Global Statistical Jason-2 assessment and cross-calibration with Jason-1
Parameter Analysis and System Performances

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Introduction

- General
  - OSTM/Jason-2 successfully launched on 20th of June 2008
  - In formation flying with Jason-1 (55 seconds apart) during cycles 0 to 20 from 4th of July 2008 to 26th of January 2009 (till Jason-1 was moved to its new interleaved orbit)
- Objective:
  - Assess Jason-2 data quality and system performances
- Method:
  - Analysis of missing and edited measurements
  - Using cross-calibration of Jason-2 with Jason-1 to
    - Analyze parameters
    - Assess SLA performances and consistency
- Used Data:
  - 1 Hz Jason-2 and Jason-1 data (IGDR and GDR)
  - Jason-2 cycles 1 to 20 (Jason-1 cycles 240 to 259)
  - Jason-2 cycles 3, 5 and 7 were operated in DEM mode

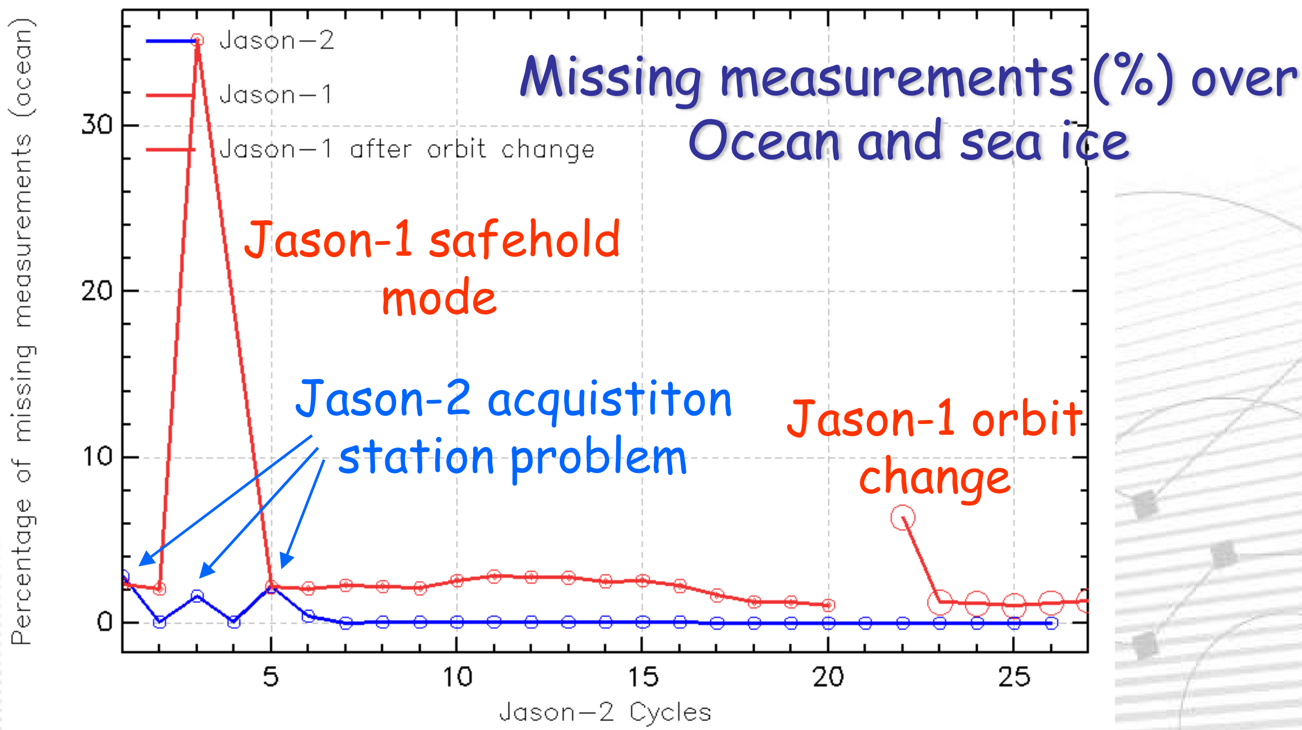
Introduction

- Main differences between IGDR and GDR:

	IGDR	GDR	Impact
Orbit	MOE (Medium Orbit Ephemeris)	POE (Precise Orbit Ephemeris)	orbit
DAC (Dynamical Atmospheric Correction)	Uses non-centered window for filtering	Uses centered window for filtering	DAC
Radiometer wet troposphere correction	New AMR characterization file since cycle 023	Use of ARCS -> calibration coefficients for each cycle	Brightness temperatures, radiometer wet troposphere, atmospheric attenuation
Poseidon-3 AGC tables	New Poseidon-3 characterization file since cycle 023	Same Poseidon-3 characterization file for entire period	Backscattering coefficient, altimeter wind speed

Missing and edited data

- Missing measurements (GDR products)
  - Only few missing measurements over ocean, mostly due to:
    - Acquisition station problems
  - Over coastal and hydrological zones, and also sea ice, Jason-2 performs better than Jason-1, thanks to new tracker algorithms

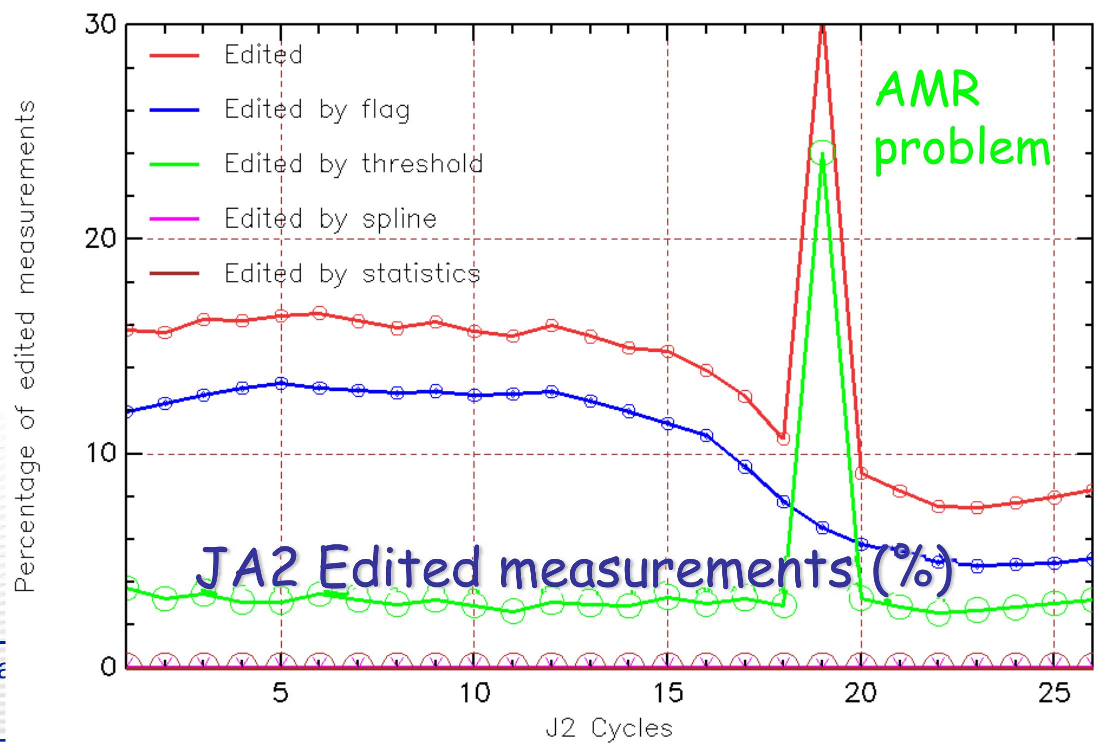


Parameter Analysis

System Performances

Missing and edited data

- Edited measurements (GDR products)
  - Over open ocean: same editing criteria used for JA1 and JA2
  - Percentage of edited measurements similar for both satellites (approx. 16% of edited measurements over ocean, mostly sea ice)
  - In Median mode till cycle 016 (upload of correction), small portions might be edited due to low signal tracking anomaly (AGC, mispointing, SWH out of threshold)
  - During cycle 019, approx. 2 days without AMR -> radiometer wet troposphere correction at default value



