DGFI Analysis Center Annual Report 2009

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Abstract

This report summarizes the activities of the DGFI Analysis Center in 2009 and outlines the planned activities for 2010.

1. General Information and Component Description

The German Geodetic Research Institute (Deutsches Geodätisches Forschungsinstitut, DGFI) is an autonomous and independent research institute hosted at the Bavarian Academy of Sciences (BADW) located in Munich. It is run by the Free State of Bavaria and it is evaluated every four years by a scientific advisory board consisting of four international experts nominated by the International Association of Geodesy (IAG) and of three professors working at German universities nominated by the German Geodetic Commission (Deutsche Geodätische Kommission, DGK). The research covers all fields of geodesy and includes participation in national and international projects as well as functions in international bodies (see also http://www.dgfi.badw.de).

2. Staff

The DGFI IVS AC (http://www.dgfi.badw.de/index.php?id=126&L=2) is operated by Robert Heinkelmann and Manuela Seitz. The recent developments and numerical optimizations of OCCAM were almost completely carried out by Michael Gerstl, who is a great gain for our team. Our activities are managed by Hermann Drewes, who also supports our work with his experience.

3. Current Status and Activities

- IVS Operational Analysis Center at DGFI:

  The first year for DGFI as an operational analysis center has passed. DGFI routinely processes the standard IVS sessions (currently the two rapid turnaround sessions R1 and R4) and additional sessions of the geodetic and astrometric programs run by IVS, and it delivers datum free normal equations in SINEX format. The duty to process and submit sessions within 24 hours after database (DB) version 4 (or higher)is available demands a certain degree of automation of the analysis and can become problematic in the rare case, that operators are out-of-office. A small but important step towards decreasing the product latency could be achieved with the help of the Institute of Applied Astronomy (IAA), St. Petersburg, which provided routines enabling the format transformation from DB to NGS. In this context, we want to thank IAA for the routines again.

- Contribution to the new conventional terrestrial reference frame: ITRF2008:

  Our VLBI group was able to successfully compute and contribute a solution including more than 3000 session SINEX files for the new realization of the terrestrial reference system ITRF2008. The VLBI intra-technique combination, an intermediate step towards the inter-

technique combination, already proved to be of better quality than the contribution to its predecessor: ITRF2005.

- Implementation of the new conventional model of thermal deformations of VLBI antennas:

  A new conventional model of antenna thermal deformation developed by the IVS Analysis Coordinator (Nothnagel, 2009) was implemented in and tested with our OCCAM VLBI software (Heinkelmann et al., 2009a). The difference between two VLBI solutions using identical analysis strategies but switching the new thermal deformation model on (A) or off (B) shows insignificant mean variations of the station coordinates but pronounced seasonal signals strongly correlated with the local air temperature. Maximal amplitudes of 3 mm can be found at sites with large antenna dimensions and strong seasonal temperature variations, such as GILCREEK, Fairbanks, Alaska and ALGOPARK, Algonquin Park, Canada. Station coordinate repeatabilities overall slightly improve, if the thermal deformations are applied (solution A). The strongest effect imposed by the thermal deformation model can be found on the epochwise network scale parameter of a seven parameter similarity transformation between A and B (Figure 1).

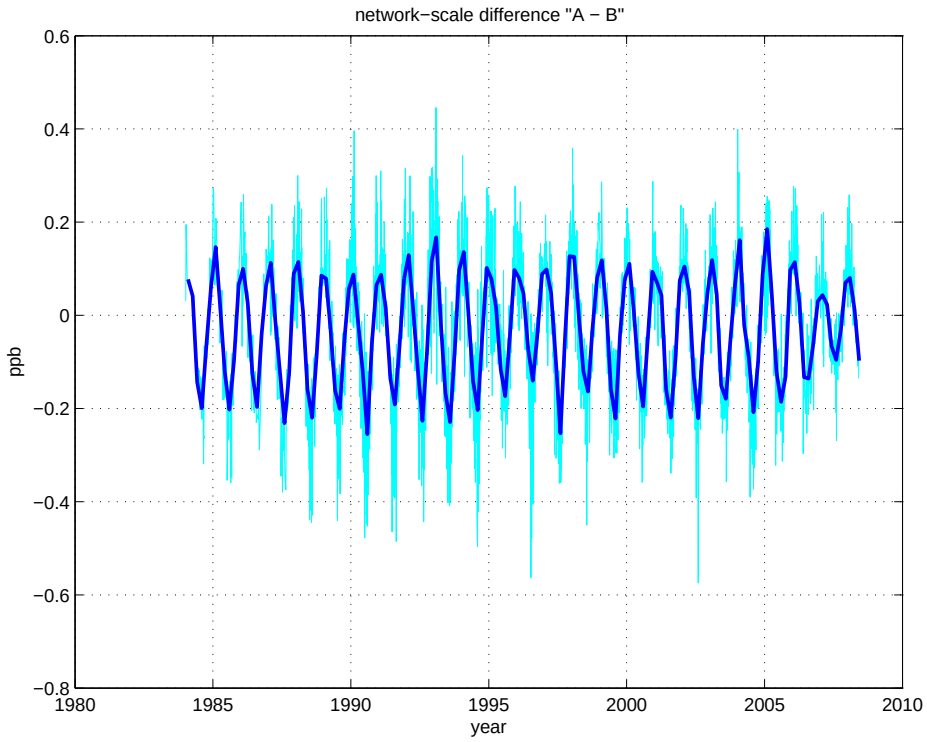

Figure 1. Difference in sessionwise network-scale determined by a 7-parameter similarity transformation.

- Comparison of ionospheric parameters:

  In cooperation with NICT the vertical total electron content (VTEC) determined by GNSS, radio occultation with COSMIC/Formosat-3 satellite constellation, radar altimetry, and VLBI was compared at DGFI. The very good agreement in particular between GNSS- and

VLBI-derived ionosphere parameters motivates us to consider a combination including the aforementioned techniques (Heinkelmann et al., 2009b).

- Atmospheric pressure loading:

  In 2009 there was a lot of discussion concerning atmospheric pressure loading. One point of view is that corrections have to be applied at the observation level in order to avoid a transfer of the effects onto other network stations due to the necessary network condition equations. In this case, however, loading corrections have to be known with appropriate precision, and that is the concern among colleagues who decline the correction at the observation level. If the corrections are not precise enough, they will worsen the observations and consequently degrade the parameters. In this context, the question is whether the small but significant improvement of station position repeatabilities in the case of applying corrections at the observation level is sufficient evidence for the correctness and accuracy of present atmospheric loading models. The fact that present models do not differ too much among themselves does not justify the application, because there might be of course the same systematics inherent in all the models (Böhm et al., 2009).

- Theoreticals considering VLBI2010 operability:

  The conventional model of VLBI theoretical delays (IERS, 2004) based on the consensus model provides an accuracy of 1 ps. Considering the simulated performance of the VLBI2010 system, the model is to be revisited in order to account for an accuracy of about 0.3 ps. In this case, the gravitational time delay (Shapiro delay) will have to consider not only the Sun and the Earth, which is today's practice, but also Jupiter, Saturn, Venus, and the Moon (Heinkelmann & Schuh, 2009).

- IVS tropospheric combination:

  In 2009 the troposphere combined products of IVS were migrated from the Institute of Geodesy and Geophysics (IGG), Vienna, to DGFI, Munich, where an interactive Web page was set up with the help of Christian Schwatke (DGFI). The new Web presentation allows the choice of any subset of Analysis Center solutions and the display of their combined solution, providing a better overview. The new Web pages are accessible through http://www.dgfi.badw.de/?194 and http://www.dgfi.badw.de/?196.

- Rearangement of the OCCAM software used and developed at DGFI:

  The IVS OCCAM Working Group, chaired by Oleg Titov, Geoscience Australia (Canberra, Australia) has been responsible for the development and maintenance of OCCAM, one of the most frequently used VLBI analysis software packages within IVS, for many years. With IGG discontinuing maintenance of OCCAM, DGFI decided to further develop its own version of OCCAM. Many smaller and bigger changes of the former OCCAM 6.1. LSM (Linux version) code have brought DGFI's VLBI software much closer to DOGS, the DGFI Orbit and Geodetic Parameter Estimation Software Package (Gerstl et al., 2000). In the near future, modifications might go so far that DGFI's OCCAM version might become a part of DOGS.

4. Future Plans

At the DGFI IVS AC we want to continue and deepen our investigations concerning the atmosphere, i.e. the ionosphere and the neutral atmosphere. In addition, the migration of OCCAM into the DOGS environment will be one of our main goals in 2010. For operational VLBI analysis we want to further automate the analysis procedure and to extend our product portfolio.

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