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COSTA: DGFI-TUM's Along Track Sea Level Product for ERS-2 and Envisat (1996-2010) in the Mediterranean Sea and in the North Sea

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The Dataset

The COastal Sea level Tailored ALES (COSTA) dataset contains dedicated coastal altimetry sea level measurements based on the Adaptive Leading Edge Subwaveform (ALES) reprocessing. In this version, the missions involved are ERS-2 (1996-2002) and Envisat (2002-2010), and the data are available in the Mediterranean Sea and in the North Sea.

The dataset is generated by the application of the ALES fitting algorithm to the radar signal provided by the official products of the missions. The ALES algorithm selects only a portion of the altimetric signal (waveform), in order to estimate the distance between the satellite and the sea surface (range) while avoiding the noise in the tail of the signal. The algorithm is based on the relation between estimated sea state, achievable precision and width of the subwaveform. The sea state bias correction, which accounts for the effects of waves and the tracking errors, is recomputed for the ALES output.

Following this pre-processing, the data are post-processed with updated geophysical corrections, tidal and mean sea surface models. Finally, the sea level measurements are averaged at 1 Hz (one measurement every ~7 km along each track) after removing the outliers. To facilitate the temporal analysis, the sea level anomalies for each track are stored in matrices in which each row corresponds to the time series at one latitude-longitude location.

The validation work, presented at the 10th Coastal Altimetry Workshop (2017-02-21 - 24, Florence, Italy), has shown a 15% decrease in the high-rate noise of the measurements if compared to the standard product, with larger improvements in the last 20 km from the coastline and a better precision also in the open ocean.

The COSTA dataset is made available to the scientific community in order to foster the application of coastal altimetry data by users, who are not necessarily trained in radar altimetry processing. Its objective is the provision of easy-to-use along-track sea level data that can be directly used for sea level and circulation studies not only in the open ocean, but also in the coastal regions.

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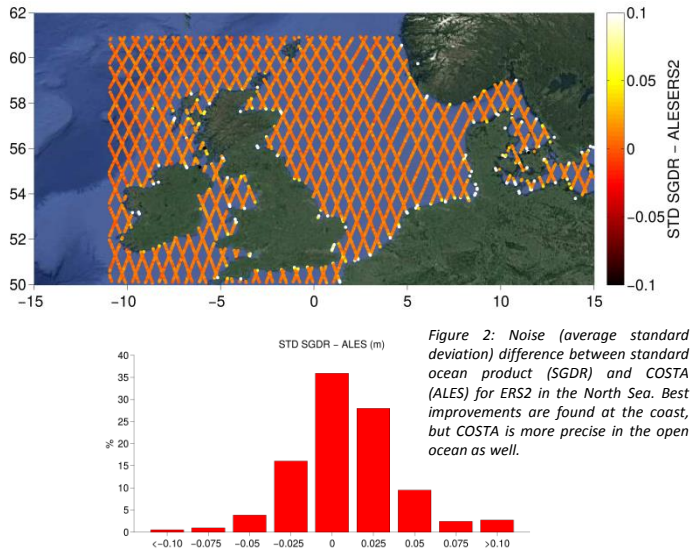

Figure 2: Noise (average standard deviation) difference between standard ocean product (SGDR) and COSTA (ALES) for ERS2 in the North Sea. Best improvements are found at the coast, but COSTA is more precise in the open ocean as well.

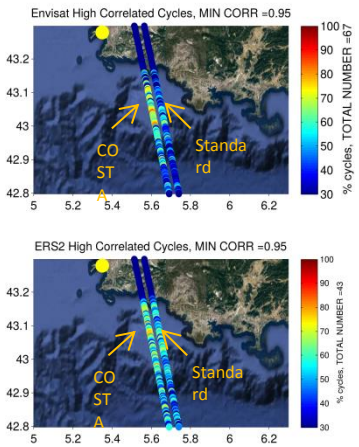

Figure 1: Percentage of cycles useful to obtain a correlation coefficient >0.95 against a Tide Gauge in Marseille (from Permanent Service of Mean Sea Level, 2017 [4]) at high frequency for COSTA and for the standard ocean produce (same track, shifted to the right)

FAQ: Difference between COSTA and ALES in PODAAC

ALES data from Jason-2 and Envisat are also available from ftp://podaac.jpl.nasa.gov/allData/coastal_alt/L2/ALES/, globally within 50 km from the coastline. COSTA is a post-processed version in which raw data are already corrected, given as „ready-to-use“ sea level data and assembled on nominal tracks in the form of time series. COSTA is a regional product, but the data availability is not limited by the distance from the coast.

Link to COSTA dataset

https://doi.pangaea.de/10.1594/PANGAEA.871920

Description of the fields

Data are provided at high-frequency (hf), i.e. one sea level measurement roughly every 350 m along the track, and low frequency (lf), i.e. post-processed measurements derived from the hf, providing one sea level measurement roughly every 7 Km. Hf data are raw measurements that are not flagged, i.e. outliers are not removed. I suggest not to use hf data closer than 3 km from the coastline.

Lf data are commonly used in sea level analysis. They are post-processed measurements, i.e. they are derived from hf data after an outlier detection procedure (see [3] for details). I suggest not to use lf data closer than 5 km from the coastline.

The scope of the data structure is to provide time series at each measurement point.

Therefore, sea level data are provided as matrices in which the coloumns correspond to the along-track locations and the rows to the satellite cycles. Each row of the matrices represent a time series at the corresponding location.

To create a time series, data points along the satellite tracks have to be collinear: it is necessary to have measurements at the same geographical location for each cycle. Nominal tracks were therefore created for this study by taking as a reference the CTOH (Centre for Topographic studies of the Ocean and Hydrosphere, http://ctoh.legos.obs-mip.fr/altimetry) 1-Hz tracks, neglecting the across-track displacement of different passes along the same track, which is normally less than 1 km.

Acknowledgements

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NetCDF Fields available (for each track)

- lon: Longitude of the nominal tracks at high frequency.
- lat: Latitude of the nominal tracks at high frequency
- lon_lf: Longitude of the nominal tracks at low frequency.
- lat_lf: Latitude of the nominal tracks at low frequency.
- Cycles: cycle number.
- time: TAI time in seconds from 1985,1,1,00:00 , Rows: corresponding cycle, Coloumns: high rate positions. Note that TAI time per definition does not include leap seconds.
- time_lf: same as time at low frequency.
- ssha (ssha_lf): Sea Surface Height Anomaly. Rows: corresponding cycle. Coloumns: high frequency (low frequency) positions .
- twle (twle_lf): Total Water Level Envelope (i.e. ssha+mean sea surface+tides) from ALES. Rows: corresponding cycle. Coloumns: high frequency positions.
- dac (dac_lf): Dynamic Atmosphere Correction from AVISO (already applied in ssha and twle). Rows: corresponding cycle. Coloumns: high frequency positions.
- swh (swh_lf): Significant Wave Height from ALES. Rows: corresponding cycle. Coloumns: high frequency positions.
- dist_to_coast_lf: distance to the nearest coastline at the low frequency positions.
- std_ssha: standard deviation of the hf ssha measurements used to obtain ssha_lf. In the literature, this statistic is used as an estimate of noise for high frequency satellite altimetry measurements. Rows: corresponding cycle. Coloumns: low frequency positions.

References

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