Splinter session III – Precision Orbit Determination

Jason-1 and Jason-2 POD Status

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Ocean Surface Topography Science Team Meeting
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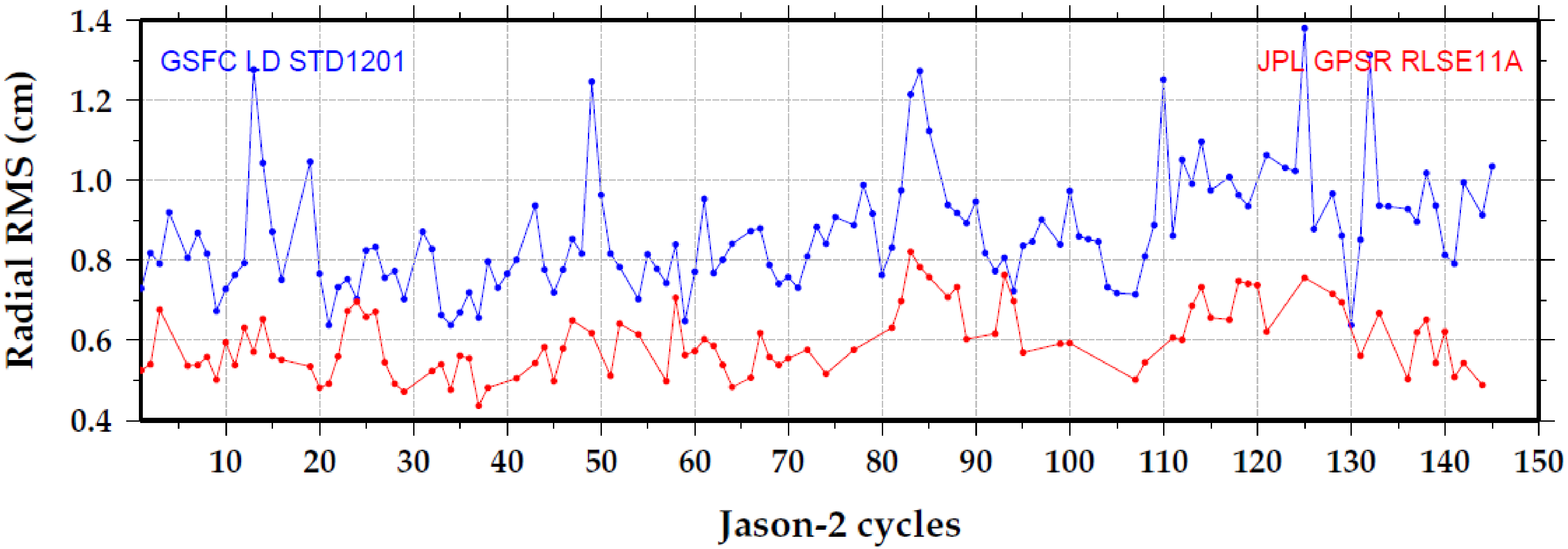
Outline

- Comparisons with External Orbits
- Performance of the Tracking Systems
- Quantifying and Characterizing GDR-D Orbit Error
- Time-Varying Gravity Field Effects on Jason's Orbit

Comparisons with External Orbits
Radial Component

RMS of radial orbit differences relative to the Jason-2 GDR-D solution

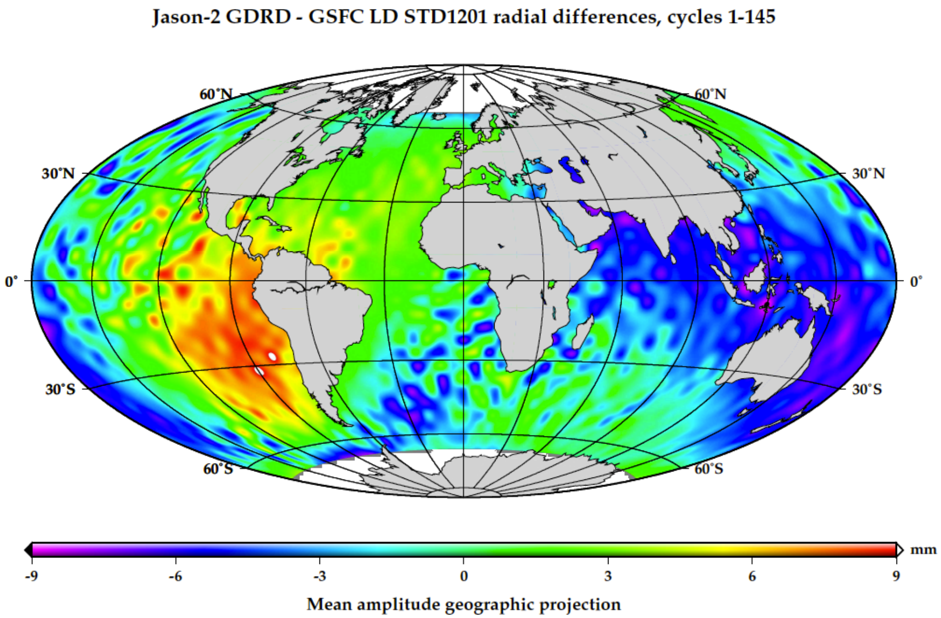


- GDR-D higher (w.r.t. the 2011 preliminary GDR-D solution) relative weight of GPS measurements explains the better agreement with the JPL orbit (~6 mm)
- *Radial RMS differences slightly increased after cycle 100 w.r.t. the GSFC orbit?*

