Mangroves

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COASTAL OCEAN ENVIRONMENT SUMMERSCHOOL IN GHANA

Outline

I. Introduction to Mangroves
II. Ecosystem Services
III. Case Study 1: Spatial Mapping
IV. Case Study 2: Wave Attenuation
V. Exploitation and Conservation

Mangroves

- Halophytes
- Shrubs or small tress
- Tropical and Subtropical Coastal Vegetation

Physical Surroundings

- Salty
- Marshy Area
- Low-Oxygen
- Inundation of water

Survival of Mangroves

How do they survive in such harsh conditions?

Survival of mangroves

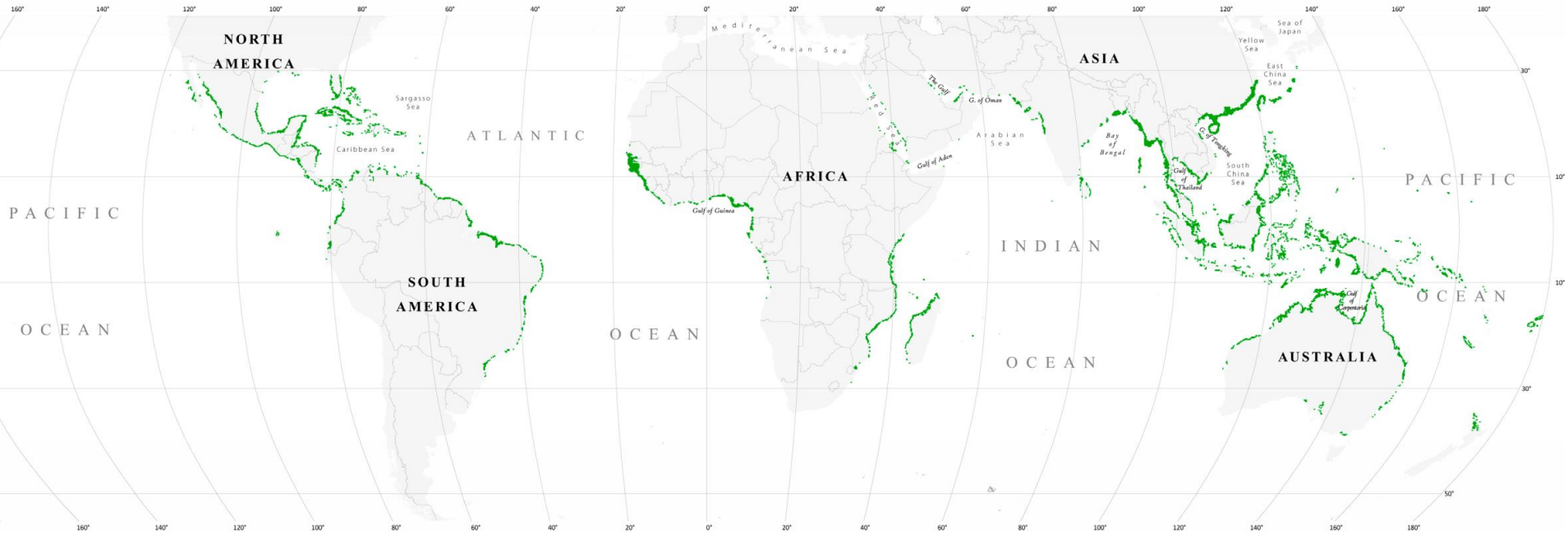
- **Extract freshwater into thick succulent leaves**
- **Waxy Coating - minimal evaporation**
- **Small hairs deflect sunlight and deflect wind**

Survival of mangroves

- **Silt root**
- **Knee roots**
- **Pneumatophores**

Inundation of Water

Mangroves in the World?



Where are mangroves Ghana?

Species of Mangroves

- **Red Mangroves**
  - *Rhizophora racemosa*
  - *Rhizophora mangle*
  - *Rhizophora harrisonii*

- **White Mangrove**

  Avicennia germinans

  Laguncularia racemosa

Ecosystem Services

“Ecosystem services, or ‘nature’s benefits,’ are the contributions that a biological community and its habitat provide to the physical and mental well-being of the human population.”

