Coastal sea level time series and trends from reprocessed Jason altimetry

The Climate Change Initiative Coastal Sea Level Team

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ESA CLIMATE CHANGE INITIATIVE EXTENSION (CCI+)

The Coastal Sea Level Project (2019-2022)

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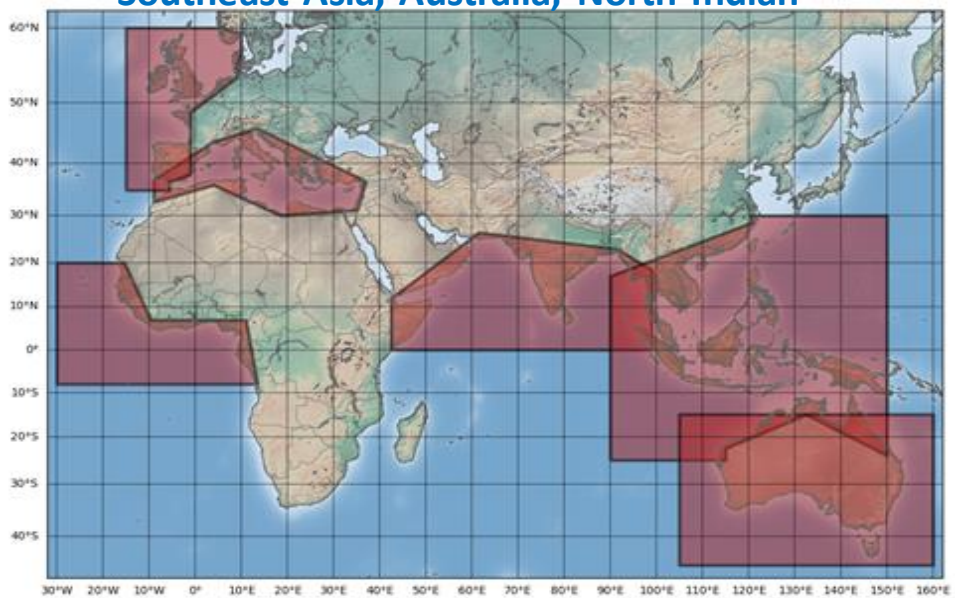
Objectives of the project:

- Produce, validate and deliver consistent sea level time series in several coastal regions worldwide
- Compute sea level trends as close as possible to the coast in order to answer the question :" **Is sea level at the coast rising at the same rate as in the open ocean?"**
- Does the answer depend on regions? Does it depend on the Bathymetry (presence or not of coastal shelves) ?
- Does small-scale ocean dynamics impact sea level variations at the coast? If yes, how? What is its relation with the large-scale ocean circulation
- What is the influence on natural modes of climate variability (e. G. ENSO/PDO, NAO, AMO, etc.) on interannual coastal sea level ?
- Can we explain (in terms of climate & non climate-related contributions) coastal sea level trends?

6 regions considered:
Western Europe, Mediterranean Sea, Western Africa, Southeast Asia, Australia, North Indian



1. Aproach

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

- Use of X-TRACK processing system developed at LEGOS (CTOH; Birol et al., 2017)

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

- Resolution : 20 Hz along track (350 m)

- Period covered: June 2002 to May 2018: 16 years

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

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

2. Content of the product

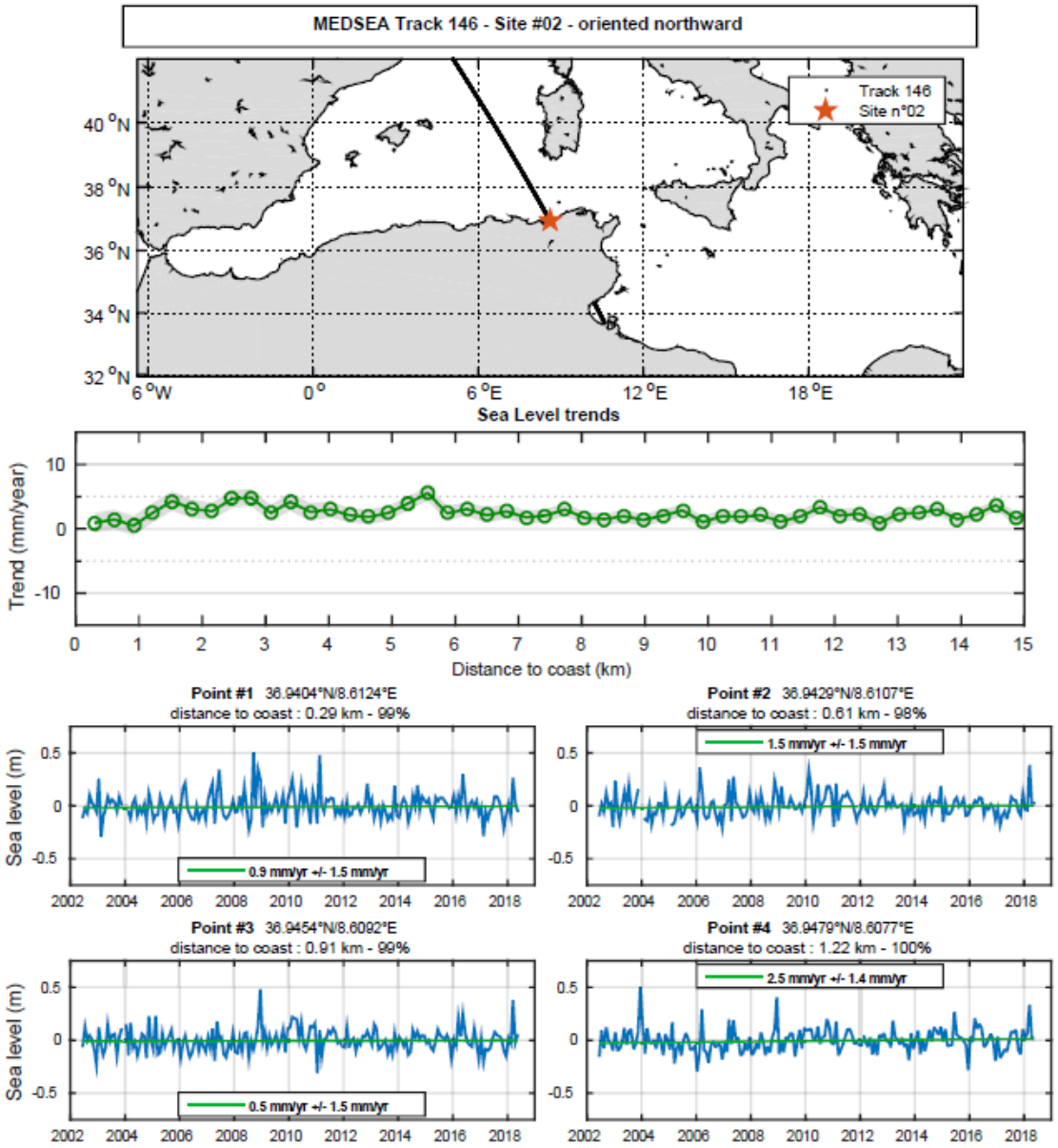
- **The coastal sea level product will contain 429 portions of 20km-long tracks, crossing land at different locations across all regions in netCDF files**

Content of a file:

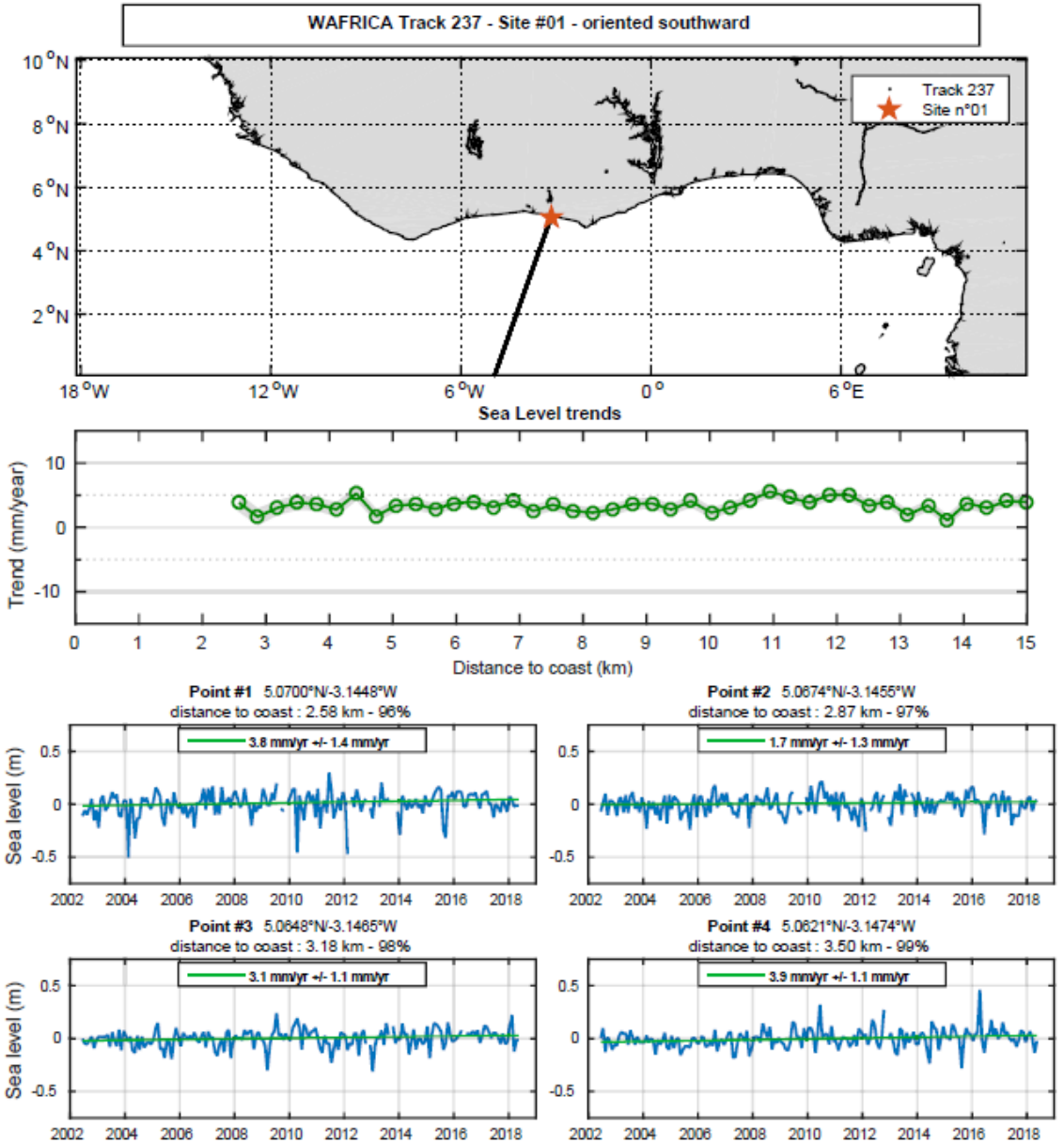
Variables	Description
lat	Latitude of each 20 Hz point
lon	Longitude of each 20 Hz point
distance_to_coast	Distance to a reference point at the coast of each 20 Hz point
time	Time of measurements
sla	Monthly Sea Level Anomalies from X-TRACK/ALES 20 Hz
local_msl_trend	Sea level trends computed from the monthly SLA
local_msl_trend_error	Sea level trend errors

