DGFI-TUM

User Manual

COSTA v1.0
DGFI-TUM 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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Contents

1 Introduction

This document describes the content of the NetCDF files available from the PANGAEA platform and presented at the 10th Coastal Altimetry Workshop (http://www.coastalaltimetry.org/) [1]. The COastal Sea level Tailored ALES (COSTA) dataset contains dedicated coastal altimetry sea level measurements based on the ALES reprocessing [2] for the altimetry missions ERS-2 (1996-2002) and Envisat (2002-2010). The dataset is divided into two geographical boxes:

- North Sea: 50°N to 61°N Latitude, 11°W to 15°E Longitude
- Mediterranean Sea: 28°N to 46°N Latitude, 6°W to 37°E Longitude

2 File naming

The file naming convention is the following:

X_pY_ALES_processed

where X ist the mission name (ERS2 or Envisat) and Y is the pass number. Each file contains all the available cycles reprocessed for the corresponding pass.

3 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.

The NetCDF file description descibes the unity of measure for each field. The fields available for each file are the following:

- 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: Sea Surface Height Anomaly. Rows: corresponding cycle. Coloumns: high frequency positions.
- twle: Total Water Level Envelope (i.e. ssha+mean sea surface+tides) from ALES. Rows: corresponding cycle. Coloumns: high frequency positions.
- dac: Dynamic Atmosphere Correction from AVISO (already applied in ssha and twle). Rows: corresponding cycle. Coloumns: high frequency positions.
- swh: Significant Wave Height from ALES. Rows: corresponding cycle. Coloumns: high frequency positions.
- ssha_lf: same as ssha at low frequency.
- twle_lf: same as twle at low frequency.
- swh_lf: same as swh at low frequency.
- dac_lf: same as dac at low frequency.
- 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.

4 Corrections applied to the sea level measurements

The ssha has been derived using the following formula:

$$\begin{aligned}\text{SSHA} = &\text{Orbit altitude} - \text{Corrected Range} - \text{Mean Sea Surface} - \\ &+ (\text{Solid Earth Tide} + \text{Load Tide} + \text{Ocean Tide} + \text{Pole Tide})\end{aligned} \tag{1}$$

where

$$\begin{aligned}\text{Corrected Range} = &\text{Range} + \text{Dry tropospheric correction} + \text{Wet Tropospheric Correction} + \\ &+ \text{Sea State Bias} + \text{Ionospheric correction} + \text{Dynamic Atmosphere Correction}\end{aligned} \tag{2}$$

All the fields are taken from the latest version of the Sensor Geodetic Data Records for Envisat (version 2.1) and ERS-2 (version REAPER). The following exceptions apply:

- Range is estimated from ALES
- Sea State Bias is estimated using ALES-derived Significant Wave Height and Wind as explained in [4]
- The Mean Sea Surface model is the DTU15 [5]
- The Ionospheric Correction is derived from the NIC09 model [6]
- Ocean Tide and Pole Tide are derived from the EOT11a model [7]
- The Dynamic Atmosphere Correction is taken from http://www.aviso.altimetry.fr/en/data/products/auxiliary-products/atmospheric-corrections.html

5 Intermission biases

In order to cross-calibrate the ERS-2 and Envisat missions, I suggest to use the following absolute bias:

- $Envisat - ERS2 = -0.14m$

The offset is computed by comparing the ssha_lf fields from the two missions during the overlap of the dataset (10 cycles).

6 Acknowledgements

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