WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #25

Reporting Period: April 1 to June 30, 2008

July 2008

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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-fifth such WAAS quarterly report. This report covers WAAS performance during the period from April 1, 2008 to June 30 2008.

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

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	All Sites Site/Maximum	All Sites Site/Minimum
95% Horizontal Accuracy	Arcata 1.499	Washington DC 0.516 meters	Arcata 1.499 meters	Bethel 0.455 meters
95% Vertical Accuracy	Arcata 1.456 meters	Salt Lake City 0.677 meters	San Jose De Cabo 1.629 meters	Salt Lake City 0.677 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Atlantic City 100%	Arcata 99.68%	Atlantic City 100%	Tapachula 41.19%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	Salt Lake City 99.978%	Arcata 96.07%	Salt Lake City 99.978%	Tapachula 5.09%
95% HPL	Arcata 20.471 meters	Memphis 12.26 meters	San Juan 51.85 meters	Memphis 12.26 meters
95% VPL	Oakland 33.837 meters	Minneapolis 20.70 meters	San Juan 80.46 meters	Chicago 20.513 meters

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1.0 INTRODUCTION

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

Objectives of this report are:

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

The WAAS data transmitted from Geostationary satellites (GEO) PRN#135 (CRW) and PRN#138 (CRE) were used in the evaluation. Currently both CRW and CRE GEOs provide a ranging capability for enroute through NPA service, but not for PA service.

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

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	90	7771940
Atlantic City	91	7851165
Oklahoma City	81	6988357
WAAS:		
Albuquerque	91	7825832
Anchorage	91	7820354
Atlanta	91	7848222
Chicago	91	7841874
Barrow	90	7798484
Bethel	91	7831580
Billings	91	7841788
Boston	91	7845834
Cleveland	91	7849741
Cold Bay	89	7653784
Dallas	91	7842707
Denver	91	7840681
Fairbanks	90	7812025
Gander	91	7822091
Goose Bay	89	7729938
Houston	91	7847724
Iqaluit	91	7827163
Jacksonville	91	7847084
Juneau	90	7814512
Kansas	90	7805095
Kotzebue	91	7832255
Los Angeles	91	7843702
Memphis	91	7848374
Merida	91	7829948
Mexico City	91	7841463
Miami	91	7845005
Minneapolis	91	7843341
New York	91	7847104
Oakland	91	7834515
Puerto Vallarta	89	7664311
Salt Lake City	90	7813839
San Jose Del Cabo	91	7826759
San Juan	87	7522700
Seattle	91	7839793
Tapachula	89	7711399
Washington DC	91	7846179
Winnipeg	91	7848828

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	91	7835897
Anchorage	91	7834802
Atlanta	91	7858649
Barrow	91	7834889
Bethel	91	7848179
Billings	90	7794439
Boston	91	7857089
Cleveland	79	6848619
Cold Bay	89	7678924
Fairbanks	91	7835611
Gander	91	7839279
Honolulu	90	7759471
Houston	91	7857647
Iqaluit	91	7839733
Juneau	91	7840581
Kansas City	90	7815875
Kotzebue	91	7848432
Los Angeles	91	7855815
Merida	91	7841960
Miami	91	7857742
Minneapolis	91	7858538
Oakland	91	7847483
Salt Lake City	90	7737792
San Jose Del Cabo	90	7755399
San Juan	88	7630558
Seattle	77	6663431
Tapachula	91	7836453
Washington DC	91	7856400

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

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
1473 day 3	4/2/08	All sites	See DR#68, "Satellite Outages Caused Loss of Availability in CONUS Region"
1473 day 5	4/4/08	Goose Bay	Goose Bay WEI outage
1474 day 1 to 1475 day 6	4/7/08 to 4/19/08	Goose Bay	Goose Bay Thread A outage
1475 day 2	4/15/08	All sites	Per NANU 2008040, PRN 11 outage affected LPV and LPV 200 coverage
1476 day 6 to 1477 day 2	4/26/08 to 4/29/08	All sites	Per NANU 2008045, PRN2 outage from 4/26 1214 to 4/29 2304 affected Alaska and CONUS coverage
1477 day 2	4/29/08	All sites	Per NANU 2008046, PRN 30 outage affected coverage
1480 day 4	5/22/08	All sites	PRN21 low availability (93%)
1481 day 3	6/6/08	All sites	WEI outage
1483 day 0 to 1483 day 1	6/8/08 to 6/9/08	Alaska sites	See DR#72 , "Loss of Availability in Alaska due to Satellite Maintenance" on PRN9
1485 day 1	6/23/08	All sites	Multiple outages
1485 day 4 to 1485 day 5	6/25/08 to 6/26/08	Alaska sites	Per NANU 2008060, PRN8 Outage affected Alaska and CONUS LPV and LPV 200 coverage
1483 day 3 to 1486 day 1	6/11/08 to 6/30/08	Minneapolis	Minneapolis Thread 2 high position error and ratio caused by receiver losing PRN21 L2 lock due to multipath.
1481 day 5 to 1486 day 0	5/30/08 to 6/29/08	Seattle	High position error and ratio due to degraded receiver

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 three receivers within the WAAS service area.

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

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

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

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

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

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

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

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

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

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

Section 13 summarizes the GPS IGS SPS accuracy performance. It provides the 95% and 99.99% vertical and horizontal accuracy from data at a selection of high rate IGS stations.

2.0 WAAS POSITION ACCURACY

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

Table 2-1 Operational Service Levels

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

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

During this reporting period, the 95% horizontal and vertical accuracy at all evaluated sites are less than 2 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are 1.499 meters and 1.456 meters, both at Arcata, respectively. The minimum 95% horizontal and vertical LPV errors are 0.516 meters at Washington DC and 0.677 meters at Salt Lake City. The maximum 95% and 99.999% NPA horizontal errors are 2.262 meters at Hononulu and 9.326 meters at Los Angeles, respectively. The minimum 95% and 99.999% horizontal errors are .718 meters at Iqaluit and 1.754 meters at Washington DC.

Currently, both CRE and CRW GEO satellites provide a ranging capability for enroute through NPA service, but not for 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 2.17 show the distributions of the vertical and horizontal errors in triangle charts and 2-D histogram plots for the quarter at three locations, Kansas City, Washington DC and Seattle. The triangle charts 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 horizontal lines at various protection levels represent the various operational service levels as defined in Table 2.1. The 2-D histogram plots contain four histograms showing the distributions of vertical and horizontal position errors and normalized position errors. The left top and bottom histograms show 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 right top and bottom histograms 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	1.499	1.500	1.456	100	*	*
Atlantic City	0.626	0.626	0.990	100	*	*
Oklahoma City	0.785	0.785	1.006	100	*	*
Albuquerque	0.599	0.599	0.740	100	2.143	4.528
Anchorage	0.515	0.515	0.850	100	*	*
Atlanta	0.569	0.569	0.923	100	2.346	5.426
Barrow	0.537	0.537	1.237	99.98268	*	*
Bethel	0.455	0.455	0.828	100	1.990	4.023
Billings	0.629	0.629	0.844	100	2.149	4.212
Boston	0.522	0.522	0.865	100	2.163	4.615
Cleveland	0.574	0.574	0.935	100	2.296	5.095
Cold Bay	0.758	0.759	0.913	100	*	*
Dallas	0.606	0.606	0.947	100	*	*
Denver	0.598	0.598	0.800	100	*	*
Fairbanks	0.462	0.462	0.944	100	1.939	4.075
Gander	0.685	0.685	0.912	99.97784	*	*
Goose Bay	0.538	0.538	1.073	99.97806	*	*
Houston	0.641	0.641	1.037	100	2.203	4.581
Iqaluit	0.542	0.550	1.572	99.98356	*	*
Jacksonville	0.548	0.548	0.979	100	*	*
Juneau	0.541	0.541	0.900	100	*	*
Kansas	0.594	0.594	0.887	100	2.332	4.984
Kotzebue	0.527	0.527	1.144	99.98296	1.945	4.080
Los Angeles	0.701	0.701	1.126	100	2.336	5.658
Memphis	0.556	0.556	0.914	100	*	*
Merida	0.802	0.802	1.020	100	*	*
Mexico City	1.065	1.064	1.020	100	*	*
Miami	0.613	0.613	1.113	100	2.294	5.063
Minneapolis	0.597	0.597	0.876	100	2.284	4.702
New York	0.557	0.557	0.880	100	*	*
Oakland	0.700	0.700	1.125	100	2.283	5.831
Puerto Vallarta	1.032	1.033	1.408	100	*	*
Salt Lake City	0.591	0.591	0.677	100	2.144	4.636
San Jose Del Cabo	0.982	0.988	1.629	100	*	*
San Juan	0.830	0.884	1.300	98.78167	*	*
Seattle	0.751	0.751	0.766	100	2.355	5.152
Tapachula	1.172	1.202	1.293	98.59113	*	*
Washington DC	0.516	0.516	0.839	100	2.287	5.171
Winnipeg	0.659	0.659	0.949	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	1.032	3.471	100	3.566
Anchorage	1.475	2.603	100	2.781
Atlanta	1.065	2.171	100	2.536
Barrow	1.152	2.238	99.994	6.748
Bethel	1.248	2.328	100	2.556
Billings	1.233	5.629	100	5.753
Boston	0.92	1.911	100	2.022
Cleveland	1.048	1.840	100	3.379
Cold Bay	1.401	2.761	100	2.973
Fairbanks	1.37	2.705	100	4.174
Gander	1.102	2.489	99.992	2.706
Honolulu	2.262	5.438	99.984	5.635
Houston	1.316	3.483	100	3.556
Iqaluit	0.718	2.338	99.993	8.443
Juneau	1.306	2.393	100	2.483
Kansas City	1.023	1.929	100	2.120
Kotzebue	1.267	2.984	99.992	3.052
Los Angeles	1.211	9.326	100	9.898
Merida	1.899	3.775	100	4.114
Miami	1.301	3.102	100	3.216
Minneapolis	1.217	4.534	100	4.916
Oakland	1.174	4.016	100	4.759
Salt Lake City	1.127	2.083	100	2.326
San Jose Del Cabo	2.005	5.618	100	5.859
San Juan	1.404	2.639	100	2.803
Seattle	1.218	2.824	100	4.596
Tapachula	2.226	5.521	100	5.629
Washington DC	0.982	1.754	100	2.017

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	3.417	0.230	0.230	4.204	0.128	0.198
Atlantic City	1.522	0.055	0.113	2.552	0.099	0.131
Oklahoma City	1.550	0.046	0.159	4.520	0.132	0.212
Albuquerque	1.486	0.070	0.147	2.709	0.120	0.153
Anchorage	1.493	0.101	0.104	3.647	0.119	0.119
Atlanta	1.321	0.057	0.111	2.589	0.139	0.140
Chicago	1.504	0.052	0.123	2.407	0.113	0.186
Barrow	3.371	0.187	0.187	5.463	0.168	0.168
Bethel	1.579	0.053	0.097	2.606	0.065	0.107
Billings	2.337	0.089	0.119	2.558	0.130	0.130
Boston	1.726	0.132	0.132	2.485	0.089	0.143
Cleveland	2.023	0.116	0.147	3.181	0.153	0.176
Cold Bay	2.107	0.068	0.090	3.027	0.071	0.103
Dallas	2.835	0.085	0.145	3.264	0.172	0.172
Denver	2.030	0.076	0.116	3.401	0.122	0.158
Fairbanks	2.021	0.127	0.127	4.040	0.143	0.143
Gander	1.761	0.083	0.105	3.191	0.077	0.094
Goose Bay	1.518	0.077	0.109	2.808	0.065	0.127
Houston	2.367	0.110	0.133	2.752	0.076	0.133
Iqaluit	4.726	0.143	0.169	4.695	0.128	0.193
Jacksonville	1.129	0.091	0.111	2.631	0.115	0.141
Juneau	1.710	0.093	0.116	3.368	0.114	0.150
Kansas City	1.553	0.116	0.142	2.423	0.120	0.126
Kotzebue	2.272	0.110	0.110	3.922	0.185	0.185
Los Angeles	2.443	0.227	0.227	3.737	0.081	0.189
Memphis	1.355	0.057	0.120	2.547	0.096	0.148
Merida	1.721	0.097	0.129	4.195	0.118	0.118
Mexico City	2.557	0.092	0.123	2.851	0.068	0.101
Miami	1.365	0.116	0.118	2.899	0.095	0.131
Minneapolis	3.545	0.324	0.324	3.548	0.176	0.176
New York	1.329	0.103	0.103	2.742	0.084	0.117
Oakland	1.748	0.088	0.116	3.143	0.068	0.130
Puerto Vallarta	2.957	0.096	0.123	4.969	0.125	0.131
Salt Lake City	2.271	0.099	0.140	3.075	0.122	0.137
San Jose Del Cabo	3.435	0.164	0.171	4.771	0.106	0.138
San Juan	3.739	0.100	0.111	5.859	0.184	0.184
Seattle	4.679	0.252	0.252	4.553	0.196	0.255
Tapachula	2.982	0.089	0.131	4.071	0.088	0.103
Washington DC	1.539	0.044	0.103	2.313	0.064	0.118
Winnipeg	1.673	0.131	0.137	2.474	0.125	0.132

