IVS Memorandum 2009-002v01

5 March 2009

"Comparison of Results Using CONT05B versus CONT05A Databases"

Dan MacMillan

Comparison of Results Using CONT05B versus CONT05A Databases

Dan MacMillan

December 2008

1. Introduction

The CONT05 series of 15 databases was reprocessed to create 14 CONT05B databases starting at 0 UT and ending at 24 UT replacing the standard versions that begin at 17 UT. The refringing process is described in Bertarini et al. (2007). One reason for doing this was to allow easier comparison with non-VLBI techniques. For example, with sessions starting at 0 UT, one avoids having to interpolate IGS daily EOP series to compare with VLBI estimates at session midpoints. In the new fringe fitting process, one global fourfit control file was used. This should have the effect of reducing session boundary discontinuities.

This memo discusses comparisons between the results of the CONT05A and CONT05B processings. The three types of comparisons were: 1) experiment session residuals, 2) baseline length and station position repeatabilities, and 3) VLBI-IGS EOP differences.

2. Experiment session fits

I ran two types of solutions to compare the performance of CONT05A and CONT05B database versions: a) terrestrial reference frame (TRF) solution and b) baseline solution. In the first, CONT05 EOP solutions were run as BACK SOLVE solutions. In these solutions, the site positions and velocities as well as the source positions were fixed to global estimates from a quarterly TRF frame solution (2006d) and local parameters including EOP were estimated for the CONT05 sessions. The overall solution fit of 19.137 ps was better for the 15 CONT05 A versions than for CONT05B that fit at 19.713 ps. The $\chi 2$/dof of 0.970 from the CONT05A solution was also better than for CONT05B which had a $\chi 2$/dof of 1.020.

For the baseline solution, site positions were estimated as local (arc) parameters for each session applying a no-net-translation constraint. Baseline solution fits with the CONT05 A databases were on average 19.051 ps (average $\chi 2$/dof was 0.812), which was less noisy than the average fit of 19.589 ps (average $\chi 2$/dof was 0.835) for the B versions.

Figures 1 and 2 compare the distributions of session fits from CONT05A and CONT05B. These figures indicate that the distribution of session fits for CONT05A is shifted toward better wrms fit with respect to the distribution for CONT05B.

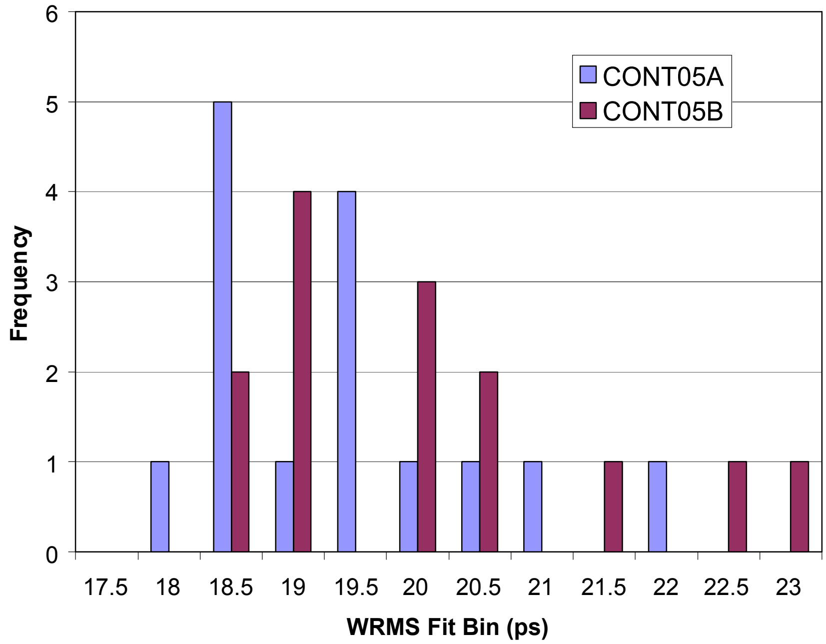

Figure 1. Histogram of session fits for CONT05A and CONT05B from EOP solutions. The global fits and $\chi 2$/dof were 19.137 ps and 0.970 for CONT05A and 19.713 ps and 1.020 for CONT05B

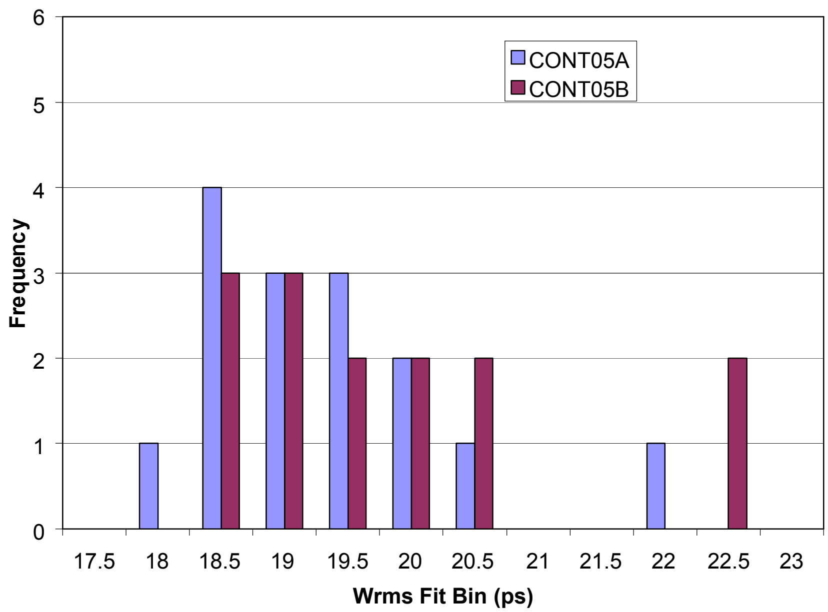

Figure 2. Histogram of session fits for CONT05A and CONT05B from baseline solutions. The average session fit and $\chi 2$/dof were 19.051 ps and 0.812 for CONT05A and 19.589 ps and 0.835 for CONT05B.

3. Baseline Length and Site Position Repeatability

To assess the relative observed precision of CONT05A and CONT05B, we computed the baseline length and site position repeatabilities from the baseline solutions described above. Figure 3 and 4 show baseline length repeatabilities and the difference in repeatabilities from CONT05A and CONT05B. Figure 4 shows that the repeatabilities are somewhat worse for CONT05B than from CONT05A. Out of 54 baselines, 33 had better CONT05A repeatabilities. CONT05B repeatabilities were worse on average by 0.24 mm.

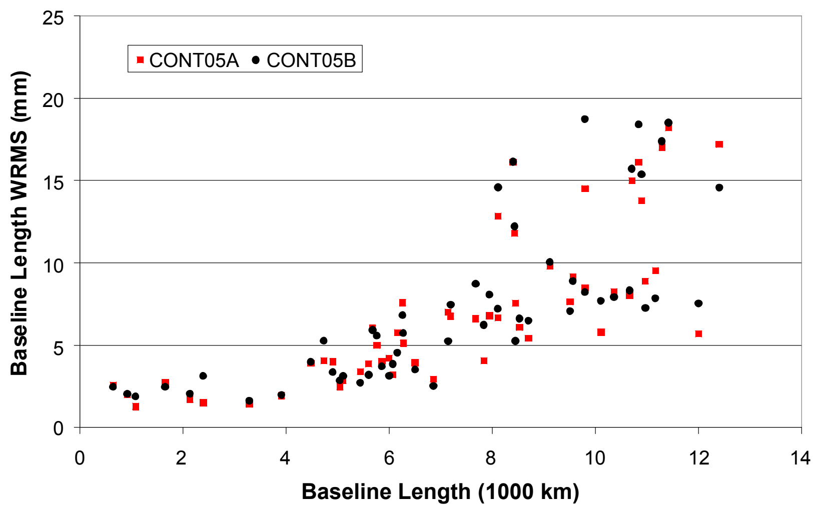

Figure 3. Baseline length repeatabilities from CONT05A and CONT05B.

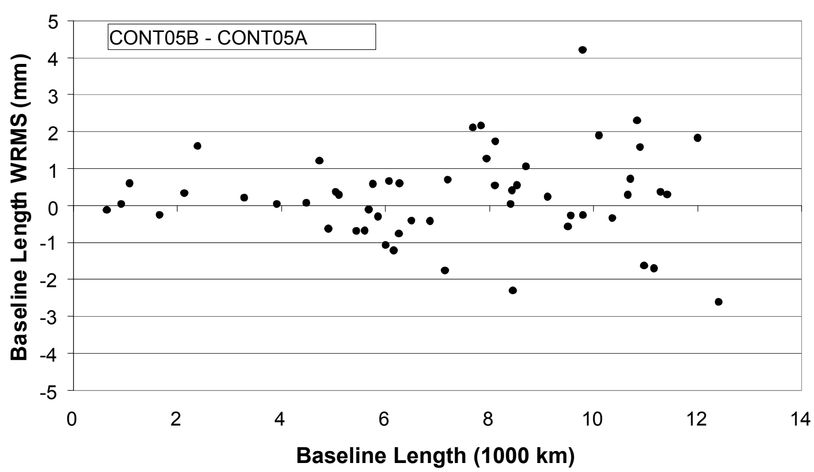

Figure 4. Length repeatability differences between baseline solution estimates using the CONT05A and CONT05B databases. The sense of the difference is CONT05B minus CONT05A.

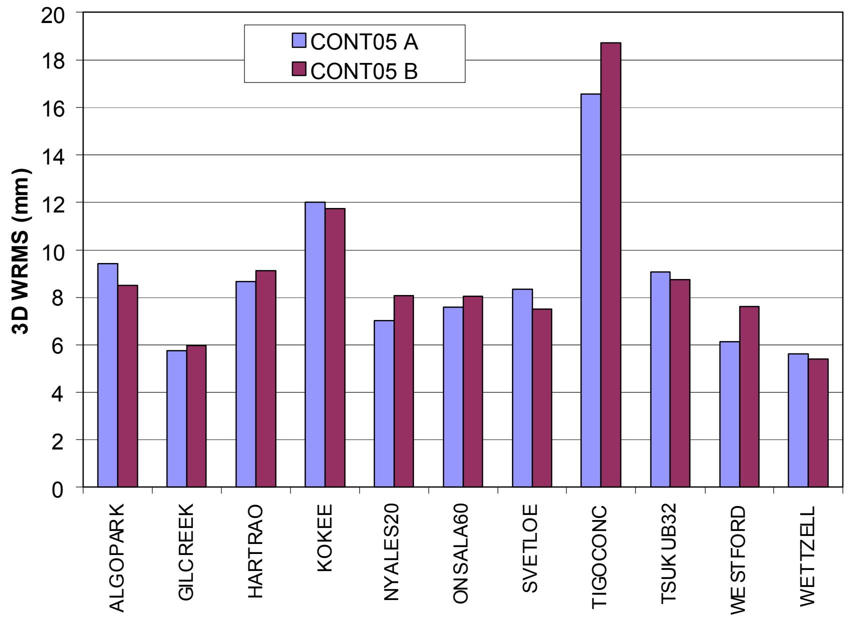

Figure 5. Comparison of 3D site position wrms repeatabilities from CONT05A and CONT05B.

The 3D site position repeatabilities are not significantly different for CONT05A and CONT05B. The average 3D position repeatabilities are 9.2 mm for CONT05B and 8.9 mm for CONT05A.

4. Comparisons with IGS EOP

One of the primary reasons for refringing CONT05 was to align the VLBI observing day with the GPS day. Formally, the most precise VLBI EOP estimate is at the midpoint of the session. The starting time for CONT05 sessions was 17 UT making the session midpoint about 5 UT. The refringed databases resulted in shifting the session boundaries from 17 UT to 0 UT. This allows one to compare VLBI EOP at the session midpoint with GPS without interpolation.

In this section, I computed the statistics of the differences between IGS and VLBI using CONT05A and CONT05B databases. For this comparison, the IGS daily series was interpolated to the VLBI epochs and the VLBI-GPS differences were computed. Table 1 provides the statistics of the differences for the original CONT05A databases. In this case, the GPS series had to be interpolated to 5 UT. Table 2 gives the corresponding statistics using the 14 CONT05B sessions. In these tables the weighted root mean square (WRMS) of the differences larger for CONT05B than CONT05A. Figure 6 compares the differences from the two solutions.

In a third solution, I estimated EOP at noon for the CONT05A sessions. In this case the VLBI-IGS X-pole and Y-pole differences are much larger than the first two solutions. This can easily be seen from the plots in Figure 7.

Table 1 VLBI (CONT05A midpoint) - IGS

Parameter	Offset	WRMS	$\chi2$/dof	N
X-pole (uas)	34 ± 10	62	2.5	15
Y-pole (uas)	-198 ± 10	39	0.9	15
X-pole rate (uas/d)	-127 ± 28	195	3.2	15
Y-pole rate (uas/d)	60 ± 29	144	1.7	15
LOD (us/d)	16 ± 2	17	6.2	15

Table 2 VLBI (CONT05B midpoint) - IGS

Parameter	Offset	WRMS	$\chi2$/dof	N
X-pole (uas)	18 ± 12	67	2.4	14
Y-pole (uas)	-202 ± 12	48	1.2	14
X-pole rate (uas/d)	81 ± 33	148	1.4	14
Y-pole rate (uas/d)	-44 ± 32	192	2.5	14
LOD (us/d)	14 ± 2	17	6.9	14

Table 3 VLBI (CONT05A noon) - IGS

Parameter	Offset	WRMS	$\chi2$/dof	N
X-pole (uas)	-38 ± 13	86	3.0	15
Y-pole (uas)	-196 ± 13	56	1.2	15
X-pole rate (uas/d)	-133 ± 32	190	2.4	15
Y-pole rate (uas/d)	56 ± 32	134	1.1	15
LOD (us/d)	16 ± 2	19	5.0	15

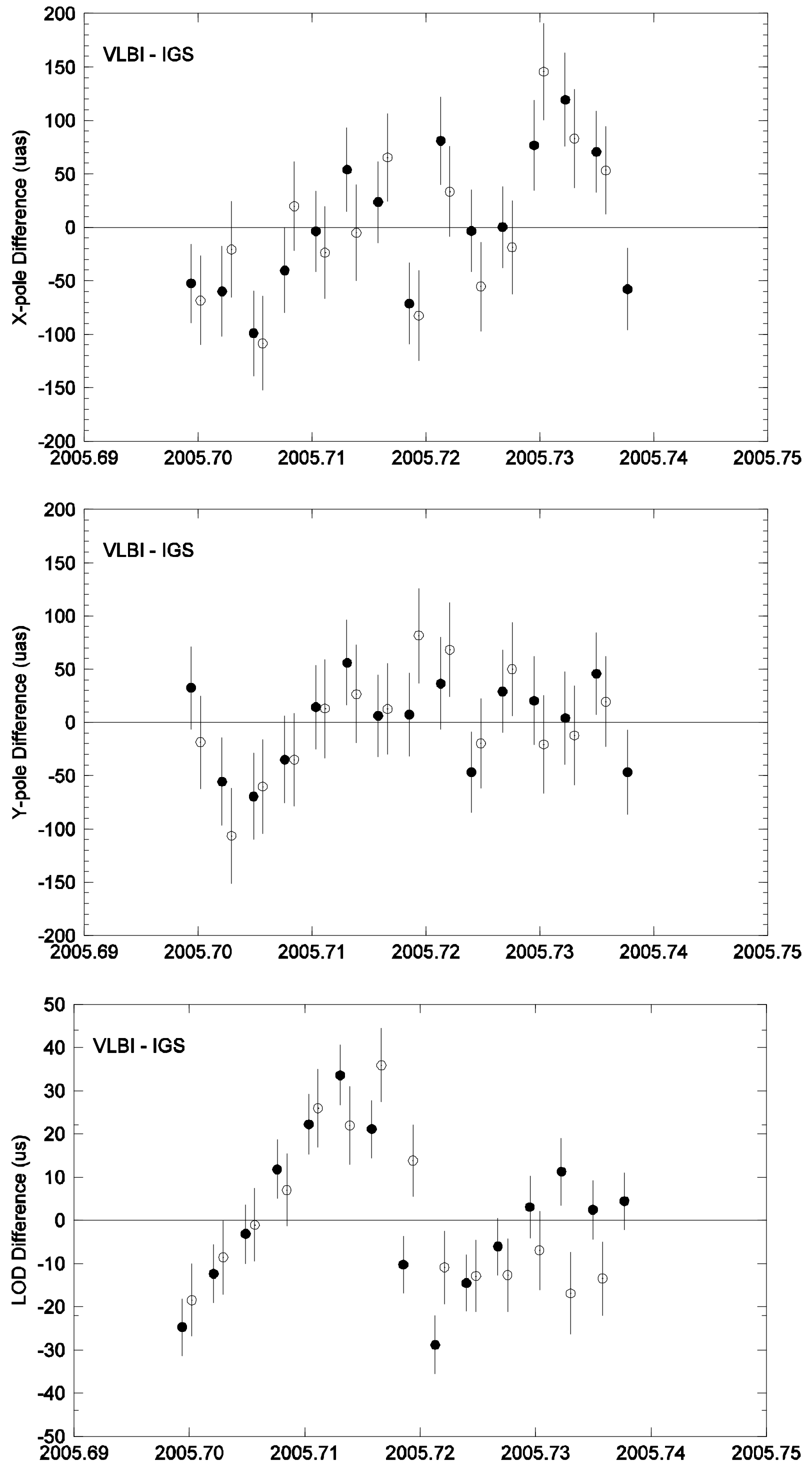

Figure 6. VLBI-IGS differences for X-pole, Y-pole, and LOD. The 14 CONT05B session differences are indicated by the open circles and the 15 CONT05A sessions by solid circles.

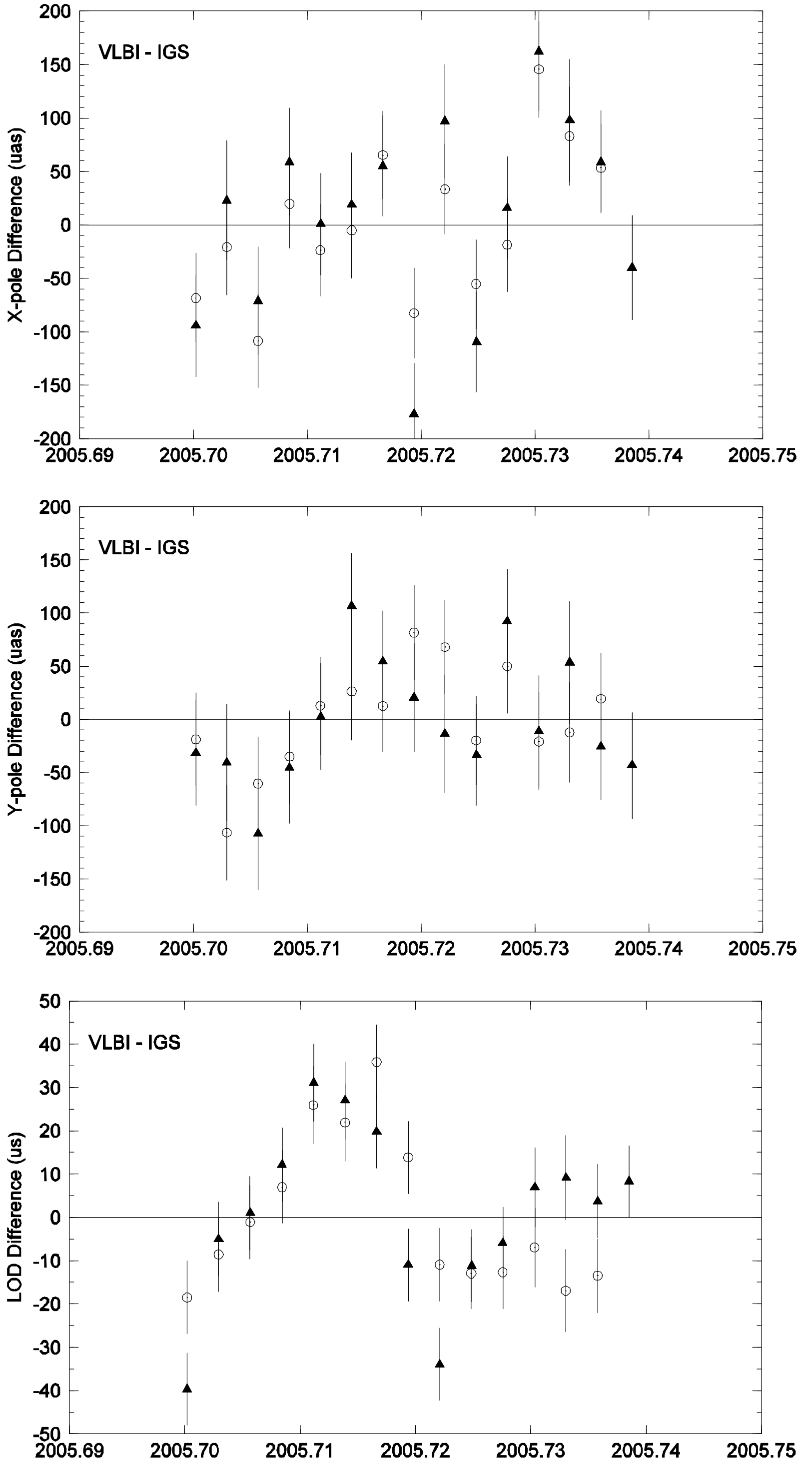

Figure 7. VLBI-IGS differences for X-pole, Y-pole, and LOD. The 14 CONT05B session differences are indicated by the open circles. The 15 CONT05A session differences where VLBI estimates were made at noon are the solid triangles.

5. Conclusions.

I made several solutions were using the CONT05A databases and the refringed databases CONT05 B. By several measures of performance, the CONT0A databases gave slightly better results than the CONT05B databases. Session solution residual fits and length repeatabilities were somewhat better for CONT05A. VLBI-IGS polar motion rms differences were less for CONT05A than CONT05B, where the IGS series was interpolated to the epochs of the VLBI session midpoints. When the EOP were estimated at noon instead of at the session midpoints, the CONT05A polar motion rms VLBI-IGS differences were clearly much larger.

6. References

Bertarini, A., B. Corey, K. Kingham, A. L. Roy, CONT05B, IVS Technical Memorandum 2007-002v01, April 2007.