http://www.habitat.noaa.gov/abouthabitat/ecosystemservices101.html

Ecosystem Services

1. Habitat
2. Valuable goods
3. Carbon sequestration
4. Wave attenuation
5. Erosion control
6. Water treatment

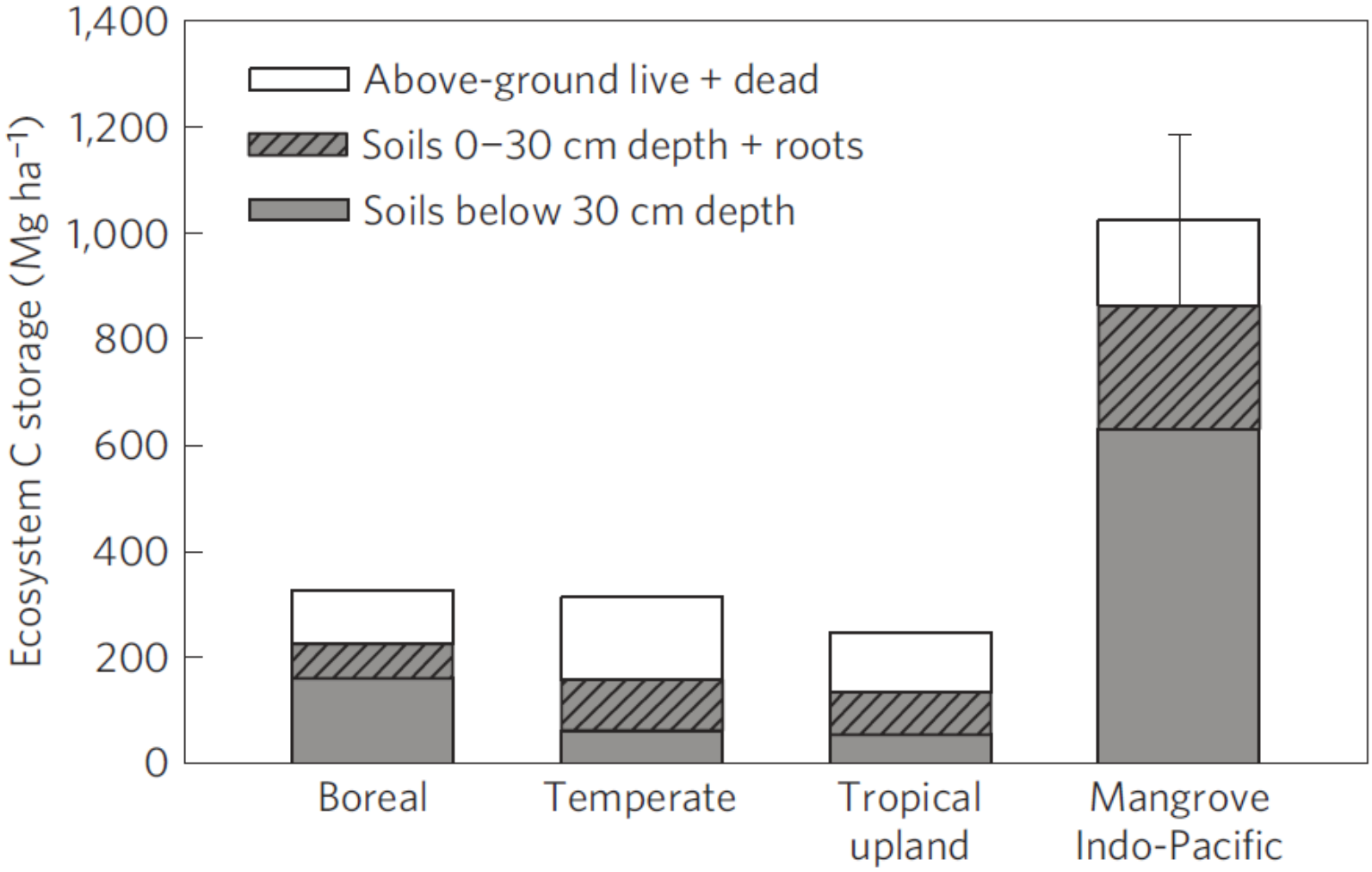
Ecosystem Services

1. Habitat
2. Valuable goods
3. **Carbon sequestration**
4. **Wave attenuation**
5. Erosion control
6. Water treatment

"Blue Carbon" → Carbon stored in wet environments

http://www.habitat.noaa.gov/coastalbluecarbon.html

Mangroves among the most carbon-rich forests in the tropics



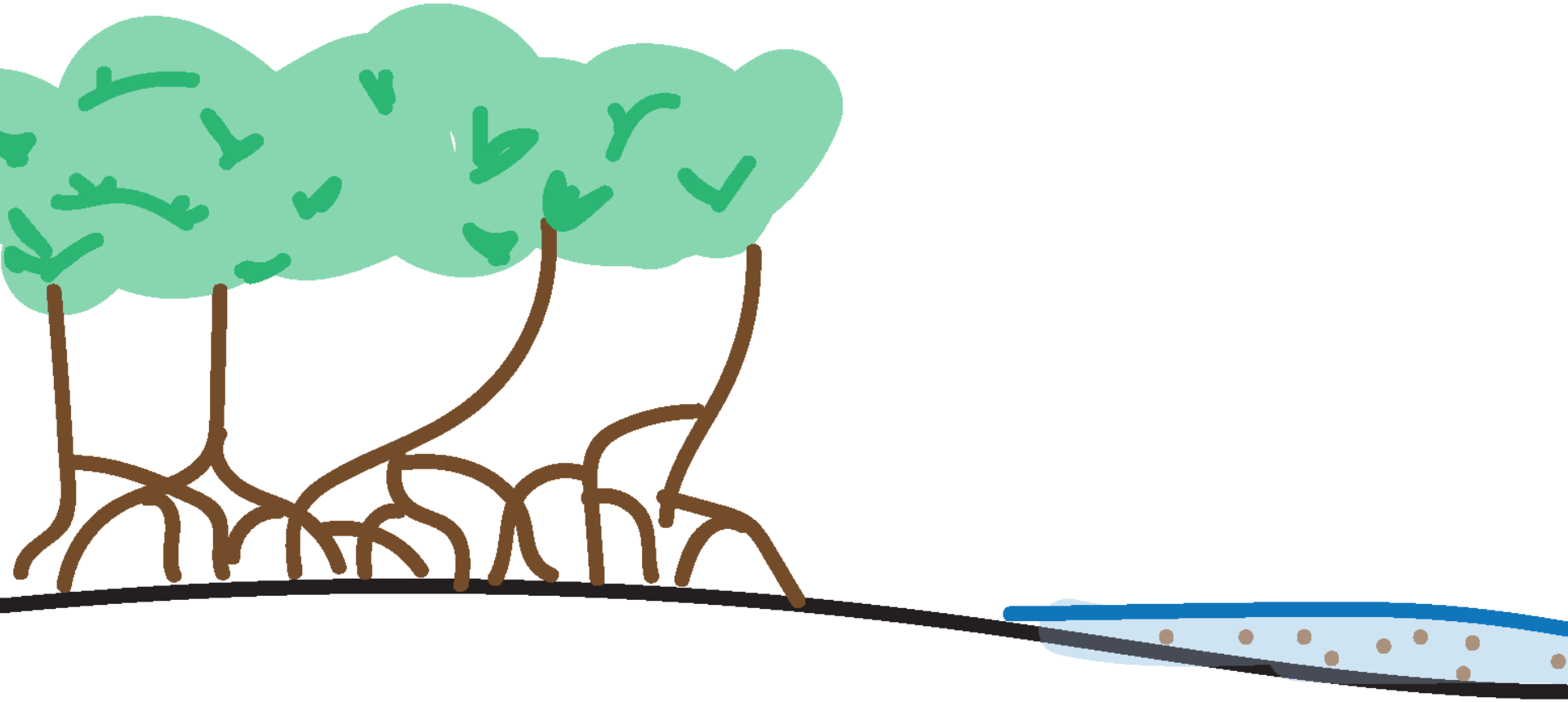
Donato et al 2011

Carbon Sequestration: Two Main Pathways

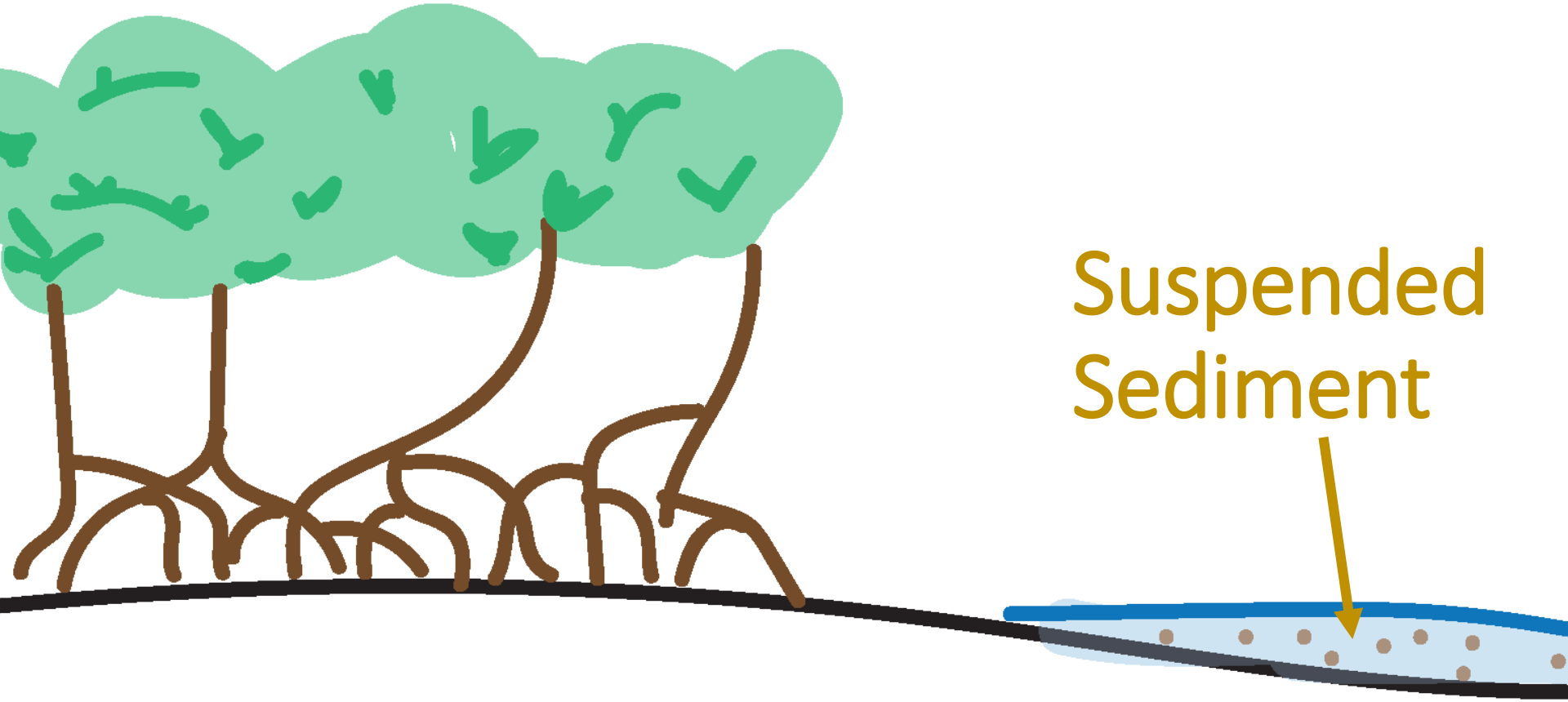
Carbon Sequestration: Two Main Pathways

1. Sediment capture (sedimentation)
2. Burial of biomass

Sediment Capture



Sediment Capture



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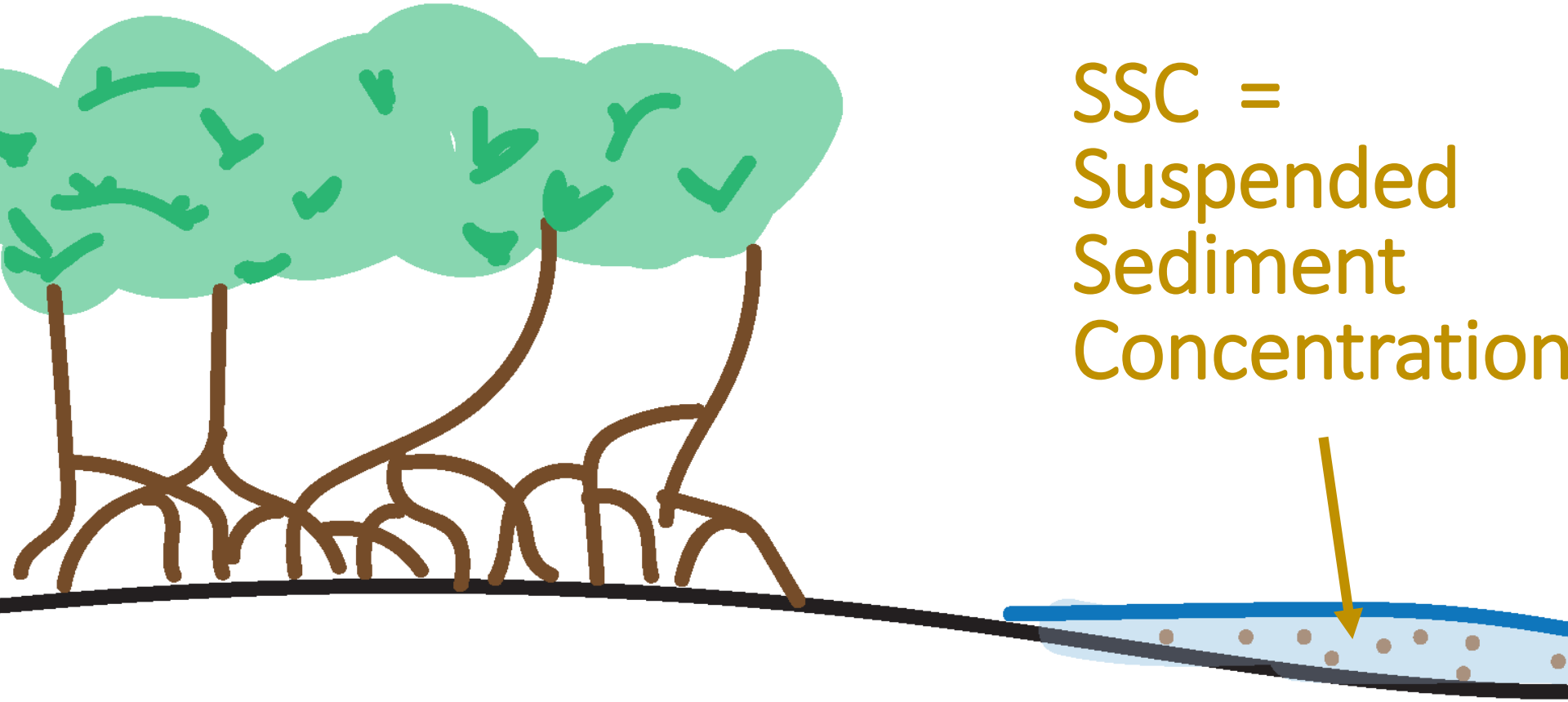

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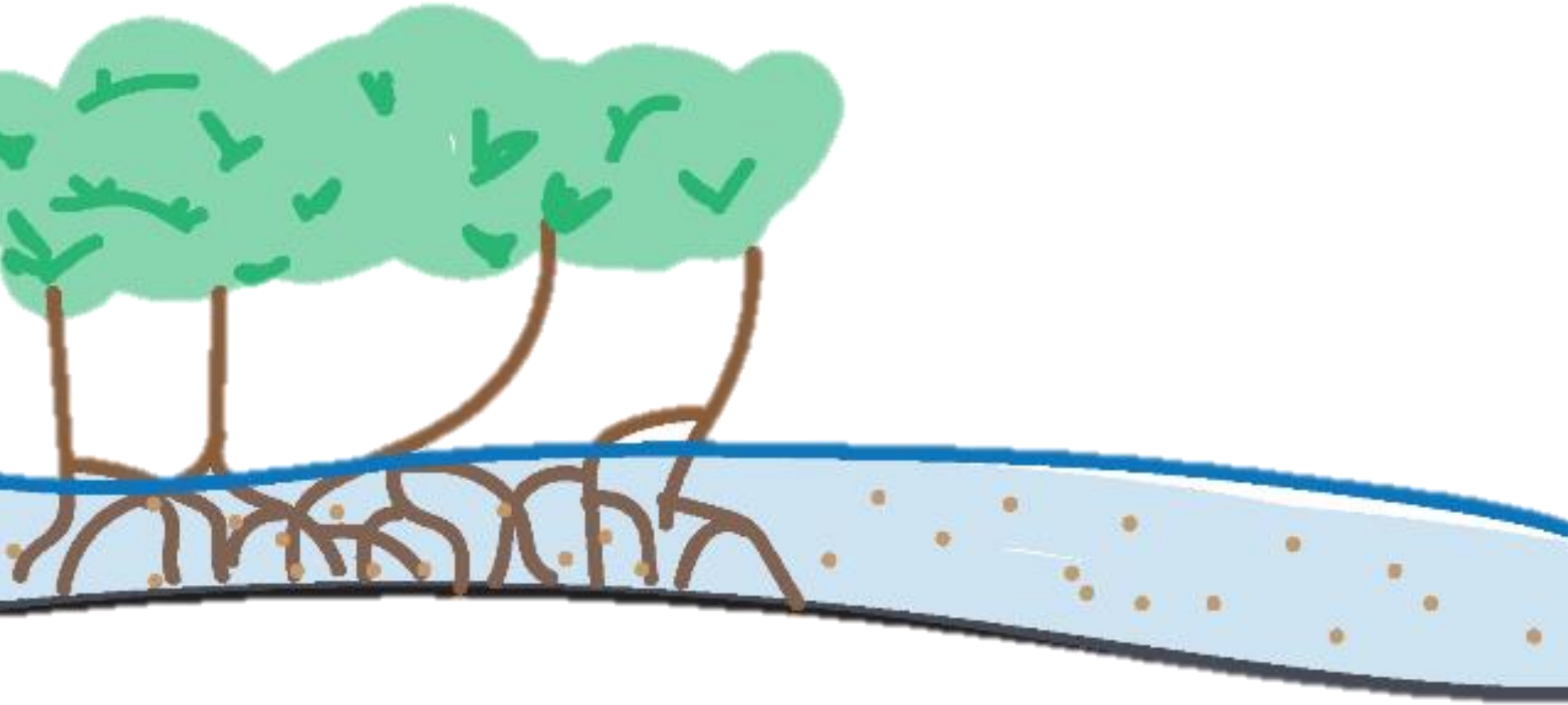

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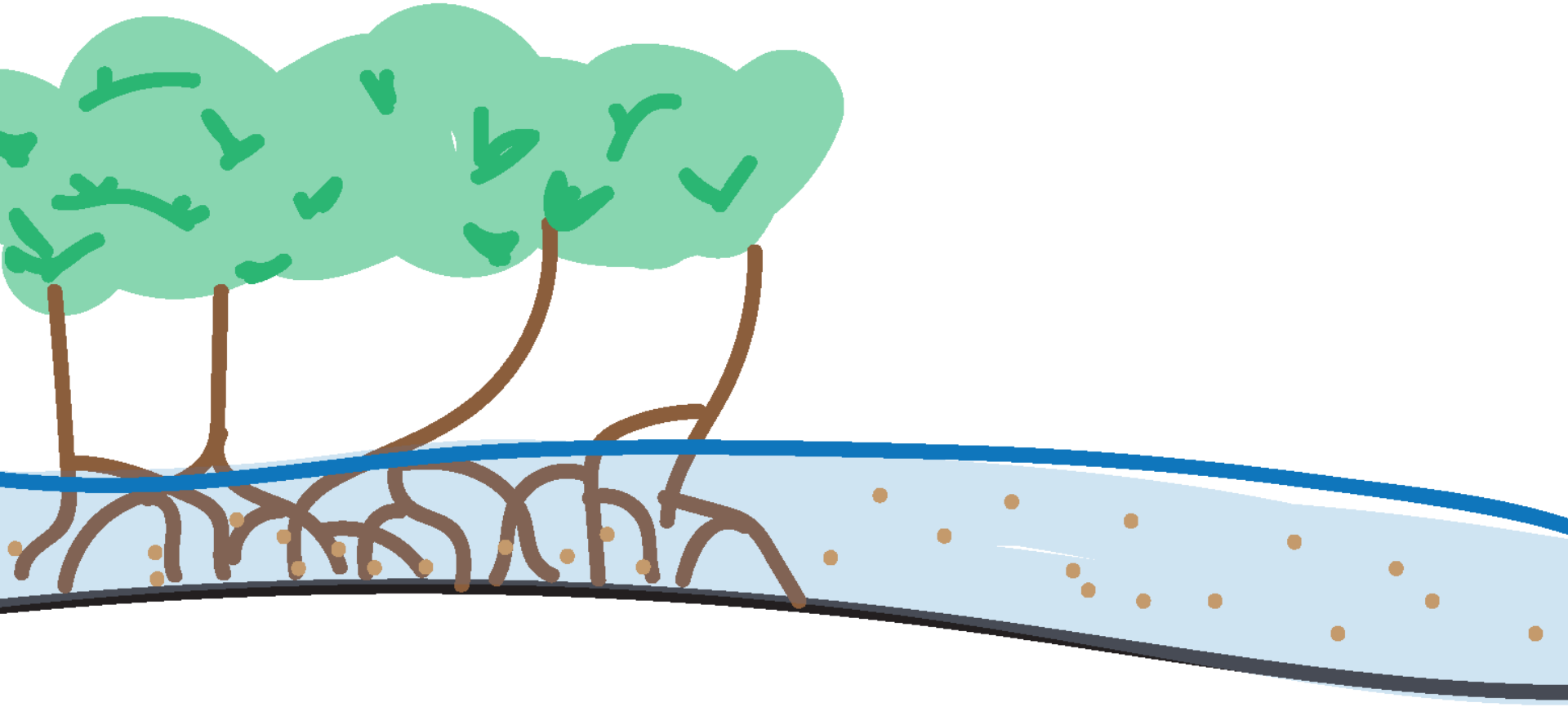

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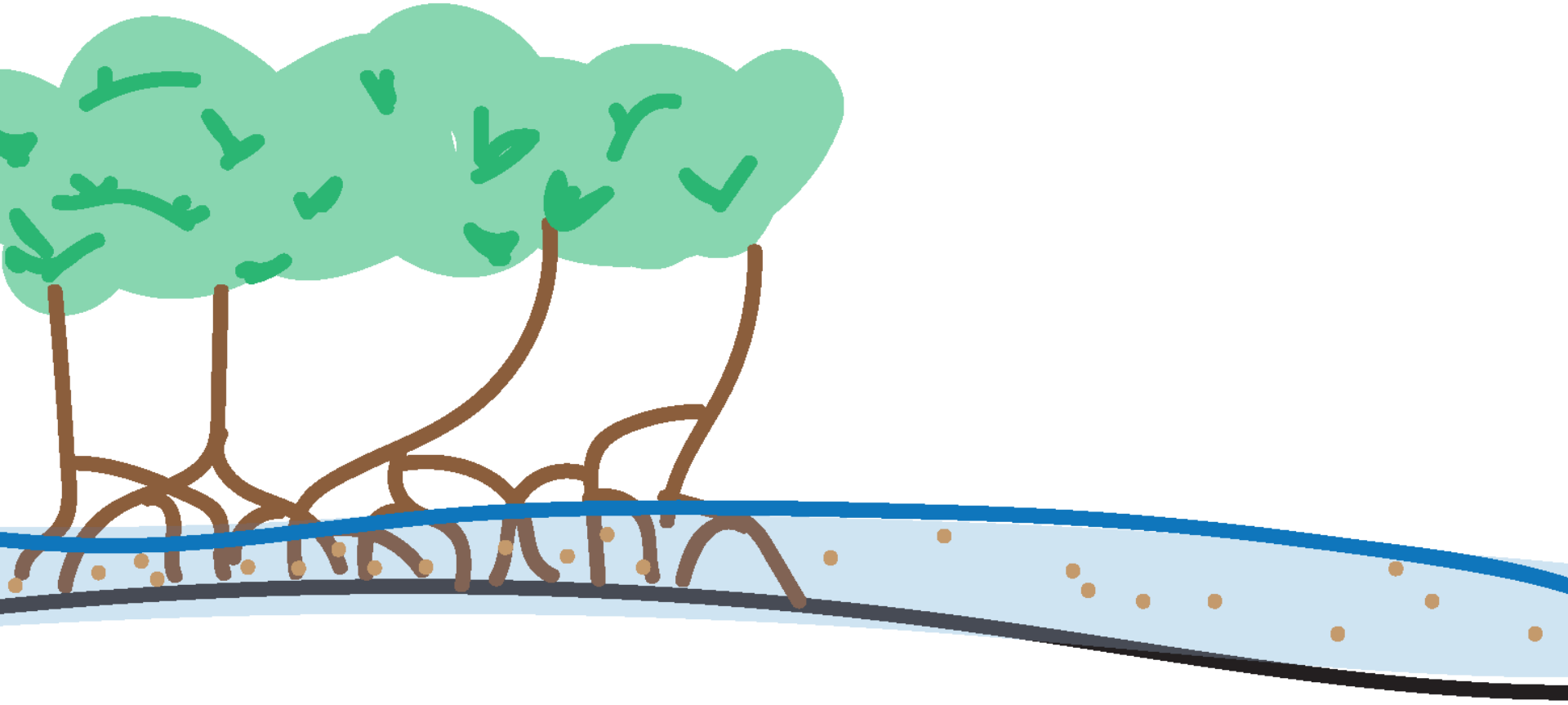

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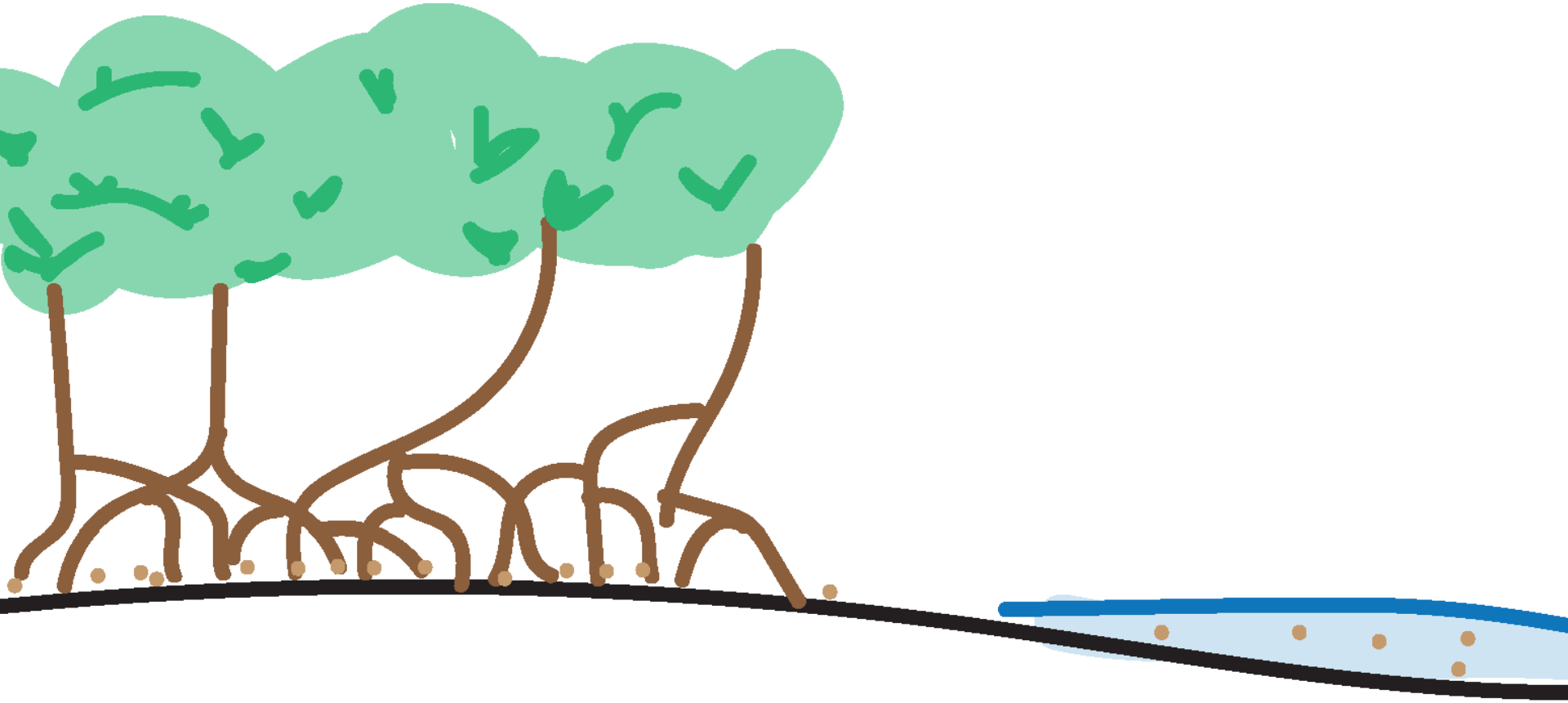

