Jason-2 Precision Orbit Determination Status

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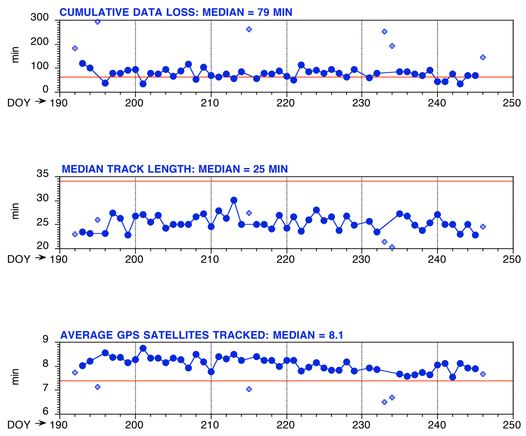
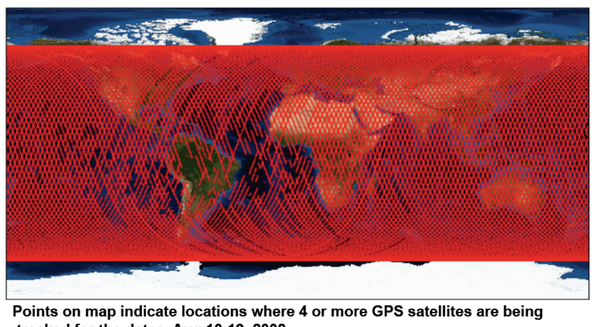
Abstract

We have begun analyzing all the available GPS data on Jason-2 to assess the accuracy and precision of the orbit determined with GPS data. After initial tuning of both the force and measurement models (antenna calibrations), our fits over 30-hours centered on noon of each day have median RMS radial overlaps of 2.7 mm (July-October 2008). In the presentation, we will discuss the details of our force modeling and our calibration of the GPS antenna phase and code centers. RMS data fit residuals are at the 6 mm level for phase and 26 cm for code when using GPS transmitter calibrations fixed to the current IGS values. Agreement with independent Jason-2 orbit solutions is at the 1-cm level (radial, RMS). Comparisons will include antenna calibration effects on reference frame and comparisons to reserved satellite laser ranging data (SLR). Finally, we discuss results from a new technique to better constrain the carrier phase biases based on global network solution products.

Tracking Data Coverage/Characteristics

- **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 0.7 cm (RMS, 5 m sampled)
- **Early GPS-based POD results are excellent**
  - 3-mm radial RMS overlap (daily solutions) for definitive 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)**





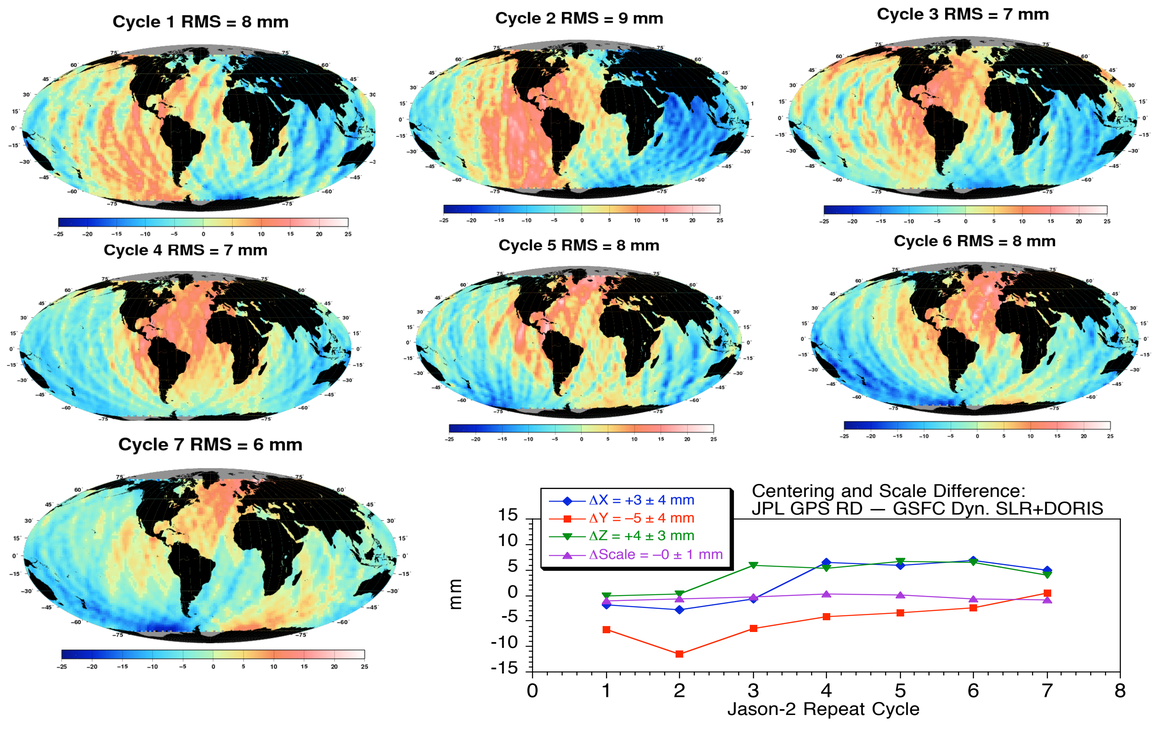
Points on map indicate locations where 4 or more GPS satellites are being tracked for the dates, Aug 10-19, 2008

