WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #29

Reporting Period: April 1 to June 30, 2009

July 2009

FAA/William J. Hughes Technical Center
NSTB/WAAS T&E Team
Atlantic City International Airport, NJ 08405
Website: http://www.nstb.tc.faa.gov/

Executive Summary

Since 1999 the WAAS Test Team at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS Test Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the twenty-ninth such WAAS quarterly report. This report covers WAAS performance during the period from April 1, 2009 to June 30, 2009.

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	Arcata 1.521 meters	Memphis 0.481 meters	Fairbanks 0.705 meters	Barrow 0.47 meters
95% Vertical Accuracy	Arcata 1.92 meters	Salt Lake City 0.705 meters	Kotzebue 1.485 meters	Bethel 0.794 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Washington DC 100%	Arcata 100%	Juneau 100%	Barrow 99.86%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	Salt Lake City 100%	Oakland 96.91%	Juneau 99.98%	Cold Bay 94.24%
95% HPL	Arcata 15.875 meters	Memphis 11.249 meters	Cold Bay 25.221 meters	Fairbanks 13.125 meters
95% VPL	Oakland 30.551 meters	Memphis 19.557 meters	Cold Bay 34.32 meters	Juneau 21.787 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 April 1, 2009 to June 30, 2009.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	91	7852298
Oklahoma City	81	6968443
WAAS:		
Albuquerque	91	7856971
Anchorage	91	7857939
Atlanta	91	7855499
Barrow	91	7859292
Bethel	91	7844686
Billings	91	7859116
Boston	91	7857895
Chicago	83	7196866
Cleveland	91	7853139
Cold Bay	91	7855942
Dallas	91	7855937
Denver	91	7853807
Fairbanks	91	7859686
Gander	91	7857854
Goose Bay	91	7856985
Houston	91	7855286
Iqaluit	91	7855869
Jacksonville	91	7855090
Juneau	91	7856943
Kansas City	91	7857810
Kotzebue	91	7856896
Los Angeles	88	7588455
Memphis	91	7856125
Merida	91	7855751
Mexico City	91	7859181
Miami	91	7857093
Minneapolis	91	7856354
New York	91	7854852
Oakland	91	7857705
Puerto Vallarta	91	7859511
Salt Lake City	91	7857279
San Jose Del Cabo	91	7858827
San Juan	91	7845895
Seattle	91	7857173
Tapachula	91	7848072
Washington DC	91	7858316
Winnipeg	91	7853420

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	91	7857217
Anchorage	91	7858240
Atlanta	91	7848485
Barrow	91	7859133
Bethel	84	7232755
Billings	91	7859356
Boston	91	7858314
Cleveland	91	7858337
Cold Bay	91	7856188
Fairbanks	91	7859490
Gander	91	7858095
Honolulu	91	7857512
Houston	91	7855533
Iqaluit	91	7859420
Juneau	91	7857183
Kansas City	91	7857697
Kotzebue	91	7856698
Los Angeles	91	7856543
Merida	91	7855997
Miami	91	7857339
Minneapolis	91	7857475
Oakland	91	7857966
Salt Lake City	91	7857521
San Jose Del Cabo	91	7850654
San Juan	91	7857278
Seattle	91	7858102
Tapachula	91	7848286
Washington DC	91	7857626

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 1-4 Test Events

GPS Week	Date	Sites	Events
1525 day 3	4/1/09	Barrow	Loss of service due to localized scintillation. PRN18 dropped by all 3 threads.
1525 day 4	4/2/09	Alaska	PRN18 outage (NANU2009024) caused a drop in coverage.
1526 day 6	4/15/09	Iqaluit	High VPE (6m) due to scintillation.
1528 day 5	4/24/09	CRW	CRW manual GUS switchover, Littleton to Napa – 3s gap.
1528 day 6	4/25/09	Alaska	CRW Doppler spikes (2)
1529 day 0	4/26/09	Alaska	CRE GUS switchover, Woodbine faulted, Brewster to primary - 24 missed messages (12s, 7s, 5s gaps).
1529 day 4	4/30/09	Alaska	CRW SIS outage (2659s) caused a drop in Alaska LPV/LPV200 coverage.
1529 day 4	4/30/09	CONUS	PRN16 outage (NANU2009030) caused a drop LPV200 coverage on the east coast
1530 day 3	5/6/09	Alaska	CRW manual GUS switchover, Napa to Littleton – 3s gap.
1531 day 0	5/10/09	All Sites	CRW Doppler spike, 3 missed messages.
1531 day 1	5/11/09	Alaska	CRE GUS manual switchover: Brewster to Woodbine – 3s gap.
1531 day 1	5/11/09	All Sites	WEI Outage: 144634 – 144644,
1531 day 1	5/11/09	Alaska	High PRN135 UDREI (11) caused loss of LPV200 coverage.
1531 day 1	5/12/09	Alaska	PRN 27 outage (NANU 2009032) caused a drop in Alaska coverage.
1531 day 2	5/12/09	Alaska	CRW Doppler spike, 7 missed messages.

1531 day 6	5/16/09	Alaska	CRW GUS manual switchovers (3), with Littleton primary – three 3s gaps.
1531 day 3	5/20/09	CRE	CRE switchover.
1532 day 4	5/21/09	CRW	CRW transmitted 7 T6 messages. See DR #81 -CRW Type 6 Messages set Multiple Satellites to NM.
1532 day 5	5/22/09	All sites	CRE GUS 2 switchovers: Brewster faulted, then Woodbine. Brewster to primary. Geo gaps, 12s and 11s.
1533 day 1	5/25/09	All sites	CRE GUS switchover: Brewster faulted, Woodbine to primary.
1533 day 5	5/29/09	CRE	CRE manual GUS switchover, Woodbine to Brewster – 3s gap.
1533 day 6	5/30/09	CRE	CRE Delta V – PA availability = 93%.
1534 day 0	5/31/09	All sites	WEI Outages: 19348 – 19553, 23482 – 23689.
1534 day 1	6/1/09	CRE	CRE 1s missed message.
1535 day 5 to 1535 day 6	6/12/09 to 6/13/09	Alaska	PRN30, 2 SV alerts. AK LPV200 coverage drop.
1536 day 4	6/18/09	CRE	CRE GUS switchover: Brewster faulted, Woodbine to primary - 12s gap.
1536 day 5	6/19/09	Alaska	PRN32 outage (NANU2009036). AK LPV/LPV200 Coverage drop.
1536 day 5	6/19/09	Iqaluit	Iqaluit high PDOP, poor satellite constellation and PRN32 outage.
1537 day 5	6/26/09	All sites	PRN 25 usable until further notice.
1538 day 0	6/28/09	Iqaluit	Iqaluit high VPE, scintillation event.

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 1.521 meters and 1.92 meters both at Arcata, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.481 meters at Memphis and 0.705 meters at Salt Lake City, respectively. The maximum 95% and 99.999% NPA horizontal errors are 2.383 meters and 4.818 meters, both at Honolulu, respectively. The minimum 95% and 99.999% horizontal errors are 0.838 meters at Iqaluit and 1.651 meters at Albuquerque, respectively.

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	1.521	1.521	1.920	100	*	*
Oklahoma City	0.772	0.772	1.102	100	*	*
Albuquerque	0.538	0.538	0.922	100	1.963	4.396
Anchorage	0.570	0.570	0.945	100	*	*
Atlanta	0.621	0.621	1.068	100	2.004	4.607
Barrow	0.470	0.470	1.128	99.94211	*	*
Bethel	0.503	0.503	0.794	100	1.847	4.048
Billings	0.850	0.850	0.921	100	2.009	3.911
Boston	0.656	0.656	1.332	100	1.897	4.064
Chicago	0.831	0.831	0.974	100	*	*
Cleveland	0.570	0.570	1.041	100	1.978	4.218
Cold Bay	0.695	0.695	0.996	100	*	*
Dallas	0.521	0.521	1.097	100	*	*
Denver	0.539	0.539	0.978	100	*	*
Fairbanks	0.705	0.705	1.120	100	1.730	3.999
Gander	0.669	0.669	1.133	99.97686	*	*
Goose Bay	0.564	0.564	1.168	99.97359	*	*
Houston	0.672	0.672	1.031	100	2.055	4.694
Iqaluit	0.620	0.620	1.821	99.96788	*	*
Jacksonville	0.541	0.541	1.018	100	*	*
Juneau	0.578	0.578	0.886	100	*	*
Kansas City	0.495	0.495	0.971	100	1.999	4.348
Kotzebue	0.601	0.601	1.485	99.93981	1.706	3.935
Los Angeles	0.658	0.658	1.233	100	2.101	5.028
Memphis	0.481	0.481	1.127	100	*	*
Merida	0.523	0.523	1.065	100	*	*
Mexico City	0.637	0.637	1.234	100	*	*
Miami	0.655	0.655	1.537	100	2.230	4.849
Minneapolis	0.666	0.666	0.969	100	2.000	4.017
New York	0.837	0.837	1.144	100	*	*
Oakland	0.687	0.687	1.157	100	2.076	4.869
Puerto Vallarta	0.622	0.622	1.311	100	*	*
Salt Lake City	0.610	0.610	0.705	100	1.992	4.415
San Jose Del Cabo	0.644	0.644	1.541	100	*	*
San Juan	0.985	1.087	1.511	99.99658	*	*
Seattle	0.847	0.847	0.776	100	2.142	4.253
Tapachula	0.709	0.717	1.198	99.99995	*	*
Washington DC	0.548	0.548	0.947	100	2.004	4.303
Winnipeg	0.591	0.591	0.994	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	0.921	1.651	100	2.141
Anchorage	1.517	2.681	100	2.869
Atlanta	1.103	1.952	100	2.072
Barrow	0.987	1.928	99.96	4.019
Bethel	1.377	2.306	100	3.009
Billings	1.502	2.362	100	2.721
Boston	1.053	2.053	100	2.200
Cleveland	0.985	2.073	100	2.462
Cold Bay	1.408	2.294	100	2.688
Fairbanks	1.542	2.883	100	3.251
Gander	1.051	2.591	99.99	2.779
Honolulu	2.383	4.818	100	5.068
Houston	1.157	2.322	100	2.570
Iqaluit	0.838	2.770	99.99	4.042
Juneau	1.274	2.290	100	2.442
Kansas City	1.089	2.077	100	2.391
Kotzebue	1.265	2.565	99.96	2.807
Los Angeles	1.154	2.174	100	2.746
Merida	1.558	3.703	100	3.954
Miami	1.457	3.181	100	3.309
Minneapolis	1.206	4.389	100	4.805
Oakland	1.224	2.151	100	2.290
Salt Lake City	1.111	1.886	100	2.262
San Jose Del Cabo	1.617	3.175	100	3.394
San Juan	1.426	3.754	100	4.021
Seattle	1.383	2.367	100	2.755
Tapachula	1.905	3.878	100	4.040
Washington DC	1.176	2.407	100	2.583

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

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Arcata	3.765	0.260	0.262	7.295	0.221	0.225
Oklahoma City	2.107	0.195	0.195	3.941	0.165	0.165
Albuquerque	2.185	0.136	0.159	2.908	0.087	0.163
Anchorage	1.688	0.124	0.136	3.734	0.182	0.182
Atlanta	1.876	0.115	0.156	3.806	0.189	0.218
Barrow	2.640	0.177	0.183	6.733	0.257	0.257
Bethel	1.826	0.080	0.088	2.726	0.099	0.099
Billings	2.238	0.182	0.182	2.506	0.106	0.143
Boston	2.602	0.190	0.191	3.450	0.117	0.158
Chicago	2.389	0.218	0.218	3.707	0.136	0.147
Cleveland	2.827	0.210	0.210	4.664	0.192	0.207
Cold Bay	2.887	0.134	0.134	2.886	0.060	0.108
Dallas	1.744	0.075	0.170	3.344	0.200	0.200
Denver	1.637	0.146	0.146	3.760	0.178	0.178
Fairbanks	1.518	0.111	0.127	2.966	0.111	0.137
Gander	2.028	0.080	0.091	3.121	0.084	0.096
Goose Bay	1.724	0.121	0.121	2.533	0.095	0.118
Houston	1.747	0.106	0.162	3.320	0.108	0.175
Iqaluit	2.303	0.121	0.121	5.937	0.162	0.191
Jacksonville	1.445	0.137	0.142	3.079	0.122	0.131
Juneau	1.622	0.143	0.150	3.328	0.178	0.194
Kansas City	1.653	0.068	0.123	2.665	0.118	0.165
Kotzebue	1.569	0.105	0.108	4.512	0.144	0.158
Los Angeles	2.079	0.181	0.181	3.829	0.124	0.149
Memphis	1.469	0.129	0.131	2.838	0.115	0.156
Merida	1.394	0.056	0.106	2.974	0.087	0.126
Mexico City	2.305	0.123	0.123	3.892	0.167	0.167
Miami	1.613	0.080	0.123	4.384	0.151	0.160
Minneapolis	3.678	0.380	0.380	3.625	0.203	0.203
New York	1.846	0.106	0.130	2.849	0.110	0.140
Oakland	1.562	0.090	0.133	3.352	0.145	0.145
Puerto Vallarta	1.824	0.062	0.088	4.580	0.117	0.130
Salt Lake City	2.166	0.197	0.197	2.327	0.124	0.135
San Jose Del Cabo	1.588	0.092	0.099	4.015	0.140	0.140
San Juan	3.225	0.101	0.101	6.281	0.126	0.127
Seattle	1.991	0.136	0.167	2.858	0.082	0.171
Tapachula	2.237	0.057	0.094	4.669	0.152	0.152
Washington DC	1.650	0.099	0.122	2.804	0.101	0.140
Winnipeg	1.586	0.061	0.125	2.671	0.151	0.151

