



Time-Variable Gravity, Geocenter and Jason-2 Orbit Determination With GPS

Willy Bertiger, Shailen Desai, Angie Dorsey, Miquel Garcia-Fernandez, Bruce Haines, Felix Landerer, Aurore Sibois, David Wiese, Dah-Ning Yuan

Jet Propulsion Laboratory, Calif. Inst. of Tech., Pasadena CA USA







GPSP-B max sats = 8; GPSP-A max sats = 12





- GPSP-A
 - On 8/23/2014, GPSP-A began resetting repeatedly every 31 seconds
 - GPSP-A has been running since 6/22/2008
 - The GPSP lifetime requirement is 3 years
 - The cause of the anomaly is unknown
 - Based on the primary current signature, may be a system crash
 - It is unknown if the cause is hardware or software
 - The anomaly does not appear to be a corrupted software
 - Ground tests on exact copy
 - A full software reload is not recommended at this time
- GPSP-B
 - Powered on 8/26/2014
 - did not initially return POD data
 - Began functioning properly and outputting data on 9/10/2014
 - No definitive explanation, should be independent of diagnostic upload Sept. 8
 - Degrades on the L2 frequency when the temperature increases $1^{\circ}-2^{\circ}C$
 - Temperature control is under investigation
 - Fit residuals overlaps not as good as (PC: 27.4 cm LC: 5.5 mm > GPSP-A PC: 22.0 LC: 3.3)
 - Antenna map
 - Radial Overlaps not as good (3.5 mm > GPSP-A 1.1 mm)
 - Antenna map, not as many sats





- POD with GPS
- Time Variable Gravity
 - EIGEN-6S2.extended.v2, CNES/GRGS
 - JPLRL05Mtvg
 - Atmospheric/Ocean de-aliasing
 - 3-Hr ITRF2013 AOD (till June 2014)
 - Pascal Gegout, CNRS/GET/GRGS
 - GRACE AOD1B (6-Hr Time Series, with recent corrections)
- Geocenter
 - SLR consensus annual model (John Ries 2013 AGU)
 - GPS No Net Rotation Model (NNR)





- Rlse14a = Rlse13a + JPLRL05Mtvg + GPS_{repro}
- Reduced-Dynamic, Bias Fixed
- Fiducial (ITRF2008) JPL Repro 2.1(2014)
- GPSP-A
- Cycles 1-225, July 2008 Aug. 2014





Crossovers cycles 1-223

	Crossover variance (mm ²)			
EIGEN-6S2.extended.v2 CNES/GRGS	1567.281			
JPLRL05Mtvg with GRACE _{J2}	1567.926			
JPLRL05Mtvg uses SLR _{J2}	1567.597			
GDRD	1613.567			

$$\frac{\sqrt{1567.926 - 1567.281}}{2} \approx 0.4 mm$$
$$\frac{\sqrt{1613.567 - 1567.281}}{2} \approx 3.4 mm$$



Annual Radial JPLRL05Mtvg – EIGEN6S2extended Scale 0.1 mm, 6°x6° Bins







Radial Drift JPLRL05Mtvg – EIGEN6S2extended Scale 0.1 mm/yr, 6°x6° Bins

















Cycle



Crossover Variance JPLRIse14a—GDRE Cycles 1-223 (missing about 10)







Geocenter Models











Inter-Cycle Crossover Geocenter Model Tests Cycles 1-164, Units: mm²



GDRD			Rlse14a		Rlse14a+SLR			Rlse14a+NNR			
Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.	Mean	Median	S.D.
9114.19	9261.035	1279	9122.83	9289.785	1296	9187.00	9348.065	1324	9103.07	9242.28	1288





JPLrlse14a — GDRE Looks Like Geocenter







Quacks Like Geocenter Cycles 1-164











- Switch to GPSP-B currently degraded
 - There is hope for improvement
- GDRD agrees with Rlse14a at the 6.3 mm level
 - Crossovers suggest Rlse14a is more accurate
- TVG effects are at the few 0.1 mm annual and few 0.1 mm/yr drift level
- Geocenter errors have a complex transfer function
 - Accuracy tests need work
 - Effects are about 50% of the model with bias fixing
- GDRE agrees with Rlse14a at the 4.4 mm level
 - Further investigation of Geocenter modeling, good initial agreement













GSFC SLR/DORIS(1404) Reduced Dynamic vs JPLrlse14a









Geocenter Shifts Near Zero Without Bias Fixing

