3. A few examples of the product (1/3)

Mediterranean Sea

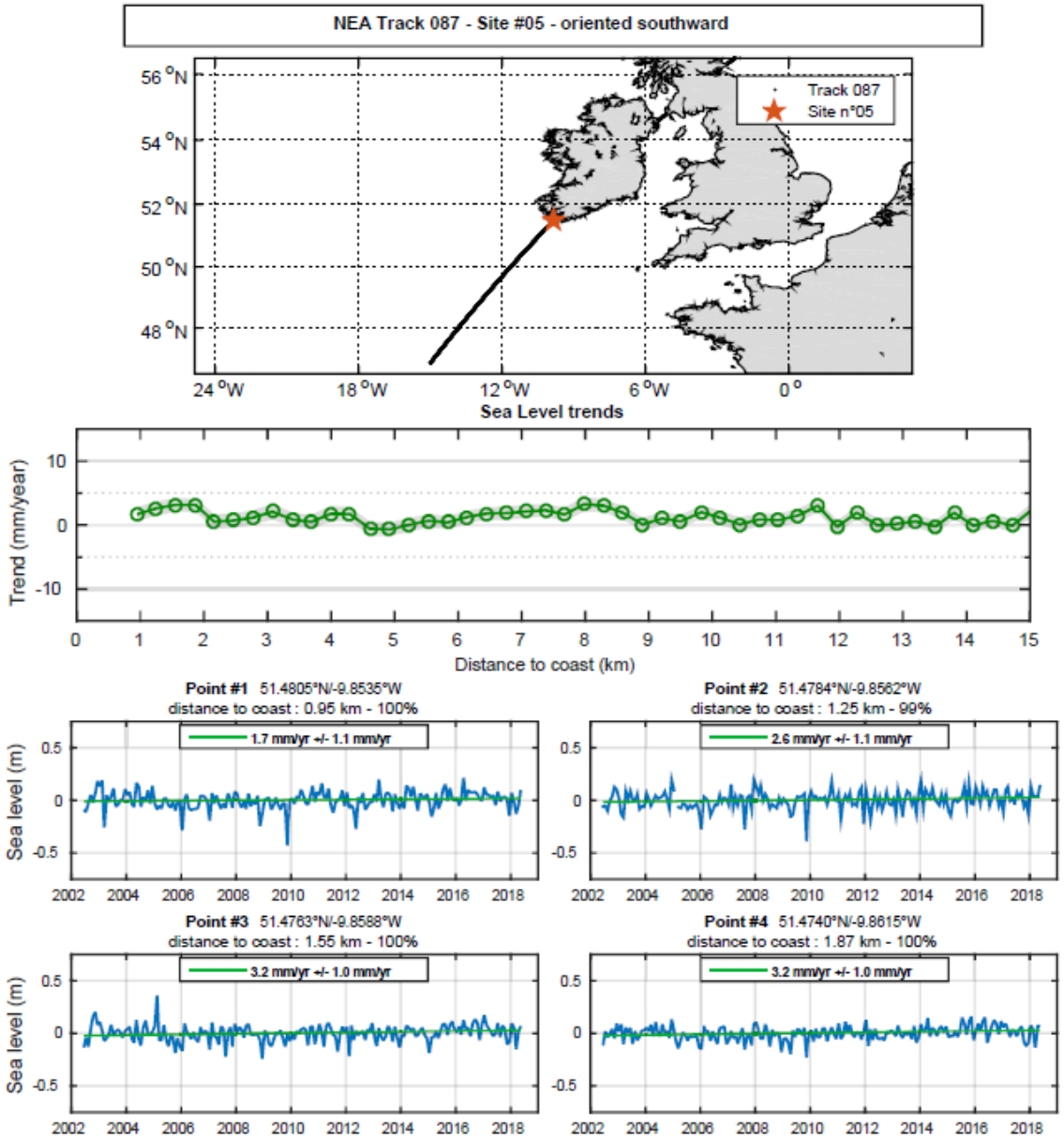


West Africa

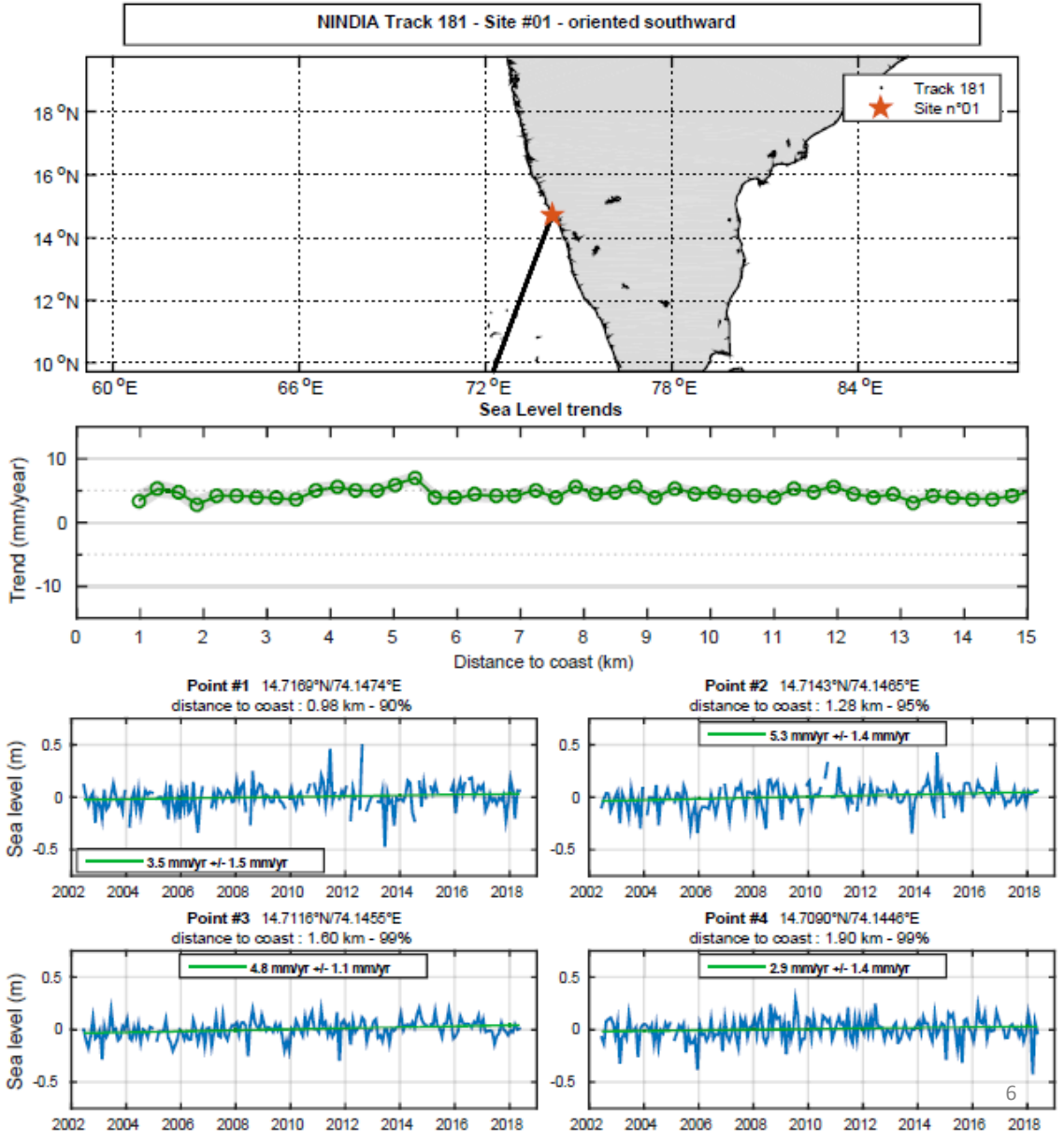


