

Global Cross Calibration of Jason-1/2 GDR-C Data

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Outline

- Method (Discrete Crossover Analysis, DCA)
- Data
- Jason-1 Improvements with GDR-C products
- Jason-1 Orbit Change
- Jason-2 Relative Calibration

Discrete Crossover Analysis (DCA)

1) Computation of Crossovers

Computation of crossovers in all combinations
(single-satellite as well as dual-satellite crossovers)

2) Least Square Adjustment

Determination of radial errors per mission in 3D (time, latitude, longitude)
Method: Minimization of crossovers as well as of consecutive errors

3) Error Decomposition

Separation of range bias from differences in center-of-origin realization
Computation of geographically correlated errors

Input Data

- Missions: TOPEX, Jason-1/2, ERS-1/2, Envisat, GFO, Icesat
- Time period: 1992-2009
- MWR correction whenever available (without replacement product for J1)
- EOT08a tide model
- Dynamic Atmospheric Correction (DAC) from AVISO

Changes w.r.t. last years computations

- new TOPEX orbits (GRACE-based GSFC instead of JGM-3)
- change in Envisat orbits (GDR instead of DEOS orbits after Cycle 37)
- GFO orbits corrected with radial errors from previous DCA
- improved DAC product from AVISO

Output Data

- Time series of radial errors per mission (spectral properties assessable)
- Range bias per 10 days (cycle of reference mission)
- Global mean range bias per mission
- Differences in the centre-of-origin realizations
- Geographically correlated errors

see Poster by Bosch et al.:

” Geographically Correlated Errors from Multi-Mission Crossover Analysis ”

Jason-1 GDR-C

Comparison of Jason-1 GDR-B and GDR-C

Reference mission: TOPEX

Time period:

Cycle 001 – 139 of Jason-1 (TOPEX lifetime)

not all GDR-C already available

=> about 30 Cycles missing

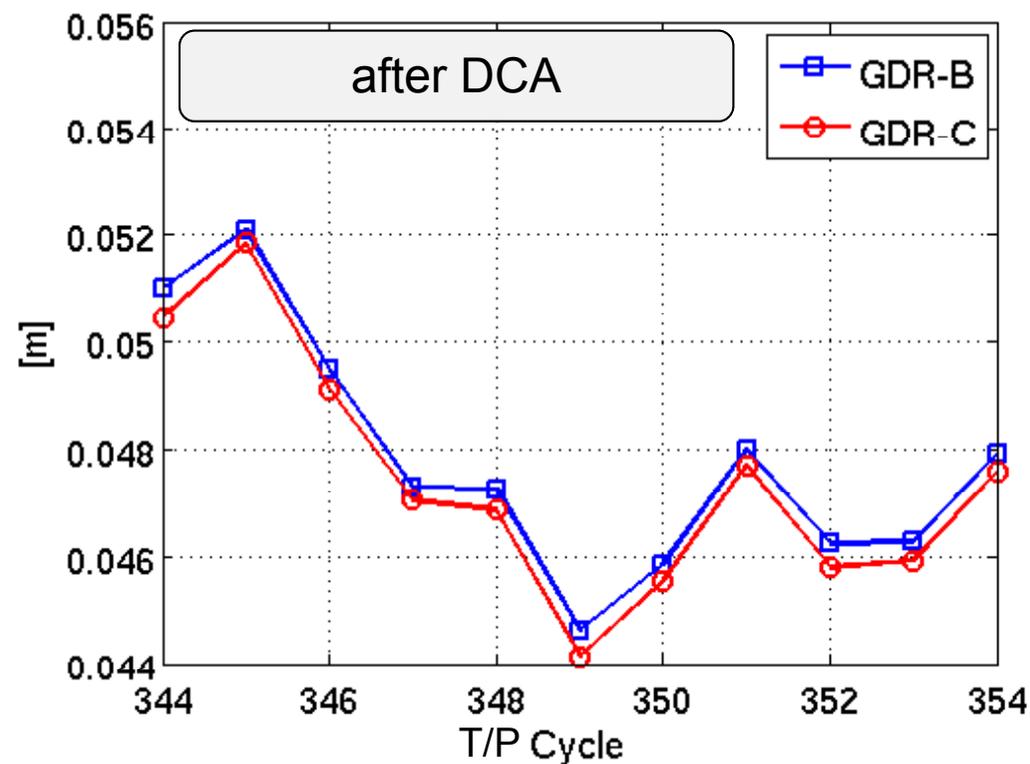
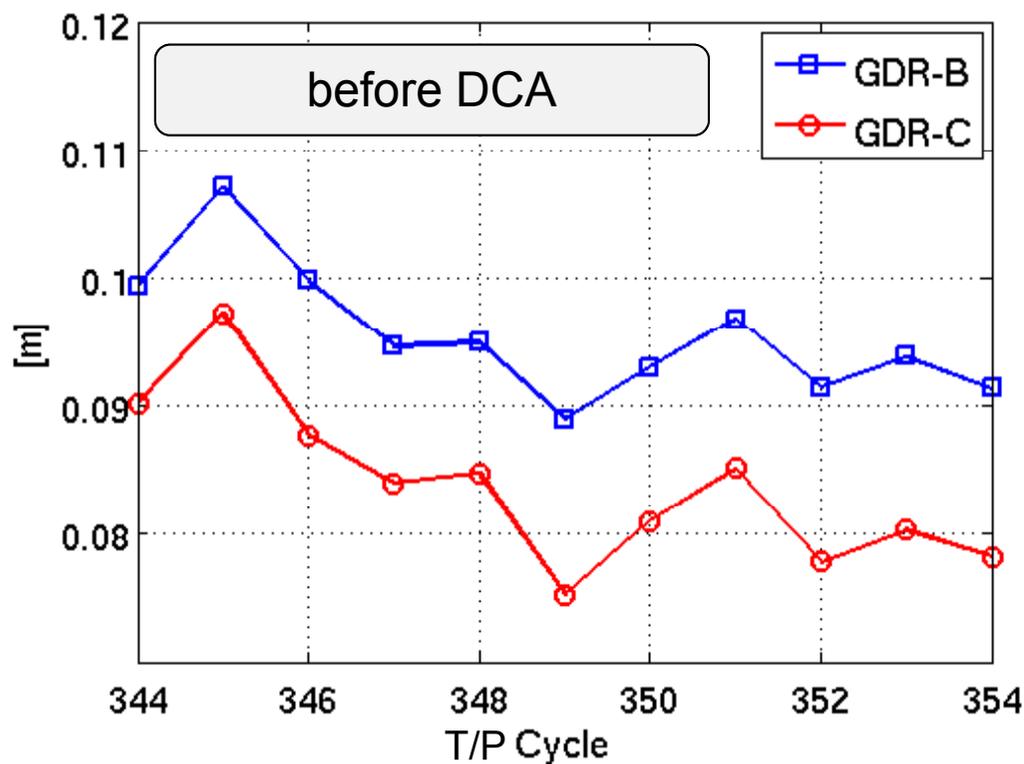
Other missions included: ERS-2, GFO, Envisat

Jason-1 GDR-C

Number of Crossovers

Slightly increased number of valid crossovers ($\approx 400/\text{cyc}$)
up to 1.5% more crossovers per cycle

