WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #34

Reporting Period: July 1 to September 30, 2010

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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 thirty-fourth such WAAS quarterly report. This report covers WAAS performance during the period from July 1, 2010 to September 30, 2010.

The following table shows observations for accuracy and availability made during the reporting period for CONUS and Alaska sites. The international sites are excluded from this table, but are included in the body of the report. 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 table below 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**	**Alaska Site/Maximum**	**Alaska Site/Minimum**
95% Horizontal Accuracy	Grand Forks 1.341 meters	Jacksonville 0.558 meters	Cold Bay 0.692 meters	Fairbanks 0.492 meters
95% Vertical Accuracy	Oakland 1.715 meters	Billings 0.741 meters	Kotzebue 1.154 meters	Juneau 0.926 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Seattle 100%	Los Angeles 99.95%	Anchorage 99.97%	Barrow 97.62%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	New York 100%	Oakland 98.28%	Anchorage 99.95%	Barrow 79.69%
95% HPL	Arcata 17.067 meters	Memphis 11.044 meters	Cold Bay 28.59 meters	Fairbanks 14.26 meters
95% VPL	Arcata 30.261 meters	Kansas City 18.753 meters	Barrow 42.657 meters	Juneau 22.90 meters

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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 PA service.

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, 2010 to September 30, 2010.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	70	6075881
Grand Forks	91	7854872
Oklahoma City	67	5764418
WAAS:		
Albuquerque	92	7944964
Anchorage	92	7946968
Atlanta	92	7947244
Barrow	92	7941335
Bethel	92	7943496
Billings	92	7945842
Boston	92	7947220
Chicago	92	7947258
Cleveland	92	7947182
Cold Bay	92	7946071
Dallas	92	7947204
Denver	92	7939109
Fairbanks	92	7944552
Gander	92	7947122
Goose Bay	92	7946380
Houston	92	7946826
Iqaluit	92	7938308
Jacksonville	92	7947013
Juneau	92	7942905
Kansas City	92	7946962
Kotzebue	92	7939921
Los Angeles	92	7946064
Memphis	92	7946897
Merida	92	7946104
Mexico City	92	7946314
Miami	92	7946802
Minneapolis	92	7938846
New York	92	7947028
Oakland	92	7945697
Puerto Vallarta	92	7942370
Salt Lake City	92	7947263
San Jose Del Cabo	92	7941005
San Juan	92	7908375
Seattle	92	7947025
Tapachula	0	9579
Washington DC	92	7946971
Winnipeg	92	7947248

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	92	7943448
Anchorage	92	7944945
Atlanta	92	7940263
Barrow	92	7943669
Bethel	91	7892173
Billings	92	7944007
Boston	92	7944965
Cleveland	92	7945035
Cold Bay	92	7943258
Fairbanks	92	7943114
Gander	92	7944867
Honolulu	81	6991303
Houston	92	7945032
Iqaluit	92	7941333
Juneau	92	7939489
Kansas City	92	7944986
Kotzebue	92	7938448
Los Angeles	85	7349787
Merida	92	7944256
Miami	92	7945006
Minneapolis	92	7945021
Oakland	92	7944968
Salt Lake City	92	7944973
San Jose Del Cabo	92	7932260
San Juan	92	7944948
Seattle	92	7945006
Tapachula	0	9858
Washington DC	92	7945036

The report is divided in the performance categories listed below. This report also includes WAAS LPV and LPV 200 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 1 and 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 1.5 lists events related to Release 1 upgrades that happened this quarter. No WAAS changes/upgrades occurred this quarter. Table 1.6 lists events related to GUS switchovers.

Table 1-4 Test Events

Start Date	End Date	Location/ Satellite	Service Affected	Event Description
6/4/10	9/21/10	PRN135	LPV Alaska, LPV200 Alaska	GEO 135 message type 28 bumped UDREI to 11 beginning on 6/4/10. UDREi starting to intermittently bump to 12 on 7/710. UDREi at 13 starting on 9/12/10. This is the new expected performance due to CRW orbit drift. Alaska coverage is affected.
7/1/10	7/1/10	PRN135	Alaska	Planned SIS Outage on GEO 135 to support IntelSAT Testing. Event lasted 4280 seconds. Alaska coverage is affected.
7/7/10	7/8/10	PRN135, PRN 138	LPV 200, Alaska	Elevated UDREi on GEO 135 and GEO 138 reduced coverage.
7/15/10	7/15/10	PRN135, PRN 138	LPV 200, Alaska	Elevated UDREi on GEO 135 and GEO 138 reduced PA ranging availability affecting coverage.
7/18/10	7/20/10	PRN21	LPV200 CONUS	PRN 21 UDREi jumped to NPA caused LPV200 outage in CONUS with no SV Alert.

Start Date	End Date	Location/ Satellite	Service Affected	Event Description
7/23/10	7/23/10	PRN138	LPV200 Alaska	High UDREi on PRN138 due to maneuver. Alaska coverage is affected.
7/23/10	7/23/10	PRN32	LPV200 Alaska	PRN 32 UDREi jumped from 5 to 14. This event affected LPV200 Alaska coverage.
7/26/10	7/30/10	Los Angeles (ZLA1), Los Angeles (ZLA2), Los Angeles (ZLA3)	Local	Military GPS Jamming Test occurring this week. 15:00 - 17:00Z & 21:00 - 23:00 expected outages occurred.
7/29/10	7/29/10	PRN16	All	NANU2010103
8/2/10	8/2/10	Los Angeles (C&V)	None	ZLA C&V faulted, suspected zyphr clock problem.
8/3/10	8/4/10	CONUS, Alaska, Canada	CONUS, Alaska, Canada	Ionospheric storm created high GIVEs causing LPV outages (KP=6).
8/14/10	8/14/10	PRN138	LPV200 Alaska	CCC monitor trip caused GEO to go to Do Not Use.
8/17/10	8/18/10	Denver (ZDV1), Denver (ZDV2), Denver (ZDV3)	Local	Denver outage on all Threads. Started end of day on 8/17/10 into the next day.
8/19/10	8/19/10	PRN10	LPV200 Alaska	PRN10 Delta V. NANU2010107, 0010 to 0440.
8/22/10	8/22/10	PRN30	LPV200 Alaska	PRN 30 Alert caused a lower than expected coverage in Alaska.
8/24/10	8/24/10	PRN14	All	NANU 2010111 Planned Maintenance for Delta-V.
8/25/10	8/25/10	PRN27, PRN30	LPV200 Alaska	A combination of Alerts on PRN 27 & 30 and elevated KP (=5) caused low LPV200 in Alaska.
8/27/10	8/27/10	PRN25	None	NANU2010113. PRN 25 first IIF satellite into service.
8/30/10	8/30/10	PRN25	None	PRN 25 carrier spikes caused a large number of receivers to drop track of satellite. PRN 25 was never set unhealthy but NANU 2010116 was issued. The problem was the result of an issue onboard the satellite. The issue ended when the GPS ground control corrected the problem. See DR #97 Large number of not monitored alarms on PRN 25.
9/7/10	9/11/10	All Satellites	None	NANU 2010117 and NANU 2010118. Flex Power Testing from 9/7/2010 to 9/11/2010.

Start Date	End Date	Location/ Satellite	Service Affected	Event Description
9/10/10	9/11/10	PRN3, PRN6	None	Bad measurements at Bethel on 9/10/11 caused a false RDM trip for PRN 6. Bad measurement at Goose Bay on 9/11/10 caused a false RDM trip on PRN 3. UDRE spiked to 12 for both.
9/21/10	9/21/10	PRN19	LPV200 CONUS	NANU 2010126. Caused loss of LPV200 coverage in the east coast.
9/26/10	9/26/10	Barrow (BRW1), Barrow (BRW2), Barrow (BRW3), PRN135	Alaska	GEO 135 began to dip below 5 degree elevation causing loss of WAAS service at Barrow.
9/27/10	9/28/10	PRN5	LPV Alaska, LPV200 Alaska	NANU 2010128.
9/29/10	9/29/10	PRN25	Alaska, LPV200 Alaska	NANU 2010129.
9/30/10	10/1/10	PRN30	LPV200 Alaska	NANU 2010130.

Table 1-5 WAAS Release 1 Upgrades

No WAAS changes/upgrades during this quarter.

Table 1-6 GUS Switchovers

Start Date	End Date	GUS Switch	Location/ Satellite	Service Affected	Event Description Start Date
07/14/10	07/14/10	Manual	Woodbine, PRN138	LPV200 Alaska	GUS switchover 138 for maintenance at Woodbine.
07/19/10	07/19/10	Manual	Littleton	None	Manual GUS Switch.
07/21/10	07/21/10	Manual	Brewster, PRN138	LPV200 All	Manual GUS Switch for maintenance next day to install mil spec. connectors. Low PA availability at 73% due to GUS switch and failure of the operator to enter maneuver data.
07/28/10	07/28/10	Faulted	Woodbine, PRN138	Canada	Woodbine Faulted.
08/01/10	08/01/10	Manual	Brewster, PRN138	Canada	Manual GUS switchover from Brewster to Woodbine for planned fall maintenance.
08/09/10	08/09/10	Manual	Littleton	Alaska	Manual GUS Switchover from Littleton to Napa.
08/24/10	08/24/10	Manual	Woodbine, PRN138	Canada	Manual GUS Switch from Woodbine to Brewster.

Start Date	End Date	GUS Switch	Location/ Satellite	Service Affected	Event Description Start Date
08/30/10	08/30/10	Manual	PRN138	Alaska	Manual GUS Switch from Brewster to Woodbine for FTI Maintenance on Comm lines to be done before CRW fails.
09/01/10	09/01/10	Manual	Woodbine, PRN138	LPV200 Alaska	Manual GUS switchover from Woodbine to Brewster due to FTI maintenance in Woodbine.
09/03/10	09/03/10	Manual	Brewster, PRN138	None	Manual GUS switchover from Brewster to Woodbine due corrective maintenance at Brewster.
09/06/10	09/06/10	Manual	Brewster, Woodbine, PRN138	None	2 GUS Switchovers - from Woodbine to Brewster and from Brewster to Woodbine due to planned FTI maintenance that was canceled. Problems experienced at Brewster canceled the planned maintenance.
09/07/10	09/07/10	Manual	Napa, PRN135	RNP3 Alaska, RNP1 Alaska	Manual GUS Switchover due to re-sectoring the satellite dish to track CRW as it moves eastward.
09/13/10	09/13/10	Manual	Woodbine, PRN138	None	Manual GUS switch from Woodbine to Brewster.
09/15/10	09/15/10	Manual	Brewster, PRN138	None	Manual GUS Switch from Brewster to Woodbine. The manual GUS switchover on Week 1601 Day 3 was for FTI maintenance at Brewster.
09/29/10	09/29/10	Faulted	Woodbine, PRN138	Alaska, LPV200_Alaska	GUS faulted at Woodbine due to a waveguide arc on the C1 KPA. Brewster became primary. The alarm was cleared within 11 minutes. A command was issued to re-initialize the SGS. Total down time was 39 minutes.

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. Quarterly 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 at 12 locations.

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 maximum 95% CONUS horizontal and vertical LPV errors are 1.34 meters at Grand Forks and 1.715 meters at Oakland, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.558 meters at Jacksonville and 0.741 meters at Billings, respectively. The maximum 95% and 99.999% NPA horizontal errors are 2.854 meters and .822 meters, both at Honolulu. The minimum 95% and 99.999% horizontal errors are .832 meters at Barrow and 1.8997 meters at Albuquerque.

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	0.817	0.817	1.298	100	*	*
Grand Forks	1.341	1.341	1.674	100	*	*
Oklahoma City	0.630	0.630	1.300	100	*	*
Albuquerque	0.565	0.565	0.910	100	1.992	3.457
Anchorage	0.591	0.592	0.992	100	*	*
Atlanta	0.570	0.570	0.966	100	1.992	3.265
Barrow	0.555	0.555	1.165	98.69289	*	*
Bethel	0.526	0.526	0.956	100	1.877	3.323
Billings	0.653	0.653	0.741	100	1.978	3.178
Boston	0.622	0.622	0.914	100	1.925	2.994
Chicago	0.902	0.902	1.027	100	*	*
Cleveland	0.602	0.602	0.963	100	1.912	3.249
Cold Bay	0.692	0.692	0.990	100	*	*
Dallas	0.628	0.628	1.136	100	*	*
Denver	0.577	0.577	0.880	100	*	*
Fairbanks	0.492	0.492	1.058	100	1.704	3.516
Gander	0.728	0.728	1.080	99.98430	*	*
Goose Bay	0.664	0.664	0.930	99.99303	*	*
Houston	0.586	0.586	1.195	100	2.174	3.491
Iqaluit	0.798	0.798	1.305	99.86983	*	*
Jacksonville	0.558	0.558	1.011	100	*	*
Juneau	0.596	0.597	0.926	100	*	*
Kansas City	0.596	0.596	0.973	100	1.996	3.363
Kotzebue	0.570	0.570	1.154	99.92997	1.699	3.578
Los Angeles	0.763	0.763	1.553	100	2.068	3.559
Memphis	0.609	0.609	1.048	100	*	*
Merida	0.696	0.696	1.225	100	*	*
Mexico City	0.781	0.782	1.553	100	*	*
Miami	0.656	0.656	1.103	100	2.456	3.594
Minneapolis	0.651	0.651	0.893	100	1.929	3.240
New York	0.799	0.799	0.993	100	*	*
Oakland	0.780	0.780	1.715	100	2.088	3.585
Puerto Vallarta	0.815	0.816	1.358	100	*	*
Salt Lake City	0.599	0.599	0.934	100	1.929	3.309
San Jose Del Cabo	0.722	0.723	1.549	100	*	*
San Juan	0.897	1.014	1.575	99.97676	*	*
Seattle	0.752	0.752	0.849	100	2.113	3.168
Tapachula	0.714	0.726	0.771	100	*	*
Washington DC	0.680	0.680	0.949	100	1.960	3.170
Winnipeg	0.631	0.631	0.910	100	*	*

*SPS Data not available.

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	1.037	1.897	100	2.236
Anchorage	1.070	3.756	100	3.835
Atlanta	1.074	4.274	100	4.673
Barrow	0.832	2.917	98.71	4.852
Bethel	1.131	2.363	100	2.508
Billings	1.375	3.200	100	3.398
Boston	1.068	3.490	100	3.695
Cleveland	1.047	3.251	100	3.405
Cold Bay	1.350	2.767	100	2.965
Fairbanks	0.980	3.102	100	3.233
Gander	1.097	2.463	100	2.661
Honolulu	2.910	8.220	100	8.384
Houston	1.476	3.011	100	3.175
Iqaluit	0.849	7.207	100	7.466
Juneau	0.968	3.296	100	3.470
Kansas City	1.127	2.109	100	2.332
Kotzebue	0.951	3.785	99.94	4.075
Los Angeles	1.443	3.918	100	8.368
Merida	2.100	6.140	100	6.345
Miami	1.514	3.992	100	4.161
Minneapolis	1.254	4.679	100	5.219
Oakland	1.385	3.036	100	4.096
Salt Lake City	1.021	1.922	100	3.676
San Jose Del Cabo	2.223	7.051	100	7.242
San Juan	1.865	8.048	100	8.331
Seattle	1.305	2.867	100	3.569
Tapachula	1.019	3.695	100	3.695
Washington DC	1.193	3.548	100	3.711

Table 2-4 Maximum Error Statistics

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Arcata	3.123	0.160	0.168	6.231	0.128	0.163
Grand Forks	4.839	0.208	0.257	6.413	0.175	0.268
Oklahoma City	1.917	0.142	0.176	3.703	0.198	0.243
Albuquerque	1.529	0.107	0.151	2.906	0.096	0.160
Anchorage	2.305	0.077	0.202	2.966	0.140	0.172
Atlanta	2.309	0.182	0.184	2.477	0.098	0.191
Barrow	4.466	0.186	0.186	6.975	0.157	0.157
Bethel	1.573	0.044	0.101	2.314	0.085	0.112
Billings	2.373	0.175	0.179	2.493	0.112	0.137
Boston	2.552	0.193	0.193	2.388	0.102	0.145
Chicago	2.198	0.149	0.179	2.876	0.122	0.207
Cleveland	2.185	0.218	0.242	3.340	0.176	0.236
Cold Bay	1.770	0.072	0.101	3.000	0.097	0.114
Dallas	2.129	0.122	0.140	3.304	0.240	0.241
Denver	2.106	0.132	0.155	3.690	0.147	0.167
Fairbanks	2.607	0.103	0.152	4.218	0.121	0.206
Gander	2.598	0.099	0.112	3.002	0.100	0.130
Goose Bay	2.409	0.119	0.205	3.104	0.120	0.148
Houston	1.530	0.131	0.159	3.586	0.137	0.219
Iqaluit	3.220	0.107	0.180	5.014	0.183	0.203
Jacksonville	1.943	0.102	0.125	2.231	0.114	0.150
Juneau	2.060	0.128	0.140	2.975	0.100	0.172
Kansas City	1.459	0.099	0.153	3.023	0.204	0.204
Kotzebue	3.301	0.158	0.158	4.173	0.085	0.137
Los Angeles	4.145	0.131	0.167	5.016	0.143	0.183
Memphis	1.875	0.233	0.233	4.070	0.300	0.300
Merida	2.842	0.214	0.214	2.947	0.140	0.142
Mexico City	2.952	0.122	0.161	5.023	0.130	0.147
Miami	1.609	0.158	0.158	2.813	0.152	0.154
Minneapolis	2.864	0.313	0.313	2.598	0.162	0.171
New York	1.774	0.145	0.157	3.044	0.118	0.149
Oakland	2.620	0.191	0.223	3.694	0.155	0.189
Puerto Vallarta	3.843	0.130	0.155	4.050	0.119	0.157
Salt Lake City	2.760	0.089	0.197	2.928	0.155	0.197
San Jose Del Cabo	3.486	0.161	0.161	4.858	0.139	0.185
San Juan	3.121	0.078	0.114	5.683	0.168	0.168
Seattle	2.732	0.254	0.255	4.918	0.131	0.208
Tapachula	1.066	0.034	0.044	1.302	0.036	0.038
Washington DC	1.684	0.110	0.140	2.260	0.132	0.174
Winnipeg	2.075	0.102	0.153	3.617	0.169	0.191

