

3.6.2.3 Deutsches Geodätisches Forschungsinstitut (DGFI)

In the year 2007, the activities of the IERS Combination Research Centre at DGFI concentrated on contributions to the IERS Combination Pilot Project and the closely related German project GGOS-D as well as on updates of the SLR intra-technique combination.

DGFI contributions to the IERS Combination Pilot Project

Within the IERS Combination Pilot Project (CPP), DGFI provides individual SLR and VLBI solutions and combined SLR solutions to the ILRS and IVS, respectively. DGFI has been accepted by the IERS as a Combination Centre for the inter-technique combination of the weekly/daily SINEX files provided by the Techniques' Services. Studies and inter-technique combinations performed in the year 2007 concentrated on the weighting, the handling of local ties and the datum definition. The DGFI combination software DOGS-CS has been updated and preparations for the generation of weekly combined solutions on a routine basis have been performed.

DGFI contributions to GGOS-D

Although GGOS-D is not an IERS project, the work is very closely related to the DGFI research performed as IERS Combination Research Centre. GGOS-D is funded by the German Ministry for Research and Education in the frame of the programme GEOTECHNOLOGIEN. The project involves four institutions: GeoForschungs-Zentrum Potsdam (GFZ), Bundesamt für Kartographie und Geodäsie (BKG) in Frankfurt am Main, Institut für Geodäsie und Geoinformation, Universität Bonn (IGG-B), and DGFI. In 2007, DGFI has performed the following major activities within GGOS-D:

- Based on the common standards and models that have been implemented in the different software packages (OCCAM for VLBI, DOGS-OC for SLR), the long time series of VLBI and SLR data have been homogeneously reprocessed at DGFI. Furthermore, the two individual SLR solutions of DGFI and GFZ were combined at DGFI.
- In cooperation with GFZ Potsdam and TU Munich, the GPS and VLBI data were reprocessed by applying different (fully homogenized) tropospheric mapping functions (solution 1: Niell Mapping Function (NMF) and constant a-priori zenith delay; solution 2: Vienna Mapping Function (VMF) and a-priori zenith delay from ECMWF). Based on these solutions the VLBI and GPS height time series were analysed and compared. Furthermore, investigations regarding the estimation of loading coefficients from the GPS and VLBI height time series have been carried out.
- A major focus of the DGFI work in 2007 was on the computation of a GGOS-D terrestrial reference frame (TRF) from the

VLBI, SLR and GPS long time series. The TRF computation consists of the two following major steps: (1) Accumulation of the time series normal equations per technique and analysis of the time series solutions; (2) Inter-technique combination of the accumulated multi-year normal equations per technique. Research objectives addressed include the handling of non-linear station motions, the developments of strategies for the selection of co-location sites and the implementation of local tie information, as well as the weighting and the datum definition of the final TRF solution.

SLR intra-technique combination

In 2007, DGFI has refined the intra-technique combination methodology and software for an automated combination of the individual SLR solutions. The variance component estimation, which was mainly implemented for an automatic weighting, turned out to be a useful tool also for outlier analysis of the input solutions. The software for a daily automatic combination with seven days input solutions has been developed and tested for automatic processing. Also in 2007 the test phase for a weekly combination of orbit solutions started. The software is in development.

Acknowledgements

This work was partly funded by the project GGOS-D within the GEOTECHNOLOGIEN programme of the Federal Ministry of Education and Research (BMBF: Bundesministerium für Forschung und Technologie), FKZ 03F0425C.

References

- Kelm, R.: *Rigorous variance component estimation in weekly intra-technique and inter-technique combination for global terrestrial reference frames*. Proceedings of the IAG Symposium Geodetic Reference Frames GRF 2006 Munich, Springer, in press.
- Krügel, M., Thaller, D., Tesmer, V., Rothacher, M., Angermann, D., Schmid, R.: *Troposphere parameters: Combination based on homogeneous VLBI data*. In: Schuh, H., A. Nothnagel, C. Ma (Eds.): VLBI special issue. Journal of Geodesy, 81, 515–527, DOI 10.1007/s00190-006-0127-8, 2007.
- Krügel, M., Angermann, D., Drewes, H., Gerstl, M., Meisel, B., Tesmer, V., Thaller, D.: *GGOS-D Reference Frame Computations*. GEOTECHNOLOGIEN Science Report, No. 11, ISSN 1619-7399, 2007.
- Meisel, B., Angermann, D., Krügel, M.: *Influence of time-variable effects in station positions on the terrestrial reference frame*, Proceedings of the IAG Symposium Geodetic Reference Frames GRF 2006 Munich, Springer, in press.
- Tesmer, V., Böhm, J., Heinkelmann, R., Schuh, H.: *Effect of different tropospheric mapping functions on the TRF, CRF, and position time series estimated from VLBI*. In: Schuh, H., Nothnagel,

A., Ma, C. (Eds.): VLBI special issue. *Journal of Geodesy*, 81, 409–421, DOI 10.1007/s00190-006-0127-8, 2007.

Tesmer, V., Böhm, J., Meisel, B., Rothacher, M., Steigenberger, P.: *Atmospheric loading coefficients determined from homogeneously reprocessed GPS and VLBI time series*, 5th IVS General Meeting Proceedings, 2008.

Thaller, D., Krügel, M., Rothacher, M., Tesmer, V., Schmid, R. Angermann, D.: *Combined Earth Orientation Parameters (EOP) based on homogeneous and continuous VLBI and GPS data*. In: Schuh, H., A. Nothnagel, C. Ma (Eds.): VLBI special issue. *Journal of Geodesy*, 81, 529–541, DOI 10.1007/s00190-006-0127-8, 2007.

*Detlef Angermann, Hermann Drewes, Rainer Kelm,
Barbara Meisel, Manuela Seitz, Volker Tesmer*