Parameter Analysis

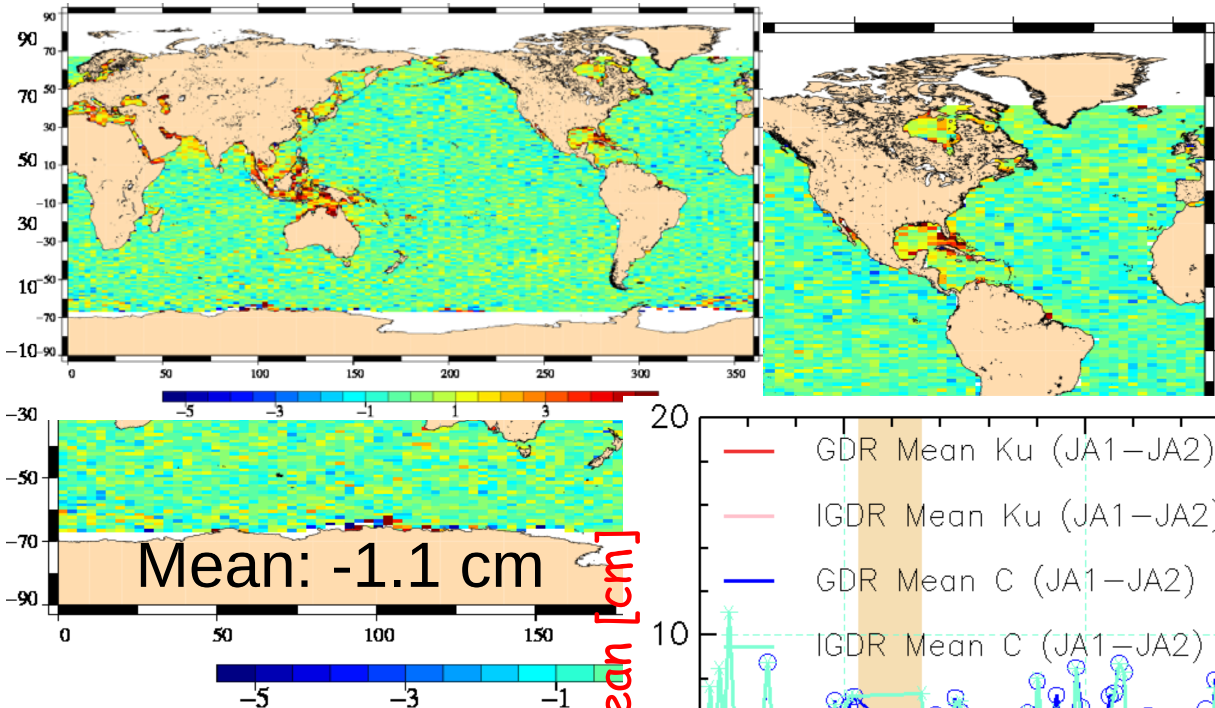
- Monitoring of altimetric parameters is very important to verify stability of measurements

- Tools:
  - Maps of Jason-1 – Jason-2 differences to observe possible geographically correlated bias
  - Daily monitoring of global Jason-1 – Jason-2 differences to observe possible drifts or jumps

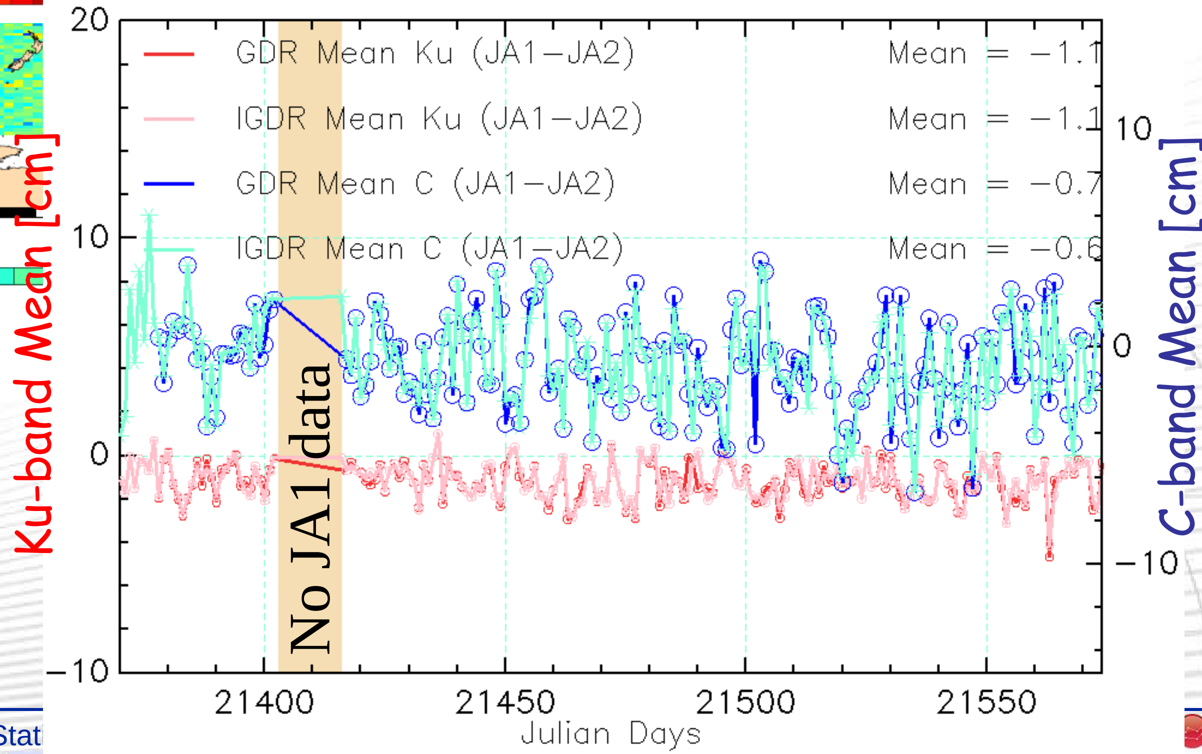
- Analyzed parameters:
  - Significant wave height
  - Altimeter ionospheric correction
  - Mispointing from waveforms
  - Backscatter coefficient
  - Altimeter wind speed
  - Radiometer wet troposphere correction

Significant Wave Height

Map of JA1 – JA2 SWH difference (Ku-band), cycles 1 to 20 [cm]



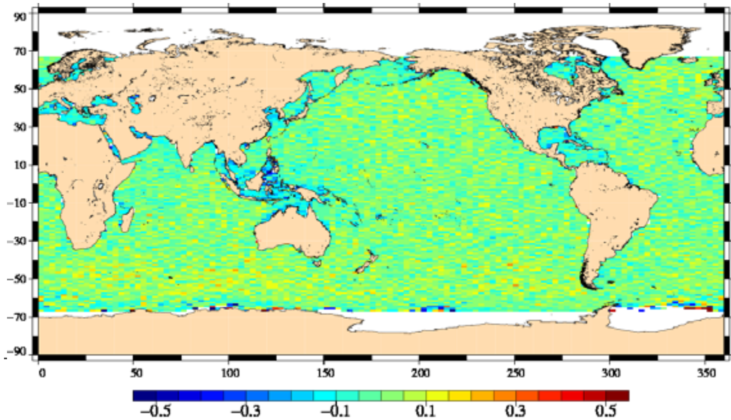
- Good agreement between JA2 and JA1
- Weak regional differences

