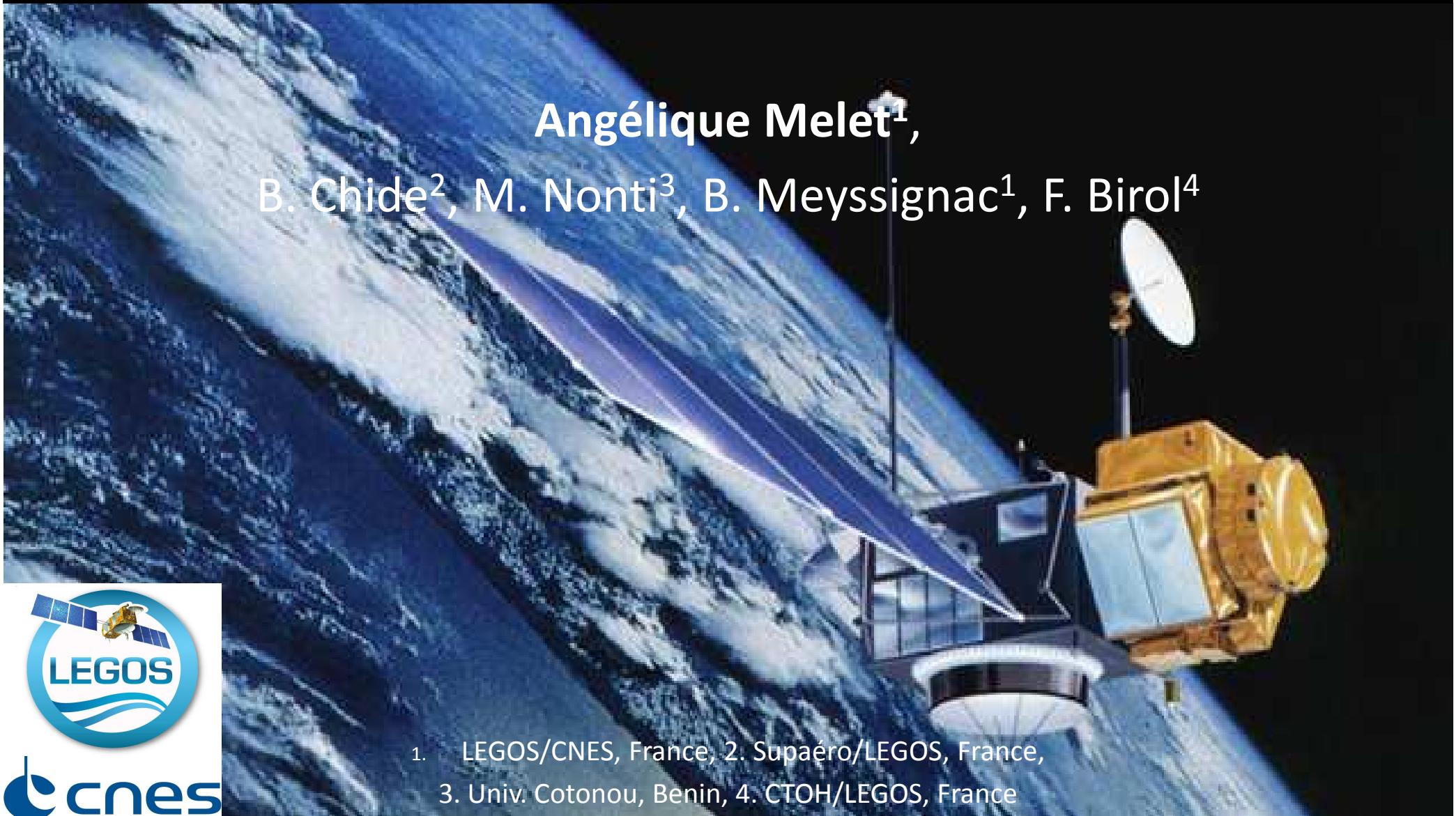


# Comparing coastal and open ocean sea level variability and trend from altimetric data

Angélique Melet<sup>1</sup>,

B. Chide<sup>2</sup>, M. Nonti<sup>3</sup>, B. Meyssignac<sup>1</sup>, F. Birol<sup>4</sup>

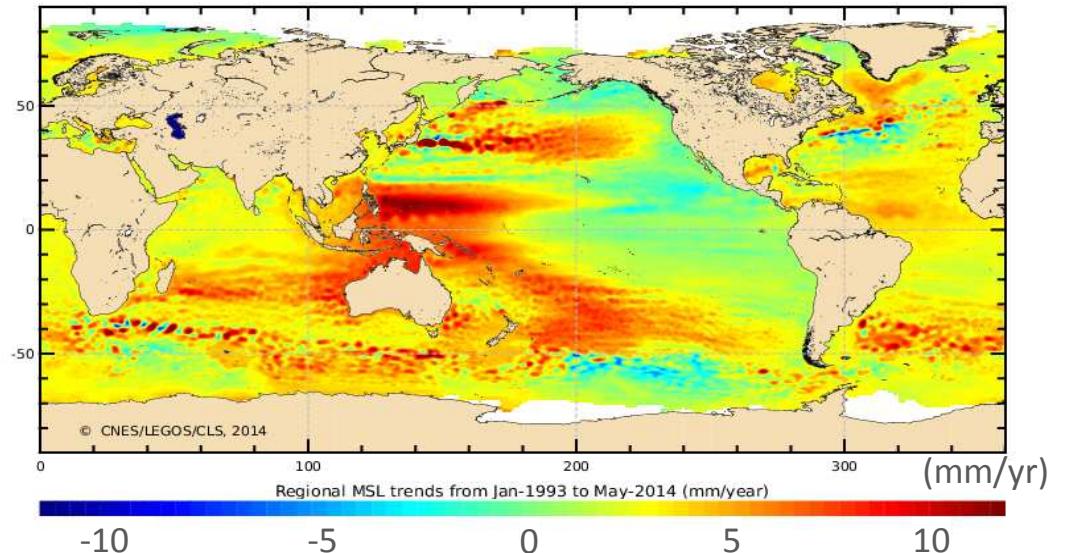


1. LEGOS/CNES, France, 2. Supaéro/LEGOS, France,
3. Univ. Cotonou, Benin, 4. CTOH/LEGOS, France

# Open ocean - coastal sea level

## ► Why coastal sea level ?

- Socio-economic impacts
- Great spatial inhomogeneity of sea level trend and variability



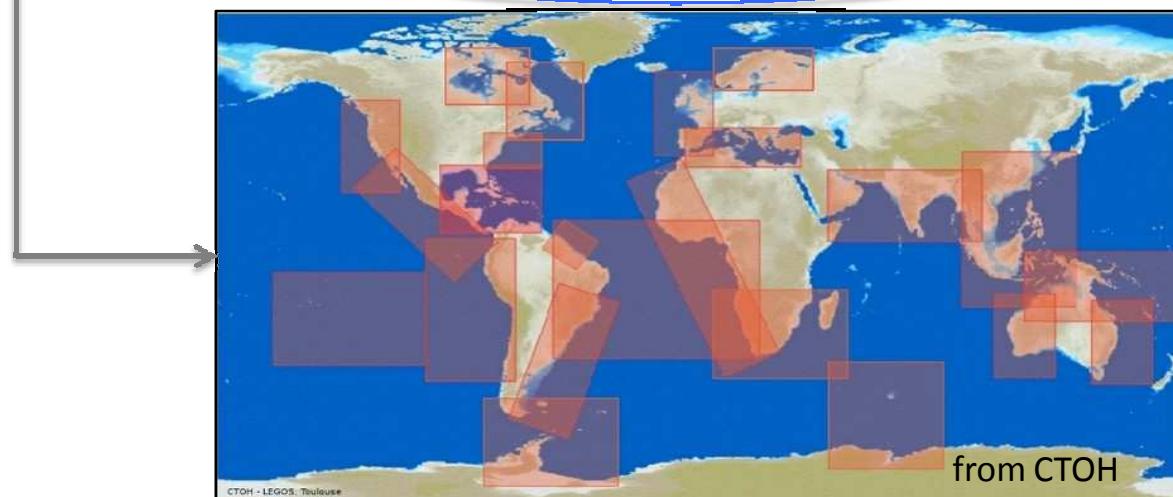
## ► Objectives

**Do sea level trend and variability change when approaching the coast ?**

# Altimetric datasets

- Missions: T/P, J1, J2 over 1993-2012, along-track

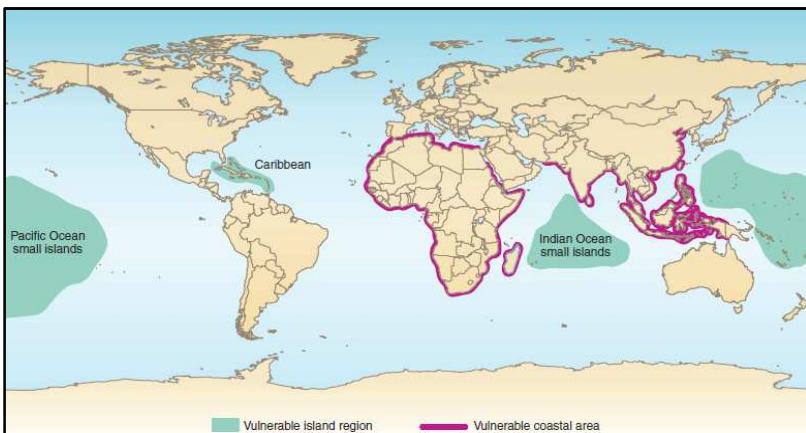
Product	Coverage	Processing	Editing	Wet tropo	Corrections		
					Orbit	Tide	DAC
AVISO SSALTO/DUAC S2014	Global	Spatial filtering	Conservative	Radiometer	✓	GOT4v8	MOG2D (ECMWF)
CTOH XTRACK	Regional	XTRACK 1 Hz	Regional Less conservative	Radiometer + Extrapolation to coast	✗	FES12	MOG2D (ECMWF)



Adapted to  
coastal  
regions !