Figure 2-1 95% Horizontal Accuracy at LPV

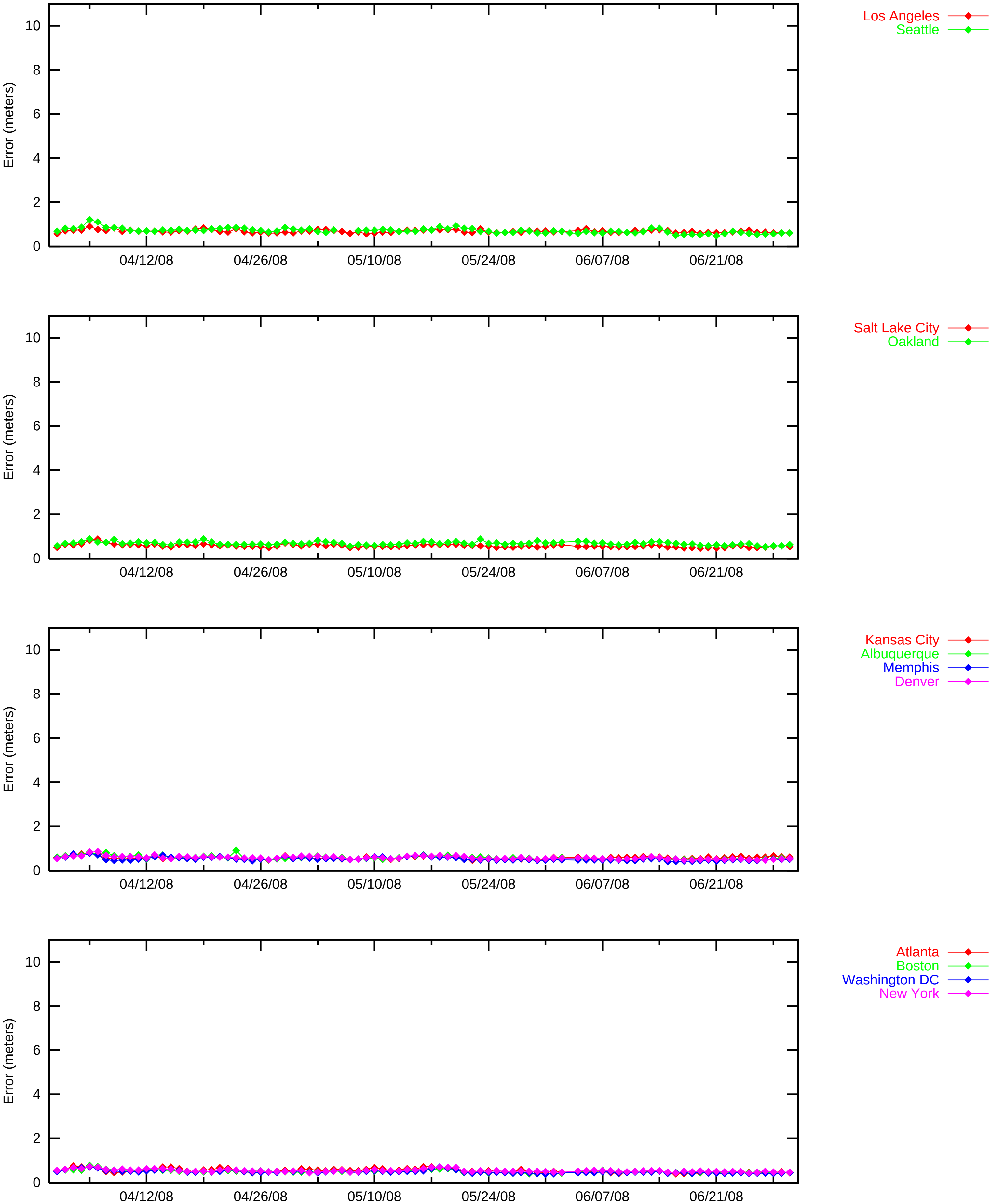


Figure 2-2 95% Horizontal Accuracy at LPV

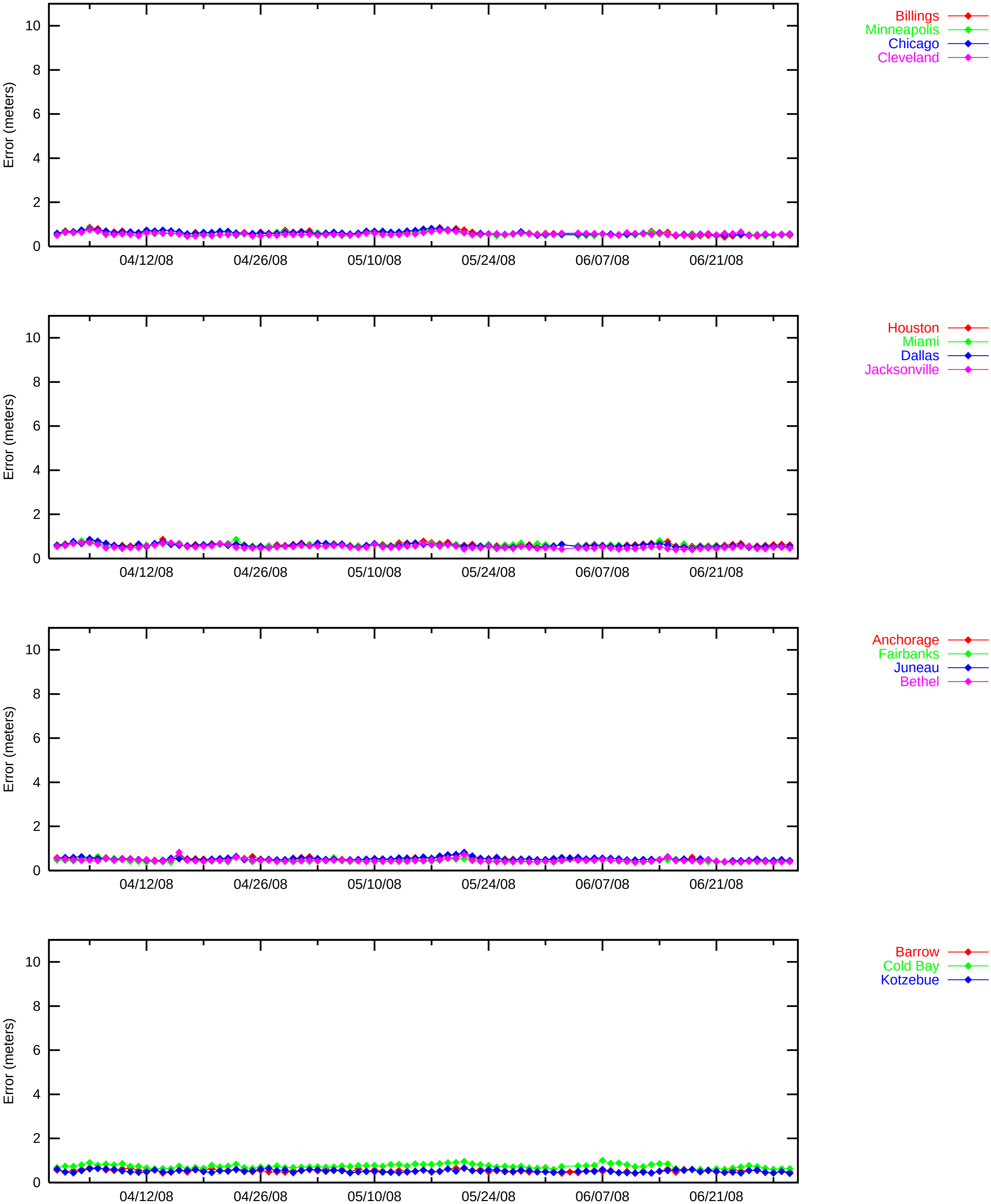


Figure 2-3 95% Horizontal Accuracy at LPV

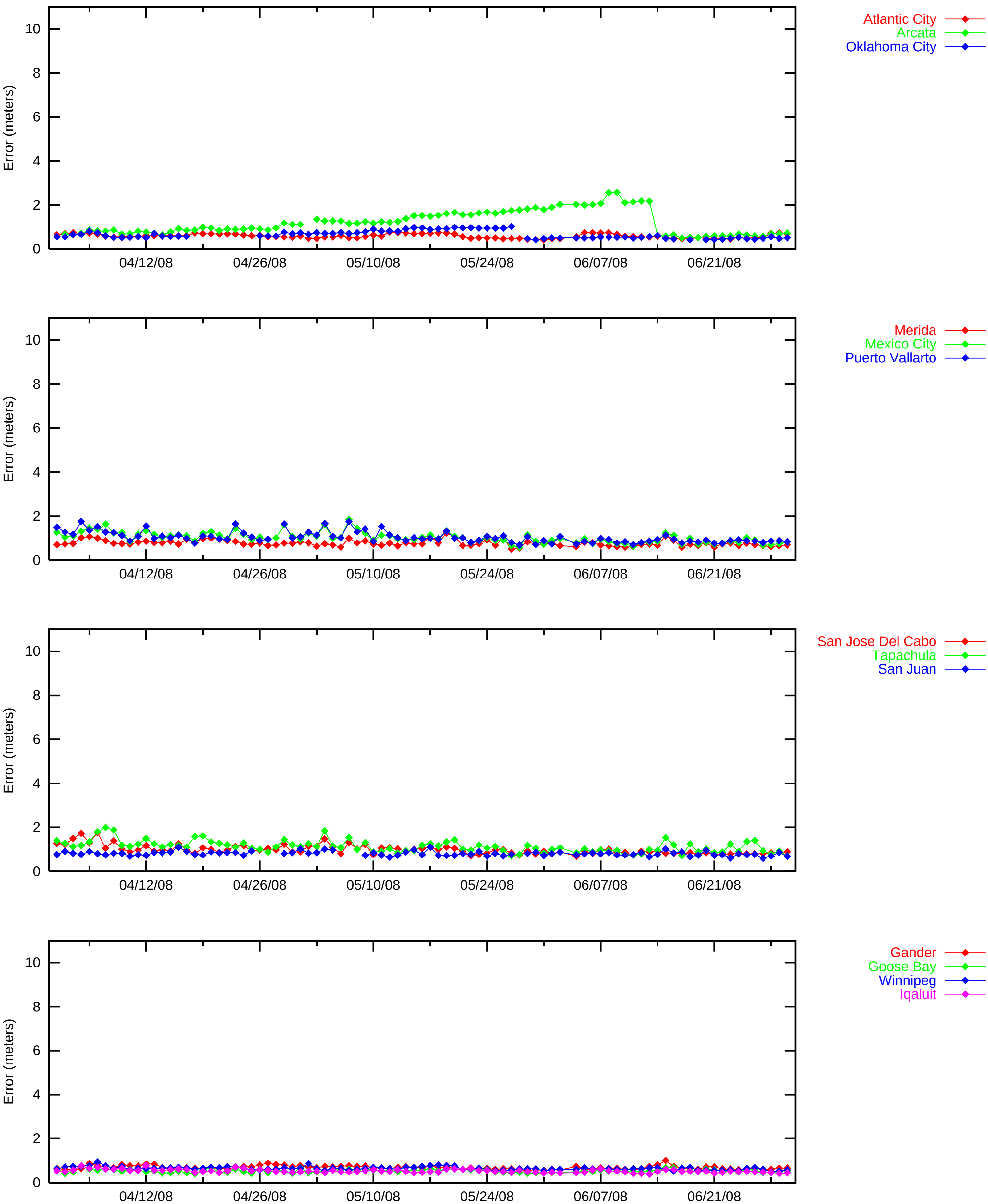


Figure 2-4 95% Vertical Accuracy at LPV

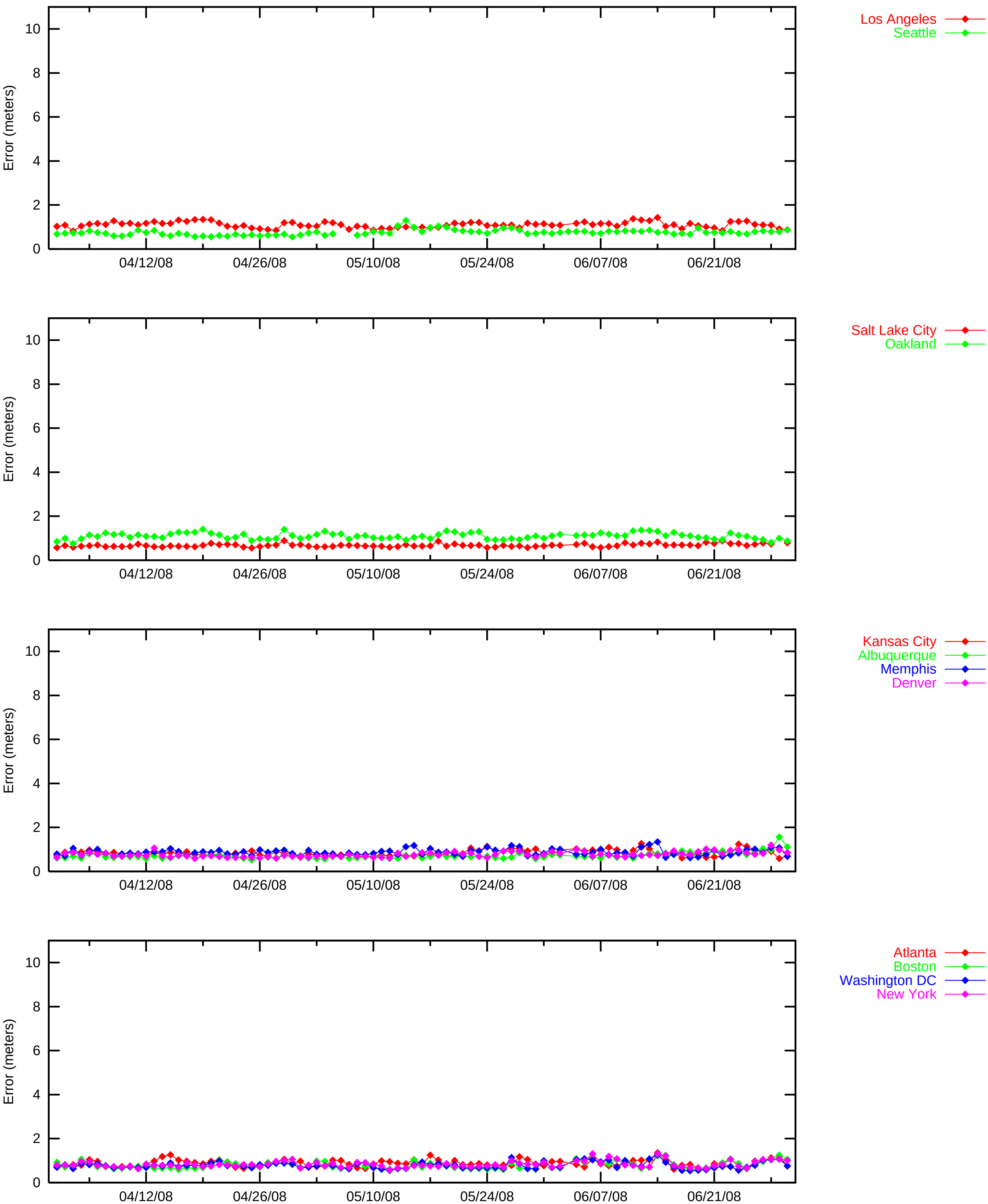


Figure 2-5 95% Vertical Accuracy at LPV

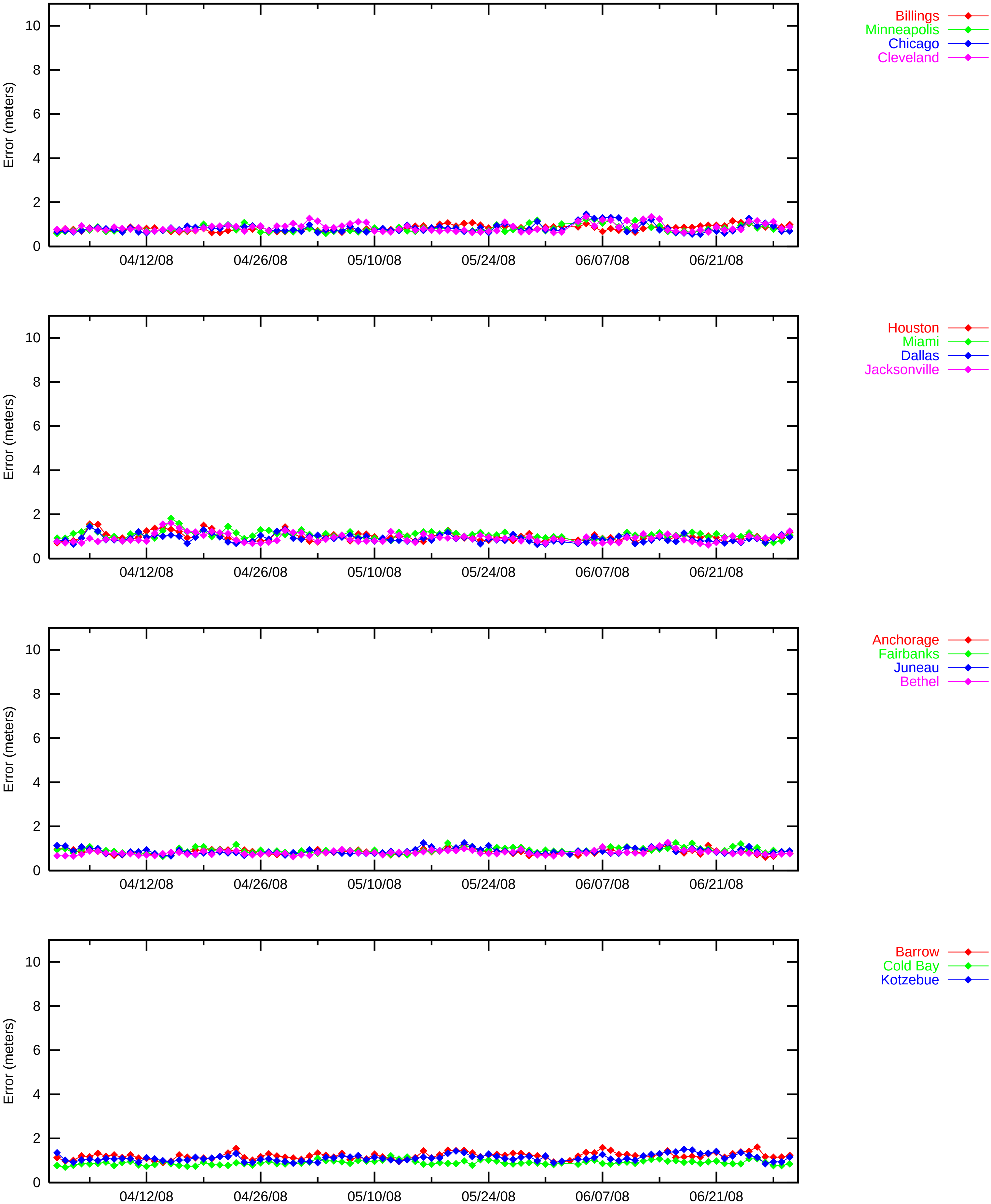


Figure 2-6 95% Vertical Accuracy at LPV

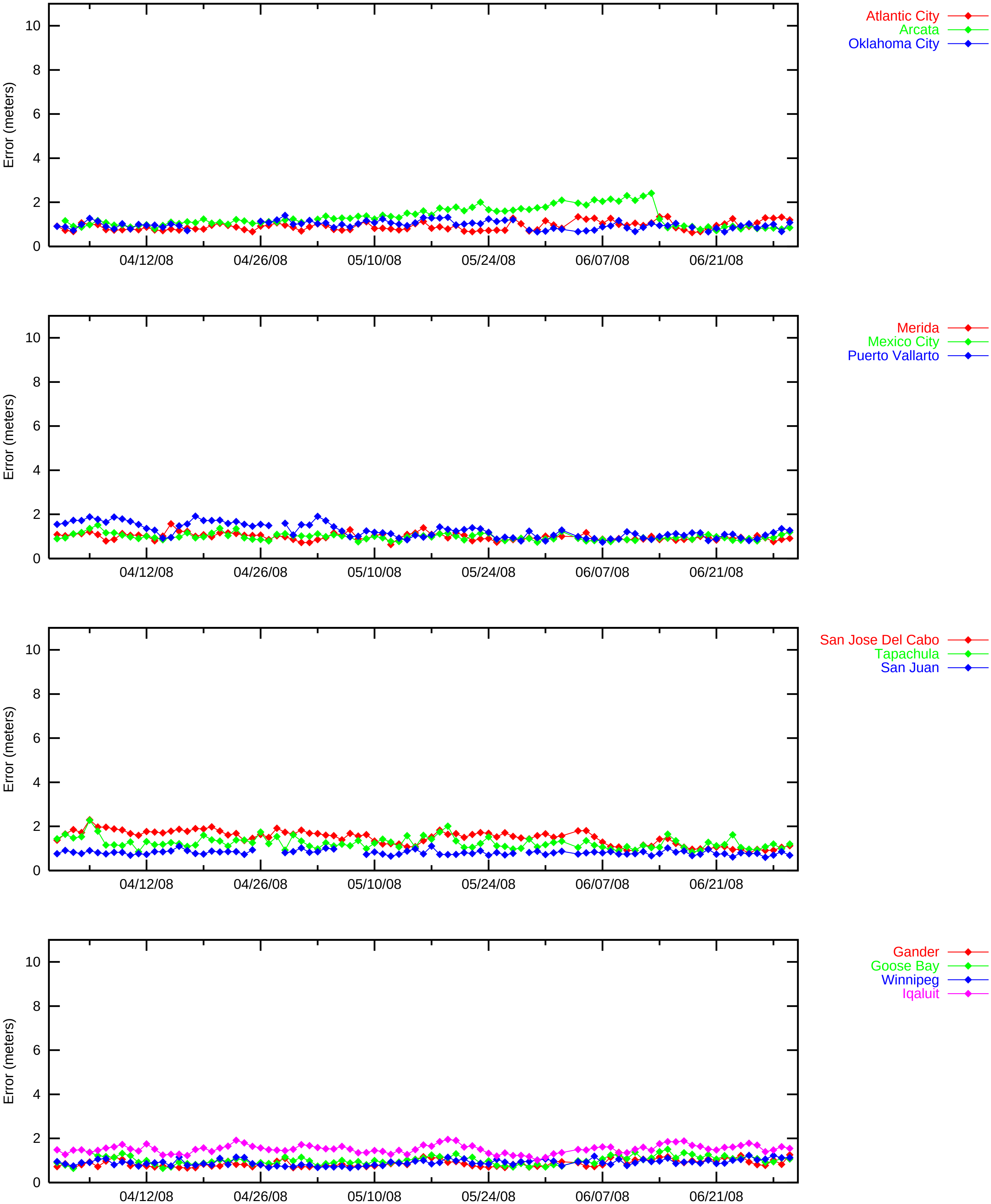
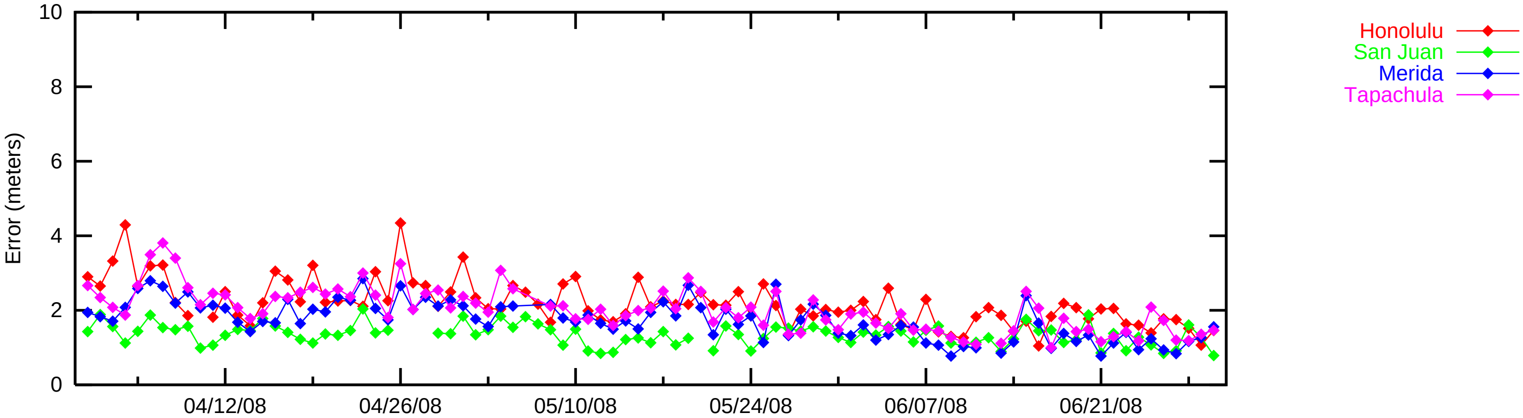
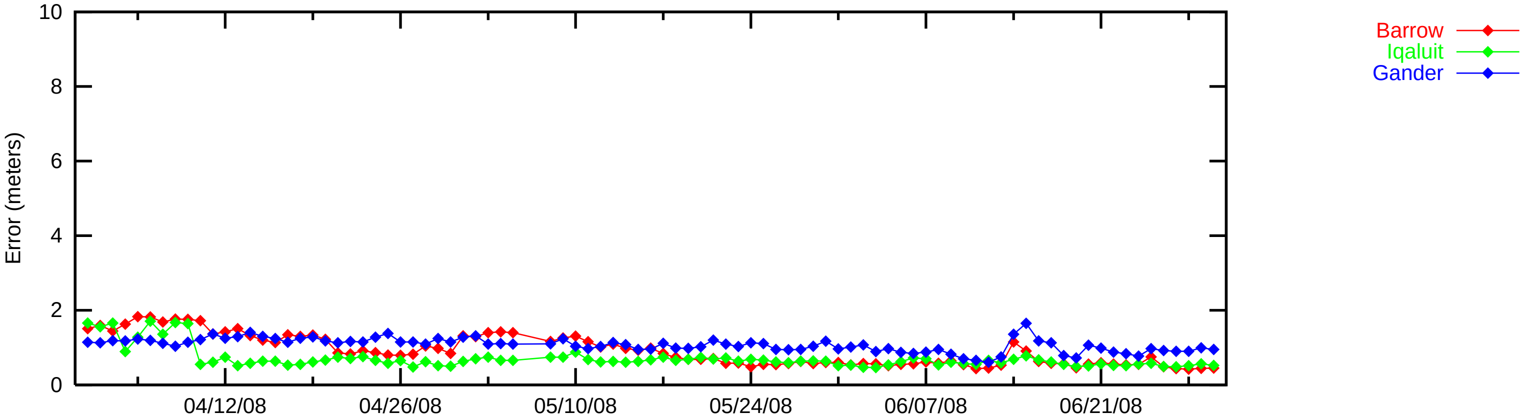
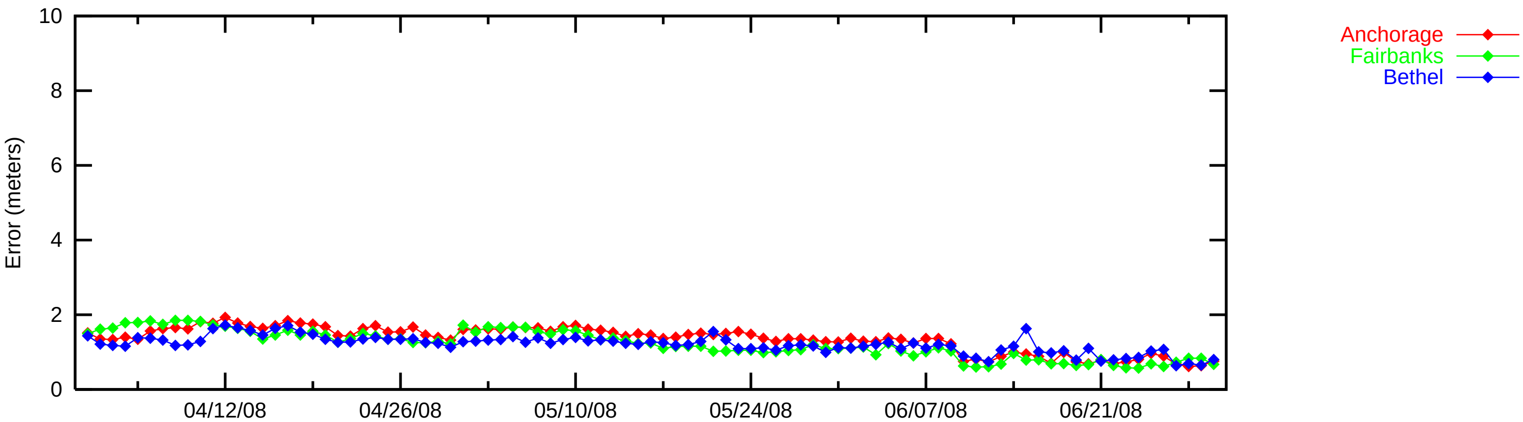