Figure 2-1 95% Horizontal Accuracy at LPV

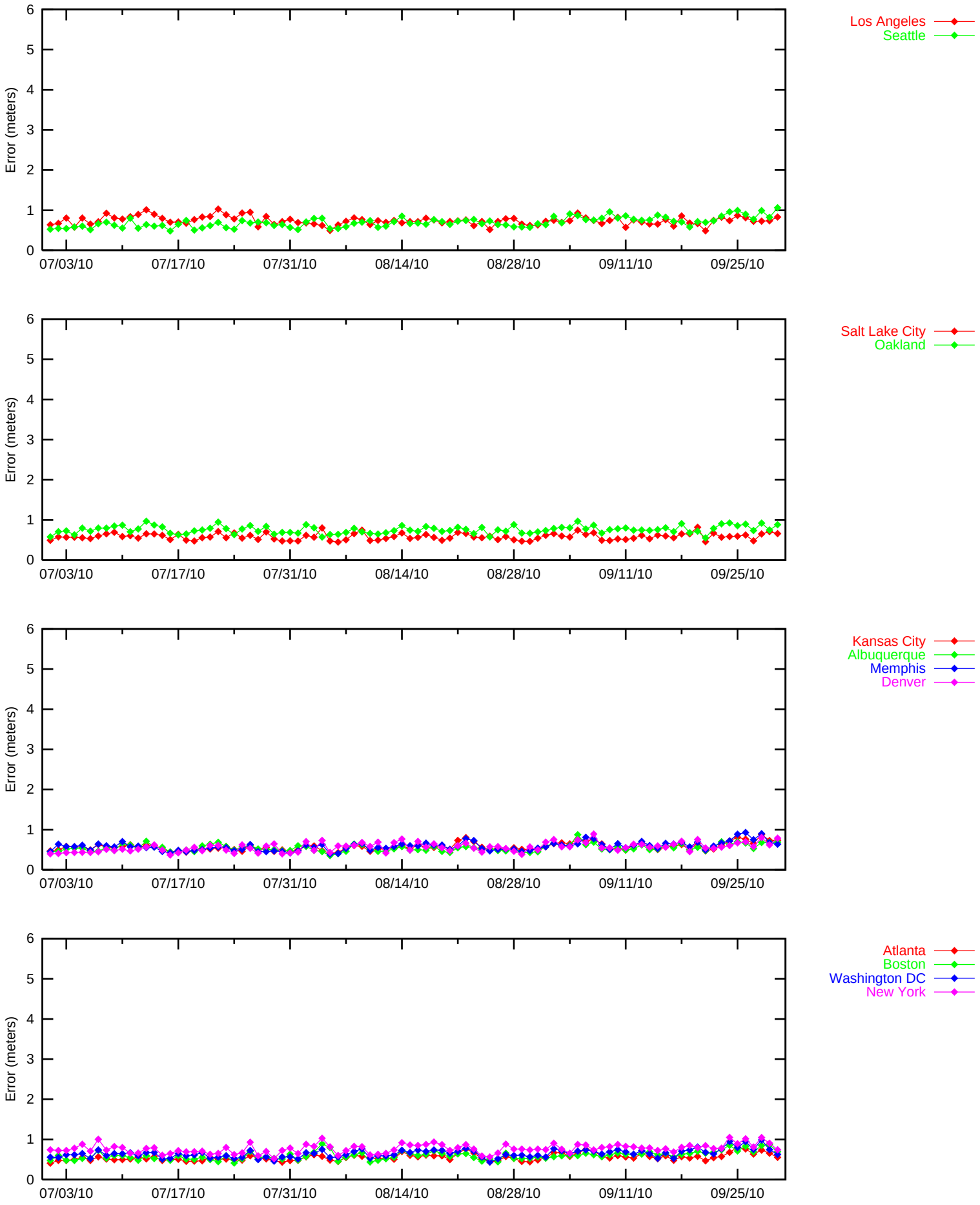


Figure 2-2 95% Horizontal Accuracy at LPV

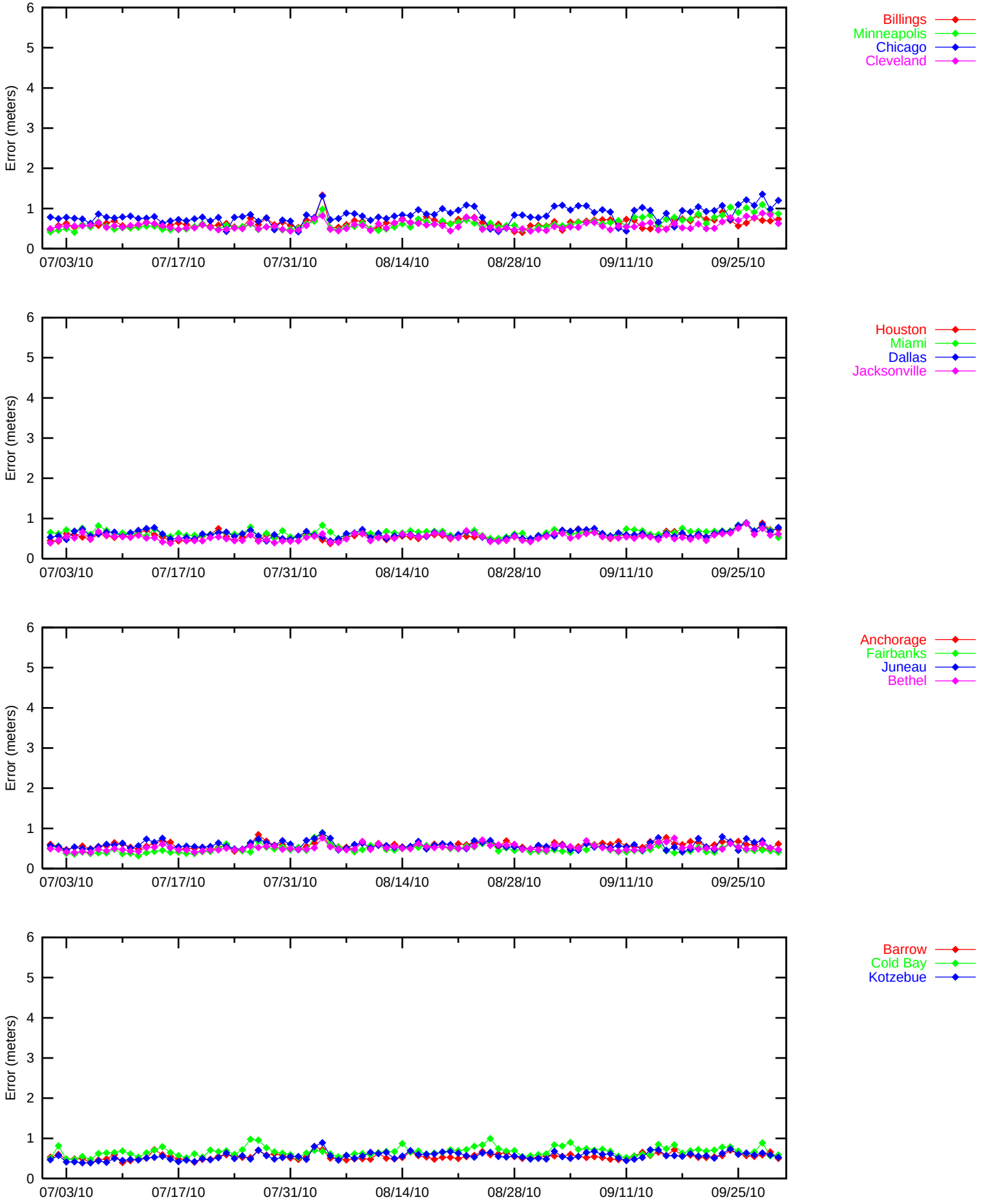


Figure 2-3 95% Horizontal Accuracy at LPV

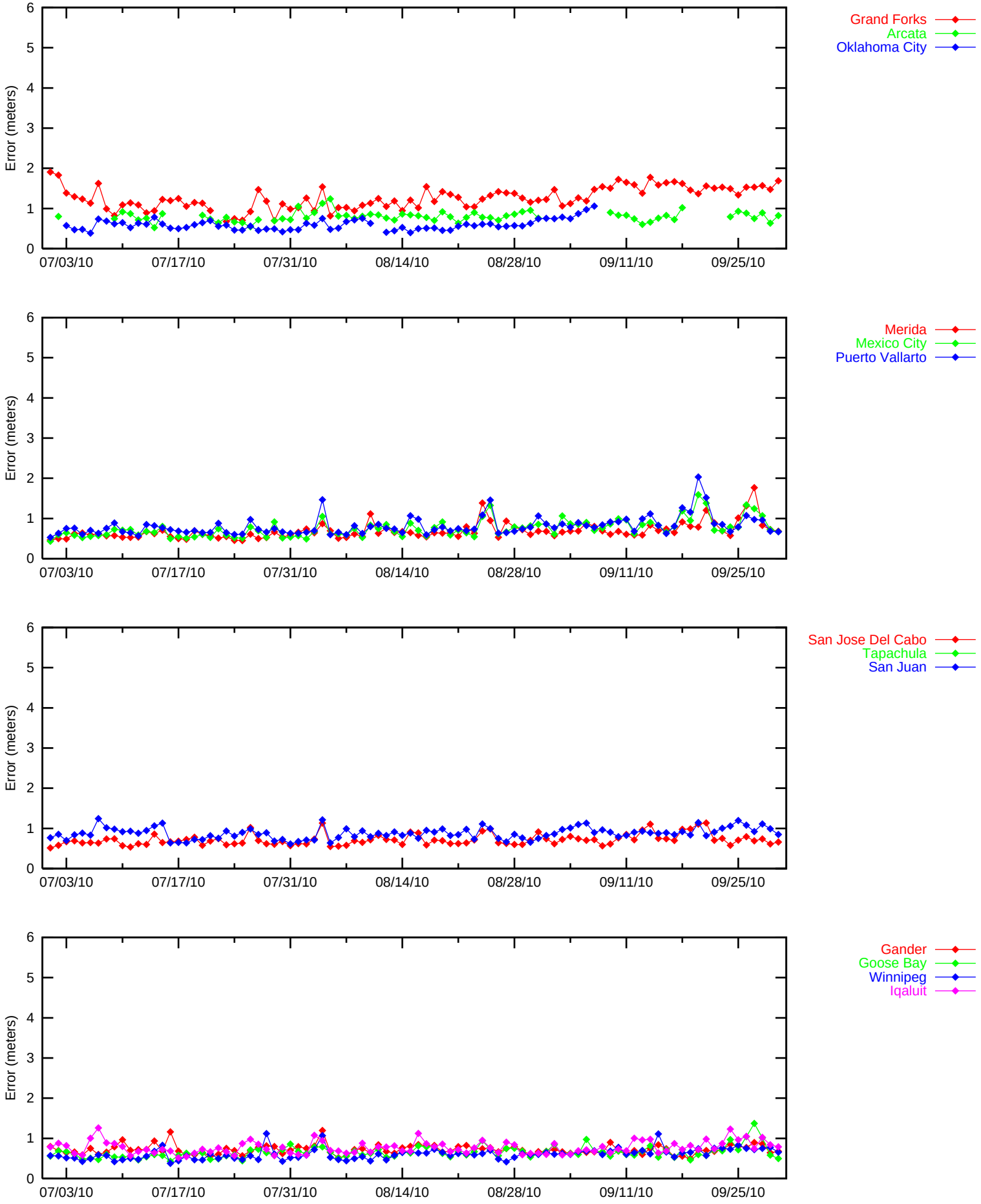


Figure 2-4 95% Vertical Accuracy at LPV

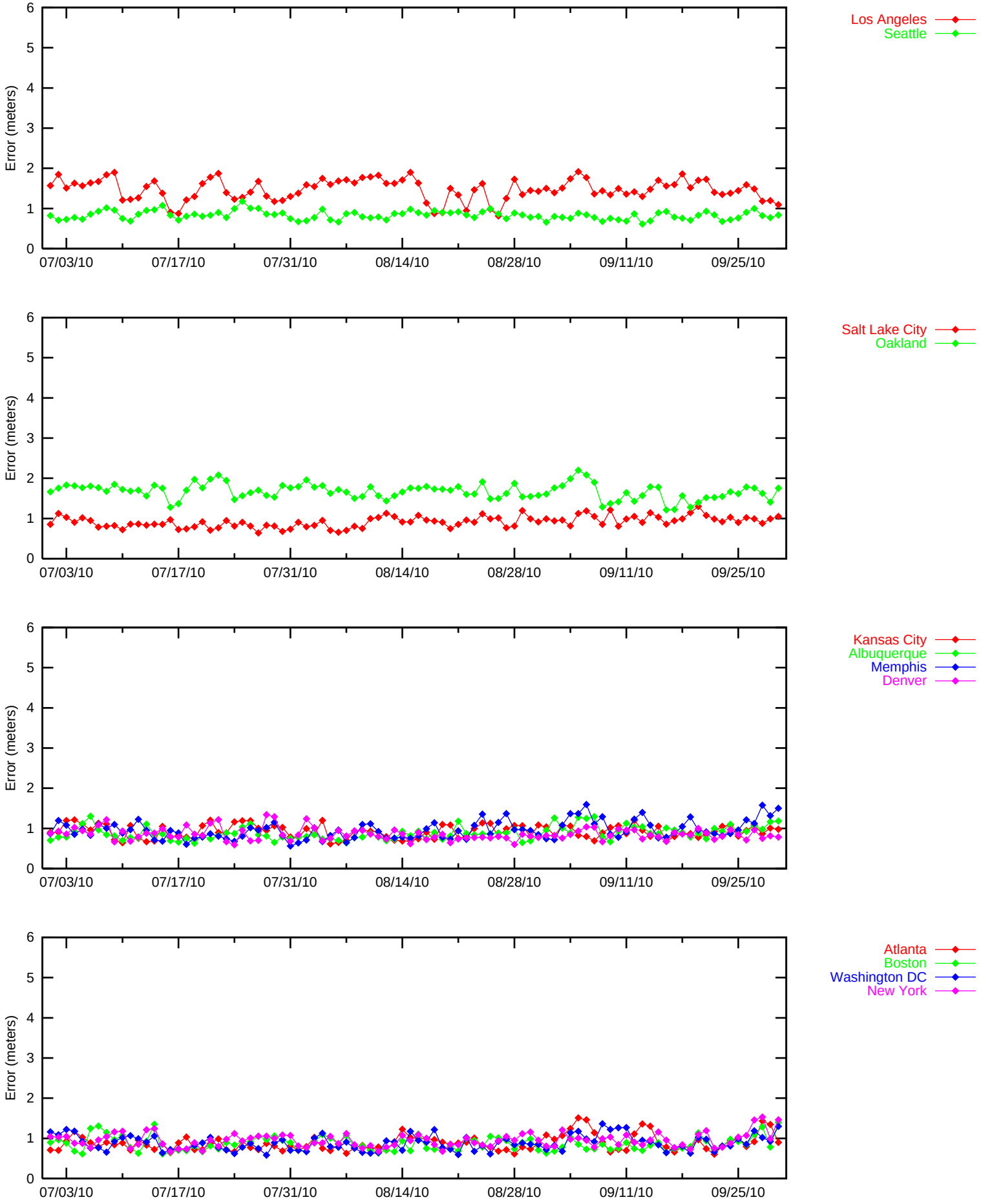


Figure 2-5 95% Vertical Accuracy at LPV

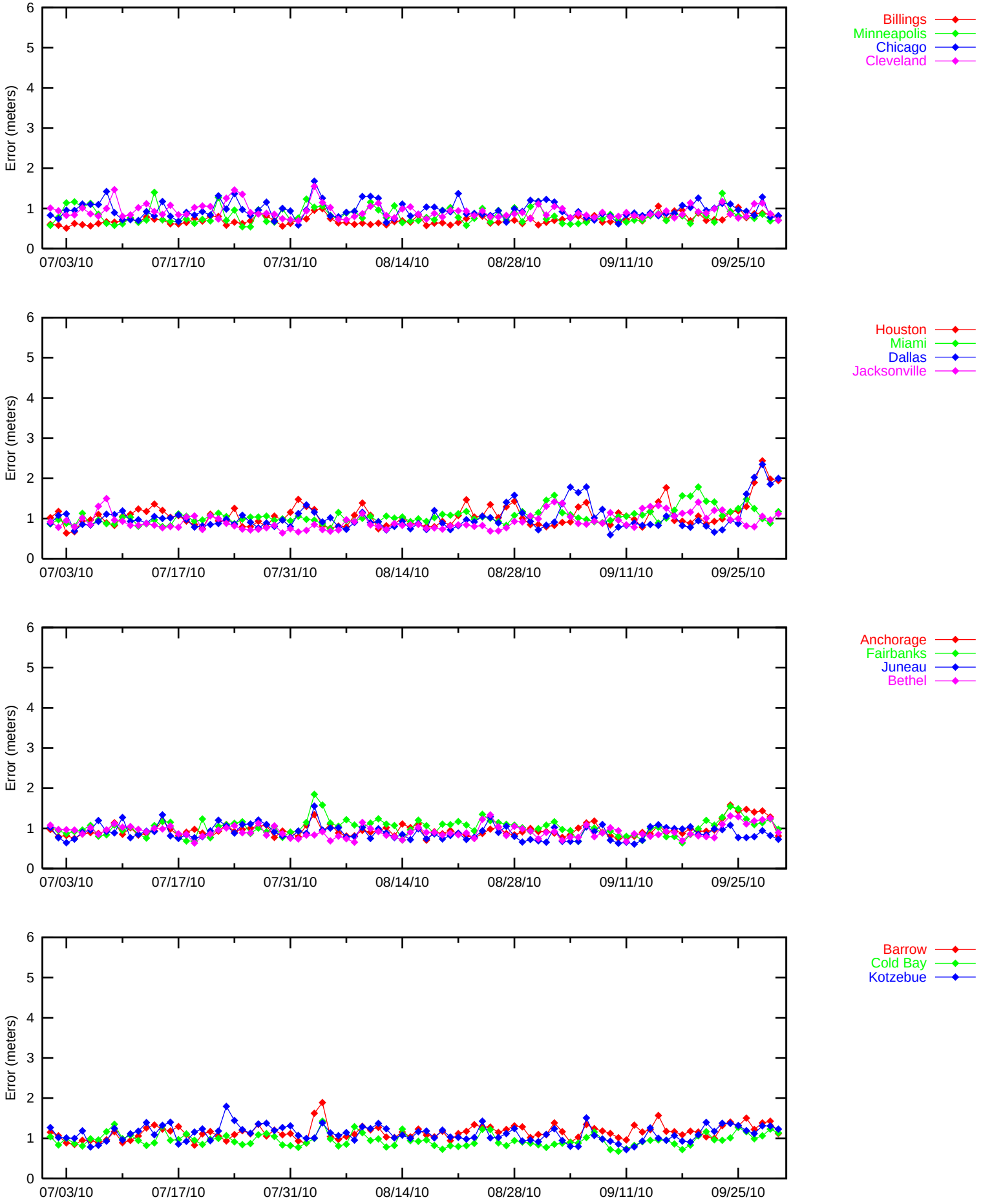


Figure 2-6 95% Vertical Accuracy at LPV

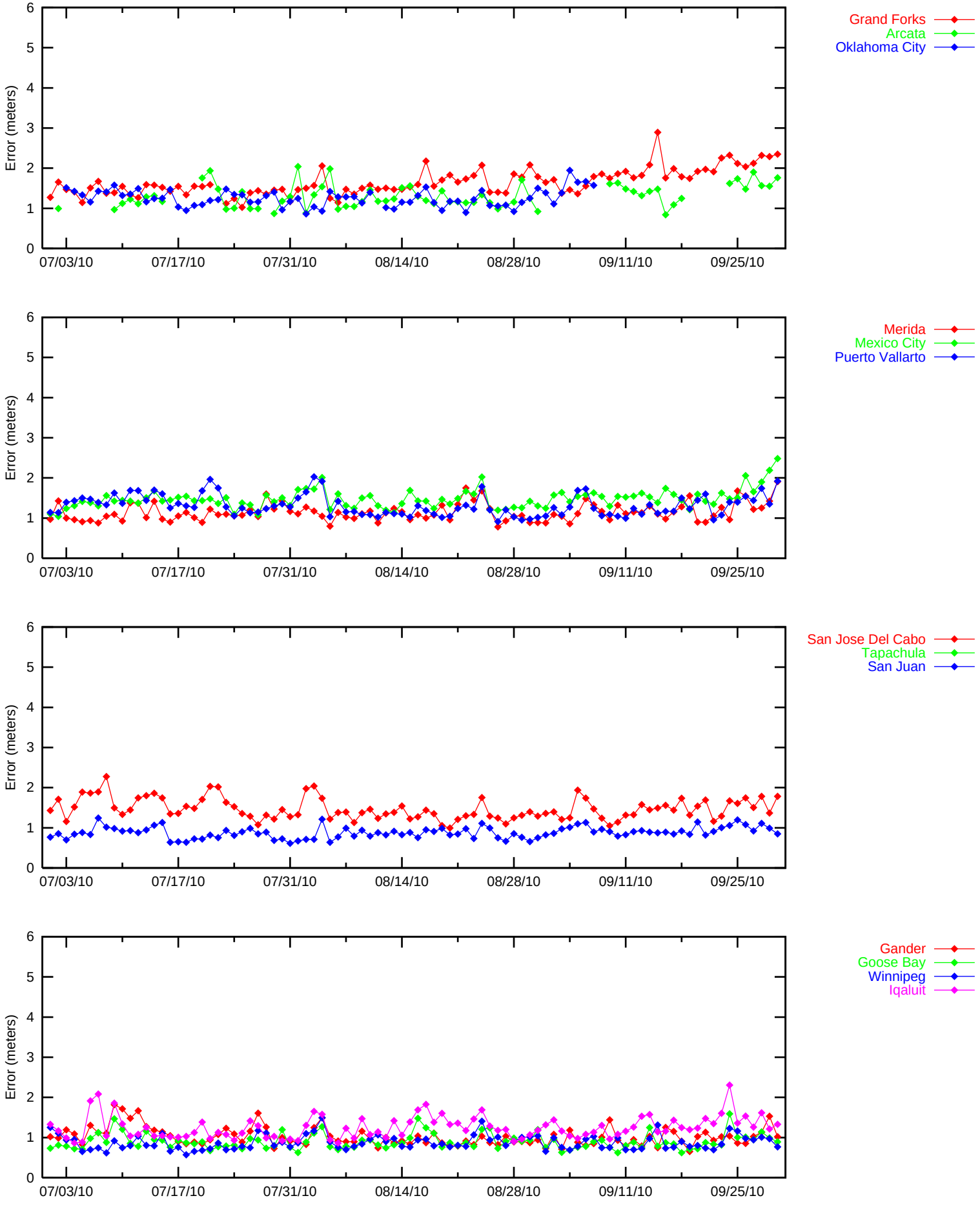


Figure 2-7 95% NPA Horizontal Accuracy

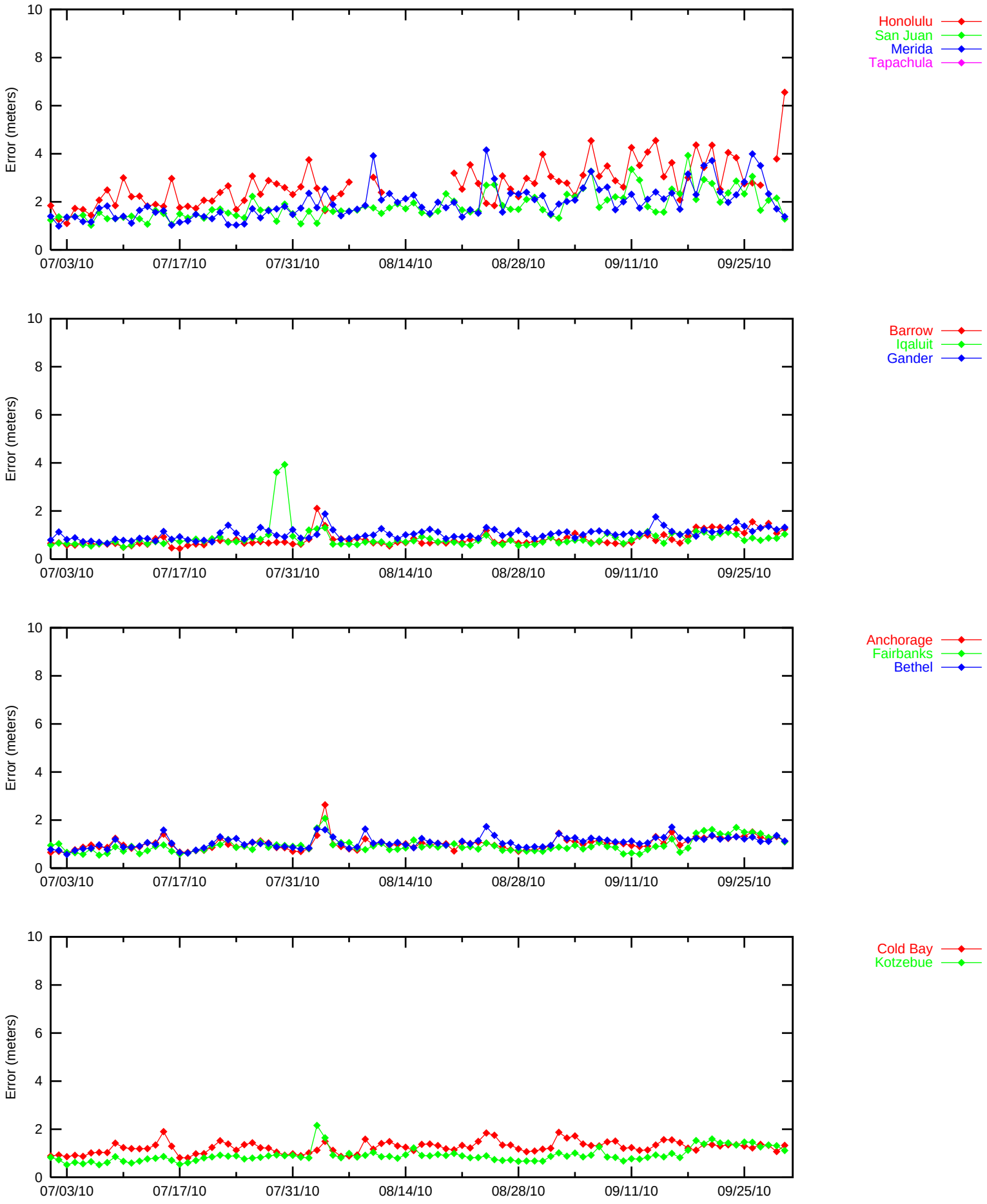


Figure 2-8 95% NPA Horizontal Accuracy

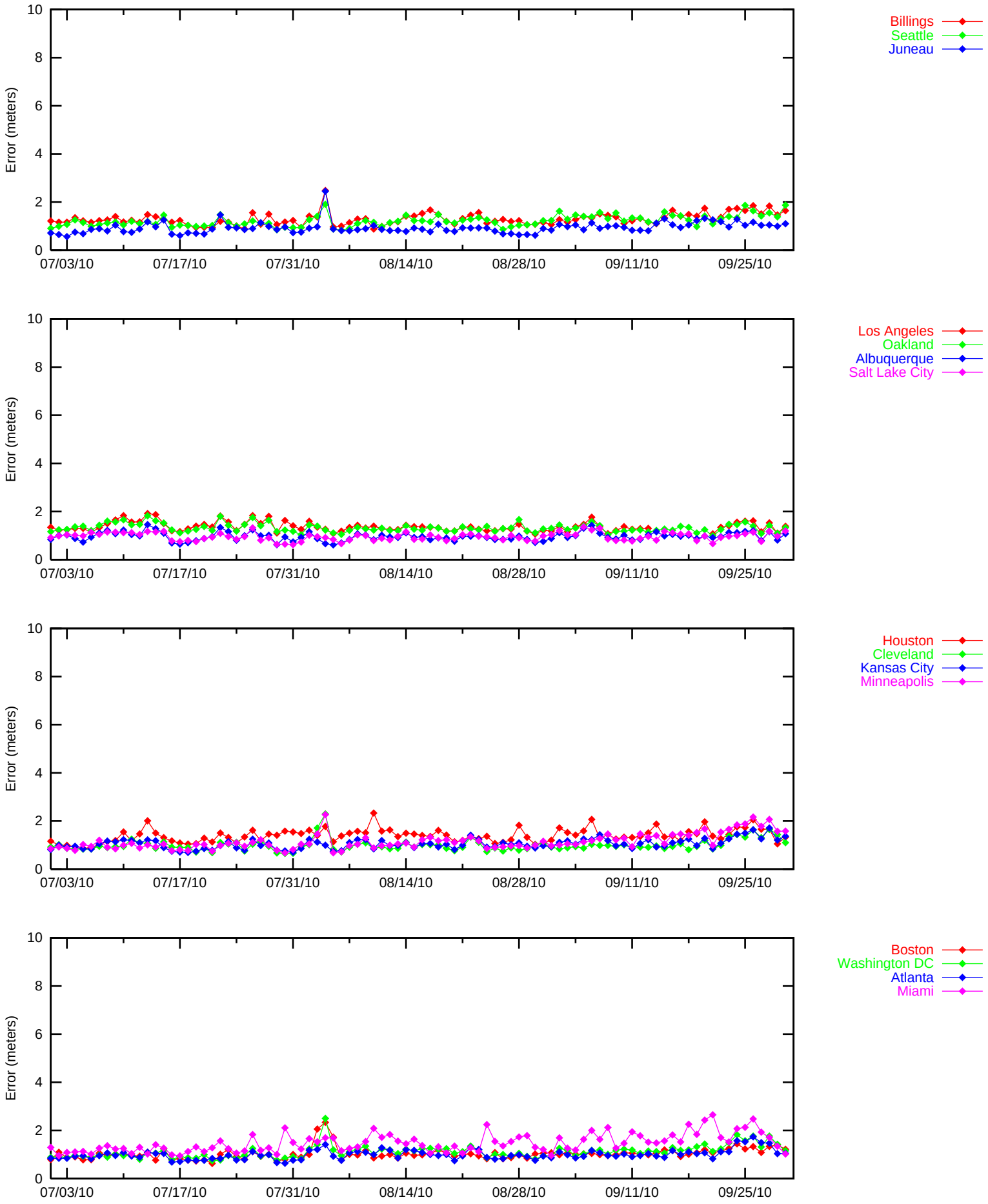


Figure 2-9 Horizontal Triangle Chart for the Quarter

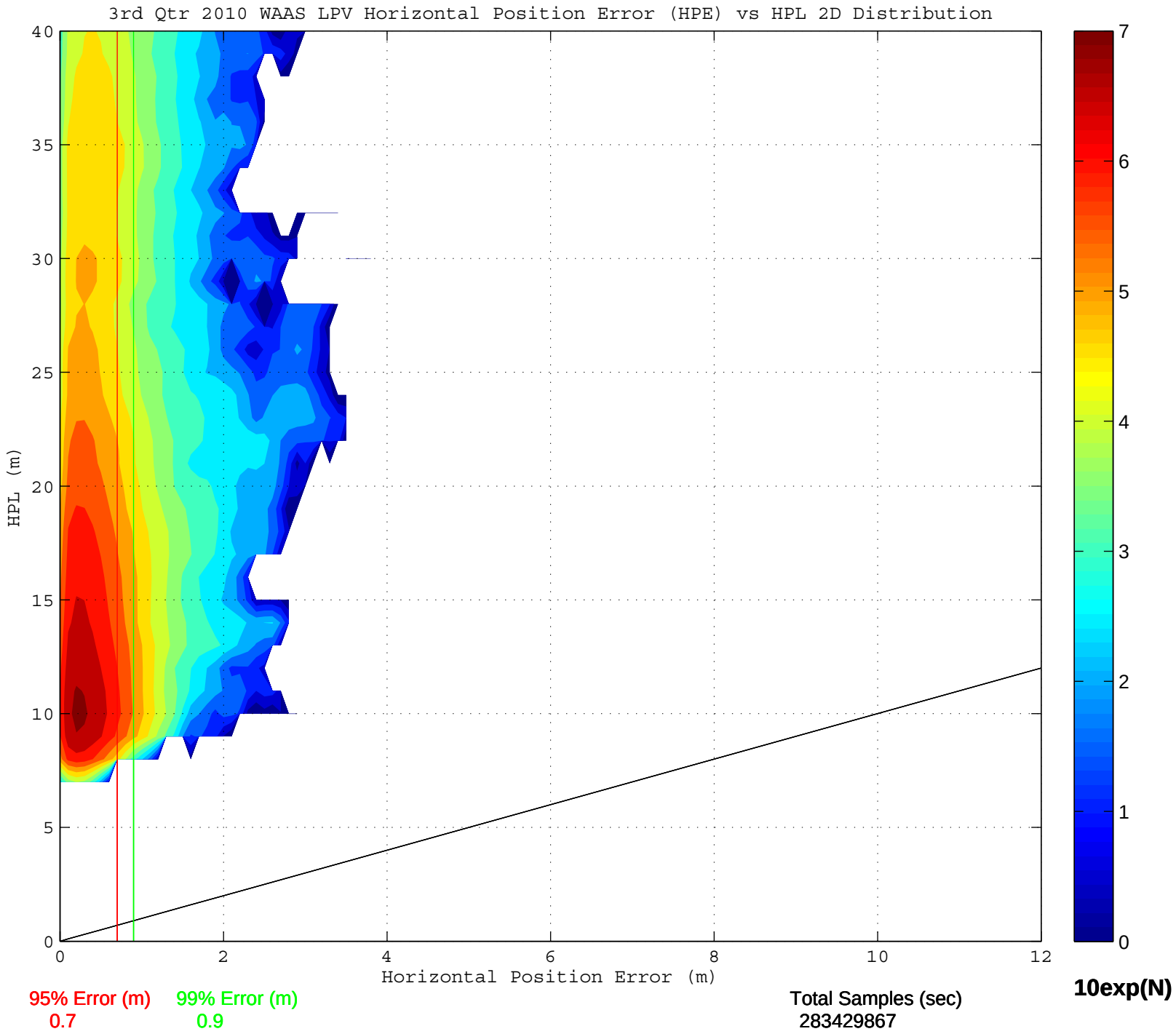


Figure 2-10 Vertical Triangle Chart for the Quarter

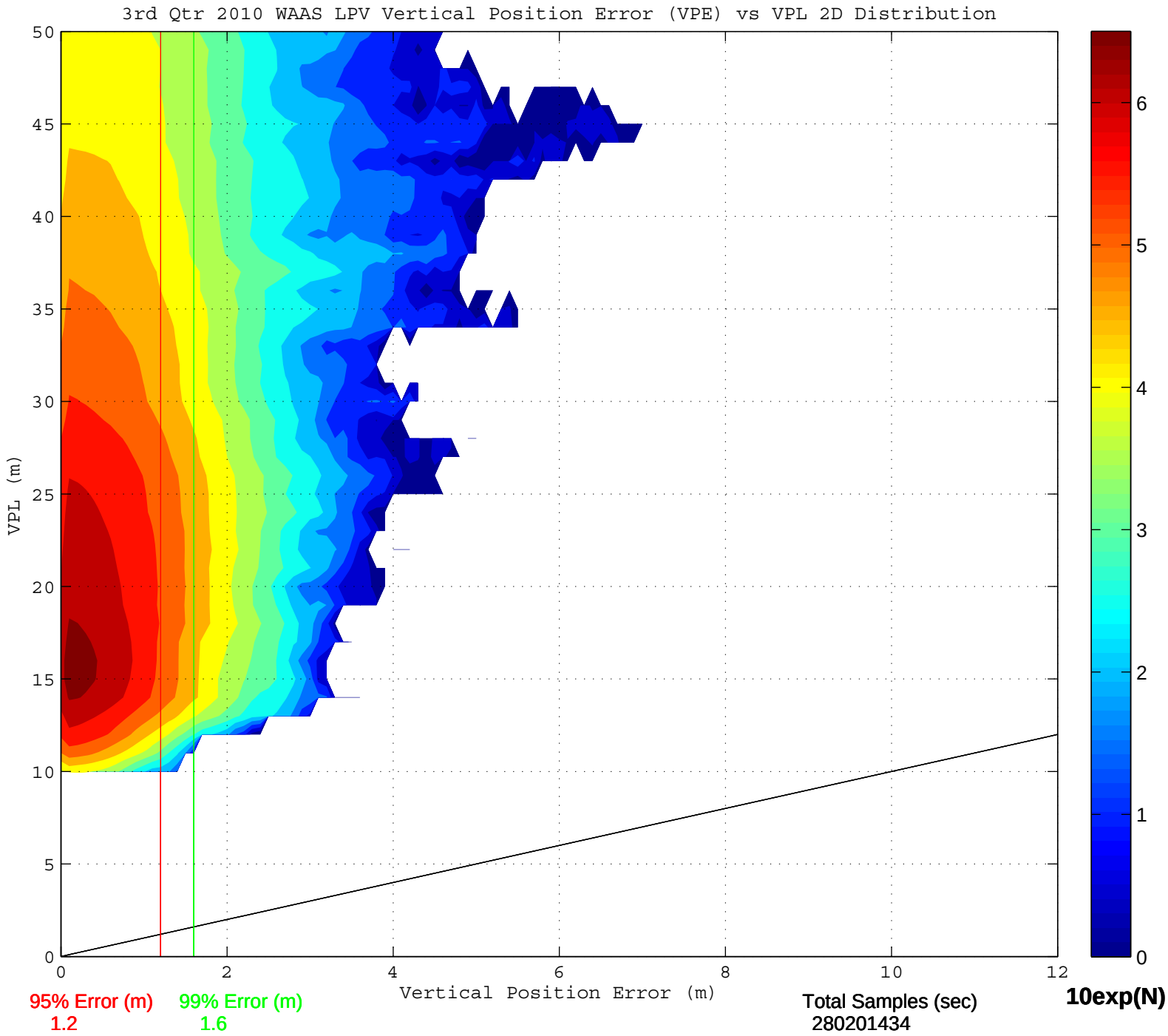


Figure 2-11 2-D Horizontal Histogram for the Quarter

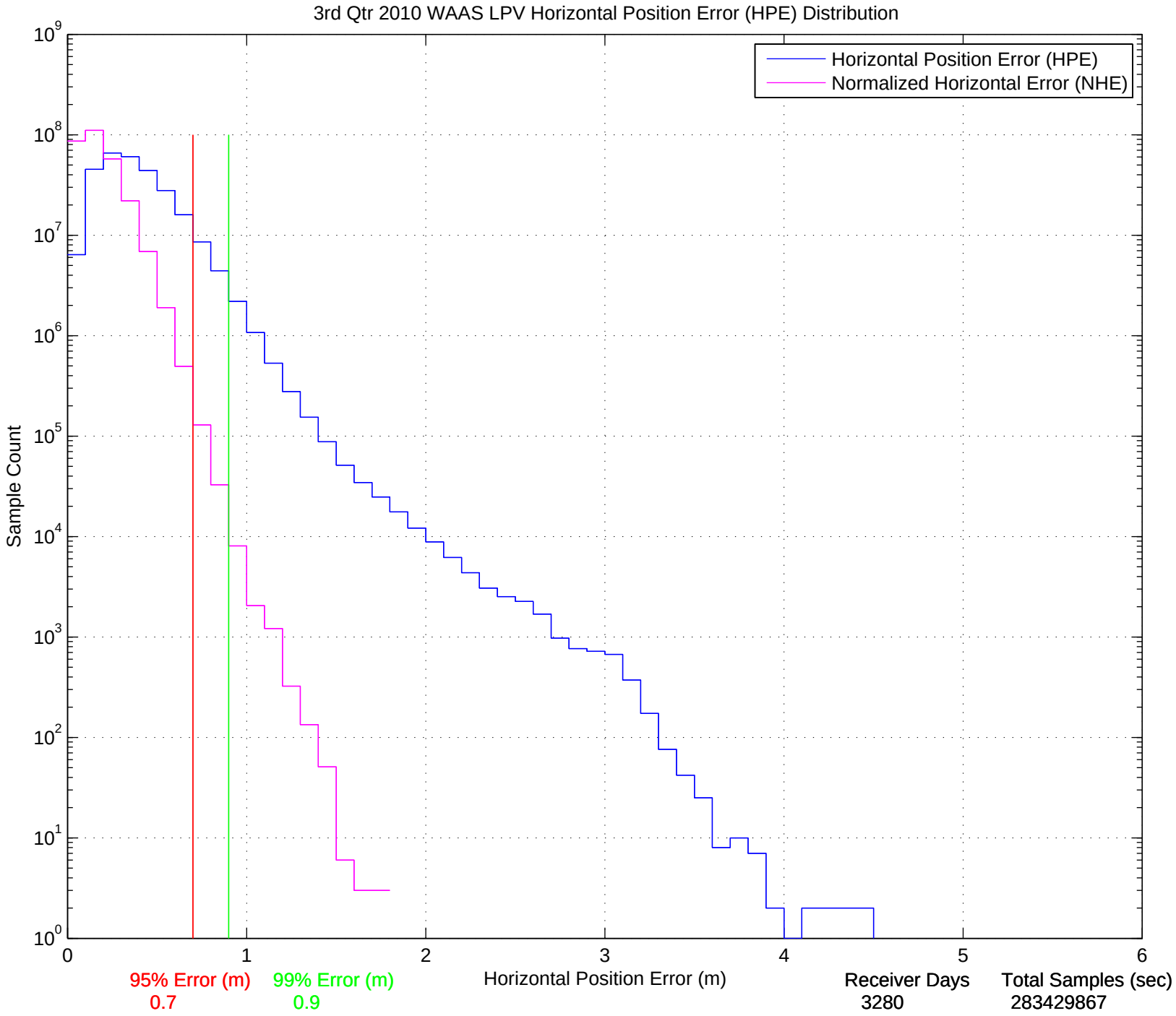
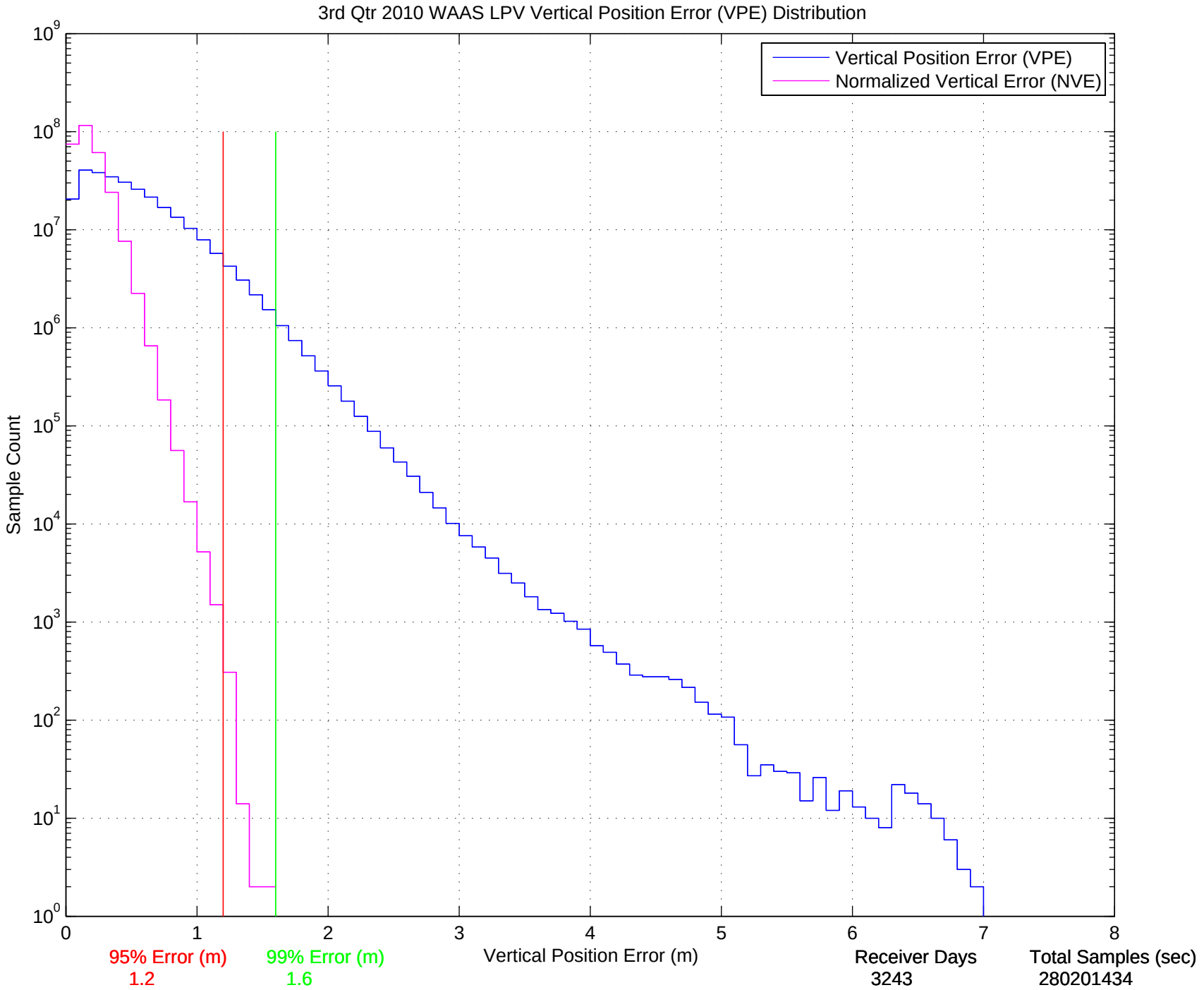


Figure 2-12 2-D Vertical Histogram for the Quarter



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 at the evaluated CONUS and Alaska sites this evaluation period. The international sites are excluded from this table, but can be found in Table 3.1.

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	Alaska Site/Maximum	Alaska Site/Minimum
95% HPL	Arcata 17.067 meters	Memphis 11.044 meters	Cold Bay 28.59 meters	Fairbanks 14.26 meters
95% VPL	Arcata 30.261 meters	Kansas City 18.753 meters	Barrow 42.657 meters	Juneau 22.90 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 = 556m) 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 evaluation period, reduced PA and NPA availability are mainly due to satellite outages and GUS switchovers. Other events that affected availability this quarter include geomagnetic storm, SIS outage and elevated UDRE. Please refer to Table 1.4 and 1.6 for events that affected availability. NPA outages at Iqaluit and Gander are due to CRE GUS switchovers; NPA outages at Barrow and Kotzebue are due to CRW GUS switchovers. Reduced Alaska availability for the quarter and a significant drop in availability at Barrow beginning on 9/26/10 is due to GEO CRW orbit drift as expected. Higher than normal outages at Los Angeles from 7/26/10 to 7/30/10 is due to Military GPS Jamming test. Ionospheric storm on 8/4/10 with a Kp index of 6 caused a significant drop in availability. A combination of ionospheric storm and elevated UDREi on PRN 27 and 30 reduced availability on 8/25/10. Elevated UDREi on GEO CRW and CRE on 7/7/10, 7/15/10 and 7/23/10 reduced mostly Alaska availability. A Planned SIS outage on GEO CRW on 7/1/10 reduced Alaska availability slightly.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	17.067	30.261	100
Grand Forks	13.046	21.139	100
Oklahoma City	12.800	21.674	100
Albuquerque	12.666	22.587	100
Anchorage	14.950	24.126	100
Atlanta	11.194	19.993	100
Barrow	18.917	42.657	98.692890
Bethel	18.292	29.026	100
Billings	12.581	20.708	100
Boston	13.193	20.750	100
Chicago	11.093	18.790	100
Cleveland	11.619	19.425	100
Cold Bay	28.599	38.144	100
Dallas	11.826	19.695	100
Denver	11.652	21.446	100
Fairbanks	14.260	25.454	100
Gander	22.312	32.885	99.984300
Goose Bay	17.032	26.837	99.993030
Houston	12.068	19.715	100
Iqaluit	30.587	40.434	99.869830
Jacksonville	12.013	21.064	100
Juneau	14.929	22.904	100
Kansas City	11.530	18.753	100
Kotzebue	18.095	37.145	99.929970
Los Angeles	15.895	26.353	100
Memphis	11.044	18.769	100
Merida	17.717	31.701	100
Mexico City	22.128	34.688	100
Miami	14.564	26.139	100
Minneapolis	11.790	19.309	100
New York	12.850	20.478	100
Oakland	16.323	28.723	100
Puerto Vallarta	23.081	38.225	100
Salt Lake City	12.105	20.929	100
San Jose Del Cabo	22.307	35.449	100
San Juan	58.016	92.626	99.976760
Seattle	14.732	23.586	100
Tapachula	37.633	65.829	100
Washington DC	11.720	19.839	100
Winnipeg	13.245	21.543	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	0.99965059	0.98420624
Grand Forks	0.99989968	0.99959541
Oklahoma City	1	0.99978315
Albuquerque	1	0.99242892
Anchorage	0.99973965	0.99952963
Atlanta	1	0.99993922
Barrow	0.97628796	0.79695440
Bethel	0.99973689	0.98699905
Billings	1	0.99986974
Boston	1	1
Chicago	1	1
Cleveland	1	1
Cold Bay	0.99599254	0.87829519
Dallas	1	0.99993381
Denver	1	0.99861068
Fairbanks	0.99962037	0.99898320
Gander	0.99893282	0.96963354
Goose Bay	0.99979337	0.99815123
Houston	1	1
Iqaluit	0.97864142	0.81302628
Jacksonville	1	1
Juneau	0.99953695	0.99908799
Kansas City	1	1
Kotzebue	0.99824192	0.90187308
Los Angeles	0.99958760	0.99666992
Memphis	1	0.99988801
Merida	0.99981060	0.97758977
Mexico City	0.99898481	0.94212172
Miami	0.99998477	0.99697891
Minneapolis	1	0.99978360
New York	1	1
Oakland	1	0.98026164
Puerto Vallarta	0.99773279	0.91435831
Salt Lake City	1	0.99998905
San Jose Del Cabo	0.99766604	0.93123868
San Juan	0.20083247	0.02042938
Seattle	0.99987467	0.99951504
Tapachula	0.77504506	0.45913283
Washington DC	1	0.99997823
Winnipeg	0.99999119	0.99983642

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	1
Anchorage	1
Atlanta	1
Barrow	0.98706794
Bethel	1
Billings	1
Boston	1
Cleveland	1
Cold Bay	1
Fairbanks	1
Gander	0.99995393
Honolulu	1
Houston	1
Iqaluit	0.99996802
Juneau	1
Kansas City	1
Kotzebue	0.99942785
Los Angeles	0.99968625
Merida	1
Miami	1
Minneapolis	1
Oakland	1
Salt Lake City	1
San Jose Del Cabo	1
San Juan	1
Seattle	1
Tapachula	1
Washington DC	1

Table 3-4 LPV and LPV 200 Outage Rate

Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	10	0.000247	111	0.002784
Grand Forks	2	0.000038	7	0.000134
Oklahoma City	0	0.0	2	0.000052
Albuquerque	0	0.0	99	0.001883
Anchorage	1	0.000019	2	0.000038
Atlanta	0	0.0	1	0.000019
Barrow	240	0.004643	961	0.022777
Bethel	1	0.000019	164	0.003138
Billings	0	0.0	1	0.000019
Boston	0	0.0	0	0.0
Chicago	0	0.0	0	0.0
Cleveland	0	0.0	0	0.0
Cold Bay	73	0.001384	625	0.013433
Dallas	0	0.0	1	0.000019
Denver	0	0.0	39	0.000738
Fairbanks	2	0.000038	17	0.000321
Gander	10	0.000189	248	0.004828
Goose Bay	5	0.000094	22	0.000416
Houston	0	0.0	0	0.0
Iqaluit	142	0.002742	1228	0.028540
Jacksonville	0	0.0	0	0.0
Juneau	1	0.000019	3	0.000057
Kansas City	0	0.0	0	0.0
Kotzebue	37	0.000700	720	0.015082
Los Angeles	5	0.000094	63	0.001193
Memphis	0	0.0	1	0.000019
Merida	7	0.000132	307	0.005928
Mexico City	12	0.000227	427	0.008556
Miami	1	0.000019	58	0.001098
Minneapolis	0	0.0	4	0.000076
New York	0	0.0	0	0.0
Oakland	0	0.0	176	0.003389
Puerto Vallarta	33	0.000625	503	0.010389
Salt Lake City	0	0.0	2	0.000038
San Jose Del Cabo	38	0.000719	487	0.009878
San Juan	979	0.096172	178	0.171895
Seattle	1	0.000019	3	0.000057
Tapachula	2	0.041034	2	0.069268
Washington DC	0	0.0	1	0.000019
Winnipeg	2	0.000038	4	0.000076

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Atlanta	0	0
Barrow	9	0.00017217
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	5	0.00009441
Honolulu	0	0
Houston	0	0
Iqaluit	3	0.00005667
Juneau	0	0
Kansas City	0	0
Kotzebue	4	0.00007563
Los Angeles	5	0.00010208
Merida	0	0
Miami	0	0
Minneapolis	0	0
Oakland	0	0
Salt Lake City	0	0
San Jose Del Cabo	0	0
San Juan	0	0
Seattle	0	0
Tapachula	0	0
Washington DC	0	0