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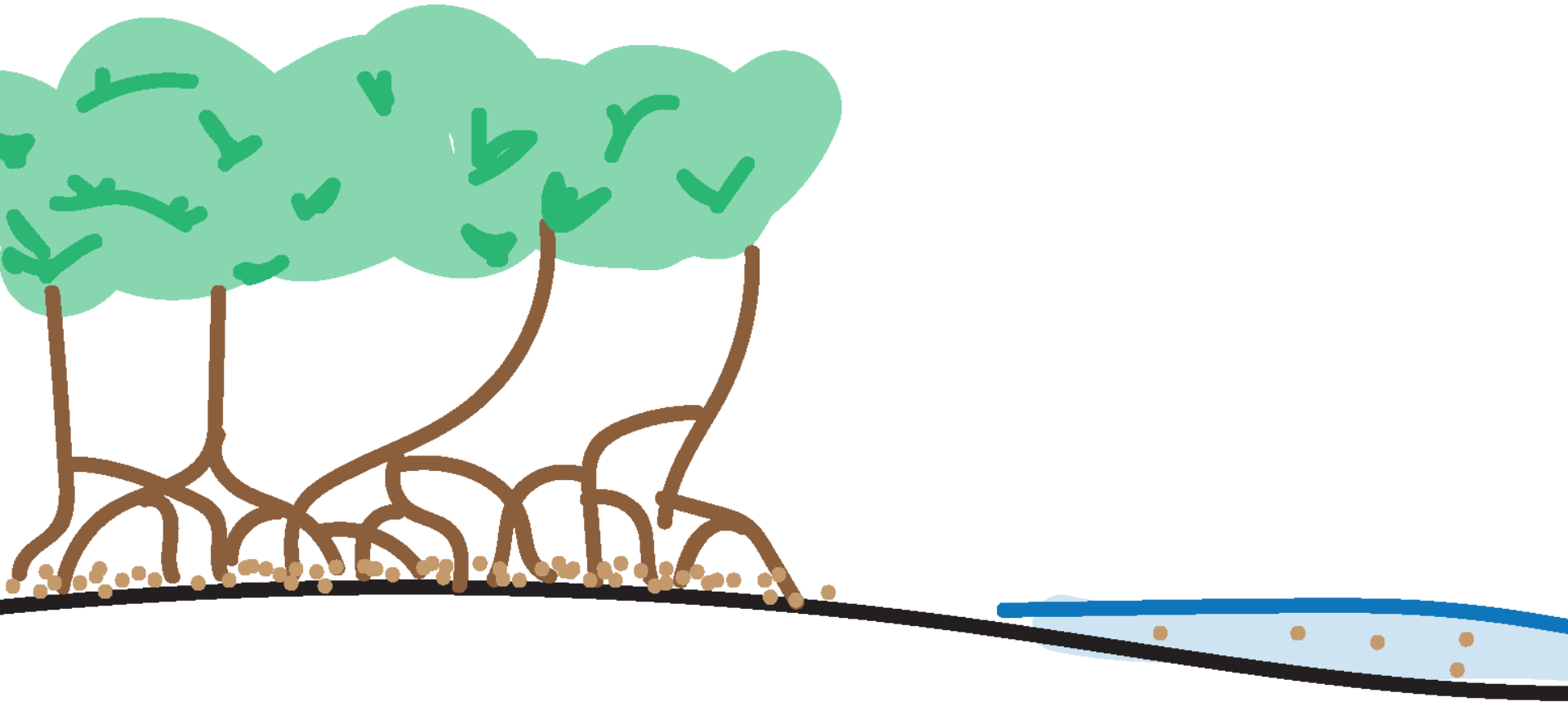

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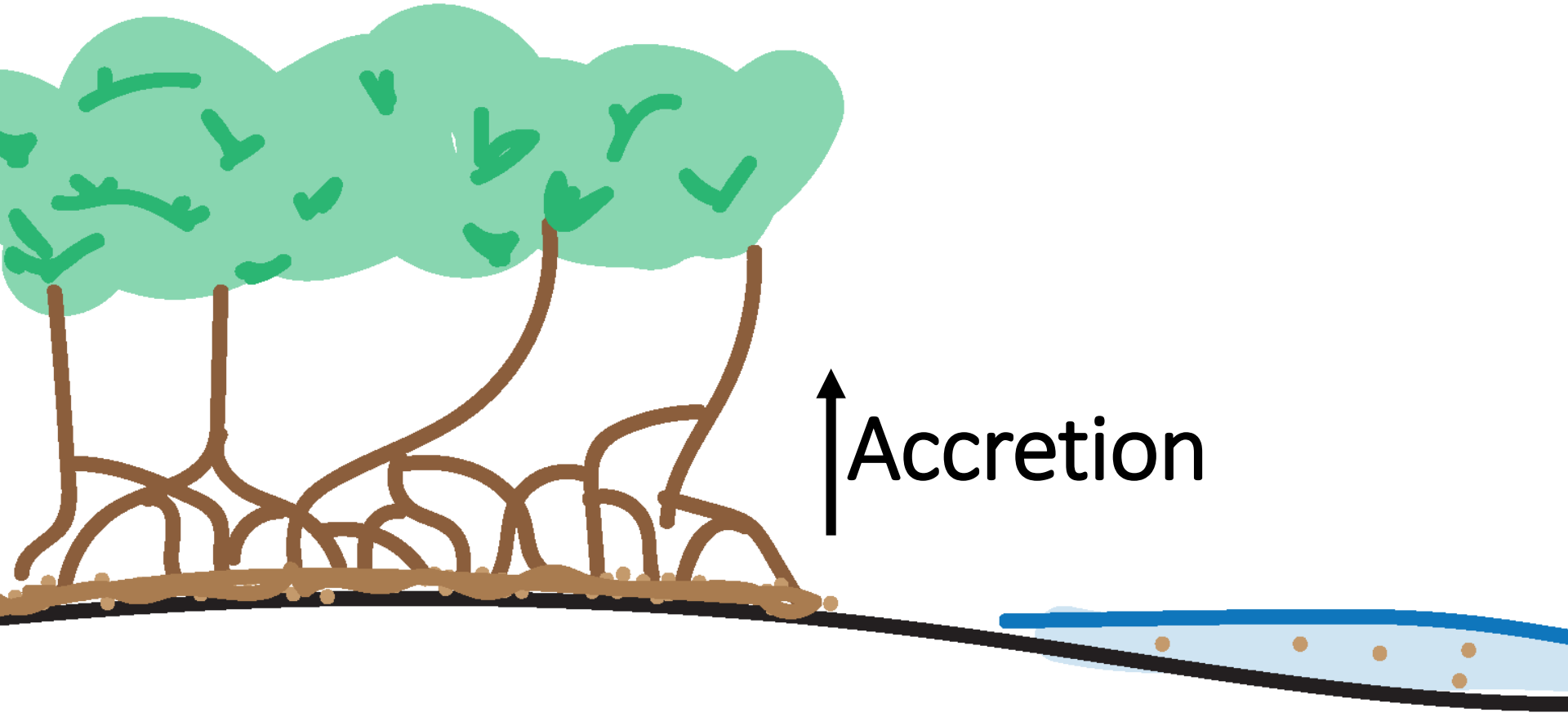
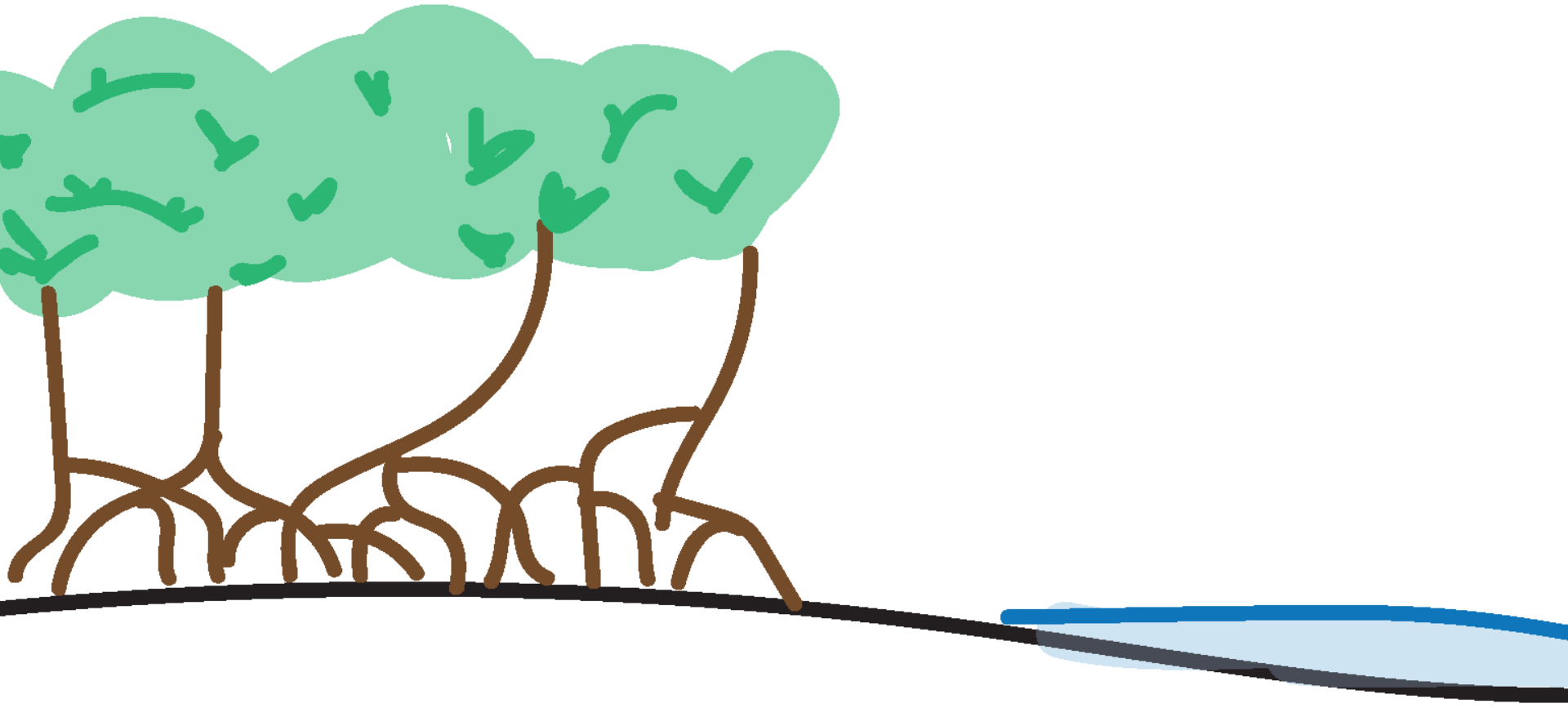


Burial of Biomass



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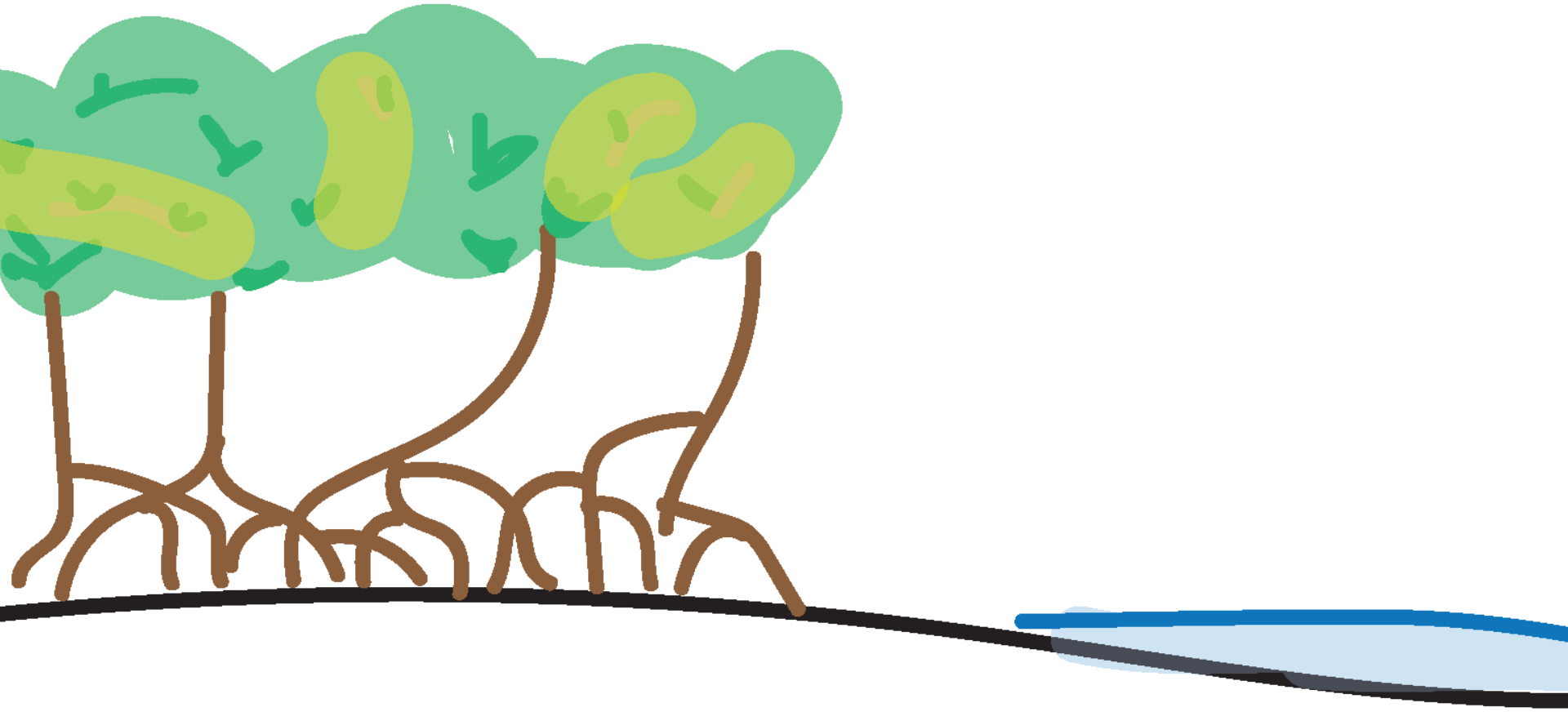

