Assessment of Orbit Quality through the SSH calculation Towards GDR-E standards

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OST/ST 2014

October 27-31, 2014
Konstanz, Germany

Overview

- GDR-E are getting prepared
- A first version was already proposed for Jason-1 reprocessing.

- The aim of this presentation is to show:
  - The evolutions planned for the future GDR-E and there impact on the Sea Level estimation
  - The validation of GDR-E preliminary correction already chosen for Jason-1

- Thanks to the Sea Surface reference, this validation is complementary to the intrinsic diagnosis dedicated to the orbit and enables mutual benefits to the Orbit experts and Altimetry communities.

Towards GDR-E standards

	J2
New Gravityfield	X
Harmonic 31 relaxed	X
Geocenter position	X
SRP model tuning	X
Reduced dynamic	X

Orbit standards are still improving, GDRE are getting prepared
(See A. Couhert and J. Moyard talks)

Several improvements on the orbit modeling:

- New Gravity field EIGEN-GRGS.RL03.MEAN-FIELD (annual, semi annual fit **+ trend estimated per year**)
- C3,1/S3,1 geopotential coefficients adjusted during the orbit determination process
- Upgrade of the modelisation of the center-of-mass of the total Earth system position
- Calibrated semi-empirical solar radiation pressure model on the solar panels
- Improved stochastic solution +minor evolutions

We will analyse the effects of each evolution to split the effects observed on the final preliminary GDR-E.

Large scales errors

Average of differences of orbits with GDR-D:

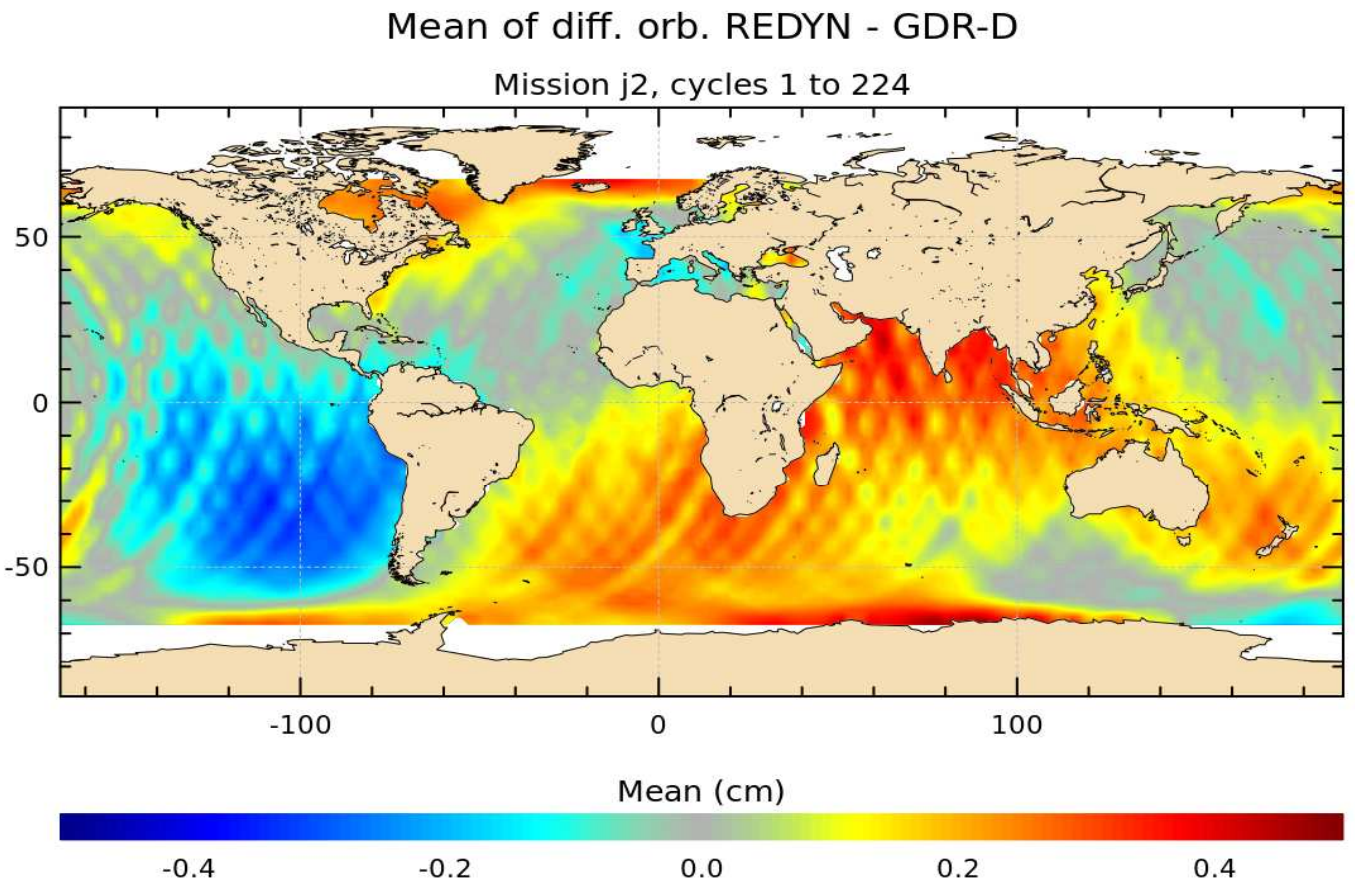
GDR-D

Gravity field

+ Harmonic 31 relaxed

+ Geocenter position

GDR-E Prelim with Reduced dynamic



Significant impact, on the average, bassin scale mainly due to the gravity field and reduced dynamics

Regional linear MSL trends

Jason-2

Negligible impact on the Global Mean Sea Level (<0.02mm/year)

Map of the differences using Orbit – GDR-D:

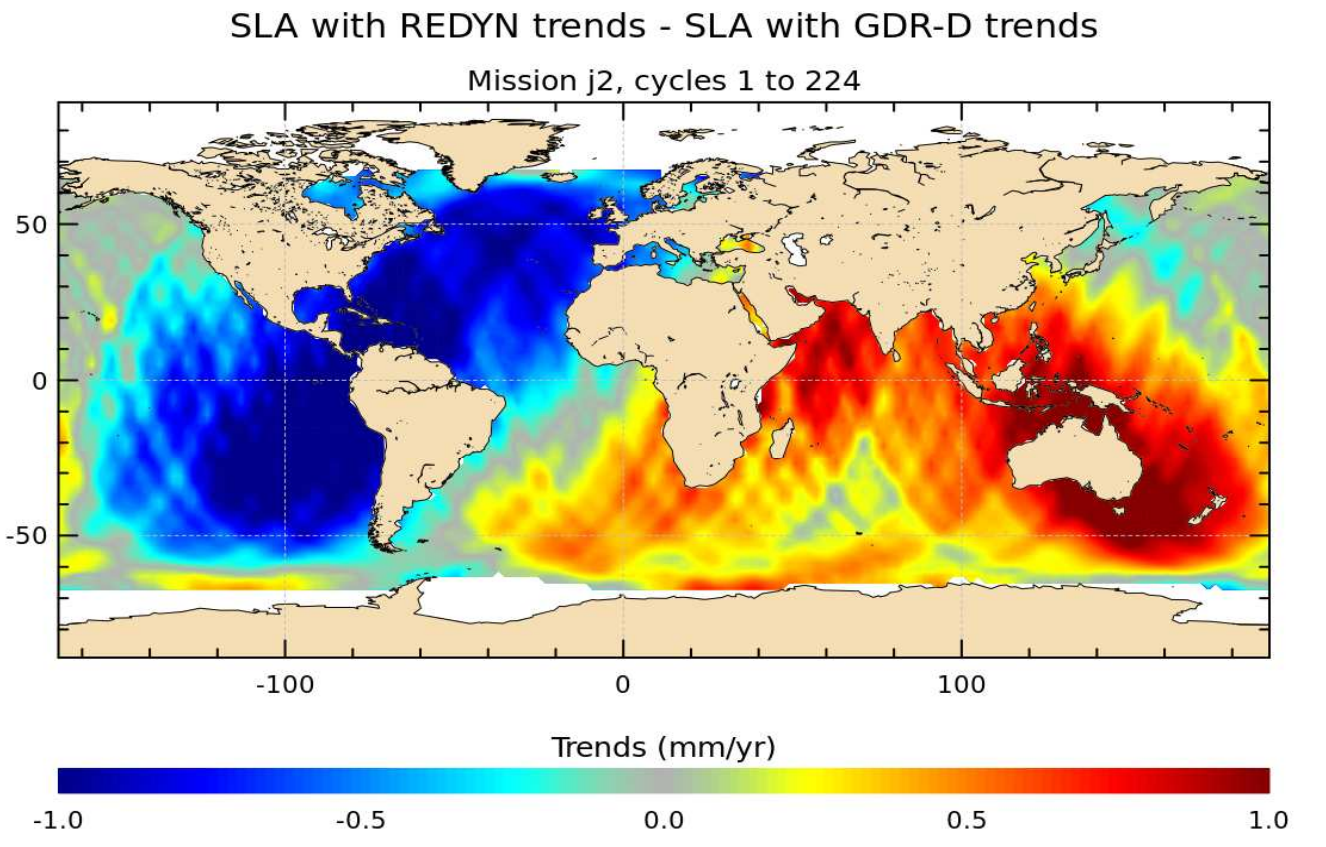
GDR-D

Gravity field

+ Harmonic 31 relaxed

+ Geocenter position

GDR-E Prelim with Reduced dynamic

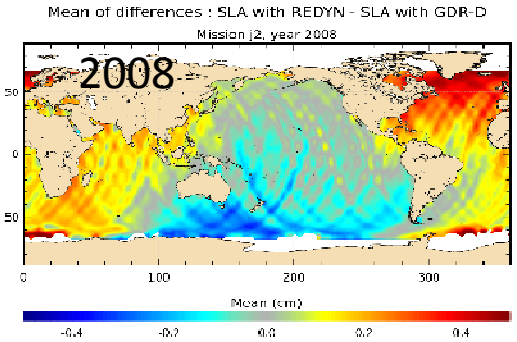


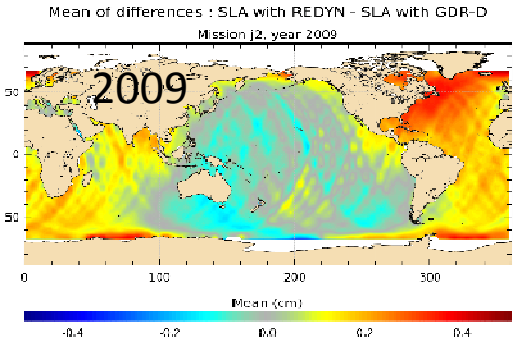
Significant impact on regional MSL trend.

