Quarterly Report
Massachusetts Institute of Technology
GAGE Facility GPS Data Analysis Center Coordinator

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Period: 2024/10/01-2024/12/31

Table of Contents

Summary 2
GPS Analysis of Level 2a and 2b products 2
Level 2a products: Rapid products 2
Level 2a products: Final products 2
Level 2a products: 12-week, 26-week supplement products 2
Analysis of Final products: September 15, 2024– December 21, 2024 3
Table 1: Statistics of the fits of 2014 stations for CWU analyzed in the finals 3
Table 2: Head and tail of WRMS scatter summary file CWU_FIN_Y7Q1.tab. 5
GLOBK Apriori coordinate file and earthquake files 12
Snapshot velocity field analysis from the reprocessed PBO analysis. 13
Table 3: Statistics of the fits of 2706 stations analyzed CWU in the reprocessed ... 13
Earthquake Analyses: 2024/09/15-2024/12/15 20
Antenna and other discontinuity events. 21
Anomalous sites 21
GNSS Rapid processing 27
Table 4: Mean differences between GPS-only and GPS+Galileo rapid solutions. .. 28
ANET Processing 29
Table 5: Statistics of the fits of 45 stations in the ANET region 29
References 31

Summary

Under the GAGE2 Facility Data Analysis sub-award, MIT has been processing SINEX files from Central Washington University (CWU) and aligning them to the GAGE NAM14 reference frame. In this report, we show analyses of the data processing for the period 2024/10/01 to 2024/12/31, as well as time series velocity field analyses for the GAGE reprocessing analyses (1996-2024). Several earthquakes were investigated this quarter up to 2024/12/15, and two of them generated any detectable co-seismic offsets. One of these earthquakes affected only two sites significantly. The other earthquake, near the Mendocino triple junction, affected 52 stations.

Analysis files (pbo format velocity files and offset files) are generated monthly and sent via Python in the middle of each month.

We continue to process ANET data. These solutions are in the ANT14 frame as defined in the ITRF2014 plate motion model [*Altamimi et al.,* 2017].

GPS Analysis of Level 2a and 2b products

Level 2a products: Rapid products

Final and rapid level 2a products have been, in general, generated routinely during this quarter for the CWU solutions. The description of these products, the delivery schedule, and the delivery list remain unchanged from the previous quarter and will not be reported here.

Level 2a products: Final products

The final products are generated weekly and are based on the final JPL orbits and clocks. Finals and rapid solutions are now being generated in the IGS14 system. In this quarter, 2014 stations were processed, the same as last quarter. In addition, up to 45 sites were processed in the ANET solutions, one more than last quarter. The number of stations processed fluctuated as data systems were updated at EarthScope.

Level 2a products: 12-week, 26-week supplement products

Each week, we also process the Supplemental (12-week latency) and six-month supplemental (26-week latency) analyses from CWU for the main GAGE2 Networks of the Americas stations (NOTA). The delivery schedule for these products is also unchanged.

Analysis of Final products: September 15, 2024– December 21, 2024

For this report, we generated the statistics using the ~3 months of CWU results between September 15, 2024, and December 21, 2024. These results are summarized in Table 1 and Figure 1.

For the three months of the final position time series generated, we fit linear trends and annual signals and compute the RMS scatters of the position residuals in north, east, and up for each station in the analysis. Table 1 shows the median (50%), 70%, and 95% limits for the RMS scatters CWU. The detailed histograms of the RMS scatters are shown in Figure 1 CWU.

Table 1: Statistics of the fits of 2014 stations for CWU analyzed in the finals analysis between September 15, 2024, and December 21, 2024.
Figure 1 shows histograms of the RMS scatters.

Center	North (mm)	East (mm)	Up (mm)
Median (50%)			
CWU	0.87	0.83	4.42
70%			
CWU	1.13	1.04	5.10
95%			
CWU	2.27	2.40	9.33

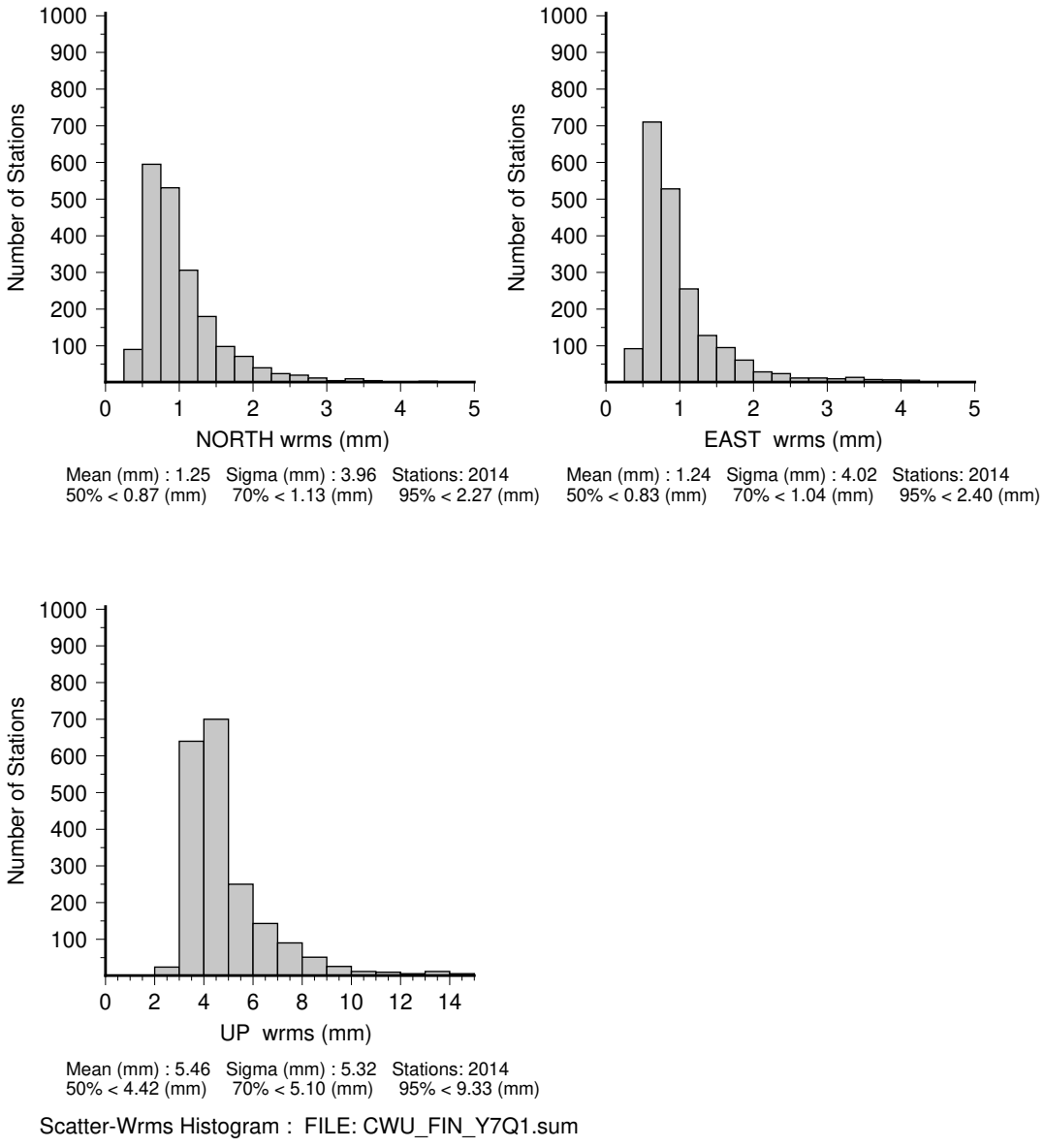


Figure 1: CWU solution histograms of the North, East, and Up RMS scatters of the position residuals for 2014 stations analyzed between September 15, 2024 and December 21, 2024. Linear trends and annual signals were estimated from the time series.

For the CWU analysis, we also evaluate the RMS scatters of the position estimates by network type. The figures below are based on our monthly submissions, but here, we use nominally three months of data to evaluate the RMS scatters. In Table 2, we give the median, 70, and 95 percentile limits on the RMS scatters. The geographical distributions of the RMS scatters by network type are shown in Figures 2-7. The values plotted are given in

CWU_FIN_Y6Q4.tab. There are 2015 stations in the file for sites with at least two measurements during the month.

Table 2: Head and tail of WRMS scatter summary file CWU_FIN_Y7Q1.tab.

```
Tabular Position RMS scatters created from CWU_FIN_Y7Q1.sum
ChiN/E/U are square root of chisquared degree of freedom of the fits.
Values of ChiN/E/U near unity indicate that the estimated error
bars are consistent the scatter of the position estimates

.Site     #    N (mm)  ChiN     E (mm) ChiE   U (mm)  ChiU     Years
 1LSU    98      1.2   0.69      1.4   0.67     6.7   0.74     21.66
 1NSU    98      0.9   0.54      1.0   0.59     5.1   0.69     20.92
 1ULM    98      0.9   0.56      1.0   0.59     4.3   0.58     21.52
 7ODM    98      1.1   0.59      0.8   0.51     4.5   0.58     23.67
…
 ZDV1    96      0.8   0.43      1.1   0.67     4.5   0.60     21.55
 ZKC1    93      0.9   0.49      0.7   0.43     5.0   0.64     21.55
 ZLA1    95      1.3   0.68      0.7   0.47     5.5   0.70     21.55
 ZLC1    97      0.8   0.41      0.7   0.42     4.4   0.57     21.78
 ZME1    97      0.9   0.53      0.8   0.51     4.8   0.63     21.78
 ZMP1    97      0.8   0.41      0.7   0.47     4.6   0.61     22.02
 ZNY1    97      0.8   0.40      0.8   0.54     4.8   0.63     21.94
 ZOA1    89      0.8   0.43      0.6   0.42     4.5   0.59     22.46
 ZSE1    97      1.1   0.48      1.0   0.64     4.7   0.63     21.94
 ZTL4    97      1.2   0.70      0.9   0.57     7.3   0.97     22.13
```

Table 2: RMS scatter of the position residuals for the CWU solution between September 15, 2024, and December 21, 2024, divided by network type. The division of networks is based on the JAVA script unavcoMetdata.jar with network codes PBO, Nucleus, Mid- SCIGN_USGS, America GAMA, COCONet and Expanded PBO

Network	North (mm)	East (mm)	Up (mm)	#Sites
Median (50%)				
PBO	0.79	0.74	4.14	814
NUCLEUS	0.70	0.64	3.85	190
GAMA	0.79	0.86	3.85	14
COCONet	1.66	1.73	7.66	72
USGS_SCIGN	0.78	0.71	3.90	124
Expanded	1.01	0.94	4.88	800
70%				
PBO	1.00	0.97	4.62	
NUCLEUS	0.83	0.75	4.21	
GAMA	0.82	0.91	4.25	

COCONet	1.84	1.85	8.89
USGS_SCIGN	0.93	0.86	4.27
Expanded	1.22	1.17	5.60
95%			
PBO	2.09	2.08	7.94
NUCLEUS	1.60	1.36	8.14
GAMA	1.00	1.02	5.12
COCONet	4.10	5.14	15.50
USGS_SCIGN	1.66	1.29	9.33
Expanded	2.44	2.77	9.29

