VLBI 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 Leipzig (UG). BKG is responsible for regular submissions of time series of the International Origin Parameters (EOP) and tropospheric parameters from the stations TSUKUBA, VERAISGK (Japan), VERAMZSW (Japan), and YEBES40M (Spain). The a priori data of the EOP time series bkg00013 is extracted from solutions for the EOP time series bkg00023 and transformed into SINEX format.

1. General Information on Data Analysis
At BKG, the latest version of the data analysis software system Calc/Solve, release 2010.05.21.3, has been used for VLBI data processing. It is installed on the BKG data center servers. As in the previous releases, the Vienna Mapping Function (VMF) has been implemented in a separate Solve version. This modified version is used for all work of data analysis. The VMF data are downloaded daily from the server of the Technical University Vienna.

2. Processing of Correlator Output
Important task in data analysis at BKG is the generation of calibrated data bases for the sessions correlated at the MPI/BKG Mark 5 AstroGas Correlator at Bonn (e.g., EURO, ORIO, 12) and submitting them to the IVS Data Centers.

3. Scheduling
BKG continued scheduling the IN2 Intensive sessions, which are observed on the baseline TSUKUBA-WETTZELL. Due to the earthquake in Japan in March 2011, scheduling at BKG was extended for the INT1 Intensive sessions on baseline KOKEE-WETTZELL on week ends. Altogether 153 schedule files were created in 2011.

4. IVS EOP Time Series bkg00013
The solution for generating the EOP series based on a global solution mode with common estimation of all parameter types. The EOP is one part of the arc parameters, i.e., estimates for each experiment session. The global parameter adjustments refer to the entire data set, e.g., station positions and velocities or source positions. Each new VLBI session generates a new correlator as database version 1 is processed and after that a new global solution with 24-hours sessions since 1984 is created. The resulting time series bkg00023 is extracted. Some topics of solution bkg00023 are:

- number of sessions: more than 4200,
- data from all VLBI stations (including those of the predecessor Networks)
- transformed to the International Terrestrial Reference Frame (ITRF2008) with respect to ITRF2008 and no-net-reduction condition for 295 defining sources with respect to ICRF2 [2],
- global parameter types station coordinates and velocities, radio source coordinates, and tropospheric parameters to the IVS (wet and total zenith path differences to IERS C04 is nearly the same (Figure 1) and no significant difference can be seen between the Int2 and Int series.

5. IVS UT1 Time Series bkg00109
The UT1-UTC time series based on independent basic solution series. The Intensive series include mainly observations of the baseline KOKEE-WETTZELL and TSUKUBA-WETTZELL, also of the networks KOKEE-WETTZELL and NYALE20-TSUKUBA-WETTZELL. Series bkg00109 is generated with fixed TSUKUBA (TSUKUBA) and fixed ICRF. The estimated parameter types are only U1-UTC, station clock, and zenith troposphere. The UT1 Intensive series are processed from 1999.01.01 on. The analysis of the UT1 Int series processed as of 2000 correlate every Monday after transferring the raw observations to eBROADNET. Solving is not always on the same day. Delays of maximal one day appeared because of problems in data transfer. Due to the Japan earthquake in March 2011 no time series of Intensive series (UT1-UTC) with station TSUKUBA were processed. The coordinates of TSUKUBA should be well-known for UT1 estimation, but the earthquake moved TSUKUBA and the rotation is still continuing. The VLBI group at BKG developed a procedure to get most probable station positions of TSUKUBA for the epochs of the Intensive series. The analysis of the Intensive series with station TSUKUBA (Int2) could be resumed on February, 2012.

Procedure of the Int2 series processing
- Global solution with 24-hours sessions since 1984 including all available sessions with TSUKUBA after Japan earthquake 2011/03/11
- Coordinates of station TSUKUBA estimated as a local parameters
- Linear interpolation of successive estimates of TSUKUBA positions to the epochs of Int2 series
- If epochs of Int2 series are after the last estimated TSUKUBA position, use coordinates of the last 24-hours session of TSUKUBA.

Comparison of UT1-UTC results of Int2 with Int1
The UT1-UTC Intensive series Int2 derived from TSUKUBA’s post-quake positions were compared with the results of Int1 that does not involve TSUKUBA. The comparisons are based on differences to ERS C04 UT1-UTC values. The WRMS of both series computed on the basis of differences to ERS C04 is nearly the same (Figure 1) and no significant difference can be seen between the Int2 and Int series.

Conclusion
The Int2 series derived from the described procedure can be used again for operational UT1 estimation.

6. Quarterly Updated TRF and CRF Solutions for Submission to IVS
Every quarterly updated solution 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 bkg00013. The results of the radio source positions are submitted to IVS in ERS 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 decompounded normal matrix and vector.

7. Tropospheric Parameters
The VLBI group of BKG continues regular submissions of long term series of tropospheric parameters to the IVS (net and total zenith delays, horizontal gradients) for all available VLBI sessions since 1984. The tropospheric parameters are extracted from the standard global solution for the EOP time series bkg00023 and transformed into SINEX format.

8. 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 coordinate, radio source coordinate, and EOP including the X,Y, and Z rotation parameters. The a priori datum for TRF is defined by the VTRF2008a, and ICRF is used for a priori CRF information.

9. 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 in UT1 and UT1 rate and rate of rate. Only the normal equations stored in the SINEX files are important for further combination with other space geodetic techniques.

References

Further Information
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