The IVS Special Analysis Center at the Onsala Space Observatory

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Abstract

We summarise the activities of the IVS Special Analysis Center at the Onsala Space Observatory during 2001. The future plans are briefly described.

1. Introduction

The activities of the IVS Special Analysis Center at the Onsala Space Observatory (OSO) concentrate on a couple of particular topics that are relevant to space geodesy and geosciences. These topics can be investigated by using and developing VLBI databases and corresponding analysis programs. Routine analysis of global VLBI data in a service sense is currently not performed or planned at OSO.

2. Solid Earth Tides

Investigations concerning the elastic properties of the earth's body have been performed by analysis of global geodetic VLBI data and gravimetric observations [1]. The work concentrated on observations performed at the Geodetic Observatory Ny-Ålesund and the tidal harmonic M_f (13.66 day period) because the long-period tides reach their maxima in polar regions and they are more sensitive to mantle inelasticities than diurnal earth tides. The analysis of 14 months of continuous observations with the superconducting gravimeter at Ny-Ålesund allows the determination of gravimetric factors for several tidal harmonics. However, the gravimetric factor obtained for the M_f tide still does not allow us to clearly distinguish between elastic and inelastic body tide models since the uncertainty of the determined gravimetric factor is still too large. The analysis of a data set of more than 200 global VLBI data bases involving Ny-Ålesund so far only concentrated on the question of whether the M_f tide can be detected directly from time series of VLBI station positions. Our study shows that the M_f tide could be identified successfully in the spectra of the topocentric up-component of Ny-Ålesund when this tide was not modelled in the apriori solid earth tide model. Based on this promising first step further investigations to determine directly the corresponding Love number are ongoing.

3. Ocean Tide and Atmospheric Pressure Loading

Ocean tide loading is investigated at OSO both by theoretical modelling and by empirical determination of ocean tide loading effects [2]. Ocean tide loading coefficients based on recent ocean tide models have been calculated and made available for a global set of VLBI stations (http://www.oso.chalmers.se/~hgs/README.html).

An automated ocean tide loading provider has been developed by Hans-Georg Scherneck and Machiel Bos during 2001. It is available under http://www.oso.chalmers.se/~loading and offers

the calculation of ocean tide loading coefficients based on 11 different ocean tide models for user-defined input stations.

From analysis of the VLBI data observed in the European VLBI network we can conclude that the application of the more recent loading models based on finite element ocean tide models and assimilation of satellite altimetry data results in smaller χ^2 values for the least-squares analysis than when using an ocean tide loading model based on an older ocean tide model that had been developed in the 80s [3].

Global convolution of atmopheric pressure fields is used to calculate time series of atmospheric loading predictions. They are available for most of the VLBI databases since 1990 http://www.oso.chalmers.se/~hgs/apload/apload.html.

4. European Crustal Movements

Crustal movements in Europe have been derived based on 11 years of purely European geodetic VLBI observations [3]. Figure 1 shows the weighted root mean square values (wrms) of the baseline measurements in the European VLBI network as a function of baseline length. Baselines that involve Simeiz and/or Yebes are excluded because of poor performance.

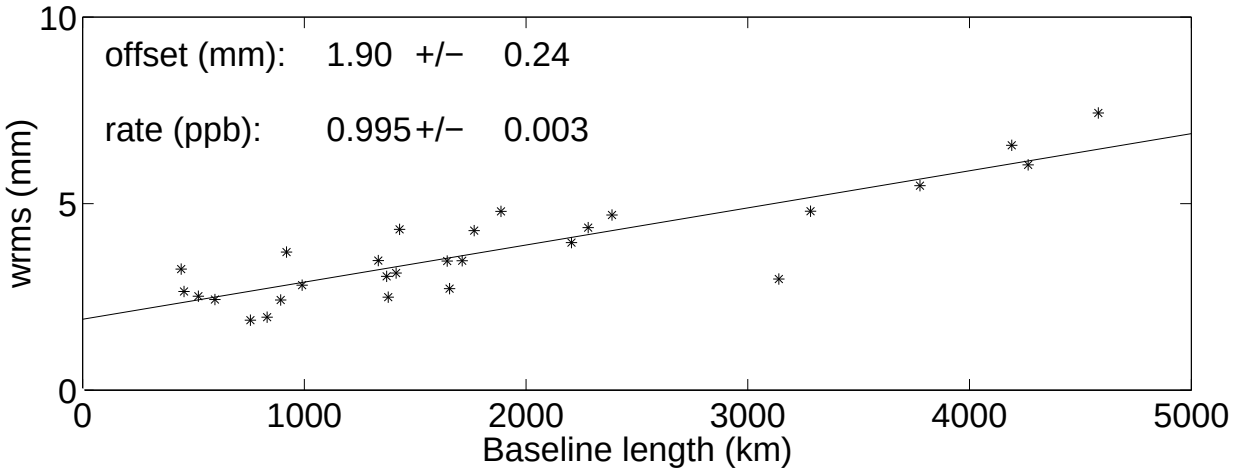

Figure 1. Baseline repeatability from analysis of the European geodetic VLBI data. Baselines involving Simeiz and/or Yebes are excluded.

The results for topocentric station motions with respect to Wettzell have been used for geological interpretation [4] and to determine the European large-scale strain-rate field [5].

5. Atmospheric Radio Wave Propagation

The usage of collocated space geodetic and remote sensing techniques for atmospheric studies has been continued [6], [7]. Results for atmospheric parameters derived from several collocated techniques (VLBI, GPS, WVR) at the three sites Onsala, Wettzell and Madrid have been compared to results from a numerical weather model for several days in 1999. Each of the three sites of the European geodetic VLBI network is located in a different climatological regime. Correlation

coefficients in the range of 75–95% are found for the zenith wet delays of the different and independent techniques [8]. While the biases of the GPS and WVR results with respect to the numerical weather model appear to be station dependent, such a station dependence does not appear to exist for the VLBI biases. VLBI seems to provide a useful calibration data set for climate studies and numerical weather models.

6. IVS Analysis Pilot Project 2

After having participated already in the First IVS Analysis Pilot Project in 2000, the IVS Special Analysis Center at OSO also participated in the Second IVS Analysis Pilot Project in 2001. Earth orientation parameters (EOP) obtained from the 104 NEOS-A sessions observed in 1999 and 2000 and the corresponding atmospheric parameters have been submitted to the IVS analysis coordinator. Figure 2 shows the EOP (left side) and the corresponding standard deviations (right side).

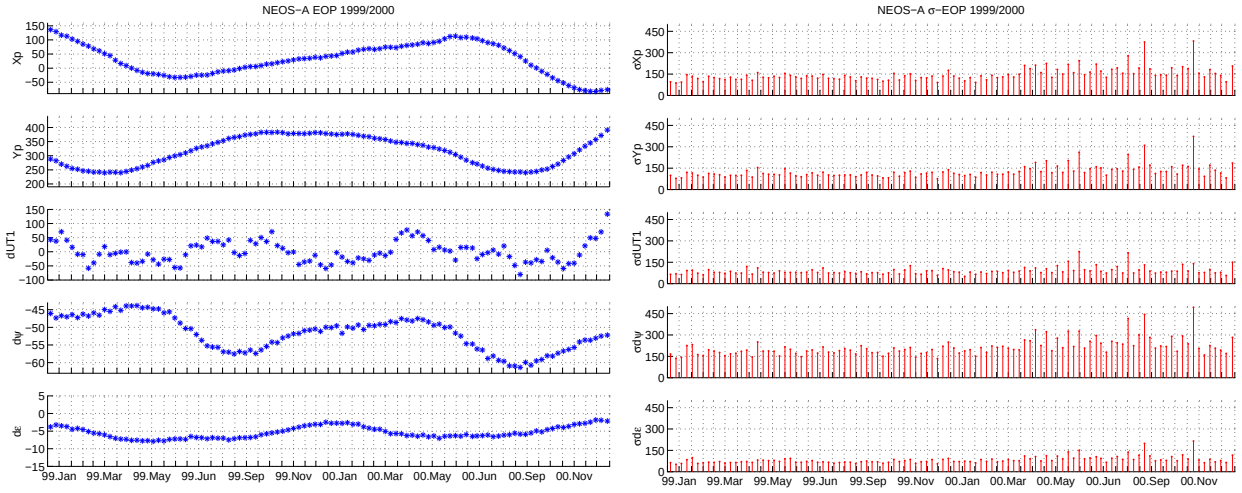

Figure 2. OSO's submission of earth orientation parameters derived from the 104 NEOS-A experiments in 1999 and 2000 for the Second IVS Analysis Pilot Project. The left column shows the earth orientation parameters in milliarcseconds, the right column shows the respective standard deviations in microarcseconds. For UT1-UTC (dUT1) an offset, a drift, a bi-annual, an annual and a semi-annual term are subtracted.

7. Outlook

The IVS Special Analysis Center at the Onsala Space Observatory will continue to work on specific topics that are relevant for space geodesy and geosciences. This includes in particular solid earth tides, loading effects due to ocean and atmosphere, earth rotation, crustal motion and atmospheric properties.

A special focus for the future will be the investigation of combination strategies for VLBI and GPS in particular to derive a more detailed picture of the strain-rate field in Europe and to investigate changes in absolute sea level. The geophysical interpretation of the derived results will be of major concern.

The study of loading phenomena due to oceanic, atmospheric and other enviromental influences will be continued especially in connection with earth rotation studies and reference frame investigations. On a longer time scale, a contribution to IVS by EOP solutions and reference frame solutions is also planned.

The atmopsheric studies will mainly focus on the application of space geodesy for climatological studies. Long time records of atmospheric parameters derived from VLBI and GPS appear to be important sources of information.

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