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

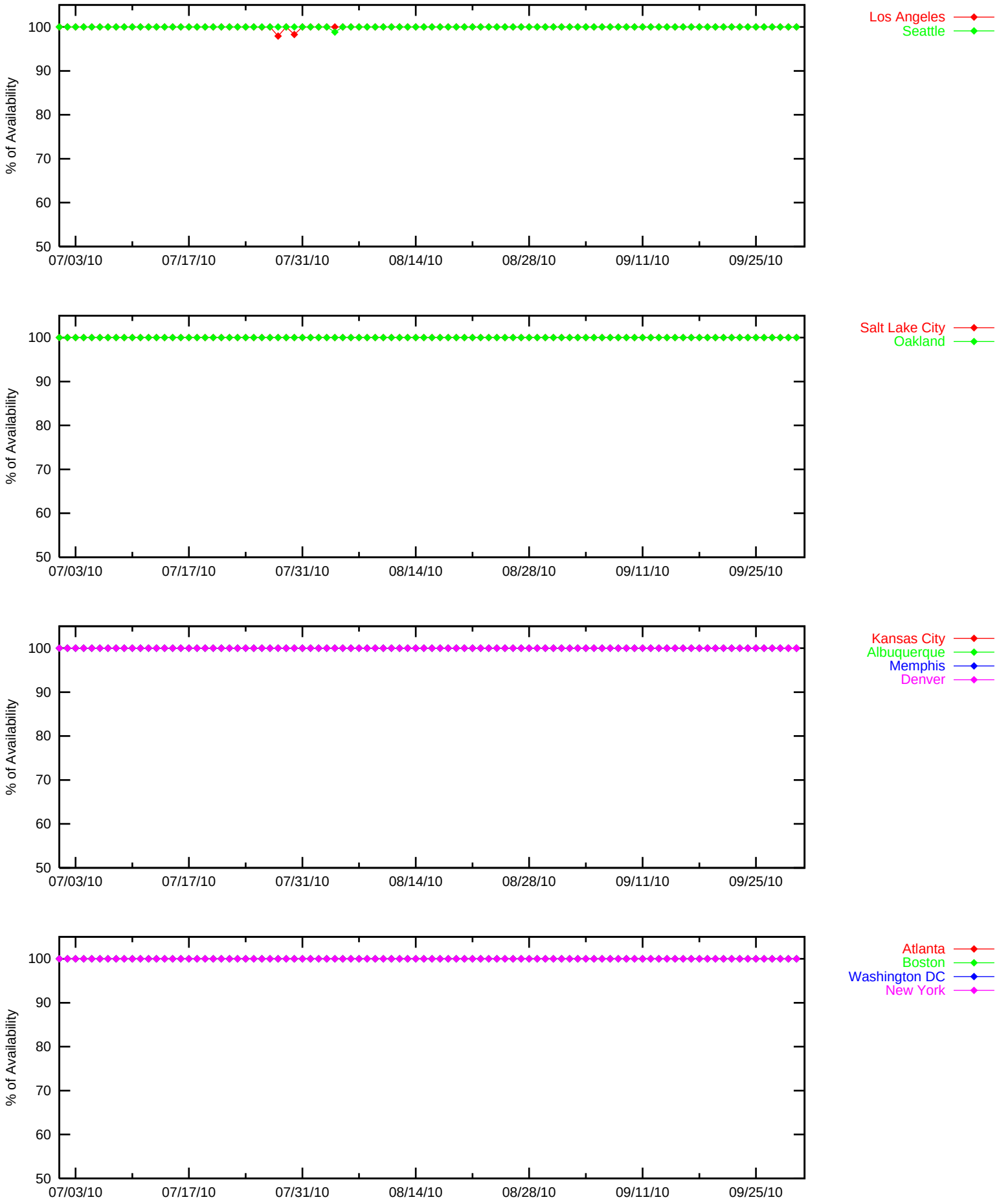


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

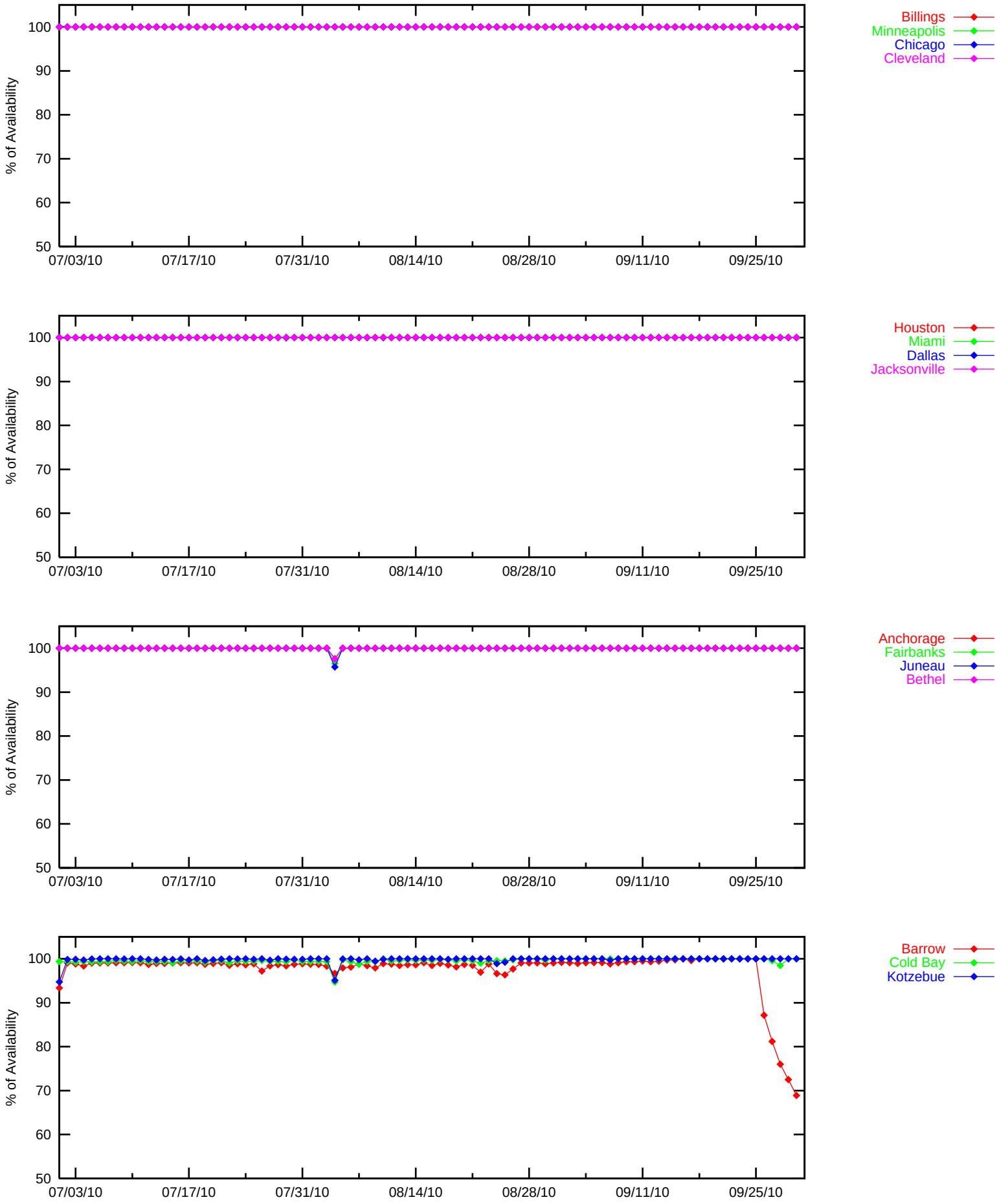


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

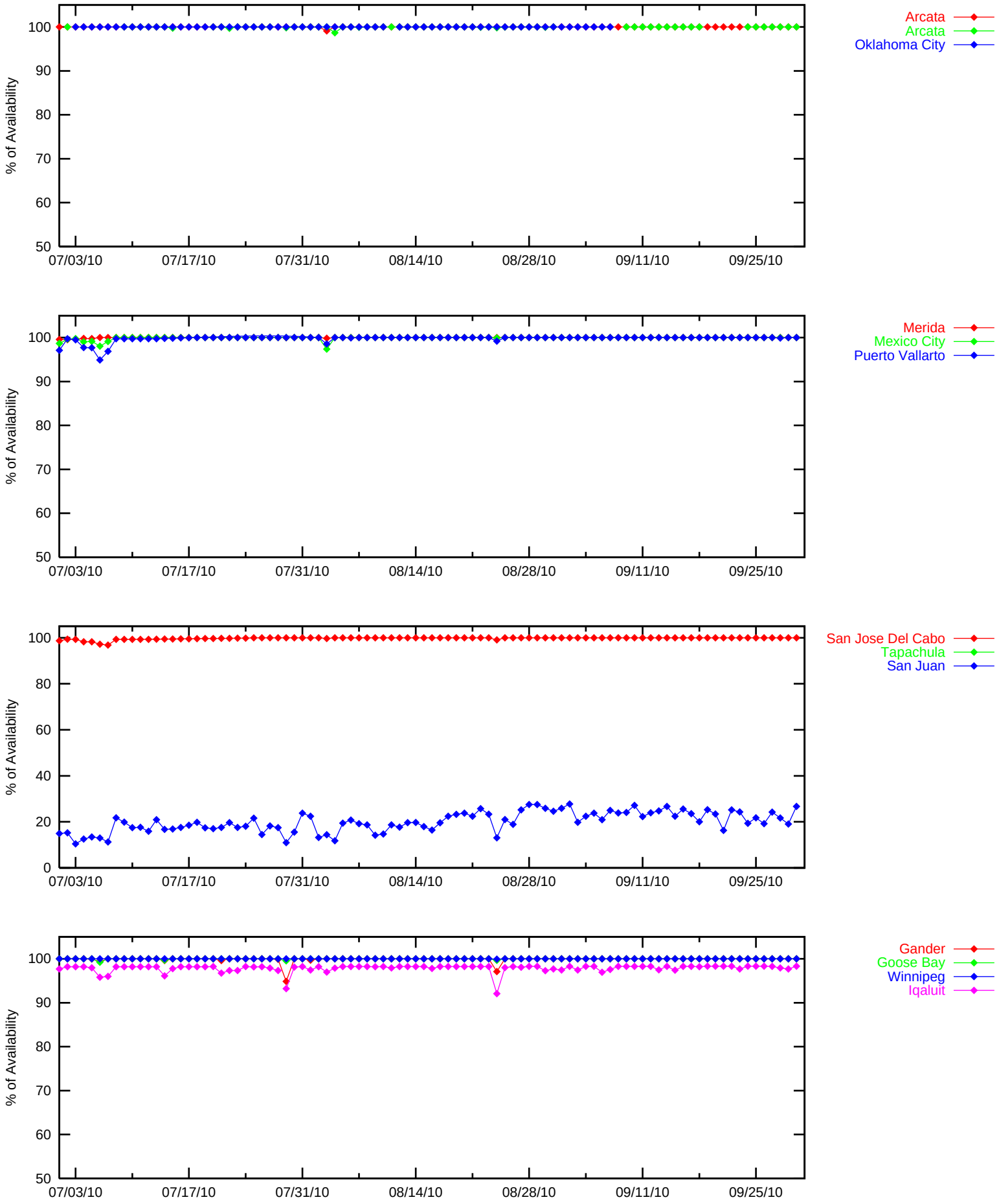


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

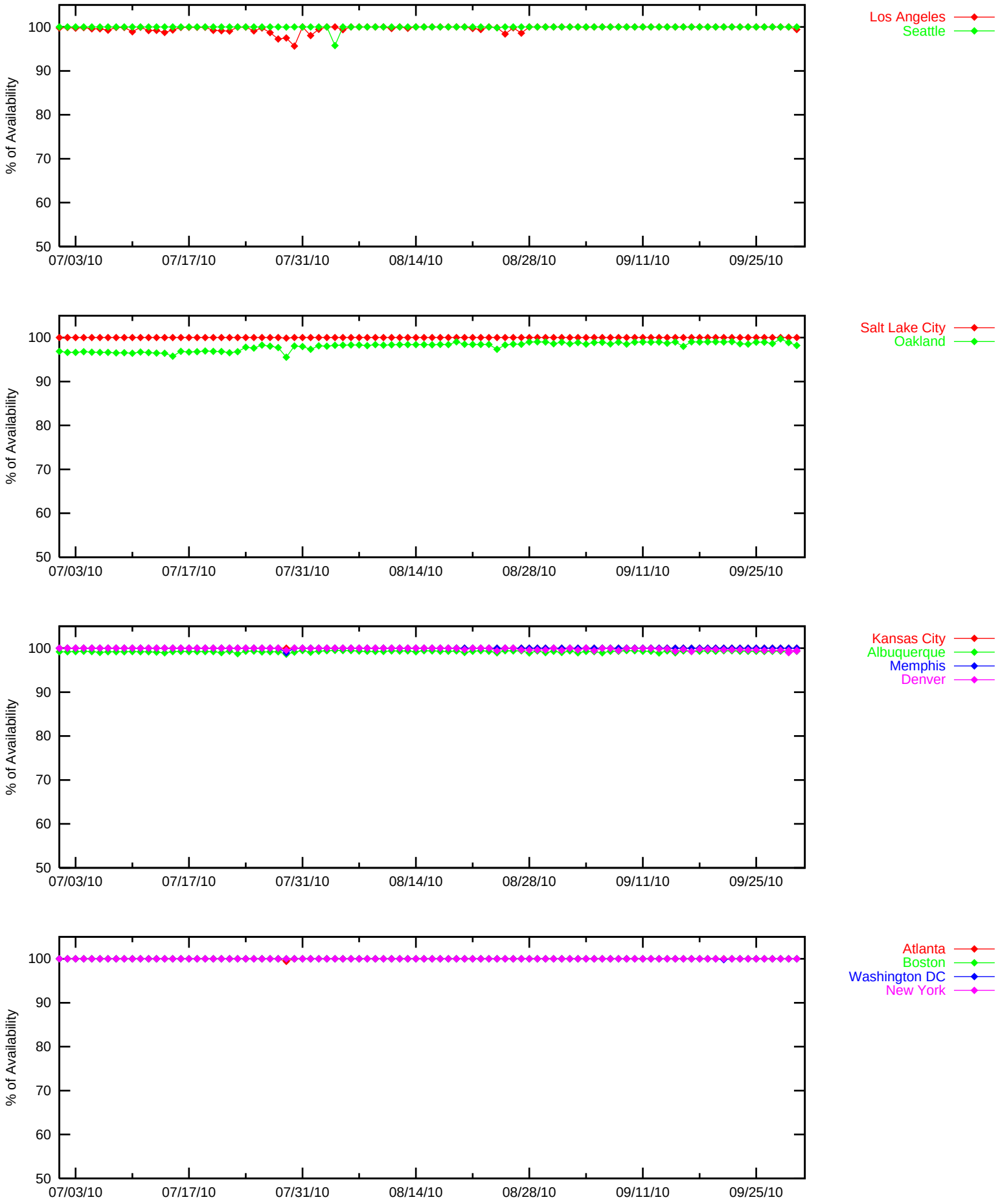


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

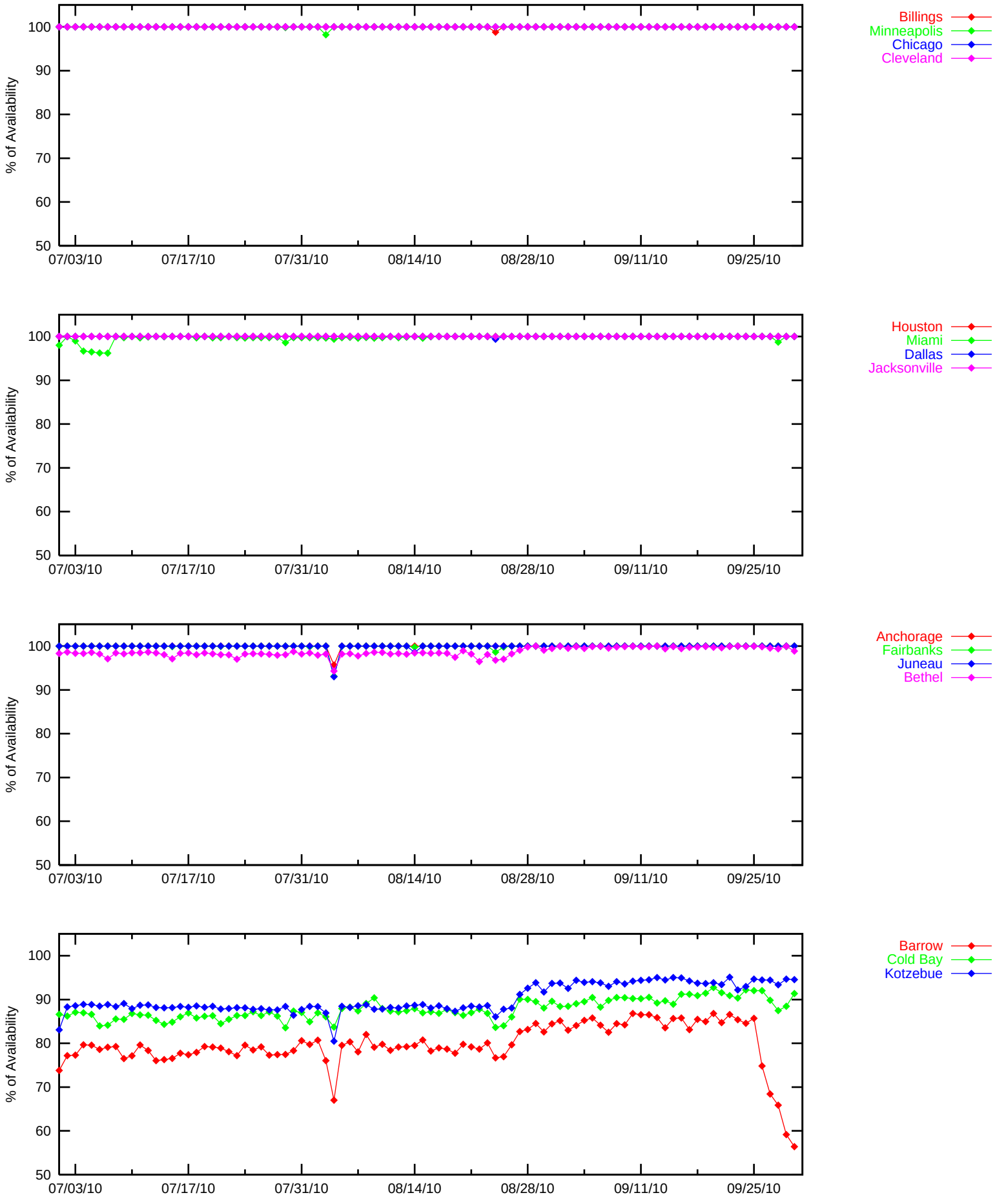


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

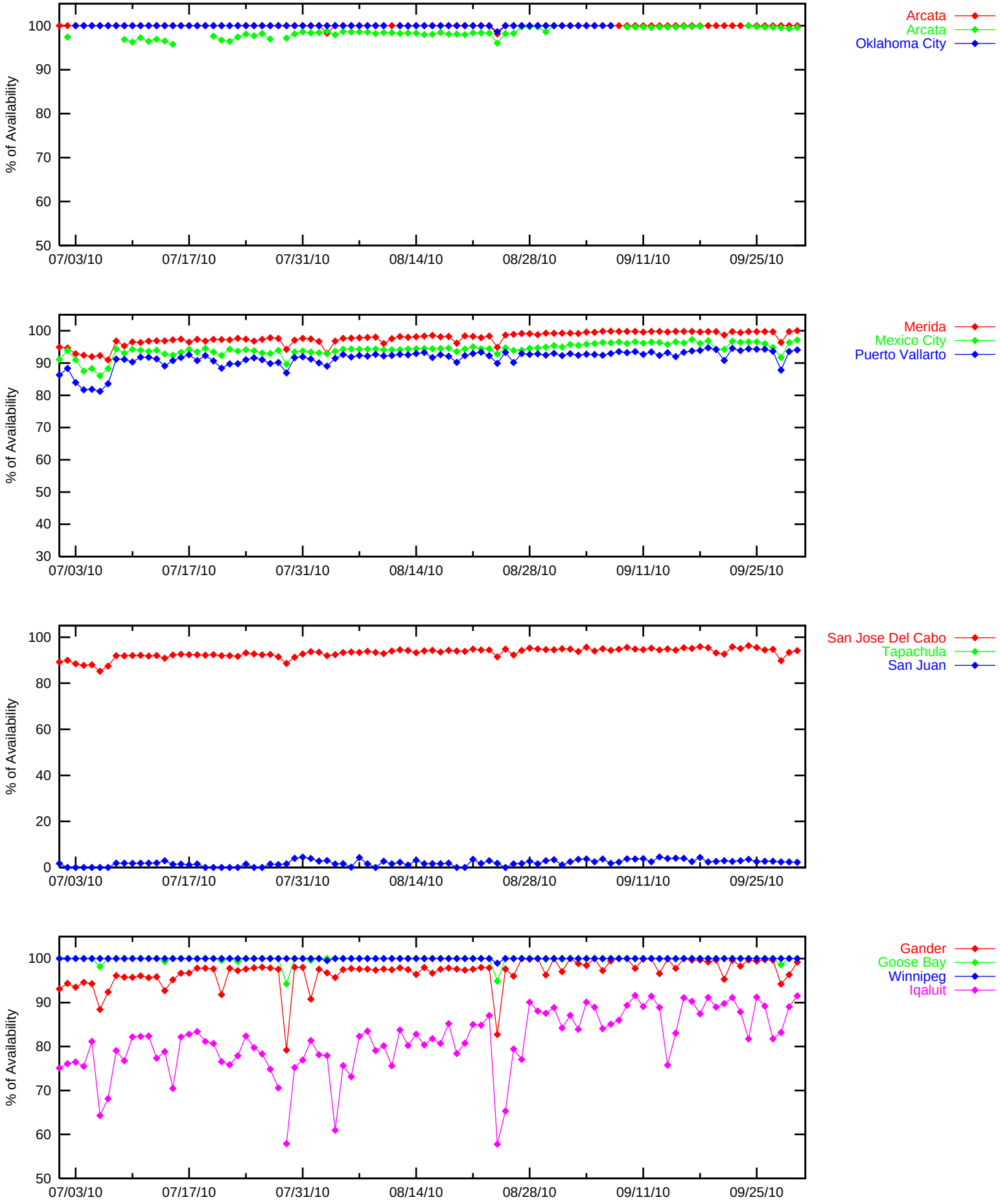


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

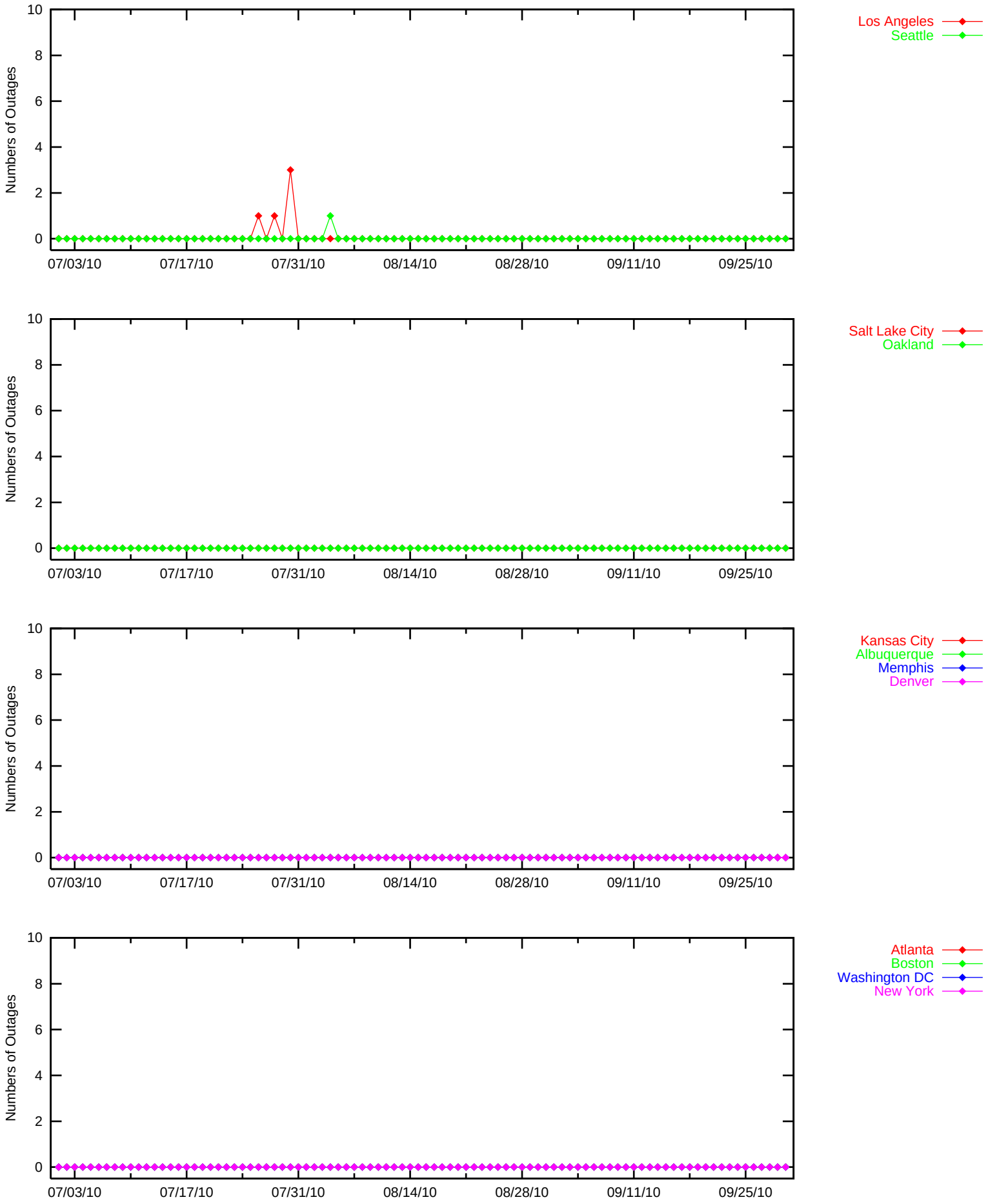


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)

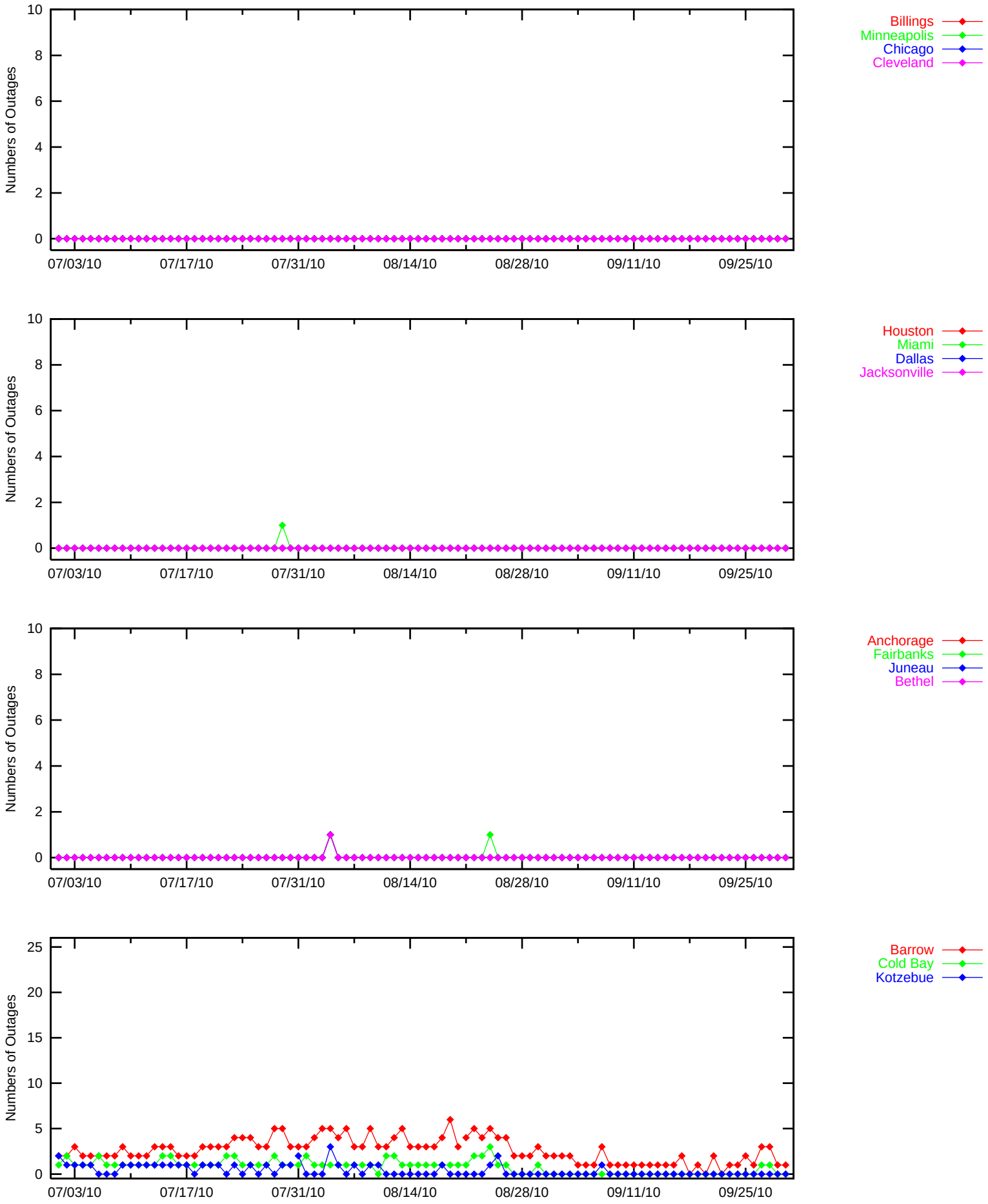


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

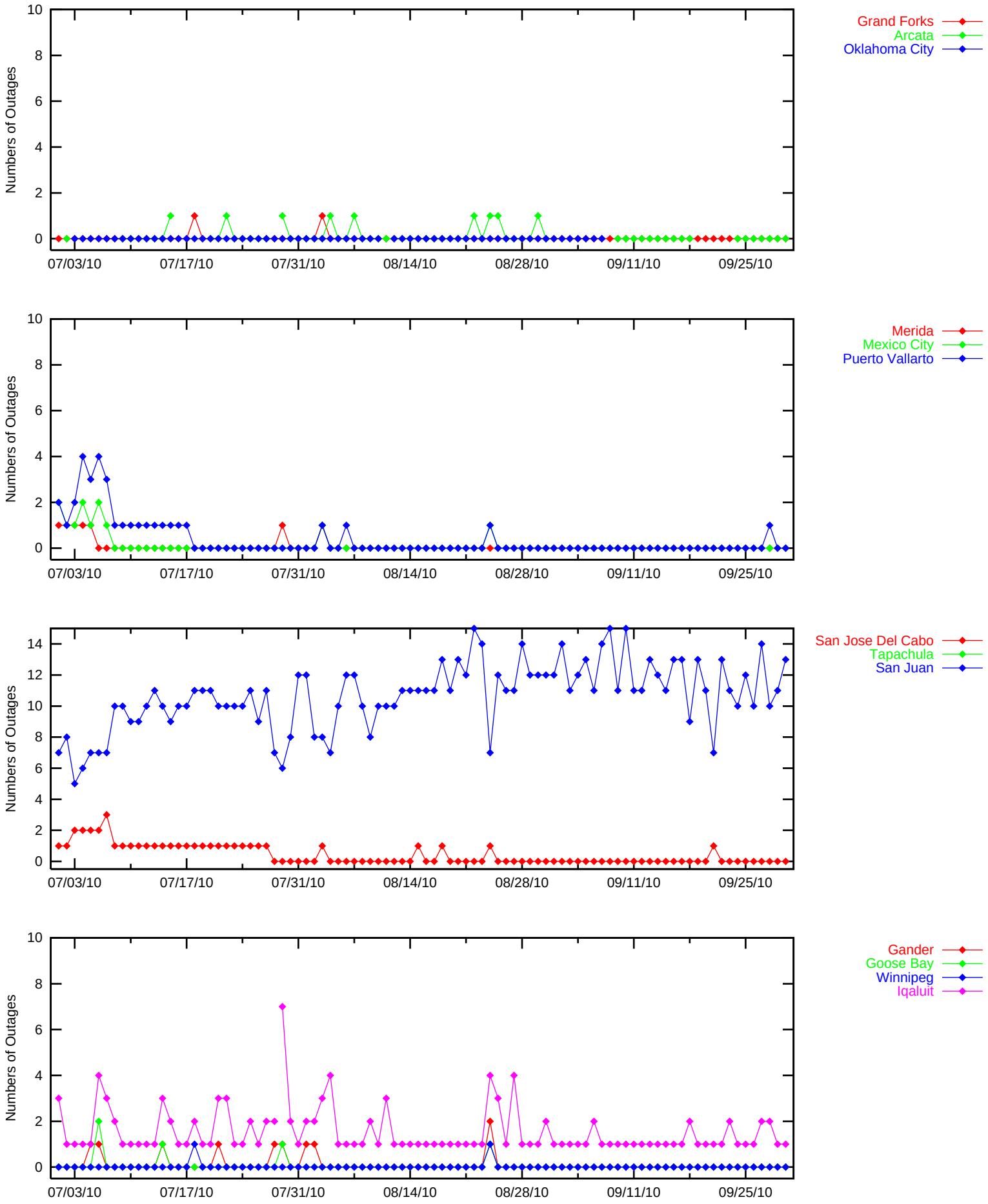


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

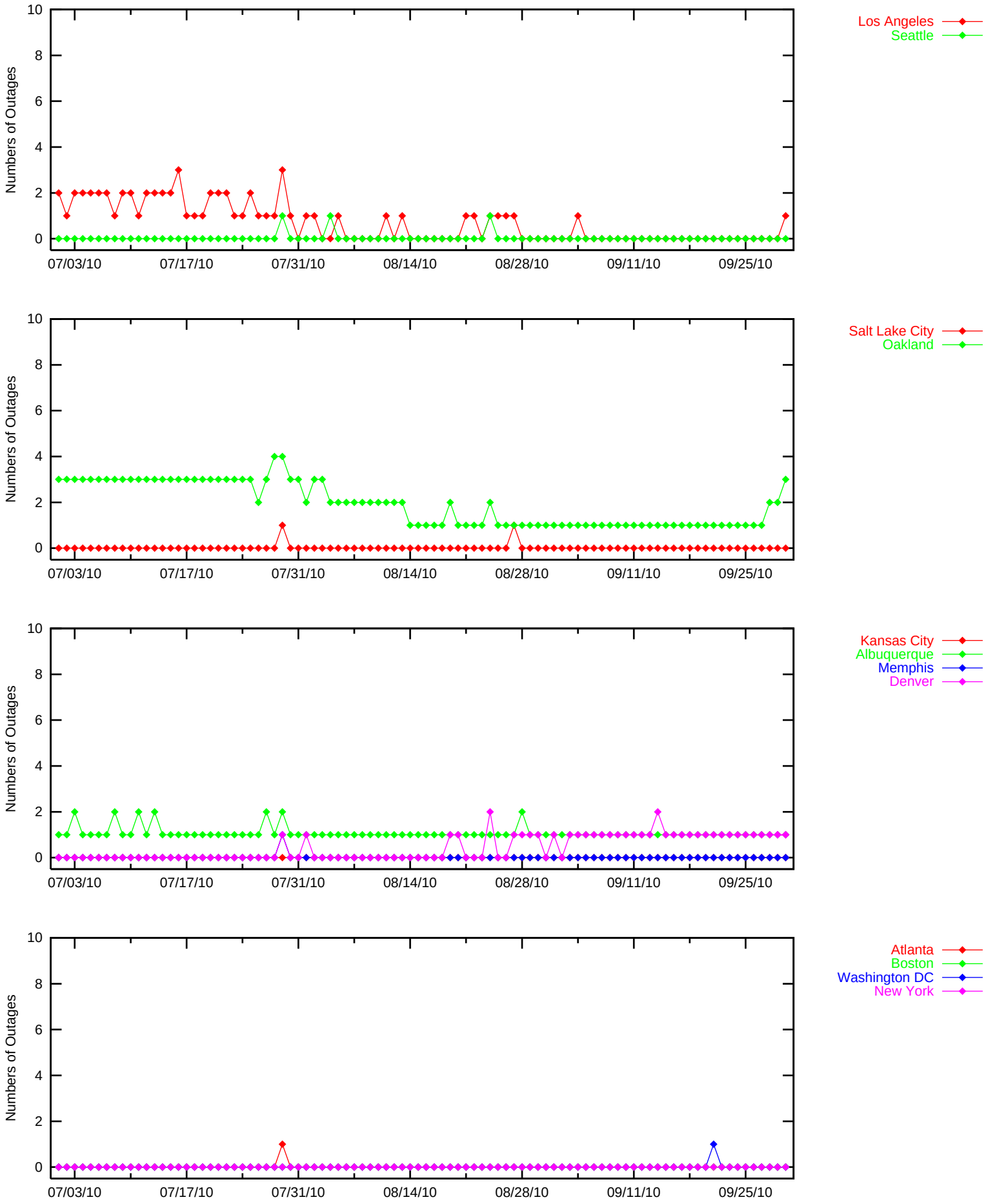


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)

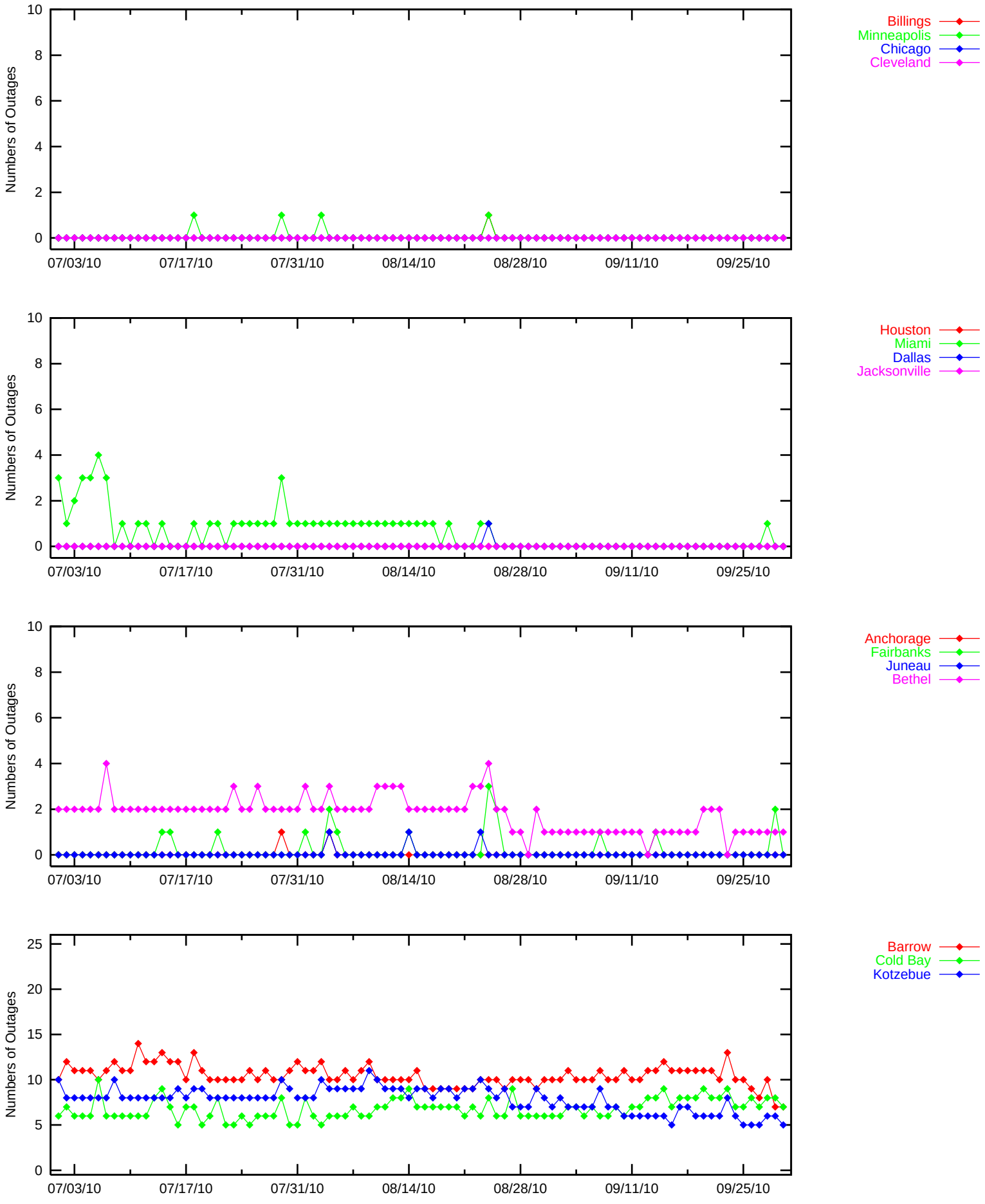
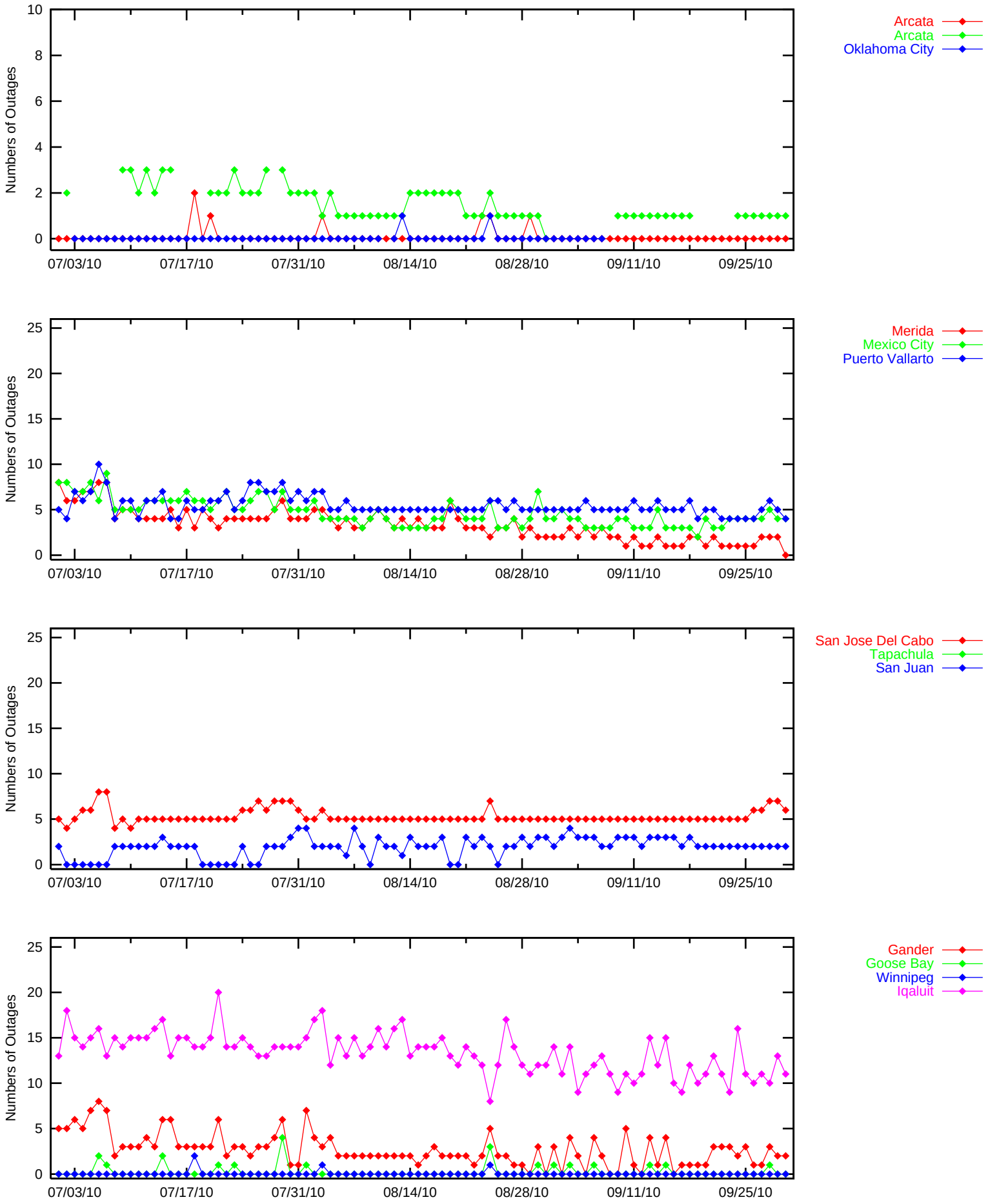


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



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 one degree spacing over the PA service volume, while NPA coverage were calculated at 30-sec intervals and five degree spacing over the NPA service volume.

Daily analysis for PA was conducted for LP, LPV and LPV 200 service levels. LP service is available when HPL is less than 40 meters. LPV service is available when HPL is less than 40 metes and VPL is less than 50 meters. LPV 200 service is available when HPL is less than 40 metes and VPL is less than 35 meters. The coverage plots provide 100, 99.9, 99, 98 and 95% availability contours. Figure 4.1 shows the rollup LP North America coverage. Figure 4.2 shows the rollup LPV North America coverage. Figure 4.3 shows the rollup LPV 200 North America coverage. Figure 4.6 shows the daily LPV and LPV 200 CONUS coverage, and Figure 4.7 shows the daily LPV Alaska coverage at 99% availability and ionosphere KP index values for this quarter. Please see Appendix B for coverage plots of 99% LPV 200 availability contour and 98% LPV availability contour.

Daily analysis for NPA was conducted for RNP 0.1 and RNP 0.3 service levels based on a 100% availability requirement. RNP 0.1 service is available when HPL is less than 185 meters and RNP 0.3 service is available when HPL is less than 556 meters. The NPA coverage plots provide 100, 99.9 and 99% availability contours. Figure 4.4 shows the rollup RNP 0.1 coverage and Figure 4.5 shows the rollup RNP 0.3 coverage for the quarter. Figure 4.8 shows the daily RNP coverage at 100% availability and ionosphere Kp index values for this quarter.

During this evaluation period, low PA and NPA coverage are mainly due to satellite outages and GUS switchovers. Other events that affect coverage this quarter include geomagnetic storm, SIS outage and elevated UDRE. Please refer Table 1.4 and 1.6 for events that affected coverage. Reduced Alaska coverage for the quarter is expected due to CRW orbit drift. Ionospheric storm on 8/4/10 with a Kp index of 6 caused a significant drop in coverage. A combination of ionospheric storm and elevated UDREi on PRN 27 and 30 reduced Alaska coverage on 8/25/10. Elevated UDREi on GEO CRW and CRE on 7/7/10, 7/15/10 and 7/23/10 reduced Alaska coverage. A Planned SIS outage on GEO CRW on 7/1/10 reduced coverage slightly.

