landform are influenced by the **tide range**



Salt marshes

Mudflats

Funnel Estuaries

Tidal Deltas

Barrier Islands

River Deltas

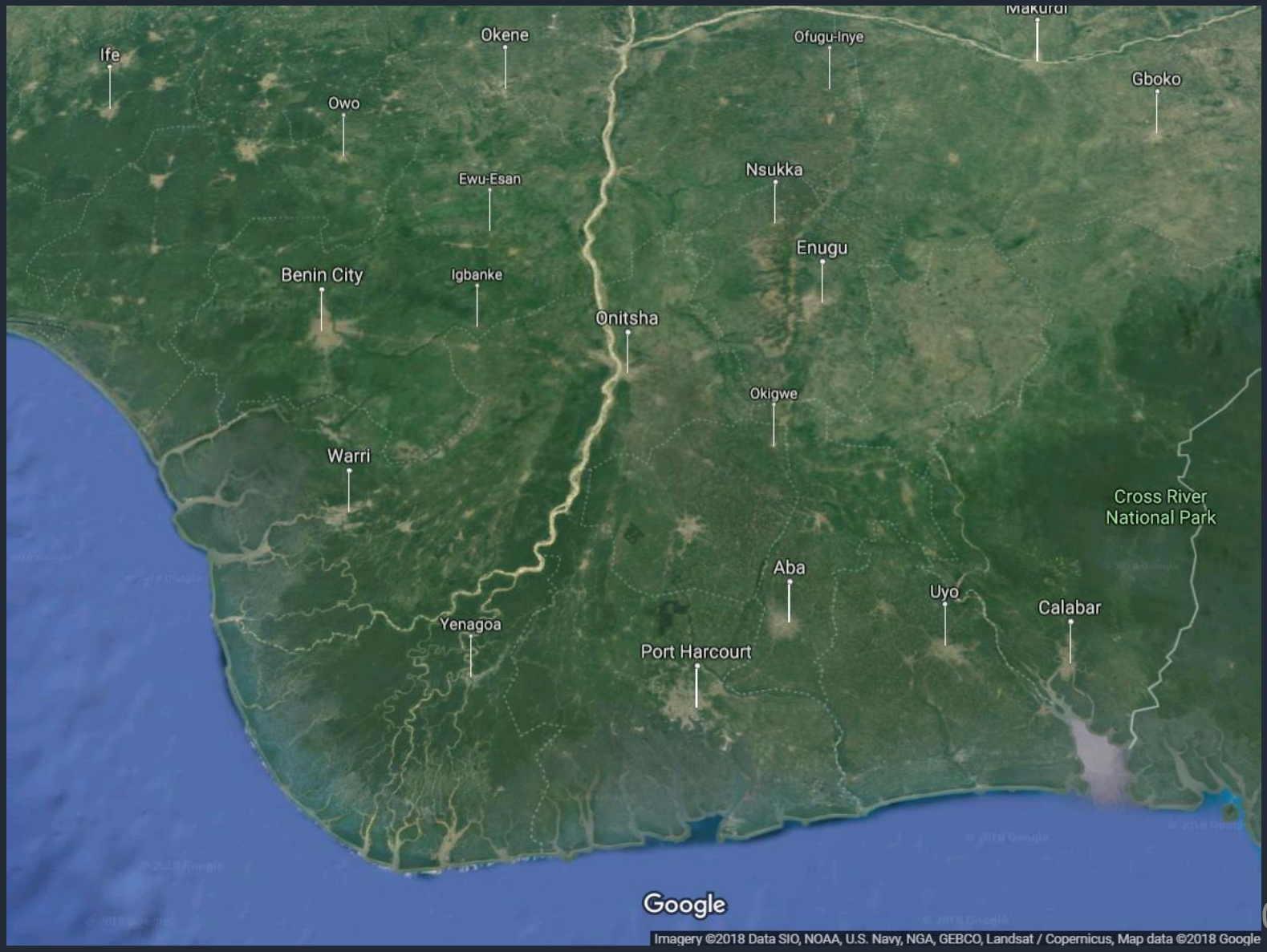
Microtidal

Mesotidal

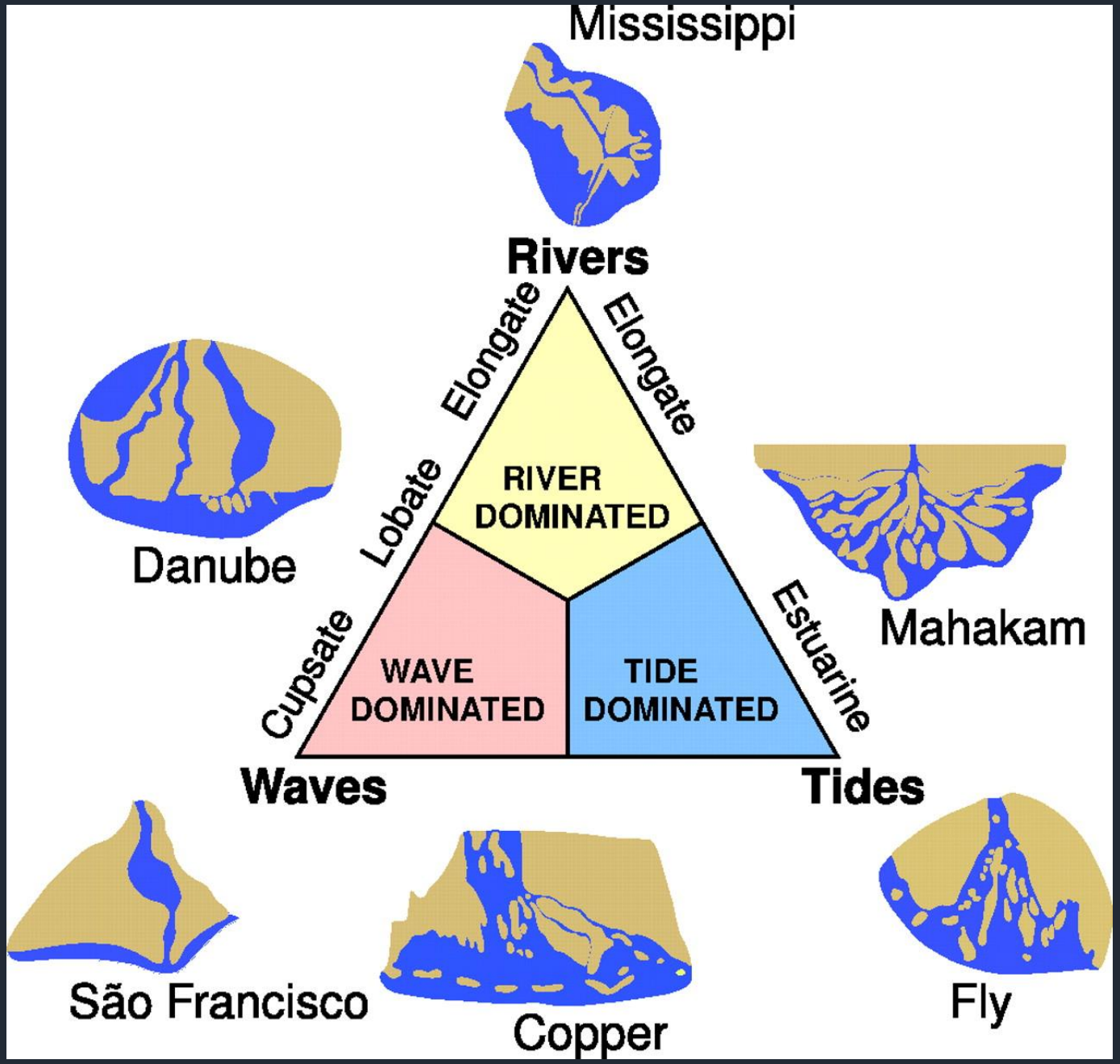
Macrotidal

Adopted from Haslett, Coastal Systems

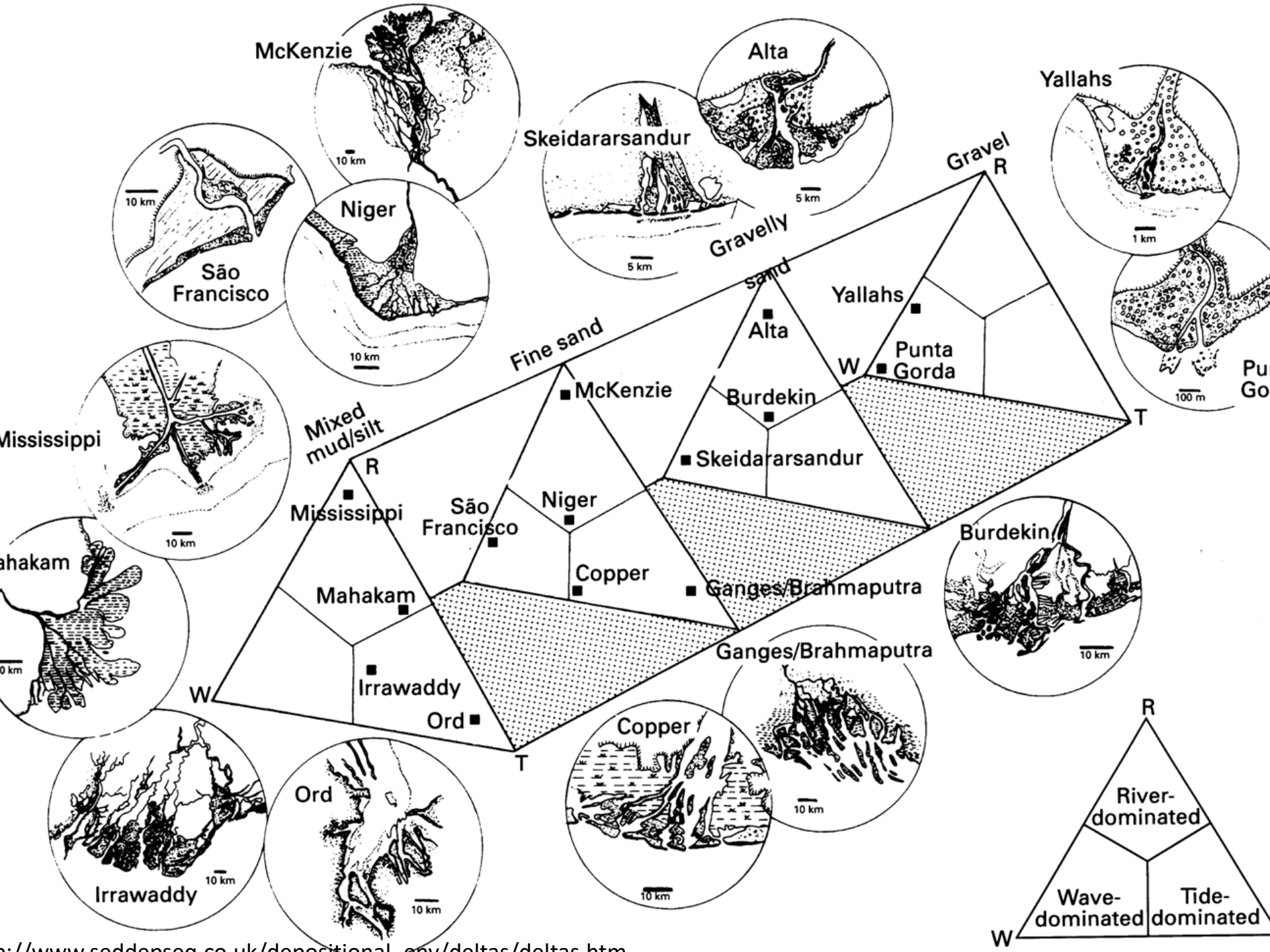
River-dominated coasts



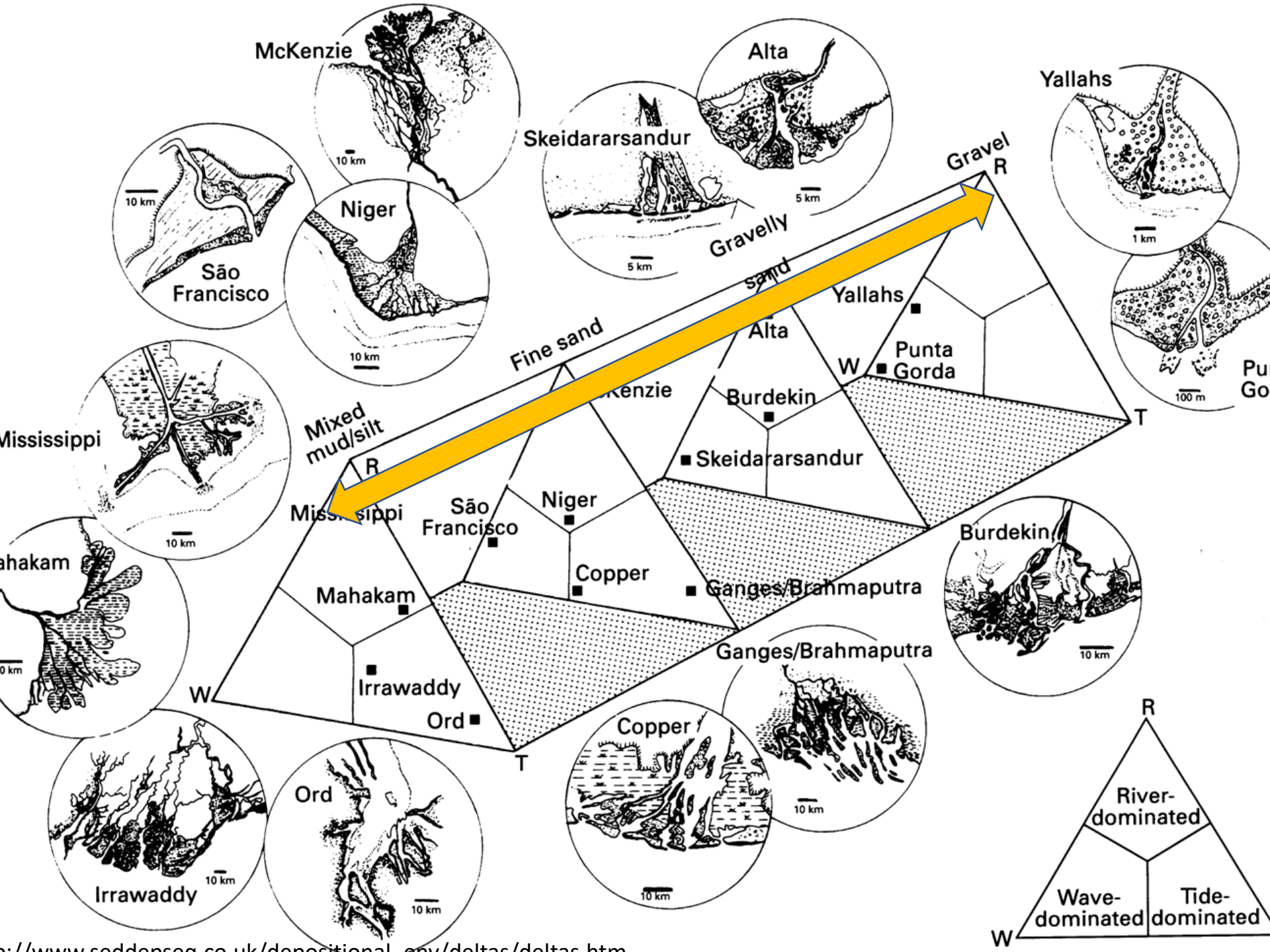
River-dominated coasts



