Jason-2 Data Quality Assessment and Cross-calibration with Jason-1

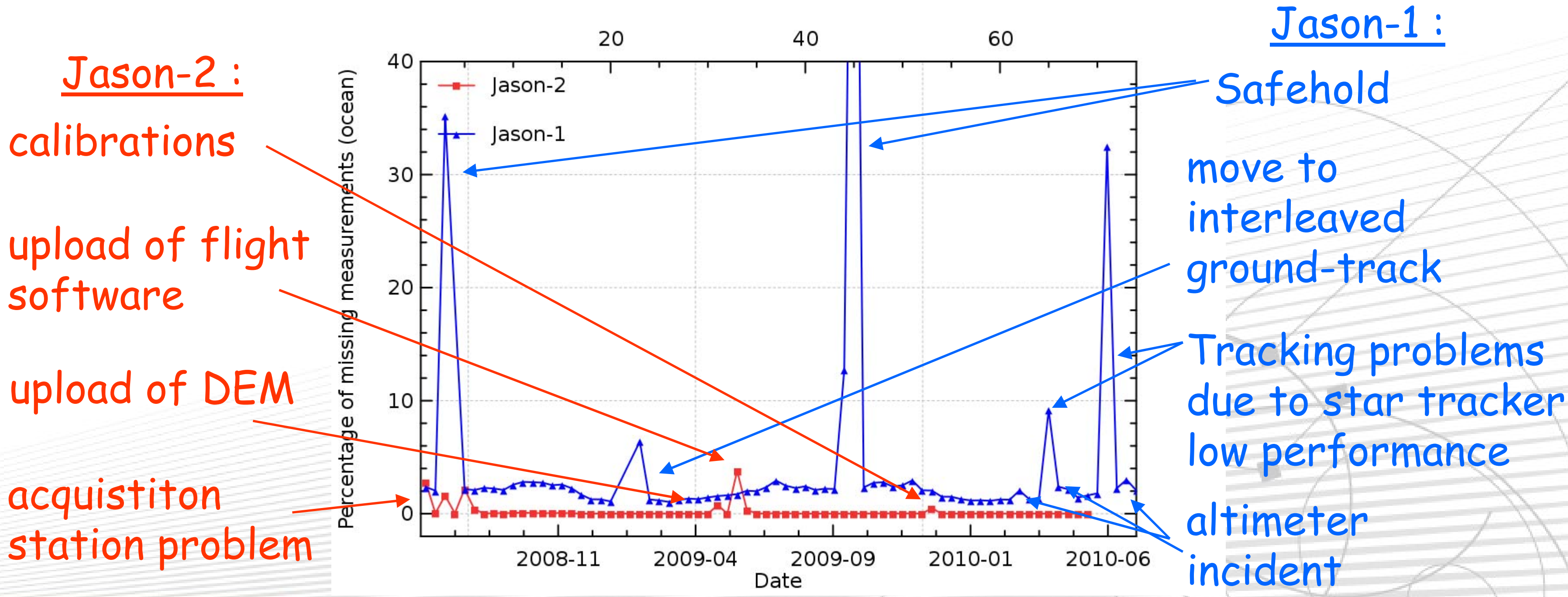
S. Philipps, M. Ablain, P. Thibaut (CLS)
N Picot, E. Bronner (CNES)

Introduction

- Objective:
  - Assess Jason-2 data quality and system performances
  - Operational validation of each GDR cycle before release to users
- Data used:
  - 1 Hz Jason-2 (GDR-T) and Jason-1 data (GDR-C)
- Overview:
  - Analysis of missing and edited measurements
  - Using cross-calibration of Jason-2 with Jason-1 to
    - Analyze altimeter and radiometer parameters
    - Assess Sea Surface Height (SSH) performances and consistency at crossovers
    - Assess along-track Sea Level Anomaly (SLA) performances and consistency
    - Compare Mean Sea Level (MSL) trends

Missing measurements

- Missing measurements
  - Excellent data availability for Jason-2, only few missing measurements over ocean, mostly due to:
    - Planned uploads/ calibrations
    - Acquisition station problems (beginning of mission)
  - Over ice, coastal and hydrological zones, Jason-2 better than Jason-1, thanks to new tracker algorithms



Edited measurements

- Edited measurements
  - Percentage of edited measurements show an annual signal due to ice coverage
  - Jason-2 edits more measurements than Jason-1 (principally ice). Due to higher tracking performances of JA2.
  - Very few measurements edited due to anomalies

Jason-2 :

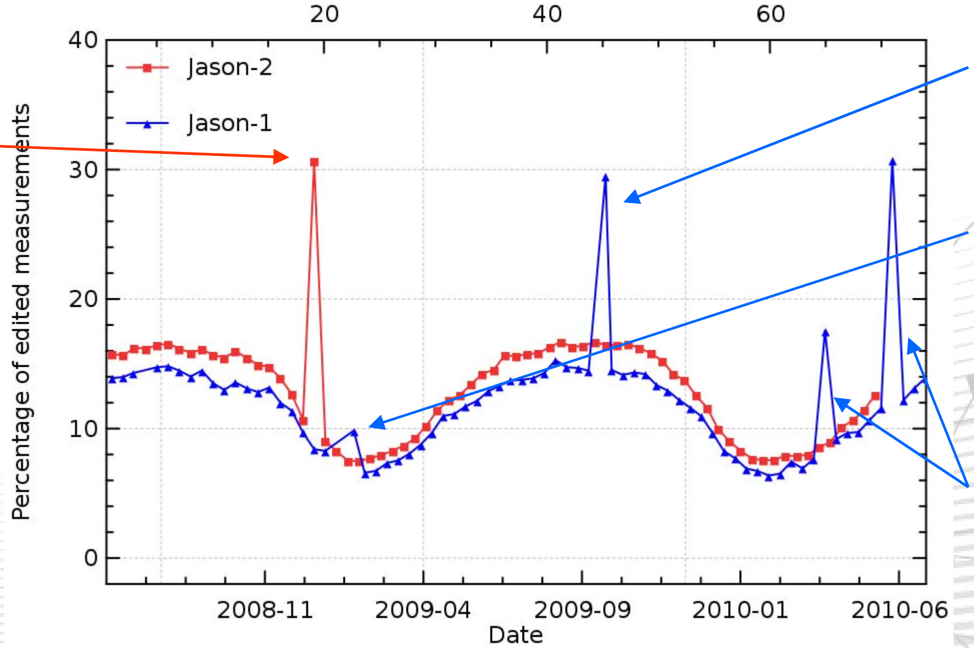
AMR unavailability

Jason-1 :

JMR switched on latter after Safehold

SLA out of threshold during maneuver

Tracking problems due to star tracker low performance -> altimeter parameters at default value