Figure 2-7 95% NPA Horizontal Accuracy







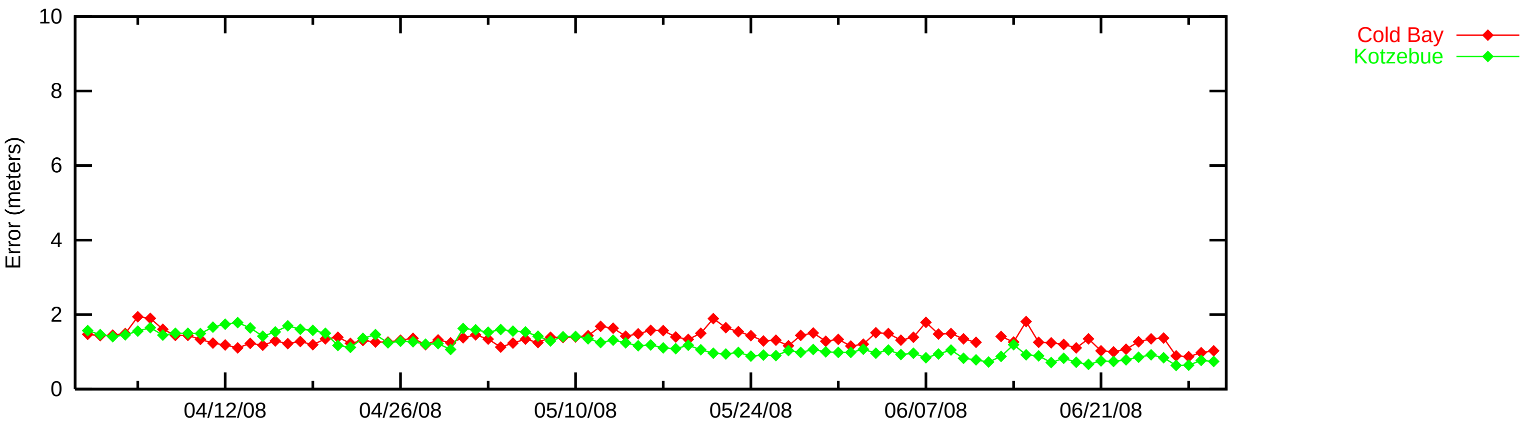


Figure 2-8 95% NPA Horizontal Accuracy

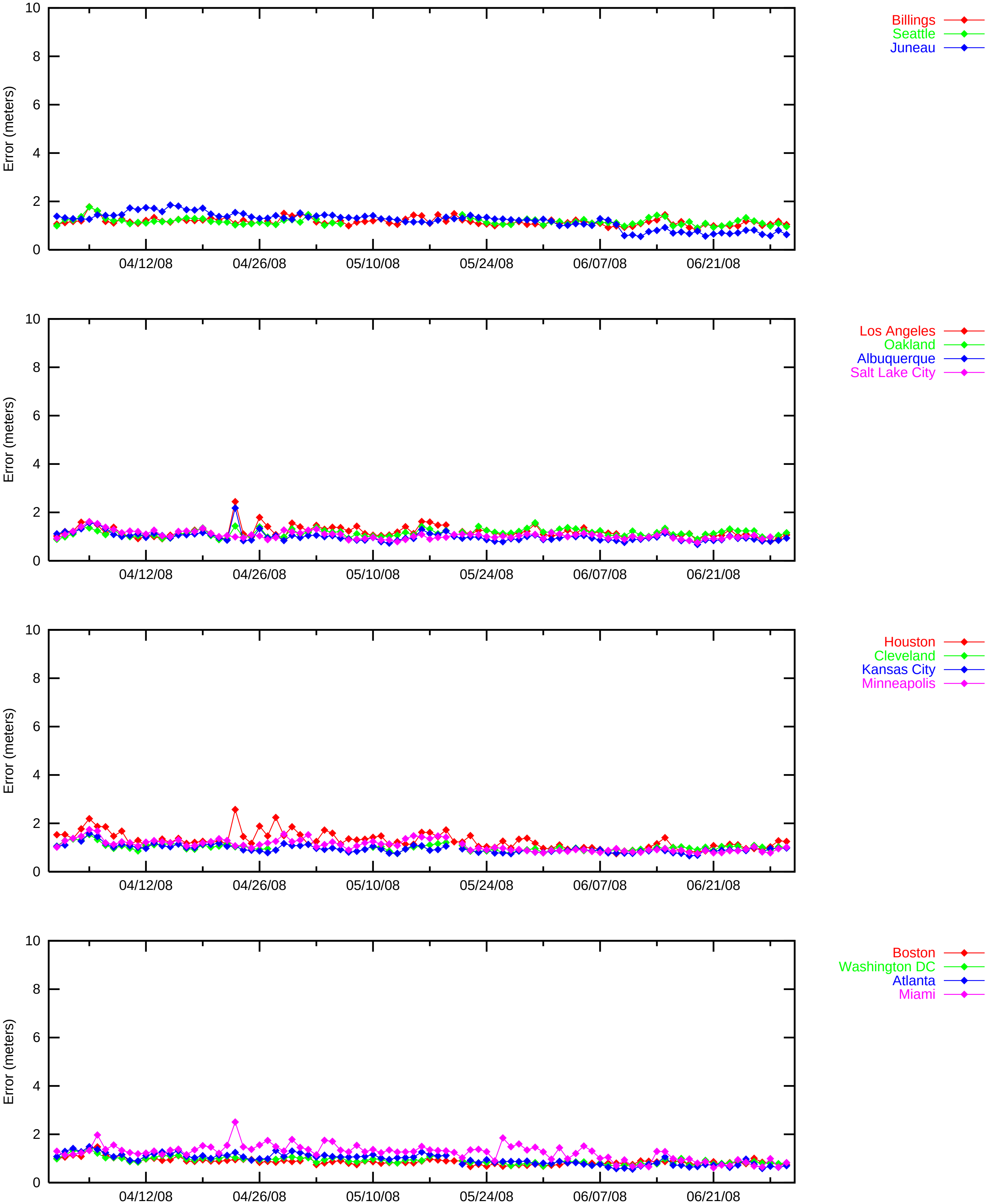


Figure 2-9 Horizontal Triangle Chart for Kansas City

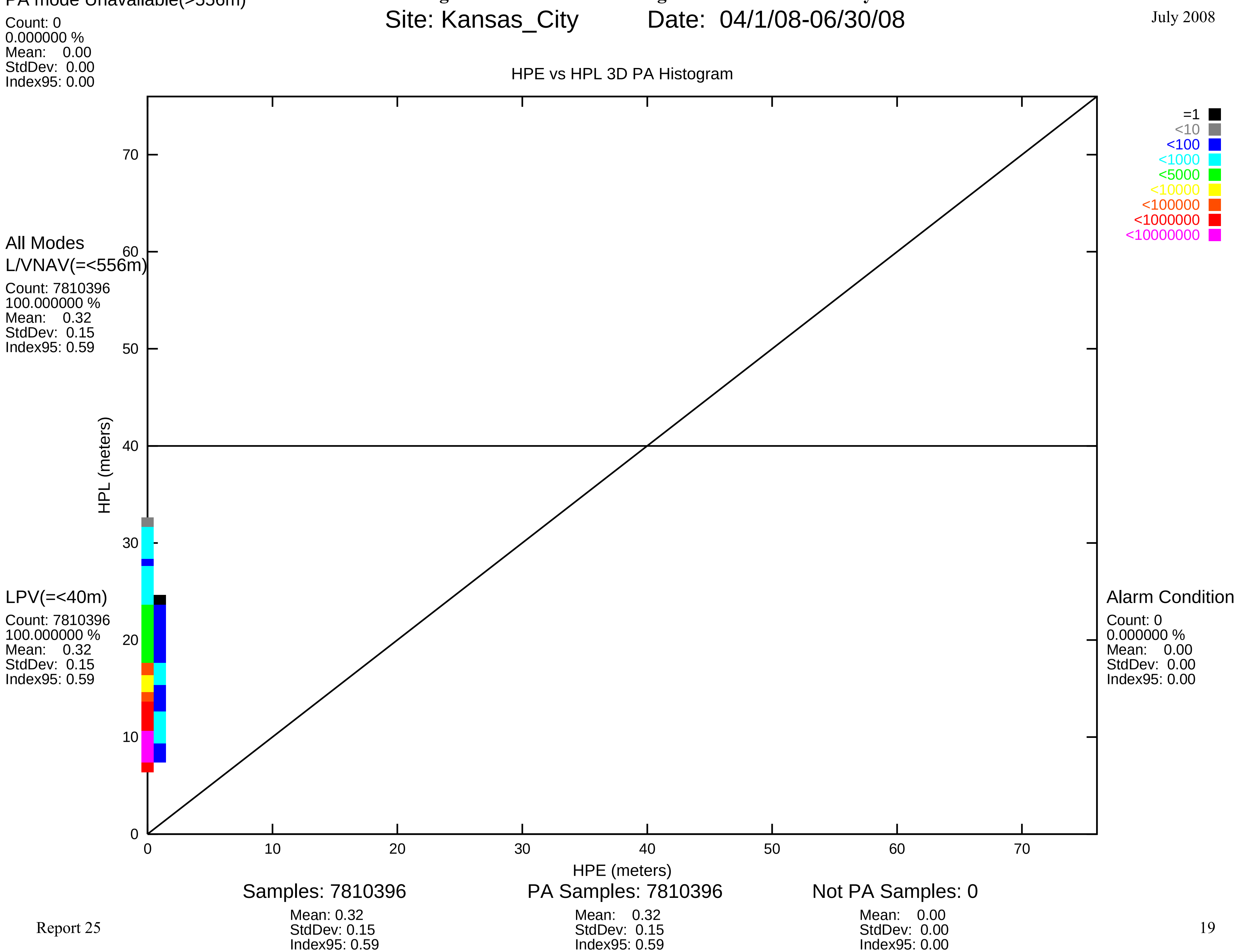


Figure 2-10 Vertical Triangle Chart for Kansas City

Site: Kansas_City Date: 04/1/08-06/30/08

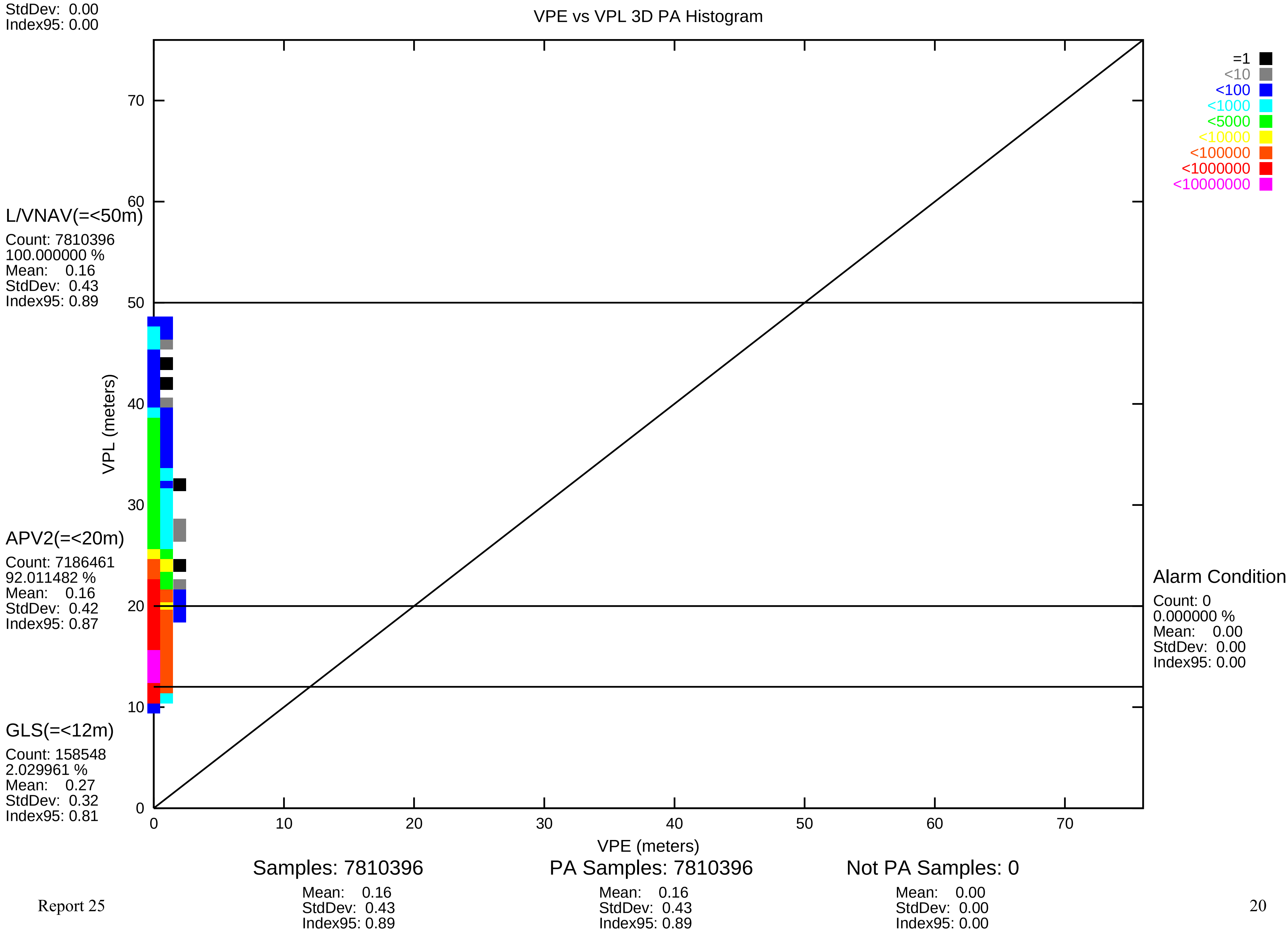


Figure 2-11 2-D Histogram for Kansas City

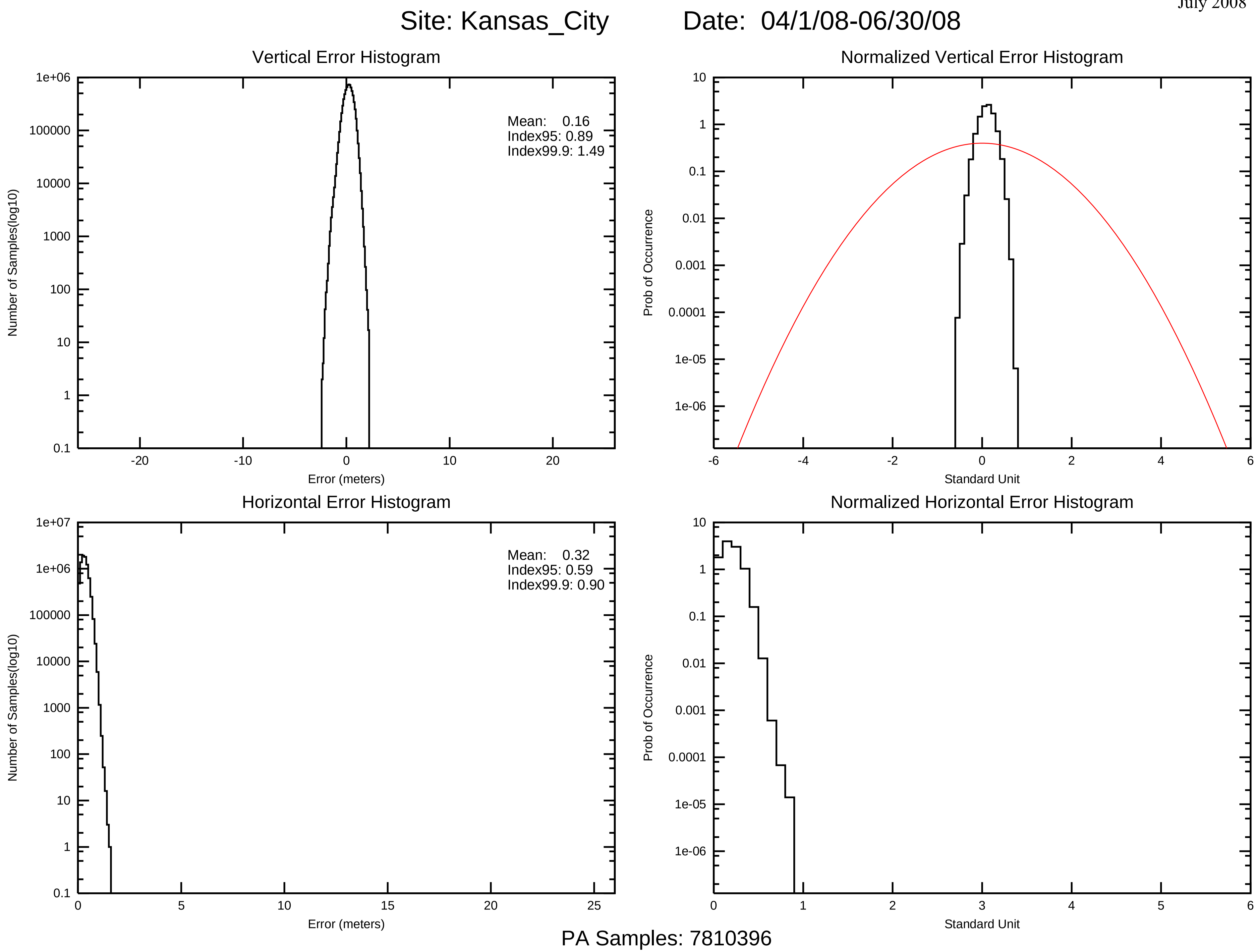


Figure 2-12 Horizontal Triangle Chart for Washington, DC

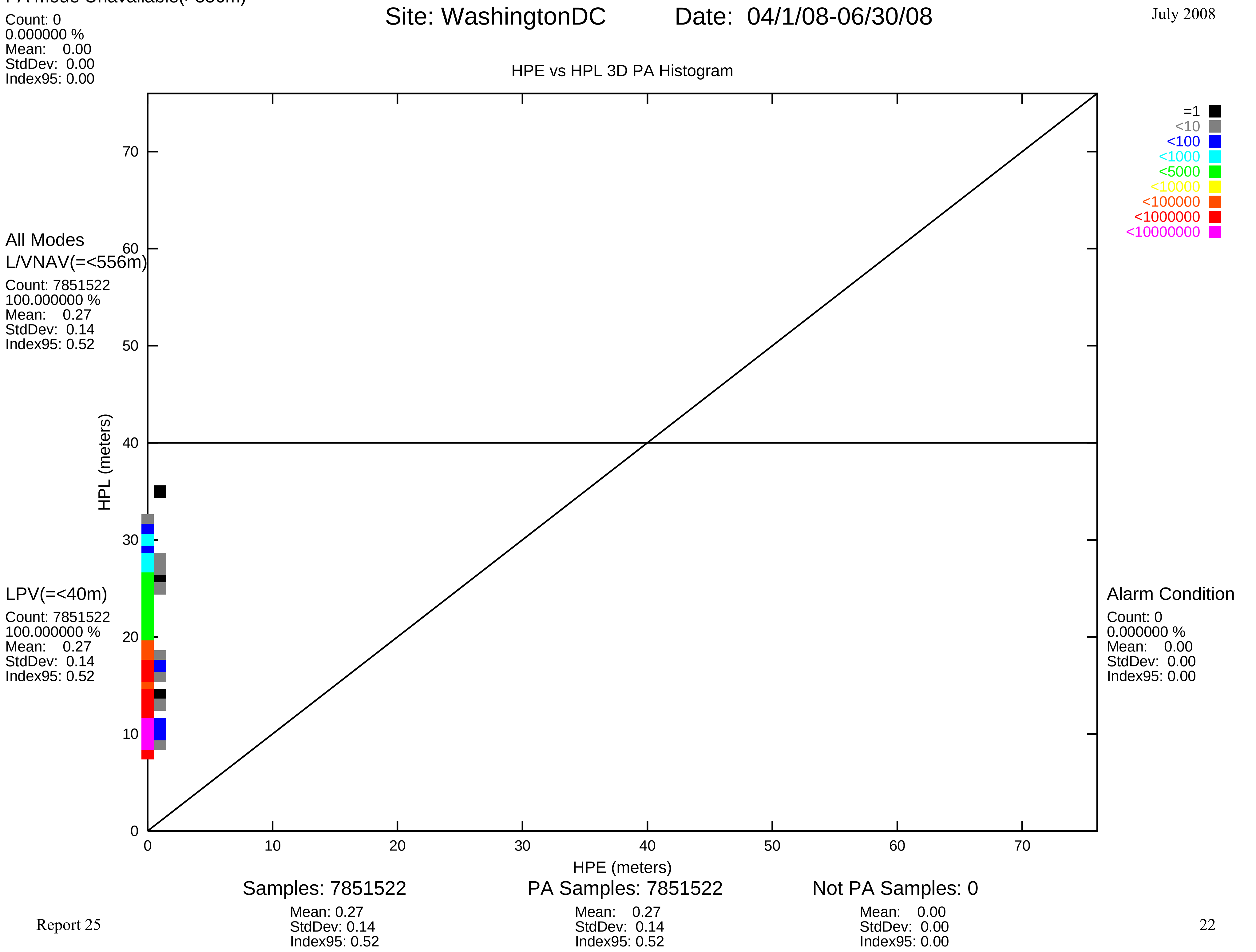


Figure 2-13 Vertical Triangle Chart for Washington, DC

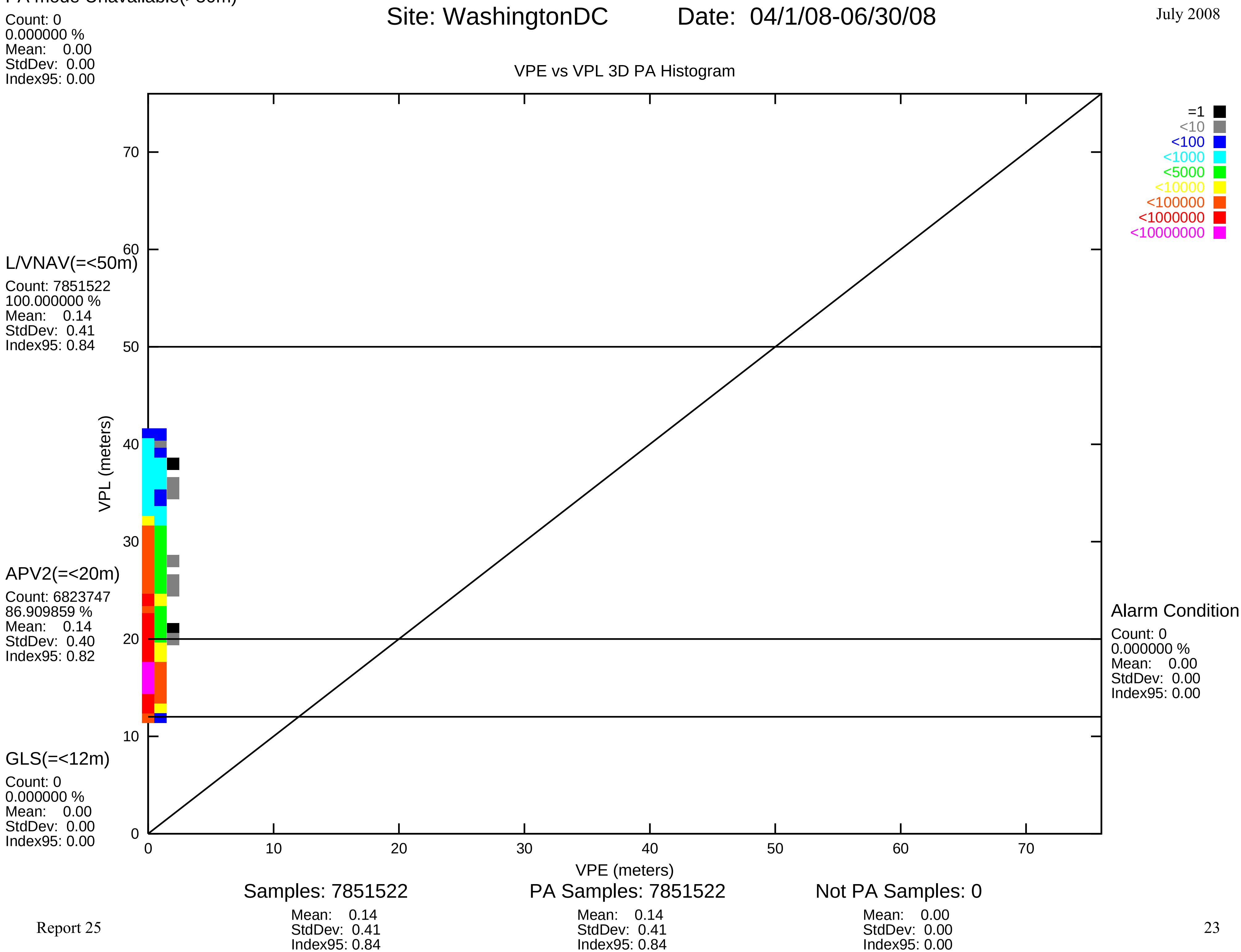


Figure 2-14 2-D Histogram for Washington, DC

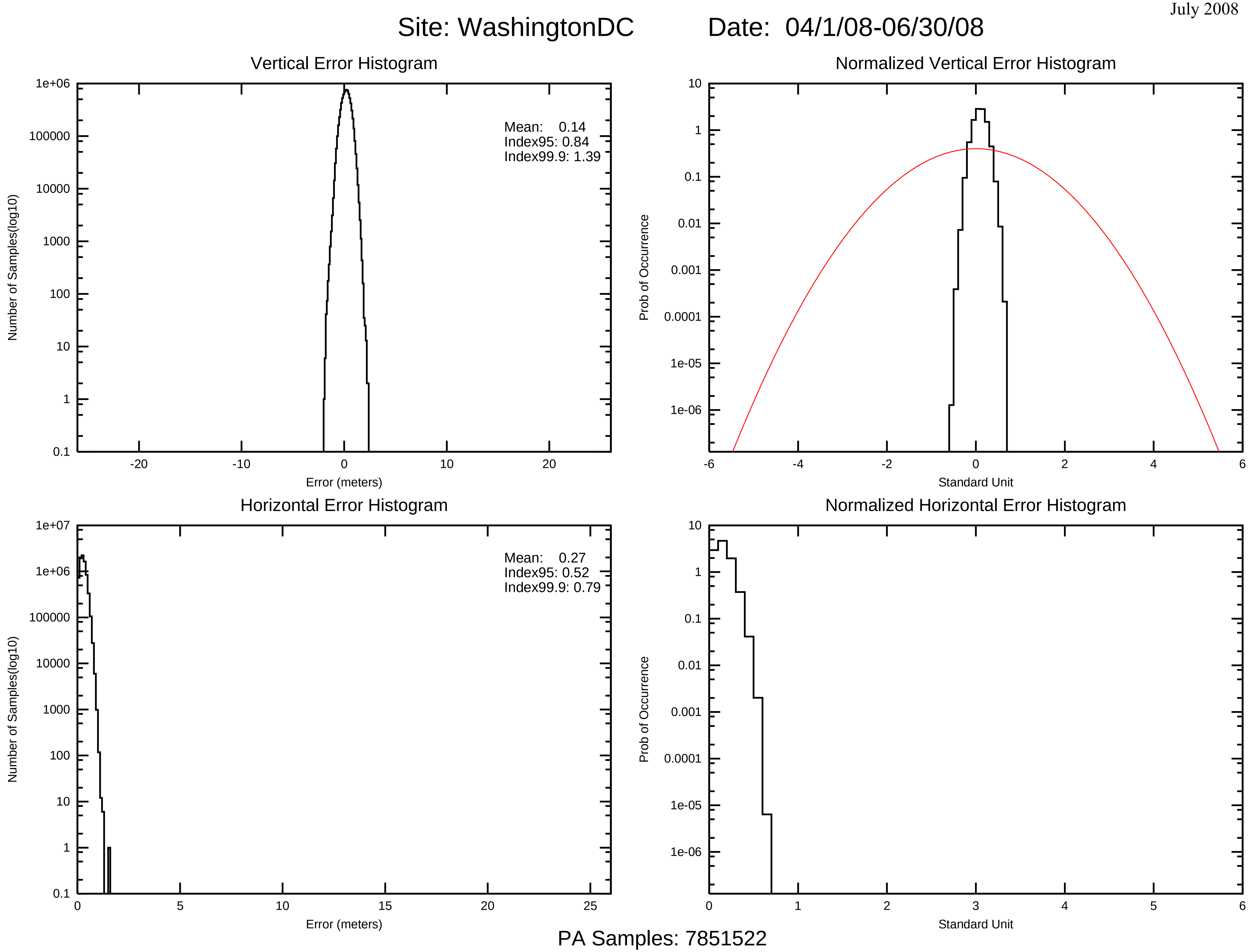


Figure 2-15 Horizontal Triangle Chart for Seattle

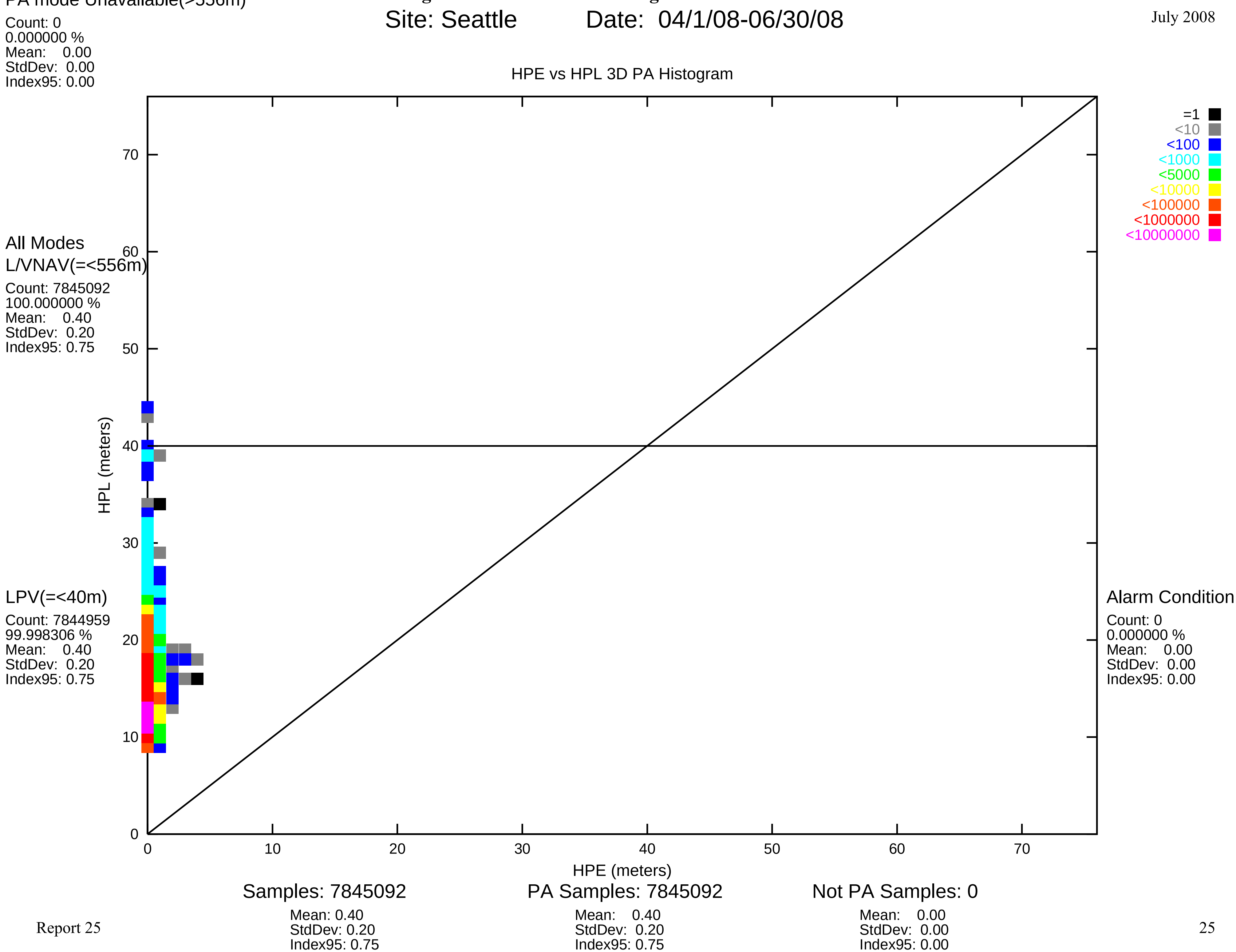


Figure 2-16 Vertical Triangle Chart for Seattle

Site: Seattle Date: 04/1/08-06/30/08

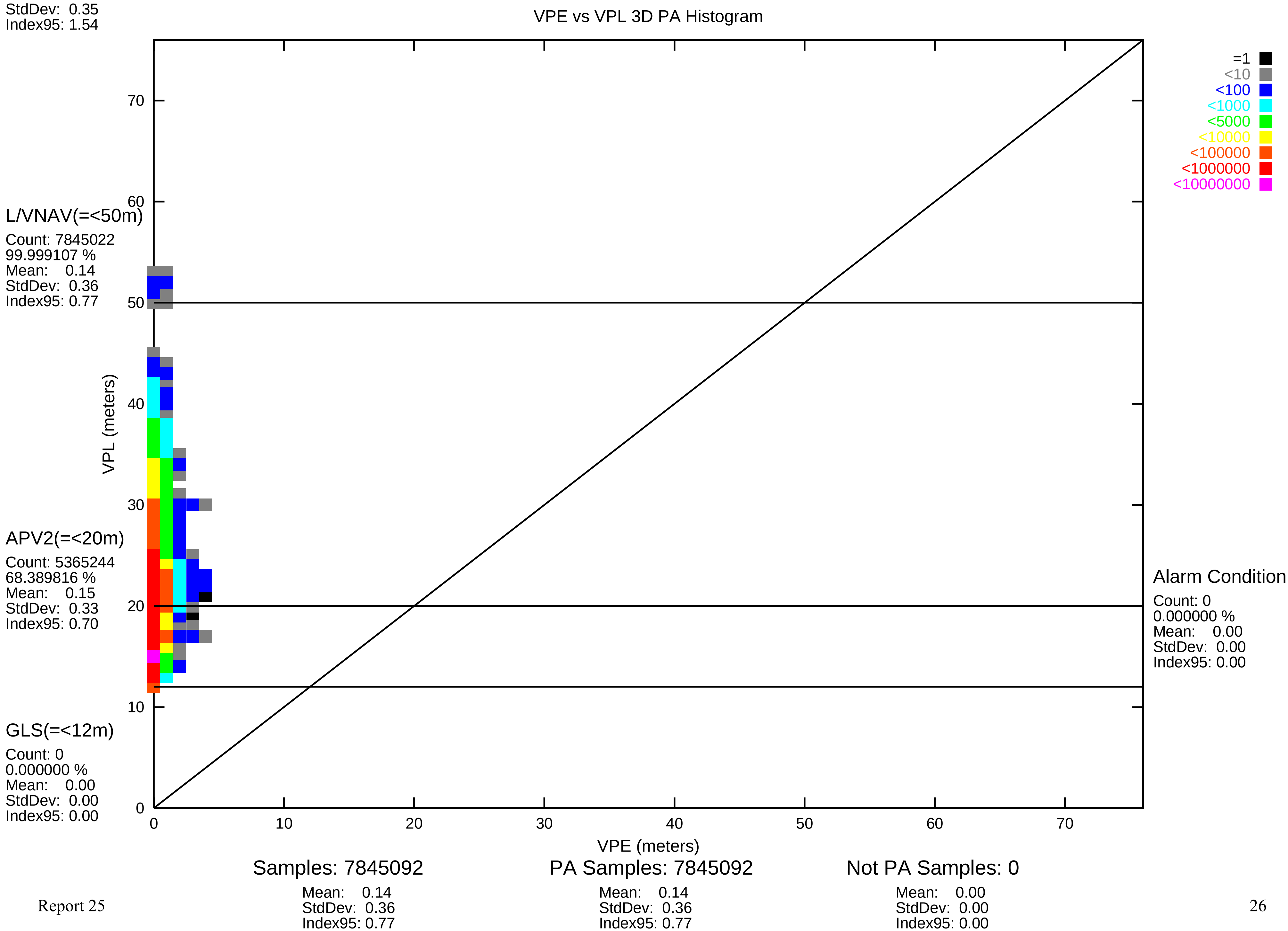
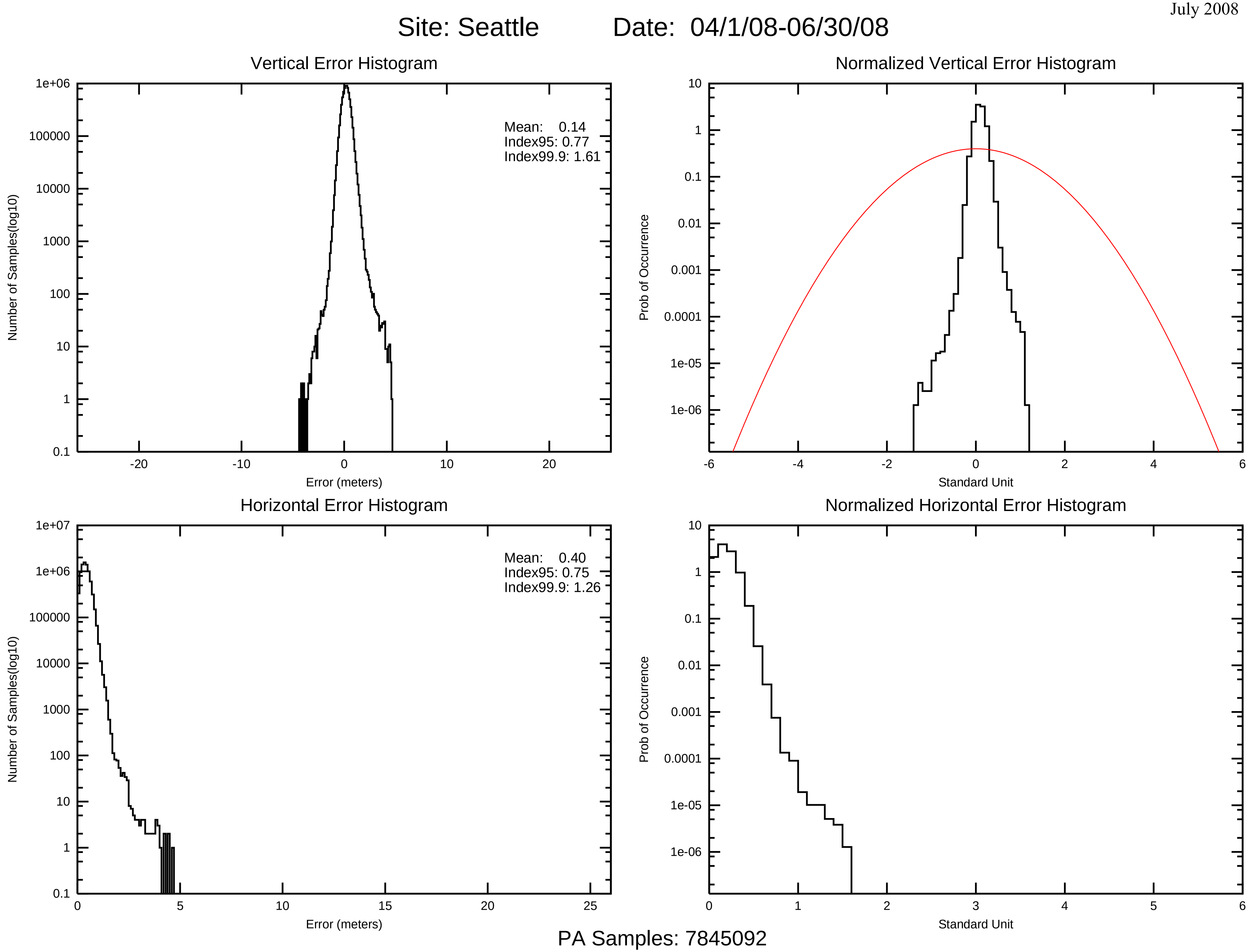


Figure 2-17 2-D Histogram for Seattle



3.0 AVAILABILITY

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

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

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

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	All Sites Site/Maximum	All Sites Site/Minimum
95% HPL	Arcata 20.471 meters	Memphis 12.26 meters	San Juan 51.85 meters	Memphis 12.26 meters
95% VPL	Oakland 33.837 meters	Minneapolis 20.70 meters	San Juan 80.46 meters	Chicago 20.513 meters

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

During this reporting period, satellite outages have caused the loss of LPV and NPA service (see DR#68 and DR#72). NPA outages at Iqaluit and Gander are mainly due to CRE GUS switchovers and NPA outages at Barrow and Kotzebue are due to CRE GUS switchovers.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	20.471	33.235	100
Atlantic City	15.638	24.936	100
Oklahoma City	12.865	22.215	100
Albuquerque	14.251	22.879	100
Anchorage	17.255	29.735	100
Atlanta	12.754	22.548	100
Chicago	13.534	20.513	100
Barrow	20.677	52.406	99.982680
Bethel	20.874	34.890	100
Billings	14.436	21.672	100
Boston	16.356	23.910	100
Cleveland	14.858	22.516	100
Cold Bay	31.861	45.635	100
Dallas	12.548	22.423	100