Figure 2-1 95% Horizontal Accuracy at LPV

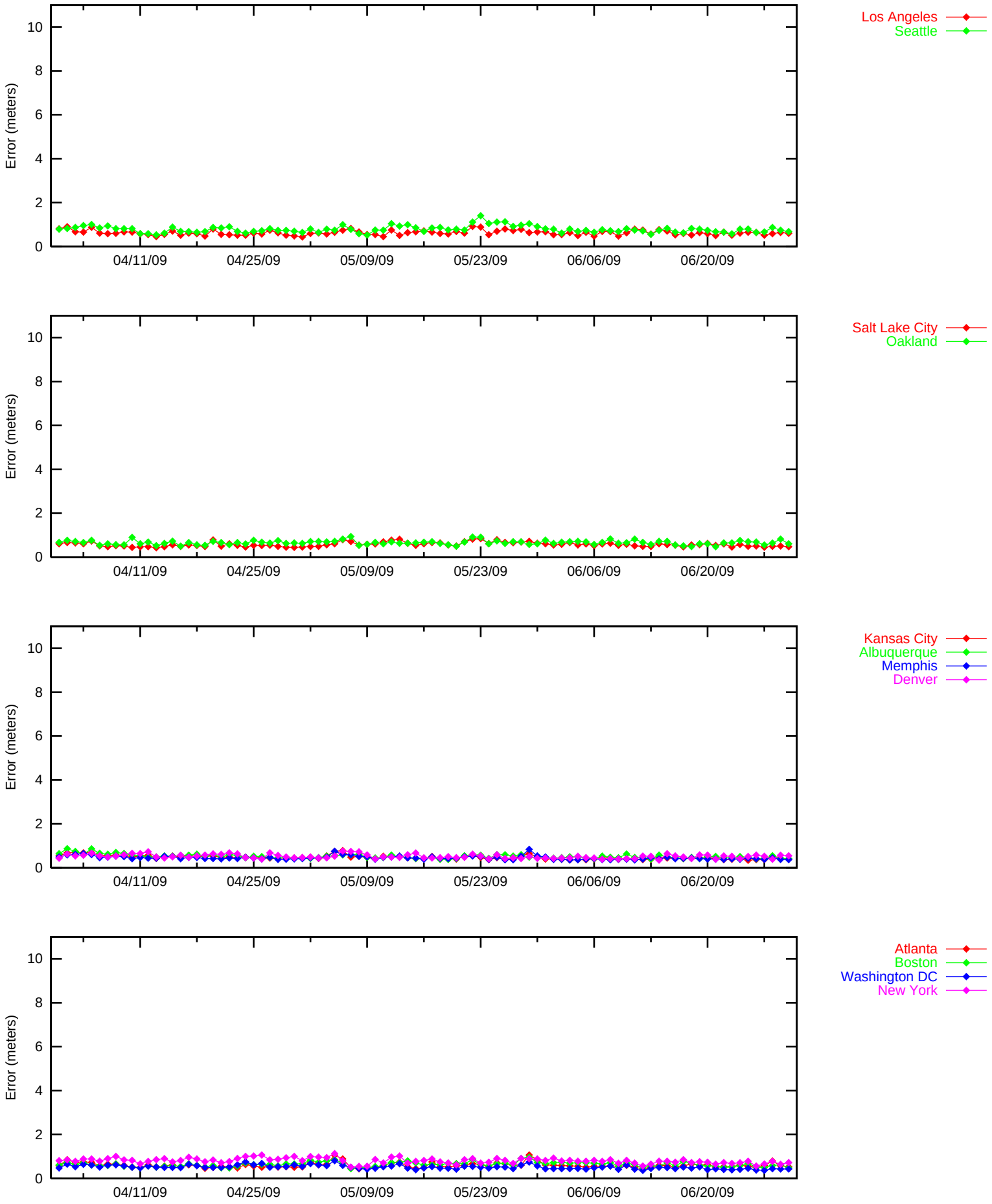


Figure 2-2 95% Horizontal Accuracy at LPV

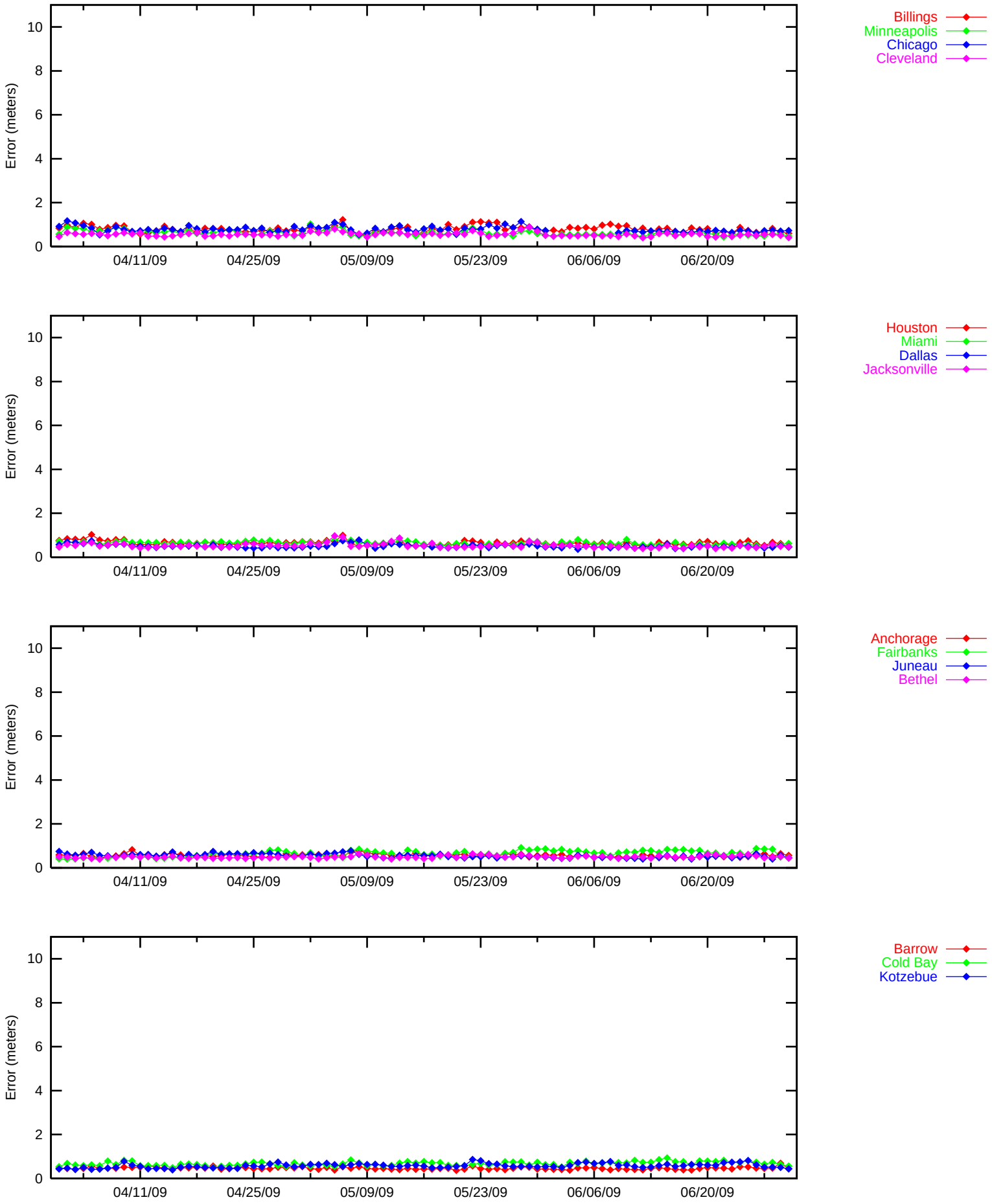


Figure 2-3 95% Horizontal Accuracy at LPV

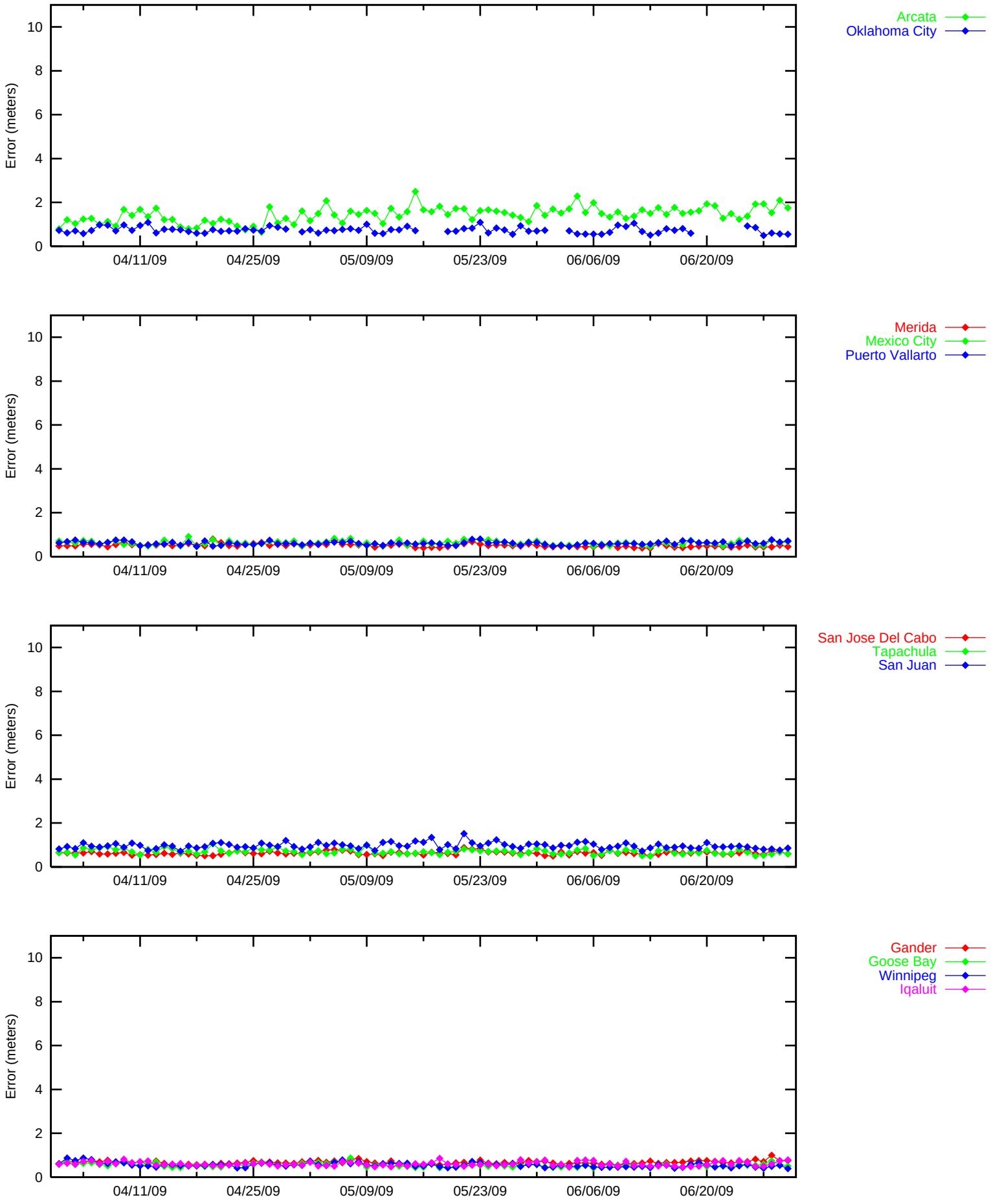


Figure 2-4 95% Vertical Accuracy at LPV

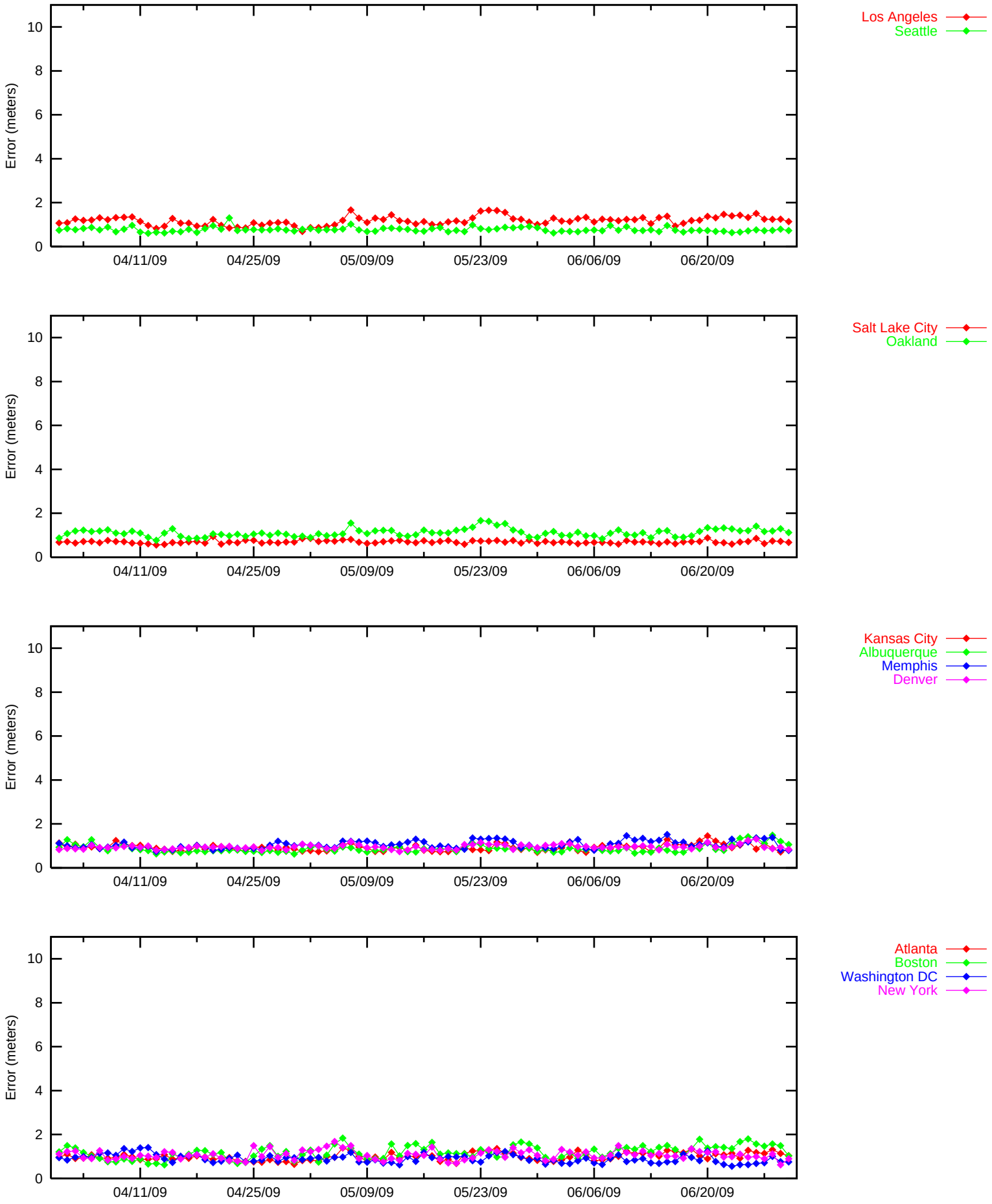


Figure 2-5 95% Vertical Accuracy at LPV

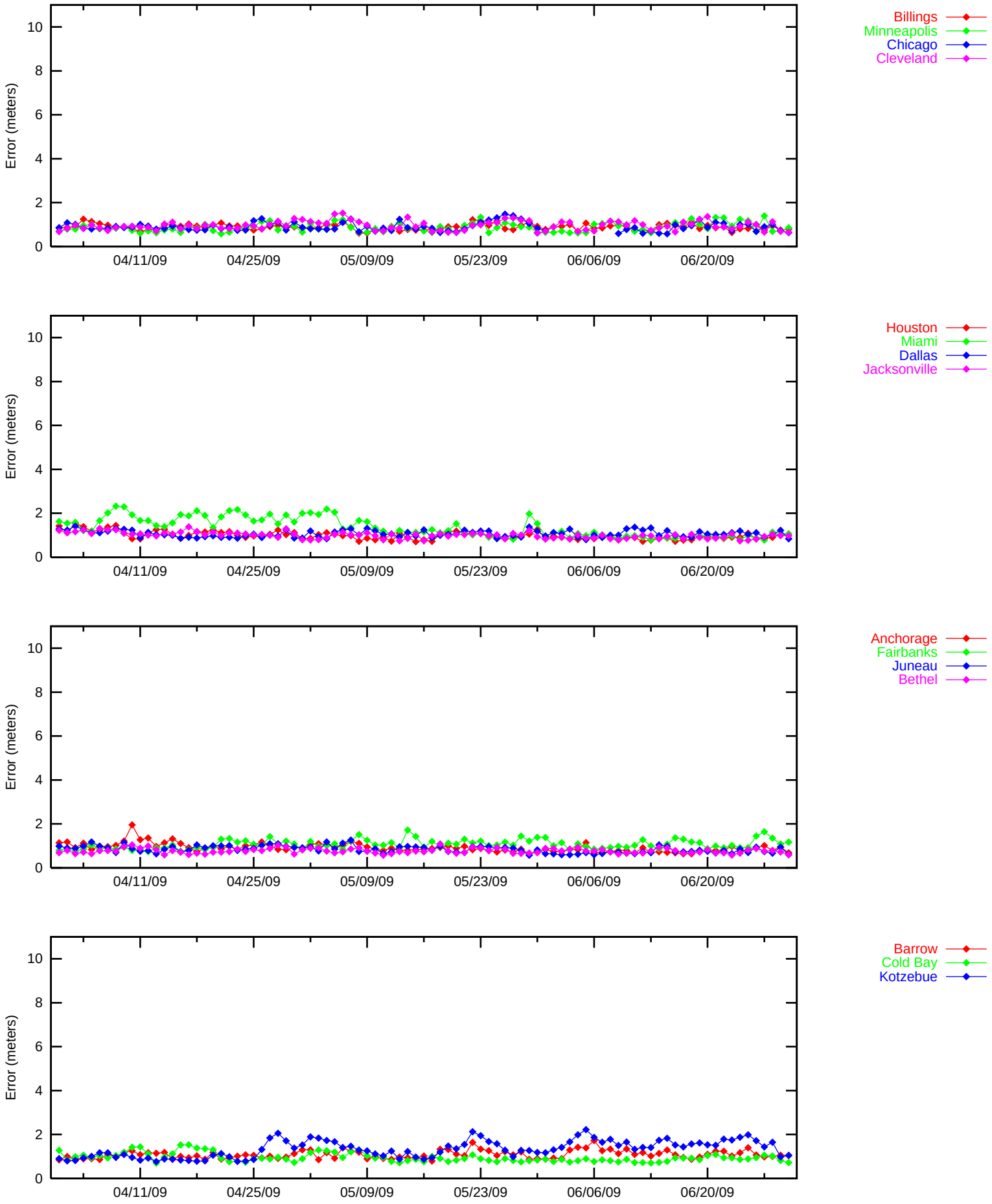


Figure 2-6 95% Vertical Accuracy at LPV

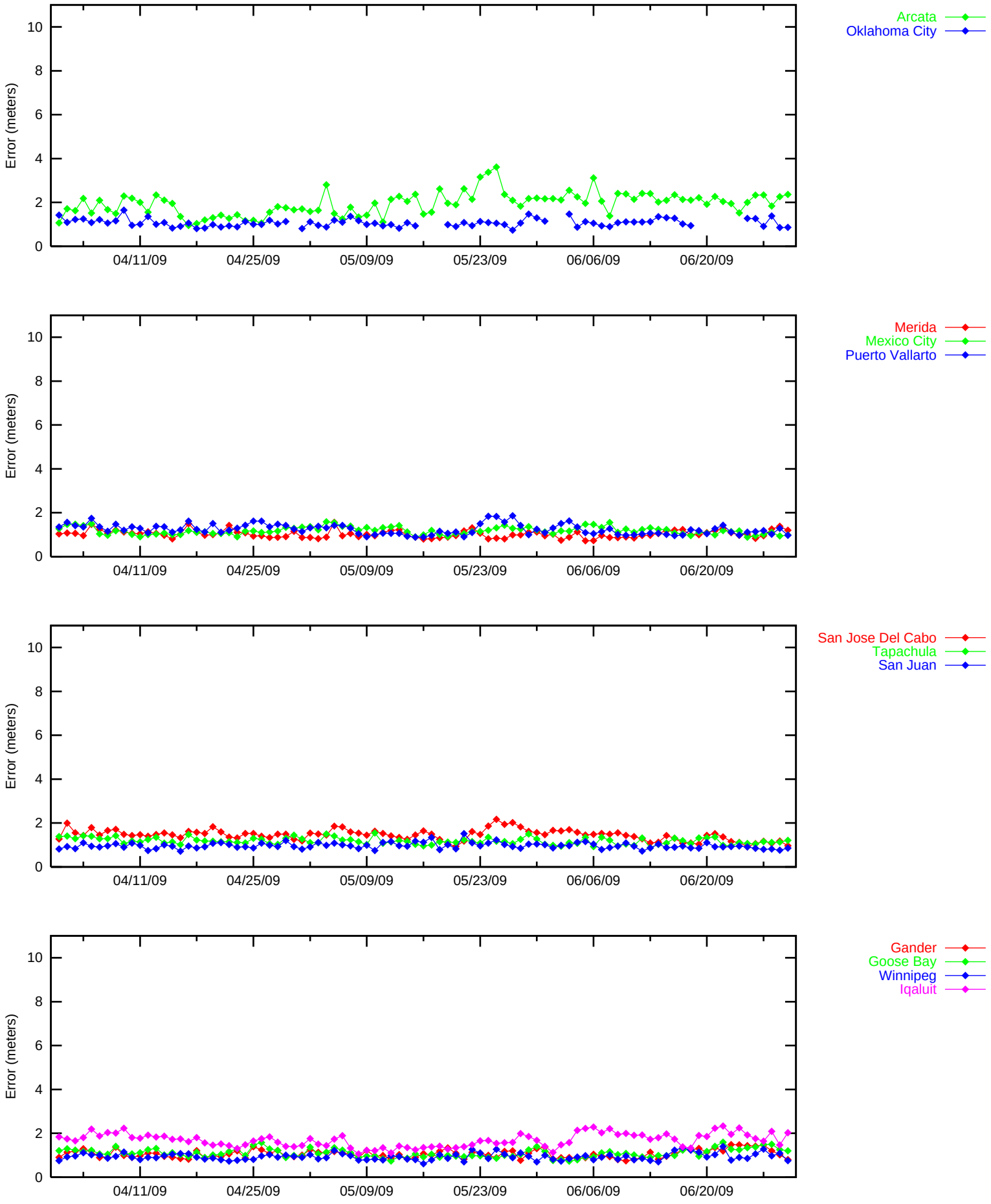


Figure 2-7 95% NPA Horizontal Accuracy

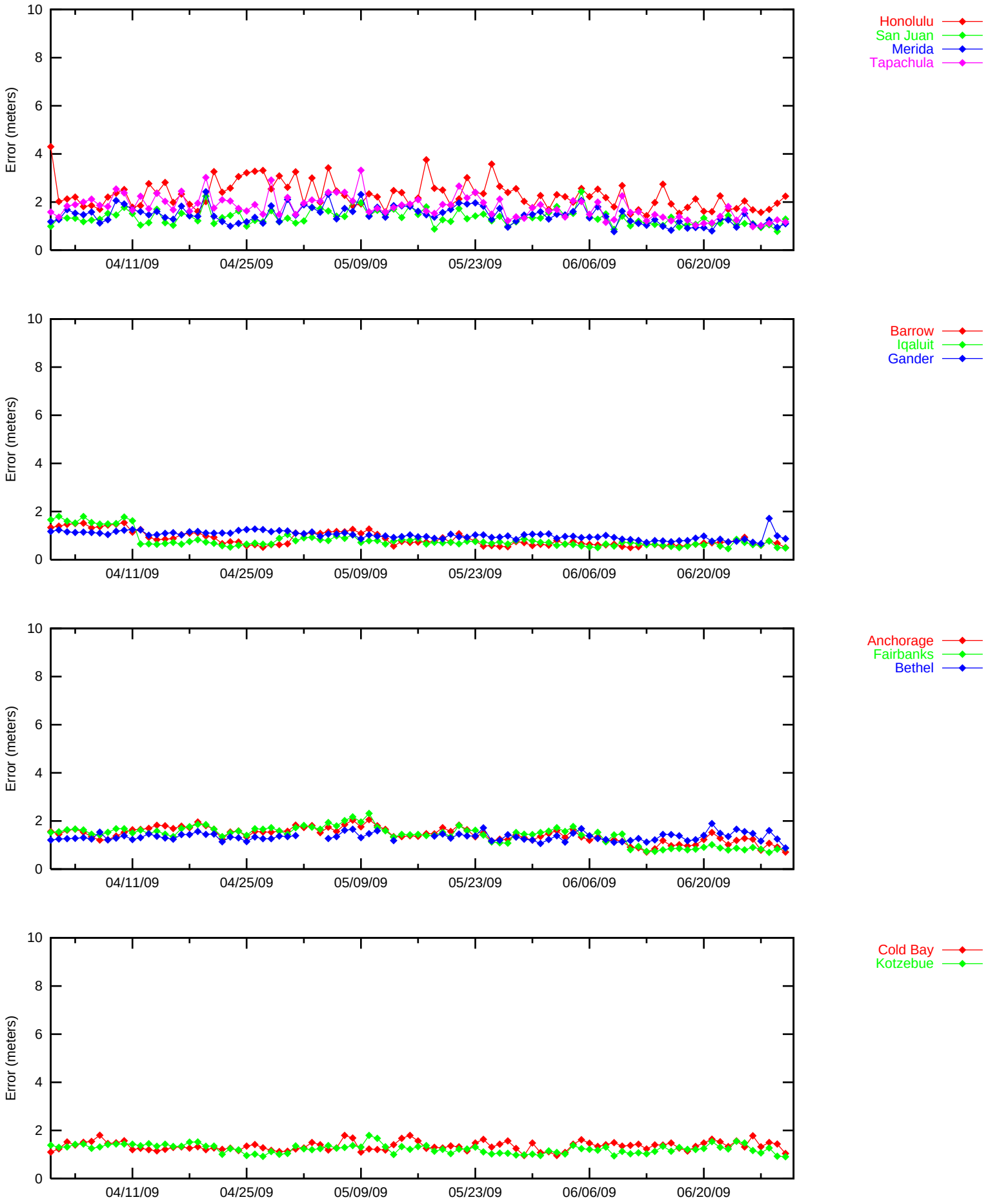


Figure 2-8 95% NPA Horizontal Accuracy

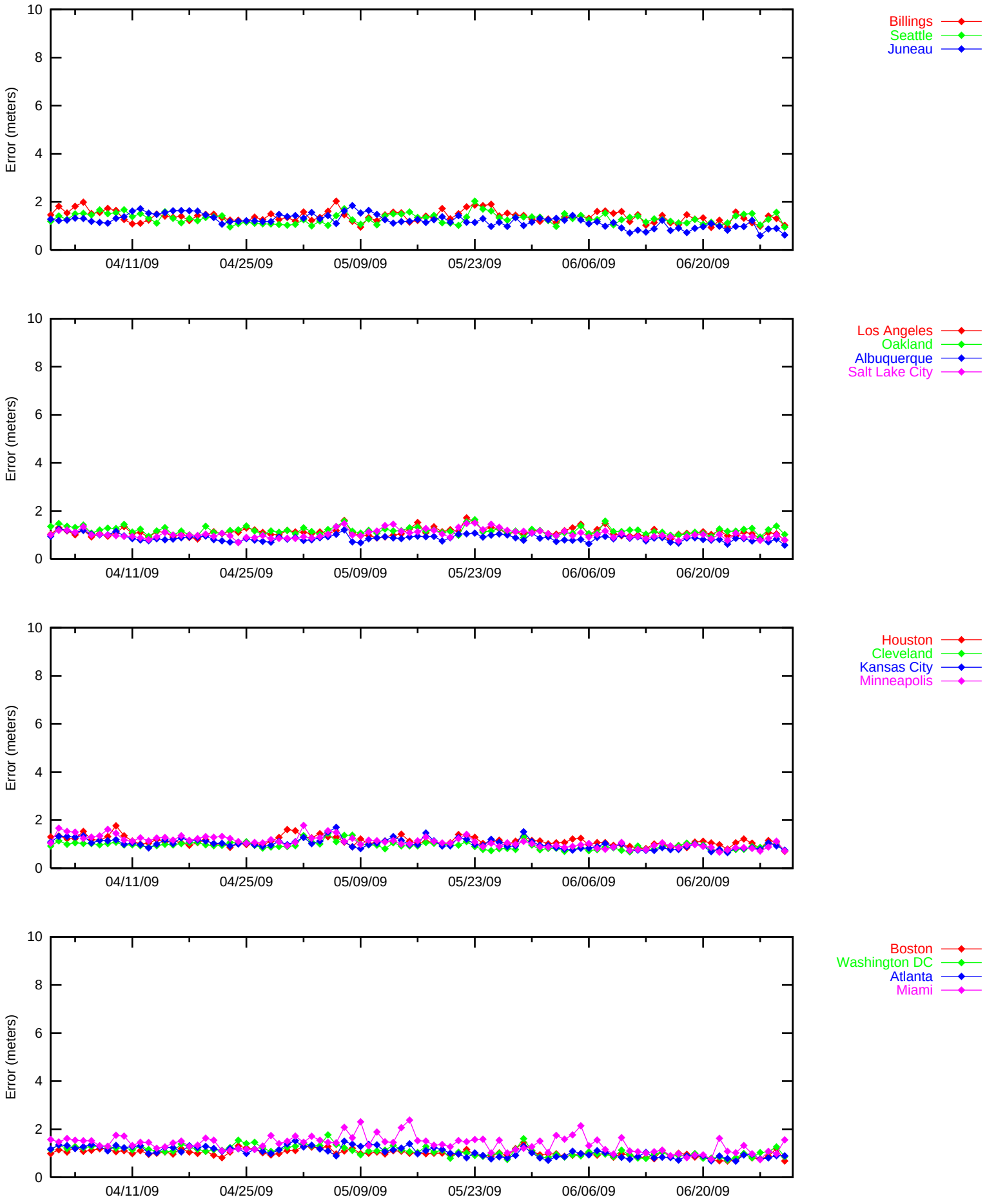


Figure 2-9 Horizontal Triangle Chart for the Quarter

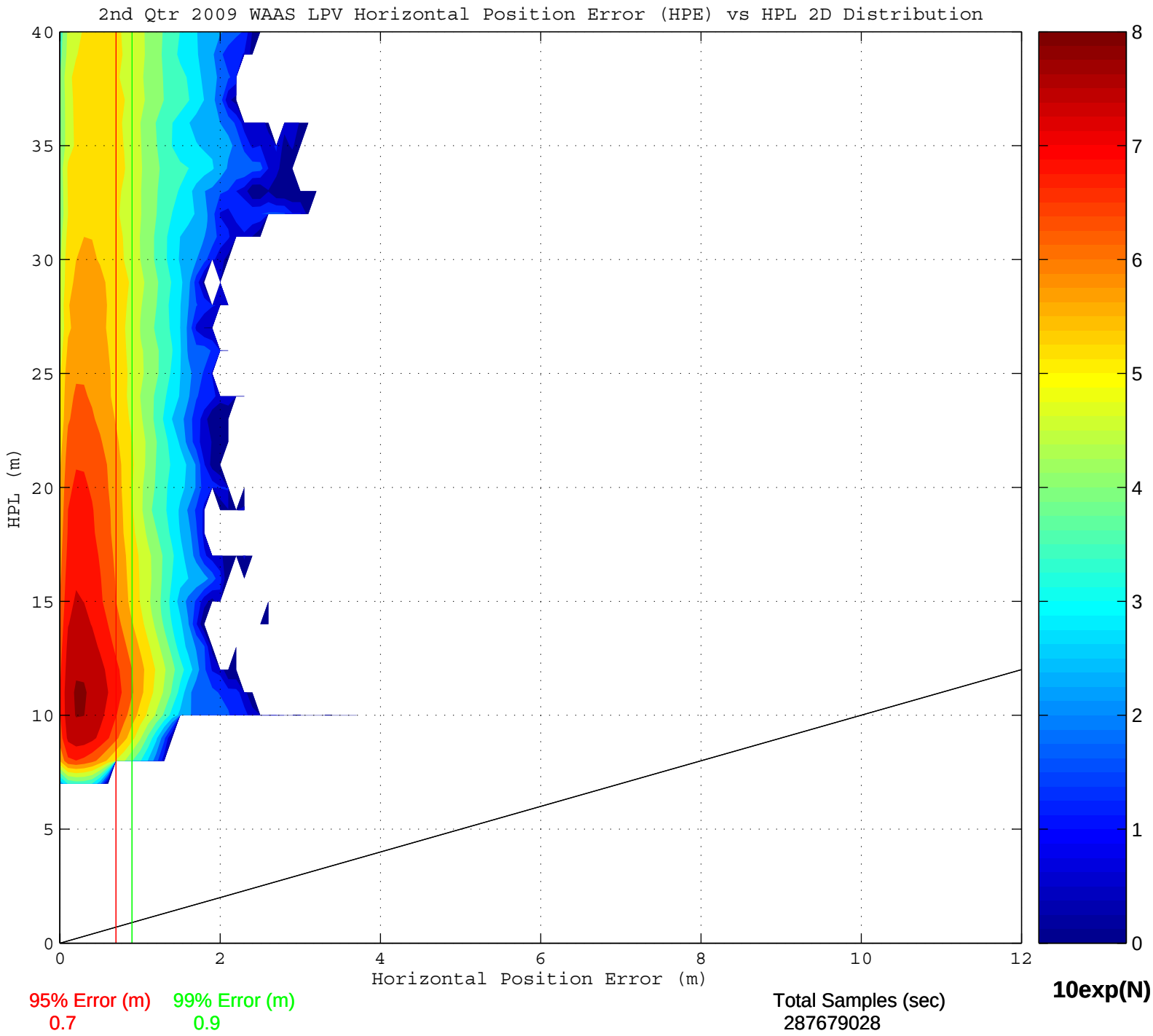


Figure 2-10 Vertical Triangle Chart for the Quarter

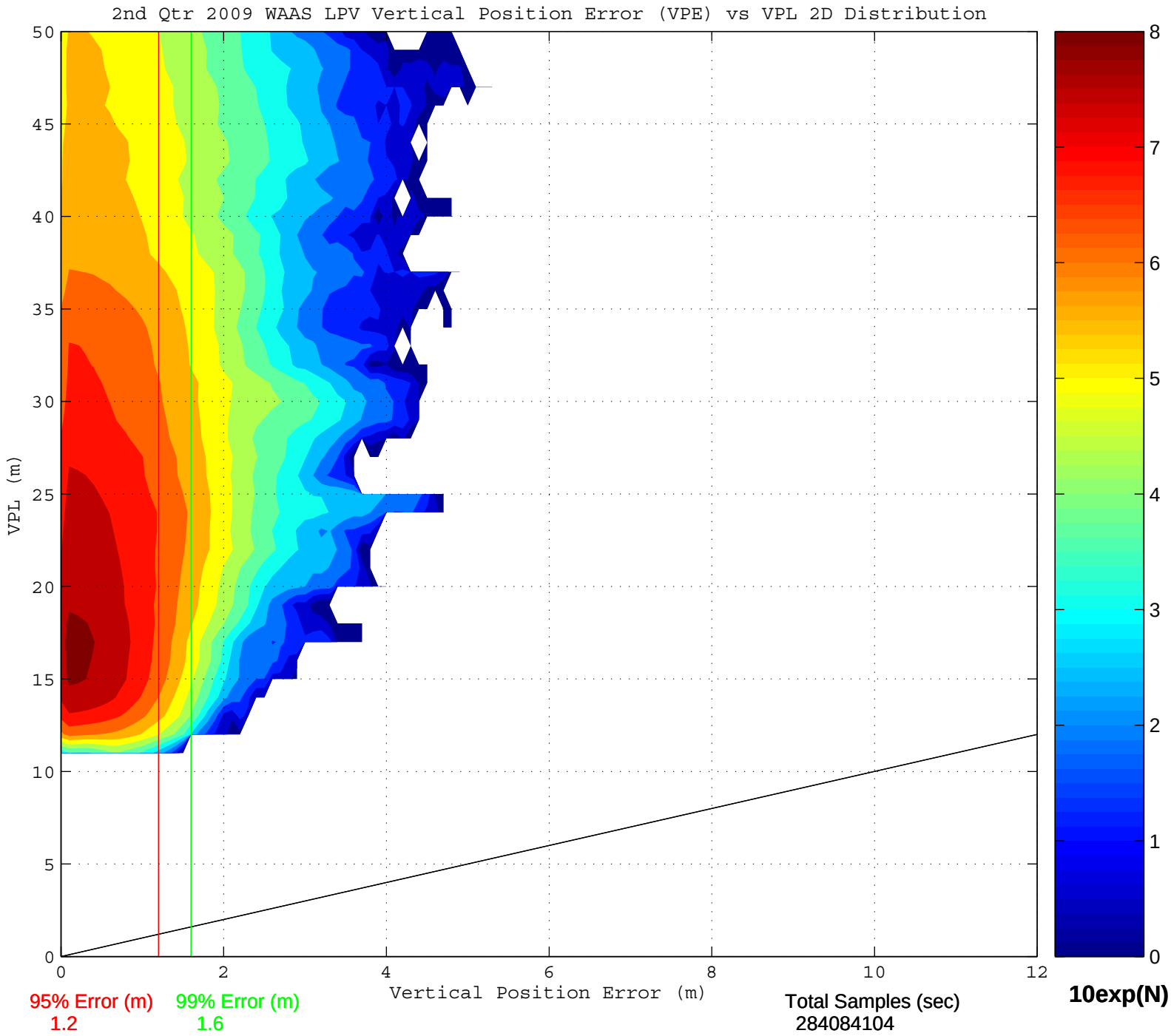


Figure 2-11 2-D Horizontal Histogram for the Quarter

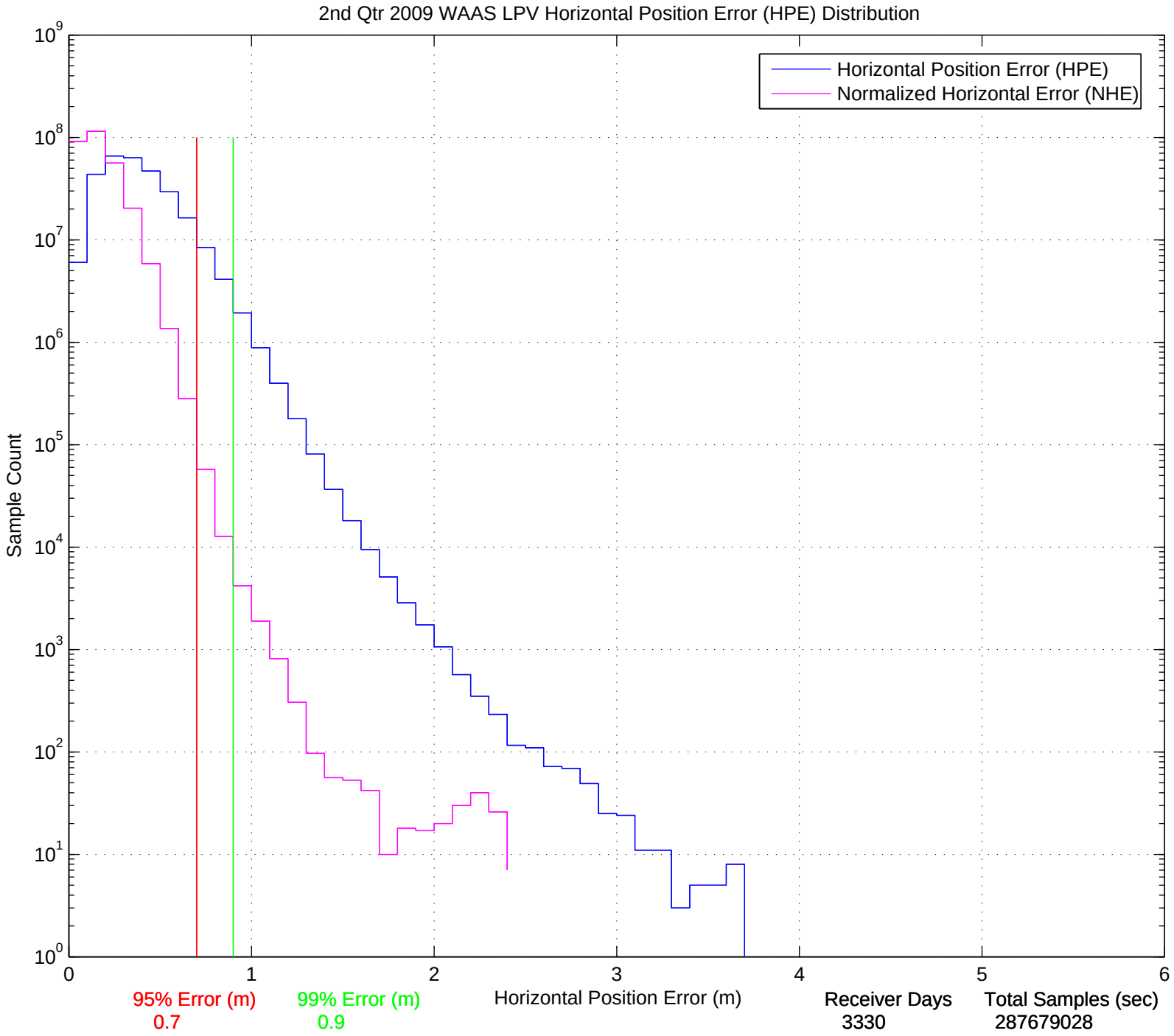
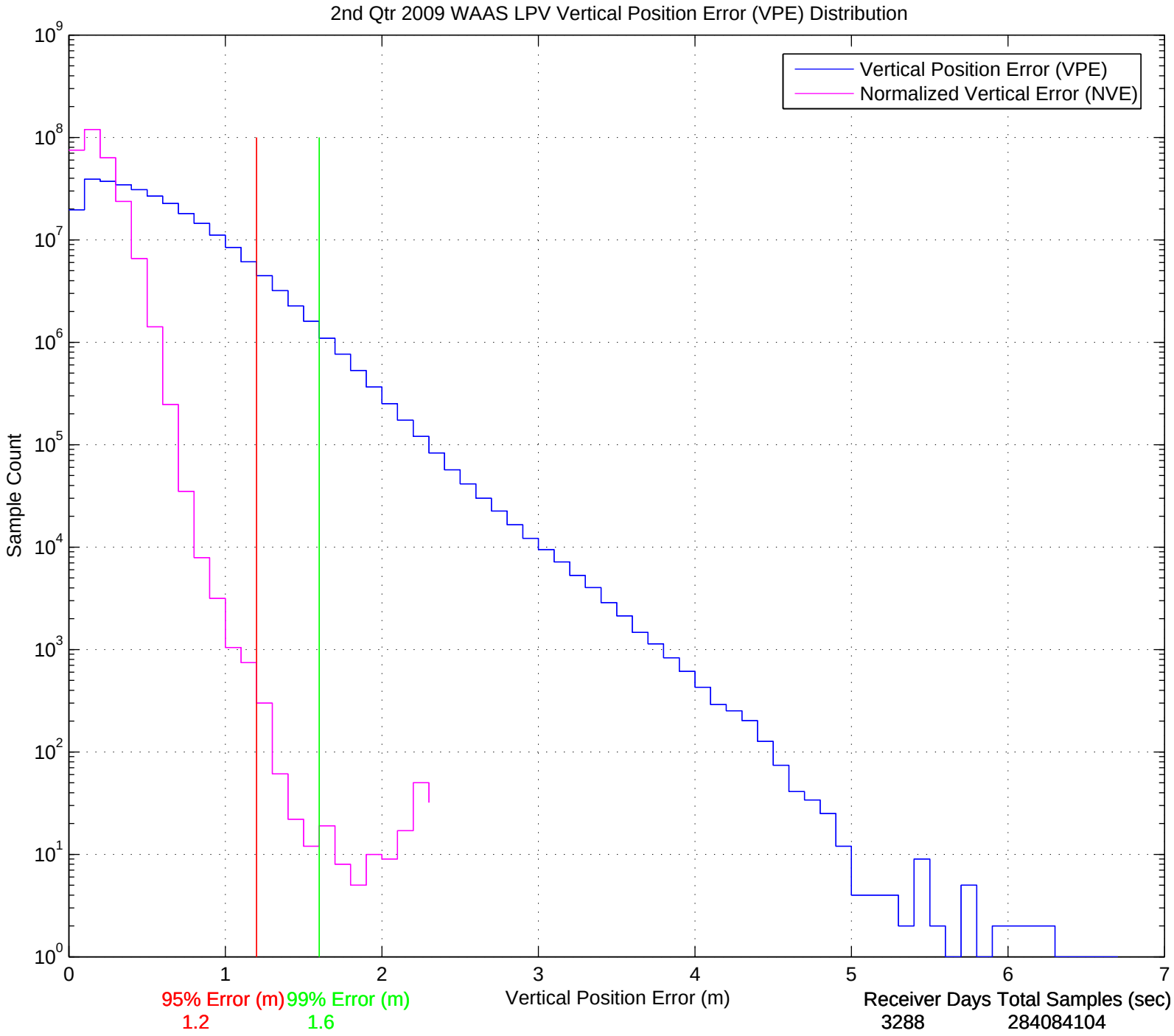


Figure 2-12 2-D Vertical Histogram for the Quarter



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 15.875 meters	Memphis 11.249 meters	Cold Bay 25.221 meters	Fairbanks 13.125 meters
95% VPL	Oakland 30.551 meters	Memphis 19.557 meters	Cold Bay 34.32 meters	Juneau 21.787 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, GUS switchovers and Doppler Spikes. Please refer to Table 1.4 for events that affected availability. NPA outages at Iqaluit and Gander are mainly due to CRE GUS switchovers. NPA outages at Barrow and Kotzebue are due to CRW GUS switchovers. PRN 18 out for service on 4/2/09 and PRN 32 out for service on 6/19/09 affected PA availability on both days. GUS switchovers on 4/24/09, 4/26/09, 5/6/09, 5/11/09, and 5/16/09 caused PA outages mainly at Alaska sites. CRW Doppler spikes on 4/25/09, 5/10/09 and 5/12/09 and CRW signal in space outage on 4/30/09 affected PA availability at most sites. T6 Alert transmitted by CRW on 5/21/09 set multiple satellites to Not Monitor affected availability (see DR# 81 – CRW Type 6 Messages set Multiple Satellites to Not Monitor).

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	15.875	28.908	100
Oklahoma City	11.500	21.152	100
Albuquerque	12.564	22.585	100
Anchorage	13.759	22.541	100
Atlanta	11.628	21.165	100
Barrow	17.404	33.704	99.942110
Bethel	16.807	26.589	100
Billings	13.167	21.433	100
Boston	14.282	21.213	100
Chicago	12.719	20.819	100
Cleveland	13.573	21.879	100
Cold Bay	25.221	34.320	100
Dallas	11.491	21.764	100
Denver	11.785	21.446	100
Fairbanks	13.125	23.175	100
Gander	23.702	36.133	99.976860
Goose Bay	18.757	28.118	99.973590
Houston	11.753	22.197	100
Iqaluit	27.609	40.916	99.967880
Jacksonville	12.572	22.768	100
Juneau	13.304	21.787	100
Kansas City	11.954	19.862	100
Kotzebue	15.889	29.942	99.939810
Los Angeles	15.534	27.020	100
Memphis	11.249	19.557	100
Merida	17.508	32.908	100
Mexico City	21.087	33.992	100
Miami	14.030	26.691	100
Minneapolis	12.561	20.884	100
New York	13.744	20.957	100
Oakland	15.559	30.551	100
Puerto Vallarta	23.547	37.859	100
Salt Lake City	12.099	21.871	100
San Jose Del Cabo	21.550	35.693	100
San Juan	62.674	90.625	99.996580
Seattle	13.980	22.687	100
Tapachula	32.735	51.638	99.999950
Washington DC	13.143	20.885	100
Winnipeg	14.847	21.822	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	1	0.97754084
Oklahoma City	1	1
Albuquerque	1	0.99990951
Anchorage	0.99999224	0.99986320
Atlanta	1	1
Barrow	0.99863016	0.95715759
Bethel	0.99996023	0.99939513
Billings	1	1
Boston	1	0.99993777
Chicago	1	1
Cleveland	1	0.99987241
Cold Bay	0.99975076	0.94241162
Dallas	1	1
Denver	1	0.99999452
Fairbanks	0.99997086	0.99987264
Gander	0.99920564	0.91078366
Goose Bay	0.99972063	0.99837953
Houston	1	1
Iqaluit	0.98122940	0.76446373
Jacksonville	1	0.99991623
Juneau	1	0.99988189
Kansas City	1	1
Kotzebue	0.99931996	0.99349731
Los Angeles	1	0.99955628
Memphis	1	1
Merida	1	0.97830099
Mexico City	0.99721510	0.95391454
Miami	1	0.99840590
Minneapolis	1	1
New York	1	0.99991687
Oakland	1	0.96913463
Puerto Vallarta	0.99632853	0.87890150
Salt Lake City	1	1
San Jose Del Cabo	0.99996259	0.91281154
San Juan	0.24413296	0.01131155
Seattle	1	0.99941709
Tapachula	0.89168652	0.44819301
Washington DC	1	0.99968199
Winnipeg	1	1

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	1
Anchorage	1
Atlanta	1
Barrow	0.99959614
Bethel	1
Billings	1
Boston	1
Cleveland	1
Cold Bay	1
Fairbanks	1
Gander	0.99992479
Honolulu	1
Houston	1
Iqaluit	0.99992811
Juneau	1
Kansas City	1
Kotzebue	0.99959538
Los Angeles	1
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	0	0.00	106	0.002071
Oklahoma City	0	0.00	0	0.00
Albuquerque	0	0.00	9	0.000172
Anchorage	1	0.000019	2	0.000038
Atlanta	0	0.00	0	0.00
Barrow	25	0.000478	568	0.011326
Bethel	1	0.000019	9	0.000172
Billings	0	0.00	0	0.00
Boston	0	0.00	2	0.000038
Chicago	0	0.00	0	0.00
Cleveland	0	0.00	1	0.000019
Cold Bay	3	0.000057	488	0.009887
Dallas	0	0.00	0	0.00
Denver	0	0.00	1	0.000019
Fairbanks	1	0.000019	3	0.000057
Gander	21	0.000401	561	0.011758
Goose Bay	9	0.000172	32	0.000612
Houston	0	0.00	0	0.00
Iqaluit	138	0.002686	1247	0.031148
Jacksonville	0	0.00	2	0.000038
Juneau	0	0.00	2	0.000038
Kansas City	0	0.00	0	0.00
Kotzebue	8	0.000153	91	0.001749
Los Angeles	0	0.00	8	0.000153
Memphis	0	0.00	0	0.00
Merida	0	0.00	305	0.005953
Mexico City	82	0.001569	580	0.011605
Miami	0	0.00	23	0.000440
Minneapolis	0	0.00	0	0.00
New York	0	0.00	3	0.000057
Oakland	0	0.00	325	0.006402
Puerto Vallarta	111	0.002126	622	0.013507
Salt Lake City	0	0.00	0	0.00
San Jose Del Cabo	2	0.000038	600	0.012546
San Juan	849	0.067466	115	0.197233
Seattle	0	0	38	0.000726
Tapachula	694	0.014876	1316	0.056120
Washington DC	0	0.00	4	0.000076
Winnipeg	0	0.00	0	0.00

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Atlanta	0	0
Barrow	6	0.00011456
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	8	0.00015272
Honolulu	0	0
Houston	0	0
Iqaluit	8	0.00015269
Juneau	0	0
Kansas City	0	0
Kotzebue	6	0.00011460
Los Angeles	0	0
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)

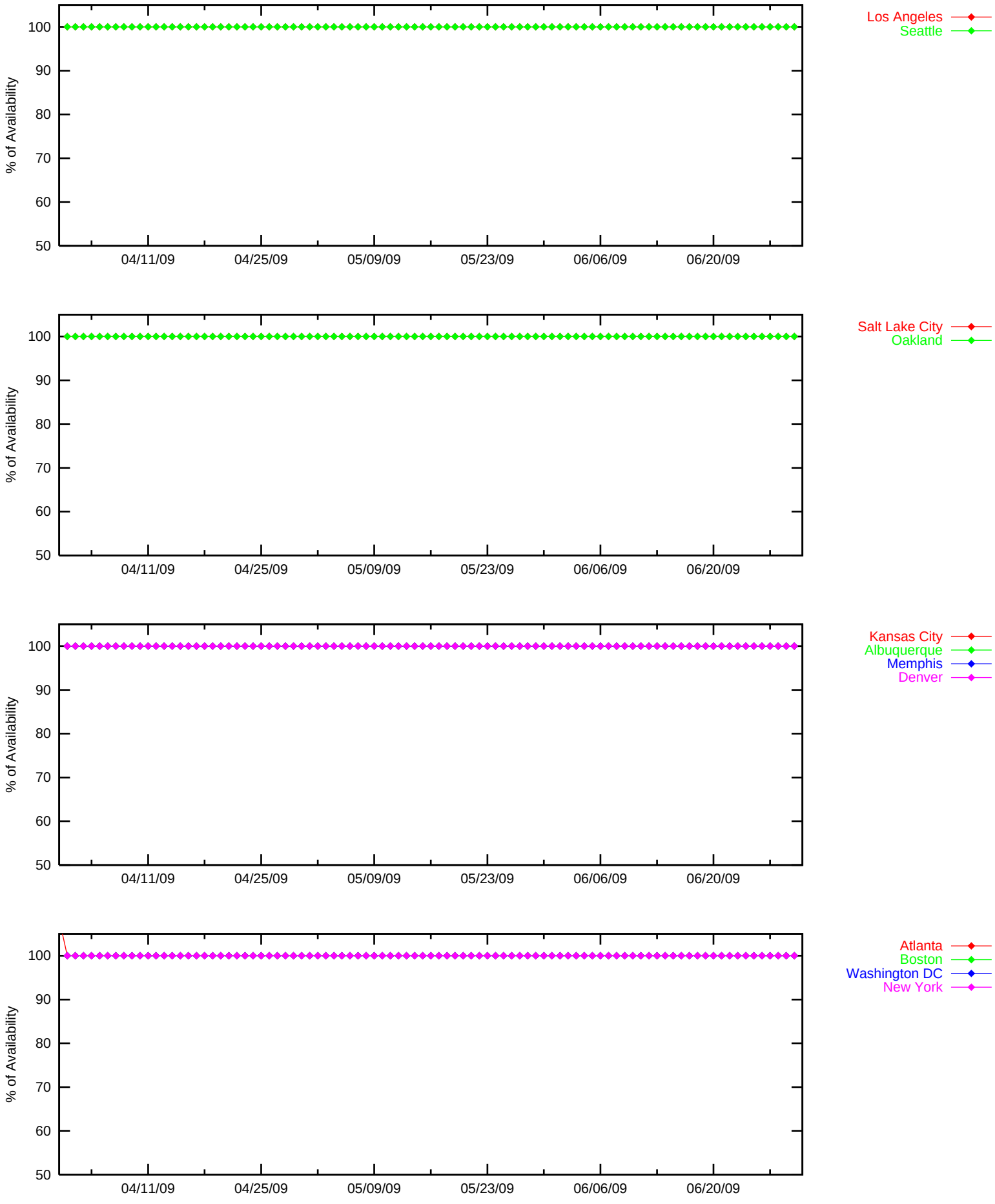


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

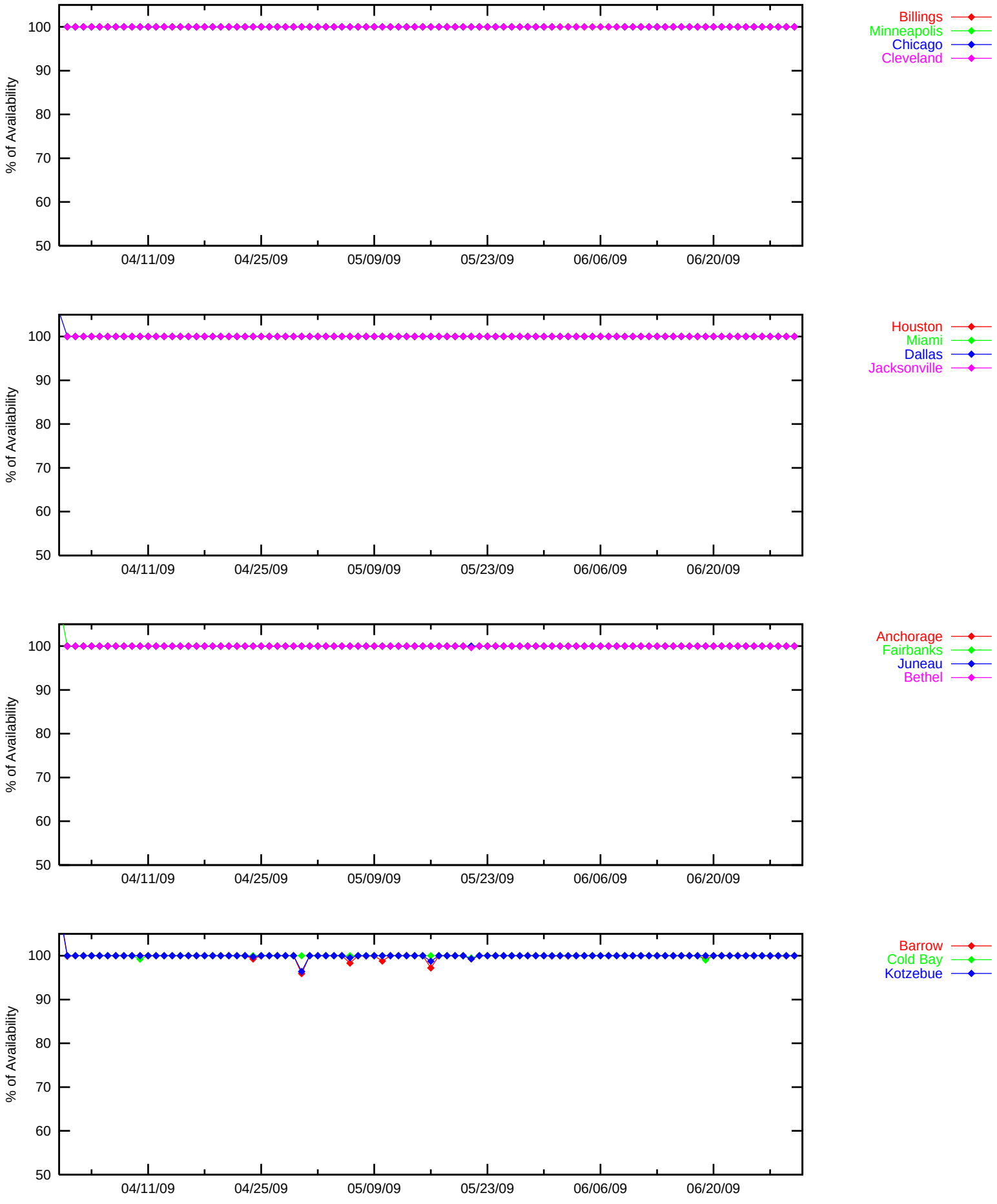


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

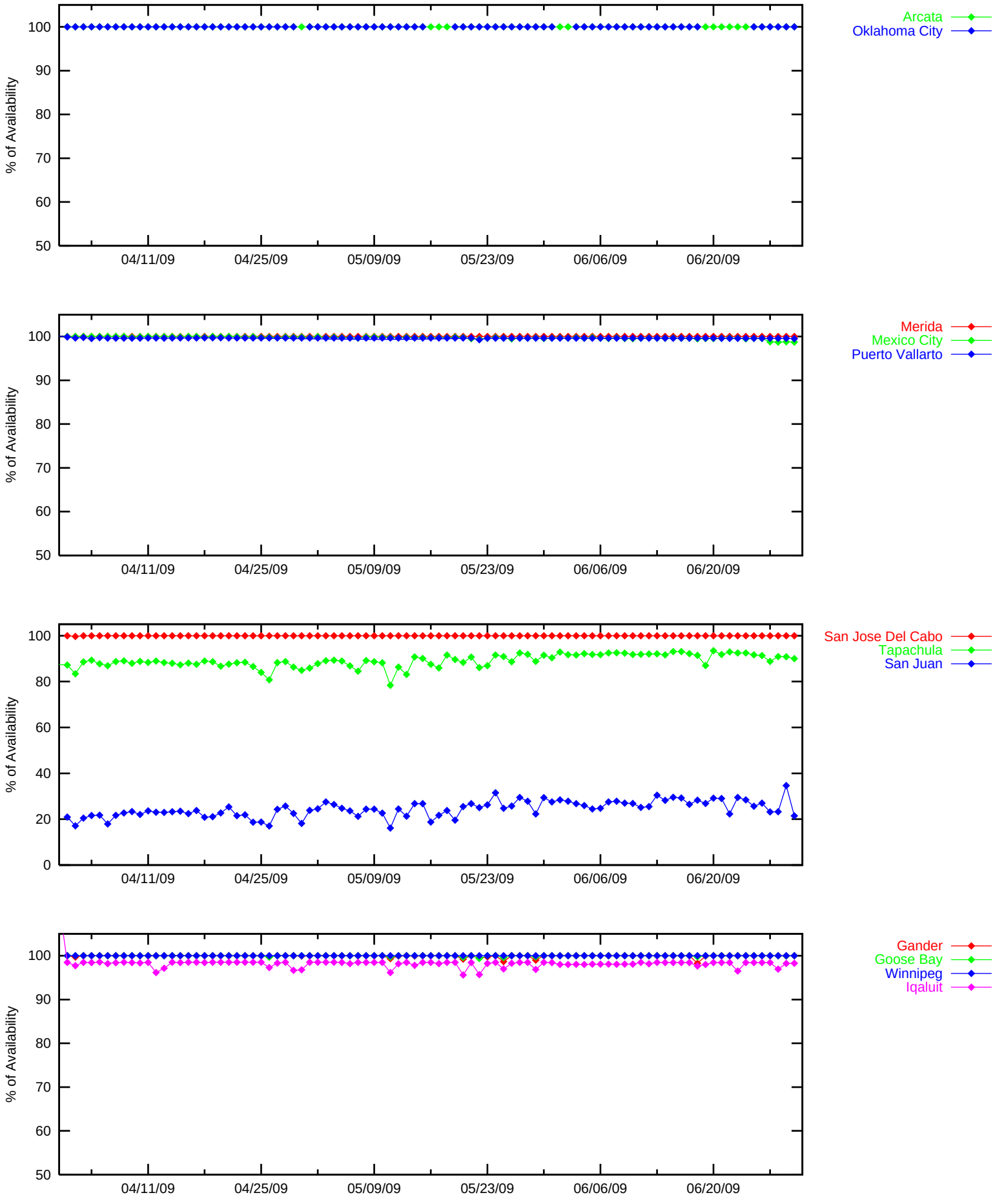


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

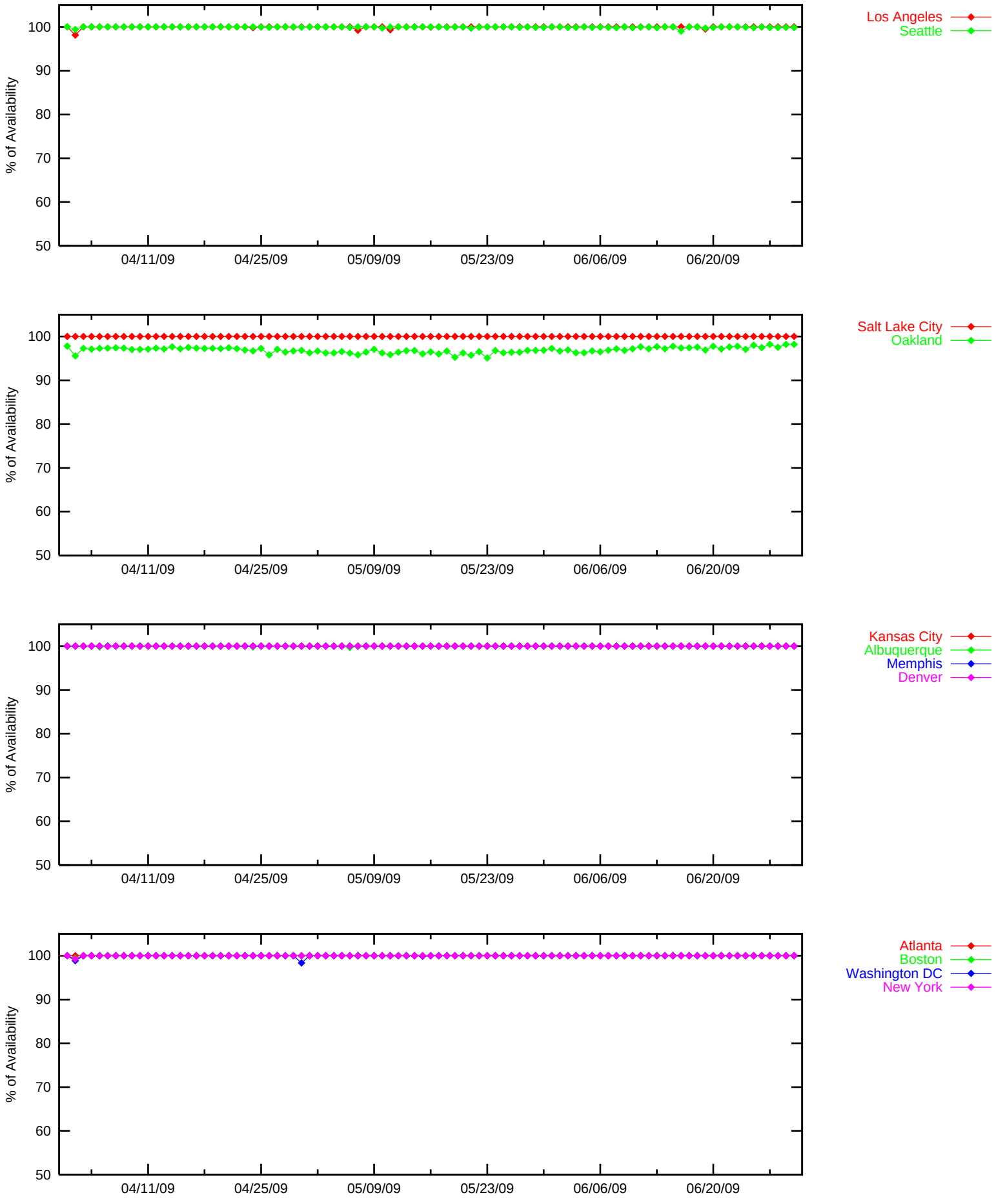


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

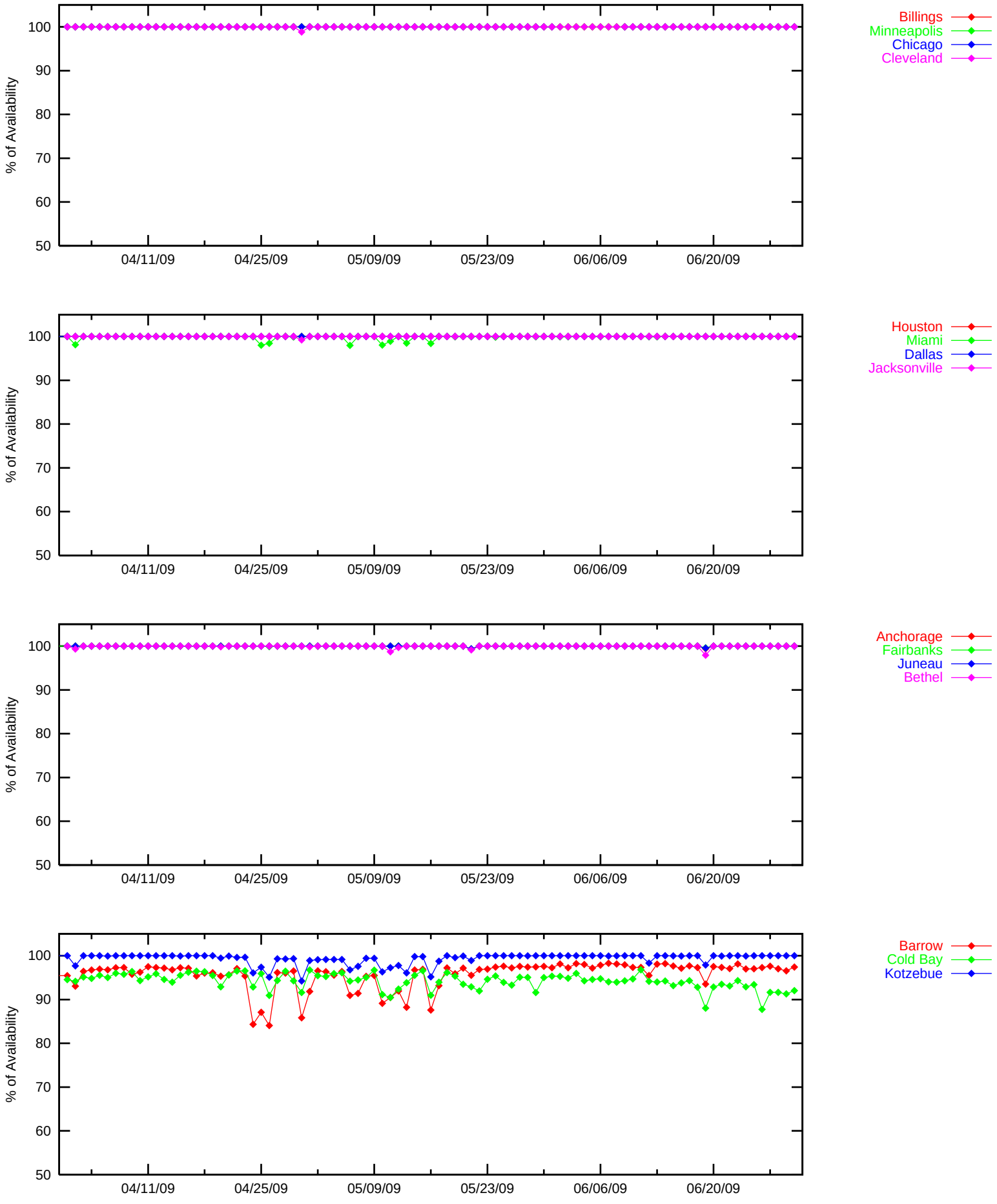


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

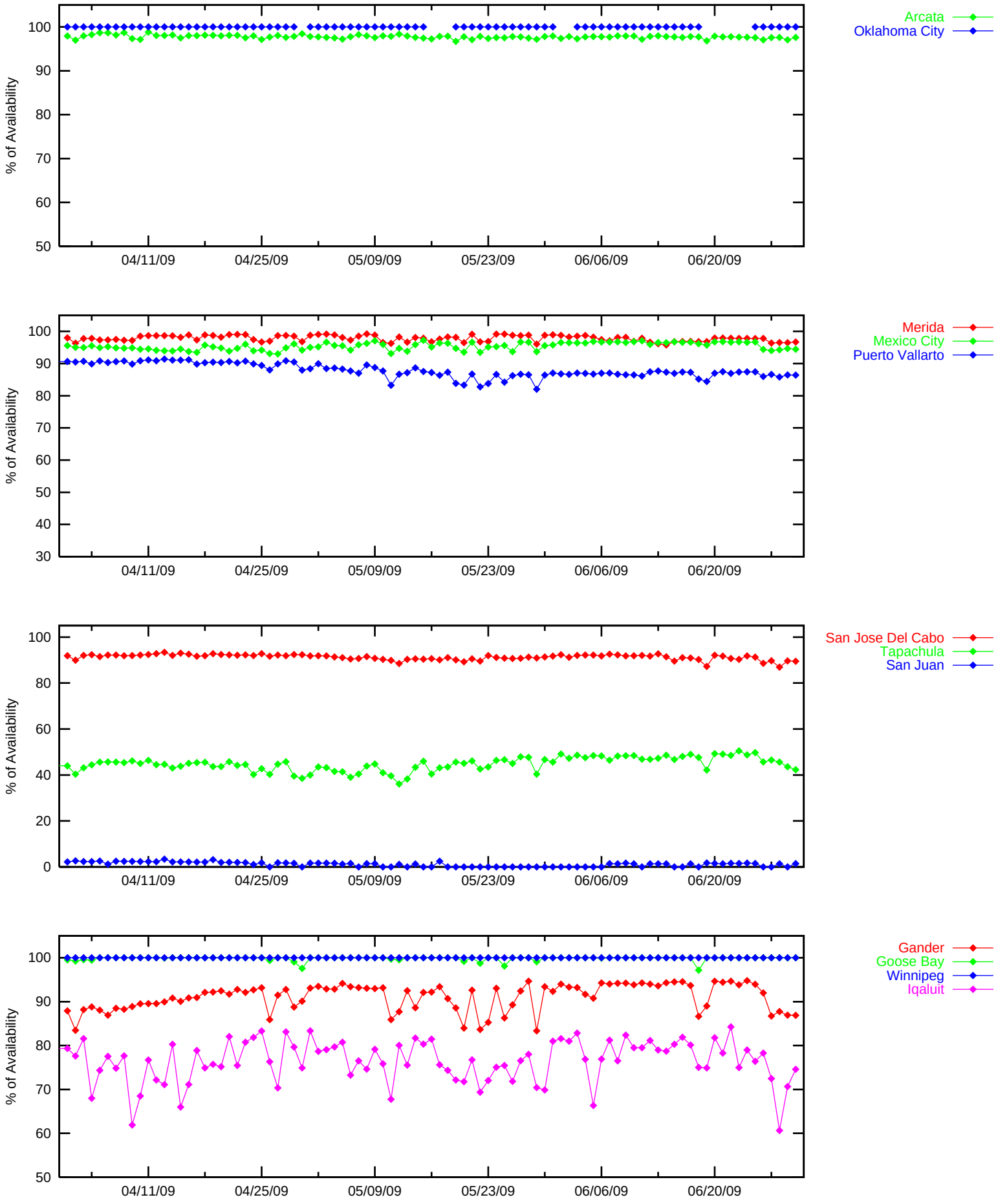


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

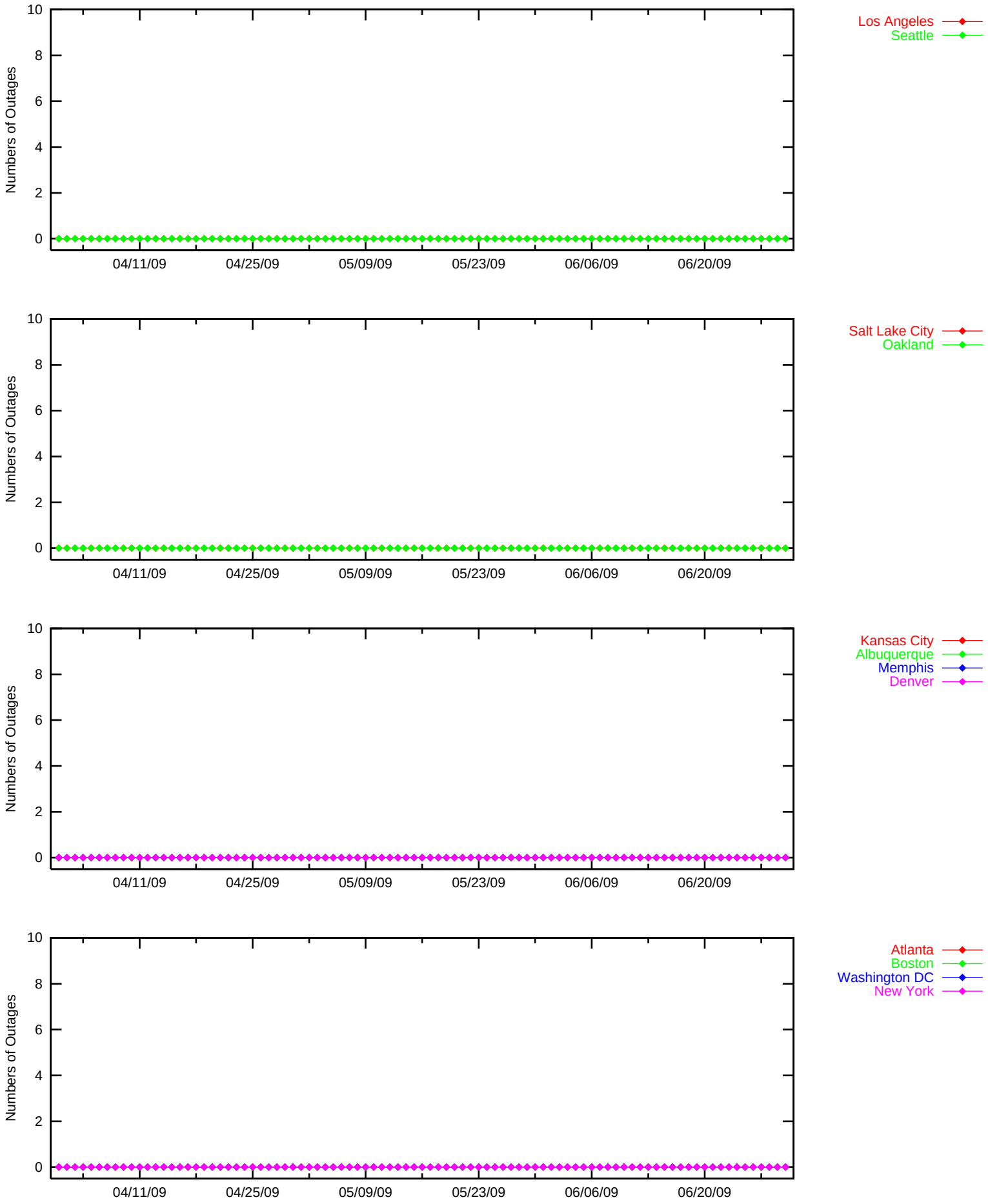


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)

