Assessment of Orbit Quality through the Sea Surface Height calculation

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Introduction

- Altimetric system have benefitted from the last improvements of POD standards
- In return, the study of altimetry performance provides a complementary assessment to intrinsic orbital diagnosis

Plan of the talk:

1- Mesoscale monomission effects

2- Multimission consistency effect

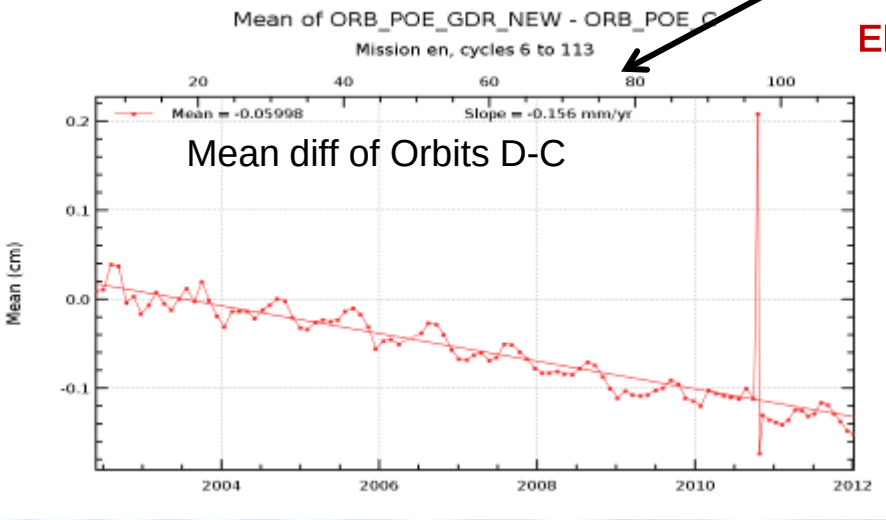
3- Long term effects

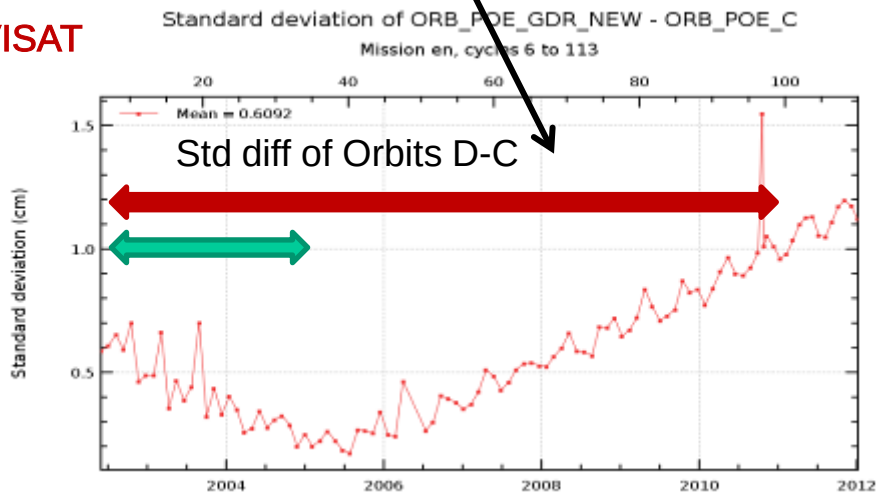
Introduction

- Main Differences between both standards considered: GDR-C and GDR-D POE:

Orbit standard	GDR-C	GDR-D
Variable gravity field	EIGEN-GL04S Drift:Annual+Semi-annual 50x50 from EIGEN-GL04SANNUAL	EIGEN-GRGS_RL02bis_MEAN-FIELD
Signal modelled	Annual/semi annual	Annual/semi annual + drift
Period of estimation	2003-2005	2002-2011
Itrf	2005	2008

