

living planet symposium | BONN 23-27 May 2022

TAKING THE PULSE OF OUR PLANET FROM SPACE



The Submerged Parts of the Coastal Picture

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esa Coastal Erosion Project

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05/24/2022



Indicators for describing the « submerged »



- **Foreshore morphology** is influencing the dynamics of the coastlines
- Submerged indicators for assessing the overall **sedimentary budget**
- Assess the impact and effectiveness of **coastal protection measures** such as beach nourishment or sandbags barrier.
- Valuable information for submerged **ecosystem changes**

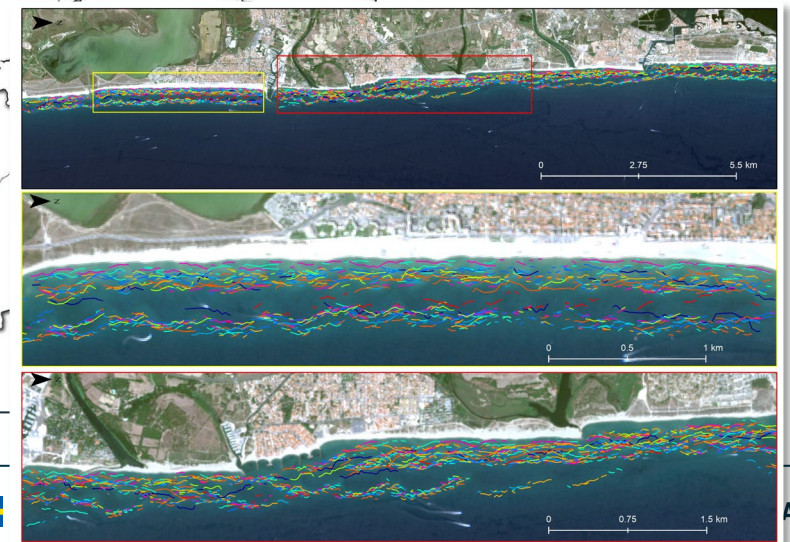
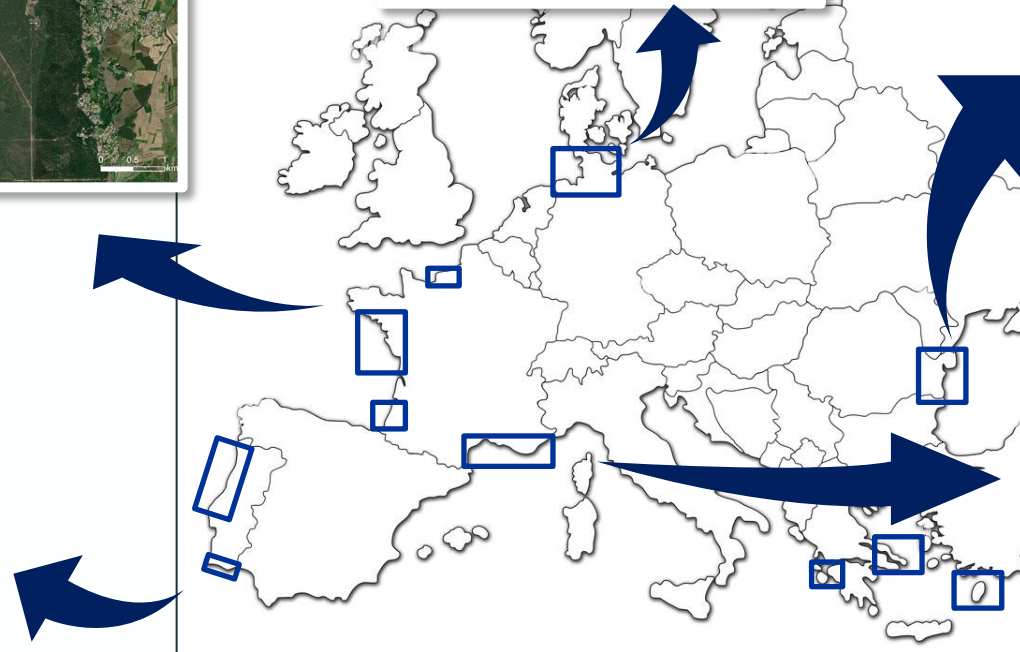
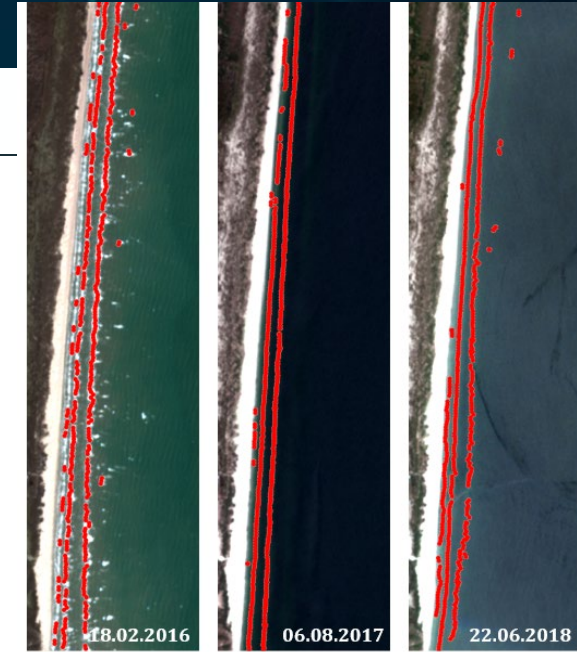
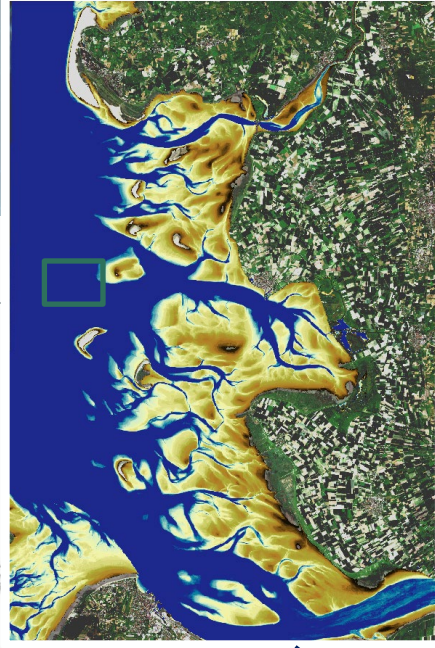
- Key indicators for the submerged systems have been developed

Vertical erosion of the foreshore
Strong dynamics of the nearshore sandbars
intertidal flat dynamics



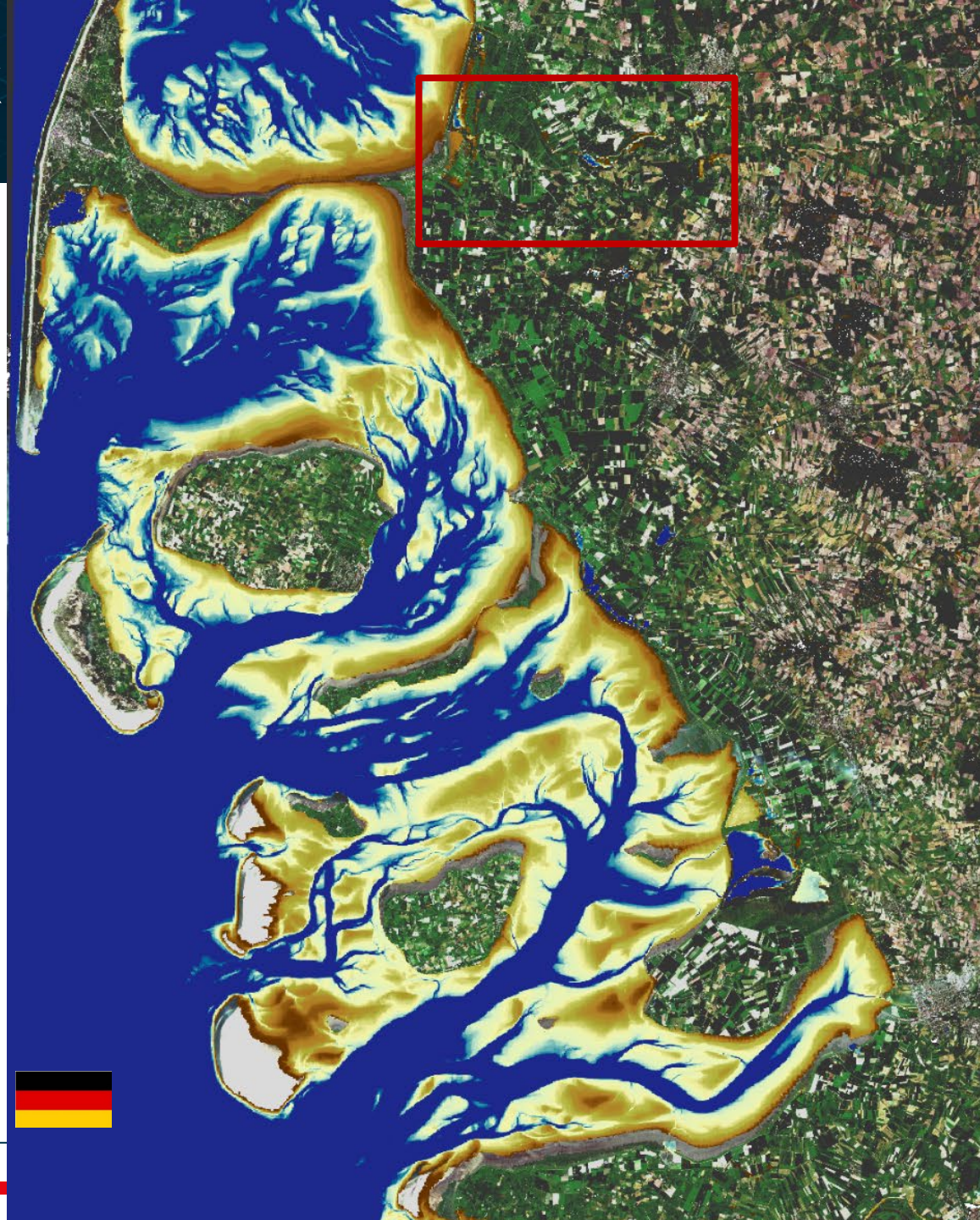
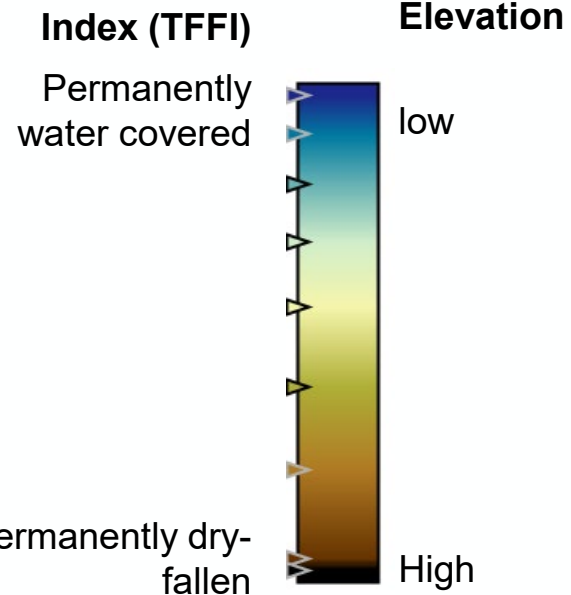
Precursors for coastal erosion
Information on sediment depletion
Detection of human impact
Adaptation of the system to climate change

Areas of interest



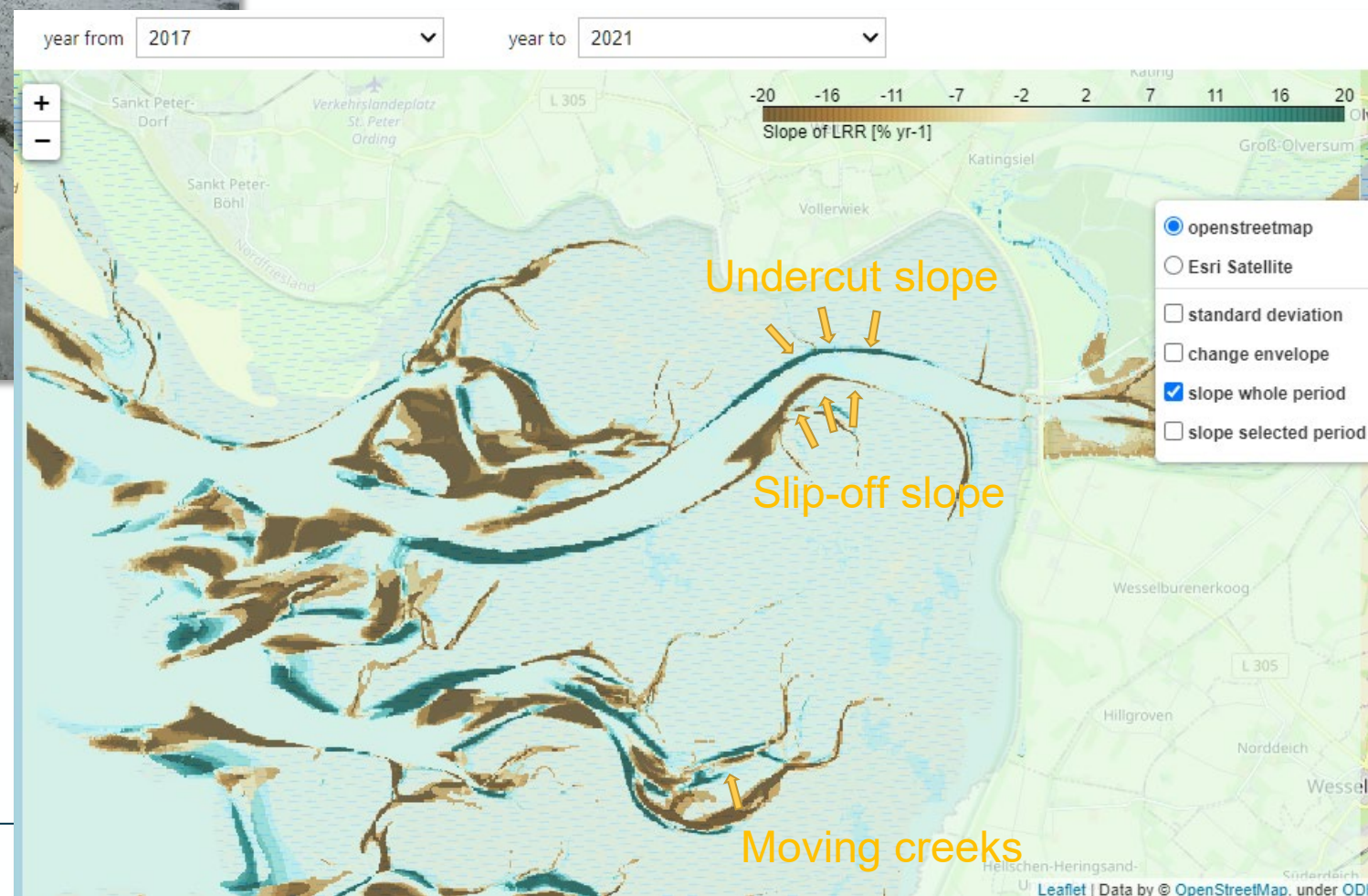
Intertidal widths and flooding index


- Automated selection of cloudfree images of all water levels for user defined regions
- Distribution of dry-fallen water covered areas by spectral indices and thresholding
- Relation between dry-fallen and water covered cases
- Manual quality check during the process possible





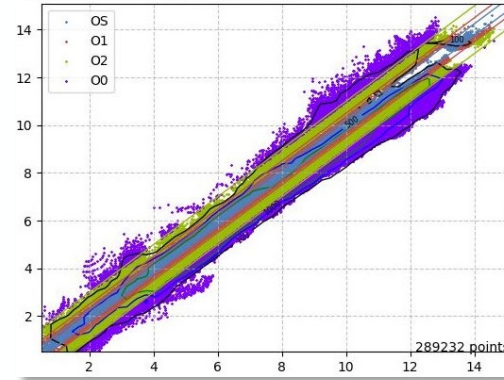
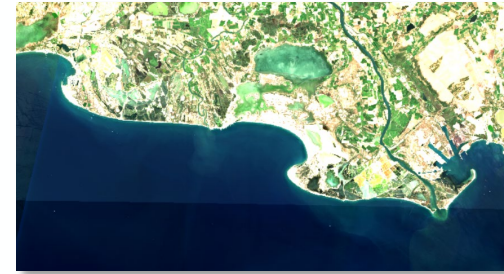
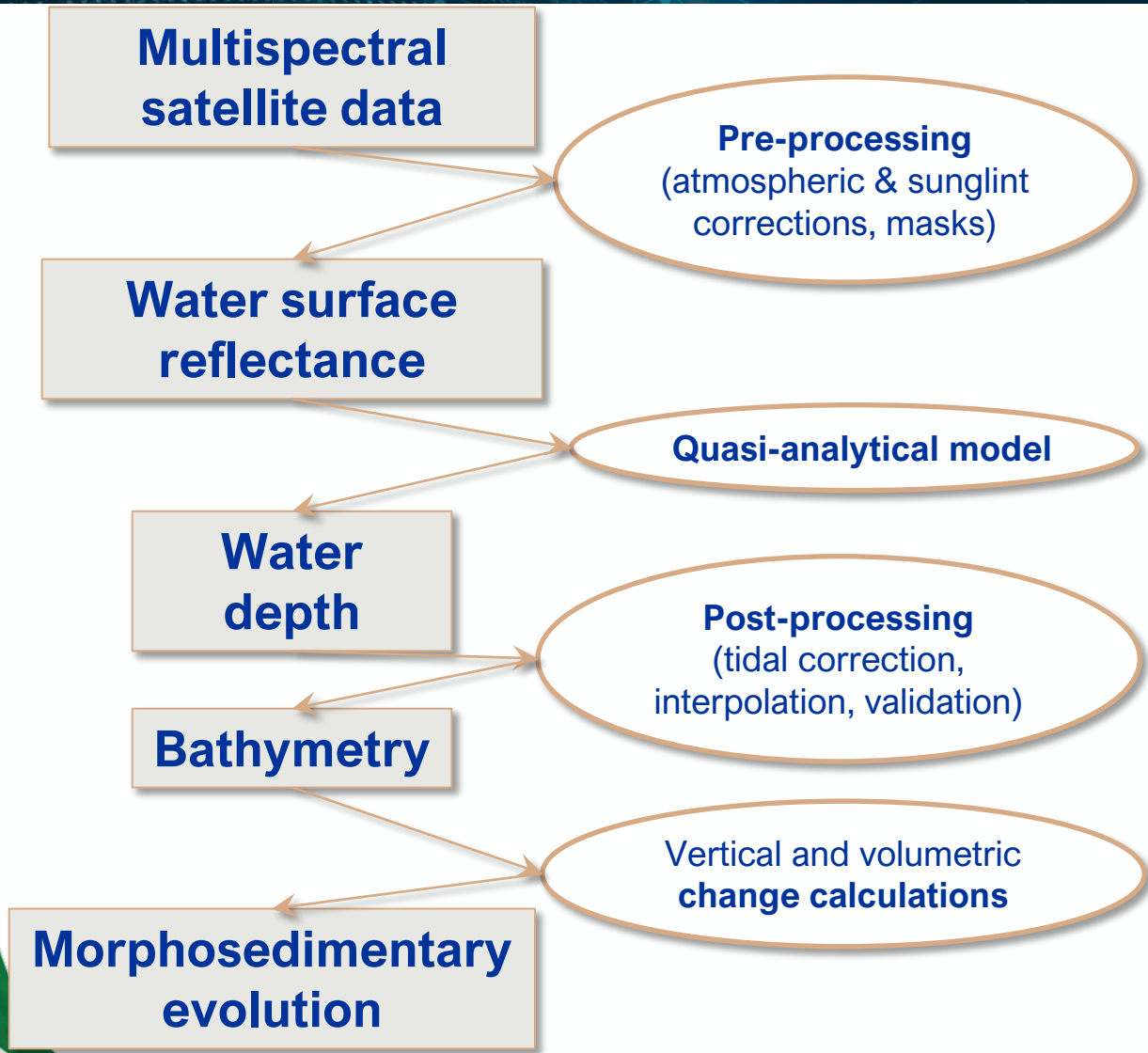
Intertidal Creeks – a moving environment



- Low tide acquisitions 
- Development over time: index of water covered to dry—fallen cases or vice versa
- Identification of stable and changing areas

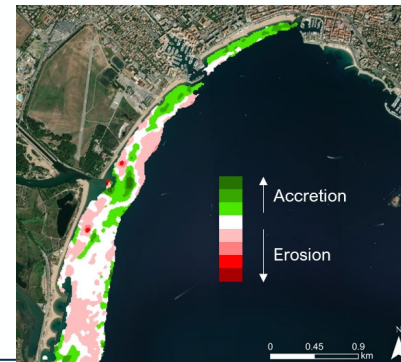


Bathymetry - derived from optical satellite imagery



Lee et al., 1998
Capo et al., 2014

TOSCA MORITO 



Highest vertical accuracy reached:

- 0.51 m (Landsat)
- 0.46 m (Pléiades)
- 0.43 m (Sentinel-2)

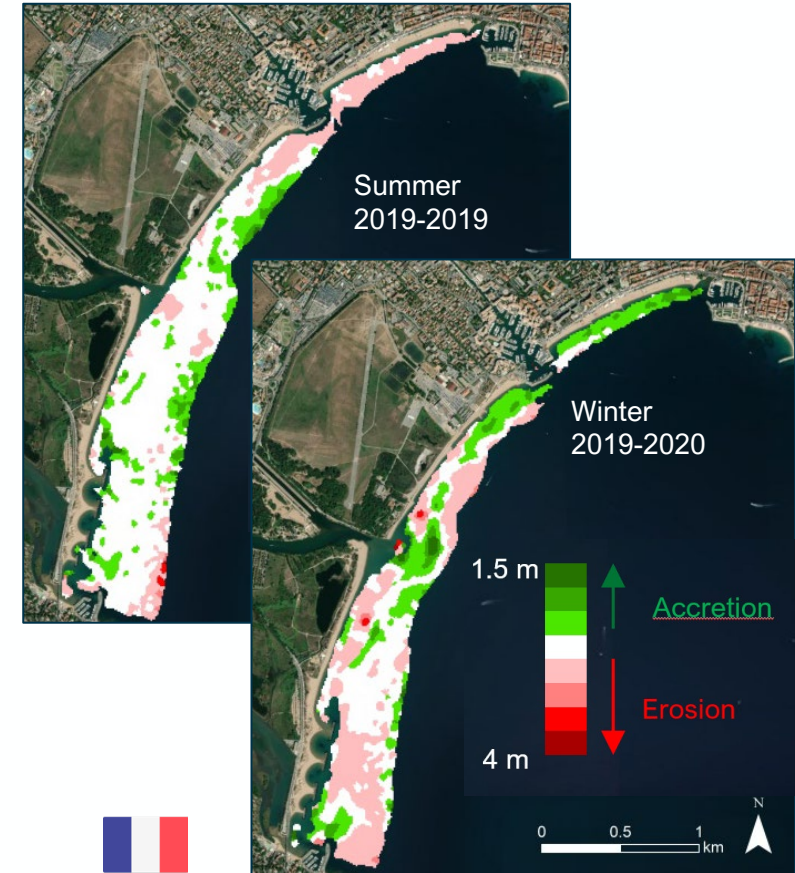


Bathymetry - derived products



 Meso-tidal context

 Deltaic deposits



Seasonal sedimentary fluctuations

Submerged Sandbars – extraction from optical data

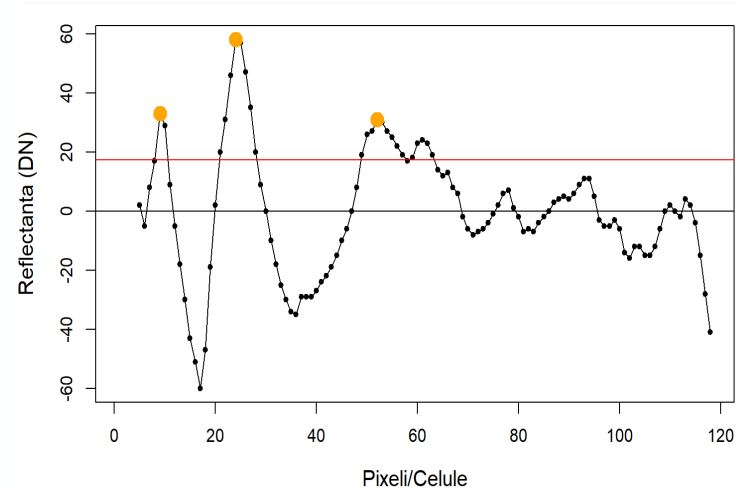
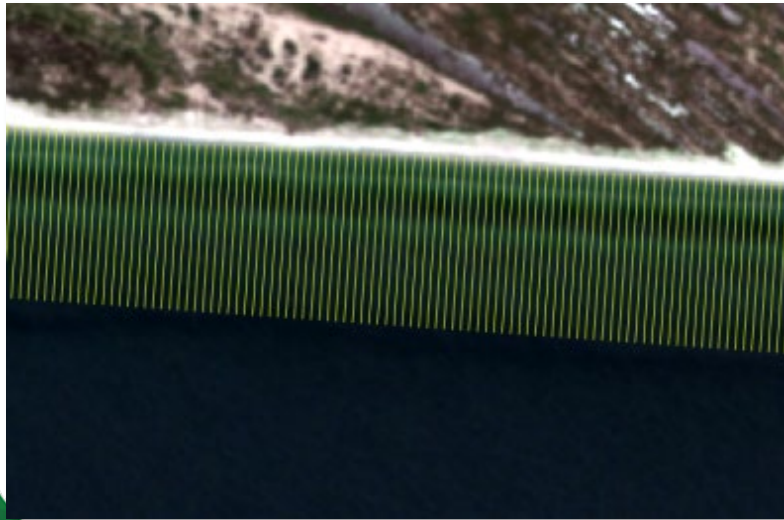


Approach based on

- the spectral response of sandbars locations
- multispectral satellite data.

Each submerged sandbar position extracted using perpendicular profiles along the shoreline.

- For each profile, **reflectance values** are extracted, thus taking advantage of all information in the visible part of the electromagnetic spectrum.

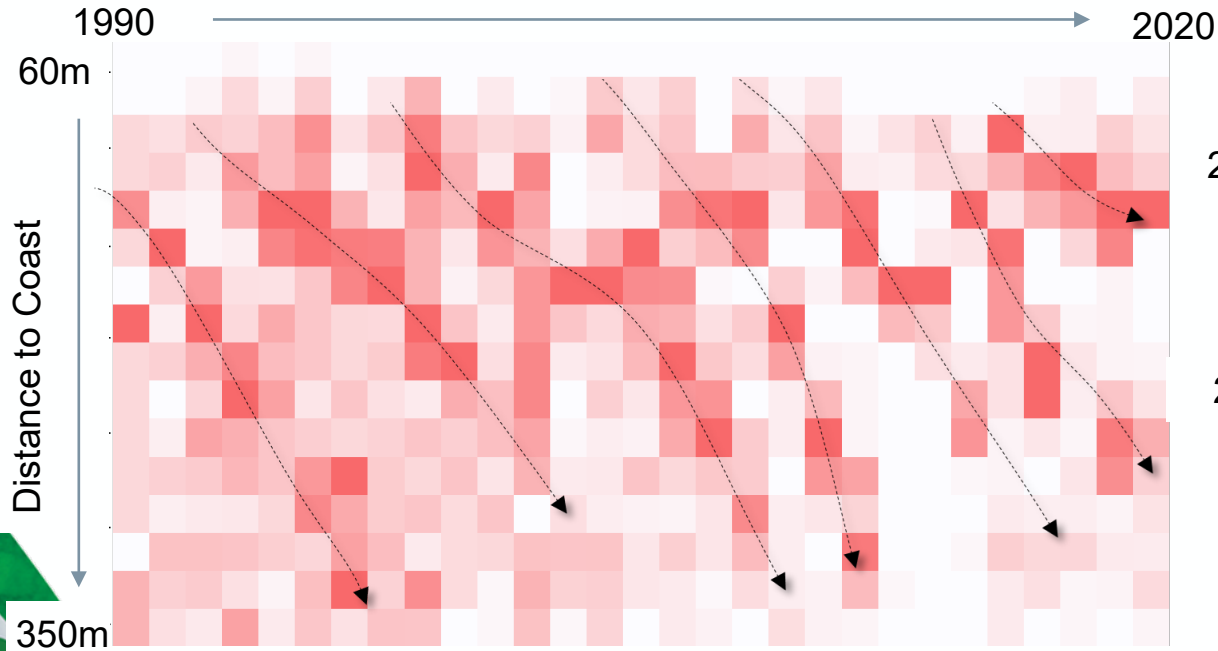


Highest planar accuracy reached:

- 9.37 m (Landsat)
- 3.87 m (Pléiades)
- 3.35 m (SPOT 7)
- 3.82 m (Sentinel-2)

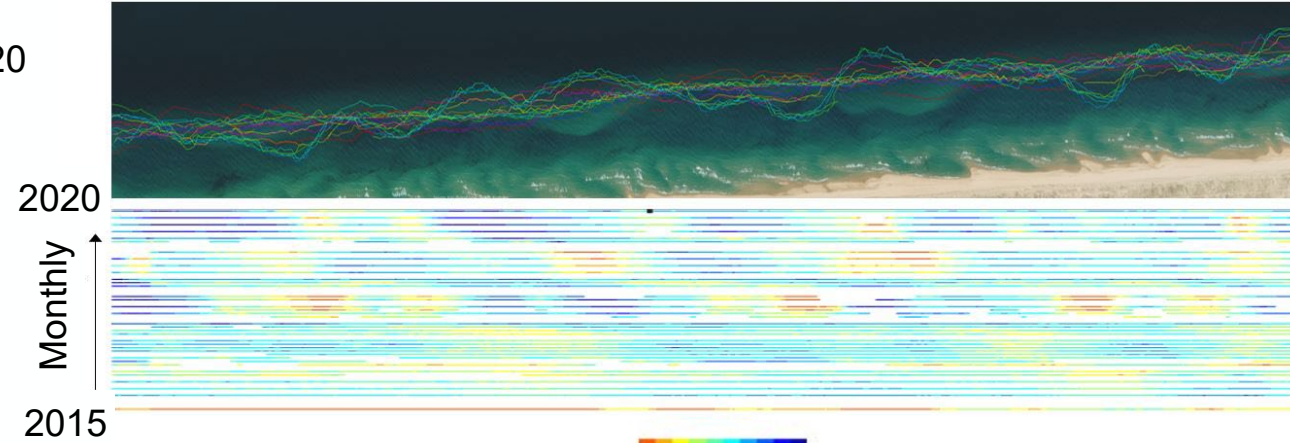
High diversity of sandbar morphologies and dynamics

Sandbar migration cycles

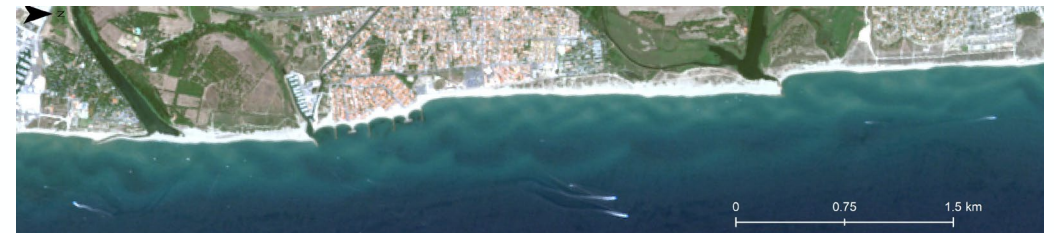


Occurrence of sandbars signal along a sample of 11 profiles (1 km alongshore, 20 m crossshore interval) every study year

Sandbar morphological transformation cycles

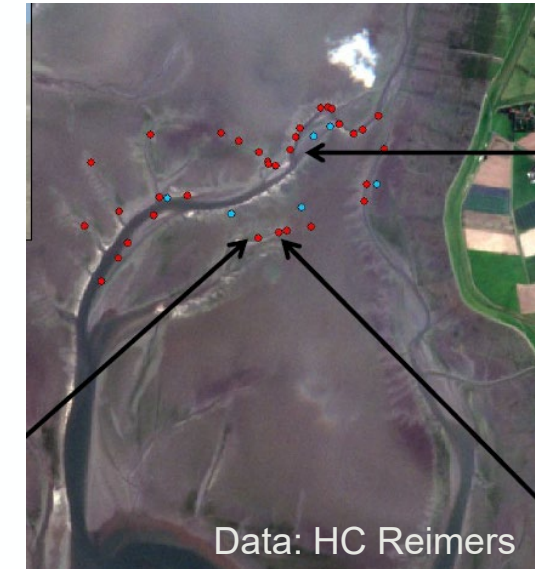


Closest Farthest
Sandbar position from coast



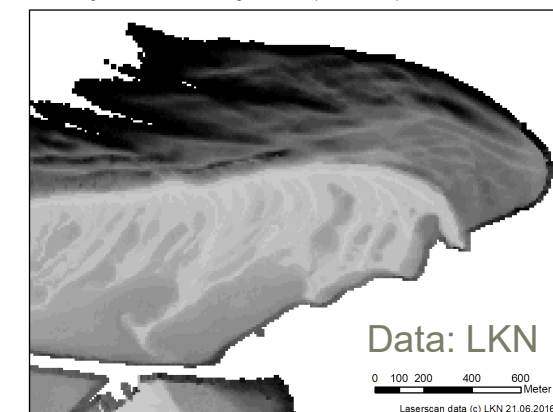
Highly complex sandbar networks

- Available data sets
 - Field measurements (intertidal - FEW!)
 - Airborne orthophotos
 - Airborne Laserscan data
- Validation in the foreshore is challenging due to difficult data collection.
- Intertidal areas can only be visited during low tide
- measurements depend on water level (e.g. position of creeks)
- Fast changing environment



Field measurements

Submerged Sandbars Heiligenhafen (Baltic Sea)



Laserscan data



- The submerged part and intertidal areas have been addressed with several indicators
- Users have now data and tools on hand that provide information they did not see before

“It is incredible what is possible meanwhile“

“Those are tools we were awaiting for a long time“

Turning indicators into qualitative and holistic information:

- Sediment budget

- Vulnerability Indicator