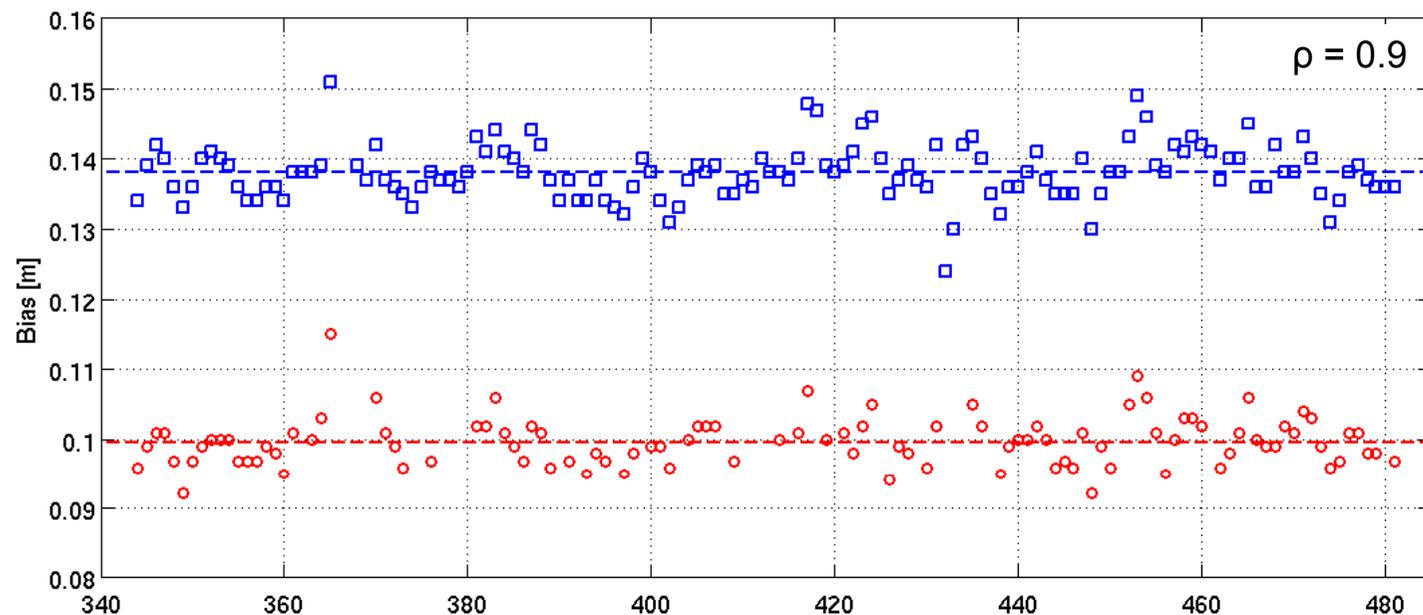
RMS of Crossover



45.5 mm \Rightarrow 45.2 mm (mean, # 68 cyc)

Jason-1 GDR-C

Relative Range Bias

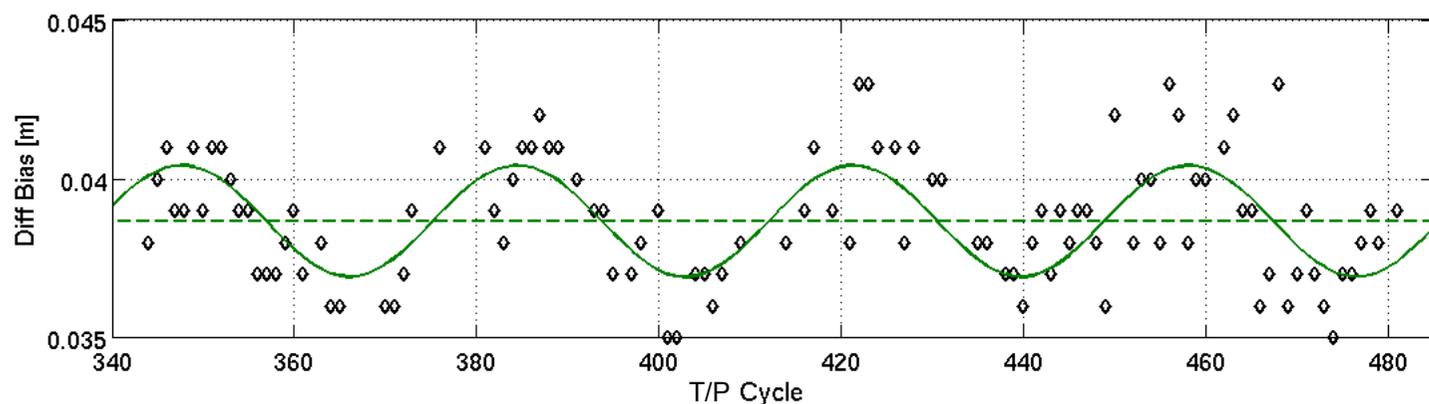


Bias w.r.t TOPEX

GDR-B: 123.4 mm

GDR-C: 84.7 mm

(taking TP Bias into account which has been applied in MGDRs)

