An Introduction to the GPS-OGDR-SSHA Product for OSTM/Jason-2

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Abstract

We present a quantitative assessment of a new OSTM/Jason-2 value-added near-real-time (NRT) sea surface height product, the GPS-OGDR-SSH product. This research-grade product is identical to the formal OGDR-SSH product, except for two additional fields: a GPS-based orbit altitude, and a sea surface height anomaly derived by replacing the DORIS-DIODE orbit with the GPS-based orbit altitude. The GPS-OGDR-SSH product is typically available within 3.5-5 hours of real time and the GPS-based orbit altitude on the product has typical accuracies of < 1.0 cm (RMS). We describe the approach used to compute the NRT GPS-based orbit for OSTM/Jason-2 and present results that demonstrate the orbit accuracy. We also provide a comparison between the sea surface height component measurements provided on the OSTM/Jason-2 (GPS-)OGDRs and I/GDRs to assess their relative accuracy, particularly in light of the accuracy of the NRT GPS-based orbits. The GPSOGDR-SSH product is available via ftp at the Physical Oceanography Distributed Active Archive Center (PO.DAAC), ftp://podaac.jpl.nasa.gov/pub/sea_surface_height/ostm/preview/.

Motivation: OGDR-SSHA vs. IGDR SSHA

- **GOAL: Improve accuracy of OSTM/Jason-2 NRT OGDR-SSHA by improving accuracy of NRT orbit for OSTM/Jason-2**

SSHA Parameter		OGDR	IGDR	RMS Difference, IGDR-OGDR (mm)
Orbit Altitude		**DIODE (DORIS)**	**MOE (DORIS)**	**38**
Ku Range		Retracked	Retracked	22
Dry Troposphere		Predicted	Analyzed	2
Wet Troposphere:	AMR	Uncalibrated	Uncalibrated	< 1
	Model	Not Available	Available	
Ionosphere:	ALT	Dual frequency	Dual frequency	13
	Model	Not Available	Available	
Sea State Bias		Uncalibrated	Uncalibrated	4
Inverse Barometer		Predicted	Analyzed	9
Pole Tide		Predicted	Predicted	0
HF Dealiasing		Not Available	Preliminary	
OGDR-SSHA				**47**

The GPS-OGDR-SSHA Product

Two GPS-based fields added to the OSTM/Jason-2 OGDR-SSHA product:

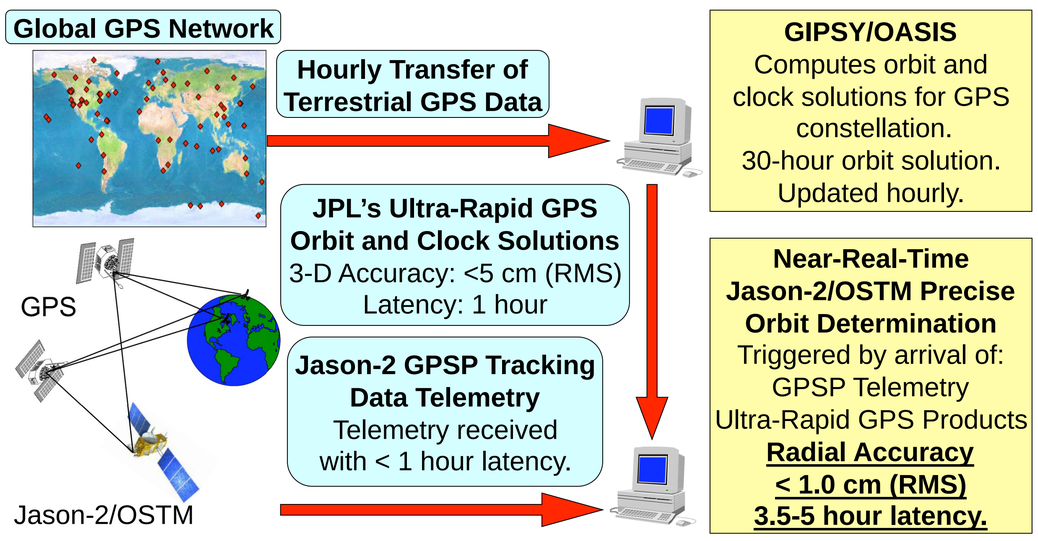
- Orbit altitude derived from near-real-time GPS-based precise orbit determination (POD) of OSTM/Jason-2. (gps_alt)
  - **Radial orbit accuracy of < 1 cm (RMS).**
- Sea surface height anomaly derived from GPS-based orbit altitude. (gps_ssha)
- **Typical latency of 3.5-5 hours (or lag of 1 OGDR).**