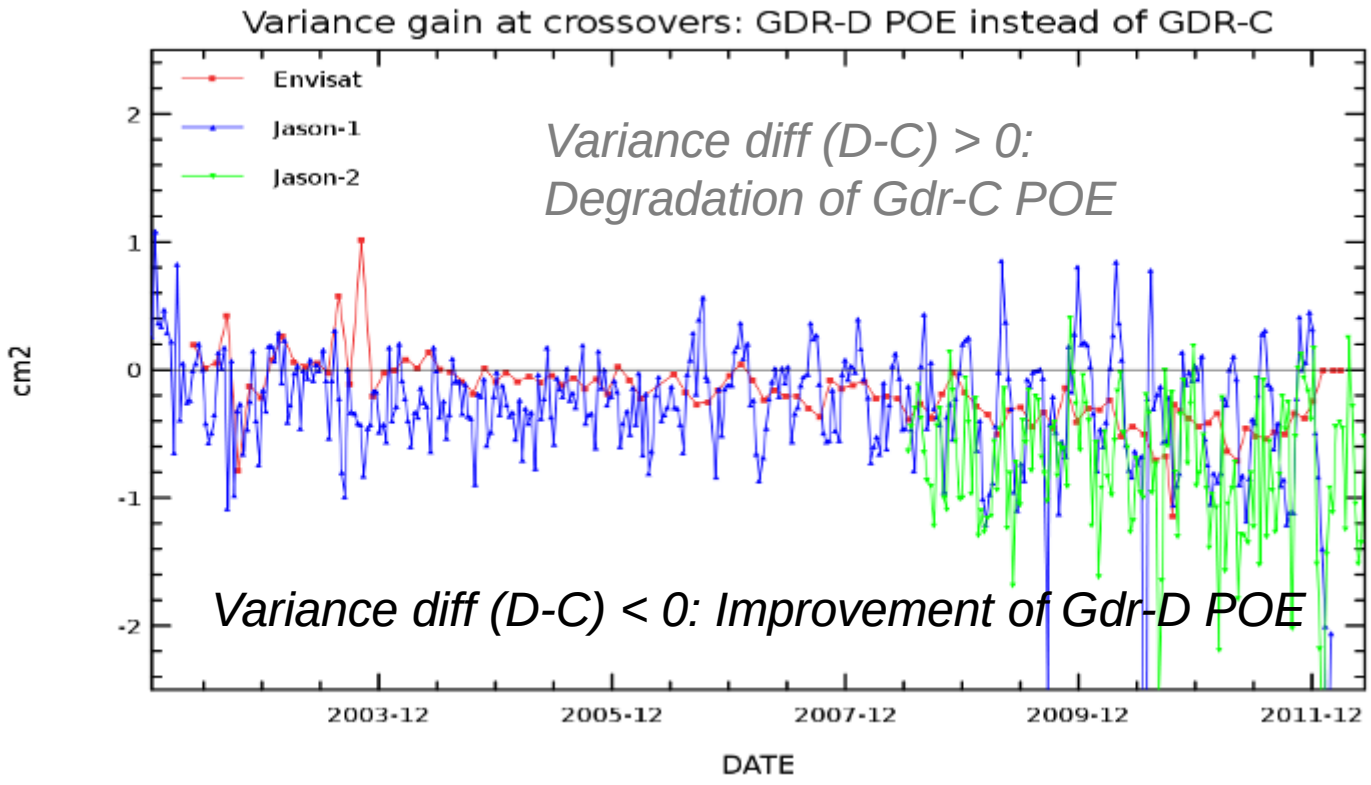
ENVISAT





Monomission diagnosis

- GDR-D Orbits better than GDR-C in terms of **variance at cross overs** for all missions ➔ good indication of quality for mesoscale scales (lower than 10days)



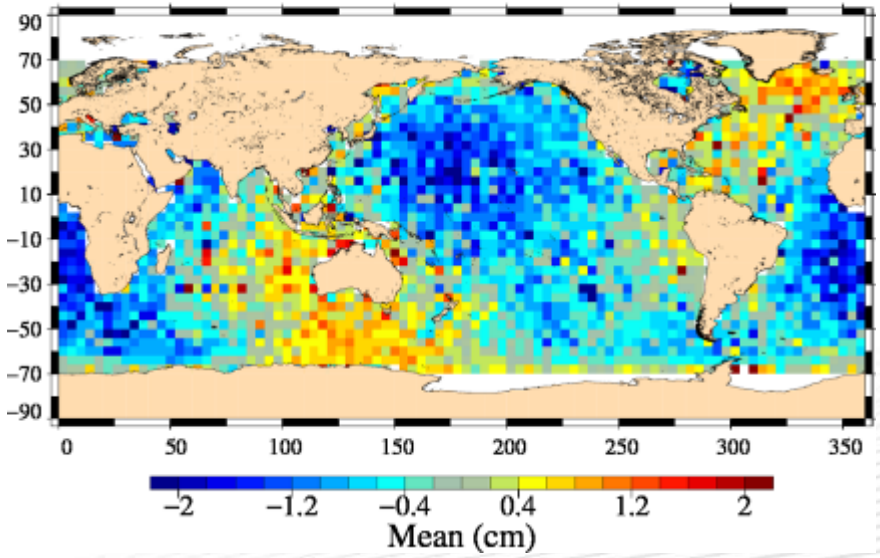
➔ Better consistency of Sea Surface Hight at crossovers, increasing the relevance of mesoscale measurements

