Sea Level CCI project

Status

Outline

- Project status (G. Larnicol, CLS)
- Closure budget study status (B. Meyssignac,LEGOS)
- Preliminary feedbacks from Sea Level CCI CRG (D. Stammer, UoH)

Project Status

WP6: **Project Managemet**

WP1: **Requirements analysis & Products specification**

WP2: **Algorithm development, intercomparison & selection**

WP3: **System prototyping & ECV Sea Level production**

WP4: **Validation & User Assessment**

WP5: **System specification**

Main Project

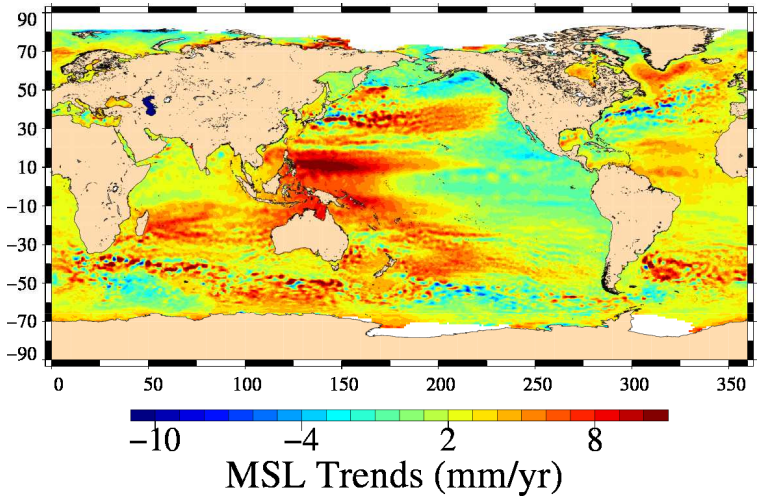
In progress

Unveiled during the 20 Years of progress in radar altimetry Venice symposium

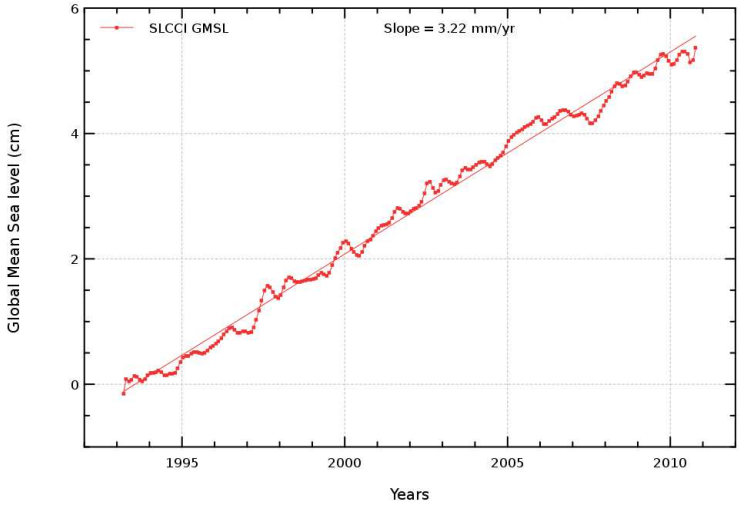
Sea Level ECV products

Access via: http://www.esa-sealevel-cci.org/
Please contact us: info-sealevel@esa-sealevel-cci.org

Regional Mean Sea Level trends

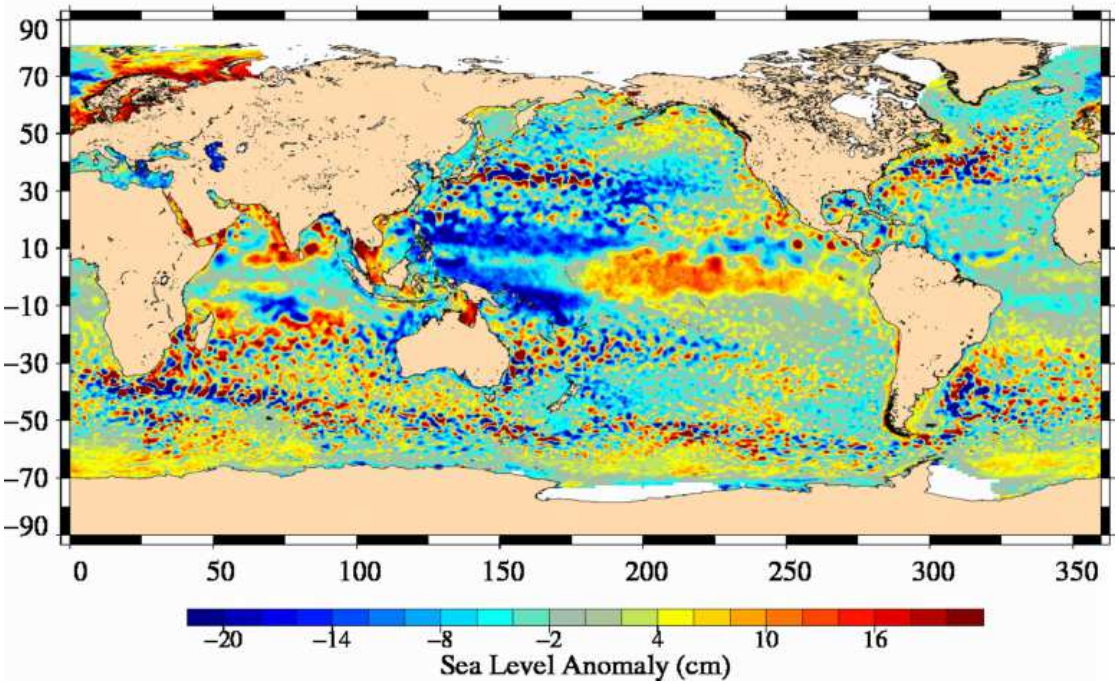


Global Mean sea level



Period 1993-2010

¼° Gridded Monthly mean



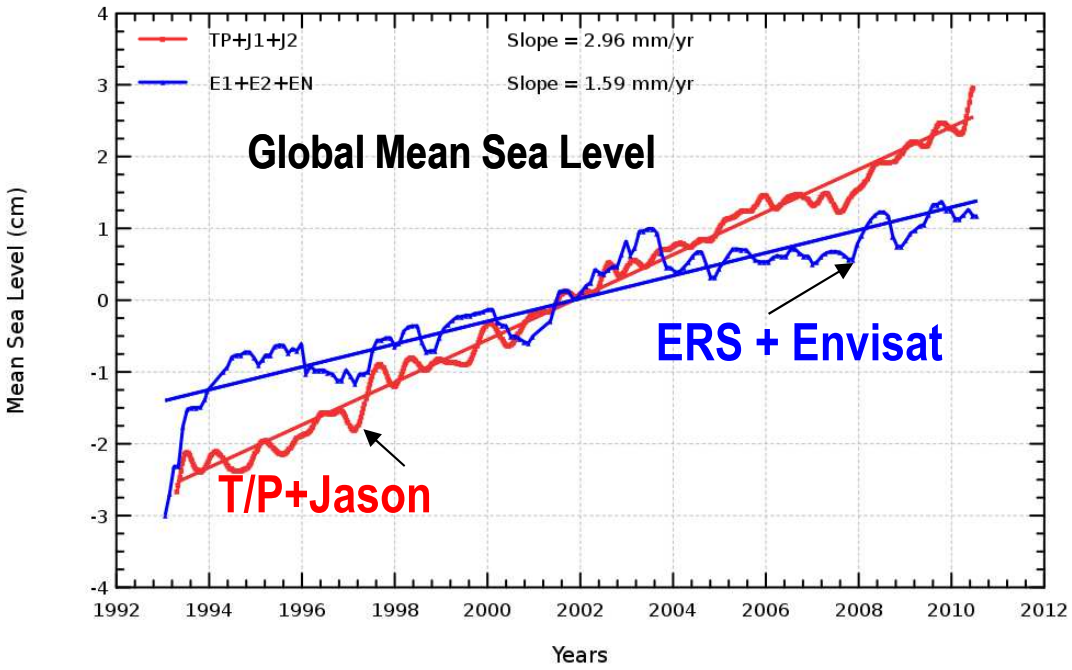
Global Mean Sea Level

- The altimetry data record has been improved at several temporal scales

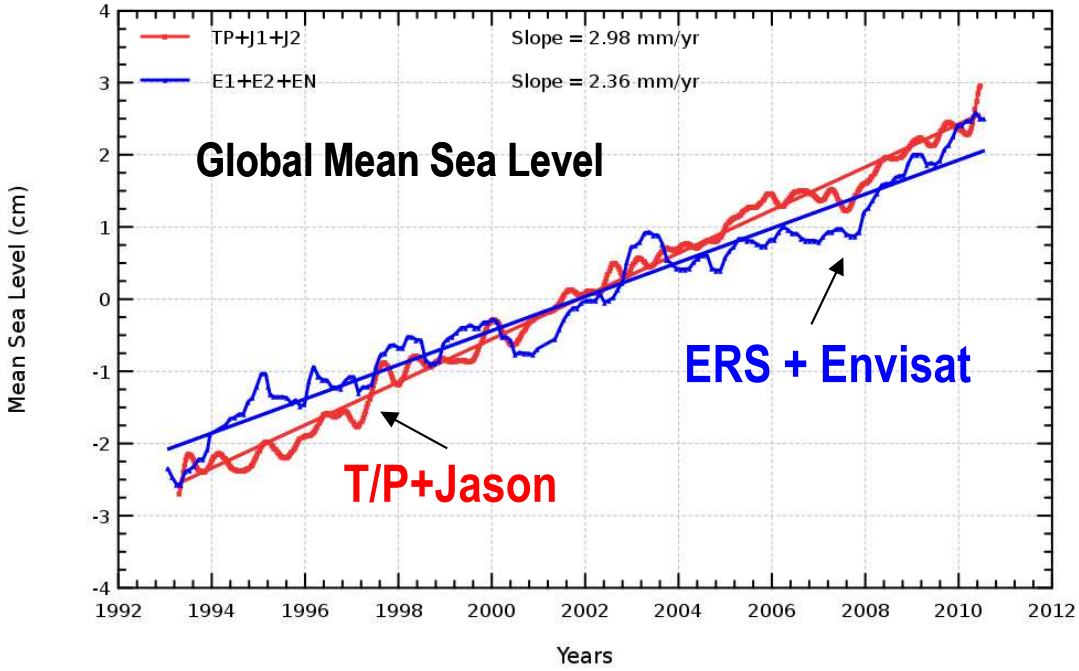
- The Global Mean Sea Level (GMSL) derived from ESA missions (ERS-1&2, Envisat) has been significantly improved:

⇒The long-term trend is now close to TOPEX/Jason-1/Jason-2 GMSL trend

⇒The inter-annual signal is more consistent with other missions



Before the SLCCI project

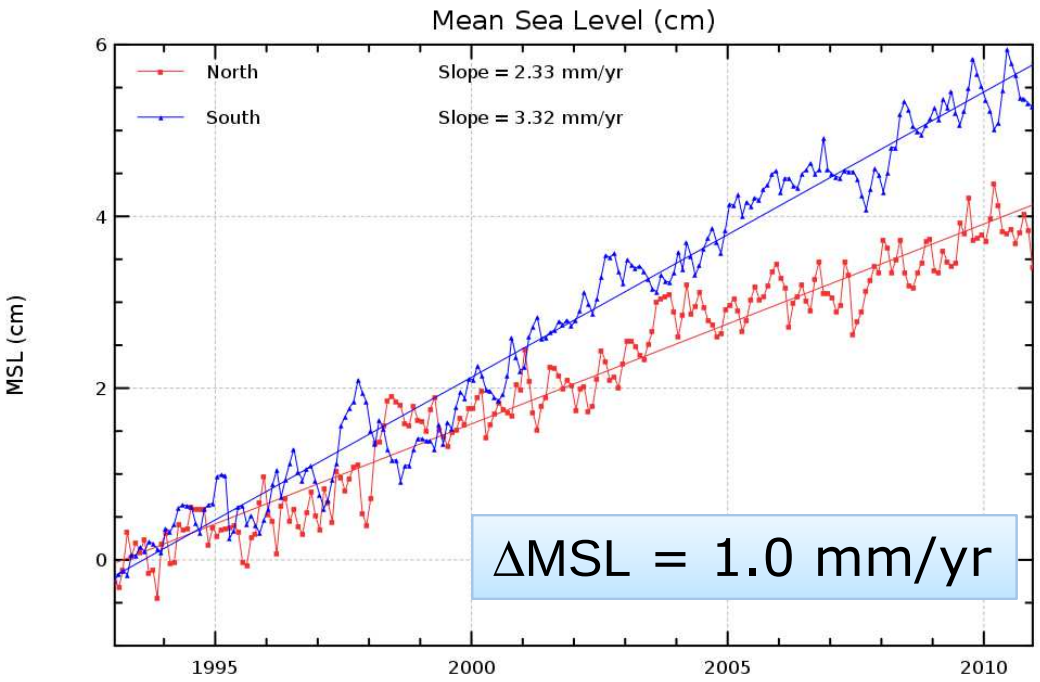


Thanks to the SLCCI project

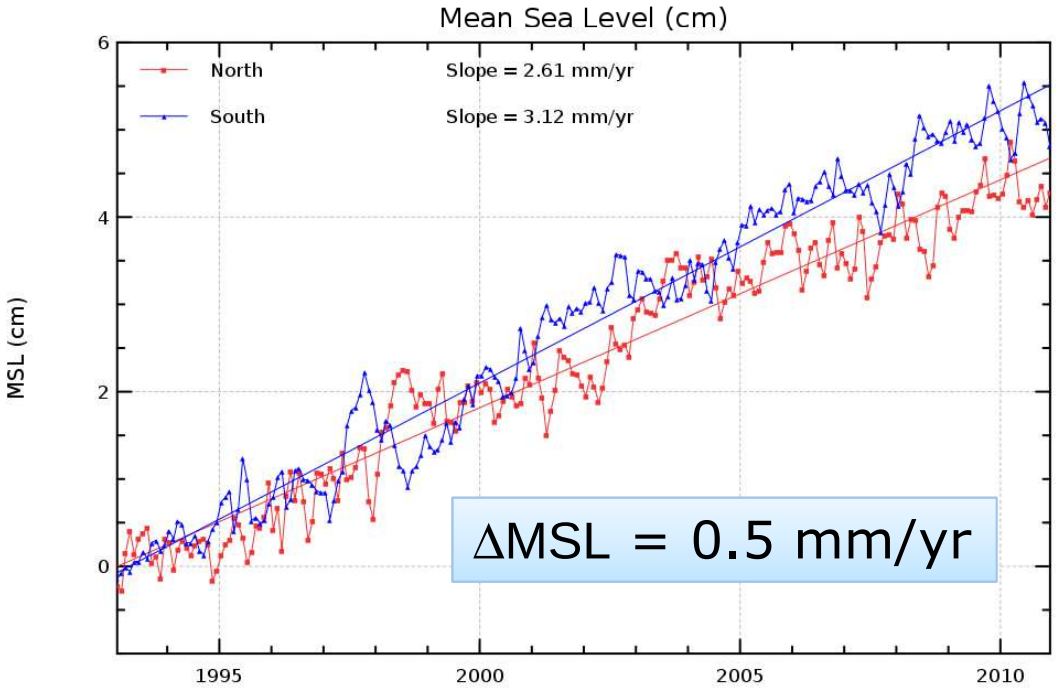
Global Mean Sea Level

• Impact of new SLCCI products on MSL separating North and South hemispheres
⇒ MSL trends are more homogenous between North and South hemispheres with new SLCCI products

Hemispheric MSL for Aviso products



Hemispheric MSL for SLCCI products



Regional Mean Sea Level

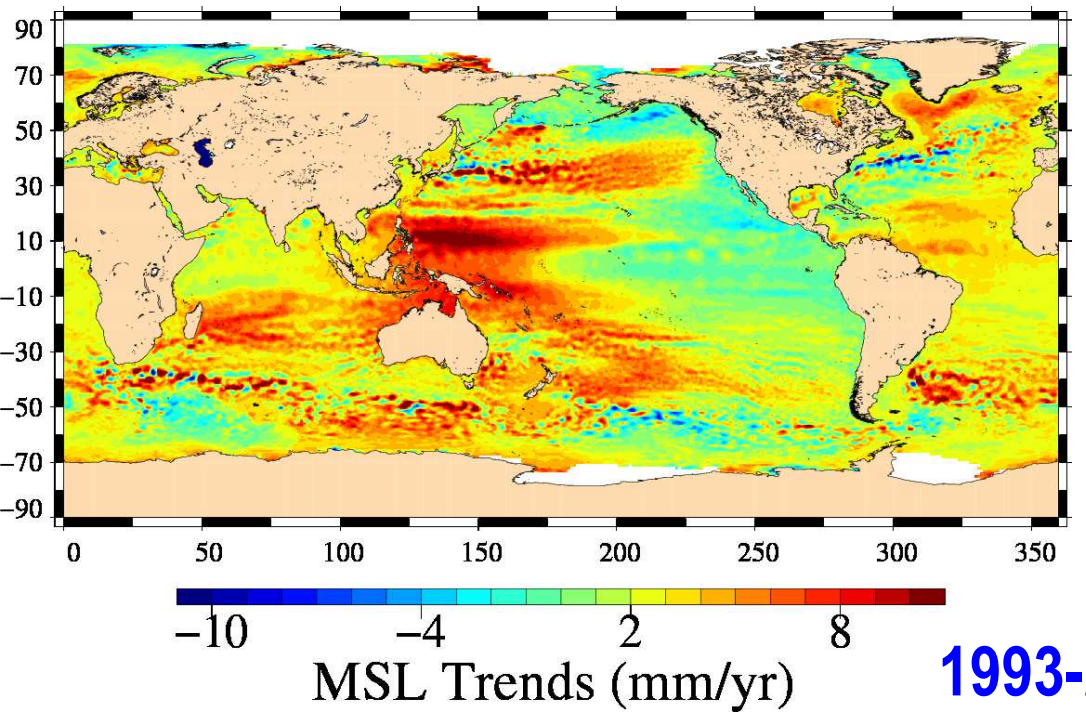
- The regional Mean Sea Level trends have been significantly improved :

⇒ differences in the range +/- 2 mm/yr at local scale

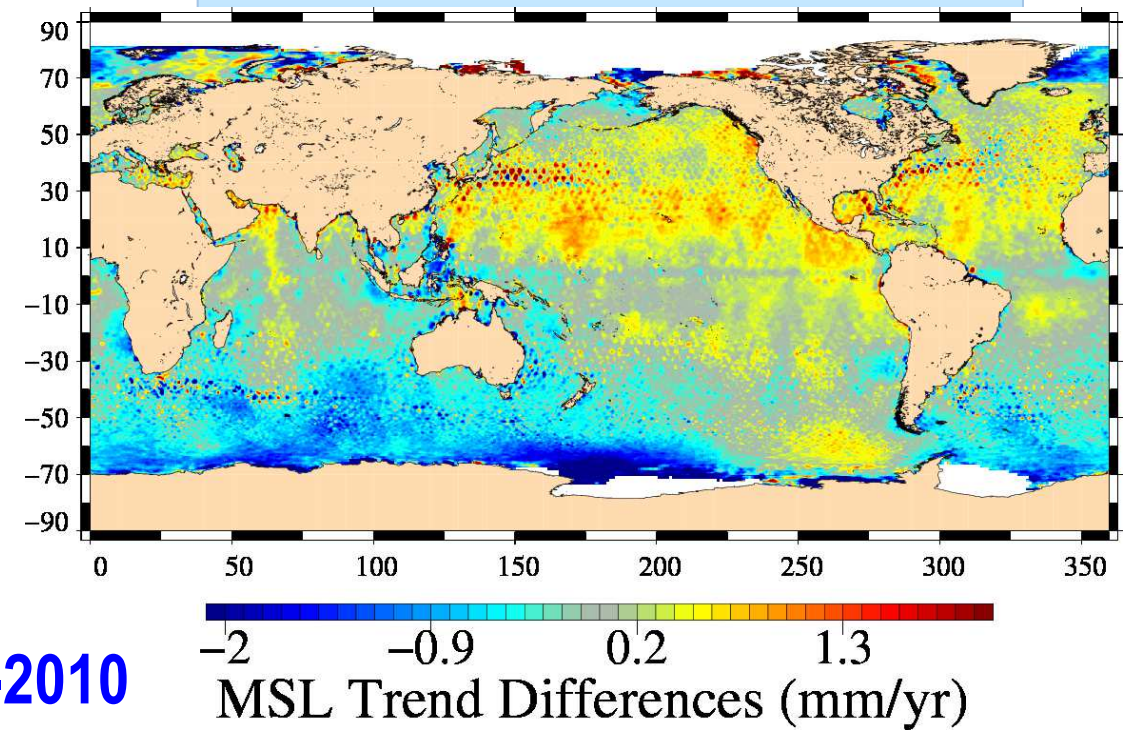
⇒these differences are significant since regional Mean Sea Level trends are ranging between +/- 10 mm/yr from 1993 onwards