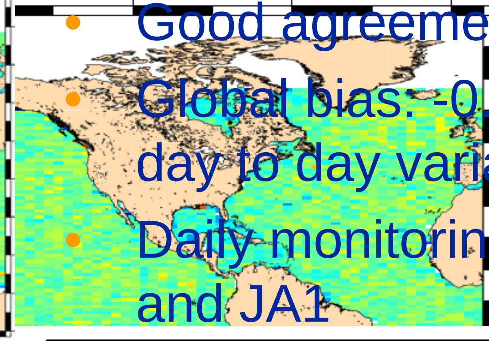


- Daily monitoring of JA1 – JA2 SWH difference is temporally stable

Dual-frequency Ionospheric Correction

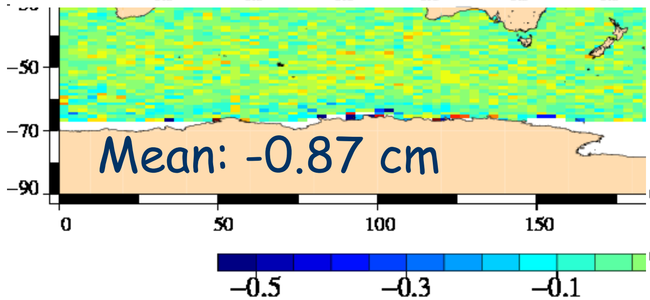
Map of JA1 – JA2 ionosphere difference (Ku-band), cycles 1 to 20 [cm]

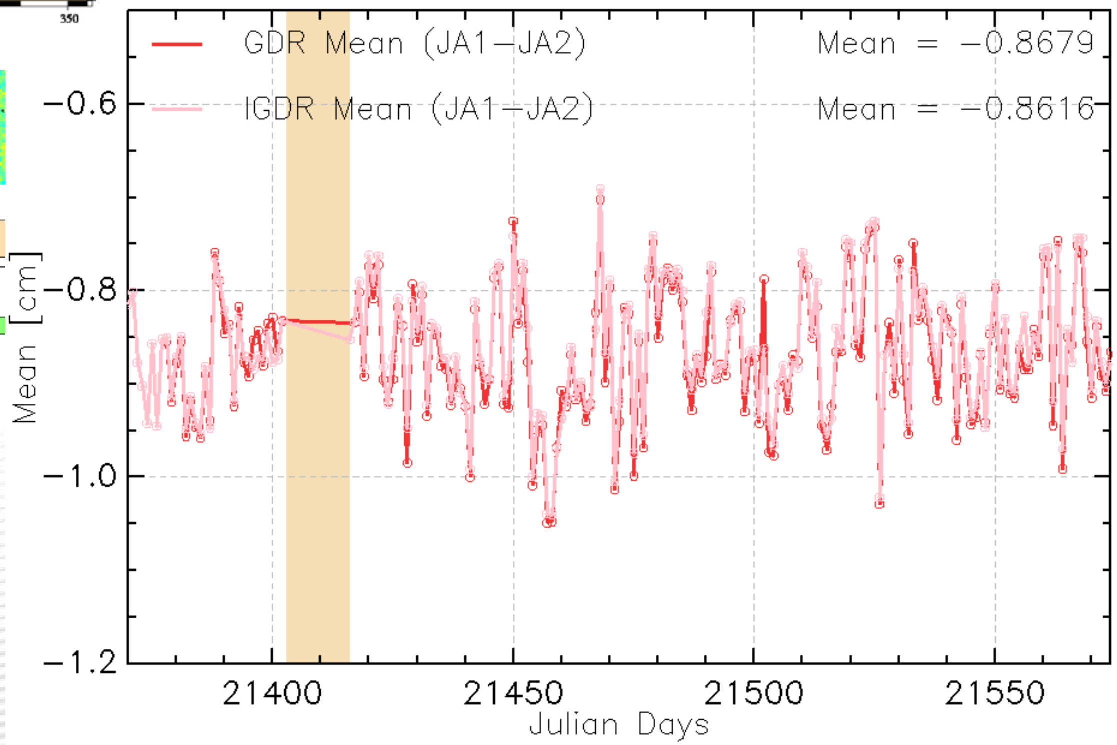




- Good agreement between JA2 and JA1
- Global bias: -0.87 cm with small (2mm) day to day variations
- Daily monitoring: no drift between JA2 and JA1

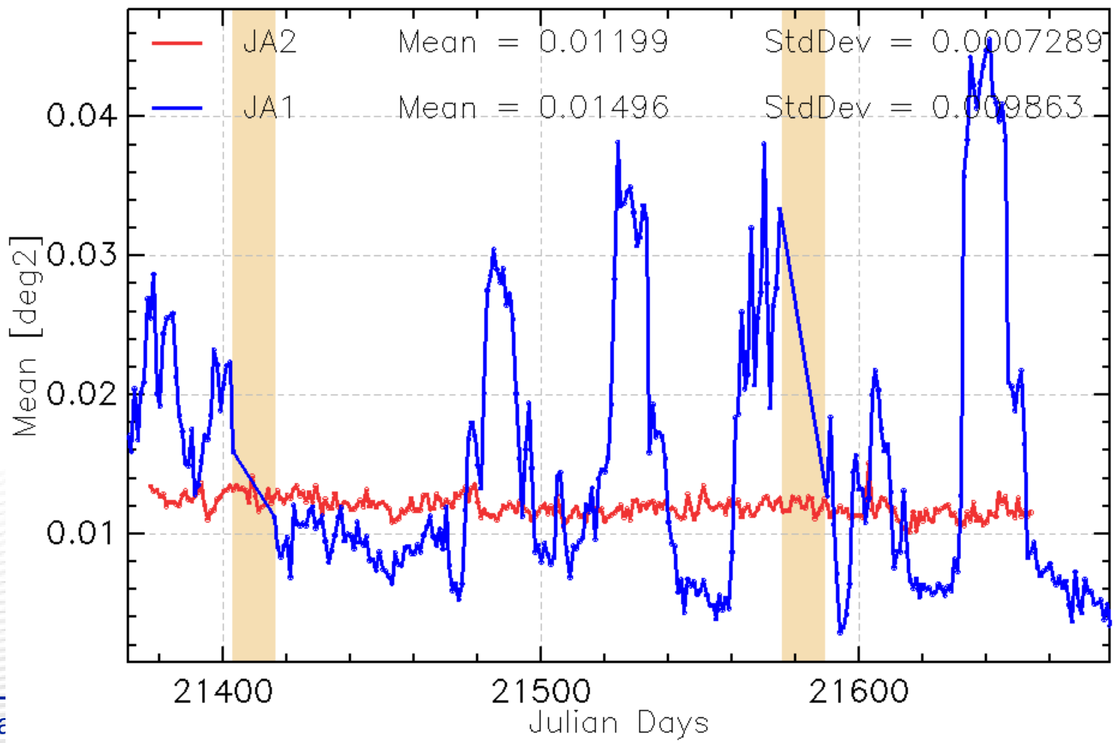
- Good agreement between JA2 and JA1
- Global bias: -0.87





Mispointing from waveforms

- JA1: reduced star tracker availability ➡ poorer pointing (no impact on scientific applications)
- Daily monitoring of JA2 mispointing from waveforms much more stable than JA1
- JA2: no real mispointing, but mean of 0.012 deg2. This value is understood ➡ see presentation P.Thibaut

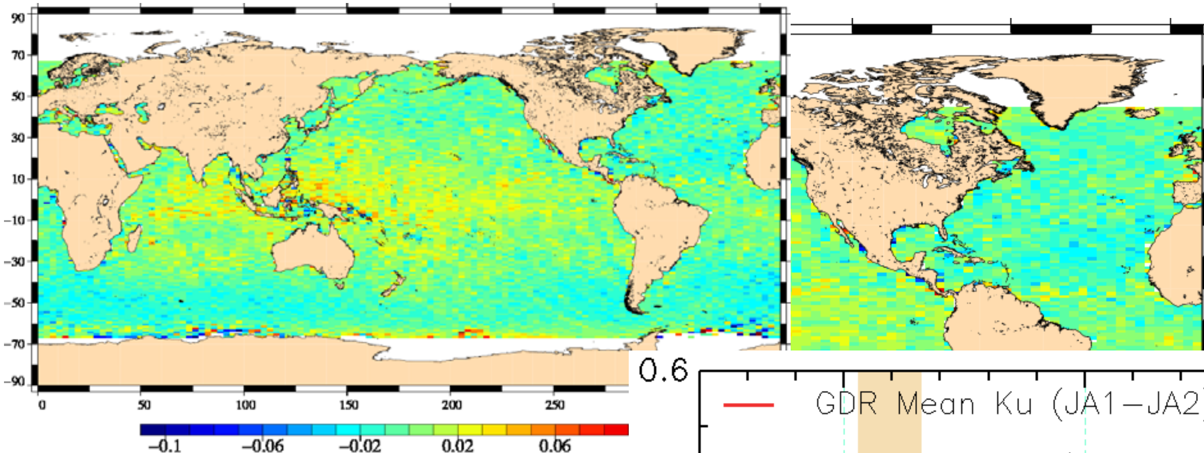


Parameter Analysis

System Performances

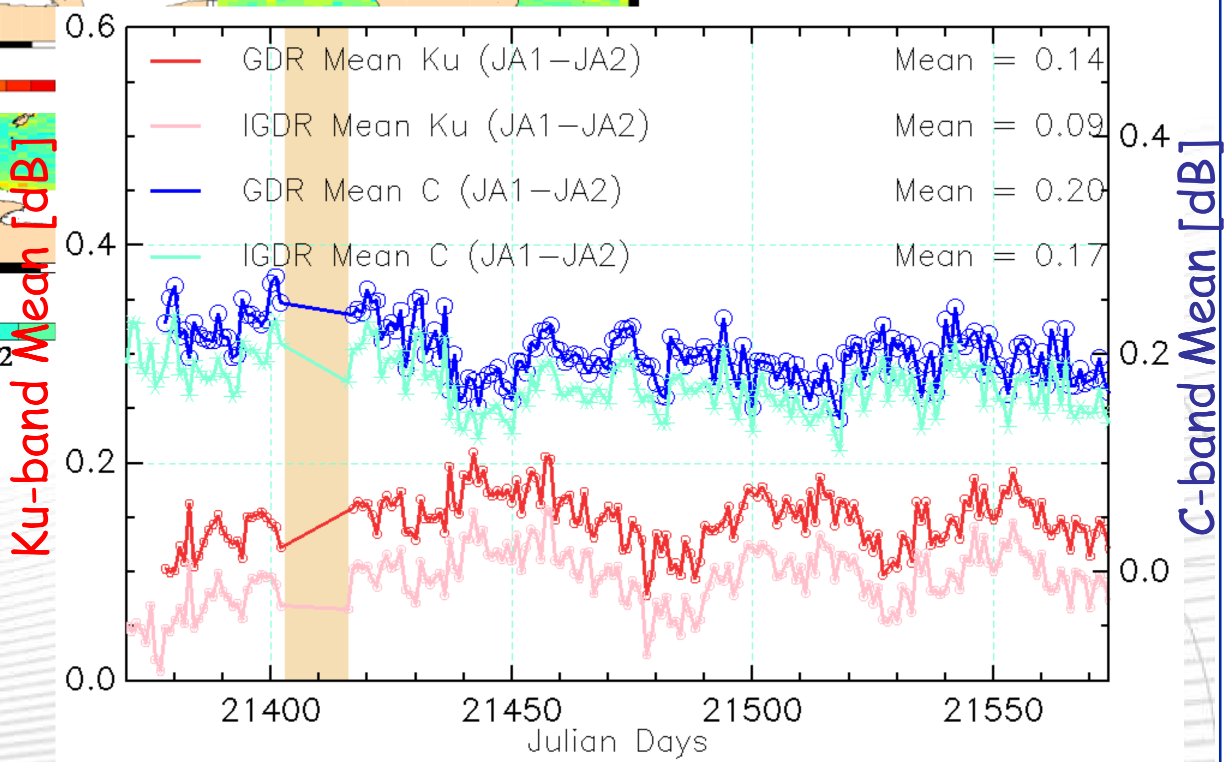
Backscattering coefficient

Map of JA1 – JA2 backscattering coefficient difference (Ku-band), cycles 1 to 20 [dB]



- Jason-2 backscattering coefficient shows good agreement with Jason-1

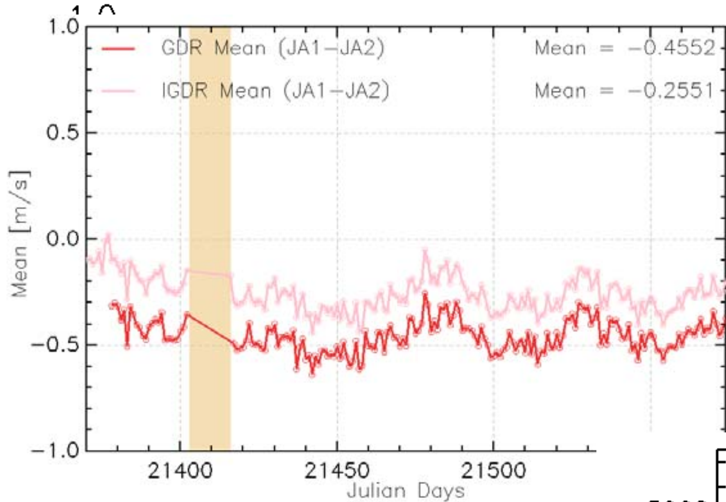
- Bias for GDR higher than for IGDR (different altimeter characterization files)
- Temporal variations (0.05dB amplitude)



Parameter Analysis

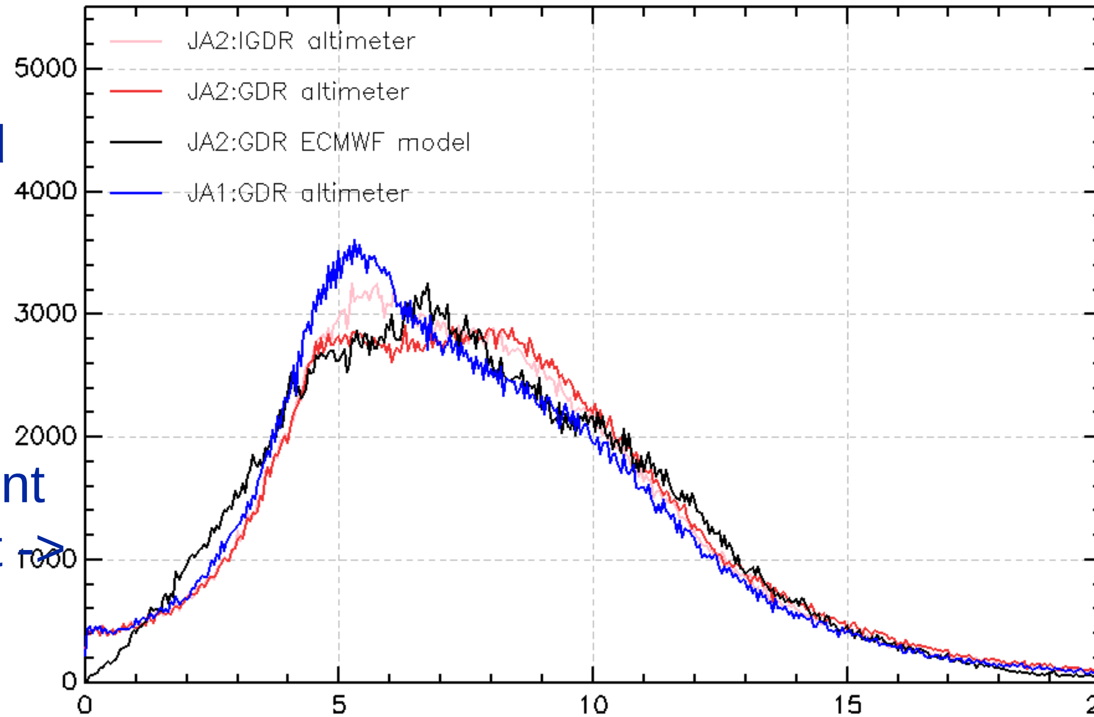
System Performances

Altimeter wind speed



- Good agreement between JA2 and JA1
- Small temporal variations
- Different altimeter

