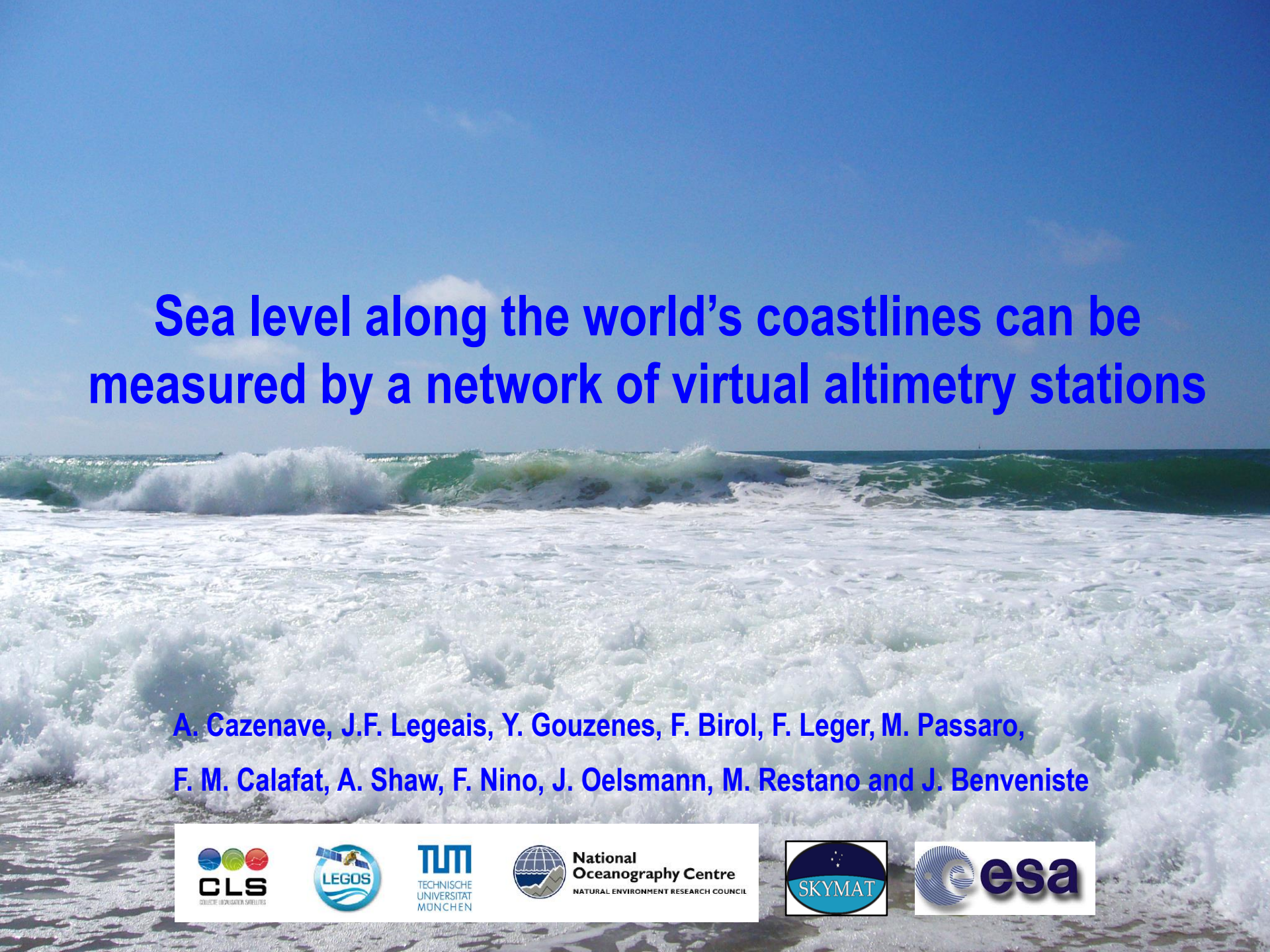
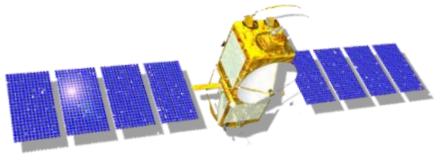
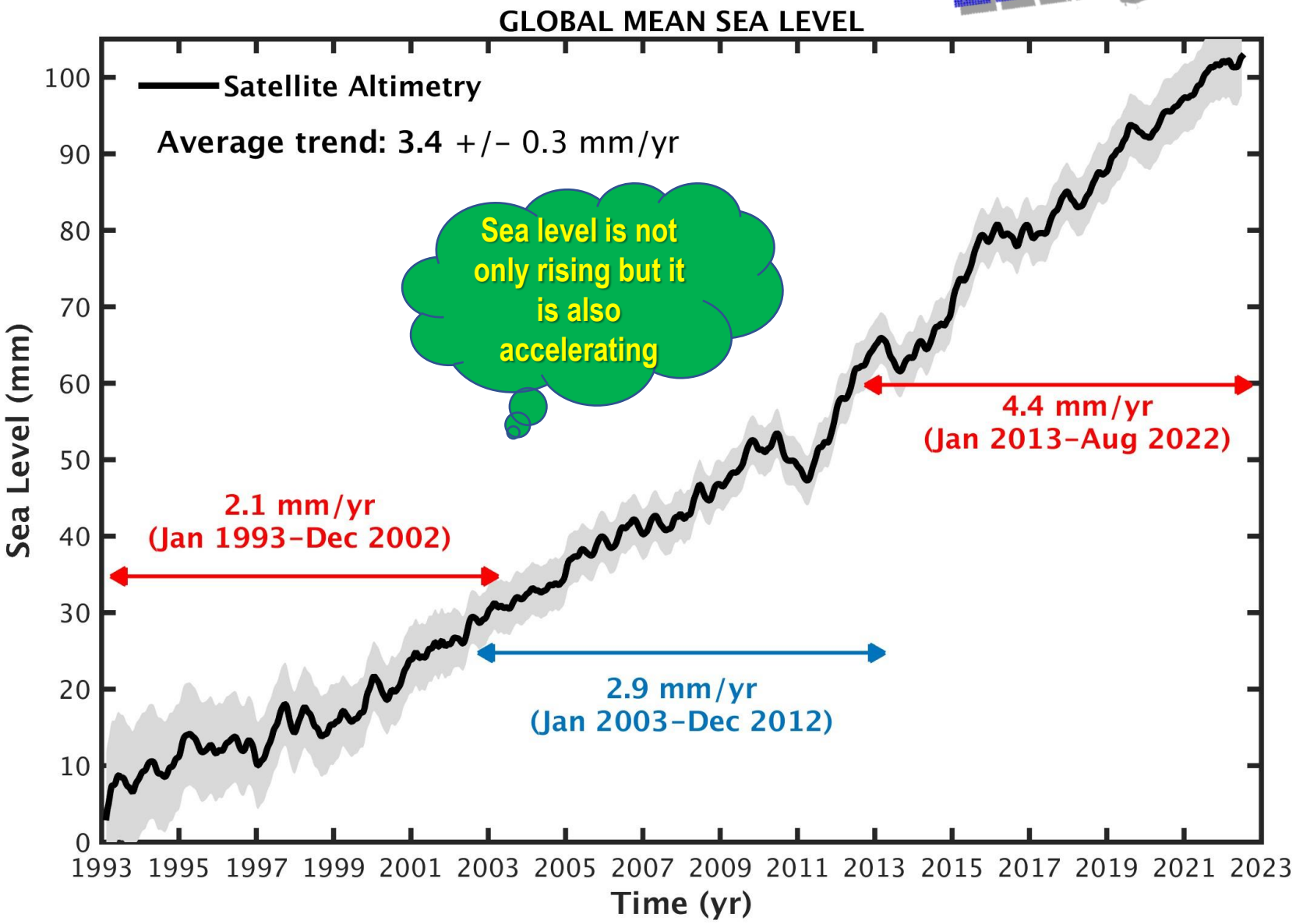


Sea level along the world's coastlines can be measured by a network of virtual altimetry stations