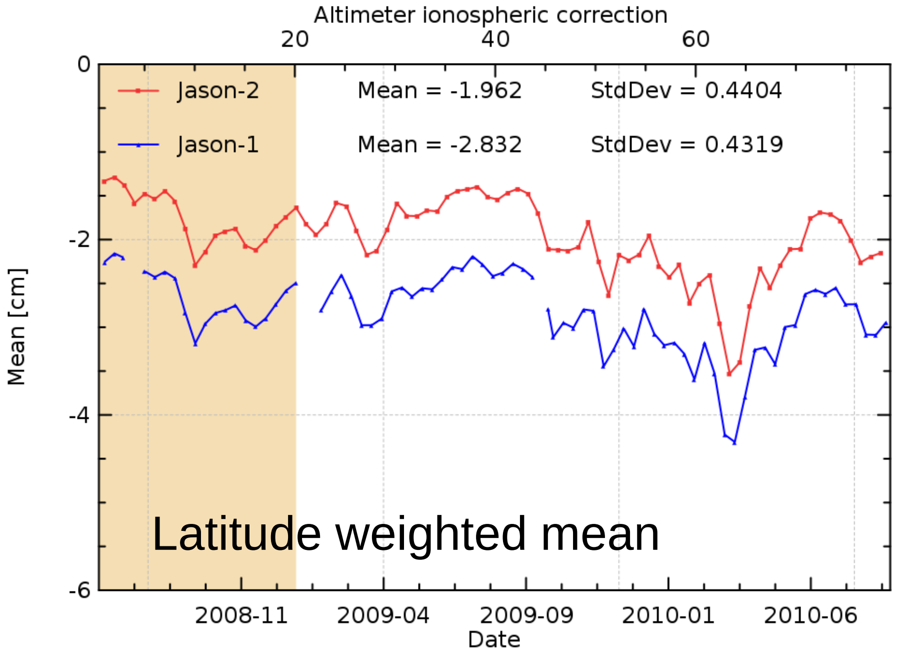
Monitoring of parameters

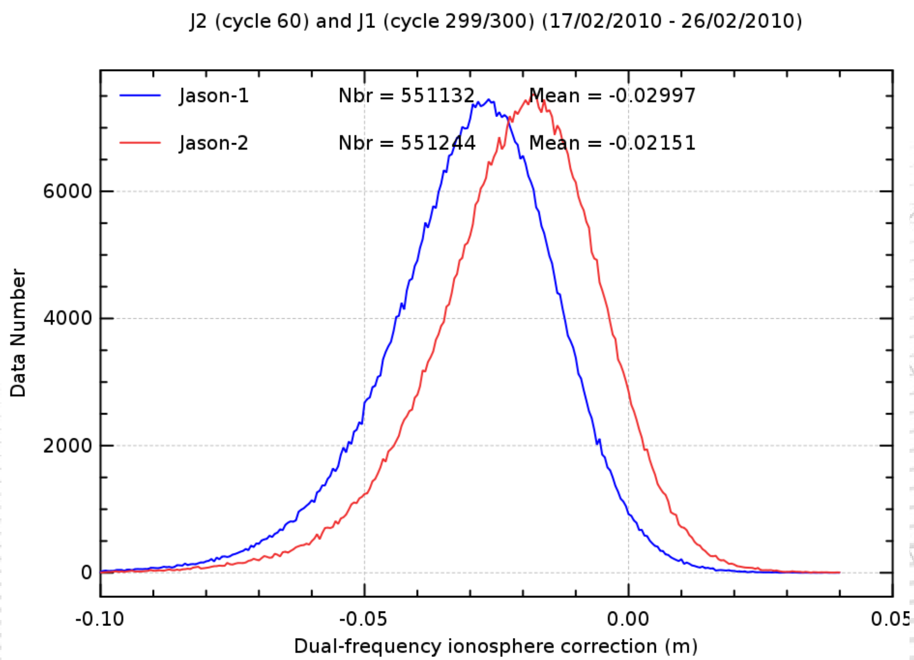
- Monitoring of altimetric parameters is very important to
  - Verify stability of measurements
  - Detect anomalies (jumps, drifts)
  - Monitor natural evolution of parameters

- Method:
  - Histograms of parameters for each cycle
  - Monitoring of cyclic mean of parameters (simple mean or weighted by latitude)

Dual-frequency ionospheric correction

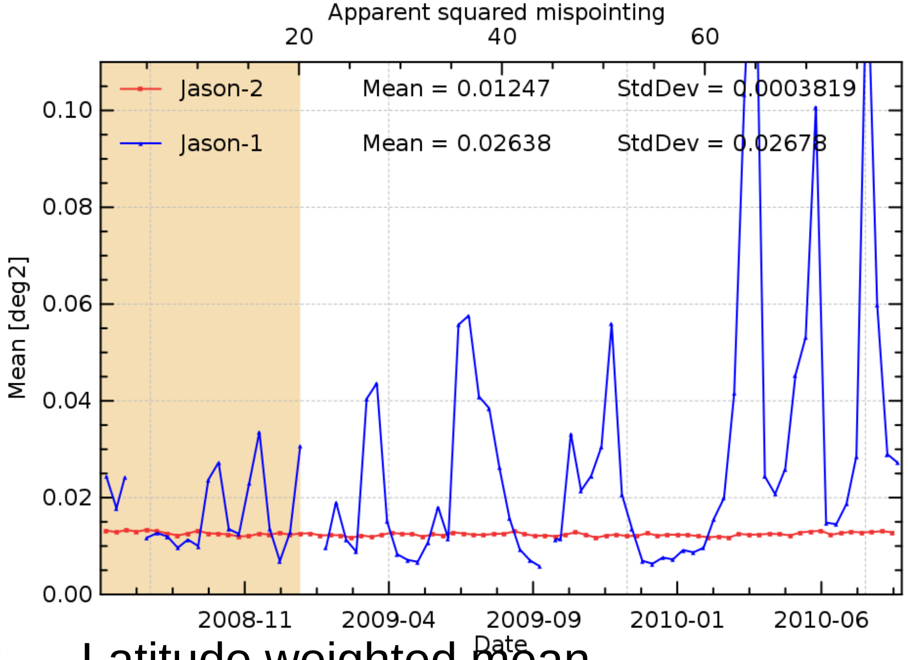
- Similar behavior of the dual-frequency ionospheric correction for both satellites
  - Bias of about 8.5 mm due to range differences between Jason-1 and Jason-2. Should it be corrected before GDRC release?



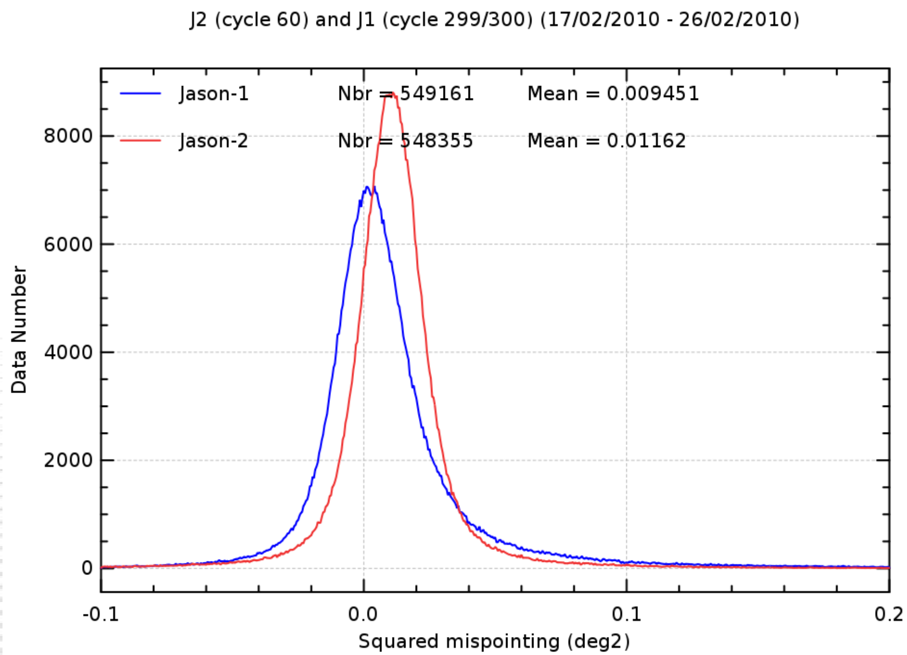


Mispointing

- Apparent squared mispointing is stable for Jason-2 (about 0.012 deg2)
  - Small bias is related to antenna aperture
- Jason-1 is periodically impacted by low star tracker performances related to beta angle value (environment conditions)



