

Multi-mission cross-calibration

Latest results

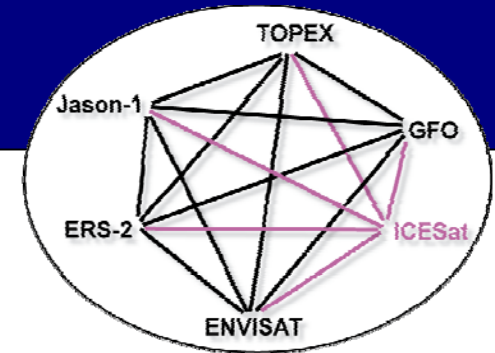
with new missions and products



Denise Dettmering & Wolfgang Bosch

Deutsches Geodätisches Forschungsinstitut (DGFI)
Centrum für Geodätische Erdsystemforschung (CGE)
Munich, Germany
email: dettmering@dgfi.badw.de

Multi-Mission Cross-Calibration (MMXO)



Basics

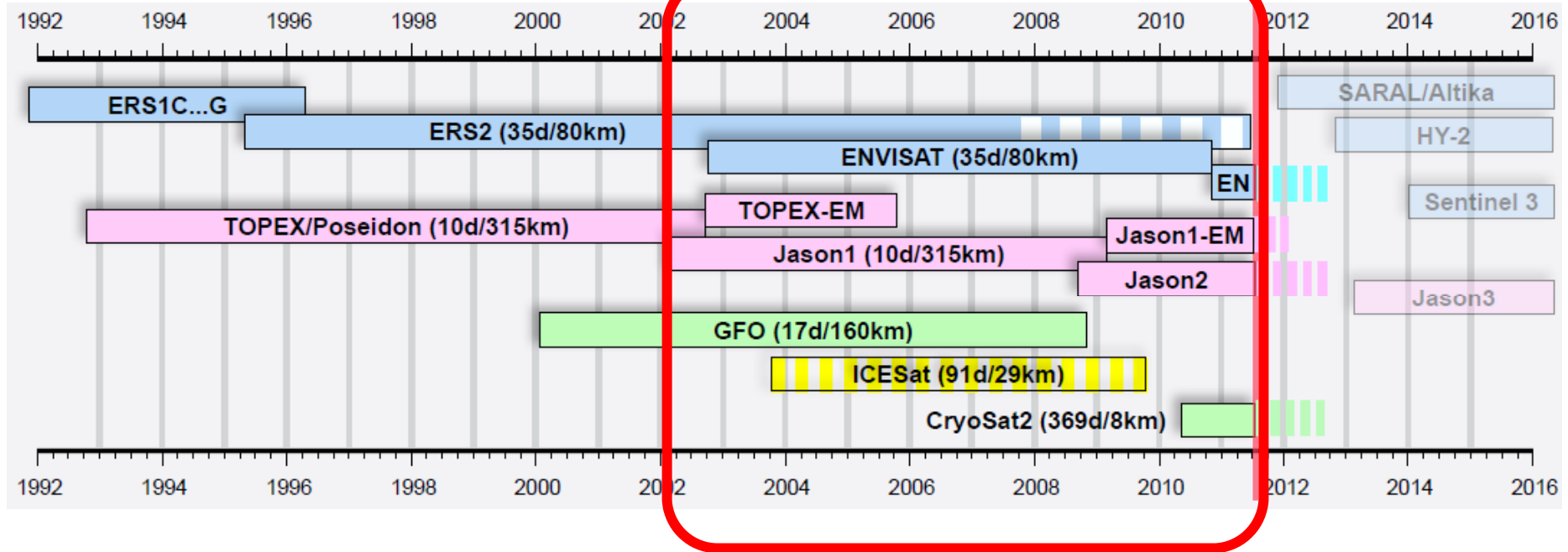
- single- and dual satellite crossover differences in all combinations
- using only crossovers close in time ($\Delta t < 2$ days)
- least squares adjustment of radial errors minimizing crossover and the along-track consecutive differences
- Weighting of missions done by variance component estimation (VCE)
- TOPEX (later Jason1) taken as reference mission
- Segmentation into 10-day cycles of reference mission plus 2 days overlap (errors in the overlap differ by mm only)
- up to 120000(240000) crossovers (unknowns) per segment
- iterative solution with conjugate gradient algorithm

Results

- time series of radial errors per mission (w.r.t. to reference mission)
- range bias (per 10 days period)
- geographically correlated error pattern
- differences in the realization of the origin of reference frame (first order harmonics)
- differences in the realization of the rotation axis (second order harmonics)

