

DGFI-TUM Analysis Center

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Abstract This report describes the activities of the DGFI-TUM Analysis Center (AC) in 2023 and 2024. We finalized our studies on the application of atmospheric, hydrological, and oceanic non-tidal loading corrections in the VLBI analysis. We established an operational processing for the Intensive sessions and conducted investigations and comparisons between the legacy and VGOS Intensive series. Furthermore, we processed and submitted the input data series for the ITRS 2020 realization updates, and we analyzed the ITRS 2020 realizations w.r.t. scale.

1 General Information

DGFI-TUM has been serving as an IVS AC since the establishment of the IVS in 1999. Since November 2008, we are an operational AC regularly submitting datum-free normal equations for the rapid turnaround sessions in SINEX format. Starting in 2023, we also started processing Intensive sessions on a regular basis. Since 2008, we have been involved in the BKG/DGFI-TUM Combination Center at the Bundesamt für Kartographie und Geodäsie (BKG) by maintaining the combination software DOGS-CS (DGFI Orbit and Geodetic parameter estimation Software – Combination & Solution). DGFI-TUM is an institute of the Technische Universität München (TUM) since January 2015 and is located in the city center of Munich, Germany. The research performed at DGFI-TUM

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covers many different fields of geodesy (e.g., reference systems, satellite altimetry, Earth system modeling) and includes contributions to national and international scientific services and research projects, as well as various functions in scientific organizations (see <https://www.dgfi.tum.de>).

2 Staff

For the last three-and-a-half years, Matthias Glomsda was responsible for the operational IVS analysis and the development of the VLBI analysis software DOGS-RI (Radio Interferometry). He left DGFI-TUM in September 2024 and Manuela Seitz, who supported the AC until then, took over the responsibility. Both were supported and deputized first by Detlef Angermann and later by Mathis Bloßfeld in their functions as the head of the Reference Systems research area at DGFI-TUM, to which the IVS AC belongs. Since June 2025, a new colleague, Matthias Reber, completes our VLBI group. Table 1 lists all VLBI related staff members.

Table 1 Staff members and their main areas of activity.

Name	Tasks
Matthias Glomsda	Operational data analysis; software development (until September 2024)
Manuela Seitz	Operational data analysis (from October 2024); CRF/TRF combination
Matthias Reber	VLBI data analysis (from June 2025)
Mathis Bloßfeld	Head of DGFI-TUM research area Reference Systems (from June 2024)
Detlef Angermann	Head of DGFI-TUM research area Reference Systems (until May 2024)

3 Current Status and Activities

In 2023 and 2024, we finalized our investigations on the reduction of non-tidal loading (NTL) in the analysis of VLBI observations, in particular with respect to VLBI-only secular terrestrial reference frames [1]. We consider all three globally modeled components of NTL, namely atmospherical, hydrological, and oceanic NTL. It was shown that the consideration of NTL signals improves the stability of positions of stations with short observation periods. Furthermore, the IVS AC re-processed all VLBI sessions using ITRF2020 as a priori reference frame, as well as additional gravitational deformation models for particular antennas. Glomsda et al. [2] analyzed the corresponding new operational series (dgf2023a) and investigated their impact on the estimated geodetic parameters. To validate the new ITRS realizations, the scale parameters between the dgf2023a series and the three ITRS 2020 realizations (i.e., ITRF2020, JTRF2020, and DTRF2020) were analyzed. We detected a significant difference between the VLBI scale series (see Fig. 1). The moving medians (red lines) show that the VLBI scale is drifting upwards from 2013 in relation to ITRF2020 and JTRF2020, but not in relation to DTRF2020, the ITRS realization of DGFI-TUM. The IVS AC of DGFI-TUM is participating in a corresponding IVS working group, which has the task of investigating this further.

The ITRS 2020 realizations are extended to include observation data between 2021 and 2023, and in the further course they are updated by the data series of 2024. The IVS AC at DGFI-TUM processed all remaining sessions that were not yet included in dgf2023a and provided the input series for both ITRS realization updates (dgf2023b and dgf2023c).

In addition, we established and tested the operational processing of Intensive sessions. The routine Intensive session processing became operational in March 2024. We process the legacy Intensive sessions IVS-INT-1 and IVS-INT-2 and the VGOS Intensive sessions VGOS-INT-A and VGOS-INT-B. To extend our Intensive series, we processed and provided all corresponding sessions back to 2020.0, except for VGOS-INT-B sessions which started regularly observing in 2022. The DGFI-TUM Intensive series is named dgf2024a. The Intensive sessions are parameterized by one dUT1 offset, a quadratic clock offset (three parameters) per station w.r.t. the reference clock, and

a single zenith delay per station. Station positions, quasar coordinates, and remaining Earth orientation parameters (EOP) are fixed to ITRF2020 (including post-seismic deformation and excluding periodic signals), ICRF3, and IERS 20 C04 [4], respectively.

We performed a detailed validation of our Intensive sessions by comparisons with the parallel observed 24-hour sessions, the Intensives series of other ACs, and the IERS 20 C04 series (IERS 20 C04), and we presented the results at the 13th IVS General Meeting in March 2024 in Tsukuba, Japan. It could be shown that our Intensive dUT1 series agrees in general very well with the other series in terms of offset, drift, and standard deviations. Comparing dUT1 series of different IVS ACs, systematic differences are detected. These offsets can be referred to differences in the (fixed) station coordinates. Annual signals in the dUT1 difference series arise from the fact that some ACs incorporate corrections to the precision-nutation model for the (fixed) a priori celestial pole offsets, while others do not. The results are summarized in a paper of the Proceedings of the IVS 2024 General Meeting [3].

4 Future Plans

A prominent issue of the ITRS 2020 realizations and their updates are the differences in the scale drifts found for the single AC and combined IVS time series w.r.t. the different ITRS realizations. We are participating in the corresponding IVS Working Group to investigate this matter. While only a small number of 36 VGOS sessions contribute to the ITRS 2020 realizations, for their updates more than 160 VGOS sessions are available, now including three VGOS stations in the Southern hemisphere. This leads to a strong improvement of the VGOS contribution to the ITRS realizations. We will investigate the inclusion of the VGOS sessions into VLBI TRF solutions by using the different options discussed by [5], and we will analyze the impact of VGOS on the TRF and EOP parameters. Furthermore, we will investigate the impact of the gravitational deformation models on the VLBI session series, the VLBI TRF, and, in particular, the realized VLBI scale.

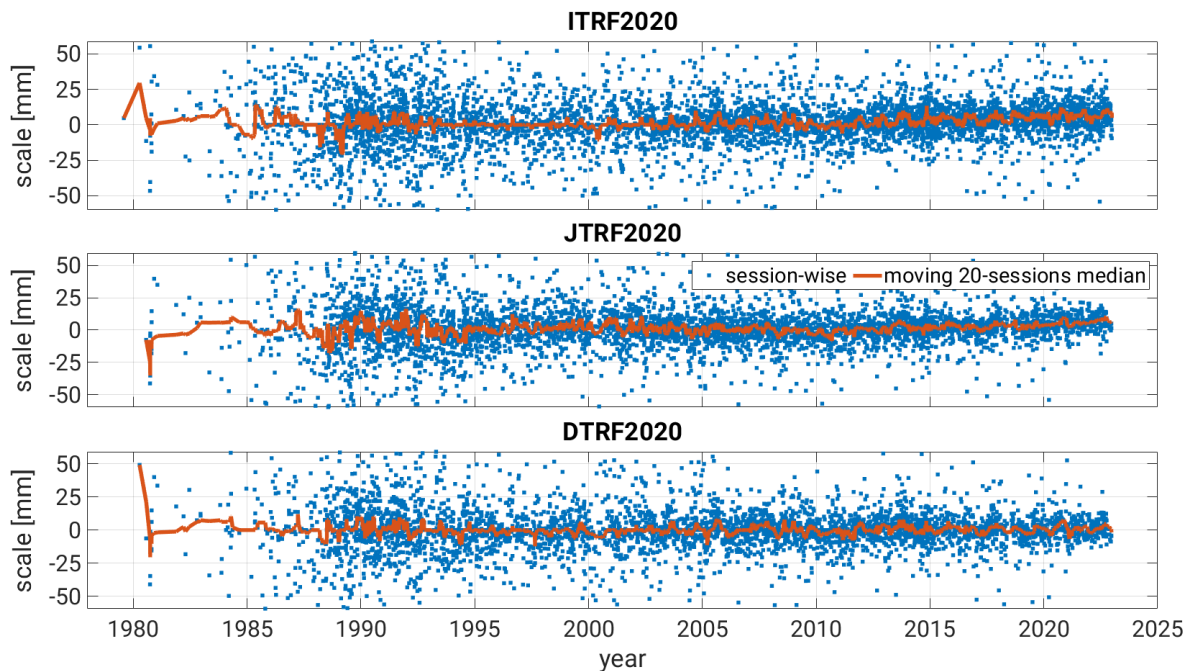


Fig. 1 Scale parameters (blue dots) and moving medians (red lines) of similarity transformations between VLBI single session solutions and ITRF2020 (top), JTRF2020 (middle), and DTRF2020 (bottom).

References

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