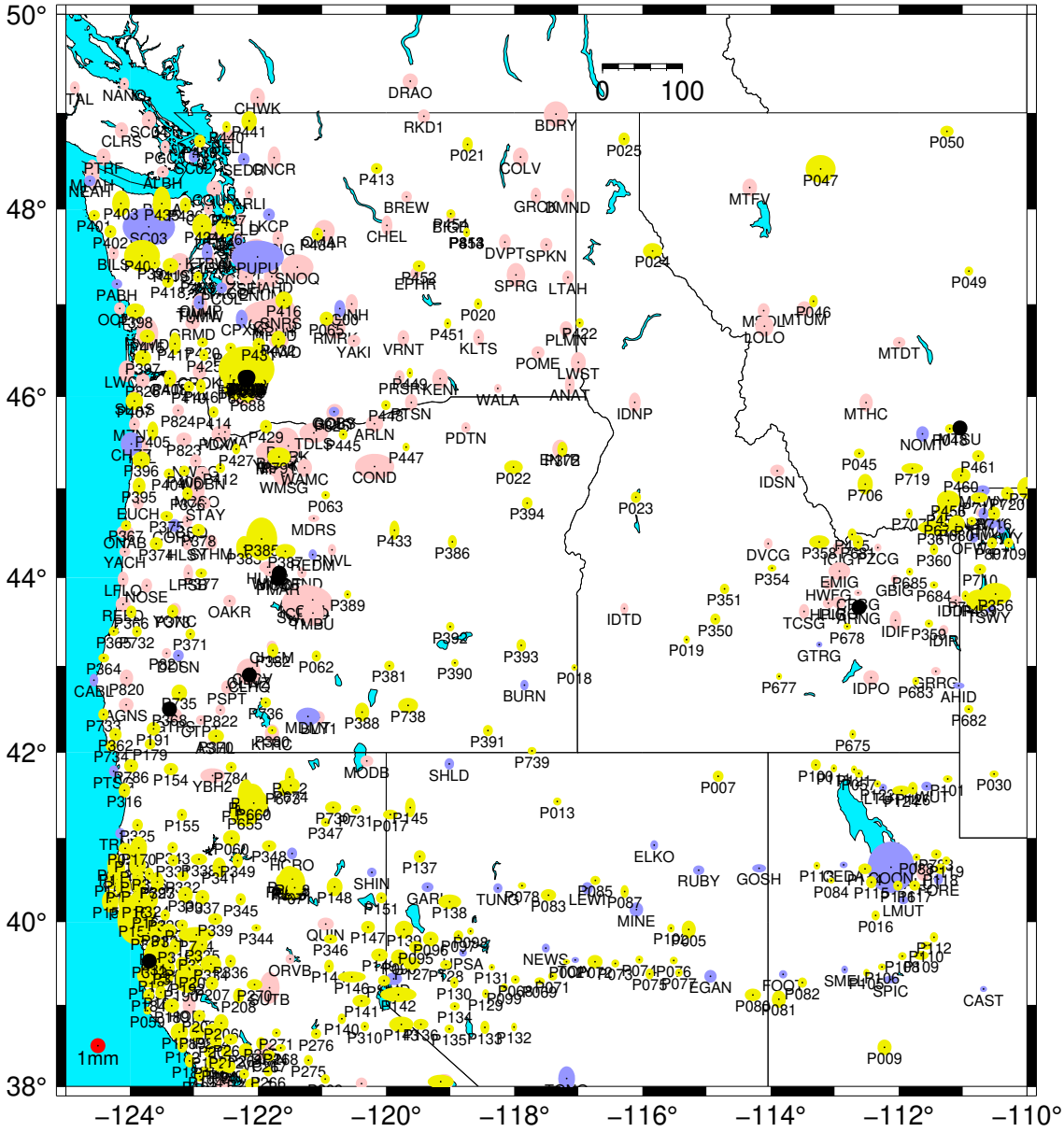


Figure 2: Distribution of the RMS scatters of horizontal position estimates from the CWU analysis for the Northern Western United States. The color of the ellipses that give the north and east RMS scatters denotes the network given by the legend in the figure. The small red circle shows the size of 1 mm scatters. Sites shown with black circles have combined RMS scatters in north and east greater than 5 mm or are sites that have no data during this 3-month interval.

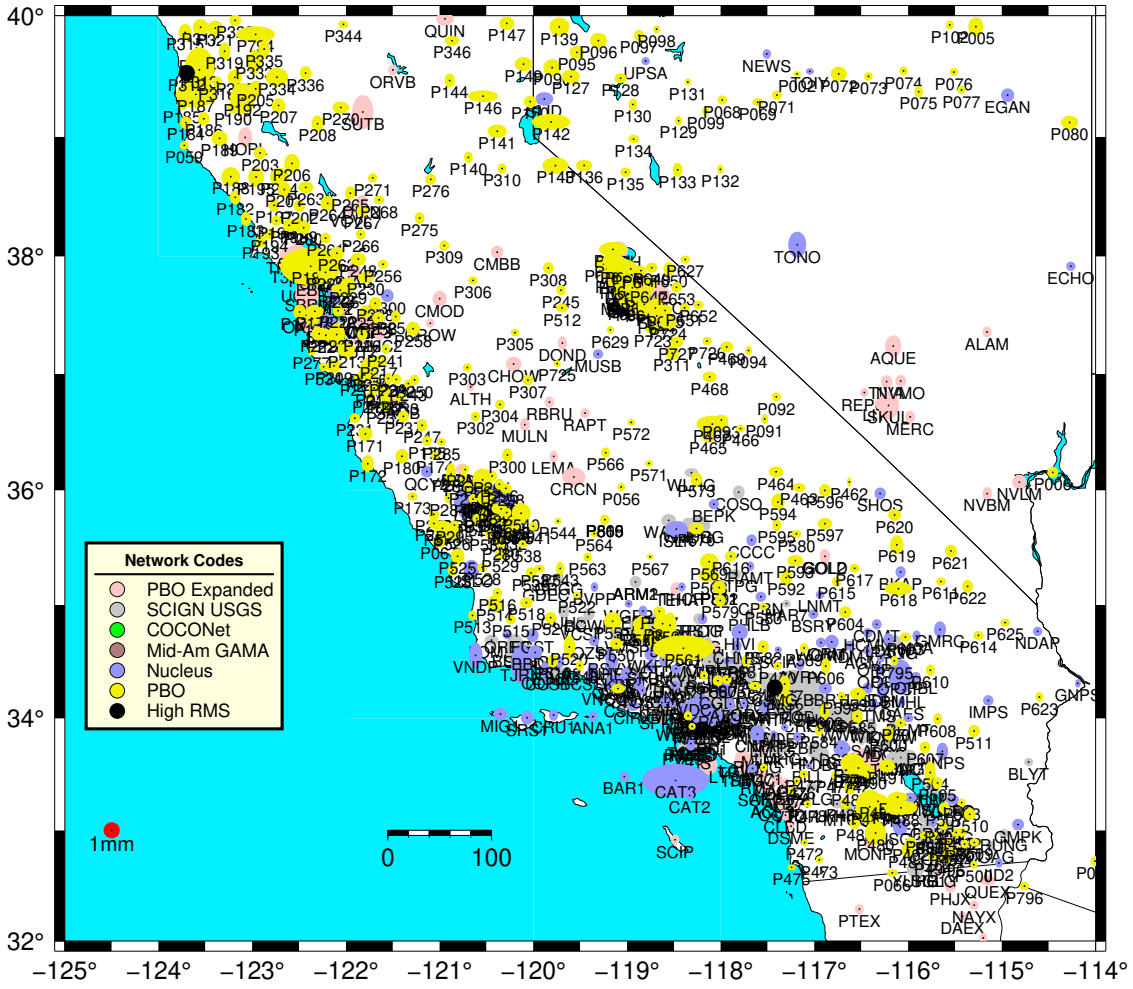


Figure 3: Same as Figure 4 except for the Southern Western United States. Black circles show large RMS scatter sites.

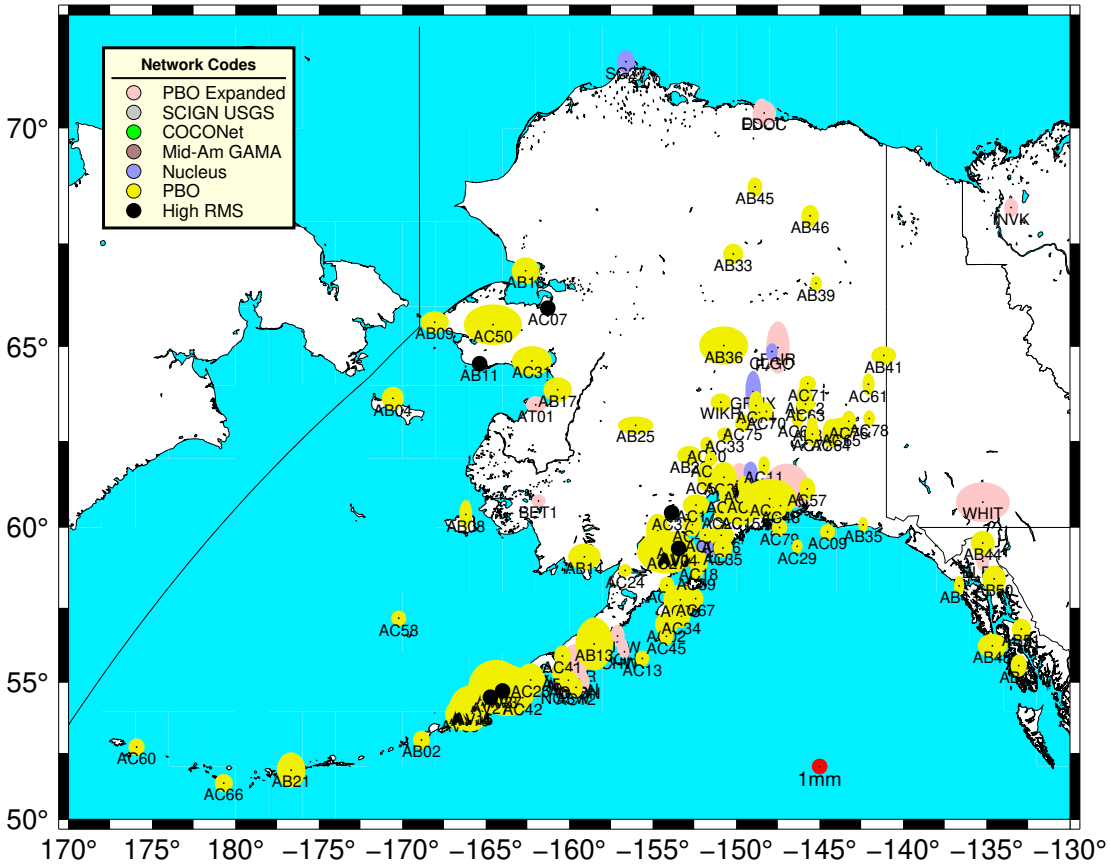


Figure 4: Same as Figure 4 except for the Alaskan region.

