

EFFECT OF THE REFERENCE RADIO SOURCE SELECTION ON VLBI CRF REALIZATION

J.R. SOKOLOVA
Pulkovo Observatory
Pulkovskoe Ch., 65/1, St. Petersburg 196140, RUSSIA
e-mail: jrs@mars.hg.tuwien.ac.at

ABSTRACT. Up to now, four stability criteria based on different schemes have been used for the reference radio sources selection. Four lists of reference radio sources based on these schemes have been compiled. But significant inconsistencies between these lists were found. In this paper we tried to analyze an impact of these different selection schemes on the CRF solution as well as on radio source coordinate time-series.

1. INTRODUCTION

It is well known, that the selection of reference sources affects the precision and accuracy of the CRF derived from the VLBI observations. Therefore, it is important to select the most stable sources to be used as reference. So far four stability criteria based on different schemes have been derived for reference radio source selection and four list of stable sources were compiled applying these schemes.

1. The ICRF defining sources, published by Ma et.al. (1998) - 'ICRF'
2. Stable radio sources determined by Feissel-Vernier (2003)- 'FV'
3. Structure indices of radio sources set up by Charlot and Fey (1997) - 'ChF'
4. The list of Engelhardt and Thorandt (2006) - 'ET'

But significant inconsistencies between these lists of selected radio sources can be found (some examples of these inconsistencies are given in Table 1).

Source	ET	ICRF	ChF	FV
0003+380	-	+	-	+
0003-066	+	-	-	+
0300+470	+	-	+	+
0319+121	+	-	-	+
0306+102	+	+	-	+
0319+121	+	-	-	+
0420-014	+	-	-	-
0014+813	-	+	+	-
1611+343	+	-	-	+
2201+315	+	-	-	+
0237-233	-	-	-	+
2145+067	-	+	+	-

Table 1: Examples of the selection schemes inconsistencies. + Stable, - Unstable

2. TIME SERIES ANALYSIS

For our analysis we used the software package OCCAM 6.2 (LSQM) (Titov, et al., 2004). Radio source coordinate time series for 217 ICRF sources have been calculated and analyzed.

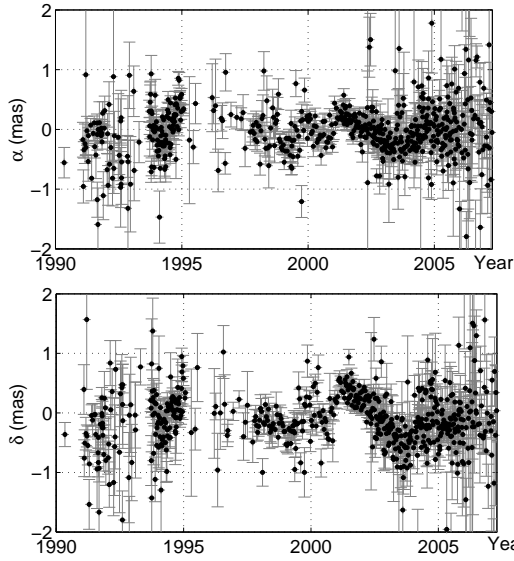


Fig. 1 Variation Radio Source positions by R.A and Dec.

One can see that the radio source positions demonstrate the synchronous change in both coordinates after 2001.0 (Fig 1). According to astrophysical data, the centroid of radio brightness had moved on 500 as from its original position by the end of 2003 and returned back by the end of 2004. The positional variations can be explained by jet motion in the south-west direction between 2001 and 2004. The direction is confirmed by the X-Band radio images from the USNO Radio Reference Frame Image Database (RRFID) (Fey and Charlot, 1997; Fey and Charlot, 2000)

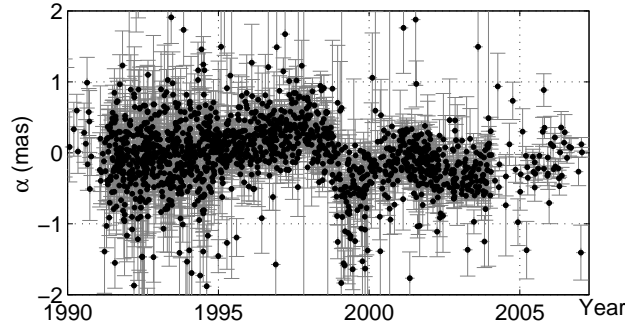


Fig. 2 Variation Radio Source positions by R.A and Dec.

The set of radio images which is available at RRFID after 1994 shows a long jet in the south-east direction, moreover, structure of the jet is variable. Variations of radio source coordinates by R.A. can be expressed as linear trend and quasi periodical variations of 1.5 mas range (O. Titov, 2006)

3. IMPACT OF REFERENCE RADIO SOURCE SELECTION ON NUTATION PARAMETERS DURING GLOBAL SOLUTION

To calculate a global solution all sources have been splitted up into 3 groups:

1. Reference sources - for NNR constraints (group1)
2. Global sources - coordinate of these sources are treated as global parameters (group2)
3. Arc sources - coordinate of these sources are treated as local parameters (group 3)

According this division into groups two global solutions have been calculated:

Source 2201+315

- ICRF "other" group
- Stable source by M. Feissel
- Stable (in first group of 121 radio sources) by G. Engelhardt and V. Thorandt
- Index 3 (X-band), and 1 (S-band) by Patrick Charlot

Source 2145+067

- ICRF "defining" group
- Unstable source by M. Feissel
- Unstable by G. Engelhardt and V. Thorandt
- Index 2 (X-band) by Patrick Charlot

- GG07JS01a - Number of reference sources = 212 ICRF "defining" sources, number of sources treated as arc parameters = 102 ICRF "other group"
- IGG07JS01b - Number of reference sources = 199 "stable" sources by M. Feissel, number of sources treated as arc parameters = 163 "unstable" sources by M. Feissel

To analyze the impact of applying different lists of reference sources on nutation offset estimations, two nutation time series have been calculated using these two CRF catalogues. After that we used a test, which can help us to get some independent estimates of the quality of these catalogues. The first estimate is the WRMS difference between the computed celestial pole offsets and the IAU2000A model supplemented with the Free Core Nutation (FCN) contribution. The second estimate is computed as weighted Allan deviation of the celestial pole (Malkin, 2007). The results of this test presented in table 2. show no significant improvement of the scatter of celestial pole offsets estimates.

Catalogue	FCN			ADEV		
	X	Y	Mean	X	Y	Mean
IGG07JS01a	99	105	102	103	106	105
IGG07JS02a	97	104	101	102	105	104

Table 2: Scatter of the celestial pole offset time series calculated with two catalogues. FCN column shows the scatter w.r.t. FCN model, the ADEV column shows Allan deviation. Unit as.

Thus we can consider that there is no impact of applying different lists of reference sources on the nutation offset estimations calculated from global solution when sources which were excluded from group 1 were added to group 2 or group 3. The effect of the applying different radio sources lists during daily solution will be much clearer due to fixing coordinates of all sources.

4. IMPACT OF REFERENCE RADIO SOURCE SELECTION ON NUTATION PARAMETERS DURING DAILY SOLUTION

To study the impact of source instability on nutation offset estimations, several nutation time series have been calculated during the daily solution (Kalman filter) in different modes. In this paper we present only a few of them:

1. NUT ALL - The coordinates of all sources have been fixed
2. NUT 2201+315 - The coordinates of all sources except 2201+315
3. NUT 2145+067 - The coordinates of all sources except 2145+067 have been fixed

Next step we calculated the differences between the NUT ALL and NUT 2201+315 (Fig. 3) and NUT 2145+067 (Fig. 6).

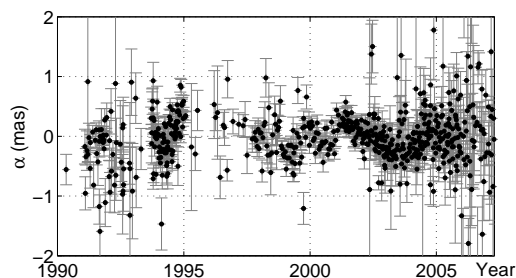


Fig. 3 Variation of Radio Source positions by R.A

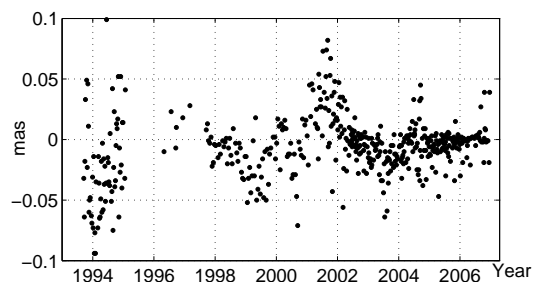


Fig. 4 Nutation Dpsi offset difference (NUT ALL - NUT 2201+315).

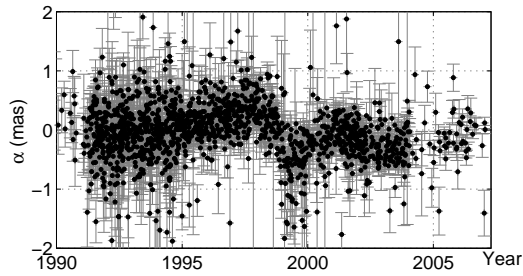


Fig. 5 Variation of Radio Source positions by R.A

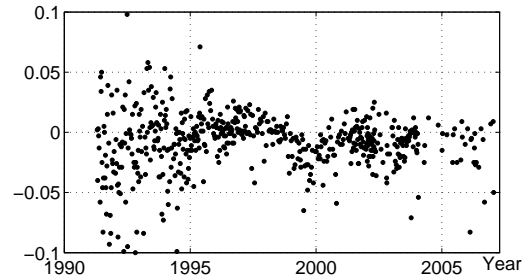


Fig. 6 Nutation Deps offset difference (NUT ALL - NUT 2145+067).

5. SUMMARY

Thus we can consider that:

1. All four selection schemes have significant inconsistencies. Thus, It is necessary to develop a combination of the statistical and astrophysical criteria with the analysis of nutation time series for the procedure of stable radio source selection. As a preliminary version of a list of 'stable' sources the mix of 'stable' lists by Charlot and by Feissel proposed by O. Titov can be used
2. Variations of radio source coordinates significantly affect on the determination of nutation time series during daily solution, in which coordinates of all sources are fixed.

6. REFERENCE

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