The IVS Analysis Center at the Onsala Space Observatory

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Abstract

We give a brief overview of the activities of the IVS Analysis Center at the Onsala Space Observatory during 2003. Some examples of achieved results and ongoing analyses related to earth rotation, loading phenomena, and atmospheric research are presented.

1. Introduction

The IVS Analysis Center at the Onsala Space Observatory (OSO) is active in research concentrating on a number of particular topics that are relevant to space geodesy and geosciences. These research topics are important for geodetic VLBI and are investigated using VLBI observations and corresponding analysis programs. In the following we will briefly address some of these topics and present some examples of performed and ongoing analyses. For the future we plan to continue VLBI related research along those lines, concentrating on particular research topics. There are no plans at OSO for a routine analysis of global VLBI data in a service sense.

2. Earth Rotation Variations and ENSO

We analysed the combined IVS time series of earth orientation parameters [1] to study El-Niño/Southern Oscilation (ENSO). The IVS UT1 values were processed similar to the description in [2] and using the effective atmospheric angular momentum functions as calculated from NCEP/NCAR reanalyses [3]. The resulting excess length-of-day (dLOD) values are shown in Figure 1 together with the Multivariate ENSO Index (MEI) [4]. There is a clear correlation between the two time series and both clearly show the ENSO events during the last 23 years.

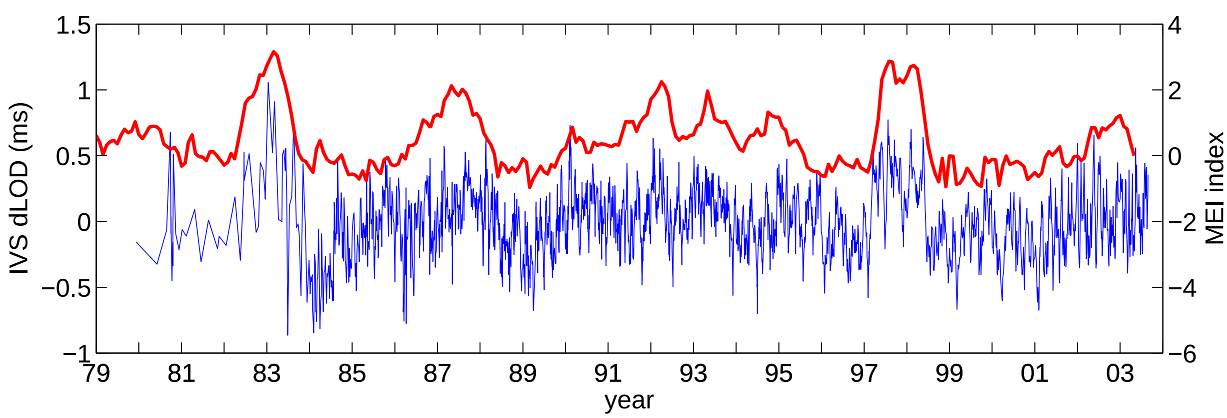

Figure 1. Lower blue curve, left scale: Excess in length of day (dLOD) in ms derived from combined IVS EOP values [1]. Top red curve, right scale: Multivariate ENSO index (MEI) [4]. Both time series clearly show the ENSO events during the last 23 years.

3. High-frequency EOP During CONT02

We analysed the CONT02 VLBI observations and determined polar motion and UT1 values with a time resolution of 1 hour. Figure 2 displays the time series and their corresponding spectra. Variations with 12 hour and 24 hour periodicity are detectable both in polar motion and UT1. A variation with an 8 hour period is detected marginally above the significance limit in Yp. Further investigations are ongoing.