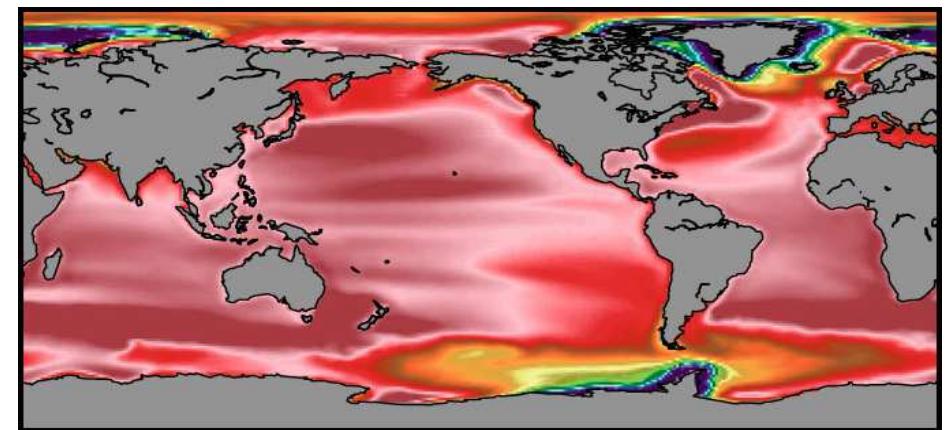
# Regions studied

## ► Vulnerability

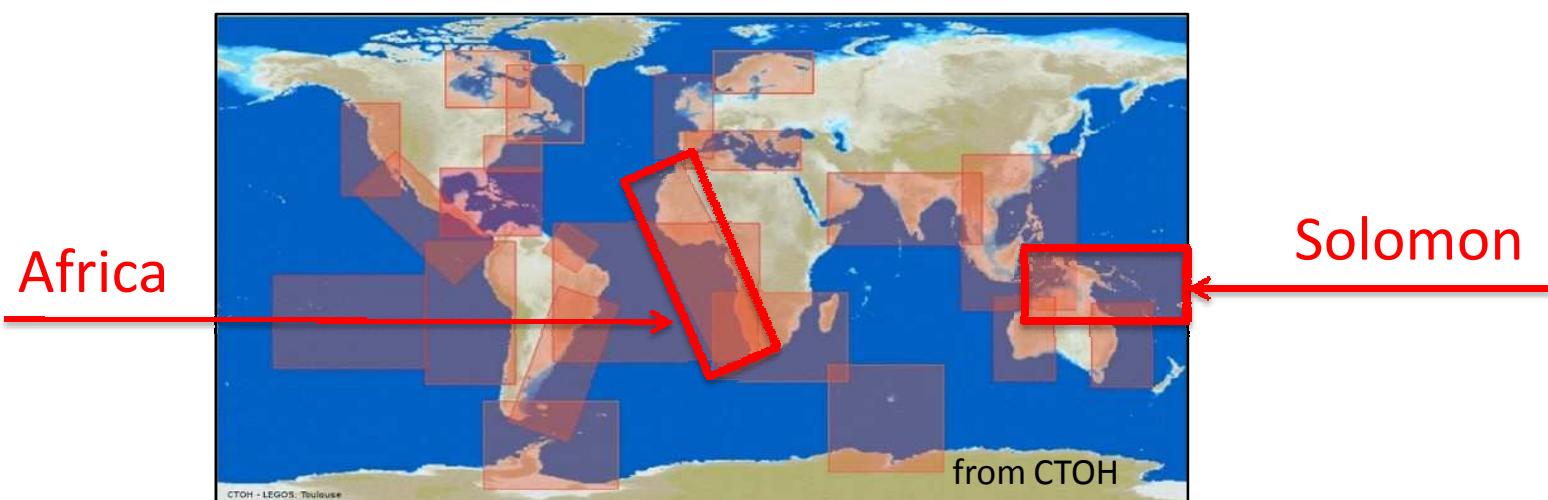


Nicholls and Cazenave 2010

## ► Future sea level rise



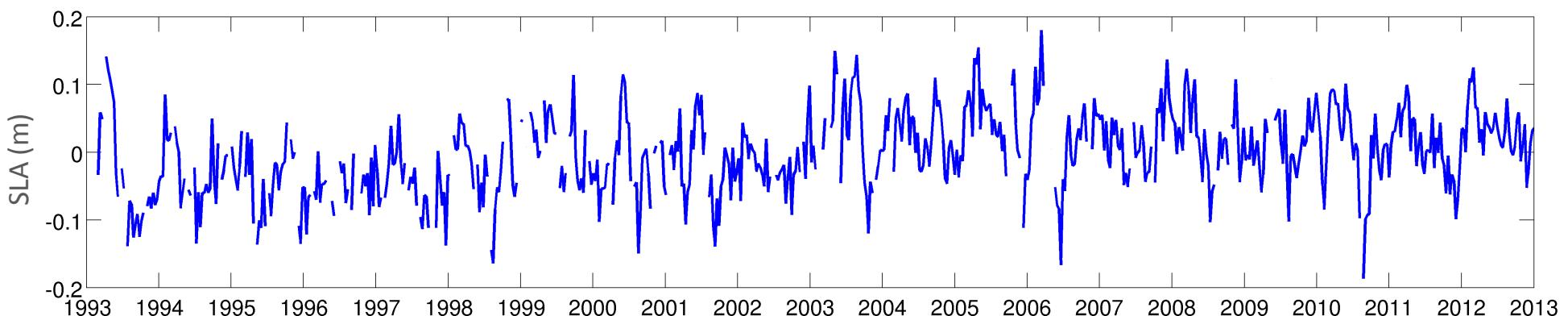
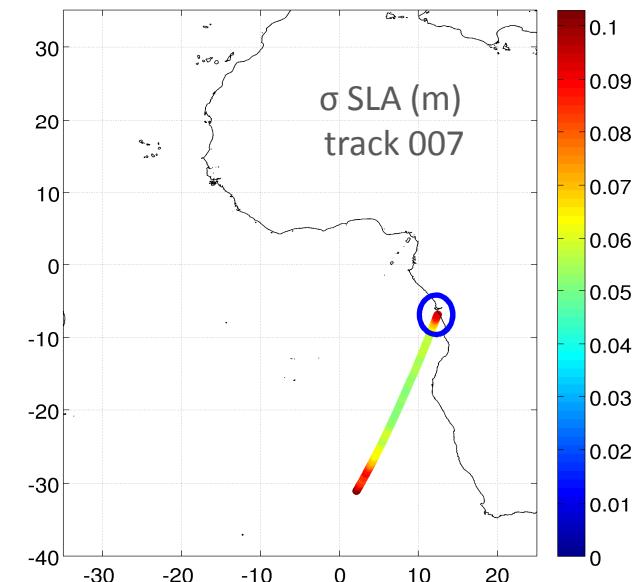
Sea level change (m) 2081-2100 from 1986-2005  
using scenario RCP8.5. Slanen et al. 2014



# Post-processing of CTOH/XTRACK data

## ► Need to flag erroneous data

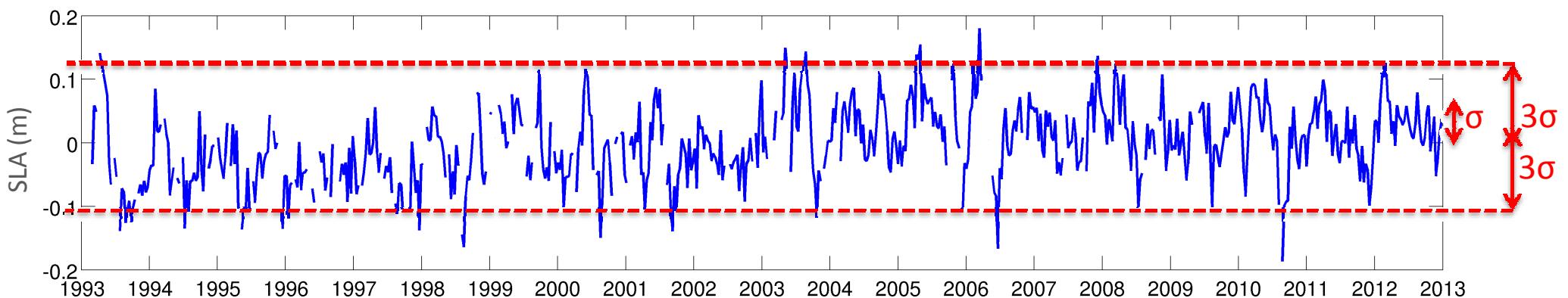
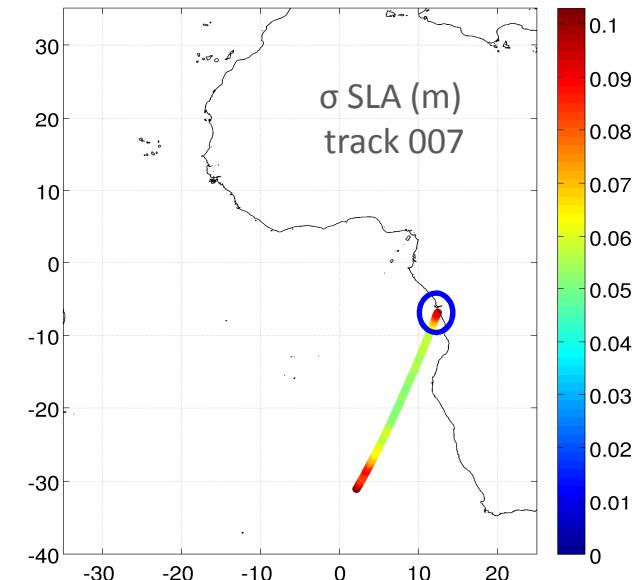
- Number of valid cycles : 500 over 747
- Filter  $3\sigma$
- Filter  $2\sigma$
- Filter for coastal points:  $\Delta\sigma$
- Differences Jason – T/P :  $\Delta\sigma$



# Post-processing of CTOH/XTRACK data

## ► Need to flag erroneous data

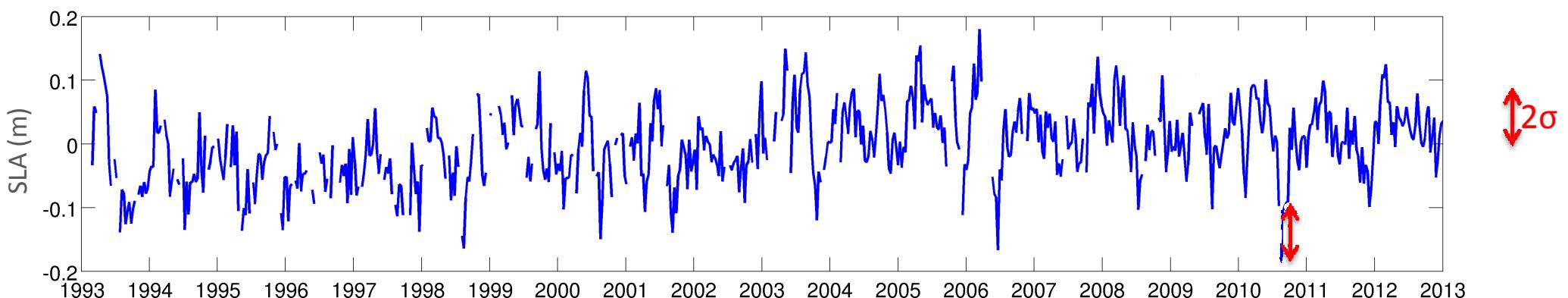
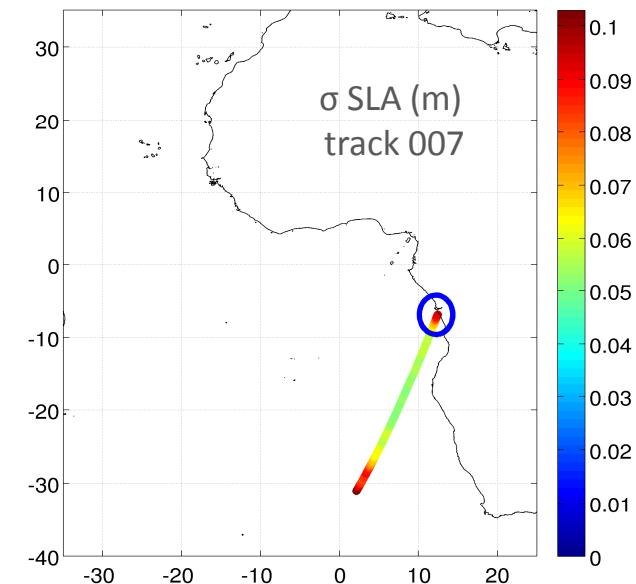
- Number of valid cycles : 500 over 747
- **Filter 3- $\sigma$**
- Filter 2- $\sigma$  cycle-to-cycle
- Filter for coastal points:  $\Delta\sigma$
- Differences Jason – T/P :  $\Delta\sigma$



# Post-processing of CTOH/XTRACK data

## ► Need to flag erroneous data

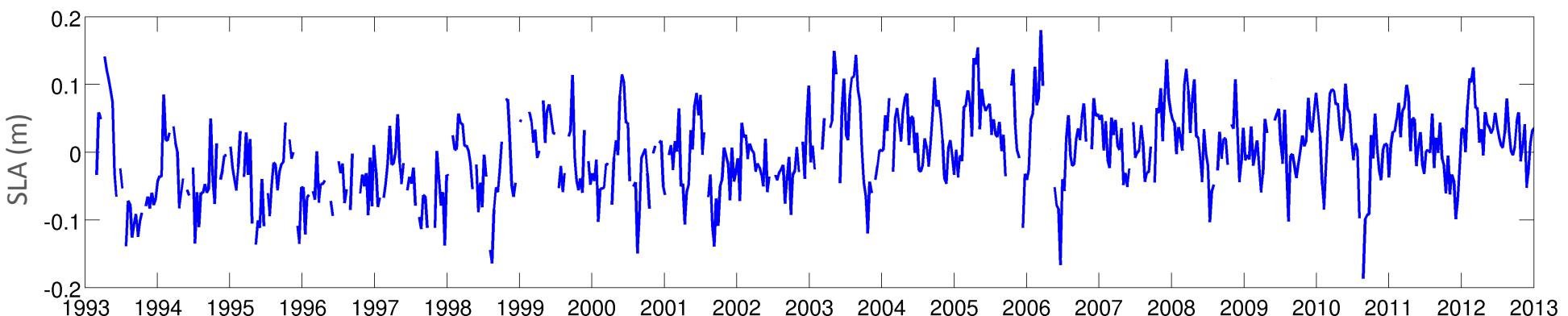
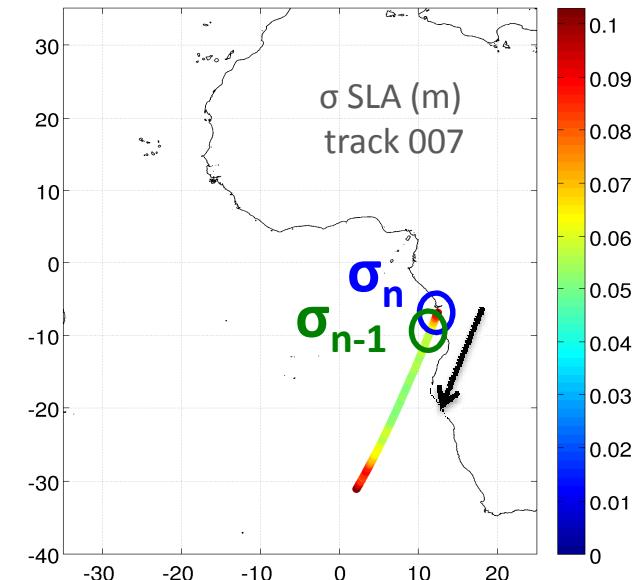
- Number of valid cycles : 500 over 747
- Filter 3- $\sigma$
- **Filter 2- $\sigma$  cycle-to-cycle**
- Filter for coastal points:  $\Delta\sigma$
- Differences Jason – T/P :  $\Delta\sigma$