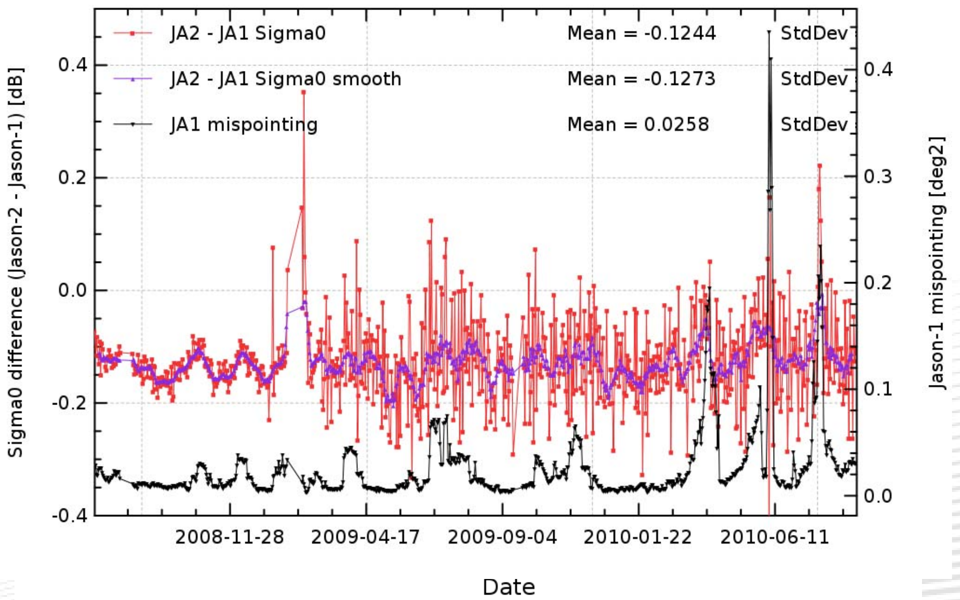
Latitude weighted mean

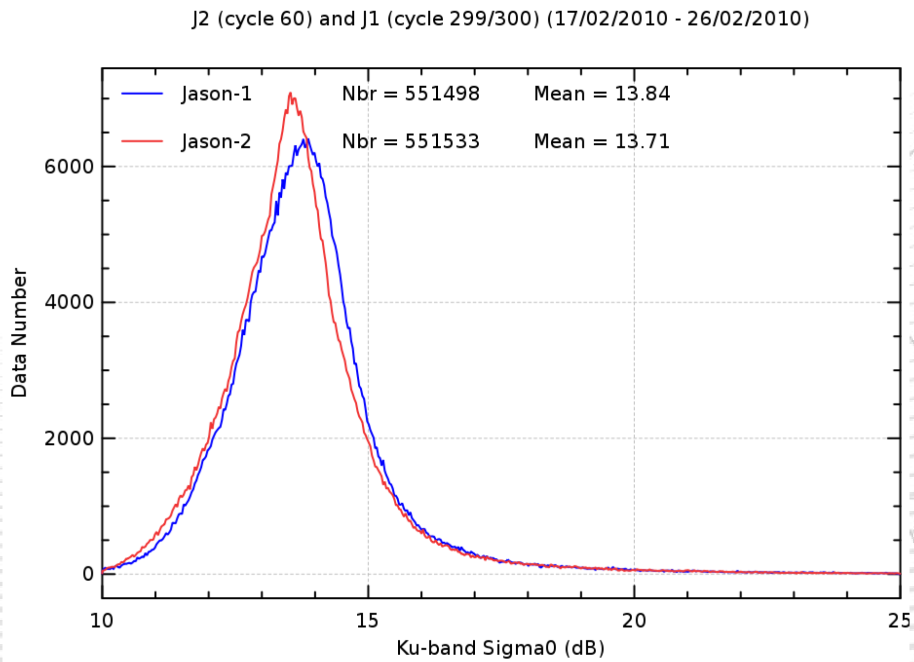


See also talk about: Jason-2 GDR-C standards

Backscattering coefficent

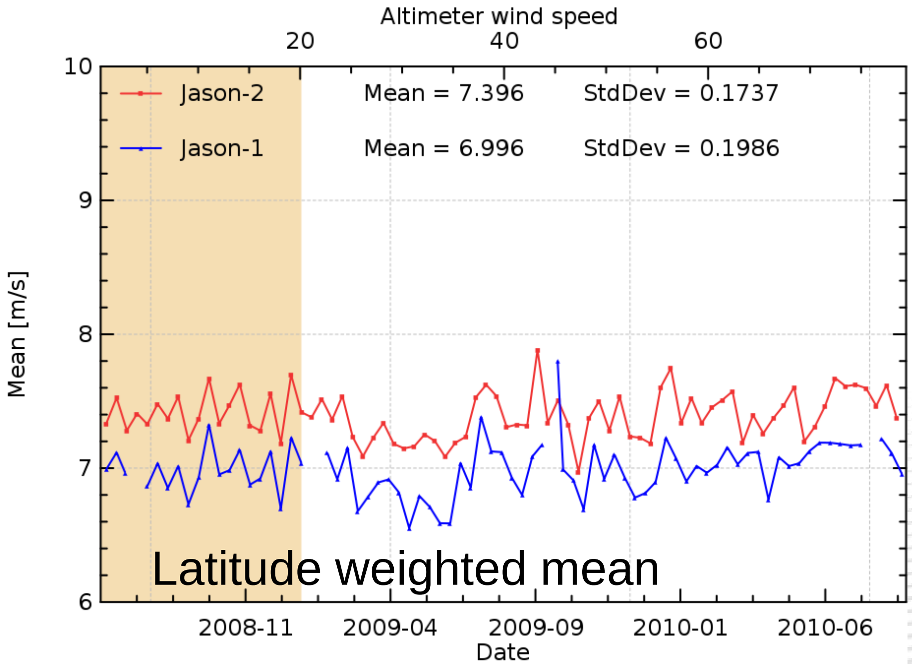
- Similar behavior of backscattering coefficient for both satellites
  - Bias of about 0.1 dB → impact on wind speed computation
  - Difference between Jason-1 and Jason-2 backscattering coefficient is impacted by periodically high mispointing of Jason-1

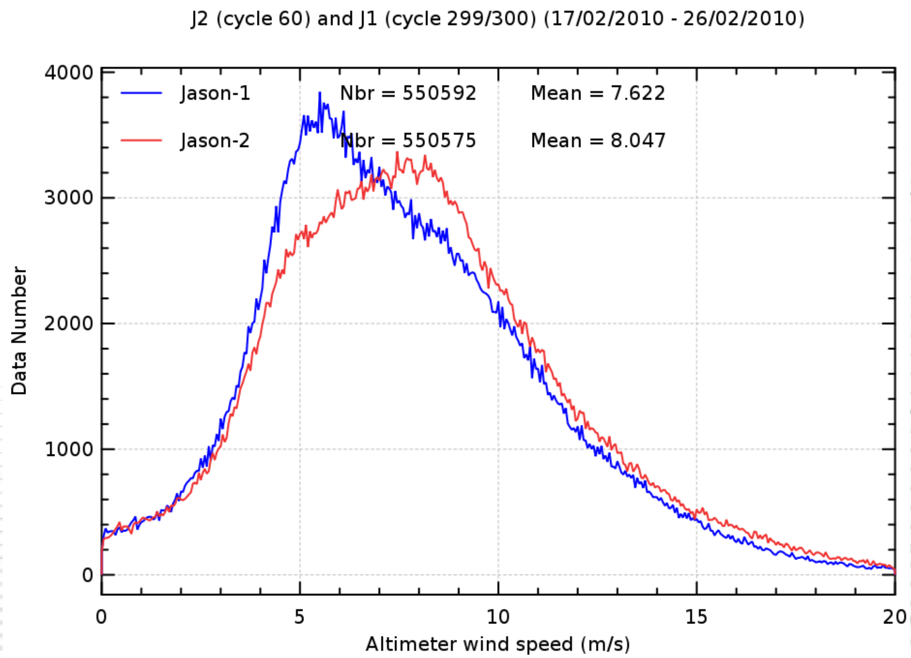




Altimeter wind speed

- Jason-2 wind speed is slightly higher by about 0.4 m/s than Jason-1 one´s
- Wind speed histogram have different shapes. Should it be corrected for GDRC release?

