Estimating altimetry Sea Level trends uncertainties in coastal areas

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Overview

While global Mean Sea Level (MSL) rise is an important indicator in climate studies, coastal sea level affects more directly human populations. Accurately measuring the sea level trend near coasts is therefore an important challenge, currently undertaken in the ESA Sea Level CCI project by reprocessing altimeter data using the X-track (LEGOS/CTOH) coastal processing toolbox and the ALES retracking (TUM)(Passaro et al., 2018).

Part of that work is estimating the MSL trends uncertainties near coasts, which is the objective of this study (see also F. Birol's talk: »Impact of Geophysical Corrections on altimetry Sea Level estimations near coast » To assess the trend uncertainty, we compared the Sea Level Anomaly (SLA) trends for 320 different combinations (see tabular on the right) along the historical TOPEX ground-track i.e. a « set » approach. To compute local SLA trends, TOPEX/Poseidon, Jason-1 and Jason-2 data is first projected on the theoretical track. Then, the trends uncertainties is estimated simply by taking the standard deviation of the 320 different SLA trends. This method is Earth tide (1) only able to estimate trends uncertainties linked to commission errors i.e. where the standards show differences.

1. CLS, Toulouse, France 2. LEGOS, Toulouse, France



Editing (2)	Ocean processing, Coastal processing
Orbit (1)	Precise Orbit (POE)
Range (1)	Ocean (MLE4 retracking)
Ocean tide (2)	GOT4V10, FES2014
Wet tropo. (5)	Radiometer: (L2 Products), (Picard et al., 2016) Model: ERA-Interim, ECMWF operational analysis, GPD+ (Fernandes et al, 2015)
Dry tropo. (2)	ERA-Interim, ECMWF operational analysis
DAC (2)	ERA-Interim, ECMWF operational analysis
lono (2)	GIM, Altimeter bi-freq,
Sea state Bias (1)	Non parametric (Tran et al,, 2012)
Farth tide (1)	(Cartwright and Tayler 1971)

(Desaï et al., 2015)

Pole tide (1)

 \rightarrow

Mediterranean Sea

Sea Level trend



Sea level trends w.r.t coast distance on the Mediterranean Sea. Measurement occurrences are represented in a red scale.

Level trends seem to Sea increase by 1 mm/yr near coasts





Map of Sea Level trend uncertainties on Mediterranean Sea with respect to coast distance and bathymetry



Sea level trend uncertainties w.r.t coast distance Mediterranean Sea. Measurement occurrences are represented in a red scale.

- Higher sea level trend uncertainties in coastal areas
- Sea level trend uncertainties are high (~1,2 mm/yr) in some areas while lower (~0,6mm/yr) away from coasts (red encirclements)
- \circ 0.7 mm/yr average trend uncertainty in the Mediterranean Sea



- Most part of this uncertainty is attributed to errors in the Wet Tropospheric Correction,
- To a lesser extent, the lonospheric Correction locally contributes to trend uncertainties

West Africa

Sea Level trend

Sea Level trend uncertainties





Sea level trends w.r.t coast distance on the Coasts. Measurement occurrences are represented in a red scale.

No specific pattern for sea level trends w.r.t coastal distance

Map of Sea Level trend uncertainties on the West Africa Seas with respect to coast distance and bathymetry.



the West Africa Seas. Measurement occurrences are represented in a red scale.

- Higher sea level trend uncertainty in coastal areas (1.2 mm/yr vs 0,6 0 mm/yr in open ocean)
- \circ 2 zones with different behaviours: 0.5 mm/yr sea level trend uncertainties in the gulf of Guinea and 1 mm/yr sea level trend uncertainties near Cape Verde.



• Most part of these uncertainties is attributed to errors in the Wet Tropospheric Correction

West Europe

Sea Level trend



Sea Level trend uncertainties



← Map of Sea Level trend uncertainties on West European Seas with respect to coast distance and bathymetry

> Predominant source of Sea Level trends uncertainty in the set. \rightarrow

> > trends

coast

are

predominant source \rightarrow

Western

wrt

Measurement



Outlook

Conclusion:

- Higher trends uncertainties in coastal areas: 0.6mm/yr in open ocean to 1.2 mm/yr near coasts.
- No significant difference between coastal and open ocean sea level trend has been be detected (<1mm/yr i.e. within 90%



Sea level trends w.r.t coast distance in Western Europe Measurement occurrences are represented in a red scale.

No specific pattern for sea level trends w.r.t coastal distance

- Higher sea level trends uncertainties in coastal areas
- Sea level trend uncertainties are high in some areas (up to 1,6mm/yr) while lower (~0,6 mm/yr) away from coast.

• Most part of these uncertainties is attributed to errors in the Wet **Tropospheric Correction**

confidence level of local trend).

- No correlation between trends uncertainties and bathymetry has been highlighted,
- Some exceptions: high trends uncertainties in specific non coastal areas \rightarrow to be investigated,
- Wet Tropospheric Correction is a major source for Sea Level trends uncertainties, In some local cases, the lonospheric
 - Correction seems to have an impact.

Prospects:

• Take into account some error sources that are missed by this method i.e. omission errors.



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