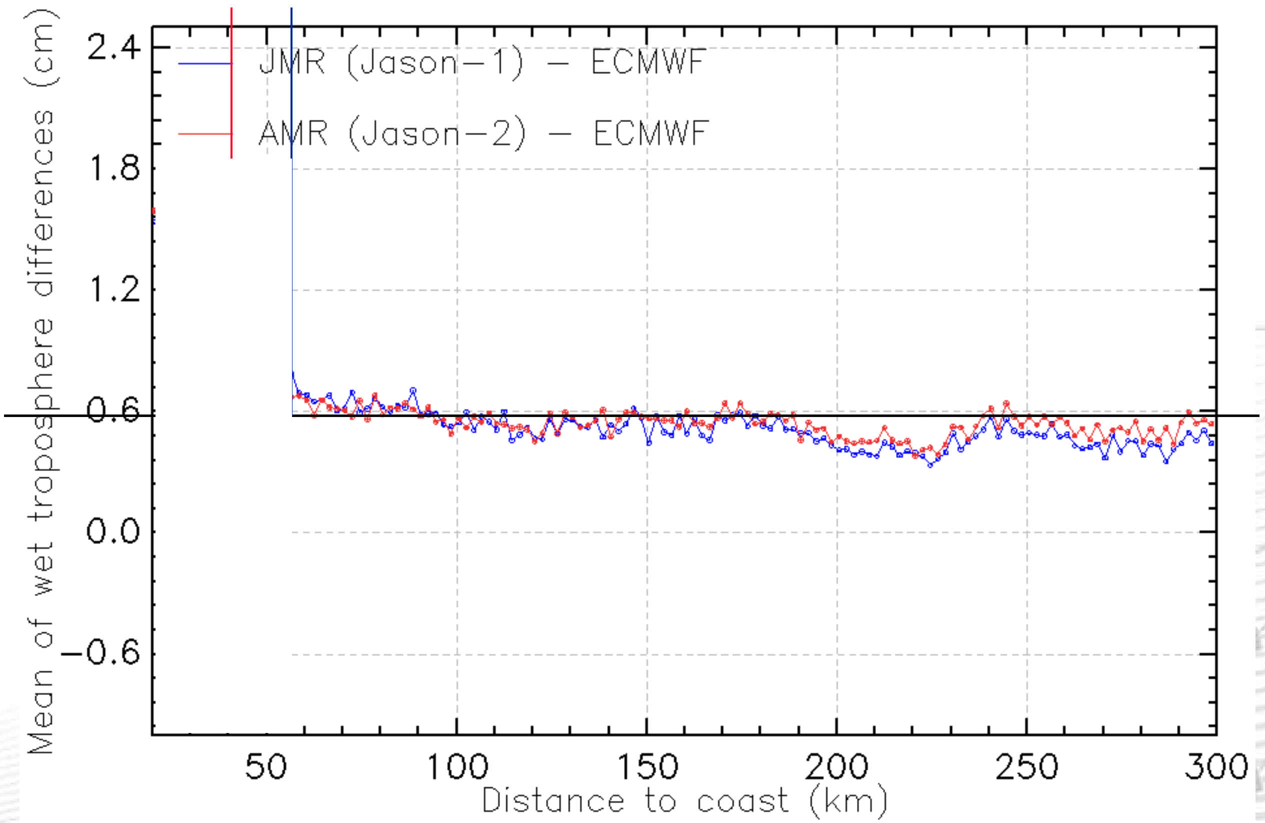
Wind speed histogram for one cycle



- JA1, JA2 and model wind speed histograms have different shapes
- Different altimeter characterization files for IGDR and GDR -> different backscattering coefficient -> different wind speed

Wet tropospheric correction

- For from coast, AMR and JMR have same behavior
- Near to coast, AMR stays longer stable than JMR



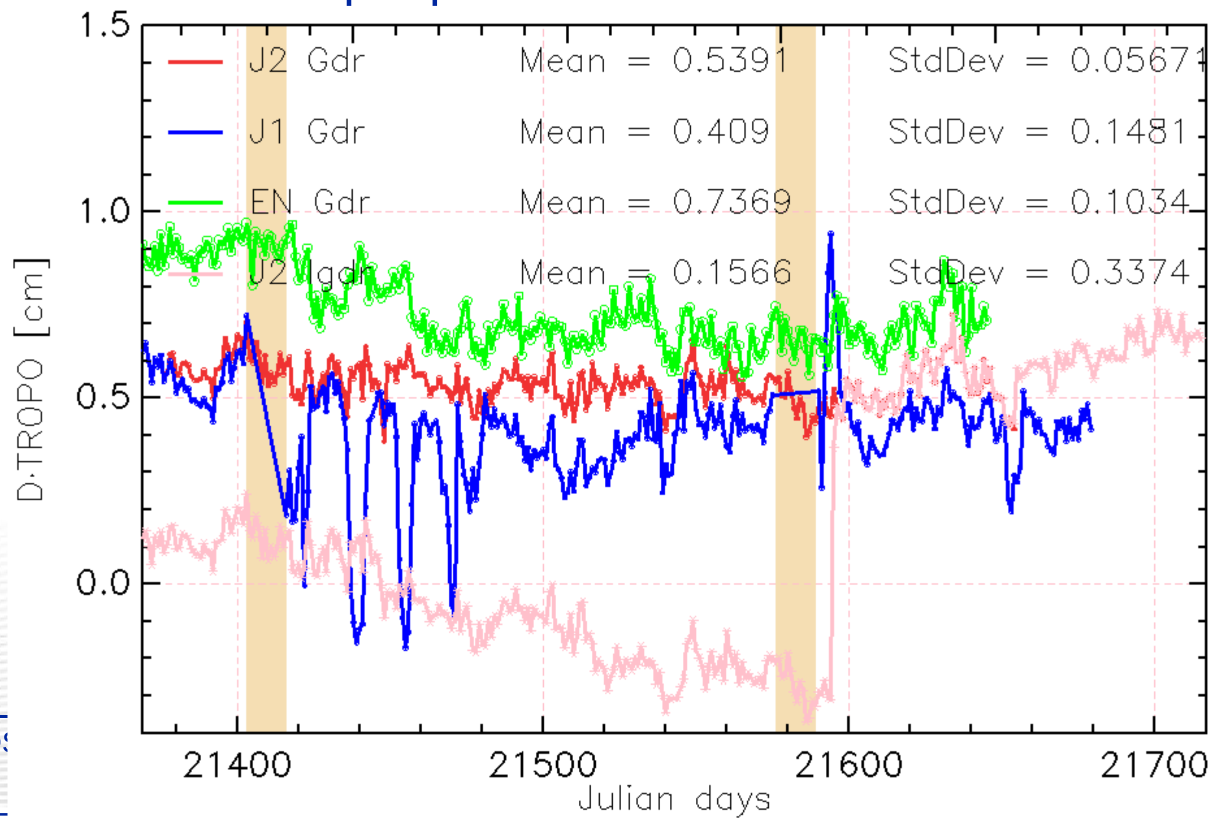
Radiometer – model wet troposphere correction as a function of distance to the cost