Seybold et al. 2007



http://www.seddenseg.co.uk/depositional_env/deltas/deltas.htm



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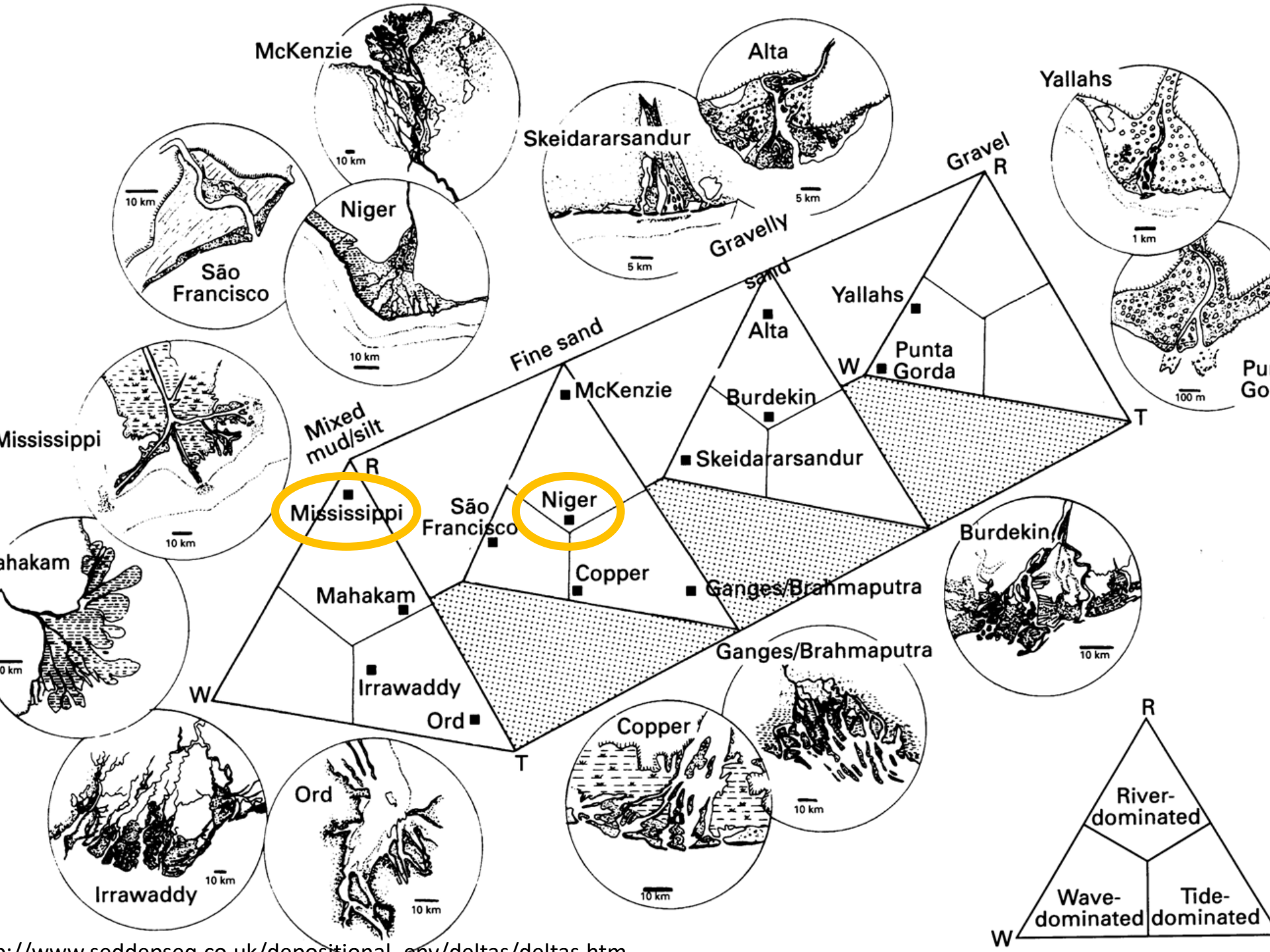

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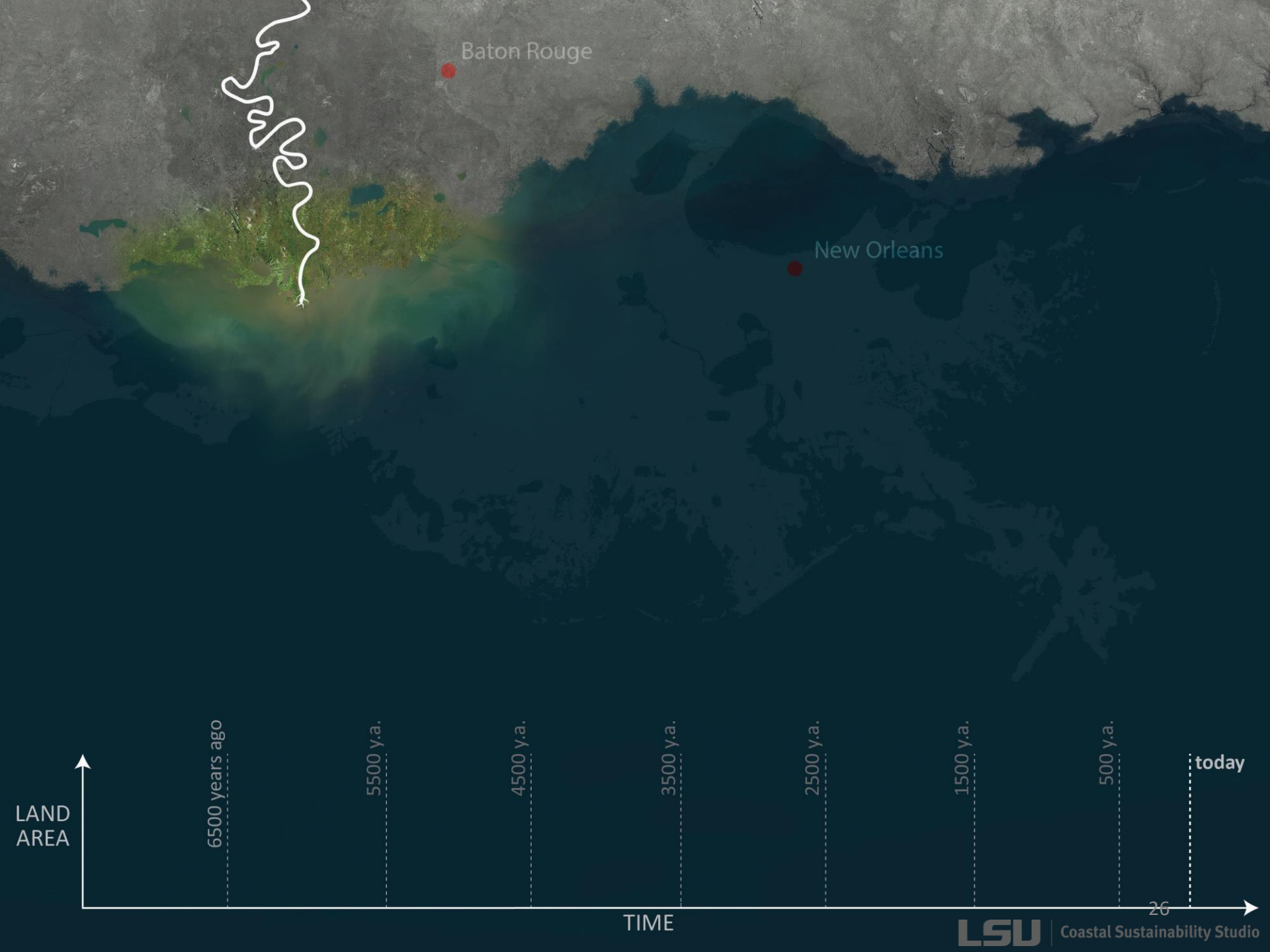
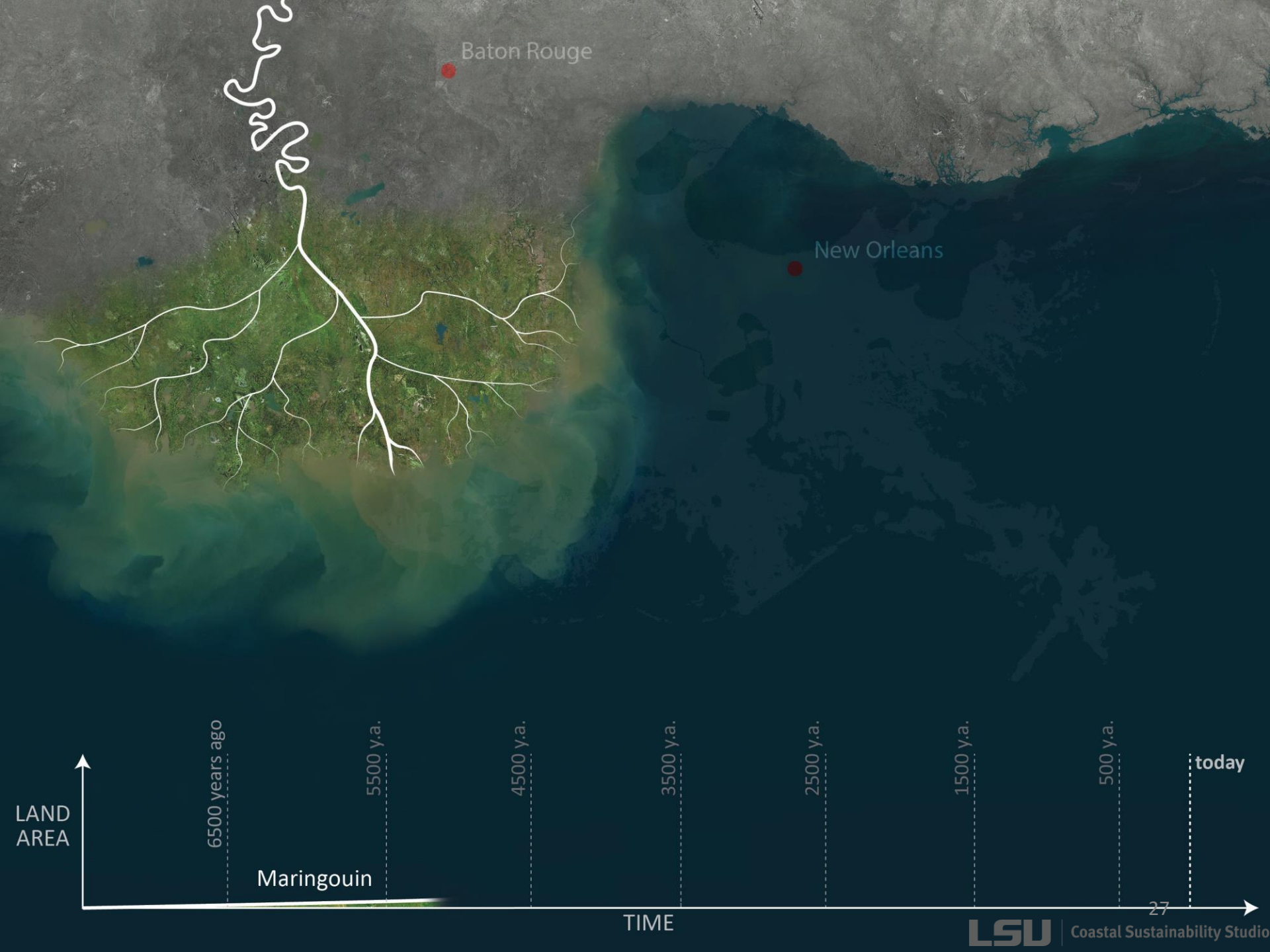

Baton Rouge
New Orleans
LAND AREA
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
TIME


