JASON-2 Precision Orbit Determination Status

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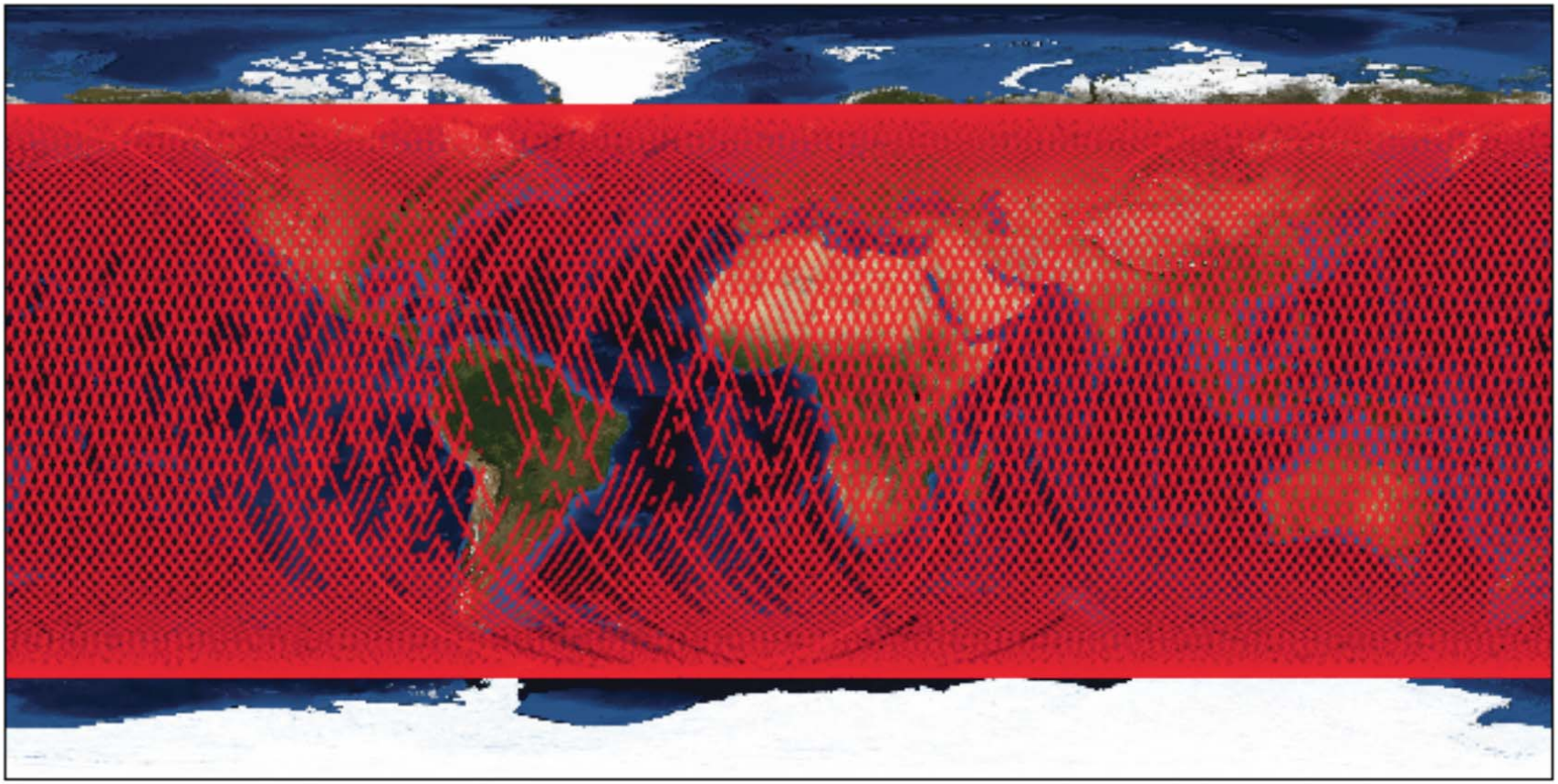
OSTM/Jason-2 GPSP Status