Figure 4-1 LP North America Coverage for the Quarater

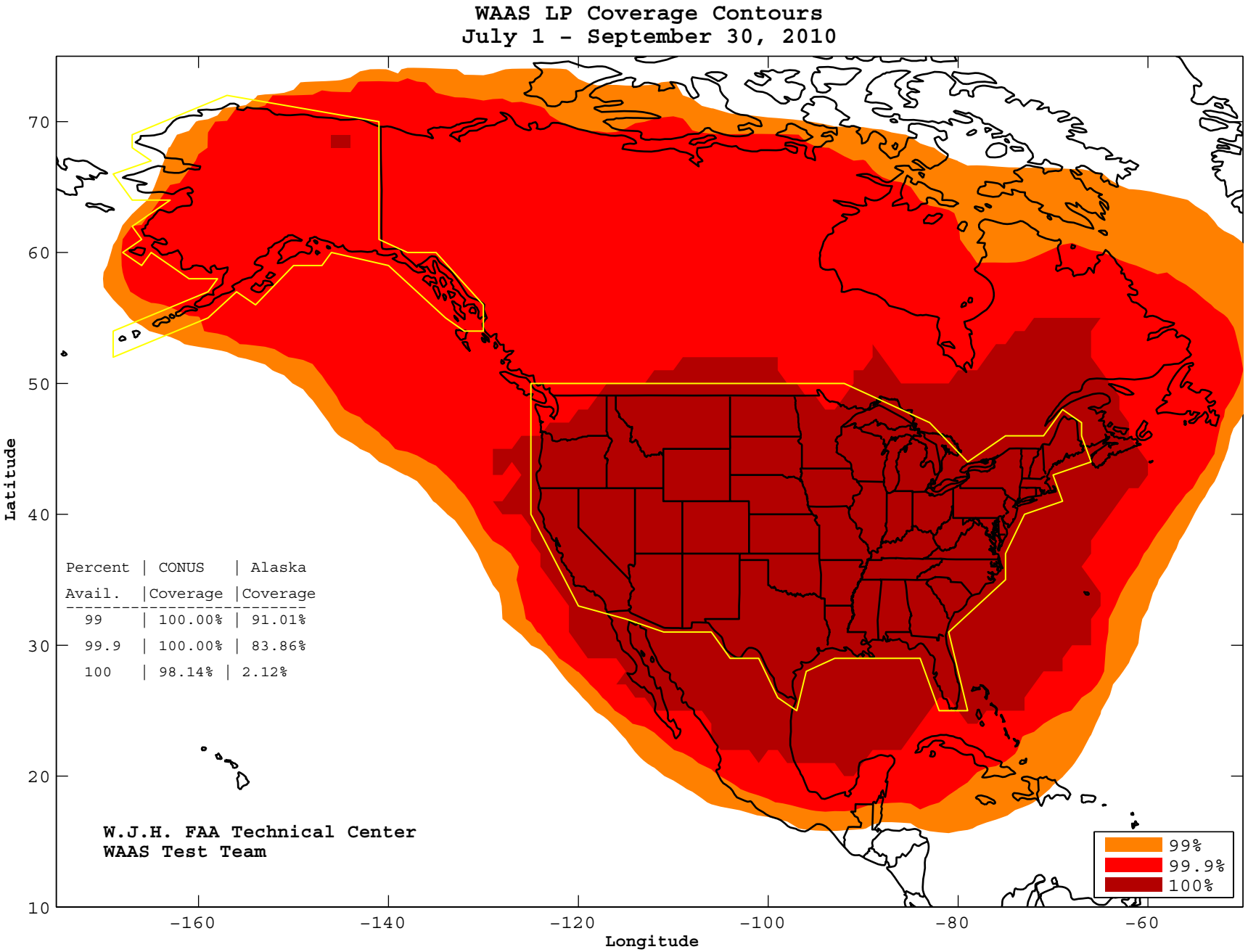


Figure 4-2 LPV North America Coverage for the Quarter

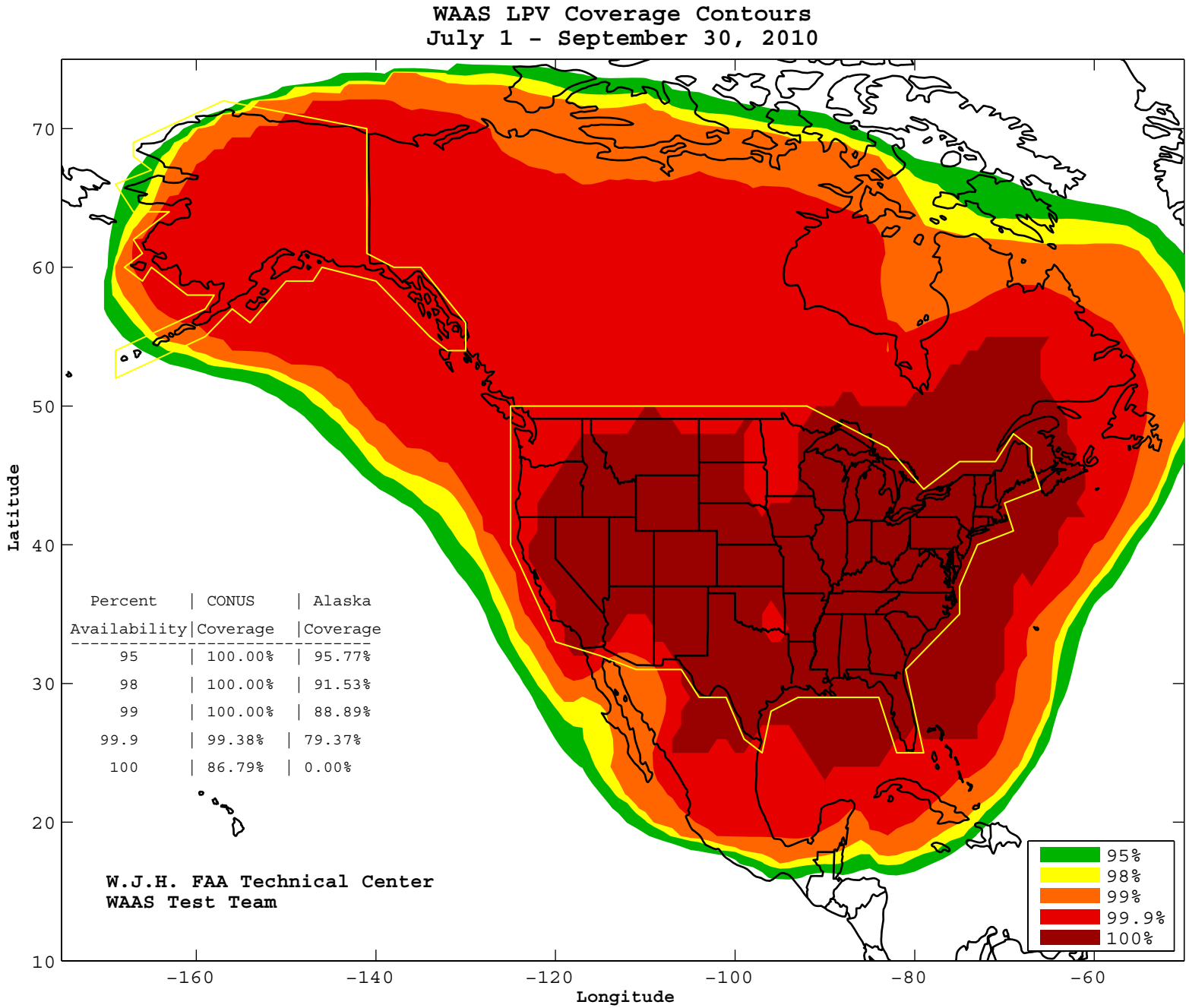


Figure 4-3 LPV 200 North America Coverage for the Quarter

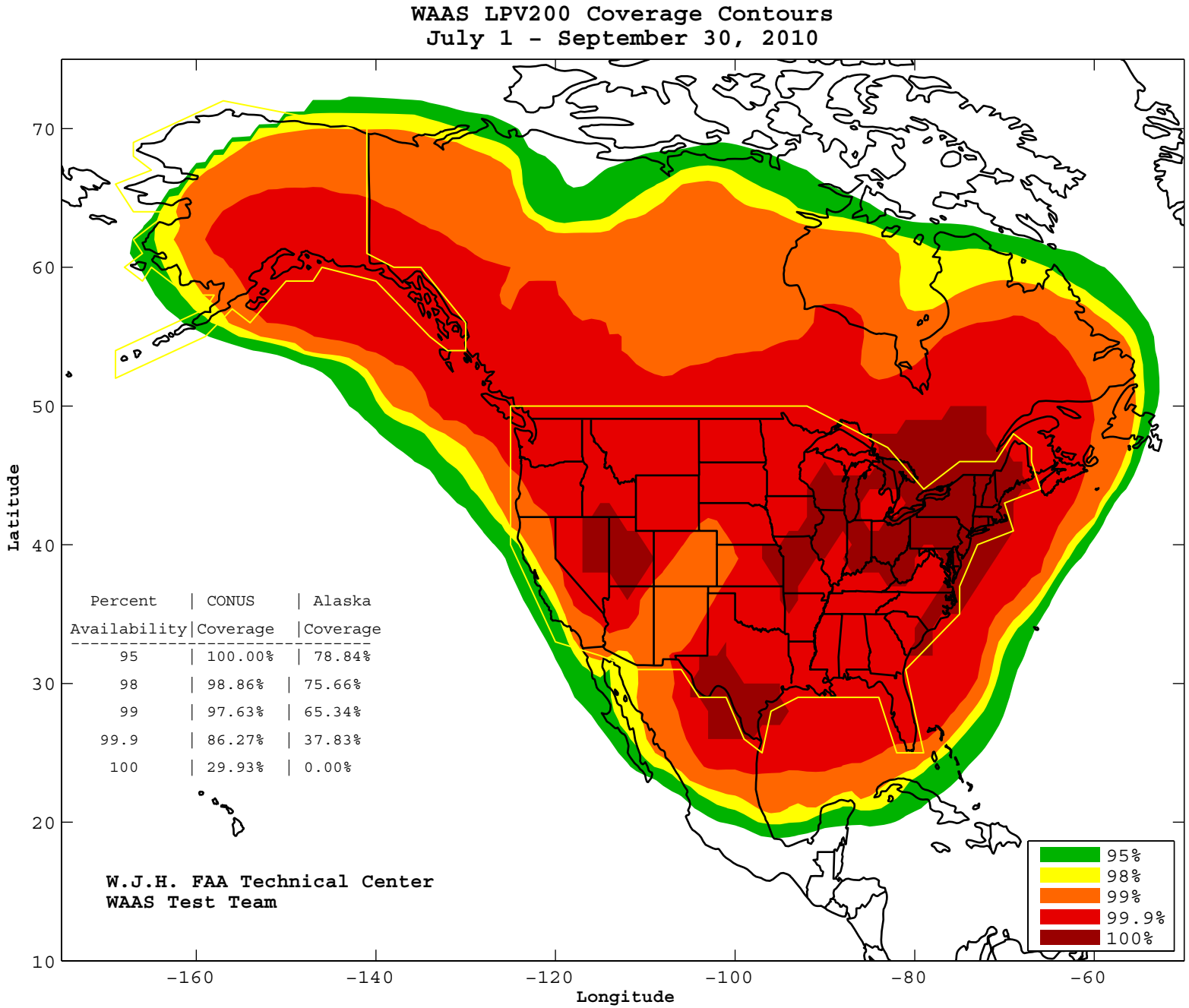


Figure 4-4 RNP 0.1 World Coverage for the Quarter

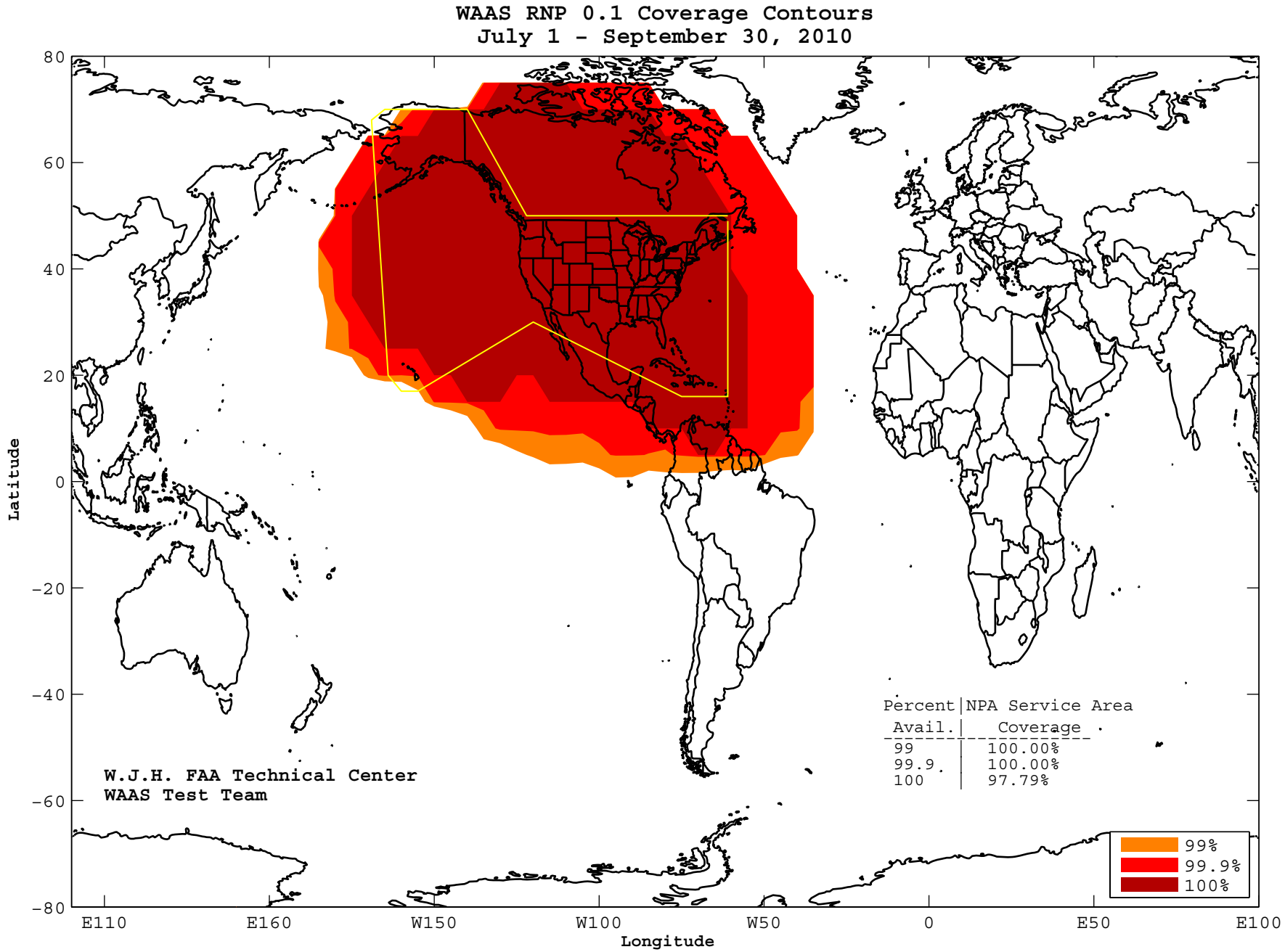


Figure 4-5 RNP 0.3 World Coverage for the Quarter

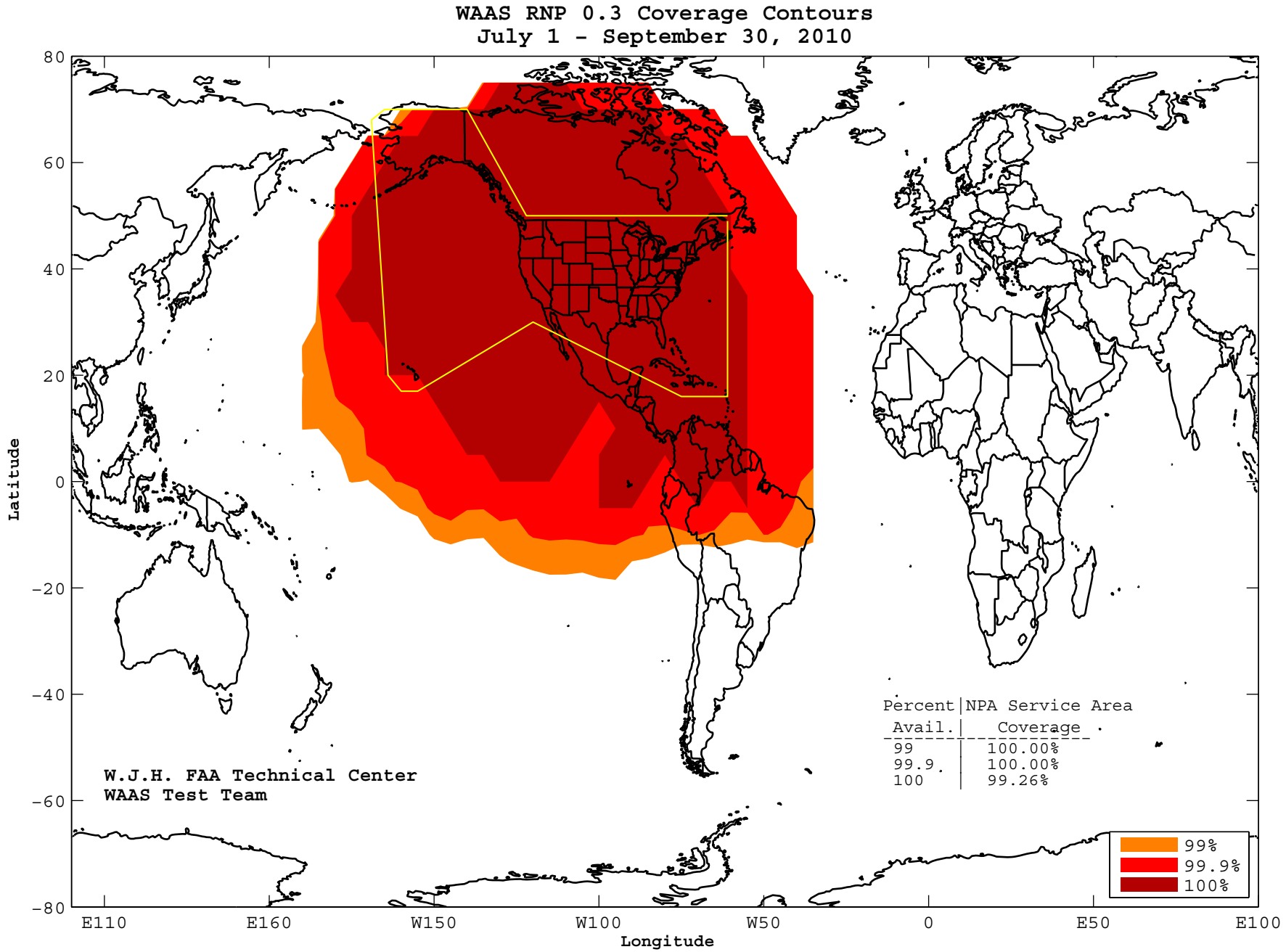


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

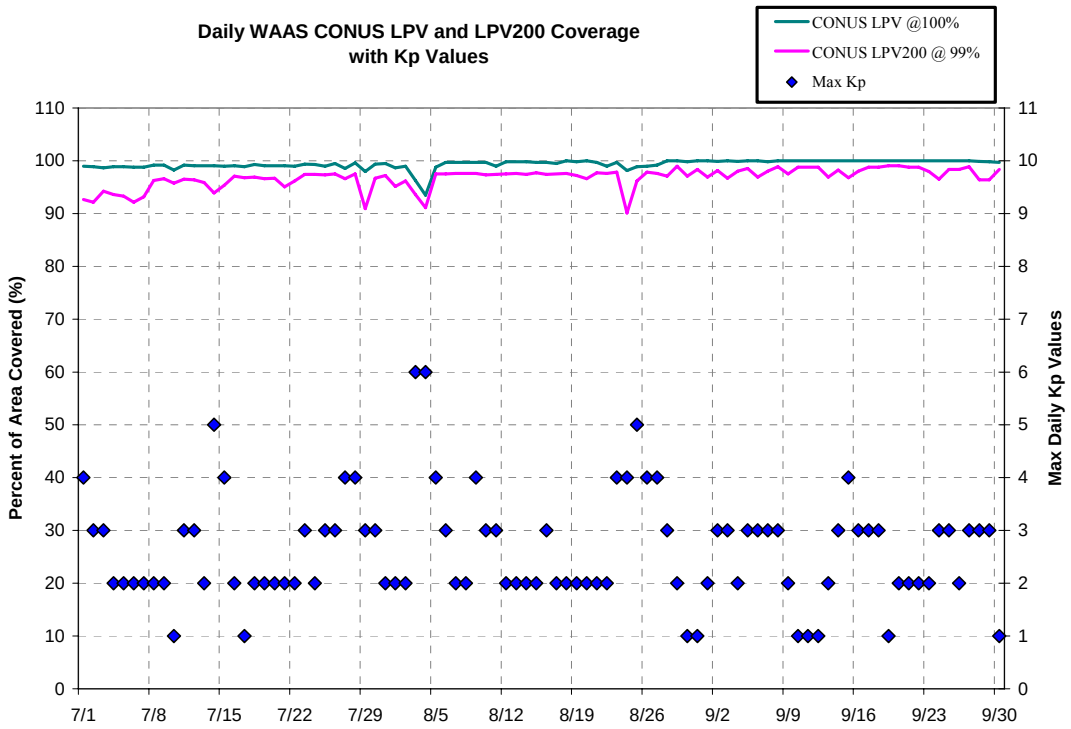


Figure 4-7 Daily LPV Alaska Coverage

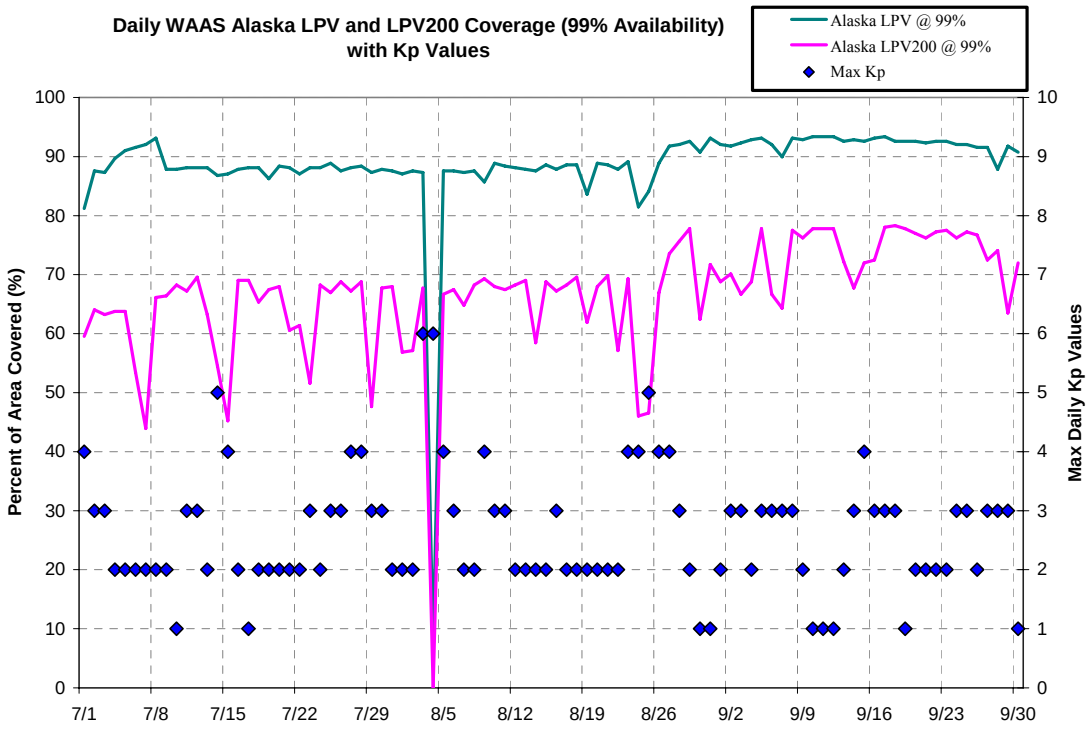
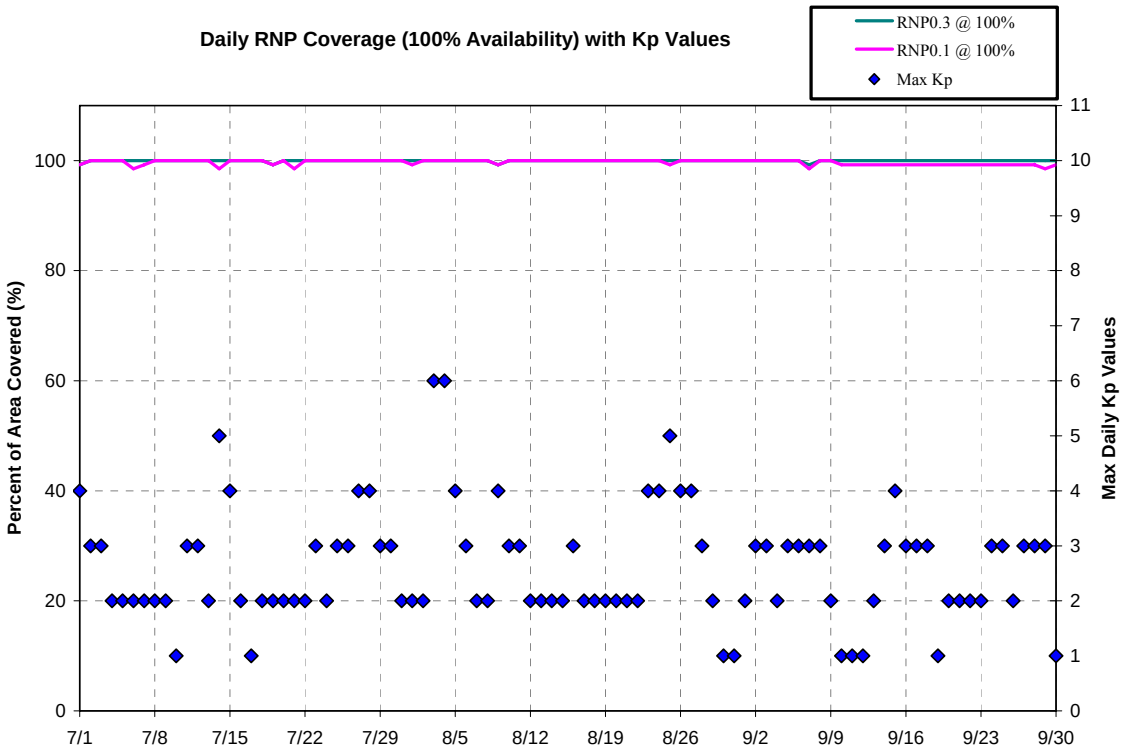


Figure 4-8 Daily RNP Coverage



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 3.2 at Minneapolis. 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		
	Horizontal	Vertical	Number of HMIs
Arcata	6.26	7.79	0
Grand Forks	4.81	5.71	0
Oklahoma City	7.04	5.05	0
Albuquerque	12.52	10.41	0
Anchorage	12.96	7.15	0
Atlanta	5.49	10.16	0
Barrow	5.38	6.36	0
Bethel	22.92	11.77	0
Billings	5.72	8.93	0
Boston	5.17	9.81	0
Chicago	6.71	8.18	0
Cleveland	4.59	5.68	0
Cold Bay	13.81	10.33	0
Dallas	8.21	4.17	0
Denver	12.72	6.82	0
Fairbanks	9.69	8.27	0
Gander	10.07	10.01	0
Goose Bay	8.43	8.32	0
Houston	7.65	7.28	0
Iqaluit	9.31	5.47	0
Jacksonville	9.78	8.80	0
Juneau	7.79	10.01	0
Kansas City	10.73	4.89	0
Kotzebue	6.33	11.78	0
Los Angeles	7.62	7.00	0
Memphis	4.29	3.33	0
Merida	4.66	7.14	0
Mexico City	8.18	7.69	0
Miami	6.33	6.58	0
Minneapolis	3.20	6.16	0
New York	6.91	8.50	0
Oakland	5.23	6.43	0
Puerto Vallarta	7.71	8.40	0
Salt Lake City	11.19	6.43	0
San Jose Del Cabo	6.20	7.20	0
San Juan	12.79	5.97	0
Seattle	3.93	7.63	0
Tapachula	29.58	27.79	0
Washington DC	9.10	7.57	0
Winnipeg	9.82	5.91	0

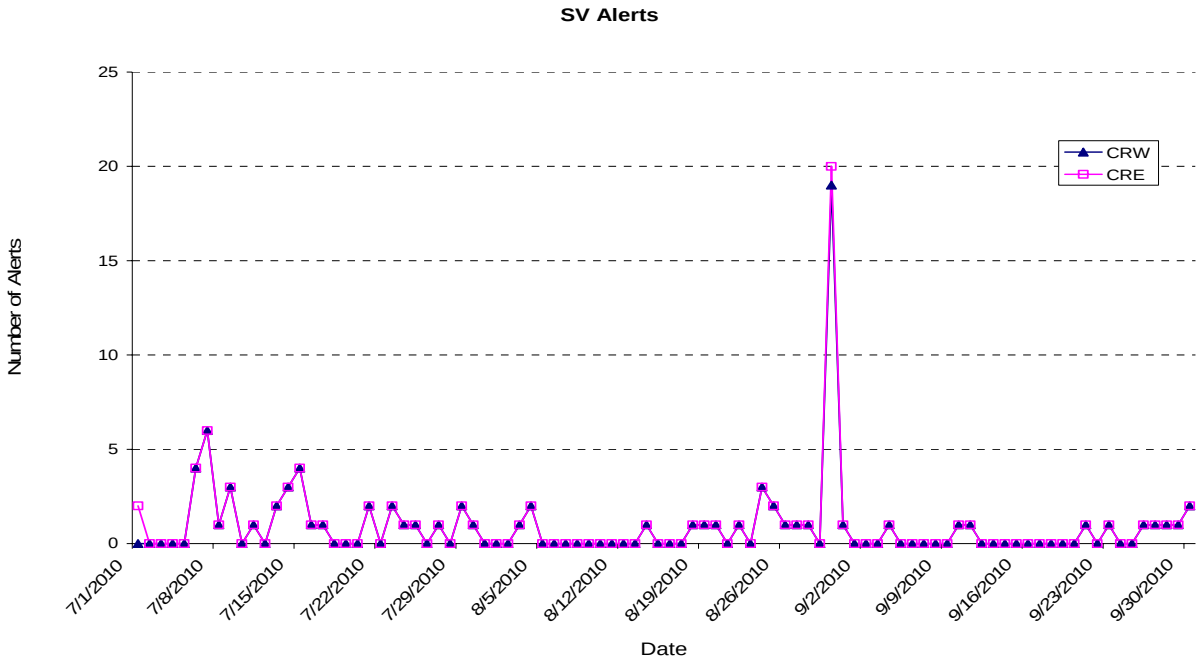
5.2 Broadcast Alerts

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	10	10	0.1087	0.1087
3	39	40	0.4239	0.4348
4	34	36	0.3696	0.3913
5	0	0	0.0000	0.0000
6	0	0	0.0000	0.0000
24	0	0	0.0000	0.0000
26	0	0	0.0000	0.0000
Total Alerts	83	86	0.9022	0.9348

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	108112	1	4334
2	1324025	58	4286
3	1324140	36	4286
4	1324124	38	4286
7	100605	5	4443
9	93099	1	4340
10	100619	6	4422

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

SV	On Time	Late	Max Late Length (seconds)
2	48430	0	0
3	51189	1	162
4	49141	0	0
5	49040	0	0
6	52062	0	0
7	48296	0	0
8	48079	0	0
9	50597	0	0
10	50561	0	0
11	52399	0	0
12	49841	0	0
13	48369	0	0
14	48513	0	0
15	50878	0	0
16	49111	0	0
17	48640	0	0
18	48237	2	4352
19	51068	0	0
20	51022	0	0
21	47628	0	0
22	49008	0	0
23	47927	0	0
24	49974	0	0
25	19495	0	0
26	49874	0	0
27	53004	0	0
28	49339	0	0
29	48477	0	0
30	51375	0	0
31	49449	0	0
32	49199	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	39773	0	0
3	42049	2	209
4	40368	0	0
5	40234	0	0
6	42784	0	0
7	39644	0	0
8	39453	1	4364
9	41625	0	0
10	41492	0	0
11	43063	0	0
12	40991	0	0
13	39740	0	0
14	39879	0	0
15	41713	0	0
16	40326	0	0
17	39960	0	0
18	39570	1	4369
19	41949	0	0
20	41852	0	0
21	39144	0	0
22	40191	1	209
23	39352	0	0
24	41037	0	0
25	16007	0	0
26	40954	0	0
27	43554	0	0
28	40514	0	0
29	39858	1	4369
30	42278	1	124
31	40572	0	0
32	40399	0	0
135	76265	0	0
138	74627	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27580	5	4424
0	1	27581	4	4399
0	2	27590	3	4418
1	0	27582	3	4408
1	1	27584	5	4418
1	2	27592	5	4412
1	3	27578	7	4419
1	4	27585	4	4422
2	0	27580	5	4419
2	1	27581	8	4440
2	2	27578	7	4446
2	3	27589	3	4707
2	4	27600	4	4728
2	5	27572	4	4718
3	0	27584	4	4710
3	1	27574	6	4706
3	2	27587	8	4710
9	0	27569	6	4690
9	1	27587	4	4707
9	2	27570	9	4712
9	3	27583	8	4708
9	4	27578	9	4712
9	5	27576	7	4688
9	6	27582	7	4405

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

Band	On Time	Late	Max Late Length (seconds)
0	36111	1	4513
1	36115	1	4400
2	36087	1	4365
3	36106	1	4531
9	36067	1	4538

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

Message Type	On Time	Late	Max Late Length (seconds)
1	108501	3	162
2	1324692	72	32
3	1324823	49	29
4	1324809	52	26
7	100674	6	130
9	93150	0	0
10	100551	8	138
17	31743	5	470

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

SV	On Time	Late	Max Late Length (seconds)
2	48485	1	177
3	51237	0	0
4	49140	0	0
5	49089	0	0
6	52108	0	0
7	48348	0	0
8	48122	1	166
9	50595	2	174
10	50612	0	0
11	52404	0	0
12	49870	1	169
13	48374	0	0
14	48519	0	0
15	50917	0	0
16	49160	0	0
17	48658	0	0
18	48284	0	0
19	51067	0	0
20	51021	0	0
21	47688	0	0
22	49045	1	166
23	47928	0	0
24	50019	2	174
25	19500	0	0
26	49925	1	169
27	53027	1	178
28	49341	1	178
29	48527	0	0
30	51417	1	174
31	49444	0	0
32	49213	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	39819	0	0
3	42088	0	0
4	40376	0	0
5	40274	0	0
6	42815	0	0
7	39687	0	0
8	39499	0	0
9	41645	0	0
10	41544	1	127
11	43053	1	124
12	41000	0	0
13	39746	1	211
14	39882	0	0
15	41758	0	0
16	40361	1	127
17	39964	0	0
18	39608	1	124
19	41950	1	122
20	41861	0	0
21	39188	0	0
22	40222	1	207
23	39357	0	0
24	41076	0	0
25	16004	1	211
26	40990	0	0
27	43576	1	207
28	40501	0	0
29	39894	0	0
30	42322	0	0
31	40563	0	0
32	40393	0	0
135	76267	0	0
138	74662	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27597	5	541
0	1	27588	3	545
0	2	27601	6	557
1	0	27587	5	305
1	1	27595	5	308
1	2	27611	5	306
1	3	27607	4	305
1	4	27594	5	304
2	0	27597	5	475
2	1	27589	5	494
2	2	27598	4	511
2	3	27603	7	512
2	4	27594	8	524
2	5	27603	7	536
3	0	27579	11	506
3	1	27602	5	309
3	2	27601	6	307
9	0	27599	3	576
9	1	27586	5	311
9	2	27604	3	302
9	3	27590	1	302
9	4	27603	4	305
9	5	27604	3	304
9	6	27595	3	535

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

Band	On Time	Late	Max Late Length (seconds)
0	36134	0	0
1	36121	0	0
2	36209	0	0
3	36210	0	0
9	36198	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 Washington DC 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 Washington DC reference station.

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	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	1.921	100	1.350	100	1.787	100	1.490	100	1.965	100	1.829	100
3	0.886	100	1.314	100	1.129	100	1.643	100	1.694	100	1.788	100
4	1.348	100	1.964	100	1.552	100	1.555	100	1.782	100	2.127	100
5	1.368	100	1.653	100	1.213	100	1.504	100	2.662	100	1.507	100
6	1.610	100	1.425	100	1.352	100	1.500	100	1.858	100	1.469	100
7	0.957	100	1.472	100	0.961	100	1.119	100	1.417	100	1.557	100
8	1.106	100	1.294	100	0.891	100	0.865	100	1.242	100	1.431	100
9	1.061	100	1.337	100	1.059	100	1.272	100	1.420	100	1.363	100
10	0.726	100	1.005	100	0.898	100	1.090	100	1.279	100	1.109	100
11	1.058	100	1.269	100	1.021	100	1.124	100	1.399	100	1.023	100
12	0.978	100	1.409	100	1.134	100	1.332	100	2.388	100	1.616	100
13	1.258	100	1.408	100	1.020	100	1.083	100	1.209	100	1.591	100
14	1.359	100	1.049	100	0.905	100	0.983	100	1.461	100	1.113	100
15	1.305	100	1.528	100	1.361	100	1.618	100	1.365	100	1.611	100
16	1.009	100	1.014	100	1.154	100	1.096	100	1.156	100	1.000	100
17	1.286	100	1.469	100	1.283	100	1.182	100	1.269	100	1.389	100
18	1.364	100	1.071	100	1.172	100	1.130	100	1.731	100	1.155	100
19	2.399	100	1.843	100	2.142	100	1.861	100	2.296	100	1.846	100
20	1.114	100	1.309	100	1.423	100	0.834	100	1.601	100	1.441	100
21	1.230	100	1.367	100	1.157	100	1.112	100	1.491	100	1.461	100
22	1.157	100	0.996	100	1.388	100	1.193	100	1.394	100	1.209	100
23	1.643	100	1.600	100	1.796	100	1.721	100	2.040	100	1.551	100
24	1.824	100	1.973	100	1.659	100	1.860	100	1.959	100	2.133	100
25	1.889	100	2.273	100	2.097	100	2.354	100	2.036	100	2.564	100
26	1.252	100	1.695	100	1.398	100	1.638	100	2.347	100	1.688	100
27	1.108	100	1.127	100	1.310	100	1.538	100	1.503	100	1.405	100
28	0.937	100	1.044	100	1.280	100	0.985	100	1.544	100	0.845	100
29	1.373	100	2.016	100	1.008	100	1.471	100	1.159	100	1.853	100
30	1.453	100	1.663	100	1.637	100	1.755	100	1.866	100	1.505	100
31	1.949	100	1.561	100	0.821	100	1.333	100	1.720	100	1.491	100
32	0.899	100	1.224	100	0.860	100	0.847	100	1.280	100	1.590	100
135	1.525	100	2.125	100	2.162	100	2.115	100	3.094	100	1.633	100
138	1.689	100	1.766	100	1.652	100	1.607	100	2.040	100	1.903	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	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	-	-	-	-	-	-	-	-	1.786	100	-	-
2	2.047	100	1.693	100	1.839	100	1.456	100	1.323	100	1.665	100
3	0.927	100	1.095	100	1.704	100	1.602	100	2.229	100	1.259	100
4	1.235	100	1.171	100	2.270	100	1.427	100	2.419	100	1.401	100
5	0.970	100	1.324	100	1.496	100	1.471	100	2.241	100	1.193	100
6	1.219	100	1.342	100	1.452	100	1.412	100	2.517	100	1.644	100
7	0.965	100	1.051	100	1.477	100	1.041	100	2.190	100	1.214	100
8	0.919	100	0.771	100	1.253	100	1.143	100	2.375	100	1.281	100
9	0.940	100	1.206	100	1.248	100	1.339	100	2.022	100	1.475	100
10	1.479	100	1.153	100	1.337	100	0.795	100	1.532	100	0.864	100
11	1.482	100	1.014	100	0.967	100	0.878	100	1.501	100	1.067	100
12	1.113	100	0.904	100	1.215	100	1.206	100	2.277	100	1.069	100
13	0.950	100	2.494	100	2.209	100	0.905	100	2.377	100	1.140	100
14	0.946	100	1.057	100	1.301	100	0.921	100	1.712	100	0.837	100
15	1.007	100	0.980	100	1.683	100	1.435	100	2.753	100	1.515	100
16	1.720	100	1.092	100	1.090	100	0.990	100	1.752	100	0.900	100
17	0.935	100	0.950	100	1.271	100	1.045	100	2.478	100	1.097	100
18	1.506	100	2.033	100	1.024	100	1.078	100	1.271	100	1.314	100
19	2.629	100	2.352	100	2.116	100	2.081	100	1.864	100	2.075	100
20	1.643	100	1.528	100	1.141	100	1.027	100	1.565	100	0.885	100
21	1.415	100	1.147	100	1.512	100	1.243	100	1.288	100	0.950	100
22	1.656	100	1.411	100	1.535	100	1.177	100	1.321	100	1.250	100
23	2.210	100	1.968	100	1.553	100	1.525	100	1.564	100	1.735	100
24	1.231	100	1.772	100	2.230	100	1.938	100	2.766	100	1.935	100
25	2.066	100	2.014	100	2.558	100	2.589	100	3.680	100	2.106	100
26	1.016	100	1.170	100	1.669	100	1.803	100	2.654	100	1.268	100
27	1.014	100	0.984	100	1.520	100	1.682	100	2.299	100	1.294	100
28	1.316	100	1.199	100	2.082	100	0.785	100	1.742	100	0.770	100
29	0.951	100	2.515	100	1.851	100	1.558	100	2.098	100	1.416	100
30	1.428	100	1.191	100	1.723	100	1.631	100	2.795	100	1.550	100
31	1.015	100	1.049	100	1.644	100	1.268	100	2.259	100	1.051	100
32	0.947	100	1.257	100	1.288	100	1.224	100	2.001	100	0.983	100
135	1.917	100	1.558	100	1.996	100	2.949	100	2.040	100	1.436	100
138	2.395	100	1.837	100	1.719	100	1.756	100	1.781	100	1.493	100

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	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	1.378	100	0.852	100	1.170	100	0.904	100	1.116	100	1.021	100
3	0.332	100	0.508	100	0.291	100	0.556	100	0.715	100	0.715	100
4	0.879	100	1.223	100	1.053	100	1.029	100	1.098	100	1.500	100
5	0.751	100	0.817	100	0.515	100	0.715	100	1.243	100	0.689	100
6	0.639	100	0.744	100	0.540	100	0.584	100	0.922	100	0.595	100
7	0.485	100	0.573	100	0.354	100	0.513	100	0.520	100	0.639	100
8	0.490	100	0.388	100	0.517	100	0.399	100	0.569	100	0.514	100
9	0.443	100	0.653	100	0.354	100	0.443	100	0.621	100	0.459	100
10	0.401	100	0.437	100	0.377	100	0.362	100	0.494	100	0.431	100
11	0.677	100	0.681	100	0.483	100	0.402	100	0.610	100	0.511	100
12	0.390	100	0.598	100	0.439	100	0.533	100	0.828	100	0.698	100
13	0.501	100	0.497	100	0.325	100	0.413	100	0.663	100	0.600	100
14	0.732	100	0.455	100	0.404	100	0.386	100	0.709	100	0.344	100
15	0.657	100	0.683	100	0.597	100	0.778	100	0.857	100	0.707	100
16	0.704	100	0.482	100	0.592	100	0.419	100	0.642	100	0.502	100
17	0.730	100	0.574	100	0.787	100	0.608	100	0.484	100	0.648	100
18	1.042	100	0.636	100	0.776	100	0.718	100	0.732	100	0.665	100
19	1.634	100	1.298	100	1.549	100	1.388	100	1.519	100	1.439	100
20	0.768	100	0.568	100	0.704	100	0.433	100	0.695	100	0.700	100
21	0.919	100	0.761	100	0.820	100	0.898	100	0.992	100	0.915	100
22	1.017	100	0.639	100	0.956	100	0.821	100	0.780	100	0.735	100
23	1.446	100	1.224	100	1.456	100	1.424	100	1.440	100	1.126	100
24	0.950	100	1.117	100	0.830	100	0.937	100	0.933	100	1.084	100
25	1.169	100	1.473	100	1.360	100	1.339	100	1.234	100	1.383	100
26	0.637	100	0.707	100	0.554	100	0.712	100	1.187	100	0.740	100
27	0.500	100	0.535	100	0.508	100	0.573	100	0.586	100	0.552	100
28	0.752	100	0.426	100	0.790	100	0.467	100	0.864	100	0.444	100
29	0.679	100	0.980	100	0.600	100	0.743	100	0.770	100	0.895	100
30	0.687	100	0.872	100	0.748	100	0.708	100	0.831	100	0.666	100
31	1.211	100	0.628	100	0.233	100	0.683	100	1.153	100	0.626	100
32	0.580	100	0.577	100	0.322	100	0.329	100	0.450	100	0.577	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	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	-	-	-	-	-	-	-	-	1.340	100	-	-
2	1.133	100	0.994	100	1.026	100	0.974	100	0.793	100	1.077	100
3	0.492	100	0.409	100	0.646	100	0.778	100	1.347	100	0.495	100
4	0.817	100	0.839	100	1.612	100	0.891	100	1.974	100	0.773	100
5	0.559	100	0.721	100	0.950	100	0.712	100	1.656	100	0.628	100
6	0.627	100	0.542	100	0.556	100	0.622	100	1.473	100	0.668	100
7	0.477	100	0.401	100	0.692	100	0.382	100	1.614	100	0.559	100
8	0.341	100	0.321	100	0.515	100	0.494	100	1.563	100	0.569	100
9	0.403	100	0.494	100	0.563	100	0.588	100	1.225	100	0.656	100
10	0.654	100	0.470	100	0.490	100	0.380	100	1.065	100	0.373	100
11	0.669	100	0.462	100	0.444	100	0.464	100	0.848	100	0.584	100
12	0.497	100	0.444	100	0.710	100	0.527	100	1.408	100	0.554	100
13	0.397	100	1.126	100	0.867	100	0.460	100	1.514	100	0.397	100
14	0.428	100	0.594	100	0.642	100	0.461	100	1.255	100	0.545	100
15	0.573	100	0.486	100	0.813	100	0.593	100	1.840	100	0.690	100
16	0.876	100	0.527	100	0.403	100	0.583	100	1.206	100	0.626	100
17	0.488	100	0.540	100	0.758	100	0.551	100	1.798	100	0.517	100
18	0.804	100	1.331	100	0.489	100	0.886	100	0.931	100	1.051	100
19	1.630	100	1.573	100	1.314	100	1.532	100	1.156	100	1.531	100
20	0.723	100	0.600	100	0.735	100	0.606	100	0.804	100	0.675	100
21	0.692	100	0.736	100	1.070	100	1.066	100	0.930	100	0.853	100
22	0.877	100	0.861	100	0.963	100	0.856	100	0.920	100	0.984	100
23	1.360	100	1.446	100	1.218	100	1.351	100	0.971	100	1.332	100
24	1.021	100	1.054	100	1.345	100	0.989	100	1.862	100	0.946	100
25	1.368	100	1.263	100	1.688	100	1.584	100	2.399	100	1.500	100
26	0.598	100	0.559	100	0.785	100	0.918	100	1.625	100	0.599	100
27	0.493	100	0.468	100	0.672	100	0.818	100	1.378	100	0.554	100
28	0.660	100	0.546	100	1.200	100	0.445	100	1.182	100	0.503	100
29	0.681	100	1.087	100	1.139	100	0.815	100	1.542	100	0.717	100
30	0.846	100	0.729	100	0.915	100	0.758	100	1.619	100	0.765	100
31	0.600	100	0.641	100	0.997	100	0.584	100	1.725	100	0.378	100
32	0.402	100	0.573	100	0.713	100	0.467	100	1.281	100	0.317	100

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

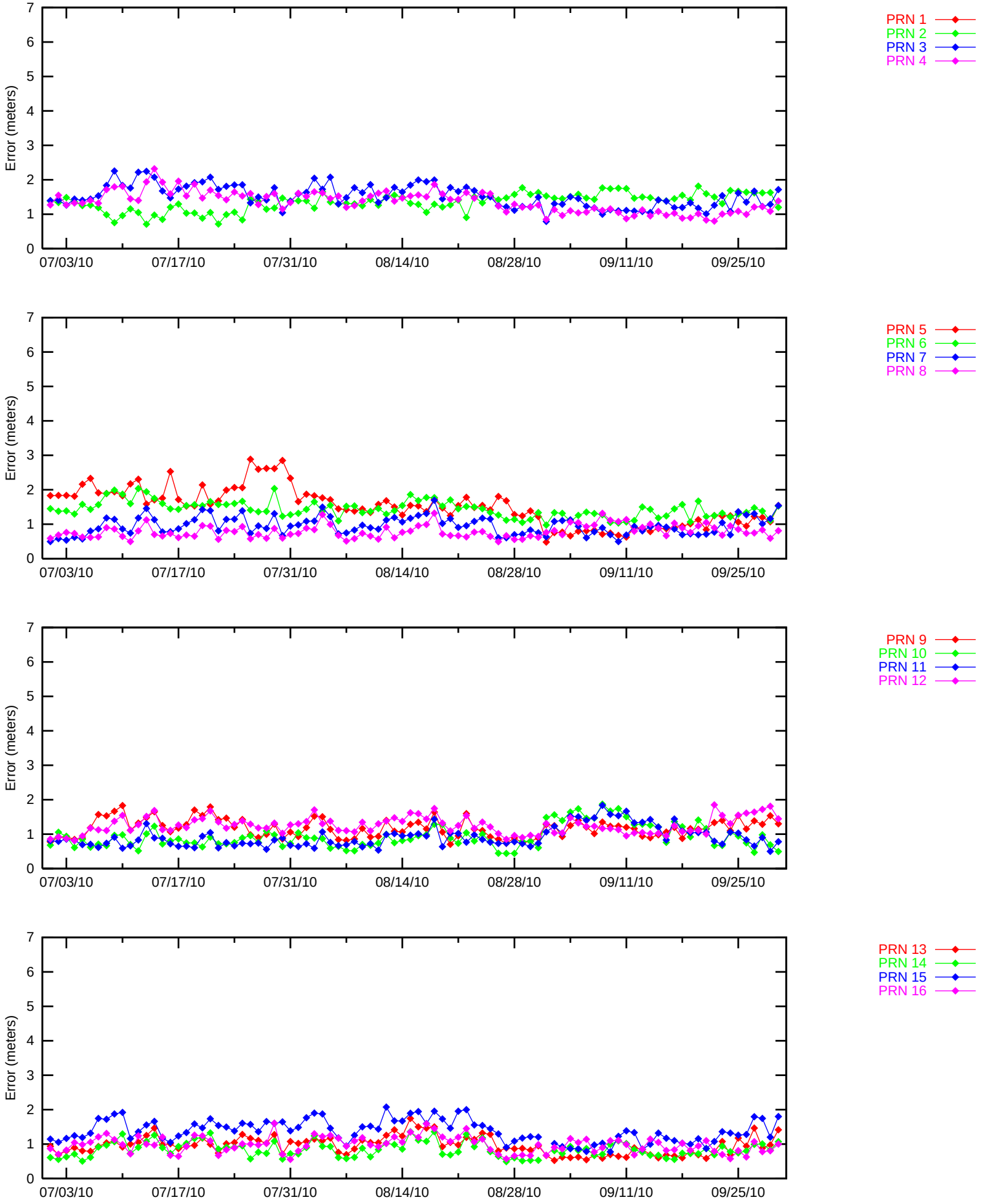


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Washington DC

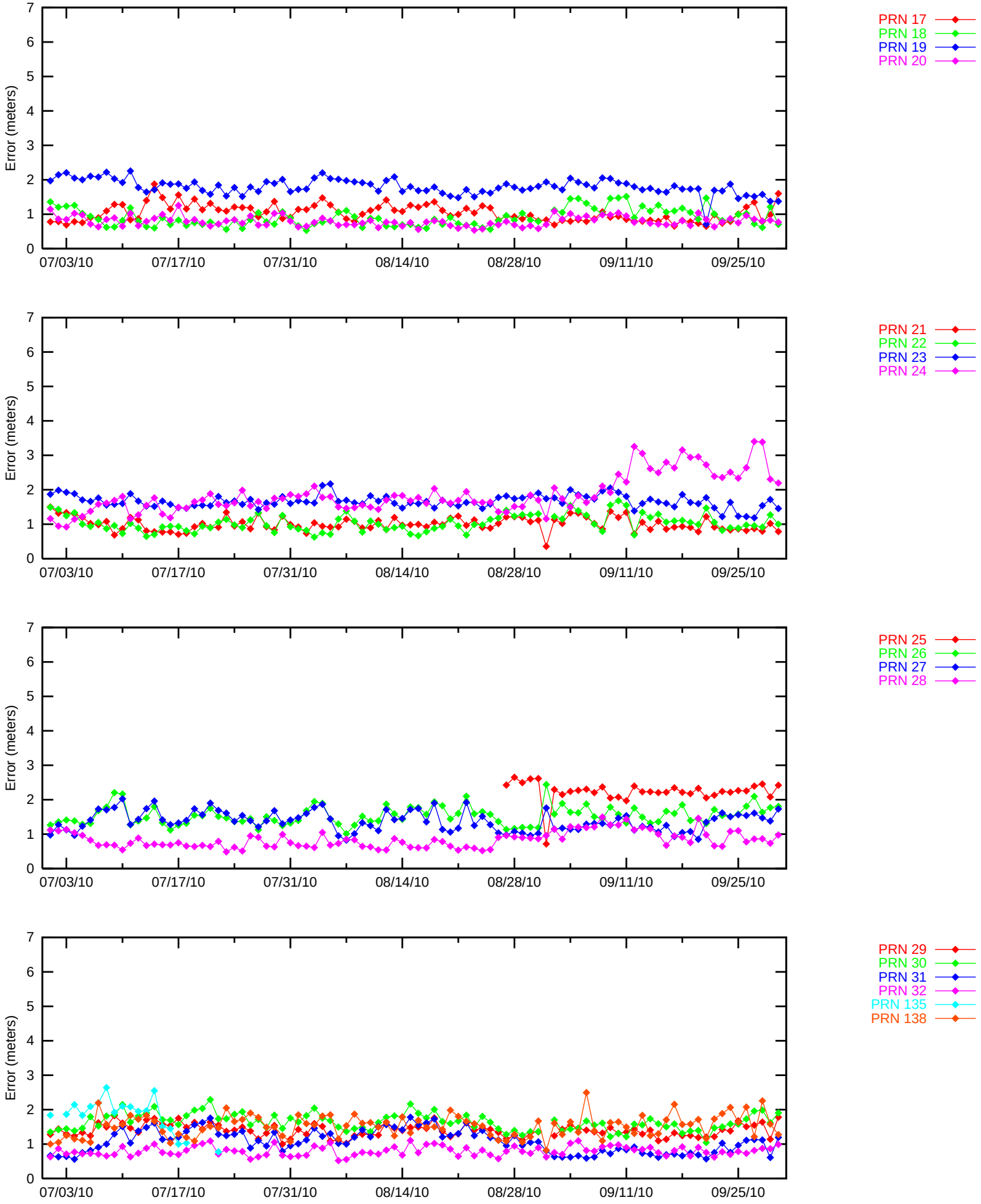


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Washington DC

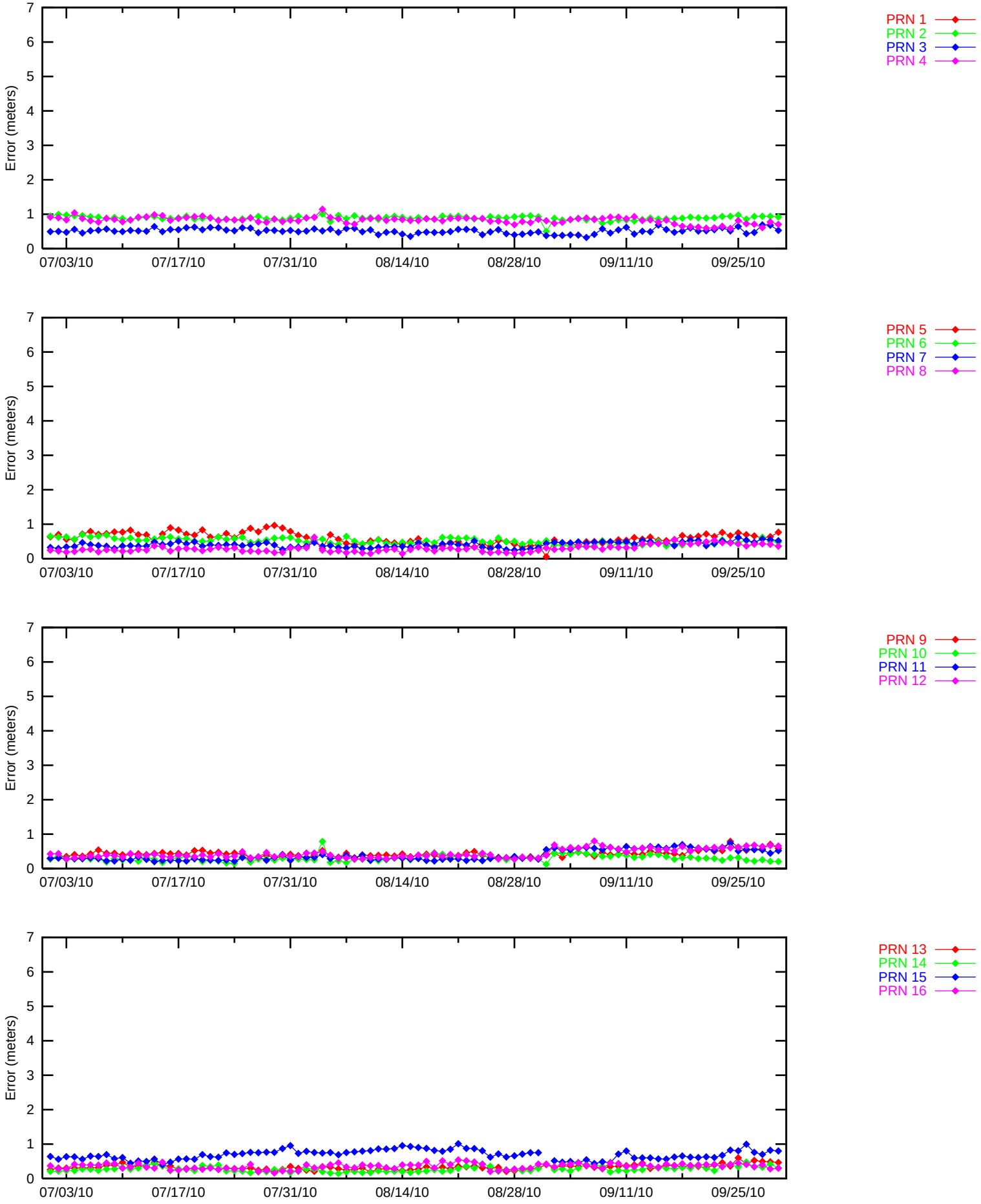
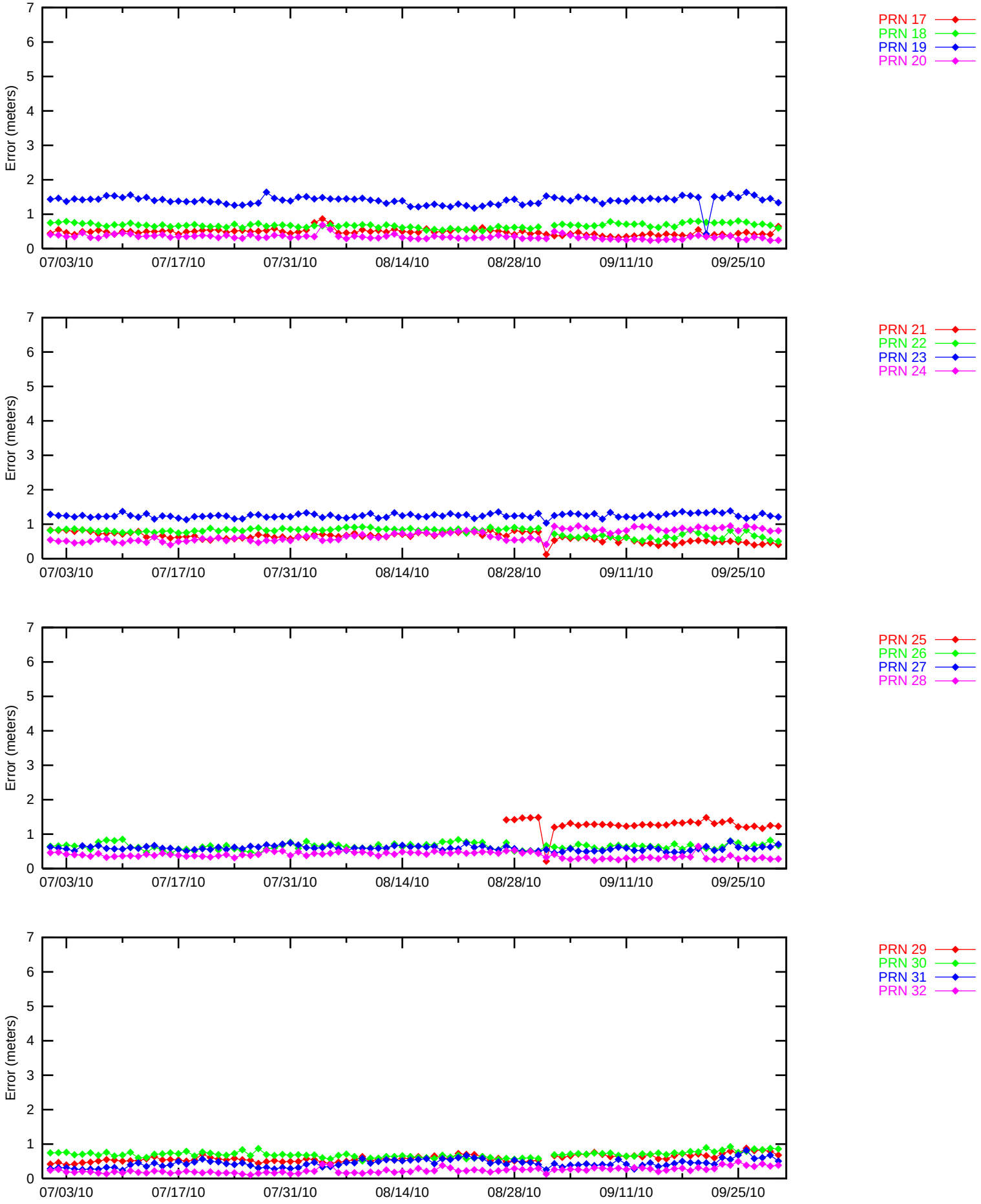


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Washington DC



7.0 GEO RANGING PERFORMANCE

WAAS GEO navigation messages provide corrections and UDRE values for each satellite. The GEO ranging availability from each GEO navigation message source was evaluated separately to determine the quality of service provided. For the evaluation period, both CRW (PRN 135) and CRE (PRN 138) GEO satellites provide ranging capability for enroute through NPA and PA service. 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 CRW GEO PA Ranging Availability and Figure 7.2 shows the trend of CRE GEO PA Ranging Availability.