3. A few examples (2/3)

North East Atlantic

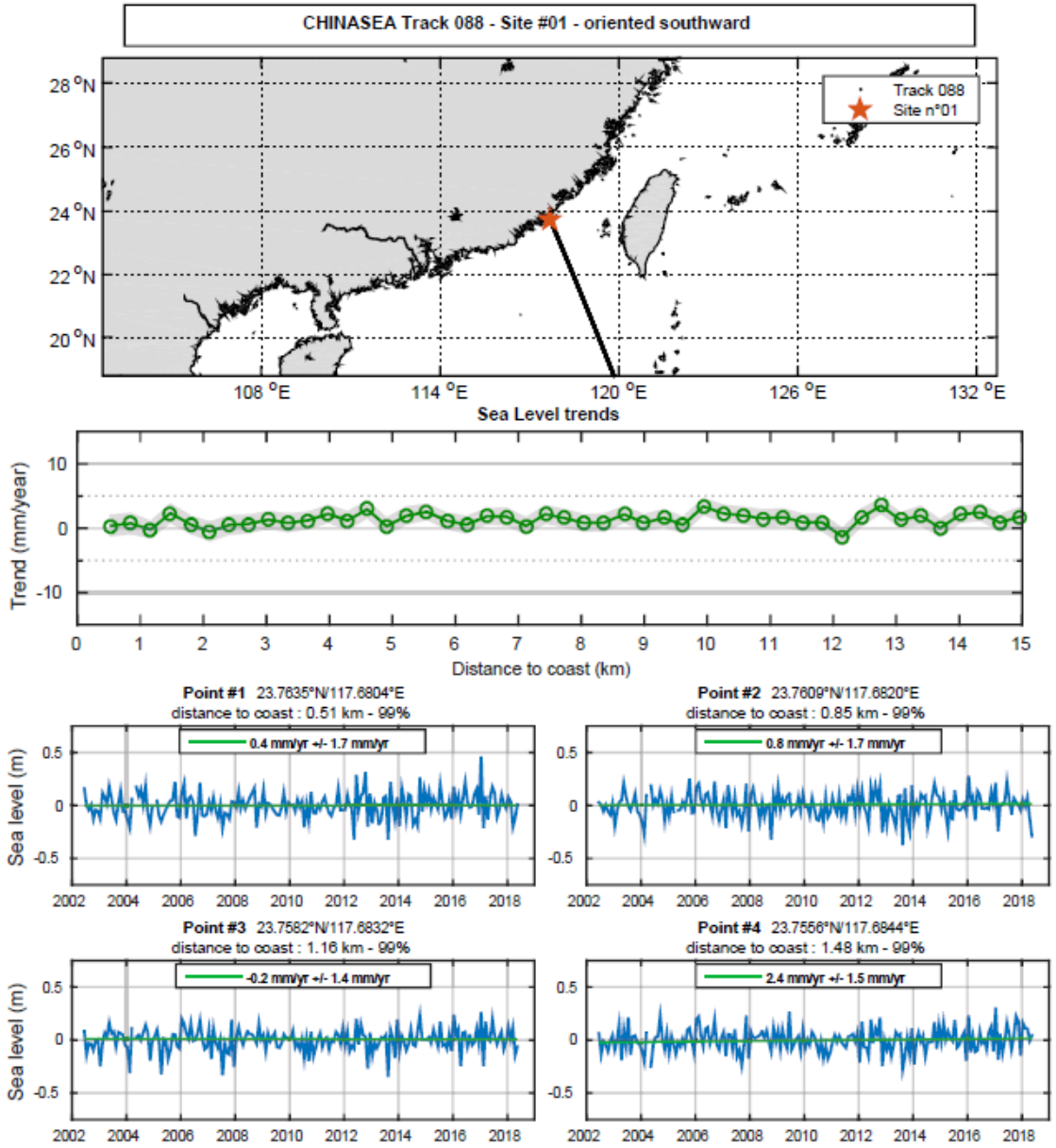


North Indian Ocean

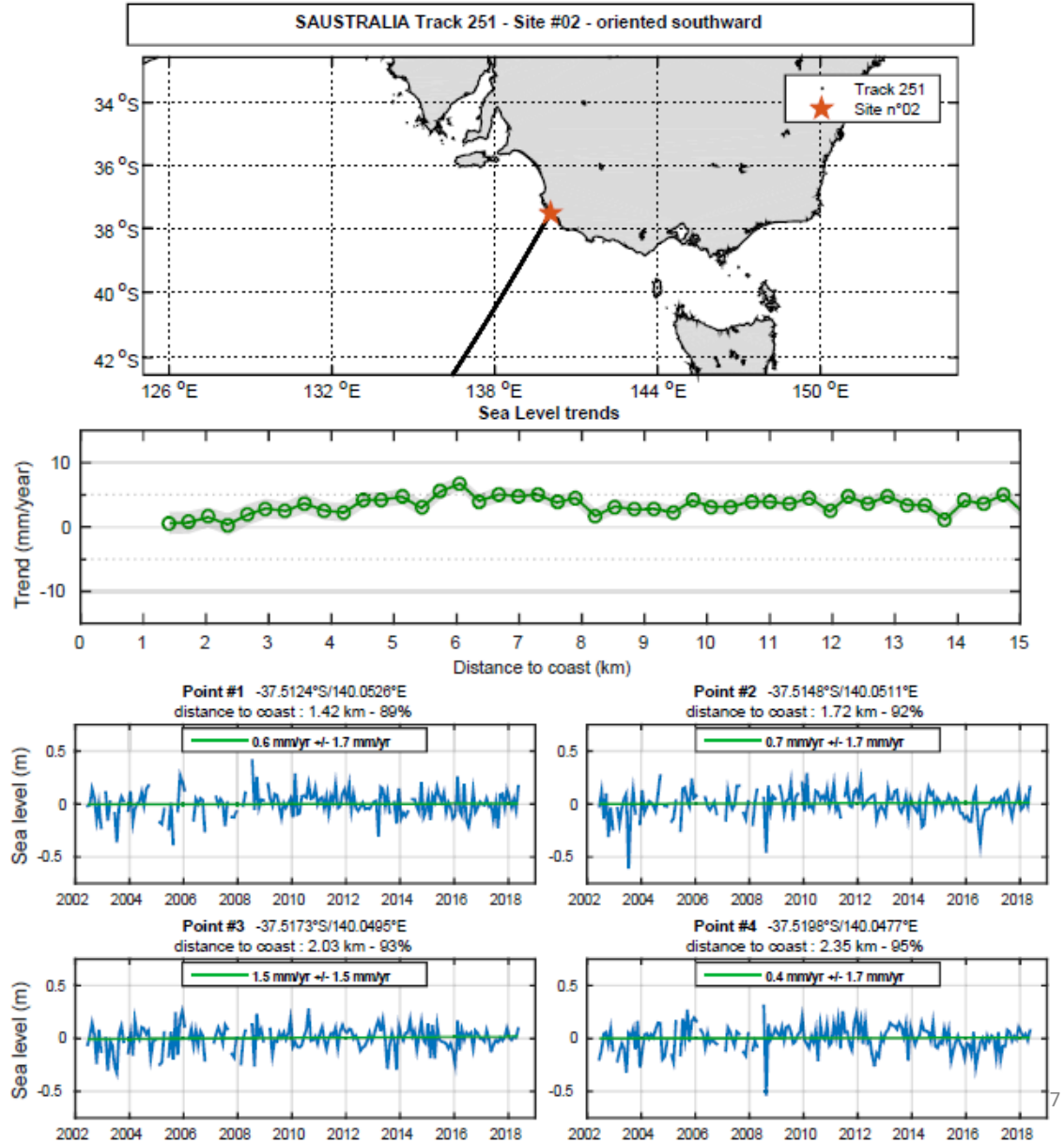


3. A few examples (3/3)

South East Asia



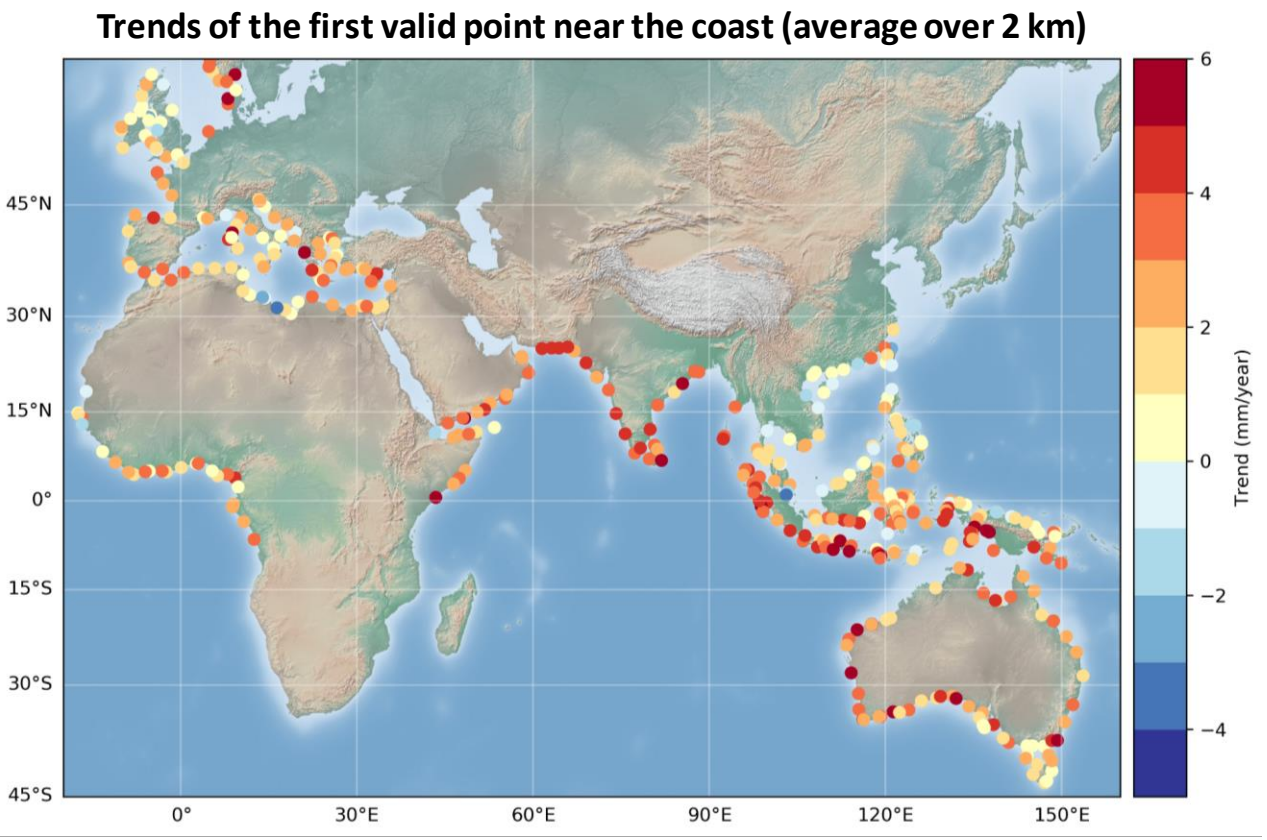
South Australia

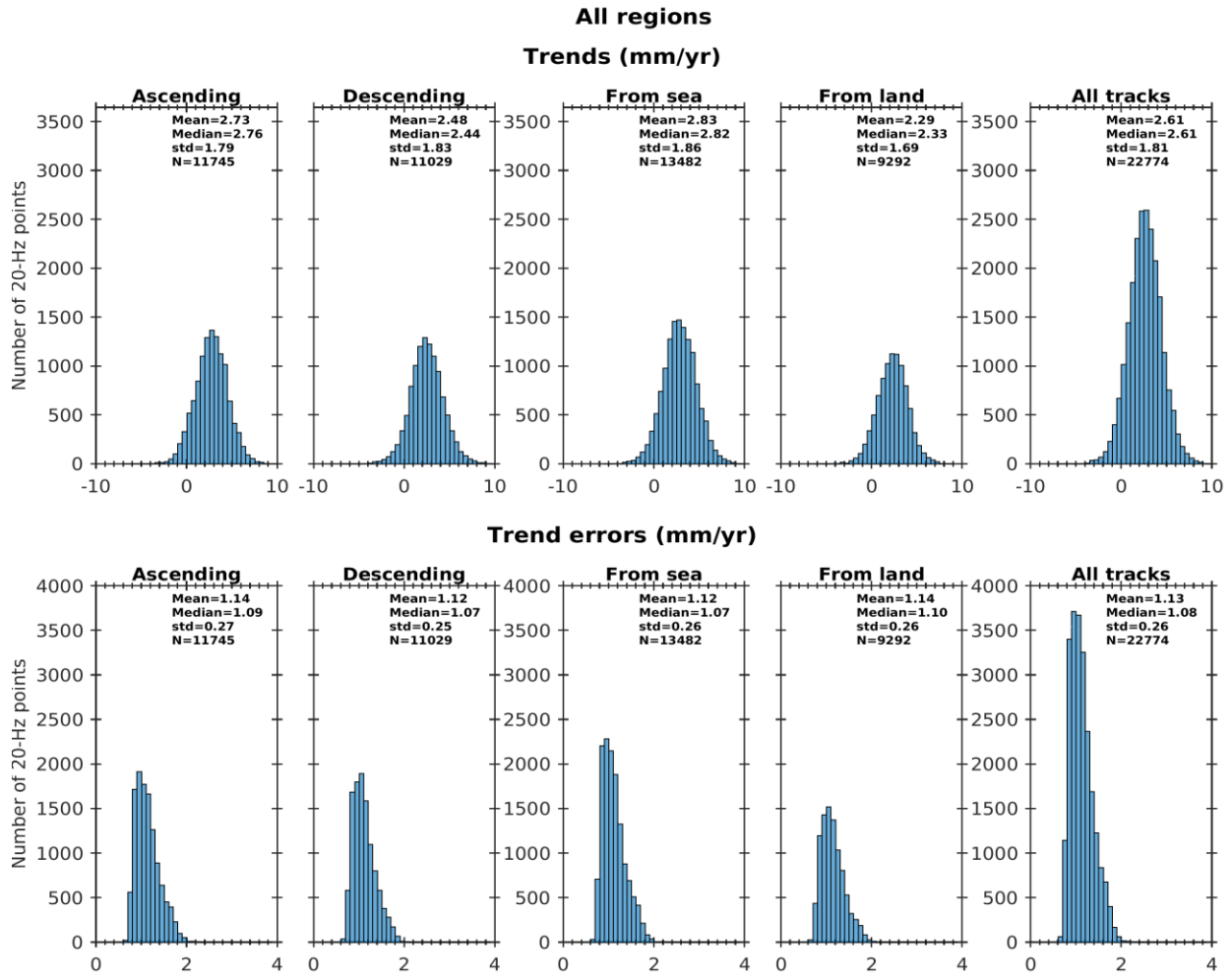


4. Statistics of the product (1/3)

- Altimetry-based coastal sea level trends (mm/yr) 2002/2018

- Mean trend for all regions: 2.6 mm/yr (no GIA correction)

