Analysis Center of Saint-Petersburg University

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Abstract

This report briefly summarized the activity of the Analysis Center of Saint Petersburg University from its initiation till the end of 2002. Detailed description of our solutions spu00002.eopi, spu00002.eops, the comparison of the spu00002.eops solutions under different way of troposphere gradients estimations and our future plans are given.

1. Introduction

Analysis Center of Saint Petersburg University was founded in 1998. Initially our center obtained UT1-UTC values from NEOS-Intensive sessions only. Since 2000 it also derives Earth Orientation Parameters (x,y coordinates of pole, UT1-UTC, nutation offsets) by processing NEOS-A, R1, R4 sessions. OCCAM software version 5.0 is used for the purpose.

2. Staff

Veniamin Vityazev – Director of Astronomical Institute of Saint-Petersburg University, PhD. General coordination and support of activity at the Astronomical Institute.

Maria Kudryashova – Postgraduate student of Saint-Petersburg University. Processing of VLBI data.

3. Description of Solutions

The data obtained by NEOS-A (from 1-Jan-1995 till 31-Dec-2001) and R1, R4 (since 1-Jan-2002) observational programs were processed in order to derive the spu00002.eops time series. All five Earth Orientation Parameters were defined using the IAU 1980 nutation model. The time series contains 447 estimates.

All parameters have been adjusted using Kalman filter technique. For all stations (except the reference one) wet delay, clock offsets, clock rates and troposphere gradients are estimated. Troposphere wet delay, clock offsets and troposphere gradients are modeled as a stochastic process like random walk with a priori spectral density equal to 0.1 $picosec^2/sec$, 1.0 $picosec^2/sec$, 0.001 $picosec^2/sec$, respectively. Clock rates usually are considered as constant parameters.

During the processing of some sessions the χ^2 value may become greater than one. In this case OCCAM software automatically reweights 'bad' observations. It may occur that automatic reweighting is not enough. Usually this is caused by nonlinear behavior of hydrogen masers at one VLBI site. OCCAM software provides some ways to get χ^2 of one. There are:

- change the input weight of the site whose maser has unusual behavior;
- change the reference station;
- consider clock rate of the site as a stochastic process;
- correct the 'jump' in maser behavior;

These methods may be used in any combination.

During 2002 regular submission of the UT1-UTC (from NEOS-Intensive and Int1 observational programs) has been extended. Our time series contains 1161 estimates since Sept. 1, 1997.

All estimated parameters (UT1-UTC, offset for wet delay, offsets and rates of station clocks) have been adjusted using least square technique. Troposphere gradients were not estimated in this solution. The MBH2000 nutation model is used as a priori one.

Settings described below were common for spu00002.eops as well as spu00002.eopi. The VLBI station Wettzell was used as a clock reference station when available. The celestial reference frame was fixed to ICRF Extension catalogue. Terrestrial reference frame was fixed to ITRF 2000 catalogue. Models IAU 1976 was chosen for precession. Relativistic corrections are calculated in accordance with IERS 1992 model.

4. Influence of Troposphere Gradient Estimation on the Obtained Solution

The OCCAM software 5.0 provides the possibility to estimate the troposphere gradients as constant parameters, as stochastic parameters or to not estimate them at all. In this section we demonstrate comparison of the spu00002.eops solution under different ways of troposphere gradients estimation. Three options mentioned above are the following:

1. The troposphere gradients are modeled as a random walk stochastic processes with a priori spectral density equal to 0.001 $picosec^2/sec$).
2. The troposphere gradients are considered as constant parameters (i.e. a priori spectral density equal to 0.000 $picosec^2/sec$);
3. The troposphere gradients are not estimated at all.

Biases and rates, which were subtracted from the series at the first step of comparison, are summarized in table 1. It is apparent that the missing of troposphere gradients in the list of estimated parameters would shift the polar coordinates as well as UT. Treatment of the gradients as random walk parameters does not change the results significantly. The nutation offsets are stable for all cases.

Table 1. Biases and rates of spu00002 EOP series under different ways of troposphere gradients estimation

	x_p		y_p		$UT1-UTC$		$d\psi$		$d\epsilon$	
	bias $[\mu as]$	rate $[\mu as/y]$	bias $[\mu as]$	rate $[\mu as/y]$	bias $[\mu s]$	rate $[\mu s/y]$	bias $[\mu as]$	rate $[\mu as/y]$	bias $[\mu as]$	rate $[\mu as/y]$
without grad	-37.6	-28.0	-8.9	52.9	1.1	12.3	-28.1	-430.7	-8.2	63.9
const grad	-16.6	-26.8	-13.2	56.6	0.8	1.4	-28.0	-430.7	-8.3	65.3
rand grad	-18.5	-27.2	-4.5	53.6	0.5	1.4	-27.8	434.4	-8.1	61.7

Figures 1, 2, 3 reveals that the scatter of the post fit residuals (represented by weighted rms) is less in the case of estimating troposphere gradients as a stochastic process. However, the wrms mean differences for all three options are so small that it is impossible to use them as rigorous criteria for comparison.

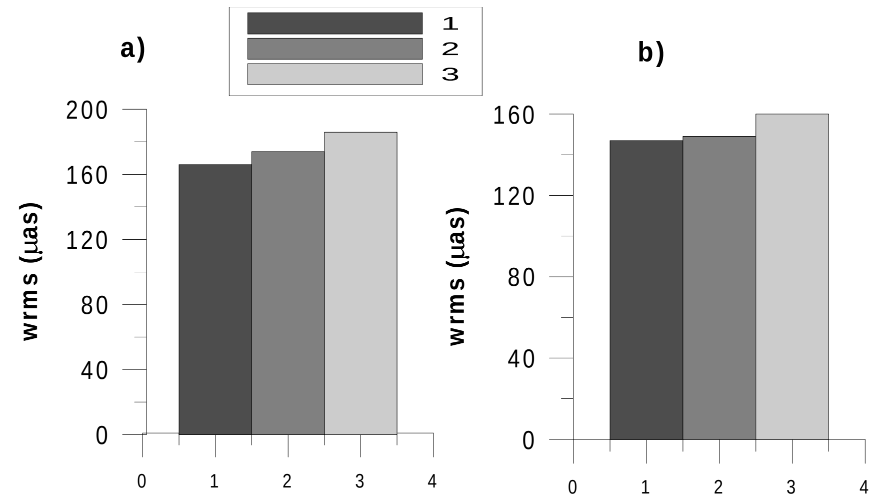

Figure 1. a) Weighted rms for x-coordinates of Pole; b) Weighted rms for y-coordinates of Pole. Here **1** is wrms of coordinates when troposphere gradients were considered as stochastic process; **2** - troposphere gradients were considered as constant parameters; **3** - troposphere gradients were not estimated.

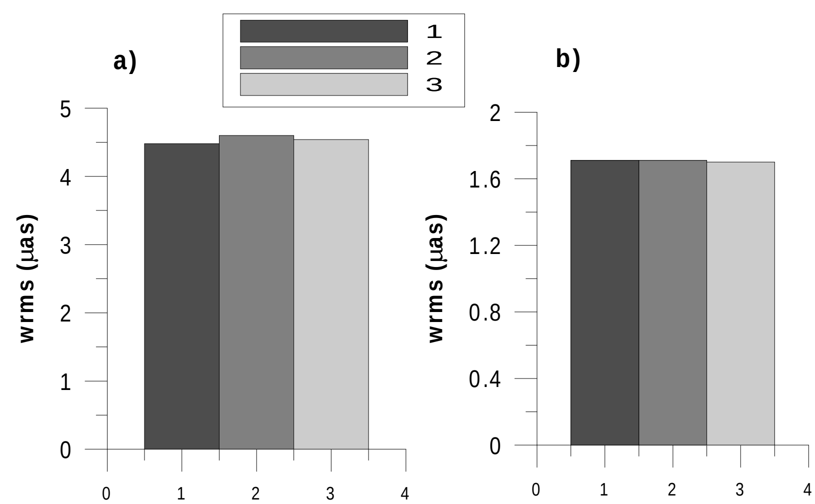

Figure 2. a) Weighted rms for $d\psi$; b) Weighted rms for $d\epsilon$. Here **1** is wrms of nutation angles when troposphere gradients were considered as stochastic process; **2** - troposphere gradients were considered as constant parameters; **3** - troposphere gradients were not estimated.

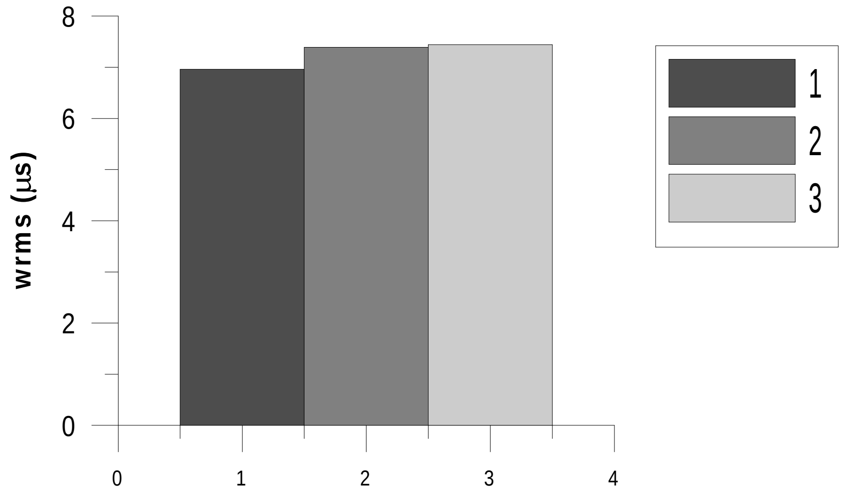

Figure 3. Weighted rms for $UT1-UTC$ values. Here **1** is wrms of Universal time when troposphere gradients were considered as stochastic process; **2** - troposphere gradients were considered as constant parameters; **3** - troposphere gradients were not estimated.

5. Plans

In the coming year we plan

- to recompute whole series of EOP from 1983 with new nutation model MBH 2000 and new terrestrial reference frame.
- to make spectral analysis of EOP series with subdiurnal time resolution, obtained by least square collocation method.

References

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[3] McCarthy, D., (ed.), IERS Conventions 2000, Paris Observatory, 2000.