3.6.1.3 Natural Resources, Canada (NRCan)

The combination effort was limited to comparisons between the IGS official and reprocessed weekly solutions with respect to the available ITRF08P combinations. The original IGS submission for the ITRF08P was made at the beginning of February 2009 using the combined Analysis Centers (AC) reprocessed solutions. It covered the period 2000.0–2008.0 (Wks 1043–1459) and included weekly solutions for a total of 515 stations as well as daily pole positions, pole rates and LOD. A second and final contribution was possible at the end of July 2009. It covered the period of 1997.0–2009.5 (Wks 0886–1537). It included 561 stations that met the criteria of having a minimum of 2 years of data and a valid DOME#. The original 2000.0–2008.0 submission was resubmitted to account for minor improvements and new stations that met the above minimum criteria. Subsequently, older IGS reprocessed solutions from 1994.0–1997.0 (Wks 0730–0885) became available. The comparison below uses the combinations of 1994.0–1997.0 that could not be included in ITRF08, as well as the more recent solutions of 2009.5 – 2010.0 (Wks 1538–1566). This increases the independence of the comparison since the data used for comparison have not been included in the ITRF08P combination.

The first comparison includes the pole position and pole rate values for the older combined ig1 reprocessed data. Ig1 solutions are aligned to the IGS realization of ITRF2005. Figures 1a and 1b show the differences in pole position whereas Figures 2a & 2b show the differences in pole rates for the period of 1994.0–2009.5 (MJD 49354.5–55016.5). Table 1 shows some statistics of the pole position and pole rate value differences between ig1 and ITRF08P for the period of 1995.0–1997.0 (MJD 49718.5–50448.5):

Table 1: Differences between ig1 and ITRF08P

	dXp	dYp	dXpr	dYpr
	(mas)	(mas)	(mas/d)	(mas/d)
Average:	0.00	0.06	0.13	0.11
Std.:	0.22	0.22	0.68	0.69

The combinations from the 1994 period were excluded from the above statistics. A lower quality of the alignment to the reference frame was observed due to the limited number (sometimes around 10 stations) and sub-optimal distribution of available reference frame stations. Note that for the 1995.0–1997.0 period, the ITRF08P pole position estimates are available every day, while the pole rates were only available about 1/3 of the time.

The ITRF05 and ITRF08P are aligned in orientation and rates. Although the ITRF08P frames and the IGS05 frame realization should also be aligned, Rebischung et al. (2010) estimated the transformation between the two frames. Using their transformation and propagating it back to 1996.0, the estimated rotations are about RX = +0.031 mas and RY =+0.036 mas with formal uncertainty at the 0.03 to 0.04 mas level in both directions. Taking into account the estimated frames mis-alignment, the average pole position differences become:

RX – dYp = 0.031 – 0.06 = –0.029 mas

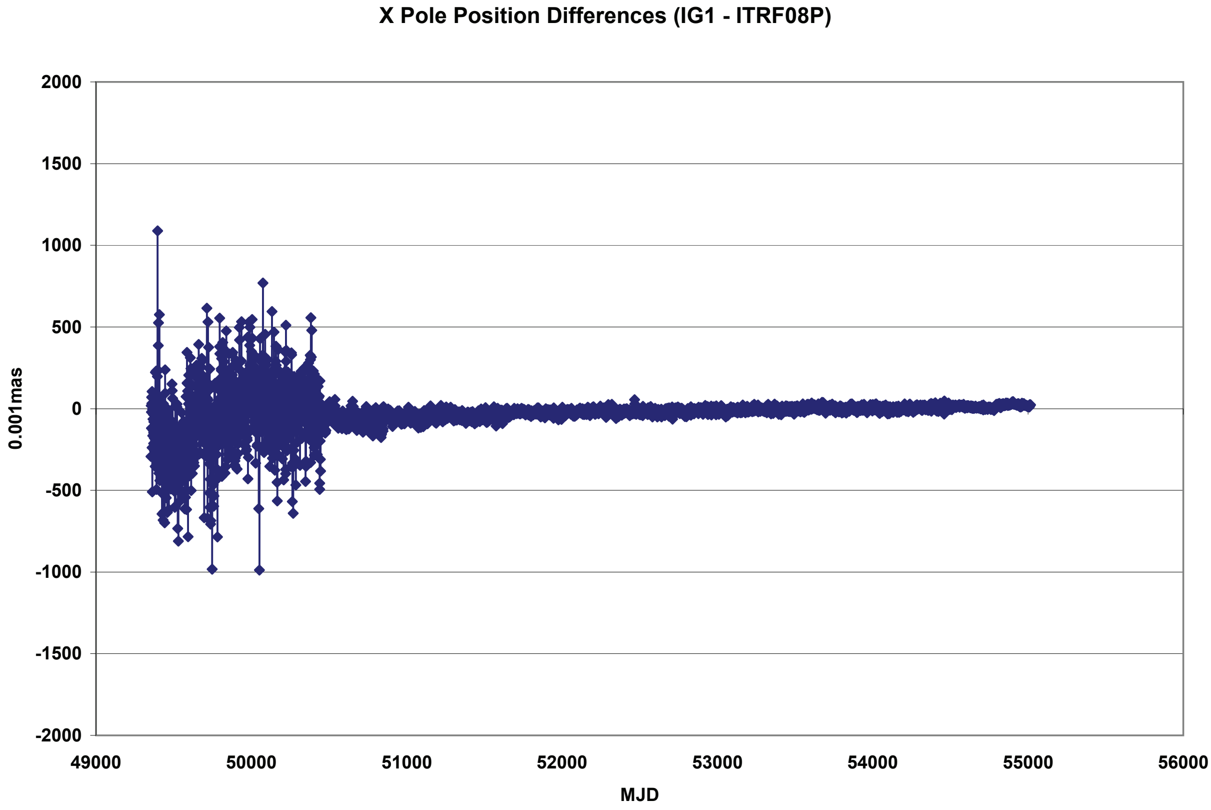
RY – dXp = 0.036 – 0.00 = 0.036 mas

The average pole position differences are about at the same level as the formal uncertainty of the transformation parameters and smaller than the above standard deviations, suggesting that there is no significant misalignment in the pole position (and rates) between ITRF08P and the IGS weekly combined reprocessed solutions. The effect of the transformations on the pole rate statistics is negligible.

Given the relatively good accuracy of the ig1 pole position with respect to the ITRF08P combined for the 1995.0–1997.0 period, it is also possible to assess the ITRF08P formal sigmas. During that period, the formal sigmas of the daily IGS pole position were between 0.05 and 0.1 mas. For simplicity, let's assume 0.075 mas for that period. From the above information, the relative noise contribution of the ig1 pole position estimates to the total noise can be estimated to be ~35%. The same exercise was repeated with the 1994 ERPs and the 1995–1996 pole rates, but due to the reduced differentiation between the ITRF08P and the ig1 noise level at that time (see Figures 1 and 2), the results are less reliable. The normalized residuals of the pole position differences ((ITRF08P-IG1)/sigma (ITRF08P)) was also estimated. The normalized sigmas are 1.35 and 1.42 for the X and Y pole components. Now, if we remove the ig1 noise contribution from the normalized differences (and sigmas), we get 0.88 and 0.92. This suggest that the combined ITRF08P pole position formal sigmas for the 1995.0–1997.0 period is close (i.e. within 10%) of the expected values. Since the ITRF08P is combined rigorously, this also suggests that the formal sigmas for the other parameters are also close to the expected values.

Comparisons can also be done between the ITRF08P station coordinates and the igs reprocessed weekly solutions. Similarly to the above pole comparison, this comparison uses data that were not included in ITRF08P, namely, just before and just after the period included in ITRF08P.

First, the igs official weekly solutions were used for the period of 2009.5–2010.0 (Wks 1538–1566) and compared to the ITRF08P.



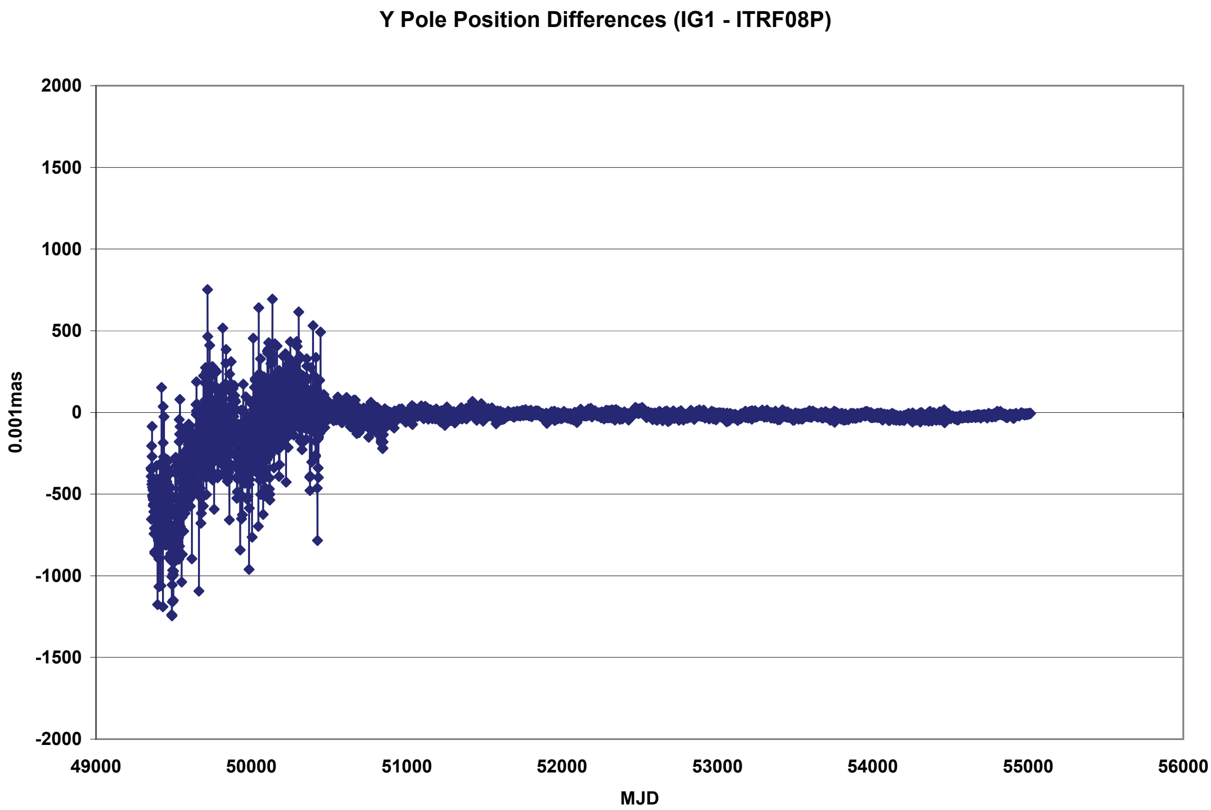
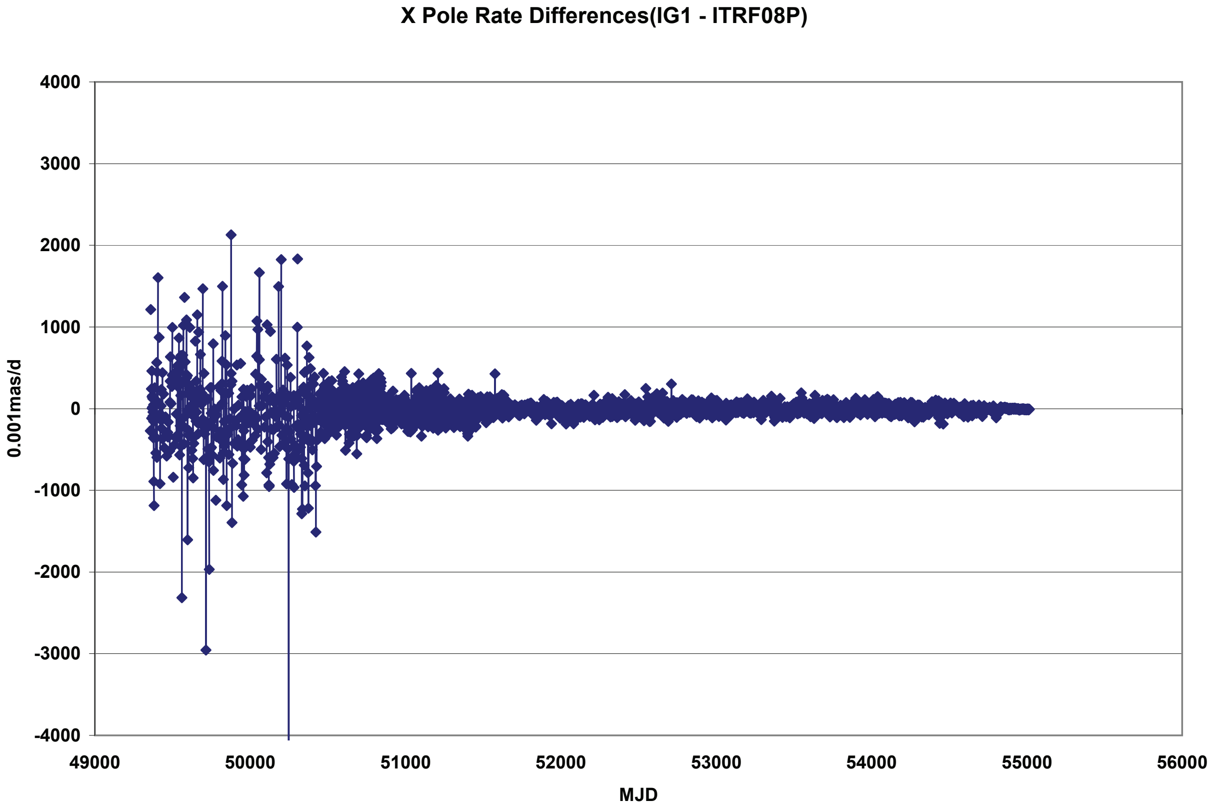


Fig. 1: Daily X and Y (top and bottom) pole position differences between the IGS combination of the reprocessed solutions and the ITRF08P combination.



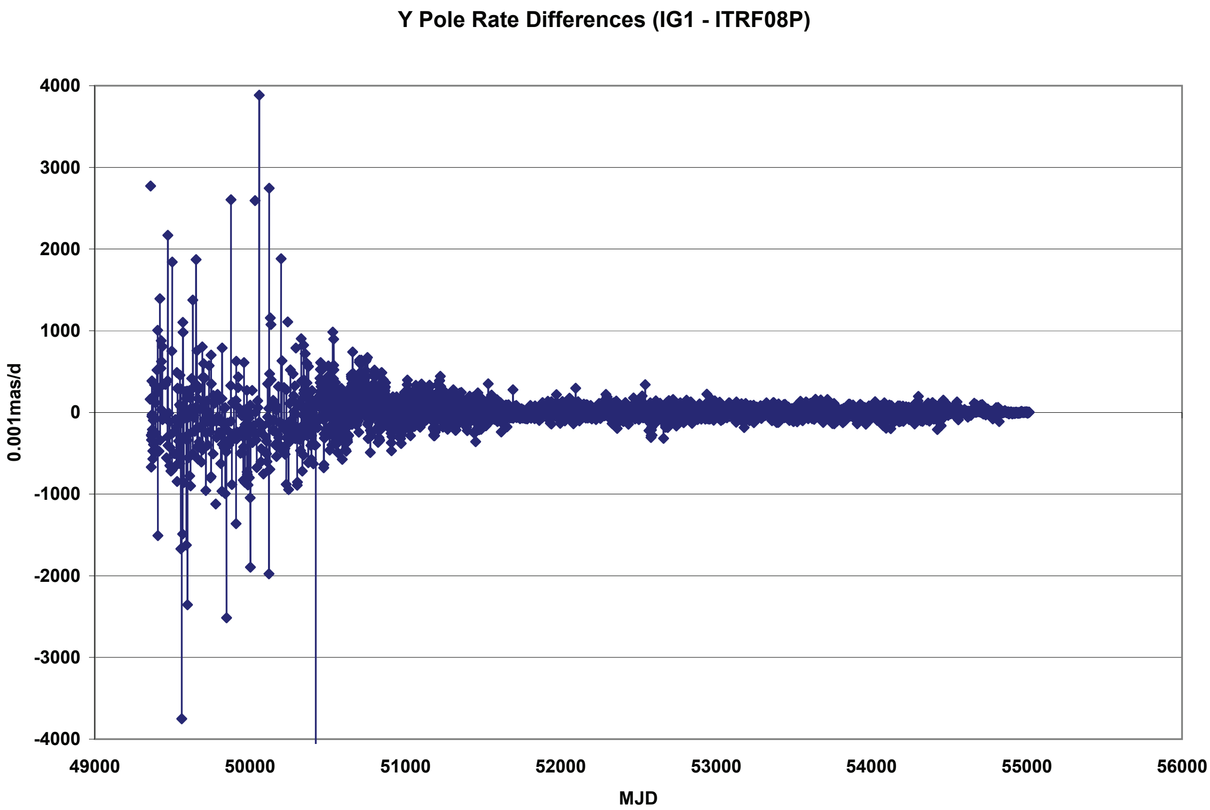


Fig. 2: Daily X and Y (top and bottom) pole rate differences between the IGS combination of the reprocessed solutions and the ITRF08P combination.

The igs weekly solutions were aligned to ITRF08P and residuals were computed, resulting in about 7000 station position differences. 13 stations were removed from the comparison mainly due to discontinuities. The average differences in the N, E, and H components were 0.4 ± 2.0 mm, 0.2 ± 2.5 mm and –0.1 ± 4.9 mm respectively. This confirms the excellent agreement of the observed station coordinates and the ITRF08P when extrapolated forward in time.

Similar comparisons were done using the older reprocessed ig1 weekly solutions. First we compared the period of 1995.0–1997.0 (Wks 0782–0885). Weekly solutions were aligned to ITRF08P propagated to the corresponding ig1 week. 20 stations were removed from the comparison, again mainly due to discontinuities. Residuals were computed for about 10200 station position differences. The average differences and standard deviations in the N, E, and H components were respectively 0.4 ± 3.0 mm, 0.0 ± 3.3 mm and 0.7 ± 7.1 mm. Second, we compared the period of 1994.0–1995.0 (Wks 0730–0781) using the same procedure as above. The average differences and standard deviations in the N, E, and H components were 0.2 ± 3.1 mm, 0.0 ± 3.7 mm and 0.0 ± 8.7 mm (~1700 station position differences). The 1994 results are quite acceptable despite the reduced number of ACs that contributed and the reduced number of stations available. So, the agreement between the ITRF08P extrapolated backward and the ig1 reprocessed combinations is also good for the older data set.

In summary, the ERP comparison (ITRF08P-IGS) for 1995–1996 agrees within the expected noise level. The formal ITRF08P sigmas on ERPs are consistent with the observed noise level. There is also a good agreement of the observed IGS station positions with the ITRF08P predicted positions outside the combination period. Those statistics are also consistent with similar results obtained by Rebischung et al. (2010) when the IGS05 was compared to ITRF08P.

References

Rebischung, P. and Garayt, B. (2010). ITRF2008-P: Some evaluation elements and impact on IGS RF products (IGS-IC-348).

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