STABILITY of DETERMINING the EARTH ROTATION PARAMETERS (ERP) with VLBI

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Abstract

By using the observations of IRIS network, the stability of determinang ERP with VLBI is studied. It is concluded that the uncertainties from initial values of ERP, the errors of other parameters are at the same level as the formal errors in determination of ERP. The geometric effect on determination of ERP is important and appears as systematic errors. Geometric uncertainty on polar motion is greater than that on UT1. and specially much worse for the continenal network. The stability of determining ERP with VLBI can be improved either by increasing new stations at reasonable location in a VLBI network or by increasing new networks.

I. Introduction

In 1977 the project of POLARIS was operated in NGS (NOAA, USA)(Carter et al.,1979). In recent years, POLARIS has been developed to IRIS (the International Radio Interferometric Surveying).IRIS consists of 5 stations which are distributed in northern America and Europe. The IRIS network is sensitive to determination of ERP (Carter et al, 1984).

By using the analysis and comparison of several series obtained by resolving the observations from IRIS network, the stability of determining ERP is studied, which includes the uncertaintied from the ERP initial values errors, the errors of unadjusted parameters and geometric errors from network.

II. Data

1.ERP series from IRIS Bullitin with Code of ''Q''(QR) and the Definite Results (DR) from nov. 1984 to May 1985.

2.(a).resolved ERP series from Nov.1984 to May,1985 by the single day's session and ERP from Circular D of BIH as initial values, same clock pattern and atmospheric zenith height parameters as in QR, and fixing positions of sources and stations.

(b).ERP series from re-structured 3 VLBI networks by IRIS observations. The IRIS observations is composed of those in two Euro-America networks and an American network as shown in Fig.1.

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The parameter for the 3 networks are shown as follows:

European-American networks:

(I)E-F-W

baseline	L o	F o	length (km)
E-F	197	-20	3134.9
E-W	64	5	5998.3
F-W	49	11	8417.6

(II) E-R-W

baseline	L o	F o	length (km)
E-R	66	-50	2044.5
E-W	64	5	5998.3
R-W	65	16	7588.4

American network

(III) E-F-R

baseline	L o	F o	length (km)
E-R	66	-50	2044.5
E-F	197	-20	3134.9
F-R	-9	-12	2362.6

E-Westford,Mass.; Westford Observatory
F-Ft.Davis,Texas; Harvard Observation Station
R-Miami, Fla.; Richmond POLARIS Observatory
W-Wettzell, Federal Republic of Germany

The background for solving ERP from the observations of these networks is the same as in (a). In the new solution, the same computer and the software are used as in processing the data of IRIS Bulletin.

III. Comparison and Conclusion

1. uncertainty from the initial values of ERP

Comparing the series between QR and 2.(a) in section II., we obtained the uncertainty from the errors of initial values of ERP, which are shown on the first line of Table 1. The maximum difference of ERP between Rapid Service and Circular D of BIH during the studied period is 5 ms for UT1 and 10 mas for x,y components, but both the systematic errors (Mean) and random errors(RMS) in ERP series caused by these are almost equal to the internal errors in magnitude (formal errors, 0.05ms for UT1 and 1 mas for x,y).

Table 1. uncertainties from initial values of ERP (A) and other unadjusted parameters (B)

Code	Number	DUT1 Mean (0.01ms)	DUT1 RMS	Dx Mean (0.1mas)	Dx RMS	Dy Mean (0.1mas)	Dy RMS
(A)	33	-2	±5	+2	±6	-1	±6
(B)	35	-7	5	+6	6	-2	6

2. uncertainty from other unadjusted parameters

This type of uncertainty is obtained by comparing the series between DR and 2.(a) in section II. and shown on the second line of Table 1. It is obvious that the uncertainty from the unadjusted parameters is greater than that from initial values of ERP, but still is almost equal to the formal errors in magnitude.

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3. Geometric uncertainty of IRIS network

The geometric uncertainty of IRIS network on determining ERP are studied by comparing the series in 2.(b) with the one in 2.(a) in section II. and shown in Table 2 and Fig 2.

From Table 2 and Fig.2, the following arguments can be drawn:

There is a systematic error about 3 mas in x component for (E-F-W) network.

There is a systematic error about 2 mas in x and y components for (E-R-W) network.

But for the American network (E-F-R), there are big systematic error (Mean) and statistical error (RMS) in y component, and a strong correlation exists between x components and UT1 because of the location of stations.

Table 2. Geometric uncertainty of VLBI network on determining ERP

		Formal Errors			External Accuracy					
network	number	SUT1	Sx	Sy	DUT1		Dx		Dy	
					Mean	RMS	Mean	RMS	Mean	RMS
E-F-W	35	± 5	±11	± 8	+8	± 4	-28	±13	0	± 7
E-R-W	31	6	13	11	+3	9	+23	14	+17	16
E-F-R	31	16	18	31	-22	26	+20	28	-72	37

The systematic errors in x component for 2 European-American networks are nearly equal in magnitude, but opposite in sign (Fig.2).

So it is suggested that a new station should be set up in IRIS network in order to reduce the uncertainty from the geometry of network when the observations fail in some stations. On the other hand, some realistic and new intercontinental networks should be set up to determine ERP regularly in order to improve the stability of ERP by combining the results from different networks.

IV. Acknowledgements

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Fig. 1. Restructured 3 VLBI networks

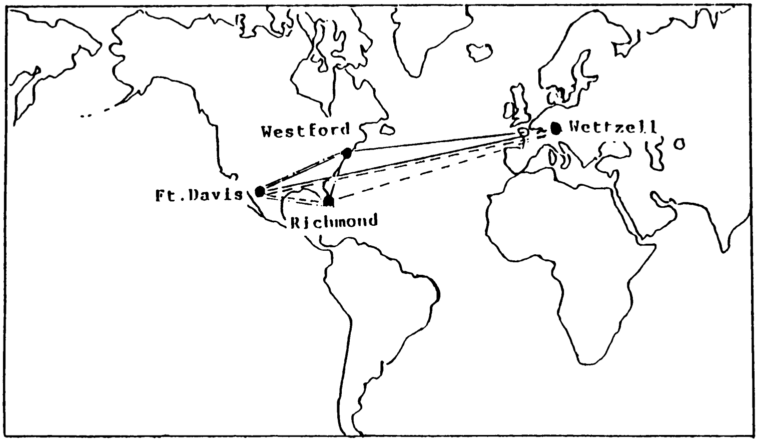
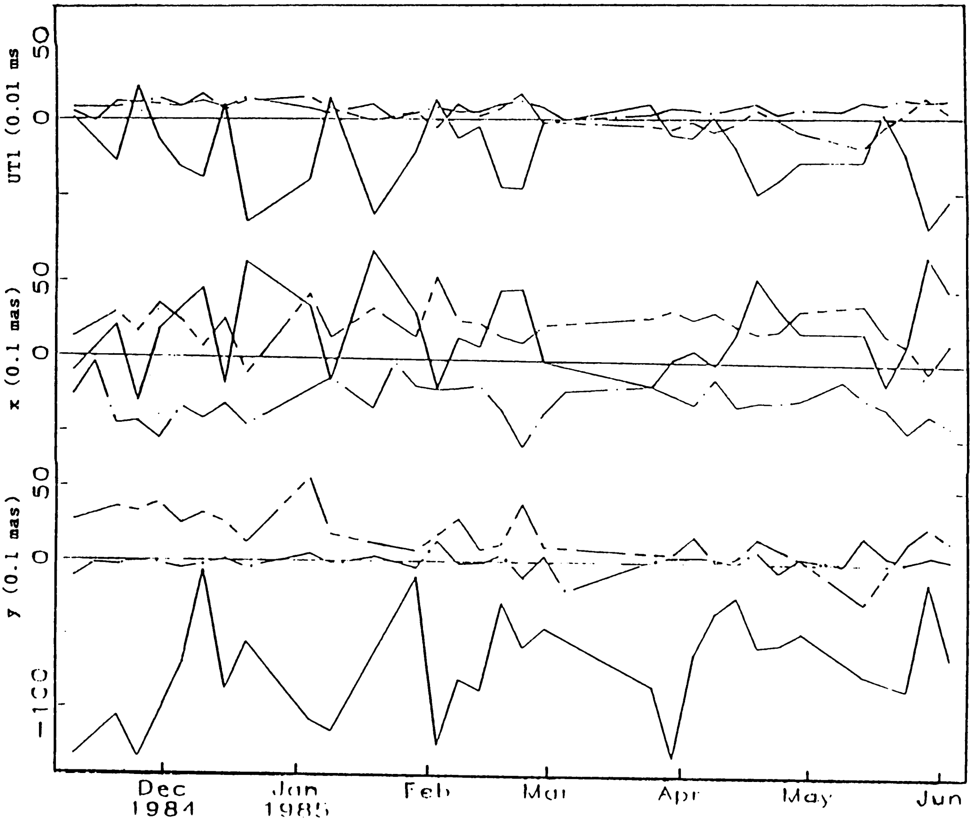


Fig. 2. Geometric effects on UT1, x and y



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