

BKG/DGFI Combination Center Annual Report 2013

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Abstract This report summarizes the activities of the BKG/DGFI Combination Center in 2013 and outlines the planned activities for 2014. The main focus in 2013 was on the inclusion of source positions in the combination process and the preparation for the IVS contribution to ITRF2013.

1 General Information

The BKG/DGFI Combination Center was established in October 2008 as a joint effort of the Federal Agency for Cartography and Geodesy (Bundesamt für Kartographie und Geodäsie, or BKG) and the German Geodetic Research Institute (Deutsches Geodätisches Forschungsinstitut, or DGFI). The participating institutions, as well as the tasks and the structure of the IVS Combination Center, are described in [1]. The tasks comprise quality control and a timely combination of the session-based intermediate results of the IVS Analysis Centers into a final combination product (e.g., Earth orientation parameters, EOP). In coordination with the IVS Analysis Coordinator, the combination results are released as official IVS products. The Combination Center is also expected to contribute to the generation of the official IVS input to any ITRF activities.

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The BKG/DGFI Combination Center performs a combination of session-based results of the IVS Analysis Centers on an operational basis. The strategy for the combination is based on the combination of normal equations and was adopted from the combination process as developed and performed by the IVS Analysis Coordinator (cf. [2], [3]). At BKG, the following tasks are performed:

- Quality control of the Analysis Center results: checking the format of the results and their suitability for combination, identification, and reduction of outliers, comparison of the Analysis Centers' results with each other, and comparison of the results with external time series provided by IERS or IGS.
- Feedback to the Analysis Centers: quality control results are available at the BKG IVS Combination Center Web page [5].
- Generation of high-quality combination products and timely archiving and distribution: combination products are created by using the combination part DOGS-CS of DGFI's software package DOGS (DGFI orbit and geodetic parameter estimation software) [4].
- Submission of official IVS combination products to the IERS: the products are submitted to the responsible IERS components to be used for IERS product generation (e.g., EOP rapid products and the EOP series IERS C04).
- Generation of the official IVS input to the ITRF: the combined session products (from 1984 to present) are submitted for ITRF computation in the form of normal equations in SINEX format. This work is also supported by the staff of the IERS Central Bureau, hosted by BKG.

- Final results are archived in the BKG Data Center and mirrored to the IVS Data Centers at Observatoire de Paris (OPAR) and Goddard Space Flight Center (GSFC). This work is assisted by the staff of the BKG Data Center in Leipzig.

The inclusion of new Analysis Centers has continued, a newly designed Web page was brought online, and the Web-based analysis tools have been enhanced.

DGFI is in charge of the following Combination Center functions:

- DGFI is developing state-of-the-art combination procedures. This work, as well as the following item, is also related to the ITRS Combination Center at DGFI and DGFI's efforts within the IERS WG on Combination at the Observation Level (COL).
- The software DOGS-CS is updated by implementing and documenting the developed state-of-the-art combination procedures.
- Adhering to IERS Conventions: the DGFI DOGS software package is continuously updated to be in accordance with the IERS Conventions.

2 Activities During the Past Year

At BKG, the following activities were performed during 2013:

- Generation of a combined solution of IVS 24h rapid sessions twice a week.
- Generation of a combined long-term (quarterly) solution of IVS 24h sessions every three months.
- Further development of the IVS Combination Center's Web sites [5].
- Refinements of the combination procedure and implementation of source parameter combination.
- Development of an alternative combination procedure using the Bernese GNSS Software; implementation of the basic VLBI combination functions and preprocessing routines in cooperation with the University of Bonn.
- Participation in a pilot project on digital object identifiers (DOI) for data in cooperation with R. Heinkelmann (Deutsches GeoForschungsZentrum, Germany); feasibility investigation for providing data and meta data.

- A guideline for potential Analysis Centers that intend to contribute to the combined solution has been drafted in cooperation with R. Heinkelmann (GFZ). This guideline is available at <http://ccivs.bkg.bund.de/bid>.

Figure 1 shows an example plot of the differences in declination and right ascension for selected sources between combined source positions and their ICRF2 position. The differences are in the range of ± 0.4 mas.

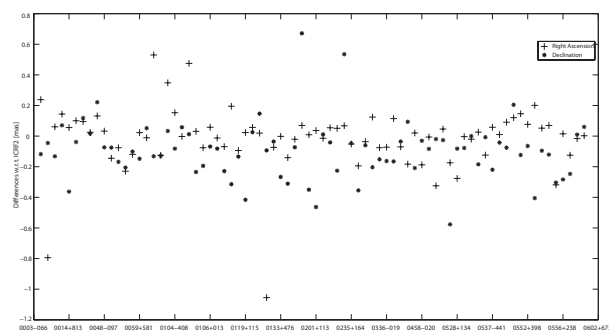


Fig. 1 Difference in right ascension (+) and declination (*) between combined and ICRF2 source positions.

At DGFI the following activities were performed during 2013:

- Application of tidal corrections to UT1 according to IERS Conventions (2010) by DOGS-CS.
- Development of an EOP routine to switch between piecewise linear (offsets at 0h) and offset+drift representation.
- Improved realization of observation epochs in DOGS-CS with 8-byte precision.
- Handling of radio source position parameters with DOGS-CS.

2.1 Staff

The list of the staff members of the BKG/DGFI Combination Center in 2013 is given in Table 1.

Figure 2 shows the VLBI and IERS group at BKG in Frankfurt. From left to right: Ole Roggenbuck (DFG project on reference frames; combination at the observation level), Dr. Wolfgang Dick (IERS Central Bureau), Michael Lösler (IVS combination; replaced by

Table 1 Staff members of the BKG/DGFI Combination Center.

Name	Affiliation	Function	E-Mail
Michael Gerstl	DGFI	Software maintenance	gerstl@dgfi.badw.de
Ralf Schmid	DGFI	Combination strategies	schmid@dgfi.badw.de
Mathis Bloßfeld	DGFI	Combination strategies	blossfeld@dgfi.badw.de
Sabine Bachmann	BKG	Combination procedure development	sabine.bachmann@bkg.bund.de
Linda Messerschmitt ¹	BKG	Operational Combination /Web site maintenance	linda.messerschmitt@bkg.bund.de
Michael Lösler ²	BKG	Operational Combination /Web site maintenance	michael.loesler@bkg.bund.de

Linda Messerschmitt), Sabine Bachmann (IVS combination) and Dr. Daniela Thaller (head of section).

**Fig. 2** IVS combination and IERS group at BKG in Frankfurt.

More details on the IVS Combination Center at BKG can be found in an interview for the IVS Newsletter [6].

3 Current Status

In 2013, six IVS Analysis Centers (BKG, DGFI, GSFC, IAA, OPA, and USNO) contributed to the IVS combined product (see [5]). The rapid solutions contain only R1 and R4 sessions, and new data points are added twice a week as soon as the SINEX files of at least four IVS Analysis Centers are available.

¹ Linda Messerschmitt joined the BKG Combination Center in October 2013.

² Michael Lösler left the BKG Combination Center in July 2013.

Long-term series are generated quarterly and include every 24h session since 1984. The quarterly series include long-term EOP, station positions, and velocities. Furthermore, a VLBI TRF is generated and published. The preprocessing to read and write source positions was implemented, and the software was extended to process source parameters. The results of the combination process are archived by the BKG Data Center in Leipzig. The combined rapid EOP series, as well as the results of the quality control of the Analysis Center results, are also available directly at the BKG/DGFI Combination Center Web page [5] or via the IVS Analysis Coordinator Web site.

4 Future Plans

In 2014, the work of the BKG/DGFI Combination Center will focus on the following aspects:

- Generation of the IVS contribution to ITRF2013: input data investigation, combination strategy and evaluation of the combined EOP and station coordinate time series as well as the comparison of the individual contributions of the Analysis Centers.
- Investigation into combination of source coordinates for time series of source coordinates and generation of a combined celestial reference frame based on VLBI intra-technique combination.
- Establish the digital object identifier (DOI) for combined VLBI products in cooperation with GFZ.

References

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