ESA CLIMATE CHANGE INITIATIVE EXTENSION (CCI+)

Sea Level Project

Introduction

A. Cazenave

Project Manager
Science Leader
Partners
Objectives of the CCI+ Sea Level Project

1. **COASTAL SEA LEVEL**
   - Produce, validate and deliver consistent sea level time series in a series of selected coastal regions known for their vulnerability to climate change impacts, using reprocessed LRM satellite altimetry missions plus SAR altimetry on Sentinel 3A&3B
   - Estimate the rate of sea level change at the coast over the altimetry era
   - building-up on previous projects (ESA SL_cci and SL_cci ‘Bridging Phase’ projects)

2. **CCI-BASED SEA LEVEL PRODUCTS UNCERTAINTIES**
   - Characterization and reduction of errors affecting sea level products from global to coastal scales
CCI+ Sea Level Project: Part 1 ‘Coastal Sea Level’
Preliminary results on coastal sea level trends from the ESA CCI « Bridging Phase » project (2017/18)

- Combination of ALES retracking with XTRACK 20-Hz sea level data
- Jason-1 + Jason-2 missions (2002-2016)
- 3 pilot regions

Partners:

- CLS
- Technische Universität München
- TUM
- LEGOS
- Consiglio Nazionale delle Ricerche
- National Oceanography Centre
- SKYMAT
Coastal sea level rise in Western Africa from ‘reprocessed’ nadir altimetry

Cameroun

700 m from the coast
Coastal sea level rise in Western Africa from ‘reprocessed’ nadir altimetry

**J1+J2 SLA trends**

Track 174
July 2002 - June 2016

**ESA Climate Change Initiative (CCI) Sea Level Project, 2019**

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image © 2018 DigitalGlobe

DAKAR (Senegal)

2 km from coast de la côte

**Sea level rise (mm/yr)**

**Trend (mm/year)**

**Distance to coast (km)**
1.4 km

Niger River delta

Nigeria

SLA trends along the track

Trend (mm/year)

Distance coastline - point (km)
Coastal Sea Level Change in the Mediterranean Sea
Jason Tracks Coverage

Sea level trends (July 2002 - June 2016) - C3S product

ESA CCI Sea Level Project (Bridging Phase)
Sea level trends

Track 111 N
July 2002 - June 2016

Spain

La Mamola
La Rábita
Guainos Altos
Adra
Venta Nueva
Balanegra
Enseñada

Track 111 N

Trend (mm/yr)

Distance coastline to point (km)

Point #1 36.7371°N/3.0688°W - distance to coast GSHHS: 0.86 km - 58%

Sea level (m)

3.6 mm/yr +/- 1.8 mm/yr

Data: NOAA, U.S. Navy, NGA, GEBCO
© 2018 Google
Sea level trends

Track 085 #2 N
July 2002 - June 2016

Track 085 #2 N

Distance coastline to point (km)

Trend (mm/yr)

Point #1 41.5460°N/8.7894°E - distance to coast GSHHS: 0.70 km - 84%

9.9 mm/yr +/- 2.0 mm/yr

Corsica
Cala d’Avera
Golfe de Murtofi
Golfe de Roccapi

10 km
Sea level trends

Track 020 S
July 2002 - June 2016
Distance to coast (km)

13 valid coastal points (over 23)
at distance <2 km from coast

Computed trend at the closest point to coast (mm/yr)
Mediterranean Sea
Distance to coastline of the closest valid point
Proposed study regions in the CCI+ Sea Level Project

- LRM missions (Jason-1/2/3; Envisat; Saral/Altika) + SAR on Sentinel 3A & 3B
- “Seamless” gridded trends from open ocean to coast
- 2002 - present
- Validation with tide gauges
- Interpretation

Explain observed trends in the coastal zone
- Trends in waves
- Fresh water input from rivers
- Small scale currents
- .......

- Comparison with high-resolution ocean reanalyses
CCI+ Sea Level Project: Part 2 on ‘Uncertainties’
Uncertainty in the estimate of Global Mean Sea Level changes, trend and acceleration (Ablain et al., ESSD, 2019)

→ Quantification of the total Error Budget of the altimetry system for the different missions (empirical models used for each type of error)

- TOPEX A Altimeter drift
- Long term orbit errors
- GIA secular uncertainty
- Interannual/decadal orbit errors
- Wet tropospheric error (interannual time scale)
- Seasonal & subseasonal errors in geophysical corrections
- Bias error due to imperfect link between successive altimetry missions
Uncertainty of the altimetry-based GMSL time series

Error variance-covariance matrix of altimeter GMSL on the 25-years period (January 1993 to December 2017).

Ablain et al. (2019)
Evolution of the GMSL uncertainty (90% confidence level → 1.65 sigma)

Ablain et al., 2019
GMSL + Uncertainty (Ablain et al., 2019)
Uncertainty in the estimate of the GMSL trend

GMSL trend uncertainty (mm/yr) estimated for different record lengths over the 25-year-long time span (January 1993 to December 2017). The confidence level is 90% (i.e. 1.65σ).

Ablain et al. (2019)
Errors in regional sea level trends

Very preliminary sea level trend uncertainties (mm/yr) estimated for the altimetry 25-years period (January 1993 to December 2017). The confidence level is 90% (i.e. 1.65σ).
More in WP4 presentation (Pierre Prandi & Benoit Meyssignac)