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
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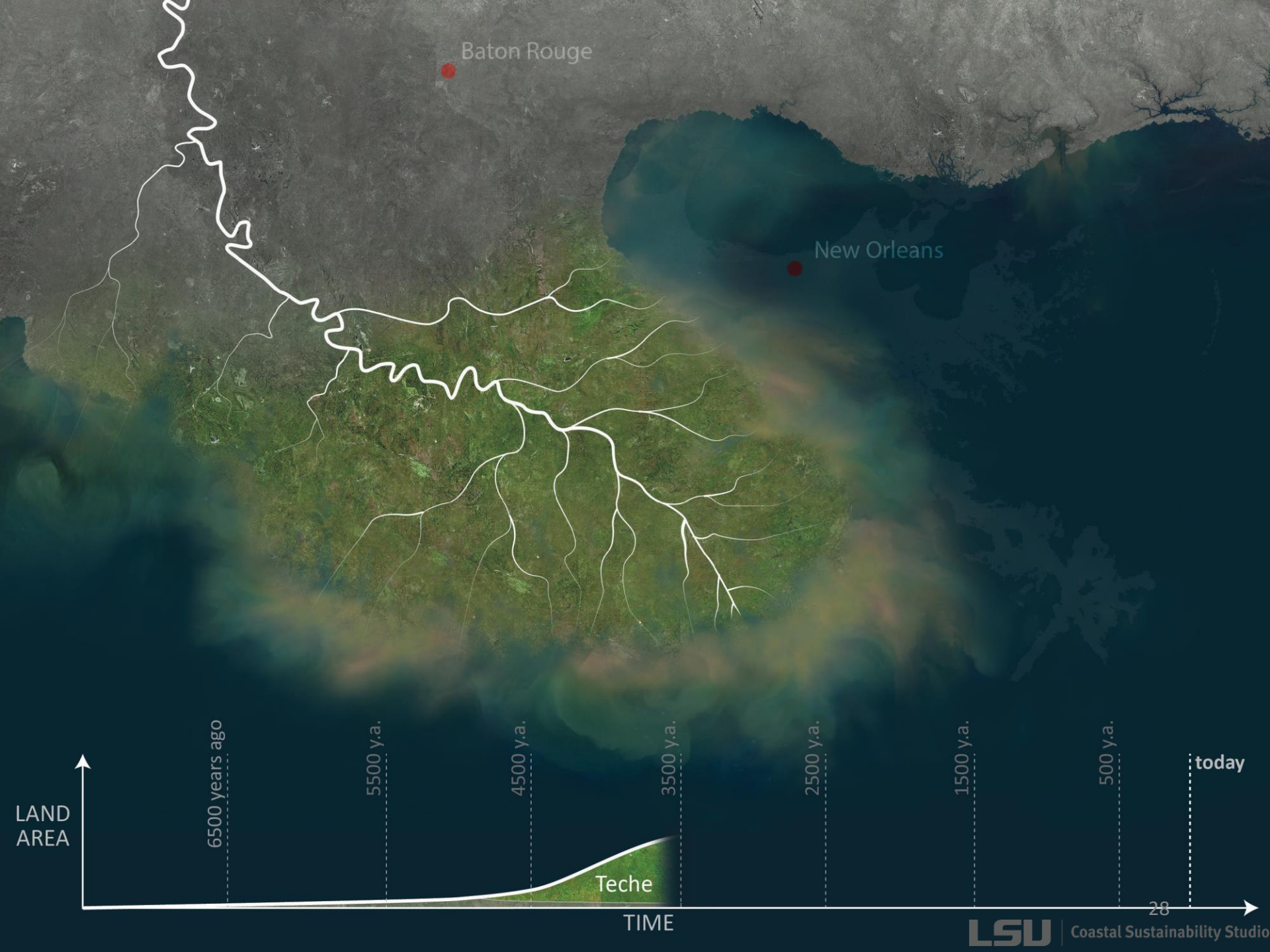
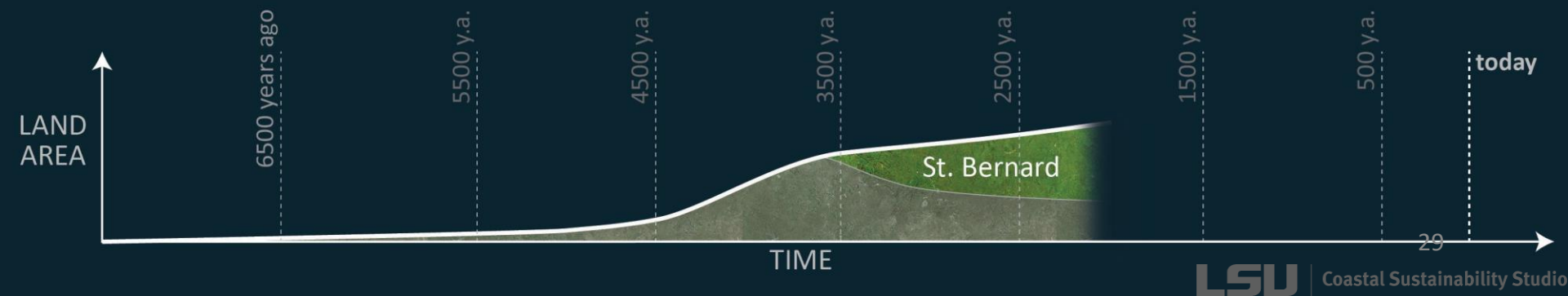
500 y.a.
today
LAND AREA
Maringouin
TIME


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
LAND AREA
Teche
TIME


Baton Rouge
New Orleans

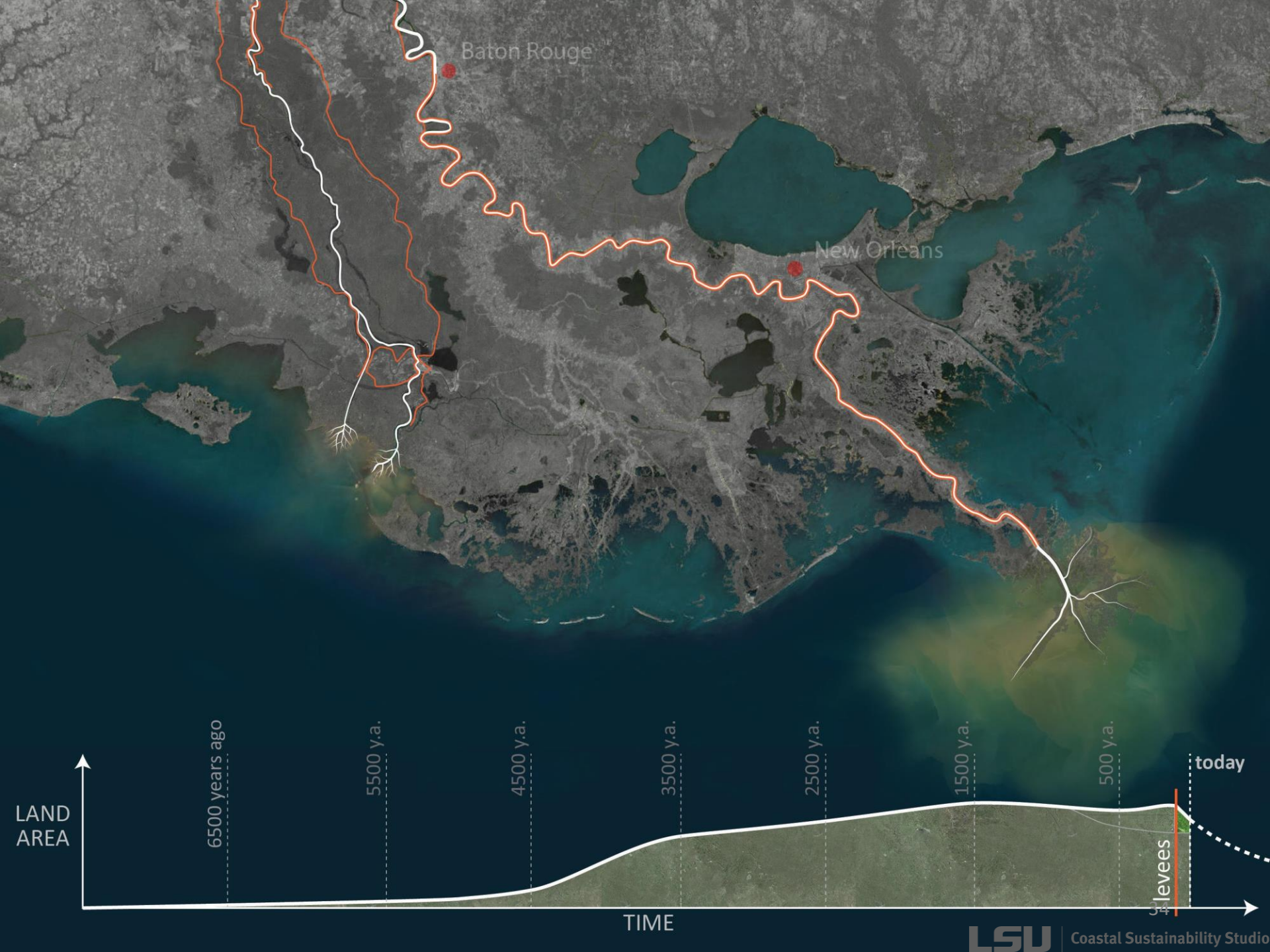

LAND AREA
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
St. Bernard
TIME


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
LAND AREA
Lafourche
TIME


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
LAND AREA
Plaquemines
TIME


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
LAND AREA
levees
TIME
LSU
Coastal Sustainability Studio


Baton Rouge
New Orleans
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
LAND AREA
levees
TIME
LSU
Coastal Sustainability Studio

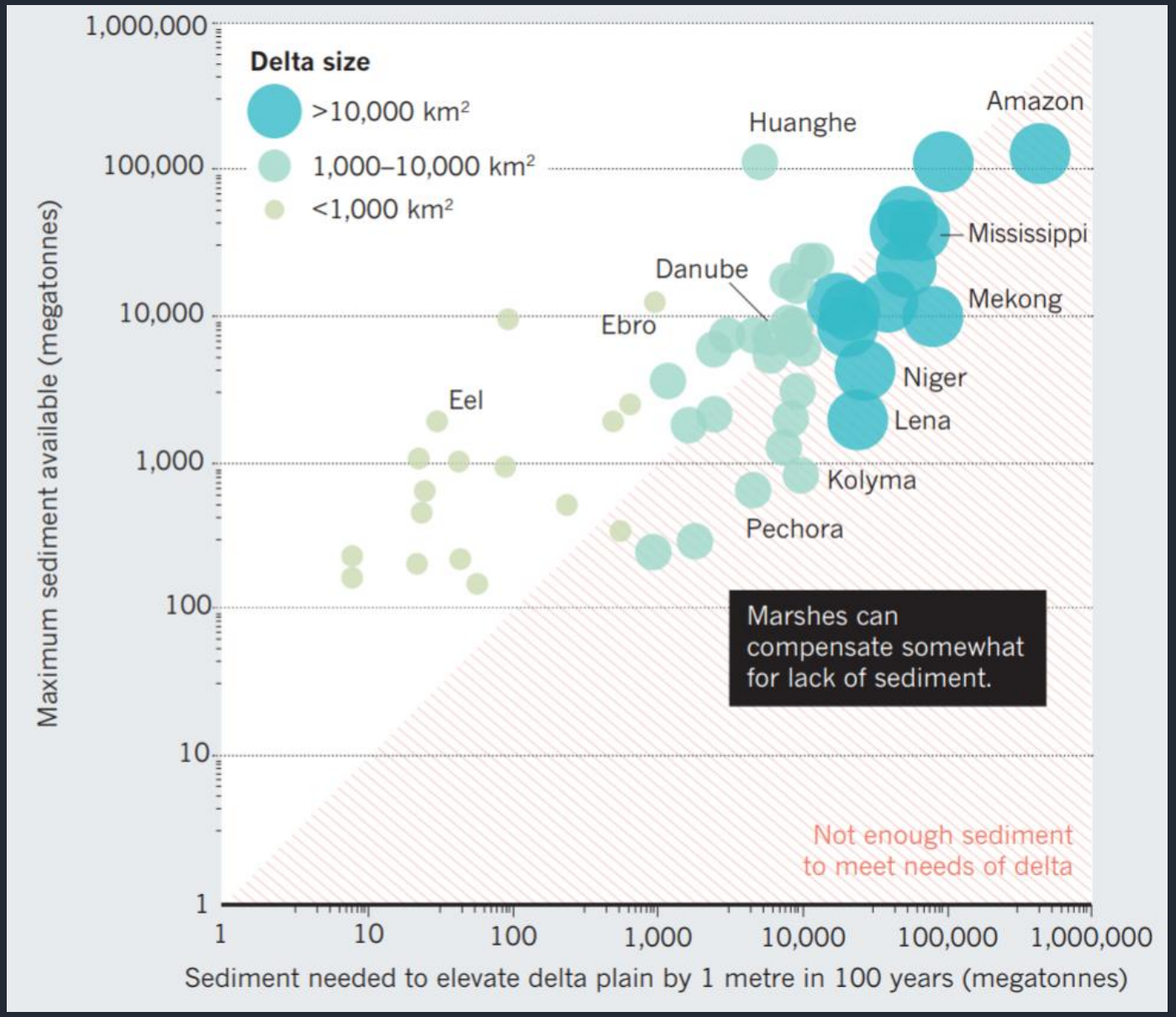

Baton Rouge
New Orleans
LAND AREA
6500 years ago
5500 y.a.
4500 y.a.
3500 y.a.
2500 y.a.
1500 y.a.
500 y.a.
today
levees
TIME

Causes of sea level change

Physical Process	Spatial Scale			Temporal Scale	Potential Magnitude (yearly)
	Global	Regional	Local		
Wind Waves (e.g., dynamical effects, runup)			X	seconds to minutes	<10 m
Tsunami		X	X	minutes to hours	<10s of m
Storm Surge (e.g., tropical storms or nor'easters)		X	X	minutes to days	<15 m
Tides			X	hours	<15 m
Seasonal Cycles		X	X	months	<0.5 m
Ocean/Atmospheric Variability (e.g., ENSO response)		X	X	months to years	<0.5 m
Ocean Eddies, Planetary Waves		X	X	months to years	<0.5 m
Ocean Gyre and Over-turning Variability (e.g., PDO response)		X	X	years to decades	<0.5 m
Land Ice Melt/Discharge	X	X	X	years to centuries	millimeters to centimeters
Thermal Expansion	X	X	X	years to centuries	millimeters to centimeters
Vertical Land Motion		X	X	minutes to centuries	millimeters to centimeters

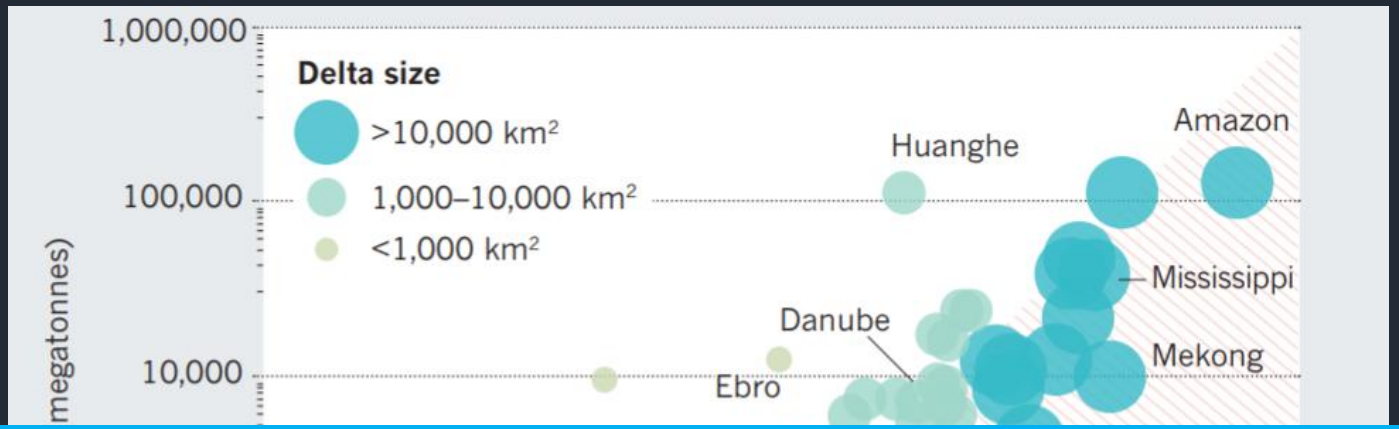
Sweet et al. 2017

Can deltas keep pace with sea-level rise?