For this reporting period, low CRW PA ranging availability is due to satellite orbit drift. This is expected performance.

.

Table 7-1 GEO Ranging Availability

GEO Source	GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
CRW 135	CRW	11.592	88.108	0.249	0
CRW 135	CRE	95.183	2.428	0.779	1.56
CRE 138	CRW	11.632	88.045	0.255	0.066
CRE 138	CRE	95.234	2.428	0.777	1.559

Figure 7-1 Daily PA CRW GEO Ranging Availability Trend

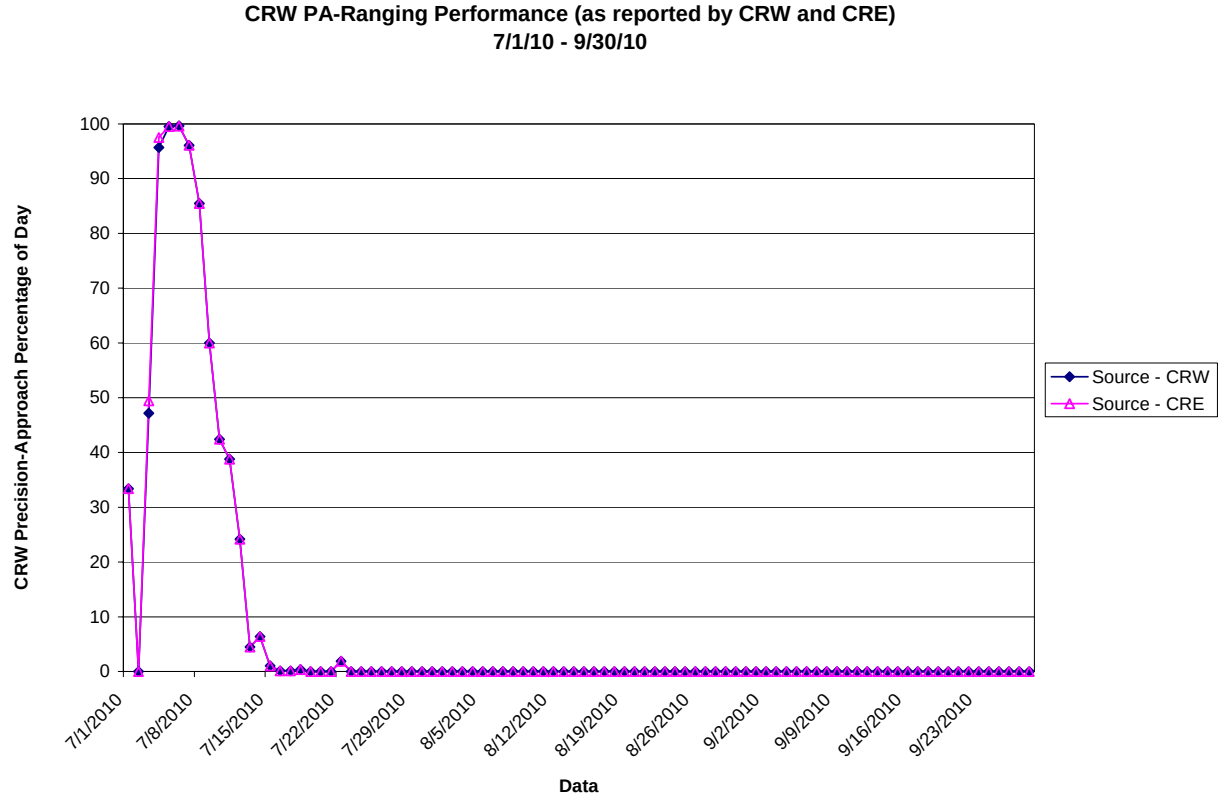
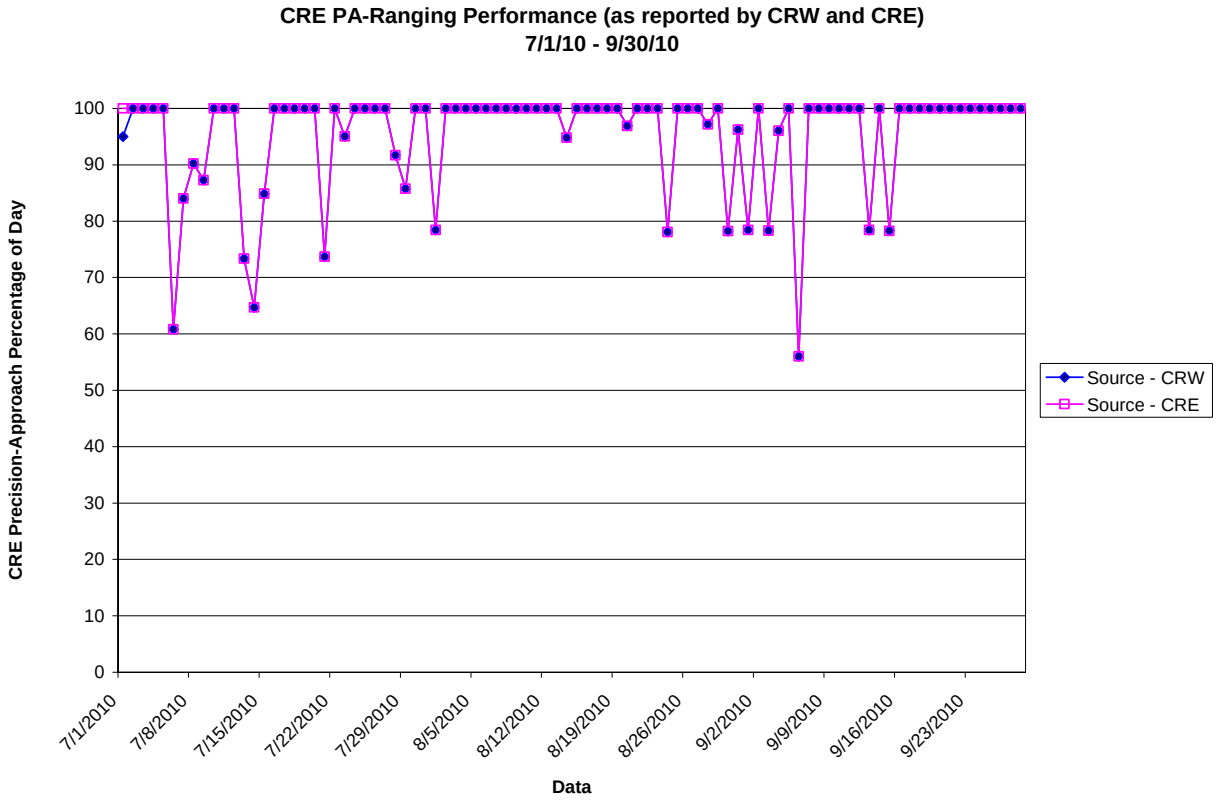


Figure 7-2 Daily PA CRE GEO Ranging Availability Trend



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	Event Description
08/30/10	PRN 25 carrier spikes caused a large number of receivers to drop track of satellite. PRN 25 was never set unhealthy but NANU 2010116 was issued. The problem was the result of an issue onboard the satellite. The issue ended when the GPS ground control corrected the problem. See DR #97 Large number of not monitored alarms on PRN 25.

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, which provide a graphical representation of WAAS LPV service availability and outage counts, are omitted for this reporting period.

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PACD	COLD BAY	AK	68	0.996187	604	0.876078
PAGA	EDWARD G. PITKA SR	AK	1	0.999594	26	0.997963
PAEM	EMMONAK	AK	2	0.999669	183	0.977172
PAFA	FAIRBANKS INTL	AK	1	0.999615	16	0.999014
PAGB	GALBRAITH LAKE	AK	3	0.999737	79	0.993968
PAGK	GULKANA	AK	1	0.999734	3	0.999627
PAHO	HOMER	AK	1	0.999707	2	0.999425
PAHL	HUSLIA	AK	1	0.999597	40	0.997128
PAEN	KENAI MUNICIPAL	AK	1	0.999734	3	0.999595
PAKT	KETCHIKAN INTL	AK	1	0.999511	1	0.999463
PAKN	KING SALMON	AK	1	0.999717	64	0.994605
PARY	RUBY	AK	1	0.999594	18	0.998525
PASK	SELAWIK	AK	2	0.999781	170	0.987067
PASM	ST MARY'S	AK	2	0.999674	161	0.984956
PAMK	ST MICHAEL	AK	1	0.999697	134	0.987380
PANC	TED STEVENS ANCHORAGE INTL	AK	1	0.999737	1	0.999526
PAYA	YAKUTAT	AK	1	0.999548	3	0.999379
8A0	ALBERTVILLE RGNL-THOMAS J BRUM	AL	0	1	1	0.999907
ANB	ANNISTON METROPOLITAN	AL	0	1	1	0.999910
AUO	AUBURN-OPELIKA ROBERT G PITTS	AL	0	1	2	0.999921
EKY	BESSEMER	AL	0	1	2	0.999858
BHM	BIRMINGHAM INTL	AL	0	1	2	0.999863
SEM	CRAIG FIELD	AL	0	1	2	0.999883
DHN	DOTHAN RGNL	AL	0	1	3	0.999897
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	0	1	1	0.999900
JKA	JACK EDWARDS	AL	0	1	2	0.999888
MDQ	MADISON COUNTY EXECUTIVE/TOM S	AL	0	1	1	0.999907
BFM	MOBILE DOWNTOWN	AL	0	1	3	0.999882
MOB	MOBILE RGNL	AL	0	1	2	0.999888

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MGM	MONTGOMERY RGNL DANNELLY FIELD	AL	0	1	2	0.999894
GAD	NORTHEAST ALABAMA RGNL	AL	0	1	1	0.999909
MSL	NORTHWEST ALABAMA RGNL	AL	0	1	2	0.999856
DCU	PRYOR FIELD RGNL	AL	0	1	2	0.999896
79J	SOUTH ALABAMA RGNL AT BILL BEN	AL	0	1	2	0.999908
PLR	ST CLAIR COUNTY	AL	0	1	2	0.999901
2R5	ST ELMO	AL	0	1	2	0.999888
ASN	TALLADEGA MUNICIPAL	AL	0	1	1	0.999906
TOI	TROY MUNICIPAL	AL	0	1	2	0.999917
TCL	TUSCALOOSA RGNL	AL	0	1	2	0.999850
LIT	ADAMS FIELD	AR	0	1	1	0.999956
M73	ALMYRA MUNICIPAL	AR	0	1	1	0.999924
BYH	ARKANSAS INTL	AR	0	1	1	0.999889
VBT	BENTONVILLE MUNICIPAL	AR	0	1	0	1
HRO	BOONE COUNTY	AR	0	1	1	0.999995
FSM	FORT SMITH RGNL	AR	0	1	1	1
PBF	GRIDER FIELD	AR	0	1	1	0.999938
JBR	JONESBORO MUNICIPAL	AR	0	1	1	0.999914
M19	NEWPORT MUNICIPAL	AR	0	1	1	0.999926
ORK	NORTH LITTLE ROCK MUNICIPAL	AR	0	1	1	0.999957
XNA	NORTHWEST ARKANSAS RGNL	AR	0	1	0	1
BPK	OZARK RGNL	AR	0	1	2	0.999987
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1	0	1
RUE	RUSSELLVILLE RGNL	AR	0	1	1	0.999990
SUZ	SALINE COUNTY RGNL	AR	0	1	1	0.999963
SRC	SEARCY MUNICIPAL	AR	0	1	1	0.999945
SLG	SMITH FIELD	AR	0	1	0	1
ELD	SOUTH ARKANSAS RGNL AT GOODWIN	AR	0	1	1	0.999961
ASG	SPRINGDALE MUNICIPAL	AR	0	1	0	1
SGT	STUTTGART MUNICIPAL	AR	0	1	1	0.999934
ARG	WALNUT RIDGE RGNL	AR	0	1	1	0.999926
PRC	ERNEST A. LOVE FIELD	AZ	0	1	13	0.999775
GEU	GLENDALE MUNICIPAL	AZ	5	0.999939	72	0.995838
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1	1	1
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1	16	0.999574
PGA	PAGE MUNICIPAL	AZ	0	1	0	1
DVT	PHOENIX DEER VALLEY	AZ	5	0.999952	68	0.996689
PHX	PHOENIX SKY HARBOR INTL	AZ	12	0.999773	92	0.993497
IWA	PHOENIX-MESA GATEWAY	AZ	14	0.999759	97	0.993356
SJN	ST JOHNS INDUSTRIAL AIR PARK	AZ	0	1	119	0.996532
TUS	TUCSON INTL	AZ	43	0.999046	95	0.991579
APV	APPLE VALLEY	CA	0	1	36	0.998052
ACV	ARCATA	CA	2	0.999910	112	0.989951
DAG	BARSTOW-DAGGETT	CA	0	1	27	0.998638
C83	BYRON	CA	0	1	162	0.983659
CMA	CAMARILLO	CA	0	1	134	0.980738
CNO	CHINO	CA	0	1	60	0.995913
FAT	FRESNO YOSEMITE INTL	CA	0	1	87	0.991488
WJF	GENERAL WM J FOX AIRFIELD	CA	0	1	63	0.996745
HAF	HALF MOON BAY	CA	7	0.999940	278	0.974274
HWD	HAYWARD EXECUTIVE	CA	3	0.999997	225	0.978739

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
CVH	HOLLISTER MUNICIPAL	CA	0	1	163	0.978865
SNA	JOHN WAYNE AIRPORT-ORANGE COUN	CA	0	1	75	0.993233
LGB	LONG BEACH /DAUGHERTY FIELD	CA	0	1	107	0.990393
LAX	LOS ANGELES INTL	CA	0	1	126	0.987944
MAE	MADERA MUNICIPAL	CA	0	1	89	0.989559
CRQ	MC CLELLAN-PALOMAR	CA	0	1	85	0.992525
BFL	MEADOWS FIELD	CA	0	1	93	0.989962
MCE	MERCED MUNICIPAL/ MACREADY FIELD	CA	0	1	100	0.988617
OAK	METROPOLITAN OAKLAND INTL	CA	3	0.999993	233	0.978299
MOD	MODESTO CITY-CO-HARRY SHAM FLD	CA	0	1	119	0.987433
MRY	MONTEREY PENINSULA	CA	1	0.999952	214	0.973202
APC	NAPA COUNTY	CA	1	0.999998	227	0.980765
O02	NERVINO	CA	0	1	35	0.998920
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	1	0.999998	208	0.978376
VCB	NUT TREE	CA	0	1	197	0.984551
ONT	ONTARIO INTL	CA	0	1	54	0.996305
OXR	OXNARD	CA	0	1	135	0.978538
PMD	PALMDALE RGNL/USAF PLANT 42	CA	0	1	65	0.996901
RBL	RED BLUFF MUNICIPAL	CA	0	1	95	0.994104
RDD	REDDING MUNICIPAL	CA	0	1	77	0.994953
RAL	RIVERSIDE MUNICIPAL	CA	0	1	57	0.996235
SMF	SACRAMENTO INTL	CA	0	1	160	0.990435
MHR	SACRAMENTO MATHER	CA	0	1	135	0.991871
SFO	SAN FRANCISCO INTL	CA	6	0.999982	262	0.976042
SBA	SANTA BARBARA MUNICIPAL	CA	1	0.999998	143	0.974354
TCY	TRACY MUNICIPAL	CA	0	1	145	0.983890
APA	CENTENNIAL	CO	0	1	92	0.990113
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	0	1	91	0.989718
AKO	COLORADO PLAINS RGNL	CO	0	1	91	0.989536
CEZ	CORTEZ MUNICIPAL	CO	0	1	58	0.997539
DEN	DENVER INTL	CO	0	1	92	0.990930
FTG	FRONT RANGE	CO	0	1	92	0.989901
RIL	GARFIELD COUNTY RGNL	CO	0	1	2	0.999956
GXY	GREELEY-WELD COUNTY	CO	0	1	56	0.996710
ITR	KIT CARSON COUNTY	CO	0	1	91	0.991558
LAA	LAMAR MUNICIPAL	CO	0	1	91	0.993330
PUB	PUEBLO MEMORIAL	CO	0	1	91	0.989722
ALS	SAN LUIS VALLEY RGNL/ BERGMAN FIELD	CO	0	1	91	0.989687
HDN	YAMPA VALLEY	CO	0	1	1	0.999940
BDL	BRADLEY INTL	CT	0	1	0	1
GON	GROTON-NEW LONDON	CT	0	1	0	1
HVN	TWEED-NEW HAVEN	CT	0	1	0	1
OXC	WATERBURY-OXFORD	CT	0	1	0	1
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	0	1	0	1
EVY	SUMMIT	DE	0	1	0	1
GED	SUSSEX COUNTY	DE	0	1	0	1
AAF	APALACHICOLA MUNICIPAL	FL	0	1	1	0.999880
CEW	BOB SIKES	FL	0	1	2	0.999896

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
BCT	BOCA RATON	FL	0	1	40	0.998989
PGD	CHARLOTTE COUNTY	FL	0	1	2	0.999738
DAB	DAYTONA BEACH INTL	FL	0	1	2	0.999869
DED	DELAND MUNICIPAL-SIDNEY H TAYLOR FIELD	FL	0	1	2	0.999869
XFL	FLAGLER COUNTY	FL	0	1	1	0.999878
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1	41	0.998539
FLL	FORT LAUDERDALE/HOLLYWOOD INTL	FL	1	0.999995	43	0.998322
GNV	GAINESVILLE RGNL	FL	0	1	1	0.999881
BKV	HERNANDO COUNTY	FL	0	1	2	0.999873
JAX	JACKSONVILLE INTL	FL	0	1	1	0.999915
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	1	0.999983	73	0.997771
EYW	KEY WEST INTL	FL	1	0.999983	125	0.994908
ISM	KISSIMMEE GATEWAY	FL	0	1	2	0.999844
X14	LA BELLE MUNICIPAL	FL	0	1	4	0.999734
LCQ	LAKE CITY MUNICIPAL	FL	0	1	1	0.999907
LAL	LAKELAND LINDER RGNL	FL	0	1	2	0.999845
LEE	LEESBURG INTL	FL	0	1	2	0.999872
MLB	MELBOURNE INTL	FL	0	1	2	0.999810
COI	MERRITT ISLAND	FL	0	1	2	0.999814
MIA	MIAMI INTL	FL	1	0.999983	48	0.997933
APF	NAPLES MUNICIPAL	FL	0	1	24	0.999409
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1	2	0.999858
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1	1	0.999877
MCO	ORLANDO INTL	FL	0	1	2	0.999846
SFB	ORLANDO SANFORD INTL	FL	0	1	2	0.999855
PHK	PALM BEACH CO GLADES	FL	0	1	9	0.999728
PBI	PALM BEACH INTL	FL	0	1	22	0.999525
PFN	PANAMA CITY-BAY CO INTL	FL	0	1	1	0.999897
PNS	PENSACOLA RGNL	FL	0	1	2	0.999884
PMP	POMPANO BEACH AIRPARK	FL	0	1	41	0.998586
SRQ	SARASOTA/BRADENTON INTL	FL	0	1	2	0.999820
RSW	SOUTHWEST FLORIDA INTL	FL	0	1	6	0.999713
FPR	ST LUCIE COUNTY INTL	FL	0	1	2	0.999788
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1	2	0.999855
TLH	TALLAHASSEE RGNL	FL	0	1	1	0.999912
TPA	TAMPA INTL	FL	0	1	2	0.999855
MTH	THE FLORIDA KEYS MARATHON	FL	1	0.999976	137	0.994866
VDF	VANDENBERG	FL	0	1	2	0.999851
GIF	WINTER HAVEN'S GILBERT	FL	0	1	2	0.999831
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	0	1	2	0.999925
BQK	BRUNSWICK GOLDEN ISLES	GA	0	1	1	0.999947
VPC	CARTERSVILLE	GA	0	1	1	0.999934
47A	CHEROKEE COUNTY	GA	0	1	1	0.999943
RYY	COBB COUNTY-MC COLLUM FIELD	GA	0	1	1	0.999938
CSG	COLUMBUS METROPOLITAN	GA	0	1	2	0.999899
15J	COOK COUNTY	GA	0	1	2	0.999930
CKF	CRISP COUNTY-CORDELE	GA	0	1	2	0.999919
DNN	DALTON MUNICIPAL	GA	0	1	1	0.999938
SBO	EMANUEL COUNTY	GA	0	1	2	0.999928
18A	FRANKLIN COUNTY	GA	0	1	2	0.999875

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FTY	FULTON COUNTY AIRPORT-BROWN FIELD	GA	0	1	1	0.999938
ATL	HARTSFIELD - JACKSON ATLANTA	GA	0	1	2	0.999934
EZM	HEART OF GEORGIA RGNL	GA	0	1	2	0.999914
19A	JACKSON COUNTY	GA	0	1	2	0.999905
GVL	LEE GILMER MEMORIAL	GA	0	1	2	0.999945
MCN	MIDDLE GEORGIA RGNL	GA	0	1	2	0.999874
MGR	MOULTRIE MUNICIPAL	GA	0	1	2	0.999927
CCO	NEWNAN COWETA COUNTY	GA	0	1	1	0.999930
FFC	PEACHTREE CITY-FALCON FIELD	GA	0	1	2	0.999921
PXE	PERRY-HOUSTON COUNTY	GA	0	1	2	0.999886
JZP	PICKENS COUNTY	GA	0	1	1	0.999944
JYL	PLANTATION ARPK	GA	0	1	2	0.999967
SAV	SAVANNAH/HILTON HEAD INTL	GA	0	1	0	1
ACJ	SOUTHER FIELD	GA	0	1	2	0.999910
ABY	SOUTHWEST GEORGIA RGNL	GA	0	1	3	0.999912
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1	2	0.999971
MQW	TELFAIR-WHEELER	GA	0	1	2	0.999934
TVI	THOMASVILLE RGNL	GA	0	1	2	0.999918
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1	2	0.999939
VLD	VALDOSTA RGNL	GA	0	1	1	0.999924
VDI	VIDALIA RGNL	GA	0	1	2	0.999956
IIY	WASHINGTON-WILKES COUNTY	GA	0	1	2	0.999886
AYS	WAYCROSS-WARE COUNTY	GA	0	1	2	0.999940
CTJ	WEST GEORGIA RGNL – O V GRAY FIELD	GA	0	1	1	0.999925
WDR	WINDER-BARROW	GA	0	1	2	0.999885
IKV	ANKENY RGNL	IA	0	1	2	0.999867
CBF	COUNCIL BLUFFS MUNICIPAL	IA	0	1	1	0.999939
DVN	DAVENPORT MUNICIPAL	IA	0	1	1	0.999999
DNS	DENISON MUNICIPAL	IA	0	1	1	0.999913
DSM	DES MOINES INTL	IA	0	1	2	0.999875
DBQ	DUBUQUE RGNL	IA	0	1	1	0.999999
EST	ESTHERVILLE MUNICIPAL	IA	0	1	3	0.999854
FFL	FAIRFIELD MUNICIPAL	IA	0	1	1	0.999999
GGI	GRINNELL RGNL	IA	0	1	1	0.999999
EOK	KEOKUK MUNICIPAL	IA	0	1	1	0.999999
MCW	MASON CITY MUNICIPAL	IA	0	1	2	0.999827
MXO	MONTICELLO RGNL	IA	0	1	1	0.999999
MUT	MUSCATINE MUNICIPAL	IA	0	1	1	0.999999
TNU	NEWTON MUNICIPAL	IA	0	1	2	0.999917
OTM	OTTUMWA INDUSTRIAL	IA	0	1	1	0.999999
PRO	PERRY MUNICIPAL	IA	0	1	1	0.999879
SDA	SHENANDOAH MUNICIPAL	IA	0	1	0	1
SLB	STORM LAKE MUNICIPAL	IA	0	1	1	0.999896
CID	THE EASTERN IOWA	IA	0	1	1	0.999999
ALO	WATERLOO RGNL	IA	0	1	2	0.999957
BOI	BOISE AIR TERMINAL/GOWEN FLD	ID	0	1	1	0.999970
EUL	CALDWELL INDUSTRIAL	ID	0	1	1	0.999958
GNG	GOODING MUNICIPAL	ID	0	1	0	1
IDA	IDAHO FALLS RGNL	ID	0	1	1	0.999964
LWS	LEWISTON-NEZ PERCE COUNTY	ID	0	1	1	0.999916

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S67	NAMPA MUNICIPAL	ID	0	1	1	0.999963
PIH	POCATELLO RGNL	ID	0	1	1	0.999983
SPI	ABRAHAM LINCOLN CAPITAL	IL	0	1	0	1
FEP	ALBERTUS	IL	0	1	1	0.999999
ARR	AURORA MUNICIPAL	IL	0	1	0	1
BMI	CENTRAL IL REGL ARPT AT BLOOMI	IL	0	1	0	1
ENL	CENTRALIA MUNICIPAL	IL	0	1	2	0.999995
MDW	CHICAGO MIDWAY INTL	IL	0	1	0	1
ORD	CHICAGO O'HARE INTL	IL	0	1	0	1
RFD	CHICAGO/ROCKFORD INTL	IL	0	1	1	0.999999
DKB	DE KALB TAYLOR MUNICIPAL	IL	0	1	0	1
DEC	DECATUR	IL	0	1	1	0.999994
FOA	FLORA MUNICIPAL	IL	0	1	1	0.999998
IKK	GREATER KANKAKEE	IL	0	1	1	0.999997
PIA	GREATER PEORIA RGNL	IL	0	1	0	1
IGQ	LANSING MUNICIPAL	IL	0	1	1	0.999997
LOT	LEWIS UNIVERSITY	IL	0	1	0	1
3LF	LITCHFIELD MUNICIPAL	IL	0	1	1	0.999997
C15	PEKIN MUNICIPAL	IL	0	1	0	1
PPQ	PITTSFIELD PENSTONE MUNICIPAL	IL	0	1	1	0.999999
PNT	PONTIAC MUNICIPAL	IL	0	1	0	1
MLI	QUAD CITY INTL	IL	0	1	1	0.999999
UIN	QUINCY RGNL-BALDWIN FIELD	IL	0	1	1	0.999999
TIP	RANTOUL NATL AVN CNTR	IL	0	1	1	0.999990
RSV	ROBINSON MUNICIPAL	IL	0	1	1	1
SLO	SALEM-LECKRONE	IL	0	1	1	0.999994
ALN	ST LOUIS RGNL	IL	0	1	1	0.999999
DNV	VERMILION COUNTY	IL	0	1	1	0.999985
UGN	WAUKEGAN RGNL	IL	0	1	0	1
MWA	WILLIAMSON COUNTY RGNL	IL	0	1	1	0.999968
BAK	COLUMBUS MUNICIPAL	IN	0	1	0	1
GWB	DE KALB COUNTY	IN	0	1	1	0.999986
MIE	DELAWARE COUNTY - JOHNSON FIELD	IN	0	1	0	1
EYE	EAGLE CREEK AIRPARK	IN	0	1	0	1
EKM	ELKHART MUNICIPAL	IN	0	1	1	0.999990
FWA	FORT WAYNE INTL	IN	0	1	1	0.999992
SER	FREEMAN MUNICIPAL	IN	0	1	0	1
RCR	FULTON COUNTY	IN	0	1	1	0.999989
GSH	GOSHEN MUNICIPAL	IN	0	1	1	0.999991
HFY	GREENWOOD MUNICIPAL	IN	0	1	0	1
TYQ	INDIANAPOLIS EXECUTIVE	IN	0	1	1	0.999999
IND	INDIANAPOLIS INTL	IN	0	1	0	1
GGP	LOGANSPORT/CASS COUNTY	IN	0	1	1	0.999986
IMS	MADISON MUNICIPAL	IN	0	1	0	1
MZZ	MARION MUNICIPAL	IN	0	1	1	0.999997
CEV	METTEL FIELD	IN	0	1	0	1
BMG	MONROE COUNTY	IN	0	1	0	1
VPZ	PORTER COUNTY MUNICIPAL	IN	0	1	1	0.999995
LAF	PURDUE UNIVERSITY	IN	0	1	1	0.999984
4I7	PUTNAM COUNTY	IN	0	1	1	0.999998
GEZ	SHELBYVILLE MUNICIPAL	IN	0	1	0	1
SBN	SOUTH BEND RGNL	IN	0	1	1	0.999992

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OXI	STARKE COUNTY	IN	0	1	1	0.999993
ANQ	TRI-STATE STEUBEN COUNTY	IN	0	1	1	0.999986
PTS	ATKINSON MUNICIPAL	KS	0	1	0	1
AAO	COLONEL JAMES JABARA	KS	0	1	1	0.999977
DDC	DODGE CITY RGNL	KS	0	1	10	0.999856
EMP	EMPORIA MUNICIPAL	KS	0	1	0	1
FOE	FORBES FIELD	KS	0	1	0	1
FSK	FORT SCOTT MUNICIPAL	KS	0	1	0	1
GCK	GARDEN CITY RGNL	KS	0	1	53	0.999087
HYS	HAYS RGNL	KS	0	1	2	0.999953
HQG	HUGOTON MUNICIPAL	KS	0	1	48	0.999212
OJC	JOHNSON COUNTY EXECUTIVE	KS	0	1	0	1
LWC	LAWRENCE MUNICIPAL	KS	0	1	0	1
LBL	LIBERAL MID-AMERICA RGNL	KS	0	1	19	0.999737
MHK	MANHATTAN RGNL	KS	0	1	0	1
MPR	MC PHERSON	KS	0	1	1	0.999992
IXD	NEW CENTURY AIRCENTER	KS	0	1	0	1
EWK	NEWTON-CITY-COUNTY	KS	0	1	1	0.999981
OEL	OAKLEY MUNICIPAL	KS	0	1	92	0.996021
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1	0	1
PTT	PRATT INDUSTRIAL	KS	0	1	2	0.999915
GLD	RENNER FLD /GOODLAND MUNICIPAL	KS	0	1	91	0.992788
RSL	RUSSELL MUNICIPAL	KS	0	1	2	0.999997
SLN	SALINA MUNICIPAL	KS	0	1	2	0.999995
TQK	SCOTT CITY MUNICIPAL	KS	0	1	91	0.997525
CBK	SHALZ FIELD	KS	0	1	92	0.994555
WLD	STROTHER FIELD	KS	0	1	1	0.999966
PPF	TRI-CITY	KS	0	1	0	1
ULS	ULYSSES	KS	0	1	76	0.998401
EGT	WELLINGTON MUNICIPAL	KS	0	1	1	0.999976
ICT	WICHITA MID-CONTINENT	KS	0	1	1	0.999980
EKX	ADDINGTON FIELD	KY	0	1	1	0.999995
PAH	BARKLEY RGNL	KY	0	1	1	0.999945
K22	BIG SANDY RGNL	KY	0	1	0	1
LEX	BLUE GRASS	KY	0	1	0	1
LOU	BOWMAN FIELD	KY	0	1	0	1
CVG	CINCINNATI/NORTHERN KENTUCKY	KY	0	1	0	1
27K	GEORGETOWN SCOTT COUNTY - MARS	KY	0	1	0	1
GLW	GLASGOW MUNICIPAL	KY	0	1	1	0.999974
EHR	HENDERSON CITY-COUNTY	KY	0	1	1	0.999986
SME	LAKE CUMBERLAND RGNL	KY	0	1	1	0.999985
LOZ	LONDON-CORBIN ARPT-MAGEE FLD	KY	0	1	1	0.999992
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	0	1	0	1
OWB	OWENSBORO-DAVIESS COUNTY	KY	0	1	1	0.999989
DVK	STUART POWELL FIELD	KY	0	1	1	1
W38	WILLIAMSBURG-WHITLEY COUNTY	KY	0	1	1	0.999982
ARA	ACADIANA RGNL	LA	0	1	1	0.999968
AEX	ALEXANDRIA INTL	LA	0	1	2	0.999937
BTR	BATON ROUGE METROPOLITAN RYAN	LA	0	1	2	0.999947
DRI	BEAUREGARD RGNL	LA	0	1	1	0.999969
CWF	CHENNAULT INTL	LA	0	1	1	0.999966
ESF	ESLER RGNL	LA	0	1	2	0.999934

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HZR	FALSE RIVER RGNL	LA	0	1	2	0.999952
PTN	HARRY P WILLIAMS MEMORIAL	LA	0	1	2	0.999953
LFT	LAFAYETTE RGNL	LA	0	1	1	0.999964
LCH	LAKE CHARLES RGNL	LA	0	1	1	0.999968
NEW	LAKEFRONT	LA	0	1	2	0.999910
MSY	LOUIS ARMSTRONG NEW ORLEANS	LA	0	1	2	0.999917
BQP	MOREHOUSE MEMORIAL	LA	0	1	1	0.999929
DTN	SHREVEPORT DOWNTOWN	LA	0	1	2	0.999953
SHV	SHREVEPORT RGNL	LA	0	1	2	0.999957
GAO	SOUTH LAFOURCHE LEONARD MILLER	LA	0	1	2	0.999928
TVR	VICKSBURG TALLULAH RGNL	LA	0	1	1	0.999919
BAF	BARNES MUNICIPAL	MA	0	1	0	1
HYA	BARNSTABLE MUNICIPAL - BOARDMAN/POLAN	MA	0	1	0	1
BOS	GENERAL EDWARD LAWRENCE LOGAN	MA	0	1	0	1
BED	LAURENCE G HANSCOM FLD	MA	0	1	0	1
MVY	MARTHAS VINEYARD	MA	0	1	0	1
OWD	NORWOOD MEMORIAL	MA	0	1	0	1
PVC	PROVINCETOWN MUNICIPAL	MA	0	1	0	1
ORH	WORCESTER RGNL	MA	0	1	0	1
BWI	BALTIMORE/WASHINGTON INTL	MD	0	1	0	1
DMW	CARROLL COUNTY RGNL	MD	0	1	0	1
ESN	EASTON/NEWNAM FIELD	MD	0	1	0	1
FDK	FREDERICK MUNICIPAL	MD	0	1	0	1
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1	0	1
2W6	ST. MARY'S COUNTY RGNL	MD	0	1	1	0.999998
LEW	AUBURN/LEWISTON MUNICIPAL	ME	0	1	0	1
AUG	AUGUSTA STATE	ME	0	1	0	1
BGR	BANGOR INTL	ME	0	1	0	1
BHB	HANCOCK COUNTY-BAR HARBOR	ME	0	1	0	1
PQI	NORTHERN MAINE RGNL ARPT	ME	0	1	1	0.999996
PWM	PORTLAND INTL JETPORT	ME	0	1	0	1
WVL	WATERVILLE ROBERT LAFLEUR	ME	0	1	0	1
ARB	ANN ARBOR MUNICIPAL	MI	0	1	1	0.999979
ACB	ANTRIM COUNTY	MI	0	1	1	1
FNT	BISHOP INTL	MI	0	1	1	0.999983
OEB	BRANCH COUNTY MEMORIAL	MI	0	1	1	0.999988
CVX	CHARLEVOIX MUNICIPAL	MI	0	1	1	0.999992
CIU	CHIPPEWA COUNTY INTL	MI	0	1	1	0.999987
TTF	CUSTER	MI	0	1	1	0.999990
DTW	DETROIT METROPOLITAN WAYNE COUNTY	MI	0	1	1	0.999981
FFX	FREMONT MUNICIPAL	MI	0	1	0	1
GRR	GERALD R. FORD INTL	MI	0	1	1	0.999987
CMX	HOUGHTON COUNTY MEMORIAL	MI	0	1	3	0.999940
BAX	HURON COUNTY MEMORIAL	MI	0	1	1	0.999999
AZO	KALAMAZOO/BATTLE CREEK INTL	MI	0	1	1	0.999989
ADG	LENAWEE COUNTY	MI	0	1	1	0.999982
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	0	1	1	0.999984
LDM	MASON COUNTY	MI	0	1	0	1
MBS	MBS INTL	MI	0	1	1	0.999996
MKG	MUSKEGON COUNTY	MI	0	1	1	0.999998

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
RNP	OWOSSO COMMUNITY	MI	0	1	1	0.999982
HYX	SAGINAW COUNTY H.W. BROWNE	MI	0	1	1	0.999992
BIV	TULIP CITY	MI	0	1	1	0.999992
YIP	WILLOW RUN	MI	0	1	1	0.999979
AEL	ALBERT LEA MUNICIPAL	MN	0	1	2	0.999815
ANE	ANOKA COUNTY-BLAINE ARPT	MN	1	0.999904	4	0.999729
AUM	AUSTIN MUNICIPAL	MN	0	1	2	0.999817
BDE	BAUDETTE INTL	MN	1	0.999982	5	0.999553
BRD	BRAINERD LAKES RGNL	MN	1	0.999844	5	0.999627
AXN	CHANDLER FIELD	MN	1	0.999871	5	0.999625
HIB	CHISHOLM-HIBBING	MN	0	1	5	0.999647
CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	1	0.999891	3	0.999580
DTL	DETROIT LAKES-WETHING FIELD	MN	1	0.999879	4	0.999556
DLH	DULUTH INTL	MN	0	1	5	0.999885
INL	FALLS INTL	MN	0	1	4	0.999549
MSP	MINNEAPOLIS-ST PAUL INTL	MN	1	0.999908	4	0.999761
RGK	RED WING RGNL	MN	0	1	2	0.999869
RST	ROCHESTER INTL	MN	0	1	2	0.999871
ROX	ROSEAU MUNICIPAL/ RUDY BILLBERG FIELD	MN	0	1	4	0.999649
MML	SOUTHWEST MINNESOTA RGNL MARSH	MN	1	0.999884	5	0.999696
STC	ST CLOUD RGNL	MN	1	0.999843	4	0.999692
JYG	ST JAMES MUNICIPAL	MN	1	0.999856	4	0.999804
STP	ST PAUL DOWNTOWN HOLMAN FLD	MN	0	1	4	0.999770
RRT	WARROAD INTL MEMORIAL	MN	1	0.999998	4	0.999662
BDH	WILLMAR MUNICIPAL- JOHN L RICE FIELD	MN	1	0.999867	5	0.999671
M17	BOLIVAR MUNICIPAL	MO	0	1	0	1
CGI	CAPE GIRARDEAU RGNL	MO	0	1	1	0.999946
M05	CARUTHERSVILLE MEMORIAL	MO	0	1	1	0.999898
MKC	CHARLES B. WHEELER DOWNTOWN	MO	0	1	0	1
COU	COLUMBIA RGNL	MO	1	0.999999	1	0.999999
1H0	CREVE COEUR	MO	0	1	0	1
DXE	DEXTER MUNICIPAL	MO	0	1	1	0.999919
LBO	FLOYD W. JONES LEBANON	MO	0	1	0	1
K57	GOULD PETERSON MUNICIPAL	MO	0	1	0	1
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	0	1	0	1
JEF	JEFFERSON CITY MEMORIAL	MO	1	0.999999	1	0.999999
VER	JESSE VIERTEL MEMORIAL	MO	0	1	0	1
JLN	JOPLIN RGNL	MO	0	1	0	1
MCI	KANSAS CITY INTL	MO	0	1	0	1
TKX	KENNETT MEMORIAL	MO	0	1	1	0.999898
IRK	KIRKSVILLE RGNL	MO	1	0.999999	1	0.999999
STL	LAMBERT-ST LOUIS INTL	MO	0	1	0	1
LRY	LAWRENCE SMITH MEMORIAL	MO	0	1	0	1
AIZ	LEE C FINE MEMORIAL	MO	0	1	0	1
LXT	LEE'S SUMMIT MUNICIPAL	MO	0	1	0	1
6M6	LEWIS COUNTY RGNL	MO	0	1	1	0.999999
MHL	MARSHALL MEMORIAL MUNICIPAL	MO	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MYJ	MEXICO MEMORIAL	MO	1	0.999999	1	0.999999
GPH	MIDWEST NATIONAL AIR CENTER	MO	0	1	0	1
M58	MONETT MUNICIPAL	MO	0	1	0	1
EOS	NEOSHO HUGH ROBINSON	MO	0	1	0	1
POF	POPLAR BLUFF MUNICIPAL	MO	0	1	1	0.999918
STJ	ROSECRANS MEMORIAL	MO	0	1	0	1
DMO	SEDALIA MEMORIAL	MO	0	1	0	1
SIK	SIKESTON MEMORIAL MUNICIPAL	MO	0	1	1	0.999930
RCM	SKYHAVEN	MO	0	1	0	1
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	0	1	0	1
TBN	WAYNESVILLE RGNL ARPT AT FORNE	MO	0	1	0	1
UNO	WEST PLAINS MUNICIPAL	MO	0	1	2	0.999965
STF	GEORGE M BRYAN	MS	0	1	2	0.999876
GTR	GOLDEN TRIANGLE RGNL	MS	0	1	2	0.999866
GWO	GREENWOOD-LEFLORE	MS	0	1	1	0.999894
GNF	GRENADA MUNICIPAL	MS	0	1	1	0.999885
GPT	GULFPORT-BILOXI INTL	MS	0	1	2	0.999896
HEZ	HARDY-ANDERS FIELD NATCHEZ-ADA	MS	0	1	1	0.999933
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	0	1	2	0.999889
PIB	HATTIESBURG-LAUREL RGNL	MS	0	1	2	0.999893
LUL	HESLER-NOBLE FIELD	MS	0	1	2	0.999888
JAN	JACKSON-EVERS INTL	MS	0	1	2	0.999912
M16	JOHN BELL WILLIAMS	MS	0	1	1	0.999916
MEI	KEY FIELD	MS	0	1	2	0.999884
MCB	MC COMB/PIKE COUNTY	MS	0	1	2	0.999923
M40	MONROE COUNTY	MS	0	1	2	0.999858
OLV	OLIVE BRANCH	MS	0	1	1	0.999882
MJD	PICAYUNE MUNICIPAL	MS	0	1	2	0.999895
M43	PRENTISS-JEFFERSON DAVIS COUNT	MS	0	1	2	0.999905
CRX	ROSCOE TURNER	MS	0	1	2	0.999852
HSA	STENNIS INTL	MS	0	1	2	0.999897
PQL	TRENT LOTT INTL	MS	0	1	2	0.999892
UTA	TUNICA MUNICIPAL	MS	0	1	1	0.999892
UOX	UNIVERSITY-OXFORD	MS	0	1	1	0.999875
BTM	BERT MOONEY	MT	0	1	2	0.999903
BIL	BILLINGS LOGAN INTL	MT	0	1	1	0.999868
MLS	FRANK WILEY FIELD	MT	0	1	3	0.999874
GPI	GLACIER PARK INTL	MT	0	1	3	0.999759
GTF	GREAT FALLS INTL	MT	0	1	2	0.999848
HLN	HELENA RGNL	MT	0	1	2	0.999875
LWT	LEWISTOWN MUNICIPAL	MT	0	1	1	0.999862
OAJ	ALBERT J ELLIS	NC	0	1	1	0.999990
AFP	ANSON COUNTY	NC	0	1	1	0.999968
HBI	ASHEBORO RGNL	NC	0	1	1	0.999956
AVL	ASHEVILLE RGNL	NC	0	1	1	0.999981
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1	1	0.999940
JQF	CONCORD RGNL	NC	0	1	1	0.999942
EWN	CRAVEN COUNTY RGNL	NC	0	1	0	1
ECG	ELIZABETH CITY CG AIR STATION	NC	0	1	0	1
FAY	FAYETTEVILLE RGNL/GRANNIS FIELD	NC	0	1	0	1
LHZ	FRANKLIN COUNTY	NC	0	1	1	0.999999

