Quarterly Report
Massachusetts Institute of Technology
GAGE Facility GPS Data Analysis Center Coordinator
And
GAGE Facility GAMIT/GLOBK Community Support

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Period: 2014/04/01-2014/06/30

Table of Contents

Summary

Under the GAGE Facility Data Analysis subcontract, MIT has been combining results from the New Mexico Tech (NMT) and Central Washington University (CWU). In this report, we show analyses of the data processing for the period 03/15/2014 to 06/14/2014, time series velocity field analyses for the GAGE mostly new CWU reprocessing analyses (1996-2014), earthquake effects during the interval (2 detectable events), comparison between results from the previous quarter, and an analysis of the ambiguity resolution issue in the Central Washington reprocessing results. We have shifted the analysis interval compared to the last two quarters to ensure that we capture the final analysis results in the report. Because the quarterly reports are due near the start of the month and the data used in the finals processing has an age between 2-3 weeks, early in the month the finals results the last two weeks of the previous month are not available. For this quarter the last finals results were for June 14, 2014. Associated with the report are ASCII text files that are linked into this document.

Under the GAGE Facility GAMIT/GLOBK Community Support we report on activities during this quarter.

GPS Analysis of Level 2a and 2b products

Level 2a products: Rapid products

Final and rapid level 2a products have been generated routinely during this quarter. 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 IGS orbits. The description of these products, the delivery schedule and the delivery list remain unchanged from the previous quarter and will not be reported here. Data volumes being transferred also remains the same since the average number of sites is about the same. In this quarter 1837 sites were processed compared to 1847 for the previous quarter.

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 the ACs. The delivery schedule for these products is also unchanged. All supplement products are now up to date and have been transmitted to the UNAVCO GAGE archive. The 12-week and 26-week supplemental time series are included with the finals time series since the orbit used for these solutions is the IGS final orbit. (The rapid solution uses the IGS rapid orbit solution and these are replaced with final orbit solutions when the final orbits become available.)

Analysis of Final products: March 15, 2014 and June 14, 2014

Each month, we submit reports of the statistics of the PBO combined analyses and estimates of the latest velocity fields in the NAM08 reference frame based on the time series analysis of data between 2004 and month preceding the report (we need to allow 2-3 weeks for the generation of the final products). For this report, we generated the statistics using the ~3 months of results generated between March 15, 2014 and June 14, 2014. These results are summarized in table 1 and figures 1-3.

For the three months of the final position time series generated by NMT, CWU and combination of the two (PBO), we fit linear trends and annual signals and compute the RMS scatters of the position residuals in north, east and up for each site in the analysis. Our first analysis of the distribution of these RMS scatters by analysis center and the combination. Table 1 shows the median (50%), 70% and 95% limits for the RMS scatters for PBO, NMT and CWU. The median horizontal RMS scatters are less than 1.2 mm for all centers and as low as 0.8 mm for NMT and PBO north component. The up RMS scatters are less than 4.8 mm and as low as 3.9 mm. These statistics are improved over the previous quarter especially for CWU. It is encouraging to see that in heights, the combined solution has smaller WRMS than either of the two input series. In the NAM08 frame realization, scale changes are not estimated. If scale changes were estimated, the up scatter would be reduced but the sum of scale change RMS and the lower height scatter would equal the values shown in Table 1. The detailed histograms of the RMS scatters are shown in Figures 1-3 for PBO, NMT and CWU.

Table 1: Statistics of the fits of 1863 sites for PBO and 1862 each for NMT and CWU analyzed in the finals analysis between March 15, 2014 and June 14, 2014. (Finals are run 1-2 weeks behind current date and at the beginning of the month not all all data from the previous month have been processed. PBO is the combined solution. Histograms of the RMS scatters are shown in Figure 1-3.

Center	North (mm)	East (mm)	Up (mm)
Median (50%)			
PBO	0.8	0.9	3.9
NMT	0.8	0.9	4.2
CWU	1.1	1.2	4.8
70%			
PBO	1.0	1.1	4.3
NMT	1.0	1.1	4.7
CWU	1.3	1.4	5.5
95%			
PBO	1.8	1.9	6.1
NMT	1.7	1.9	6.2
CWU	2.4	2.3	8.3

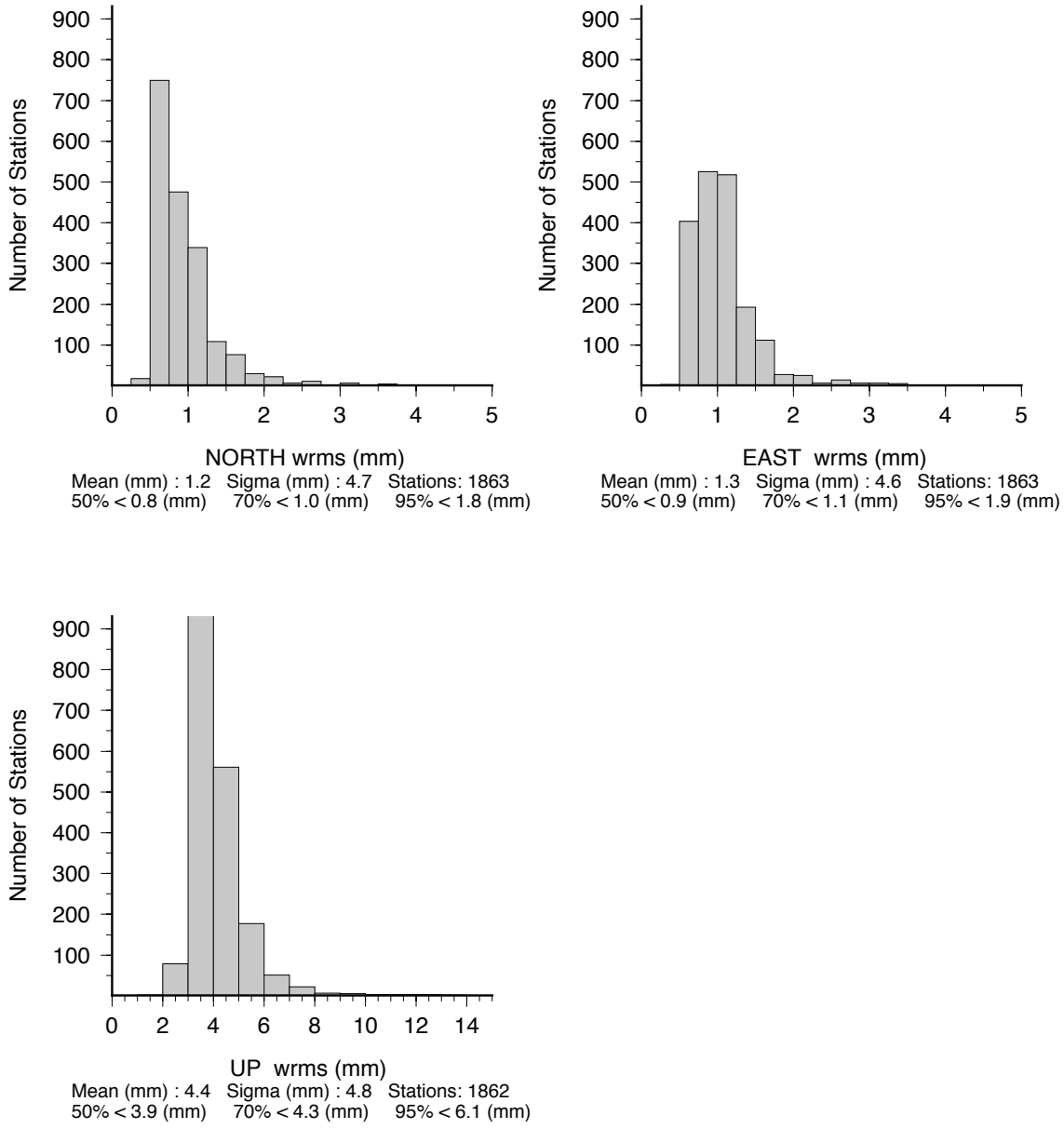

Figure 1: PBO combined solution histograms of the North, East and Up RMS scatters of the position residuals for 1837 sites analyzed between March 15, 2014 and June 14, 2014. Linear trends and annual signals were estimated from the time series.

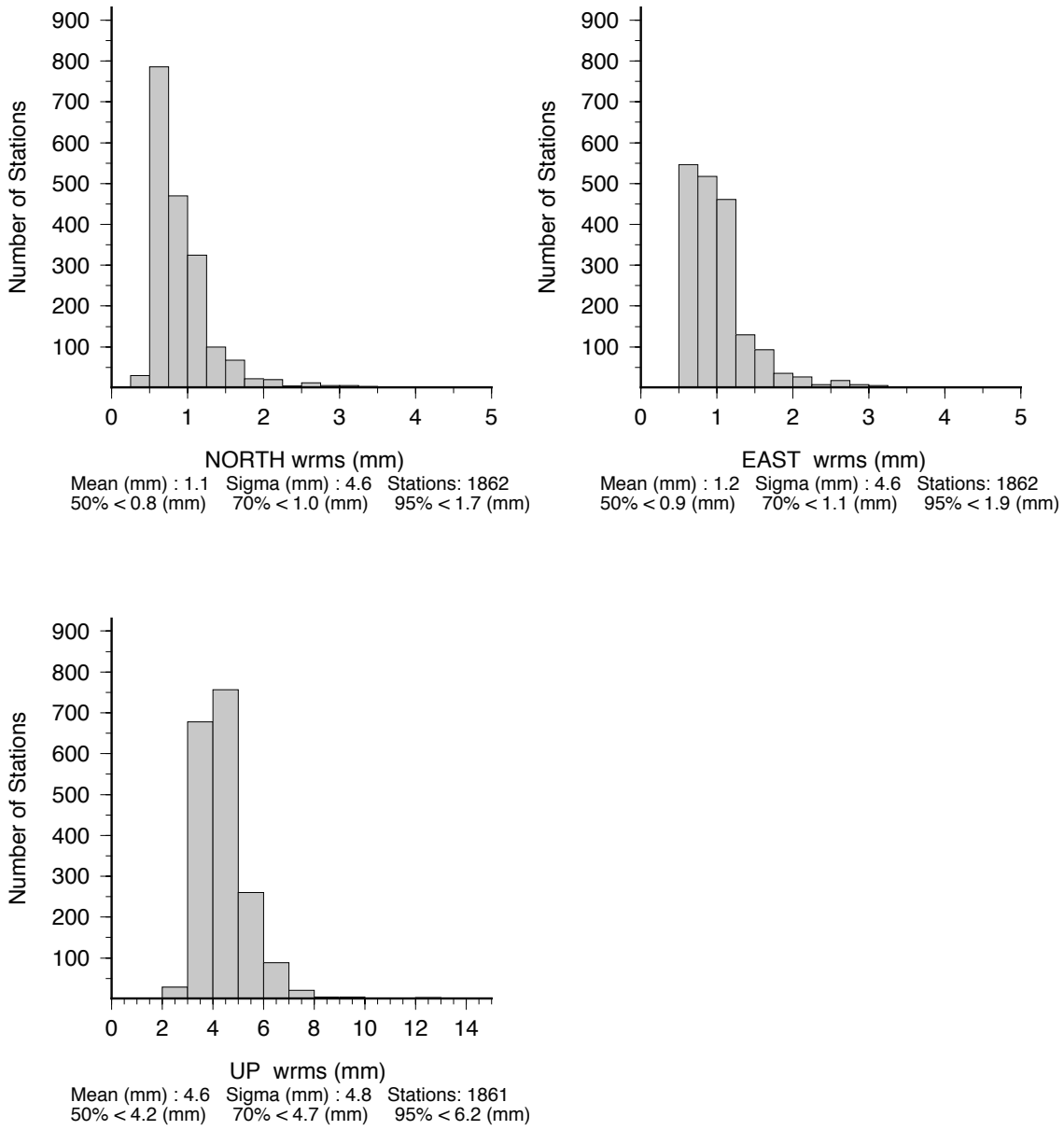

Figure 2: NMT combined solution histograms of the North, East and Up RMS scatters of the position residuals for 1834 sites analyzed between March 15, 2014 and June 14, 2014. Linear trends and annual signals were estimated from the time series.

