The JPL IGS Analysis Center: Status and Plans

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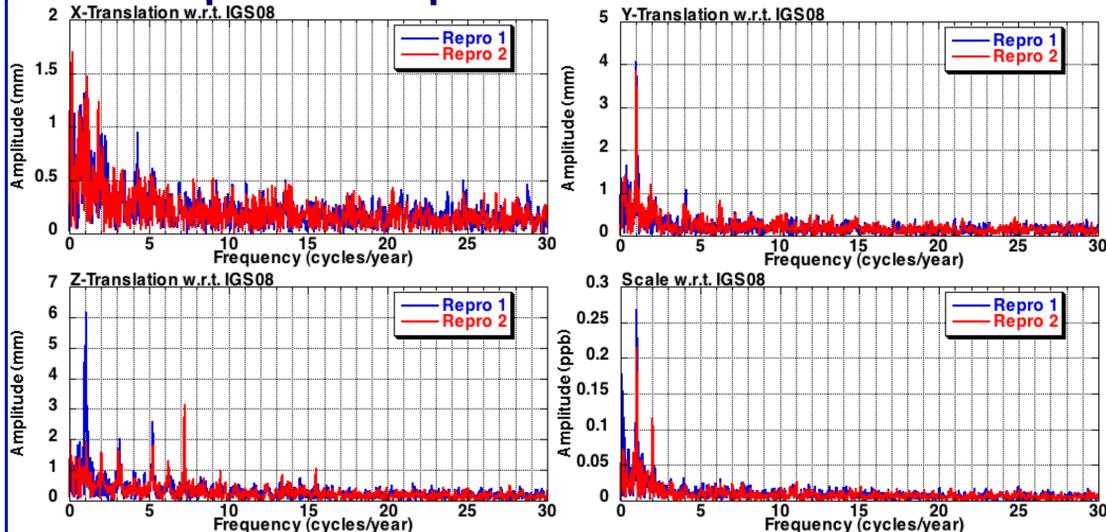Contact: shailen.desai@jpl.nasa.gov

Abstract

We present an overview of the activities being performed by the Jet Propulsion Laboratory (JPL) in support of the International GNSS Service (IGS). The JPL IGS Analysis Center will contribute products from a reanalysis of global GPS data from 1993-present to the next IGS reprocessing campaign, using our GIPSY/OASIS software package. In particular, we will deliver solutions for the orbit positions and clock biases of the GPS constellation of satellites, Earth Orientation Parameters, daily SINEX files with station positions, troposphere observations, and yaw rates for the GPS satellites. Our clock products will include 5-minute solutions for the full reanalysis period, and 30-second solutions for 1996-present.

We present results from a first reanalysis of GPS data from 1994-present for the IGS "Repro 2" campaign. This first reanalysis used the recently released IGS08 reference frame and associated antenna calibrations, IERS 2010 standards, and an updated solar radiation pressure model (GSPM10). We show that the precision of these new orbit and clock products improves by an average of 25 and 12 percent, respectively, compared to our products from the first IGS reprocessing campaign. **More importantly, our most recent reanalysis also includes products that enable single receiver ambiguity resolved positioning for the entire duration (1993-present), which are automatically applied when performing positioning with the GIPSY/OASIS software.** We show that 30-70% variance reduction in station repeatability is achieved from the cumulative effect of our improved orbit and clock products and the capability to perform single receiver ambiguity resolved point positioning. Typical east, north and up station repeatabilities of 2, 2, and 6 mm are achieved for daily static precise point positioning, and 6, 7, and 16 mm for unconstrained white noise 5-minute kinematic point positioning.

We conclude by presenting our plans for the minor adjustments that will be made prior to a second reanalysis from 1993-present for submission to the next IGS reprocessing campaign, and plans for the next release of the GIPSY/OASIS software, version 6.2.

GPS Orbit/Clock "Repro 2" Reprocessing Strategy
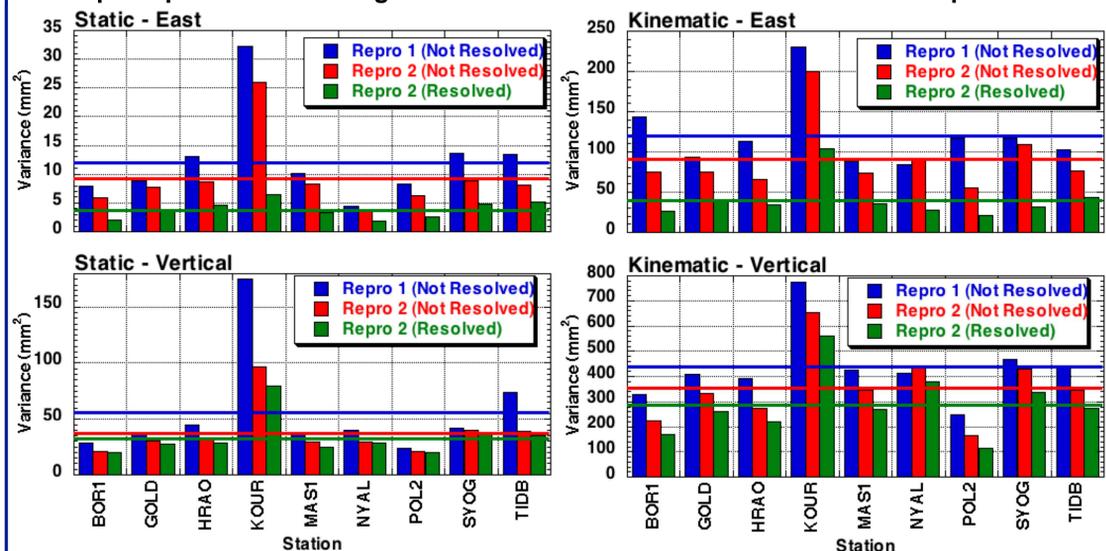
Orbit Arc	30 hours
Number of Stations	80 (40-80 before 1995-04-17)
Elevation Angle Cutoff	7 degrees
Station Information	IGS08 SINEX and Discontinuity
Receiver/Transmitter Antenna Calibrations	igs08.atx
Troposphere Mapping Function	GMF
A Priori Dry Troposphere Model	GPT
Solid Earth Tide (Geometric and Gravity)	IERS2010
Pole Tide (Geometric and Gravity)	IERS2010 (IERS2010 Mean Pole)
Ocean Tide Loading Model	FES2004 with harddisp.f
Earth Orientation	IERS 2010 Tidal Model, EOPC04 (ITRF08)
Nutation	IAU2006A
Static Gravity Field	EGM2008 (12x12, C20, C30, C40, C21, S21 per IERS 2010)
Ocean Tide Gravity Field	FES2004 (convolution)
Solar Radiation Pressure	GSPM10 (JPL)
Albedo Model	Knocke (1989)
Transmitter Clocks	5-minute and 30-second Products
Yaw Rates	**To be estimated for IGS submission**
Second Order Ionosphere Model	**To be applied for IGS submission**
S1/S2 Atmospheric Loading Model	**To be applied for IGS submission**

GPS Orbit and Clock Precision
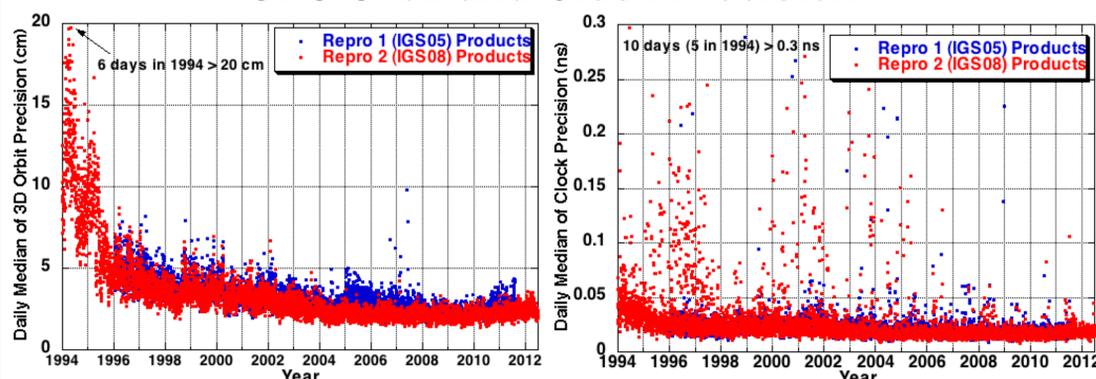
- Precision = RMS of differences during middle 5 hours of 6-hour adjacent-day overlap period.
- Average variance reduction (Repro 2 vs. Repro 1): 25% for orbits; 12% for clocks.
- 1993 products expected by August 2012.

Impact of "Repro 2" on Reference Frame

	Bias (Epoch=2005.0, mm and ppb)				Drift (mm/yr and ppb/yr)			
	TX	TY	TZ	Scale	TX	TY	TZ	Scale
Repro 1	-1.1	-4.0	-9.1	1.1	-0.4	-0.1	0.2	-0.03
Repro 2	-0.3	-4.4	-12.3	-0.2	-0.6	0.2	0.5	0.00

- Most noticeable impact on Z-Translation and Scale (Draconitic/annual frequencies, stability.)
  - New solar radiation pressure force model (GSPM10 vs. GSPM04)
  - New antenna calibrations (IGS08 vs. IGS05)
  - Repro 2 currently does not use 2nd order ionosphere model. Repro 1 used model.

Station Repeatability From Precise Point Positioning

	Static Point Positions (mm)			Kinematic Point Positions (mm)		
	East	North	Up	East	North	Up
Repro 1 (Not Resolved)	3.5	2.4	7.5	11.0	10.0	20.8
Repro 2 (Not Resolved)	3.0	2.1	6.1	9.5	8.8	18.9
Repro 2 (Resolved)	**2.0**	**2.0**	**5.8**	**6.3**	**7.2**	**16.9**

30-70% average variance reduction in station repeatability from improved accuracy of orbit and clock products, AND using GIPSY/OASIS single receiver ambiguity resolution.

- 9 stations selected for global coverage and > 12-year occupation history.
- Static Point Position = Use PPP to estimate 1 station position every day.
- Kinematic Point Position = Use PPP to estimate 1 station position every 5 minutes.
- **GIPSY/OASIS can perform single receiver ambiguity resolution during PPP using Repro 2 products. Most significant relative variance reduction in east component.**

GIPSY/OASIS Status

- **Current released version is GIPSY 6.1.2 (January, 2012).**
  - **Single receiver ambiguity-resolved PPP using released "Repro 2" orbit and clock products.**
- Version 6.2 release expected by December 2012.
  - Improved second order ionosphere model.
  - Addition of S1/S2 atmospheric loading model.
  - Addition of albedo modeling for Block I satellites.
- Version 6.2 to be used for "Repro 2" orbit/clock/sinex file submission to IGS.