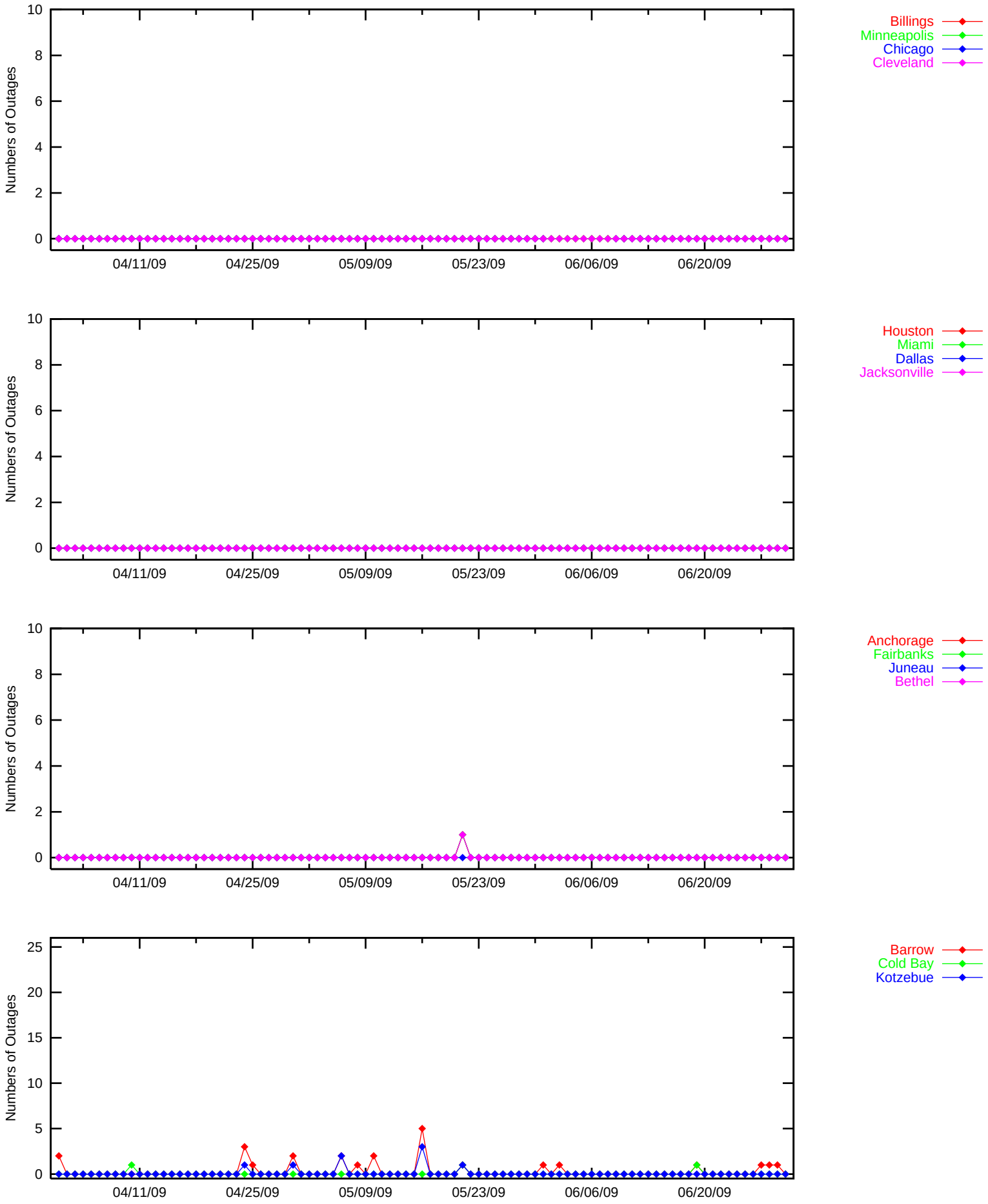


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

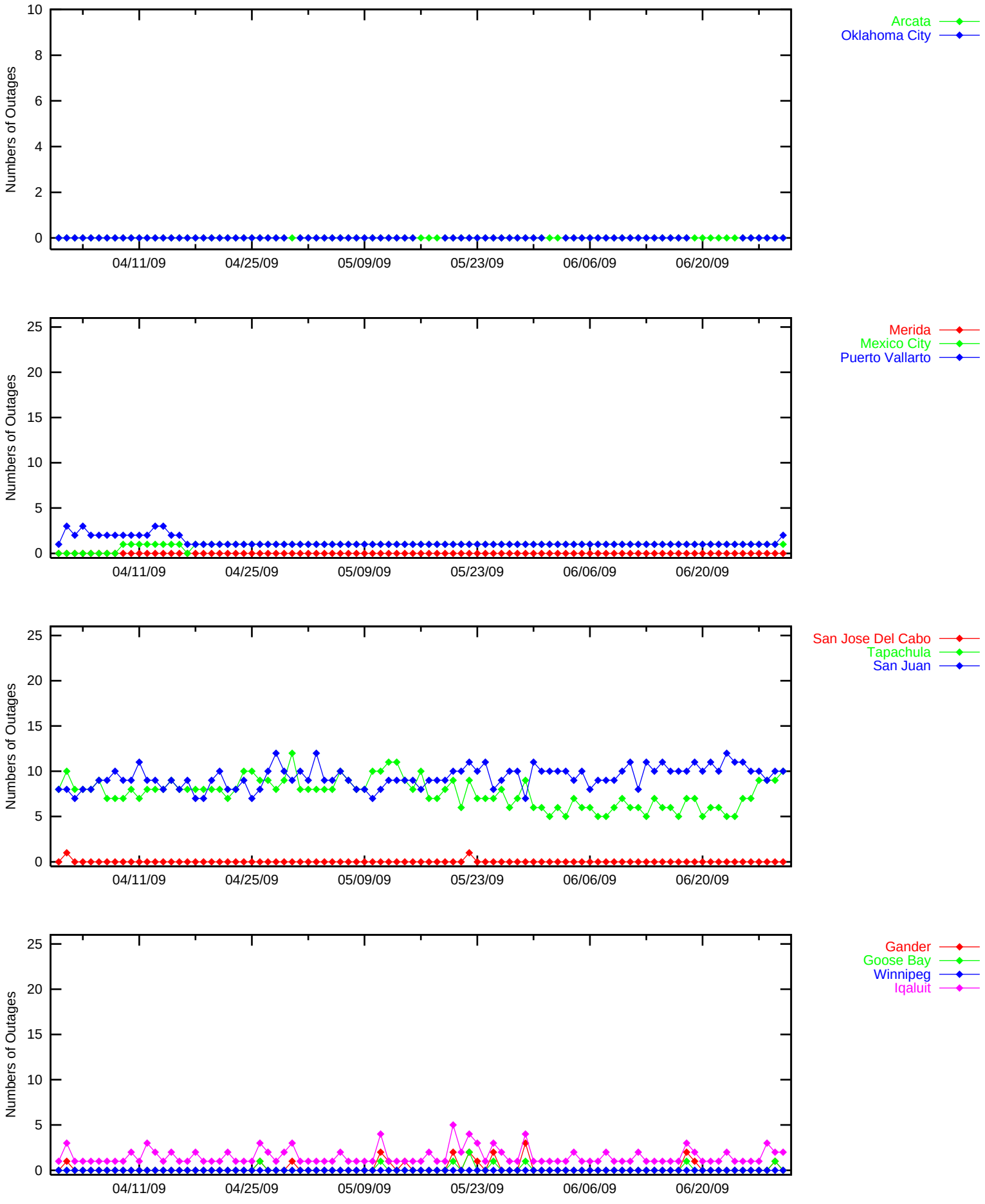


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

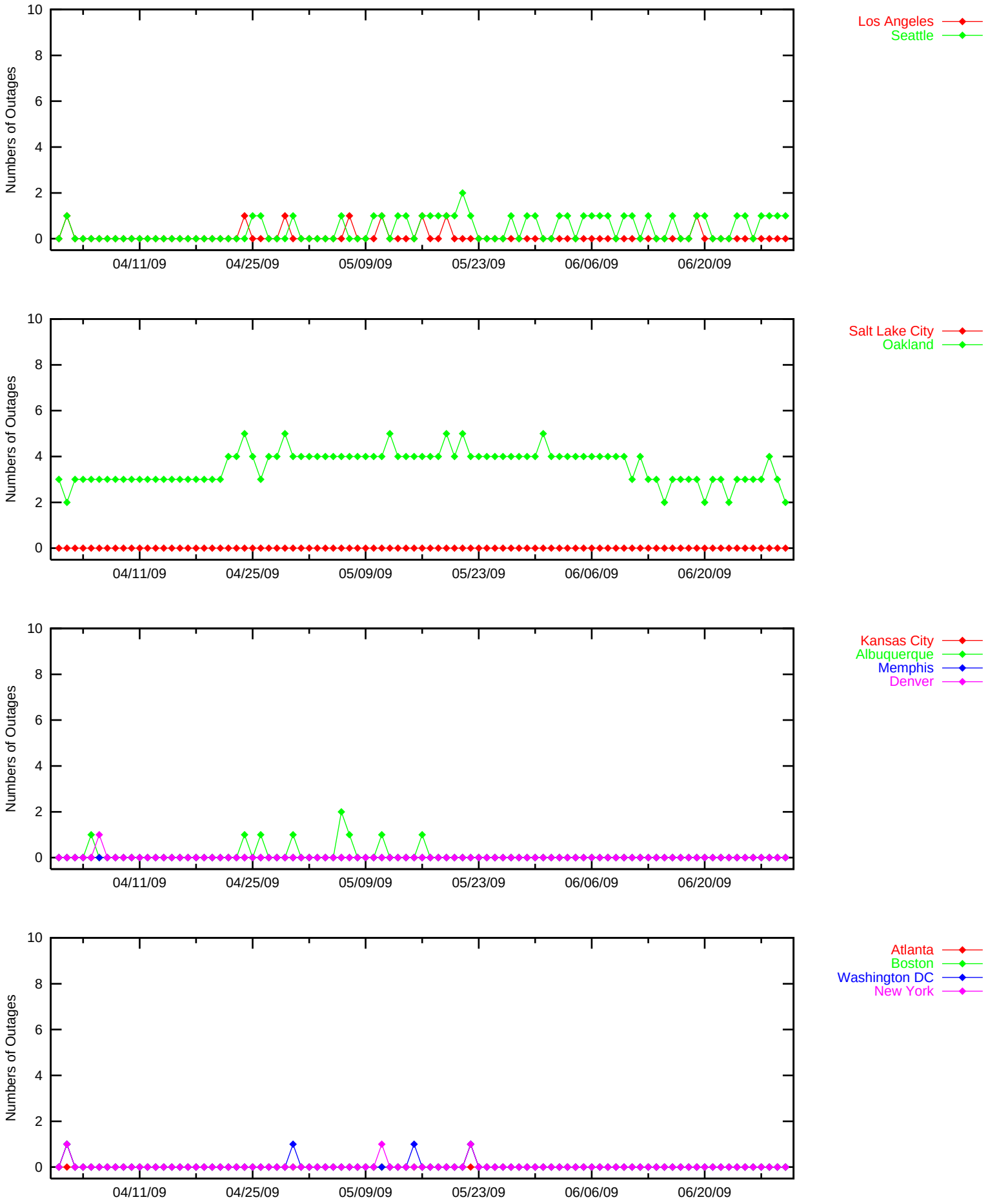


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)

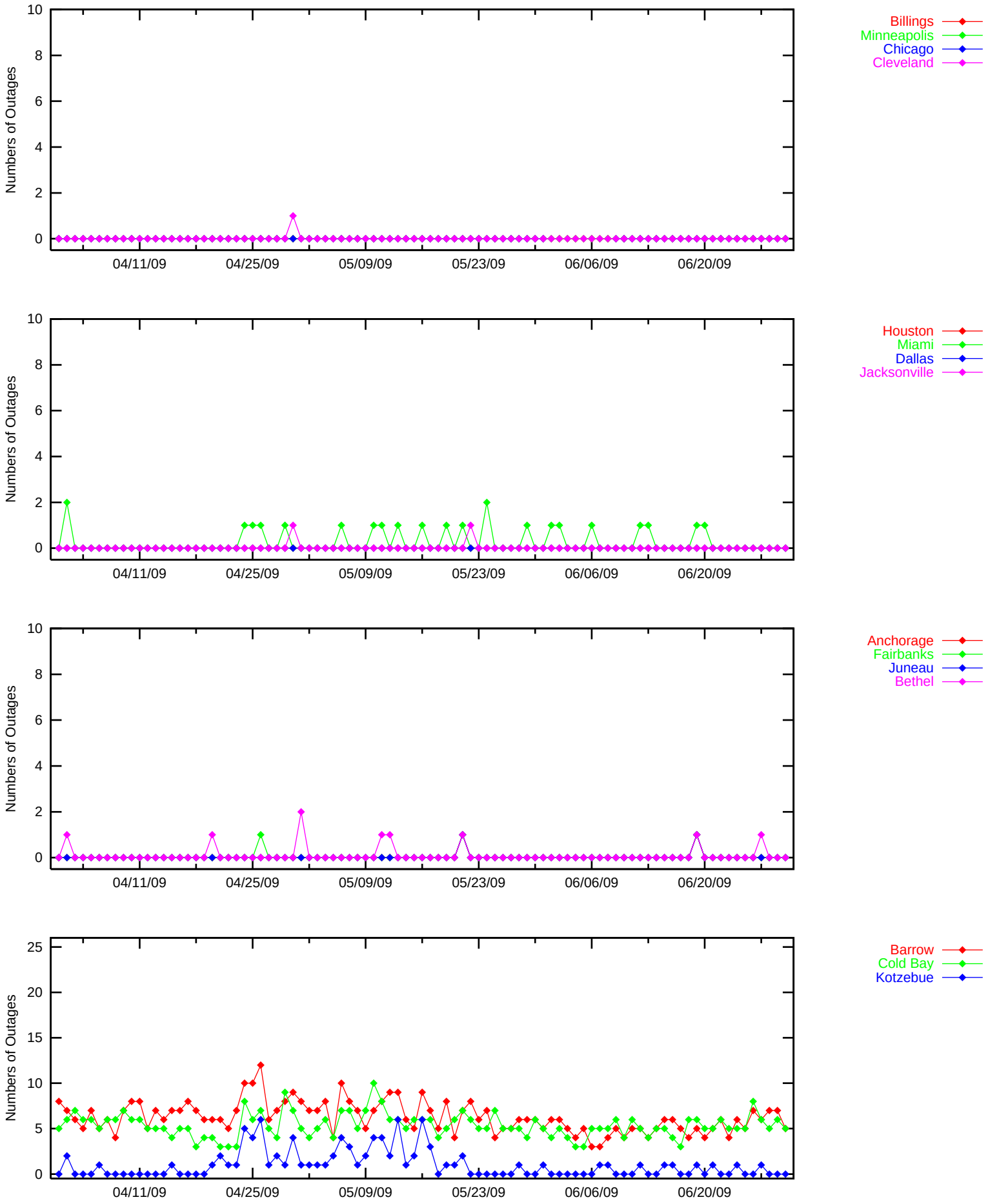
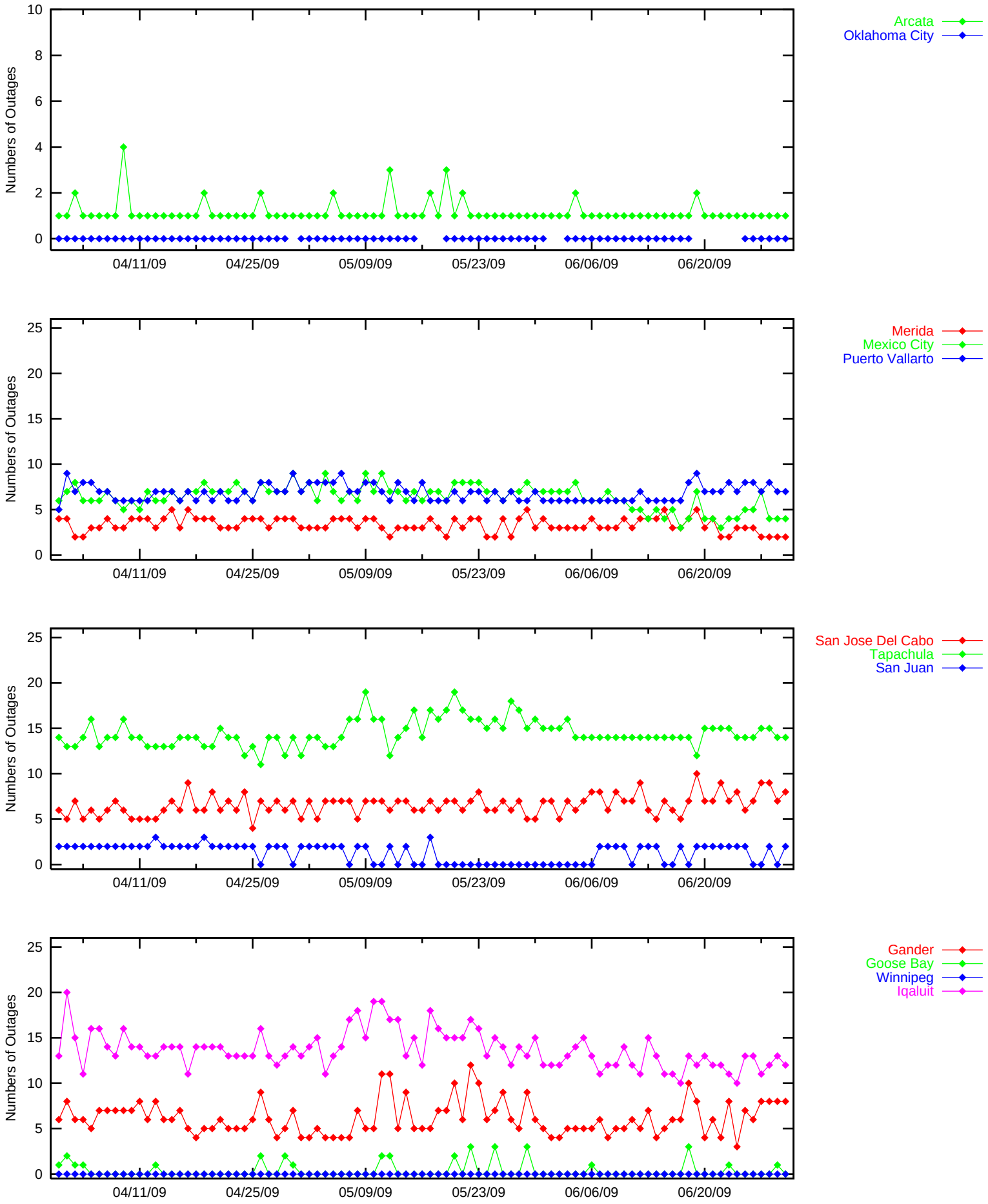


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



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 satellites outages, GUS switchovers and CRW Doppler spikes. Please refer to Table 1.4 for events that affected coverage. PRN 18 out for service on 4/2/09 and PRN 32 out for service on 6/19/09 caused a significant drop in PA coverage on both days. GUS switchovers on 4/24/09, 4/26/09, 5/6/09, 5/11/09, and 5/16/09 caused a small drop in CONUS LPV 200 and RNP coverage, but a bigger drop in Alaska coverage. CRW Doppler spikes on 4/25/09, 5/10/09 and 5/12/09 affected mainly Alaska coverage. A CRW signal in space outage on 4/30/09 along with PRN 16 out for service caused both PA and NPA coverage drop. T6 Alert on 5/21/09 affected both PA and NPA coverage (see DR# 81 – CRW Type 6 Messages set Multiple Satellites to Not Monitor).

Figure 4-1 LP North America Coverage for the Quarater

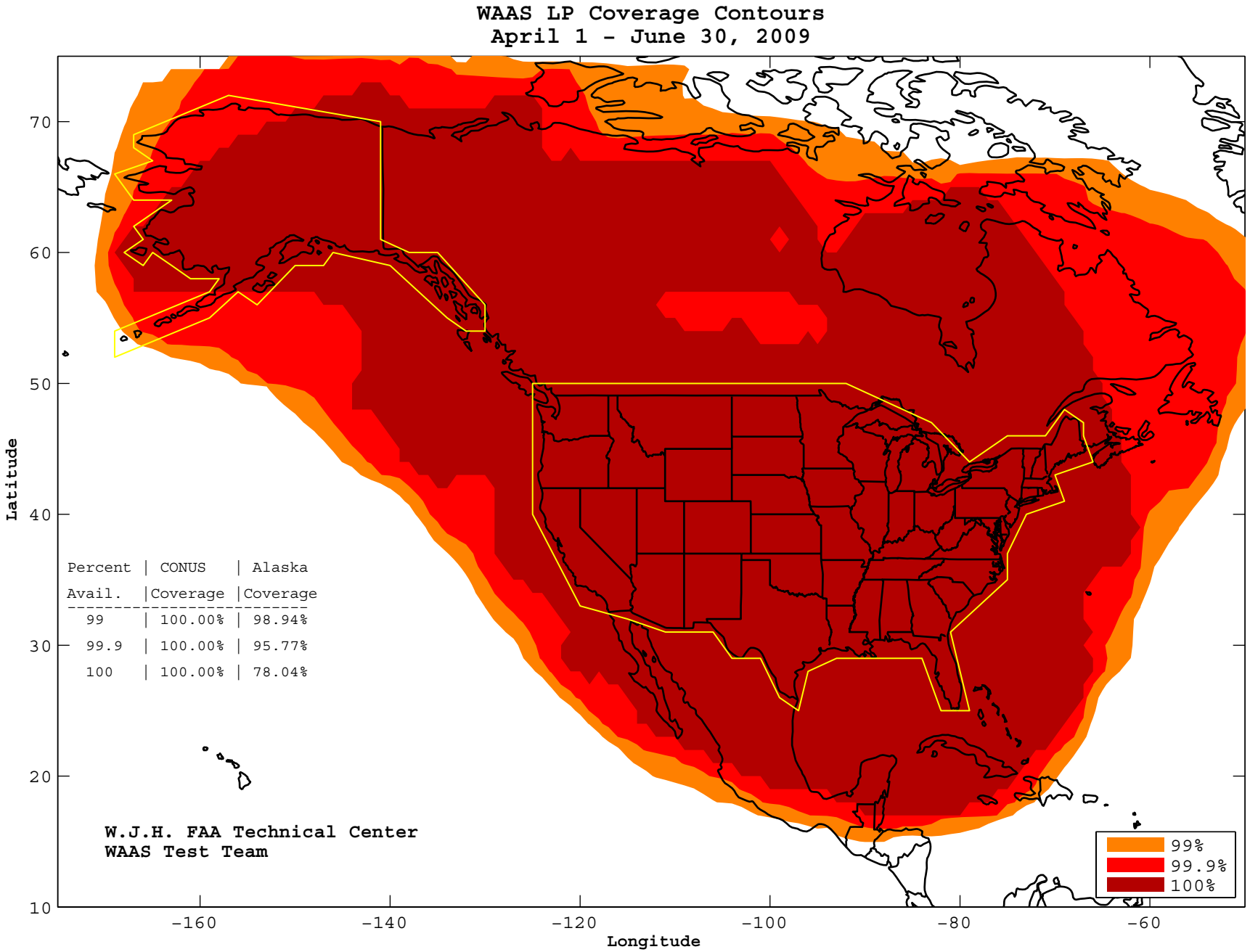


Figure 4-2 LPV North America Coverage for the Quarter

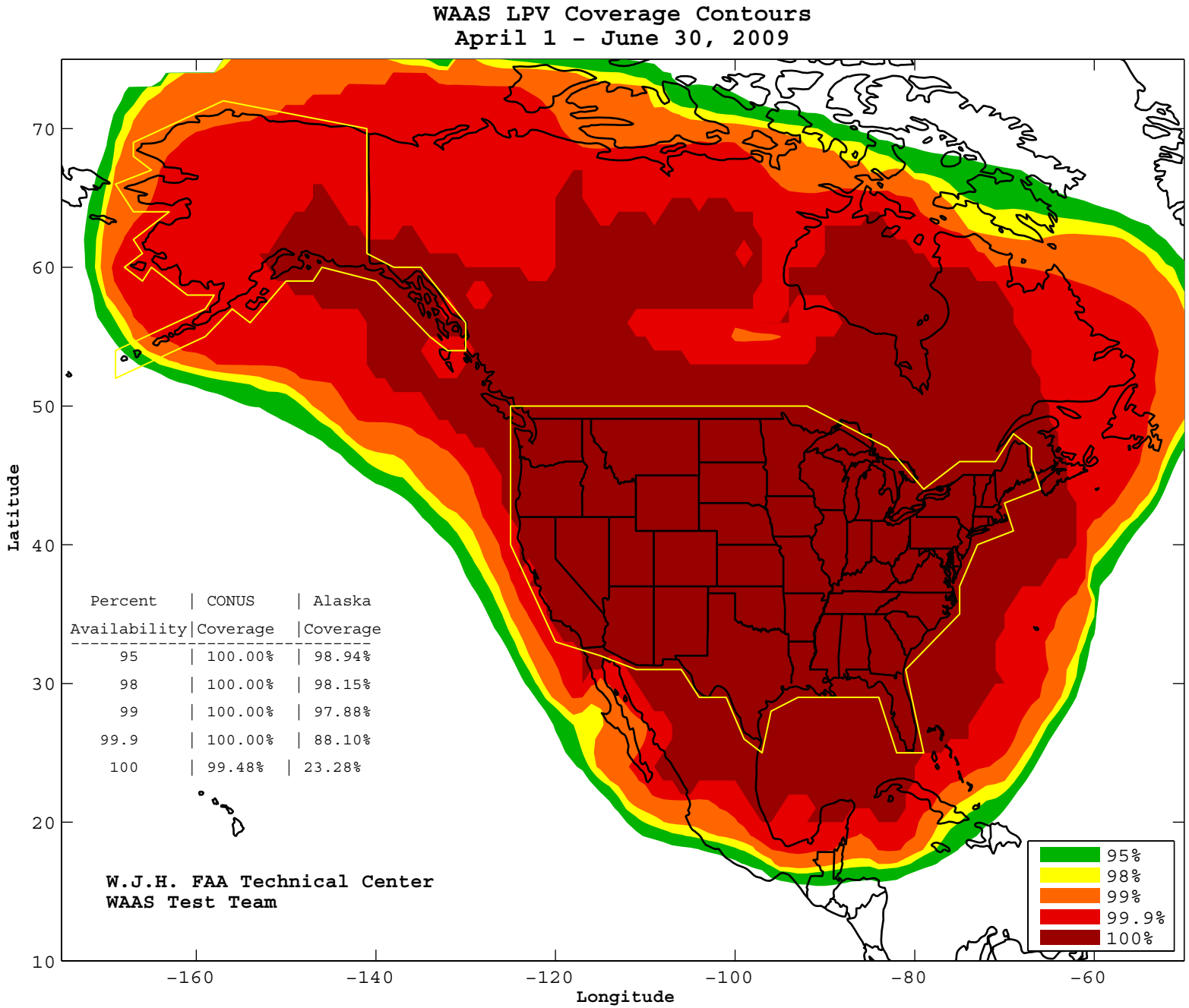


Figure 4-3 LPV 200 North America Coverage for the Quarter

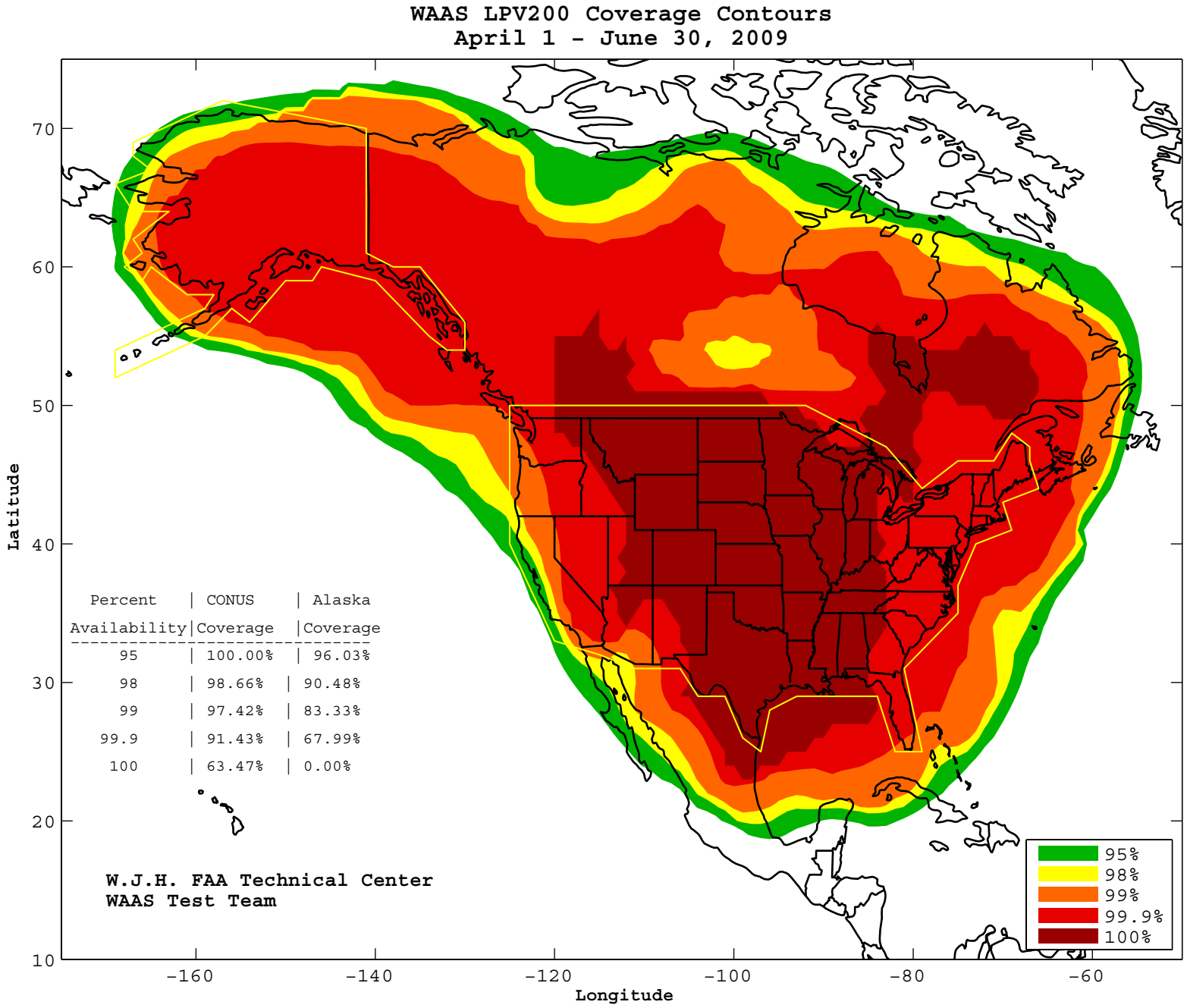


Figure 4-4 RNP 0.1 World Coverage for the Quarter

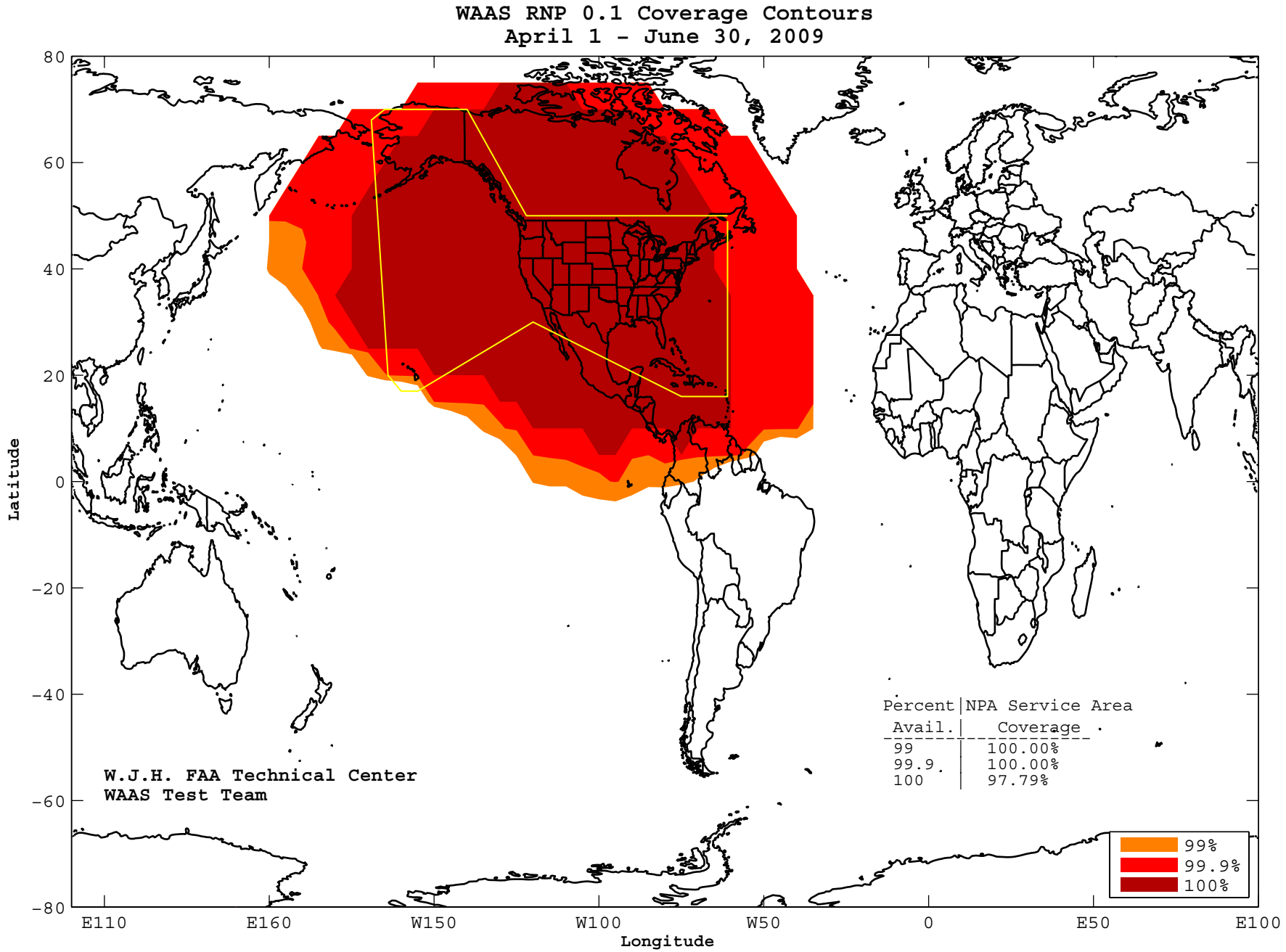


Figure 4-5 RNP 0.3 World Coverage for the Quarter

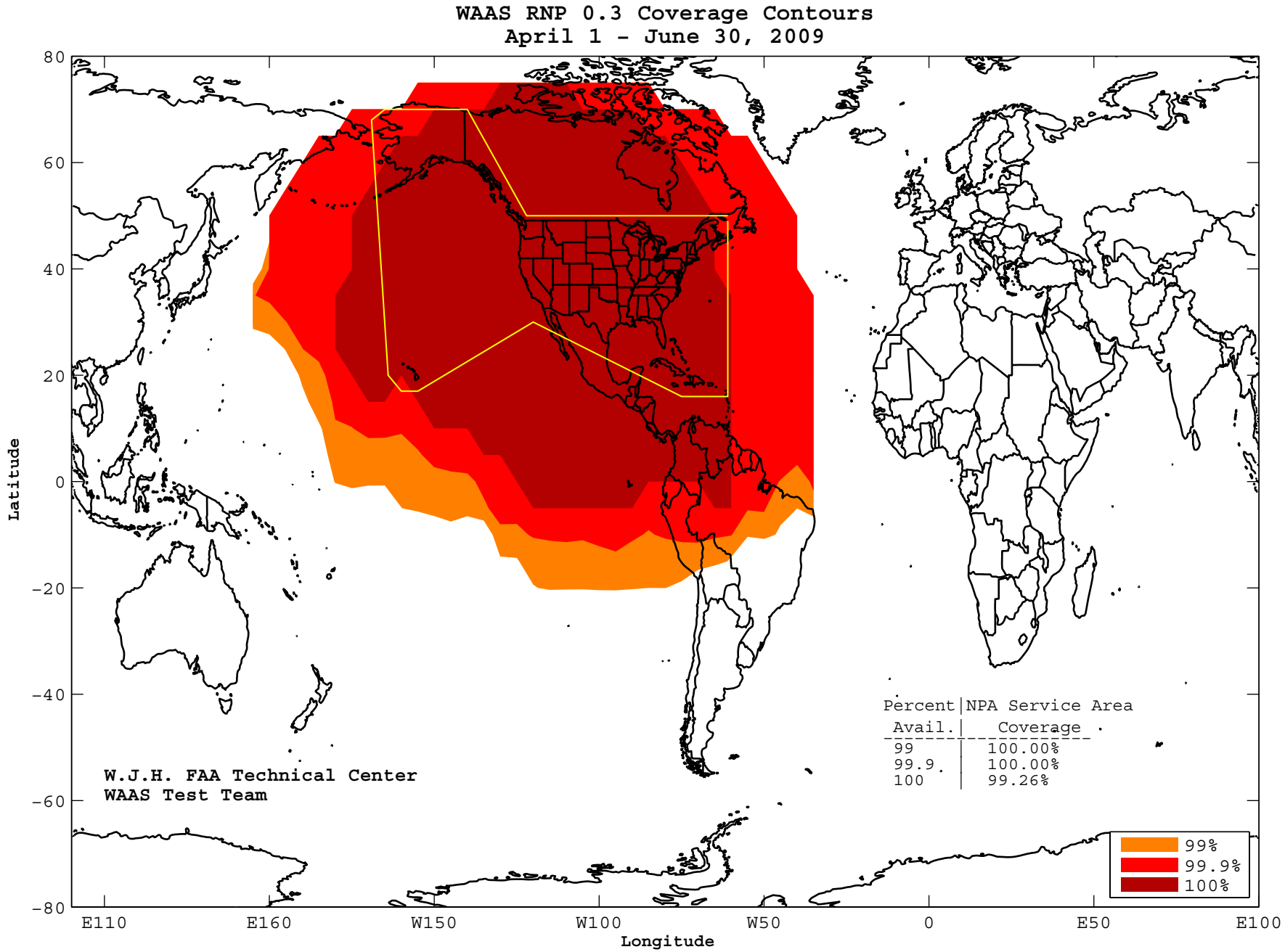


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

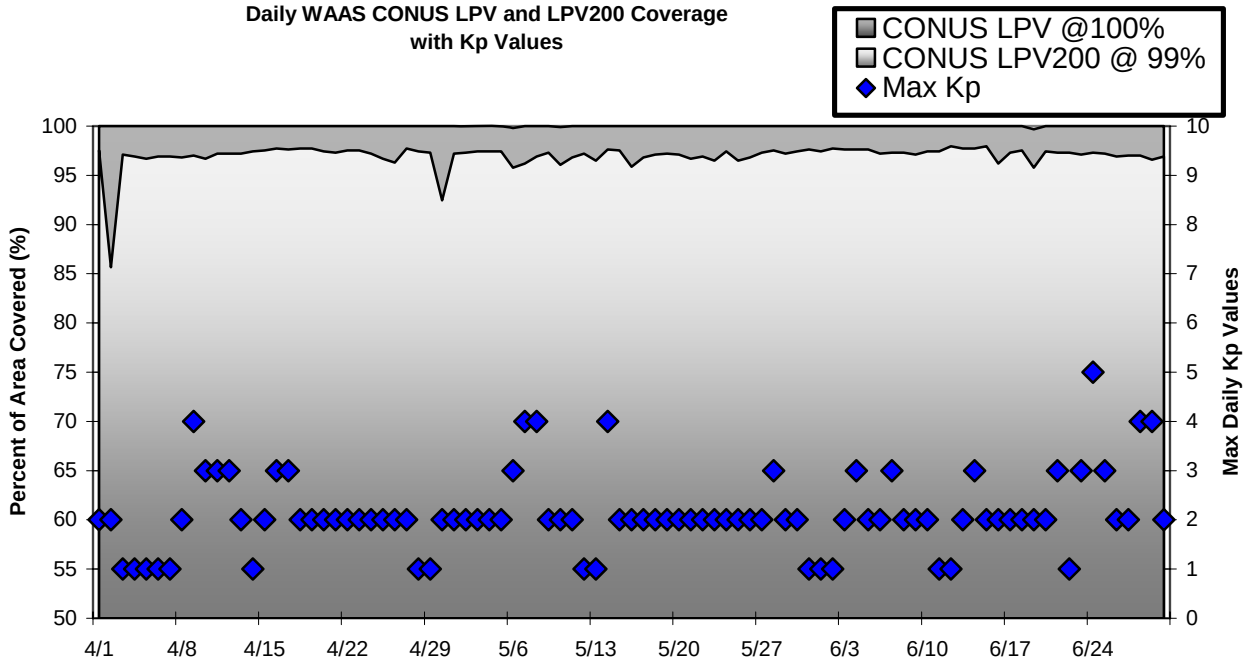


Figure 4-7 Daily LPV Alaska Coverage

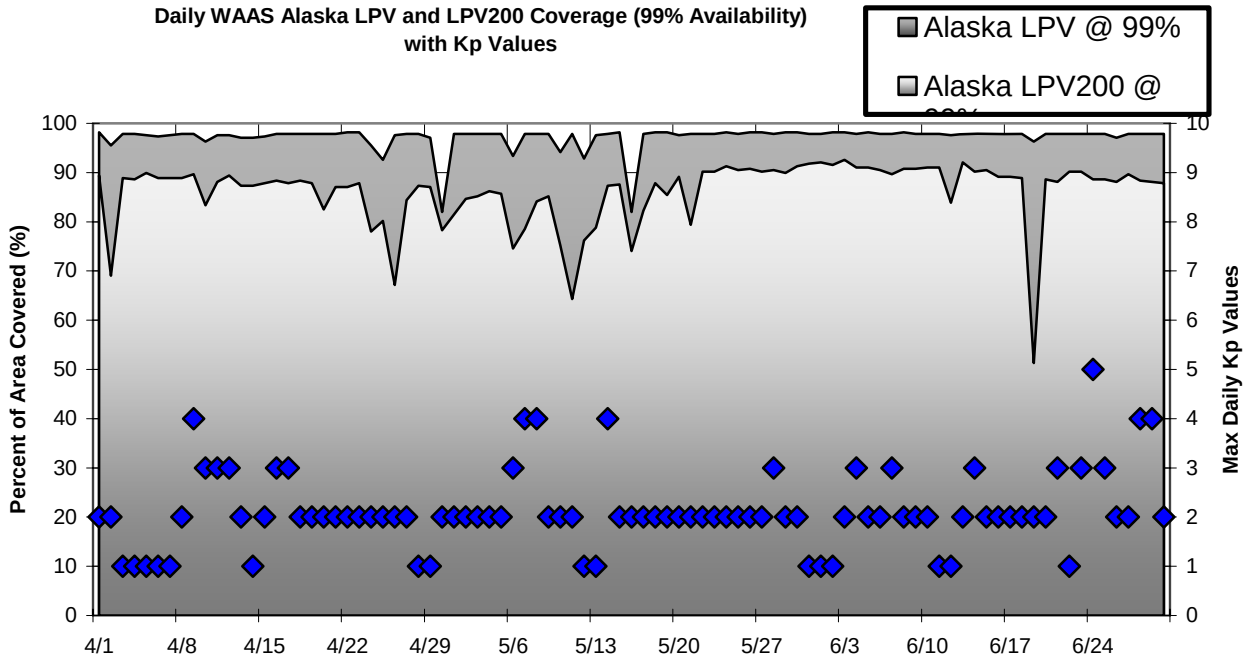
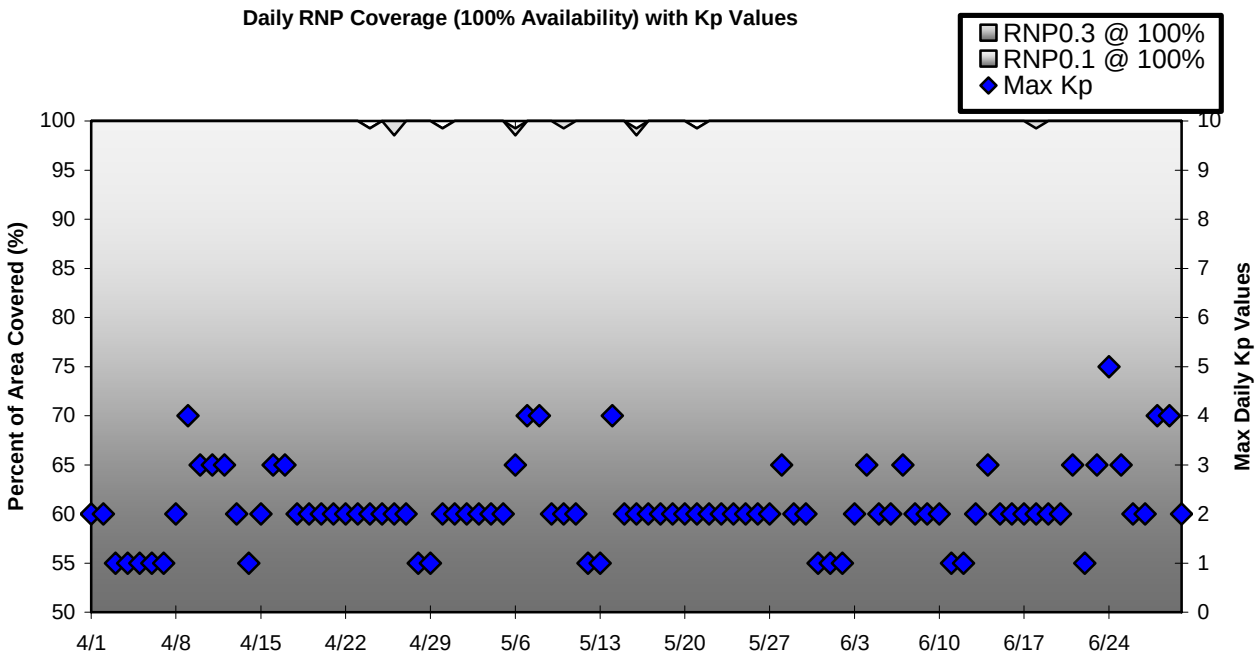