Regional MSL trends from SLCCI project

Improvements of SLCCI project on regional MSL trends



1993-2010



Project Status

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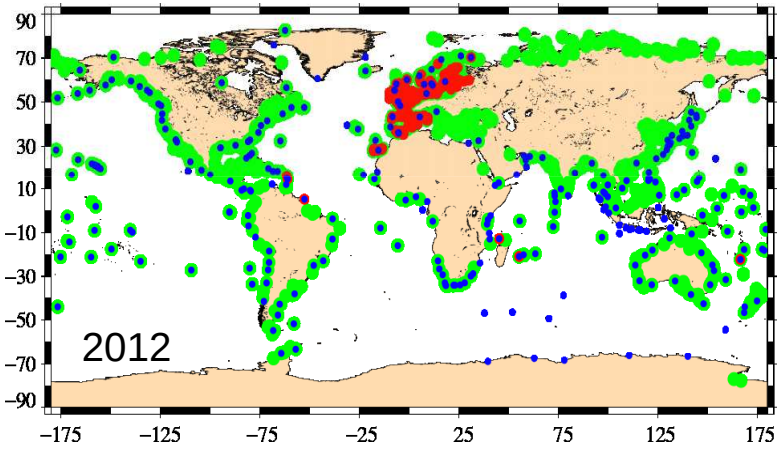
WP4100: Final product intercomparison and validation
Comparison with tide gauges and ARGO floats

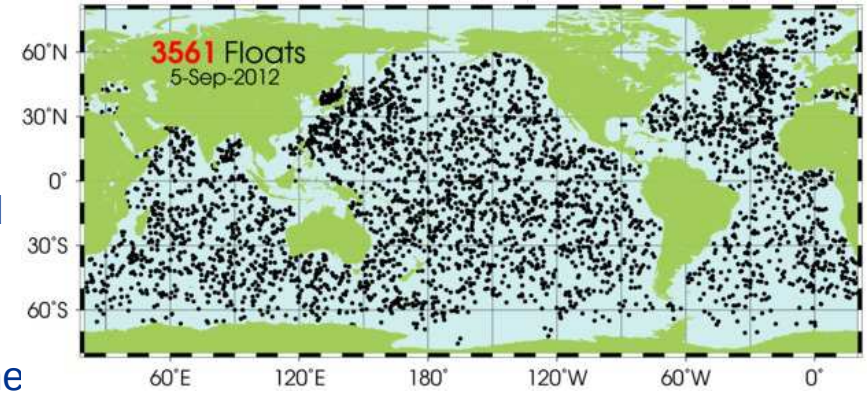
→The round robin exercice (RR) applied to each individual algortihms/ corrections has been performed to compare SL CCI and DUACS products.

→ Comparison with in-situ independant data is investigated with the same approach than in the RR consisting in separating different time scales (annual, interannual, trends)

- **Tide gauges : monthly data from the PSMSL database**
  - Calculation of the correlation alti/TG
  - Altimetry at maximum correlation level is extracted (200 km)
  - Kept if r > 0.3 and the TG time serie is complete at more than 80%
  - Tide gauge time serie are first centered



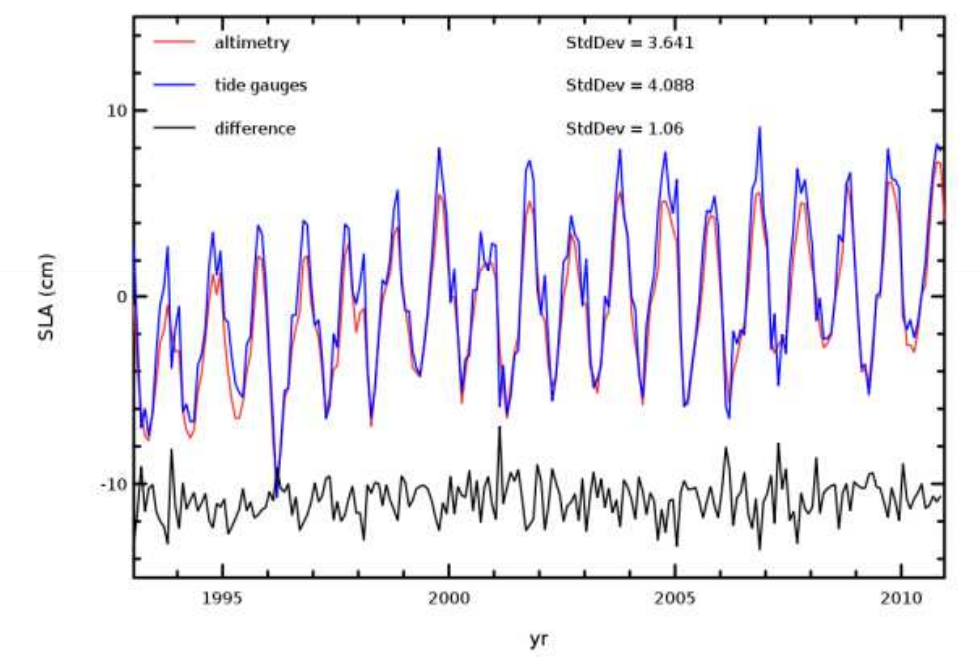
- **Argo : Coriolis database,**
  - Calculation of the dynamic height from the T/S profile
  - The mass component is subsequently added (GRACE RL04)
  - Interpolation of the altimeter measurement at the date and position of the Argo profile
  - Statistics are computed into 2° and 10 days boxes



WP4100: Final product intercomparison and validation
Comparison with tide gauges and ARGO floats

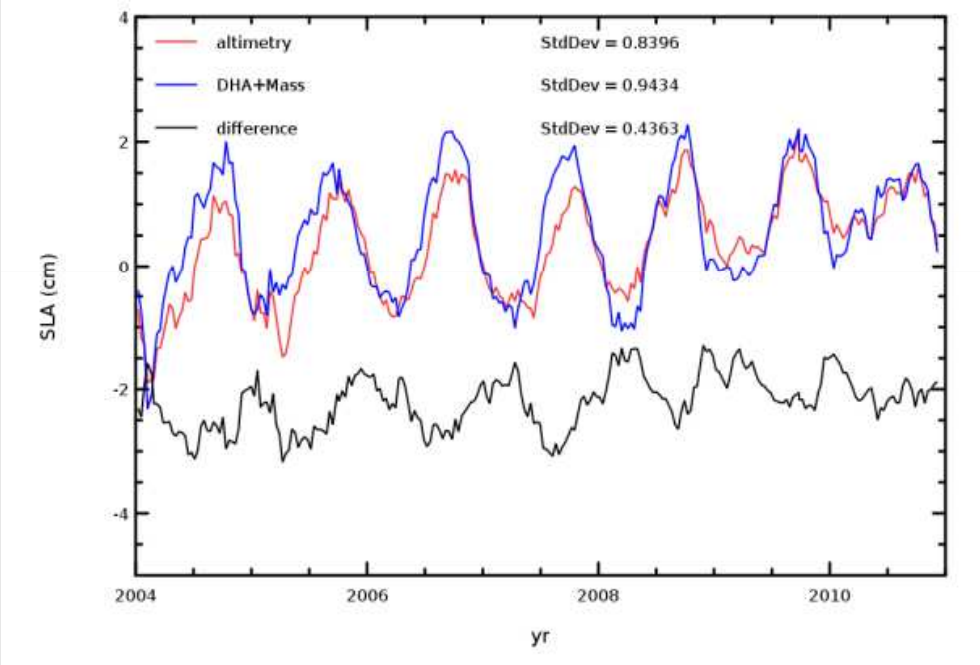
Global comparison, all time scales

Tide Gauges



Annual signal is preponderant,
R= 0.96

Argo

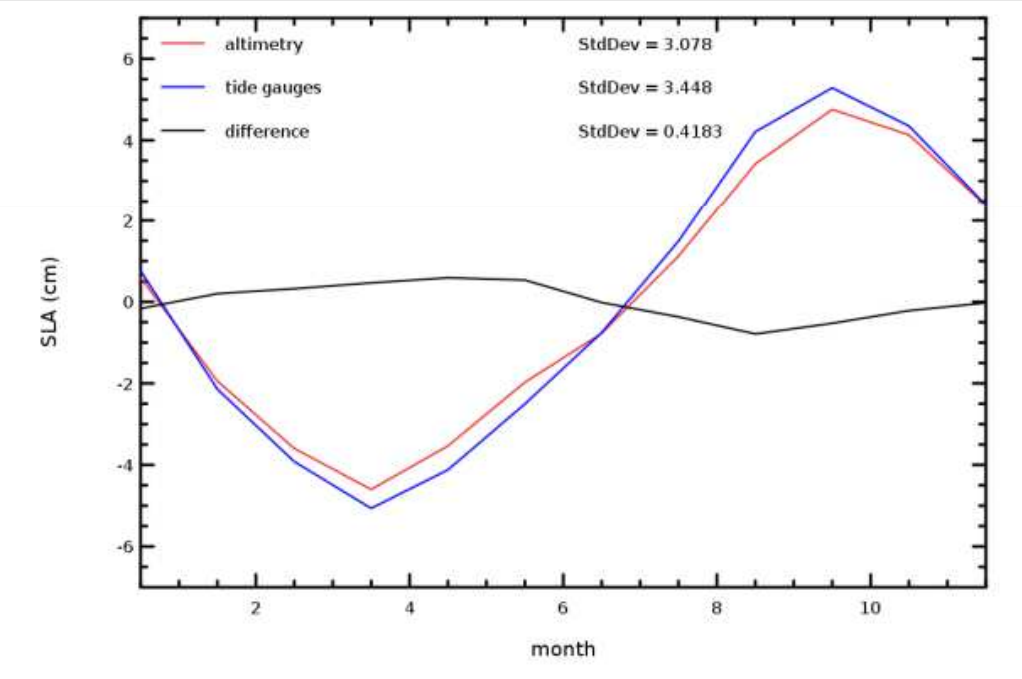


Annual signal is preponderant,
R = 0.84,
Annual signal visible in the differences time serie

WP4100: Final product intercomparison and validation
Comparison with tide gauges and ARGO floats

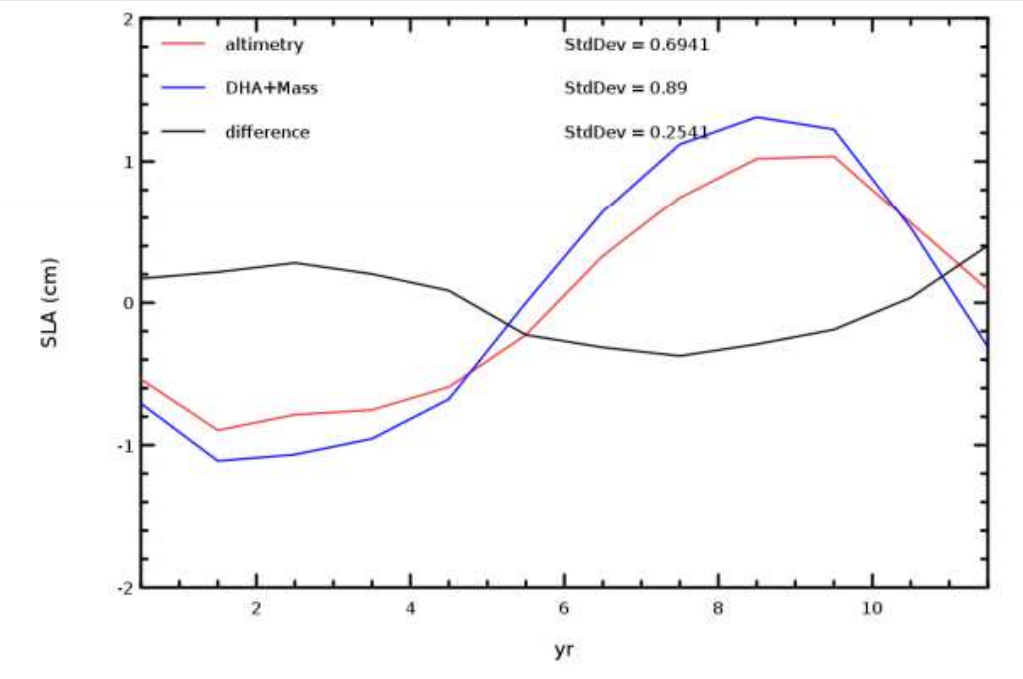
Global comparison, annual signal

Tide Gauges



Amplitude ~5 cm
phase OK
Amplitude alti < TG (~1 cm)

Argo

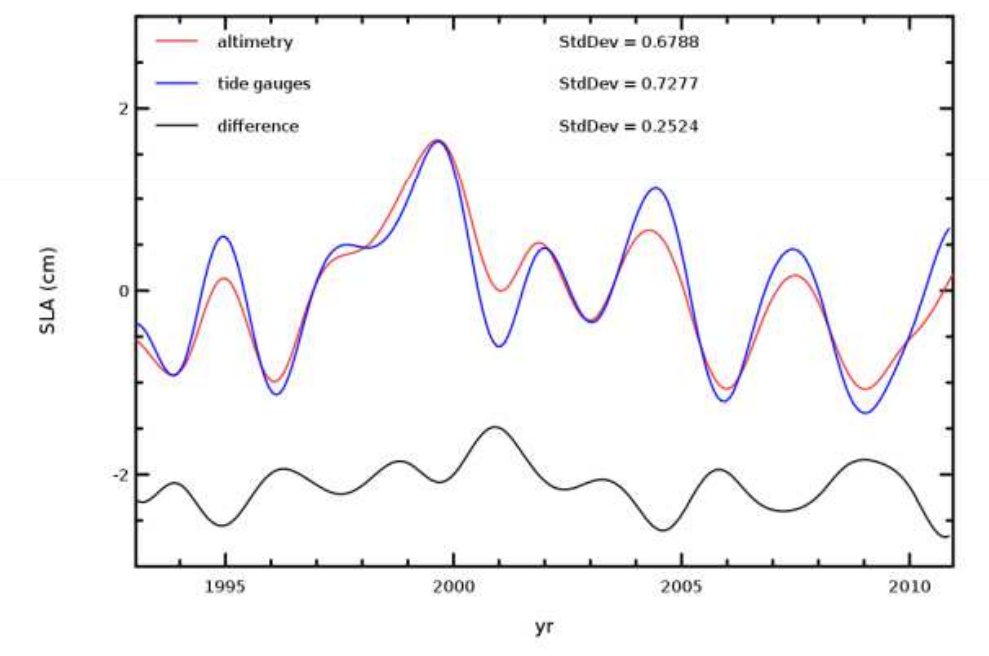


Weaker annual signal (~1 cm)
Larger differences

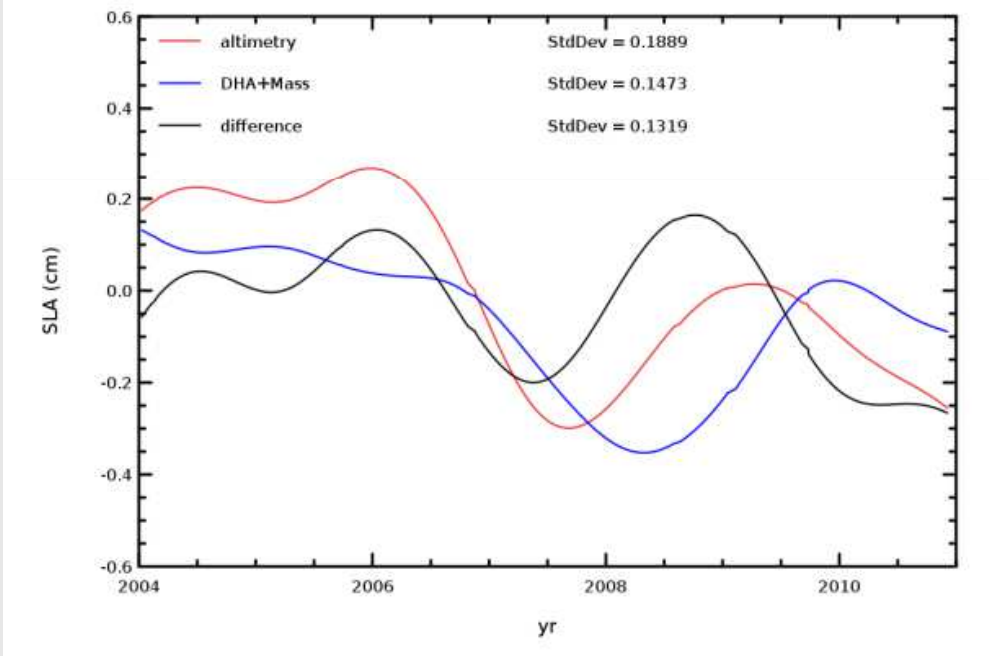
WP4100: Final product intercomparison and validation
Comparison with tide gauges and ARGO floats

Global comparisons, interannual variability (T > 2 years)

Tide Gauges

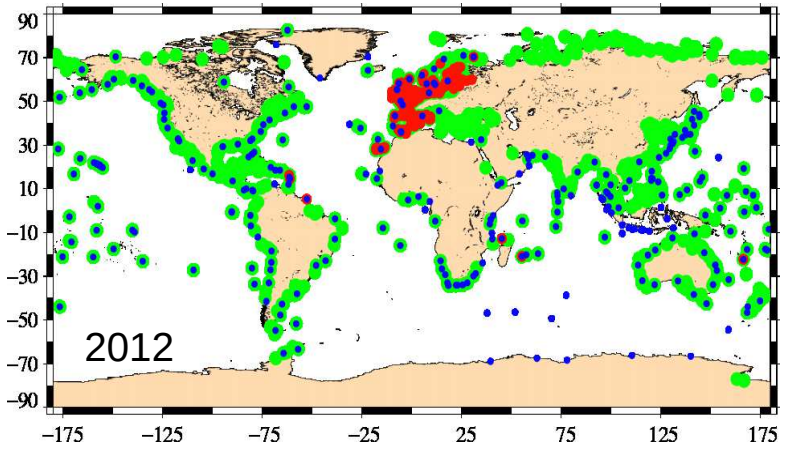


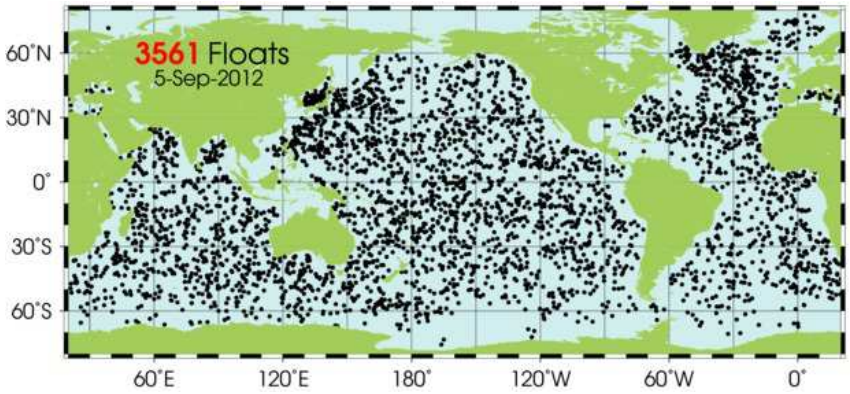
Argo



WP4100: Final product intercomparison and validation
Comparison with tide gauges and ARGO floats

- → **This activities are performed with the objective and to characterise the differences versions of the products.**
- → **Then it could be also use to characterise the impact of the algorithms & corrections used in the Sea level calculation**
- → **More investigation needed to improve the methodology .**
- → **Interest to share with other ocean ECV their experience in similar comparison exercice.**

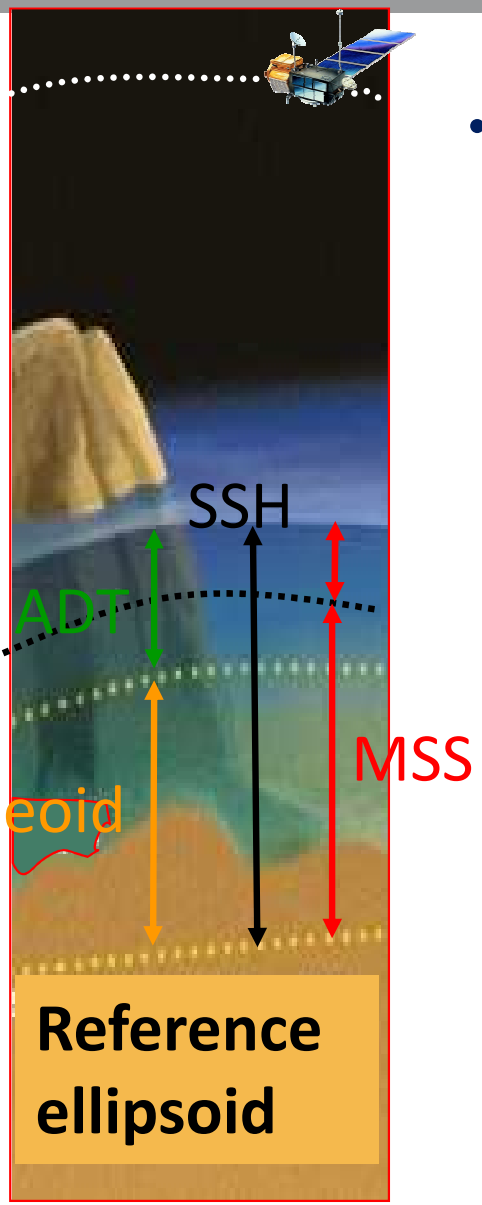




WP4 status

B. Meyssignac
&
D Stammer

V1 product versus V0 products: the Reference period



- The Ssalto/Duacs SL Anomalies products are historically referenced to the 7-year period [1993, 1999].

