Vienna IGG Special Analysis Center Annual Report 2002

Harald Schuh, Johannes Boehm, Thomas Hobiger

Abstract

In April 2002, the Institute of Geodesy and Geophysics (IGG), Vienna, was asked by the IVS Directing Board to coordinate the IVS Pilot Project - Tropospheric Parameters. This project aims at providing tropospheric parameters (total and wet zenith delays) on a regular basis as IVS products. As of January 2003, seven IVS Analysis Centers have joined the project and the combined time series determined so far are of high quality (Schuh et al., 2003 [2]). The IGG also continued its research on the determination of ionospheric parameters using VLBI data.

1. General Information

The IVS Special Analysis Center at the Department of Advanced Geodesy of the Institute of Geodesy and Geophysics (IGG) is part of the University of Technology, Vienna. It is mainly engaged in atmospheric research (troposphere and ionosphere) and the development of the VLBI software package OCCAM.

Figure 1. **Members of the IVS AC at IGG, Vienna** (from left Th. Hobiger, H. Schuh, J. Boehm). The picture was taken at the IVS General Meeting in Tsukuba, Japan.

2. Staff

Personnel at IGG associated with the IVS Special Analysis Center in Vienna are Harald Schuh (Head of the Department of Advanced Geodesy, Member of the IVS Directing Board) and the

research assistants Johannes Boehm and Thomas Hobiger. While Johannes Boehm is mainly concentrating on tropospheric resarches, Thomas Hobiger focuses on the ionosphere.

3. Current Status and Activities

- **Modification of the VLBI software package OCCAM**
  Together with Oleg Titov (Australian Surveying and Land Information Group (AUSLIG)), chairman of the 'OCCAM Group', and several other scientists from various countries, IGG is involved in the development of the OCCAM software. In particular, it is in charge of the classical least-squares approach using the Gauss-Markov model. New models for loading effects have been implemented (atmosphere, snow, hydrology, non-tidal oceanic effects), too, and the new isobaric mapping functions (Niell, 2001 [1]) with a priori hydrostatic gradients have been included.
  An OCCAM User Workshop was held in Vienna (2002, April 29-30) with 12 participants from 5 countries to discuss new features of the software and the future collaboration.

- **IVS Pilot Project - Tropospheric Parameters**
  In April 2002 the IVS Pilot Project - Tropospheric Parameters was set up by the IVS Directing Board and the Institute of Geodesy and Geophysics was asked to coordinate the project. After the call for participation six IVS Analysis Centers joined the project and submitted their estimates of tropospheric parameters (wet and total zenith delays, horizontal gradients) for all IVS-R1 and IVS-R4 sessions since January 1st, 2002, on a regular basis. A seventh Analysis Center joined in January 2003. Using a two-step procedure the individual submissions are combined to stable and robust tropospheric parameters with 1 hr resolution and high accuracy (Schuh et al., 2003 [2]). Figure 2 shows a typical example of the individual submissions and the combined series during a time interval of 24 hours in the GPS week 1194 (November 26, 2002).

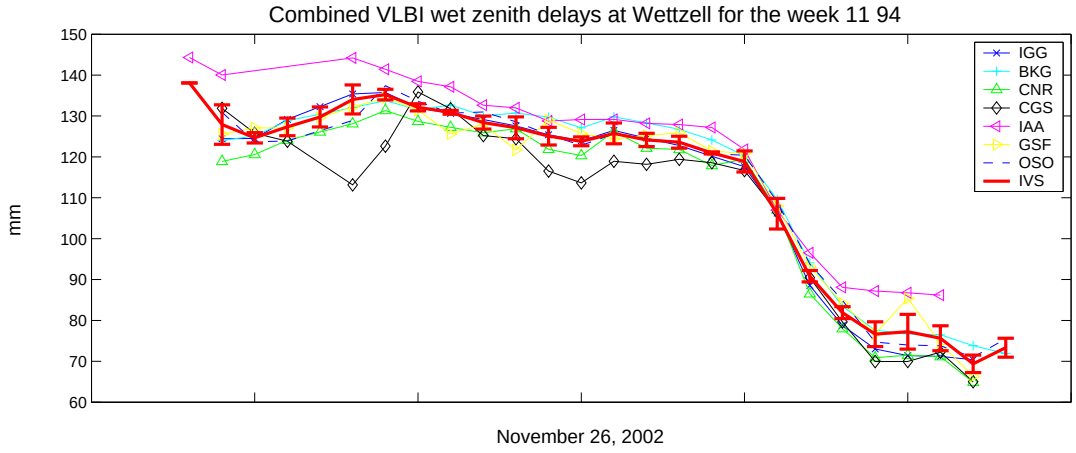

Figure 2. **Submissions for the wet zenith delays** by the Analysis Centers (GPS week number 1194) and the combined VLBI solutions (red bold line with error bars).