Figure 4-8 Daily RNP Coverage



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 2.63 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	3.84	4.53	0
Oklahoma City	5.13	6.07	0
Albuquerque	7.35	11.47	0
Anchorage	8.06	5.48	0
Atlanta	8.68	5.29	0
Barrow	5.64	3.90	0
Bethel	12.45	10.13	0
Billings	5.49	9.46	0
Boston	5.26	8.57	0
Chicago	4.58	7.34	0
Cleveland	4.76	5.21	0
Cold Bay	7.46	16.78	0
Dallas	13.35	4.99	0
Denver	6.84	5.63	0
Fairbanks	8.99	8.99	0
Gander	12.50	11.86	0
Goose Bay	8.30	10.51	0
Houston	9.42	9.23	0
Iqaluit	8.27	6.16	0
Jacksonville	7.28	8.21	0
Juneau	7.02	5.62	0
Kansas City	14.70	8.44	0
Kotzebue	9.55	6.96	0
Los Angeles	6.67	8.09	0
Memphis	7.76	8.71	0
Merida	17.88	11.43	0
Mexico City	8.14	5.99	0
Miami	12.46	6.62	0
Minneapolis	2.63	4.93	0
New York	9.40	9.11	0
Oakland	11.06	6.91	0
Puerto Vallarta	16.04	8.57	0
Salt Lake City	5.09	8.06	0
San Jose Del Cabo	10.92	7.14	0
San Juan	9.95	7.92	0
Seattle	7.33	12.22	0
Tapachula	17.46	6.58	0
Washington DC	22.94	9.90	0
Winnipeg	16.37	6.64	0

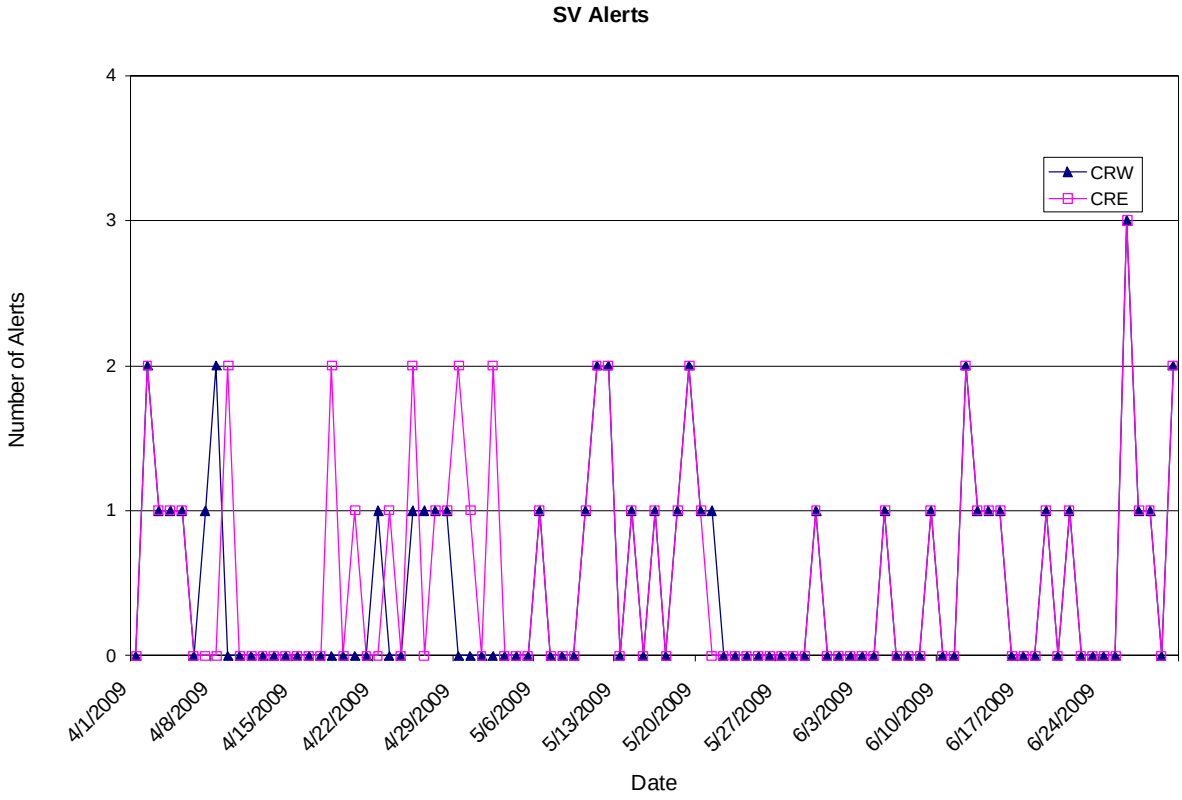
5.2 Broadcast Alerts

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	9	9	0.0989	0.0989
3	17	17	0.1868	0.1868
4	22	23	0.2418	0.2527
5	0	0	0	0
6	1	0	0.0110	0
24	0	0	0	0
26	0	0	0	0
Total Alerts	49	49	0.5385	0.5385

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	107753	1	2750
2	1309918	39	2669
3	1309951	33	2666
4	1309974	28	2666
7	99845	11	2731
9	92104	1	2738
10	99880	7	2725
17	31424	1	2821

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

PRN	On Time	Late	Max Late Length (seconds)
2	47730	0	0
3	50911	0	0
4	48510	0	0
6	51893	0	0
7	48281	0	0
8	47572	0	0
9	49626	0	0
10	48540	0	0
11	52279	1	124
12	49266	0	0
13	48037	1	185
14	47975	0	0
15	50899	0	0
16	48975	0	0
17	47797	0	0
18	47356	0	0
19	51167	0	0
20	50460	0	0
21	47659	0	0
22	48503	0	0
23	47549	0	0
24	47964	0	0
25	46875	1	124
26	48299	0	0
27	51723	0	0
28	48734	1	185
29	48063	0	0
30	50852	0	0
31	48945	0	0
32	48270	1	2706

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

PRN	On Time	Late	Max Late Length (seconds)
2	39154	0	0
3	41836	0	0
4	39825	0	0
6	42596	0	0
7	39609	0	0
8	39076	0	0
9	40799	0	0
10	39856	0	0
11	42899	0	0
12	40442	0	0
13	39505	0	0
14	39424	1	2808
15	41754	0	0
16	40186	0	0
17	39266	0	0
18	38913	0	0
19	41996	0	0
20	41471	1	2826
21	39122	0	0
22	39847	1	122
23	39041	0	0
24	39400	0	0
25	38499	0	0
26	39643	0	0
27	42464	1	122
28	40025	0	0
29	39545	0	0
30	41797	1	2805
31	40200	0	0
32	39607	1	2808
135	75381	0	0
138	75167	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27283	8	2881
0	1	27283	4	2887
0	2	27282	8	3170
1	0	27283	7	3169
1	1	27287	7	3168
1	2	27281	5	3168
1	3	27282	4	3175
1	4	27277	13	3176
2	0	27274	8	3179
2	1	27296	7	2882
2	2	27272	8	2881
2	3	27276	8	2880
2	4	27285	11	2882
2	5	27279	9	2881
3	0	27282	9	2880
3	1	27290	5	2880
3	2	27286	9	2880
9	0	27293	2	2882
9	1	27277	10	2880
9	2	27268	11	2880
9	3	27282	9	2880
9	4	27278	9	2882
9	5	27285	10	2880
9	6	27284	11	2881

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

Band	On Time	Late	Max Late Length (seconds)
0	35804	1	2965
1	35848	1	2943
2	35813	1	2895
3	35871	1	2953
9	35856	1	2964

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

Message Type	On Time	Late	Max Late Length (seconds)
0	56	8	532339
1	103226	0	0
2	1310341	42	30
3	1310374	36	27
4	1310405	30	26
7	95912	8	132
9	92136	0	0
10	95857	11	156
17	31055	2	447

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

PRN	On Time	Late	Max Late Length (seconds)
2	47752	0	0
3	50915	0	0
4	48553	1	170
6	51890	0	0
7	48268	0	0
8	47584	2	157
9	49654	2	167
10	48546	0	0
11	52313	0	0
12	49292	0	0
13	48044	0	0
14	48002	0	0
15	50911	0	0
16	48965	1	168
17	47823	0	0
18	47348	0	0
19	51161	0	0
20	50487	0	0
21	47661	0	0
22	48503	0	0
23	47560	0	0
24	47974	1	167
25	46869	0	0
26	48320	1	163
27	51751	0	0
28	48779	0	0
29	48059	0	0
30	50897	0	0
31	48944	0	0
32	48288	0	0

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

PRN	On Time	Late	Max Late Length (seconds)
2	39182	0	0
3	41834	0	0
4	39859	0	0
6	42598	2	179
7	39616	1	208
8	39093	0	0
9	40825	2	209
10	39853	1	121
11	42930	0	0
12	40469	0	0
13	39511	0	0
14	39467	2	128
15	41765	0	0
16	40185	0	0
17	39297	0	0
18	38909	0	0
19	41994	3	209
20	41514	0	0
21	39115	4	206
22	39842	2	209
23	39036	0	0
24	39394	1	209
25	38497	0	0
26	39667	0	0
27	42486	2	206
28	40050	0	0
29	39535	2	208
30	41826	0	0
31	40180	0	0
32	39642	0	0
135	75367	0	0
138	75165	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27304	9	307
0	1	27288	9	305
0	2	27292	5	325
1	0	27287	10	313
1	1	27296	5	304
1	2	27295	11	306
1	3	27294	4	304
1	4	27296	6	305
2	0	27290	4	304
2	1	27301	8	586
2	2	27292	6	306
2	3	27306	4	306
2	4	27287	2	581
2	5	27294	4	304
3	0	27289	9	305
3	1	27308	6	306
3	2	27289	5	306
9	0	27295	7	310
9	1	27290	8	309
9	2	27289	5	310
9	3	27292	9	578
9	4	27299	7	326
9	5	27299	7	314
9	6	27285	8	309

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

Band	On Time	Late	Max Late Length (seconds)
1	35246	0	0
2	35291	1	434
3	35304	0	0
9	35296	1	466

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	
PRN ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.441	100	1.461	100	1.241	100	1.400	100	3.887	100	1.475	100
3	0.729	100	1.385	100	1.248	100	1.233	100	1.148	100	1.376	100
4	1.434	100	1.631	100	1.791	100	1.338	100	1.720	100	1.871	100
5	-	-	-	-	-	-	-	-	-	-	-	-
6	1.484	100	1.197	100	1.387	100	1.212	100	1.781	100	1.306	100
7	1.258	100	1.257	100	1.574	100	1.008	100	1.046	100	1.256	100
8	1.028	100	1.049	100	1.250	100	0.923	100	1.023	100	1.221	100
9	0.938	100	1.204	100	0.954	100	0.956	100	1.258	100	1.171	100
10	0.872	100	1.284	100	1.144	100	1.558	100	1.060	100	1.230	100
11	0.797	100	0.846	100	1.020	100	1.412	100	1.066	100	0.751	100
12	1.215	100	1.398	100	1.431	100	1.107	100	1.338	100	1.612	100
13	1.455	100	1.191	100	1.522	100	0.939	100	1.398	100	1.396	100
14	1.630	100	1.025	100	1.000	100	1.061	100	1.209	100	1.023	100
15	1.146	100	1.588	100	1.573	100	1.916	100	1.460	100	1.869	100
16	0.981	100	0.962	100	1.146	100	0.937	100	1.265	100	1.323	100
17	1.832	100	1.328	100	1.907	100	0.967	100	1.007	100	1.141	100
18	0.922	100	0.865	100	1.302	100	1.326	100	1.533	100	0.945	100
19	2.742	100	2.077	100	2.106	100	2.086	100	2.651	100	2.477	100
20	0.863	100	1.251	100	1.117	100	1.048	100	1.419	100	1.229	100
21	1.279	100	1.264	100	1.378	100	1.315	100	1.040	100	0.870	100
22	1.078	100	0.957	100	1.783	100	1.589	100	1.319	100	1.171	100
23	1.419	100	1.653	100	1.764	100	1.765	100	2.208	100	1.738	100
24	1.627	100	1.555	100	1.811	100	1.527	100	1.424	100	1.675	100
25	0.918	100	0.976	100	1.982	100	0.933	100	1.258	100	1.081	100
26	1.555	100	1.670	100	1.630	100	1.810	100	1.745	100	1.890	100
27	1.302	100	1.464	100	1.500	100	1.483	100	1.605	100	1.460	100
28	0.808	100	0.845	100	0.900	100	1.004	100	1.160	100	0.853	100
29	1.592	100	1.671	100	1.158	100	1.168	100	1.150	100	1.689	100
30	1.757	100	1.507	100	1.964	100	1.561	100	2.012	100	1.993	100
31	1.088	100	1.363	100	0.883	100	1.110	100	1.537	100	1.322	100
32	1.309	100	1.078	100	1.236	100	0.981	100	1.087	100	1.445	100
135	1.715	100	1.435	100	2.884	100	2.013	100	1.672	100	1.573	100
138	1.375	100	1.306	100	1.329	100	1.189	100	1.362	100	1.332	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
PRN ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	2.345	100	1.771	100	2.230	100	1.682	100	1.019	100	1.709	100
3	0.817	100	1.028	100	1.085	100	1.361	100	1.400	100	1.140	100
4	1.154	100	1.334	100	2.096	100	1.337	100	1.885	100	1.376	100
5	-	-	-	-	-	-	-	-	-	-	-	-
6	1.138	100	1.530	100	1.007	100	1.386	100	1.631	100	1.264	100
7	0.872	100	1.122	100	2.197	100	1.408	100	1.484	100	1.186	100
8	0.801	100	0.882	100	0.847	100	1.173	100	1.499	100	0.955	100
9	1.311	100	1.209	100	1.093	100	1.357	100	1.628	100	0.957	100
10	1.187	100	0.863	100	1.116	100	1.218	100	1.165	100	0.770	100
11	1.428	100	1.100	100	1.216	100	1.433	100	0.912	100	1.091	100
12	0.898	100	1.127	100	1.473	100	1.111	100	1.734	100	1.012	100
13	0.799	100	1.223	100	1.591	100	1.095	100	1.474	100	1.063	100
14	1.031	100	0.863	100	1.490	100	0.803	100	1.124	100	0.782	100
15	1.649	100	1.107	100	1.552	100	1.228	100	1.942	100	1.201	100
16	1.547	100	1.049	100	1.435	100	1.002	100	0.892	100	0.983	100
17	0.853	100	1.168	100	0.993	100	0.917	100	1.509	100	0.899	100
18	1.686	100	1.902	100	1.823	100	1.142	100	1.044	100	1.277	100
19	3.733	100	2.217	100	2.619	100	2.366	100	2.017	100	2.240	100
20	1.546	100	1.298	100	1.346	100	1.037	100	0.972	100	1.009	100
21	1.943	100	0.960	100	1.975	100	1.025	100	0.799	100	1.223	100
22	1.626	100	1.567	100	2.395	100	1.321	100	1.182	100	1.475	100
23	1.991	100	1.574	100	2.220	100	1.581	100	1.329	100	1.542	100
24	1.184	100	1.561	100	1.573	100	1.471	100	1.869	100	1.587	100
25	0.707	100	0.811	100	1.151	100	1.100	100	1.406	100	1.151	100
26	1.118	100	1.437	100	1.822	100	1.420	100	2.006	100	1.464	100
27	1.201	100	1.055	100	1.421	100	1.276	100	1.673	100	1.103	100
28	1.313	100	0.813	100	1.635	100	0.877	100	0.790	100	0.788	100
29	0.807	100	1.652	100	1.979	100	1.285	100	1.713	100	1.265	100
30	1.108	100	1.166	100	1.780	100	1.322	100	2.321	100	1.538	100
31	1.059	100	0.787	100	1.463	100	0.757	100	1.301	100	1.177	100
32	0.973	100	0.874	100	1.106	100	0.856	100	1.197	100	0.793	100
135	1.746	100	1.359	100	2.262	100	1.598	100	1.543	100	1.290	100
138	1.280	100	1.233	100	1.680	100	1.528	100	1.393	100	1.229	100

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
PRN ↓	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.162	100	0.919	100	1.094	100	1.018	100	2.403	100	0.899	100
3	0.297	100	0.517	100	0.264	100	0.471	100	0.586	100	0.684	100
4	0.862	100	1.249	100	1.105	100	0.869	100	1.345	100	1.517	100
5	-	-	-	-	-	-	-	-	-	-	-	-
6	0.533	100	0.681	100	0.524	100	0.691	100	0.950	100	0.579	100
7	0.719	100	0.671	100	0.517	100	0.593	100	0.643	100	0.682	100
8	0.521	100	0.581	100	0.487	100	0.493	100	0.647	100	0.657	100
9	0.416	100	0.692	100	0.380	100	0.400	100	0.510	100	0.548	100
10	0.660	100	0.773	100	0.520	100	0.628	100	0.574	100	0.539	100
11	0.493	100	0.377	100	0.482	100	0.612	100	0.527	100	0.326	100
12	0.543	100	0.767	100	0.506	100	0.487	100	0.654	100	0.738	100
13	0.543	100	0.709	100	0.584	100	0.451	100	0.830	100	0.721	100
14	1.054	100	0.435	100	0.760	100	0.275	100	0.629	100	0.457	100
15	0.604	100	0.922	100	0.510	100	1.078	100	0.871	100	1.056	100
16	0.768	100	0.447	100	0.536	100	0.517	100	0.602	100	0.458	100
17	1.167	100	0.863	100	1.003	100	0.602	100	0.625	100	0.660	100
18	0.876	100	0.613	100	0.794	100	0.719	100	0.824	100	0.486	100
19	1.823	100	1.438	100	1.596	100	1.456	100	1.932	100	1.511	100
20	0.596	100	0.573	100	0.689	100	0.410	100	0.630	100	0.502	100
21	1.087	100	0.728	100	1.110	100	0.910	100	0.668	100	0.570	100
22	0.933	100	0.671	100	1.071	100	0.906	100	0.847	100	0.713	100
23	1.183	100	1.228	100	1.447	100	1.281	100	1.754	100	1.139	100
24	1.023	100	1.042	100	0.763	100	0.888	100	0.957	100	1.018	100
25	0.400	100	0.505	100	0.730	100	0.474	100	0.682	100	0.523	100
26	0.773	100	0.919	100	0.676	100	0.955	100	1.022	100	1.018	100
27	0.601	100	0.767	100	0.567	100	0.605	100	0.792	100	0.687	100
28	0.628	100	0.450	100	0.625	100	0.571	100	0.608	100	0.365	100
29	0.802	100	1.021	100	0.609	100	0.680	100	0.859	100	0.919	100
30	0.757	100	0.925	100	0.843	100	0.729	100	0.979	100	0.890	100
31	0.510	100	0.660	100	0.211	100	0.406	100	0.896	100	0.923	100
32	0.471	100	0.478	100	0.458	100	0.365	100	0.450	100	0.699	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
PRN ↓	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.269	100	1.180	100	1.094	100	1.202	100	0.707	100	1.285	100
3	0.330	100	0.468	100	0.564	100	0.597	100	0.627	100	0.457	100
4	0.855	100	0.900	100	1.316	100	0.830	100	1.098	100	0.718	100
5	-	-	-	-	-	-	-	-	-	-	-	-
6	0.576	100	0.553	100	0.595	100	0.544	100	0.840	100	0.537	100
7	0.505	100	0.683	100	0.977	100	0.707	100	0.855	100	0.661	100
8	0.489	100	0.529	100	0.723	100	0.522	100	0.755	100	0.458	100
9	0.551	100	0.575	100	0.541	100	0.525	100	0.766	100	0.491	100
10	0.613	100	0.447	100	0.536	100	0.578	100	0.438	100	0.491	100
11	0.705	100	0.540	100	0.454	100	0.680	100	0.444	100	0.555	100
12	0.597	100	0.639	100	0.747	100	0.438	100	0.800	100	0.428	100
13	0.524	100	0.629	100	0.975	100	0.449	100	0.764	100	0.491	100
14	0.512	100	0.534	100	0.566	100	0.433	100	0.382	100	0.588	100
15	0.774	100	0.649	100	0.738	100	0.563	100	0.939	100	0.601	100
16	0.792	100	0.629	100	0.390	100	0.604	100	0.275	100	0.811	100
17	0.618	100	0.728	100	0.893	100	0.365	100	0.820	100	0.379	100
18	0.905	100	1.157	100	0.593	100	0.846	100	0.576	100	1.122	100
19	2.066	100	1.546	100	1.291	100	1.690	100	1.341	100	1.681	100
20	0.721	100	0.626	100	0.622	100	0.715	100	0.411	100	0.581	100
21	0.926	100	0.708	100	1.150	100	0.845	100	0.564	100	0.939	100
22	0.899	100	0.934	100	1.008	100	1.071	100	0.696	100	1.033	100
23	1.302	100	1.181	100	1.373	100	1.188	100	1.092	100	1.191	100
24	1.094	100	1.205	100	1.041	100	0.841	100	1.101	100	0.994	100
25	0.527	100	0.447	100	0.718	100	0.523	100	0.697	100	0.550	100
26	0.693	100	0.802	100	0.967	100	0.724	100	1.037	100	0.782	100
27	0.626	100	0.592	100	0.832	100	0.579	100	0.726	100	0.529	100
28	0.627	100	0.465	100	0.875	100	0.688	100	0.431	100	0.628	100
29	0.704	100	1.084	100	1.167	100	0.705	100	0.970	100	0.801	100
30	0.792	100	0.784	100	1.089	100	0.638	100	1.083	100	0.772	100
31	0.612	100	0.443	100	0.651	100	0.240	100	0.584	100	0.434	100
32	0.413	100	0.393	100	0.728	100	0.350	100	0.609	100	0.389	100

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

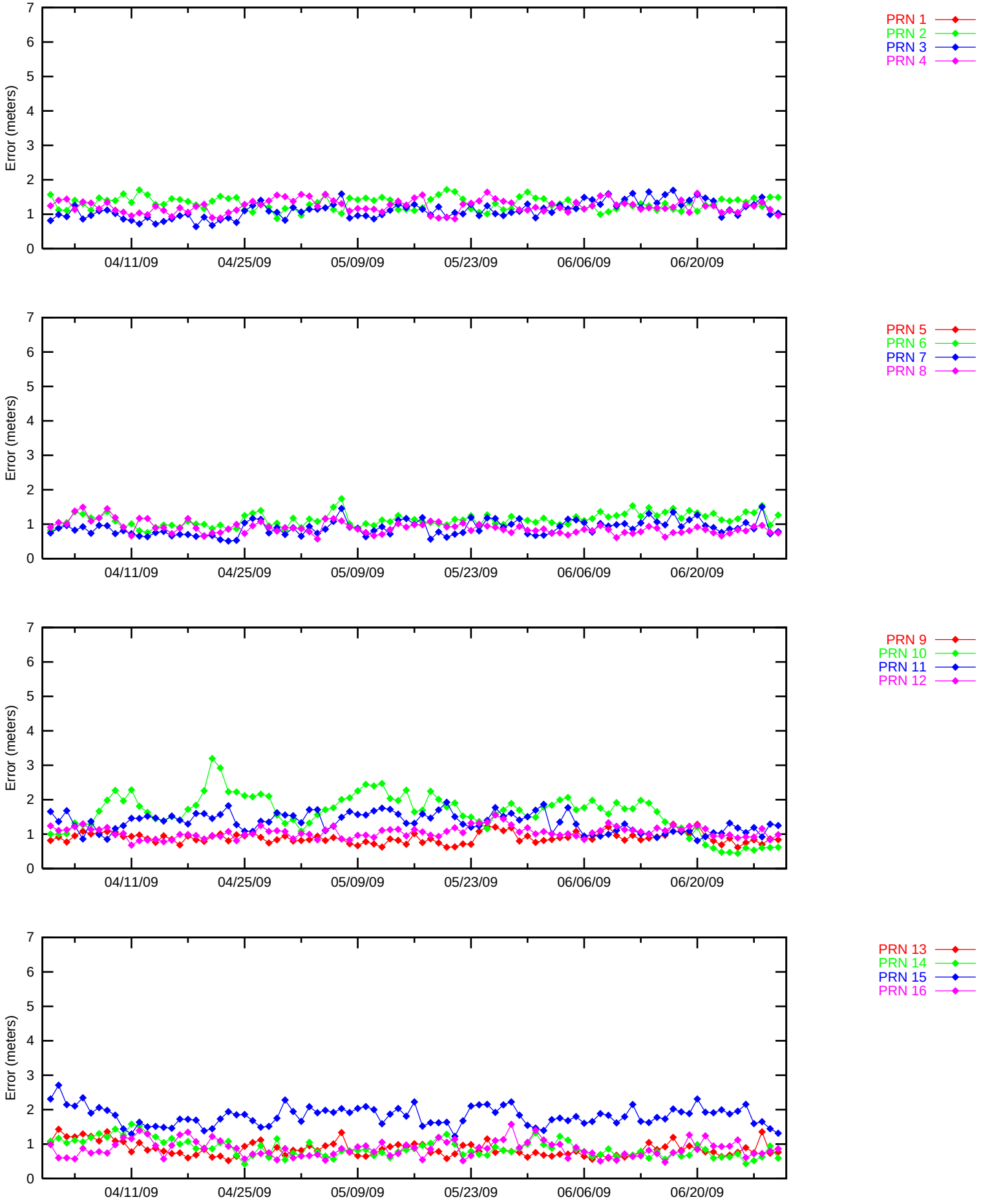


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Washington DC

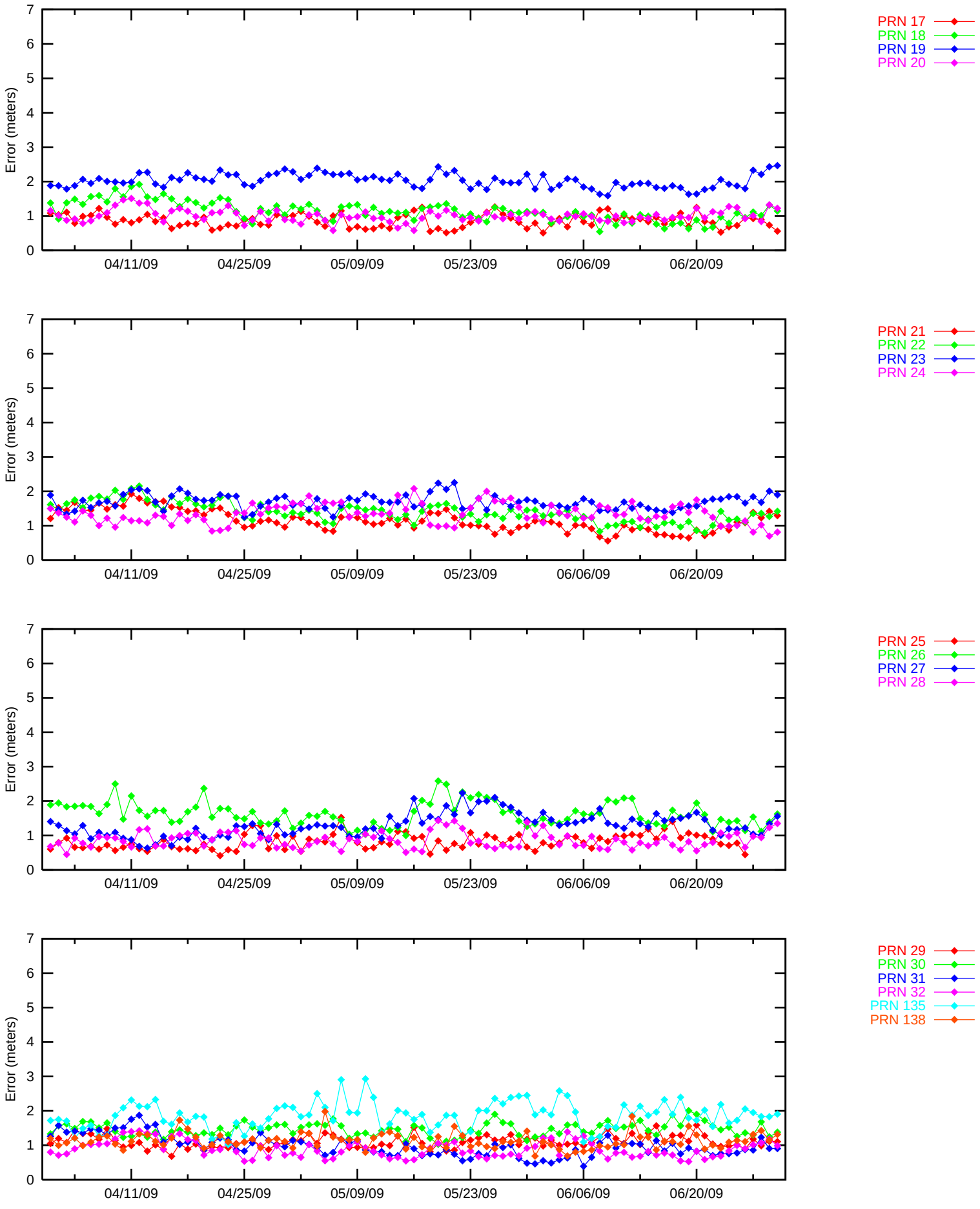


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Washington DC

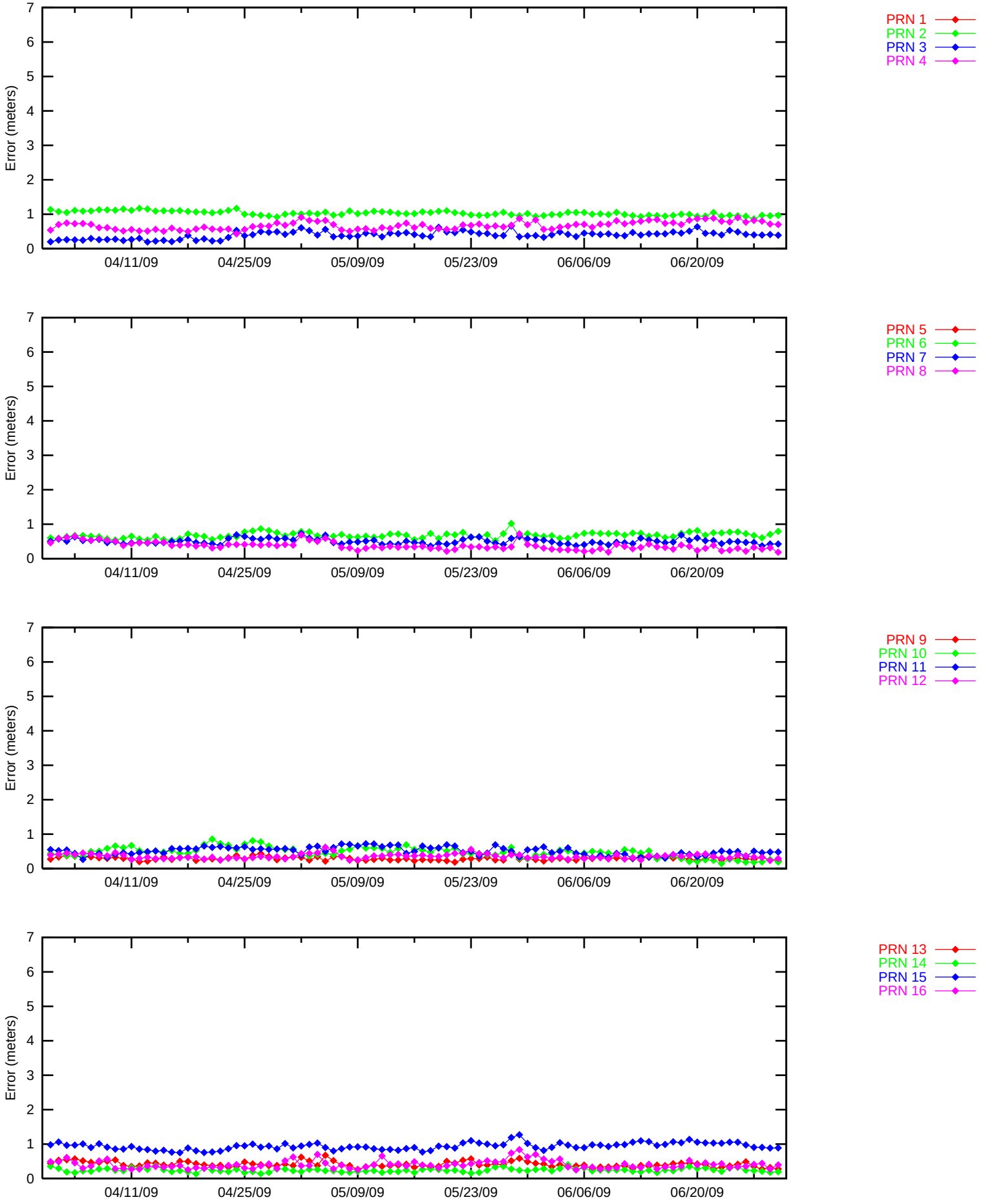
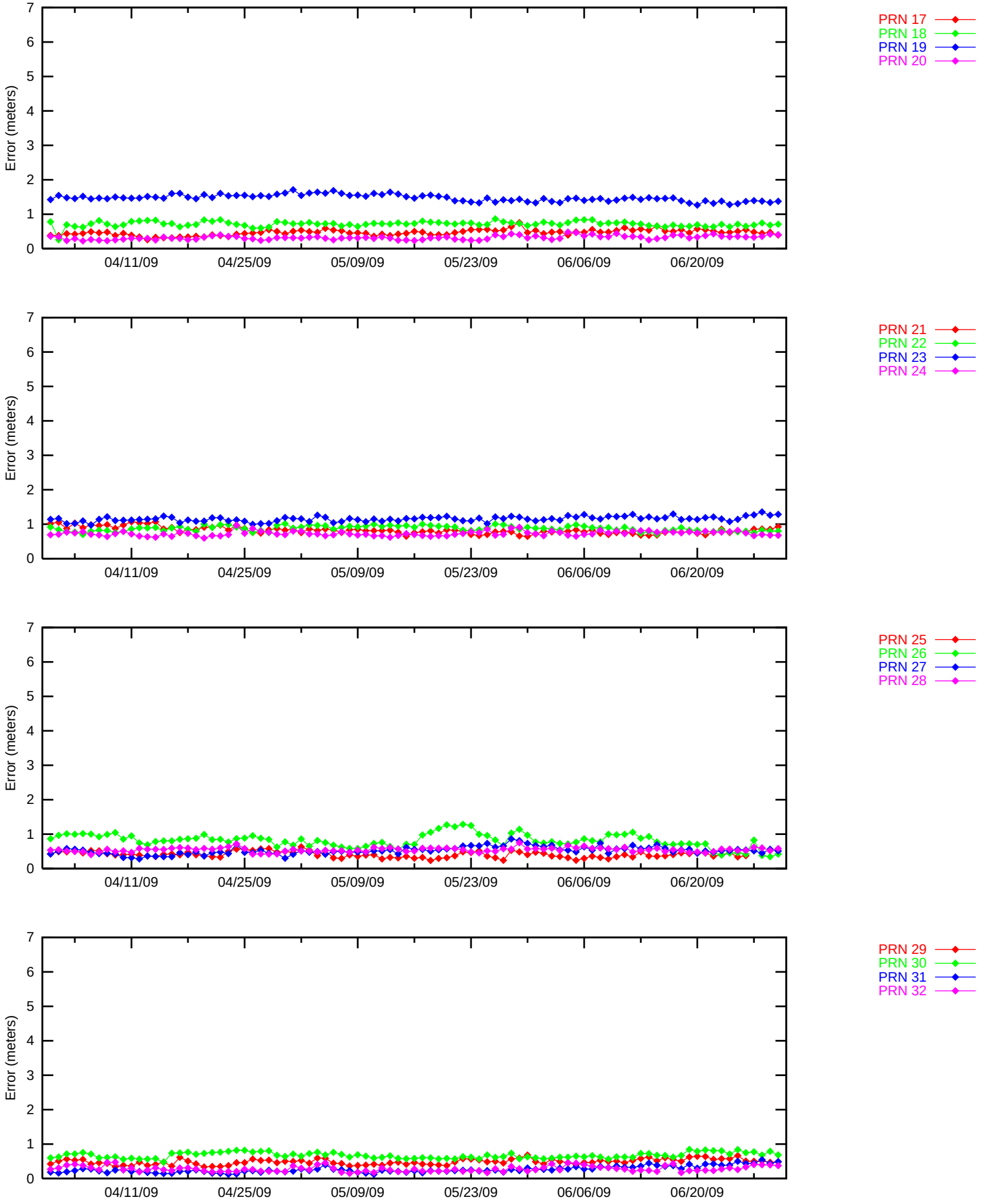


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Washington DC



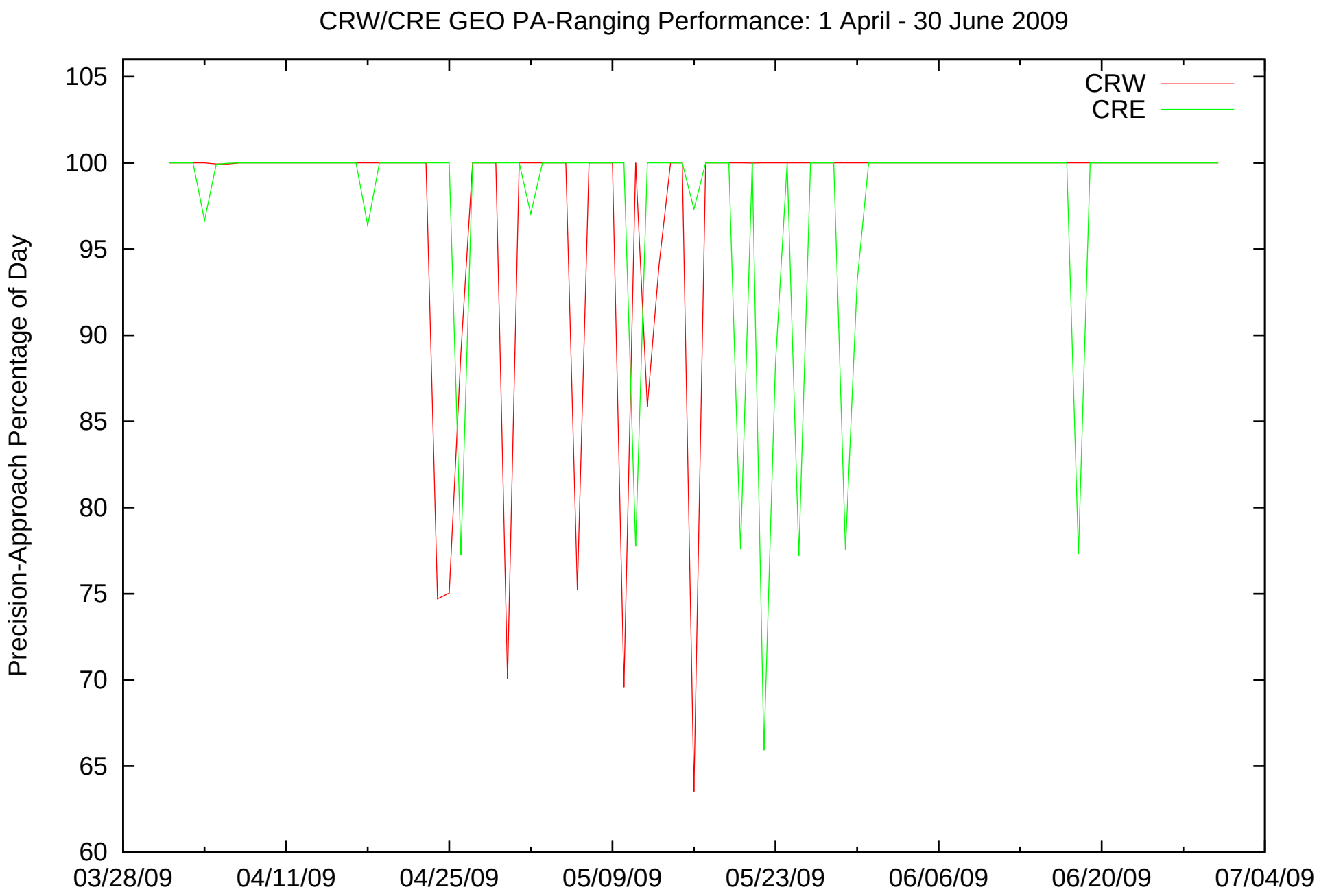
7.0 GEO RANGING PERFORMANCE

For the evaluation period, both CRW and CRE 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 NPA Ranging Availability for the CRE and CRW GEO satellite.

Table 7-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
CRW	97.768	1.853	0.343	0
CRE	97.757	1.534	0.497	0.176

Figure 7-1 Daily PA GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

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

Table 8-1 WAAS Problem Summary

Date	Events
5/21/09	CRW transmitted 7 T6 messages. See DR #81 -CRW Type 6 Messages set Multiple Satellites to NM.

9.0 WAAS AIRPORT AVAILABILITY

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

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PACD	COLD BAY	AK	3	0.999725	434	0.935420
PAGA	EDWARD G. PITKA SR	AK	1	0.999951	6	0.999660
PAEM	EMMONAK	AK	1	0.999938	25	0.998378
PAFA	FAIRBANKS INTL	AK	1	0.999972	3	0.999824
PAGB	GALBRAITH LAKE	AK	1	0.999963	10	0.998867
PAGK	GULKANA	AK	1	0.999985	2	0.999899
PAHO	HOMER	AK	1	0.999977	2	0.999777
PAHL	HUSLIA	AK	1	0.999951	6	0.999580
PAEN	KENAI MUNICIPAL	AK	1	0.999977	2	0.999793
PAKT	KETCHIKAN INTL	AK	0	1	1	0.999918
PAKN	KING SALMON	AK	1	0.999951	5	0.999583
PARY	RUBY	AK	1	0.999965	5	0.999707
PASK	SELAWIK	AK	1	0.999932	16	0.998794
PASM	ST MARY'S	AK	1	0.999938	12	0.999078
PAMK	ST MICHAEL	AK	1	0.999938	7	0.999464
PANC	TED STEVENS ANCHORAGE INTL	AK	1	0.999977	2	0.999831
PAYA	YAKUTAT	AK	0	1	1	0.999917
8A0	ALBERTVILLE RGNL-THOMAS J BRUM	AL	0	1	0	1
ANB	ANNISTON METROPOLITAN	AL	0	1	0	1
AUO	AUBURN-OPELIKA ROBERT G PITTS	AL	0	1	0	1
EKY	BESSEMER	AL	0	1	0	1
BHM	BIRMINGHAM INTL	AL	0	1	0	1
SEM	CRAIG FIELD	AL	0	1	0	1
DHN	DOTHAN RGNL	AL	0	1	1	0.999985
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	0	1	0	1
JKA	JACK EDWARDS	AL	0	1	0	1
MDQ	MADISON COUNTY EXECUTIVE/TOM S	AL	0	1	0	1
BFM	MOBILE DOWNTOWN	AL	0	1	0	1

MOB	MOBILE RGNL	AL	0	1	0	1
MGM	MONTGOMERY RGNL (DANNELLY FIELD)	AL	0	1	0	1
GAD	NORTHEAST ALABAMA RGNL	AL	0	1	0	1
MSL	NORTHWEST ALABAMA RGNL	AL	0	1	0	1
DCU	PRYOR FIELD RGNL	AL	0	1	0	1
79J	SOUTH ALABAMA RGNL	AL	0	1	0	1
PLR	ST CLAIR COUNTY	AL	0	1	0	1
2R5	ST ELMO	AL	0	1	0	1
ASN	TALLADEGA MUNICIPAL	AL	0	1	0	1
TOI	TROY MUNICIPAL	AL	0	1	0	1
TCL	TUSCALOOSA RGNL	AL	0	1	0	1
LIT	ADAMS FIELD	AR	0	1	0	1
M73	ALMYRA MUNICIPAL	AR	0	1	0	1
BYH	ARKANSAS INTL	AR	0	1	0	1
VBT	BENTONVILLE MUNICIPAL/ LOUISE M THAD	AR	0	1	0	1
HRO	BOONE COUNTY	AR	0	1	0	1
FSM	FORT SMITH RGNL	AR	0	1	0	1
PBF	GRIDER FIELD	AR	0	1	0	1
JBR	JONESBORO MUNICIPAL	AR	0	1	0	1
M19	NEWPORT MUNICIPAL	AR	0	1	0	1
ORK	NORTH LITTLE ROCK MUNICIPAL	AR	0	1	0	1
XNA	NORTHWEST ARKANSAS RGNL	AR	0	1	0	1
BPK	OZARK RGNL	AR	0	1	0	1
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1	0	1
RUE	RUSSELLVILLE RGNL	AR	0	1	0	1
SUZ	SALINE COUNTY RGNL	AR	0	1	0	1
SRC	SEARCY MUNICIPAL	AR	0	1	0	1
SLG	SMITH FIELD	AR	0	1	0	1
ELD	SOUTH ARKANSAS RGNL AT GOODWIN	AR	0	1	0	1
ASG	SPRINGDALE MUNICIPAL	AR	0	1	0	1
SGT	STUTTGART MUNICIPAL	AR	0	1	0	1
ARG	WALNUT RIDGE RGNL	AR	0	1	0	1
PRC	ERNEST A. LOVE FIELD	AZ	0	1	0	1
GEU	GLENDALE MUNICIPAL	AZ	0	1	2	0.999964
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1	0	1
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1	0	1
PGA	PAGE MUNICIPAL	AZ	0	1	0	1
DVT	PHOENIX DEER VALLEY	AZ	0	1	0	1
PHX	PHOENIX SKY HARBOR INTL	AZ	0	1	31	0.998849
IWA	PHOENIX-MESA GATEWAY	AZ	0	1	66	0.996044
SJN	ST JOHNS INDUSTRIAL AIR PARK	AZ	0	1	6	0.999793
TUS	TUCSON INTL	AZ	0	1	91	0.991566
APV	APPLE VALLEY	CA	0	1	4	0.999794
ACV	ARCATA	CA	0	1	101	0.977849
DAG	BARSTOW-DAGGETT	CA	0	1	2	0.999930
C83	BYRON	CA	0	1	294	0.972882
CMA	CAMARILLO	CA	0	1	154	0.985857
CNO	CHINO	CA	0	1	17	0.999113
FAT	FRESNO YOSEMITE INTL	CA	0	1	92	0.995884
WJF	GENERAL WM J FOX AIRFIELD	CA	0	1	9	0.999499
HAF	HALF MOON BAY	CA	0	1	341	0.956341

HWD	HAYWARD EXECUTIVE	CA	0	1	327	0.962510
CVH	HOLLISTER MUNICIPAL	CA	0	1	326	0.968028
SNA	JOHN WAYNE AIRPORT-ORANGE COUNTY	CA	0	1	63	0.996623
LGB	LONG BEACH /DAUGHERTY FIELD	CA	0	1	64	0.996107
LAX	LOS ANGELES INTL	CA	0	1	88	0.993774
MAE	MADERA MUNICIPAL	CA	0	1	154	0.991977
CRQ	MC CLELLAN-PALOMAR	CA	0	1	86	0.994776
BFL	MEADOWS FIELD	CA	0	1	67	0.996201
MCE	MERCED MUNICIPAL/ MACREADY FIELD	CA	0	1	236	0.986695
OAK	METROPOLITAN OAKLAND INTL	CA	0	1	328	0.961631
MOD	MODESTO CITY-CO-HARRY SHAM FLD	CA	0	1	256	0.982203
MRY	MONTEREY PENINSULA	CA	0	1	341	0.960255
APC	NAPA COUNTY	CA	0	1	299	0.966753
O02	NERVINO	CA	0	1	91	0.994812
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	0	1	329	0.963332
VCB	NUT TREE	CA	0	1	262	0.974180
ONT	ONTARIO INTL	CA	0	1	12	0.999341
OXR	OXNARD	CA	0	1	167	0.983684
PMD	PALMDALE RGNL/USAF PLANT 42	CA	0	1	9	0.999482
RBL	RED BLUFF MUNICIPAL	CA	0	1	120	0.985880
RDD	REDDING MUNICIPAL	CA	0	1	107	0.988717
RAL	RIVERSIDE MUNICIPAL	CA	0	1	11	0.999350
SMF	SACRAMENTO INTL	CA	0	1	209	0.981774
MHR	SACRAMENTO MATHER	CA	0	1	197	0.984754
SFO	SAN FRANCISCO INTL	CA	0	1	333	0.958918
SBA	SANTA BARBARA MUNICIPAL	CA	0	1	239	0.974037
TCY	TRACY MUNICIPAL	CA	0	1	294	0.974094
APA	CENTENNIAL	CO	0	1	0	1
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	0	1	0	1
AKO	COLORADO PLAINS RGNL	CO	0	1	0	1
CEZ	CORTEZ MUNICIPAL	CO	0	1	0	1
DEN	DENVER INTL	CO	0	1	0	1
FTG	FRONT RANGE	CO	0	1	0	1
RIL	GARFIELD COUNTY RGNL	CO	0	1	0	1
GXY	GREELEY-WELD COUNTY	CO	0	1	0	1
ITR	KIT CARSON COUNTY	CO	0	1	0	1
LAA	LAMAR MUNICIPAL	CO	0	1	0	1
PUB	PUEBLO MEMORIAL	CO	0	1	0	1
ALS	SAN LUIS VALLEY RGNL	CO	0	1	0	1
HDN	YAMPA VALLEY	CO	0	1	0	1
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	1	0.999767
EVY	SUMMIT	DE	0	1	1	0.999912
GED	SUSSEX COUNTY	DE	0	1	1	0.999846
AAF	APALACHICOLA MUNICIPAL	FL	0	1	1	0.999959
CEW	BOB SIKES	FL	0	1	0	1
BCT	BOCA RATON	FL	0	1	9	0.998612

PGD	CHARLOTTE COUNTY	FL	0	1	4	0.999445
DAB	DAYTONA BEACH INTL	FL	0	1	2	0.999928
DED	DELAND MUNICIPAL-SIDNEY H TAYLOR FIELD	FL	0	1	2	0.999938
XFL	FLAGLER COUNTY	FL	0	1	1	0.999929
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1	10	0.998424
FLL	FORT LAUDERDALE/HOLLYWOOD INTL	FL	0	1	10	0.998357
GNV	GAINESVILLE RGNL	FL	0	1	1	0.999930
BKV	HERNANDO COUNTY	FL	0	1	2	0.999902
JAX	JACKSONVILLE INTL	FL	0	1	1	0.999881
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	0	1	11	0.998127
EYW	KEY WEST INTL	FL	0	1	13	0.997747
ISM	KISSIMMEE GATEWAY	FL	0	1	3	0.999640
X14	LA BELLE MUNICIPAL	FL	0	1	7	0.999277
LCQ	LAKE CITY MUNICIPAL	FL	0	1	1	0.999907
LAL	LAKELAND LINDER RGNL	FL	0	1	3	0.999604
LEE	LEESBURG INTL	FL	0	1	2	0.999959
MLB	MELBOURNE INTL	FL	0	1	3	0.999521
COI	MERRITT ISLAND	FL	0	1	3	0.999549
MIA	MIAMI INTL	FL	0	1	11	0.998224
APF	NAPLES MUNICIPAL	FL	0	1	7	0.998834
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1	4	0.999766
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1	1	0.999960
MCO	ORLANDO INTL	FL	0	1	3	0.999654
SFB	ORLANDO SANFORD INTL	FL	0	1	4	0.999749
PHK	PALM BEACH CO GLADES	FL	0	1	7	0.998909
PBI	PALM BEACH INTL	FL	0	1	8	0.998756
PFN	PANAMA CITY-BAY CO INTL	FL	0	1	1	0.999952
PNS	PENSACOLA RGNL	FL	0	1	0	1
PMP	POMPANO BEACH AIRPARK	FL	0	1	9	0.998451
SRQ	SARASOTA/BRADENTON INTL	FL	0	1	3	0.999560
RSW	SOUTHWEST FLORIDA INTL	FL	0	1	7	0.999264
FPR	ST LUCIE COUNTY INTL	FL	0	1	4	0.999427
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1	3	0.999669
TLH	TALLAHASSEE RGNL	FL	0	1	1	0.999922
TPA	TAMPA INTL	FL	0	1	3	0.999669
MTH	THE FLORIDA KEYS MARATHON	FL	0	1	15	0.997637
VDF	VANDENBERG	FL	0	1	3	0.999668
GIF	WINTER HAVEN'S GILBERT	FL	0	1	3	0.999574
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	0	1	1	0.999872
BQK	BRUNSWICK GOLDEN ISLES	GA	0	1	1	0.999860
VPC	CARTERSVILLE	GA	0	1	0	1
47A	CHEROKEE COUNTY	GA	0	1	0	1
RYY	COBB COUNTY-MC COLLUM FIELD	GA	0	1	0	1
CSG	COLUMBUS METROPOLITAN	GA	0	1	0	1
15J	COOK COUNTY	GA	0	1	1	0.999902
CKF	CRISP COUNTY-CORDELE	GA	0	1	1	0.999916
DNN	DALTON MUNICIPAL	GA	0	1	0	1
SBO	EMANUEL COUNTY	GA	0	1	1	0.999879
18A	FRANKLIN COUNTY	GA	0	1	1	0.999968
FTY	FULTON COUNTY AIRPORT-BROWN FIELD	GA	0	1	0	1
ATL	HARTSFIELD - JACKSON ATLANTA	GA	0	1	0	1
EZM	HEART OF GEORGIA RGNL	GA	0	1	1	0.999884

19A	JACKSON COUNTY	GA	0	1	1	0.999983
GVL	LEE GILMER MEMORIAL	GA	0	1	1	0.999985
MCN	MIDDLE GEORGIA RGNL	GA	0	1	1	0.999918
MGR	MOULTRIE MUNICIPAL	GA	0	1	1	0.999903
CCO	NEWNAN COWETA COUNTY	GA	0	1	0	1
FFC	PEACHTREE CITY-FALCON FIELD	GA	0	1	0	1
PXE	PERRY-HOUSTON COUNTY	GA	0	1	1	0.999918
JZP	PICKENS COUNTY	GA	0	1	0	1
JYL	PLANTATION ARPK	GA	0	1	1	0.999849
SAV	SAVANNAH/HILTON HEAD INTL	GA	0	1	1	0.999855
ACJ	SOUTHER FIELD	GA	0	1	1	0.999969
ABY	SOUTHWEST GEORGIA RGNL	GA	0	1	1	0.999917
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1	1	0.999856
MQW	TELFAIR-WHEELER	GA	0	1	1	0.999880
TVI	THOMASVILLE RGNL	GA	0	1	1	0.999908
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1	1	0.999970
VLD	VALDOSTA RGNL	GA	0	1	1	0.999905
VDI	VIDALIA RGNL	GA	0	1	1	0.999872
IIY	WASHINGTON-WILKES COUNTY	GA	0	1	1	0.999916
AYS	WAYCROSS-WARE COUNTY	GA	0	1	1	0.999886
CTJ	WEST GEORGIA RGNL - O V GRAY	GA	0	1	0	1
WDR	WINDER-BARROW	GA	0	1	1	0.999984
IKV	ANKENY RGNL	IA	0	1	0	1
CBF	COUNCIL BLUFFS MUNICIPAL	IA	0	1	0	1
DVN	DAVENPORT MUNICIPAL	IA	0	1	0	1
DNS	DENISON MUNICIPAL	IA	0	1	0	1
DSM	DES MOINES INTL	IA	0	1	0	1
DBQ	DUBUQUE RGNL	IA	0	1	0	1
EST	ESTHERVILLE MUNICIPAL	IA	0	1	0	1
FFL	FAIRFIELD MUNICIPAL	IA	0	1	0	1
GGI	GRINNELL RGNL	IA	0	1	0	1
EOK	KEOKUK MUNICIPAL	IA	0	1	0	1
MCW	MASON CITY MUNICIPAL	IA	0	1	0	1
MXO	MONTICELLO RGNL	IA	0	1	0	1
MUT	MUSCATINE MUNICIPAL	IA	0	1	0	1
TNU	NEWTON MUNICIPAL	IA	0	1	0	1
OTM	OTTUMWA INDUSTRIAL	IA	0	1	0	1
PRO	PERRY MUNICIPAL	IA	0	1	0	1
SDA	SHENANDOAH MUNICIPAL	IA	0	1	0	1
SLB	STORM LAKE MUNICIPAL	IA	0	1	0	1
CID	THE EASTERN IOWA	IA	0	1	0	1
ALO	WATERLOO RGNL	IA	0	1	0	1
BOI	BOISE AIR TERMINAL/GOWEN FLD	ID	0	1	0	1
EUL	CALDWELL INDUSTRIAL	ID	0	1	0	1
GNG	GOODING MUNICIPAL	ID	0	1	0	1
IDA	IDAHO FALLS RGNL	ID	0	1	0	1
LWS	LEWISTON-NEZ PERCE COUNTY	ID	0	1	0	1
S67	NAMPA MUNICIPAL	ID	0	1	0	1
PIH	POCATELLO RGNL	ID	0	1	0	1
SPI	ABRAHAM LINCOLN CAPITAL	IL	0	1	0	1
FEP	ALBERTUS	IL	0	1	0	1
ARR	AURORA MUNICIPAL	IL	0	1	0	1
BMI	CENTRAL IL REGL ARPT	IL	0	1	0	1

ENL	CENTRALIA MUNICIPAL	IL	0	1	0	1
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	0	1
DKB	DE KALB TAYLOR MUNICIPAL	IL	0	1	0	1
DEC	DECATUR	IL	0	1	0	1
FOA	FLORA MUNICIPAL	IL	0	1	0	1
IKK	GREATER KANKAKEE	IL	0	1	0	1
PIA	GREATER PEORIA RGNL	IL	0	1	0	1
IGQ	LANSING MUNICIPAL	IL	0	1	0	1
LOT	LEWIS UNIVERSITY	IL	0	1	0	1
3LF	LITCHFIELD MUNICIPAL	IL	0	1	0	1
C15	PEKIN MUNICIPAL	IL	0	1	0	1
PPQ	PITTSFIELD PENSTONE MUNICIPAL	IL	0	1	0	1
PNT	PONTIAC MUNICIPAL	IL	0	1	0	1
MLI	QUAD CITY INTL	IL	0	1	0	1
UIN	QUINCY RGNL-BALDWIN FIELD	IL	0	1	0	1
TIP	RANTOUL NATL AVN CNTR-FRANK EL	IL	0	1	0	1
RSV	ROBINSON MUNICIPAL	IL	0	1	0	1
SLO	SALEM-LECKRONE	IL	0	1	0	1
ALN	ST LOUIS RGNL	IL	0	1	0	1
DNV	VERMILION COUNTY	IL	0	1	0	1
UGN	WAUKEGAN RGNL	IL	0	1	0	1
MWA	WILLIAMSON COUNTY RGNL	IL	0	1	0	1
BAK	COLUMBUS MUNICIPAL	IN	0	1	0	1
GWB	DE KALB COUNTY	IN	0	1	0	1
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	0	1
FWA	FORT WAYNE INTL	IN	0	1	0	1
SER	FREEMAN MUNICIPAL	IN	0	1	0	1
RCR	FULTON COUNTY	IN	0	1	0	1
GSH	GOSHEN MUNICIPAL	IN	0	1	0	1
HFY	GREENWOOD MUNICIPAL	IN	0	1	0	1
TYQ	INDIANAPOLIS EXECUTIVE	IN	0	1	0	1
IND	INDIANAPOLIS INTL	IN	0	1	0	1
GGP	LOGANSPORT/CASS COUNTY	IN	0	1	0	1
IMS	MADISON MUNICIPAL	IN	0	1	0	1
MZZ	MARION MUNICIPAL	IN	0	1	0	1
CEV	METTEL FIELD	IN	0	1	0	1
BMG	MONROE COUNTY	IN	0	1	0	1
VPZ	PORTER COUNTY MUNICIPAL	IN	0	1	0	1
LAF	PURDUE UNIVERSITY	IN	0	1	0	1
4I7	PUTNAM COUNTY	IN	0	1	0	1
GEZ	SHELBYVILLE MUNICIPAL	IN	0	1	0	1
SBN	SOUTH BEND RGNL	IN	0	1	0	1
OXI	STARKE COUNTY	IN	0	1	0	1
ANQ	TRI-STATE STEUBEN COUNTY	IN	0	1	0	1
PTS	ATKINSON MUNICIPAL	KS	0	1	0	1
AAO	COLONEL JAMES JABARA	KS	0	1	0	1
DDC	DODGE CITY RGNL	KS	0	1	0	1
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	0	1
HYS	HAYS RGNL	KS	0	1	0	1
HQG	HUGOTON MUNICIPAL	KS	0	1	0	1
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	0	1
MHK	MANHATTAN RGNL	KS	0	1	0	1
MPR	MC PHERSON	KS	0	1	0	1
IXD	NEW CENTURY AIRCENTER	KS	0	1	0	1
EWK	NEWTON-CITY-COUNTY	KS	0	1	0	1
OEL	OAKLEY MUNICIPAL	KS	0	1	0	1
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1	0	1
PTT	PRATT INDUSTRIAL	KS	0	1	0	1
GLD	RENNER FLD /GOODLAND MUNICIPAL	KS	0	1	0	1
RSL	RUSSELL MUNICIPAL	KS	0	1	0	1
SLN	SALINA MUNICIPAL	KS	0	1	0	1
TQK	SCOTT CITY MUNICIPAL	KS	0	1	0	1
CBK	SHALZ FIELD	KS	0	1	0	1
WLD	STROTHER FIELD	KS	0	1	0	1
PPF	TRI-CITY	KS	0	1	0	1
ULS	ULYSSES	KS	0	1	0	1
EGT	WELLINGTON MUNICIPAL	KS	0	1	0	1
ICT	WICHITA MID-CONTINENT	KS	0	1	0	1
EKX	ADDINGTON FIELD	KY	0	1	0	1
PAH	BARKLEY RGNL	KY	0	1	0	1
K22	BIG SANDY RGNL	KY	0	1	1	0.999940
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	0	1
EHR	HENDERSON CITY-COUNTY	KY	0	1	0	1
SME	LAKE CUMBERLAND RGNL	KY	0	1	0	1
LOZ	LONDON-CORBIN ARPT-MAGEE FLD	KY	0	1	0	1
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	0	1	0	1
OWB	OWENSBORO-DAVIESS COUNTY	KY	0	1	0	1
DVK	STUART POWELL FIELD	KY	0	1	0	1
W38	WILLIAMSBURG-WHITLEY COUNTY	KY	0	1	0	1
ARA	ACADIANA RGNL	LA	0	1	0	1
AEX	ALEXANDRIA INTL	LA	0	1	0	1
BTR	BATON ROUGE METROPOLITAN RYAN	LA	0	1	0	1
DRI	BEAUREGARD RGNL	LA	0	1	0	1
CWF	CHENNAULT INTL	LA	0	1	0	1
ESF	ESLER RGNL	LA	0	1	0	1
HZR	FALSE RIVER RGNL	LA	0	1	0	1
PTN	HARRY P WILLIAMS MEMORIAL	LA	0	1	0	1
LFT	LAFAYETTE RGNL	LA	0	1	0	1
LCH	LAKE CHARLES RGNL	LA	0	1	0	1
NEW	LAKEFRONT	LA	0	1	0	1
MSY	LOUIS ARMSTRONG NEW ORLEANS	LA	0	1	0	1
BQP	MOREHOUSE MEMORIAL	LA	0	1	0	1
DTN	SHREVEPORT DOWNTOWN	LA	0	1	0	1

SHV	SHREVEPORT RGNL	LA	0	1	0	1
GAO	SOUTH LAFOURCHE LEONARD MILLER	LA	0	1	0	1
TVR	VICKSBURG TALLULAH RGNL	LA	0	1	0	1
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	1	0.999764
DMW	CARROLL COUNTY RGNL	MD	0	1	1	0.999830
ESN	EASTON/NEWNAM FIELD	MD	0	1	1	0.999799
FDK	FREDERICK MUNICIPAL	MD	0	1	1	0.999783
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1	1	0.999775
2W6	ST. MARY'S COUNTY RGNL	MD	0	1	1	0.999750
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	0	1
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	0.999982
ACB	ANTRIM COUNTY	MI	0	1	0	1
FNT	BISHOP INTL	MI	0	1	0	1
OEB	BRANCH COUNTY MEMORIAL	MI	0	1	0	1
CVX	CHARLEVOIX MUNICIPAL	MI	0	1	0	1
CIU	CHIPPEWA COUNTY INTL	MI	0	1	1	0.999985
TTF	CUSTER	MI	0	1	1	0.999974
DTW	DETROIT METROPOLITAN WAYNE	MI	0	1	1	0.999975
FFX	FREMONT MUNICIPAL	MI	0	1	0	1
GRR	GERALD R. FORD INTL	MI	0	1	0	1
CMX	HOUGHTON COUNTY MEMORIAL	MI	0	1	1	0.999985
BAX	HURON COUNTY MEMORIAL	MI	0	1	1	0.999947
AZO	KALAMAZOO/BATTLE CREEK INTL	MI	0	1	0	1
ADG	LENAWEE COUNTY	MI	0	1	0	1
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	0	1	0	1
LDM	MASON COUNTY	MI	0	1	0	1
MBS	MBS INTL	MI	0	1	1	0.999985
MKG	MUSKEGON COUNTY	MI	0	1	0	1
RNP	OWOSSO COMMUNICIPALTY	MI	0	1	0	1
HYX	SAGINAW COUNTY H.W. BROWNE	MI	0	1	1	0.999980
BIV	TULIP CITY	MI	0	1	0	1
YIP	WILLOW RUN	MI	0	1	1	0.999978
AEL	ALBERT LEA MUNICIPAL	MN	0	1	0	1
ANE	ANOKA COUNTY-BLAINE ARPT	MN	0	1	0	1
AUM	AUSTIN MUNICIPAL	MN	0	1	0	1
BDE	BAUDETTE INTL	MN	0	1	0	1
BRD	BRAINERD LAKES RGNL	MN	0	1	0	1
AXN	CHANDLER FIELD	MN	0	1	0	1
HIB	CHISHOLM-HIBBING	MN	0	1	0	1

CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	0	1	0	1
DTL	DETROIT LAKES-WETHING FIELD	MN	0	1	0	1
DLH	DULUTH INTL	MN	0	1	0	1
INL	FALLS INTL	MN	0	1	0	1
MSP	MINNEAPOLIS-ST PAUL INTL/WOLD	MN	0	1	0	1
RGK	RED WING RGNL	MN	0	1	0	1
RST	ROCHESTER INTL	MN	0	1	0	1
ROX	ROSEAU MUNICIPAL/ RUDY BILLBERG FIELD	MN	0	1	0	1
MML	SOUTHWEST MINNESOTA RGNL MARSH	MN	0	1	0	1
STC	ST CLOUD RGNL	MN	0	1	0	1
JYG	ST JAMES MUNICIPAL	MN	0	1	0	1
STP	ST PAUL DOWNTOWN HOLMAN FLD	MN	0	1	0	1
RRT	WARROAD INTL MEMORIAL	MN	0	1	0	1
BDH	WILLMAR MUNICIPAL- JOHN L RICE FIELD	MN	0	1	0	1
M17	BOLIVAR MUNICIPAL	MO	0	1	0	1
CGI	CAPE GIRARDEAU RGNL	MO	0	1	0	1
M05	CARUTHERSVILLE MEMORIAL	MO	0	1	0	1
MKC	CHARLES B. WHEELER DOWNTOWN	MO	0	1	0	1
COU	COLUMBIA RGNL	MO	0	1	0	1
1H0	CREVE COEUR	MO	0	1	0	1
DXE	DEXTER MUNICIPAL	MO	0	1	0	1
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	0	1	0	1
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	0	1
IRK	KIRKSVILLE RGNL	MO	0	1	0	1
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	0	1
MHL	MARSHALL MEMORIAL MUNICIPAL	MO	0	1	0	1
MYJ	MEXICO MEMORIAL	MO	0	1	0	1
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	0	1
STJ	ROSECRANS MEMORIAL	MO	0	1	0	1
DMO	SEDALIA MEMORIAL	MO	0	1	0	1
SIK	SIKESTON MEMORIAL MUNICIPAL	MO	0	1	0	1
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	0	1
STF	GEORGE M BRYAN	MS	0	1	0	1
GTR	GOLDEN TRIANGLE RGNL	MS	0	1	0	1

GWO	GREENWOOD-LEFLORE	MS	0	1	0	1
GNF	GRENADA MUNICIPAL	MS	0	1	0	1
GPT	GULFPORT-BILOXI INTL	MS	0	1	0	1
HEZ	HARDY-ANDERS FIELD NATCHEZ-ADA	MS	0	1	0	1
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	0	1	0	1
PIB	HATTIESBURG-LAUREL RGNL	MS	0	1	0	1
LUL	HESLER-NOBLE FIELD	MS	0	1	0	1
JAN	JACKSON-EVERS INTL	MS	0	1	0	1
M16	JOHN BELL WILLIAMS	MS	0	1	0	1
MEI	KEY FIELD	MS	0	1	0	1
MCB	MC COMB/PIKE COUNTY	MS	0	1	0	1
M40	MONROE COUNTY	MS	0	1	0	1
OLV	OLIVE BRANCH	MS	0	1	0	1
MJD	PICAYUNE MUNICIPAL	MS	0	1	0	1
M43	PRENTISS-JEFFERSON DAVIS COUNTY	MS	0	1	0	1
CRX	ROSCOE TURNER	MS	0	1	0	1
HSA	STENNIS INTL	MS	0	1	0	1
PQL	TRENT LOTT INTL	MS	0	1	0	1
UTA	TUNICA MUNICIPAL	MS	0	1	0	1
UOX	UNIVERSITY-OXFORD	MS	0	1	0	1
BTM	BERT MOONEY	MT	0	1	0	1
BIL	BILLINGS LOGAN INTL	MT	0	1	0	1
MLS	FRANK WILEY FIELD	MT	0	1	0	1
GPI	GLACIER PARK INTL	MT	0	1	0	1
GTF	GREAT FALLS INTL	MT	0	1	0	1
HLN	HELENA RGNL	MT	0	1	0	1
LWT	LEWISTOWN MUNICIPAL	MT	0	1	1	0.999985
OAJ	ALBERT J ELLIS	NC	0	1	1	0.999731
AFP	ANSON COUNTY	NC	0	1	1	0.999820
HBI	ASHEBORO RGNL	NC	0	1	1	0.999821
AVL	ASHEVILLE RGNL	NC	0	1	1	0.999932
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1	1	0.999859
JQF	CONCORD RGNL	NC	0	1	1	0.999858
EWN	CRAVEN COUNTY RGNL	NC	0	1	1	0.999721
ECG	ELIZABETH CITY CG AIR STATION	NC	0	1	1	0.999710
FAY	FAYETTEVILLE RGNL/GRANNIS FIELD	NC	0	1	1	0.999773
LHZ	FRANKLIN COUNTY	NC	0	1	1	0.999774
AKH	GASTONIA MUNICIPAL	NC	0	1	1	0.999870
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	0	1	1	0.999752
HRJ	HARNETT RGNL JETPORT	NC	0	1	1	0.999776
HNZ	HENDERSON-OXFORD	NC	0	1	1	0.999786
ISO	KINSTON RGNL JETPORT	NC	0	1	1	0.999732
EQY	MONROE RGNL	NC	0	1	1	0.999851
EDE	NORTHEASTERN RGNL	NC	0	1	1	0.999720
GSO	PIEDMONT TRIAD INTL	NC	0	1	1	0.999829
PGV	PITT-GREENVILLE	NC	0	1	1	0.999732
RDU	RALEIGH-DURHAM INTL	NC	0	1	1	0.999784
RWI	ROCKY MOUNT-WILSON RGNL	NC	0	1	1	0.999756
RUQ	ROWAN COUNTY	NC	0	1	1	0.999850
TTA	SANFORD-LEE COUNTY RGNL	NC	0	1	1	0.999799
SVH	STATESVILLE RGNL	NC	0	1	1	0.999867
ILM	WILMINGTON INTL	NC	0	1	1	0.999736

BIS	BISMARCK MUNICIPAL	ND	0	1	0	1
5N8	CASSELTON ROBERT MILLER RGNL	ND	0	1	0	1
DVL	DEVILS LAKE RGNL	ND	0	1	0	1
DIK	DICKINSON - THEODORE ROOSEVELT	ND	0	1	0	1
GFK	GRAND FORKS INTL	ND	0	1	0	1
FAR	HECTOR INTL	ND	0	1	0	1
JMS	JAMESTOWN RGNL	ND	0	1	0	1
MOT	MINOT INTL	ND	0	1	0	1
ANW	AINSWORTH MUNICIPAL	NE	0	1	0	1
BVN	ALBION MUNICIPAL	NE	0	1	0	1
AIA	ALLIANCE MUNICIPAL	NE	0	1	0	1
AUH	AURORA MUNICIPAL – AL POTTER FIELD	NE	0	1	0	1
BIE	BEATRICE MUNICIPAL	NE	0	1	0	1
FNB	BRENNER FIELD	NE	0	1	0	1
HDE	BREWSTER FIELD	NE	0	1	0	1
BBW	BROKEN BOW MUNICIPAL	NE	0	1	0	1
GRI	CENTRAL NEBRASKA RGNL	NE	0	1	0	1
CDR	CHADRON MUNICIPAL	NE	0	1	0	1
OLU	COLUMBUS MUNICIPAL	NE	0	1	0	1
CZD	COZAD MUNICIPAL	NE	0	1	0	1
CEK	CRETE MUNICIPAL	NE	0	1	0	1
OMA	EPPLEY AIRFIELD	NE	0	1	0	1
FBY	FAIRBURY MUNICIPAL	NE	0	1	0	1
FET	FREMONT MUNICIPAL	NE	0	1	0	1
OKS	GARDEN COUNTY	NE	0	1	0	1
GRN	GORDON MUNICIPAL	NE	0	1	0	1
GGF	GRANT MUNICIPAL	NE	0	1	0	1
HSI	HASTINGS MUNICIPAL	NE	0	1	0	1
IML	IMPERIAL MUNICIPAL	NE	0	1	0	1
LXN	JIM KELLY FIELD	NE	0	1	0	1
OFK	KARL STEFAN MEMORIAL	NE	0	1	0	1
EAR	KEARNEY RGNL	NE	0	1	0	1
IBM	KIMBALL MUNICIPAL ROBERT E ARRAJ FIELD	NE	0	1	0	1
LNK	LINCOLN	NE	0	1	0	1
MCK	MC COOK RGNL	NE	0	1	0	1
MLE	MILLARD	NE	0	1	0	1
VTN	MILLER FIELD	NE	0	1	0	1
AFK	NEBRASKA CITY MUNICIPAL	NE	0	1	0	1
LBF	NORTH PLATTE RGNL AIRPORT LEE	NE	0	1	0	1
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1	0	1
SCB	SCRIBNER STATE	NE	0	1	0	1
OGA	SEARLE FIELD	NE	0	1	0	1
SWT	SEWARD MUNICIPAL	NE	0	1	0	1
SNY	SIDNEY MUNICIPAL/ LLOYD W. CARR FIELD	NE	0	1	0	1
ONL	THE O'NEILL MUNICIPAL- JOHN L BAKER	NE	0	1	0	1
AHQ	WAHOO MUNICIPAL	NE	0	1	0	1
LCG	WAYNE MUNICIPAL	NE	0	1	0	1
BFF	WESTERN NEB. RGNL	NE	0	1	0	1
JYR	YORK MUNICIPAL	NE	0	1	0	1
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	1	0.999943
WWD	CAPE MAY COUNTY	NJ	0	1	1	0.999898
MIV	MILLVILLE MUNICIPAL	NJ	0	1	1	0.999922
EWR	NEWARK LIBERTY INTL	NJ	0	1	0	1
TEB	TETERBORO	NJ	0	1	0	1
ABQ	ALBUQUERQUE INTL SUNPORT	NM	0	1	0	1
CVN	CLOVIS MUNICIPAL	NM	0	1	0	1
AEG	DOUBLE EAGLE II	NM	0	1	0	1
FMN	FOUR CORNERS RGNL	NM	0	1	0	1
SVC	GRANT COUNTY	NM	0	1	23	0.999106
LRU	LAS CRUCES INTL	NM	0	1	15	0.999557
ROW	ROSWELL INTL AIR CENTER	NM	0	1	0	1
LAS	MC CARRAN INTL	NV	0	1	0	1
4SD	RENO/STEAD	NV	0	1	79	0.996611
RNO	RENO/TAHOE INTL	NV	0	1	72	0.997047
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	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
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	1	0.999931
LUK	CINCINNATI MUNICIPAL AIRPORT LUNKEN	OH	0	1	0	1
CLE	CLEVELAND-HOPKINS INTL	OH	0	1	1	0.999924
MGY	DAYTON-WRIGHT BROTHERS	OH	0	1	0	1
DLZ	DELAWARE MUNICIPAL	OH	0	1	1	0.999965
LHQ	FAIRFIELD COUNTY	OH	0	1	1	0.999952
FDY	FINDLAY	OH	0	1	1	0.999982
PMH	GREATER PORTSMOUTH RGNL	OH	0	1	1	0.999951

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	1	0.999911
I68	LEBANON-WARREN COUNTY	OH	0	1	0	1
UYF	MADISON COUNTY	OH	0	1	1	0.999974
MNN	MARION MUNICIPAL	OH	0	1	1	0.999963
AXV	NEIL ARMSTRONG	OH	0	1	0	1
OSU	OHIO STATE UNIVERSITY	OH	0	1	1	0.999962
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	0	1	1	0.999933
CMH	PORT COLUMBUS INTL	OH	0	1	1	0.999958
RZT	ROSS COUNTY	OH	0	1	1	0.999954
TOL	TOLEDO EXPRESS	OH	0	1	0	1
1G0	WOOD COUNTY	OH	0	1	1	0.999982
YNG	YOUNGSTOWN-WARREN RGNL	OH	0	1	1	0.999887
AVK	ALVA RGNL	OK	0	1	0	1
BVO	BARTLESVILLE MUNICIPAL	OK	0	1	0	1
CQB	CHANDLER RGNL	OK	0	1	0	1
CHK	CHICKASHA MUNICIPAL	OK	0	1	0	1
GCM	CLAREMORE RGNL	OK	0	1	0	1
F29	CLARENCE E PAGE MUNICIPAL	OK	0	1	0	1
1K4	DAVID JAY PERRY	OK	0	1	0	1
MKO	DAVIS FIELD	OK	0	1	0	1
DUA	EAKER FIELD	OK	0	1	0	1
ELK	ELK CITY RGNL BUSINESS	OK	0	1	0	1
GMJ	GROVE MUNICIPAL	OK	0	1	0	1
GOK	GUTHRIE-EDMOND RGNL	OK	0	1	0	1
2O8	HINTON MUNICIPAL	OK	0	1	0	1
HBR	HOBART RGNL	OK	0	1	0	1
MLC	MC ALESTER RGNL	OK	0	1	0	1
MIO	MIAMI MUNICIPAL	OK	0	1	0	1
MDF	MOORELAND MUNICIPAL	OK	0	1	0	1
OKM	OKMULGEE RGNL	OK	0	1	0	1
PVJ	PAULS VALLEY MUNICIPAL	OK	0	1	0	1
PNC	PONCA CITY RGNL	OK	0	1	0	1
RVS	RICHARD LLOYD JONES JR	OK	0	1	0	1
2K4	SCOTT FIELD	OK	0	1	0	1
SNL	SHAWNEE RGNL	OK	0	1	0	1
SWO	STILLWATER RGNL	OK	0	1	0	1
TQH	TAHLEQUAH MUNICIPAL	OK	0	1	0	1
TUL	TULSA INTL	OK	0	1	0	1
OUN	UNIVERSITY OF OKLAHOMA	OK	0	1	0	1
OKC	WILL ROGERS WORLD	OK	0	1	0	1
UAO	AURORA STATE	OR	0	1	87	0.994871
BDN	BEND MUNICIPAL	OR	0	1	67	0.997206
LMT	KLAMATH FALLS	OR	0	1	88	0.994857
LGD	LA GRANDE/UNION COUNTY	OR	0	1	0	1
EUG	MAHLON SWEET FIELD	OR	0	1	92	0.992229
MMV	MC MINNVILLE MUNICIPAL	OR	0	1	92	0.993972
SLE	MCNARY FLD	OR	0	1	92	0.993990
ONP	NEWPORT MUNICIPAL	OR	0	1	93	0.990498
ONO	ONTARIO MUNICIPAL	OR	0	1	0	1
PDX	PORTLAND INTL	OR	0	1	84	0.995487
AGC	ALLEGHENY COUNTY	PA	0	1	1	0.999860

AOO	ALTOONA-BLAIR COUNTY	PA	0	1	1	0.999821
LBE	ARNOLD PALMER RGNL	PA	0	1	1	0.999848
BFD	BRADFORD RGNL	PA	0	1	0	1
BTP	BUTLER COUNTY/ K W SCHOLTER FIELD	PA	0	1	1	0.999865
MQS	CHESTER COUNTY G O CARLSON	PA	0	1	1	0.999947
AXQ	CLARION COUNTY	PA	0	1	1	0.999858
9D4	DECK	PA	0	1	1	0.999964
DUJ	DUBOIS RGNL	PA	0	1	1	0.999905
WAY	GREENE COUNTY	PA	0	1	1	0.999871
HZL	HAZLETON MUNICIPAL	PA	0	1	0	1
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	0	1	1	0.999838
LNS	LANCASTER	PA	0	1	1	0.999945
ABE	LEHIGH VALLEY INTL	PA	0	1	0	1
RVL	MIFFLIN COUNTY	PA	0	1	1	0.999941
UCP	NEW CASTLE MUNICIPAL	PA	0	1	1	0.999876
PNE	NORTHEAST PHILADELPHIA	PA	0	1	1	0.999978
PHL	PHILADELPHIA INTL	PA	0	1	1	0.999957
PIT	PITTSBURGH INTL	PA	0	1	1	0.999880
FWQ	ROSTRAVER	PA	0	1	1	0.999857
2G9	SOMERSET COUNTY	PA	0	1	1	0.999837
OYM	ST MARYS MUNICIPAL	PA	0	1	1	0.999979
UNV	UNIVERSITY PARK	PA	0	1	1	0.999948
FKL	VENANGO RGNL	PA	0	1	1	0.999867
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	1	0.999872
AND	ANDERSON RGNL	SC	0	1	1	0.999933
CHS	CHARLESTON AFB/INTL	SC	0	1	1	0.999809
JZI	CHARLESTON EXECUTIVE	SC	0	1	1	0.999814
CAE	COLUMBIA METROPOLITAN	SC	0	1	1	0.999847
UDG	DARLINGTON COUNTY JETPORT	SC	0	1	1	0.999804
GYH	DONALDSON CENTER	SC	0	1	1	0.999918
GGE	GEORGETOWN COUNTY	SC	0	1	1	0.999785
GSP	GREENVILLE SPARTANBURG INTL	SC	0	1	1	0.999908
MYR	MYRTLE BEACH INTL	SC	0	1	1	0.999771
CEU	OCONEE COUNTY RGNL	SC	0	1	1	0.999933
CDN	WOODWARD FIELD	SC	0	1	1	0.999833
ABR	ABERDEEN RGNL	SD	0	1	0	1
BKX	BROOKINGS RGNL	SD	0	1	0	1
YKN	CHAN GURNEY MUNICIPAL	SD	0	1	0	1
HON	HURON RGNL	SD	0	1	0	1
FSD	JOE FOSS FIELD	SD	0	1	0	1
MHE	MITCHELL MUNICIPAL	SD	0	1	0	1
PIR	PIERRE RGNL	SD	0	1	0	1
RAP	RAPID CITY RGNL	SD	0	1	0	1
ATY	WATERTOWN RGNL	SD	0	1	0	1
PVE	BEECH RIVER RGNL	TN	0	1	0	1
SYI	BOMAR FIELD- SHELBYVILLE MUNICIPAL	TN	0	1	0	1
UCY	EVERETT-STEWART RGNL	TN	0	1	0	1
CHA	LOVELL FIELD	TN	0	1	0	1
TYS	MC GHEE TYSON	TN	0	1	0	1

