

Latest results of DGFI's multi-mission crossover analysis

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Multi-mission crossover analysis

Goals:

- check the consistency between different altimeter missions
- extract information on the noise level of different instruments
- detect systematic errors in the data sets

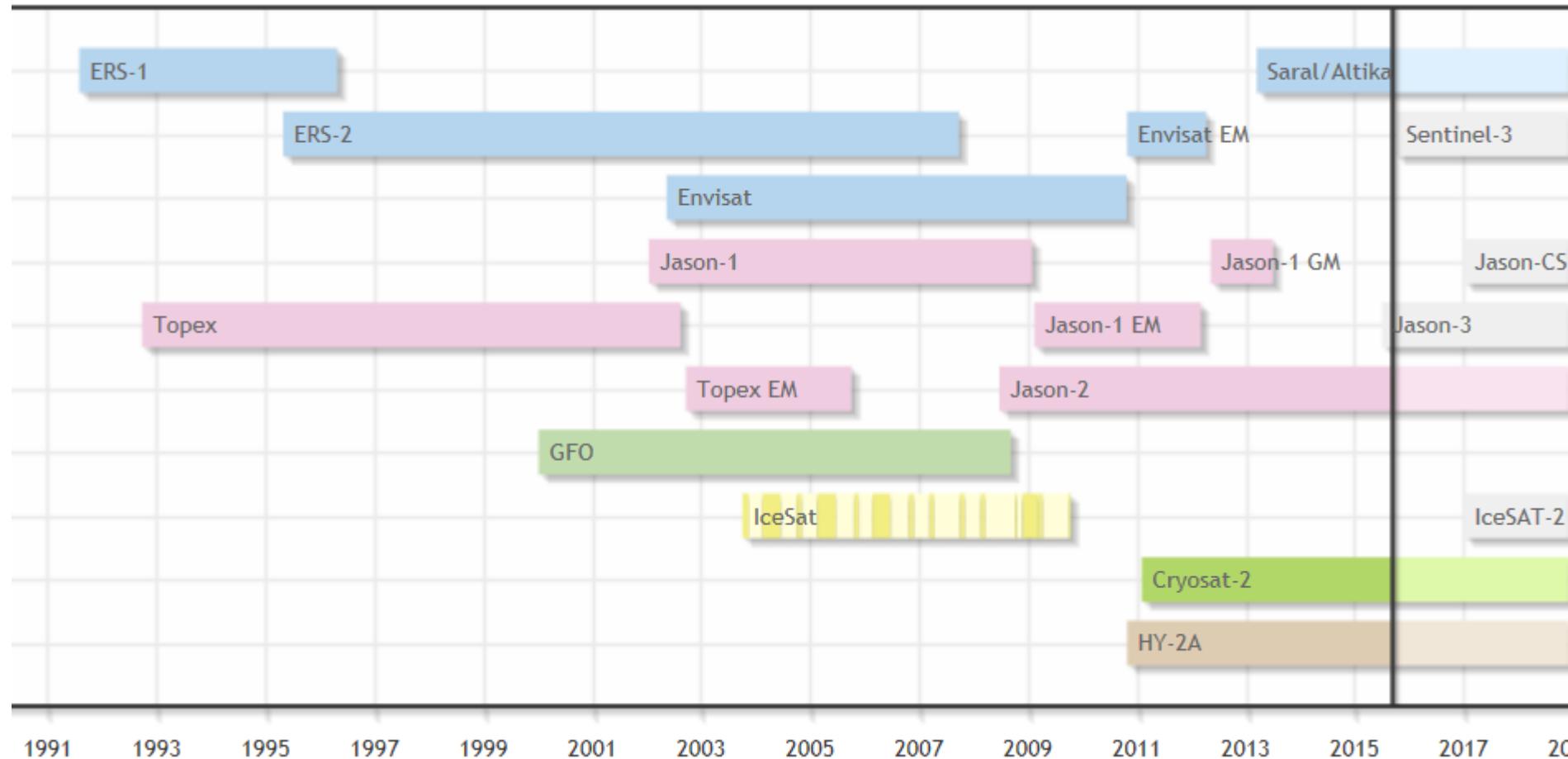
Method:

- building single- and dual satellite crossover differences in all combinations ($\Delta t < 2$ days)
- minimizing crossover diff. and the along-track consecutive diff. in an least squares adjustment
- TOPEX (later Jason1 and Jason-2) taken as reference mission

Output:

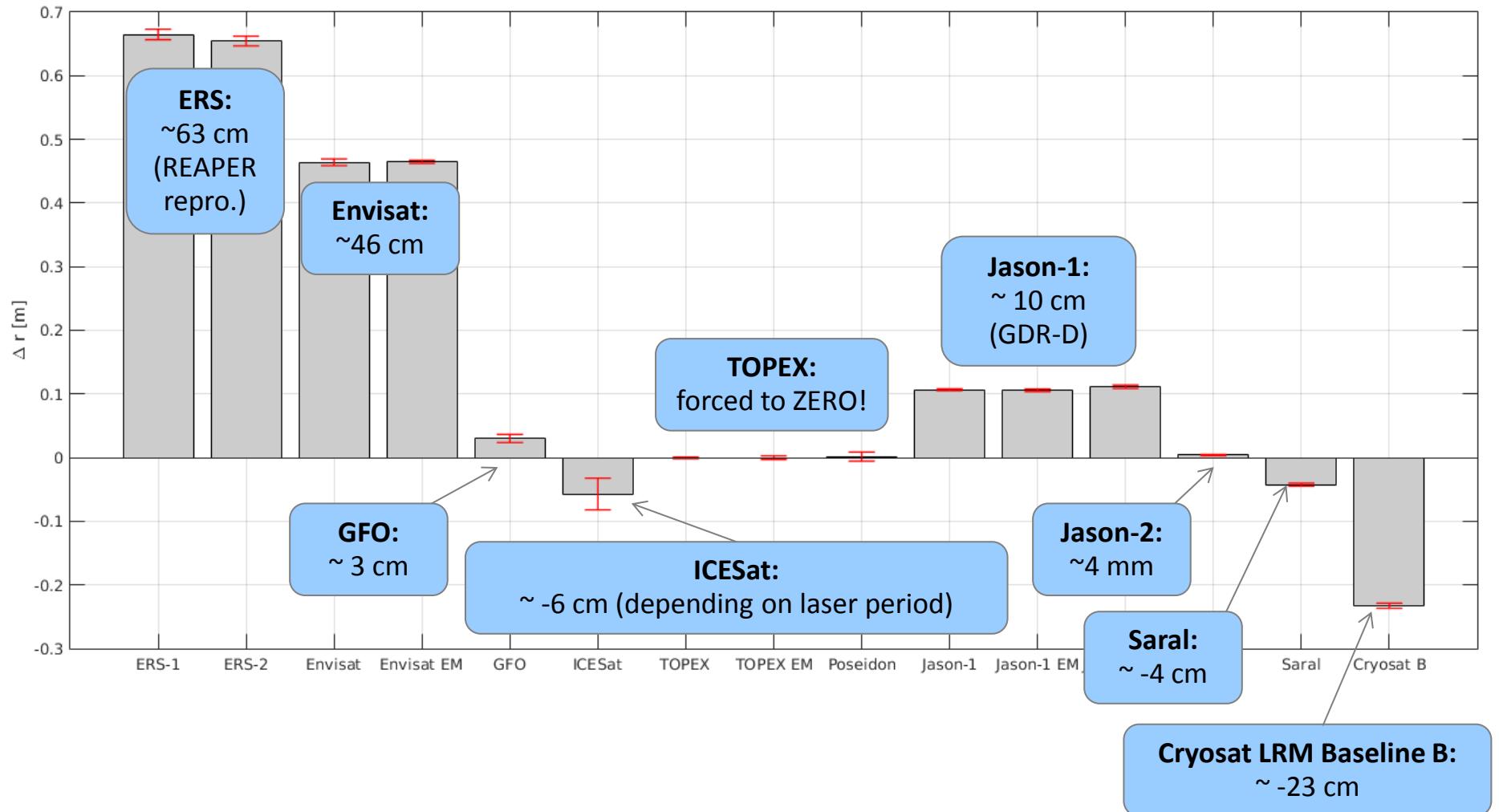
- Time series of radial errors
- Relative range biases (global mean and per cycle)
- Relative instrument drifts
- Geographically correlated SSH errors

Altimeter Missions



- ✓ consistent reference systems
- ✓ harmonized data sets
- ✓ most recent satellite orbits and correction models

Radial errors of all missions

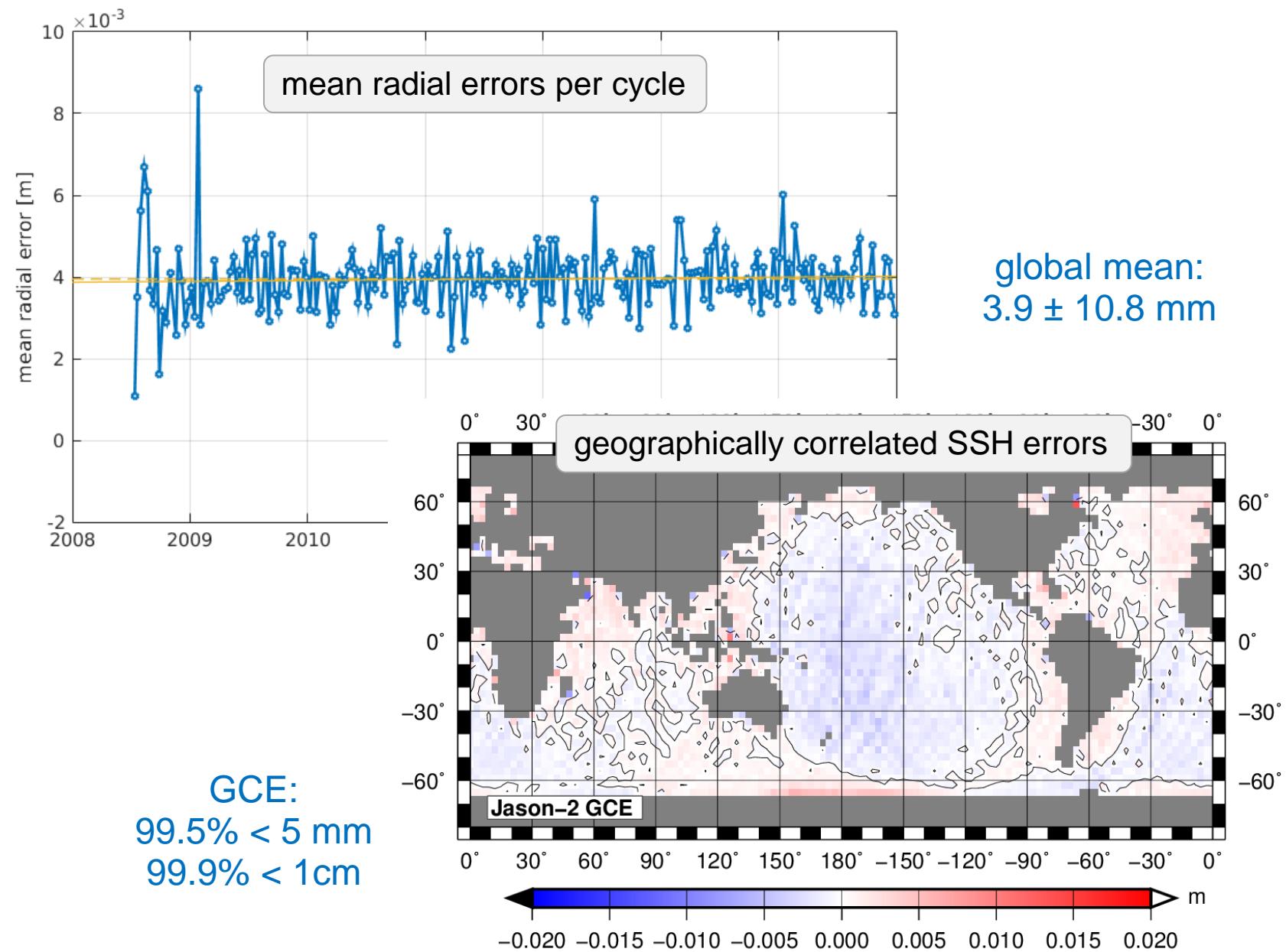


for some missions (or mission phases) systematic behavior detectable

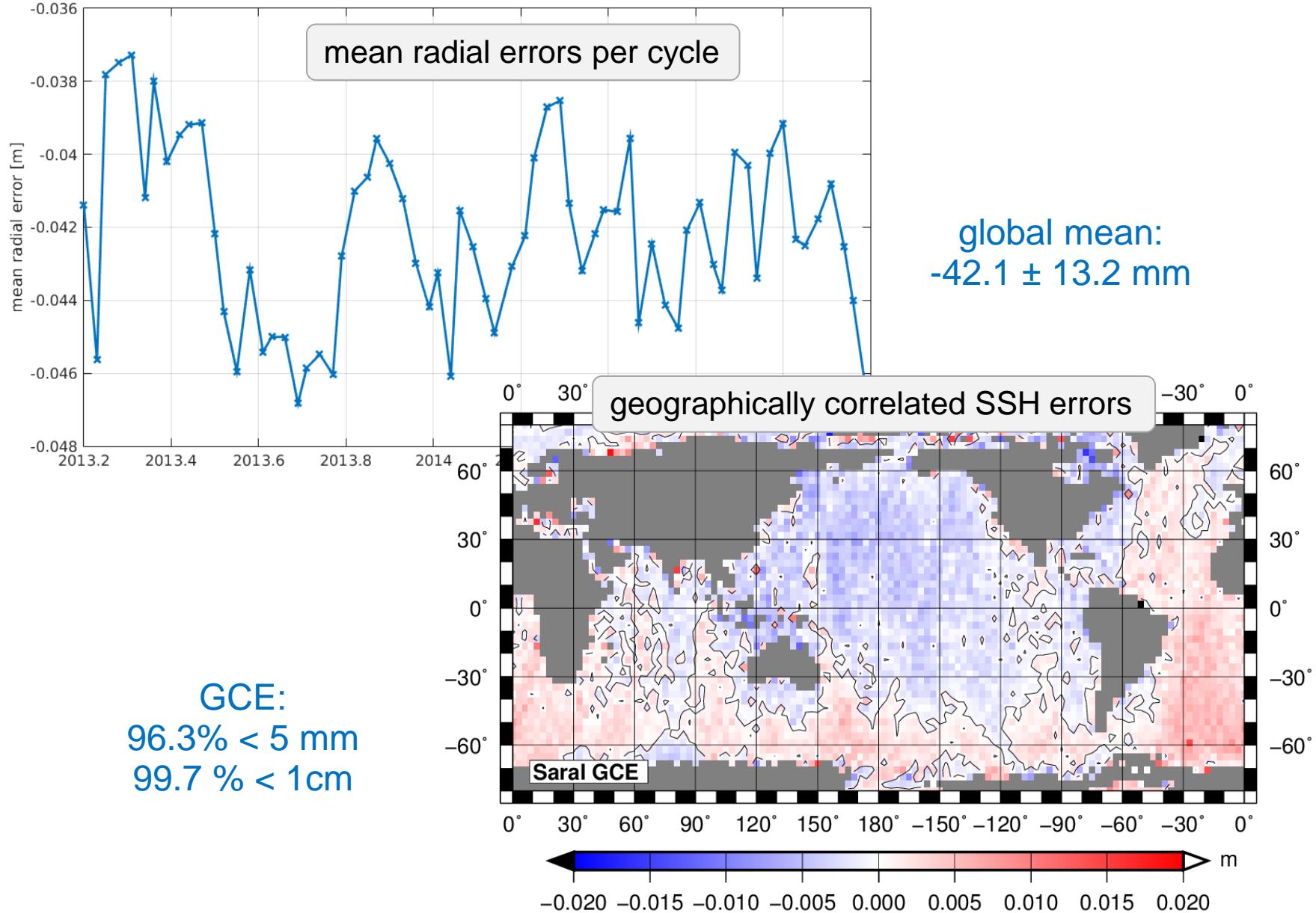
Selected Results