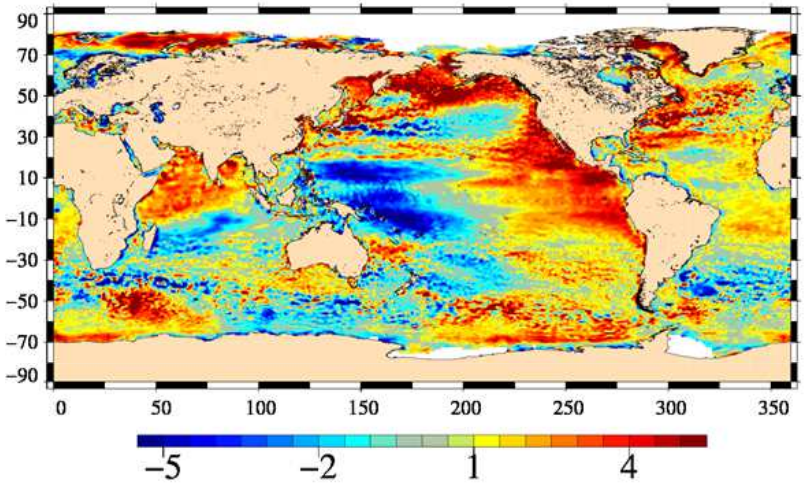
$$SLA_{Aviso} = SSH - [PM/MSS\ CNESCLS]_{93-99}$$

- The SLCCI SL Anomalies products are referenced to a 17-year period [1993, 2010].

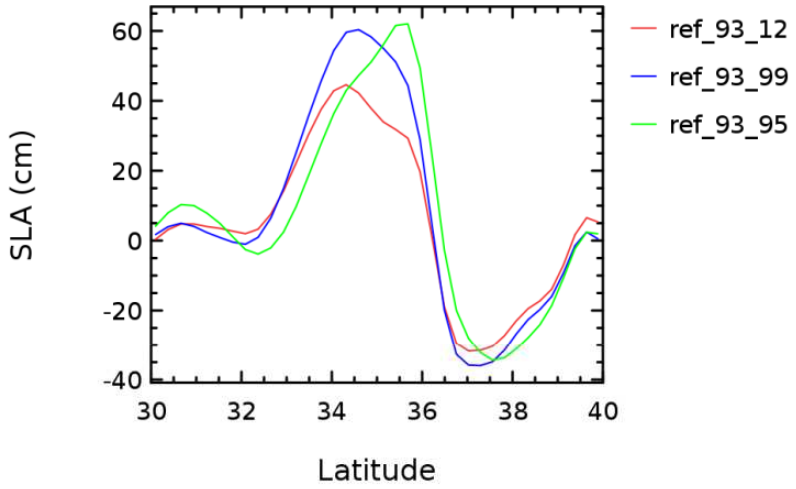
$$SLA_{SLCCI} = SSH - [MSS\ CNESDTY]_{93-10}$$

WP4200: Assessment in models
The time period reference issue

Mean Sea Level Anomalies differences between SL-CCI and AVISO/DUACS products (cm)



Latitudinal section across the Kuroshio current of Sea Level Anomaly computed with different reference period.



It is fundamental to take into account this difference in time period reference when comparing the two datasets

A note has been written and distributed to the WP4 partners, as well as a conversion file, that can be used to convert the SLA datasets from one period to another

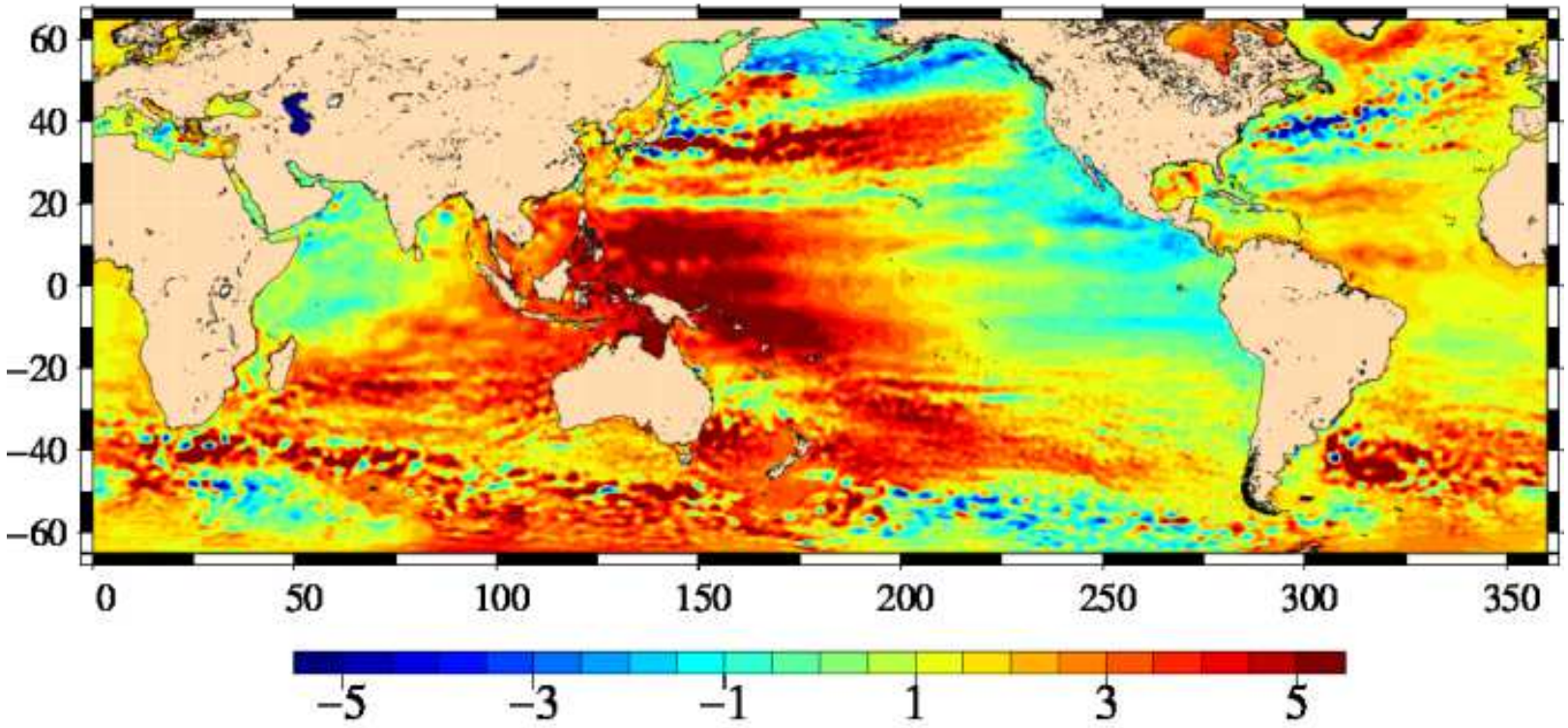
SLA (Ref DTU10 period) = SLA (Ref Aviso) + $\langle MSLA \rangle_{9809}$

$\langle MSLA \rangle_{9809}$: The 1998-2009 time period is used because a study has shown that although the DTU MSS is computed over the 1993-2010 period, due to higher density of altimeter data in the 2000s, the DTU MSS is more likely centered on 2003.5 (mean of the 1998-2009 time period)

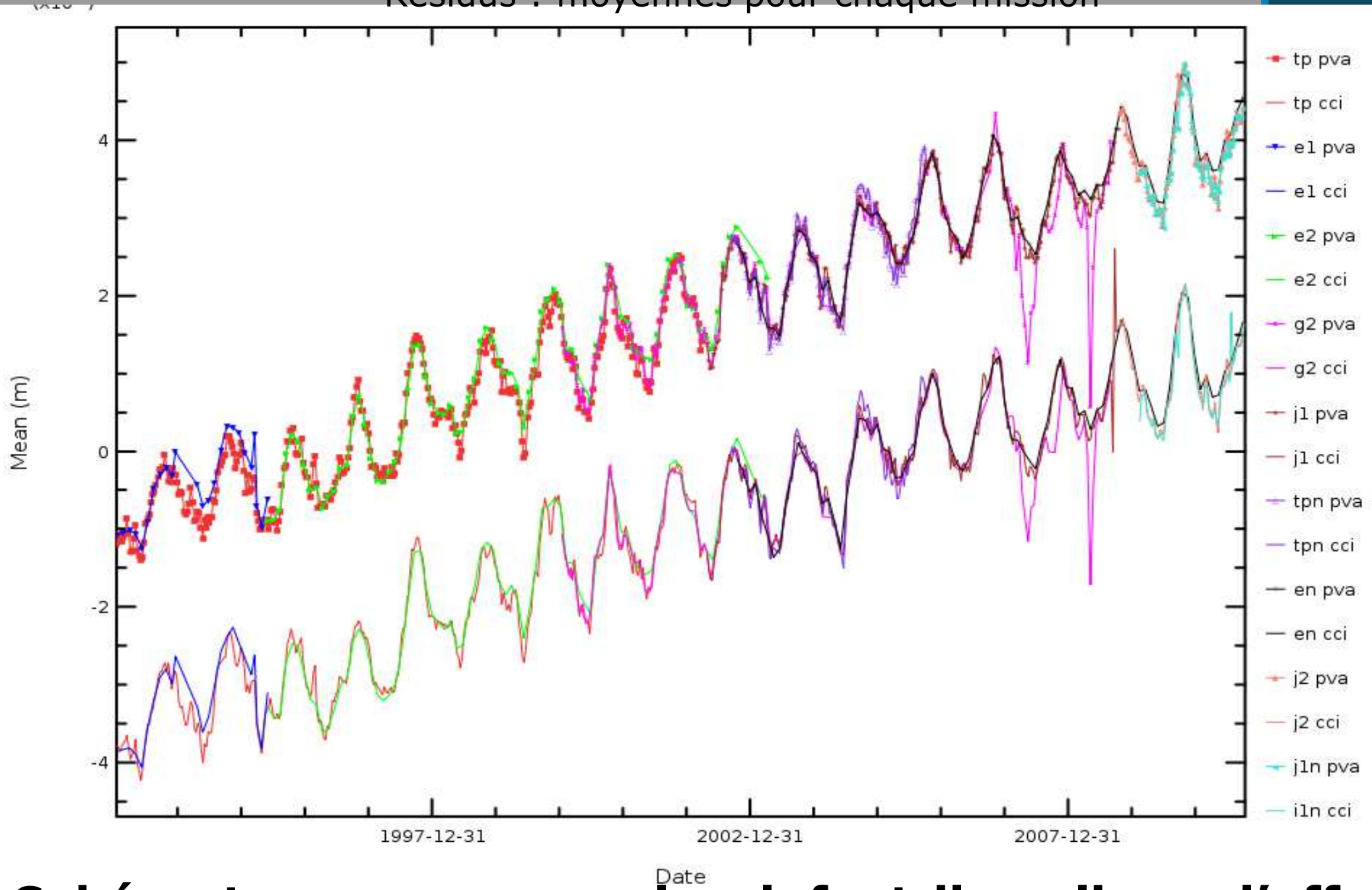
DUACS upgrades in 2013: New reference period