# Post-processing of CTOH/XTRACK data

## ► Need to flag erroneous data

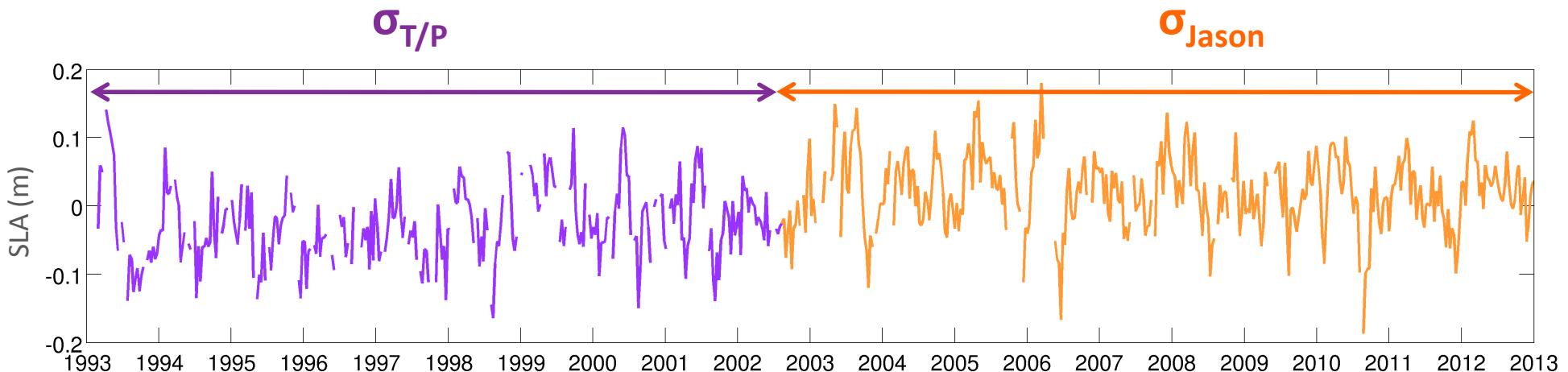
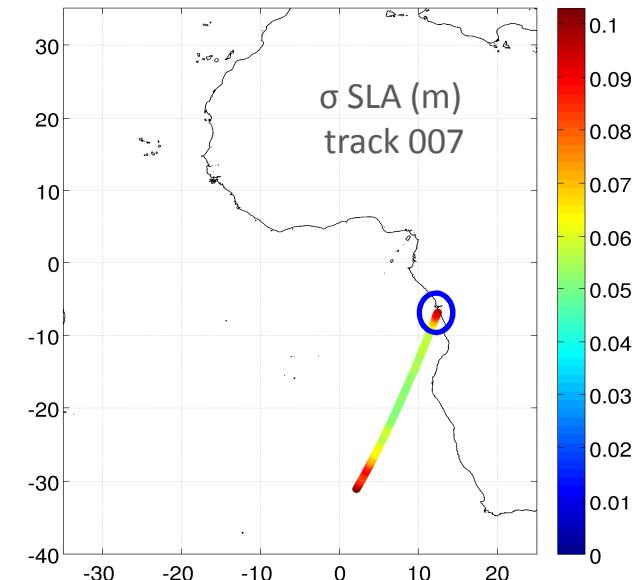
- Number of valid cycles : 500 over 747
- Filter 3- $\sigma$
- Filter 2- $\sigma$  cycle-to-cycle
- **Filter for coastal points:  $\Delta\sigma$**
- Differences Jason – T/P :  $\Delta\sigma$



# Post-processing of CTOH/XTRACK data

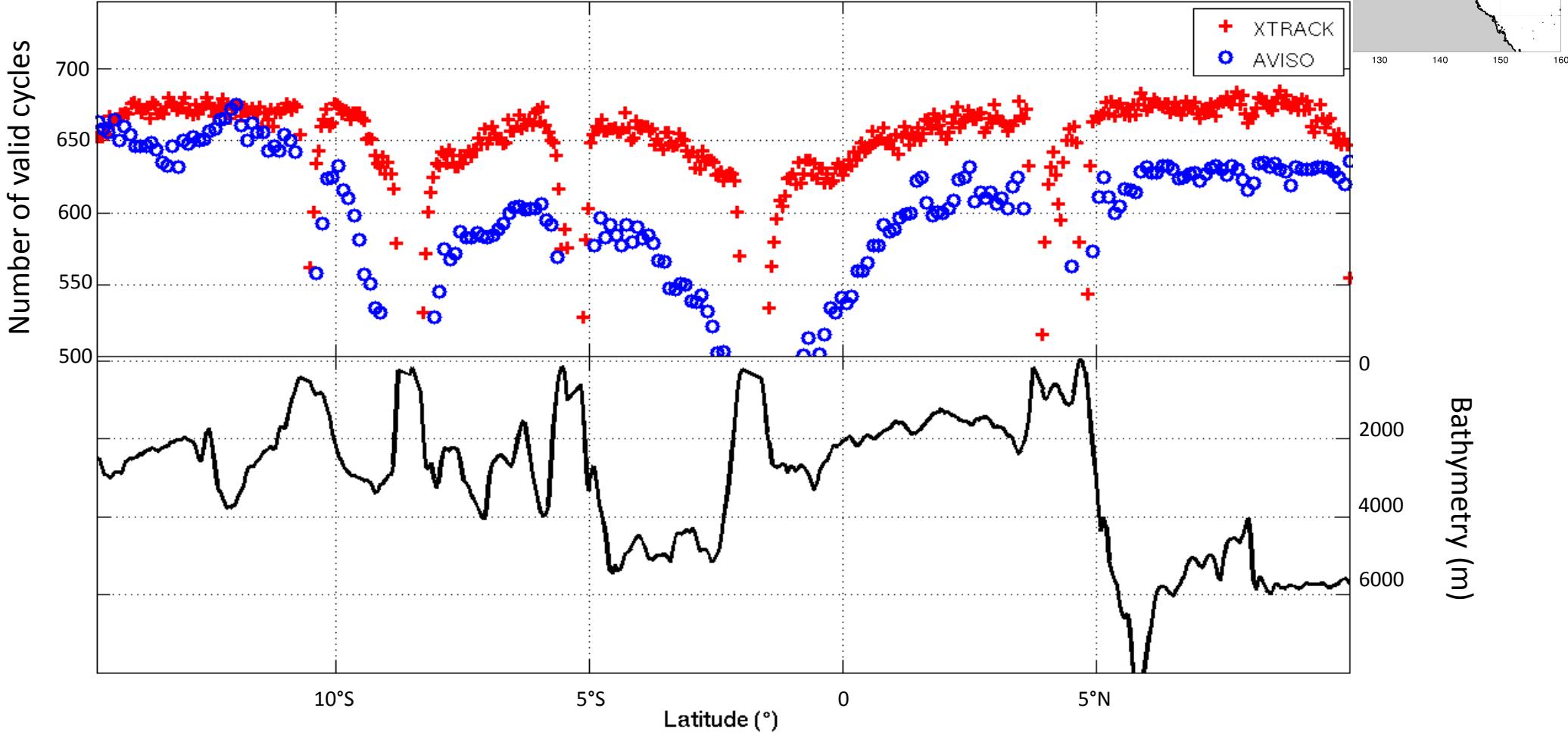
## ► Need to flag erroneous data

- Number of valid cycles : 500 over 747
- Filter 3- $\sigma$
- Filter 2- $\sigma$  cycle-to-cycle
- Filter for coastal points:  $\Delta\sigma$
- **Differences Jason – T/P :  $\Delta\sigma$**



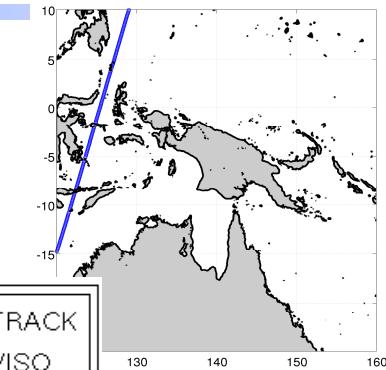
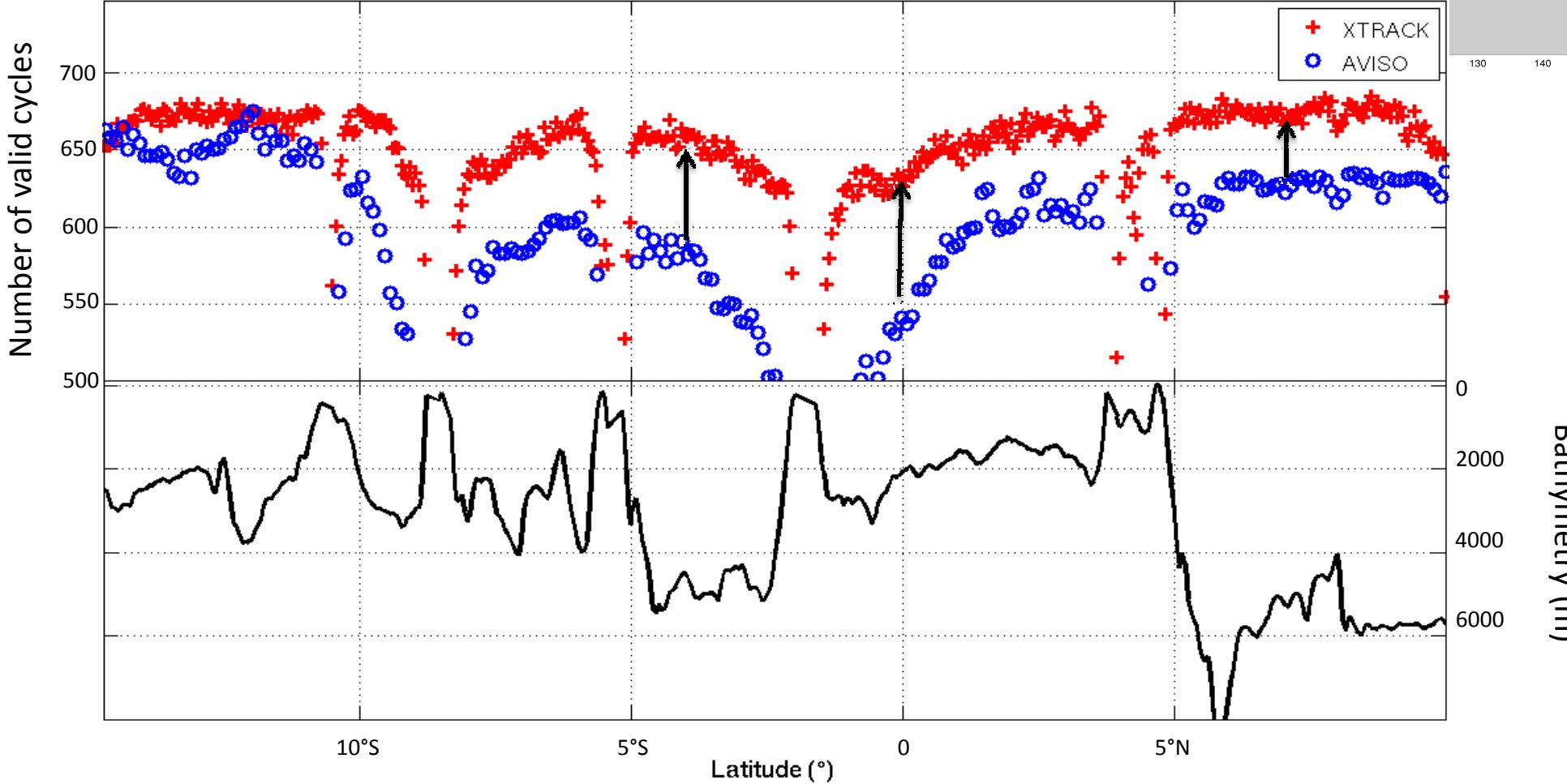
# Comparing AVISO and XTRACK

## ► Gain of information



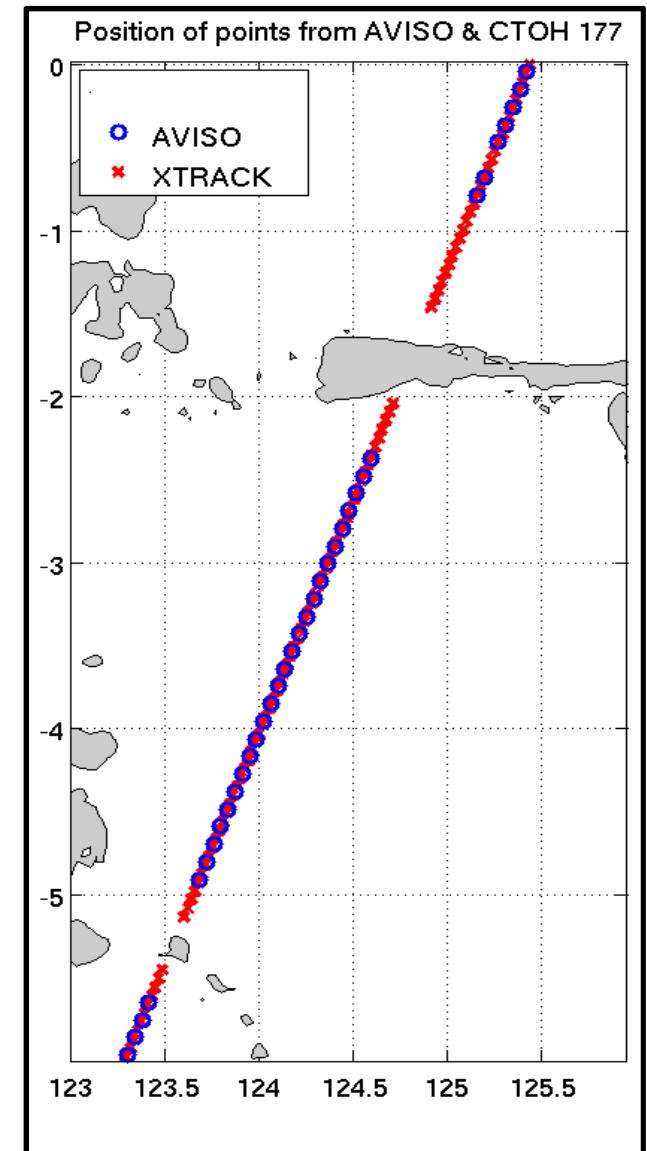
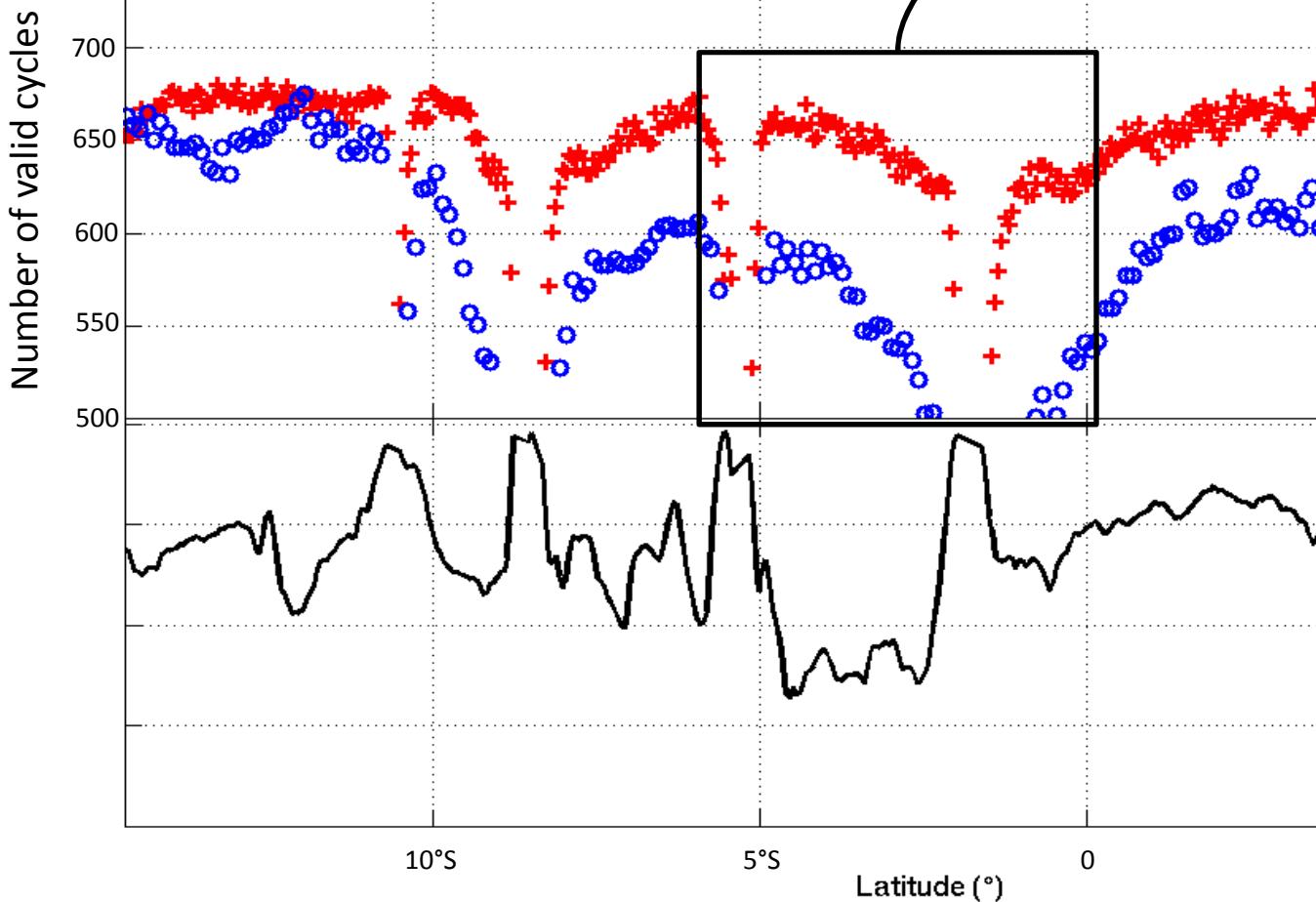
# Comparing AVISO and XTRACK

