GAGE Analysis transition to IGS14 system

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Summary

At GPS week 2005 day 0, 2018 June 10, the GAGE analysis centers will switch fully to the IGS14 reference system. At this time, horizontal offsets in position for most sites will be <0.2 mm and vertical offsets will be 2-3 mm. For some antenna types the changes will be larger with horizontal offsets up to 2 mm and height offsets of 8 mm.

Analysis

The GAGE analysis centers will transition to operationally using the IGS14 antenna calibration models starting with final orbit runs for day 0 of GPS week 2005, 2018 June 10. This change is one week after JPL switched to generating final orbit and clock products in the IGS14 system. Since the IGS transition to ITRF2014/IGS14 on January 29, 2017 (GPS week 1934 day 0), the GAGE analysis centers having generating results in mixed systems due to JPL orbits and clocks not being available for the final orbit products in the IGS14 system. Rapid orbit and clock products have been available in the IGS14 systems since January 29, 2017. The GAGE analysis strategy for handling this situation was discussed in the "GAGE/PBO analysis transition to ITRF2014/IGS14" note. (https://www.unavco.org/data/gps-gnss/derived-products/docs/GAGE_IGS14_transition_plan_20170327.pdf). Tables of expected position changes, generated by the IGS, were given in that note. Since JPL is now generating IGS14 products for both rapid and final orbits, both analysis centers will switch to using the IGS14 antenna calibration file. The alignment of the GAGE product reference frame will remain unchanged (NAM08 and IGS08) while reprocessed results in the IGS14 are generated and a new North America reference frame realization is developed. The reprocessing will take several months to complete and analyze. Retention of the same reference frame realizations deduced the impact of switching to the full IGS14 system.

This note discusses the impact on the GAGE times series products with the transition to the IGS14 antenna phase center model. The GAGE analysis have processed selected weeks of data with the IGS14 antenna file and for CWU recently released IGS14 orbits and clocks from JPL. NMT has used the same antenna calibration file and either the IGS operational final orbit files after January 29, 2017 or the IGS orbits from the second reprocessing aligned to the IGS14 system. Here we examine the differences between the new IGS14 processing and the old operational IGS08 processing. For both sets of processing we align through rotation and translation (but no scale change) to the same NAM08 reference frame realized with typically 500 sites spread over the GAGE network extent.

The overall summary of the results is given in Table 1. Reprocessed results from selected weeks between 2015-2017 were compared with the standard GAGE processing from those same weeks. The time series for each station were differenced and the mean and statistics of the differences were computed for each station. The statistics are the weighted root-mean-square (WRMS) scatter of differences and the normalized RMS scatter (square-root chi-squared per degree of freedom) of the differences. Mean differences for 2057 stations were computed. Table 1 shows the median of the mean, WRMS and NRMS differences for the North, East and Up components by analysis center. The median changes in the horizontal components are small (<0.2 mm) but the median of the height changes are 2.30 to 3.35 mm depending on the AC or the PBO combination. On average, the antenna model change is expected to increase height estimates by ~3 mm. The increase is smaller than the expected changes for the IGS08-IGS14 change (discussed in the earlier note cited above) because we are aligning to the same reference frame in our time series generation. Figures 1-3 show the histogram of the mean differences for the combined PBO analysis and from each of the ACs.

In terms of the visual impact of the changes when time series are viewed, the NRMS value of ~0.3 shows that the "jump" in the heights at week 2005 will be about a "third of a sigma" and so will not be that obvious when time series are viewed. However, the offsets are systematic and users should be cautious of long-term averaging which will more likely show the systematic offset across the week 2005 boundary. When the reprocessing is complete, this offset will no longer be present.

Table 1: Characteristics of the changes in time series to be expected with the switch from the IGS08 antenna calibration file to IGS14 antenna calibration.

Center		North			East			Up	
	Median	WRMS	NRMS	Median	WRMS	NRMS	Median	WRMS	NRMS
	(mm)	(mm)		(mm)	(mm)		(mm)	(mm)	
CWU	-0.02	0.59	0.21	-0.12	0.48	0.21	2.49	2.71	0.26
NMT	-0.03	0.36	0.14	0.12	0.47	0.21	3.35	2.34	0.27
PBO	-0.08	0.43	0.22	-0.16	0.40	0.24	2.30	2.37	0.35

The summary in Table 1 shows the overall nature of the change but, as noted by the IGS and in our earlier note on the impact of the change from IGS08 to IGS14, specific antennas can have larger or smaller changes. Table 2 gives the medians of the changes in mean north, east, up position from the PBO combination grouped by antenna type. Some antennas/radomes, such as the TRM29659.00/SCIS had new robot calibrations in IGS14 replacing the converted relative calibration in the IGS08 system. For stations with some antenna types, the change in positions at the week 2005 boundary could be several times larger than the overall median values. Figure 4 and 5 show the histograms for the TRM29659.00 SCIT and the TRM41249.00 SCIT antenna/radome combinations.

Included with report is a folder with postscript plots of the histograms of the mean differences by analysis center and antenna/radome type, and text files with extent .sum which give the mean differences in NEU of each station from the CWU, NMT, and PBO analyses.

Table 2: Medians of the mean differences in the position estimates between IGS14 and IGS08 summarized by antenna type and in decreasing of number of stations with specific antenna types.

Antenna	Radome	Number	ΔN (mm)	ΔE (mm)	ΔU (mm)
TRM29659.00	SCIT	656	-0.07	-0.20	2.16
TRM59800.80	SCIT	244	-0.09	-0.19	2.29
TRM59800.00	SCIT	199	-0.01	-0.20	2.24
TRM57971.00	NONE	178	-0.04	-0.48	7.36
ASH701945B_M	SCIT	109	-0.54	0.01	2.22
TRM41249.00	NONE	84	0.03	-0.13	2.40
TPSCR.G3	SCIT	79	-0.27	-0.15	2.01
TRM29659.00	SCIS	42	0.59	0.78	1.13
TRM55971.00	NONE	38	0.11	0.05	2.24
TRM41249.00	SCIT	36	1.31	1.88	6.15
LEIAR10	NONE	31	-0.54	-1.50	2.67
TRM57971.00	SCIT	29	1.44	-0.15	5.34
LEIAT504	LEIS	21	-0.15	1.04	0.91
MPL_WAAS_2225NW	NONE	20	-0.40	0.21	2.27
TRM59800.00	SCIS	17	-0.59	1.23	-2.22

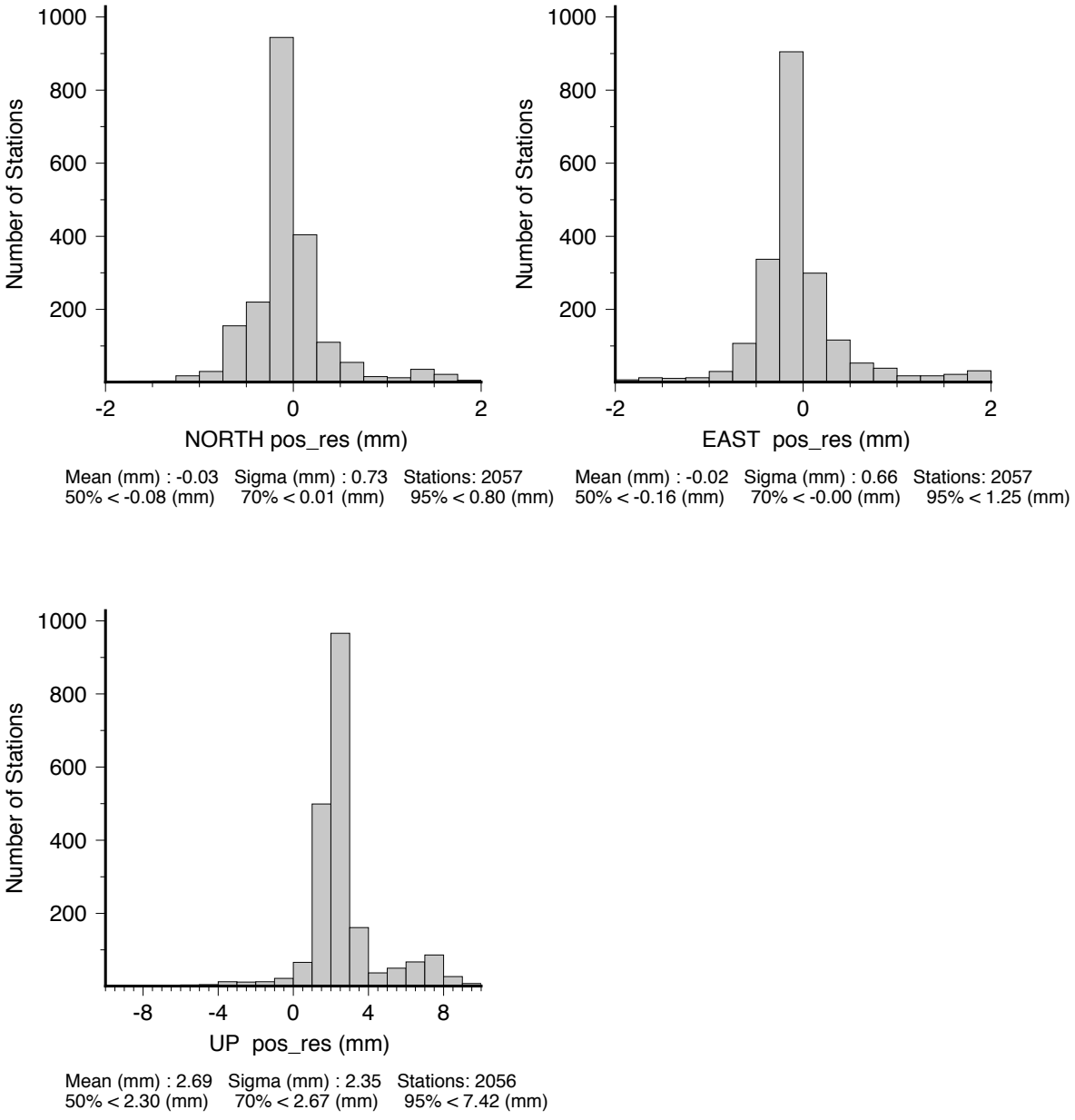

Figure 1: Histogram of the differences in the North, East and Up coordinates for the 2057 stations for selected weeks in 2015-2017 between the IGS14 reprocessing and the IGS08 operational processing. Both analyses are aligned to the same NAM08 reference frame using ~500 stations each day.

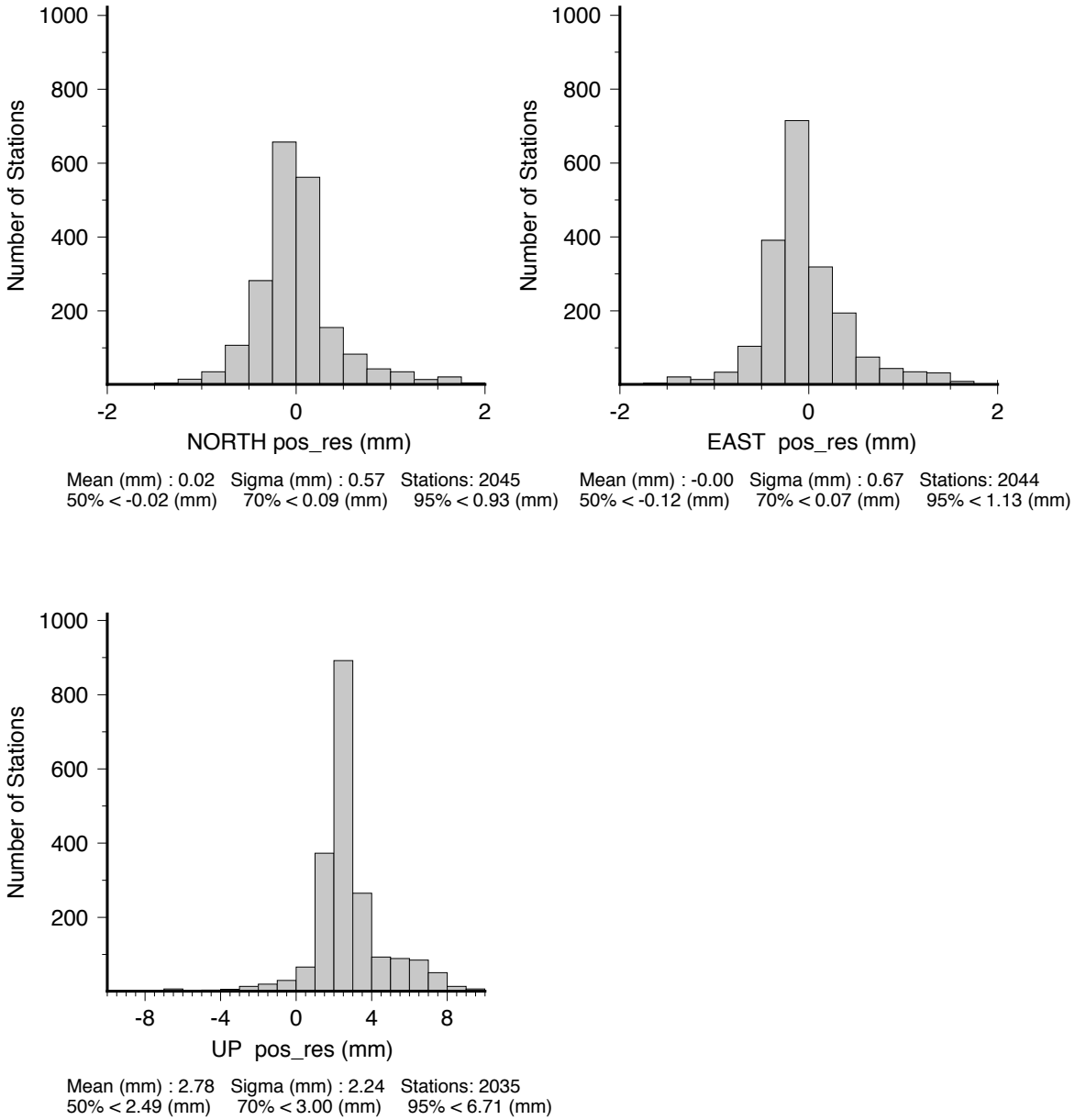

Figure 2: Similar to Figure 1 except for the CWU analysis.

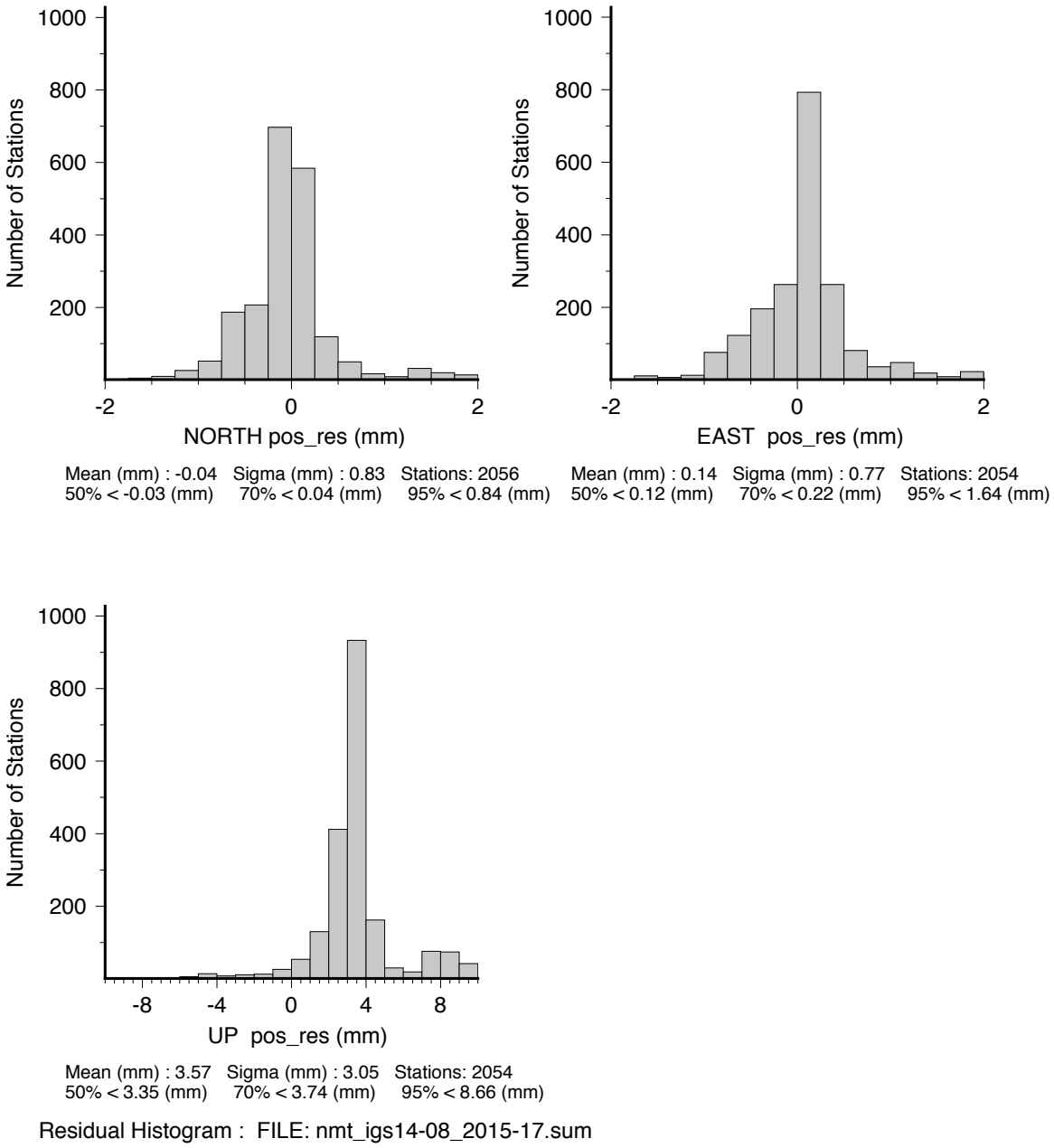

Figure 3: Similar to Figure 1 except for the NMT analysis.

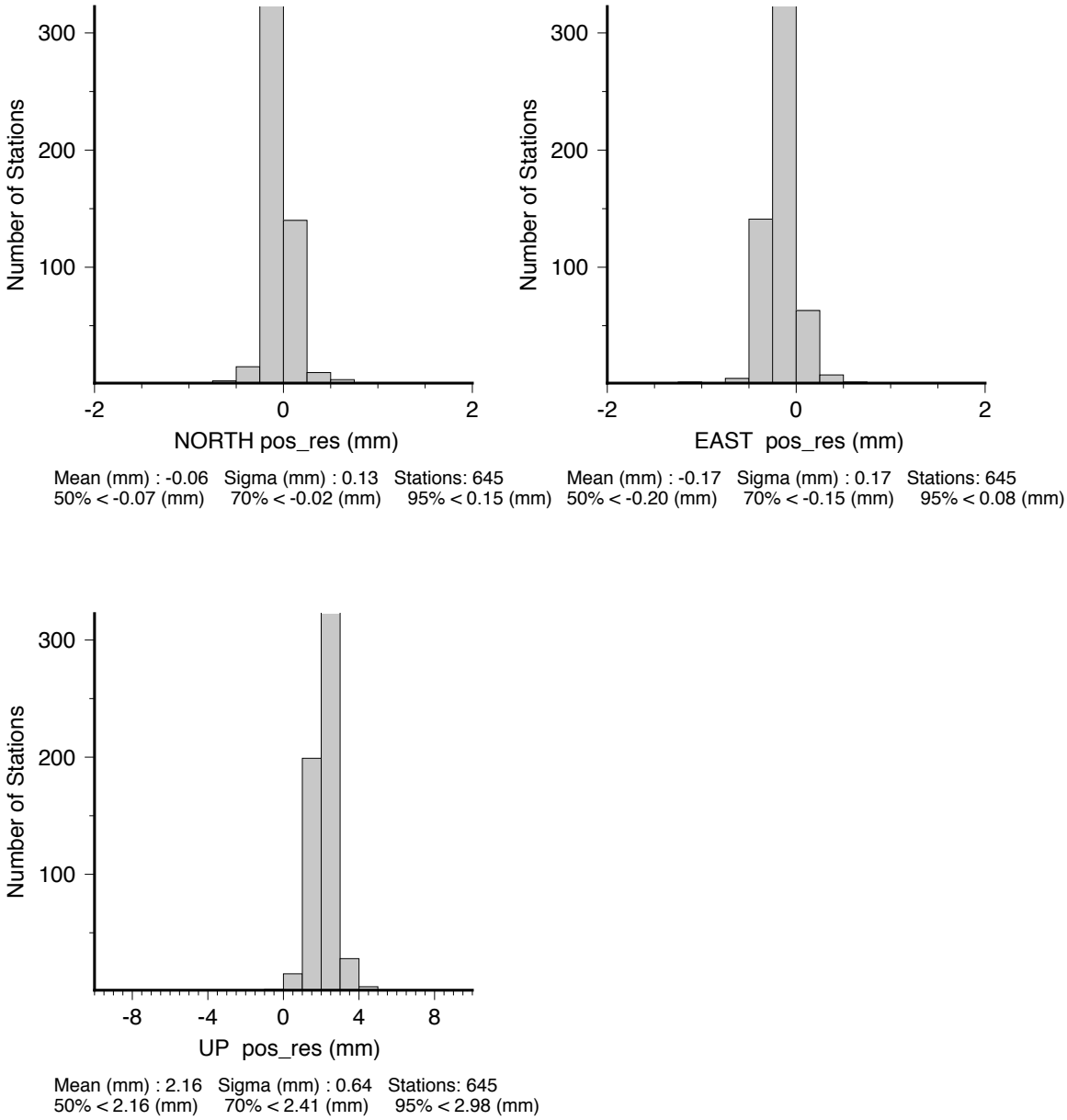

Figure 4: Similar to Figure 1 except from the combined PBO analysis for sites with the TRM29659.00 SCIT antenna/radome.

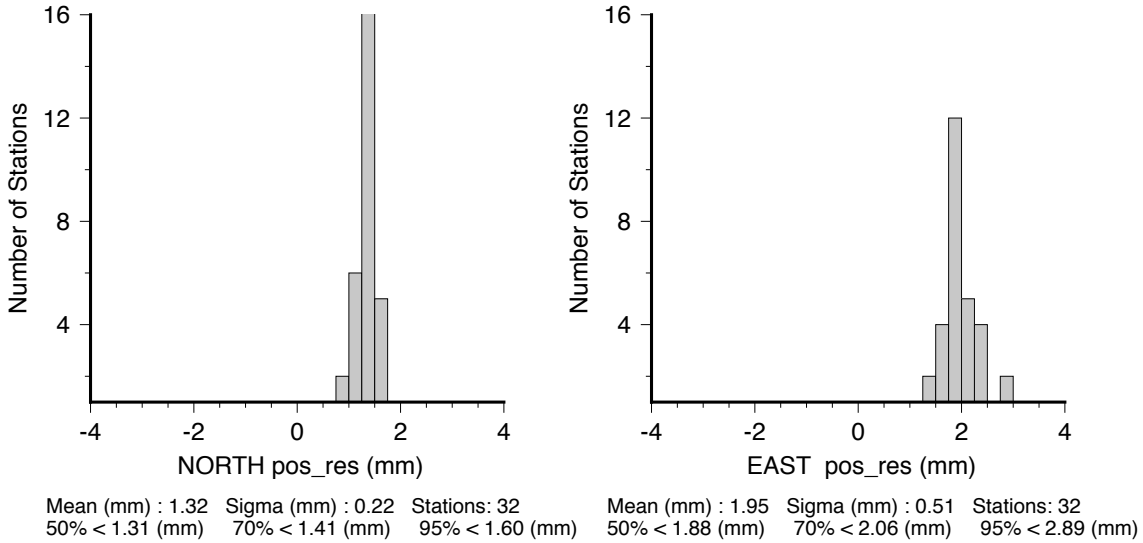

Figure 5: Similar to Figure 1 except from the combined PBO analysis for sites with the TRM41249.00 SCIT antenna/radome.