IAA VLBI Analysis Center Report 2001

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Abstract

The report contains a brief overview of IAA activity as IVS Analysis Center in 2001 and the plans for nearest future. Results of investigations obtained during period passed since the last report are presented.

1. General Information

The IAA Analysis Center (IAA AC) is located at the Institute of Applied Astronomy of the Russian Academy of Sciences. The main fields of the activity include EOP service, computation of station and radio source coordinates, geodynamical investigations, comparison and combination of EOP, TRF and CRF realizations, and development and comparison of algorithms and software for processing VLBI observations. The IAA AC works in close cooperation with the IERS and IVS. We regularly submit the results of operational computation of EOP (both 24h and intensive series) to the IVS and yearly submit long-time EOP series (starting from 1996) and CRF realizations (starting from 1999) to the IERS Annual Reports. The IAA AC web page `http://www.ipa.nw.ru/PAGE/DEPFUND/GEO/ac_vlbi/` was originated in 2001.

2. Organization and Staff

Three VLBI groups of IAA contribute to IAA AC activity:

1. Lab of Space Geodesy and Earth Rotation (LSGER group): Dr. Zinovy Malkin (head), Elena Skurikhina, Dr. Maria Sokolskaya (left IAA in the middle of 2001). The main tasks of this group related to IVS activity are: management of the IAA EOP Service, determination of EOP, station and radio source coordinates, comparison and combination of VLBI, GPS, and SLR products. The group also maintains VLBI observations and EOP series data bases for use by all interested groups of the IAA. In 2001 the group explored two program packages: OCCAM/GROSS for EOP and TRF computation, and ERA for CRF computation.

2. Lab of Ephemeris Astronomy (LEA group): Prof. George Krasinsky (head), Dr. Mikhail Vasilyev, Nadejda Shuygina. The main IVS related activity of this group is development of the ERA software for investigations in Earth sciences and dynamical astronomy based on processing VLBI observations including combining VLBI, SLR, LLR, radar and optical observations on the observational level. In particular, determination of EOP from the combination of VLBI and SLR observations is under development.

3. Lab of New Methods in Astrometry and Geodynamics (LNMAG group): Prof. Vadim Gubanov (head), Igor Surkis, Iraida Kozlova, Yuriy Rusinov. The main task of this group related to IVS activity is determination of EOP, station and source coordinates and other astrometric and geophysical parameters using QUASAR with emphasis on investigation of stochastic parameters (EOP, troposphere, clocks).

3. Analysis Activities

3.1. LSGER Group

The activities of the LSGER group in 2001 included:

- Development of the OCCAM and GROSS software used for processing of the VLBI observations. Main improvements made in the period are:
  - New algorithms have been implemented to allow more processing of problematic sessions.
  - An advanced model of antenna thermal deformations has been developed which is suitable for all mount types and allows accounting for horizontal displacement.
  - Output has been made consistent with the new IVS format.
  - SINEX output has been implemented (with participation of Natalia Panafidina).
  - Software for automatically downloading VLBI data, submitting the results to IERS and IVS, and data base support has been modified.
  - Some algorithms from the IERS2000 have been implemented (DE405 ephemerides, new version of ocean loading coefficients from H.-G. Scherneck, Saastamoinen model for ZPD, daily and subdaily EOP variations, site displacement due to solid Earth tide, IAU2000A nutation model with FCN contribution taken from the MHB model). The possibility of using atmospheric loading series (computed by H.-G.Scherneck) is under investigation due to a problem of consistency with the ITRF. As expected, using a new model for intraday EOP variations caused systematic change in nutation estimates; the replacement of other models practically has no influence on computed EOP.
  - Elevation-dependent weighting of observations has been implemented.
  - Software for comparison and combination of EOP and station coordinates has been advanced.
- Continued operational (nearly every day) processing of the 24h and intensive VLBI sessions, submitting the results to the IERS and IVS. Processing of the intensive sessions is fully automated. In 2001 new series iaao0106.eops and iaai0104.eopi were started.
- New results were submitted to the IERS in April of 2001. These are two EOP series (2155 24h sessions over a period from Sep 1980 until Mar 2001 and about 3700 intensive sessions over a period from Apr 1984 until Mar 2001) and a catalog of 337 radio source coordinates RSC(IAA)01R02. The latter was computed in cooperation with G. Krasinsky.
- A troposphere estimate series was submitted to the IVS in the framework of the Second IVS Pilot Project.
- A comparison of European baseline length variations obtained from VLBI and GPS observations was made. It was found that the rates of baseline lengths obtained with both techniques are consistent, but this is not the case for seasonal variations. It was shown also that an atmospheric loading series (computed by H.-G.Scherneck) contains a trend component which must be accounted for during computation of station velocities and baselength variations.
- A comparison of six nutation series available in the IVS data base was made. It was shown that differences between VLBI nutation series and the MHB2000 model reveal common details which may indicate some deficiency of the model. Comparison of the longitude component of the nutation series shows a rather large seasonal term (0.15–0.18 mas) in differences

between results obtained with OCCAM (AUS, IAA, SPU) and CALC/SOLVE (BKG, GSF, USN) series. The most probable reason for this was found in inconsistent accounting for the geodesic nutation effect in the OCCAM package. Correcting the OCCAM code eliminated the seasonal term in differences between IAA and BKG/GSF/USN series.

- Some proposals were made for the computation of IVS combined EOP series independent of IERS, improvement of its long-term stability, and computation of more adequate formal errors of combined solutions.
- Data bases of VLBI observations and products are supported. At the moment only X band NGS files are stored in the VLBI observations data base (about 7600 experiments).

3.2. LEA Group

The program package ERA has been implemented with a Kalman filter to describe stochastic behavior of atmosphere and station clocks. Five EOP components also may be estimated as stochastic parameters. Applying this approach to NEOS-A VLBI series the postfit residuals become of the order 13–18 ps which is a threefold improvement in comparison with the previous version of the software. As the first application all four NEOS-A series (1998–2000) have been processed estimating simultaneously EOP, coordinates of stations, Love numbers h_2, l_2 and the amplitude of the largest periodic tidal component in h_2. It appears that the coordinates undergo considerable seasonal variations, while corrections to h_2, l_2 are rather stable. As an example in Figure 1 the time series of the estimations of l_2 is shown. The resulting estimate is $l_2 = 0.0883 \pm 0.0004$ (the adopted value l_2 is 0.0852). General analysis of the results is in progress.

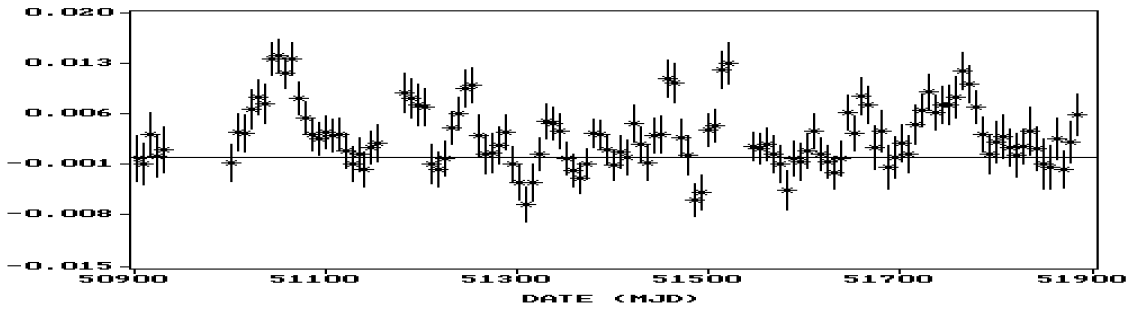

Figure 1. Love number l_2 time series from NEOS-A 1998–2000 observations.

3.3. LNMAG Group

Multifunctional software QUASAR was modified to be in accordance with the draft version of IERS Conventions (2000) and applied to the processing of 461 NEOS-A and CONT-94 VLBI sessions from 1993–2001. The EOP, coordinates and velocities of 9 VLBI stations and coordinates of 268 radio sources were derived using the Least-Squares Collocation (LSC) technique. The results of estimating station and radio source coordinates are presented in Figure 2 and Table 1. A lot of other parameters were estimated too, for example, corrections to nominal Love and Shida numbers, PPN parameter γ, zenith troposphere delay and troposphere gradients for all stations, etc.

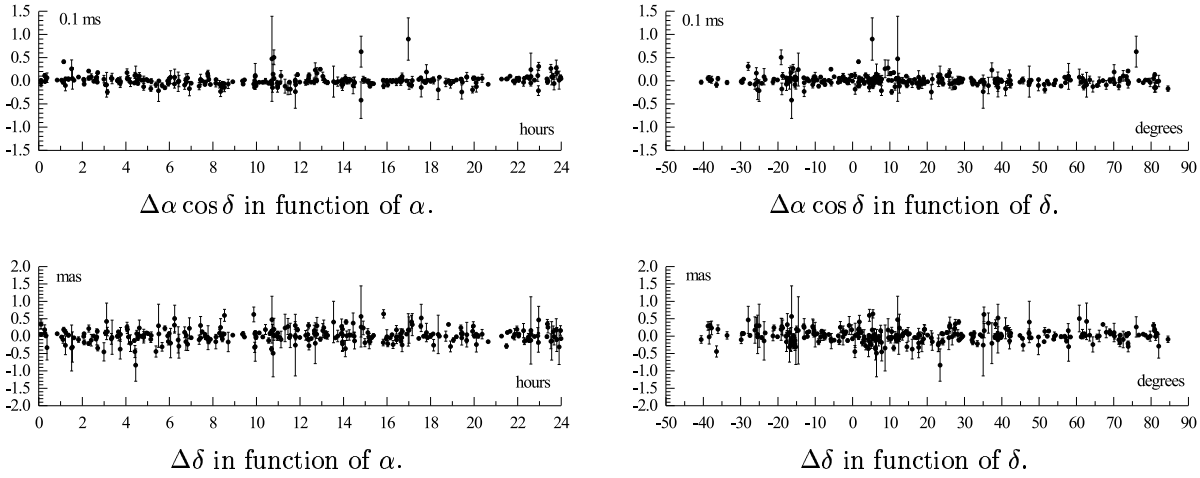

Figure 2. Corrections to radio source coordinates.

Table 1. Corrections to station coordinates, mm, and velocities, mm/y.

Station	X	Y	Z	Vx	Vy	Vz
GILCREEK	–1.2±0.3	1.5±0.3	–0.8±0.5	–0.5±0.1	0.2±0.1	–0.4±0.1
NRAO85 3	2.8±0.7	3.8±2.1	–4.1±1.5	2.0±0.3	1.1±0.8	–1.4±0.6
WETTZELL	3.3±0.7	3.6±0.3	3.2±0.8	0.6±0.1	0.0±0.1	0.2±0.1
MATERA	–9.1±3.8	–0.6±1.3	–10.4±3.5	0.8±0.4	0.0±0.2	1.5±0.4
KOKEE	–8.4±1.5	–7.0±0.6	1.6±0.7	–1.0±0.1	0.0±0.1	0.0±0.1
ALGOPARK	–1.7±0.5	–1.6±1.5	2.5±1.5	–0.2±0.1	3.2±0.2	–2.8±0.3
FORTLEZA	14.9±1.4	–20.7±1.1	–7.5±0.5	–0.3±0.2	0.2±0.2	–0.1±0.1
NYALES20	–2.1±0.4	3.2±0.3	–2.3±1.5	–0.1±0.1	0.0±0.1	0.1±0.2
NRAO20	–0.7±0.3	–7.0±0.9	4.6±0.8	0.3±0.1	–2.7±0.2	2.2±0.2

4. Outlook

Plans for the coming year include:

- Continue improvement of the software for processing of VLBI observations.
- Continue regular computation of EOP series and station coordinates with OCCAM package.
- Continue activity in comparison and combination of results obtained with VLBI and other space geodesy techniques.
- Submit to the IERS and IVS a global solution obtained with the QUASAR package from NEOS-A observations for the period 1993–2001.
- Begin regular submission of results obtained with the QUASAR package.
- Update hardware used for storing VLBI data bases and begin to store database files in X and S bands.