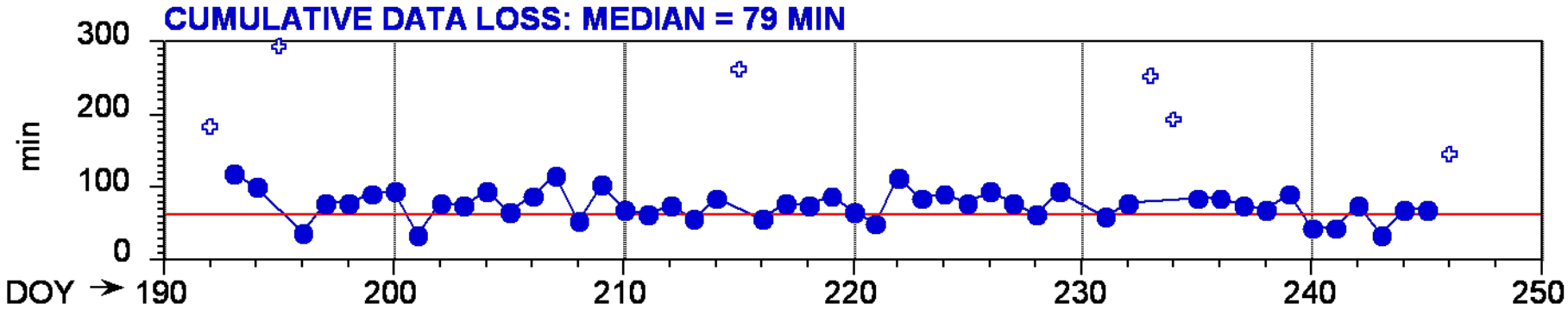
- **Tracking 8+ GPS satellites simultaneously (capped at 12)**
- **Temporal coverage of 95%**
  - Gaps over SAA
  - Similar temporal coverage to Jason-1
- **POD coverage of 100%**
  - Special processing required for maneuver day and Aug 20-21 upload sequence.
- **Quality of tracking data (point-to-point) is excellent**
  - P1 multipath 26 cm (RMS, 10 s)
  - P2 multipath 20 cm (RMS, 10 s)
  - PC (ionosphere free) postfit residual 26 cm (RMS, 5 m smoothed)
  - LC (ionosphere free) postfit residual 0.6 cm (RMS, 5 m sampled)
- **Early GPS-based POD results are excellent**
  - 2–3 mm radial RMS overlap (daily solutions) for definitive solutions
  - 1–2 mm radial RMS overlap for bias-resolved solutions
  - 1-cm radial RMS agreement with independent CNES & GSFC solutions
  - Near real-time POD process now on-line
    - **< 2.5 cm radial RMS for OGDR +0 hr**
    - **< 2 cm radial RMS for OGDR +2 hr**
    - **See poster on GPS-based NRT OGDR-SSHA (Desai and Haines)**

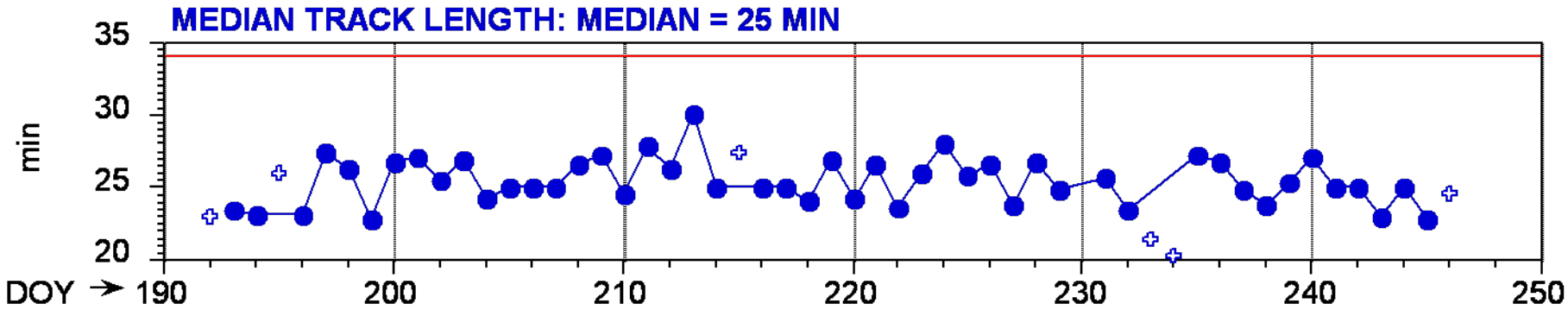
Typical Data Coverage

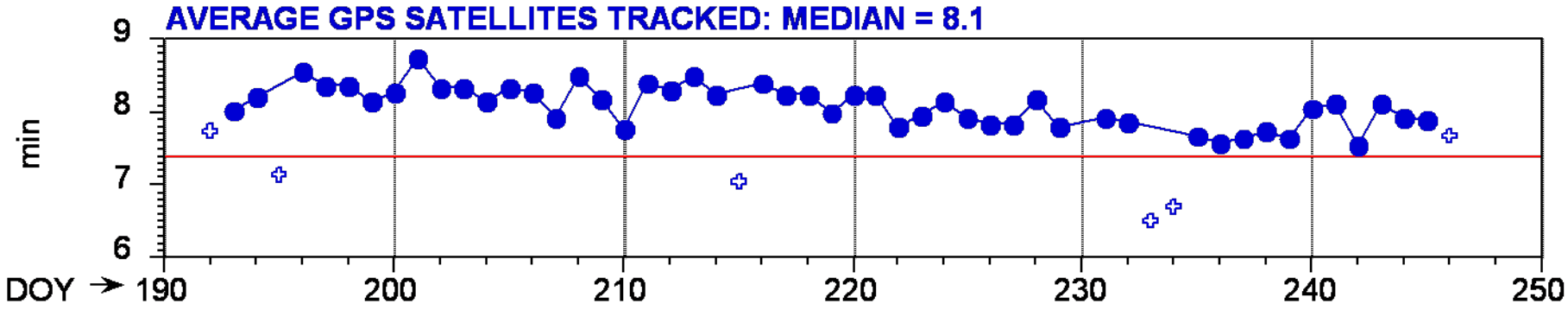


Points on map indicate locations where 4 or more GPS satellites are being tracked for the dates, Aug 10-19, 2008