## ► Gain of information



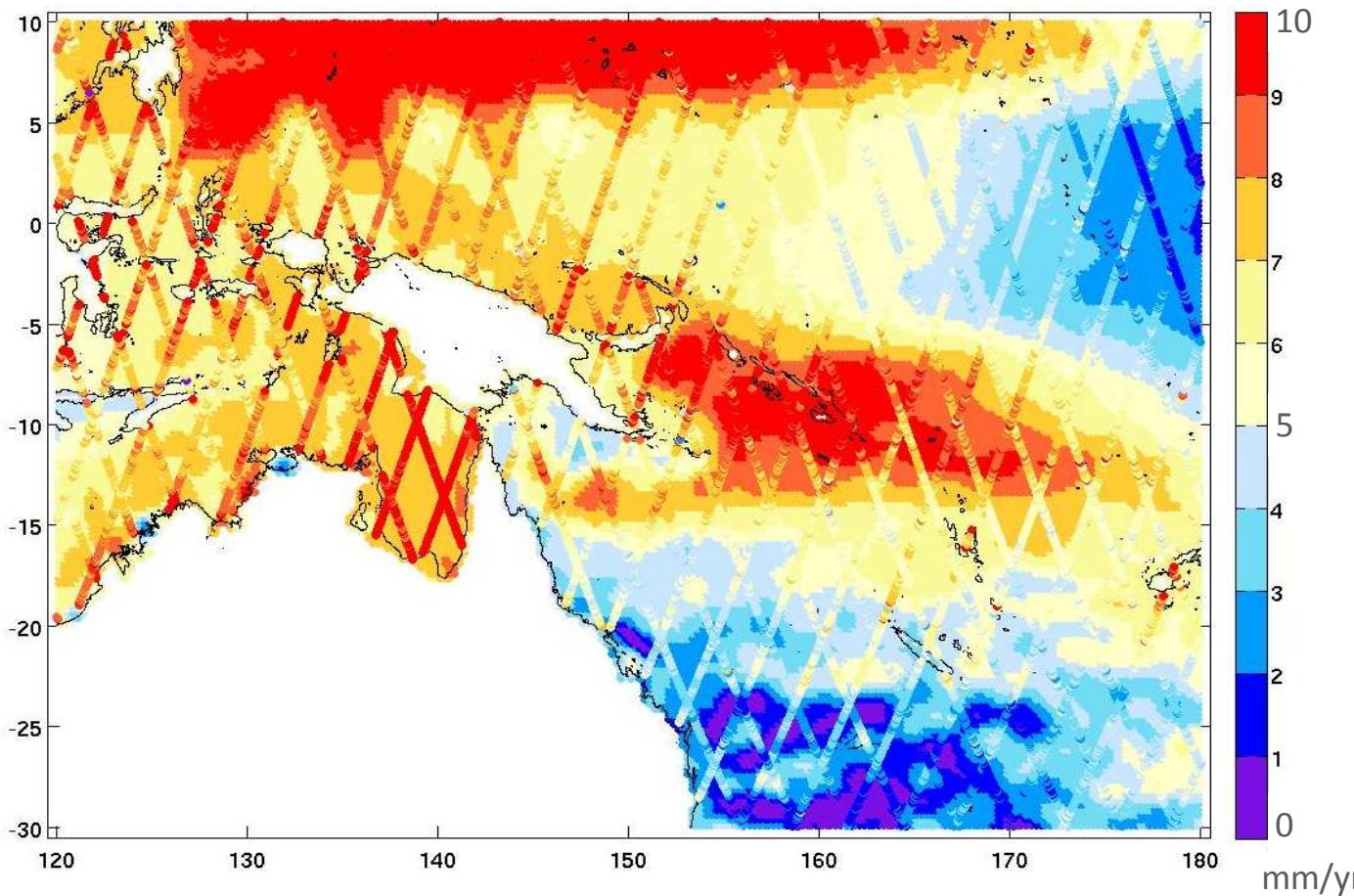
# Comparing AVISO and XTRACK

## ► Gain of information



# Comparing AVISO (gridded) and XTRACK

- ▶ Trend in sea level over 1993-2012



Orbit and LW correction  
missing in XTRACK



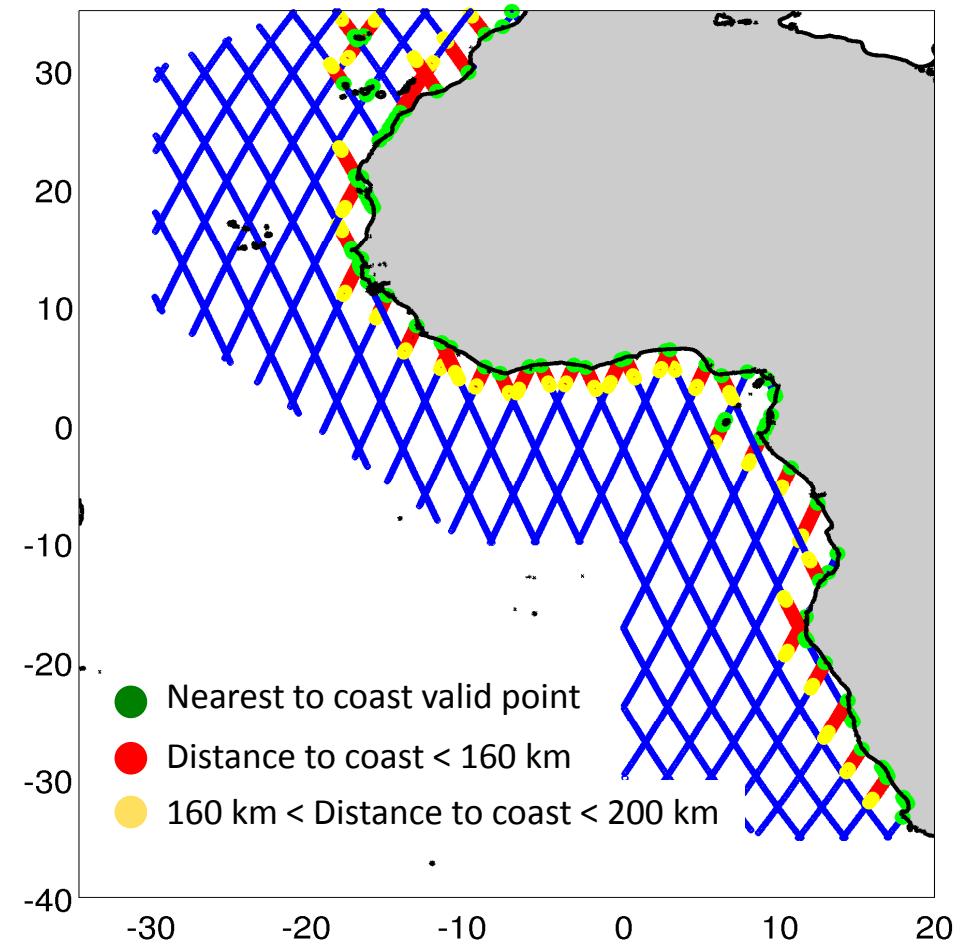
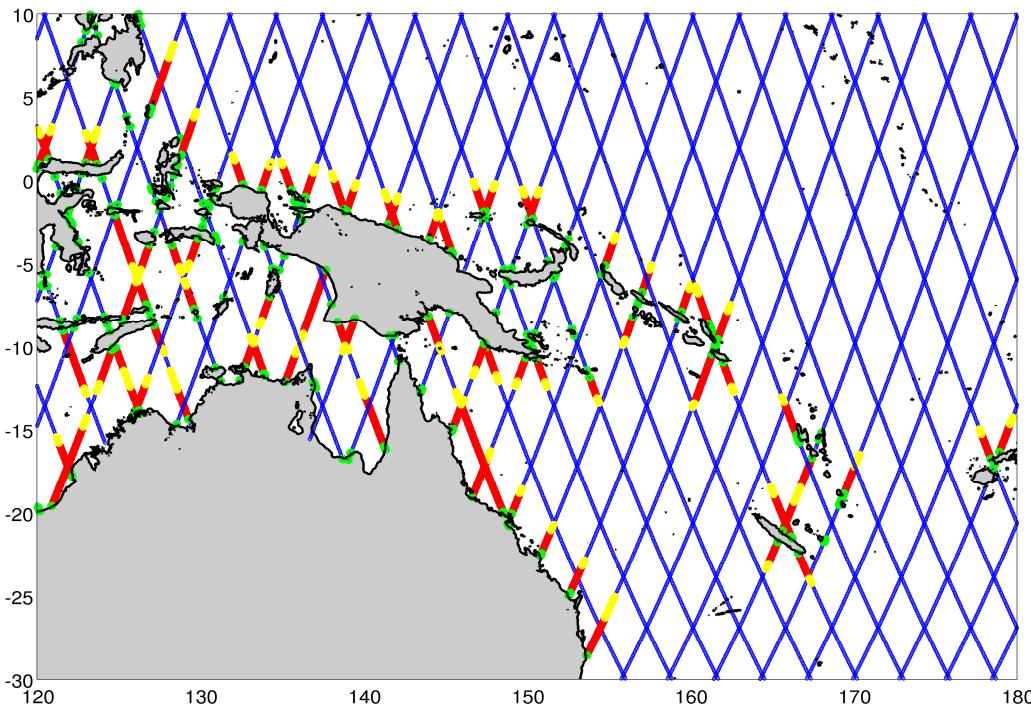
Lack of inter-calibration