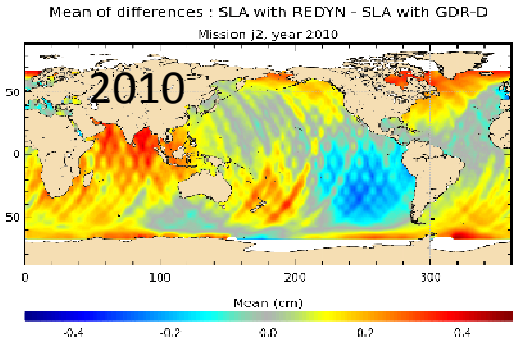
Interannual evolution of regional MSL

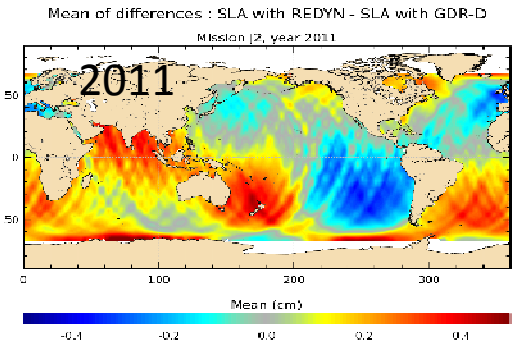
Jason-2

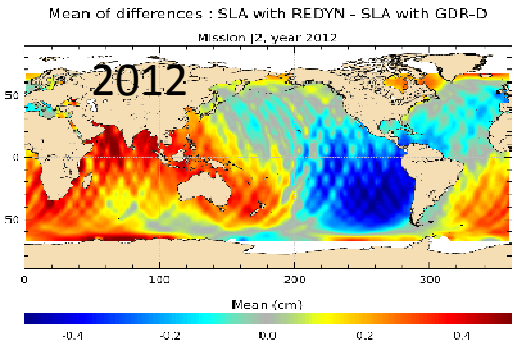
Average per year of the differences GDR-E prelim – GDR-D:

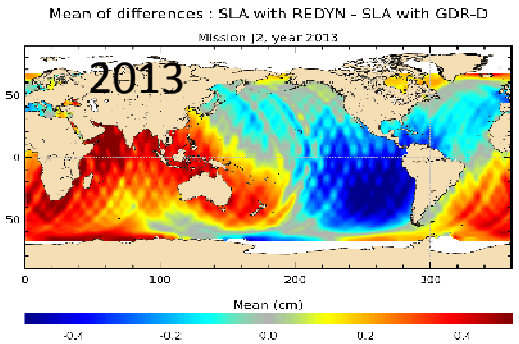




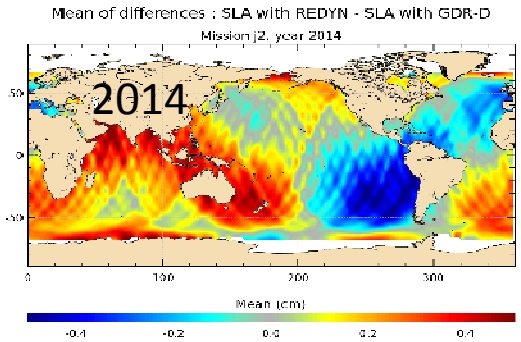








-0.5 cm 0.5



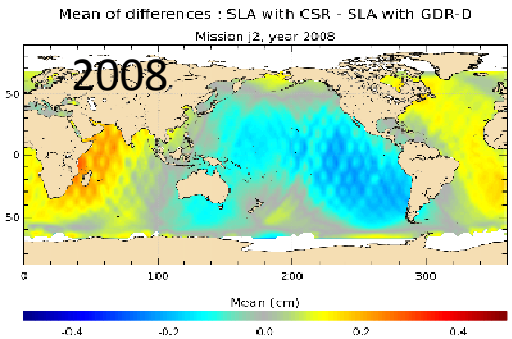
-0.5 cm 0.5

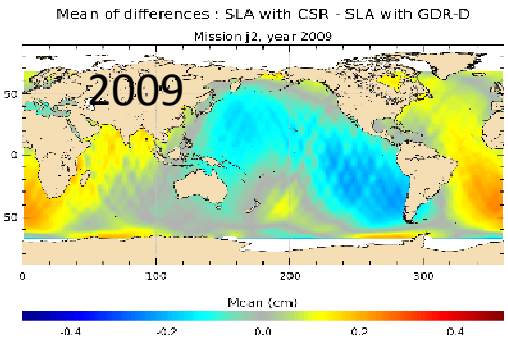
Non linear interannual effect on the regional MSL.
The solution is closer to the monthly average based on Grace.

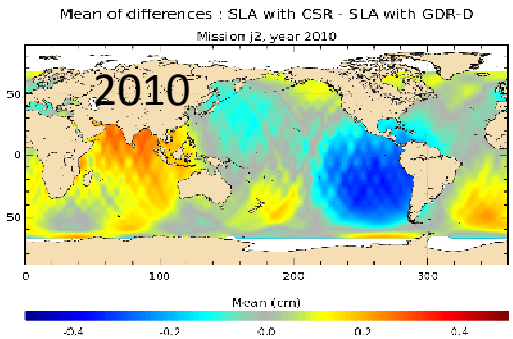
Interannual evolution of regional MSL

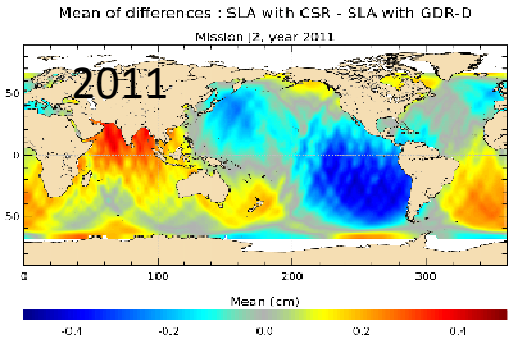
Jason-2

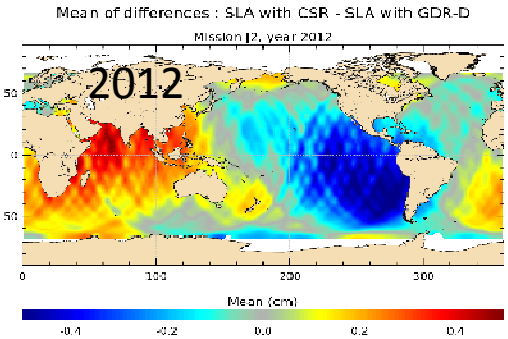
Average per year of the differences GDR-D – CSR (monthly grace based):

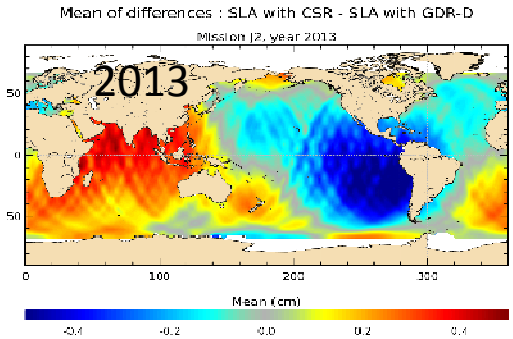




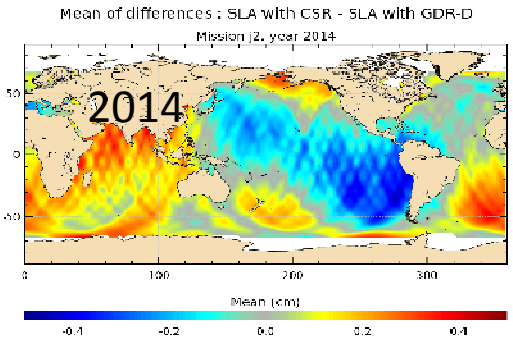








-0.5 cm 0.5



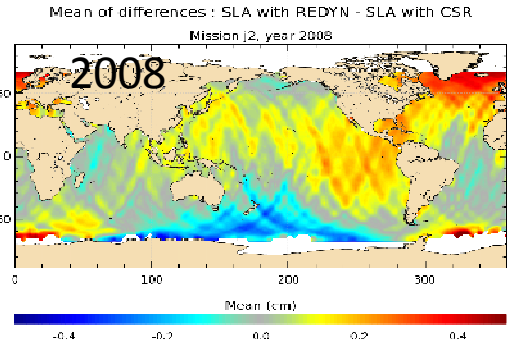
-0.5 cm 0.5

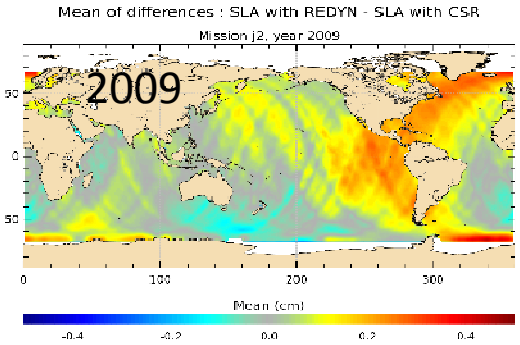
Non linear interannual effect on the regional MSL.
The solution is closer to the monthly average based on Grace.