Denver	13.175	21.970	100
Fairbanks	16.372	31.076	100
Gander	25.092	36.745	99.977840
Goose Bay	20.619	29.066	99.978060
Houston	13.197	22.824	100
Iqaluit	24.247	38.829	99.983560
Jacksonville	14.207	26.454	100
Juneau	16.680	27.362	100
Kansas	12.823	21.217	100
Kotzebue	19.582	39.967	99.982960
Los Angeles	17.836	30.771	100
Memphis	12.260	21.090	100
Merida	21.197	34.532	100
Mexico City	29.424	46.915	100
Miami	16.523	29.864	100
Minneapolis	13.751	20.707	100
New York	15.607	23.477	100
Oakland	20.391	33.837	100
Puerto Vallarta	35.556	51.757	100
Salt Lake City	13.868	22.326	100
San Jose Del Cabo	31.847	45.144	100
San Juan	51.856	80.466	98.781670
Seattle	17.918	25.194	100
Tapachula	51.299	77.572	98.591130
Washington DC	14.755	23.901	100
Winnipeg	16.592	21.828	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	0.996869893	0.960736316
Atlantic City	1	0.998809603
Oklahoma City	0.99998426	0.999105941
Albuquerque	1	0.998881908
Anchorage	0.999399516	0.984151485
Atlanta	1	0.999698403
Chicago	0.999939555	0.998896565
Barrow	0.933226664	0.752501688
Bethel	0.993688375	0.936598617
Billings	1	0.999595373
Boston	1	0.99832905
Cleveland	0.999956304	0.999183667
Cold Bay	0.965826838	0.724918811
Dallas	0.999967741	0.998951
Denver	1	0.999314218
Fairbanks	0.999193167	0.973026712
Gander	0.992879442	0.903821085
Goose Bay	0.998422067	0.99003406
Houston	0.999897295	0.99875174
Iqaluit	0.983251532	0.901636907
Jacksonville	1	0.999471778
Juneau	0.99995342	0.986862135
Kansas	1	0.998952095
Kotzebue	0.971397533	0.890960594
Los Angeles	0.999862182	0.983766211
Memphis	0.999984583	0.999009094
Merida	0.99777291	0.942178415
Mexico City	0.956015478	0.746345293
Miami	1	0.987663105
Minneapolis	0.999931789	0.998582364
New York	1	0.999052772
Oakland	0.998374977	0.955122378
Puerto Vallarta	0.8912569	0.583127922
Salt Lake City	0.999999872	0.999781541
San Jose Del Cabo	0.954349431	0.696413803
San Juan	0.568942194	0.15800978
Seattle	0.999971232	0.998000552
Tapachula	0.411941003	0.050973725
Washington DC	1	0.999470315
Winnipeg	0.999895144	0.999203575

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	1.00
Anchorage	1.00
Atlanta	1.00
Barrow	0.99992686
Bethel	1.00
Billings	1.00
Boston	1.00
Cleveland	1.00
Cold Bay	1.00
Fairbanks	1.00
Gander	0.99988896
Honolulu	0.99983413
Houston	1.00
Iqaluit	0.99992827
Juneau	1.00