- Impact of the choice of reference period:
  - ✓ Spatial impact on the mean for all SLA along track and gridded products: up to 5cm regional biases
  - ✓ No temporal impact, no impact on MSL Trends

[93-99] to [93-2011] impact (cm)



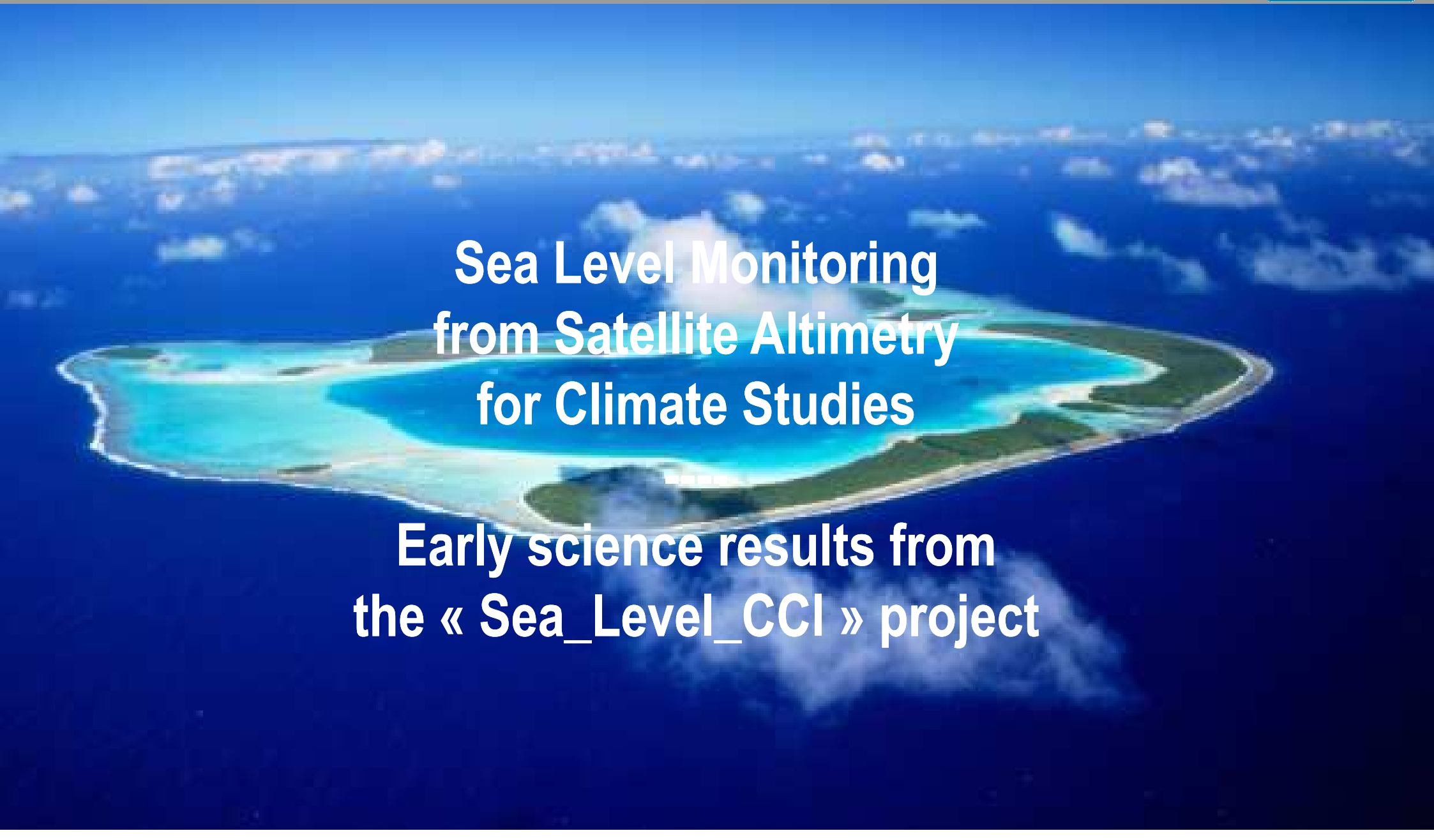
Résidus : moyennes pour chaque mission



Cohérent avec mean sea level, faut-il appliquer l'offset comme pour les cartes pour commencer à 0?

Sea_level_CCI

WP4300



Sea Level Monitoring from Satellite Altimetry for Climate Studies

Early science results from the « Sea_Level_CCI » project

Project requirements ⇨

- **improve the precision of the interannual variability**

  Reduce current uncertainty of +/- 2 mm to <1 mm

- **improve the precision of the global mean sea level trend**

  Reduce the current uncertainty (of 0.5-0.6 mm/yr) to <0.3 mm/yr

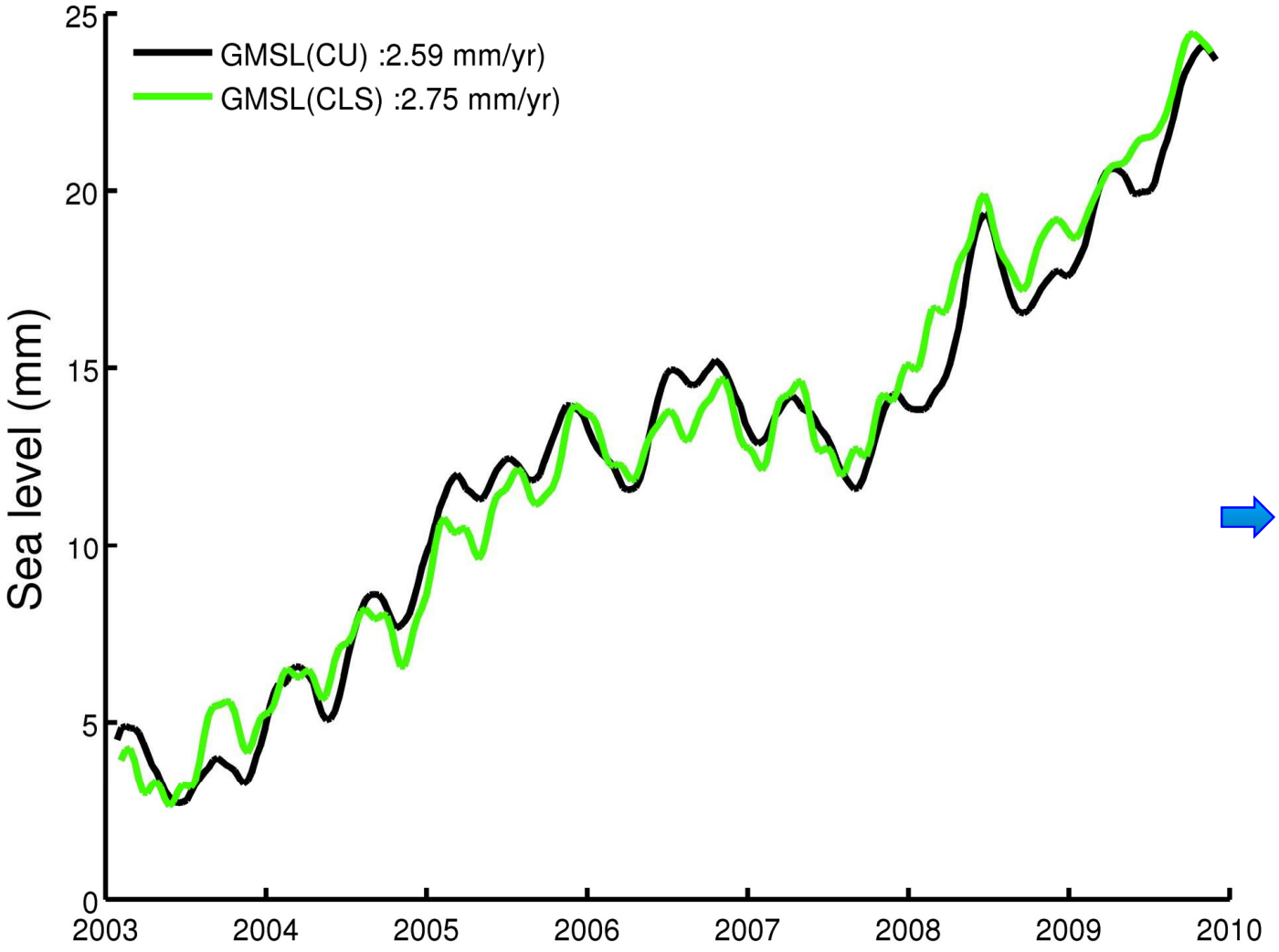
- **improve the precision of the regional variability**

  Reduce current uncertainty of >2 mm/yr to <1 mm/yr

Sea_level_CCI

WP4300: Sea level record

Sea level Observed by satellite altimetry (2003-2012)



Different processing:

- **different averaging method**
- **different wet tropospheric correction**
- **different J1-J2 data continuity**