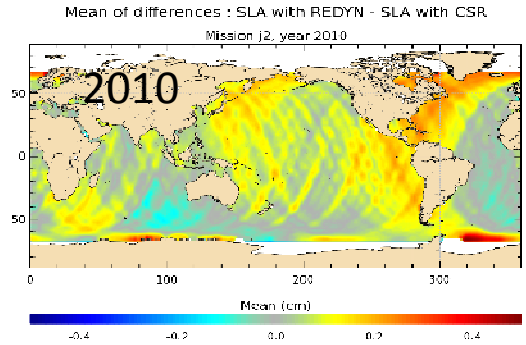
Interannual evolution of regional MSL

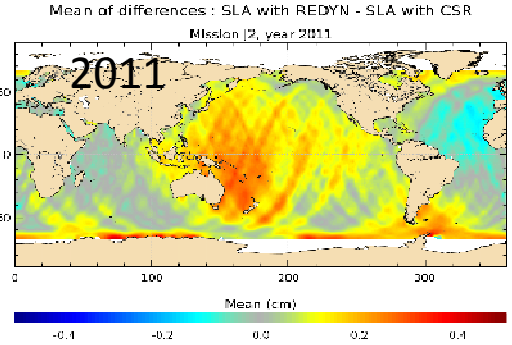
Jason-2

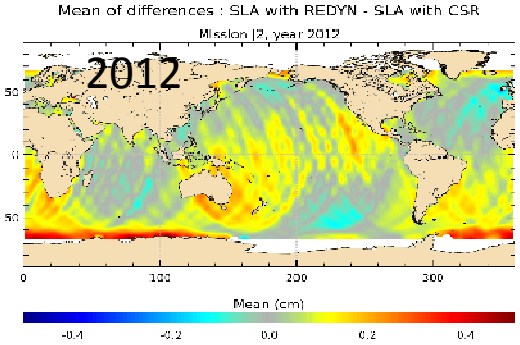
Average per year of the differences GDR-E prelim – CSR (monthly grace based):

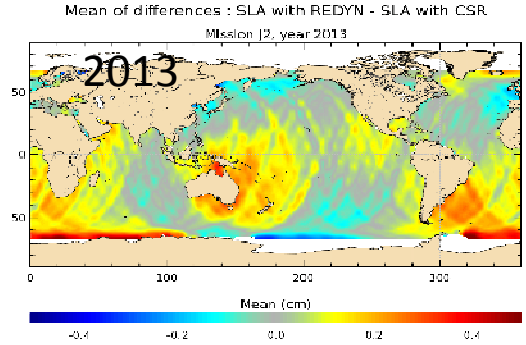




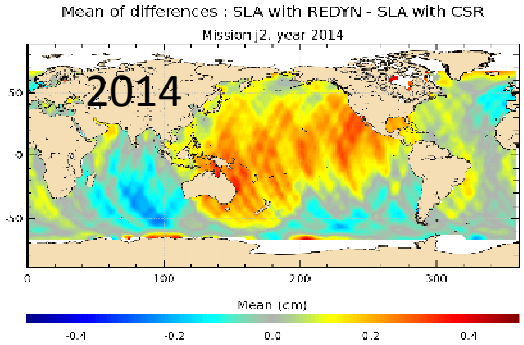








-0.5 cm 0.5



-0.5 cm 0.5

Non linear interannual effect on the regional MSL.
The solution is closer to the monthly average based on Grace.

Large scales errors

Jason-2

Geographically correlated errors at crossovers:

