WIDE-AREA AUGMENTATION SYSTEM
PERFORMANCE ANALYSIS REPORT

Report #28

Reporting Period: January 1 to March 31, 2009

April 2009

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NSTB/WAAS T&E Team
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Website: http://www.nstb.tc.faa.gov/

Executive Summary

Since 1999 the WAAS Test Team at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS Test Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the twenty-eighth such WAAS quarterly report. This report covers WAAS performance during the period from January 1, 2009 to March 31, 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 1.268 meters	Denver 0.573 meters	Cold Bay 0.654 meters	Fairbanks 0.452 meters
95% Vertical Accuracy	Miami 2.041 meters	Salt Lake City 0.846 meters	Kotzebue 1.182 meters	Bethel 0.793 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Washington DC 100%	Arcata 99.99%	Anchorage 100%	Barrow 99.24%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	Washington DC 100%	Oakland 97.00%	Anchorage 100%	Cold Bay 90.182%
95% HPL	Arcata 16.216 meters	Memphis 11.306 meters	Cold Bay 25.551 meters	Fairbanks 12.941 meters
95% VPL	Oakland 31.47 meters	Memphis 19.17 meters	Cold Bay 37.247 meters	Juneau 22.082 meters

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

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 January 1, 2009 to March 31, 2009

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	77	6635063
Oklahoma City	79	6829919
WAAS:		
Albuquerque	89	7680265
Anchorage	89	7675771
Atlanta	85	7356255
Barrow	90	7763164
Bethel	90	7763717
Billings	90	7765059
Boston	90	7764549
Chicago	86	7472069
Cleveland	90	7763927
Cold Bay	87	7487312
Dallas	85	7344577
Denver	89	7678021
Fairbanks	90	7764112
Gander	89	7702598
Goose Bay	90	7764207
Houston	89	7678426
Iqaluit	89	7731605
Jacksonville	85	7345621
Juneau	84	7282790
Kansas City	85	7344351
Kotzebue	90	7754865
Los Angeles	89	7679249
Memphis	90	7766179
Merida	90	7761394
Mexico City	90	7764391
Miami	90	7763185
Minneapolis	89	7681052
New York	89	7680921
Oakland	90	7764387
Puerto Vallarta	88	7586110
Salt Lake City	89	7680241
San Jose Del Cabo	88	7632159
San Juan	85	7312431
Seattle	90	7764233
Tapachula	90	7764930
Washington DC	90	7765890
Winnipeg	90	7766239

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	90	7764415
Anchorage	90	7759880
Atlanta	84	7227113
Barrow	90	7762082
Bethel	90	7762414
Billings	90	7763650
Boston	90	7763164
Cleveland	89	7677519
Cold Bay	87	7486769
Fairbanks	90	7762655
Gander	89	7701392
Honolulu	90	7743402
Houston	90	7764063
Iqaluit	90	7734332
Juneau	85	7329104
Kansas City	86	7397630
Kotzebue	90	7753377
Los Angeles	90	7763025
Merida	90	7759910
Miami	89	7677951
Minneapolis	89	7666007
Oakland	89	7678068
Salt Lake City	90	7758002
San Jose Del Cabo	90	7765389
San Juan	85	7307886
Seattle	84	7238974
Tapachula	90	7764254
Washington DC	90	7764465

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 1and FAA Specification FAA-E-2976, as applicable.

Table 1-3 WAAS Performance Parameters

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

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

1.1 Event Summary

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

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1513 day 2 to 1513 day 6	1/6/09 to 1/10/09 1/12/09 to 1/15/09	zfw, zjx, zkc, ztl, jnu, yqx, zsu	ZTL Ring 2 Backbone failure caused intermittent outages at the following sites: Dallas, Jacksonville, Kansas City, Atlanta, Juneau, Gander, and San Juan.
1513 day 3	1/7/09	CRE	3 CRE switchovers – 6s, 9s, 3s gaps. CRE Delta V – PA availability is 58%.
1514 day 3	1/14/09	All Sites	CRE - 1 missed msg. Doppler spike at QWE, BRE was primary.
1514 day 3	1/14/09	Alaska	ZLA clock drift faults: CRW – 8 (1s) missed messages. AK LPV/LPV200 Coverage drop.
1514 day 4	1/15/09	Alaska	CRW GUS switchover: APA faulted, APC to primary – 3s gap. AK LPV/LPV200 Coverage drop.
1514 day 4	1/15/09	All Sites	CRE GUS switchover: BRE faulted, QWE to primary - 12s gap.
1515 day 2 to 1515 day 3	1/20/09 to 1/21/09	All Sites	WEI Outage: 253931 – 308339.
1515 day 3	1/21/09	Napa	APC outage for maintenance.
1515 day 6	1/24/09	CRW	CRW – 592s outage. See DR #79 – Doppler Spike caused CRW Signal in Space Outage. AK LPV/LPV200 Coverage drop.
1516 day 3	1/27/09	CRE	CRE Delta V, CRE Delta-V and CCC trip caused CRE to be set to DNU. CRE PA availability = 52%. AK

GPS Week	Date	Sites	Events
			LPV/LPV200 Coverage drop.
1517 day 6	2/7/09	All Sites	CRE GUS switchover: QWE faulted, BRE to primary - 12s gap.
1518 day 2	2/10/09	Barrow, Kotzebue	CRW GUS switchover: APA faulted, APC to primary – 12s gap. AK LPV/LPV200 Coverage drop.
1518 day 3 to 1518 day 4	2/11/09 to 2/12/09	Barrow, Kotzebue	PRN19 outage (NANU2009003) affected Barrow and Kotzebue LPV availability.
1518 day 4	2/12/09	All Sites	WEI outage.
1518day 5	2/13/09	All Sites	WEI outage.
1518 day 5	2/13/09	CRW	CRW went to NPA for 15s due to Carrier Phase Anomaly.
1519 day 2	2/17/09	CRW	CRW – 2 (1s) missed messages due to Doppler Carrier Phase Spikes.
1519 day 3	2/18/09	All Sites	WEI outage.
1520 day 3	2/25/09	Alaska	CRW GUS manual switchover, APC to APA - 3s gap. AK LPV/LPV200 Coverage drop.
1520 day 4	2/26/09	Alaska	CRE GUS switchover: BRE faulted, QWE to primary - 11s gap. PRN26 DNU (NANU2009016). AK LPV/LPV200 Coverage drop.
1520 day 5	2/27/09	Barrow, Kotzebue	See DR #80 Ionospheric Scintillation caused High Position Error at Fairbanks and Kotzebue.
1521 day 0	3/1/09	Alaska	CRW GUS switchover: APA faulted, APC to primary – 9s gap. AK LPV/LPV200 Coverage drop.
1521 day 2	3/3/09	Alaska	CRW – 4 (3s and 1s) missed messages due to Doppler Spikes. PRN4 DNU (2009018). AK LPV/LPV200 Coverage drop.
1521 day 3	3/4/09	Alaska	CRW GUS switchover: APC to backup (did not fault), APA to primary. 3 missed messages due to Doppler Spikes. AK LPV/LPV200 Coverage drop.
1521 day 4	3/4/09	Alaska	CRW GUS switchover: APA faulted, APC to primary – 11s gap. AK LPV/LPV200 Coverage drop.
1521 day 4	3/5/09	All Sites	CRE GUS switchover: QWE to maintenance, BRE to primary. 3s gap. AK LPV/LPV200 Coverage drop.
1522 day 1	3/9/09	All Sites	WEI Outages.
1523 day 3	3/18/09	Juneau	Juneau satellite Communications 31613s outage.
1523 day 5	3/20/09	All Sites	CRW Source Selection switch, ZLA to ZTL - 1s Geo gap.
1524 day 5	3/27/09	All Sites	CRE GUS switchover: BRE to backup, QWE to primary - 3s gap.
1525 day 1	3/29/09	All Sites	See DR #78 – False WAAS satellite alert for PRN29.

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 1.267 meters at Arcata and 2.041 meters at Miami, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.573 meters at Denver and 0.846 meters at Salt Lake City, respectively. The maximum 95% and 99.999% NPA horizontal errors are 2.181 meters and 5.55 meters, both at Honolulu, respectively. The minimum 95% and 99.999% horizontal errors are 0.894 meters and 1.841 meters at Barrow, respectively. The high maximum NPA horizontal error observed at Barrow is due to a GUS switchover. Shortly after the GUS switchover, the receiver at Barrow observed high horizontal errors for just a few seconds as the receiver acquired new correction messages after initialization.

For this evaluation period, both CRW and CRE GEOs provide a ranging capability for enroute through NPA and PA service.

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	1.268	1.268	1.216	100	*	*
Oklahoma City	0.903	0.903	1.140	100	*	*
Albuquerque	0.640	0.640	0.892	100	2.154	4.095
Anchorage	0.560	0.560	1.149	100	*	*
Atlanta	0.795	0.795	1.054	100	2.441	4.538
Barrow	0.524	0.524	1.285	99.95866	*	*
Bethel	0.491	0.491	0.793	100	1.903	4.867
Billings	0.895	0.895	1.058	100	2.297	4.047
Boston	0.767	0.767	1.026	100	2.526	4.378
Chicago	0.884	0.884	0.852	100	*	*
Cleveland	0.667	0.667	0.847	100	2.569	4.292
Cold Bay	0.654	0.654	1.126	100	*	*
Dallas	0.587	0.587	1.045	100	*	*
Denver	0.573	0.573	0.938	100	*	*
Fairbanks	0.452	0.452	0.997	100	1.722	4.918
Gander	0.791	0.792	1.109	99.97215	*	*
Goose Bay	0.697	0.697	1.184	99.97224	*	*
Houston	0.781	0.781	1.289	100	2.157	4.499
Iqaluit	0.794	0.799	1.909	99.97111	*	*
Jacksonville	0.776	0.776	1.232	100	*	*
Juneau	0.604	0.604	0.854	100	*	*
Kansas City	0.654	0.654	0.805	100	2.494	4.244
Kotzebue	0.526	0.526	1.182	99.96030	1.751	4.942
Los Angeles	0.759	0.759	0.987	100	2.090	4.671
Memphis	0.655	0.655	0.942	100	*	*
Merida	0.637	0.637	1.404	100	*	*
Mexico City	0.640	0.640	1.379	100	*	*
Miami	0.904	0.904	2.041	100	2.285	4.866
Minneapolis	0.838	0.838	0.936	100	2.459	4.194
New York	0.944	0.944	1.062	100	*	*
Oakland	0.694	0.694	0.929	100	2.175	4.734
Puerto Vallarta	0.650	0.650	1.395	100	*	*
Salt Lake City	0.638	0.638	0.846	100	2.248	4.137
San Jose Del Cabo	0.657	0.657	1.482	100	*	*
San Juan	1.037	1.148	1.700	100	*	*
Seattle	0.841	0.841	0.848	100	2.236	4.369
Tapachula	0.803	0.804	1.705	100	*	*
Washington DC	0.750	0.750	1.070	100	2.630	4.437
Winnipeg	0.797	0.797	1.089	100	*	*

* SPS accuracy not computed for this location.

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

Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	1.010	2.158	100	2.315
Anchorage	1.166	2.545	100	2.66
Atlanta	1.272	2.179	100	2.475
Barrow	0.894	1.841	99.982	7.838
Bethel	1.125	2.147	100	2.567
Billings	1.627	2.786	100	3.054
Boston	1.476	2.643	100	2.748
Cleveland	1.277	2.433	100	2.803
Cold Bay	1.232	2.163	100	2.536
Fairbanks	1.046	2.408	100	2.547
Gander	1.503	3.101	99.991	3.842
Honolulu	2.181	5.555	100	5.834
Houston	1.243	2.481	100	2.774
Iqaluit	0.994	2.234	99.992	3.503
Juneau	1.038	2.143	100	2.248
Kansas City	1.351	2.231	100	2.989
Kotzebue	1.046	2.697	99.983	2.957
Los Angeles	0.982	2.179	100	2.407
Merida	1.244	3.196	100	3.775
Miami	1.273	2.356	100	2.494
Minneapolis	1.538	2.653	100	4.934
Oakland	1.339	2.723	100	2.917
Salt Lake City	1.190	2.037	100	2.166
San Jose Del Cabo	1.041	3.189	100	3.370
San Juan	1.217	2.876	100	3.040
Seattle	1.407	2.969	100	3.294
Tapachula	1.721	4.215	100	4.556
Washington DC	1.601	2.718	100	2.825

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	3.211	0.219	0.230	7.179	0.213	0.225
Oklahoma City	2.019	0.157	0.219	3.640	0.161	0.184
Albuquerque	1.694	0.178	0.178	3.446	0.096	0.133
Anchorage	1.716	0.123	0.130	4.110	0.171	0.171
Atlanta	1.857	0.190	0.193	3.873	0.183	0.199
Barrow	2.449	0.168	0.168	4.851	0.196	0.196
Bethel	1.336	0.097	0.097	2.925	0.080	0.102
Billings	1.965	0.179	0.183	3.152	0.145	0.145
Boston	2.729	0.214	0.214	2.777	0.129	0.133
Chicago	1.870	0.128	0.195	4.046	0.184	0.184
Cleveland	1.651	0.119	0.159	3.266	0.142	0.150
Cold Bay	2.916	0.112	0.127	4.181	0.088	0.129
Dallas	1.834	0.176	0.176	2.825	0.167	0.202
Denver	1.803	0.173	0.173	3.326	0.163	0.176
Fairbanks	1.965	0.130	0.157	8.018	0.226	0.226
Gander	3.152	0.106	0.112	3.143	0.092	0.098
Goose Bay	1.837	0.073	0.129	3.359	0.067	0.118
Houston	1.930	0.154	0.173	3.051	0.172	0.194
Iqaluit	2.963	0.145	0.178	5.817	0.223	0.223
Jacksonville	1.639	0.148	0.161	3.451	0.140	0.160
Juneau	1.722	0.136	0.136	3.328	0.185	0.185
Kansas City	1.435	0.160	0.177	2.410	0.147	0.147
Kotzebue	1.837	0.108	0.119	7.226	0.153	0.153
Los Angeles	2.220	0.190	0.190	3.657	0.121	0.147
Memphis	1.598	0.184	0.184	2.838	0.129	0.146
Merida	1.458	0.076	0.125	3.262	0.105	0.143
Mexico City	2.022	0.097	0.107	3.111	0.093	0.138
Miami	1.990	0.153	0.174	4.462	0.155	0.198
Minneapolis	2.258	0.083	0.191	3.138	0.141	0.187
New York	1.926	0.154	0.168	3.502	0.120	0.195
Oakland	2.443	0.186	0.186	3.955	0.148	0.148
Puerto Vallarta	1.713	0.091	0.086	3.734	0.090	0.131
Salt Lake City	1.555	0.144	0.145	2.819	0.129	0.129
San Jose Del Cabo	1.940	0.092	0.120	3.873	0.138	0.140
San Juan	2.922	0.090	0.090	5.635	0.138	0.138
Seattle	2.682	0.136	0.163	3.226	0.174	0.184
Tapachula	2.324	0.062	0.110	4.179	0.112	0.137
Washington DC	1.620	0.119	0.161	3.168	0.127	0.167
Winnipeg	1.812	0.111	0.158	3.172	0.123	0.149

Figure 2-1 95% Horizontal Accuracy at LPV

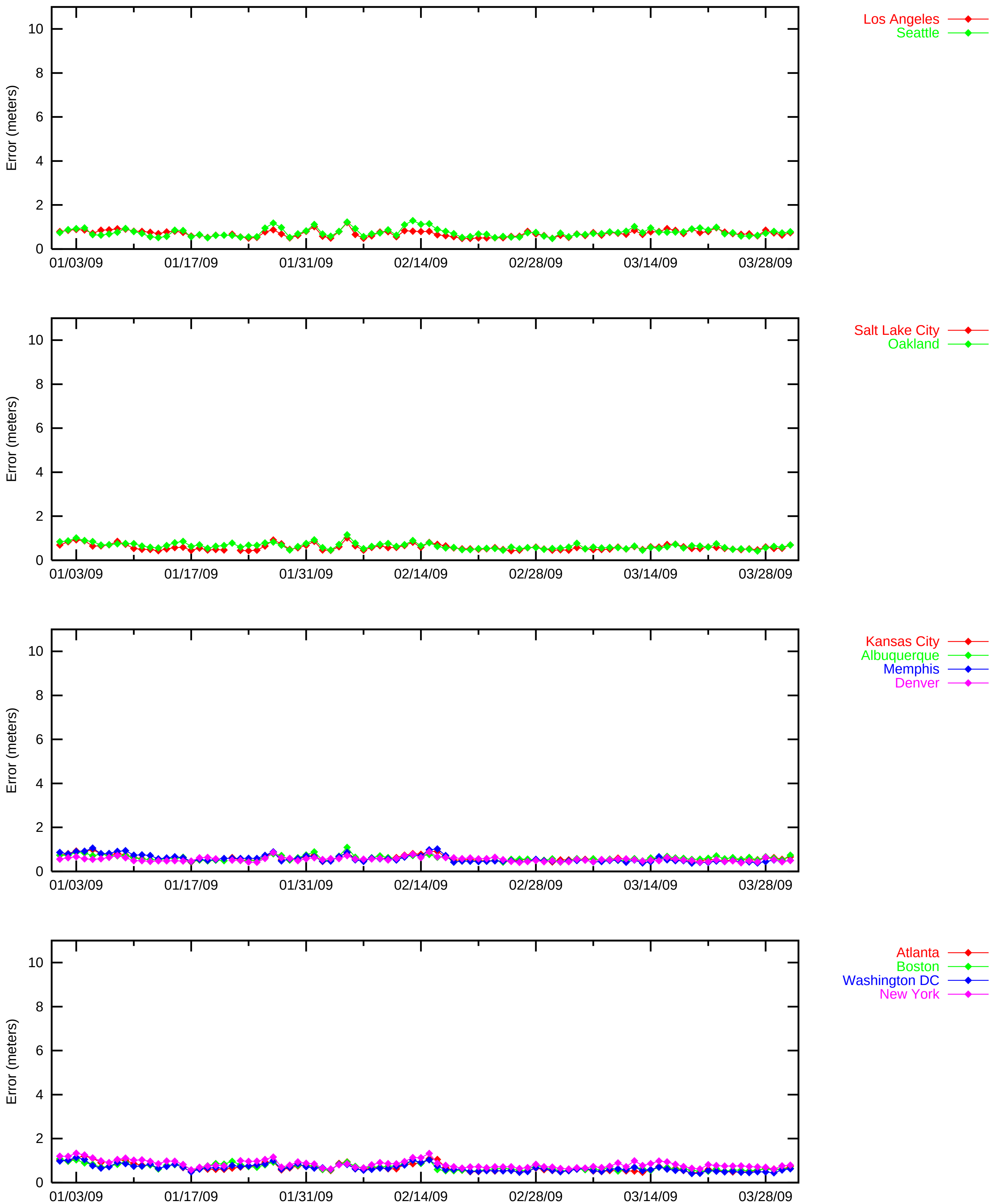


Figure 2-2 95% Horizontal Accuracy at LPV

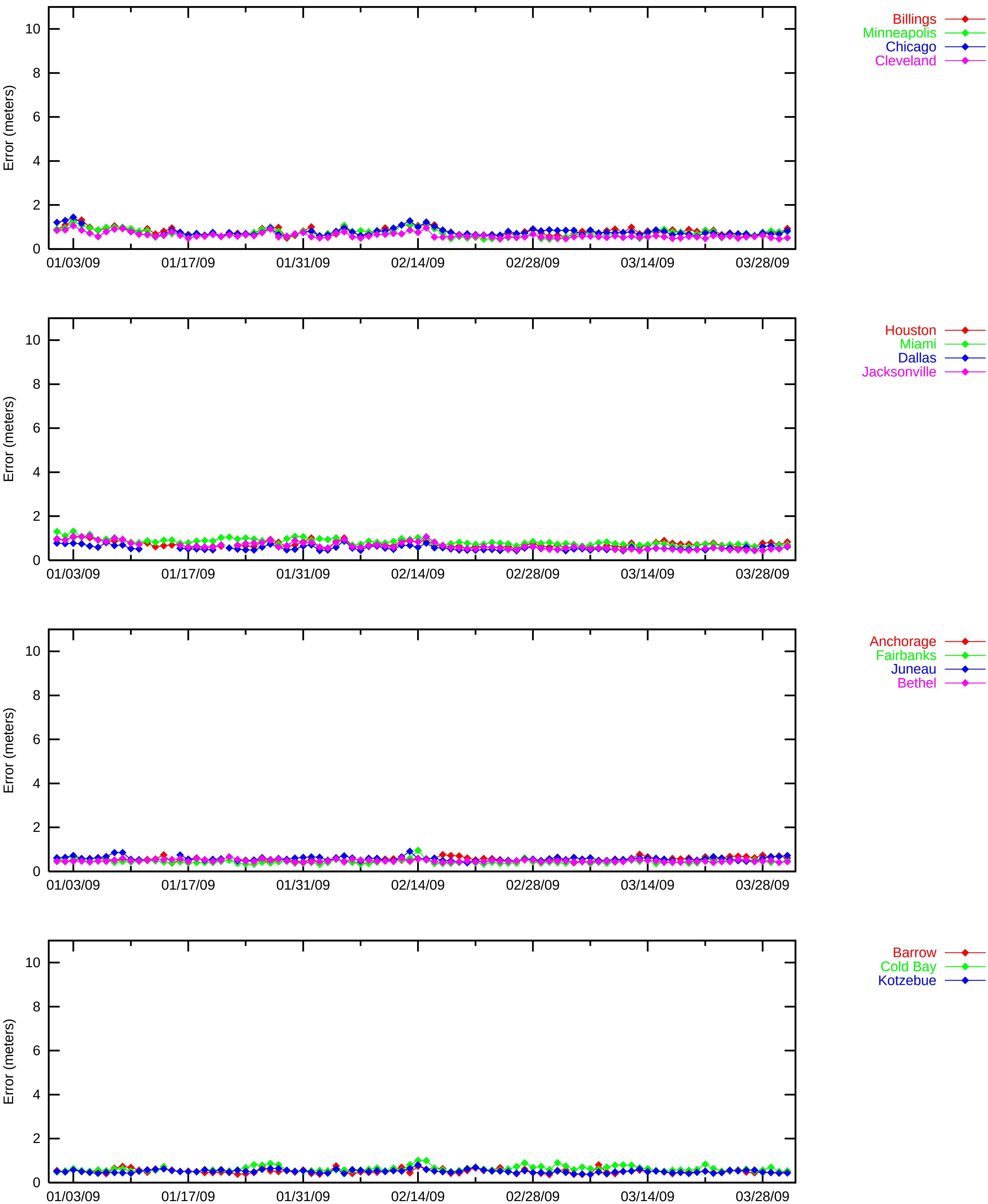


Figure 2-3 95% Horizontal Accuracy at LPV

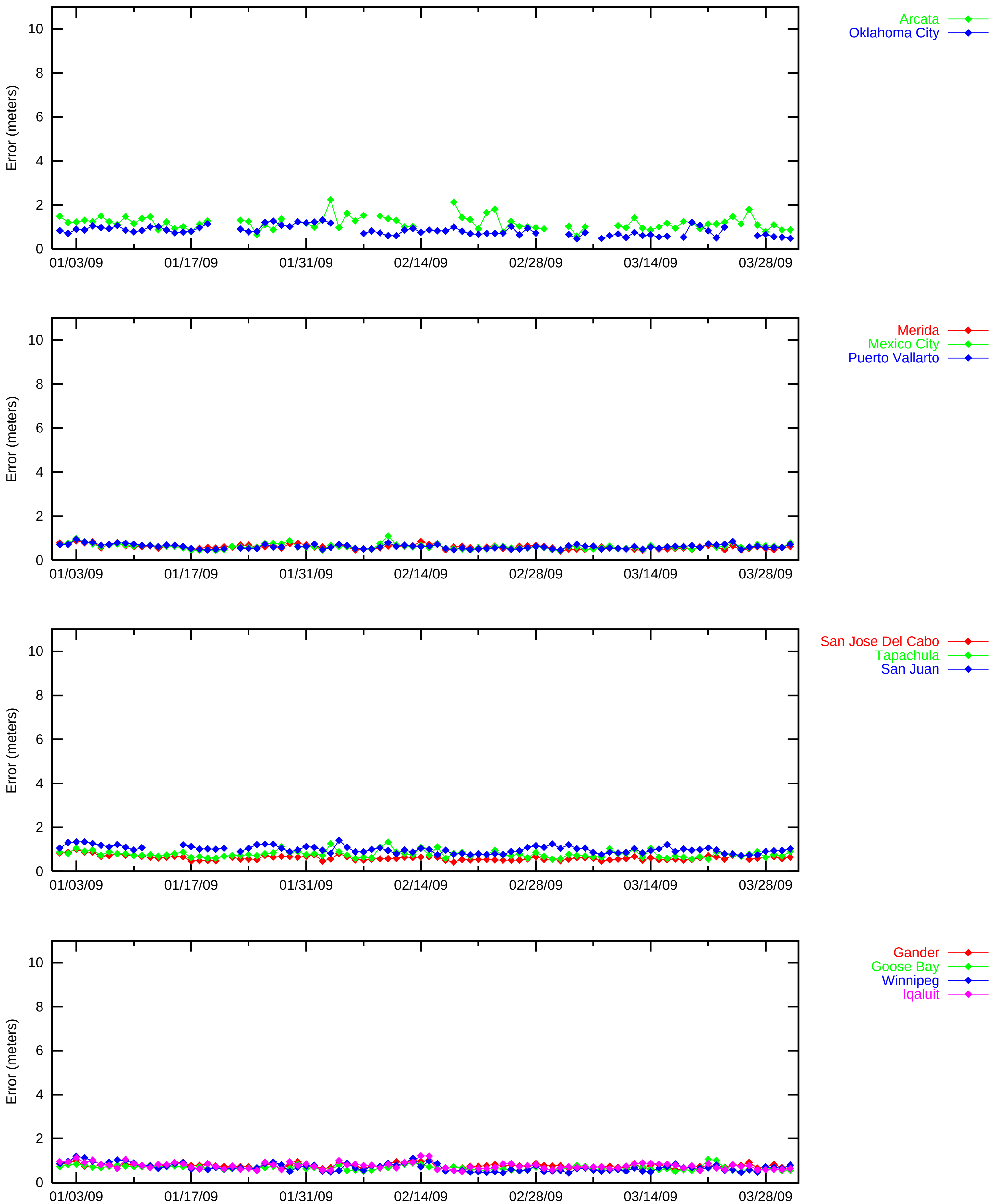


Figure 2-4 95% Vertical Accuracy at LPV

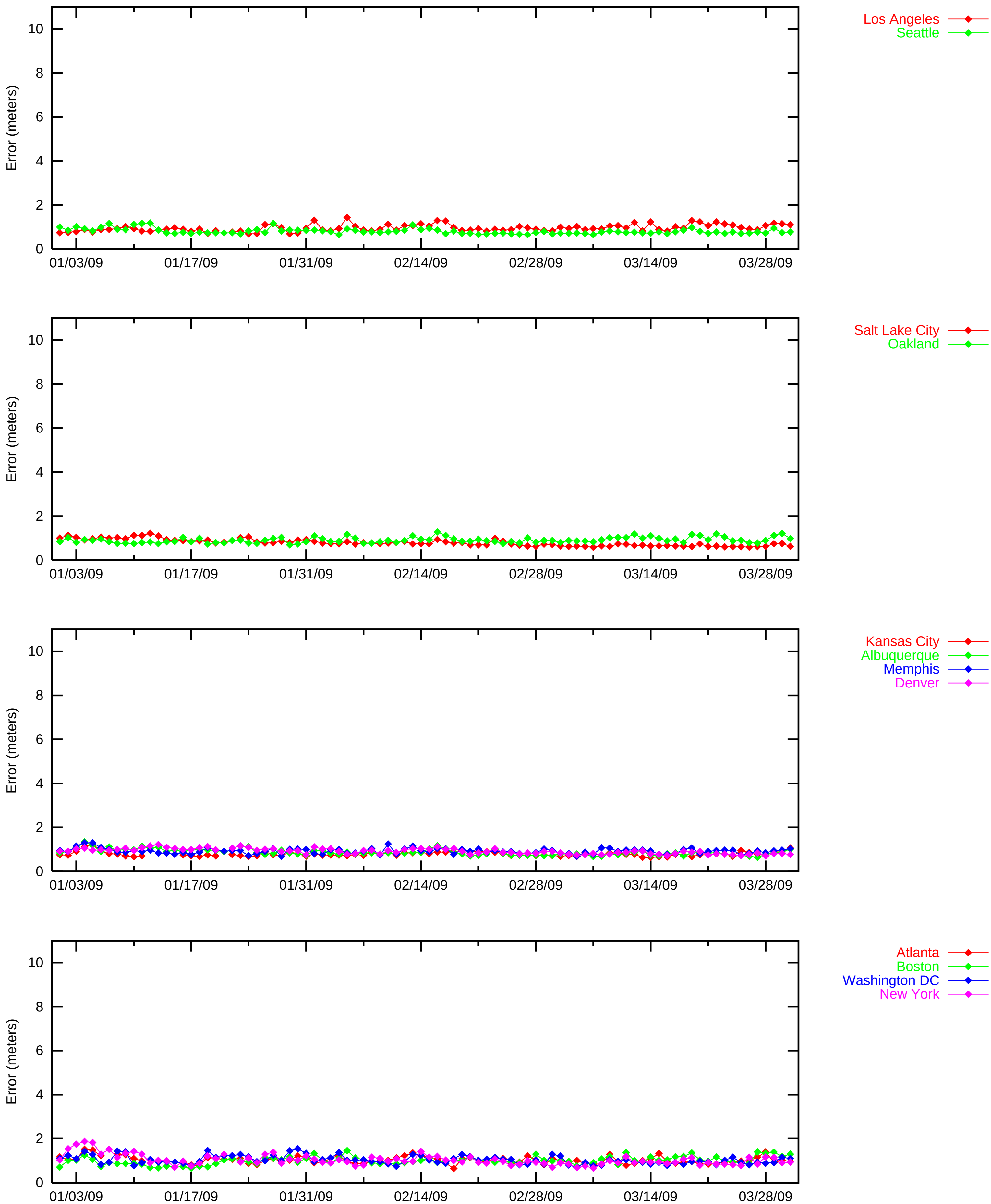


Figure 2-5 95% Vertical Accuracy at LPV

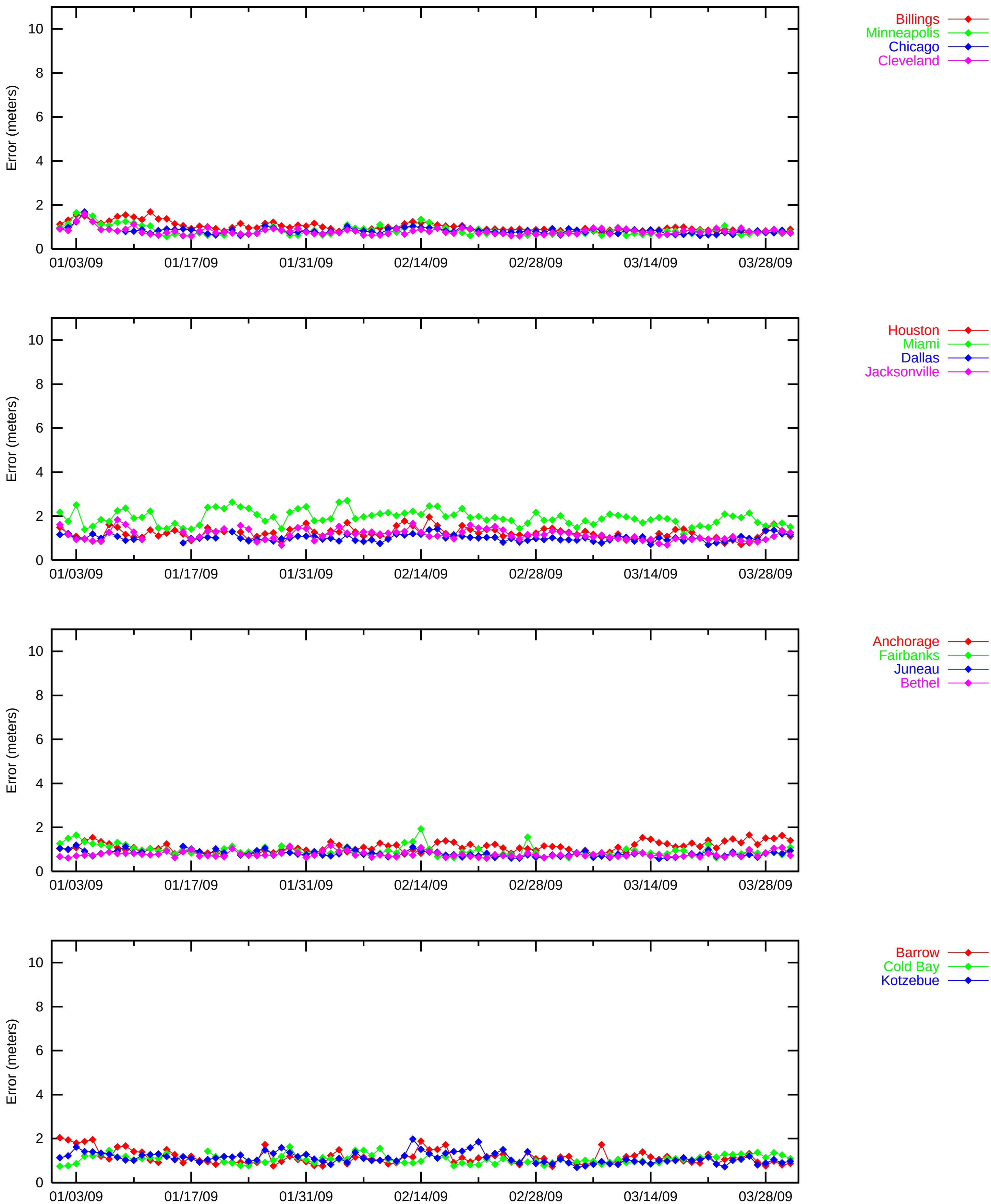


Figure 2-6 95% Vertical Accuracy at LPV

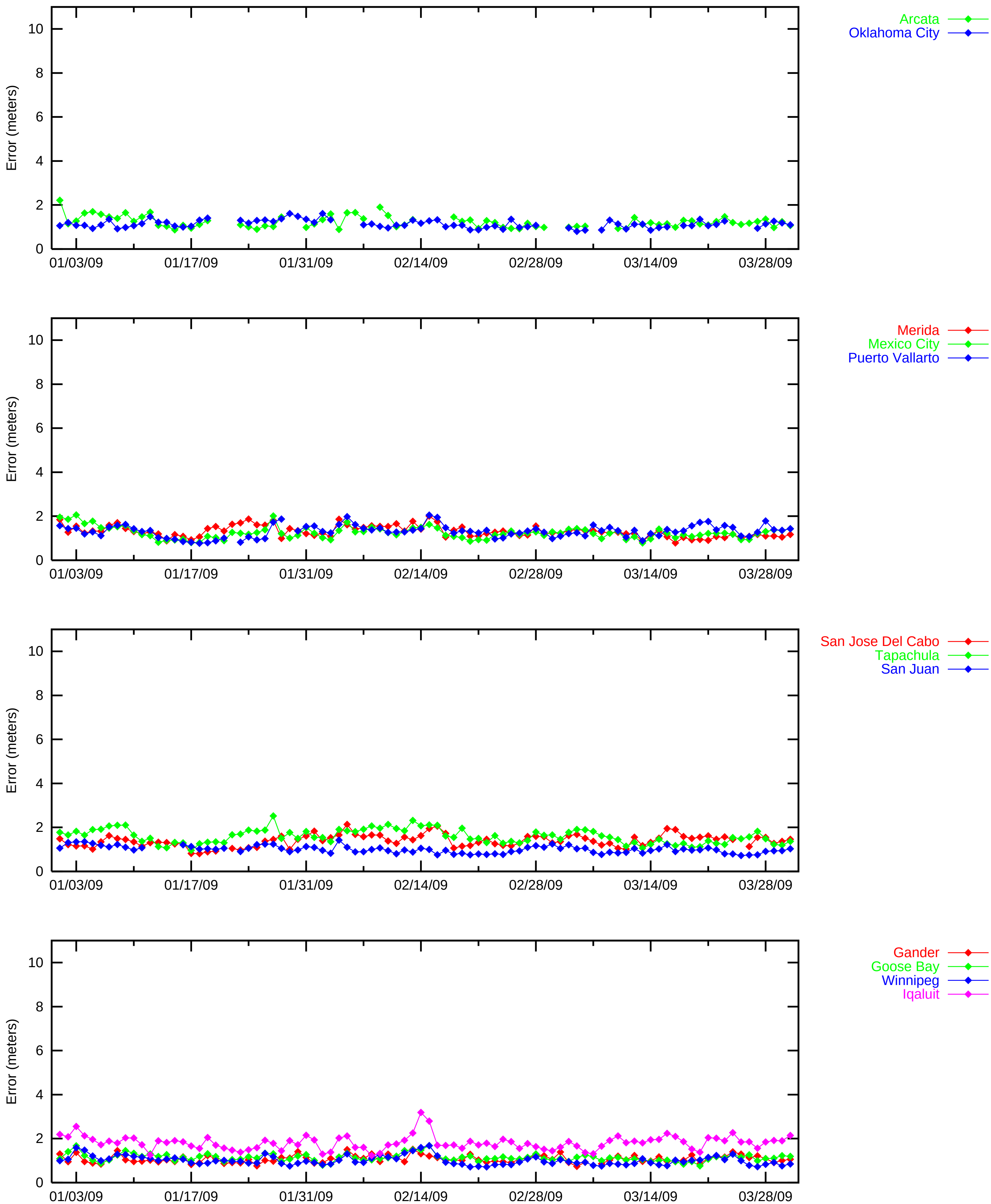


Figure 2-7 95% NPA Horizontal Accuracy

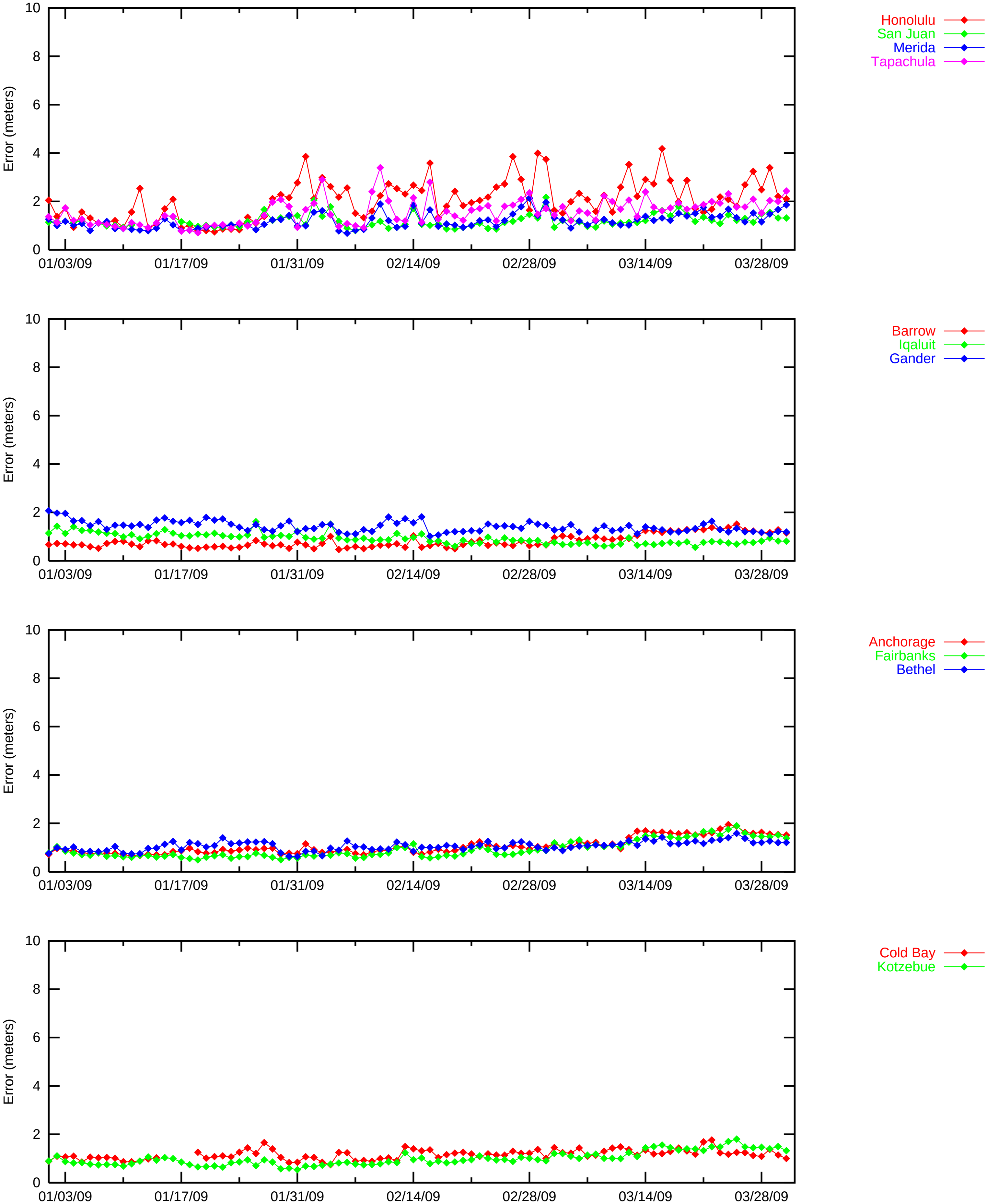
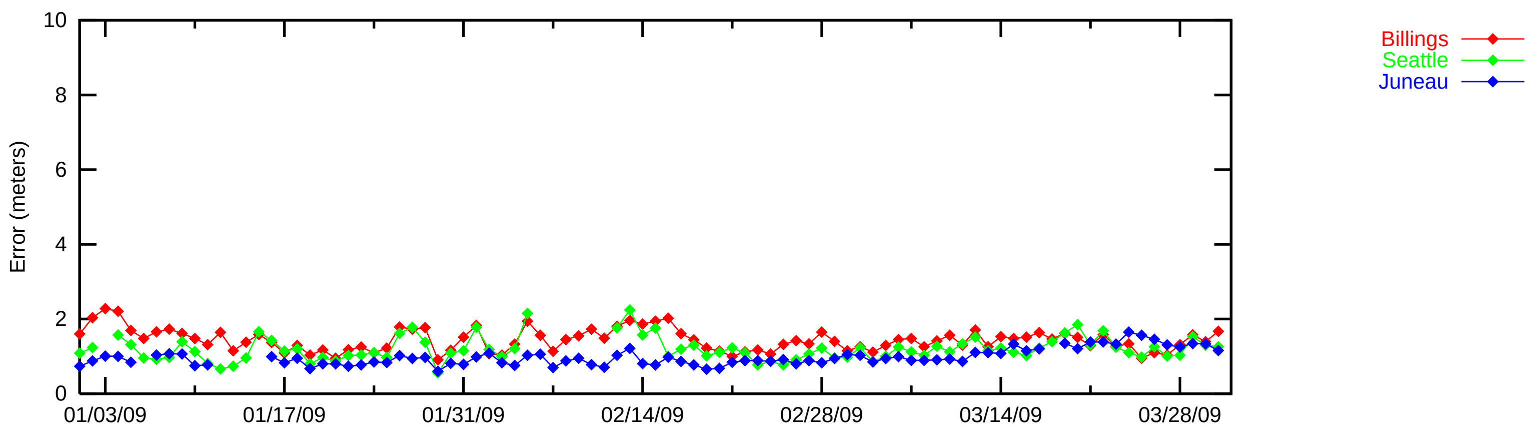
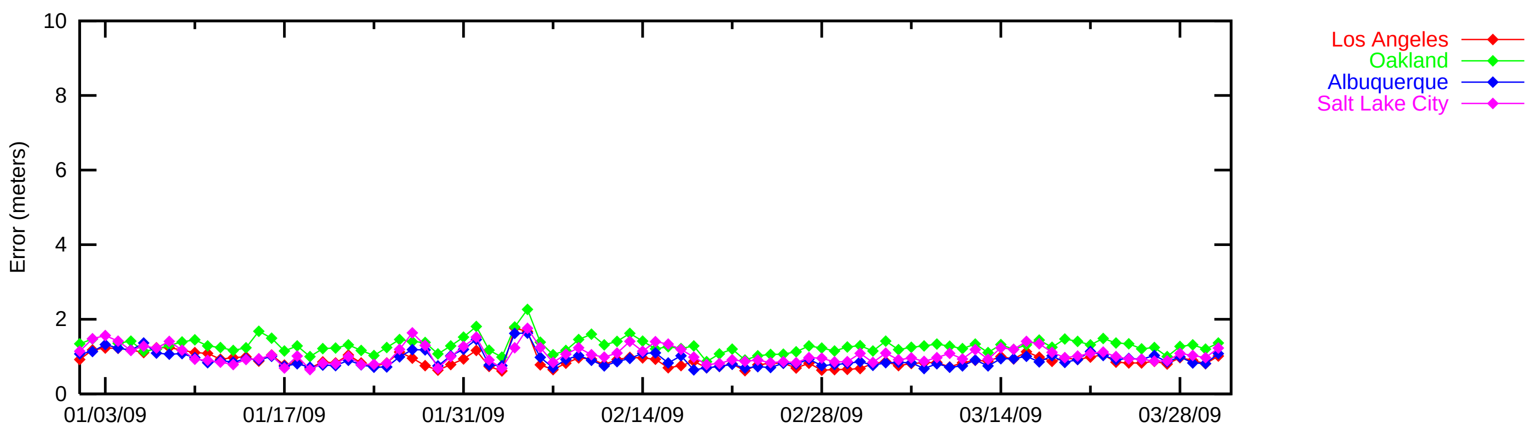
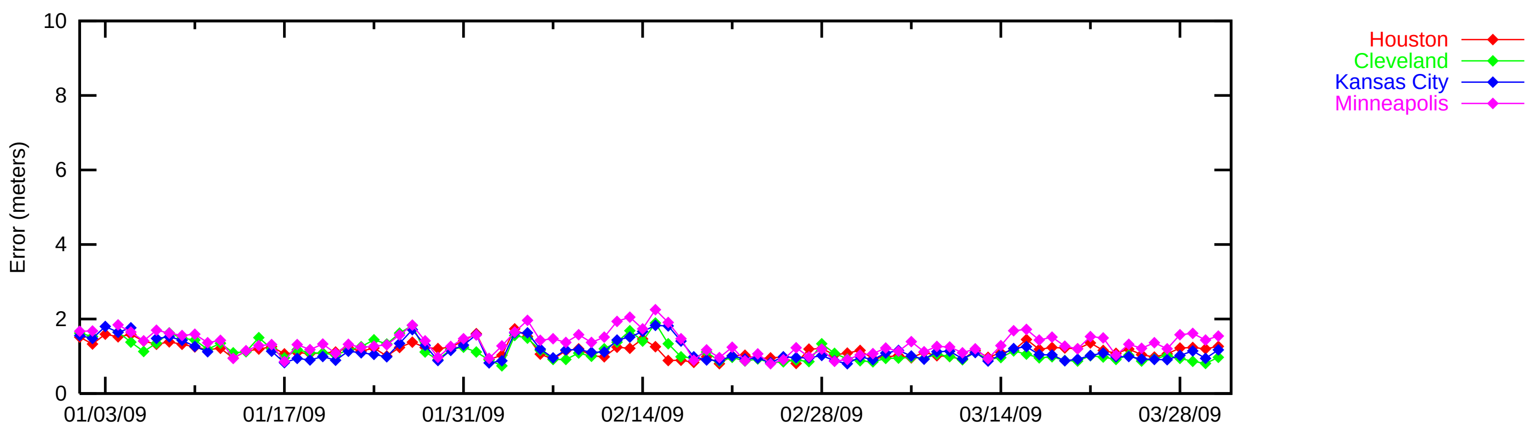


Figure 2-8 95% NPA Horizontal Accuracy







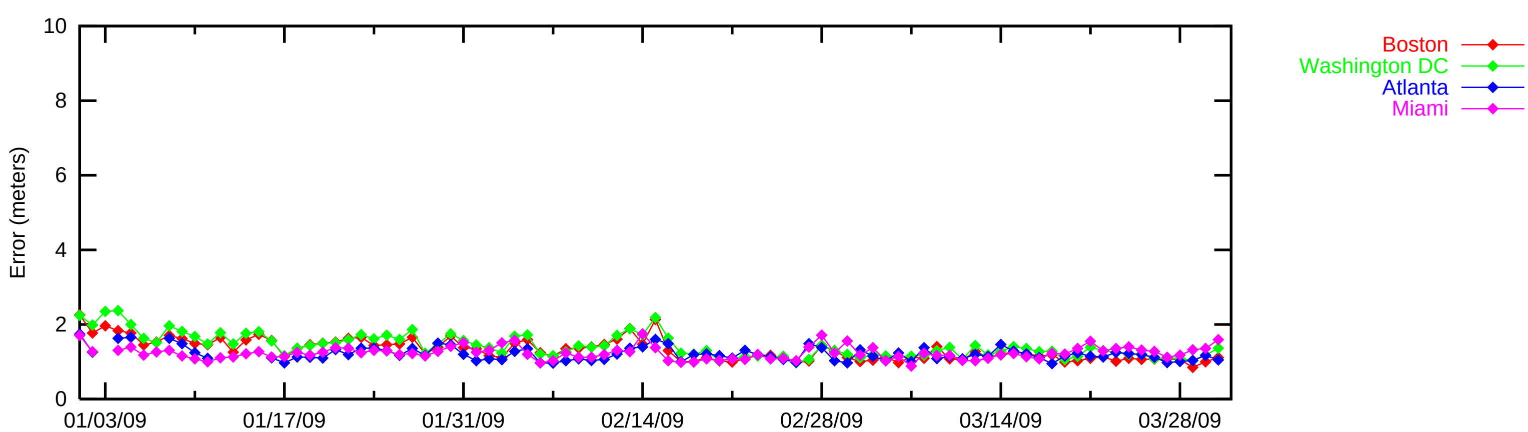


Figure 2-9 Horizontal Triangle Chart for the Quarter

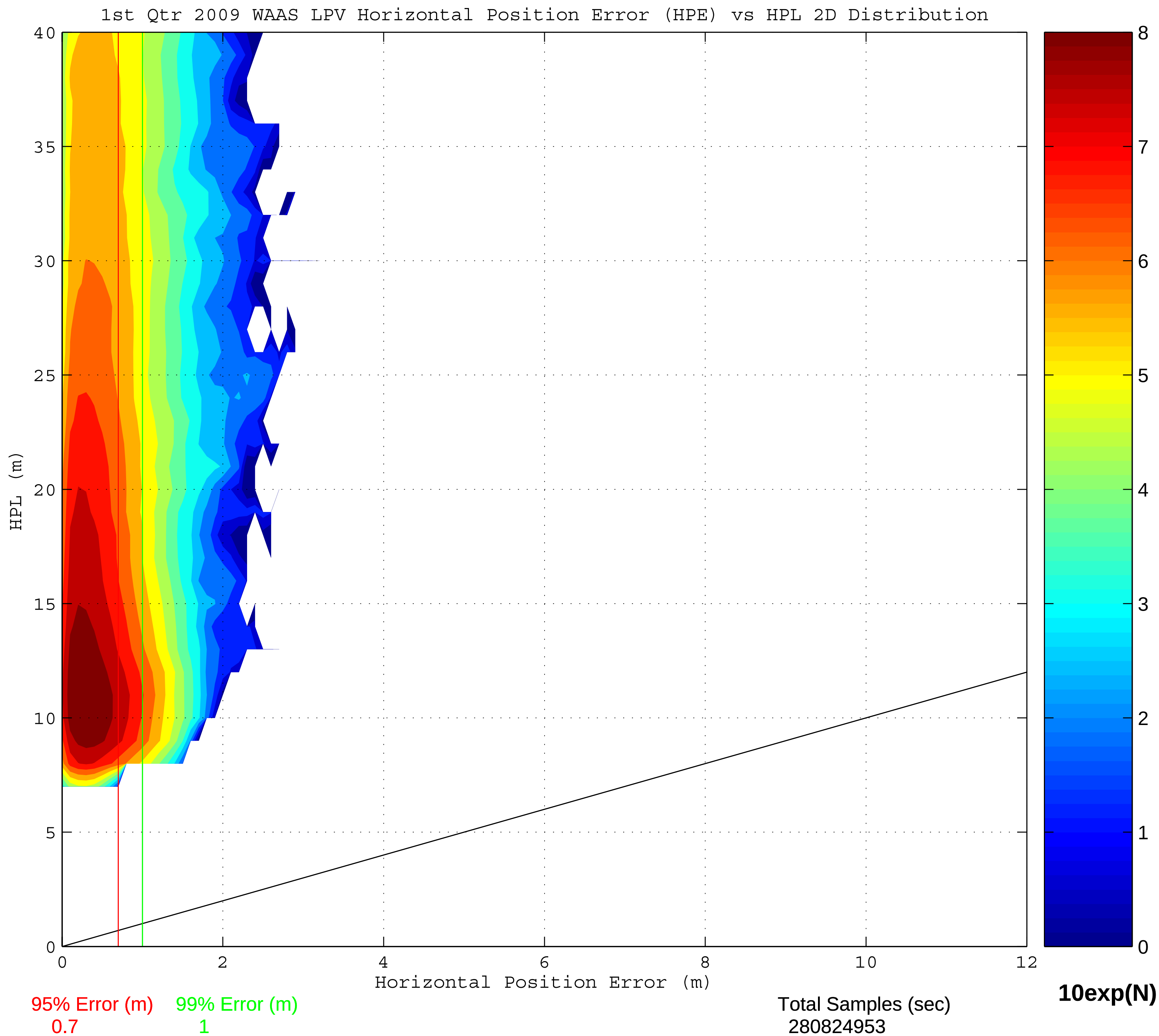


Figure 2-10 Vertical Triangle Chart for the Quarter

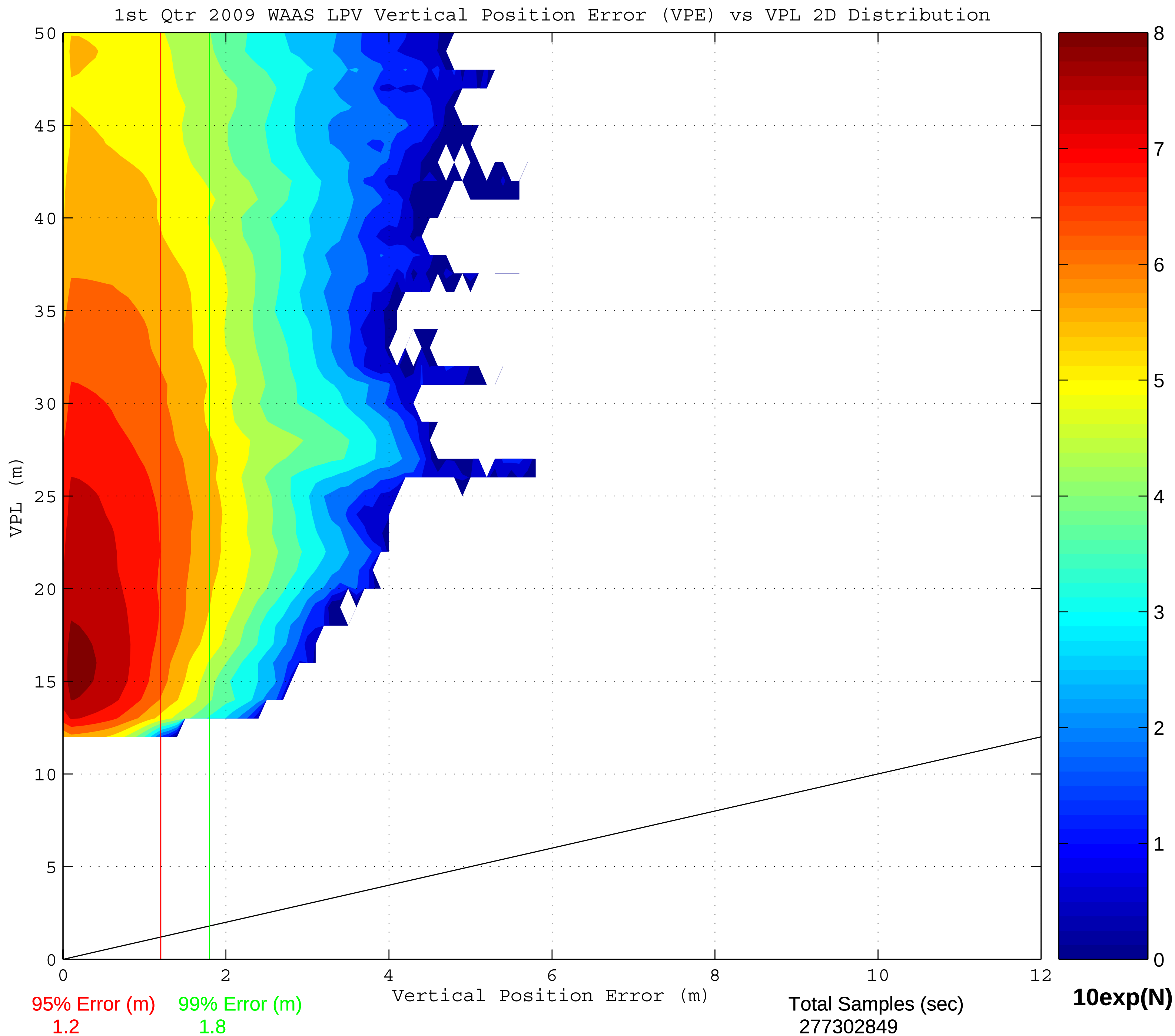


Figure 2-11 2-D Horizontal Histogram for the Quarter

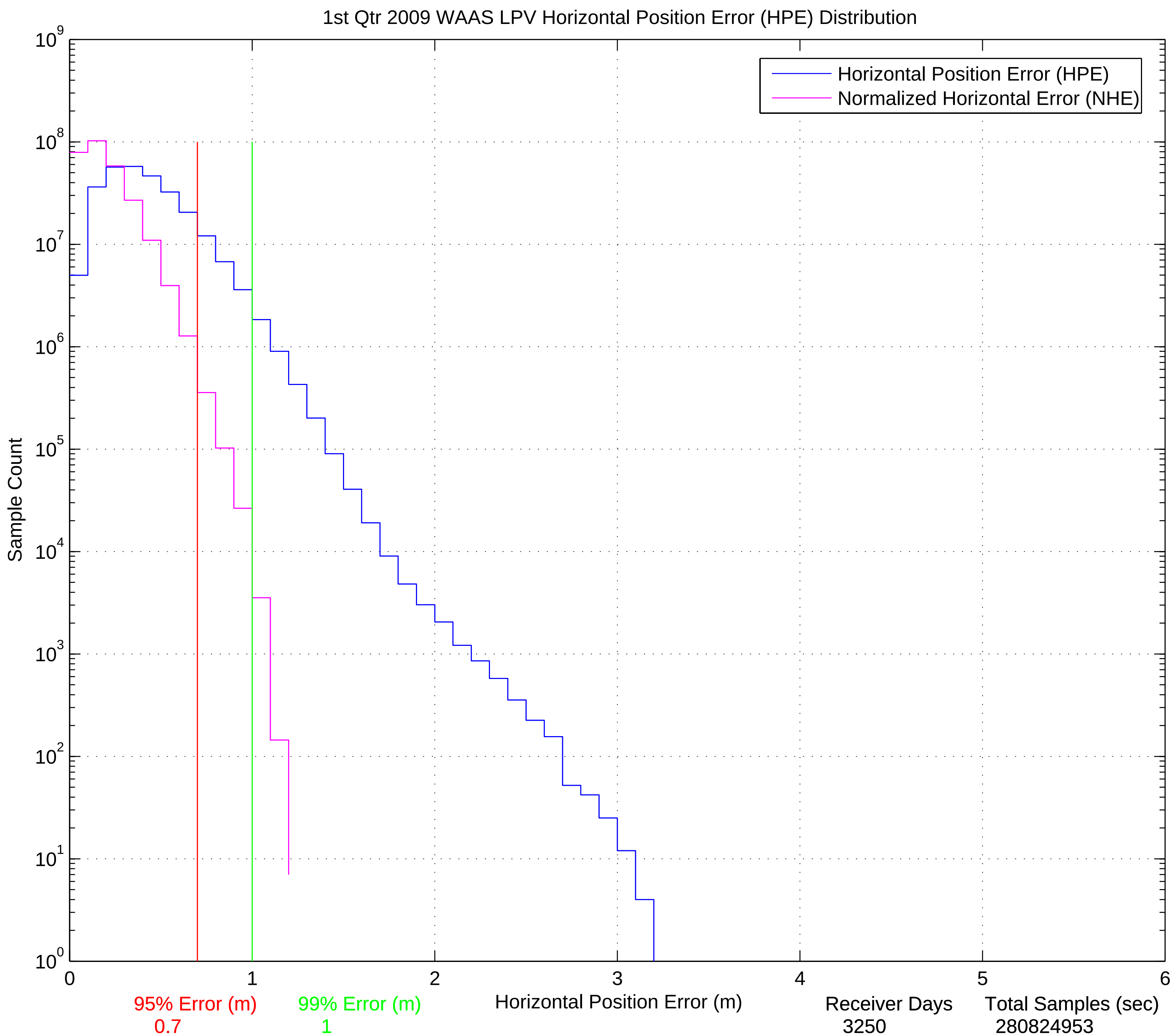
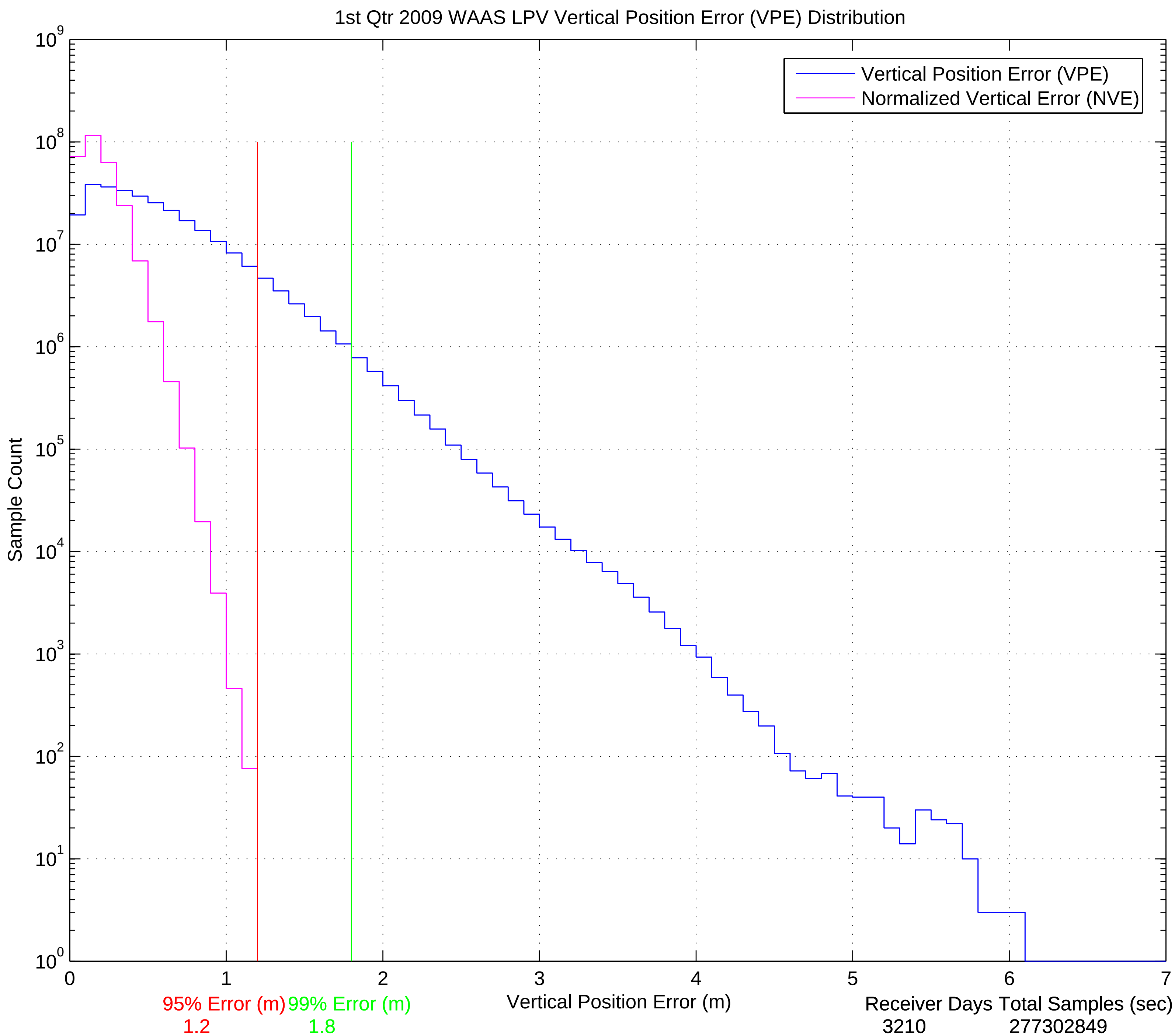


Figure 2-12 2-D Vertical Histogram for the Quarter



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 16.216 meters	Memphis 11.306 meters	Cold Bay 25.551 meters	Fairbanks 12.941 meters
95% VPL	Arcata 3`.47 meters	Memphis 19.17 meters	Cold Bay 37.247 meters	Juneau 22.082 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 reporting period, NPA outages at Iqaluit and Gander are mainly due to CRE GUS switchovers and NPA outages at Barrow and Kotzebue are due to CRW GUS switchovers. A Doppler spike caused CRW signal in space outage on 1/24/2009 (see DR #79). Ionospheric Scintillation caused high position error at Fairbanks and Kotzebue on 2/27/2009 (see DR #80).

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	16.216	31.302	100
Oklahoma City	11.528	20.859	100
Albuquerque	12.213	22.338	100
Anchorage	13.509	23.125	100
Atlanta	11.640	21.190	100
Barrow	18.223	36.876	99.958660
Bethel	16.790	27.986	100
Billings	13.058	20.814	100
Boston	15.343	21.574	100
Chicago	12.366	19.766	100
Cleveland	13.469	21.778	100
Cold Bay	25.551	37.247	100
Dallas	11.410	21.242	100
Denver	11.590	21.406	100
Fairbanks	12.941	24.285	100
Gander	25.052	37.716	99.972150
Goose Bay	20.351	28.265	99.972240
Houston	11.622	21.404	100
Iqaluit	29.214	40.415	99.971110
Jacksonville	11.951	23.348	100
Juneau	13.246	22.082	100
Kansas City	11.643	19.660	100
Kotzebue	16.045	32.405	99.960300
Los Angeles	15.064	27.435	100
Memphis	11.306	19.170	100
Merida	16.640	31.079	100
Mexico City	20.190	33.669	100
Miami	13.579	26.731	100
Minneapolis	13.057	19.625	100
New York	14.684	21.574	100
Oakland	15.743	31.470	100
Puerto Vallarta	22.451	35.672	100
Salt Lake City	11.914	21.746	100
San Jose Del Cabo	21.199	35.240	100
San Juan	59.036	85.968	100
Seattle	13.905	23.512	100
Tapachula	31.463	50.180	100
Washington DC	13.729	22.538	100
Winnipeg	15.394	21.353	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	0.99987491	0.97699972
Oklahoma City	1	0.99999649
Albuquerque	1	0.99809704
Anchorage	1	1
Atlanta	1	1
Barrow	0.99242055	0.90902147
Bethel	1	0.99535751
Billings	1	0.9999999
Boston	1	1
Chicago	1	1
Cleveland	1	1
Cold Bay	0.99862659	0.90182653
Dallas	1	0.99998529
Denver	1	0.99998724
Fairbanks	0.99999691	0.99995930
Gander	0.99546115	0.86632809
Goose Bay	0.99963044	0.99523414
Houston	1	0.99999583
Iqaluit	0.97471374	0.83063925
Jacksonville	1	0.99996569
Juneau	0.99997968	0.99997762
Kansas City	1	0.99999728
Kotzebue	0.99861994	0.96482798
Los Angeles	1	0.99886813
Memphis	1	0.99999691
Merida	0.99996946	0.98231913
Mexico City	0.99996059	0.95747266
Miami	1	0.99994898
Minneapolis	1	0.99999753
New York	1	0.9999999
Oakland	0.99990249	0.97001212
Puerto Vallarta	0.99936838	0.90605158
Salt Lake City	1	0.99999675
San Jose Del Cabo	0.99983424	0.93430734
San Juan	0.18580550	0.01877699
Seattle	1	0.99988832
Tapachula	0.92425444	0.42812469
Washington DC	1	1
Winnipeg	1	1

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	100
Anchorage	100
Atlanta	100
Barrow	99.98247
Bethel	100
Billings	100
Boston	100
Cleveland	100
Cold Bay	100
Fairbanks	100
Gander	99.99144
Honolulu	100
Houston	100
Iqaluit	99.99166
Juneau	100
Kansas City	100
Kotzebue	99.98254
Los Angeles	100
Merida	100
Miami	100
Minneapolis	100
Oakland	100
Salt Lake City	100
San Jose Del Cabo	100
San Juan	100
Seattle	100
Tapachula	100
Washington DC	100

Table 3-4 LPV and LPV 200 Outage Rate

Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	2	0.000045	155	0.003587
Oklahoma City	0	0.00	1	0.000022
Albuquerque	0	0.00	72	0.001409
Anchorage	0	0.00	0	0.00
Atlanta	0	0.00	0	0.00
Barrow	93	0.001811	645	0.013712
Bethel	0	0.00	71	0.001378
Billings	0	0.00	1	0.000019
Boston	0	0.00	0	0.00
Chicago	0	0.00	0	0.00
Cleveland	0	0.00	0	0.00
Cold Bay	36	0.000722	567	0.012597
Dallas	0	0.00	3	0.000061
Denver	0	0.00	2	0.000039
Fairbanks	1	0.000019	6	0.000116
Gander	62	0.001213	551	0.012387
Goose Bay	9	0.000174	87	0.001689
Houston	0	0.00	3	0.000059
Iqaluit	244	0.004858	1084	0.025326
Jacksonville	0	0.00	1	0.000020
Juneau	1	0.000021	1	0.000021
Kansas City	0	0.00	1	0.000020
Kotzebue	27	0.000523	335	0.006717
Los Angeles	0	0.00	27	0.000528
Memphis	0	0.00	1	0.000019
Merida	1	0.000019	180	0.003542
Mexico City	4	0.000077	384	0.007749
Miami	0	0.00	5	0.000097
Minneapolis	0	0.00	1	0.000020
New York	0	0.00	1	0.000020
Oakland	1	0.000019	311	0.006195
Puerto Vallarta	44	0.000871	610	0.013314
Salt Lake City	0	0.00	2	0.000039
San Jose Del Cabo	21	0.000413	365	0.007679
San Juan	718	0.081483	139	0.156094
Seattle	0	0.00	3	0.000058
Tapachula	659	0.013776	1255	0.056639
Washington DC	0	0.00	0	0.00
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	11	0.00021261
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	8	0.00015583
Honolulu	0	0
Houston	0	0
Iqaluit	8	0.00015517
Juneau	0	0
Kansas City	0	0
Kotzebue	11	0.00021285
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)

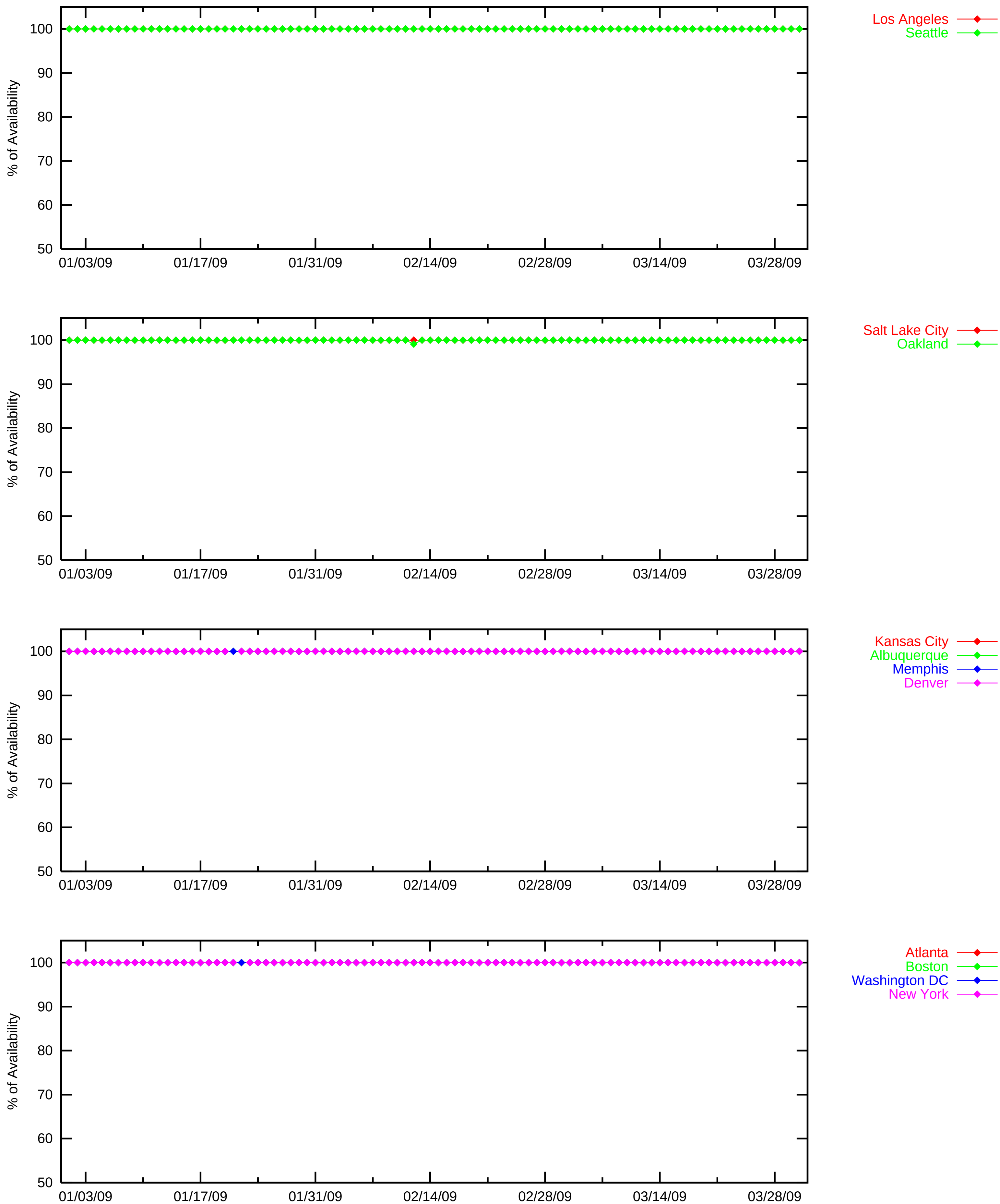


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

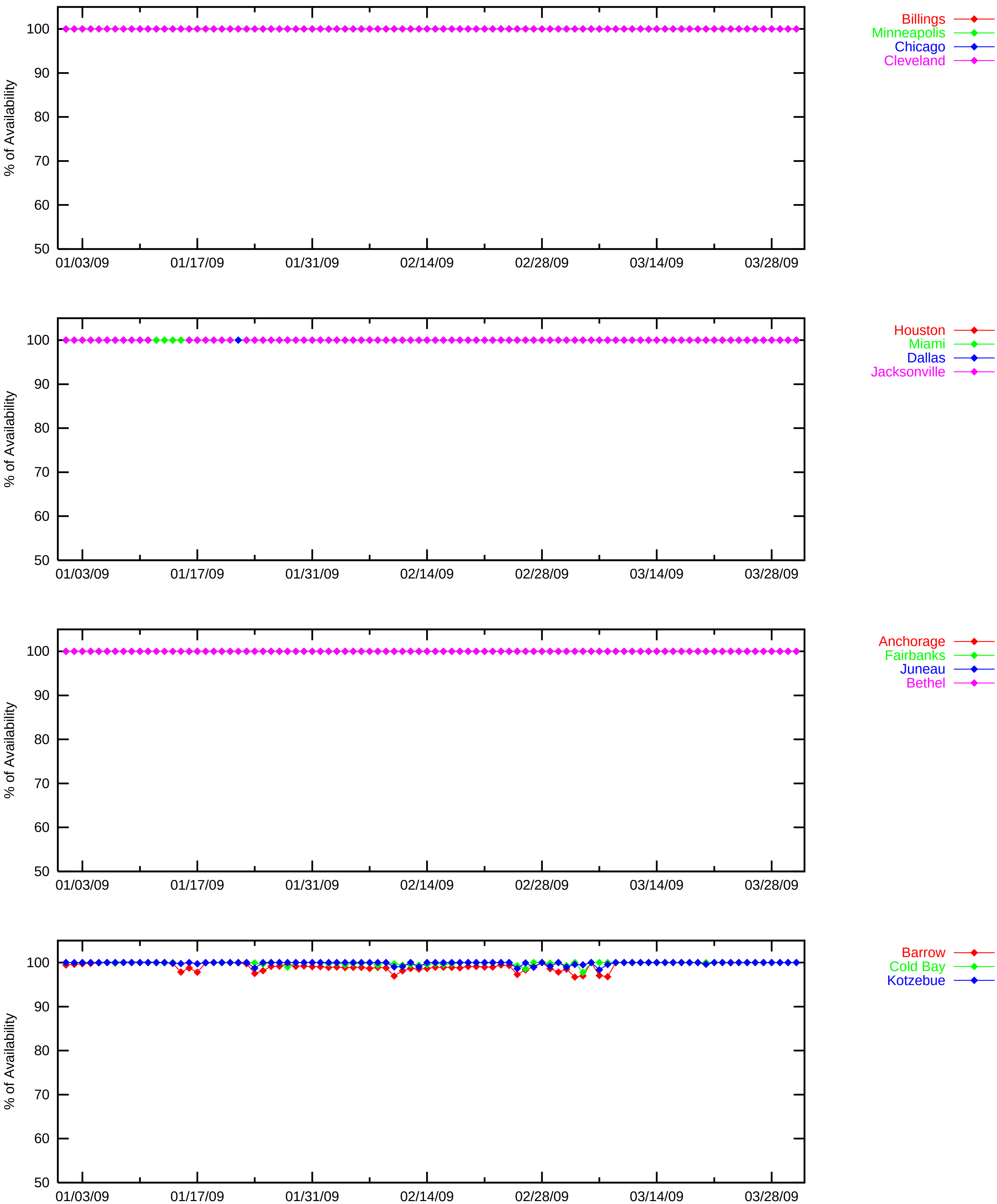


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

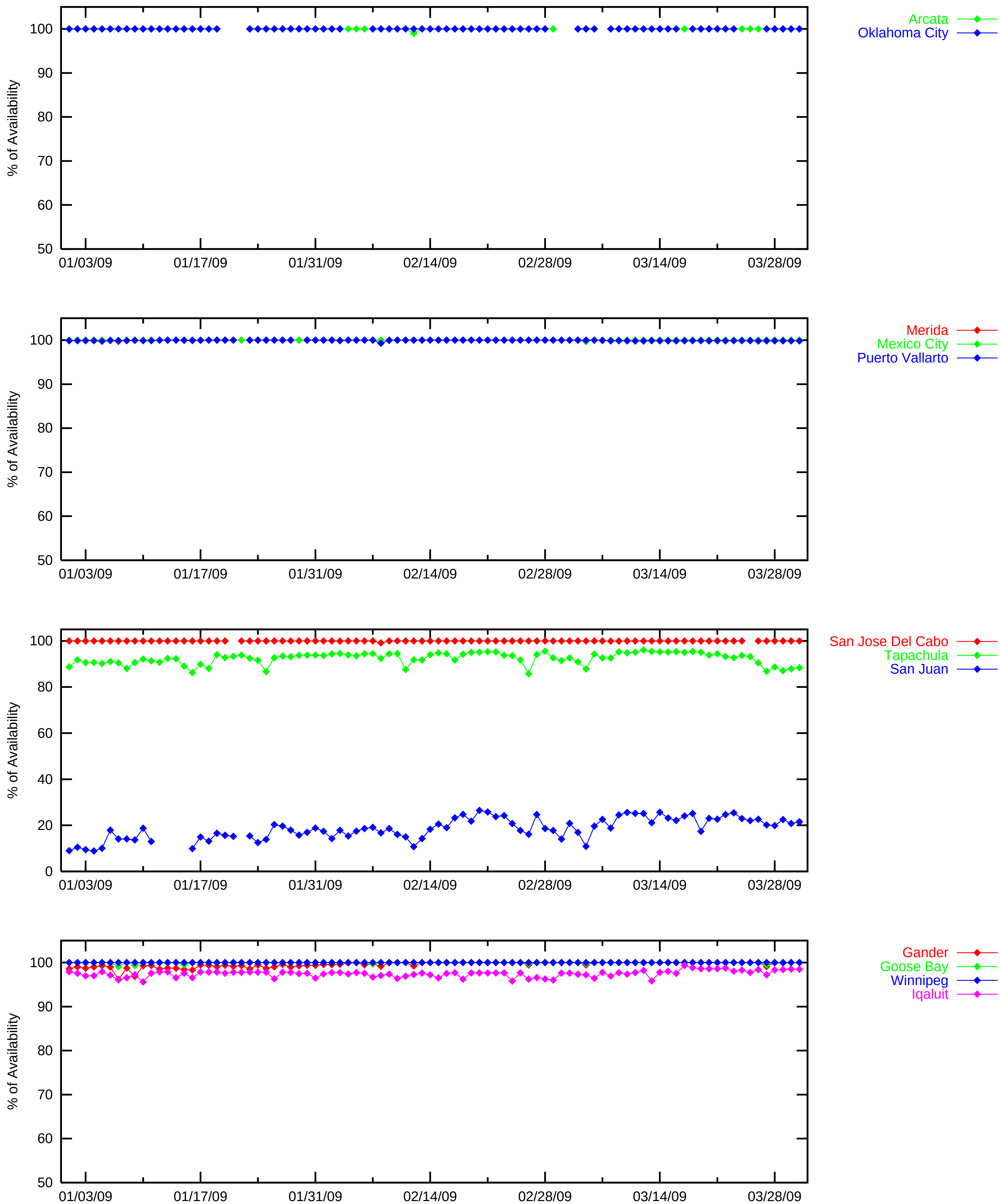


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

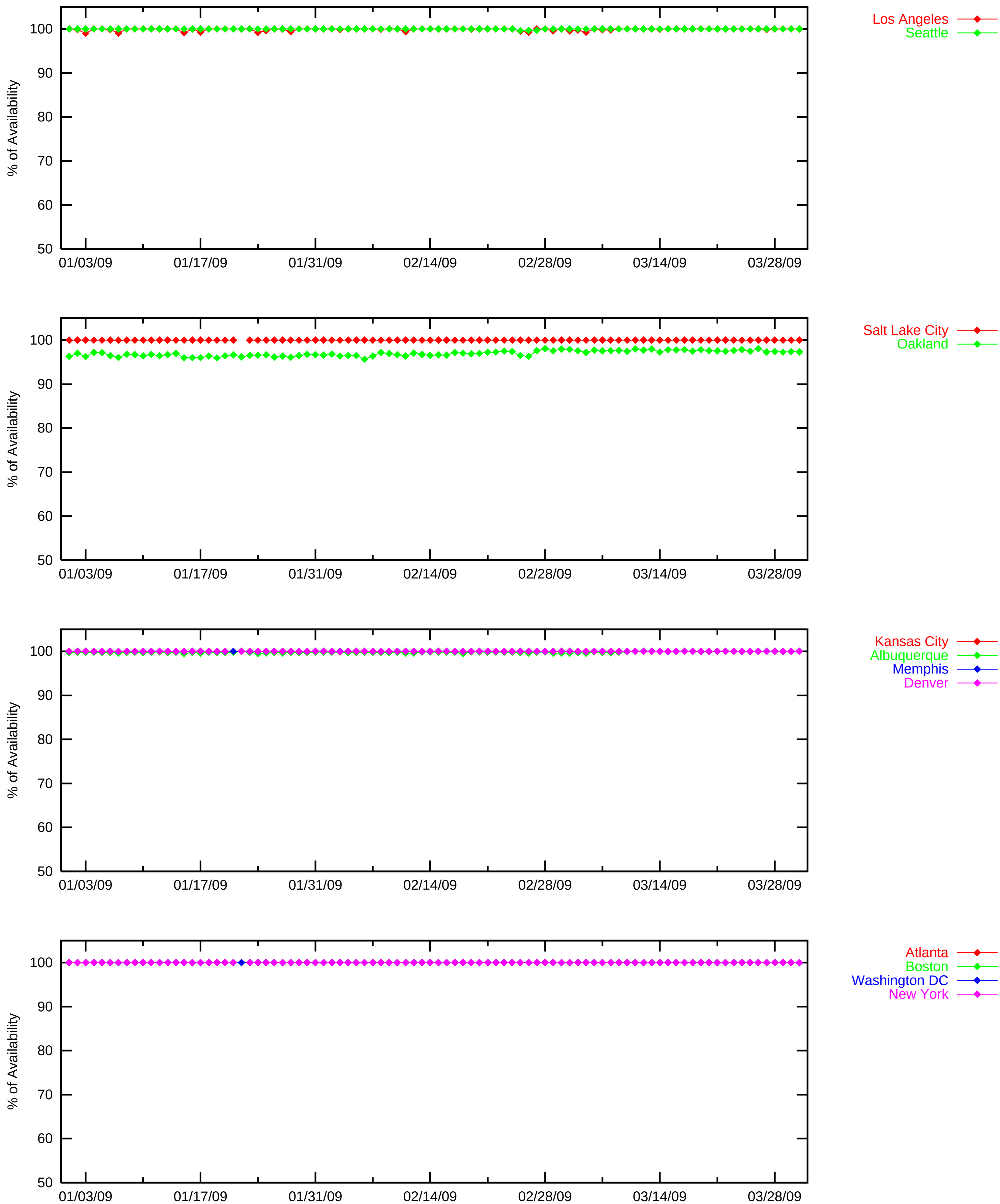


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

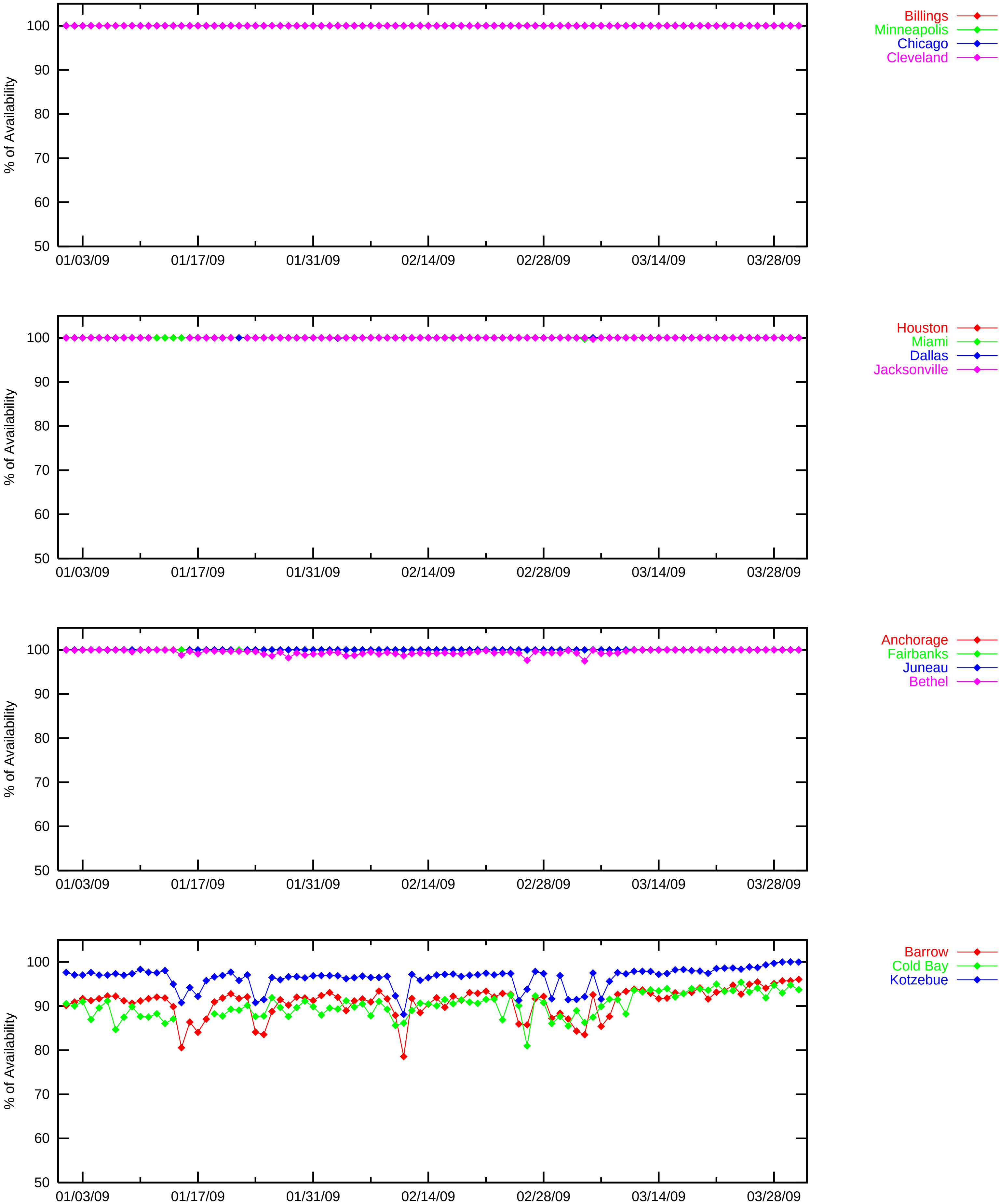
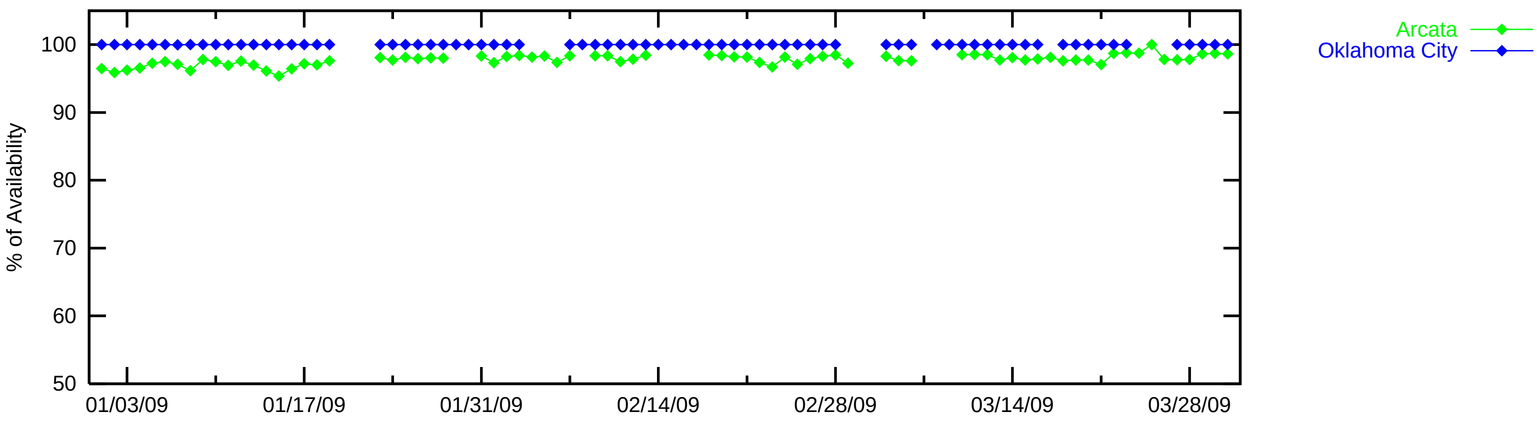
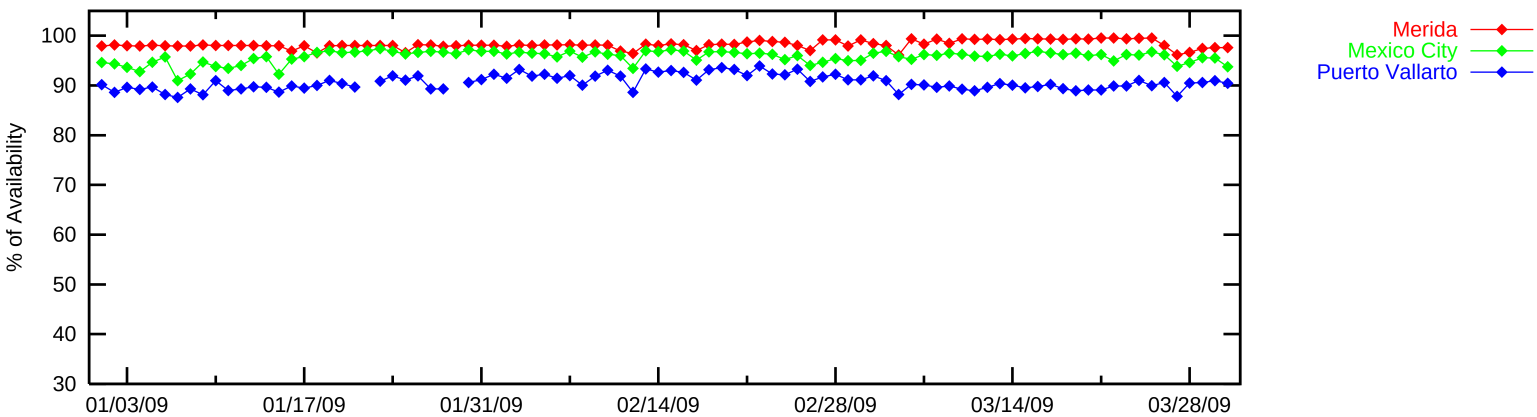
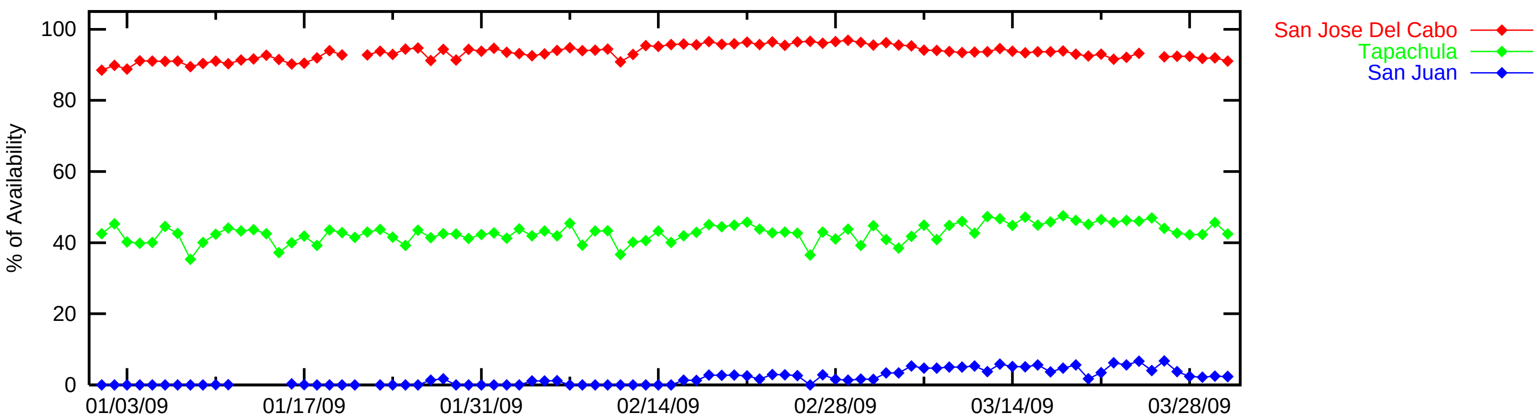


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)







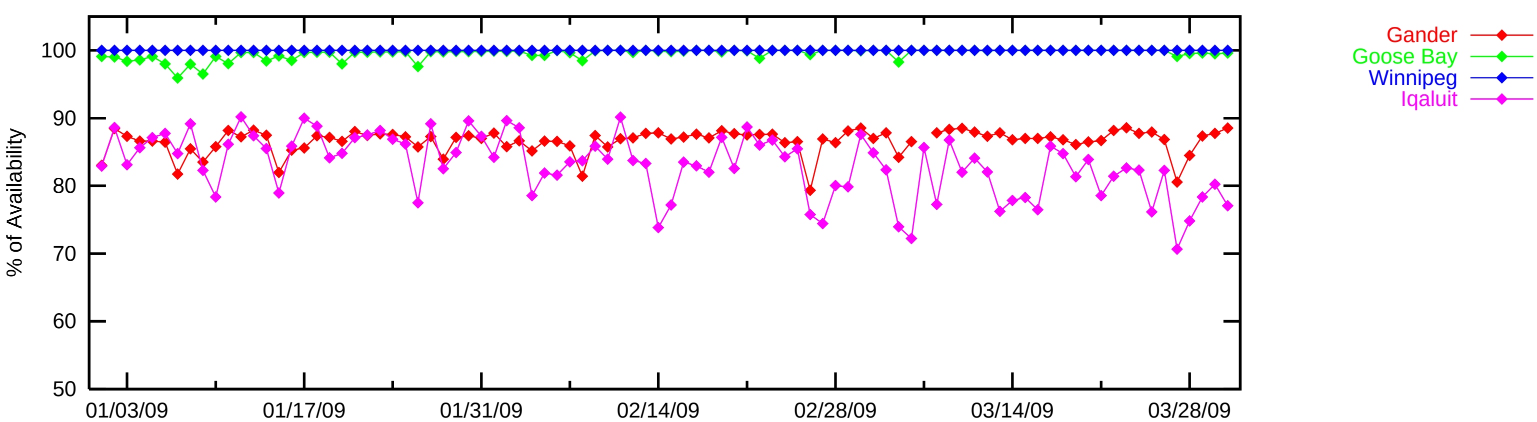
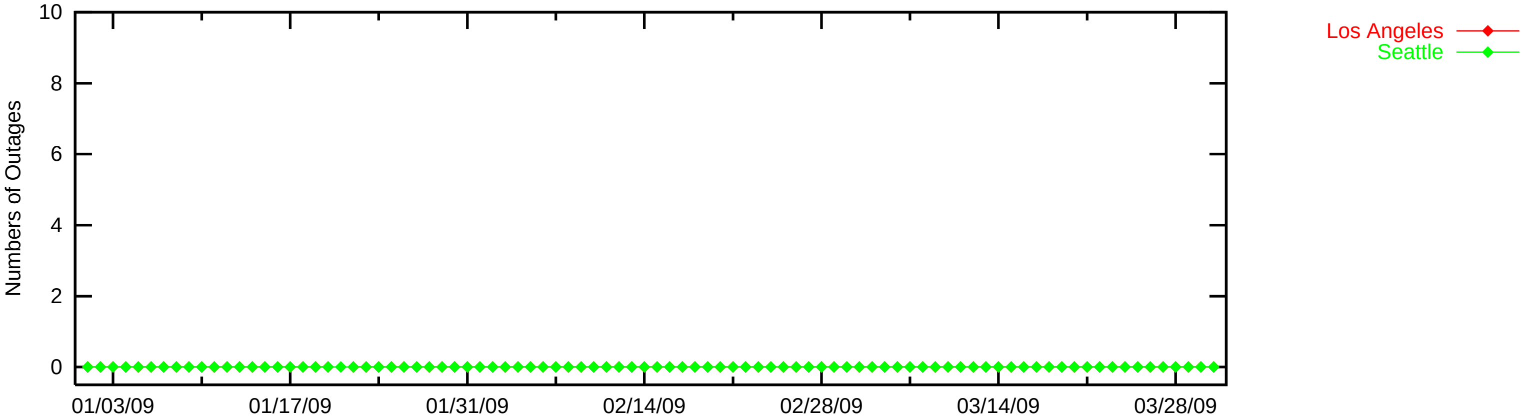
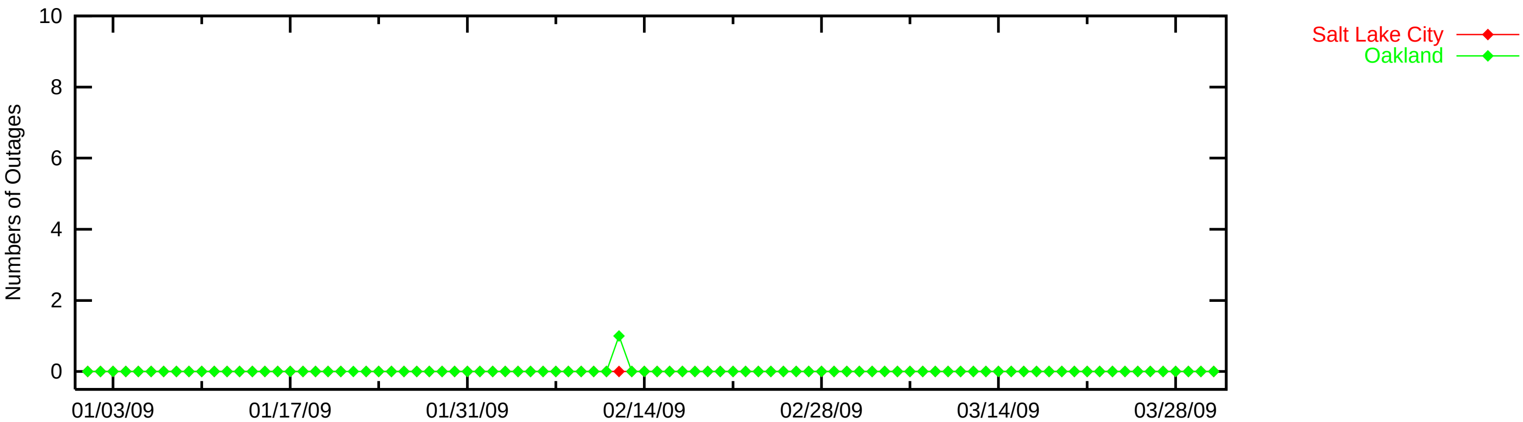
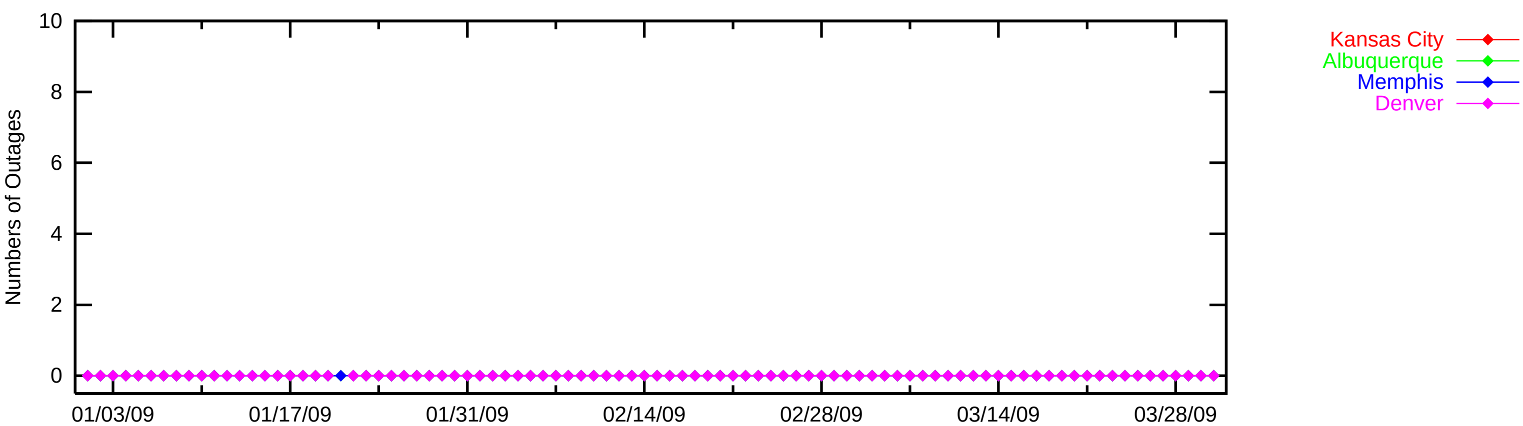


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)







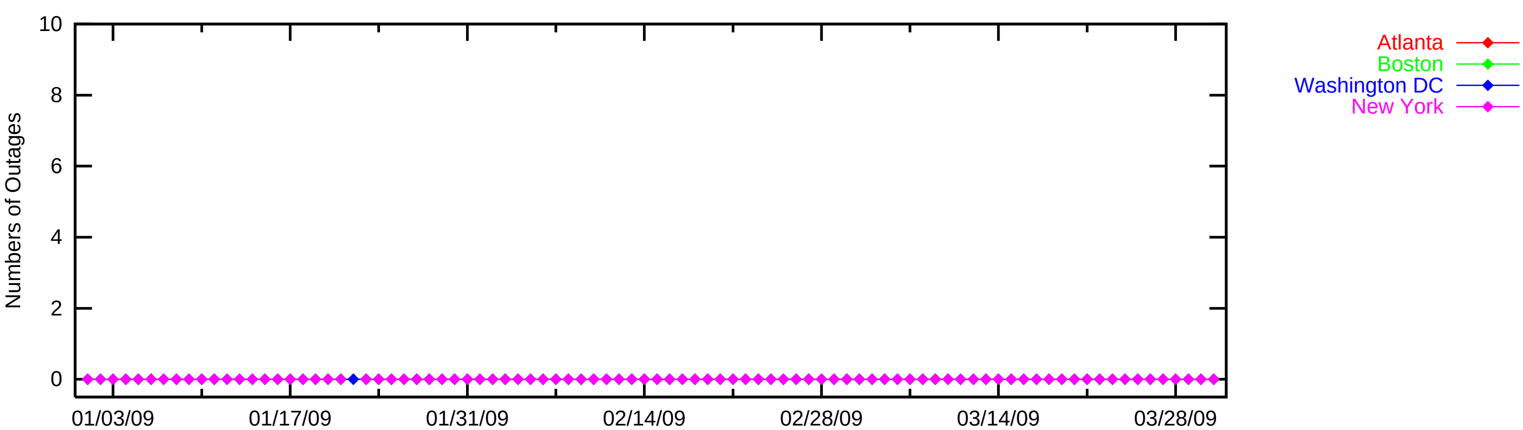
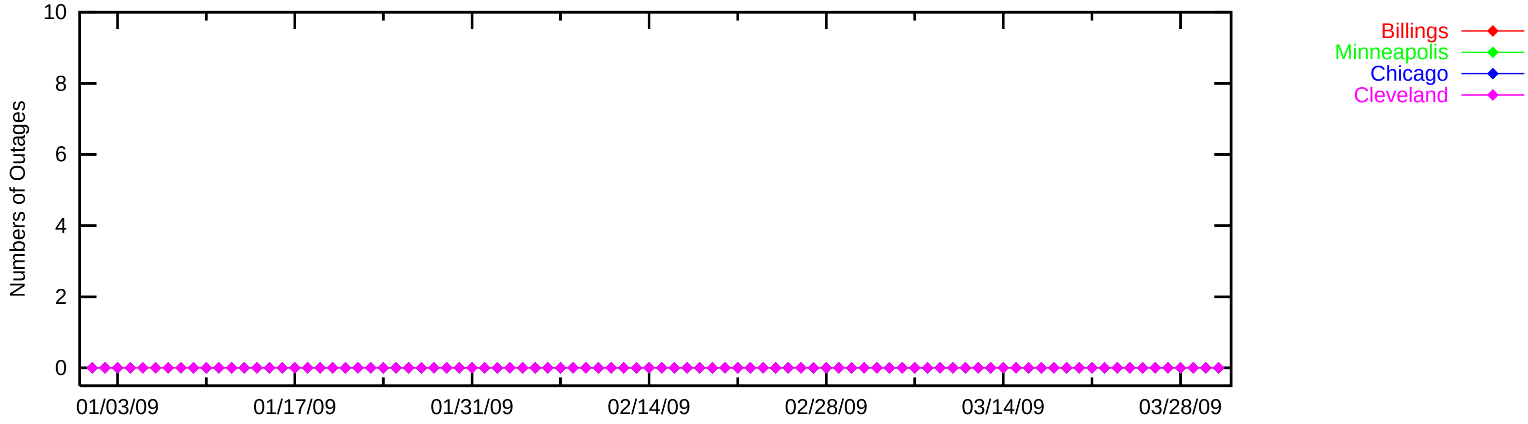
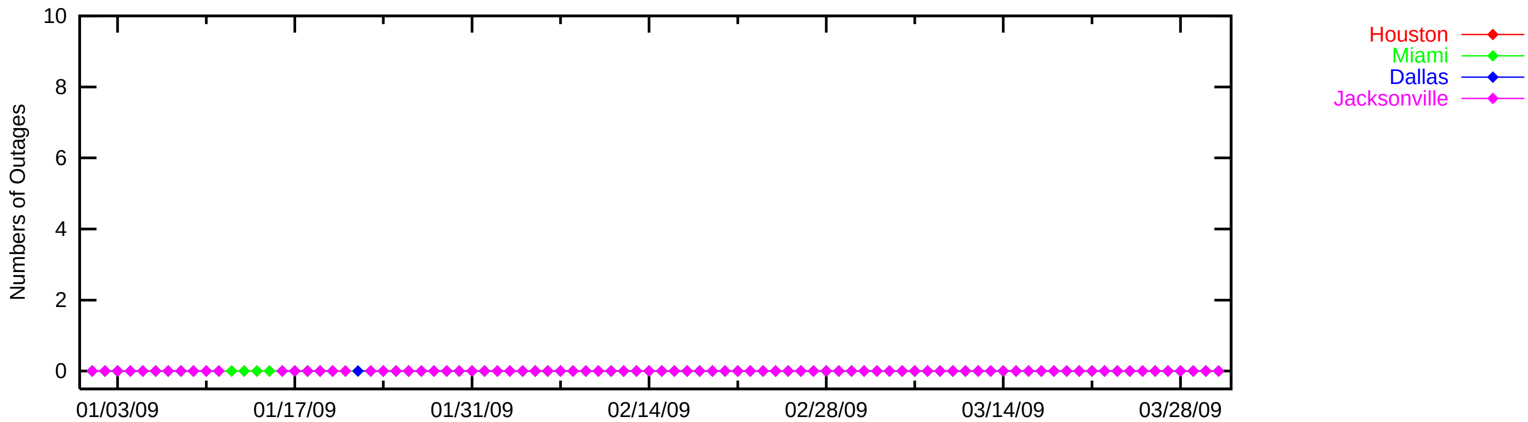
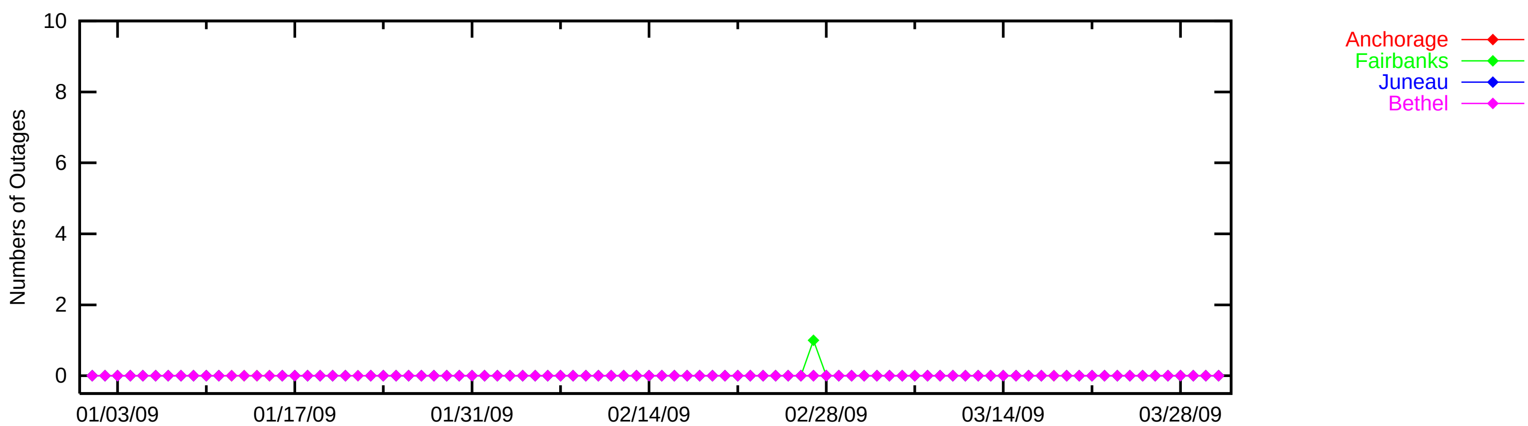


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)







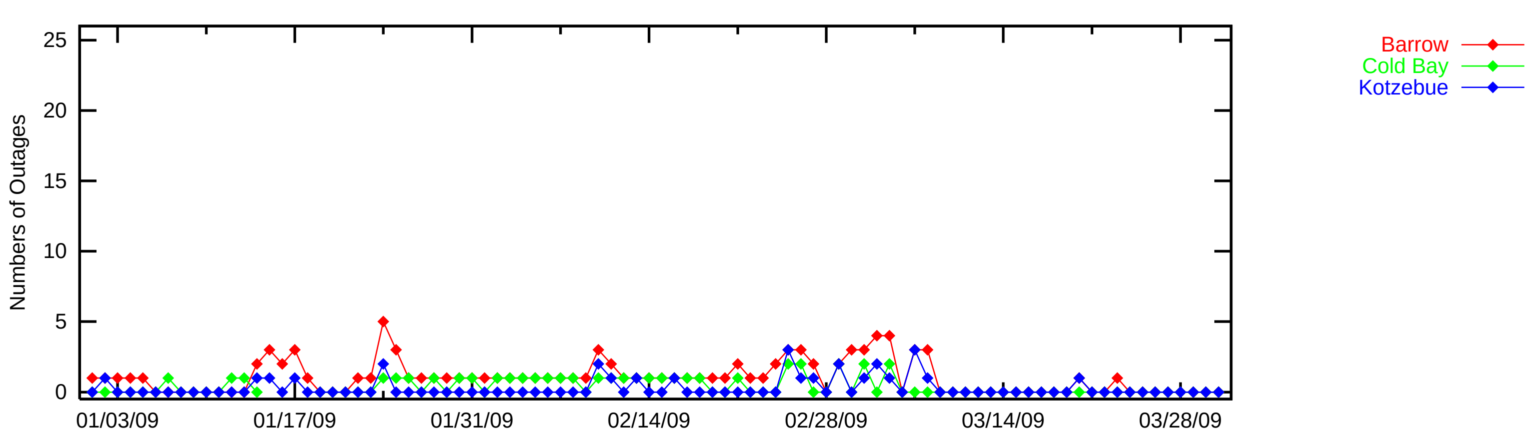


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

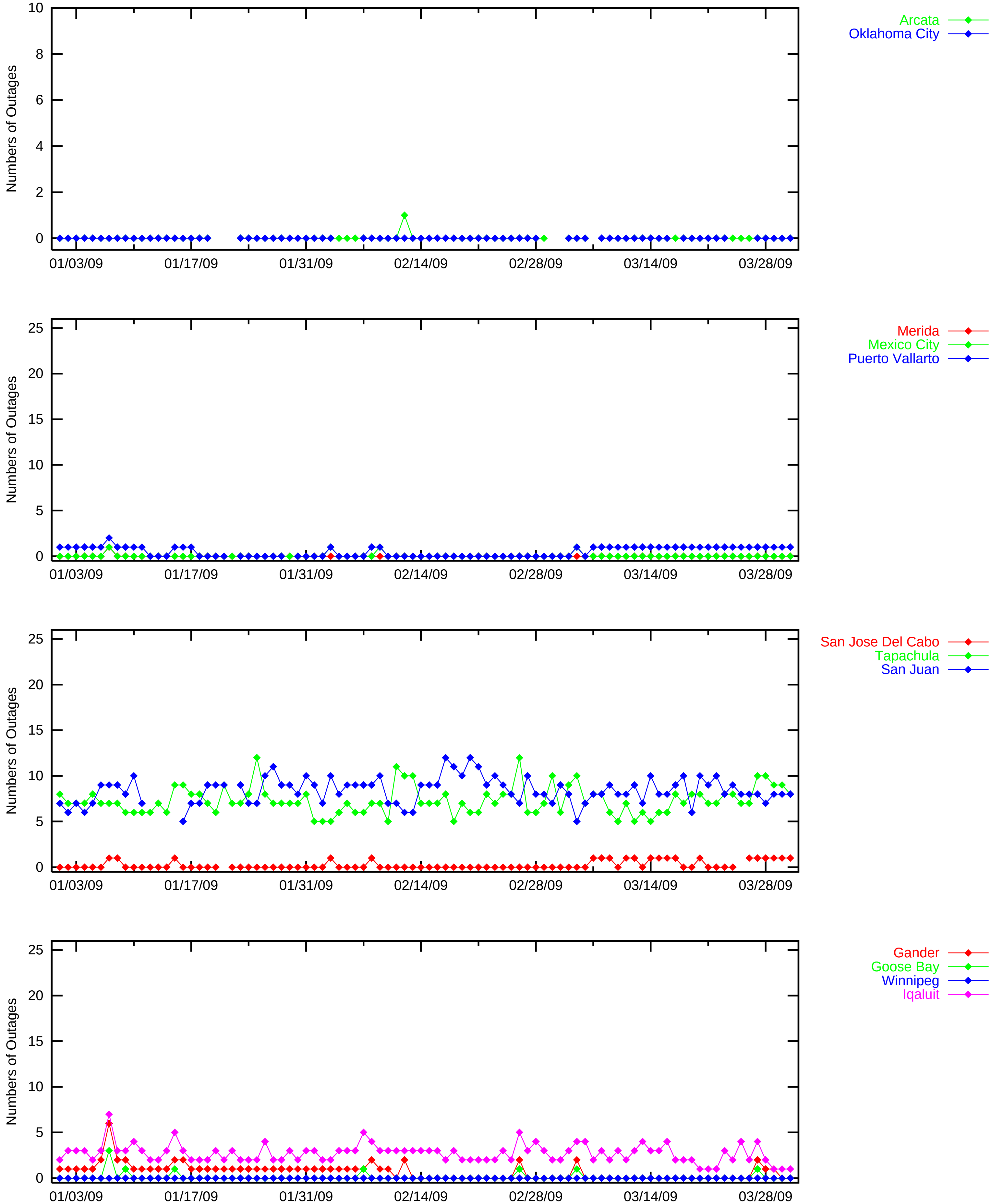


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

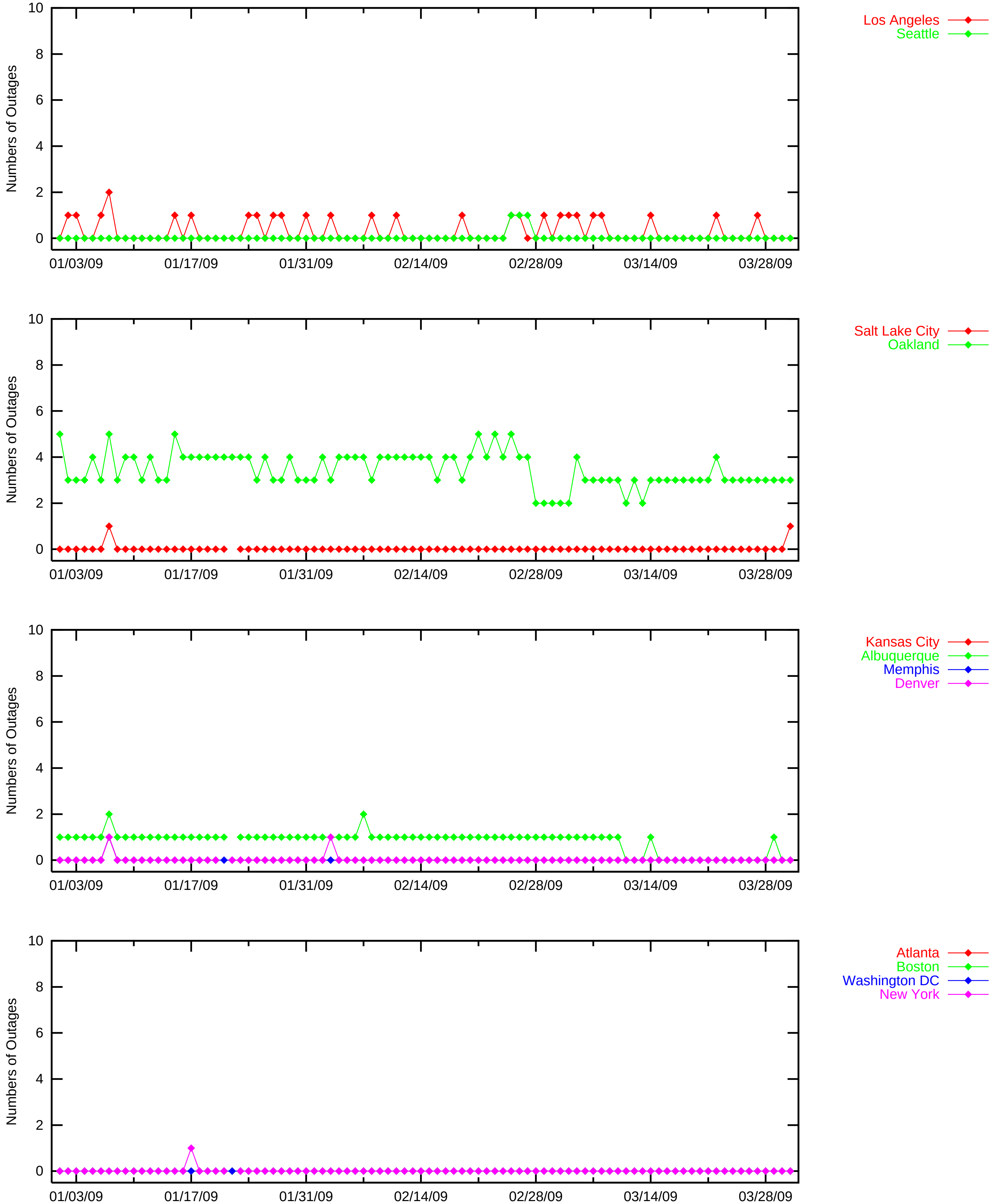
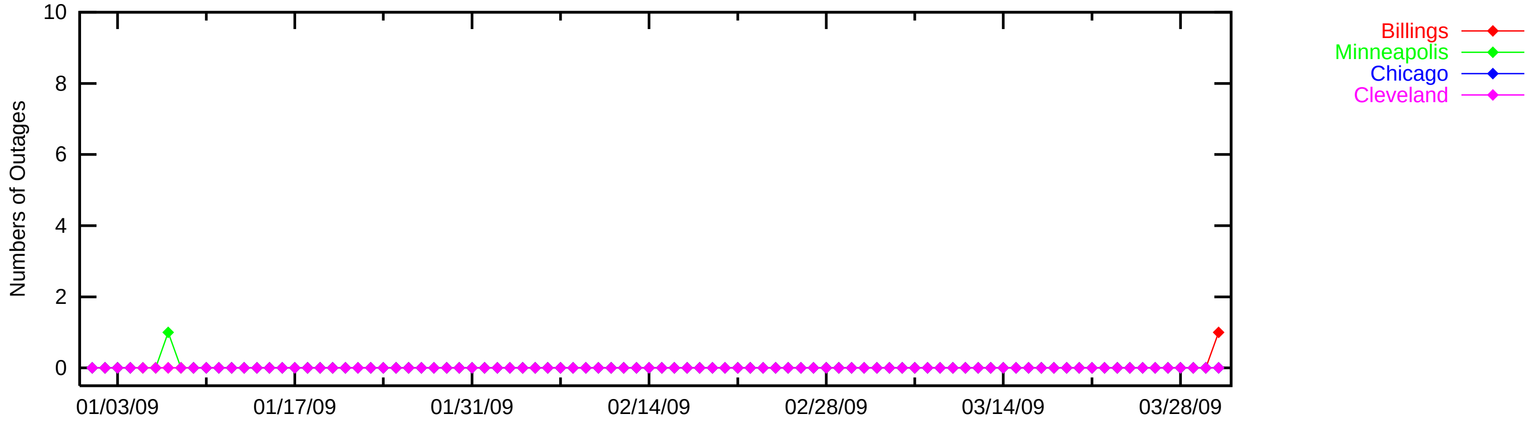
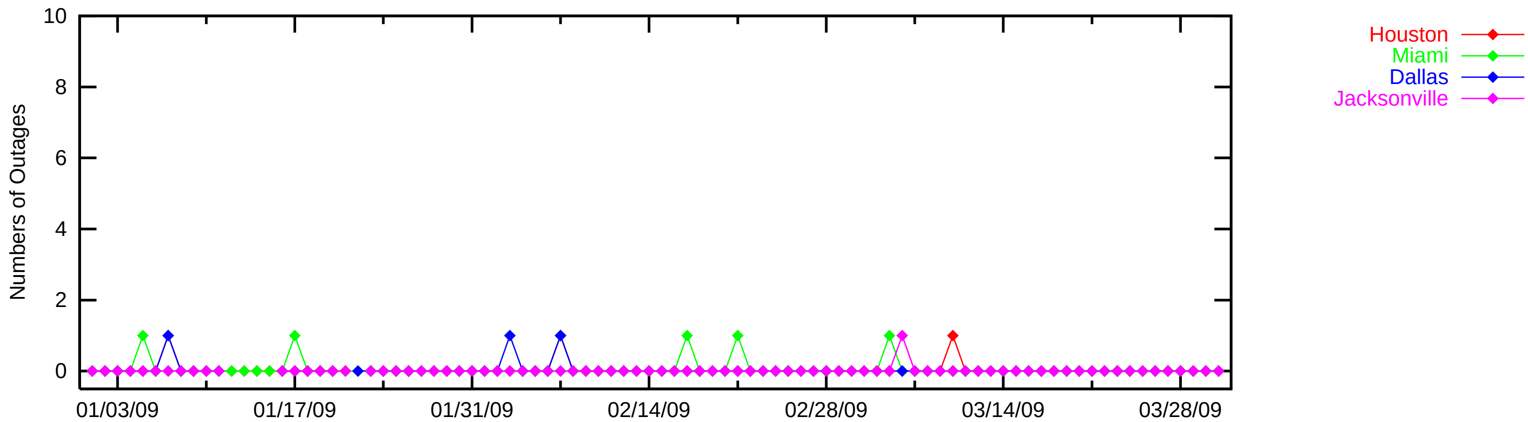
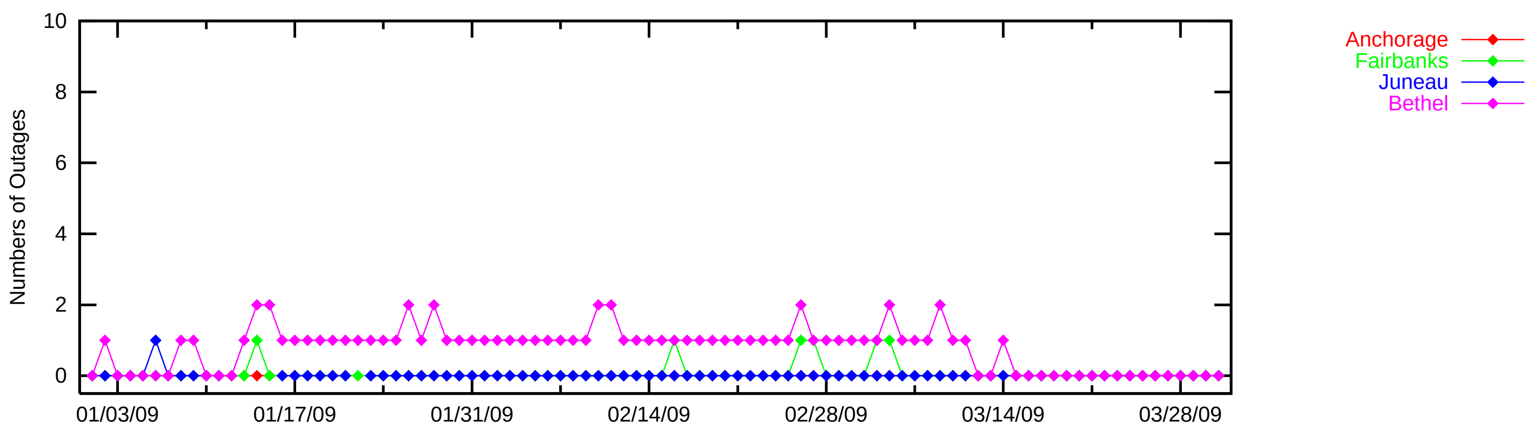


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)







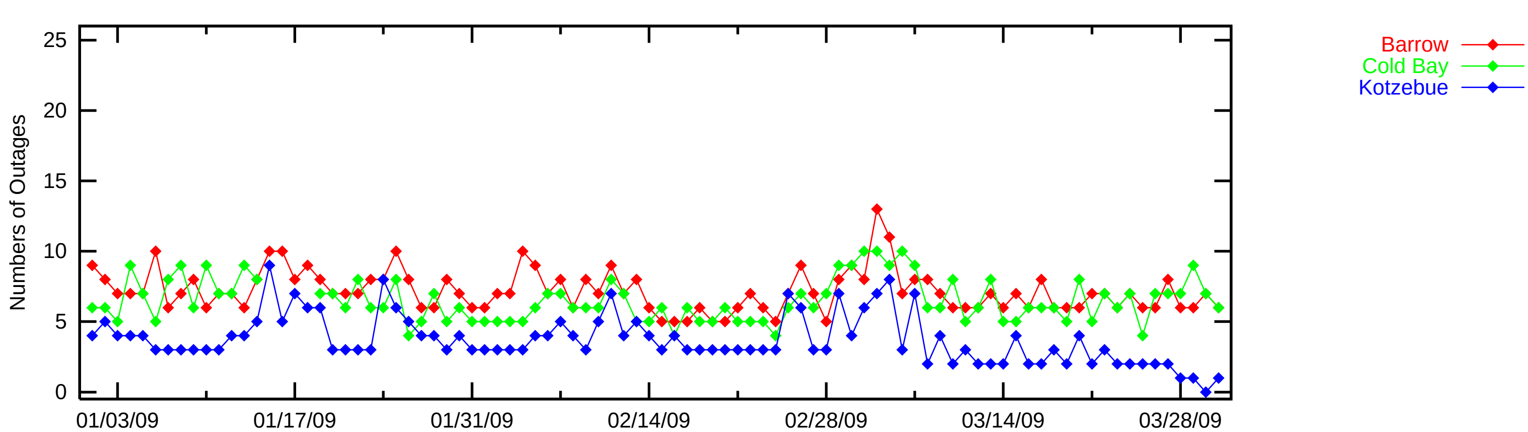
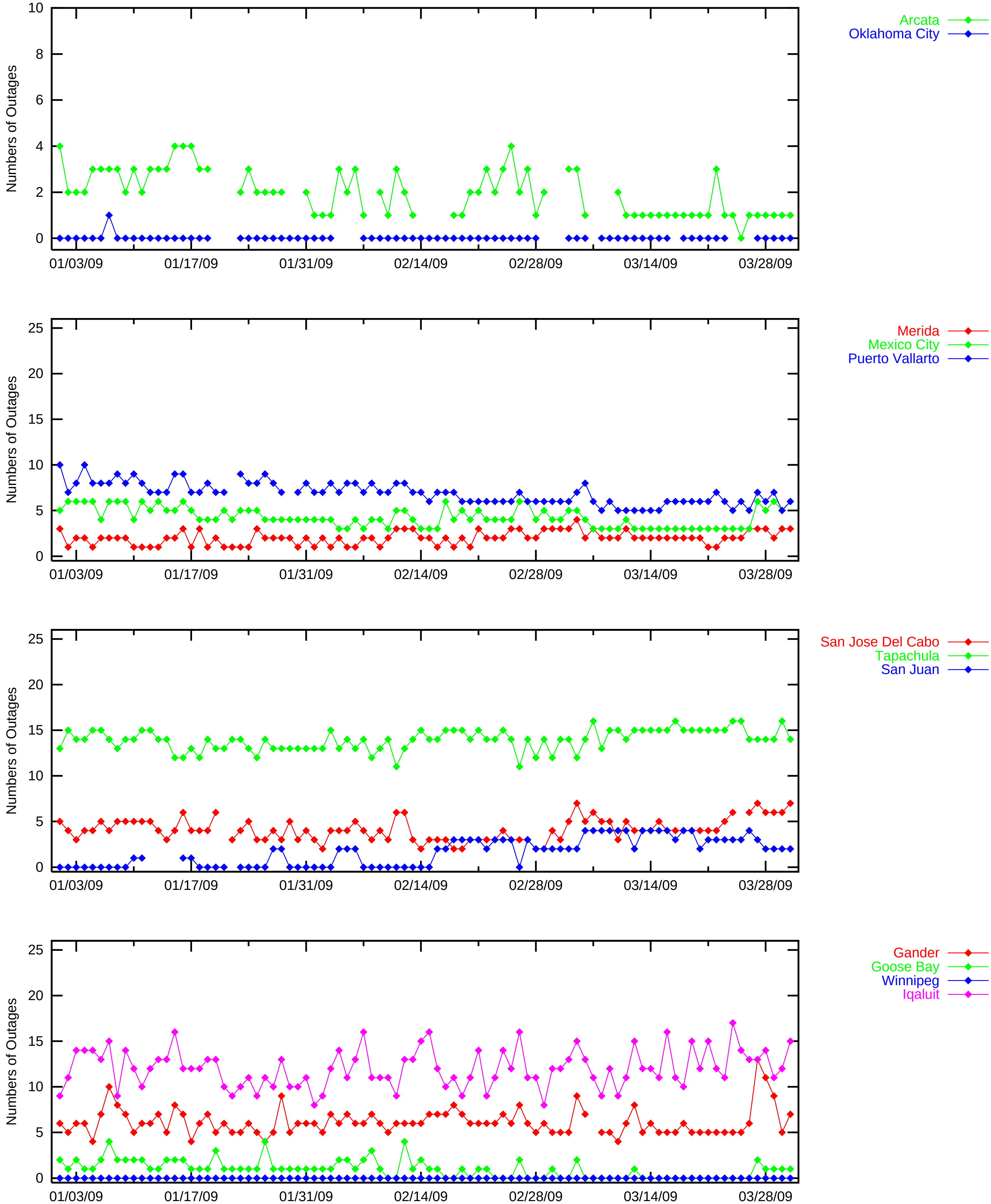


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



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 and GUS switchovers. Please refer to Table 1.4 for events that affected coverage. Small coverage drops in Alaska LPV coverage and RNP coverage are mostly due to CRW GUS switchovers. On 1/24/2009, a Doppler spike caused CRW signal in space outage (see DR #79).

Figure 4-1 LP North America Coverage for the Quarater

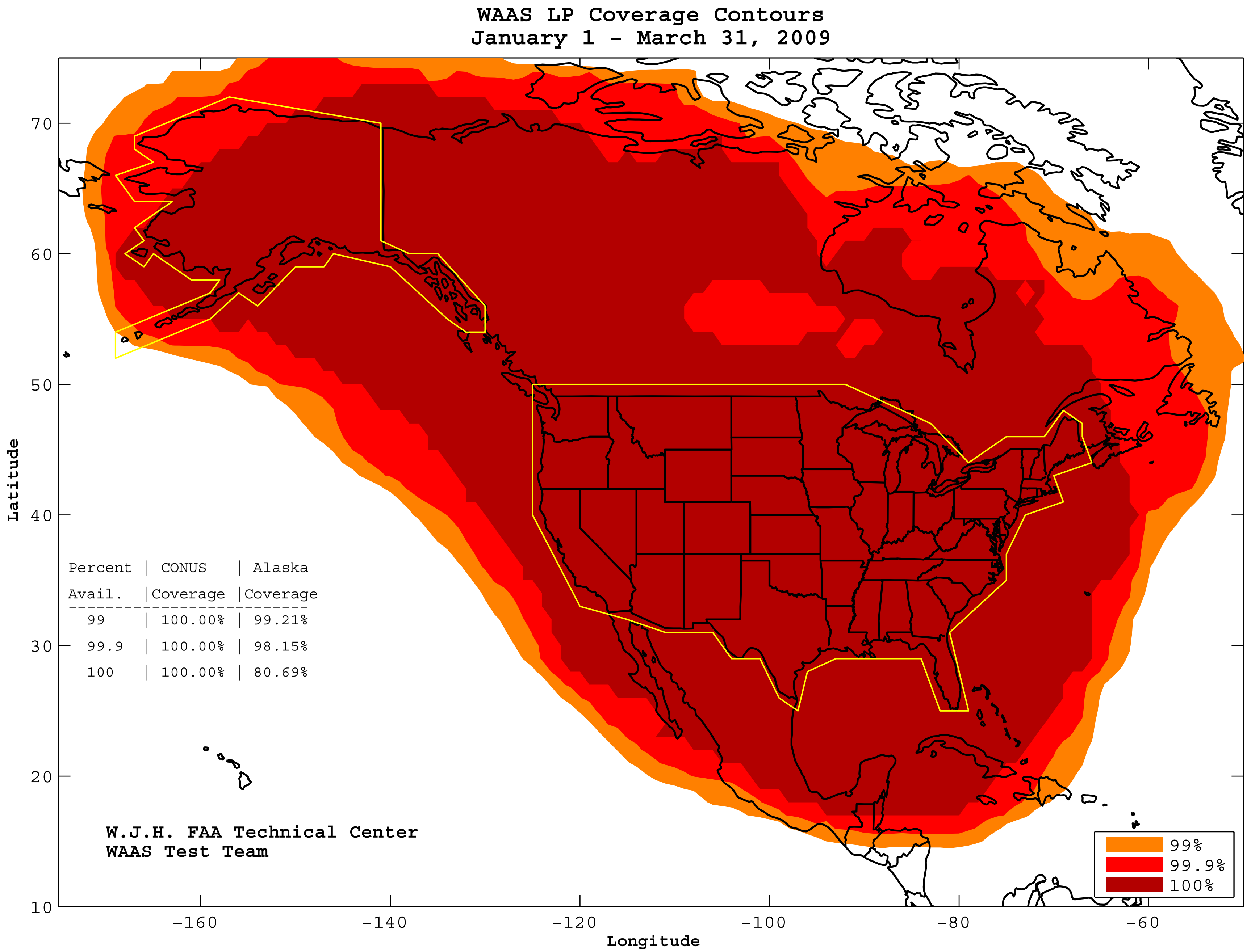


Figure 4-2 LPV North America Coverage for the Quarter

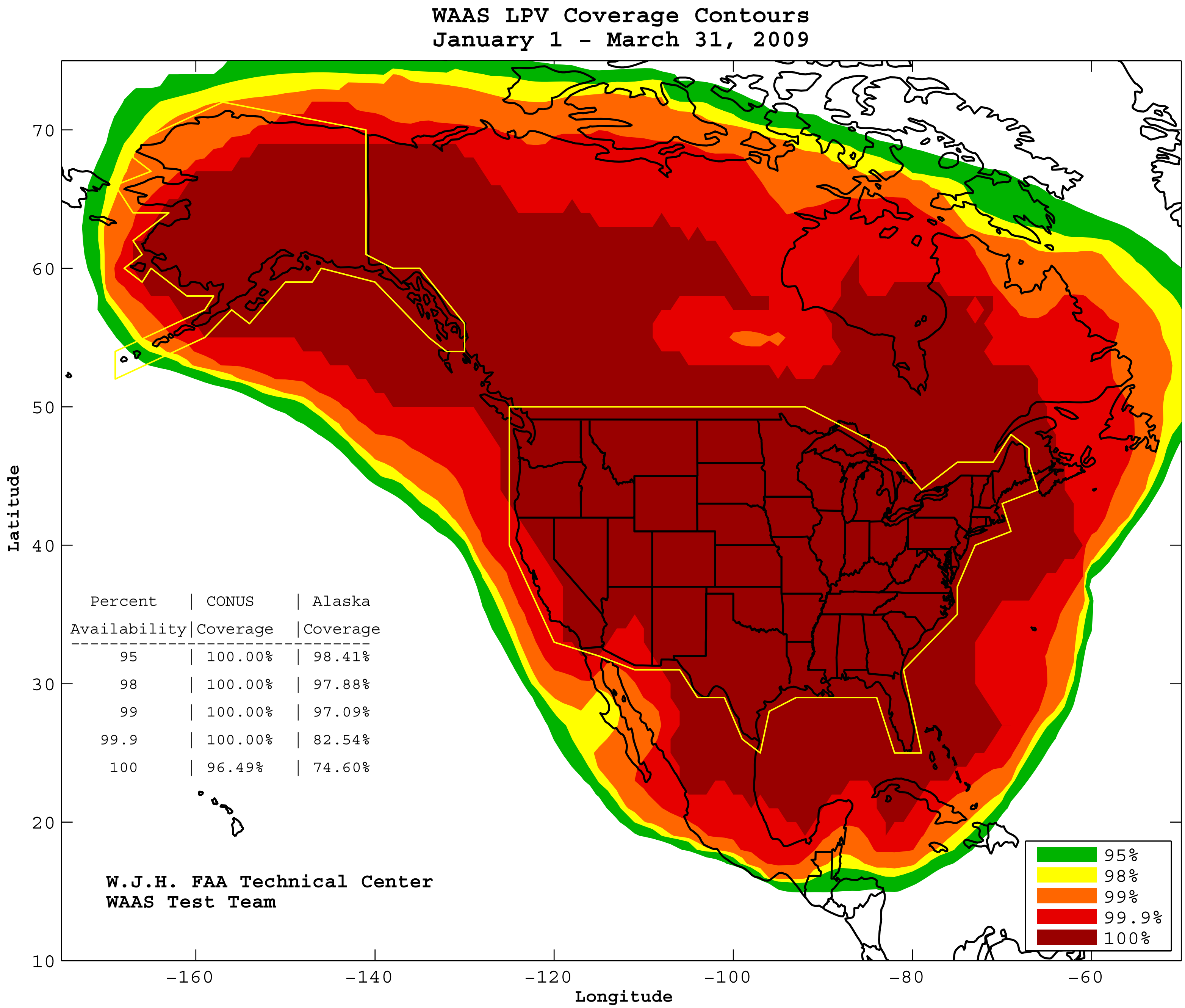


Figure 4-3 LPV 200 North America Coverage for the Quarter

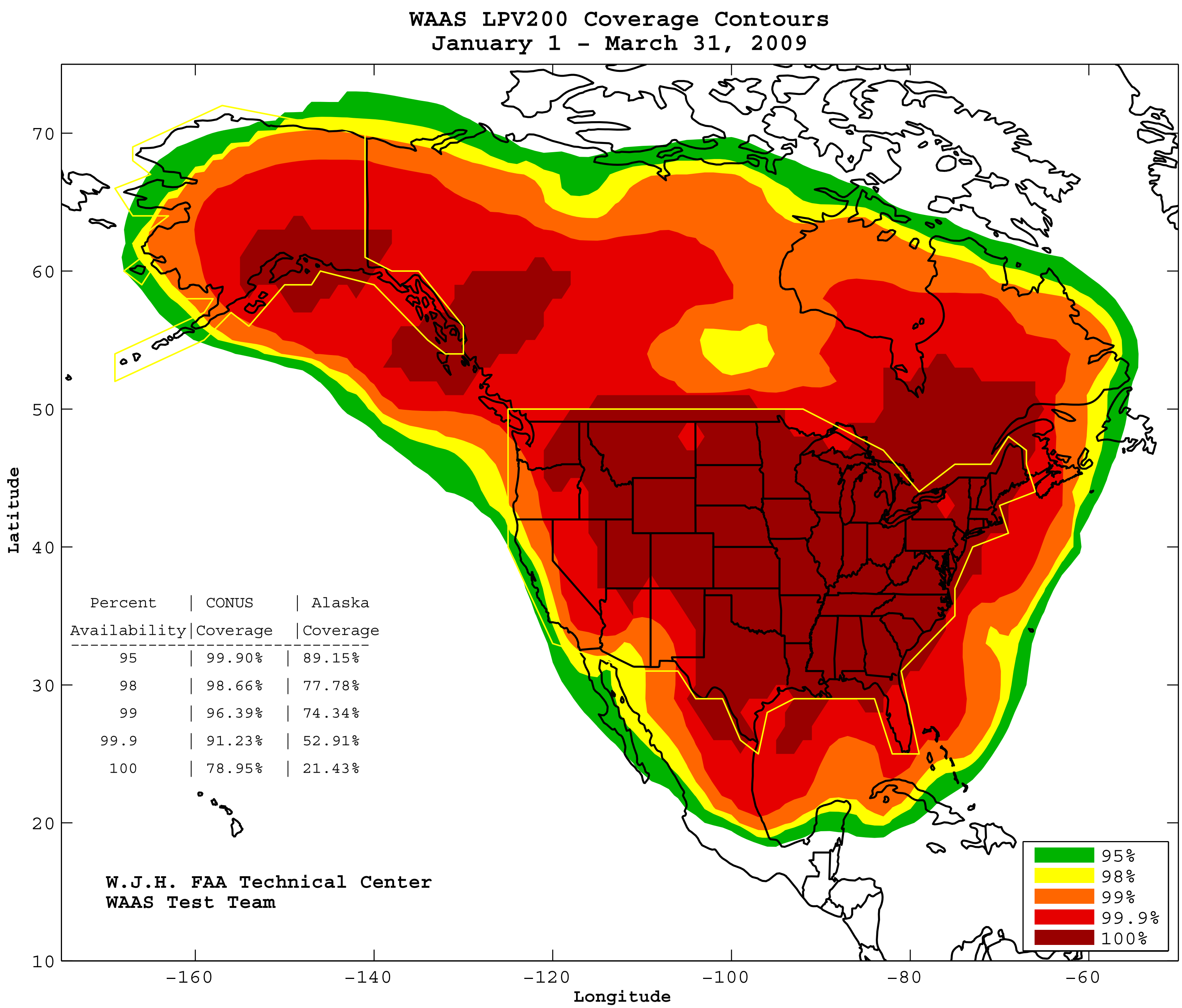


Figure 4-4 RNP 0.1 World Coverage for the Quarter

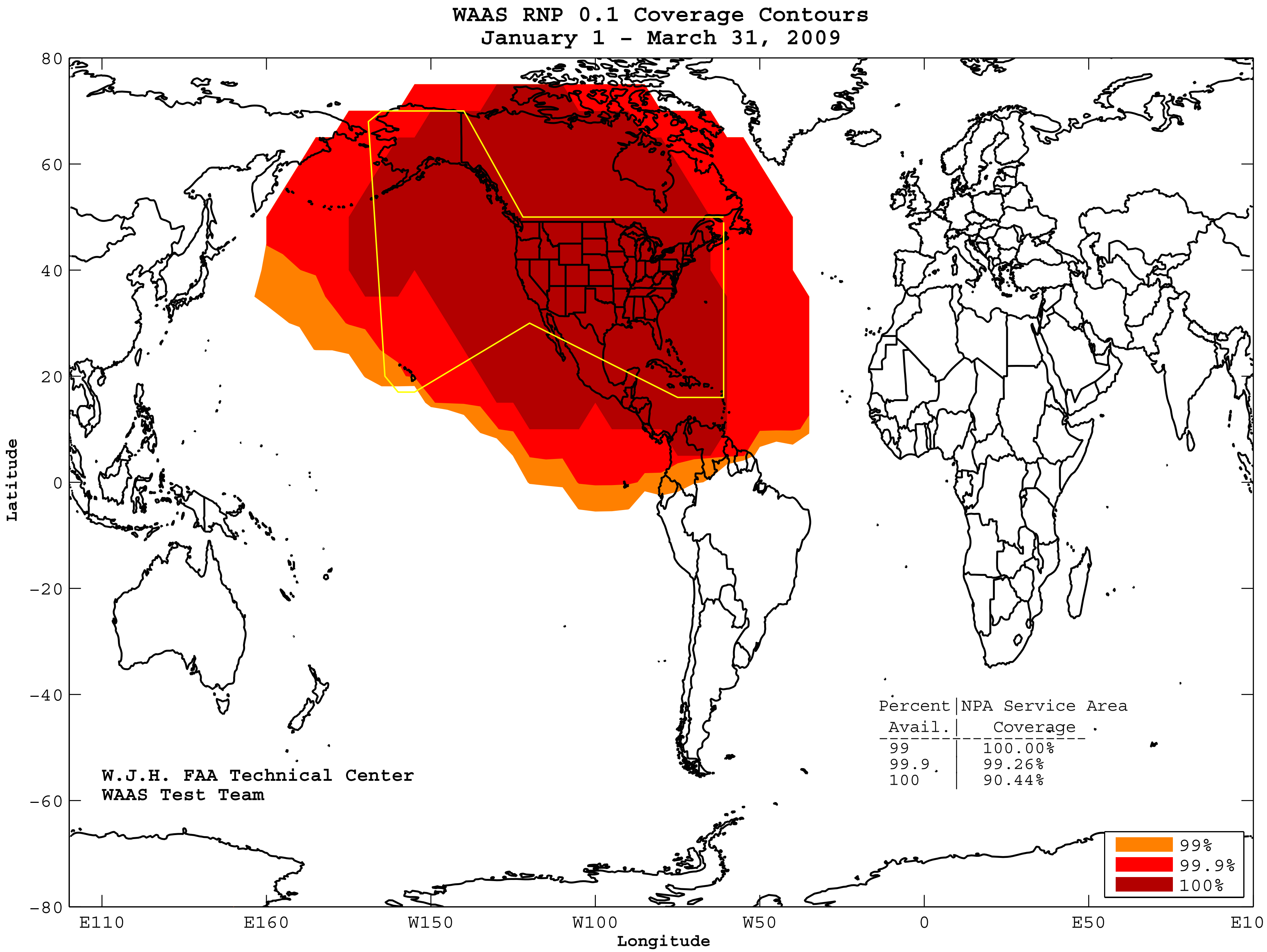


Figure 4-5 RNP 0.3 World Coverage for the Quarter

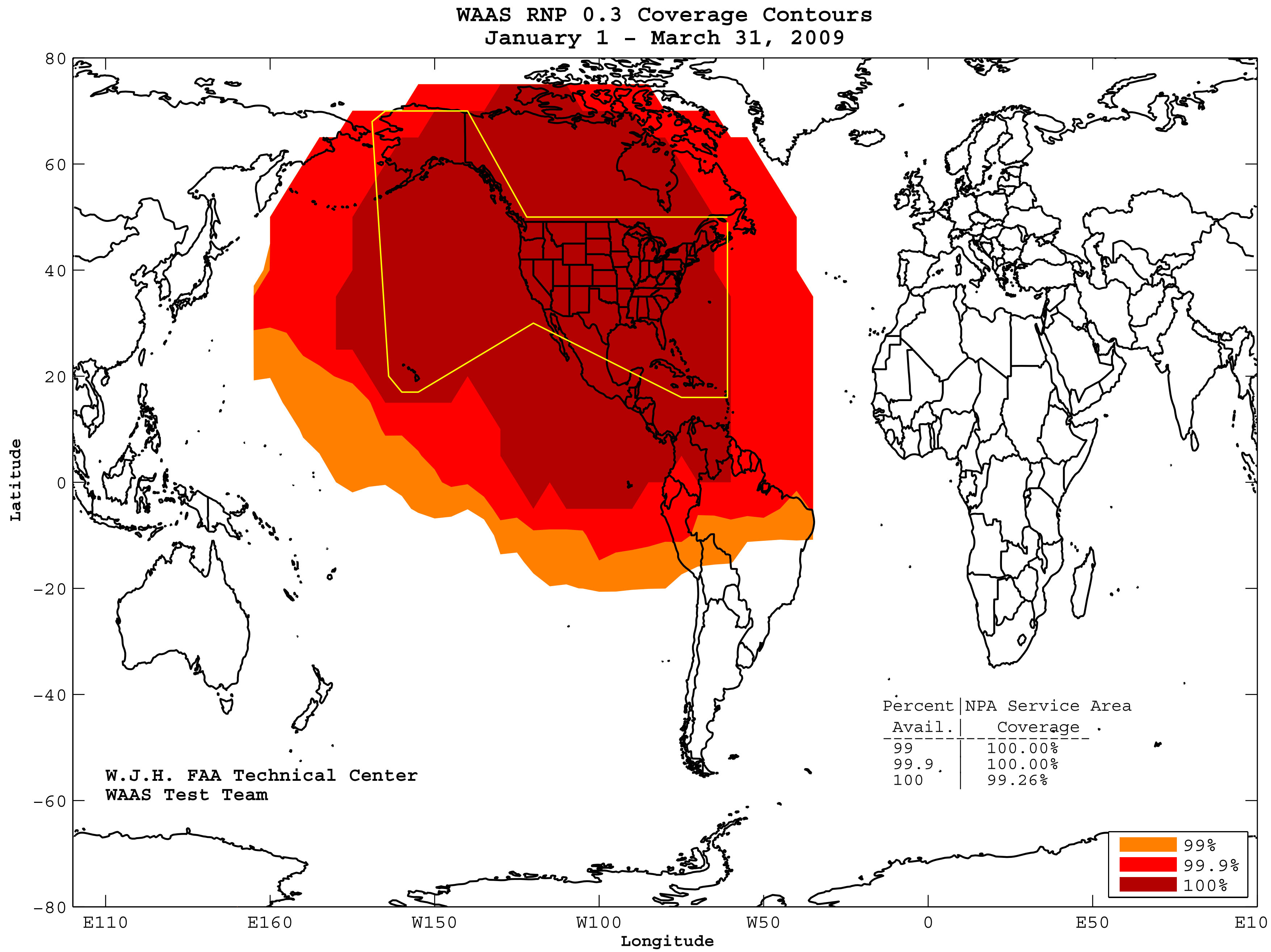


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

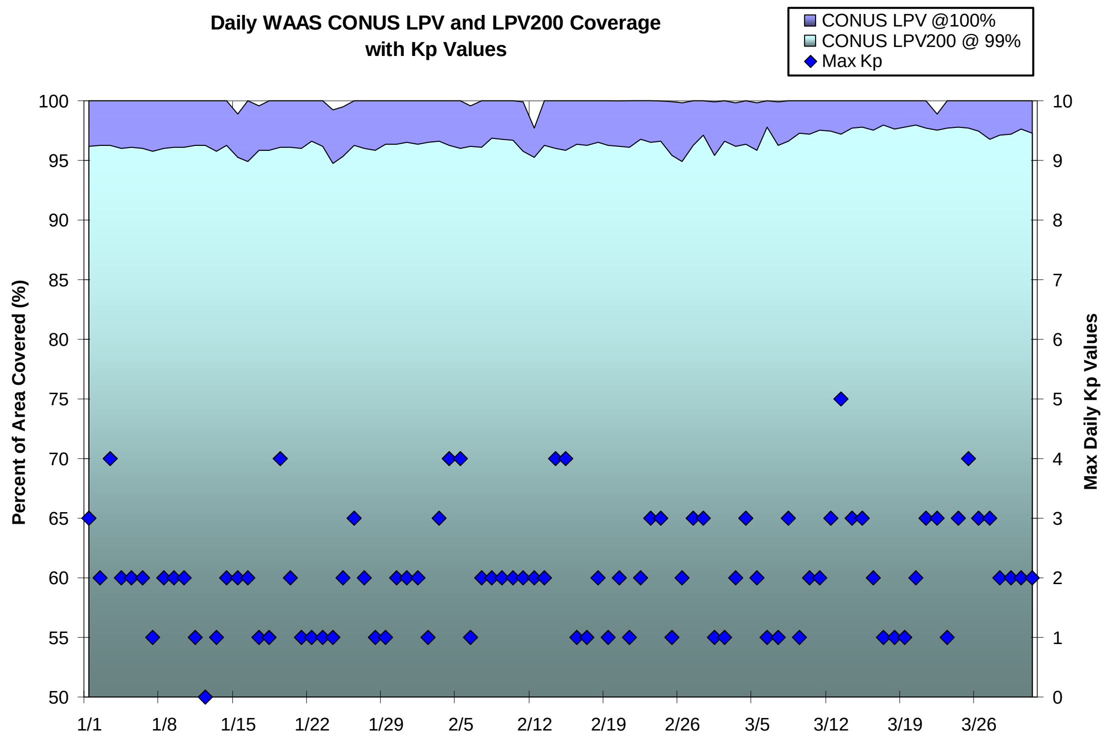


Figure 4-7 Daily LPV Alaska Coverage

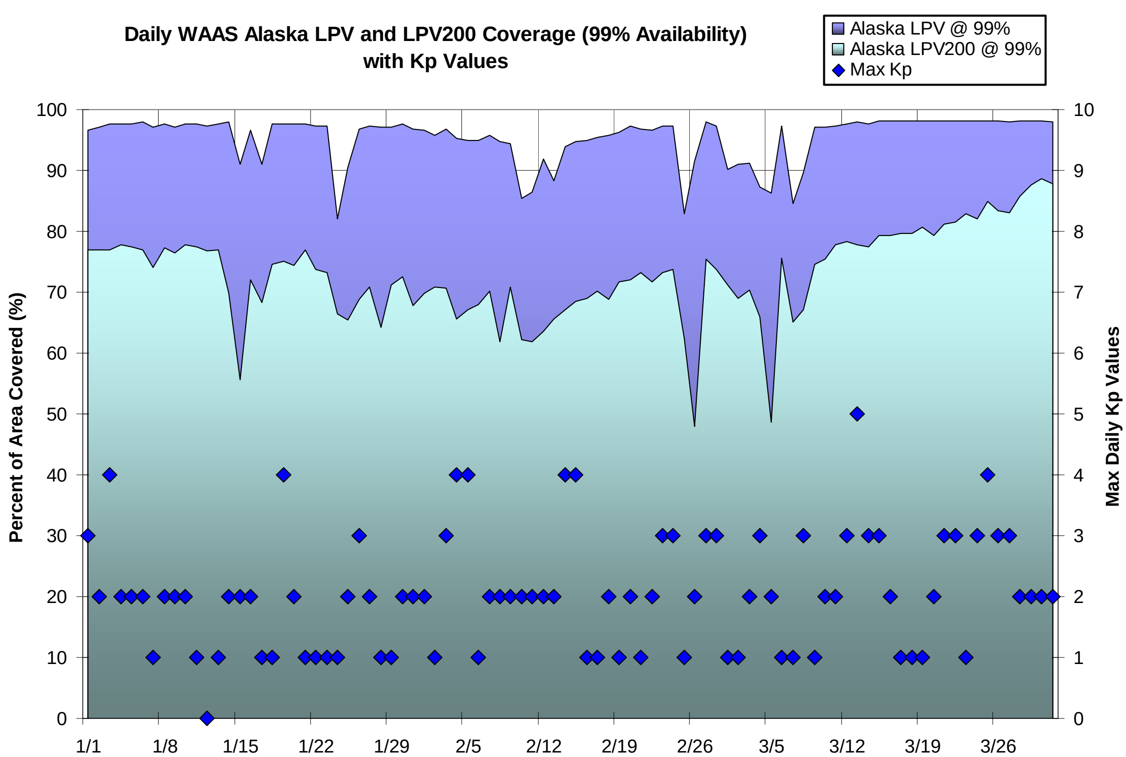
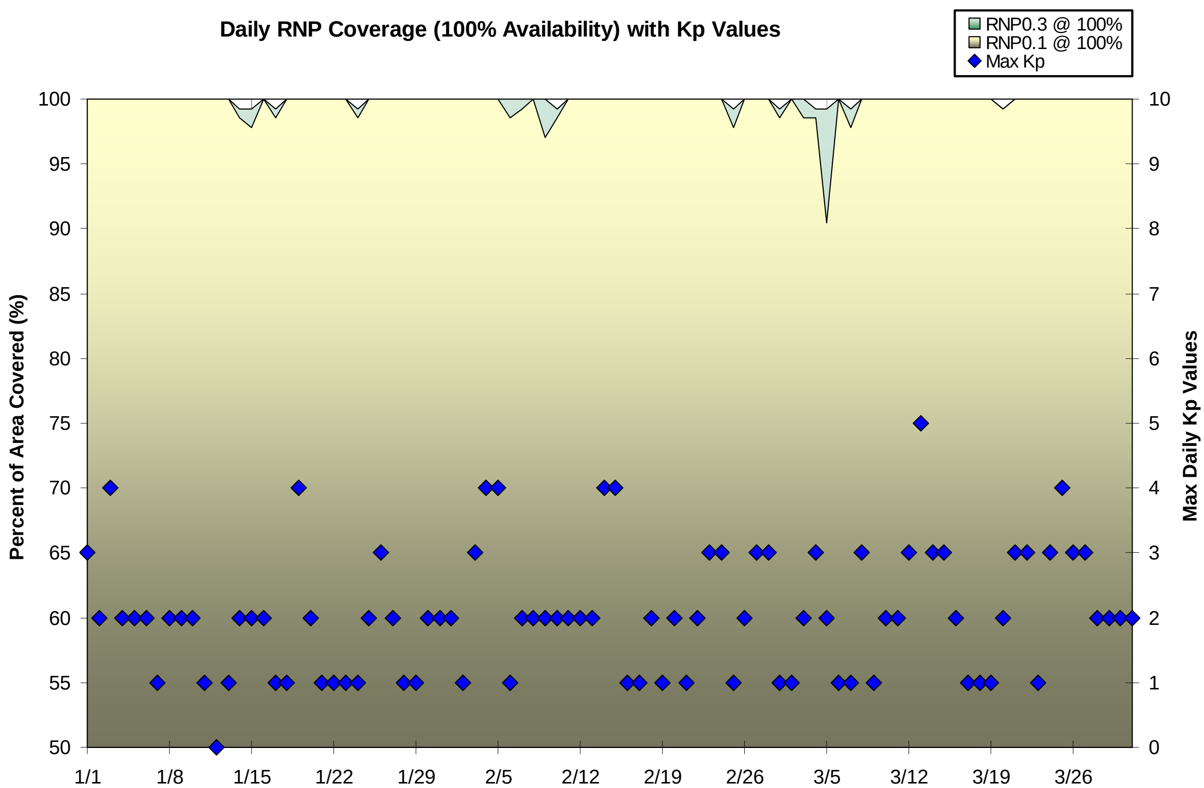


Figure 4-8 Daily RNP Coverage



5.0 <u>INTEGRITY</u>

5.1 HMI Analysis

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

Table 5.1 lists the safety index and the number of HMIs. For this evaluation period, the lowest safety margin index is 4.43 at Fairbanks. There was no HMI event. Since WAAS was made available to the public in August 2000 there has not been an HMI event. WAAS was commissioned by the FAA for safety of life services in July 2003.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Arcata	4.56	4.70	0
Oklahoma City	6.38	6.22	0
Albuquerque	5.62	10.46	0
Anchorage	8.11	5.86	0
Atlanta	5.26	5.48	0
Barrow	5.95	5.11	0
Bethel	10.27	12.48	0
Billings	5.59	6.90	0
Boston	4.67	7.72	0
Chicago	7.83	5.45	0
Cleveland	8.39	7.06	0
Cold Bay	8.92	11.35	0
Dallas	5.69	5.99	0
Denver	5.78	6.12	0
Fairbanks	7.68	4.43	0
Gander	9.46	10.84	0
Goose Bay	13.66	14.86	0
Houston	6.49	5.82	0
Iqaluit	6.88	4.47	0
Jacksonville	6.75	7.14	0
Juneau	7.34	5.40	0
Kansas City	6.27	6.81	0
Kotzebue	9.28	6.53	0
Los Angeles	5.25	8.27	0
Memphis	5.44	7.76	0
Merida	13.20	9.53	0
Mexico City	10.28	10.77	0
Miami	6.56	6.46	0
Minneapolis	12.06	7.08	0
New York	6.51	8.31	0
Oakland	5.37	6.76	0
Puerto Vallarta	11.66	11.17	0
Salt Lake City	6.94	7.76	0
San Jose Del Cabo	10.83	7.23	0
San Juan	11.05	9.45	0
Seattle	7.33	5.76	0
Tapachula	16.03	8.91	0
Washington DC	8.38	7.85	0
Winnipeg	8.98	8.12	0

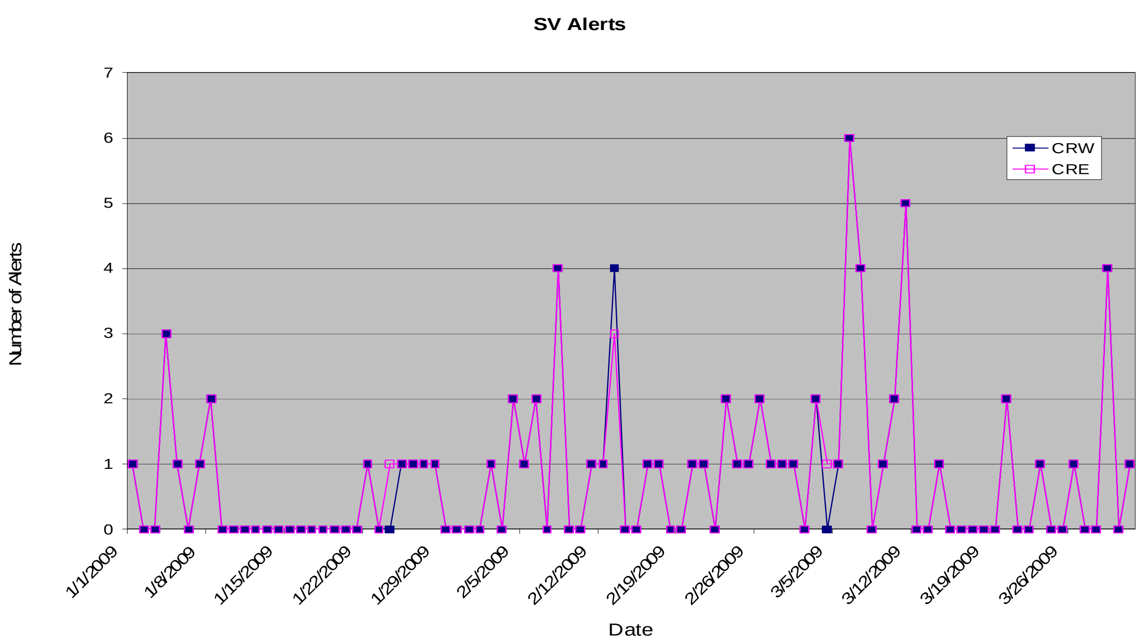
5.2 Broadcast Alerts

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	40	40	0.4444	0.4444
3	23	23	0.2556	0.2556
4	10	11	0.1111	0.1222
5	0	0	0.0000	0.0000
6	0	0	0.0000	0.0000
24	0	0	0.0000	0.0000
26	0	0	0.0000	0.0000
Total Alerts	73	74	0.8111	0.8222

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	107512	7	693
2	1295948	45	261
3	1295878	60	246
4	1295832	69	253
7	99156	15	343
9	91117	1	689
10	99150	11	307
17	31127	5	687

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

PRN	On Time	Late	Max Late Length (seconds)
2	46849	1	166
3	50466	1	176
4	47866	1	589
5	46925	1	350
6	50972	0	0
7	47493	1	179
8	46810	0	0
9	49336	0	0
10	47736	0	0
11	51806	0	0
12	49000	0	0
13	47323	1	167
14	47452	1	602
15	49805	0	0
16	48494	0	0
17	47330	0	0
18	47296	3	698
19	49894	1	589
20	49999	1	350
21	46879	0	0
22	48044	0	0
23	46852	1	179
24	47613	0	0
25	48653	0	0
26	48547	0	0
27	49000	0	0
28	48287	1	602
29	47452	1	167
30	50712	0	0
31	48523	0	0
32	48015	2	698

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

PRN	On Time	Late	Max Late Length (seconds)
2	38434	1	121
3	41446	0	0
4	39276	1	162
5	38546	2	729
6	41852	3	206
7	38975	3	408
8	38420	1	129
9	40524	3	528
10	39176	1	121
11	42522	2	165
12	40286	1	121
13	38893	1	152
14	38972	1	196
15	40862	3	320
16	39856	1	122
17	38887	0	0
18	38809	1	729
19	40986	2	378
20	41065	2	528
21	38435	1	165
22	39449	0	0
23	38480	1	191
24	39079	0	0
25	39875	0	0
26	39845	1	128
27	40278	2	205
28	39653	2	183
29	39042	0	0
30	41714	1	176
31	39830	1	192
32	39418	3	391
135	74423	4	191
138	73954	4	729

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26975	13	873
0	1	26986	13	1155
0	2	26997	16	751
1	0	26981	12	865
1	1	26974	18	867
1	2	26970	15	868
1	3	26994	13	723
1	4	26975	19	868
2	0	26981	12	866
2	1	26979	14	867
2	2	26989	15	868
2	3	26973	24	453
2	4	26970	15	872
2	5	26984	14	458
3	0	26985	11	867
3	1	26974	11	867
3	2	26987	17	873
9	0	26978	20	866
9	1	26975	9	867
9	2	26997	12	866
9	3	26983	14	869
9	4	26975	14	866
9	5	26984	20	867
9	6	26968	16	868

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

Band	On Time	Late	Max Late Length (seconds)
1	35502	1	874
2	35497	3	542
3	35512	2	878
9	35516	5	913

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

Message Type	On Time	Late	Max Late Length (seconds)
1	104749	3	125
2	1296054	33	29
3	1295975	51	26
4	1295934	56	26
7	96873	11	132
9	91122	1	169
10	96662	12	158
17	30903	1	305

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

PRN	On Time	Late	Max Late Length (seconds)
2	46849	0	0
3	50471	1	161
4	47879	0	0
5	46928	0	0
6	50975	0	0
7	47499	0	0
8	46821	0	0
9	49337	0	0
10	47737	0	0
11	51813	1	149
12	49010	0	0
13	47339	1	165
14	47458	0	0
15	49821	0	0
16	48497	0	0
17	47339	0	0
18	47319	1	161
19	49905	0	0
20	50020	0	0
21	46876	0	0
22	48055	0	0
23	46846	0	0
24	47603	1	161
25	48658	1	149
26	48553	0	0
27	49014	0	0
28	48289	0	0
29	47447	1	165
30	50707	1	167
31	48507	0	0
32	48027	0	0

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

PRN	On Time	Late	Max Late Length (seconds)
2	38448	0	0
3	41440	2	130
4	39300	0	0
5	38546	0	0
6	41864	0	0
7	38985	1	192
8	38431	0	0
9	40545	1	128
10	39186	0	0
11	42545	1	210
12	40279	0	0
13	38875	2	208
14	38984	1	185
15	40869	0	0
16	39873	0	0
17	38882	0	0
18	38815	0	0
19	40977	1	126
20	41073	1	124
21	38427	0	0
22	39466	1	289
23	38487	0	0
24	39071	2	208
25	39878	2	122
26	39850	0	0
27	40291	1	122
28	39678	3	210
29	39045	0	0
30	41706	1	124
31	39818	0	0
32	39431	0	0
135	74104	1	151
138	73988	1	146

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26999	5	402
0	1	26982	9	576
0	2	26994	6	414
1	0	26982	10	415
1	1	26995	14	306
1	2	26987	5	306
1	3	26987	13	306
1	4	26979	13	306
2	0	26993	7	305
2	1	26983	12	445
2	2	26997	10	445
2	3	26997	6	417
2	4	26994	9	428
2	5	26980	11	576
3	0	26991	7	581
3	1	26985	14	427
3	2	26986	13	416
9	0	26990	8	580
9	1	26992	11	416
9	2	26998	13	415
9	3	26975	8	415
9	4	26981	11	400
9	5	26987	13	395
9	6	26980	16	390

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

Band	On Time	Late	Max Late Length (seconds)
1	35201	1	414
2	35151	0	0
3	35217	0	0
9	35210	0	0

6.0 SV RANGE ACCURACY

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

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

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

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

Table 6-1 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	1.343	100	1.144	100	1.598	100	1.708	100	2.285	100	1.824	100
3	1.357	100	1.324	100	1.443	100	1.068	100	1.277	100	1.245	100
4	1.982	100	1.794	100	1.677	100	1.249	100	1.867	100	1.394	100
5	1.310	100	1.196	100	1.542	100	1.689	100	1.405	100	1.183	100
6	1.881	100	1.393	100	1.430	100	1.086	100	1.549	100	1.147	100
7	1.883	100	1.415	100	1.426	100	1.032	100	0.918	100	1.126	100
8	1.494	100	1.185	100	1.087	100	0.928	100	1.143	100	1.110	100
9	1.565	100	1.360	100	0.957	100	0.920	100	1.549	100	1.194	100
10	1.420	100	1.245	100	1.048	100	1.632	100	1.060	100	1.208	100
11	1.204	100	1.081	100	0.899	100	1.461	100	1.130	100	0.683	100
12	1.582	100	1.666	100	1.412	100	0.874	100	1.274	100	1.620	100
13	2.069	100	1.254	100	1.524	100	1.078	100	1.106	100	1.378	100
14	1.638	100	0.917	100	1.129	100	1.386	100	0.999	100	0.970	100
15	1.890	100	1.714	100	1.157	100	1.487	100	1.399	100	1.533	100
16	0.987	100	0.865	100	0.993	100	1.080	100	1.233	100	1.053	100
17	3.164	100	1.467	100	1.424	100	1.089	100	1.313	100	0.977	100
18	1.159	100	0.769	100	1.640	100	1.819	100	1.717	100	1.043	100
19	1.835	100	1.846	100	2.215	100	2.024	100	2.748	100	1.858	100
20	1.092	100	1.133	100	1.407	100	1.143	100	1.588	100	1.027	100
21	1.211	100	1.040	100	1.485	100	1.864	100	1.363	100	1.113	100
22	1.042	100	0.773	100	1.857	100	1.977	100	1.422	100	1.258	100
23	1.382	100	1.339	100	1.924	100	1.935	100	2.167	100	1.508	100
24	2.201	100	1.786	100	1.289	100	1.051	100	1.314	100	1.477	100
25	1.660	100	1.291	100	2.004	100	0.958	100	1.111	100	1.039	100
26	2.213	100	1.654	100	1.303	100	1.283	100	1.758	100	1.906	100
27	2.020	100	1.660	100	1.544	100	1.332	100	1.369	100	1.730	100
28	0.815	100	0.910	100	0.918	100	1.223	100	1.629	100	0.955	100
29	2.349	100	1.778	100	1.227	100	1.213	100	1.284	100	1.630	100
30	2.255	100	1.406	100	1.923	100	1.422	100	1.393	100	1.695	100
31	1.421	100	1.379	100	1.080	100	1.462	100	1.088	100	1.346	100
32	1.588	100	1.164	100	1.049	100	0.961	100	1.136	100	1.284	100
135	2.283	100	1.593	100	2.536	100	2.016	100	2.142	100	1.510	100
138	1.191	100	1.228	100	1.412	100	1.334	100	1.950	100	1.218	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
PRN ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.691	100	1.473	100	1.883	100	1.731	100	1.224	100	1.312	100
3	1.045	100	1.147	100	0.817	100	1.589	100	1.133	100	1.549	100
4	1.537	100	1.801	100	1.764	100	1.279	100	1.702	100	1.925	100
5	0.919	100	1.146	100	1.784	100	0.946	100	1.177	100	1.044	100
6	1.650	100	1.408	100	0.817	100	1.305	100	1.459	100	1.550	100
7	1.143	100	1.289	100	2.135	100	1.322	100	1.211	100	1.753	100
8	0.877	100	1.096	100	1.036	100	1.488	100	1.339	100	1.286	100
9	1.236	100	1.379	100	1.130	100	1.003	100	1.470	100	1.320	100
10	1.005	100	0.878	100	0.986	100	1.252	100	1.042	100	1.050	100
11	0.995	100	0.872	100	1.225	100	1.048	100	1.004	100	1.060	100
12	0.950	100	1.241	100	1.556	100	1.179	100	1.345	100	1.184	100
13	0.969	100	1.515	100	1.198	100	1.042	100	1.216	100	1.496	100
14	0.773	100	0.982	100	1.989	100	1.138	100	1.099	100	0.874	100
15	1.204	100	1.215	100	0.975	100	1.515	100	1.542	100	1.898	100
16	1.225	100	0.824	100	1.935	100	1.015	100	1.038	100	0.940	100
17	1.398	100	1.453	100	1.325	100	0.804	100	1.366	100	1.335	100
18	1.314	100	1.152	100	2.282	100	1.210	100	1.446	100	1.235	100
19	3.245	100	2.256	100	2.680	100	2.186	100	2.093	100	2.161	100
20	1.044	100	1.142	100	0.941	100	0.992	100	0.966	100	0.925	100
21	1.703	100	1.019	100	1.997	100	1.229	100	1.251	100	1.287	100
22	1.295	100	1.049	100	2.742	100	1.492	100	1.527	100	1.360	100
23	1.552	100	1.376	100	2.432	100	1.587	100	1.574	100	1.645	100
24	1.364	100	1.713	100	1.002	100	1.428	100	1.571	100	1.980	100
25	1.084	100	1.165	100	0.934	100	1.311	100	1.183	100	1.643	100
26	1.568	100	1.476	100	1.304	100	1.952	100	1.709	100	1.789	100
27	1.221	100	1.603	100	1.305	100	1.475	100	1.647	100	1.863	100
28	0.996	100	0.796	100	1.920	100	0.896	100	1.013	100	0.950	100
29	1.013	100	1.465	100	1.539	100	1.321	100	1.438	100	1.533	100
30	1.193	100	1.306	100	1.956	100	1.376	100	2.035	100	1.568	100
31	0.818	100	0.800	100	1.777	100	0.802	100	0.952	100	1.116	100
32	0.875	100	1.050	100	0.937	100	1.102	100	1.068	100	1.275	100
135	1.723	100	1.262	100	1.948	100	2.315	100	1.860	100	1.512	100
138	1.149	100	1.483	100	2.227	100	1.556	100	1.273	100	1.479	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	1.170	100	0.823	100	1.199	100	1.136	100	1.086	100	1.076	100
3	0.555	100	0.647	100	0.579	100	0.374	100	0.804	100	0.583	100
4	1.107	100	1.221	100	1.227	100	0.755	100	1.280	100	1.230	100
5	0.409	100	0.497	100	0.510	100	0.379	100	0.550	100	0.343	100
6	0.835	100	0.650	100	0.632	100	0.475	100	0.766	100	0.479	100
7	1.156	100	0.787	100	0.672	100	0.581	100	0.747	100	0.723	100
8	0.777	100	0.587	100	0.552	100	0.376	100	0.569	100	0.640	100
9	0.691	100	0.774	100	0.495	100	0.476	100	0.536	100	0.662	100
10	0.712	100	0.536	100	0.534	100	0.916	100	0.573	100	0.546	100
11	0.505	100	0.406	100	0.434	100	0.690	100	0.593	100	0.342	100
12	0.698	100	0.865	100	0.572	100	0.391	100	0.557	100	0.739	100
13	1.100	100	0.847	100	0.603	100	0.511	100	0.850	100	0.759	100
14	0.966	100	0.496	100	0.435	100	0.411	100	0.377	100	0.359	100
15	1.077	100	0.983	100	0.648	100	1.054	100	0.824	100	0.992	100
16	0.603	100	0.435	100	0.612	100	0.608	100	0.686	100	0.447	100
17	2.006	100	0.842	100	0.842	100	0.514	100	0.724	100	0.652	100
18	0.782	100	0.501	100	0.955	100	0.864	100	0.943	100	0.582	100
19	1.455	100	1.357	100	1.655	100	1.572	100	2.026	100	1.461	100
20	0.531	100	0.568	100	0.800	100	0.468	100	0.722	100	0.508	100
21	1.078	100	0.699	100	1.132	100	1.092	100	0.835	100	0.677	100
22	0.837	100	0.459	100	0.976	100	1.069	100	0.746	100	0.706	100
23	1.187	100	1.093	100	1.578	100	1.449	100	1.576	100	1.098	100
24	1.407	100	1.067	100	0.941	100	0.878	100	0.990	100	0.999	100
25	0.997	100	0.777	100	0.831	100	0.531	100	0.788	100	0.661	100
26	1.124	100	0.942	100	0.599	100	0.671	100	1.004	100	0.985	100
27	1.149	100	1.034	100	0.746	100	0.697	100	0.894	100	0.975	100
28	0.630	100	0.412	100	0.510	100	0.773	100	0.816	100	0.525	100
29	1.163	100	1.059	100	0.627	100	0.641	100	0.865	100	0.931	100
30	1.031	100	0.752	100	0.963	100	0.753	100	0.716	100	0.713	100
31	0.737	100	0.854	100	0.272	100	0.367	100	0.827	100	0.952	100
32	0.832	100	0.745	100	0.475	100	0.356	100	0.623	100	0.636	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	1.083	100	1.051	100	1.024	100	1.197	100	0.812	100	0.980	100
3	0.473	100	0.470	100	0.616	100	0.568	100	0.561	100	0.741	100
4	0.884	100	1.203	100	1.534	100	0.784	100	0.966	100	1.114	100
5	0.306	100	0.387	100	0.383	100	0.373	100	0.486	100	0.466	100
6	0.742	100	0.547	100	0.671	100	0.504	100	0.748	100	0.783	100
7	0.686	100	0.711	100	1.017	100	0.631	100	0.811	100	0.995	100
8	0.524	100	0.537	100	0.605	100	0.601	100	0.618	100	0.671	100
9	0.556	100	0.648	100	0.729	100	0.505	100	0.844	100	0.759	100
10	0.489	100	0.355	100	0.475	100	0.464	100	0.371	100	0.554	100
11	0.562	100	0.373	100	0.463	100	0.527	100	0.548	100	0.520	100
12	0.561	100	0.538	100	0.631	100	0.399	100	0.603	100	0.628	100
13	0.735	100	0.804	100	0.935	100	0.481	100	0.716	100	0.866	100
14	0.497	100	0.534	100	0.678	100	0.526	100	0.440	100	0.538	100
15	0.592	100	0.622	100	0.771	100	0.703	100	0.809	100	1.079	100
16	0.669	100	0.518	100	0.555	100	0.626	100	0.487	100	0.548	100
17	0.794	100	0.772	100	1.041	100	0.402	100	0.790	100	0.708	100
18	0.736	100	0.910	100	0.731	100	0.877	100	0.752	100	0.784	100
19	1.933	100	1.588	100	1.419	100	1.680	100	1.471	100	1.475	100
20	0.447	100	0.582	100	0.525	100	0.587	100	0.472	100	0.464	100
21	0.891	100	0.705	100	1.138	100	0.911	100	0.744	100	0.843	100
22	0.748	100	0.751	100	1.111	100	1.097	100	0.770	100	0.840	100
23	1.095	100	1.169	100	1.584	100	1.327	100	1.262	100	1.219	100
24	0.985	100	1.109	100	1.100	100	0.941	100	1.014	100	1.305	100
25	0.718	100	0.679	100	0.861	100	0.654	100	0.784	100	0.914	100
26	0.889	100	0.725	100	0.884	100	0.849	100	0.852	100	0.991	100
27	0.826	100	0.946	100	1.052	100	0.741	100	0.940	100	1.126	100
28	0.424	100	0.460	100	0.939	100	0.656	100	0.528	100	0.629	100
29	0.772	100	0.898	100	1.073	100	0.589	100	0.902	100	1.070	100
30	0.752	100	0.793	100	1.055	100	0.564	100	0.919	100	0.946	100
31	0.454	100	0.359	100	0.591	100	0.266	100	0.547	100	0.643	100
32	0.579	100	0.471	100	0.721	100	0.406	100	0.612	100	0.785	100

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

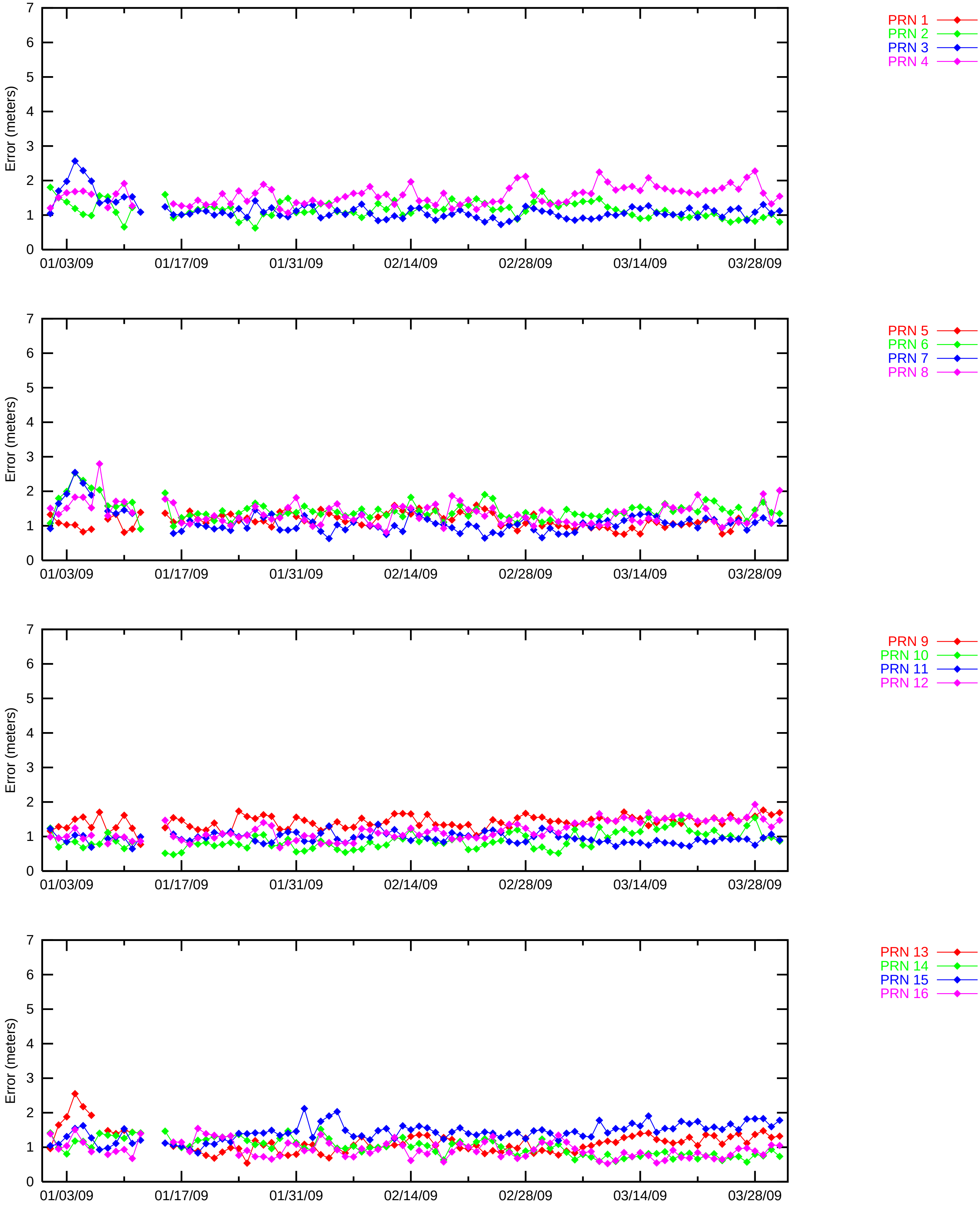


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Atlanta

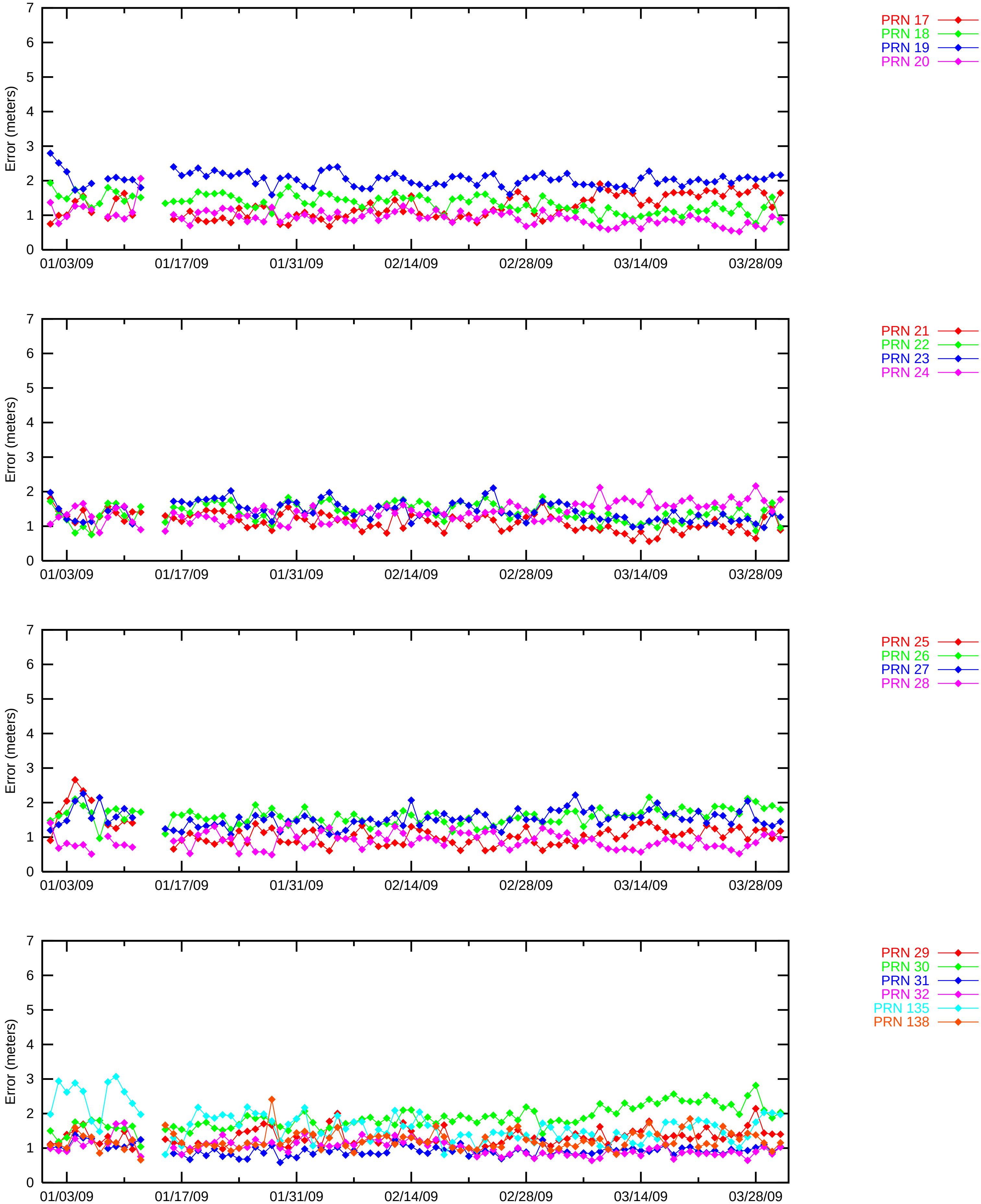
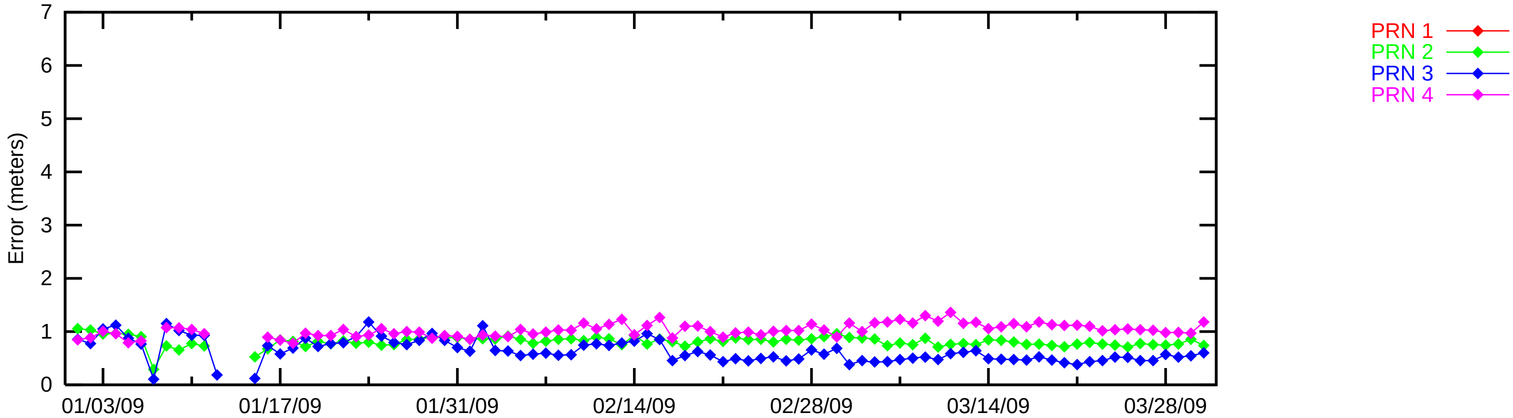
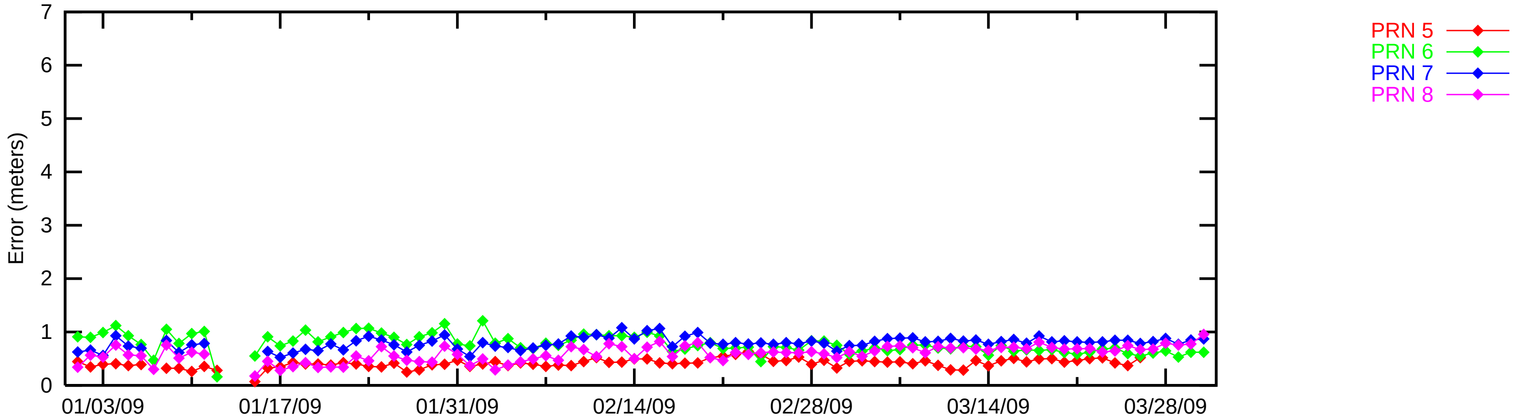
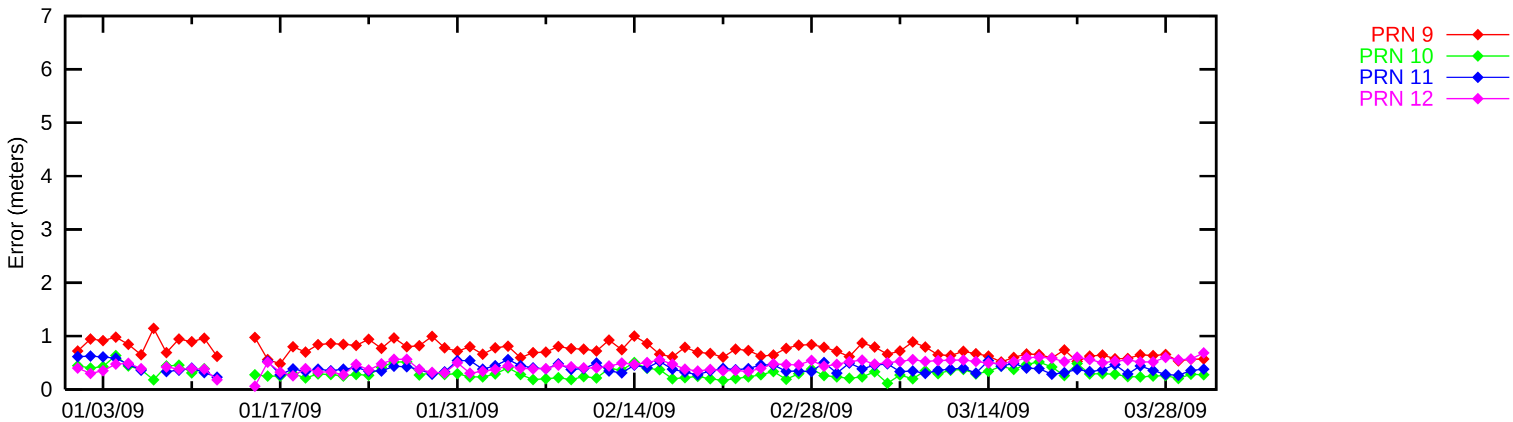


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Atlanta







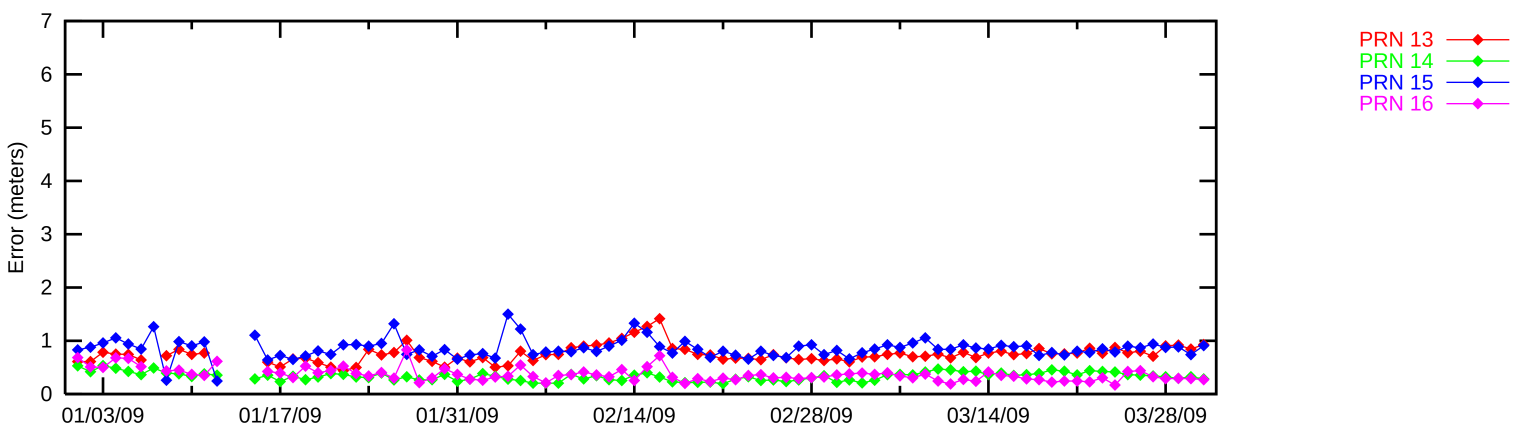
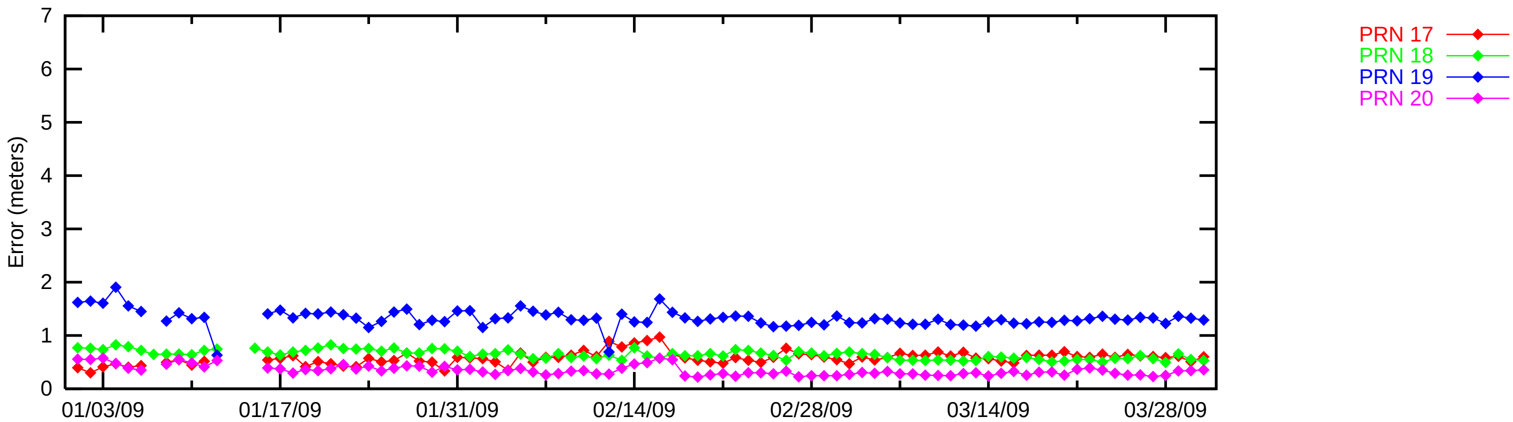
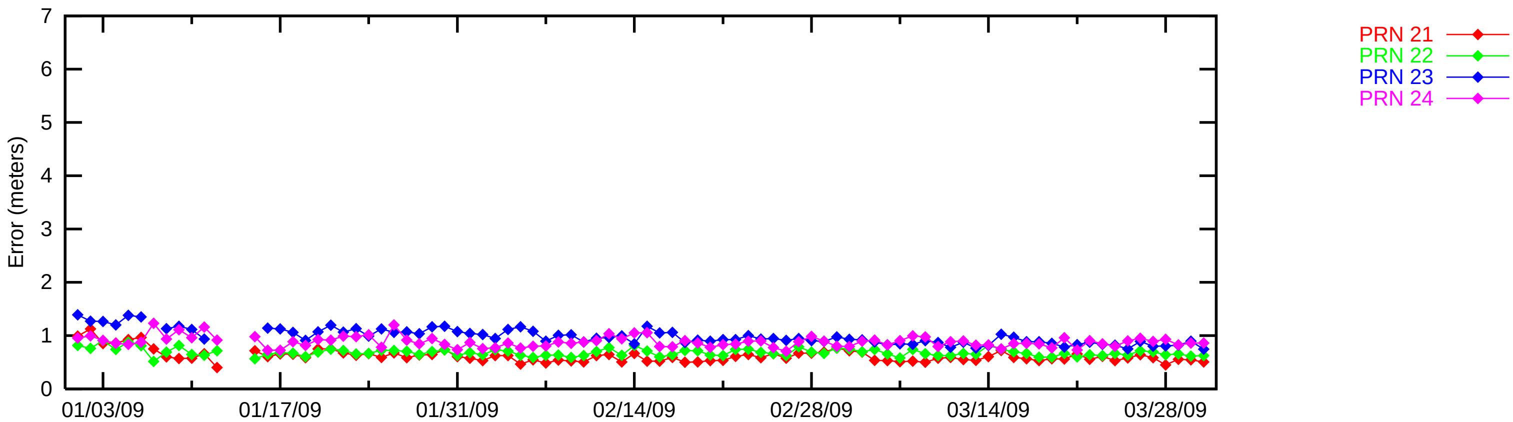
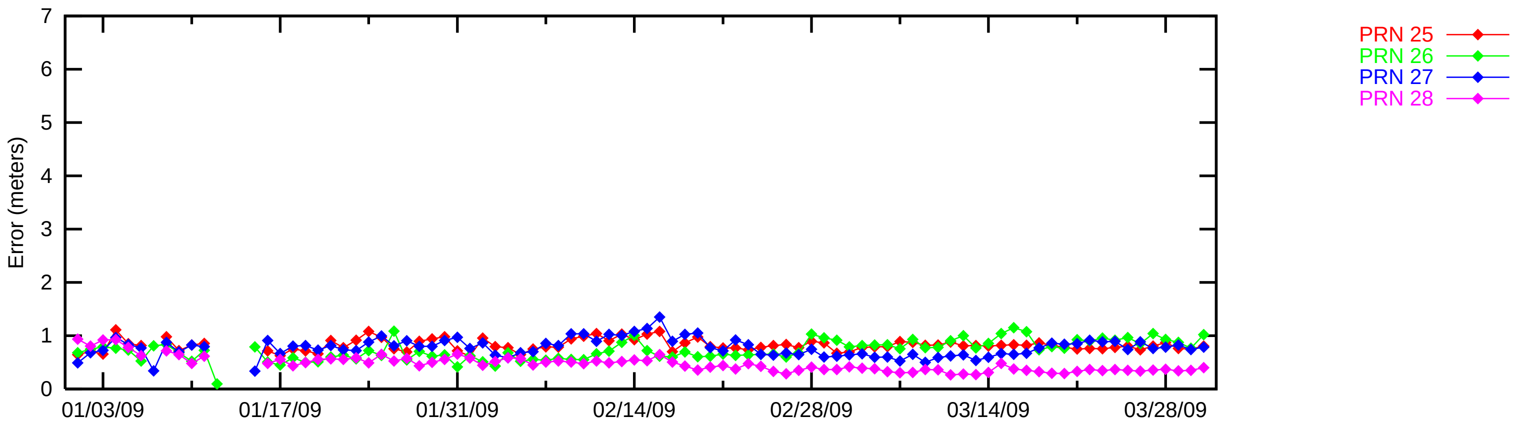
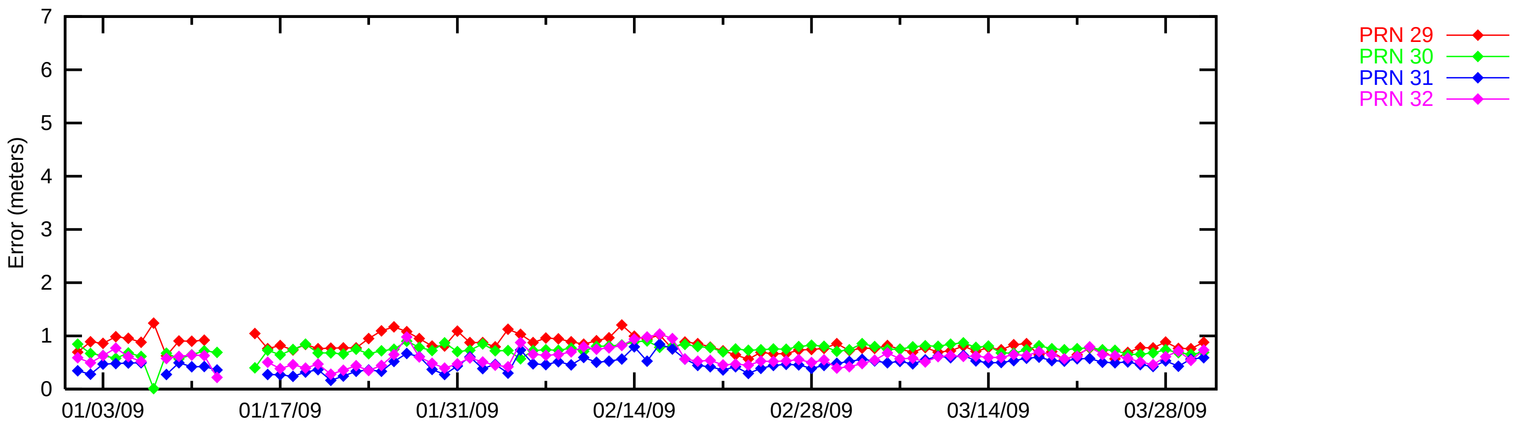


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Atlanta









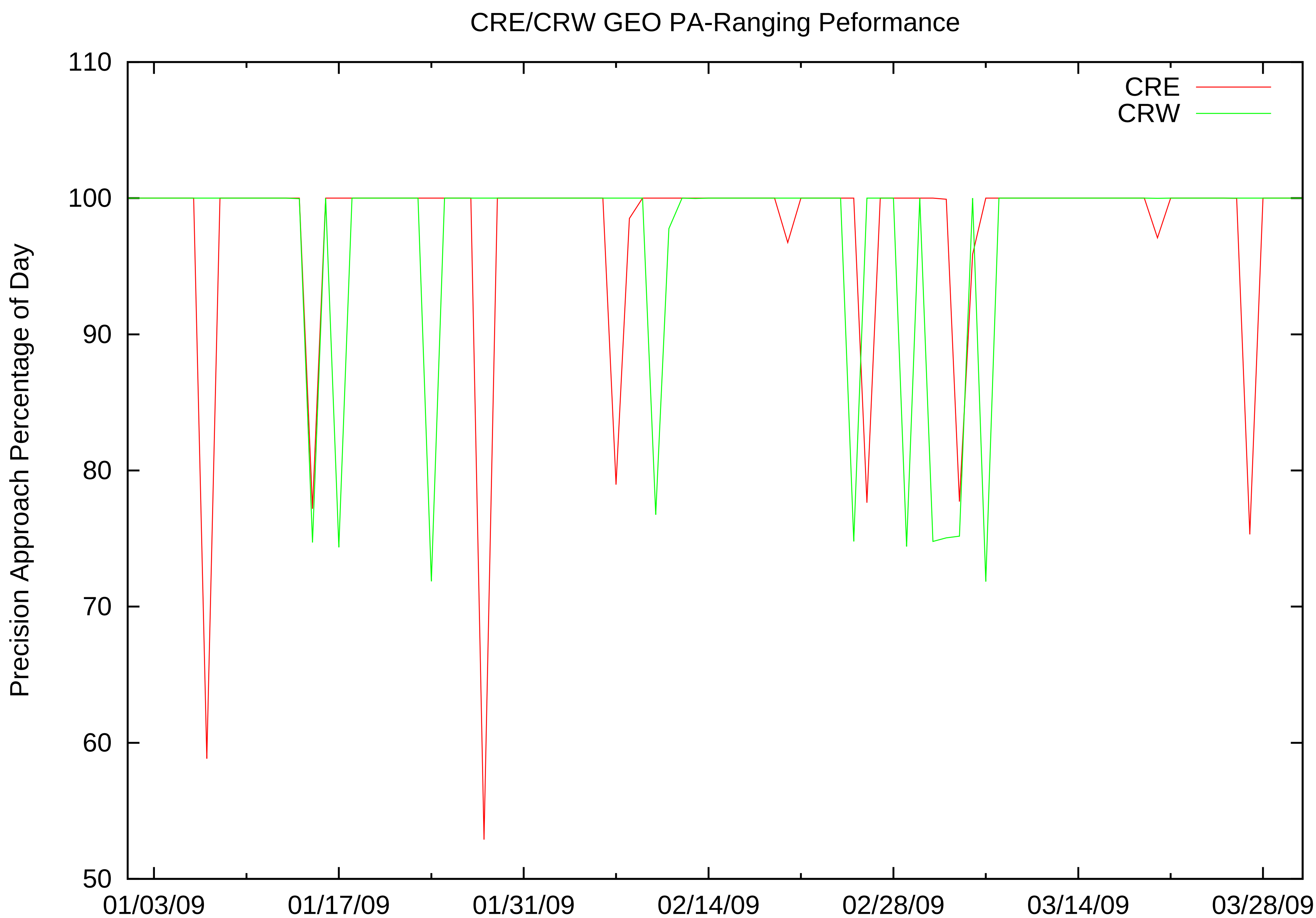
7.0 GEO RANGING PERFORMANCE

For the evaluation period, both CRW and CRE GEO satellites provide ranging capability for enroute through NPA 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	97.127	2.303	0.562	0
CRE	97.62	1.192	0.444	0.735

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
1/24/09	See DR #79 – Doppler Spike caused CRW Signal in Space Outage. CRW has 592 sec outage. AK LPV/LPV200 Coverage drop.
2/27/09	See DR #80 Ionospheric Scintillation caused High Position Error at Fairbanks and Kotzebue.
3/29/09	See DR #78 – False WAAS satellite alert for PRN29.

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	36	0.998244	572	0.897807
PAGA	EDWARD G. PITKA SR	AK	0	1	12	0.999462
PAEM	EMMONAK	AK	0	1	101	0.988917
PAFA	FAIRBANKS INTL	AK	0	1	3	0.999937
PAGB	GALBRAITH LAKE	AK	0	1	37	0.997465
PAGK	GULKANA	AK	0	1	0	1
PAHO	HOMER	AK	0	1	0	1
PAHL	HUSLIA	AK	0	1	14	0.999276
PAEN	KENAI MUNICIPAL	AK	0	1	0	1
PAKT	KETCHIKAN INTL	AK	0	1	0	1
PAKN	KING SALMON	AK	0	1	15	0.999621
PARY	RUBY	AK	0	1	10	0.999630
PASK	SELAWIK	AK	0	1	89	0.991611
PASM	ST MARY'S	AK	0	1	81	0.992524
PAMK	ST MICHAEL	AK	0	1	72	0.994567
PANC	TED STEVENS ANCHORAGE INTL	AK	0	1	0	1
PAYA	YAKUTAT	AK	0	1	1	0.999893
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	0	1
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	0	1	0	1
JKA	JACK EDWARDS	AL	0	1	1	0.999982
MDQ	MADISON COUNTY EXECUTIVE/TOM S	AL	0	1	0	1
BFM	MOBILE DOWNTOWN	AL	0	1	1	0.999982

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MOB	MOBILE RGNL	AL	0	1	1	0.999982
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	1	0.999982
DCU	PRYOR FIELD RGNL	AL	0	1	0	1
79J	SOUTH ALABAMA RGNL AT BILL BEN	AL	0	1	0	1
PLR	ST CLAIR COUNTY	AL	0	1	0	1
2R5	ST ELMO	AL	0	1	1	0.999982
ASN	TALLADEGA MUNICIPAL	AL	0	1	0	1
TOI	TROY MUNICIPAL	AL	0	1	0	1
TCL	TUSCALOOSA RGNL	AL	0	1	1	0.999982
LIT	ADAMS FIELD	AR	0	1	1	0.999982
M73	ALMYRA MUNICIPAL	AR	0	1	1	0.999982
BYH	ARKANSAS INTL	AR	0	1	1	0.999983
VBT	BENTONVILLE MUNICIPAL/ LOUISE M THAD	AR	0	1	1	0.999982
HRO	BOONE COUNTY	AR	0	1	1	0.999982
FSM	FORT SMITH RGNL	AR	0	1	1	0.999982
PBF	GRIDER FIELD	AR	0	1	1	0.999982
JBR	JONESBORO MUNICIPAL	AR	0	1	1	0.999982
M19	NEWPORT MUNICIPAL	AR	0	1	1	0.999982
ORK	NORTH LITTLE ROCK MUNICIPAL	AR	0	1	1	0.999982
XNA	NORTHWEST ARKANSAS RGNL	AR	0	1	1	0.999982
BPK	OZARK RGNL	AR	0	1	1	0.999982
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1	1	0.999982
RUE	RUSSELLVILLE RGNL	AR	0	1	1	0.999982
SUZ	SALINE COUNTY RGNL	AR	0	1	1	0.999982
SRC	SEARCY MUNICIPAL	AR	0	1	1	0.999982
SLG	SMITH FIELD	AR	0	1	1	0.999982
ELD	SOUTH ARKANSAS RGNL AT GOODWIN	AR	0	1	1	0.999982
ASG	SPRINGDALE MUNICIPAL	AR	0	1	1	0.999982
SGT	STUTTGART MUNICIPAL	AR	0	1	1	0.999982
ARG	WALNUT RIDGE RGNL	AR	0	1	1	0.999982
PRC	ERNEST A. LOVE FIELD	AZ	0	1	3	0.999941
GEU	GLENDALE MUNICIPAL	AZ	0	1	42	0.997560
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1	1	0.999982
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1	5	0.999855
PGA	PAGE MUNICIPAL	AZ	0	1	1	0.999982
DVT	PHOENIX DEER VALLEY	AZ	0	1	41	0.997608
PHX	PHOENIX SKY HARBOR INTL	AZ	0	1	73	0.992233
IWA	PHOENIX-MESA GATEWAY	AZ	1	0.999984	93	0.989055
SJN	ST JOHNS INDUSTRIAL AIR PARK	AZ	0	1	65	0.997291
TUS	TUCSON INTL	AZ	4	0.999850	93	0.986246
APV	APPLE VALLEY	CA	0	1	20	0.999006
ACV	ARCATA	CA	1	0.999892	176	0.978525
DAG	BARSTOW-DAGGETT	CA	0	1	10	0.999536
C83	BYRON	CA	1	0.999890	305	0.971057
CMA	CAMARILLO	CA	1	0.999982	128	0.985558
CNO	CHINO	CA	0	1	66	0.996112
FAT	FRESNO YOSEMITE INTL	CA	1	0.999969	172	0.990188
WJF	GENERAL WM J FOX AIRFIELD	CA	0	1	40	0.997661

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
HAF	HALF MOON BAY	CA	1	0.999860	325	0.958564
HWD	HAYWARD EXECUTIVE	CA	1	0.999887	309	0.964490
CVH	HOLLISTER MUNICIPAL	CA	1	0.999889	281	0.970667
SNA	JOHN WAYNE AIRPORT-ORANGE COUNTY	CA	0	1	96	0.991885
LGB	LONG BEACH /DAUGHERTY FIELD	CA	0	1	99	0.991208
LAX	LOS ANGELES INTL	CA	1	0.999984	100	0.989764
MAE	MADERA MUNICIPAL	CA	1	0.999947	214	0.985792
CRQ	MC CLELLAN-PALOMAR	CA	0	1	98	0.990186
BFL	MEADOWS FIELD	CA	0	1	114	0.991262
MCE	MERCED MUNICIPAL/ MACREADY FIELD	CA	1	0.999926	256	0.981908
OAK	METROPOLITAN OAKLAND INTL	CA	1	0.999886	313	0.963468
MOD	MODESTO CITY-CO-HARRY SHAM FLD	CA	1	0.999901	280	0.977863
MRY	MONTEREY PENINSULA	CA	1	0.999851	310	0.962392
APC	NAPA COUNTY	CA	1	0.999882	312	0.965176
O02	NERVINO	CA	0	1	96	0.996082
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	1	0.999877	307	0.965825
VCB	NUT TREE	CA	1	0.999889	309	0.970280
ONT	ONTARIO INTL	CA	0	1	57	0.996830
OXR	OXNARD	CA	0	1	149	0.984020
PMD	PALMDALE RGNL/USAF PLANT 42	CA	0	1	30	0.998025
RBL	RED BLUFF MUNICIPAL	CA	0	1	173	0.987526
RDD	REDDING MUNICIPAL	CA	0	1	126	0.989262
RAL	RIVERSIDE MUNICIPAL	CA	0	1	61	0.996555
SMF	SACRAMENTO INTL	CA	1	0.999915	285	0.978489
MHR	SACRAMENTO MATHER	CA	1	0.999917	276	0.980942
SFO	SAN FRANCISCO INTL	CA	1	0.999875	318	0.960995
SBA	SANTA BARBARA MUNICIPAL	CA	1	0.999965	214	0.975949
TCY	TRACY MUNICIPAL	CA	1	0.999891	302	0.972547
APA	CENTENNIAL	CO	0	1	3	0.999940
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	0	1	3	0.999940
AKO	COLORADO PLAINS RGNL	CO	0	1	2	0.999957
CEZ	CORTEZ MUNICIPAL	CO	0	1	1	0.999982
DEN	DENVER INTL	CO	0	1	3	0.999940
FTG	FRONT RANGE	CO	0	1	3	0.999940
RIL	GARFIELD COUNTY RGNL	CO	0	1	2	0.999966
GXY	GREELEY-WELD COUNTY	CO	0	1	2	0.999957
ITR	KIT CARSON COUNTY	CO	0	1	2	0.999957
LAA	LAMAR MUNICIPAL	CO	0	1	3	0.999940
PUB	PUEBLO MEMORIAL	CO	0	1	3	0.999940
ALS	SAN LUIS VALLEY RGNL/BERGMAN F	CO	0	1	2	0.999966
HDN	YAMPA VALLEY	CO	0	1	2	0.999957
BDL	BRADLEY INTL	CT	0	1	2	0.999898
GON	GROTON-NEW LONDON	CT	0	1	2	0.999893
HVN	TWEED-NEW HAVEN	CT	0	1	2	0.999885
OXC	WATERBURY-OXFORD	CT	0	1	2	0.999883
DCA	RONALD REAGAN WASHINGTON NTL	DC	0	1	1	0.999844
EVY	SUMMIT	DE	0	1	1	0.999868
GED	SUSSEX COUNTY	DE	0	1	1	0.999864
AAF	APALACHICOLA MUNICIPAL	FL	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
CEW	BOB SIKES	FL	0	1	0	1
BCT	BOCA RATON	FL	0	1	9	0.999592
PGD	CHARLOTTE COUNTY	FL	0	1	3	0.999757
DAB	DAYTONA BEACH INTL	FL	0	1	4	0.999817
DED	DELAND MUNICIPAL-SIDNEY H TAYLOR FIELD	FL	0	1	3	0.999844
XFL	FLAGLER COUNTY	FL	0	1	3	0.999842
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1	7	0.999621
FLL	FORT LAUDERDALE/HOLLYWOOD INTL	FL	0	1	8	0.999575
GNV	GAINESVILLE RGNL	FL	0	1	1	0.999957
BKV	HERNANDO COUNTY	FL	0	1	2	0.999883
JAX	JACKSONVILLE INTL	FL	0	1	1	0.999958
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	0	1	8	0.999599
EYW	KEY WEST INTL	FL	0	1	8	0.999496
ISM	KISSIMMEE GATEWAY	FL	0	1	3	0.999814
X14	LA BELLE MUNICIPAL	FL	0	1	3	0.999766
LCQ	LAKE CITY MUNICIPAL	FL	0	1	0	1
LAL	LAKELAND LINDER RGNL	FL	0	1	3	0.999821
LEE	LEESBURG INTL	FL	0	1	3	0.999852
MLB	MELBOURNE INTL	FL	0	1	2	0.999802
COI	MERRITT ISLAND	FL	0	1	4	0.999772
MIA	MIAMI INTL	FL	0	1	9	0.999565
APF	NAPLES MUNICIPAL	FL	0	1	6	0.999706
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1	4	0.999805
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1	2	0.999895
MCO	ORLANDO INTL	FL	0	1	3	0.999814
SFB	ORLANDO SANFORD INTL	FL	0	1	4	0.999810
PHK	PALM BEACH CO GLADES	FL	0	1	2	0.999782
PBI	PALM BEACH INTL	FL	0	1	5	0.999701
PFN	PANAMA CITY-BAY CO INTL	FL	0	1	0	1
PNS	PENSACOLA RGNL	FL	0	1	1	0.999982
PMP	POMPANO BEACH AIRPARK	FL	0	1	10	0.999569
SRQ	SARASOTA/BRADENTON INTL	FL	0	1	3	0.999806
RSW	SOUTHWEST FLORIDA INTL	FL	0	1	5	0.999724
FPR	ST LUCIE COUNTY INTL	FL	0	1	3	0.999771
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1	3	0.999851
TLH	TALLAHASSEE RGNL	FL	0	1	0	1
TPA	TAMPA INTL	FL	0	1	3	0.999851
MTH	THE FLORIDA KEYS MARATHON	FL	0	1	8	0.999479
VDF	VANDENBERG	FL	0	1	3	0.999843
GIF	WINTER HAVEN'S GILBERT	FL	0	1	3	0.999818
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	0	1	0	1
BQK	BRUNSWICK GOLDEN ISLES	GA	0	1	1	0.999985
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	0	1
CKF	CRISP COUNTY-CORDELE	GA	0	1	0	1
DNN	DALTON MUNICIPAL	GA	0	1	0	1
SBO	EMANUEL COUNTY	GA	0	1	0	1
18A	FRANKLIN COUNTY	GA	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
FTY	FULTON COUNTY AIRPORT-BROWN FI	GA	0	1	0	1
ATL	HARTSFIELD - JACKSON ATLANTA I	GA	0	1	0	1
EZM	HEART OF GEORGIA RGNL	GA	0	1	0	1
19A	JACKSON COUNTY	GA	0	1	0	1
GVL	LEE GILMER MEMORIAL	GA	0	1	0	1
MCN	MIDDLE GEORGIA RGNL	GA	0	1	0	1
MGR	MOULTRIE MUNICIPAL	GA	0	1	0	1
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	0	1
JZP	PICKENS COUNTY	GA	0	1	0	1
JYL	PLANTATION ARPK	GA	0	1	0	1
SAV	SAVANNAH/HILTON HEAD INTL	GA	0	1	1	0.999985
ACJ	SOUTHER FIELD	GA	0	1	0	1
ABY	SOUTHWEST GEORGIA RGNL	GA	0	1	0	1
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1	0	1
MQW	TELFAIR-WHEELER	GA	0	1	0	1
TVI	THOMASVILLE RGNL	GA	0	1	0	1
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1	0	1
VLD	VALDOSTA RGNL	GA	0	1	0	1
VDI	VIDALIA RGNL	GA	0	1	0	1
IIY	WASHINGTON-WILKES COUNTY	GA	0	1	0	1
AYS	WAYCROSS-WARE COUNTY	GA	0	1	0	1
CTJ	WEST GEORGIA RGNL - O V GRAY F	GA	0	1	0	1
WDR	WINDER-BARROW	GA	0	1	0	1
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	2	0.999874
EUL	CALDWELL INDUSTRIAL	ID	0	1	2	0.999862
GNG	GOODING MUNICIPAL	ID	0	1	2	0.999914
IDA	IDAHO FALLS RGNL	ID	0	1	0	1
LWS	LEWISTON-NEZ PERCE COUNTY	ID	0	1	1	0.999965
S67	NAMPA MUNICIPAL	ID	0	1	2	0.999865
PIH	POCATELLO RGNL	ID	0	1	0	1

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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 AT BLOOMI	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 FIEL	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

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PTS	ATKINSON MUNICIPAL	KS	0	1	1	0.999982
AAO	COLONEL JAMES JABARA	KS	0	1	1	0.999982
DDC	DODGE CITY RGNL	KS	0	1	2	0.999966
EMP	EMPORIA MUNICIPAL	KS	0	1	1	0.999982
FOE	FORBES FIELD	KS	0	1	1	0.999982
FSK	FORT SCOTT MUNICIPAL	KS	0	1	1	0.999982
GCK	GARDEN CITY RGNL	KS	0	1	2	0.999957
HYS	HAYS RGNL	KS	0	1	1	0.999982
HQG	HUGOTON MUNICIPAL	KS	0	1	3	0.999940
OJC	JOHNSON COUNTY EXECUTIVE	KS	0	1	1	0.999985
LWC	LAWRENCE MUNICIPAL	KS	0	1	1	0.999984
LBL	LIBERAL MID-AMERICA RGNL	KS	0	1	3	0.999941
MHK	MANHATTAN RGNL	KS	0	1	1	0.999982
MPR	MC PHERSON	KS	0	1	1	0.999982
IXD	NEW CENTURY AIRCENTER	KS	0	1	1	0.999984
EWK	NEWTON-CITY-COUNTY	KS	0	1	1	0.999982
OEL	OAKLEY MUNICIPAL	KS	0	1	1	0.999982
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1	1	0.999982
PTT	PRATT INDUSTRIAL	KS	0	1	1	0.999982
GLD	RENNER FLD /GOODLAND MUNICIPAL/	KS	0	1	2	0.999966
RSL	RUSSELL MUNICIPAL	KS	0	1	1	0.999982
SLN	SALINA MUNICIPAL	KS	0	1	1	0.999982
TQK	SCOTT CITY MUNICIPAL	KS	0	1	2	0.999966
CBK	SHALZ FIELD	KS	0	1	1	0.999982
WLD	STROTHER FIELD	KS	0	1	1	0.999982
PPF	TRI-CITY	KS	0	1	1	0.999982
ULS	ULYSSES	KS	0	1	3	0.999941
EGT	WELLINGTON MUNICIPAL	KS	0	1	1	0.999982
ICT	WICHITA MID-CONTINENT	KS	0	1	1	0.999982
EKX	ADDINGTON FIELD	KY	0	1	0	1
PAH	BARKLEY RGNL	KY	0	1	0	1
K22	BIG SANDY RGNL	KY	0	1	0	1
LEX	BLUE GRASS	KY	0	1	0	1
LOU	BOWMAN FIELD	KY	0	1	0	1
CVG	CINCINNATI/NORTHERN KENTUCKY I	KY	0	1	0	1
27K	GEORGETOWN SCOTT COUNTY	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	3	0.999940
AEX	ALEXANDRIA INTL	LA	0	1	2	0.999957
BTR	BATON ROUGE METROPOLITAN` RYAN	LA	0	1	2	0.999957
DRI	BEAUREGARD RGNL	LA	0	1	3	0.999940
CWF	CHENNAULT INTL	LA	0	1	3	0.999940
ESF	ESLER RGNL	LA	0	1	2	0.999957
HZR	FALSE RIVER RGNL	LA	0	1	2	0.999957
PTN	HARRY P WILLIAMS MEMORIAL	LA	0	1	2	0.999957

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LFT	LAFAYETTE RGNL	LA	0	1	3	0.999940
LCH	LAKE CHARLES RGNL	LA	0	1	3	0.999940
NEW	LAKEFRONT	LA	0	1	2	0.999957
MSY	LOUIS ARMSTRONG NEW ORLEANS IN	LA	0	1	2	0.999957
BQP	MOREHOUSE MEMORIAL	LA	0	1	1	0.999982
DTN	SHREVEPORT DOWNTOWN	LA	0	1	2	0.999966
SHV	SHREVEPORT RGNL	LA	0	1	2	0.999957
GAO	SOUTH LAFOURCHE LEONARD MILLER	LA	0	1	2	0.999957
TVR	VICKSBURG TALLULAH RGNL	LA	0	1	1	0.999982
BAF	BARNES MUNICIPAL	MA	0	1	1	0.999913
HYA	BARNSTABLE MUNICIPAL-BOARDMAN/POLAN	MA	0	1	1	0.999909
BOS	GENERAL EDWARD LAWRENCE LOGAN	MA	0	1	1	0.999925
BED	LAURENCE G HANSCOM FLD	MA	0	1	1	0.999921
MVY	MARTHAS VINEYARD	MA	0	1	2	0.999902
OWD	NORWOOD MEMORIAL	MA	0	1	1	0.999921
PVC	PROVINCETOWN MUNICIPAL	MA	0	1	1	0.999928
ORH	WORCESTER RGNL	MA	0	1	1	0.999912
BWI	BALTIMORE/WASHINGTON INTL THUR	MD	0	1	1	0.999852
DMW	CARROLL COUNTY RGNL/JACK B POA	MD	0	1	1	0.999850
ESN	EASTON/NEWNAM FIELD	MD	0	1	1	0.999857
FDK	FREDERICK MUNICIPAL	MD	0	1	1	0.999844
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1	1	0.999845
2W6	ST. MARY'S COUNTY RGNL	MD	0	1	1	0.999846
LEW	AUBURN/LEWISTON MUNICIPAL	ME	0	1	1	0.999948
AUG	AUGUSTA STATE	ME	0	1	1	0.999945
BGR	BANGOR INTL	ME	0	1	1	0.999959
BHB	HANCOCK COUNTY-BAR HARBOR	ME	0	1	1	0.999963
PQI	NORTHERN MAINE RGNL ARPT AT PR	ME	0	1	1	0.999958
PWM	PORTLAND INTL JETPORT	ME	0	1	1	0.999936
WVL	WATERVILLE ROBERT LAFLEUR	ME	0	1	1	0.999947
ARB	ANN ARBOR MUNICIPAL	MI	0	1	0	1
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	0	1
TTF	CUSTER	MI	0	1	0	1
DTW	DETROIT METROPOLITAN WAYNE COU	MI	0	1	0	1
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	0.999982
BAX	HURON COUNTY MEMORIAL	MI	0	1	0	1
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	0	1
MKG	MUSKEGON COUNTY	MI	0	1	0	1
RNP	OWOSSO COMMUNITY	MI	0	1	0	1
HYX	SAGINAW COUNTY H.W. BROWNE	MI	0	1	0	1
BIV	TULIP CITY	MI	0	1	0	1

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YIP	WILLOW RUN	MI	0	1	0	1
AEL	ALBERT LEA MUNICIPAL	MN	0	1	0	1
ANE	ANOKA COUNTY-BLAINE ARPT(JANES	MN	0	1	1	0.999982
AUM	AUSTIN MUNICIPAL	MN	0	1	0	1
BDE	BAUDETTE INTL	MN	0	1	1	0.999982
BRD	BRAINERD LAKES RGNL	MN	0	1	1	0.999982
AXN	CHANDLER FIELD	MN	0	1	1	0.999982
HIB	CHISHOLM-HIBBING	MN	0	1	1	0.999982
CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	0	1	2	0.999966
DTL	DETROIT LAKES-WETHING FIELD	MN	0	1	1	0.999982
DLH	DULUTH INTL	MN	0	1	1	0.999982
INL	FALLS INTL	MN	0	1	2	0.999957
MSP	MINNEAPOLIS-ST PAUL INTL	MN	0	1	1	0.999984
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	1	0.999982
MML	SOUTHWEST MINNESOTA RGNL MARSH	MN	0	1	0	1
STC	ST CLOUD RGNL	MN	0	1	1	0.999982
JYG	ST JAMES MUNICIPAL	MN	0	1	0	1
STP	ST PAUL DOWNTOWN HOLMAN FLD	MN	0	1	1	0.999982
RRT	WARROAD INTL MEMORIAL	MN	0	1	1	0.999982
BDH	WILLMAR MUNICIPAL- JOHN L RICE FIELD	MN	0	1	1	0.999982
M17	BOLIVAR MUNICIPAL	MO	0	1	1	0.999983
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	1	0.999982
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	1	0.999985
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	1	0.999982
EOS	NEOSHO HUGH ROBINSON	MO	0	1	1	0.999982

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
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	1	0.999982
TBN	WAYNESVILLE RGNL ARPT AT FORNE	MO	0	1	0	1
UNO	WEST PLAINS MUNICIPAL	MO	0	1	1	0.999984
STF	GEORGE M BRYAN	MS	0	1	1	0.999982
GTR	GOLDEN TRIANGLE RGNL	MS	0	1	1	0.999982
GWO	GREENWOOD-LEFLORE	MS	0	1	1	0.999982
GNF	GRENADA MUNICIPAL	MS	0	1	1	0.999982
GPT	GULFPORT-BILOXI INTL	MS	0	1	1	0.999982
HEZ	HARDY-ANDERS FIELD NATCHEZ-ADA	MS	0	1	1	0.999982
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	0	1	1	0.999982
PIB	HATTIESBURG-LAUREL RGNL	MS	0	1	1	0.999982
LUL	HESLER-NOBLE FIELD	MS	0	1	1	0.999982
JAN	JACKSON-EVERS INTL	MS	0	1	1	0.999982
M16	JOHN BELL WILLIAMS	MS	0	1	1	0.999982
MEI	KEY FIELD	MS	0	1	1	0.999982
MCB	MC COMB/PIKE COUNTY/JOHN E LEW	MS	0	1	1	0.999982
M40	MONROE COUNTY	MS	0	1	1	0.999982
OLV	OLIVE BRANCH	MS	0	1	1	0.999982
MJD	PICAYUNE MUNICIPAL	MS	0	1	1	0.999982
M43	PRENTISS- JEFFERSON DAVIS COUNTY	MS	0	1	1	0.999982
CRX	ROSCOE TURNER	MS	0	1	1	0.999982
HSA	STENNIS INTL	MS	0	1	2	0.999966
PQL	TRENT LOTT INTL	MS	0	1	1	0.999982
UTA	TUNICA MUNICIPAL	MS	0	1	1	0.999982
UOX	UNIVERSITY-OXFORD	MS	0	1	1	0.999982
BTM	BERT MOONEY	MT	0	1	1	0.999985
BIL	BILLINGS LOGAN INTL	MT	0	1	1	0.999985
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	1	0.999984
LWT	LEWISTOWN MUNICIPAL	MT	0	1	1	0.999982
OAJ	ALBERT J ELLIS	NC	0	1	1	0.999794
AFP	ANSON COUNTY	NC	0	1	1	0.999793
HBI	ASHEBORO RGNL	NC	0	1	1	0.999800
AVL	ASHEVILLE RGNL	NC	0	1	0	1
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1	1	0.999940
JQF	CONCORD RGNL	NC	0	1	1	0.999913
EWN	CRAVEN COUNTY RGNL	NC	0	1	1	0.999805
ECG	ELIZABETH CITY CG AIR STATION	NC	0	1	1	0.999831
FAY	FAYETTEVILLE RGNL/GRANNIS FIELD	NC	0	1	1	0.999800
LHZ	FRANKLIN COUNTY	NC	0	1	1	0.999818
AKH	GASTONIA MUNICIPAL	NC	0	1	1	0.999943
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	0	1	1	0.999797
HRJ	HARNETT RGNL JETPORT	NC	0	1	1	0.999806

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
HNZ	HENDERSON-OXFORD	NC	0	1	1	0.999819
ISO	KINSTON RGNL JETPORT AT STALLI	NC	0	1	1	0.999800
EQY	MONROE RGNL	NC	0	1	1	0.999850
EDE	NORTHEASTERN RGNL	NC	0	1	1	0.999822
GSO	PIEDMONT TRIAD INTL	NC	0	1	1	0.999837
PGV	PITT-GREENVILLE	NC	0	1	1	0.999807
RDU	RALEIGH-DURHAM INTL	NC	0	1	1	0.999812
RWI	ROCKY MOUNT-WILSON RGNL	NC	0	1	1	0.999815
RUQ	ROWAN COUNTY	NC	0	1	1	0.999910
TTA	SANFORD-LEE COUNTY RGNL	NC	0	1	1	0.999809
SVH	STATESVILLE RGNL	NC	0	1	1	0.999921
ILM	WILMINGTON INTL	NC	0	1	1	0.999782
BIS	BISMARCK MUNICIPAL	ND	0	1	1	0.999982
5N8	CASSELTON ROBERT MILLER RGNL	ND	0	1	1	0.999982
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	1	0.999982
FAR	HECTOR INTL	ND	0	1	1	0.999982
JMS	JAMESTOWN RGNL	ND	0	1	2	0.999966
MOT	MINOT INTL	ND	0	1	0	1
ANW	AINSWORTH MUNICIPAL	NE	0	1	1	0.999982
BVN	ALBION MUNICIPAL	NE	0	1	1	0.999982
AIA	ALLIANCE MUNICIPAL	NE	0	1	1	0.999982
AUH	AURORA MUNICIPAL – AL POTTER FIELD	NE	0	1	1	0.999982
BIE	BEATRICE MUNICIPAL	NE	0	1	1	0.999982
FNB	BRENNER FIELD	NE	0	1	1	0.999984
HDE	BREWSTER FIELD	NE	0	1	1	0.999982
BBW	BROKEN BOW MUNICIPAL	NE	0	1	1	0.999982
GRI	CENTRAL NEBRASKA RGNL	NE	0	1	1	0.999982
CDR	CHADRON MUNICIPAL	NE	0	1	1	0.999982
OLU	COLUMBUS MUNICIPAL	NE	0	1	1	0.999982
CZD	COZAD MUNICIPAL	NE	0	1	1	0.999982
CEK	CRETE MUNICIPAL	NE	0	1	1	0.999982
OMA	EPPLEY AIRFIELD	NE	0	1	0	1
FBY	FAIRBURY MUNICIPAL	NE	0	1	1	0.999982
FET	FREMONT MUNICIPAL	NE	0	1	1	0.999984
OKS	GARDEN COUNTY	NE	0	1	1	0.999982
GRN	GORDON MUNICIPAL	NE	0	1	1	0.999982
GGF	GRANT MUNICIPAL	NE	0	1	1	0.999982
HSI	HASTINGS MUNICIPAL	NE	0	1	1	0.999982
IML	IMPERIAL MUNICIPAL	NE	0	1	1	0.999982
LXN	JIM KELLY FIELD	NE	0	1	1	0.999982
OFK	KARL STEFAN MEMORIAL	NE	0	1	1	0.999982
EAR	KEARNEY RGNL	NE	0	1	1	0.999982
IBM	KIMBALL MUNICIPAL/ ROBERT E ARRAJ FIELD	NE	0	1	2	0.999966
LNK	LINCOLN	NE	0	1	1	0.999982
MCK	MC COOK RGNL	NE	0	1	1	0.999982
MLE	MILLARD	NE	0	1	1	0.999985
VTN	MILLER FIELD	NE	0	1	1	0.999982
AFK	NEBRASKA CITY MUNICIPAL	NE	0	1	1	0.999984

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
LBF	NORTH PLATTE RGNL AIRPORT	NE	0	1	1	0.999982
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1	1	0.999985
SCB	SCRIBNER STATE	NE	0	1	1	0.999984
OGA	SEARLE FIELD	NE	0	1	1	0.999982
SWT	SEWARD MUNICIPAL	NE	0	1	1	0.999982
SNY	SIDNEY MUNICIPAL/ LLOYD W. CARR FIELD	NE	0	1	1	0.999982
ONL	THE O'NEILL MUNICIPAL- JOHN L BAKER	NE	0	1	1	0.999982
AHQ	WAHOO MUNICIPAL	NE	0	1	1	0.999983
LCG	WAYNE MUNICIPAL	NE	0	1	1	0.999984
BFF	WESTERN NEB. RGNL/WILLIAM B. H	NE	0	1	1	0.999982
JYR	YORK MUNICIPAL	NE	0	1	1	0.999982
ASH	BOIRE FIELD	NH	0	1	1	0.999921
CON	CONCORD MUNICIPAL	NH	0	1	1	0.999927
EEN	DILLANT-HOPKINS	NH	0	1	1	0.999922
LCI	LACONIA MUNICIPAL	NH	0	1	1	0.999936
MHT	MANCHESTER	NH	0	1	1	0.999923
PSM	PORTSMOUTH INTL AT PEASE	NH	0	1	1	0.999931
ACY	ATLANTIC CITY INTL	NJ	0	1	1	0.999882
WWD	CAPE MAY COUNTY	NJ	0	1	1	0.999873
MIV	MILLVILLE MUNICIPAL	NJ	0	1	1	0.999874
EWR	NEWARK LIBERTY INTL	NJ	0	1	1	0.999885
TEB	TETERBORO	NJ	0	1	2	0.999871
ABQ	ALBUQUERQUE INTL SUNPORT	NM	0	1	13	0.999697
CVN	CLOVIS MUNICIPAL	NM	0	1	2	0.999966
AEG	DOUBLE EAGLE II	NM	0	1	14	0.999679
FMN	FOUR CORNERS RGNL	NM	0	1	3	0.999947
SVC	GRANT COUNTY	NM	0	1	93	0.993916
LRU	LAS CRUCES INTL	NM	0	1	88	0.996149
ROW	ROSWELL INTL AIR CENTER	NM	0	1	2	0.999966
LAS	MC CARRAN INTL	NV	0	1	4	0.999866
4SD	RENO/STEAD	NV	0	1	41	0.998612
RNO	RENO/TAHOE INTL	NV	0	1	36	0.998802
WMC	WINNEMUCCA MUNICIPAL	NV	0	1	2	0.999805
9G3	AKRON	NY	0	1	1	0.999930
ALB	ALBANY INTL	NY	0	1	1	0.999902
HWV	BROOKHAVEN	NY	0	1	2	0.999882
BUF	BUFFALO NIAGARA INTL	NY	0	1	1	0.999939
OLE	CATTARAUGUS COUNTY-OLEAN	NY	0	1	1	0.999914
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	0	1	1	0.999949
ELM	ELMIRA/CORNING RGNL	NY	0	1	1	0.999874
FOK	FRANCIS S GABRESKI	NY	0	1	2	0.999887
BGM	GREATER BINGHAMTON	NY	0	1	2	0.999863
ROC	GREATER ROCHESTER INTL	NY	0	1	1	0.999899
JFK	JOHN F KENNEDY INTL	NY	0	1	1	0.999891
LGA	LA GUARDIA	NY	0	1	1	0.999890
MSS	MASSENA INTL-RICHARDS FIELD	NY	0	1	1	0.999922
N66	ONEONTA MUNICIPAL	NY	0	1	1	0.999882
PEO	PENN YAN	NY	0	1	1	0.999879
PBG	PLATTSBURGH INTL	NY	0	1	1	0.999928
44N	SKY ACRES	NY	0	1	1	0.999897

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
SWF	STEWART INTL	NY	0	1	1	0.999890
SYR	SYRACUSE HANCOCK INTL	NY	0	1	2	0.999862
ELZ	WELLSVILLE MUNICIPAL ARPT`TARANTINE	NY	0	1	1	0.999896
HPN	WESTCHESTER COUNTY	NY	0	1	1	0.999894
SDC	WILLIAMSON-SODUS	NY	0	1	1	0.999886
HAO	BUTLER CO RGNL	OH	0	1	0	1
CXY	CAPITAL CITY	OH	0	1	1	0.999856
LUK	CINCINNATI MUNICIPAL AIRPORT LUNKEN	OH	0	1	0	1
CLE	CLEVELAND-HOPKINS INTL	OH	0	1	0	1
MGY	DAYTON-WRIGHT BROTHERS	OH	0	1	0	1
DLZ	DELAWARE MUNICIPAL	OH	0	1	0	1
LHQ	FAIRFIELD COUNTY	OH	0	1	0	1
FDY	FINDLAY	OH	0	1	0	1
PMH	GREATER PORTSMOUTH RGNL	OH	0	1	0	1
I19	GREENE COUNTY-LEWIS A. JACKSON	OH	0	1	0	1
DAY	JAMES M COX DAYTON INTL	OH	0	1	0	1
1G3	KENT STATE UNIV	OH	0	1	0	1
I68	LEBANON-WARREN COUNTY	OH	0	1	0	1
UYF	MADISON COUNTY	OH	0	1	0	1
MNN	MARION MUNICIPAL	OH	0	1	0	1
AXV	NEIL ARMSTRONG	OH	0	1	0	1
OSU	OHIO STATE UNIVERSITY	OH	0	1	0	1
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	0	1	0	1
CMH	PORT COLUMBUS INTL	OH	0	1	0	1
RZT	ROSS COUNTY	OH	0	1	0	1
TOL	TOLEDO EXPRESS	OH	0	1	0	1
1G0	WOOD COUNTY	OH	0	1	0	1
YNG	YOUNGSTOWN-WARREN RGNL	OH	0	1	0	1
AVK	ALVA RGNL	OK	0	1	2	0.999966
BVO	BARTLESVILLE MUNICIPAL	OK	0	1	1	0.999982
CQB	CHANDLER RGNL	OK	0	1	1	0.999982
CHK	CHICKASHA MUNICIPAL	OK	0	1	3	0.999941
GCM	CLAREMORE RGNL	OK	0	1	1	0.999982
F29	CLARENCE E PAGE MUNICIPAL	OK	0	1	2	0.999957
1K4	DAVID JAY PERRY	OK	0	1	2	0.999957
MKO	DAVIS FIELD	OK	0	1	1	0.999982
DUA	EAKER FIELD	OK	0	1	3	0.999941
ELK	ELK CITY RGNL BUSINESS	OK	0	1	3	0.999940
GMJ	GROVE MUNICIPAL	OK	0	1	1	0.999982
GOK	GUTHRIE-EDMOND RGNL	OK	0	1	1	0.999982
2O8	HINTON MUNICIPAL	OK	0	1	3	0.999941
HBR	HOBART RGNL	OK	0	1	3	0.999940
MLC	MC ALESTER RGNL	OK	0	1	1	0.999982
MIO	MIAMI MUNICIPAL	OK	0	1	1	0.999982
MDF	MOORELAND MUNICIPAL	OK	0	1	2	0.999957
OKM	OKMULGEE RGNL	OK	0	1	1	0.999982
PVJ	PAULS VALLEY MUNICIPAL	OK	0	1	3	0.999941
PNC	PONCA CITY RGNL	OK	0	1	1	0.999982
RVS	RICHARD LLOYD JONES JR	OK	0	1	1	0.999982
2K4	SCOTT FIELD	OK	0	1	3	0.999940

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
SNL	SHAWNEE RGNL	OK	0	1	2	0.999966
SWO	STILLWATER RGNL	OK	0	1	1	0.999982
TQH	TAHLEQUAH MUNICIPAL	OK	0	1	1	0.999982
TUL	TULSA INTL	OK	0	1	1	0.999982
OUN	UNIVERSITY OF OKLAHOMA WESTHEI	OK	0	1	2	0.999966
OKC	WILL ROGERS WORLD	OK	0	1	2	0.999966
UAO	AURORA STATE	OR	0	1	87	0.995491
BDN	BEND MUNICIPAL	OR	0	1	27	0.999276
LMT	KLAMATH FALLS	OR	0	1	90	0.995517
LGD	LA GRANDE/UNION COUNTY	OR	0	1	1	0.999925
EUG	MAHLON SWEET FIELD	OR	0	1	93	0.992765
MMV	MC MINNVILLE MUNICIPAL	OR	0	1	94	0.994367
SLE	MCNARY FLD	OR	0	1	92	0.994482
ONP	NEWPORT MUNICIPAL	OR	0	1	94	0.991136
ONO	ONTARIO MUNICIPAL	OR	0	1	3	0.999845
PDX	PORTLAND INTL	OR	0	1	78	0.996617
AGC	ALLEGHENY COUNTY	PA	0	1	1	0.999971
AOO	ALTOONA-BLAIR COUNTY	PA	0	1	1	0.999872
LBE	ARNOLD PALMER RGNL	PA	0	1	1	0.999941
BFD	BRADFORD RGNL	PA	0	1	1	0.999918
BTP	BUTLER COUNTY/ K W SCHOLTER FIELD	PA	0	1	1	0.999974
MQS	CHESTER COUNTY G O CARLSON	PA	0	1	1	0.999868
AXQ	CLARION COUNTY	PA	0	1	1	0.999960
9D4	DECK	PA	0	1	1	0.999864
DUJ	DUBOIS RGNL	PA	0	1	1	0.999930
WAY	GREENE COUNTY	PA	0	1	1	0.999973
HZL	HAZLETON MUNICIPAL	PA	0	1	1	0.999869
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	0	1	1	0.999916
LNS	LANCASTER	PA	0	1	1	0.999863
ABE	LEHIGH VALLEY INTL	PA	0	1	1	0.999875
RVL	MIFFLIN COUNTY	PA	0	1	1	0.999852
UCP	NEW CASTLE MUNICIPAL	PA	0	1	0	1
PNE	NORTHEAST PHILADELPHIA	PA	0	1	1	0.999878
PHL	PHILADELPHIA INTL	PA	0	1	1	0.999875
PIT	PITTSBURGH INTL	PA	0	1	0	1
FWQ	ROSTRAVER	PA	0	1	1	0.999964
2G9	SOMERSET COUNTY	PA	0	1	1	0.999918
OYM	ST MARYS MUNICIPAL	PA	0	1	1	0.999904
UNV	UNIVERSITY PARK	PA	0	1	1	0.999863
FKL	VENANGO RGNL	PA	0	1	1	0.999979
BID	BLOCK ISLAND STATE	RI	0	1	2	0.999888
OQU	QUONSET STATE	RI	0	1	2	0.999899
PVD	THEODORE FRANCIS GREEN STATE	RI	0	1	2	0.999899
AIK	AIKEN MUNICIPAL	SC	0	1	0	1
AND	ANDERSON RGNL	SC	0	1	0	1
CHS	CHARLESTON AFB/INTL	SC	0	1	1	0.999916
JZI	CHARLESTON EXECUTIVE	SC	0	1	1	0.999914
CAE	COLUMBIA METROPOLITAN	SC	0	1	0	1
UDG	DARLINGTON COUNTY JETPORT	SC	0	1	1	0.999799
GYH	DONALDSON CENTER	SC	0	1	0	1
GGE	GEORGETOWN COUNTY	SC	0	1	1	0.999805

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GSP	GREENVILLE SPARTANBURG INTL	SC	0	1	0	1
MYR	MYRTLE BEACH INTL	SC	0	1	1	0.999793
CEU	OCONEE COUNTY RGNL	SC	0	1	0	1
CDN	WOODWARD FIELD	SC	0	1	1	0.999828
ABR	ABERDEEN RGNL	SD	0	1	1	0.999982
BKX	BROOKINGS RGNL	SD	0	1	0	1
YKN	CHAN GURNEY MUNICIPAL	SD	0	1	1	0.999984
HON	HURON RGNL	SD	0	1	1	0.999984
FSD	JOE FOSS FIELD	SD	0	1	0	1
MHE	MITCHELL MUNICIPAL	SD	0	1	1	0.999984
PIR	PIERRE RGNL	SD	0	1	1	0.999982
RAP	RAPID CITY RGNL	SD	0	1	1	0.999982
ATY	WATERTOWN RGNL	SD	0	1	1	0.999982
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	1	0.999982
NQA	MILLINGTON RGNL JETPORT	TN	0	1	1	0.999982
BNA	NASHVILLE INTL	TN	0	1	0	1
SZY	ROBERT SIBLEY	TN	0	1	1	0.999982
TRI	TRI-CITIES RGNL TN/VA	TN	0	1	0	1
BGF	WINCHESTER MUNICIPAL	TN	0	1	0	1
ABI	ABILENE RGNL	TX	0	1	2	0.999966
ADS	ADDISON	TX	0	1	3	0.999940
ALI	ALICE INTL	TX	0	1	3	0.999940
LFK	ANGELINA COUNTY	TX	0	1	4	0.999925
GKY	ARLINGTON MUNICIPAL	TX	0	1	3	0.999950
AUS	AUSTIN-BERGSTROM INTL	TX	0	1	3	0.999951
LBX	BRAZORIA COUNTY	TX	0	1	4	0.999934
BWD	BROWNWOOD RGNL	TX	0	1	2	0.999966
E30	BRUCE FIELD	TX	0	1	2	0.999966
TKI	COLLIN COUNTY RGNL AT MCKINNEY	TX	0	1	3	0.999940
CRP	CORPUS CHRISTI INTL	TX	0	1	3	0.999940
CFD	COULTER FIELD	TX	0	1	3	0.999951
PRX	COX FIELD	TX	0	1	2	0.999966
BBD	CURTIS FIELD	TX	0	1	2	0.999966
RBD	DALLAS EXECUTIVE	TX	0	1	3	0.999940
DAL	DALLAS LOVE FIELD	TX	0	1	3	0.999940
DFW	DALLAS/FORT WORTH INTL	TX	0	1	3	0.999940
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	0	1	3	0.999950
LUD	DECATUR MUNICIPAL	TX	0	1	3	0.999940
DRT	DEL RIO INTL	TX	0	1	3	0.999950
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	0	1	2	0.999966
GGG	EAST TEXAS RGNL	TX	0	1	3	0.999941
CLL	EASTERWOOD FIELD	TX	0	1	3	0.999951
ELP	EL PASO INTL	TX	0	1	87	0.996950
AFW	FORT WORTH ALLIANCE	TX	0	1	3	0.999941
FWS	FORT WORTH SPINKS	TX	0	1	3	0.999950
IAH	GEORGE BUSH INTERCONTINENTAL	TX	0	1	3	0.999950

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PVW	HALE COUNTY	TX	0	1	2	0.999966
INJ	HILLSBORO MUNICIPAL	TX	0	1	2	0.999966
TME	HOUSTON EXECUTIVE	TX	0	1	3	0.999950
AXH	HOUSTON-SOUTHWEST	TX	0	1	3	0.999950
ERV	KERRVILLE MUNICIPAL/ LOUIS SCHREINER	TX	0	1	3	0.999950
LNC	LANCASTER	TX	0	1	3	0.999940
LRD	LAREDO INTL	TX	0	1	2	0.999957
CXO	LONE STAR EXECUTIVE	TX	0	1	3	0.999950
LBB	LUBBOCK PRESTON SMITH INTL	TX	0	1	2	0.999966
GVT	MAJORS	TX	0	1	3	0.999941
5T9	MAVERICK COUNTY MEMORIAL INTL	TX	0	1	3	0.999950
MFE	MC ALLEN MILLER INTL	TX	0	1	3	0.999941
HQZ	MESQUITE METRO	TX	0	1	3	0.999940
MAF	MIDLAND INTL	TX	0	1	2	0.999966
OSA	MOUNT PLEASANT RGNL	TX	0	1	2	0.999957
RAS	MUSTANG BEACH	TX	0	1	3	0.999940
BAZ	NEW BRAUNFELS MUNICIPAL	TX	0	1	3	0.999950
PIL	PORT ISABEL-CAMERON COUNTY	TX	0	1	3	0.999941
AMA	RICK HUSBAND AMARILLO INTL	TX	0	1	2	0.999966
SJT	SAN ANGELO RGNL/MATHIS FIELD	TX	0	1	2	0.999966
SAT	SAN ANTONIO INTL	TX	0	1	3	0.999950
HYI	SAN MARCOS MUNICIPAL	TX	0	1	3	0.999950
GLS	SCHOLES INTL AT GALVESTON	TX	0	1	3	0.999950
SPS	SHEPPARD AFB/ WICHITA FALLS MUNICIPAL	TX	0	1	3	0.999940
EBG	SOUTH TEXAS INTL AT EDINBURG	TX	0	1	3	0.999941
SGR	SUGAR LAND RGNL	TX	0	1	3	0.999950
TFP	T P MC CAMPBELL	TX	0	1	3	0.999940
TRL	TERRELL MUNICIPAL	TX	0	1	3	0.999940
TYR	TYLER POUNDS RGNL	TX	0	1	3	0.999940
HRL	VALLEY INTL	TX	0	1	3	0.999941
IWS	WEST HOUSTON	TX	0	1	3	0.999950
HOU	WILLIAM P HOBBY	TX	0	1	3	0.999950
CDC	CEDAR CITY RGNL	UT	0	1	1	0.999982
KNB	KANAB MUNICIPAL	UT	0	1	1	0.999982
LGU	LOGAN-CACHE	UT	0	1	3	0.999950
OGD	OGDEN-HINCKLEY	UT	0	1	2	0.999966
PVU	PROVO MUNICIPAL	UT	0	1	1	0.999982
SLC	SALT LAKE CITY INTL	UT	0	1	2	0.999966
SGU	ST GEORGE MUNICIPAL	UT	0	1	2	0.999966
MFV	ACCOMACK COUNTY	VA	0	1	1	0.999851
MTV	BLUE RIDGE	VA	0	1	1	0.999873
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1	1	0.999838
FCI	CHESTERFIELD COUNTY	VA	0	1	1	0.999826
CJR	CULPEPER RGNL	VA	0	1	1	0.999842
PTB	DINWIDDIE COUNTY	VA	0	1	1	0.999824
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1	1	0.999830
JYO	LEESBURG EXECUTIVE	VA	0	1	1	0.999841
LNP	LONESOME PINE	VA	0	1	0	1
LYH	LYNCHBURG RGNL/PRESTON GLENN	VA	0	1	1	0.999844
HEF	MANASSAS RGNL/HARRY P. DAVIS	VA	0	1	1	0.999838

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MKJ	MOUNTAIN EMPIRE	VA	0	1	1	0.999983
PSK	NEW RIVER VALLEY	VA	0	1	1	0.999947
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	0	1	1	0.999836
ORF	NORFOLK INTL	VA	0	1	1	0.999837
RIC	RICHMOND INTL	VA	0	1	1	0.999828
RMN	STAFFORD RGNL	VA	0	1	1	0.999836
XSA	TAPPAHANNOCK-ESSEX COUNTY	VA	0	1	1	0.999838
BCB	VIRGINIA TECH/MONTGOMERY EXECU	VA	0	1	1	0.999931
IAD	WASHINGTON DULLES INTL	VA	0	1	1	0.999840
BTV	BURLINGTON INTL	VT	0	1	1	0.999928
FSO	FRANKLIN COUNTY STATE	VT	0	1	1	0.999934
BLI	BELLINGHAM INTL	WA	0	1	5	0.999624
HQM	BOWERMAN	WA	0	1	88	0.995682
PWT	BREMERTON NATIONAL	WA	0	1	20	0.999370
DEW	DEER PARK	WA	0	1	0	1
FHR	FRIDAY HARBOR	WA	0	1	10	0.999505
MWH	GRANT CO INTL	WA	0	1	1	0.999965
OLM	OLYMPIA	WA	0	1	47	0.998546
PUW	PULLMAN/MOSCOW RGNL	WA	0	1	1	0.999975
RLD	RICHLAND	WA	0	1	1	0.999935
SEA	SEATTLE-TACOMA INTL	WA	0	1	4	0.999740
BVS	SKAGIT RGNL	WA	0	1	5	0.999613
PAE	SNOHOMISH COUNTY (PAINE FLD)	WA	0	1	1	0.999337
GEG	SPOKANE INTL	WA	0	1	0	1
TIW	TACOMA NARROWS	WA	0	1	15	0.999491
PSC	TRI-CITIES	WA	0	1	1	0.999935
ALW	WALLA WALLA RGNL	WA	0	1	1	0.999939
CLM	WILLIAM R FAIRCHILD INTL	WA	0	1	20	0.999181
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	1	0.999983
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	1	0.999982
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	1	0.999982
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	1	0.999983
RRL	MERRILL MUNICIPAL	WI	0	1	1	0.999982
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	1	0.999982
RHI	RHINELANDER-ONEIDA COUNTY	WI	0	1	1	0.999982
RPD	RICE LAKE RGNL - CARL'S FIELD	WI	0	1	1	0.999982
HYR	SAWYER COUNTY	WI	0	1	1	0.999982

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	0	1	0	1
JVL	SOUTHERN WISCONSIN RGNL	WI	0	1	0	1
TKV	TOMAHAWK RGNL	WI	0	1	1	0.999982
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	0.999848
PKB	MID-OHIO VALLEY RGNL	WV	0	1	0	1
HTS	TRI-STATE/MILTON J. FERGUSON	WV	0	1	0	1
CYS	CHEYENNE RGNL/ JERRY OLSON FIELD	WY	0	1	2	0.999957
EVW	EVANSTON- UINTA COUNTY BURNS FIELD	WY	0	1	3	0.999950
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1	2	0.999966
JAC	JACKSON HOLE	WY	0	1	1	0.999985
LAR	LARAMIE RGNL	WY	0	1	2	0.999957
CPR	NATRONA COUNTY INTL	WY	0	1	2	0.999957
RIW	RIVERTON RGNL	WY	0	1	2	0.999957
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1	2	0.999957
SHR	SHERIDAN COUNTY	WY	0	1	1	0.999982
COD	YELLOWSTONE RGNL	WY	0	1	0	1

Figure 9-1 WAAS LPV Availability

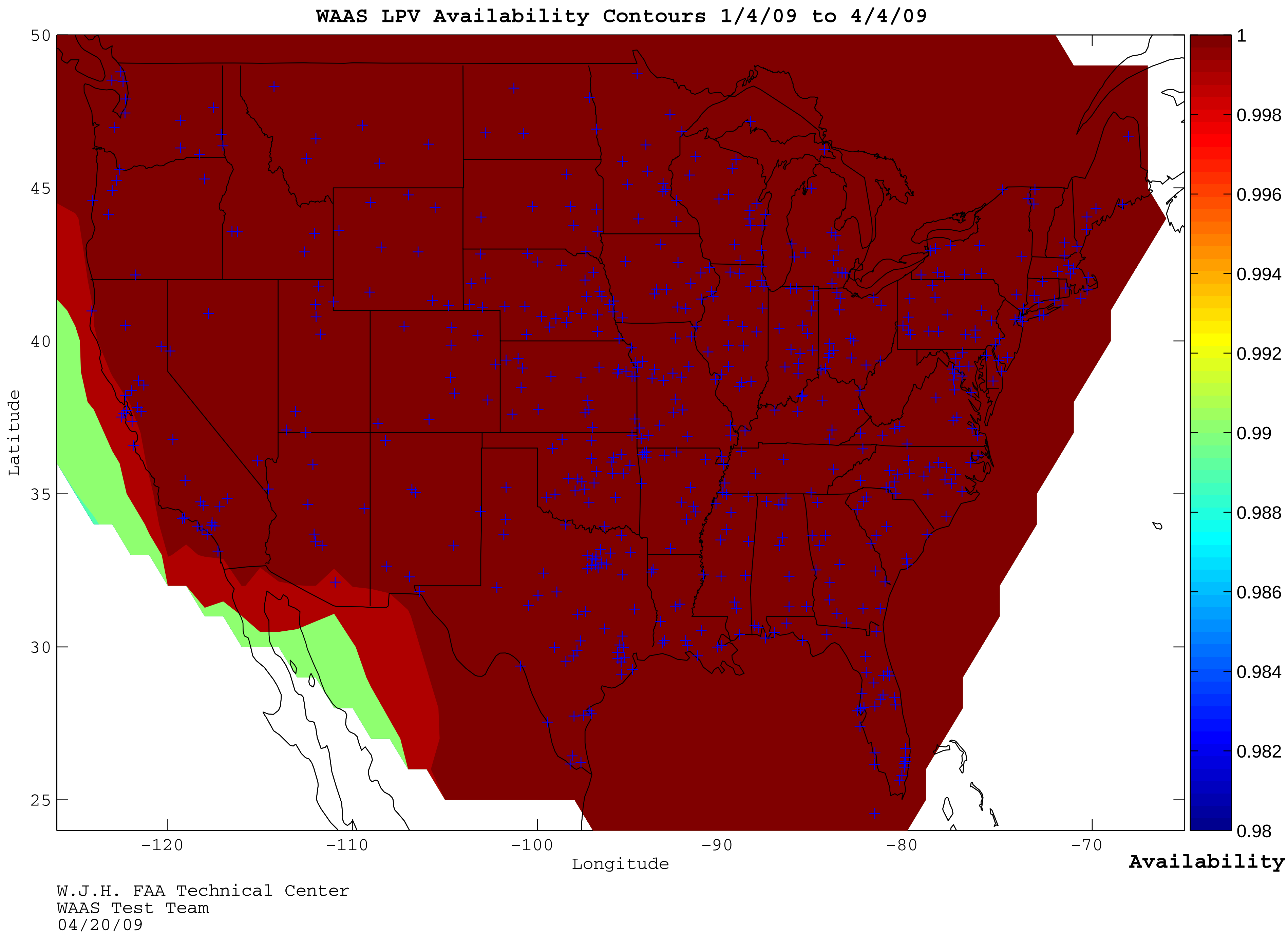
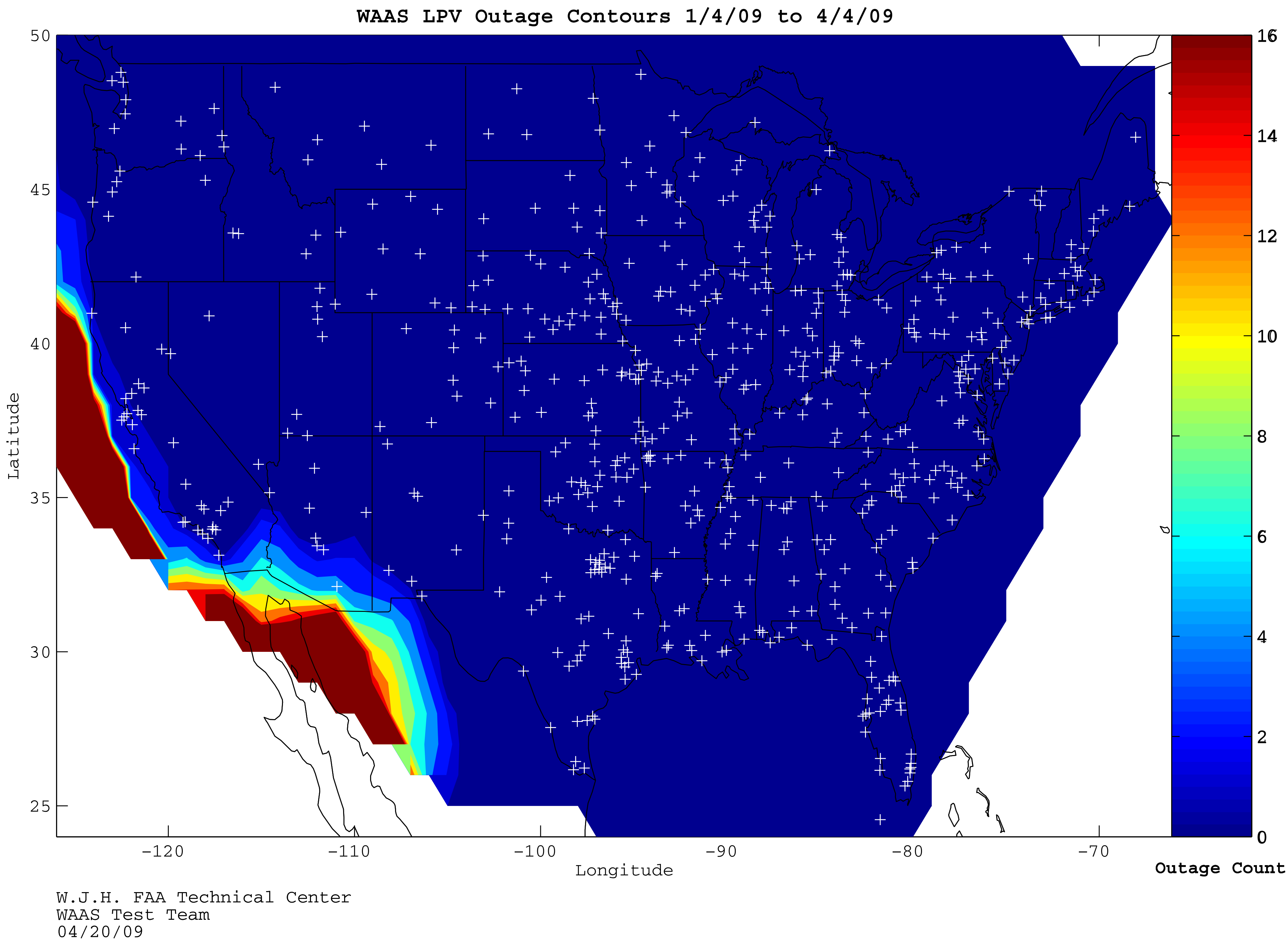


Figure 9-2 WAAS LPV Outage



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	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sep 08	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 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	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sep 08	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 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%
🟢 **Good** - 4σ bounded 100%
🟡 **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
🔴 **Poor** – Requires manual review
– No data available

11.0 WAAS REFERENCE STATION SURVEY VALIDATION

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

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

OPUS antenna position surveys were preformed for the WAAS antennas using a 24 hour set of data from 3/21/09 for 113 of the 114 WAAS receivers. The Winnipeg B (YWG-2) receiver was off-line on 3/21/09 so 3/31/09 data was used for Winnipeg B. 30 second RINEX data was created from recorded WAAS binary data. The overall RMS qualities reported by OPUS were all less than or equal to 2.2 cm.

The positions were then compared to the positions in the current WAAS software Release 8/9.2a. 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.

MMX-B is the largest outlier at 10.3 cm. Except for Mexico City, all sites are well under the 10 cm goal and the 25 cm take action thresholds.

Mexico City is a known issue because of the rapid subsidence in the Mexico City area due to water being depleted from an underground lake. The .2a version of Release 8/9 pre-displaced Mexico City lower so that the error will be maintained to a minimal level until the next scheduled release of WAAS software in November 2009. The WAAS Integrity Performance Panel (WIPP) authorized this deviation from the 25 cm take action threshold requirement.

Table 11.1 lists the WAAS antenna positions as of 3/21/09. The positions are in IRTF-2000 and are the OPUS calculated positions.

Figure 11.1 to 11.3 show the RSS of the ECEF difference between the WRS antenna phase center locations in the current software and the 3/21/09 OPUS surveys. Each reference station has three independent strings of WAAS receiving equipment (WRE). A surveyed antenna phase center location is required for each WRE. All three strings of a reference station are shown in the three figures. For example, BET1 identifies the RSS delta for the Bethel WRS string 1. The next two bars in the chart are Bethel string 2 and Bethel string 3. Figure 11.4 to 11.6 show the OPUS overall RMS quality indications.

Figure 11.7 to 11.9 show the RSS of the ECEF difference between the positions obtained from OPUS and the positions obtained from the Canadian Spatial Reference System (CSRS). Note that that OPUS positions are in ITRF-2000 and the CSRS positions are in ITRF-2005. The OPUS surveys agree with the CSRS surveys to less than 4 cm for all sites but Barrow Alaska. The Barrow differences are 5 cm.

Table 11-1 WAAS Survey Positions as of 12/5/08

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
BET1	-2965384.956	-972576.636	5543892.946	60.78791631666670	-161.84172421111100	52.185
BET2	-2965385.725	-972580.359	5543891.891	60.78789688333330	-161.84166366388900	52.187
BET3	-2965388.293	-972577.49	5543891.021	60.78788096111110	-161.84172840833300	52.183
BIL1	-1416445.827	-4223577.034	4550862.181	45.80370703333330	-108.53972235277800	1112.264
BIL2	-1416449.9	-4223574.887	4550862.9	45.80371631944440	-108.53978080000000	1112.263
BIL3	-1416441.521	-4223574.3	4550866.031	45.80375672500000	-108.53968102500000	1112.263
BRW1	-1886758.839	-809058.697	6018494.532	71.28276562500000	-156.78992297500000	15.604
BRW2	-1886756.254	-809055.948	6018495.71	71.28279837500000	-156.78996505555600	15.61
BRW3	-1886755.165	-809059.735	6018495.537	71.28279370555550	-156.78985593888900	15.603
CDB1	-3483634.765	-1083799.454	5214187.702	55.20033453888890	-162.71847206388900	53.656
CDB2	-3483629.895	-1083796.788	5214191.49	55.20039409722220	-162.71848932222200	53.661
CDB3	-3483631.908	-1083788.436	5214191.889	55.20040026666670	-162.71862395833300	53.67
FAI1	-2304741.703	-1448715.26	5748843.702	64.80963089722220	-147.84734000277800	149.907
FAI2	-2304741.229	-1448706.46	5748846.092	64.80968128888890	-147.84749150277800	149.906
FAI3	-2304732.705	-1448707.387	5748849.24	64.80974787500000	-147.84737950833300	149.893
HNL1	-5508637.061	-2234493.537	2303722.076	21.31298913055560	-157.92082534444400	24.673
HNL2	-5508656.226	-2234483.859	2303686.833	21.31264624166670	-157.92098121666700	25.019
HNL3	-5508647.635	-2234497.792	2303693.926	21.31271486388890	-157.92082565000000	25.06
JNU1	-2354254.8	-2388549.644	5407043.078	58.36257497222220	-134.58570596944400	16.033
JNU2	-2354252.72	-2388565.767	5407036.915	58.36246933888890	-134.58548730555600	16.044
JNU3	-2354239.501	-2388568.608	5407041.369	58.36254577500000	-134.58529239444400	16.03
MMD1	35070.448	-5959686.693	2264365.762	20.93190913888890	-89.66284041944450	29.142
MMD2	35065.523	-5959687.061	2264364.977	20.93190142222220	-89.66288778888890	29.178
MMD3	35065.188	-5959685.281	2264369.634	20.93194645833330	-89.66289090833330	29.178
MMX1	-948701.203	-5943936.394	2109212.957	19.43165328333330	-99.06838944722220	2236.428
MMX2	-948696.775	-5943936.236	2109215.39	19.43167656944440	-99.06834806111110	2236.432
MMX3	-948705.633	-5943936.59	2109210.533	19.43162996111110	-99.06843079444440	2236.463
MPR1	-1570142.188	-5759530.632	2238184.759	20.67900329166670	-105.24920283888900	10.996
MPR2	-1570139.367	-5759530.139	2238188.807	20.67904138333330	-105.24917796111100	11.287
MPR3	-1570143.475	-5759528.015	2238190.573	20.67905939722220	-105.24922136111100	11.004
MSD1	-1979519.594	-5523223.146	2493106.718	23.16044614166670	-109.71764658611100	104.298
MSD2	-1979521.161	-5523225.479	2493100.32	23.16038335000000	-109.71765330555600	104.287
MSD3	-1979525.611	-5523222.213	2493103.995	23.16041944444440	-109.71770497222200	104.286
MTP1	-254854.346	-6162909.196	1617805.086	14.79136610555560	-92.36799910277780	54.976
MTP2	-254850.739	-6162910.229	1617801.658	14.79133411388890	-92.36796523055560	54.954
MTP3	-254855.498	-6162910.341	1617800.129	14.79132004166670	-92.36800935555550	54.862
OTZ1	-2396055.932	-750356.186	5843502.572	66.88733300000000	-162.61137177222200	10.907
OTZ2	-2396052.755	-750354.36	5843504.09	66.88736785000000	-162.61138986944400	10.899
OTZ3	-2396052.746	-750358.295	5843503.616	66.88735655277780	-162.61130411666700	10.921
YFB1	1035381.528	-2634289.643	5696539.497	63.73149009444440	-68.54318192500000	10.003
YFB2	1035372.308	-2634296.046	5696538.14	63.73146390000000	-68.54340303888890	9.931
YFB3	1035366.238	-2634306.801	5696534.365	63.73138625277780	-68.54359703055560	9.993

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
YQX1	2430424.687	-3419640.413	4788223.792	48.96648944722220	-54.59763173611110	146.879
YQX2	2430432.646	-3419639.072	4788220.734	48.96644753611110	-54.59753252777780	146.882
YQX3	2430440.552	-3419637.701	4788217.735	48.96640634444450	-54.59743367222220	146.893
YWG1	-520164.299	-4083475.895	4855842.98	49.90057436944440	-97.25939663888890	222.02
YWG2	-520150.435	-4083468.84	4855850.364	49.90067730277780	-97.25921762500000	222.032
YWG3	-520152.296	-4083477.955	4855842.54	49.90056819722220	-97.25922728888890	222.022
YYR1	1885341.482	-3321428.373	5091171.604	53.30864654166670	-60.41946763888890	37.829
YYR2	1885344.445	-3321419.888	5091176.023	53.30871289444440	-60.41936614444440	37.837
YYR3	1885340.158	-3321413.069	5091182.022	53.30880307500000	-60.41937157777780	37.84
ZAB1	-1488636.785	-5003946.554	3654557.701	35.17357535555560	-106.56734912222200	1620.119
ZAB2	-1488631.453	-5003948.232	3654557.681	35.17357475000000	-106.56728778333300	1620.18
ZAB3	-1488632.23	-5003950.831	3654553.825	35.17353226666670	-106.56728782500000	1620.176
ZAN1	-2659536.526	-1549114.828	5567750.754	61.22920237222220	-149.78024884166700	80.656
ZAN2	-2659548.281	-1549110.871	5567746.268	61.22911876388890	-149.78042263333300	80.654
ZAN3	-2659541.234	-1549106.748	5567750.742	61.22920231111110	-149.78042292777800	80.646
ZAU1	138704.175	-4761244.171	4227763.942	41.78265793611110	-88.33133598611110	195.918
ZAU2	138704.433	-4761248.776	4227758.776	41.78259559444440	-88.33133449722220	195.914
ZAU3	138711.142	-4761248.507	4227758.856	41.78259657500000	-88.33125373888890	195.913
ZBW1	1490299.288	-4448983.177	4306010.467	42.73572013888890	-71.48042510000000	39.115
ZBW2	1490304.396	-4448981.165	4306010.813	42.73572417222220	-71.48035815000000	39.14
ZBW3	1490306.107	-4448984.796	4306006.508	42.73567135555560	-71.48035242222220	39.147
ZDC1	1069125.825	-4839599.004	4001126.494	39.10159563611110	-77.54274587222220	80.078
ZDC2	1069128.223	-4839603.642	4001120.293	39.10152362222220	-77.54273036944440	80.083
ZDC3	1069124.116	-4839602.732	4001122.488	39.10154904722220	-77.54277446111110	80.091
ZDV1	-1273628.561	-4711375.598	4094890.121	40.18730328333330	-105.12722370555600	1541.369
ZDV2	-1273622.859	-4711377.113	4094890.139	40.18730355555560	-105.12715444444400	1541.361
ZDV3	-1273624.864	-4711380.3	4094885.85	40.18725314166670	-105.12716740277800	1541.344
ZFW1	-659983.155	-5324060.799	3438276.478	32.83064969444440	-97.06647129722220	155.636
ZFW2	-659988.425	-5324063.352	3438271.479	32.83059626388890	-97.06652379722220	155.6
ZFW3	-659983.457	-5324063.887	3438271.695	32.83059829444440	-97.06647043888890	155.649
ZHU1	-513864.429	-5506451.772	3166720.5	29.96189628333330	-95.33142577222220	10.917
ZHU2	-513867.079	-5506455.17	3166714.341	29.96183179444440	-95.33144983611110	10.986
ZHU3	-513873.356	-5506457.806	3166708.738	29.96177355277780	-95.33151204722220	10.966
ZJX1	772646.494	-5434462.212	3237231.729	30.69885941111110	-81.90818462500000	2.155
ZJX2	772649.821	-5434463.757	3237228.333	30.69882387222220	-81.90815251388890	2.139
ZJX3	772645.759	-5434466.191	3237225.223	30.69879128611110	-81.90819806666670	2.132
ZKC1	-415247.462	-4954556.406	3982161.109	38.88015929166670	-94.79083318611110	305.903
ZKC2	-415231.074	-4954557.735	3982161.175	38.88016000555560	-94.79064371388890	305.91
ZKC3	-415237.19	-4954561.08	3982155.974	38.88010180000000	-94.79071072777780	305.638
ZLA1	-2474409.853	-4637294.731	3602183.496	34.60351785277780	-118.08389415833300	763.518
ZLA2	-2474404.573	-4637297.541	3602183.498	34.60351790000000	-118.08382895833300	763.513
ZLA3	-2474411.185	-4637297.221	3602179.521	34.60347390833330	-118.08389418888900	763.585

WRE	X (m)	Y (m)	Z (m)	Latitude	Longitude	Height (m)
ZLC1	-1808273.147	-4486410.838	4145303.033	40.78604345000000	-111.95217675000000	1287.433
ZLC2	-1808274.547	-4486414.444	4145298.538	40.78599006111110	-111.95217616388900	1287.426
ZLC3	-1808270.335	-4486416.145	4145298.527	40.78598996666670	-111.95212235833300	1287.421
ZMA1	966042.334	-5662999.842	2761581.491	25.82461203333330	-80.31918949444440	-7.569
ZMA2	966029.359	-5662999.133	2761585.972	25.82465976944440	-80.31931586944440	-8.21
ZMA3	966037.446	-5662997.976	2761586.33	25.82466181666670	-80.31923442222220	-7.857
ZME1	4070.946	-5226189.301	3644028.41	35.06739399444450	-89.95536939722220	68.599
ZME2	4070.98	-5226186.762	3644032.527	35.06743751666670	-89.95536900277780	68.886
ZME3	4064.781	-5226186.633	3644032.68	35.06743933888890	-89.95543696388890	68.864
ZMP1	-249978.314	-4539297.523	4458955.057	44.63746317500000	-93.15208461944450	262.672
ZMP2	-249972.506	-4539297.87	4458955.059	44.63746301666670	-93.15201128888890	262.692
ZMP3	-249973.606	-4539302.147	4458950.586	44.63740699166670	-93.15202216944450	262.631
ZNY1	1406144.704	-4627344.001	4144322.048	40.78432830833330	-73.09716496388890	6.471
ZNY2	1406146.498	-4627347.041	4144317.269	40.78427554444440	-73.09715510000000	5.947
ZNY3	1406140.939	-4627348.689	4144317.299	40.78427598055560	-73.09722378888890	5.937
ZOA1	-2684436.794	-4293337.537	3865351.809	37.54305310555560	-122.01594625277800	-3.478
ZOA2	-2684433.777	-4293341.598	3865349.377	37.54302560833330	-122.01589294444400	-3.498
ZOA3	-2684438.156	-4293342.489	3865345.524	37.54298118888890	-122.01592961388900	-3.407
ZOB1	650770.235	-4754715.679	4187420.735	41.29715426666670	-82.20644413611110	223.682
ZOB2	650777.924	-4754714.864	4187422.764	41.29716659444440	-82.20635186666670	225.197
ZOB3	650776.252	-4754719.686	4187414.968	41.29708681388890	-82.20637945000000	223.471
ZSE1	-2308930.218	-3668169.692	4663526.49	47.28699343333330	-122.18837213055600	82.099
ZSE2	-2308934.617	-3668175.258	4663520.093	47.28690778611110	-122.18838214722200	82.183
ZSE3	-2308935.678	-3668179.527	4663516.152	47.28685612777780	-122.18836395555600	82.122
ZSU1	2462589.359	-5529371.566	2003724.588	18.43133828333330	-65.99347531666670	-28.573
ZSU2	2462587.273	-5529377.316	2003711.593	18.43121431944440	-65.99351549722220	-28.504
ZSU3	2462593.916	-5529375.104	2003709.533	18.43119471666670	-65.99344953888890	-28.508
ZTL1	529840.455	-5305248.831	3489342.839	33.37968838055560	-84.29672547777780	261.151
ZTL2	529846.825	-5305248.001	3489343.128	33.37969151111110	-84.29665647500000	261.149
ZTL3	529847.52	-5305251.424	3489337.891	33.37963484722220	-84.29665270000000	261.169

Figure 11-1 Survey Delta for OPUS

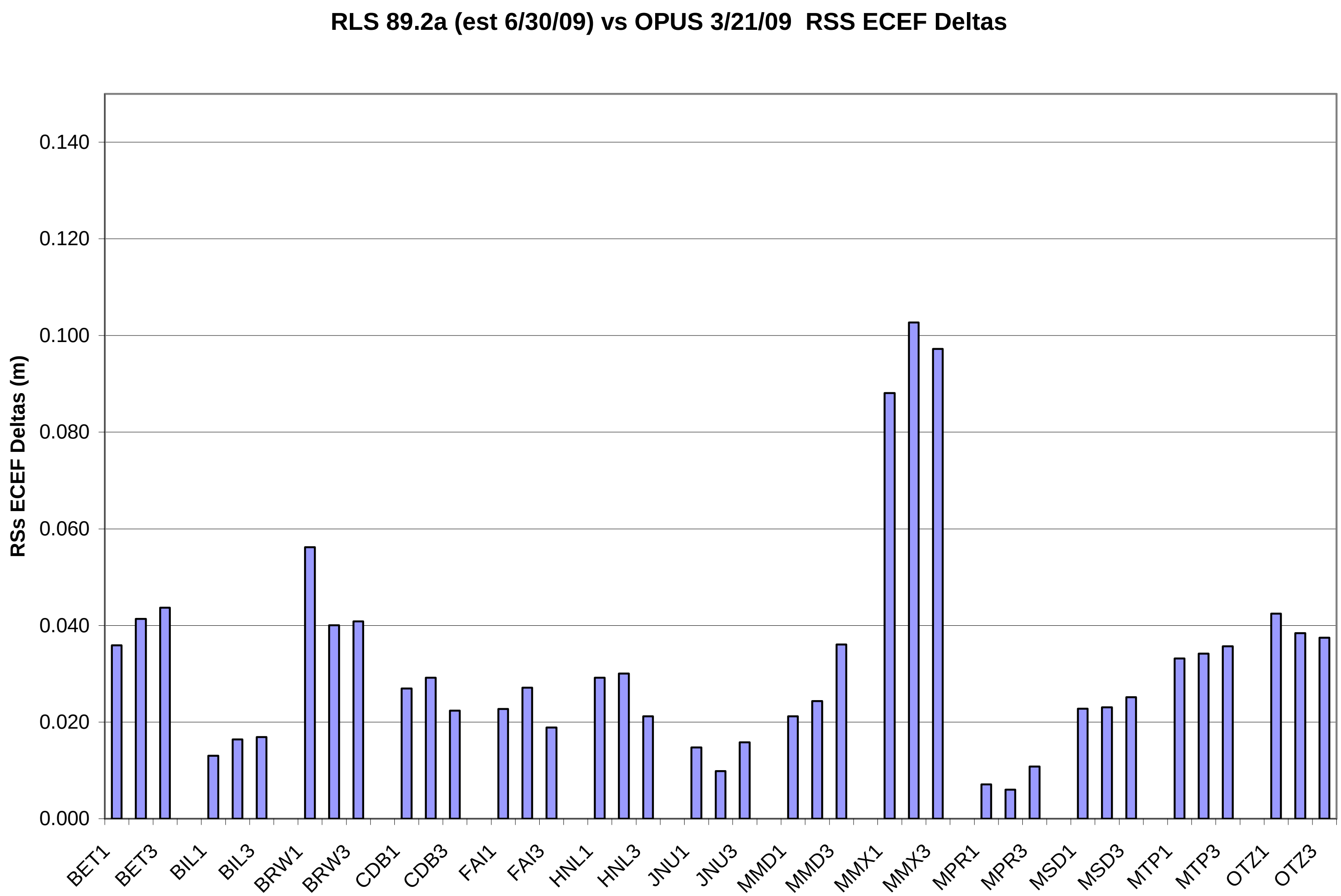


Figure 11-2 Survey Delta for CSRS and OPUS

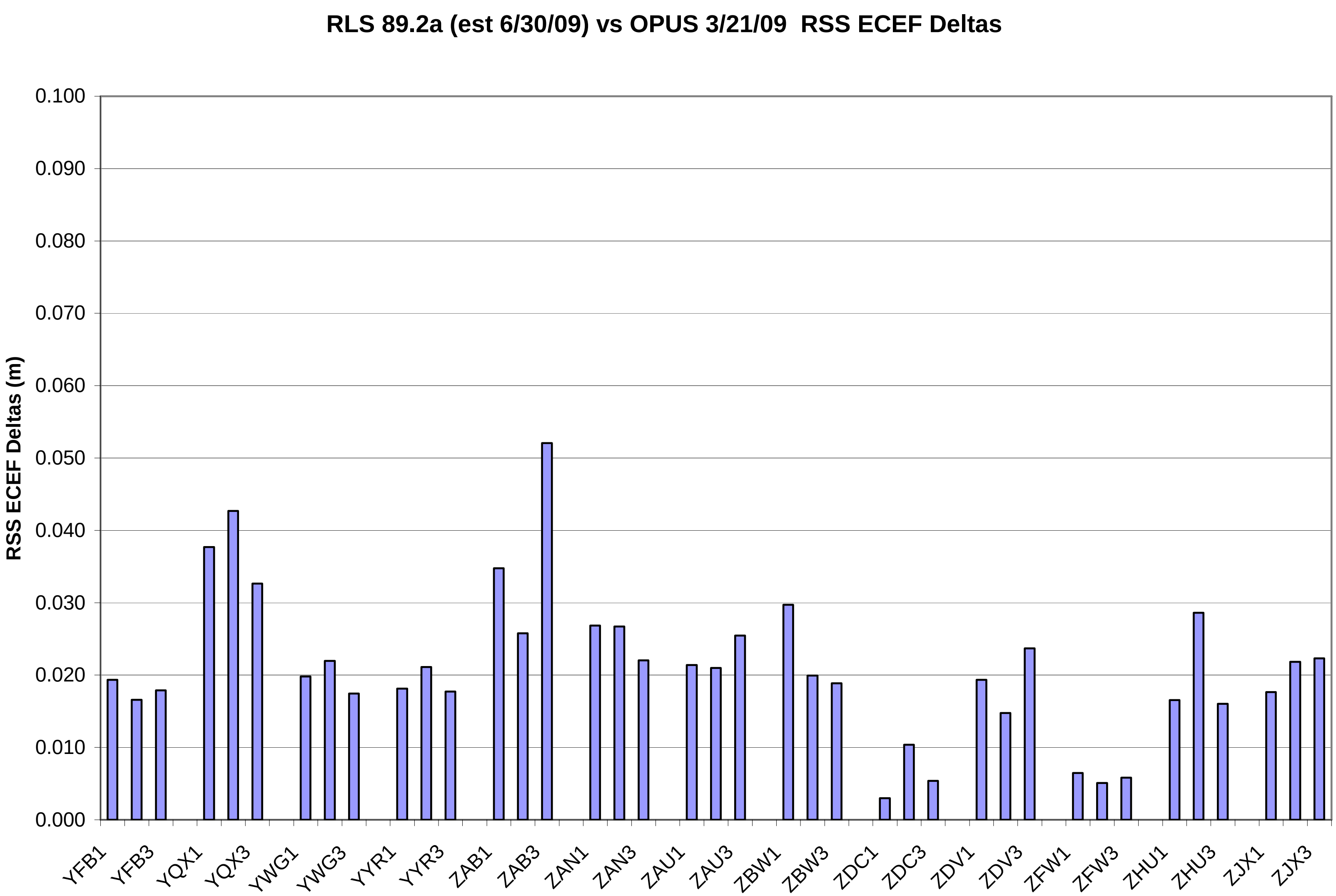


Figure 11-3 Survey Delta for OPUS

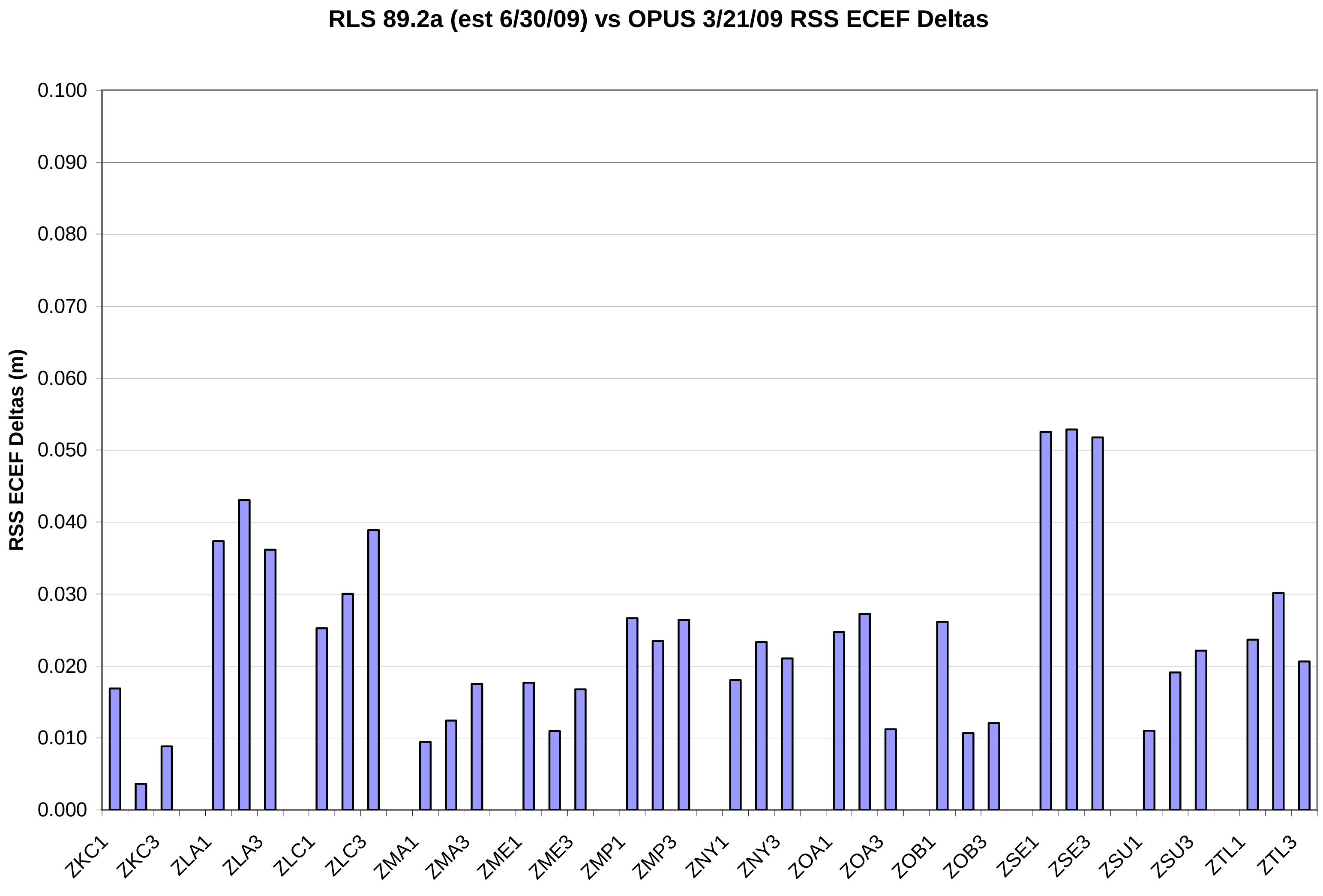


Figure 11-4 OPUS Survey Overall RMS Qualities

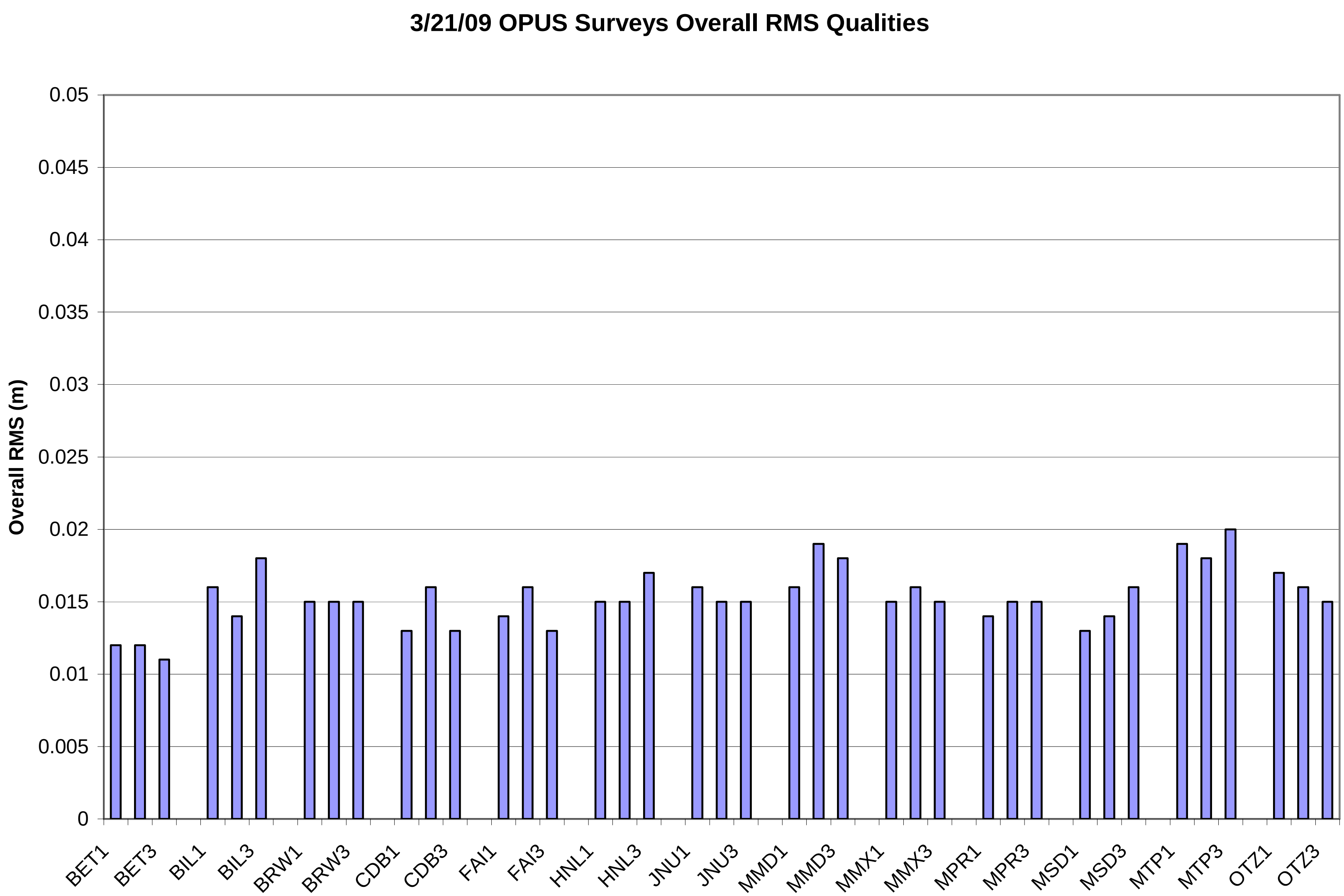


Figure 11-5 OPUS Survey Overall RMS Qualities

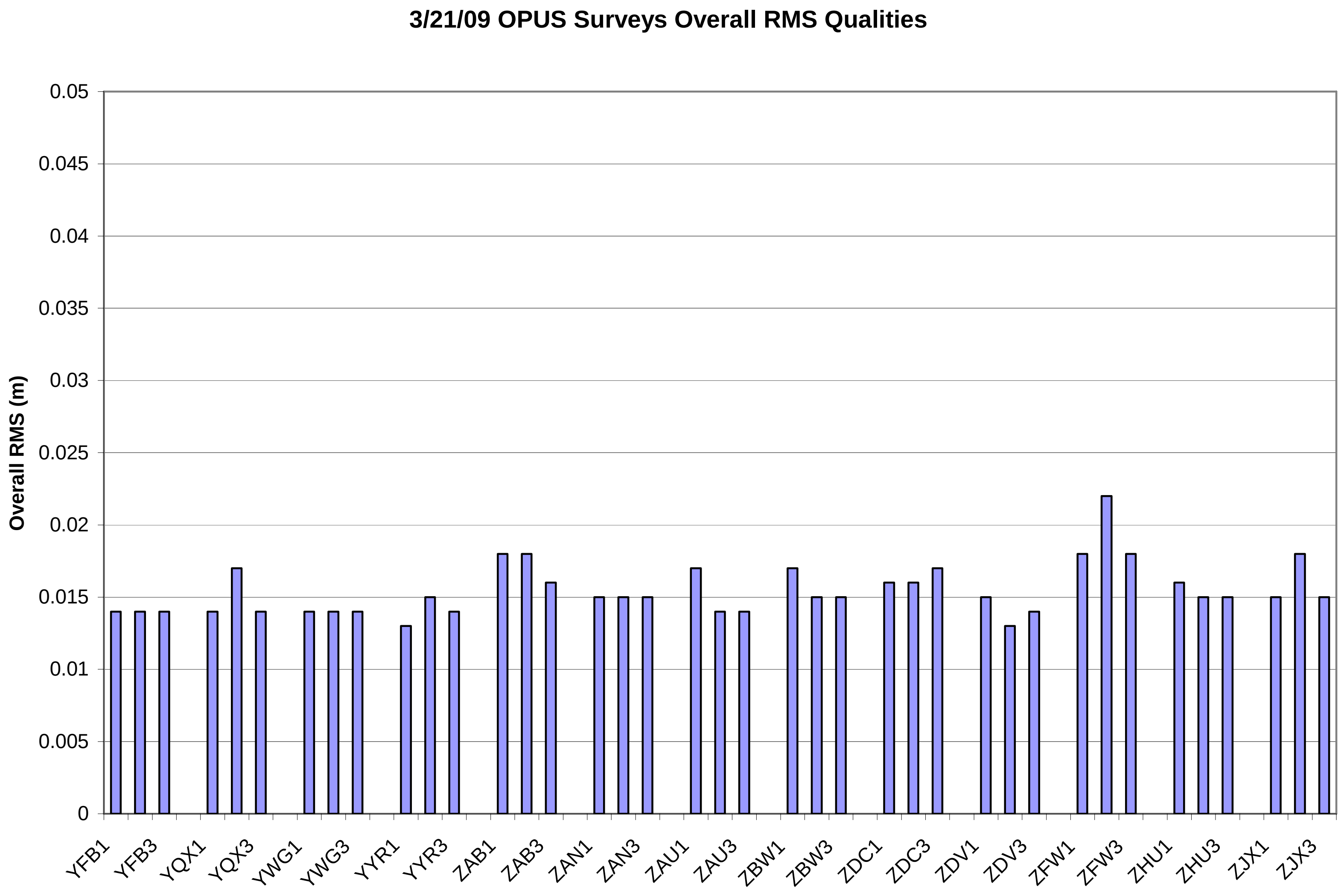


Figure 11-6 S OPUS Survey Overall RMS Qualities

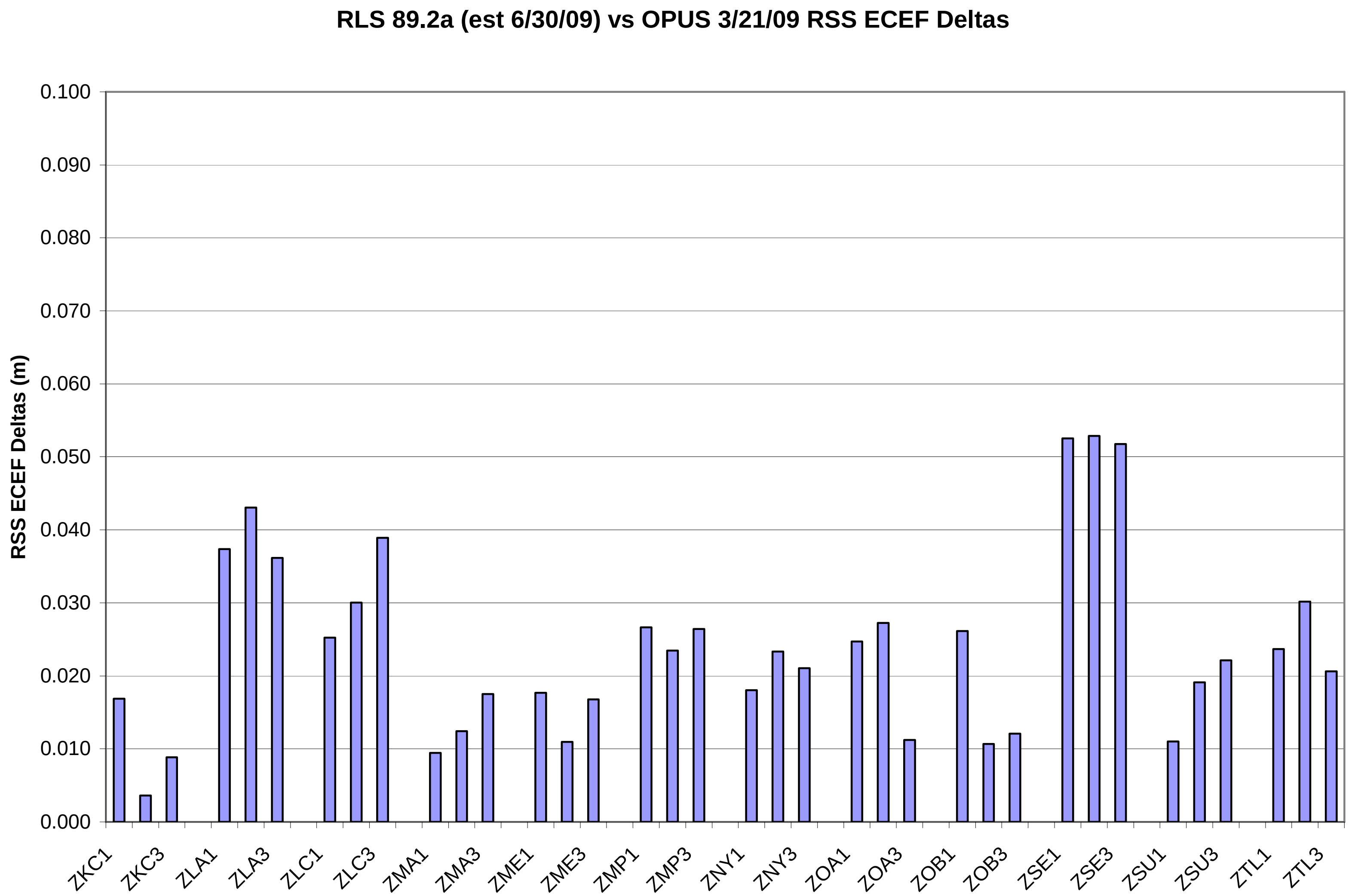


Figure 11-7 OPUS vs. CSRS RSS ECEF Deltas

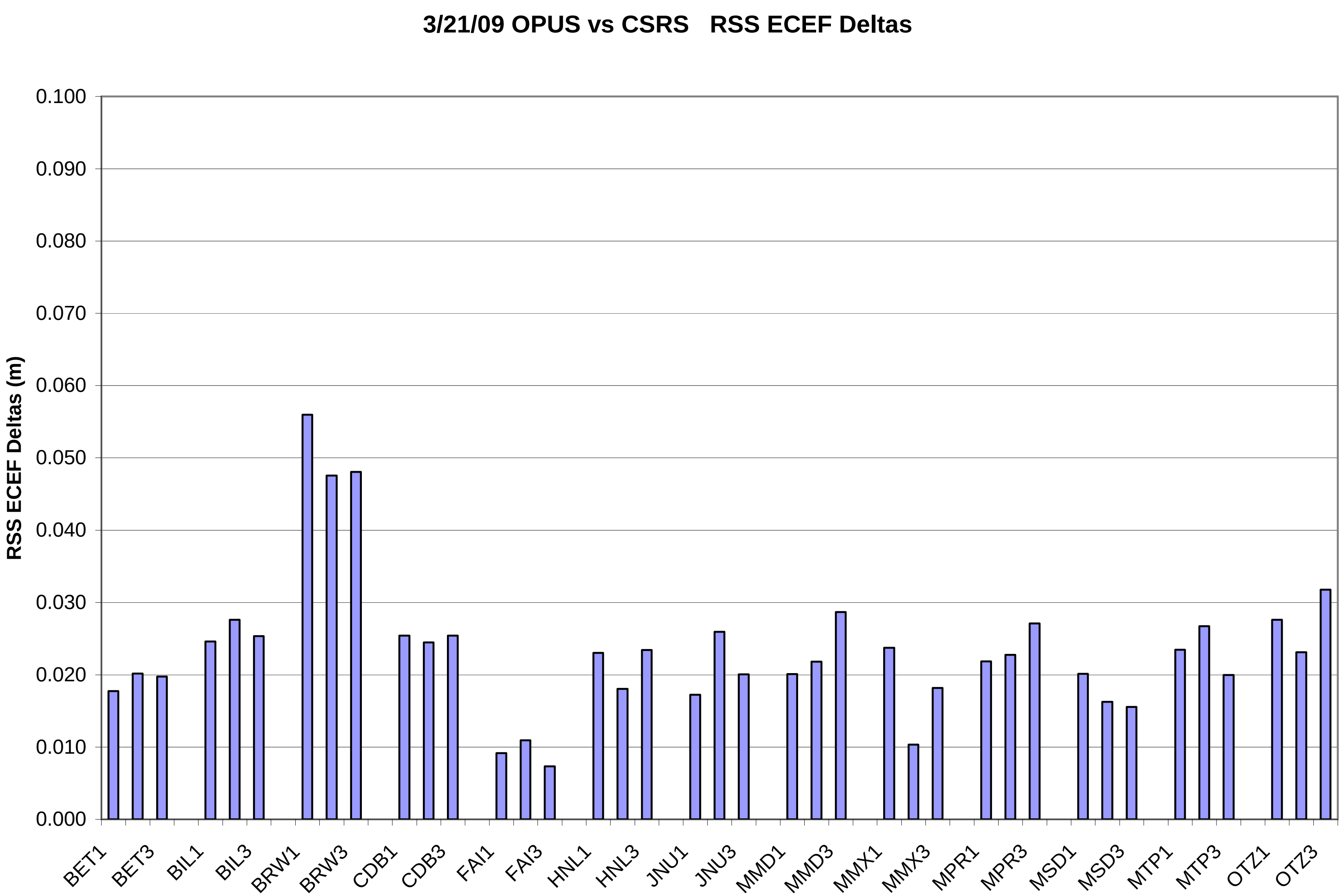


Figure 11-8 OPUS vs. CSRS RSS ECEF Deltas

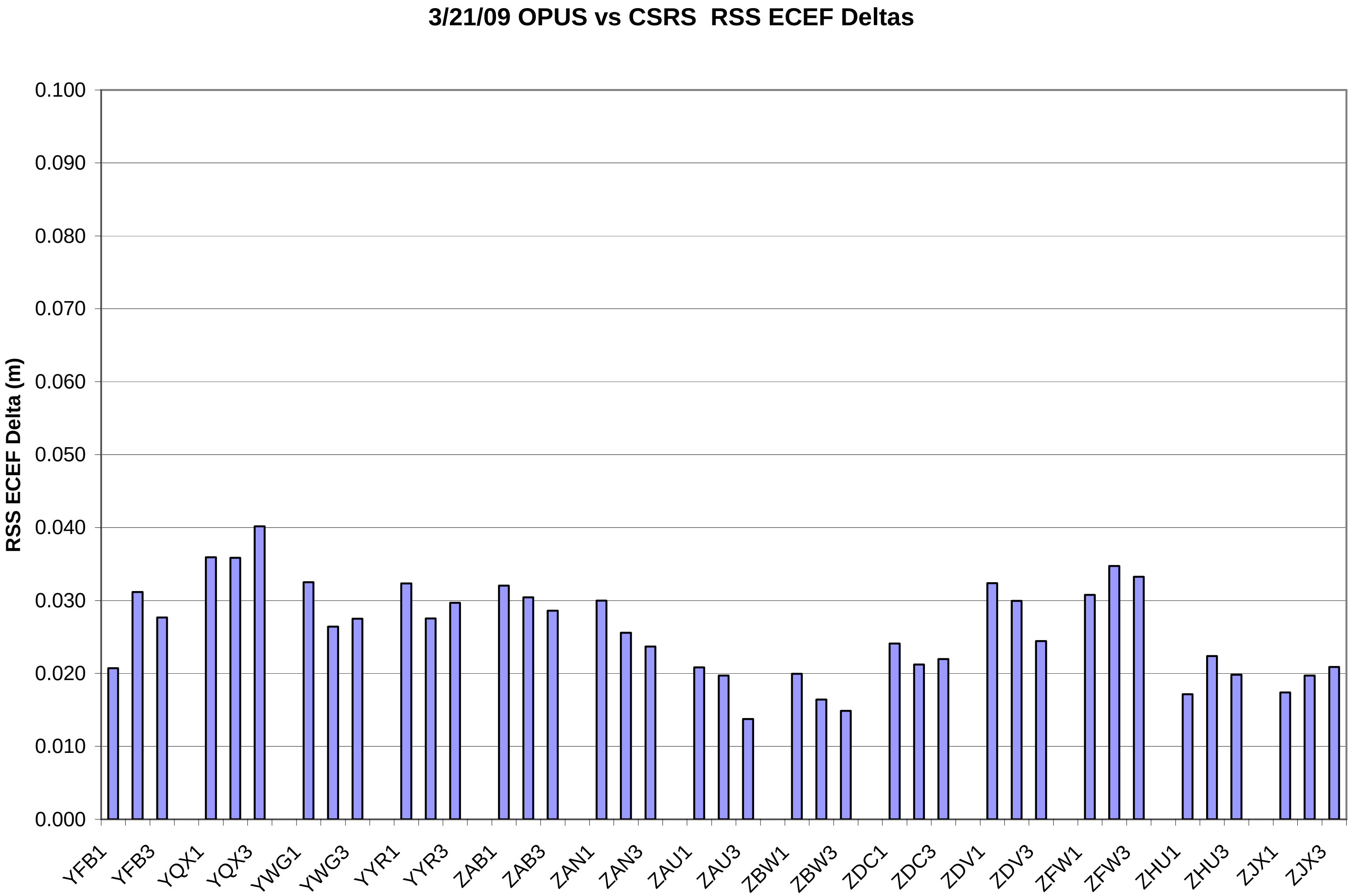
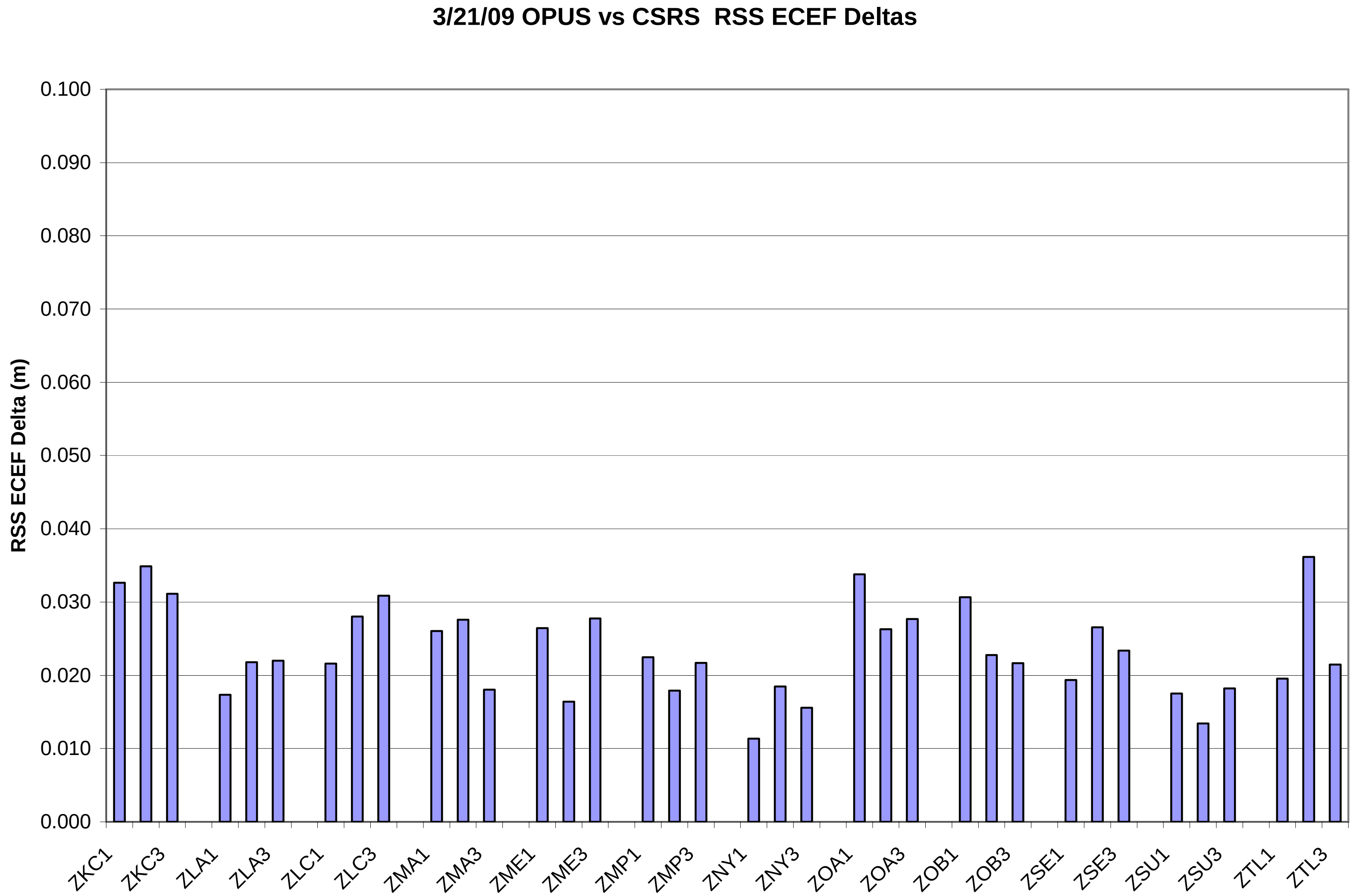


Figure 11-9 OPUS vs. CSRS RSS ECEF Deltas



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 1518 Day 3	2/11/2009	Canadian and Alaska sites had more data outage than normal causing a spike in PRN bias.
Week 1522 Day 0	3/8/2009	Canadian and Alaska sites had more data outage than normal 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. As expected, the type biases are consistent from day to day.

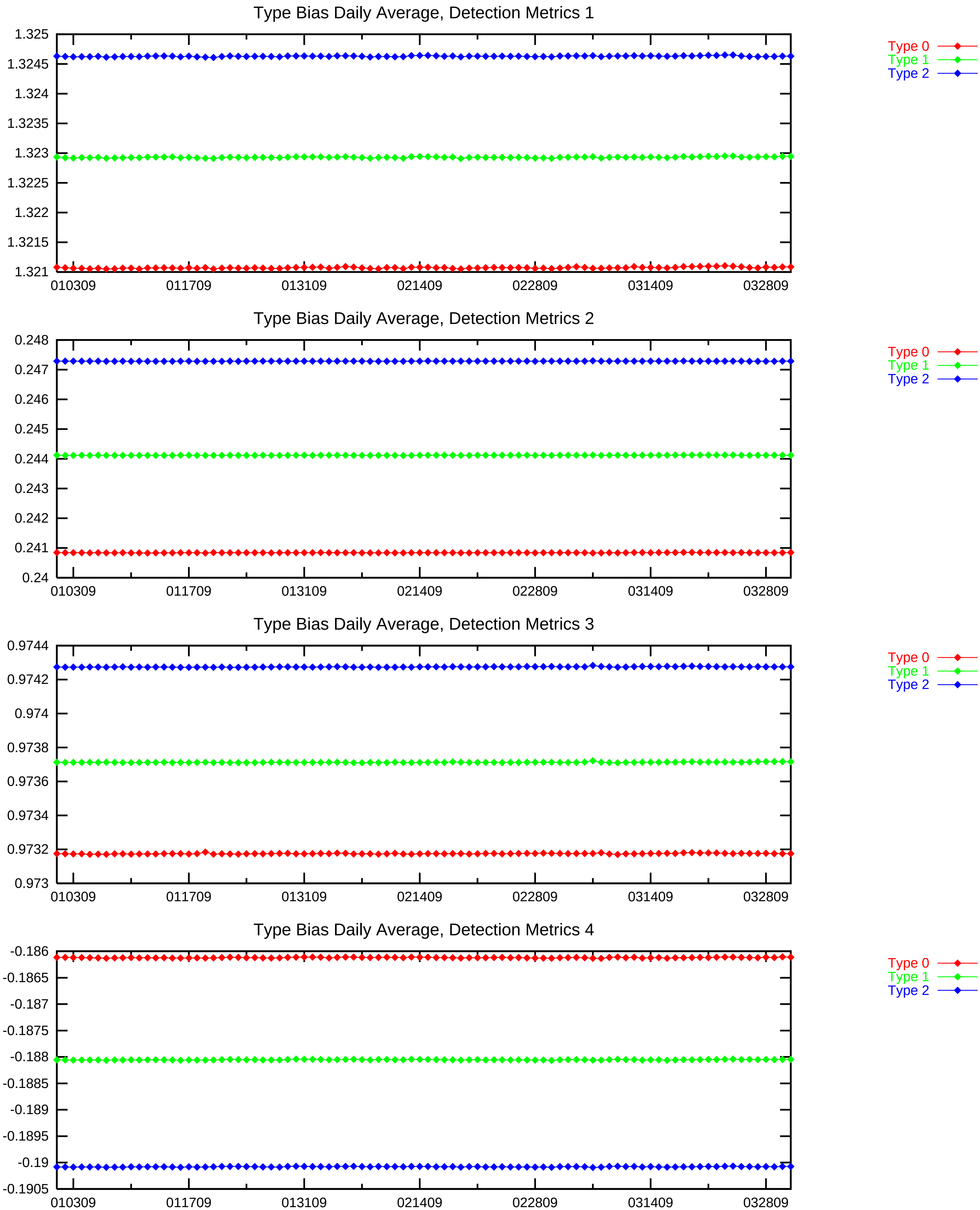
Table 12-3 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32107	1.32293	1.32463
DM 2	0.240839	0.244118	0.247285
DM 3	0.973175	0.973713	0.974275
DM 4	-0.18612	-0.188053	-0.190079

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

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32109	1.32293	1.32463
DM 2	0.240843	0.244115	0.247286
DM 3	0.973177	0.973713	0.974275
DM 4	-0.186111	-0.188054	-0.190084

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 2/11/2009 and 3/8/2009 are likely due to data gap occurred at Canadian and Alaska sites.

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 0.00095976. The maximum average for DM2 is PRN 11 at 0.00018881. The maximum average for DM3 is PRN 10 at 0.00026840 and the maximum average for DM4 is PRN 23 at 0.00041610.

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.

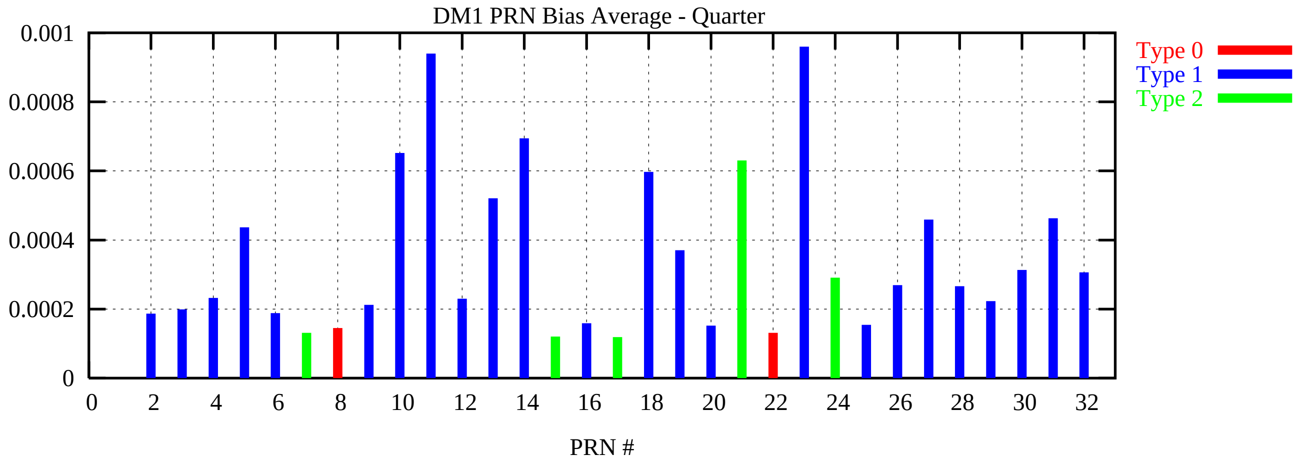
Table 12-5 PRN Bias Average for the Quarter

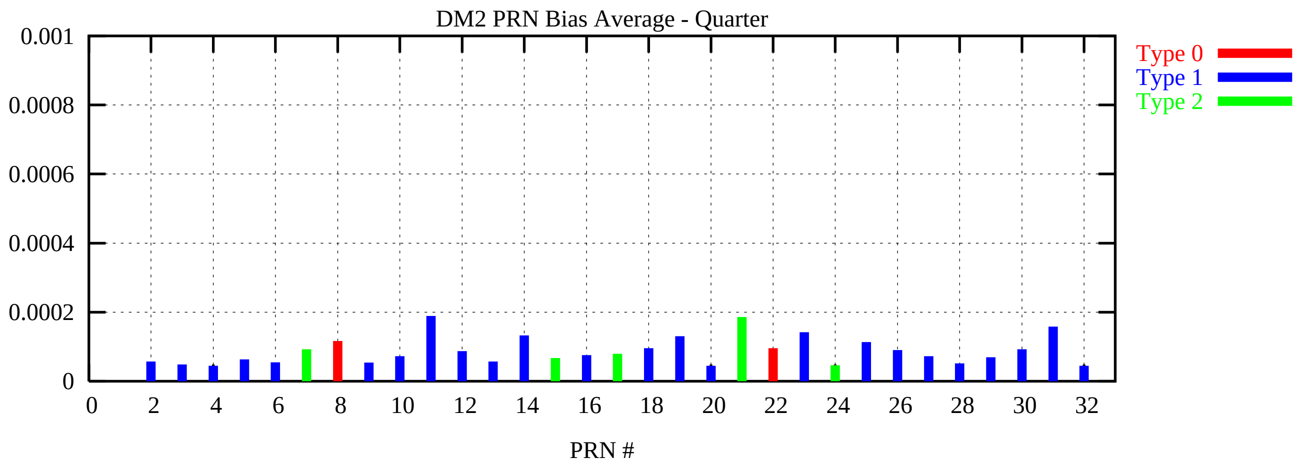
PRN	DM1	DM2	DM3	DM4
2	0.00018702	0.00005678	0.00002356	0.00009470
3	0.00019961	0.00004843	0.00008464	0.00033161
4	0.00023219	0.00004460	0.00007324	0.00012550
5	0.00043581	0.00006335	0.00013031	0.00014963
6	0.00018779	0.00005480	0.00004375	0.00010479
7	0.00013118	0.00009248	0.00003678	0.00011845
8	0.00014536	0.00011617	0.00004354	0.00009828
9	0.00021236	0.00005375	0.00006873	0.00010737
10	0.00065241	0.00007234	0.00026840	0.00008716
11	0.00093917	0.00018881	0.00007001	0.00022901
12	0.00023025	0.00008732	0.00010647	0.00007667
13	0.00052085	0.00005751	0.00005678	0.00016102
14	0.00069438	0.00013277	0.00011505	0.00013551
15	0.00012066	0.00006733	0.00002641	0.00014140
16	0.00015855	0.00007554	0.00010697	0.00033608
17	0.00011854	0.00007961	0.00003377	0.00011702
18	0.00059723	0.00009585	0.00003882	0.00021275
19	0.00037061	0.00013077	0.00003343	0.00008204
20	0.00015195	0.00004504	0.00004473	0.00010539
21	0.00063024	0.00018589	0.00020344	0.00008518
22	0.00013151	0.00009604	0.00010012	0.00010029
23	0.00095976	0.00014195	0.00003499	0.00041610
24	0.00029029	0.00004593	0.00003380	0.00009635
25	0.00015423	0.00011371	0.00008162	0.00029510
26	0.00026943	0.00009041	0.00015282	0.00008768
27	0.00045941	0.00007229	0.00006513	0.00031143
28	0.00026575	0.00005152	0.00003251	0.00009005
29	0.00022263	0.00006905	0.00010790	0.00029542
30	0.00031319	0.00009273	0.00002796	0.00012374
31	0.00046298	0.00015811	0.00004021	0.00024375
32	0.00030676	0.00004495	0.00011247	0.00009817

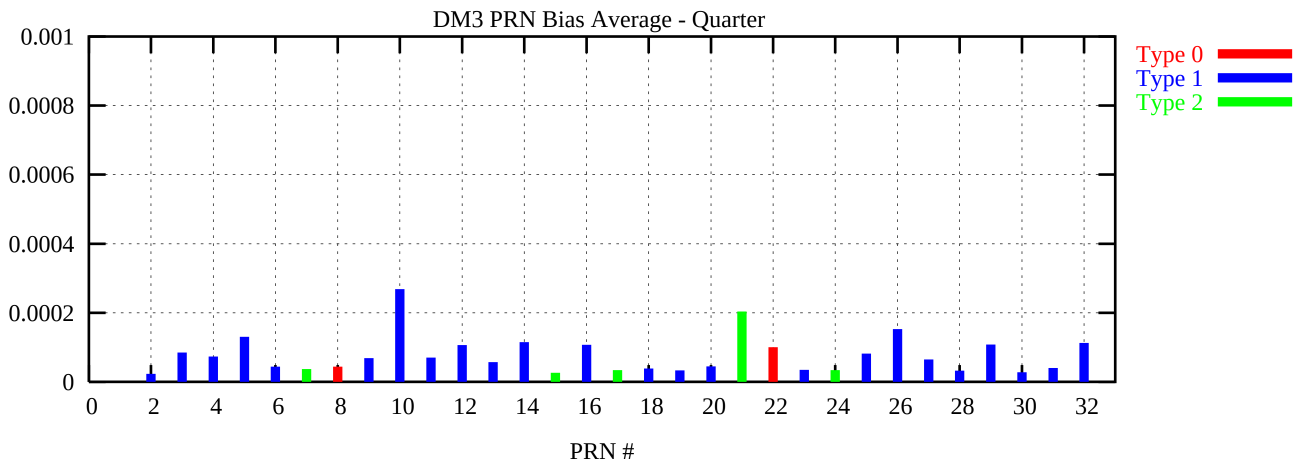
Table 12-6 PRN Bias Average Since January 1, 2008

PRN	DM1	DM2	DM3	DM4
2	0.00018300	0.00005888	0.00002228	0.00009559
3	0.00020979	0.00005240	0.00008549	0.00033926
4	0.00023682	0.00004551	0.00007386	0.00012820
5	0.00042811	0.00006545	0.00011891	0.00015722
6	0.00016999	0.00005468	0.00004580	0.00011486
7	0.00012894	0.00009458	0.00003618	0.00012408
8	0.00015177	0.00012004	0.00004403	0.00010212
9	0.00023104	0.00005341	0.00006946	0.00011025
10	0.00064672	0.00007271	0.00026884	0.00009237
11	0.00092469	0.00018530	0.00006640	0.00023128
12	0.00023793	0.00008569	0.00010521	0.00007961
13	0.00051867	0.00005960	0.00005888	0.00016371
14	0.00067839	0.00013198	0.00011501	0.00013189
15	0.00012032	0.00006940	0.00002736	0.00013523
16	0.00015767	0.00007650	0.00010865	0.00033516
17	0.00011593	0.00008032	0.00003103	0.00011639
18	0.00059343	0.00009752	0.00003983	0.00020755
19	0.00037542	0.00013127	0.00003324	0.00008606
20	0.00015579	0.00004779	0.00004519	0.00010368
21	0.00062725	0.00018651	0.00020216	0.00008519
22	0.00014852	0.00008798	0.00010209	0.00010048
23	0.00095519	0.00013839	0.00003516	0.00042359
24	0.00029602	0.00004532	0.00003458	0.00009991
25	0.00015459	0.00011043	0.00008196	0.00030217
26	0.00026504	0.00009242	0.00015352	0.00009194
27	0.00045501	0.00007663	0.00006912	0.00030763
28	0.00025495	0.00005288	0.00003193	0.00009083
29	0.00022877	0.00006621	0.00010645	0.00029568
30	0.00029770	0.00009462	0.00002828	0.00011962
31	0.00046756	0.00015751	0.00003886	0.00024932
32	0.00031888	0.00004723	0.00011363	0.00010267

Figure 12-2 PRN Bias Average for the Quarter







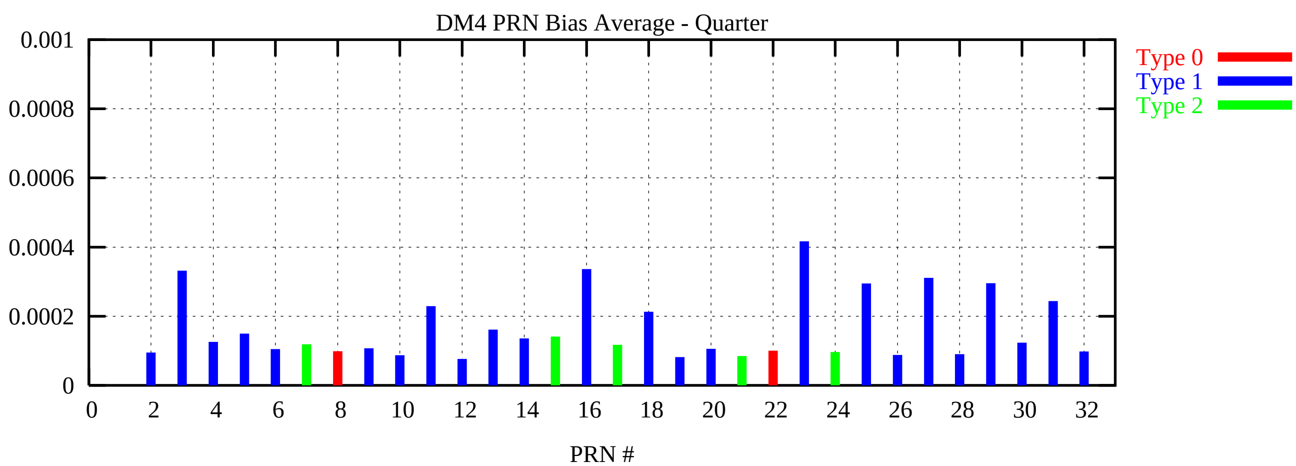


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)

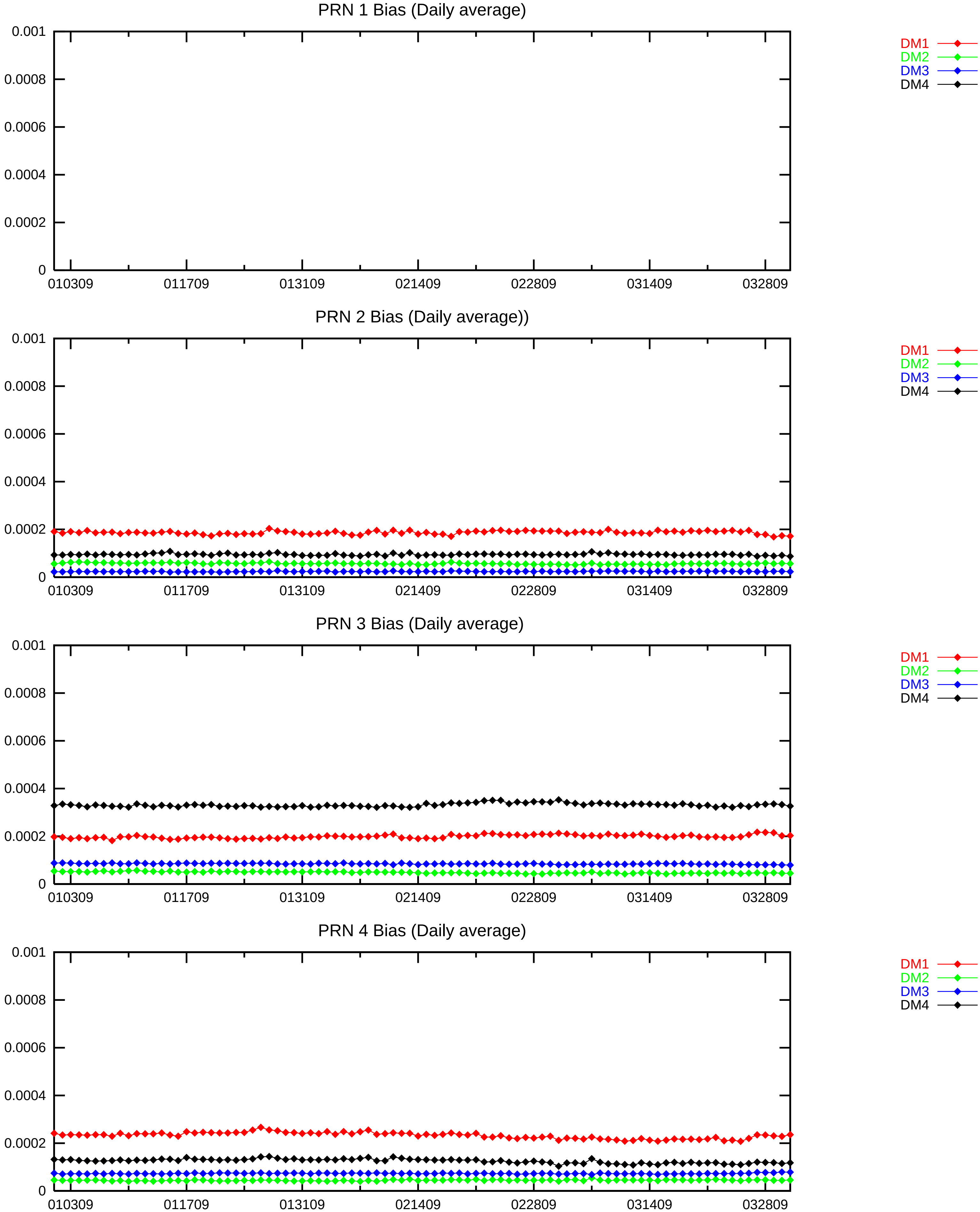
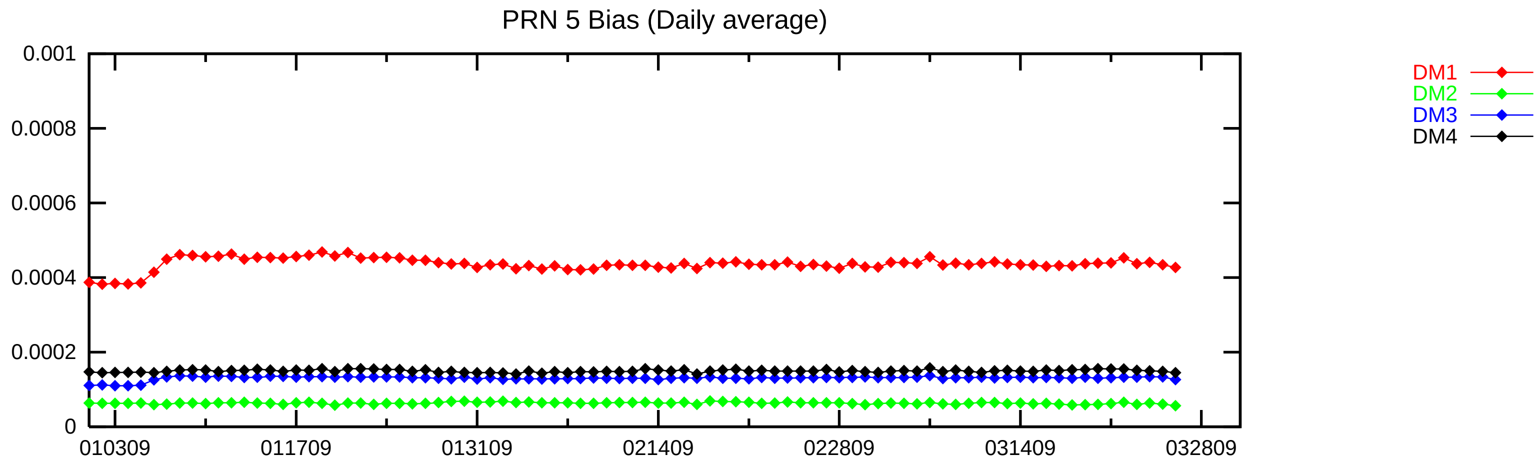
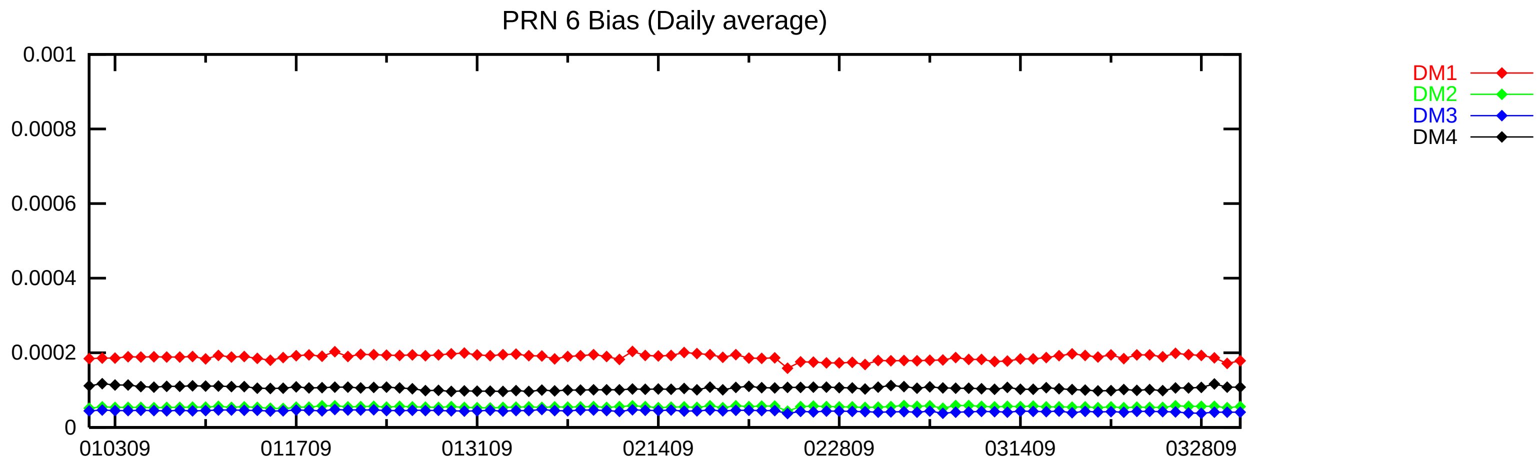
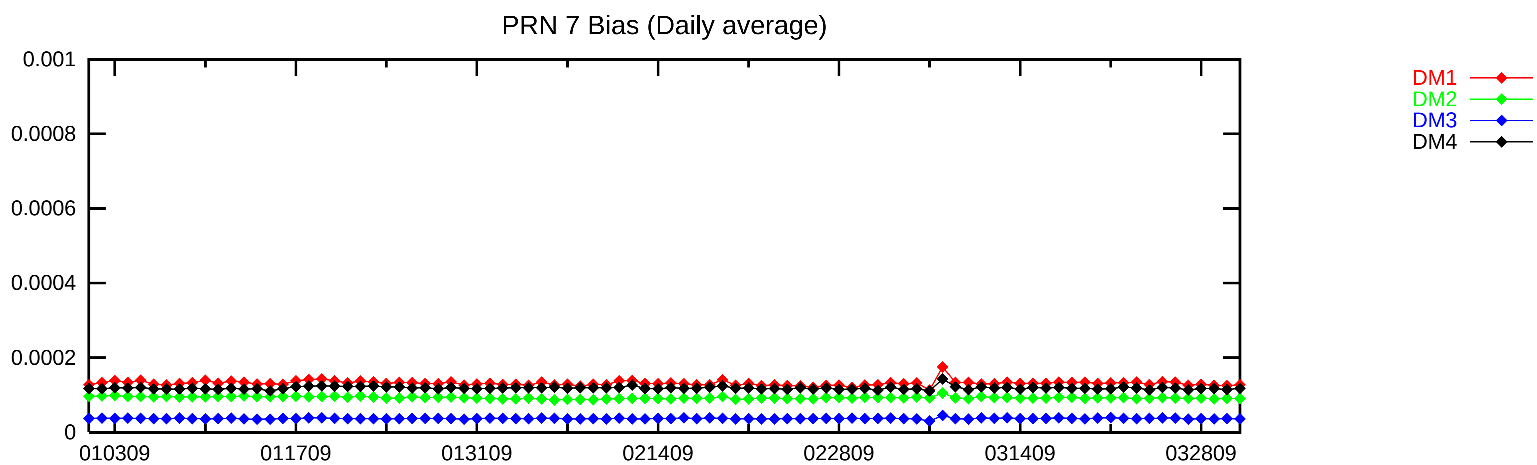


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)







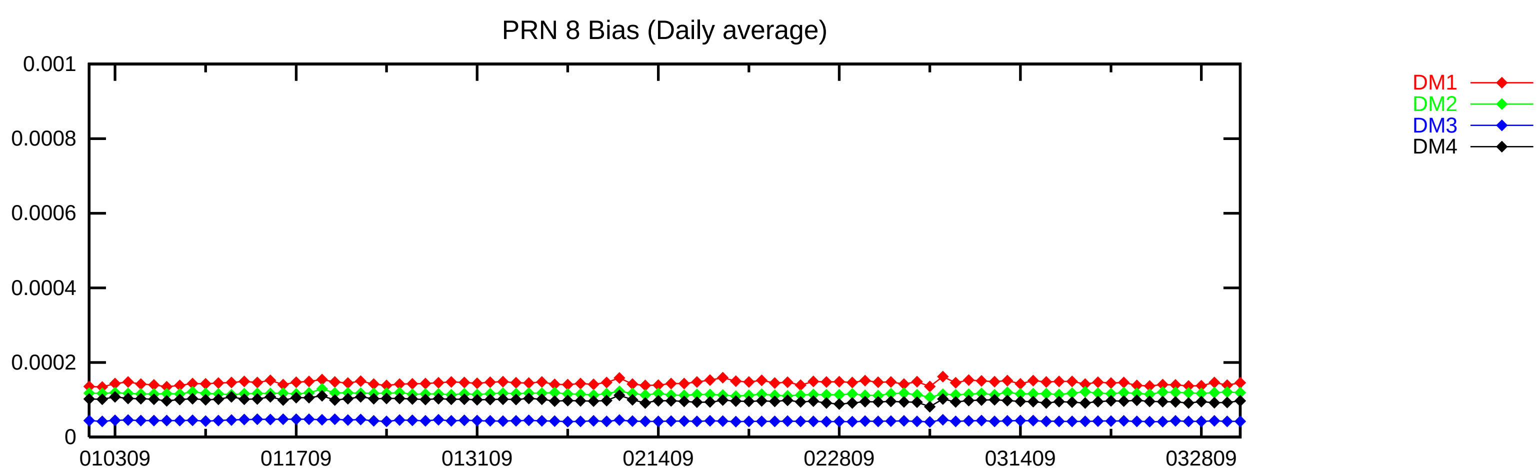
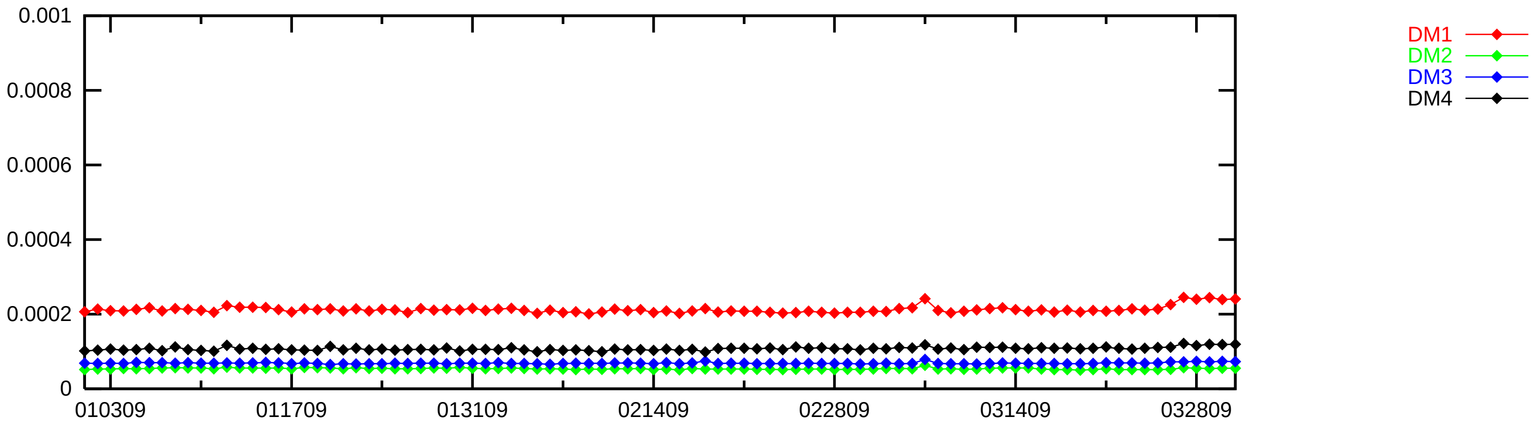
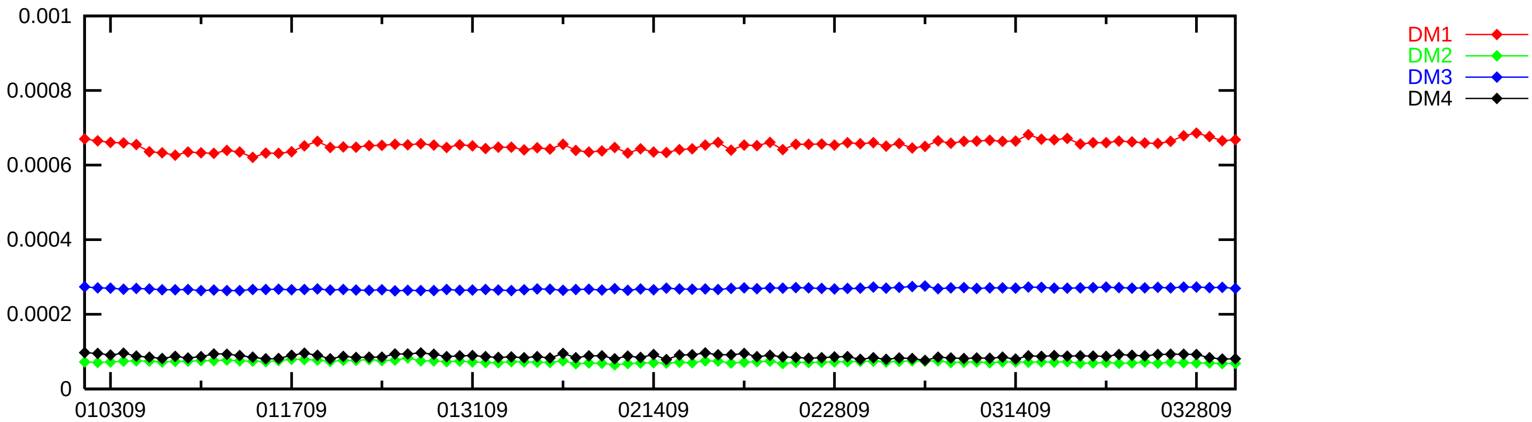


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)

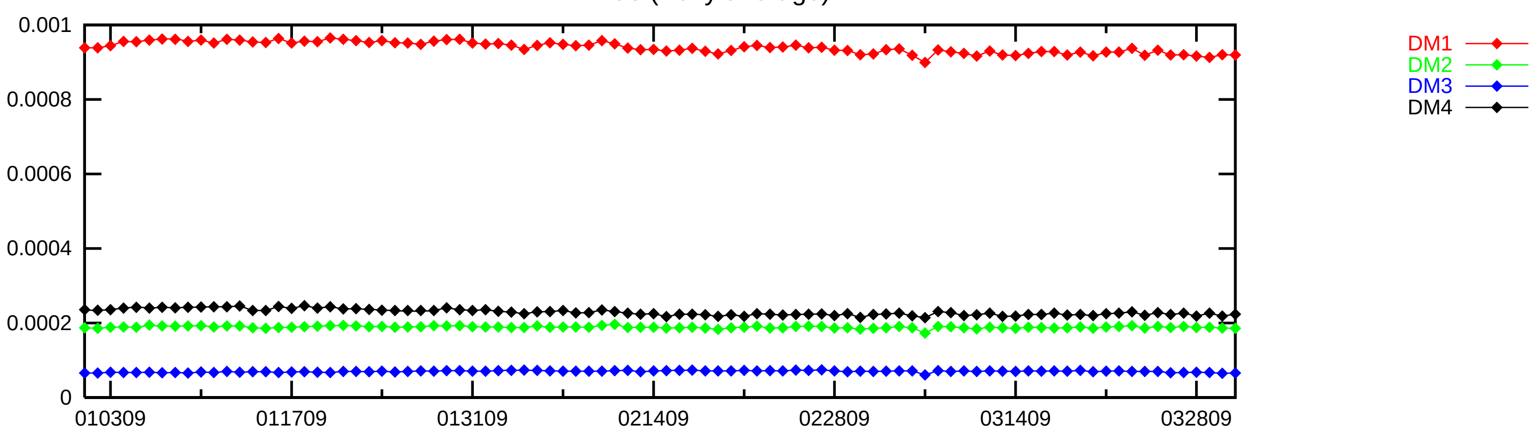
PRN 9 Bias (Daily average)



PRN 10 Bias (Daily average)



PRN 11 Bias (Daily average)



PRN 12 Bias (Daily average)

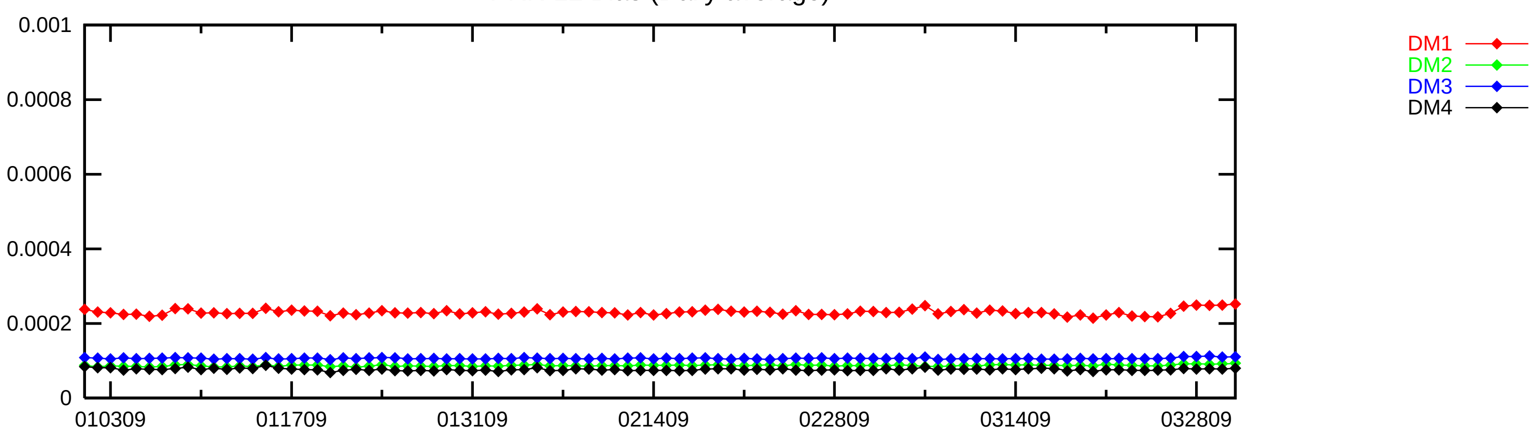


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)

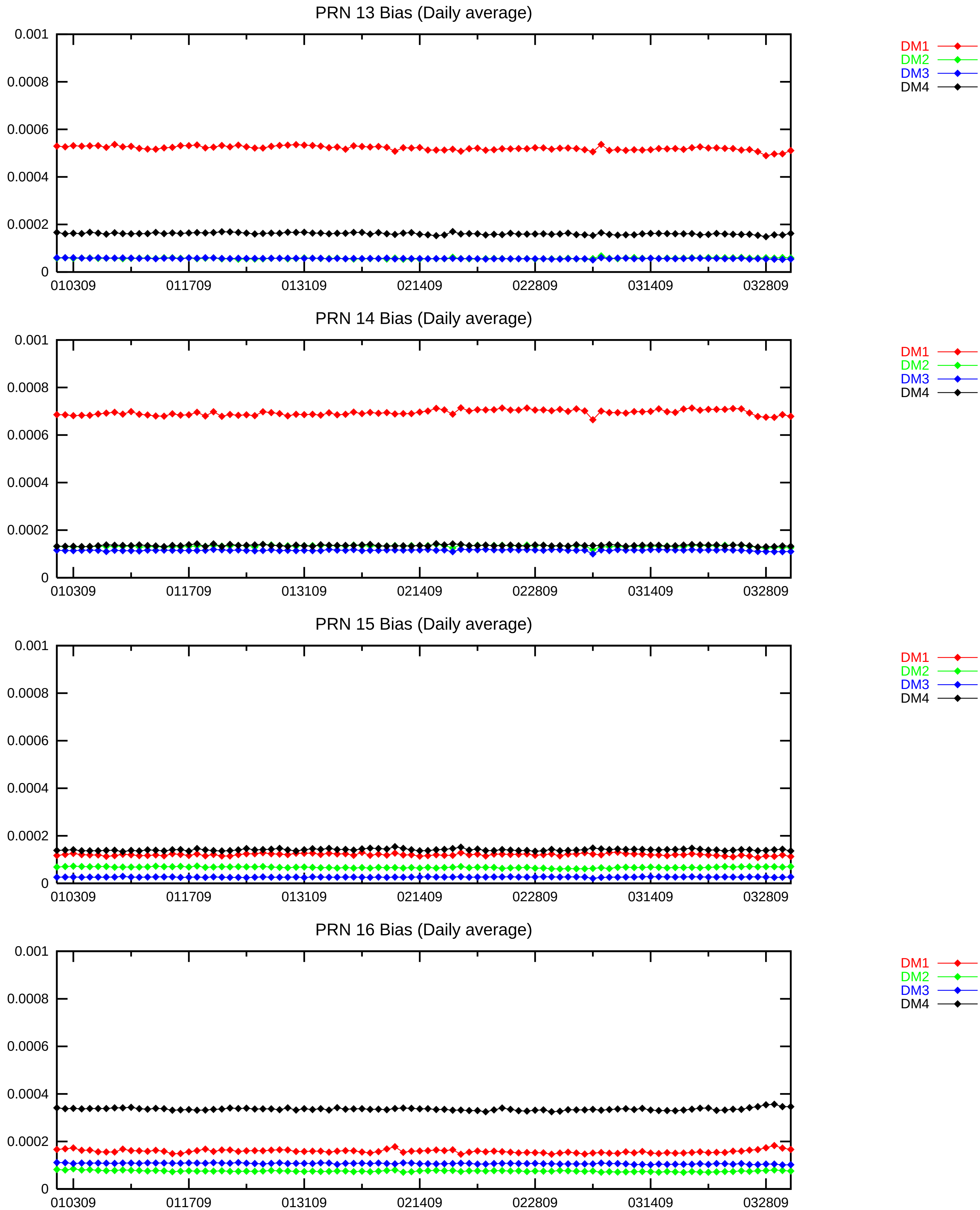
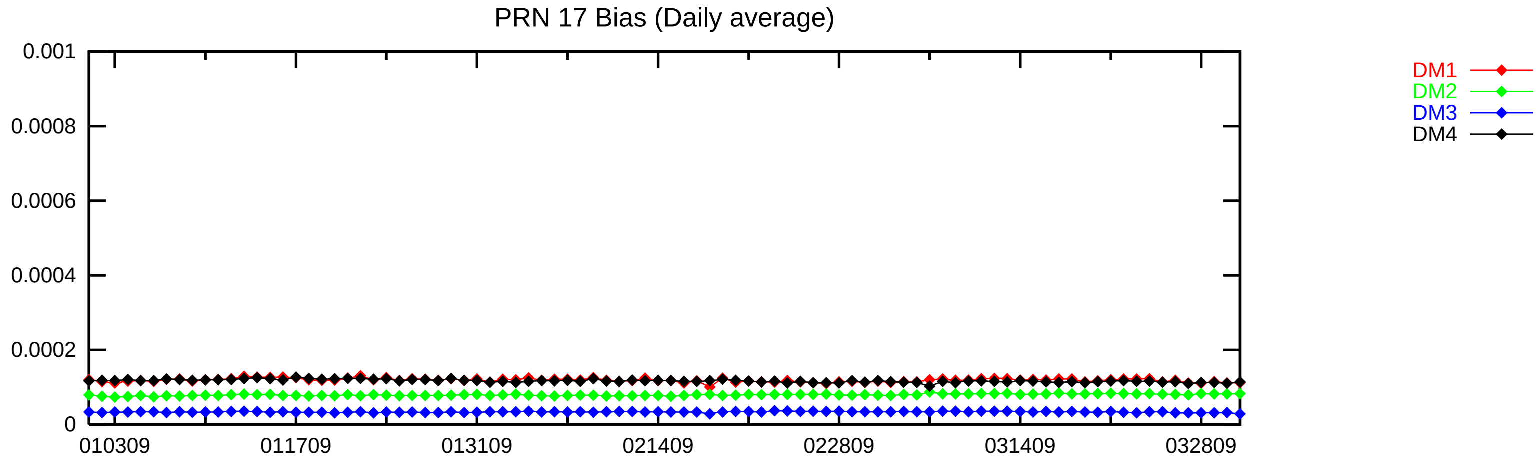
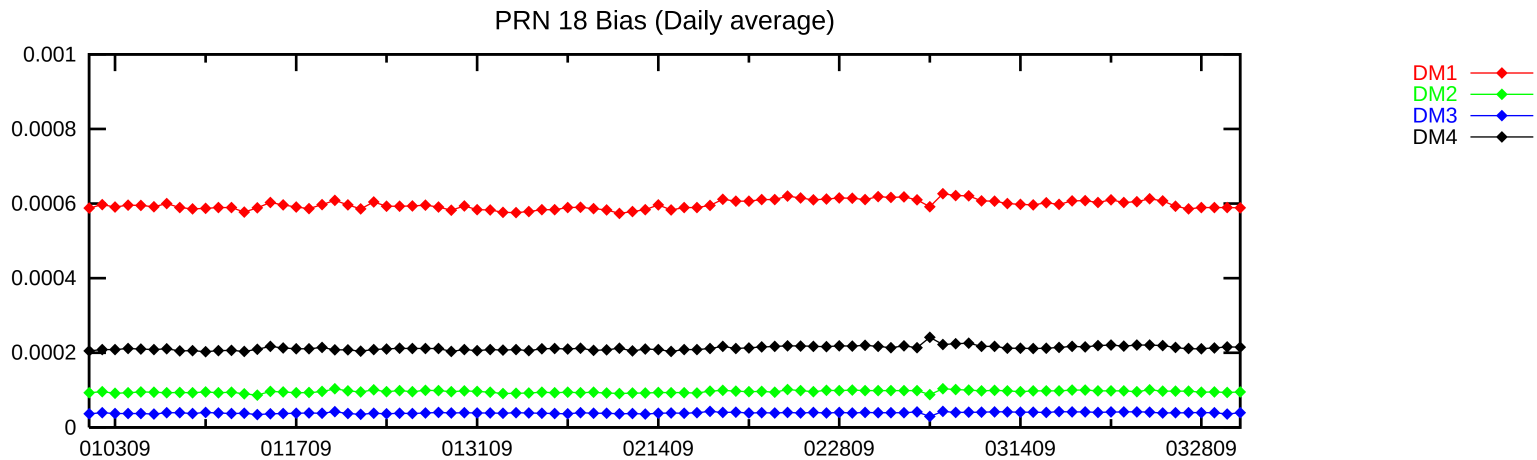
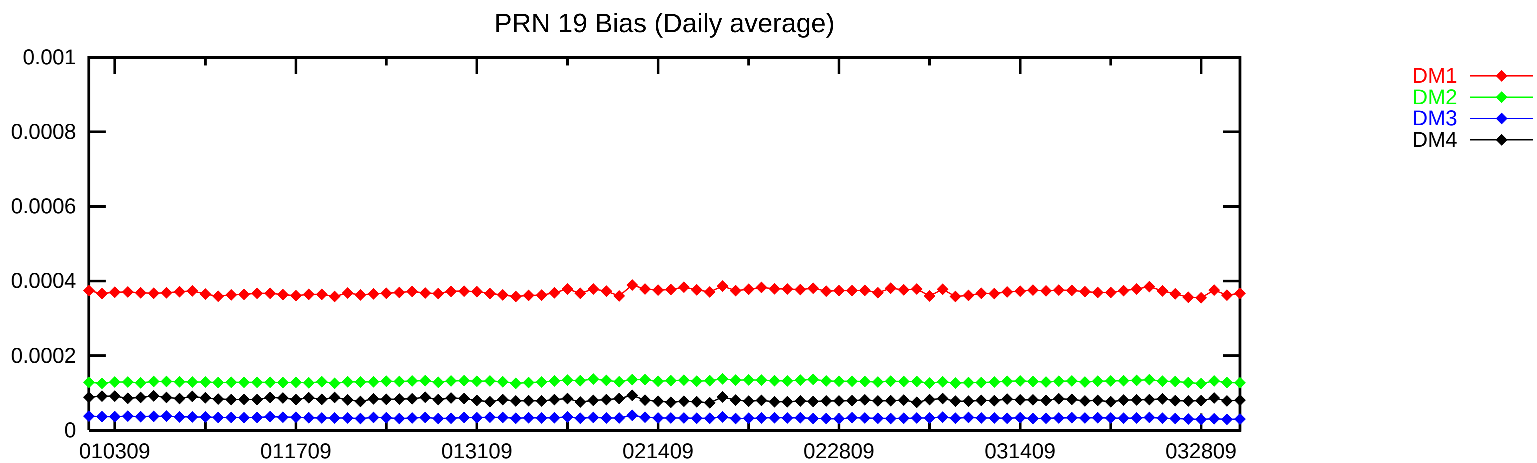


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)







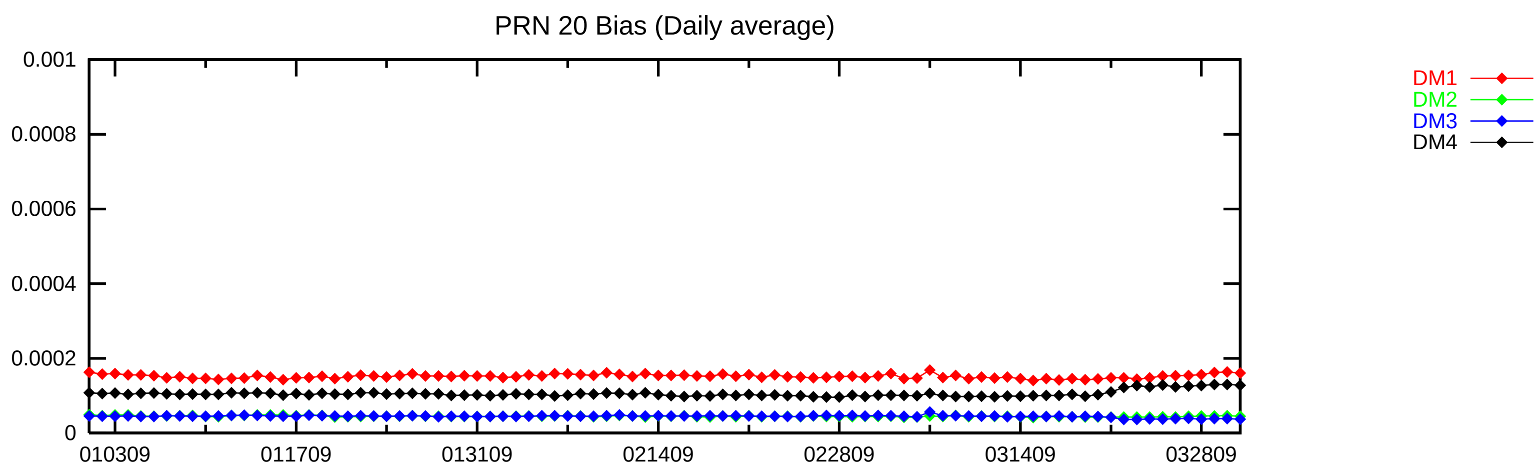


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)

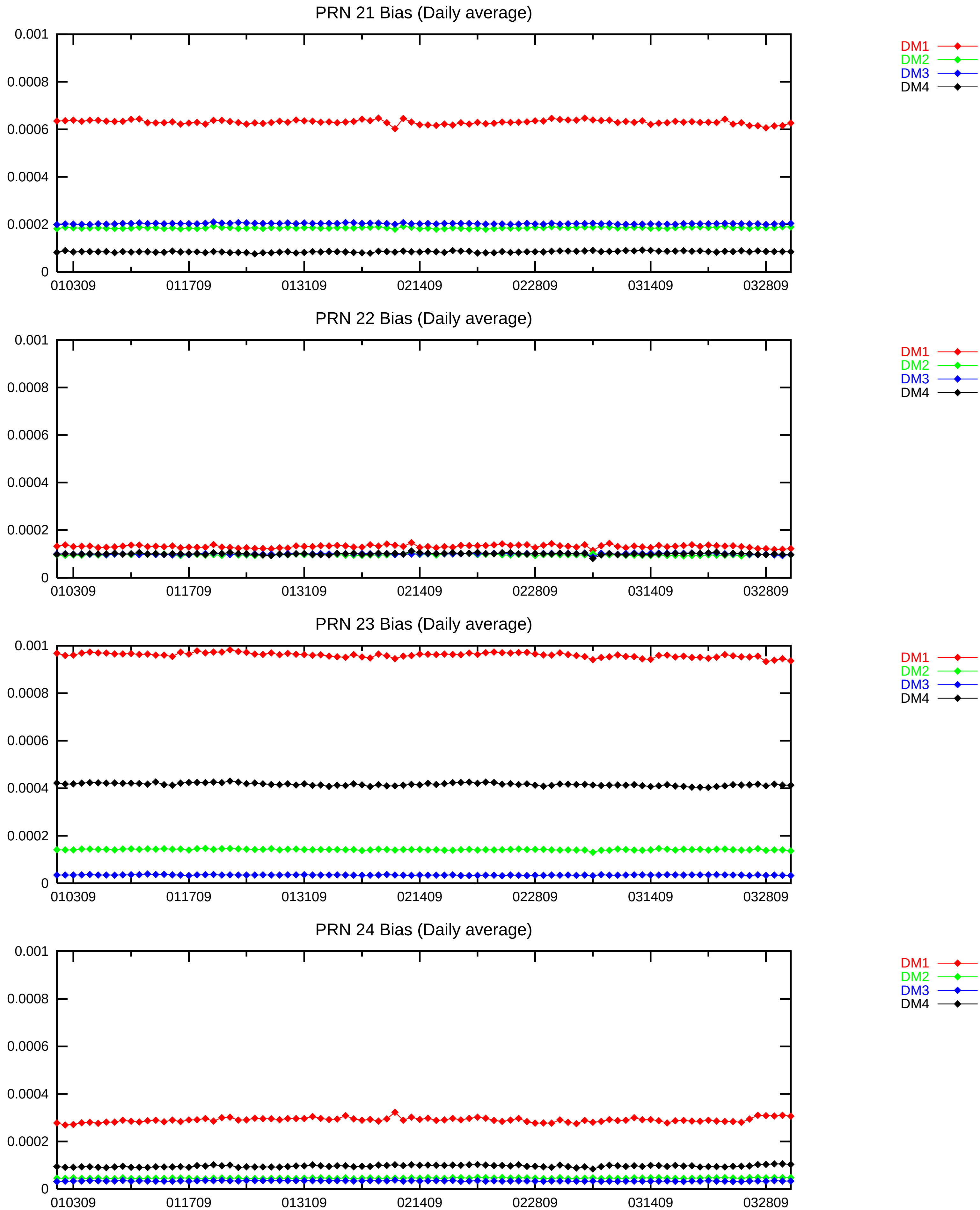
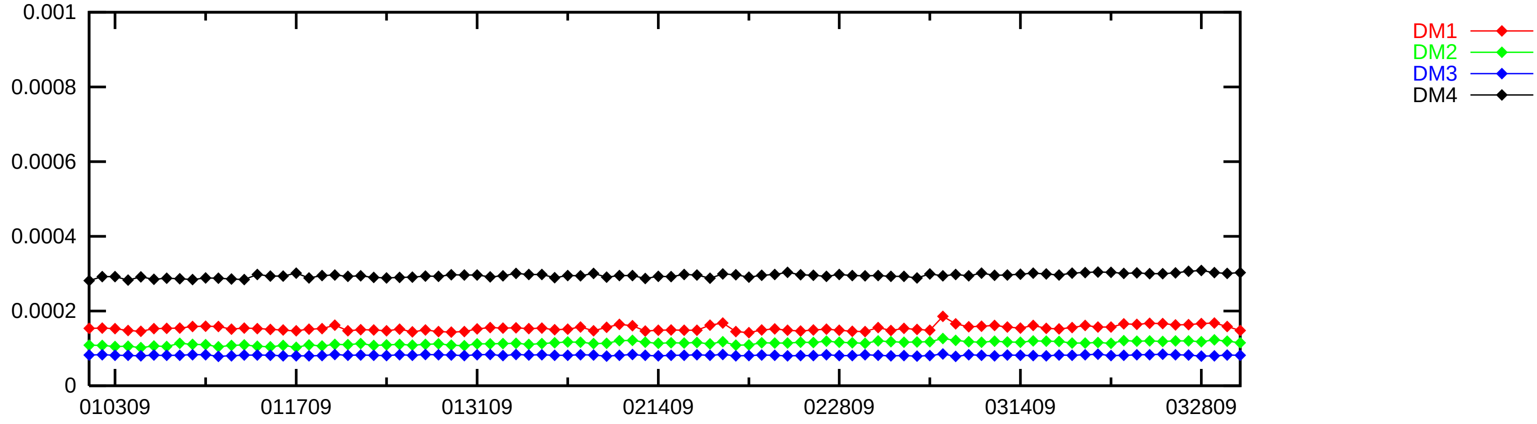
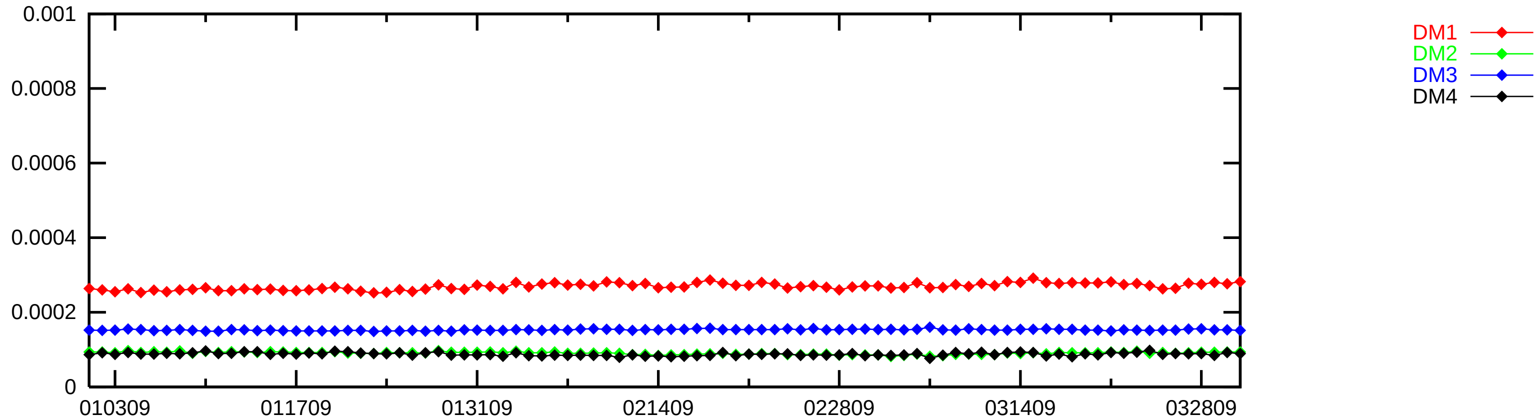


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)

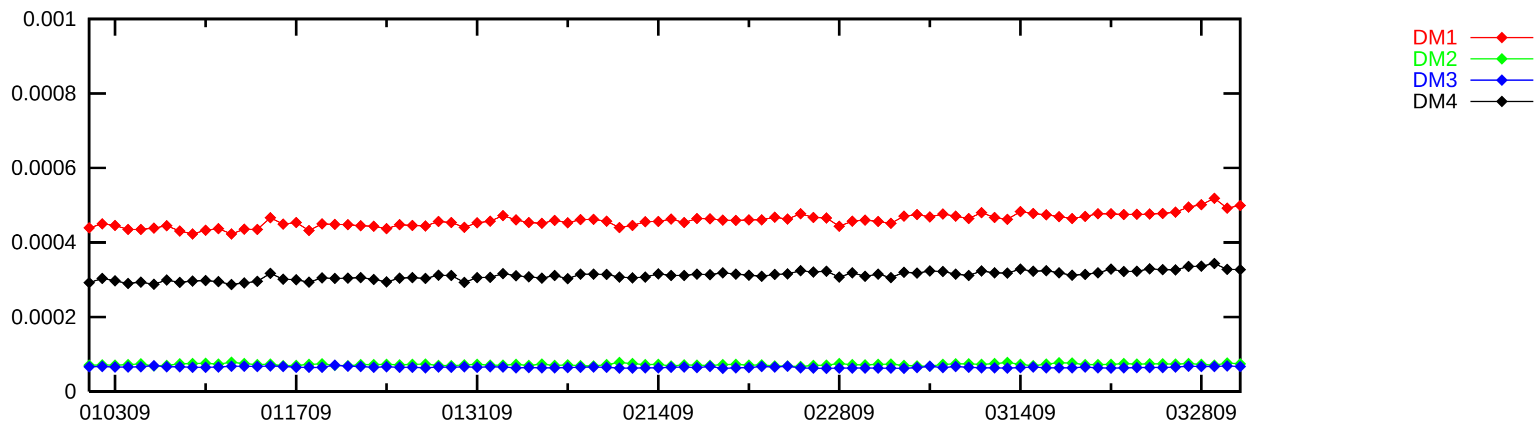
PRN 25 Bias (Daily average)



PRN 26 Bias (Daily average)



PRN 27 Bias (Daily average)



PRN 28 Bias (Daily average)

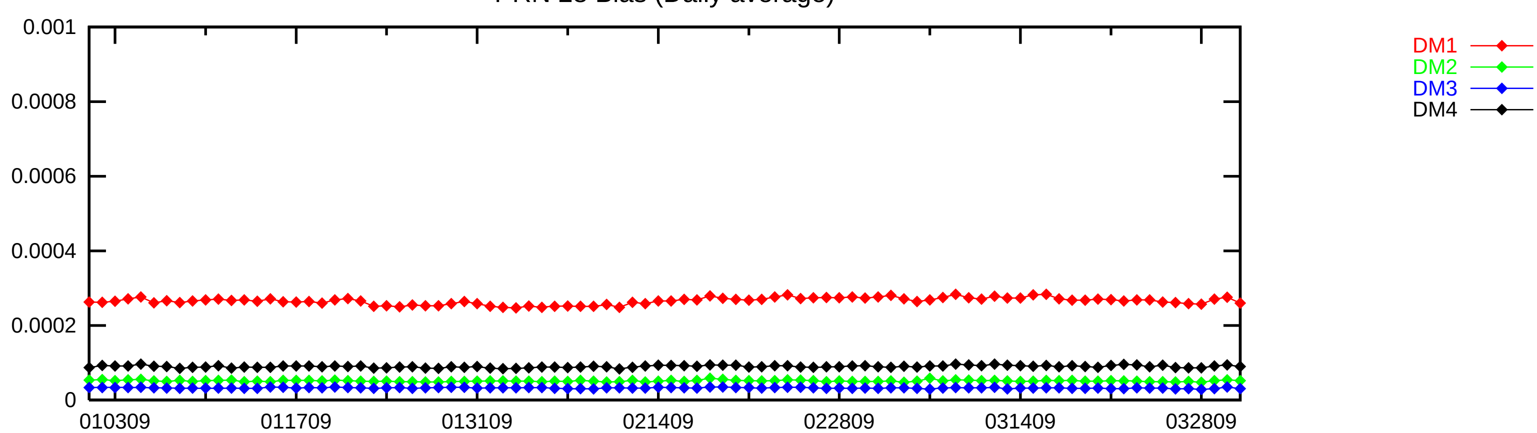
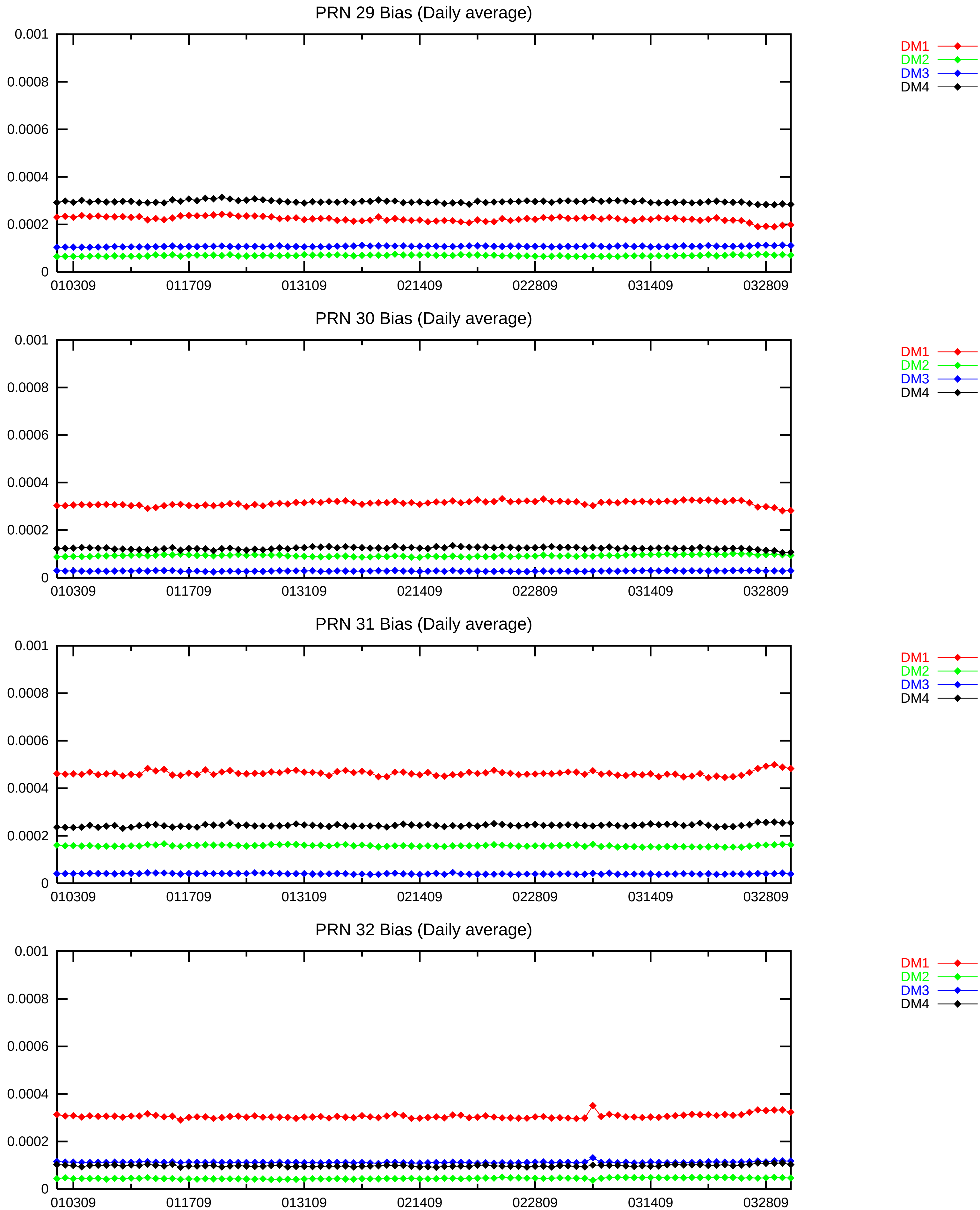


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN 32)



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

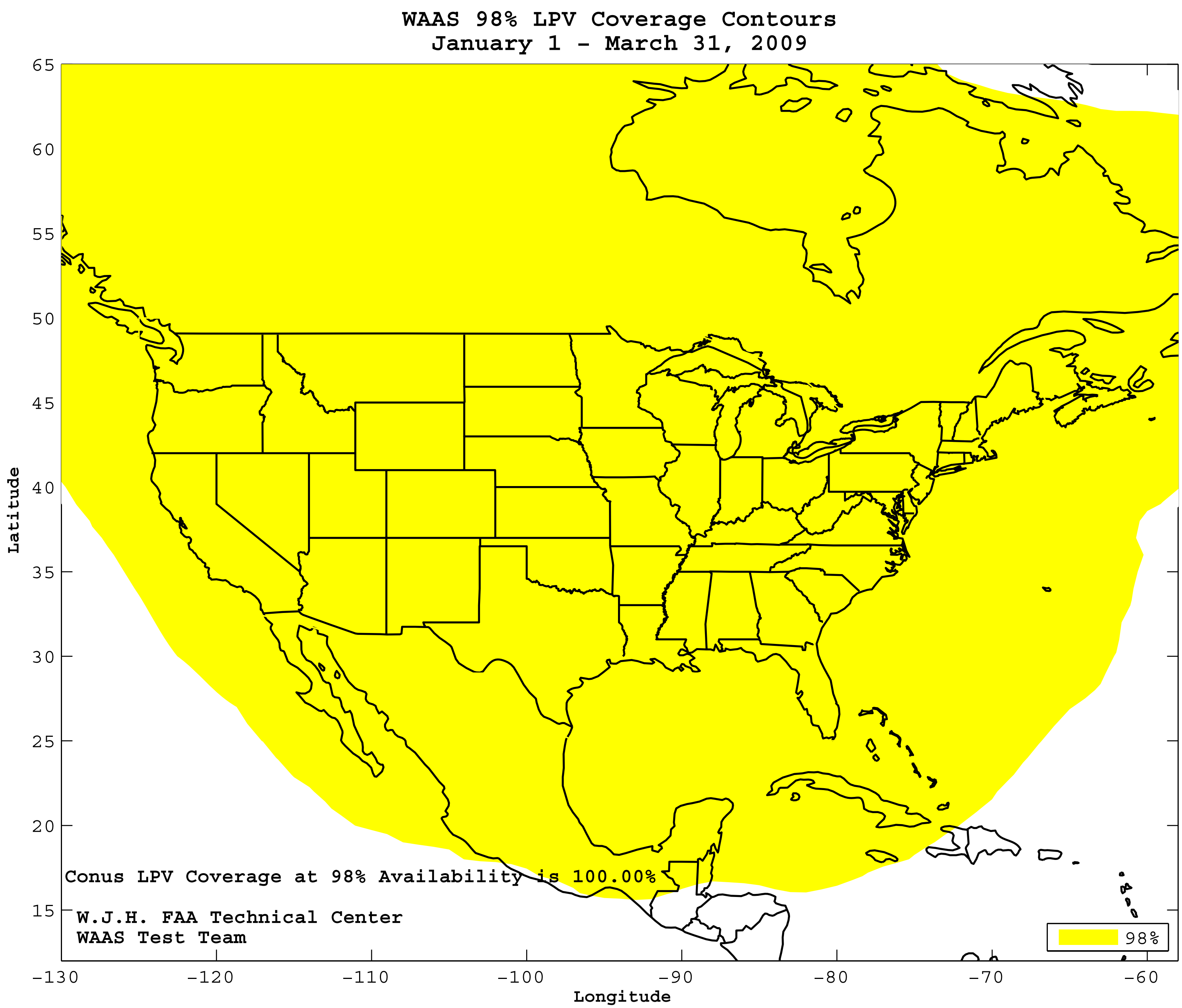


Figure B-2 98% Alaska LPV Availability Contour for the Quarter

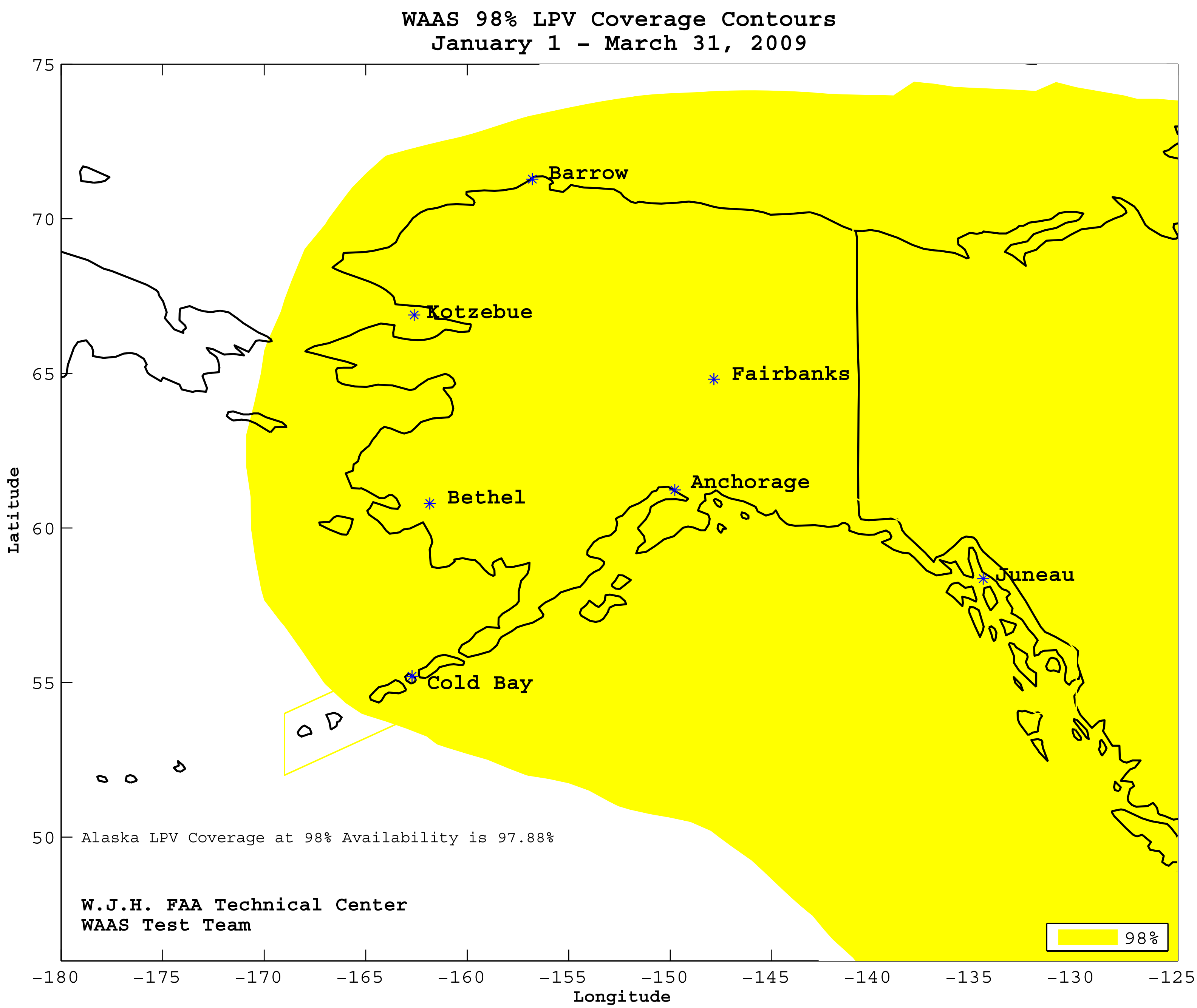


Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter

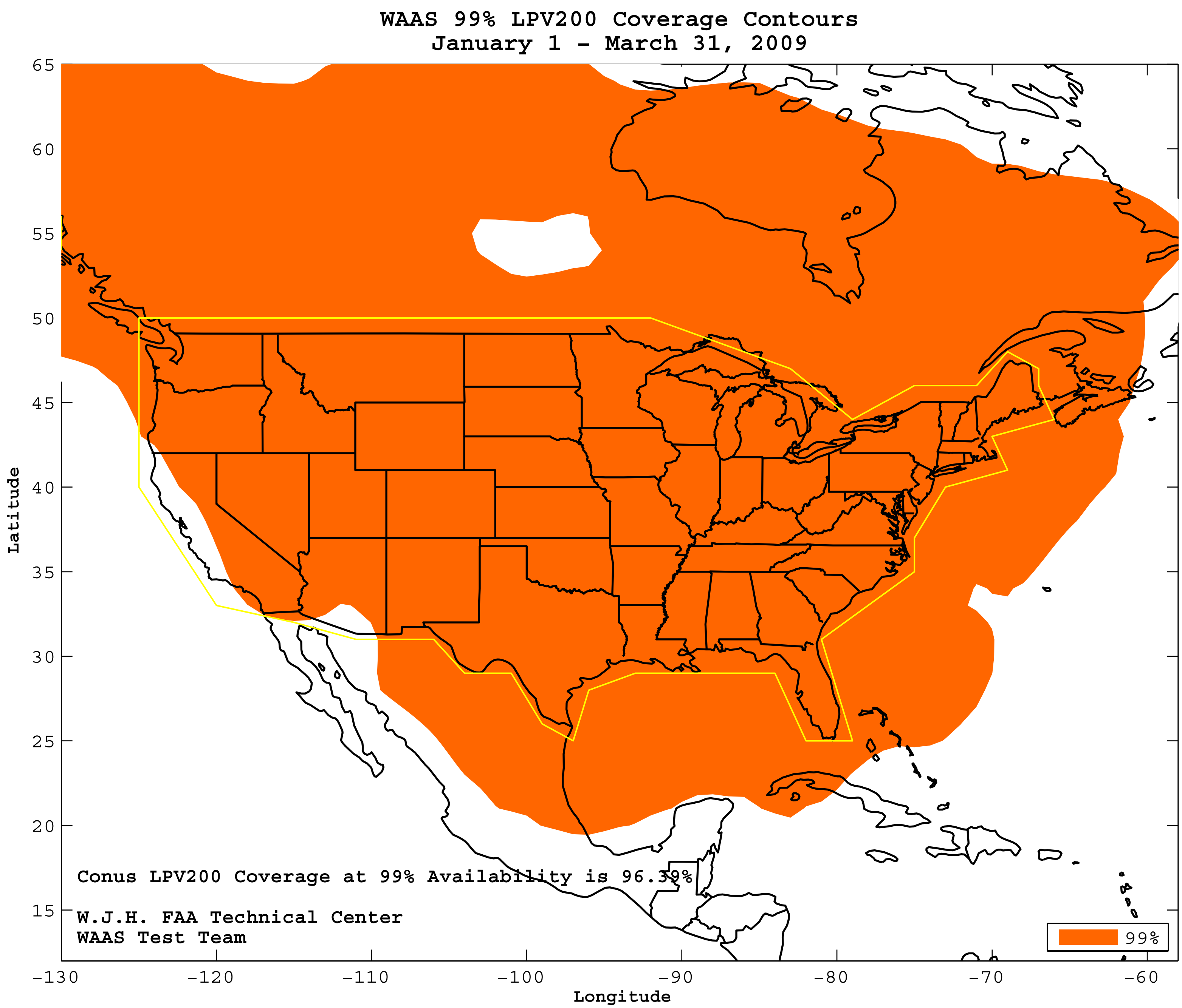


Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter