Transitioning the JPL IGS Analysis Center Operations from GIPSY-OASIS to GIPSYx

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A. Sibois, W. Bertiger, M. Heflin, M. Miller, D. Murphy, P. Ries, C. Selle and A. Sibthorpe
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA
Contact: aurore.e.sibois@jpl.nasa.gov

Abstract

As part of NASA's Satellite Geodesy Project, JPL's legacy software is being replaced with a more capable, modern software package. This new software, GIPSYx, consists of a single core software library that supports both real-time and post-processing of geodetic data with an emphasis on GNSS data. GIPSYx uses modern programming languages and provides extra capabilities compared to JPL's legacy software, GIPSY-OASIS (GOA). As an analysis center of the International GNSS Service (IGS), we are planning on transitioning our operations from GOA to GIPSYx within a year. In this presentation, we give an overview of the capabilities of the GIPSYx software and discuss the quality our users should expect from our future final products. To assess the quality of our modern products and contrast it with that of our current operations software, we processed one year of Global Positioning System (GPS) data following the precise orbit determination strategies currently implemented for our final contributions to the IGS. The set of products analyzed includes orbit and clock solutions, station positions and estimates of the frame and Earth orientation parameters. We show results from these analyses and comparisons with products obtained using our legacy software.

Highlights

- **GIPSYx**: GIPSY-OASIS software package entirely rewritten; compiled code in C++ with wrapper scripts in python2.7 compatible with python3 (transition to python3 planned).
- **Current status**: main development phase completed; on-going extensive testing and finer tuning of the estimation strategy in progress. All measurement/force/geophysical models used to generate current products implemented.
- **Timeline for transition in operations**: transition is planned to occur in the second half of 2016. All IGS products will be delivered as before.

We expect the transition will not impact product quality.

New capabilities and future prospects

- GIPSYx supports **new constellations**
  ➔Potential for future contribution to multi-GNSS products (GLONASS, Beidou POD tests already underway, next is Galileo)
- GIPSYx supports **large problems** through parallel processing
  ➔Facilitates investigations into the possible benefits from using larger ground networks in daily ops processes.
  ➔Enables investigations of simultaneous multi-GNSS bias fixing as well as longer arcs (GNSS GEOs).
  ➔Considering generation of full set of high-rate products.

Performance Analysis

- Comparisons between our current Final operational ("ops") products and "dev" products generated by the process under development over the year 2015.
- Known differences between the two solutions:
  - No constraints enforced on ground network; i.e. daily ground network most likely differs between current and under-development (dev) operational processes.
  - More satellites included in the dev solution than in the ops solution on average.

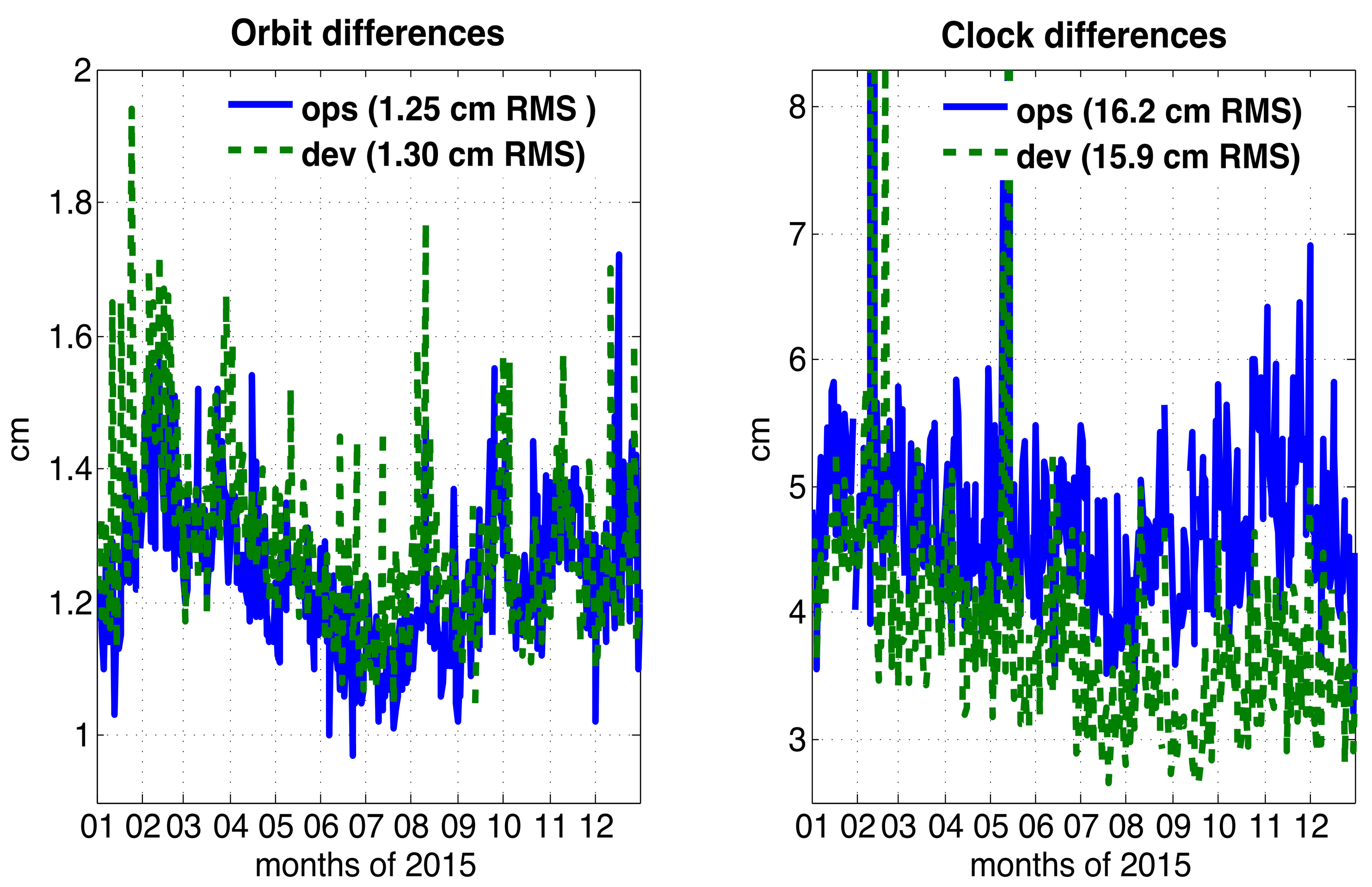

Figure 1: ***Comparison with IGS final combination orbit and clock products***. Improvement in clock agreement for dev process is currently attributed to the use of an improved yaw model (see Kuang et al. poster for more info) but will be investigated further.

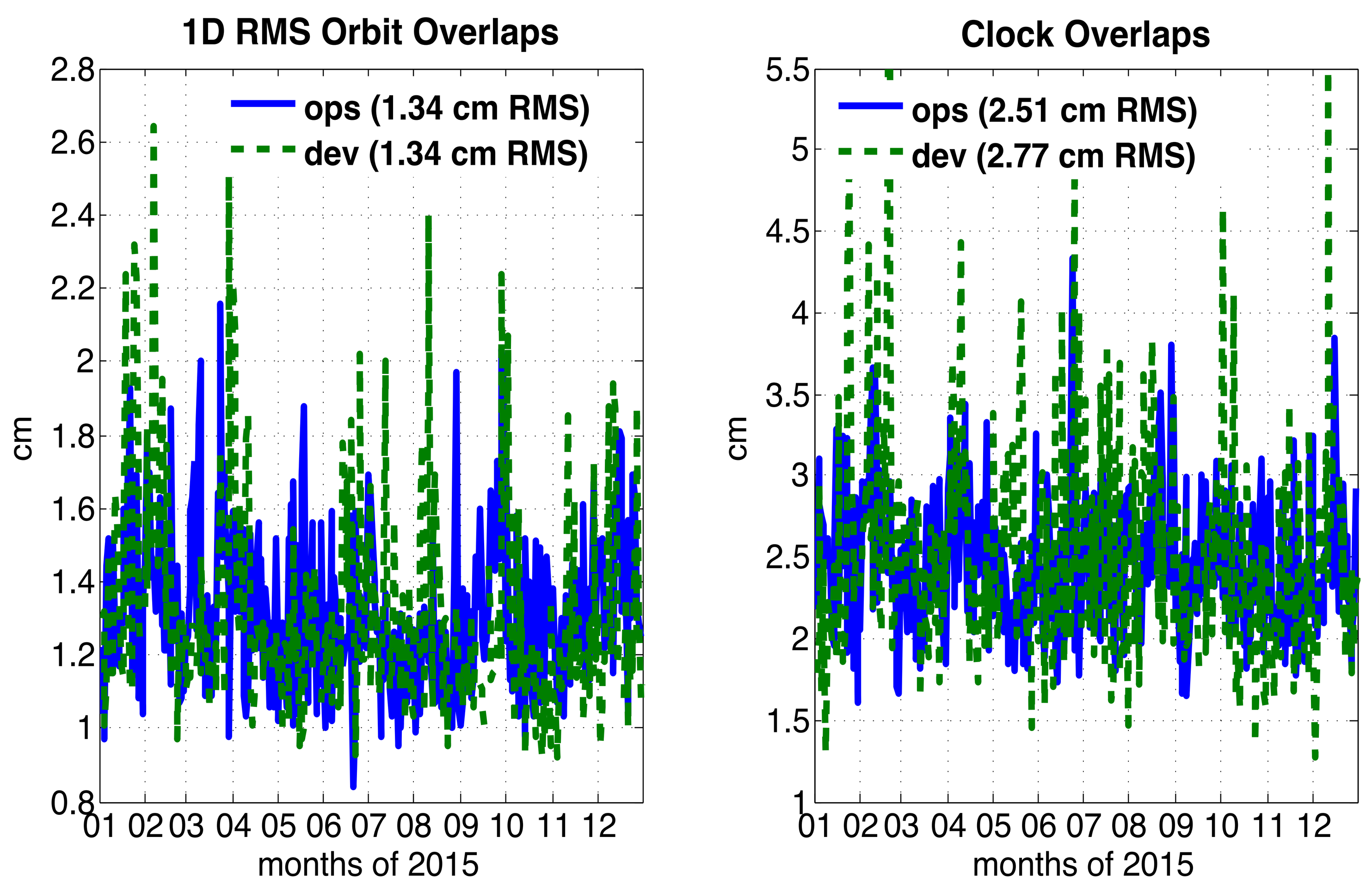

Figure 2: ***Internal orbit and clock overlaps***. Daily solutions for both processes span 30 hours, adjacent days overlapping for 6 hours. Statistics computed are median of the 1D RMS orbit overlaps and RMS of the clock overlaps. Results indicate comparable quality between ops and dev processes in terms of internal consistency and precision.

	OPS PROCESS	DEV PROCESS
AMC2	4.7	4.3
TOW2	3.9	4.0
NTUS	4.1	4.6
THTI	5.5	5.3
KAZA	9.9	9.5
MCM4	3.5	3.5

Table 1: ***Repeatability in station position deviation (mm)***. Statistics represent the scatter of the norm of the station position deviation vector relative to IGb08 positions. Station position deviation vectors are estimated via precise point positioning (without bias fixing) using orbit and clock products from ops and dev processes. Statistics were computed over one year. The 6 sites shown here were picked randomly and are globally distributed.

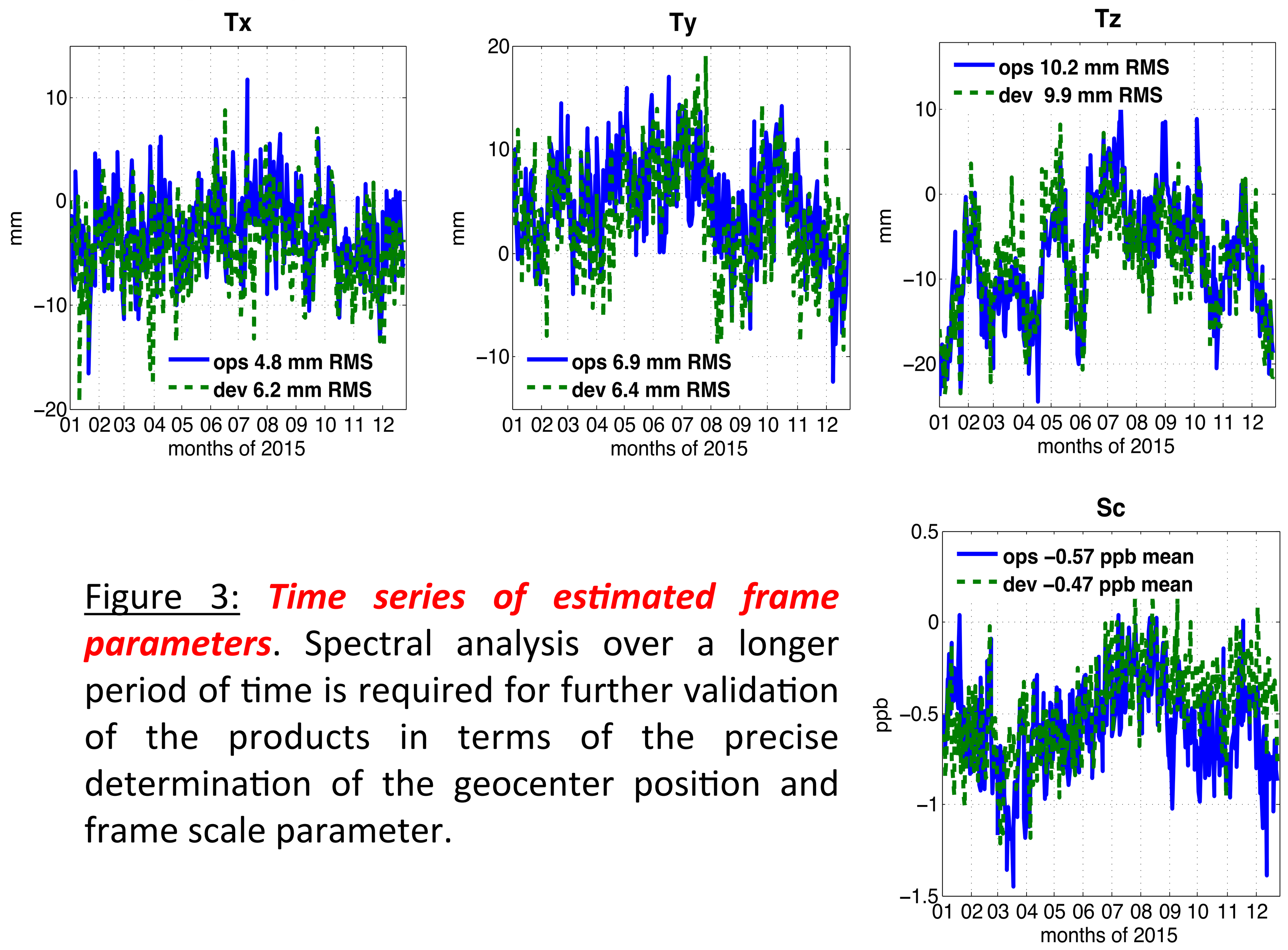

Figure 3: ***Time series of estimated frame parameters***. Spectral analysis over a longer period of time is required for further validation of the products in terms of the precise determination of the geocenter position and frame scale parameter.

	Differences
Xp	1.7 mm
Yp	1.6 mm
Xp rate	2.6 mm/day
Yp rate	2.6 mm/day
LOD	11.7 mm/day

Table 2: ***RMS values of differences between adjustments to Earth Rotation Parameters*** estimated in the ops and dev processes. Numbers represent equivalent distances at the surface of the Earth. Similar to the frame parameters, a longer test period is being analyzed for further validation of the products in terms of the precise determination of the ERPs.