Evaluation of ITRF2014 Solutions

Introduction

For the most recent International Terrestrial Reference Frame (ITRF) realization, three institutions have provided solutions. They are significantly different in the way they have been generated and in their parametrizations:

- Deutsches Geodätisches Forschungsinstutut at TU Munich (DGFI-TUM, Germany), (Beitz et al. 2016)
- DTRF2014, based on a modelling of time series by station coordinates and linear velocities (after correcting for loading effects) (JTFR2014). Correlation between atmospheric pressure loading and hydrological effects are mapped
- Institut national de l'information géographique et forestière (IGN, France) (Altmimi et al. 2016)

DTRF2014L, based on coordinate, linear velocities, and empirical post-seismic deformation corrections (together with annual/semiannual periodic functions in the background) (ITRF2014P: periodic functions recovered)

Jet Propulsion Laboratory (JPL, USA) (Wu et al. 2015)

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Background on the GNSS Data Processing

Consistent GNSS solutions have been established for each of the five reference frame coordinate sets. They were derived from an identical set of normal equations where the ESA-ANTEX antenna phase center corrections were still used. Consequently, the scale for these solutions is consistent to the zero epoch solution of the International GNSS Service (IGS) and therefore with the reference frame solutions. The modelling of the GNSS data is derived from the processing standards of the CODE analysis center (Center for Orbit Determination in Europe) of the IGS as they were used in summer 2015 (Dach et al. 2015a).

According to the practice within the IGS, a no-net-translation condition has been applied for datum definition. In this way the center of mass (relevant, e.g., for the satellite orbit modelling) is forced to coincide with the origin of the reference coordinate system.

SLR Residuals for Satellites

The time series of SLR residuals for one of the GPS satellites are shown in Figure 1. For this reference frame the slr residuals for the GPS satellite are determined as well as for the SLR analysis. At the beginning of the time series an annual signal is visible that becomes a general scatter in the later years. More stations were able to track GLONASS satellites in the second part of the time interval, but the number of stations tracking GNSS satellites during day-time increased as well. Therefore, geometric effects of the SLR tracking network became less pronounced towards the end of the experiment. At the same time the dependency on the elevation of the Sun above the orbital plane becomes more visible.

About 10 stations (in the early years even fewer) provide SLR measurements to GPS and GLONASS satellites whereas only sites with coordinates in the related reference frame solutions are considered (station 7406, San Juan, Argentina is not contained in the JPL solution for a certain interval).

The standard deviations of the SLR residuals per station are in the order of magnitudes of 5 cm. Comparing the values between the reference frame solutions in Figure 5 they are smaller for the ITRF2014 solutions followed in most cases by the DTRF2014L solution. This is consistent with the discussion on the network geometry in the GNSS solutions (Dach et al. 2016b).

Summary and Conclusions

The standard deviations of the SLR residuals per station are in the order of magnitudes of 5 cm. Comparing the values between the reference frame solutions in Figure 5 they are smaller for the ITRF2014 solutions followed in most cases by the DTRF2014L solution. This is consistent with the discussion on the network geometry in the GNSS solutions (Dach et al. 2016b).

References


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