Kansas City	1.00
Kotzebue	0.99992004
Los Angeles	1.00
Merida	1.00
Miami	1.00
Minneapolis	1.00
Oakland	1.00
Puerto Rico	1.00
Salt Lake City	1.00
San Jose Del Cabo	1.00
Seattle	1.00
Tapachula	0.99999987
Washington DC	1.00

Table 3-4 LPV and LPV 200 Outage Rate

Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	81	0.001568	449	0.009020
Atlantic City	0	0.000000	46	0.000880
Oklahoma City	2	0.000043	10	0.000215
Albuquerque	0	0.000000	14	0.000269
Anchorage	3	0.000058	193	0.003761
Atlanta	0	0.000000	7	0.000134
Chicago	1	0.000019	8	0.000153
Barrow	489	0.010077	1076	0.027499
Bethel	88	0.001696	437	0.008937
Billings	0	0.000000	9	0.000172
Boston	0	0.000000	66	0.001264
Cleveland	1	0.000019	11	0.000210
Cold Bay	330	0.006696	1060	0.028657
Dallas	1	0.000019	15	0.000287
Denver	0	0.000000	10	0.000191
Fairbanks	11	0.000211	364	0.007183
Gander	66	0.001274	622	0.013194
Goose Bay	38	0.000738	118	0.002312
Houston	1	0.000019	11	0.000211
Iqaluit	190	0.003703	767	0.016300
Jacksonville	0	0.000000	8	0.000153
Juneau	5	0.000096	140	0.002723
Kansas	0	0.000000	11	0.000212
Kotzebue	335	0.006604	871	0.018719
Los Angeles	11	0.000210	295	0.005735
Memphis	1	0.000019	9	0.000172
Merida	24	0.000461	520	0.010573
Mexico City	373	0.007463	1087	0.027860
Miami	0	0.000000	100	0.001936
Minneapolis	1	0.000019	9	0.000172
New York	0	0.000000	48	0.000918
Oakland	41	0.000786	494	0.009903
Puerto Vallarta	402	0.008828	977	0.032791
Salt Lake City	1	0.000019	9	0.000173
San Jose Del Cabo	244	0.004900	909	0.025015
San Juan	1169	0.042327	604	0.078746
Seattle	3	0.000059	51	0.000998
Tapachula	1151	0.053753	349	0.131717
Washington DC	0	0.000000	9	0.000172
Winnipeg	2	0.000038	6	0.000115

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Atlanta	0	0
Barrow	8	0.00015759
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	7	0.00013751
Honolulu	4	0.00007764
Houston	0	0
Iqaluit	6	0.00011781
Juneau	0	0
Kansas City	0	0
Kotzbue	8	0.00015354
Los Angeles	0	0
Merida	0	0
Miami	0	0
Minneapolis	0	0
Oakland	0	0
San Juan	0	0
Salt Lake City	0	0
San Jose Del Cabo	0	0
Seattle	0	0
Tapachula	1	0.00001965
Washington DC	0	0

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

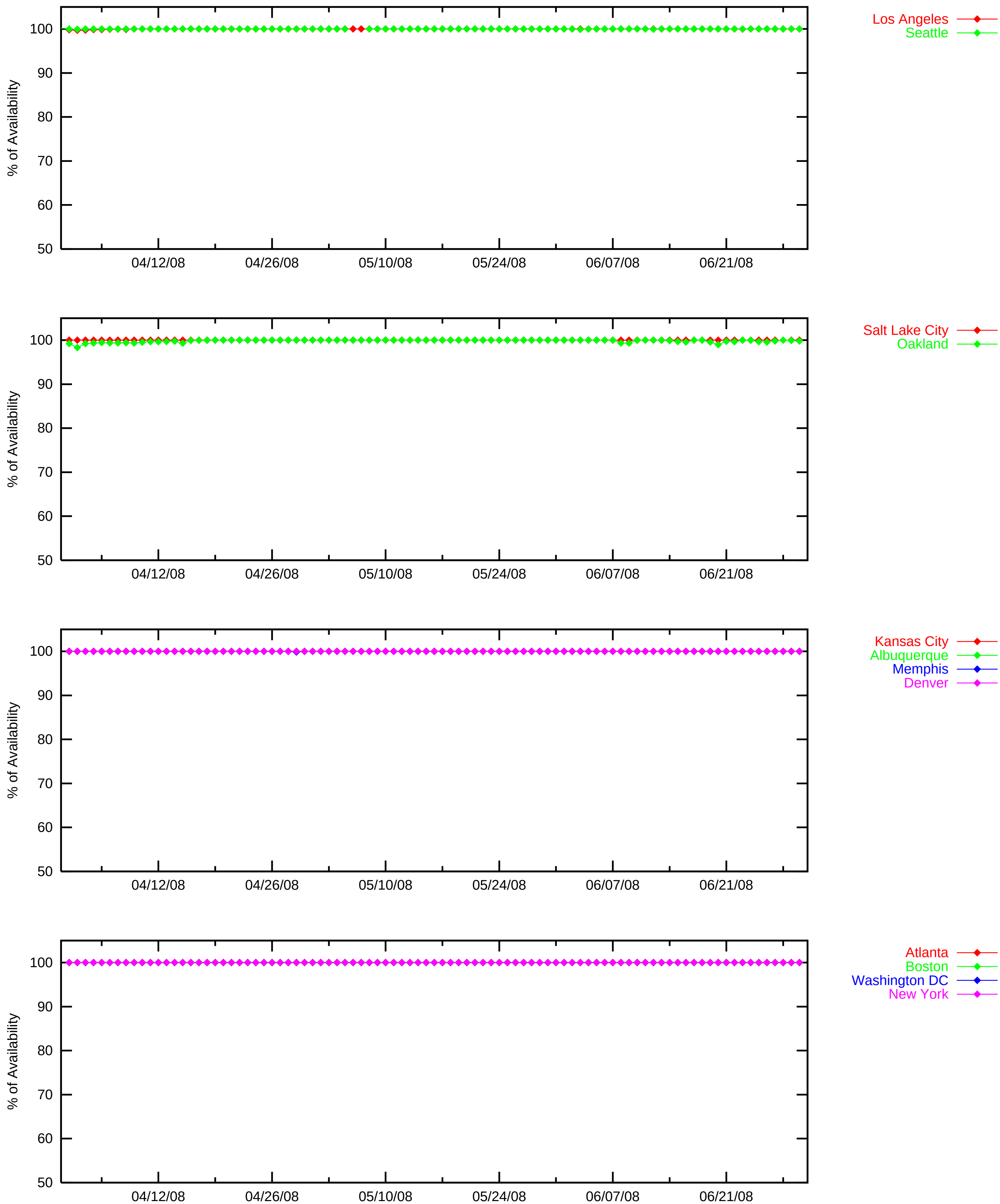
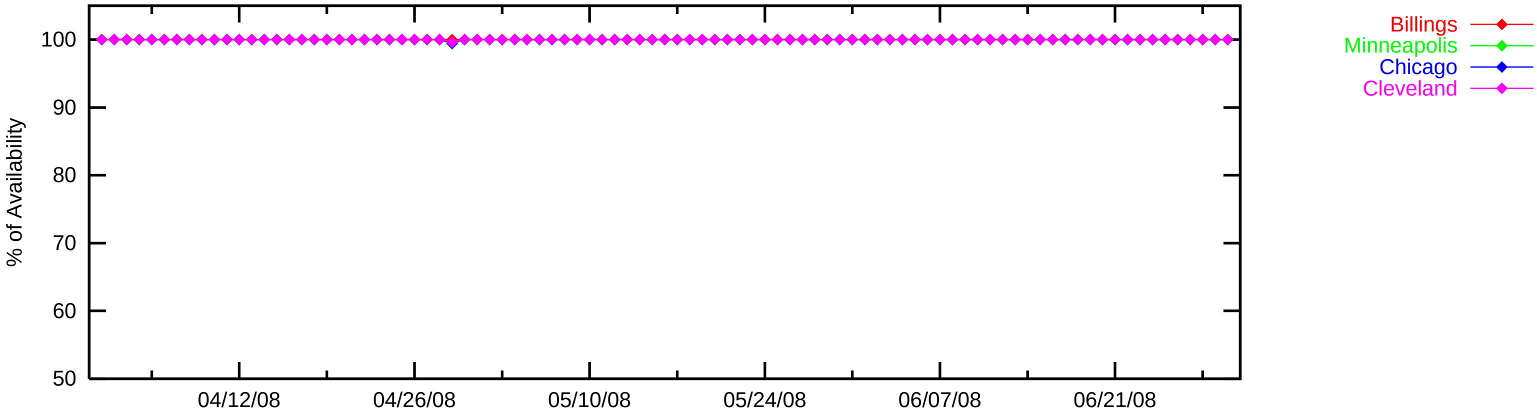
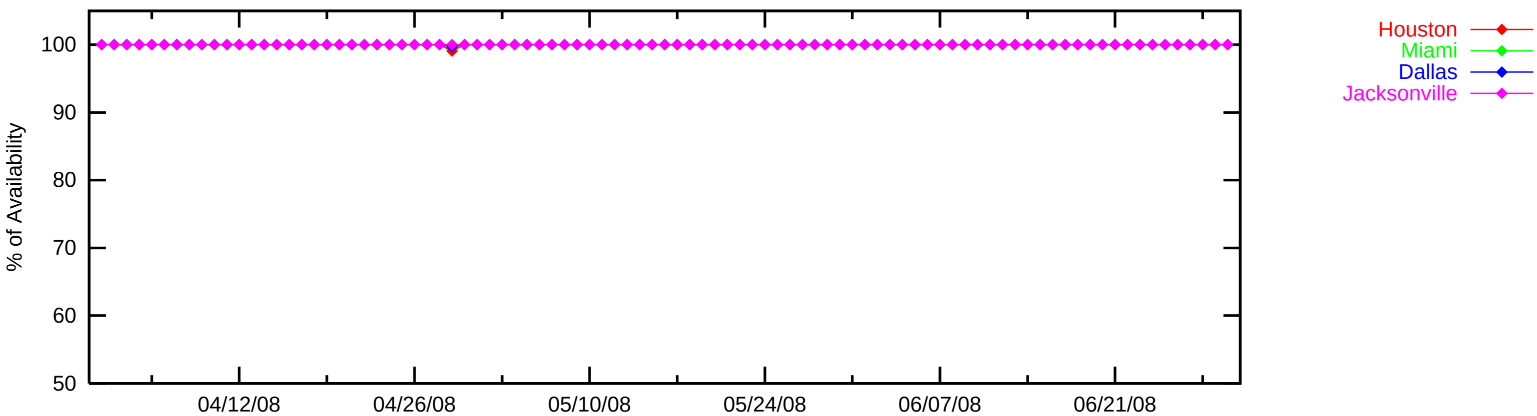
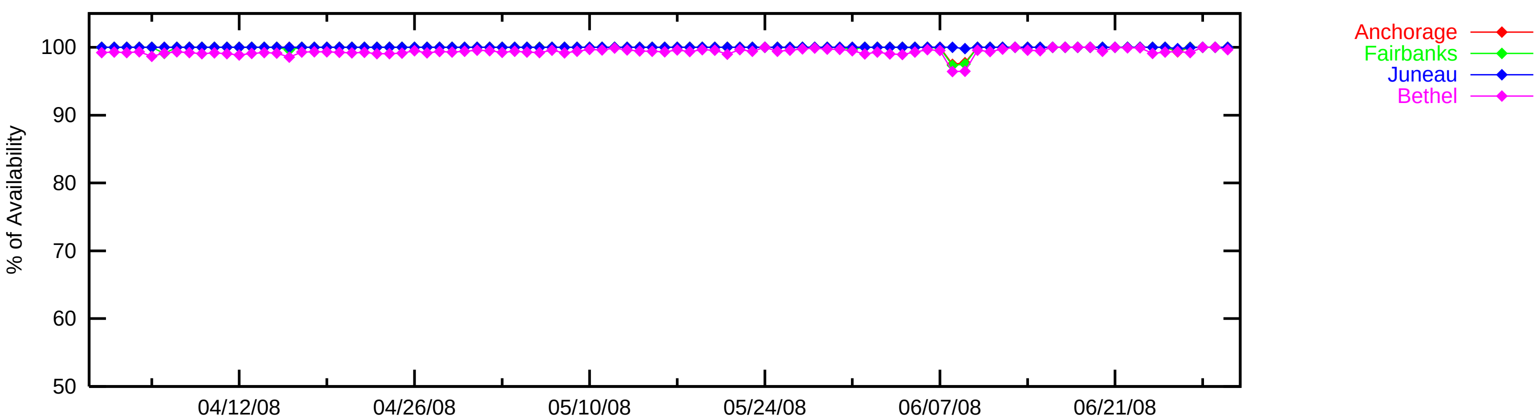


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)







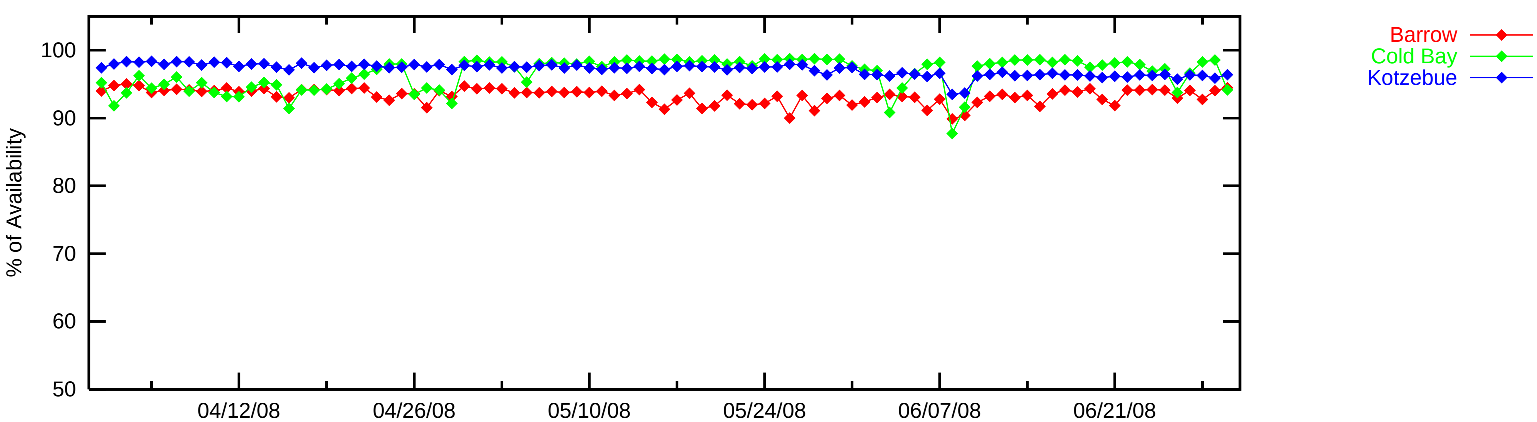


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

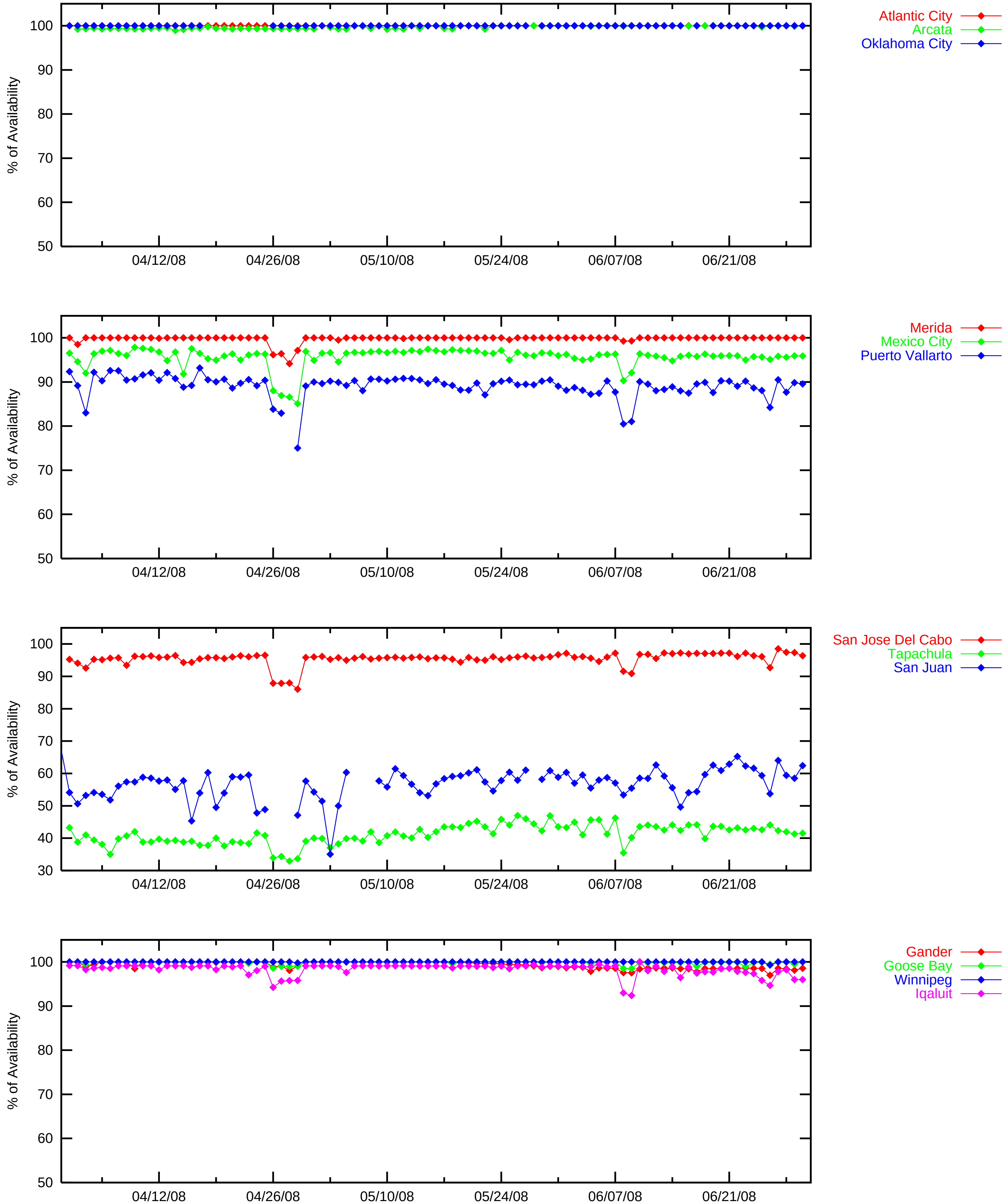


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

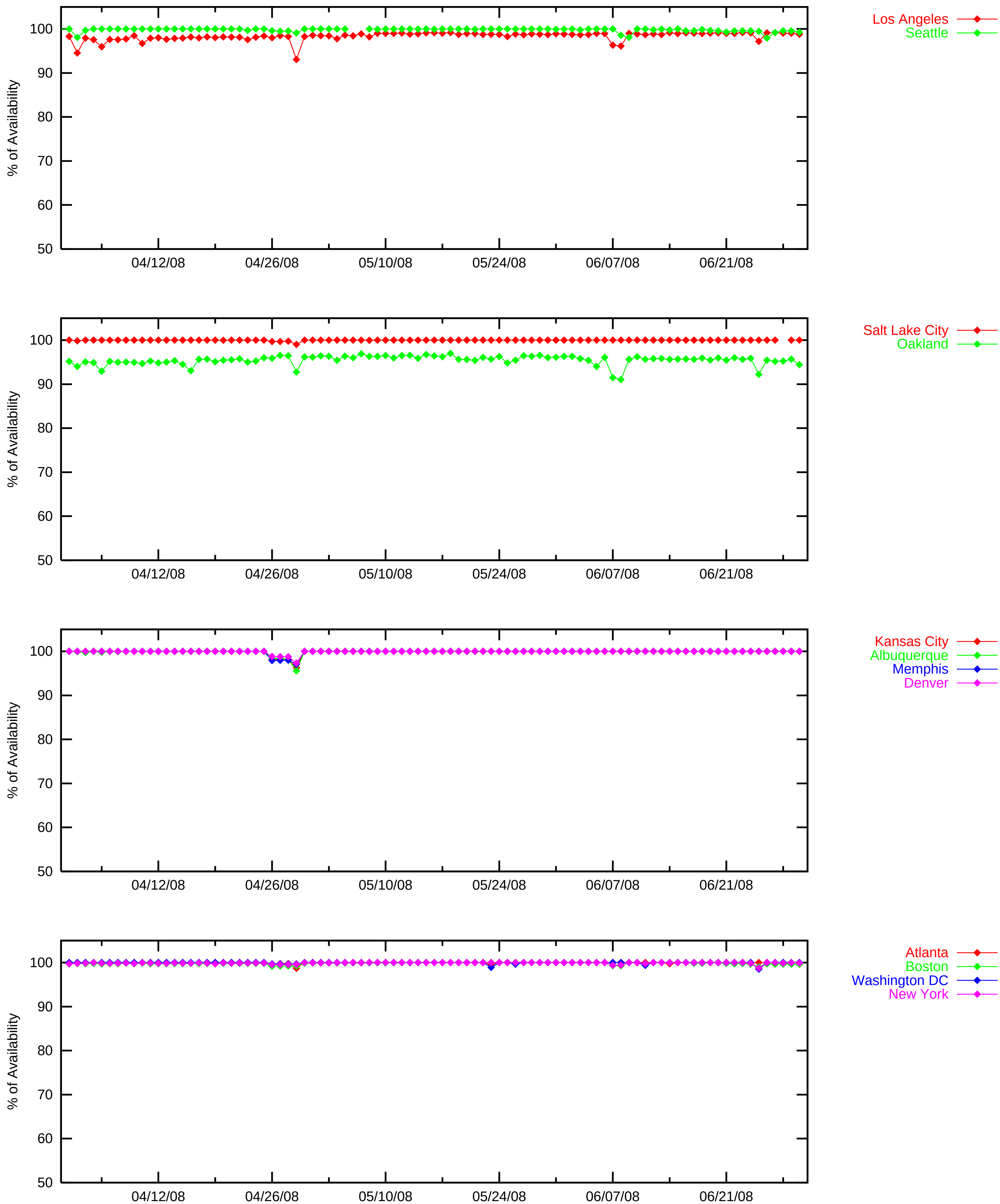


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

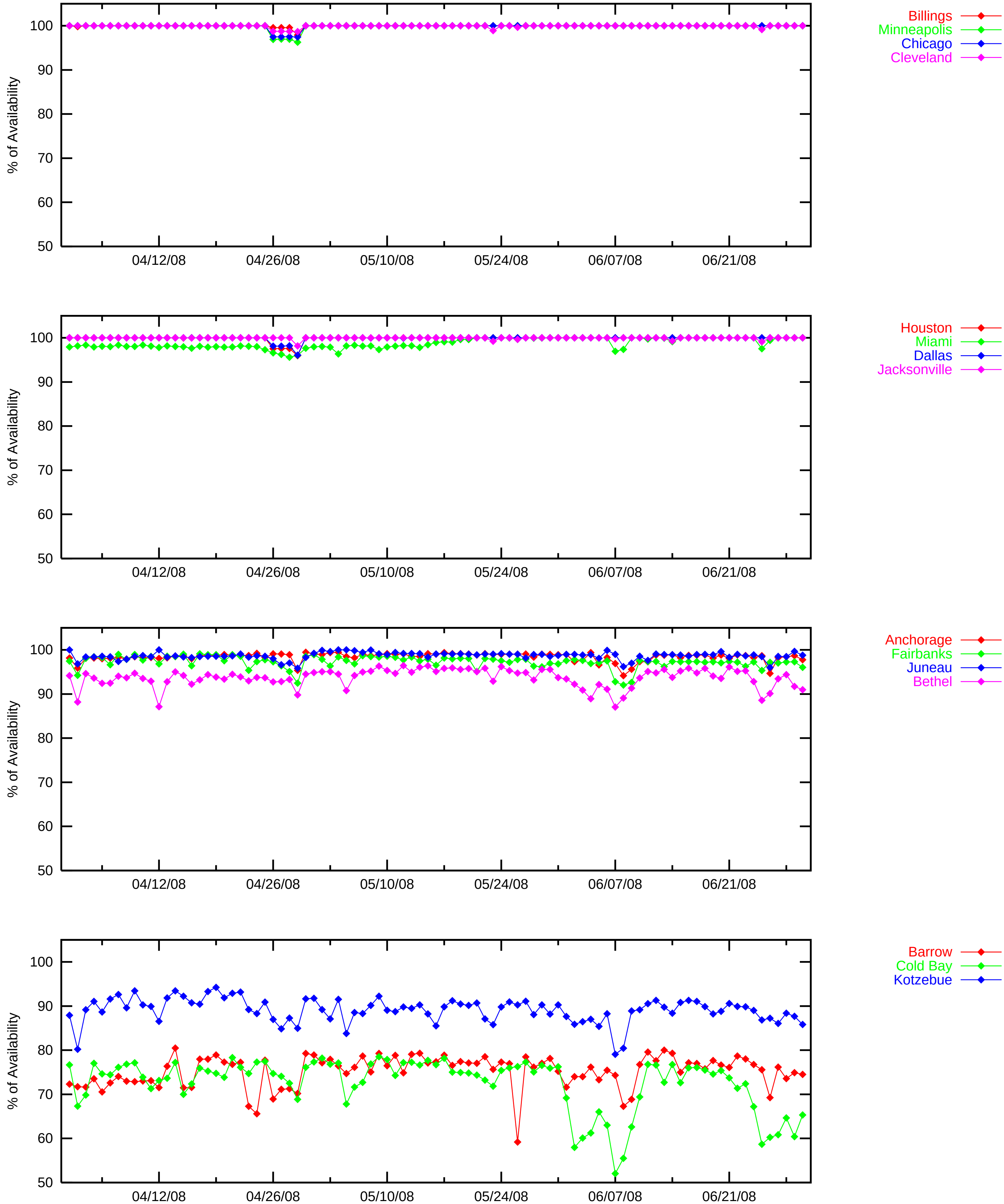


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

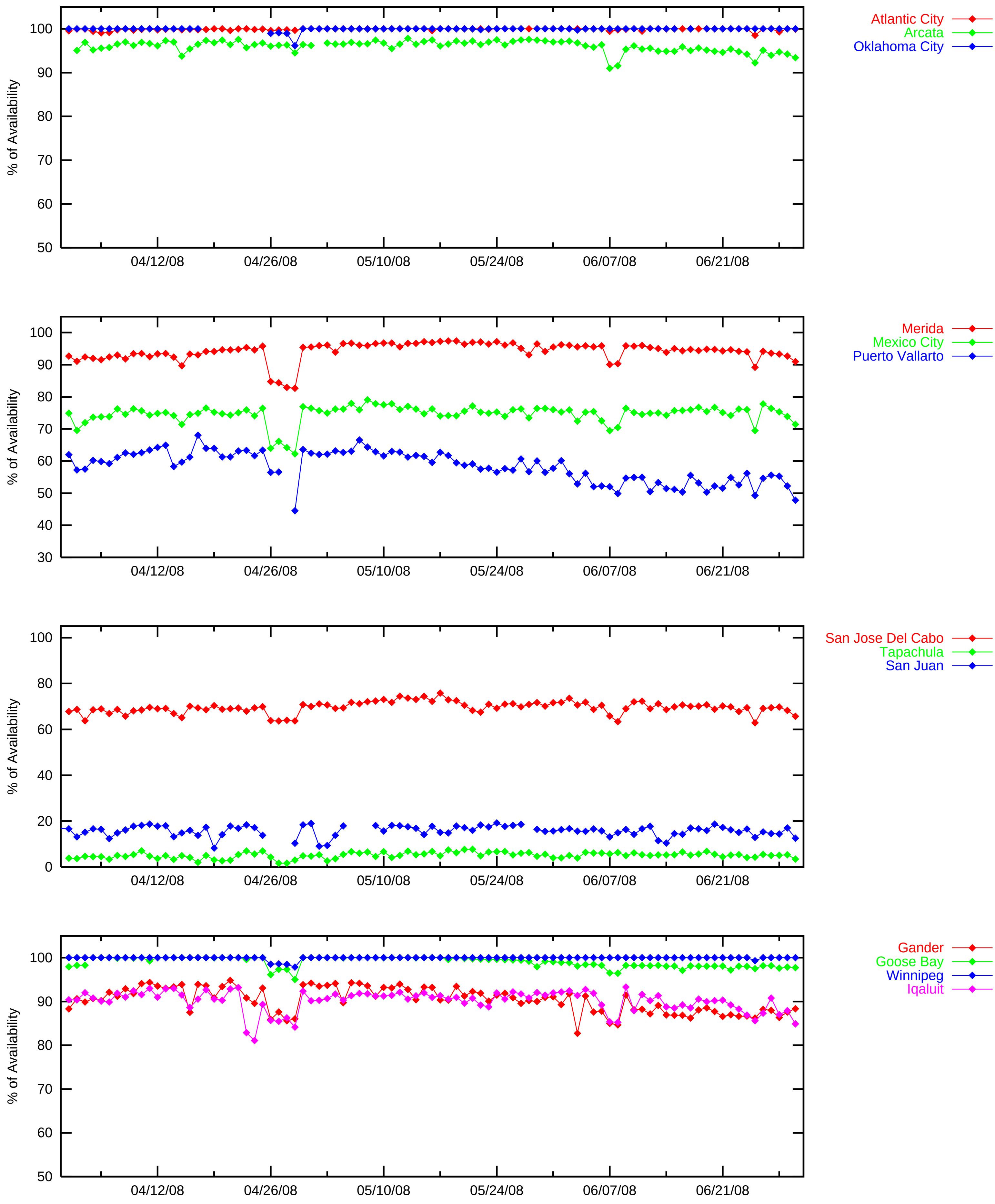


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

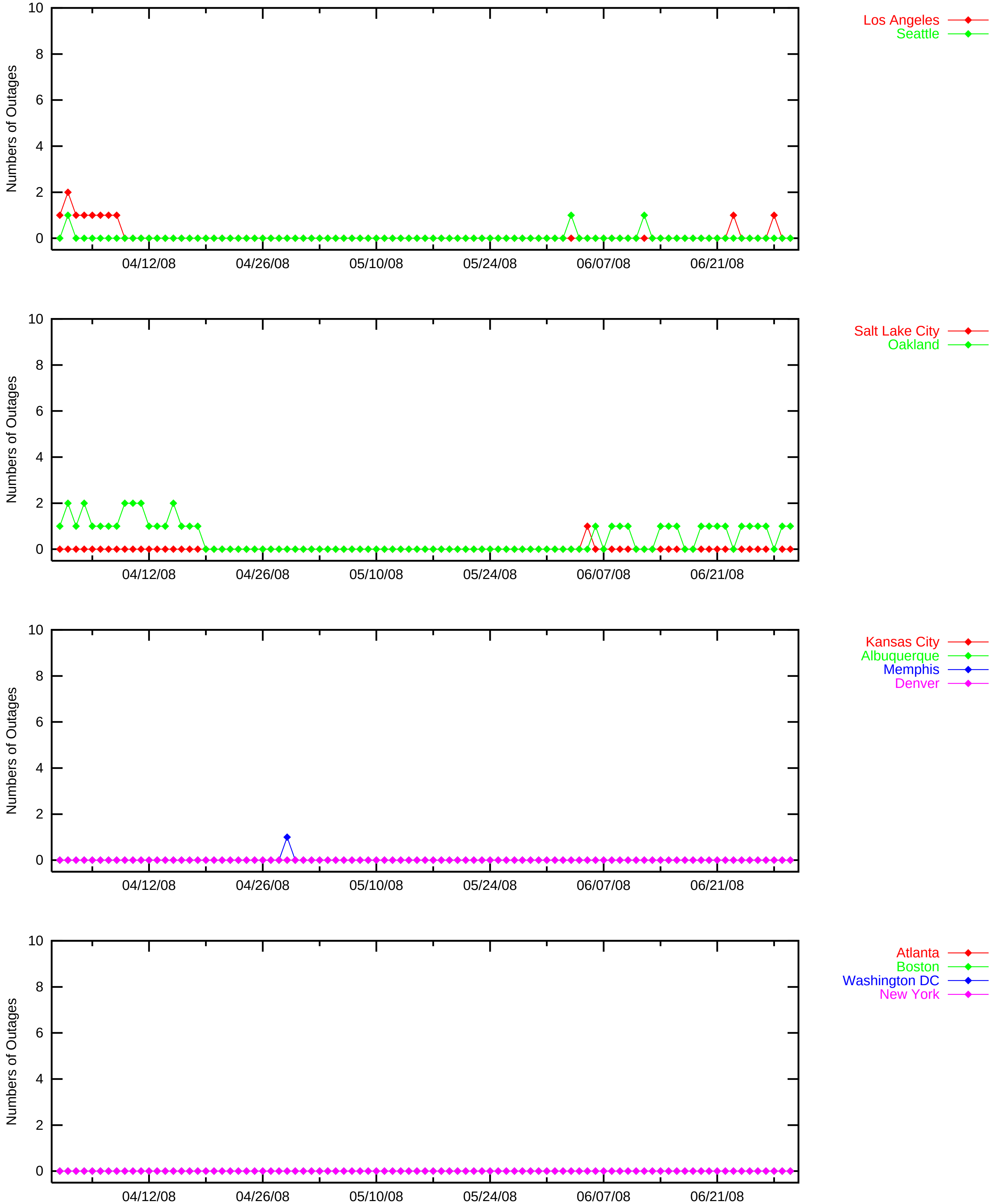
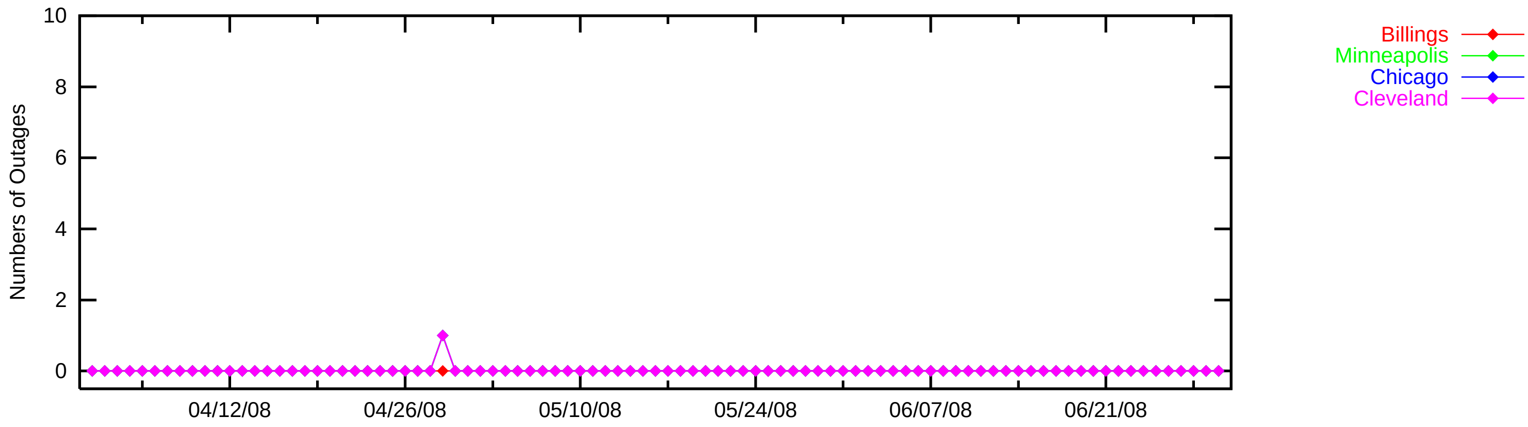
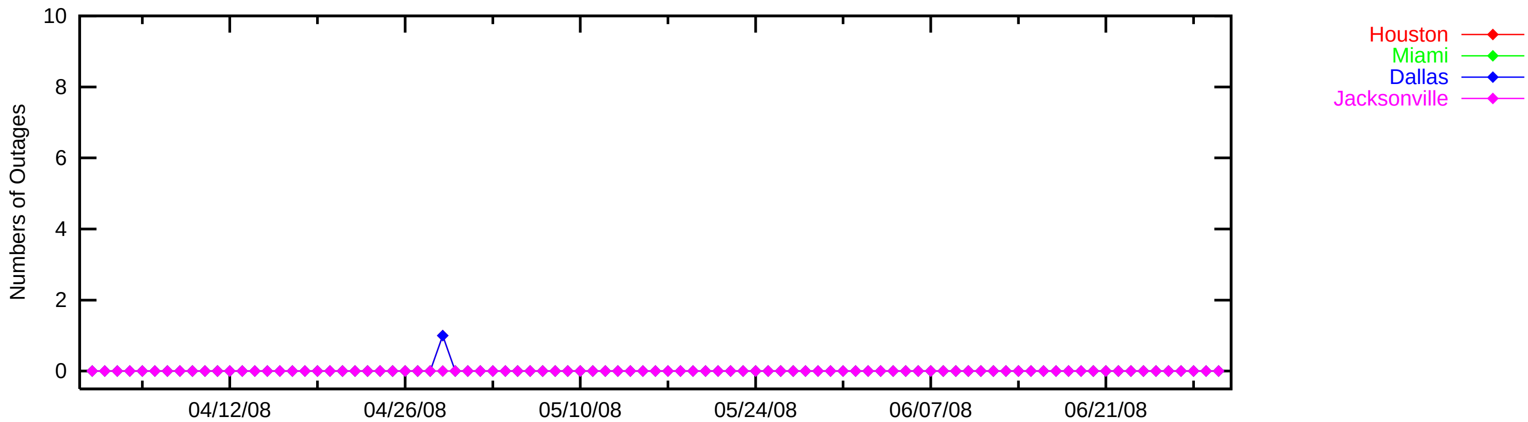
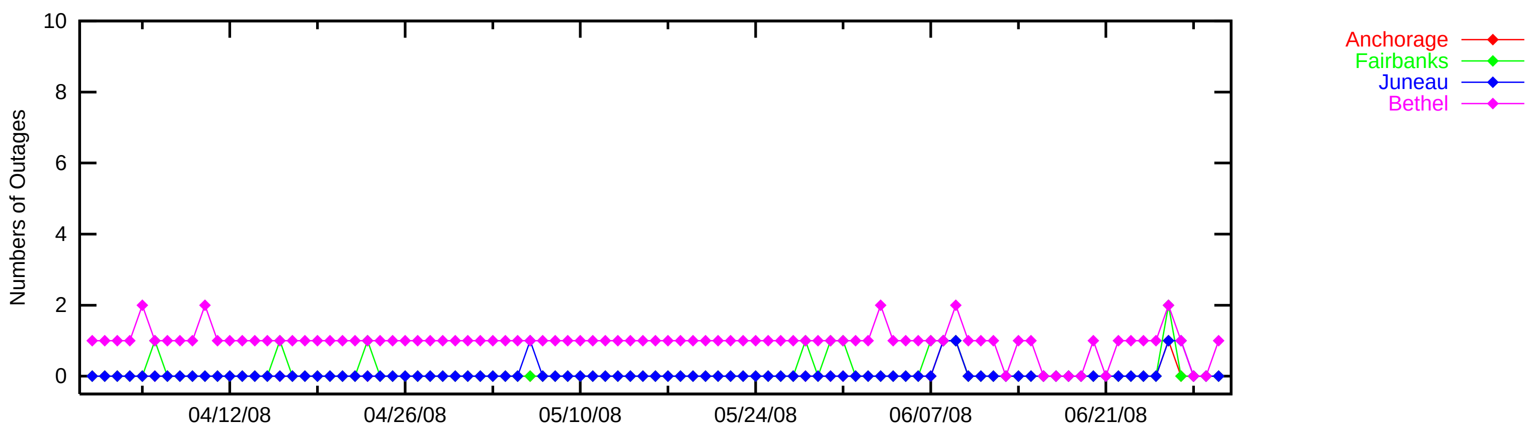


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)







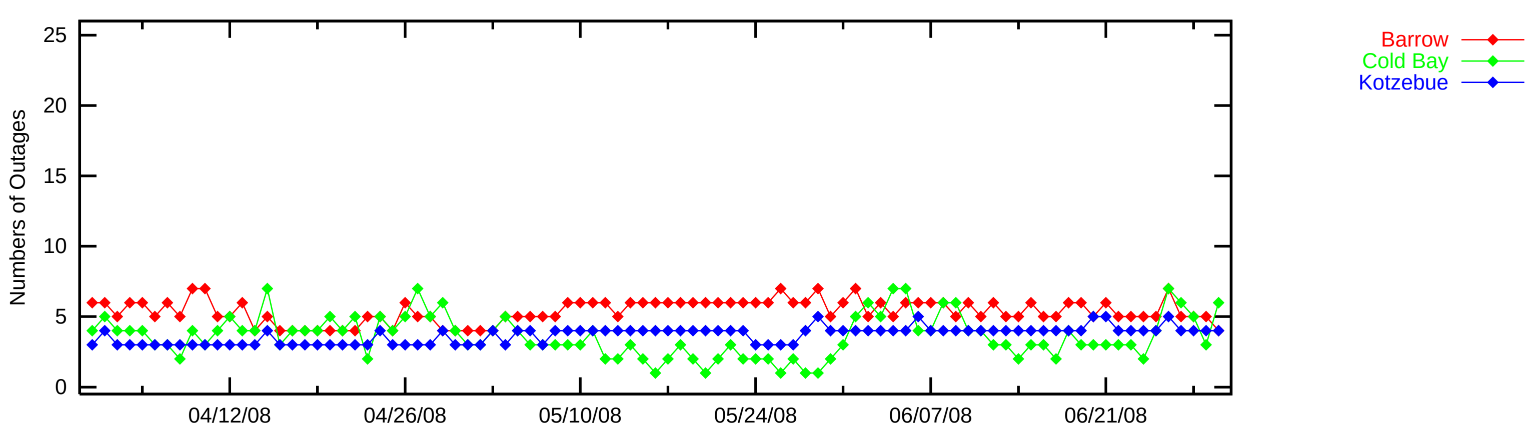


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

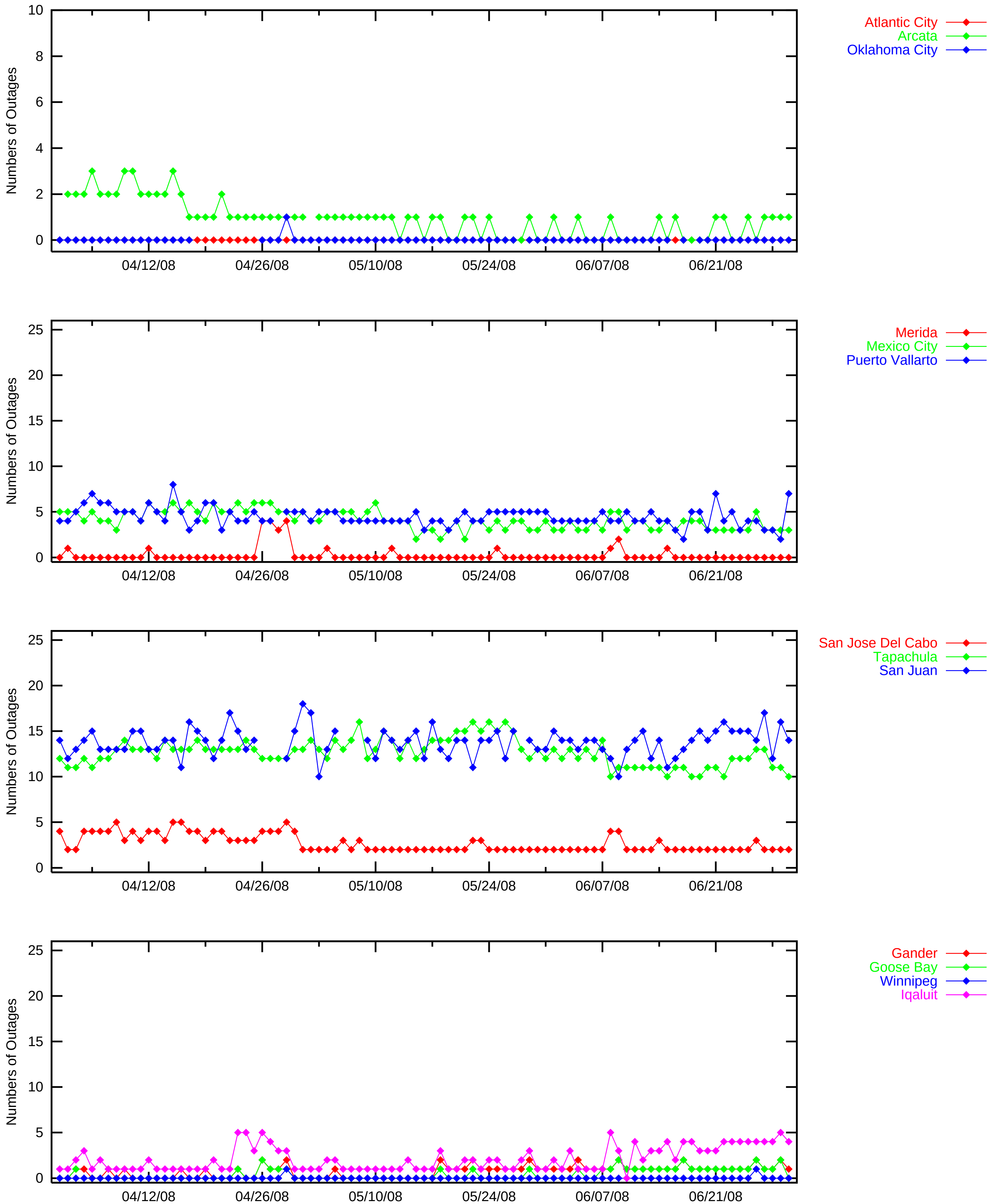


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

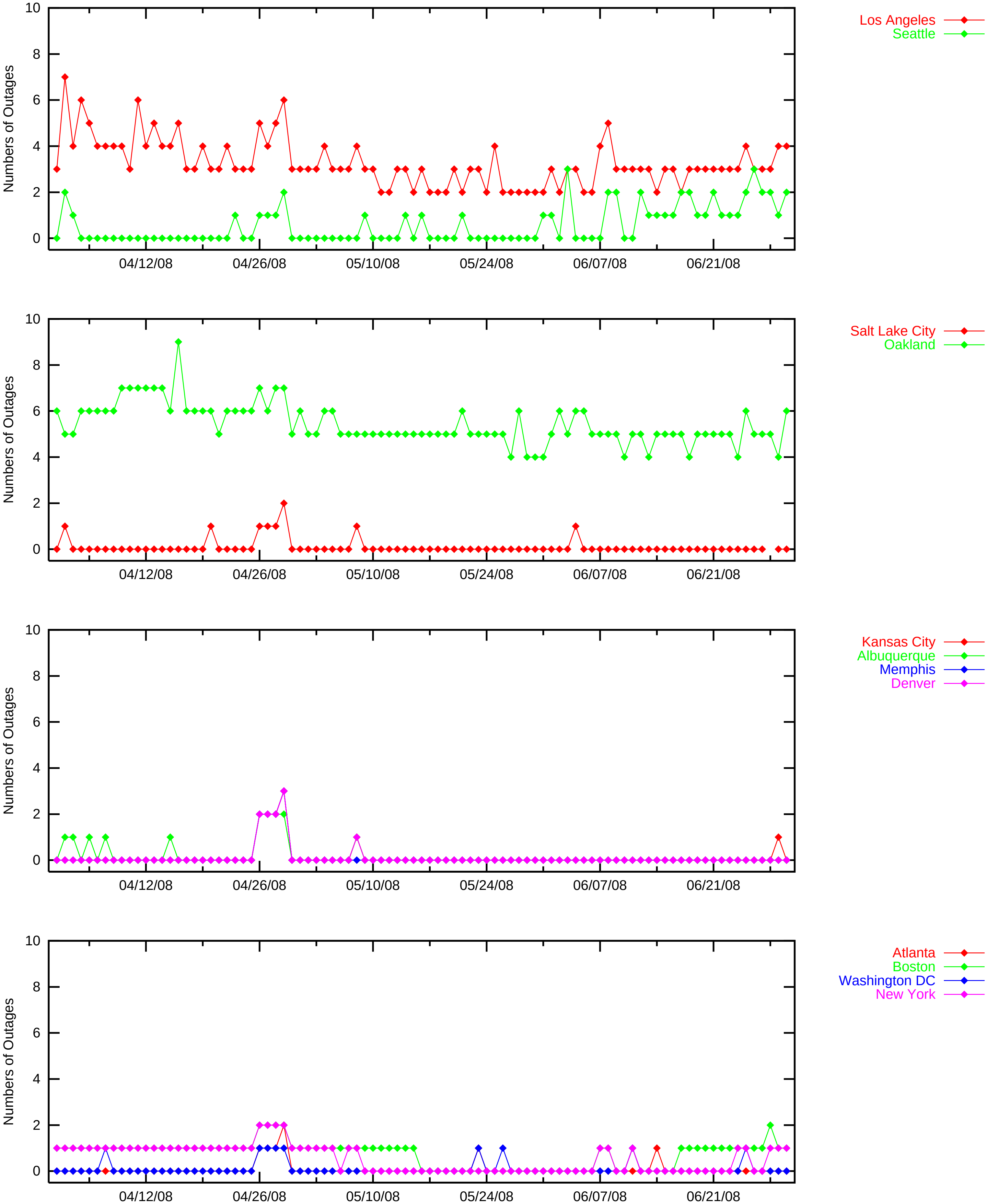


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)