Giosan et al. 2014

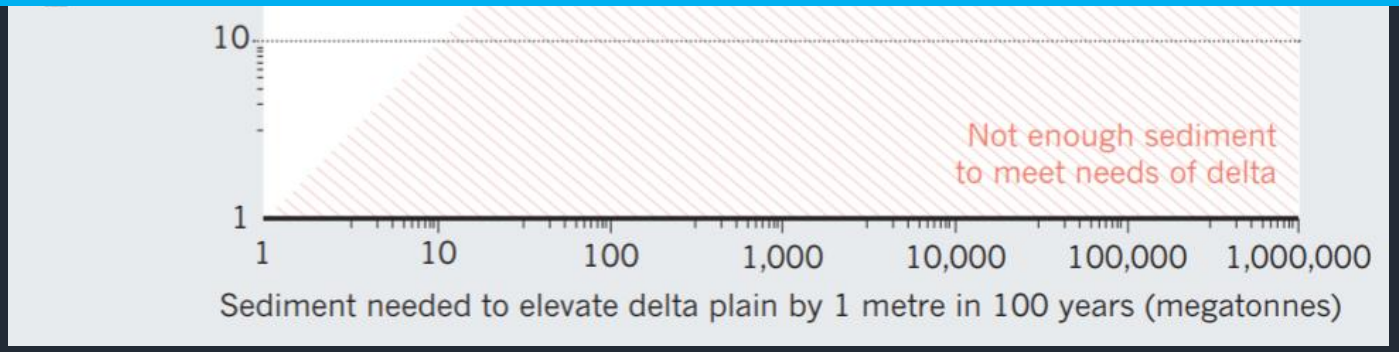
Can deltas keep pace with sea-level rise?



no net emissions → sea-level rise = 0.3 m by 2100

high emissions → sea-level rise = 2.5 m by 2100

(Sweet et al. 2017)



Giosan et al. 2014

Ecosystem Services from salt marshes and mangroves

1. Habitat
2. Carbon sequestration
3. Water treatment
4. Wave attenuation/erosion control
5. Valuable goods
6. Flood reduction

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Carbon Sequestration

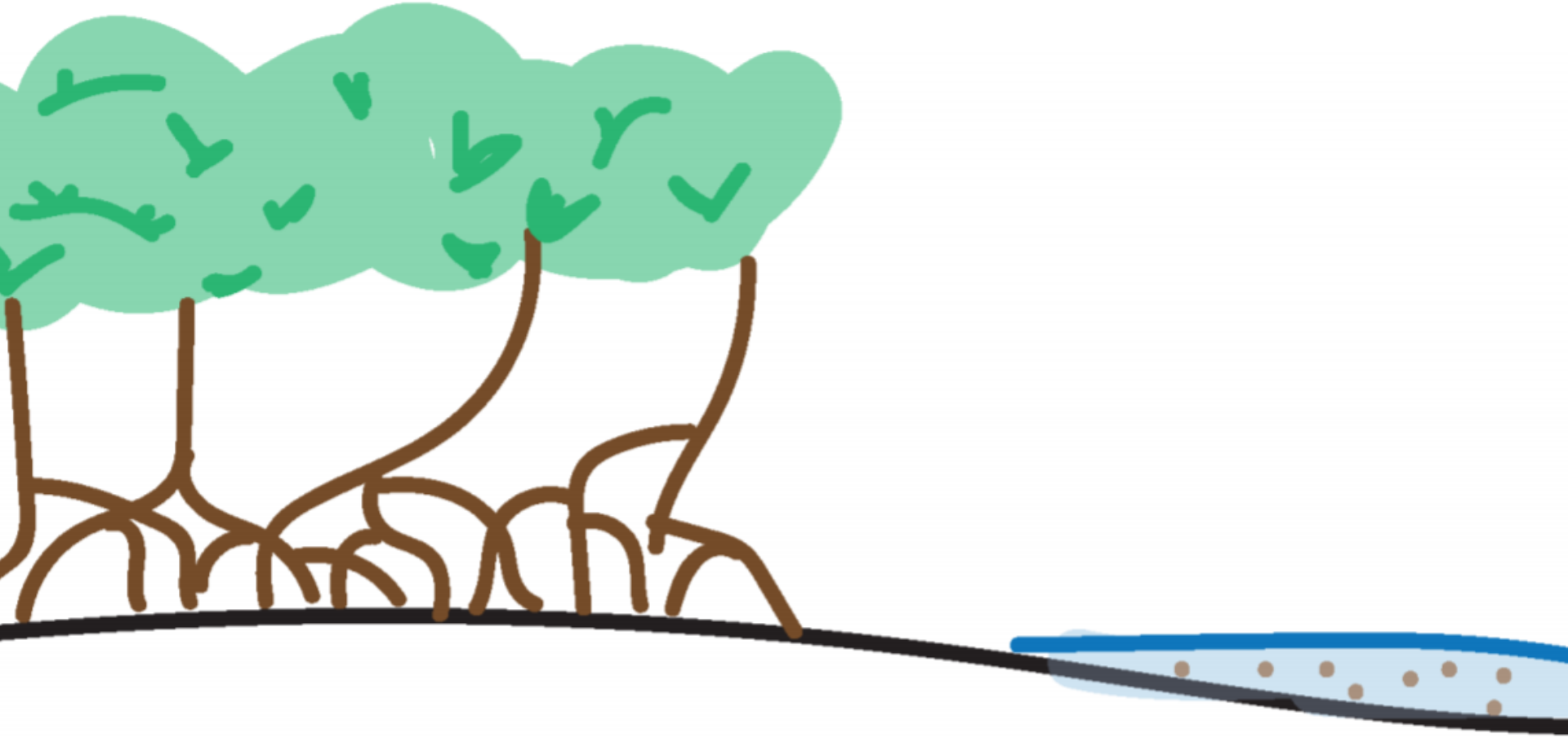
Carbon Sequestration

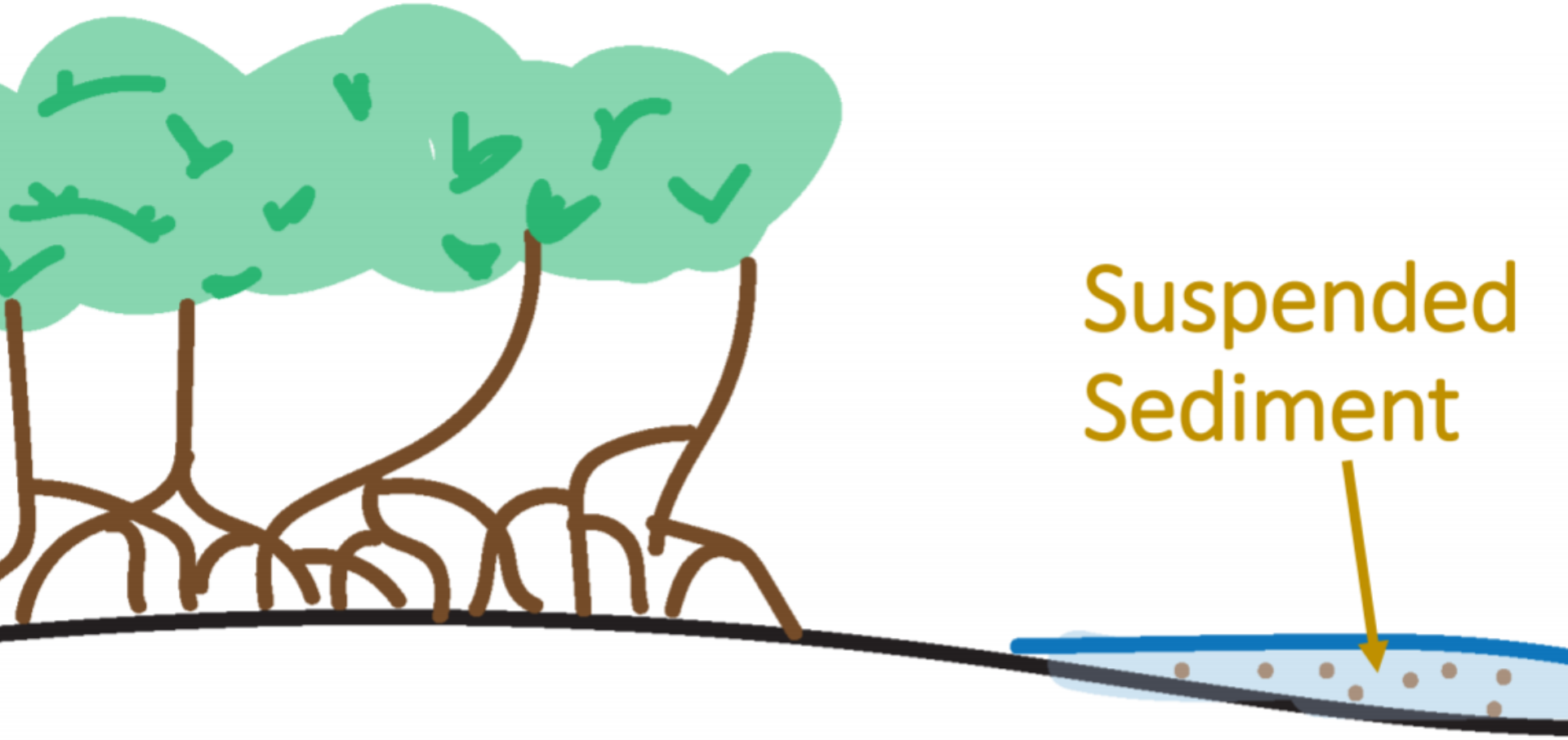
"Blue Carbon" is carbon stored in wet environments (marshes, sea grass, mangroves)

Carbon Sequestration

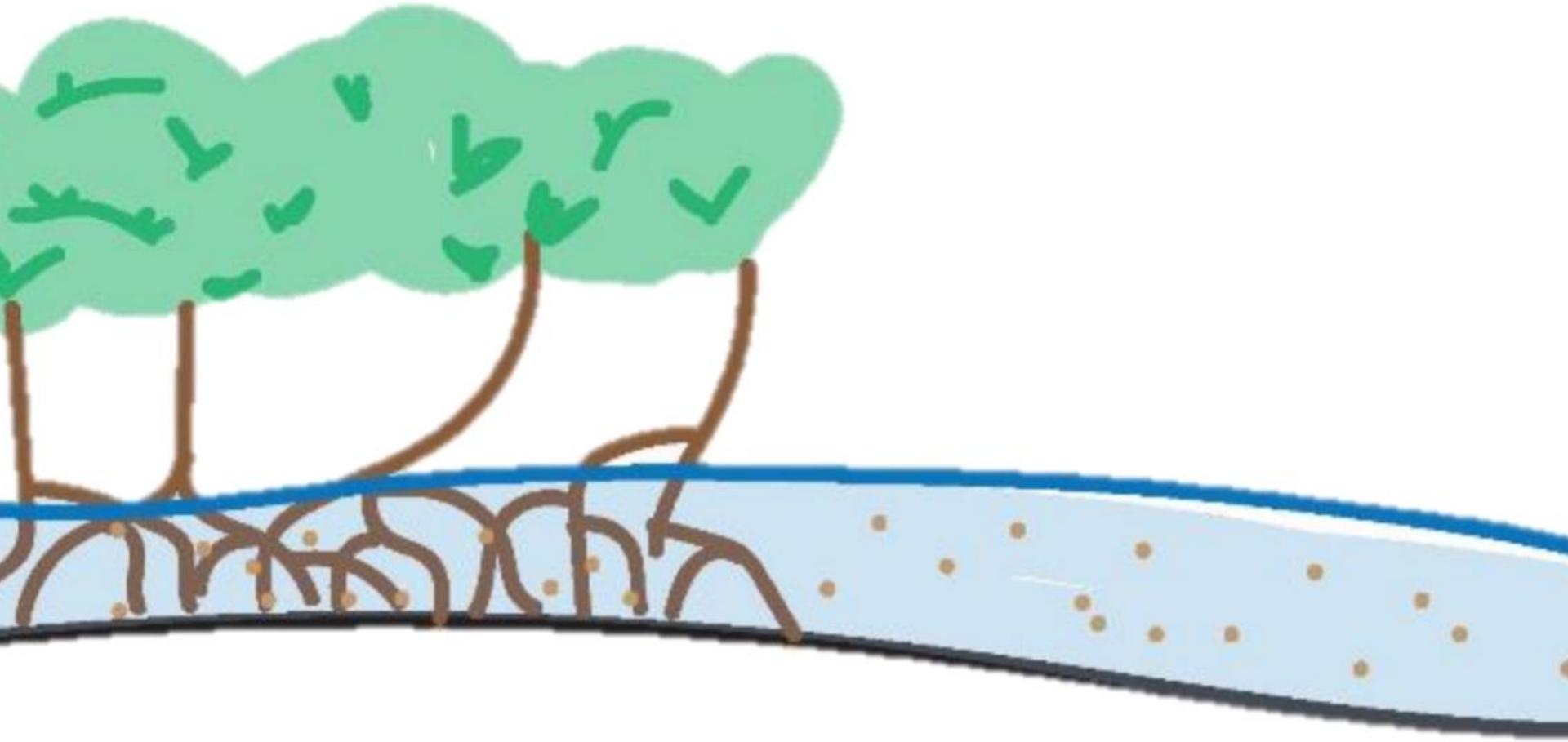
"Blue Carbon" is carbon stored in wet environments (marshes, sea grass, mangroves)