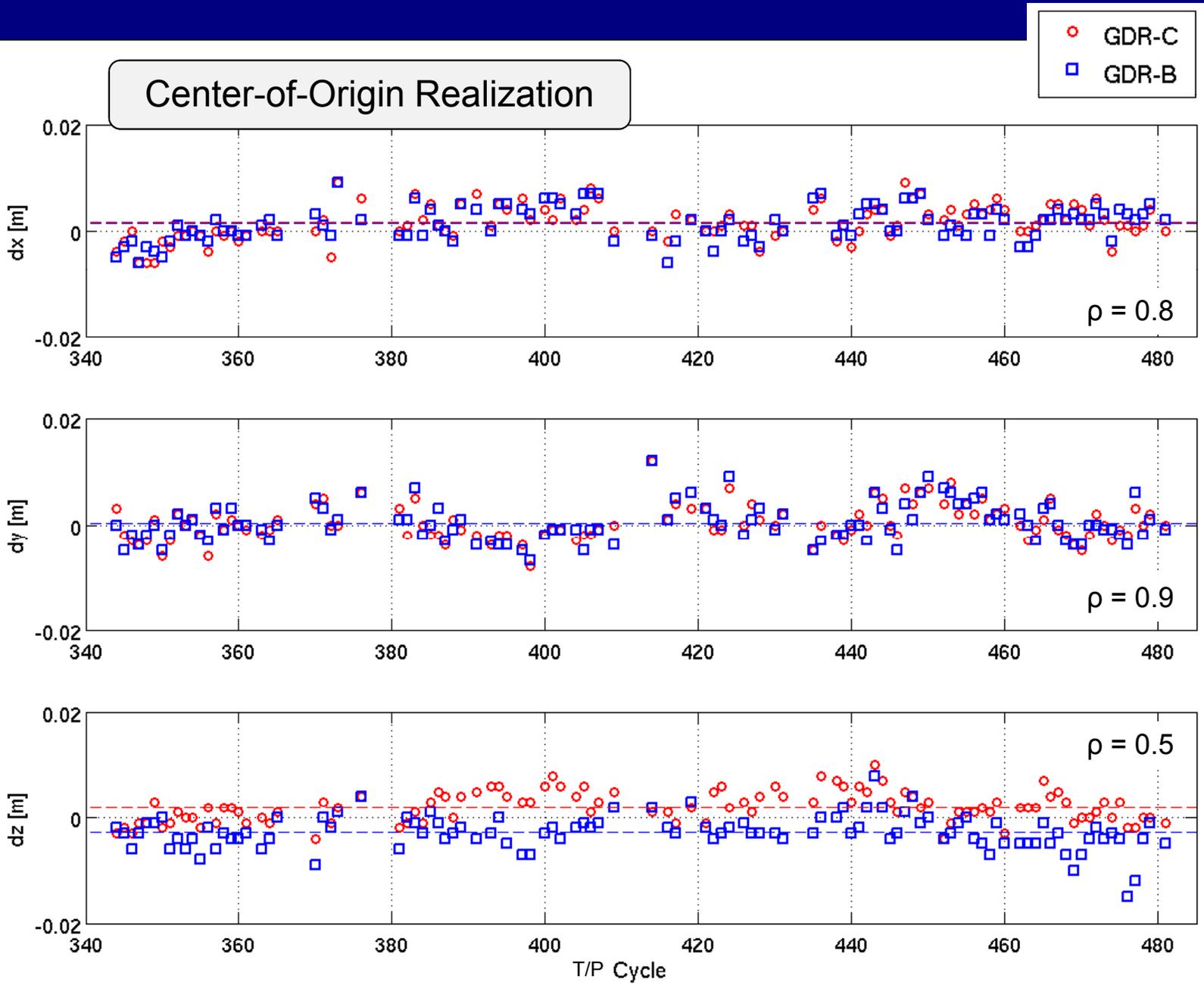


Rel. Bias

$\text{Bias}_{\text{GDR-B}} - \text{Bias}_{\text{GDR-C}}$

3.9 0.2 cm

Jason-1 GDR-C



1.3 3.2 mm
 1.5 3.2 mm ✓

0.3 3.6 mm
 0.3 3.4 mm ✓

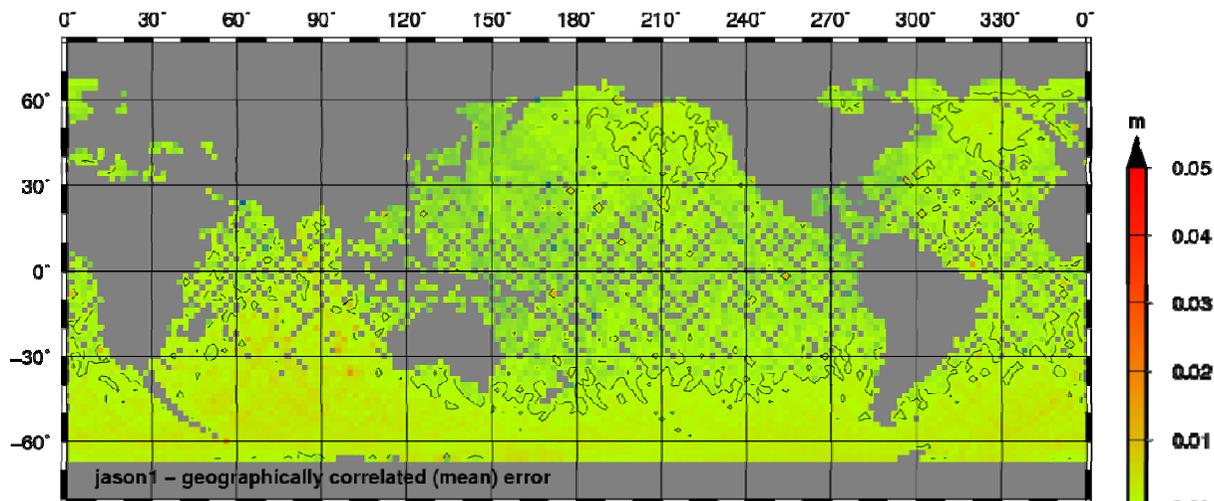
-2.8 3.2 mm
 2.0 ± 2.9 mm



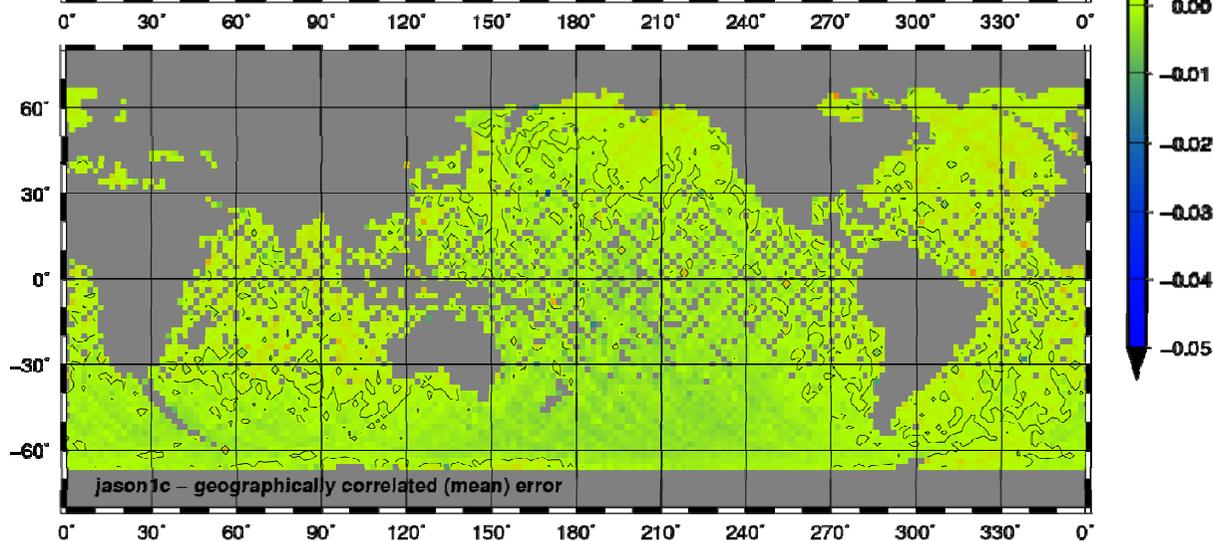
Jason-1 GDR-C

Geographically correlated mean errors

GDR-B
[# 136 Cycle]



GDR-C
[# 105 Cycle]



Jason-1 orbit change

Comparison of Jason-1 GDR-C before and after orbit change

Reference mission: Jason-1

Time period:

- Cycle 240 – 267 of Jason-1 (since start of Jason-2)

- 20 Cycles before orbit change (Tandem Phase)

- 4 Cycles after orbit change (Interleaved Ground Track)

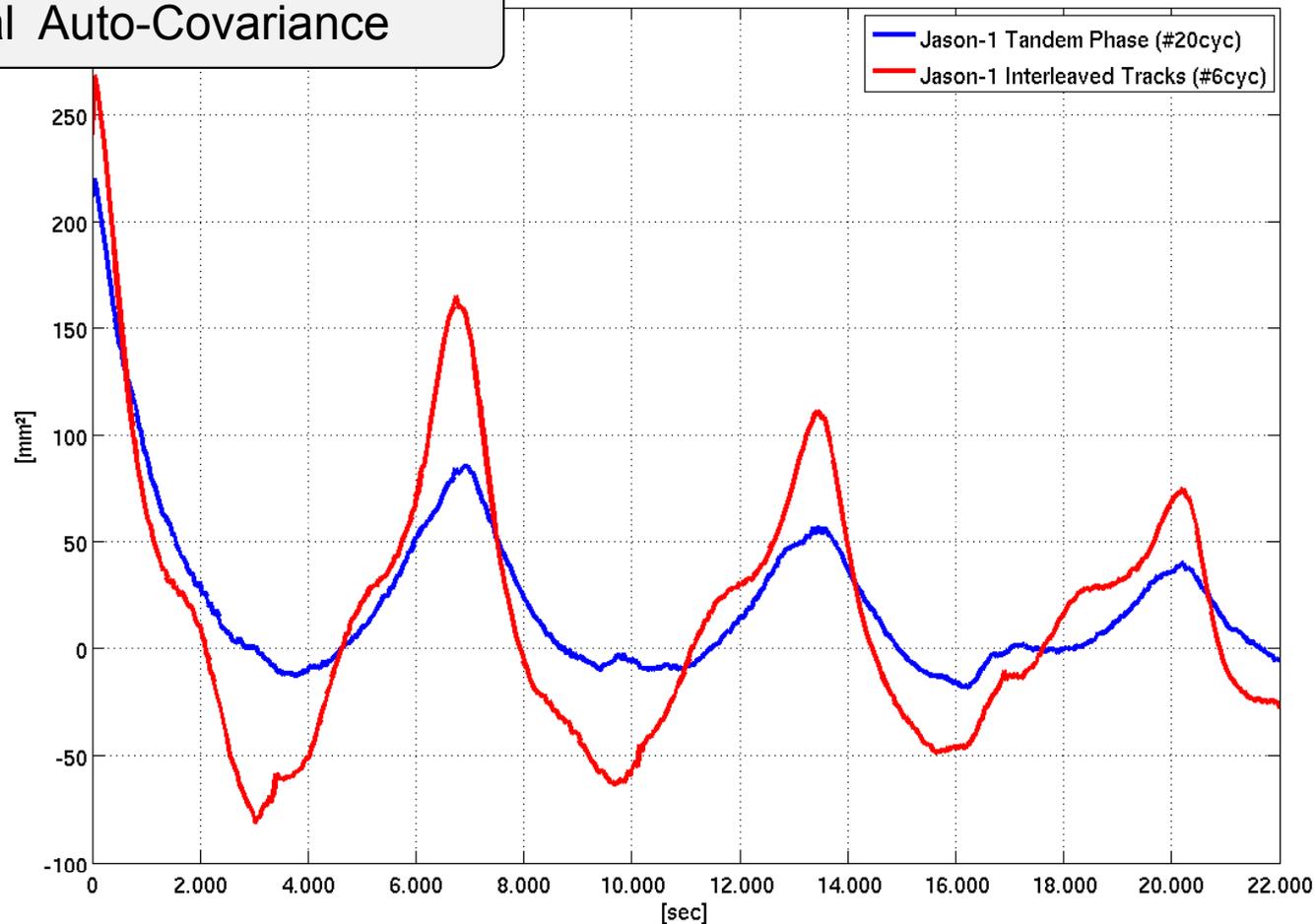
Other included missions: Envisat

Jason-1 orbit change

Radial Errors

around ZERO because Jason-1 is reference mission, spectral properties are different

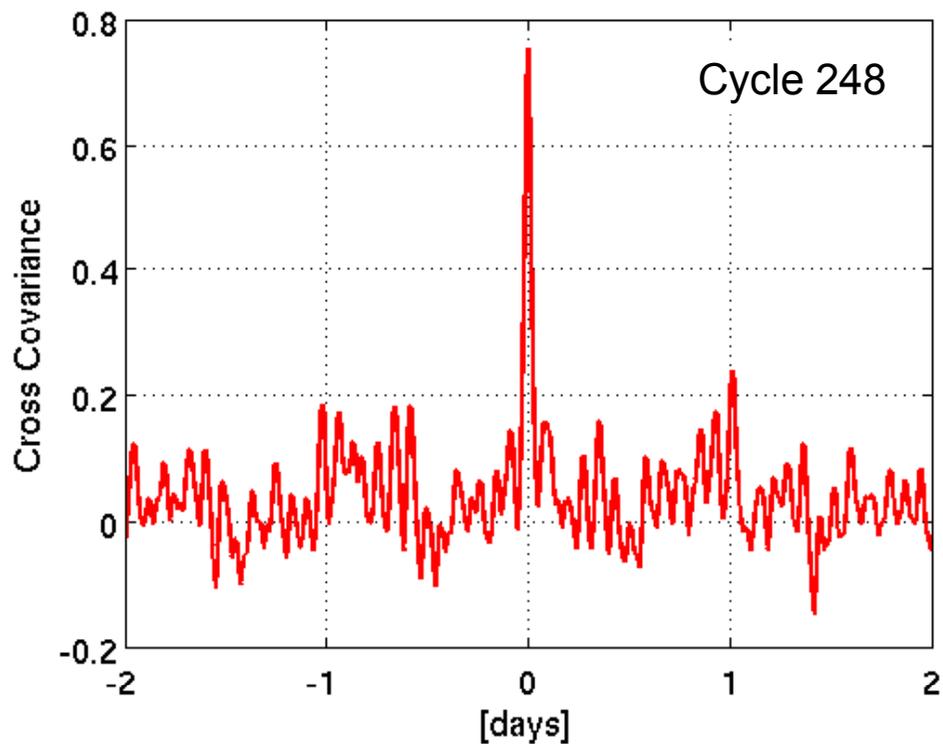
Empirical Auto-Covariance



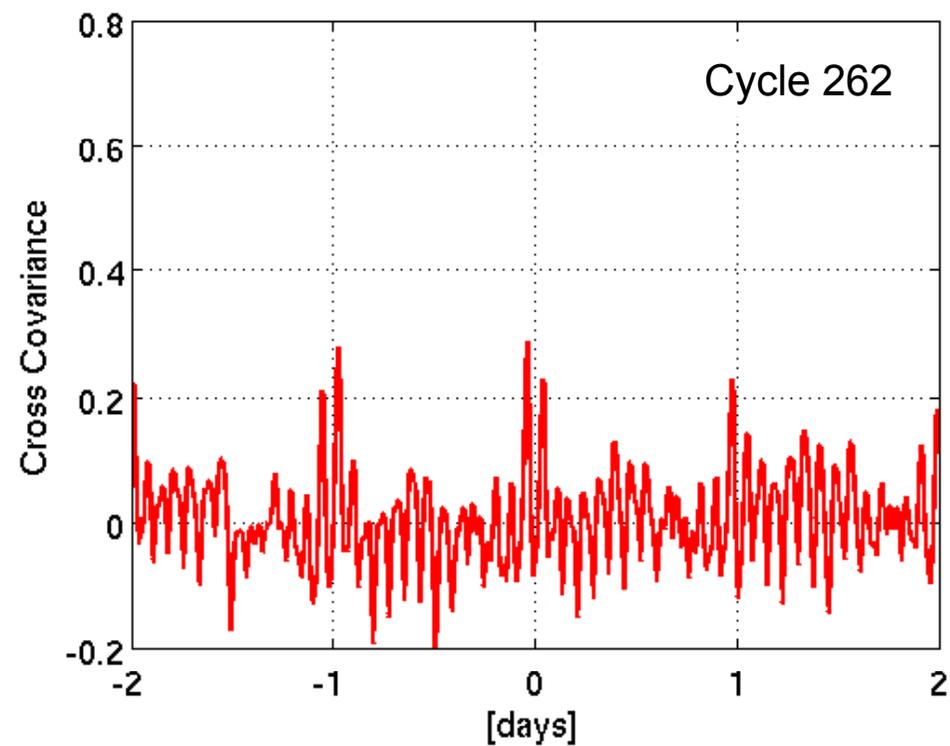
Jason-1 orbit change

Cross-Covariance (Radial Errors Jason-1 \leftrightarrow Jason-2)

