



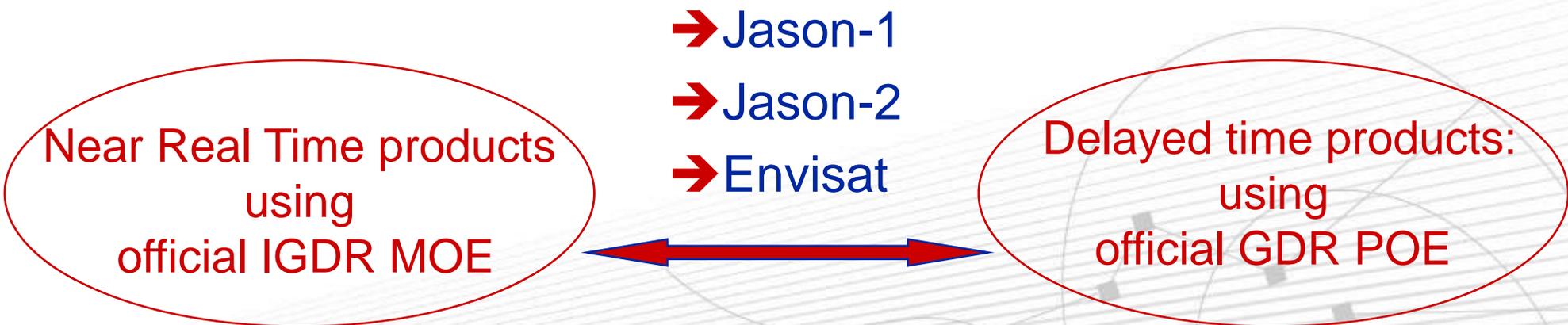
SERVICE
ALTIMETRIE
&
LOCALISATION
PRECISE

Assessment of Jason-2 orbit quality using SSH cross-calibration with Jason-1 and Envisat

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Introduction

- CalVal exercise performed on the Sea Level Height (SSH) is a complementary way of enlightening geographically related patterns or particular behaviors signing on the ocean altimetric observations.
- For this purpose, monomission SSH cross-over analysis are analysed for the three precise altimetric missions:



Overview

In this presentation, results are analyzed in terms of :

1. Geographically correlated mean biases

- Average maps of SSH cross-over differences over Jason-2 life time
- Cyclic monitoring of bias statistics at cross-over.

2. Time Variability of those biases

- Standard deviation of SSH cross over differences maps over Jason-2 life time
- Cyclic monomission statistics monitoring at cross-over

1. *Geographically correlated biases*

Orbit POE – MOE for the 3 missions over 220 days

Along track average over 22 J2 cycles:

J1: +/- 2 cm geographic biases

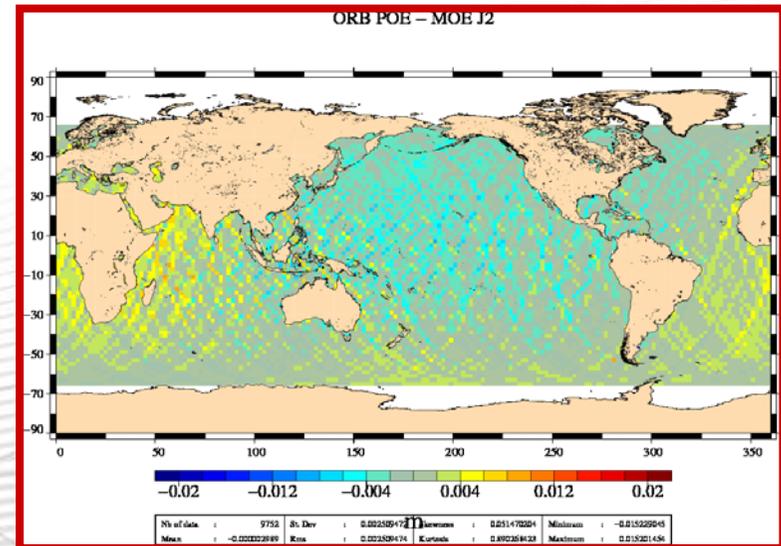
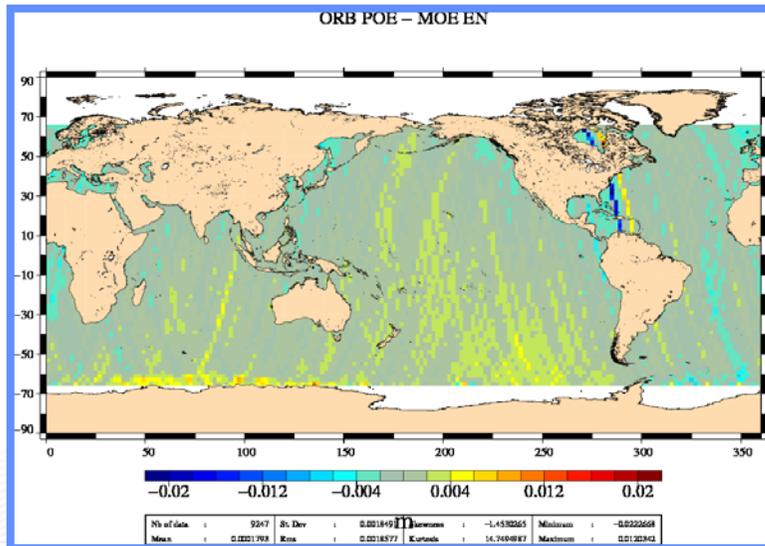
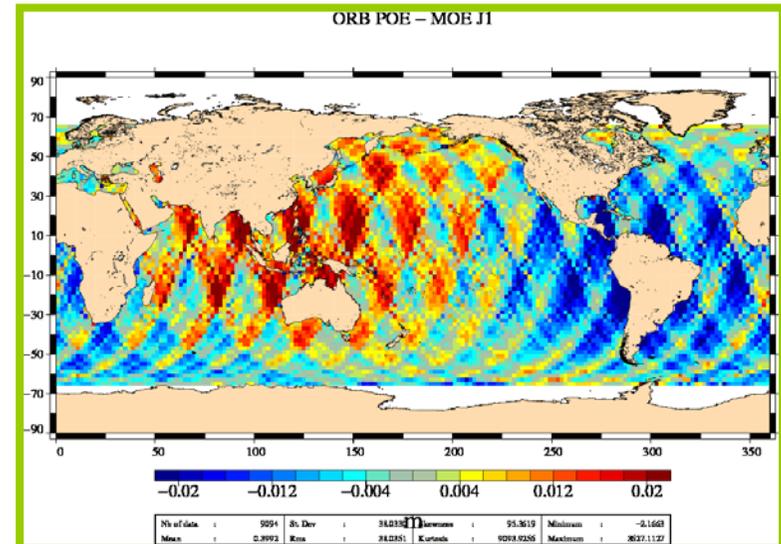
→ Centimetric discrepancies

EN: +/- 1mm geographic biases

→ Very similar

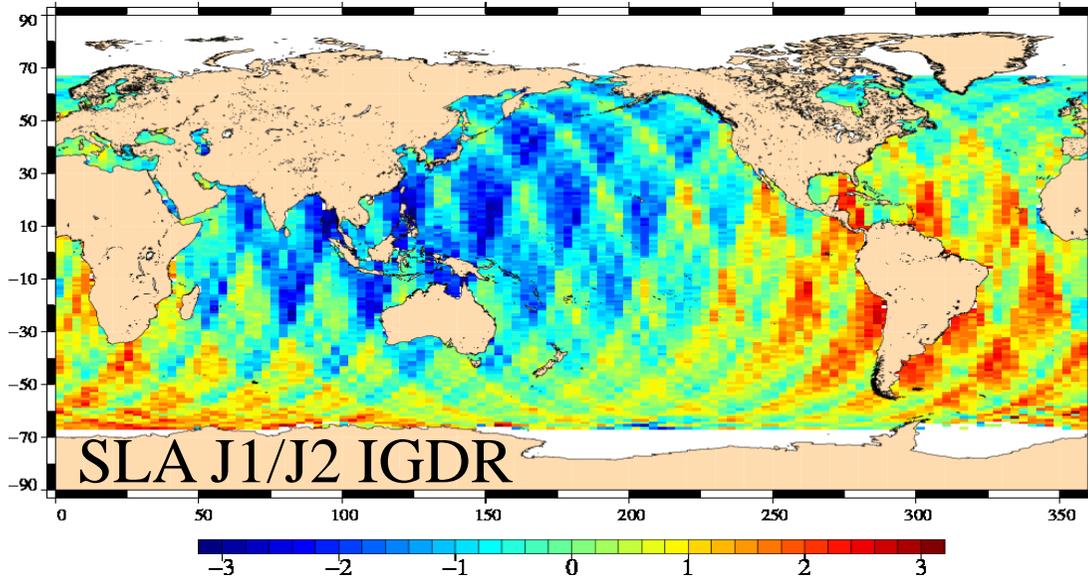
J2: +/- 2.5 mm geographic biases

→ Good consistency



SLA Performances and Consistency

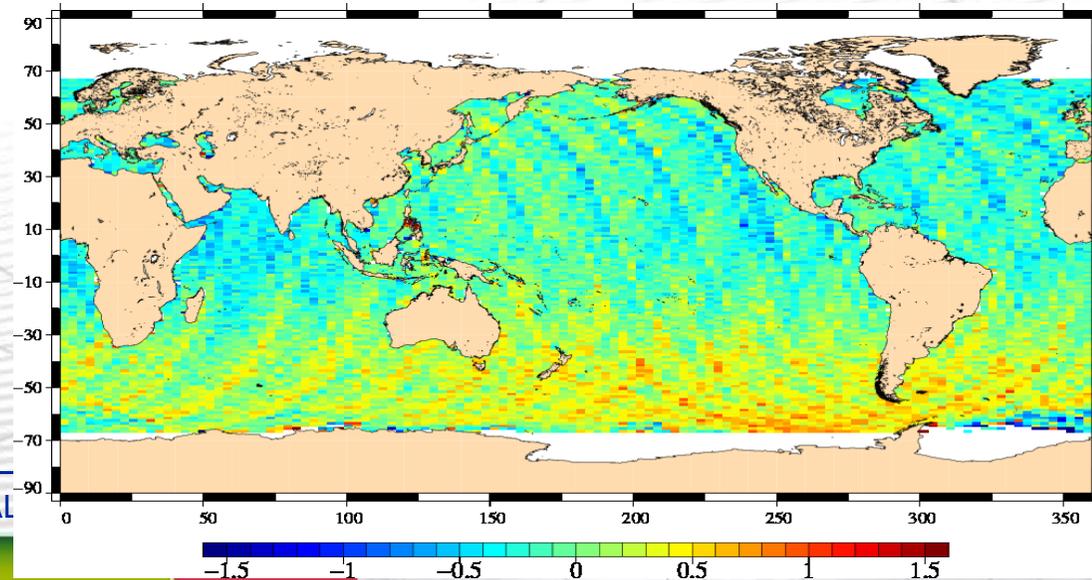
From S.Philipps presentation J2 System Performances



- For IGDR: Geographically correlated patterns (± 3 cm amplitude)

Map of mean JA1/JA2 SLA (orbit - range - mss) differences over cycles 1 to 20

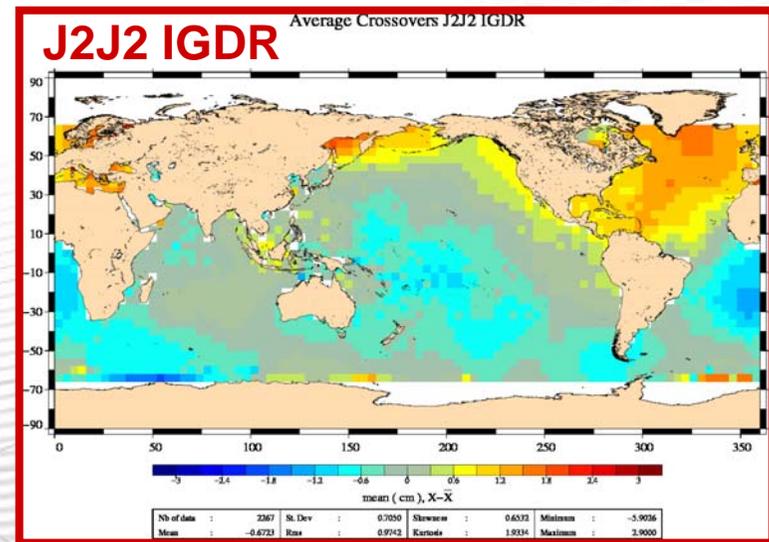
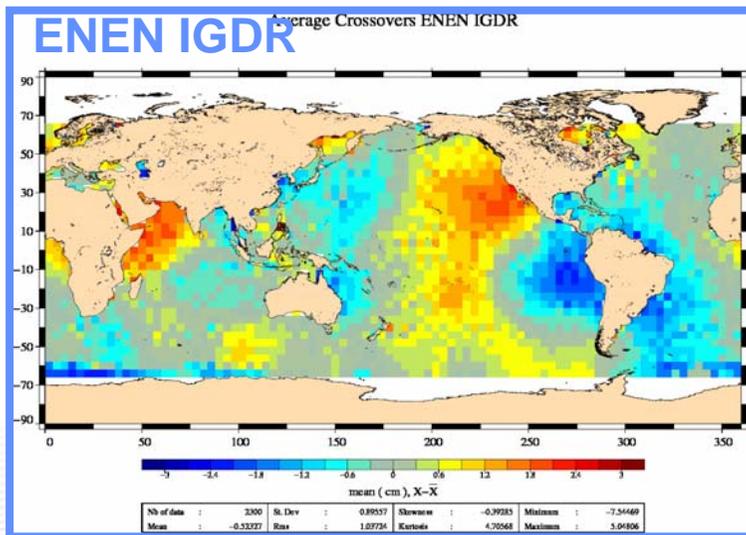
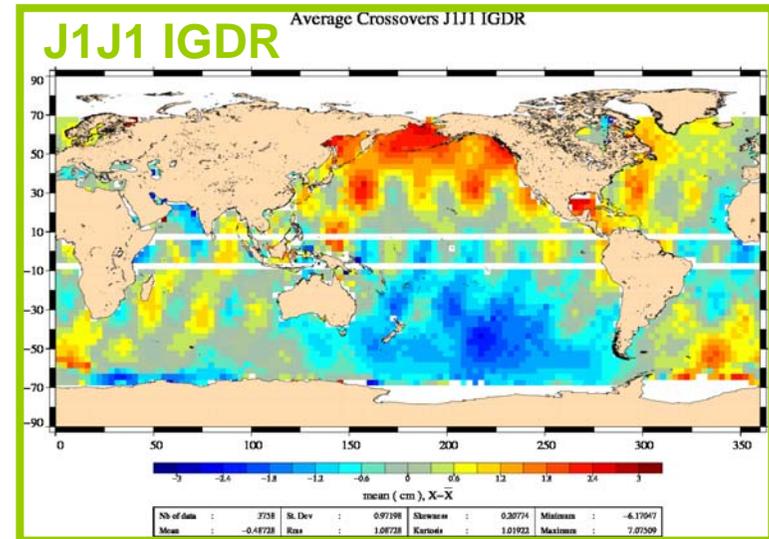
- For GDR: very good consistency, though
- Small hemispheric bias (± 1 cm) is visible -> likely due to slight orbit calculation differences



Average at cross-overs using IGDR SSH (with MOE)

Maps display the asc/dsc SSH differences for IGDR → include the orbit error impact on the SSH.

- **J1:** +/- 3 cm geographic biases
- **EN:** +/- 1cm weak geographic biases
- **J2:** +/- <1cm very weak geographic biases

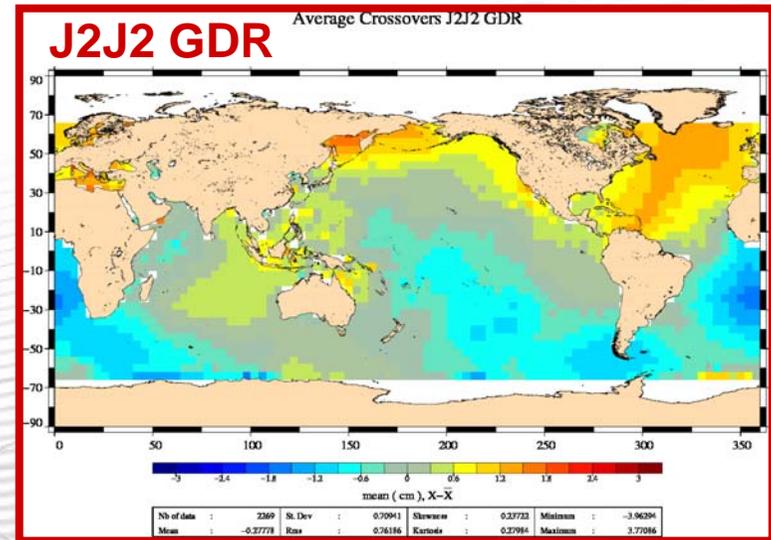
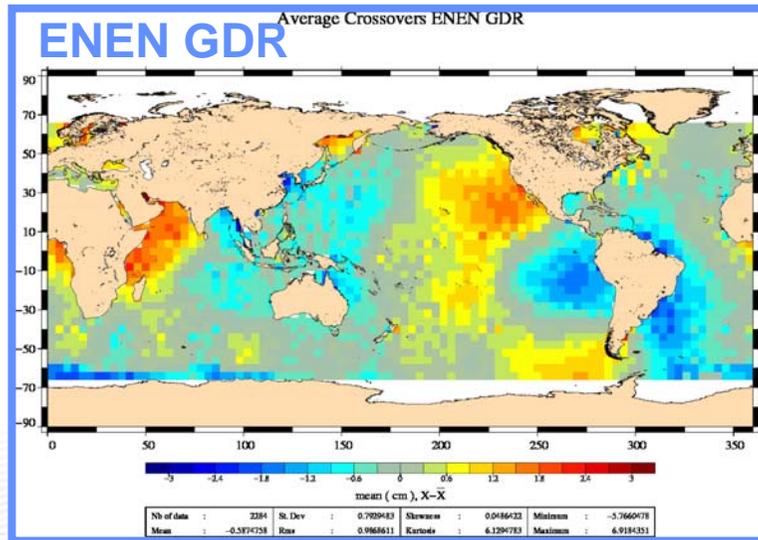
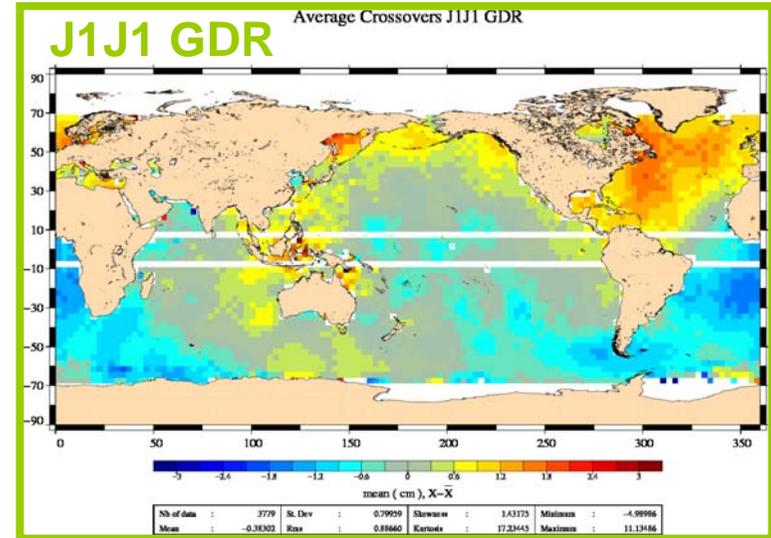


Average at cross-overs using GDR SSH (with POE)

→ Jason-1 Strong improvement in terms of geographical biases: weaker biases than with MOE

→ Jason-2 and Envisat weak impact

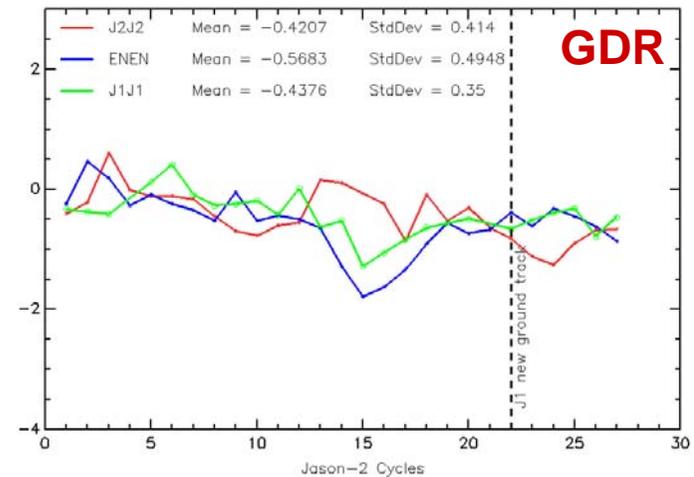
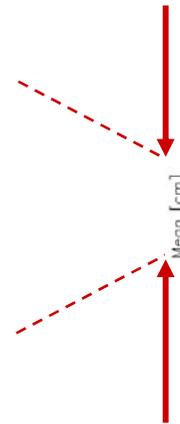
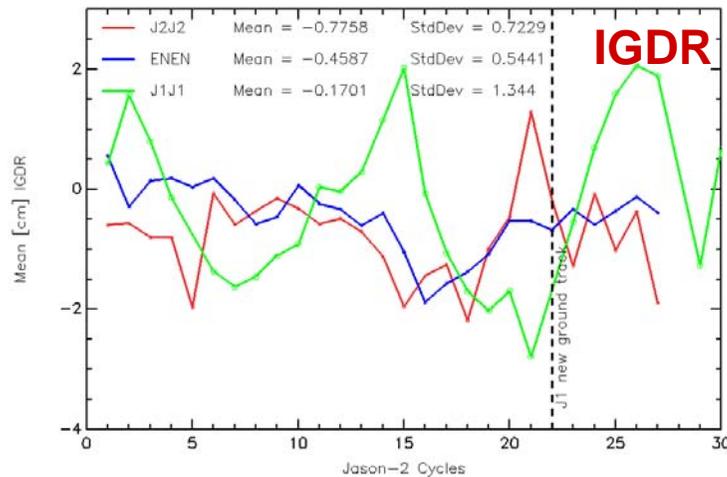
All missions present very weak geographically correlated biases (below 1cm)



2. Geographical and temporal stability of the biases

Temporal variability of the biases

Mean Asc-Desc Monomission SSH at cross-over over ocean for IGDR and GDR:



Weak biases (all slightly negative) varying in time:

→ **J1**: Beta cycle (120 Days) in IGDR reduced in GDR (could be reduced by the SAA model now applied on IGDR)

→ **EN**: Best stability with MOE not so much improved in GDR (the known annual signal can be observed on these data)

→ **J2**: good stability slightly improved in GDR

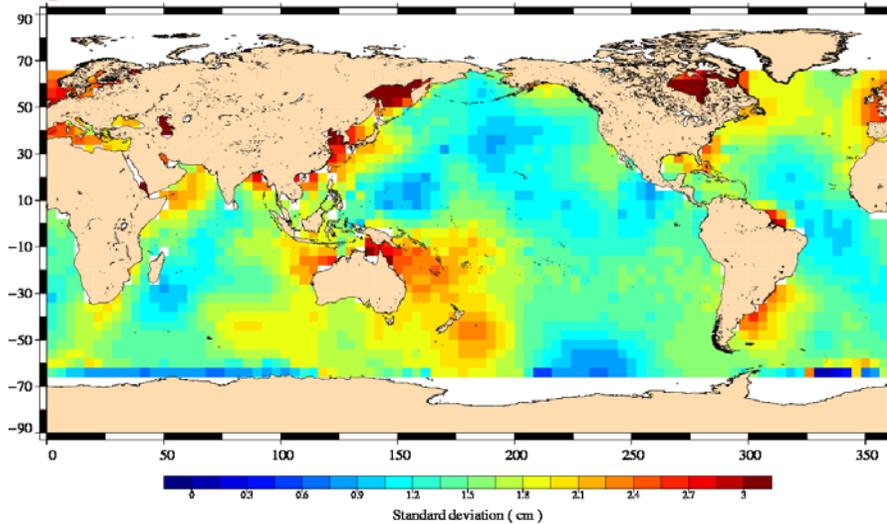
| Standard deviation of the cyclic average | IGDR | GDR |
|--|---------|---------|
| J1 | 1.3 cm | 0.35 cm |
| EN | 0.54 cm | 0.49 cm |
| J2 | 0.72 cm | 0.41 cm |

Geographic variability of the biases

Standard deviation of the cyclic mean SSH differences at cross-overs over ocean

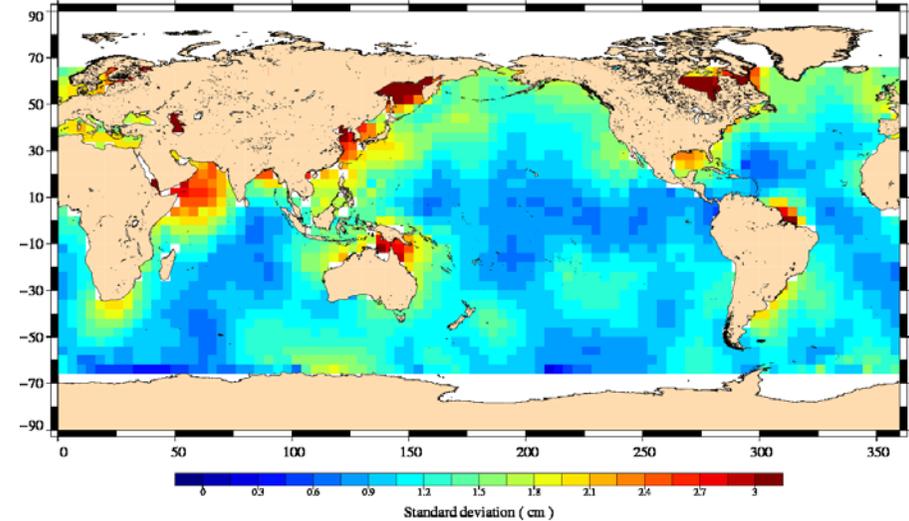
Crossovers Standard deviation J2J2 IGDR

J2J2 IGDR



Crossovers Standard deviation J2J2 GDR

J2J2 GDR



Computed on 22 cycles.

A smoothing is also applied in order to identify the long wave length variations (and not the one linked to the ocean variability)

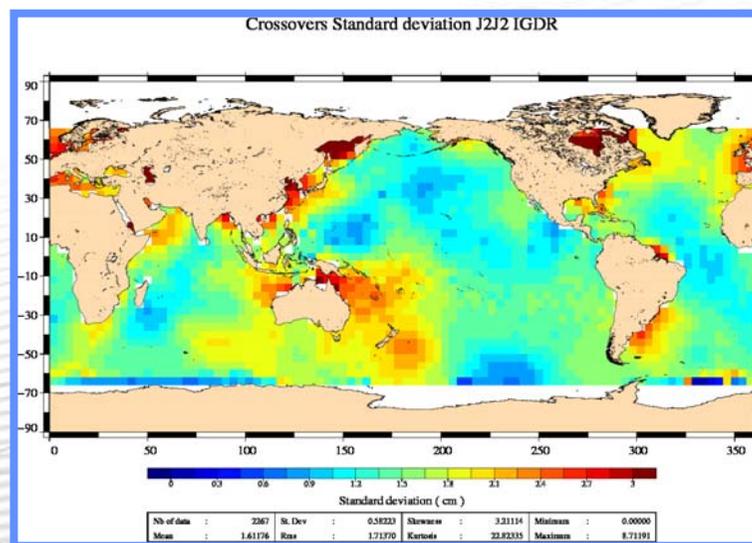
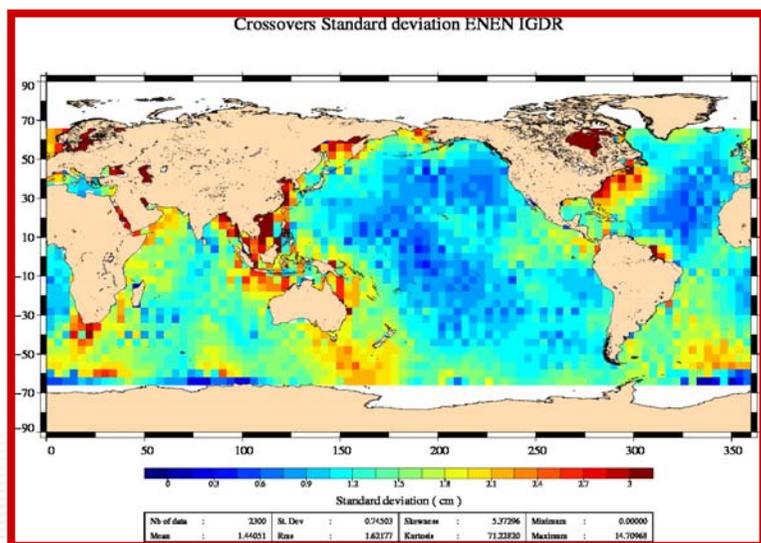
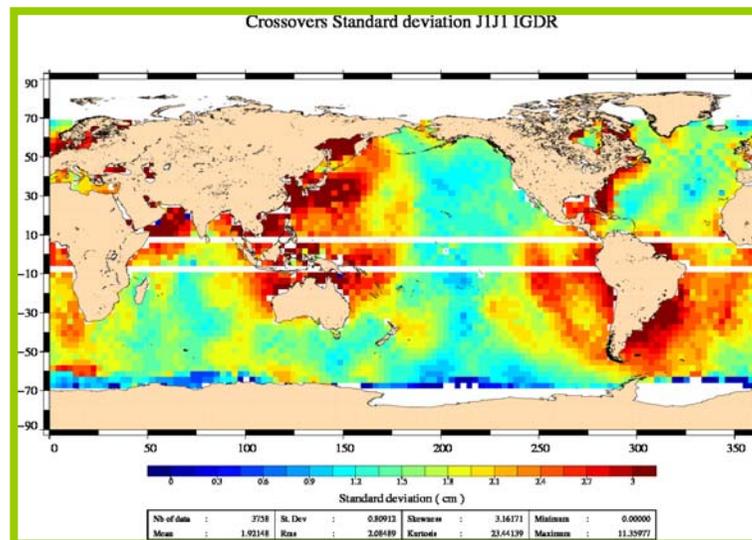
| Geographic Mean Standard deviation | IGDR | GDR |
|------------------------------------|--------|--------|
| J1 | 1.9 cm | 1.4 cm |
| EN | 1.4 cm | 1.3 cm |
| J2 | 1.6 cm | 1.2 cm |

Conclusion

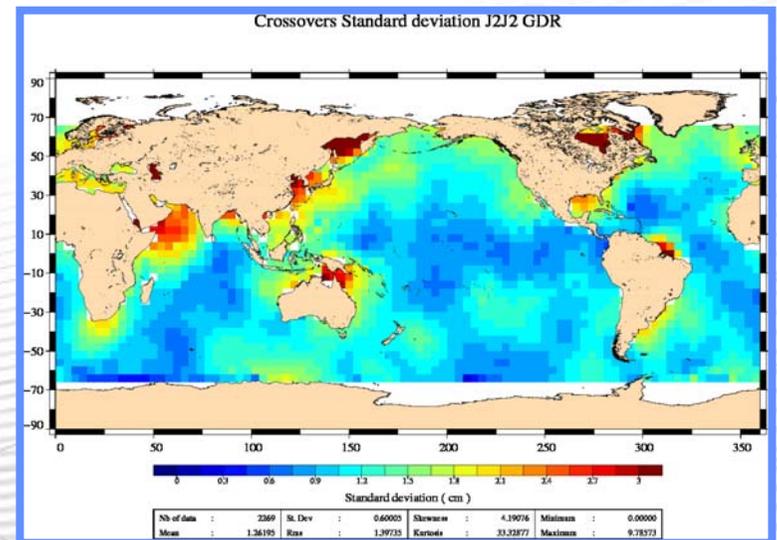
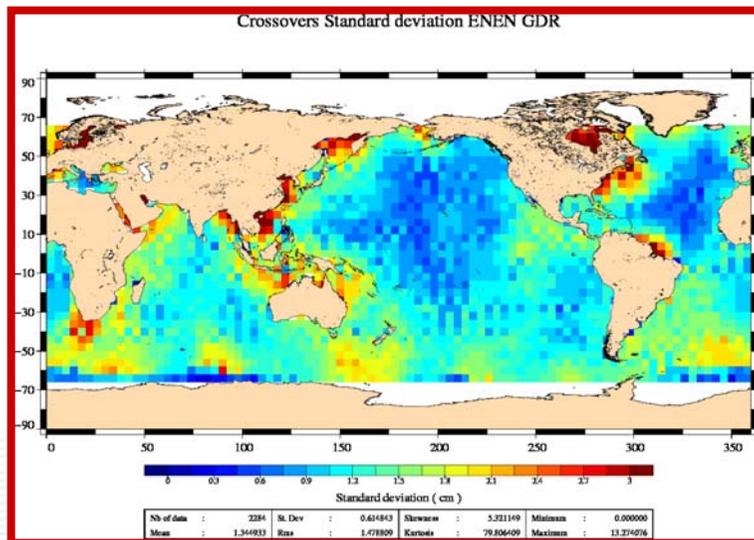
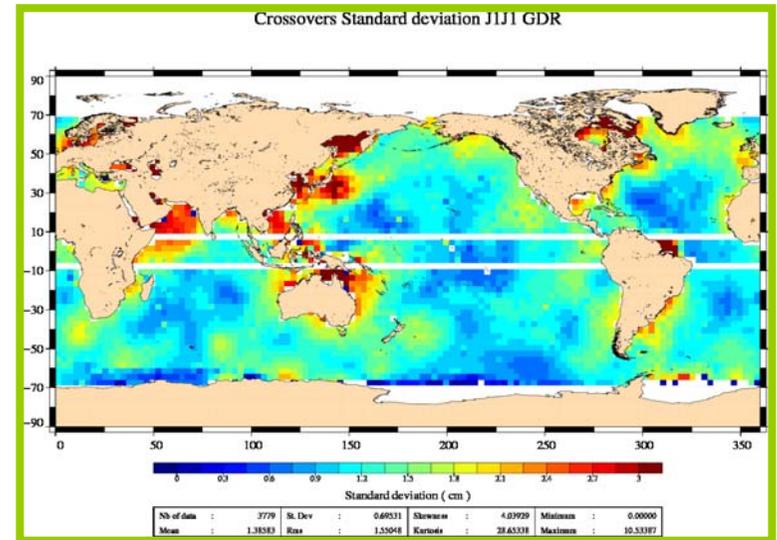
- Centimetric precision is reached for all orbits.
- **Jason-1** POE improvement (weaker bias per basin and better time stability) compared to the MOE can be seen on the SSH cross-over analysis
- **Envisat** MOE and POE have very similar quality with still some weak geographical biases observed between ascending and descending tracks.
- Jason-2 POE and MOE both give homogeneous (geographically) and stable (temporally) Asc/Dsc discrepancies. **Jason-1 and 2 are very consistent using POE orbits.**
- More results about Envisat altimetric data and on the dual cross calibration between missions in « Calval session » presentations and posters

Additional slides

Standard dev at cross-overs using IGDR SSH (with MOE)



Standard dev at cross-overs using GDR SSH (with POE)



Ascending/Descending discrepancies for the difference Orbit POE – MOE

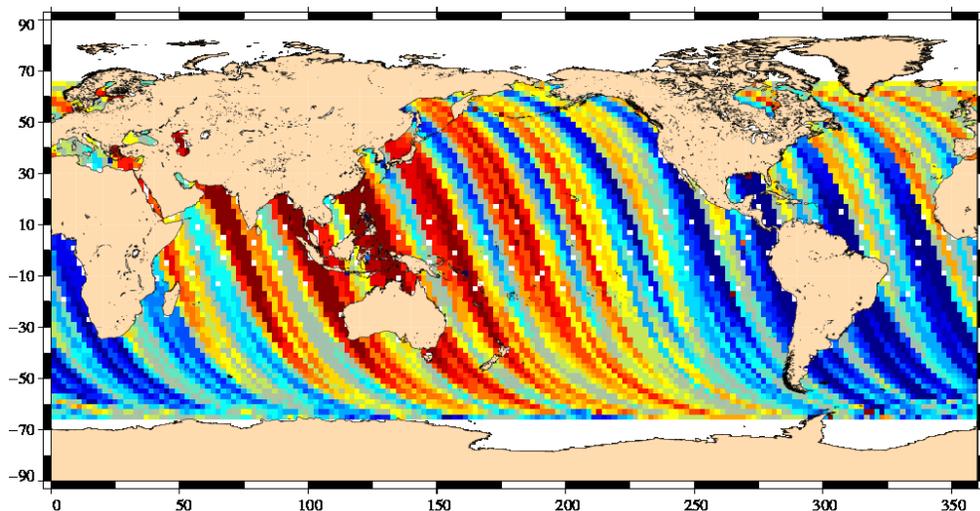
Jason-1:

➔ Discrepancies on both ascending and descending tracks

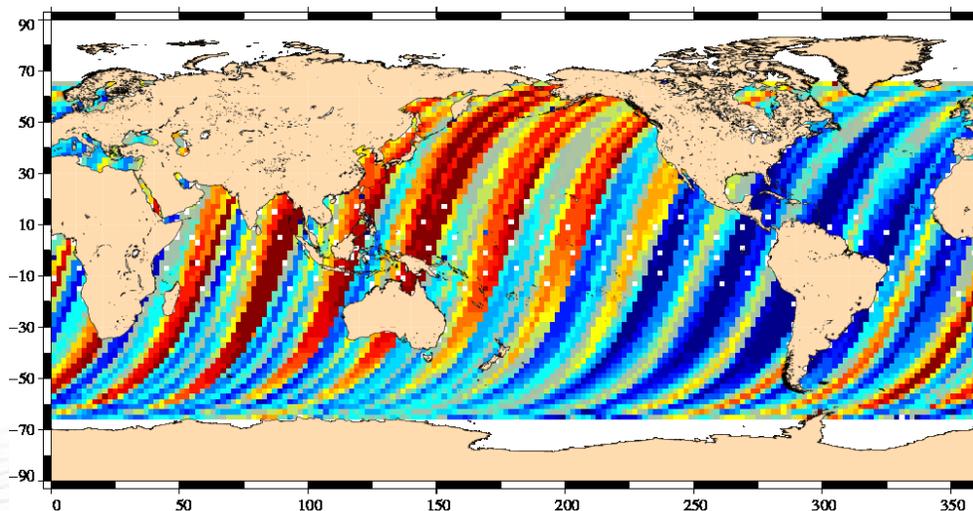
Cycles 239-260

Even tracks ORB POE – MOE J1

Odd tracks ORB POE – MOE J1



| | | | | | | | |
|--------------|----------|-----------|----------|------------|-------------|-----------|-----------|
| Nb of data : | 8878 | St. Dev : | 0.280012 | Skewness : | 91.546939 | Minimum : | -3.031016 |
| Mean : | 0.002823 | Rms : | 0.280027 | Kurtosis : | 8562.070790 | Maximum : | 26.145967 |



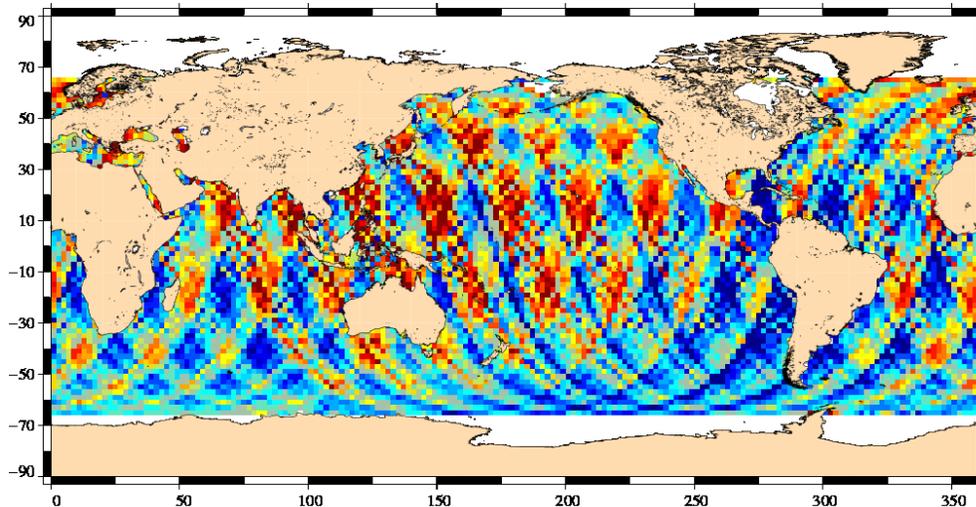
| | | | | | | | |
|--------------|--------|-----------|---------|------------|-----------|-----------|-----------|
| Nb of data : | 8882 | St. Dev : | 38.4843 | Skewness : | 94.2425 | Minimum : | -5.4550 |
| Mean : | 0.4078 | Rms : | 38.4865 | Kurtosis : | 8881.7671 | Maximum : | 3627.1127 |

SAA introduction effect

Strong reduction effect on the POE-MOE Jason-1 difference

Cycles 257-260

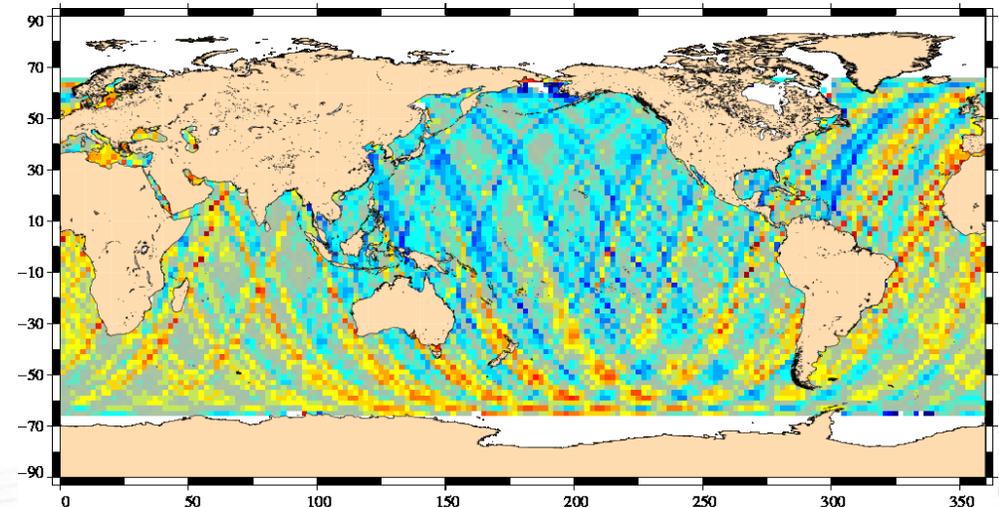
ORB POE – MOE J1



| | | | | | | | |
|--------------|-----------|-----------|-----------|------------|--------------|-----------|------------|
| Nb of data : | 8984 | St. Dev : | 0.0964593 | Skewness : | 71.6030969 | Minimum : | -0.1836429 |
| Mean : | -0.002844 | Rms : | 0.0964543 | Kurtosis : | 5422.2072282 | Maximum : | 7.8435500 |

Cycles 267-270

ORB POE – MOE J1

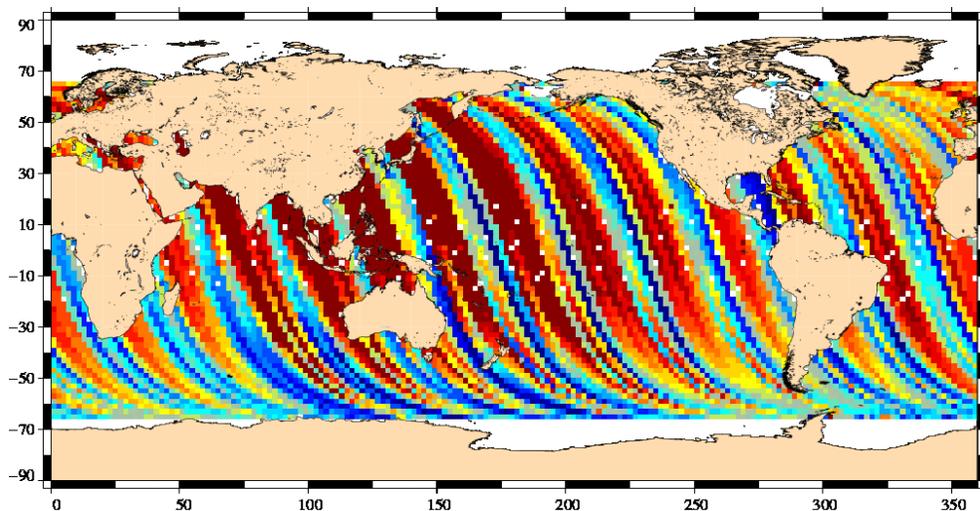


| | | | | | | | |
|--------------|-------------|-----------|-------------|------------|-------------|-----------|-------------|
| Nb of data : | 8972 | St. Dev : | 0.00556919 | Skewness : | 0.172749134 | Minimum : | -0.02638333 |
| Mean : | -0.00042375 | Rms : | 0.005585251 | Kurtosis : | 0.352142821 | Maximum : | 0.02800000 |

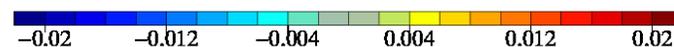
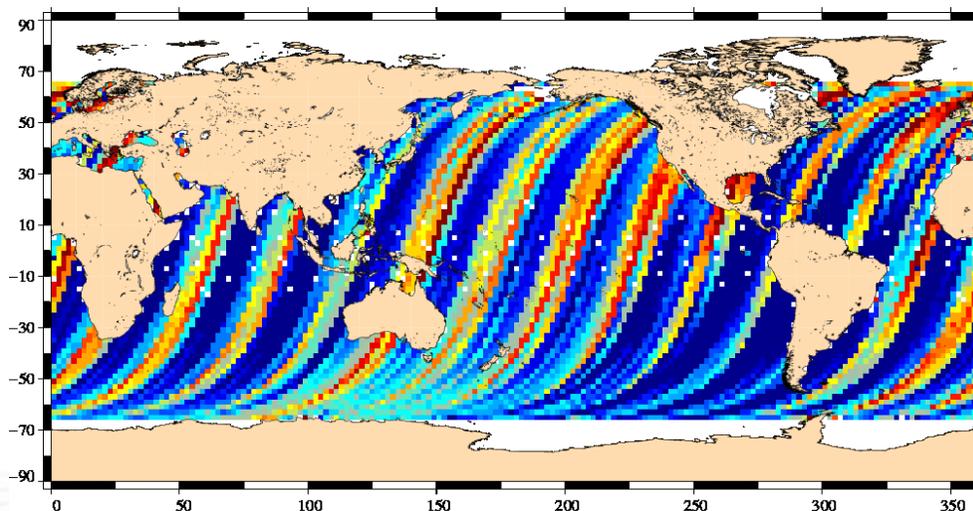
Cycles 257-260

Even tracks ORB POE – MOE J1

Odd tracks ORB POE – MOE J1



| | | | | | | | |
|--------------|----------|-----------|-----------|------------|-------------|-----------|-----------|
| Nb of data : | 8758 | St. Dev : | 0.0284703 | Kurtosis : | 88.815843 | Minimum : | -1.555182 |
| Mean : | 0.008946 | Rms : | 0.284845 | Kurtosis : | 8119.566495 | Maximum : | 26.145967 |

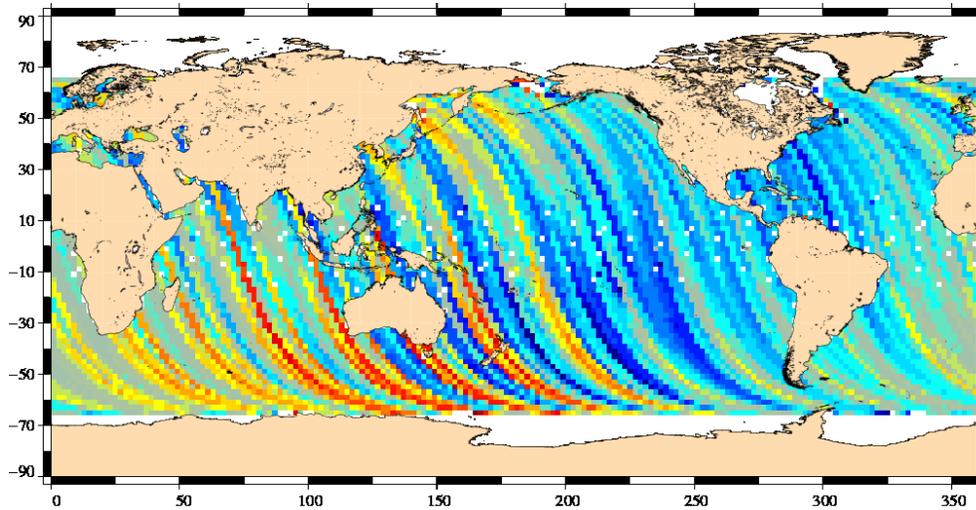


| | | | | | | | |
|--------------|-----------|-----------|----------|------------|-------------|-----------|-----------|
| Nb of data : | 8766 | St. Dev : | 0.022803 | Kurtosis : | 43.990211 | Minimum : | -0.055746 |
| Mean : | -0.008650 | Rms : | 0.026391 | Kurtosis : | 3202.446854 | Maximum : | 1.651625 |

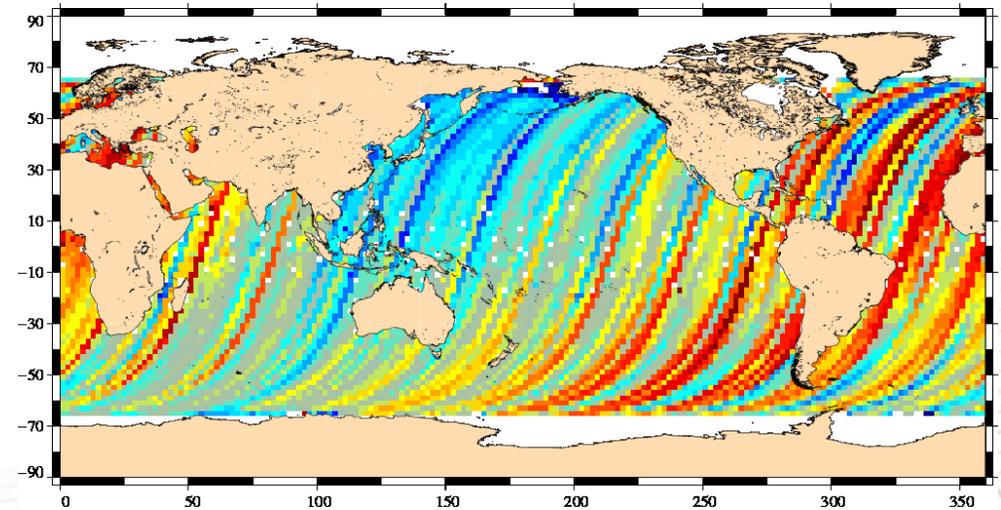
Cycles 267-270

Even tracks ORB POE – MOE J1

Odd tracks ORB POE – MOE J1



| | | | | | | | |
|--------------|-------------|-----------|------------|------------|------------|-----------|-------------|
| Nb of data : | 8756 | St. Dev : | 0.00687088 | Skewness : | 0.37539992 | Minimum : | -0.02565000 |
| Mean : | -0.00291029 | Rms : | 0.00746184 | Kurtosis : | 0.11899187 | Maximum : | 0.02680000 |



| | | | | | | | |
|--------------|------------|-----------|------------|------------|-------------|-----------|-------------|
| Nb of data : | 8751 | St. Dev : | 0.00771561 | Skewness : | 0.28257149 | Minimum : | -0.02739810 |
| Mean : | 0.00203924 | Rms : | 0.00798055 | Kurtosis : | -0.15627506 | Maximum : | 0.04050000 |

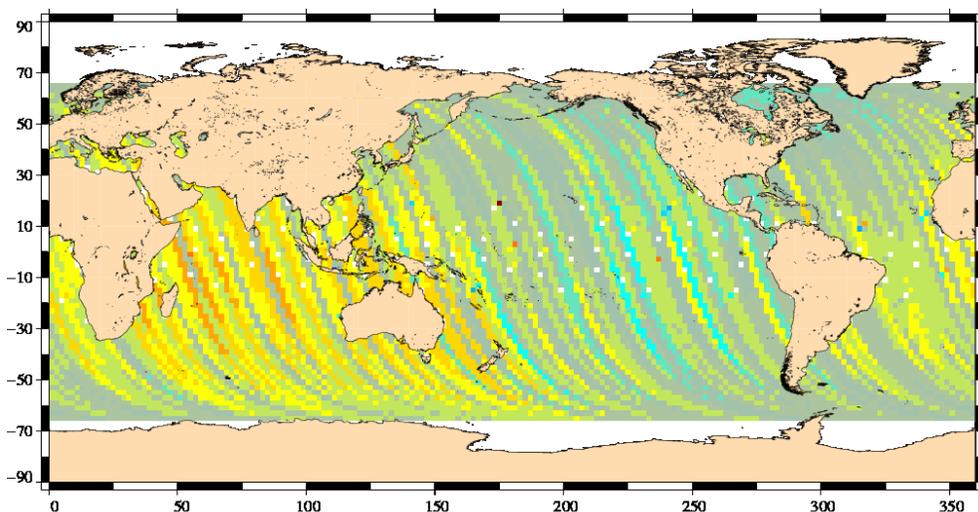
Ascending/Descending discrepancies for the difference Orbit POE – MOE

Jason-2:

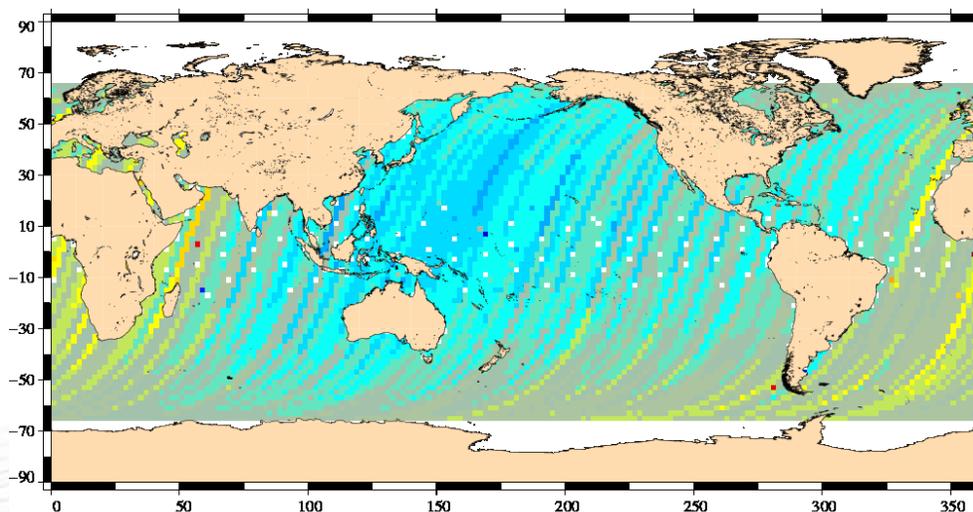
➔ Around 4mm bias between Ascending and descending tracks (due to MOE, cf Average X_SSH GDR/IGDR)

Even tracks ORB POE – MOE J2

Odd tracks ORB POE – MOE J2



| | | | | | | | |
|--------------|----------|-----------|----------|------------|----------|-----------|-----------|
| Nb of data : | 9419 | St. Dev : | 0.002758 | Skewness : | 0.184997 | Minimum : | -0.015930 |
| Mean : | 0.002018 | Rms : | 0.003416 | Kurtosis : | 3.028519 | Maximum : | 0.026815 |



| | | | | | | | |
|--------------|-----------|-----------|----------|------------|----------|-----------|-----------|
| Nb of data : | 9417 | St. Dev : | 0.003190 | Skewness : | 0.433959 | Minimum : | -0.023167 |
| Mean : | -0.002045 | Rms : | 0.003789 | Kurtosis : | 2.971400 | Maximum : | 0.029278 |

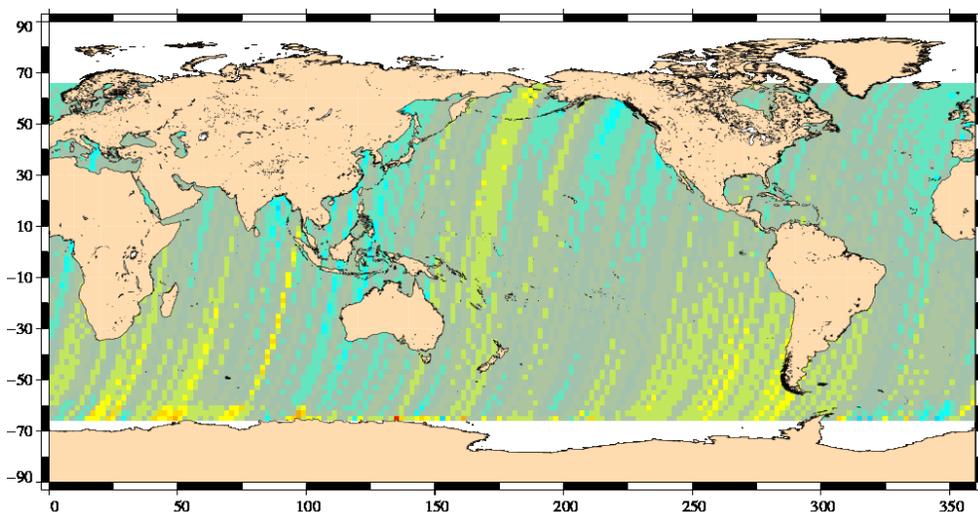
Ascending/Descending discrepancies for the difference Orbit POE – MOE

Envisat:

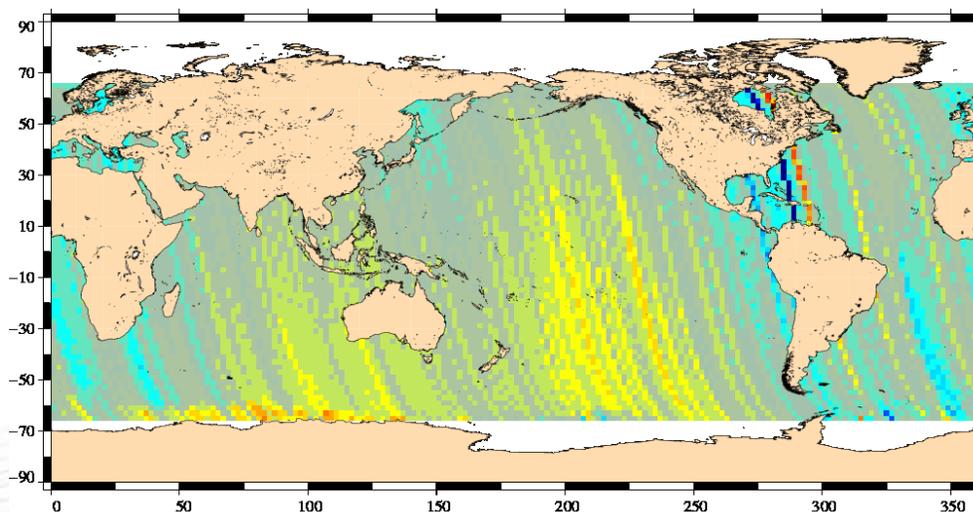
➔ Very good consistency both on Ascending and descending tracks

Even tracks ORB POE – MOE EN

Odd tracks ORB POE – MOE EN



| | | | | | | | |
|--------------|-------------|-----------|-------------|------------|-------------|-----------|--------------|
| Nb of data : | 9223 | St. Dev : | 0.001998043 | Skewness : | 0.124704566 | Minimum : | -0.008965517 |
| Mean : | -0.00000779 | Rms : | 0.001998064 | Kurtosis : | 0.492347978 | Maximum : | 0.014214286 |



| | | | | | | | |
|--------------|-----------|-----------|-----------|------------|------------|-----------|------------|
| Nb of data : | 9222 | St. Dev : | 0.0029511 | Skewness : | -2.6226652 | Minimum : | -0.0429614 |
| Mean : | 0.0003585 | Rms : | 0.0029735 | Kurtosis : | 22.0160573 | Maximum : | 0.0265737 |