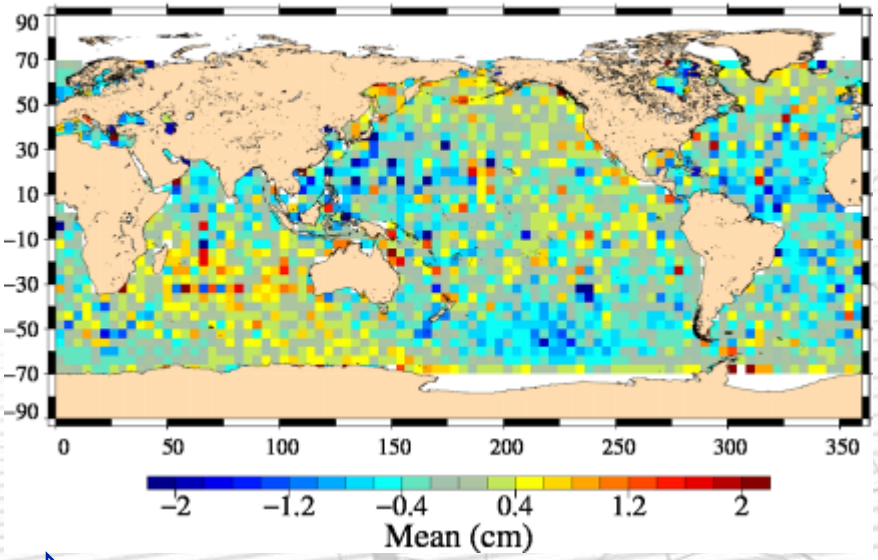
Monomission diagnosis

- GDR-D Orbits better than GDR-C in terms of **mean difference at cross overs** for all missions ➔ Systematic geographical biaises between asc/dsc passes behavior are largely reduced :

*Ascending/descending SSH cross-over **mean** differences over the entire mission*

POE GDR-C spanning 2008-2012 — Jason-2 — POE GDR-D spanning 2008-2012





Large geographical correlated patterns (-2 cm amplitude)

➔ Amplitude of geographical correlated patterns are reduced

➔ Mean Asc/Desc geographically correlated patterns are reduced for all missions

Monomission diagnosis

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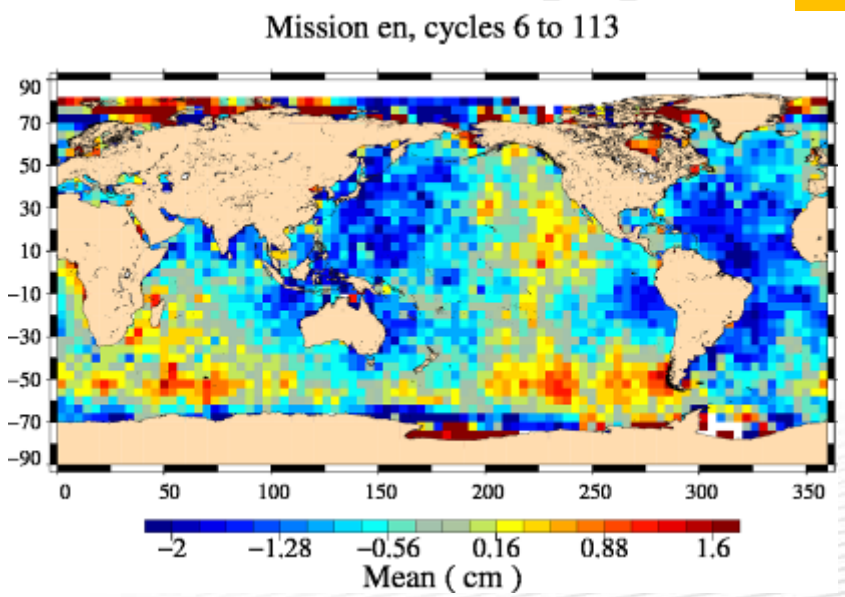
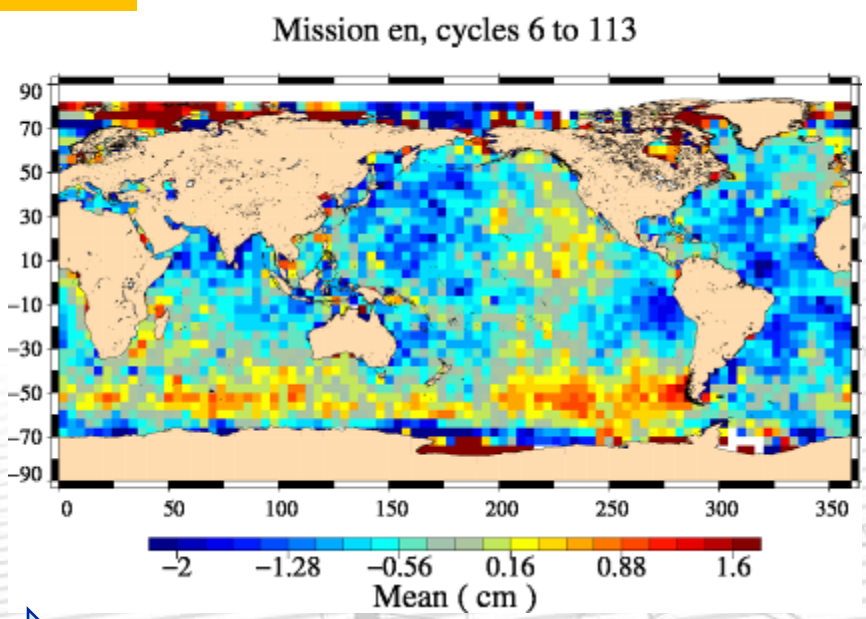
POE GDR-C spanning 2003-2012 — Envisat — POE GDR-D spanning 2003-2012