mainly due to orbit errors => POD session

Missions



~ 2002-2011

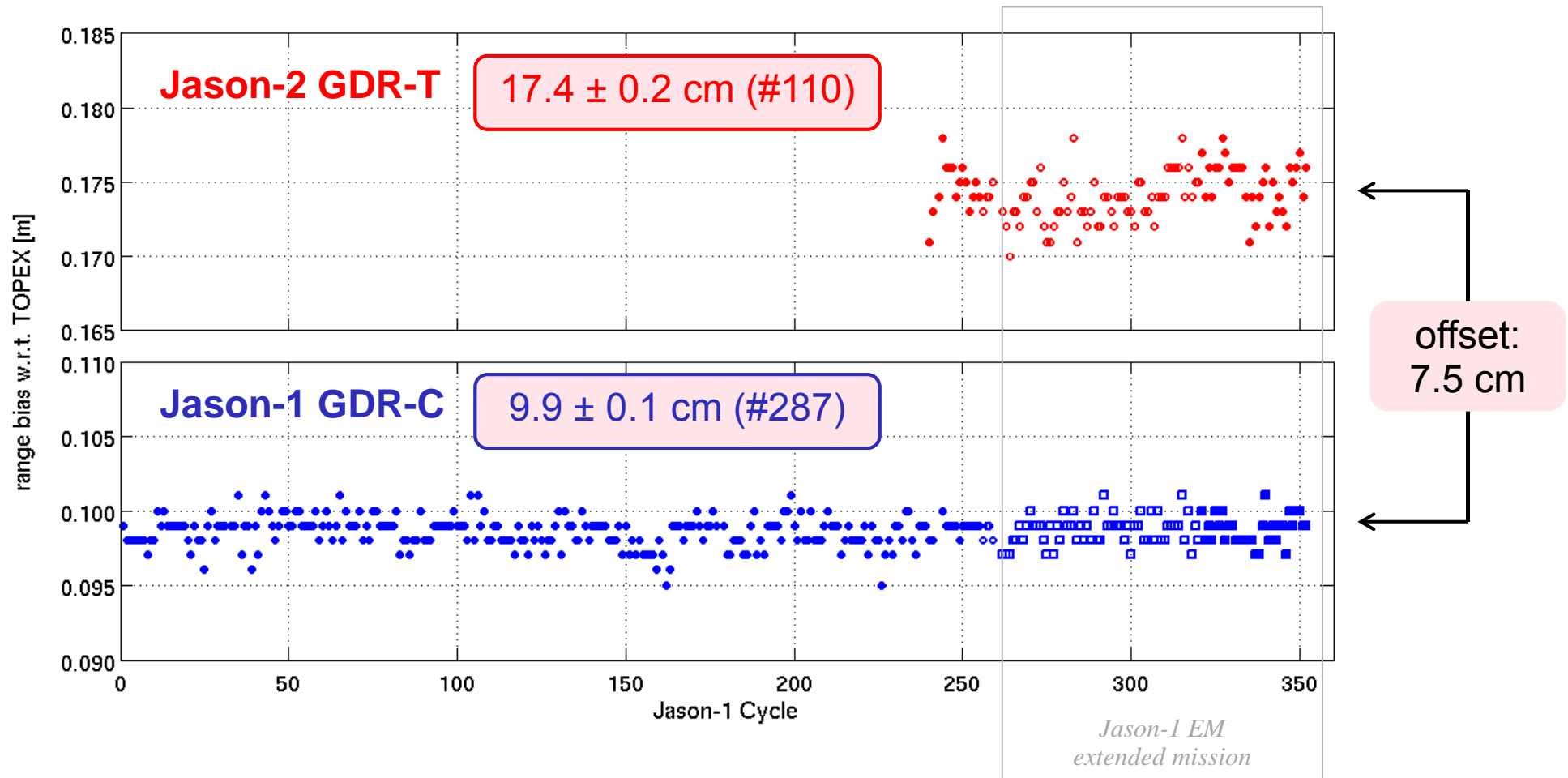
Reference mission: Jason-1

Results for: Jason-1, Jason-2, Envisat, Cryosat

Jason-1/2

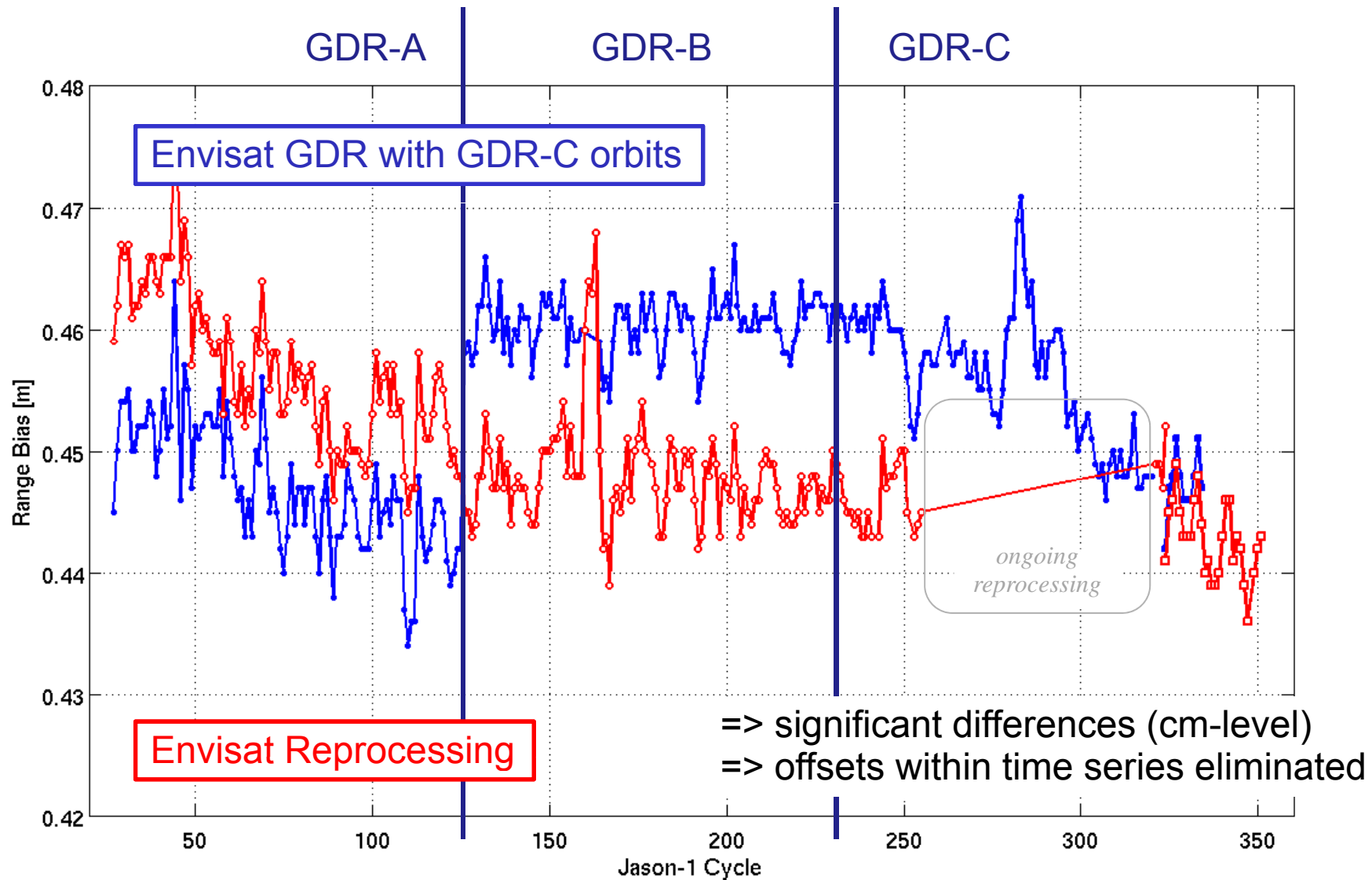
Jason-1/2

Global mean range bias per cycle (10 days) with respect to TOPEX



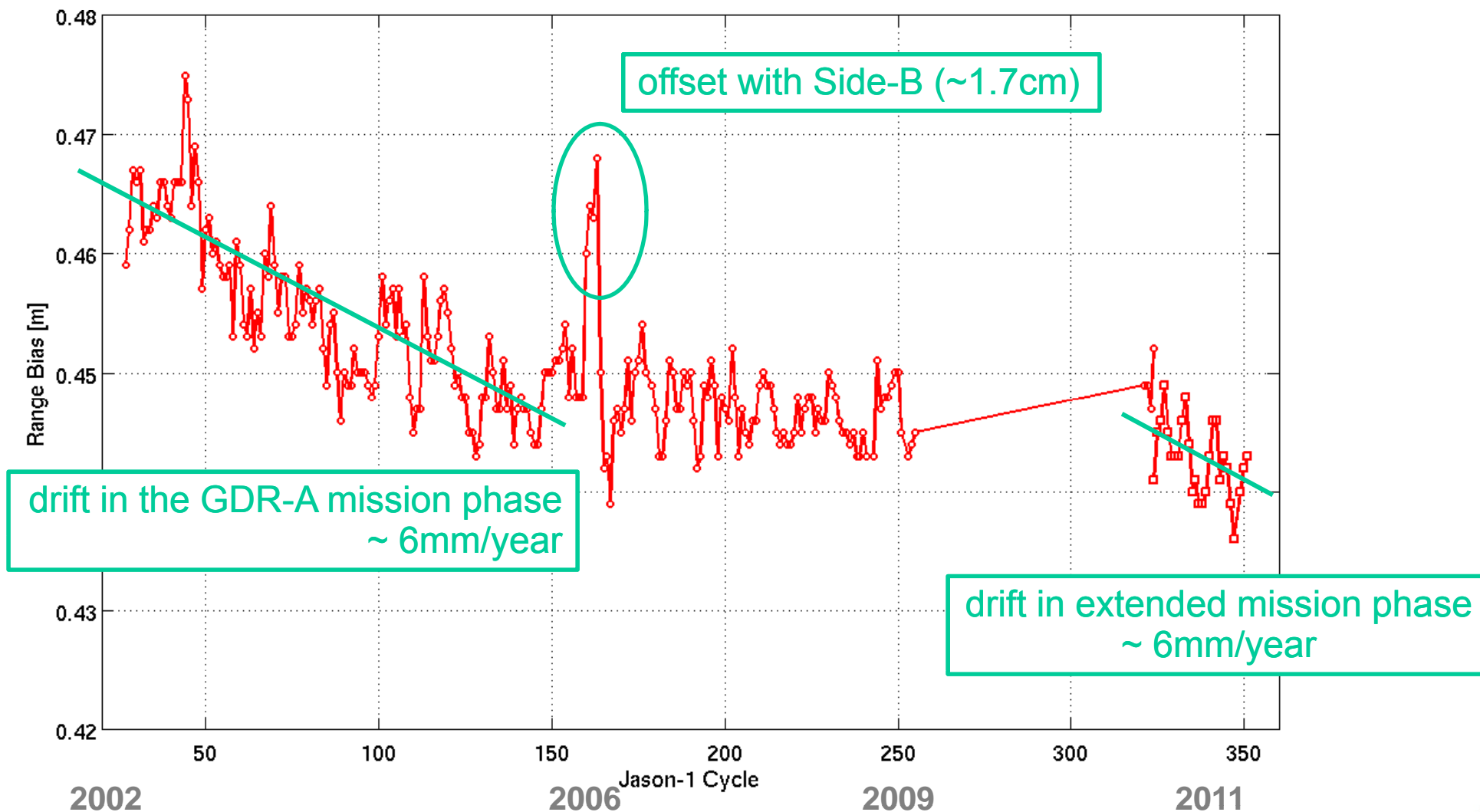
Envisat

Envisat Reprocessing – range bias



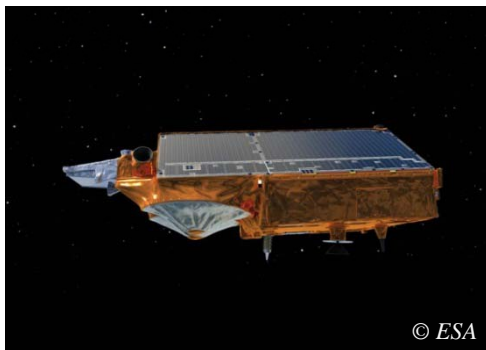
Envisat Reprocessing – range bias

Envisat range bias w.r.t. TOPEX: 45.0 ± 0.7 cm (#263)

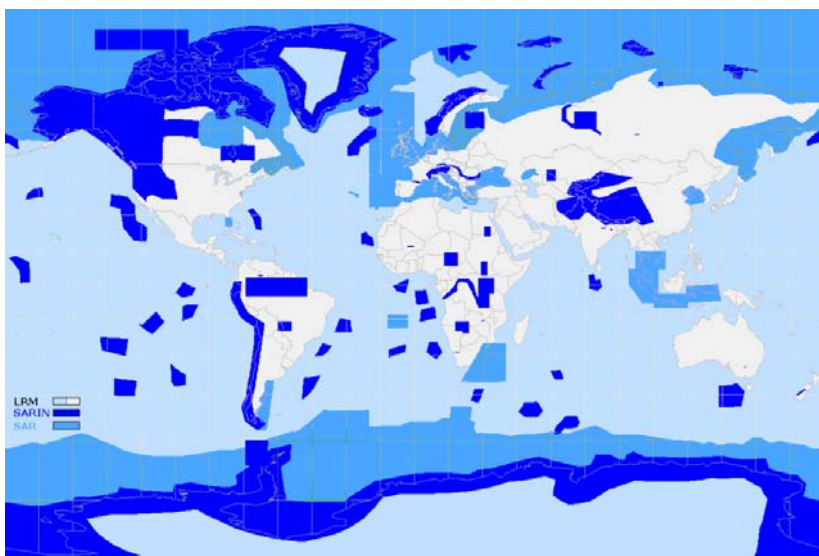
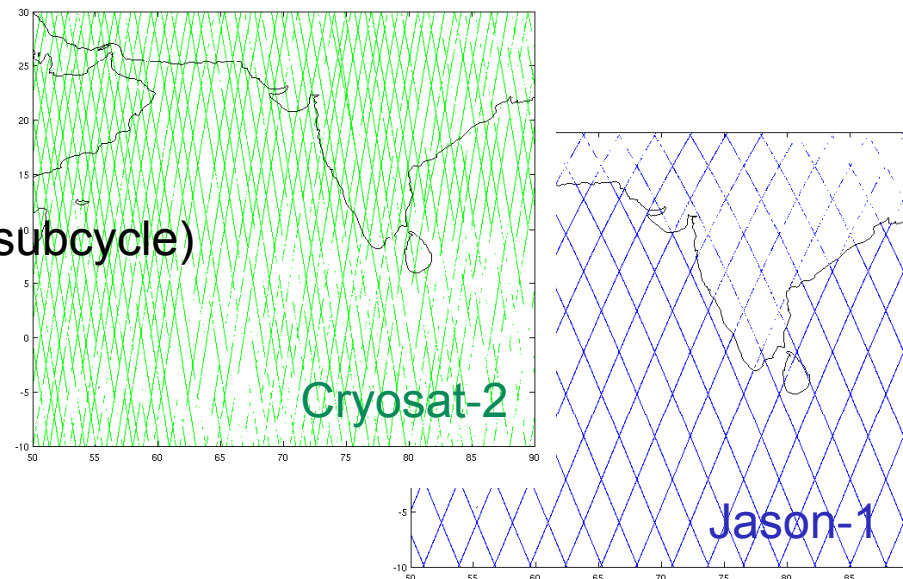


Cryosat-2

Cryosat-2



Launch: 04/2010
Height = 717 km
incl = 92°
369day repeat (30day subcycle)
~8km spacing



Geographical mask:

Synthetic Aperture Radar (**SAR**), medium-blue
SAR Interferometric (**SARIn**), dark-blue
Low Resolution Mode (**LRM**), light-blue

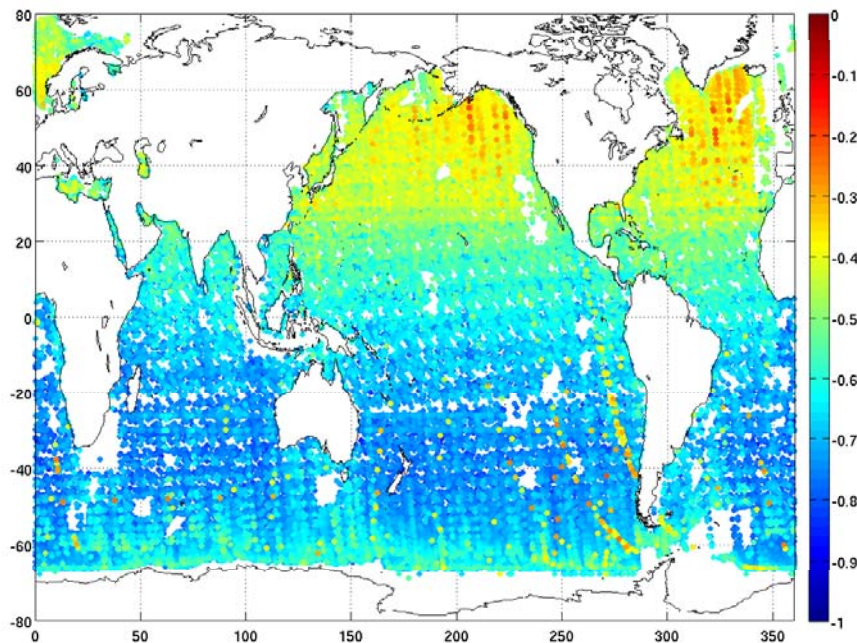
Used data set:

LRM from Level 2 GDR (IPF2GDR_2A/2.1)
Feb-July 2011 (6 month)

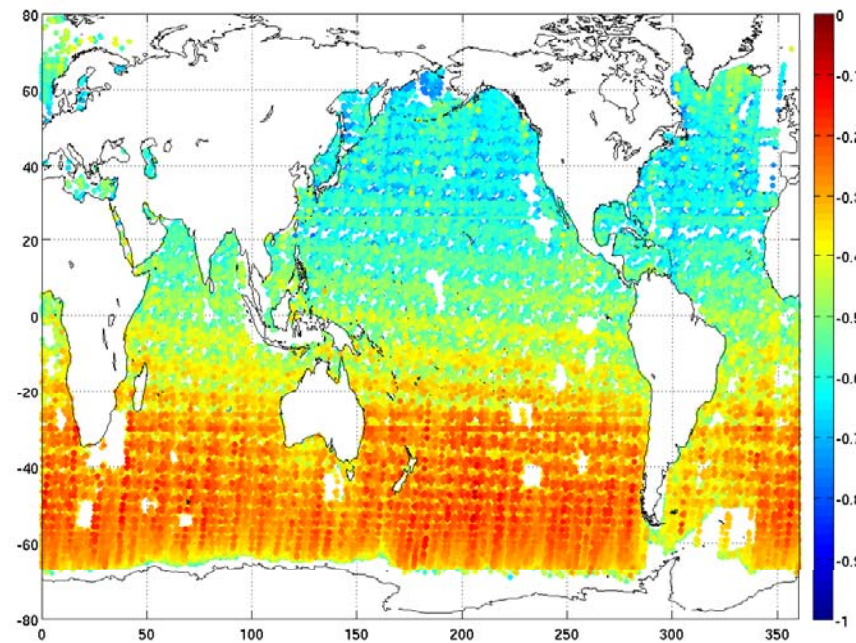
Cryosat-2 Radial Errors

Cryosat LRM radial errors: 0...1 m

ascending passes



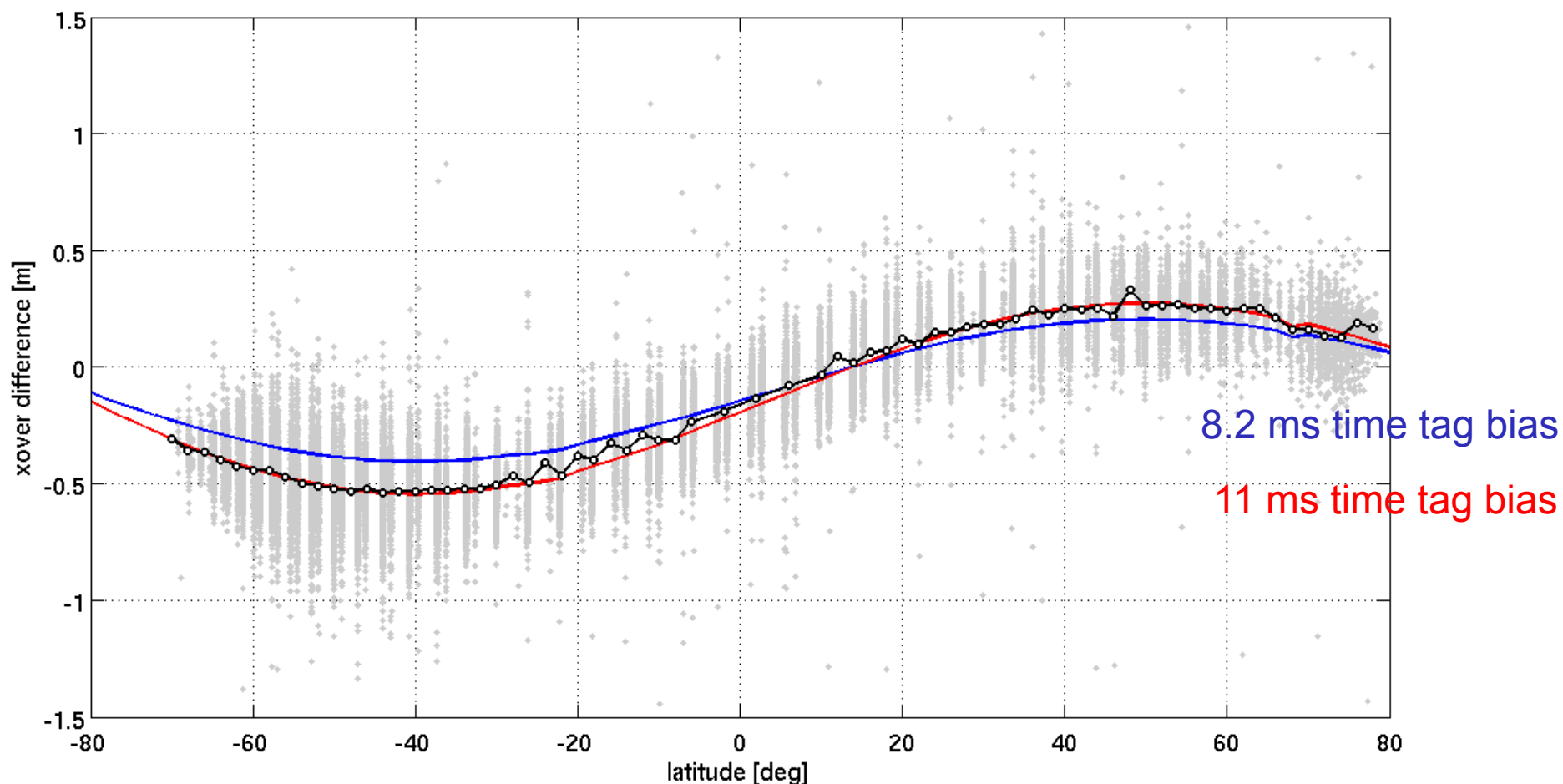
descending passes



=> time tag error visible

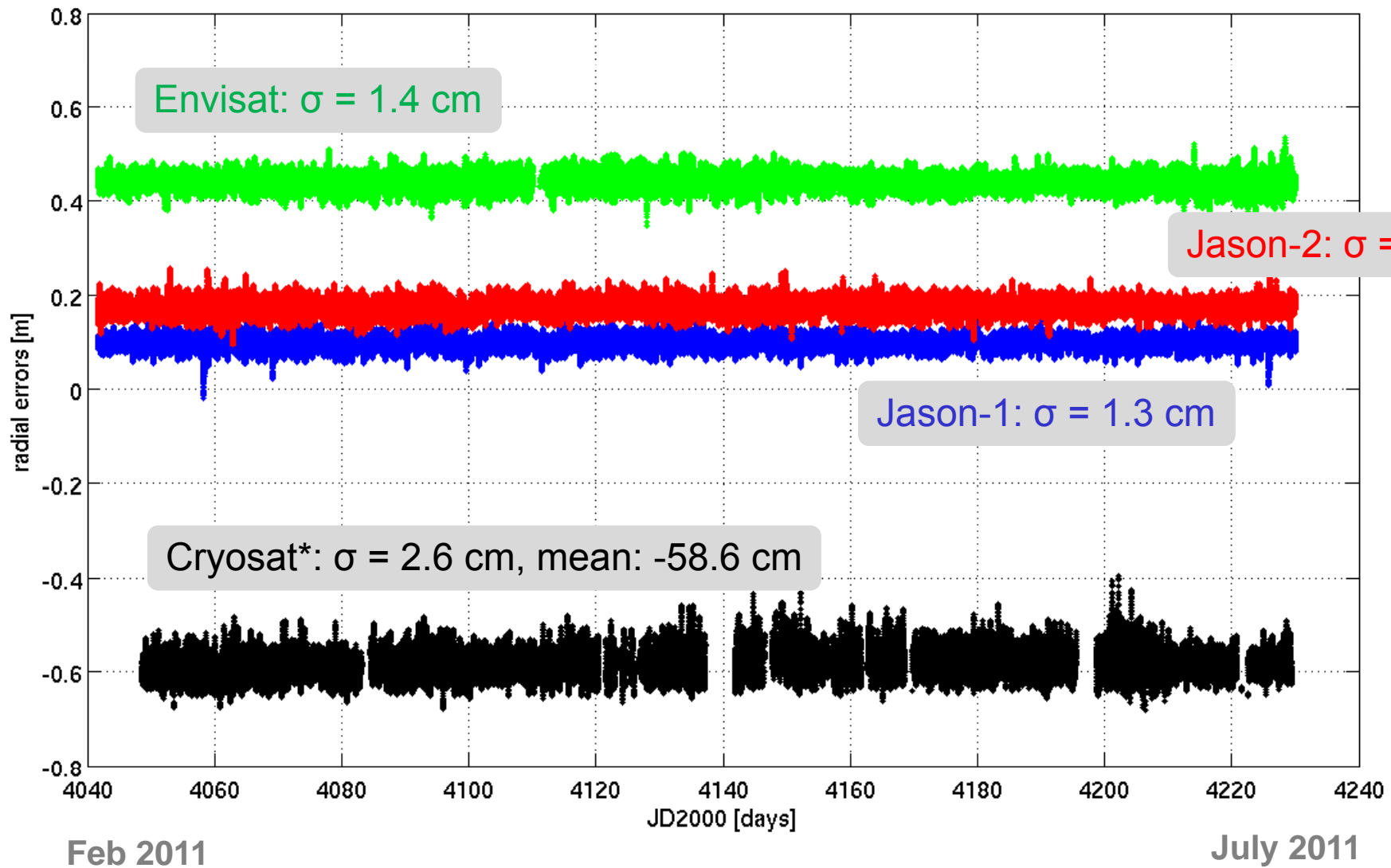
Cryosat-2 Time Tag Bias

Single-satellite crossover-differences Cryosat (grey) and 2° latitude means (black)



time tag bias change from version 2.0 to 2.1 or drift in time tag bias ?
=> future work: adjustment of time tag bias per cycle within the MMXO

Cryosat-2 Radial Error



**Cryosat LRM (11ms time tag bias applied)*

Conclusion

Jason-1/2

- ✓ Jason-1: global mean **range bias** of 9.9 cm with respect to TOPEX
- ✓ Jason-2: global mean **range bias** of 17.4 cm with respect to TOPEX

Conclusion

Envisat

- ✓ Global mean **range bias** of 45 cm with respect to TOPEX
- ✓ **Side-B range bias** differs by about 1.7 cm from Side-A range bias
! attention when using Envisat Cycle 47/48!
- ✓ significant **drift** (-6mm/yr) in the first mission phase (original GDR-A) still visible in reprocessing data set; same drift in extended mission phase
! cm-error possible when using one mean global range bias for Envisat in a combination with other missions
- ✓ Ionosphere measurements: about 8 mm offset to GIM model
- ✓ Wet troposphere measurements: about 6.5 mm offset to ECMWF model (increasing, drift of about 0.3 mm/year)
- ✓ **new orbit** has no influence on Envisat global mean range bias

Conclusion

Cryosat-2

Used data set:

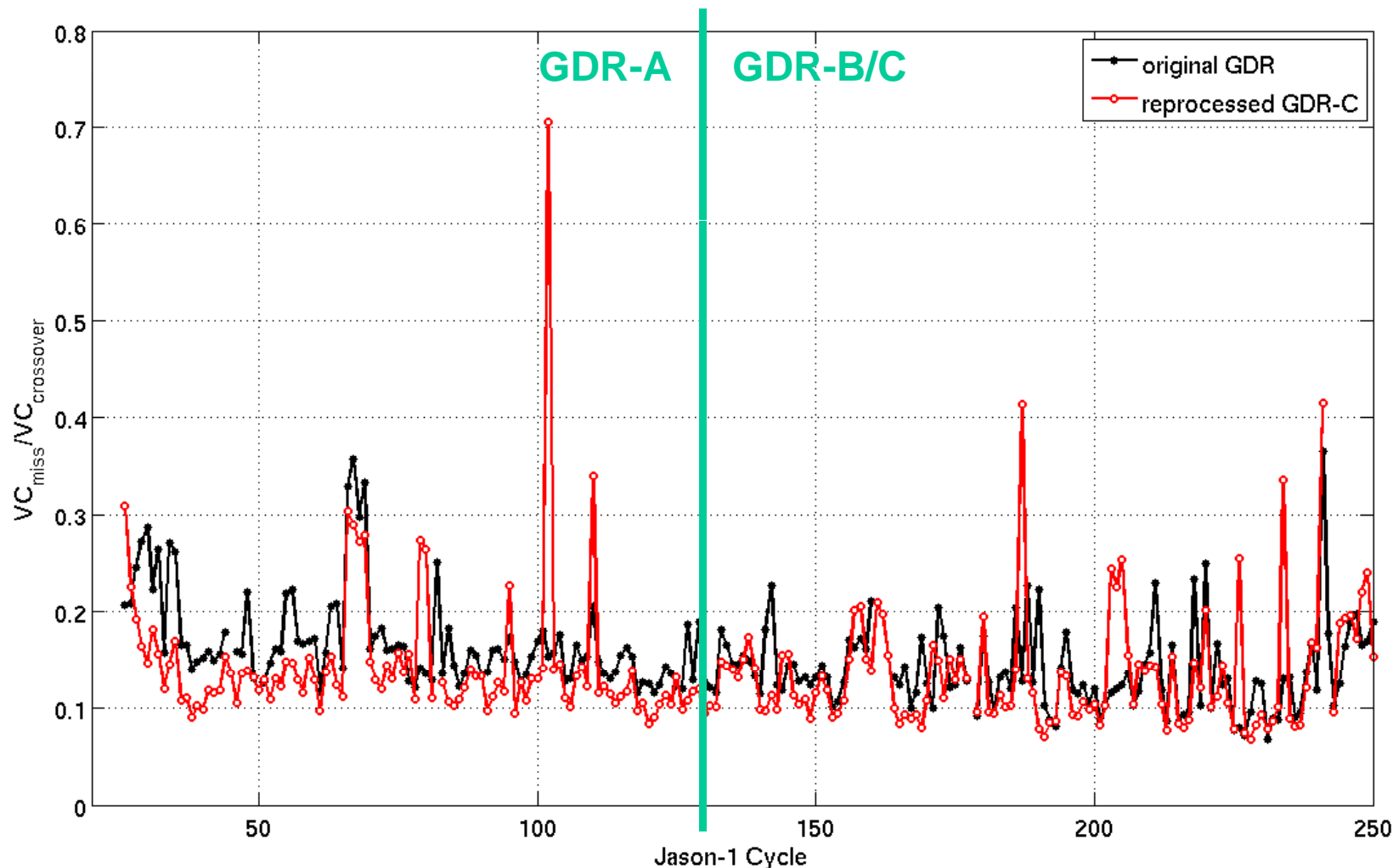
Level 2 GDR (IPF2GDR_2A/2.1)
Feb-July 2011 (6 month)

Results:

- ✓ only LRM usable; SAR and SARin show significant offsets
 - ✓ SSB not usable
 - ✓ range bias of -59 cm (-4 m for V2.0)
 - ✓ time tag bias of about 11 ms (8.2 ms for V2.0)
 - ✓ scatter of radial errors is still worse by a factor of 2 compared to Jason/TOPEX
-
- ✓ geographical distribution / ground track promise significant added value for products such as EOT/DOT

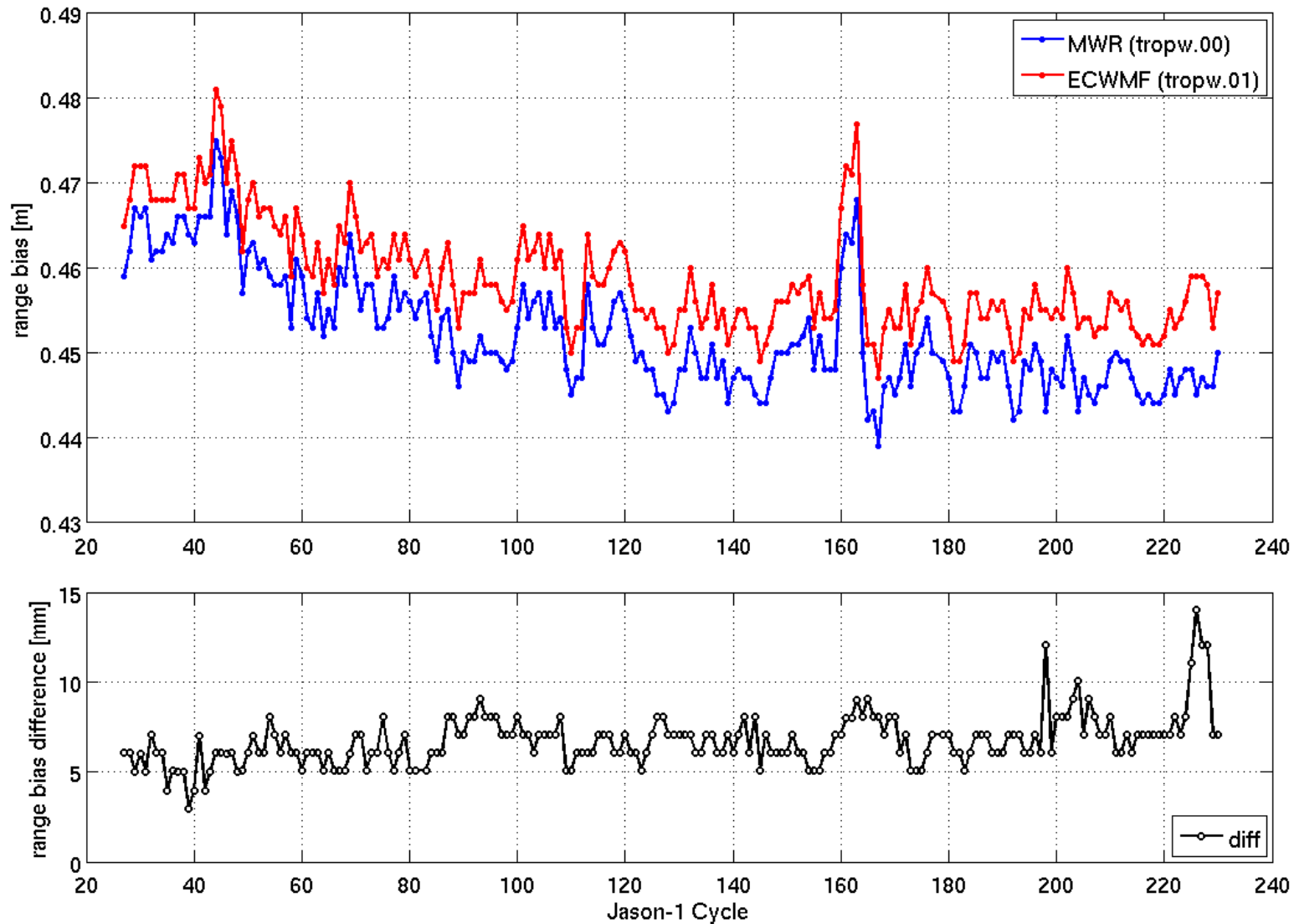
THANK YOU !

Envisat Reprocessing – variance components



- ⇒ significant improvement due to reprocessing, mainly in GDR-A period
- ⇒ some cycles with increased variance components after reprocessing (reason unknown)

Envisat Reprocessing – wet tropospheric correction

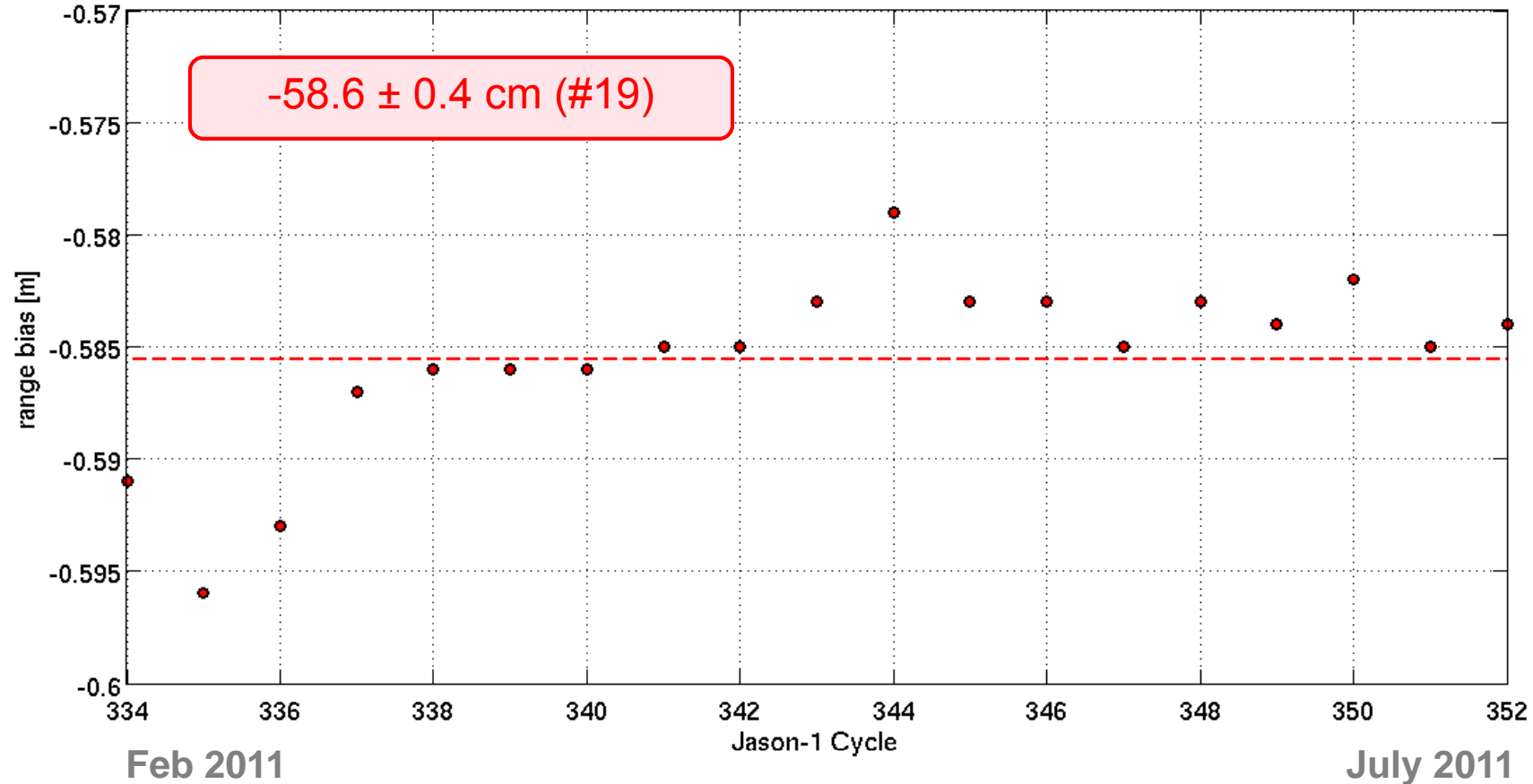


offset
 6.5 ± 1.2 mm

trend
 ≈ 0.3 mm/year

Cryosat-2 Range Bias

Cryosat LRM range bias (11ms time tag bias applied)



V2.0: ~ -4m range bias; 8.2ms time tag bias