IVS Memorandum 2007-009v01

23 August 2007

“Cut-off elevation angle and EOP results (a case of CONT05)”

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August 23, 2007

Introduction

Earlier, the Goddard and Vienna groups have performed several studies of the impact of the cut-off elevation angle (CEA) on the geodetic results such as baseline length repeatability, troposphere parameters, and station heights. Those results were based on simulation.

In this memo, the results of processing of the CONT05 observations aiming at investigation of the impact of the CEA on the EOP estimates are presented. For this test, CONT05A observations were processed with different CEA (e_0) from 3 to 25º, keeping all other options the same as used during the routine processing:

Kalman filter mode,
random walk model for clocks, PSD=1.5 ps^2/s,
random walk model for ZTD, PSD=0.25 ps^2/s,
one NS and EW troposphere gradient estimate for the session.

Test results

Results are shown in tables and figures below. Notation is the following:

Xp, Yp – terrestrial pole coordinates,
XYp – mean of Xp and Yp,
Xc, Yc – celestial pole coordinates,
XYc – mean of Xc and Yc,
WADEV – weighted Allan deviation (the method developed in Malkin, 2007, accepted to Journal of Geodesy).

All the results related to the Xp, Yp, Xc and Yc are given in µas, the results related to the UT1 are given in µs.

The case of e_0 = 3º includes all the observations since no observations were made at the elevation less than 4º.

The last raw of the tables (R) contain the results of the routine processing, without elevation cut-off, but with elevation depending weighting using the weight factor $P=(\cos(z_0)/\cos(z))^2$, where normally z_0=80º, and z is the maximum zenith distance of the source at two stations.

Table 1. EOP statistics.

e_0, deg	Uncertainty							WADEV		
	Xp	Yp	UT1	Xc	Yc	XYp	XYc	Xc	Yc	XYc
3	26	25	1.1	21	19	26	20	53	58	56
5	26	25	1.1	21	19	26	20	55	56	56
7	26	24	1.1	20	18	25	19	53	55	54
9	27	26	1.2	20	18	26	19	54	52	53
11	30	27	1.2	20	18	28	19	49	55	52
13	33	30	1.3	19	18	32	18	46	52	49
15	37	33	1.4	19	18	34	18	45	50	48
17	40	36	1.5	19	18	38	18	51	47	49
19	45	40	1.6	19	18	42	18	55	48	52
21	50	44	1.7	19	19	47	19	56	51	54
23	56	49	1.9	20	19	52	20	55	45	50
25	62	56	2.0	21	20	59	20	63	57	60
R	26	24	1.1	20	18	25	19	53	58	56

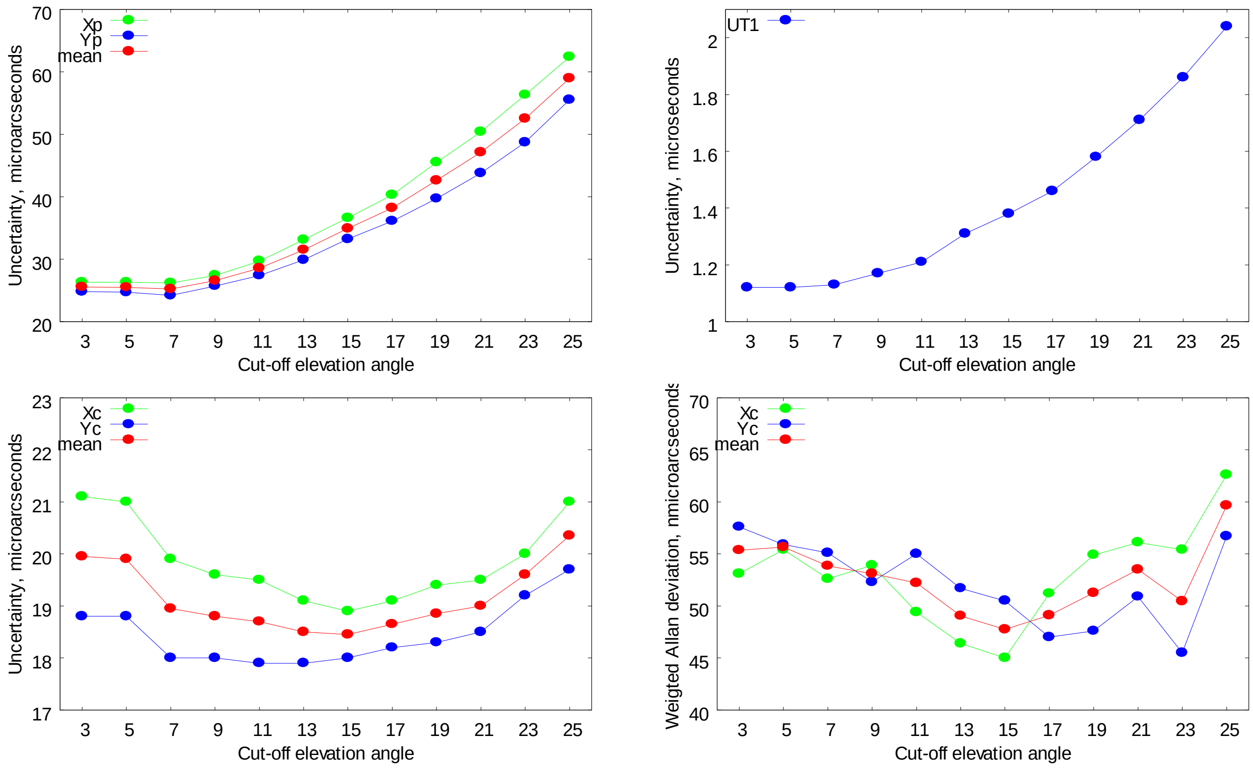

Fig. 1. EOP statistics (represents data from Table 1).

Table 2. Comparison with IGS.

e_0, deg	bias		WRMS	
	Xp	Yp	Xp	Yp
3	-114 ± 21	118 ± 23	79	87
5	-117 ± 22	114 ± 23	82	86
7	-125 ± 23	92 ± 19	84	72
9	-114 ± 20	84 ± 17	76	62
11	-120 ± 22	78 ± 17	81	63
13	-112 ± 21	75 ± 17	79	62
15	-112 ± 20	73 ± 16	75	60
17	-103 ± 20	72 ± 16	76	60
19	-104 ± 22	64 ± 15	84	57
21	-108 ± 20	50 ± 24	76	88
23	-127 ± 24	39 ± 31	90	115
25	-155 ± 37	2 ± 34	138	128
R	-120 ± 22	108 ± 20	81	74

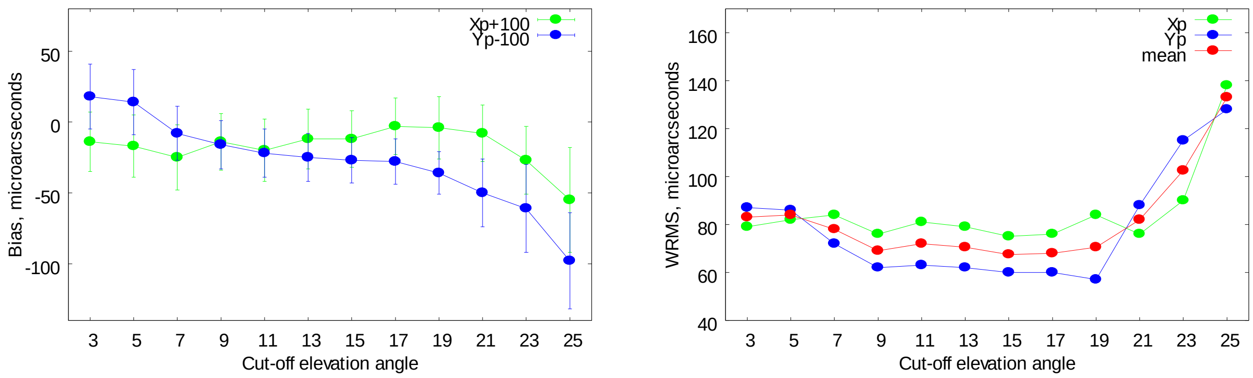

Fig. 2. Comparison with IGS (represents data from Table 2).

Table 3. EOP correlations.

e_0, deg	Xp / Yp	Xp / UT1	Yp / UT1	Xc / Yc
3	0.116	-0.117	-0.018	0.036
5	0.114	-0.110	-0.014	0.036
7	0.147	-0.114	0.014	0.039
9	0.167	-0.109	0.019	0.041
11	0.174	-0.129	-0.001	0.043
13	0.192	-0.148	-0.012	0.043
15	0.182	-0.153	-0.042	0.038
17	0.204	-0.156	-0.050	0.035
19	0.204	-0.162	-0.055	0.030
21	0.194	-0.149	-0.074	0.021
23	0.206	-0.147	-0.081	0.036
25	0.211	-0.169	-0.103	0.051
R	0.140	-0.120	-0.007	0.039

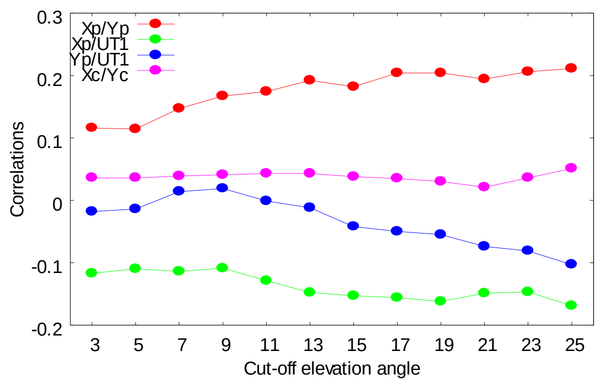

Fig. 3. EOP statistics (represents data from Table 3).

Conclusion and discussion

The preliminary conclusions from this test are the following.

- The Xp, Yp and UT1 uncertainties grow with the increasing cut-off angle after ~10º. Most probably, this reflects the fact that only about 6% of the total number of observations were made at the elevations below 10º. The Xc and Yc uncertainties and scatter depend on the CEA much less.

- Xp bias w.r.t. IGS slightly depends on the CEA, except the maximum tested CEA values, evidently unrealistic. In contrast, Yp bias substantially changes with increasing CEA. Most probably, this can be explained by the CONT05 network orientation, for which the longitude of the central meridian λ_0=265º just corresponds to the Y direction of the terrestrial coordinate system.
- Some statistics such as the uncertainty and the scatter of the Xc and Yc, as well as the WRMS of Xp and Yp w.r.t. IGS have the minimum at the CEA around ~15º, which is interesting and deserves a supplement investigation.
- As one can expect, the correlations between EOP comprising Xp and Yp grow with increasing CEA, but remain small due to good CONT05 network geometry. The same can be expected for the IVS2010 network. The correlation between Xc and Yc remain practically the same for all tested CEA, except the maximum tested CEA value, evidently unrealistic.