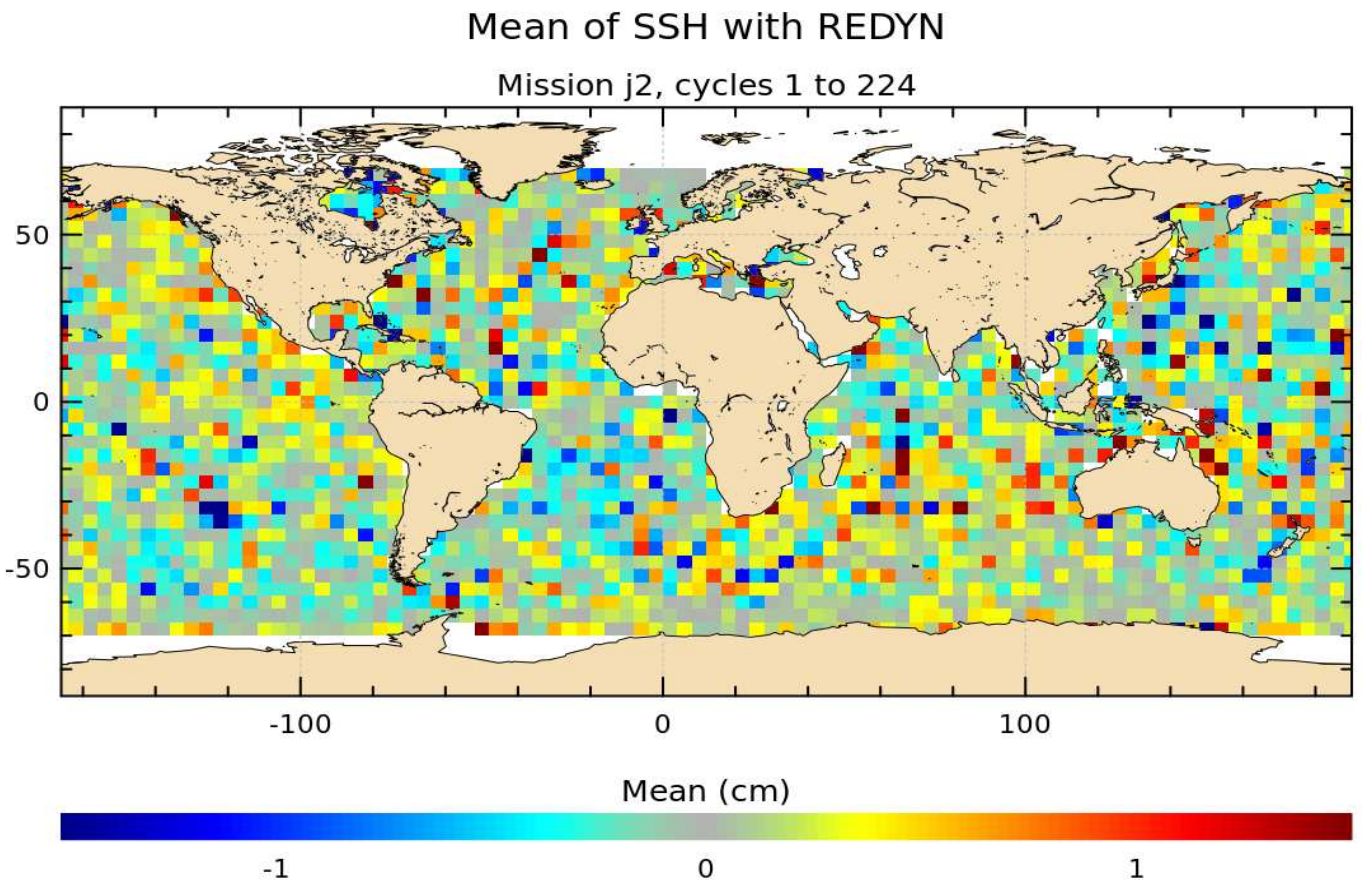
GDR-D

Gravity field

+ Harmonic 31 relaxed

+ Geocenter position

GDR-E Prelim with Reduced dynamic



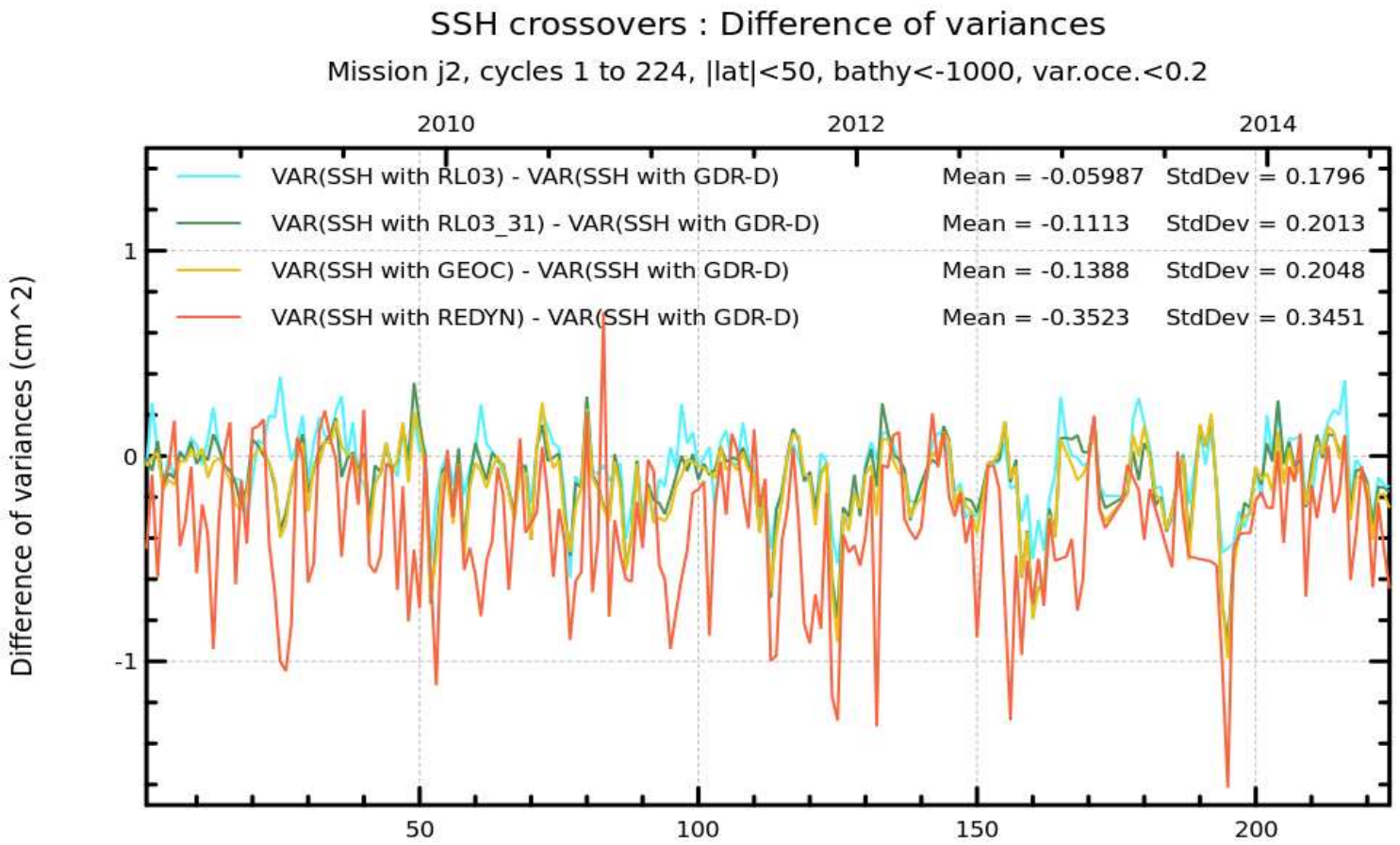
Significant impact, mainly due to the gravity field upgrade and reduced dynamic

Mesoscale impact

Jason-2

Monitoring of the differences of variance at crossovers Orbit – GDR-D:

- GDR-D
- Gravity field
- + Harmonic 31 relaxed
- + Geocenter position
- GDR-E Prelim with Reduced dynamic



Significant improvement, mainly due to the dynamic reduction + solar radiation pressure.

Jason-1 GDR-E' standards

- For Jason-1, the reprocessing calendar urged the standard upgrade
- Already assessed and included in the full mission reprocessing (on going, see Ablain et al. Poster).

	mission	
	J2	J1
New Gravityfield	X	X
Harmonic 31 relaxed	X	
Geocenter position	X	
SRP model tuning	X	X
Reduced dynamic	X	
Doris in SAA zone tuning		X

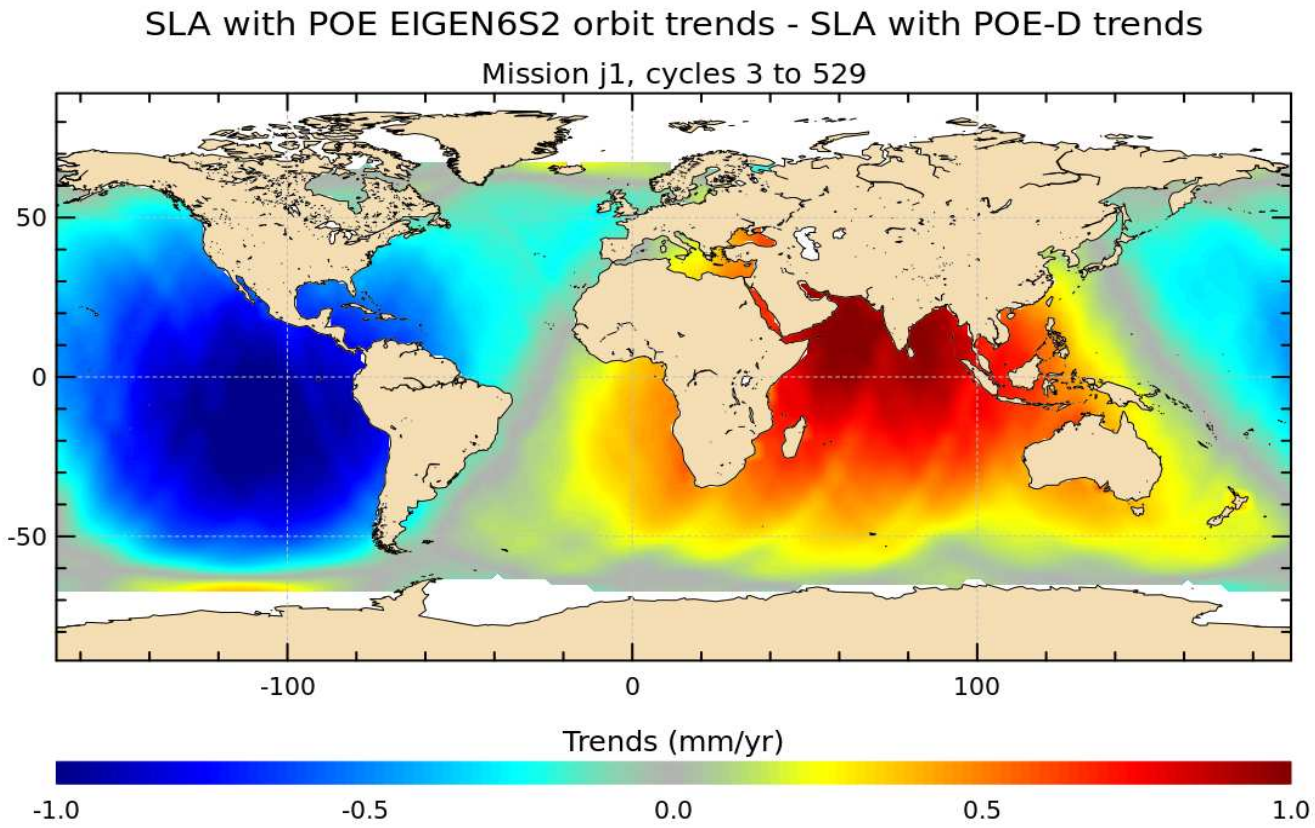
- GRR-E preliminary take into account only 2 of the 5 evolutions + an additional one

- New Gravity field EIGEN-GRGS.RL03.MEAN-FIELD (annual, semi annual fit **+ trend estimated per year**)
- Calibrated semi-empirical solar radiation pressure model on the solar panels
- Reduction of the SAA doris station downweighting

Impact of EIGEN-GRGS.RL03.MEAN-FIELD (GDR-E) instead of EIGEN6S2 (GDR-D)

GDR-D

Gravity field



Significant impact, on the average, bassin scale

Regional linear MSL trends

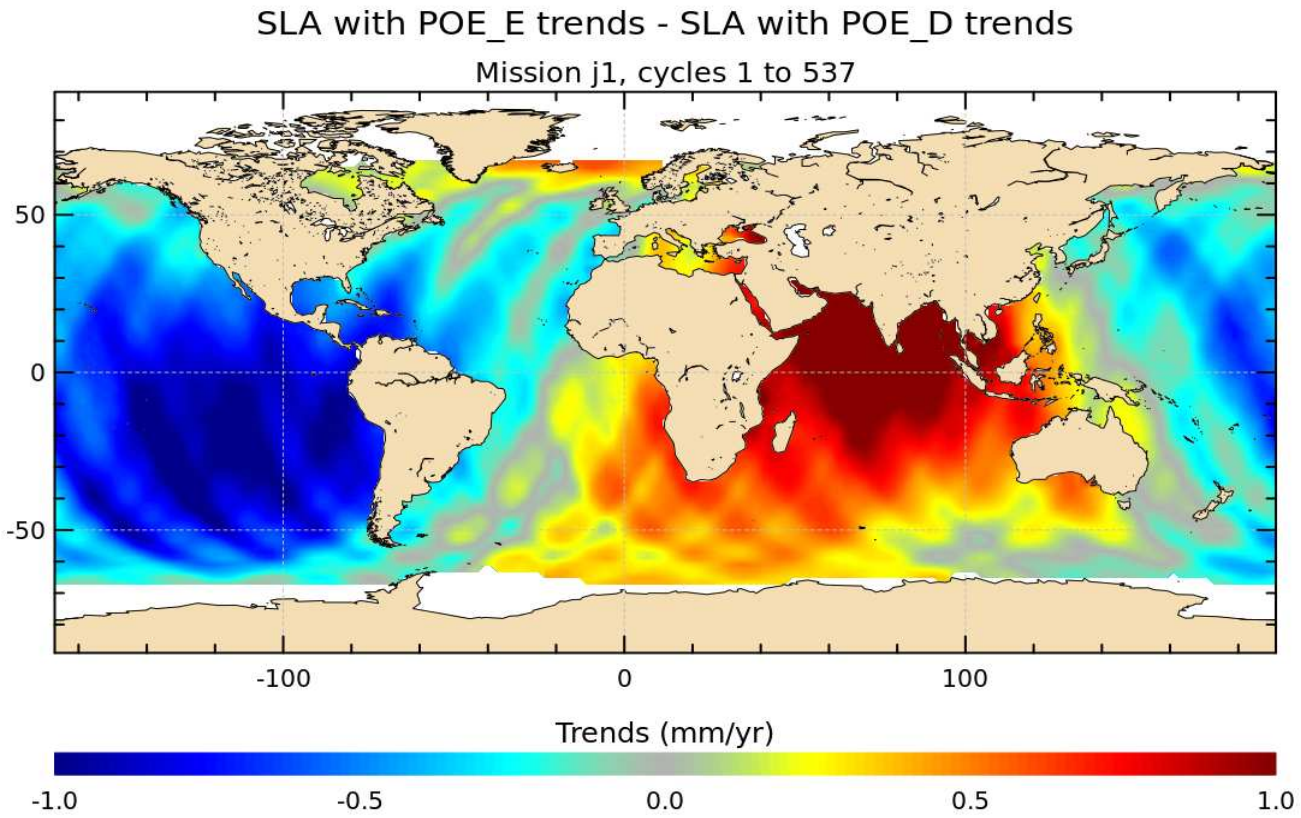
Impact of GDR-E prelim instead of (GDR-D)