Need to look at  
sea level RELATIVE  
to open ocean values

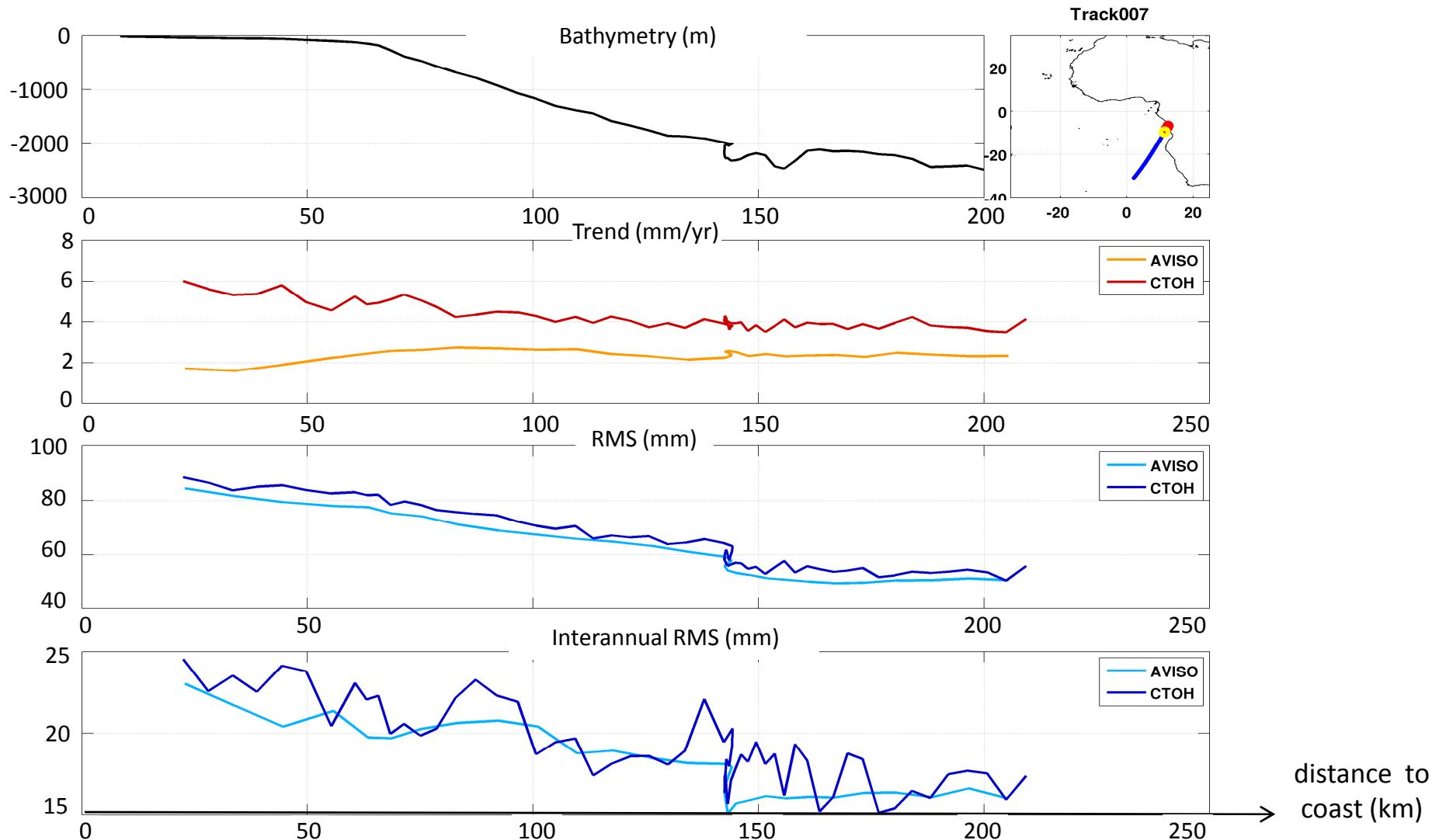
# Sea level relative to open ocean

- ▶ **Coastal sections** : 0-200 km offshore
- ▶ **Distance to the coast** : CLS
- ▶ **« Open ocean »** : 160-200 km offshore



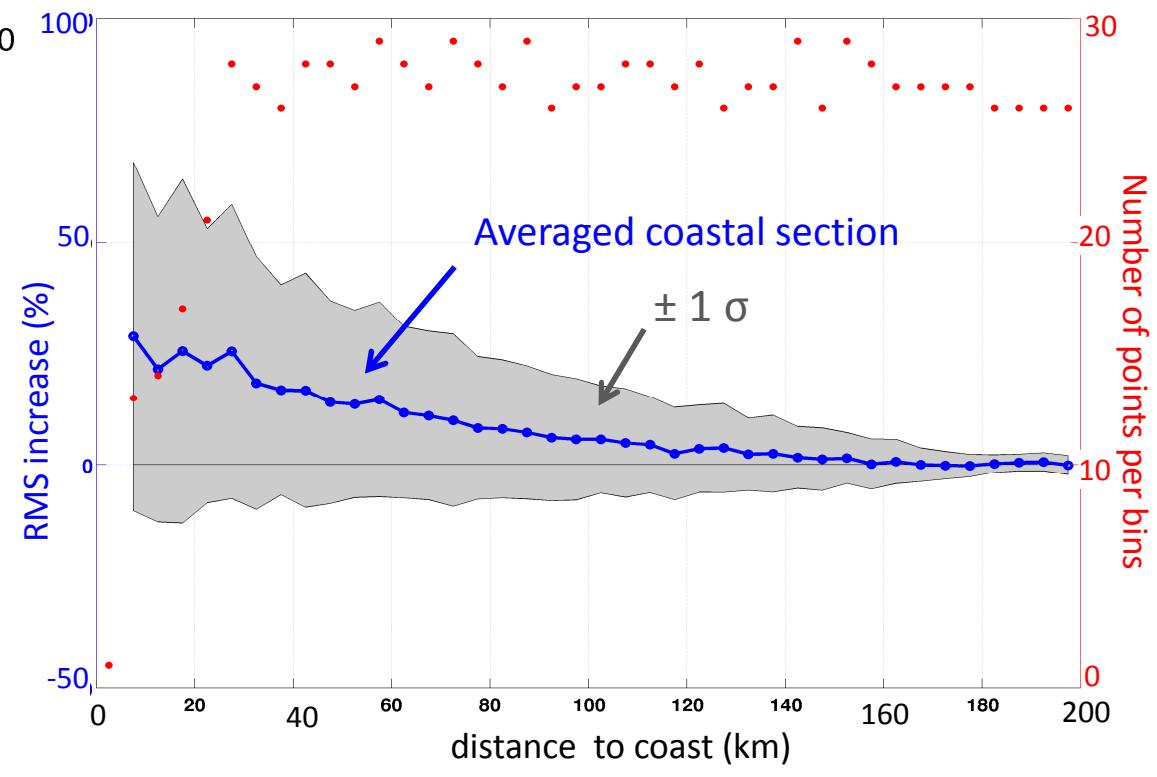
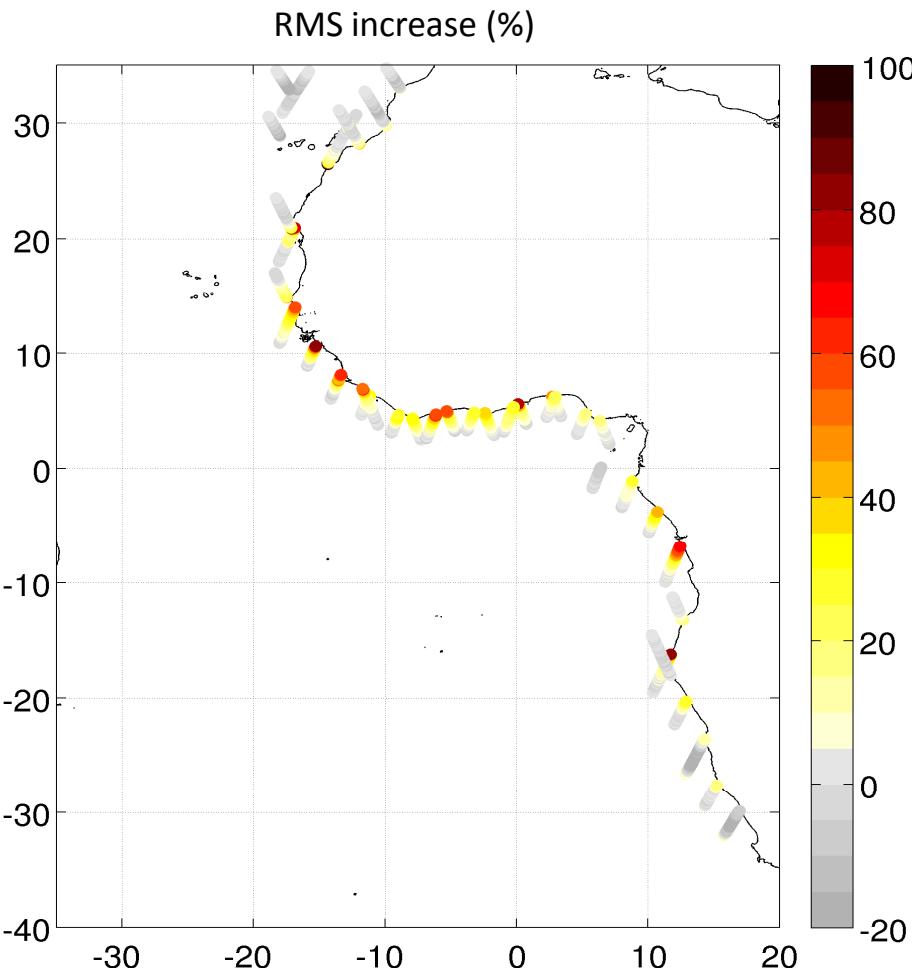
# Sea level relative to open ocean

- **Coastal sections** : trend, rms, interannual rms of SLA



# Sea level variability

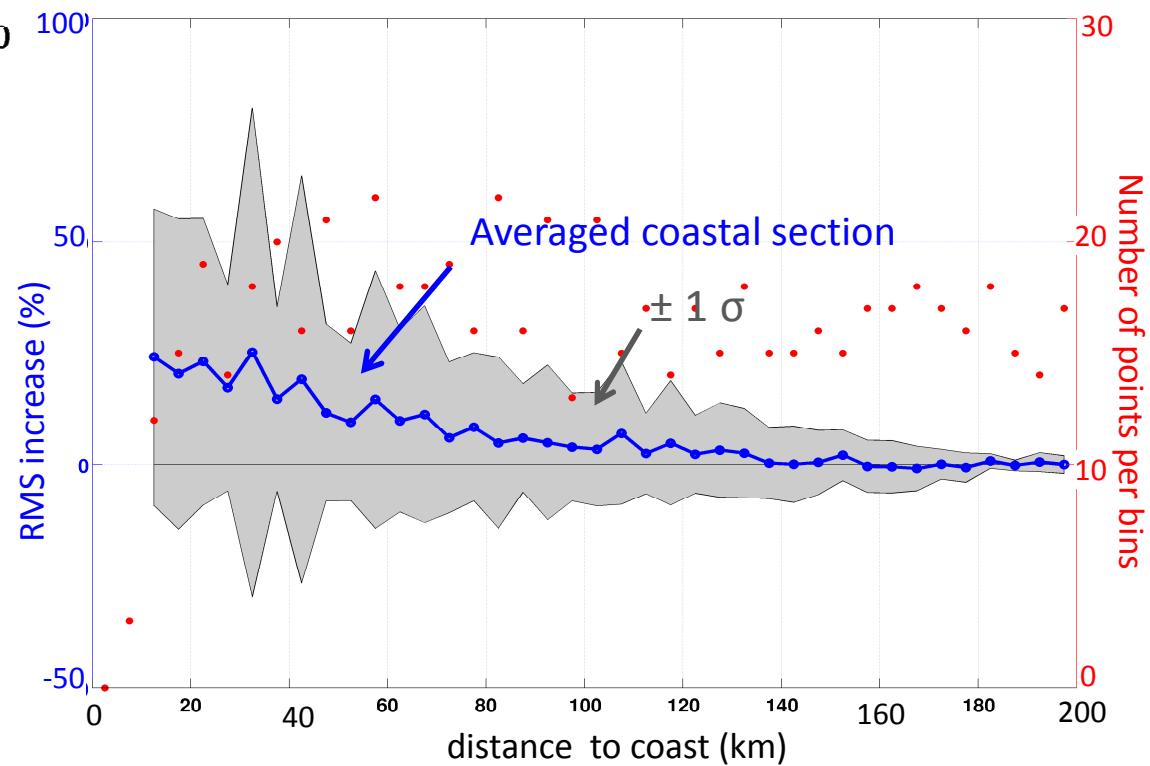
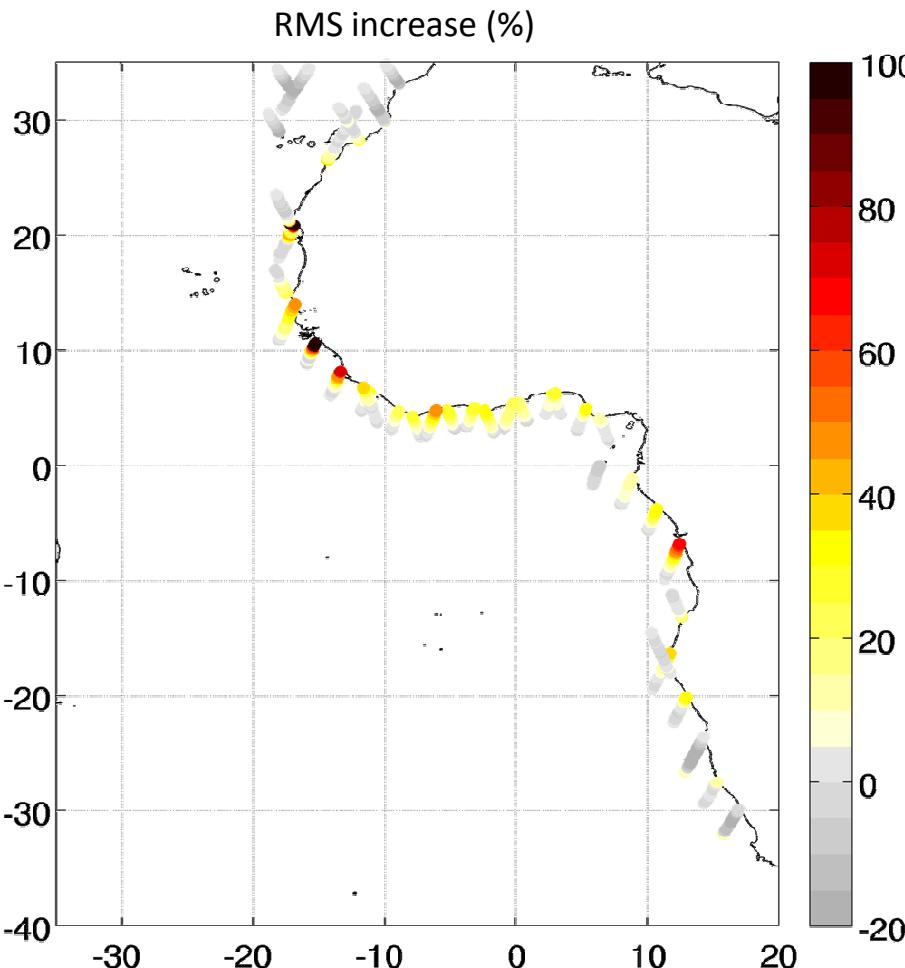
- **Coastal sections** : rms CTOH/XTRACK