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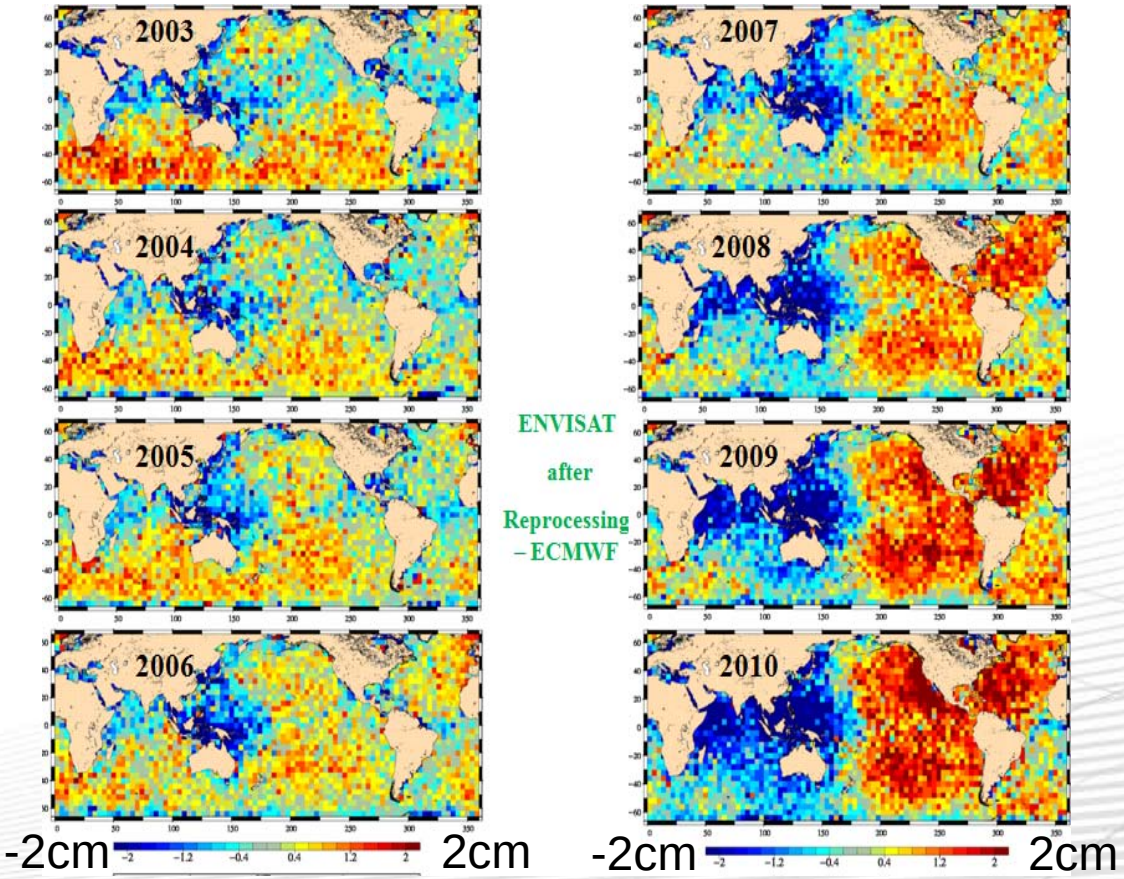
➔ Mean Asc/Desc geographically correlated patterns are reduced for all missions

Geographical bias reduction and long term impact

- Strong geographical East West bias signature and increasing with time already shown to be related to the gravity field included in the orbit solution (OSTST 2011)

Mean difference Envisat (V2.1) -Jason-1 at crossovers over 2011 (with model wet tropo)