MEM	MEMPHIS INTL	TN	0	1	0	1
NQA	MILLINGTON RGNL JETPORT	TN	0	1	0	1
BNA	NASHVILLE INTL	TN	0	1	0	1
SZY	ROBERT SIBLEY	TN	0	1	0	1
TRI	TRI-CITIES RGNL TN/VA	TN	0	1	1	0.999933
BGF	WINCHESTER MUNICIPAL	TN	0	1	0	1
ABI	ABILENE RGNL	TX	0	1	0	1
ADS	ADDISON	TX	0	1	0	1
ALI	ALICE INTL	TX	0	1	0	1
LFK	ANGELINA COUNTY	TX	0	1	0	1
GKY	ARLINGTON MUNICIPAL	TX	0	1	0	1
AUS	AUSTIN-BERGSTROM INTL	TX	0	1	0	1
LBX	BRAZORIA COUNTY	TX	0	1	0	1
BWD	BROWNWOOD RGNL	TX	0	1	0	1
E30	BRUCE FIELD	TX	0	1	0	1
TKI	COLLIN COUNTY RGNL AT MC KINNEY	TX	0	1	0	1
CRP	CORPUS CHRISTI INTL	TX	0	1	0	1
CFD	COULTER FIELD	TX	0	1	0	1
PRX	COX FIELD	TX	0	1	0	1
BBD	CURTIS FIELD	TX	0	1	0	1
RBD	DALLAS EXECUTIVE	TX	0	1	0	1
DAL	DALLAS LOVE FIELD	TX	0	1	0	1
DFW	DALLAS/FORT WORTH INTL	TX	0	1	0	1
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	0	1	0	1
LUD	DECATUR MUNICIPAL	TX	0	1	0	1
DRT	DEL RIO INTL	TX	0	1	0	1
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	0	1	0	1
GGG	EAST TEXAS RGNL	TX	0	1	0	1
CLL	EASTERWOOD FIELD	TX	0	1	0	1
ELP	EL PASO INTL	TX	0	1	15	0.999613
AFW	FORT WORTH ALLIANCE	TX	0	1	0	1
FWS	FORT WORTH SPINKS	TX	0	1	0	1
IAH	GEORGE BUSH INTERCONTINENTAL	TX	0	1	0	1
PVW	HALE COUNTY	TX	0	1	0	1
INJ	HILLSBORO MUNICIPAL	TX	0	1	0	1
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	0	1
LRD	LAREDO INTL	TX	0	1	0	1
CXO	LONE STAR EXECUTIVE	TX	0	1	0	1
LBB	LUBBOCK PRESTON SMITH INTL	TX	0	1	0	1
GVT	MAJORS	TX	0	1	0	1
5T9	MAVERICK COUNTY MEMORIAL INTL	TX	0	1	0	1
MFE	MC ALLEN MILLER INTL	TX	0	1	0	1
HQZ	MESQUITE METRO	TX	0	1	0	1
MAF	MIDLAND INTL	TX	0	1	0	1
OSA	MOUNT PLEASANT RGNL	TX	0	1	0	1
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	0	1
AMA	RICK HUSBAND AMARILLO INTL	TX	0	1	0	1
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	0	1
EBG	SOUTH TEXAS INTL AT EDINBURG	TX	0	1	0	1
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	0	1
TYR	TYLER POUNDS RGNL	TX	0	1	0	1
HRL	VALLEY INTL	TX	0	1	0	1
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	0	1
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	1	0.999717
MTV	BLUE RIDGE	VA	0	1	1	0.999838
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1	1	0.999804
FCI	CHESTERFIELD COUNTY	VA	0	1	1	0.999762
CJR	CULPEPER RGNL	VA	0	1	1	0.999792
PTB	DINWIDDIE COUNTY	VA	0	1	1	0.999759
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1	1	0.999761
JYO	LEESBURG EXECUTIVE	VA	0	1	1	0.999781
LNP	LONESOME PINE	VA	0	1	1	0.999941
LYH	LYNCHBURG RGNL/ PRESTON GLENN F	VA	0	1	1	0.999824
HEF	MANASSAS RGNL/HARRY P. DAVIS F	VA	0	1	1	0.999776
MKJ	MOUNTAIN EMPIRE	VA	0	1	1	0.999894
PSK	NEW RIVER VALLEY	VA	0	1	1	0.999872
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	0	1	1	0.999733
ORF	NORFOLK INTL	VA	0	1	1	0.999726
RIC	RICHMOND INTL	VA	0	1	1	0.999757
RMN	STAFFORD RGNL	VA	0	1	1	0.999771
XSA	TAPPAHANNOCK-ESSEX COUNTY	VA	0	1	1	0.999752
BCB	VIRGINIA TECH/ MONTGOMERY EXECUTIVE	VA	0	1	1	0.999868
IAD	WASHINGTON DULLES INTL	VA	0	1	1	0.999778
BTV	BURLINGTON INTL	VT	0	1	0	1
FSO	FRANKLIN COUNTY STATE	VT	0	1	0	1
BLI	BELLINGHAM INTL	WA	0	1	19	0.999372
HQM	BOWERMAN	WA	0	1	91	0.994336
PWT	BREMERTON NATIONAL	WA	0	1	73	0.997294
DEW	DEER PARK	WA	0	1	0	1
FHR	FRIDAY HARBOR	WA	0	1	28	0.998998
MWH	GRANT CO INTL	WA	0	1	2	0.999956
OLM	OLYMPIA	WA	0	1	86	0.996196
PUW	PULLMAN/MOSCOW RGNL	WA	0	1	0	1
RLD	RICHLAND	WA	0	1	4	0.999881
SEA	SEATTLE-TACOMA INTL	WA	0	1	56	0.998093

BVS	SKAGIT RGNL	WA	0	1	19	0.999349
PAE	SNOHOMISH COUNTY (PAINE FLD)	WA	0	1	7	0.995597
GEG	SPOKANE INTL	WA	0	1	0	1
TIW	TACOMA NARROWS	WA	0	1	71	0.997256
PSC	TRI-CITIES	WA	0	1	3	0.999915
ALW	WALLA WALLA RGNL	WA	0	1	0	1
CLM	WILLIAM R FAIRCHILD INTL	WA	0	1	67	0.997348
GRB	AUSTIN STRAUBEL INTL	WI	0	1	0	1
DLL	BARABOO WISCONSIN DELLS	WI	0	1	0	1
OVS	BOSCOBEL	WI	0	1	0	1
CWA	CENTRAL WISCONSIN	WI	0	1	0	1
EAU	CHIPPEWA VALLEY RGNL	WI	0	1	0	1
MSN	DANE COUNTY RGNL-TRUAX FIELD	WI	0	1	0	1
UNU	DODGE COUNTY	WI	0	1	0	1
SUE	DOOR COUNTY CHERRYLAND	WI	0	1	0	1
EGV	EAGLE RIVER UNION	WI	0	1	0	1
FLD	FOND DU LAC COUNTY	WI	0	1	0	1
MKE	GENERAL MITCHELL INTL	WI	0	1	0	1
ASX	JOHN F KENNEDY MEMORIAL	WI	0	1	0	1
LSE	LA CROSSE MUNICIPAL	WI	0	1	0	1
MTW	MANITOWOC COUNTY	WI	0	1	0	1
MFI	MARSHFIELD MUNICIPAL	WI	0	1	0	1
LUM	MENOMONIE MUNICIPAL-SCORE FIELD	WI	0	1	0	1
RRL	MERRILL MUNICIPAL	WI	0	1	0	1
C29	MIDDLETON MUNICIPAL – MOREY FIELD	WI	0	1	0	1
ATW	OUTAGAMIE COUNTY RGNL	WI	0	1	0	1
PBH	PRICE COUNTY	WI	0	1	0	1
RHI	RHINELANDER-ONEIDA COUNTY	WI	0	1	0	1
RPD	RICE LAKE RGNL - CARL'S FIELD	WI	0	1	0	1
HYR	SAWYER COUNTY	WI	0	1	0	1
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	0	1	0	1
JVL	SOUTHERN WISCONSIN RGNL	WI	0	1	0	1
TKV	TOMAHAWK RGNL	WI	0	1	0	1
LNR	TRI-COUNTY RGNL	WI	0	1	0	1
OSH	WITTMAN RGNL	WI	0	1	0	1
MRB	EASTERN WV RGNL/SHEPHERD FLD	WV	0	1	1	0.999805
PKB	MID-OHIO VALLEY RGNL	WV	0	1	1	0.999912
HTS	TRI-STATE/MILTON J. FERGUSON F	WV	0	1	1	0.999940
CYS	CHEYENNE RGNL/ JERRY OLSON FIELD	WY	0	1	0	1
EVW	EVANSTON-UINTA COUNTY BURNS FIELD	WY	0	1	0	1
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1	0	1
JAC	JACKSON HOLE	WY	0	1	0	1
LAR	LARAMIE RGNL	WY	0	1	0	1
CPR	NATRONA COUNTY INTL	WY	0	1	0	1
RIW	RIVERTON RGNL	WY	0	1	0	1
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1	0	1
SHR	SHERIDAN COUNTY	WY	0	1	0	1
COD	YELLOWSTONE RGNL	WY	0	1	0	1

Figure 9-1 WAAS LPV Availability

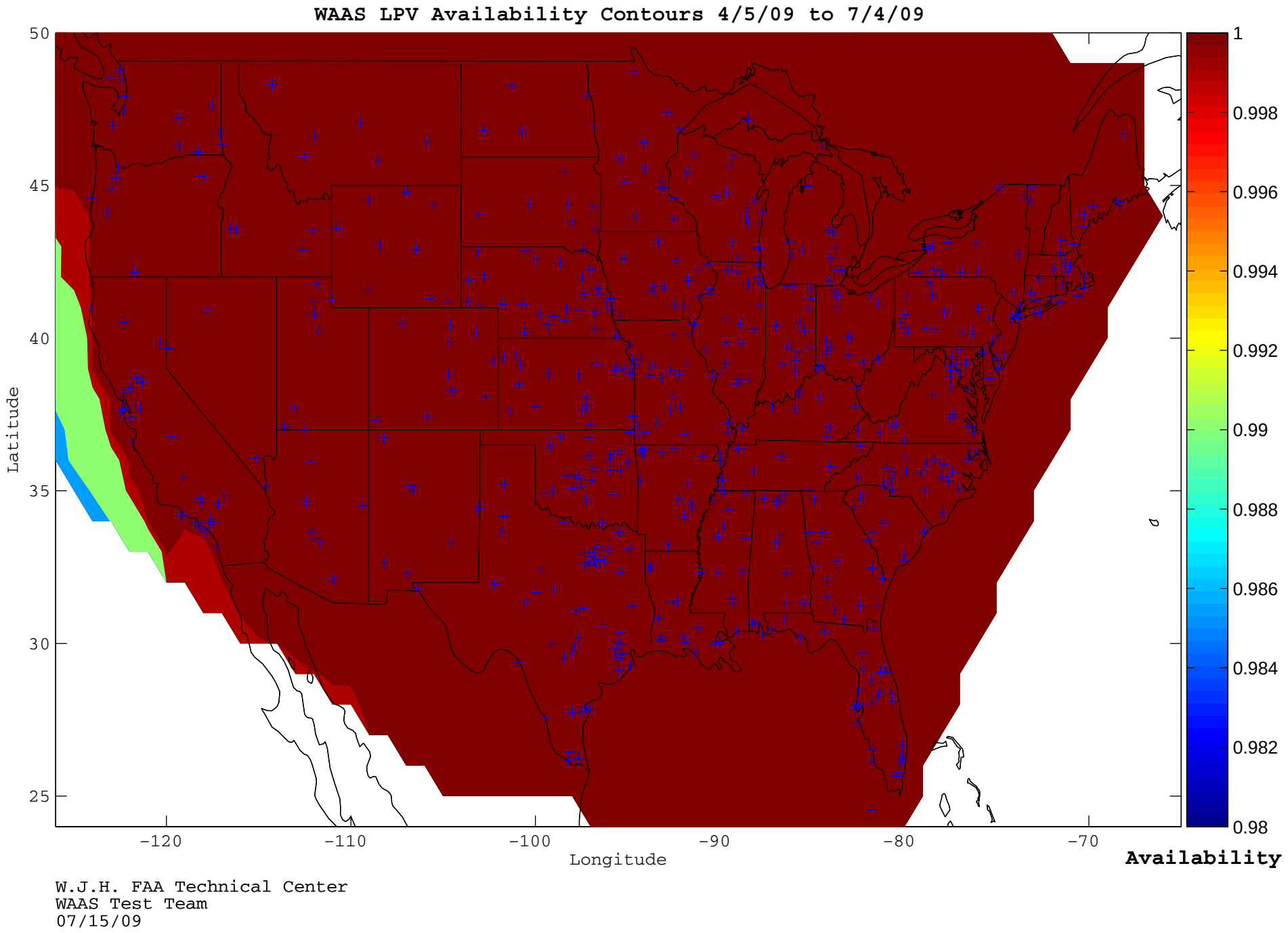
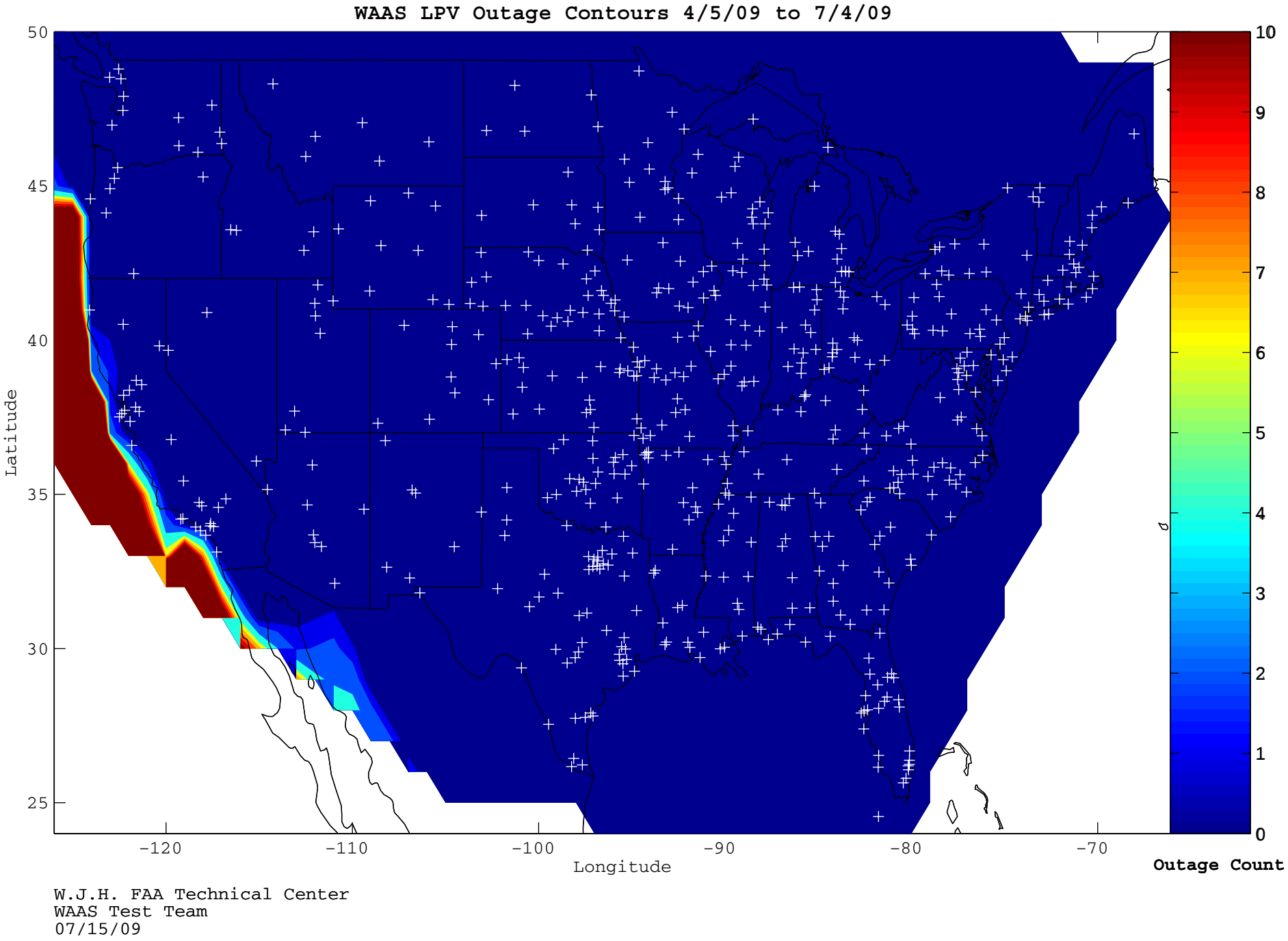


Figure 9-2 WAAS LPV Outage



10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

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

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

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

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Jul 08	Aug 08	Sep 08	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09
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	Jul 08	Aug 08	Sep 08	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09
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%
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● **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 position surveys were preformed for the WAAS antennas using a 25 hour set of data from 23:00 on 6/21/09 to 23:59:59 on 6/22/09 for all of the 114 WAAS receivers. 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 2.3 cm. The RSS of the ECEF sigma's were all less than 15 mm for the CSRS surveys. The OPUS and CSRS surveys agreed to 4 cm or better for all receivers except ZKC-C which agreed to 5 cm.

The positions were then compared to the positions in the current WAAS software Release 8/9.2b and the WAAS Follow On (WFO) release 1 of software that will be fielded this fall. The Release 8/9 positions have been interpolated forward to 6/30/09 to account for tectonic plate movement in order to minimize how often the software needs to be updated. The WFO Release 1 antenna positions have been interpolated forward to 8/1/10. The Cold Bay Alaska WAAS site will be relocated across the airport this summer. The WFO RLS1 software contains the survey locations for the new Cold Bay positions, so comparison to the current positions reported by OPUS are non applicable.

The OPUS surveys agree with the RLS 8/9.2b positions to better than or equal to 4 cm with the exceptions of Seattle (all three) and Albuquerque C which are in the 5 cm range.

The OPUS surveys agree with the WFO RLS1 positions to better than or equal to 6 cm with the expected exceptions of Mexico City (30 cm), San Jose De Cabo (7.5 cm), and Honolulu (10 cm). These are the highest movement sites. Honolulu will be under the 10 cm target threshold before WFO RLS1 is fielded. Mexico City will be under the 25 cm take action threshold before WFO RLS1 is fielded.

Table 11.1 lists the WAAS antenna L1 phase center positions as of 6/22/09. The positions are in IRTF-2000 and are the OPUS estimated positions.

Figure 11.1 to 11.6 show the RSS of the ECEF difference between the 6/22/09 OPUS survey antenna phase center locations and the locations in the current RLS-8/9.2b software and in the future WFO release 1 software which will be fielded this fall. 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 11.7 to 11.9 shows the OPUS overall RMS quality indications.

Figure 11.10 to 11.12 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. The OPUS surveys agree with the CSRS surveys to less than 4 cm for all sites but Kansas City C which is 5 cm. Figures 11.13 to 11.15 show the RSS of ECEF sigma's report by CSRS.

Table 11-1 WAAS Survey Positions (OPUS ITRF-2000) as of 6/22/09

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
BET1	-2965384.981	-972576.626	5543892.963	60.78791622777780	-161.84172453055600	52.210
BET2	-2965385.754	-972580.352	5543891.911	60.78789677222220	-161.84166395277800	52.217
BET3	-2965388.319	-972577.480	5543891.037	60.78788086388890	-161.84172873055600	52.207
BIL1	-1416445.826	-4223577.037	4550862.179	45.80370700555560	-108.53972232777800	1112.264
BIL2	-1416449.900	-4223574.898	4550862.908	45.80371630000000	-108.53978075555600	1112.276
BIL3	-1416441.522	-4223574.296	4550866.024	45.80375670277780	-108.53968105277800	1112.255
BRW1	-1886758.832	-809058.661	6018494.516	71.28276575277780	-156.78992382222200	15.582
BRW2	-1886756.249	-809055.925	6018495.703	71.28279847222220	-156.78996559166700	15.599
BRW3	-1886755.161	-809059.707	6018495.525	71.28279379444440	-156.78985661388900	15.587
CDB1	-3483634.759	-1083799.455	5214187.691	55.20033452222220	-162.71847201944400	53.644
CDB2	-3483629.891	-1083796.786	5214191.482	55.20039408888890	-162.71848933333300	53.652
CDB3	-3483631.900	-1083788.438	5214191.880	55.20040027222220	-162.71862388888900	53.658
FAI1	-2304741.725	-1448715.273	5748843.719	64.80963075555560	-147.84734001666700	149.934
FAI2	-2304741.257	-1448706.464	5748846.120	64.80968118611110	-147.84749174444400	149.942
FAI3	-2304732.710	-1448707.392	5748849.257	64.80974788333330	-147.84737947500000	149.911
HNL1	-5508637.062	-2234493.525	2303722.082	21.31298919444440	-157.92082545555600	24.672
HNL2	-5508656.235	-2234483.842	2303686.836	21.31264626111110	-157.92098140000000	25.022
HNL3	-5508647.651	-2234497.788	2303693.930	21.31271485277780	-157.92082574166700	25.074
JNU1	-2354254.811	-2388549.649	5407043.073	58.36257486388890	-134.58570604166700	16.035
JNU2	-2354252.725	-2388565.757	5407036.909	58.36246933888890	-134.58548748611100	16.037
JNU3	-2354239.508	-2388568.609	5407041.369	58.36254573333330	-134.58529246666700	16.033
MMD1	35070.455	-5959686.696	2264365.759	20.93190910277780	-89.66284035277780	29.144
MMD2	35065.533	-5959687.064	2264364.976	20.93190140277780	-89.66288769166670	29.181
MMD3	35065.196	-5959685.279	2264369.633	20.93194645555560	-89.66289083055560	29.175
MMX1	-948701.196	-5943936.340	2109212.941	19.43165331111110	-99.06838946388890	2236.371
MMX2	-948696.770	-5943936.166	2109215.367	19.43167658333330	-99.06834811944440	2236.359
MMX3	-948705.625	-5943936.531	2109210.512	19.43162996111110	-99.06843080833330	2236.400
MPR1	-1570142.200	-5759530.646	2238184.763	20.67900327222220	-105.24920291388900	11.013
MPR2	-1570139.378	-5759530.158	2238188.813	20.67904136666670	-105.24917801388900	11.309
MPR3	-1570143.489	-5759528.035	2238190.581	20.67905939166670	-105.24922144166700	11.028
MSD1	-1979519.602	-5523223.153	2493106.728	23.16044619166670	-109.71764663611100	104.310
MSD2	-1979521.170	-5523225.488	2493100.330	23.16038339166670	-109.71765335833300	104.301
MSD3	-1979525.617	-5523222.213	2493104.005	23.16041951944440	-109.71770502777800	104.291
MTP1	-254854.346	-6162909.190	1617805.090	14.79136615555560	-92.36799910555560	54.971
MTP2	-254850.729	-6162910.230	1617801.657	14.79133410555560	-92.36796513611110	54.955
MTP3	-254855.490	-6162910.331	1617800.132	14.79132009166670	-92.36800928333330	54.853
OTZ1	-2396055.947	-750356.171	5843502.572	66.88733291944440	-162.61137220000000	10.911
OTZ2	-2396052.770	-750354.345	5843504.093	66.88736777777780	-162.61139030000000	10.906
OTZ3	-2396052.758	-750358.283	5843503.608	66.88735645833330	-162.61130446111100	10.917
YFB1	1035381.530	-2634289.653	5696539.490	63.73148998611110	-68.54318196111110	10.001
YFB2	1035372.314	-2634296.053	5696538.138	63.73146382222220	-68.54340297777780	9.933
YFB3	1035366.240	-2634306.816	5696534.358	63.73138610833330	-68.54359710555550	9.993

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
YQX1	2430424.681	-3419640.392	4788223.784	48.96648953888890	-54.59763163611110	146.860
YQX2	2430432.646	-3419639.044	4788220.725	48.96644763611110	-54.59753230555560	146.860
YQX3	2430440.552	-3419637.678	4788217.723	48.96640640277780	-54.59743349166670	146.872
YWG1	-520164.301	-4083475.891	4855842.979	49.90057438888890	-97.25939667222220	222.016
YWG2	-520150.431	-4083468.831	4855850.364	49.90067736666670	-97.25921758333330	222.026
YWG3	-520152.291	-4083477.950	4855842.540	49.90056823611110	-97.25922722777780	222.019
YYR1	1885341.473	-3321428.359	5091171.591	53.30864659166670	-60.41946765277780	37.808
YYR2	1885344.437	-3321419.878	5091176.006	53.30871289444440	-60.41936617500000	37.816
YYR3	1885340.151	-3321413.057	5091182.013	53.30880312777780	-60.41937157777780	37.824
ZAB1	-1488636.788	-5003946.554	3654557.707	35.17357539444440	-106.56734915555600	1620.123
ZAB2	-1488631.456	-5003948.238	3654557.686	35.17357475277780	-106.56728779722200	1620.188
ZAB3	-1488632.233	-5003950.822	3654553.830	35.17353234444440	-106.56728788333300	1620.172
ZAN1	-2659536.545	-1549114.826	5567750.765	61.22920230000000	-149.78024905277800	80.673
ZAN2	-2659548.299	-1549110.872	5567746.276	61.22911867222220	-149.78042278611100	80.669
ZAN3	-2659541.251	-1549106.746	5567750.755	61.22920225833330	-149.78042311944400	80.664
ZAU1	138704.169	-4761244.162	4227763.945	41.78265801111110	-88.33133605555560	195.913
ZAU2	138704.426	-4761248.774	4227758.774	41.78259559444440	-88.33133458055550	195.911
ZAU3	138711.132	-4761248.514	4227758.860	41.78259656111110	-88.33125386111110	195.920
ZBW1	1490299.275	-4448983.186	4306010.482	42.73572021111110	-71.48042528611110	39.128
ZBW2	1490304.381	-4448981.165	4306010.816	42.73572421944440	-71.48035832222220	39.139
ZBW3	1490306.097	-4448984.787	4306006.513	42.73567145833330	-71.48035250277780	39.141
ZDC1	1069125.828	-4839599.009	4001126.504	39.10159567500000	-77.54274585277780	80.089
ZDC2	1069128.218	-4839603.646	4001120.295	39.10152362222220	-77.54273043611110	80.087
ZDC3	1069124.112	-4839602.735	4001122.490	39.10154905000000	-77.54277451388890	80.094
ZDV1	-1273628.559	-4711375.601	4094890.123	40.18730328333330	-105.12722367500000	1541.372
ZDV2	-1273622.855	-4711377.115	4094890.136	40.18730353055560	-105.12715439166700	1541.360
ZDV3	-1273624.864	-4711380.306	4094885.854	40.18725313333330	-105.12716738333300	1541.351
ZFW1	-659983.165	-5324060.804	3438276.481	32.83064968888890	-97.06647139444440	155.643
ZFW2	-659988.428	-5324063.343	3438271.479	32.83059630555560	-97.06652384166670	155.592
ZFW3	-659983.458	-5324063.887	3438271.694	32.83059828611110	-97.06647045000000	155.649
ZHU1	-513864.429	-5506451.755	3166720.490	29.96189628055560	-95.33142578888890	10.897
ZHU2	-513867.084	-5506455.157	3166714.332	29.96183178055560	-95.33144990000000	10.970
ZHU3	-513873.357	-5506457.797	3166708.732	29.96177354722220	-95.33151206666670	10.956
ZJX1	772646.484	-5434462.234	3237231.742	30.69885941666670	-81.90818476111110	2.179
ZJX2	772649.816	-5434463.782	3237228.327	30.69882371388890	-81.90815260277780	2.157
ZJX3	772645.752	-5434466.206	3237225.224	30.69879123055560	-81.90819816111110	2.144
ZKC1	-415247.463	-4954556.398	3982161.116	38.88015938611110	-94.79083320555560	305.901
ZKC2	-415231.075	-4954557.726	3982161.178	38.88016007500000	-94.79064373333330	305.905
ZKC3	-415237.205	-4954561.079	3982155.962	38.88010171666670	-94.79071090277780	305.631
ZLA1	-2474409.861	-4637294.726	3602183.493	34.60351783333330	-118.08389426111100	763.515
ZLA2	-2474404.584	-4637297.530	3602183.502	34.60351795277780	-118.08382911944400	763.512
ZLA3	-2474411.189	-4637297.208	3602179.520	34.60347395000000	-118.08389429444400	763.576

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
ZLC1	-1808273.151	-4486410.828	4145303.026	40.78604344722220	-111.95217683888900	1287.423
ZLC2	-1808274.541	-4486414.437	4145298.532	40.78599007222220	-111.95217612777800	1287.415
ZLC3	-1808270.336	-4486416.144	4145298.526	40.78598996388890	-111.95212237222200	1287.420
ZMA1	966042.340	-5662999.857	2761581.487	25.82461193888890	-80.31918946111110	-7.557
ZMA2	966029.366	-5662999.137	2761585.963	25.82465967777780	-80.31931580833330	-8.210
ZMA3	966037.444	-5662997.979	2761586.329	25.82466179722220	-80.31923444722220	-7.855
ZME1	4070.948	-5226189.309	3644028.420	35.06739402777780	-89.95536937500000	68.611
ZME2	4070.976	-5226186.769	3644032.530	35.06743750277780	-89.95536904722220	68.894
ZME3	4064.775	-5226186.648	3644032.692	35.06743935000000	-89.95543702777780	68.884
ZMP1	-249978.316	-4539297.532	4458955.058	44.63746312500000	-93.15208463611110	262.679
ZMP2	-249972.514	-4539297.870	4458955.062	44.63746303333330	-93.15201139166670	262.695
ZMP3	-249973.612	-4539302.152	4458950.584	44.63740694722220	-93.15202224166670	262.634
ZNY1	1406144.694	-4627344.000	4144322.046	40.78432831666670	-73.09716507500000	6.467
ZNY2	1406146.494	-4627347.039	4144317.265	40.78427553611110	-73.09715513888890	5.942
ZNY3	1406140.933	-4627348.702	4144317.305	40.78427595833330	-73.09722390277780	5.949
ZOA1	-2684436.795	-4293337.534	3865351.810	37.54305312500000	-122.01594628055600	-3.479
ZOA2	-2684433.778	-4293341.593	3865349.388	37.54302570833330	-122.01589298333300	-3.495
ZOA3	-2684438.148	-4293342.479	3865345.521	37.54298123611110	-122.01592959722200	-3.418
ZOB1	650770.243	-4754715.689	4187420.750	41.29715430277780	-82.20644405833330	223.700
ZOB2	650777.916	-4754714.873	4187422.773	41.29716660833330	-82.20635197500000	225.209
ZOB3	650776.251	-4754719.698	4187414.984	41.29708685277780	-82.20637948055560	223.491
ZSE1	-2308930.218	-3668169.689	4663526.495	47.28699348055560	-122.18837215000000	82.101
ZSE2	-2308934.610	-3668175.242	4663520.084	47.28690784444440	-122.18838218055600	82.165
ZSE3	-2308935.670	-3668179.517	4663516.137	47.28685612222220	-122.18836393611100	82.102
ZSU1	2462589.352	-5529371.560	2003724.589	18.43133831666670	-65.99347535555560	-28.581
ZSU2	2462587.281	-5529377.322	2003711.599	18.43121434722220	-65.99351545277780	-28.494
ZSU3	2462593.916	-5529375.109	2003709.541	18.43119477222220	-65.99344955833330	-28.501
ZTL1	529840.457	-5305248.841	3489342.841	33.37968834444440	-84.29672546666670	261.160
ZTL2	529846.835	-5305247.984	3489343.121	33.37969153888890	-84.29665635000000	261.131
ZTL3	529847.514	-5305251.427	3489337.888	33.37963481388890	-84.29665276666670	261.169

