Growth and erosion dynamics of mangroves in Suriname and Indonesia

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WOTRO SDG & WCFD HUB Project on Mangroves

Monitoring Dynamic Mangrove Systems in Suriname and Indonesia

Learn from timeseries of satellite imagery 1985- now: coastal monitoring

Evaluate Mangrove Building with Nature project WnZ

Capacity & awareness building

NWO Netherlands Organisation for Scientific Research

SDG 4 13 14 15

WWF

Anton de Kom Universiteit van Suriname

Conservation International Suriname

UNDP Suriname

Wetlands International

Utrecht University

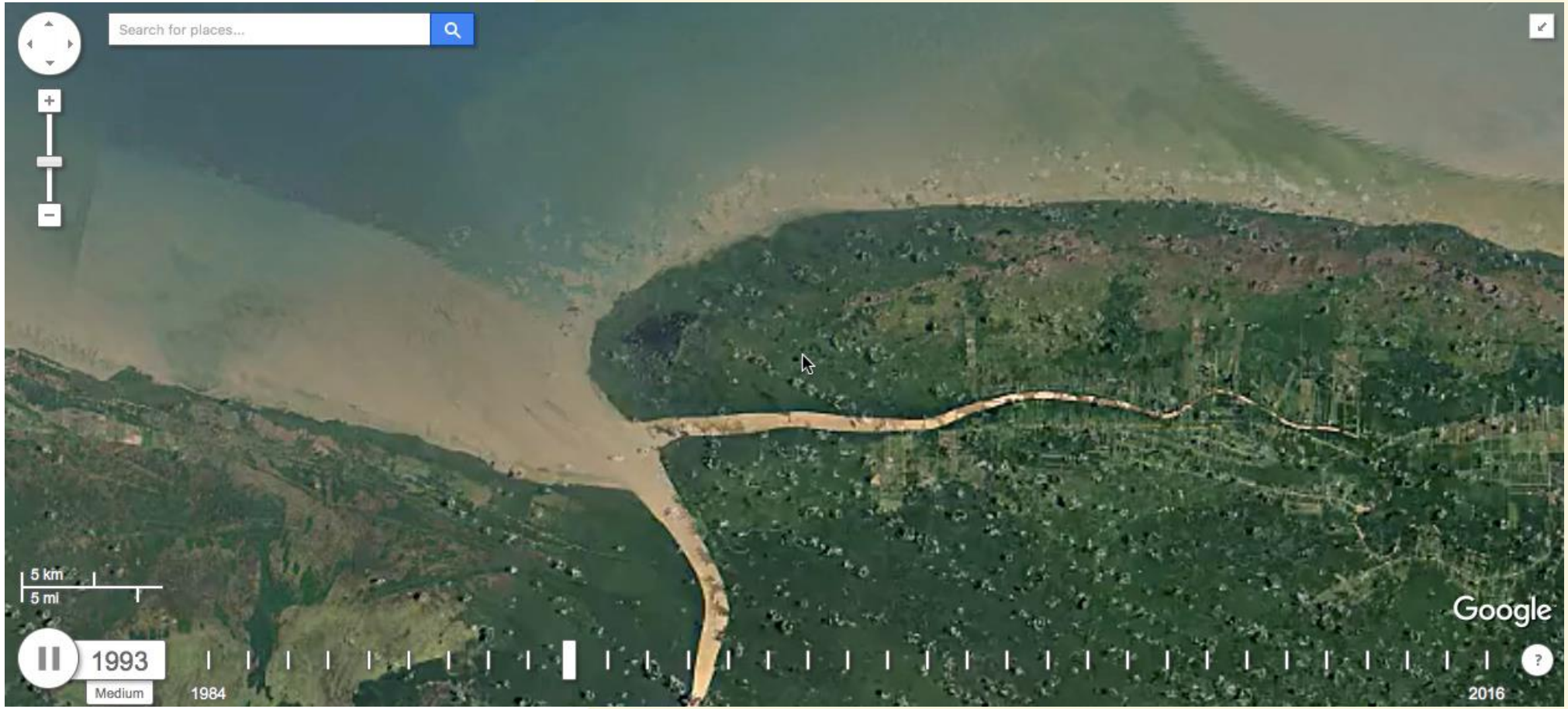
Mangroves

- Productive ecosystems rich in biodiversity
- Habitats for flora and fauna: fish, birds, reptiles, benthos
- Coastal protection against wave energy & storms, tsunamis
- Provide resources such as timber, firewoord, food
- Carbon sink & green belt
- Helpful for protection against sea level rise

- Mangrove area ~15 million hectare worldwide, spread over 123 countries
- About > one third of the mangroves are lost or degraded worldwide
- Conversion to aquaculture, agriculture, urban areas, harbours & infrastructure
- Degraded due to pollution (oil, plastics, over-harvesting, sea level rise)

- Pristine mangrove areas left: mainly Guianas, Brazil, Orinoco delta, West Africa

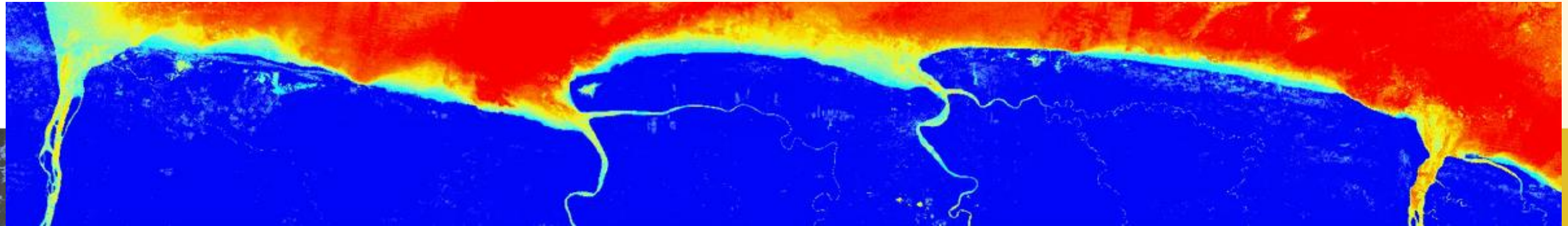
Coastal Erosion/Accretion Coppename, 1984 – 2016 & entire Suriname



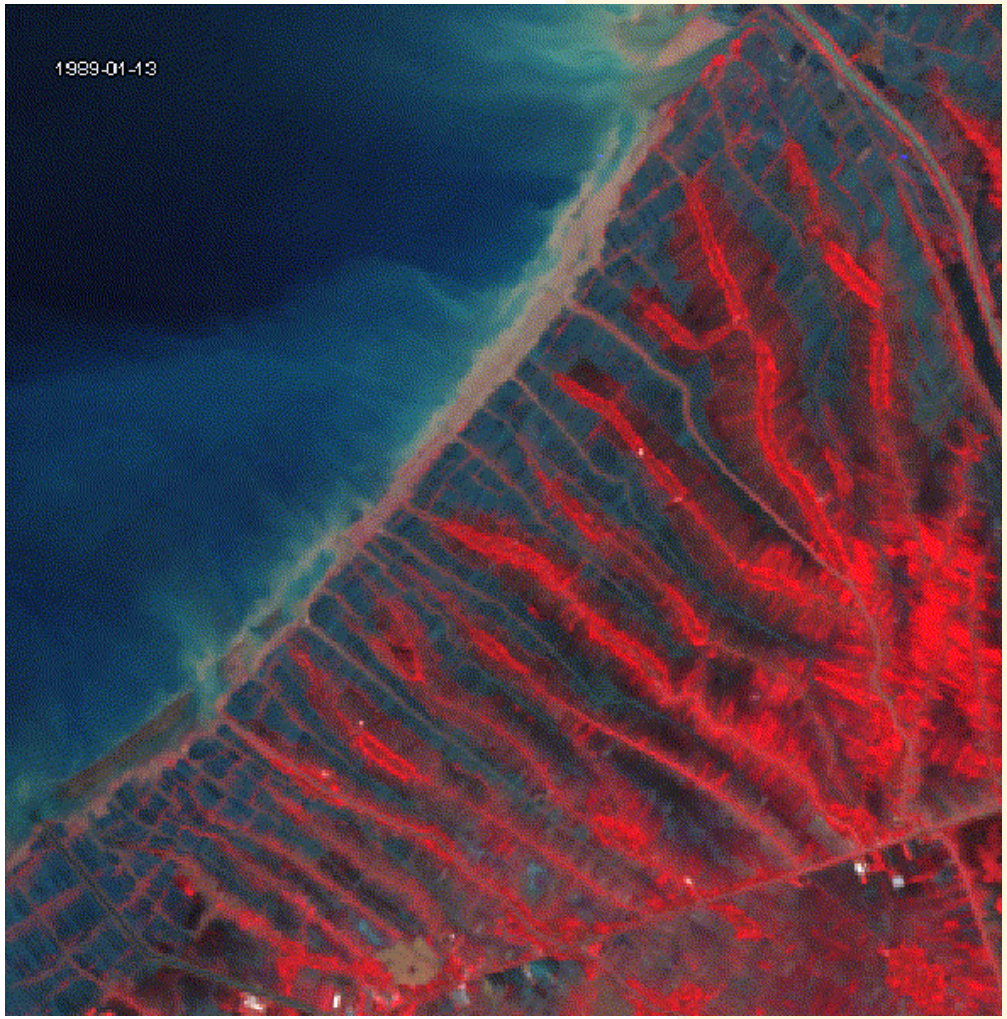
Suriname:

- Dynamic coast due to migrating mudbanks originating from the Amazon
- Pristine zones

Migrating mudbanks



Demak coast and remains of mangrove areas



Demak, timeseries of Satellite imagery 1990-2020

Demak coast

- Far less mangrove left (since 70s) as patches in the image left show
- History of extensive aquaculture

- Land subsidence 10 to 15 cm/year between 2011-2016 (groundwater abstraction) & sea level rise

- Less clear sources of sediments for the mangroves
- Complex tides and currents

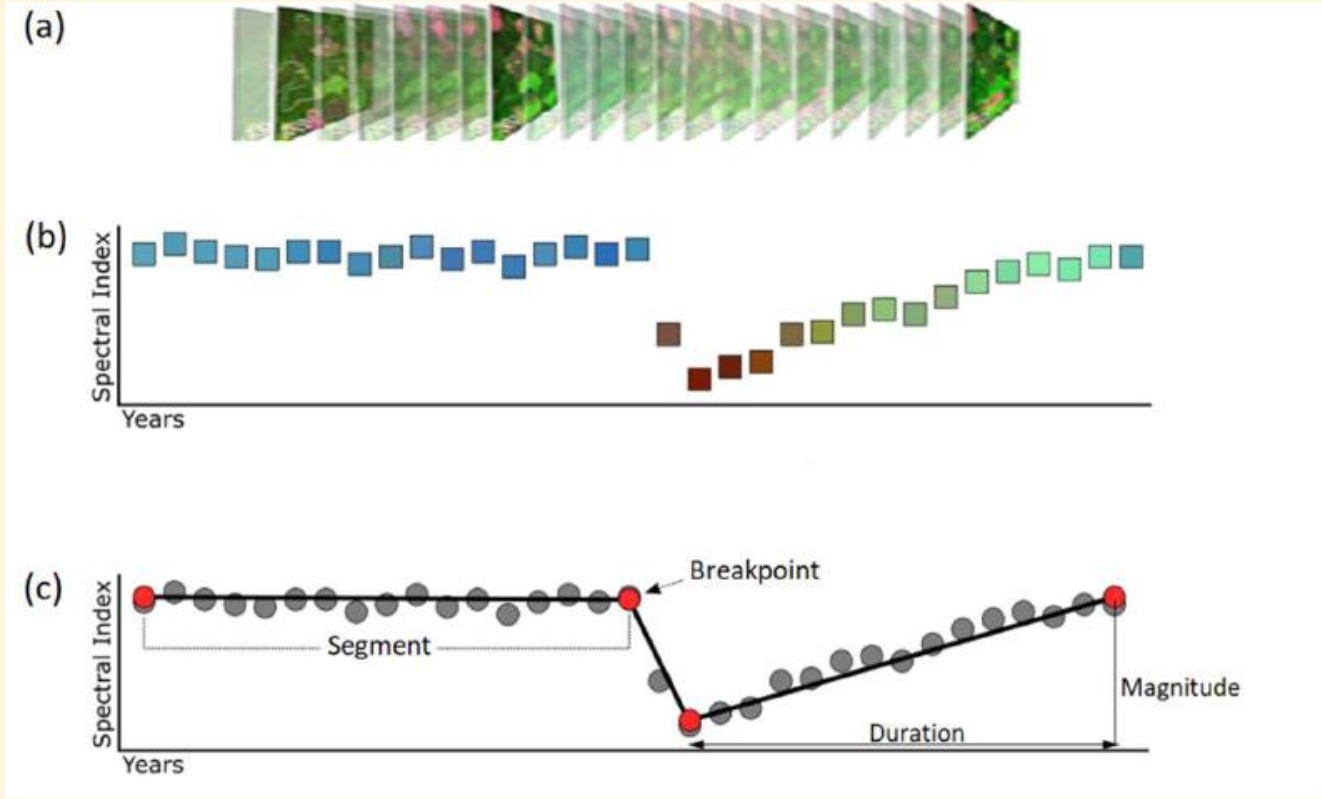
Land subsidence & urban development 1985 2000 2019 mangroves & people trapped between dike & sea

1985 2000 2019

Methods

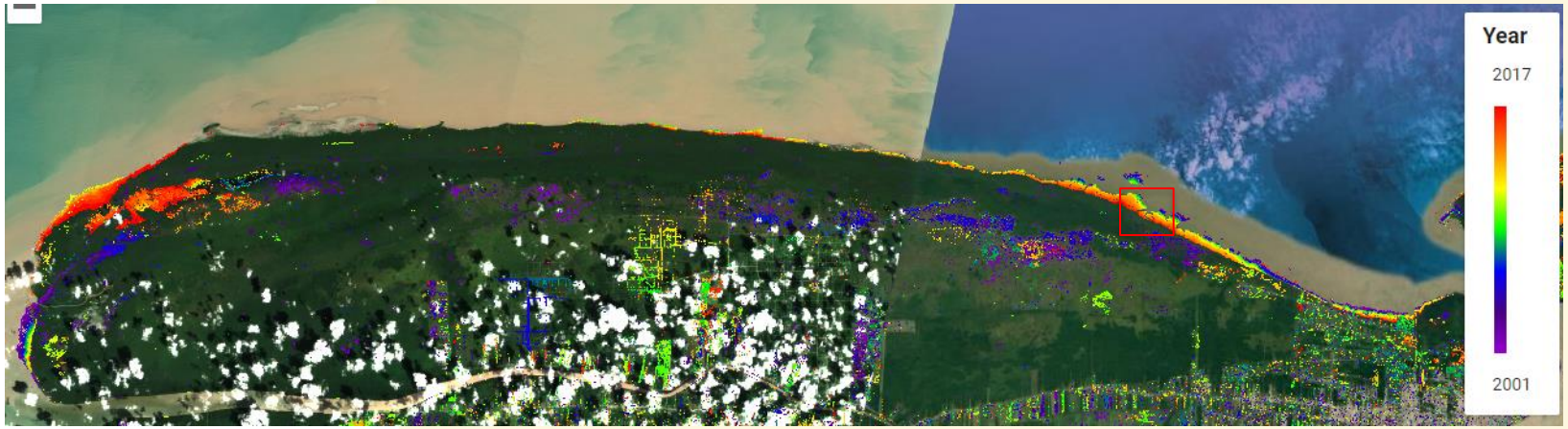
- Timeseries satellite images i.e. Landsat, Sentinel-2 available in Google Earth Engine (GEE)
- Algorithm to identify/recognize spectrally the mangroves: Modular Mangrove Recognition Index MMRI
- Change algorithm 'LandTrendr' for rate and timing of mangrove removal/erosion & recovery

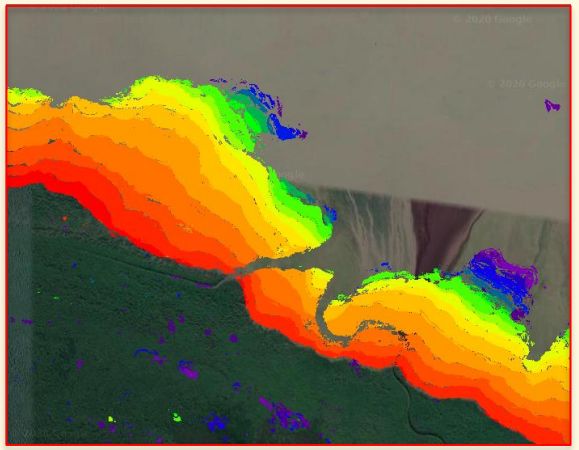
$$MMRI = \frac{|MNDWI| - |NDVI|}{|MNDWI| + |NDVI|}$$



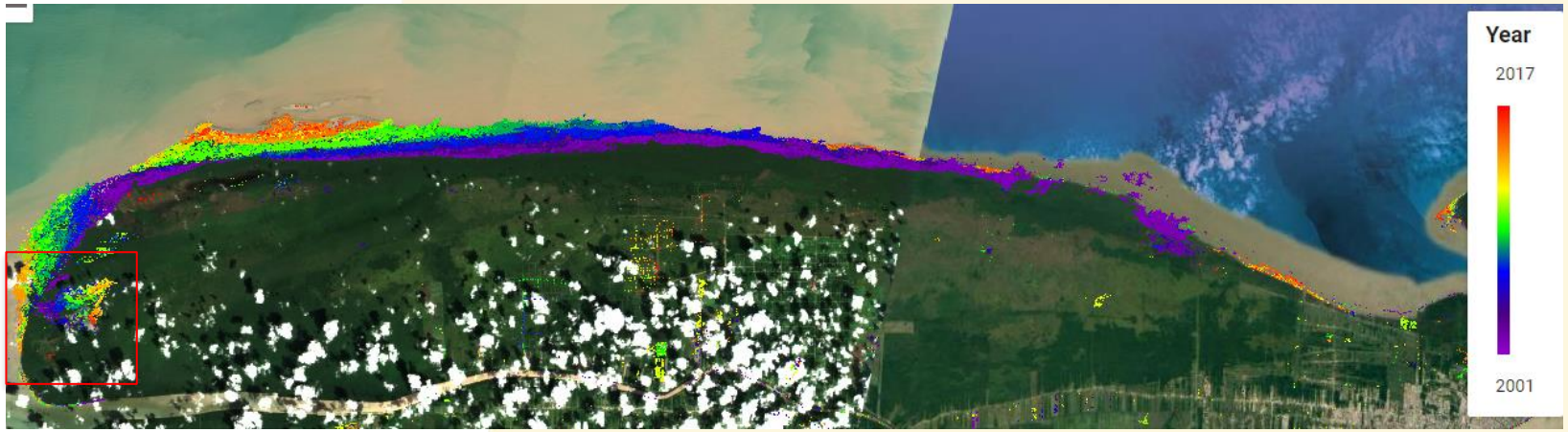
Selected results for Suriname (Saramacca) westward cyclic pattern of mangrove erosion and colonization

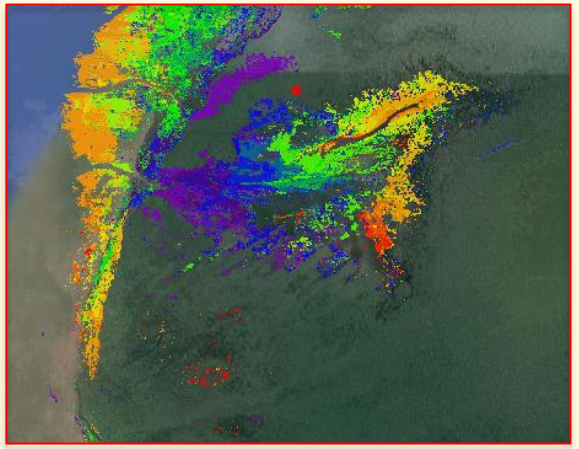
- Loss





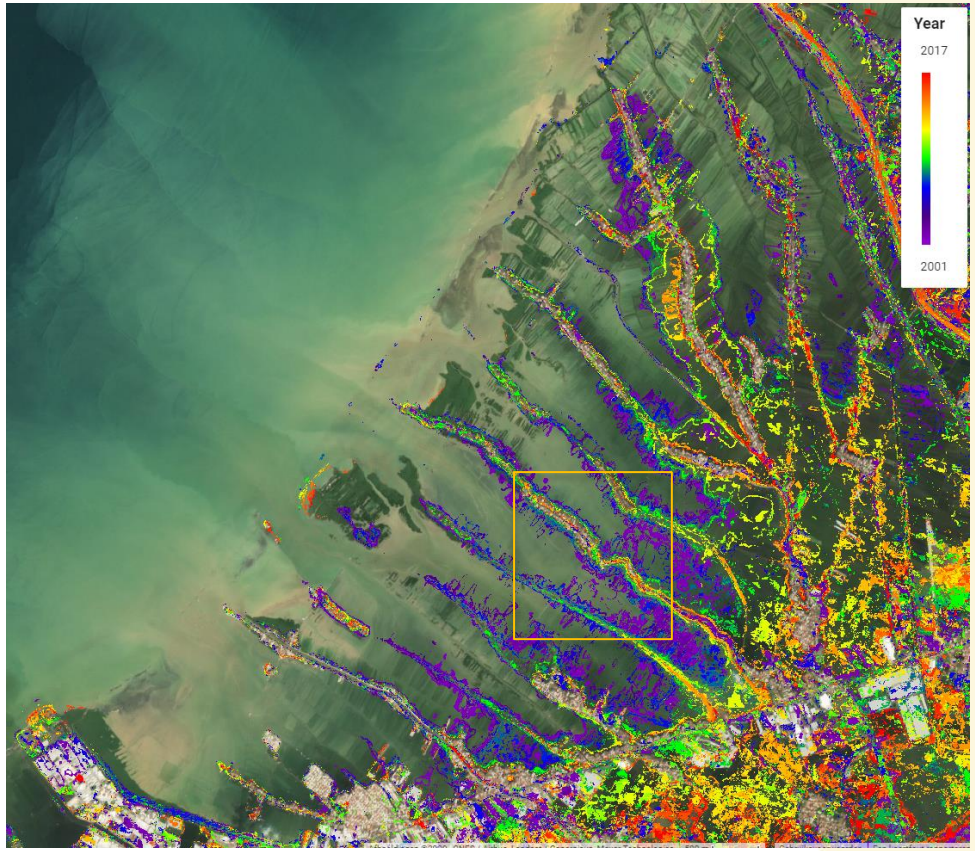
- Gain

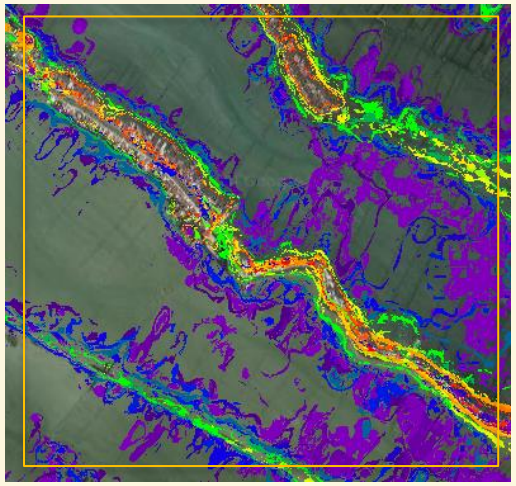


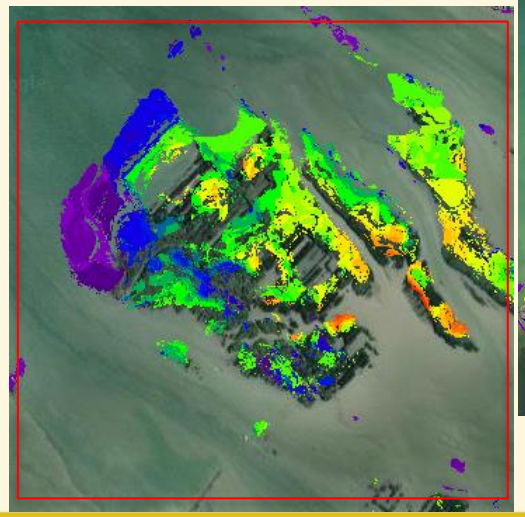


Selected results for Demak, Indonesia
Patches remain & relative SLR is a problem

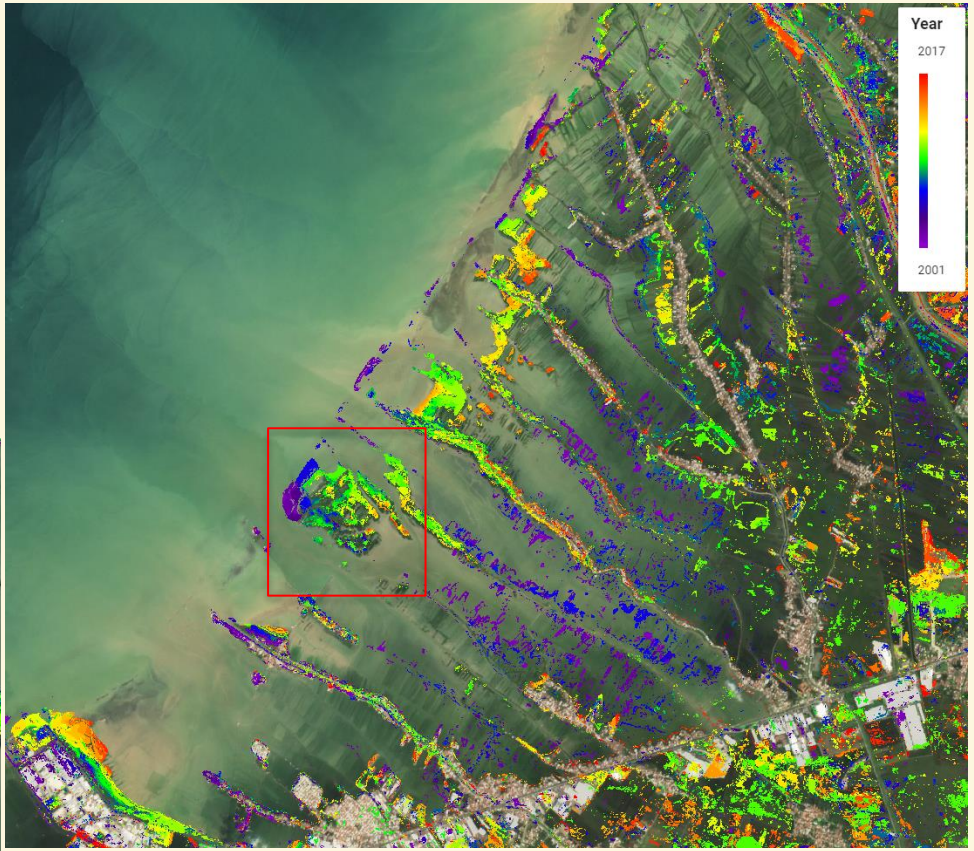
Loss







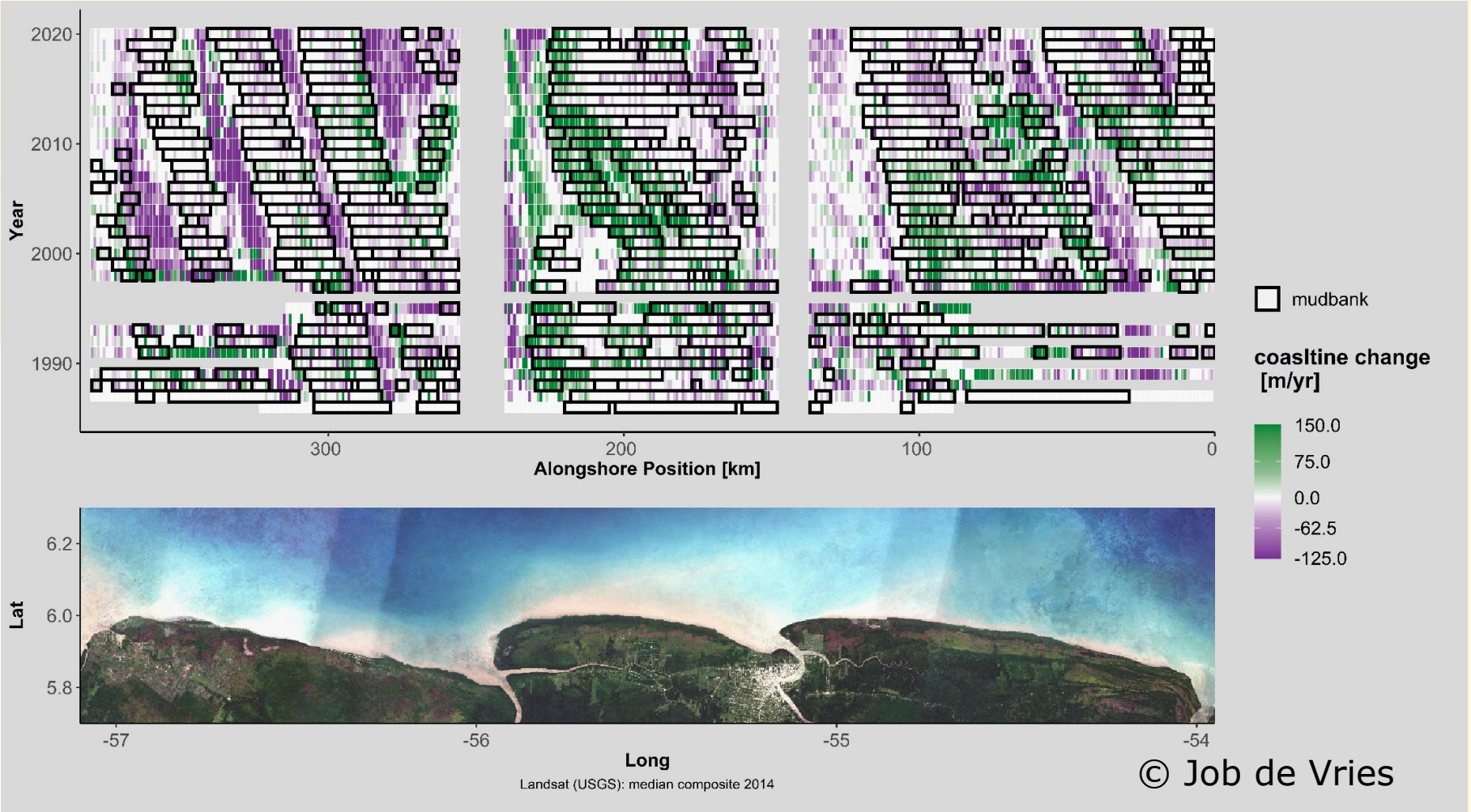
Gain



Our next steps:
improve understanding complex coastal systems

Time-shoreline plot >>

- What magnitudes of erosion and accretion to be expected?
- What spatial & temporal variability?
- Visualize & quantify patterns & processes



Our next steps:
assist to develop and monitor Building with Nature projects

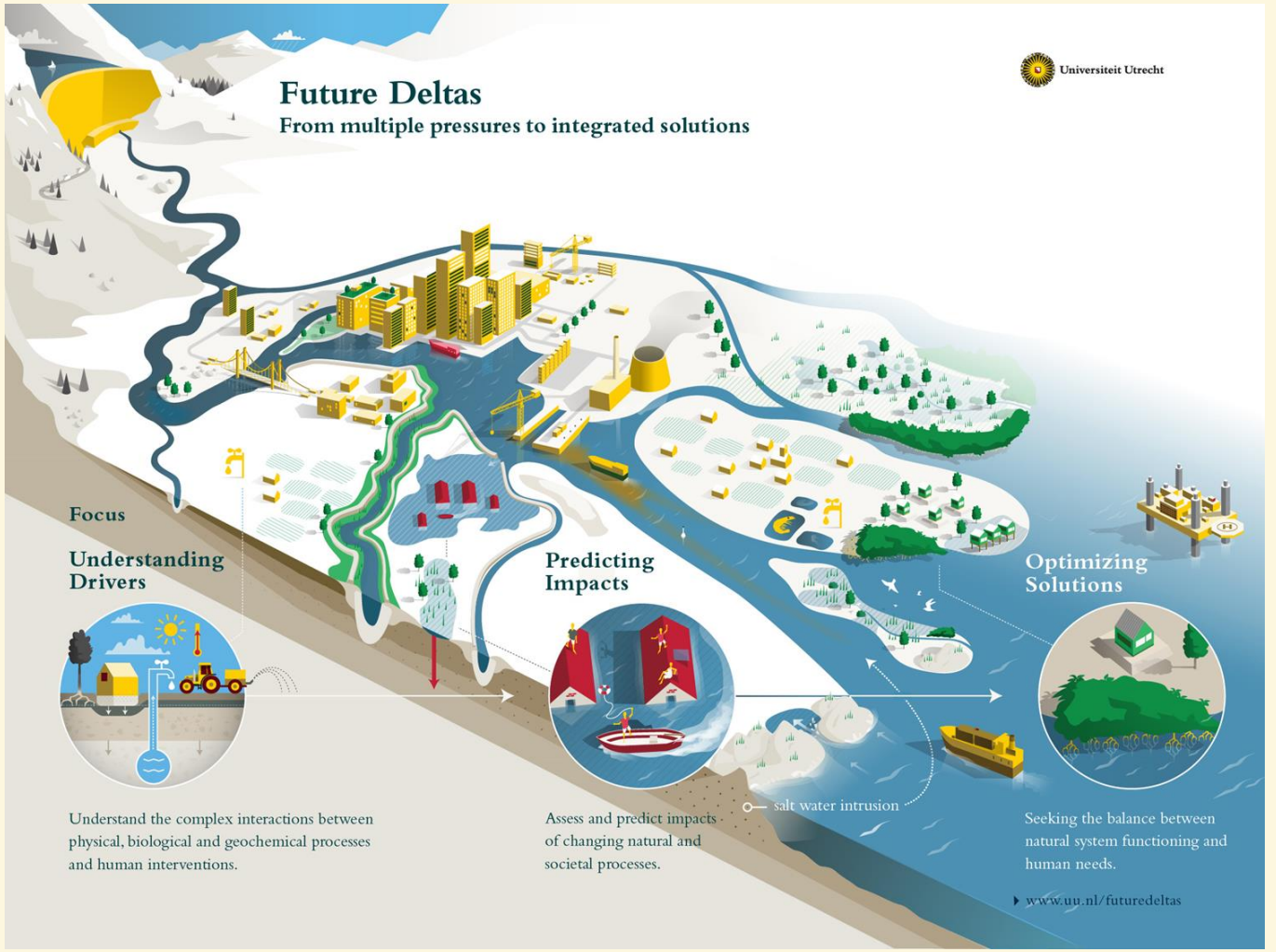
Building with nature options: Soft and ‘hard’ engineering options

Mangrove Building with Nature
Weg naar Zee, Suriname

Hard dikes impede mangrove colonization
Guiana

Conclusions /take home

- Mangroves: important ecosystems to protect
- Coastal systems complex & not fully understood
  Different systems in Suriname, Demak, …..
- Satellite timeseries and models help us to understand these complex coastal systems
- Natural protection of coast by e.g. mangroves are valuable options
- Pristine mangroves zones become sparse, let us protect and preserve them



Recent oil discoveries in Suriname triggered harbour & industry plans …..

Further (project) reading

- De Vries J., B. van Maanen, G. Ruessink, P.A. Verweij, S.M. de Jong, 2021. Unmixing water and mud: characterizing diffuse boundaries of subtidal mud banks from individual satellite observations. Int J of Applied Earth Observations and Geoinformation 95, 102252. https://doi.org/10.1016/j.jag.2020.102252

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- Van Bijsterveldt, C.E.J., B.K. van Wesenbeeck, D.van der Wal, N. Afiati, R. Pribadi, B. Brown, & T.J. Bouma, 2020. *How to restore mangroves for greenbelt creation along eroding coasts with abandoned aquaculture ponds*. *Estuarine, Coastal and Shelf Science* 235. https://doi.org/10.1016/j.ecss.2019.106576

- Verhoeve, S.L., C.E.J. van Bijsterveldt, J. de Vries, S.M. de Jong, 2021. Monitoring mangrove erosion and settlement over space and time in Suriname (Weg naar Zee) and Indonesia (Demak Region). Final Report to Water Climate & Future Deltas HUB of Utrecht University.

- De Vries J., B. van Maanen, G. Ruessink, P.A. Verweij, Steven M. de Jong. Multi-decadal coastline dynamics controlled by migrating subtidal mudbanks. Earth Surface Processes & Landforms, submitted.

Thank you for your attention

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UU Water Climate Future Delta HUB Project (Steye Verhoeve)

UU Bright Minds Project: Mapping Mangroves using LandTrendr (Youchen Shen)