GDR-D

Gravity field

SLR model tuning

Downweighting for JA1 Doris in SAA 60%

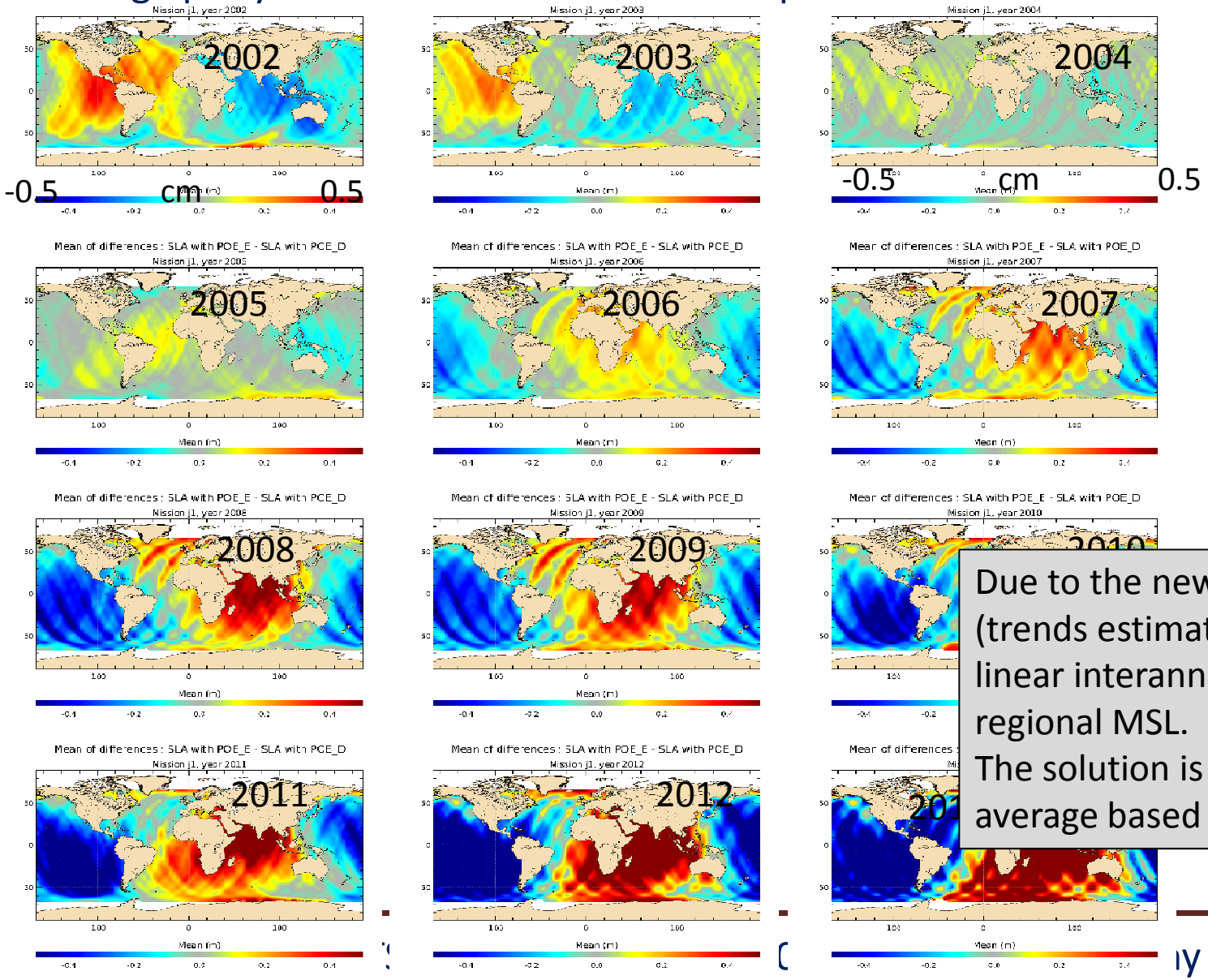


Effect of Gravity field dominates / SAA upgrade and SLR upgrade

Interannual evolution of regional MSL

Jason-1

Average per year of the differences GDR-E prelim – GDR-D:



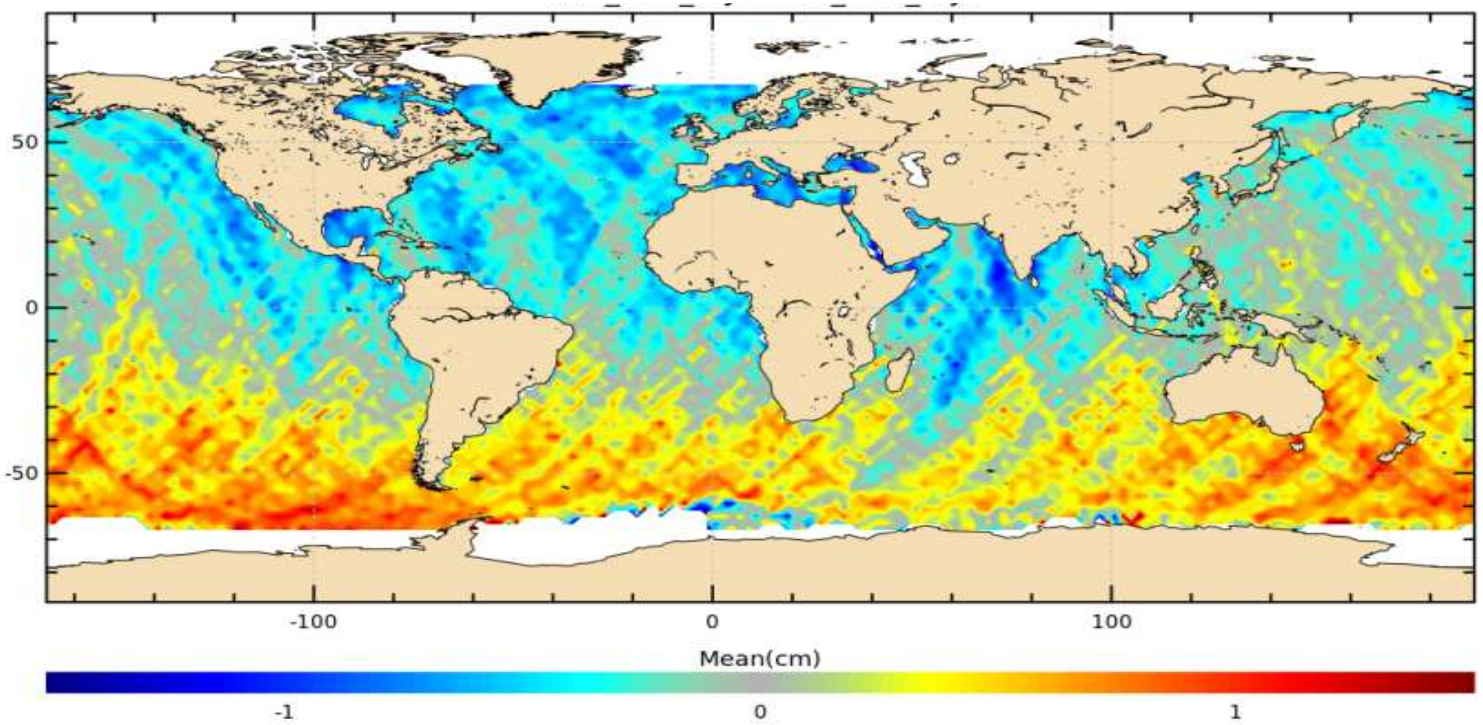
Due to the new gravity field model (trends estimated per year) Non linear interannual effect on the regional MSL.
The solution is closer to the monthly average based on Grace.

Jason-1 GDR-E' standards: SAA modeling

Impact of downweighting of DORIS beacons in SAA region (on Doris only orbits):

GDR-D

J1 – J2 SSH residual over tandem phase

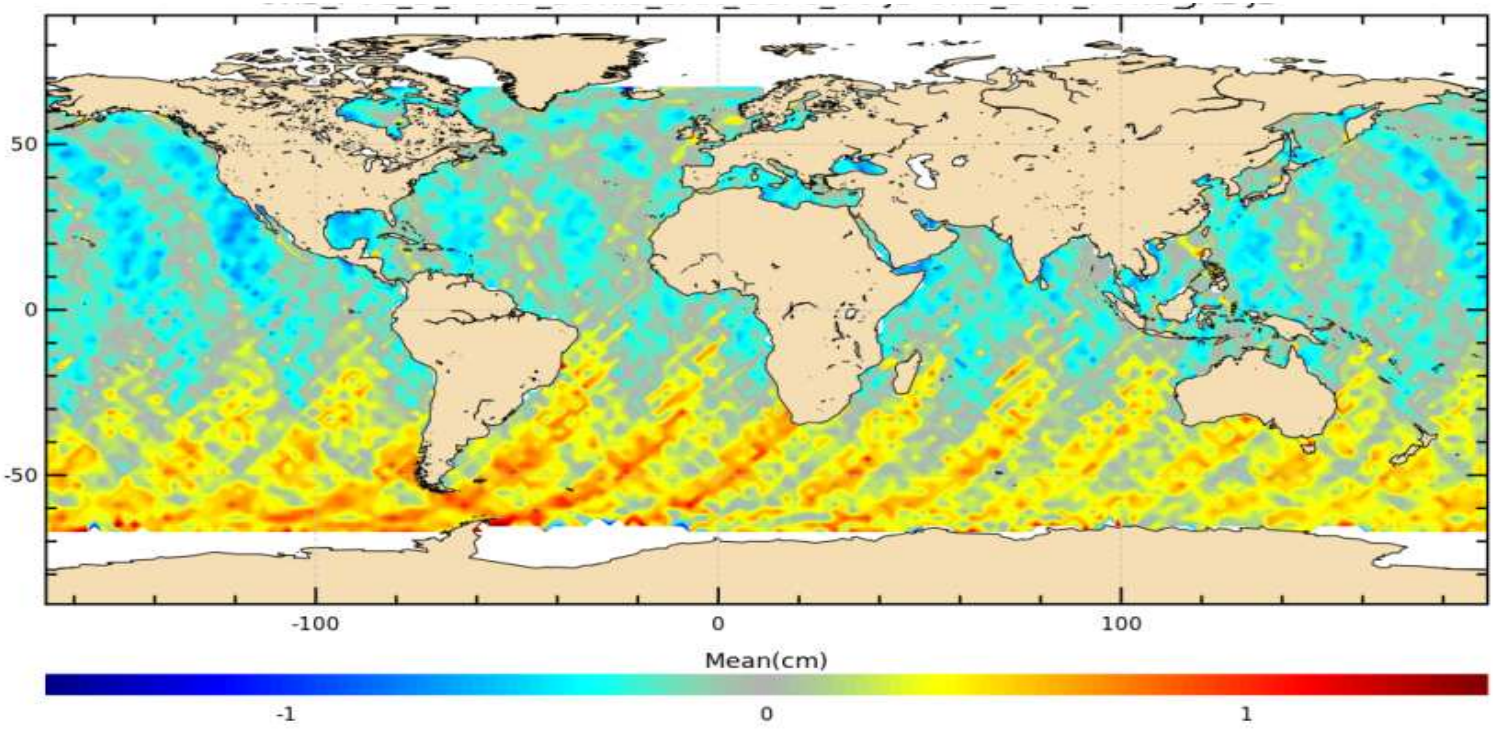


Downweighting for JA1 Doris in SAA 10%

Jason-1 GDR-E' standards: SAA modeling

Impact of downweighting of DORIS beacons in SAA region (on Doris only orbits) Doris only (V6) downweighting of 0.6, instead of 0.1 previously used :

J1 – J2 SSH residual over tandem phase



Downweighting for JA1 Doris in SAA 60%

⇒Reduces slightly north/south bias between JA1/JA2

⇒Sligt degradation of the orbit performences because more weight given to degraded SAA stations

Performance at crossovers

Jason-1

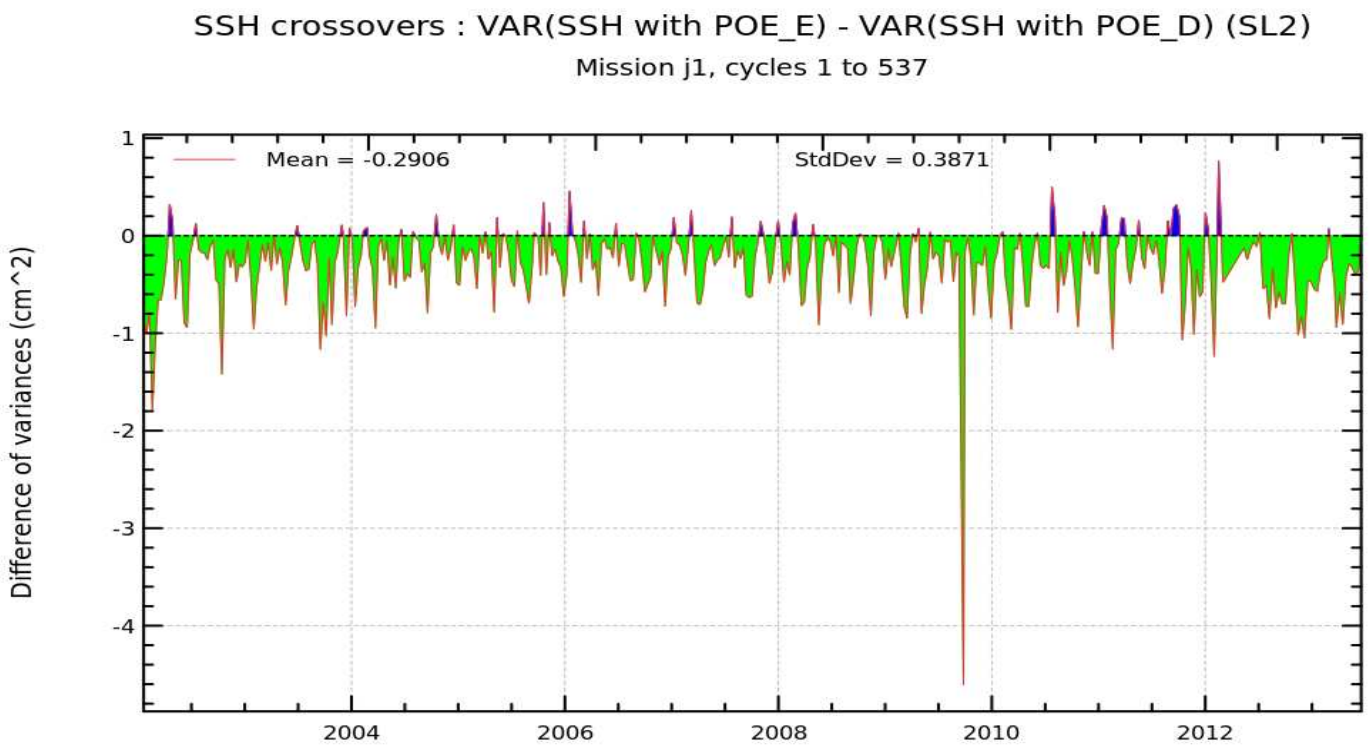
Even without any stochastic improvement (reduced dynamics) the solution is much improved at crossovers!

GDR-D

Gravity field

SRP model tuning

Downweighting for JA1 Doris in SAA 60%



=> These cumulated evolutions improves the consistency of the X_SSH variance by 0.3cm²!