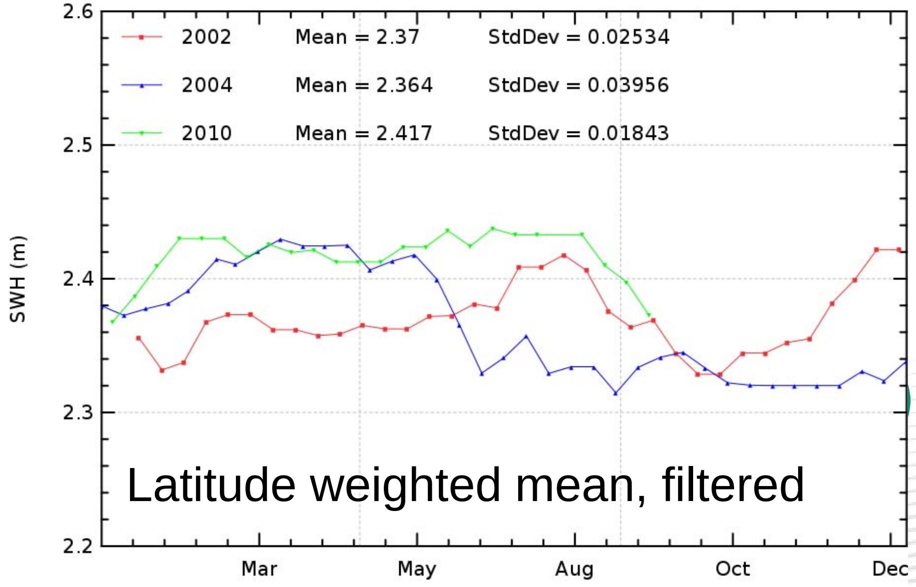


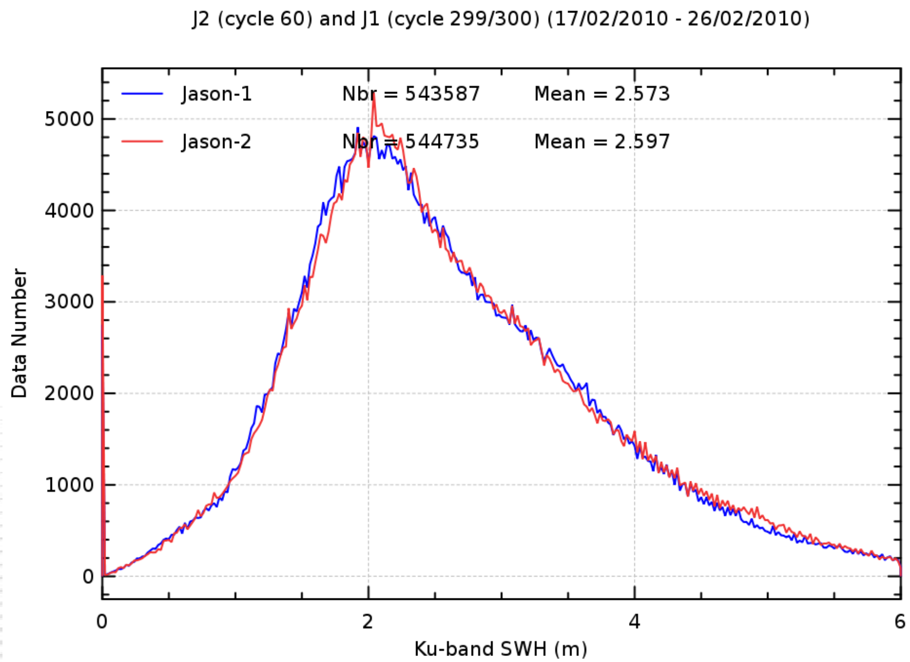


See also talk M. Ablain, N. Tran

Significant wave height

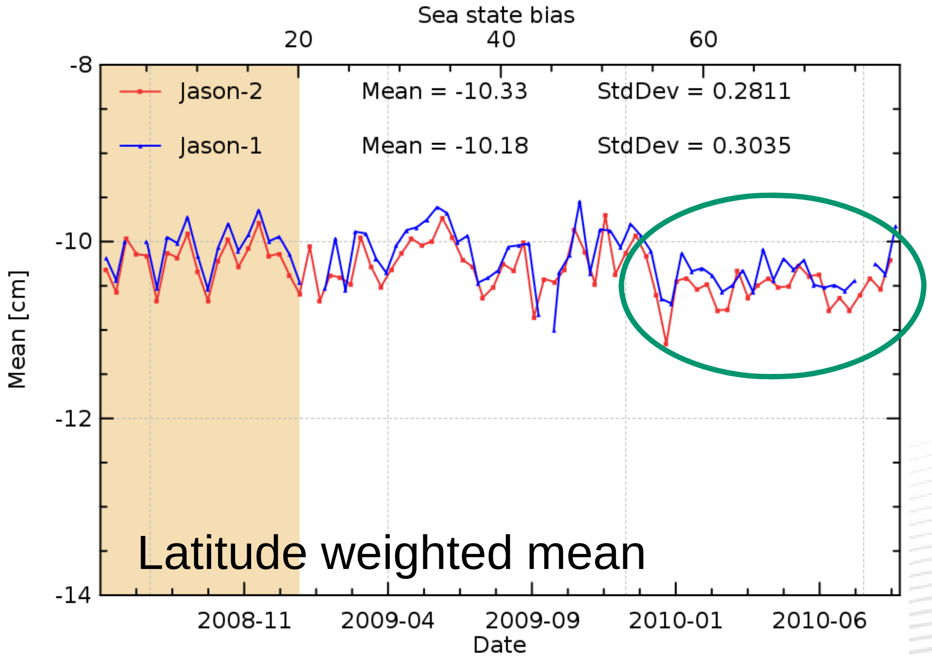
- Similar behavior for SWH of both satellites
- Small increase observed during first semester of 2010
  - Natural variability, already observed for previous years in Jason-1 data

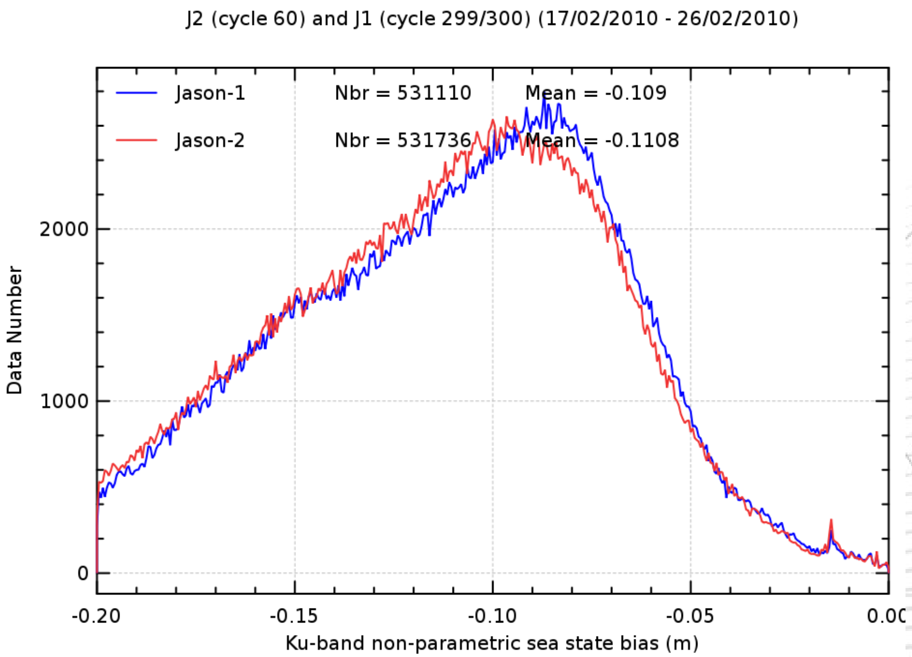




Sea State Biais

- Similar behavior for SSB of both satellites, small bias of ~1 mm
- Small decrease observed during first semester of 2010

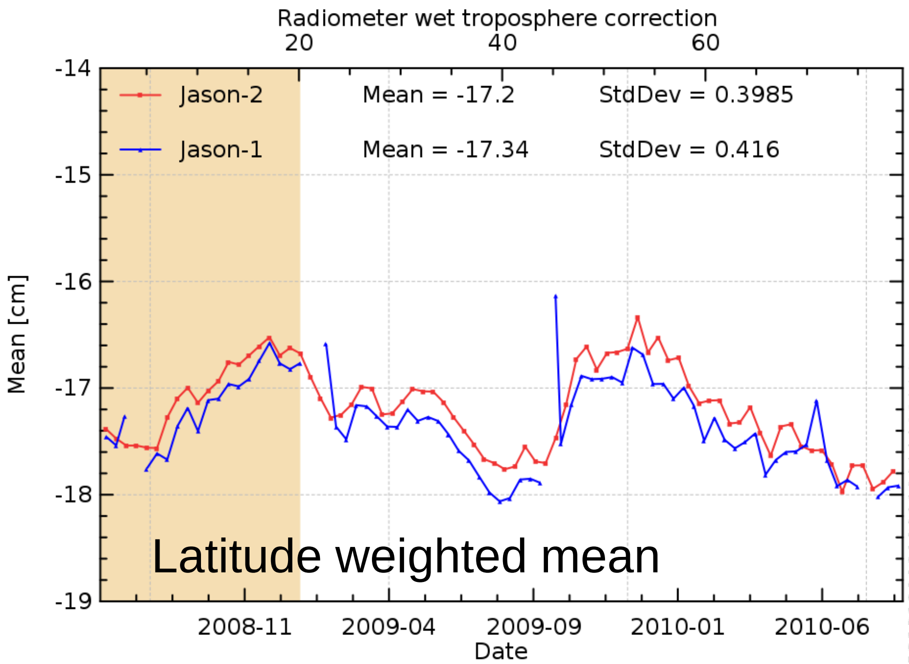


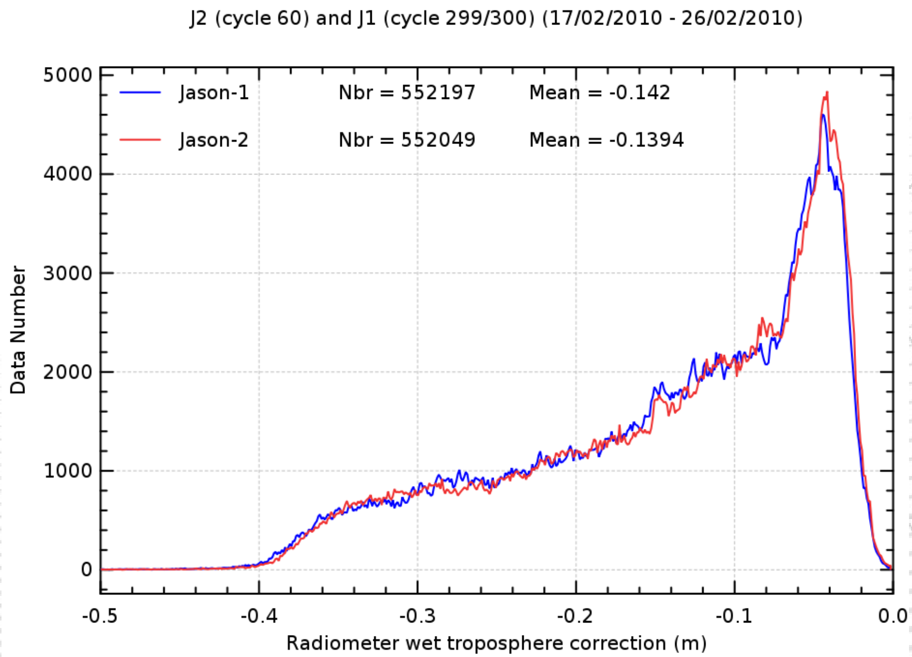


See also talk N. Tran: Overview and update of the Sea State Bias corrections for Jason-2, Jason-1 and TOPEX missions

Radiometer wet troposphere correction

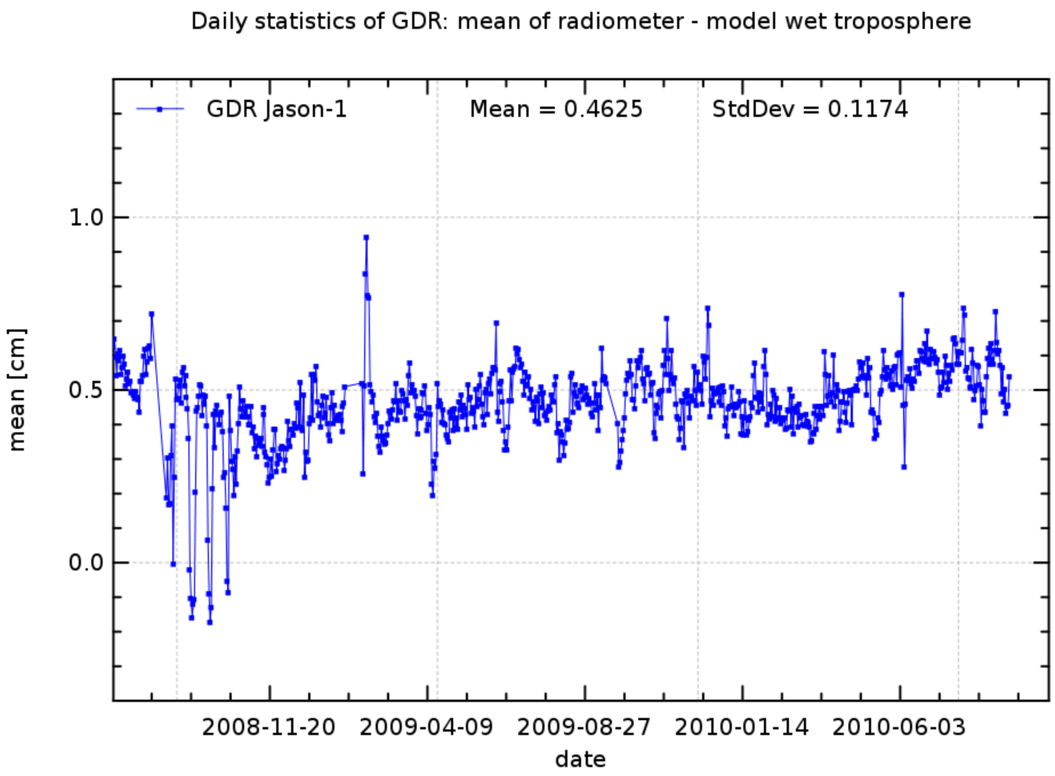
- Radiometer wet troposphere correction shows annual signal due to natural seasonal variations of the atmosphere
- Jason-2 is slightly lower than Jason-1 (17.2/17.3, using latitude weighted mean) -> will probably corrected in GDRC release with new AMR calibration files.