A. Cazenave, J.F. Legeais, Y. Gouzenes, F. Birol, F. Leger, M. Passaro,

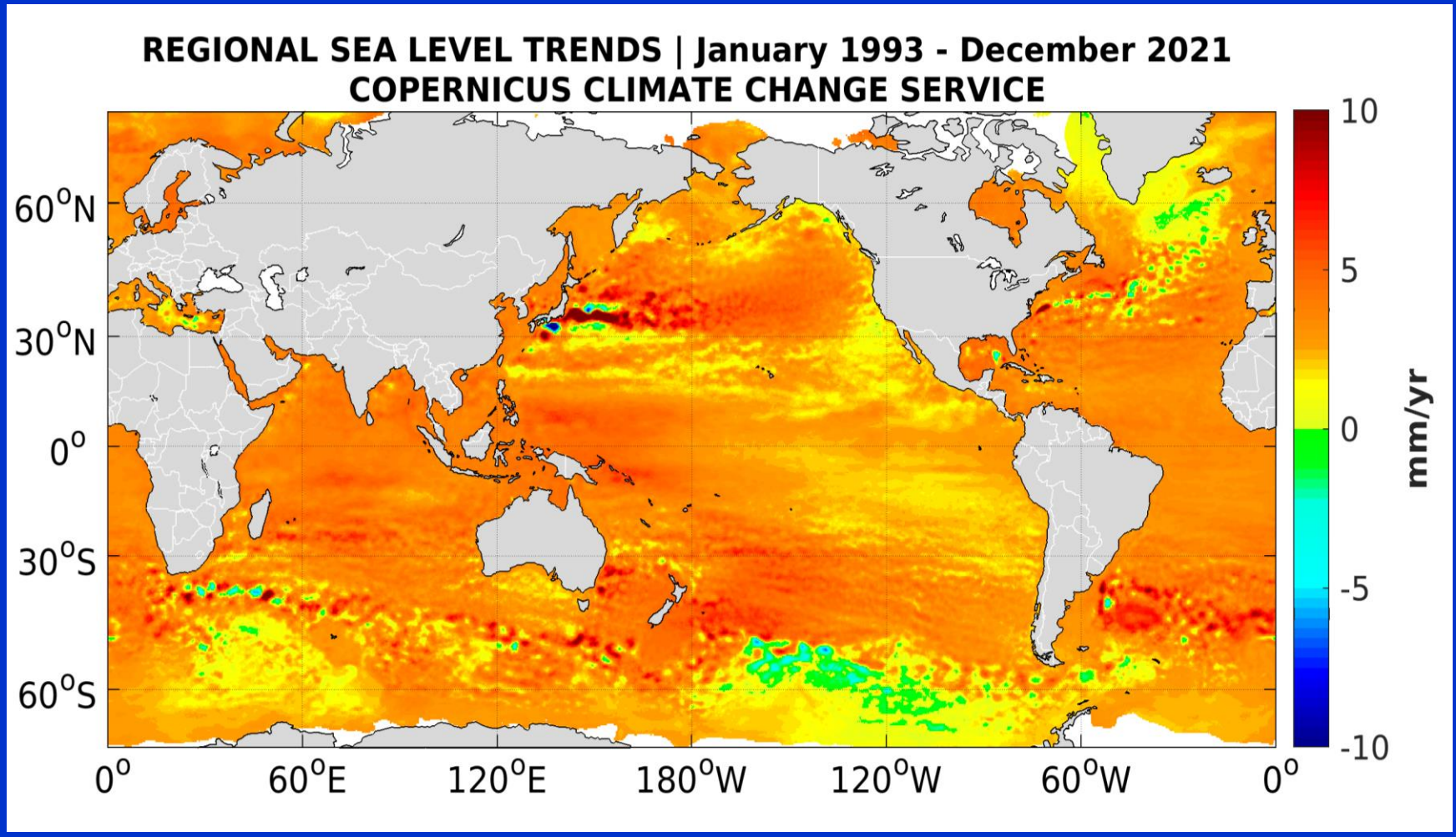
F. M. Calafat, A. Shaw, F. Nino, J. Oelsmann, M. Restano and J. Benveniste



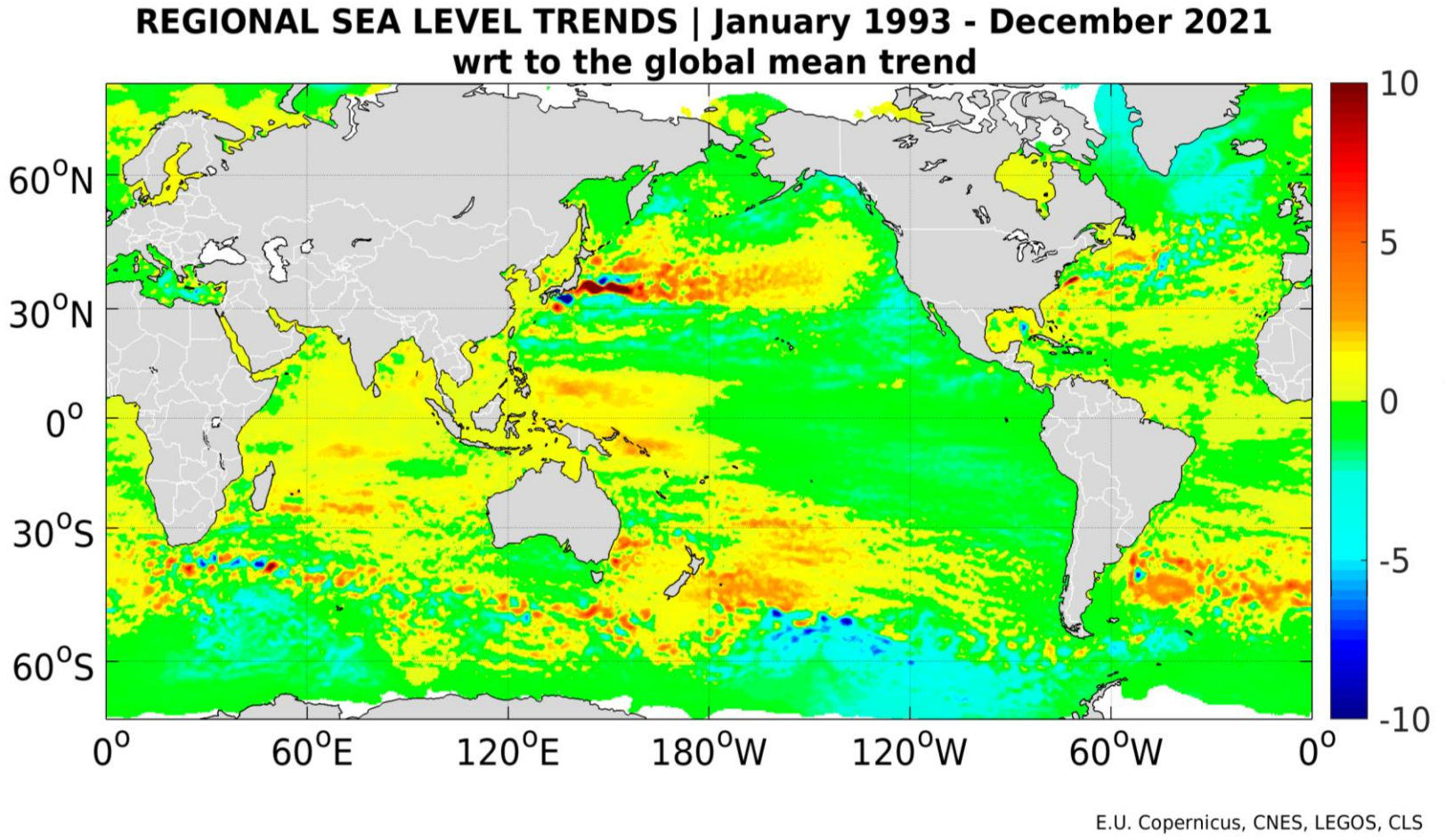


Source LEGOS

Regional sea level trends (1993-2021) (mm/yr)



Regional sea level trends (1993-2021) (mm/yr)
Global mean trend (3.4 mm/yr) removed



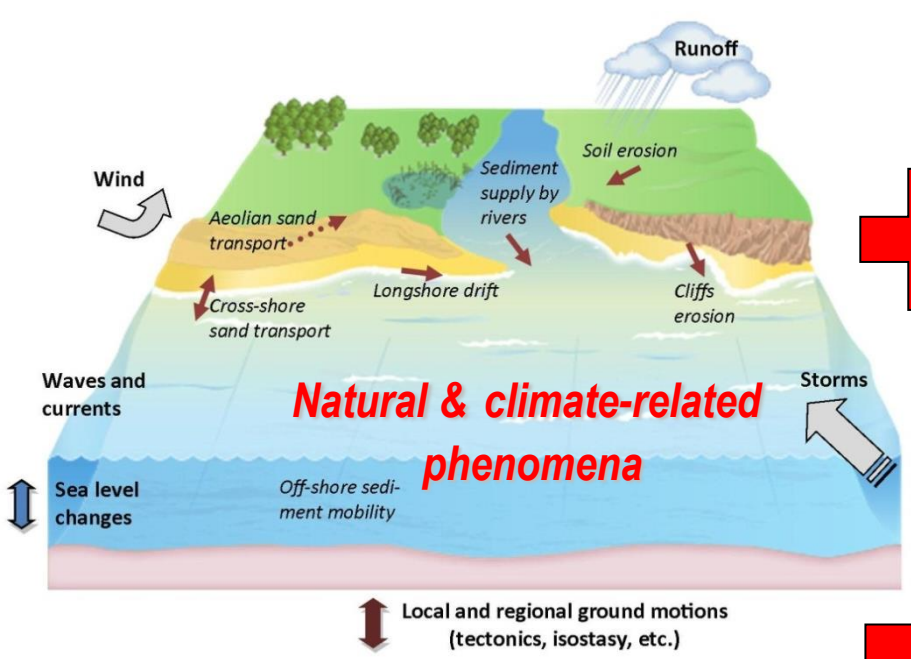
Question:

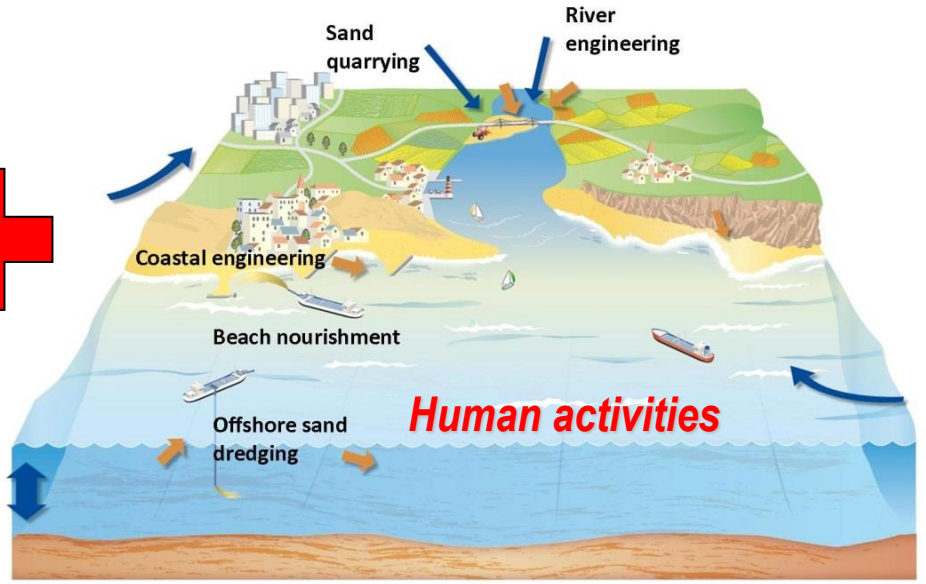
« Does sea level at the coast rise at the same rate as in the open ocean?»

Coastal sea level rise = global mean rise + regional variability + small-scale coastal processes

Ex. of small-scale coastal processes: shelf currents, small-scale eddies, trends in waves, fresh water input from river runoff in deltas and estuaries....

World Coastal Zones





Complex processes and impacts

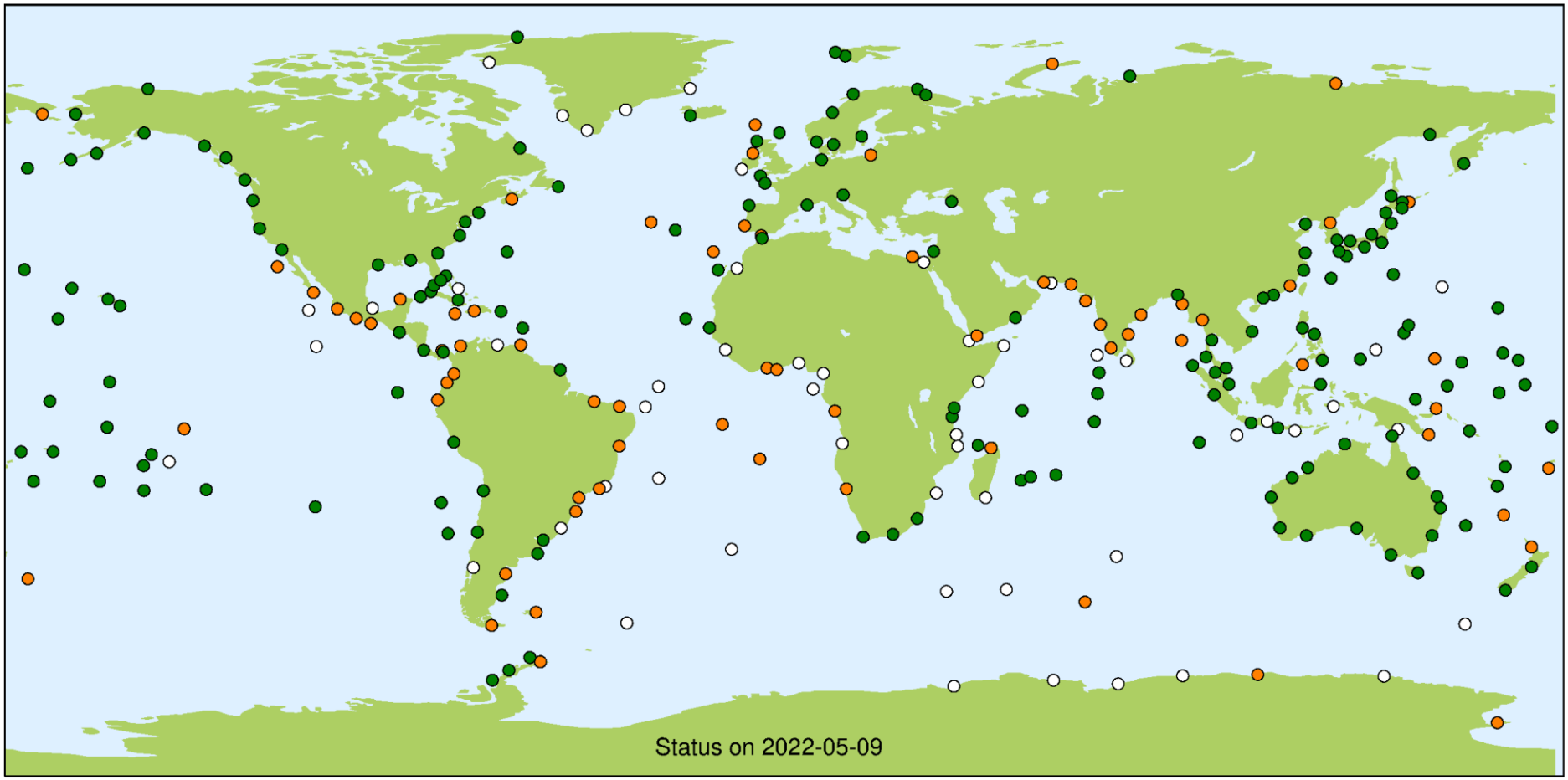
Climate & Other Drivers

- Sea level rise
- Hurricanes, Storm surges
- Extreme waves and winds
- Changes in sea state, coastal currents & eddies, nutrient supply
- River floods
- Ground subsidence
- Coastal engineering
- etc……

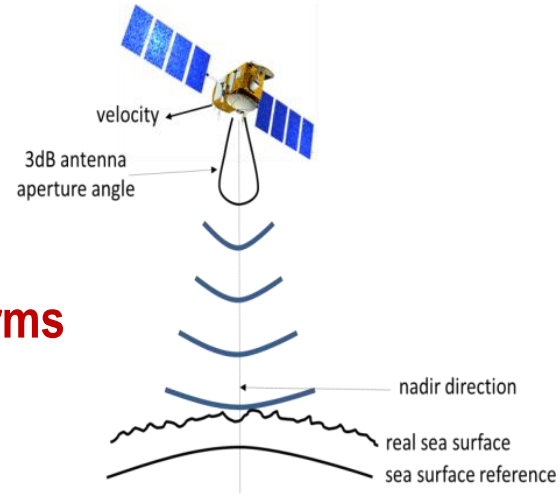
Coastal Impacts

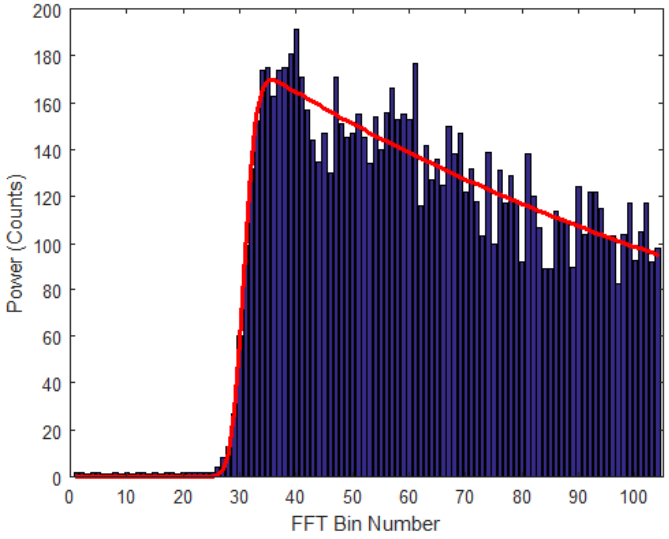
- Shoreline erosion and retreat
- Temporary and permanent flooding
- Changes in sediment stores and seafloor topography
- Changes in estuaries morphology
- Changes in coastal ecosystems
- Salinization of coastal aquifers
- etc……..