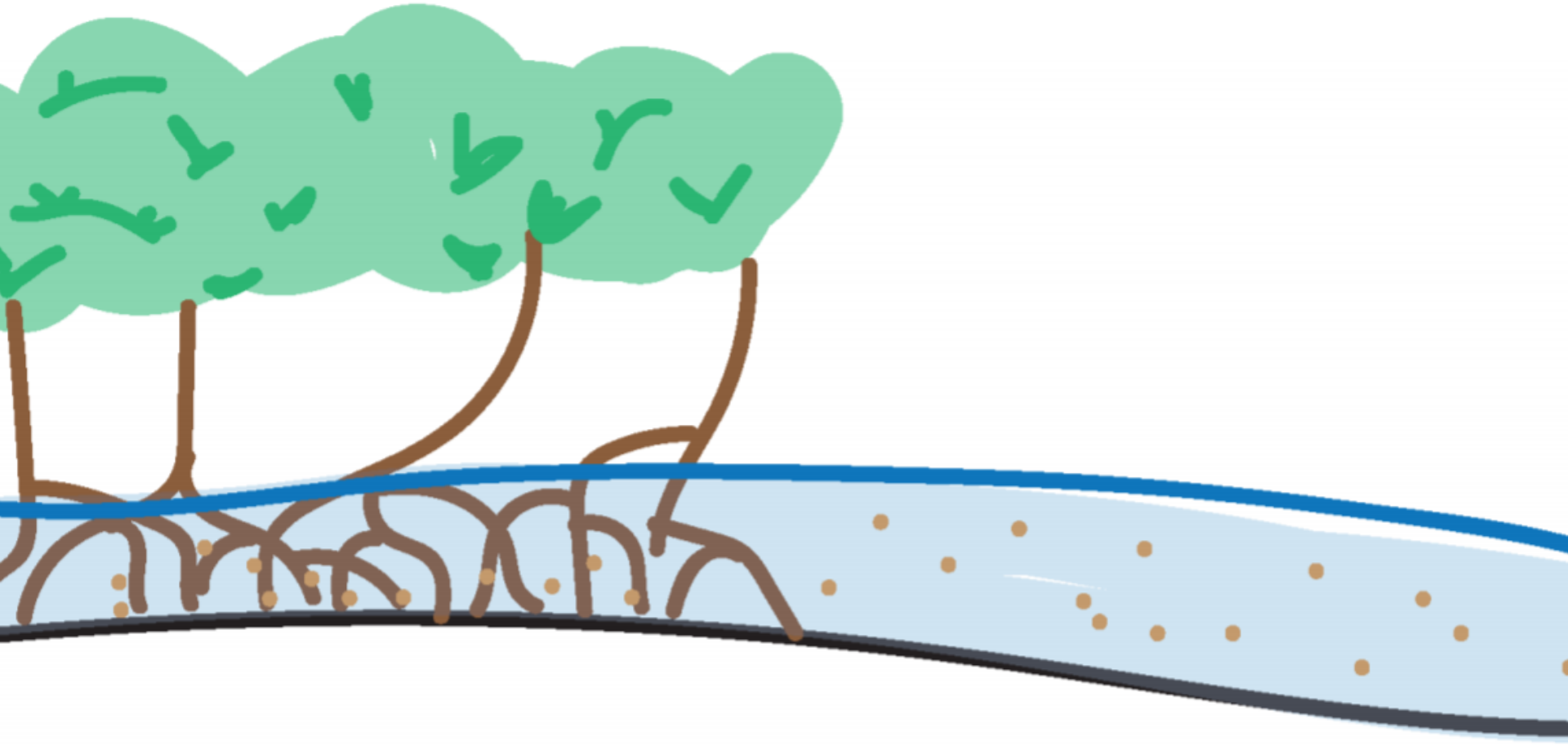
Occurs via **sedimentation** and **biomass burial**