- Extended time series for J2 and SARAL
- TOPEX long-term drifts?
- Jason-1 GDR-E
- ERS Reaper products
- HY-2A

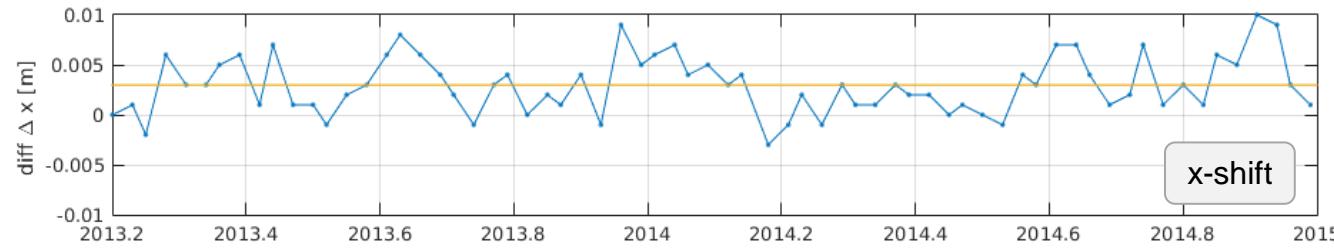
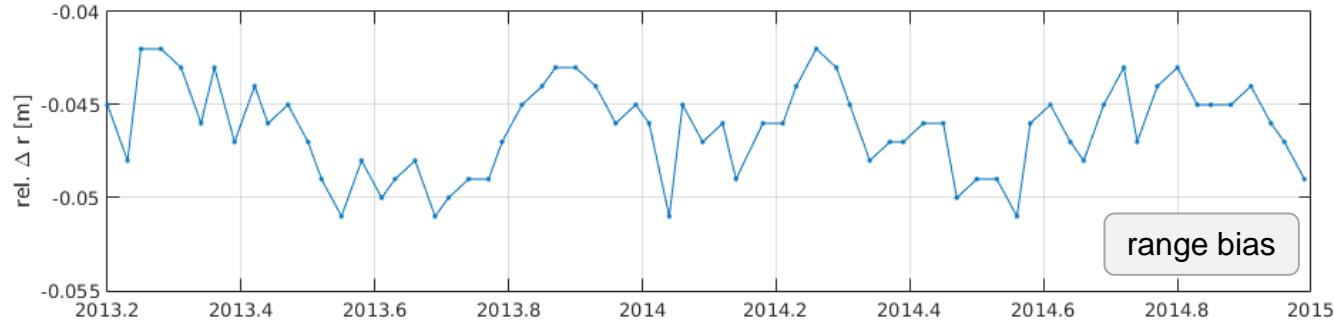
Jason-2



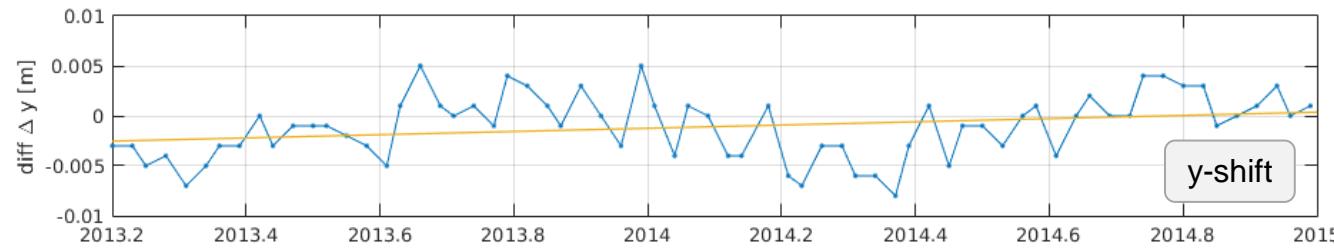
Saral



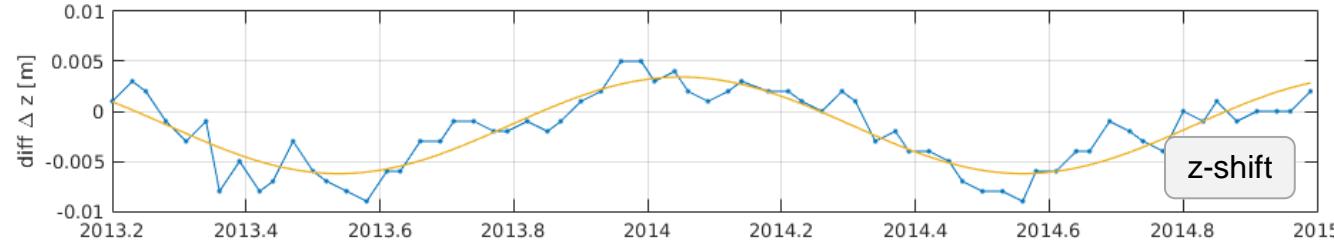
Relative Differences between Saral and Jason-2