Performance at crossovers

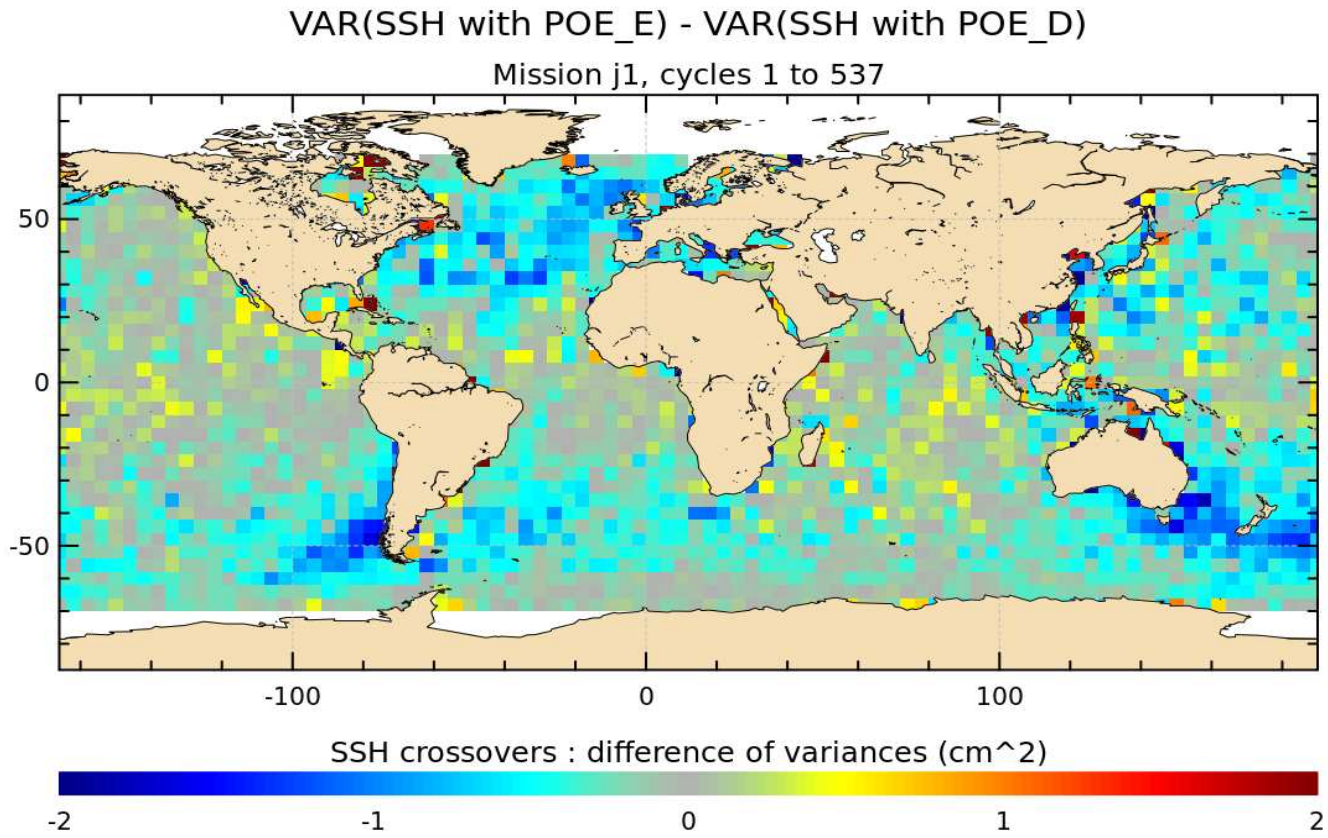
Jason-1

GDR-D

Gravity field

SRP model tuning

Downweighting for JA1 Doris in SAA 60%



Spatially, many zones where variance of SSH at crossover is decreased for POE-E
-> better performance at crossover

Synthesis on future GDR-E POD standards

	mission		Impact on Sea Surface Restitution			
	J2	J1	J1/J2 Consistency	Regional Mean Sea Level trend AND interannual signature	Mean difference at crossovers	Variance reduction at crossovers
New Gravityfield	X	X		Large scale significant		
Harmonic 31 relaxed	X			Large scale significant		
Geocenter position	X				Weak	Weak
SRP model tuning	X	X			Great improvement	Great improvement
Reduced dynamic	X				Great improvement	Great improvement
Doris in SAA zone tuning		X	N/S biais reduced			Slight degradation

Conclusion - perspectives

From the altimetry point of view:

- The future GDR-E POE available in altimetry products are getting prepared… and they will be good (at least for Jason-1 and 2!)
- The quality of the orbits are keeping improving: Points that were previously considered as negligible are now observable!!!

- Last upgrade GDR-C to GDR-D had been the introduction of a **drift in the time gravity field** with a large impact in regional Mean Sea Level trend.
- Today, the change from GDR-D to GDR-E is dominated by the impact of the **interannual variability** on the regional MSL + **variance reduction at crossovers** due to a better SLR modeling and/or stochastic model improvement.

- The impact must now also be studied for **other missions**. This will enable to make a more complete assessment using multimission comparisons.

- Following these studies and if no regression is noticed, the full GDR-E standards will be computed, including **ITRF** last update.

Thank you for your attention

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Temporal evolution

Monitoring of the differences Orbit – GDR-D:

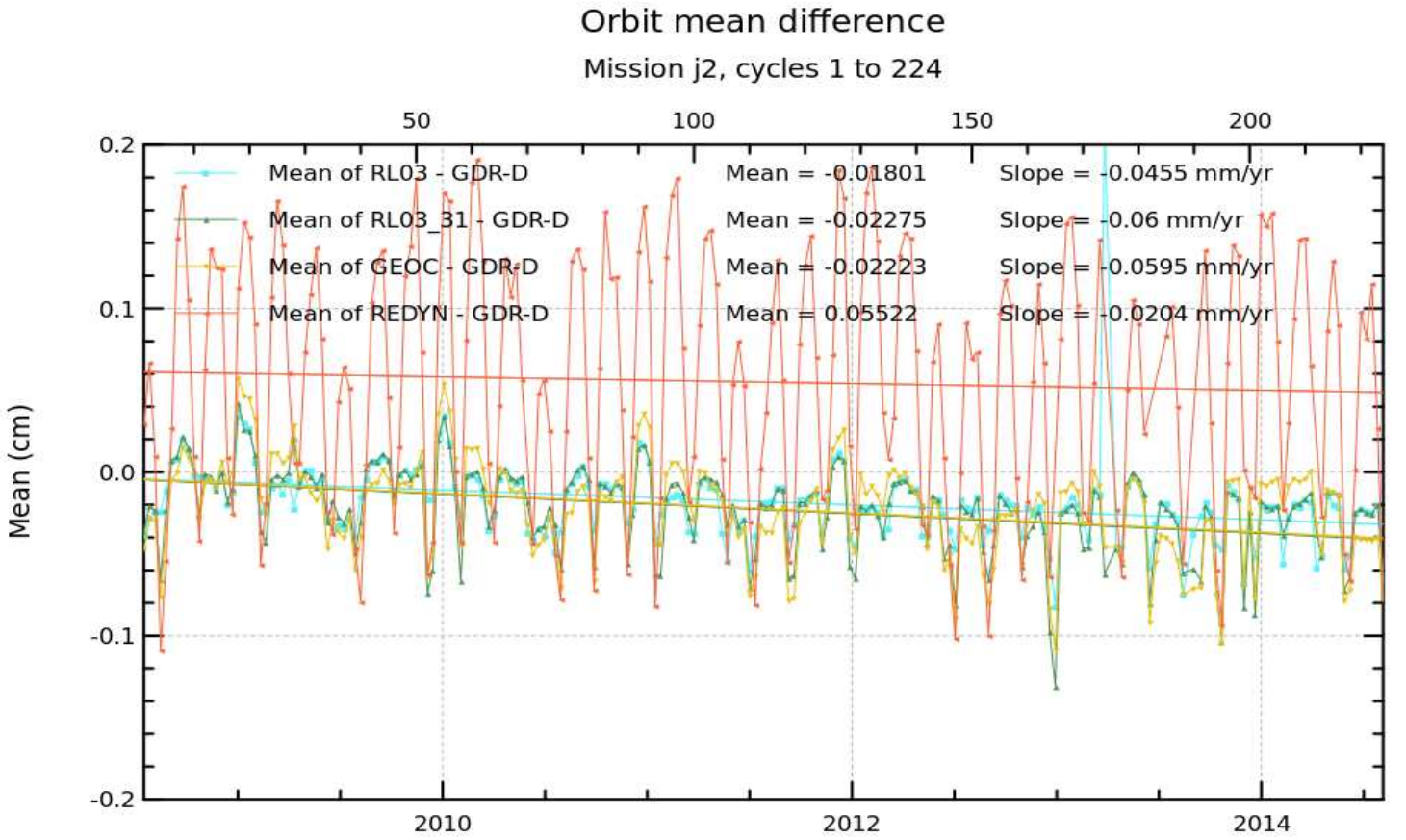
GDR-D

Gravity field

+ Harmonic 31 relaxed

+ Geocenter position

GDR-E Prelim with Reduced dynamic

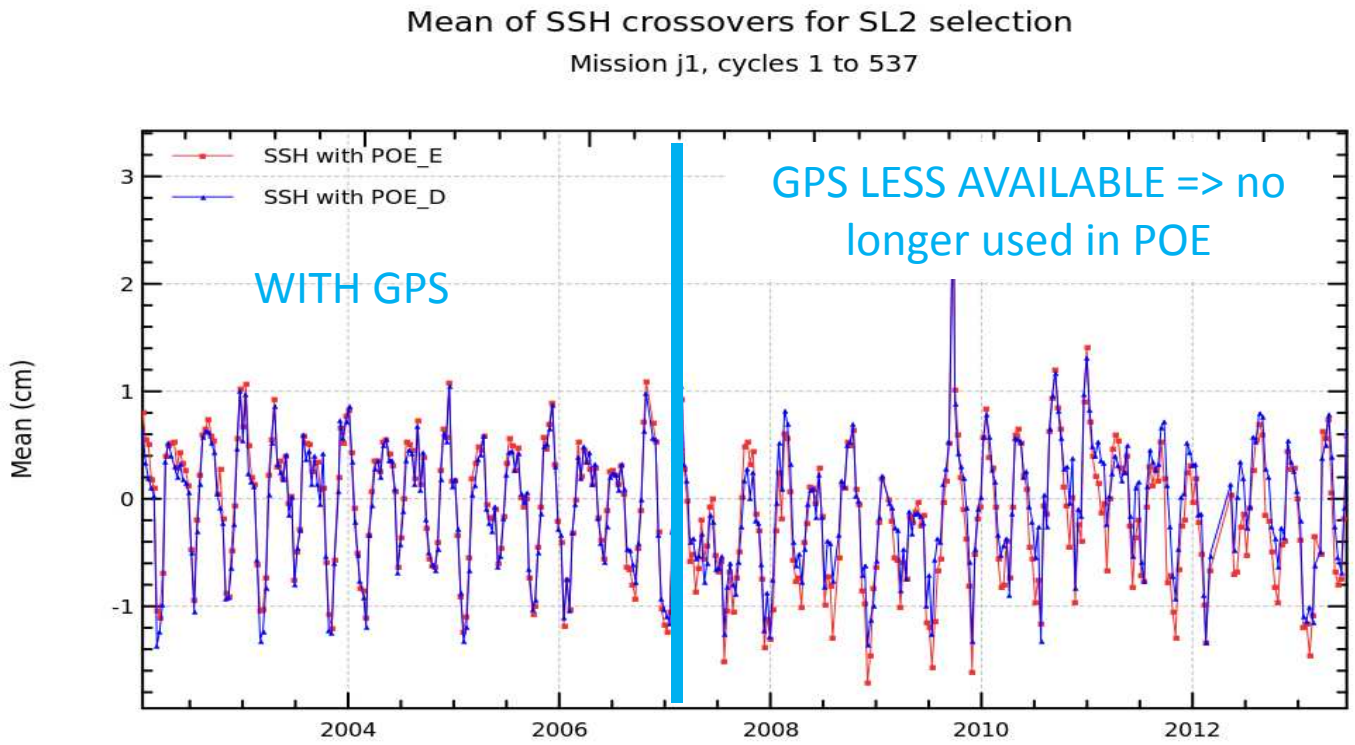


Small impact, mainly due to the gravity field upgrade and new geocenter position.
Negligeible impact on MSL global trend

Jason-1 GDR-E' standards: Perfo at crossovers

GDR-D

GDR-E '

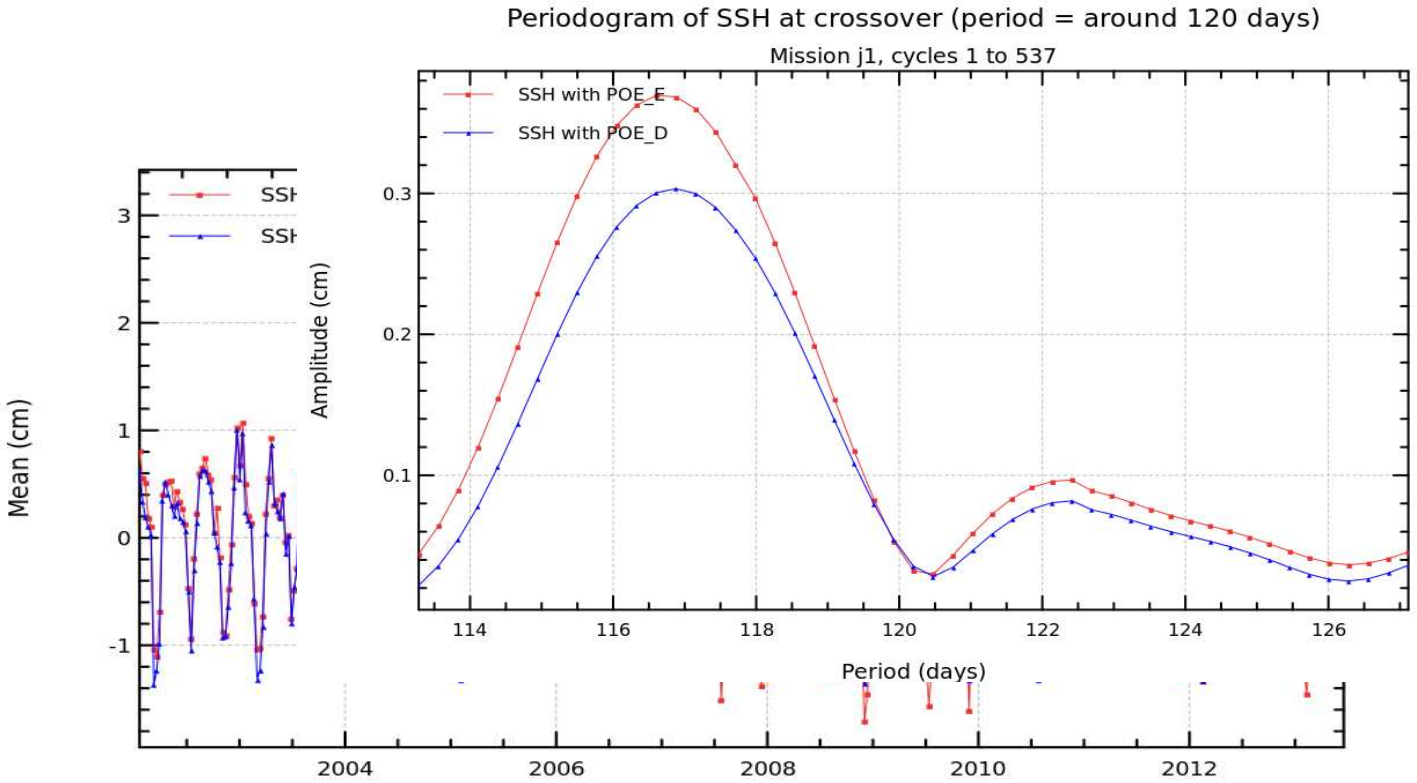


For the period without GPS, the quality remains good but the orbit is slighly less constrained

Jason-1 GDR-E' standards: Perfo at crossovers

GDR-D

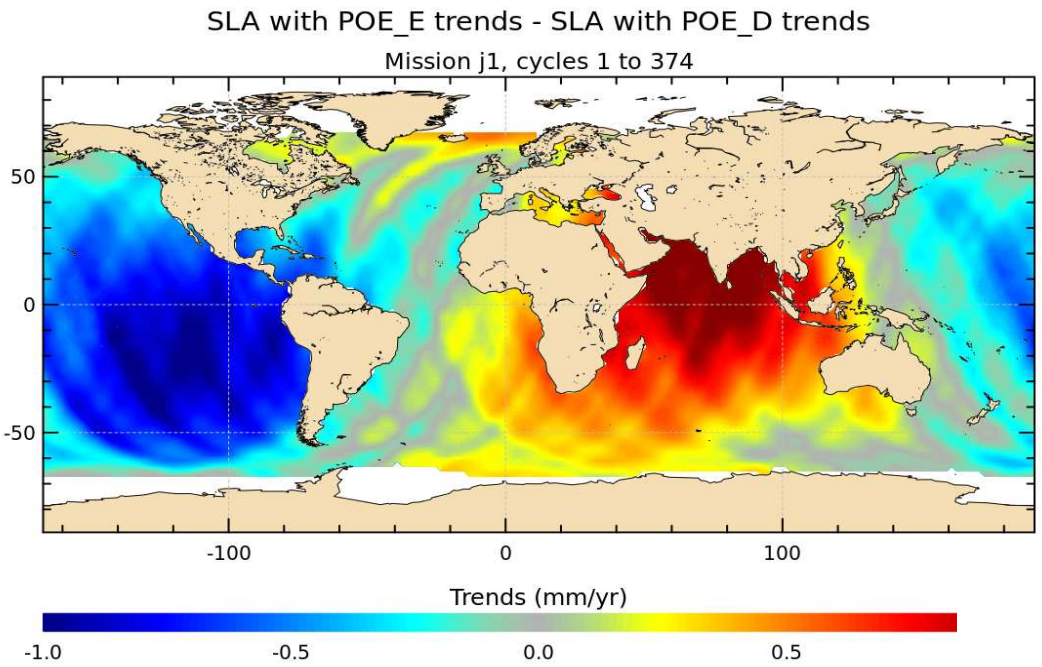
GDR-E '



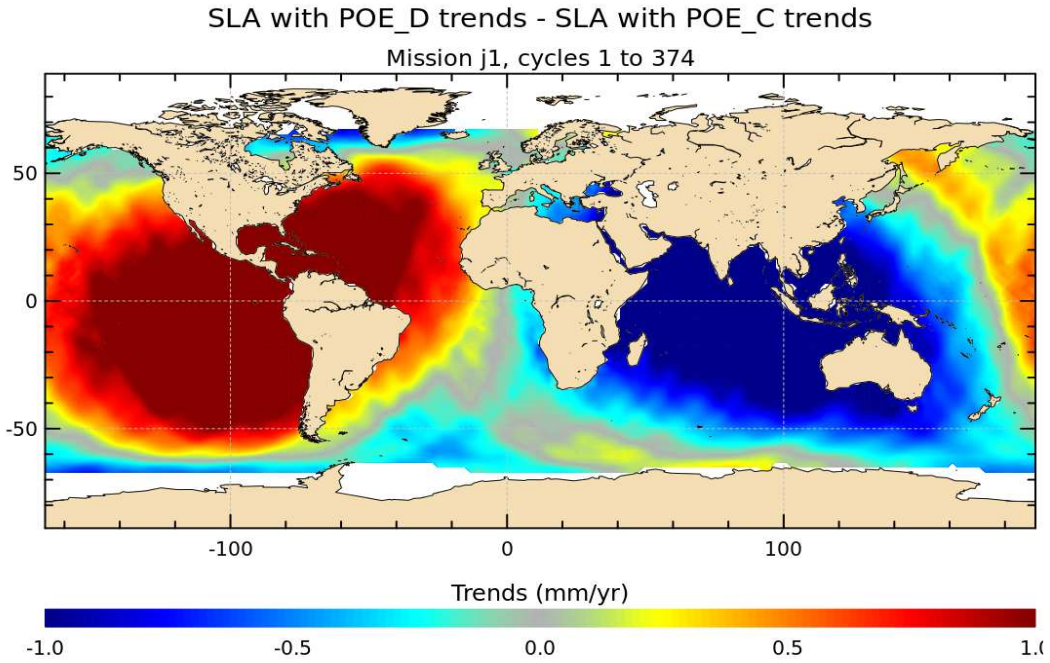
Amplitude of ~120 days signal of SSH differences at crossovers is slightly increased for POE-E.

This is not significant and can be due to the different modeling of solar radiation pressure, exposed with a beta cycle.

Trends



The amplitude of the correction of regional MSL trend are reduced from a standard to another => errors are getting smaller and smaller!



Differences of orbits per year SLA (POE-D – POE-C)