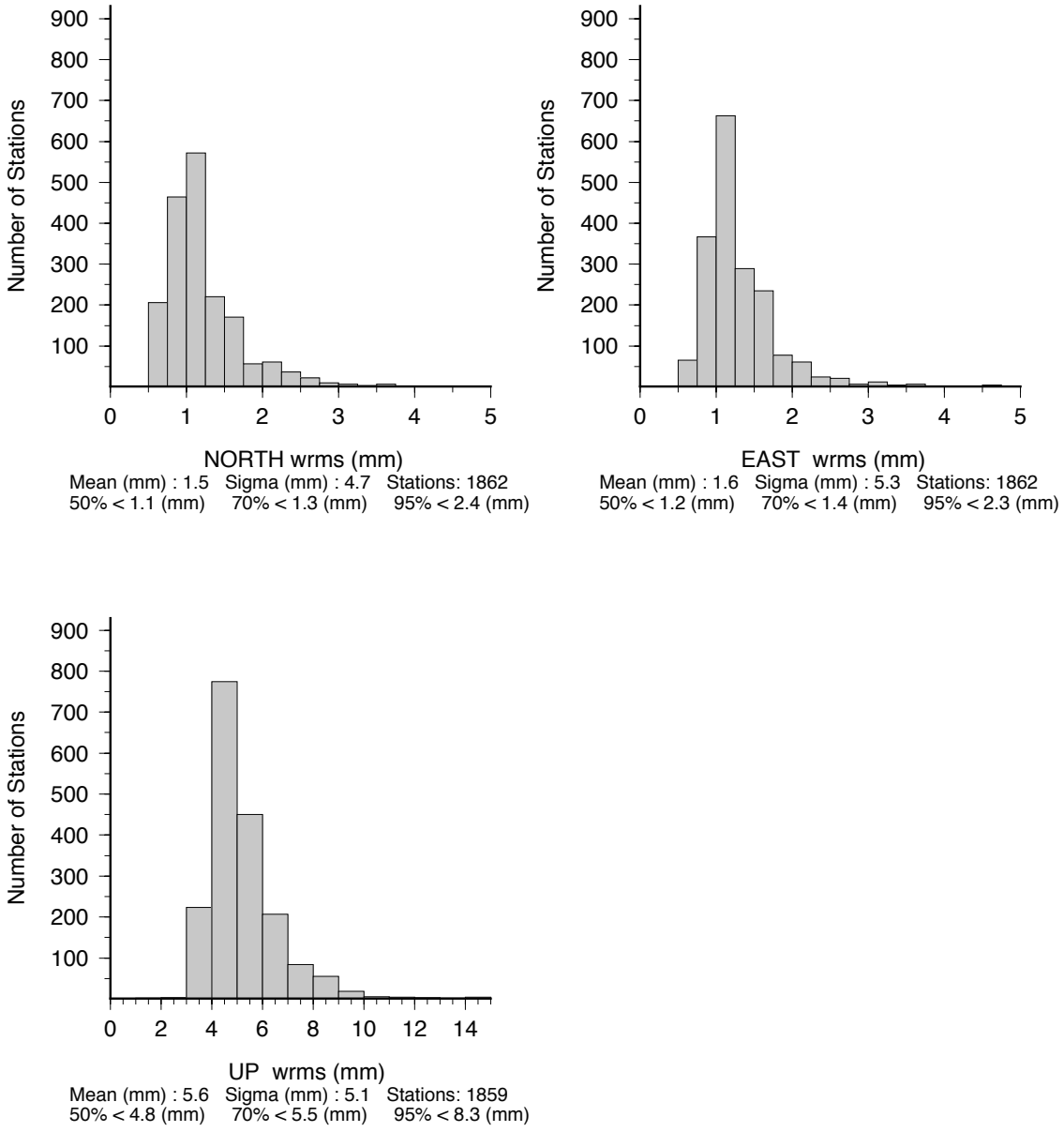

Figure 3: CWU combined solution histograms of the North, East and Up RMS scatters of the position residuals for 1834 sites analyzed between March 15, 2014 and June 14, 2014. Linear trends and annual signals were estimated from the time series.

For the PBO combined 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 3 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 4-9. The values plotted are given in PBO_FIN_Q03.tab. There are 1838 sites in the file. The contents of the files is of this form:

```
Tabular Position RMS scatters created from PBO_FIN_Q03.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
 1LSU    92       1.0   0.56      1.4   0.74     3.9   0.56
 1NSU    89       0.9   0.53      1.2   0.65     4.0   0.57
 1ULM    92       0.8   0.46      1.2   0.69     3.7   0.57
 7ODM    87       1.1   0.53      0.9   0.52     3.7   0.50
…
 ZLA1    92       1.2   0.55      1.3   0.69     4.1   0.52
 ZME1    92       1.2   0.58      1.2   0.59     4.7   0.58
 ZNY1    92       0.9   0.44      1.1   0.61     4.0   0.55
 ZSE1    92       1.0   0.40      0.8   0.42     4.1   0.54
 ZTL4    92       1.0   0.51      1.3   0.64     4.3   0.55
```

Table 2: RMS scatter of the position residuals for the PBO combined solution between March 15, 2014 and June 14, 2014 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, Expanded_PBO, COCONet and Expanded_PBO

Network	North (mm)	East (mm)	Up (mm)	#Sites
Median (50%)				
PBO	0.7	0.8	3.7	893
NUCLEUS	0.7	0.9	3.5	209
USGS SCIGN	0.8	1.0	3.6	103
Expanded	0.9	1.1	4.0	555
GAMA	0.9	1.2	4.1	13
COCO Net	1.4	1.5	6.0	90
70 %				
PBO	0.9	1.0	4.2	
NUCLEUS	0.8	1.0	3.9	
USGS SCIGN	1.0	1.1	4.0	
Expanded	1.1	1.3	4.4	
GAMA	1.0	1.2	4.4	
COCO Net	1.7	1.9	6.6	
95%				
PBO	1.6	1.6	5.6	
NUCLEUS	1.4	1.5	5.4	
USGS SCIGN	1.5	1.6	5.3	
Expanded	1.7	1.8	5.6	
GAMA	1.2	2.3	5.8	
COCO Net	3.5	5.3	12.8	

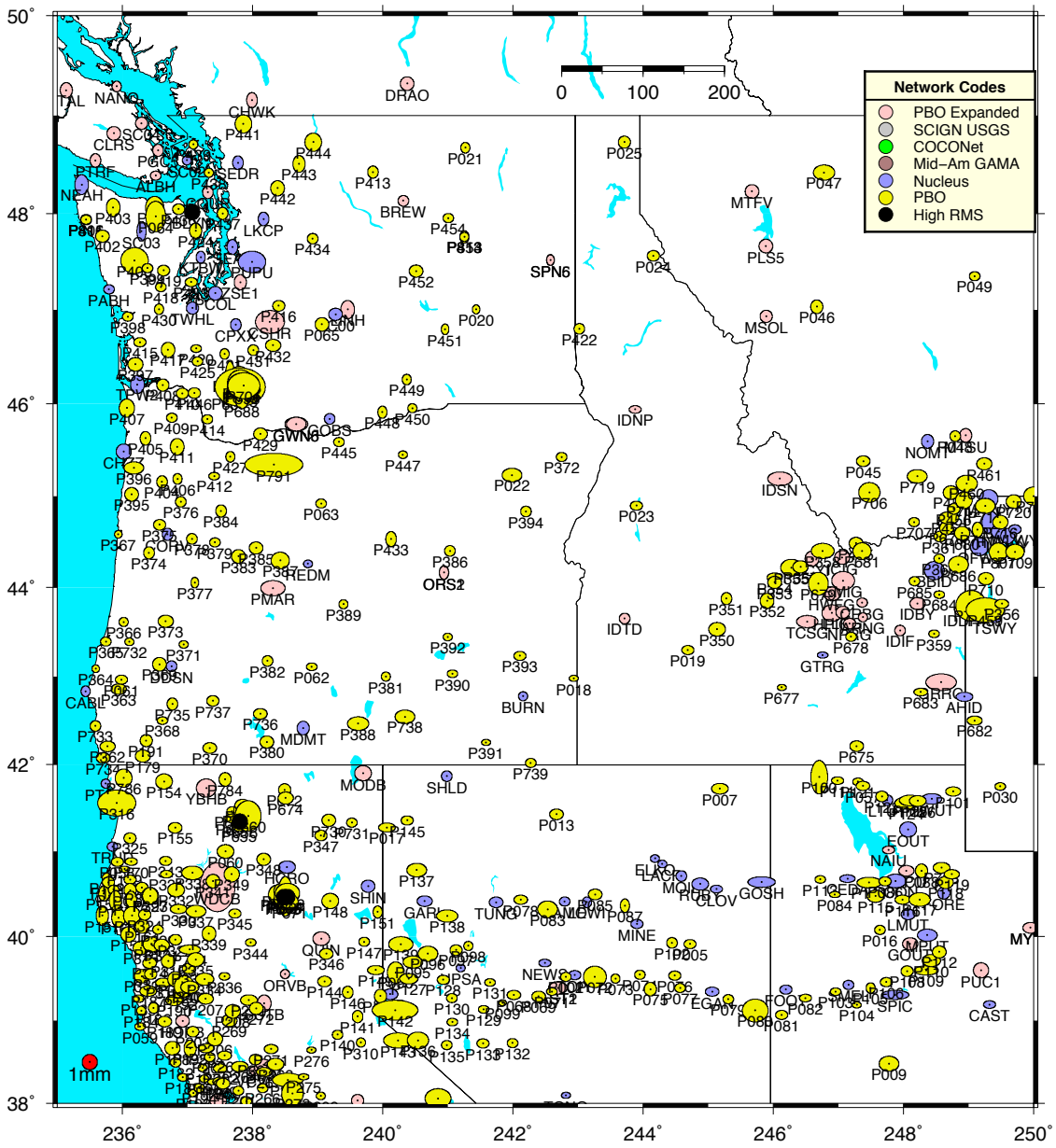

Figure 4: Distribution of the RMS scatters of horizontal position estimates from the PBO combined analysis for the Northern Western United States. The color of the ellipses that give the north and east RMS scatters denotes the network given by the legend in the figure. The small red circle shows the 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 which have no data during this 3-month interval.

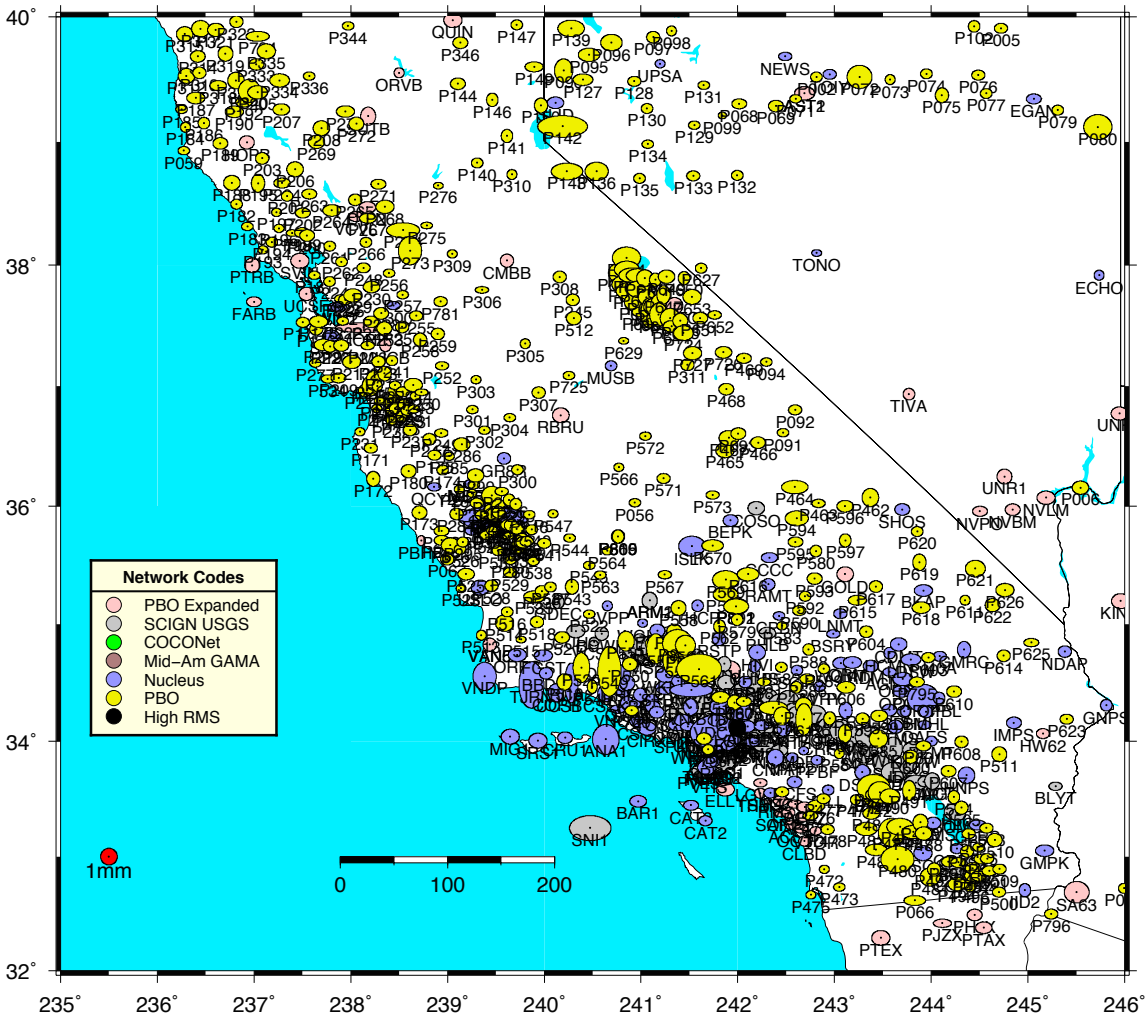

Figure 5: Same as Figure 4 except for the Southern Western United States. Black circles in the Yucca mountain region have no data during this 3-month period.

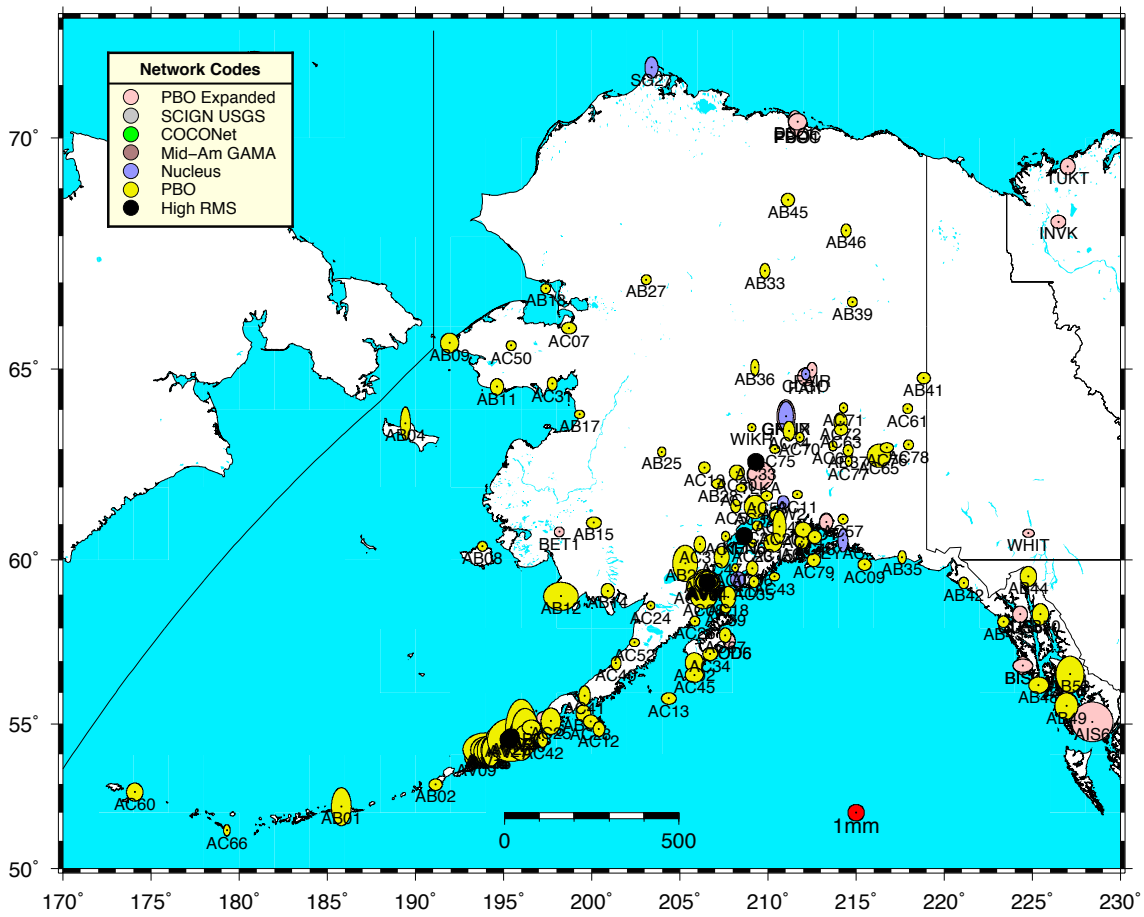

Figure 6: Same as Figure 4 except for the Alaskan region.

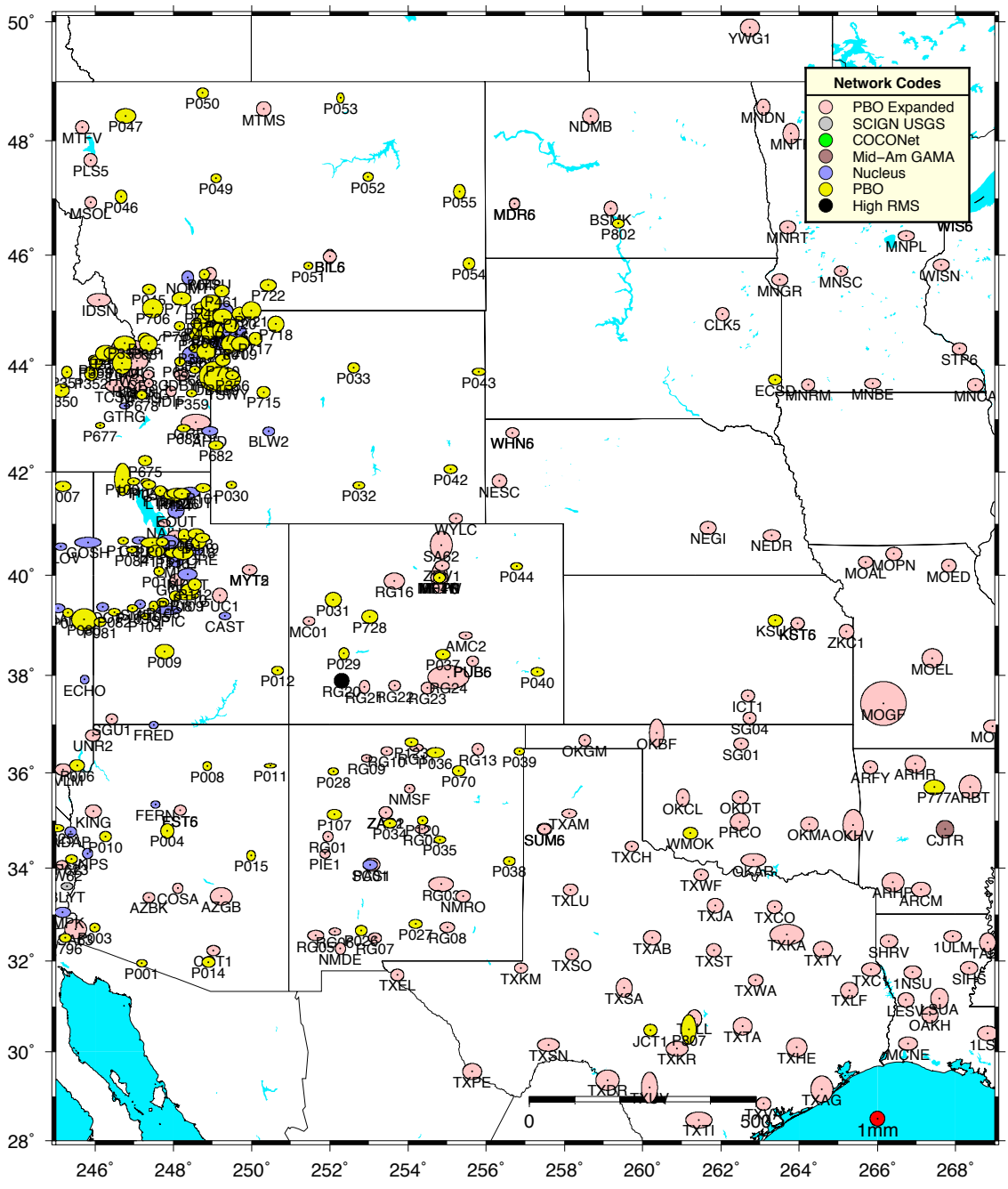

Figure 7: Same as Figure 4 except for the Central United States

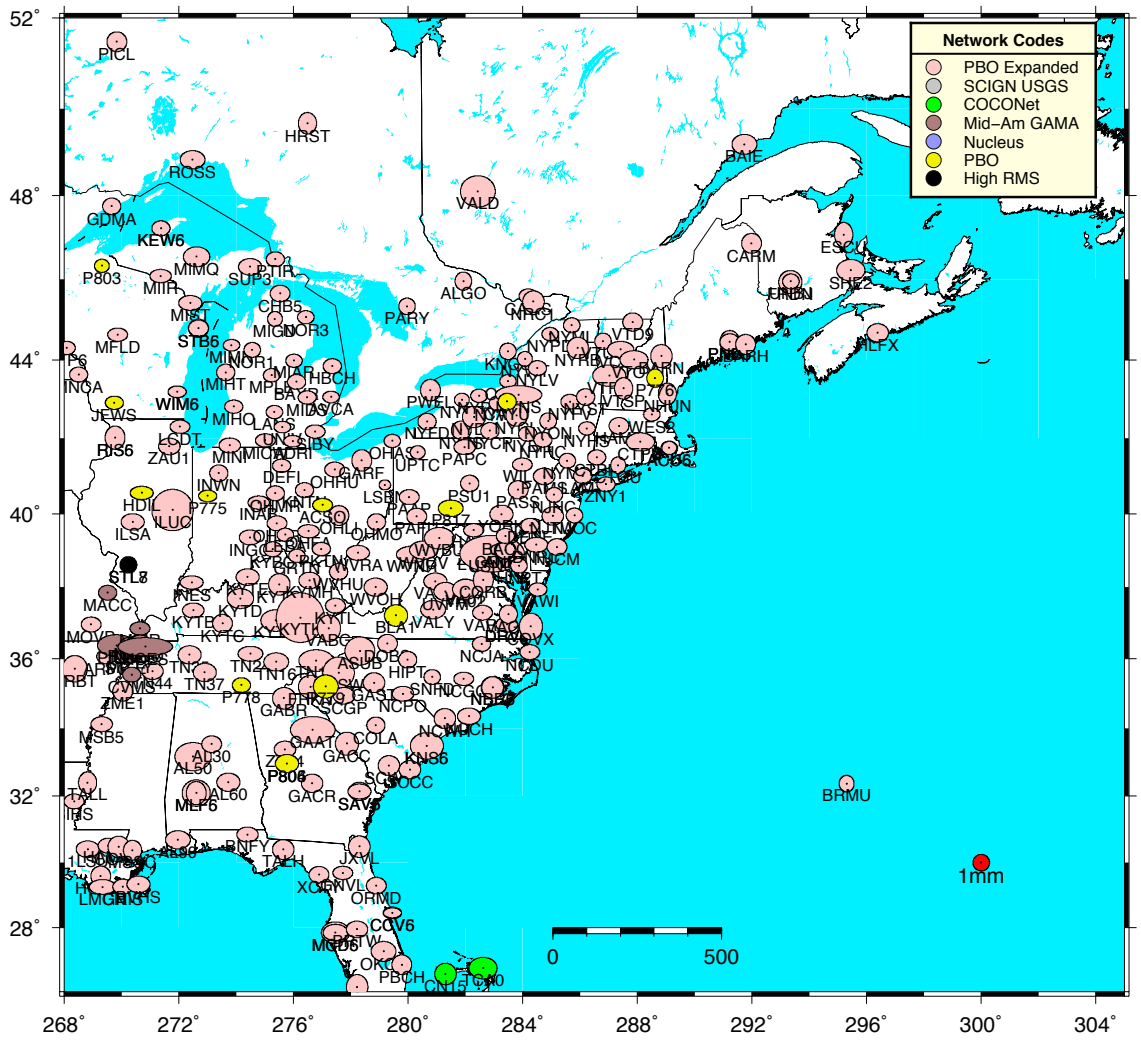

Figure 8: Same as Figure 4 except for the Eastern United States

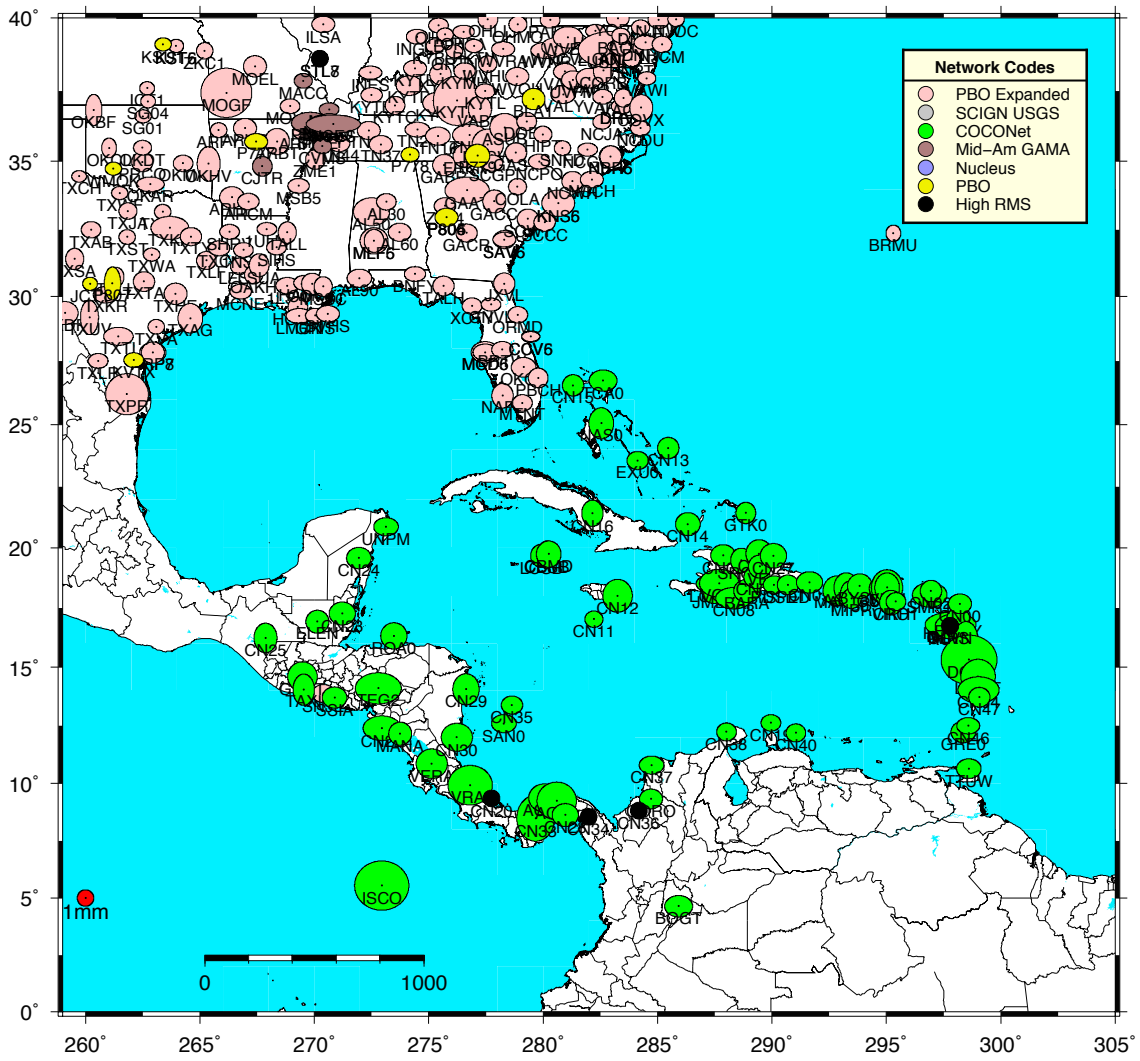

Figure 9: Same as Figure 4 except for the Caribbean region.

Snapshot velocity field analysis from the reprocessed PBO analysis.

In our monthly reports, we generate "snapshot" velocity fields in the NAM08 reference frame based on the time series analysis of all data processed to that time. For this quarterly report, we generate these velocity estimates for the reprocessed results and the current GAGE analyses (starting 2012/09/23) that are in the NAM08 reference frame. There 2052 sites, 8 more than last quarter, in the analyses and the statistics of the fits to results are shown in Table 3. 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 fits along with the duration of the data used are given in the following linked files: pbo_nam08_140416.tab, nmt_nam08_140416.tab and cwu_nam08_140416.tab. The velocity estimates are shown by region and network type in Figures 10-15. The color scheme used is the same as Figures 4-9. The snapshot velocity field files are linked as: pbo_nam08_140616.snpvel, nmt_nam08_140416.snpvel and cwu_nam08_140416.snpvel.

Table 3: Statistics of the fits of 2054 sites analyzed in the reprocessed analysis for data collected between Jan 1, 1996 and June 14, 2014.

Center	North (mm)	East (mm)	Up (mm)
Median (50%)			
PBO	1.4	1.5	7.3
NMT	1.2	1.3	5.5
CWU	1.7	2.0	8.4
70%			
PBO	1.8	2.3	7.8
NMT	1.5	1.7	6.4
CWU	2.2	2.9	9.2
95%			
PBO	3.7	3.7	10.7
NMT	3.4	3.2	8.9
CWU	4.4	5.0	13.3

Different tolerances are used for maximum standard deviation in each of the figures 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 which aims to account for temporal correlations in the time series residuals. This algorithm is also called the "Realistic Sigma" model.

A direct comparison of the NMT and CWU solutions shows the weighted root-mean-square (WRMS) difference between the two velocity fields is 0.18 mm/yr horizontal and 1.11 mm/yr vertical in direct difference of all sites in both solutions (2039 sites). The χ^2/f of the difference is $(1.98)^2$ for the horizontal components and $(1.80)^2$ for height. Since the RMS is weighted, sites with small standard deviations with tend to dominate the WRMS. Establishing a lower bound on the standard deviation of the velocity estimates 0.19 mm/yr (summed squared into the horizontal velocity standard deviations) and 0.85 mm/yr in heights generates and RMS difference of 0.33 mm/yr with a χ^2/f of unity horizontal only and 1.43 mm/yr for height. We have modified the method used to compute these values and the height results show a larger scatter than previous reports. When we use only sites with small uncertainties so that about only half the sites are used (minimum NE sigma 0.25 mm/yr and U sigma 1.06 mm/yr such that all sigma components must satisfy these limits in both solutions), 1054 sites are compared the WRMS differences are 0.21 and 1.06 mm/yr in NE and Up. The NRMS values (sqrt(χ^2/f) are 0.73 and 0.77 indicating the re-weighting factors could be too large and a simple additive baseline variance for the velocity estimates is not complete enough. Most likely there could also be a scale to be applied to the sigmas as well.

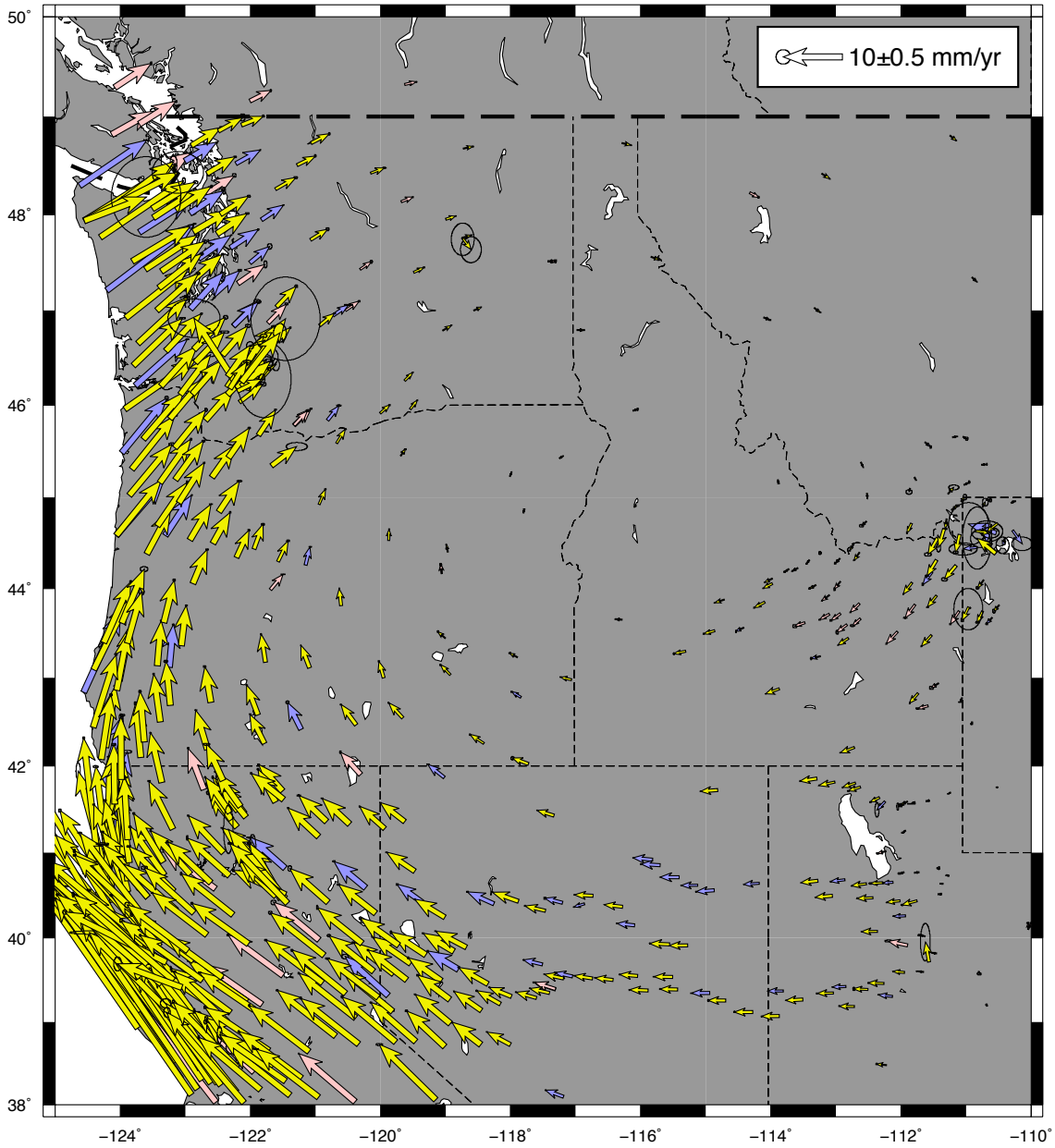

Figure 10: Velocity field estimates from the combined PBO solutions generated using time series analysis and the FOGMEX error model. 95% confidence interval error ellipses are shown. The color scheme of the vectors matches the network type legend in Figure 4. Only velocities with horizontal standard deviations less than 3 mm/yr are shown.

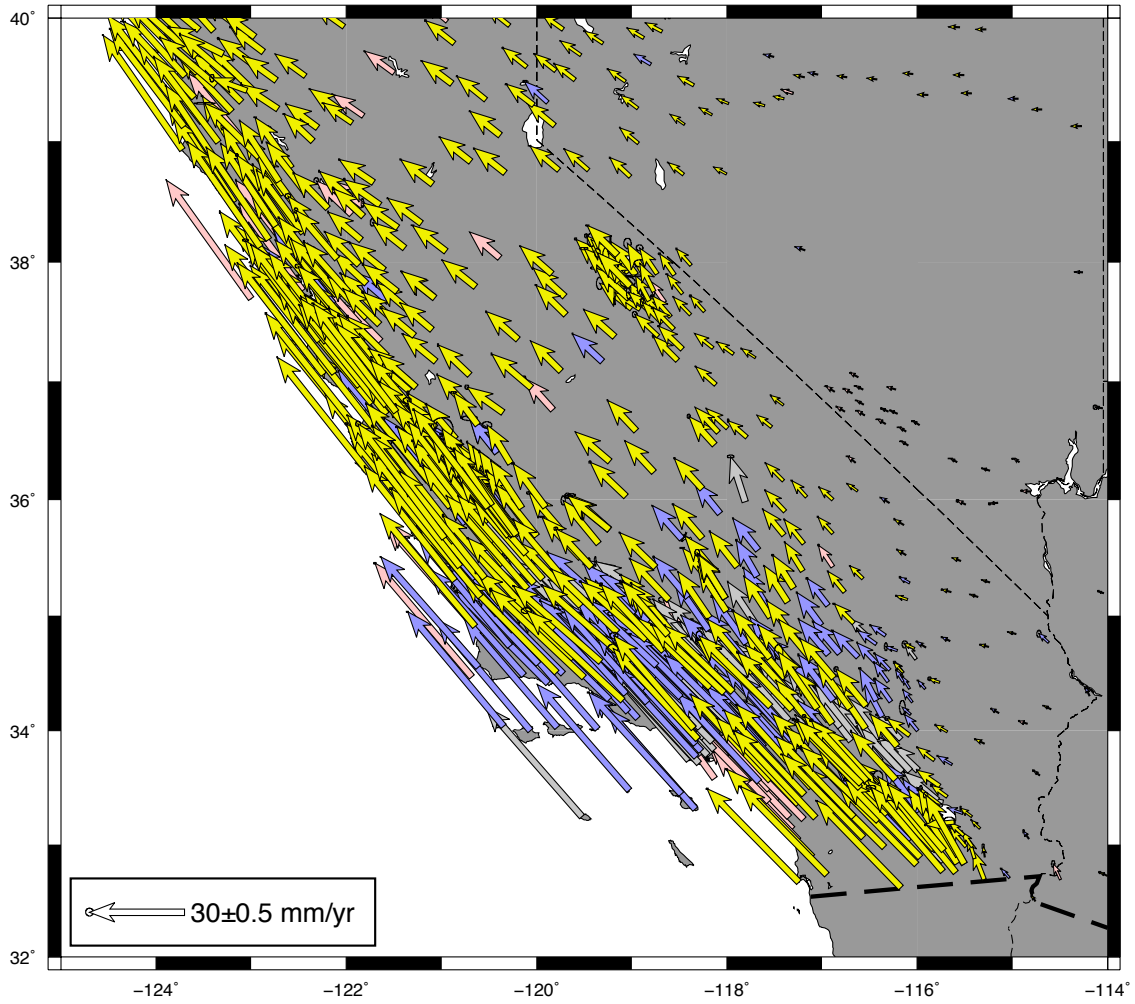

Figure 11: Same as Figure 10 except for South Western United States. Only velocities with horizontal standard deviations less than 5 mm/yr are shown. The anomalous site at latitude 34, longitude -117 is P613 and is effected by the estimation of post-seismic motion after the 2010 Apr 4 El Major Cucupah earthquake.

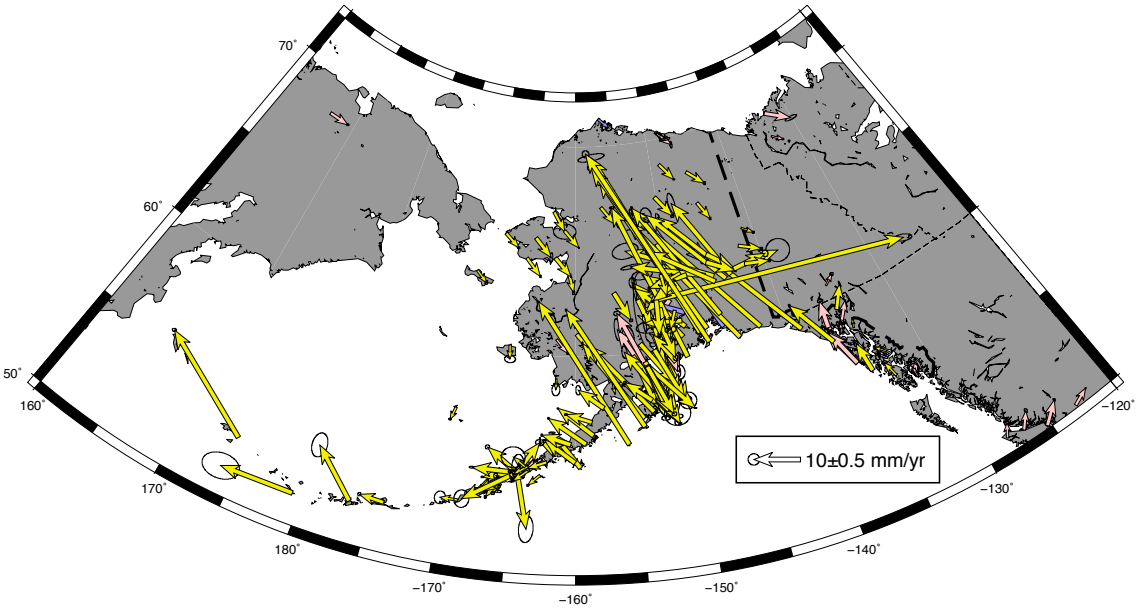

Figure 12: Same as Figure 10 except for Alaska. Only velocities with horizontal standard deviations less than 5 mm/yr are shown. The anomalous vector in Central Alaska is AC55 as the sites does move with anomalous motion. The site was discontinued in mid-2010.

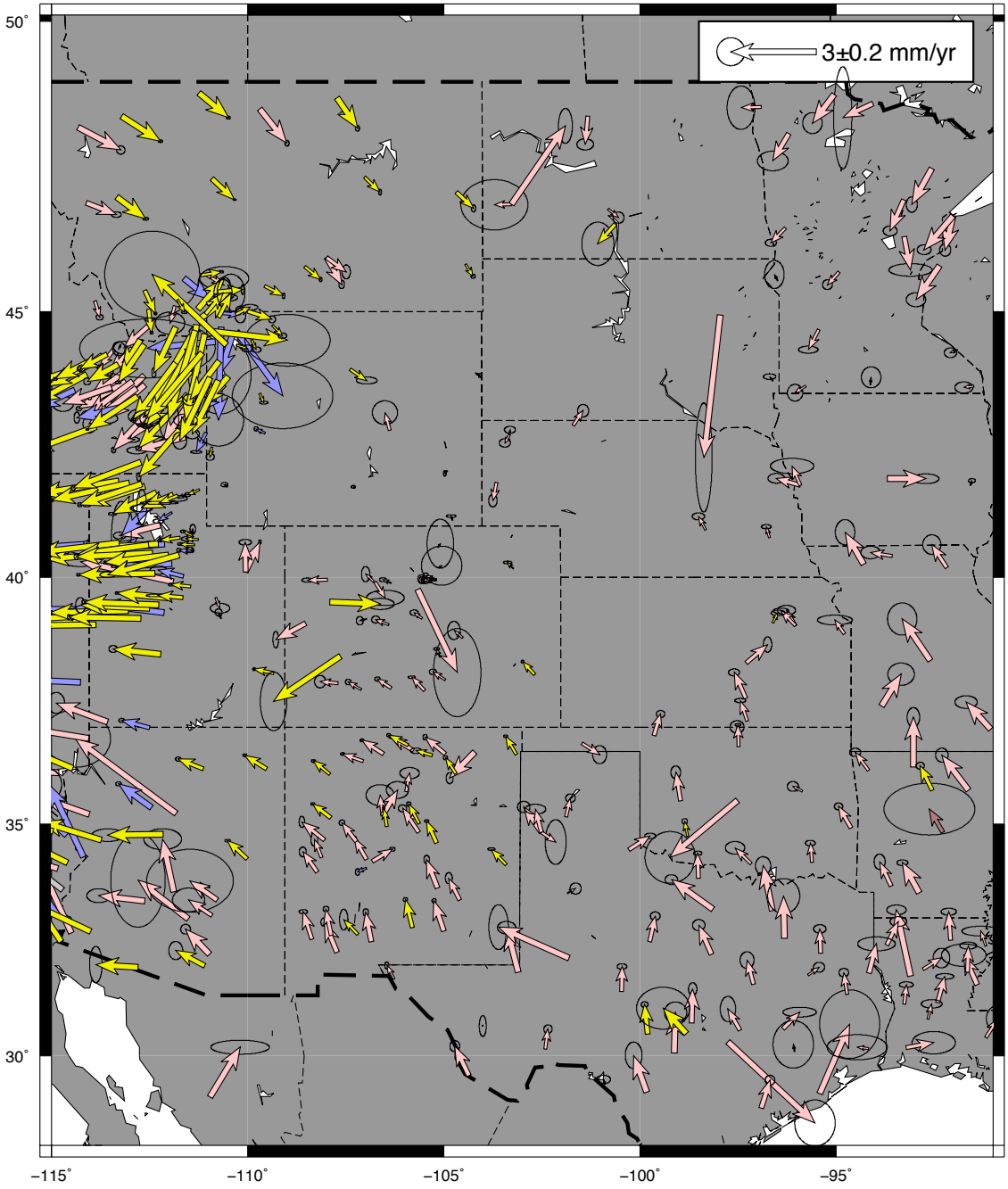

Figure 13: Same as Figure 10 except for Central United States. Only velocities with horizontal standard deviations less than 1 mm/yr are shown.

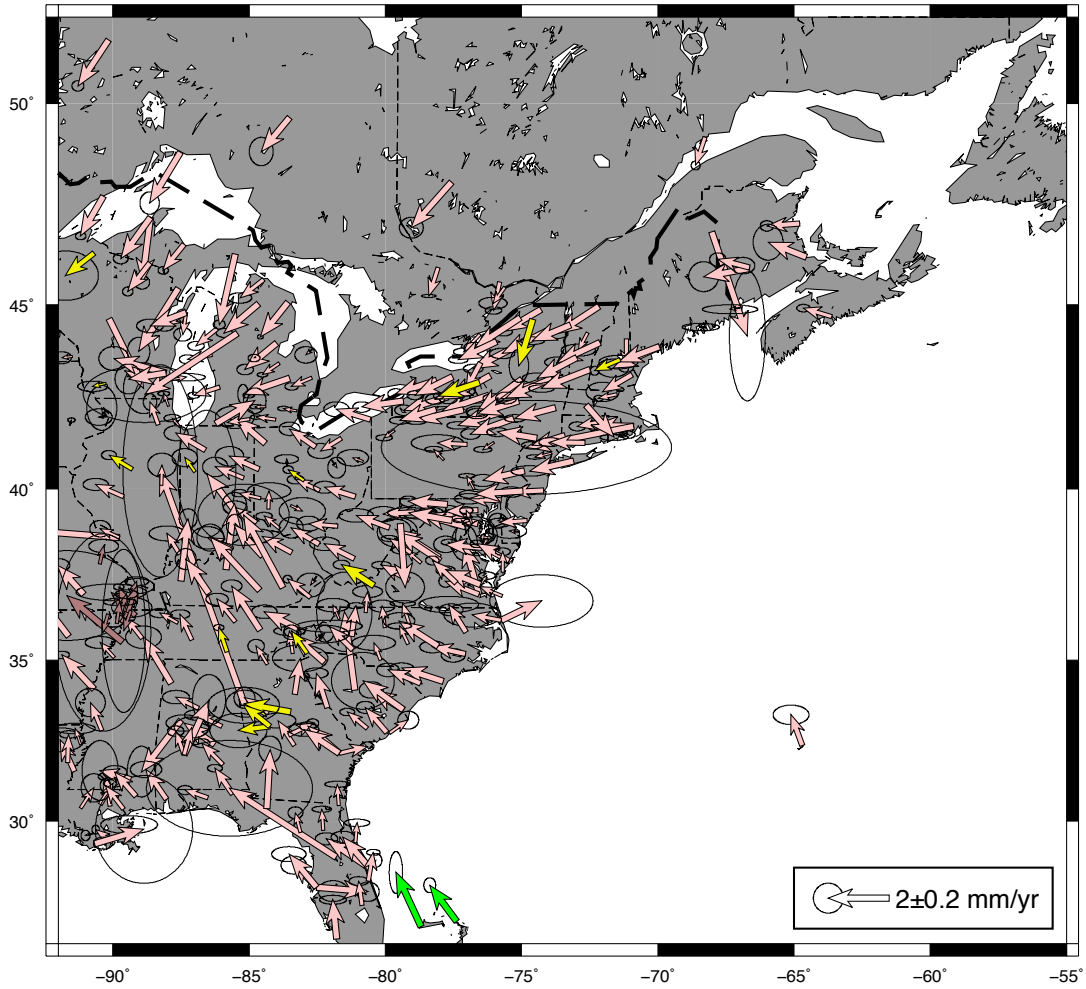

Figure 14: Same as Figure 10 except for the Eastern United States. Only velocities with horizontal standard deviations less than 2 mm/yr are shown. The systematic western velocity of sites in the Northeast is being investigated.

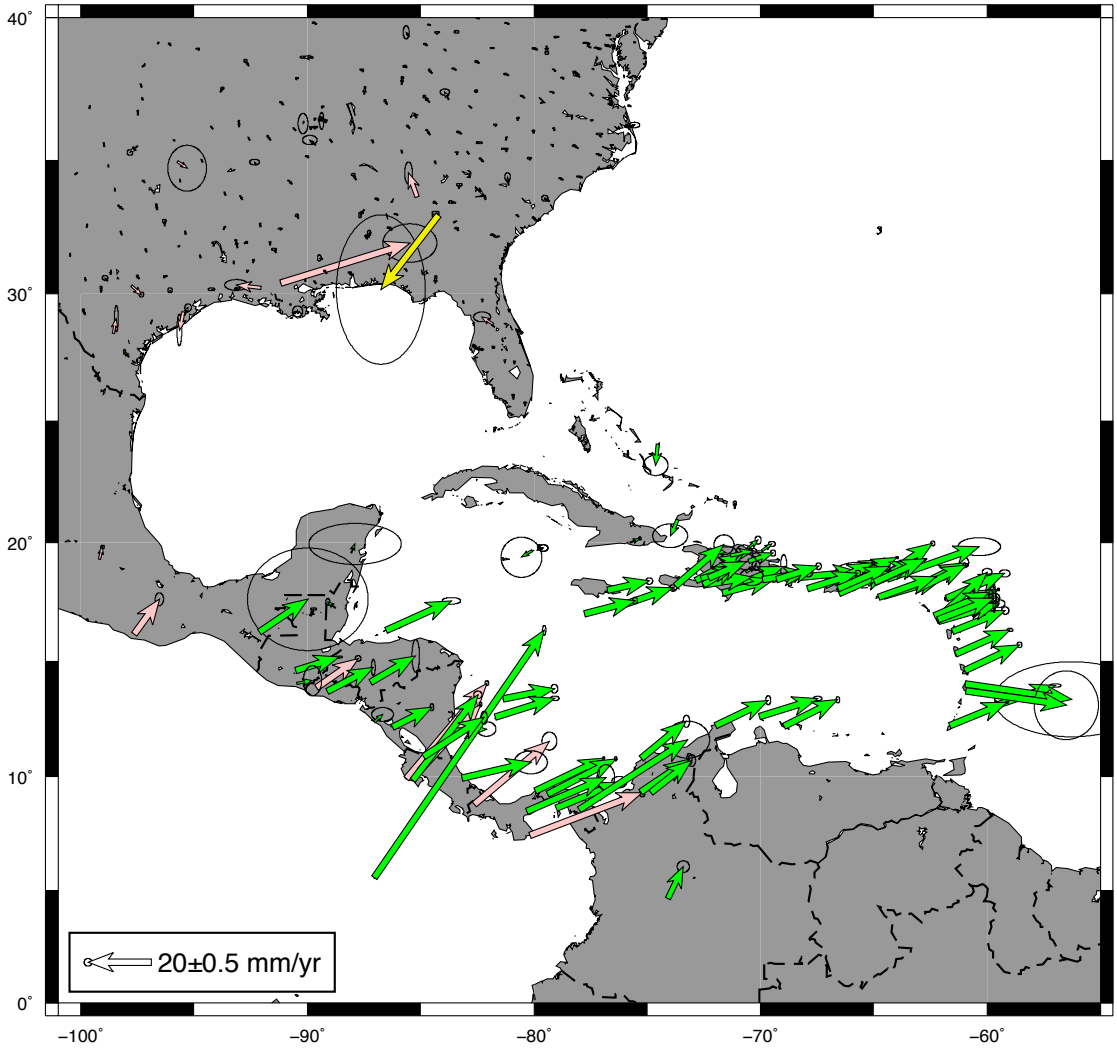

Figure 15: Same as Figure 10 except for the Caribbean region. Only velocities with horizontal standard deviations less than 10 mm/yr are shown. The anomalous yellow vector in the southeastern United States is P806 which has a failed antenna. The other site in pink in Louisiana is LST1 which has a very span of data in 2006.

Earthquake Analyses: 2014/03/01-2014/06/30.

We use the NEIC catalog to search for earthquakes that could cause coseismic offsets at the sites analyzed by the GAGE analysis centers. We examined the following earthquakes. In these output, each earthquake that might have generated coseismic displacements is numbered and the "SEQ Earthquka # n" starts the block of information about the earthquake. The EQ MM lines, give site name, distance from hypocenter (km), maximum distance that could cause coseismic offsets > 1 mm, and the "CoS" (coseismic offset) value is the possible offset in the mm. The eq_def lines give the event number, latitude, longitude, radius of influence, and depth of event followed by the date and time of the event. If an event is found to be significant, the event number is modified to reflect

the total number of events so far included in the PBO analyses. Large events are often given a two char code to reflect their location (e.g., PA is Parkfield).

```
* SEQ Earthquake # 2
* EQ 79 LAPC_GPS       9.83      10.90 CoS        1.3 mm
* EQ 79 LFRS_GPS       7.94      10.90 CoS        2.0 mm
* EQ 79 UCLP_GPS       8.29      10.90 CoS        1.9 mm
* EQ 79 VIMT_GPS       2.91      10.90 CoS       15.1 mm
* EQ_DEF M4.4 9km NNW of Westwood
 eq_def 02   34.1347 -118.4858     10.9 8 2014 03 17 13 26    0.002
 eq_rename 02
 eq_coseis 02  0.001 0.001 0.001      0.002      0.002      0.002
Although VIMT good have had a large displacement, none was observed in the time
series.

* SEQ Earthquake # 5
* EQ 364 NRWY_GPS       6.38      12.80 CoS        7.9 mm
* EQ_DEF M4.7 37km ENE of West Yellowstone
 eq_def 05   44.7720 -110.6847     12.8 8 2014 03 30 12 35    0.005
 eq_rename 05
 eq_coseis 05  0.001 0.001 0.001      0.005      0.005      0.005
* ----------------------------------
* SEQ Earthquake # 6
* EQ 366 NRWY_GPS       6.15       8.80 CoS        0.0 mm
* EQ_DEF M3.6 34km ENE of West Yellowstone
 eq_def 06   44.7697 -110.6880      8.8 8 2014 03 30 13 31    0.000
 eq_rename 06
 eq_coseis 06  0.001 0.001 0.001      0.000      0.000      0.000
Neither of these small events shows a cosesimic offset although this site is
undergoing large non-secular motions starting in late 2013.  10-20 mm SE motion
and 50 mm uplift since Jan 2014.

    The following earthquake did generate co-seismic offsets. Earthquake is
event number 29.  The following products were sent to UNAVCO (these are the
revised products).  Maximum co-seismic offset was <3 mm.  Some of the co-
sesimic could be from aftershocks as well  (M4.1 2km SE of Rowland Heights
33.9613 -117.8923  2014 03 29 21 33

pbo_140329_0410_EQ30_coseis_rapid.evt.20140404171520
pbo_140329_0410_EQ30_coseis_rapid.ps.20140404171520
```

In March 2014, the following events were investigated but none show co-seismic offsets.

```
Events investigated.
* SEQ Earthquake # 1
* EQ 59 MANA_GPS       5.88      17.20 CoS       25.9 mm
* EQ_DEF M5.1 5km ENE of Ciudad Sandino
 eq_def 01   12.1764  -86.2965     17.2 8 2014 04 14 05 08    0.014
 eq_rename 01
 eq_coseis 01  0.001 0.001 0.001      0.014      0.014      0.014
* ----------------------------------
* SEQ Earthquake # 3
* EQ 199 UNIP_GPS     261.09     277.50 CoS        3.0 mm
* EQ_DEF M7.2 36km NNW of Tecpan de Galeana
 eq_def 03   17.5519 -100.8159    277.5 8 2014 04 18 14 28    3.144
 eq_rename 03
 eq_coseis 03  0.001 0.001 0.001      3.144      3.144      3.144
* ----------------------------------
* SEQ Earthquake # 4
* EQ 372 BCOV_GPS      88.72     110.60 CoS        5.5 mm
* EQ 372 ELIZ_GPS      23.16     110.60 CoS       80.5 mm
* EQ 372 GLDR_GPS      96.33     110.60 CoS        4.7 mm
* EQ 372 HOLB_GPS     101.25     110.60 CoS        4.2 mm
* EQ 372 NTKA_GPS      65.81     110.60 CoS       10.0 mm
```

```
* EQ_DEF M6.6 94km S of Port Hardy
 eq_def 04   49.8459 -127.4440    110.6 8 2014 04 24 03 11    0.675
 eq_rename 04
 eq_coseis 04  0.001 0.001 0.001      0.675      0.675      0.675
* ----------------------------------
* SEQ Earthquake # 5
* EQ 373 ELIZ_GPS       5.41      15.80 CoS       24.1 mm
* EQ_DEF M5.0 95km S of Port Hardy
 eq_def 05   49.8510 -127.1912     15.8 8 2014 04 24 03 21    0.011
 eq_rename 05
 eq_coseis 05  0.001 0.001 0.001      0.011      0.011      0.011
* ----------------------------------
* SEQ Earthquake # 6
* EQ 583 PSTX_GPS       6.33       8.80 CoS        0.0 mm
* EQ_DEF M3.6 50km NNE of Camalu
 eq_def 06   31.2732 -115.8842      8.8 8 2014 05 04 15 14    0.000
 eq_rename 06
 eq_coseis 06  0.001 0.001 0.001      0.000      0.000      0.000
```

The following earthquakes we examined to see if there were any co-seismic offsets. None were detected but we could not evaluate the 2014 06 04 11 59 M5.7 73km WSW of Haines earthquake (SEQ Earthquake # 5) becuase there are np data for BMCP and QUIC since the June 2013 for BMCP and Dec 2012 for QUIC.

```
* EQDEFS for 2014 05 13 to 2014 06 15 Generated Mon Jun 16 13:51:39 EDT 2014
* Proximity based on Week_All.Pos file
* ----------------------------------
* SEQ Earthquake # 1
* EQ 169 BBRY_GPS       5.73       9.20 CoS        2.0 mm
* EQ_DEF M3.8 2km ESE of Big Bear City
 eq_def 01   34.2533 -116.8248      9.2 8 2014 05 19 20 09    0.001
 eq_rename 01
 eq_coseis 01  0.001 0.001 0.001      0.001      0.001      0.001
* ----------------------------------
* SEQ Earthquake # 2
* EQ 234 AC66_GPS       2.72      10.20 CoS        8.7 mm
* EQ_DEF M4.2 65km SSW of Semisopochnoi Island
 eq_def 02   51.4002  179.2846     10.2 8 2014 05 23 18 01    0.001
 eq_rename 02
 eq_coseis 02  0.001 0.001 0.001      0.001      0.001      0.001
* ----------------------------------
* SEQ Earthquake # 3
* EQ 418 LFRS_GPS       7.10      10.00 CoS        1.3 mm
* EQ 418 UCLP_GPS       5.32      10.00 CoS        2.3 mm
* EQ 418 VIMT_GPS       4.10      10.00 CoS        3.8 mm
* EQ_DEF M4.2 7km NW of Westwood
 eq_def 03   34.0958 -118.4912     10.0 8 2014 06 02 02 37    0.001
 eq_rename 03
 eq_coseis 03  0.001 0.001 0.001      0.001      0.001      0.001
* ----------------------------------
* SEQ Earthquake # 4
* EQ 440 P278_GPS       5.21       8.70 CoS        0.0 mm
* EQ 440 P279_GPS       7.65       8.70 CoS        0.0 mm
* EQ_DEF M3.5 12km NE of San Simeon
 eq_def 04   35.7345 -121.1122      8.7 8 2014 06 03 08 54    0.000
 eq_rename 04
 eq_coseis 04  0.001 0.001 0.001      0.000      0.000      0.000
* ----------------------------------
* SEQ Earthquake # 5
* EQ 453 BMCP_GPS      26.19      32.10 CoS        6.2 mm
* EQ 453 QUIC_GPS      10.91      32.10 CoS       36.0 mm
* EQ_DEF M5.7 73km WSW of Haines
 eq_def 05   59.0001 -136.6561     32.1 8 2014 06 04 11 59    0.067
```

```
eq_rename 05
eq_coseis 05  0.001 0.001 0.001      0.067      0.067      0.067
```

Antenna Change Offsets: 2014/04/01-2014/05/31

The follow antenna changes were investigated and reported on in the MIT ACC monthly reports.

```
Site       Date              From            To
ELTS_2PS 2014  3  6 19 33    TPSCR.G3        TRM57971.00
CN37_2PS 2014  4 12  0  0    TRM57971.00     TRM59800.00
HAMP_2PS 2014  4 29 17 35    TRM41249.00     TRM57971.00
NYNS_2PS 2014  4  1  6  0    LEIAT504        LEIAR10
CN36_2PS 2014  5 28  0 51    TRM57971.00     TRM59800.00
P232_2PS 2014  5 29  0  0    TRM29659.00     TRM59800.00
P514_2PS 2014  5  9  0  0    TRM29659.00    TRM59800.00
```

There is almost a 1 year gap in the ELTS data until the new antenna is installed so it is difficult to see any offsets. Estimates are 0.2 N, 2.4 E, -8.4 mm U +- 0.9 mm NE, +-2.9 mm U (estimates with an annual estimated). The changes at CN37 and HAMP did not seem to result in any large position shifts compared the noise in the data. The NYNS change resulted in a large east shift. There are a number of days when the ACs used the wrong antenna model which results in a large 100 mm Up shift. The estimates below are give all components of the offset based on a few weeks of data on either side of the antenna change. The large 23 mm east shift is very apparent.

```
NYHS dPosition dN  -2.28 +-   0.54, dE  23.04 +-   1.36,  dU 1.72 +-   2.03 mm
```

For CN36 There is a 1-year gap in the data that makes assessing the possible offsets difficult. CN37 which had the same antenna switch in April 2014 (last monthly report) did not show a large offset. The other two sites did show offsets:

```
P232 dN  -2.30 +-   0.16 dE   0.02 +-   0.21 dU 2.35 +-   1.21 mm
P514 dN   2.71 +-   0.21 dE  -2.49 +-   0.21 dU 3.18 +-   0.85 mm
```

In addition to antenna change breaks, there are also breaks of unknown nature (not equipment changes) We added breaks at P158 initially for a tree being cut down. The offsets due to this are dN 8.01 +- 0.59 dE 4.48 +- 0.40 dU -30.39 +- 1.90 mm where these values are from the NMT solution and use data back to Jan 2014. In height there is a general increase until the time of the tree cutting. The CWU solutions are degraded in East starting around Jan 2010 presumably from the growth of the tree (but we will need to wait until the CWU re-analysis to see if the new solutions show the same problems). While looking at the site two other offsets are seen in the time series and the origin of these is unknown. These offsets are of the same magnitude in East (each a 6-8 mm. There is curvature in the timeseries in North which makes offset estimation not consistent with the short term offset (based only on data around the time of the offset). The following discontinuities have been added to P158 to account for the tree effects.

```
rename P158_GPS P158_APS 2005  6 14 24  0 2010  1 10  0  0
rename P158_GPS P158_BPS 2010  1 10  0  0 2014  3 17 24  0
rename P158_GPS P158_CPS 2014  3 17 24  0
```

CWU re-reprocessing

Based on the analysis presented in our last quarterly report, CWU found several significant errors in their reprocessing, and are now re-reprocessing with these errors fixed. This new processing is significantly better than the original reprocessing. In Figures 16 and 17 we show the comparison between the original reprocessing and the new re-reprocessing. The improvement is very apparent. Figure 18 adds the NMT results to Figure 17 to allow a direct comparison. It is expected that the CWU re-reprocessing should be complete by mid-July. NMT also re-reprocessed between 2006/11/04 and 2007/03/31 in add in stations that had been missed originally due to network communication problems with the UNAVCO servers at the time of the original processing. These updated results will be included when the new CWU solutions become available.

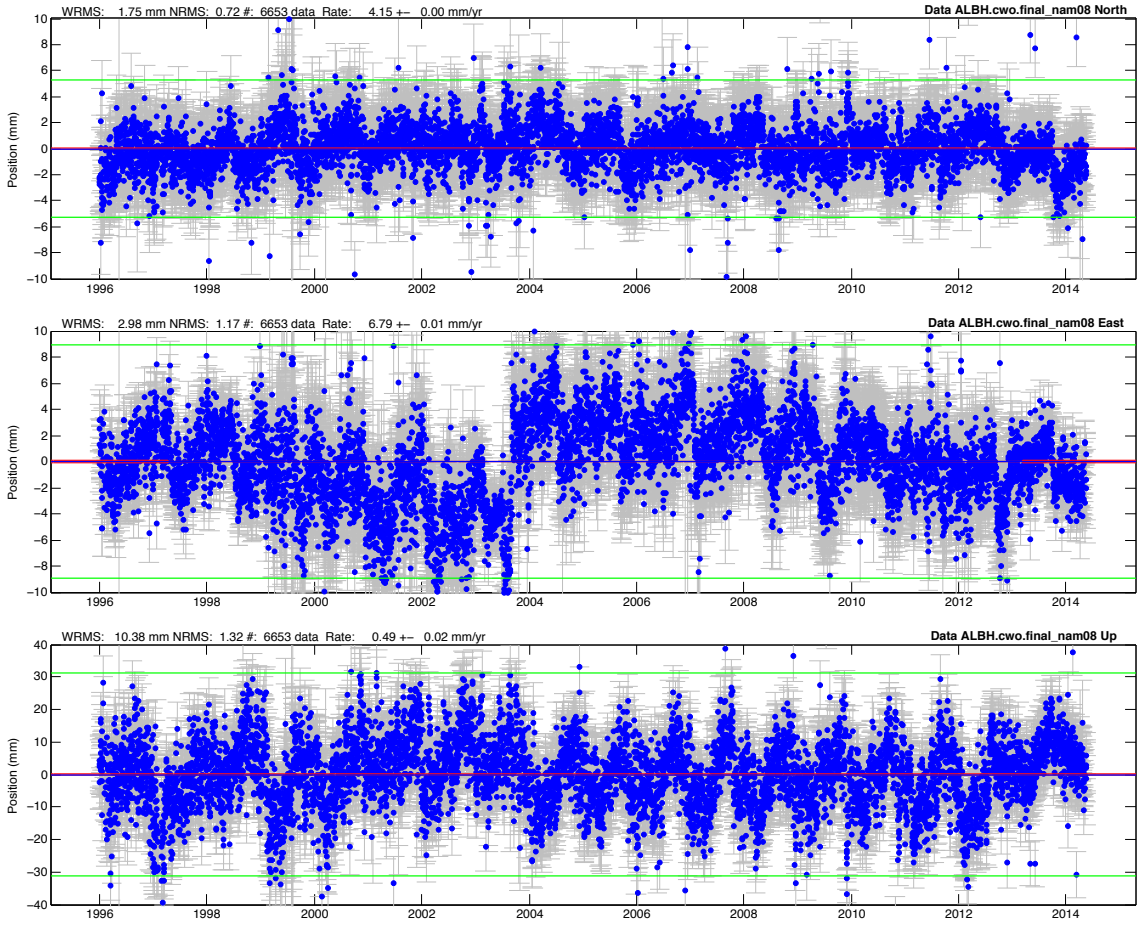

Figure 16: Original CWU reprocessing of the ALBH station. The ETS events in the east components can be barely seen. Results after Jan 1, 2012 had already been re-reprocessed. After Jan 2013, normal routine processing results consistent with the reprocessing models have been used.

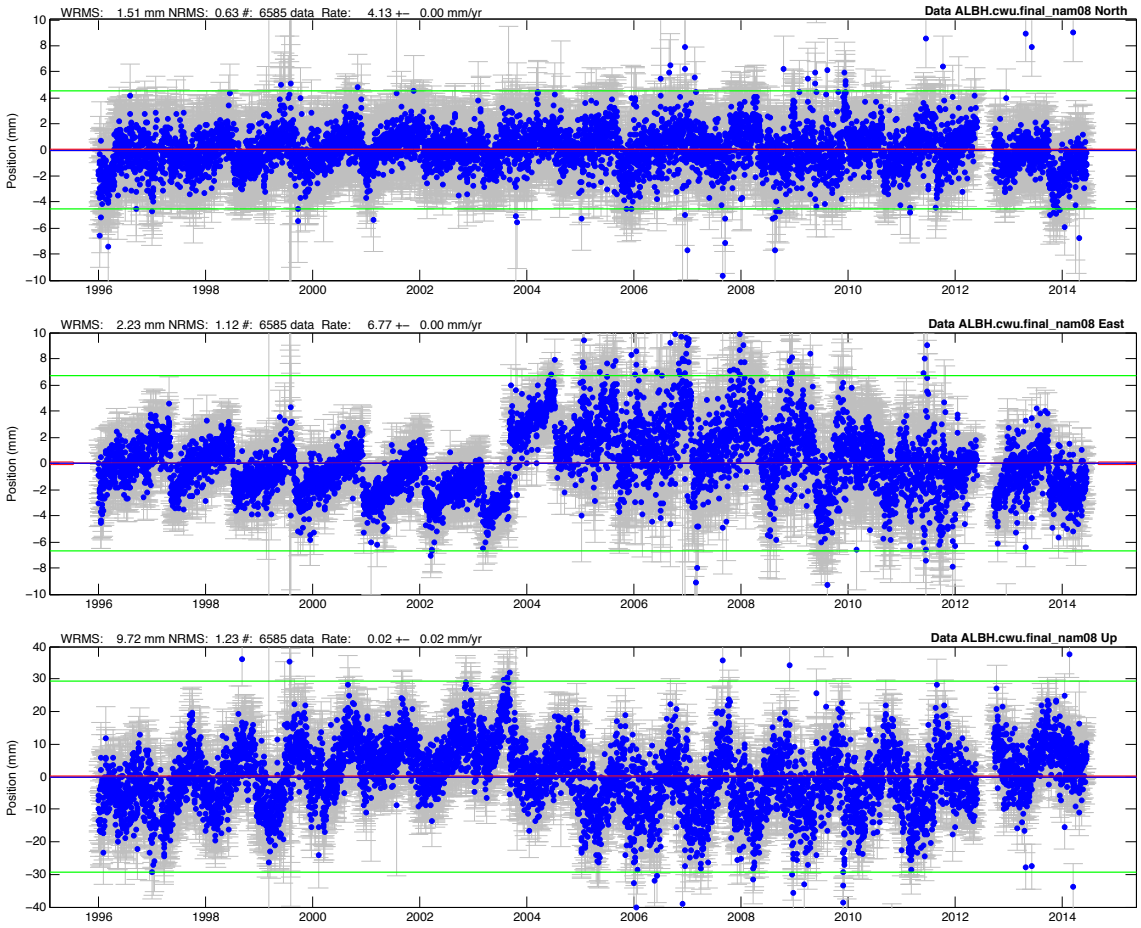

Figure 17: Updated processing by CWU. Updated processing has used up until the end of 2004. The offset in 2009/09/05 is due to replacing the EMRA radome with a SCIT dome.

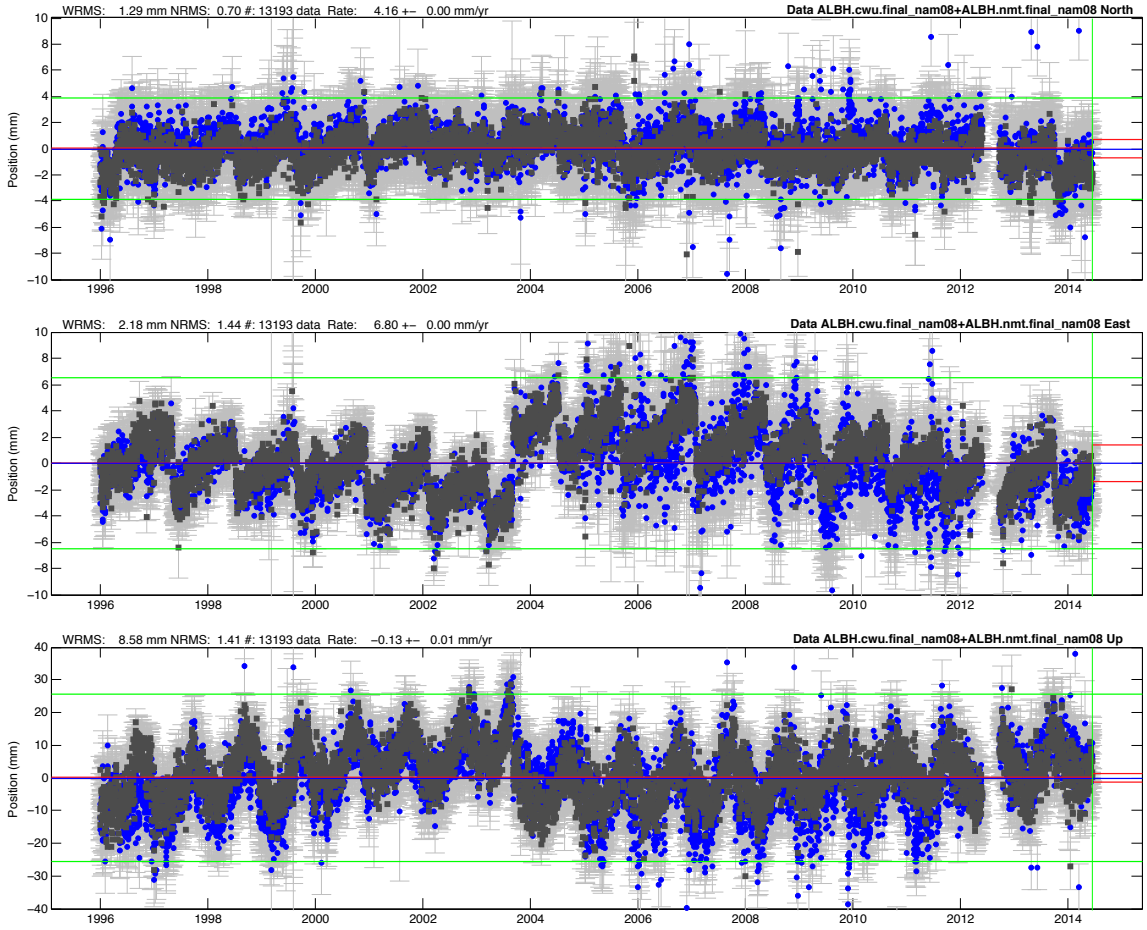

Figure 18: Similar to Figure 17 but with the NMT result added in black (CWU results are blue). ETS events are now clearly seen.

Script updates

We have now abandoned trying to use LDM to transfer reprocessed SINEX files to UNAVCO. There was too much unexplained loss of data presumably due to overflows of the 12 Gbyte queue at MIT and slow transfer of the results from the UNAVCO queue to the ftp area. A special scp area has been set up and transfer with scp has been much successful. Currently (2014/07/11) updated SINEX files through to GPS week 1289 (2014/09/19) have been sent to UNAVCO and the products ftp area has been updated to about 1040 (end of 1999). We will continue transferring reprocessed results with scp and the archive should be updated rapidly. The standard products will continue to be delivered with LDM and provided only a few Gbytes of results are queued at one time, this procedure should be adequate. We will run scripts that verify the ftp products area is consistent with the MIT products.

We also needed to update scripts here that need lists of stations from specific networks (e.g., PBO, COCO Net, GAMA etc) because the java routine used to return metadata and obtain lists of sites is timing out for the PBO network. The other network lists still work fine. As a work around, we now use static lists of stations with the original static list for

PBO generated by testing each station in the processing that did not appear in the other network lists to see if the station is PBO or not. This change effected both our quarterly and monthly report generation.

GAMIT/GLOBK Community Support

During this period we carried out routine development of the GAMIT/GLOBK software: minor enhancement of 10 features, including the script that combines field surveys with PBO solution files; table updates for a new GPS satellite launch; and support for 2 new receivers and 2 new antennas.

There were no workshops, but we spent 5-10 hours per week in email support for users. During this period, we issued royalty-free licenses to 22 new users from universities and government laboratories.