Larger variability closer to the coast ( $\approx +30\%$ )

# Sea level variability

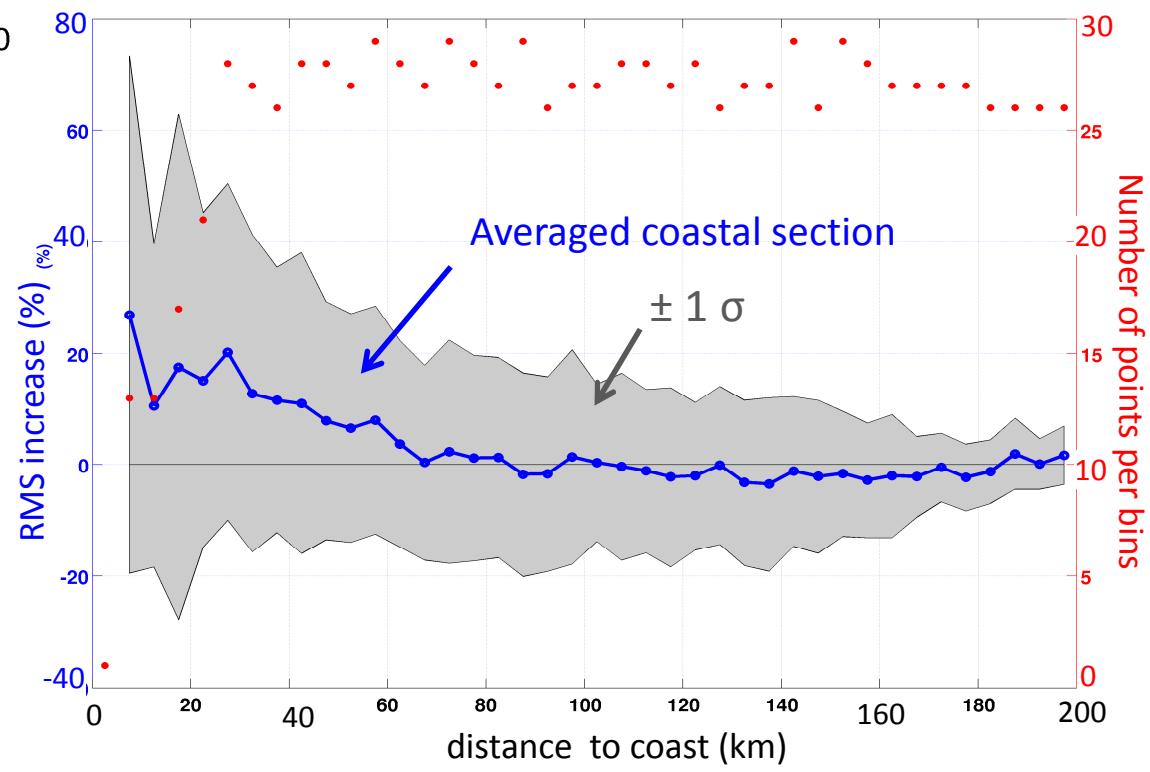
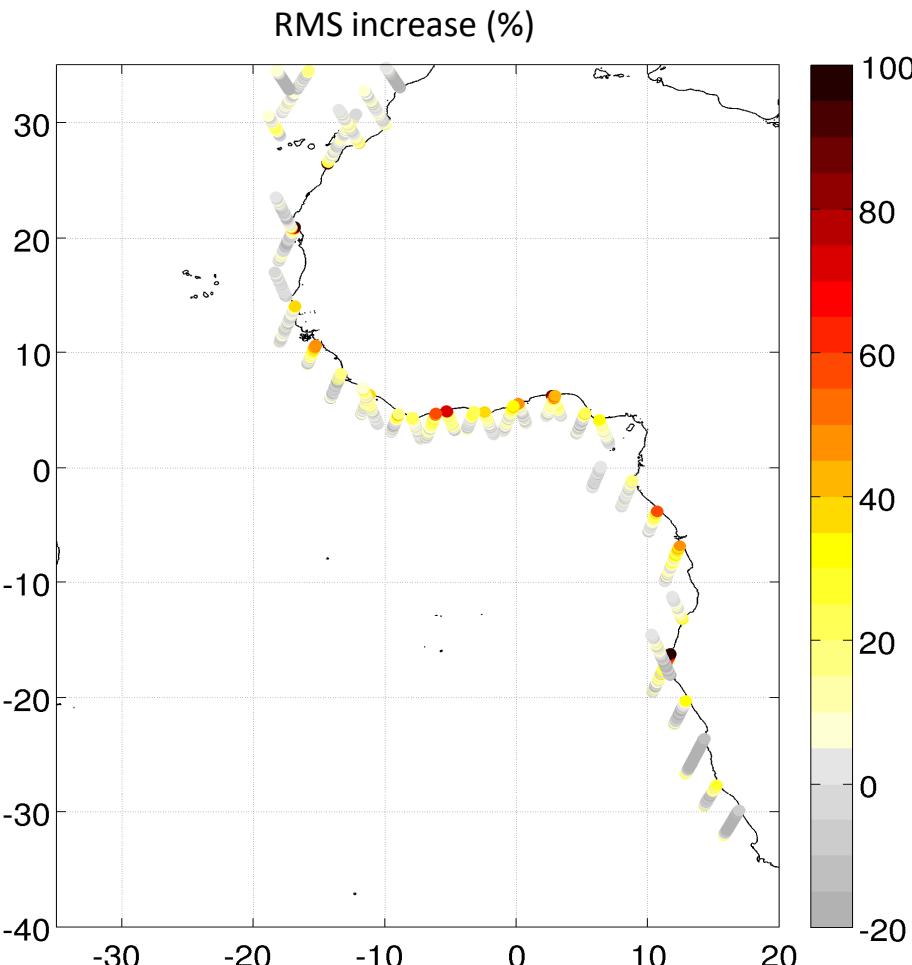
## ► Coastal sections : rms AVISO



Robust patterns

# Sea level variability

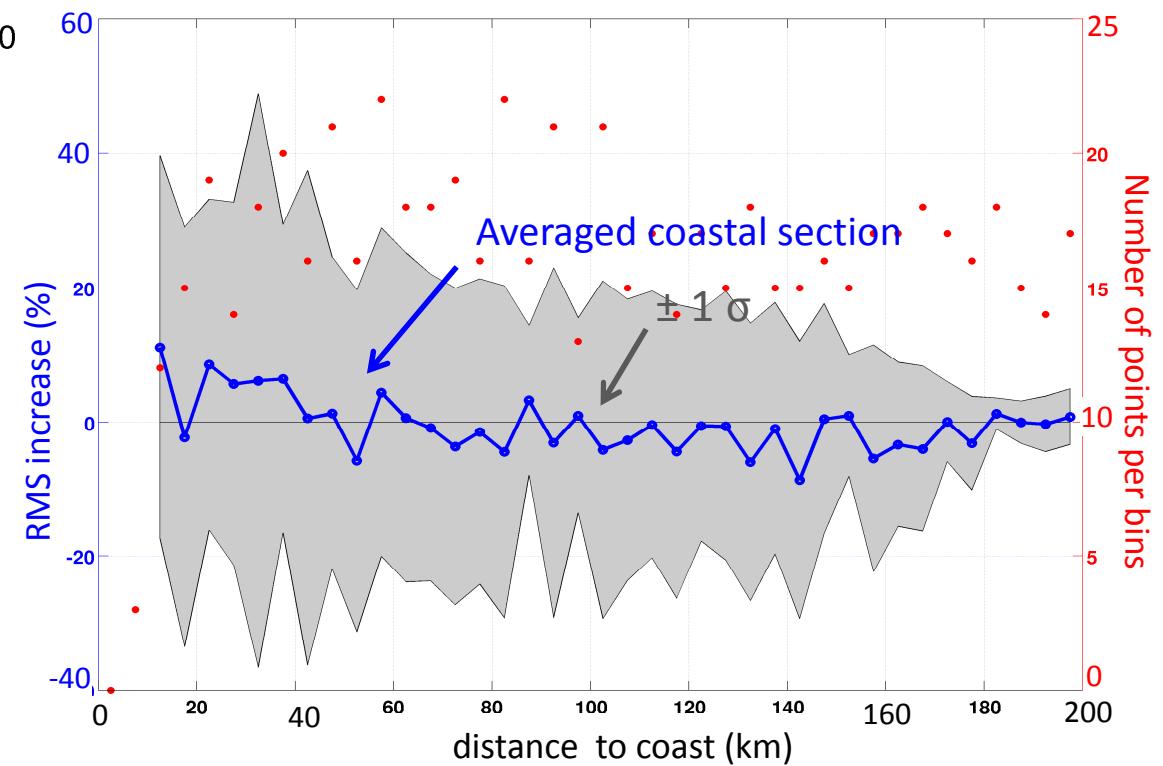
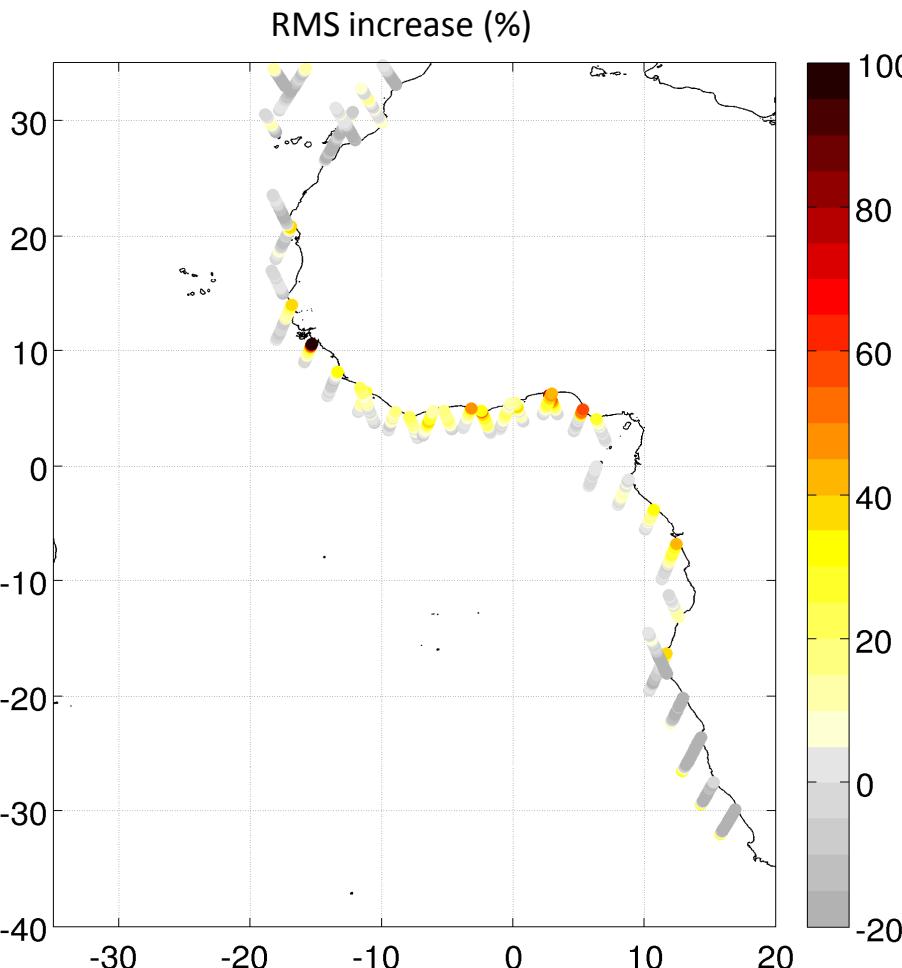
- **Coastal sections** : rms at interannual scales CTOH/XTRACK



Larger variability closer to the coast  
at interannual time scales too ( $\approx +20\%$ )