Using GDR-C orbits

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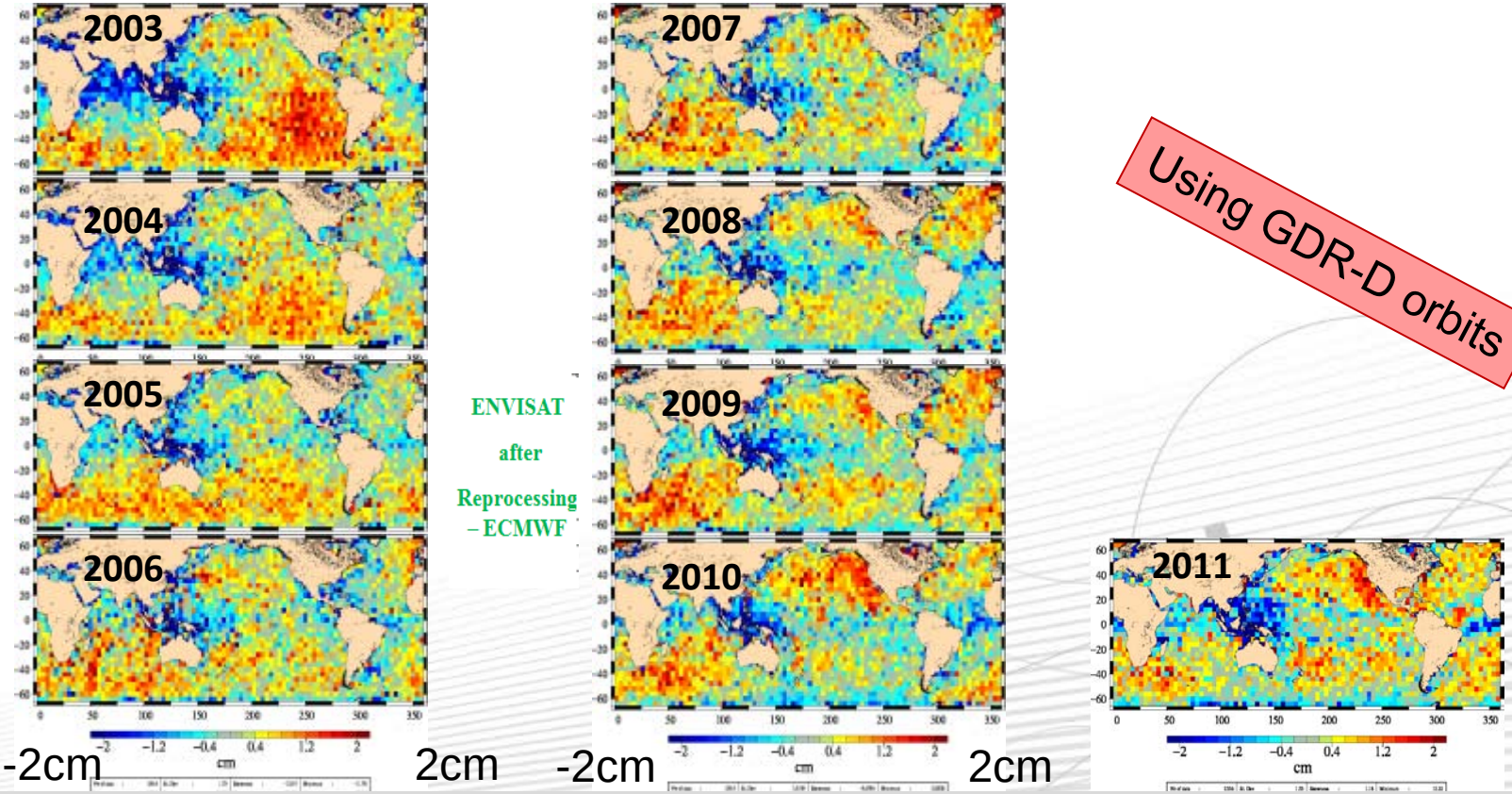


➔ Discrepancies between missions largely reduced (*Ollivier et al. Marine Geodesy 2012)*

Multimission consistency: mutual benefits of cross-comparison between missions

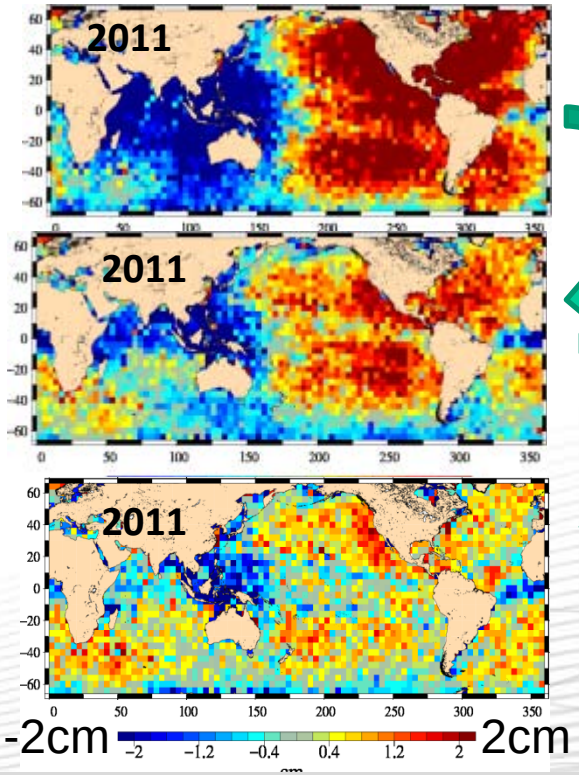
- Standards D improve consistency of monomission and multimission/ C standard
- Strong impact of Envisat (lower altitude) but impact on all missions

Mean difference Envisat (V2.1) -Jason-1 at crossovers over 2011 (with model wet tropo)

EN GDR-C POE/
J1 GDR-C POE

EN Gdr-D POE/
J1 GDR-C POE

EN Gdr-D POE/
J1 GDR-D POE



Removal of Envisat error contribution

Removal of Jason-1 error contribution

➔ Multimission comparisons enable to evidence discrepencies and possibly to improve all missions

