WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #26

Reporting Period: July 1 to September 30, 2008

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Atlantic City International Airport, NJ 08405
Website: http://www.nstb.tc.faa.gov/

Executive Summary

Since 1999 the WAAS Test Team at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS Test Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the twenty-sixth such WAAS quarterly report. This report covers WAAS performance during the period from July 1, 2008 to September 30, 2008.

The following table shows observations for accuracy and availability made during the reporting period. See the body of the report for additional results in accuracy, availability, safety index, range accuracy; WAAS broadcast message rates and GEO ranging availability. Please note that the results in the below table are valid when the Localizer Precision with Vertical Guidance (LPV) service is available. LPV service is available when the calculated Horizontal Protection Level (HPL) is less than 40 meters and the Vertical Protection Level (VPL) is less than 50 meters. LPV 200 service is available when the calculated HPL is less than 40 meters and the VPL is less than 35 meters.

Parameter	**CONUS Site/Maximum**	**CONUS Site/Minimum**	**All Sites Site/Maximum**	**All Sites Site/Minimum**
95% Horizontal Accuracy	Seattle 0.767	Washington DC 0.511 meters	Tapachula 1.104 meters	Fairbanks 0.476 meters
95% Vertical Accuracy	Atlantic City 1.222 meters	Salt Lake City 0.798 meters	Iqaluit 1.7 meters	Salt Lake City 0.798 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Salt Lake City 99.99576%	Oakland 99.752%	Salt Lake City 99.99576%	Tapachula 42.779%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	Salt Lake City 99.977%	Arcata 93.684%	Billings 99.981%	Tapachula 9.32%
95% HPL	Arcata 20.43 meters	Memphis 12.557 meters	San Juan 56.156 meters	Memphis 12.557 meters
95% VPL	Arcata 35.219 meters	Chicago 20.299 meters	San Juan 90.805 meters	Chicago 20.299 meters

Please note the following changes to this and all future reports. Section 2 – Accuracy will replace histograms of vertical and horizontal error distribution for three receivers with histograms of error distribution of 38 WAAS receiver location combined. Section 4 – Coverage will no longer include monthly coverage plots. Section 13 – GPS IGS SPS accuracy performance will be evaluated in the GPS PAN report.

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1.0 INTRODUCTION

The FAA began monitoring GPS SPS performance in order to ensure the safe and effective use of the satellite navigation system in the National Airspace System (NAS). The Wide Area Augmentation System (WAAS) adds more timely integrity monitoring of GPS and improves position accuracy and availability of GPS within the WAAS coverage area.

Objectives of this report are:

a. To evaluate and monitor the ability of WAAS to augment GPS by characterizing important performance parameters.
b. To analyze the effects of GPS satellite operation and maintenance, and ionospheric activity on the WAAS performance.
c. To investigate any GPS and WAAS anomalies and determine their impact on potential users.
d. To archive performance of GPS and WAAS for future evaluations.

The WAAS data transmitted from Geostationary satellites (GEO) PRN#135 (CRW) and PRN#138 (CRE) were used in the evaluation. For this evaluation period, both CRW and CRE GEOs provide a ranging capability for enroute through NPA and begin providing a ranging capability for PA service on September 22, 2008 when Release 8/9.2 software becomes operational.

Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from July 1, 2008 to September 30, 2008

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	84	7238873
Atlantic City	83	7150620
Oklahoma City	77	6693733
WAAS:		
Albuquerque	92	7935124
Anchorage	92	7936972
Atlanta	92	7936044
Barrow	92	7921997
Bethel	92	7924922
Billings	92	7917680
Boston	92	7936990
Chicago	92	7938410
Cleveland	92	7933298
Cold Bay	89	7701527
Dallas	92	7920070
Denver	91	7902632
Fairbanks	92	7905949
Gander	92	7919918
Goose Bay	92	7907493
Houston	92	7934395
Iqaluit	92	7935779
Jacksonville	92	7934692
Juneau	84	7250115
Kansas City	92	7932227
Kotzebue	92	7922709
Los Angeles	92	7936138
Memphis	92	7934296
Merida	90	7788460
Mexico City	58	4981365
Miami	92	7935339
Minneapolis	92	7932539
New York	92	7930574
Oakland	92	7921504
Puerto Vallarta	90	7802438
Salt Lake City	92	7924878
San Jose Del Cabo	91	7856303
San Juan	92	7910972
Seattle	92	7919911
Tapachula	90	7809135
Washington DC	92	7936528
Winnipeg	92	7934639

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	92	7940583
Anchorage	92	7942418
Atlanta	92	7939874
Barrow	92	7928609
Bethel	92	7930368
Billings	92	7923085
Boston	92	7942437
Cleveland	92	7942629
Cold Bay	89	7706989
Fairbanks	92	7911487
Gander	92	7925375
Honolulu	92	7940444
Houston	92	7940126
Iqaluit	92	7941525
Juneau	84	7255503
Kansas City	92	7935159
Kotzebue	92	7928516
Los Angeles	92	7942218
Merida	90	7793905
Miami	92	7941421
Minneapolis	92	7941801
Oakland	92	7942320
Salt Lake City	85	7328072
San Jose Del Cabo	91	7857181
San Juan	92	7941503
Seattle	92	7922451
Tapachula	90	7814596
Washington DC	92	7939886

The report is divided in the performance categories listed below. This report also includes WAAS LPV Service Availability at Selected Airports, WAAS Deterministic Code Noise and Multipath (CNMP) Bounding Analysis, WAAS reference station survey validation and SQM type and PRN bias monitoring.

1. WAAS Position Accuracy
2. WAAS Operational Service Availability
3. Coverage
4. Integrity
5. WAAS Range Domain Accuracy
6. GEO Ranging Performance

Table 1.3 lists the performance parameters evaluated for the WAAS in this report. Please note that these are the performance parameters associated with the WAAS IOC system. These requirements are extracted from the FAA Specification FAA-E-2892B Change 1and FAA Specification FAA-E-2976, as applicable.

Table 1-3 WAAS Performance Parameters

Performance Parameter	Expected WAAS Performance
LPV Accuracy Horizontal	≤ 1.5m error 95% of the time
LPV Accuracy Vertical	≤ 2m error 95% of the time
LNAV Accuracy Horizontal	≤ 36m error 95% of the time
Availability LPV CONUS	99% availability of 100% of CONUS
Availability LPV Alaska	95% availability of 75% of Alaska
Availability LNAV CONUS	99.99% availability with HPL < 556m
Availability LNAV Alaska	99.9% availability with HPL < 556m
Availability Enroute OCONUS	99.9% availability with HPL < 2nmi
Probability of HMI	< 10e-7 per approach

* Instantaneous availability (i.e. Availability is calculated every second.)

1.1 Event Summary

Table 1.4 lists test events that occurred during the reporting period that affected WAAS performance or the ability to determine the WAAS performance. These events include GPS or WAAS anomalies, relevant receiver malfunctions, and receiver maintenance conducted. Detailed analyses of particular events are documented in the Discrepancy Reports (DR). The DRs are posted on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports' and can also be accessed via hyperlink from Table 1.4 below.

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1486 day 2 to 1487 day 1	7/1/08 to 7/7/08	Salt Lake City	Salt Lake City Thread A outage - Bad frequency standard on thread A.
1487 day 5	7/11/08	All Sites	Split Selected Source - 3 CRW, 2 CRE SV Alerts.
1487 day 5	7/11/08	CONUS	CONUS Coverage drop due to PRN 4 outage (NANU 2008064).
1488 day 4	7/17/08	All Sites	CRW manual GUS switchover from APA to APC.
1488 day 5	7/18/08	CONUS	CONUS Coverage drop due to PRN 20 outage (NANU 2008069)
1489 day 3	7/23/08	Cleveland	Cleveland High Error/ratio - Bad OCX0 card.
1490 day 0	7/27/08	All Sites	WEI Outage – 77 seconds.
1490 day 1	7/28/08	All Sites	CRW outage – 1 sec, not Source Select or GUS sw.
1490 day 1	7/28/08	All Sites	Coverage drop due to PRN 31 outage (NANU 2008076).
1490 day 3	7/30/08	CONUS	CONUS Coverage drop due to PRN 17 outage (NANU 2008077).
1490 day 3	7/30/08	All Sites	CRW outage – 1 sec, not Source Select or GUS sw.
1490 day 6	8/2/08	All Sites	WEI Outage – 74 sec.
1491 day 4 to 1491 day 5	8/7/08 to 8/8/08	All Sites	Coverage drop due to PRN 28 outage (NANU 2008086).
1493 day 2	8/19/08	Barrow, Kotzebue	ZLA C&V Fault – selected source for CRW. No effect on Reference stations in Dual GEO Service area, except Barrow and Kotzebue.
1494 day 2	8/26/08	All Sites	Release 8/9.2 Cutover began.
1494 day 2	8/26/08	All sites	CRW outage - no loss of Coverage to users in Dual Geo Area.
1494 day 4	8/28/08	All sites	Coverage drop due to PRN31 outage (NANU2008095).
1494 day 6	8/30/08	All sites	CRW outages – See DR #73, "CRW High L5 C/N0 and GUS Switchovers".
1495 day 0	8/31/08	Memphis	Memphis High Error/ratio due to bad OCX0 card.
1495 day 0	8/31/08	All sites	CRW outage – See DR #74, "CRW 32 min SIS Outage".
1495 day 0	8/31/08	Los Angeles Houston Dallas	LPV Outages due to an improper GEO data stream switch at the time of the CRW signal in space outage.
1495 day 0	8/31/08	OKC	OKC Coverage – hardware fault.
1495 day 3	9/03/08	All sites	WEI Outage.
1495 day 5	9/05/08	CONUS	Coverage drop due to PRN 7 outage (NANU 2008099).
1495 day 6	9/06/08	All Sites	Data Outage – Ring 1 and Ring 2.
1496 day 0	9/07/08	All Sites	Data Outage – Ring 1 and Ring 2.
1496 day 5	9/12/08	CONUS Sites	Coverage drop due to PRN 23 outage (NANU2008104).
1497 day 2	9/16/08	Wash. DC	ZDC Comm Outage.
1497 day 2 to 1497 day 3	9/16/08 to 9/17/08	All Sites	Coverage drop due to PRN 17 outage (NANU2008106).
1497 day 5	9/19/08	Denver	ZDV Clock Error.
1498 day 1	9/22/08	All Sites	Coverage drop due to PRN 11, 22, and 32 go to NPA mode when new RL8/9.2 software becomes operational.
1498 day 1	9/22/08	All Sites	Release 8/9.2 Cutover completed.
1498 day 3 to 1499 day 2	9/24/08 to 9/30/08	Juneau	Local comm outage, all three threads.
1498 day 4	9/25/08	All sites	Wei Outage.
1498 day 6	9/27/08	CONUS Sites	See DR #75, "C&V Initialization Caused WAAS Service Outage".

1.2 Report Overview

Section 2 provides the vertical and horizontal position accuracies from data collected, on a daily basis, at one-second intervals. The 95% accuracy index and the maximum accuracy for the reporting period are tabulated. The daily 95% accuracy index is plotted graphically for each receiver. Histograms of the vertical and horizontal error distribution are provided for the combined 38 WAAS receiver location within the WAAS service area.

Section 3 summarizes the WAAS instantaneous availability performance, at each receiver, for three operational service levels during the reporting period. Daily availability is also plotted for each receiver evaluated. The number of outages and outage rate for each site is reported.

Section 4 provides the percent of coverage provided by WAAS on a daily basis. Monthly roll-up graphs presented indicate the portions of service volume covered, and the percentage of time that WAAS was available.

Section 5 summarizes the number of HMI's detected during the reporting period and presents a safety margin index for each receiver. The safety index reflects the amount of over bounding of position error by WAAS protection levels. This section also includes update rates of WAAS messages transmitted from CRE and CRW.

Section 6 provides the UDRE and GIVE bounding percentage and the 95% index of the range and ionospheric accuracy for each satellite tracked by the WAAS receiver in Atlanta.

Section 7 provides the GEO ranging performance for CRE and CRW.

Section 8 summarizes WAAS anomalies and problems identified during the reporting period, which adversely affect WAAS performance described in Table 1.3.

Section 9 provides WAAS LPV availability and outages at selected airports.

Section 10 provides the assessment of WAAS CNMP bounding for 114 WAAS receivers.

Section 11 provides the surveyed positions of all WREs and the difference between the WRE survey in the current software and the survey in this report.

Section 12 provides the daily and quarterly average of SQM PRN type biases and PRN biases.

2.0 WAAS POSITION ACCURACY

Navigation error data, collected from WAAS and NSTB reference stations, was processed to determine position accuracy at each location. This was accomplished by utilizing the GPS/WAAS position solution tool to compute a MOPS-weighted least squares user navigation solution, and WAAS horizontal and vertical protection levels (HPL & VPL), once every second. The user position calculated for each receiver was compared to the surveyed position of the antenna to assess position error associated with the WAAS SIS over time. The position errors were analyzed and statistics were generated for three operational service levels: WAAS LPV, WAAS LPV 200, and WAAS LNAV/VNAV, as shown in Table 2.1. For this evaluation, the WAAS operational service level is considered available at a given time and location, if the computed WAAS HPL and VPL are within the horizontal and vertical alarm limits (HAL & VAL) specified in Table 2.1.

Table 2-1 Operational Service Levels

WAAS Operational Service Levels	Horizontal Alert Limit HAL (meters)	Vertical Alert Limit VAL (meters)
LPV (LOC/VNAV)	40	50
LNAV/VNAV	556	50
LPV 200	40	35

Table 2.2 shows PA horizontal and vertical position accuracy maintained for 95% of the time at LPV and LNAV/VNAV operational service levels for the quarter. The table also includes 95% SPS accuracy for certain locations. Figures 2.1 to 2.6 show the daily horizontal and vertical 95% accuracy for LPV operational service level for the period. Note that WAAS accuracy statistics presented are compiled only when all WAAS corrections (fast, long term, and ionospheric) for at least 4 satellites are available. This is referred to as PA navigation mode. The percentage of time that PA navigation mode was supported by WAAS at each receiver is also shown in Table 2.2. A user is considered to be in NPA navigation mode if only WAAS fast and long term corrections are available to a user (i.e. no ionospheric corrections). Table 2.3 shows NPA horizontal position accuracy for 95% and 99.999% of the time. This table also shows the maximum NPA horizontal position error for the quarter. Figures 2.7 to 2.8 show the daily horizontal 95% accuracy for NPA.

During this reporting period, the 95% horizontal and vertical accuracy at all evaluated sites are less than 2 meters for both WAAS operational service levels. The maximum 95% CONUS horizontal and vertical LPV errors are 0.767 meters at Seattle and 1.222 meters at Atlantic City, respectively. The minimum 95% horizontal and vertical LPV errors are 0.516 meters at Washington DC and 0.798 meters at Salt Lake City, respectively. The maximum 95% and 99.999% NPA horizontal errors are 1.89 meters and 5.305 meters, both at Honolulu, respectively. The minimum 95% and 99.999% horizontal errors are .614 meters at Barrow and 1.642 meters at Iqaluit, respectively.

For this evaluation period, both CRW and CRE GEOs provide a ranging capability for enroute through NPA and begin providing a ranging capability for PA service on September 22, 2008 when Release 8/9.2 software becomes operational.

Table 2.4 shows the maximum horizontal and vertical position errors while the calculated HPL and VPL met the LPV service levels. The column marked 'Horizontal (or Vertical) Error/HPL (or VPL)' is the ratio of position error to protection level at the time the maximum error occurred. The column marked 'Horizontal (or Vertical) Maximum Ratio' is the maximum position error to protection level ratio for the quarter.

Figures 2.9 to 2.12 show the distributions of the vertical and horizontal errors at all 38 WAAS receiver locations combined in triangle charts and 2-D histogram plots for the quarter. The triangle charts in Figure 2.9 and 2.10 show the distributions of vertical position errors (VPE) versus vertical protection levels (VPL) and horizontal position errors (HPE) versus horizontal protection levels (HPL). The horizontal axis is the position error and the vertical axis is the WAAS protection levels. Lower protection levels equate to better availability. The diagonal line shows the point where error equals protection level. Above and to the left of the diagonal line in the chart, errors are bounded (WAAS is providing integrity in the position domain); below and to the right, errors are not bounded (HMI could be present). The 2-D histogram plots in Figure 2.11 and 2.12 show the distributions of vertical and horizontal position errors and normalized position errors. The blue trace shows the distributions of the actual vertical and horizontal errors. The horizontal axis is the position errors and the vertical axis is the total count of data samples (log scale) in each 0.1-meter bin. The magenta trace show the distributions of the actual vertical and horizontal errors normalized by one-sigma value of the protection level; vertical - (VPL/5.33) and horizontal - (HPL/6.0). The horizontal axis is the standard units and vertical axis is the observed distribution of normalized errors data samples in each 0.1-sigma bin. Narrowness of the normalized error distributions shows very good observed safety performance.

Table 2-2 PA 95% Horizontal and Vertical Accuracy

Location	Horizontal (HAL=40m) (Meters)	Horizontal (HAL=556m) (Meters)	Vertical (VAL=50m) (Meters)	Percentage in PA mode (%)	SPS Accuracy	
					95% Horizontal (Meters)	95% Vertical (Meters)
Arcata	0.874	0.874	1.139	99.99565	*	*
Atlantic City	0.740	0.741	1.222	99.99478	*	*
Oklahoma City	0.570	0.570	1.006	99.98887	*	*
Albuquerque	0.572	0.572	1.150	99.99588	1.994	3.438
Anchorage	0.497	0.497	0.945	99.99720	1.734	3.515
Atlanta	0.513	0.513	1.128	99.99553	2.008	3.939
Barrow	0.558	0.558	1.291	99.91885	1.473	4.061
Bethel	0.500	0.500	0.890	99.99681	1.814	3.550
Billings	0.635	0.635	1.051	99.99590	2.048	3.516
Boston	0.539	0.539	1.100	99.99530	2.005	3.946
Chicago	0.630	0.630	1.156	99.99565	*	*
Cleveland	0.600	0.600	1.094	99.99553	2.089	4.022
Cold Bay	0.796	0.800	0.913	99.99683	2.082	3.532
Dallas	0.564	0.564	1.056	99.99102	*	*
Denver	0.570	0.570	1.100	100.00	*	*
Fairbanks	0.476	0.476	1.057	99.99742	1.629	3.743
Gander	0.696	0.696	1.209	99.97429	1.958	3.455
Goose Bay	0.550	0.550	1.243	99.97511	*	*
Houston	0.612	0.612	1.165	99.99565	1.958	3.688
Iqaluit	0.582	0.592	1.700	99.96557	1.630	3.632
Jacksonville	0.516	0.516	1.216	99.99553	*	*
Juneau	0.509	0.509	1.133	100.00	1.873	3.380
Kansas City	0.580	0.580	1.164	99.99565	2.061	3.746
Kotzebue	0.517	0.518	1.245	99.92328	1.562	3.788
Los Angeles	0.688	0.688	1.029	99.99594	2.019	3.979
Memphis	0.524	0.524	1.201	99.99565	*	*
Merida	0.722	0.722	1.069	99.99533	2.214	3.834
Mexico City	0.839	0.839	0.970	99.99386	*	*
Miami	0.565	0.566	1.157	99.99553	2.061	4.007
Minneapolis	0.605	0.605	1.078	99.99565	2.013	3.716
New York	0.571	0.571	0.996	99.99530	*	*
Oakland	0.680	0.680	1.061	99.99596	2.061	4.093
Puerto Vallarta	0.911	0.915	1.157	99.99217	*	**
Salt Lake City	0.577	0.577	0.798	99.99590	2.057	3.577
San Jose Del Cabo	0.851	0.852	1.138	99.99544	2.202	3.552
San Juan	0.758	0.867	1.142	98.51511	2.008	4.114
Seattle	0.767	0.767	0.846	99.99591	2.106	3.545
Tapachula	1.104	1.135	1.103	98.90641	2.469	3.775
Washington DC	0.511	0.511	0.986	99.99530	2.012	4.025
Winnipeg	0.615	0.615	1.265	99.99573	*	*

* SPS accuracy not computed for this location.

Table 2-3 NPA 95% and 99.999% Horizontal Accuracy

Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	0.866	1.877	99.999070	3.038
Anchorage	0.904	1.894	99.999070	2.430
Atlanta	0.742	1.756	99.999070	2.222
Barrow	0.614	1.701	99.951910	2.483
Bethel	1.081	1.791	99.999070	2.436
Billings	1.222	2.491	99.999070	2.906
Boston	0.897	1.742	99.999070	6.662
Cleveland	0.951	2.957	99.999070	3.412
Cold Bay	1.329	2.306	99.999070	2.962
Fairbanks	0.799	1.917	99.999070	2.546
Gander	0.960	2.585	99.992150	2.776
Honolulu	1.890	5.305	99.983940	5.752
Houston	0.970	2.189	99.999040	2.571
Iqaluit	0.619	1.642	99.992310	2.049
Juneau	0.800	1.654	100.000000	2.631
Kansas City	0.957	1.714	99.999070	2.386
Kotzebue	0.864	1.917	99.951690	6.065
Los Angeles	1.000	1.799	99.999070	2.007
Merida	1.305	3.823	99.999030	3.988
Miami	0.914	2.642	99.999020	2.758
Minneapolis	1.023	1.884	99.999070	2.251
Oakland	1.122	4.646	99.999070	7.004
Salt Lake City	1.006	2.245	99.998990	5.143
San Jose Del Cabo	1.267	3.949	99.999030	4.054
San Juan	1.235	2.993	99.999020	3.095
Seattle	1.256	2.925	99.999070	5.735
Tapachula	1.704	3.747	99.999030	3.928
Washington DC	0.891	1.837	99.999070	2.030

Table 2-4 Maximum Position Errors and Position Error/Protection Level Ratio

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Arcata	2.619	0.129	0.167	4.809	0.146	0.159
Atlantic City	3.546	0.245	0.276	5.273	0.239	0.248
Oklahoma City	1.93	0.052	0.143	2.819	0.098	0.135
Albuquerque	2.438	0.154	0.158	3.267	0.103	0.164
Anchorage	2.24	0.157	0.157	3.518	0.071	0.122
Atlanta	1.645	0.062	0.171	4.674	0.189	0.251
Barrow	2.476	0.078	0.162	4.316	0.108	0.175
Bethel	2.515	0.143	0.143	3.585	0.103	0.103
Billings	2.281	0.118	0.161	2.935	0.099	0.139
Boston	1.845	0.046	0.139	2.809	0.109	0.16
Chicago	2.409	0.107	0.152	2.722	0.151	0.199
Cleveland	2.191	0.064	0.146	2.931	0.151	0.175
Cold Bay	2.505	0.082	0.104	4.542	0.116	0.13
Dallas	2.246	0.137	0.175	2.56	0.096	0.146
Denver	2.404	0.063	0.165	5.025	0.177	0.177
Fairbanks	2.608	0.179	0.182	4.332	0.178	0.178
Gander	2.271	0.057	0.09	3.059	0.094	0.108
Goose Bay	2.797	0.134	0.185	5.324	0.108	0.142
Houston	2.044	0.12	0.142	2.829	0.143	0.147
Iqaluit	2.55	0.129	0.129	5.302	0.181	0.181
Jacksonville	1.467	0.043	0.112	2.969	0.074	0.134
Juneau	2.173	0.156	0.156	3.617	0.133	0.158
Kansas City	2.279	0.124	0.154	3.316	0.129	0.198
Kotzebue	1.818	0.129	0.13	4.234	0.095	0.114
Los Angeles	2.508	0.136	0.174	3.18	0.165	0.165
Memphis	1.597	0.103	0.12	2.768	0.094	0.149
Merida	2.569	0.112	0.116	3.934	0.112	0.134
Mexico City	1.92	0.073	0.096	4.611	0.119	0.119
Miami	1.718	0.121	0.148	3.65	0.11	0.154
Minneapolis	2.353	0.211	0.212	2.997	0.147	0.151
New York	1.877	0.057	0.12	2.785	0.122	0.158
Oakland	2.665	0.167	0.172	4.808	0.202	0.202
Puerto Vallarta	2.669	0.095	0.116	4.867	0.144	0.17
Salt Lake City	2.362	0.142	0.161	2.435	0.14	0.14
San Jose Del Cabo	3.577	0.168	0.168	5.566	0.175	0.207
San Juan	2.906	0.073	0.098	5.305	0.153	0.156
Seattle	4.35	0.178	0.215	4.638	0.217	0.217
Tapachula	3.476	0.101	0.102	3.706	0.109	0.109
Washington DC	1.535	0.044	0.126	2.966	0.167	0.167
Winnipeg	2.609	0.096	0.151	2.881	0.109	0.168

Figure 2-1 95% Horizontal Accuracy at LPV

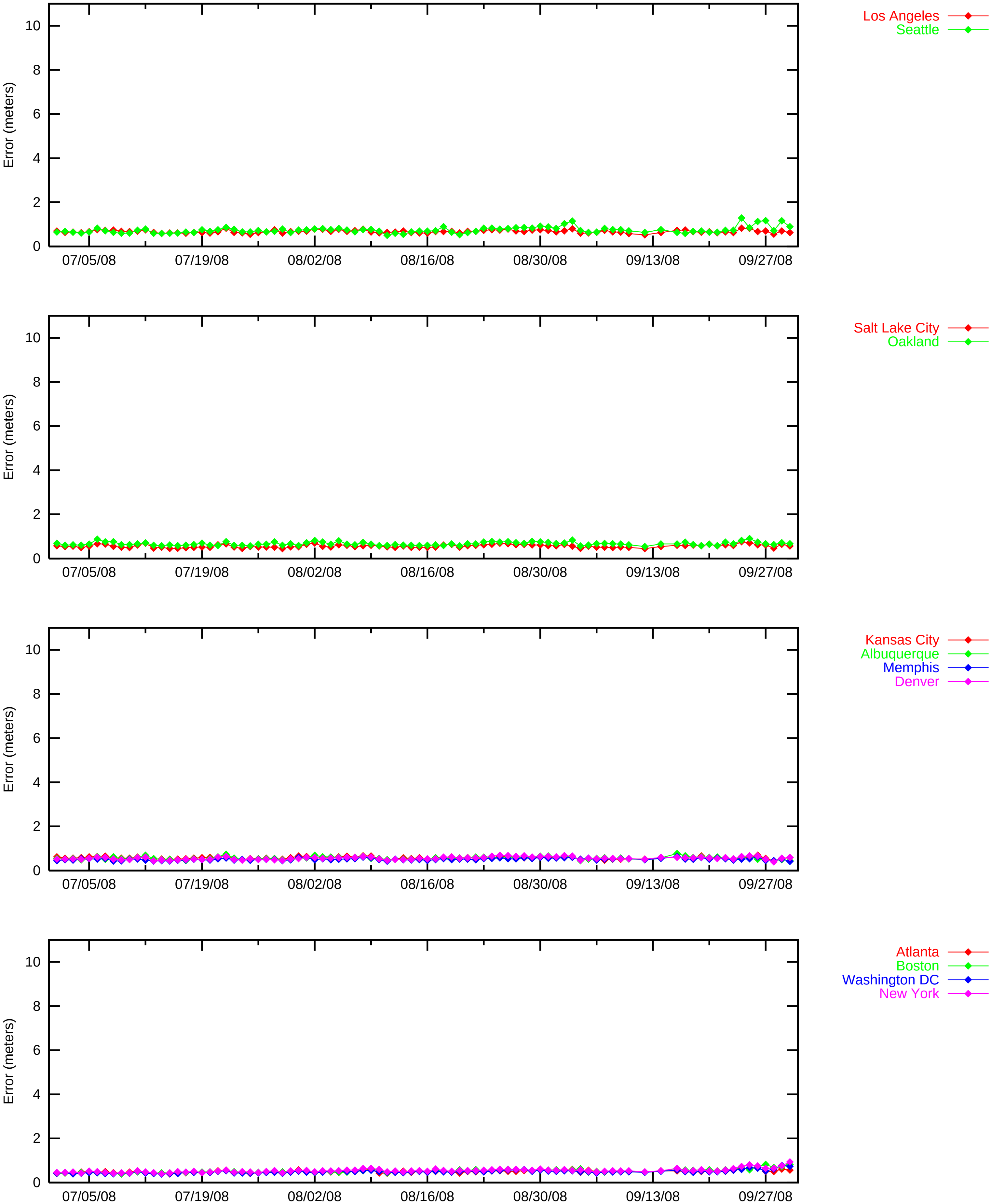


Figure 2-2 95% Horizontal Accuracy at LPV

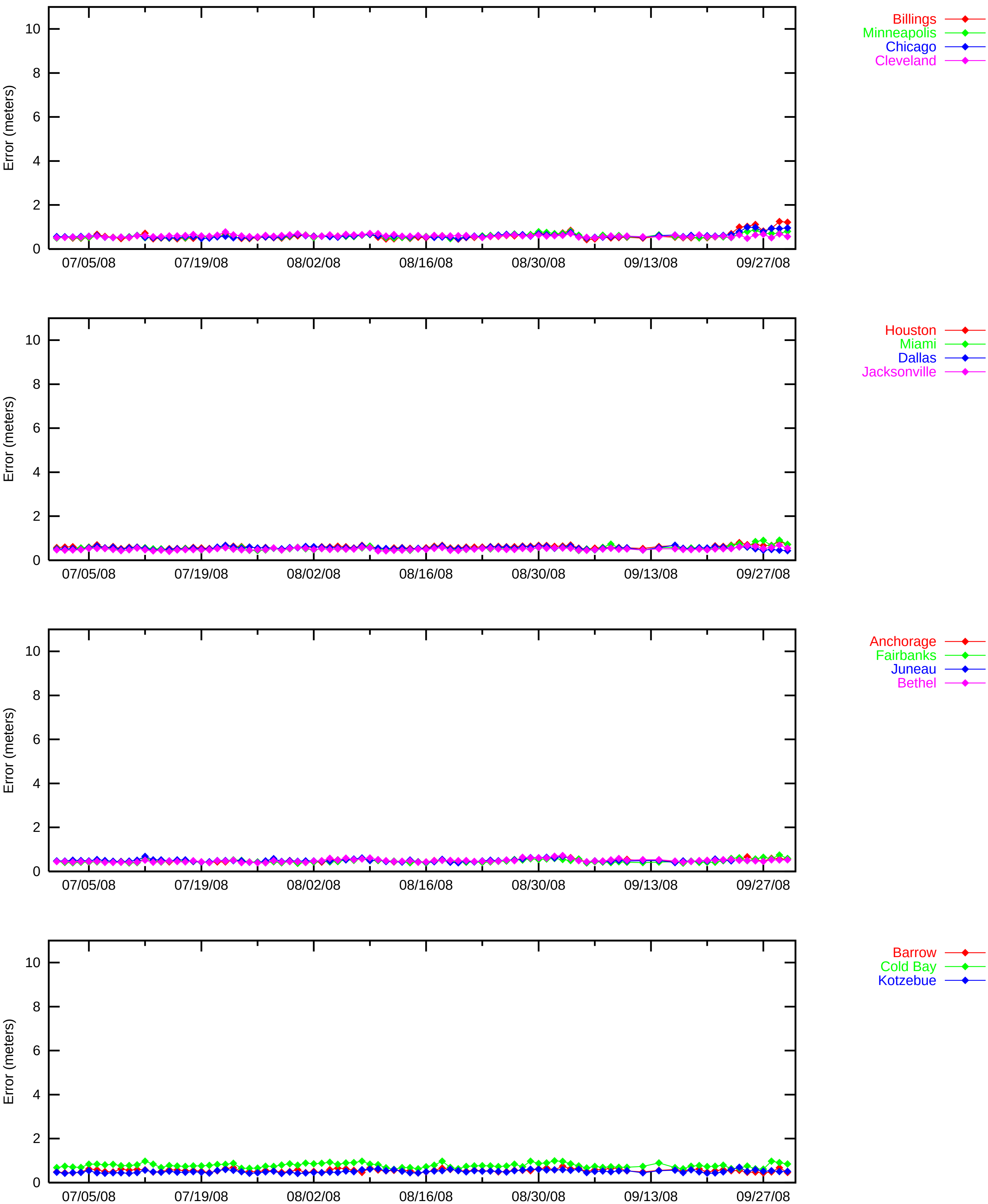


Figure 2-3 95% Horizontal Accuracy at LPV

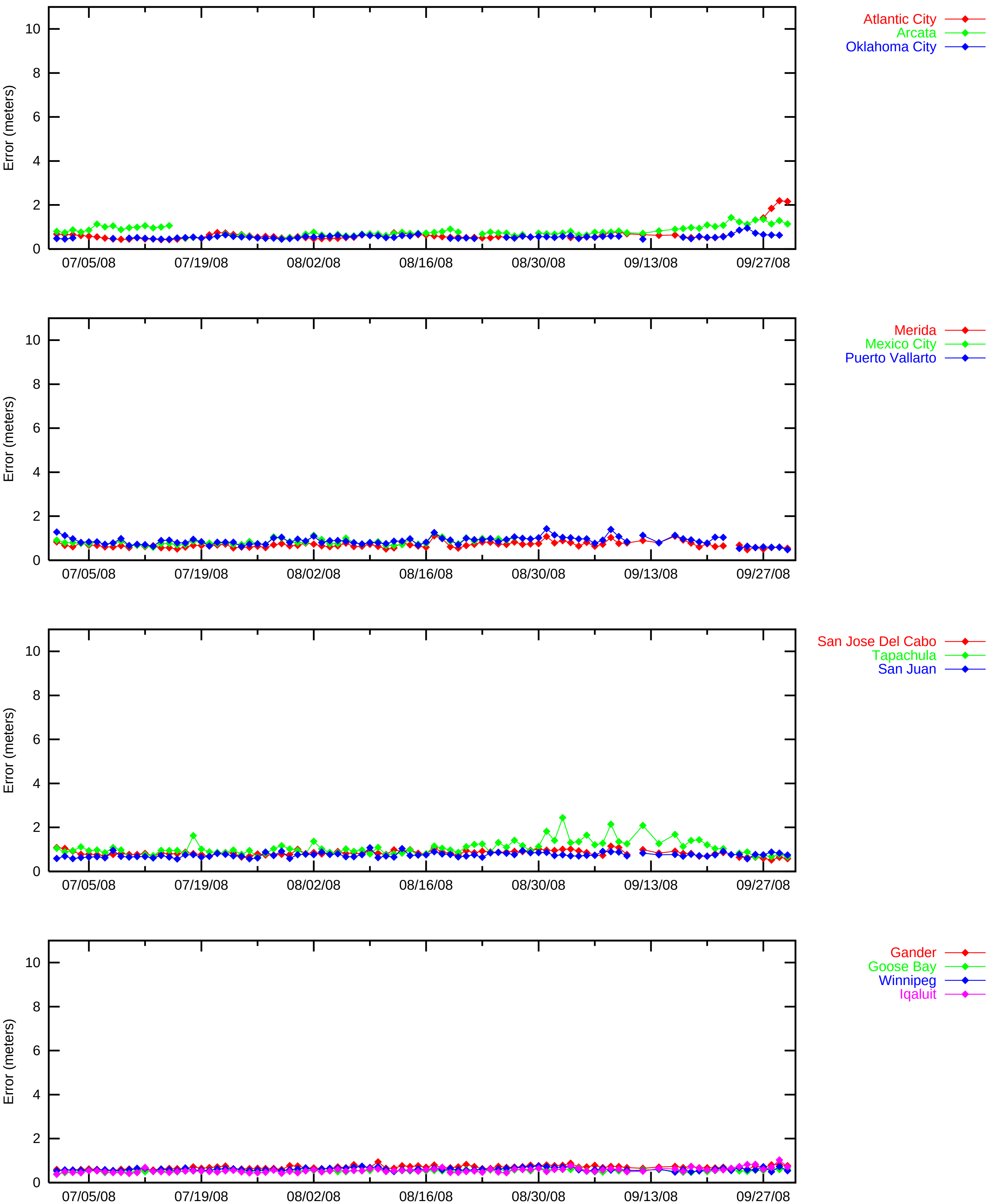


Figure 2-4 95% Vertical Accuracy at LPV

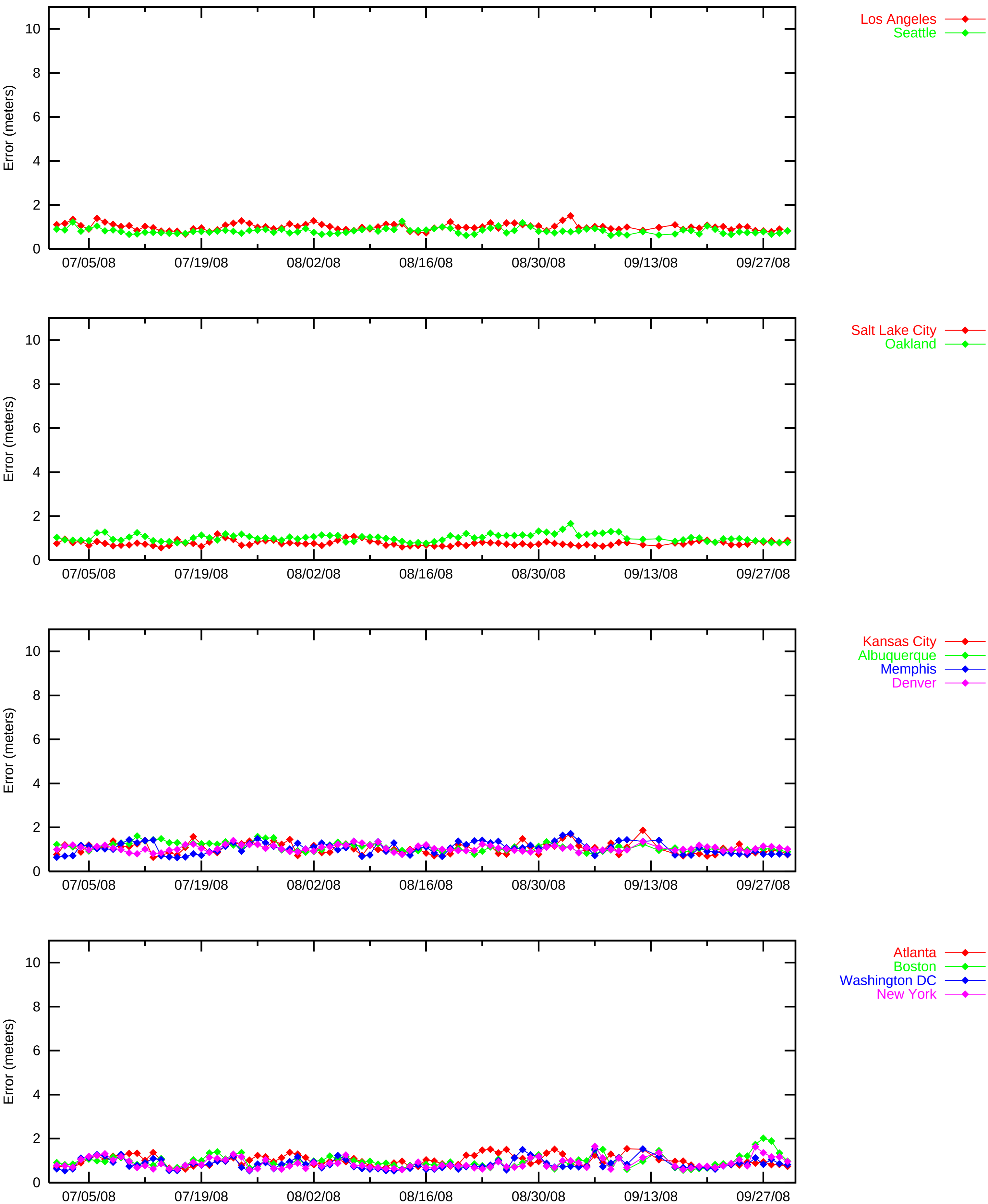


Figure 2-5 95% Vertical Accuracy at LPV

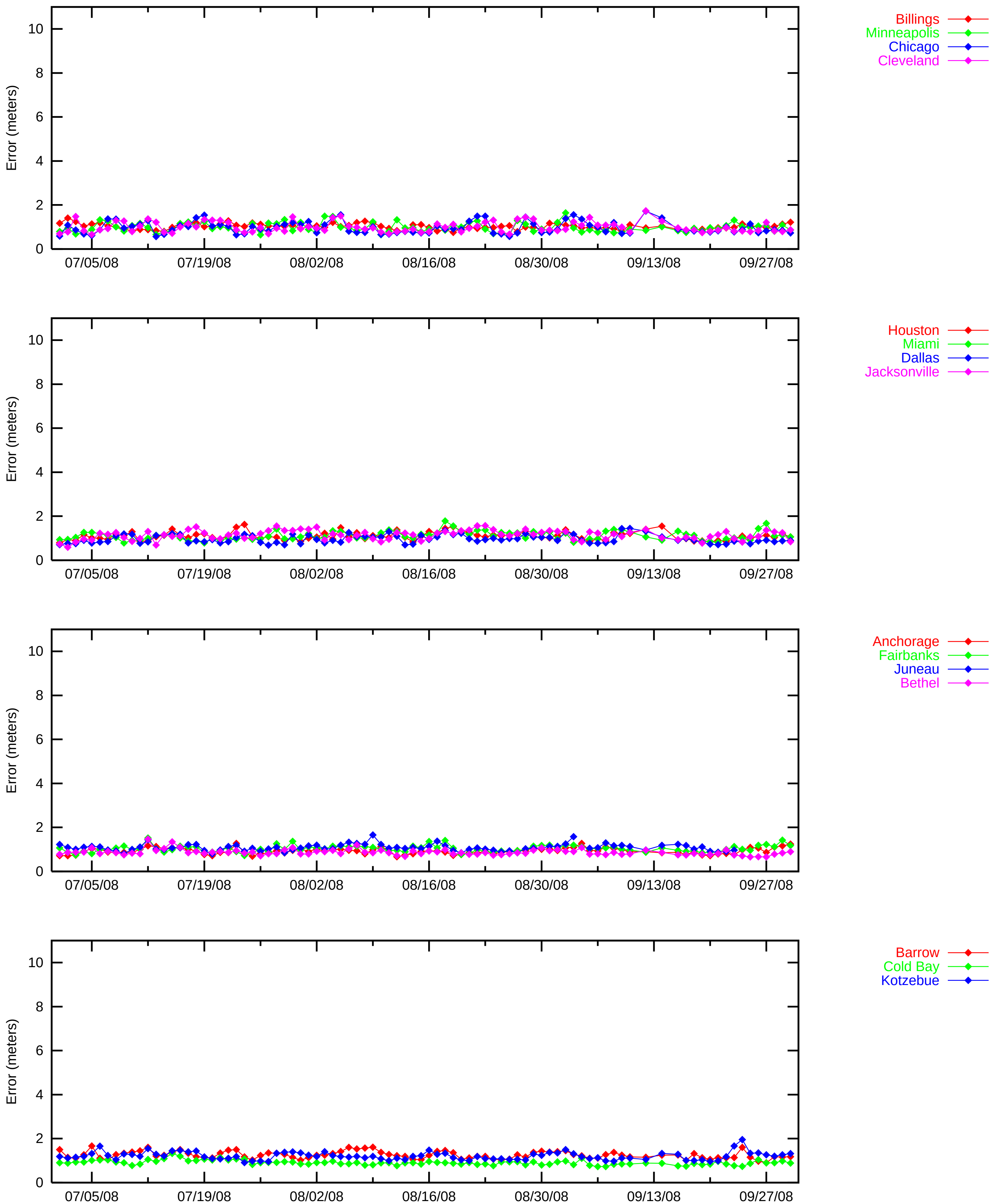


Figure 2-6 95% Vertical Accuracy at LPV

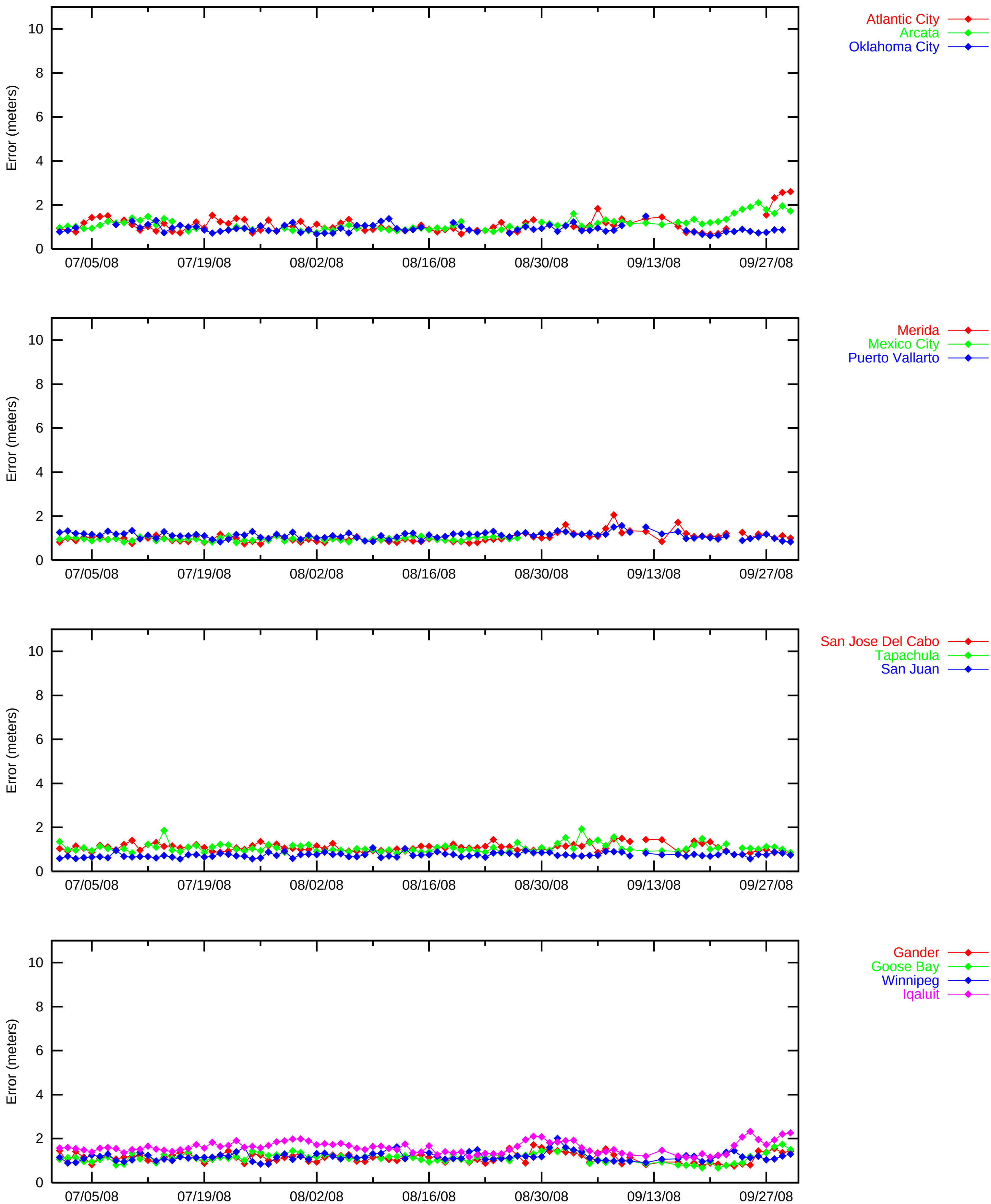


Figure 2-7 95% NPA Horizontal Accuracy

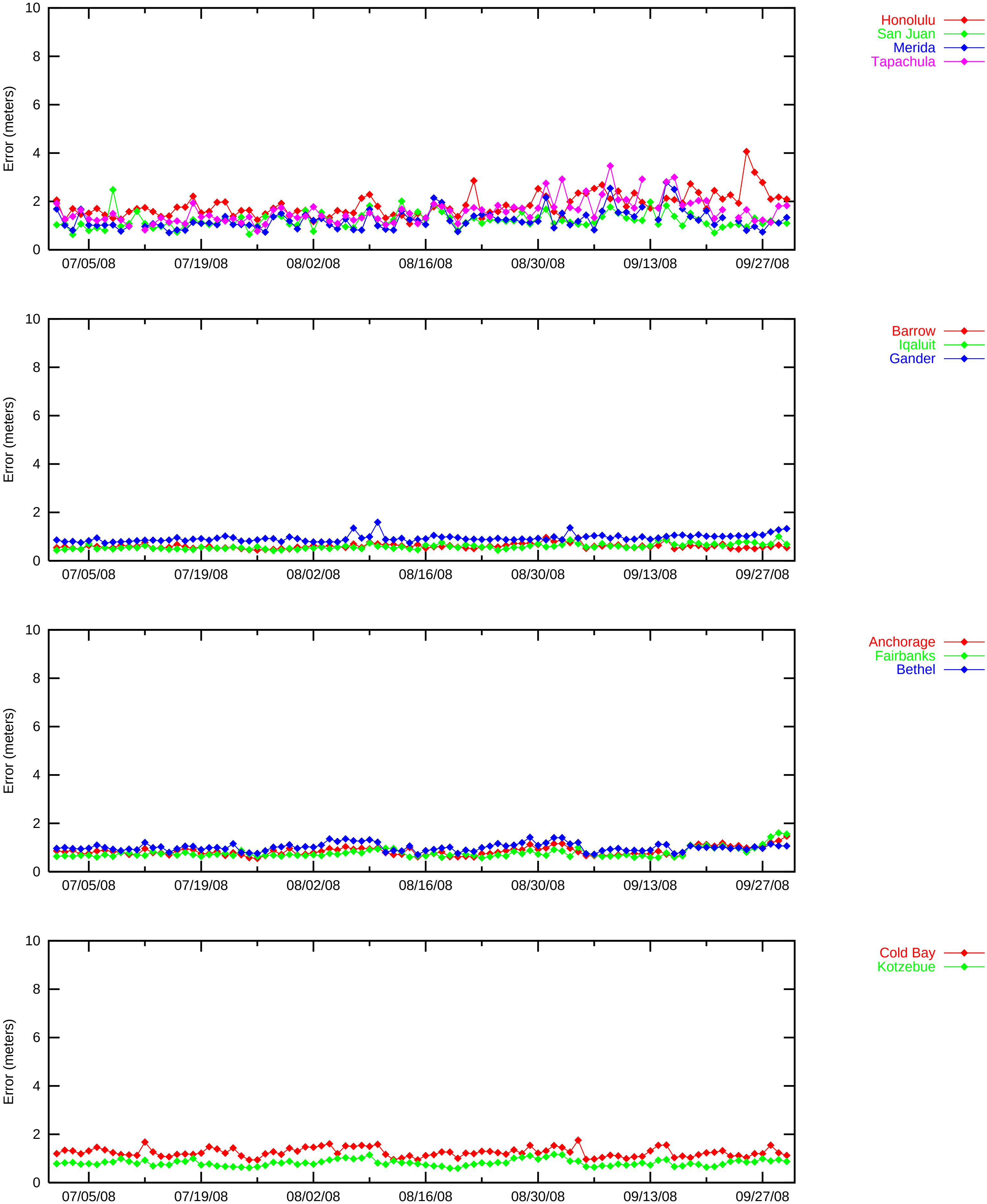
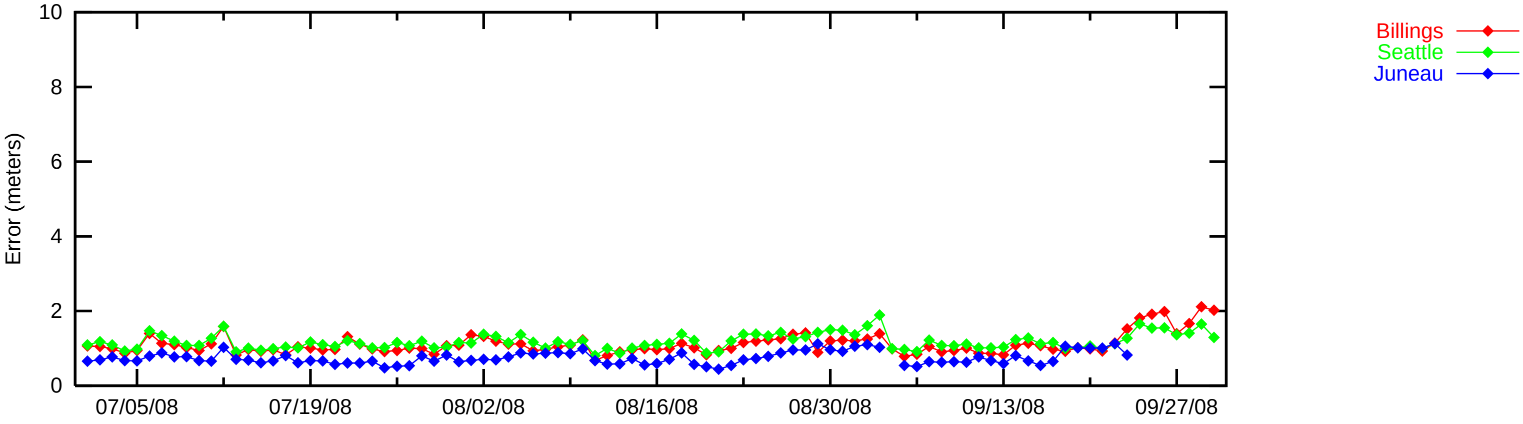
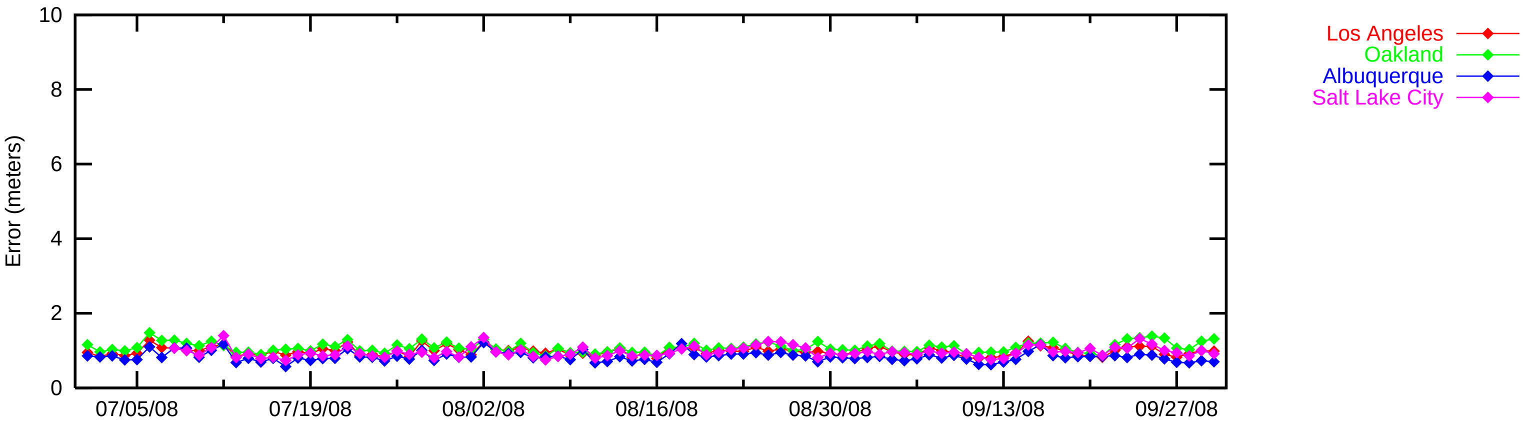
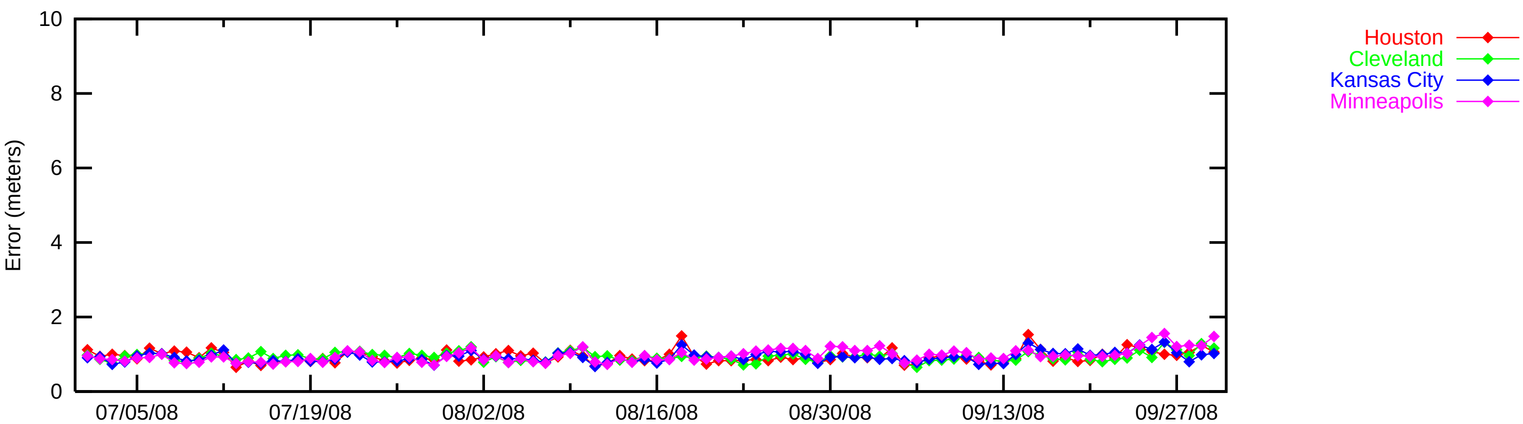


Figure 2-8 95% NPA Horizontal Accuracy







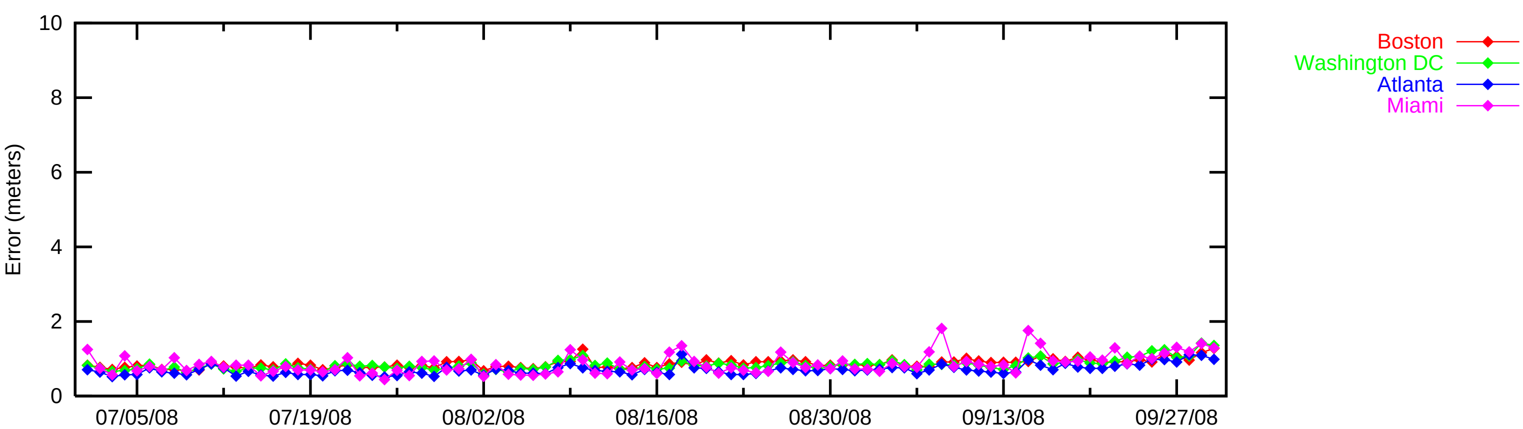


Figure 2-9 Horizontal Triangle Chart for the Quarter

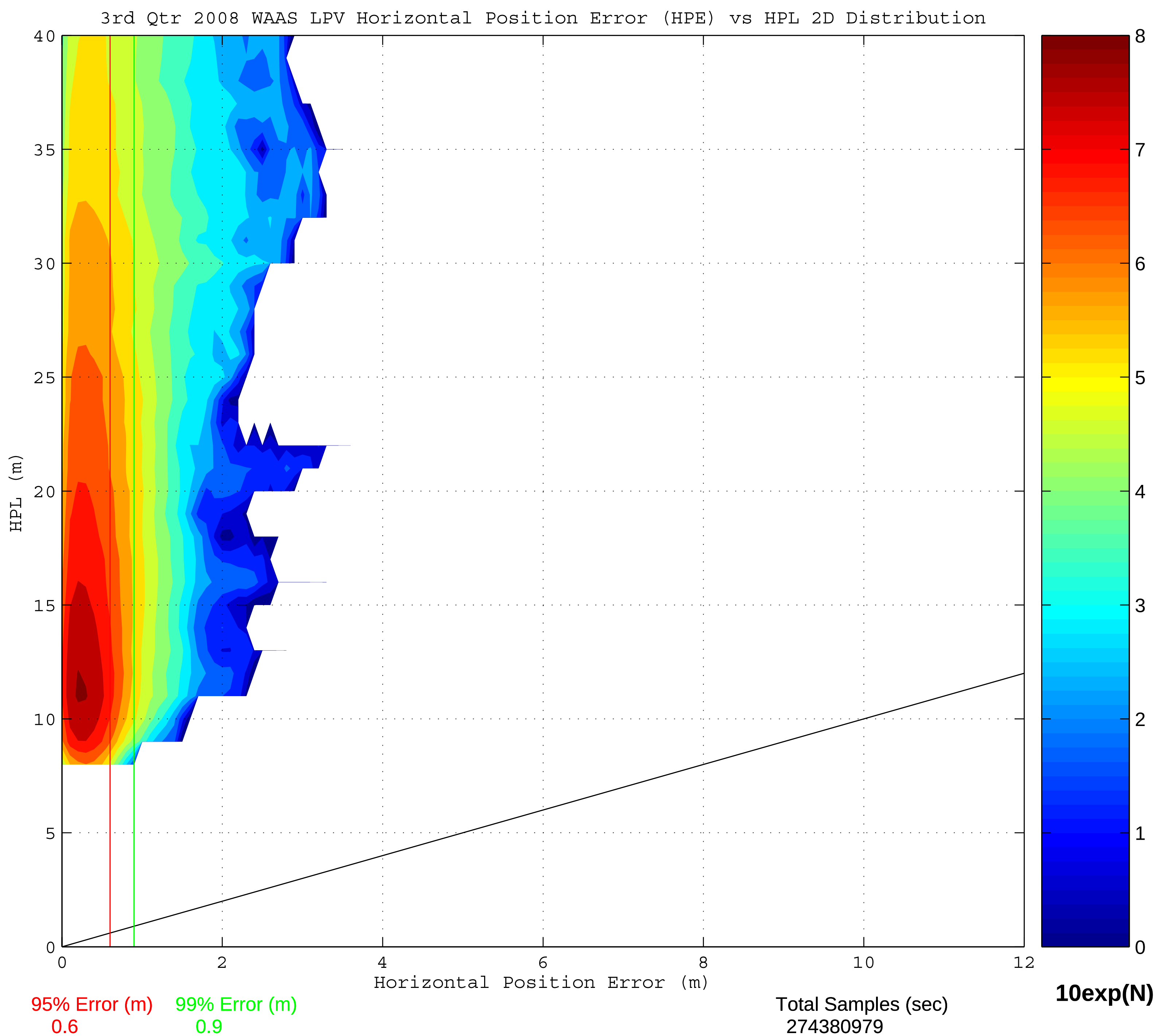


Figure 2-10 Vertical Triangle Chart for the Quarter

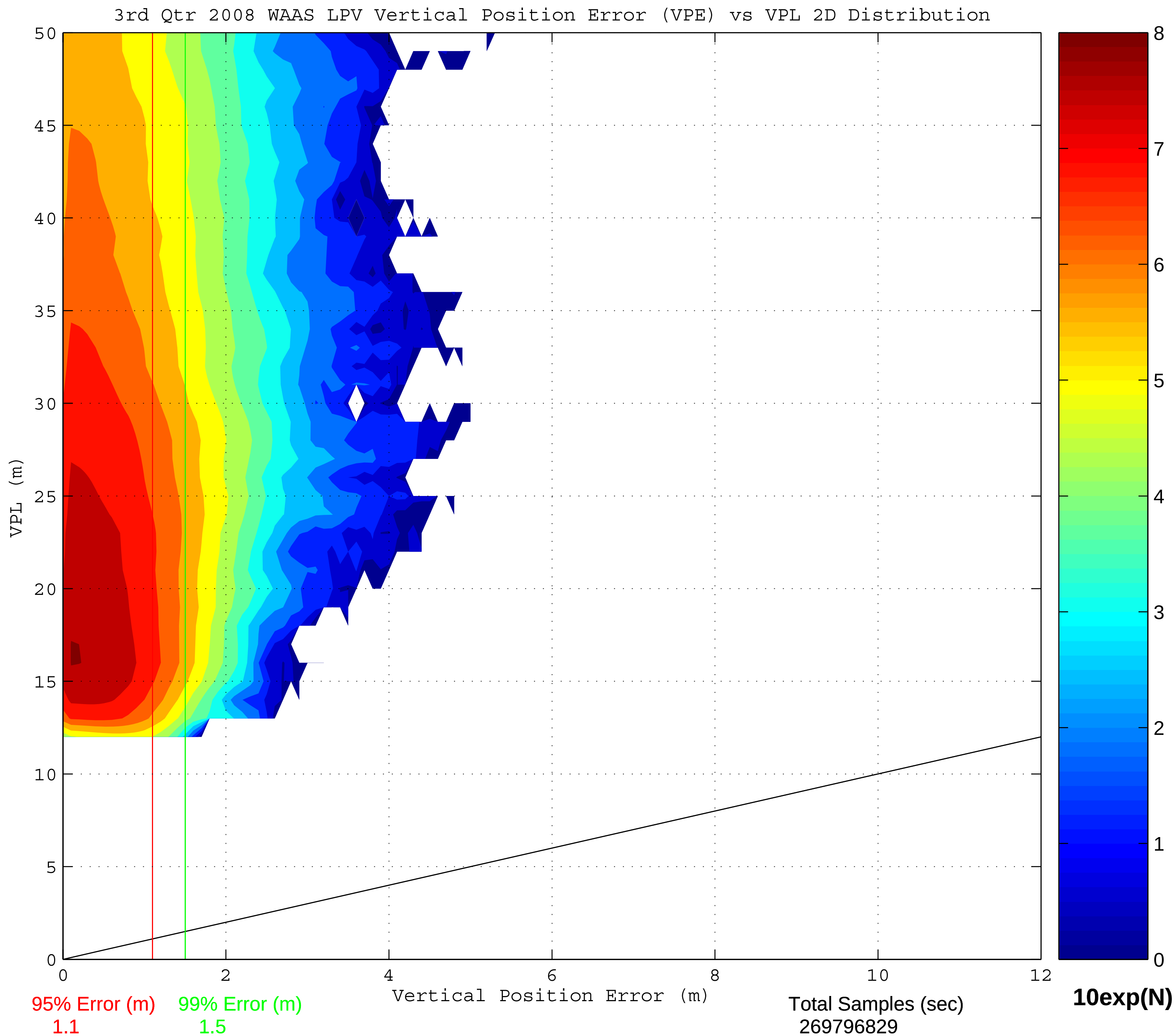


Figure 2-11 2-D Horizontal Histogram for the Quarter

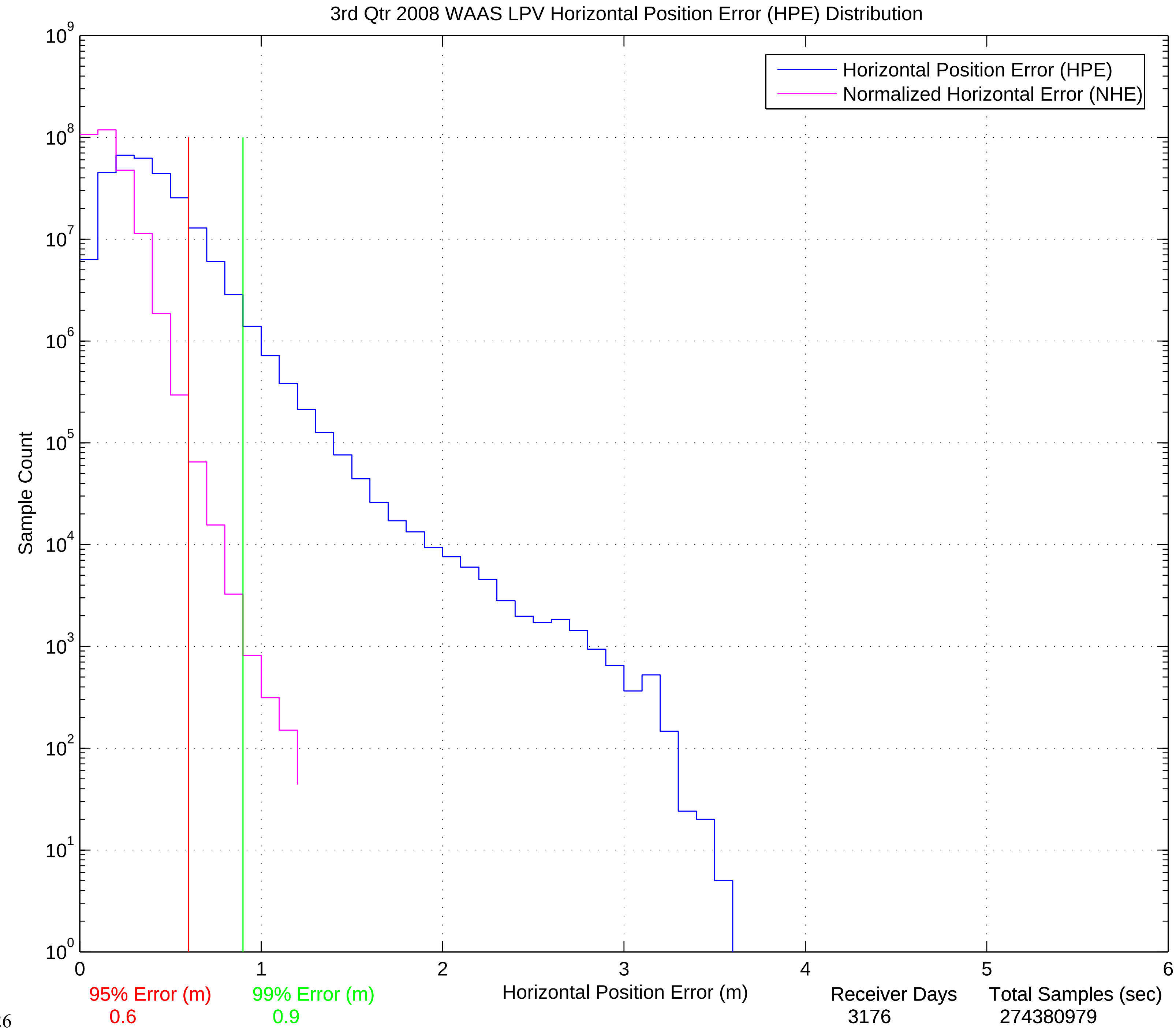
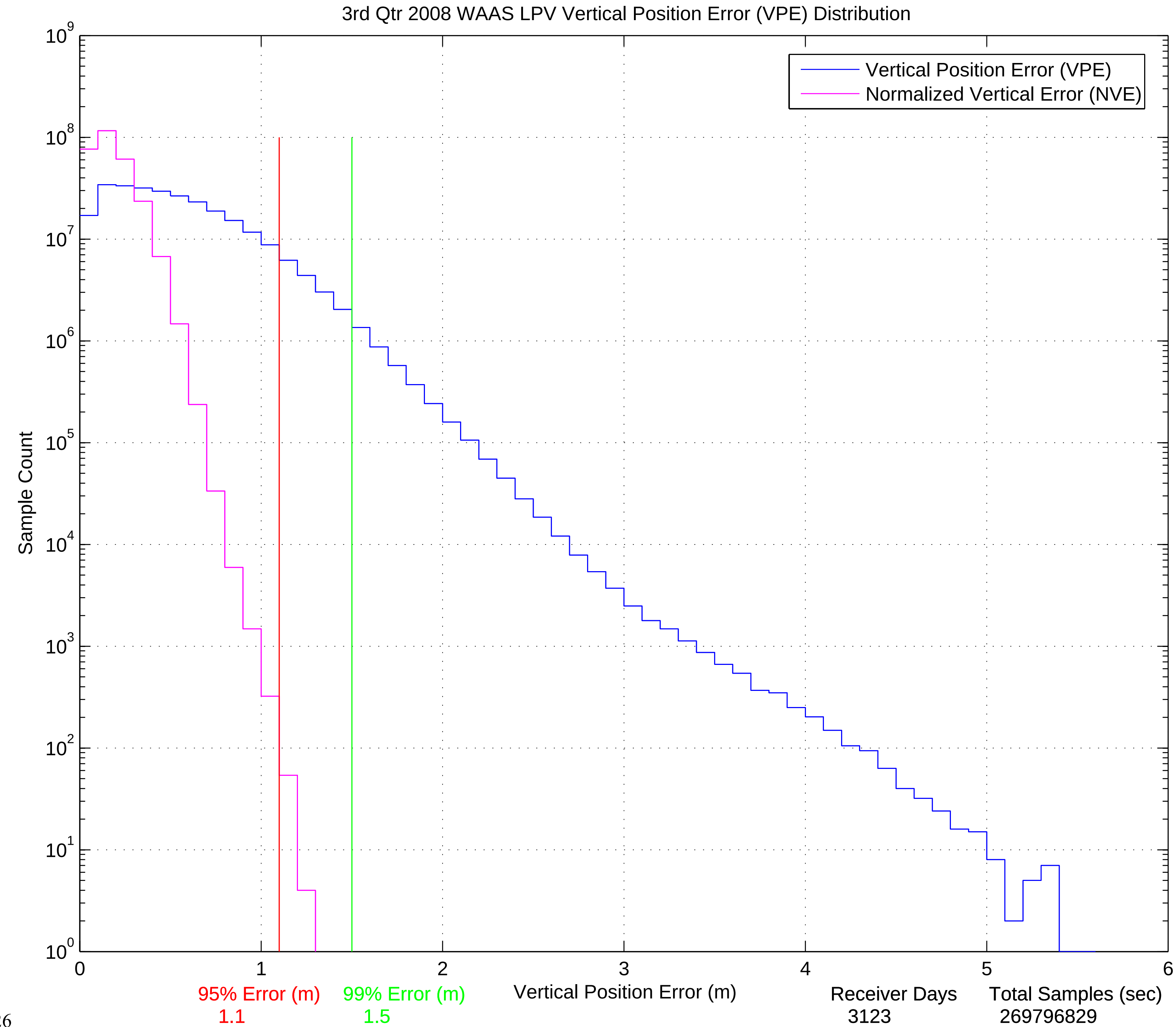


Figure 2-11 2-D Vertical Histogram for the Quarter



3.0 AVAILABILITY

WAAS availability evaluation estimates the probability that the WAAS can provide service for the operational service levels (LPV and LPV 200) defined in Table 2.1. At each receiver, the WAAS message, along with the GPS/GEO satellites tracked, were used to produce WAAS protection levels in accordance with the WAAS MOPS. Table 3.1 shows the protection levels that were maintained for 95% of the time for each receiver location for the quarter. The table also included the percentage in PA mode as described in section 2.0.

Availability LPV and LPV 200 service is evaluated by monitoring the WAAS protection levels at receiver locations throughout the test period. If both the vertical and horizontal protection levels are not greater than their respective alert limits (VAL and HAL) then the service is available. If either of the protection levels exceeds the required alert level then the operational service at that location is considered unavailable and an outage in service is recorded with its duration. The operational service is not considered available again until the protection levels are both within the alert limits for at least 15 minutes. Although this will reduce operational service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. The percent of time that LPV and LPV 200 service is available using the fifteen-minute window criteria is presented in Table 3.2. The LPV and LPV 200 service outages and associated outage rate for the test period is presented in Table 3.4. The outage rate is the percent of approaches that theoretically would be interrupted by a loss of operational service once the approach had started. Figures 3.1 through 3.6 show the daily availability of LPV and LPV 200 service levels, and Figures 3.7 through 3.12 show the daily interruptions of LPV and LPV 200 service levels for the evaluation period.

The following table shows the maximum and minimum 95% HPL and VPL observed for this evaluation period.

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	All Sites Site/Maximum	All Sites Site/Minimum
95% HPL	Arcata 20.43 meters	Memphis 12.557 meters	San Juan 56.156 meters	Memphis 12.557 meters
95% VPL	Arcata 35.219 meters	Chicago 20.299 meters	San Juan 90.805 meters	Chicago 20.299 meters

Availability of NPA service is evaluated by monitoring the WAAS horizontal protection level at receiver locations throughout the test period. If the horizontal protection level is not greater than the horizontal alert limit (HAL = 40m) then the service is available. If the horizontal protection level exceeds the required alert level or if WAAS navigation message is not received then the NPA service at that location is considered unavailable and an outage in service is recorded with its duration. The NPA service is not considered available again until the horizontal protection level is within the alert limit for at least 15 minutes. The percent of time that NPA service is available using the fifteen-minute window criteria is presented in Table 3.3. The NPA service outages and associated outage rate for this period is presented in Table 3.5. The outage rate is the percent of NPA approaches that theoretically would be interrupted by a loss of operational service once the approach had started.

During this reporting period, many satellite outages have caused the loss of LPV and NPA service (see Table 1.4 for these events). C&V initialization caused WAAS service outage on September 27, 2008 (see DR# 75). NPA outages at Iqaluit and Gander are mainly due to CRE GUS switchovers and NPA outages at Barrow and Kotzebue are due to CRE GUS switchovers. Honolulu has two additional NPA outages; outage occurred on July 11, 2009 is due to poor satellite constellation and outage on August 7, 2009 is due to a change in satellite constellation.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	20.413	35.219	99.995650
Atlantic City	15.583	26.047	99.994780
Oklahoma City	12.762	21.866	99.988870
Albuquerque	13.720	23.577	99.995880
Anchorage	17.012	29.126	99.997200
Atlanta	12.936	23.649	99.995530
Barrow	20.848	51.343	99.918850
Bethel	21.255	34.695	99.996810
Billings	14.912	22.540	99.995900
Boston	16.459	24.583	99.995300
Chicago	13.556	20.299	99.995650
Cleveland	14.643	23.065	99.995530
Cold Bay	31.452	43.996	99.996830
Dallas	12.803	22.057	99.991020
Denver	13.497	22.734	100.00
Fairbanks	16.243	30.420	99.997420
Gander	25.545	38.546	99.974290
Goose Bay	21.208	30.032	99.975110
Houston	13.220	22.193	99.995650
Iqaluit	29.556	41.310	99.965570
Jacksonville	14.319	26.374	99.995530
Juneau	16.857	26.831	100.00
Kansas City	12.808	20.827	99.995650
Kotzebue	20.533	43.022	99.923280
Los Angeles	17.316	31.182	99.995940
Memphis	12.557	21.036	99.995650
Merida	20.630	36.681	99.995330
Mexico City	28.628	49.003	99.993860
Miami	16.107	30.347	99.995530
Minneapolis	14.714	20.490	99.995650
New York	15.560	24.255	99.995300
Oakland	19.679	34.959	99.995960
Puerto Vallarta	33.461	51.654	99.992170
Salt Lake City	14.305	23.233	99.995900
San Jose Del Cabo	29.658	45.786	99.995440
San Juan	56.156	90.805	98.515110
Seattle	18.438	25.902	99.995910
Tapachula	47.882	84.488	98.906410
Washington DC	14.974	25.611	99.995300
Winnipeg	16.804	22.303	99.995730

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	0.997855135	0.936847343
Atlantic City	0.999081934	0.995097188
Oklahoma City	0.999778253	0.999486686
Albuquerque	0.9999574	0.999190983
Anchorage	0.999694799	0.985556277
Atlanta	0.999828707	0.999129596
Barrow	0.942164356	0.735308343
Bethel	0.998162385	0.941056457
Billings	0.99989528	0.999817589
Boston	0.999230904	0.992477575
Chicago	0.999812873	0.999688642
Cleveland	0.999764143	0.999188575
Cold Bay	0.971760283	0.707889057
Dallas	0.999905641	0.999495445
Denver	0.999944659	0.997922961
Fairbanks	0.998892942	0.97409418
Gander	0.978723663	0.861717186
Goose Bay	0.998461106	0.979677836
Houston	0.999949969	0.999554412
Iqaluit	0.969356845	0.86861532
Jacksonville	0.999744383	0.998845816
Juneau	0.999591855	0.983977788
Kansas City	0.999837223	0.999738045
Kotzebue	0.965282043	0.870816152
Los Angeles	0.999660078	0.984518441
Memphis	0.999878439	0.999589194
Merida	0.99213514	0.908770191
Mexico City	0.946110755	0.707712846
Miami	0.999055131	0.992331358
Minneapolis	0.999862121	0.99968697
New York	0.999302737	0.996690055
Oakland	0.997527916	0.943835726
Puerto Vallarta	0.896738784	0.524798172
Salt Lake City	0.999957604	0.999770016
San Jose Del Cabo	0.969009796	0.681457026
San Juan	0.538571467	0.141902407
Seattle	0.999730836	0.988149227
Tapachula	0.427795568	0.093287549
Washington DC	0.999668507	0.998629351
Winnipeg	0.999941372	0.999625431

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	0.99999068
Anchorage	0.99999068
Atlanta	0.99999068
Barrow	0.99951618
Bethel	0.99999067
Billings	0.99999066
Boston	0.99999068
Cleveland	0.99999068
Cold Bay	0.99999066
Fairbanks	0.99999065
Gander	0.99985793
Honolulu	0.99982885
Houston	0.99999018
Iqaluit	0.99985834
Juneau	1.00000000
Kansas City	0.99999067
Kotzebue	0.99951403
Los Angeles	0.99999068
Merida	0.99998999
Miami	0.99999018
Minneapolis	0.99999068
Oakland	0.99999068
Salt Lake City	0.99998990
San Jose Del Cabo	0.99999007
San Juan	0.99999018
Seattle	0.99999066
Tapachula	0.99999002
Washington DC	0.99999068

Table 3-4 LPV and LPV 200 Outage Rate

Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	30	0.000646092	330	0.007569818
Atlantic City	6	0.000128419	71	0.00152571
Oklahoma City	2	0.000044959	8	0.000179887
Albuquerque	1	0.000019542	18	0.000352031
Anchorage	4	0.00007818	191	0.003786669
Atlanta	5	0.000097712	11	0.000215118
Barrow	425	0.008842438	1126	0.030017787
Bethel	37	0.00072542	423	0.008796576
Billings	2	0.000039176	3	0.000058769
Boston	8	0.000156414	97	0.001909427
Chicago	2	0.000039074	3	0.000058618
Cleveland	4	0.000078203	10	0.00019562
Cold Bay	367	0.007608368	1158	0.032955506
Dallas	2	0.000039157	5	0.000097933
Denver	1	0.000019625	20	0.000393304
Fairbanks	46	0.000903387	289	0.005820117
Gander	151	0.003020861	735	0.016700768
Goose Bay	33	0.000648196	191	0.003823611
Houston	3	0.000058633	7	0.000136864
Iqaluit	362	0.007297552	762	0.017142723
Jacksonville	4	0.00007819	12	0.000234782
Juneau	14	0.000300545	131	0.002856863
Kansas City	2	0.000039104	3	0.000058662
Kotzebue	367	0.00744546	917	0.020621611
Los Angeles	23	0.000449475	269	0.005337753
Memphis	2	0.000039092	4	0.000078206
Merida	102	0.002040688	573	0.01251549
Mexico City	245	0.007797709	751	0.031954038
Miami	24	0.000469426	158	0.003111326
Minneapolis	2	0.000039102	4	0.000078217
New York	7	0.000136967	65	0.001275171
Oakland	48	0.000941987	458	0.009499432
Puerto Vallarta	483	0.010715118	950	0.036011985
Salt Lake City	1	0.000019568	3	0.000058716
San Jose Del Cabo	194	0.003955745	961	0.027863752
San Juan	1228	0.045180823	551	0.076941552
Seattle	5	0.000097928	150	0.002972267
Tapachula	1011	0.047750515	429	0.092917345
Washington DC	6	0.000117266	11	0.000215212
Winnipeg	2	0.000039088	5	0.00009775

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	1	0.00001889
Anchorage	1	0.00001889
Atlanta	1	0.00001889
Barrow	18	0.00034070
Bethel	1	0.00001892
Billings	1	0.00001893
Boston	1	0.00001889
Cleveland	1	0.00001889
Cold Bay	1	0.00001946
Fairbanks	1	0.00001896
Gander	8	0.00015143
Honolulu	3	0.00005668
Houston	1	0.00001889
Iqaluit	8	0.00015113
Juneau	0	0.00000000
Kansas City	1	0.00001890
Kotzebue	18	0.00034071
Los Angeles	1	0.00001889
Merida	1	0.00001925
Miami	1	0.00001889
Minneapolis	1	0.00001889
Oakland	1	0.00001889
Salt Lake City	1	0.00002047
San Jose Del Cabo	1	0.00001909
San Juan	1	0.00001889
Seattle	1	0.00001893
Tapachula	1	0.00001920
Washington DC	1	0.00001889

Figure 3-1 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

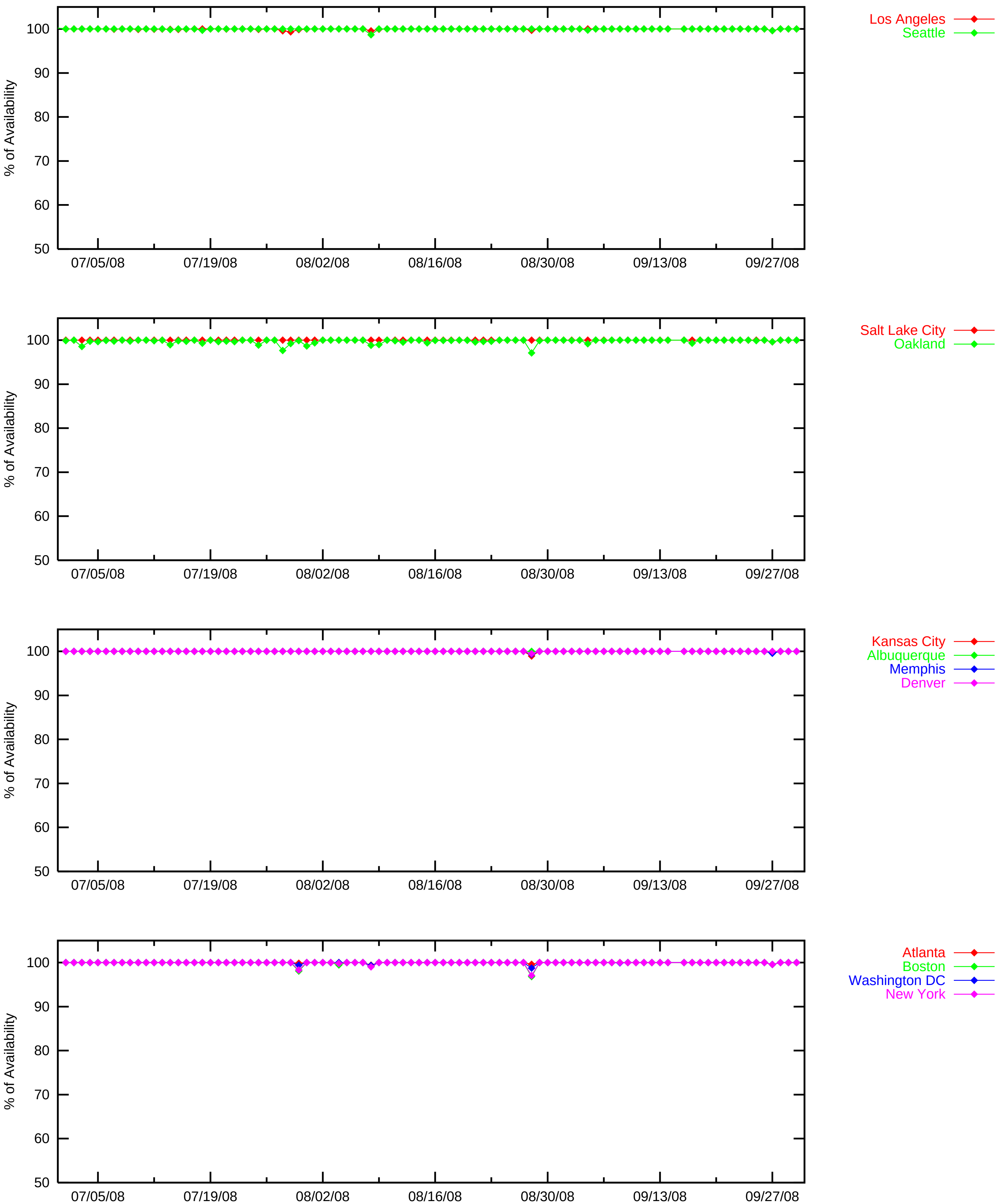


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

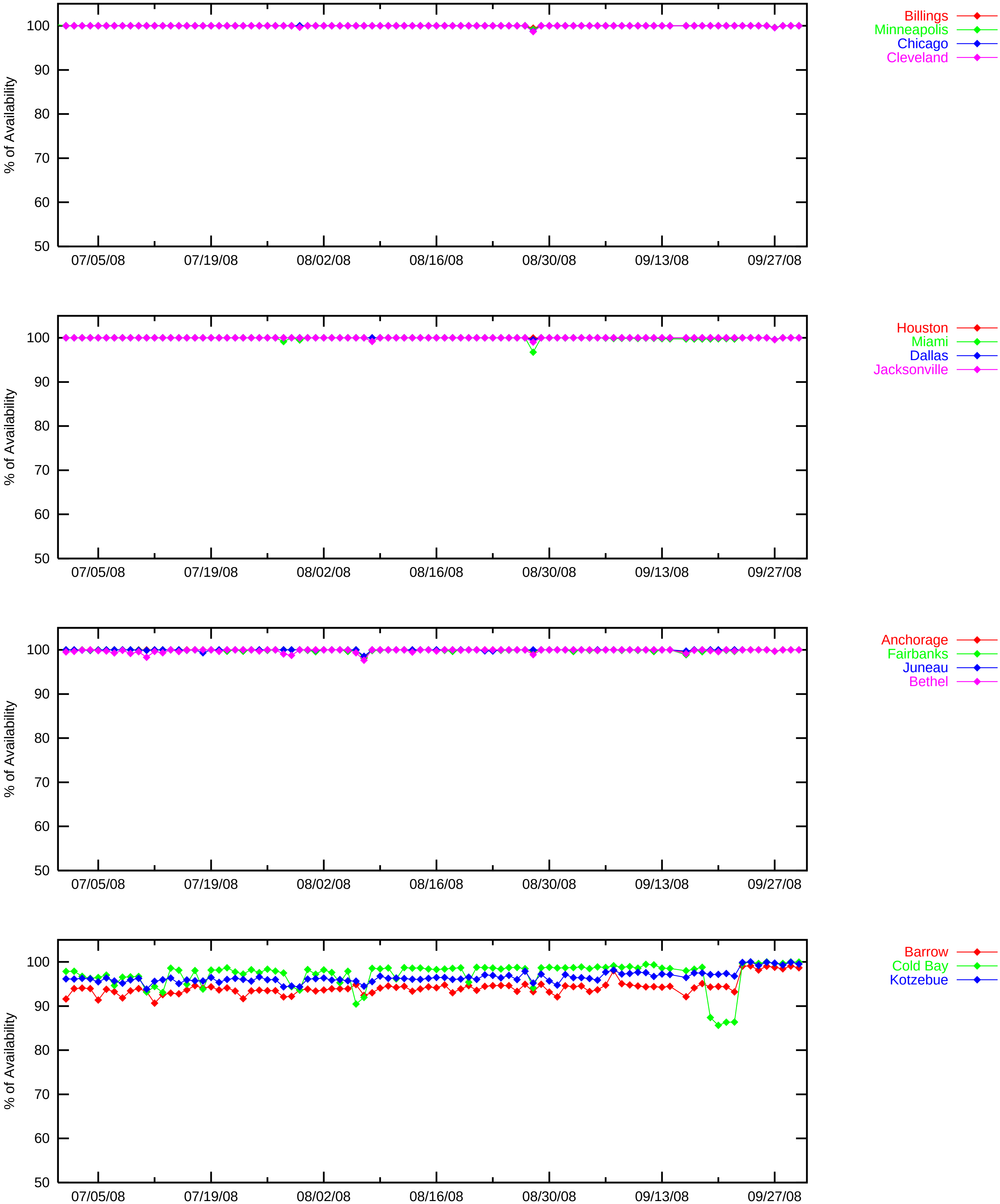


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

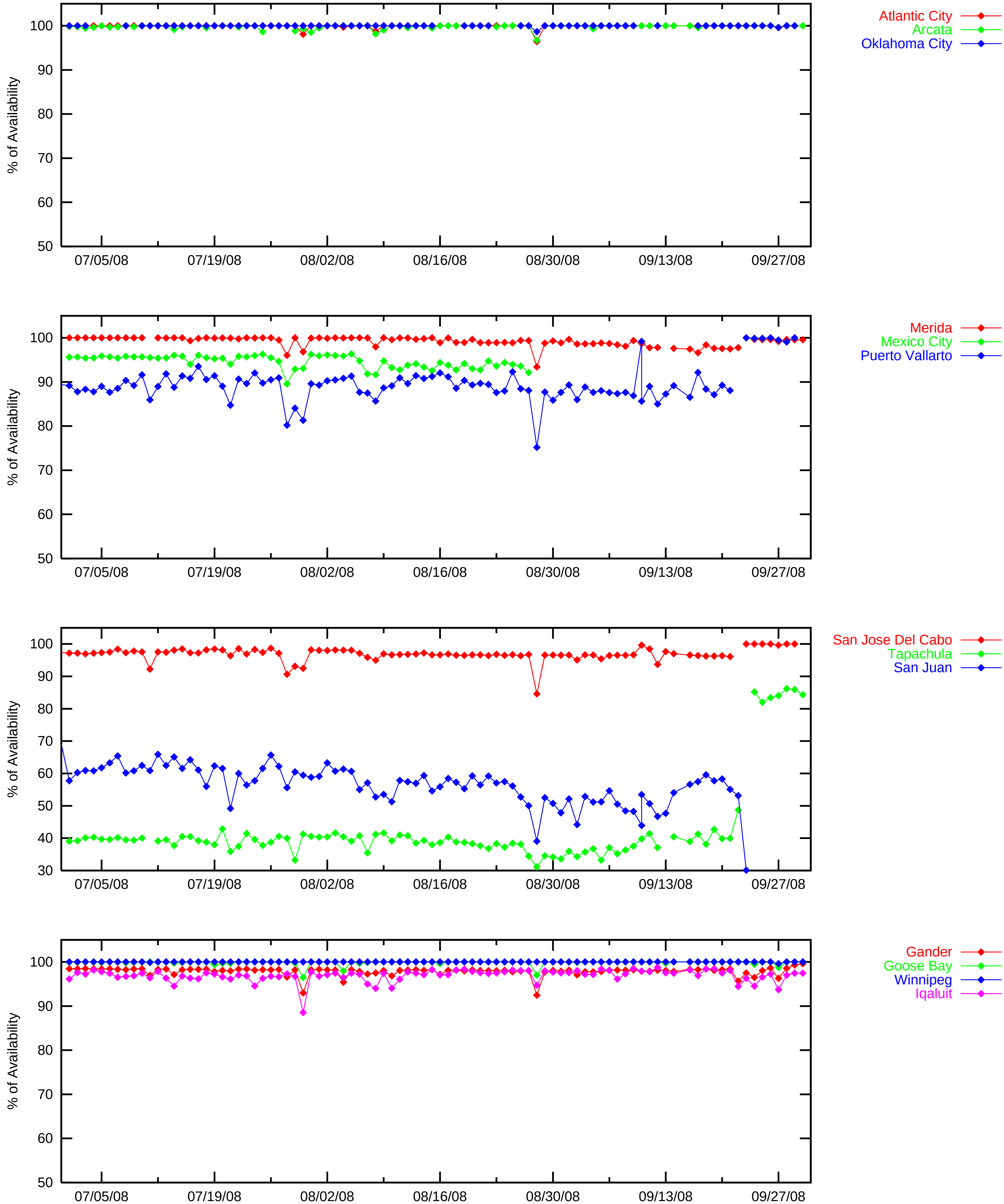


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

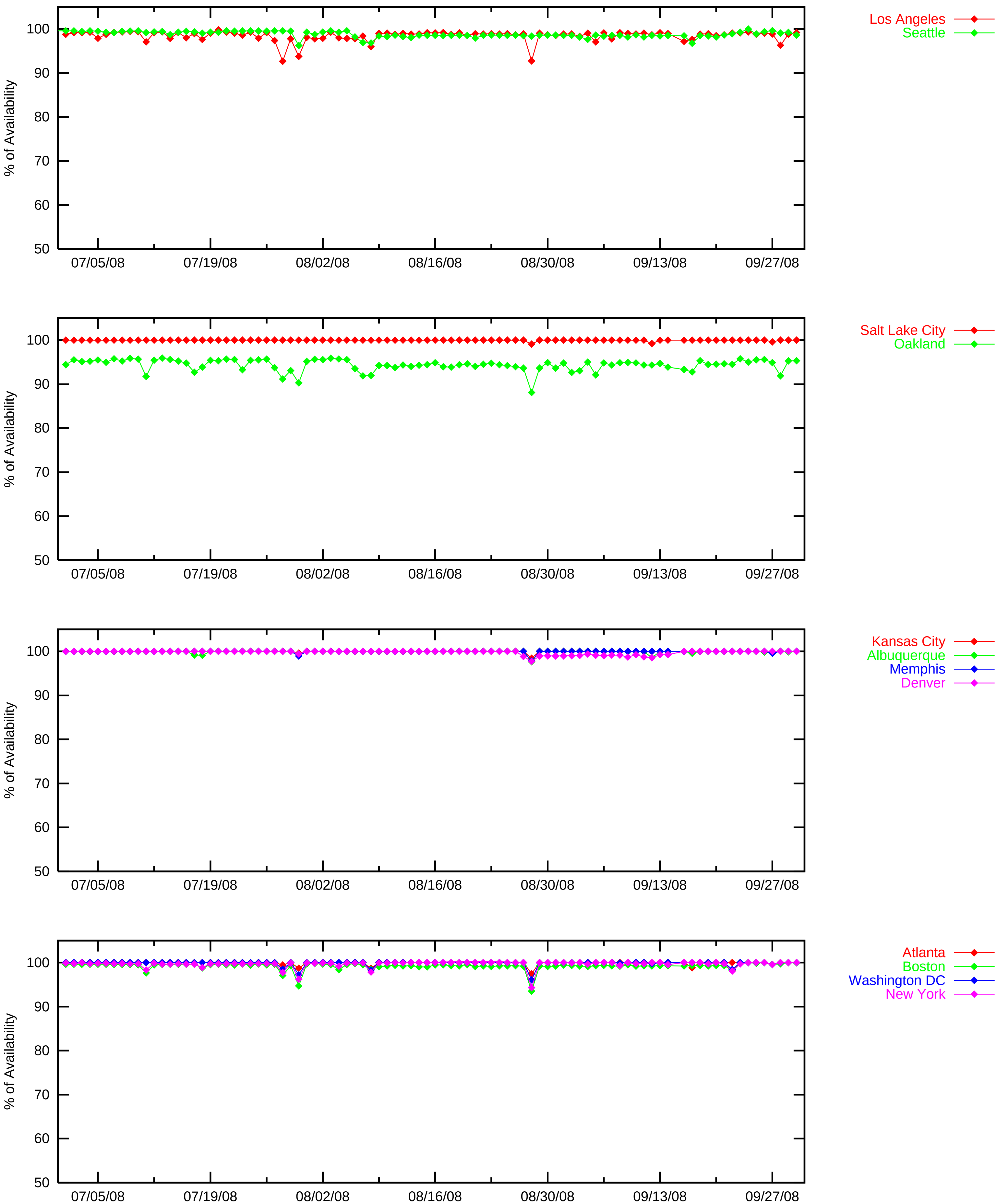


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

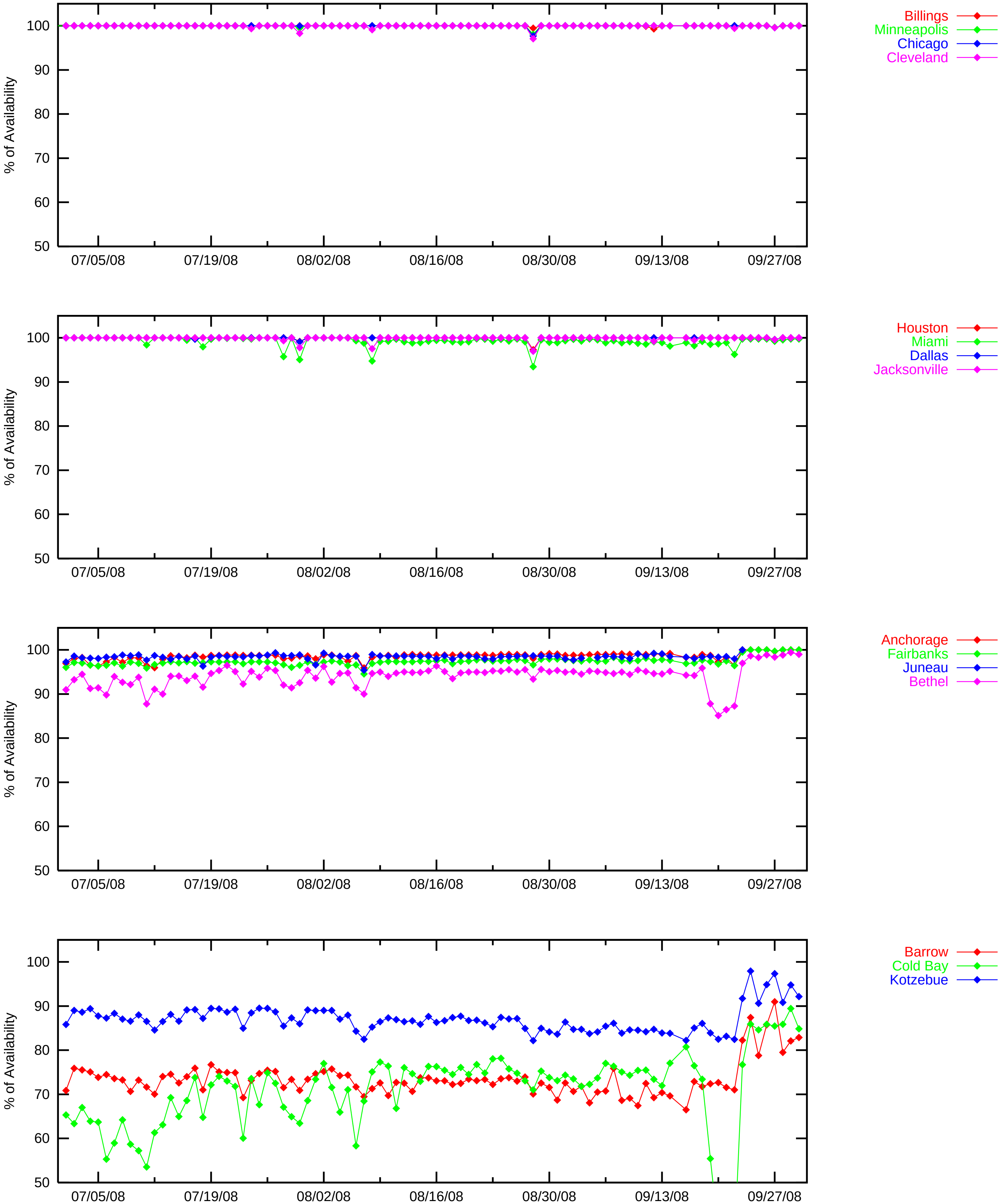


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

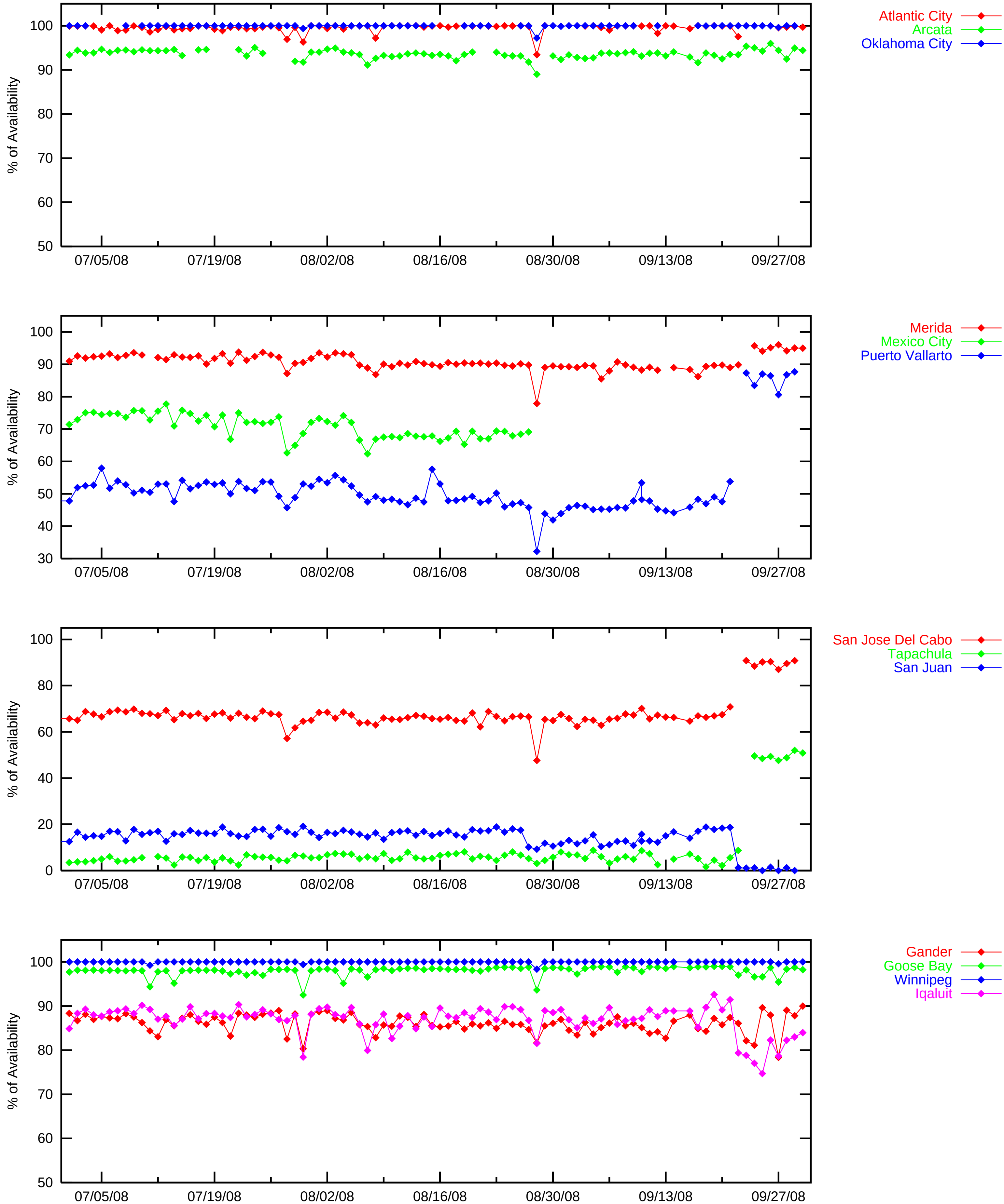


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

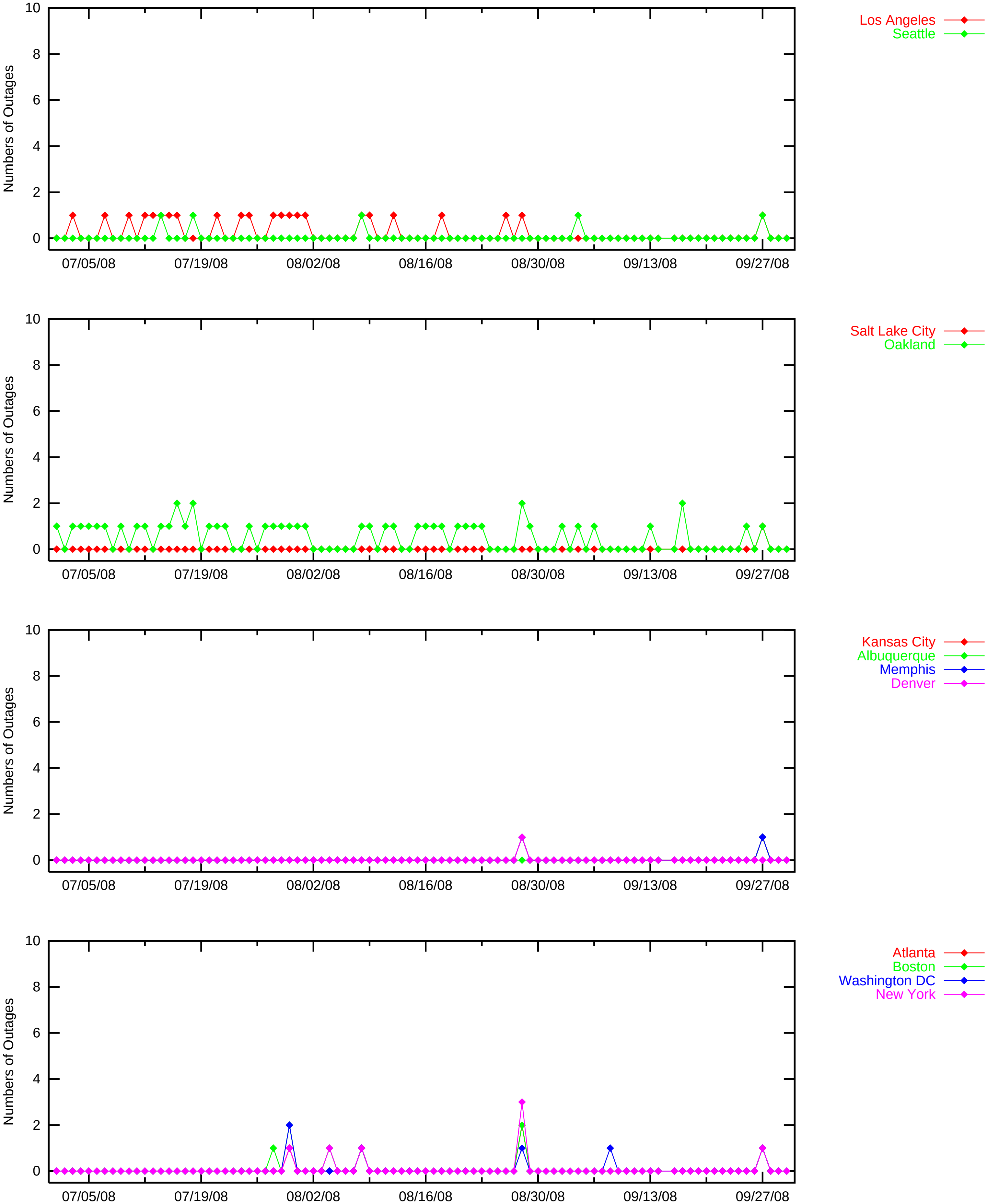


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)

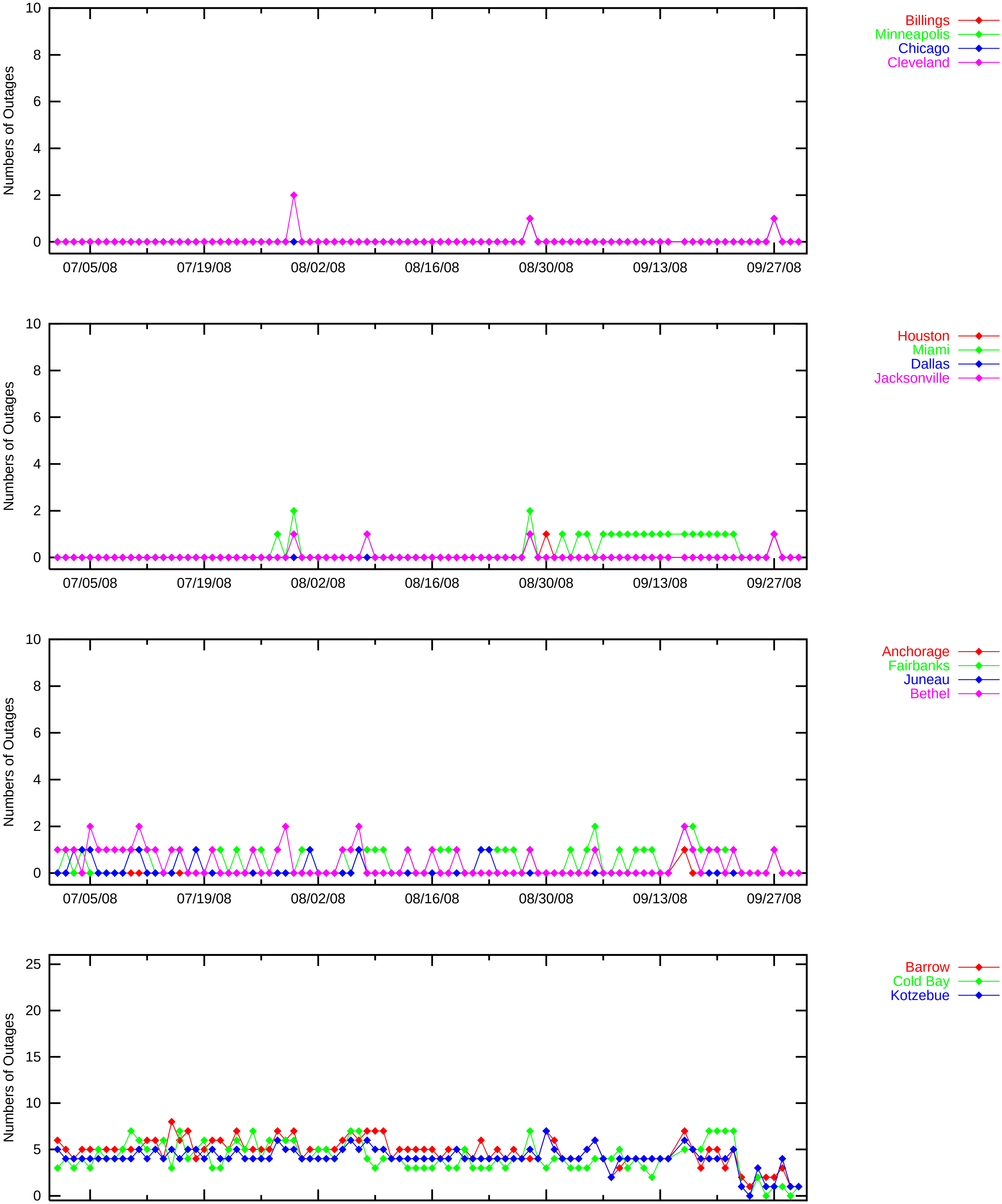


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

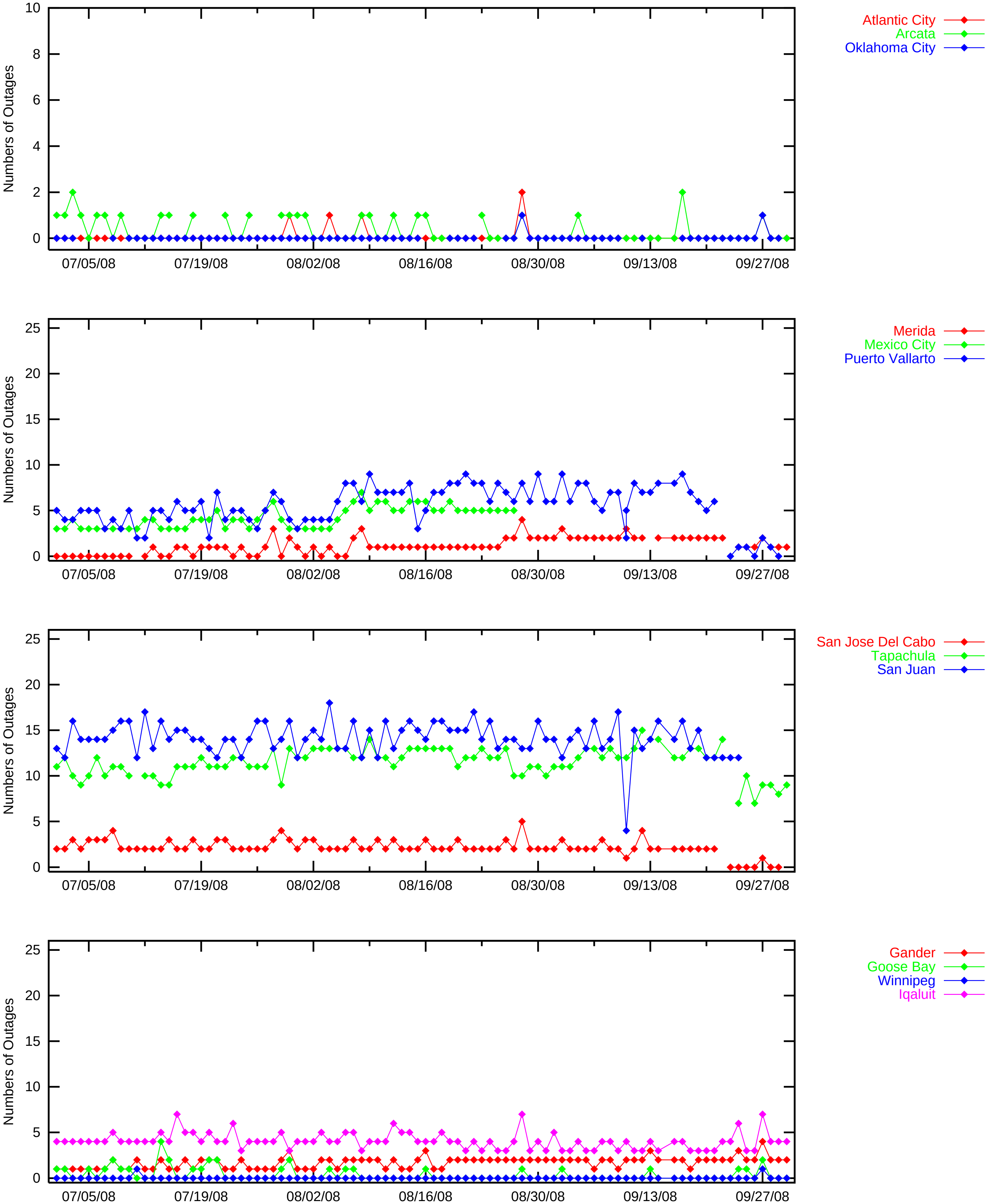


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

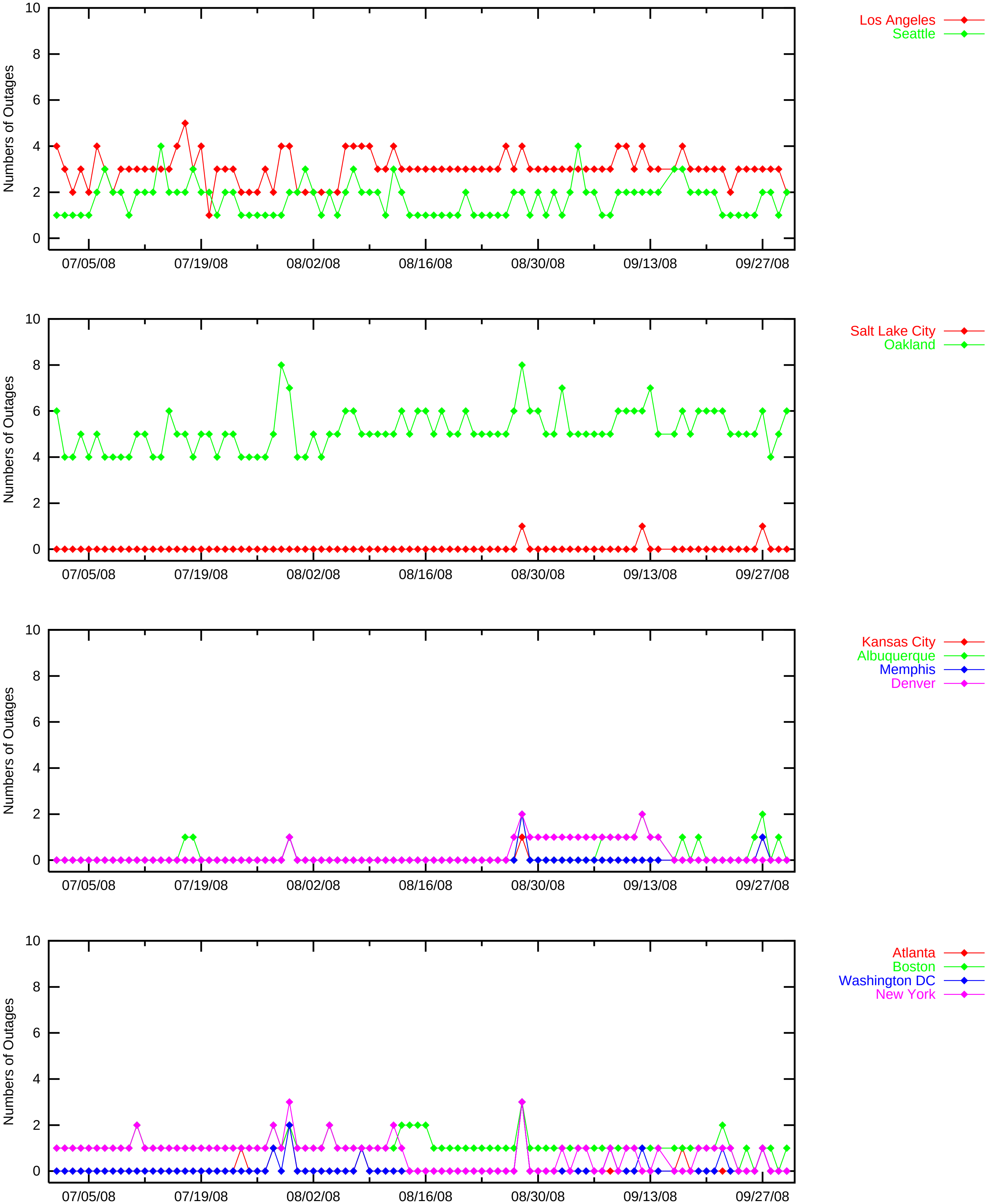


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)

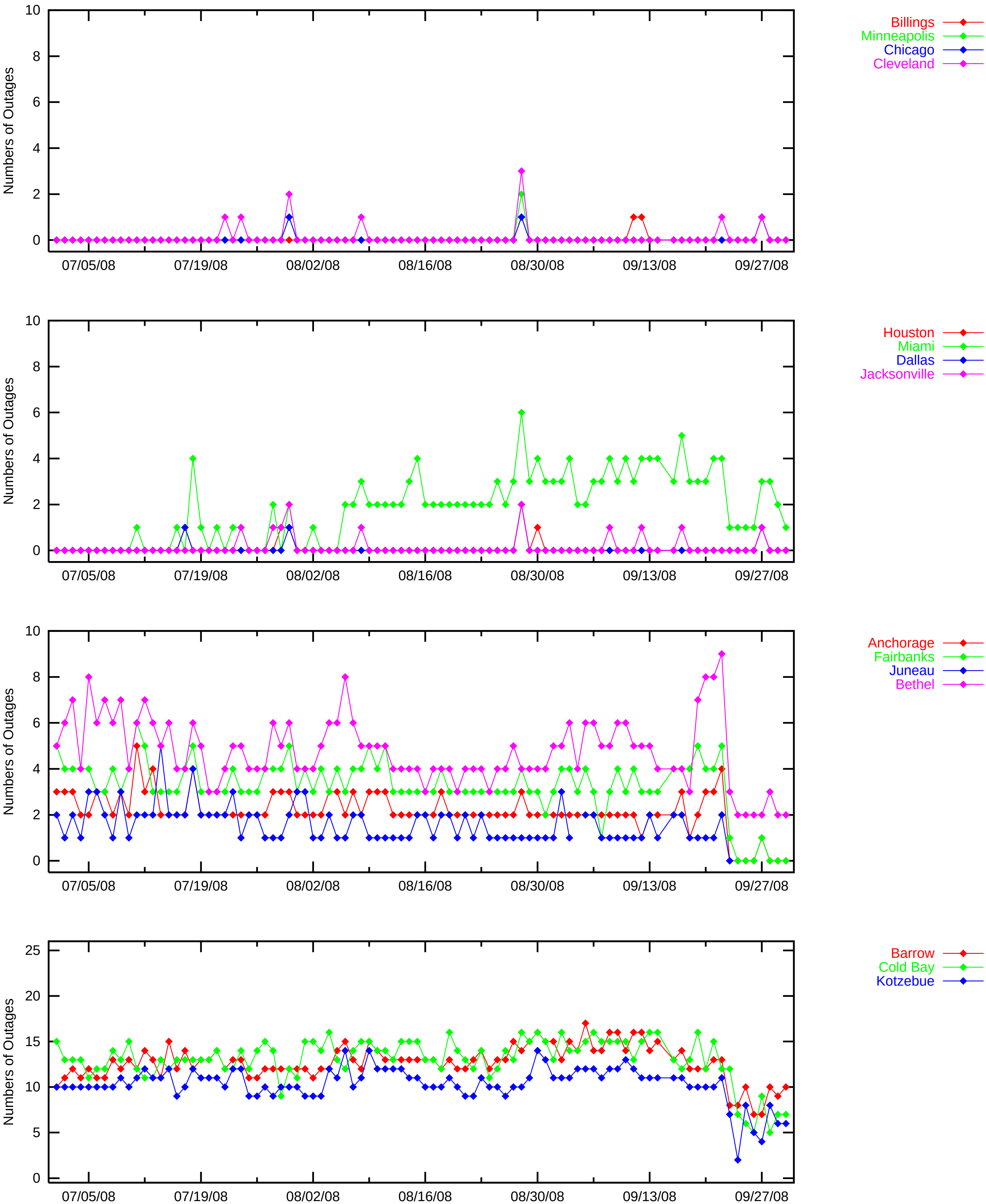
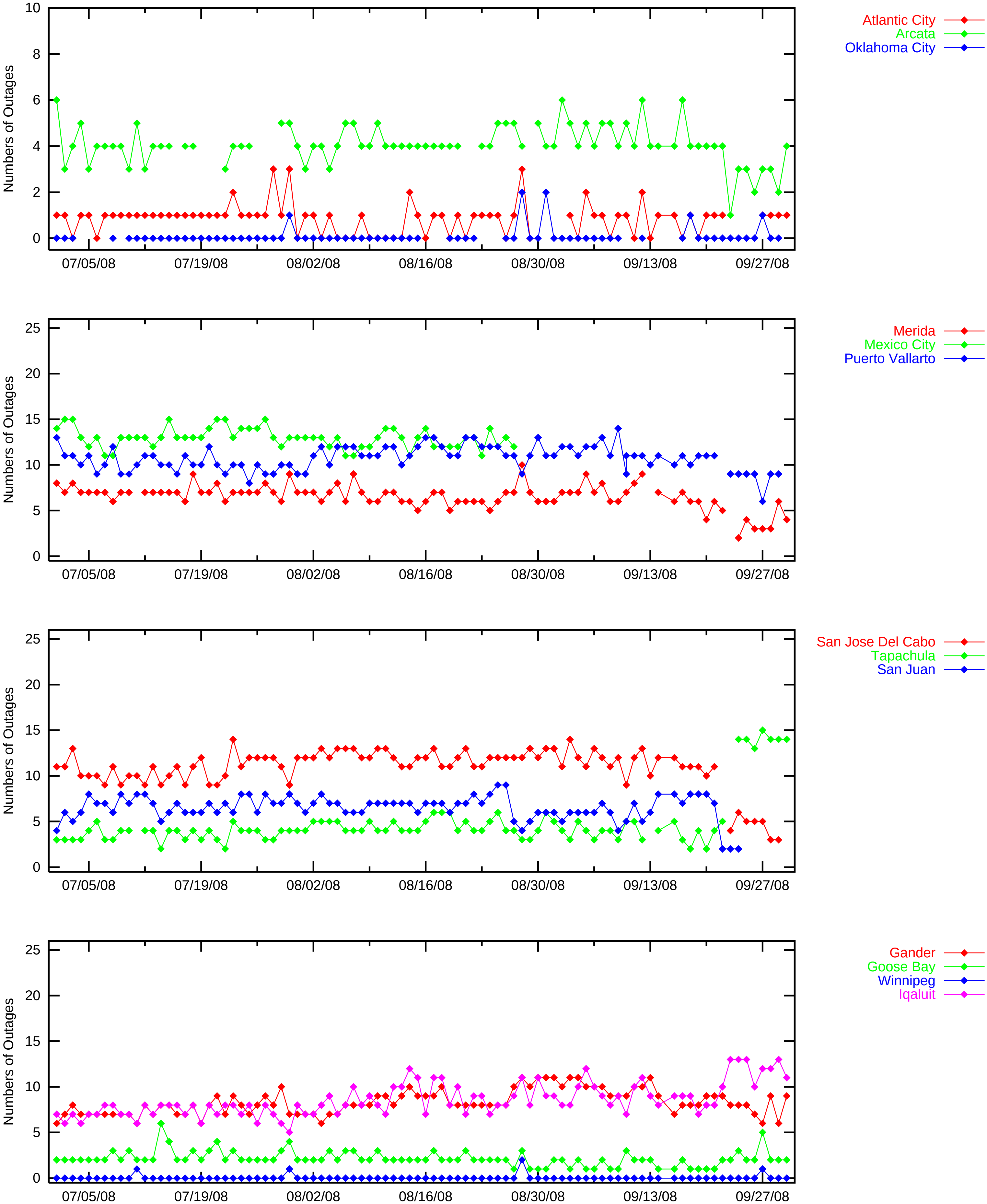


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



4.0 COVERAGE

WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LPV 200, and NPA services. The WAAS message and the GPS/GEO satellite status are used to determine WAAS availability across North America. For PA coverage, protection levels were calculated at 30-sec intervals and at two degree spacing over the PA service volume, while NPA coverage was calculated at 30-sec intervals and five degree spacing over the NPA service volume.

Daily analysis for PA was conducted for LPV and LPV 200 service levels. The coverage plots provide 100, 99.9, 99, 98 and 95% availability contours. Rollup PA coverage for the quarter are shown as followed: LPV CONUS coverage in Figure 4.1, LPV Alaska coverage in Figure 4.1, LPV 200 CONUS coverage in Figure 4.3 and LPV 200 Alaska coverage in Figure 4.4. Figure 4.5 shows the daily LPV and LPV 200 CONUS coverage, and Figure 4.6 shows the daily LPV Alaska coverage at 99% availability and ionosphere KP index values for this quarter.

Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots provide 100, 99.9 and 99% availability contours. Figure 4.5 shows the rollup NPA coverage for the quarter. Figure 4.6 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

During this evaluation period, low PA and NPA coverage are mainly due to satellites outages. Please refer to Table 1.4 for events that affected coverage. A significant drop in LPV, LPV 200, and NPA coverage on /8/7/08 and 8/8/08 is due to PRN 28 outage, on 8/28/08 is due to PRN 31 outage and on 9/17/08 is due to PRN 12 outage. A C&V initialization caused WAAS service outage on September 27, 2008 (see DR# 75). This event has little impact on the 99% LPV and LPV coverage but caused a big drop in 99.9% NPA coverage.

Figure 4-1 LPV CONUS Coverage for the Quarater

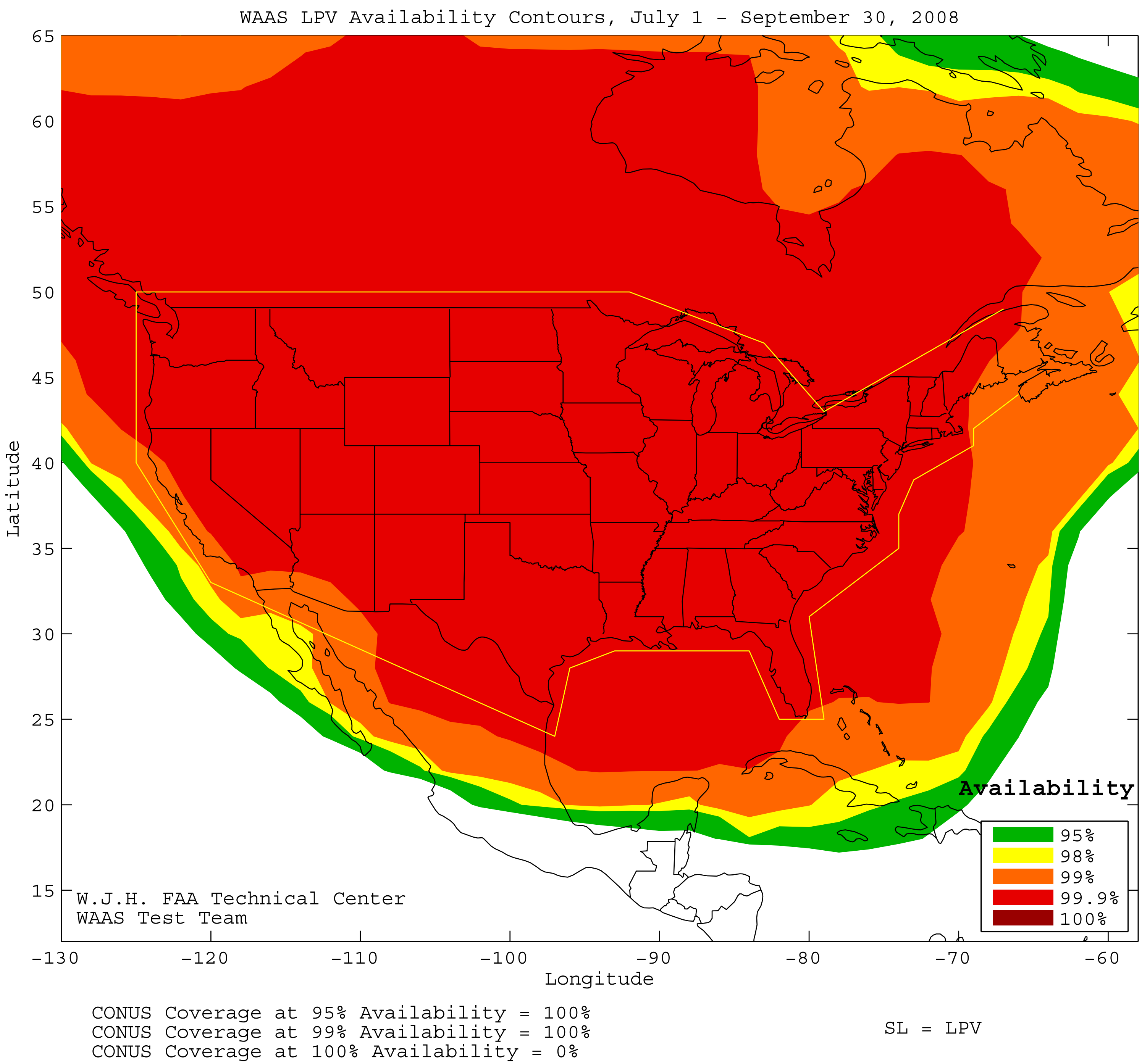


Figure 4-2 LPV Alaska Coverage for the Quarter

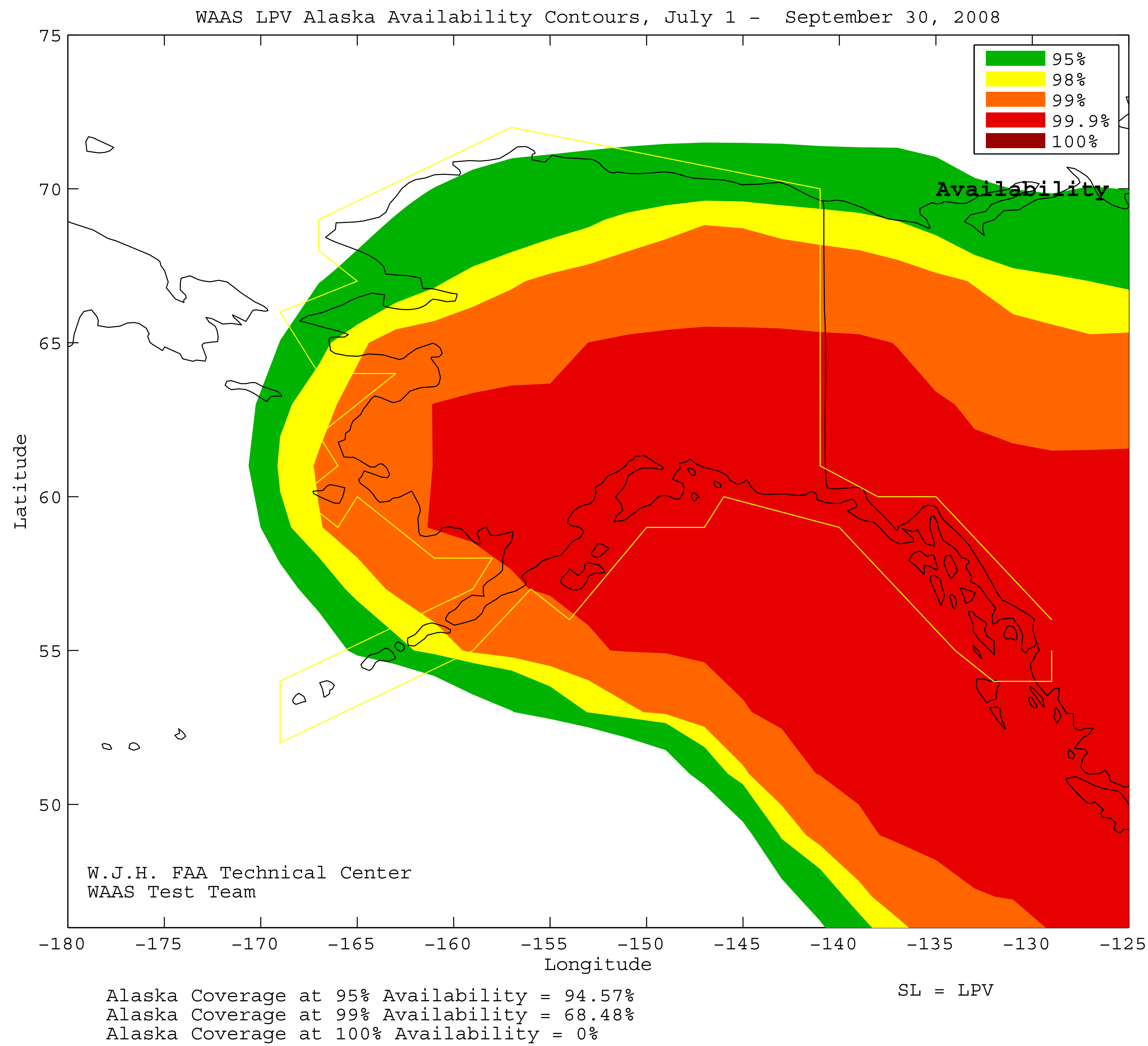


Figure 4-3 LPV 200 CONUS Coverage for the Quarter

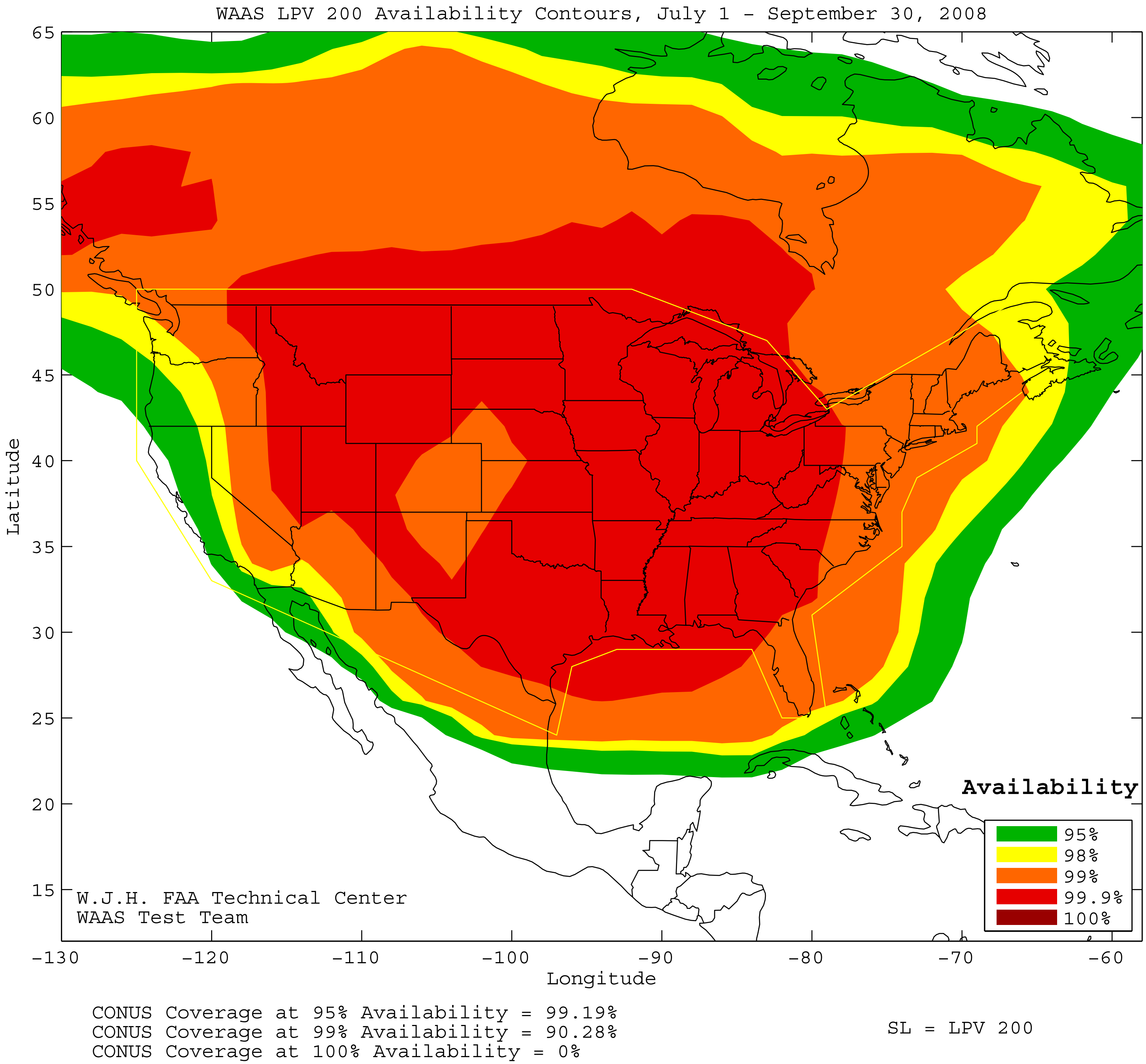


Figure 4-4 LPV 200 Alaska Coverage for the Quarter

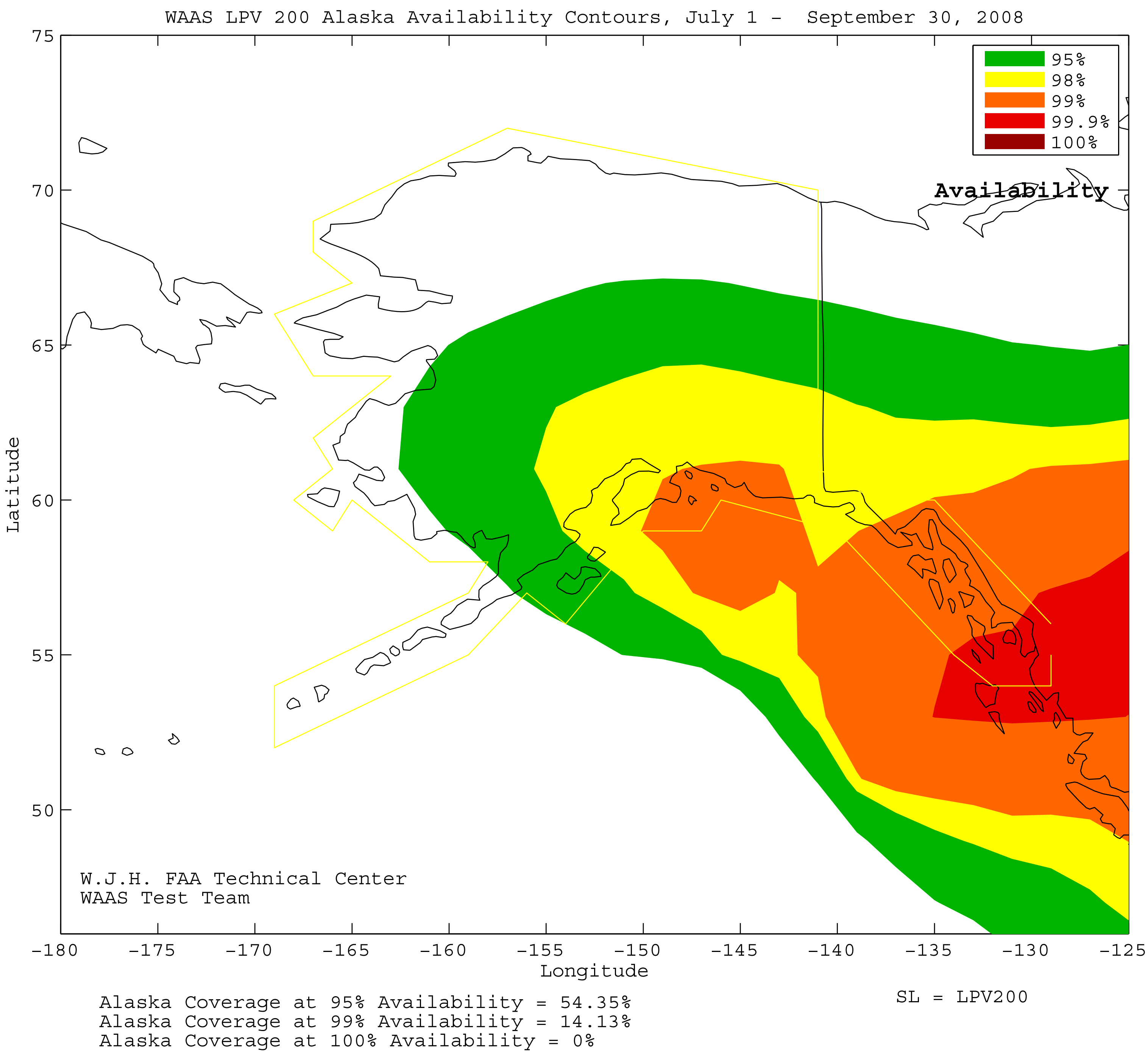


Figure 4-5 NPA Coverage for the Quarter

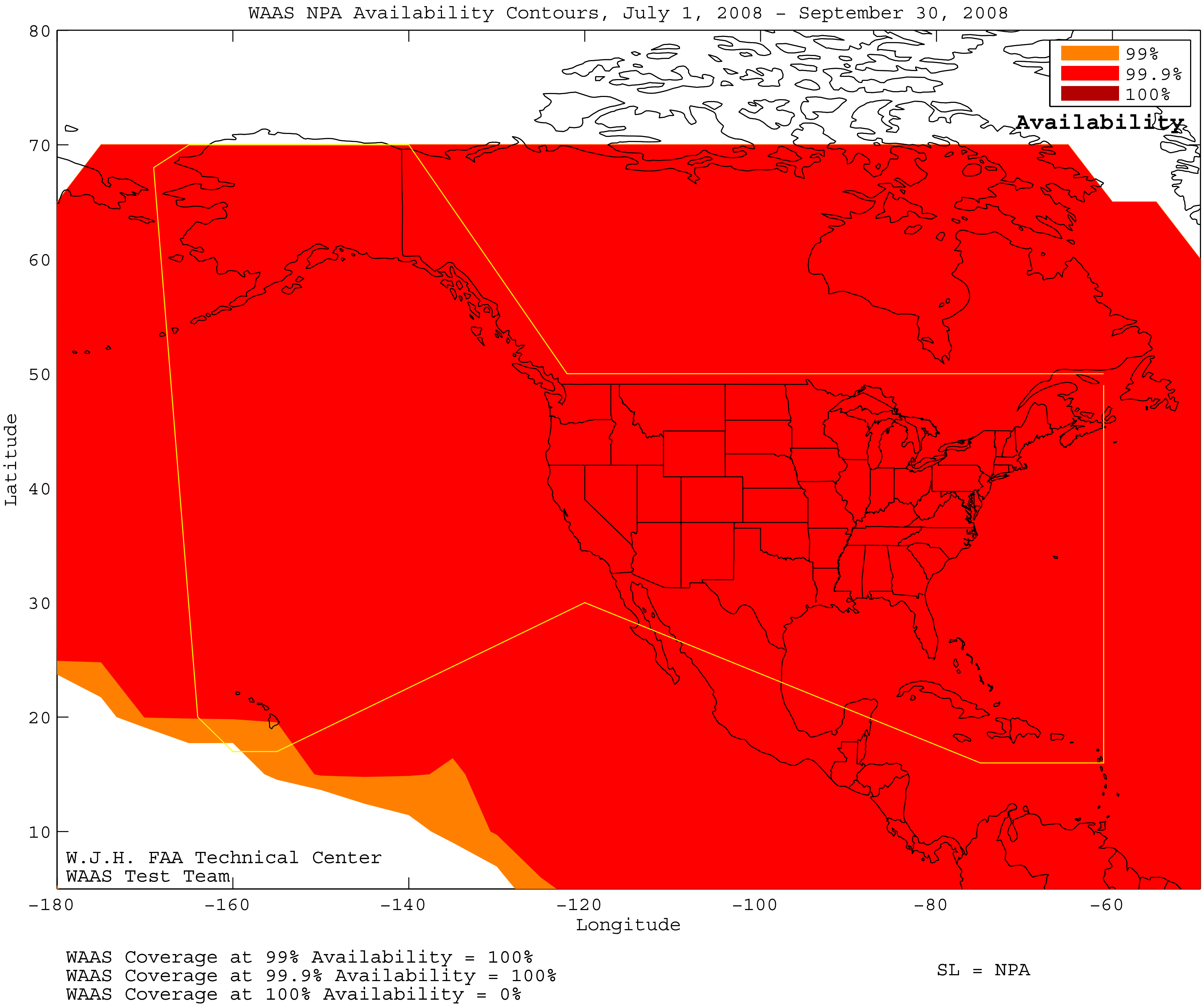


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

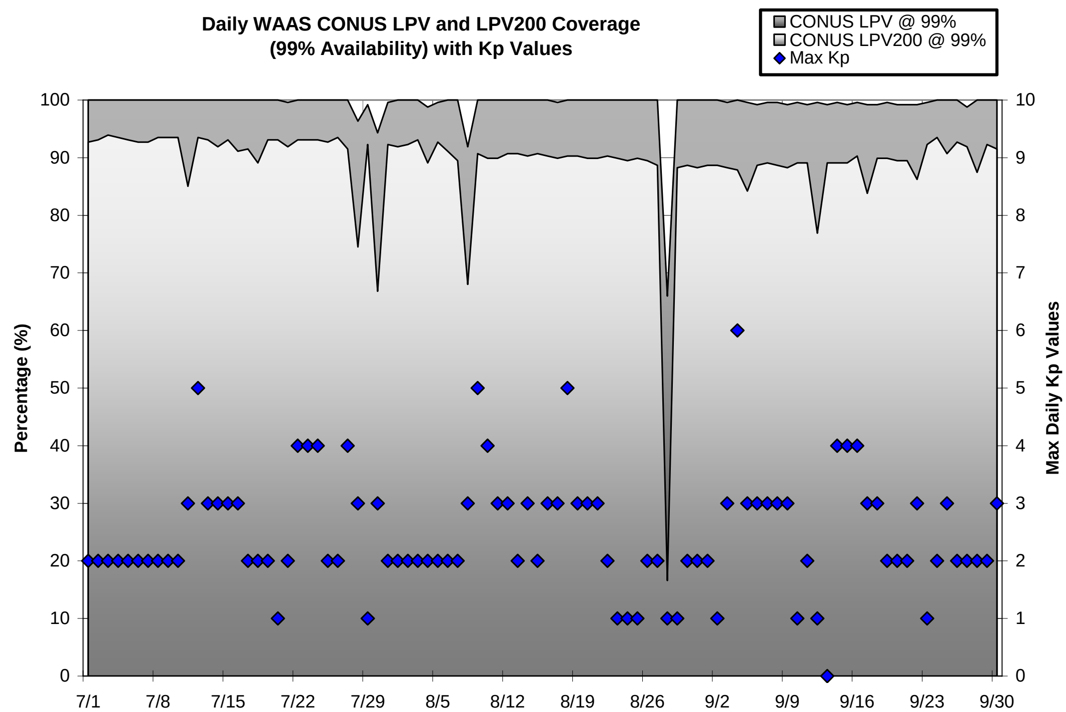


Figure 4-7 Daily LPV Alaska Coverage

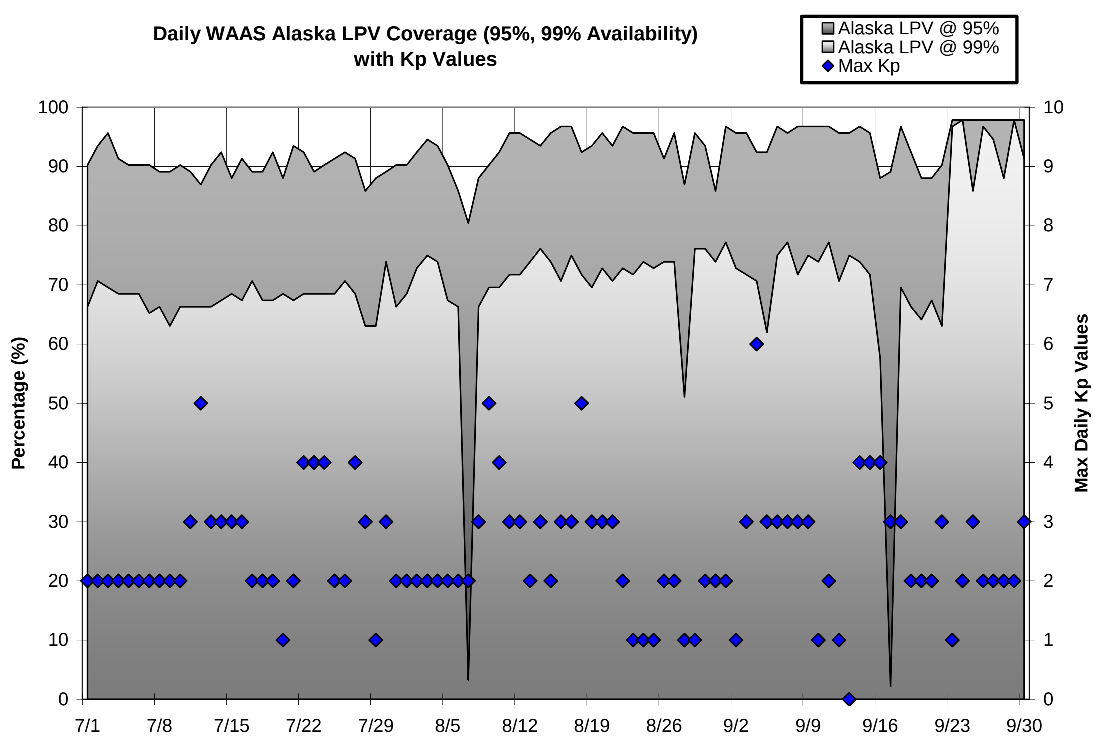
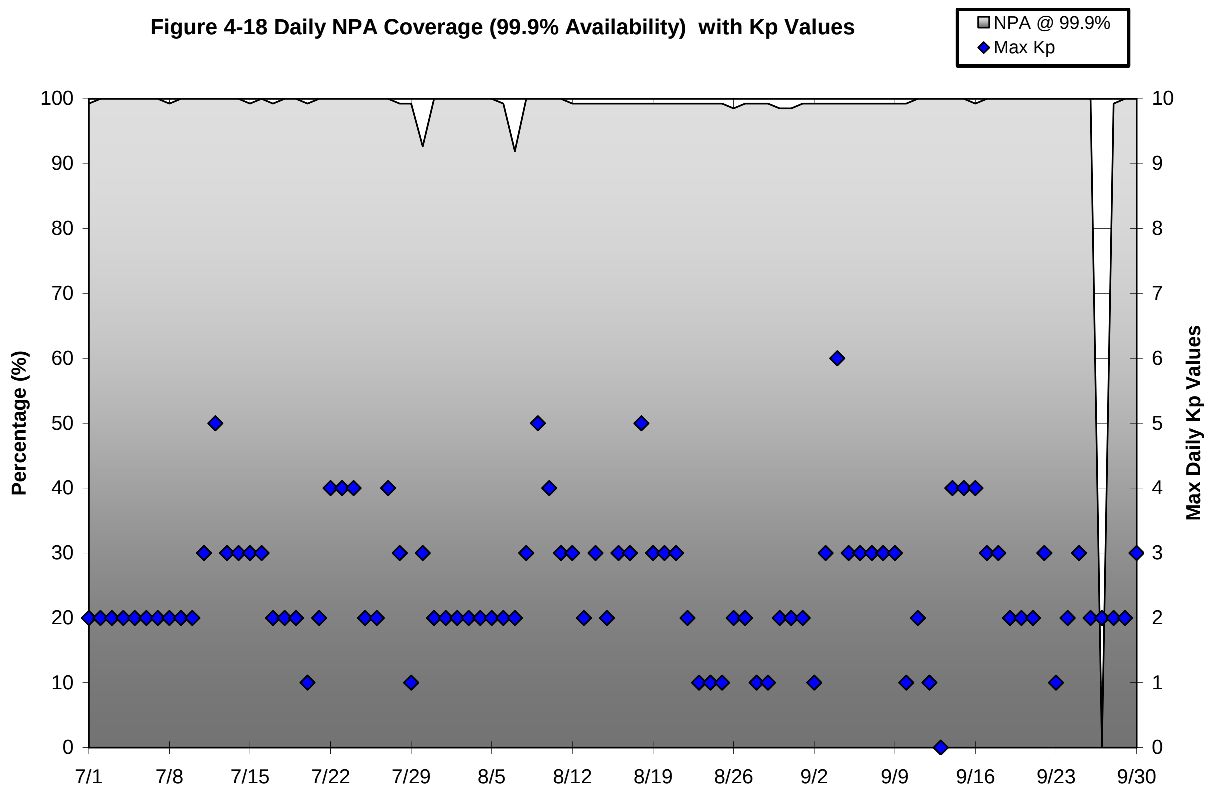


Figure 4-8 Daily NPA Coverage



5.0 INTEGRITY

5.1 HMI Analysis

Analysis of integrity includes the identification and evaluation of HMI (hazardously misleading information), as well as the generation of a safety index to illustrate the margin of safety that WAAS protection levels are providing. The safety index is a metric that shows how well the protection levels are bounding the maximum observed error when LPV service is available. The process for determining this index involves dividing the protection limit observed by the maximum observed error. An observed safety index of greater than one indicates safe bounding of the greatest observed error, less than one indicates that the maximum error was not bounded, and a result equal to one means that the error was equal to the protection level. An HMI occurs if the position error exceeds the protection level in the vertical or horizontal dimensions at any time and 6.2 seconds or more passes before this event is corrected by WAAS.

Table 5.1 lists the safety index and the number of HMIs. For this evaluation period, the lowest safety margin index is 4.07 at Atlantic City. There was no HMI event. Since WAAS was made available to the public in August 2000 there has not been an HMI event. WAAS was commissioned by the FAA for safety of life services in July 2003.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Arcata	7.78	6.83	0
Atlantic City	4.07	4.18	0
Oklahoma City	19.29	10.20	0
Albuquerque	6.51	9.69	0
Anchorage	6.37	14.18	0
Atlanta	16.11	5.28	0
Barrow	12.86	9.24	0
Bethel	6.98	9.74	0
Billings	8.45	10.08	0
Boston	21.62	9.16	0
Chicago	9.35	8.19	0
Cleveland	15.63	6.64	0
Cold Bay	12.24	8.66	0
Dallas	7.30	7.72	0
Denver	15.94	5.65	0
Fairbanks	5.58	5.63	0
Gander	17.53	10.67	0
Goose Bay	7.48	9.22	0
Houston	8.32	6.85	0
Iqaluit	7.73	5.54	0
Jacksonville	23.38	13.59	0
Juneau	6.39	7.52	0
Kansas City	8.05	7.75	0
Kotzebue	7.74	10.54	0
Los Angeles	7.96	6.07	0
Memphis	9.68	10.59	0
Merida	8.89	8.91	0
Mexico City	13.62	8.41	0
Miami	8.25	9.05	0
Minneapolis	4.74	6.80	0
New York	20.36	8.22	0
Oakland	5.99	4.80	0
Puerto Vallarta	10.58	6.96	0
Salt Lake City	4.56	4.78	0
San Jose Del Cabo	5.96	5.72	0
San Juan	13.63	6.55	0
Seattle	5.62	4.62	0
Tapachula	9.85	9.19	0
Washington DC	22.96	5.99	0
Winnipeg	10.45	9.18	0

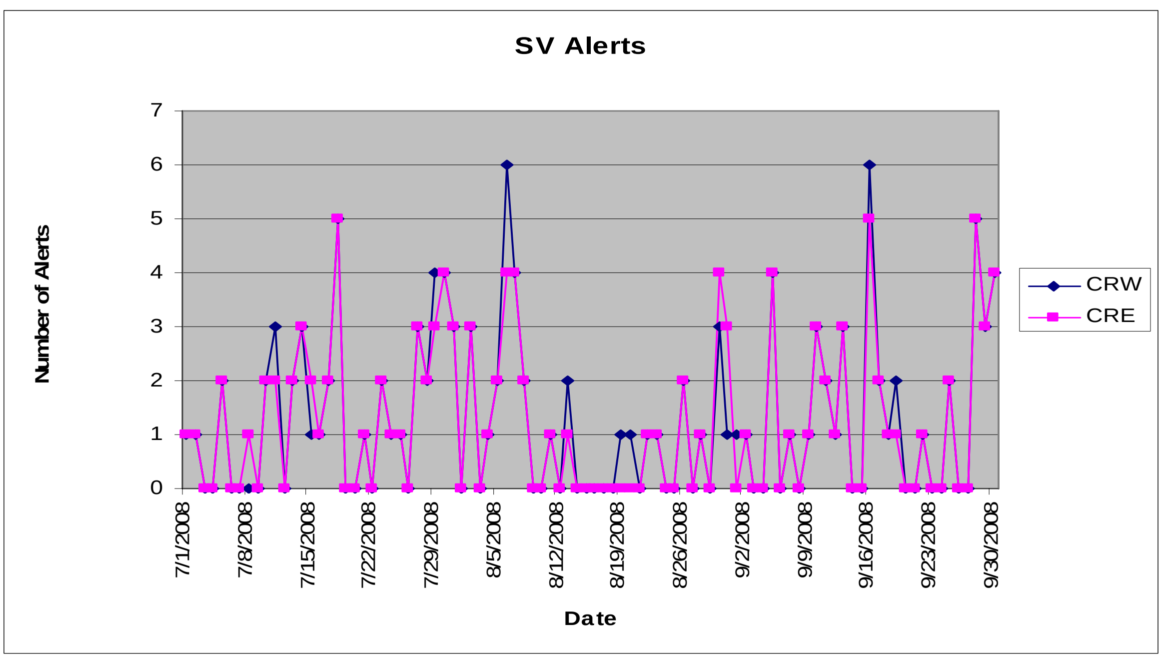
5.2 Broadcast Alerts

The WAAS transmits alert messages to protect the users from satellite degradation or severe ionospheric activity, both of which can cause unsafe conditions for a user. Space Vehicle (SV) alerts increase the User Differential Range Error (UDRE) of satellites, which can reduce the weighting of the satellite in the navigation solution, or completely exclude it from the navigation solution. An increase in UDRE's after an alert effectively increases the user protection levels (HPL and VPL), which affect the availability. Additionally, if an alert message sequence lasts for more than 12 seconds, WAAS fast corrections can time out, causing a loss of continuity. Table 5.2 shows the total number of alerts and the average number of alerts per day. Figure 5.1 shows the number of SV alerts that occurred daily during the reporting period. Often the number of alerts on one GEO is the same as the number of alerts on the other GEO. Therefore, lines tend to overlap in most points on this plot.

Table 5-2 WAAS SV Alert

	Number of Alerts		Average Alerts Per Day	
Message Type	**CRW**	**CRE**	**CRW**	**CRE**
2	60	52	0.6593	0.5714
3	31	30	0.3407	0.3297
4	30	34	0.3297	0.3736
5	0	0	0	0
6	0	0	0	0
24	0	0	0	0
26	0	0	0	0
Total Alerts	121	116	1.3297	1.2747

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (CRE and CRW)

For an accurate and current user position to be calculated, the content of the WAAS message must be broadcast and received within precise time specifications. This aspect of the WAAS is critical to maintaining integrity requirements. Each message type in the WAAS SIS has a specific amount of time for which it must be received anew. Although the content of every message is relevant to the functionality of the system, the importance of different messages varies along with the frequency with which they must be received. Table 5.3 lists the maximum intervals at which each message must broadcast to meet system requirements.

GUS switchovers or broadcast WAAS alerts can interrupt the normal broadcast message stream. If these events occur at a time when the maximum interval of a specific message is approaching, that message may be delayed, resulting in its late transmittal.

Late messages statistics reported during the quarter were mainly caused by GEO SIS outages, GUS switchovers and SV alerts except message type 7 and 10. Occasionally, message type 7 and 10 were late and they were not caused by GEO SIS outages, GUS switchovers or SV alerts. The lateness of type 7 and type 10 messages has little or no impact on user performance and safety.

Tables 5.4 to 5.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on CRW. Table 5.9 to 5.13 show message rates statistics broadcasted on CRE.

Table 5-3 Update Rates for WAAS Messages

Data	**Associated Message Types**	**Maximum Update Interval** (seconds)	**En Route, Terminal, NPA Timeout** (seconds)	**Precision Approach Timeout** (seconds)
WAAS in Test Mode	0	6	N/A	N/A
PRN Mask	1	60	None	None
UDREI	2-6, 24	6	18	12
Fast Corrections	2-5, 24	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C
Long Term Corrections	24, 25	120	360	240
GEO Nav. Data	9	120	360	240
Fast Correction Degradation	7	120	360	240
Weighting Factors	8	120	240	240
Degradation Parameters	10	120	360	240
Ionospheric Grid Mask	18	300	None	None
Ionospheric Corrections	26	300	600	600
UTC Timing Data	12	300	None	None
Almanac Data	17	300	None	None

Table 5-4 WAAS Fast Correction and Degradation Message Rates – CRW

Message Type	**On Time**	**Late**	**Max Late Length (seconds)**
1	115966	69	1944
2	1324541	64	1901
3	1324444	78	1896
4	1324451	72	1903
7	104647	149	1997
9	93126	2	1957
10	104741	151	2024
17	32100	29	2135

Table 5-5 WAAS Long Correction Message Rates (Type 24 and 25) - CRW

PRN	On Time	Late	Max Late Length (seconds)
2	46411	0	0
3	51030	0	0
4	47747	1	2047
5	19644	0	0
6	51907	2	181
7	46964	1	181
8	46282	0	0
9	50648	0	0
10	47265	1	162
11	51793	1	178
12	49189	0	0
13	47766	0	0
14	47755	0	0
15	50309	0	0
16	47954	0	0
17	47645	1	167
18	47059	0	0
19	49327	1	174
20	50143	1	2047
21	45440	2	181
22	47349	0	0
23	46242	0	0
24	48180	0	0
25	37454	1	178
26	49232	0	0
27	47029	0	0
28	47743	1	167
29	47766	0	0
30	51435	0	0
31	47844	0	0
32	48268	1	167

Table 5-6 WAAS Ephemeris Covariance Message Rates (Type 28) – CRW

PRN	On Time	Late	Max Late Length (seconds)
2	43013	1	146
3	47168	2	192
4	44313	1	2016
5	18464	0	0
6	48019	3	161
7	43461	2	135
8	42795	1	161
9	46853	2	169
10	43689	0	0
11	47975	1	158
12	45528	2	2016
13	44221	0	0
14	44106	1	145
15	46361	0	0
16	44148	1	126
17	43459	0	0
18	42846	0	0
19	44421	1	134
20	44703	2	2023
21	40535	3	123
22	42164	0	0
23	41300	0	0
24	42976	2	144
25	33449	1	138
26	43877	5	193
27	41966	2	163
28	42565	2	2016
29	42665	2	168
30	45879	0	0
31	42679	0	0
32	42996	0	0
135	82432	1	136
138	82499	3	2009

Table 5-7 WAAS Ionospheric Correction Message Rates (Type 26) - CRW

Band	Block	On Time	Late	Max Late Length (seconds)
0	1	27508	62	2369
0	2	27536	59	2347
0	3	25320	34	2352
1	0	27511	59	2078
1	1	27520	46	2088
1	2	27507	59	2087
1	3	27515	54	2072
1	4	27518	47	2076
2	0	27525	58	2070
2	1	27527	54	2093
2	2	27525	56	2064
2	3	27517	52	2086
2	4	27521	56	2087
2	5	27515	63	2082
3	0	27514	64	2088
3	1	27499	64	2099
3	2	27532	46	2113
9	0	27535	52	2136
9	1	27520	49	2382
9	2	27507	60	2376
9	3	27526	57	2378
9	4	27517	57	2376
9	5	2214	1	459
9	6	2214	1	301

Table 5-8 WAAS Ionospheric Mask Message Rates (Type 18) - CRW

Band	On Time	Late	Max Late Length (seconds)
1	78194	2	2033
2	78103	2	2026
3	78139	1	2041
9	78102	1	1931

Table 5-9 WAAS Fast Correction and Degradation Message Rates – CRE

Message Type	On Time	Late	Max Late Length (seconds)
1	116353	57	161
2	1324854	59	30
3	1324765	77	24
4	1324800	63	24
7	105032	142	197
9	93150	0	0
10	105188	136	188
17	32173	14	408

Table 5-10 WAAS Long Correction Message Rates (Type 24 and 25) - CRE

PRN	On Time	Late	Max Late Length (seconds)
2	46440	0	0
3	51043	1	167
4	47775	0	0
5	19642	0	0
6	51916	0	0
7	46984	0	0
8	46299	0	0
9	50687	0	0
10	47282	0	0
11	51823	0	0
12	49209	0	0
13	47768	0	0
14	47781	0	0
15	50314	0	0
16	47964	0	0
17	47693	0	0
18	47056	1	167
19	49340	0	0
20	50166	0	0
21	45450	0	0
22	47348	0	0
23	46274	0	0
24	48178	0	0
25	37452	0	0
26	49246	0	0
27	47040	0	0
28	47750	0	0
29	47781	0	0
30	51466	0	0
31	47846	0	0
32	48303	0	0

Table 5-11 WAAS Ephemeris Covariance Message Rates (Type 28) – CRE

PRN	On Time	Late	Max Late Length (seconds)
2	43043	0	0
3	47178	0	0
4	44330	0	0
5	18464	0	0
6	48024	1	121
7	43481	1	155
8	42811	0	0
9	46887	0	0
10	43714	0	0
11	47984	1	163
12	45549	0	0
13	44213	0	0
14	44129	0	0
15	46374	1	121
16	44168	0	0
17	43486	0	0
18	42859	1	138
19	44427	0	0
20	44744	1	131
21	40552	2	162
22	42190	2	186
23	41326	0	0
24	42983	0	0
25	33440	1	151
26	43898	1	150
27	41975	0	0
28	42601	0	0
29	42699	0	0
30	45924	1	121
31	42684	0	0
32	43013	1	157
135	81860	2	175
138	82509	2	168

Table 5-12 WAAS Ionospheric Correction Message Rates (Type 26) – CRE

Band	Block	On Time	Late	Max Late Length (seconds)
0	1	27524	49	522
0	2	27510	53	576
0	3	25303	64	532
1	0	27543	64	522
1	1	27521	63	510
1	2	27543	50	445
1	3	27519	46	449
1	4	27539	43	370
2	0	27527	47	387
2	1	27523	55	390
2	2	27528	46	392
2	3	27534	40	370
2	4	27536	46	334
2	5	27547	43	339
3	0	27532	54	327
3	1	27564	35	370
3	2	27534	41	364
9	0	27545	33	485
9	1	27530	48	480
9	2	27520	58	482
9	3	27535	49	496
9	4	27523	52	499
9	5	2215	2	497
9	6	2216	2	504

Table 5-13 WAAS Ionospheric Mask Message Rates (Type 18) - CRE

Band	On Time	Late	Max Late Length (seconds)
1	78319	0	0
2	78330	2	336
3	78480	1	313
9	78277	0	0

6.0 SV RANGE ACCURACY

Range accuracy evaluation computes the probability that the WAAS User Differential Range Error (UDRE) and Grid Ionospheric Vertical Error (GIVE) statistically bound 99.9% of the range residuals for each satellite tracked by the receiver. A UDRE is broadcast by the WAAS for each satellite that is monitored by the system and the 99.9% bound (3.29 sigma) of the residual error on a pseudorange after application of fast and long-term corrections is checked. The pseudorange residual error is determined by taking the difference between the raw pseudorange and a calculated reference range. The reference range is equal to the true range between the corrected satellite position and surveyed user antenna plus all corrections (WAAS Fast Clock, WAAS Long-Term Clock, WAAS Ionospheric delay, Tropospheric delay, Receiver Clock Bias, and Multipath). Since the true ionospheric delay and multipath error are not precisely known, the estimated variance in these error sources are added to the UDRE before the comparing it to the residual error.

GPS satellite range residual errors were calculated for twelve WAAS receivers during the quarter. Table 6.1 and 6.2 show the range error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.1 and 6.2 show the range error for each SV as measured by the WAAS receivers at the Atlanta reference station.

A GIVE is broadcast by the WAAS for each IGP that is monitored by the system and the 99.9% (3.29 sigma) bound of the ionospheric error is checked. The WAAS broadcasts the ionospheric model using IGP's at predefined geographic locations. Each IGP contains the vertical ionospheric delay and the error in that delay in the form of the GIVE. The ionospheric error is determined by taking the difference between the WAAS vertical ionospheric delay interpolated from the IGP's and GPS dual frequency measurement at that GPS satellite.

GPS satellite ionospheric errors were calculated for twelve WAAS receivers during the quarter. Table 6.3 and 6.4 show the ionospheric error 95% index and 99.9% (3.29 sigma) bounding statistics for each SV at the selected locations. Figures 6.3 and 6.4 show the ionospheric error for each SV as measured by the WAAS receiver at the Atlanta reference station.

Table 6-1Range Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
PRN ↓	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.177	100	1.237	100	1.271	100	1.198	100	1.549	100	1.192	100
3	1.963	100	1.282	100	1.295	100	1.215	100	1.605	100	1.278	100
4	2.015	100	1.893	100	1.566	100	1.505	100	2.037	100	1.653	100
5	1.014	100	1.042	100	1.371	100	0.824	100	1.227	100	1.049	100
6	1.594	100	1.35	100	1.542	100	1.256	100	1.606	100	1.646	100
7	2.01	100	1.486	100	1.448	100	0.948	100	1.387	100	1.535	100
8	1.588	100	1.078	100	1.076	100	0.899	100	0.978	100	1.18	100
9	1.379	100	1.36	100	1.257	100	1.313	100	1.5	100	1.476	100
10	0.709	100	1.335	100	0.832	100	0.97	100	1.449	100	1.632	100
11	1.087	100	0.807	100	0.727	100	1.253	100	0.94	100	0.942	100
12	1.469	100	1.413	100	1.245	100	1.091	100	1.362	100	1.492	100
13	1.647	100	1.525	100	1.668	100	1.018	100	1.717	100	1.594	100
14	1.979	100	1.104	100	1.215	100	0.779	100	1.172	100	1.692	100
15	1.616	100	1.469	100	1.538	100	1.731	100	1.39	100	1.565	100
16	0.892	100	1.144	100	0.724	100	1.249	100	1.421	100	1.053	100
17	1.663	100	1.513	100	1.147	100	1.096	100	1.573	100	1.46	100
18	0.652	100	0.741	100	0.784	100	1.091	100	1.136	100	0.896	100
19	2.079	100	2.249	100	1.898	100	1.941	100	2.97	100	2.36	100
20	0.81	100	0.98	100	0.926	100	0.976	100	1.31	100	1.349	100
21	0.94	100	1.488	100	1.103	100	1.331	100	1.31	100	0.947	100
22	0.984	100	0.902	100	1.119	100	1.45	100	0.968	100	1.024	100
23	0.939	100	1.534	100	1.698	100	1.666	100	2.031	100	1.3	100
24	1.8	100	1.879	100	1.997	100	1.398	100	1.406	100	1.682	100
25	1.489	100	1.416	100	1.27	100	0.943	100	1.281	100	1.423	100
26	1.942	100	1.511	100	1.687	100	1.461	100	1.367	100	1.91	100
27	1.381	100	1.328	100	1.074	100	1.133	100	1.326	100	1.617	100
28	0.569	100	0.795	100	0.697	100	0.926	100	0.945	100	0.739	100
29	1.454	100	1.623	100	1.434	100	1.59	100	1.568	100	1.627	100
30	1.949	100	1.422	100	2.281	100	1.876	100	1.749	100	1.936	100
31	2.425	100	1.574	100	1.137	100	1.017	100	1.805	100	1.842	100
32	1.844	100	1.348	100	1.293	100	0.861	100	1.195	100	1.646	100
135	1.761	100	1.795	100	2.864	100	1.663	100	2.086	100	1.519	100
138	1.47	100	1.666	100	1.911	100	1.288	100	1.739	100	1.631	100

Table 6-2 Range Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
PRN ↓	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.861	100	1.598	100	1.475	100	1.234	100	1.069	100	0.964	100
3	0.924	100	0.995	100	1.559	100	1.51	100	1.347	100	1.455	100
4	1.227	100	1.496	100	2.407	100	1.571	100	1.865	100	1.932	100
5	1.139	100	1.153	100	1.045	100	1.482	100	1.122	100	1.175	100
6	1.3	100	1.367	100	1.477	100	1.614	100	1.628	100	2.375	100
7	0.851	100	1.168	100	1.958	100	1.376	100	1.369	100	1.901	100
8	0.691	100	0.91	100	1.298	100	1.189	100	1.154	100	1.47	100
9	1.01	100	1.165	100	1.258	100	1.129	100	1.266	100	1.383	100
10	1.101	100	0.783	100	0.724	100	0.729	100	0.931	100	1.086	100
11	1.701	100	1.148	100	0.785	100	1.118	100	0.822	100	0.796	100
12	1.045	100	1.127	100	1.167	100	1.363	100	1.685	100	1.561	100
13	0.819	100	1.263	100	1.798	100	1.412	100	1.62	100	1.603	100
14	0.735	100	0.684	100	1.116	100	1.15	100	1.161	100	1.162	100
15	1.766	100	1.092	100	1.206	100	1.447	100	1.581	100	1.984	100
16	1.189	100	1.022	100	1.188	100	0.849	100	0.719	100	0.882	100
17	0.829	100	0.925	100	1.358	100	1.135	100	1.455	100	1.58	100
18	1.746	100	1.454	100	0.931	100	0.877	100	0.814	100	0.857	100
19	3.446	100	2.092	100	2.049	100	1.789	100	2.07	100	2.271	100
20	1.292	100	1.154	100	1.001	100	0.902	100	1.035	100	0.87	100
21	1.715	100	1.176	100	1.29	100	0.919	100	0.875	100	0.91	100
22	1.421	100	1.183	100	1.115	100	0.792	100	0.873	100	0.799	100
23	1.828	100	1.396	100	1.642	100	1.667	100	1.167	100	1.124	100
24	1.124	100	1.348	100	1.438	100	1.631	100	1.66	100	1.976	100
25	0.843	100	1.227	100	1.267	100	1.433	100	1.293	100	1.665	100
26	0.893	100	1.222	100	1.63	100	1.557	100	1.6	100	1.825	100
27	0.759	100	1.096	100	1.324	100	1.53	100	1.436	100	1.75	100
28	1.387	100	0.799	100	2.28	100	0.601	100	0.735	100	0.831	100
29	1.327	100	1.252	100	1.785	100	1.453	100	1.515	100	1.796	100
30	1.173	100	1.384	100	2.18	100	1.67	100	2.015	100	1.861	100
31	1.135	100	1.04	100	1.492	100	1.382	100	1.403	100	1.574	100
32	0.757	100	1.032	100	1.491	100	1.534	100	1.348	100	1.544	100
135	1.918	100	1.425	100	3.052	100	2.483	100	1.528	100	1.463	100
138	1.454	100	1.831	100	2.083	100	1.305	100	1.434	100	0.934	100

Table 6-3 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
PRN ↓	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	0.859308	100	0.965172	100	0.898841	100	0.947954	100	0.895954	100	0.862793	100
3	0.803858	100	0.476582	100	0.428391	100	0.350115	100	0.713511	100	0.440335	100
4	1.307437	100	1.093598	100	1.044063	100	0.848551	100	1.335797	100	1.001278	100
5	0.436842	100	0.459493	100	0.511444	100	0.284655	100	0.623399	100	0.301533	100
6	0.742031	100	0.530418	100	0.640047	100	0.439643	100	0.764818	100	0.574529	100
7	1.189409	100	0.519826	100	0.717587	100	0.406065	100	0.575104	100	0.644189	100
8	0.711744	100	0.338877	100	0.396029	100	0.355474	100	0.470473	100	0.455472	100
9	0.63953	100	0.618665	100	0.44674	100	0.430599	100	0.596341	100	0.612334	100
10	0.3349	100	0.631918	100	0.29997	100	0.518564	100	0.654534	100	0.744853	100
11	0.3515	100	0.424284	100	0.337741	100	0.640175	100	0.407966	100	0.497669	100
12	0.781753	100	0.62509	100	0.516413	100	0.373824	100	0.51418	100	0.610421	100
13	0.843681	100	0.58304	100	0.648575	100	0.322517	100	0.660323	100	0.56534	100
14	1.421075	100	0.383107	100	0.678992	100	0.314742	100	0.60403	100	0.540993	100
15	0.925804	100	0.763895	100	0.585851	100	1.002888	100	0.681473	100	0.763604	100
16	0.445678	100	0.542272	100	0.349776	100	0.721585	100	0.570009	100	0.45774	100
17	1.138011	100	0.686211	100	0.586869	100	0.494626	100	0.921692	100	0.746614	100
18	0.439695	100	0.553959	100	0.478279	100	0.755934	100	0.618228	100	0.536821	100
19	1.391621	100	1.555469	100	1.444805	100	1.518672	100	1.880858	100	1.571426	100
20	0.3501	100	0.353154	100	0.505797	100	0.477454	100	0.6425	100	0.650122	100
21	0.605558	100	0.946436	100	0.86428	100	1.052669	100	0.849617	100	0.721138	100
22	0.504254	100	0.549214	100	0.863601	100	1.017785	100	0.580667	100	0.704517	100
23	0.950836	100	1.198062	100	1.277026	100	1.343527	100	1.637309	100	1.140295	100
24	1.245987	100	1.216764	100	0.992061	100	0.777903	100	0.839455	100	0.90034	100
25	0.764598	100	0.464856	100	0.540866	100	0.370078	100	0.485977	100	0.466995	100
26	1.037361	100	0.797278	100	0.659743	100	0.618437	100	0.721559	100	0.873336	100
27	0.60808	100	0.437397	100	0.395639	100	0.439583	100	0.555919	100	0.610588	100
28	0.331404	100	0.471348	100	0.530315	100	0.663774	100	0.623396	100	0.418921	100
29	0.98498	100	0.945405	100	0.848499	100	0.872476	100	0.968639	100	0.928371	100
30	1.119315	100	0.738441	100	1.175383	100	0.772271	100	0.711027	100	0.820573	100
31	1.532937	100	0.711673	100	0.578765	100	0.473924	100	0.877728	100	0.71484	100
32	0.793607	100	0.464032	100	0.45125	100	0.342019	100	0.402896	100	0.487278	100

Table 6-4 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
PRN ↓	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.221622	100	1.070763	100	0.965043	100	0.93532	100	0.663138	100	0.708226	100
3	0.401819	100	0.378876	100	0.492368	100	0.568821	100	0.436962	100	0.679977	100
4	0.732061	100	0.919484	100	1.450886	100	0.8856	100	1.048208	100	1.213492	100
5	0.460352	100	0.409819	100	0.419999	100	0.452502	100	0.50987	100	0.48612	100
6	0.639422	100	0.573272	100	0.613145	100	0.622175	100	0.665268	100	1.117321	100
7	0.388601	100	0.642034	100	0.807933	100	0.57279	100	0.61427	100	1.109914	100
8	0.286047	100	0.454034	100	0.645607	100	0.378904	100	0.466803	100	0.823646	100
9	0.423672	100	0.533286	100	0.547569	100	0.488036	100	0.535747	100	0.698662	100
10	0.664109	100	0.305205	100	0.313643	100	0.354771	100	0.317722	100	0.435717	100
11	0.889519	100	0.529204	100	0.358369	100	0.375809	100	0.382528	100	0.463463	100
12	0.416334	100	0.483077	100	0.635085	100	0.533144	100	0.783373	100	0.849349	100
13	0.422115	100	0.604424	100	0.782101	100	0.508248	100	0.582648	100	0.837474	100
14	0.495804	100	0.426172	100	0.48271	100	0.421926	100	0.315295	100	0.35295	100
15	0.661954	100	0.594677	100	0.592283	100	0.642382	100	0.83965	100	1.080528	100
16	0.565753	100	0.490278	100	0.567596	100	0.363485	100	0.295626	100	0.343713	100
17	0.466545	100	0.429559	100	0.641351	100	0.451372	100	0.674886	100	0.776867	100
18	0.803769	100	0.757028	100	0.563395	100	0.565514	100	0.444788	100	0.569326	100
19	1.88163	100	1.486106	100	1.378879	100	1.386958	100	1.400124	100	1.588474	100
20	0.620594	100	0.602628	100	0.58124	100	0.4733	100	0.330549	100	0.332307	100
21	0.926942	100	0.74743	100	1.009106	100	0.819151	100	0.702278	100	0.663325	100
22	0.836528	100	0.76194	100	0.811455	100	0.7126	100	0.582669	100	0.557404	100
23	1.268128	100	1.168763	100	1.199948	100	1.601922	100	0.953639	100	0.801218	100
24	1.02892	100	1.056786	100	0.892252	100	0.946775	100	1.034558	100	1.401017	100
25	0.38269	100	0.594641	100	0.538041	100	0.573468	100	0.629207	100	1.052966	100
26	0.635483	100	0.581421	100	0.816386	100	0.718091	100	0.796764	100	1.009495	100
27	0.320942	100	0.450721	100	0.595674	100	0.550113	100	0.571181	100	0.981474	100
28	0.847594	100	0.537993	100	1.299629	100	0.51009	100	0.402543	100	0.3663	100
29	0.838784	100	0.866055	100	1.111004	100	0.839791	100	0.958833	100	1.113943	100
30	0.742147	100	0.848634	100	1.088963	100	0.830091	100	0.944947	100	1.04933	100
31	0.779058	100	0.529727	100	0.631374	100	0.535714	100	0.615921	100	0.840934	100
32	0.373188	100	0.38295	100	0.597489	100	0.469464	100	0.470192	100	0.701354	100

Figure 6-1 95% Range Error (PRN 1 - PRN 16) - Atlanta

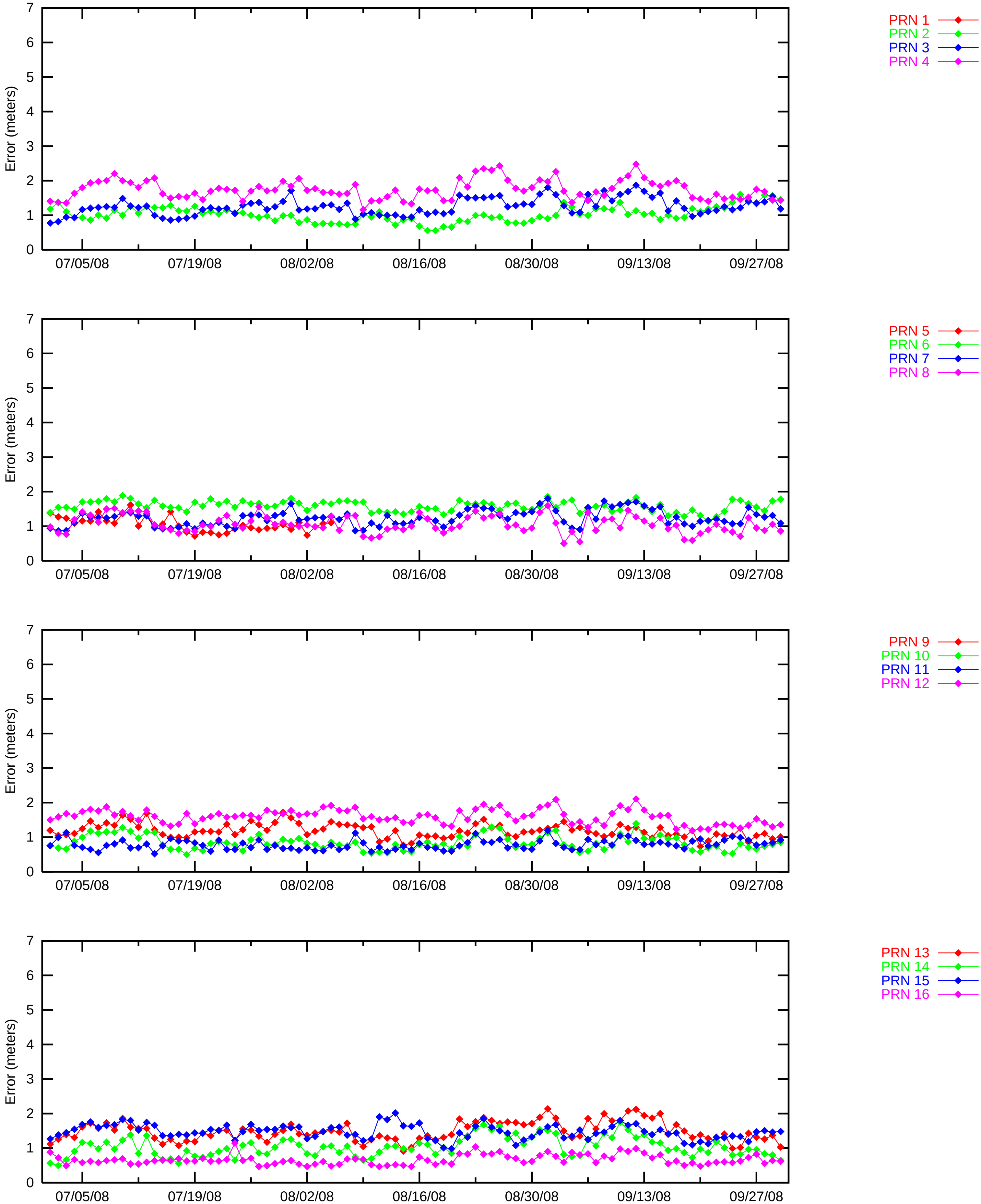


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Atlanta

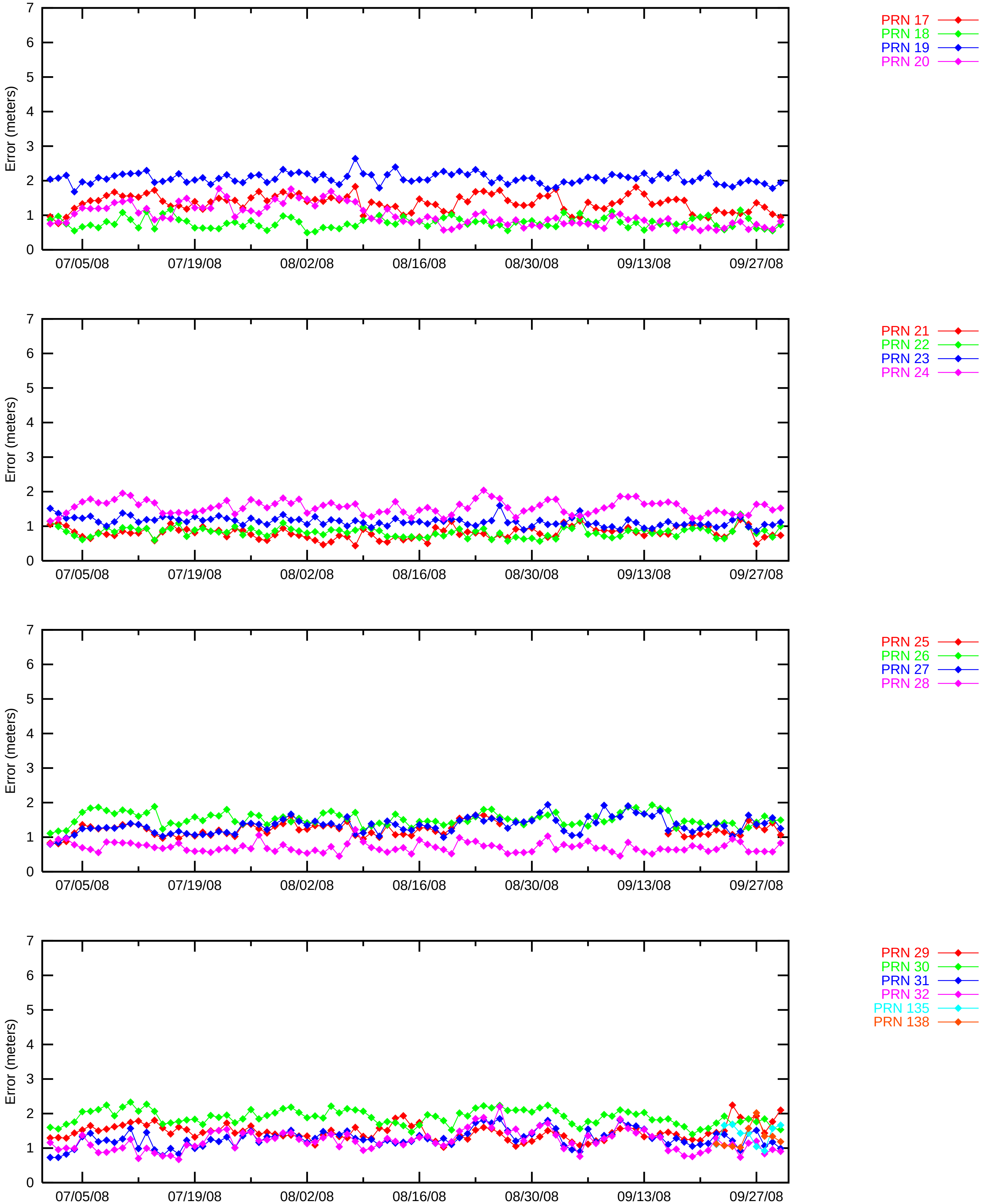
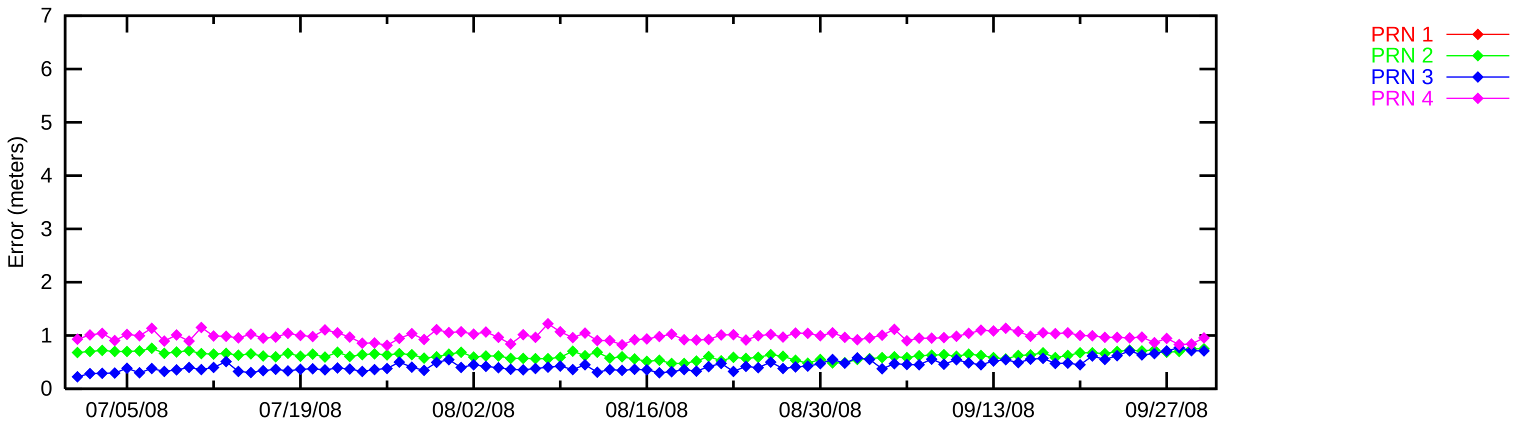
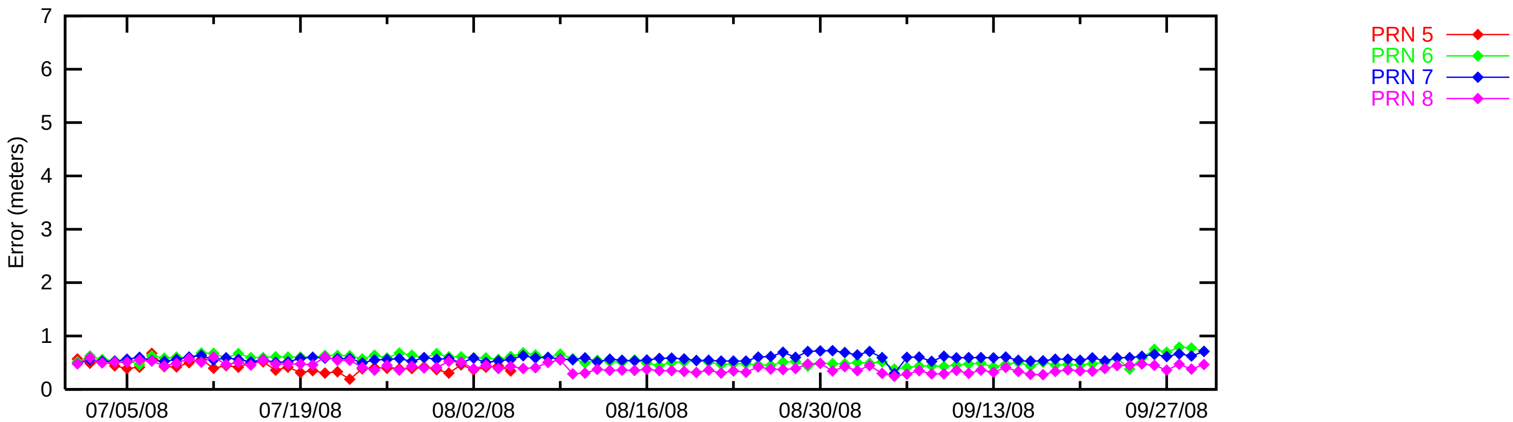
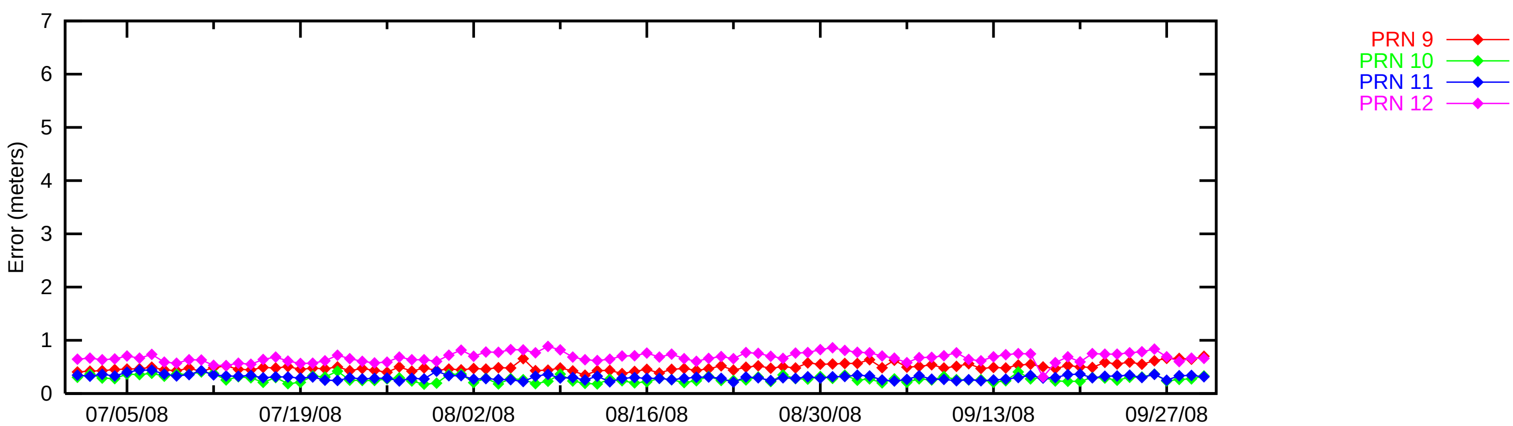


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Atlanta







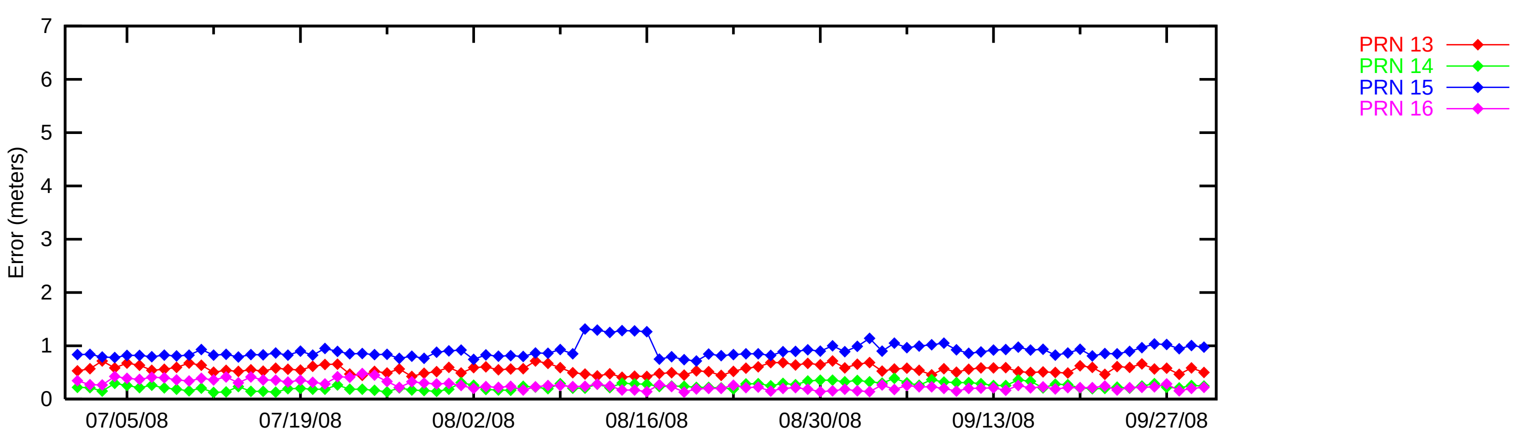
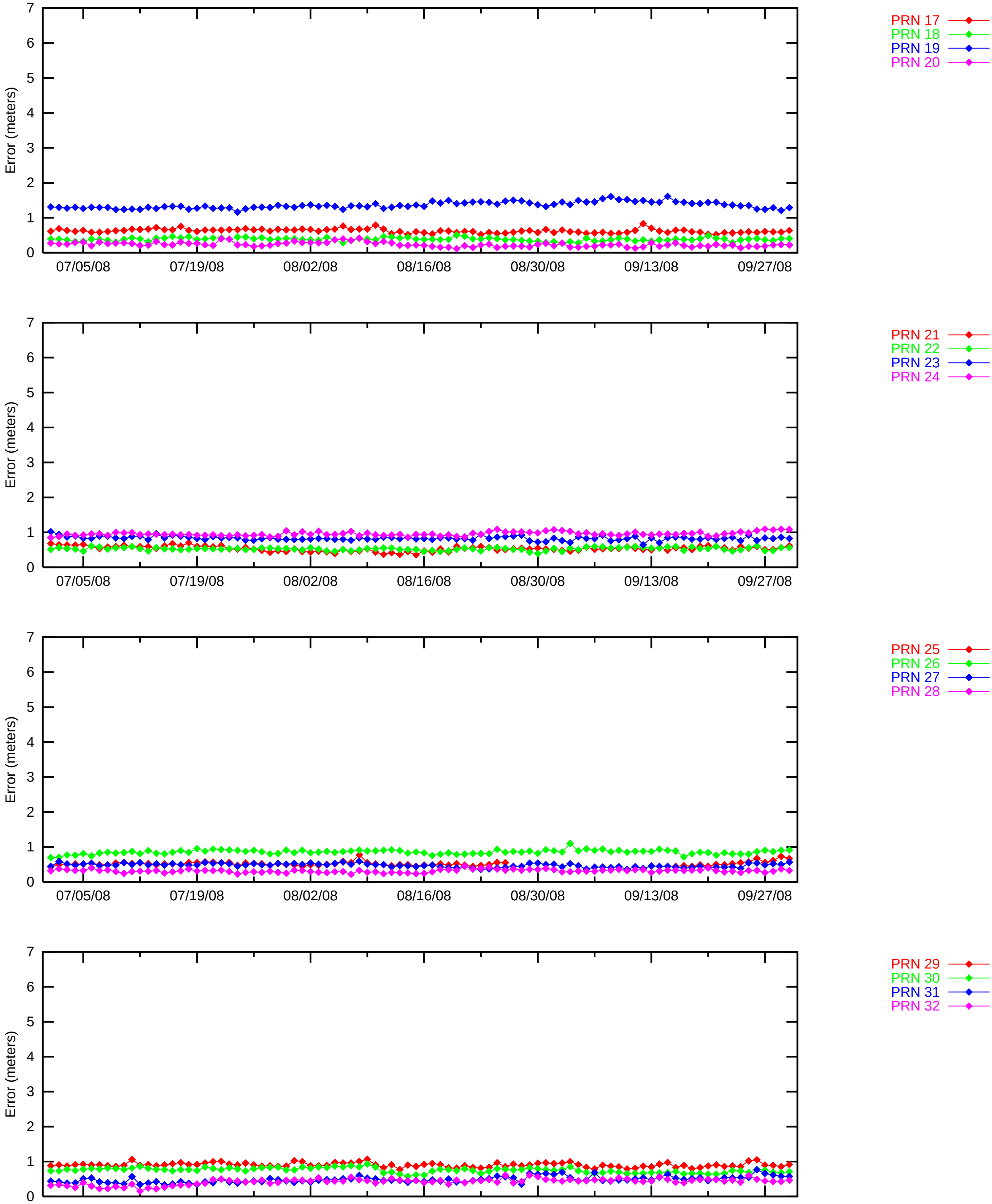


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Atlanta



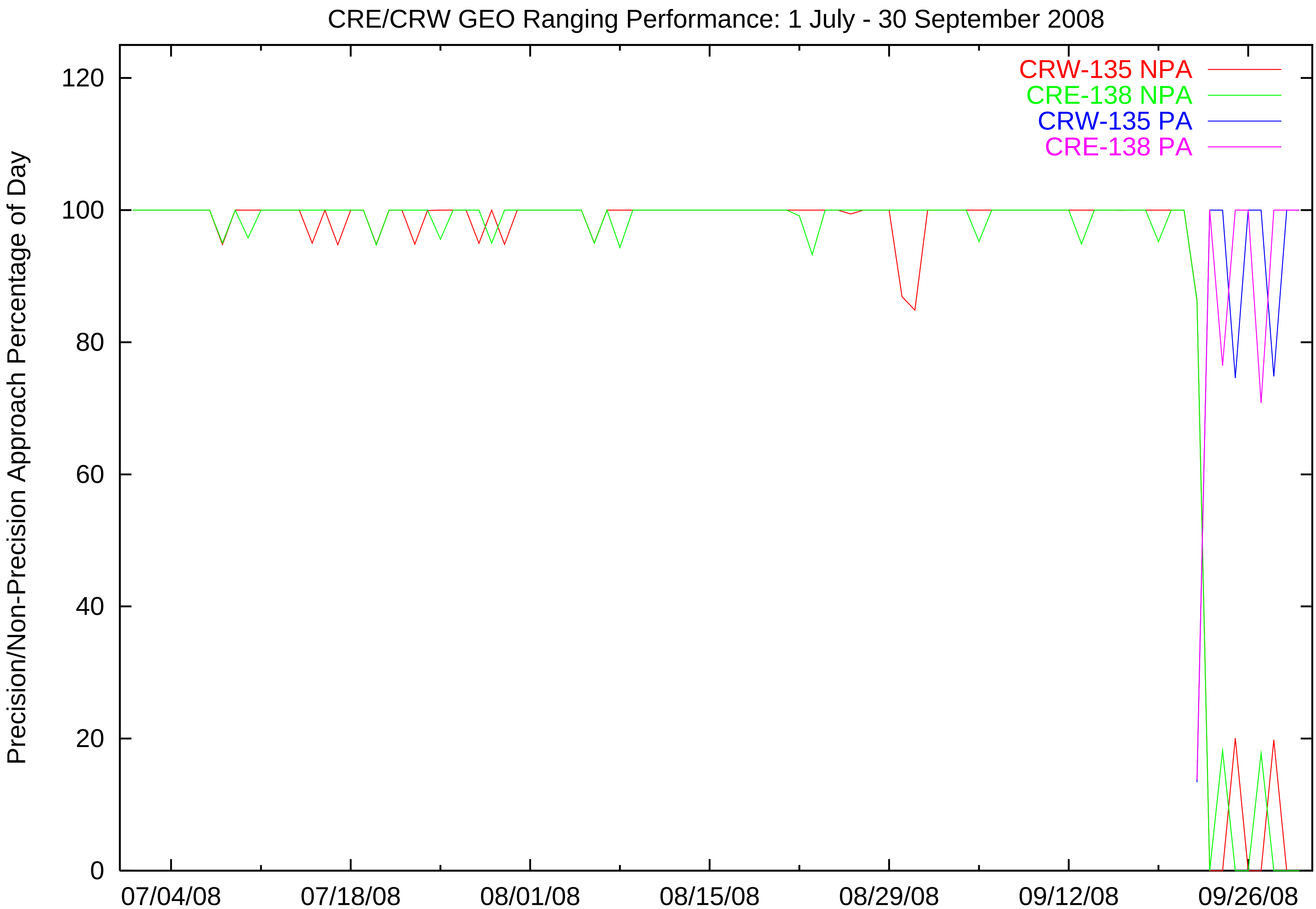
7.0 GEO RANGING PERFORMANCE

For the evaluation period, both CRW and CRE GEO satellites provide ranging capability for enroute through NPA service and begin providing a ranging capability for PA service on September 22, 2008 when Release 8/9.2 software becomes operational. Table 7.1 shows the GEO-Ranging performance for CRE and CRW GEO satellites throughout the evaluation period. Figure 7.1 shows the trend of NPA Ranging Availability for the CRE and CRW GEO satellite.

Table 7-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
CRW	8.291	90.123	1.420	0.165
CRE	8.272	90.928	0.599	0.200

Figure 7-1 Daily PA GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

Events that adversely affected the WAAS service for this evaluation period are listed in Table 8.1. These events include any WAAS anomalies and problems that affected the WAAS performance. Detailed analyses of particular events are documented in the Discrepancy Reports (DR). The DRs are posted on the website http://www.nstb.tc.faa.gov under 'WAAS Technical Reports', and can also be accessed via hyperlink from Table 8.1 below.

Table 8-1 WAAS Problem Summary

Date	Events
8/30/08	See DR #73, "CRW High L5 C/N0 and GUS Switchovers".
8/31/08	See DR #74, "CRW 32 min SIS Outage".
9/27/08	See DR #75, "C&V Initialization Caused WAAS Service Outage".

9.0 WAAS AIRPORT AVAILABILITY

The WAAS airport availability evaluation determines the number and length LVP service outages at selected airports from the transmitted WAAS navigation message. The navigation messages transmitted from all GEO satellites are processed simultaneously, and WAAS protection levels (VPL and HPL) are computed at each airport once a second in accordance with the WAAS MOPS. Once the protection levels have been produced at each airport an LPV service evaluation is conducted to identify outages in service (i.e. when protection levels exceed alert limits). WAAS LPV service is available for a user when the vertical protection level (VPL) is less than or equal to vertical alert limit (VAL) of 50 meters and the horizontal protection level (HPL) is less than or equal to horizontal alert limit (HAL) of 40 meters. If both conditions are met at a specified airport location then WAAS LPV service is available at that airport. If either one of the conditions are not met at a specified airport location then WAAS LPV service at that airport is unavailable and an outage in LPV service is recorded with its duration. When the LPV service becomes unavailable it is not considered available again until protection levels are below or equal to alert limits for at least 15 minutes. Although this will reduce LPV service availability minimally, it substantially reduces the number of service outages and prevents excessive switching in and out of service availability. When computing LPV service availability, an extra two minutes of outage time was prefixed to each outage. The number of WAAS LPV service outages and the availability at selected airports for this evaluation period of WAAS operation is presented in Table 9.1. Figures 9.1 and 9.2 provide a graphical representation of WAAS LPV service availability and outage counts for the same period, respectively.

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	Outages	Availability
PANC	Anchorage Intl	AK	4	0.999516
PAEN	Emmonak	AK	5	0.999480
PAFA	Fairbanks Intl	AK	38	0.998421
PAHO	Homer	AK	5	0.999459
PAEN	Kenai Municipal	AK	5	0.999480
PASK	Selawik	AK	336	0.977276
PAMK	St Michael	AK	46	0.997422
AUO	Auburn-Opelika Robert G. Pitts	AL	4	0.999789
EKY	Bessemer	AL	4	0.999845
BHM	Birmingham Intl	AL	3	0.999869
SEM	Craig Field	AL	3	0.999838
DHN	Dothan Regional	AL	4	0.999772
HSV	Huntsville Intl - Carl T. Jones Field	AL	3	0.999855
JKA	Jack Edwards	AL	4	0.999827
MDQ	Madison County Executive/Tom Sharp Jr Field	AL	3	0.999852
BFM	Mobile Downtown	AL	3	0.999869
MOB	Mobile Regional	AL	3	0.999878
MGM	Montgomery Regional (Dannelly Field)	AL	3	0.999821
MSL	Northwest Alabama Regional	AL	2	0.999876
DCU	Pryor Field Regional	AL	3	0.999857
79J	South Alabama Regional at Bill Benton Field	AL	4	0.999798
PLR	St Clair County	AL	4	0.999844
8A0	The Albertville Municipal-Thomas J. Brumlik Field	AL	3	0.999857
LIT	Adams Field	AR	2	0.999828
M73	Almyra Municipal	AR	2	0.999845
BYH	Arkansas Intl	AR	2	0.999833
VBT	Bentonville Municipal/Louise M. Thaden Field	AR	2	0.999771
HRO	Boone County	AR	2	0.999791
FSM	Fort Smith Regional	AR	2	0.999778

Airport Id	Airport Name	State	Outages	Availability
PBF	Grider Field	AR	2	0.999838
XNA	Northwest Arkansas Regional	AR	2	0.999770
BPK	Ozark Regional	AR	2	0.999797
ROG	Rogers Municipal-Carter Field	AR	2	0.999773
RUE	Russellville Regional	AR	2	0.999803
SRC	Searcy Municipal	AR	2	0.999828
SLG	Smith Field	AR	2	0.999768
ELD	South Arkansas Regional at Goodwin Field	AR	2	0.999829
ASG	Springdale Municipal	AR	2	0.999772
SGT	Stuggart Municipal	AR	2	0.999841
ARG	Walnut Ridge Regional	AR	2	0.999820
PRC	Ernest A. Love Field	AZ	4	0.999856
GEU	Glendale Municipal	AZ	8	0.999795
GCN	Grand Canyon National Park	AZ	2	0.999903
IFP	Laughlin/Bullhead Intl	AZ	3	0.999878
DVT	Phoenix Deer Valley	AZ	3	0.999867
PHX	Phoenix Sky Harbor Intl	AZ	8	0.999799
SJN	St Johns Industrial Airpark	AZ	1	0.999942
TUS	Tucson Intl	AZ	44	0.998350
IWA	Williams Gateway	AZ	8	0.999771
APV	Apple Valley	CA	3	0.999832
ACV	Arcata	CA	28	0.998055
BFL	Bakersfield/Meadows Field	CA	26	0.998977
DAG	Barstow-Daggett	CA	3	0.999846
C83	Byron	CA	35	0.997986
CMA	Camarillo	CA	66	0.997407
CNO	Chino	CA	9	0.999677
FAT	Fresno Yosemite Intl	CA	15	0.999109
WJF	General Wm J Fox Airfield	CA	16	0.999464
HAF	Half Moon Bay	CA	51	0.996490
SNA	John Wayne Airport-Orange County	CA	16	0.999438
LGB	Long Beach (Daugherty Field)	CA	26	0.999111
LAX	Los Angeles Intl	CA	36	0.998774
CRQ	McClellan-Palomar	CA	7	0.999691
OAK	Metropolitan Oakland Intl	CA	46	0.997123
MRY	Monterey Peninsula	CA	63	0.995618
APC	Napa County	CA	42	0.997678
O02	Nervino	CA	14	0.999294
SJC	Norman Y. Mineta San Jose Intl	CA	46	0.997124
VCB	Nut Tree	CA	33	0.997954
ONT	Ontario Intl	CA	9	0.999689
OXR	Oxnard	CA	70	0.997134
PMD	Palmdale Production Flight	CA	12	0.999553
RDD	Redding Municipal	CA	19	0.998780
RAL	Riverside Municipal	CA	5	0.999771
SMF	Sacramento Intl	CA	28	0.998395
MHR	Sacramento Mather	CA	27	0.998495
SFO	San Francisco Intl	CA	50	0.996907
TCY	Tracy Municipal	CA	35	0.998052
COS	City Of Colorado Springs Municipal	CO	2	0.999889
AKO	Colorado Plains Regional	CO	2	0.999839
CEZ	Cortez Municipal	CO	1	0.999942

Airport Id	Airport Name	State	Outages	Availability
DEN	Denver Intl	CO	2	0.999870
GXY	Greeley-Weld County	CO	2	0.999860
ITR	Kit Carson County	CO	2	0.999835
LAA	Lamar Municipal	CO	2	0.999861
PUB	Pueblo Memorial	CO	2	0.999895
ALS	San Luis Valley Regional/Bergman Field	CO	1	0.999941
HDN	Yampa Valley	CO	2	0.999905
BDL	Bradley Intl	CT	8	0.999223
GON	Groton-New London	CT	8	0.999031
HVN	Tweed-New Haven	CT	8	0.999219
OXC	Waterbury-Oxford	CT	8	0.999243
DCA	Ronald Reagan Washington National	DC	6	0.999594
EVY	Summit	DE	6	0.999501
GED	Sussex County	DE	6	0.999463
AAF	Apalachicola Municipal	FL	3	0.999802
CEW	Bob Sikes	FL	4	0.999797
BCT	Boca Raton	FL	22	0.998776
BKV	Brooksville	FL	5	0.999691
DAB	Daytona Beach Intl	FL	5	0.999655
DED	Deland Municipal-Sidney H. Taylor Field	FL	5	0.999661
FXE	Fort Lauderdale Executive	FL	22	0.998748
FLL	Fort Lauderdale-Hollywood Intl	FL	25	0.998640
GNV	Gainesville Regional	FL	4	0.999711
JAX	Jacksonville Intl	FL	4	0.999690
TMB	Kendall-Tamiami Executive	FL	27	0.998549
EYW	Key West Intl	FL	9	0.999092
ISM	Kissimmee Gateway	FL	5	0.999639
LAL	Lakeland Linder Regional	FL	5	0.999644
LEE	Leesburg Intl	FL	5	0.999673
MLB	Melbourne Intl	FL	6	0.999565
COI	Merritt Island	FL	5	0.999589
MIA	Miami Intl	FL	27	0.998521
APF	Naples Municipal	FL	7	0.999513
EVB	New Smyrna Beach Municipal	FL	5	0.999643
OCF	Ocala Intl-Jim Taylor Field	FL	4	0.999705
MCO	Orlando Intl	FL	5	0.999638
PBI	Palm Beach Intl	FL	20	0.998930
PFN	Panama City-Bay County Intl	FL	3	0.999810
PNS	Pensacola Regional	FL	4	0.999822
PMP	Pompano Beach Airpark	FL	22	0.998752
SRQ	Sarasota/Bradenton Intl	FL	5	0.999612
RSW	Southwest Florida Intl	FL	5	0.999565
PIE	St Petersburg-Clearwater Intl	FL	5	0.999681
TLH	Tallahassee Regional	FL	3	0.999781
TPA	Tampa Intl	FL	5	0.999676
MTH	The Florida Keys Marathon	FL	9	0.999122
VDF	Vandenburg	FL	5	0.999671
GIF	Winter Haven's Gilbert	FL	5	0.999642
AGS	Augusta Regional at Bush Field	GA	5	0.999708
BQK	Brunswick Golden Isle	GA	5	0.999662
VPC	Cartersville	GA	5	0.999803
RYY	Cobb County-McCollum Field	GA	5	0.999785

Airport Id	Airport Name	State	Outages	Availability
CSG	Columbus Metropolitan	GA	4	0.999771
CKF	Crisp County-Cordele	GA	4	0.999730
DNN	Dalton Municipal	GA	4	0.999811
SBO	Emanuel County	GA	4	0.999704
FTY	Fulton County Airport-Brown Field	GA	5	0.999775
ATL	Hartsfield-Jackson Atlanta Intl	GA	5	0.999766
EZM	Heart of Georgia Regional	GA	4	0.999709
19A	Jackson County	GA	5	0.999772
GVL	Lee Gilmer Memorial	GA	5	0.999779
MCN	Middle Georgia Regional	GA	4	0.999732
MGR	Moultrie Municipal	GA	4	0.999734
CCO	Newnan Coweta County	GA	6	0.999760
FFC	Peachtree City-Falcon Field	GA	6	0.999750
PXE	Perry-Houston County	GA	4	0.999734
JZP	Pickens County	GA	4	0.999800
JYL	Plantation Airpark	GA	4	0.999694
SAV	Savannah Intl	GA	5	0.999659
ACJ	Souther Field	GA	3	0.999759
ABY	Southwest Georgia Regional	GA	3	0.999756
TBR	Statesboro-Bulloch County	GA	4	0.999692
TOC	Toccoa RG Letourneau Field	GA	5	0.999774
VLD	Valdosta Regional	GA	4	0.999722
AYS	Waycross-Ware County	GA	4	0.999696
CTJ	West Georgia Regional-O V Gray Field	GA	4	0.999811
WDR	Winder-Barrow	GA	5	0.999758
IKV	Ankeny	IA	2	0.999821
DVN	Davenport Municipal	IA	2	0.999792
DSM	Des Moines Intl	IA	2	0.999821
DBQ	Dubuque Regional	IA	2	0.999786
EST	Estherville Municipal	IA	2	0.999855
FFL	Fairfield Municipal	IA	2	0.999794
EOK	Keokuk Municipal	IA	2	0.999797
MCW	Mason City Municipal	IA	2	0.999829
MXO	Monticello Regional	IA	2	0.999788
MUT	Muscatine Municipal	IA	2	0.999793
TNU	Newton Municipal	IA	2	0.999811
OTM	Ottumwa Industrial	IA	2	0.999796
SDA	Shenandoah Municipal	IA	2	0.999845
SLB	Storm Lake Municipal	IA	2	0.999857
CID	The Eastern Iowa	IA	2	0.999792
ALO	Waterloo Municipal	IA	2	0.999809
BOI	Boise Air Terminal/Gowen Field	ID	2	0.999926
IDA	Idaho Falls Regional	ID	1	0.999943
LWS	Lewiston-Nez Perce County	ID	1	0.999943
S67	Nampa Municipal	ID	2	0.999912
PIH	Pocatello Regional	ID	1	0.999943
SPI	Abraham Lincoln Capital	IL	2	0.999800
FEP	Albertus	IL	2	0.999784
ARR	Aurora Municipal	IL	2	0.999787
BMI	Central Il Regional Airport Bloomington-Normal	IL	2	0.999796
ENL	Centralia Municipal	IL	2	0.999808
MDW	Chicago Midway	IL	2	0.999784

Airport Id	Airport Name	State	Outages	Availability
ORD	Chicago O'Hare Intl	IL	2	0.999784
RFD	Chicago/Rockford Intl	IL	2	0.999784
DEC	Decatur	IL	2	0.999800
FOA	Flora Municipal	IL	2	0.999807
IKK	Greater Kankakee	IL	2	0.999790
PIA	Greater Peoria Regional	IL	2	0.999796
IGQ	Lansing Municipal	IL	2	0.999787
LOT	Lewis University	IL	2	0.999786
3LF	Litchfield Municipal	IL	2	0.999804
PPQ	Pittsfiled-Penstone Municipal	IL	2	0.999801
MLI	Quad City Intl	IL	2	0.999794
UIN	Quincy Regional-Baldwin Field	IL	2	0.999799
TIP	Rantoul Natl Aviation Center-Frank Elliot Field	IL	2	0.999795
SLO	Salem-Leckrone	IL	2	0.999807
ALN	St Louis Regional	IL	2	0.999805
DNV	Vermillion County	IL	2	0.999797
UGN	Waukegan Regional	IL	2	0.999777
MWA	Williamson County Regional	IL	2	0.999808
BAK	Columbus Municipal	IN	2	0.999798
GWB	DeKalb County	IN	2	0.999786
MIE	Delaware County-Johnson Field	IN	2	0.999793
EKM	Elkhart Municipal	IN	2	0.999784
FWA	Fort Wayne	IN	2	0.999788
SER	Freeman Municipal	IN	3	0.999783
HFY	Greenwood Municipal	IN	2	0.999798
IND	Indianapolis Intl	IN	2	0.999799
GGP	Logansport/Cass County	IN	2	0.999791
MZZ	Marion Municipal	IN	2	0.999792
CEV	Mettel Field	IN	3	0.999765
BMG	Monroe County	IN	2	0.999801
LAF	Purdue University	IN	2	0.999794
GEZ	Shelbyville Municipal	IN	2	0.999797
SBN	South Bend	IN	2	0.999784
ANQ	Tri-State Steuben County	IN	2	0.999784
PTS	Atkinson Municipal	KS	2	0.999778
AAO	Colonel James Jabara	KS	2	0.999771
DDC	Dodge City Regional	KS	2	0.999804
EMP	Emporia Municipal	KS	2	0.999813
FOE	Forbes Field	KS	2	0.999816
FSK	Fort Scott Municipal	KS	2	0.999784
GCK	Garden City Regional	KS	2	0.999819
HYS	Hays Regional	KS	2	0.999778
HQG	Hugoton Municipal	KS	2	0.999846
OJC	Johnson County Executive	KS	2	0.999809
LWC	Lawrence Municipal	KS	2	0.999818
LBL	Liberal Mid-America Regional	KS	2	0.999839
MHK	Manhattan Regional	KS	2	0.999832
MPR	McPherson	KS	2	0.999776
IXD	New Century Aircenter	KS	2	0.999811
EWK	Newton-City-County	KS	2	0.999774
OEL	Oakley Municipal	KS	2	0.999805
TOP	Philip Billard Municipal	KS	2	0.999817

Airport Id	Airport Name	State	Outages	Availability
GLD	Renner Field/Goodland Municipal	KS	2	0.999820
RSL	Russell Municipal	KS	2	0.999779
SLN	Salina Municipal	KS	2	0.999778
TQK	Scott City Municipal	KS	2	0.999816
CBK	Shalz Field	KS	2	0.999806
WLD	Strother Field	KS	2	0.999763
ULS	Ulysses	KS	2	0.999839
EGT	Wellington Municipal	KS	2	0.999762
ICT	Wichita Mid-Continent	KS	2	0.999769
EKX	Addington Field	KY	3	0.999779
PAH	Barkley Regional	KY	1	0.999203
K22	Big Sandy Regional	KY	4	0.999724
LEX	Blue Grass	KY	3	0.999730
LOU	Bowman Field	KY	3	0.999766
CVG	Cincinnati/Northern Kentucky Intl	KY	3	0.999737
LOZ	London-Corbin Airport-Magee Field	KY	4	0.999728
SDF	Louisville Intl-Standiford Field	KY	3	0.999768
OWB	Owensboro-Daviess County	KY	2	0.999809
SME	Somerset-Pulaski County-J.T. Wilson Field	KY	4	0.999739
W38	Williamsburg-Whitley County	KY	4	0.999738
ARA	Acadiana Regional	LA	2	0.999910
AEX	Alexandria Intl	LA	2	0.999871
BTR	Baton Rouge Metropolitan	LA	2	0.999905
DRI	Beauregard Regional	LA	2	0.999898
CWF	Chennault Intl	LA	2	0.999923
ESF	Esler Regional	LA	2	0.999872
LFT	Lafayette Regional	LA	2	0.999905
LCH	Lake Charles Regional	LA	2	0.999923
NEW	Lakefront	LA	1	0.999939
MSY	New Orleans Intl	LA	1	0.999939
PTN	Patterson	LA	1	0.999940
DTN	Shreveport Downtown	LA	2	0.999831
SHV	Shreveport Regional	LA	2	0.999836
TVR	Vicksburg Tallulah Regional	LA	2	0.999872
BAF	Barnes Municipal	MA	8	0.999236
HYA	Barnstable Municipal-Boardman/Polando Field	MA	10	0.998789
BOS	Gen Edward Lawrence Logan Intl	MA	10	0.998918
BED	Laurence G. Hanscom Field	MA	11	0.999054
MVY	Marthas Vineyard	MA	10	0.998864
OWD	Norwood	MA	10	0.998928
PVC	Provincetown Municipal	MA	10	0.998782
ORH	Worcester Regional	MA	8	0.999172
BWI	Baltimore-Washington Intl	MD	6	0.999572
DMW	Carroll County Regional/Jack B Poage Field	MD	5	0.999588
ESN	Easton/Newnam Field	MD	7	0.999502
FDK	Frederick	MD	6	0.999584
GAI	Montgomery County Airpark	MD	6	0.999583
2W6	St Mary's County Regional	MD	7	0.999567
LEW	Auburn/Lewiston Municipal	ME	10	0.998881
AUG	Augusta State	ME	10	0.998817
BHB	Hancock County-Bar Harbor	ME	10	0.998609
PQI	Northern Maine Regional Airport at Presque Is	ME	9	0.998926

Airport Id	Airport Name	State	Outages	Availability
PWM	Portland Intl Jetport	ME	11	0.998823
WVL	Waterville Robert LaFleur	ME	9	0.998833
ARB	Ann Arbor Municipal	MI	3	0.999758
ACB	Antrim County	MI	2	0.999755
FNT	Bishop Intl	MI	2	0.999769
CIU	Chippewa County Intl	MI	2	0.999741
DTW	Detroit Metro Wayne County	MI	3	0.999754
3FM	Fremont Municipal	MI	2	0.999768
GRR	Gerald R. Ford Intl	MI	2	0.999772
CMX	Houghton County Memorial	MI	2	0.999773
BAX	Huron County	MI	4	0.999717
AZO	Kalamazoo/Battle Creek Intl	MI	2	0.999778
ADG	Lenawee County	MI	3	0.999757
OZW	Livingston County Spencer J. Hardy	MI	2	0.999771
MBS	MBS Intl	MI	2	0.999764
MKG	Muskegon County	MI	2	0.999770
HYX	Saginaw Co H.W. Browne	MI	2	0.999764
BIV	Tulip City	MI	2	0.999777
YIP	Willow Run	MI	3	0.999756
AEL	Albert Lea Municipal	MN	2	0.999833
ANE	Anoka Co-Blaine Airportt (Janes Field)	MN	2	0.999839
BDE	Baudette Intl	MN	2	0.999880
BRD	Brainerd Lakes Regional	MN	2	0.999861
AXN	Chandler Field	MN	2	0.999881
HIB	Chisholm-Hibbing	MN	2	0.999843
CKN	Crookston Municipal Kirkwood Fld	MN	2	0.999914
DTL	Detroit Lakes-Wething Field	MN	2	0.999894
DLH	Duluth Intl	MN	2	0.999830
MSP	Minneapolis-St Paul Intl	MN	2	0.999837
RGK	Red Wing Regional	MN	2	0.999823
RST	Rochester Intl	MN	2	0.999820
ROX	Roseau Municipal/Rudy Billberg Field	MN	1	0.999940
STC	St Cloud Regional	MN	2	0.999855
JYG	St James Municipal	MN	2	0.999855
STP	St Paul Downtown Holman Field	MN	2	0.999835
BDH	Willmar Municipal	MN	2	0.999872
M17	Bolivar Municipal	MO	2	0.999793
CGI	Cape Girardeau Regional	MO	2	0.999806
MKC	Charles B. Wheeler Downtown	MO	2	0.999812
COU	Columbia Regional	MO	2	0.999802
1H0	Creve Coeur	MO	2	0.999806
LBO	Floyd W. Jones Lebanon	MO	2	0.999798
HIG	Higginsville Industrial Municipal	MO	2	0.999800
JEF	Jefferson City Memorial	MO	2	0.999802
VER	Jesse Viertel Memorial	MO	2	0.999804
JLN	Joplin Regional	MO	2	0.999775
MCI	Kansas City Intl	MO	2	0.999816
TKX	Kennett Memorial	MO	2	0.999828
IRK	Kirksville Regional	MO	2	0.999801
STL	Lambert-St Louis Intl	MO	2	0.999806
AIZ	Lee C Fine Memorial	MO	2	0.999803
LXT	Lee's Summit Municipal	MO	2	0.999805

Airport Id	Airport Name	State	Outages	Availability
6M6	Lewis County Regional	MO	2	0.999799
MYJ	Mexico Memorial	MO	2	0.999804
GPH	Midwest National Air Center	MO	2	0.999812
M58	Monett Municipal	MO	2	0.999776
EOS	Neosho Hugh Robinson	MO	2	0.999773
POF	Poplar Bluff Municipal	MO	2	0.999812
STJ	Rosecrans Memorial	MO	2	0.999827
DMO	Sedalia	MO	2	0.999801
SIK	Sikeston Memorial Municipal	MO	2	0.999813
RCM	Skyhaven	MO	2	0.999799
SGF	Springfield-Branson National	MO	2	0.999790
TBN	Waynesville Regional Arpt at Forney Field	MO	2	0.999804
UNO	West Plains Municipal	MO	2	0.999798
STF	George M Bryan	MS	2	0.999891
GTR	Golden Triangle Regional	MS	2	0.999894
GWO	Greenwood-LeFlore	MS	2	0.999878
GNF	Grenada Municipal	MS	2	0.999874
GPT	Gulfport-Biloxi Intl	MS	2	0.999919
HEZ	Hardy-Anders Fld Natchez-Adams County	MS	2	0.999876
HBG	Hattiesburg Bobby L Chain Municipal	MS	2	0.999918
PIB	Hattiesburg-Laurel Regional	MS	2	0.999914
LUL	Hesler-Noble Field	MS	2	0.999915
JAN	Jackson-Evers Intl	MS	2	0.999891
M16	John Bell Williams	MS	2	0.999885
MEI	Key Field	MS	2	0.999914
M40	Monroe County	MS	2	0.999887
OLV	Olive Branch	MS	2	0.999854
CRX	Roscoe Turner	MS	2	0.999866
PQL	Trent Lott Intl	MS	2	0.999910
UTA	Tunica Municipal	MS	2	0.999855
UOX	University-Oxford	MS	2	0.999868
BTM	Bert Mooney	MT	2	0.999919
BIL	Billings Logan Intl	MT	2	0.999868
MLS	Frank Wiley Field	MT	2	0.999892
GPI	Glacier Park Intl	MT	2	0.999900
GTF	Great Falls Intl	MT	2	0.999897
HLN	Helena Regional	MT	2	0.999900
LWT	Lewistown Municipal	MT	2	0.999895
HBI	Asheboro Municipal	NC	5	0.999710
AVL	Asheville Regional	NC	4	0.999773
CLT	Charlotte/Douglas Intl	NC	4	0.999755
JQF	Concord Regional	NC	4	0.999751
EWN	Craven County Regional	NC	6	0.999554
ECG	Elizabeth City CG Air Station/Regional	NC	6	0.999534
FAY	Fayetteville Regional/Grannis Field	NC	6	0.999657
LHZ	Franklin County	NC	5	0.999683
AKH	Gastonia Municipal	NC	4	0.999758
GWW	Goldsboro-Wayne Municipal	NC	6	0.999676
HRJ	Harnett Regional Jetport	NC	6	0.999688
ISO	Kinston Regional Jetport at Stallings Fld	NC	6	0.999631
EQY	Monroe Regional	NC	5	0.999722
EDE	Northeastern Regional	NC	6	0.999541

Airport Id	Airport Name	State	Outages	Availability
GSO	Piedmont-Triad Intl	NC	5	0.999713
PGV	Pitt-Greenville	NC	6	0.999583
RDU	Raleigh-Durham Intl	NC	5	0.999692
RWI	Rocky Mount-Wilson Regional	NC	6	0.999653
RUQ	Rowan County	NC	4	0.999748
TTA	Sanford-Lee County Regional	NC	5	0.999700
SVH	Statesville Regional	NC	4	0.999754
ILM	Wilmington Intl	NC	6	0.999560
BIS	Bismarck Municipal	ND	2	0.999903
DIK	Dickinson Municipal	ND	2	0.999901
GFK	Grand Forks Intl	ND	1	0.999940
FAR	Hector Intl	ND	2	0.999911
JMS	Jamestown Regional	ND	1	0.999940
MOT	Minot Intl	ND	2	0.999871
ANW	Ainsworth Municipal	NE	2	0.999892
AIA	Alliance Municipal	NE	2	0.999821
BIE	Beatrice Municipal	NE	2	0.999851
FNB	Brenner Field	NE	2	0.999840
HDE	Breswter Field	NE	2	0.999791
GRI	Central Nebraska Regional	NE	2	0.999854
CDR	Chadron Municipal	NE	2	0.999836
OLU	Columbus Municipal	NE	2	0.999883
OMA	Eppley Airfield	NE	2	0.999858
FET	Fremont Municipal	NE	2	0.999870
HSI	Hastings Municipal	NE	2	0.999823
IML	Imperial Municipal	NE	2	0.999801
LXN	Jim Kelly Field	NE	2	0.999793
OFK	Karl Stefan Memorial	NE	2	0.999890
EAR	Kearney Municipal	NE	2	0.999792
IBM	Kimball Municipal/Robert E. Arraj Field	NE	2	0.999832
LNK	Lincoln Municipal	NE	2	0.999867
MCK	McCook Municipal	NE	2	0.999788
MLE	Millard	NE	2	0.999861
VTN	Miller Field	NE	2	0.999878
LBF	North Platte Regional Airport Lee Bird Field	NE	2	0.999796
PMV	Plattsmouth Municipal	NE	2	0.999855
SCB	Scribner State	NE	2	0.999873
OGA	Searle Field	NE	2	0.999808
SNY	Sidney Municipal	NE	2	0.999821
ONL	The O'Neill Municipal-John L Baker Field	NE	2	0.999906
LCG	Wayne Municipal	NE	2	0.999884
BFF	Western Neb. Regional/William B. Heilig Field	NE	2	0.999822
JYR	York Municipal	NE	2	0.999872
ASH	Boire Field	NH	8	0.999144
CON	Concord Municipal	NH	9	0.999146
LCI	Laconia Municipal	NH	9	0.999151
PSM	Portsmouth Intl At Pease	NH	10	0.998887
ACY	Atlantic City Intl	NJ	6	0.999410
WWD	Cape May County	NJ	6	0.999440
MIV	Millville Municipal	NJ	6	0.999440
EWR	Newark Liberty Intl	NJ	6	0.999306
ABQ	Albuquerque Intl Sunport	NM	1	0.999942

Airport Id	Airport Name	State	Outages	Availability
CVN	Clovis Municipal	NM	1	0.999941
AEG	Double Eagle II	NM	1	0.999942
FMN	Four Corners Regional	NM	1	0.999942
SVC	Grant County	NM	1	0.999942
LRU	Las Cruces Intl	NM	1	0.999942
ROW	Roswell Intl Air Center	NM	1	0.999941
LAS	McCarran Intl	NV	3	0.999861
4SD	Reno/Stead	NV	11	0.999436
WMC	Winnemucca Municipal	NV	2	0.999804
9G3	Akron	NY	3	0.999557
ALB	Albany Intl	NY	7	0.999363
HWV	Brookhaven	NY	8	0.999190
BUF	Buffalo Niagara Intl	NY	3	0.999565
OLE	Cattaraugus County-Olean	NY	3	0.999540
JHW	Chautauqua County/Jamestown	NY	3	0.999572
ELM	Elmira/Corning Regional	NY	5	0.999442
BGM	Greater Binghamton/Edwin A Link Field	NY	6	0.999415
ROC	Greater Rochester Intl	NY	3	0.999526
JFK	John F. Kennedy Intl	NY	7	0.999271
LGA	LaGuardia	NY	7	0.999282
MSS	Massena Intl-Richards Field	NY	7	0.999454
PBG	Plattsburgh Intl	NY	8	0.999354
SWF	Stewart Intl	NY	6	0.999335
SYR	Syracuse Hancock Intl	NY	6	0.999458
ELZ	Wellsville Municipal/Tarantine Field	NY	4	0.999502
HPN	Westchester County	NY	7	0.999277
FOK	Westhampton	NY	8	0.999178
HAO	Butler County Regional	OH	3	0.999736
CXY	Capital City	OH	6	0.999548
LUK	Cincinnati Municipal Arpt-Lunken Field	OH	3	0.999728
CLE	Cleveland-Hopkins Intl	OH	3	0.999725
MGY	Dayton-Wright Brothers	OH	3	0.999729
FDY	Findlay	OH	3	0.999743
I19	Greene County-Lewis A. Jackson Regional	OH	3	0.999728
DAY	James M Cox Dayton Intl	OH	3	0.999735
1G3	Kent State University	OH	3	0.999716
I68	Lebanon-Warren County	OH	3	0.999728
MNN	Marion Municipal	OH	4	0.999714
OSU	Ohio State University	OH	4	0.999707
UNI	Ohio University Snyder Field	OH	4	0.999680
CMH	Port Coulmbus Intl	OH	3	0.999719
RZT	Ross County	OH	3	0.999710
TOL	Toledo Express	OH	3	0.999753
1G0	Wood County	OH	3	0.999748
AVK	Alva Regional	OK	2	0.999788
BVO	Bartlesville Municipal	OK	2	0.999763
CQB	Chandler Municipal	OK	2	0.999756
CHK	Chickasha	OK	2	0.999795
GCM	Claremore Regional	OK	2	0.999757
F29	Clarence E. Page Municipal	OK	2	0.999785
1K4	David J Perry	OK	2	0.999781
MKO	Davis Field	OK	2	0.999755

Airport Id	Airport Name	State	Outages	Availability
DUA	Eaker Field	OK	2	0.999816
2O8	Hinton Municipal	OK	2	0.999798
HBR	Hobart	OK	2	0.999824
MLC	McAlester Regional	OK	2	0.999766
MIO	Miami	OK	2	0.999772
MDF	Mooreland Municipal	OK	2	0.999806
OKM	Okmulgee Regional	OK	2	0.999742
PVJ	Pauls Valley Municipal	OK	2	0.999794
PNC	Ponca City Regional	OK	2	0.999753
RVS	Richard Lloyd Jones Jr	OK	2	0.999747
2K4	Scott Field	OK	2	0.999838
SNL	Shawnee	OK	2	0.999764
SWO	Stillwater Regional	OK	2	0.999758
TQH	Tahlequah	OK	2	0.999761
TUL	Tulsa Intl	OK	2	0.999752
OUN	University of Okalahoma Westheimer	OK	2	0.999779
OKC	Will Rogers World	OK	2	0.999781
UAO	Aurora State	OR	4	0.999786
LMT	Klamath Falls	OR	6	0.999621
LGD	La Grande/Union County	OR	2	0.999917
EUG	Mahlon Sweet Field	OR	4	0.999772
SLE	McNary Field	OR	4	0.999781
ONP	Newport Municipal	OR	5	0.999741
PDX	Portland Intl	OR	4	0.999790
AGC	Allegheny County	PA	4	0.999652
ABE	Allentown	PA	6	0.999364
AOO	Altoona-Blair County	PA	5	0.999602
LBE	Arnold Plamer Regional	PA	4	0.999640
BFD	Bradford Regional	PA	4	0.999522
BTP	Butler County/K W Scholter Field	PA	4	0.999667
9D4	Deck	PA	6	0.999529
HZL	Hazelton Municipal	PA	5	0.999404
JST	John Murtha Johnstown-Cambria County	PA	4	0.999629
LNS	Lancaster	PA	5	0.999550
UCP	New Castle Municipal	PA	3	0.999701
PNE	Northeast Philadelphia	PA	6	0.999451
PHL	Philadelphia Intl	PA	6	0.999457
PIT	Pittsburgh Intl	PA	4	0.999670
FWQ	Rostraver	PA	4	0.999652
2G9	Somerset County	PA	4	0.999644
OYM	St Marys Municipal	PA	5	0.999605
UNV	University Park	PA	5	0.999563
FKL	Venango Regional	PA	3	0.999697
BID	Block Island State	RI	8	0.998996
OQU	Ouonset State	RI	8	0.998980
PVD	Theodore Francis Green State	RI	8	0.998978
AIK	Aiken Municipal	SC	5	0.999703
AND	Anderson Regional	SC	5	0.999757
CHS	Charleston AFB/Intl	SC	4	0.999662
JZI	Charleston Executive	SC	4	0.999648
CAE	Columbia Metropolitan	SC	5	0.999697
UDG	Darlington County Jetport	SC	5	0.999679

Airport Id	Airport Name	State	Outages	Availability
GYH	Donaldson Center	SC	4	0.999776
GSP	Greenville-Spartanburg Intl-Roger Milliken	SC	4	0.999773
MYR	Myrtle Beach Intl	SC	6	0.999619
CEU	Oconee County Regional	SC	4	0.999784
CDN	Woodward Field	SC	5	0.999692
ABR	Aberdeen Regional	SD	1	0.999940
BKX	Brookings Municipal	SD	2	0.999895
YKN	Chan Gurney Municipal	SD	2	0.999895
HON	Huron Regional	SD	2	0.999920
MHE	Mitchell Municipal	SD	2	0.999913
PIR	Pierre Regional	SD	1	0.999940
RAP	Rapid City Regional	SD	2	0.999868
FSD	Sioux Falls	SD	2	0.999889
ATY	Watertown Regional	SD	2	0.999905
PVE	Beech River Regional	TN	2	0.999850
UCY	Everett-Stewart	TN	2	0.999829
CHA	Lovell Field	TN	4	0.999789
TYS	McGhee Tyson	TN	4	0.999768
MEM	Memphis Intl	TN	2	0.999850
NQA	Millington Municipal	TN	2	0.999844
BNA	Nashville Intl	TN	2	0.999848
TRI	Tri-Cities Regional TN/VA	TN	4	0.999763
ABI	Abilene Regional	TX	1	0.999941
ADS	Addison	TX	2	0.999866
ALI	Alice	TX	1	0.999941
AMA	Amarillo Intl	TX	2	0.999887
LFK	Angelina County	TX	2	0.999911
GKY	Arlington Municipal	TX	2	0.999885
AUS	Austin-Bergstrom Intl	TX	1	0.999941
LBX	Brazoria County	TX	2	0.999907
BWD	Brownwood Regional	TX	2	0.999914
E30	Bruce Field	TX	2	0.999917
TKI	Collin County Regional at McKinney	TX	2	0.999853
CRP	Corpus Christi Intl	TX	1	0.999941
CFD	Coulter Field	TX	2	0.999905
PRX	Cox Field	TX	2	0.999814
RBD	Dallas Executive	TX	2	0.999880
DAL	Dallas Love Field	TX	2	0.999872
DFW	Dallas/Fort Worth Intl	TX	2	0.999873
DWH	David Wayne Hooks Memorial	TX	2	0.999920
DRT	Del Rio Intl	TX	2	0.999923
TPL	Draughton-Miller Central Texas Regional	TX	2	0.999912
GGG	East Texas Regional	TX	2	0.999856
CLL	Easterwood Field	TX	2	0.999906
EBG	Edingburg Intl	TX	4	0.999793
ELP	El Paso Intl	TX	2	0.999924
AFW	Fort Worth Alliance	TX	2	0.999873
FWS	Fort Worth Spinks	TX	2	0.999892
IAH	George Bush Intercontinental/Houston	TX	2	0.999921
PVW	Hale County	TX	2	0.999905
TME	Houston Executive	TX	2	0.999913
AXH	Houston-Southwest	TX	2	0.999913

Airport Id	Airport Name	State	Outages	Availability
ERV	Kerrville Municipal/Louis Schreiner Field	TX	1	0.999941
LNC	Lancaster	TX	2	0.999880
LRD	Laredo Intl	TX	2	0.999876
CXO	Lone Star Executive	TX	2	0.999918
LBB	Lubbock Intl	TX	2	0.999917
GVT	Majors	TX	2	0.999850
MFE	McAllen Miller Intl	TX	4	0.999766
HQZ	Mesquite Metro	TX	2	0.999872
MAF	Midland Intl	TX	1	0.999941
OSA	Mount Pleasant Municipal	TX	2	0.999829
RAS	Mustang Beach	TX	1	0.999941
BAZ	New Braunfels	TX	2	0.999920
GRK	Robert Gray AAF	TX	2	0.999921
SJT	San Angelo Regional/Mathis Field	TX	2	0.999913
SAT	San Antonio Intl	TX	2	0.999923
HYI	San Marcos	TX	1	0.999941
GLS	Scholes Intl at Galveston	TX	2	0.999917
SPS	Sheppard AFB/Wichita Falls Municipal	TX	2	0.999843
SGR	Sugarland Municipal/Hull Field	TX	2	0.999913
TFP	T P McCampbell	TX	1	0.999941
TRL	Terrell Municipal	TX	2	0.999869
TYR	Tyler Pounds Field	TX	2	0.999871
HRL	Valley Intl	TX	4	0.999762
IWS	West Houston	TX	2	0.999915
HOU	William P Hobby	TX	2	0.999918
CDC	Cedar City Regional	UT	2	0.999888
KNB	Kanab Municipal	UT	2	0.999911
LGU	Logan-Cache	UT	1	0.999943
OGD	Ogden-Hinckley	UT	1	0.999943
PVU	Provo Municipal	UT	1	0.999943
SGU	Saint George Municipal	UT	2	0.999875
SLC	Salt Lake City Intl	UT	1	0.999943
MFV	Accomack County	VA	6	0.999505
MTV	Blue Ridge	VA	4	0.999729
CHO	Charlottesville-Albemarle	VA	5	0.999661
FCI	Chesterfield County	VA	5	0.999638
CJR	Culpeper Regional	VA	6	0.999608
PTB	Dinwiddie County	VA	5	0.999635
OFP	Hanover County Municipal	VA	5	0.999640
HEF	Harry P. Davis Field	VA	6	0.999605
JYO	Leesburg Executive	VA	6	0.999589
LNP	Lonesome Pine	VA	4	0.999733
LYH	Lynchburg Regional/Preston Glenn Field	VA	5	0.999690
MKJ	Mountain Empire	VA	4	0.999748
PSK	New River Valley	VA	4	0.999738
PHF	Newport News/Wmsburg Intl	VA	8	0.999508
ORF	Norfolk Intl	VA	6	0.999540
RIC	Richmond	VA	5	0.999638
RMN	Stafford Regional	VA	6	0.999629
BCB	Virginia Rech/Montgomery Executive	VA	4	0.999733
IAD	Washington Dulles Intl	VA	6	0.999590
BTV	Burlington Intl	VT	6	0.999363

Airport Id	Airport Name	State	Outages	Availability
FSO	Franklin County State	VT	8	0.999326
BLI	Bellingham Intl	WA	8	0.999666
HQM	Bowerman	WA	7	0.999640
FHR	Friday Harbor	WA	9	0.999629
MWH	Grant Co Intl	WA	1	0.999943
OLM	Olympia	WA	7	0.999691
PUW	Pullman/Moscow Regional	WA	1	0.999943
RLD	Richland	WA	2	0.999905
SEA	Seattle-Tacoma Intl	WA	7	0.999719
BVS	Skagit Regional	WA	6	0.999727
PAE	Snohomish County (Paine Field)	WA	1	0.999261
GEG	Spokane Intl	WA	1	0.999943
PSC	Tri-Cities	WA	2	0.999911
ALW	Walla Walla Regional	WA	1	0.999943
CLM	William R Fairchild Intl	WA	7	0.999651
GRB	Austin Strauble Intl	WI	2	0.999758
DLL	Baraboo Wisconsin Dells	WI	2	0.999771
OVS	Boscobel	WI	2	0.999784
CWA	Central Wisconsin	WI	2	0.999775
MSN	Dane County Regional-Traux Field	WI	2	0.999774
SUE	Door County Cherryland	WI	2	0.999757
EGV	Eagle River Union	WI	2	0.999777
FLD	Fond Du Lac County	WI	2	0.999764
MKE	General Mitchell Intl	WI	2	0.999771
MTW	Manitowoc County	WI	2	0.999759
MFI	Marshfield Municipal	WI	2	0.999786
LUM	Menomonie Municipal-Score Field	WI	2	0.999815
RRL	Merrill Municipal	WI	2	0.999778
C29	Middleton Municipal-Morey Field	WI	2	0.999773
ATW	Outgamie County Regional	WI	2	0.999761
PBH	Price County	WI	2	0.999796
RHI	Rhinelander – Oneida County	WI	2	0.999777
RPD	Rice Lake Regional-Carl's Field	WI	2	0.999817
HYR	Sawyer County	WI	2	0.999815
SBM	Sheboygan County Memorial	WI	2	0.999763
JVL	Southern Wisconsin Regional	WI	2	0.999777
OSH	Wittman Regional	WI	2	0.999763
PKB	Mid-Ohio Valley Regional	WV	4	0.999667
HTS	Tri-State/Milton J. Ferguson Field	WV	4	0.999701
CYS	Cheyenne Regional/Jerry Olson Field	WY	2	0.999850
EVW	Evanston-Uinta County Burns Field	WY	1	0.999943
GCC	Gillette-Campbell County	WY	2	0.999851
JAC	Jackson Hole	WY	2	0.999926
LAR	Laramie Regional	WY	2	0.999863
CPR	Natrona County Intl	WY	2	0.999860
RIW	Riverton Regional	WY	2	0.999893
RKS	Rock Springs-Sweetwater County	WY	2	0.999926
SHR	Sheridan County	WY	2	0.999853
COD	Yellowstone Regional	WY	2	0.999883

Figure 9-1 WAAS LPV Availability

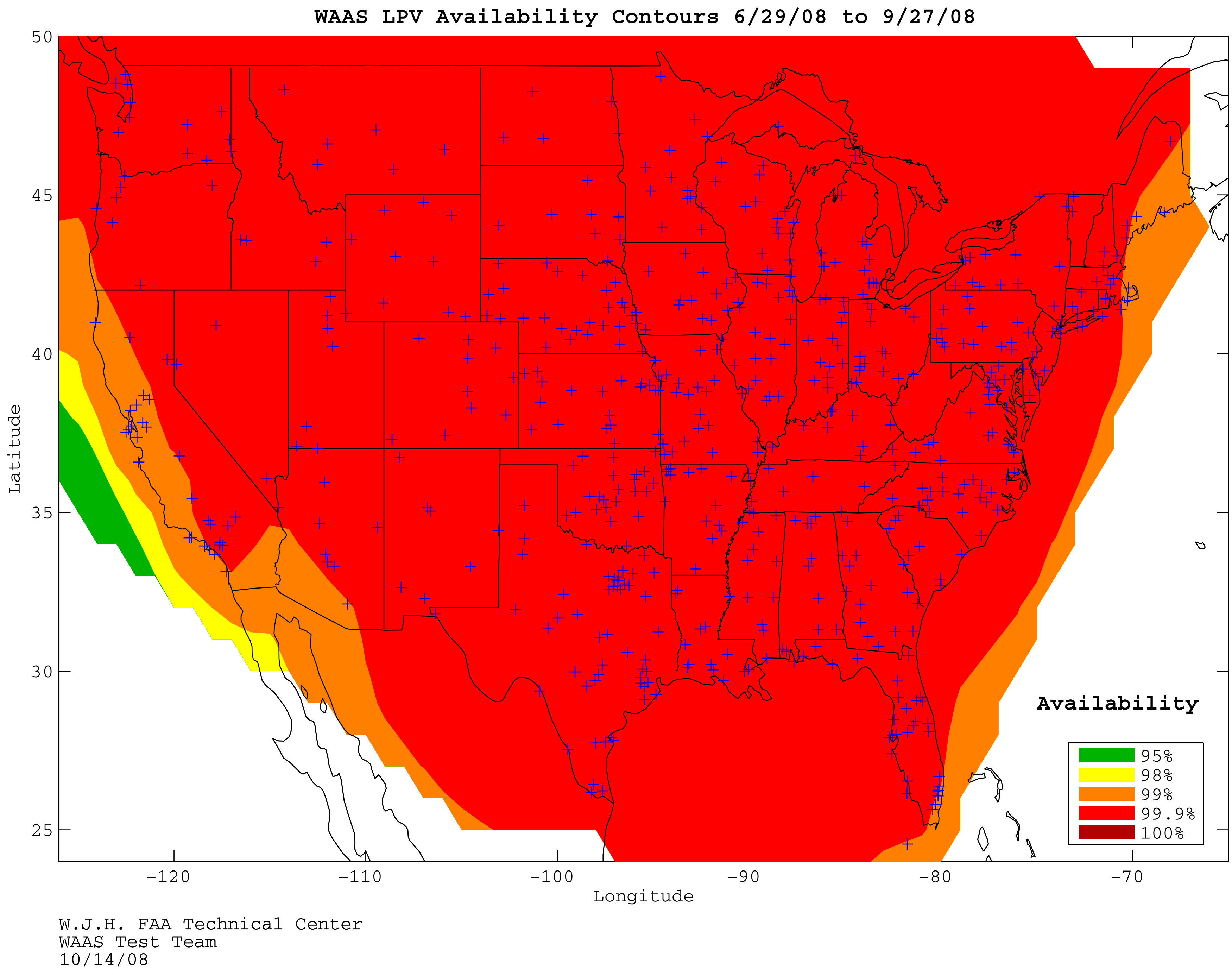
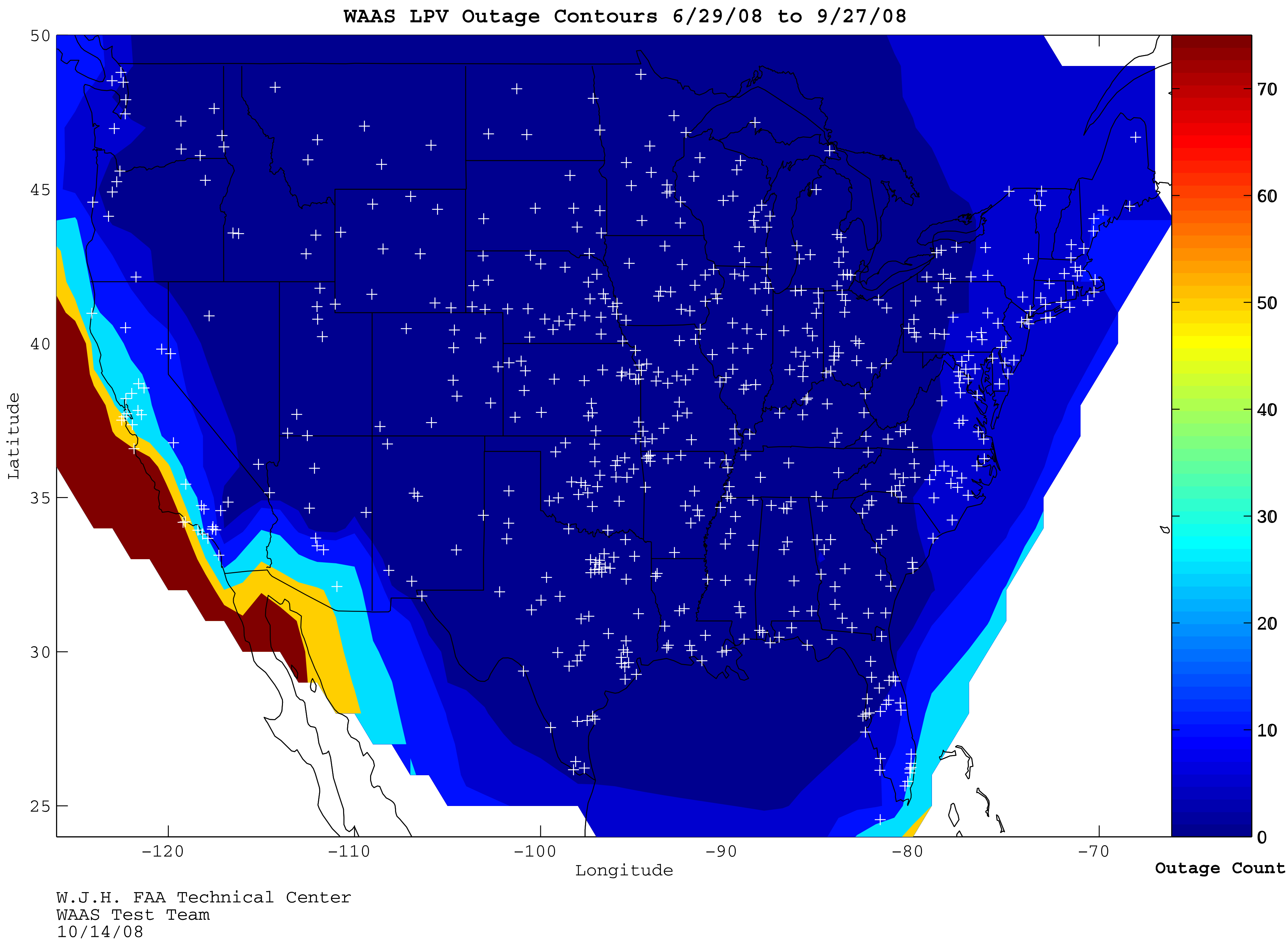


Figure 9-2 WAAS LPV Outage



10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

WAAS utilizes a deterministic model to estimate the residual CNMP noise after the application of standard dual frequency carrier smoothing techniques to minimize the effects of multipath and code noise. This analysis performs an assessment of how well that deterministic model bounds the actual errors. This analysis is periodically performed as part of the WAAS Test Team's off-line monitoring to ensure that there are no drastic detrimental changes to the multipath environment at the WAAS Reference Stations (WRSs). This analysis also ensures that WAAS system is not indefinitely exposed to conspiring receiver failure symptoms that would invalidate the CNMP bounding estimate in a manner that would exceed the assumption that no more than one receiver is conspiring to deceive the WAAS monitors at any time by underestimating the residual measurement noise the safety monitors. Although some failures mechanisms that cause CNMP bounding issues are occasionally seen, no "conspiring" errors have ever been detected. That is, data has caused the safety monitors to trip unnecessarily versus missing a necessary trip.

The analysis post processes measurement data to estimate the pseudorange code to carrier ambiguity for each entire arc of measurements for each satellite pass. The ambiguity estimate is then used to level the carrier measurement. The leveled carrier is then used as a multipath free truth estimate. The WAAS real time deterministic CNMP smoothing algorithm is then applied to the original measurements. The difference between the smoothed measurements and the leveled truth measurements is compared to the deterministic noise estimates. Only arcs with continuous carrier phase greater in length than 7200 seconds are utilized for this analysis to minimize the impacts of non-zero mean multipath biasing the truth estimates. The WAAS dual frequency cycle slip detector algorithm is used to detect any discontinuities in the carrier phase.

Statistics are calculated on how well the 0.1 multiples of the deterministically estimated standard deviation bounds the difference between the leveled truth and the real time smoothed measurements. Those statistics are then compared to a theoretical gaussian distribution and an extensive set of plots are generated and manually reviewed. Table 10.1 recaps the results of that manual analysis.

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sep 08
Albuquerque	A	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Yellow	Blue	Green	Blue	Green	Blue	Blue	Green	Blue
	C	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
Anchorage	A	Yellow	–	–	Green	Green	Blue	Blue	Blue	Blue	Green	Yellow	Blue
	B	Green	–	Blue	Blue	Green	Green	Blue	Green	Green	Green	Green	Green
	C	Yellow	–	–	Green	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue
Atlanta	A	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	C	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue
Barrow	A	Blue	Blue	Yellow	Green	Blue	Green	Green	Blue	Blue	Green	Green	Yellow
	B	Green	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green
	C	Blue	Blue	Blue	Yellow	Green	Blue	Blue	Green	Green	Blue	Blue	Blue
Bethel	A	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	C	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Billings	A	Yellow	Blue	Blue	Blue	Yellow	Blue	Yellow	Green	Blue	Blue	Blue	Blue
	B	Yellow	Green	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Green	Blue	Blue
	C	Blue	Blue	Green	Green	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Boston	A	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Green	Yellow	Blue
	B	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
	C	Blue	Blue	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Blue	Blue
Chicago	A	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	C	Red	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Cleveland	A	Yellow	Blue	Blue	Yellow	Blue	Green	Green	Green	Blue	Yellow	Red	Yellow
	B	Blue	Blue	Yellow	Blue	Yellow	Blue	Blue	Yellow	Blue	Green	Yellow	Blue
	C	Yellow	Green	Blue	Blue	Blue	Yellow	Blue	Blue	Green	Blue	Blue	Blue
Cold Bay	A	Yellow	Green	Blue	Blue	Yellow	Blue	Green	Blue	Blue	Blue	Blue	Blue
	B	Blue	Yellow	Blue	Blue	Blue	Yellow	Blue	Blue	Blue	Blue	Yellow	Green
	C	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Dallas	A	Yellow	Blue	Green	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Green	Green
	B	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Green
	C	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Yellow	Yellow	Green	Yellow	Yellow
Denver	A	Blue	Yellow	Blue	Blue	Yellow	Yellow	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green
	C	Blue	Blue	Blue	Blue	Blue	Blue	Green	Green	Blue	Green	Yellow	Blue
Fairbanks	A	Blue	Blue	–	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue
	C	Blue	Blue	–	Blue	Yellow	Yellow	Green	Green	Blue	Blue	Yellow	Blue
Gander	A	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	B	Blue	Blue	Blue	Yellow	Green	Blue	Blue	Blue	Green	Blue	Blue	Blue
	C	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Goose Bay	A	Blue	Blue	Blue	Blue	Blue	Yellow	Green	Green	Blue	Blue	Blue	Yellow
	B	Yellow	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	C	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue

WAAS Site	WRE	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sep 08
Honolulu	A	● (red)	● (yellow)	● (blue)	● (blue)	● (yellow)	● (yellow)	● (blue)	● (blue)	● (green)	● (blue)	● (blue)	● (green)
	B	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (yellow)	● (yellow)	● (blue)	● (blue)	● (blue)
	C	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (red)	● (yellow)	● (red)	● (green)	● (blue)	● (blue)
Houston	A	● (blue)	● (blue)	● (yellow)	● (yellow)	● (blue)	● (green)	● (green)	● (yellow)	● (green)	● (yellow)	● (green)	● (yellow)
	B	● (blue)	● (blue)	● (green)	● (yellow)	● (red)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (green)
	C	● (green)	● (green)	● (green)	● (yellow)	● (yellow)	● (green)	● (red)	● (red)	● (yellow)	● (red)	● (yellow)	● (blue)
Iqaluit	A	● (blue)	–	–	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)
	B	● (blue)	● (green)	● (green)	● (blue)	● (blue)	● (blue)	● (blue)	● (green)	● (blue)	● (blue)	● (blue)	● (blue)
	C	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)
Jacksonville	A	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (green)	● (blue)	● (blue)	● (blue)	● (blue)
	B	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (yellow)	● (yellow)	● (green)	● (yellow)	● (blue)	● (blue)
	C	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)

□ (blue) **Excellent** - 3.29σ bounded 100%
□ (green) **Good** - 4σ bounded 100%
□ (yellow) **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
□ (red) **Poor** – Requires manual review

Shaded receivers represent legacy receivers (non-G2). These receivers are predominantly the trouble receivers, with over 95% of their failures occurring on the L2 frequency.

11.0 WAAS REFERENCE STATION SURVEY VALIDATION

The precisely surveyed location of each WAAS WRS is updated occasionally. This update requires a change to the WAAS software. To ensure there is no large (> 10cm RSS) change in the WAAS reference station position between software updates, a new survey is calculated each quarter. The RSS difference between the current survey location and the newly calculated survey location is shown in this section.

The surveys calculate the L1 phase center positions (ECEF X, Y, and Z) of each WRS antenna in IRTF-2000. The latitude, longitude, and height are in WGS-84 computed from the IRTF ECEF using a GraftNet utility after interpolation. The results are cross-checked against OPUS (USA and Mexico) or CSRS (Canada) using 24 hours worth of data.

The survey from the current software is from the 'Release 8/9.2a' version of the WAAS operational software. The Release 8/9 positions have been interpolated forward to 6/30/09 to account for tectonic plate movement in order to minimize how often the software needs to be updated.

WAAS software release 8/9.2a antenna positions are compared to OPUS surveys for a 10/20/08 data set. Twenty four hour 30 second rate RINEX files were created from recorded WAAS data. All of the OPUS "Overall RMS" quality indications were 2.5 cm or less. All of the OPUS "OBS USED %" quality indications were 90% or greater except all three threads at Fairbanks which were 86% with overall RMS values of 0.015, 0.014, and 0.014 which are very good. All of the OPUS "FIXED AMB %" quality indications were 55% or greater. These qualities were achieved with IGS rapid orbits. Since these qualities are satisfactory, the surveys do not need to be rechecked later with precise orbits.

The 10/20/08 data set was chosen because it was the first day in October 2008 that all 114 receivers were operational for the entire day and there were no FAA Technical Center data collection issues.

All sites except Mexico City were well below the 10 cm take action threshold. Mexico City is currently off by 29 cm as of 10/20/08. This is the expected displacement that was factored into the .2a version of release 8/9 in anticipation of the ~30 cm / yr subsidence at Mexico City.

At approximately 6cm, Albuequerque is a slight outlier for a smaller tectonic plate movement site. This is because CORS refined the published position of ZAB1 and ZAB2 sites after the WAAS release 8/9.2a software build was generated. WAAS release 8/9.2a sofware was fielded mid September 2008.

Table 11.1 shows the WAAS antenna positions (US and MX are IRTF-2000 from OPUS, Canadian sites are IRTF 2005 from CSRS, for WAAS purposes the difference between IRTF-2000 and IRTF-2005 is negligible).

Figure 11.1 to 11.3 show the difference between the WRS locations in the current software and the latest survey. Each reference station has three independent strings of equipment, and a surveyed location is required for each string. All three strings of a reference station are shown in the three figures. For example, BET1 identifies the RSS delta for the Bethel WRS string 1. The next two bars in the chart are Bethel string 2 and Bethel string 3. Figure 11.4 shows the OPUS overall RMS.

Table 11-1 WAAS Survey Positions

WRE	X	Y	Z	Lat	Long	H (m)
BET1	-2965384.952	-972576.623	5543892.971	60.787916486	-161.841724416	52.203
BET2	-2965385.719	-972580.346	5543891.915	60.787897064	-161.841663857	52.204
BET3	-2965388.288	-972577.477	5543891.043	60.787881127	-161.841728605	52.198
BIL1	-1416445.82	-4223577.03	4550862.184	45.803707088	-108.539722283	1112.261
BIL2	-1416449.888	-4223574.888	4550862.908	45.803716383	-108.539780649	1112.266
BIL3	-1416441.513	-4223574.29	4550866.033	45.803756811	-108.539680968	1112.255
BRW1	-1886758.812	-809058.669	6018494.516	71.282765883	-156.789923397	15.577
BRW2	-1886756.23	-809055.928	6018495.698	71.282798595	-156.789965306	15.589
BRW3	-1886755.14	-809059.713	6018495.52	71.282793925	-156.789856228	15.577
CDB1	-3483634.74	-1083799.447	5214187.71	55.200334771	-162.718472052	53.648
CDB2	-3483629.871	-1083796.776	5214191.497	55.200394330	-162.718489390	53.652
CDB3	-3483631.881	-1083788.429	5214191.893	55.200400493	-162.718623936	53.657
FAI1	-2304741.684	-1448715.26	5748843.691	64.809630987	-147.847339789	149.891
FAI2	-2304741.211	-1448706.454	5748846.091	64.809681435	-147.847491409	149.897
FAI3	-2304732.678	-1448707.387	5748849.232	64.809748030	-147.847379206	149.876
HNL1	-5508637.055	-2234493.586	2303722.057	21.312988930	-157.920824884	24.678
HNL2	-5508656.221	-2234483.908	2303686.805	21.312645960	-157.920980760	25.022
HNL3	-5508647.632	-2234497.846	2303693.9	21.312714586	-157.920825156	25.067
JNU1	-2354254.792	-2388549.638	5407043.073	58.362575024	-134.585705943	16.024
JNU2	-2354252.708	-2388565.753	5407036.909	58.362469451	-134.585487326	16.029
JNU3	-2354239.484	-2388568.602	5407041.368	58.362545895	-134.585292259	16.020
MMD1	35070.455	-5959686.685	2264365.758	20.931909130	-89.662840352	29.133
MMD2	35065.528	-5959687.055	2264364.972	20.931901399	-89.662887739	29.171
MMD3	35065.195	-5959685.271	2264369.633	20.931946482	-89.662890840	29.168
MMX1	-948701.237	-5943936.592	2109213.018	19.431653203	-99.068389471	2236.638
MMX2	-948696.808	-5943936.418	2109215.444	19.431676477	-99.068348099	2236.625
MMX3	-948705.664	-5943936.768	2109210.589	19.431629899	-99.068430820	2236.652
MPR1	-1570142.185	-5759530.608	2238184.758	20.679003359	-105.249202871	10.973
MPR2	-1570139.363	-5759530.12	2238188.809	20.679041461	-105.249177972	11.269
MPR3	-1570143.471	-5759528	2238190.574	20.679059454	-105.249221363	10.990
MSD1	-1979519.559	-5523223.167	2493106.697	23.160445938	-109.717646195	104.297
MSD2	-1979521.124	-5523225.5	2493100.298	23.160383141	-109.717652895	104.285
MSD3	-1979525.573	-5523222.23	2493103.967	23.160419201	-109.717704568	104.277
MTP1	-254854.344	-6162909.184	1617805.079	14.791366074	-92.367999089	54.962
MTP2	-254850.727	-6162910.227	1617801.649	14.791334042	-92.367965119	54.950
MTP3	-254855.507	-6162910.336	1617800.119	14.791319966	-92.368009440	54.855
OTZ1	-2396055.921	-750356.171	5843502.582	66.887333160	-162.611372024	10.911
OTZ2	-2396052.748	-750354.342	5843504.106	66.887368005	-162.611390215	10.909
OTZ3	-2396052.728	-750358.277	5843503.617	66.887356742	-162.611304386	10.913
YFB1	1035381.544	-2634289.638	5696539.518	63.731490169	-68.543181586	10.022
YFB2	1035372.331	-2634296.039	5696538.169	63.731464001	-68.543402553	9.957
YFB3	1035366.254	-2634306.793	5696534.389	63.731386362	-68.543596671	10.014
YQX1	2430424.722	-3419640.39	4788223.803	48.966489496	-54.597631164	146.888
YQX2	2430432.674	-3419639.049	4788220.744	48.966447606	-54.597532034	146.887
YQX3	2430440.591	-3419637.674	4788217.743	48.966406383	-54.597433025	146.899
YWG1	-520164.268	-4083475.888	4855843.018	49.900574663	-97.259396222	222.042
YWG2	-520150.405	-4083468.832	4855850.399	49.900677586	-97.259217224	222.051
YWG3	-520152.267	-4083477.952	4855842.575	49.900568446	-97.259226893	222.045
YYR1	1885341.503	-3321428.349	5091171.613	53.308646665	-60.419467188	37.830
YYR2	1885344.468	-3321419.868	5091176.036	53.308713007	-60.419365697	37.844
YYR3	1885340.184	-3321413.051	5091182.04	53.308803193	-60.419371104	37.853

WRE	X	Y	Z	Lat	Long	H (m)
ZAB1	-1488636.786	-5003946.545	3654557.709	35.173575457	-106.567349162	1620.117
ZAB2	-1488631.452	-5003948.23	3654557.686	35.173574799	-106.567287780	1620.181
ZAB3	-1488632.23	-5003950.814	3654553.827	35.173532365	-106.567287878	1620.164
ZAN1	-2659536.522	-1549114.821	5567750.763	61.229202467	-149.780248917	80.660
ZAN2	-2659548.278	-1549110.866	5567746.27	61.229118812	-149.780422686	80.653
ZAN3	-2659541.23	-1549106.741	5567750.748	61.229202391	-149.780423003	80.648
ZAU1	138704.178	-4761244.175	4227763.937	41.782657876	-88.331335953	195.918
ZAU2	138704.438	-4761248.786	4227758.775	41.782595526	-88.331334442	195.921
ZAU3	138711.141	-4761248.525	4227758.856	41.782596464	-88.331253756	195.926
ZBW1	1490299.296	-4448983.182	4306010.474	42.735720140	-71.480425027	39.125
ZBW2	1490304.41	-4448981.172	4306010.817	42.735724128	-71.480358015	39.151
ZBW3	1490306.118	-4448984.796	4306006.505	42.735671312	-71.480352294	39.147
ZDC1	1069125.838	-4839599.008	4001126.495	39.101595603	-77.542745736	80.084
ZDC2	1069128.23	-4839603.64	4001120.288	39.101523590	-77.542730286	80.080
ZDC3	1069124.131	-4839602.734	4001122.483	39.101548982	-77.542774296	80.092
ZDV1	-1273628.549	-4711375.622	4094890.143	40.187303318	-105.127223496	1541.399
ZDV2	-1273622.844	-4711377.141	4094890.158	40.187303552	-105.127154188	1541.391
ZDV3	-1273624.856	-4711380.332	4094885.868	40.187253096	-105.127167214	1541.377
ZFW1	-659983.143	-5324060.782	3438276.472	32.830649739	-97.066471191	155.617
ZFW2	-659988.409	-5324063.332	3438271.47	32.830596303	-97.066523654	155.576
ZFW3	-659983.439	-5324063.862	3438271.683	32.830598335	-97.066470282	155.620
ZHU1	-513864.426	-5506451.764	3166720.497	29.961896297	-95.331425748	10.908
ZHU2	-513867.07	-5506455.161	3166714.334	29.961831785	-95.331449752	10.974
ZHU3	-513873.351	-5506457.799	3166708.735	29.961773563	-95.331512004	10.958
ZJX1	772646.499	-5434462.208	3237231.723	30.698859379	-81.908184568	2.149
ZJX2	772649.825	-5434463.762	3237228.326	30.698823791	-81.908152480	2.140
ZJX3	772645.764	-5434466.197	3237225.218	30.698791217	-81.908198025	2.135
ZKC1	-415247.455	-4954556.406	3982161.112	38.880159315	-94.790833106	305.904
ZKC2	-415231.063	-4954557.73	3982161.171	38.880160009	-94.790643592	305.903
ZKC3	-415237.18	-4954561.079	3982155.974	38.880101810	-94.790710614	305.636
ZLA1	-2474409.838	-4637294.744	3602183.496	34.603517830	-118.083893947	763.521
ZLA2	-2474404.563	-4637297.554	3602183.5	34.603517881	-118.083828796	763.520
ZLA3	-2474411.173	-4637297.244	3602179.524	34.603473855	-118.083893956	763.598
ZLC1	-1808273.143	-4486410.821	4145303.035	40.786043564	-111.952176782	1287.421
ZLC2	-1808274.54	-4486414.43	4145298.542	40.785990178	-111.952176149	1287.416
ZLC3	-1808270.33	-4486416.141	4145298.537	40.785990067	-111.952122320	1287.423
ZMA1	966042.346	-5662999.834	2761581.48	25.824611968	-80.319189364	-7.579
ZMA2	966029.371	-5662999.137	2761585.967	25.824659706	-80.319315758	-8.207
ZMA3	966037.45	-5662997.975	2761586.322	25.824661752	-80.319234381	-7.861
ZME1	4070.955	-5226189.309	3644028.417	35.067394005	-89.955369299	68.609
ZME2	4070.986	-5226186.758	3644032.527	35.067437537	-89.955368937	68.883
ZME3	4064.79	-5226186.636	3644032.687	35.067439374	-89.955436864	68.871
ZMP1	-249978.309	-4539297.528	4458955.063	44.637463181	-93.152084552	262.679
ZMP2	-249972.504	-4539297.867	4458955.063	44.637463059	-93.152011267	262.693
ZMP3	-249973.601	-4539302.144	4458950.585	44.637407004	-93.152022108	262.628
ZNY1	1406144.71	-4627343.993	4144322.033	40.784328238	-73.097164869	6.457
ZNY2	1406146.509	-4627347.028	4144317.254	40.784275495	-73.097154931	5.930
ZNY3	1406140.951	-4627348.689	4144317.294	40.784275925	-73.097223653	5.936
ZOA1	-2684436.759	-4293337.54	3865351.799	37.543053122	-122.015945899	-3.497
ZOA2	-2684433.758	-4293341.635	3865349.378	37.543025498	-122.015892540	-3.481
ZOA3	-2684438.134	-4293342.511	3865345.526	37.542981164	-122.015929270	-3.400
ZOB1	650770.253	-4754715.681	4187420.741	41.297154278	-82.206443927	223.689

WRE	X	Y	Z	Lat	Long	H (m)
ZOB2	650777.934	-4754714.855	4187422.757	41.297166589	-82.206351733	225.187
ZOB3	650776.263	-4754719.681	4187414.967	41.297086827	-82.206379312	223.468
ZSE1	-2308930.219	-3668169.698	4663526.504	47.286993478	-122.188372098	82.112
ZSE2	-2308934.607	-3668175.239	4663520.092	47.286907917	-122.188382169	82.168
ZSE3	-2308935.668	-3668179.512	4663516.147	47.286856213	-122.188363949	82.105
ZSU1	2462589.316	-5529371.561	2003724.59	18.431338366	-65.993475669	-28.594
ZSU2	2462587.236	-5529377.314	2003711.592	18.431214363	-65.993515810	-28.520
ZSU3	2462593.881	-5529375.099	2003709.533	18.431194772	-65.993449821	-28.526
ZTL1	529840.463	-5305248.818	3489342.834	33.379688402	-84.296725378	261.138
ZTL2	529846.838	-5305247.979	3489343.119	33.379691546	-84.296656313	261.126
ZTL3	529847.521	-5305251.418	3489337.885	33.379634831	-84.296652682	261.161

Figure 11-1 Survey Delta for OPUS

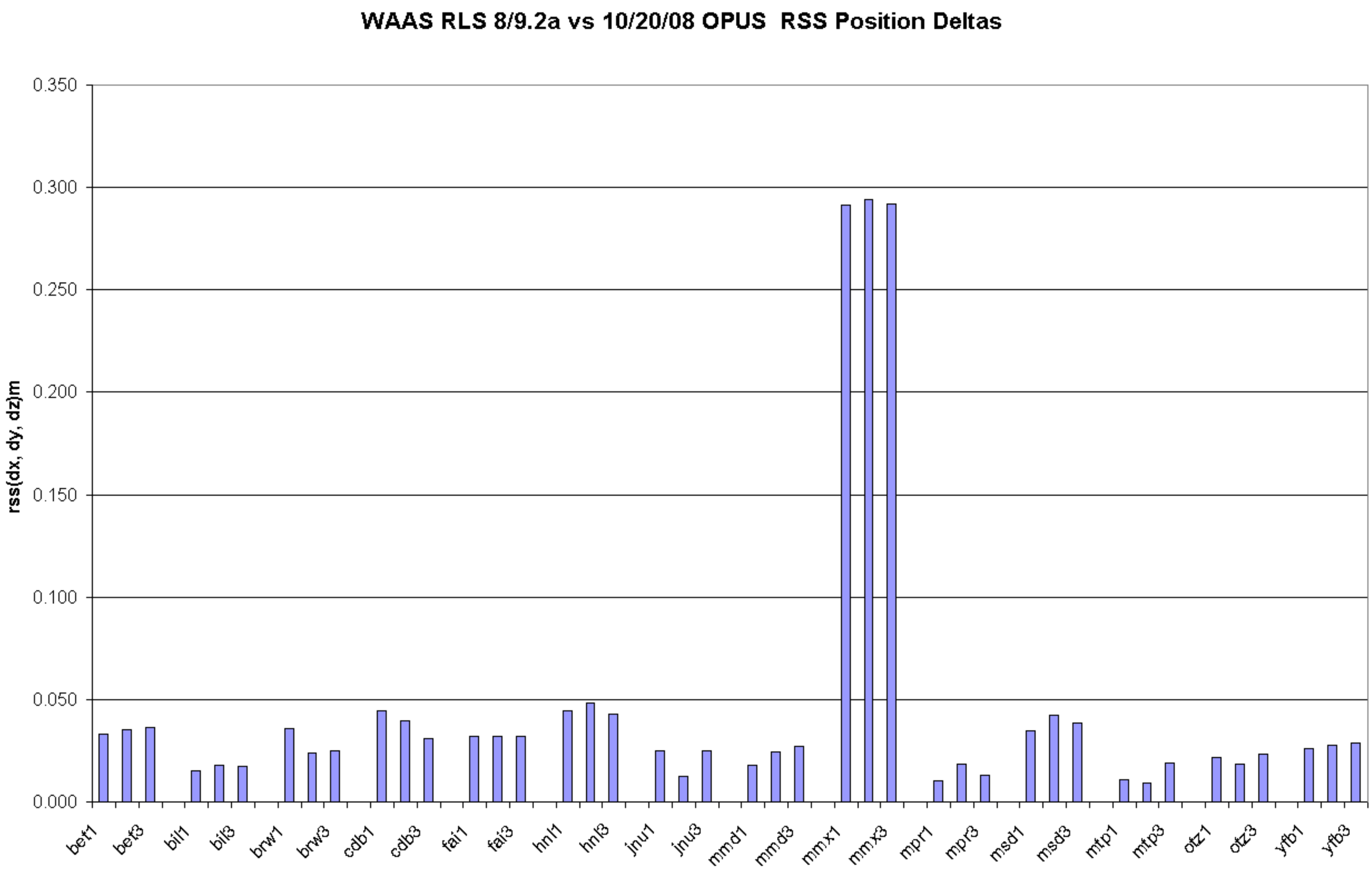


Figure 11-2 Survey Delta for CSRS and OPUS

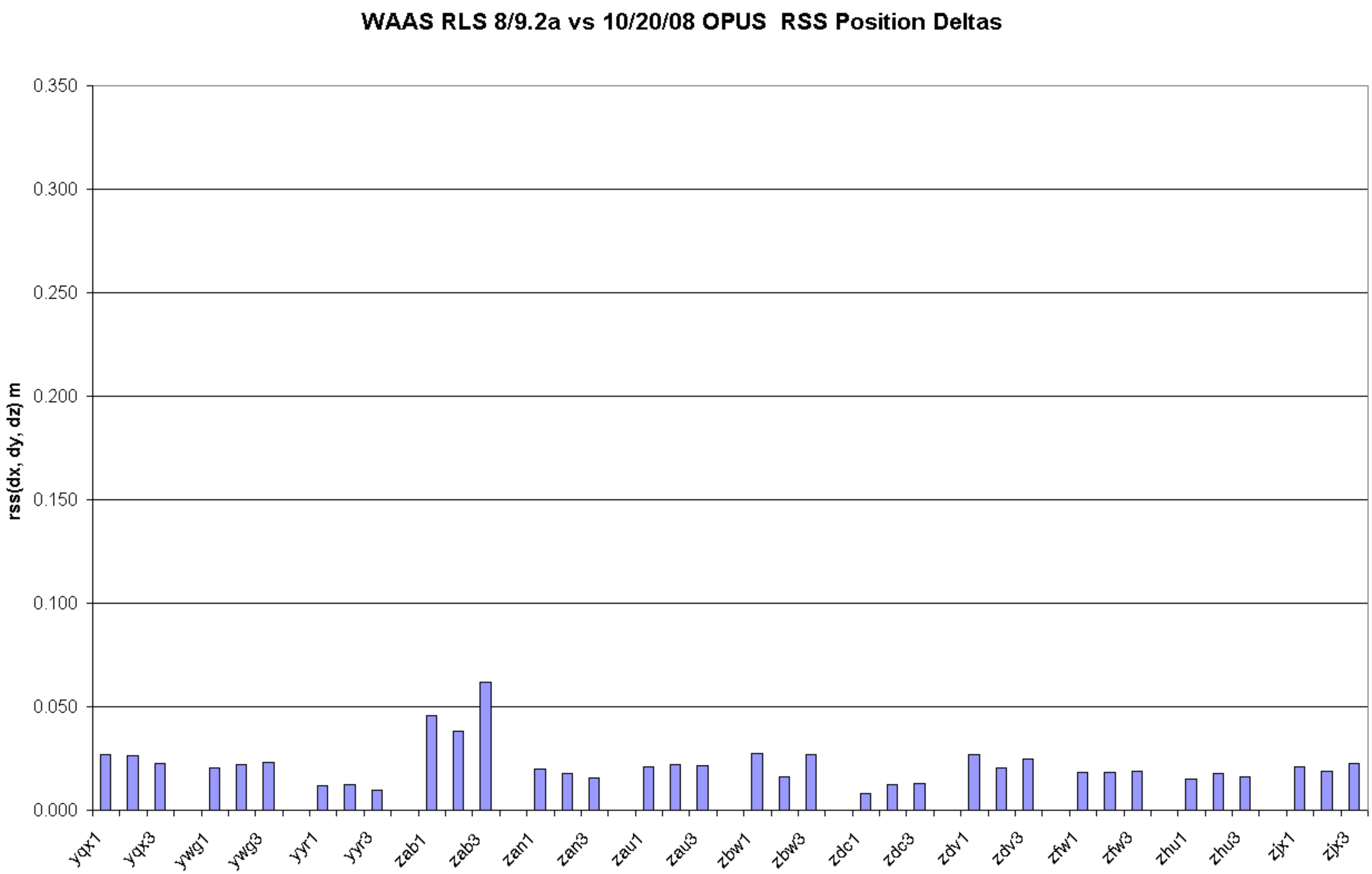


Figure 11-3 Survey Delta for OPUS

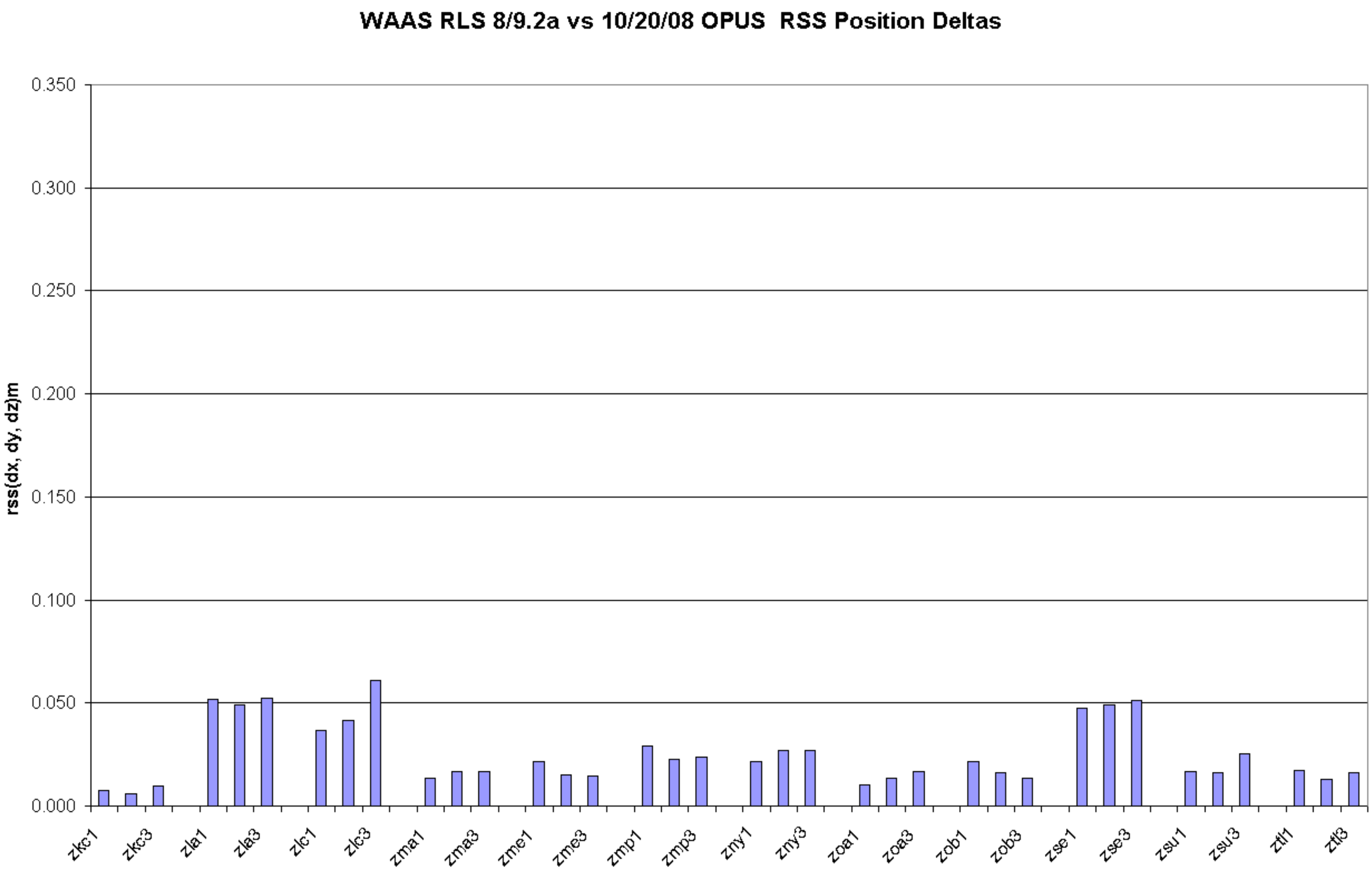
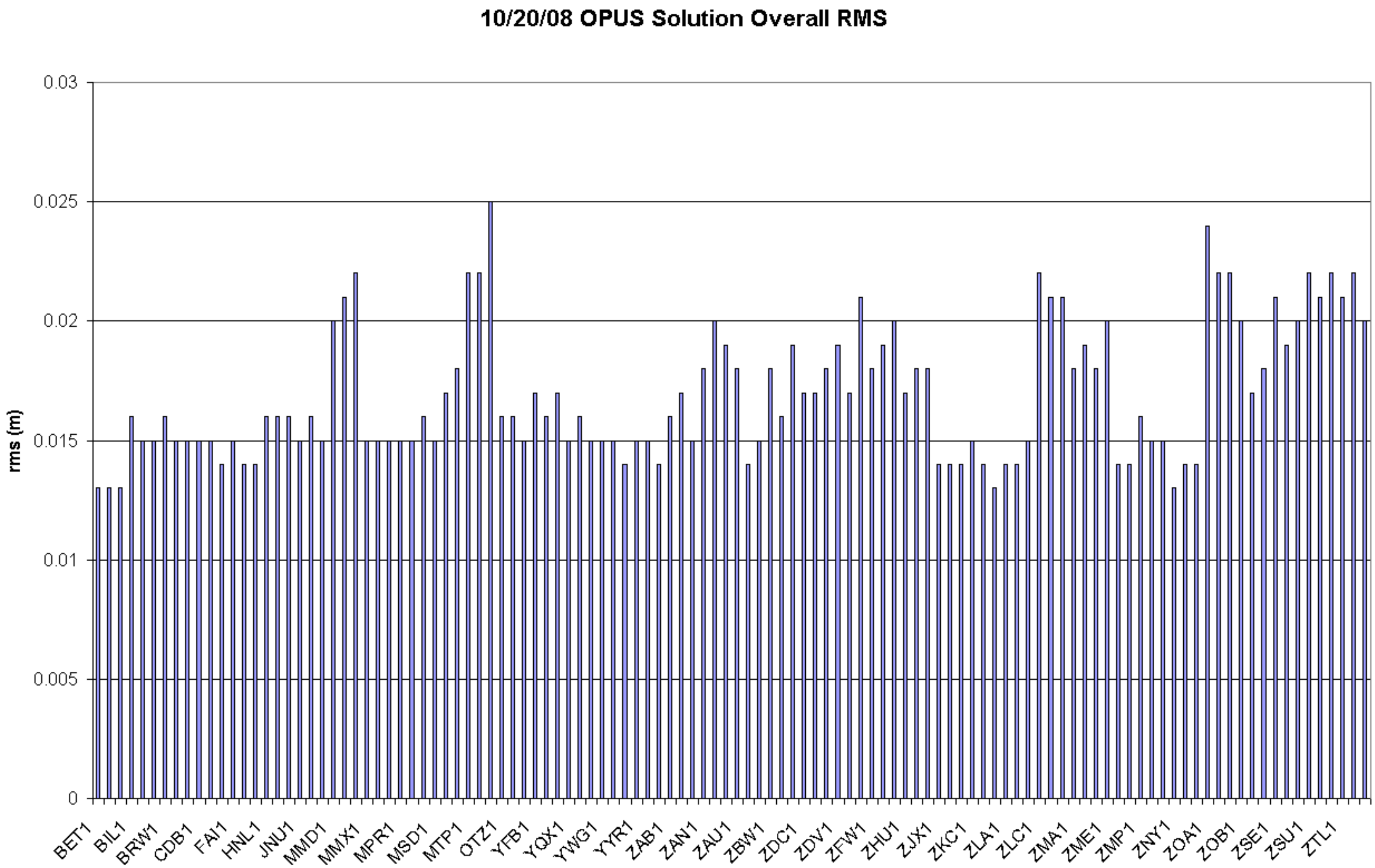


Figure 11-4 Survey RMS for OPUS



12.0 SIGNAL QUALITY MONITOR (SQM)

The Signal Quality Monitor (SQM) is designed to detect signal deformations that originate in the GPS or GEO satellites and ensures that the UDREs are sufficiently inflated to protect given the monitor's current observations. SQM processes correlator measurements produced at the reference station receivers forming four detection metrics for each receiver channel and calculates statistics based on the observed performance against "ideal" signal correlation peaks. This results in an estimate of the overall deformation per satellite. The deformation level calculated is then compared against threshold values, which includes the acceptable error levels per UDRE. If the estimated deformation exceeds threshold, the monitor trips for the given satellite, the UDRE is set to 'Don't use'. The monitor depends on the entire ground network in order to ensure that the satellite is the source of any problem detected rather than a localized affect. Currently all 114 receivers are being used in the SQM computations.

WAAS SQM offline monitoring effort includes the monitoring of the PRN type biases, trips, and the estimated deformation for each satellite that will be referred to as PRN bias in this report.

12.1 Alpha Metrics

The alpha metrics values are pre-determined by offline integrity analysis and are defined as constants in the SQM algorithm. These values remained unchanged for this reporting period and are listed in Table 12.1. Currently there are 4 sets of alpha metrics in the WAAS SQM algorithm that form four detection metrics for each receiver channel. For this report, the four detection metrics will be referred to as: DM1, DM2, DM3, and DM4.

Table 12-1 Alpha Metrics

Correlator Spacing	DM1	DM2	DM3	DM4
-0.1	0	0.43407318	0	-0.36110353
-0.075	0	0.48570652	-0.0058771682	-0.74860302
-0.05	-0.4071265	-0.69931105	-0.011382325	0.23726003
-0.025	1	-0.010099034	0.00037033029	-0.0076011735
0	0	0	0	0
0.025	-0.25	0.13317879	0.99991788	-0.062414070
0.05	1.008525	-0.22851782	0	0.25177272
0.075	0	0.10209042	0	0.42875623
0.1	0	0.078436452	0	0.41602138

12.2 Event Summary

Table 12.2 lists the events that occurred during the reporting period that affected the SQM statistics.

Table 12-2 Event Summary

GPS Week	Date	Events
Week 1490 Day 6 to Week 1491 Day 1	8/2/2008 to 8/4/2008	Loss of data due to workstation power outage.
Week 1491 Day 4 to Week 1491 Day 5	8/7/2008 to 8/8/2008	Workstation went offline for hard drive upgrade.
Week 1492 Day 0 to Week 1492 Day 1	8/10/2008 to 8/11/2008	Loss of data due to workstation power outage.

12.3 Type Bias

PRN Type biases are evaluated as part of the WAAS SQM offline monitoring effort. Depending on the PRN number of any given satellite, it can be classified into three categories of correlation function shapes: skinny (Type 0), nominal (Type 1), and broad (Type 2). Wideband geostationary satellites are considered a different type (Type 3). PRN-type estimates are computed at each epoch and daily averages are computed for each type, for four detection metrics.

For this reporting period, geostationary satellites type biases are not evaluated. Table12.3 shows the rollup average for the quarter. Table 12.4 shows the rollup average since January 1, 2008. Figure 12.1 shows the daily average for the four detection metrics. Please refer to Table 12.2 for events that affected SQM data availability. As expected, the type biases are consistent from day to day.

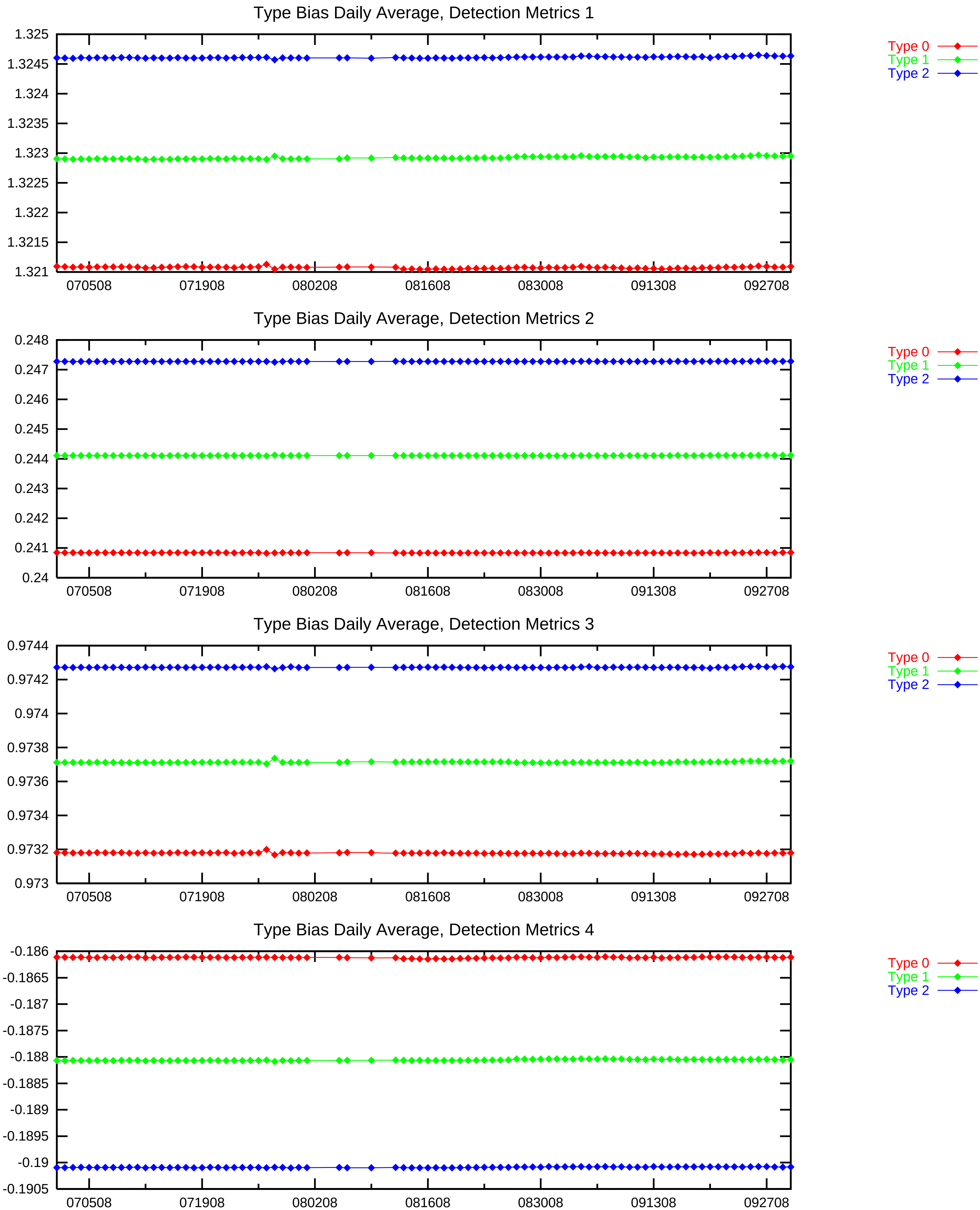
Table 12-3 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32108	1.32292	1.32461
DM 2	0.240836	0.244109	0.247275
DM 3	0.973178	0.973714	0.974272
DM 4	-0.186119	-0.188057	-0.190088

Table 12-4 Type Bias Average Since January 1, 2008

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.3209	1.32293	1.32463
DM 2	0.240843	0.244113	0.247286
DM 3	0.973178	0.973713	0.974276
DM 4	-0.186107	-0.188053	-0.190086

Figure 12-1 PRN Type Bias Average Trend



12.4 PRN Bias

PRN biases are evaluated as part of the WAAS SQM offline monitoring effort. PRN bias is the overall estimated deformation per satellite across receivers. Detection metrics are adjusted for inter-receiver bias, corrected for PRN type bias, and combined across receivers for each satellite. Relying on the assertion that the majority of the SV signals are healthy and normal, detection metrics are normalized over all the satellites on orbit resulting in an overall PRN bias for each satellite. PRN biases are collected at each epoch and daily averages are computed for each satellite, for four detection metrics.

For this reporting period, geostationary satellite biases are not evaluated. Please refer to Table 12.2 for events that affected SQM data availability and Table 1.4 for other events such as satellite out for service that may have an impact on PRN bias statistics. Please note that PRN 1 was decommissioned since March 18, 2008 and PRN 5 since August 6, 2008.

Table 12.5 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.6 shows the rollup PRN bias average since January 1, 2008. The maximum average for DM1 for this quarter is PRN 23 at 0.00095047. The maximum average for DM2 is PRN 21 at 0.00018953. The maximum average for DM3 is PRN 10 at 0.00026680 and the maximum average for DM4 is PRN 23 at 0.00042462.

Figure 12.3 to 12.10 show the PRN bias average trend for each SV. PRN biases, for the majority of SVs, are highest for DM1 than the other DMs.

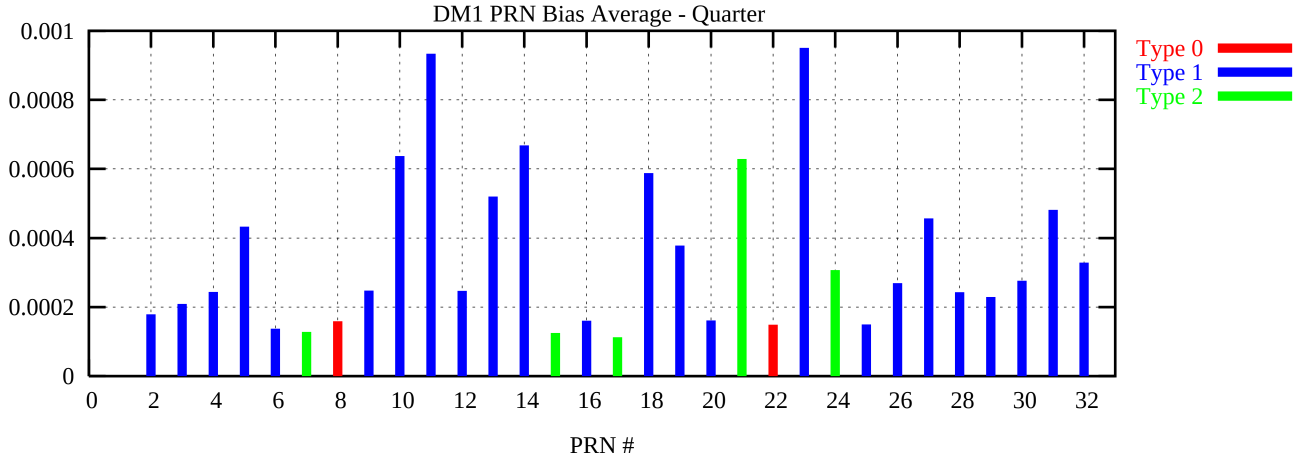
Table 12-5 PRN Bias Average for the Quarter

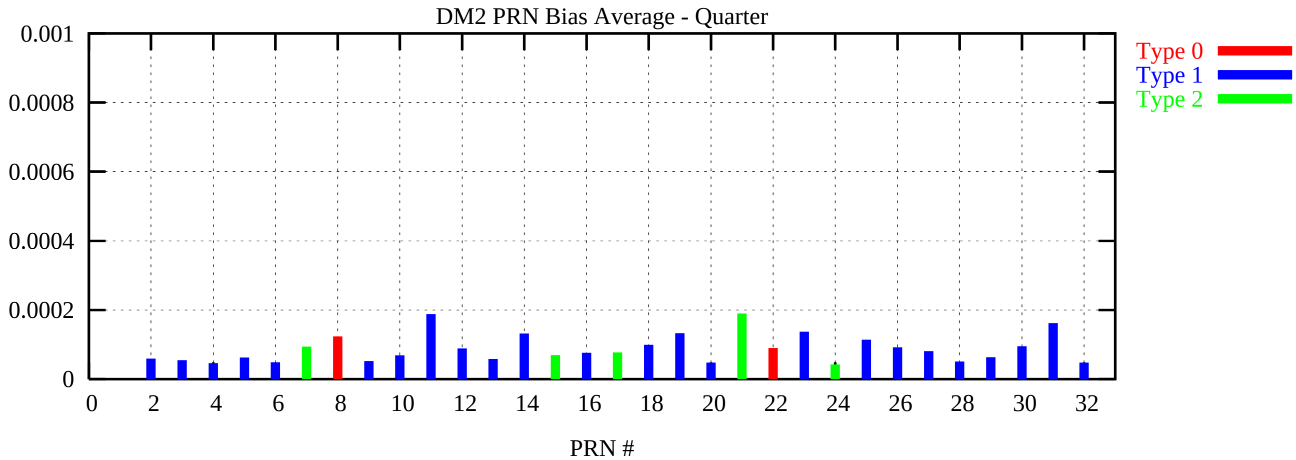
PRN	DM1	DM2	DM3	DM4
2	0.00017864	0.00005980	0.00002095	0.00009301
3	0.00020921	0.00005448	0.00008602	0.00034433
4	0.00024383	0.00004666	0.00007653	0.00013342
5	0.00043301	0.00006251	0.00011635	0.00016364
6	0.00013738	0.00004884	0.00003957	0.00012873
7	0.00012788	0.00009428	0.00003489	0.00012376
8	0.00015862	0.00012372	0.00004414	0.00009787
9	0.00024750	0.00005258	0.00007107	0.00011467
10	0.00063756	0.00006888	0.00026680	0.00009869
11	0.00093339	0.00018799	0.00006412	0.00023842
12	0.00024704	0.00008884	0.00010779	0.00007949
13	0.00052026	0.00005879	0.00006000	0.00016256
14	0.00066845	0.00013211	0.00011370	0.00012995
15	0.00012536	0.00006923	0.00002815	0.00013116
16	0.00016054	0.00007642	0.00010988	0.00034017
17	0.00011274	0.00007752	0.00002957	0.00011372
18	0.00058767	0.00009921	0.00003879	0.00020733
19	0.00037804	0.00013292	0.00003341	0.00008616
20	0.00016156	0.00004807	0.00004648	0.00010249
21	0.00062914	0.00018953	0.00020084	0.00008636
22	0.00014913	0.00009027	0.00009854	0.00010425
23	0.00095047	0.00013697	0.00003461	0.00042462
24	0.00030736	0.00004268	0.00003618	0.00010710
25	0.00014991	0.00011384	0.00008369	0.00030847
26	0.00026960	0.00009190	0.00015672	0.00009342
27	0.00045679	0.00008113	0.00006926	0.00031598
28	0.00024277	0.00005128	0.00003135	0.00008819
29	0.00022916	0.00006319	0.00010644	0.00029041
30	0.00027611	0.00009484	0.00002905	0.00010986
31	0.00048166	0.00016221	0.00003887	0.00025295
32	0.00032863	0.00004821	0.00011490	0.00010198

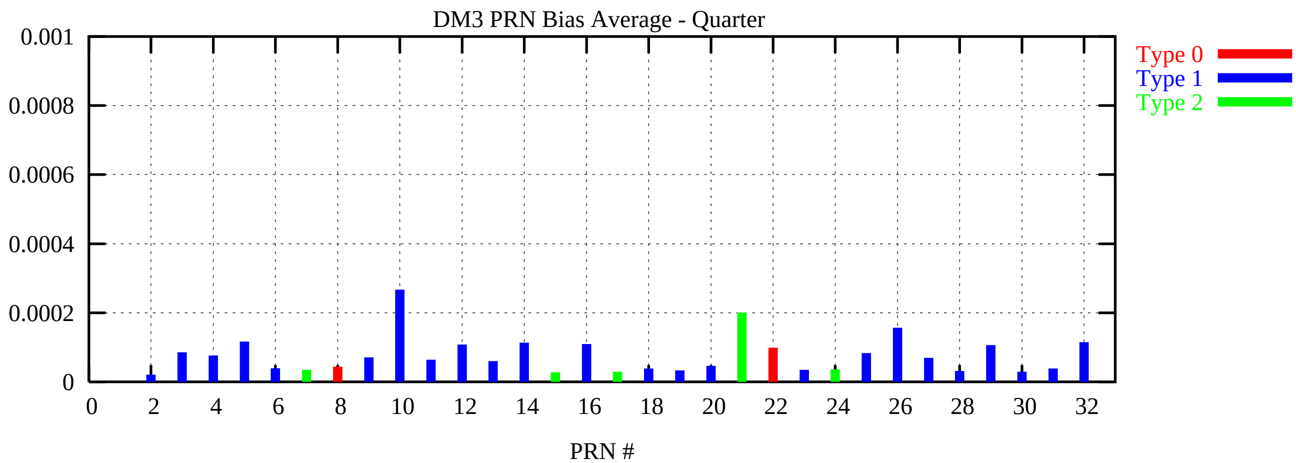
Table 12-6 PRN Bias Average Since January 1, 2008

PRN	DM1	DM2	DM3	DM4
2	0.00017841	0.00005987	0.00002188	0.00009598
3	0.00021185	0.00005319	0.00008521	0.00033843
4	0.00024218	0.00004596	0.00007451	0.00012920
5	0.00043971	0.00006679	0.00011673	0.00016442
6	0.00016608	0.00005532	0.00004684	0.00011497
7	0.00012733	0.00009518	0.00003567	0.00012855
8	0.00015798	0.00011957	0.00004392	0.00010074
9	0.00024003	0.00005354	0.00006937	0.00011229
10	0.00064385	0.00007252	0.00026749	0.00009478
11	0.00092053	0.00018446	0.00006559	0.00023304
12	0.00024465	0.00008573	0.00010475	0.00008165
13	0.00051370	0.00006065	0.00005946	0.00016416
14	0.00066939	0.00013157	0.00011478	0.00012990
15	0.00012160	0.00006972	0.00002770	0.00013298
16	0.00016083	0.00007802	0.00010810	0.00033485
17	0.00011540	0.00008140	0.00002992	0.00011503
18	0.00058912	0.00009807	0.00004055	0.00020558
19	0.00037970	0.00013283	0.00003306	0.00008764
20	0.00015979	0.00004898	0.00004556	0.00010366
21	0.00062471	0.00018701	0.00020250	0.00008547
22	0.00016022	0.00008285	0.00010385	0.00010090
23	0.00095079	0.00013762	0.00003549	0.00042538
24	0.00030280	0.00004458	0.00003518	0.00010169
25	0.00015492	0.00010909	0.00008208	0.00030720
26	0.00026635	0.00009308	0.00015420	0.00009255
27	0.00045947	0.00007754	0.00007049	0.00030939
28	0.00024789	0.00005306	0.00003132	0.00009008
29	0.00022609	0.00006590	0.00010630	0.00029470
30	0.00028843	0.00009662	0.00002856	0.00011587
31	0.00047125	0.00015636	0.00003827	0.00025395
32	0.00033238	0.00004927	0.00011475	0.00010821

Figure 12-2 PRN Bias Average for the Quarter







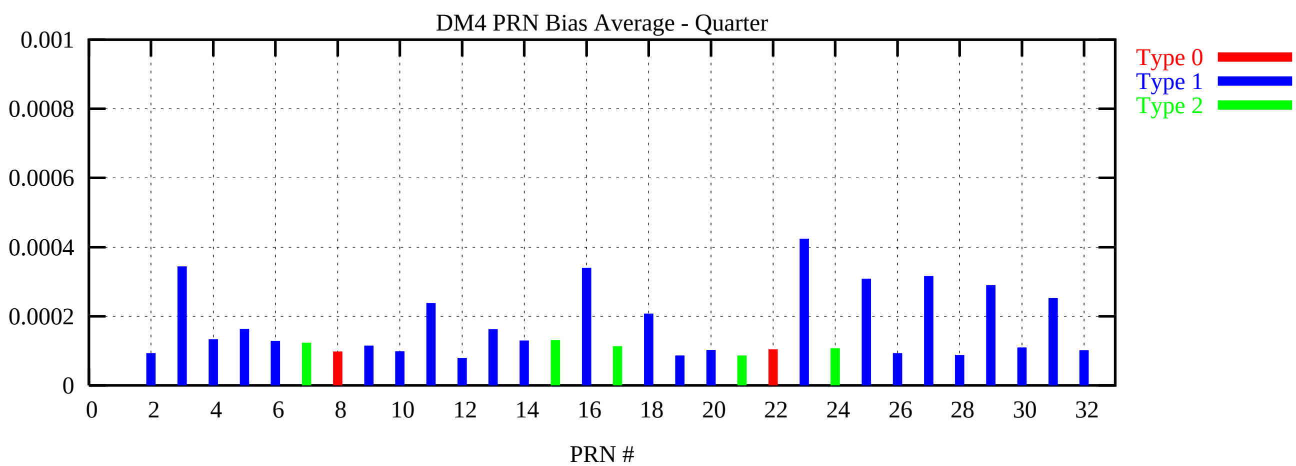
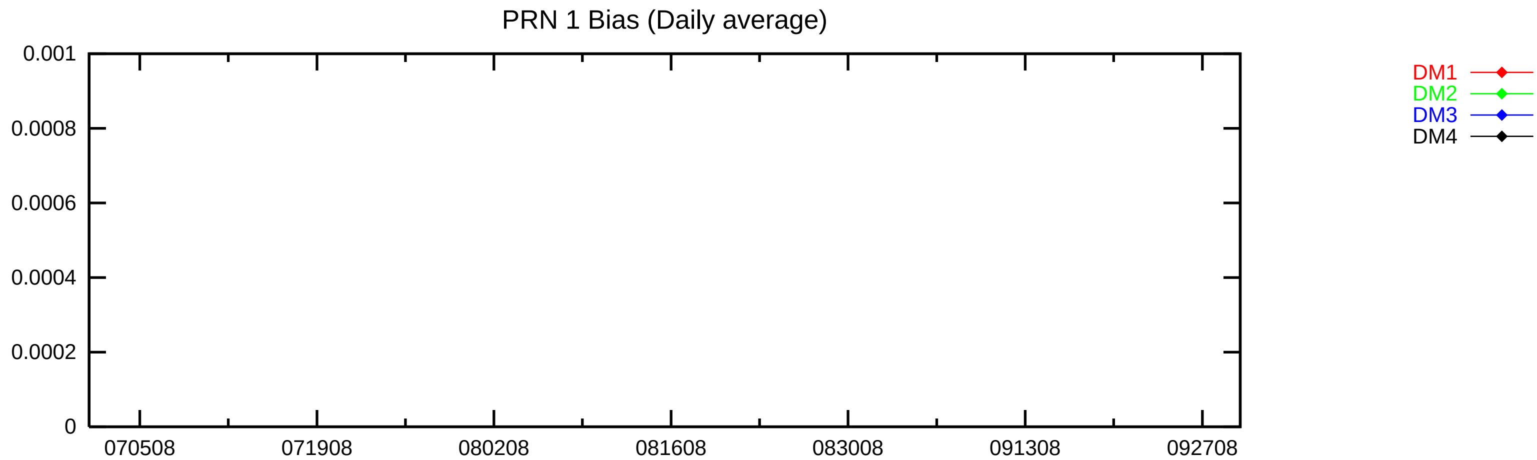
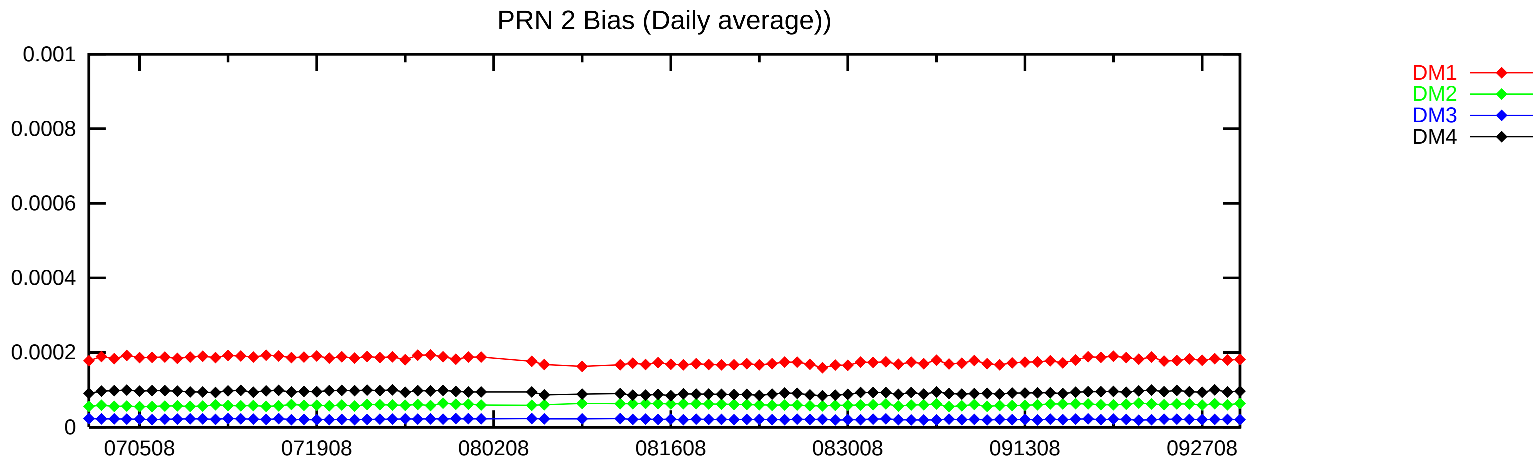
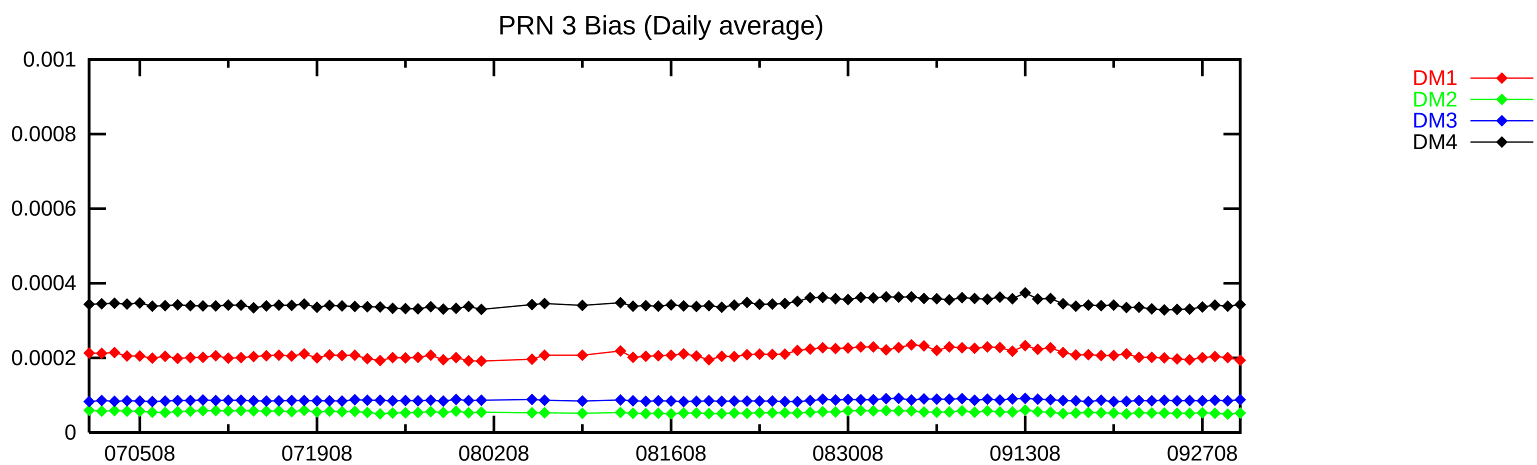


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)







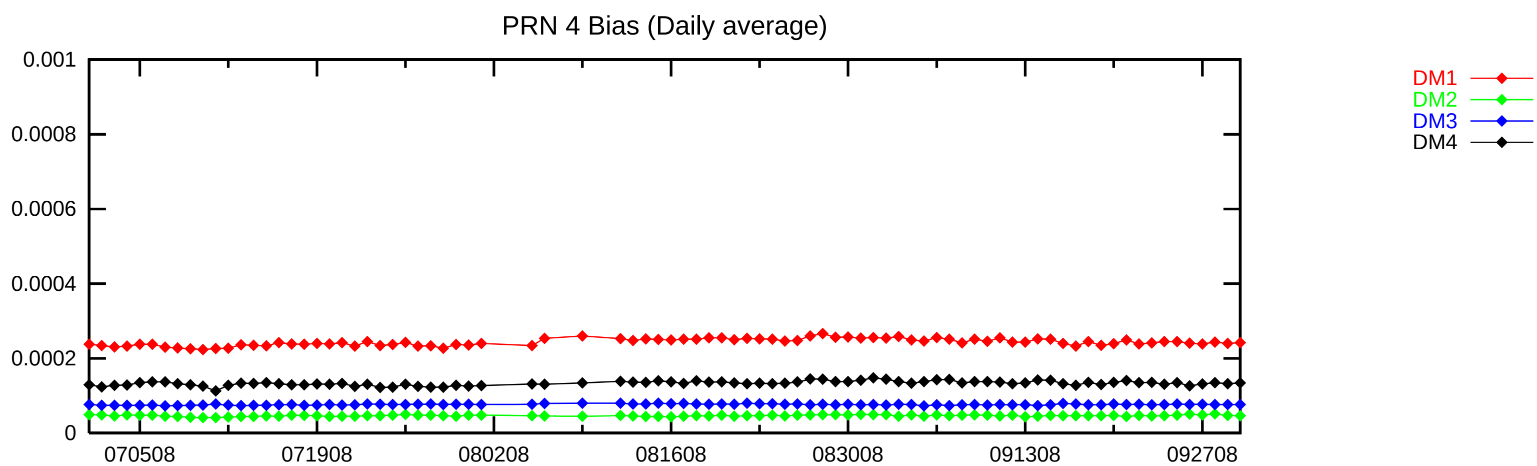
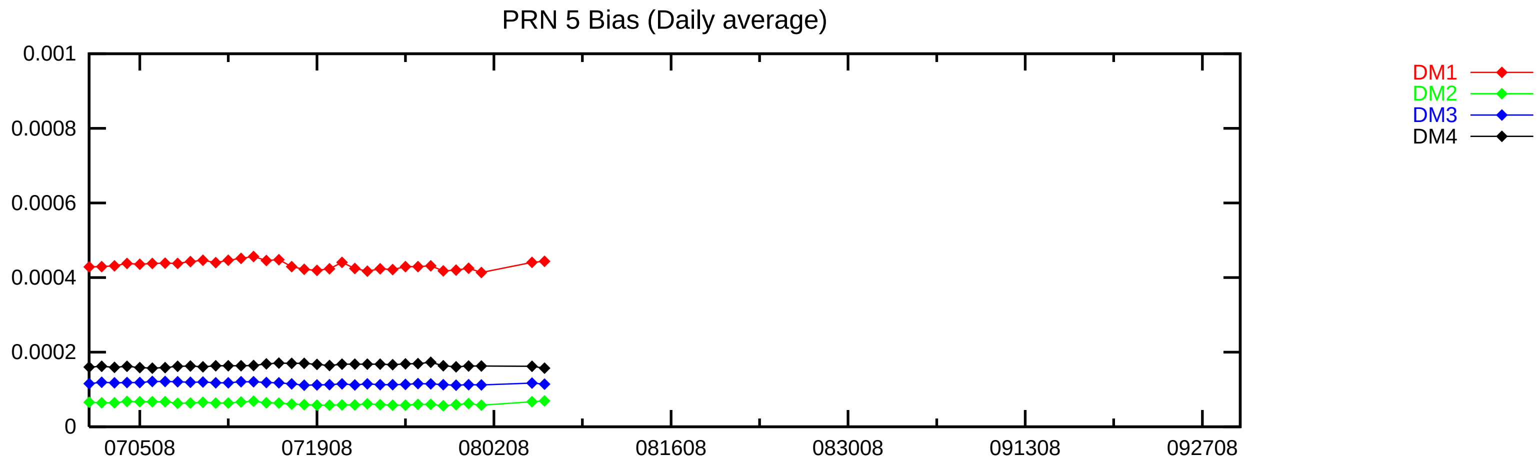
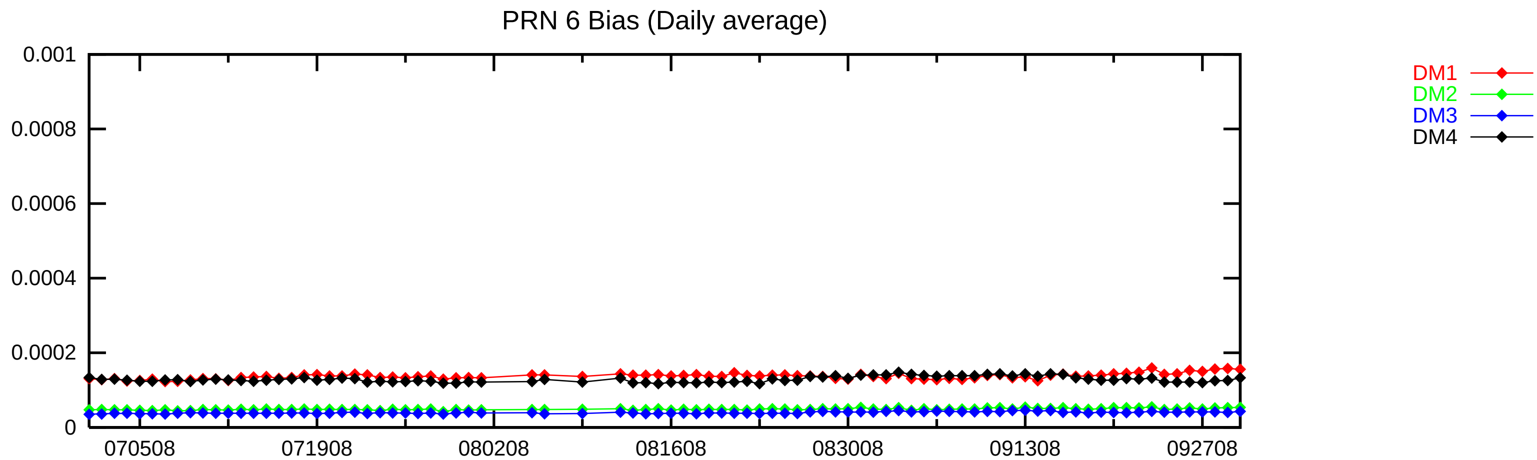
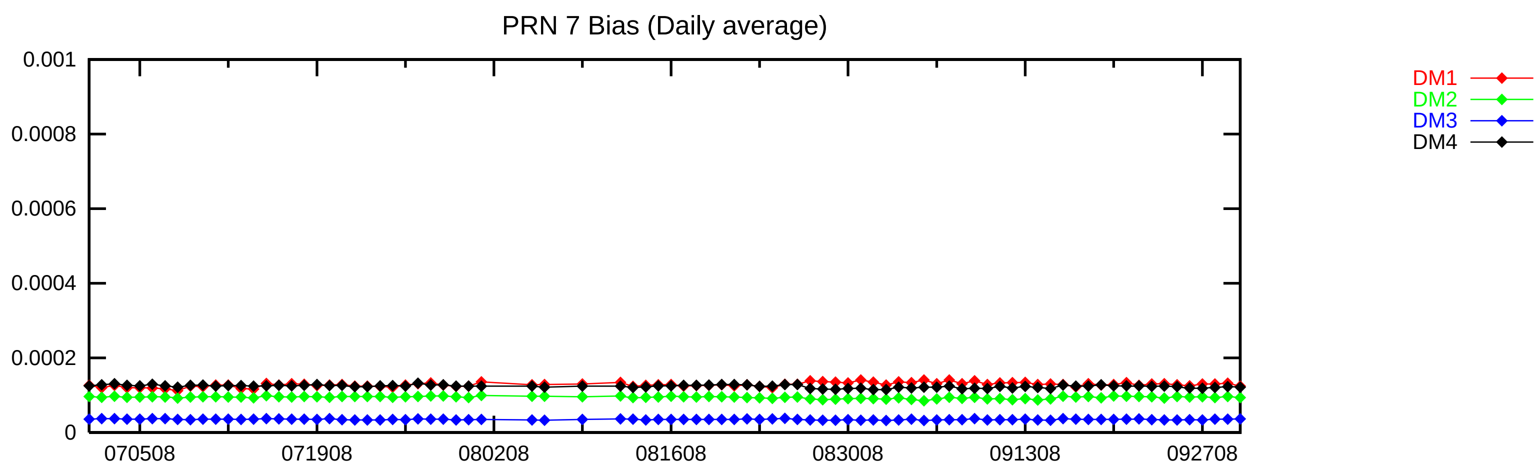


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)







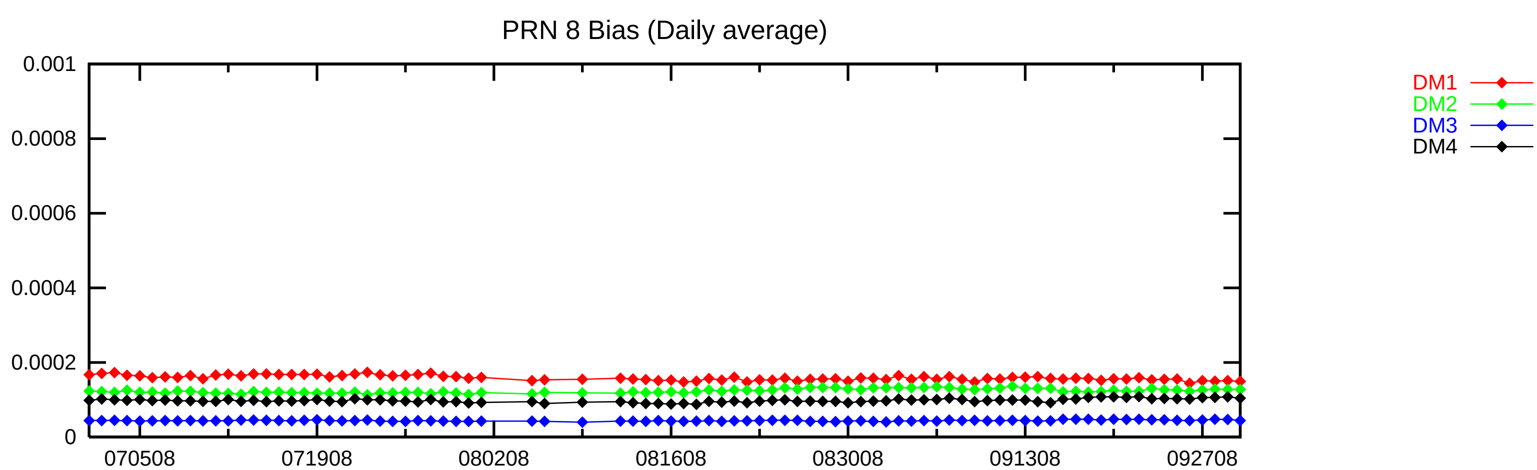
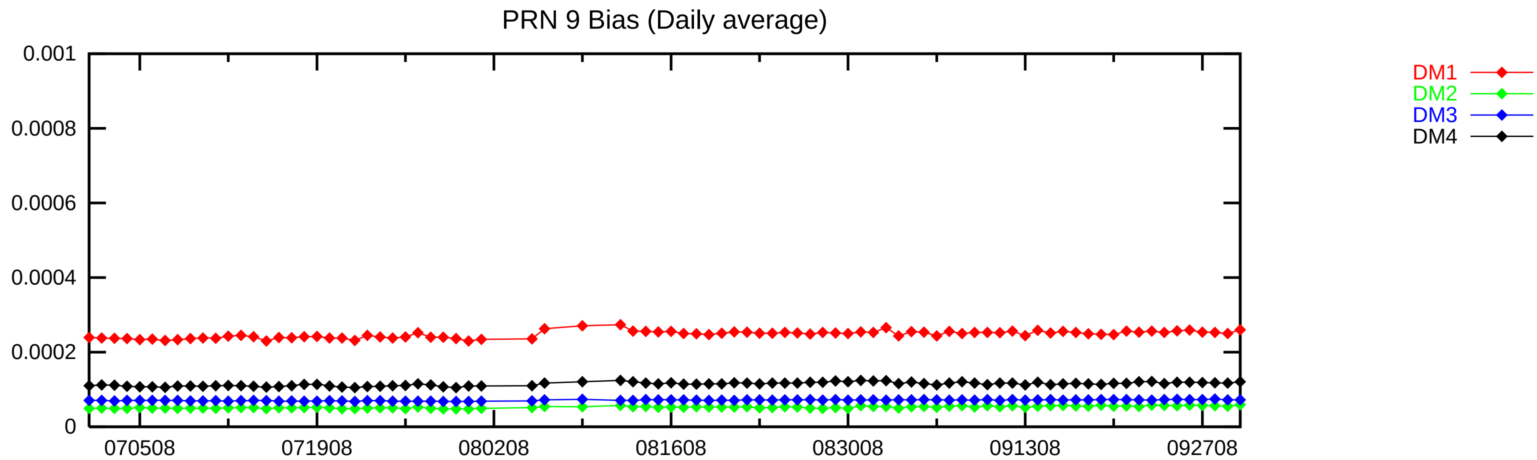
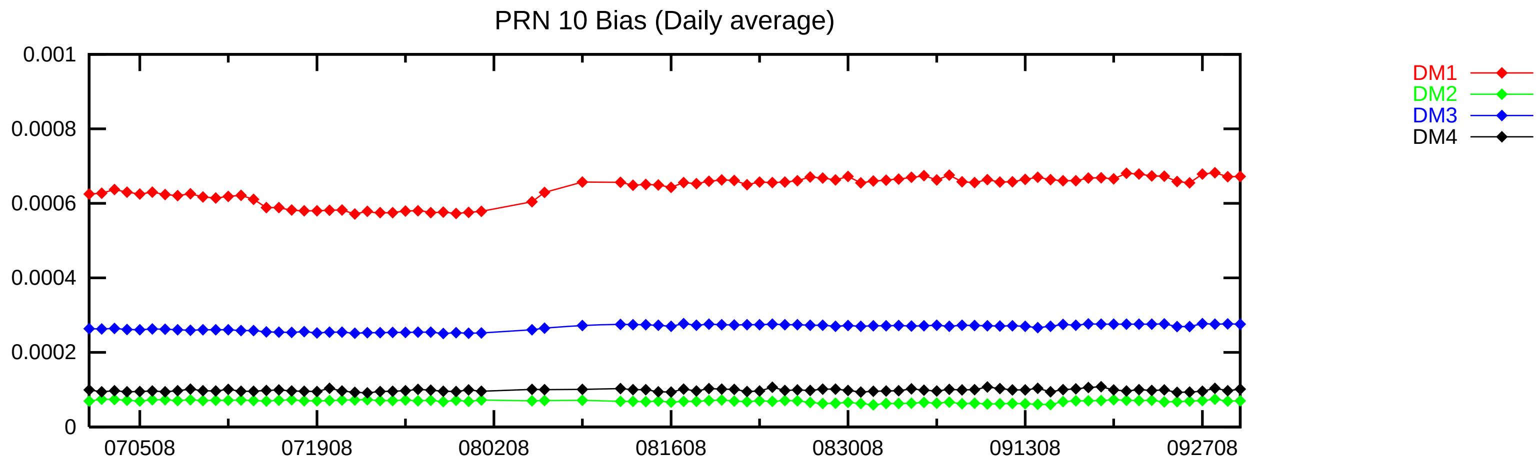
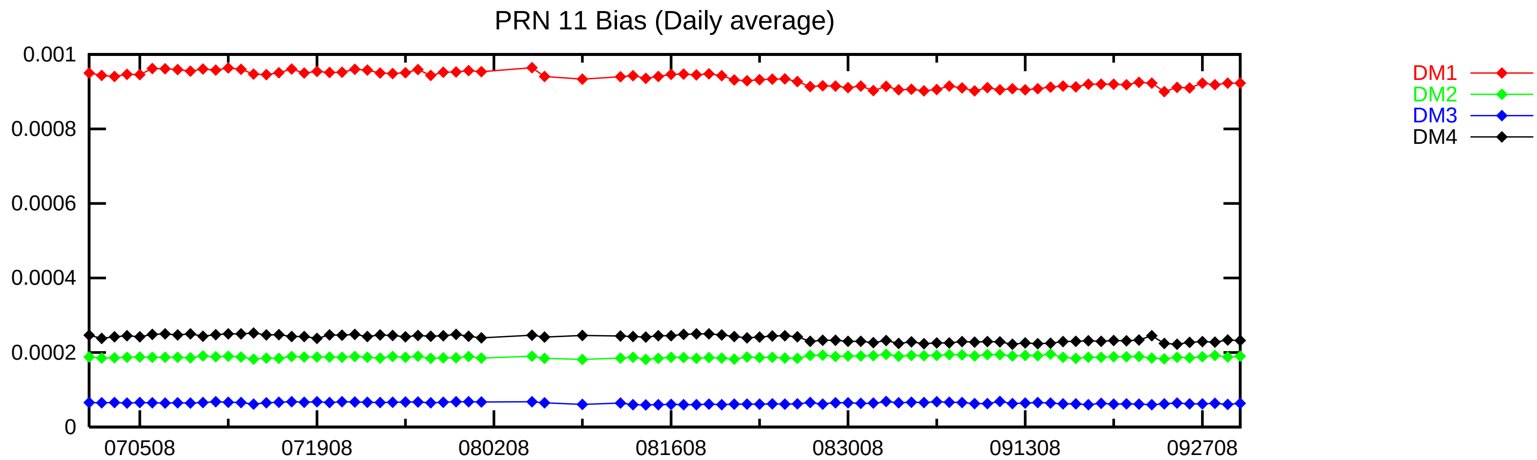


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)







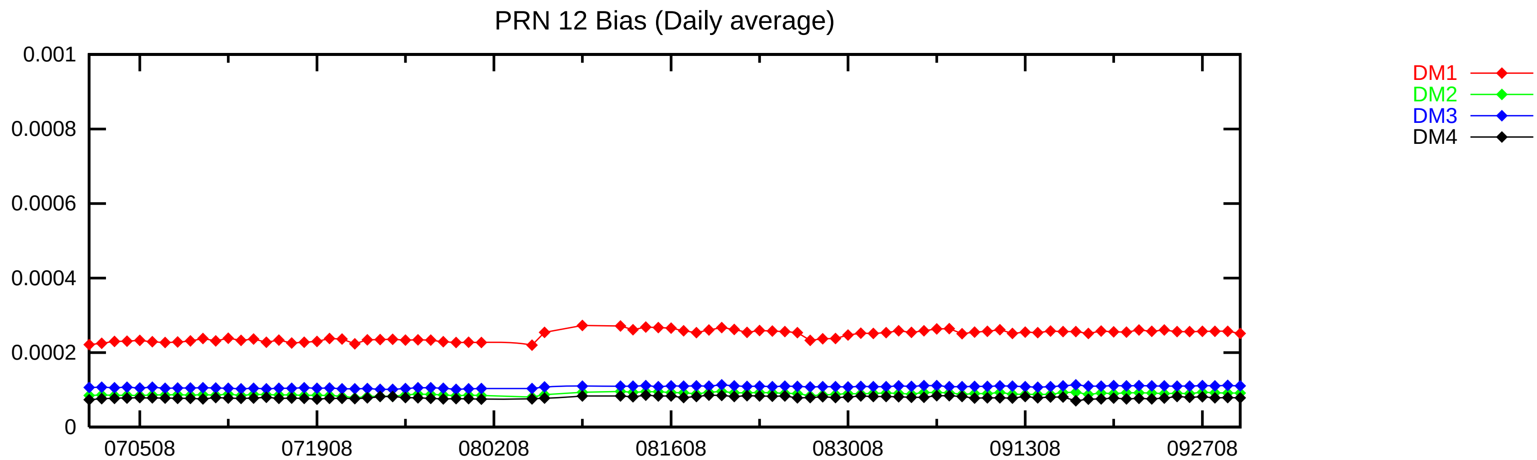
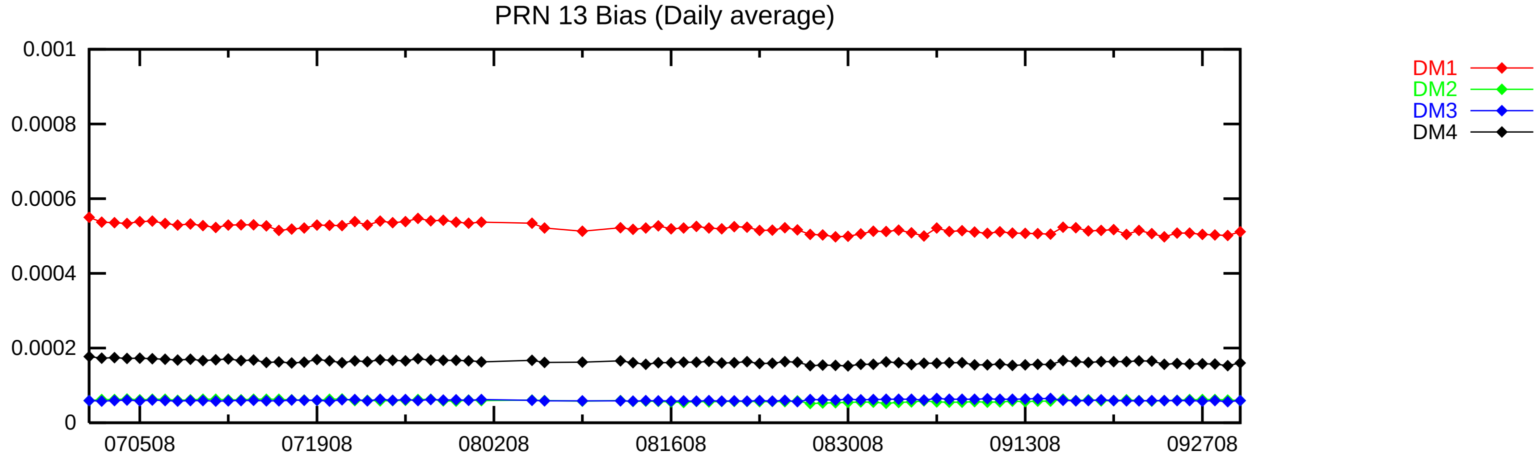
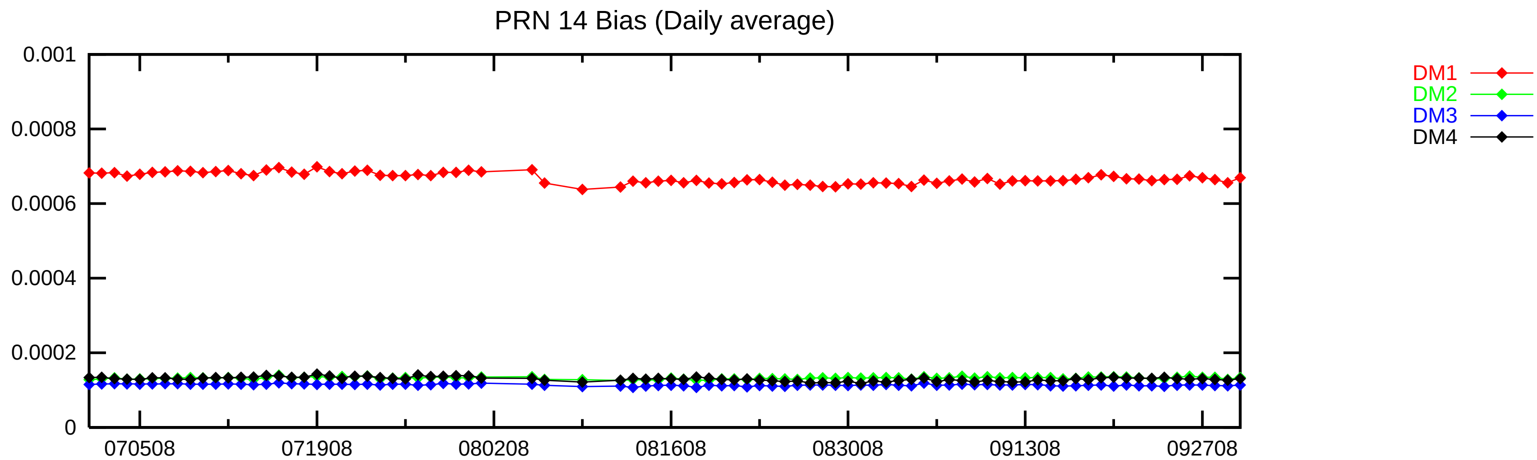
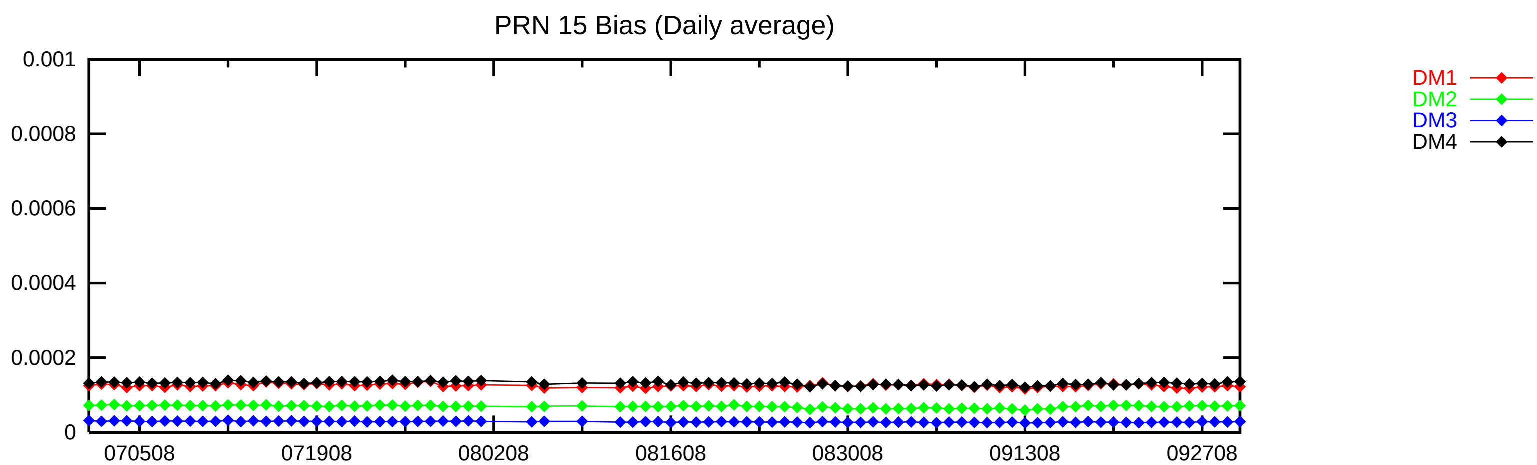


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)







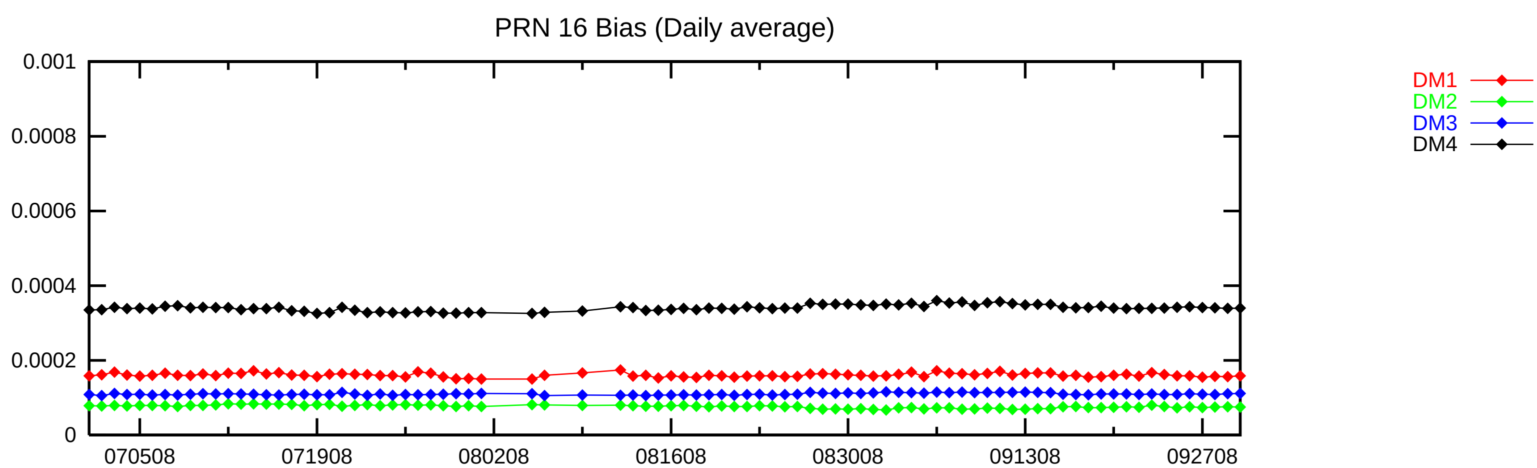


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)

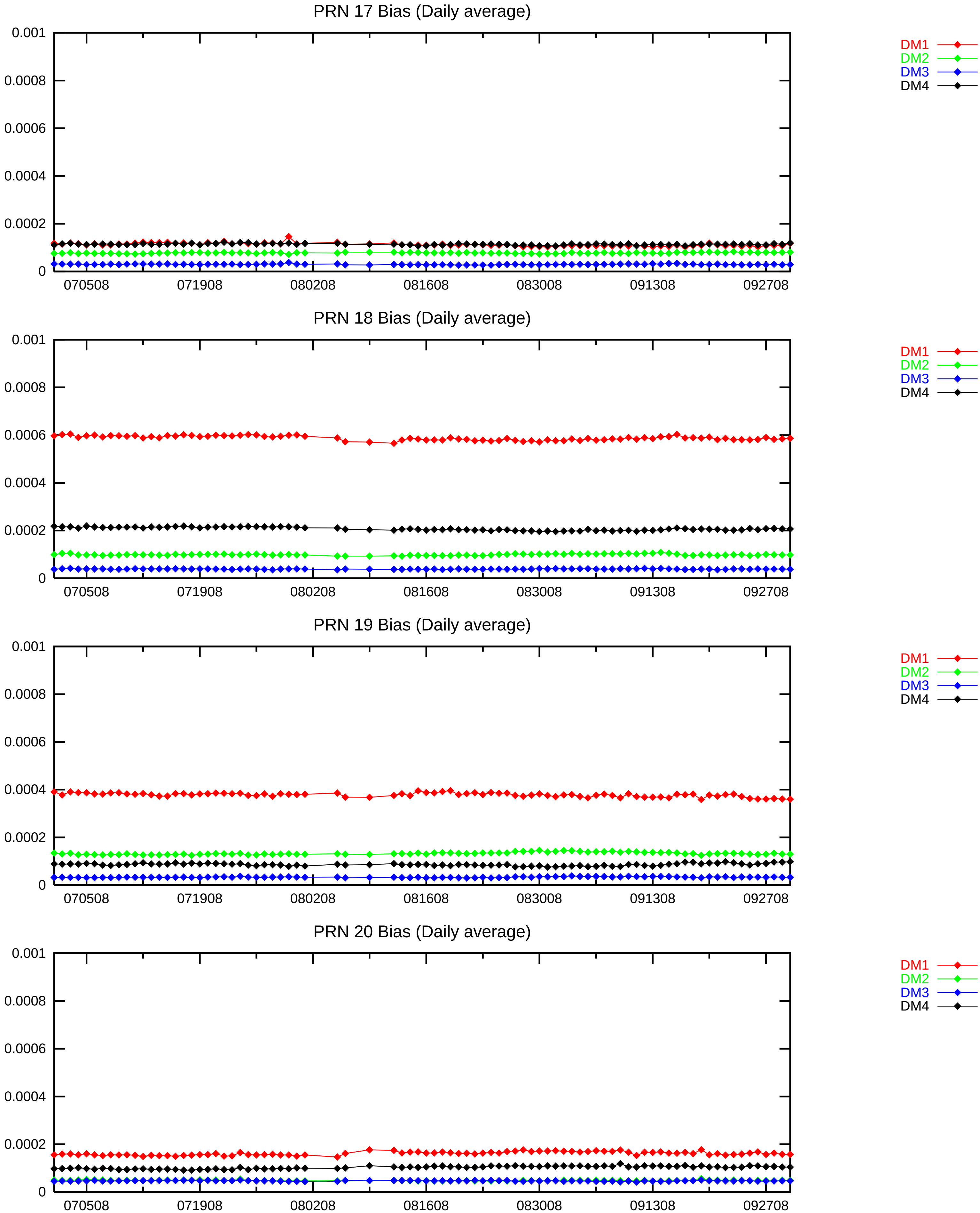


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)

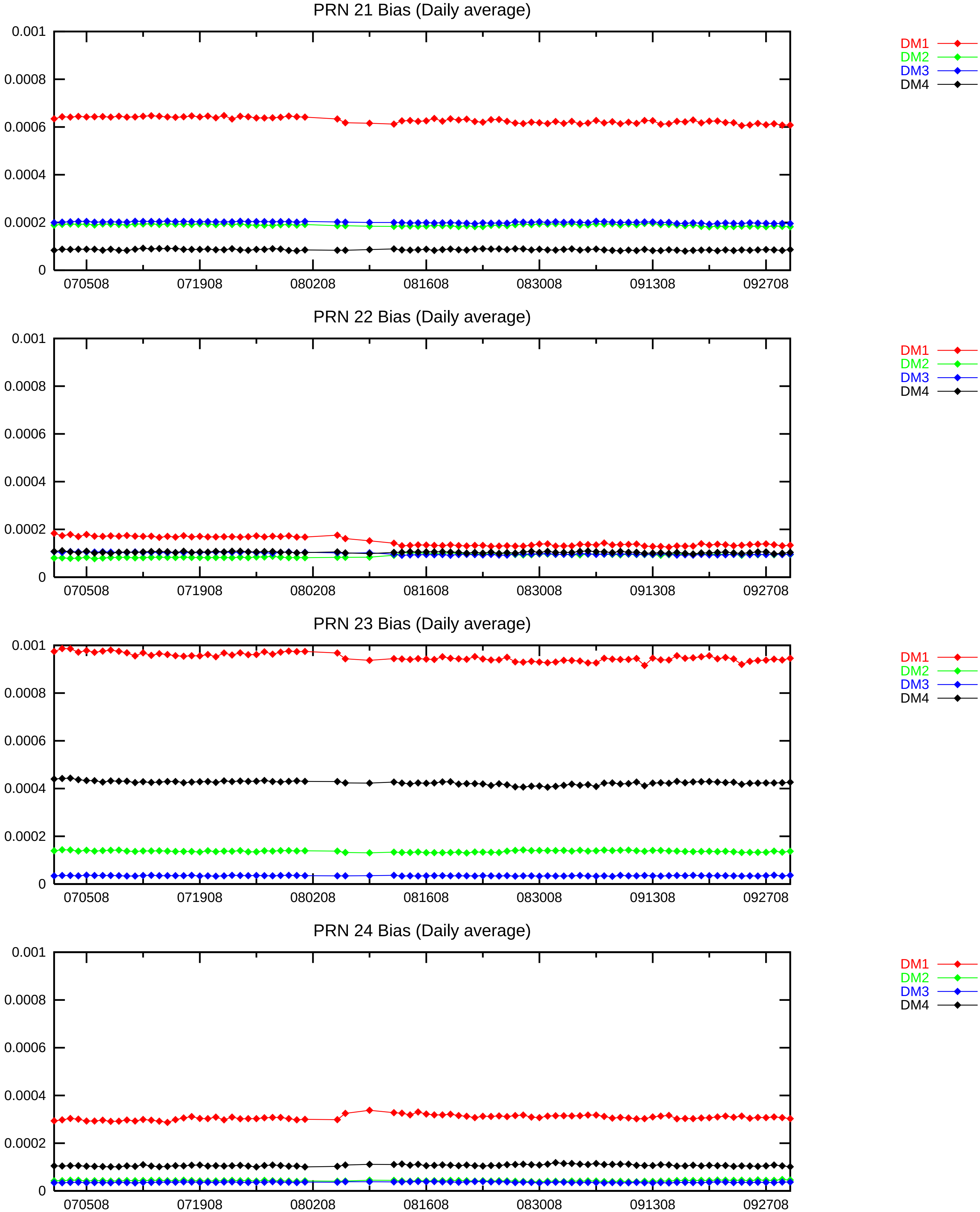


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)

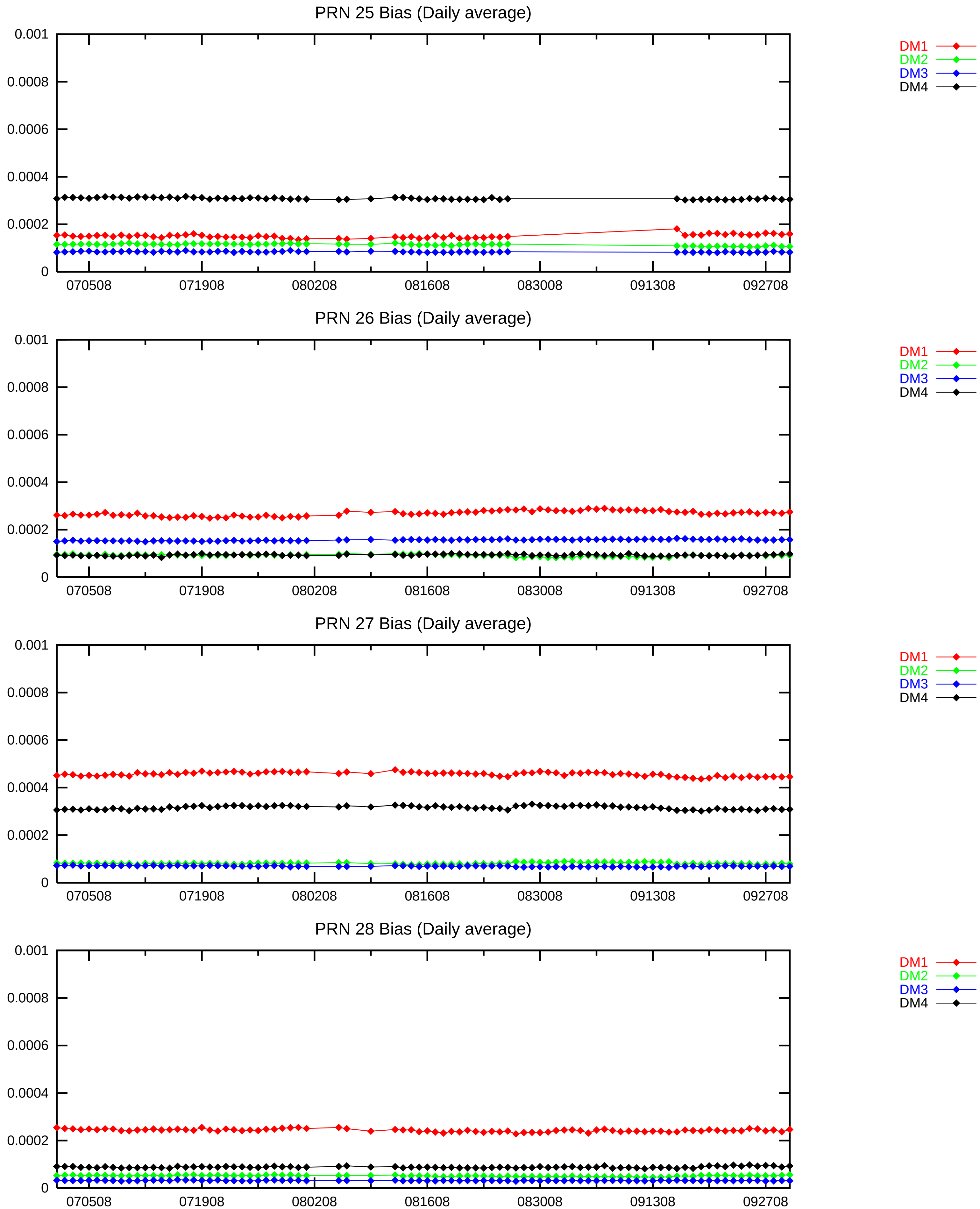
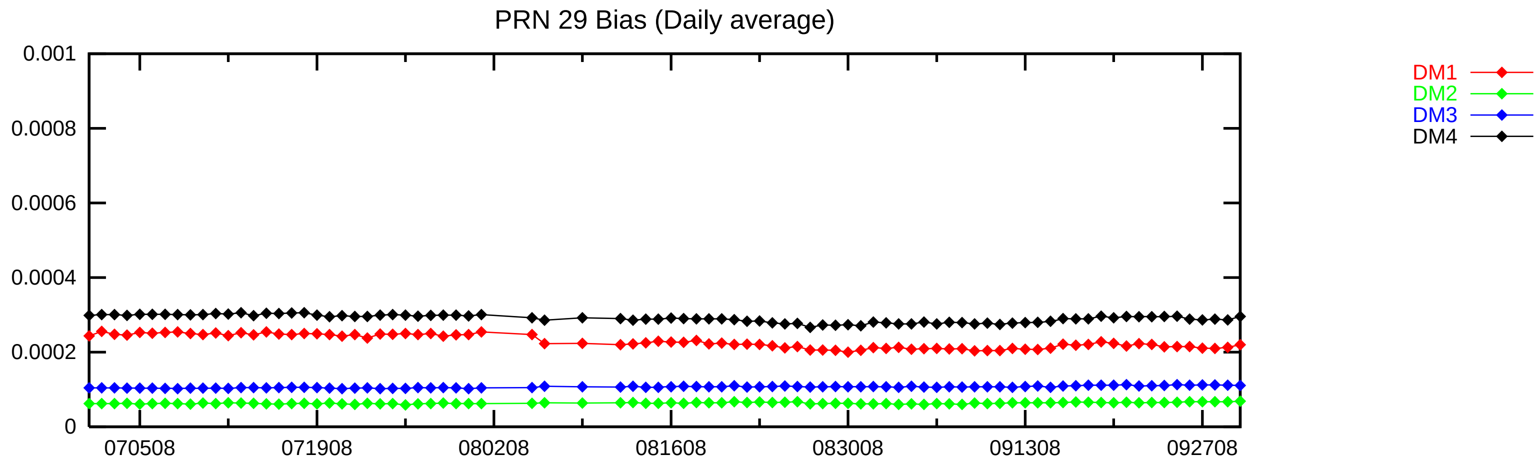
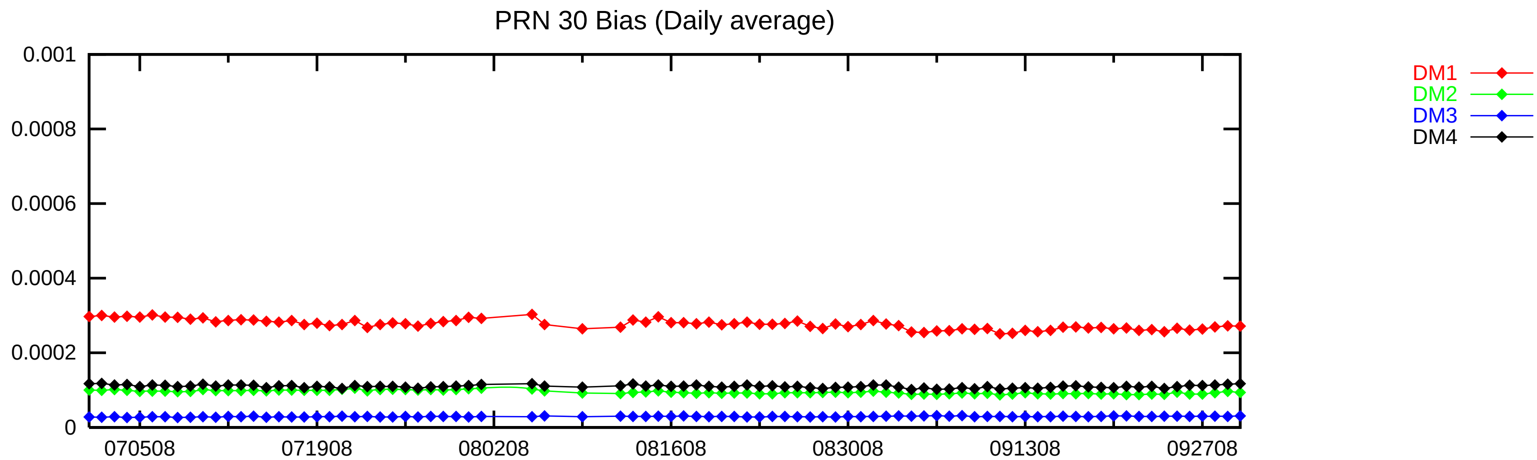
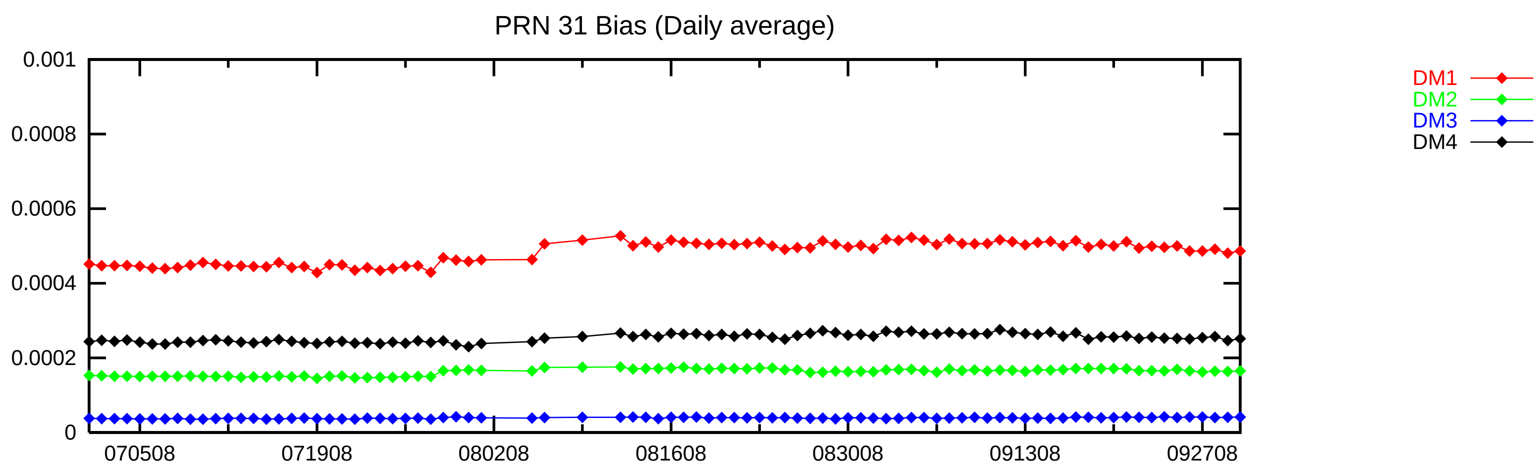
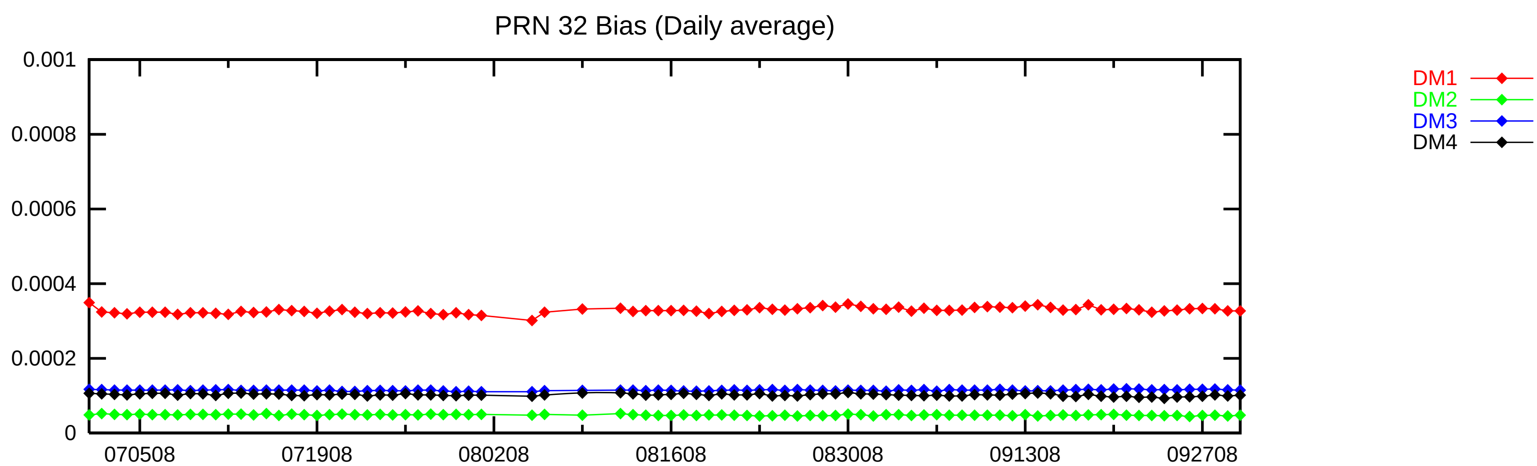


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN









12.5 SQM Trips

SQM trip occurs when the estimated deformation exceeds threshold. There are no SQM trips for this quarter.

Appendix A: Glossary

General Terms and Definitions

Alert. An alert is an indication provided by the GPS/WAAS equipment to inform the user when the positioning performance achieved by the equipment does not meet the integrity requirements.

Availability. The availability of a navigation system is the ability of the system to provide the required function and performance at the initiation of the intended operation. Availability is an indication of the ability of the system to provide usable service within the specified coverage area.

CONUS. Continental United States.

Continuity. The continuity of a system is the ability of the total system (comprising all elements necessary to maintain aircraft position within the defined airspace) to perform its function without interruption during the intended operation. More specifically, continuity is the probability that the specified system performance will be maintained for the duration of a phase of operation, presuming that the system was available at the beginning of that phase of operation.

Coverage. The coverage provided by a radio navigation system is that surface area or space volume in which the signals are adequate to permit the user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, and other factors that affect signal availability.

Dilution of Precision (DOP). The magnifying effect on GPS position error induced by mapping GPS ranging errors into position through the position solution. The DOP may be represented in any user local coordinate desired. Examples are HDOP for local horizontal, VDOP for local vertical, PDOP for all three coordinates, and TDOP for time.

DR. Discrepancy Report

Fault Detection and Exclusion (FDE). Fault detection and exclusion is a receiver processing scheme that autonomously provides integrity monitoring for the position solution, using redundant range measurements. The FDE consists of two distinct parts: fault detection and fault exclusion. The fault detection part detects the presence of an unacceptably large position error for a given mode of flight. Upon the detection, fault exclusion follows and excludes the source of the unacceptably large position error, thereby allowing navigation to return to normal performance without an interruption in service.

GEO. Geostationary Satellite.

Global Positioning System (GPS). A space-based positioning, velocity, and time system composed of space, control, and user segments. The space segment, when fully operational, will be composed of 24 satellites in six orbital planes. The control segment consists of five monitor stations, three ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that provide positioning, velocity, and precise timing to the user.

Grid Ionospheric Vertical Error (GIVE). GIVEs indicate the accuracy of ionospheric vertical delay correction at a geographically defined ionospheric grid point (IGP). WAAS transmits one GIVE for each IGP in the mask.

Hazardous Misleading Information (HMI). Hazardous misleading information is any position data, that is output, that has an error larger than the current protection level (HPL/VPL), without any indication of the error (e.g., alert message sequence).

Horizontal Alert Limit (HAL). The Horizontal Alert Limit (HAL) is the radius of a circle in the horizontal plane (the local plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated horizontal position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Horizontal Protection Level (HPL). The Horizontal Protection Level is the radius of a circle in the horizontal plane (the plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated horizontal position. It is based upon the error estimates provided by WAAS.

IGS. International GPS Service.

Ionospheric Grid Point (IGP). IGP is a geographically defined point for which the WAAS provides the vertical ionospheric delay.

LNAV. Lateral Navigation.

LPV. Localizer Precision with Vertical Guidance. LPV is a WAAS operational service level with a HAL equal to 40 meters and a VAL equal to 50 meters.

LPV 200. Localizer Precision with Vertical Guidance to 200 ft decision height. LPV 200 is a WAAS operational service level with a HAL equal to 40 meters and a VAL equal to 35 meters.

MOPS. Minimum Operational Performance Standards.

Navigation Message. Message structure designed to carry navigation data.

Non-Precision Approach (NPA) Navigation Mode. The Non-Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with fast and long term WAAS corrections (no WAAS ionospheric corrections) available.

Position Solution. The use of ranging signal measurements and navigation data from at least four satellites to solve for three position coordinates and a time offset.

Precision Approach (PA) Navigation Mode. The Precision Approach navigation mode refers to the navigation solution operating with a minimum of four satellites with all WAAS corrections (fast, long term, and ionospheric) available.

Selective Availability. Protection technique employed by the DOD to deny full system accuracy to unauthorized users.

Signal Quality Monitor (SQM). SQM monitors correlator measurements to detect signal deformations that originate in the GPS or GEO satellites and ensures that the UDREs are sufficiently inflated to protect given the monitor's current observations.

Standard Positioning Service (SPS). Three-dimensional position and time determination capability provided to a user equipped with a minimum capability GPS SPS receiver in accordance with GPS national policy and the performance specifications.

SV. Space Vehicle.

User Differential Range Error (UDRE). UDRE's indicate the accuracy of combined fast and slow error corrections. WAAS transmits one UDRE for each satellite in the mask.

Vertical Alert Limit (VAL). The Vertical Alert Limit is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated vertical position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

Vertical Protection Level (VPL). The Vertical Protection Level is half the length of a segment on the vertical axis (perpendicular to the horizontal plane of WGS-84 ellipsoid), with its center being at the true position, which describes the region that is assured to contain the indicated vertical position. It is based upon the error estimates provided by WAAS.

VNAV. Vertical Navigation.

Wide Area Augmentation System (WAAS). The WAAS is made up of an integrity reference monitoring network, processing facilities, geostationary satellites, and control facilities. Wide area reference stations and integrity monitors are widely dispersed data collection sites that contain GPS/WAAS ranging receivers that monitor all signals from the GPS, as well as the WAAS geostationary satellites. The reference stations collect measurements from the GPS and WAAS satellites so that differential corrections, ionospheric delay information, GPS/WAAS accuracy, WAAS network time, GPS time, and UTC can be determined. The wide area reference station and integrity monitor data are forwarded to the central data processing sites. These sites process the data in order to determine differential corrections, ionospheric delay information, and GPS/WAAS accuracy, as well as verify residual error bounds for each monitored satellite. The central data processing sites also generate navigation messages for the geostationary satellites and WAAS messages. This information is modulated on the GPS-like signal and broadcast to the users from geostationary satellites.