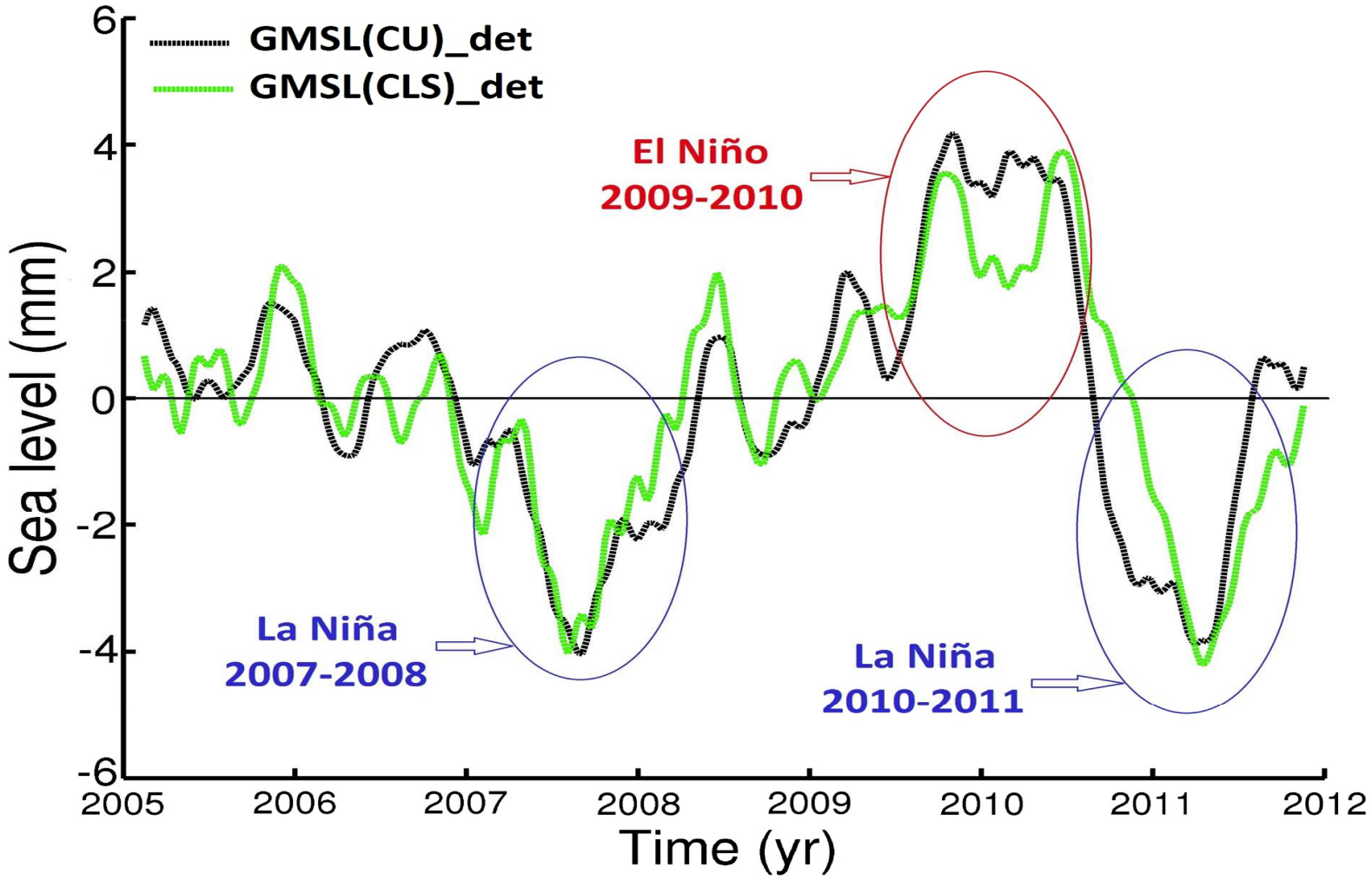
➡ **Same data (from Topex, Jason 1 and 2)**
But different interannual variability

Masters et al, 2012
Henry et al, submitted

Sea_level_CCI

WP4300: Sea level record

Sea level Observed by satellite altimetry (2003-2012)

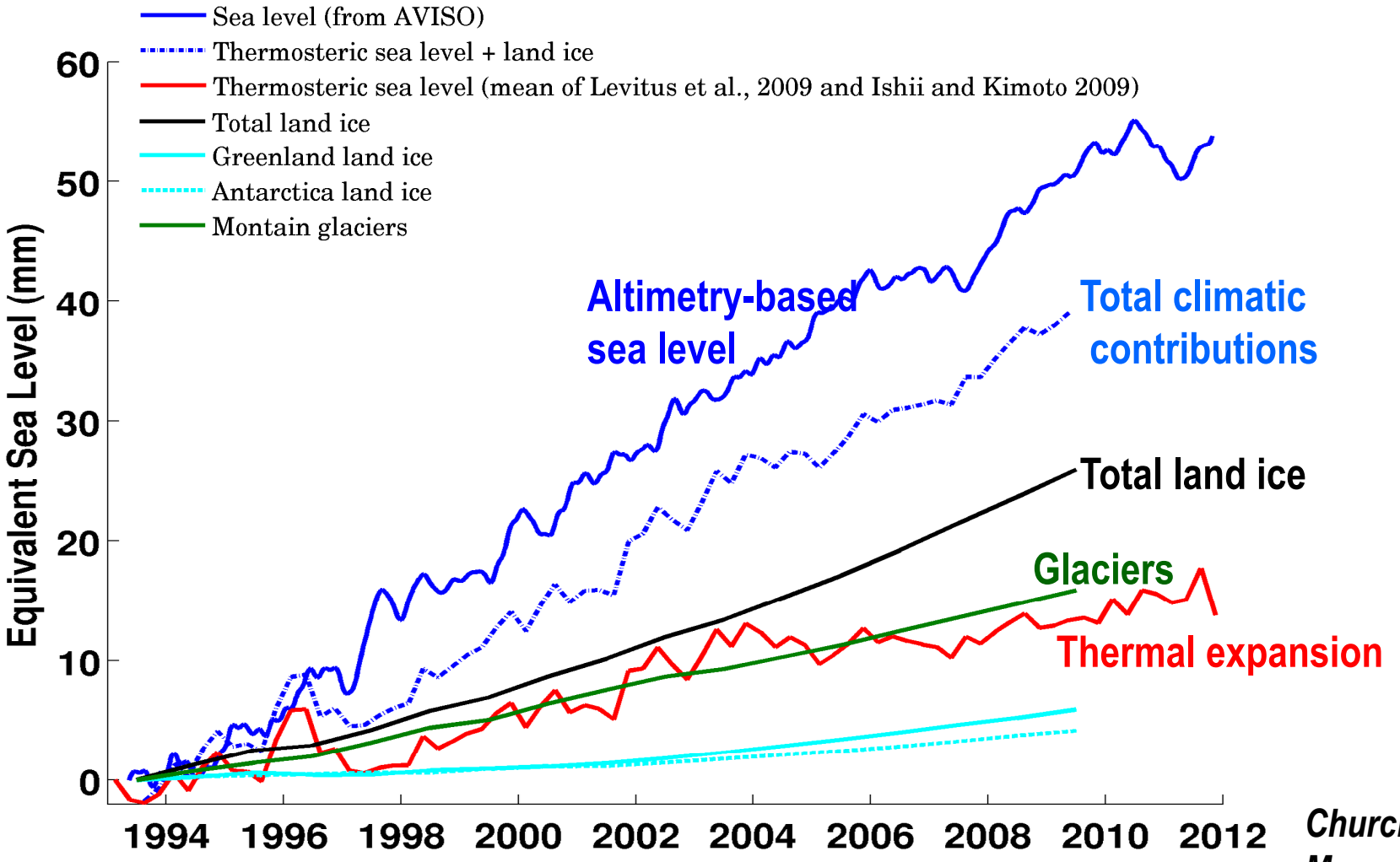


It is essential to develop climatic sea level record like the CCI sea level record

Sea_level_CCI

WP4300: MSL closure budget

Climatic contributions to the global mean sea level (1993-2012)