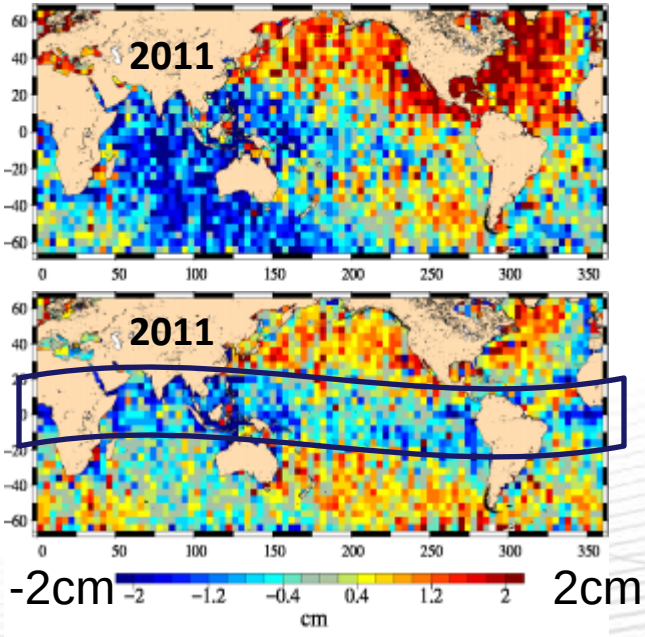
Multimission consistency: mutual benefits of cross-comparison between missions

- Standards D improve consistency monomission and multimission/ C standard

Mean difference Cryosat-2-Jason-2 at crossovers over 2011

C2(*) Gdr-D/ J2(reprocessed+ model wet tropo) with GDR-C POE

C2 Gdr-D/ J2(reprocessed+ model wet tropo) with GDR-D POE



Removal of Jason-2 GDR-C POD error contribution

Iono model on C2/ bifrequency on J2 effect

➔ Very fine known difference, hidden until now can now be evidenced in the cross over differences

(*) Cryosat data consist in CPP delayed time reprocessing , in LRM mode

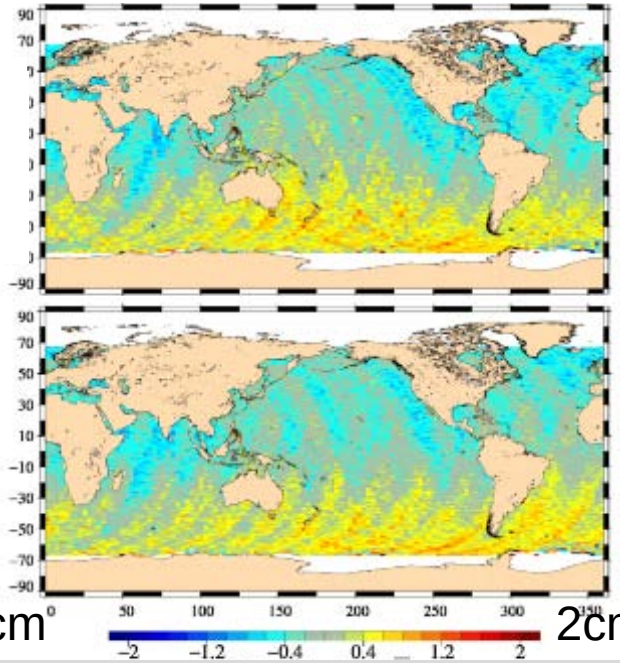
Multimission consistency: mutual benefits of cross-comparison between missions

- Concerning Jason-1 and 2, the consistency was already very good (sister missions). Yet, some questions remain (Fine N/S signature):

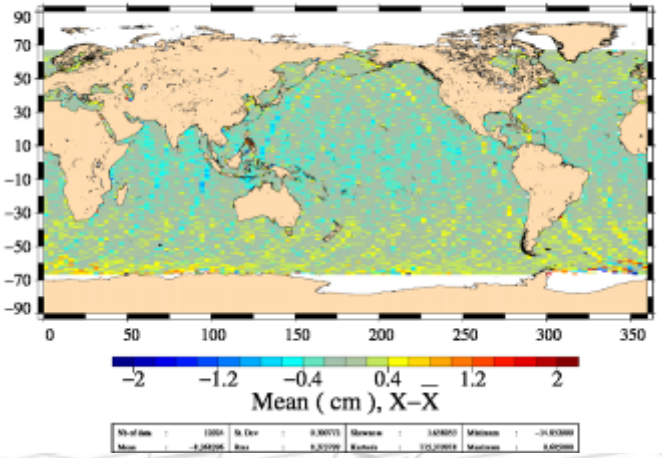
J1-J2 centered mean SSH difference during the formation flight phase (july2008-january2009)

Using standard GDR-D POE

Using Doris/Laser GDR-D POE for J1 and J2



Using standard GSFC_0905 POE

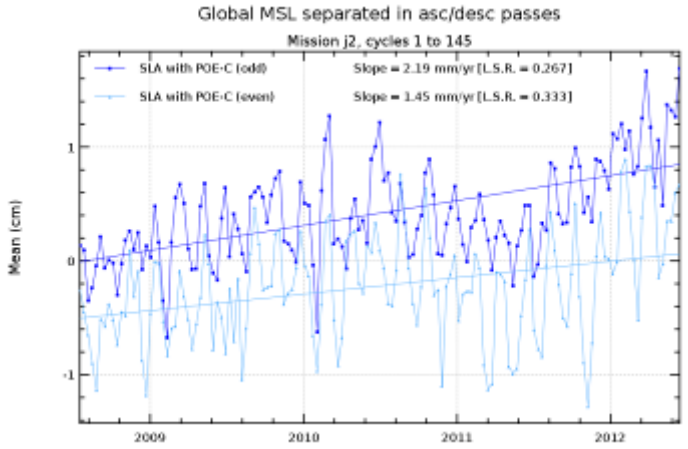


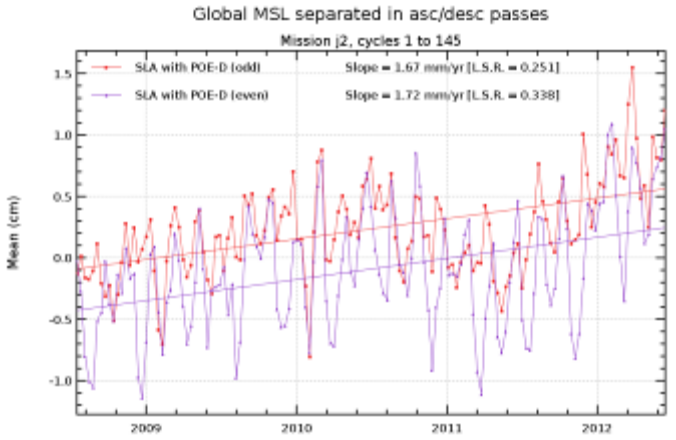
Those fine N/S discrepencies are observed on GDR-D CNES solutions but not in GSFC_0905 solutions… The difference are not due the lack of GPS on J1 (already tested with DL solutions) but might be justified and explained. ➔ Tests to be done concerning the differences of SAA modelling

Long term applications

Orbit standards and long term applications

- Global MSL: week impact on Envisat difference using GDR-D-GDR-C POE < 0.2mm/yr, negligible for other missions.
- Asc/dsc MSL discrepencies:
  - reduced for J2 (0.8mm/yr diff with GDR-C POE / -0.05mm/yr using GDR-D POE)
  - negligible impact on other mission: already very good consistency for EN and J1 (absolute difference < 0.3mm/yr)





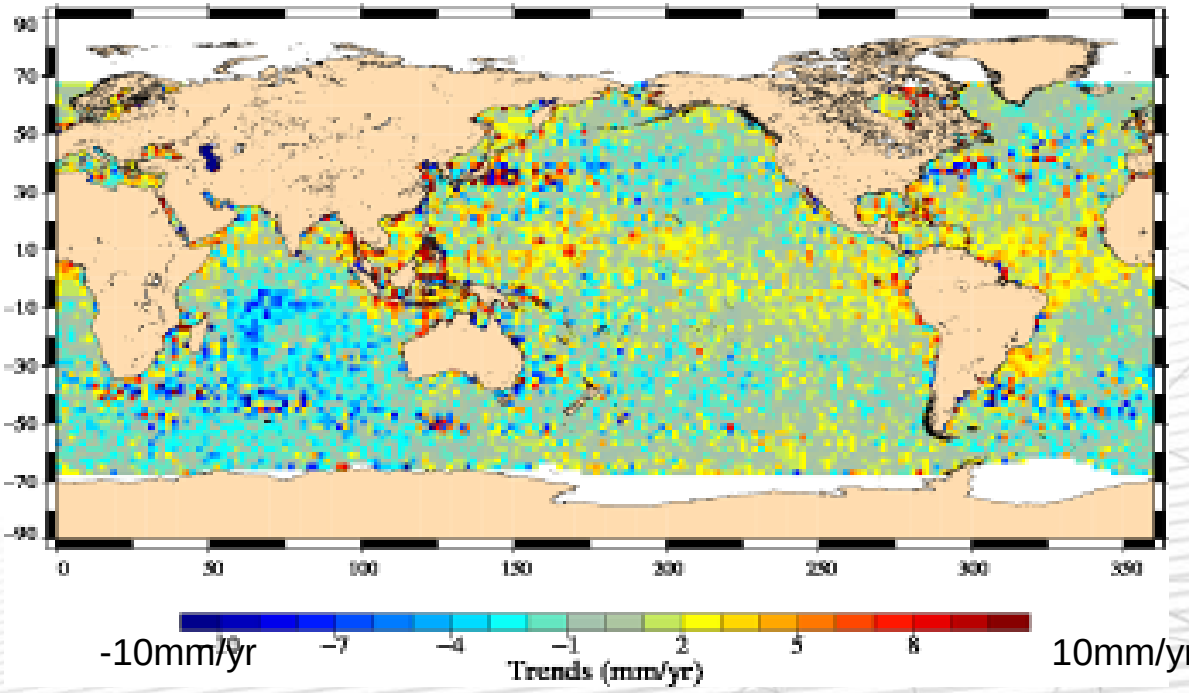
➔ No/weak impacts of GDR-C/D evolution on the Global Mean Sea Level trends

Orbit standards and long term applications

- The change in the time varying field used in GDR-C and GDR-D standards corrects for effects varying with a large time dependency: this has a signature on the regional Mean Sea Level trends:

Centered difference of regional Mean Sea Level trends between Jason-1 and Envisat missions

EI EN Gdr-D POE/
J1 J1 GDR-D POE

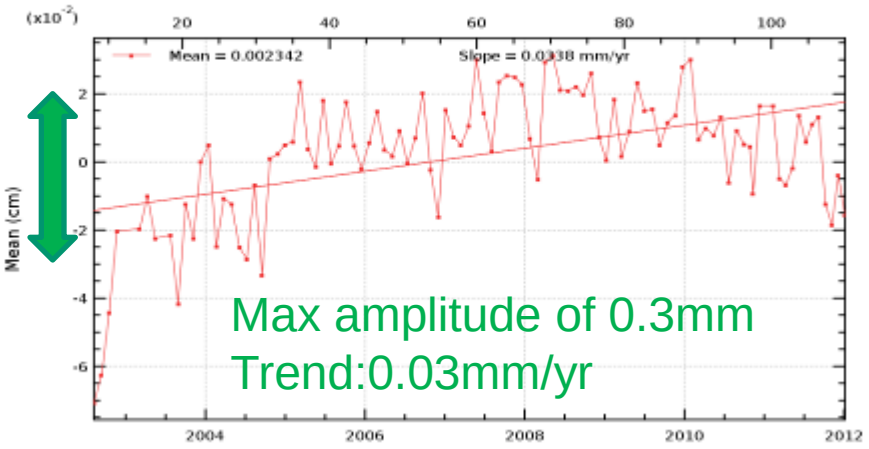


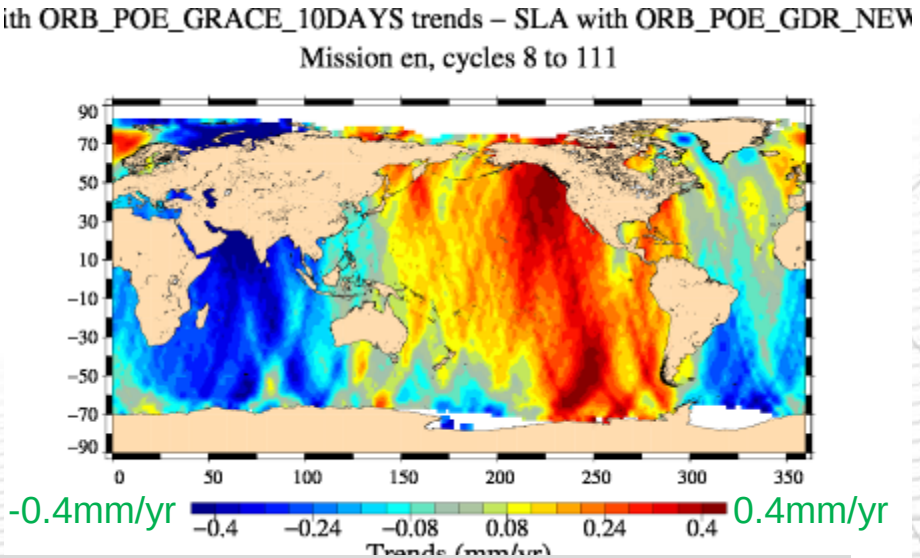
➔ We are now more confident in the regional MSL… for this period (2002-2011)…

Orbit standards and long term applications

- Some questions were raised in previous OSTST concerning the divergence between the « Real » Gravity field and the models used for POD purposes.
- We analysed the impact on a POE built (L. Cerri, CNES-POD) with a 10 day- gravity field in input.

Impact on the Mean Sea Level trends between Grace10days - GDR-D orbit solution





➔ Interesting signature but Very weak impact on global and regional MSL:
-Globally: Less than 0.04mm impact for a goal of 0.5mm/yr precision (negligible)
-Regionally: Less than 0.5mm/yr for a goal of 3mm/yr precision (weak)

Conclusions

Summary:

- GDR-D POE standards, compared to GDR-C standards:
  - improve the monomission perfo
  - improve the consistency between independant missions
- Very weak discrepencies between J1/J2 verif phase for cnes standards are still questionable.
- Using Grace 10 days gravity field in the POE instead of the one used in GDR-D POE does not show any significant impact on the global and weak impact on the regional MSL results for Envisat.

Lessons learned:

- Cross comparisons studies highlight weaker and weaker discrepancies between sister or independent missions. Some remaining low frequency bias are still questionable and could still be improved.

Thank you!