IERS SINEX Combination Campaign: First Results at NRCan

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This is a contribution to the research activities of the IERS SINEX Combination Campaign. The objective of this campaign is to simultaneously combine weekly station coordinates and daily ERPs from various techniques, using all the available covariance information, and analyze the results. Several solutions from four techniques (GPS, SLR, VLBI, DORIS) and inter-technique local ties were provided for this research activity by various centers for year 1999.

In this preliminary analysis, 3 inter-technique combinations were computed. The combinations were limited to the first month of 1999 and all included the IGS weekly solutions. Two inter-technique GPS/SLR combinations used SLR solutions provided by DGFI and JCET, while the GPS/DORIS combination involved the solution provided by IGN. All the provided solutions were aligned to the ITRF2000 reference frame and included weekly/monthly estimates of station coordinates and daily ERPs along with fully populated covariance matrices. The combined solutions were realigned to ITRF2000 using the 54 reference frame stations routinely used by IGS for the alignment of its products. Due to the short time span, no station velocities were estimated. The combined IGS-DGFI and IGS-JCET solutions have 3D-RMS station coordinates residuals at 5–6 mm. Ties from 11 stations were used to connect the solutions. Figure 1 shows the daily X&Y pole position residuals time series of the IGS, DGFI and combined IGS-DGFI solutions with respect to Bulletin A.

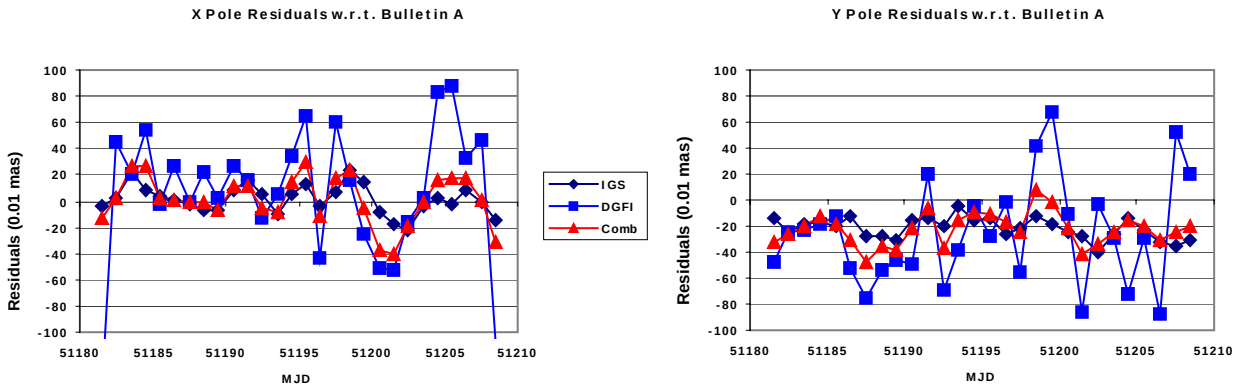

Fig. 1 X & Y pole time series residuals of the IGS, DGFI and IGS-DGFI combined solutions with respect to Bulletin A

The GPS/DORIS combination between the IGS and IGN solutions has 3D-RMS coordinates residuals of 6mm for IGS and 52mm for IGN. In this case, 16 ties were connecting the solutions. Table 1 below summarizes the statistics of the daily X&Y pole residuals with respect to Bulletin A for each solution used and each of the inter-technique combination.

Table 1 X & Y pole statistics for each solution (IGS, DGFI, JCET, IGN) and their individual combination with IGS with respect to Bulletin A

	Solution Statistics				Combined with IGS statistics			
	X Pole (mas)		Y Pole (mas)		X Pole (mas)		Y Pole (mas)	
	Avg.	Std.	Avg.	Std.	Avg.	Std.	Avg.	Std.
IGS	0.01	0.11	0.22	0.08				
DGFI	0.07	0.52	0.26	0.40	0.01	0.19	0.22	0.12
JCET	0.14	0.81	0.13	0.73	0.01	0.19	0.22	0.12
IGN	0.42	3.16	0.03	2.16	0.01	0.11	0.21	0.08

The solution statistics suggest that the bias observed by IGS in the Y pole component with respect to Bulletin A may also be present in the SLR solutions (DGFI, JCET). A longer combination interval may confirm/infirm this hypothesis. When DGFI, JCET and IGN solutions are individually combined with IGS, the daily combined pole estimates are dominated by the IGS pole estimate. The addition of more solutions may somewhat diminish this effect, however, the IGS contribution to a multi-technique combined solution is expected to remain important.

A cumulative solution for year 1999 including all weekly IGS station coordinates and daily ERPs was also estimated. All station coordinates available in the weekly IGS solutions were used in the combination. For each station, the combined solution included an initial position and a velocity estimate. The main objective of this analysis was to assess the effect of the accumulation of station coordinates on the ERPs. The combined solution was also aligned to the IGS realization of ITRF2000 using a subset (54) of high quality stations by estimating and applying a 14-parameter (3 translations, 3 rotations, 1 scale & rates) unweighted transformation on the cumulative solution. The comparison between the daily pole position estimates of the weekly and cumulative solutions shows an average bias below 0.01 mas with a standard deviation of about 0.03 mas. The corresponding standard deviations on the station coordinates north, east and height components residuals are 2.0 mm, 2.7 mm and 6.3 mm respectively. Comparisons of the ERPs from the weekly IGS combination and the annual combination with Bulletin A show for both cases average differences in X and Y pole position of 0.03 mas (±0.09 mas) and 0.21 mas (±0.08 mas). Note that during 1999, the IGS SINEX production/ combination activities were in their pilot phase.

Although the above inter-technique combination results are very preliminary, they validate the multi-technique combination strategy. They already indicate that the IGS solution will likely have a very significant (if not overwhelming) contribution in station coordinates & ERPs multi-technique combined product. Some issues, such as the proper interpolation and combination of ERPs provided at different epochs need further work.