Jason-2 GPSP: Daily Tracking Statistics







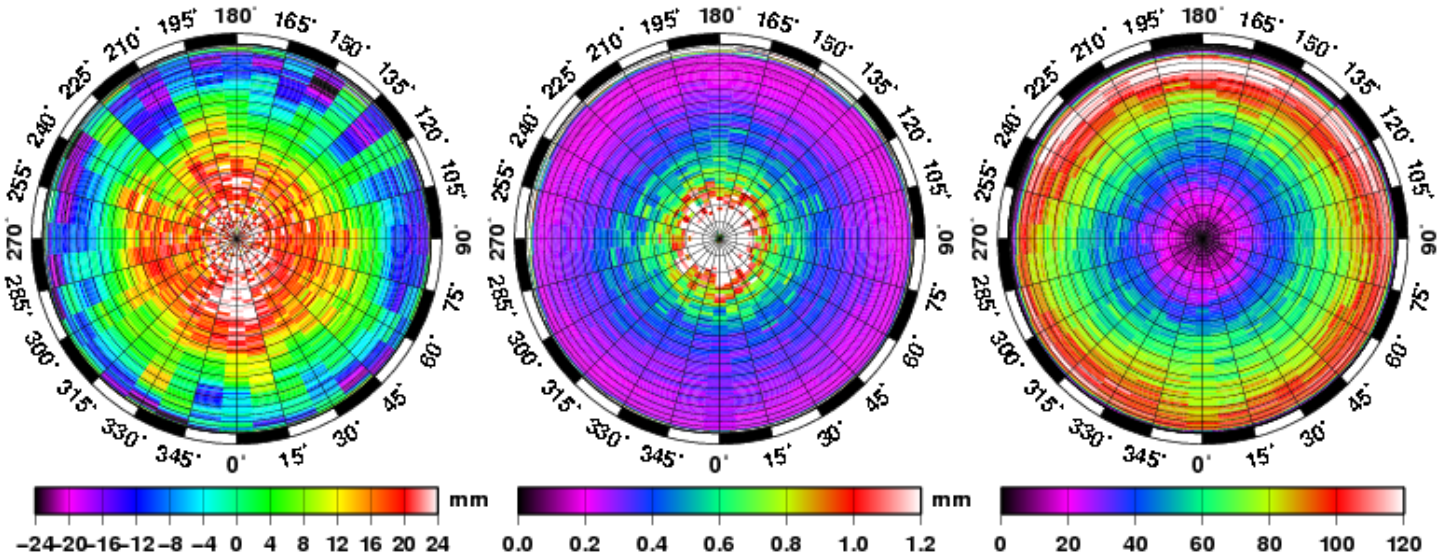
POD Strategy

- **Reduced dynamics (same as Jason-1 strategy)**
- **GGM02C (200X200) with AOD1B (thru September 14)**
- **Prelaunch (CNES) macro model for surface forces**
  - SRP coefficient estimates close to 1.0 (no addl. tuning).
- **New GPS s/c orbit and clock solutions**
  - Use IGS phase variation maps
  - Typical 1D RMS overlap (GPS s/c) of 1.5 cm (2.6 cm 3D)
  - Official JPL submission to IGS beginning Sept. 14, 2008.
  - ITRF2005 (using fiducial “tag up” solution).
- **New phase and group delay variation maps for Jason-2 antenna**
  - Transmitter reference: IGS offsets, and phase variation maps.
    - **Defaults to offset at nadir angles > 14 degrees**
  - Receiver reference: pre-launch offset only (no anechoic map)
  - Results using GRACE-based maps pending

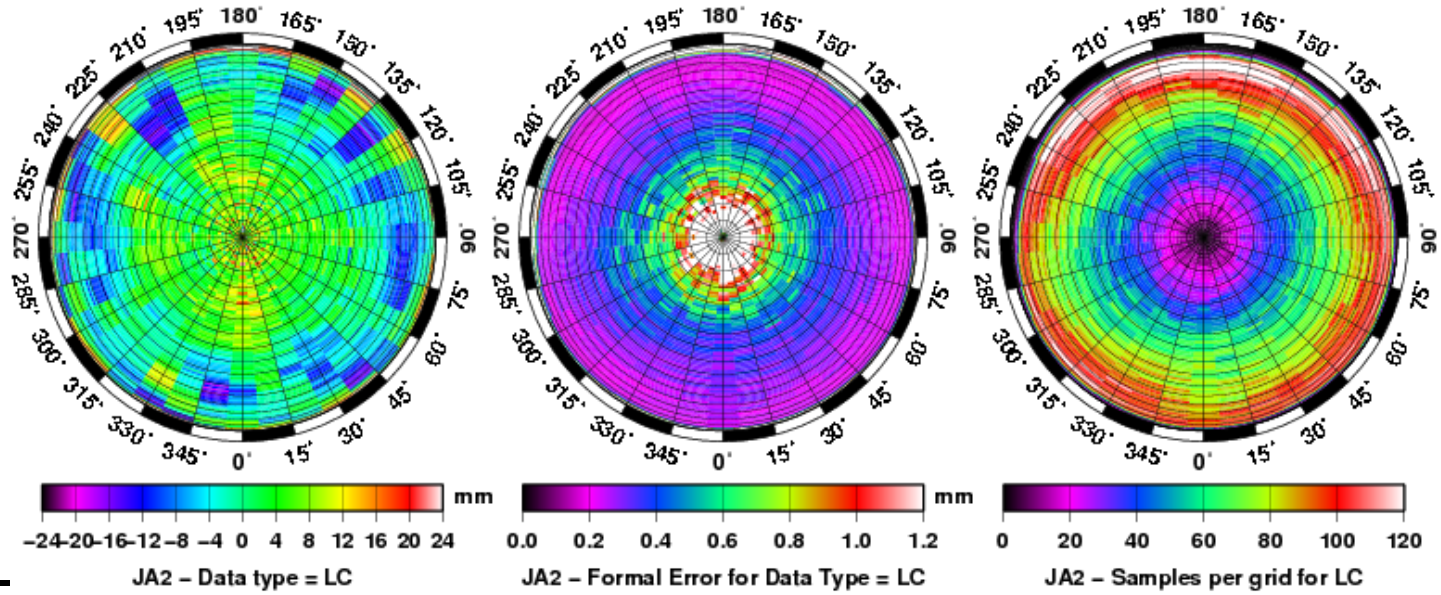
Jason-2 GPS Antenna Phase Variations

From In-Flight Data Referenced to IGS Transmitter Maps

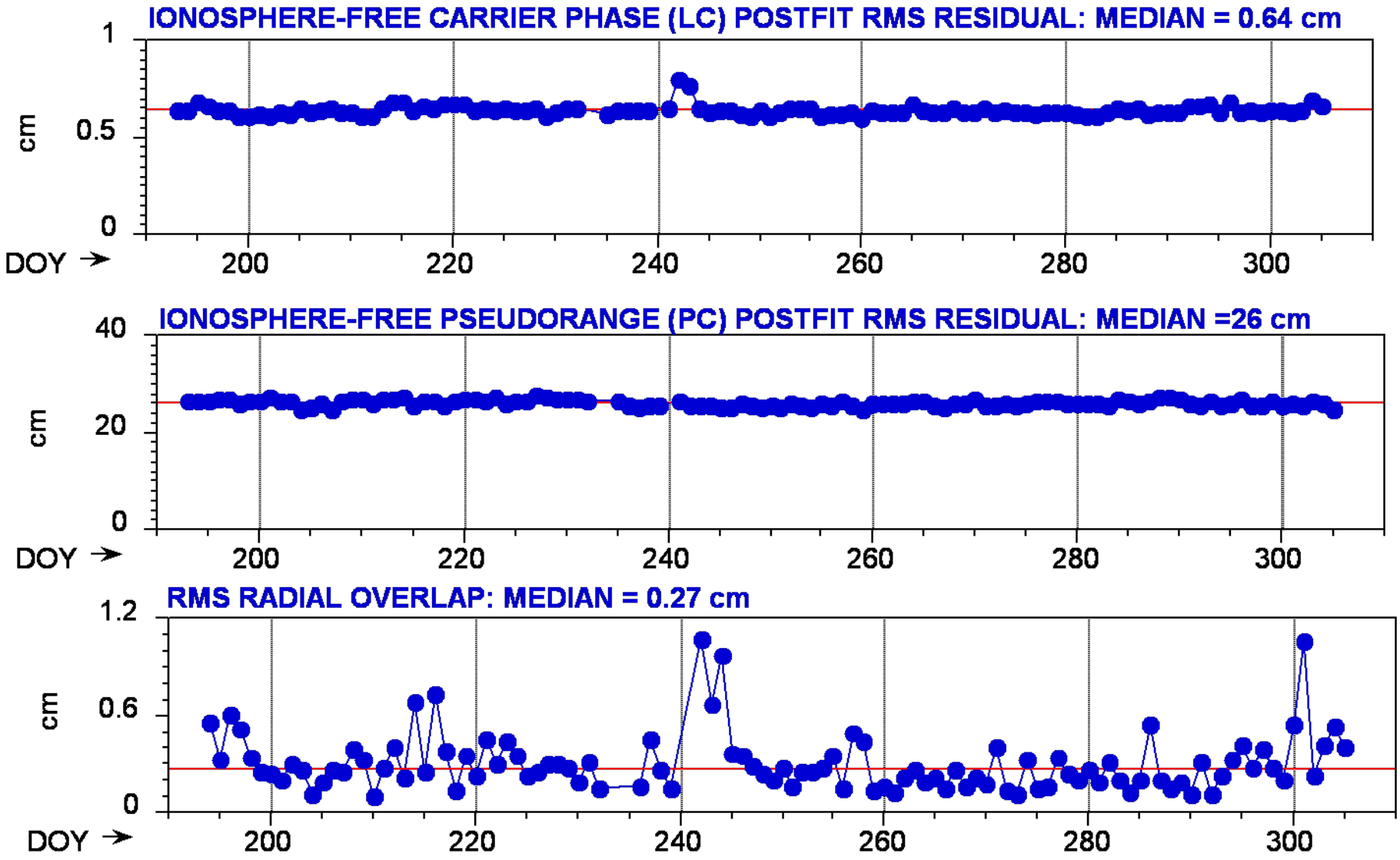
Total Correction:



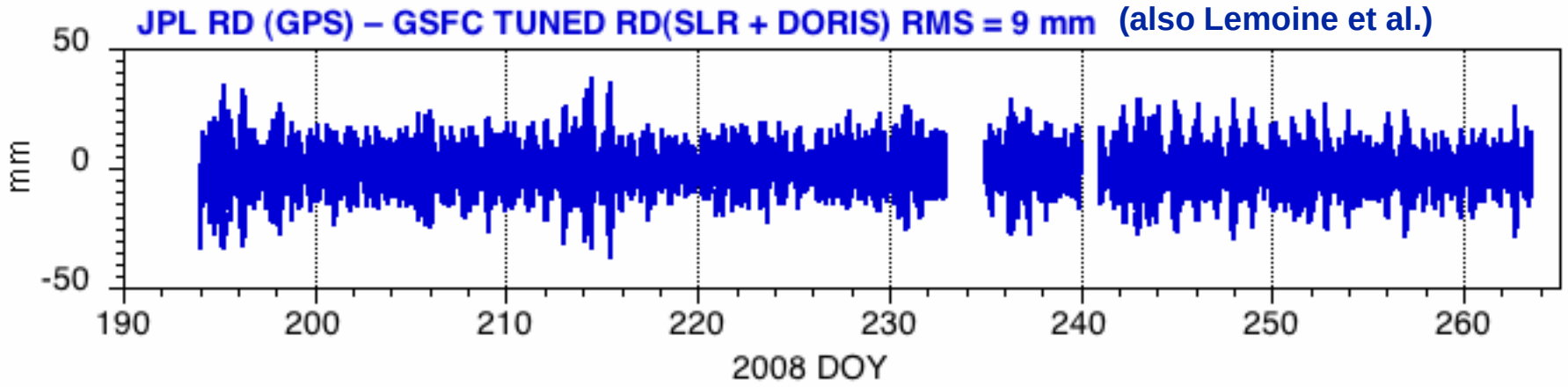
Δ Offset Removed:



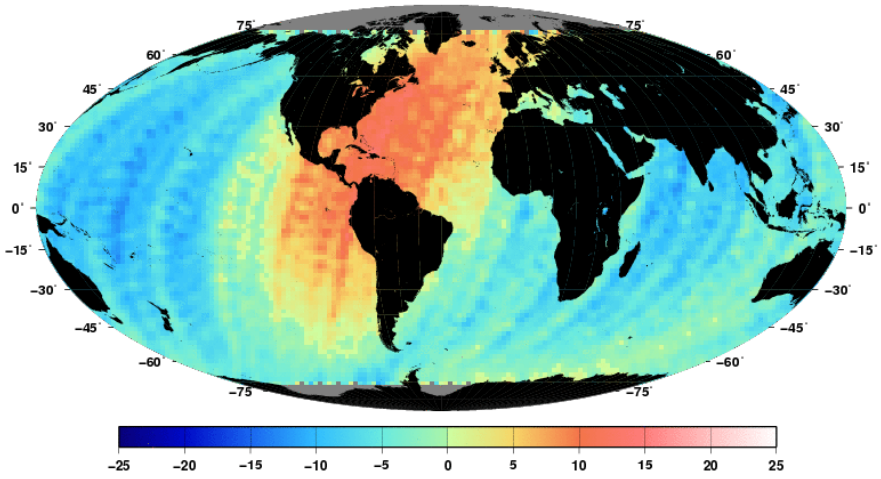
GPSP: Daily POD Statistics



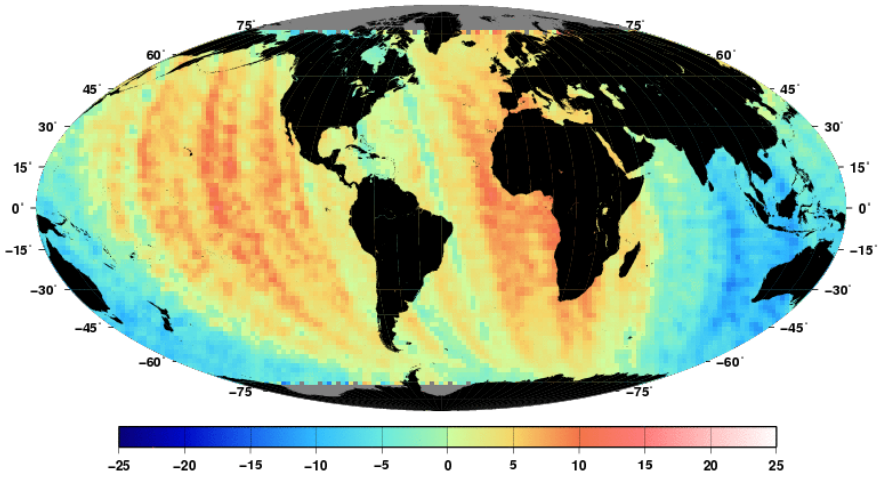
Jason-2 Radial Orbit Accuracy:
External Measure Yields <1 cm Agreement



RMS ASC = 7 mm



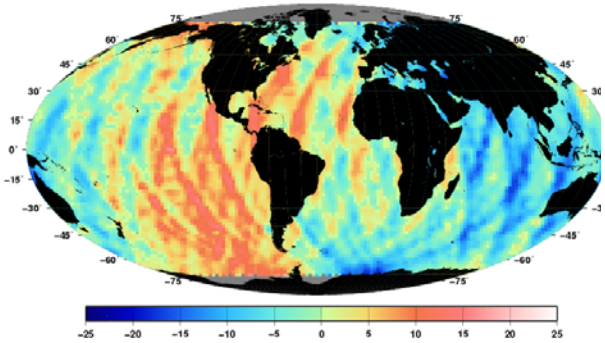
RMS DES = 6 mm



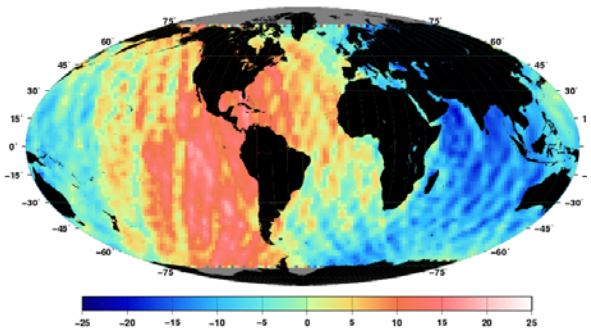
High Elevation SLR Range Biases: RMS = 15 mm, with 7 mm repeatability at both Yaragadee (N = 66) and Graz (N = 35)

Geographically Correlated Errors
JPL RD v GSFC Dynamic (Tuned) SLR+DORIS

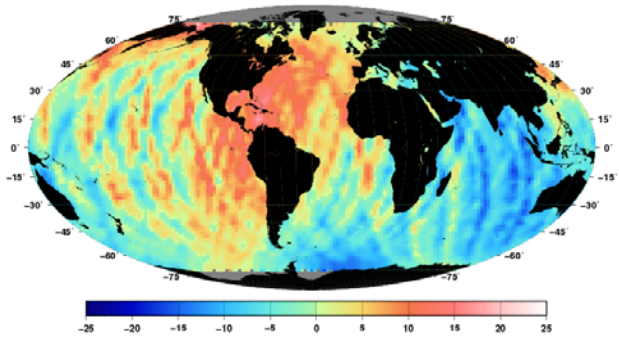
Cycle 1 RMS = 8 mm



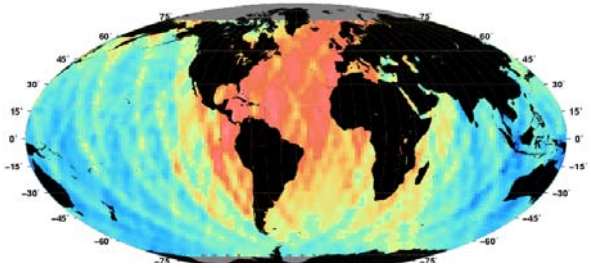
Cycle 2 RMS = 9 mm



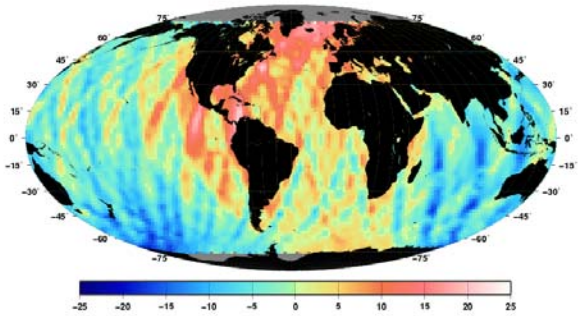
Cycle 3 RMS = 7 mm



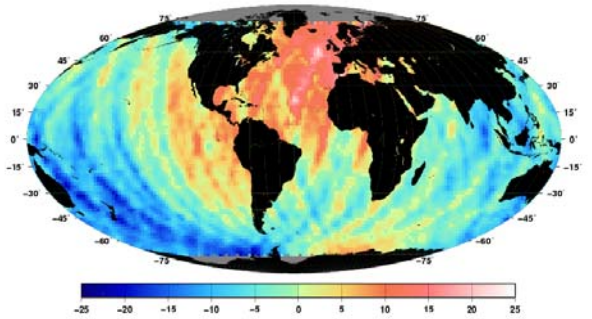
Cycle 4 RMS = 7 mm



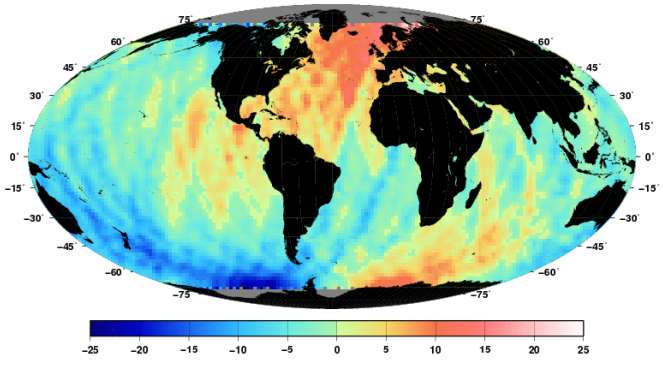
Cycle 5 RMS = 8 mm



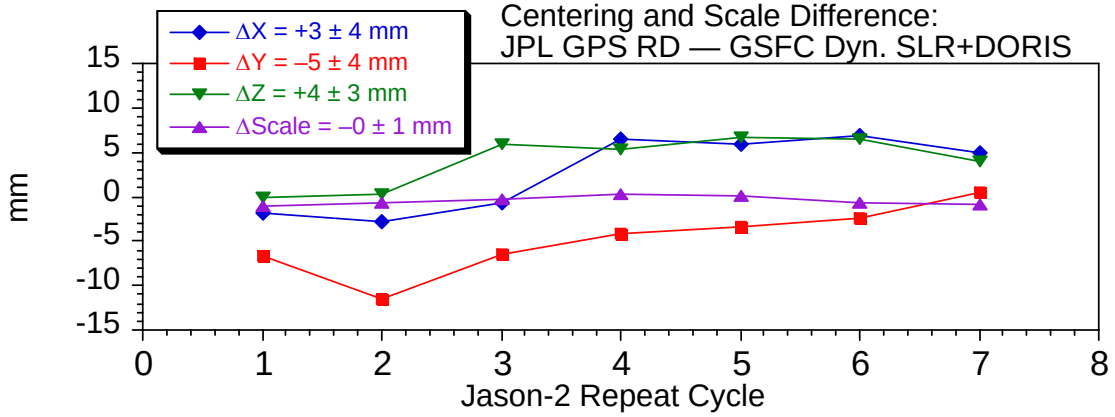
Cycle 6 RMS = 8 mm



Cycle 7 RMS = 6 mm



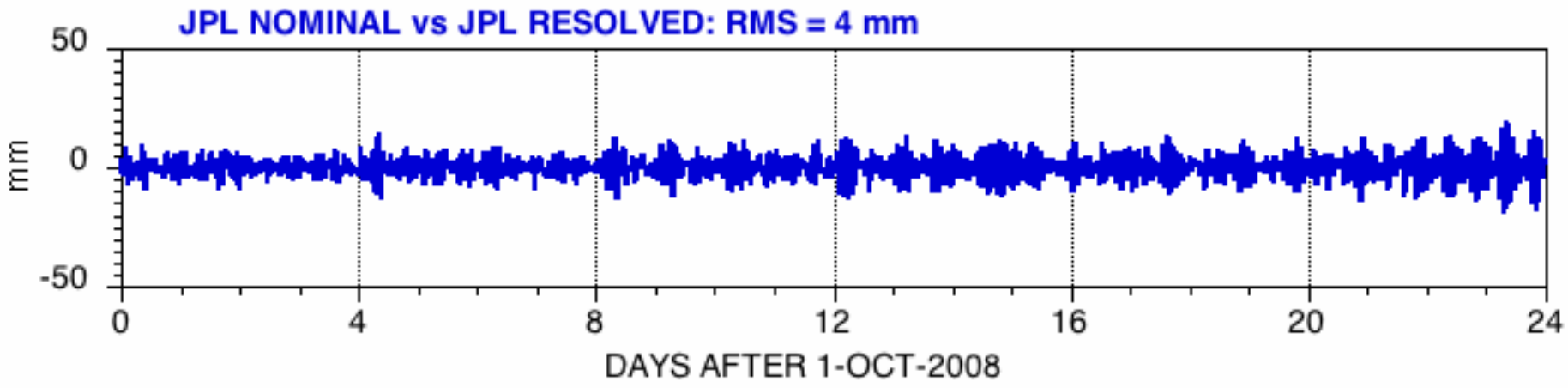
Centering and Scale Difference:
JPL GPS RD — GSFC Dyn. SLR+DORIS



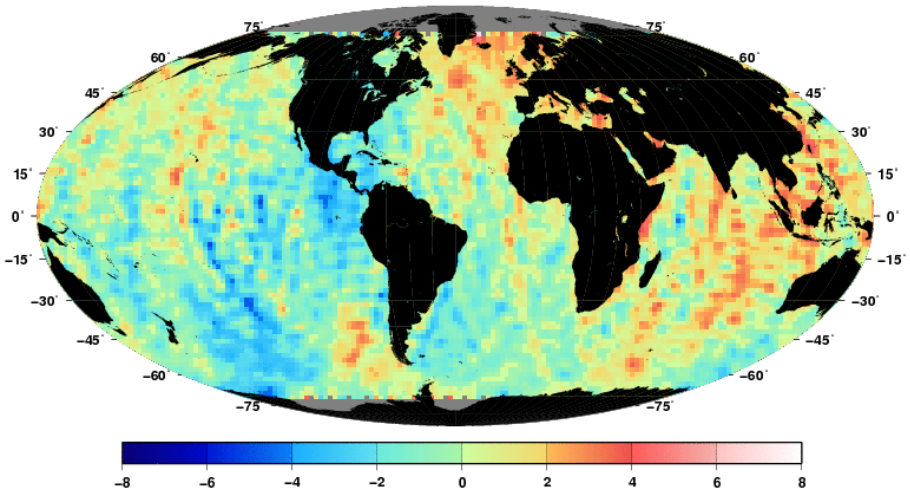
Carrier Phase Bias Resolution Experiments: Technique

- **Recover narrow and wide-lane information (ground to GPS s/c) from repository of routine global network solutions**
  - Same global network solution that provided the GPS ephemeris and clock estimates for the initial Jason-2 POD solution (biases unresolved).
- **From global solution, run solution local to Jason-2**
- **Identify double differences involving local and global (ground network) receivers**
- **Add a loose constraint for each reasonable double difference**
  - Adjusts local solution to global solution
  - Iterate (10X)
- **Tested on 24-d period (October 1–24, 2008)**

Carrier Phase Bias Resolution Experiments: POD Results: Nominal vs. Resolved



RMS = 2 mm



- Radial RMS orbit difference of 4 mm
- Median RMS radial overlap (N = 23) improves from 2.3 to 1.3 mm.
- Scatter of withheld SLR data reduced from 13 to 11 mm, improving on 24 of 24 days.
- Slight (1-mm) shift along equatorial plane.
- Small, but meaningful improvement (see also Laurichesse et al., Yoon et al.)

Summary

- **Internal POD metrics indicate < 3-mm precision (radial RMS)**
  - RMS radial overlap for bias-resolved solutions approaching 1 mm.
- **External POD metrics indicate 1-cm accuracy (radial RMS)**
  - Comparison with GSFC SLR+DORIS orbit shows 9 mm agreement (7 cycles)
  - Withheld SLR residuals approaching 1 cm (RMS); 7-mm repeatability on high elevation range biases.
- **Current flight receiver performance similar to Jason-1 (TRSR)**
  - OSTM results do benefit from improved reset and output manager behavior
  - Radiation induced outages/gaps over SAA under investigation
- **Significant POD benefit from improved GPS measurement modeling**
  - New GPS s/c ephemeris and clock products, antenna phase variation estimates
  - Improved resolution of carrier phase biases
- **POD strategy still evolving**
  - GRACE-based APV maps are the centerpiece of a new line of GPS s/c orbit and clock products.
  - GRACE-based maps well suited to LEO applications (e.g., Jason-1, Jason-2)
- **NRT POD prototype system for Jason-2 operating**
  - 2.5 cm (radial, RMS) for OGDR + 0 hr
  - < 2 cm (radial, RMS) for OGDR + 1 hr
  - NRT SSHA research product to be issued (OGDR-SSHA + GPS, see Desai talk/poster)

"POD Potential" from Kinematic Solution Reveals Effect of SAA Gaps

Kinematic Formal Error (3D)