Current Tide Gauge Network GLOSS/PSMSL (May 2022)

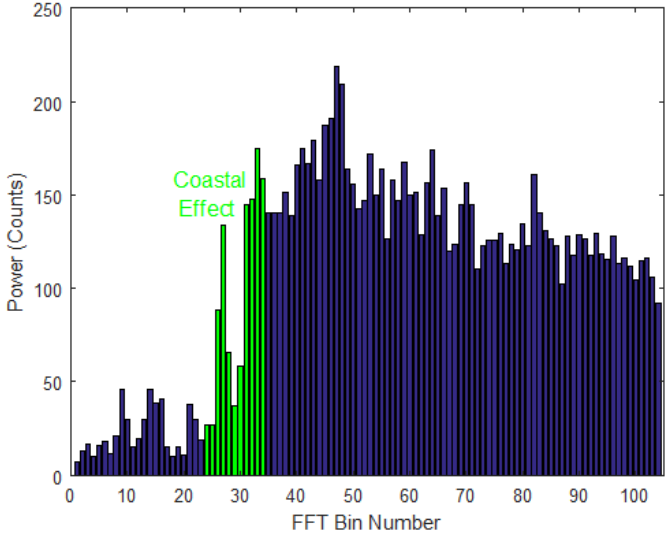


Radar altimetry waveforms





Typical open ocean radar waveform (Brown model)



Example of radar waveform in the coastal zone

sea level cci

ESA Climate Change Initiative Coastal Sea Level Project

Objective:
Reprocessing of altimetry data of the Jason-1, 2, 3 missions in the world coastal zones over 2002-2020

CLS LEGOS TECHNISCHE UNIVERSITÄT MÜNCHEN National Oceanography Centre NATURAL ENVIRONMENT RESEARCH COUNCIL SKYMAT

Partners

Objective:

- Reprocessing of along-track data from the Jason altimetry missions (retracking of radar waveforms + improvement of the geophysical corrections)

Method:

- Use of ALES (Adaptative Leading Edge Subwaveform) retracking
  - developed by Passaro et al. 2014
  - + associated Sea State Bias (SSB) (Passaro et al., 2018)

- Use of X-TRACK processing system developed at LEGOS (Birol et al., 2021)

- Missions reprocessed: Jason 1, Jason 2, Jason 3

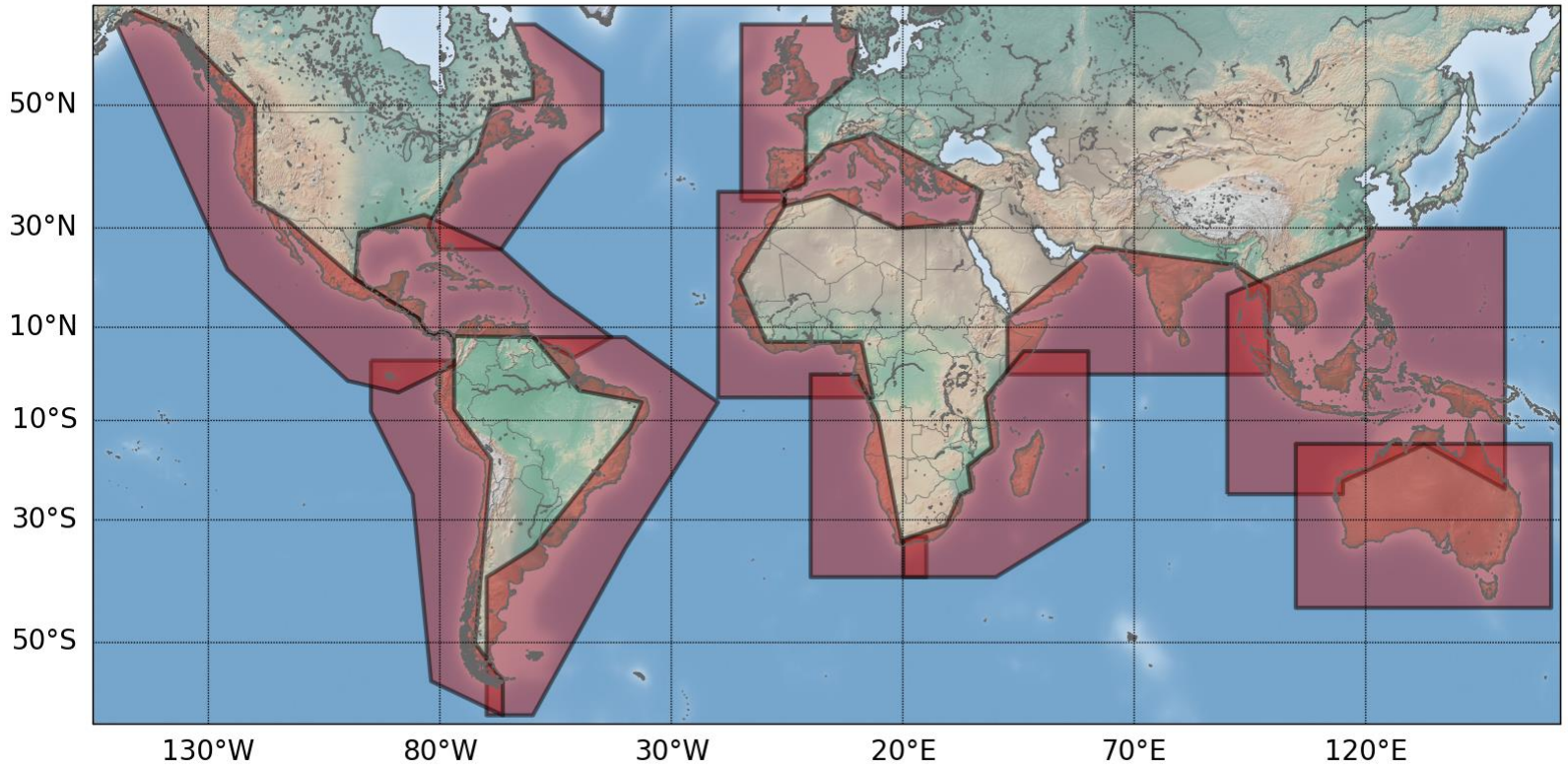
- Resolution : 20 Hz along track (350 m)

- Temporal coverage: Jan 2002 to Jan 2020: 18 years

- Selection of valid data between 0 and 20 km from the coast at numerous coastal site

- Strict editing performed in order to remove outliers (based on trend errors, % of missing data, trend continuity between successive 20 Hz points, ...)

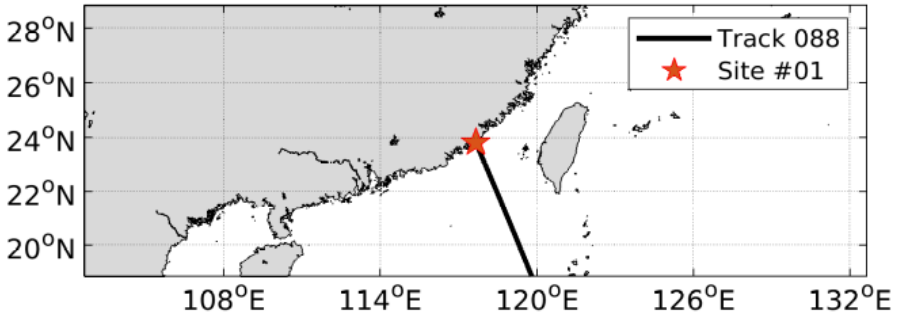
Studied Regions

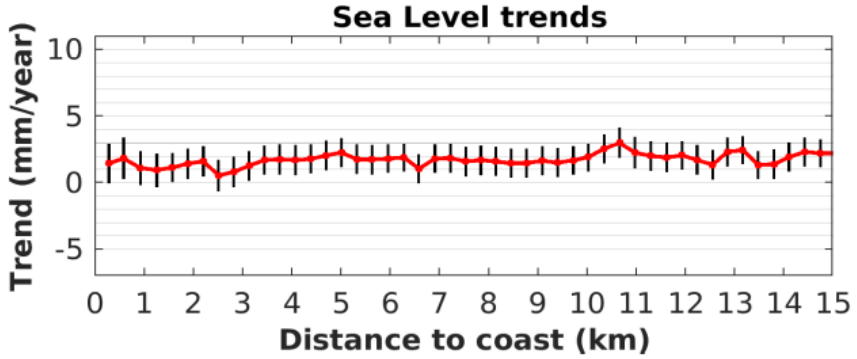


The ESA Climate Change Initiative Coastal Sea Level project

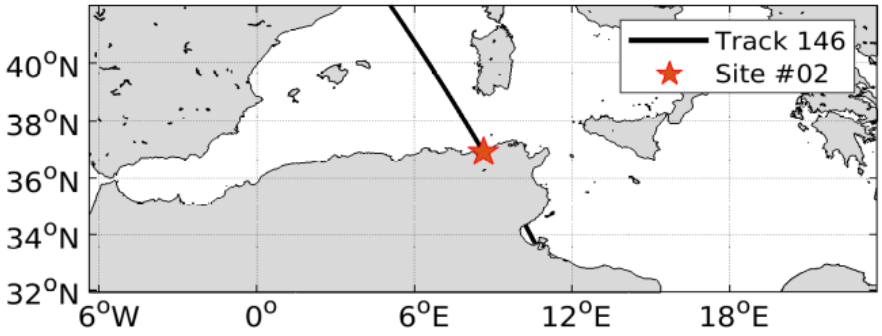
Examples from this new reprocessing: sea level trends against distance to the coast

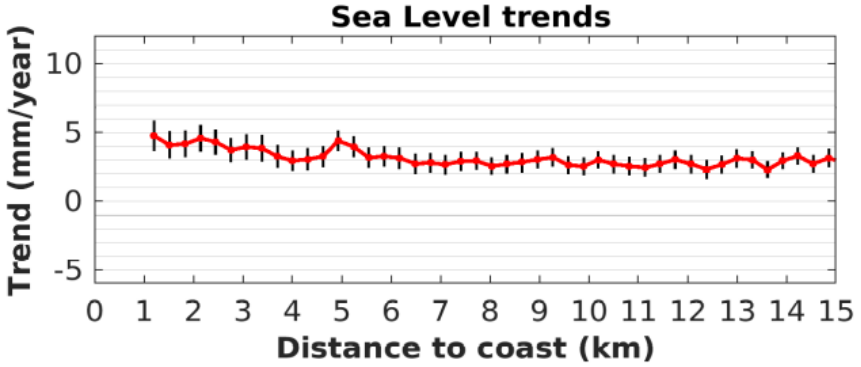
South East Asia Jason track 088 - Site #01



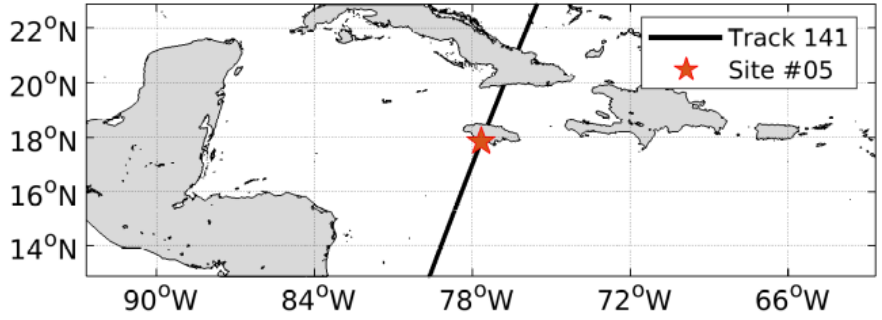


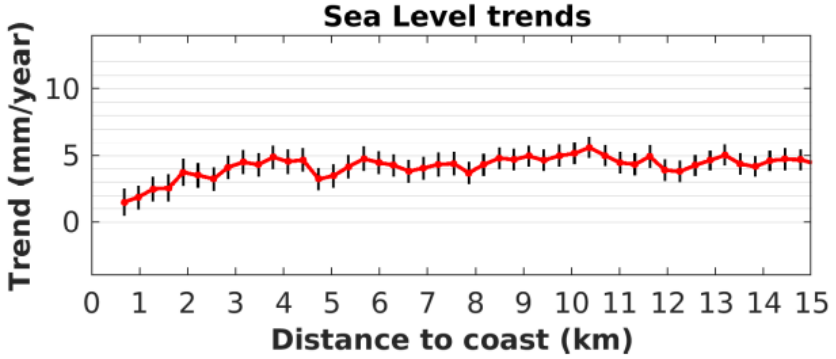
Mediterranean Sea Jason track 146 - Site #02





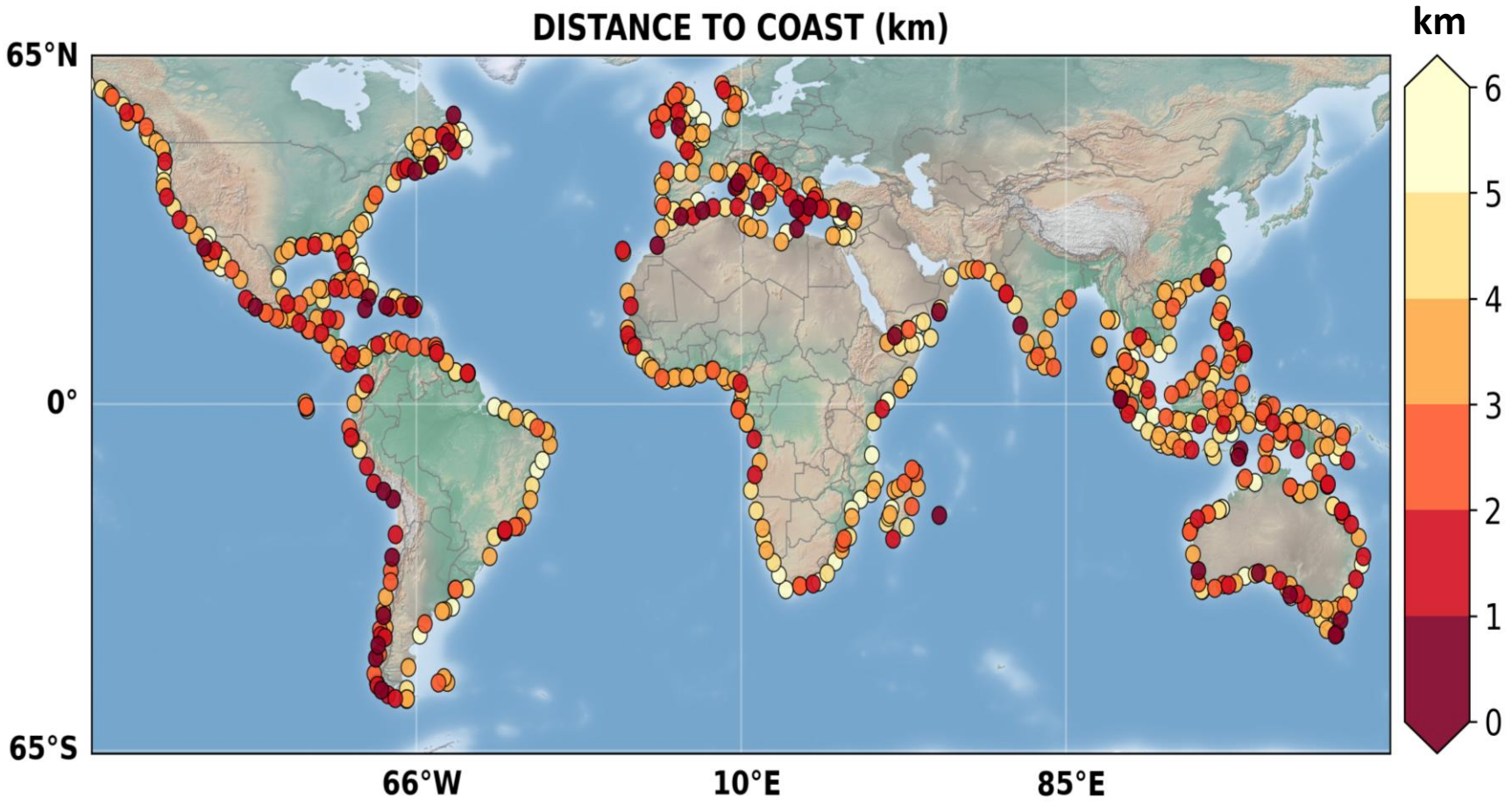
Caribbean sea Jason track 141 - Site #05