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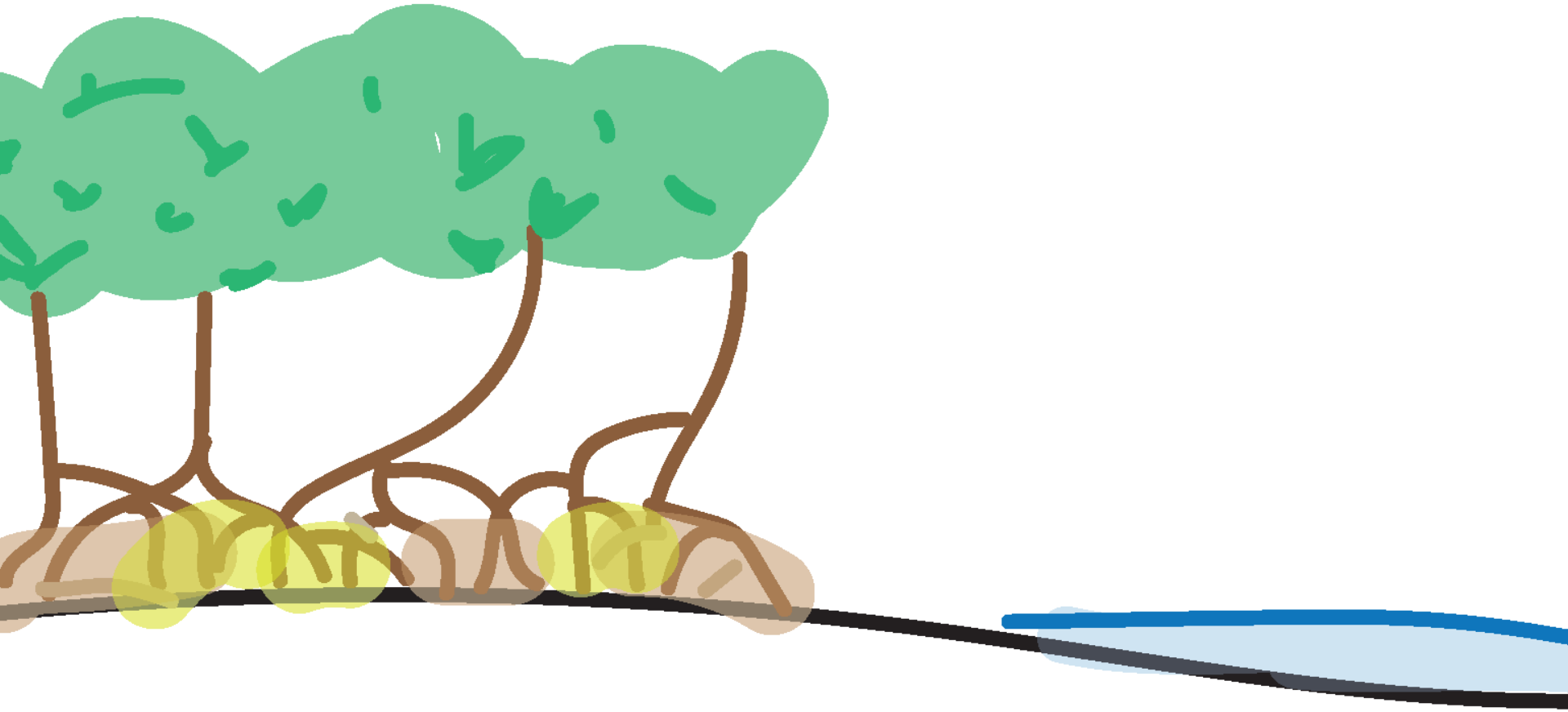

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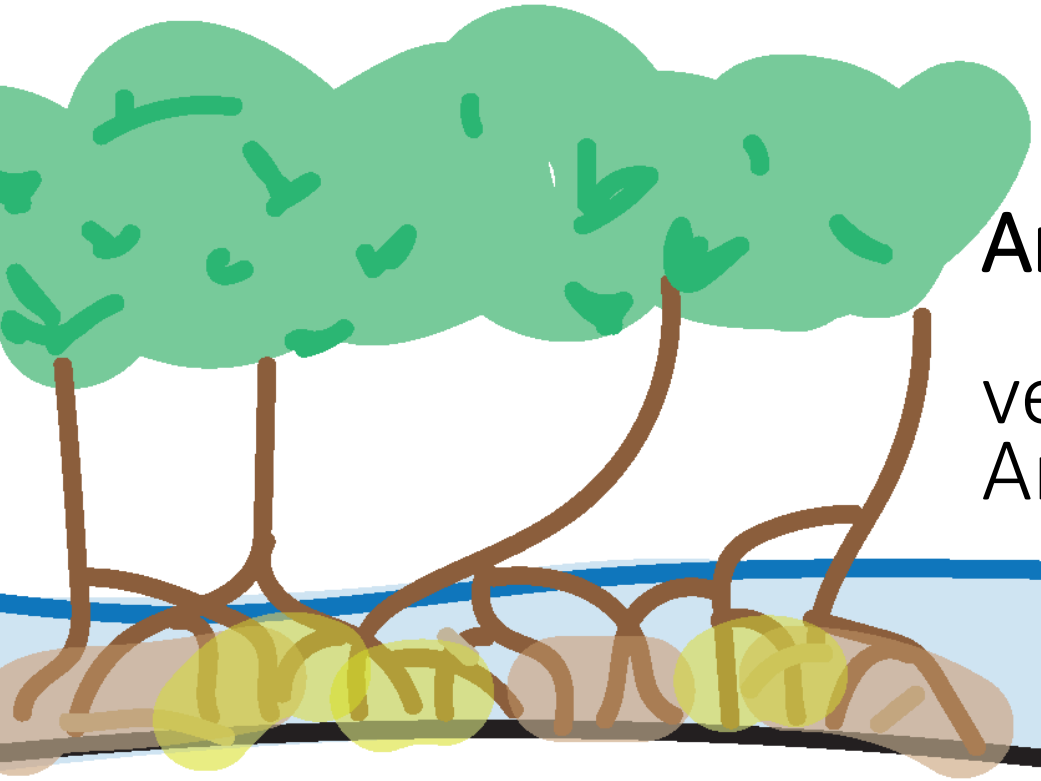
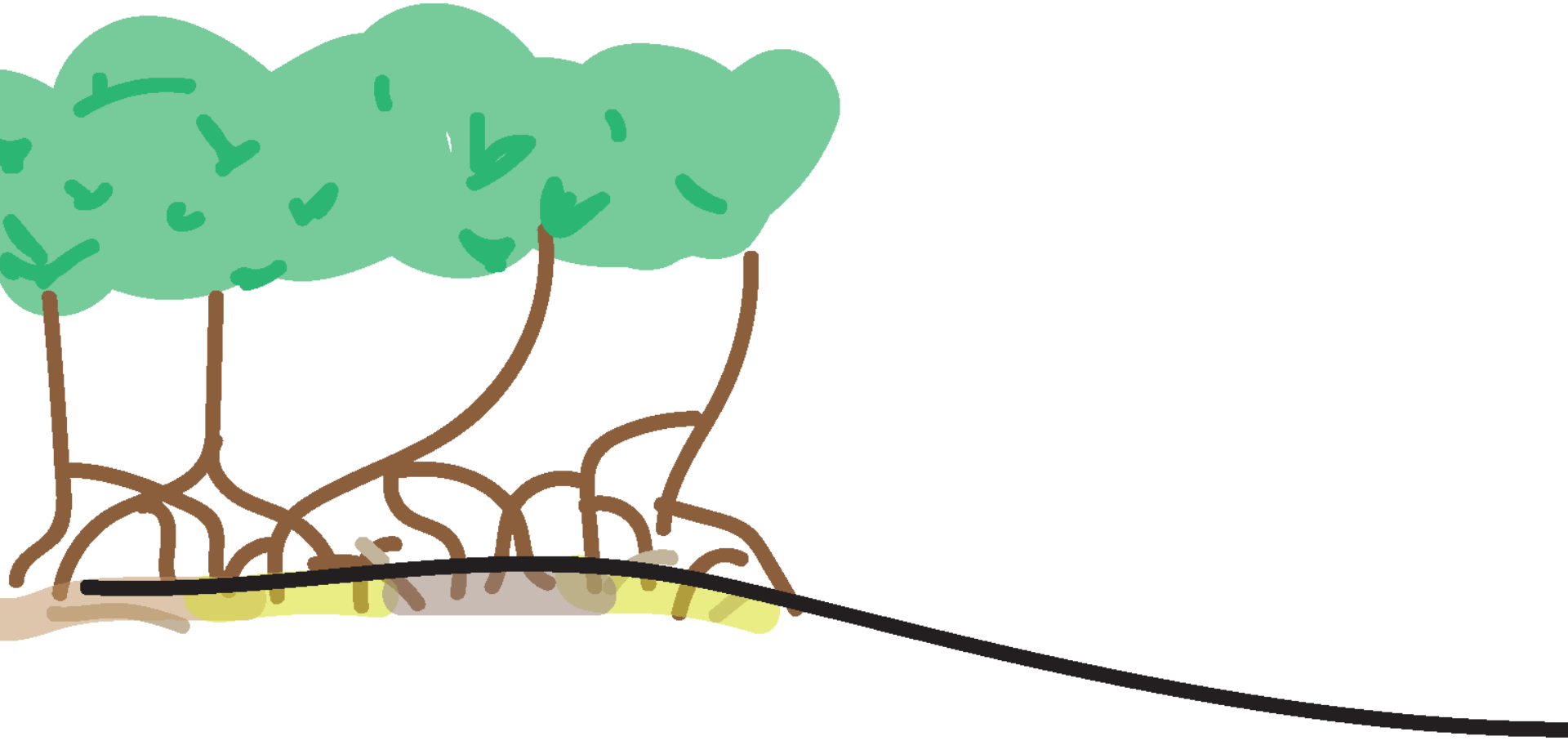


Anaerobic Decomposition

verrryyyyyyy slooooww
And can be smelly

Burial of Biomass



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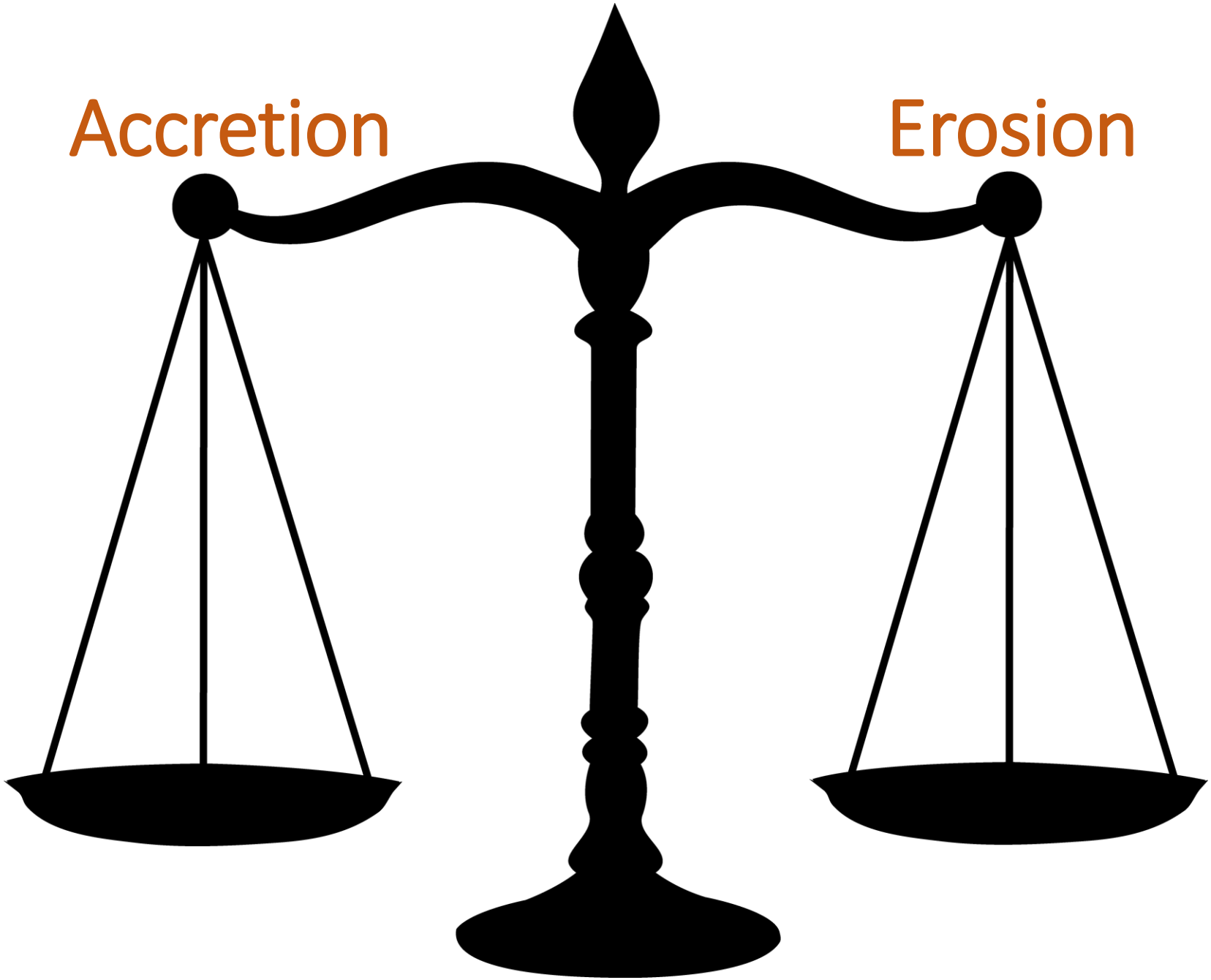
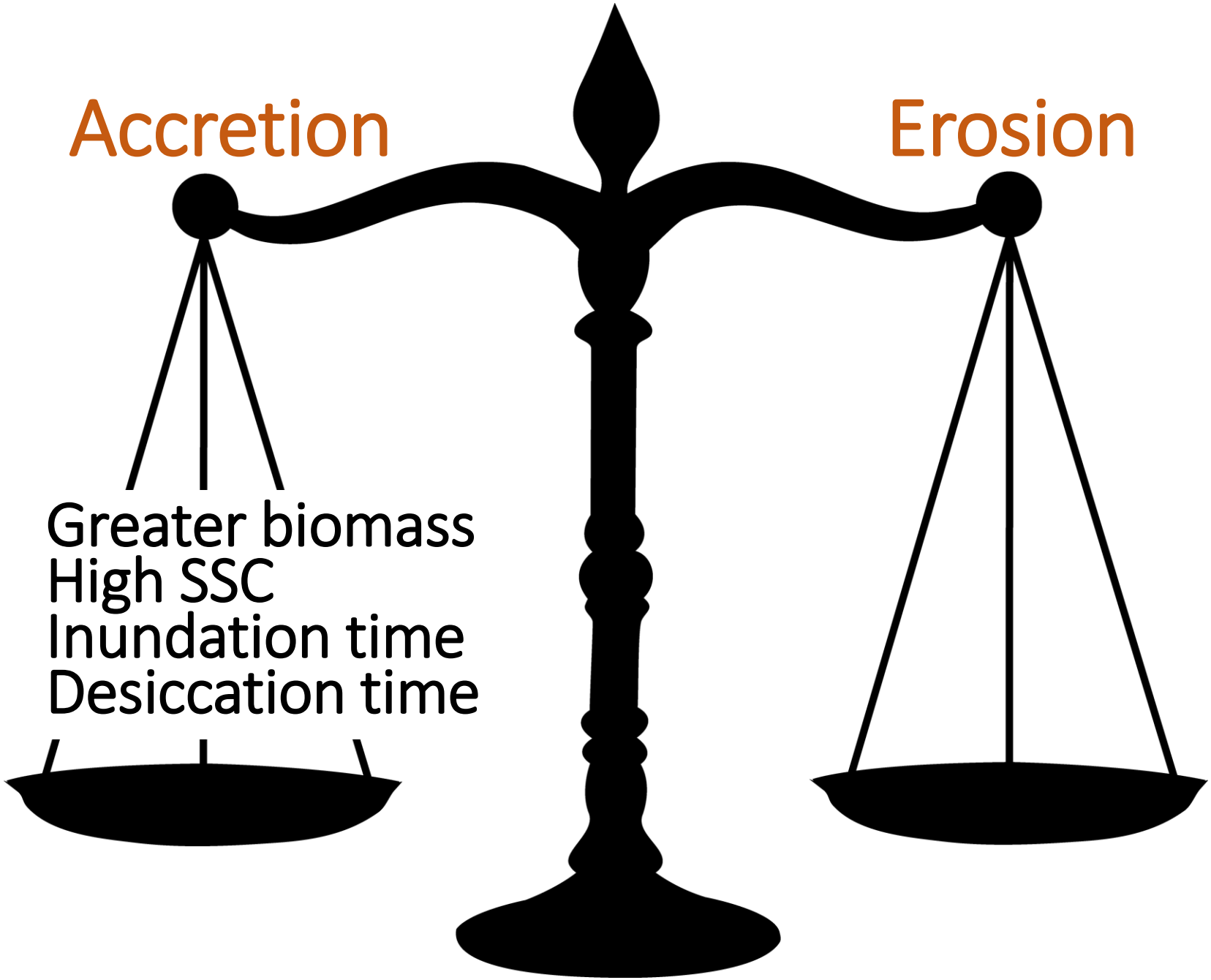
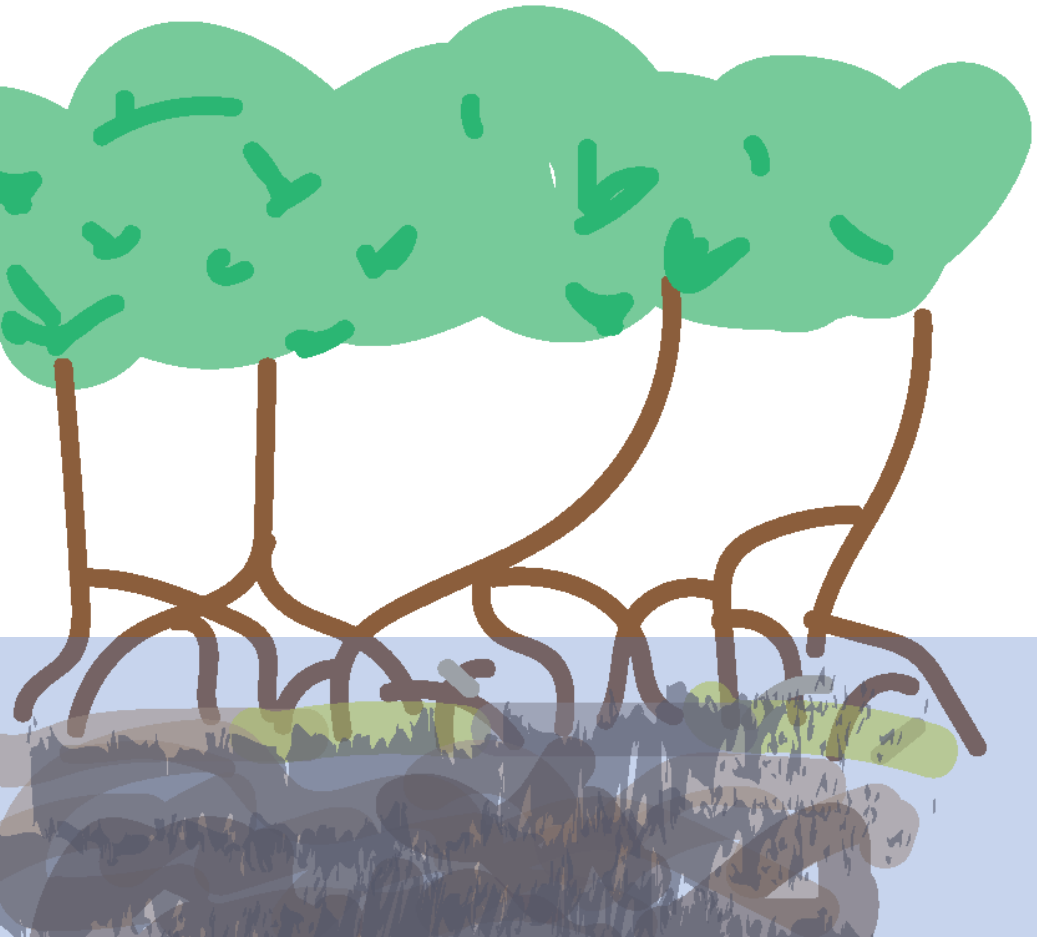
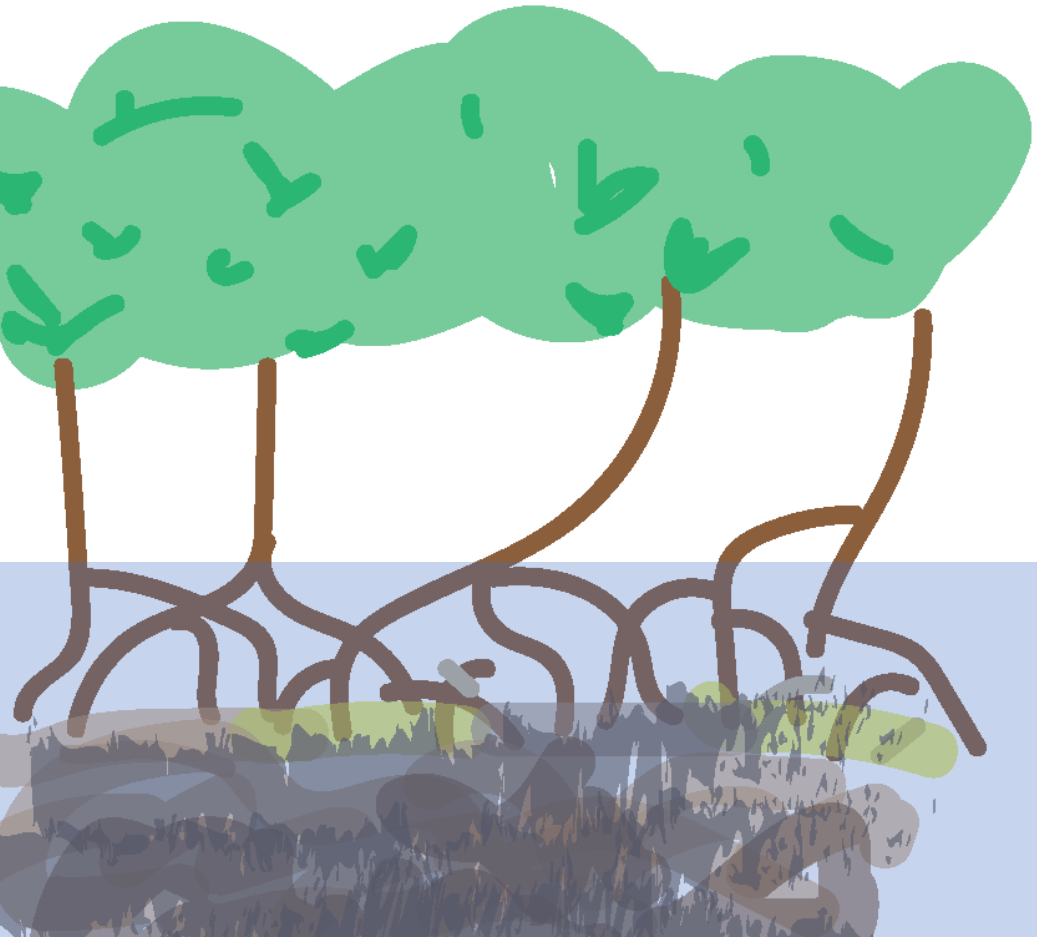

