The IVS Special Analysis Center at the Onsala Space Observatory

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Abstract

We give a short overview about the Onsala Space Observatory (OSO) in its function as an IVS Special Analysis Center. We present topics currently worked on at Onsala and describe future plans.

1. Introduction

The Onsala Space Observatory (OSO) is active as an IVS Special Analysis Center. OSO focuses on a number of special problems which can be investigated using and developing VLBI databases and analysis programs, and providing ancillary parameters. There is no intention and no capability at Onsala to do global VLBI analysis on a routine basis.

2. Staff at Onsala associated to the IVS Special Analysis Center

The staff at Onsala associated to the IVS Special Analysis center is: Hans-Georg Scherneck (scientist), Gunnar Elgered (scientist), Jan M. Johansson (scientist) and Rüdiger Haas (scientist). Corresponding e-mail addresses and telephone numbers can be found on the Onsala web page.

3. Special Analysis at Onsala

Solid Earth tides:
Space geodetic observations are affected by site deformations caused by solid Earth tides. Geodetic VLBI data are used to determine frequency dependent complex Love and Shida numbers and the complex eigenfrequency of the Free Core Nutation resonance [1].

Ocean tide loading:
Ocean tide loading is the second largest Earth deformation effect after the solid Earth tides. Geodetic VLBI observations are sensitive to this effect and it has to be accounted for in the analysis of geodetic VLBI data. Several different theoretical ocean tide loading models exist which are based on different ocean tide models [2], [3]. Ocean tide loading parameters are provided from OSO for all VLBI stations world wide. Estimates of ocean tide loading effects from geodetic VLBI observations can be used to verify and/or refine the theoretical ocean tide loading models [4].

Ocean tide loading and Earth orientation:
Ocean tide loading influences the determination of Earth orientation parameters with space geodetic techniques. Particularly mismodelling of horizontal ocean tide loading possesses a common rotation mode for a network of space geodetic stations. Neglect or mismodelling will therefore contaminate the derived Earth orientation parameters by so-called "virtual polar motion and UT1 variations". In a recent paper [5] we presented predictions for this effect for different currently used geodetic VLBI networks used for Earth rotation studies. The predictions are proved by analysis of the CONT94 VLBI data.

Atmospheric loading: Redistribution of atmospheric masses loads the Earth's surface and leads to large-scale deformations. Corrections for this effect based on different theoretical approaches are introduced in the analysis of VLBI data [6]. Empirical estimates for the effect are compared to theoretical predictions. A data base with atmospheric loading predictions based on global pressure fields has been generated for 1989–1997.

European geodetic VLBI network:
Concerning the European geodetic VLBI network the analysis at Onsala concentrates on the development of alternative analysis strategies. In collaboration with the Geodetic Institute of the University of Bonn (GIUB) we developed a two-step analysis strategy to derive realistic station displacements [7]. Based on a session by session analysis of the data in a second step station displacements are derived. This approach allows, as compared to usual vector solutions, an improved quality check of the derived displacements since obvious deviations are detected and cross-talk of station deficiencies can thus be reduced.

Integrating VLBI and GPS:
The different space geodetic methods have their advantages and disadvantages. Especially for the determination of absolute sea level changes it is useful to integrate several space geodetic techniques. For this purpose we work on the combination of GPS data from the BIFROST project with European VLBI data [8].

Thermal deformation of VLBI radio telescopes:
VLBI radio telescopes deform due to thermal influences, an effect that is continuously monitored at Onsala [9]. The thermal deformation effects show seasonal and short term behaviour. A simple model for the effect based on the telescope dimensions and ambient temperature has been described in [10]. In collaboration with the Geodetic Institute at the University of Bonn (GIUB) we started the collection of telescope dimensions to model the thermal deformation effect routinely in the VLBI analysis using SOLVE (see http://giub.geod.uni-bonn.de/vlbi/thermal-ex/index.html).

Water vapor in the atmosphere:
Water vapor in the atmosphere influences radio wave propagation and so affects the colocated techniques VLBI and GPS at Onsala. The colocated water vapor radiometer (WVR) is sensitive to emission close to the water vapor emission line. Good agreement is found for the atmospheric zenith parameters derived from simultaneous observations using the three techniques [11] [12].

4. Outlook

Special emphasis of our analysis in the near future will be on Earth tides and ocean tide loading. We will work on new formulations of loading models and the implementation into VLBI analysis software. Of importance will be parameter estimation and covariances with other parameters like terms of polar motion and UT1.

We will work on a strategy for a combined determination of parameters of the Free Core Nutation resonance from solid Earth tide deformations and nutation.

Work with global atmospheric pressure fields will be continued and used for studying atmospheric loading effects and the corresponding parameter estimation. Of special concern are dynamic response effects in near-by oceanic basins.

We will continue to study analysis strategies for the European geodetic VLBI network in order to derive the most reliable station displacements. These results will be interpreted with respect to geophysical models.

We will continue to investigate thermal deformation of VLBI telescopes and other local effects. The actually monitored vertical deformations due to thermal expansion will be used to calibrate simple models for this effect.

We will use simultaneous observations with the colocated techniques of VLBI, GPS and WVR to study atmospheric properties. We will study the effect of incorporating atmospheric propagation delay corrections derived from the other techniques in the analysis geodetic VLBI and its impact on parameter estimation.

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