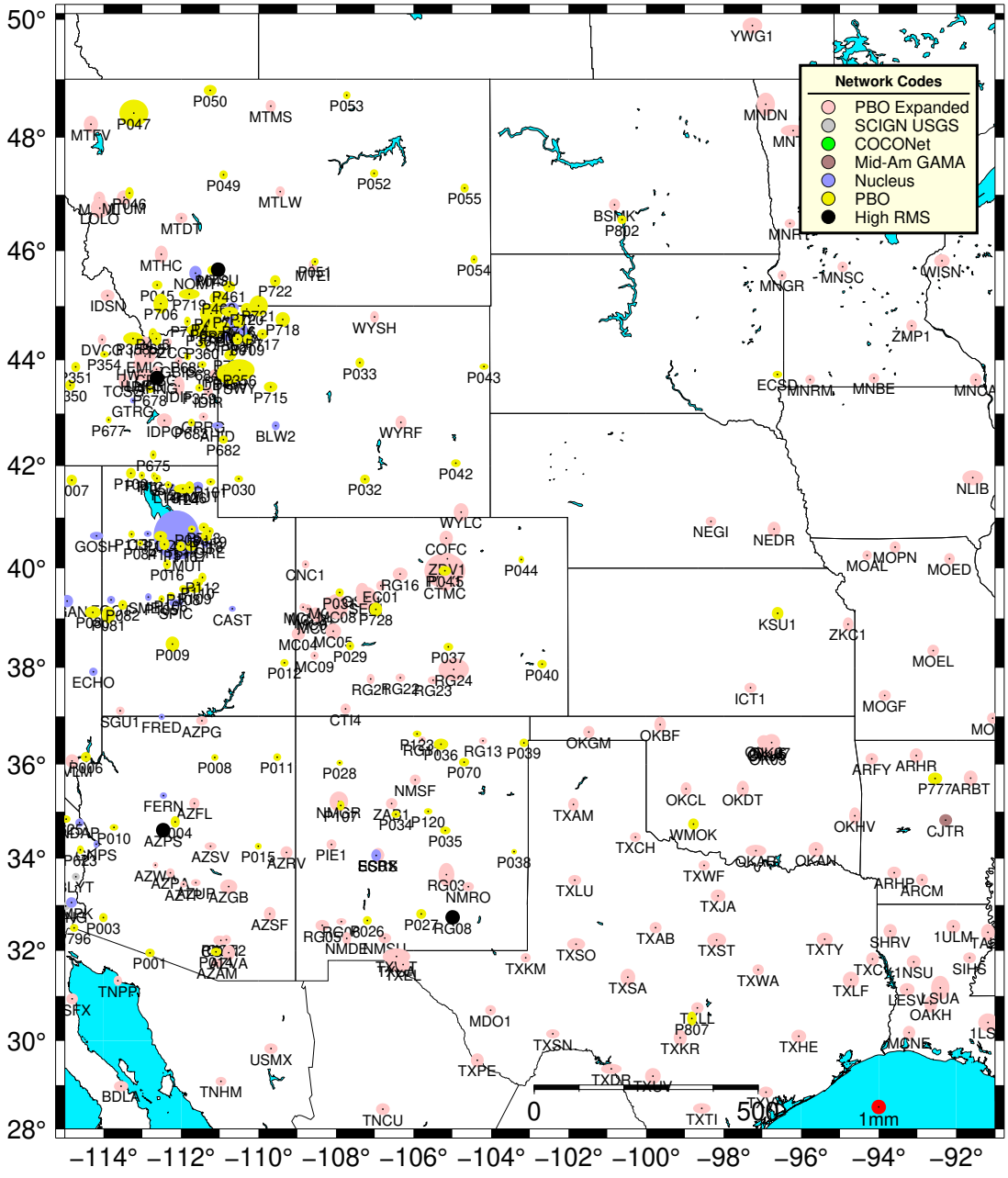


Figure 5: Same as Figure 4 except for the Central United States

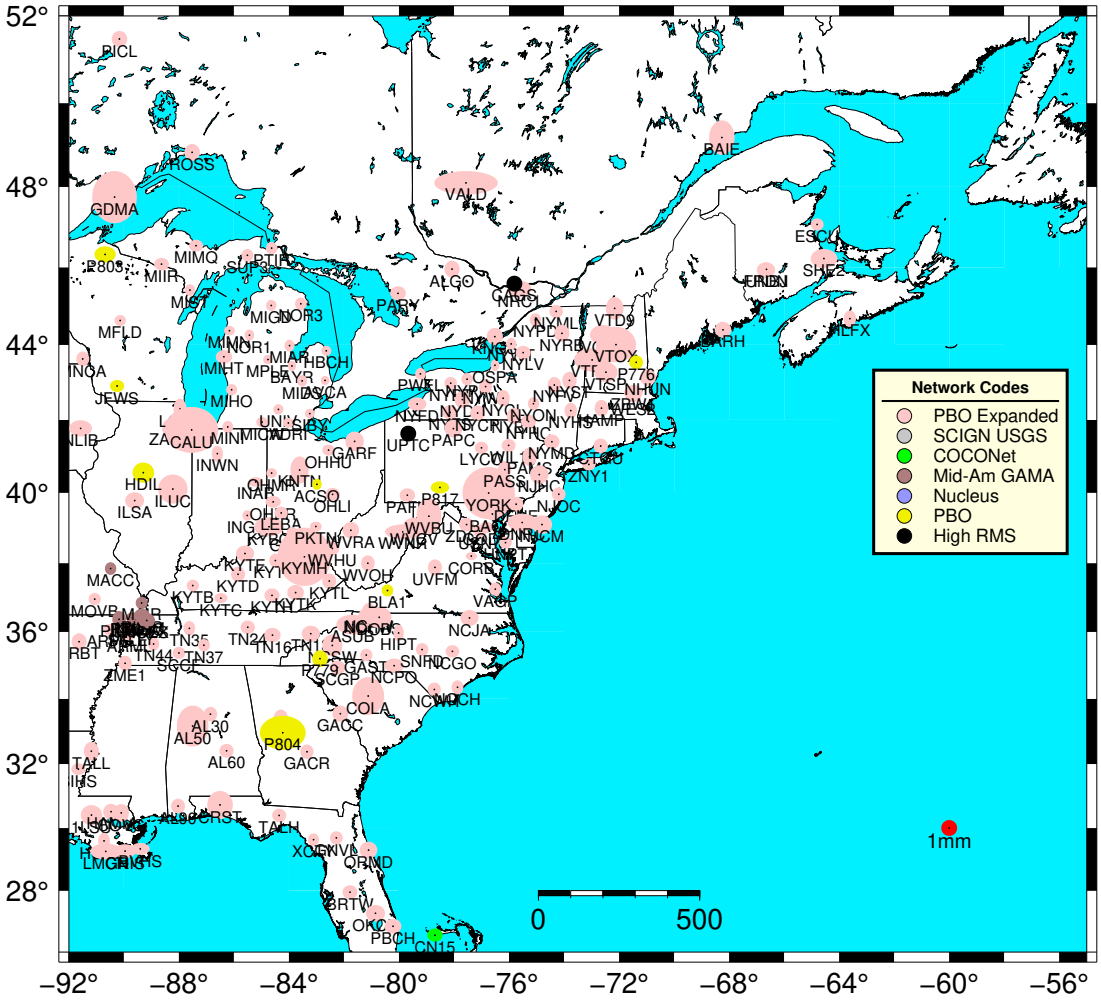


Figure 6: Same as Figure 4 except for the Eastern United States

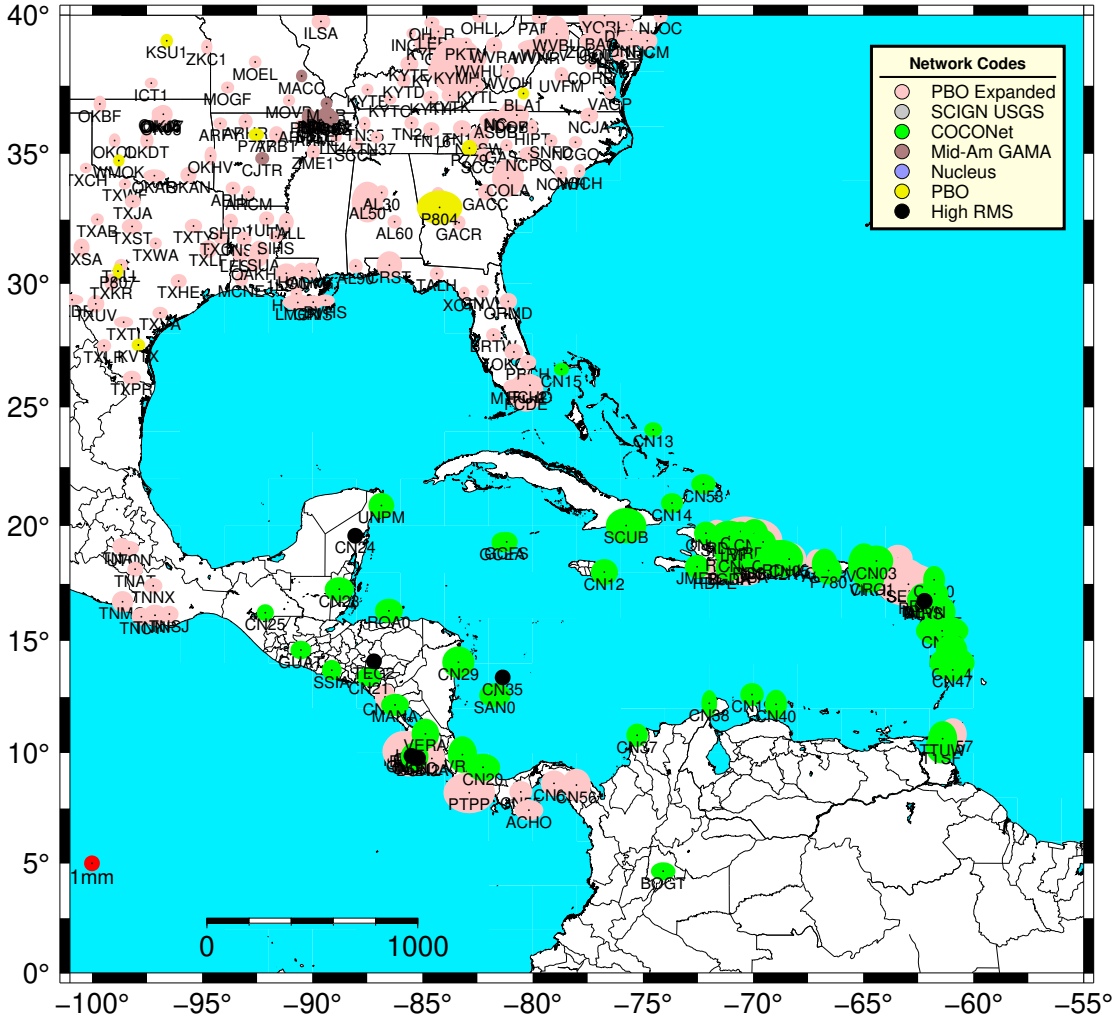


Figure 7: Same as Figure 4 except for the Caribbean region.

GLOBK Apriori coordinate file and earthquake files

As part of the quarterly analysis, we run a complete analysis of the time series files and generate position, velocity, and other parameter estimates from these time series. These files can be directly used in the GLOBK analysis files sent with the GAGE analysis documentation. The current earthquake and discontinuity files used in the GAGE ACC analyses are All_NOTA_eqs.eq All_NOTA_ants.eq All_NOTA_unkn.eq. These names have been changed to reflect that they now refer to the Network of America and no longer just the plate boundary observatory. The GLOBK apriori coordinate file All_CWU_nam14.apr is the current estimate based on data analysis in this quarterly report.

Snapshot velocity field analysis from the reprocessed PBO analysis.

For this quarterly report, we generate velocity estimates for the reprocessed results and the current GAGE analyses that are in the NAM14 reference frame using the CWU analysis. There are 2706 stations in the CWU solution. The statistics of the fits to results are shown in Table 3. Because these are cumulative statistics, they are little changed from last quarter. In this analysis, offsets are estimated for antenna changes and earthquakes. Annual signals are estimated, and for some earthquakes, logarithmic post-seismic signals are also estimated. The full tables of RMS fit, along with the duration of the data used, are given in cwu_nam14_241221.tab. The velocity estimates are shown by region and network type in Figures 8-14. The color scheme used is the same as Figures 2-7. The snapshot velocity field file for CWU is cwu_nam14_241221.snpvel.

Table 3: Statistics of the fits of 2706 stations analyzed CWU in the reprocessed analysis for data collected between Jan 1, 1996 and December 21, 2024.

Center	North (mm)	East (mm)	Up (mm)
Median (50%)			
CWU	1.42	1.39	6.27
70%			
CWU	1.79	1.76	7.16
95%			
CWU	4.21	3.80	11.79

In Figures 8-14, different tolerances are used for maximum standard deviation in each figure so that regions with small velocity vectors can be displayed at large scales without the plots being dominated by large error bar points. The standard deviations of the velocity estimated are computed using the GLOBK First-order-Gauss-Markov Extrapolation (FOGMEX) model that aims to account for temporal correlations in the time series residuals. This algorithm is also called the "Realistic Sigma" model.

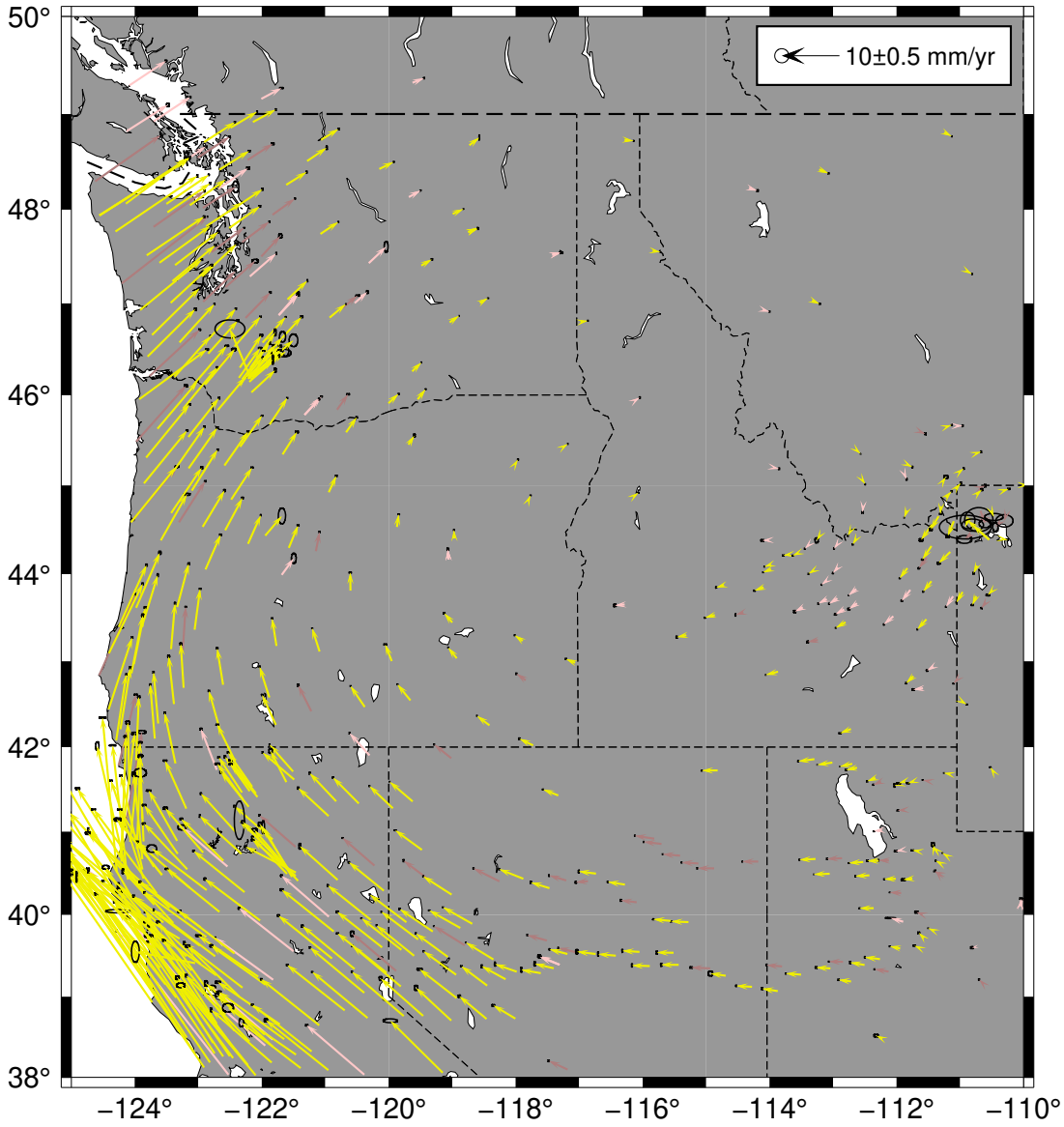


Figure 8: Velocity field estimates for the Pacific northwest from the CWU solution generated using time series analysis and the FOGMEX error model. 95% confidence interval error ellipses are shown. The color scheme of the vectors matches the network type legend in Figure 4. Only velocities with horizontal standard deviations less than 2 mm/yr are shown (this value is reduced from previous reports due to the improved velocity sigmas).

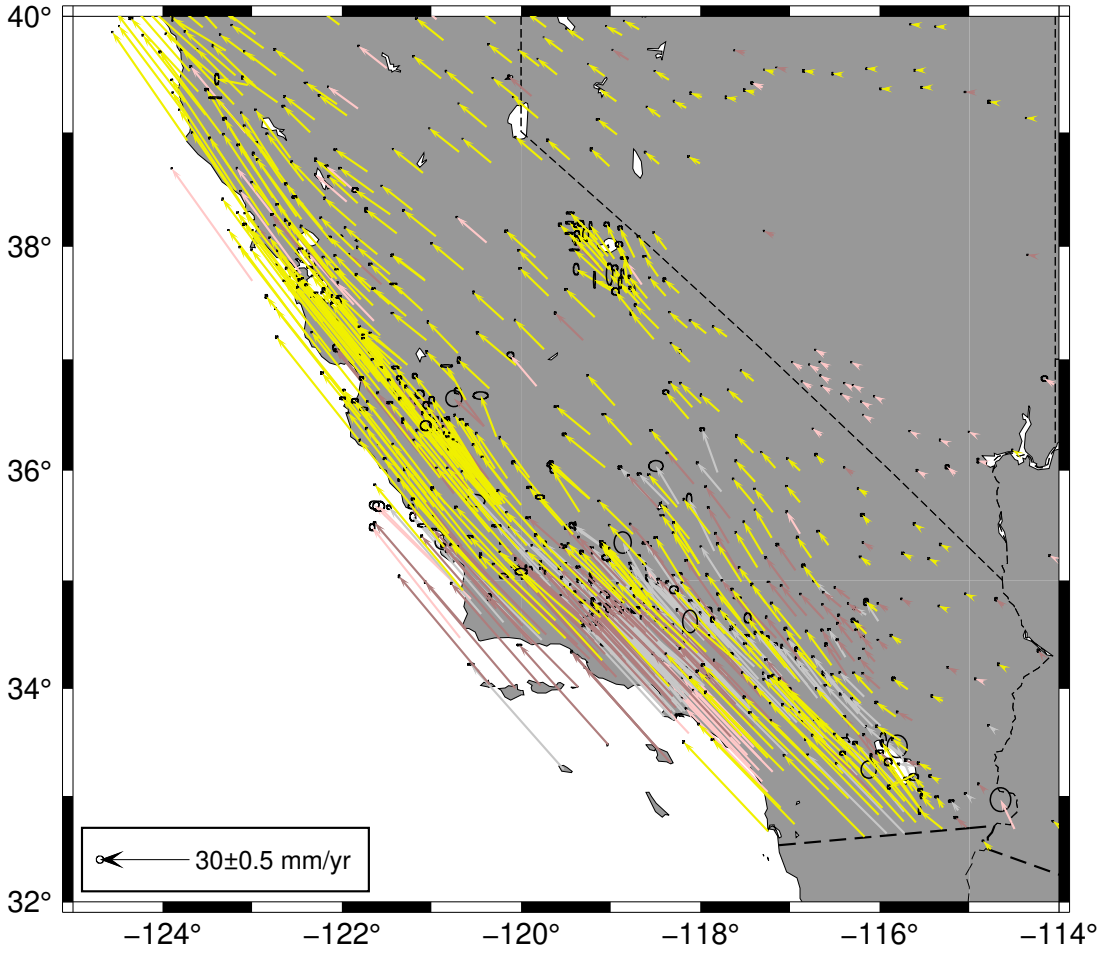


Figure 9: Same as Figure 8 except for South Western United States. Only velocities with horizontal standard deviations less than 2 mm/yr are shown.

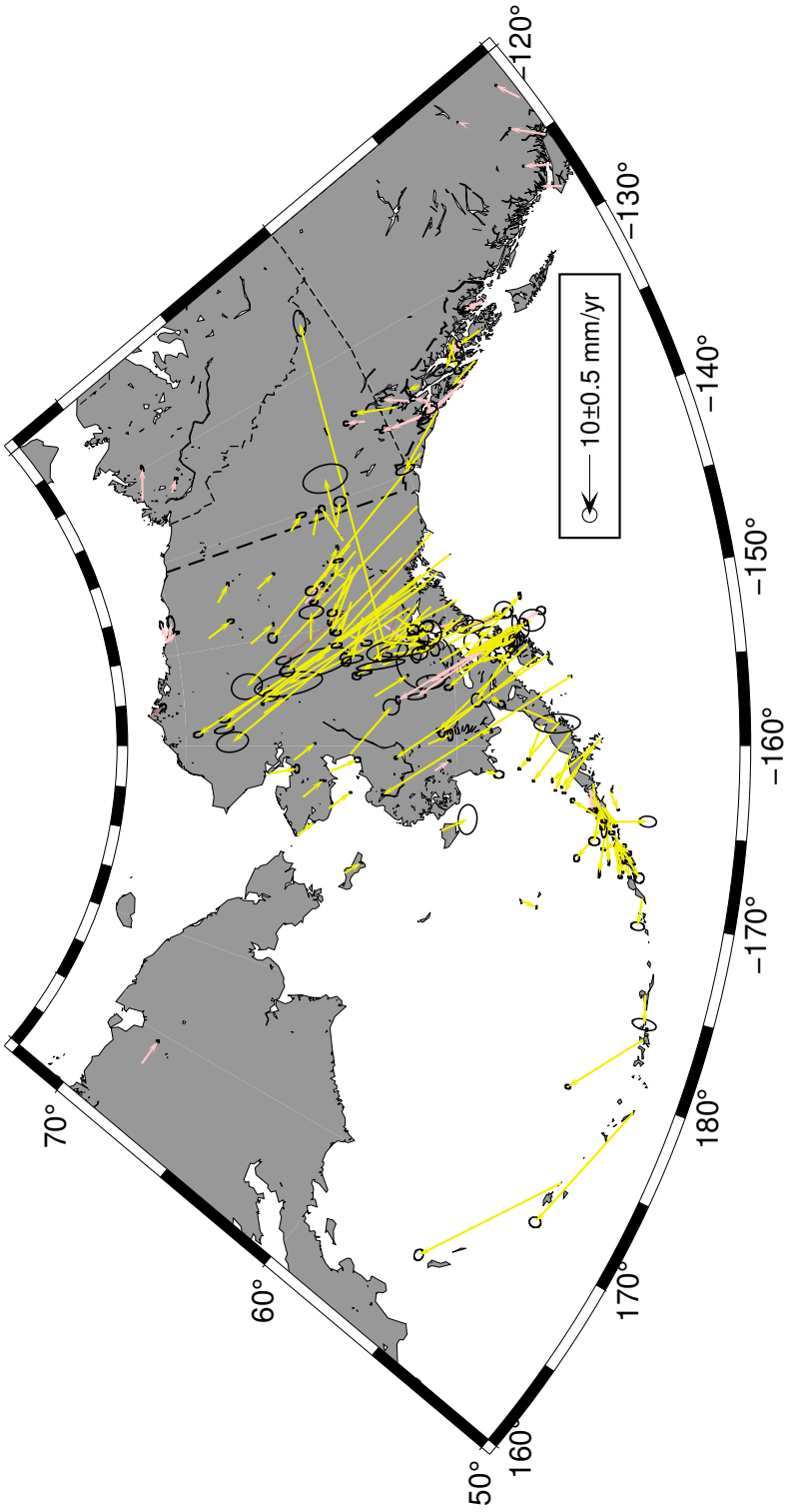


Figure 10: Same as Figure 8 except for Alaska. Only velocities with horizontal standard deviations less than 5 mm/yr are shown

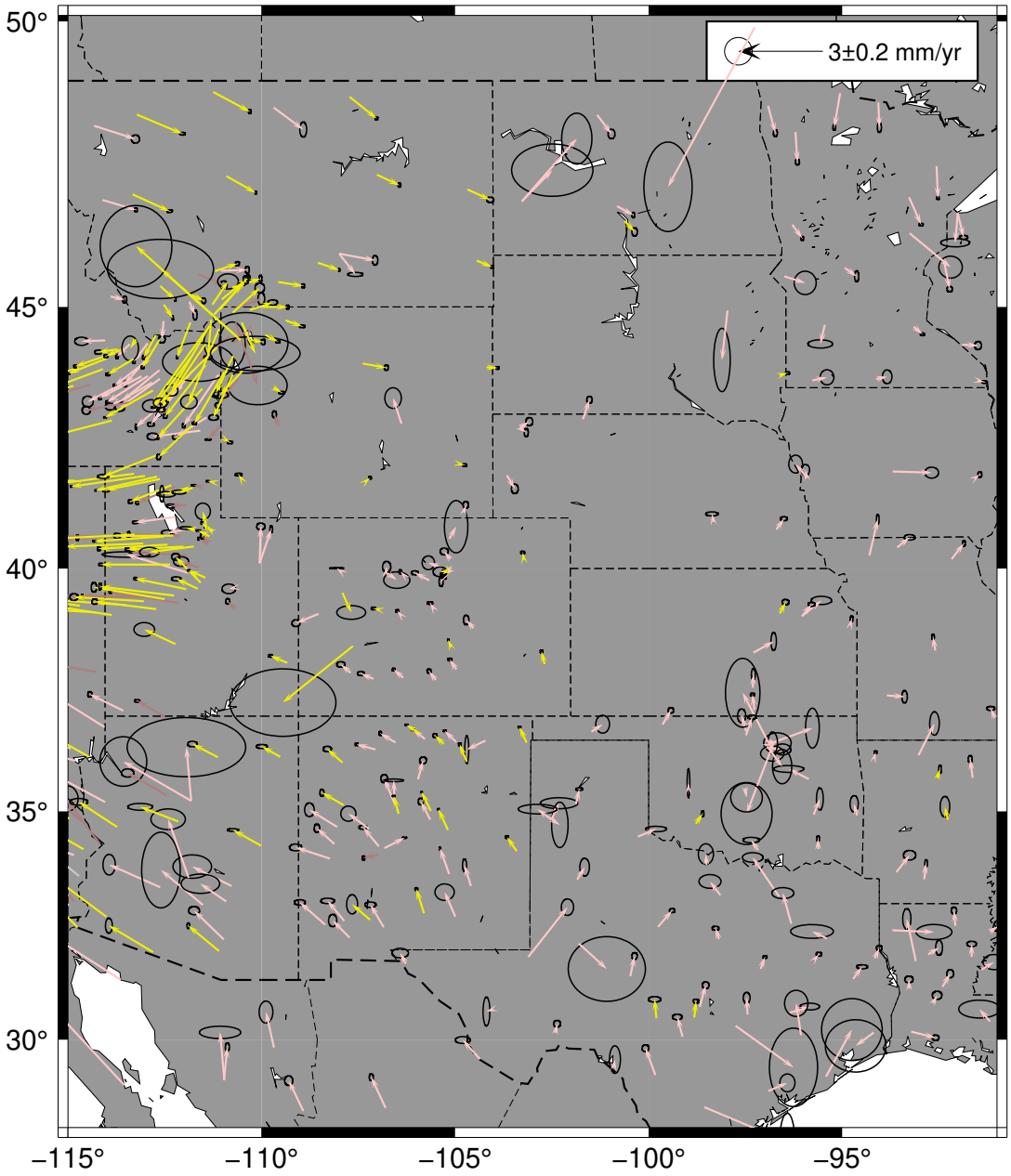


Figure 11: Same as Figure 8 except for Central United States. Only velocities with horizontal standard deviations less than 1 mm/yr are shown.

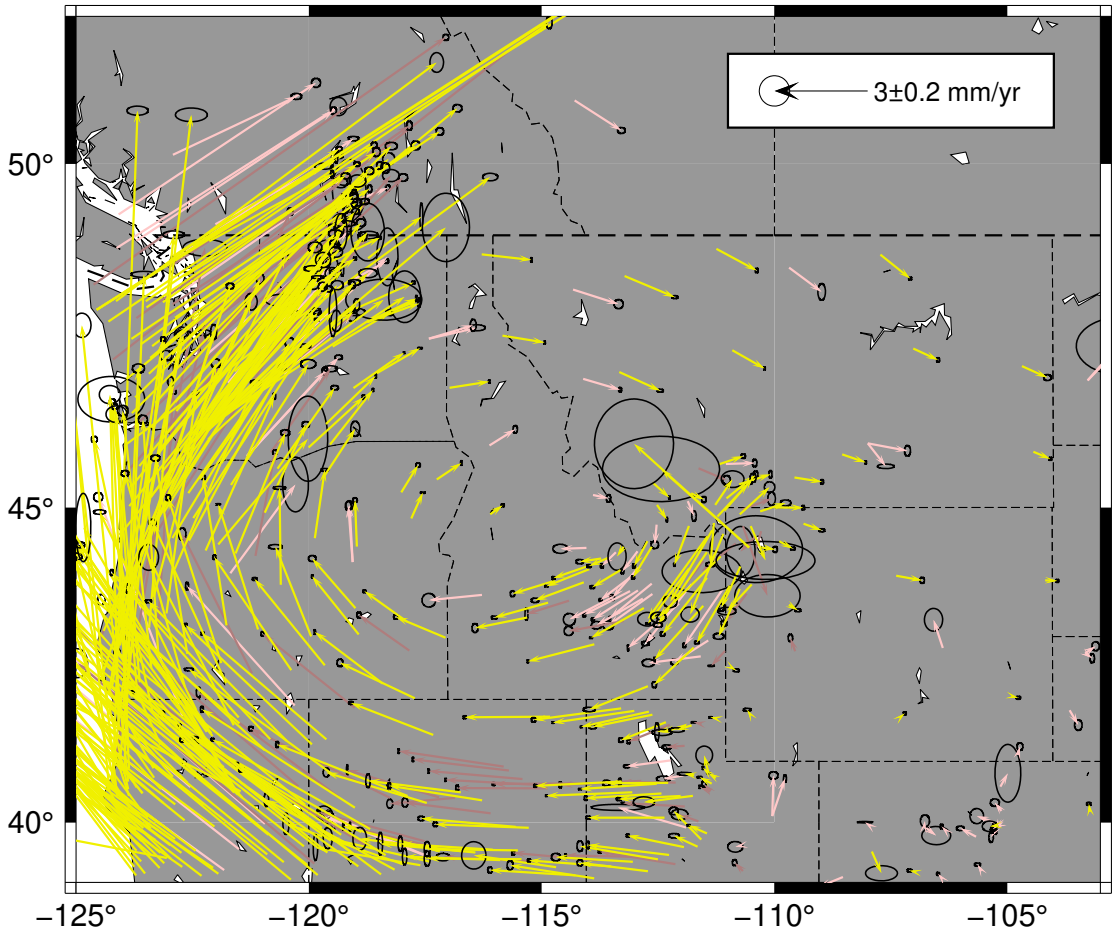


Figure 12: Same as Figure 8 except for Western Central United States. Only velocities with horizontal standard deviations less than 1 mm/yr are shown. Anomalous vectors at longitude 250° are in the Yellowstone National Park and most likely are showing volcanic processes.

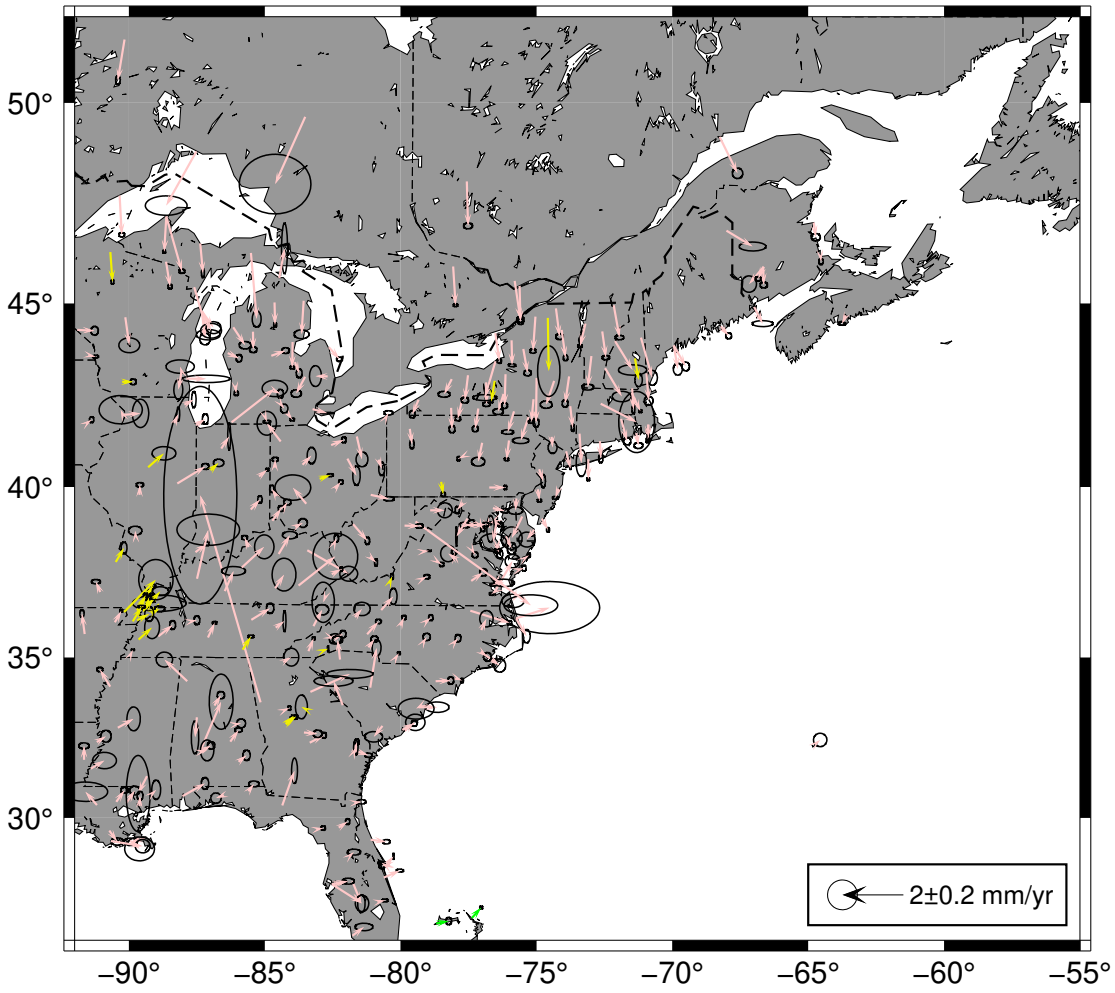


Figure 13: Same as Figure 8 except for the Eastern United States. Only velocities with horizontal standard deviations less than 2 mm/yr are shown. The systematic velocity of sites in the Northeast and central US show deviations for current GIA models in the horizontal velocities.

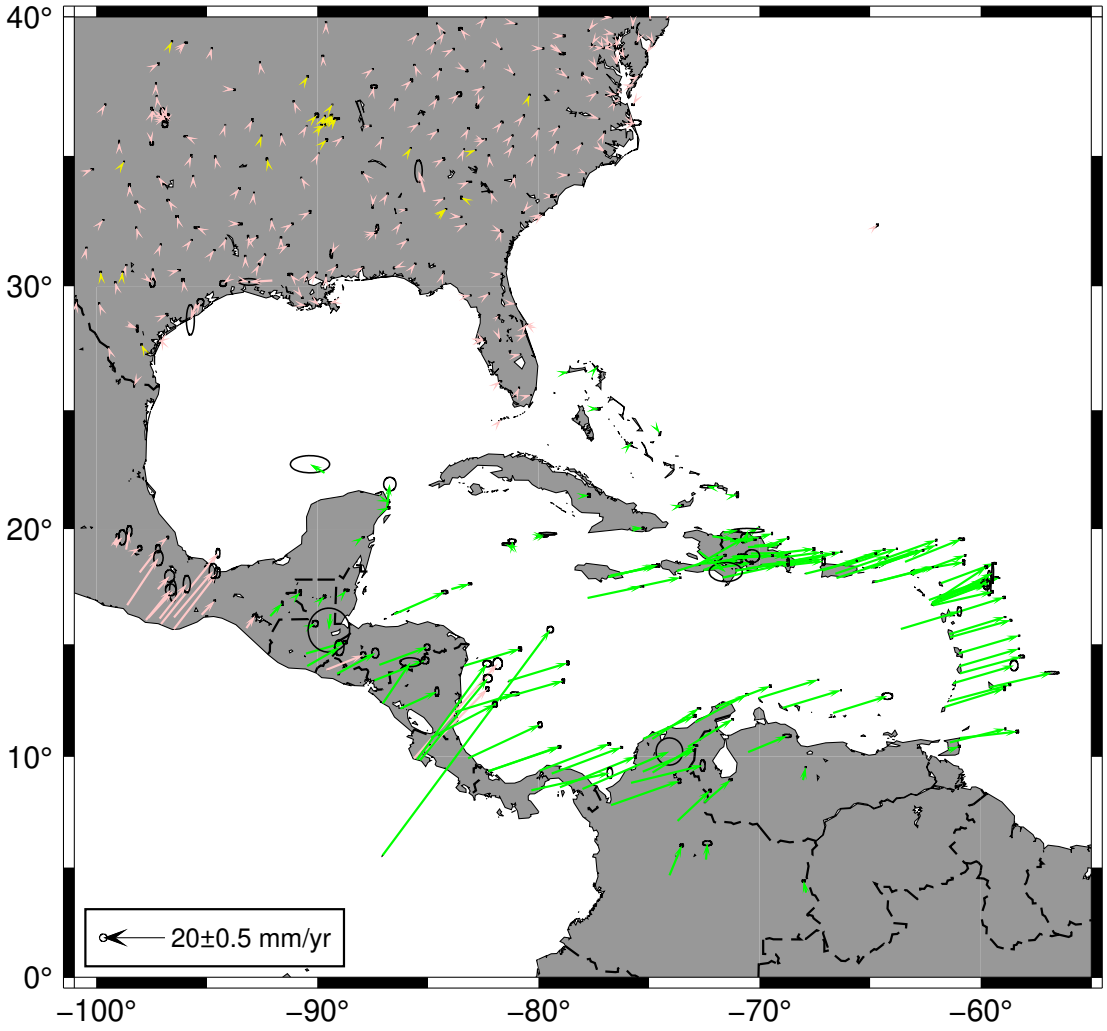


Figure 14: Same as Figure 8 except for the Caribbean region. Only velocities with horizontal standard deviations less than 5 mm/yr are shown.

Earthquake Analyses: 2024/09/15-2024/12/15

We use the NEIC catalog to search for earthquakes that could cause coseismic offsets at the sites analyzed by the GAGE analysis centers. Of the 23 earthquakes examined during this quarter, two generated co-seismic offsets greater than 1 mm, but one of them generated significant displacements at just two operating stations. The largest earthquake EQ74 ANSS(ComCat) nc75095651 mw7.0 Offshore Cape Mendocino; date and time 2024/12/05 18:45 displaced 52 stations, the largest displacement being 65 mm at station P159. The other earthquake EQ75 ANSS(ComCat) nn00888580 mw5.7 23 km NNE of

Yerington, NV; date and time 2024/12109 23:09. The largest displacement from this earthquake was 6.6 mm (P130). P134 was displaced by 1.3 mm.

Antenna and other discontinuity events.

Antenna swaps at 42 sites have been added to the list of offsets estimated when fitting velocities and other parameters to the CWU time series. These offsets were spread throughout the quarter.

Anomalous sites

The following sites have been noted as having anomalous motions during this quarter. We updated the ACC_GAGE website to show times of earthquakes, antenna changes, and offsets for unknown reasons. Plots for CWU are now generated with and without offsets (computed from the Kalman filter time series analysis) removed. The landing page for http://geoweb.mit.edu/~tah/ACC_GAGE/ now has the following explanation.

Analyses from Central Washington University (CWU). Series are:
NMT -- Old plots from New Mexico Tech Analyses (Ends 9/15/2018).
PBO -- Old plots from Combined NMT+CWU analyses (Ends 9/15/2108).
CWURAW -- Raw time series with linear trend removed
CWUOFF -- Time series with linear trend and offsets from cwu.kalts_nam14.off removed
Vertical lines denote times of offsets in time series:
Purple, solid: Earthquakes (OffEq ! EQ)
Blue, dotted: Antenna changes (Break ! AN)
Cyan, dashed: Breaks for unkown reasons (Break ! UN)

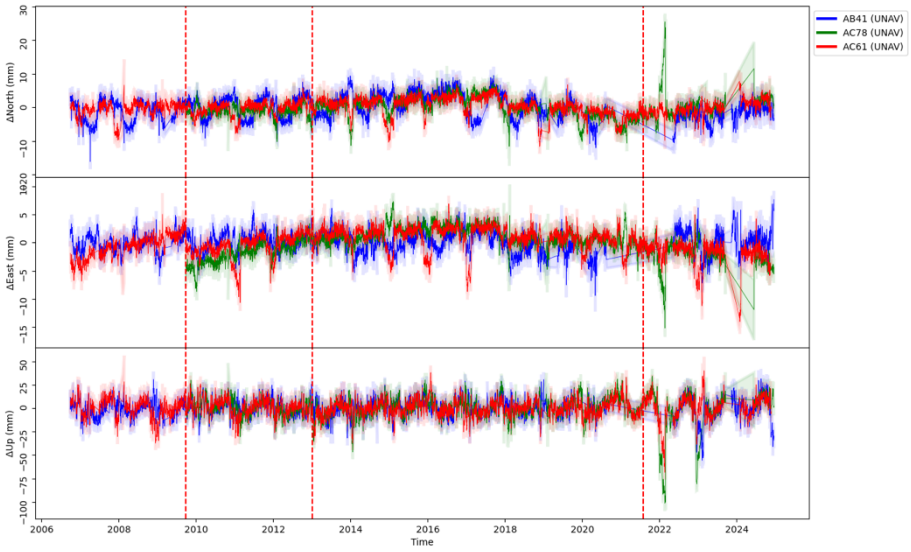
N after site name means NOTA operated site, U means UNAVCO/Earthscope log file.

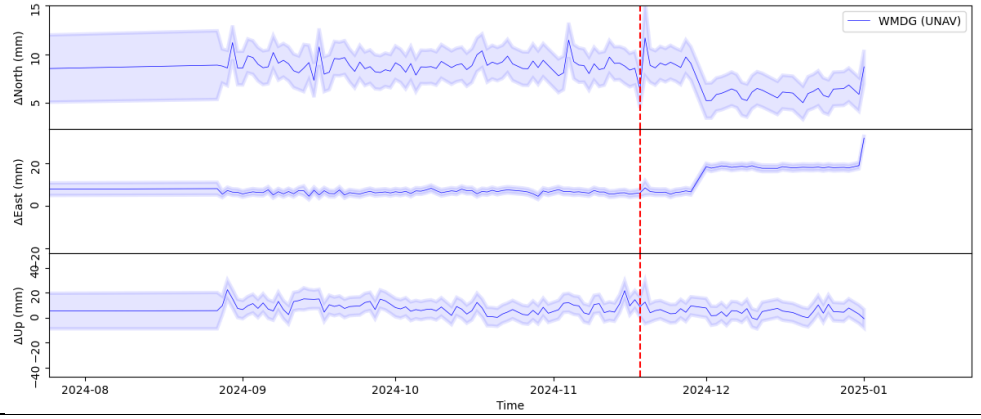
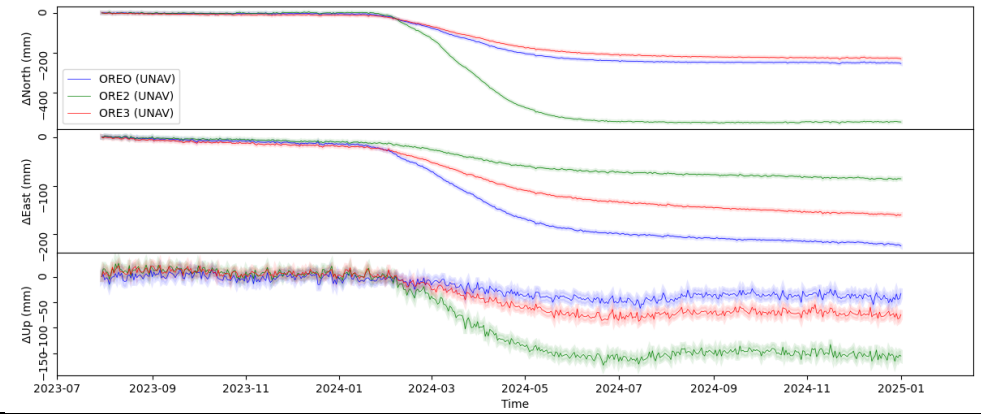
Site	N	Issues related to site
		2024-07-11
FCHO	U	Miami site, in GAGE station pages. 10 mm runoff in East. http://geoweb.mit.edu/~tah/ACC_GAGE/FCHO.CWUOFF.png
FCI2	U	Very close to FCHO. Looks like an antenna change but no update to Earthscope log. FCI1 has same type of offset (local effect or common antenna change?) http://geoweb.mit.edu/~tah/ACC_GAGE/FCI2.CWUOFF.png
KYBO		CORS site. Looks like an antenna change but no log update. http://geoweb.mit.edu/~tah/ACC_GAGE/KYBO.CWUOFF.png
		2024-07-19 Not in monthly.
P271	N	Continued poroelastic effects (see https://docs.google.com/document/d/1ecIF4wWENzKBqXBYHbUToXex8vKUYuKAV-uca8VkD8Y/edit) http://geoweb.mit.edu/~tah/ACC_GAGE/P271.CWUOFF.png
P281	N	Non-steady motions particularly in East. (No photos on station pages at the moment). http://geoweb.mit.edu/~tah/ACC_GAGE/P281.CWUOFF.png
SAJU	U	Site on west coast Costa Rica. Large postseismic but strange "noise" in mid-2023, no meta data changes.

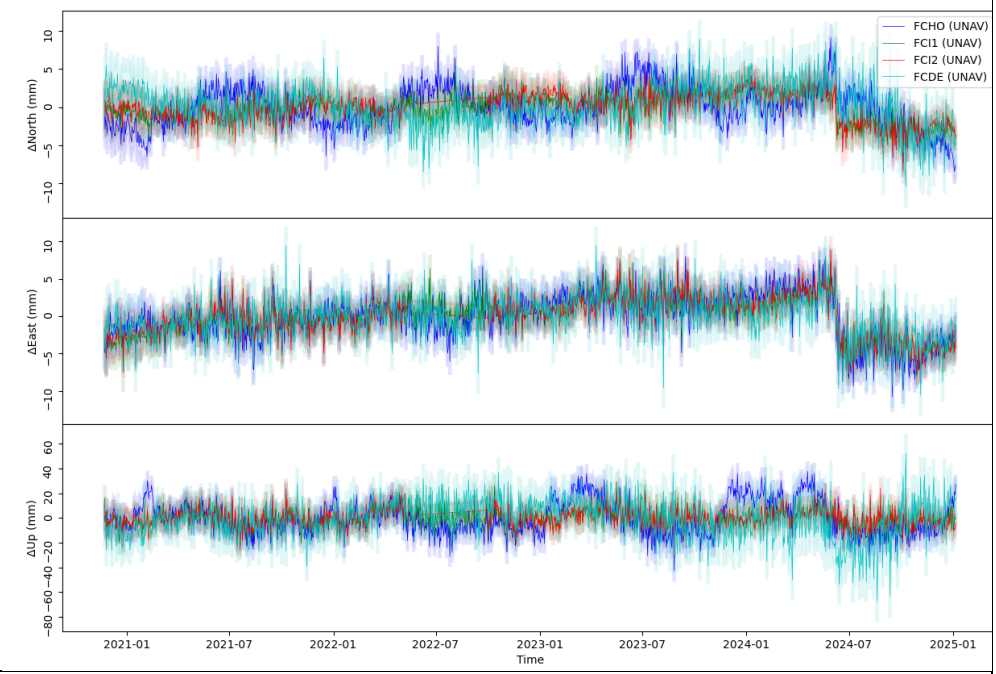
		http://geoweb.mit.edu/~tah/ACC_GAGE/SAJU.CWUOFF.png
SPRG		PANGA site in eastern WA, starting to develop annual in East component (mainly).Unknown height jump in June 2008. http://geoweb.mit.edu/~tah/ACC_GAGE/SPRG.CWUOFF.png
TBLP	U	Restart after long gap (2021). Site in central California Looks like new antenna but no metadata update. http://geoweb.mit.edu/~tah/ACC_GAGE/TBLP.CWUOFF.png
		2024-08-02
AZGB		CORS site in Arizona, Recently becoming noisy in rapids. 10 mm level systematics in time series. May be vegetation nearby (increase in easy annual.) http://geoweb.mit.edu/~tah/ACC_GAGE/AZGB.CWUOFF.png
LEPA	U	Costa Rico site with slow slip events. http://geoweb.mit.edu/~tah/ACC_GAGE/LEPA.CWUOFF.png
		2024-08-09
AC11	N	Very large long term systematics. NE of Anchorage. http://geoweb.mit.edu/~tah/ACC_GAGE/AC11.CWUOFF.png
GRNX	N	Very skewed in North. 50 mm offset in rapids. Near Denali. All photos are now missing. http://geoweb.mit.edu/~tah/ACC_GAGE/GRNX.CWUOFF.png
TTSF	N	20 mm jump in height in rapid. No meta data changes. Check later to see if persists. http://geoweb.mit.edu/~tah/ACC_GAGE/TTSF.CWUOFF.png
		2024-08-16 Not in telecon notes
ICT1		CORS site with new antenna, log file updated. http://geoweb.mit.edu/~tah/ACC_GAGE/ICT1.CWUOFF.png
		2024-08-30
P540	N	Switch to new antenna not in metadata yet. Check later to see if updated. http://geoweb.mit.edu/~tah/ACC_GAGE/P540.CWUOFF.png
CARH	U	No meta update after antenna change and gap (HUNT is the same). Also TBLP http://geoweb.mit.edu/~tah/ACC_GAGE/CARH.CWUOFF.png http://geoweb.mit.edu/~tah/ACC_GAGE/HUNT.CWUOFF.png
		2024-09-06
NGSW	U	Site in Shumagin gap, recently installed with strange outliers in Jan 2023. Seems low altitude for snow. Mostly NE outliers. Possible EQ 24/08/01 http://geoweb.mit.edu/~tah/ACC_GAGE/NGSW.CWUOFF.png
WMGD	U	Brawly seismic zone. Systematic with 2-year gap, just came back on line. Seems to OK. http://geoweb.mit.edu/~tah/ACC_GAGE/WMDG.CWUOFF.png
		2024-09-13
MC01		CORS site with new antenna. Log updated, check later. http://geoweb.mit.edu/~tah/ACC_GAGE/MC01.CWUOFF.png
P056	N	Large ground water signal, interesting differences in ling term behaviors of each component. http://geoweb.mit.edu/~tah/ACC_GAGE/P056.CWUOFF.png
		2024-09-27 Not in Telecon
AC25	N	Interesting change in rate after large earthquakes in 2020. King Cove in

		Aleutian Islands. http://geoweb.mit.edu/~tah/ACC_GAGE/AC25.CWUOFF.png
LMSG		LA Basin Site. Fitting issue with log from Ridgecrest and antenna change 2022 with large gap in data. http://geoweb.mit.edu/~tah/ACC_GAGE/LMSG.CWUOFF.png
		2024-10-04
GRZA	U	Great example of height post-seismic (Costa Rica) http://geoweb.mit.edu/~tah/ACC_GAGE/GRZA.CWUOFF.png
OBSR	U	Strange steps in time series. Site on Mt. Rainier volcano. http://geoweb.mit.edu/~tah/ACC_GAGE/OBSR.CWUOFF.png
RYMD		PANGA site near Seattle. Data quality maybe degrading? http://geoweb.mit.edu/~tah/ACC_GAGE/RYMD.CWUOFF.png
		2024-10-11
AB36	N	Just came back on line. Continues the strange North behavior. http://geoweb.mit.edu/~tah/ACC_GAGE/AB36.CWUOFF.png
		2024-10-18 Not in telecon
COON	N	Rapids are drifting away from trend in all components. Maybe starts 2024/10/07. Maybe an unknown Break 2020/03/24 in East component. Added to list. http://geoweb.mit.edu/~tah/ACC_GAGE/COON.CWUOFF.png
		2024-11-01
CAND	U	Looks like an antenna change but no new Earthscope log. http://geoweb.mit.edu/~tah/ACC_GAGE/CAND.CWUOFF.png
HEL2	U	Looks like an antenna change but no new Earthscope log. http://geoweb.mit.edu/~tah/ACC_GAGE/HEL2.CWUOFF.png
LAND	U	Same as CAND http://geoweb.mit.edu/~tah/ACC_GAGE/LAND.CWUOFF.png
NINT		PANGA site. North and East outliers in last two rapids. See if it persists. http://geoweb.mit.edu/~tah/ACC_GAGE/NINT.CWUOFF.png
P142	N	Another sites with skewed East residuals. Not obvious in other components. http://geoweb.mit.edu/~tah/ACC_GAGE/P142.CWUOFF.png
		2024-11-08
CMBB		CORS site, interior California, East of San Francisco. Looks like new antenna but no new CORS log. http://geoweb.mit.edu/~tah/ACC_GAGE/CMBB.CWUOFF.png
CVHS	U	Site in downtown LA showing large (±10 mm) east variations. Same motions seen at WCHS (2.4km), AZU1 (4.9km) and LPHS (8.0 km). VYAS may have opposite pattern (site ends 2011). Appears to be real geophysical signal. http://geoweb.mit.edu/~tah/ACC_GAGE/CVHS.CWUOFF.png
		2024-11-15
CHIL	U	Problem with meta data update. Was updated but now is not (switching back and forth). http://geoweb.mit.edu/~tah/ACC_GAGE/CHIL.CWUOFF.png
P360	N	Antenna change: Should be OK but check later. http://geoweb.mit.edu/~tah/ACC_GAGE/P360.CWUOFF.png

PHLP	U	Antenna change. Some finals processing before meta data update. http://geoweb.mit.edu/~tah/ACC_GAGE/PHLB.CWUOFF.png
PUPU	U	PANGA site. Large error bars and gaps in recent rapids. http://geoweb.mit.edu/~tah/ACC_GAGE/PUPU.CWUOFF.png
		2024-11-22 Not in telecon (telecon not held)
CBIA		Newer Alaskan station but very systematic. Earthscope log. http://geoweb.mit.edu/~tah/ACC_GAGE/CBIA.CWUOFF.png
IDPO		Panga site with outdated log (used CORS log). Two unknown breaks in time series. http://geoweb.mit.edu/~tah/ACC_GAGE/IDPO.CWUOFF.png
		2024-11-29
CCCC	N	Great Ridgecrest postseismic especially in East. http://geoweb.mit.edu/~tah/ACC_GAGE/CCCC.CWUOFF.png
GSC1		CORS sites, maybe new antenna but no log update yet. http://geoweb.mit.edu/~tah/ACC_GAGE/GSC1.CWUOFF.png
GZKA	U	Southern California, relatively new site with outliers. http://geoweb.mit.edu/~tah/ACC_GAGE/GZKA.CWUOFF.png
MC08		CORS site in Colorado. Height outlier, could be snow. http://geoweb.mit.edu/~tah/ACC_GAGE/MC08.CWUOFF.png
SCH2		IGS site, most likely snow. http://geoweb.mit.edu/~tah/ACC_GAGE/SCH2.CWUOFF.png
SE01		CORS site in Colorado; snow likely. http://geoweb.mit.edu/~tah/ACC_GAGE/SE01.CWUOFF.png
USGC	U	Site west of Salton sea, clear change in velocity after El Mayor earthquake (ANSS(ComCat) ci14607652) http://geoweb.mit.edu/~tah/ACC_GAGE/USGC.CWUOFF.png
WWFG	U	New antenna after gap since 2020. Site east of Salton Sea. Should be OK with metadata update. http://geoweb.mit.edu/~tah/ACC_GAGE/WWFG.CWUOFF.png
		2024-12-05
AV02	N	Snow but strong curvature is N and E. AV01 similar. http://geoweb.mit.edu/~tah/ACC_GAGE/AV02.CWUOFF.png
LAND +	U	New antenna but no metadata update in logfile. Same at HUNT (opposite sign H change), CAND, CARH (-dH) http://geoweb.mit.edu/~tah/ACC_GAGE/LAND.CWUOFF.png
		2024-12-17
HOTK	U	Mammoth Lakes site. Recent East changes (had been tracking nearby P646; Started to deviate May 2023. http://geoweb.mit.edu/~tah/ACC_GAGE/HOTK.CWUOFF.png
IDIF		Site in Idaho; CORS site; looks like new antenna but not new log. Single outlier point. http://geoweb.mit.edu/~tah/ACC_GAGE/IDIF.CWUOFF.png
OLVN	Y	Site on Monserrat, Strongly skewed. http://geoweb.mit.edu/~tah/ACC_GAGE/OLVN.CWUOFF.png
P058 P158 P159	N	Coseismic offset from EQ74 ANSS(ComCat) nc75095651 mw7.0 Offshore Cape Mendocino 2024/12/05 18:45. See P158 for different effect on day of earthquake. (Many other sites affected). http://geoweb.mit.edu/~tah/ACC_GAGE/P058.CWUOFF.png

		http://geoweb.mit.edu/~tah/ACC_GAGE/P158.CWUOFF.png http://geoweb.mit.edu/~tah/ACC_GAGE/P159.CWUOFF.png
P187	N	Noise level slowly increasing. Growing Tree? Seems to have pine forest nearby. http://geoweb.mit.edu/~tah/ACC_GAGE/P187.CWUOFF.png
P312	N	Also seems to have growing trees. http://geoweb.mit.edu/~tah/ACC_GAGE/P312.CWUOFF.png
P319	N	Large quadratic in North, not seen at nearby sites. http://geoweb.mit.edu/~tah/ACC_GAGE/P319.CWUOFF.png
P338	N	Skewed but not clear why in photos although terrain does look steep. http://geoweb.mit.edu/~tah/ACC_GAGE/P338.CWUOFF.png
P385	N	Site in Willamette National Forest (nearby P383 does not show anomaly). http://geoweb.mit.edu/~tah/ACC_GAGE/P385.CWUOFF.png
PTSG	U	Unknown break added 2021/03/11 (no equipment change in log). http://geoweb.mit.edu/~tah/ACC_GAGE/PTSG.CWUOFF.png
		2024-12-20 Not in telecon
AB41	N	Interesting systematics with AC61 (100km) and AC78 (2000km) away. Common signals but with winter differences. Central Alaska, near Yukon and Canadian border.  http://geoweb.mit.edu/~tah/ACC_GAGE/AB41.CWUOFF.png
P314	N	Nevada earthquake EQ75 ANSS(ComCat) nn00888580 mw5.7 23 km NNE of Yerington, NV; date and time 2024/12/09 23:09 http://geoweb.mit.edu/~tah/ACC_GAGE/P314.CWUOFF.png
P618	N	Short lived outlier in East (maybe missing data). Nice Ridgecrest post-seismic signal. North-East of Barstow. http://geoweb.mit.edu/~tah/ACC_GAGE/P618.CWUOFF.png
PRX5		East outliers and general lose of quality since 2021. Near Boulder CO. Sites stop being in Earthscope csv files at end of 2023. (Date quality is poor) http://geoweb.mit.edu/~tah/ACC_GAGE/PRX5.CWUOFF.png
		2024-12-27

P181	N	Large error bars on station for some time now. http://geoweb.mit.edu/~tah/ACC_GAGE/P181.CWUOFF.png
		2025-01-03
MHTL		Site on Mt. Hood (1750 m height). Likely snow but bigger than previous years. http://geoweb.mit.edu/~tah/ACC_GAGE/MHTL.CWUOFF.png
NRWY	U	Yellowstone site; Looks like an antenna change nearby site NBWY has no offset so likely not snow. http://geoweb.mit.edu/~tah/ACC_GAGE/NRWY.CWUOFF.png
P156	N	Gap after last earthquake in Mendocino triple junction area so shows up now. P165 25 km away may show aftershock North offset but no earthquake yet detected. https://geoweb.mit.edu/~tah/ACC_GAGE/P156.CWUOFF.png
P794	N	Bent monument, added XPS to remove data and new break at 2023 05 29. https://geoweb.mit.edu/~tah/ACC_GAGE/P794.CWUOFF.png
RBRU		CalTrans site RBRU (near Fresno). Likely tree removed. SOPAC log. https://geoweb.mit.edu/~tah/ACC_GAGE/RBRU.CWUOFF.png
WMDG	U	Looks like antenna change date is wrong (2024/11/30 not 2024/11/18). https://geoweb.mit.edu/~tah/ACC_GAGE/WMDG.CWUOFF.png 
HAR7	U	Site neat Barstow CA. Jump in height (new antenna?); no new log. https://geoweb.mit.edu/~tah/ACC_GAGE/HAR7.CWUOFF.png
OREO	U	ORE2 and ORE3 sites NE of San Jose with large creep events in both NE and height. https://geoweb.mit.edu/~tah/ACC_GAGE/OREO.CWUOFF.png 

		2025-01-10
ACHO	N	Newer NOTA site in Panama (UNR back to 2012 but ends 10/2024). Slow slip events. https://geoweb.mit.edu/~tah/ACC_GAGE/ACHO.CWUOFF.png
CAGS		IGS site near Ottawa CA. Snow but interesting exclusion in East in mid-2024 and mid-2008. https://geoweb.mit.edu/~tah/ACC_GAGE/CAGS.CWUOFF.png
CLHQ	U	Site near Crater Lake. East in seasonal with snow. https://geoweb.mit.edu/~tah/ACC_GAGE/CLHQ.CWUOFF.png
FCHO	U	Sites in Miami on coast. FCI1, FCI2 (<1.5 km away) and FCDE (40km) show east in anomaly in June 2024. https://geoweb.mit.edu/~tah/ACC_GAGE/FCHO.CWUOFF.png 
KYTG		CORS site In Kentucky. Looks like antenna change but no new meta data (KYTK, KYTL are similar (check later to see if snow). https://geoweb.mit.edu/~tah/ACC_GAGE/KYTG.CWUOFF.png https://geoweb.mit.edu/~tah/ACC_GAGE/KYTK.CWUOFF.png https://geoweb.mit.edu/~tah/ACC_GAGE/KYTL.CWUOFF.png
P804	N	Site in Ohio, seems to be failing. (P805/P806 monument test) https://geoweb.mit.edu/~tah/ACC_GAGE/P804.CWUOFF.png
WLHG	U	Very systematic but P573 8 km away does not show same behavior. Site in Sierra Nevada mountains east of Potterville. https://geoweb.mit.edu/~tah/ACC_GAGE/WLHG.CWUOFF.png
WVOH		CORS site Kentucky. Could be snow. Check later. https://geoweb.mit.edu/~tah/ACC_GAGE/WLHG.CWUOFF.png

GNSS Rapid processing

Since 2021/10/20, CWU has generated a combined GPS and Galileo rapid solution because JPL has made available orbit and clock files from a global GPS and Galileo solution. These solutions are experimental, and for a number of sites, there are systematic mean differences in position between the GPS-only and the combined solutions. For this reason, these combined solutions are not distributed through the EarthScope GAGE products portal. Initially, there were inconsistencies in the GPS-only and combined analyses (e.g., elevation angle cutoff) that affected the comparison of the results, specifically when comparing mean positions and WRMS scatters of the fits to linear trends. Starting on 2024/03/26, these inconsistencies were resolved and since that time, a direct comparison of the GPS-only and combined GPS and Galileo solutions is possible. Results of the comparisons are reported daily to the GAGE_ACS email list. With nine months of consistently processed results available, we compare the results below. The current analysis used 867 stations with up to 275 days of comparison. The median NEU scatters for the GPS+GAL solutions are 0.89, 0.89, and 4.94 mm. The corresponding values from the common GPS-only solutions are 0.97, 0.95, and 5.21 mm, slightly larger than those from the GPS+GAL solution.

Table 4: Mean differences between GPS-only and GPS+Galileo rapid solutions. Differences are taken as GPS+GAL minus GPS-only position estimates. The largest 10 positive and negative differences in Up, North, and East are shown. The sig column is the standard deviation of the mean (assuming white noise statistics), wrms is the weighted root-mean-square scatter about the mean, and nrms is the normalized root mean square ($\sqrt{\chi^2/f}$).

CWU GNSSR Analysis Tue Jan 7 22:23:48 EST 2025

Stat	enu	#	MeanDiff (mm)	sig (mm)	wrms (mm)	nrms	Receiver	Antenna	Radome
FLIN	U	275	−14.61	0.12	2.06	0.23	SEPT POLARX5	NOV750.R4	NOVS
SASK	U	275	−13.49	0.14	2.34	0.27	JAVAD TRE_G3TH DELTA	NOV750.R4	NOVS
ARBT	U	274	−9.46	0.29	4.80	0.52	TRIMBLE NETR9	TRM115000.00	NONE
PTRF	U	226	−8.57	0.29	4.31	0.44	SEPT POLARX5S	SEPCHOKE_B3E6	SPKE
HDIL	U	100	−7.53	0.63	6.33	0.52	SEPT POLARX5	TRM59800.80	SCIT
1LSU	U	221	−7.52	0.42	6.23	0.56	TRIMBLE ALLOY	TRM115000.00	NONE
MHMS	U	273	−6.76	0.21	3.42	0.34	SEPT POLARX5	TWIVC6050	SCIT
VDCY	U	275	−6.19	0.26	4.39	0.40	SEPT POLARX5	TRM59800.99	SCIT
P776	U	275	−6.15	0.26	4.32	0.46	SEPT POLARX5	TRM59800.80	SCIT
SELD	U	270	−5.87	0.26	4.30	0.45	SEPT POLARX5	TRM159800.00	SCIT
....									
CHZZ	U	274	6.38	0.46	7.55	0.54	TRIMBLE NETR9	TRM59800.80	SCIT
NWCC	U	2	6.92	6.23	4.28	0.49	SEPT POLARX5	SEPPOLANT_X_MF	NONE
ARML	U	257	7.15	0.23	3.74	0.41	SEPT POLARX5	SEPPOLANT_X_MF	NONE
HCES	U	55	7.49	0.59	4.35	0.48	SEPT POLARX5	SEPPOLANT_X_MF	NONE
LCHS	U	243	7.82	0.26	4.09	0.44	SEPT POLARX5	SEPPOLANT_X_MF	NONE
P385	U	275	9.61	0.52	8.65	0.87	SEPT POLARX5	TRM59800.80	SCIT
MCTY	U	243	9.74	0.30	4.74	0.50	SEPT POLARX5	SEPPOLANT_X_MF	NONE
P156	U	205	10.37	1.07	15.38	0.94	SEPT POLARX5	TRM59800.80	SCIT
P312	U	272	12.76	2.30	37.94	1.16	TRIMBLE NETR9	TRM59800.80	SCIT
COLA	U	274	17.67	0.84	13.90	1.45	TRIMBLE ALLOY	TRM55971.00	NONE

Stat	enu	#	MeanDiff (mm)	sig (mm)	wrms (mm)	nrms	Receiver	Antenna	Radome
LONG	N	272	−3.34	0.21	3.51	1.19	SEPT POLARX5	TWIVC6050	SCPL
COLA	N	274	−2.48	0.10	1.64	0.75	TRIMBLE ALLOY	TRM55971.00	NONE
P669	N	275	−1.64	0.05	0.83	0.31	SEPT POLARX5	TWIVC6050	SCIS
AB48	N	5	−1.56	1.43	1.20	0.38	SEPT POLARX5	TRM29659.00	SCIT
SELD	N	270	−1.54	0.06	1.03	0.35	SEPT POLARX5	TRM159800.00	SCIT
AB18	N	274	−1.53	0.05	0.78	0.27	SEPT POLARX5	TRM59800.99	SCIT

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AV02   N  125    -1.51    0.07   0.76   0.26 SEPT POLARX5         TRM159800.00     SCIT
P033   N  274    -1.51    0.13   2.12   0.87 TRIMBLE NETR9        TRM59800.80      SCIT
AB11   N  241    -1.48    0.07   1.02   0.37 SEPT POLARX5         TRM59800.99      SCIT
P224   N  273    -1.47    0.05   0.90   0.36 TRIMBLE NETR9        TRM59800.00      SCIT
....
GOLD   N  275     1.26    0.03   0.46   0.21 JAVAD TRE_G3TH DELTA AOAD/M_T          NONE
P794   N  191     1.26    0.04   0.50   0.22 SEPT POLARX5         TRM59800.00      SCIT
P776   N  275     1.27    0.05   0.81   0.33 SEPT POLARX5         TRM59800.80      SCIT
KYMH   N  252     1.32    0.08   1.20   0.53 TRIMBLE NETR3        TRM57971.00      NONE
GODE   N  260     1.45    0.04   0.66   0.29 SEPT POLARX5TR       AOAD/M_T         JPLA
P215   N  247     1.45    0.07   1.05   0.42 SEPT POLARX5         TRM59800.80      SCIT
OSPA   N  274     1.80    0.08   1.35   0.55 SEPT POLARX5         TWIVC6150        SCIS
P252   N   53     2.28    0.20   1.49   0.65 TRIMBLE NETR9        TRM29659.00      SCIT
P156   N  205     2.90    0.19   2.72   0.72 SEPT POLARX5         TRM59800.80      SCIT
P385   N  275     3.16    0.15   2.56   0.95 SEPT POLARX5         TRM59800.80      SCIT

Stat enu    # MeanDiff    sig    wrms   nrms Receiver             Antenna         Radome
                (mm)       (mm)   (mm)
CAT3   E  274    -3.09    0.54   8.90   1.13 TRIMBLE ALLOY        TRM59800.80      SCIT
P669   E  275    -1.83    0.05   0.90   0.38 SEPT POLARX5         TWIVC6050        SCIS
P187   E  275    -1.82    0.17   2.89   0.93 SEPT POLARX5         TRM59800.99      SCIT
TFNO   E  126    -1.50    0.07   0.74   0.33 SEPT POLARX5         SEPCHOKE_B3E6    SPKE
KVTX   E  275    -1.42    0.04   0.73   0.35 SEPT POLARX5         TRM59800.99      SCIT
RDF2   E   74    -1.42    0.18   1.51   0.55 TRIMBLE NETR9        TRM57971.00      NONE
RG08   E  275    -1.29    0.14   2.28   1.06 SEPT POLARX5         TRM59800.99      SCIT
AB48   E    5    -1.24    0.90   0.68   0.34 SEPT POLARX5         TRM29659.00      SCIT
P011   E  273    -1.23    0.05   0.76   0.39 SEPT POLARX5         TRM59800.80      SCIT
P051   E  274    -1.23    0.03   0.50   0.27 SEPT POLARX5         TRM59800.00      SCIT
....
SPT0   E  274     1.23    0.04   0.74   0.43 SEPT POLARX5TR       TRM59800.00      OSOD
KIR0   E  274     1.29    0.04   0.72   0.39 SEPT POLARX5         JAVRINGANT_DM    OSOD
P505   E  255     1.30    0.19   3.10   1.55 TRIMBLE NETR9        TRM59800.80      SCIT
KOKB   E  155     1.31    0.10   1.20   0.60 SEPT POLARX5TR       ASH701945G_M     NONE
P740   E  266     1.38    0.09   1.47   0.59 SEPT POLARX5         TRM59800.99      SCIT
VIS0   E  273     1.38    0.05   0.78   0.45 SEPT POLARX5         AOAD/M_T         OSOD
ONSA   E  273     1.43    0.05   0.80   0.46 SEPT POLARX5TR       AOAD/M_B         OSOD
NDAP   E  274     2.05    0.18   3.00   1.54 TRIMBLE NETR9        TRM59800.80      SCIT
EGAN   E  274     2.20    0.20   3.26   1.69 TRIMBLE NETR9        TRM59800.80      SCIS
P191   E  275     3.80    0.28   4.72   2.51 TRIMBLE NETR9        TRM59800.80      SCIT
```

ANET Processing

The ANET additional sites are being processed as a separate network, and the frame-resolved SINEX files will be given in the Antarctica 2014 reference frame (Altamimi *et al.,* 2016, 2017). We label this frame ant14. Time series and SINEX files are generated only for final orbit solutions and are labeled as fanet (instead of final to avoid name conflicts with loose solutions). The IGS14 loose submission files are labeled with "lse14" to differentiate them for the IGS08 loose submissions, which were labeled as loose. The statistics of the time series fits from the CWU solution for this quarter are given in Table 5.

Table 5: Statistics of the fits of 45 stations in the ANET region for CWU analyzed in the final orbit analysis between September 15, 2024 and December 21, 2024.

CWU	North (mm)	East (mm)	Up (mm)
Median			

ANET 70%	1.40	1.19	5.78
ANET 95%	1.67	1.58	7.61
ANET	3.17	2.49	9.52

The histograms of the RMS scatter in NEU of the results for this quarter are shown in Figure A.1

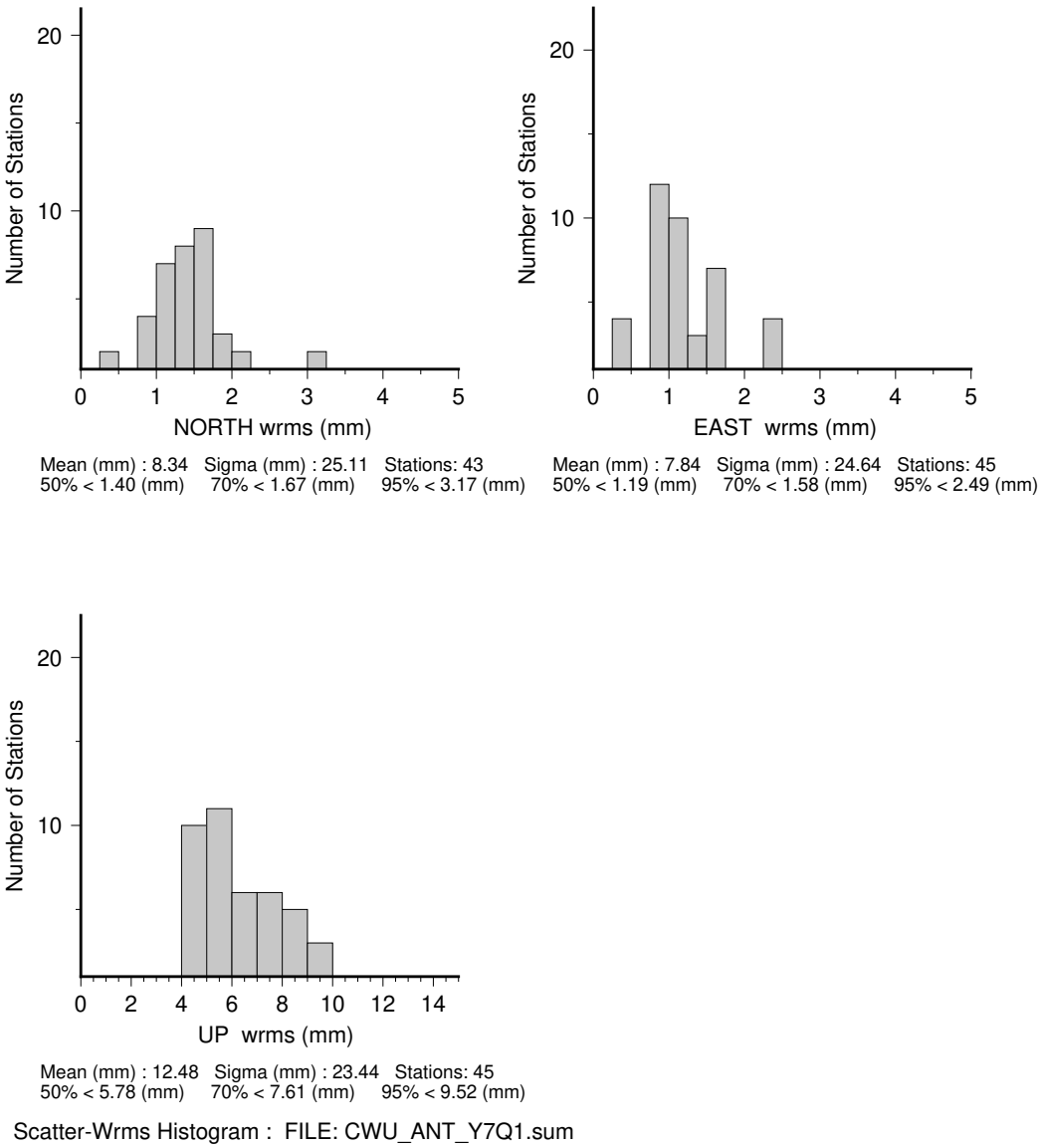

Figure A.1: CWU solution histograms of the North, East and Up RMS scatters of the position residuals for 45 stations in Antarctica analyzed between September

15, 2024 and December 21, 2024. Linear trends and annual signals were estimated from the time series.

References

Altamimi, Z., P. Rebischung, L. Metivier, and X. Collilieux (2016), ITRF2014: A new release of the International Terrestrial Reference Frame modeling nonlinear station motions, *J. Geophys. Res. Solid Earth*, 121, 6109-6131, doi: 10.1002/2016JB013098.

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