Accretion
Erosion


Accretion
Erosion
Greater biomass
High SSC
Inundation time
Desiccation time

Mangroves can keep pace with sea level rise



Mangroves can keep pace with sea level rise



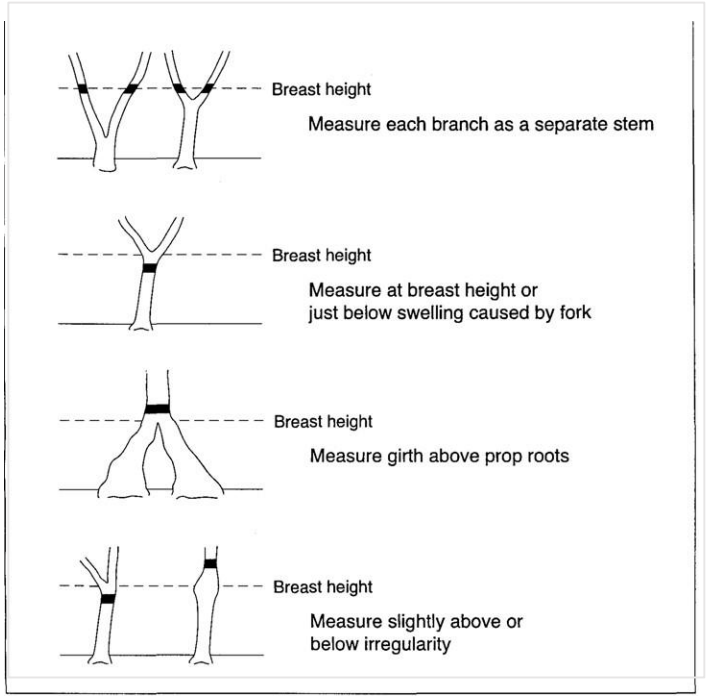
Mangroves can keep pace with sea level rise

Mangroves can keep pace with sea level rise

Important! Rate of sea level rise is increasing

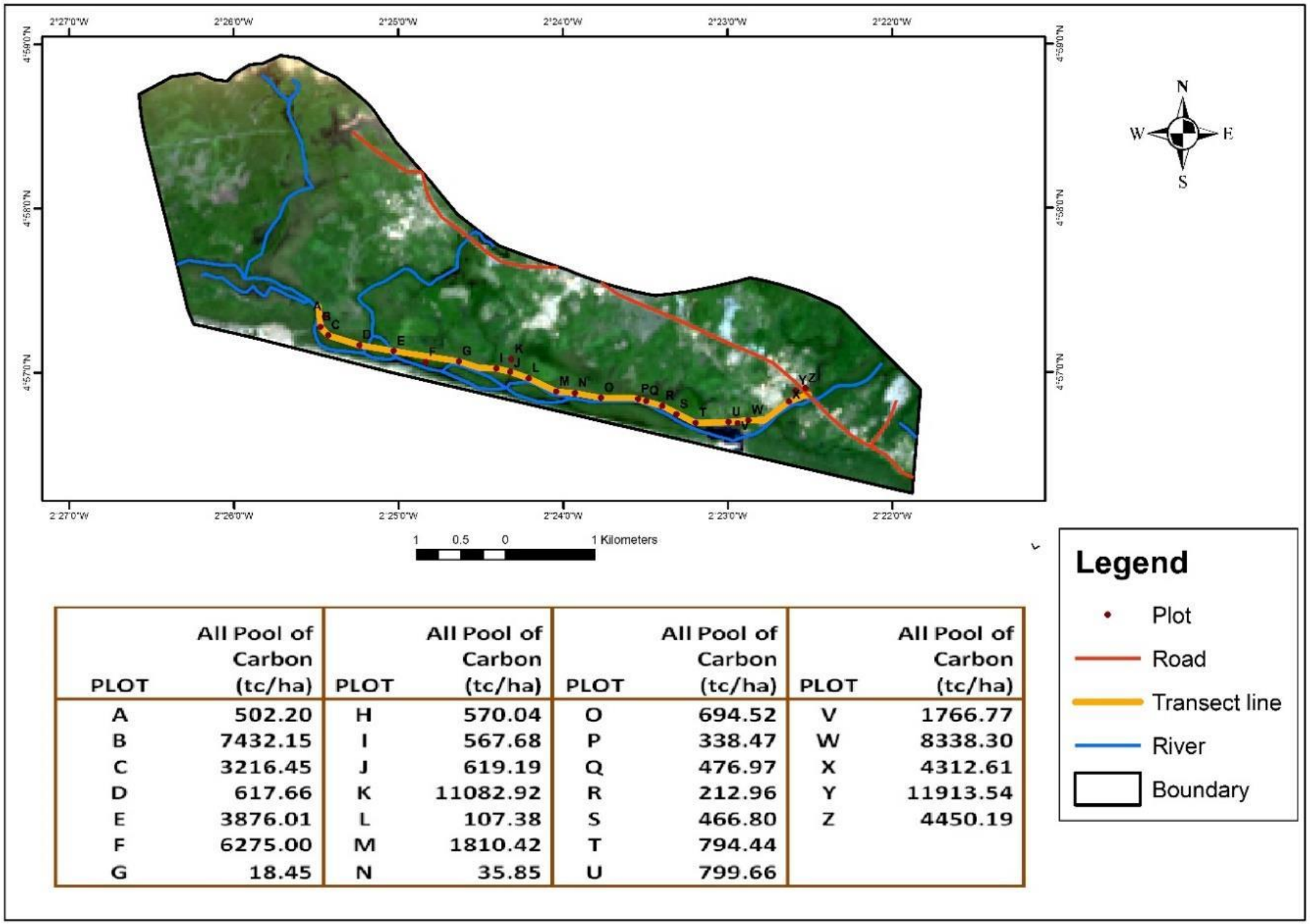
Case Study:
Spatial Mapping of Carbon Stock

- Field Measurement



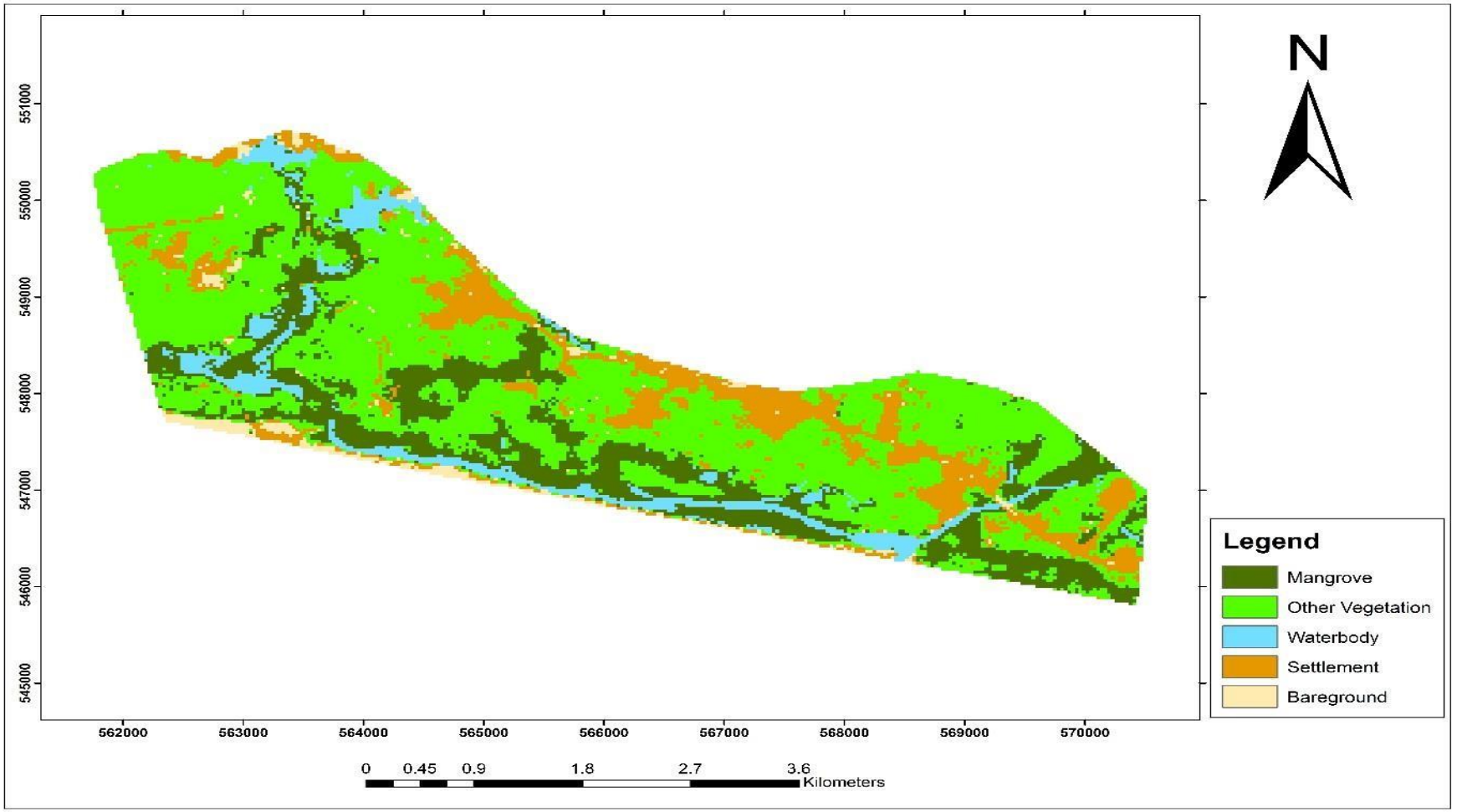
Diameter Tape

Results on Carbon Map



PLOT	All Pool of Carbon (tc/ha)	PLOT	All Pool of Carbon (tc/ha)	PLOT	All Pool of Carbon (tc/ha)	PLOT	All Pool of Carbon (tc/ha)
A	502.20	H	570.04	O	694.52	V	1766.77
B	7432.15	I	567.68	P	338.47	W	8338.30
C	3216.45	J	619.19	Q	476.97	X	4312.61
D	617.66	K	11082.92	R	212.96	Y	11913.54
E	3876.01	L	107.38	S	466.80	Z	4450.19
F	6275.00	M	1810.42	T	794.44		
G	18.45	N	35.85	U	799.66		