Radiometer wet troposphere correction

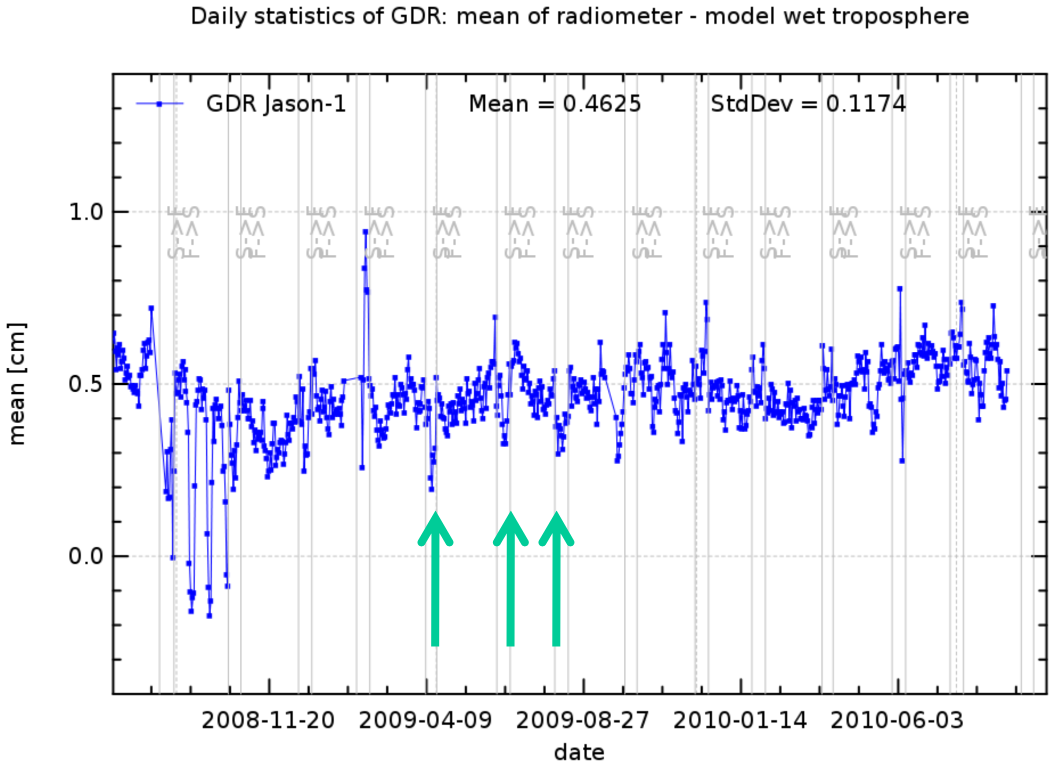
- Radiometer – Ecmwf model wet troposphere correction shows:



Radiometer wet troposphere correction

- Daily Radiometer – Ecmwf model wet troposphere correction differences show:

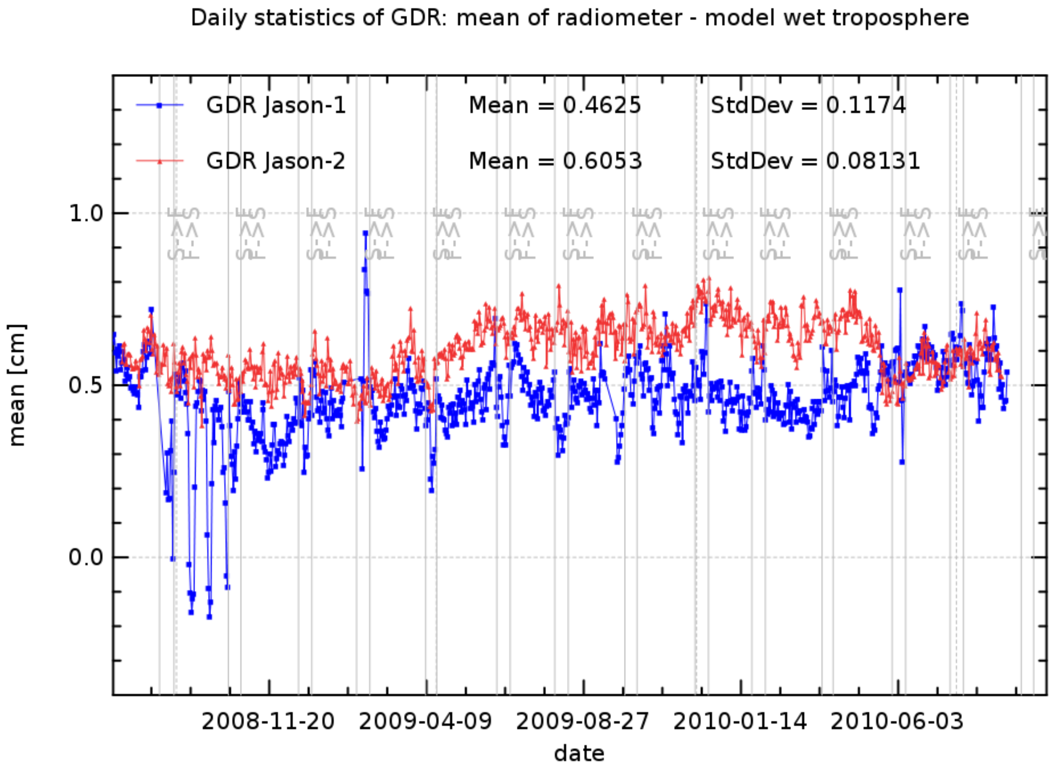
  – JMR is impacted by yaw maneuvers



Radiometer wet troposphere correction

- Daily Radiometer – Ecmwf model wet troposphere correction differences show:

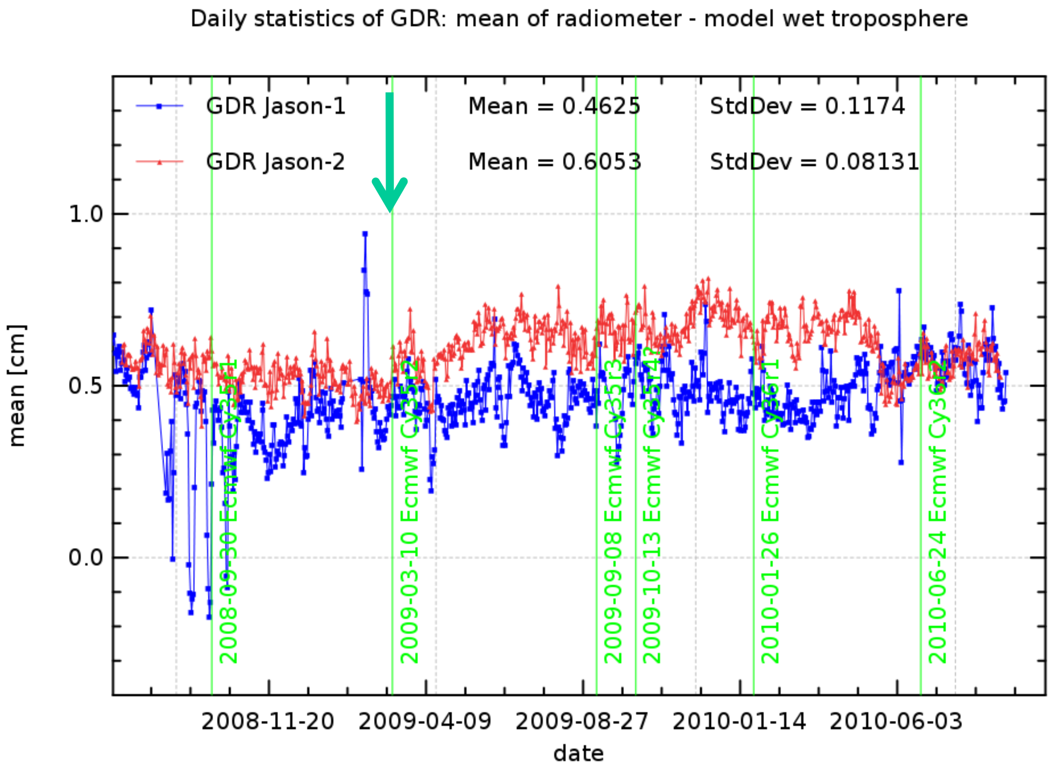
  - JMR is impacted by yaw maneuvers
  - AMR is less sensitive to yaw maneuvers
  - AMR versus Ecmwf shows temporal evolution of up to 2 or 3 mm



Radiometer wet troposphere correction

- Daily Radiometer – Ecmwf model wet troposphere correction differences show:

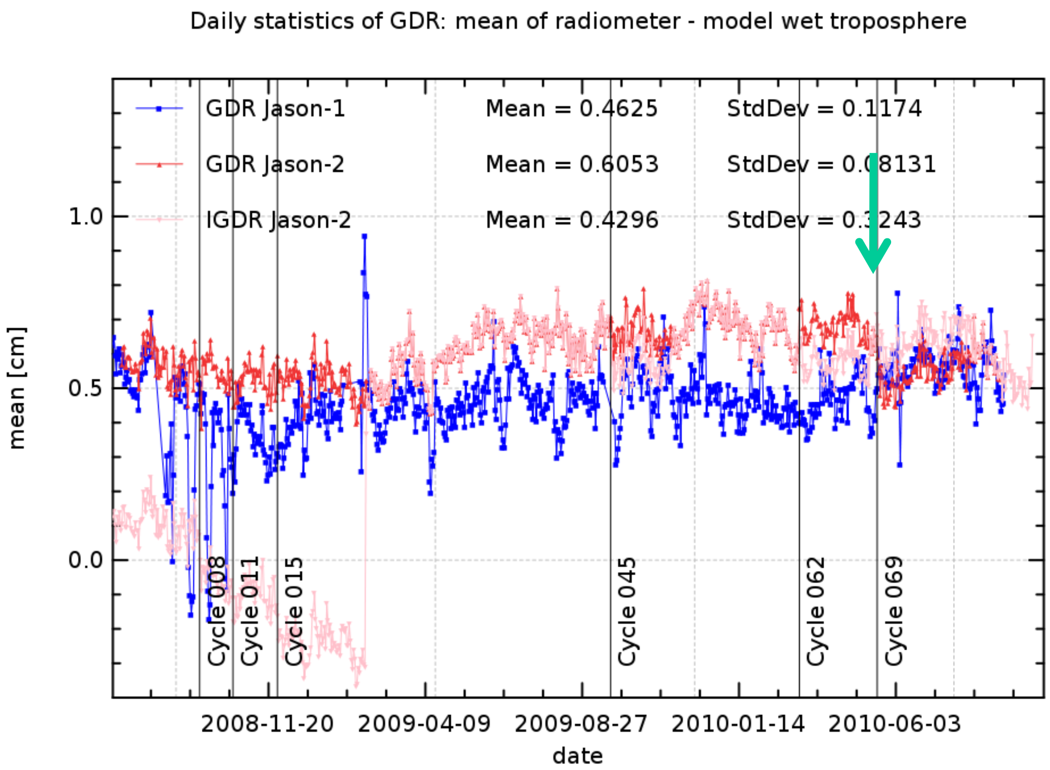
  – JMR is impacted by yaw maneuvers
  – AMR is less sensitve to yaw maneuvers
  – AMR versus Ecmwf shows temporal evolution of up to 2 or 3 mm, sometimes related to evolution of Ecmwf model



Radiometer wet troposphere correction

- Daily Radiometer – Ecmwf model wet troposphere correction differences show:

  - JMR is impacted by yaw maneuvers
  - AMR is less sensitve to yaw maneuvers
  - AMR versus Ecmwf shows temporal evolution of up to 2 or 3 mm, sometimes related to evolution of Ecmwf model
  - Decrease of about 2 mm during cycle 69: related to ARCS recalibration



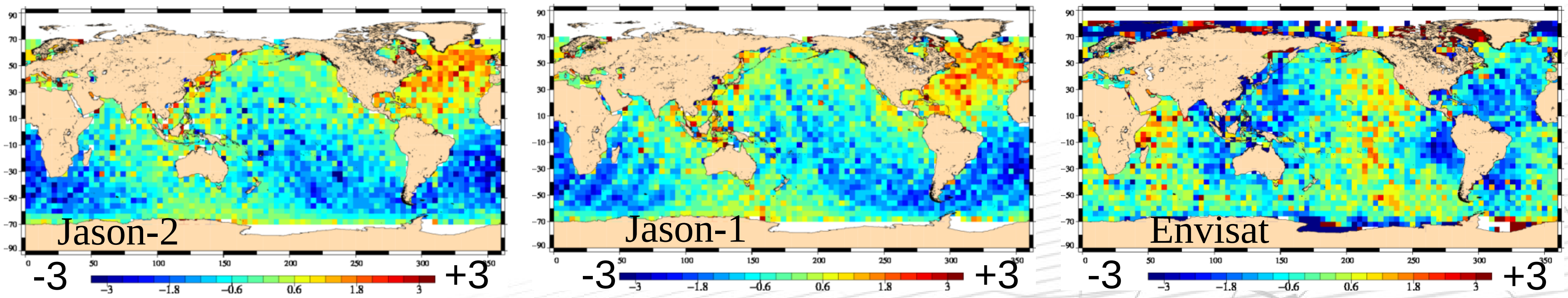
See also talk E. Obligis: Trend and variability of the atmospheric water vapour: a mean sea level issue

Summary of the parameter analysis

Missing and edited measurements	Excellent data availability and coverage Number of edited measurements is stable
Mispointing	Very stable, about 0.01 deg2 (due to antenna aperture)
Ionosphere	Similar to Jason-1, bias of about 8.5 mm
Sigma0	Similar to Jason-1, bias of about 0.1 dB
Altimeter wind speed	Similar to Jason-1, bias of about 0.4 m/s, different shape of histogram
SWH	Good agreement with Jason-1, small increase during 1 semester of 2010
Radiometer wet troposphere	Less impacted by yaw maneuvers, but radiometer/model difference shows some evolution up to 2 mm amplitude (application of calibration coefficients)

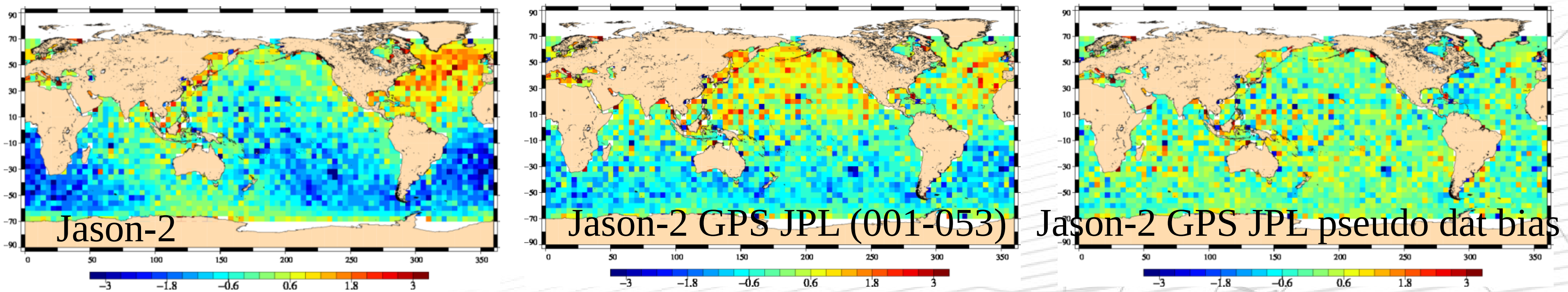
SSH performances and consistency at crossovers

- SSH performances at crossovers are good, but show geographically correlated patterns up to +/- 2 cm amplitude:
  - Positive in North Atlantic, negative in South Atlantic
- Same patterns for Jason-1
- Different patterns for Envisat



SSH performances and consistency at crossovers

- SSH performances at crossovers are good, but show geographically correlated patterns up to +/- 2 cm amplitude:
  - Positive in North Atlantic, negative in South Atlantic
- Patterns are related to orbit computation
- Patterns are strongly reduced when using reduced dynamic GPS orbit, such as from JPL rlse09a ⟹ reveals small hemispheric bias

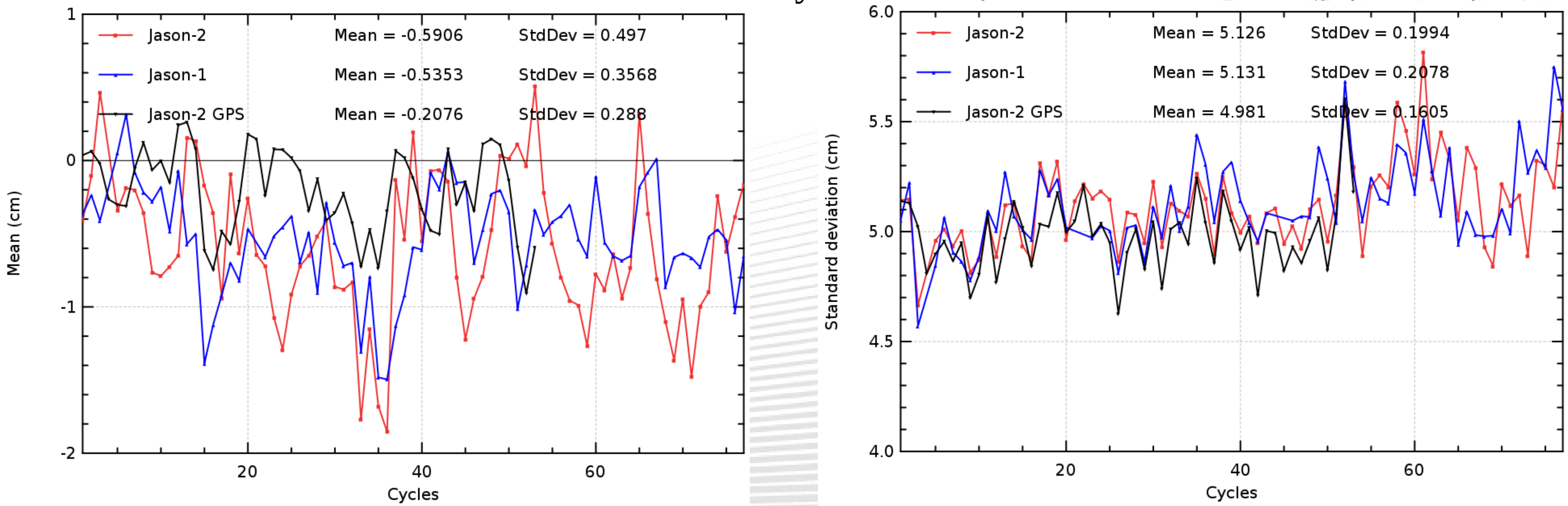


- hemispheric bias disappears when applying pseudo datation bias correction (computed similar to the one available in Jason-1 GDR-C)

SSH performances and consistency at crossovers

- Cyclic monitoring of mean SSH differences at crossovers are good, but:
  - Are generally negative (reveals systematic ascending/descending differences)
  - Show a periodic 120 day signal, related to orbit
  - Strongly reduced with JPL GPS rlse09a orbit
- Cyclic monitoring of standard deviation of SSH differences at crossovers is similar to Jason-1. Both show an increase around cycle 60 and 77

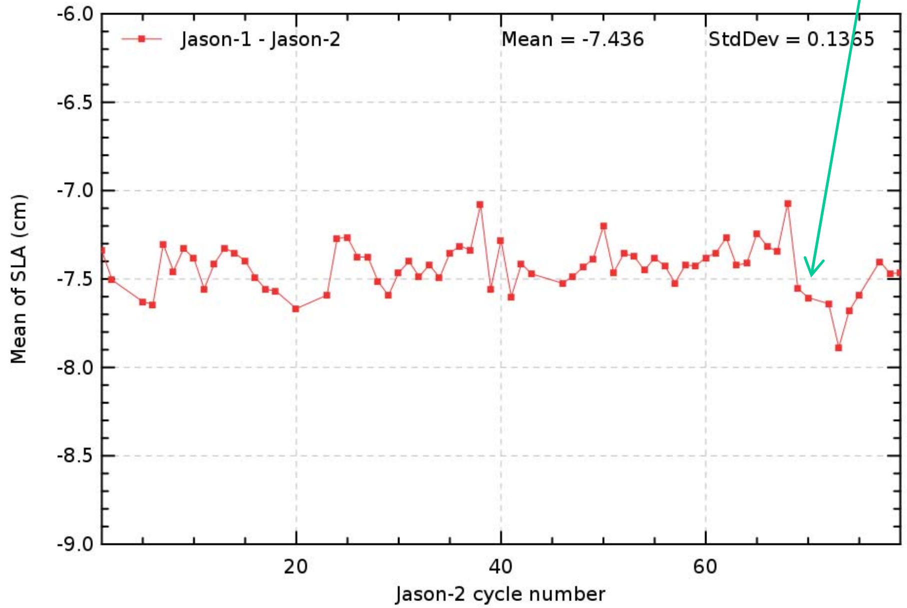
Selecting data with |latitude| < 50°, bathymetry < -1000m, low ocean variability (<20cm)

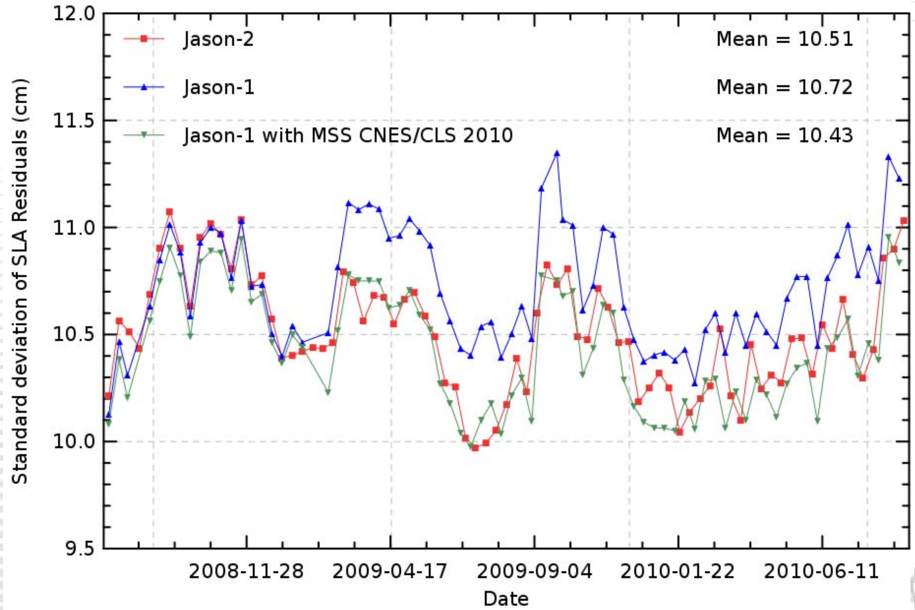


Along-track Sea Level Analysis

- Mean difference of SLA between Jason-2 and Jason-1 about 7.4 cm
- Standard deviation of SLA about 10.5 cm
  - Std of Jason-1 SLA increased since orbit change February 2009
  - Using MSS CNES/CLS2010, reduces significantly std of Jason-1 SLA even for interleaved ground-track

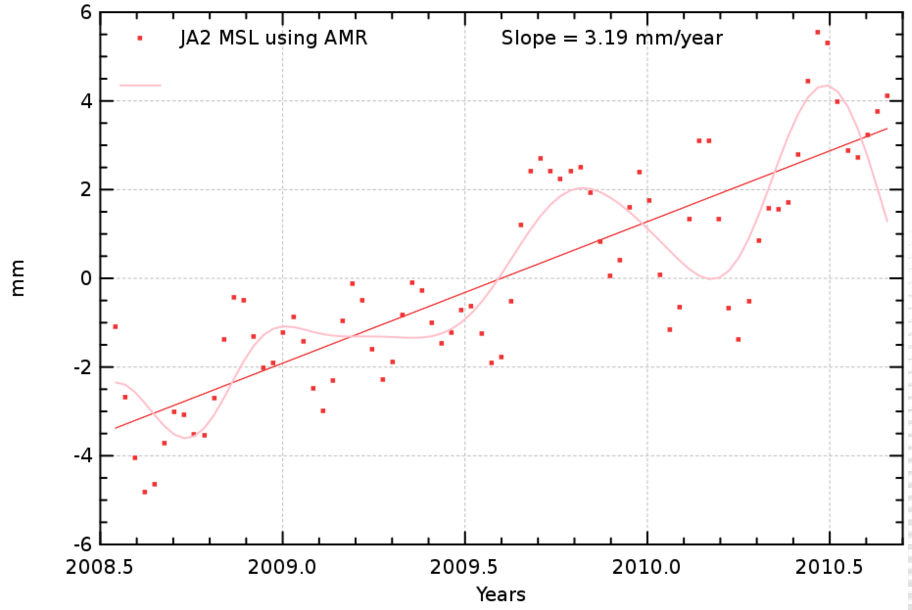
Cyc 69: New calibration coefficients for AMR

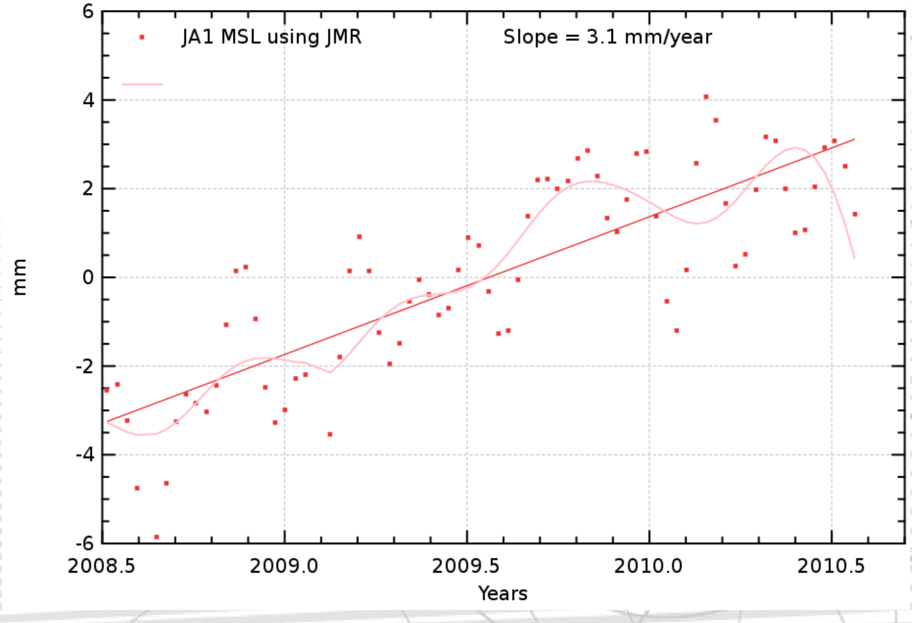




Mean Sea Level trend

- Filtering signal over 2 month (dots) and using annual and semi-annual signal from T/P and JA1 for adjustment (as Jason-2 period is quite short)
- Using radiometer wet troposphere correction for Jason-2 MSL : 3.2 mm/year
- Similar for Jason-1 (for the same period): 3.1 mm/year

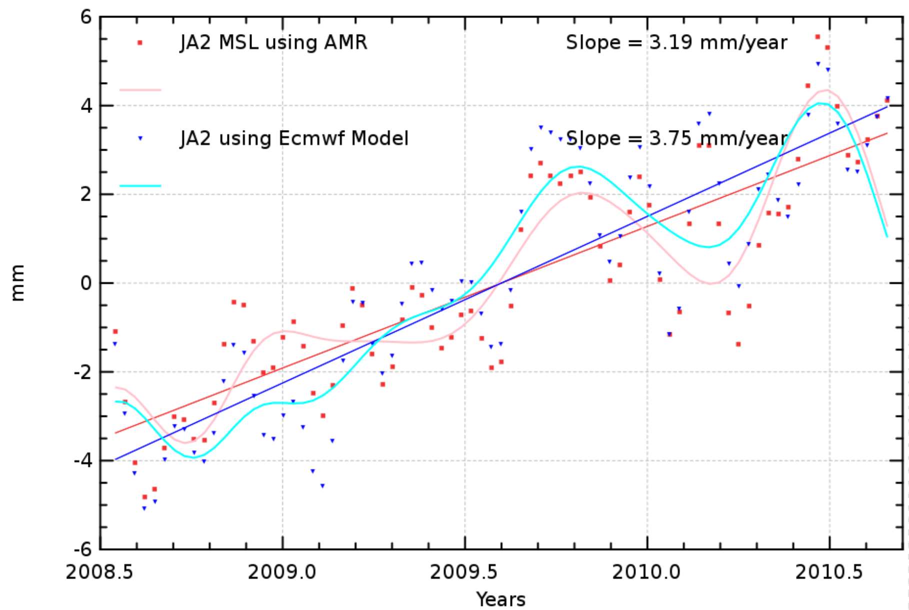


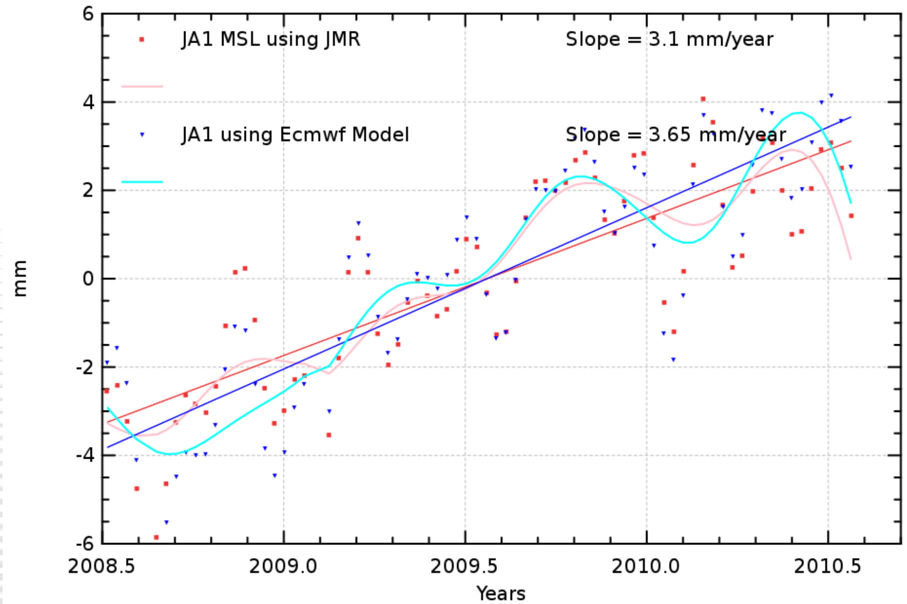


Mean Sea Level trend

- Filtering signal over 2 month (dots) and using annual and semi-annual signal from T/P and JA1 for adjustment (as Jason-2 period is quite short)
- Using radiometer wet troposphere correction for Jason-2 MSL : 3.2 mm/year

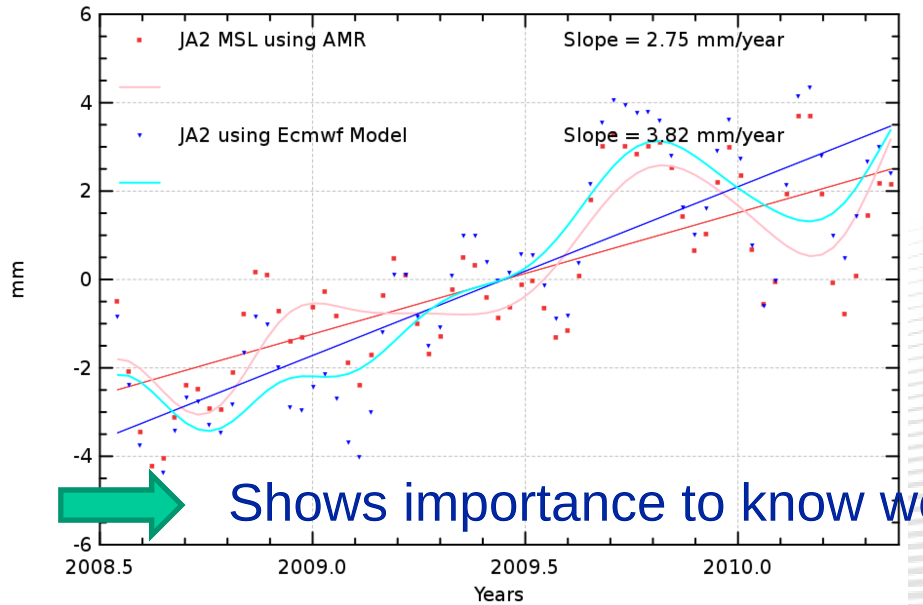
- Similar for Jason-1 (for the same period): 3.1 mm/year
- Using Ecmwf wet troposphere correction: 3.7 mm/year !

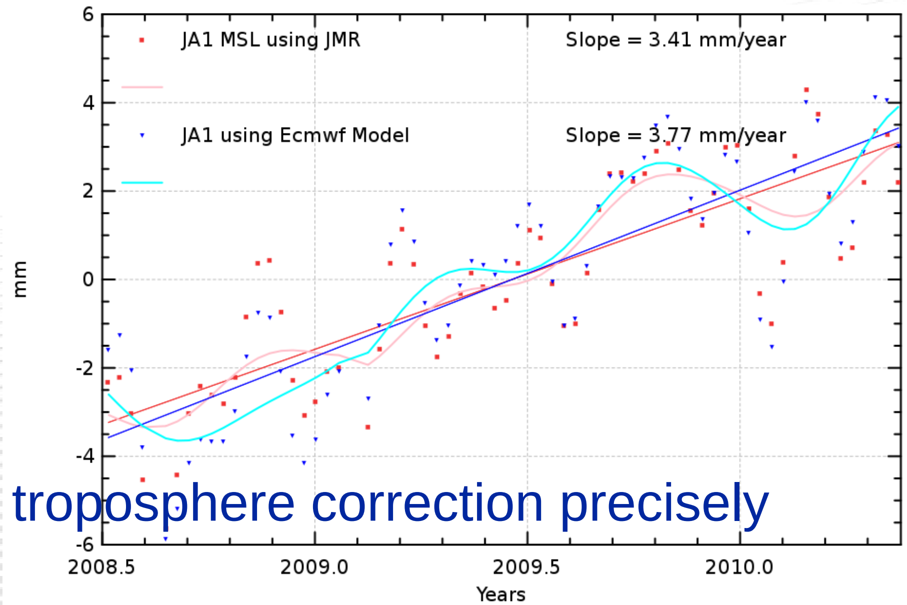




Mean Sea Level trend

- Filtering signal over 2 month (dots) and using annual and semi-annual signal from T/P and JA1 for adjustment (as Jason-2 period is quite short)
- Computing MSL trend till cycle 068 (before last AMR coefficient calibration), brings slope differences of 1 mm/year between use of radiometer or Ecmwf model wet troposphere correction





Shows importance to know wet troposphere correction precisely

Summary

- Jason-2 has excellent data availability
- Jason-2 altimeter parameters show very good quality. In order to further improve data quality:

➢ Altimeter wind speed could be improved (by using Sigma0 coming from MLE3 algorithm)

➢ Wet troposphere correction should be known more precisely, as it shows discrepancies depending which radiometer or model is considered.

➢ SSH performances at crossovers are good, but show geographically correlated patterns up to +/- 2 cm amplitude and periodic 120 day signal, related to orbit. Possible improvement in the reduction of systematic errors between reduced dynamic versus dynamic orbits and of the Doris + SLR versus GPS orbits are currently being investigated by POD teams.

➢ Applying pseudo datation bias (as already used for Jason-1) would reduce hemispheric bias