offset ?
 3.0 ± 2.9 mm



drift ?
1.6 mm/yr



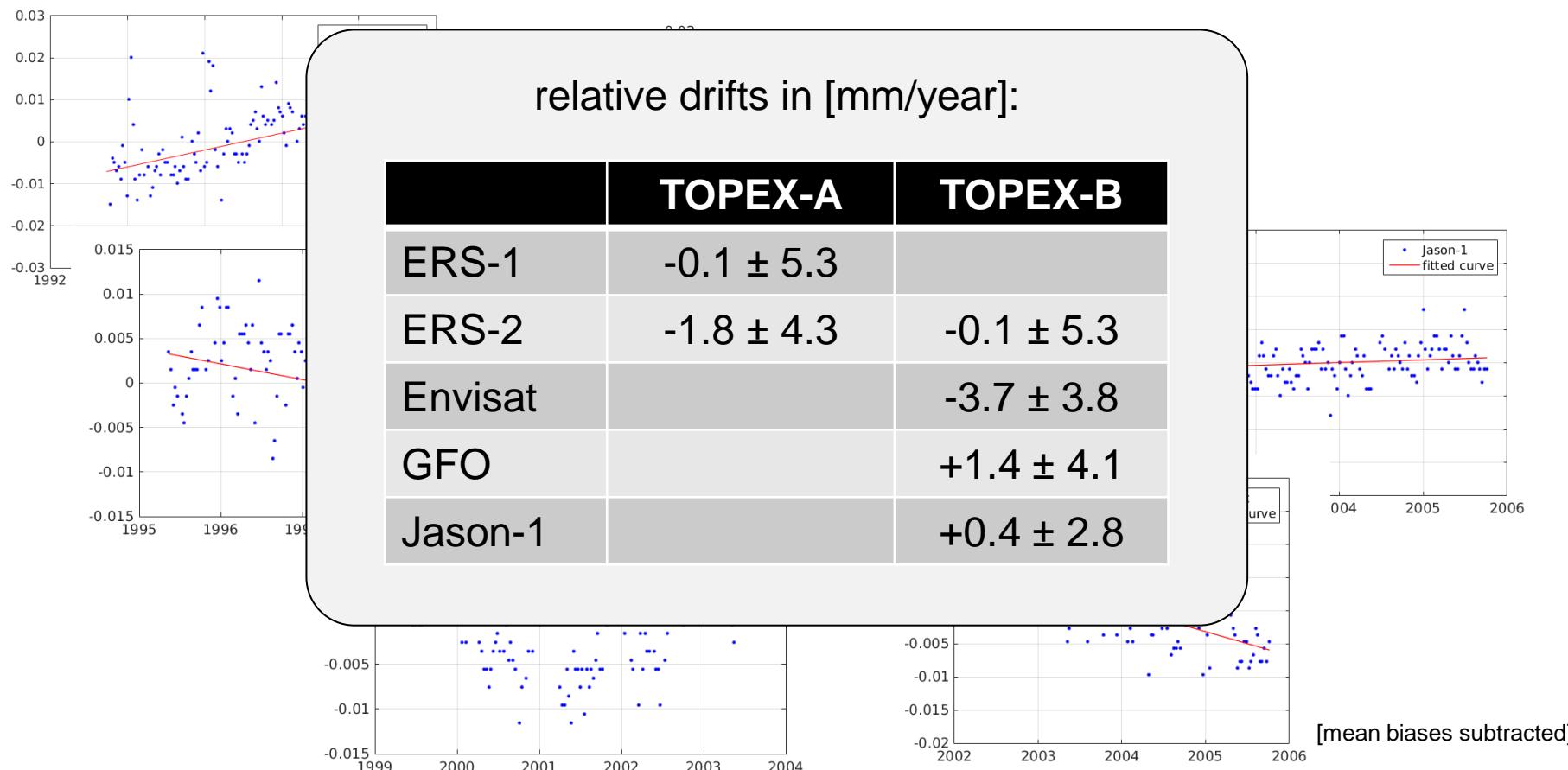
annual signal !
(due to SARAL
wet tropo)

Selected Results

- Extended time series for J2 and SARAL
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Relative long-term instrument drifts

- drifts are detectable only with respect to a reference mission
- absolute level is defined by TOPEX (bias_{TP} := 0 mm) and its processors (bias_{J1} := 107 mm bias_{J2} := 4 mm)

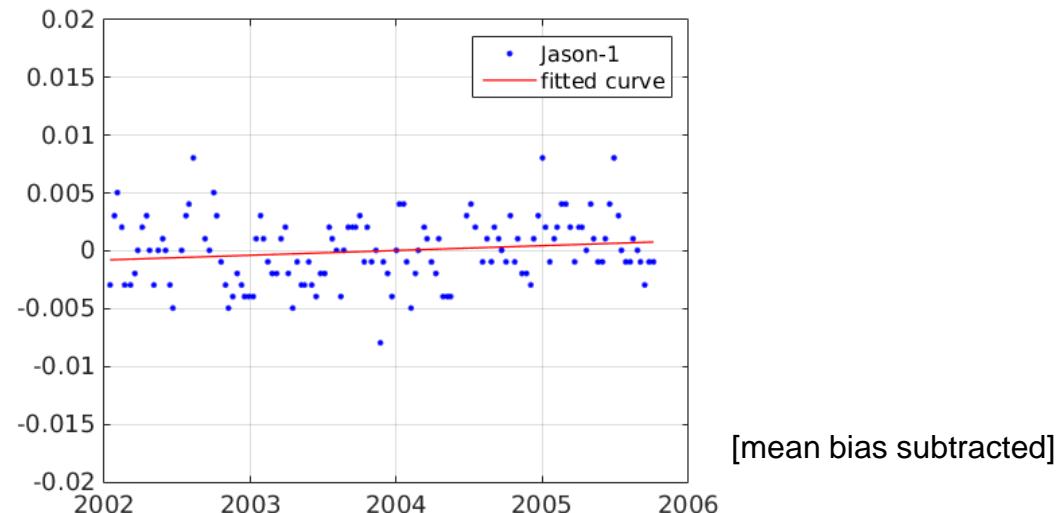


Relative long-term instrument drifts (TOPEX-B)

Relative drifts between Jason-1 (GDR-D) and TOPEX (side B)

Jason_1 – TOPEX_B:

$+0.4 \pm 2.8 \text{ mm/year}$



- Drift is mathematically not significant
- Less than 4 years of data

Watson et al, 2015:

TP_B: $0.93 \pm 0.92 \text{ mm/yr}$
J1: $0.42 \pm 0.41 \text{ mm/yr}$

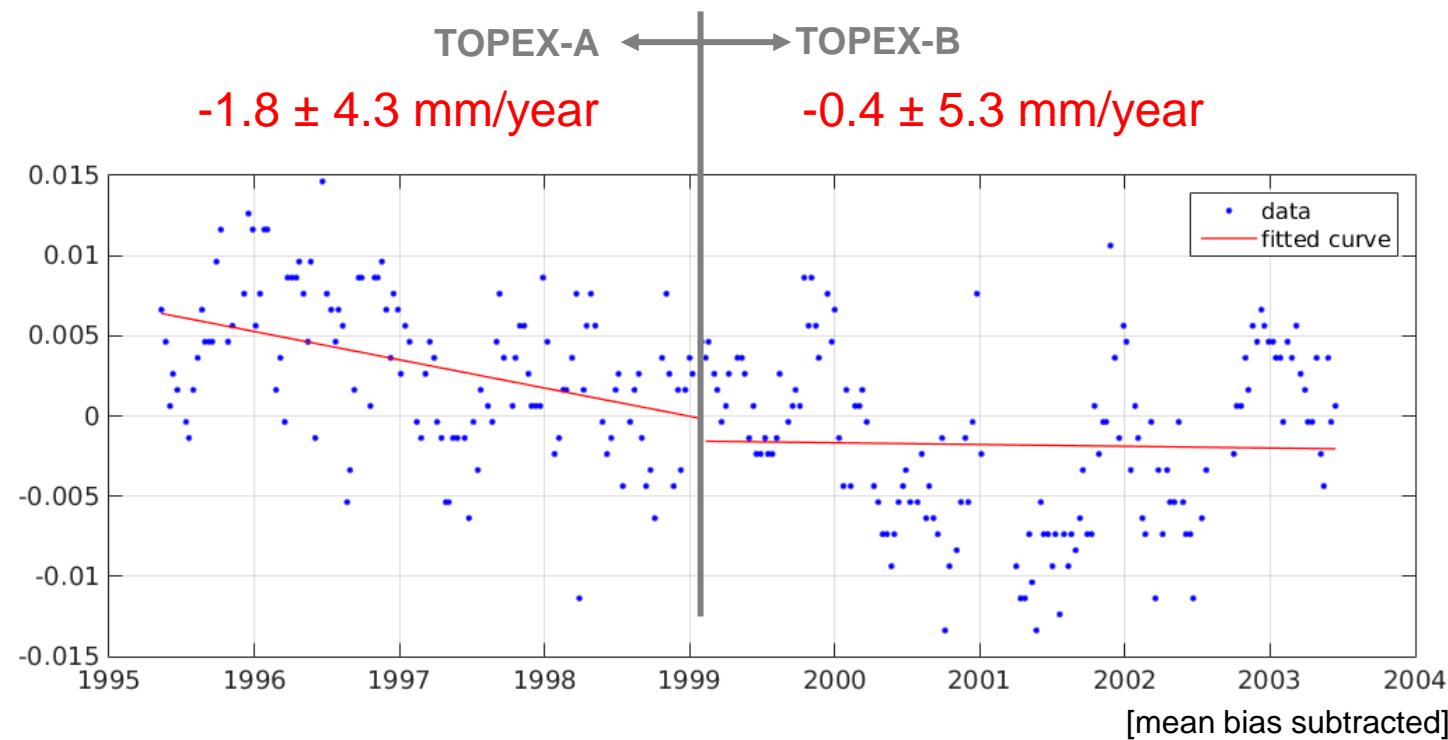
J1-TP_B:

$-0.51 \pm 1.01 \text{ mm/yr}$

- Different results!
- However: when taking the standard deviations into account, no difference can be attested

Relative long-term instrument drifts (TOPEX)

Relative range bias between ERS-2 (OPR) and TOPEX

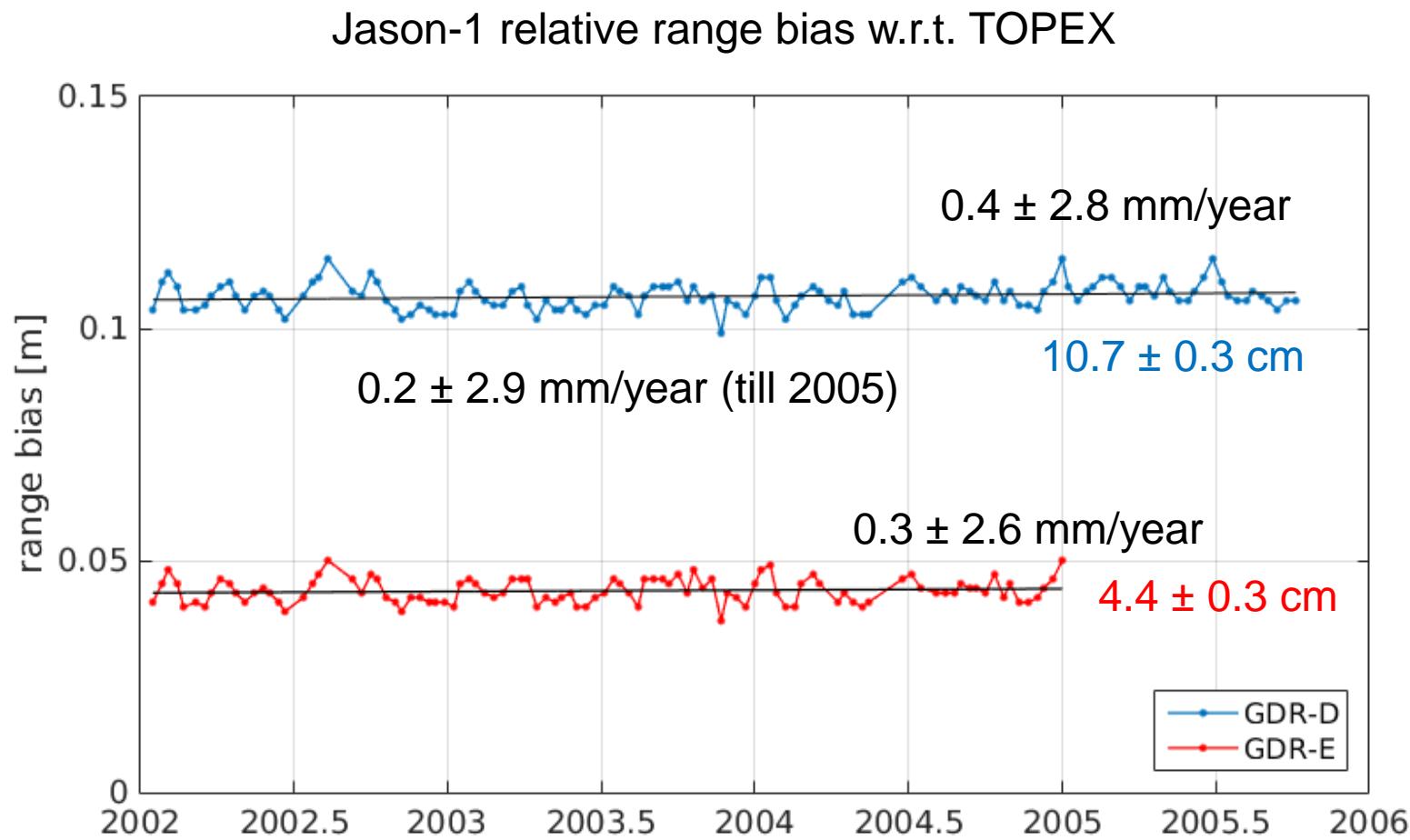


- A change in trend behavior might be detectable early 1999
- Noise and other systematics are too large to extract reliable conclusions

Selected Results

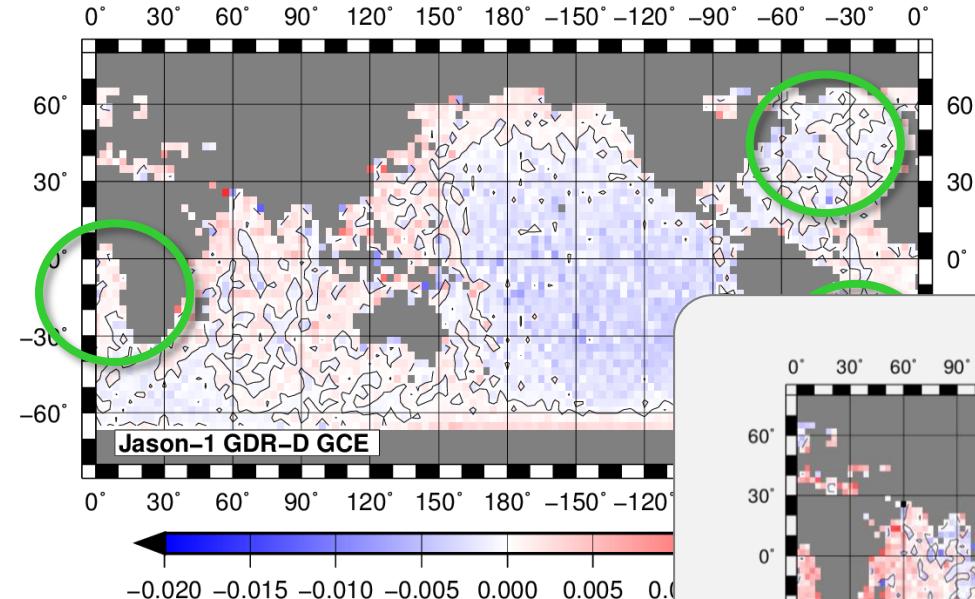
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Jason-1 GDR-E (range bias)



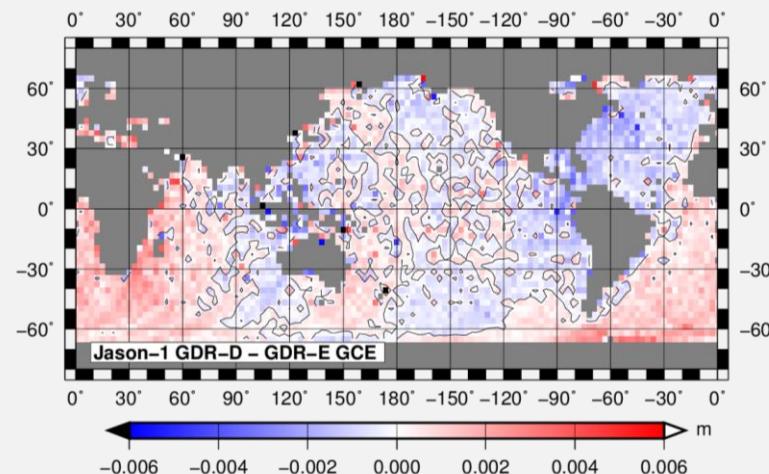
- range bias in GDR-E reduced (but still not zero)
- drifts w.r.t. TOPEX not significant

Jason-1 – Geographically Correlated Errors (GCE)

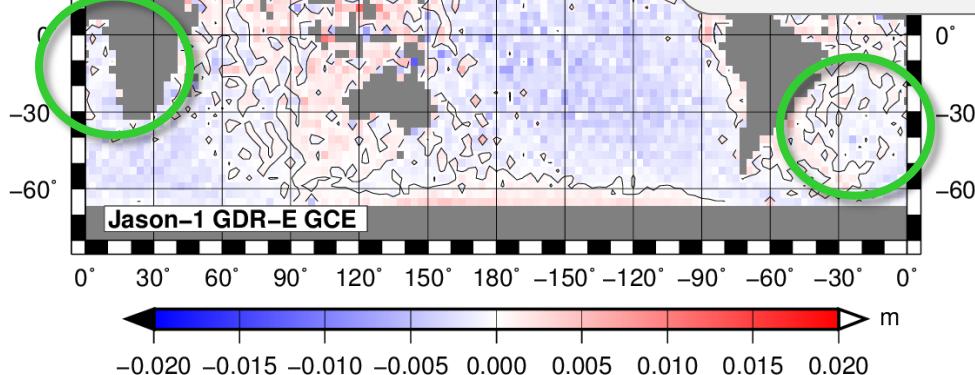


GDR-D:

standard deviation: 1.998 mm
 $0.82\% > 5 \text{ mm}$



differences
RMS: 1.2 mm



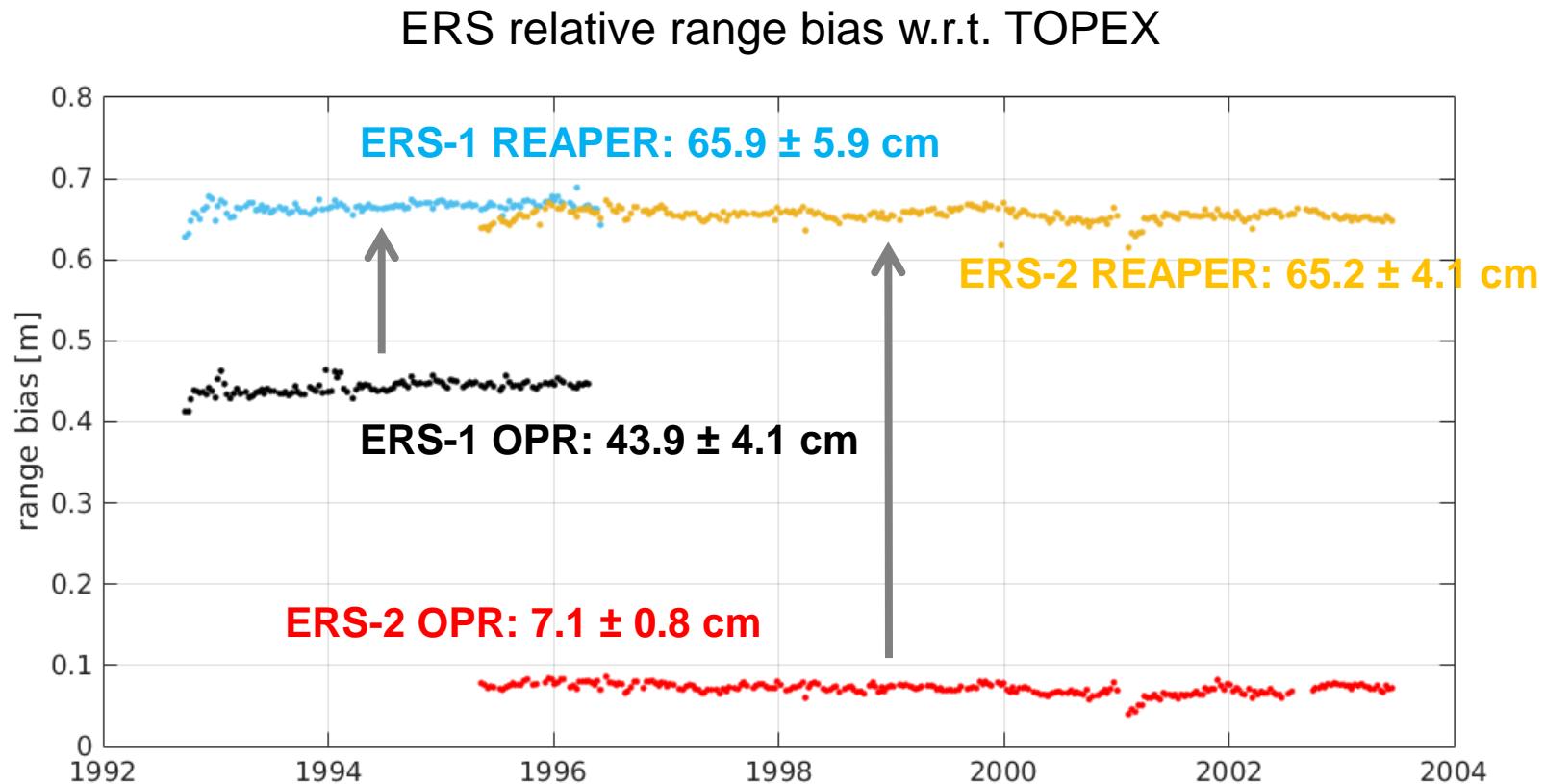
GDR-E:

Standard deviation: 1.966 mm
 $0.76\% > 5 \text{ mm}$

Selected Results

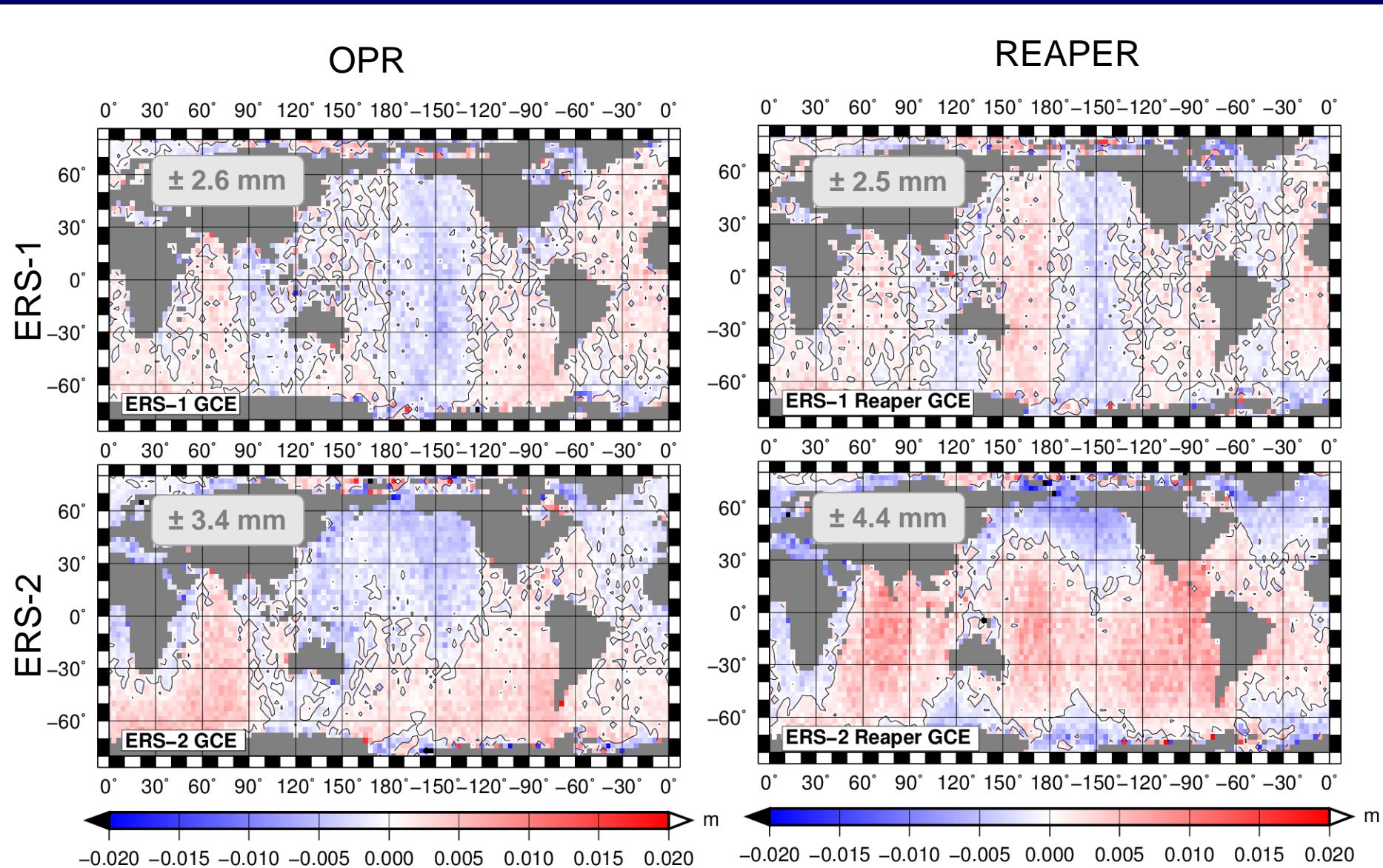
- Extended time series for J2 and SARAL
- TOPEX long-term drifts?
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- ERS Reaper products**
- HY-2A

ERS REAPER – Radial errors



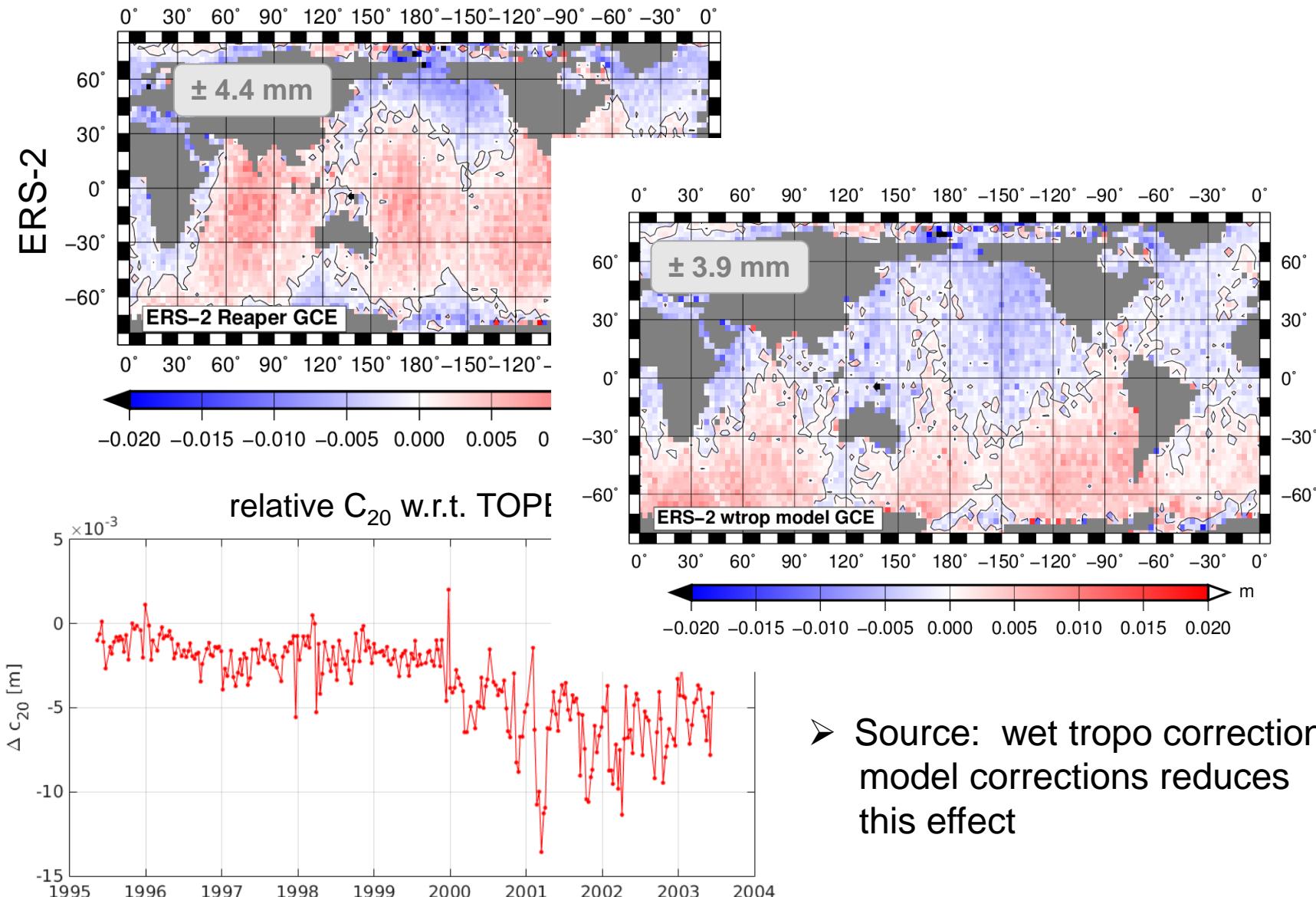
- range bias in REAPER product enlarged
- global mean range bias now similar for ERS-1, ERS-2, and ENVISAT

ERS REAPER – Geographically Correlated Errors



- Completely different patterns (despite of same corrections and similar orbits)
- ERS-2 show higher SSH GCE after the reprocessing...

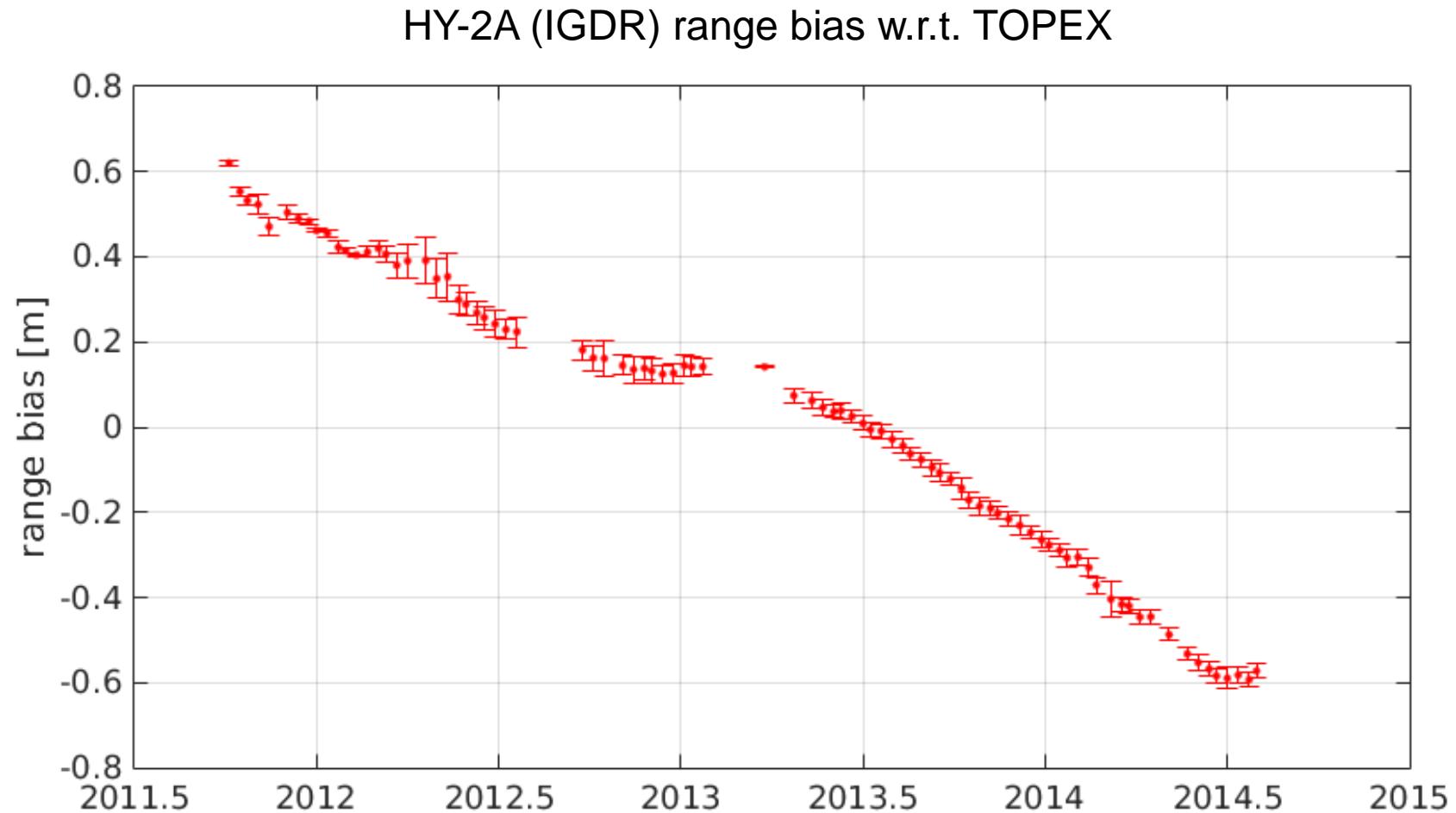
ERS-2 REAPER



Selected Results

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HY-2A



- Strong drift in Range Bias detectable
- Some periods with significant time tag bias

Conclusion

- ❑ Jason-2 shows no systematic behavior.
- ❑ Saral shows periodic signal in z-shift of the origin due to radiometer corrections.
- ❑ Jason-1 GDR-E product (first three years) shows a reduced range bias and slightly improved GCE pattern (w.r.t GDR-D).
- ❑ ERS-2 REAPER shows increased GCE; related to radiometer correction.
- ❑ HY-2A should only be used when a time-dependent instrument bias is taken into account.

- ❑ Bias drifts from Watson et al, 2015 can neither be confirmed nor disproved.

Questions ?

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