Classified Landsat Image



Results from Google Earth Engine

Source: Giri, 2016

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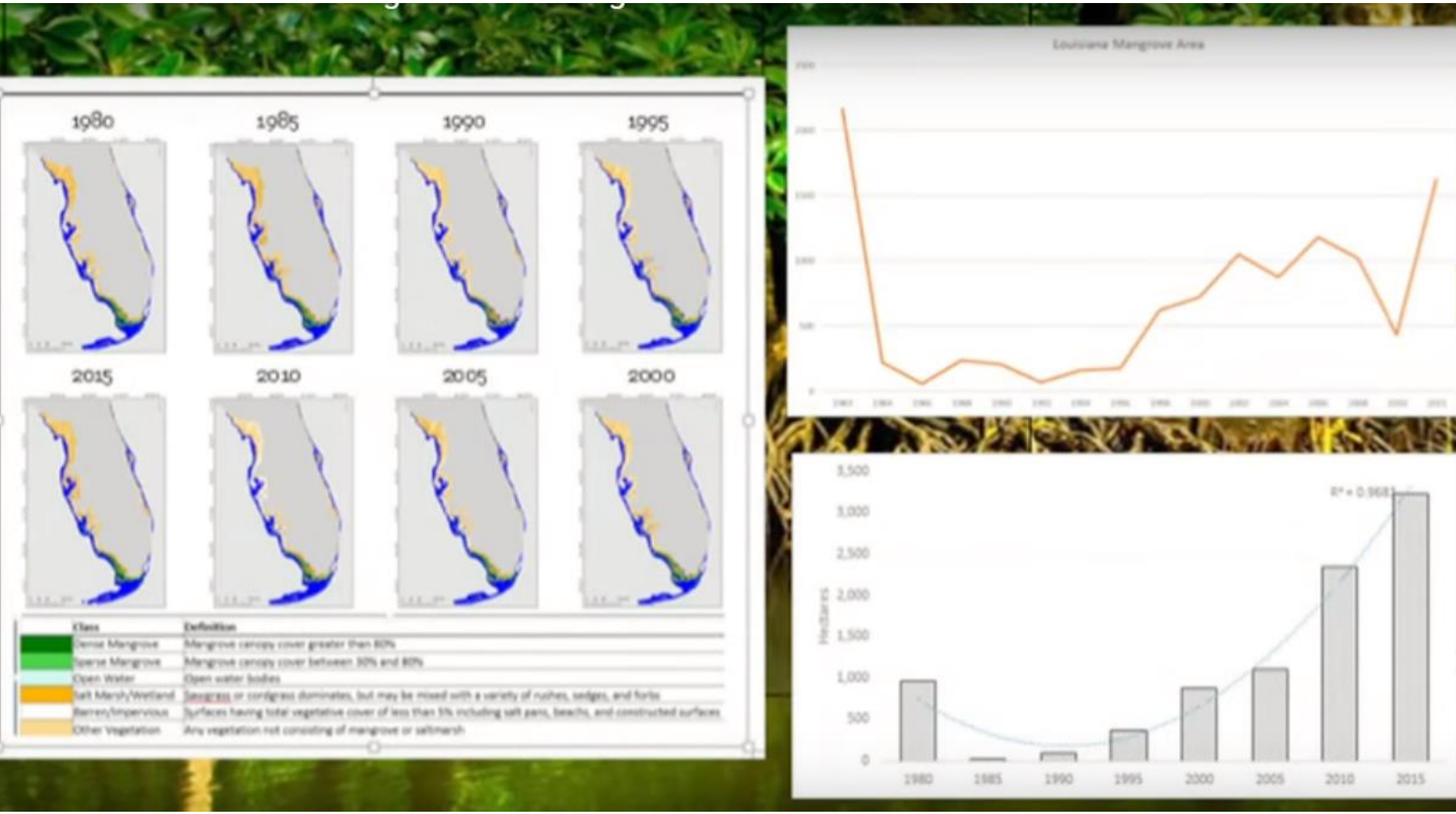
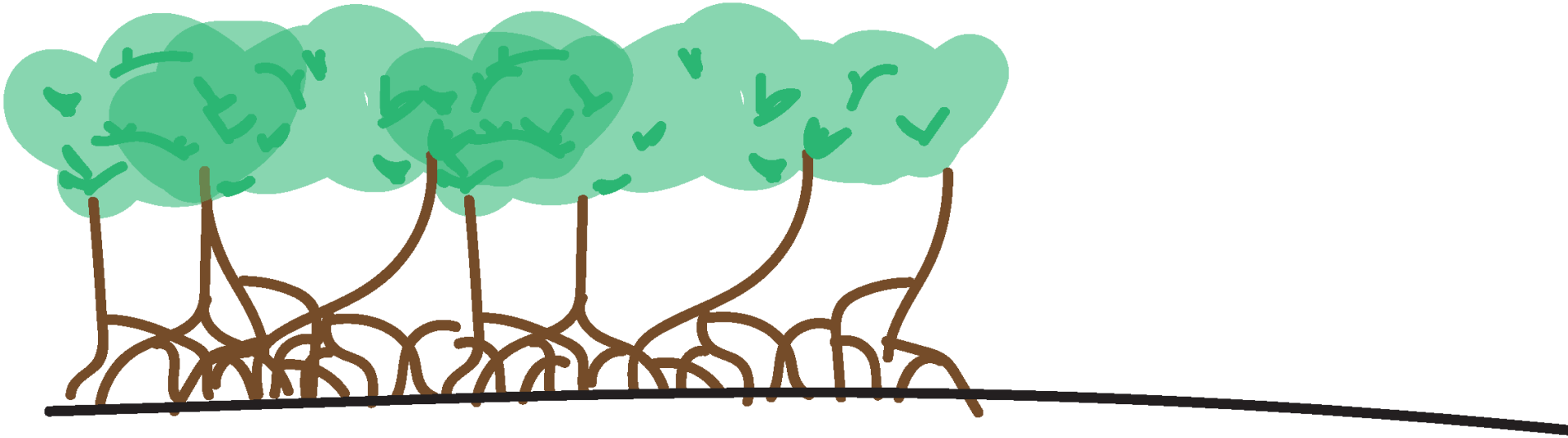


Source: Giri et al, 2016

Sourcehttps://www.youtube.com/watch?v=1YXhrzYL1Rk

Case Study: Wave Attenuation

Loss of wave energy (→calculate from wave height)



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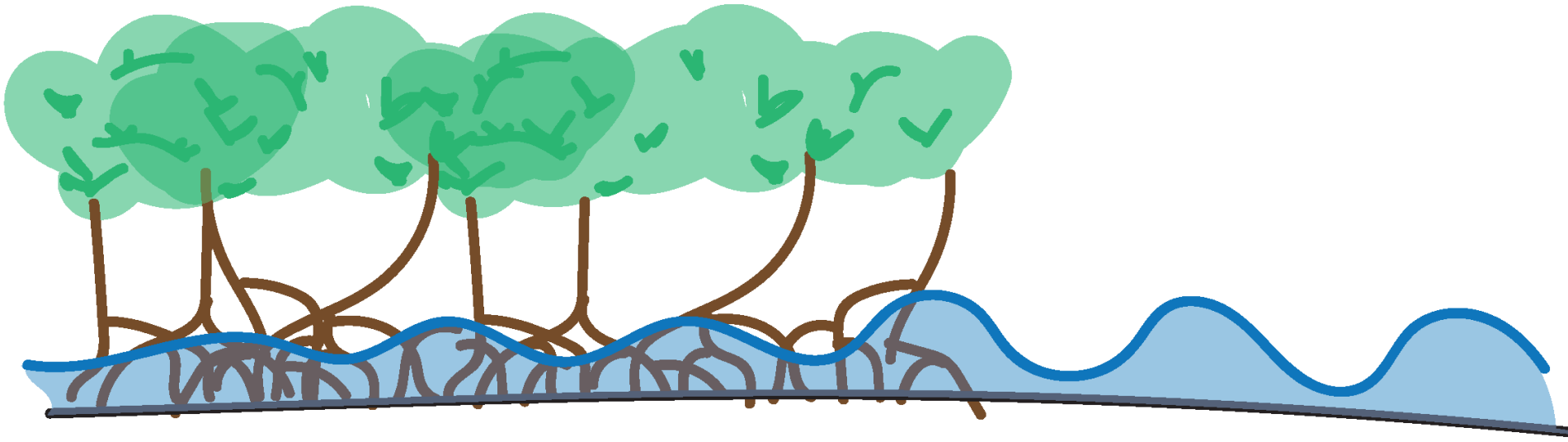

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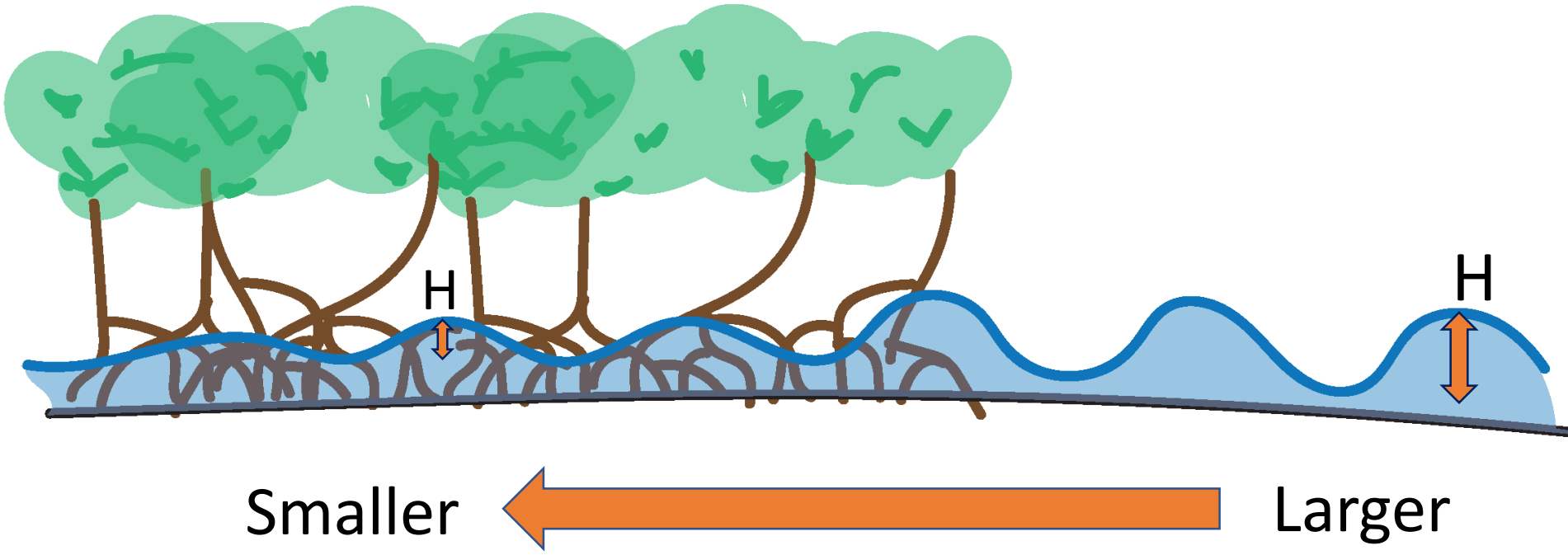
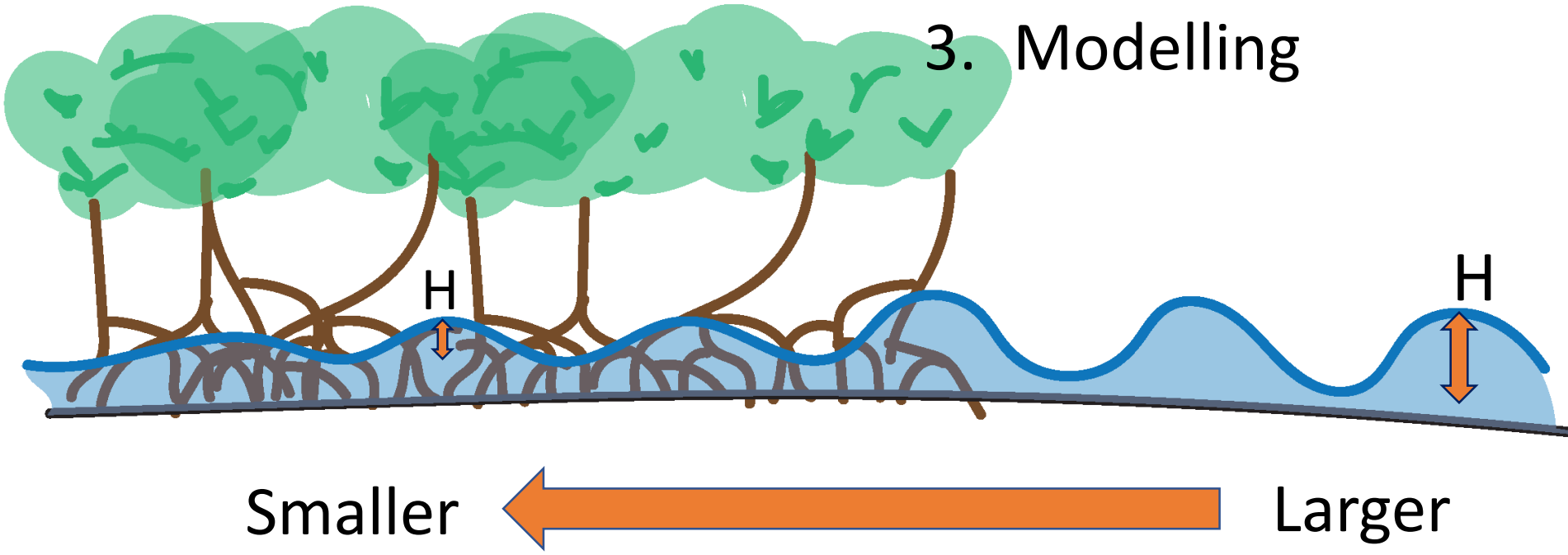


Case Study: Wave Attenuation

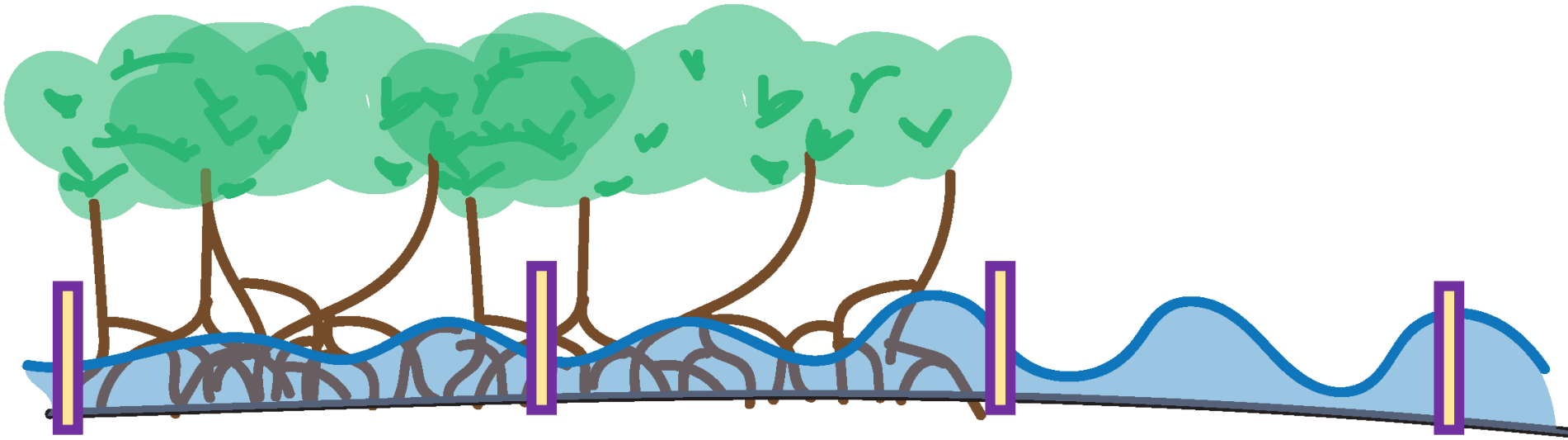
Why do we care?

1. Storm Protection
2. Geomorphology
3. Modelling



Case Study: Wave Attenuation

How do we measure it?



Case Study: Wave Attenuation

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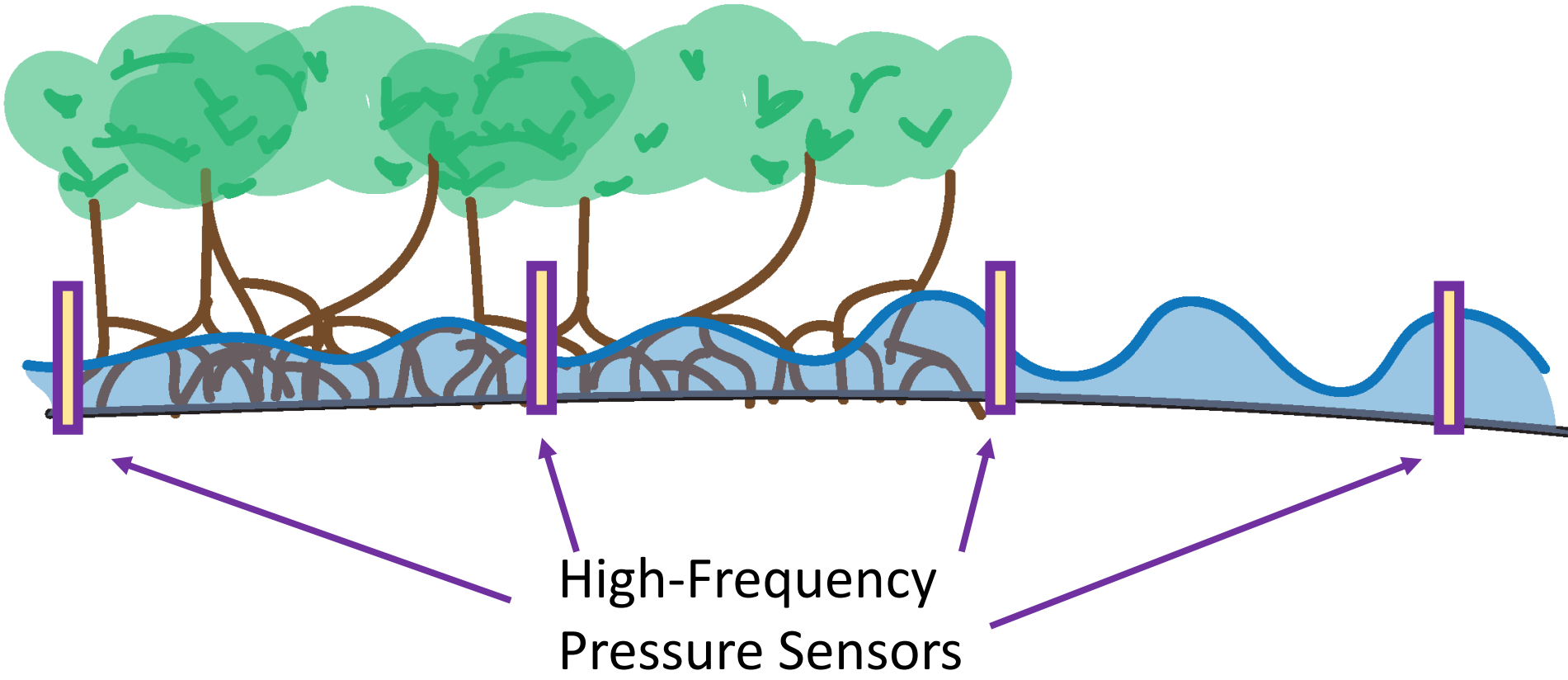

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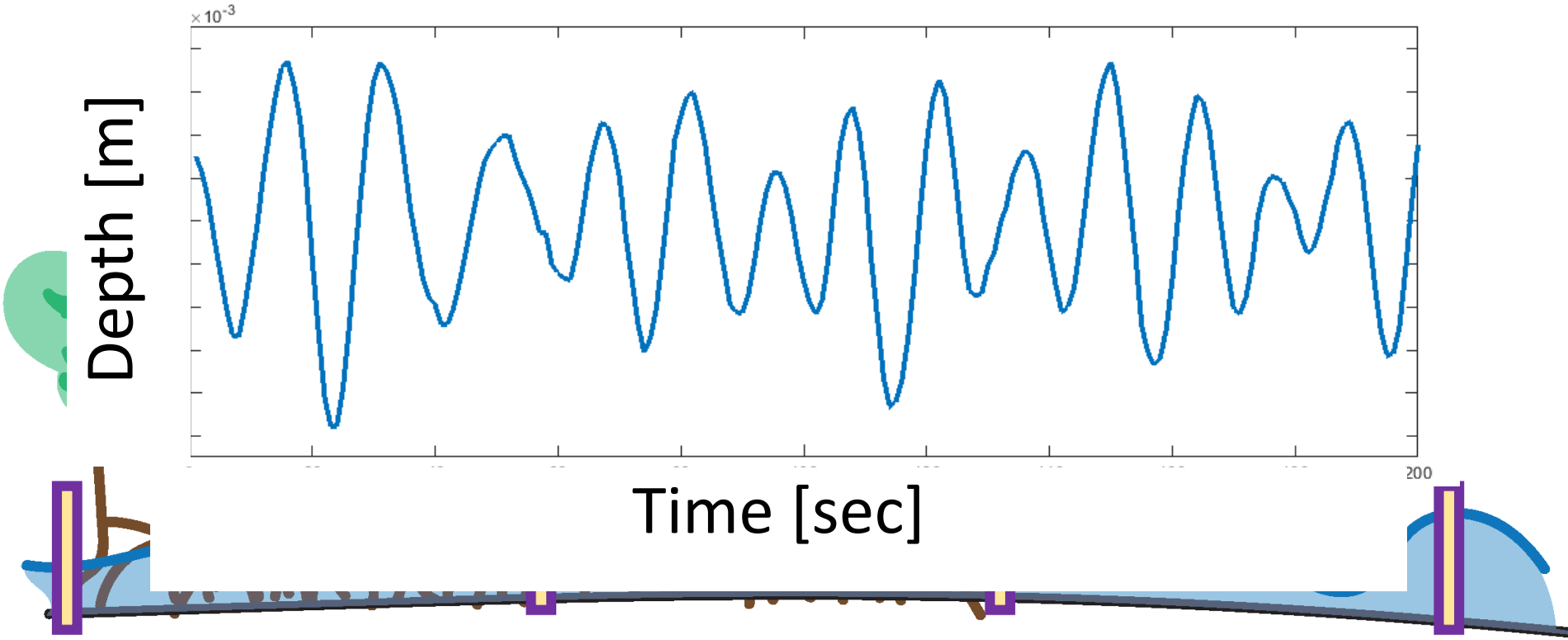

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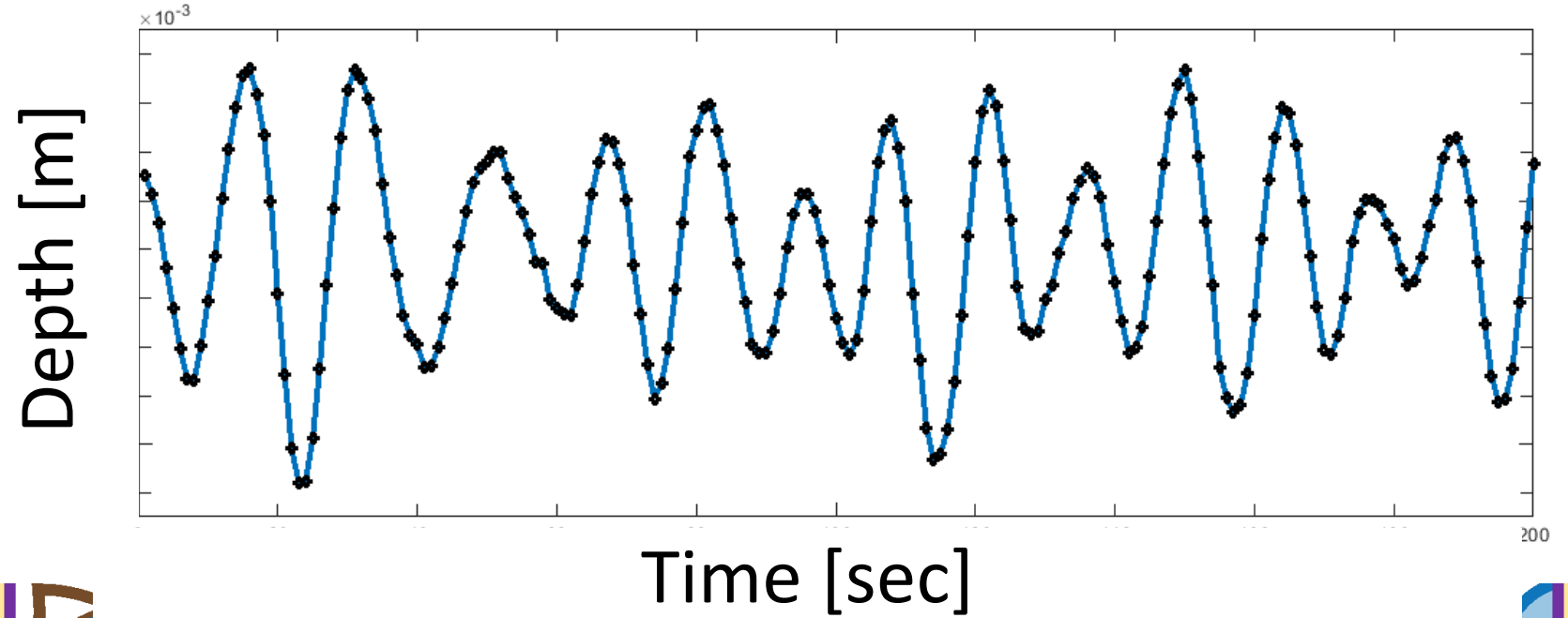

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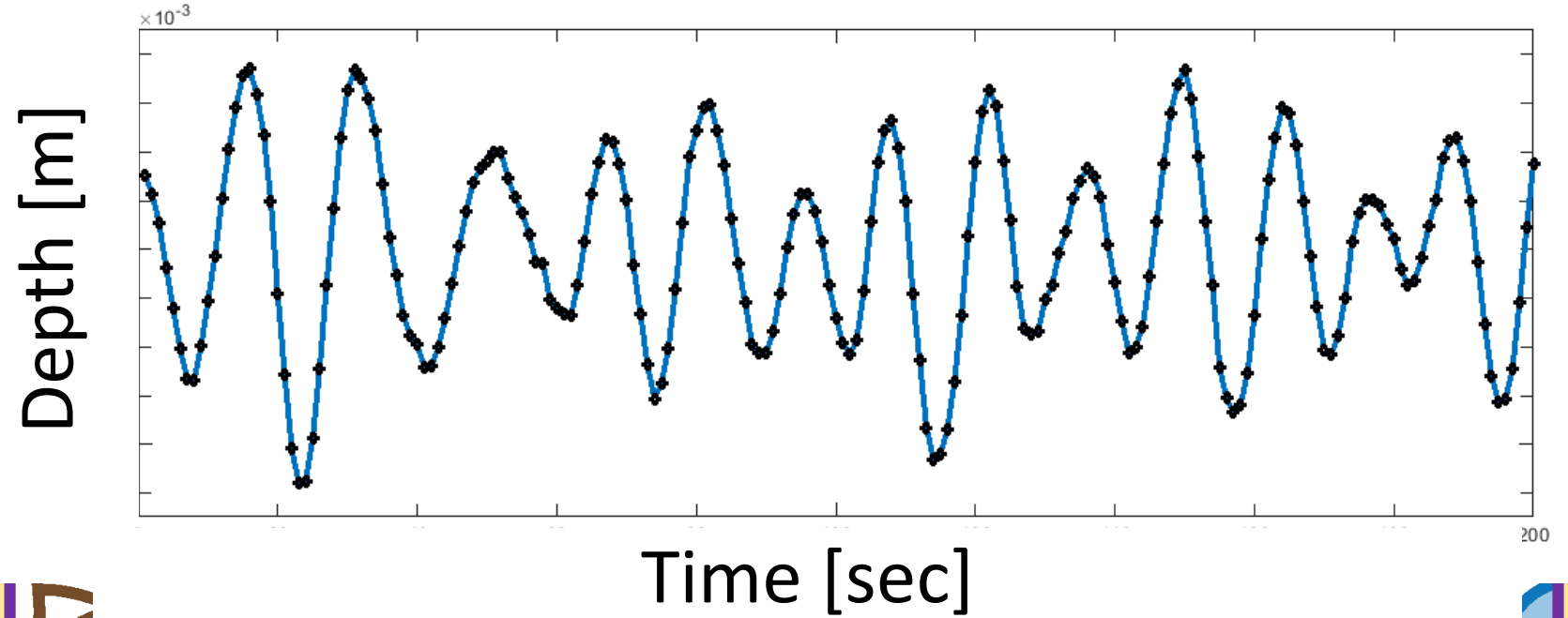
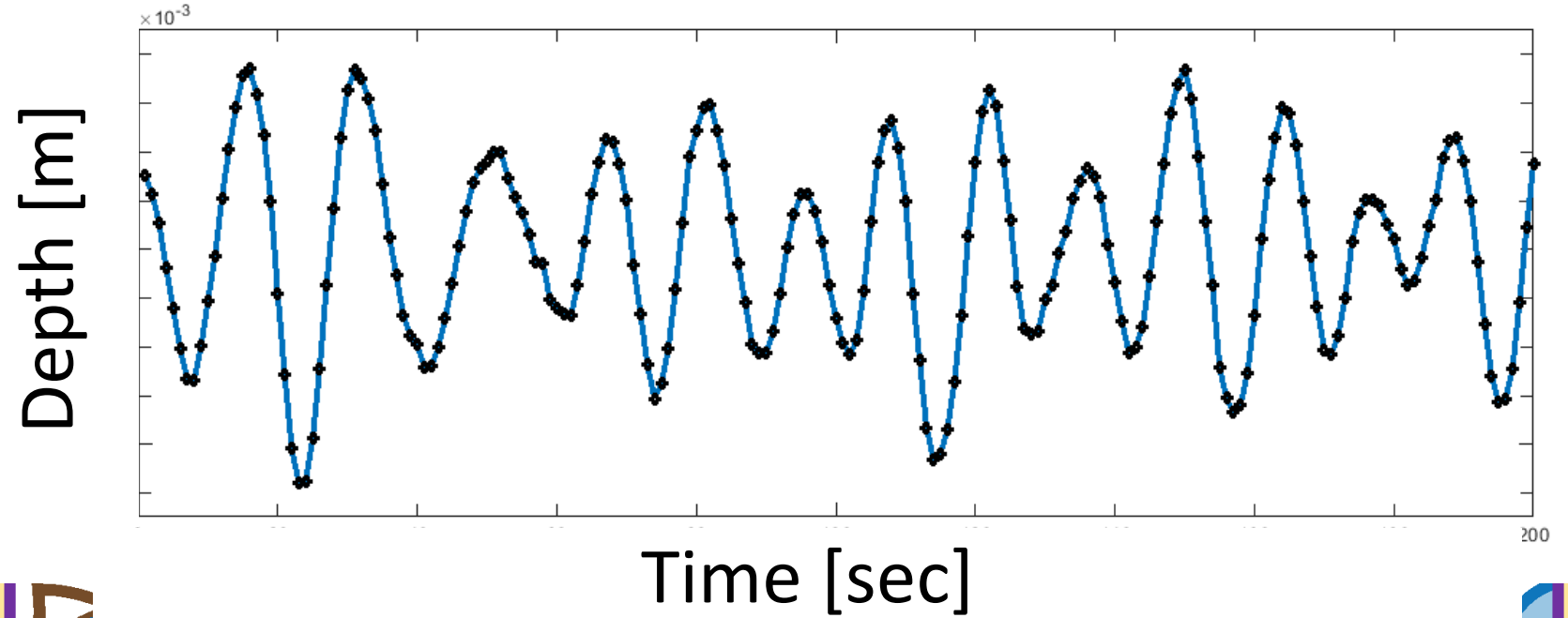