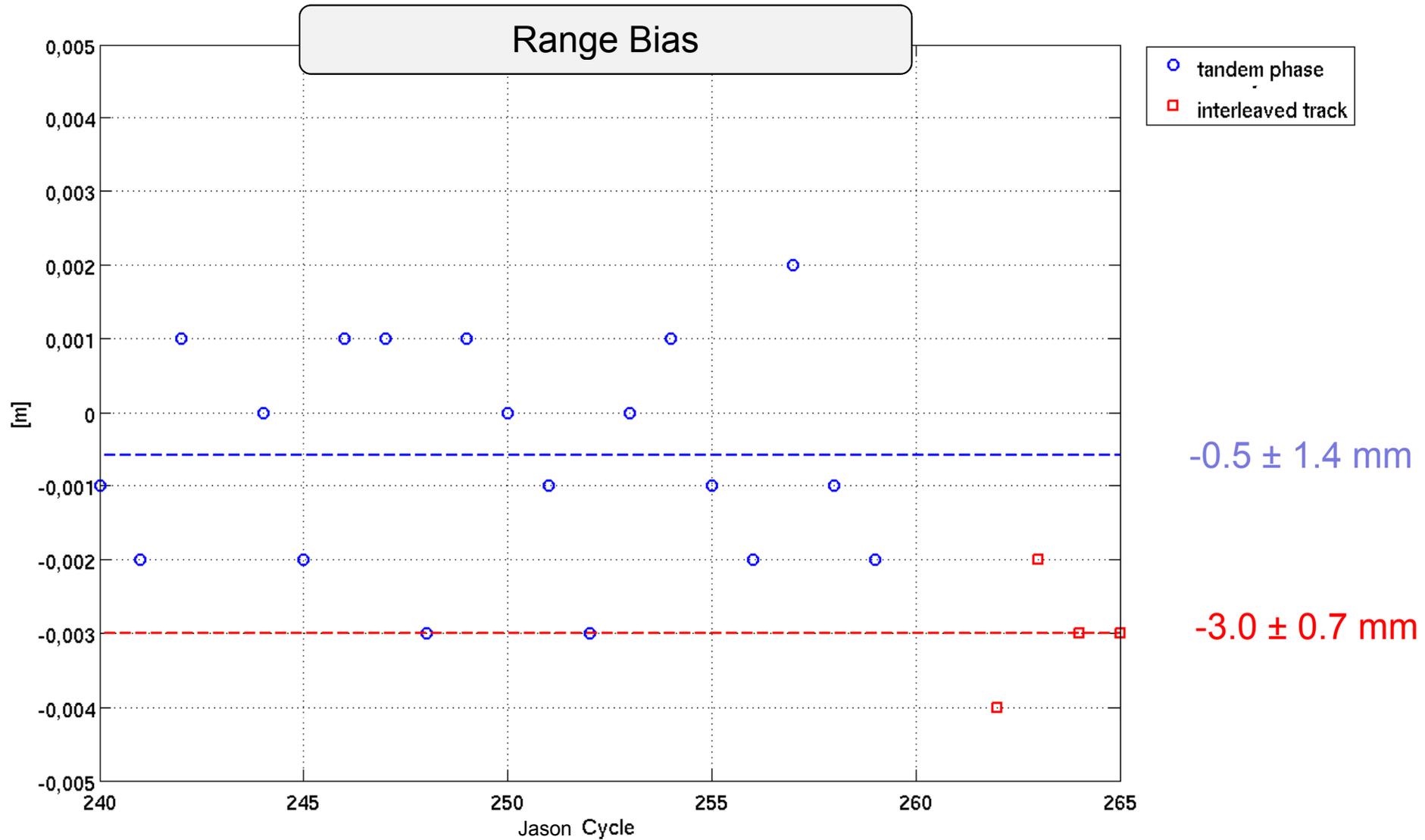
Tandem Flight



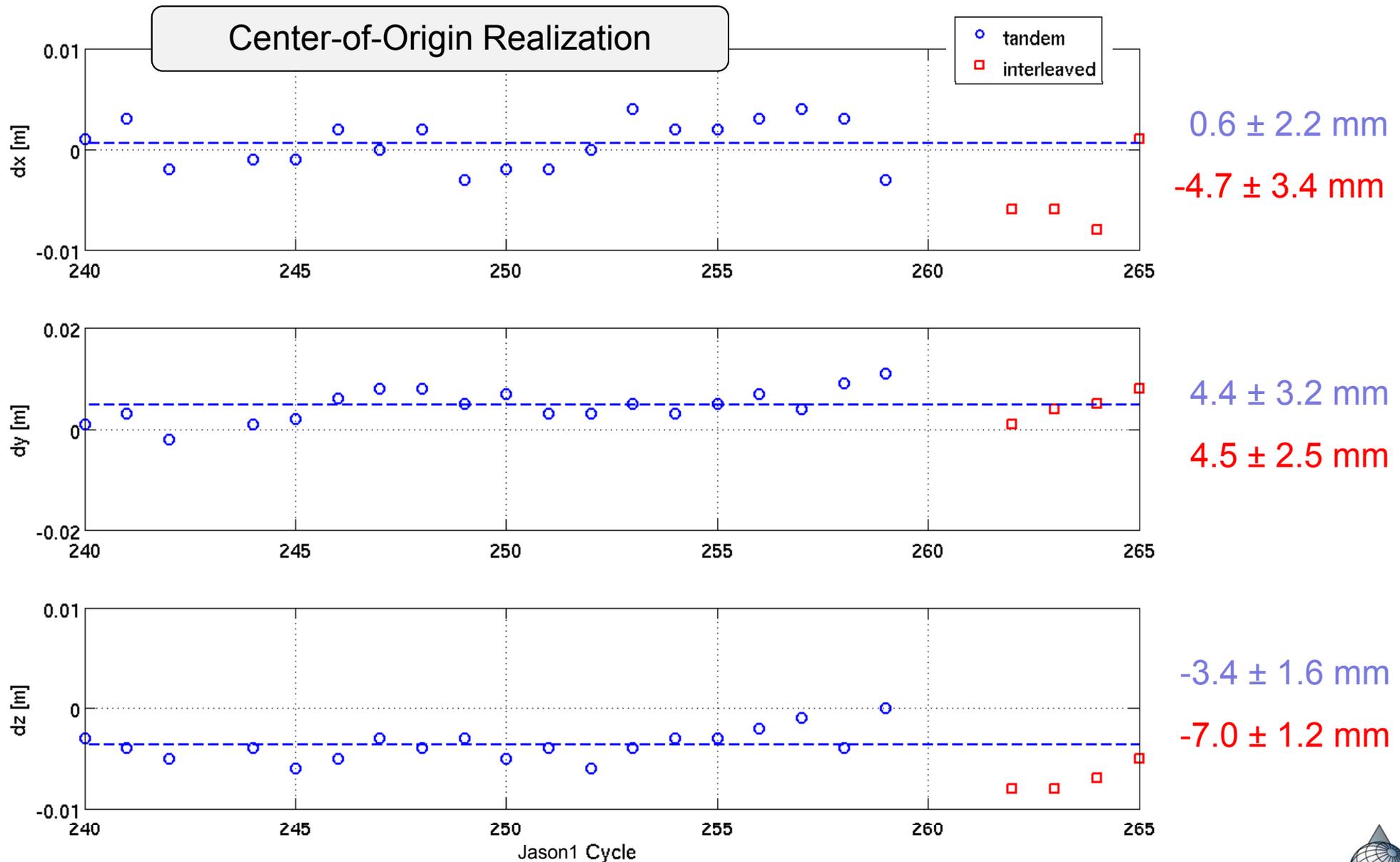
Interleaved Tracks



Jason-1 orbit change



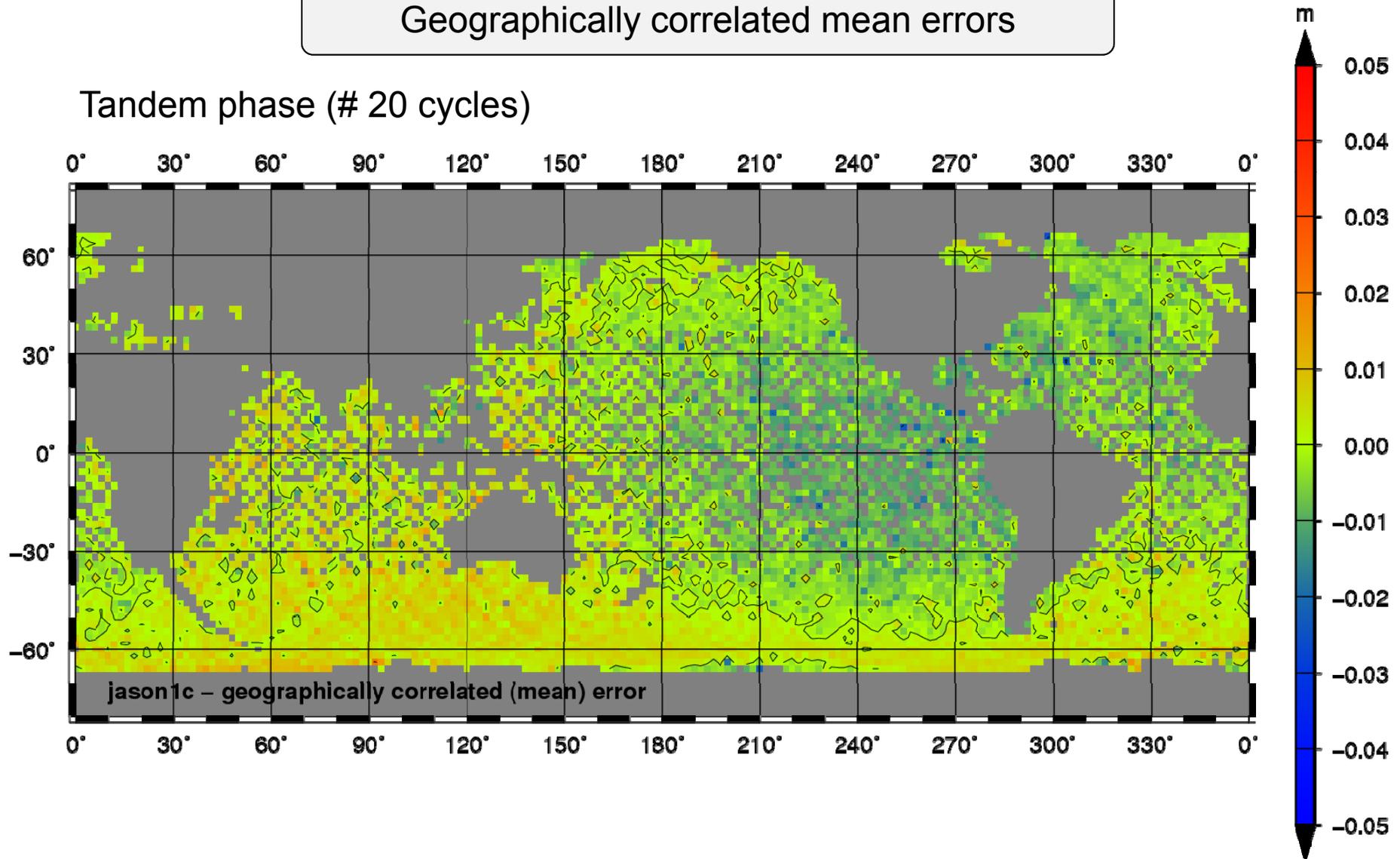
Jason-1 orbit change



Jason-1 orbit change

Geographically correlated mean errors

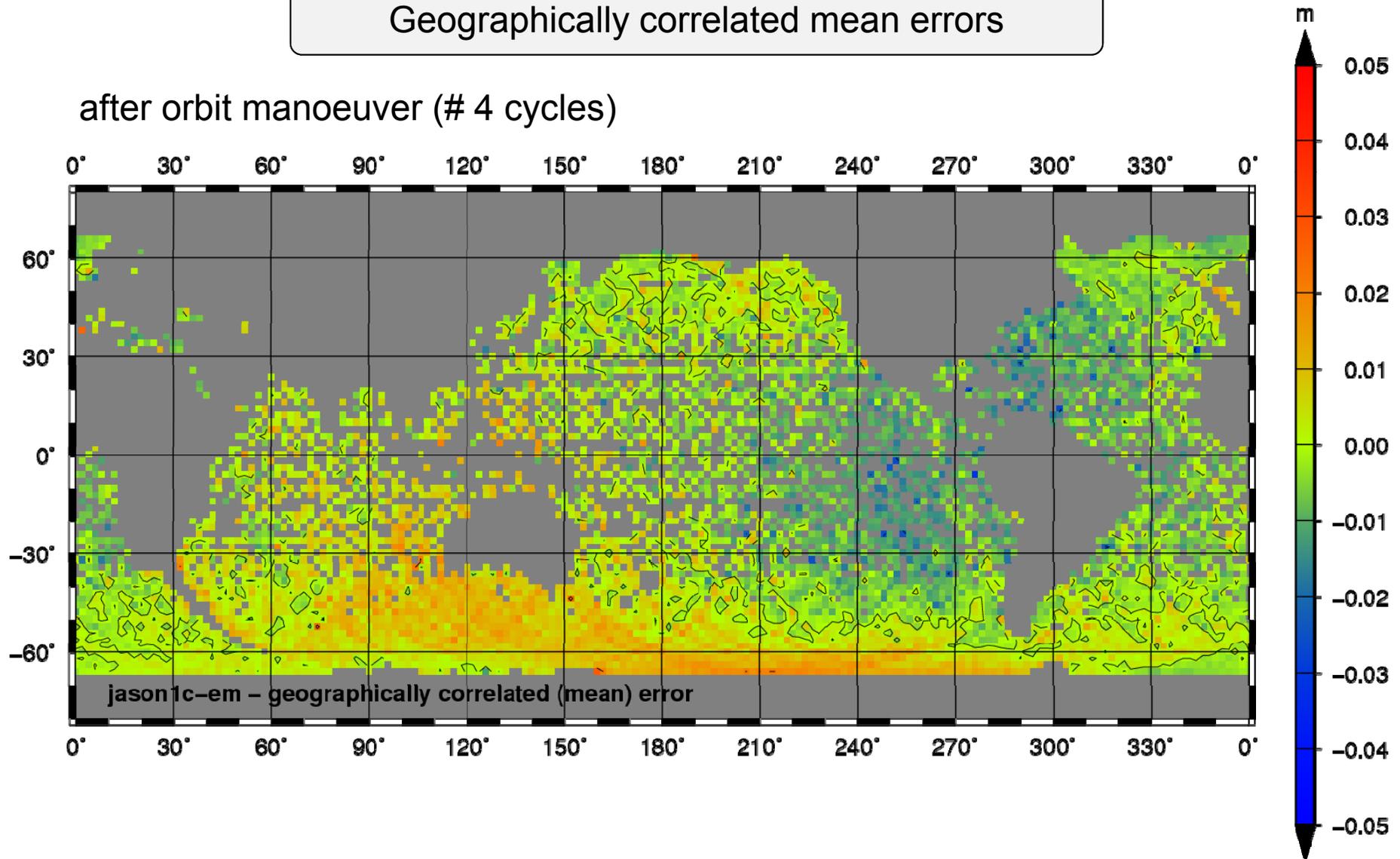
Tandem phase (# 20 cycles)