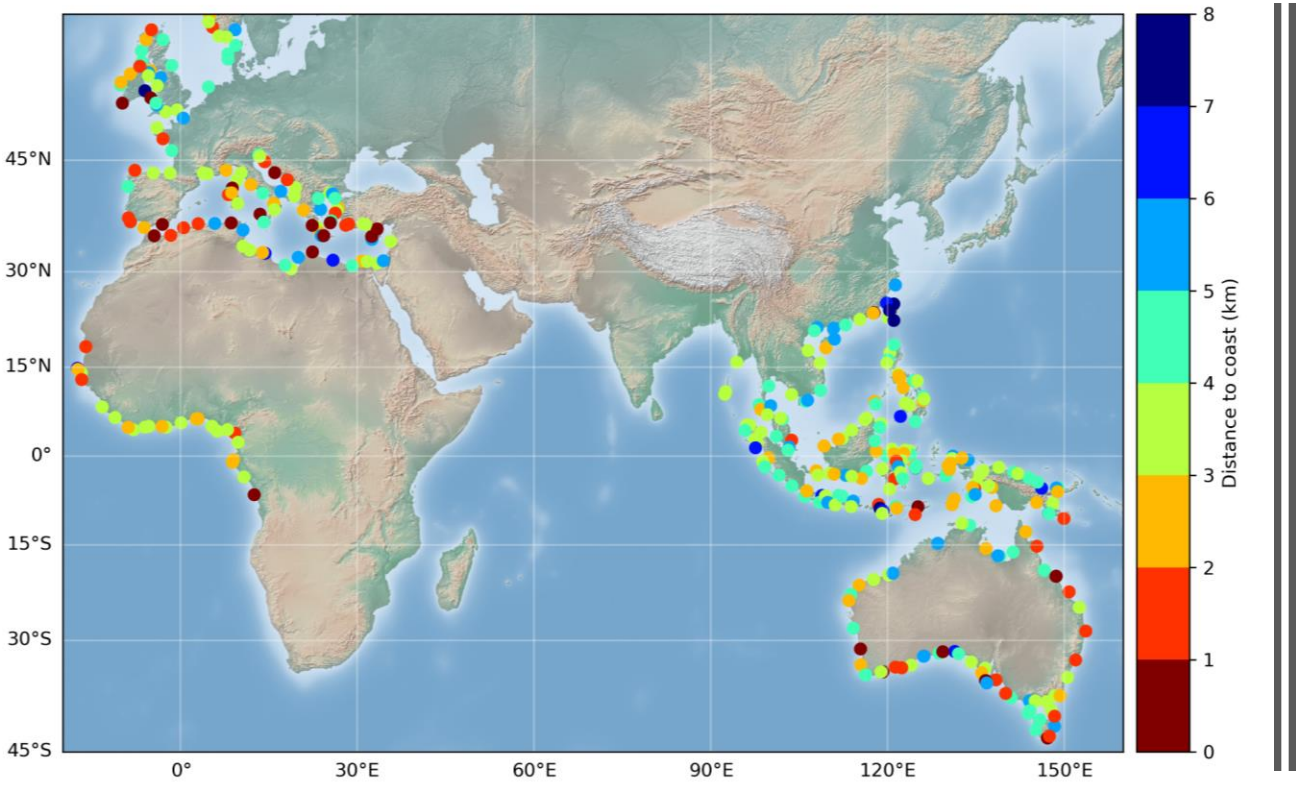


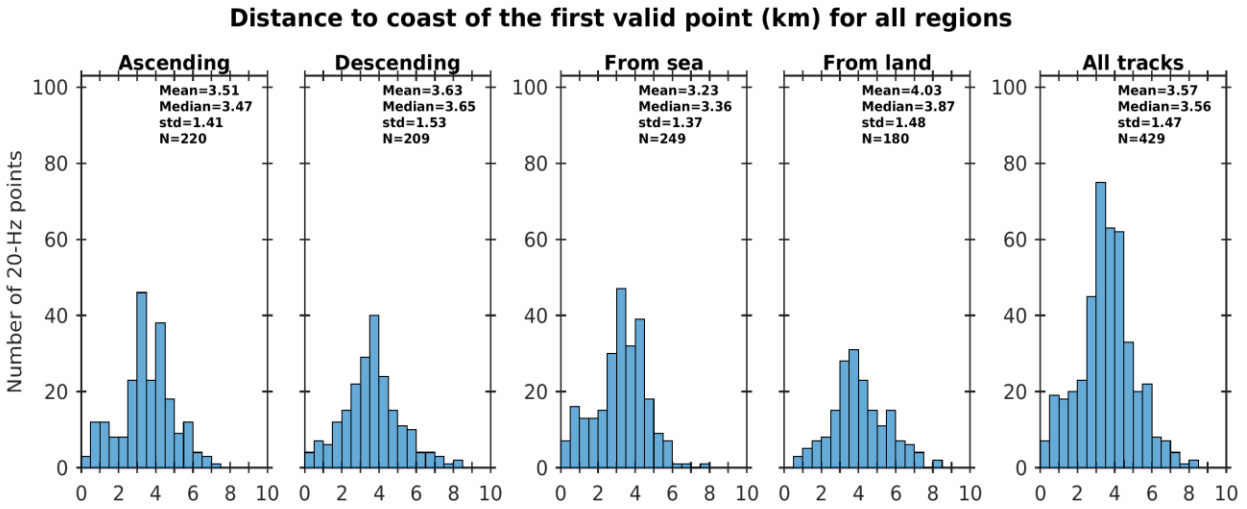


4. Statistics of the product (2/3)

- Distance to the coast of the first valid sea level trend data (km)