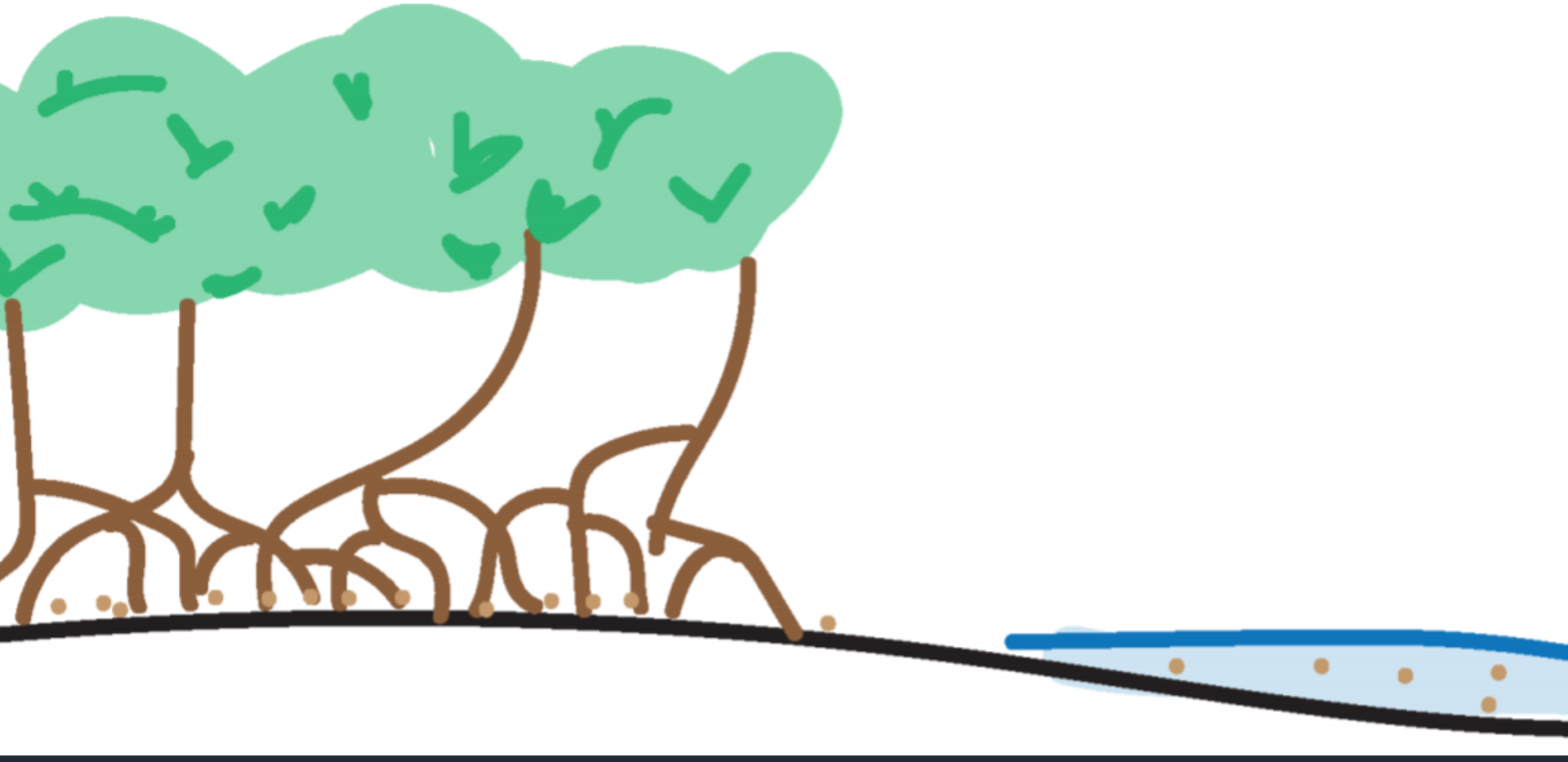


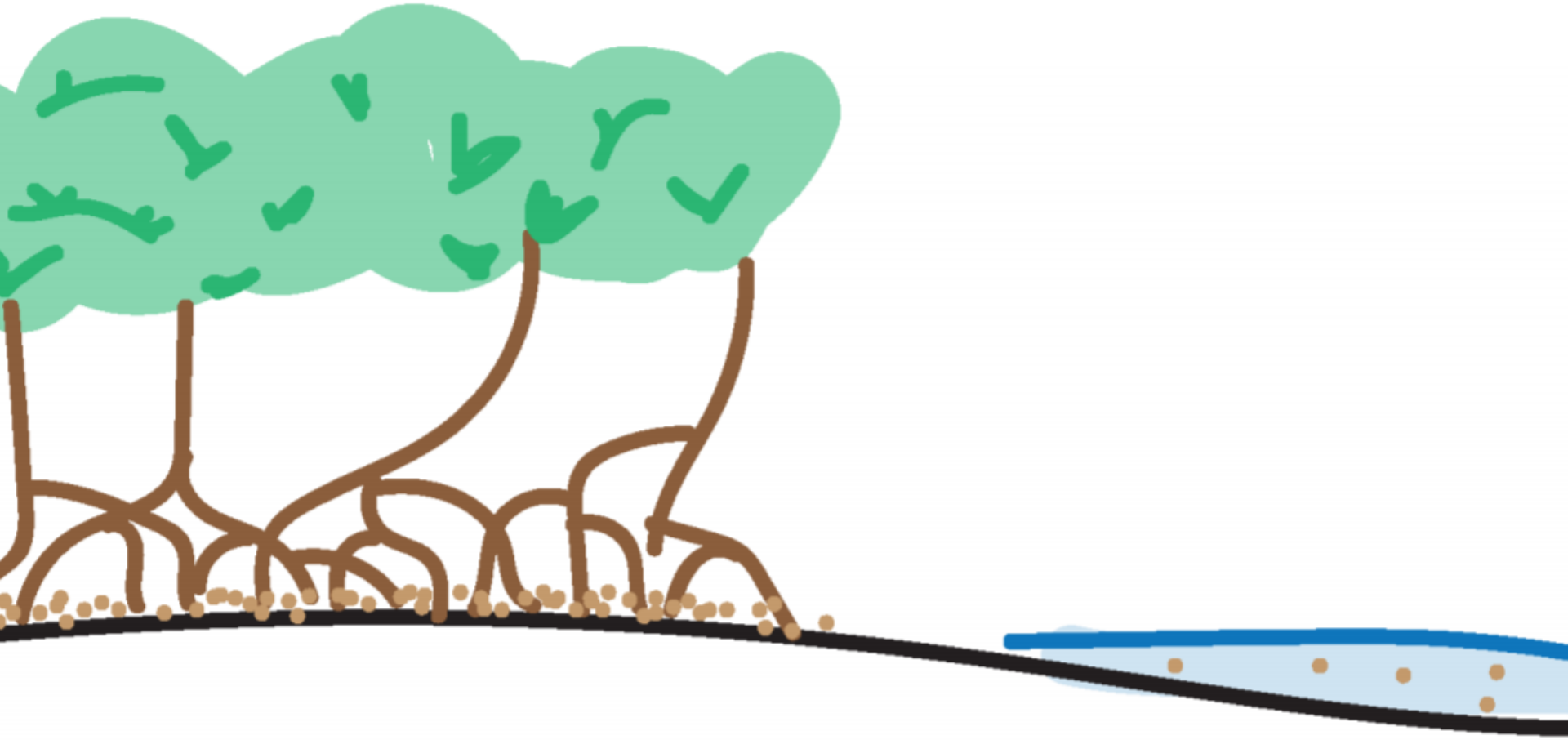

Suspended
Sediment

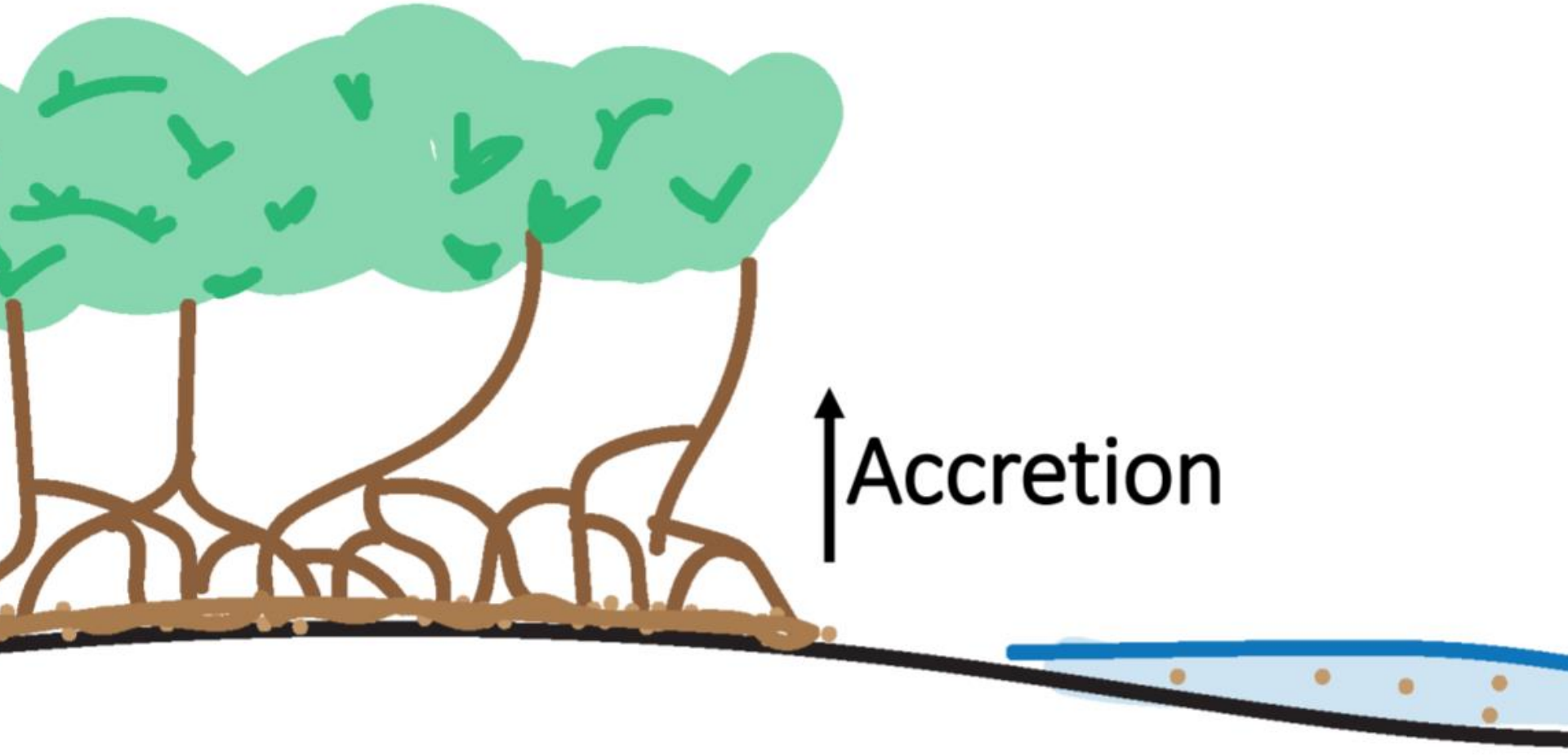

SSC =
Suspended
Sediment
Concentratio

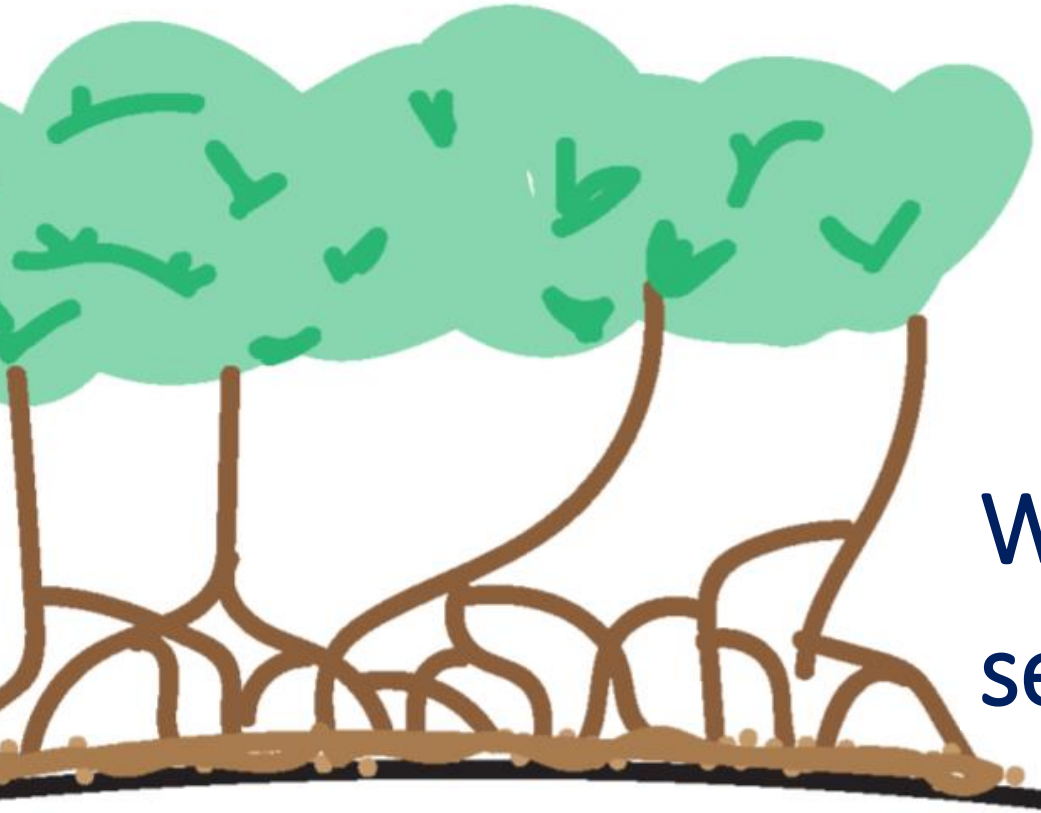




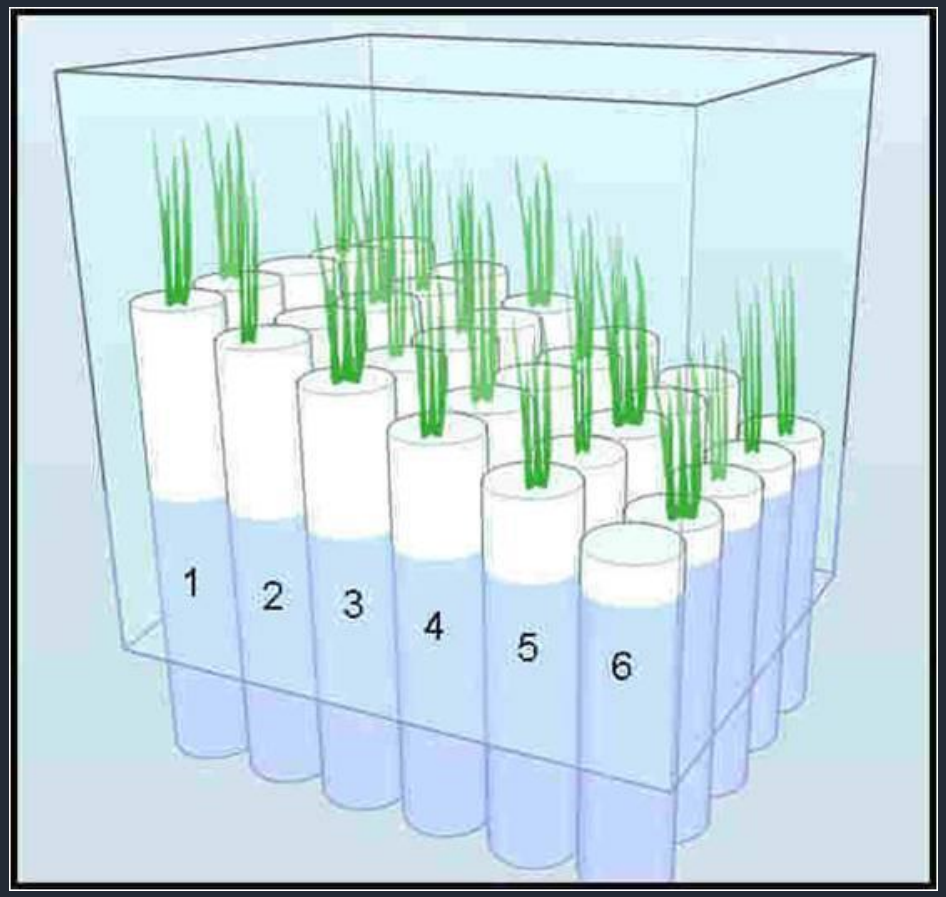





Accretion

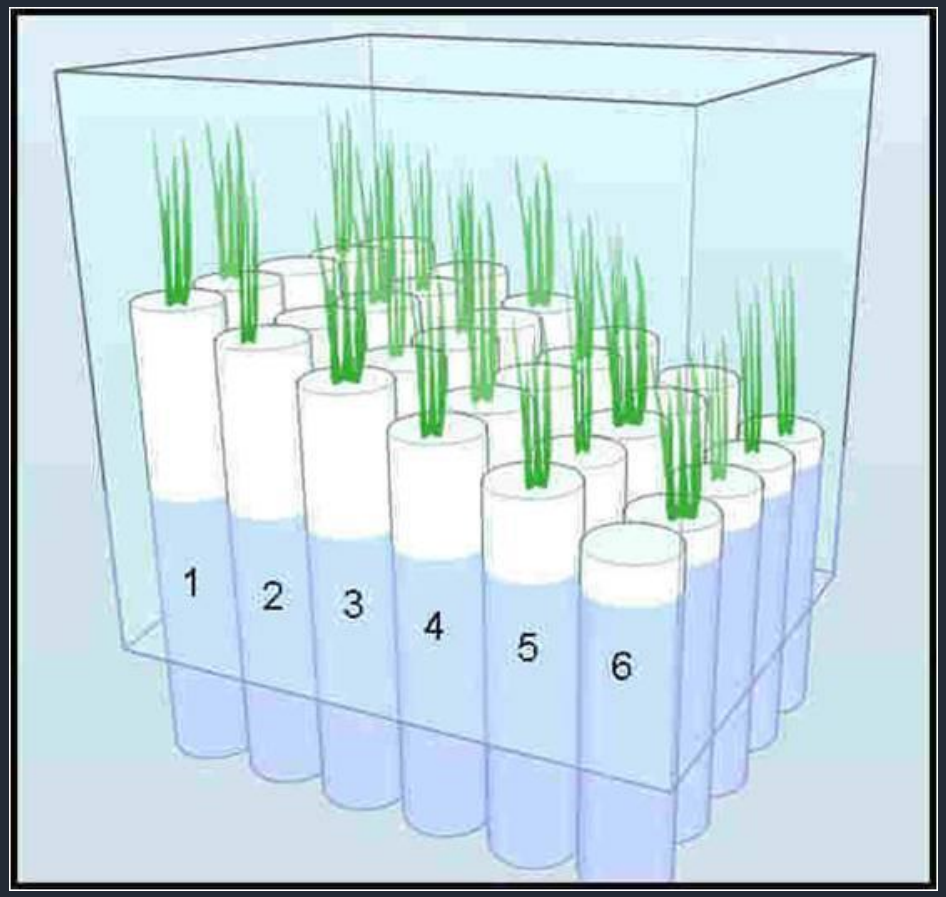


What happens with sea level rise?



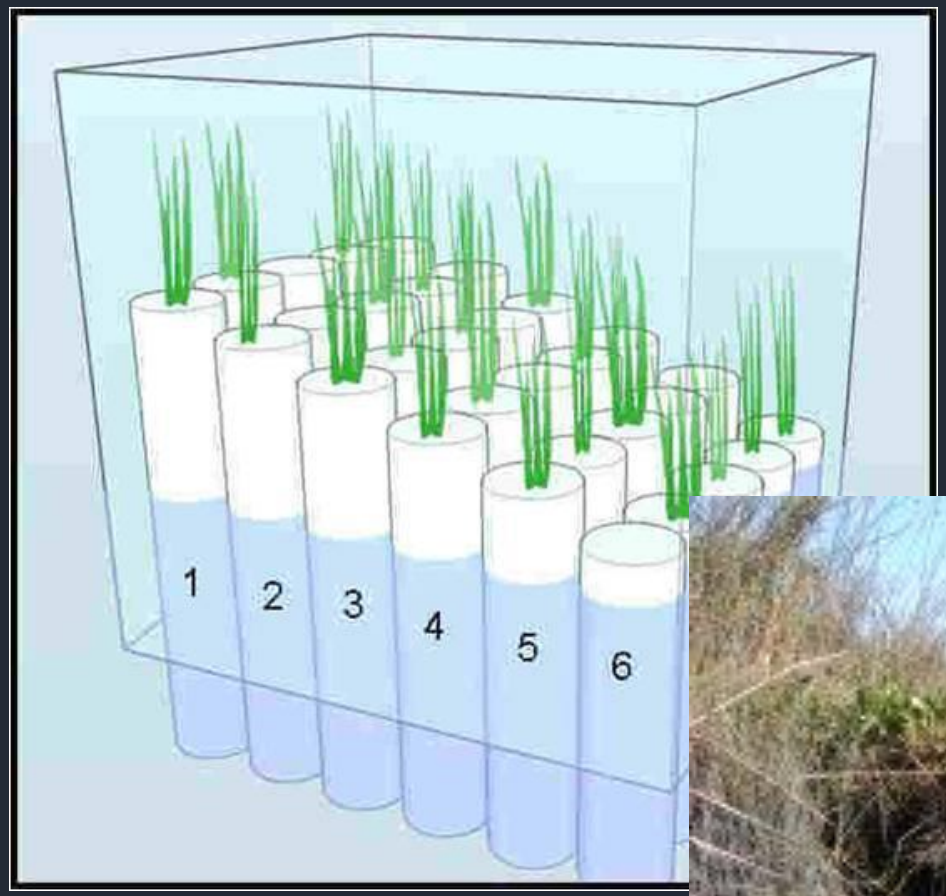
http://sercblog.si.edu

Hydroperiod = the amount of time the vegetation inundated



http://sercblog.si.edu

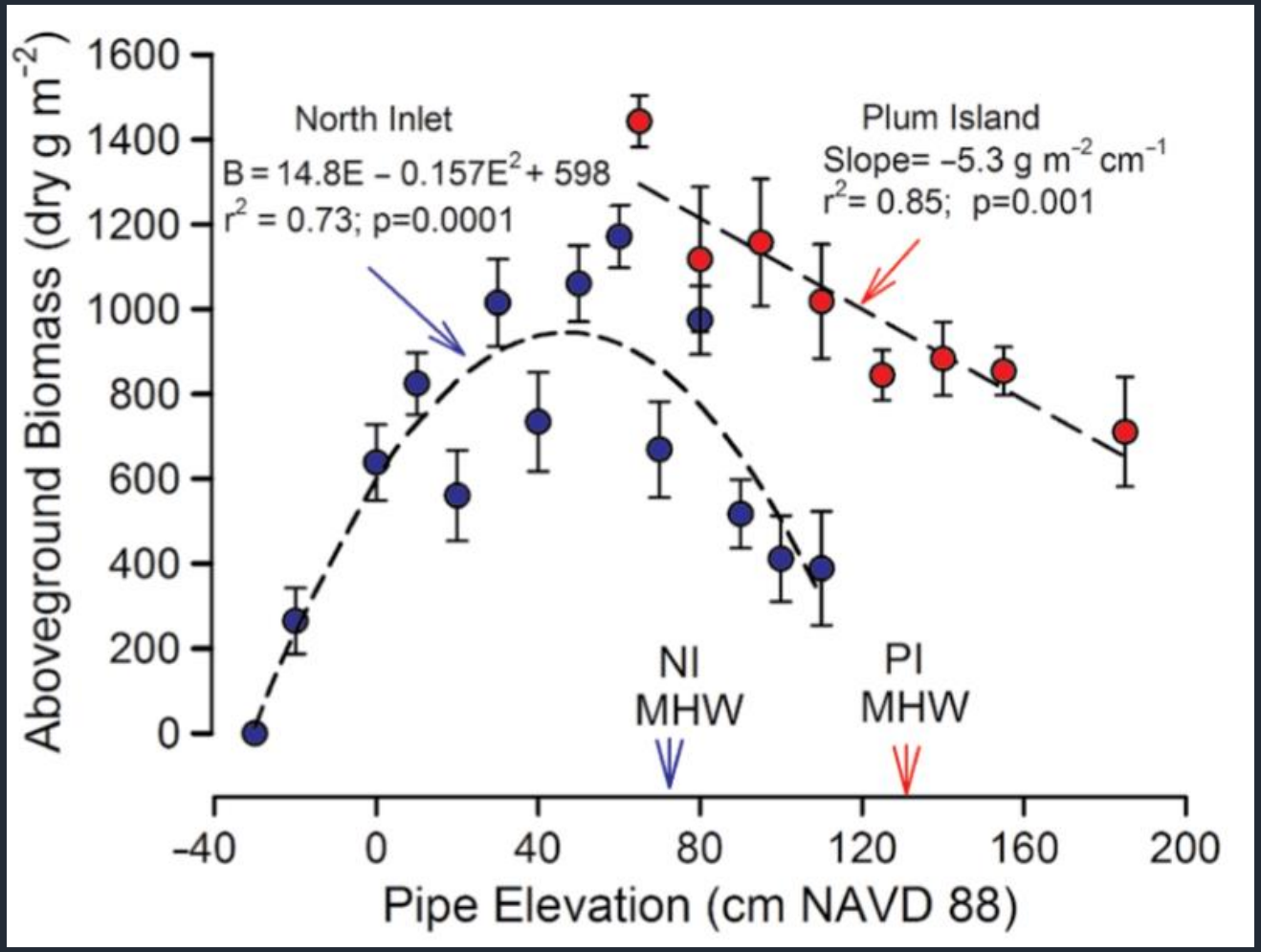
Change the hydroperiod and measure the resulting biomass



