The BKG/GIUB VLBI Analysis Center

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Abstract

The activities at the BKG/GIUB VLBI Analysis Center for the year 2004 consist of routine computations of Earth orientation parameter (EOP) time series and a number of research topics in geodetic VLBI. In 2004 the VLBI group at BKG started regular submissions of time series of tropospheric parameters for all 24 hours VLBI sessions from 1984 onward. The generation of daily SINEX (Solution INdependent EXchange format) files was continued for all available 24 hours sessions. Quarterly updated solutions were computed for the IVS products Terrestrial Reference Frame (TRF) and Celestial Reference Frame (CRF). The UT1 Intensive series was expanded by the processing of the baseline observations Tsukuba-Wettzell. At BKG also investigations related to the reliability of antenna axis offsets and radio source stability were made. At GIUB the emphasis was placed on individual research topics.

1. General Information

The BKG/GIUB VLBI Analysis Center has been established jointly by the Bundesamt für Kartographie und Geodäsie (BKG), Leipzig, and the Geodetic Institute of the University of Bonn (GIUB). Both institutions closely cooperate in the field of geodetic VLBI maintaining their own analysis groups in Leipzig and Bonn. The responsibilities include data analysis and software development. BKG is responsible for the computation of EOP time series and time series for tropospheric parameters, the generation of daily SINEX files, and quarterly updated global solutions for the TRF and the CRF. More details on the research topics of GIUB will be found below.

2. Data Analysis

At BKG the Mark 5 VLBI data analysis software system Calc/Solve, release of March 18, 2004 [1], is currently used for VLBI data processing. In addition, the older Mark IV version, release of May 15, 2003 and an independent technological software environment for the Calc/Solve software are available. The latter is used for linking up the Data Center management with the pre- and post-interactive part of the EOP series production and to monitor all Analysis and Data Center activities (Data Center topics are described in the BKG Data Center report in this issue). The Mark 4 Calc/Solve software under Fortran 77 is installed on an HP9000/280/1 workstation with an HP-UX10.20 operating system and the Mark 5 software under Fortran 90 on another HP workstation with an HP-UX11.00 operating system.

- **Processing of correlator output**
  The BKG group continued the generation of calibrated databases for the sessions correlated at the MPIfR/BKG Mark 5 Astro/Geo Correlator at Bonn (e.g. R1, T2, OHIG, EURO) and submitted them to the IVS Data Centers.
- **IVS EOP time series**
  The currently generated EOP time series bkg00006 was extracted from a global solution with 24 hour VLBI sessions since 1984. Altogether 3062 sessions were processed. The main

parameter types in this solution are globally estimated station coordinates and velocities together with radio source positions. Minimal constraints for the datum definition are applied to get zero net rotation and net translation for 26 selected station positions and velocities with respect to the VTRF2003 [2] and zero net rotation for 212 defining sources with respect to ICRF-Ext.1 [3]. The station coordinates of the stations TIGOCONC (Chile) and SVETLOE (Russia) are estimated as local parameters in each session.

The UT1 time series bkgint03 from intensive observation sessions of the baseline KOKEE-WETTZELL was expanded with observations of the baseline TSUKUBA-WETTZELL each with a duration of about 1-hour. Series bkgint03 is generated with fixed TRF (VTRF2003) and fixed CRF derived from the global BKG solution for EOP determination. The estimated parameter types are only UT1, station clock, and zenith troposphere. Currently altogether 1395 UT1 intensive sessions were analysed for the period between 1999.01.01 and 2005.01.04.

- **Quarterly updated solutions for submission to IVS**
  For the IVS products TRF and CRF quarterly updated solutions were computed. There are no differences in the solution strategy compared to the continuously computed EOP time series bkg00006. The results of the radio source positions were submitted to IVS in IERS format. The TRF solution is available in SINEX format, version 2.1, with station coordinates, velocities, and covariance matrix.

- **Tropospheric parameters**
  The VLBI group of BKG started regular submissions of long time series of tropospheric parameters to the IVS (wet and total zenith delays, horizontal gradients) for all VLBI sessions since 1984. The tropospheric parameters are directly extracted and transformed into SINEX for tropospheric estimates from the results of the standard global solution for the EOP time series bkg00006.

- **Daily SINEX files**
  The VLBI group of BKG continued the regular submissions of daily SINEX files for all available 24 hours sessions as base solutions for the IVS time series of baseline lengths and for combination techniques. In addition to the global solutions independent session solutions were computed for the parameter types station coordinates, EOP, and nutation parameters.

3. Research Topics

- **Reliability of antenna axis offsets**
  The local measurement results from an internal BKG paper of 1996 for the VLBI antenna at OHIGGINS (Antarctic) were checked. The used value of the antenna axis offset of 0 mm was confirmed. Furthermore some test solutions with estimation of antenna axis offsets were made for the comparison with the used a priori values and as contribution for the official list of VLBI antenna axis offsets issued by the IVS Analysis Coordinator.

- **Radio source stability**
  Test basis for the analysis of unstable radio sources was the paper by Martine Feissel-Vernier [4]. 162 unstable radio source positions were estimated as global parameters with their apparent proper motions together with the no-net-rotation condition of sources w.r.t. ICRF-Ext.1 for 81 stable defining sources marked in the ICRF-Ext.1 catalogue. The results prove

that about 41 percent of the investigated sources show significant source proper motion with an amount of more than a triple standard deviation of proper motion.

- **Analysis of Tsukuba - Wettzell INT2 Series**
  The analysis of the Wettzell - Tsukuba K4 Intensive series (INT2) has been continued. This year, investigations concentrated on the effects of errors in polar motion and in the nutation offsets on the UT1-UTC estimates.
- **The Use of Water Vapour Radiometer (WVR) Data in EUROPE Sessions**
  Since early 2004 the Max-Planck-Institute for Radio Astronomy in Bonn, Germany, operates a new water vapour radiometer at Effelsberg. This radiometer has been used in the Europe-74 session in December 2004 and its use and its implications for the VLBI data analysis are being studied. For a further study WVR data is being collected from Wettzell, Onsala and DSS65.
- **Pathlength Variations at Effelsberg**
  The homologous deformation of the Effelsberg telescope most certainly also affects the signal path length prior to the horn. Investigations were started on how to measure the variations in the path length due to the deformation of the paraboloid and the position of the subreflector.
- **Combination**
  Within the GIUB group, combination software is being developed for EOP results and for TRF/EOP normal equations. These activities, as well as research in the area of VLBI antenna axis offsets and their implication for the VLBI TRF, are described in the report of the IVS Analysis Coordinator (this volume).

4. Personnel

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References

[1] GSFC, NASA (2004): Release of Mark-5 VLBI Analysis Software Calc/Solve from March 18, 2004 (web-reference: http://gemini.gsfc.nasa.gov/solve).

[2] VTRF2003: A Conventional VLBI Reference Frame, Jun. 30, 2003 (web-reference: http://giub.geod.uni-bonn.de/vlbi/IVS-AC/vtrf2003/vtrf2003.html).

[3] ICRF-Ext.1 (http://hpiers.obspm.fr/webiers/results/Icrf)

[4] Feissel-Vernier M. (2003): Selecting stable extragalactic compact radio sources from the permanent astrogeodetic VLBI program, In: Astronomy and Astrophysics, 403, 105-110, 2003.