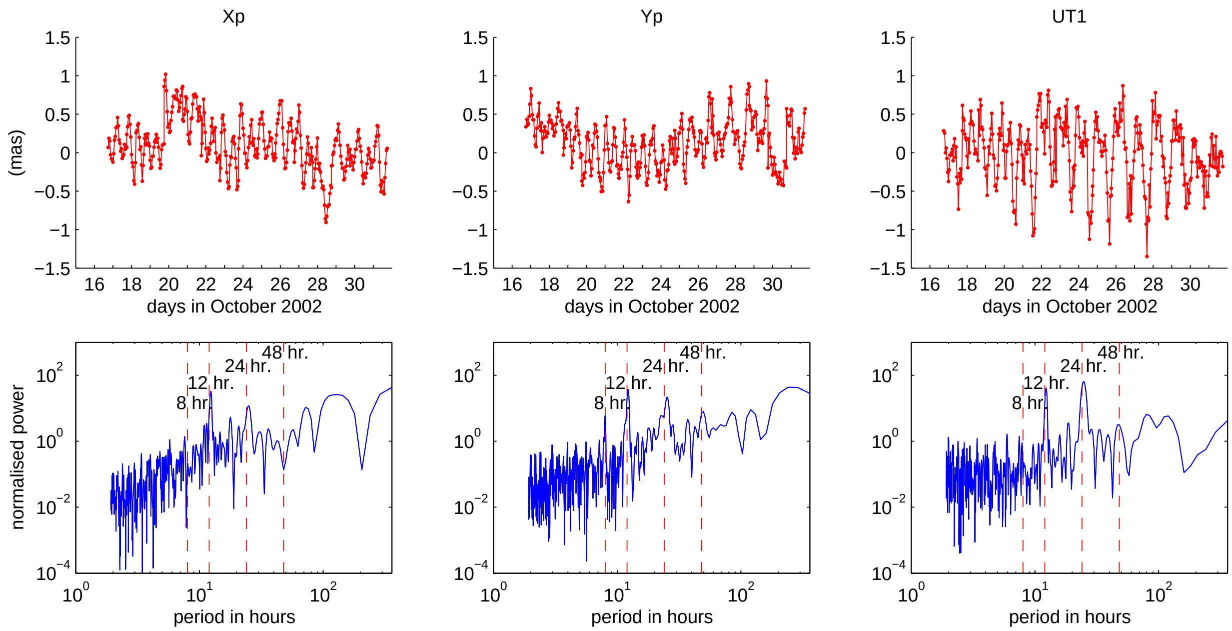

Figure 2. Polar motion and UT1 for CONT02. Upper plots in red: time series of Xp (left column), Yp (middle column) and UT1 (right column) with a time resolution of 1 hour. Lower plots in blue: spectra of the above time series. Periods of 8, 12, 24, and 48 hours are indicated with red vertical lines.

4. Ocean Tide Loading and Atmospheric Loading

The automatic ocean tide loading provider [5] has been maintained during 2003. On the website http://www.oso.chalmers.se/∼loading users can chose between 11 different ocean tide models that are available to calculate ocean tide loading parameters for site positions that can be specified interactively. The parameters are provided in several formats, and are sent to the user via e-mail.

Time series of atmospheric loading predictions that are based on global convolution of atmopheric pressure fields are available for most of the VLBI databases since 1990 on the website http://www.oso.chalmers.se/∼hgs/apload/apload.html.

5. European Crustal Motion

The analysis of the purely European geodetic VLBI observations has continued and results for crustal motion have been published in 2003 [6].

6. Atmospheric Parameters at Onsala During CONT02

Additionally to the CONT02 VLBI observations we performed simultaneous observations with the Onsala IGS permanent GPS equipment, two water vapor radiometers (WVR), and a rain radar (RR) at the observatory. The water vapor radiometer Astrid was operated in sky mapping mode, while the water vapor radiometer Konrad followed the VLBI observation schedule and was perfoming tip-curve measurements during slewing times of the VLBI telescope. Figure 3 shows preliminary results for the zenith wet delay (ZWD) derived from observations with the four collocated techniques. These prelimiary results show a reasonably good agreement between the ZWD derived from the different techniques and have been communicated the EGS-AGU-EUG Joint Assembly 2003 [7] and the 16th Working Meeting on European VLBI for Geodesy and Astrometry [8]. However, the rain radar measurements indicate that there are still some WVR-data that were influenced by rain and should be removed from the time series. Furthermore, there are still some unexplained biases and thus the investigations are continuing.

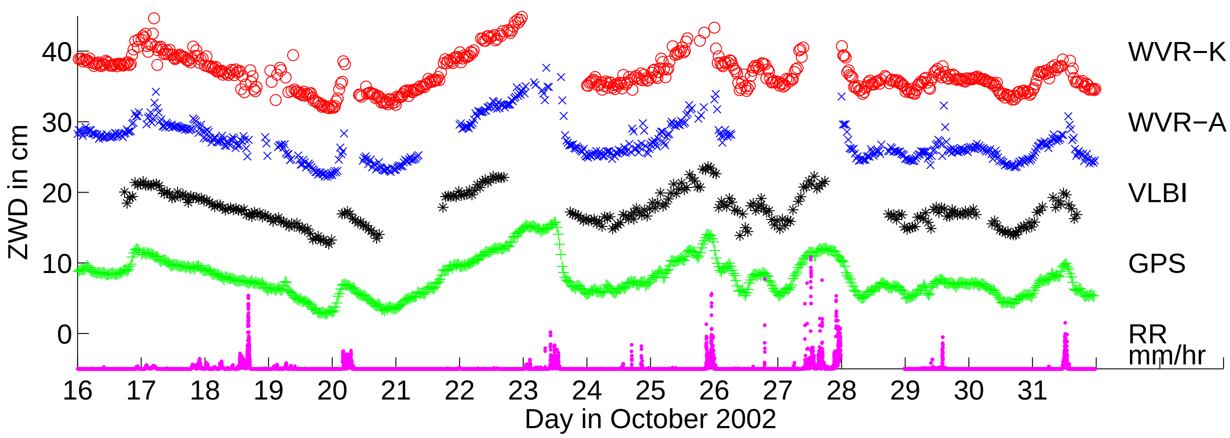

Figure 3. Equivalent zenith wet delays in cm and rain rate in mm/hr at Onsala during CONT02. Top to bottom the time series are: radiometer Konrad (red, offset by +30 cm), radiometer Astrid (blue, offset by +20 cm), VLBI (black, offset by +10 cm), GPS (green, no offset), rain radar (magenta, offset by -5 mm/hr).

7. Trends in Tropospheric Water Vapor at Onsala

We investigated trends in the tropospheric water vapor content based on ZWD data determined from observations with the three collocated techniques VLBI, GPS, and WVR at Onsala and radiosondes (RS) at Landvetter airport 37 km away from the observatory. Data for more than 23 years are available from VLBI, WVR and RS, while GPS data are available since 1993. Each of the techniques has specific advantages and disadvantages in terms of stability and time resolution. Therefore, a combination of the results of the individual techniques appears to be a promising approach. We developed strategies to assess trends in tropospheric water vapor and to combine the results of the four independent techniques in order to determine robust results that can be useful for climate related research [9].

8. Activity in the IVS Pilot Project – Tropospheric Parameters

We continued our activity in the IVS Pilot Project – Tropospheric Parameters. Tropospheric parameters for all VLBI stations observing in the IVS R1 and R4 networks were submitted to the IVS. Figure 4 shows histograms of the ZWD for four stations that are located in different climate zones: Ny-Ålesund – polar, Wettzell – temperate, Hartrao – dry, Fortaleza – tropical. A dependence of the amount of water vapor on the climate zone is obvious.

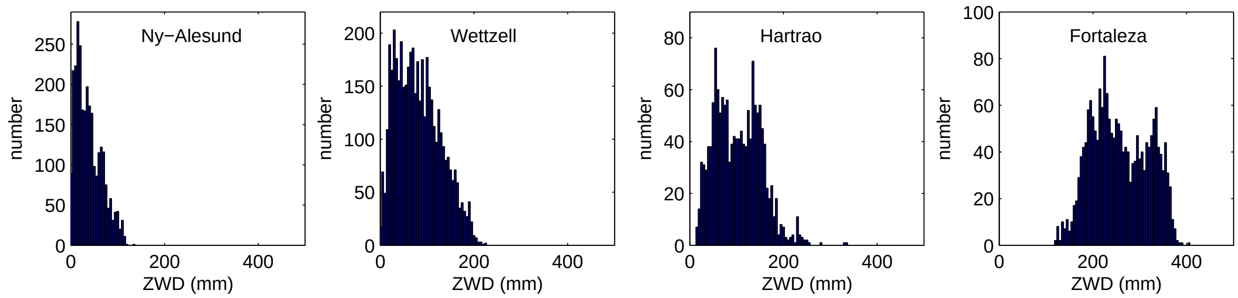

Figure 4. Histograms of zenith wet delay (ZWD) values for four stations located in four different climate regions. The histograms include results from the IVS R1 and R4 experiments during 2002 and 2003.

References

[1] Steinforth, C., and Nothnagel, A.: Official IVS EOP results, Combined series IVS03Q3 http://giub.geod.uni-bonn.de/vlbi/IVS-AC/combi-all/HTML/start.html

[2] Gipson, J. M., and Ma, C.: Signature of El Nino in length of day as measured by VLBI. IERS(1998) Technical Note No 26.

[3] Salstein, D. A., and Rosen, R. D.: Global momentum and energy signals from reanalysis systems. Preprints, 7th Conf. on Climate Variations, American Meteorological Society, Boston, MA, 344-348.

[4] Wolter, K.: Multivariate ENSO Index (MEI) webpage http://www.cdc.noaa.gov/∼kew/MEI/mei.html

[5] Scherneck, H.-G., and Bos, M.: Ocean Tide and Atmospheric Loading. In: N. R. Vandenberg and K. D. Baver (Eds.): IVS 2002 General Meeting Proceedings, NASA/CP-2002-210002, 205–214, 2002.

[6] Haas, R., Nothnagel, A., Campbell, J., and Gueguen, E.: Recent crustal movements observed with the European geodetic VLBI network: Geodetic analysis and results. *Journal of Geodynamics*, **35(4–5)**, doi:10.1016/S0264-3707(03)00003-6,2003.

[7] Haas, R., Gradinarsky, L., Elgered, G., and Johansson, J.: Studying atmospheric properties at the Onsala Space Observatory during the CONT02 experiment. *Geophys. Res. Abstr.*, **Vol. 5**, 09604, 2003.

[8] Elgered, G., and Haas, R.: The Geodetic VLBI Network Station at the Onsala Space Observatory – Activities During 2002. In: W. Schwegmann and V. Thorandt (Eds.): *Proc. of the 16th Working Meeting on European VLBI for Geodesy and Astrometry*, Bundesamt für Kartographie und Geodäsie, 61–66, 2003.

[9] Haas, R., Elgered, G., Gradinarsky, L., and Johansson, J.: Assessing Long Term Trends in the Atmospheric Water Vapor Content by Combining Data From VLBI, GPS, Radiosondes and Microwave Radiometry. *Proc. of the 16th Working Meeting European VLBI for Geodesy and Astrometry*, W. Schwegmann and V. Thorandt (eds.), Bundesamt für Geodäsie und Kartographie, 279–288, 2003.