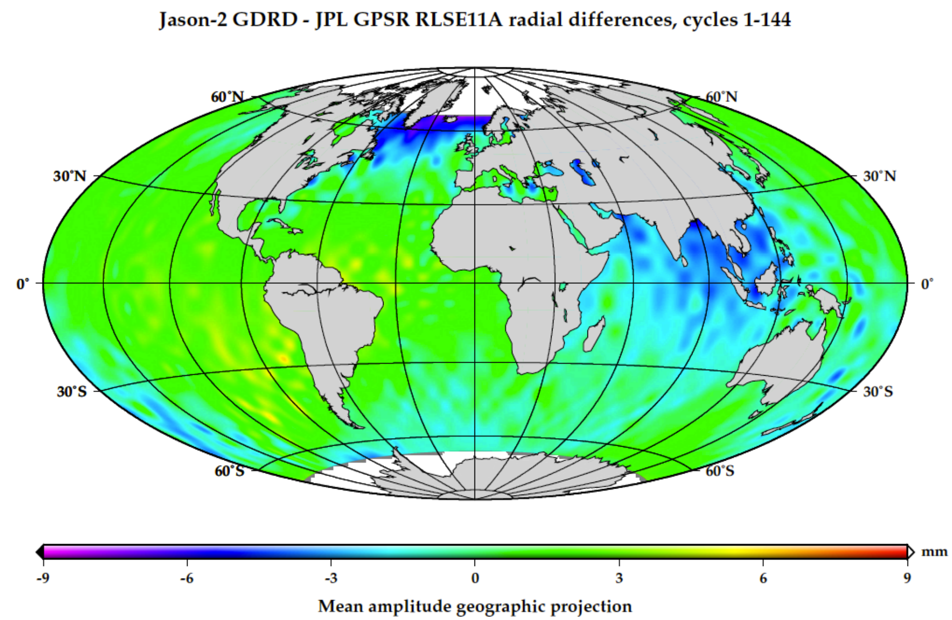
Comparisons with External Orbits

Mean Geographically Correlated Radial Differences

GDR-D – GSFC



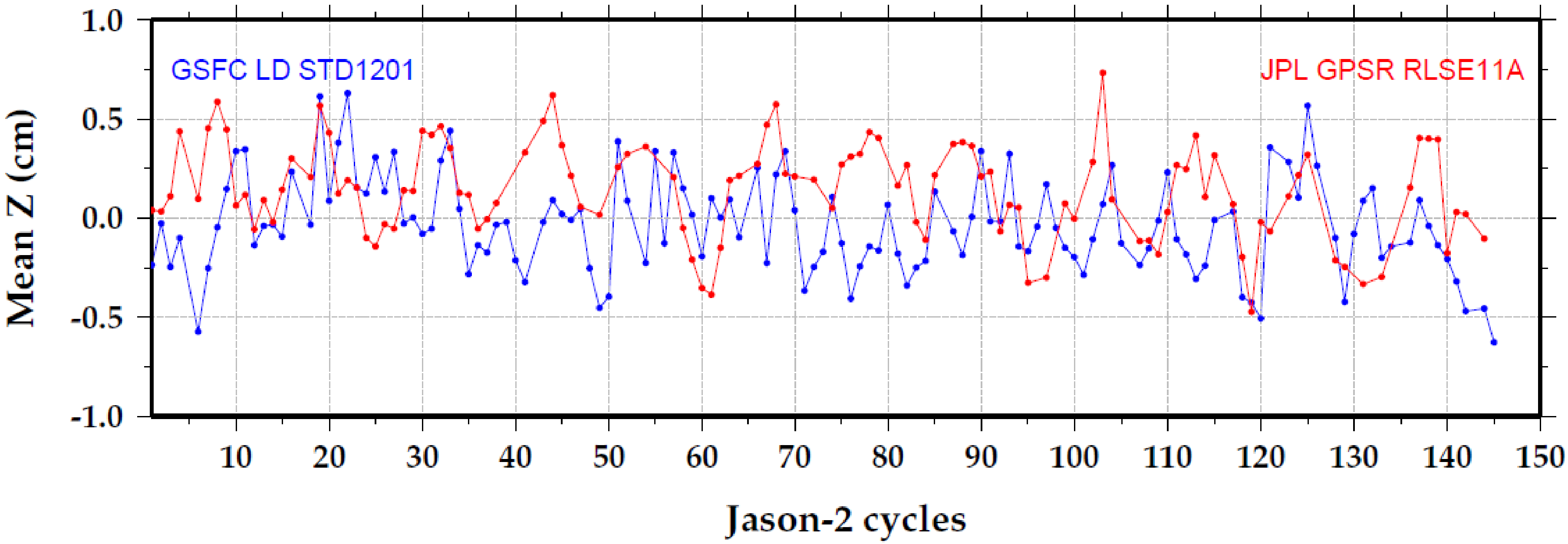
GDR-D – JPL



- The mean radial differences between the GDR-D solution and the GSFC orbit shows ~6 mm East – West patterns, typical of gravity field modeling differences

Comparisons with External Orbits
Z-centering

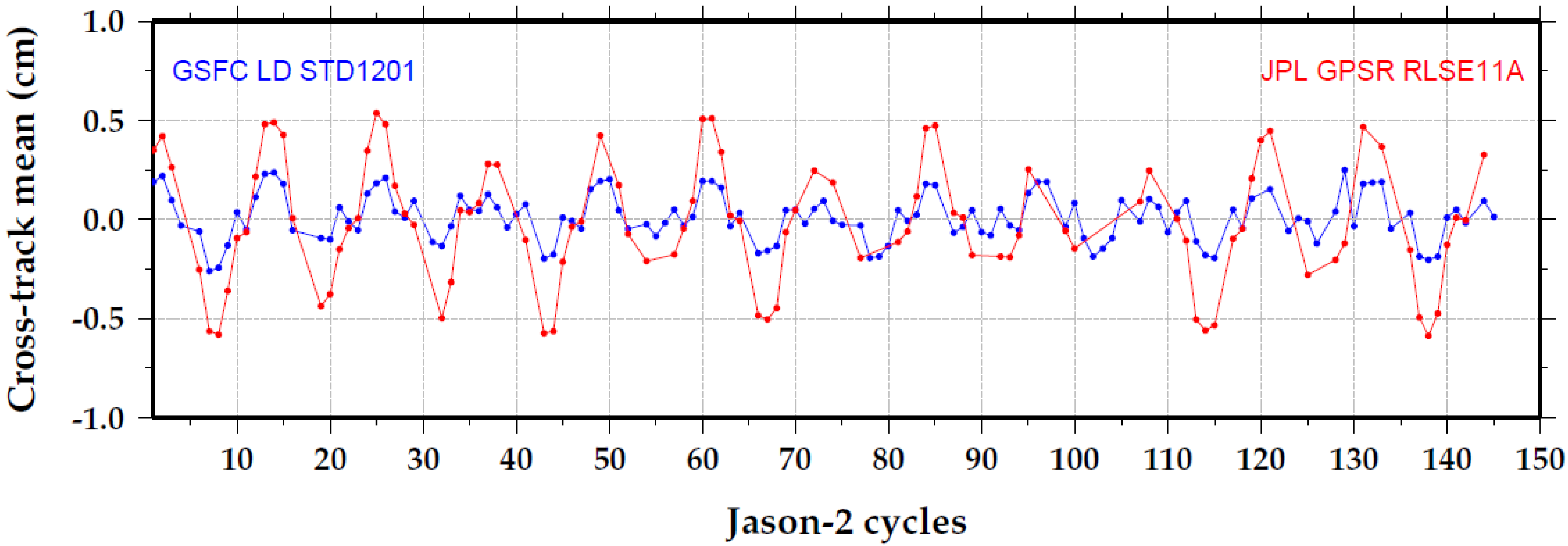
Mean of Z orbit differences relative to the Jason-2 GDR-D solution



- The GDR-D solution compares well w.r.t GSFC and JPL orbits

Comparisons with External Orbits
Cross-track Component

Mean of cross-track differences relative to the Jason-2 GDR-D solution

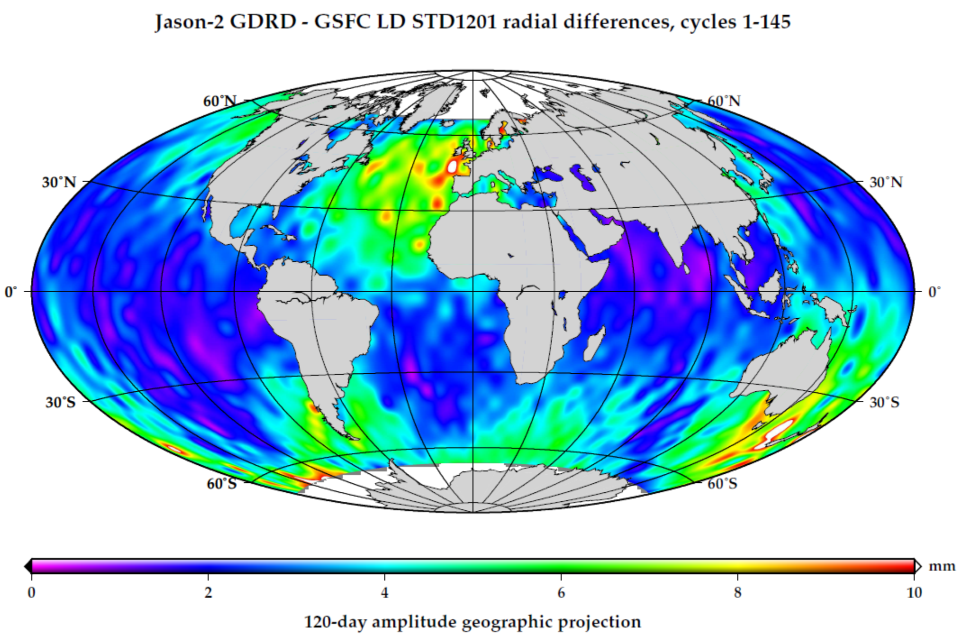


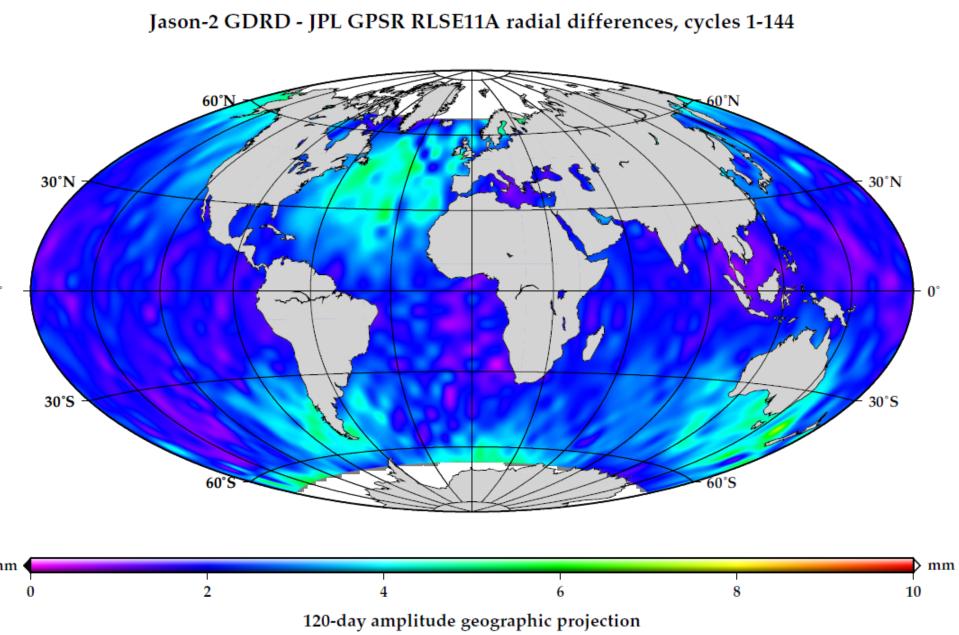
- Less than 5-mm 120-day signal in the cross-track mean differences w.r.t. the GSFC and JPL orbits

Comparisons with External Orbits

120-day Geographically Correlated Radial Signal

Typical signature of SRP model differences

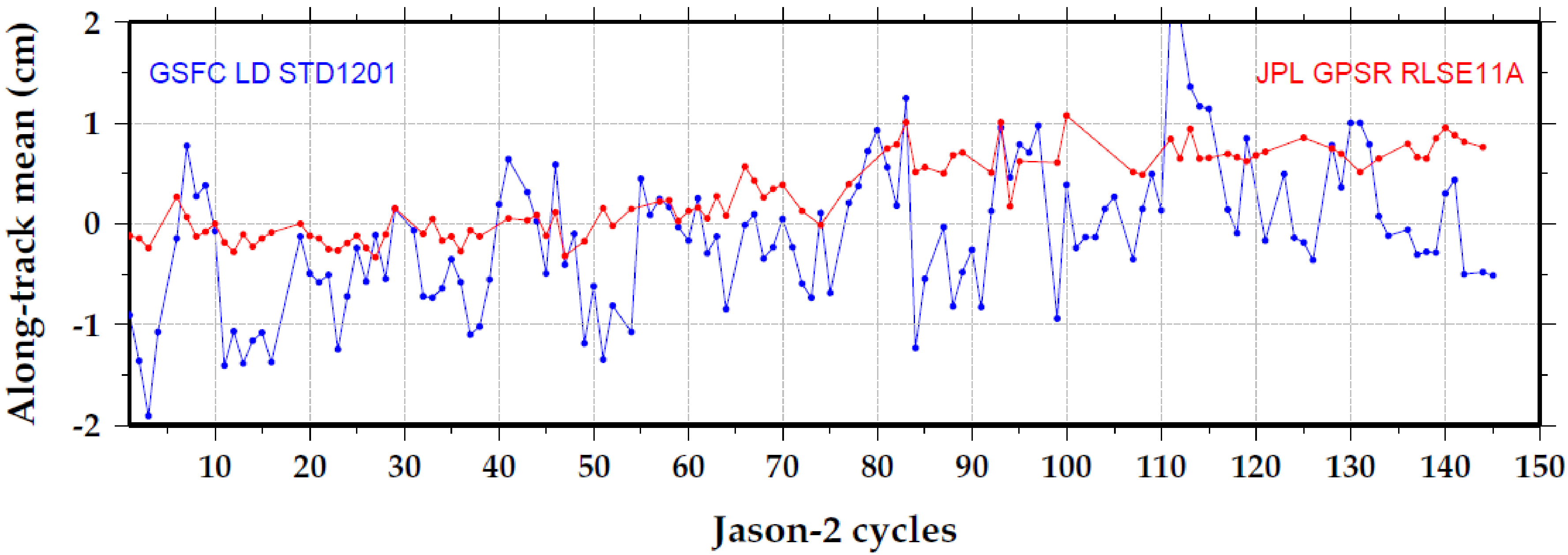




- Halving (1 cm to 5 mm) of the previous OSTST meeting 120-day signal between the GSFC orbit and the GDR-D solution
- Similar geographical distribution of these 120-day patterns in the GSFC and JPL orbits when compared to the GDR-D solution

Comparisons with External Orbits
Along-track Component

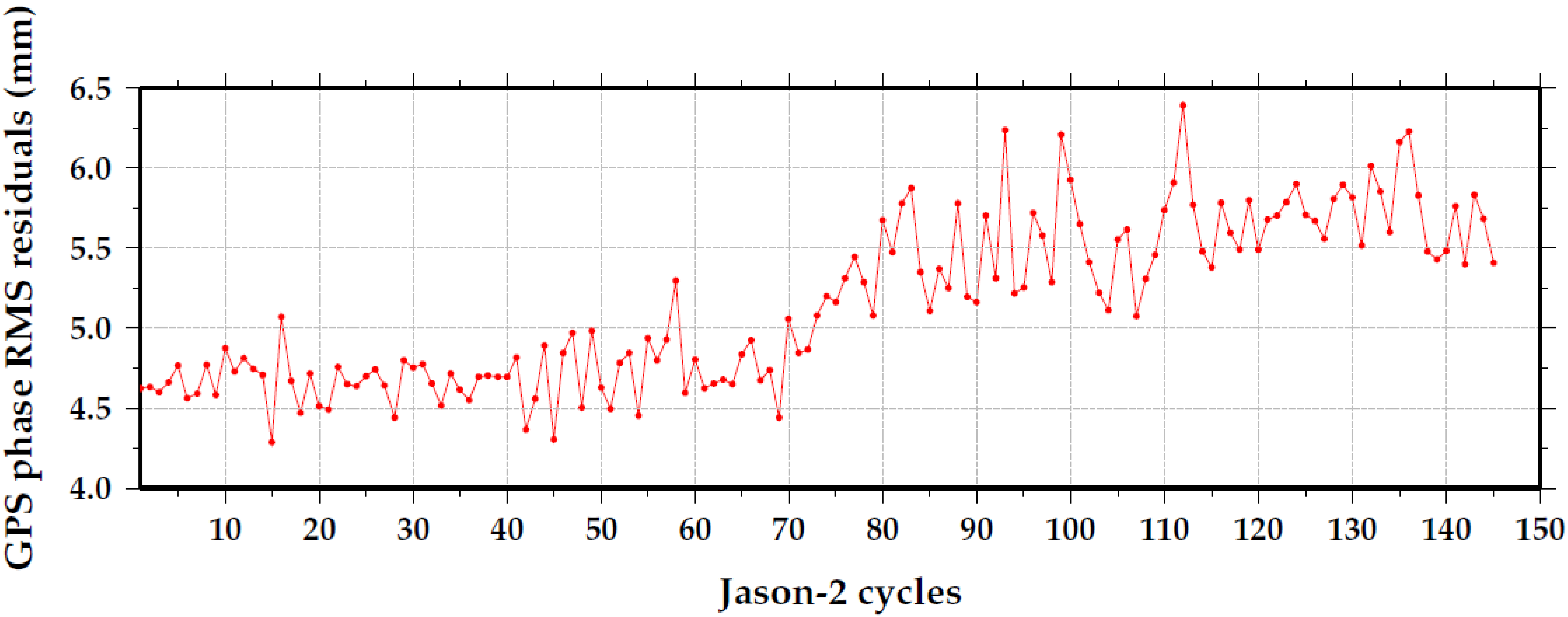
Mean of along-track differences relative to the Jason-2 GDR-D solution



- *7-mm along-track bias after the cycles 50 between the GDR-D solution and the JPL orbit*

Performance of the Tracking Systems
GPS Measurements

RMS of GPS phase post-fit residuals for the Jason-2 GDR-D solution

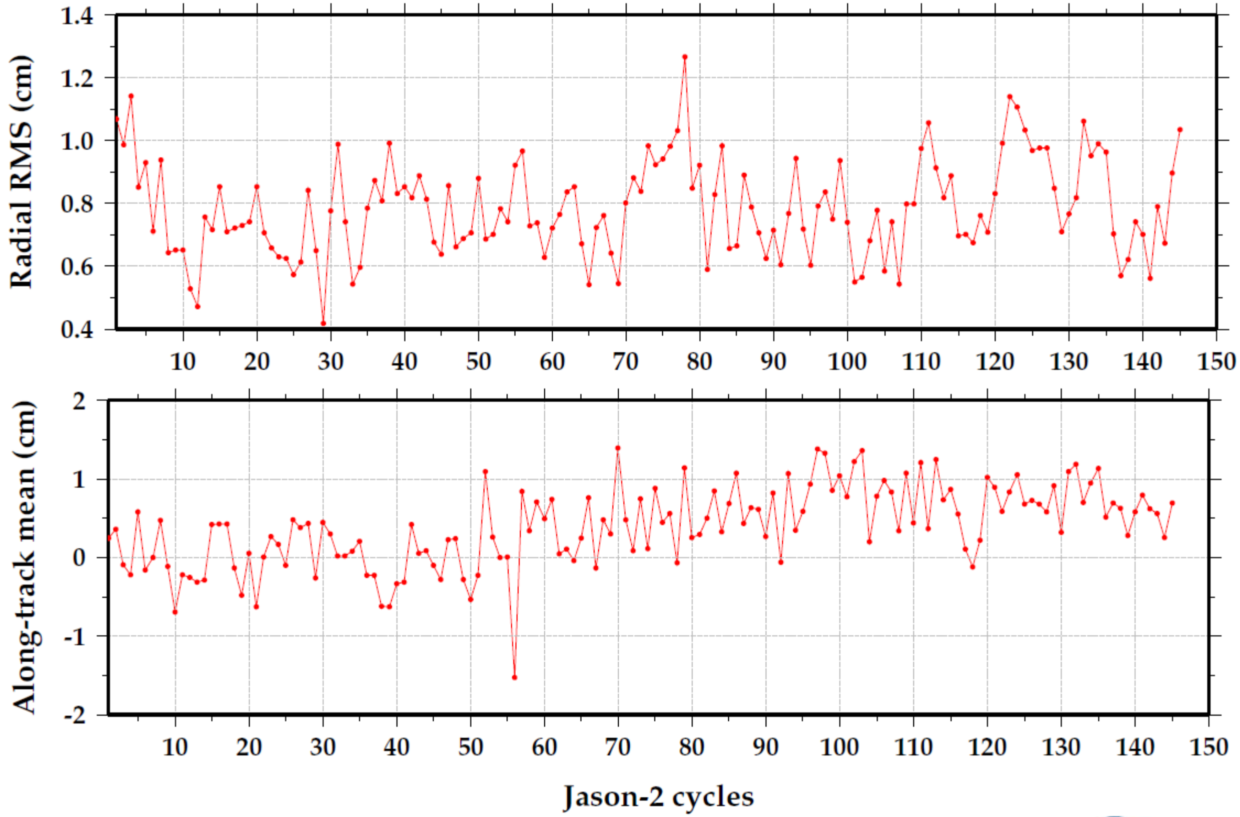


- GPS phase residuals degrades after the cycles 50:
  - » Increasing number of measurements
  - » Longer mean track length
  - » Current pre-processing is not tuned for half-cycle slips removal

Performance of the Tracking Systems
GPS Phase Residual Degradation Impact on the Orbit

Jason-2 DORIS-based orbit differences relative to its GPS-only solution counterpart

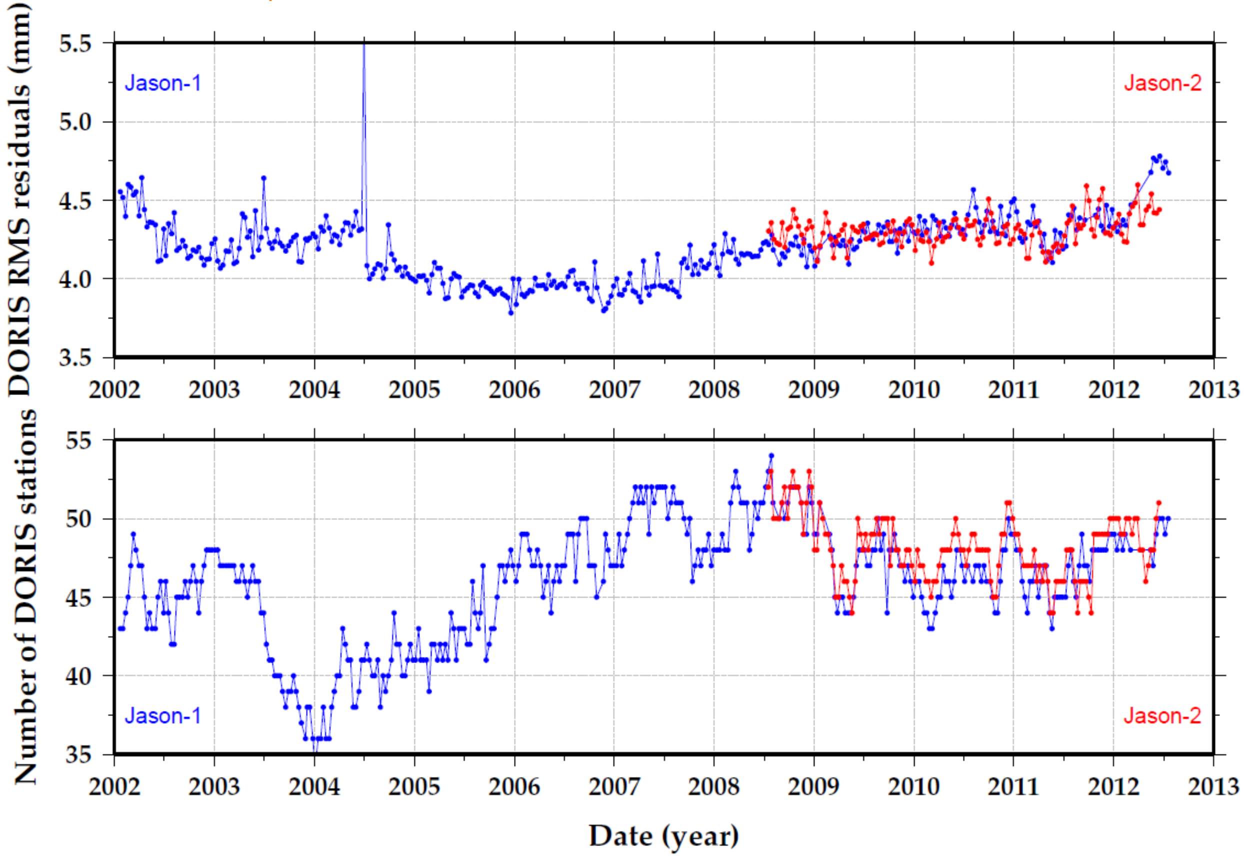
- No conclusive sign of degradation due to this effect on the radial component of the GPS orbit
- The *along-track bias* observed between the GDR-D solution and the JPL orbit seems to be correlated with this degradation



Performance of the Tracking Systems
DORIS Measurements

RMS of DORIS* post-fit residuals (10-seconds phase increments) for the Jason-1 and Jason-2 GDR-D solutions

*Worst 6 stations removed (ADFB, ARFB, CIDB, SYPB, YEMB, GR3B)



Performance of the Tracking Systems

South Atlantic Anomaly Effect on DORIS Residuals

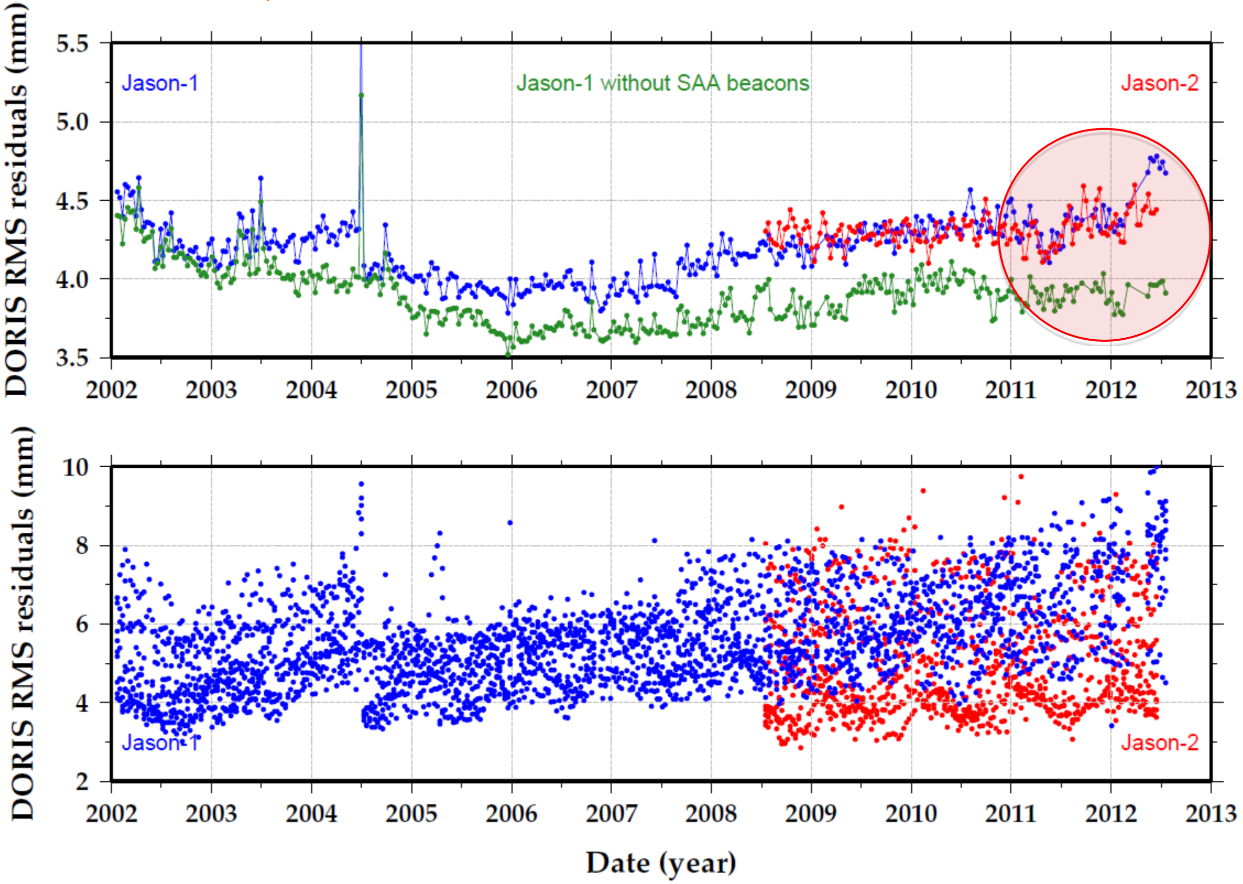
RMS of DORIS* post-fit residuals (10-seconds phase increments) for the Jason-1 and Jason-2 GDR-D solutions

*Worst 6 stations removed (ADFB, ARFB, CIDB, SYPB, YEMB, GR3B)

- Stronger SAA effect on DORIS residuals since Jason-1 orbit change: SAA corrective model problem?

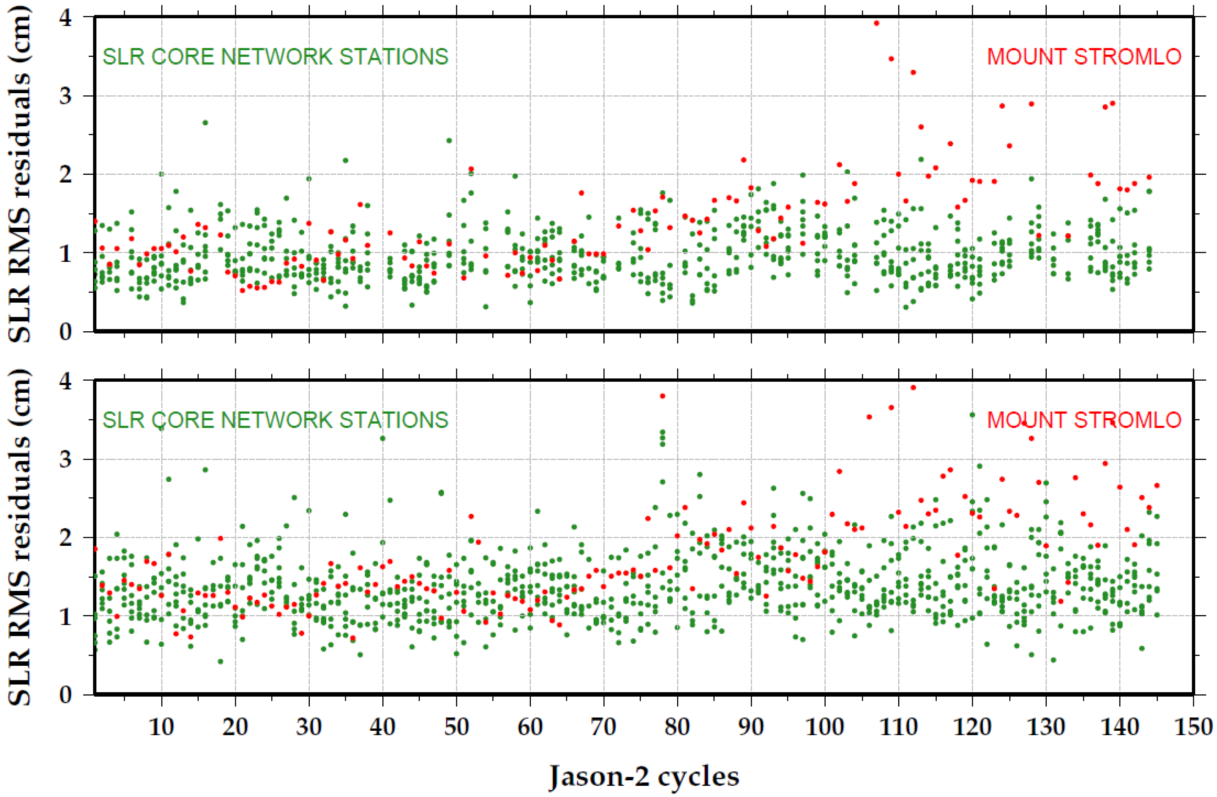
DORIS SAA beacons residuals:

- The Jason-1 DORIS residuals keep increasing on the SAA beacons



Performance of the Tracking Systems
Historically Well Performing SLR Stations

SLR reference stations (7080 Mcdo, 7090Yarr, 7105Wash, 7810Zimm, 7839Graz, 7840Hers, 7941Mate)
residuals on independent Jason-2 GPS-derived orbits (all elevations)



JPL GPS-based reduced dynamic orbit:

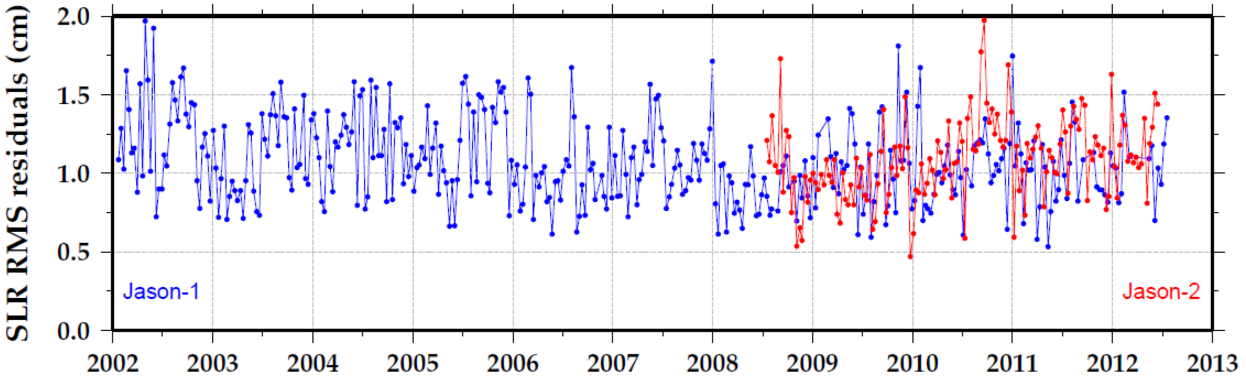
CNES GPS-based dynamic solution:

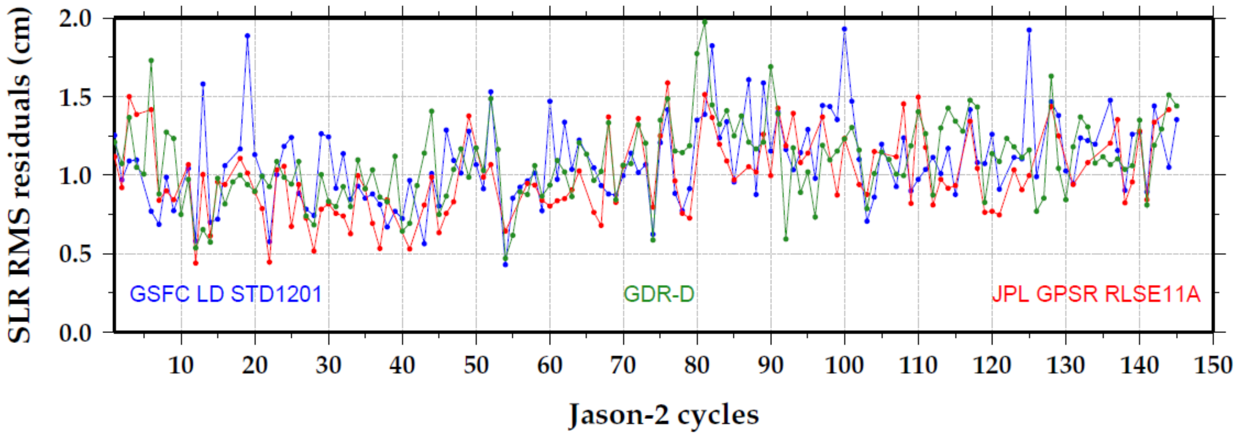
- Visible Mount Stromlo degradation over the last year

High elevation (above 70 degrees) SLR core network residuals on Jason-1 and Jason-2 GDR-D solutions

- High elevation SLR residuals reflects the radial orbit accuracy

- ~1-cm radial orbits accuracy for Jason-1 and Jason-2



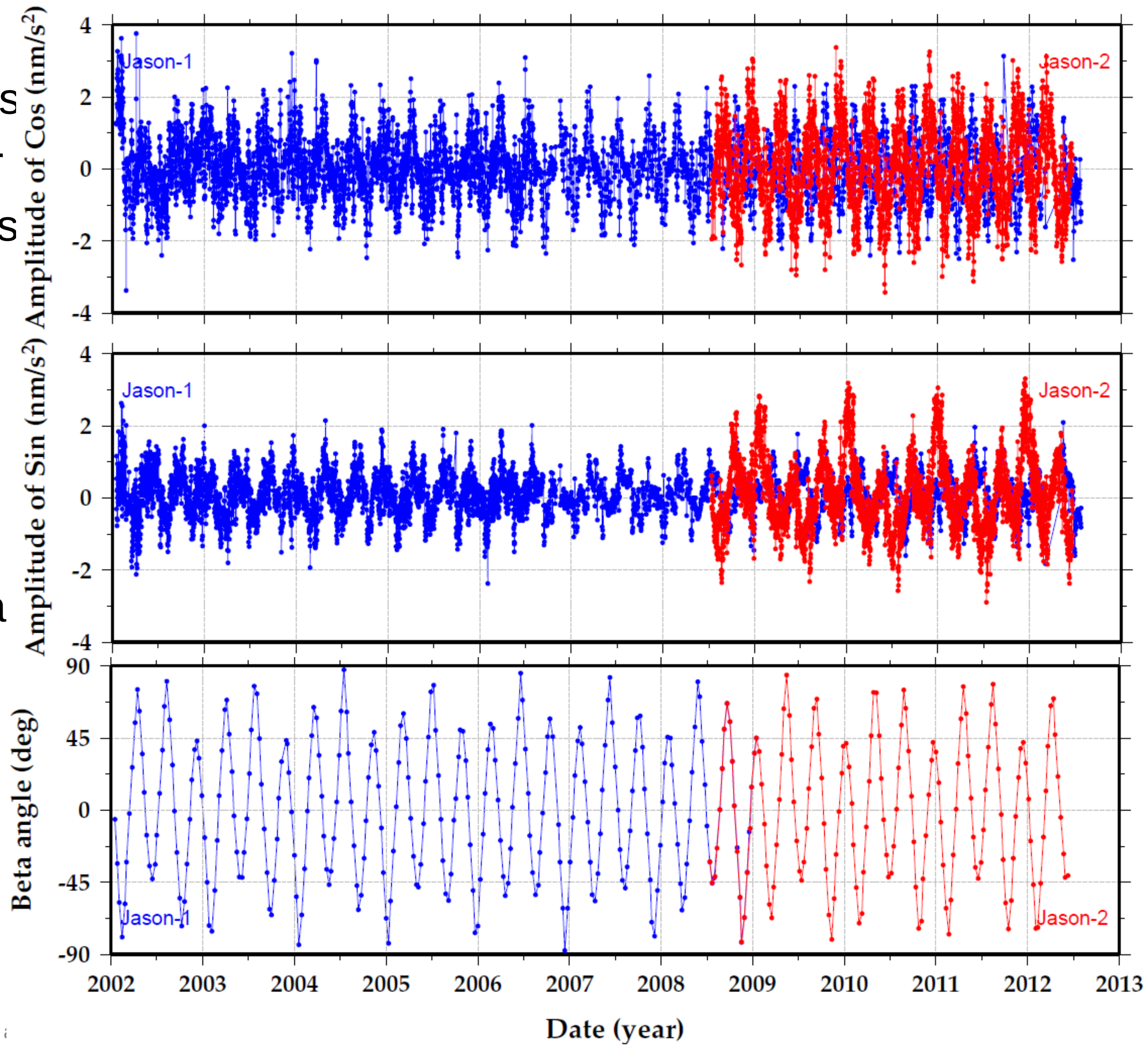


Quantifying and Characterizing GDR-D Orbit Error
Along-track 1-cpr Empirical Accelerations

- Beta-dependent patterns reveals unmodeled solar radiation pressure effects

- Jason-1 and Jason-2 periodic behaviors are correlated with their beta prime angle

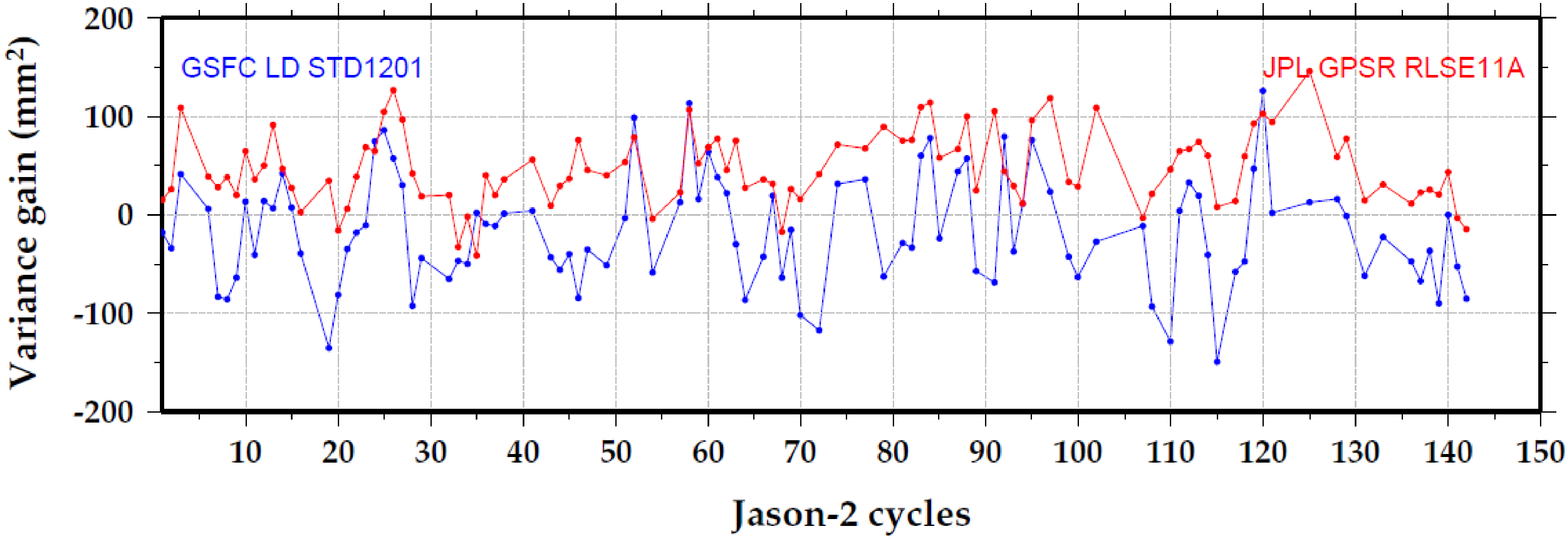
⇒ SRP model could be further improved



Quantifying and Characterizing GDR-D Orbit Error

Independent Altimeter SSH Crossover Residuals

Altimeter crossover gain (positive values) per cycle of the different Jason-2 orbits with respect to the GDR-D solution

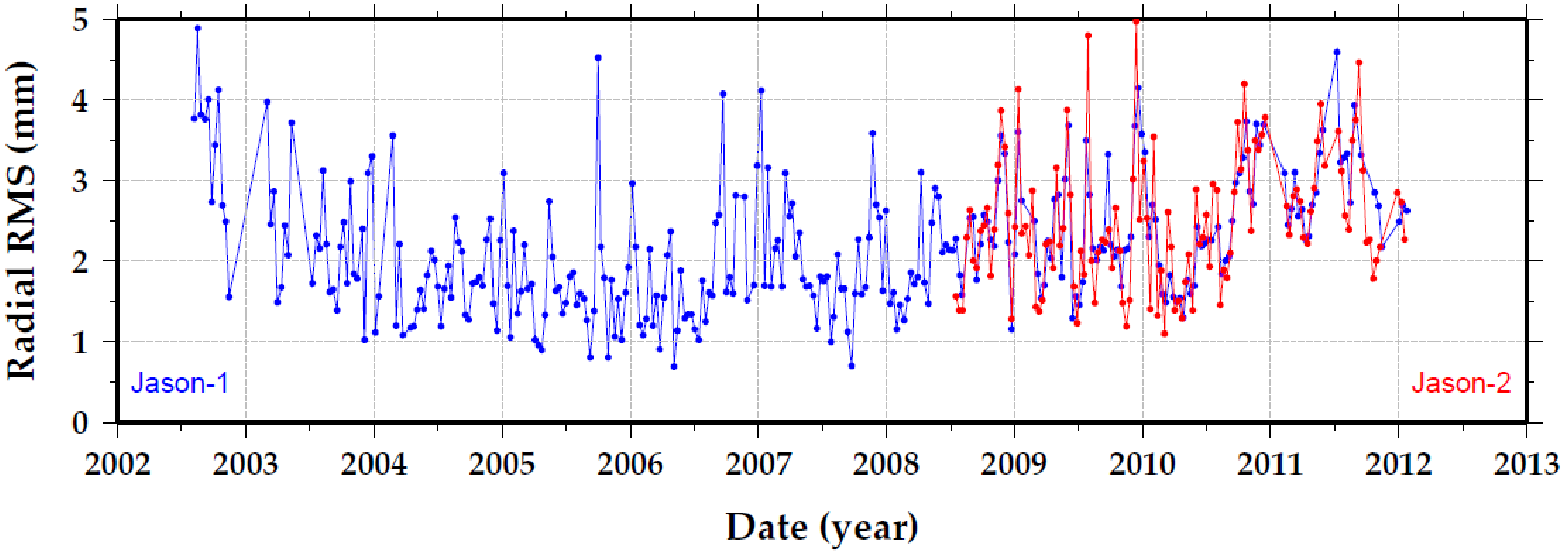


- The crossover statistics evaluate relative performance of each orbit solution
- The reduced dynamic solution performs slightly better than the dynamic orbits

Time-Varying Gravity Field Effects on Jason's Orbit

Temporal Characteristics of the Radial Orbit Error

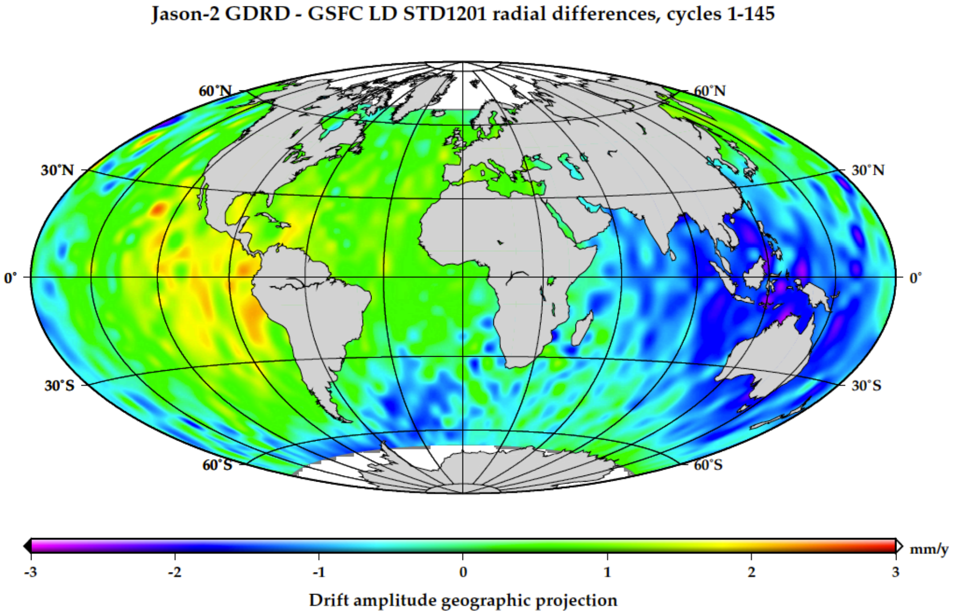
RMS of radial differences between the GDR-D solution and GDR-D orbits using the 10-day series of GRACE-derived gravity field

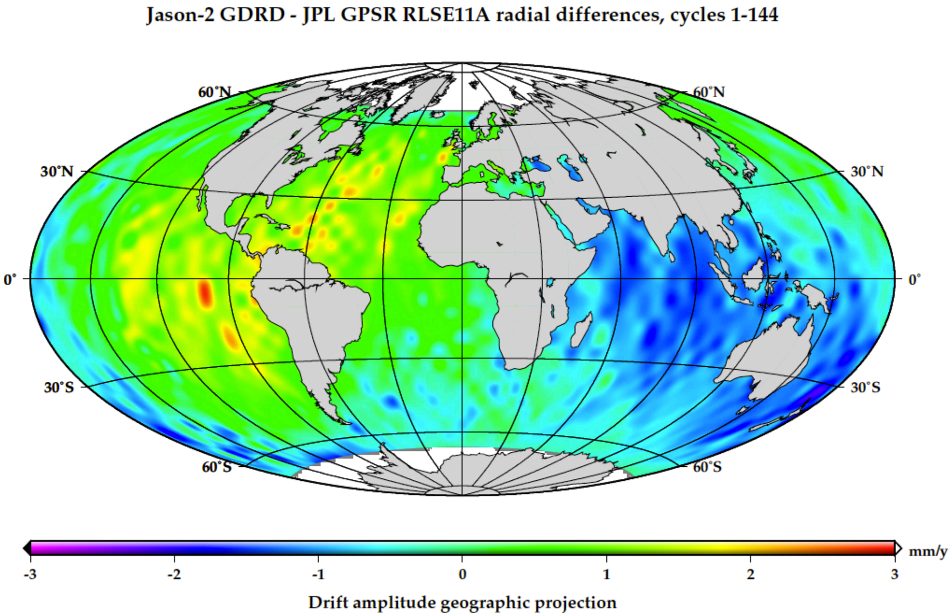


- The gravity mean model (used in the GDR-D solution) is consistent with sub-cm radial orbit accuracy, even out of the adjustment period of the mean model (before 2003 - after 2010)

Spatial Characteristics of the Radial Orbit Error

Geographically correlated radial difference drifts between the Jason-2 GDR-D solution and the GSFC/JPL orbits



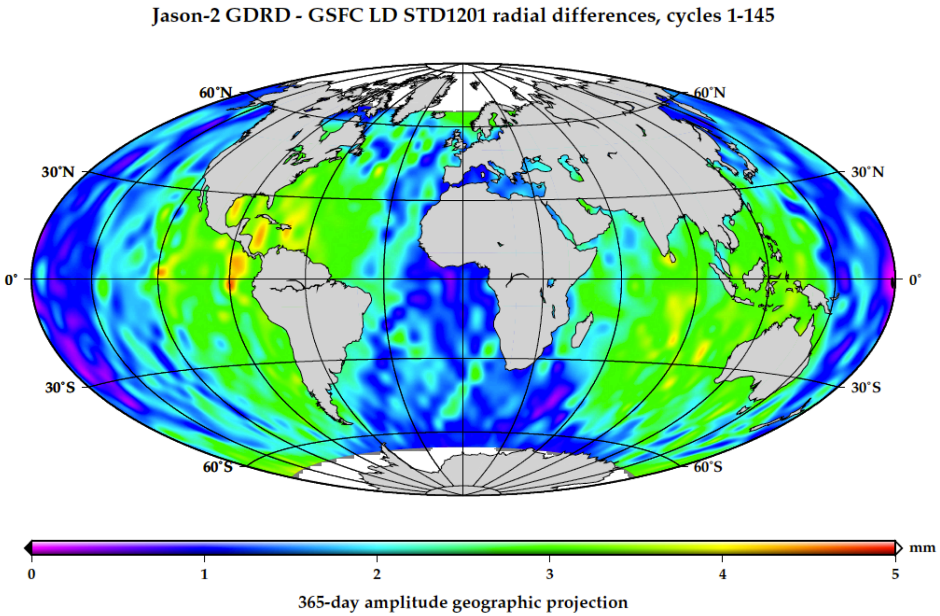


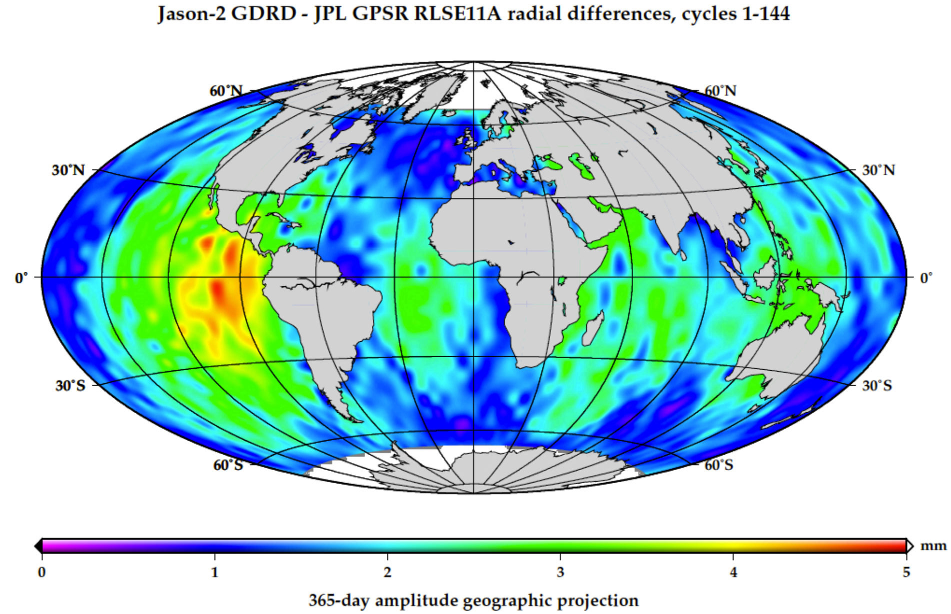
- ~2 mm/y East – West patterns common to the GSFC and JPL orbits w.r.t. the GDR-D solution, to be closely monitored

Time-Varying Gravity Field Effects on Jason's Orbit

Spatial Characteristics of the Radial Orbit Error

Annual geographically correlated radial signal between the Jason-2 GDR-D solution and the GSFC/JPL orbits



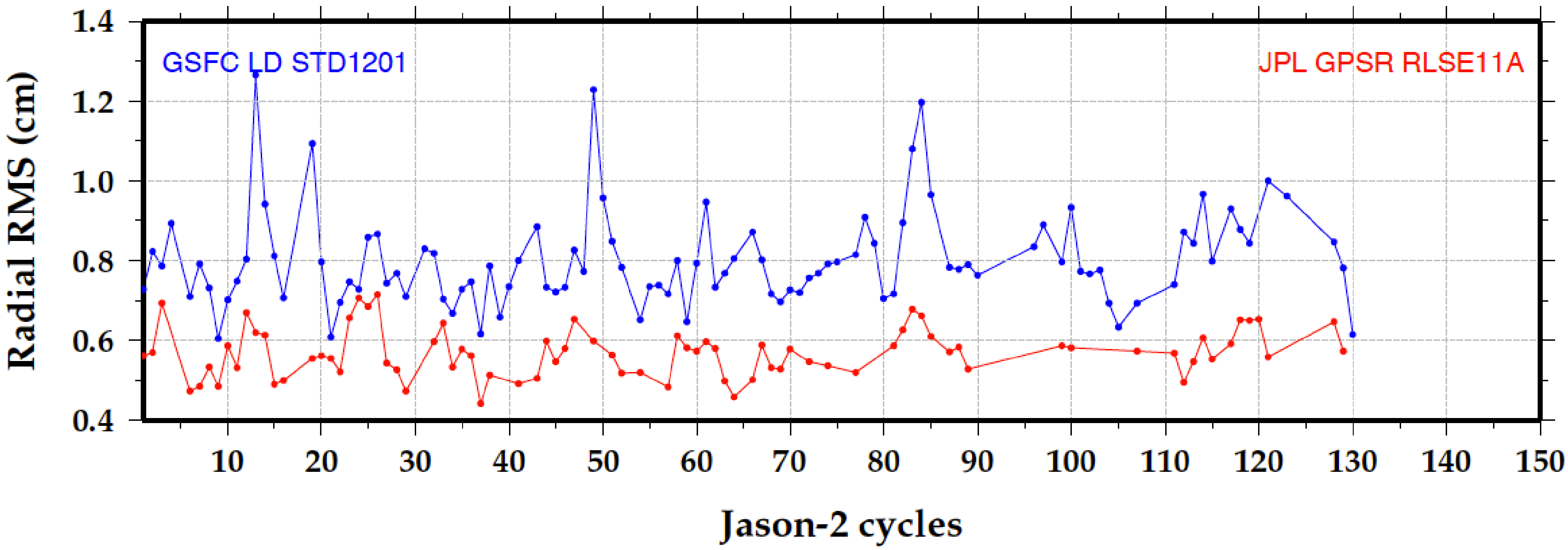


- ~3-mm type of signature observed between the GDR-D solution and the GSFC and JPL orbits

Time-Varying Gravity Field Effects on Jason's Orbit

Reason for the Increase in RMS Radial Differences

RMS of radial orbit differences relative to the Jason-2 GDR-D orbits using the 10-day series of GRACE-derived gravity field



- The 10-day series tend to reduce the RMS radial discrepancies between the GDR-D solution and the GSFC orbit

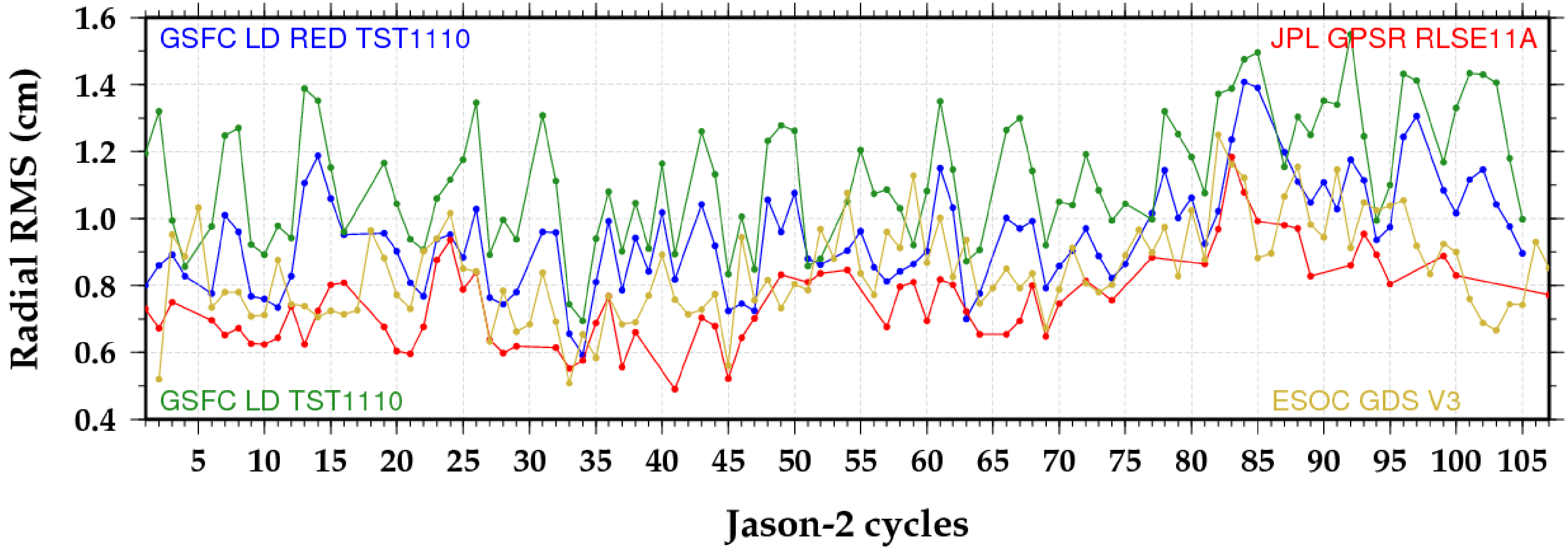
Summary

- Overall ~1 cm stable Jason-1 and Jason-2 radial orbit accuracy
- Including GRACE-derived drifts in the TVG model (GDR-D standard update) provides a significant improvement in the orbit accuracy…
- … although this mean model is still lacking for some portion of the gravity signal contained in the 10-day series of GRACE-derived field (but are not available for operational orbit production…)
- Necessary to carefully handle SAA effect on Jason-1
- Jason-2 GPS phase half-cycle slips

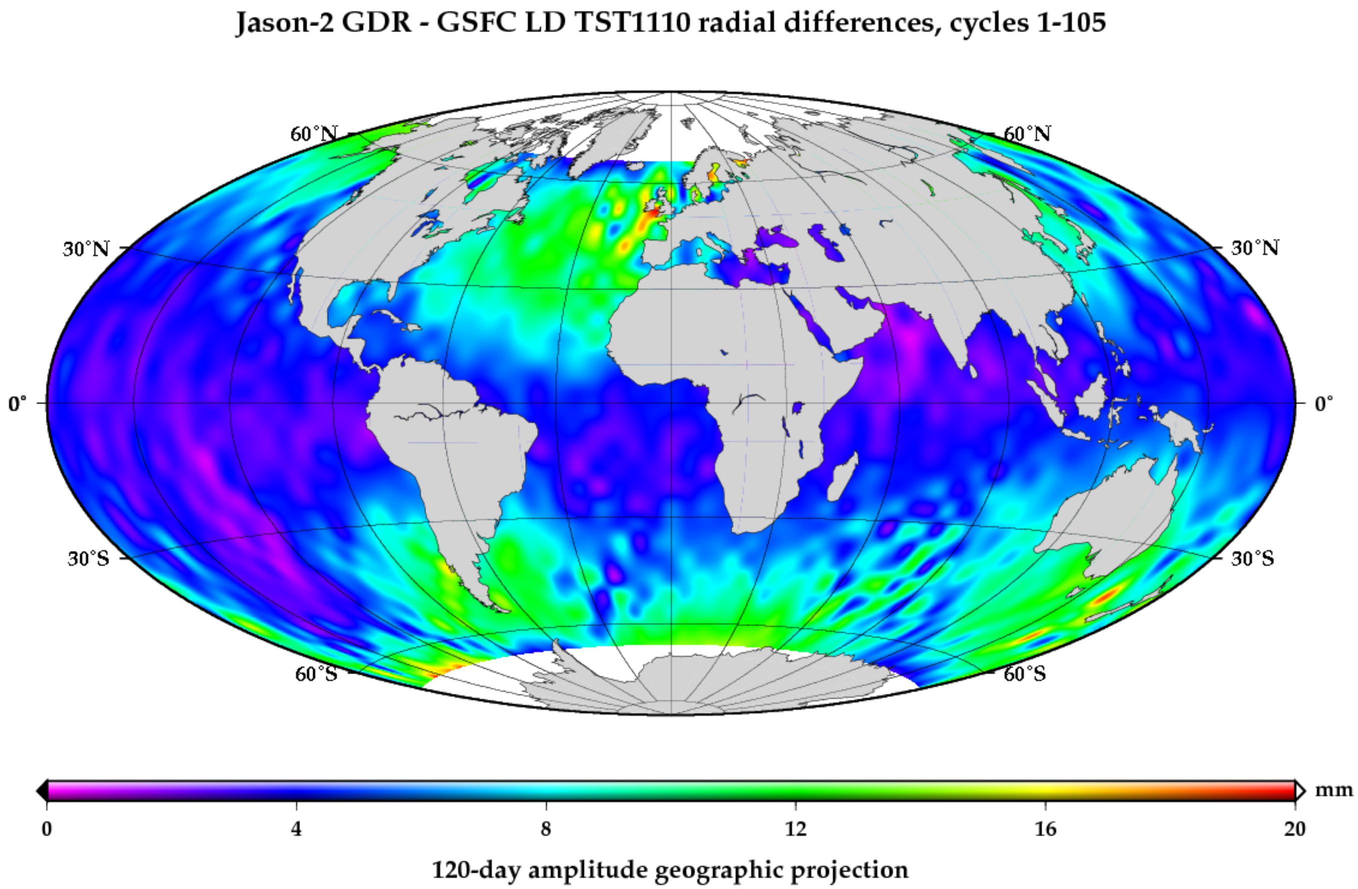

Thank you

Backup Slides

RMS of radial orbit differences relative to the GDR-D* solution



120-day geographically correlated radial signal



Amplitude estimated 1-cpr empirical accelerations cross-track