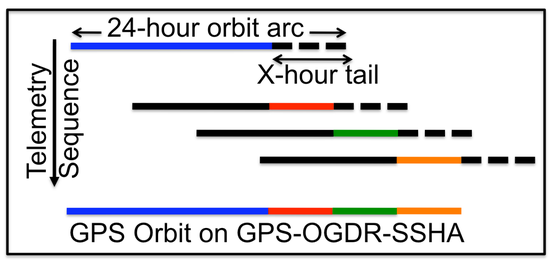
- Product released starting June 8, 2009.
- Available at PO.DAAC: ftp://podaac.jpl.nasa.gov/pub/sea_surface_height/ostm/preview/

JPL's Ultra-Rapid GPS Orbit and Clock Product

- New product with orbit and clock solutions of GPS constellation.
  - **3-D orbit accuracy of < 5 cm (RMS).**
  - **Latency of 1 hour.**
  - **Enables ambiguity resolved positioning and orbit determination.**
- Computed using GIPSY/OASIS software with backward smoothing and ambiguity resolution.
- Uses optimally distributed 40 out of 140 global terrestrial GPS sites.
- **Used for NRT GPS-based POD for OSTM/Jason-2 since May 30, 2009.**

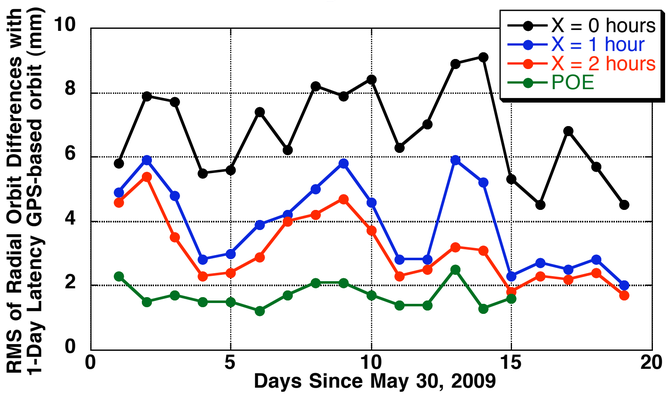
GPS NRT Orbit Determination Approach





- 24-hour POD arcs ending with each new telemetry dump.
- Ignore X-hours of tail of orbit solutions.
  - Tested X = 0, 1, and 2 hours.
- Append orbit solutions where not already defined.
- **X = 1 hour adopted in GPS-OGDR-SSHA.**

Orbit Differences with Next Day Precise GPS-based Orbit

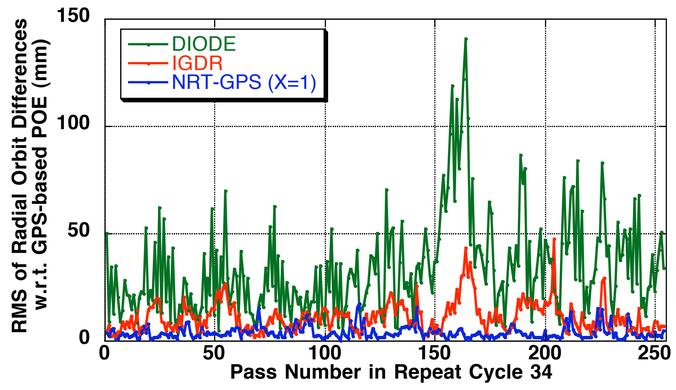


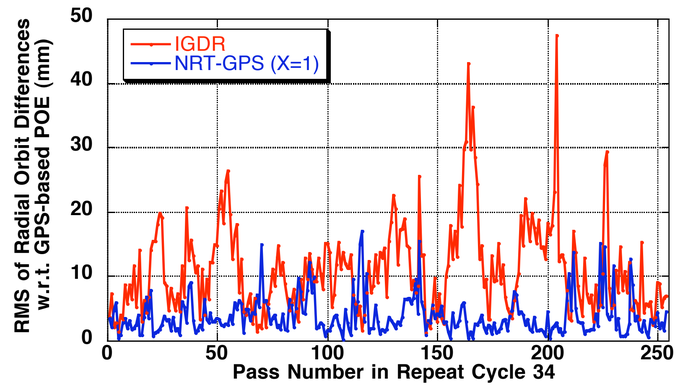
Average of Daily Radial RMS of Orbit Differences w.r.t. Next-day Orbit.

GPS-based Orbit	Average (mm)
NRT, X=0	6.8
NRT, X=1	3.9
NRT, X=2	3.1
GPS POE	1.7

- GPS-based next day and GPS-based POE agree to < 2 mm (RMS).
- 1-hour orbit cutoff requires latency of 1 OGDR lag, but provides significant (2.9 mm RMS) gain in radial orbit accuracy.
- 2-hour orbit cutoff provides additional 0.8 mm (RMS) improvement in radial orbit accuracy, but requires lag of 2 OGDRs.

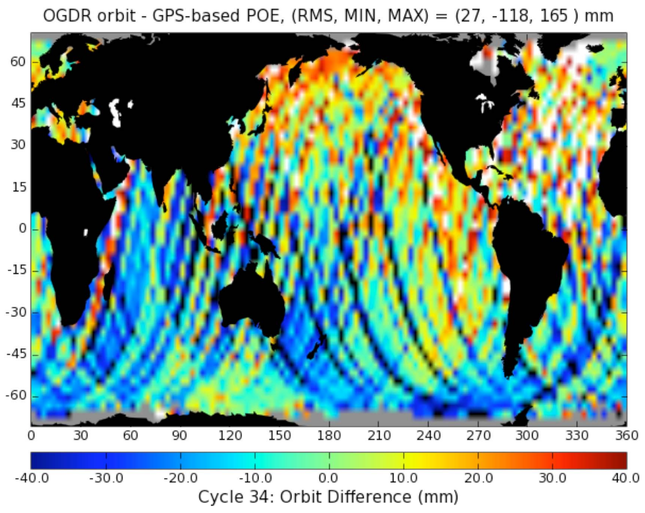
Orbit Differences with GPS-based POE: Repeat Cycle 34

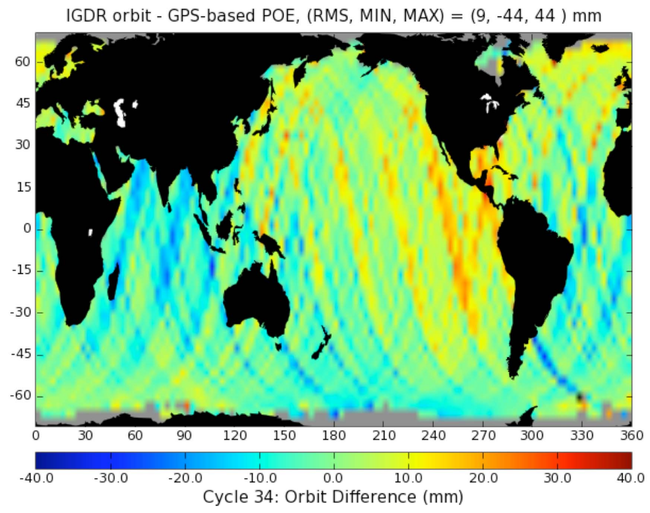


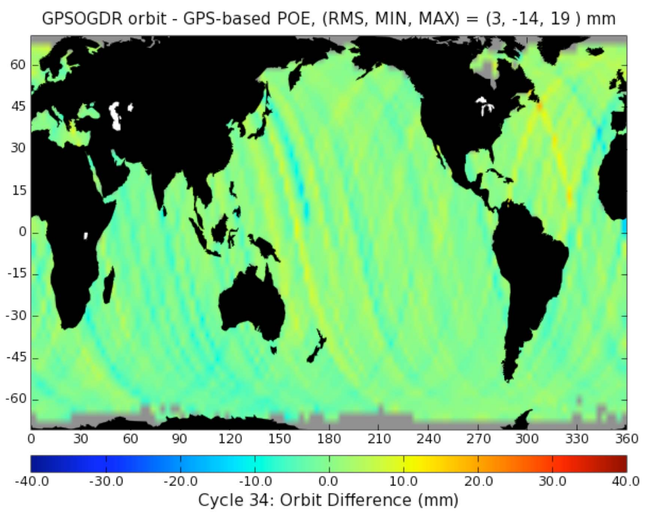


- RMS of differences over complete cycle 34:
  - DIODE: 40.9 mm, IGDR: 12.9 mm, NRT-GPS 4.8 mm
- Over entire cycle, NRT-GPS orbit has better agreement with GPS-based POE than IGDR orbit.
  - Some passes where IGDR orbit has better agreement with GPS-based POE.

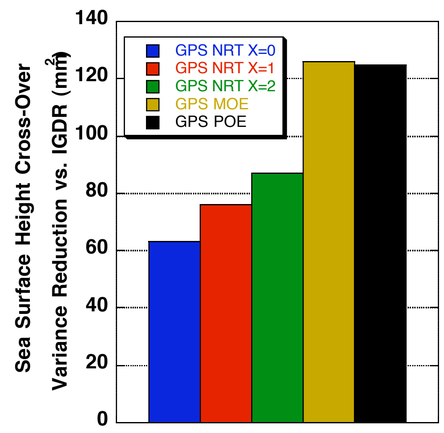
Geographically Correlated Orbit Differences: Repeat Cycle 34







Sea Surface Height Cross-Over Variance Reduction w.r.t. IGDR orbit.



- GPS-OGDR orbit provides order of magnitude reduction of geographically correlated errors compared to OGDR orbit.
- All GPS-based orbits provide smaller SSH cross-over residual variance than IGDR orbit.
- GPS-based next-day and POE orbits statistically identical.
- Cross-over residual variance with GPS-based POE smaller than with GPS-OGDR orbit by 49 mm²
- **GPS-OGDR orbit has radial orbit accuracy of < 1 cm (RMS).**

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