Recent Developments and Plans at the JPL Analysis Center

S. Desai, W. Bertiger, B. Haines, D. Kuang, M. Miller, C. Lane, F. Webb, and J. Weiss

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, U.S.A.

Abstract

We present an overview of the recent developments in the processing of global GPS data at the Jet Propulsion Laboratory IGS Analysis Center. We detail the resulting improvements in accuracy of the primary products, namely the estimates of the precise GPS orbits and clocks. We describe changes that will be implemented before we begin to reprocess these data for our submission to the IGS reprocessing campaign. We also describe the primary changes to the models and capabilities of the GIPSY-OASIS software package, particularly with regards to the new capabilities of the version 5.0 release of GIPSY. GIPSY version 5.0 will be released on June 3, 2008.

Precise Orbit Determination System for GPS Satellites

JPL's legacy precise orbit determination (POD) system retired on August 25, 2007 (GPS week 1441).
- Originally developed in 1992.
- Composed primarily of C-shell and Perl scripts wrapping around the GIPSY/OASIS software package.
- Became difficult to maintain and modify.
- Lagged development of GIPSY and IGS progress.

**New POD system implemented operationally on August 26, 2007 (GPS week 1442).**
- Composed of Python and Perl scripts wrapping around GIPSY.
- Significantly more modular, robust, and maintainable.
- Presently operating in two modes.
  1) Implements new POD strategy for JPL's contribution to IGS, and to generate new format of JPL's GPS products for GIPSY users.
  2) Implements legacy POD strategy and generates legacy format of JPL's GPS products for GIPSY users, to maintain continuous time series.

- **GIPSY users to transition to new format of GPS products by end of 2008.**
- **Reprocessing of 2000-2008 to begin in July 2008, adopting numerous changes to POD strategy. Expected to be completed by end of 2008**
- **Reprocessing of 1999 and earlier to be attempted starting October 2008.**

## Precise Orbit Determination Strategies: History and Reprocessing

|	Legacy Strategy	Current Operational Strategy	Reprocessing Strategy
Orbit Arc	30 hours	30 hours	30 hours
Number of Stations	80	80	80
Elevation Angle Cutoff	15 degrees	15 degrees	**7 degrees**
Station Information	JPL Database	**IGS Sinex**	**IGS Sinex**
Receiver Antenna Calibrations	JPL Database	**igs05.atx**	**igs05.atx**
Transmitter Antenna Calibrations	Manufacturer and JPL	**igs05.atx**	**igs05.atx**
Troposphere Mapping Function	Niell	Niell	**GMF**
Dry troposphere	Height scale	Height Scale	**GPT**
Earth Orientation	IERS1996, Bulletin B	IERS1996, Bulletin B	**IERS2003, Bulletin A**
Ocean Loading Model	FES2002	FES2002	**FES2004**
Ocean Loading Nodal Terms	GIPSY	GIPSY	**harddisp.f**
Center of Mass Correction	No	No	**Yes**
Gravity Field	JGM3	JGM3	**GRACE Static**
Ocean Tides	CSR3.0	CSR3.0	**FES2004**
Yaw Rates	Nominal	Nominal	**Nominal+Estimated**
Albedo Model	Not Applied	**Applied**	**Applied**

Orbit Quality Metrics
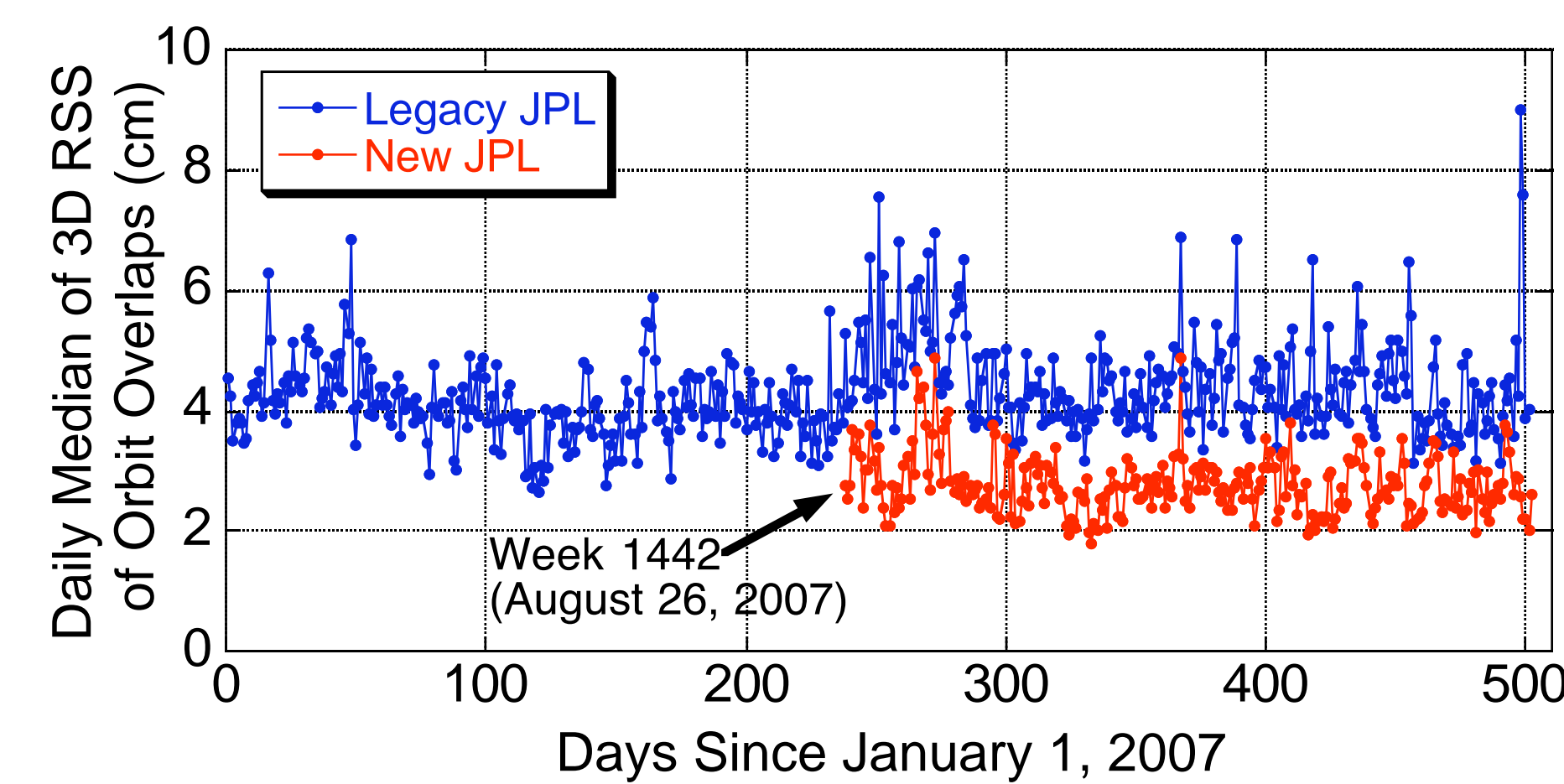
60% average variance reduction in orbit overlaps (4.5 to 2.8 cm).
- 3D RSS of orbit overlap differences computed for middle 5 hours of 6-hour daily overlap.
- Overlaps provide measure of self-consistency and precision.
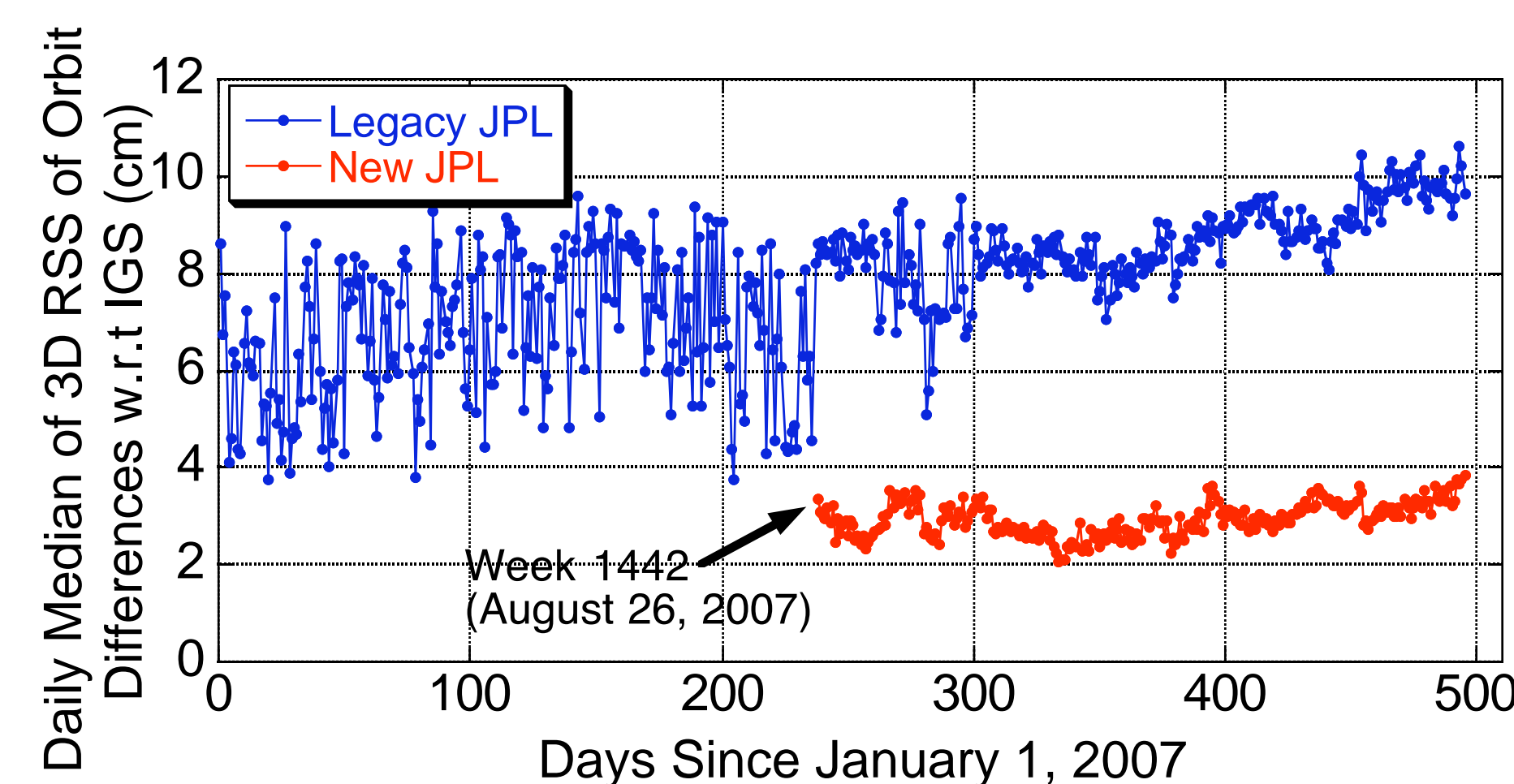
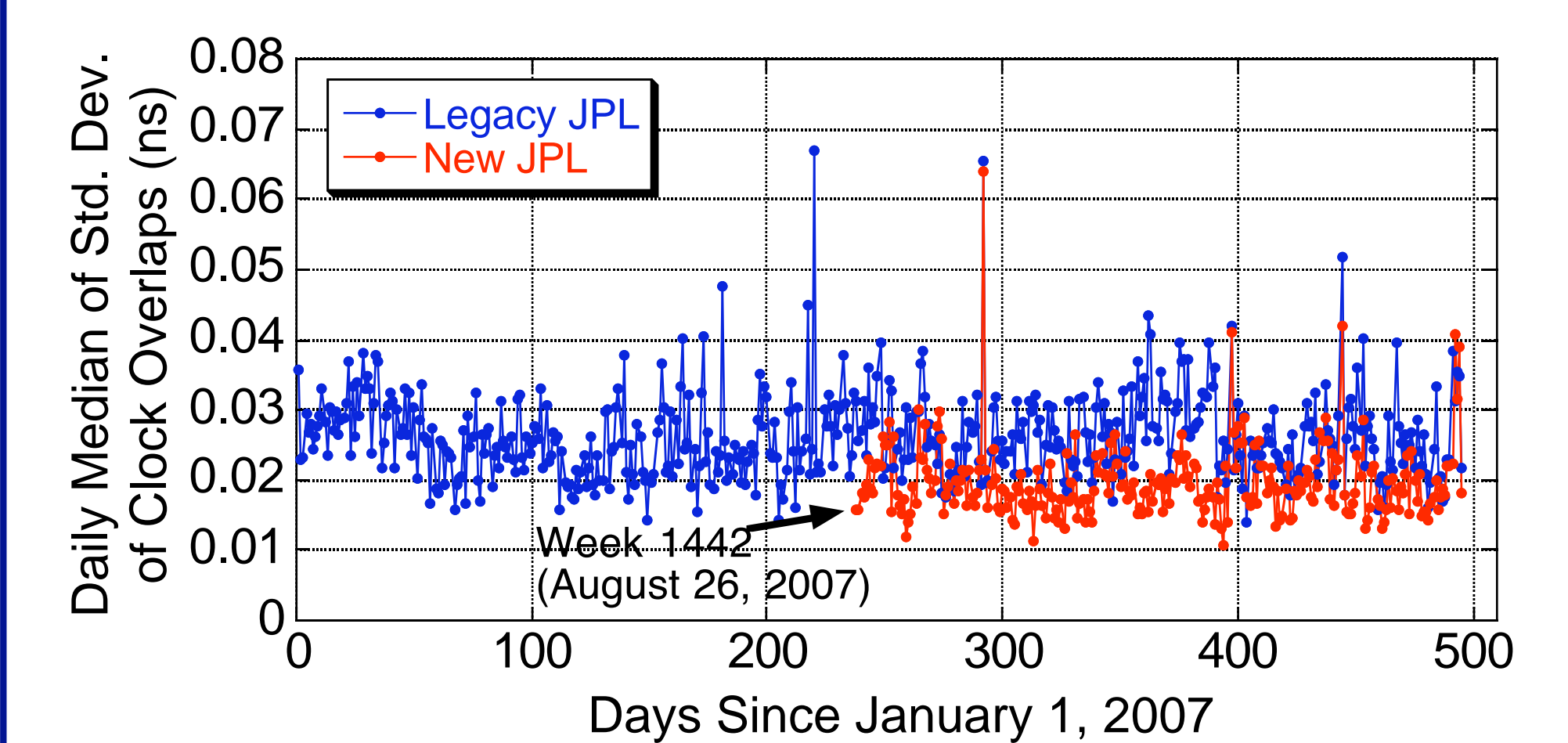**88% average variance reduction in comparisons to IGS (8.6 to 2.9 cm).**