# Sea level variability

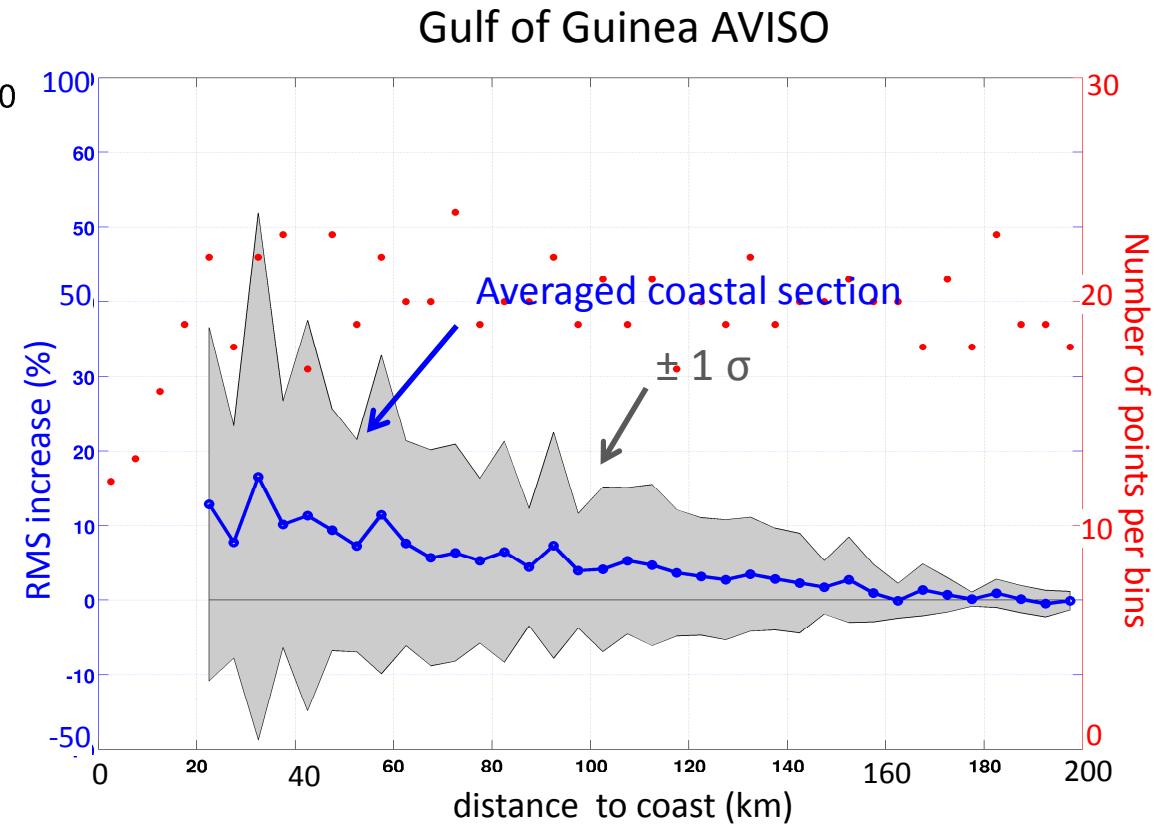
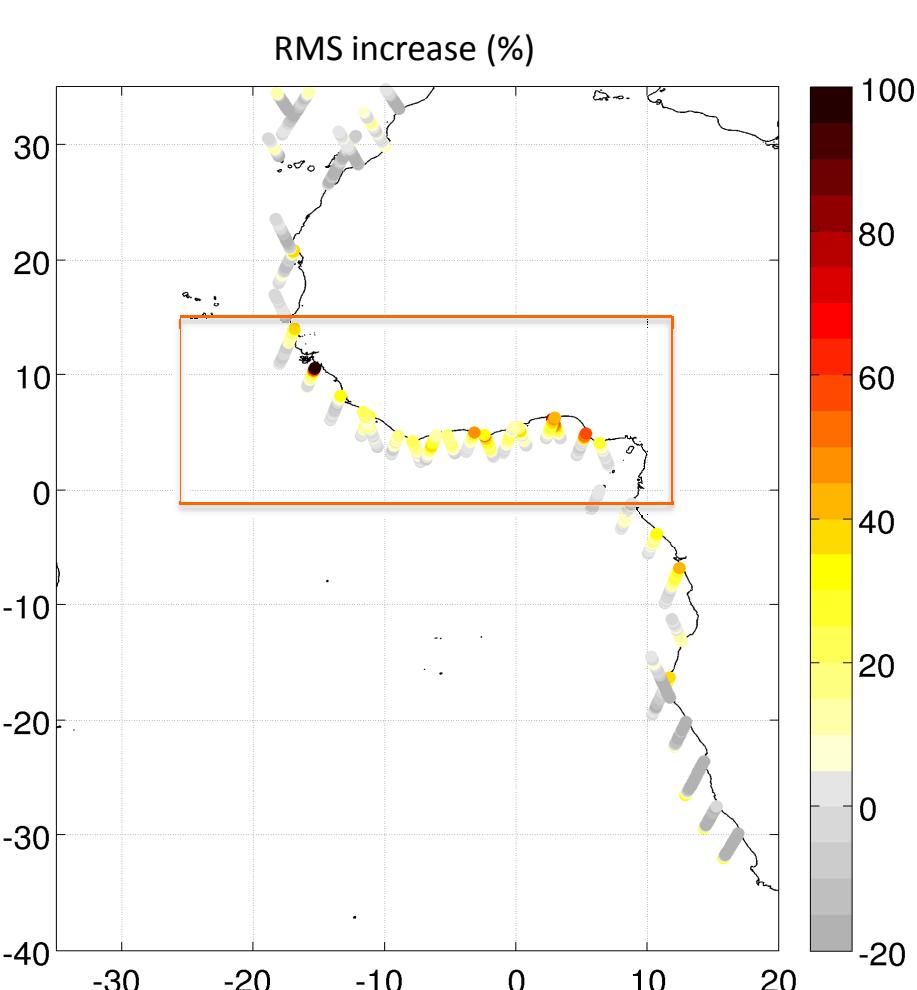
- **Coastal sections** : rms at interannual scales AVISO



Not robust for the average of  
ALL coastal sections

# Sea level variability

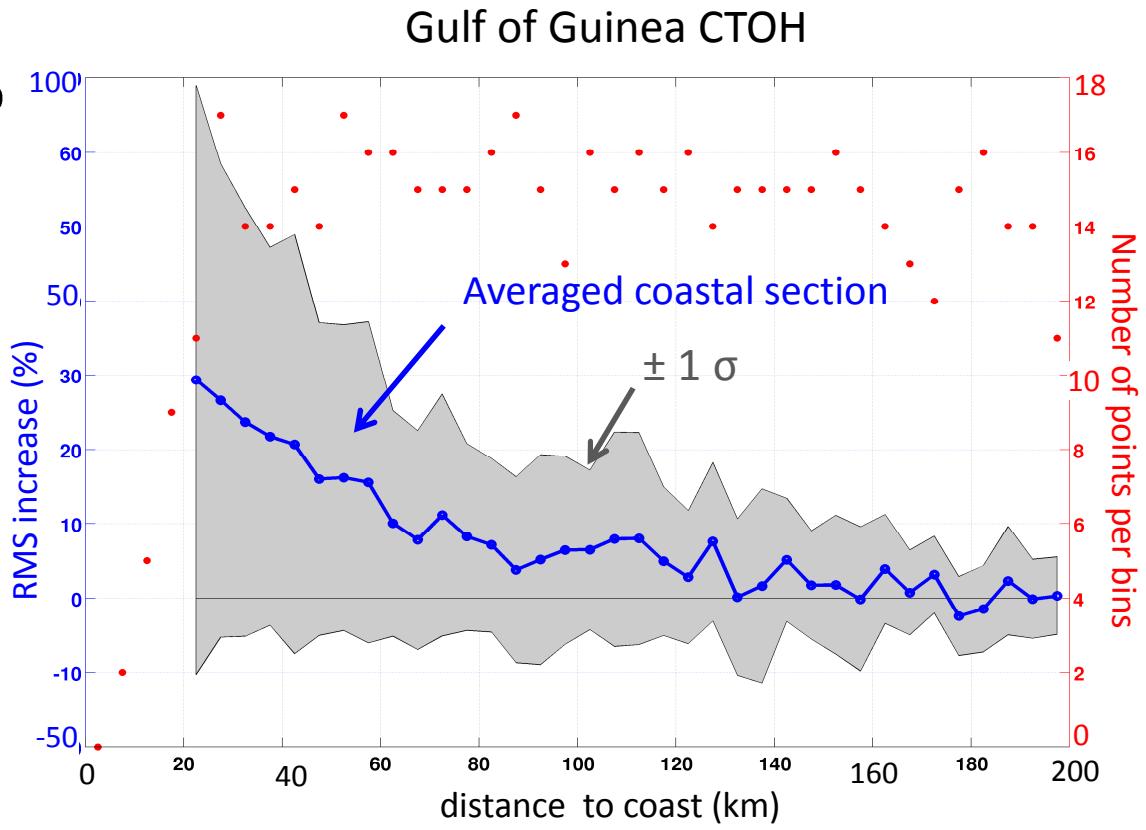
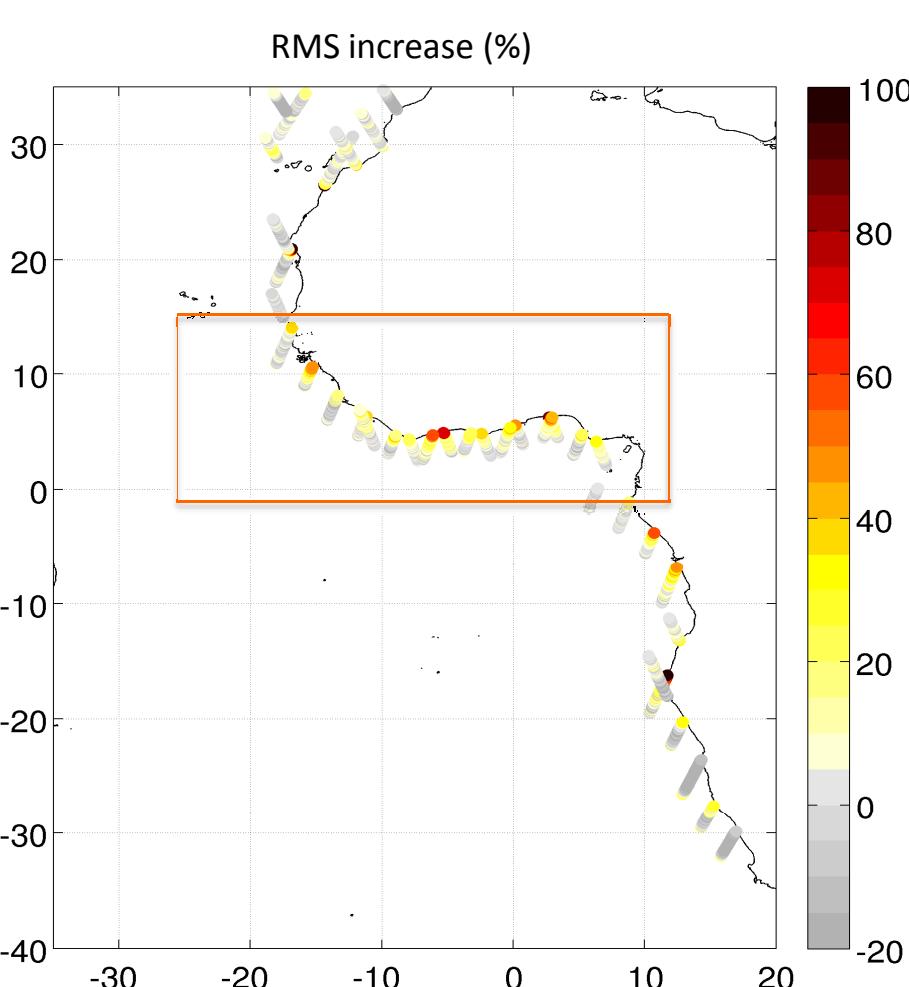
- **Coastal sections** : rms at interannual scales AVISO



Robust increase of interannual RMS onshore  
over Gulf of Guinea

# Sea level variability

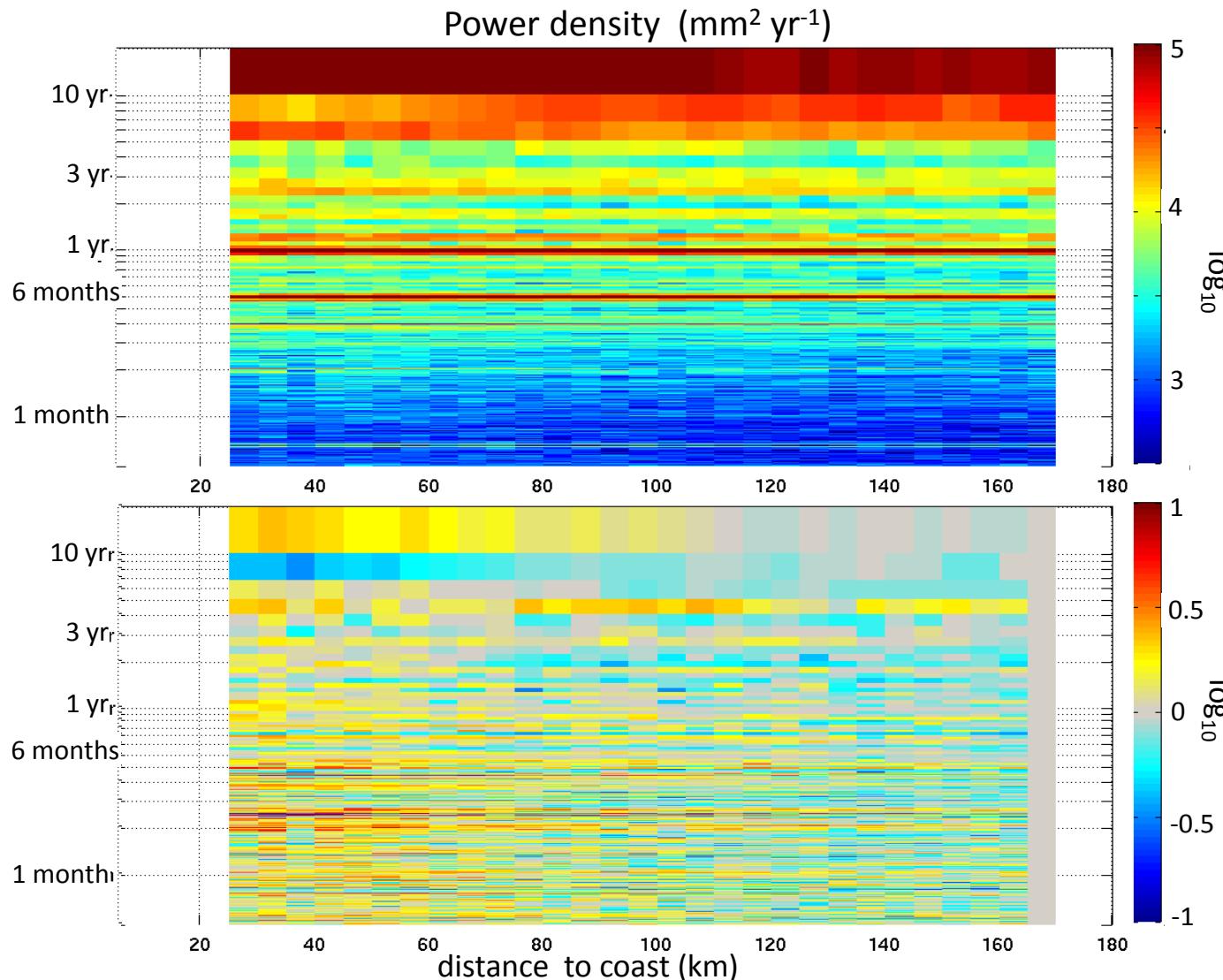
- **Coastal sections** : rms at interannual scales CTOH/XTRACK