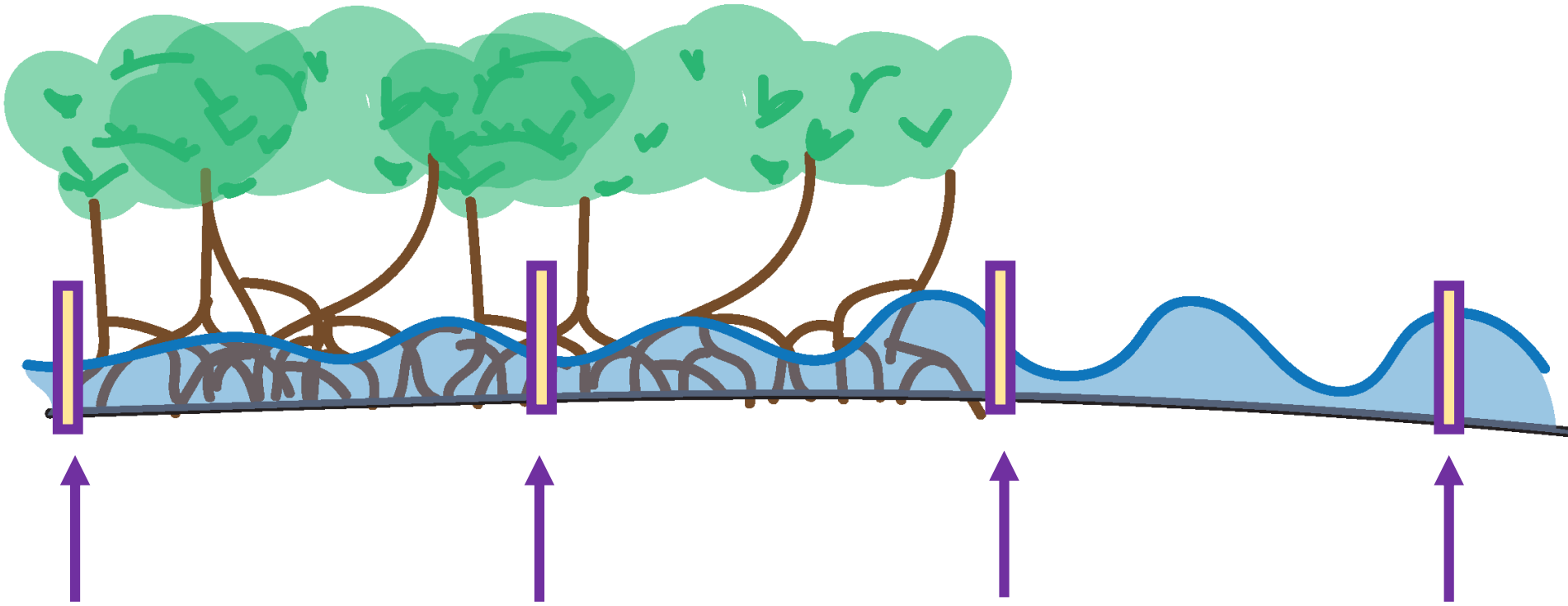
$$200\ samples * \frac{1}{8\ Hz} = 200\ samples * \frac{sec}{8\ samples} =$$

Case Study: Wave Attenuation



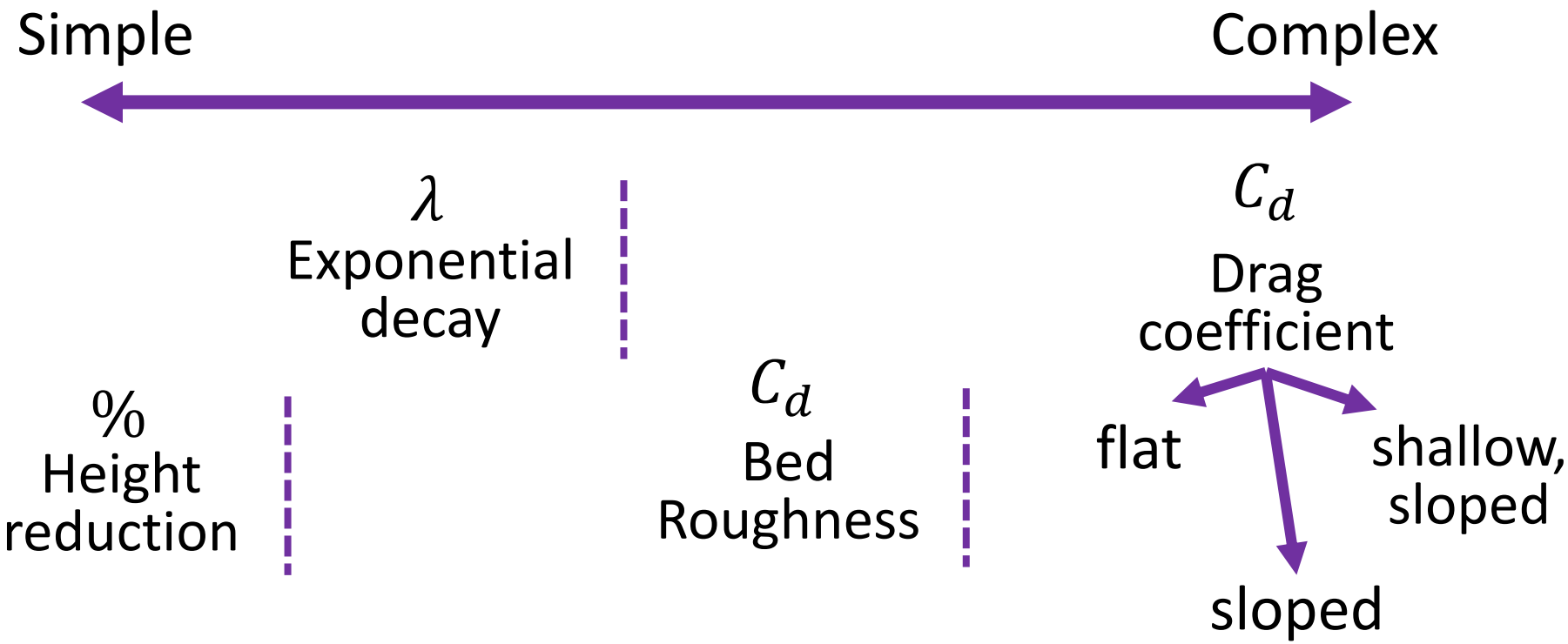
$$200\ samples * \frac{1}{8\ Hz} = 200\ samples * \frac{sec}{8\ samples} = 25\ sec$$

Case Study: Wave Attenuation



Compare the waves at each station

Model Complexity



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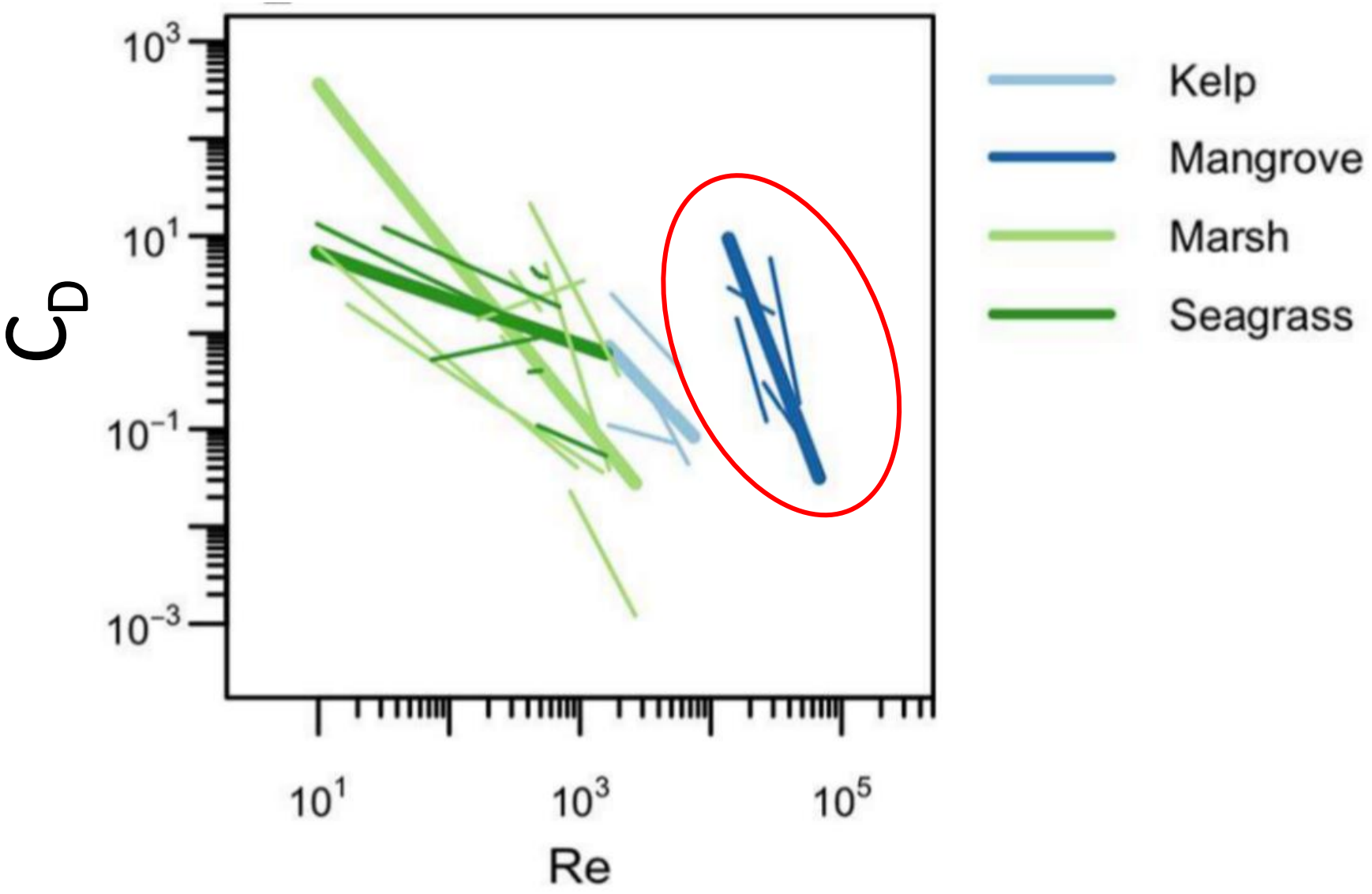
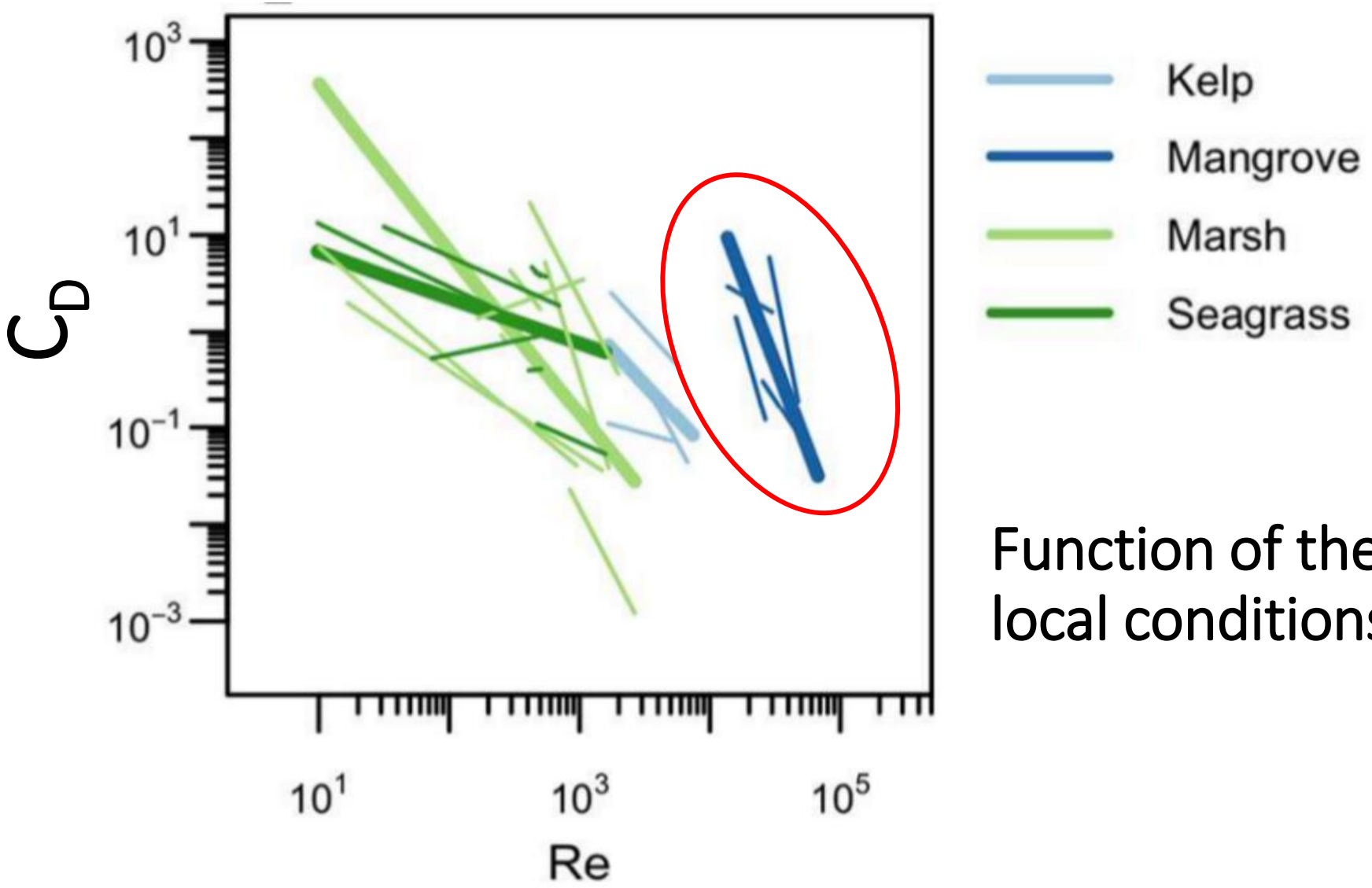


Calm ⟶ Turbulent

Pinsky et al. 2013

Wave Attenuation



Function of the local conditions

Pinsky et al. 2013

Exploitation of Mangroves

- Firewood
- Building material
- Fences and buildings
- Shrimp/ crab farming
- Salt production

Conservation of Mangroves

Friday 12th September, 2014

Print

NGO plants mangroves and woodlots at Ada

Ada (G/A), Sept. 12, GNA – The Netherlands Development Organisation (SNV), a non-governmental organisation, has called on government to step up efforts towards the protection and rehabilitation of mangroves ecosystem in the country.

Mr Enno Heijndermans, SNV Renewable Energy Sector Leader made the call at Kwalakpoloyom, a suburb of Ada during the inaugural ceremony of an eight-hectare plantation of mangrove and woodlots.

He expressed concern about the high deforestation rates in Ghana, especially mangrove forest depletion along the coastal wetlands.

Conservation of Mangroves

Secure | https://www.wetlands.org/news/more-mangroves-please/

More Mangroves Please!

Home » News » Vibrant Coasts and Deltas » Coastal wetland conservation » More Mangroves Please!

NEWS 28 July 2017

On 26 July, World Mangrove Day, the Global Mangrove Alliance launched in Washington DC. The Mangrove Alliance brings together Conservation International, IUCN, The Nature Conservancy, WWF and Wetlands International. Our aim: to expand the global extent of mangroves 20% by 2030.

The value of mangroves

More than 200 million people depend on mangroves for food and their livelihoods. They are

Thank you for listening!
Questions?

Work Cited

- Donato, D. C., J. B. Kauffman, D. Murdiyarso, S. Kurnianto, M. Stidham, and M. Kanninen (2011), Mangroves among the most carbon-rich forests in the tropics, *Nat. Geosci.*, *4*(5), 293–297, doi:10.1038/ngeo1123.
- Pinsky, M. L., G. Guannel, and K. K. Arkema (2013), Quantifying wave attenuation to inform coastal habitat conservation, *Ecosphere*, *4*(8), art95, doi:10.1890/ES13-00080.1.