Jason-1 orbit change

Geographically correlated mean errors

after orbit manoeuver (# 4 cycles)



Jason-2 Calibration

Relative calibration w.r.t. Jason-1

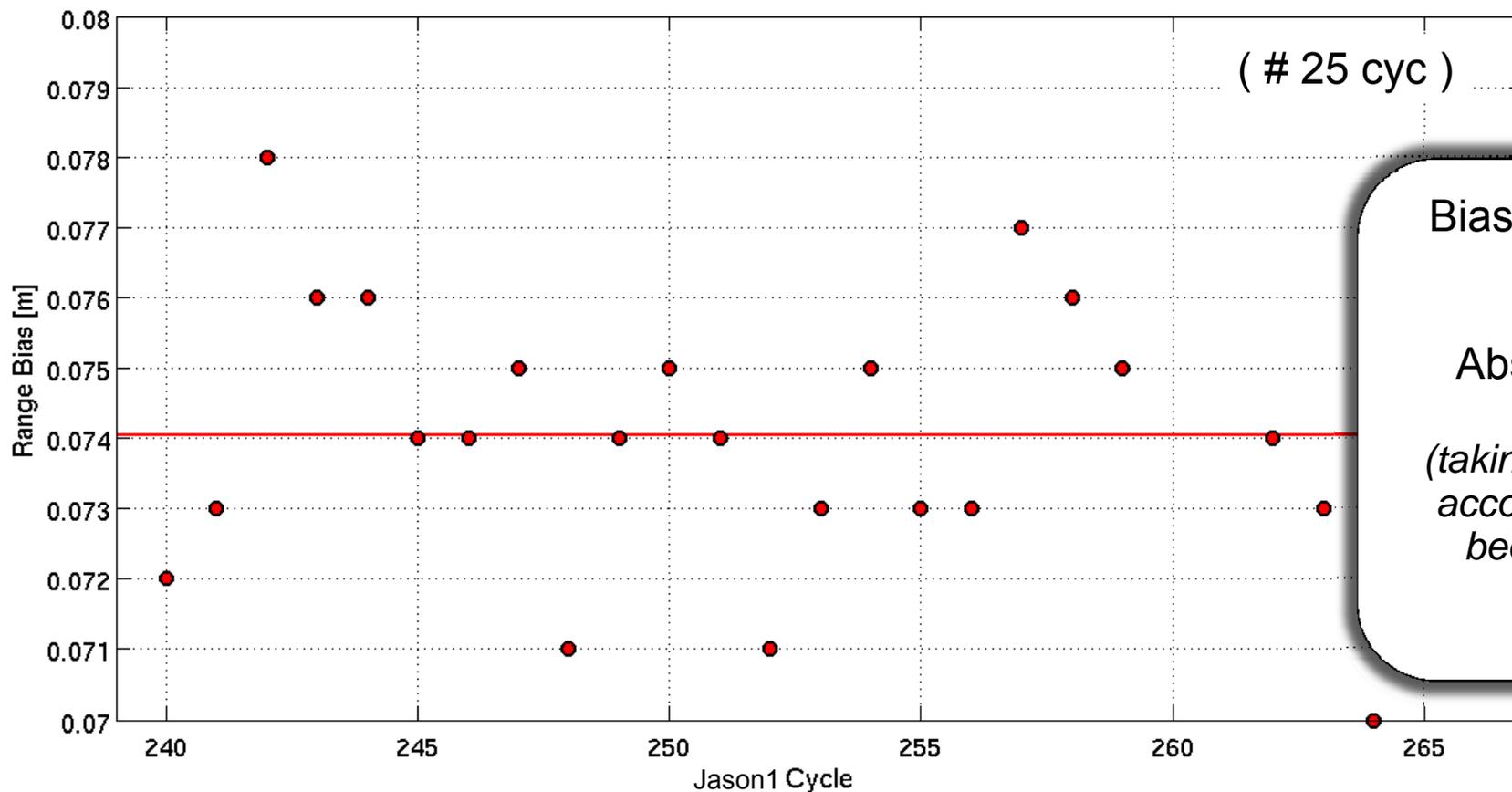
GDR-C data used

Multi-mission crossover analysis: Jason-1, Jason-2, Envisat

Time interval: 25 Cycles

Jason-2 Calibration

Range Bias per Cycle (w.r.t. Jason-1)