- Mean distance for all regions: 3.5 km

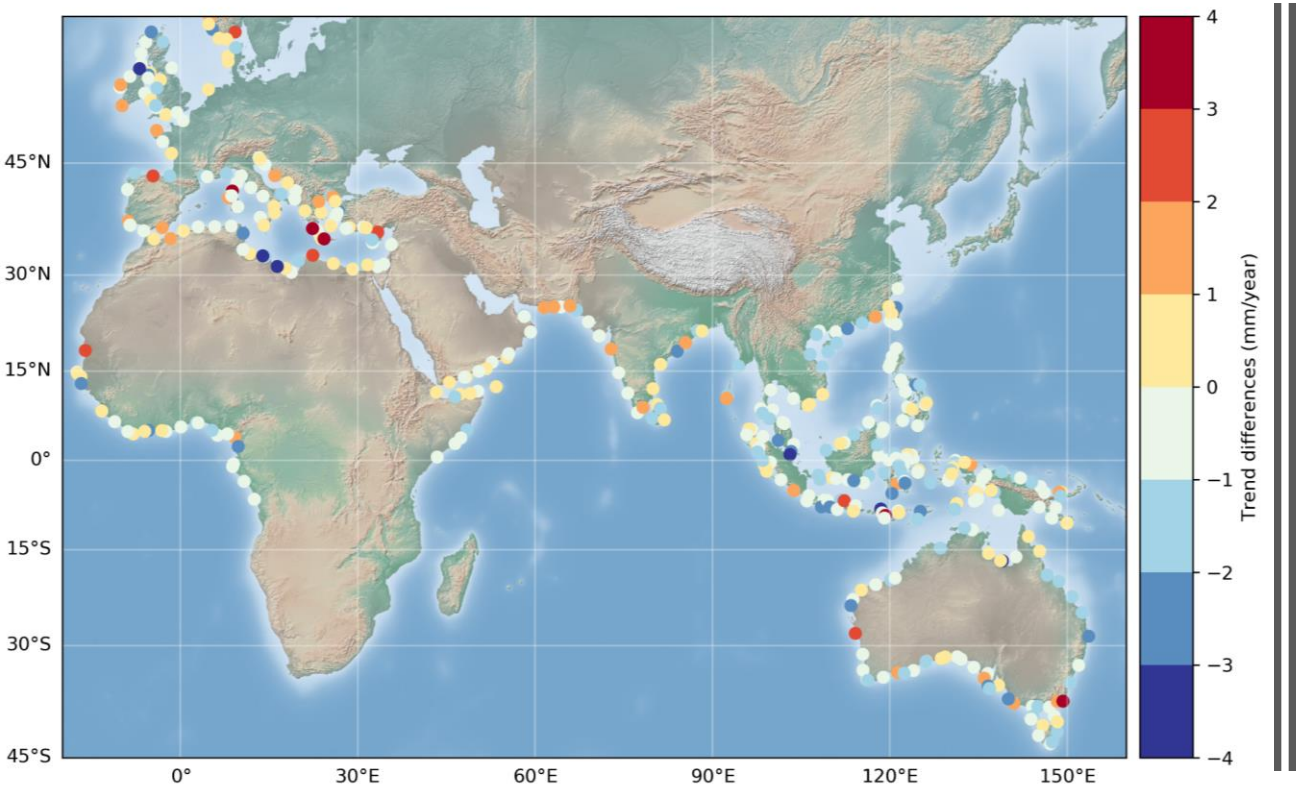


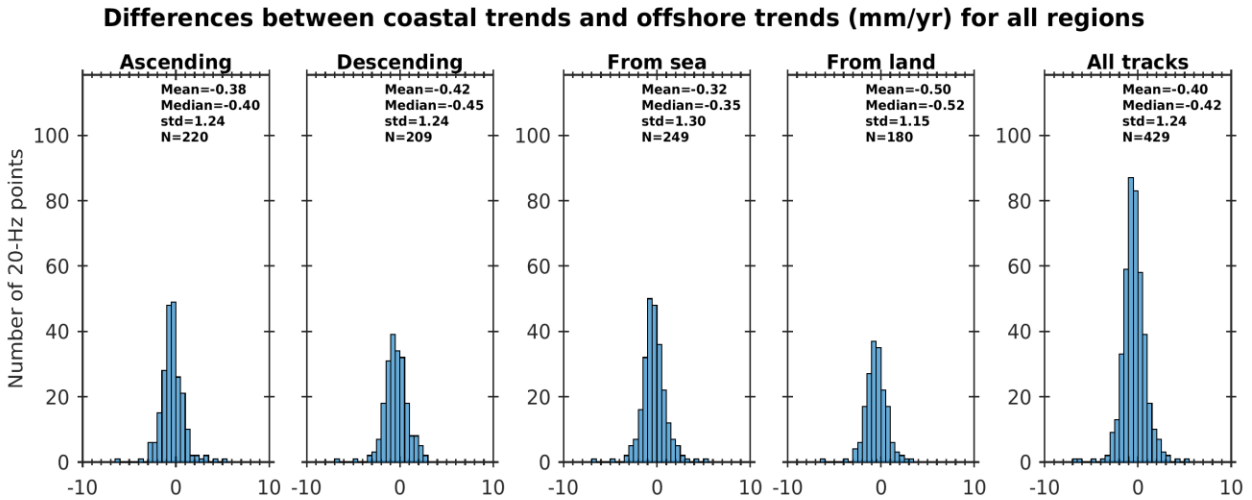


4. Statistics of the product (3/3)

- Trend differences between the first valid point near the coast (average over 2 km) and open ocean (14-16 km from coast)

- Mean difference for all regions: -0.40 mm/yr





5. Synthesis

- Mean coastal trend (averaged over all regions) is 2.6 +/- 1.1 mm/yr
- Lowest trends are seen in the Mediterranean Sea
- Largest trends are observed in the north Indian Ocean and around Australia
- On average, there is no difference between ascending and descending tracks
- We note more valid data when track come from sea in the Mediterranean Sea and Northeast Atlantic

- There are no significant trend differences between open ocean and the coast (closest valid point to coast) at most sites. *This is a totally unexpected result!*

- The average distance to coast of the first valid point is ~3.5 km (all regions)
- In the Mediterranean Sea and around Australia, we note a significant number of sites with distance of the first valid point within 2 km

Conclusion

- This monthly product will correspond to a validated and reliable sea level dataset at a large number of coastal sites
- It will allow to study long-term trends in sea level rise very close to the coast
- Reference article in preparation for publication in Nature Scientific Data
- This new coastal sea level dataset will be made freely available to users with the Nature Scientific Data publication

References

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