Change the hydroperiod and measure the resulting biomass

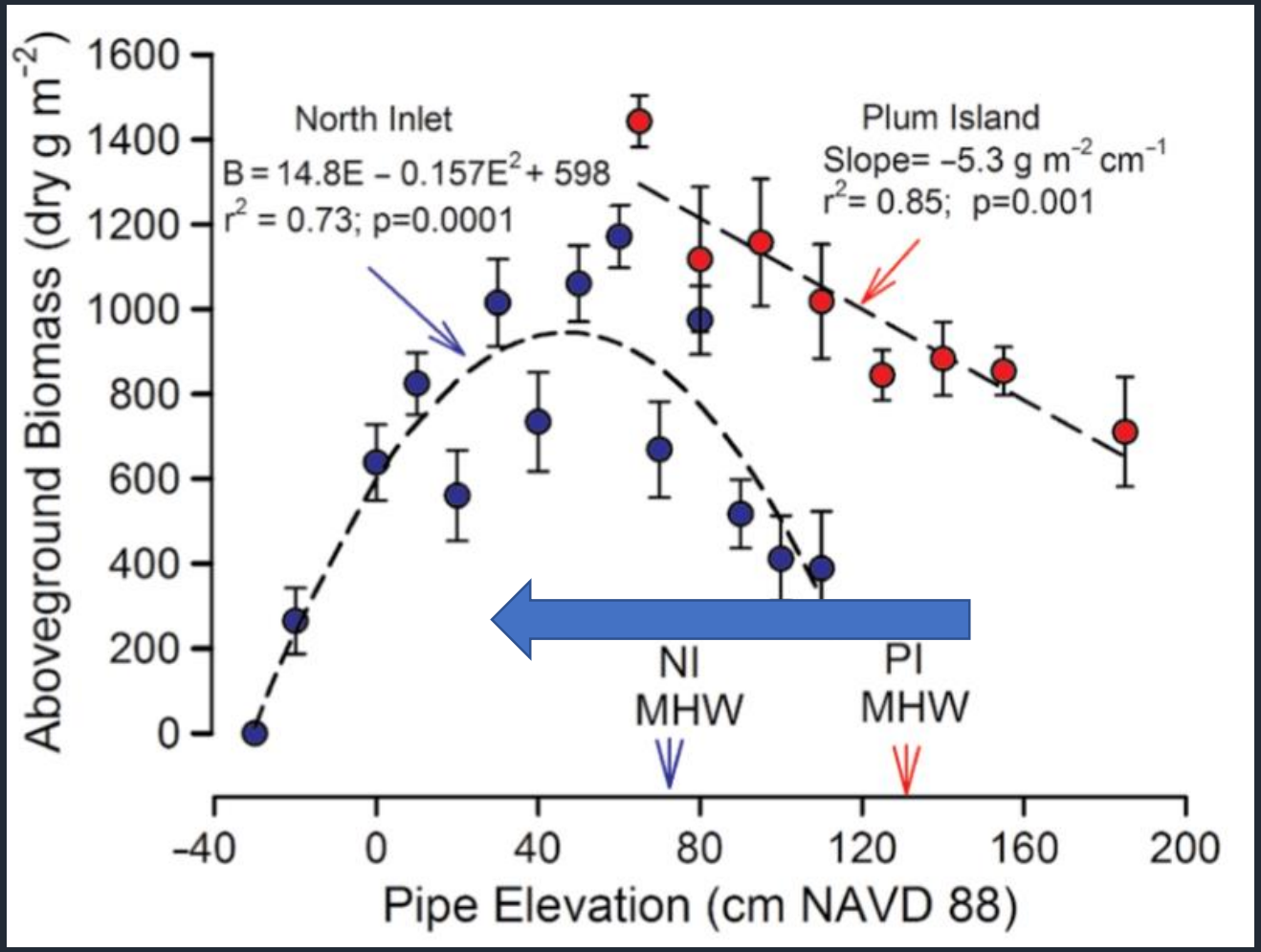
http://maggi-kelly.squarespace.com/lisa-schile/