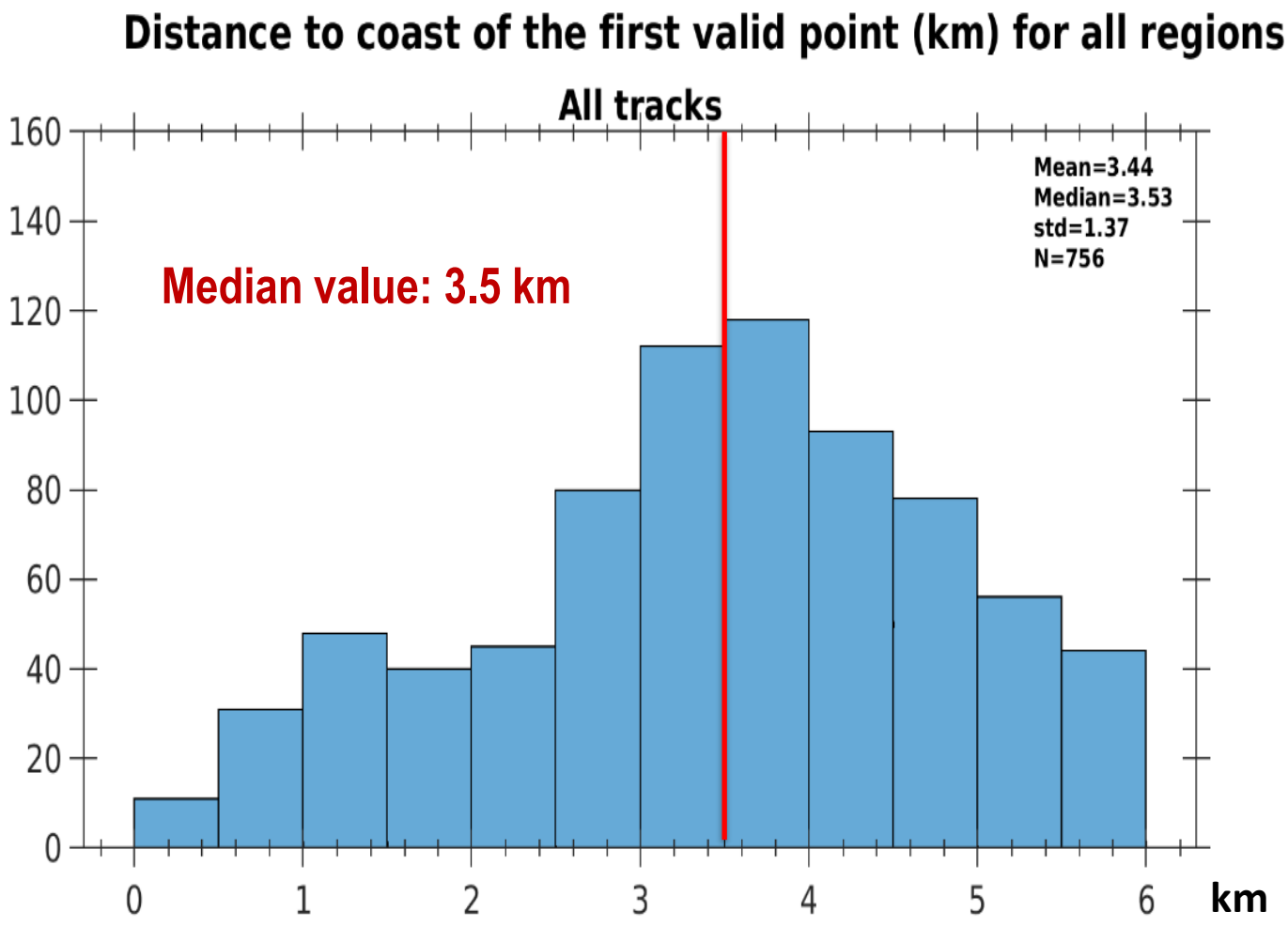




Distance (km) to the coast of the 1st valid point along the satellite track

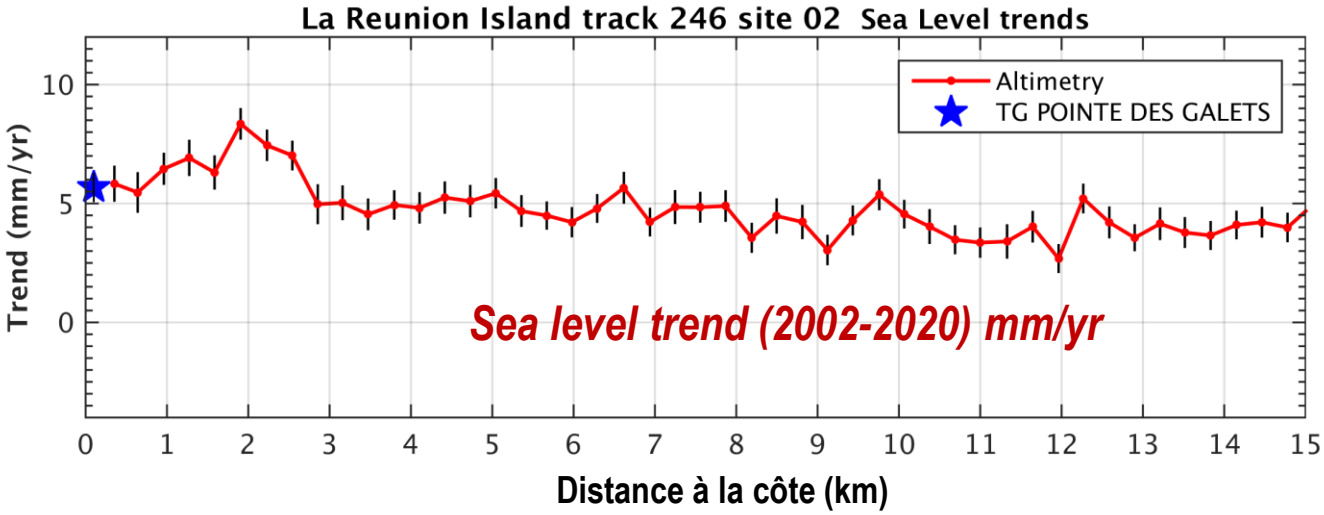
→ Concept of 'virtual' coastal altimetry stations

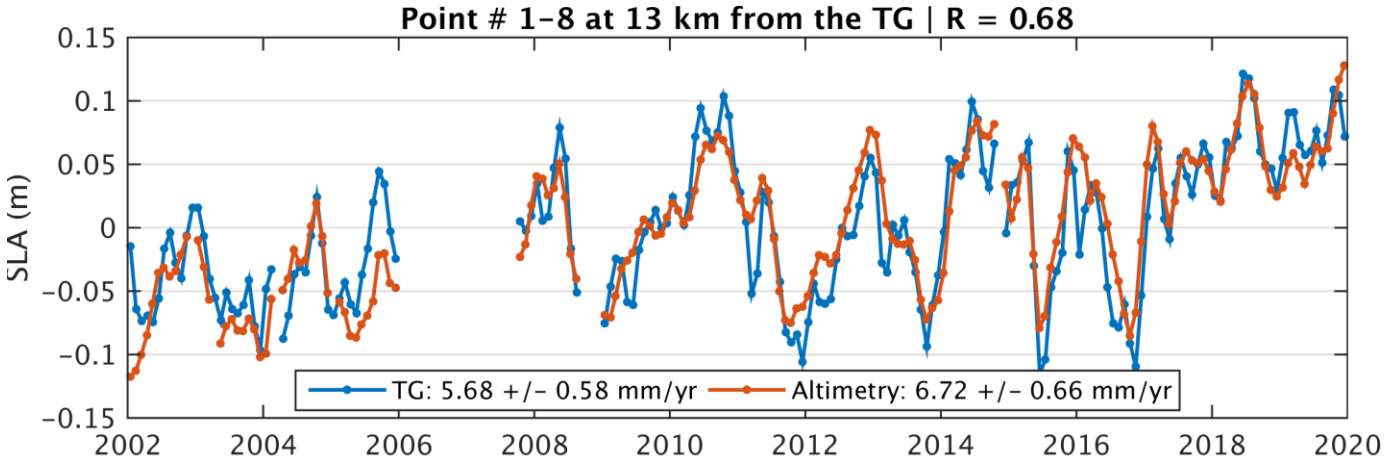


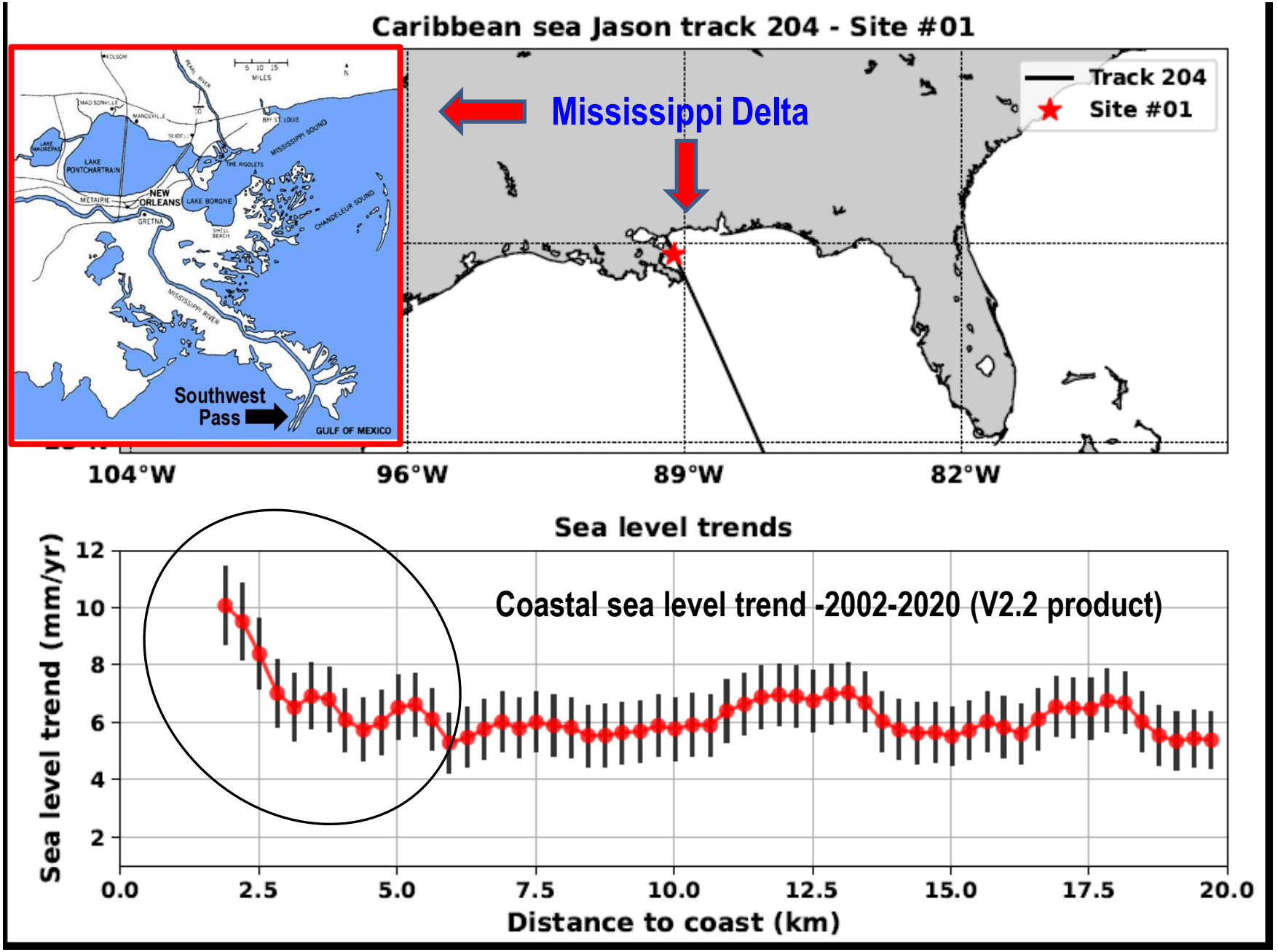

Distance to coast of the first valid point (km) for all regions
All tracks
Mean=3.44
Median=3.53
std=1.37
N=756
Median value: 3.5 km
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
km

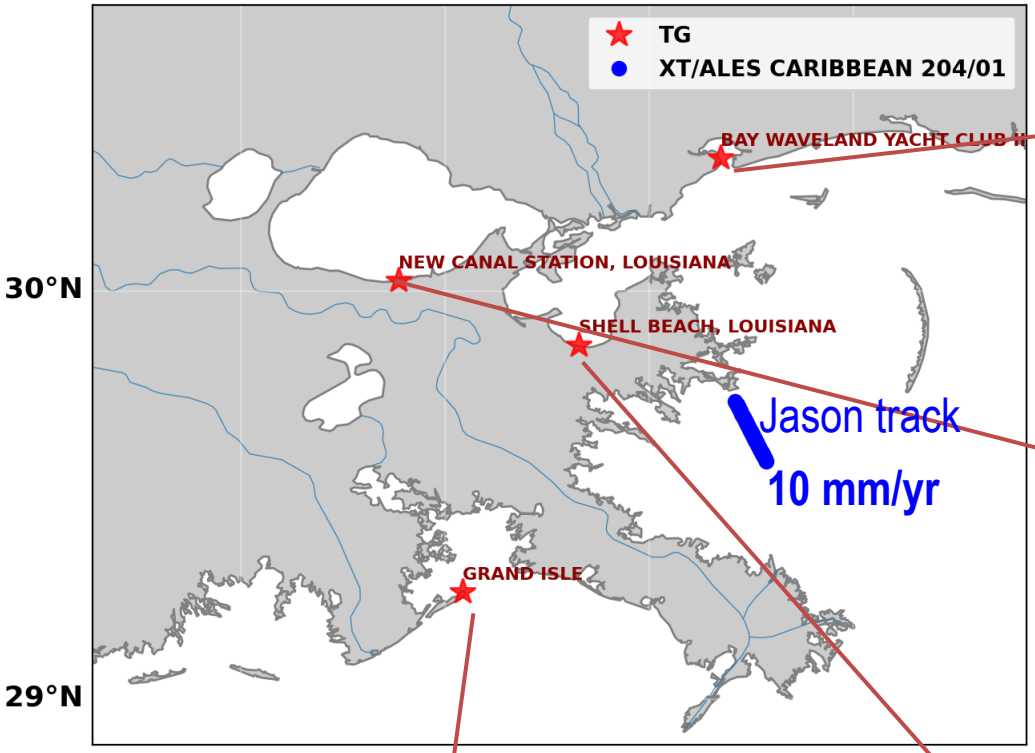
Validation with tide gauges

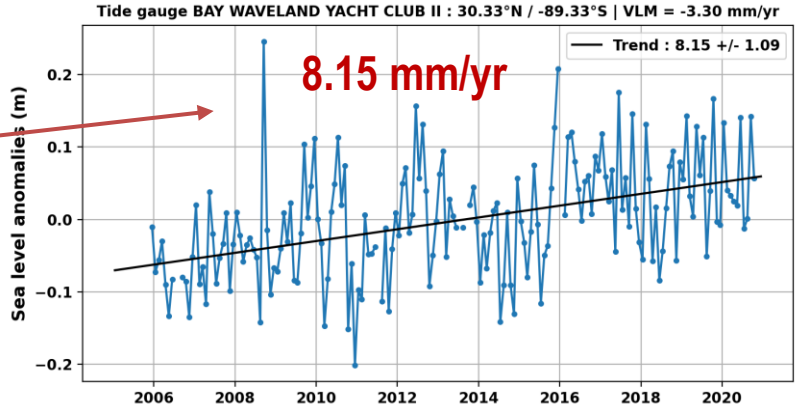
Comparison altimetry-tide gauge at La Réunion Island

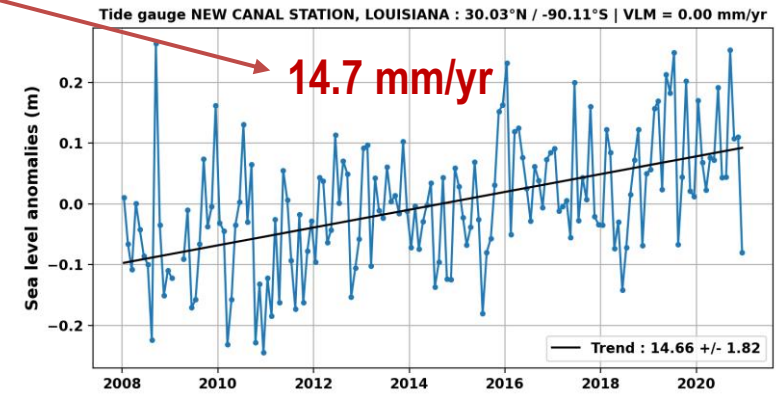


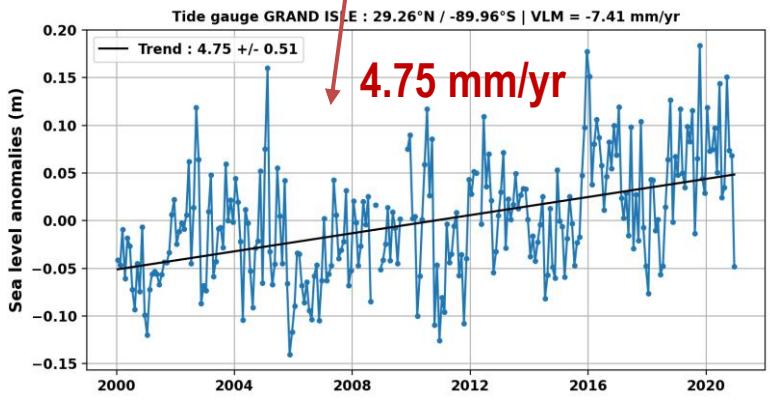


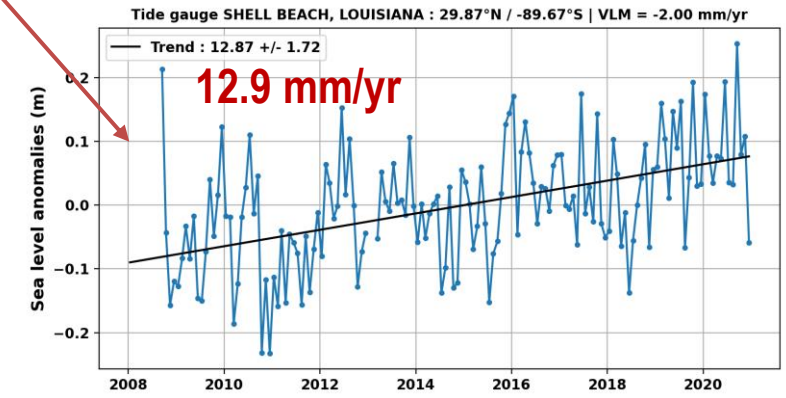

Caribbean sea Jason track 204 - Site #01
Mississippi Delta
Track 204
Site #01
Southwest Pass
GULF OF MEXICO
104°W
96°W
89°W
82°W
Sea level trends
Coastal sea level trend -2002-2020 (V2.2 product)
Sea level trend (mm/yr)
Distance to coast (km)
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
2
4
6
8
10
12











Tide gauge-based sea level corrected for vertical land motions

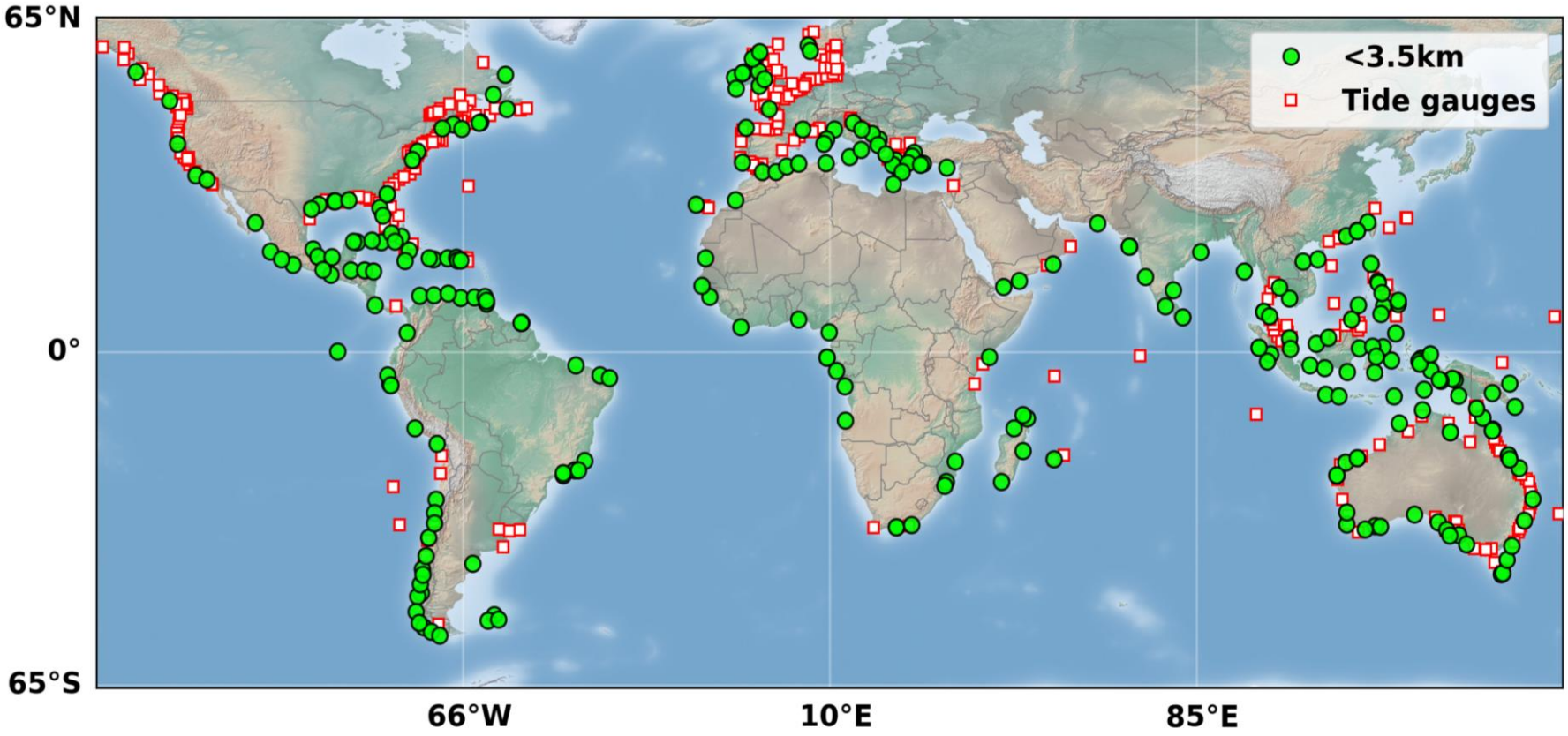
New network of virtual coastal altimetry stations

- 756 virtual stations <6 km from the coast

Including

- 271 virtual stations <3.5 km from the coast

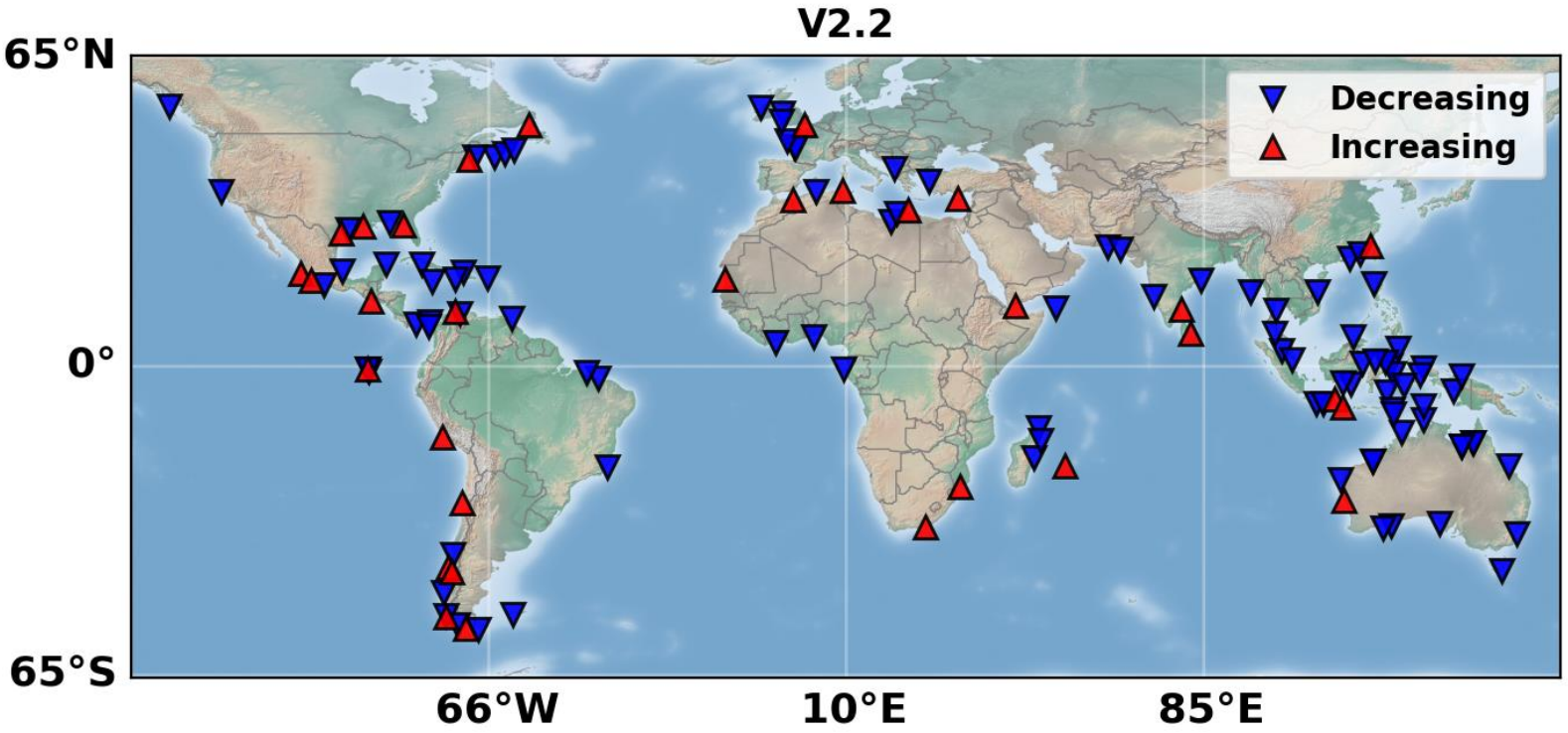
Virtual coastal stations <3.5 km
and tide gauge sites with available data over 2002-2020
(24 month data gap allowed in the tide gauge records)



Sea level trends at the coast

90% → constant trend against distance to the coast

10% → increasing or decreasing trend in the last 4-5 km to the coast compared to offshore



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Sea level along the world's coastlines can be measured by a network of virtual altimetry stations

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Coastal sea level time series
and associated trends freely available

Data access:

SEANOE website : https://doi.org/10.17882/74354


Thanks for your attention