Parameter Analysis

System Performances

Wet tropospheric correction

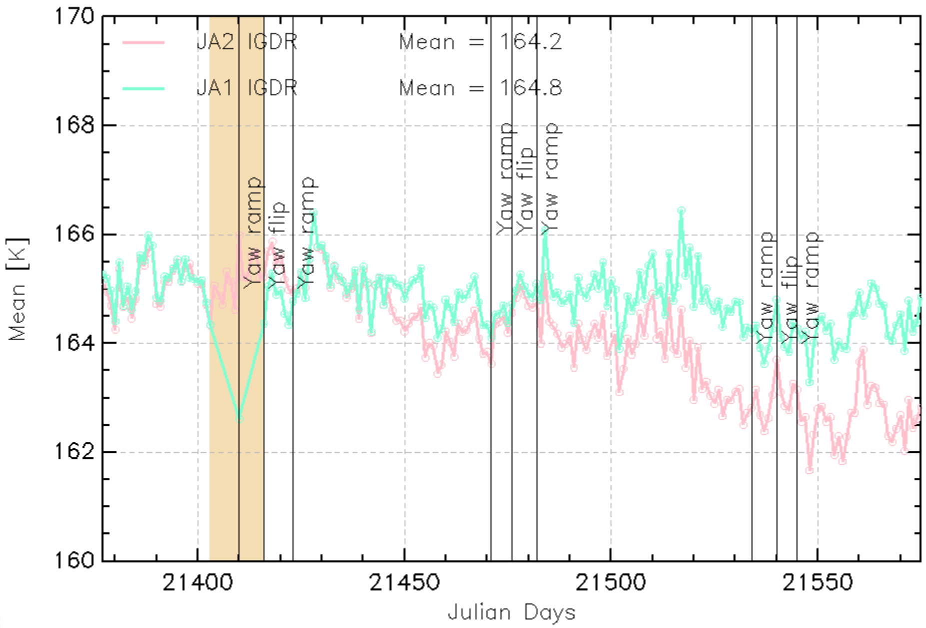
- Daily monitoring: radiometer – model wet troposphere correction very stable for JA2 GDR
- JA1 shows signals up to 7 mm amplitude
- JA2 showed a drift, corrected since cycle 23 (new AMR characterization file)
- Could there not be a risk that real geophysical signals are removed, when JA2 wet troposphere correction is calibrated for GDR?



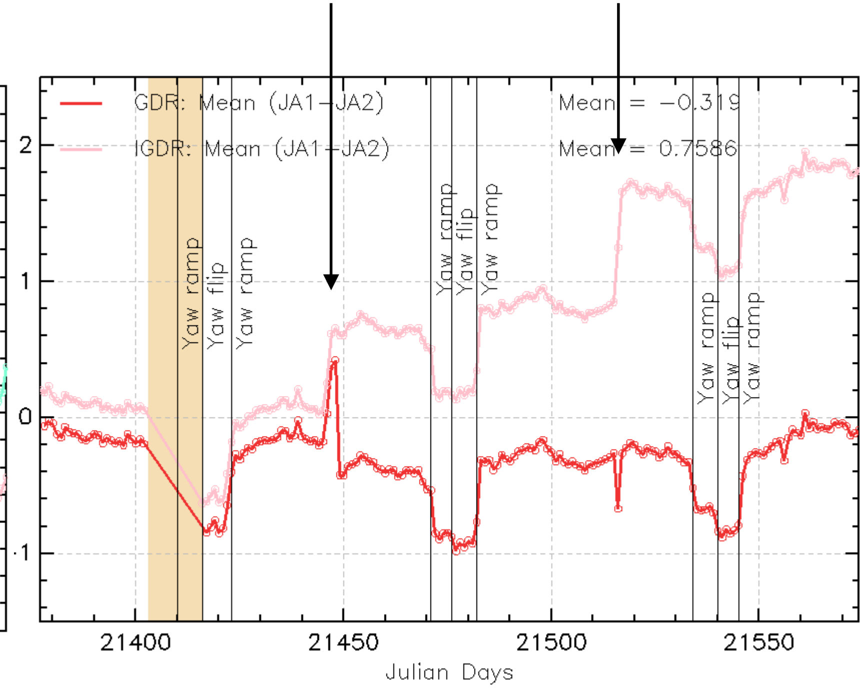
Signals up to 7 mm amplitude

Wet tropospheric correction

- Daily monitoring: JA1 – JA2 34 GHz brightness temperature not stable
- Jumps related with yaw maneuvers
- In JA2 IGDR 34GHZ there were additional jumps



34 GHz brightness temperature



Difference JA1 –JA2

Conclusion

Parameter Analysis

System Performances

- Use of 20 Jason-2 cycles in formation flight configuration with Jason-1
- Very good consistency between altimetric parameters of Jason-2 and Jason-1
- JA2 radiometer (AMR) is near coast more stable than JMR
- AMR drift observed in IGDR are removed for GDR (ARCS), JA2 radiometer wet troposphere is therefore much more stable than JA1's. But could there not be a risk that real geophysical signal is also removed (which would have an impact on MSL) ?
- Model and JA1, JA2 altimeter wind speed histograms have different shapes (due to differences in backscatter coefficients)
- Parameter analysis reveal no particular behavior linked to use of different tracking modes (Median, Diode/DEM)

System Performances

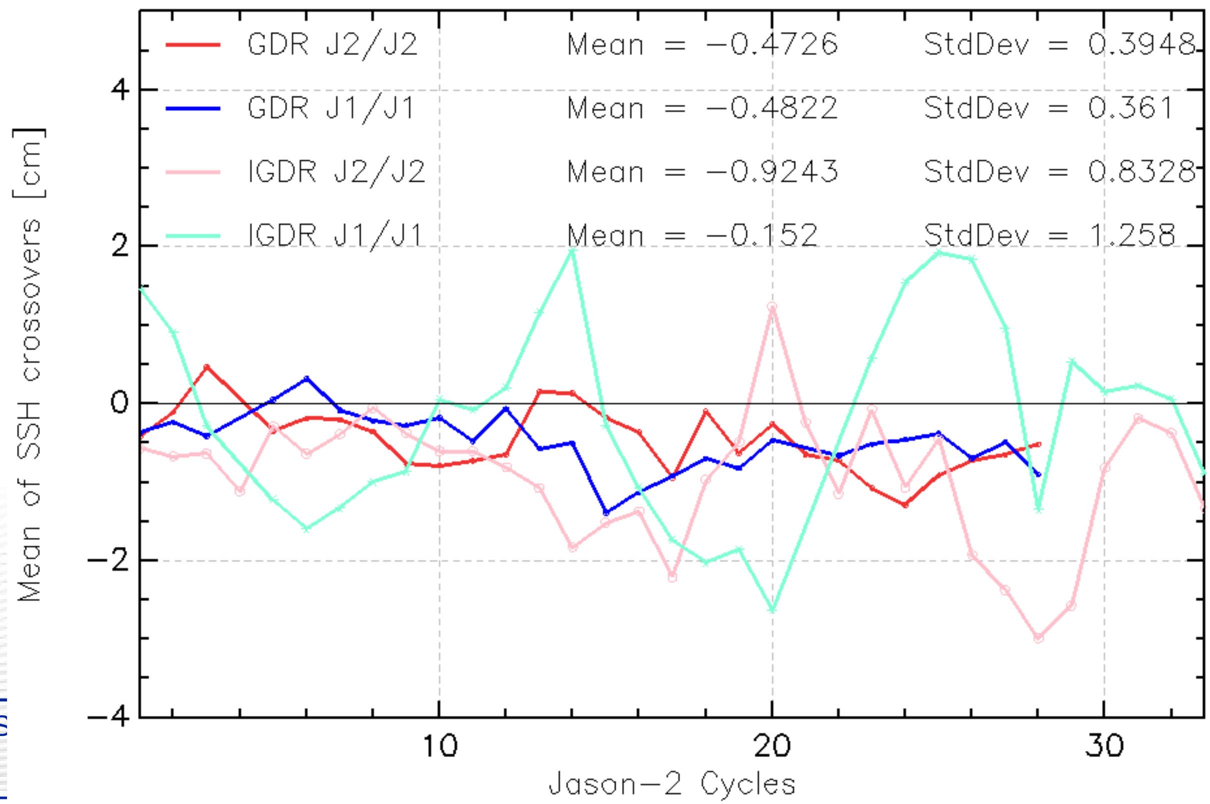
- **Objective**: Compare the SLA performances and consistency between Jason-1 and Jason-2

- **Data used**: GDRs and IGDRs from Jason-2 cycles 1 to 20/28 (corresponding cycles 240 to 259/267 for Jason-1)

- In this part, we concentrate on:
  - 1) Analyses at crossovers using IGDR and GDR
  - 2) Along-track analyses of global SLA bias and geographically correlated biases between Jason-1 and Jason-2

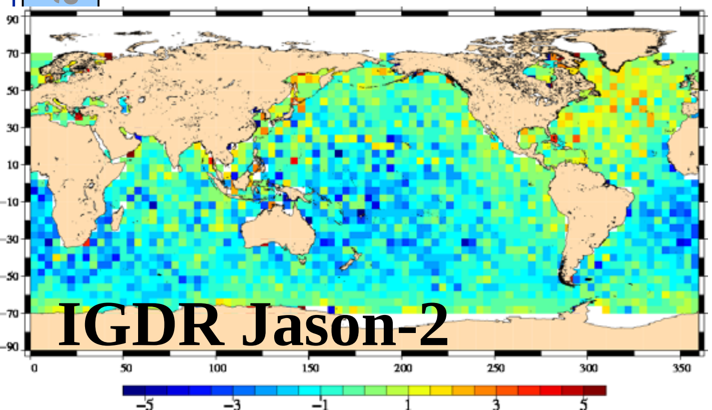
Mean of SSH at crossovers

- IGDR:
  - mean of SSH at crossovers show a signal with ~2 cm amplitude
  - JA2 more homogeneous than JA1
- GDR:
  - Mean at crossovers show a great improvement of homogeneity
  - JA1 and JA2 have similar performances

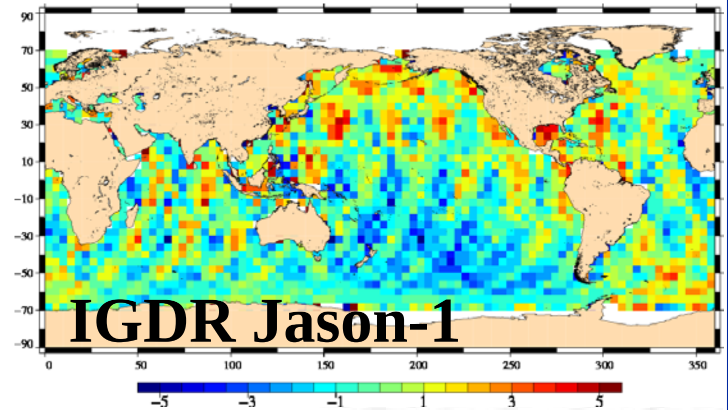


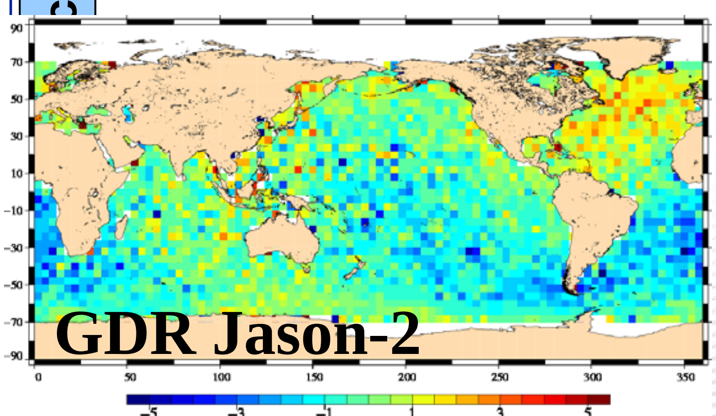
Mean of SSH at crossovers

Mean of SSH at crossovers over cycles 1 to 28

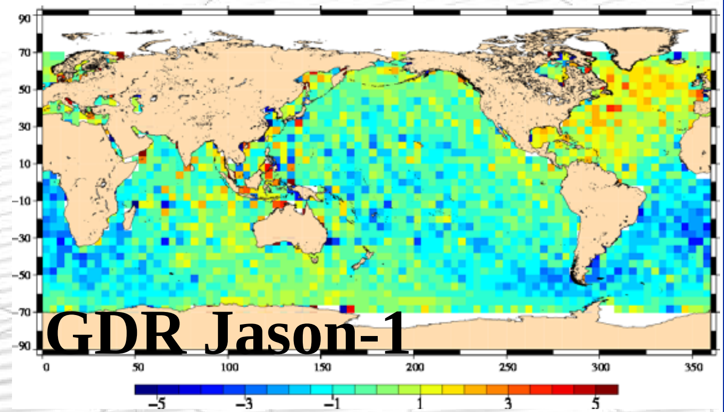


IGDR: Jason-2 more homogeneous than Jason-1



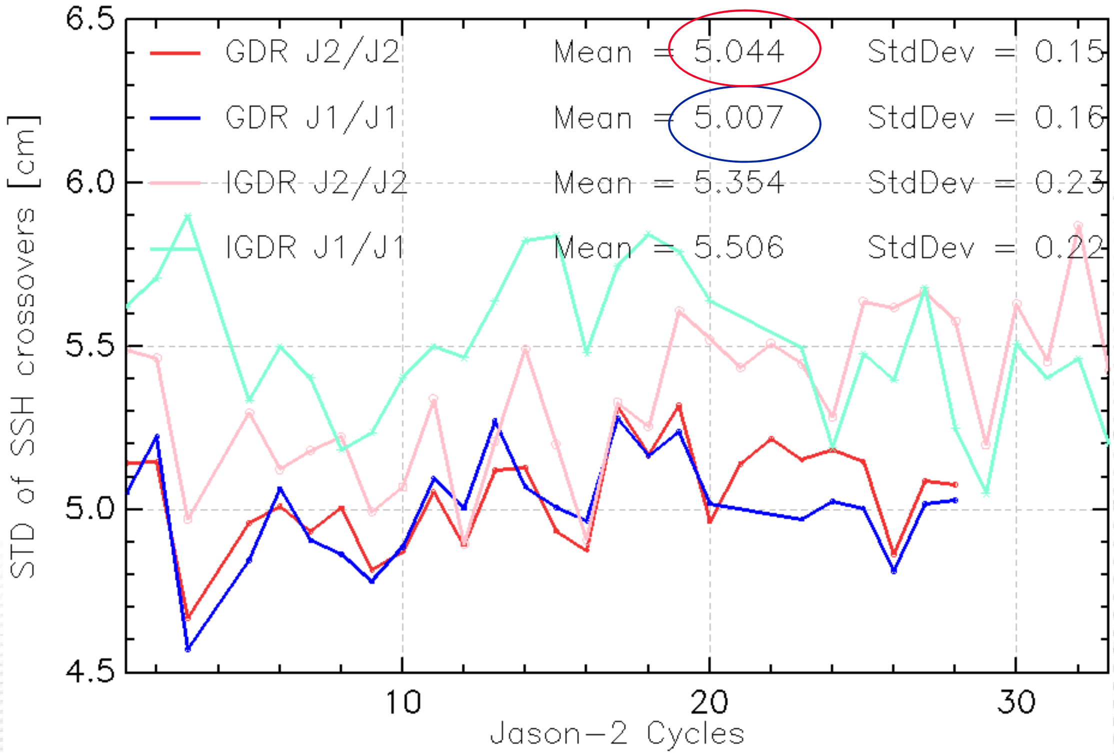


GDR: Jason-2 and Jason-1 equivalent

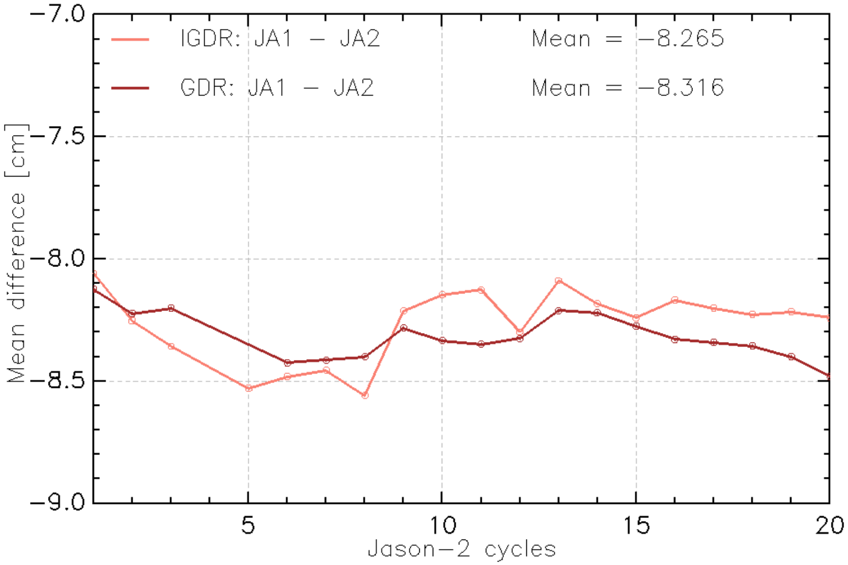


Std of SSH at crossovers

- IGDR:
  - JA2 std at crossovers globally lower (5.4cm RMS) than JA1's (5.5 cm RMS), except for last part
- GDR:
  - JA2 and JA1 have similar performances (5.0 cm)

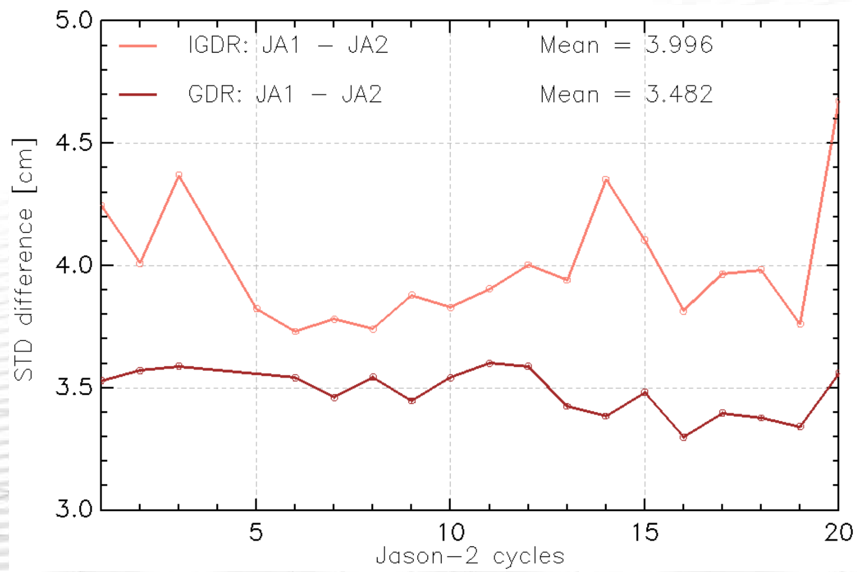


SLA Performances

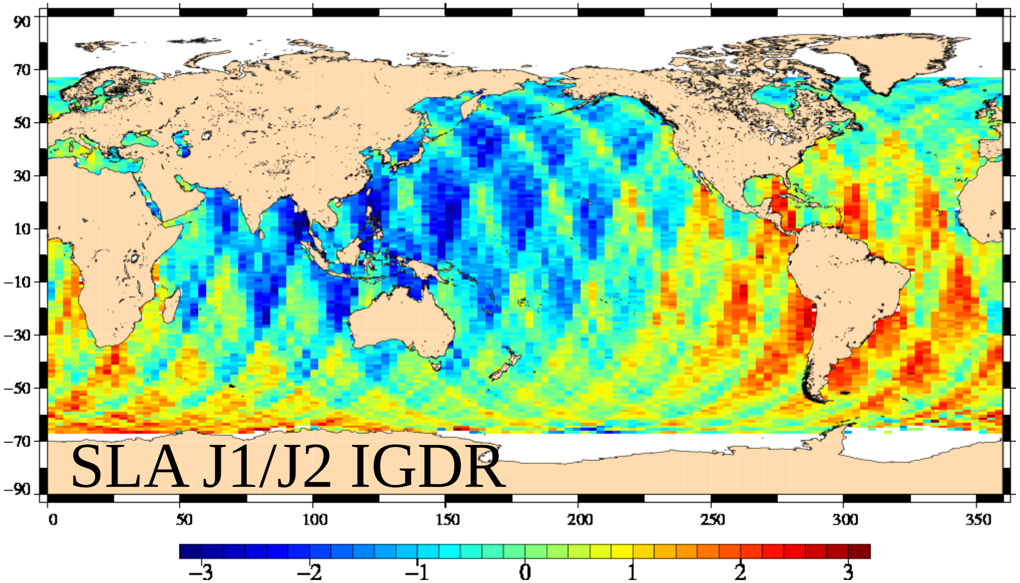


- JA1-JA2 global differences using
  Orbit – range – MSS
- Global bias of -8.3 cm
  - Similar for GDR and IGDR
  - Quite stable in time

- Std of global SLA very stable and weak :
  - IGDR: 4.0 cm RMS
  - GDR: 3.5 cm RMS



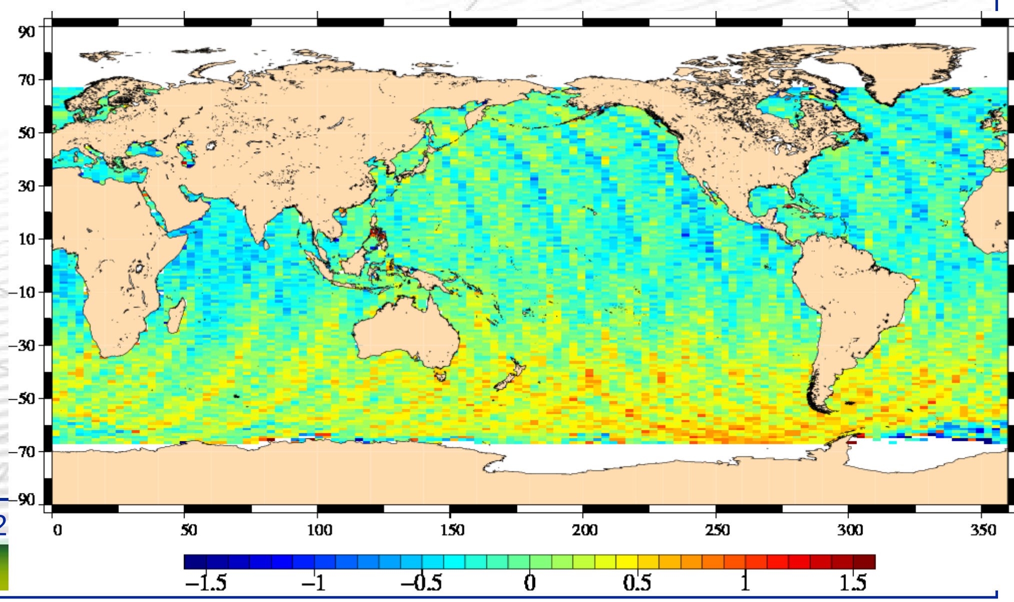
SLA Performances and Consistency



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

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

- For GDR: very good consistency, though a very small hemispheric bias (+/- 1 cm) is visible -> likely due to slight orbit calculation differences (only few GPS data for Jason-1)



Conclusion

- After 20 cycles of verification phase, Jason-2 shows good SSH performances
  - in the same order as Jason-1 for GDR
  - Better than Jason-1 for IGDR
- SLA consistency between both missions is very good
- Very good consistency between both POE, there is only a weak (+/- 1cm) hemispheric bias between them
- Jason-2 enables to continue study of Mean Sea Level evolution and allows an accurate seamless transition with Jason-1