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
AKH	GASTONIA MUNICIPAL	NC	0	1	1	0.999936
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	0	1	0	1
HRJ	HARNETT RGNL JETPORT	NC	0	1	0	1
HNZ	HENDERSON-OXFORD	NC	0	1	1	0.999982
ISO	KINSTON RGNL JETPORT	NC	0	1	0	1
EQY	MONROE RGNL	NC	0	1	1	0.999948
EDE	NORTHEASTERN RGNL	NC	0	1	0	1
GSO	PIEDMONT TRIAD INTL	NC	0	1	1	0.999946
PGV	PITT-GREENVILLE	NC	0	1	0	1
RDU	RALEIGH-DURHAM INTL	NC	0	1	1	0.999988
RWI	ROCKY MOUNT-WILSON RGNL	NC	0	1	0	1
RUQ	ROWAN COUNTY	NC	0	1	1	0.999943
TTA	SANFORD-LEE COUNTY RGNL	NC	0	1	1	0.999986
SVH	STATESVILLE RGNL	NC	0	1	1	0.999936
ILM	WILMINGTON INTL	NC	0	1	0	1
BIS	BISMARCK MUNICIPAL	ND	0	1	3	0.999920
5N8	CASSELTON ROBERT MILLER RGNL	ND	1	0.999905	3	0.999614
DVL	DEVILS LAKE RGNL	ND	0	1	5	0.999657
DIK	DICKINSON - THEODORE ROOSEVELT	ND	0	1	3	0.999900
GFK	GRAND FORKS INTL	ND	1	0.999901	4	0.999619
FAR	HECTOR INTL	ND	1	0.999897	4	0.999611
JMS	JAMESTOWN RGNL	ND	1	0.999962	4	0.999752
MOT	MINOT INTL	ND	1	0.999992	5	0.999885
ANW	AINSWORTH MUNICIPAL	NE	0	1	8	0.999945
BVN	ALBION MUNICIPAL	NE	0	1	2	0.999998
AIA	ALLIANCE MUNICIPAL	NE	0	1	31	0.999506
AUH	AURORA MUNICIPAL – AL POTTER FIELD	NE	0	1	2	0.999998
BIE	BEATRICE MUNICIPAL	NE	0	1	0	1
FNB	BRENNER FIELD	NE	0	1	0	1
HDE	BREWSTER FIELD	NE	0	1	2	0.999998
BBW	BROKEN BOW MUNICIPAL	NE	0	1	2	0.999998
GRI	CENTRAL NEBRASKA RGNL	NE	0	1	2	0.999998
CDR	CHADRON MUNICIPAL	NE	0	1	3	0.999963
OLU	COLUMBUS MUNICIPAL	NE	0	1	3	0.999983
CZD	COZAD MUNICIPAL	NE	0	1	2	0.999998
CEK	CRETE MUNICIPAL	NE	0	1	0	1
OMA	EPPLEY AIRFIELD	NE	0	1	1	0.999943
FBY	FAIRBURY MUNICIPAL	NE	0	1	1	0.999999
FET	FREMONT MUNICIPAL	NE	0	1	1	0.999959
OKS	GARDEN COUNTY	NE	0	1	92	0.996449
GRN	GORDON MUNICIPAL	NE	0	1	3	0.999974
GGF	GRANT MUNICIPAL	NE	0	1	83	0.997556
HSI	HASTINGS MUNICIPAL	NE	0	1	2	0.999998
IML	IMPERIAL MUNICIPAL	NE	0	1	91	0.993926
LXN	JIM KELLY FIELD	NE	0	1	2	0.999998
OFK	KARL STEFAN MEMORIAL	NE	0	1	3	0.999974
EAR	KEARNEY RGNL	NE	0	1	2	0.999998
IBM	KIMBALL MUNICIPAL/ ROBERT E ARRAJ FIELD	NE	0	1	56	0.996697
LNK	LINCOLN	NE	0	1	1	0.999979
MCK	MC COOK RGNL	NE	0	1	3	0.999954

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MLE	MILLARD	NE	0	1	1	0.999952
VTN	MILLER FIELD	NE	0	1	9	0.999882
AFK	NEBRASKA CITY MUNICIPAL	NE	0	1	0	1
LBF	NORTH PLATTE RGNL AIRPORT	NE	0	1	2	0.999998
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1	1	0.999950
SCB	SCRIBNER STATE	NE	0	1	2	0.999959
OGA	SEARLE FIELD	NE	0	1	51	0.999067
SWT	SEWARD MUNICIPAL	NE	0	1	2	0.999989
SNY	SIDNEY MUNICIPAL/ LLOYD W. CARR FIELD	NE	0	1	92	0.989467
ONL	THE O'NEILL MUNICIPAL- JOHN L BAKER	NE	0	1	3	0.999982
AHQ	WAHOO MUNICIPAL	NE	0	1	1	0.999966
LCG	WAYNE MUNICIPAL	NE	0	1	3	0.999955
BFF	WESTERN NEB. RGNL	NE	0	1	2	0.999951
JYR	YORK MUNICIPAL	NE	0	1	2	0.999998
ASH	BOIRE FIELD	NH	0	1	0	1
CON	CONCORD MUNICIPAL	NH	0	1	0	1
EEN	DILLANT-HOPKINS	NH	0	1	0	1
LCI	LACONIA MUNICIPAL	NH	0	1	0	1
MHT	MANCHESTER	NH	0	1	0	1
PSM	PORTSMOUTH INTL AT PEASE	NH	0	1	0	1
ACY	ATLANTIC CITY INTL	NJ	0	1	0	1
WWD	CAPE MAY COUNTY	NJ	0	1	0	1
MIV	MILLVILLE MUNICIPAL	NJ	0	1	0	1
EWR	NEWARK LIBERTY INTL	NJ	0	1	0	1
TEB	TETERBORO	NJ	0	1	0	1
ABQ	ALBUQUERQUE INTL SUNPORT	NM	0	1	91	0.991814
CVN	CLOVIS MUNICIPAL	NM	0	1	11	0.999873
AEG	DOUBLE EAGLE II	NM	0	1	91	0.991397
FMN	FOUR CORNERS RGNL	NM	0	1	92	0.991912
SVC	GRANT COUNTY	NM	0	1	125	0.998156
LRU	LAS CRUCES INTL	NM	0	1	26	0.999689
ROW	ROSWELL INTL AIR CENTER	NM	0	1	38	0.999447
LAS	MC CARRAN INTL	NV	0	1	9	0.999848
4SD	RENO/STEAD	NV	0	1	25	0.999351
RNO	RENO/TAHOE INTL	NV	0	1	26	0.999375
WMC	WINNEMUCCA MUNICIPAL	NV	0	1	0	1
9G3	AKRON	NY	0	1	0	1
ALB	ALBANY INTL	NY	0	1	0	1
HWV	BROOKHAVEN	NY	0	1	0	1
BUF	BUFFALO NIAGARA INTL	NY	0	1	0	1
OLE	CATTARAUGUS COUNTY-OLEAN	NY	0	1	0	1
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	0	1	0	1
ELM	ELMIRA/CORNING RGNL	NY	0	1	0	1
FOK	FRANCIS S GABRESKI	NY	0	1	0	1
BGM	GREATER BINGHAMTON/EDWIN A LIN	NY	0	1	0	1
ROC	GREATER ROCHESTER INTL	NY	0	1	0	1
JFK	JOHN F KENNEDY INTL	NY	0	1	0	1
LGA	LA GUARDIA	NY	0	1	0	1
MSS	MASSENA INTL-RICHARDS FIELD	NY	0	1	0	1
N66	ONEONTA MUNICIPAL	NY	0	1	0	1

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PEO	PENN YAN	NY	0	1	0	1
PBG	PLATTSBURGH INTL	NY	0	1	0	1
44N	SKY ACRES	NY	0	1	0	1
SWF	STEWART INTL	NY	0	1	0	1
SYR	SYRACUSE HANCOCK INTL	NY	0	1	0	1
ELZ	WELLSVILLE MUNICIPAL ARPT`TARANTINE	NY	0	1	0	1
HPN	WESTCHESTER COUNTY	NY	0	1	0	1
SDC	WILLIAMSON-SODUS	NY	0	1	0	1
HAO	BUTLER CO RGNL	OH	0	1	0	1
CXY	CAPITAL CITY	OH	0	1	0	1
LUK	CINCINNATI MUNICIPAL AIRPORT LUNKEN	OH	0	1	0	1
CLE	CLEVELAND-HOPKINS INTL	OH	0	1	0	1
MGY	DAYTON-WRIGHT BROTHERS	OH	0	1	0	1
DLZ	DELAWARE MUNICIPAL	OH	0	1	0	1
LHQ	FAIRFIELD COUNTY	OH	0	1	0	1
FDY	FINDLAY	OH	0	1	0	1
PMH	GREATER PORTSMOUTH RGNL	OH	0	1	0	1
I19	GREENE COUNTY-LEWIS A. JACKSON	OH	0	1	0	1
DAY	JAMES M COX DAYTON INTL	OH	0	1	0	1
1G3	KENT STATE UNIV	OH	0	1	0	1
I68	LEBANON-WARREN COUNTY	OH	0	1	0	1
UYF	MADISON COUNTY	OH	0	1	0	1
MNN	MARION MUNICIPAL	OH	0	1	0	1
AXV	NEIL ARMSTRONG	OH	0	1	0	1
OSU	OHIO STATE UNIVERSITY	OH	0	1	0	1
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	0	1	0	1
CMH	PORT COLUMBUS INTL	OH	0	1	0	1
RZT	ROSS COUNTY	OH	0	1	0	1
TOL	TOLEDO EXPRESS	OH	0	1	1	0.999996
1G0	WOOD COUNTY	OH	0	1	0	1
YNG	YOUNGSTOWN-WARREN RGNL	OH	0	1	0	1
AVK	ALVA RGNL	OK	0	1	1	0.999822
BVO	BARTLESVILLE MUNICIPAL	OK	0	1	1	0.999966
CQB	CHANDLER RGNL	OK	0	1	1	0.999863
CHK	CHICKASHA MUNICIPAL	OK	0	1	1	0.999868
GCM	CLAREMORE RGNL	OK	0	1	1	0.999980
F29	CLARENCE E PAGE MUNICIPAL	OK	0	1	1	0.999860
1K4	DAVID JAY PERRY	OK	0	1	1	0.999871
MKO	DAVIS FIELD	OK	0	1	1	0.999955
DUA	EAKER FIELD	OK	1	0.999983	1	0.999914
ELK	ELK CITY RGNL BUSINESS	OK	0	1	1	0.999844
GMJ	GROVE MUNICIPAL	OK	0	1	0	1
GOK	GUTHRIE-EDMOND RGNL	OK	0	1	1	0.999855
2O8	HINTON MUNICIPAL	OK	0	1	1	0.999854
HBR	HOBART RGNL	OK	0	1	1	0.999859
MLC	MC ALESTER RGNL	OK	1	0.999982	1	0.999915
MIO	MIAMI MUNICIPAL	OK	0	1	0	1
MDF	MOORELAND MUNICIPAL	OK	0	1	1	0.999938
OKM	OKMULGEE RGNL	OK	1	0.999996	1	0.999929
PVJ	PAULS VALLEY MUNICIPAL	OK	0	1	1	0.999884

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PNC	PONCA CITY RGNL	OK	0	1	1	0.999863
RVS	RICHARD LLOYD JONES JR	OK	0	1	1	0.999934
2K4	SCOTT FIELD	OK	0	1	1	0.999856
SNL	SHAWNEE RGNL	OK	0	1	1	0.999871
SWO	STILLWATER RGNL	OK	0	1	1	0.999850
TQH	TAHLEQUAH MUNICIPAL	OK	0	1	1	0.999996
TUL	TULSA INTL	OK	0	1	1	0.999944
OUN	UNIVERSITY OF OKLAHOMA WESTHEI	OK	0	1	1	0.999868
OKC	WILL ROGERS WORLD	OK	0	1	1	0.999864
UAO	AURORA STATE	OR	1	0.999886	6	0.999550
BDN	BEND MUNICIPAL	OR	1	0.999990	5	0.999714
LMT	KLAMATH FALLS	OR	0	1	22	0.998469
LGD	LA GRANDE/UNION COUNTY	OR	0	1	1	0.999927
EUG	MAHLON SWEET FIELD	OR	1	0.999921	12	0.999157
MMV	MC MINNVILLE MUNICIPAL	OR	1	0.999877	6	0.999504
SLE	MCNARY FLD	OR	1	0.999908	7	0.999487
ONP	NEWPORT MUNICIPAL	OR	1	0.999894	13	0.998960
ONO	ONTARIO MUNICIPAL	OR	0	1	1	0.999938
PDX	PORTLAND INTL	OR	1	0.999872	3	0.999609
AGC	ALLEGHENY COUNTY	PA	0	1	0	1
AOO	ALTOONA-BLAIR COUNTY	PA	0	1	0	1
LBE	ARNOLD PALMER RGNL	PA	0	1	0	1
BFD	BRADFORD RGNL	PA	0	1	0	1
BTP	BUTLER COUNTY/ K W SCHOLTER FIELD	PA	0	1	0	1
MQS	CHESTER COUNTY G O CARLSON	PA	0	1	0	1
AXQ	CLARION COUNTY	PA	0	1	0	1
9D4	DECK	PA	0	1	0	1
DUJ	DUBOIS RGNL	PA	0	1	0	1
WAY	GREENE COUNTY	PA	0	1	0	1
HZL	HAZLETON MUNICIPAL	PA	0	1	0	1
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	0	1	0	1
LNS	LANCASTER	PA	0	1	0	1
ABE	LEHIGH VALLEY INTL	PA	0	1	0	1
RVL	MIFFLIN COUNTY	PA	0	1	0	1
UCP	NEW CASTLE MUNICIPAL	PA	0	1	0	1
PNE	NORTHEAST PHILADELPHIA	PA	0	1	0	1
PHL	PHILADELPHIA INTL	PA	0	1	0	1
PIT	PITTSBURGH INTL	PA	0	1	0	1
FWQ	ROSTRAVER	PA	0	1	0	1
2G9	SOMERSET COUNTY	PA	0	1	0	1
OYM	ST MARYS MUNICIPAL	PA	0	1	0	1
UNV	UNIVERSITY PARK	PA	0	1	0	1
FKL	VENANGO RGNL	PA	0	1	0	1
BID	BLOCK ISLAND STATE	RI	0	1	0	1
OQU	QUONSET STATE	RI	0	1	0	1
PVD	THEODORE FRANCIS GREEN STATE	RI	0	1	0	1
AIK	AIKEN MUNICIPAL	SC	0	1	2	0.999933
AND	ANDERSON RGNL	SC	0	1	2	0.999889
CHS	CHARLESTON AFB/INTL	SC	0	1	0	1
JZI	CHARLESTON EXECUTIVE	SC	0	1	0	1
CAE	COLUMBIA METROPOLITAN	SC	0	1	2	0.999958

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UDG	DARLINGTON COUNTY JETPORT	SC	0	1	1	0.999993
GYH	DONALDSON CENTER	SC	0	1	2	0.999900
GGE	GEORGETOWN COUNTY	SC	0	1	0	1
GSP	GREENVILLE SPARTANBURG INTL	SC	0	1	2	0.999905
MYR	MYRTLE BEACH INTL	SC	0	1	0	1
CEU	OCONEE COUNTY RGNL	SC	0	1	2	0.999883
CDN	WOODWARD FIELD	SC	0	1	1	0.999972
ABR	ABERDEEN RGNL	SD	1	0.999935	4	0.999900
BKX	BROOKINGS RGNL	SD	1	0.999908	5	0.999772
YKN	CHAN GURNEY MUNICIPAL	SD	0	1	5	0.999932
HON	HURON RGNL	SD	1	0.999945	11	0.999781
FSD	JOE FOSS FIELD	SD	1	0.999943	5	0.999855
MHE	MITCHELL MUNICIPAL	SD	1	0.999971	8	0.999903
PIR	PIERRE RGNL	SD	0	1	3	0.999968
RAP	RAPID CITY RGNL	SD	0	1	3	0.999940
ATY	WATERTOWN RGNL	SD	1	0.999911	9	0.999756
PVE	BEECH RIVER RGNL	TN	0	1	2	0.999895
SYI	BOMAR FIELD-SHELBYVILLE MUNICIPAL	TN	0	1	1	0.999917
UCY	EVERETT-STEWART RGNL	TN	0	1	1	0.999918
CHA	LOVELL FIELD	TN	0	1	1	0.999934
TYS	MC GHEE TYSON	TN	0	1	1	0.999960
MEM	MEMPHIS INTL	TN	0	1	1	0.999884
NQA	MILLINGTON RGNL JETPORT	TN	0	1	1	0.999886
BNA	NASHVILLE INTL	TN	0	1	1	0.999932
SZY	ROBERT SIBLEY	TN	0	1	2	0.999867
TRI	TRI-CITIES RGNL TN/VA	TN	0	1	1	0.999987
BGF	WINCHESTER MUNICIPAL	TN	0	1	1	0.999919
ABI	ABILENE RGNL	TX	0	1	1	0.999974
ADS	ADDISON	TX	1	1	1	0.999928
ALI	ALICE INTL	TX	0	1	0	1
LFK	ANGELINA COUNTY	TX	0	1	1	0.999986
GKY	ARLINGTON MUNICIPAL	TX	0	1	1	0.999933
AUS	AUSTIN-BERGSTROM INTL	TX	0	1	1	0.999996
LBX	BRAZORIA COUNTY	TX	0	1	0	1
BWD	BROWNWOOD RGNL	TX	0	1	1	0.999943
E30	BRUCE FIELD	TX	0	1	1	0.999995
TKI	COLLIN COUNTY RGNL AT MC KINNEY	TX	1	0.999996	1	0.999925
CRP	CORPUS CHRISTI INTL	TX	0	1	0	1
CFD	COULTER FIELD	TX	0	1	1	0.999988
PRX	COX FIELD	TX	1	0.999996	1	0.999923
BBD	CURTIS FIELD	TX	0	1	1	0.999979
RBD	DALLAS EXECUTIVE	TX	0	1	1	0.999935
DAL	DALLAS LOVE FIELD	TX	0	1	1	0.999931
DFW	DALLAS/FORT WORTH INTL	TX	1	0.999999	1	0.999929
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	0	1	0	1
LUD	DECATUR MUNICIPAL	TX	1	0.999997	1	0.999929
DRT	DEL RIO INTL	TX	0	1	0	1
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	0	1	1	0.999966
GGG	EAST TEXAS RGNL	TX	0	1	1	0.999960
CLL	EASTERWOOD FIELD	TX	0	1	1	0.999991
ELP	EL PASO INTL	TX	0	1	21	0.999779

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
AFW	FORT WORTH ALLIANCE	TX	1	0.999993	1	0.999925
FWS	FORT WORTH SPINKS	TX	0	1	1	0.999934
IAH	GEORGE BUSH INTERCONTINENTAL	TX	0	1	0	1
PVW	HALE COUNTY	TX	0	1	1	0.999961
INJ	HILLSBORO MUNICIPAL	TX	0	1	1	0.999945
TME	HOUSTON EXECUTIVE	TX	0	1	0	1
AXH	HOUSTON-SOUTHWEST	TX	0	1	0	1
ERV	KERRVILLE MUNICIPAL/ LOUIS SCHREINER	TX	0	1	0	1
LNC	LANCASTER	TX	0	1	1	0.999938
LRD	LAREDO INTL	TX	0	1	1	0.999998
CXO	LONE STAR EXECUTIVE	TX	0	1	0	1
LBB	LUBBOCK PRESTON SMITH INTL	TX	0	1	1	0.999972
GVT	MAJORS	TX	0	1	1	0.999931
5T9	MAVERICK COUNTY MEMORIAL INTL	TX	0	1	0	1
MFE	MC ALLEN MILLER INTL	TX	0	1	2	0.999997
HQZ	MESQUITE METRO	TX	0	1	1	0.999935
MAF	MIDLAND INTL	TX	0	1	0	1
OSA	MOUNT PLEASANT RGNL	TX	0	1	1	0.999939
RAS	MUSTANG BEACH	TX	0	1	0	1
BAZ	NEW BRAUNFELS MUNICIPAL	TX	0	1	0	1
PIL	PORT ISABEL-CAMERON COUNTY	TX	0	1	3	0.999997
AMA	RICK HUSBAND AMARILLO INTL	TX	0	1	1	0.999937
SJT	SAN ANGELO RGNL/MATHIS FIELD	TX	0	1	0	1
SAT	SAN ANTONIO INTL	TX	0	1	0	1
HYI	SAN MARCOS MUNICIPAL	TX	0	1	0	1
GLS	SCHOLES INTL AT GALVESTON	TX	0	1	0	1
SPS	SHEPPARD AFB/ WICHITA FALLS MUNICIPAL	TX	0	1	1	0.999958
EBG	SOUTH TEXAS INTL AT EDINBURG	TX	0	1	2	0.999998
SGR	SUGAR LAND RGNL	TX	0	1	0	1
TFP	T P MC CAMPBELL	TX	0	1	0	1
TRL	TERRELL MUNICIPAL	TX	0	1	1	0.999937
TYR	TYLER POUNDS RGNL	TX	0	1	1	0.999954
HRL	VALLEY INTL	TX	0	1	3	0.999997
IWS	WEST HOUSTON	TX	0	1	0	1
HOU	WILLIAM P HOBBY	TX	0	1	0	1
CDC	CEDAR CITY RGNL	UT	0	1	0	1
KNB	KANAB MUNICIPAL	UT	0	1	0	1
LGU	LOGAN-CACHE	UT	0	1	1	0.999991
OGD	OGDEN-HINCKLEY	UT	0	1	0	1
PVU	PROVO MUNICIPAL	UT	0	1	0	1
SLC	SALT LAKE CITY INTL	UT	0	1	0	1
SGU	ST GEORGE MUNICIPAL	UT	0	1	0	1
MFV	ACCOMACK COUNTY	VA	0	1	0	1
MTV	BLUE RIDGE	VA	0	1	1	0.999941
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1	1	0.999942
FCI	CHESTERFIELD COUNTY	VA	0	1	1	0.999984
CJR	CULPEPER RGNL	VA	0	1	1	0.999940
PTB	DINWIDDIE COUNTY	VA	0	1	1	0.999992
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1	1	0.999978
JYO	LEESBURG EXECUTIVE	VA	0	1	1	0.999934

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
LNP	LONESOME PINE	VA	0	1	0	1
LYH	LYNCHBURG RGNL/ PRESTON GLENN FIELD	VA	0	1	1	0.999946
HEF	MANASSAS RGNL/ HARRY P. DAVIS FIELD	VA	0	1	1	0.999946
MKJ	MOUNTAIN EMPIRE	VA	0	1	0	1
PSK	NEW RIVER VALLEY	VA	0	1	1	0.999970
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	0	1	0	1
ORF	NORFOLK INTL	VA	0	1	0	1
RIC	RICHMOND INTL	VA	0	1	1	0.999988
RMN	STAFFORD RGNL	VA	0	1	1	0.999956
XSA	TAPPAHANNOCK-ESSEX COUNTY	VA	0	1	1	0.999990
BCB	VIRGINIA TECH/ MONTGOMERY EXECUTIVE	VA	0	1	1	0.999932
IAD	WASHINGTON DULLES INTL	VA	0	1	1	0.999940
BTV	BURLINGTON INTL	VT	0	1	0	1
FSO	FRANKLIN COUNTY STATE	VT	0	1	0	1
BLI	BELLINGHAM INTL	WA	1	0.999657	2	0.999495
HQM	BOWERMAN	WA	1	0.999814	4	0.999385
PWT	BREMERTON NATIONAL	WA	1	0.999820	2	0.999440
DEW	DEER PARK	WA	1	0.999990	1	0.999817
FHR	FRIDAY HARBOR	WA	1	0.999639	4	0.999490
MWH	GRANT CO INTL	WA	1	0.999918	2	0.999791
OLM	OLYMPIA	WA	1	0.999846	2	0.999420
PUW	PULLMAN/MOSCOW RGNL	WA	0	1	1	0.999889
RLD	RICHLAND	WA	1	0.999990	2	0.999796
SEA	SEATTLE-TACOMA INTL	WA	1	0.999873	2	0.999435
BVS	SKAGIT RGNL	WA	1	0.999660	2	0.999482
PAE	SNOHOMISH COUNTY (PAINE FLD)	WA	1	0.999836	2	0.999463
GEG	SPOKANE INTL	WA	1	0.999998	1	0.999824
TIW	TACOMA NARROWS	WA	1	0.999856	2	0.999428
PSC	TRI-CITIES	WA	1	0.999995	2	0.999806
ALW	WALLA WALLA RGNL	WA	0	1	1	0.999889
CLM	WILLIAM R FAIRCHILD INTL	WA	1	0.999657	4	0.999481
GRB	AUSTIN STRAUBEL INTL	WI	0	1	1	0.999999
DLL	BARABOO WISCONSIN DELLS	WI	0	1	1	0.999999
OVS	BOSCOBEL	WI	0	1	1	0.999999
CWA	CENTRAL WISCONSIN	WI	0	1	1	0.999999
EAU	CHIPPEWA VALLEY RGNL	WI	0	1	1	0.999999
MSN	DANE COUNTY RGNL-TRUAX FIELD	WI	0	1	1	0.999999
UNU	DODGE COUNTY	WI	0	1	1	0.999999
SUE	DOOR COUNTY CHERRYLAND	WI	0	1	2	0.999999
EGV	EAGLE RIVER UNION	WI	0	1	2	0.999991
FLD	FOND DU LAC COUNTY	WI	0	1	1	0.999999
MKE	GENERAL MITCHELL INTL	WI	0	1	0	1
ASX	JOHN F KENNEDY MEMORIAL	WI	0	1	4	0.999967
LSE	LA CROSSE MUNICIPAL	WI	0	1	1	0.999999
MTW	MANITOWOC COUNTY	WI	0	1	1	0.999999
MFI	MARSHFIELD MUNICIPAL	WI	0	1	1	0.999999
LUM	MENOMONIE MUNICIPAL-SCORE FIELD	WI	0	1	1	0.999999
RRL	MERRILL MUNICIPAL	WI	0	1	1	0.999999

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
C29	MIDDLETON MUNICIPAL – MOREY FIELD	WI	0	1	1	0.999999
ATW	OUTAGAMIE COUNTY RGNL	WI	0	1	1	0.999999
PBH	PRICE COUNTY	WI	0	1	1	0.999999
RHI	RHINELANDER-ONEIDA COUNTY	WI	0	1	2	0.999999
RPD	RICE LAKE RGNL - CARL'S FIELD	WI	0	1	2	0.999989
HYR	SAWYER COUNTY	WI	0	1	2	0.999977
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	0	1	0	1
JVL	SOUTHERN WISCONSIN RGNL	WI	0	1	1	0.999999
TKV	TOMAHAWK RGNL	WI	0	1	1	0.999999
LNR	TRI-COUNTY RGNL	WI	0	1	1	0.999999
OSH	WITTMAN RGNL	WI	0	1	1	0.999999
MRB	EASTERN WV RGNL/SHEPHERD FIELD	WV	0	1	1	0.999924
PKB	MID-OHIO VALLEY RGNL	WV	0	1	0	1
HTS	TRI-STATE/MILTON J. FERGUSON F	WV	0	1	0	1
CYS	CHEYENNE RGNL/JERRY OLSON FIELD	WY	0	1	4	0.999956
EVW	EVANSTON-UINTA COUNTY BURNS FI ELD	WY	0	1	1	0.999987
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1	1	0.999906
JAC	JACKSON HOLE	WY	0	1	1	0.999942
LAR	LARAMIE RGNL	WY	0	1	1	0.999949
CPR	NATRONA COUNTY INTL	WY	0	1	1	0.999918
RIW	RIVERTON RGNL	WY	0	1	1	0.999914
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1	1	0.999948
SHR	SHERIDAN COUNTY	WY	0	1	1	0.999881
COD	YELLOWSTONE RGNL	WY	0	1	1	0.999900

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 09	Nov 09	Dec 09	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10
Albuquerque	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Anchorage	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Atlanta	A	●	–	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Barrow	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Bethel	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Billings	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Boston	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Chicago	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Cleveland	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Cold Bay	A	–	●	●	●	●	●	●	●	●	●	●	●
	B	–	●	●	●	●	●	●	●	●	●	●	●
	C	–	●	●	●	●	●	●	●	●	●	●	●
Dallas	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Denver	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Fairbanks	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Gander	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Goose Bay	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Honolulu	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Houston	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Iqaluit	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Jacksonville	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●

● **Excellent** - 3.29σ bounded 100%
● **Good** - 4σ bounded 100%
● **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
● **Poor** – Requires manual review
– No data available

WAAS Site	WRE	Oct 09	Nov 09	Dec 09	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10
Juneau	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Kansas City	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Kotzebue	A	●	–	●	●	●	●	●	●	●	●	●	●
	B	●	–	●	●	●	●	●	●	●	●	●	●
	C	●	–	●	●	●	●	●	●	●	●	●	●
Los Angeles	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Memphis	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Merida	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Mexico City	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Miami	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Minneapolis	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
New York	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Oakland	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Puerto Vallarta	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Salt Lake City	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
San Jose Del Cabo	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
San Juan	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Seattle	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Tapachula	A	●	●	●	●	●	●	●	●	●	–	–	–
	B	●	●	●	●	●	●	●	●	●	–	–	–
	C	●	●	●	●	●	●	●	●	●	–	–	–
Washington, DC	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●
Winnipeg	A	●	●	●	●	●	●	●	●	●	●	●	●
	B	●	●	●	●	●	●	●	●	●	●	●	●
	C	●	●	●	●	●	●	●	●	●	●	●	●

● **Excellent** - 3.29σ bounded 100%
● **Good** - 4σ bounded 100%
● **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
● **Poor** – Requires manual review
– No data available

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.

Antenna L1 phase center position surveys were preformed for the WAAS antennas using a 25 hour set of data from 23:00 on 9/29/10 to 23:59:30 on 9/30/10 for all of the WAAS receivers except Tapachula Mexico (MTP). Tapachula was off line for the entire quarter and was not evaluated.

Surveys were performed using the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) and the Canadian Spatial Reference System (CSRS) Precise Point Positioning (PPP) service. The overall RMS qualities reported by OPUS were all less than or equal to 2.5 cm. The CSRS survey's RSSs of the reported ECEF sigma's were all less than equal to 1.4 cm. The OPUS and CSRS surveys agreed to 5.9 cm or better.

The positions were compared to the positions in the current WAAS software build 6.012 that was fielded during November 2009 and the next release, build 6.075, which will be fielded this fall. The build 6.012 positions have been interpolated forward to 8/1/10. The build 6.075 positions have been interpolated forward to 4/1/2011.

The OPUS surveys agree with the build 6.012 positions to better than or equal to 6.5 cm. The OPUS surveys agree with the build 6.075 positions to better or equal 6.6 cm with the exceptions of Los Angles and Mexico City. Los Angels (ZLA) is 7.8 cm and Mexico City (MMX) is 11.6 cm. These two sites are outliers because of anticipated tectonic plate movement that is included in the Build 6.075 positions.

Table 11.1 lists the WAAS antenna L1 phase center positions as of 9/30/10. The positions are in IRTF-2000 and are the OPUS estimated positions. OPUS is now using GEOID 09.

Figure 11.1 to 11.3 show the RSS of the ECEF difference between the 9/30/10 OPUS survey antenna phase center locations and the locations in the build 6.012 software which was fielded November 2009. Each reference station has three independent strings of WAAS receiving equipment (WRE). A surveyed antenna phase center location is required for each WRE. 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 to 11.6 show the OPUS overall RMS quality indications.

Figure 11.7 to 11.9 show the RSS of the ECEF difference between the positions obtained from OPUS and the positions obtained from the Canadian Spatial Reference System (CSRS). Note that that OPUS positions are in ITRF-2000 and the CSRS positions are in ITRF-2005. Figures 11.10 to 11.12 show the RSS of ECEF sigmas reported by CSRS.

Figure 11.13 to 11.15 show the RSS of the ECEF difference between the 9/30/10 OPUS survey antenna phase center locations and the locations in the build 6.075 software which will fielded about November 2010. The antenna phase center information in WFO release 2 has been interpolated forward in time to 4/1/11.

Table 11-1 WAAS Survey Positions (OPUS ITRF-2000) as of 1/3/10

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
BET1	-2965384.992	-972576.646	5543892.920	60.787915908	-161.841724244	52.181
BET2	-2965385.765	-972580.368	5543891.871	60.787896475	-161.841663736	52.190
BET3	-2965388.331	-972577.499	5543890.998	60.787880556	-161.841728467	52.182
BIL1	-1416445.844	-4223577.030	4550862.165	45.803706922	-108.539722575	1112.253
BIL2	-1416449.908	-4223574.884	4550862.882	45.803716208	-108.539780908	1112.250
BIL3	-1416441.537	-4223574.291	4550866.014	45.803756639	-108.539681256	1112.248
BRW1	-1886758.864	-809058.683	6018494.501	71.282765386	-156.789923611	15.580
BRW2	-1886756.280	-809055.939	6018495.679	71.282798114	-156.789965572	15.587
BRW3	-1886755.190	-809059.727	6018495.503	71.282793439	-156.789856419	15.578
CDB1	-3484098.996	-1084748.815	5213678.674	55.192374697	-162.706403936	49.708
CDB2	-3484105.643	-1084741.613	5213675.718	55.192328522	-162.706542931	49.682
CDB3	-3484111.909	-1084734.854	5213672.971	55.192285131	-162.706673506	49.695
FAI1	-2304741.744	-1448715.279	5748843.702	64.809630533	-147.847340122	149.926
FAI2	-2304741.266	-1448706.470	5748846.090	64.809680983	-147.847491739	149.920
FAI3	-2304732.736	-1448707.408	5748849.245	64.809747592	-147.847379481	149.913
HNL1	-5508637.076	-2234493.455	2303722.119	21.312989550	-157.920826131	24.673
HNL2	-5508656.242	-2234483.767	2303686.872	21.312646633	-157.920982094	25.015
HNL3	-5508647.652	-2234497.701	2303693.967	21.312715269	-157.920826522	25.057
JNU1	-2354254.846	-2388549.659	5407043.089	58.362574694	-134.585706347	16.065
JNU2	-2354252.761	-2388565.763	5407036.916	58.362469144	-134.585487850	16.058
JNU3	-2354239.542	-2388568.619	5407041.379	58.362545544	-134.585292761	16.057
MMD1	35070.441	-5959686.697	2264365.755	20.931909067	-89.662840486	29.143
MMD2	35065.519	-5959687.058	2264364.969	20.931901364	-89.662887825	29.172
MMD3	35065.181	-5959685.276	2264369.626	20.931946408	-89.662890975	29.170
MMX1	-948701.150	-5943936.012	2109212.819	19.431653267	-99.068389522	2236.019
MMX2	-948696.722	-5943935.834	2109215.244	19.431676542	-99.068348167	2236.001
MMX3	-948705.580	-5943936.203	2109210.393	19.431629942	-99.068430878	2236.048
MPR1	-1570142.208	-5759530.641	2238184.751	20.679003181	-105.249203000	11.006
MPR2	-1570139.388	-5759530.146	2238188.805	20.679041328	-105.249178139	11.297
MPR3	-1570143.495	-5759528.020	2238190.569	20.679059331	-105.249221533	11.012
MSD1	-1979519.657	-5523223.113	2493106.743	23.160446383	-109.717647275	104.298
MSD2	-1979521.225	-5523225.450	2493100.342	23.160383553	-109.717653989	104.290
MSD3	-1979525.674	-5523222.179	2493104.017	23.160419667	-109.717705664	104.284
MTP1	-254854.337	-6162909.198	1617805.081	14.791366058	-92.367999019	54.976
MTP2	-254850.737	-6162910.232	1617801.654	14.791334072	-92.367965211	54.956
MTP3	-254855.506	-6162910.340	1617800.127	14.791320025	-92.368009431	54.861
OTZ1	-2396055.964	-750356.178	5843502.542	66.887332664	-162.611372164	10.891
OTZ2	-2396052.795	-750354.349	5843504.069	66.887367486	-162.611390383	10.893
OTZ3	-2396052.773	-750358.287	5843503.577	66.887356222	-162.611304475	10.895
YFB1	1035381.500	-2634289.652	5696539.506	63.731490147	-68.543182519	10.010
YFB2	1035372.285	-2634296.056	5696538.148	63.731463925	-68.543403544	9.938
YFB3	1035366.209	-2634306.811	5696534.371	63.731386289	-68.543597653	9.998

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
YQX1	2430424.664	-3419640.399	4788223.794	48.966489628	-54.597631881	146.865
YQX2	2430432.629	-3419639.056	4788220.738	48.966447714	-54.597532589	146.870
YQX3	2430440.528	-3419637.688	4788217.737	48.966406522	-54.597433836	146.878
YWG1	-520164.316	-4083475.879	4855842.959	49.900574342	-97.259396900	221.995
YWG2	-520150.451	-4083468.825	4855850.343	49.900677269	-97.259217872	222.007
YWG3	-520152.313	-4083477.944	4855842.522	49.900568153	-97.259227542	222.003
YYR1	1885341.449	-3321428.359	5091171.602	53.308646736	-60.419467967	37.810
YYR2	1885344.412	-3321419.878	5091176.011	53.308713008	-60.419366503	37.813
YYR3	1885340.124	-3321413.060	5091182.021	53.308803247	-60.419371953	37.824
ZAB1	-1488636.810	-5003946.552	3654557.691	35.173575256	-106.567349392	1620.118
ZAB2	-1488631.476	-5003948.237	3654557.673	35.173574633	-106.567288011	1620.184
ZAB3	-1488632.254	-5003950.824	3654553.814	35.173532186	-106.567288100	1620.169
ZAN1	-2659536.571	-1549114.820	5567750.757	61.229202111	-149.780249392	80.675
ZAN2	-2659548.325	-1549110.865	5567746.265	61.229118475	-149.780423142	80.668
ZAN3	-2659541.285	-1549106.743	5567750.749	61.229202014	-149.780423486	80.672
ZAU1	138704.149	-4761244.161	4227763.939	41.782657981	-88.331336297	195.908
ZAU2	138704.411	-4761248.774	4227758.772	41.782595583	-88.331334761	195.909
ZAU3	138711.115	-4761248.513	4227758.856	41.782596542	-88.331254064	195.916
ZBW1	1490299.258	-4448983.184	4306010.470	42.735720178	-71.480425475	39.115
ZBW2	1490304.369	-4448981.165	4306010.816	42.735724244	-71.480358464	39.136
ZBW3	1490306.081	-4448984.799	4306006.506	42.735671375	-71.480352733	39.141
ZDC1	1069125.811	-4839599.006	4001126.497	39.101595664	-77.542746036	80.080
ZDC2	1069128.203	-4839603.651	4001120.293	39.101523597	-77.542730617	80.087
ZDC3	1069124.095	-4839602.730	4001122.491	39.101549106	-77.542774692	80.088
ZDV1	-1273628.577	-4711375.598	4094890.121	40.187303261	-105.127223886	1541.373
ZDV2	-1273622.880	-4711377.114	4094890.138	40.187303511	-105.127154678	1541.366
ZDV3	-1273624.886	-4711380.300	4094885.844	40.187253067	-105.127167653	1541.344
ZFW1	-659983.177	-5324060.797	3438276.472	32.830649647	-97.066471531	155.634
ZFW2	-659988.451	-5324063.346	3438271.473	32.830596233	-97.066524081	155.594
ZFW3	-659983.469	-5324063.881	3438271.688	32.830598261	-97.066470575	155.642
ZHU1	-513864.450	-5506451.784	3166720.491	29.961896150	-95.331425978	10.925
ZHU2	-513867.095	-5506455.179	3166714.329	29.961831656	-95.331449992	10.989
ZHU3	-513873.373	-5506457.821	3166708.730	29.961773417	-95.331512208	10.977
ZJX1	772646.459	-5434462.226	3237231.736	30.698859425	-81.908185008	2.166
ZJX2	772649.784	-5434463.760	3237228.335	30.698823897	-81.908152900	2.138
ZJX3	772645.735	-5434466.193	3237225.212	30.698791208	-81.908198319	2.125
ZKC1	-415247.486	-4954556.404	3982161.119	38.880159361	-94.790833464	305.909
ZKC2	-415231.089	-4954557.726	3982161.177	38.880160061	-94.790643894	305.905
ZKC3	-415237.211	-4954561.076	3982155.981	38.880101861	-94.790710972	305.641
ZLA1	-2474409.878	-4637294.747	3602183.521	34.603517906	-118.083894317	763.553
ZLA2	-2474404.601	-4637297.547	3602183.535	34.603518081	-118.083829197	763.550
ZLA3	-2474411.213	-4637297.222	3602179.542	34.603473992	-118.083894453	763.608

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
ZLC1	-1808273.185	-4486410.827	4145303.009	40.786043264	-111.952177217	1287.421
ZLC2	-1808274.582	-4486414.442	4145298.528	40.785989928	-111.952176556	1287.427
ZLC3	-1808270.366	-4486416.137	4145298.514	40.785989856	-111.952122733	1287.415
ZMA1	966042.322	-5662999.837	2761581.484	25.824612006	-80.319189606	-7.578
ZMA2	966029.353	-5662999.145	2761585.975	25.824659753	-80.319315950	-8.199
ZMA3	966037.418	-5662997.999	2761586.327	25.824661722	-80.319234736	-7.842
ZME1	4070.925	-5226189.294	3644028.407	35.067394008	-89.955369628	68.591
ZME2	4070.957	-5226186.742	3644032.519	35.067437561	-89.955369256	68.865
ZME3	4064.761	-5226186.619	3644032.680	35.067439411	-89.955437183	68.853
ZMP1	-249978.341	-4539297.530	4458955.049	44.637463069	-93.152084953	262.672
ZMP2	-249972.535	-4539297.869	4458955.056	44.637462994	-93.152011656	262.691
ZMP3	-249973.638	-4539302.144	4458950.575	44.637406931	-93.152022572	262.623
ZNY1	1406144.684	-4627344.005	4144322.057	40.784328381	-73.097165206	6.476
ZNY2	1406146.480	-4627347.046	4144317.278	40.784275608	-73.097155322	5.952
ZNY3	1406140.920	-4627348.702	4144317.313	40.784276036	-73.097224050	5.951
ZOA1	-2684436.814	-4293337.489	3865351.812	37.543053292	-122.015946733	-3.501
ZOA2	-2684433.807	-4293341.562	3865349.388	37.543025767	-122.015893447	-3.503
ZOA3	-2684438.180	-4293342.463	3865345.535	37.542981319	-122.015930000	-3.407
ZOB1	650770.226	-4754715.709	4187420.764	41.297154292	-82.206444292	223.722
ZOB2	650777.896	-4754714.886	4187422.787	41.297166642	-82.206352233	225.226
ZOB3	650776.221	-4754719.704	4187414.989	41.297086875	-82.206379847	223.495
ZSE1	-2308930.234	-3668169.705	4663526.482	47.286993256	-122.188372217	82.106
ZSE2	-2308934.627	-3668175.254	4663520.081	47.286907700	-122.188382286	82.176
ZSE3	-2308935.691	-3668179.524	4663516.132	47.286855978	-122.188364122	82.110
ZSU1	2462589.357	-5529371.559	2003724.606	18.431338458	-65.993475308	-28.575
ZSU2	2462587.275	-5529377.313	2003711.610	18.431214472	-65.993515469	-28.500
ZSU3	2462593.905	-5529375.091	2003709.558	18.431194978	-65.993449583	-28.516
ZTL1	529840.436	-5305248.828	3489342.835	33.379688375	-84.296725678	261.144
ZTL2	529846.802	-5305247.973	3489343.119	33.379691594	-84.296656692	261.118
ZTL3	529847.486	-5305251.414	3489337.884	33.379634861	-84.296653053	261.154

Figure 11-1 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

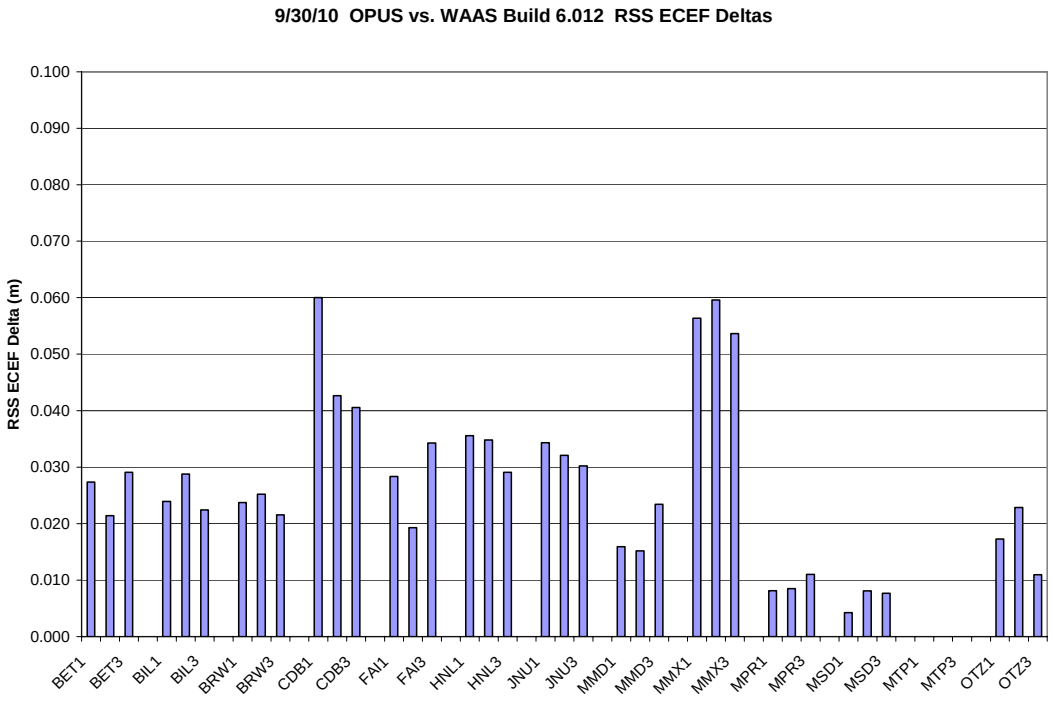


Figure 11-2 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

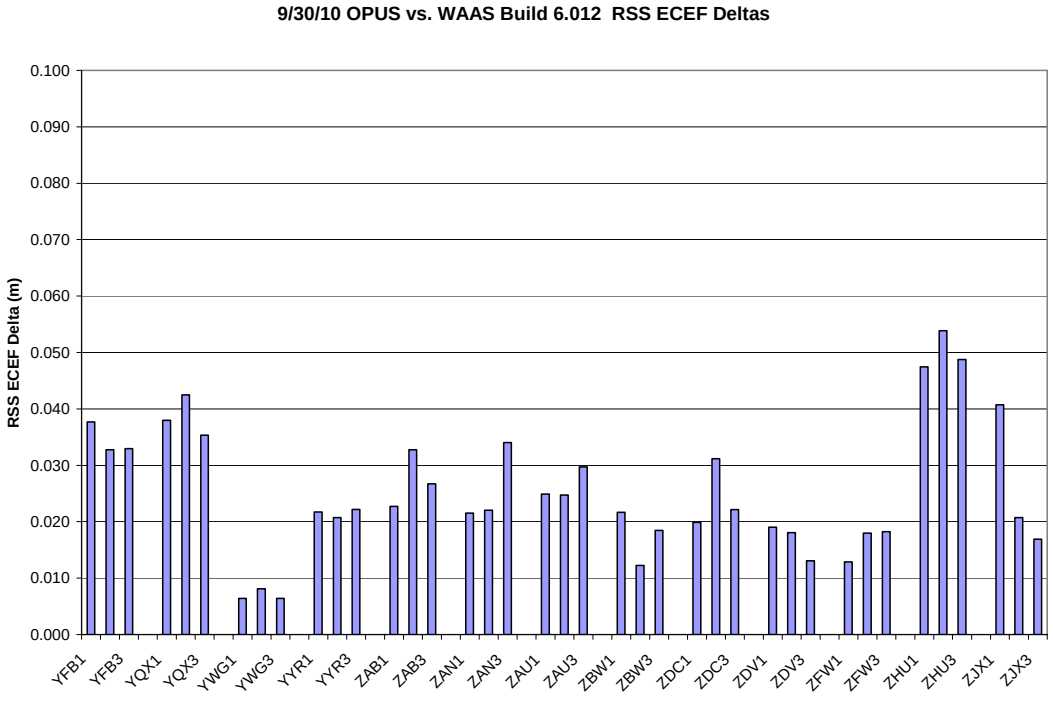


Figure 11-3 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

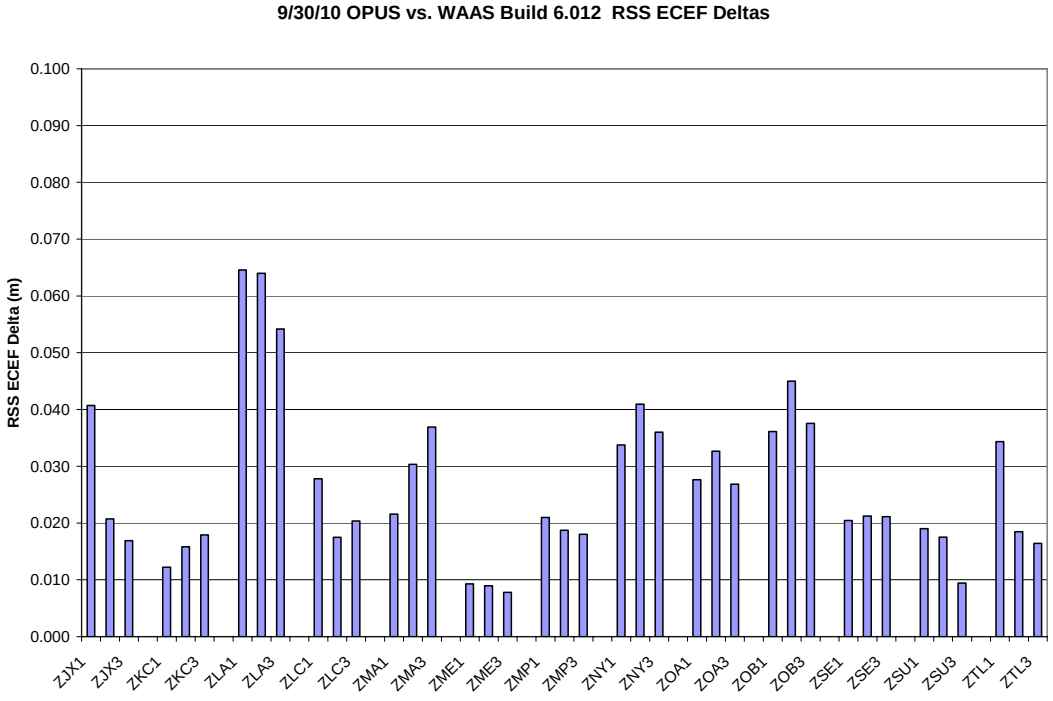


Figure 11-4 OPUS Overall RMS Qualitites

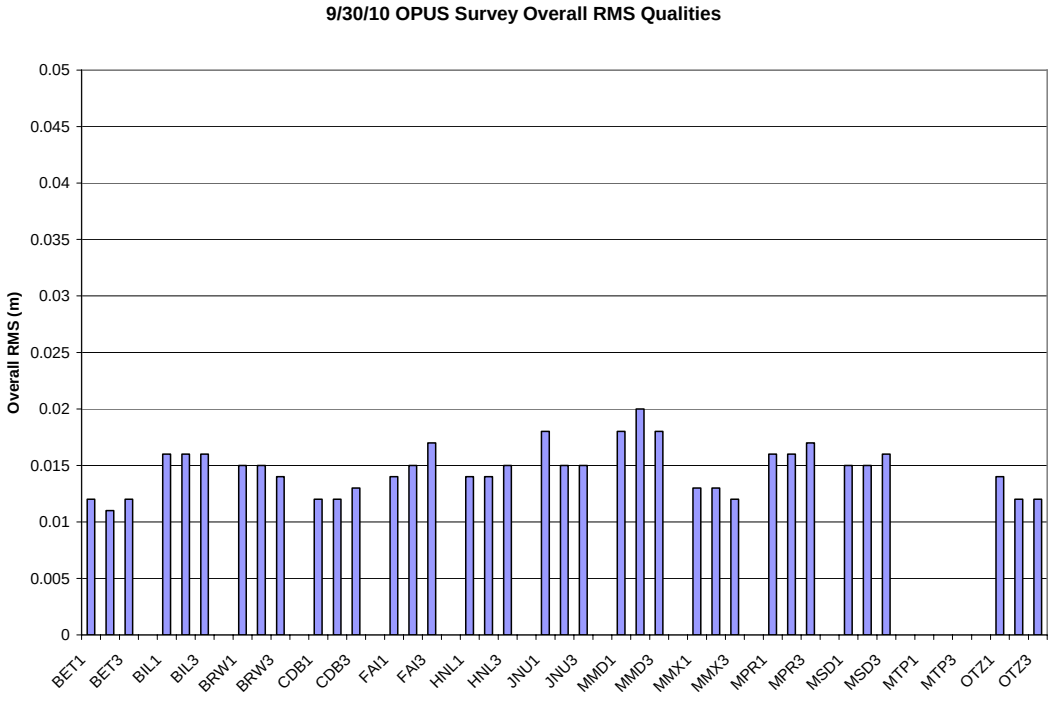


Figure 11-5 OPUS Survey Overall RMS Qualities

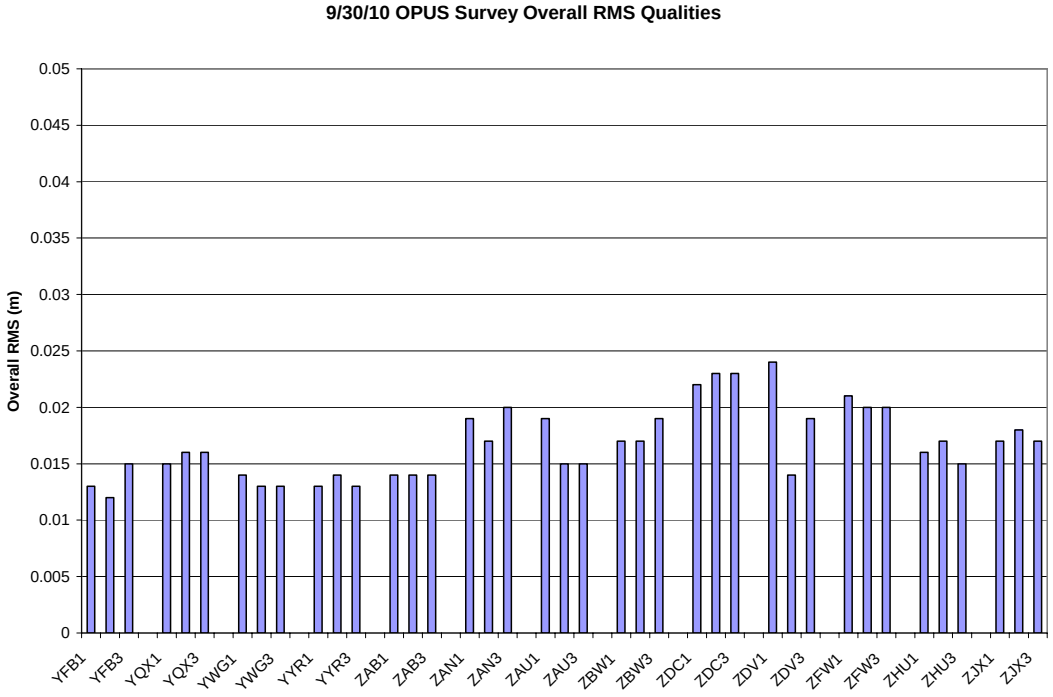


Figure 11-6 OPUS Survey Overall RMS Qualities

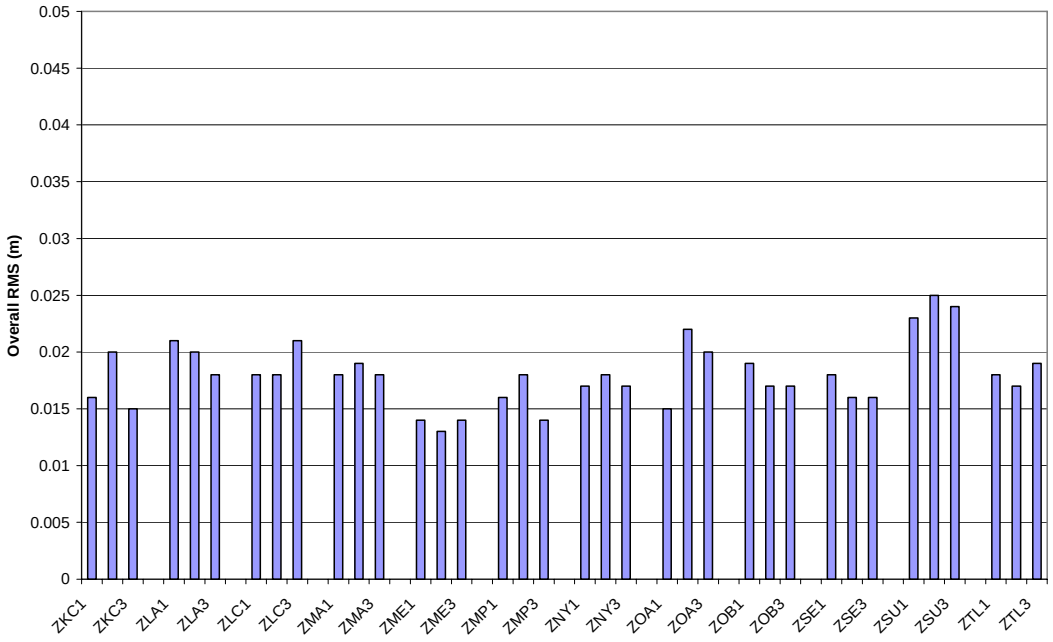


Figure 11-7 OPUS vs. CSRS RSS ECEF Deltas

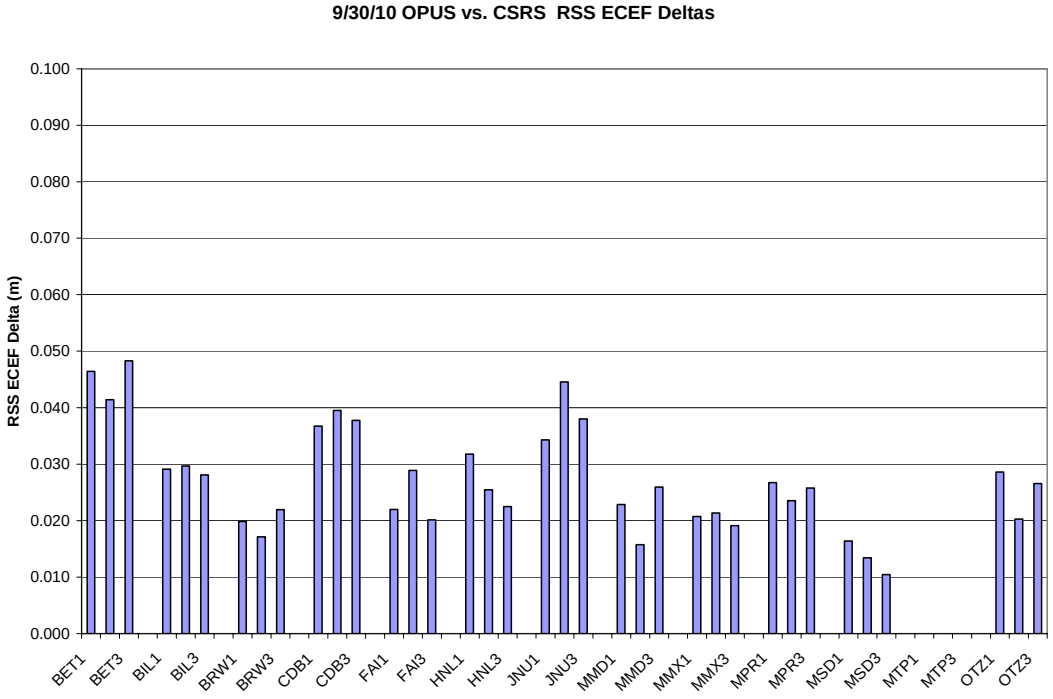


Figure 11-8 OPUS vs. CSRS RSS ECEF Deltas

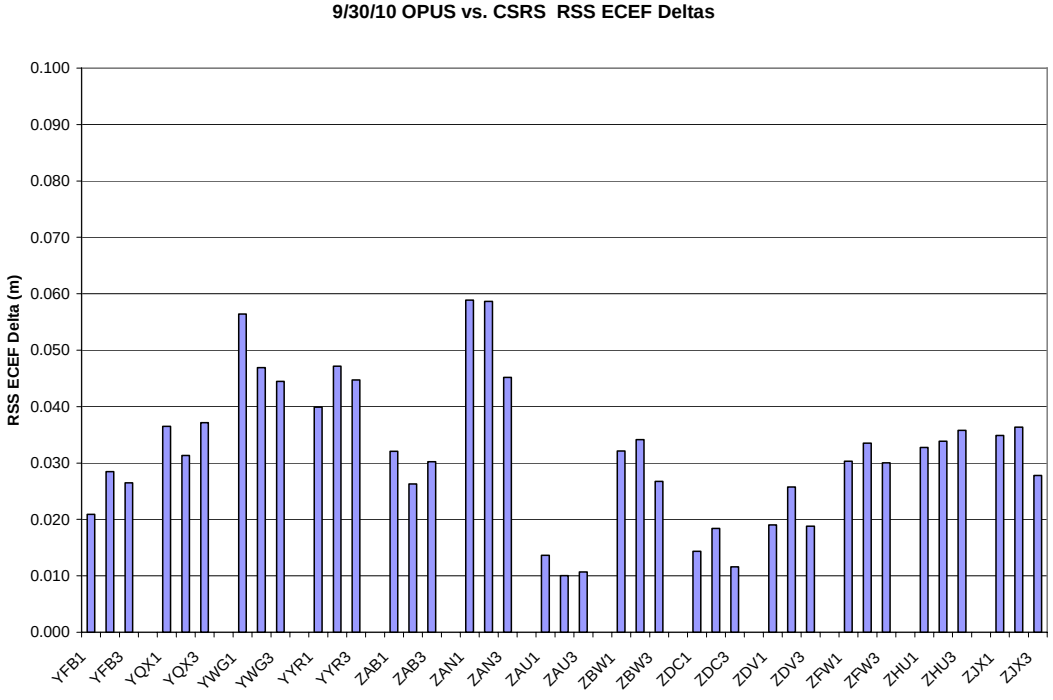


Figure 11-9 OPUS vs. CSRS RSS ECEF Deltas

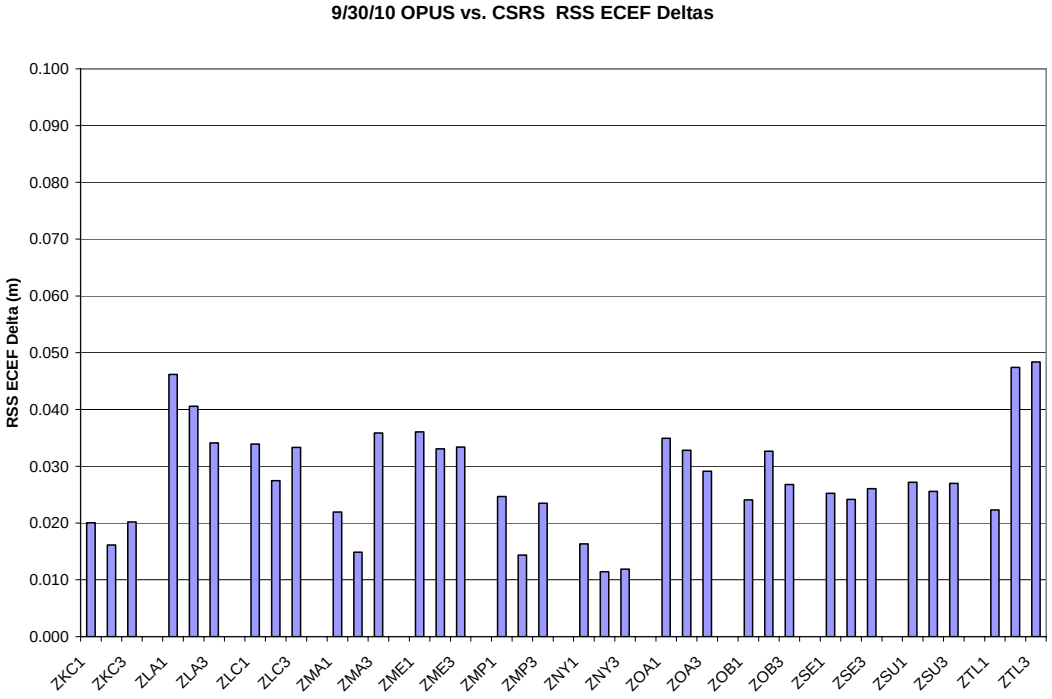


Figure 11-10 CSRS Survey Qualities

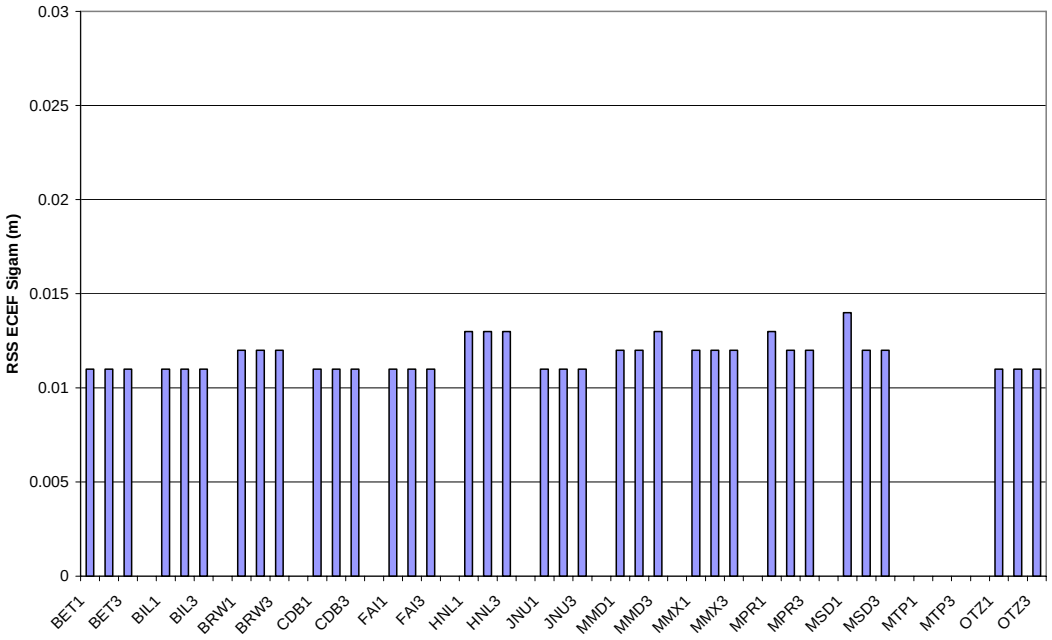


Figure 11-11 CSRS Survey Qualities

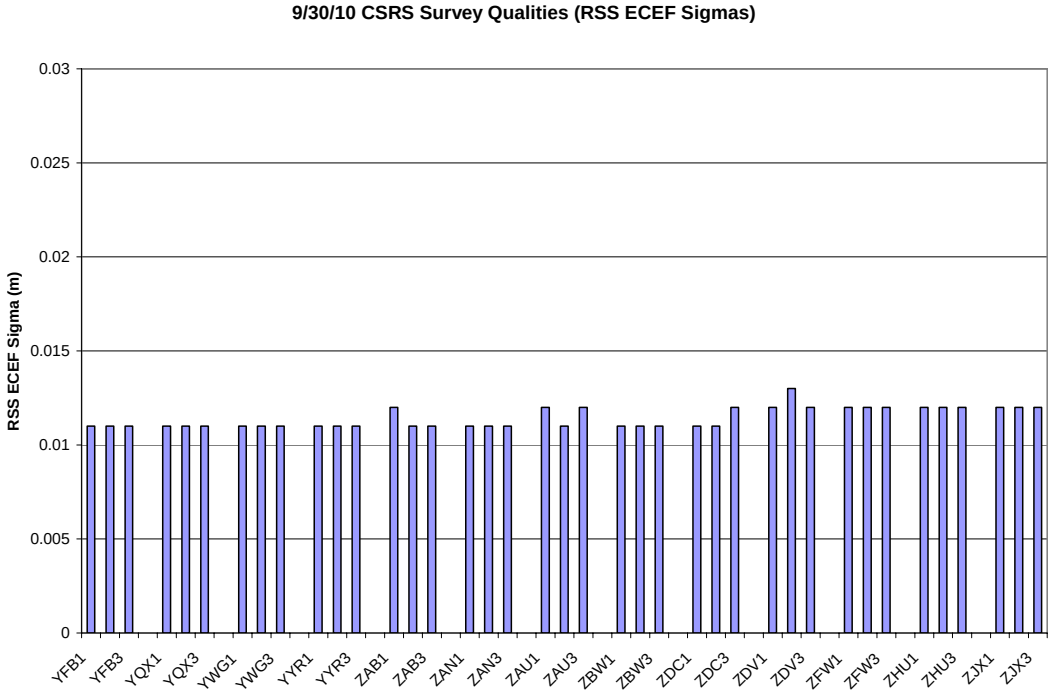


Figure 11-12 CSRS Survey Qualities

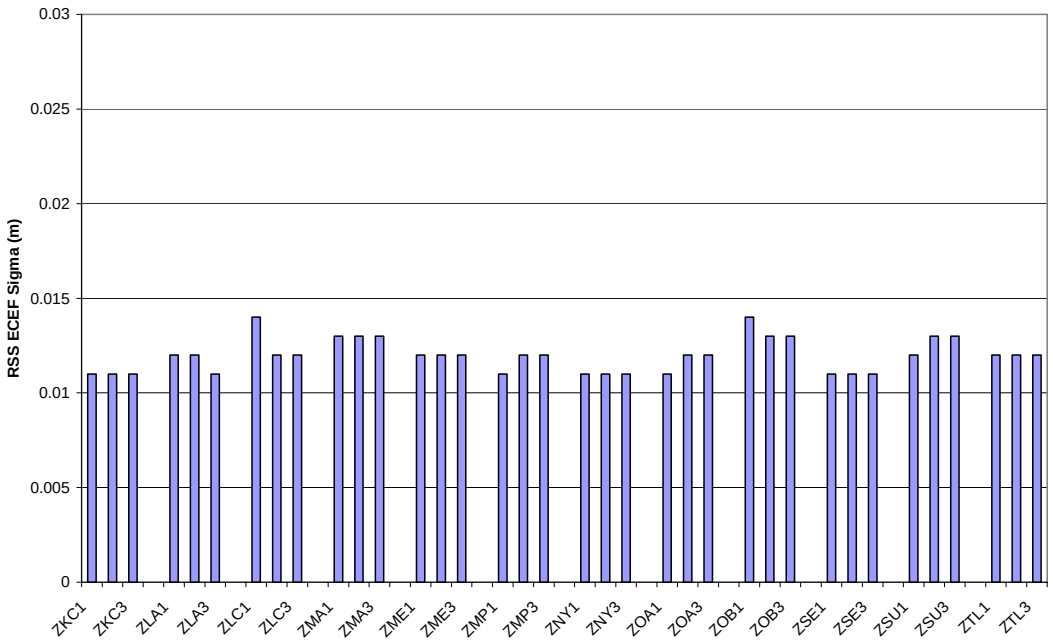


Figure 11-13 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey

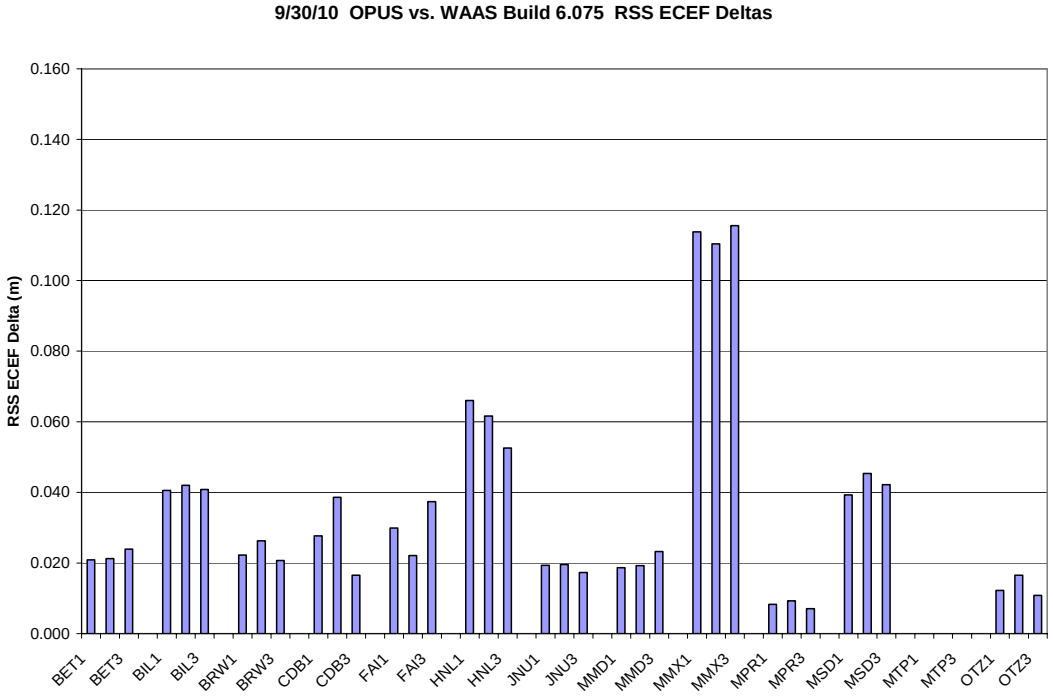


Figure 11-14 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey

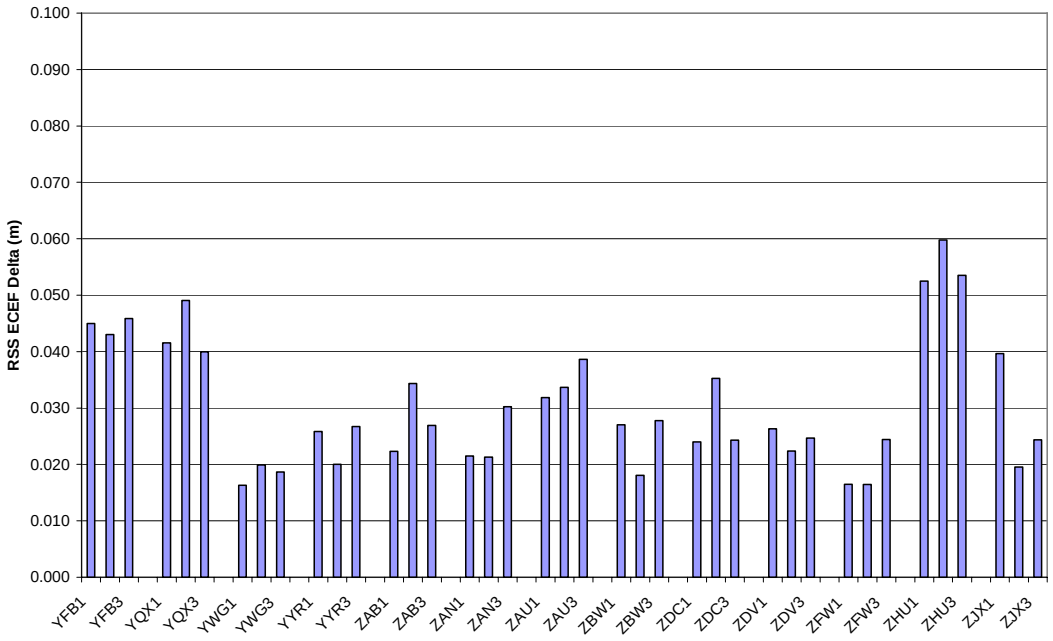
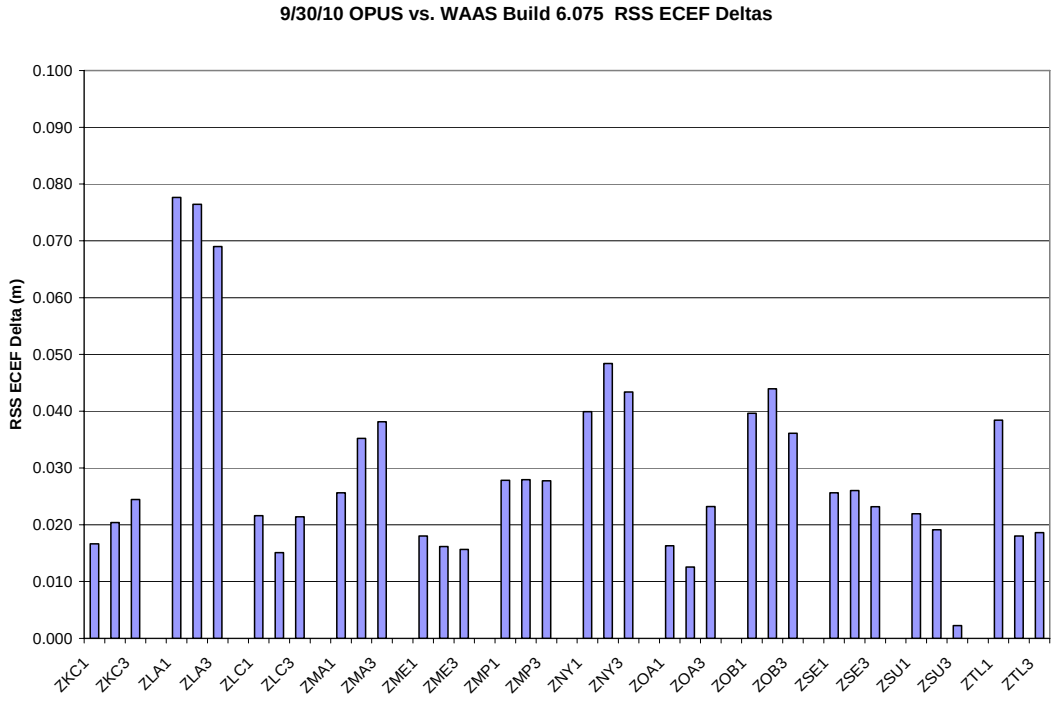


Figure 11-15 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey



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 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 for the quarter. Small spikes from 9/7/10 to 9/11/10 is due to Flex power testing.

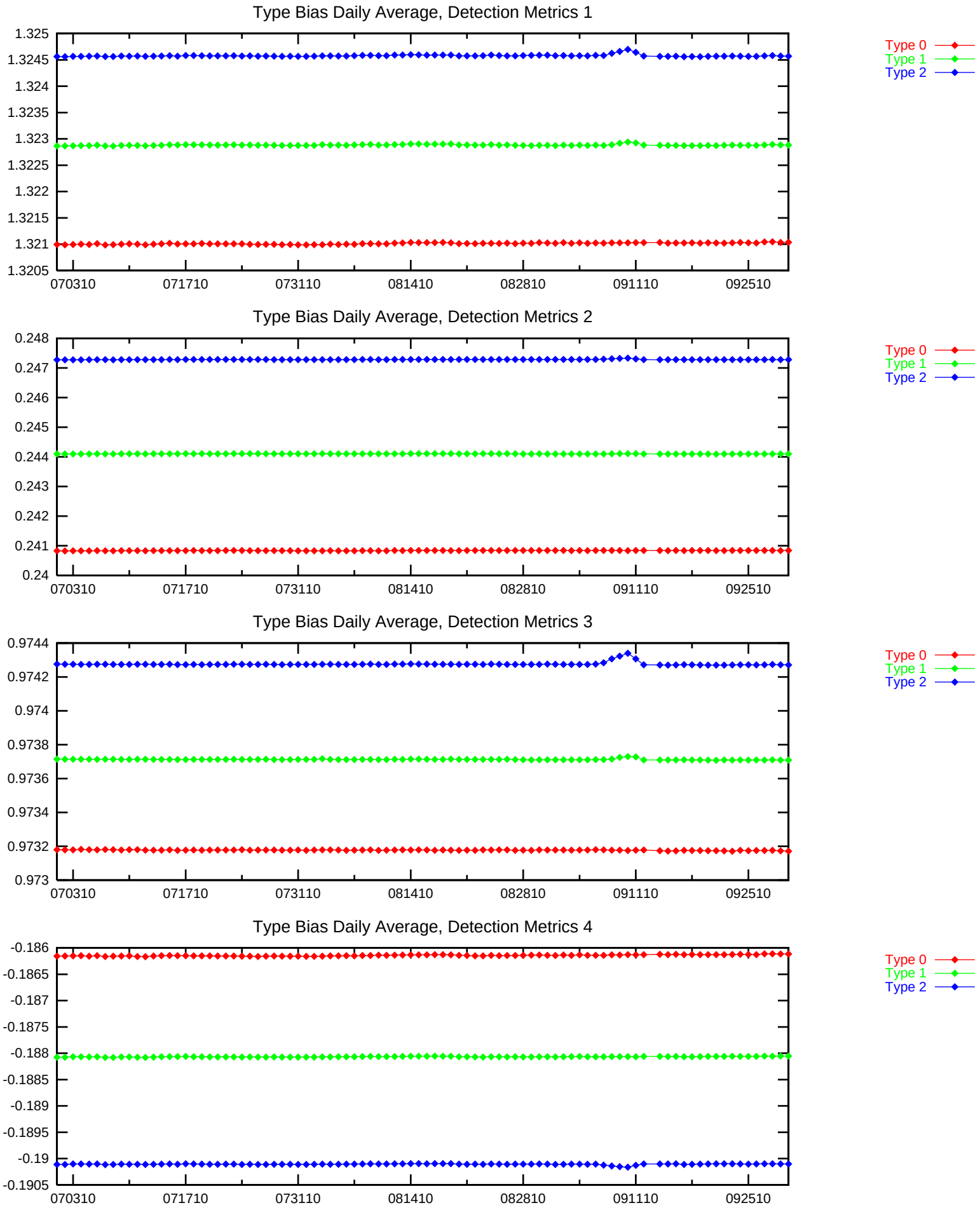
Table 12-2 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32101	1.32288	1.32458
DM 2	0.240836	0.244102	0.247284
DM 3	0.973177	0.973713	0.974276
DM 4	-0.186142	-0.188066	-0.190106

Table 12-3 Type Bias Average Since January 1, 2008

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32107	1.32292	1.32462
DM 2	0.240835	0.24411	0.247283
DM 3	0.973179	0.973714	0.974277
DM 4	-0.18612	-0.188054	-0.190082

Figure 12-1 PRN Type Bias Average Trend



12.3 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.

Table 12.4 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.5 shows the rollup PRN bias average since January 1, 2008. Figure 12.3 to 12.10 show the PRN bias average trend for each SV. The maximum average for DM1 for this quarter is PRN 23 at 0.00094954. The maximum average for DM2 is PRN 21 at 0.00019007. The maximum average for DM3 is PRN 10 at 0.00026478 and the maximum average for DM4 is PRN 23 at 0.00042672.

For this reporting period, geostationary satellite biases are not evaluated. Please refer to Table 1.4 for events that may have an impact on PRN bias statistics. Small spikes in PRN bias daily average are due to satellite outages. Flex Power testing from 9/7/10 to 9/11/10 caused a little more significant increase on some of the satellites.

Table 12-4 PRN Bias Average for the Quarter

PRN	DM1	DM2	DM3	DM4
2	0.00017812	0.00005718	0.00002279	0.00009197
3	0.00022055	0.00006624	0.00009707	0.00036701
4	0.00025454	0.00004692	0.00007492	0.00014273
5	0.00015270	0.00013673	0.00006453	0.00010308
6	0.00013903	0.00005769	0.00005088	0.00014870
7	0.00012301	0.00008239	0.00003362	0.00012167
8	0.00017105	0.00013337	0.00004399	0.00009369
9	0.00021653	0.00005400	0.00006593	0.00011221
10	0.00068864	0.00005918	0.00026478	0.00009944
11	0.00086630	0.00017956	0.00004486	0.00023833
12	0.00023522	0.00008279	0.00010399	0.00008137
13	0.00051276	0.00004839	0.00006495	0.00015710
14	0.00059788	0.00011076	0.00011119	0.00011204
15	0.00012200	0.00006281	0.00002738	0.00012724
16	0.00016828	0.00007200	0.00011637	0.00034319
17	0.00014484	0.00007272	0.00004031	0.00013094
18	0.00060625	0.00010884	0.00004138	0.00020930
19	0.00038405	0.00014253	0.00003931	0.00007734
20	0.00017464	0.00004666	0.00003324	0.00016761
21	0.00060897	0.00019007	0.00020458	0.00009225
22	0.00013900	0.00009340	0.00010511	0.00010128
23	0.00094954	0.00014854	0.00003131	0.00042672
24	0.00032970	0.00005229	0.00003866	0.00010794
25	0.00036708	0.00018015	0.00008677	0.00011724
26	0.00027937	0.00008060	0.00014981	0.00009390
27	0.00049175	0.00008790	0.00005994	0.00033778
28	0.00022203	0.00005008	0.00003057	0.00008749
29	0.00021622	0.00006104	0.00010210	0.00027273
30	0.00028257	0.00009817	0.00002595	0.00010404
31	0.00048458	0.00015730	0.00003713	0.00026631
32	0.00026903	0.00004902	0.00010819	0.00008784

Table 12-5 PRN Bias Average Since January 1, 2008

PRN	DM1	DM2	DM3	DM4
1	0.00013788	0.00004337	0.00007352	0.00007985
2	0.00017962	0.00005732	0.00002259	0.00009213
3	0.00021789	0.00005494	0.00008791	0.00035209
4	0.00024172	0.00004456	0.00007433	0.00013295
5	0.00028532	0.00010072	0.00009108	0.00012522
6	0.00015480	0.00005478	0.00004452	0.00012607
7	0.00013069	0.00009009	0.00003561	0.00012091
8	0.00015982	0.00012388	0.00004428	0.00009971
9	0.00022508	0.00005374	0.00006842	0.00011213
10	0.00066086	0.00006885	0.00026791	0.00009342
11	0.00089915	0.00018304	0.00005760	0.00023239
12	0.00023879	0.00008771	0.00010581	0.00008133
13	0.00050827	0.00005519	0.00005922	0.00015705
14	0.00064591	0.00012179	0.00011236	0.00012202
15	0.00011985	0.00006843	0.00002785	0.00013181
16	0.00016471	0.00007355	0.00010883	0.00034217
17	0.00012197	0.00007742	0.00003327	0.00011826
18	0.00060798	0.00010334	0.00004046	0.00021167
19	0.00037551	0.00013422	0.00003433	0.00008214
20	0.00016034	0.00004740	0.00004019	0.00012918
21	0.00062423	0.00018933	0.00020278	0.00008715
22	0.00014166	0.00009346	0.00010220	0.00010113
23	0.00094992	0.00014253	0.00003481	0.00042053
24	0.00030793	0.00004691	0.00003583	0.00010495
25	0.00016925	0.00011677	0.00008165	0.00029562
26	0.00027176	0.00008990	0.00015288	0.00008765
27	0.00048208	0.00008088	0.00006537	0.00032893
28	0.00024088	0.00005331	0.00003285	0.00008878
29	0.00022012	0.00006617	0.00010658	0.00028834
30	0.00029303	0.00009493	0.00002815	0.00011469
31	0.00047538	0.00015818	0.00003886	0.00025624
32	0.00030762	0.00004758	0.00011195	0.00010184

Figure 12-2 PRN Bias Average for the Quarter

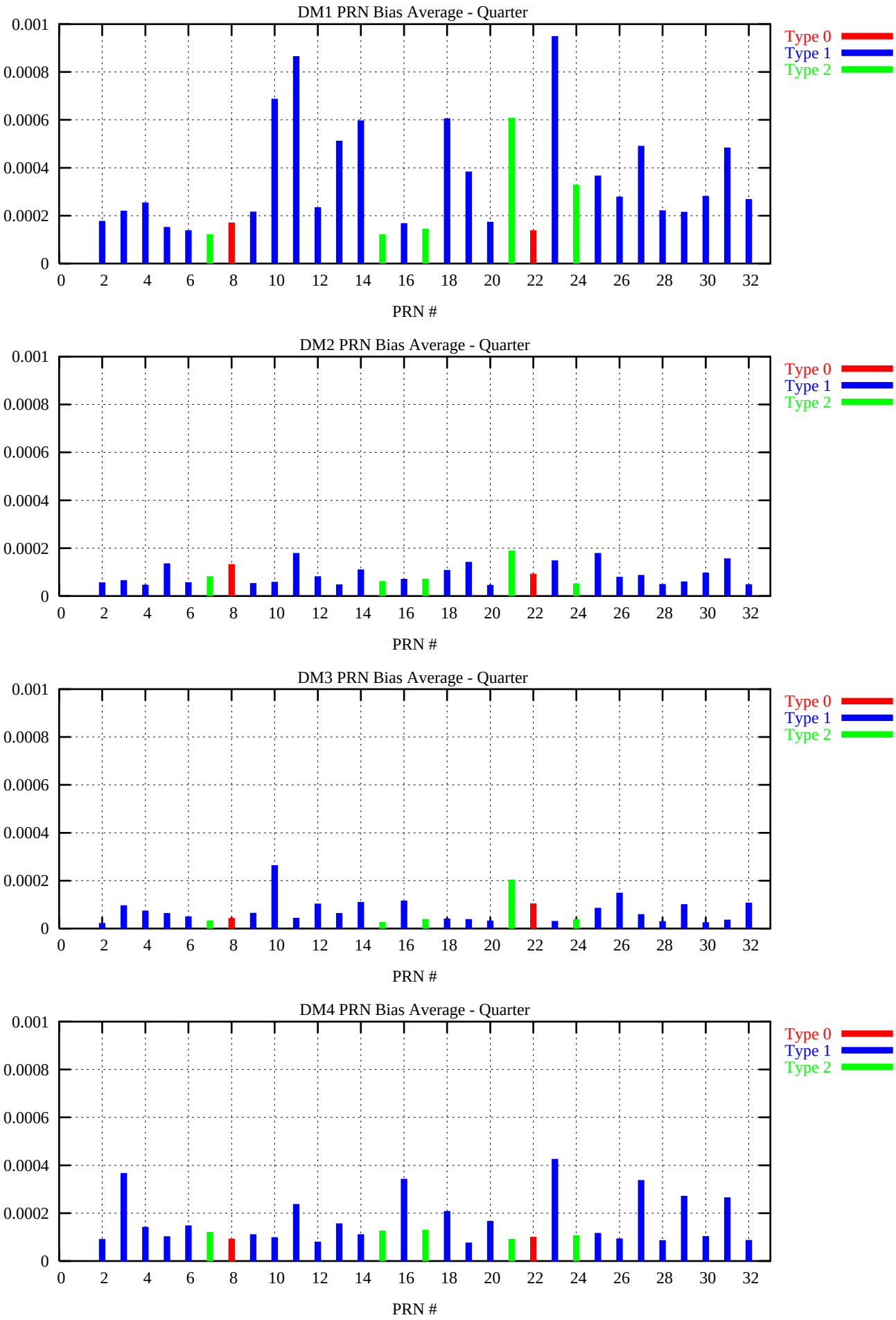


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)

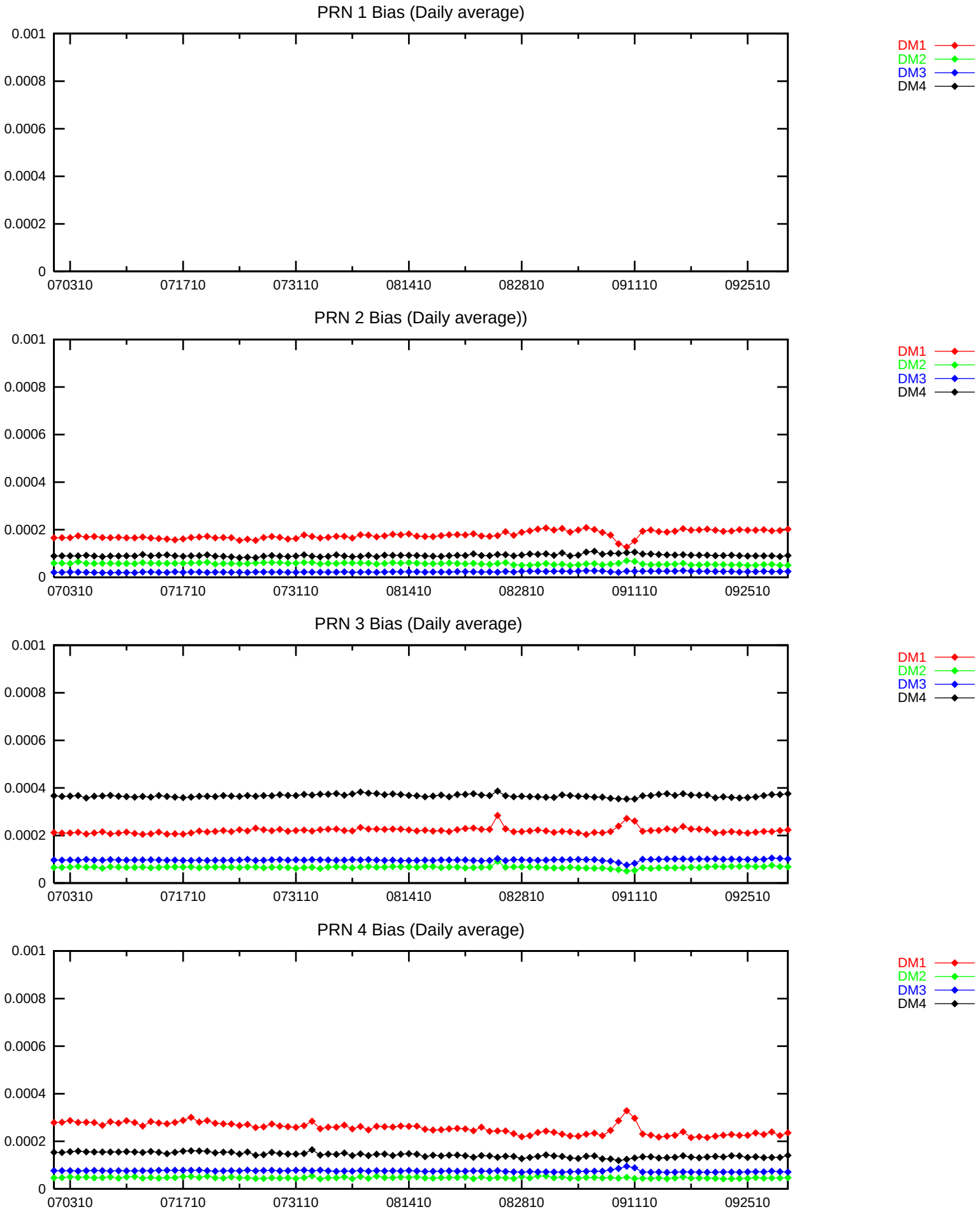


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)

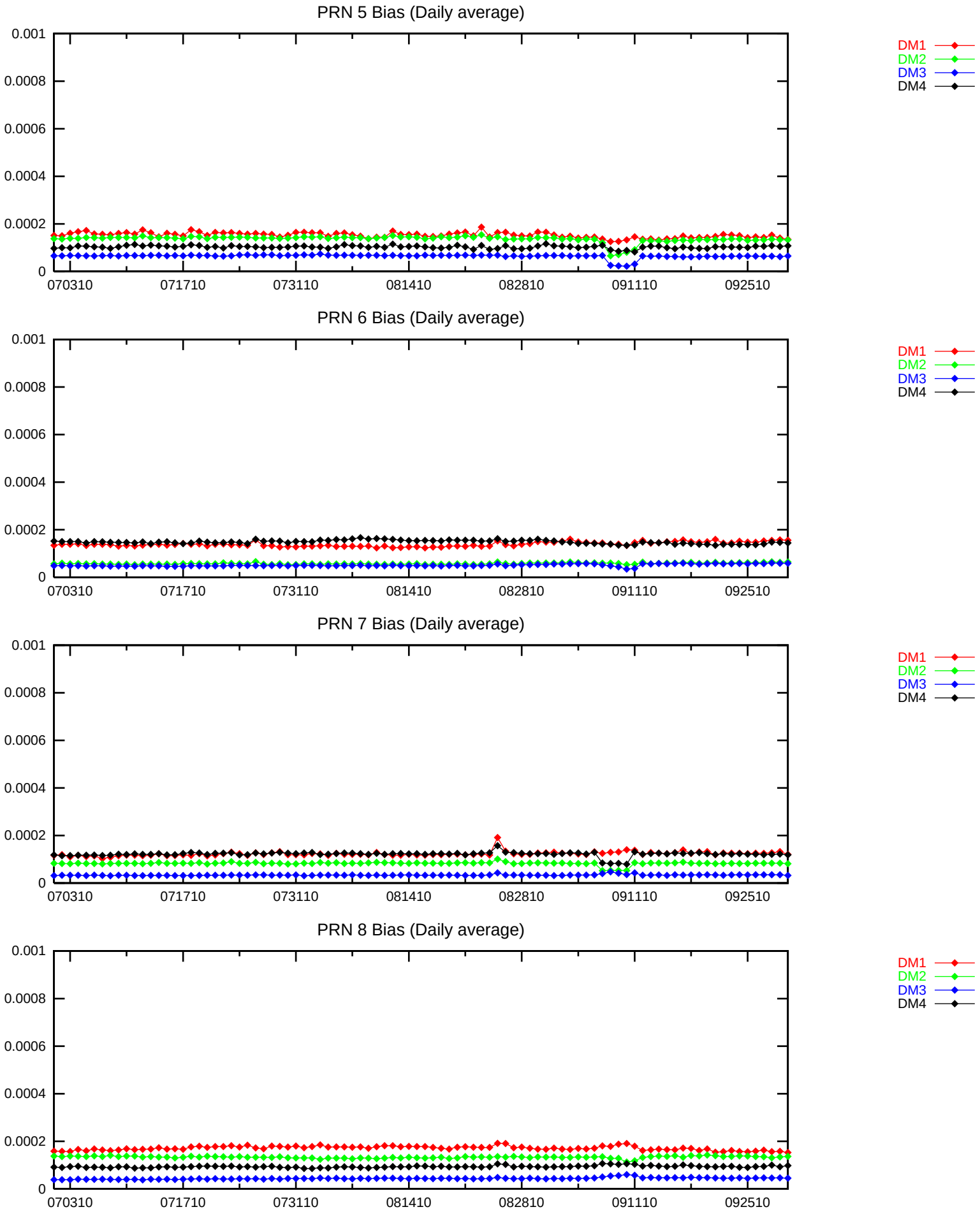


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)

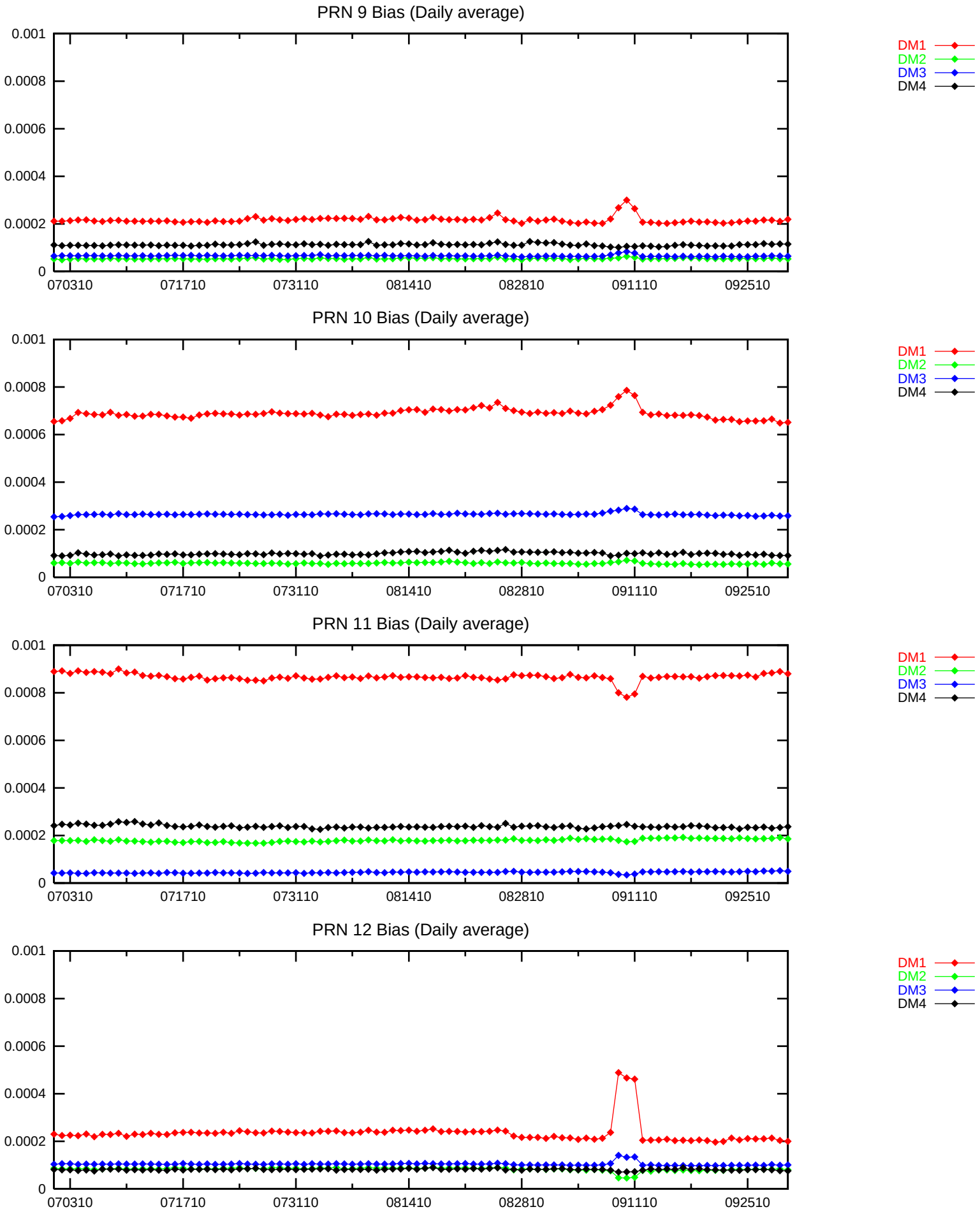


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)

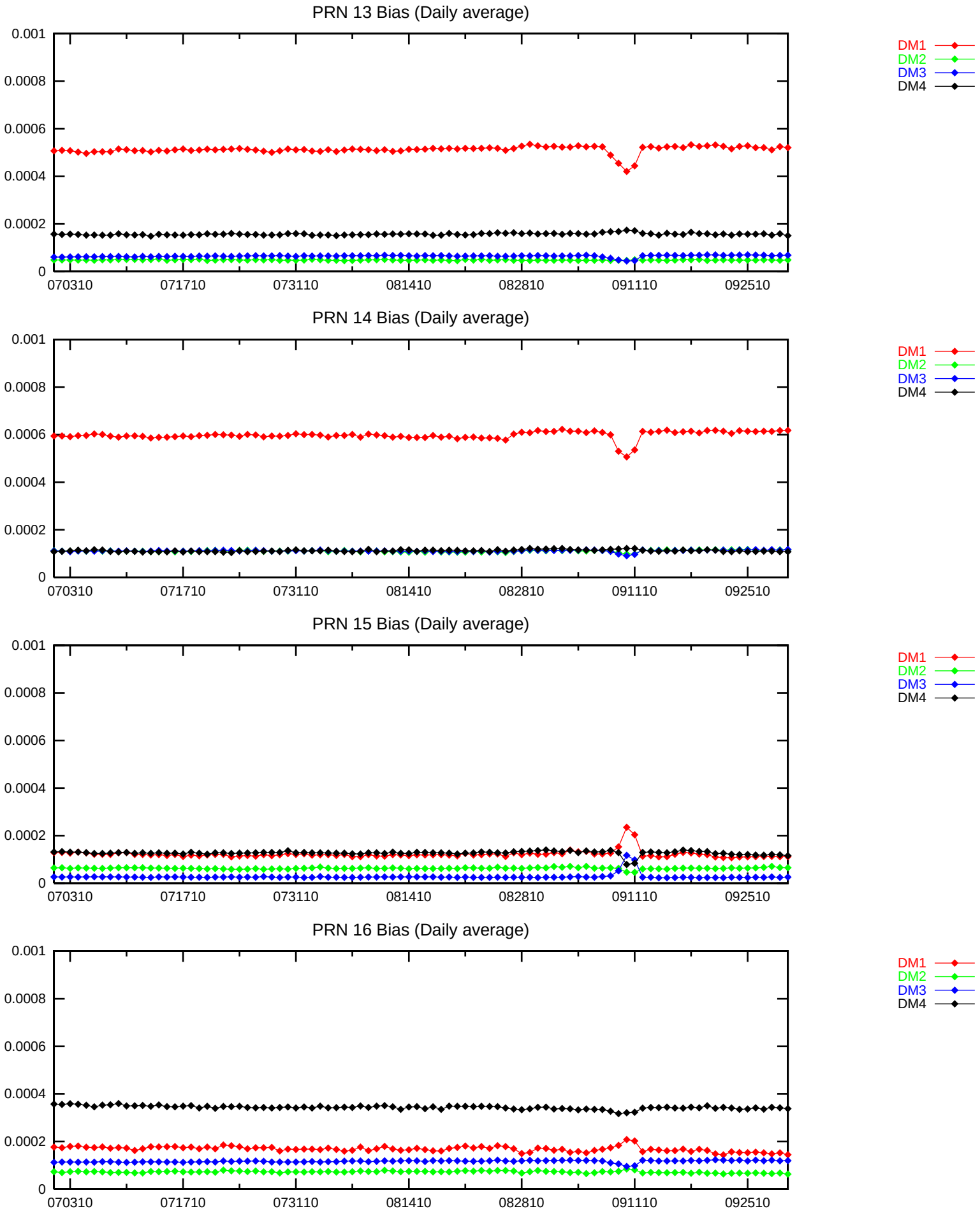


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)

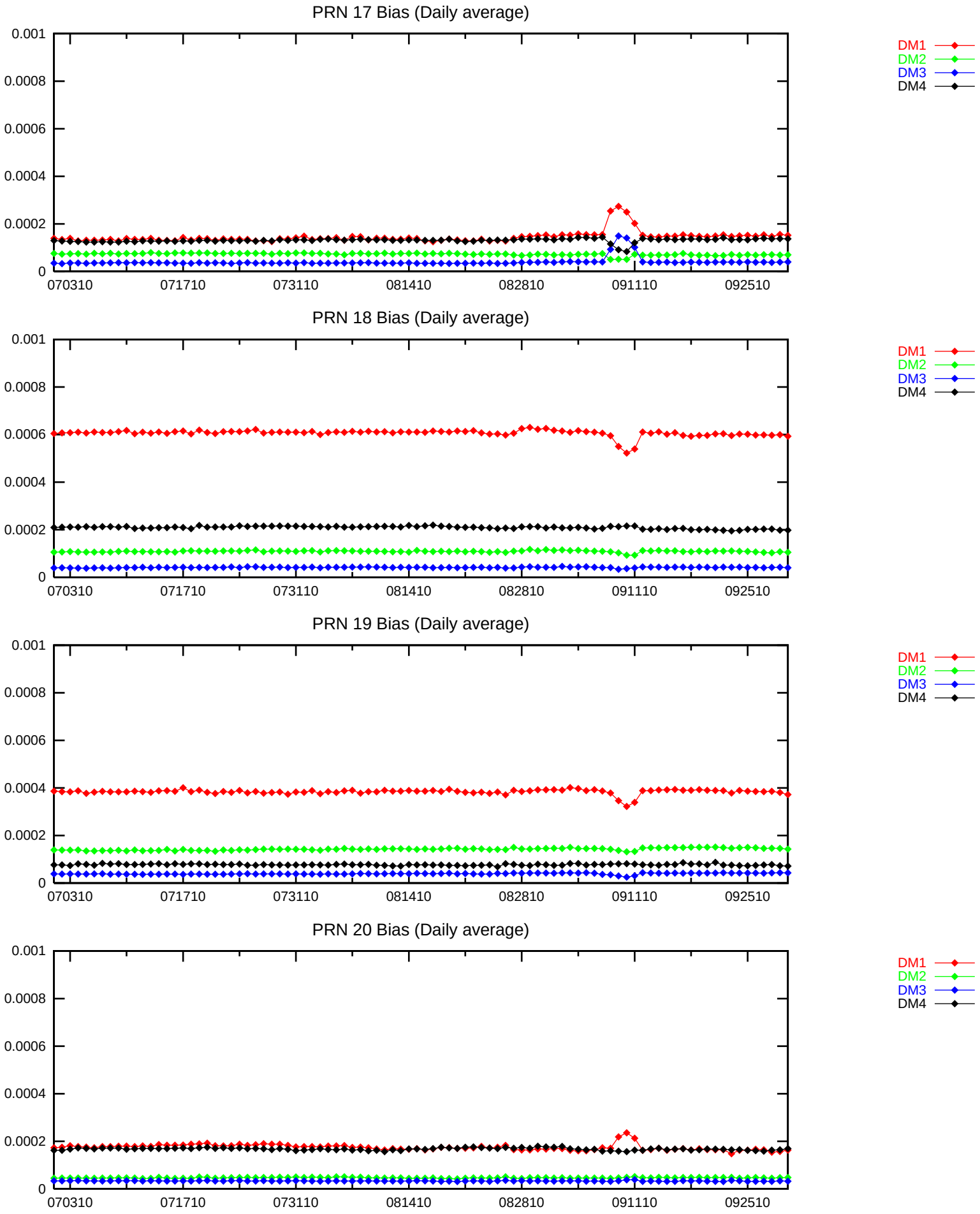


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)

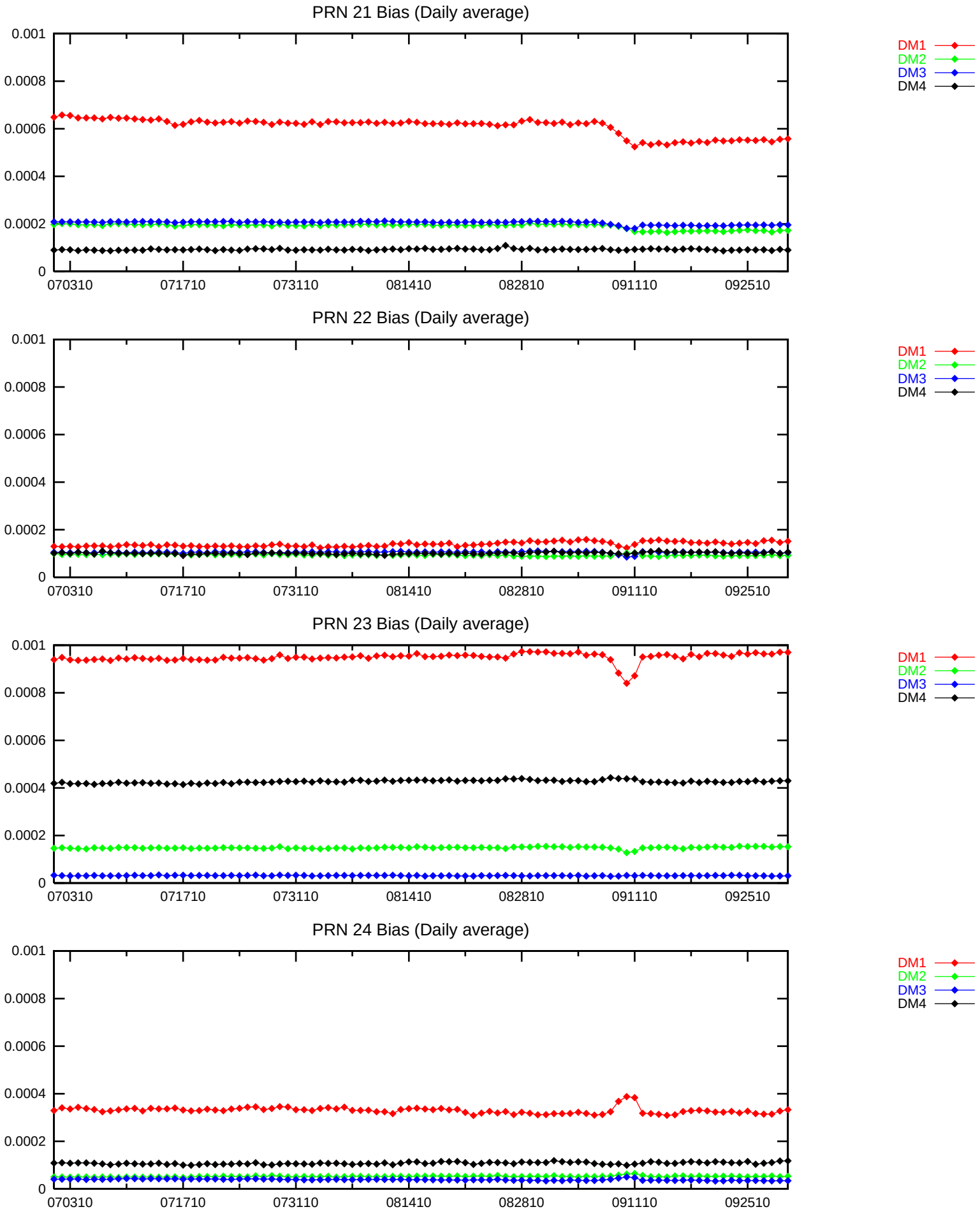


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)

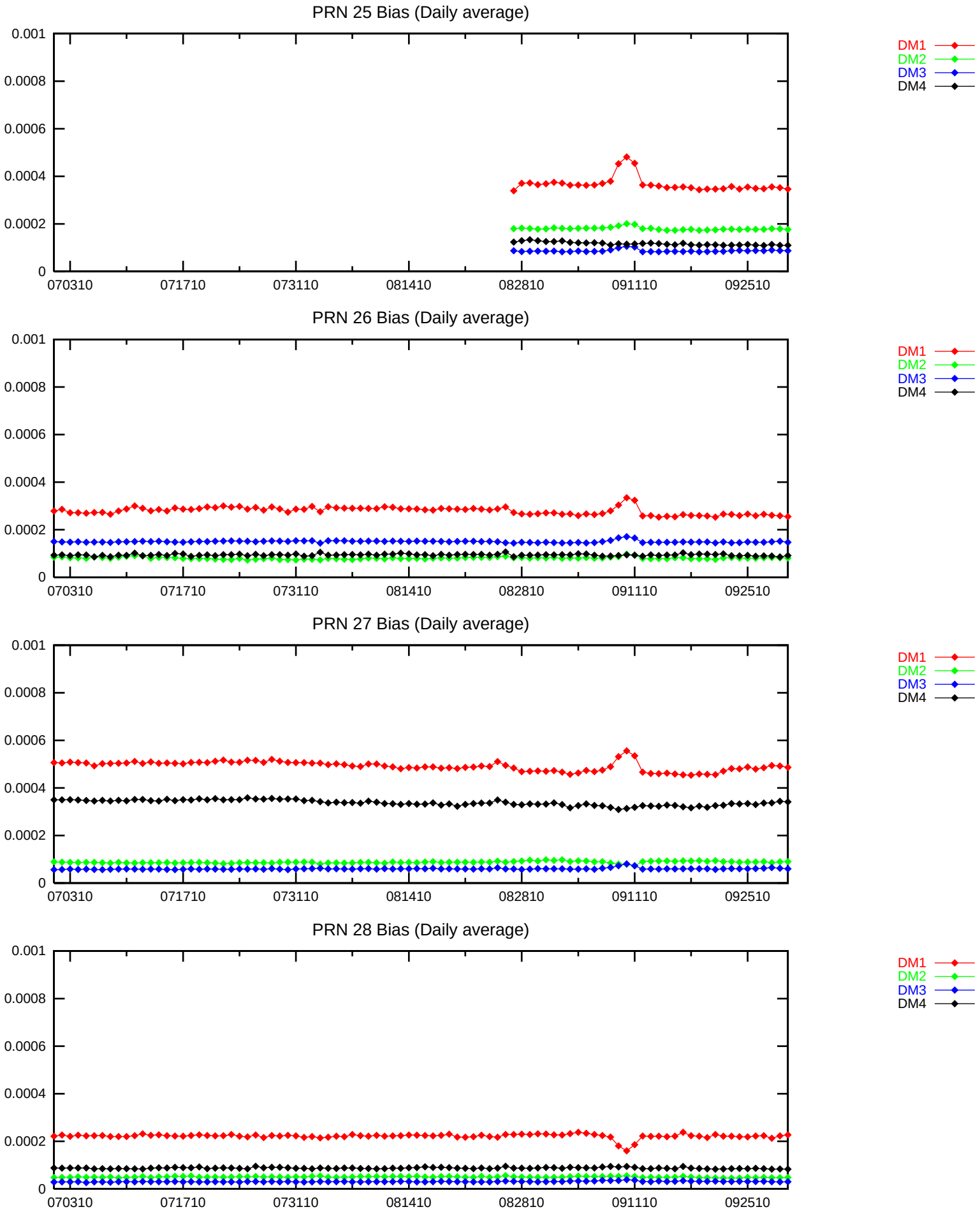
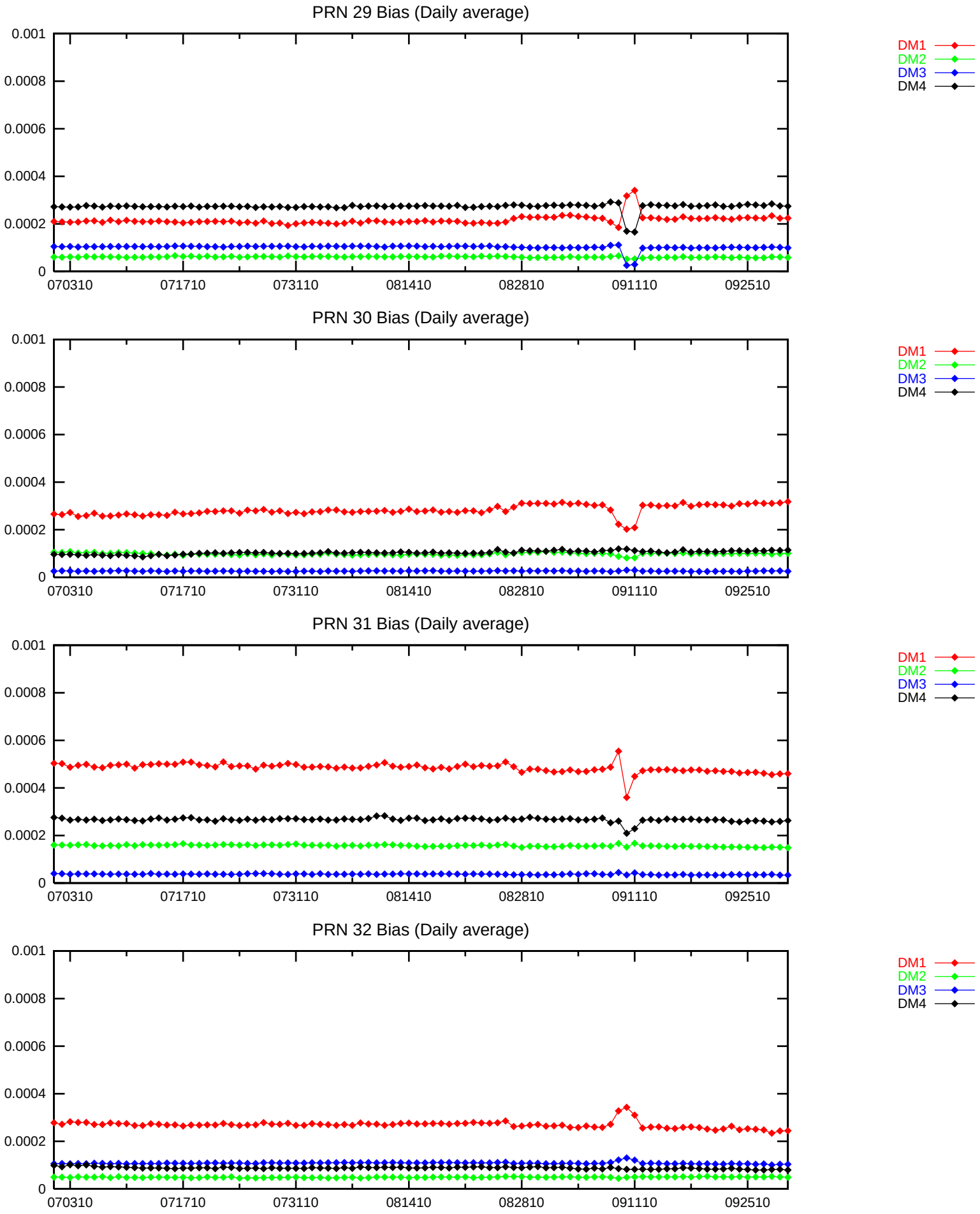


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN 32)



12.4 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.

C&V. The Correction and Verification Subsystem.

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.

S**ignal 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.

Appendix B: Additional Coverage Plots

This section includes coverage plots with 99% LPV 200 availability contour and 98% LPV availability contours for the quarter. Figure B-1 shows CONUS coverage with 98% LPV availability contour. Figure B-2 shows Alaska coverage with 98% LPV availability contour. Figure B-3 shows CONUS coverage with 99% LPV 200 availability contour. Figure B-4 shows Alaska coverage with 99% LPV 200 availability contour.

Figure B-1 98% CONUS LPV Availability Contour for the Quarter

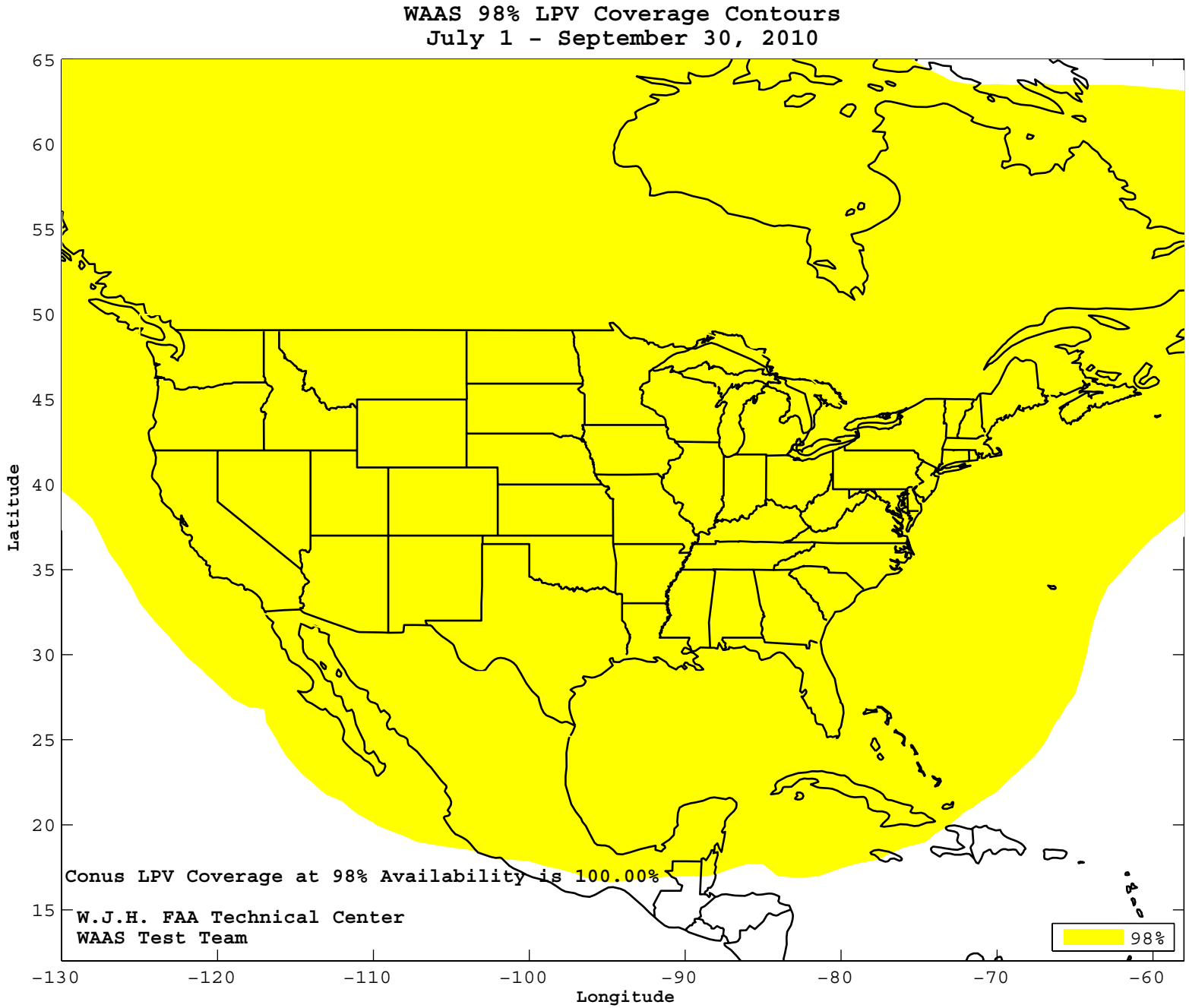


Figure B-2 98% Alaska LPV Availability Contour for the Quarter

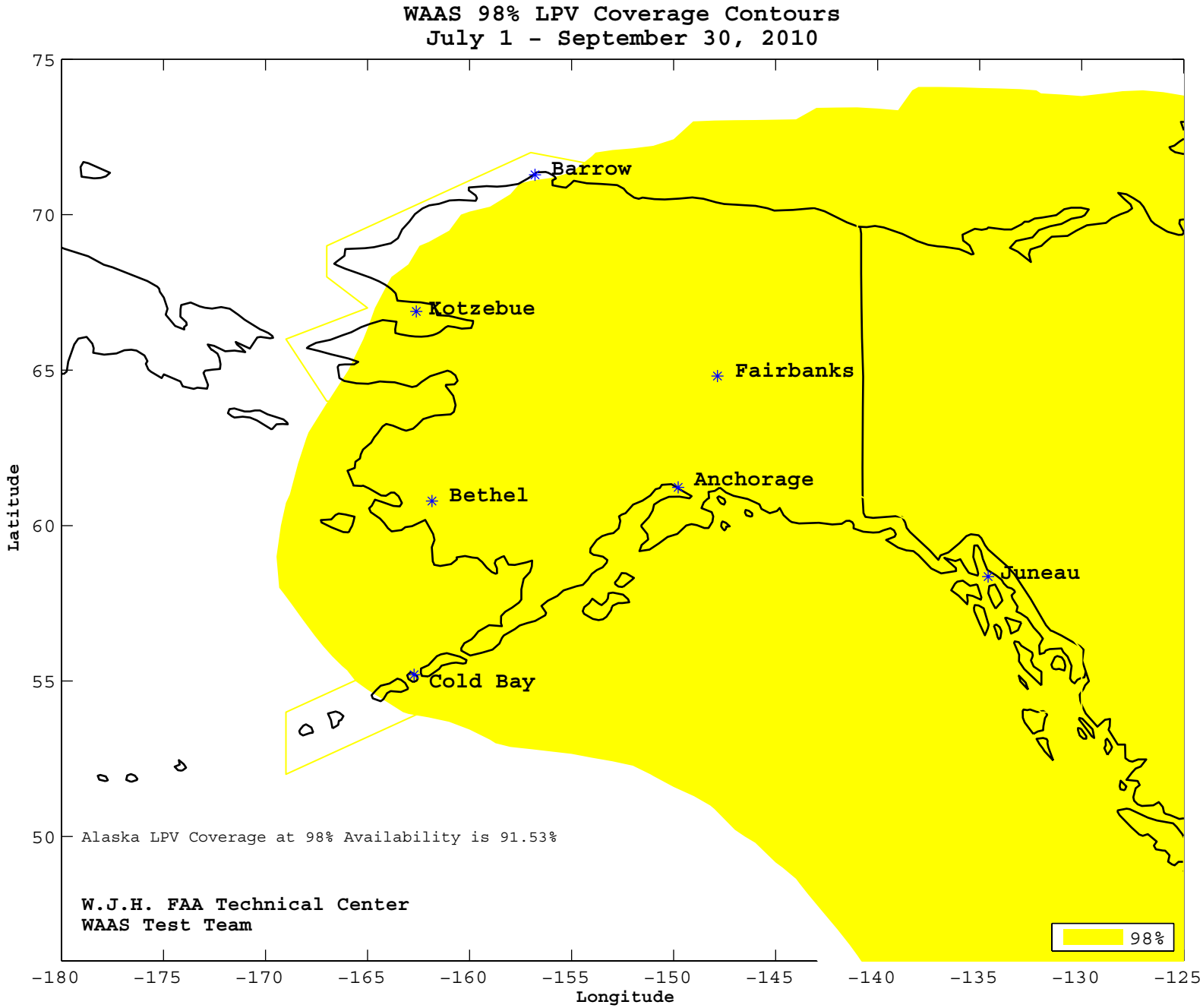


Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter

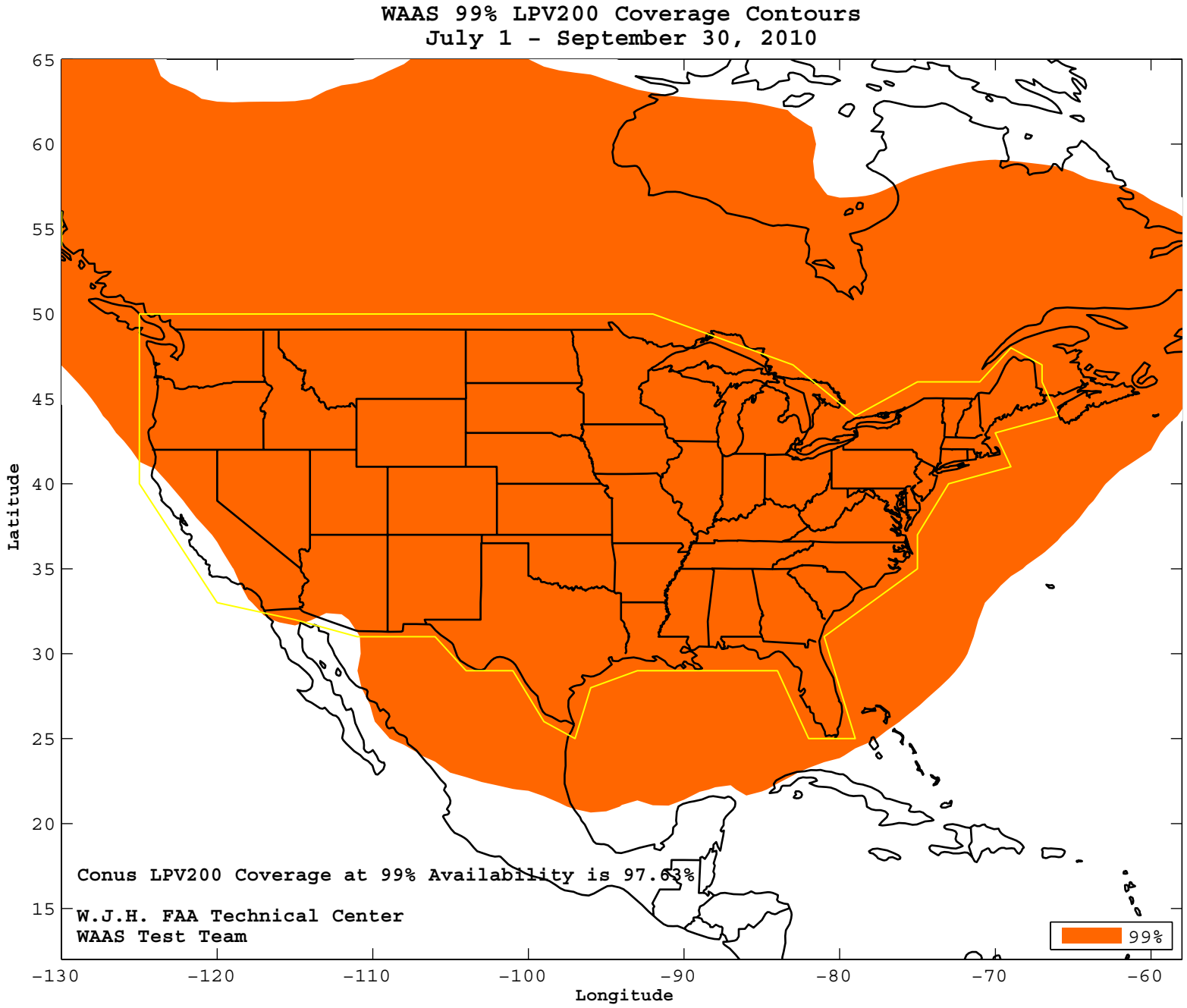


Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter