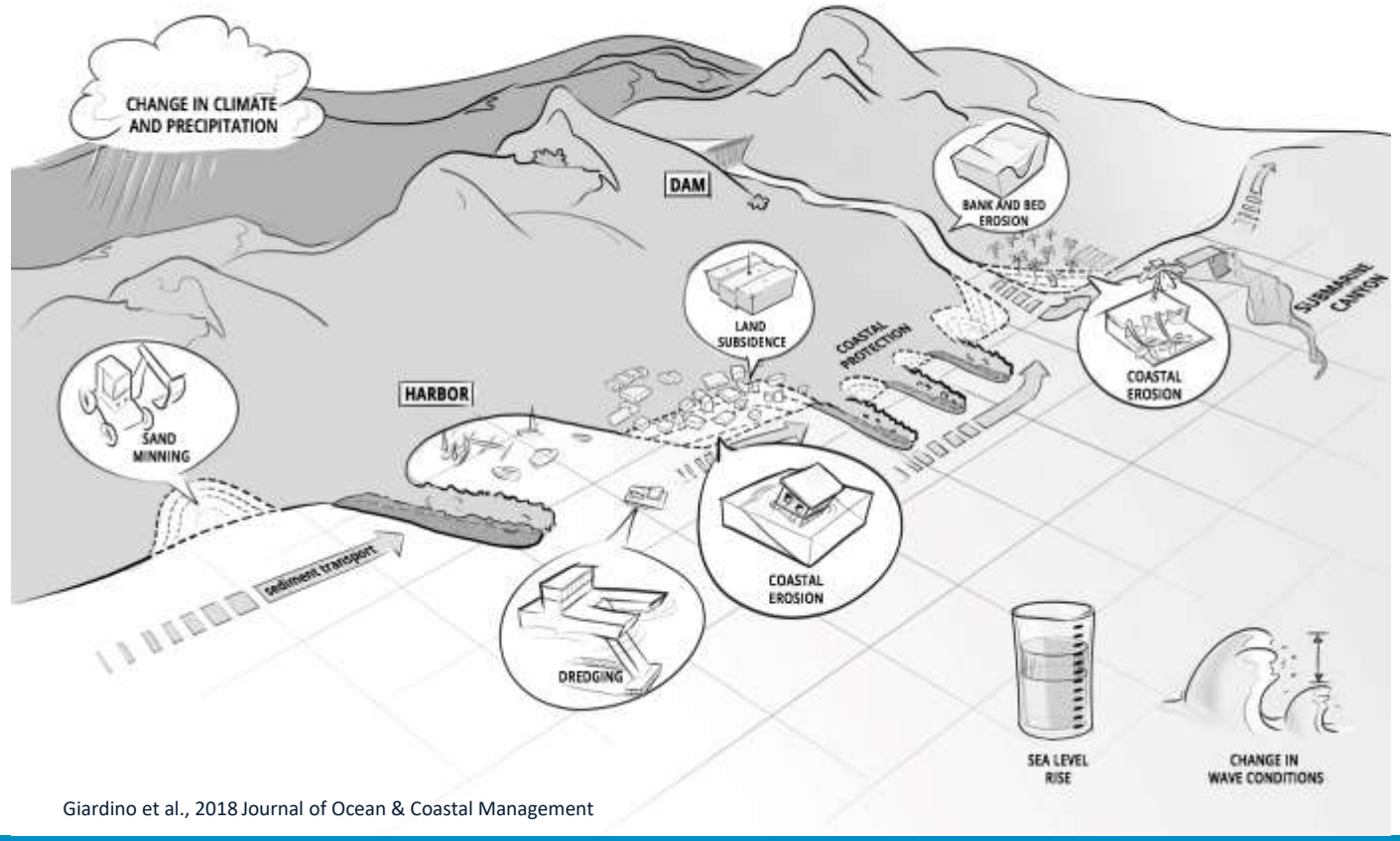

Giardino et al., 2018 Journal of Ocean & Coastal Management

Simple Solutions to Complex Problems

A Toolkit for Quick Assessment of Coastal Problems and Adaptation Solution

Alessio Giardino ***Specialist Disaster Risk Management and Climate Adaptation***

…with contribution from many other Deltares colleagues

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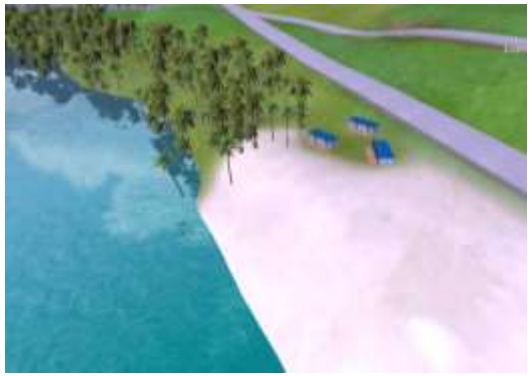
Why?

- **First order assessment** of problems and possible solutions (e.g. during a field mission)
- **Sharing of knowledge** and **capacity building**
- Participatory data collection, modelling and monitoring is a key factor to the **long-term sustainability** of many projects



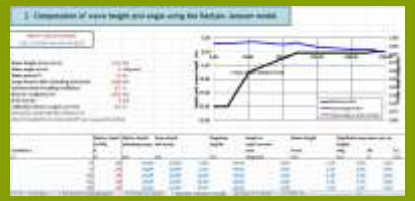



Contents of the presentations

Introduction

Data & Tools for Quick Assessment of Coastal Problems & Solutions

Simple Coast



Application

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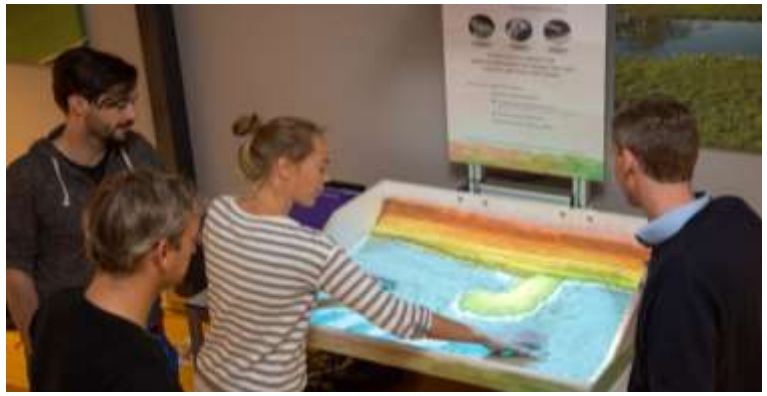
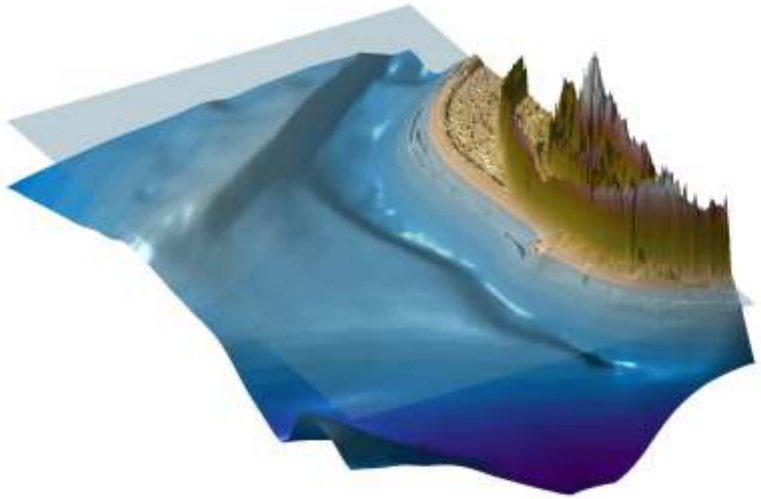
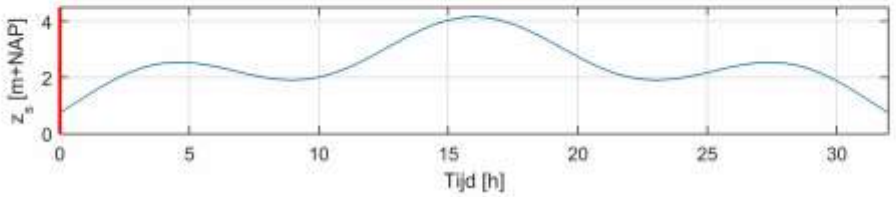
Introduction Deltares

- Deltares is an **independent research institute** for delta technology, incorporating advanced expertise on water, soil and subsurface issues.
- About 850 employees
- Research (50%) and consultancy (50%)
- NONPROFIT ORGANIZATION

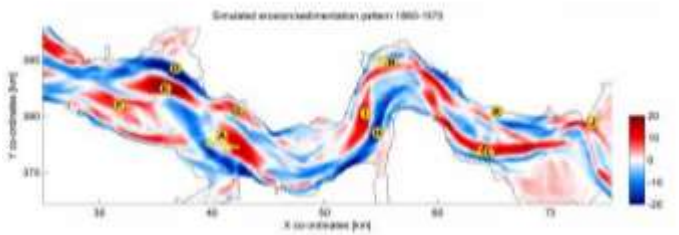


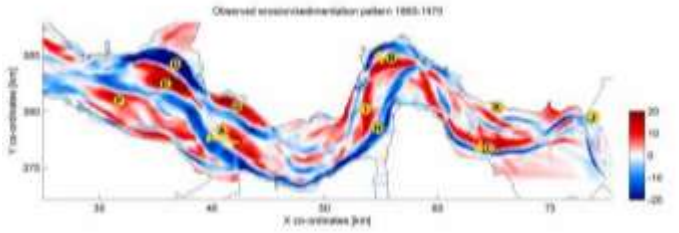
Open software

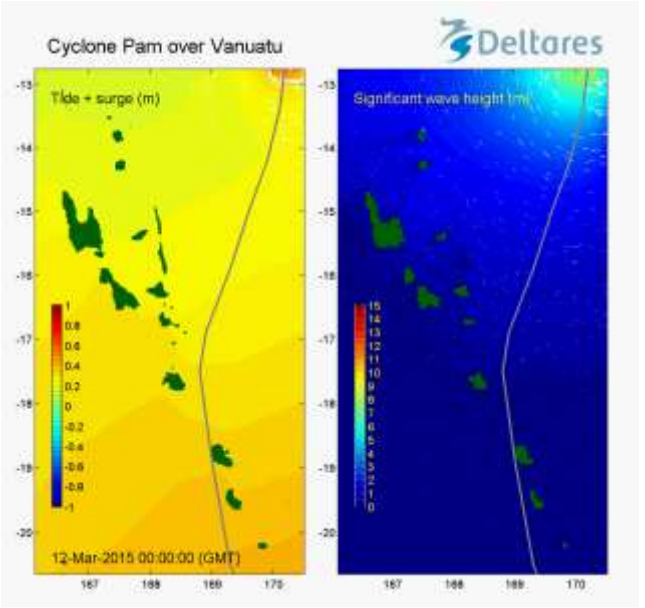




Most of our software's are free and open source (e.g. Delft3D, Xbeach)







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Tools and data for quick assessment of coastal problems and adaptation solutions

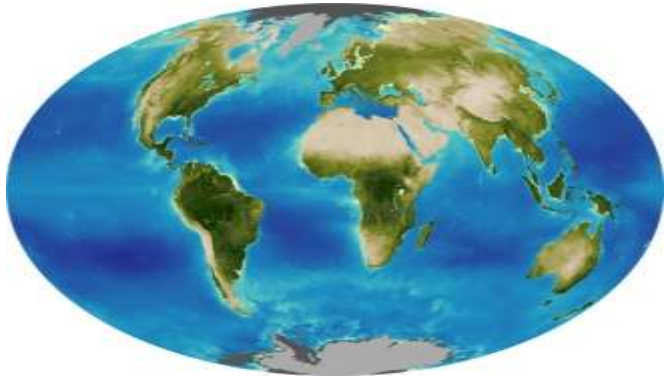
Data needs for coastal adaptation studies

Data requirement may change according to the details of the assessments
Most commonly:

- Bathymetry
- Topography
- Sediment type
- Geology
- Wind
- Waves
- Water levels
- River discharges and sediment input
- Coastal ecosystems
- Flooding/erosion maps after extreme events
- Exposure data (number of assets and values)
- Damage reports after extreme events
- Information on other indirect damages (e.g. socio-economic)
- Overview historical interventions

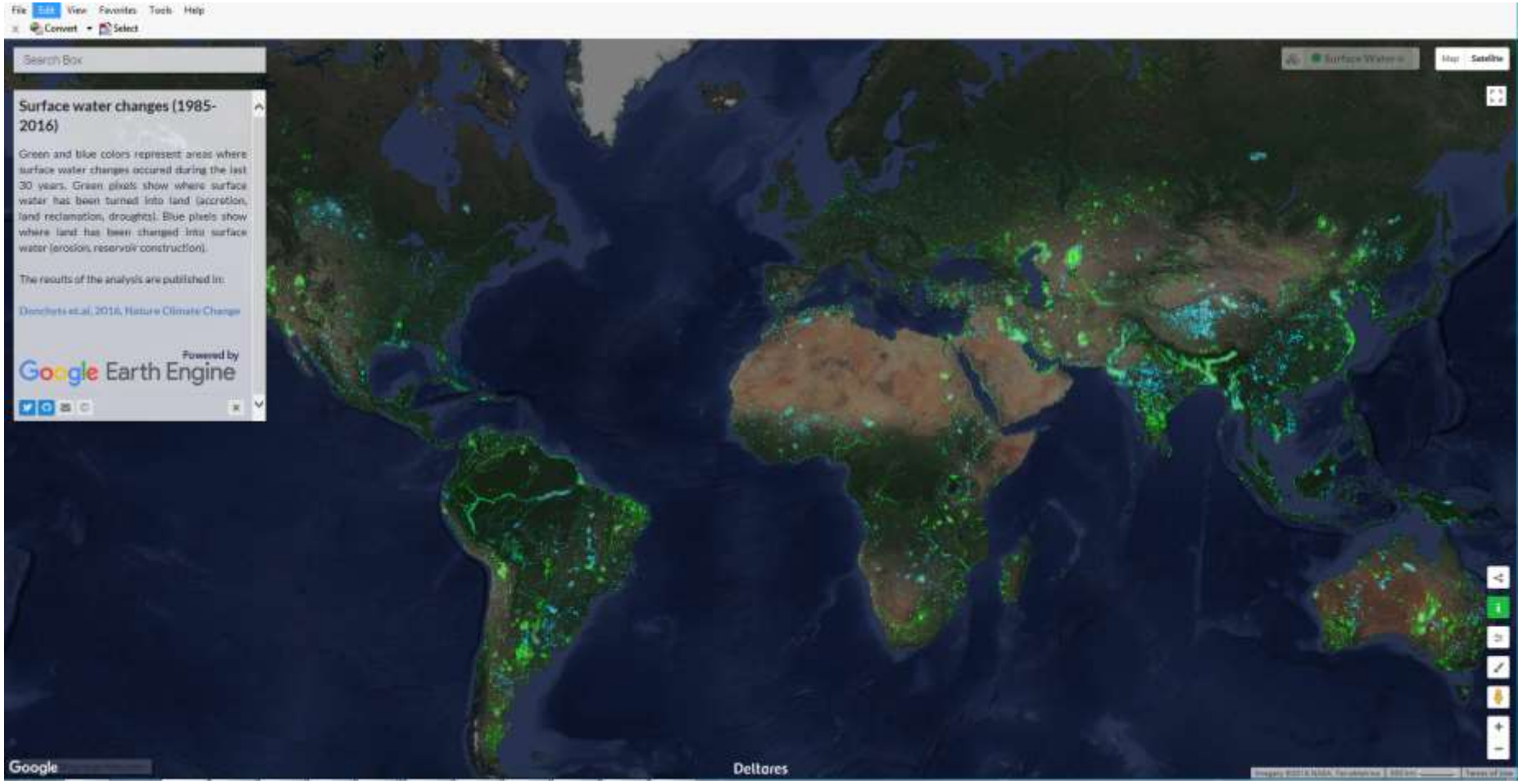
Global data versus Local Data

Global data



Local data

Surface water changes (1985 – 2016)



http://aqua-monitor.appspot.com/

Donchyts et.al, 2016, *Nature Climate Change*

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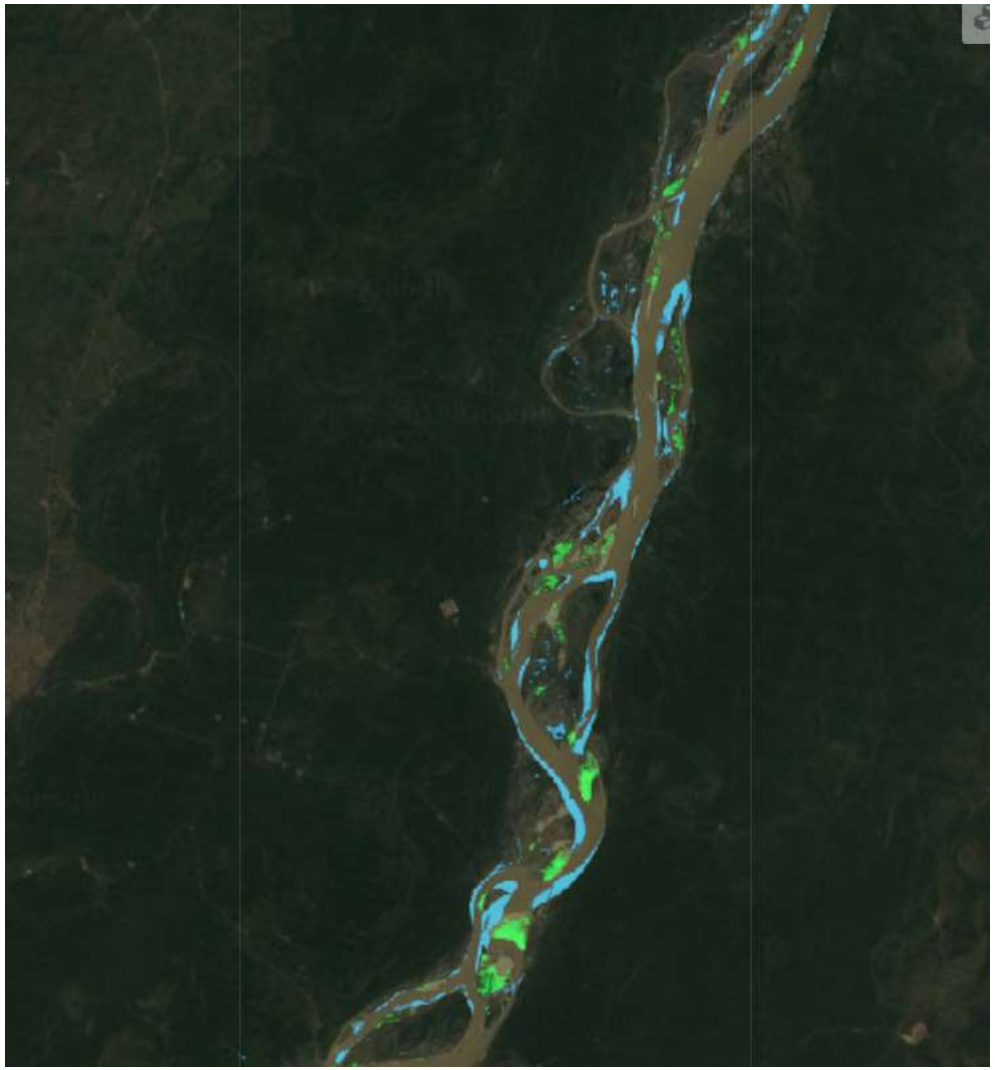
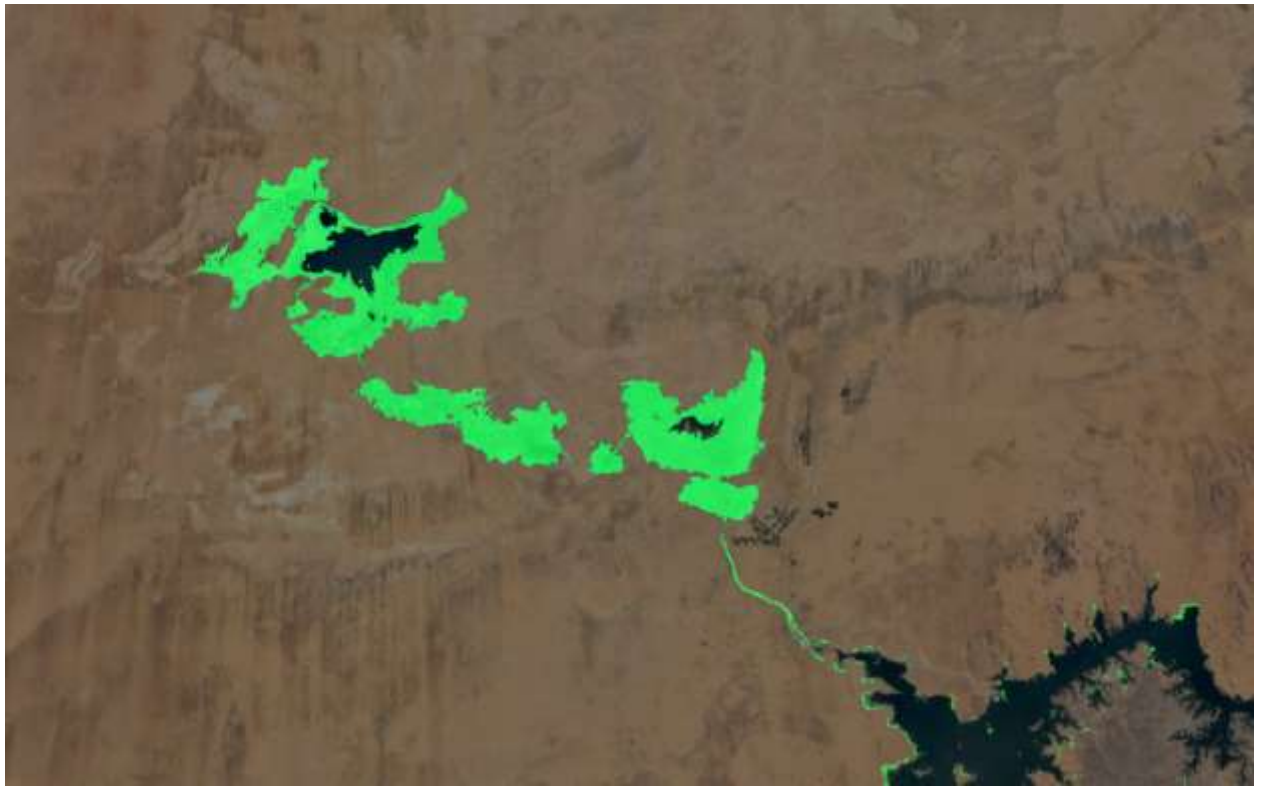
Applications

- Assessment of (long-term) morphodynamic development of river and coastlines
- Effects of anthropogenic interventions (e.g. river damming)
- Climate change effects on river and coastal waters

Examples:



Meandering Niger River



Monitoring lakes and reservoirs
(e.g. Toska Lakes, Egypt)

Shoreline monitor (1984 – 2016)

https://aqua-monitor.appspot.com/?datasets=shoreline

Luijendijk et al., 2018, *Scientific Reports*

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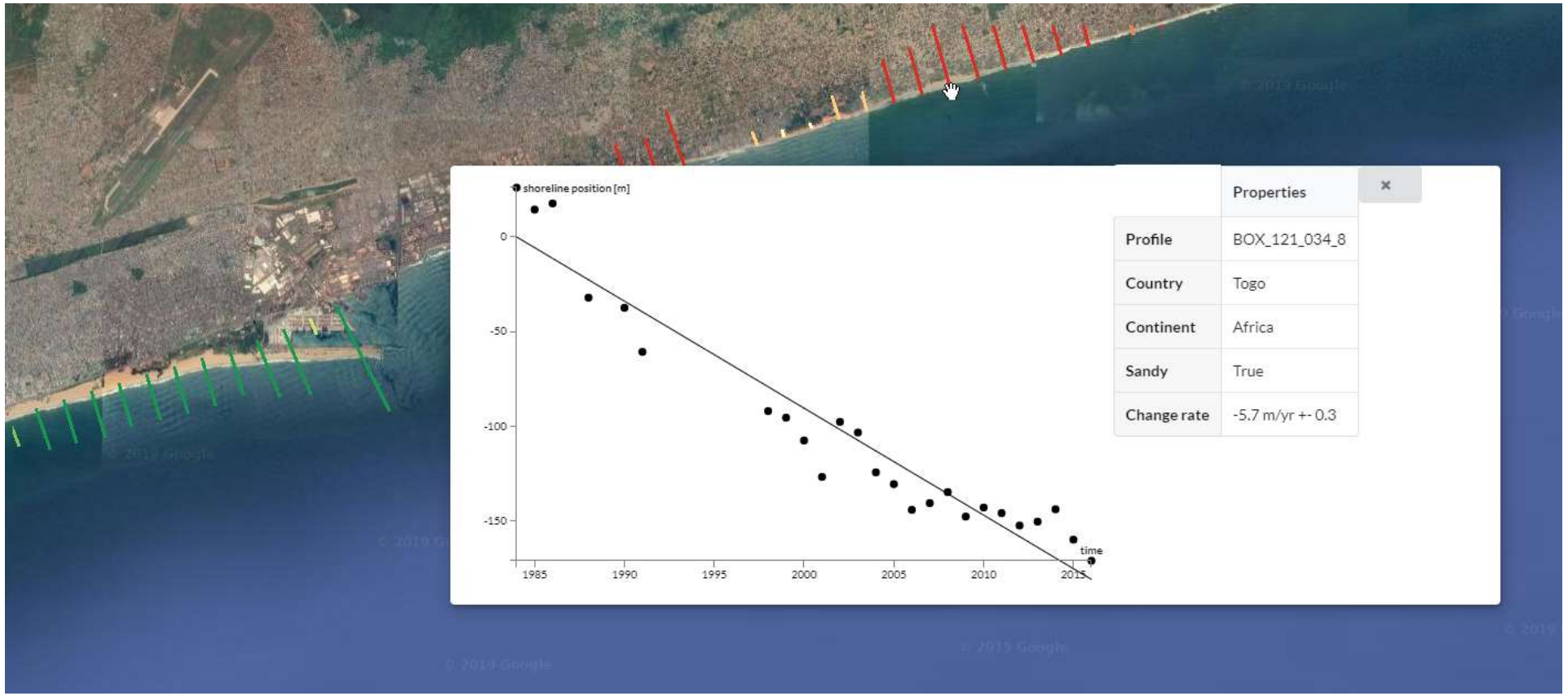
Simple Solutions to Complex Problems

Example:



Erosion east of Lomé port

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Applications

- Assessment of (long-term) morphodynamic development of coastlines
- Effects of major anthropogenic interventions (e.g. major ports, land reclamation projects, beach nourishments, etc.)

Question 1: What is the direction of natural alongshore sediment transport?

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Question 2: Using the Shoreline Monitor (https://aqua-monitor.appspot.com/?datasets=shoreline), identify area which are eroding, accreting

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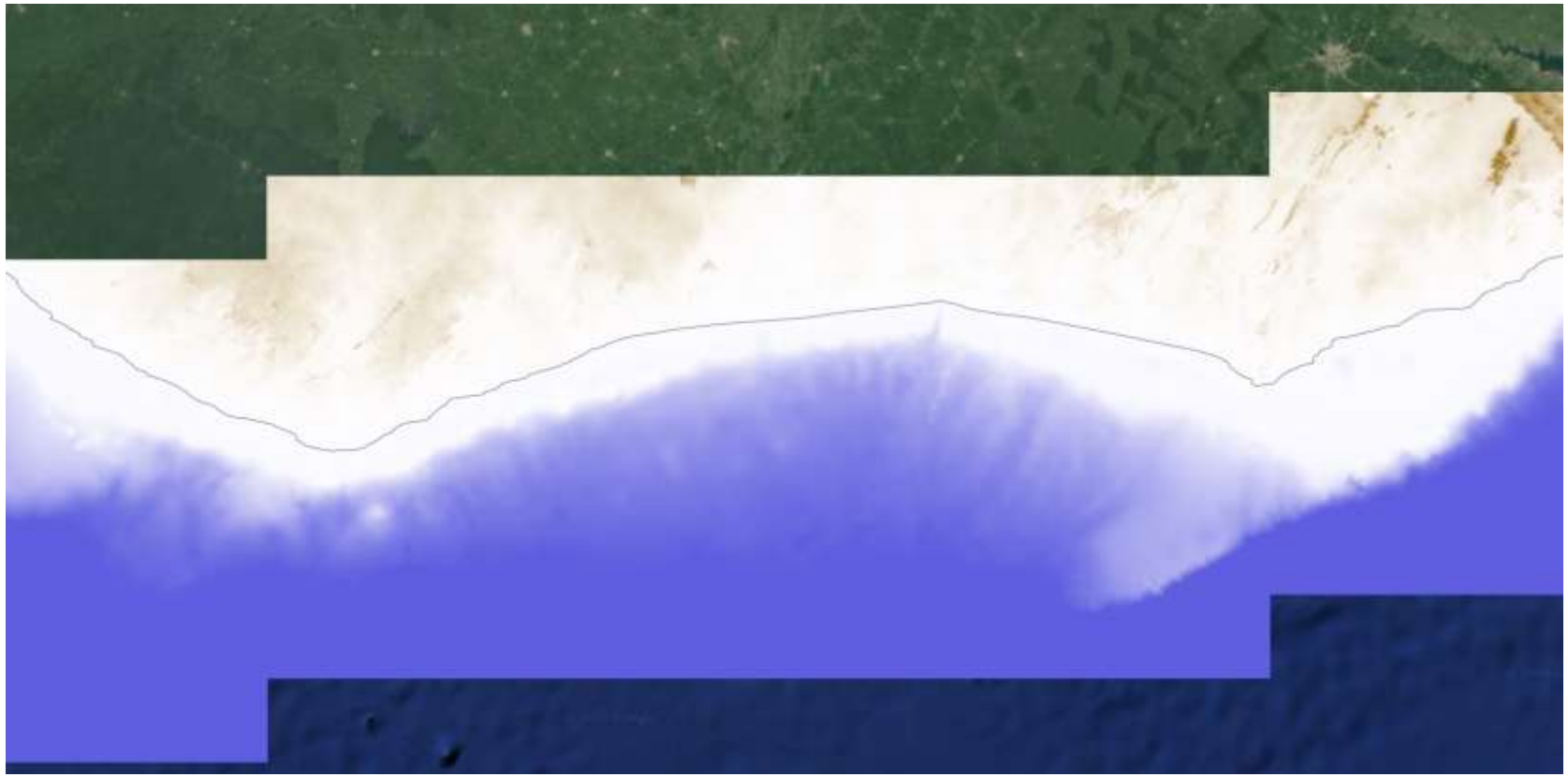
Question 2: Using the Shoreline Monitor (https://aqua-monitor.appspot.com/?datasets=shoreline), identify area which are eroding, accreting

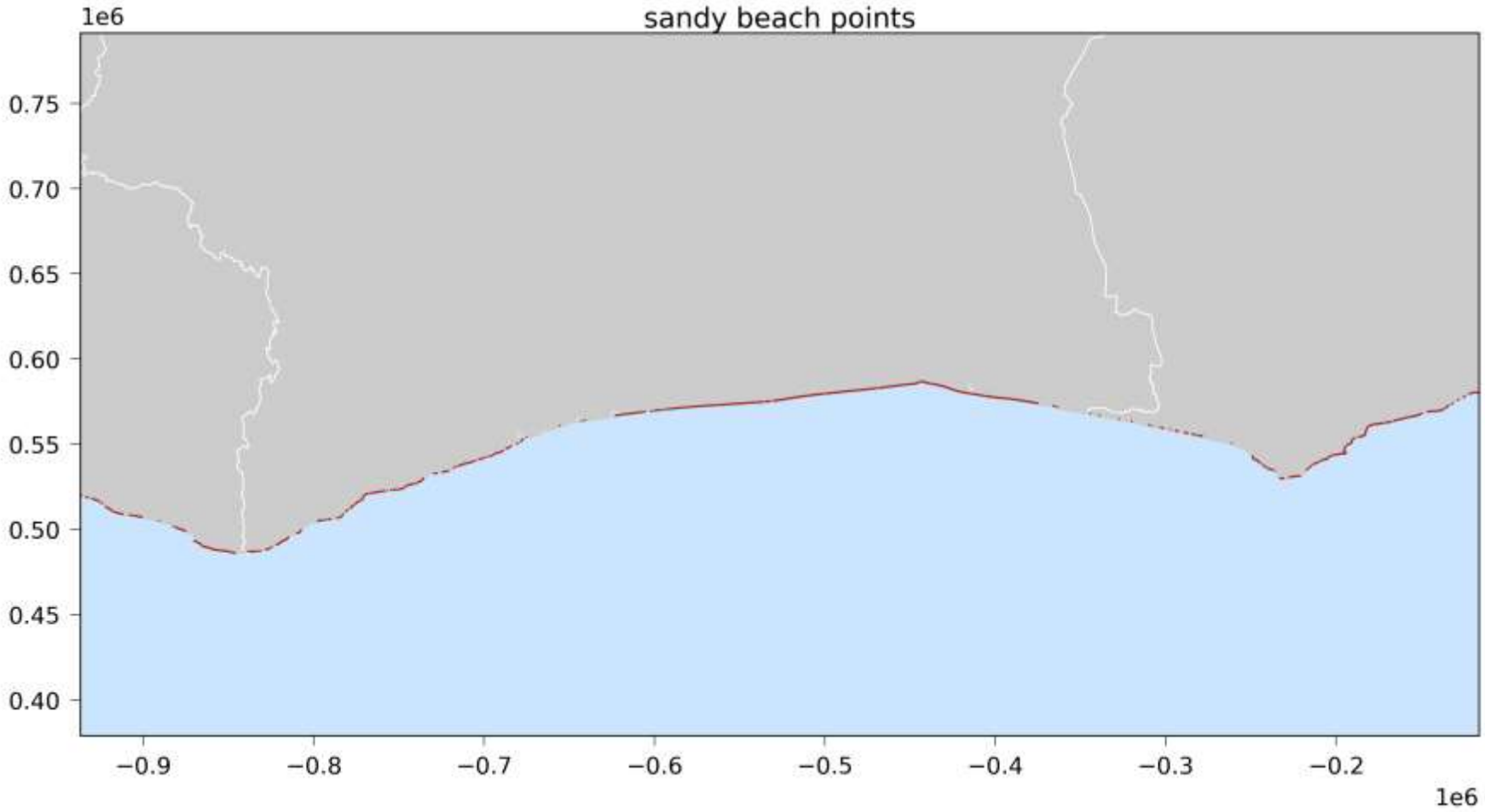
Bathymetry & Topography (GEBCO / SRTM / Merit…)



For example:

- Topography: SRTM, MERIT, TanDEM-X, ALOS World, CoastalDEM
- Bathmetry: GEBCO

Sandy beach detection



Athanasiou et al., 2019, Journal of *Earth System Science Data*

https://data.4tu.nl/repository/uuid:a8297dcd-c34e-4e6d-bf66-9fb8913d983d

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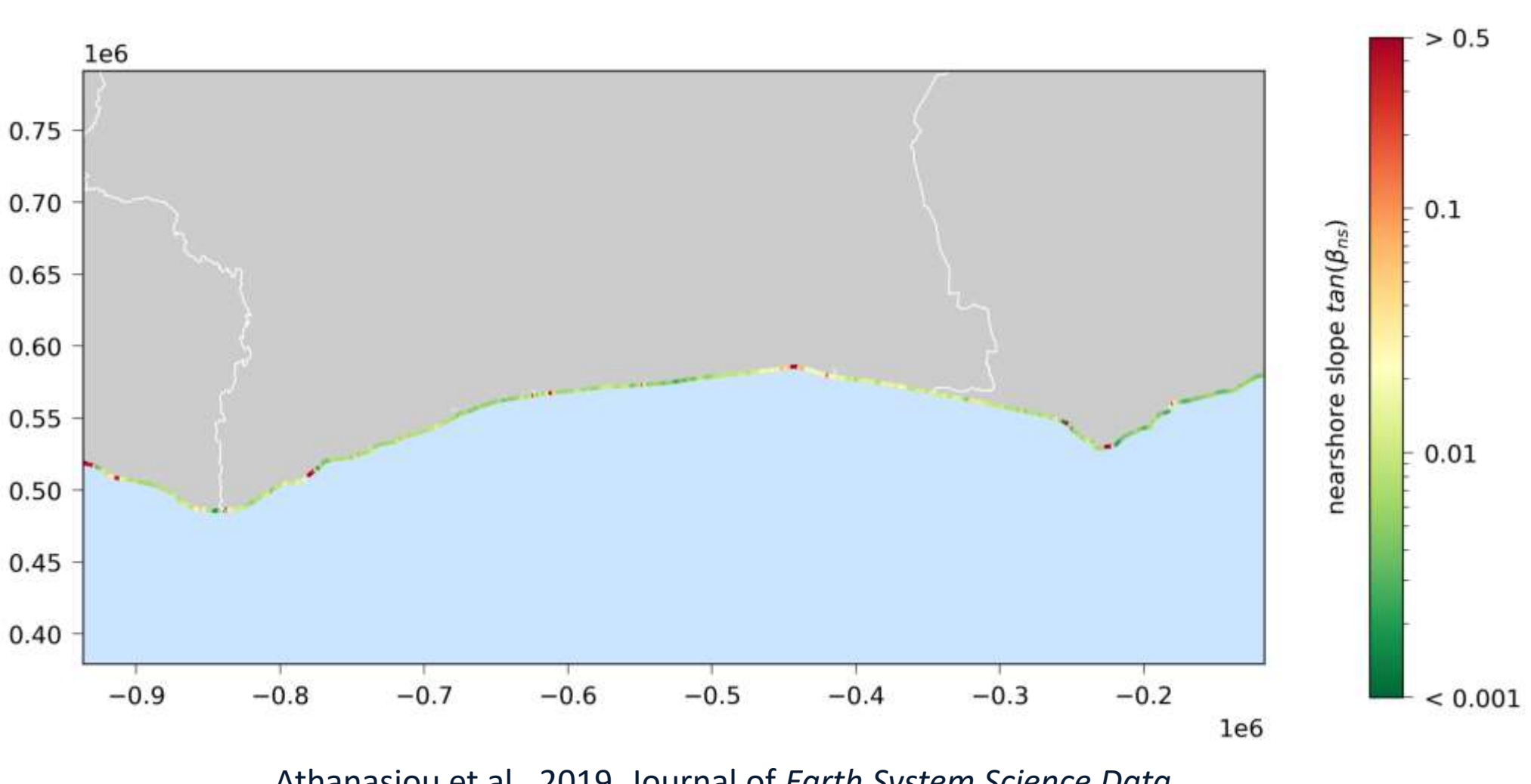
Estimated nearshore slopes



Athanasiou et al., 2019, Journal of *Earth System Science Data*

https://data.4tu.nl/repository/uuid:a8297dcd-c34e-4e6d-bf66-9fb8913d983d

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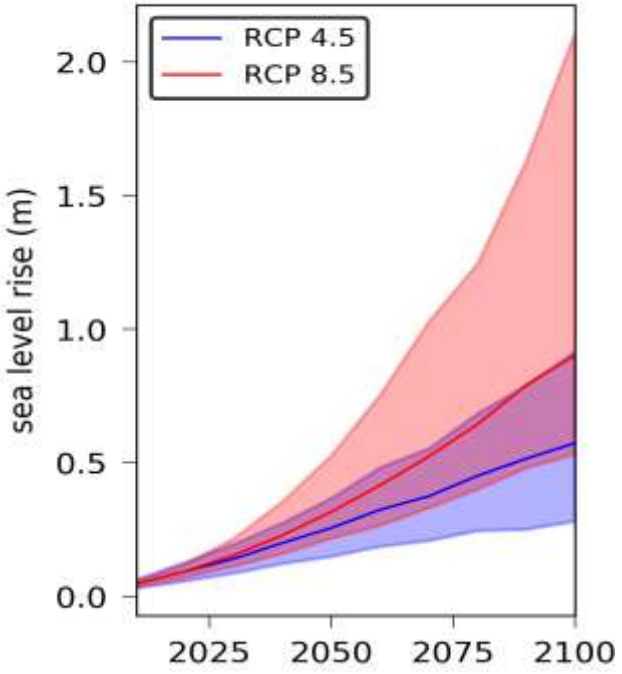
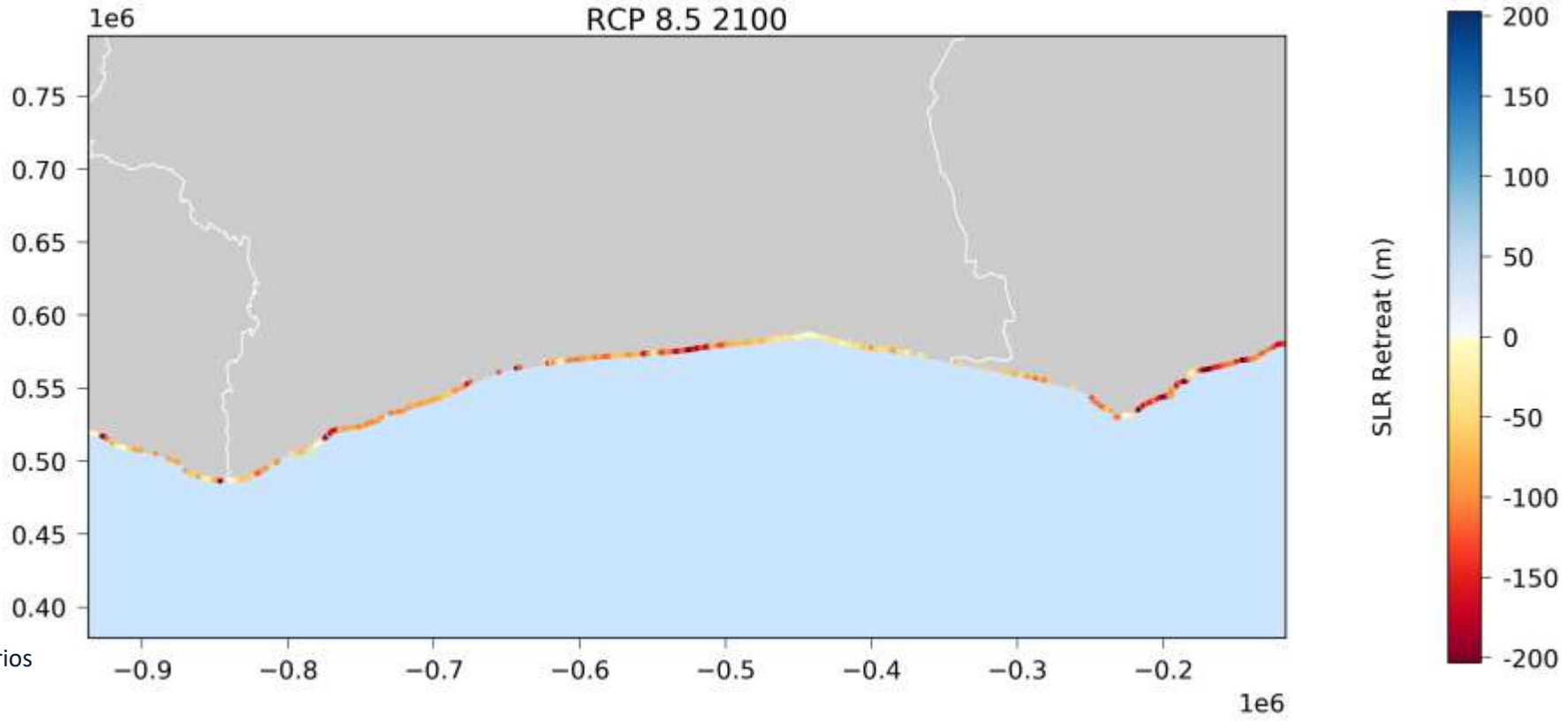
Global impact of sea level rise on sandy beaches



Projections of SLR for different climate change scenarios (Joint Research Center)



Athanasiou et al., 2019, Journal of *Earth System Science Data*

https://data.4tu.nl/repository/uuid:a8297dcd-c34e-4e6d-bf66-9fb8913d983d

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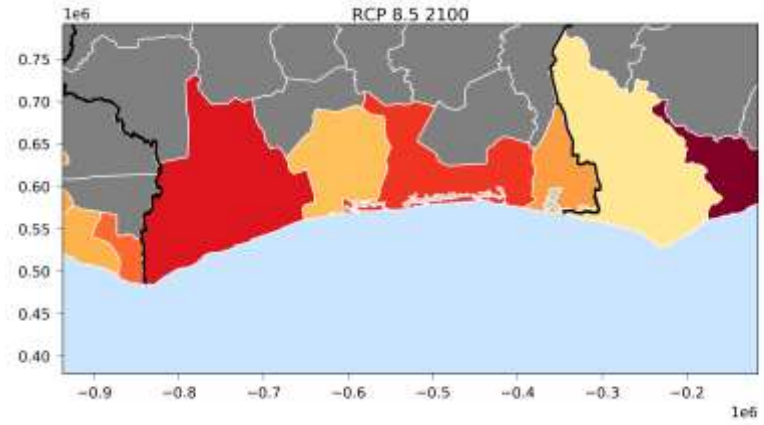
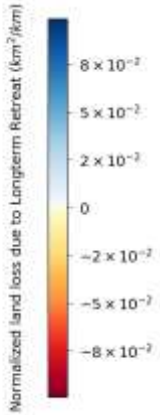
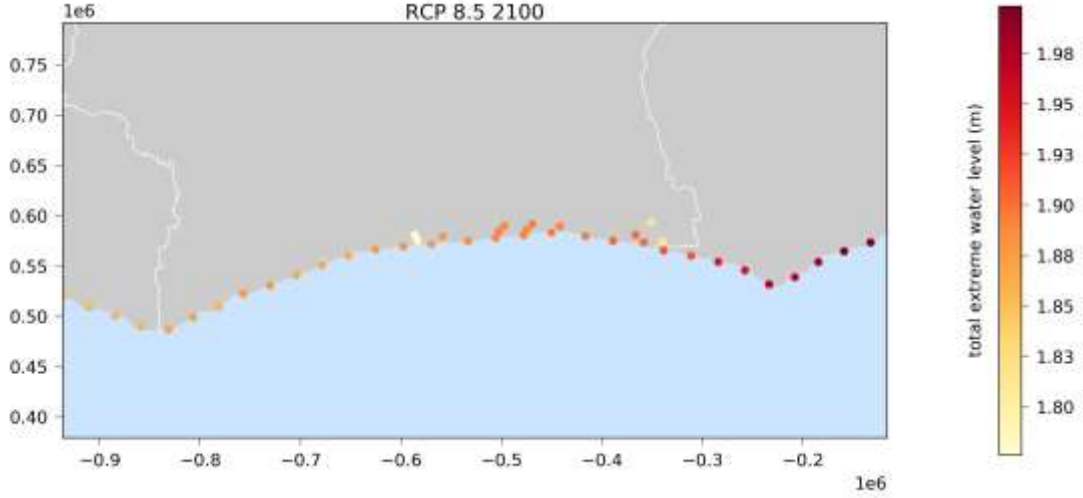
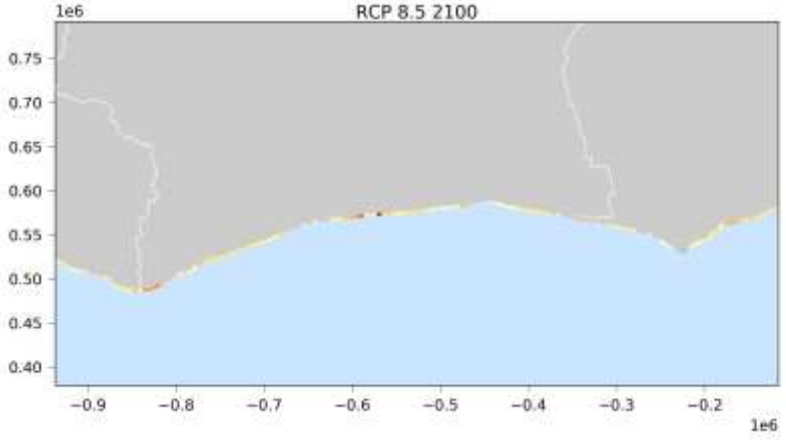
Simple Solutions to Complex Problems

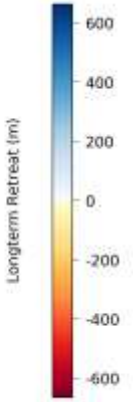
Under development: toolkit for coastal hazard assessment

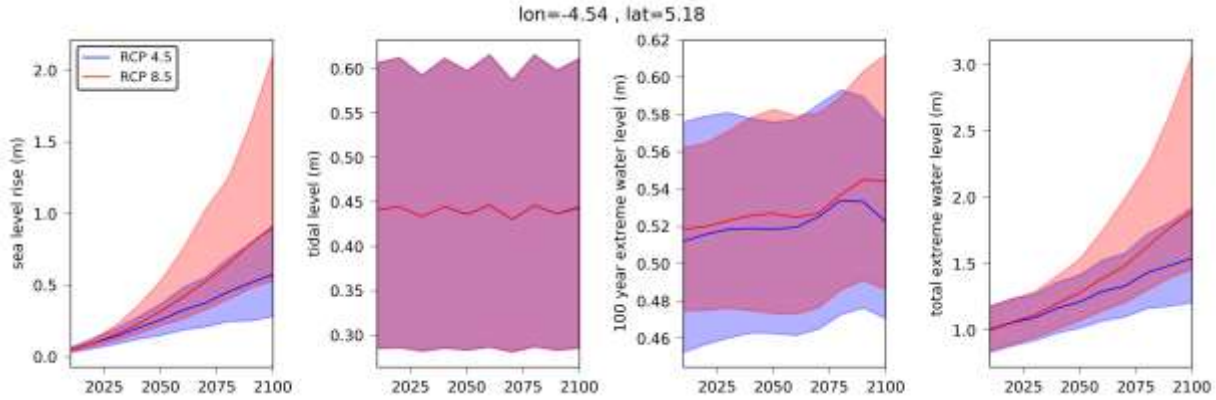












Simple Solutions to Complex Problems

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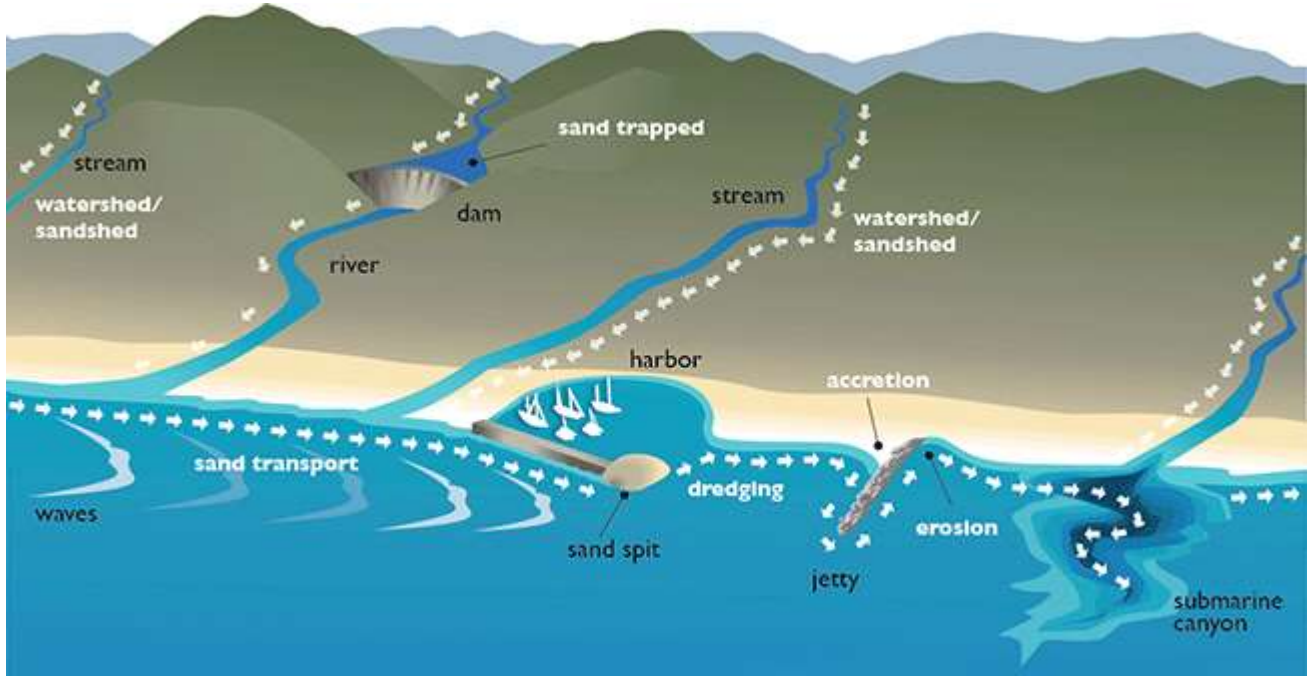
An assessment of the impact of anthropogenic interventions and climate change on the West African coastline



The Sand River: Actions taking place along the “sand river” are interrelated

- Client: World Bank
- Financer: Water Partnership Programme (WPP)

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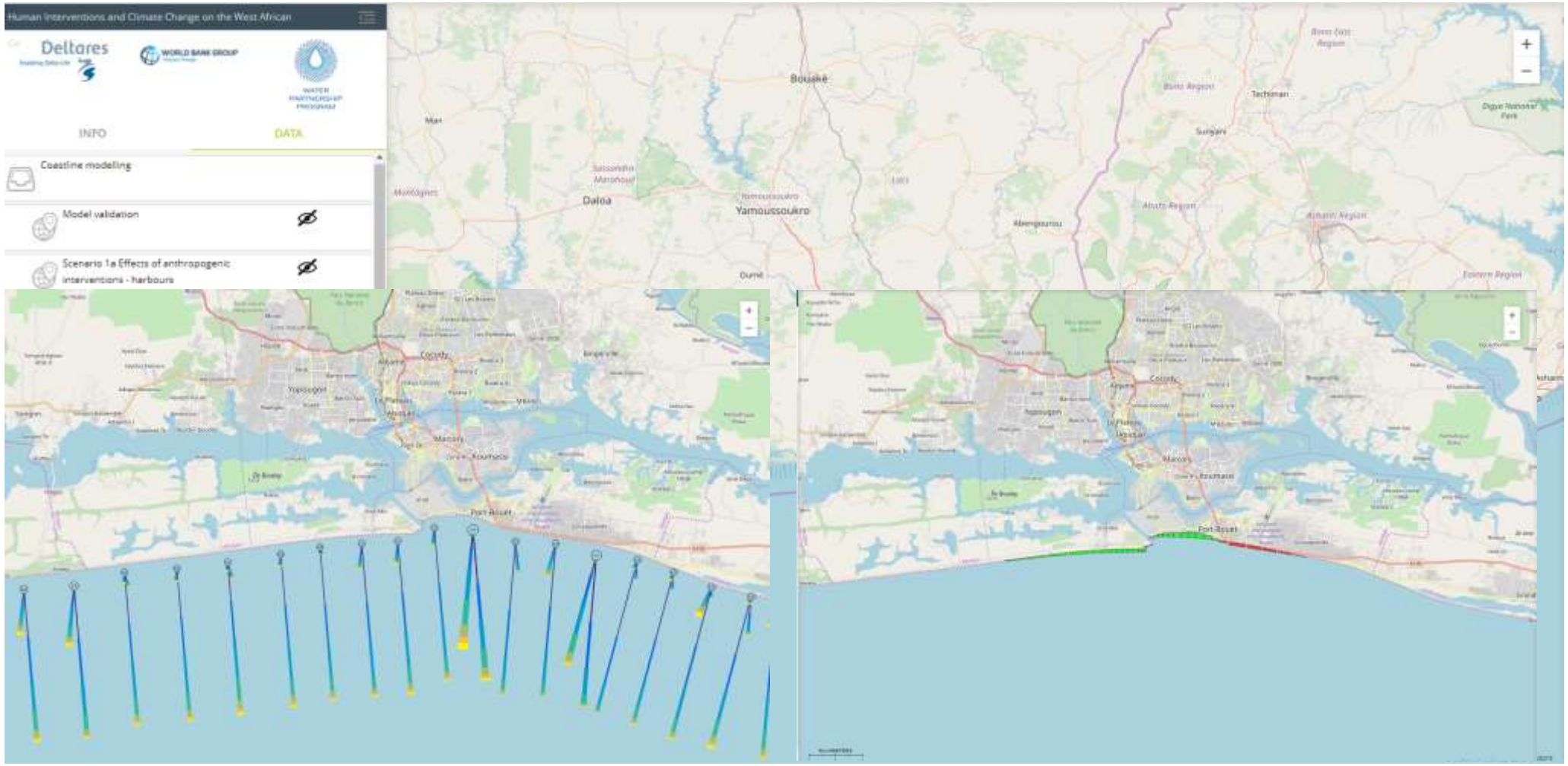
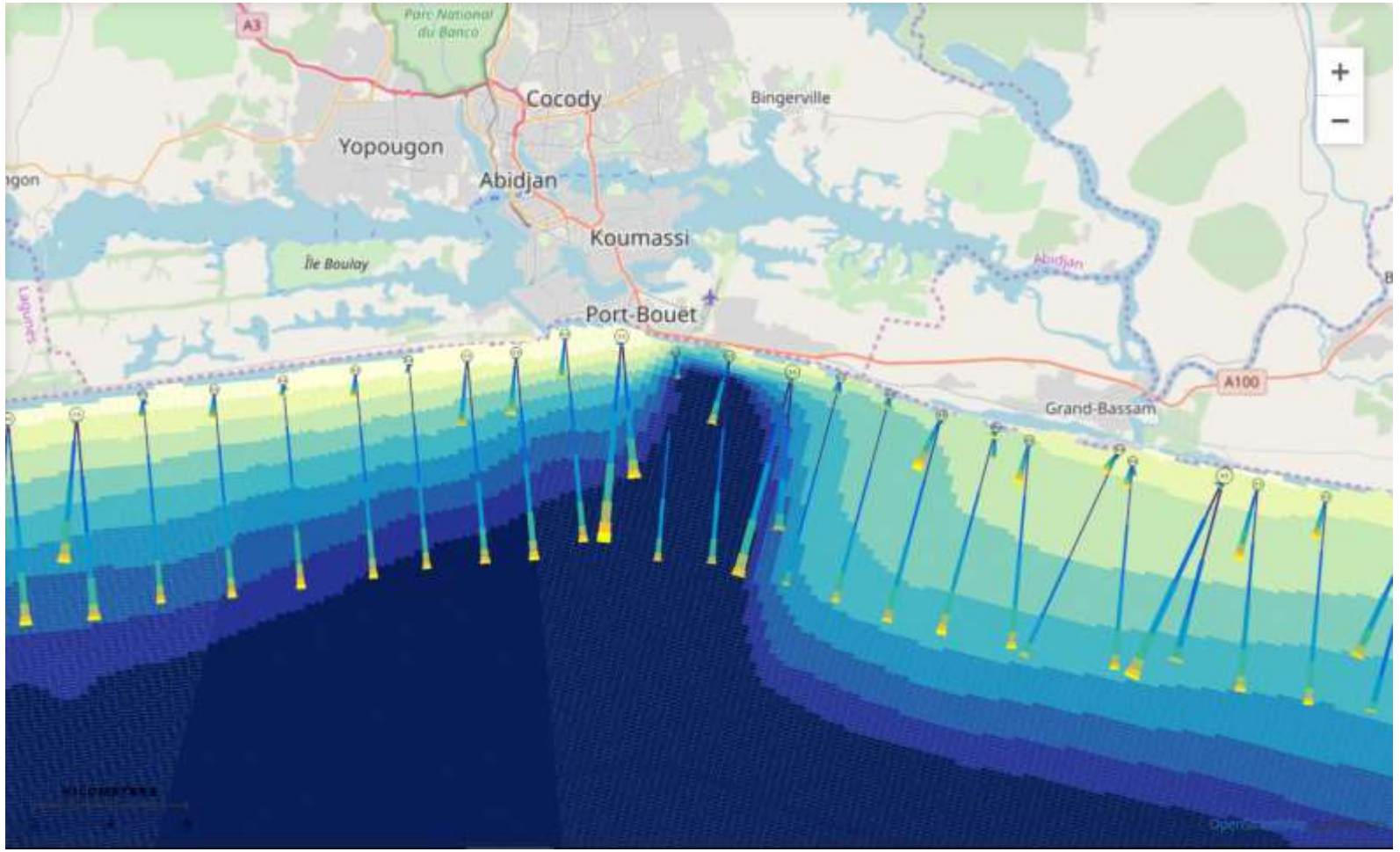
Viewer West Africa



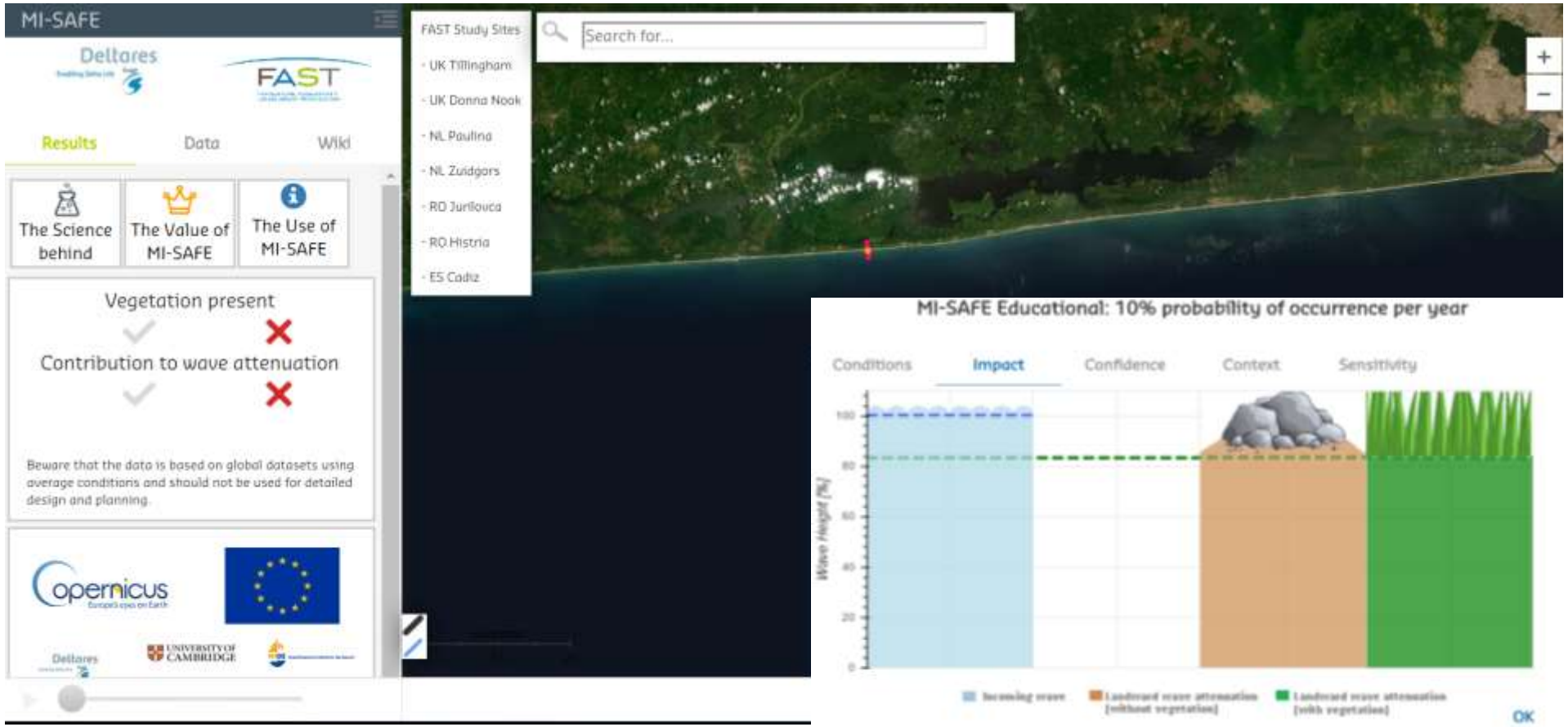
http://v-web004.deltares.nl/africa/africa/

Giardino et al., 2018. Journal of Ocean & Coastal Management



Free dataset nearshore waves:
http://opendap.deltares.nl/thredds/catalog/opendap/deltares/publications/Giardino_2017/catalog.html

Wave attenuation by foreshore vegetation



https://fast.openearth.eu/index.htm

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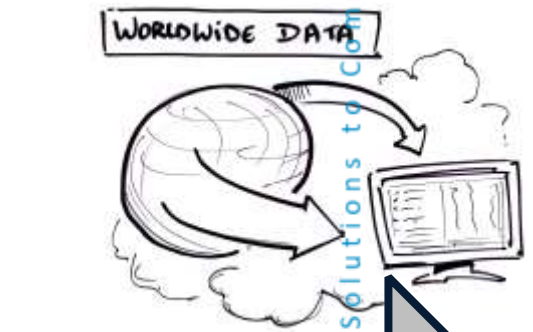
Simple Solutions to Complex Problems

CoDeS: An integrated and interactive toolbox for the design of coastal infrastructure

Generic data

- Settings
- Coastline
- Bathymetry
- Structures
- Waves
- Tide
- Sediment



Simple Solutions to Complex Problems

CoDeS Tools

- Coastline dynamics
- Breakwater design
- Wave penetration
- Channel sedimentation
- Harbour basin siltation
- eCoDeS
- Interactive flow fields

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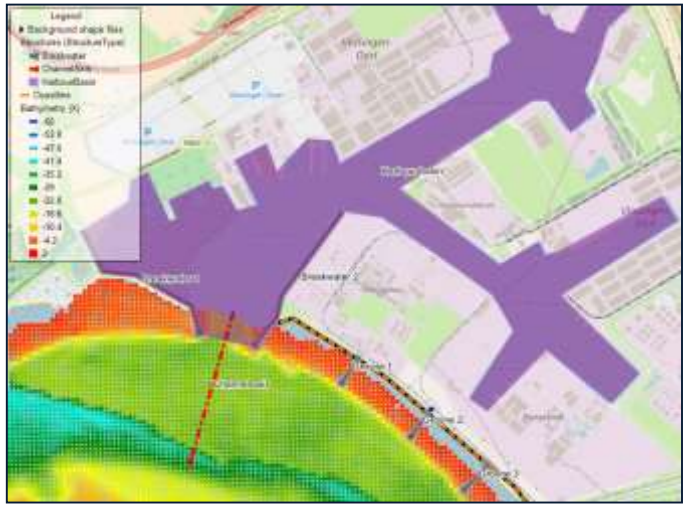
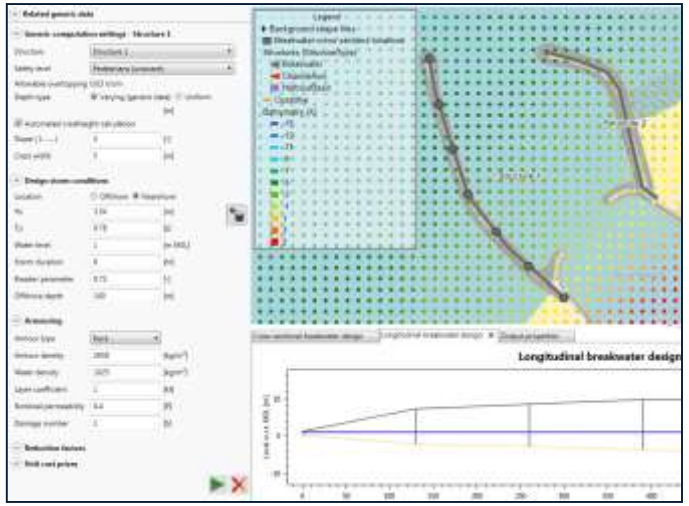
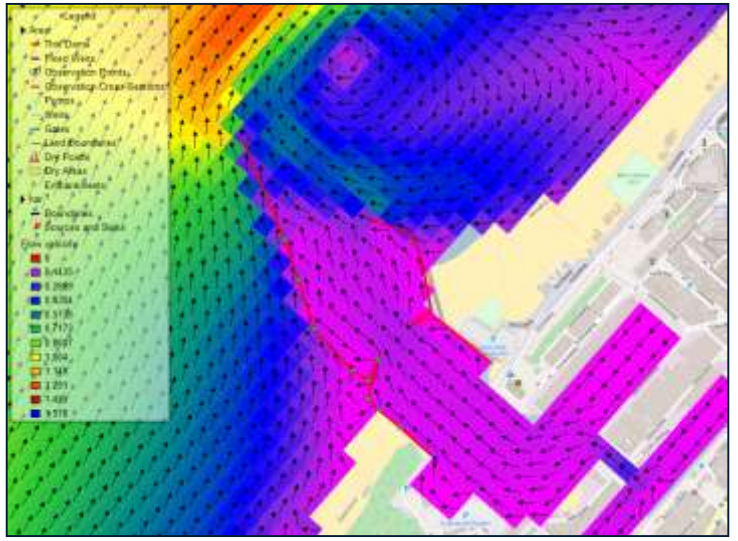
Some examples







The SimpleCoast toolkit

Do you notice any similarity in those pictures?

Aruba

Bangladesh

Sao Tome

Common challenges

Benin

Georgia

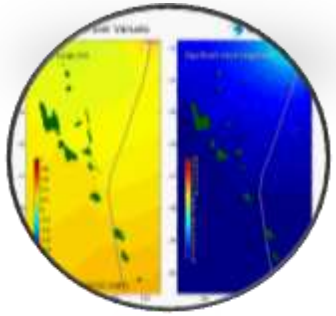
Simple Solutions to Complex Problems

Knowledge fragmentation

... when you are lucky

... when you are less lucky

What is SimpleCoast?

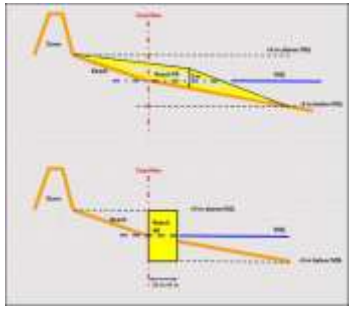


Knowledge fragmentation

Knowledge sharing platform for simple assessment of problems and solution:

- Website
- Knowledge notes
- Free tools and tutorials
- Trainings

Does NOT replace more complex models!!!



Simple Solutions to Complex Problems

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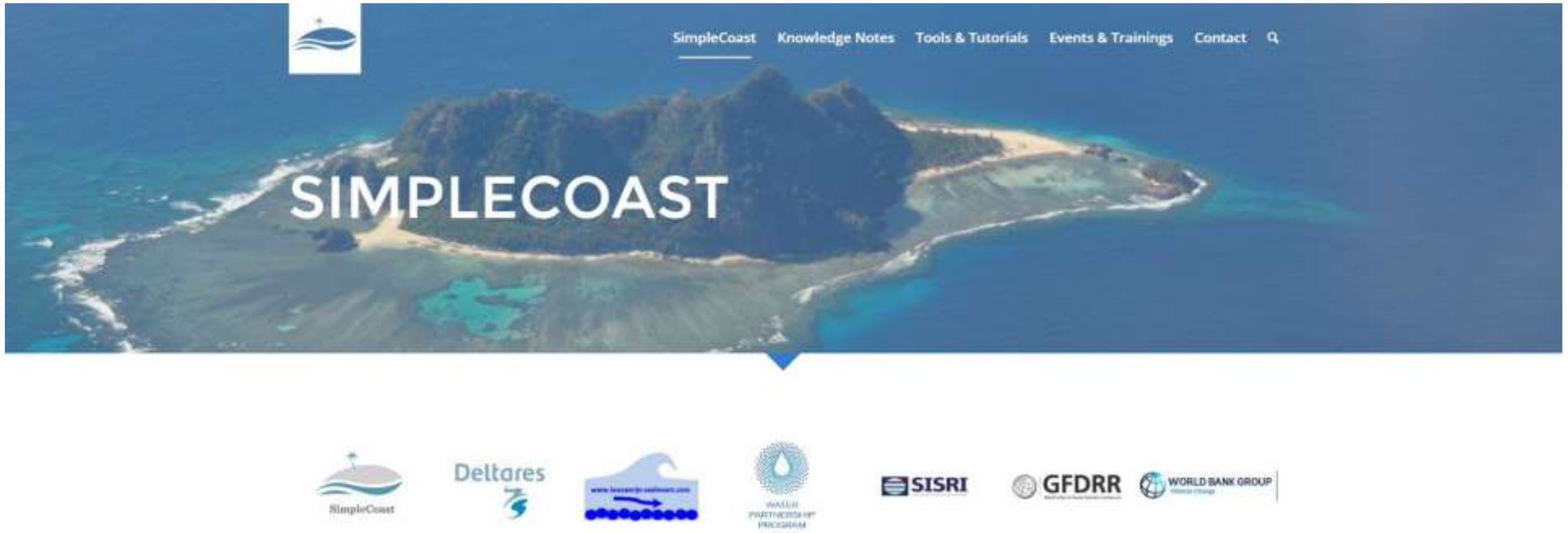
The website

http://www.simplecoast.com/



Giardino, A., 2017 Proceedings of the Medcoast 2017 Conference, Malta.

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Knowledge notes

Notes of about 15 – 20 pages on the following topics

- Adaptive Approaches to Coastal Zone Management
- Coastal Processes and Problems
- Data Collection and Monitoring
- Coastal Adaptation Solutions

“Simple and Practical”

Tools and Tutorials

- Tools + tutorials (one for each tool) including practical examples and applications

Tool name	Description
Pathway Generator	Tool to design and present adaptation pathways
Flooding.xls	Calculate flood levels for extreme conditions
Waveparameters.xls	Calculate typical wave characteristics
Sedimentparameters.xls	Calculate typical sediment characteristics
Beachnourishment.xls	Calculate the lifetime of a beach nourishment
Armour.xls	Calculate armour size for seadikes, revetments, breakwaters and toe protections
Littoral.xls	Calculate the longshore transport and dune erosion
Dunebeacherosion.xls	Calculate dune and beach erosion during storms
Riverflowandsandtransport.xls	Compute the flow discharge and sand transport in a river
Wavemodels.xls	Compute wave propagation using two simple wave models
Vegetation.xls	Compute the impact of vegetation on wave propagation using two simple wave models

SimpleCoast: practical application

Exercise

Assess the coastal erosion problem near Abidjan and possible adaptation options

Question 3: Using SimpleCoast (http://www.simplecoast.com/toolstutorials/), tool “Littoral” estimate yearly average alongshore sediment transport rate

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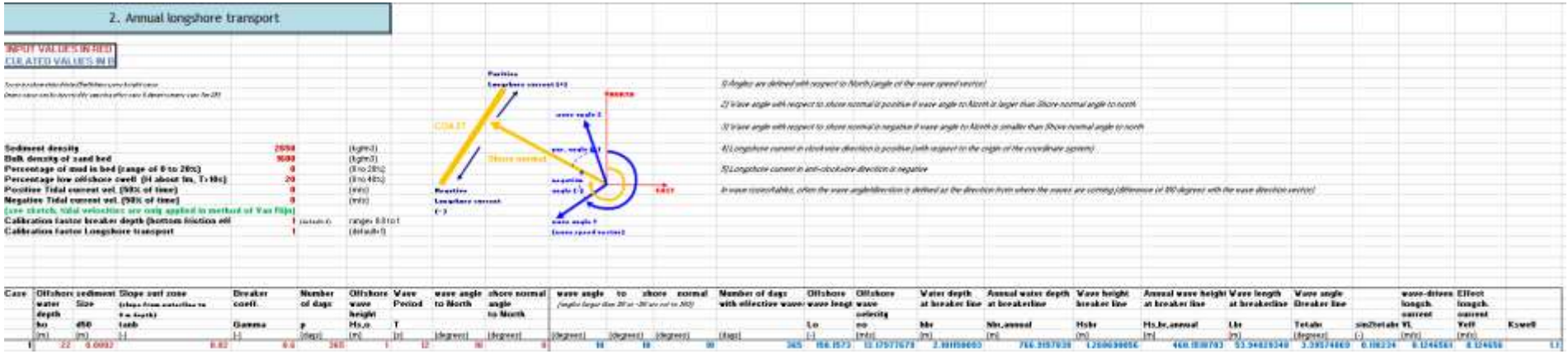
Physical setting

- Sediment size ≈ 0.2 mm
- Offshore wave height ≈ 1 m
- Tidal range spring tide ≈ 0.8 m
- Shore normal angle to North = 0°
- Wave angle to North = 10°

Alongshore sediment transport ≈ 300 – 600,000 m^3/year (depending on the formula used)



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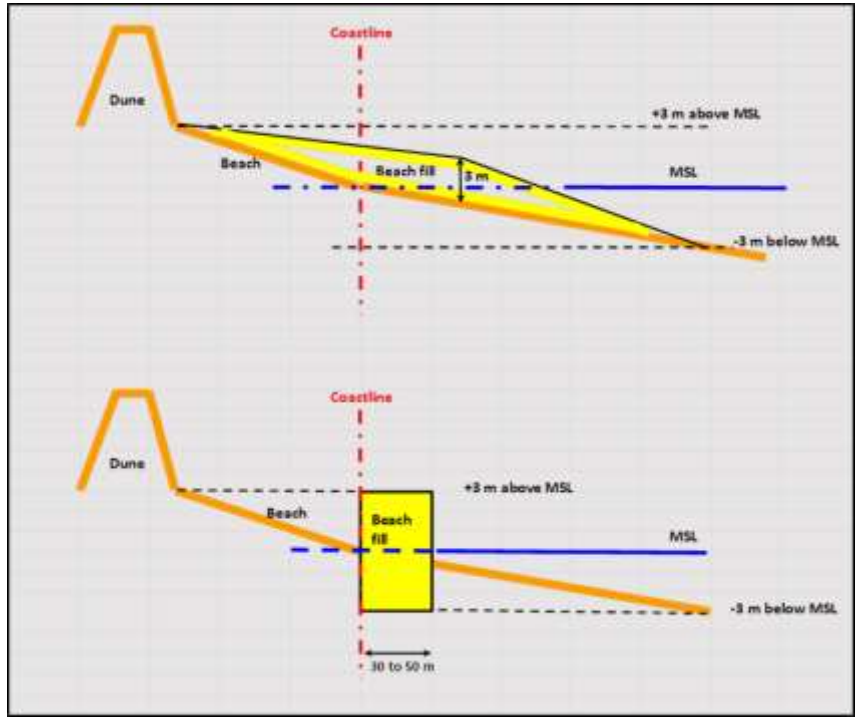
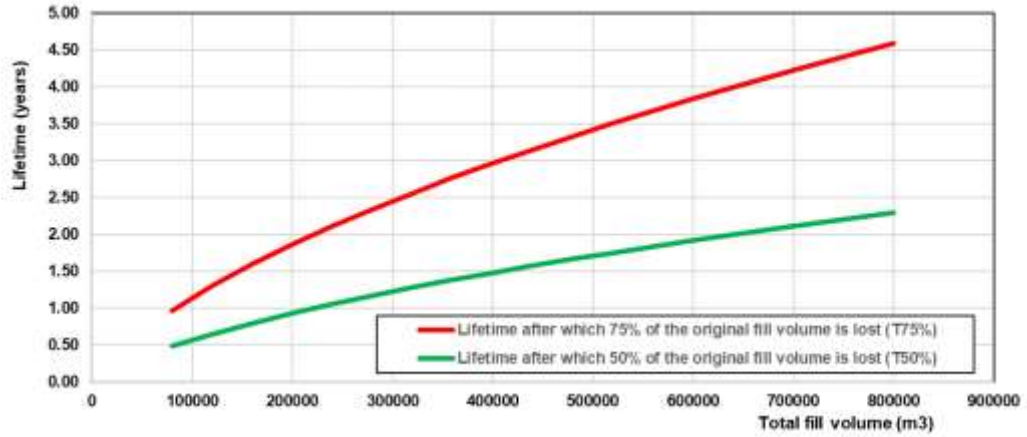
Question 4: Using SimpleCoast (http://www.simplecoast.com/toolstutorials/), tool “beachnourishment” estimate lifetime of a beach nourishment to protect the observed erosion

Physical setting

- Sediment size for the beach fill ≈ 0.25 mm
- Net alongshore sediment transport ≈ 500,000 m^3/year
- Total length nourishment = 2 km





Lifetime is about 5 years

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Discussions

- Feedback and needs on knowledge/tools to be developed
- Hands-on trainings

THANK YOU

Alessio.Giardino@deltares.nl