Figure 11-1 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey

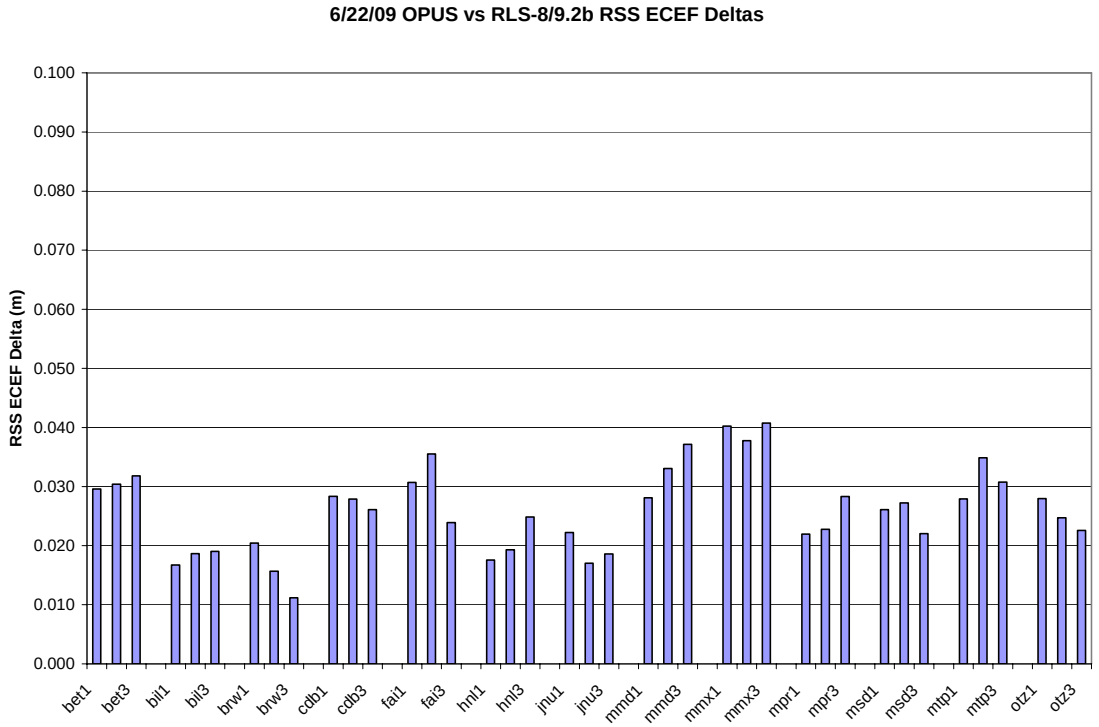


Figure 11-2 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey

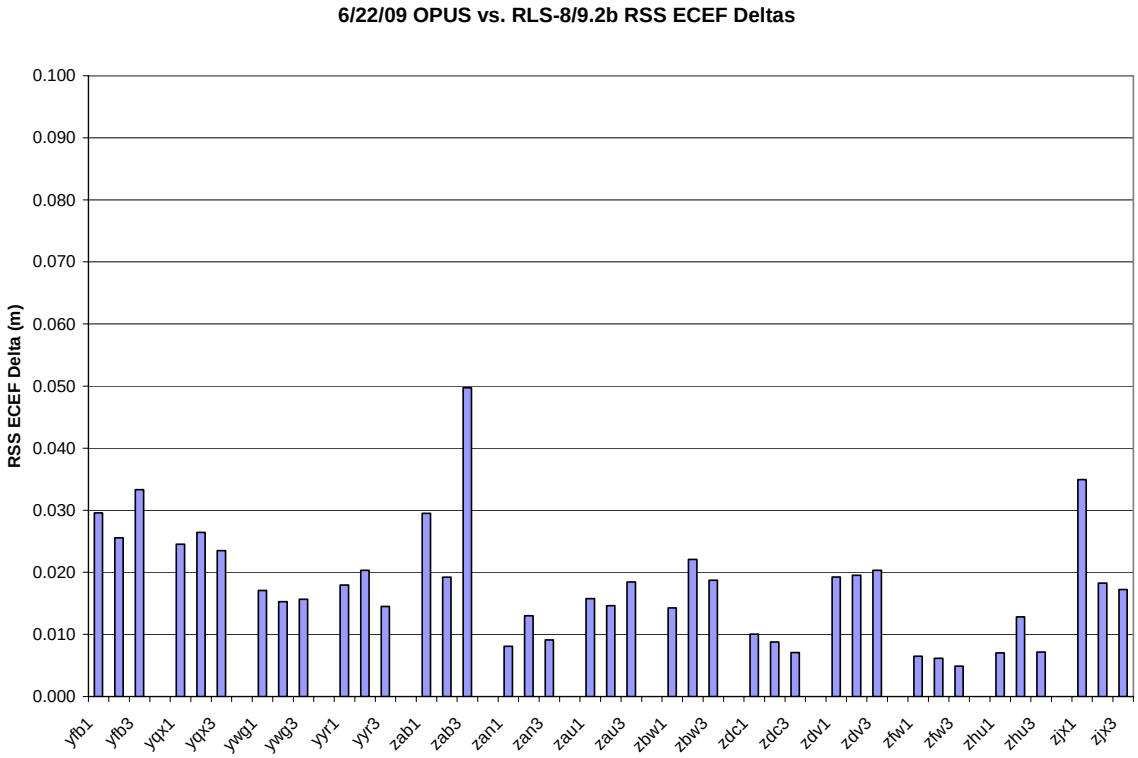


Figure 11-3 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey

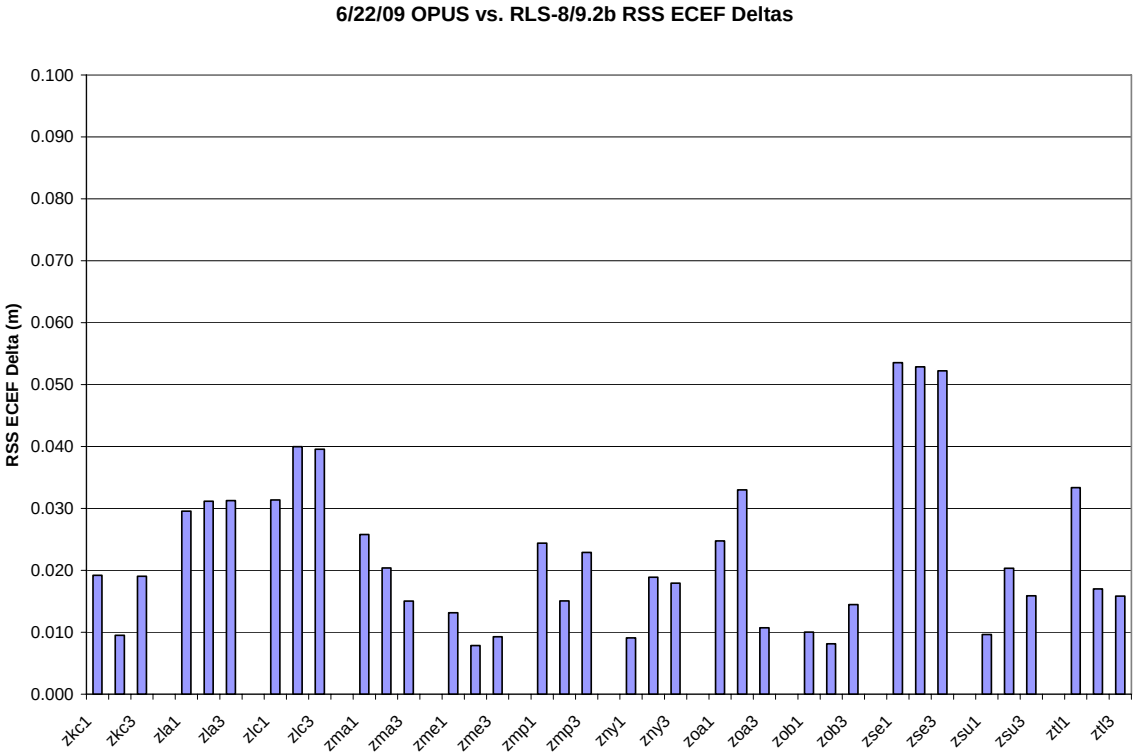


Figure 11-4 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey

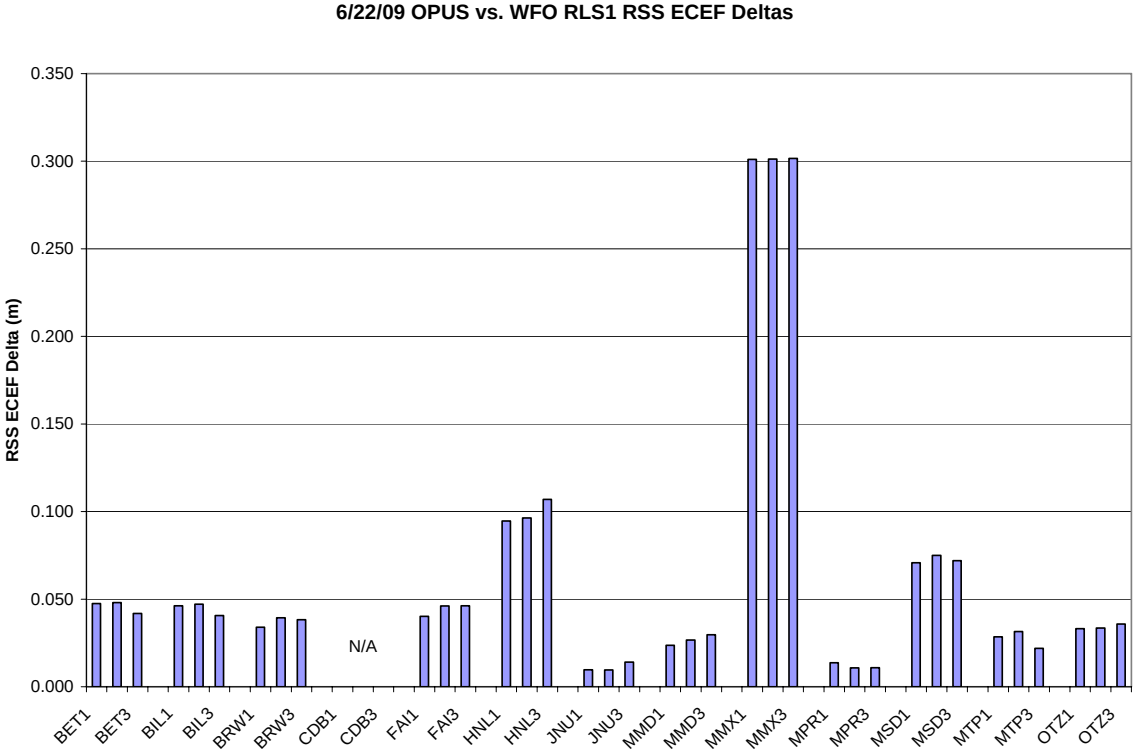


Figure 11-5 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey

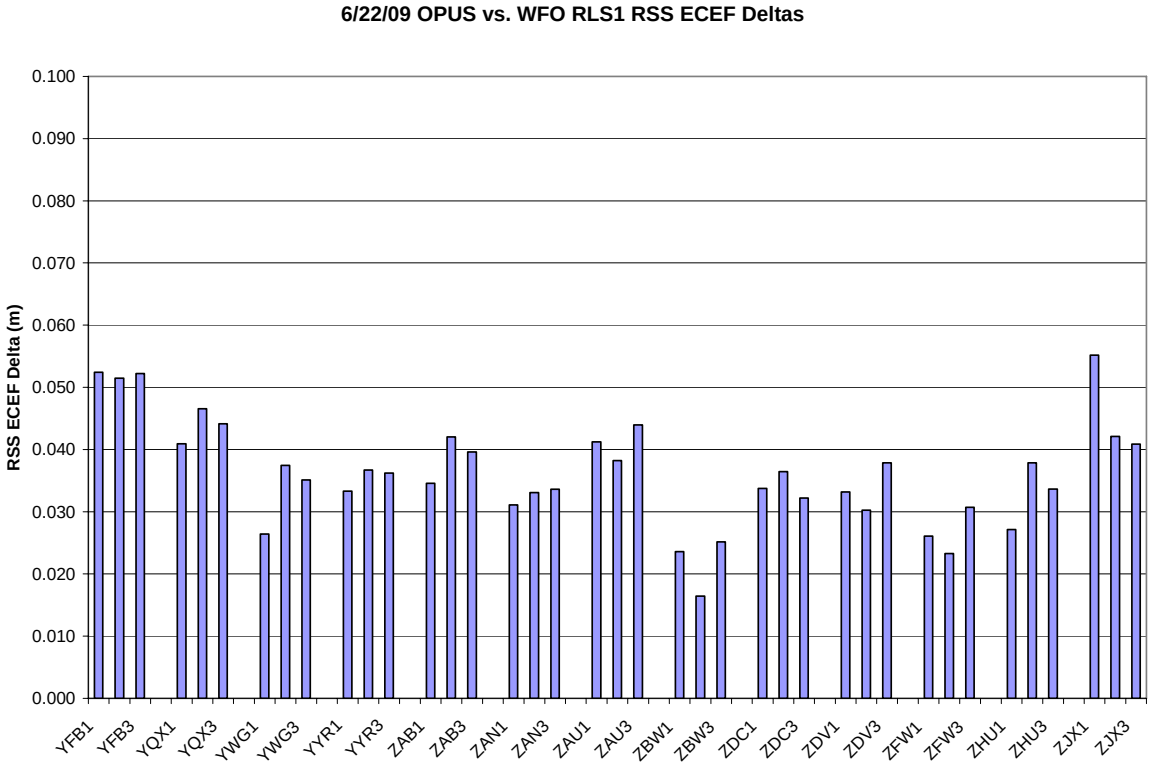


Figure 11-6 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey

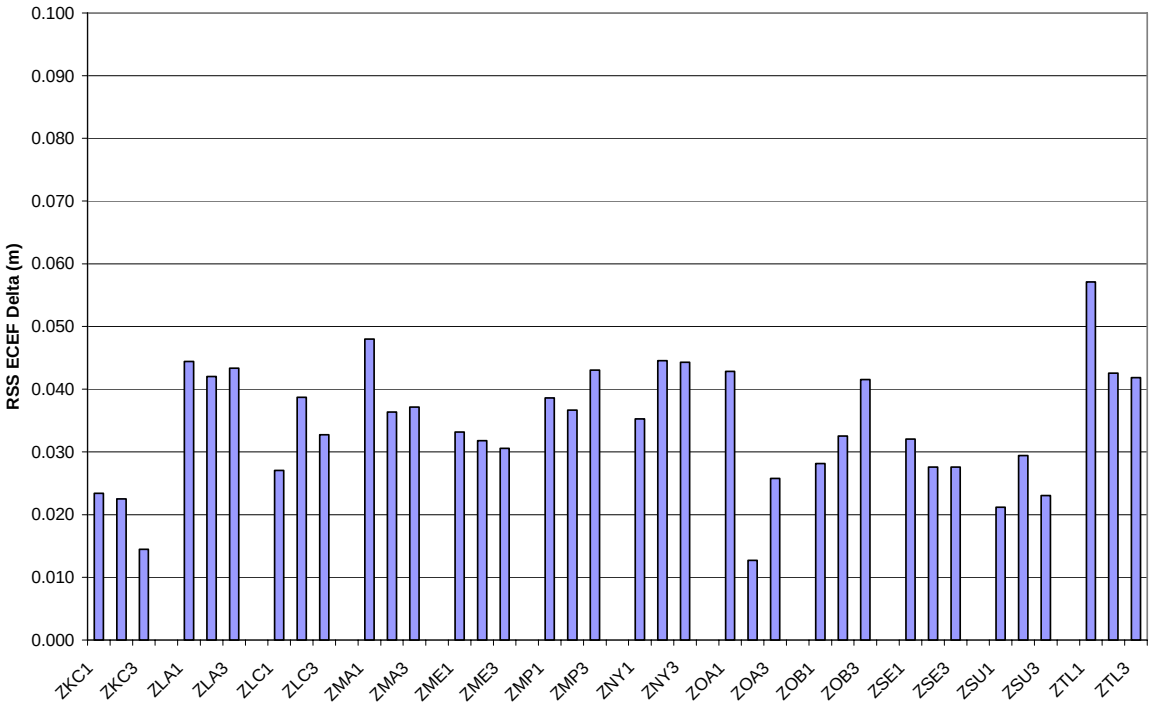


Figure 11-7 OPUS Survey Overall RMS Qualities

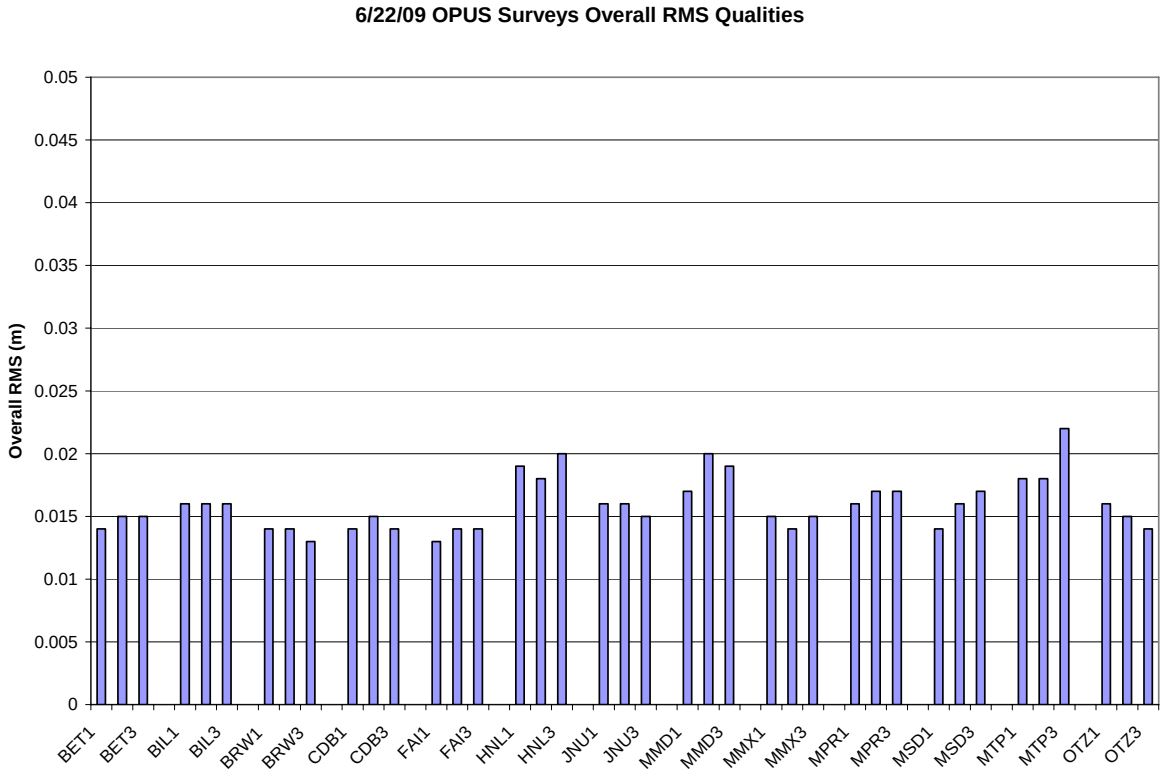


Figure 11-8 OPUS Survey Overall RMS Qualities

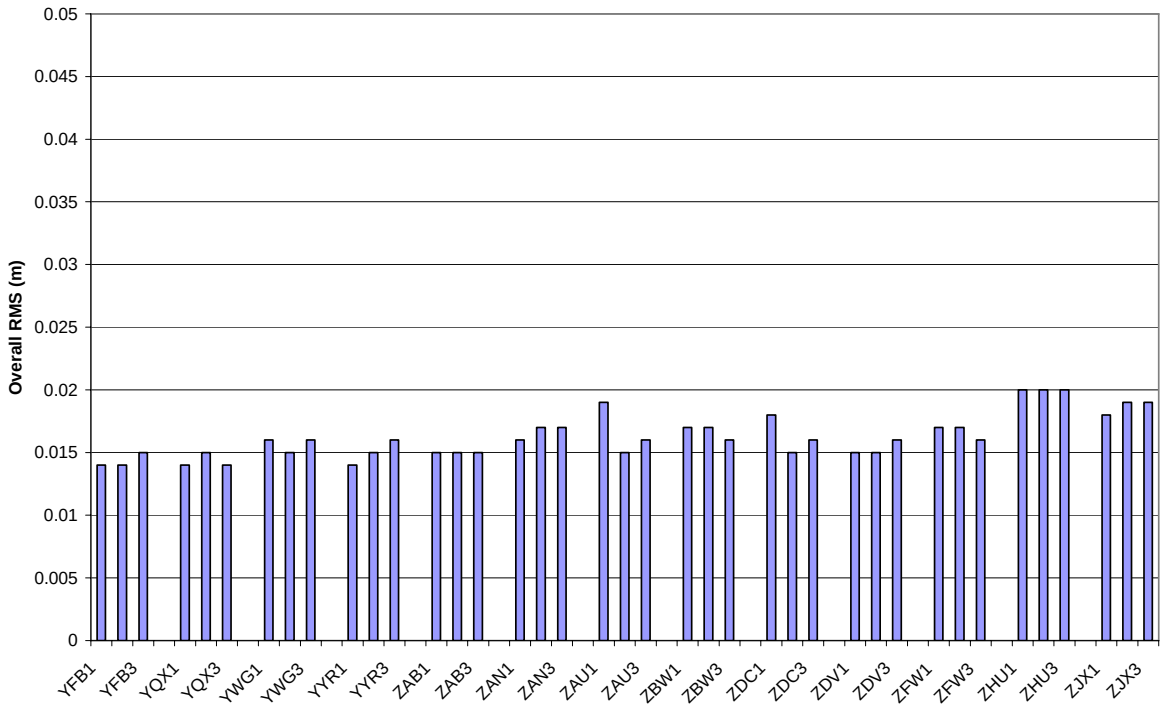


Figure 11-9 OPUS Survey Overall RMS Qualities

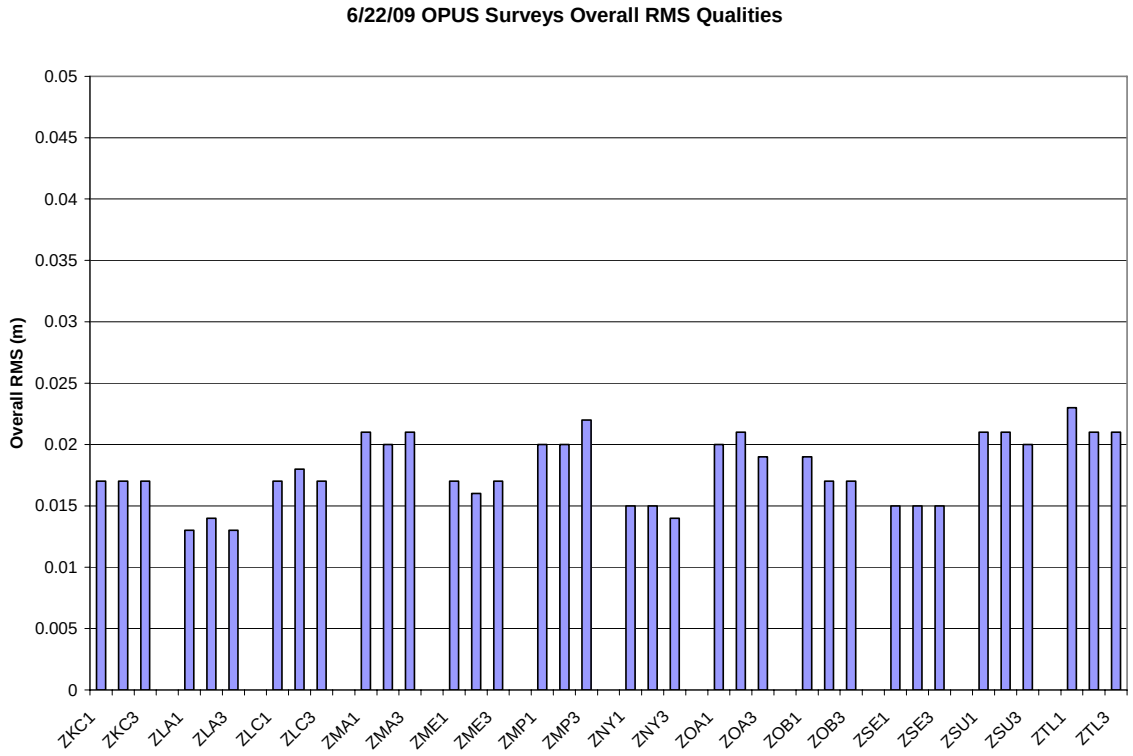


Figure 11-10 OPUS vs. CSRS RSS ECEF Deltas

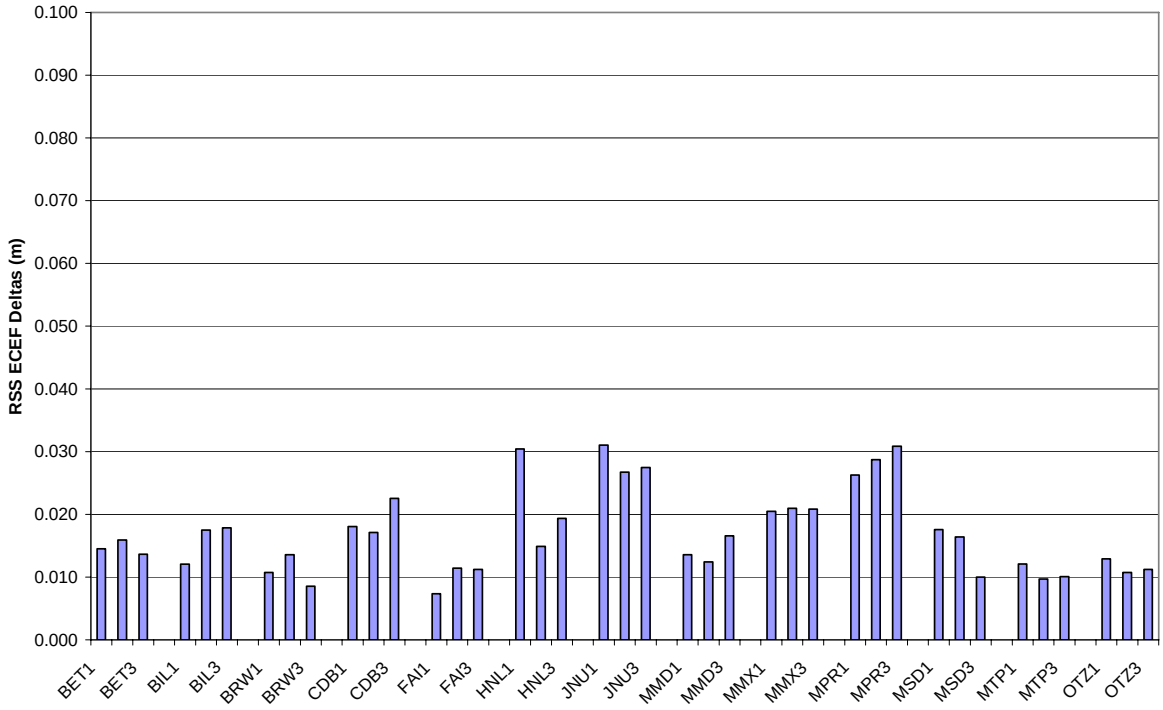


Figure 11-11 OPUS vs. CSRS RSS ECEF Deltas

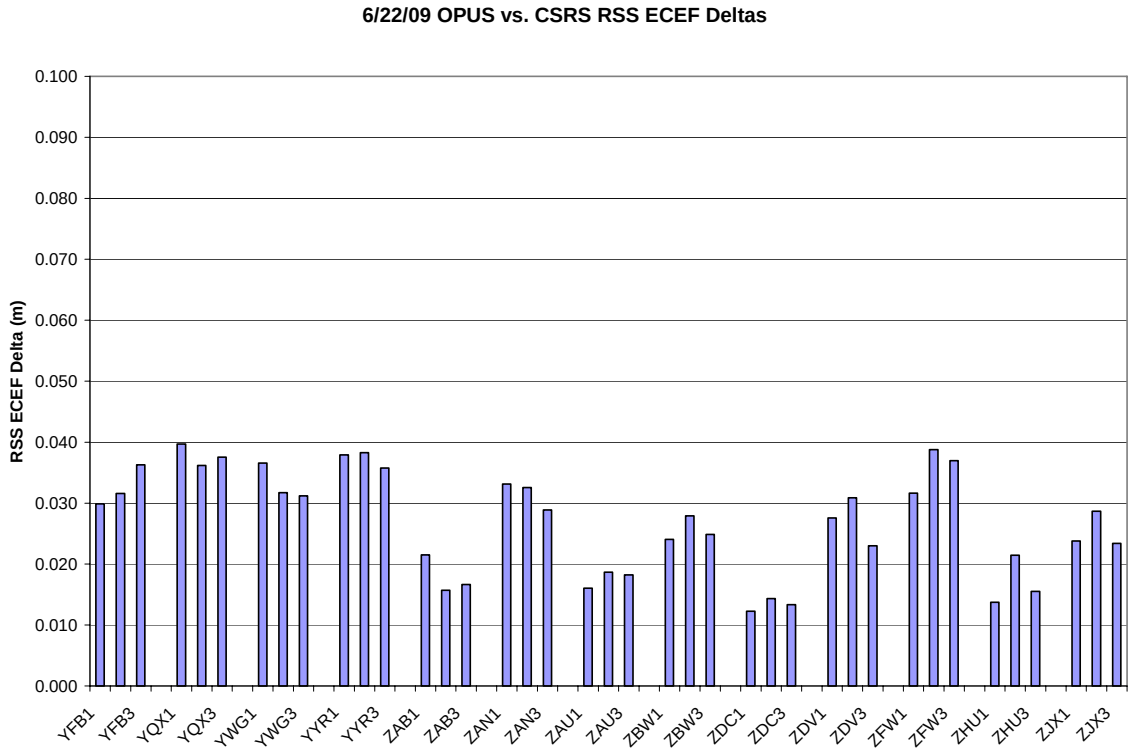


Figure 11-12 OPUS vs. CSRS RSS ECEF Deltas

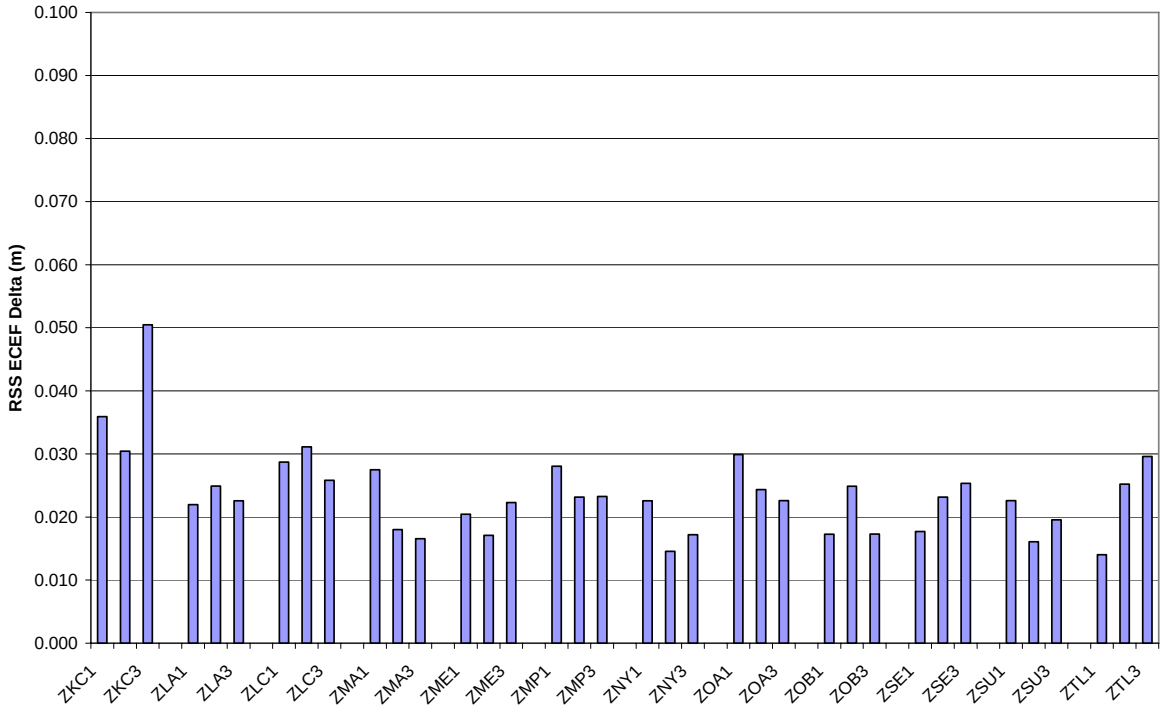


Figure 11-13 OPUS CSRS RSS ECEF Qualities

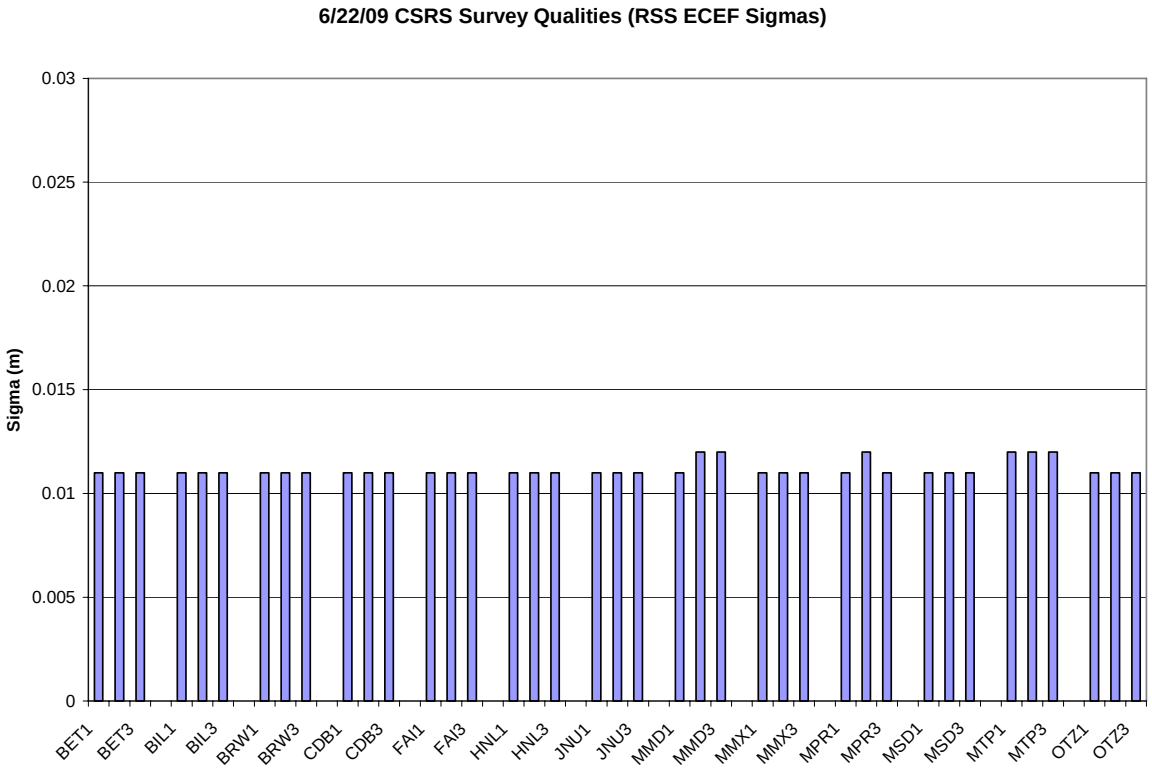


Figure 11-14 OPUS CSRS RSS ECEF Qualities

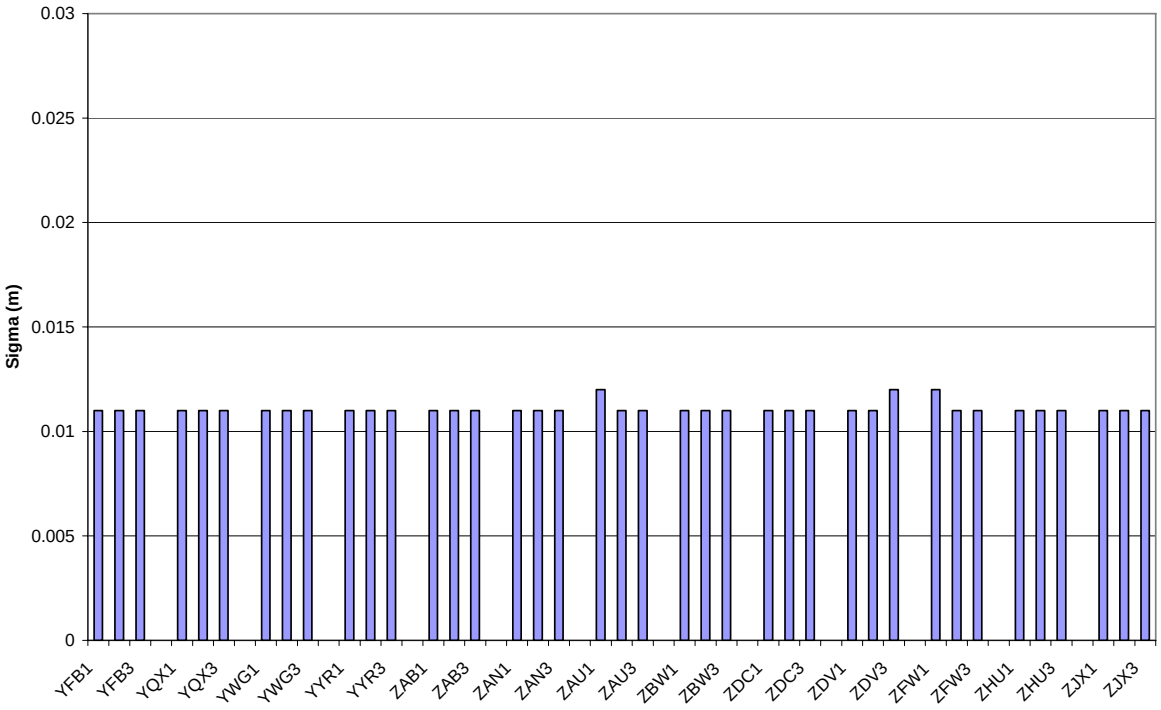
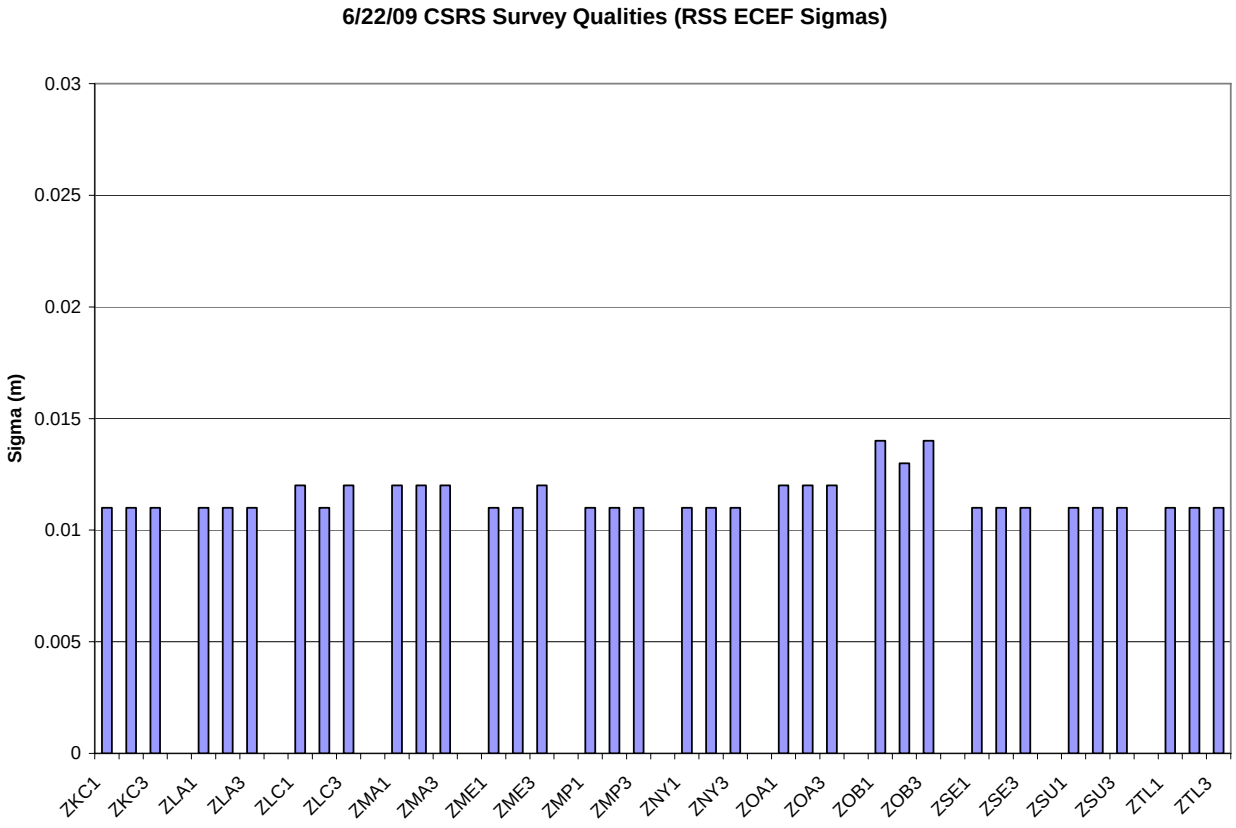


Figure 11-15 OPUS CSRS RSS ECEF Qualities



12.0 SIGNAL QUALITY MONITOR (SQM)

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

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

12.1 Alpha Metrics

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

Table 12-1 Alpha Metrics

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

12.2 Event Summary

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

Table 12-2 Event Summary

GPS Week	Date	Events
Week 1531 Day 2	5/12/2009	NANU on PRN 27 causing a spike in PRN bias.
Week 1537 Day 5	6/26/2009	NANU on PRN 25 (Do Not Use until further notice) causing a spike in PRN bias.

12.3 Type Bias

PRN Type biases are evaluated as part of the WAAS SQM offline monitoring effort. Depending on the PRN number of any given satellite, it can be classified into three categories of correlation function shapes: skinny (Type 0), nominal (Type 1), and broad (Type 2). Wideband geostationary satellites are considered a different type (Type

3). PRN-type estimates are computed at each epoch and daily averages are computed for each type, for four detection metrics.

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

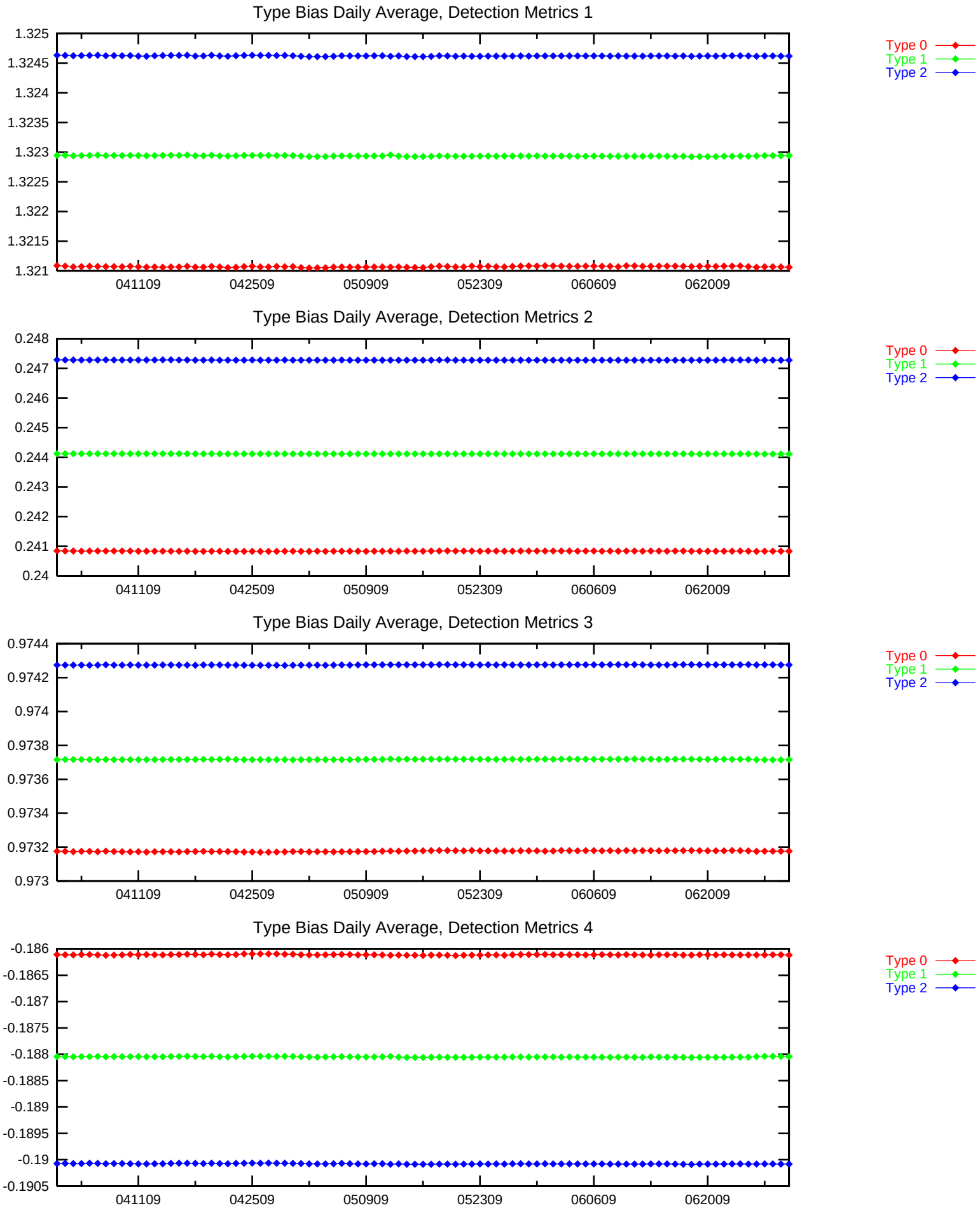
Table 12-3 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32107	1.32294	1.32462
DM 2	0.240836	0.244115	0.247277
DM 3	0.973176	0.973718	0.974275
DM 4	-0.186113	-0.188049	-0.190077

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

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32108	1.32293	1.32463
DM 2	0.240842	0.244115	0.247284
DM 3	0.973177	0.973714	0.974275
DM 4	-0.186112	-0.188053	-0.190083

Figure 12-1 PRN Type Bias Average Trend



12.4 PRN Bias

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

For this reporting period, geostationary satellite biases are not evaluated. Please refer to Table 1.4 and Table 12.2 for events such as satellite out for service that may have an impact on PRN bias statistics. Spikes on 5/12/2009 and 6/26/2009 are due to satellite outage.

Table 12.5 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.6 shows the rollup PRN bias average since January 1, 2008. The maximum average for DM1 for this quarter is PRN 23 at 0.00094952. The maximum average for DM2 is PRN 11 at 0.00019082. The maximum average for DM3 is PRN 10 at 0.00027333 and the maximum average for DM4 is PRN 23 at 0.00042265.

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

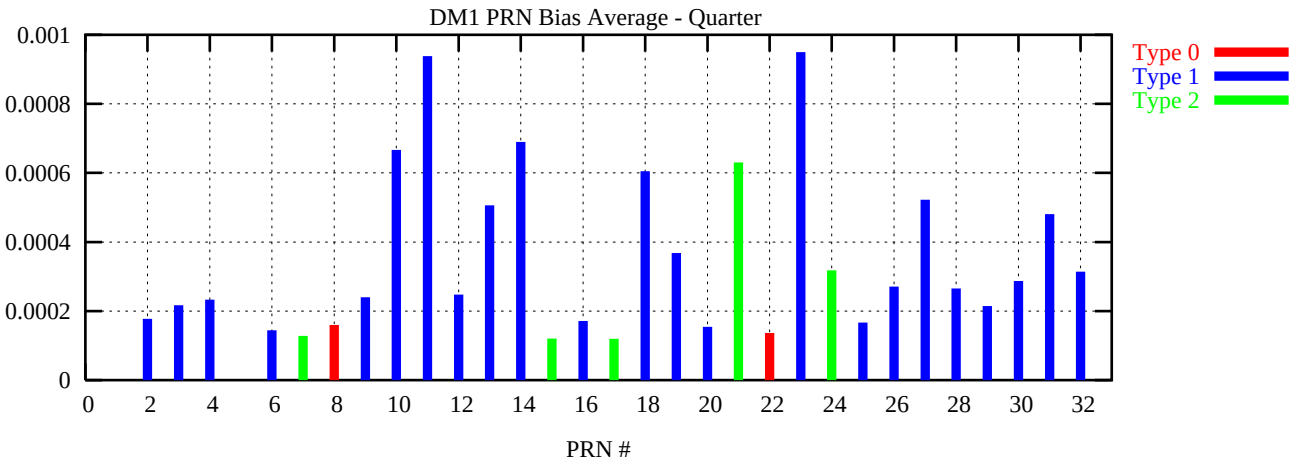
Table 12-5 PRN Bias Average for the Quarter

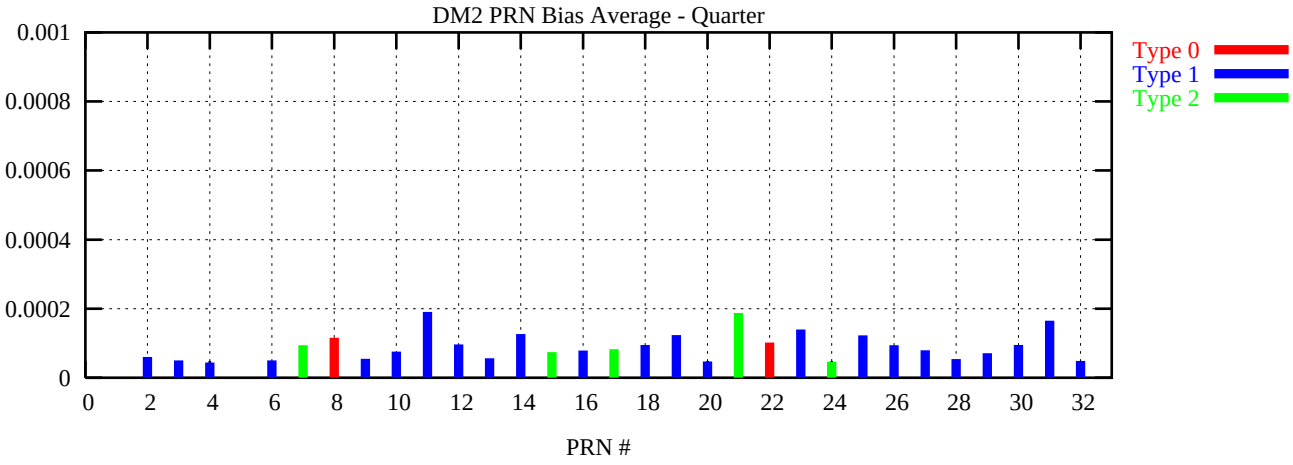
PRN	DM1	DM2	DM3	DM4
2	0.00017763	0.00006001	0.00002337	0.00009350
3	0.00021661	0.00005036	0.00008181	0.00034526
4	0.00023307	0.00004397	0.00007784	0.00012227
5				
6	0.00014423	0.00005041	0.00003663	0.00012981
7	0.00012796	0.00009435	0.00003652	0.00011816
8	0.00015949	0.00011581	0.00004475	0.00009448
9	0.00024035	0.00005491	0.00007265	0.00011889
10	0.00066659	0.00007566	0.00027333	0.00009060
11	0.00093828	0.00019082	0.00006710	0.00022876
12	0.00024735	0.00009633	0.00011009	0.00008100
13	0.00050583	0.00005663	0.00005574	0.00015528
14	0.00068996	0.00012674	0.00011320	0.00013477
15	0.00012011	0.00007393	0.00002918	0.00013987
16	0.00017093	0.00007854	0.00010241	0.00034153
17	0.00011935	0.00008238	0.00003156	0.00011407
18	0.00060507	0.00009515	0.00003892	0.00021624
19	0.00036792	0.00012312	0.00003032	0.00007937
20	0.00015428	0.00004713	0.00003834	0.00012598
21	0.00063009	0.00018775	0.00020154	0.00008686
22	0.00013691	0.00010172	0.00009887	0.00010396
23	0.00094952	0.00013958	0.00003579	0.00042265
24	0.00031788	0.00004601	0.00003635	0.00010629
25	0.00016648	0.00012277	0.00007938	0.00031138
26	0.00027075	0.00009378	0.00015595	0.00008719
27	0.00052225	0.00007955	0.00006713	0.00035188
28	0.00026511	0.00005372	0.00003277	0.00009014
29	0.00021442	0.00007088	0.00011074	0.00029137
30	0.00028736	0.00009465	0.00002743	0.00011098
31	0.00048078	0.00016534	0.00004067	0.00025355
32	0.00031390	0.00004838	0.00011573	0.00010445

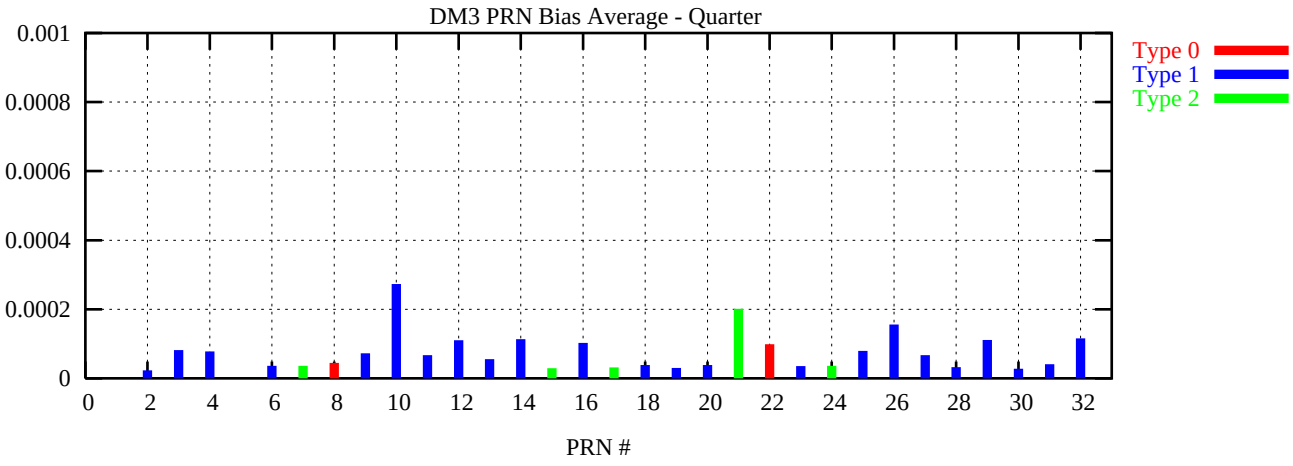
Table 12-6 PRN Bias Average Since January 1, 2008

PRN	DM1	DM2	DM3	DM4
2	0.00018207	0.00005908	0.00002246	0.00009524
3	0.00021091	0.00005204	0.00008486	0.00034025
4	0.00023620	0.00004523	0.00007456	0.00012718
5	0.00042828	0.00006544	0.00011899	0.00015721
6	0.00016560	0.00005394	0.00004421	0.00011743
7	0.00012876	0.00009453	0.00003625	0.00012288
8	0.00015309	0.00011930	0.00004417	0.00010080
9	0.00023259	0.00005368	0.00007000	0.00011174
10	0.00065019	0.00007324	0.00026961	0.00009203
11	0.00092718	0.00018629	0.00006653	0.00023087
12	0.00023952	0.00008753	0.00010607	0.00007984
13	0.00051648	0.00005907	0.00005832	0.00016227
14	0.00068042	0.00013108	0.00011469	0.00013240
15	0.00012026	0.00007019	0.00002767	0.00013604
16	0.00016000	0.00007685	0.00010757	0.00033628
17	0.00011657	0.00008067	0.00003113	0.00011601
18	0.00059544	0.00009710	0.00003966	0.00020905
19	0.00037408	0.00012985	0.00003273	0.00008487
20	0.00015552	0.00004766	0.00004400	0.00010756
21	0.00062777	0.00018672	0.00020207	0.00008547
22	0.00014643	0.00009039	0.00010152	0.00010109
23	0.00095429	0.00013863	0.00003527	0.00042344
24	0.00029983	0.00004544	0.00003489	0.00010102
25	0.00015663	0.00011258	0.00008151	0.00030374
26	0.00026601	0.00009265	0.00015394	0.00009112
27	0.00046665	0.00007711	0.00006877	0.00031531
28	0.00025677	0.00005302	0.00003208	0.00009071
29	0.00022632	0.00006704	0.00010721	0.00029499
30	0.00029595	0.00009462	0.00002813	0.00011814
31	0.00046987	0.00015889	0.00003918	0.00025006
32	0.00031782	0.00004744	0.00011404	0.00010299

Figure 12-2 PRN Bias Average for the Quarter







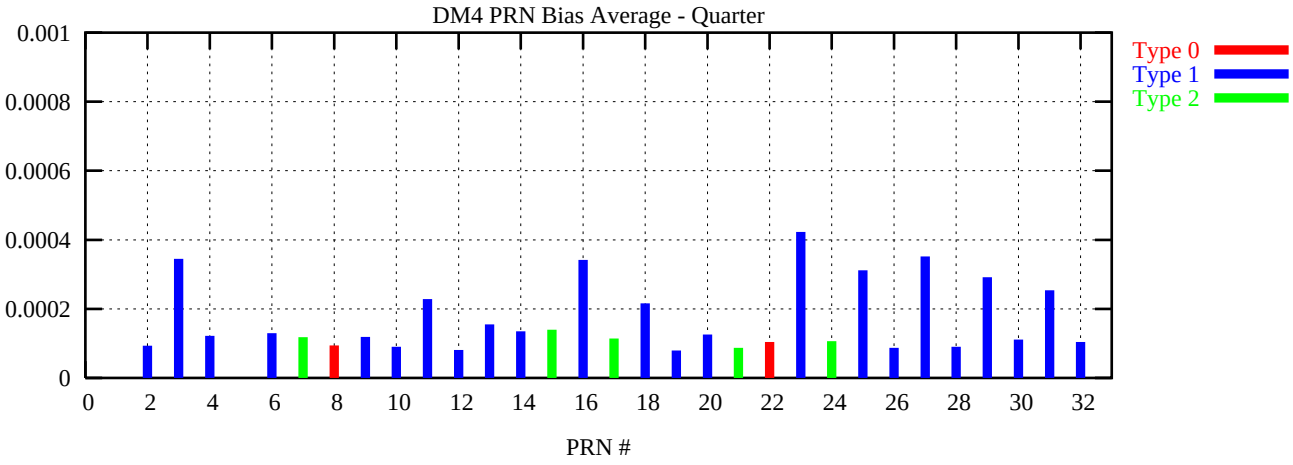


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)

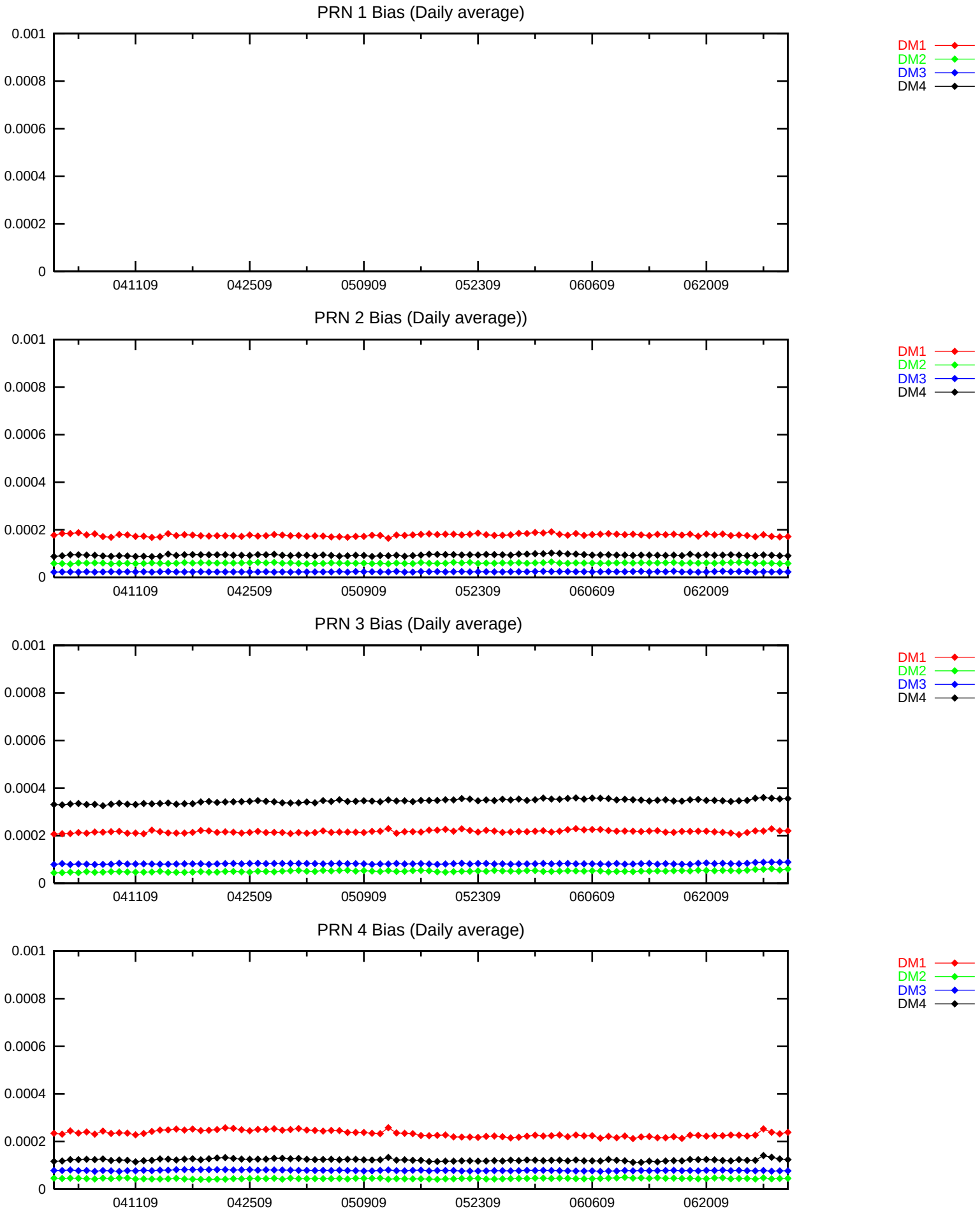


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)

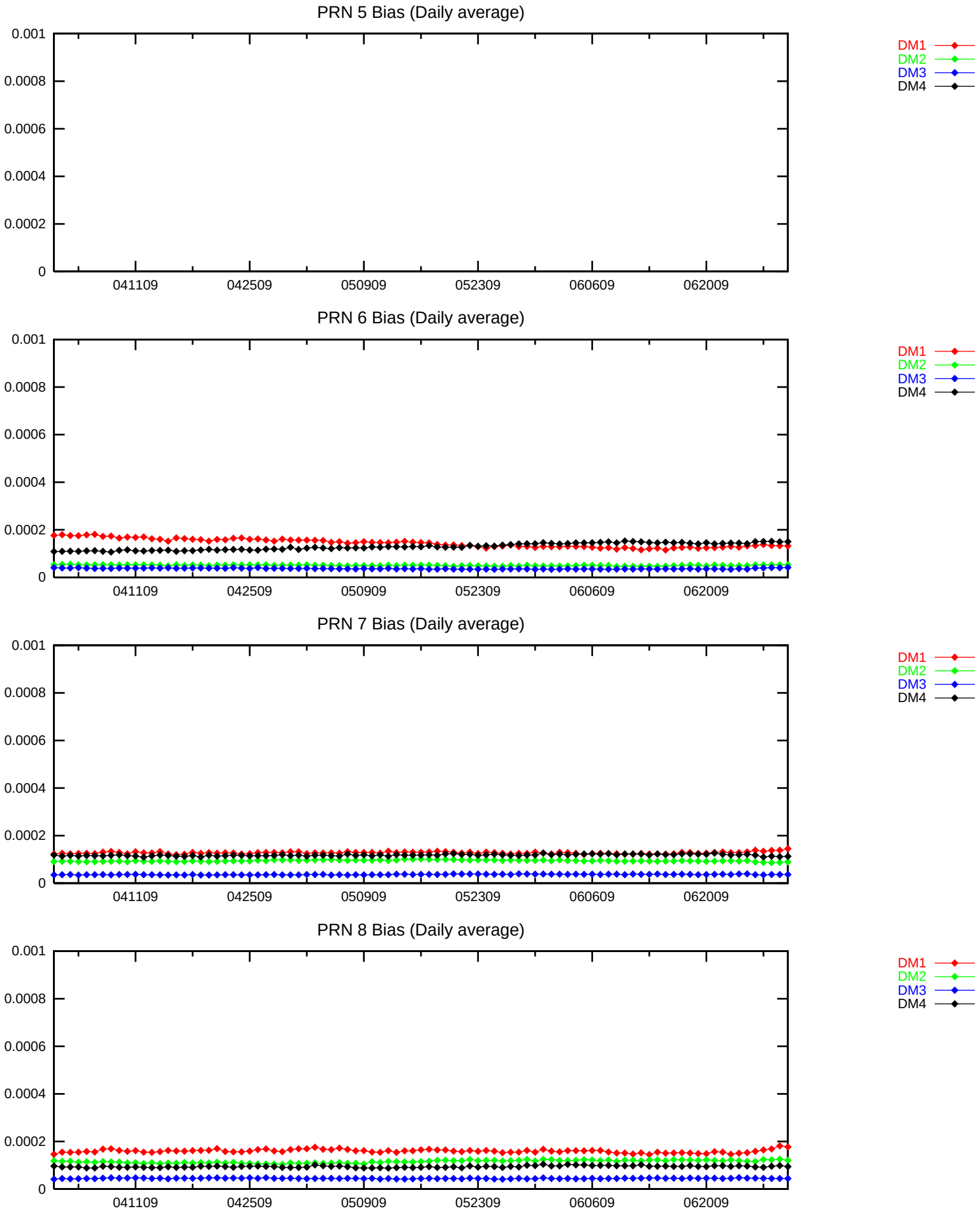


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)

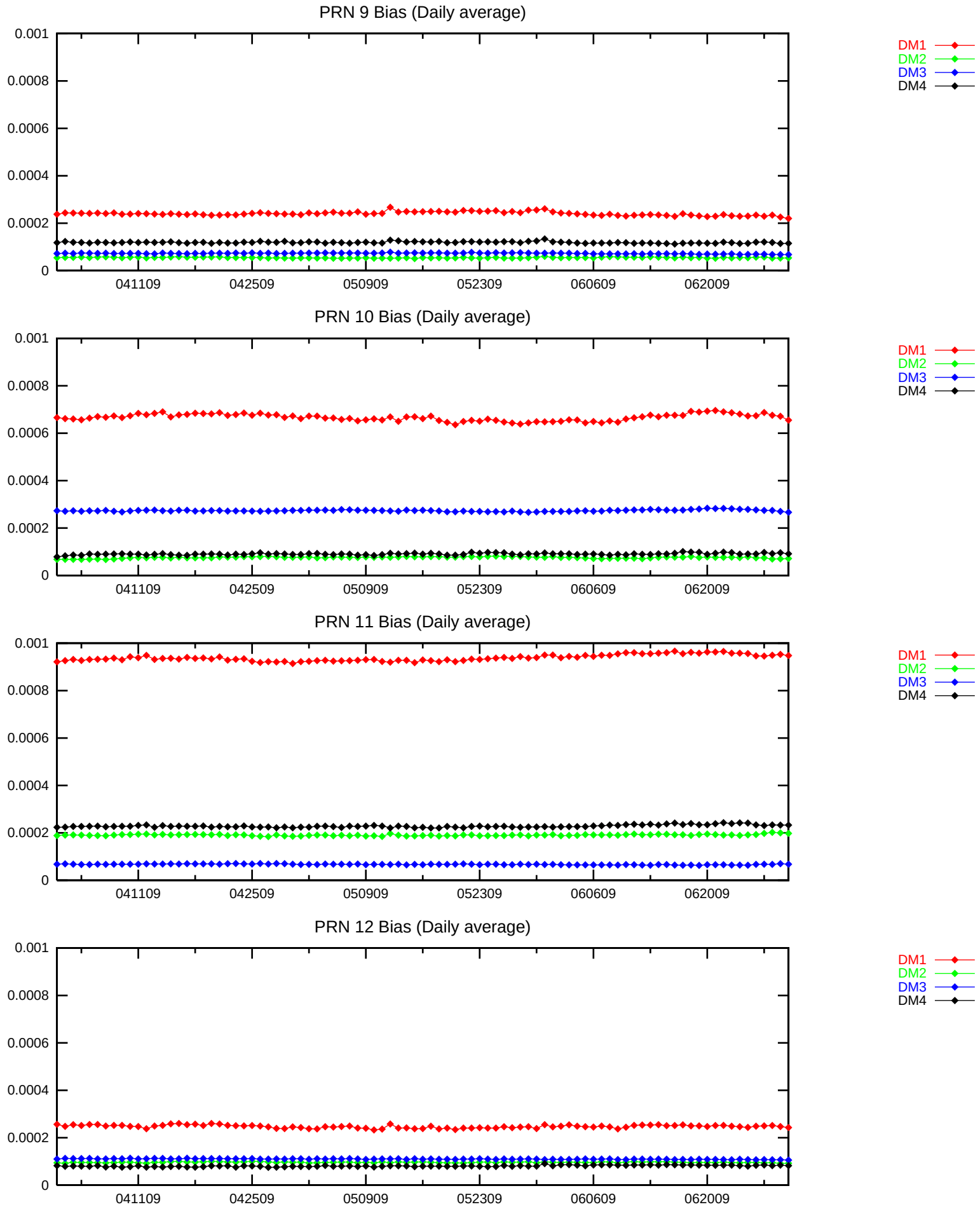


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)

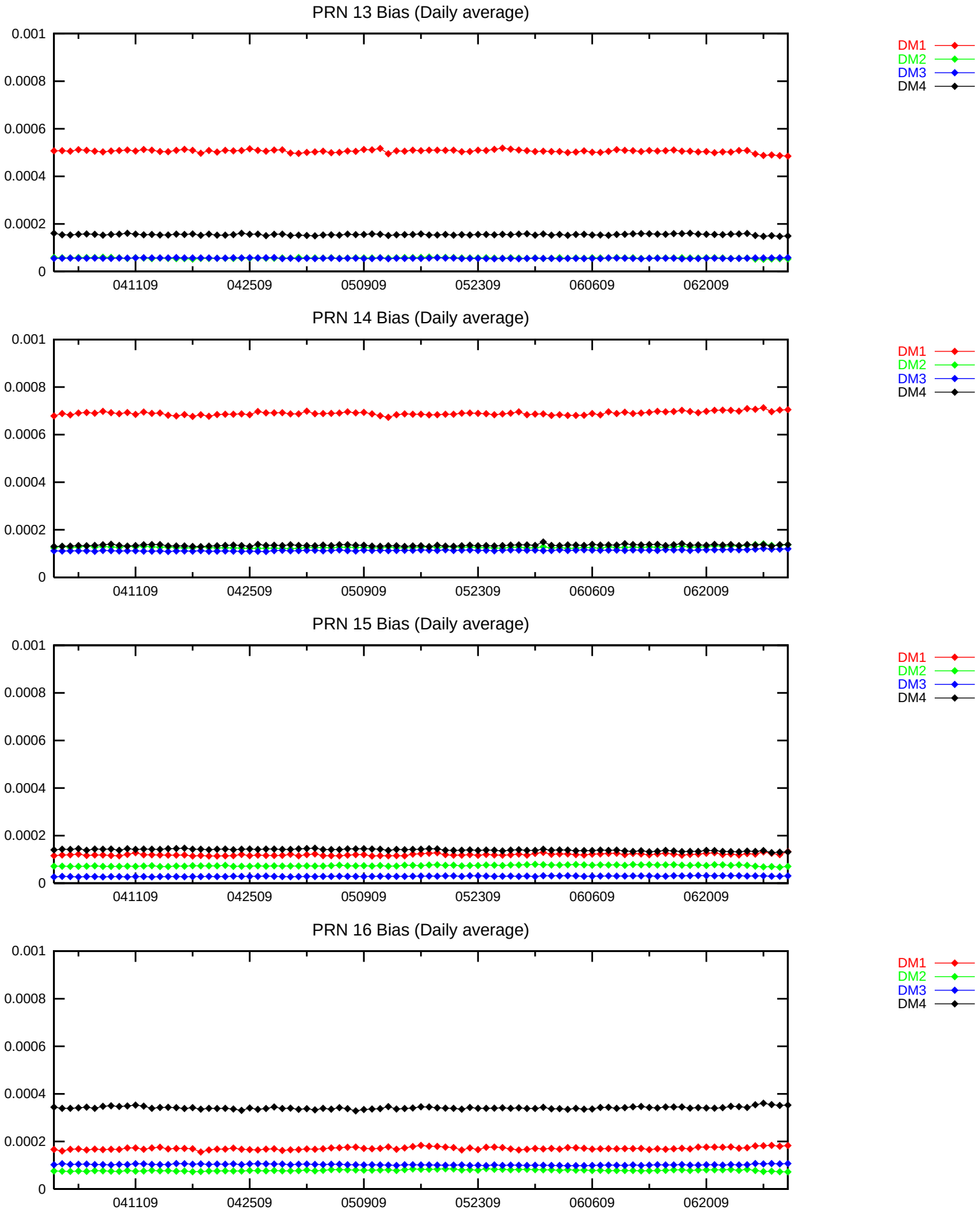


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)

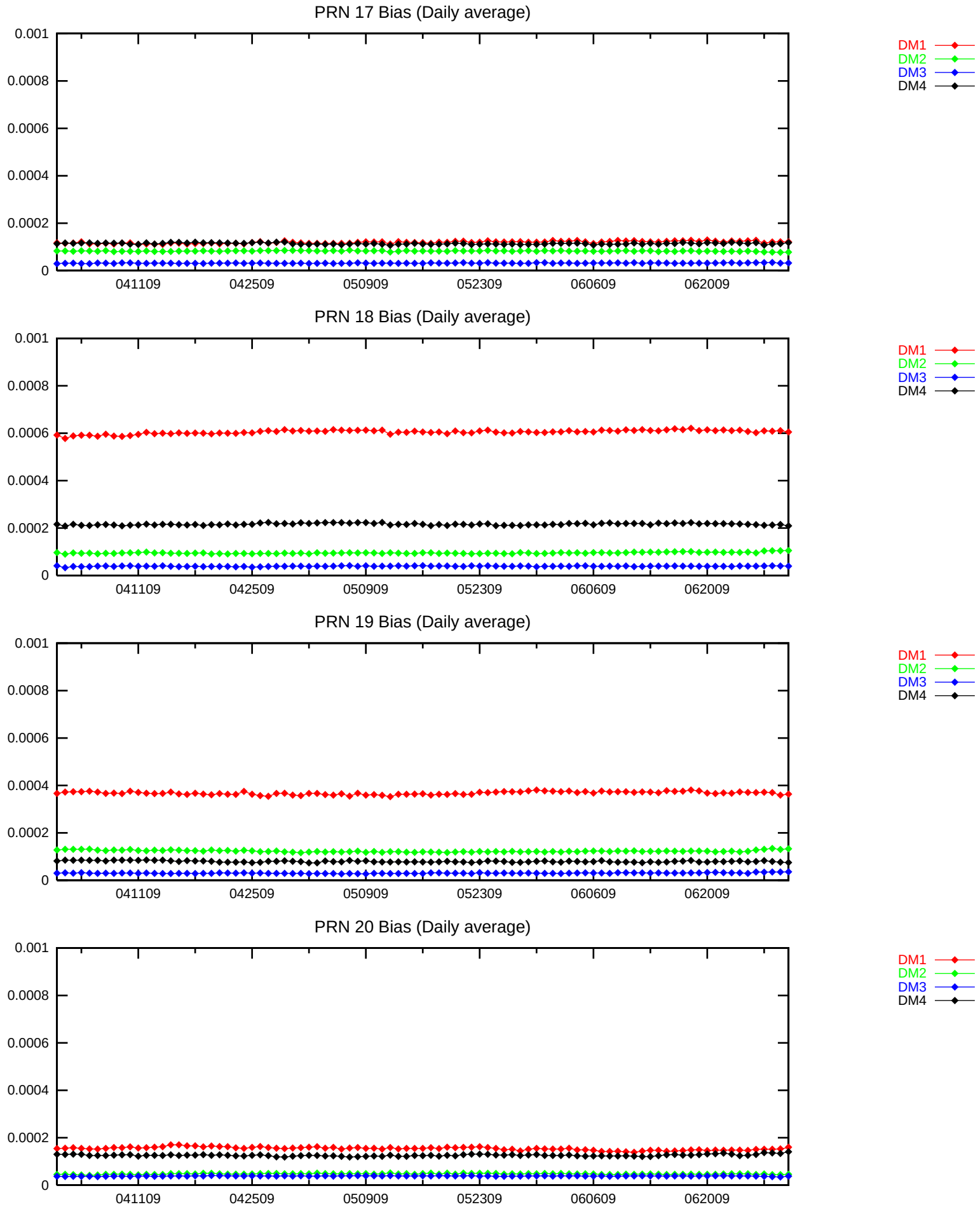


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)

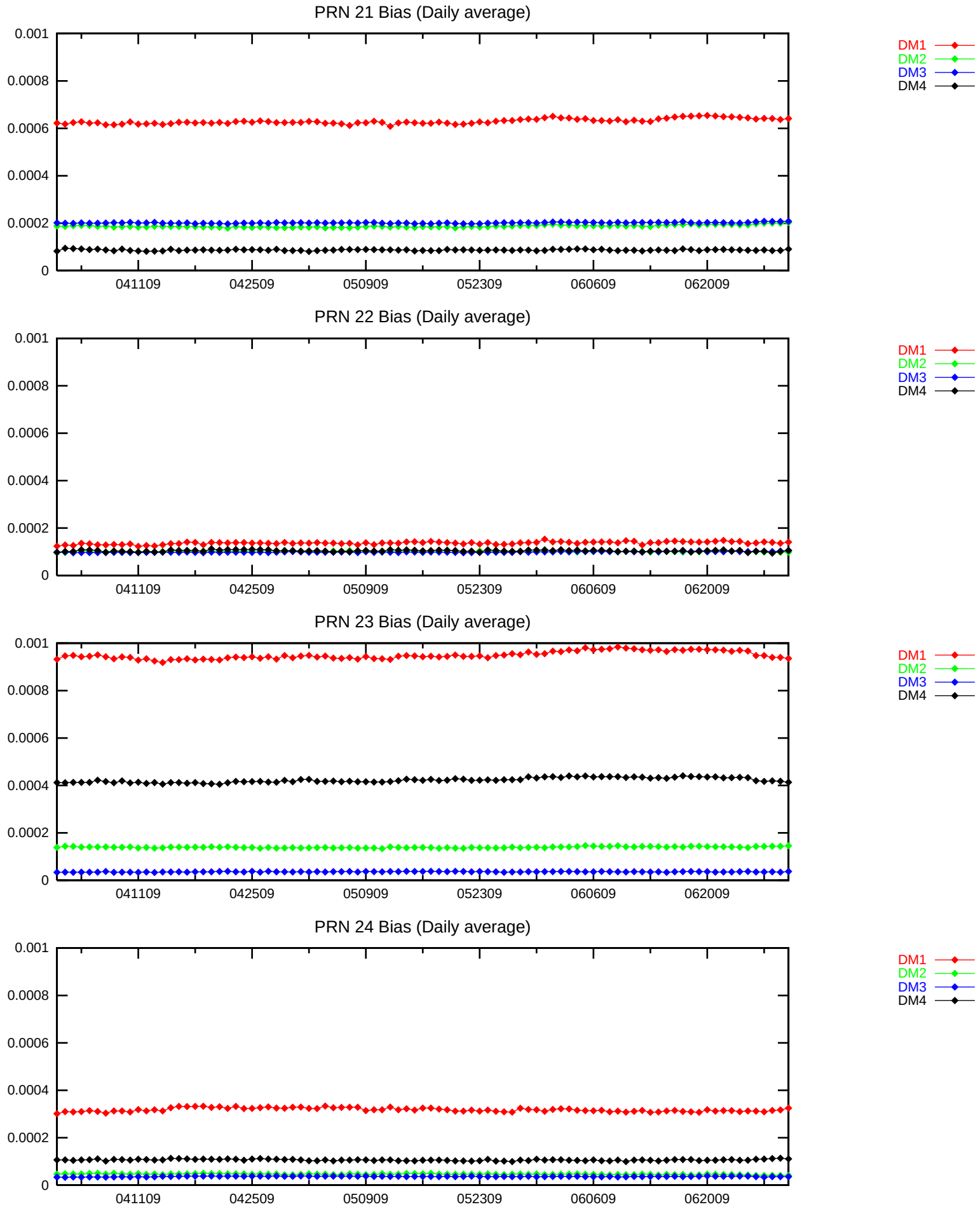


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)

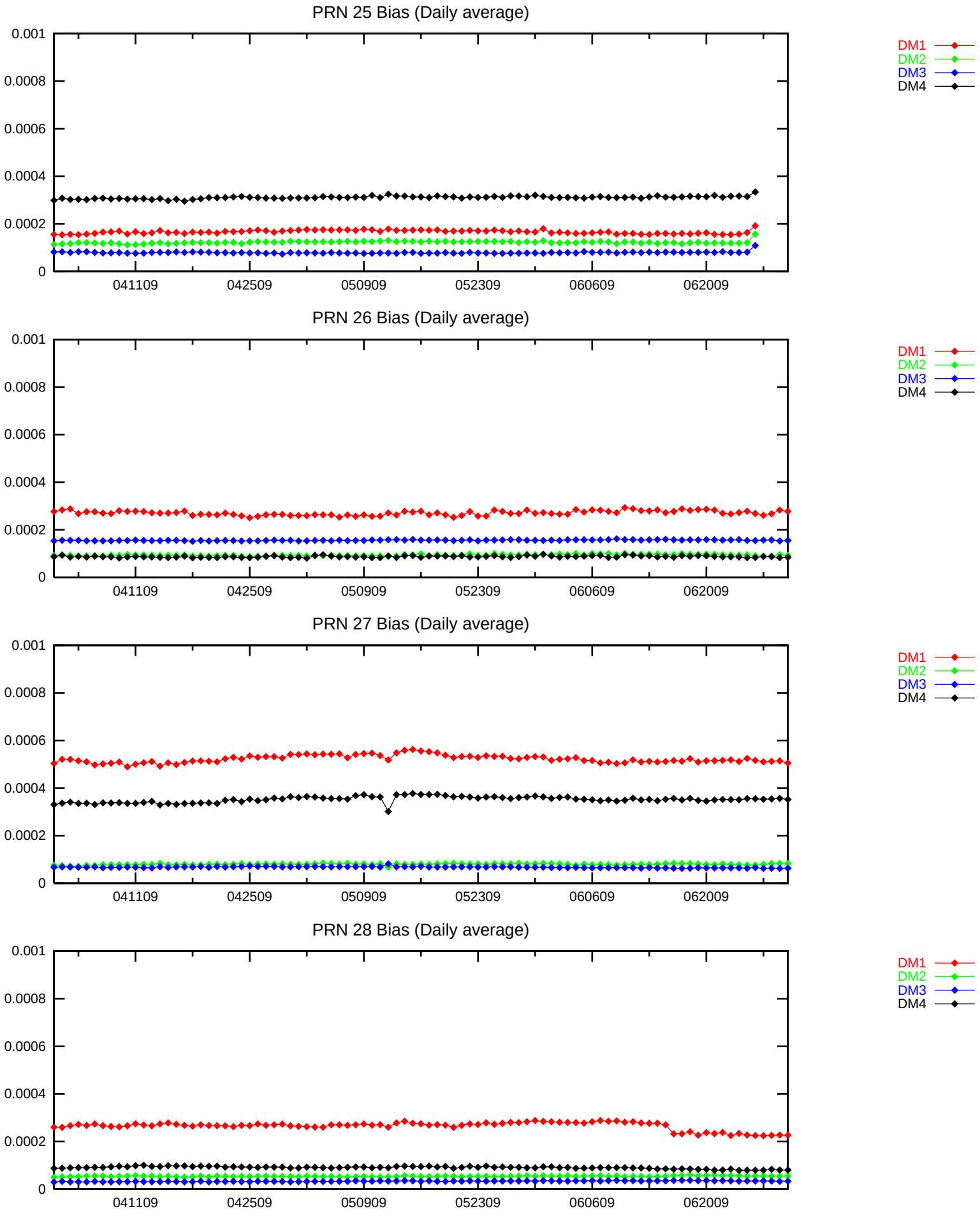
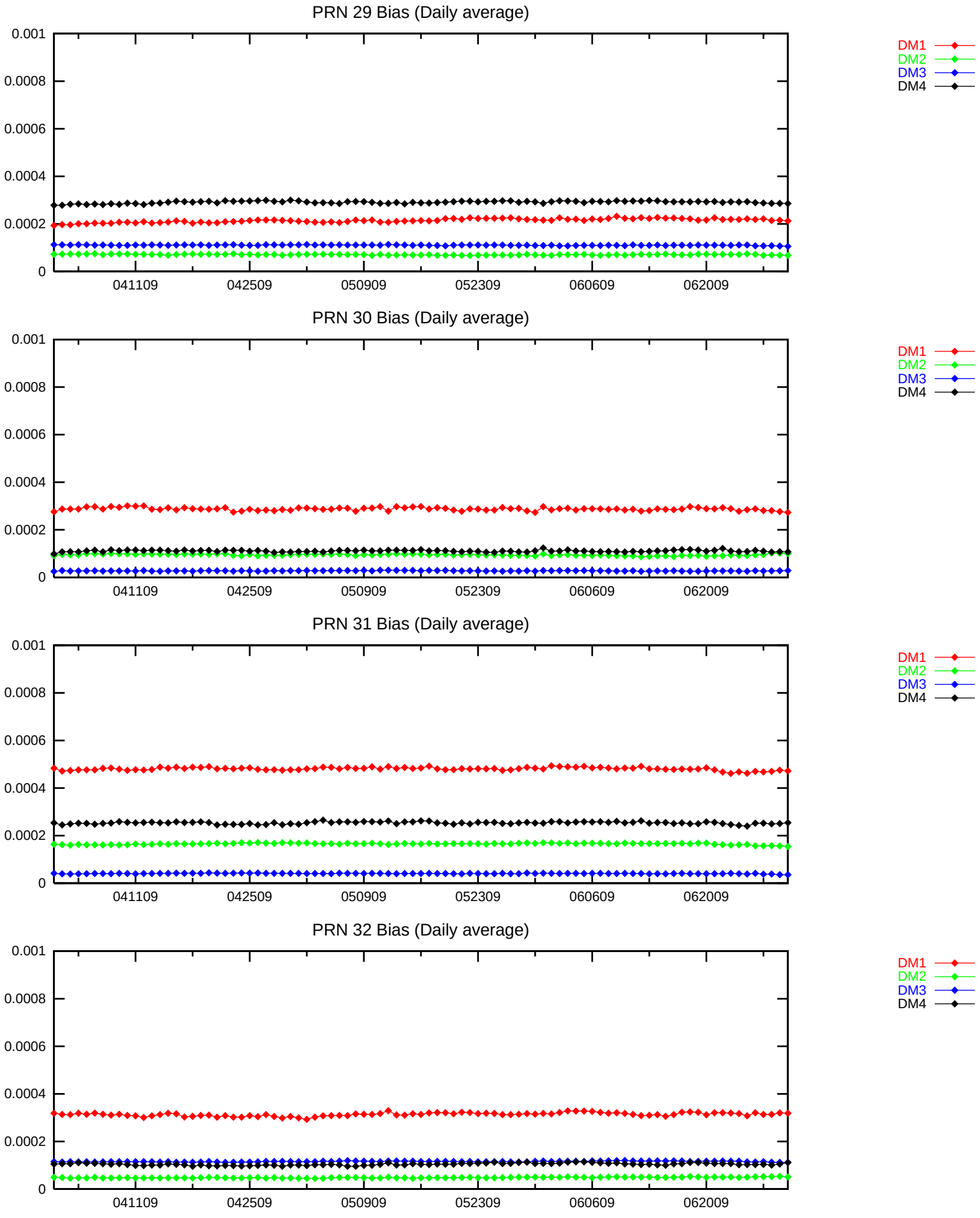


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN 32)



12.5 SQM Trips

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

Appendix A: Glossary

General Terms and Definitions

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

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

CONUS. Continental United States.

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

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

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

DR. Discrepancy Report

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

GEO. Geostationary Satellite.

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

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

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

Horizontal Alert Limit (HAL). The Horizontal Alert Limit (HAL) is the radius of a circle in the horizontal plane (the local plane tangent to the WGS-84 ellipsoid), with its center being at the true position, which describes the region that is required to contain the indicated horizontal position with a probability of $1\text{-}10^{-7}$ per flight hour, for a particular

navigation mode, assuming the probability of a GPS satellite integrity failure being included in the position solution is less than or equal to 10^{-4} per hour.

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

IGS. International GPS Service.

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

LNAV. Lateral Navigation.

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

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

MOPS. Minimum Operational Performance Standards.

Navigation Message. Message structure designed to carry navigation data.

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

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

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

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

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

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

SV. Space Vehicle.

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

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

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

VNAV. Vertical Navigation.

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

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

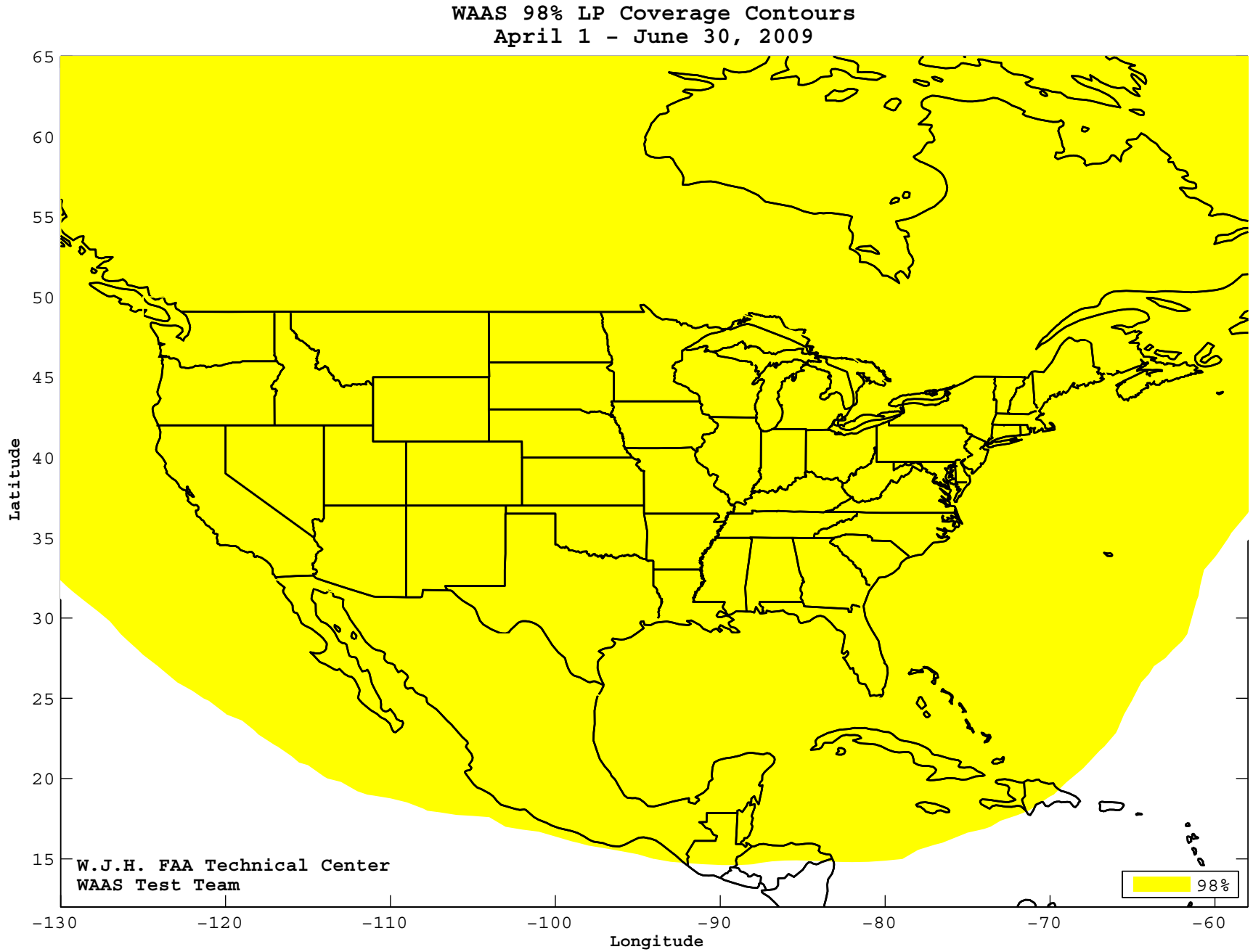


Figure B-2 98% Alaska LPV Availability Contour for the Quarter

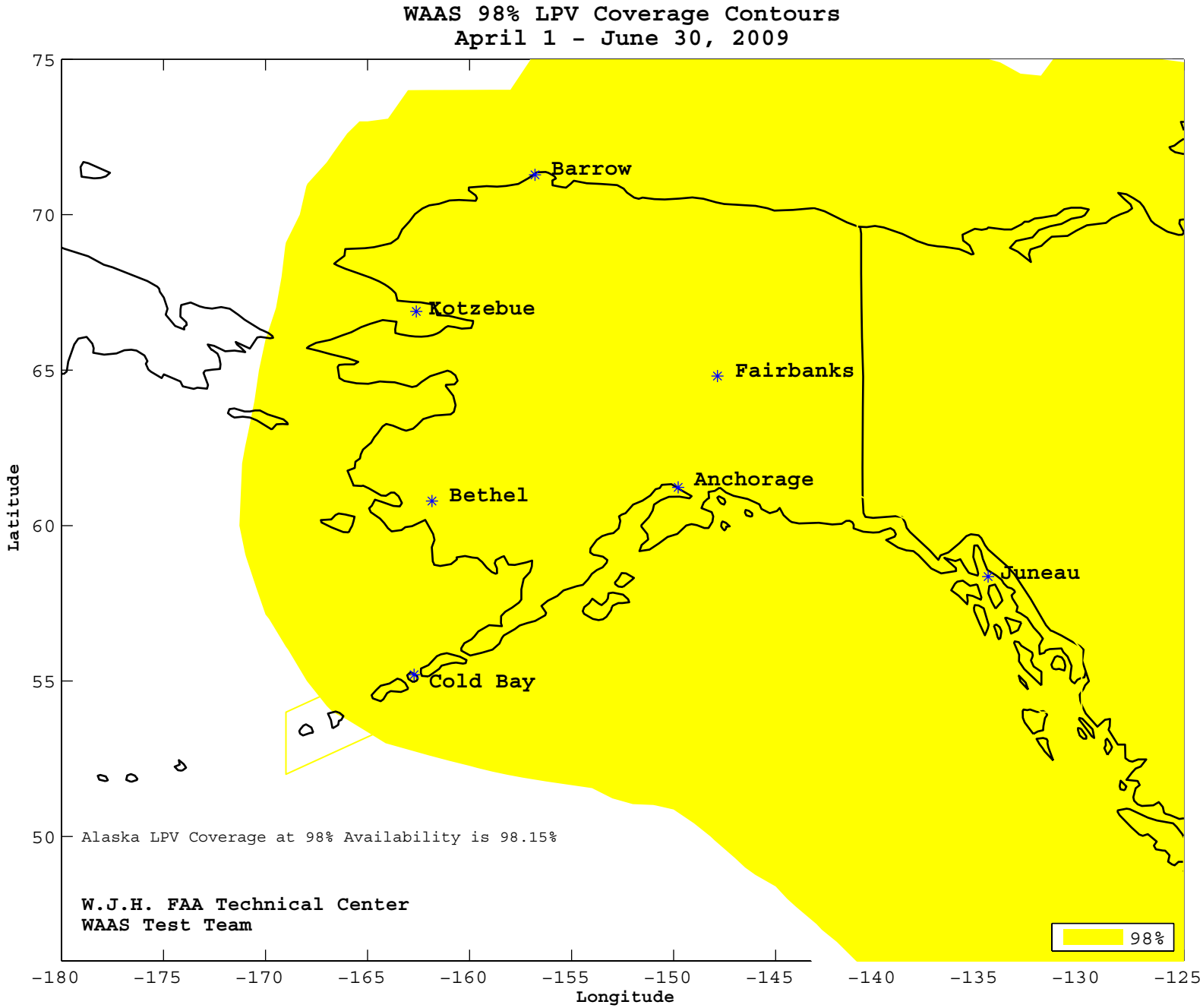


Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter

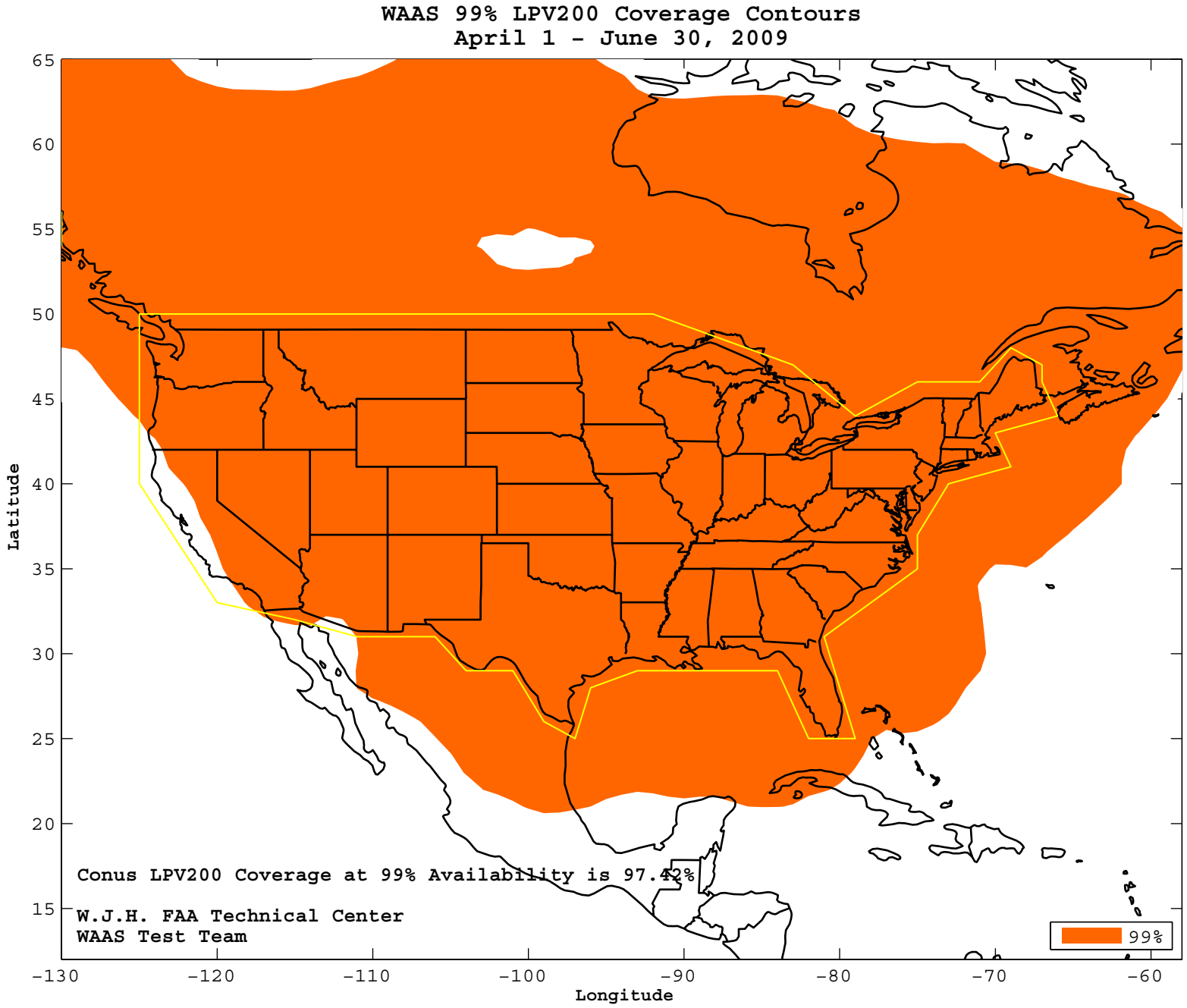


Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter