Vienna IGG Special Analysis Center Annual Report 2009

Harald Schuh, Johannes Böhm, Sigrid Böhm, Tobias Nilsson, Andrea Pany, Lucia Plank, Hana Spicakova, Kamil Teke, Jörg Wresnik

Abstract

The main activity of the VLBI group at the Institute of Geodesy and Geophysics (IGG) of Vienna University of Technology in 2009 has been the development of new VLBI software based on Matlab, called Vienna VLBI Software VieVS. Furthermore, studies related to VLBI2010 simulations, Earth rotation and geodynamical parameters from VLBI have been continued.

1. General Information

The Institute of Geodesy and Geophysics (IGG) is part of the Faculty of Mathematics and Geoinformation of the Vienna University of Technology. It is divided into three research units, one of them focusing on advanced geodesy (mathematical and physical geodesy, space geodesy). Within this research unit, one group (out of three) is dealing with geodetic VLBI.

Figure 1. Some members of the VLBI group at IGG at the EVGA Meeting 2009 in Bordeaux: Andrea Pany, Johannes Böhm, Harald Schuh, Lucia Plank, and Hana Spicakova.

2. Staff

Personnel at IGG associated with the IVS Special Analysis Center in Vienna are Harald Schuh (Head of IGG, Chair of the IVS Directing Board), and eight scientific staff members. Their main research fields are summarized in Table 1.

Table 1. Staff members ordered by their main focus of research.

Johannes Böhm	VLBI2010, Vienna VLBI Software (VieVS)
Andrea Pany	VLBI2010, troposphere, turbulence theory
Jörg Wresnik (until 08/2009)	VLBI2010, scheduling
Kamil Teke	VieVS, least squares adjustment
Lucia Plank	VieVS, Earth orientation
Hana Spicakova	VieVS, station displacements
Tobias Nilsson (from 05/2009)	VieVS, Earth orientation
Sigrid Böhm	Earth orientation, tidal influences

3. Current Status and Activities

- **Vienna VLBI Software VieVS**
  A graphical user interface (GUI) in Matlab was added to VieVS to allow simple handling. Results of VieVS, in terms of baseline length repeatabilities, were compared to those of Occam 6.1. A comparison campaign was started with the goal of comparing different VLBI analysis software packages on the basis of the computed delay and its partial derivatives, in order to detect present inadequacies in the modeling part of the software packages.

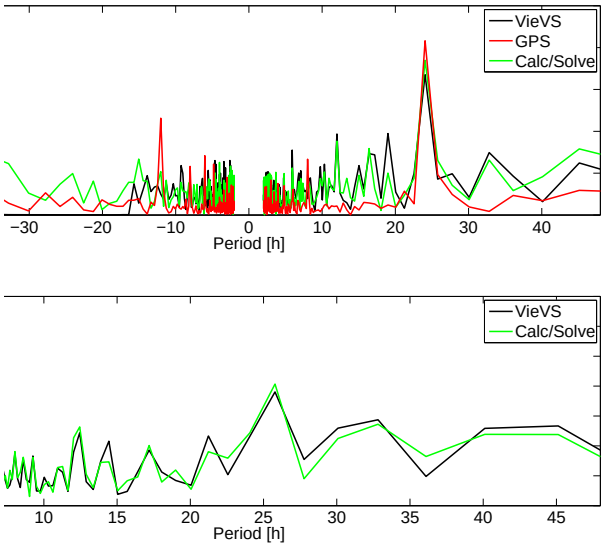

Figure 2. VieVS: Spectra of polar motion and DUT1 from the recent CONT08 campaign. For comparison, we show the spectra from another VLBI solution (made by Thomas Artz, Bonn using CALC/SOLVE) and from a GPS solution (made by Peter Steigenberger with Bernese).

- **Earth orientation parameters from VieVS and Occam 6.1**
  We have used VieVS to estimate high frequency Earth rotation variations during the contin-

uous VLBI campaigns CONT02, CONT05, and CONT08. The results were then analyzed and compared to other solutions. As an example, in Figure 2 the spectra of polar motion and DUT1 from the recent CONT08 campaign are plotted. The spectra show the residual polar motion/DUT1 that remain after removing the interpolated C04 05 values as well as the IERS model for high frequency Earth rotation variations (McCarthy and Petit, 2004 [4]). As a comparison, we also show the spectra from another VLBI solution (made by Thomas Artz, Bonn using CALC/SOLVE) and from a GPS solution (Steigenberger et al., 2006 [6]). The two VLBI solutions agree very well, while there are some differences between the VLBI spectra and the GPS spectrum (e.g., there is a peak at 12 hours prograde for VLBI and not for GPS, while GPS has a peak at 12 hours retrograde instead). The reason for this needs further investigations.

In addition to the development of VieVS, the software package Occam 6.1 was used for processing VLBI observation data from 1984-2008, focusing on the derivation of Earth rotation parameters and in particular of DUT1 with sub-daily resolution (Englich et al., 2010 [1]). The estimated DUT1 series were investigated for tidal effects with periods shorter than 35 days. The comparison with DUT1 amplitudes of the conventional IERS models showed deviations in the diurnal and semi-diurnal tidal bands of up to 2.5 microseconds. The residuals in the semi-diurnal tidal band could be reduced almost to zero by accounting for the effect of the lunisolar torque on the triaxial Earth. Concerning the zonal tidal variations our study revealed significant discrepancies ($>$ 40 microseconds) between the observed variations and variations predicted by the conventional model in the fortnightly tidal band, which could be considerably reduced when a combined model as suggested by Gross (2009 [2]) was applied.

- **Love and Shida numbers**
  A new module for global solutions is being added to VieVS which allows for the estimation of TRF/EOP/CRF as well as for the determination of geophysical parameters such as Love and Shida numbers and the Free Core Nutation period from solid Earth tidal deformations. First results are obtained from the IVS R1 and R4 sessions covering seven years, and they are shown in Figure 3.

- **Troposphere delays**
  We used ray-traced delays computed with the Kashima Ray-tracing Tools (KARAT, Hobiger et al 2008 [3]) and high-resolution numerical weather models of the Japan Meteorological Agency for the VLBI site in Tsukuba during a 14-day typhoon period in September 2007 to explore possibilities of improving mapping functions and the modeling of the asymmetric part of the wet delays (Pany et al. 2009 [5]).

4. Future Plans

In 2010 we will continue the development of the new VLBI software VieVS. This software will also include a tool for scheduling purposes. Additionally, we will contribute to the ongoing activities within VLBI2010, and we will carry out Earth orientation and reference system studies. W.r.t. troposphere delay modeling, we will test the impact of applying a priori correlations from turbulence theory to the analysis, and it is planned to equip VieVS with a Kalman Filter solution and simulation tools.

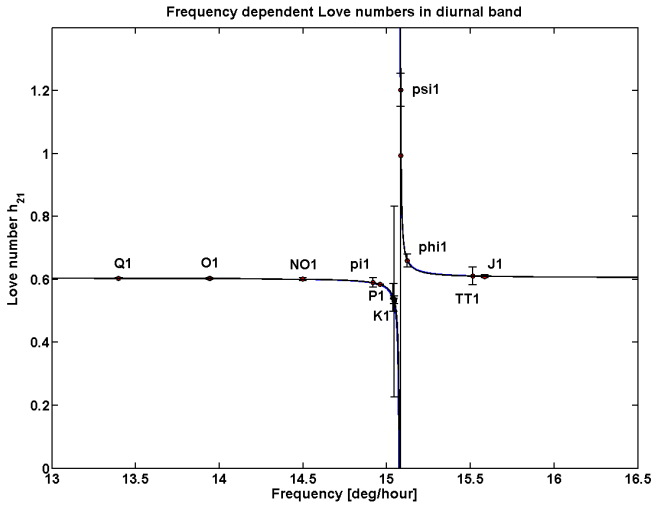

Figure 3. Love numbers: Estimation of frequency-dependent Love numbers in the diurnal band.

5. Acknowledgements

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