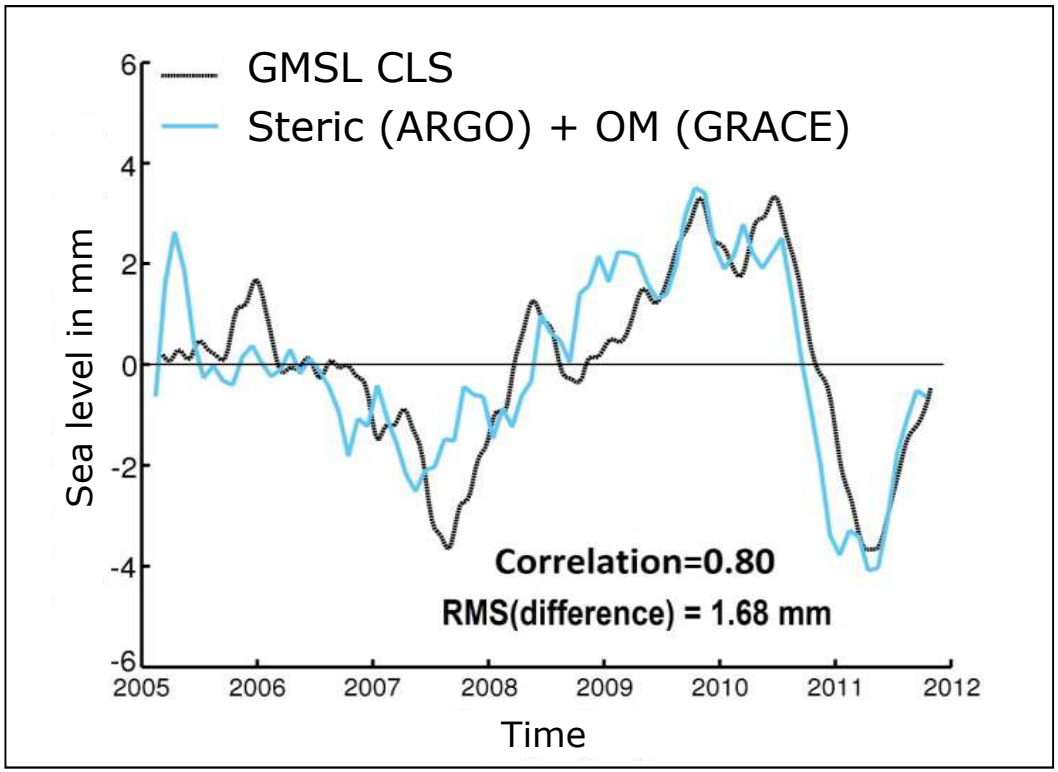


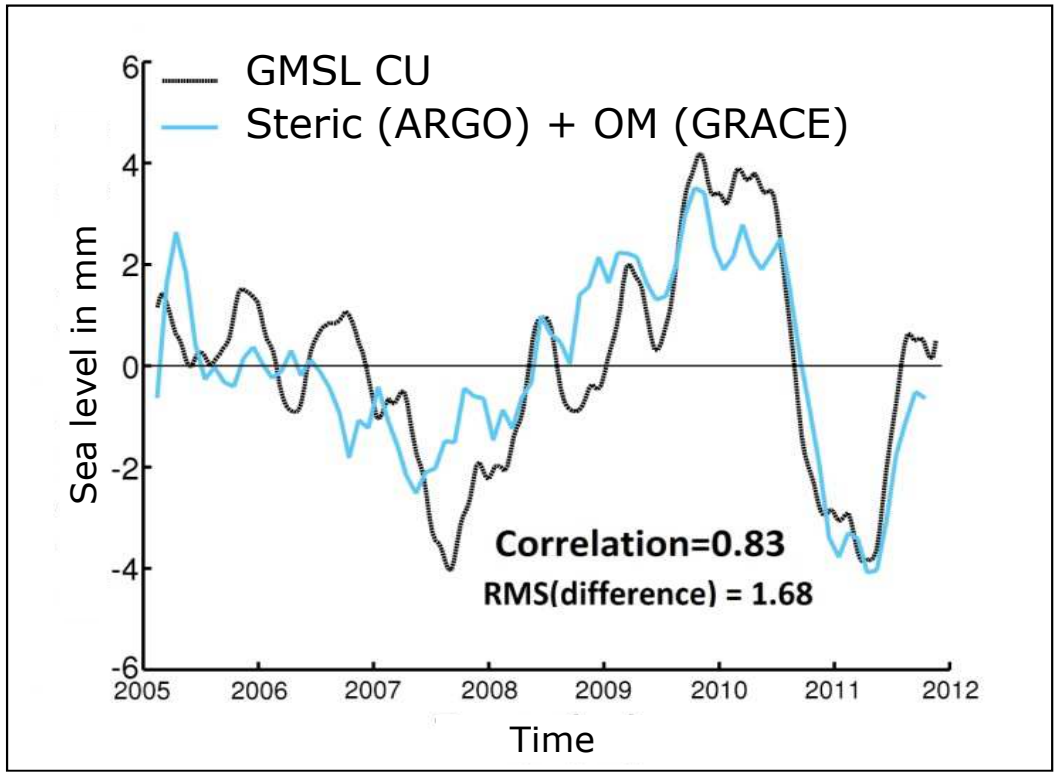
Church et al, 2011
Meyssignac &Cazenave, 2012

Sea_level_CCI

WP4300: MSL closure budget

Sea level budget (2005-2012) to analyse the interannual variabilty



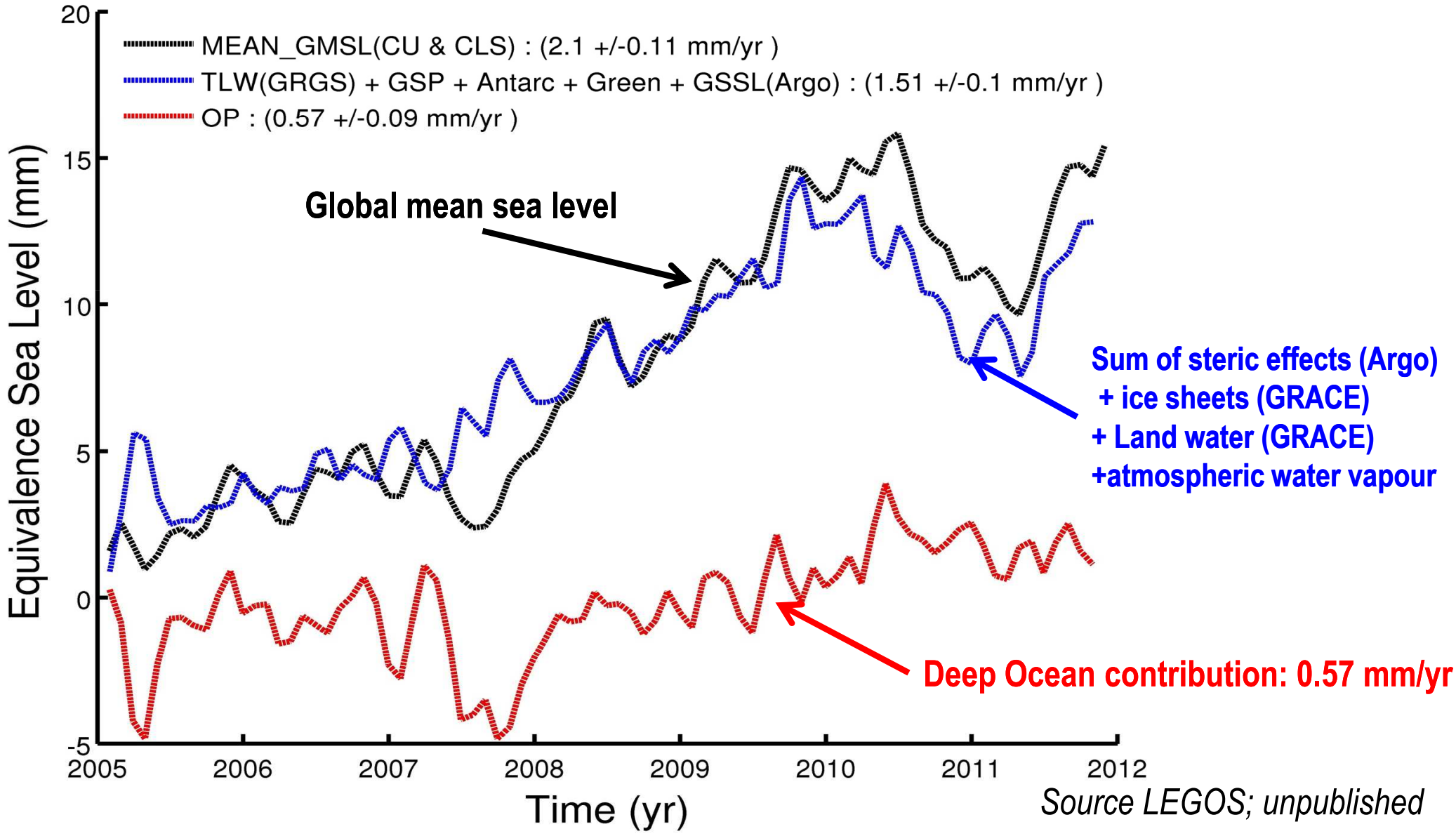


Source LEGOS; unpublished

Sea_level_CCI

WP4300: MSL closure budget

Sea level budget (2005-2012) to estimate the deep ocean warming



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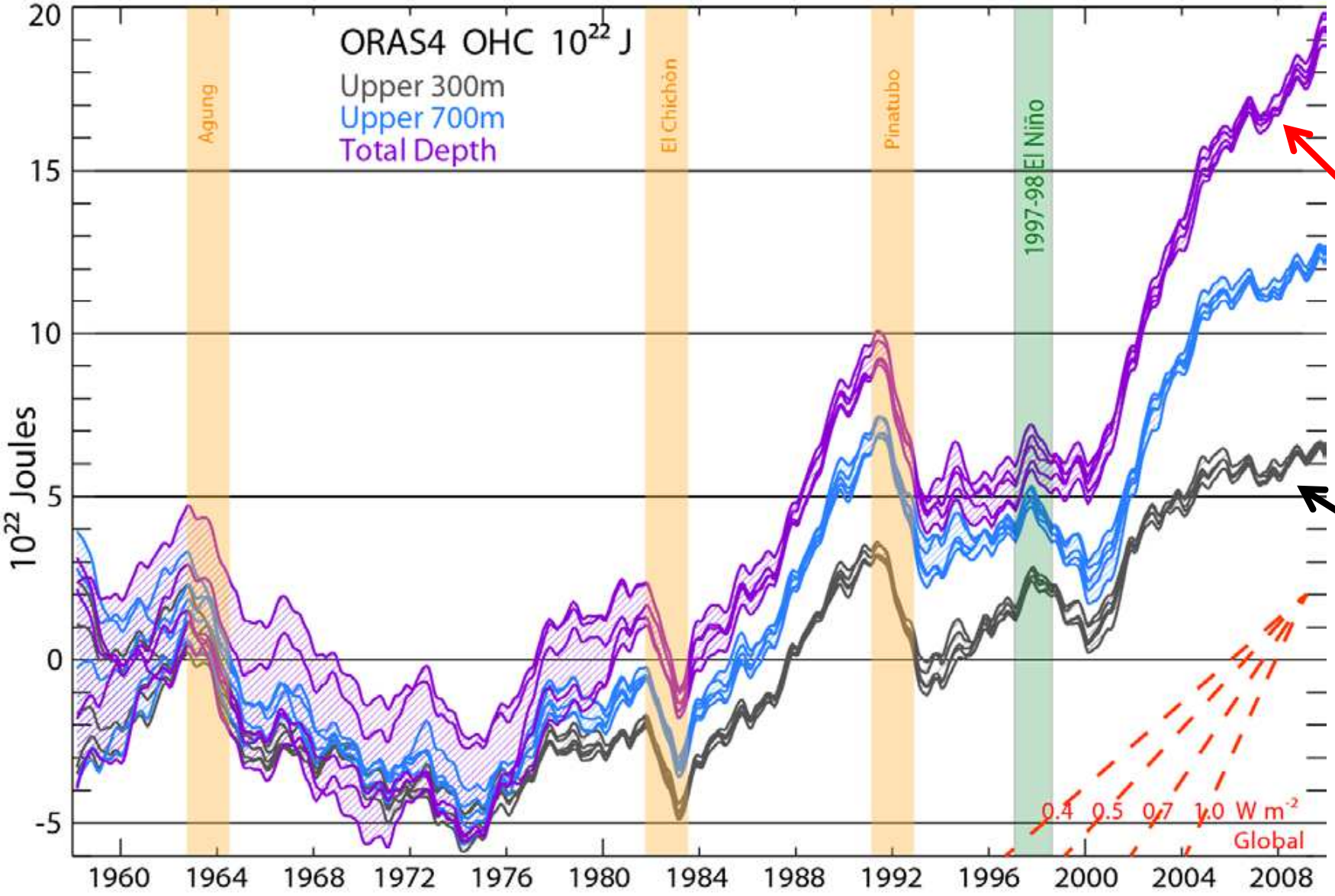

Deep Ocean Contribution consistent with an expansion of 0.57 mm/yr

No warming in the upper ocean Since 2004

Balmaseda et al. 2013

Sea_level_CCI

WP4300: Summary

- Need of a **consistent sea level record at climatic times scales** to study the **interannual variability** in sea level

- MSL budget with **high quality ECVs** (for sea level and glaciers in particular) at interannual time scales gives a better picture of the water mass exchanges between the ocean and the other components of the climate system
  since 2004 it allows to estimate the deep ocean warming (very few data available) and better understand how heat penetrates the ocean

- MSL budget with high quality ECVs will also help in **validating climate models and OGCMs** in terms of ocean circulation (through regional trends in sea level) and water mass transfers