- **Climatological studies**
  Since there have been consistent VLBI observations at some stations for nearly 20 years, a closer look was taken at the development of the zenith wet delays. For station Wettzell, Germany, a trend of about +0.8 mm/year was detected, which implies that the troposphere over Wettzell has been getting more humid with time (see Table 3).

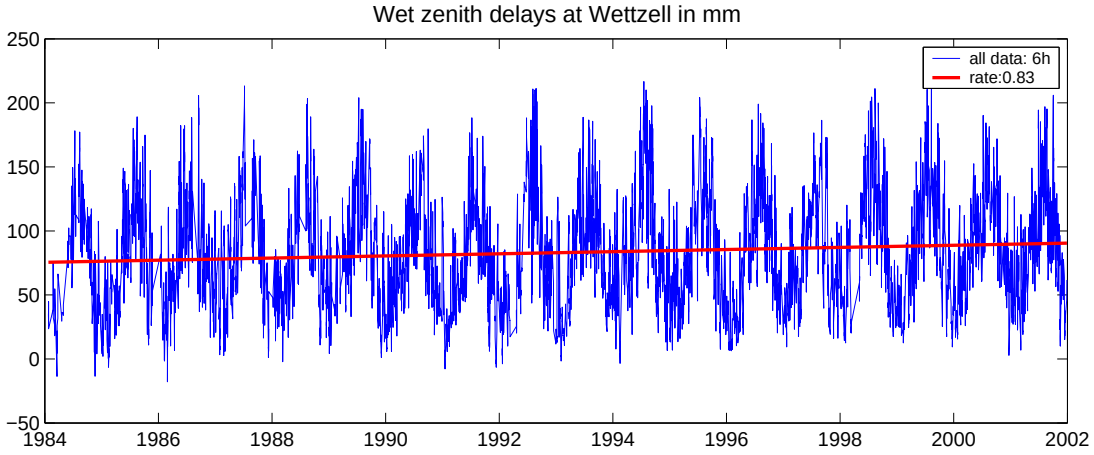

Figure 3. **Wet zenith delays in mm** at Wettzell since 1984.

- **Determination of ionospheric parameters**
  In standard geodetic VLBI data analysis ionospheric corrections are calculated from the two-frequency observations and are applied to the observed group delays. This information can also be used to study the behavior of the ionosphere. Unlike GPS, VLBI is only able to observe differences of the total electron content (TEC) values above the stations. At IGG a procedure was developed to solve for one unknown ionospheric offset per baseline and to calculate time dependent total electron content TEC values above each station. Figure 4 shows the TEC differences on the baseline Wettzell-Yebes from VLBI (EUROPE session, May 15th , 2000) and from GPS (published by IGS) displaying the offset between the two techniques.

4. Future Plans

For the year 2003 the plans of the IVS Special Analysis Center at IGG include:

- Further development of OCCAM, e.g. the estimation of radio source coordinates,
- Research on new tropospheric models that are based on numerical weather data,
- Comparisons of tropospheric parameters within the IVS Pilot Project - Tropospheric Parameters,
- Determination of total electron content (TEC) maps from VLBI,
- Investigation of atmospheric and hydrological loading by VLBI.

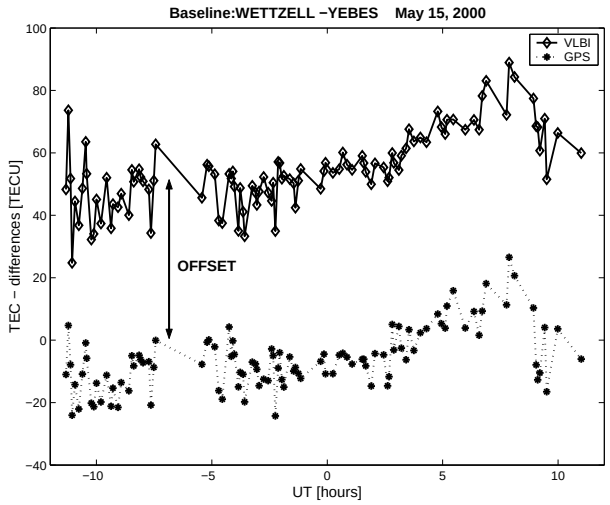

Figure 4. Comparison of TEC differences for the baseline Wettzell-Yebes for the EUROPE session on May 15th, 2000 from VLBI and GPS

References

[1] Niell, A.E.: Preliminary evaluation of atmospheric mapping functions based on numerical weather models, Phys. Chem. Earth, 26, 475-480, 2001.

[2] Schuh H., Boehm J.: IVS Pilot Project - Tropospheric Parameters, International VLBI Service for Geodesy and Astrometry 2002 Annual Report, edited by N. R. Vandenberg and K. D. Baver, NASA/TP-2003-211619, 2003.