IAA VLBI Analysis Center Report 2014

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Abstract This report presents an overview of the IAA VLBI Analysis Center activities during 2014 and the plans for the coming year.

1 General Information

The IAA IVS Analysis Center (IAA AC) is located at the Institute of Applied Astronomy of the Russian Academy of Sciences in St. Petersburg, Russia. The IAA AC contributes to IVS products, such as daily SINEX files, TRF, CRF, rapid and long-term series of EOP, and tropospheric parameters. EOP, UT1, station positions, and tropospheric parameters were estimated from domestic observation programs Ru-E and Ru-U. The IAA AC generates NGS files.

2 Activities during the Past Year

2.1 Routine Analysis

During 2014, the IAA AC continued to submit daily SINEX files for the IVS-R1 and IVS-R4 sessions as rapid solution (iaa2014a.snx) and SINEX files based on all 24-hour experiments for the quarterly solution.

The routine data processing was performed with the OCCAM/GROSS software using a Kalman filter. The IAA AC operationally processed the 24-hour and Intensive VLBI sessions and submitted the results to the IERS and the IVS on a regular basis. Processing of the Intensive sessions is fully automated. The EOP series iaa2007a.eops and iaa2005a.eopi and troposphere parameters iaa2007a.trl were continued.

2.2 Global Solution

iaa2014a.crf and iaa2014a.trf were submitted to IVS. A new global solution was calculated using all available data from 1980 until June 2014. A total of 6,912,198 delays were processed. The CRF was fixed by NNR constraints to 212 radio sources. The TRF was fixed by NNR and NNT constraints to the station positions and velocities of 15 stations: MATERA, KOKEE, WETTZELL, FORTALEZA, WESTFORD, ALGOPARK, NYALES20, ONSALA60, HARTRAO, BR-VLBA, FD-VLBA, HN-VLBA, KP-VLBA, LA-VLBA, and NL-VLBA. Stochastic signals were estimated by means of the least-squares collocation technique. The radio source coordinates, station coordinates, and corresponding velocities were estimated as global parameters. EOP, WZD, troposphere gradients, and station clocks were estimated as arc parameters for each session. 6,732 global parameters were estimated: 2,946 source positions, the positions and the velocities of 117 VLBI stations, and 23 position and velocity discontinuities.

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2.3 ITRF2014 Contribution

Daily SNX files for ITRF 2014 were calculated for the data until the end of 2014.

2.4 EOP Parameter Calculation from Domestic “Quasar” Network Observations

VLBI observations using the “Quasar” network for EOP monitoring are carried out in the framework of two domestic programs: Ru-E and Ru-U.

The purpose of the Ru-E program is to provide EOP results on a regular basis from 24-hour sessions using a three-station network: “Svetloe” – “Zelenchukskaya” – “Badary”.

The purpose of the Ru-U program is to provide UT1-UTC results on a regular basis from Intensive sessions using one baseline “Badary” – “Zelenchukskaya” (“Badary” – “Svetloe”).

Correlation is performed using the IAA ARC correlator.

Observational data from one-hour Ru-U (named as Ru-I since August 2014) sessions are transmitted to the correlator using e-VLBI data transfer. The calculation of UT1 time series is performed automatically. The result is a UT1-UTC time series available at ftp://quasar.ipa.nw.ru/pub/EOS/IAA/eopi-ru.dat.

We use e-VLBI data transfer for the data of 24-hour sessions from “Badary” and “Zelenchukskaya”. The data of 24-hour sessions are shipped to the IAA correlator on disk modules only from “Svetloe” observatory. The EOP time series is available at ftp://quasar.ipa.nw.ru/pub/EOS/IAA/eops-ru.dat.

During 2014, 48 Ru-E and 365 Ru-U sessions were observed. IAA AC performed analysis of these observations. The accuracy obtained in 2014 for EOPs in comparison to the IERS EOP 08 C04 series is presented in Table 1.

Table 1 RMS differences with EOP IERS 08 C04.

EOP	N_{sess}	Bias	RMS
X_p, mas	43	-0.59	0.73
Y_p, mas	43	0.13	1.08
UT1-UTC,μs	43	6	32
X_c,mas	43	0.02	0.27
Y_c, mas	43	0.04	0.38
UT1-UTC Int., μs	365	25	49

2.5 CONT14 Data Analysis

Processing of the CONT14 observations was carried out using software package OCCAM/GROSS. In the calculation of diurnal EOP, 15 daily sessions were combined into one 15-day session (consisting of 16,430 scans and 145,214 delays), which was processed using the forward run of the Kalman filter to estimate the stochastic parameters. EOP (pole coordinates and universal time), WZD, and clock parameters are considered as stochastic.

Diurnal variations of X_p, Y_p, and $dUT1$ were compared with the model of diurnal variations from the EOP IERS Conventions (2003) model of subdaily EOP variations (designated here as “model”). The results are presented in Figure 1. RMS differences between EOP and the “model” are presented in Table 2.

Table 2 CONT14: RMS differences between EOP and “model”.

EOP	N_{point}	RMS
X_p, μas	22,792	188
Y_p, μas	22,792	159
dUT1,μs	22,792	19

The values of Tropospheric Total Zenith Delay (TZD) obtained during CONT14 from VLBI are in good agreement with data obtained from GPS observations. The results are presented in Figure 2.

2.6 Impact of Ocean Tides in the Diurnal and Semi-diurnal Variation of the Earth Rotation from VLBI Data Analysis

The aim of the study of V. Gubanov and S. Kurdubov presented to Astronomical Letters is to determine the parameters of the model of diurnal and semi-diurnal variations of terrestrial pole coordinates and Universal Time arising from lunar-solar tides in the World ocean. For this purpose, data processing of all avail-

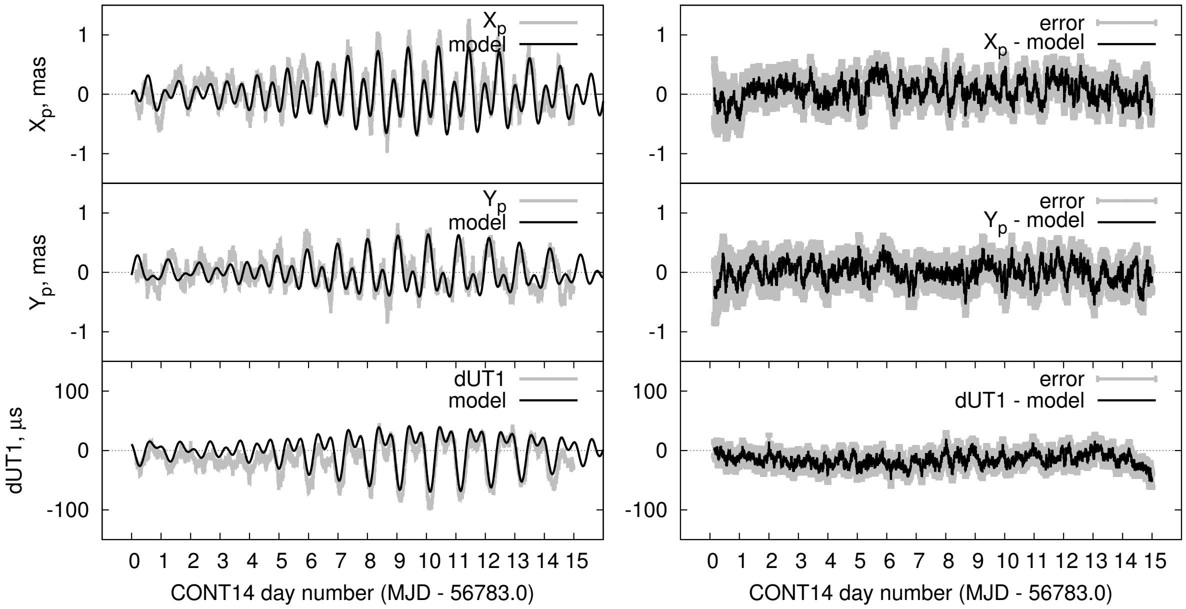

Fig. 1 EOP intra-day variations from CONT14.

able geodetic VLBI observations on a global network of stations in the past 35 years were performed using program package QUASAR IAA RAS. The complication of this problem is that the required corrections of the model parameters are within 1 mm and thus are at the limit of their detection using modern methods of ground positional measurements. This requires the analysis of long series of VLBI observations with high precision reduction and a developed control system for the processing of joint adjustments of observational data. The obtained results, in general, confirm the high accuracy of the basic model of IERS Conventions (2010), but for some harmonic variations of terrestrial pole coordinates and Universal Time, it is possible to detect statistically significant corrections that may be used to improve this model.

3 Current Status

The IAA AC performs data processing of all kinds of VLBI observation sessions. For VLBI data analysis we use the QUASAR and the OCCAM/GROSS software packages. All reductions are performed in agreement with IERS Conventions (2010). Both packages use NGS files as input data.

The IAA AC submits to the IVS Data Center all kinds of products: daily SINEX files for EOP and EOP-rates and station position estimates, SINEX files for ITRF2013, and also TRF, CRF, and tropospheric parameters.

The QUASAR and the OCCAM/GROSS software packages are supported and are being developed.

4 Future Plans

- Continue to submit all types of IVS product contributions.
- Continue investigations of EOP, station coordinates, and tropospheric parameter time series.
- Improve algorithms and software for processing VLBI observations.
- Contribute to ITRF2014.
- Contribute to ICRF3 Working Group study.

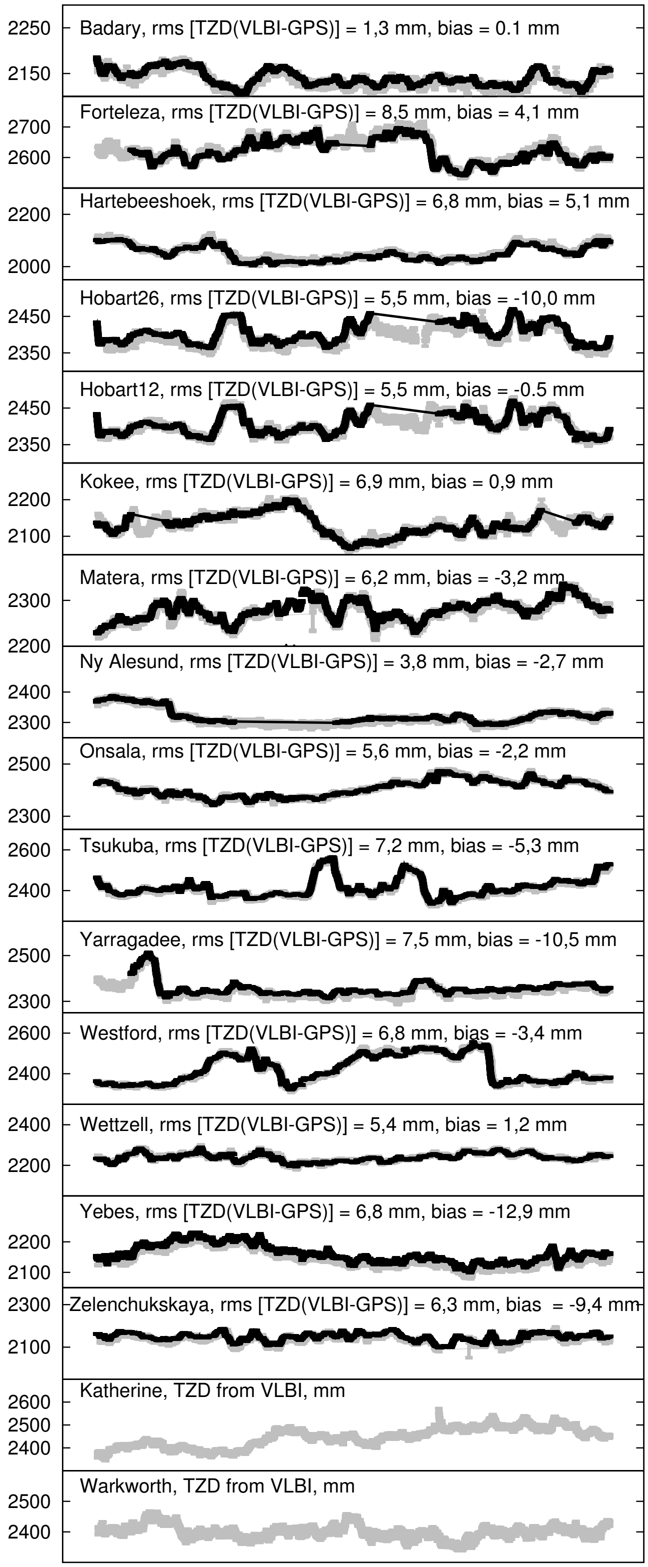

Fig. 2 TZD intra-day (VLBI compared with GPS) variations from CONT14.