

Data Analysis at BKG in the Frame of IVS

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Abstract. The VLBI group of the Federal Agency for Cartography and Geodesy (BKG) in Leipzig is part of the jointly operated IVS Analysis Center of BKG and the Institute for Geodesy and Geoinformation of the University of Bonn (IGGB). BKG is responsible for the computation of time series of Earth Orientation Parameters (EOP) and tropospheric parameters, the generation of SINEX (Solution INdependent EXchange format) files for 24-hours VLBI sessions and Intensive sessions, and quarterly updated global solutions for Terrestrial Reference Frame (TRF) and Celestial Reference Frame (CRF) realizations. The data processing steps are explained and also some problems in the procedure of data analysis are discussed. Additionally one of the three primary IVS Data Centers is managed at BKG.

1. General Information on Data Analysis

For purposes of data analysis at BKG the Mark 5 VLBI data analysis software Calc/Solve [1] including the Calc 10 implementation for complying with the IAU 2000 Resolutions and the IERS Conventions 2003 is running on a Linux operating system.

The Calc/Solve software was modified for using the Vienna Mapping Function (VMF1). Applying VMF1 in data analysis requires a daily update of the VMF1 data from the server of the Technical University of Vienna.

In addition, an independent technological software environment for the Calc/Solve software is 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.

2. Processing of Correlator Output

A main task in data analysis at BKG is the generation of calibrated databases for the sessions correlated at the MPIfR/BKG Mark 5 Astro/Geo Correlator at Bonn (e.g. EURO, OHIG, T2) and submitting them to the IVS Data Centers.

3. Scheduling

BKG is responsible for scheduling the INT2 Intensive sessions on the baseline TSUKUBA-WETTZELL since Aug. 2005. The program system SKED developed by John Gipson (NVI, Inc/NASA Goddard Space Flight Center) is used for that.

4. Data Flow and Analysis at BKG

Fig. 1 gives an impression about the main work steps in VLBI data analysis at BKG.

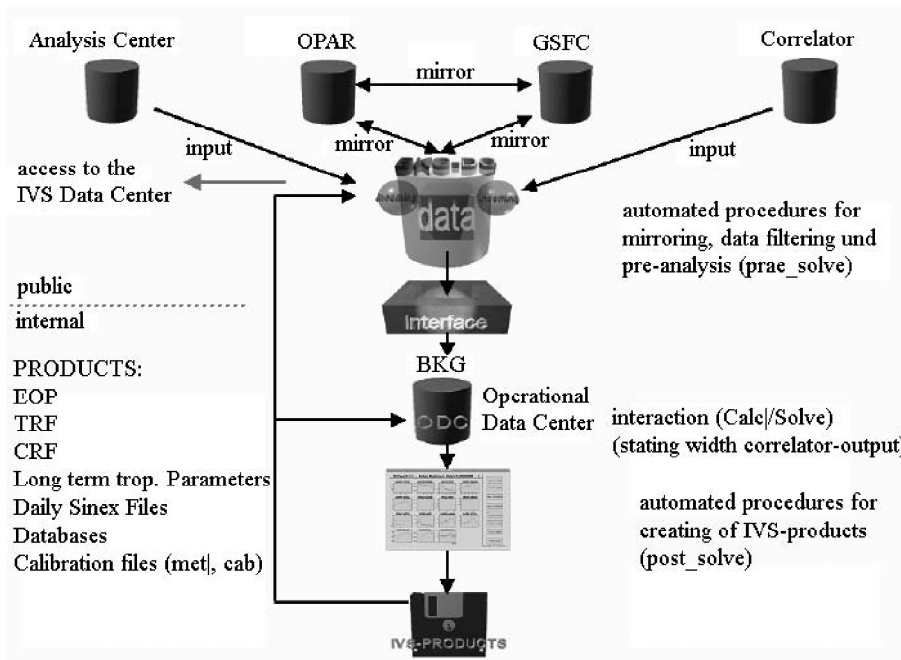


Figure 1. VLBI data flow and analysis activities at BKG

5. IVS EOP Time Series bkg00010

To create the EOP series the Vienna Mapping Function for modelling the tropospheric delay correction is used. The modelling for 3 stations was refined by non-linear site position variations estimation (GILCREEK, HRAS, PIETOWN). Furthermore the new official list of the VLBI antenna axis offsets, status May 17, 2007 and the a priori VTRF2005 are used in data processing.

After the preprocessing of any new VLBI session (correlator output data-

base version 1), a new global solution with 24-hours sessions since 1984 is computed and the EOP time series bkg00010 is extracted.

Some topics about statistics and solution description of bkg00010 are listed in the following:

- number of sessions more than 3500,
- main parameters: EOP, globally estimated station coordinates and velocities together with radio source positions, tropospheric parameters (zenith wet delays),
- local station parameters: BADARY (Russia), CTVASTJ (Canada), DSS65A (Spain), METSAHOV (Finland), ZELENCHK (Russia),
- minimal constraints for the datum definition are applied to achieve no-net-rotation and no-net-translation for 26 selected station positions and velocities with respect to VTRF2005 and no-net-rotation for 212 defining sources with respect to ICRF-Ext.1.

6. IVS UT1 Time Series bkgint07

VMF1 is used in the UT1 time series bkgint07 too. In addition to the observations of both baselines KOKEE-WETTZELL and TSUKUBA-WETTZELL, also the networks KOKEE-SVETLOE-WETTZELL and NYALESUND-TSUKUBA-WETTZELL, each with a duration of about 1 to 1.5 h, are processed regularly.

Series bkgint07 is generated with fixed TRF (VTRF2005) and fixed CRF derived from the global BKG solution for EOP determination. The estimated parameter types are only UT1, station clock, and zenith troposphere. The UT1 intensive sessions are analyzed from 1999.01.01 on.

7. Quarterly Updated TRF and CRF Solutions for Submission to IVS

Every year quarterly updated solutions for the IVS products TRF and CRF are computed. There are no differences in the solution strategy compared to the continuously computed EOP time series bkg00010. The results of the radio source positions are submitted to IVS in IERS format. The TRF solution is available in SINEX format, version 2.1 and includes station coordinates, velocities, and radio source coordinates together with the covariance matrix, information about constraints, and the decomposed normal matrix and vector.

8. Tropospheric Parameters

The VLBI group of BKG continues regular submissions of long time series of tropospheric parameters to the IVS (wet and total zenith delays, horizontal gradients) for all available VLBI sessions since 1984. The tropospheric para-

meters are extracted from the standard global solution for the EOP time series bkg00010 and transformed to SINEX format.

9. Daily SINEX Files

In addition to the global solutions daily SINEX files for all available 24-hours sessions as base solutions for the IVS time series of baseline lengths and for combination techniques are submitted. Independent session solutions are computed for the parameter types station coordinates, EOP, and nutation parameters. The a priori datum for TRF is defined by the VTRF2005 and the fixed CRF derived from the global complete BKG solution for EOP determination is used for the a priori CRF information.

10. SINEX Files for Intensive Sessions

IVS SINEX files for Intensive sessions are created and submitted to IVS. The parameter types are station coordinates, pole coordinates and their rates, and UT1 with rate. Only the normal equations stored in the SINEX files are important for further combination with other space geodetic techniques.

11. Problems with Logfile Formats

To run the extracting program for calibration data (XLOG) in an automated mode normally different errors in the logfiles have to be fixed before. The program LOGFIX developed at BKG screens the logfiles in a pre-analysis step referring to a number of errors listed as follows:

- wrong filename of the logfile (i.e. euro87ro.log to euro876a.log),
- wrong station name in the header (i.e. NyAlesun to NYALES20),
- superfluous header records,
- records outside of observation time span,
- implausible meteorological data,
- empty records,
- wrong time fields,
- format error in meteorological data field,
- wrong cable sign.

An example for the program output of program LOGFIX is shown below:

```
LOGFIX: _____ /disc2/data/log/euro85on.log _____  
        Copy of logfile: /disc2/data/log/euro85on.log.ivs  
        START OF SESSION 2007.008.12:00:00.00
```

STOP OF SESSION 2007.009.12:00:00.00
LOGFIX(format error): 2007.008.14:28:18.81;wxcom!@1h
Number of records in original logfile: 43482
Corrected station name in header:"Onsala" to "ONSALA60"
Number of corrected wx-records: 2
Outside of observation time span (records deleted): 379
Empty records deleted: 1
Format error in meteorological data (records deleted): 39
Number of written records with meteorological data: 484
Number of written records with cable data: 243
Written records in /disc2/data/log/euro85on.log: 43063
LOGFIX: _____ return _____ .

12. Work on ICRF2

The VLBI group at BKG is part of the IVS working group for the second realization of the ICRF. An important step is the computation of time series for all radio sources. On the basis of former investigations [2] a new set of time series for all radio sources was computed with nearly no change in datum definition. Based on the globally estimated source coordinates from the standard global solution bkg00010 a new set of 183 radio sources was selected to define the datum with the no-net-rotation constraints. The identification of the 183 preliminary stable sources was the result of a former analysis [2]. The new time series of radio sources were derived with 24-hours VLBI sessions from Jan. 1984 to Jul. 2007 in a complete global solution. The overall solution statistics summary for data type delay (all) shows a slightly better weighted RMS residual of 28 ps for the new time series solution in contrast to the standard solution bkg00010 with 29 ps.

It is planned to investigate the long-term stability of radio sources based on the new time series of radio source positions by using a statistical test for normal distribution of residuals to the weighted mean of a radio source component.

References

- [1] GSFC, NASA, Release of Mark 5 VLBI Analysis Software Calc/Solve Oct. 10, 2007.
- [2] Engelhardt, G., V. Thorandt. First steps to Investigate Long-Term Stability of Radio Sources in VLBI Analysis. IVS General Meeting Proceedings 2006. D. Behrend and K.D. Baver (eds.), NASA/CP-2006-214140, 2006, 281–285.