Robust increase of interannual RMS onshore  
over Gulf of Guinea

# Spectral analysis

- **Coastal sections** : CTOH/XTRACK over Gulf of Guinea

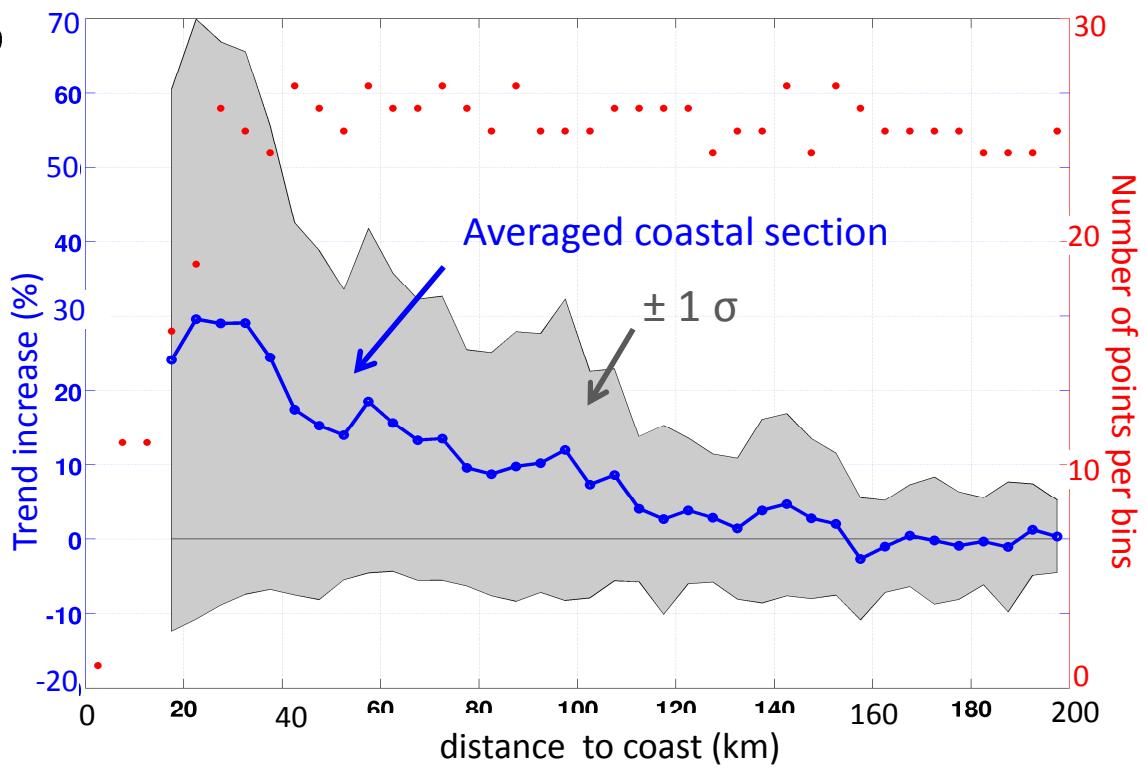
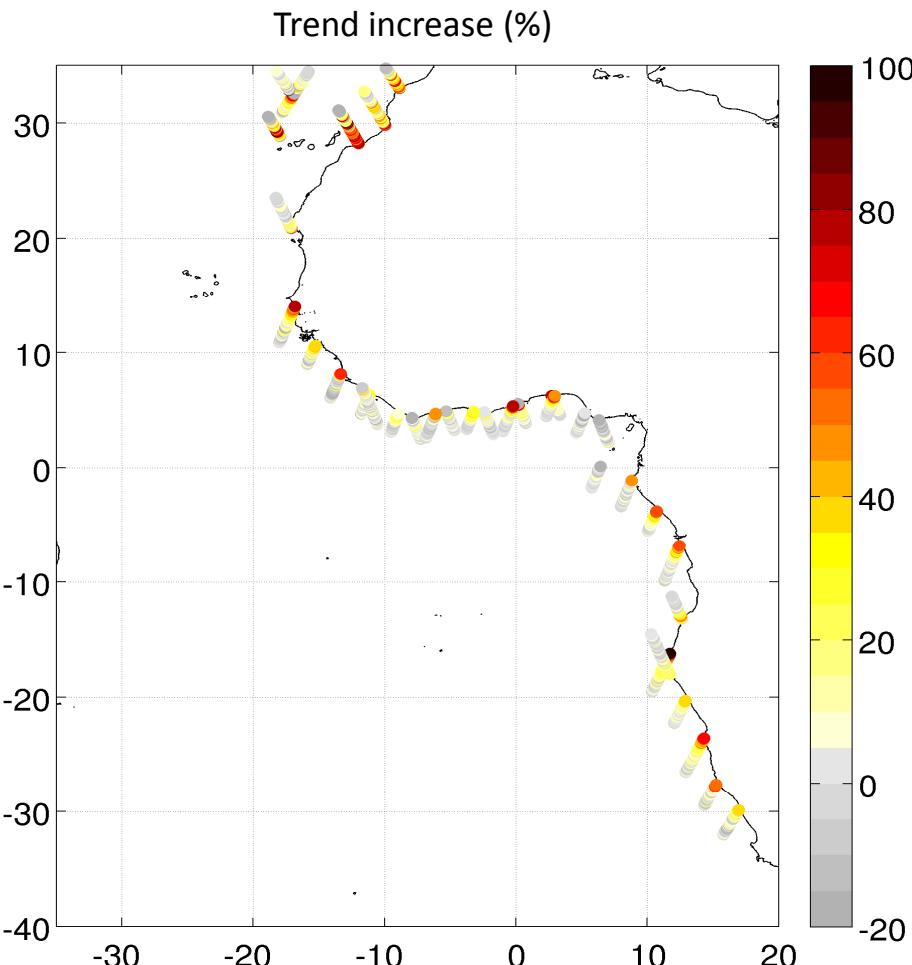


More variability onshore  
on a wide range of  
frequency ?

Power density anomalies  
from offshore point ( $\text{mm}^2$   
 $\text{yr}^{-1}$ )

# Sea level trends

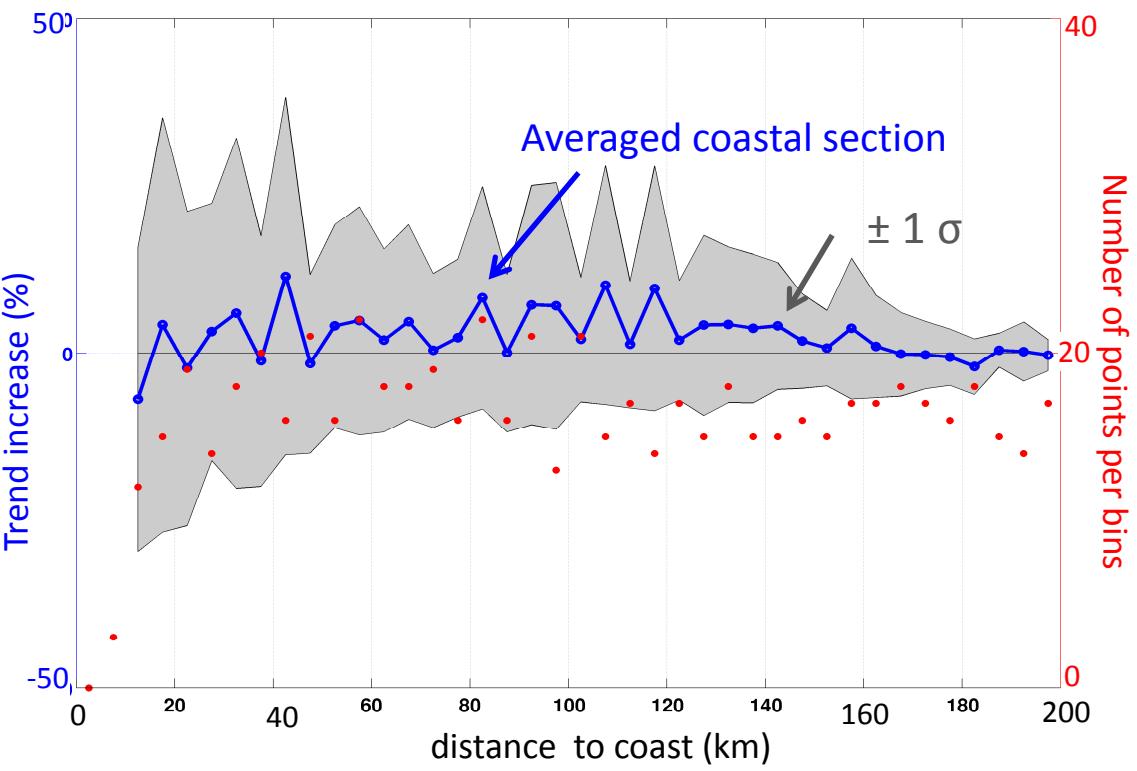
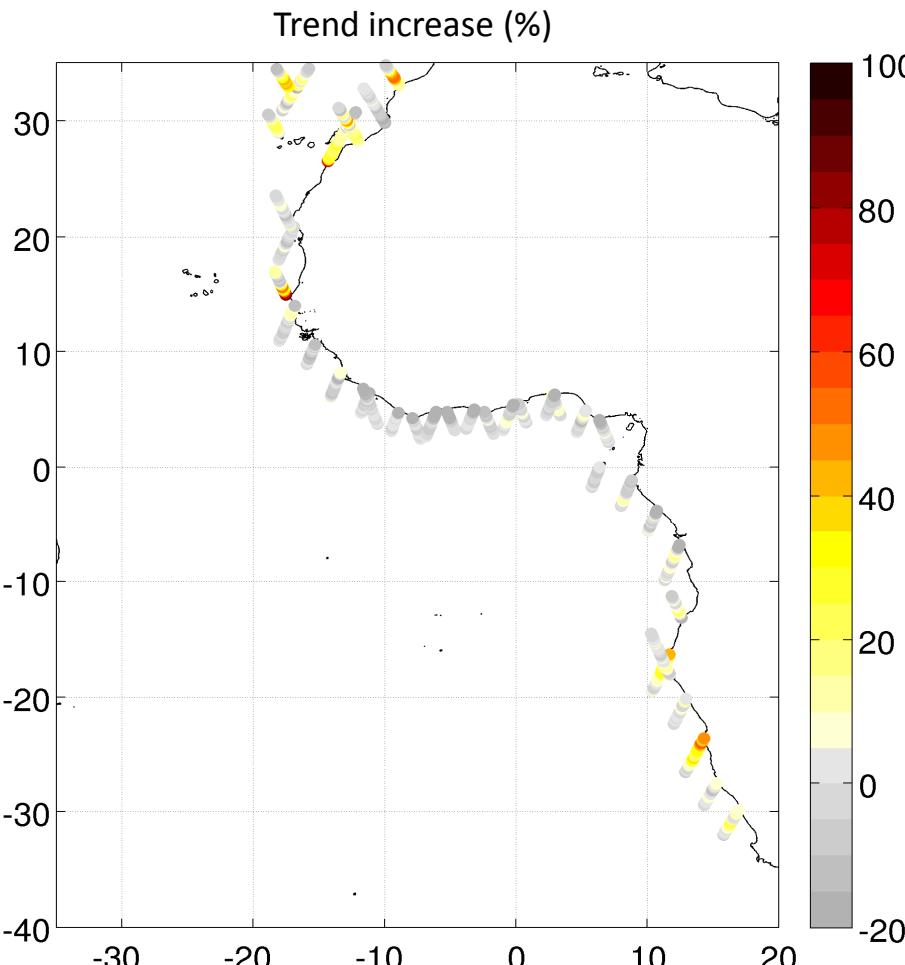
- **Coastal sections** : 1993-2012 trend CTOH/XTRACK



Faster sea level rise onshore (+20-30%)  
Robust for coastal sections

# Sea level trends

- **Coastal sections** : 1993-2012 trend AVISO



Not confirmed by AVISO data ...

# Conclusions and perspectives

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► **Conclusions :**

- **Higher sea level variability closer to the coast**
- **Faster sea level rise onshore ?**

► **Perspectives :**

- **Differences AVISO / XTRACK:** geophysical corrections ? (wet tropo ?)
- **Comparison to tide gauge**
  - Need to correct for orbit errors first...
- **Processes leading to different SLA in coastal regions**
  - Enhancement / shift of coastal currents / upwelling etc ?
  - Analyze a very high resolution model ( $1/36^\circ$ ) (See Poster 49 by Djath et al.)