Analysis Coordinator Report

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Abstract

IVS analysis coordination issues in 2008 are reported here. Routine EOP combinations on the basis of datum-free normal equations have been continued. For this, it was necessary to compute a new realization of a terrestrial reference frame. Investigations have been carried out on certain quality aspects of the IVS EOP series.

1. General Issues

The "Ninth IVS Analysis Workshop" was held at the Institute of Applied Astronomy, St. Petersburg, Russia, on March 7, 2008, in connection with the Fifth IVS General Meeting. The workshop was attended by more than 40 participants who enjoyed being hosted by the IAA with an impressive look onto the still winterly Neva. More details on the workshop can be found in Nothnagel (2008a).

2. IVS Operational Data Analysis and Combination

The combination process for the two IVS EOP series (rapid and quarterly solutions) has been continued exclusively on the basis of datum-free normal equations in SINEX format. In 2008, six IVS Analysis Centers (BKG, DGFI, GSFC, IAA, OPA, and USNO) contributed to the IVS combined products by providing input in the correct format. The rapid solutions contain only R1 and R4 sessions, and new data points are added twice a week as soon as the SINEX files of the six IVS Analysis Centers are available. The SINEX file submissions should not be later than 48 hours after the correlation is completed. A Web page is automatically updated which states the timeliness of the latest submissions of the R1 and R4 sessions. As can be seen on this Web page, the timeliness requirement is still exceeded too often for various reasons in logistics and personnel.

For the quarterly solution, updated every three months, almost all available data of 24-hour sessions from 1984 onwards are used. Since this series is designed for EOP determinations, those sessions are excluded which are observed with networks of limited extension or which are scheduled for a different purpose like radio source monitoring.

The advantages of the new combination strategy are (1) that the full variance-covariance information of the individual input solutions is rigorously carried over and (2) that one common terrestrial reference frame is applied after the combined datum-free normal matrix is generated. Thus, it is guaranteed that an identical datum is used in the combination process for all input series.

After datum definition, the combined system of normal equations is solved (inverted), and the full set of EOP (pole components, UT1–UTC, and their time derivatives as well as two nutation offsets in $d\psi$ and $d\varepsilon$ w.r.t. the IAU2000A model) are extracted into separate files. These results are then added to the two EOP time series, the rapid solution file (ivs08r1e.eops), and the quarterly solution file (ivs08q4e.eops), in the IVS EOP Exchange format. Companion files containing the nutation offsets in the X, Y paradigm are routinely generated through a standard transformation process (ivs08r1X.eops, ivs08q4X.eops).

3. VTRF2008

In 2008, it became obvious that a new TRF for the IVS EOP determinations had to be computed for several reasons. ITRF2005, used in 2007 and 2008, has a noticeable deficit due to the pole tide error which had been made in the IVS contribution to ITRF2005. The post-quake movements of GILCREEK in ITRF2005 lacked the continuity of the piece-wise linear elements, thus, introducing discontinuities. In addition, for the sites of SVETLOE, ZELENCHK, and BADARY, either only limited observations had been available for ITRF2005 or no observations had been available yet. Of course, all other stations took their benefit from more data in the new computations as well.

The new TRF (VTRF2008) has been computed from the individual combined SINEX files of all geodetic VLBI sessions available. These have been pre-reduced for EOP so that only the coefficients for the site coordinate parameters remained. In a stacking process, these sets of normal equations have then been combined to a full TRF normal equation system for site positions and velocities. The subsequent inversion process provided the complete TRF including its variance-covariance information. VTRF2008 is being used for all combinations since December 2008.

4. Station Irregularities

In the process of quality control, Volker Tesmer detected first that the estimates of the vertical component of the SESHAN25 site position exhibited a jump of up to 70 mm downwards (Fig. 1). Several tests have been made to determine from where this jump originates. Unfortunately, no conclusive explanation has been found so far.

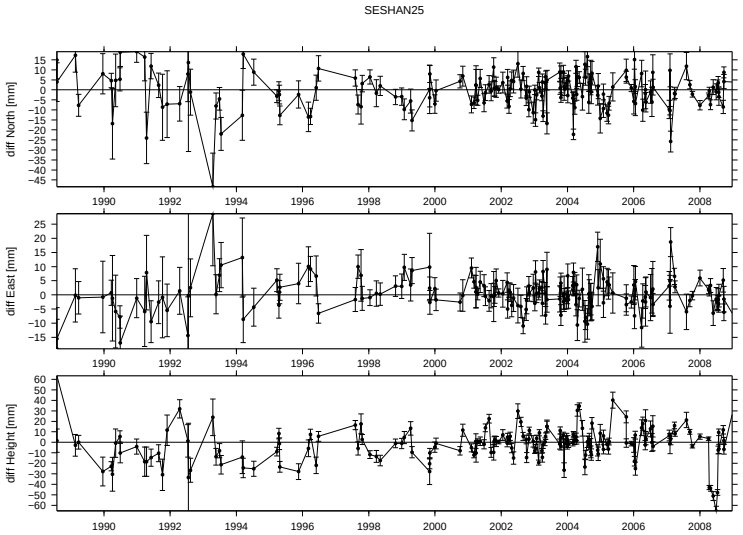

Figure 1. Time series of SESHAN25 site position

After about five months, the position has jumped back again to its original position. This is particularly puzzling but should help to find the reason for this jump.

5. Thermal Expansion of Radio Telescopes

Thermal expansion effects have been considered already for a long time but concerted activities to include it in IVS data analysis have only started in 2008. At the Ninth IVS Analysis Workshop in St. Petersburg, it was decided to make thermal expansion modeling the first chapter of the IVS Analysis Conventions. This should serve as a proper reference for all analysis descriptions. In addition, a decision was made to use the GPT model (Boehm et al. 2007) to compute the reference temperature for each telescope. Any expansion effect can and should now be computed relative to these mean temperatures. In the meantime, the current status of thermal expansion modelling has been documented in a refereed paper (Nothnagel, 2008b) which is the written documentation of Chapter 1 of the IVS Analysis Conventions.

One of the necessary parts of a model for expansion effects is a list of all telescopes' construction dimensions. In such a list, all dimensions like effective height of the elevation axis above the ground for azimuth-elevation telescopes or height of primary axis above secondary axis for polar or XY antennas, just to name a few, have to be tabulated for all telescopes. Quite some effort has been invested to collect the information for this list, and further efforts are still necessary to gather the missing information for a few more telescopes. The list is available under http://vlbi.geod.uni-bonn.de/IVS-AC/Conventions together with the reference paper.

Since the reference temperatures of all telescopes are long-term means from a model, no effective change in the realizations of terrestrial reference frames are expected. However, annual variations in station coordinates, especially in the height component, are expected to reduce. Consequently, Earth orientation parameters from VLBI observations may also be affected, mainly with an annual signature.

6. Personnel

Table 1. Personnel at the IVS Analysis Coordinator's office

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References

[1] Boehm J, Heinkelmann R, Schuh H (2007) Short note: a global model of pressure and temperature for geodetic applications. J Geod 81: 679–683. doi:10.1007/s00190-007-0135-3

[2] Nothnagel A (2008a) Notes of the Ninth IVS Analysis Workshop. In: International VLBI Service for Geodesy and Astrometry, "Measuring the Future", Proceedings of the Fifth IVS General Meeting, A. Finkelstein and D. Behrend (Eds.), Saint Petersburg, Nauka, 465–467

[3] Nothnagel A (2008b) Conventions on thermal expansion modelling of radio telescopes for geodetic and astrometric VLBI. J Geod, DOI 10.1007/s00190-008-0284-z