The 5^{th} IVS General Meeting Proceedings, 2008, p. 319–323

QUASAR National Programs of EOP Determination

Andrey Finkelstein, Elena Skurikhina, Igor Surkis, Alexander Ipatov, Ismail Rahimov, Sergey Smolentsev

Institute of Applied Astronomy, Russian Academy of Sciences, Russia

Abstract. In Aug. 2006 regular determinations of Earth orientation parameters from VLBI observations using the Russian “Quasar” Network have been put into practice. The observations are carried out in the framework of two domestic programs: 24-hour sessions for the determination of all five EOP using all three network observatories (Ru-E program) and 8-hour sessions for the determination of Universal Time using the baselines “Svetloe”–“Zelenchukskaya” or “Svetloe”–“Badary” (Ru-U program). Both session types are observed twice per month. The analysis of Ru-E observations shows that the RMS deviations of the Earth orientation parameters from the IERS EOP 05 C04 series are 0.83 mas for X_p and 1.04 mas for Y_p, 36 μs for $UT1 - UTC$, and 0.55 mas and 0.62 mas for X_c and Y_c, respectively. The RMS deviations of the Universal Time values from the IERS EOP 05 C04 series for the Ru-U program are 127 μs. In the near future it is anticipated to improve the Earth orientation parameters' accuracy for the 24-hour sessions and to determine Universal Time using e–VLBI mode.

1. Introduction

The VLBI observations with the “Quasar” Network for determining the Earth orientation parameters in the frame of IVS observing programs take about 50% of the total observational time. The “Quasar” Network consists of three radio astronomical observatories: “Svetloe” observatory (Leningradsky region), “Zelenchukskaya” (Republic Karachaevo-Cherkessia), and “Badary” (Republic Buryatia). The stations are connected via digital communication channels to the Processing Center, which is located at the Institute of Applied Astronomy in St. Petersburg. Regular domestic determinations of Earth orientation parameters have been performed since Aug. 2006. In the following we present current results of the analysis of these observations.

2. The Domestic Observational Programs

Fig. 1 shows the geometry of the "Quasar" Network [1]. Having put into operation the "Badary" observatory [7], IAA started an absolutely new type of activity—the determination of the Earth orientation parameters solely using domestic VLBI observations. The observations are carried out in the framework of two programs: Ru-E and Ru-U. The main purpose of the first program is to determine all five EOP using 24-hour observations on all three network observatories, whereas the main aim of the second program is to obtain the Universal Time using measurements collected within the 8-hours session on the "Svetloe"–"Zelenchukskaya" or "Svetloe"–"Badary" baselines. All stages of the VLBI process from preparing an observation schedule up to the analysis of the measurements are being done at IAA. The correlation processing of the observations is done with the MicroParsec correlator [2]. At present, both Ru-E and Ru-U observations are carried out biweekly in S/X range recording data on magnetic tapes in S2 format using data acquisition systems DAS Mark IV, DAS VLBA, and DAS P1000 [3]. The observational session technology is similar to the one of the IVS. The Program Committee establishes an observational schedule for a period of a month [4]. The Operational Center prepares a control file with the session time-table. After finishing the observational session the magnetic tapes are shipped to the IAA Correlator for processing. After that the files written in NGS-format are available for the Analysis Center for further EOP calculation. In a typical Ru-E session each station observes about 28 sources with fluxes of about 0.86-10.83 Jy. The total number of scans for each station is about 250–265 for the session. A typical Ru-U session consists of 80 scans of about 16 sources with the same fluxes. Examples of sources distribution for Ru-E and Ru-U sessions are presented in the Fig. 2. The number of the domestic programs carried out in 2006 and 2007 and planned for 2008 is shown in Tabl. 1.

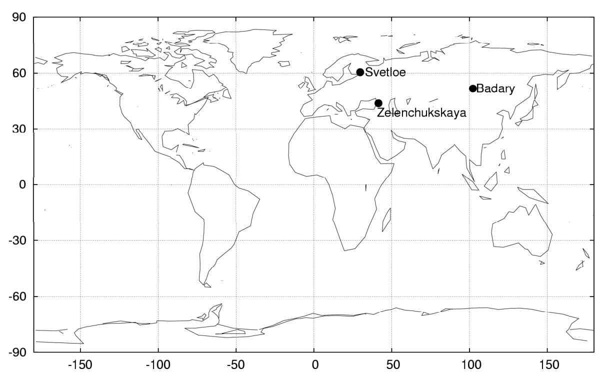

Figure 1. Stations configuration for Ru-E and Ru-U sessions

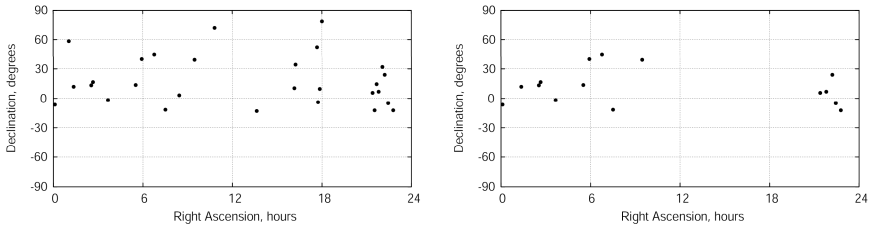

Figure 2. Sources configuration for Ru-E and Ru-U sessions

Table 1. Observational activities of the QUASAR network stations Svetloe (Sv), Zelenchukskaya (Zc), and Badary (Bd) in the domestic VLBI observation programs

year	2006			2007			2008		
Experiment Stations	Sv	Zc	Bd	Sv	Zc	Bd	Sv	Zc	Bd
Ru-E	9	9	9	9	9	9	24	24	24
Ru-U		5	5	7	8	16		24	24

3. First Results of EOP Determination

For obtaining a more accurate EOP solution, it is necessary to calculate the “Badary” and “Zelenchukskaya” station coordinates in the ITRF 2005 system. The estimation of the “Badary” coordinates was made in the first domestic VLBI sessions [5]. In this paper we used “Badary” and “Zelenchukskaya” positions obtained from both IVS and domestic VLBI sessions (28 sessions for “Badary” observatory and 77 for “Zelenchukskaya”), using velocity components obtained from GPS data in both cases. The results of this determination are presented in the Tabl. 2. Having improved the positions of the observatories, the EOP were obtained. Differences of EOPs obtained within the domestic programs and standard IERS EOP 05 C04 series are shown in Fig. 3 and 4. Root mean square residuals (EOP IAA minus IERS EOP 05 C04) after removing systematic trends are presented in Tabl. 3.

Table 2. Station positions and velocities for Zc and Bd, epoch 2000.0, in ITRF2005

Station	Station position, m			Velocity, m/year		
	X	Y	Z	V_x	V_y	V_z
Bd	−838200.729	3865751.573	4987670.956	−0.0253	−0.0002	−0.0037
	± 0.008	± 0.008	± 0.009			
Zc	3451207.821	3060375.231	4391914.941	−0.0220	0.0156	0.0082
	± 0.012	± 0.008	± 0.015			

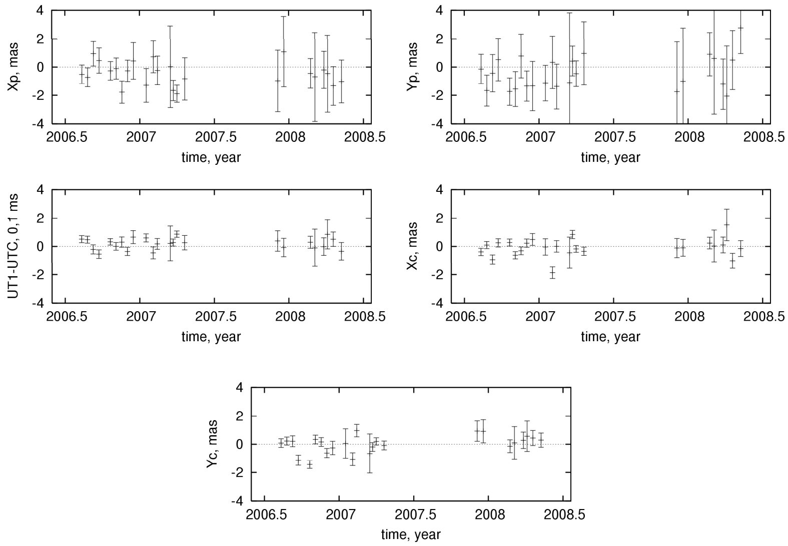

Figure 3. Differences between EOP estimations of IAA and EOP 05 C04 for Ru-E

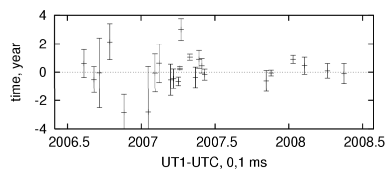

Figure 4. Differences between UT estimations of IAA and EOP 05 C04 for Ru-U

Table 3. Rms differences with EOP IERS 05C04

program N_{sess}	Ru-E 20					Ru-U 22
EOP	X_p, mas	Y_p, mas	UT, μs	X_c, mas	Y_c, mas	UT, μs
rms	0.83	1.04	36	0.55	0.62	127

4. Outlook

To further improve the EOP accuracy from the “QUASAR” network observations we plan first to use the Mark 5B registration and reproduction system, secondly to perform raw data processing at the new correlator ARC [8], and thirdly to use e–VLBI mode for determining UT.

The current results of the domestic VLBI programs show that the “Quasar” VLBI Network can be used as a basis for precise EOP determination within national projects. The use of the new generation Mark 5B data acquisition system in the near future, processing raw data with the new ARC correlator, and using e–VLBI mode [6] to transfer data within the Ru-U sessions will permit to improve the accuracy of the EOPs obtained in the framework of the domestic programs.

Acknowledgements

We would like to thank Alexey Melnikov for producing observational schedules. We also wish to thank Andrey Dyakov and Roman Sergeev for providing observation support at the "Zelenchukskaya" and "Badary" observatories, respectively.

References

[1] Finkelstein, A., A. Ipatov, S. Smolentsev. Radio Astronomy Observatories Svetloe, Zelenchukskaya and Badary of VLBI Network QUASAR. IVS 2004 General Meeting Proc. N.R. Vandenberg, K.D. Baver (eds.), NASA/CP-2004-212255, 2004, 161–165.

[2] Surkis, I., V. Zimovsky, A. Melnikov, et al. IAA Correlator Center. International VLBI Service for Geodesy and Astrometry 2006 Annual Report. N.R. Vandenberg and K.D. Baver (eds.), NASA/TP–2007–214151, 2006, 143–146.

[3] Fedotov, L. VLBI Terminal in Badary Observatory. Proceedings of the 18th European VLBI for Geodesy and Astrometry Working Meeting. J. Bohm, A. Pany, H. Schuh (eds.), ISSN 1811-8380, TU Wien, 2007, 222–224.

[4] http://quasar.ipa.nw.ru/vlbi/

[5] Skurikhina, E., S. Kurdubov, V. Gubanov. IAA VLBI Analysis Center Report 2006. International VLBI Service for Geodesy and Astrometry 2006 Annual Report. D. Behrend and K. Baver (eds.), NASA/TP-2007-214151, 2007, 204–207.

[6] Finkelstein, A., E. Skurikhina, I. Surkis, et al. Using the Quasar VLBI Network for the Fundamental Time-Positioning Service of GLONASS. Astronomy Letters, v. 34, No 1, 59–69, 2008.

[7] Smolentsev, S., R. Sergeev. Badary Radio Astronomical Observatory. International VLBI Service for Geodesy and Astrometry 2007 Annual Report.

[8] Surkis, I., V. Zimovsky, A. Melnikov, et al. The IAA RAS 6-stations VLBI Correlator. This volume.