Biomass as a function of hydroperiod



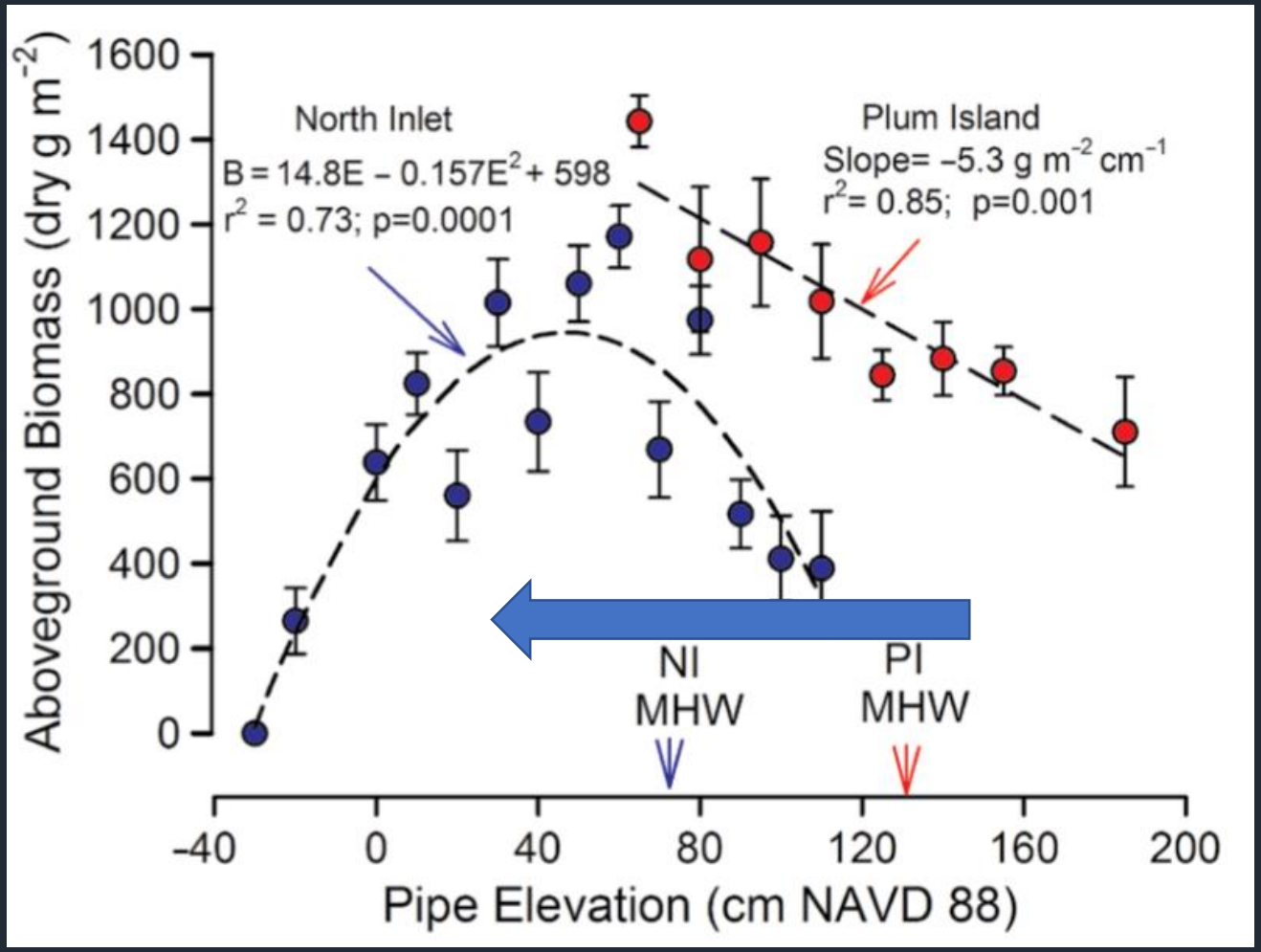
Morris et al. 2013

Sea level rise shifts your position on the curve



Morris et al. 2013

Can increase biomass in some places
Can decrease biomass in others

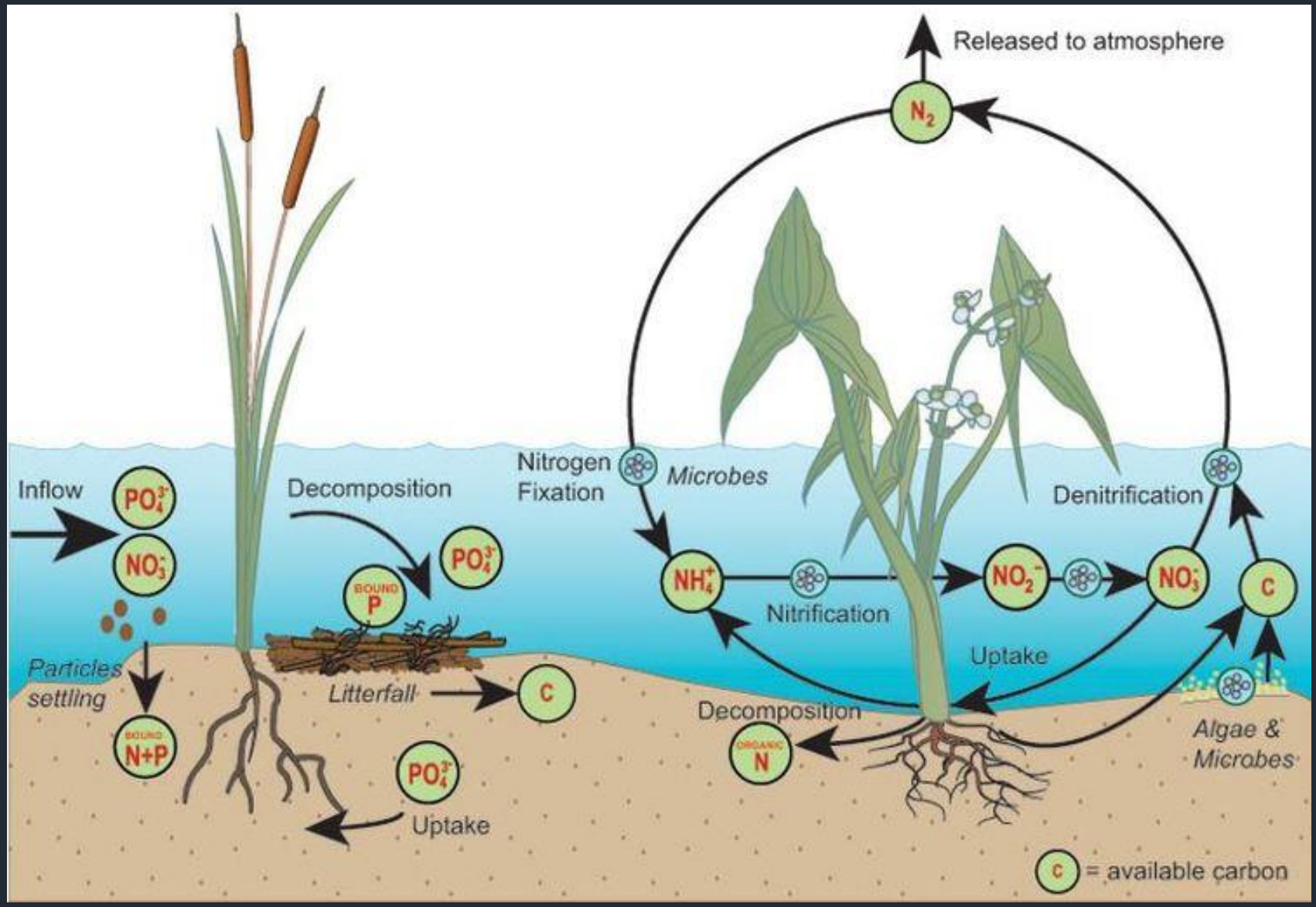


Morris 2013

Ecosystem Services from salt marshes and mangroves

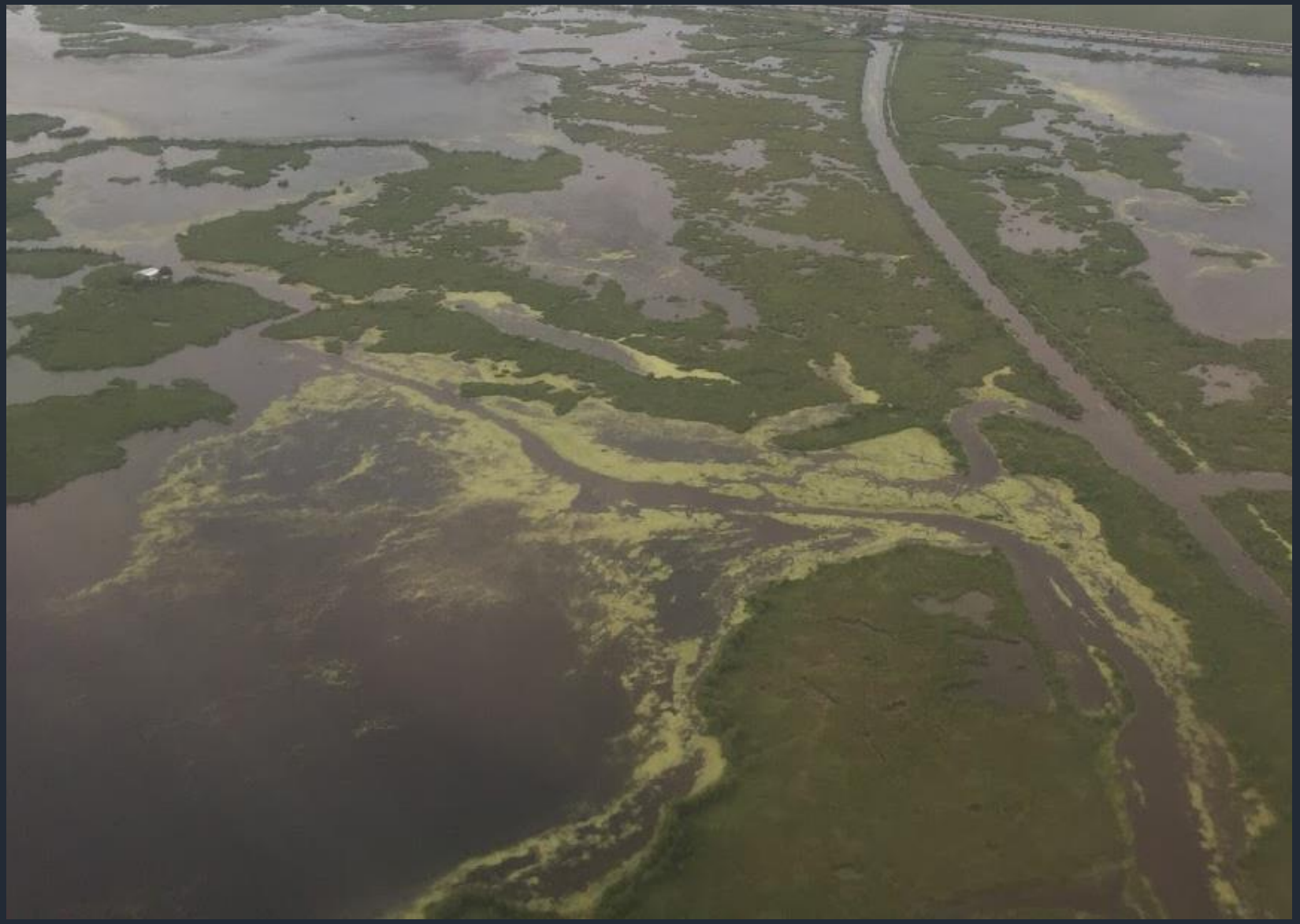
1. Habitat
2. Carbon sequestration
3. Water treatment
4. Wave attenuation/erosion control
5. Valuable goods
6. Flood reduction

Water Treatment



http://www.wetlands-initiative.org/nutrient-removal/

Water Treatment



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Conservation > Restoration

Conservation > Restoration

- Less resilient to sea level rise
- More prone to erosion
- Less belowground biomass

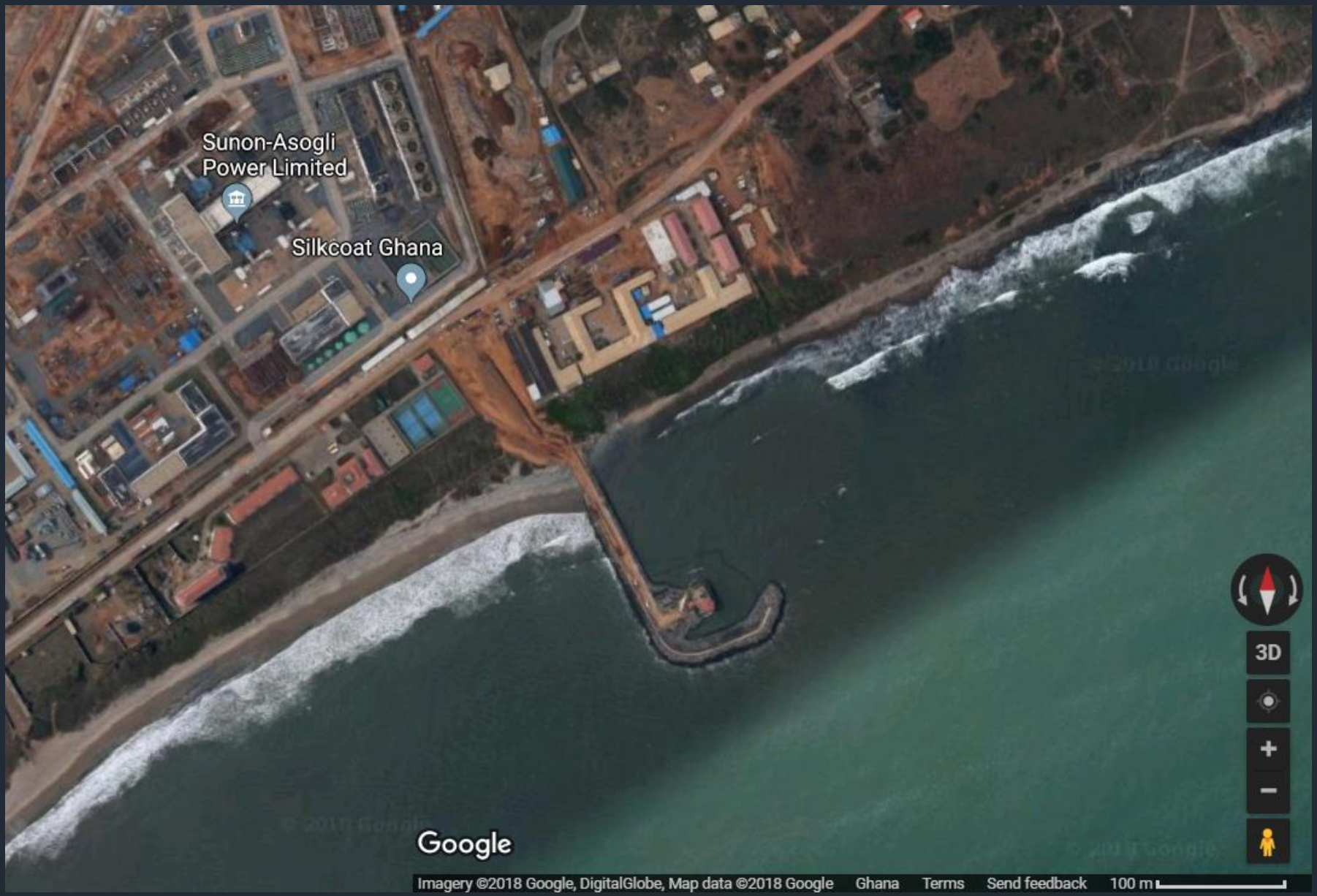
Salt ponds


Google
Imagery ©2018 CNES / Airbus, Map data ©2018 Google
Ghana
Terms
Send feedback
100 m
3D

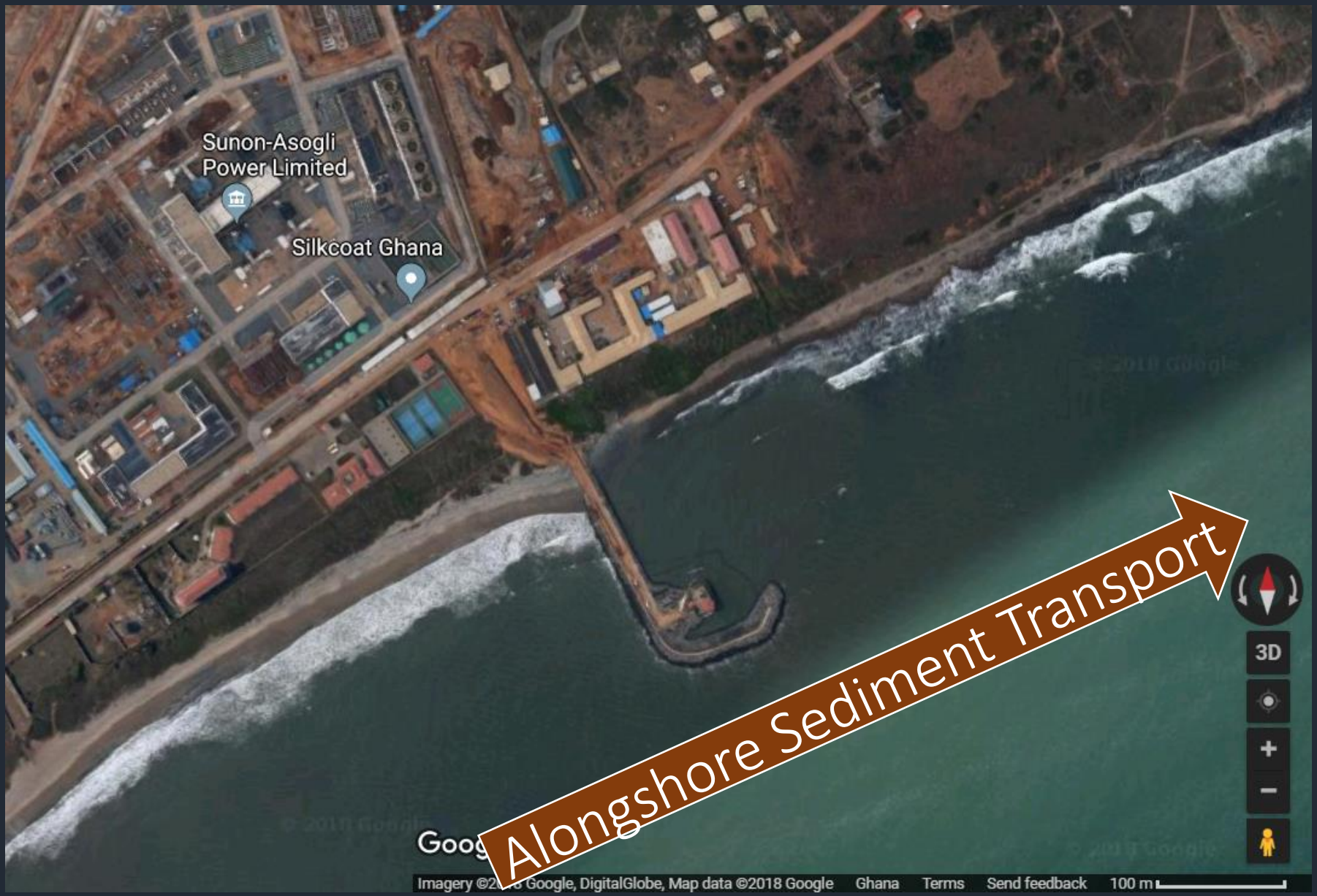
Salt ponds

Conservation > Restoration

Hardened Shorelines



Hardened Shorelines



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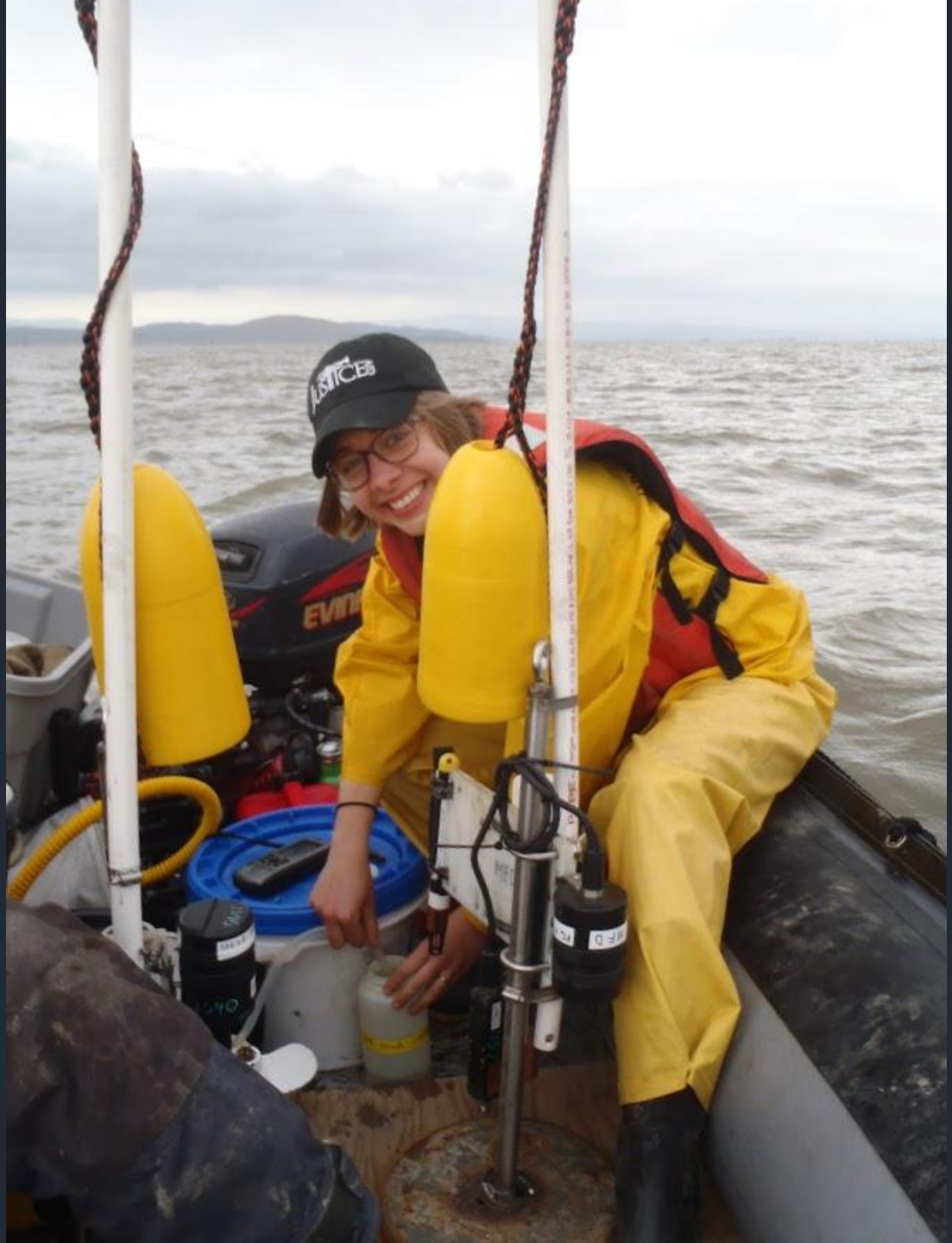
JUSTICE


SURVEY
USGS


R/V PARKE SNAVELY
SANTA CRUZ, CA