Effect of Albedo on Orbit Scale
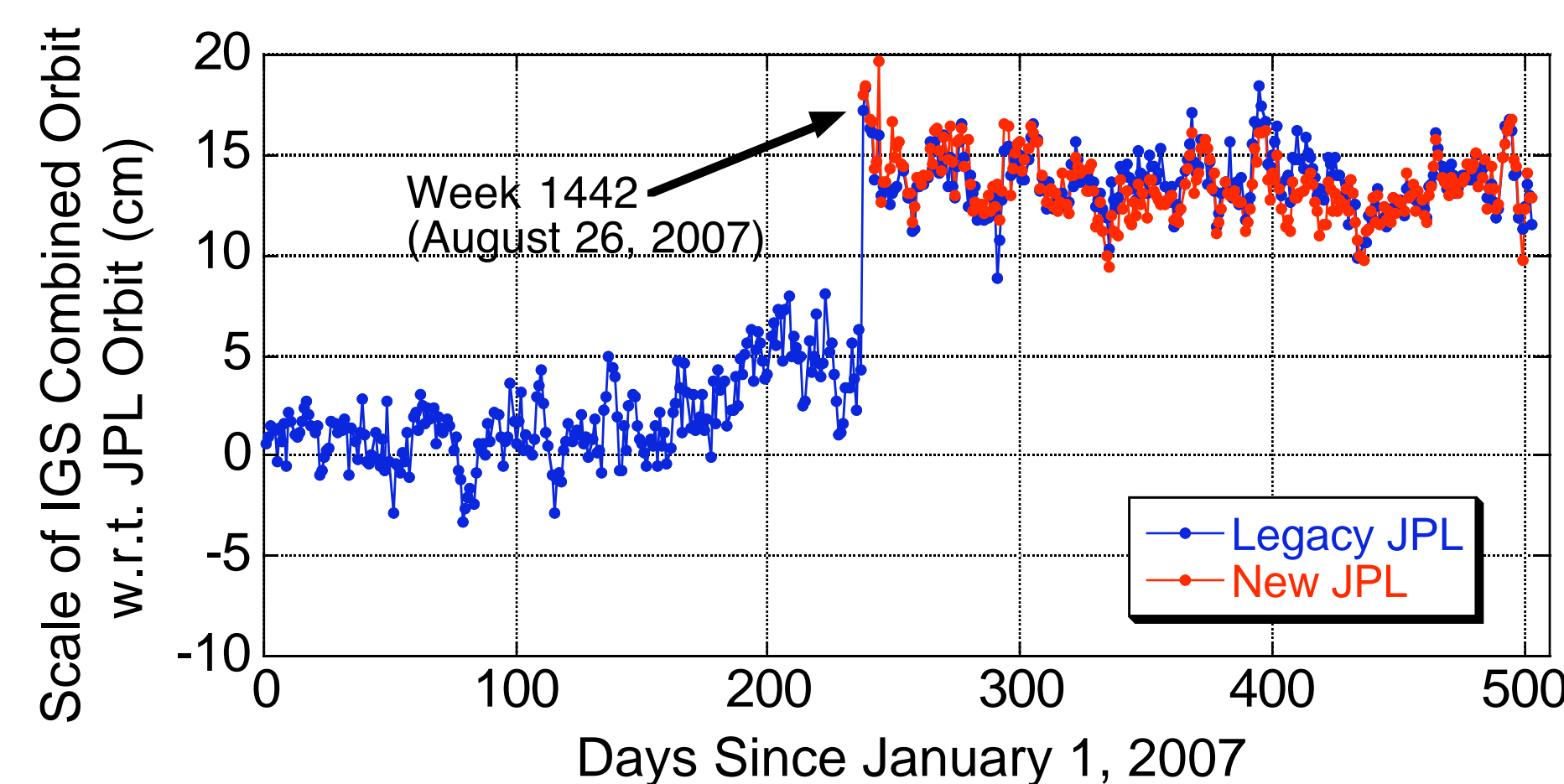
Albedo force model applied during transition to new POD system.
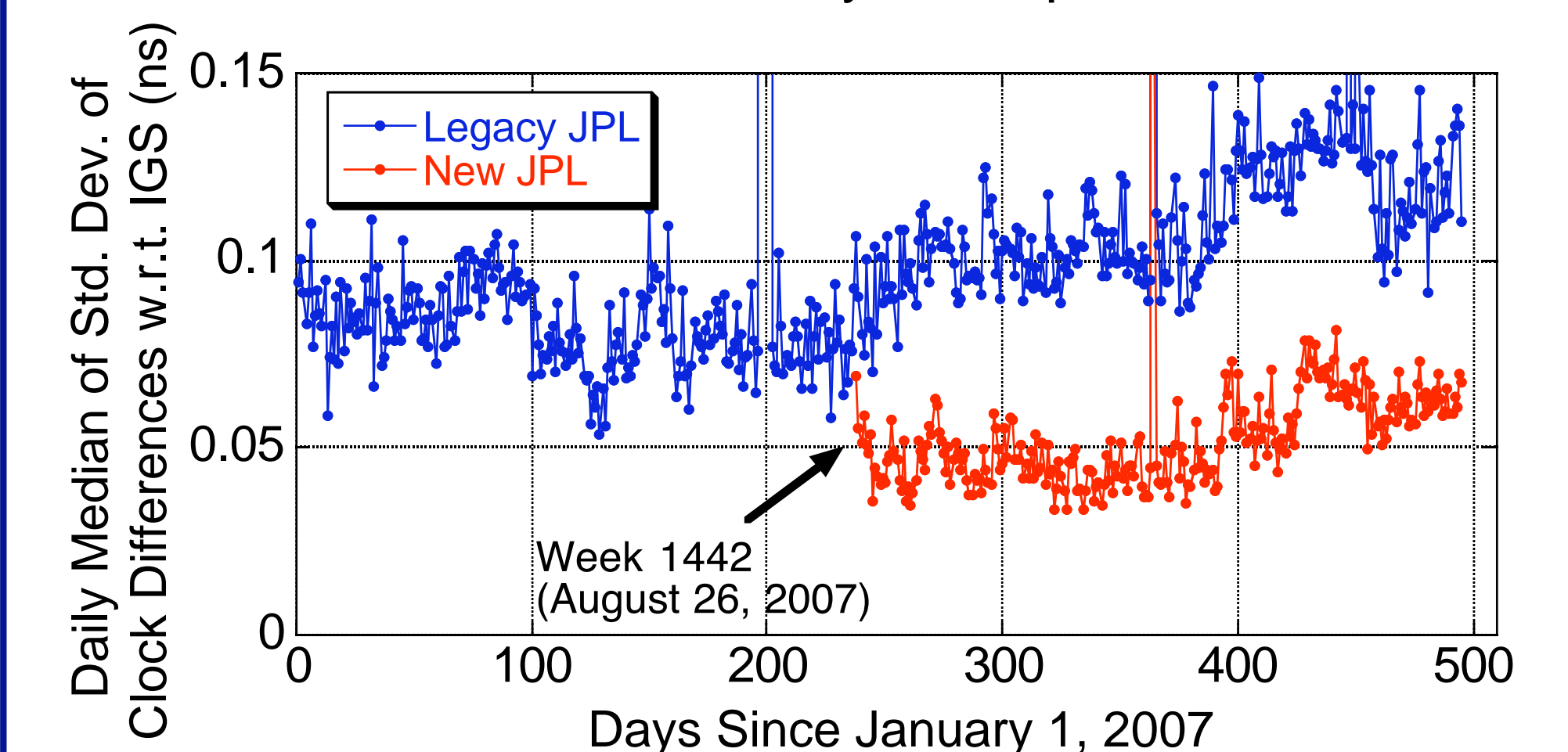- Causes JPL orbits to be lower than IGS combined orbit by 1-1.5 cm.

Clock Quality Metrics

45% average variance reduction in clock overlaps (0.027 to 0.020 ns).
- 3D RSS of clock overlap differences computed for middle 5 hours of 6-hour daily overlap.

78% average variance reduction in comparisons to IGS (0.111 to 0.053 ns).

GIPSY/OASIS Version 5.0

Release Date: June 3, 2008

https://gipsy-oasis.jpl.nasa.gov/gipsy/software.html

Required for use of new JPL orbit and clock products. New features include:
- Rootless GIPSY.
  - May be installed in any directory (e.g. not /goa)
- Antenna calibrations for transmitters and receivers.
  - Conversion routines for IGS to GIPSY formats.
- New models:
  - VMF and GMF troposphere mapping functions.
  - IERS2003 tidal models for Earth orientation parameters.
  - Second order ionosphere.
  - Convolution tidal model in orbit integrator.
  - DTM2000 drag model.
- Improved capability and efficiency of smapper ambiguity resolution.