Maps shows data outages due to GPSP response to radiation in the South Atlantic Anomaly (SAA). The flight receiver team is investigating s/w changes to improve tracking performance over this region.

In contrast to Jason-1 (TRSR), outages outside the SAA are very rare. This is due to pre-launch improvements in the receiver s/w, derived largely from the GRACE receiver development effort.

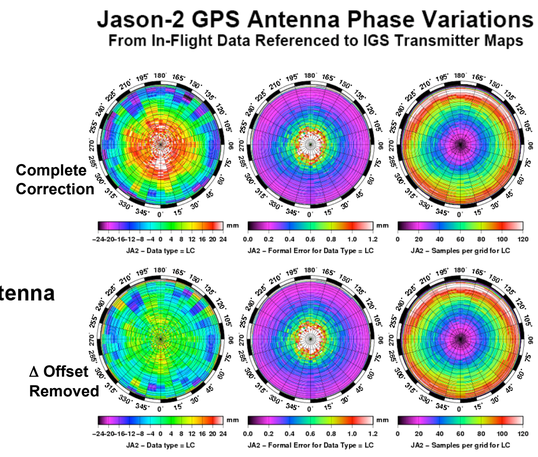
Geographically Correlated Orbit Errors

JPL GPS Reduced Dynamic vs. GSFC SLR+Doris Dynamic (see also Lemoine et al. poster)

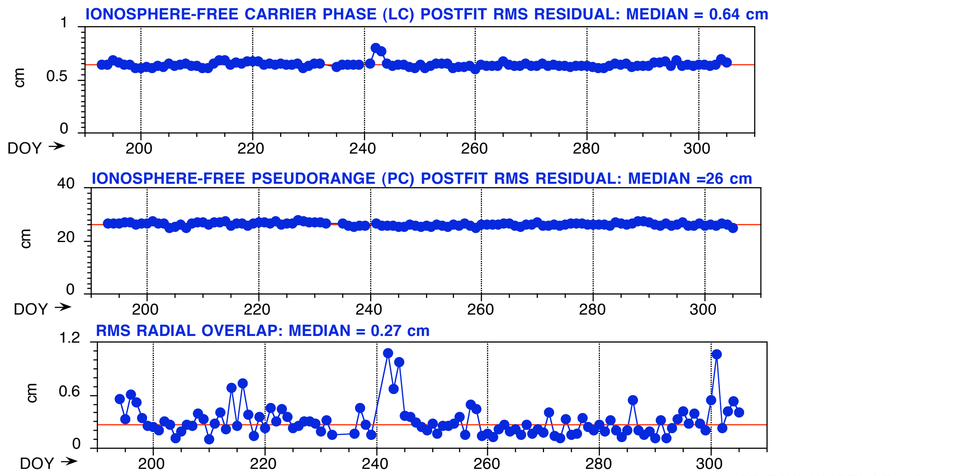


POD Strategy

- **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



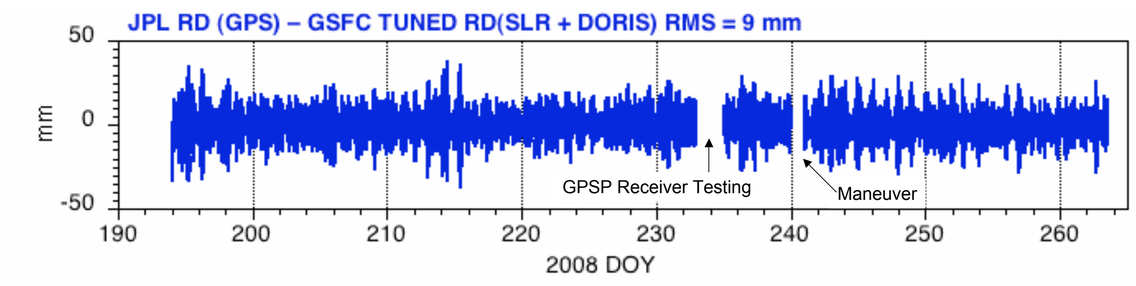
Internal Measures of Orbit Quality



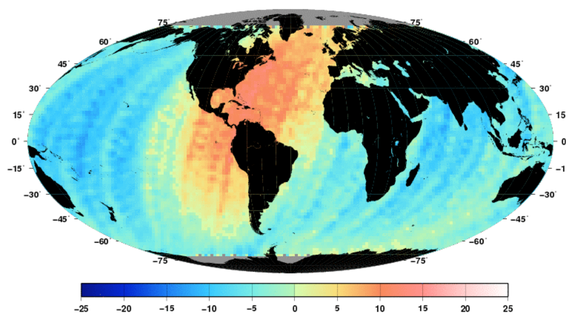
3D RSS OVERLAP = 8 mm

External Measures of Orbit Accuracy

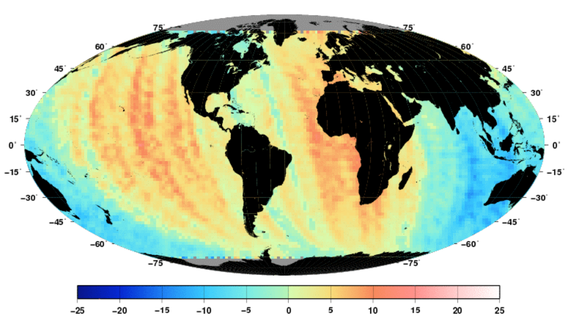
JPL GPS Reduced Dynamic vs. GSFC SLR+Doris Reduced Dynamic (see also Lemoine et al. poster)



RMS ASC = 7 mm



RMS DES = 6 mm

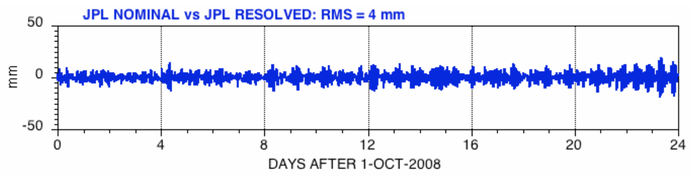


High Elevation SLR Range Biases: RMS = 15 mm, with 7 mm repeatability at both Yaragadee (N = 66) and Graz (N = 35)

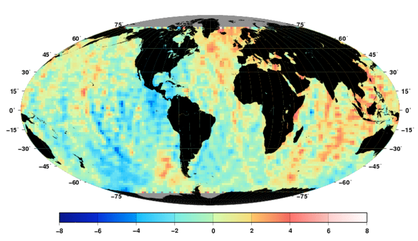
Carrier Phase Bias Resolution

- **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)**

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.)