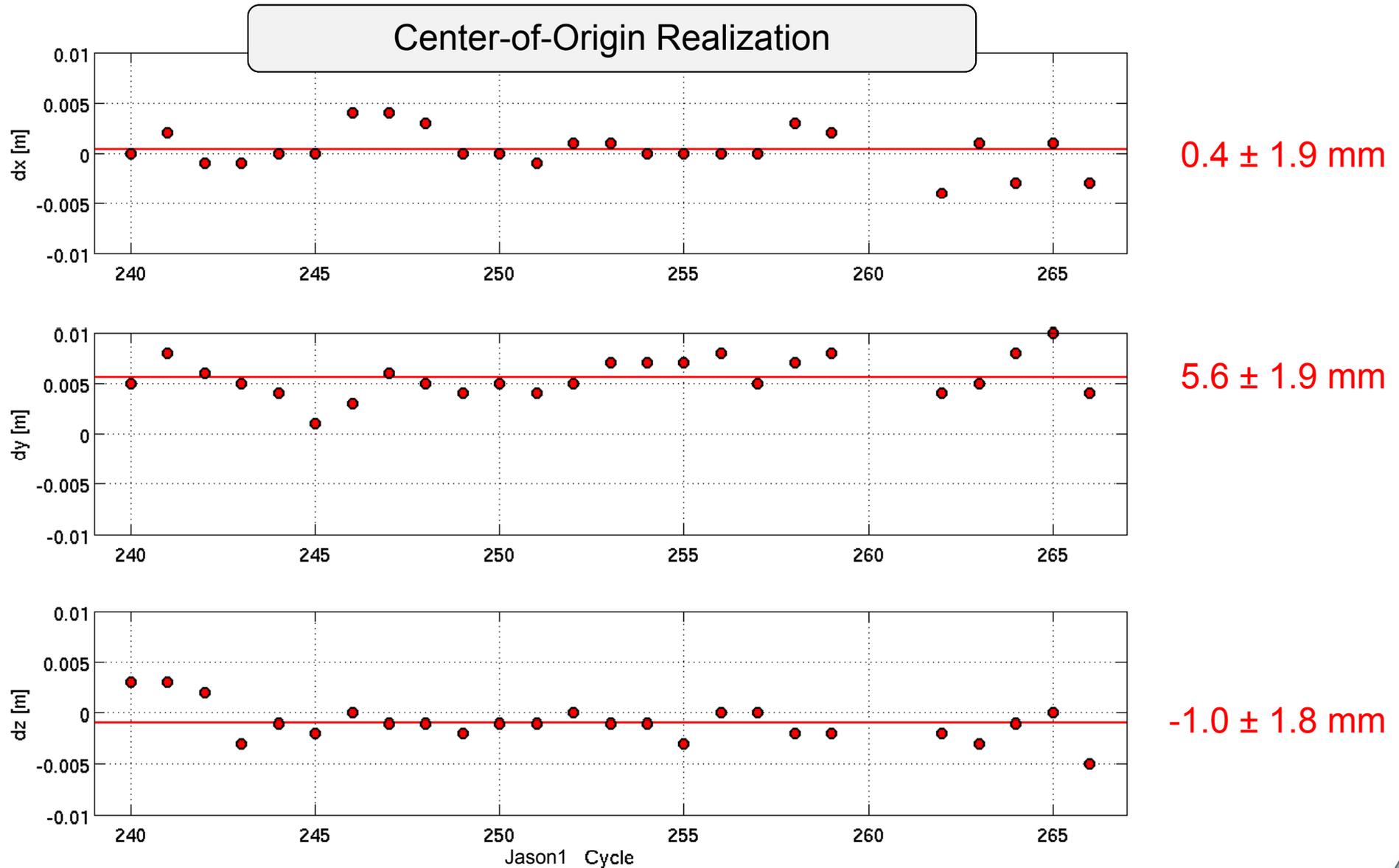


Bias w.r.t TOPEX
159 mm

Absolute Bias:
144 mm
(taking T/P Bias into
account which has
been applied in
MGDRs)

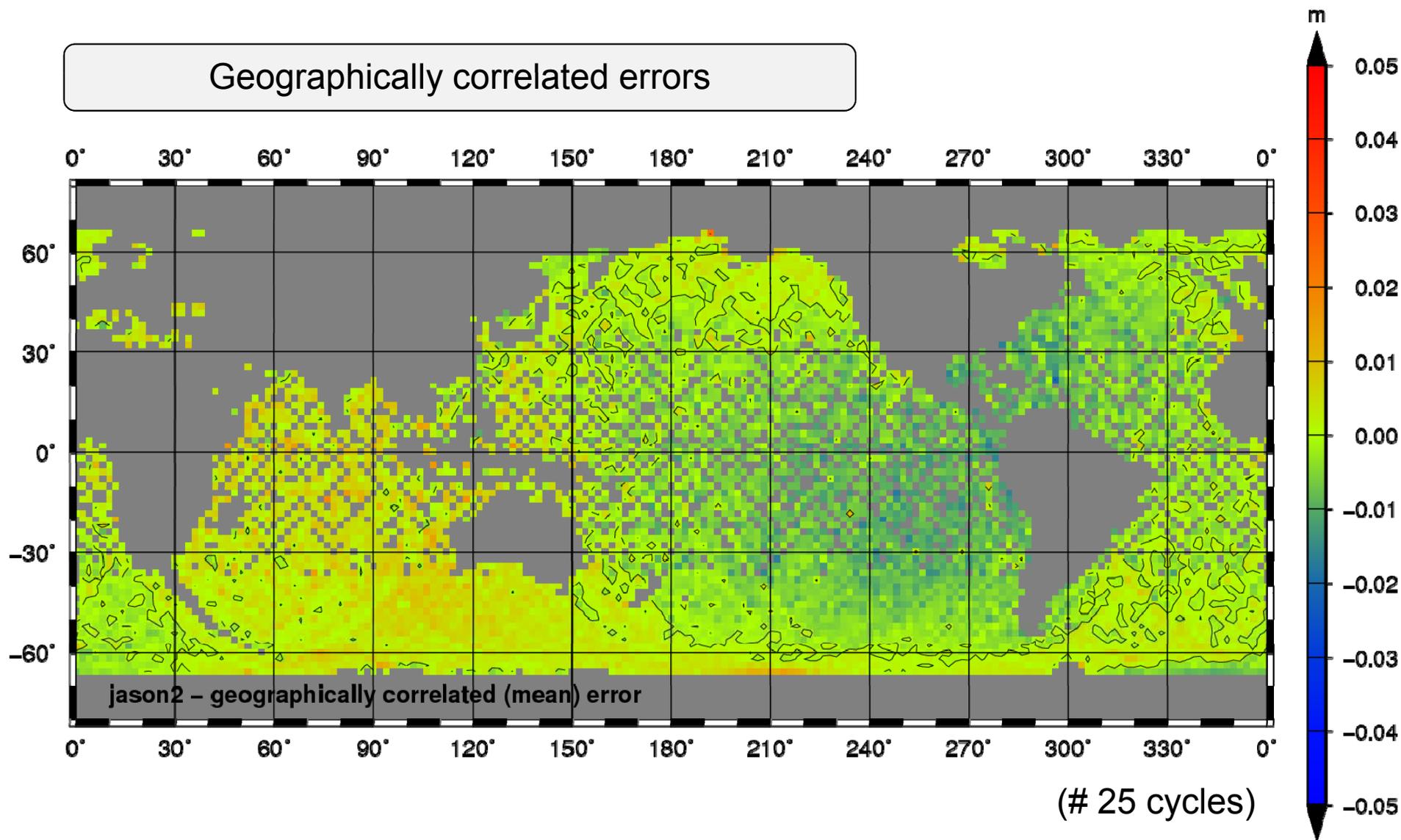
no significant trend

Jason-2 Calibration



Jason-2 Calibration

Geographically correlated errors



Summery

Comparison of Jason-1 GDR-B and GDR-C

- ⇒ more valid crossovers with GDR-C
- ⇒ slightly better consistency of crossovers
- ⇒ mean bias between GDR-B and GDR-C of 3.9 cm
- ⇒ significant differences in dz realization (≈ 5 mm)
- ⇒ same magnitude for geographically correlated errors (up to 2 cm)

Comparison of Jason-1 GDR-C before and after orbit change

- ⇒ Last 4 cycles show a slightly different behavior than before orbit change
- ⇒ Maybe just uncertainties because of the interruption?
- ⇒ More data needed for significant result!

Relative calibration of Jason-2

- ⇒ Relative Range Bias of 7.4 cm w.r.t. Jason-1
- ⇒ No significant differences in center-of-origin realization for x and z
- ⇒ Small, but significant dy of 5 mm
- ⇒ Geographically correlated errors up to 2 cm