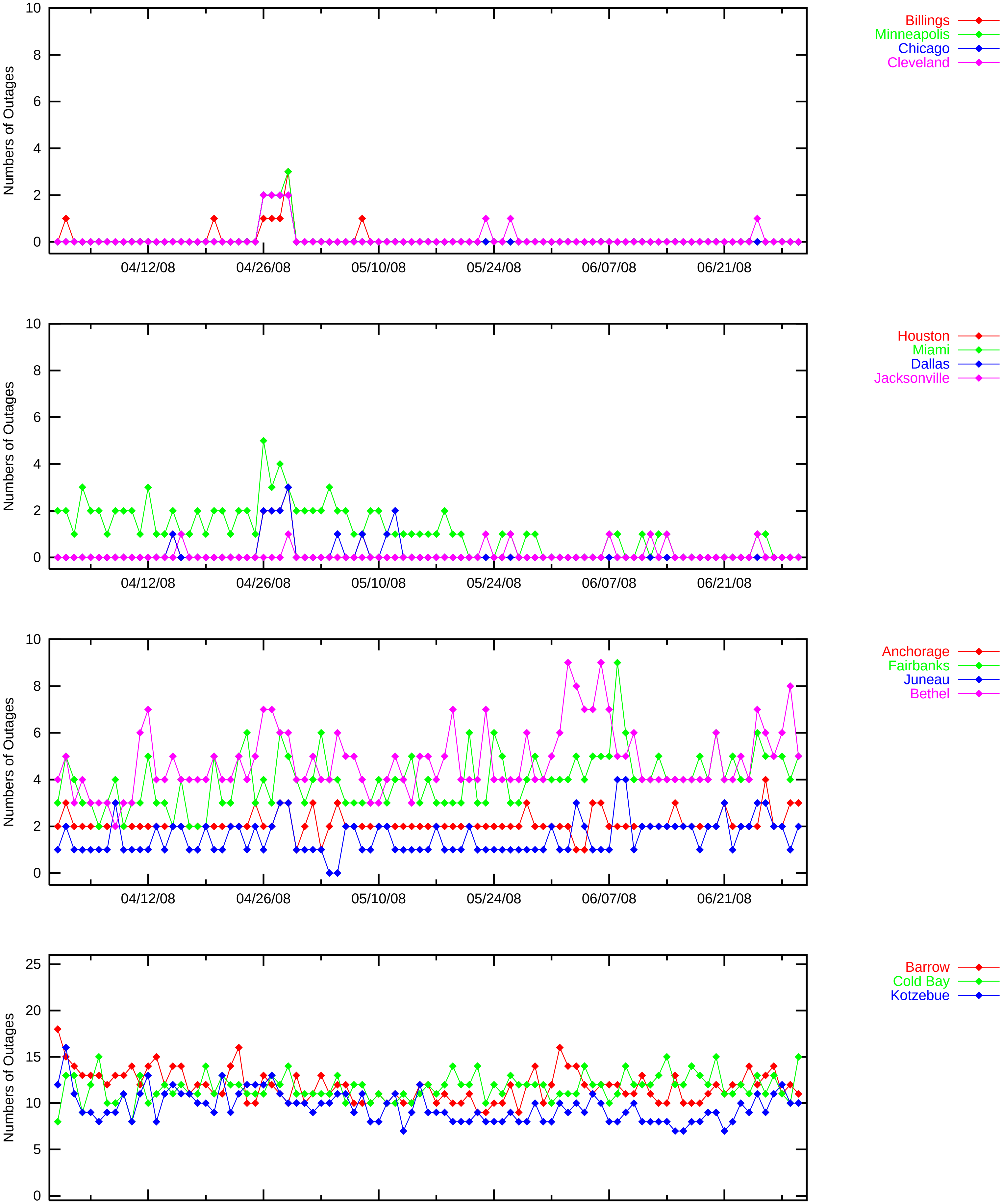
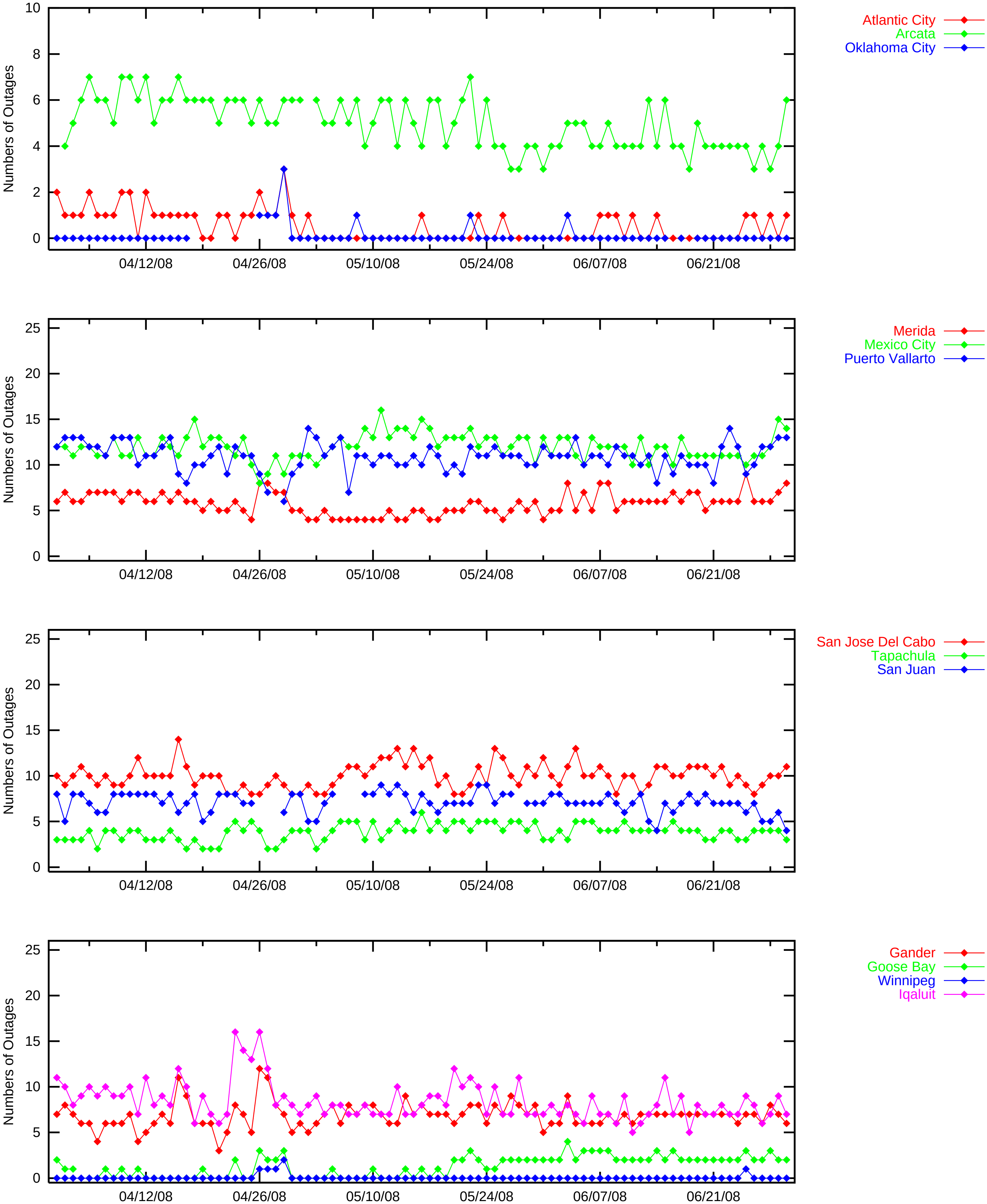


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



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

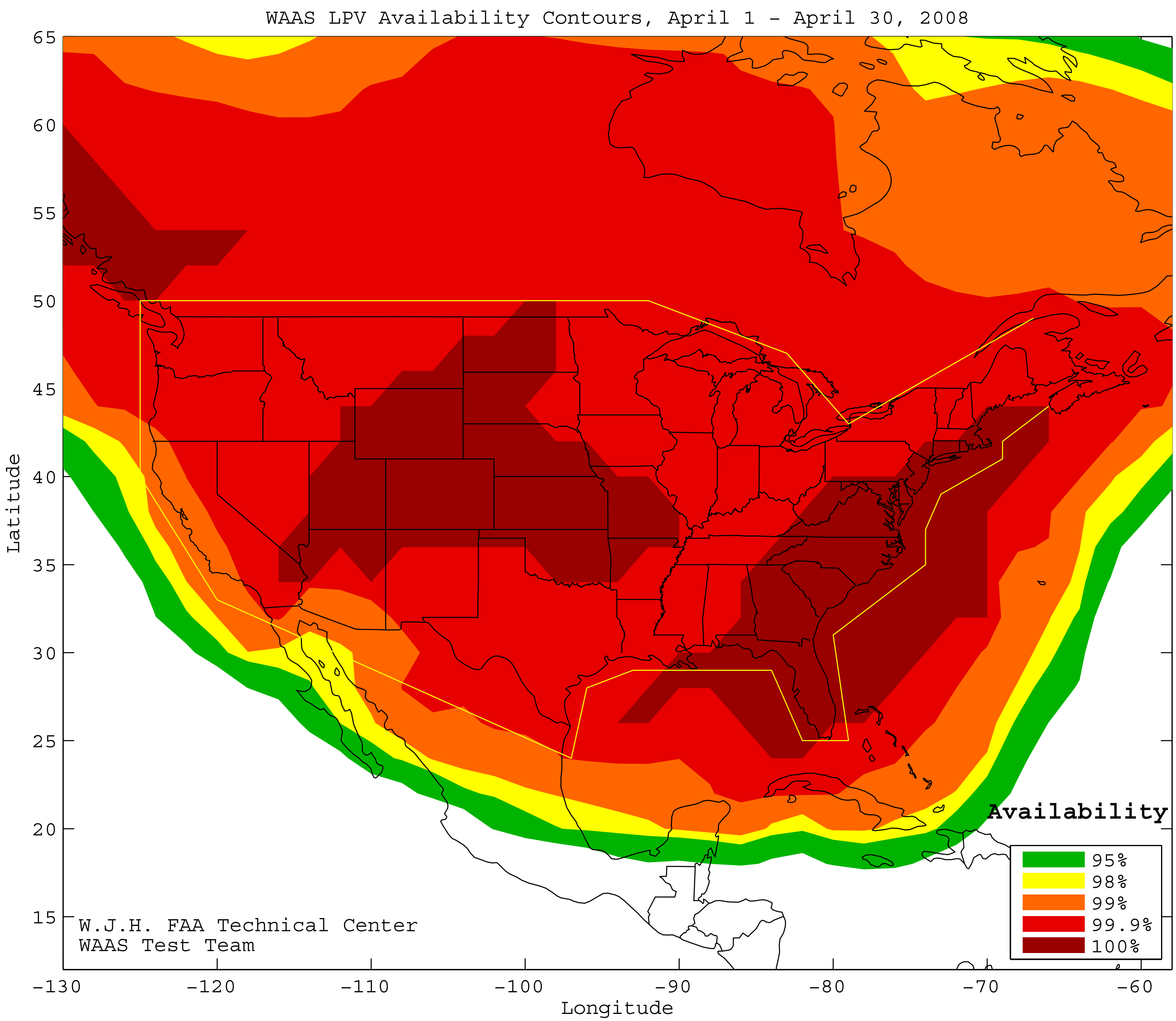
Daily analysis for PA was conducted for LPV and LPV 200 service levels. The coverage plots provide 100, 99.9, 99, 98 and 95% availability contours. Monthly coverage are shown as followed: LPV CONUS coverage in Figures 4.1 to 4.3, LPV Alaska coverage in Figures 4.5 to 4.7, LPV 200 CONUS coverage in Figures 4.9 to 4.11, and LPV 200 CONUS coverage in Figures 4.13 to 4.15. Figure 4.4, 4.8, 4.12, and 4.16 show the rollup LPV and LPV 200 for the quarter. Figure 4.21 shows the daily LPV and LPV 200 CONUS coverage, and Figure 4.19 shows the daily LPV Alaska coverage at 99% availability and ionosphere KP index values for this quarter.

Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots provide 100, 99.9 and 99% availability contours. Figure 4.17 to 4.19 show the NPA coverage area of each month and Figure 4.20 shows the rollup NPA coverage for the quarter. Figure 4.23 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

During this evaluation period, low PA coverage is mainly due to satellites outages. Please refer to Table 1.4 for events that affected coverage. Low LPV coverage on 4/2/2008 is caused by PRN 12 out for service (see DR#68). Low coverage on 4/15/2008 and 6/26/2008 are due to PRN 11 and PRN 8 out for service, respectively. PRN 2, out for service from 4/26/2008 to 4/29/2008, caused a significant drop in CONUS LPV 200 coverage on all four days. Coverage dropped even further on 4/29/2008 when both PRN 2 and PRN 30 were out for service. PRN 9, out for service on 6/8/2008 and 6/9/2008, caused a drop in Alaska LPV coverage on both days (see DR#72).

Low NPA coverage on 4/1/2008, 4/15/2008, 4/16/2008, 4/23/2008, and 4/26/2008 to 4/29/2008 are due to selected C&V source switchovers and satellites outages.

Figure 4-1 LPV CONUS Coverage - April



CONUS Coverage at 95% Availability = 100%
CONUS Coverage at 99% Availability = 99.6%
CONUS Coverage at 100% Availability = 44.94%

SL = LPV

Figure 4-2 LPV CONUS Coverage - May

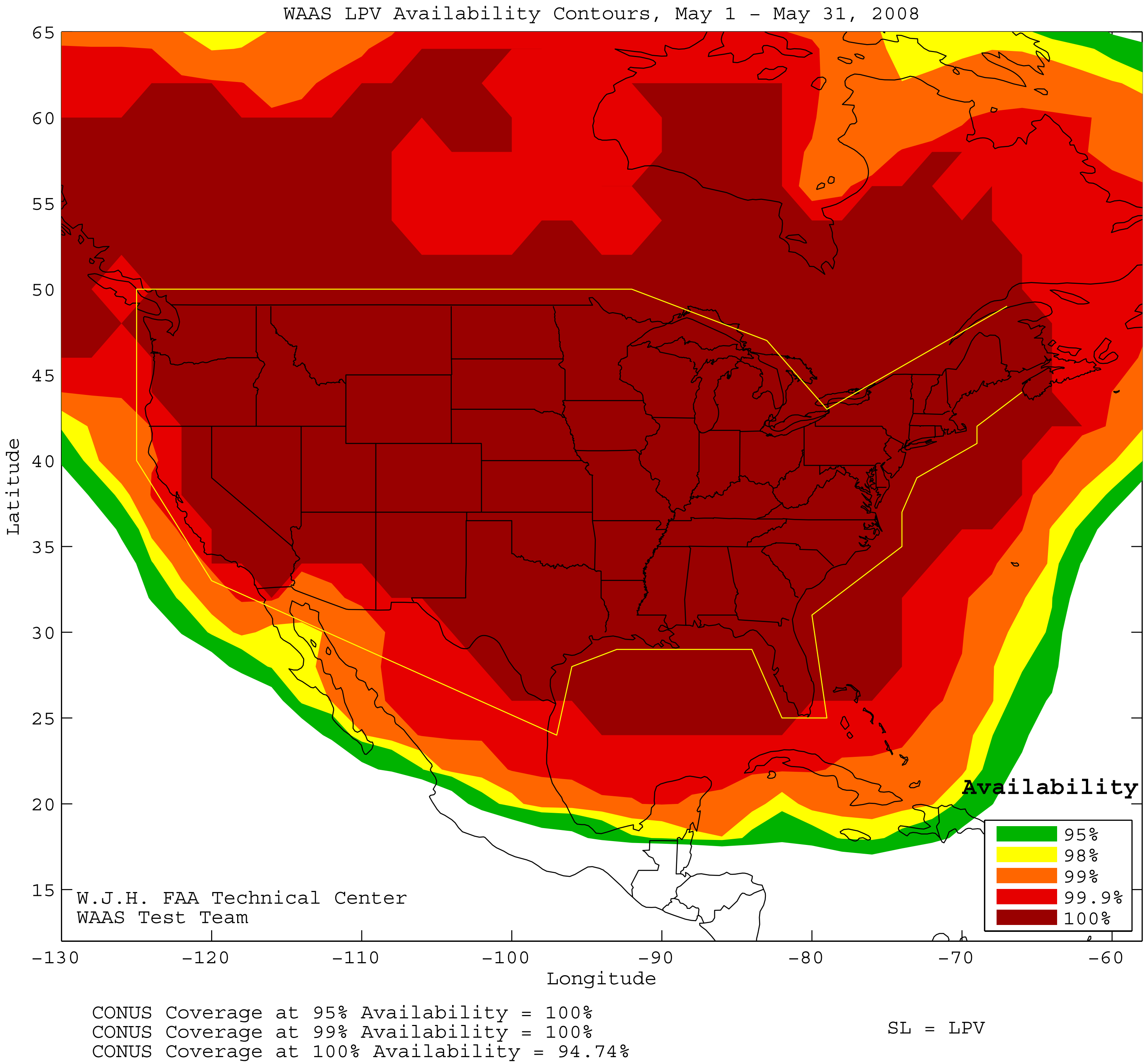
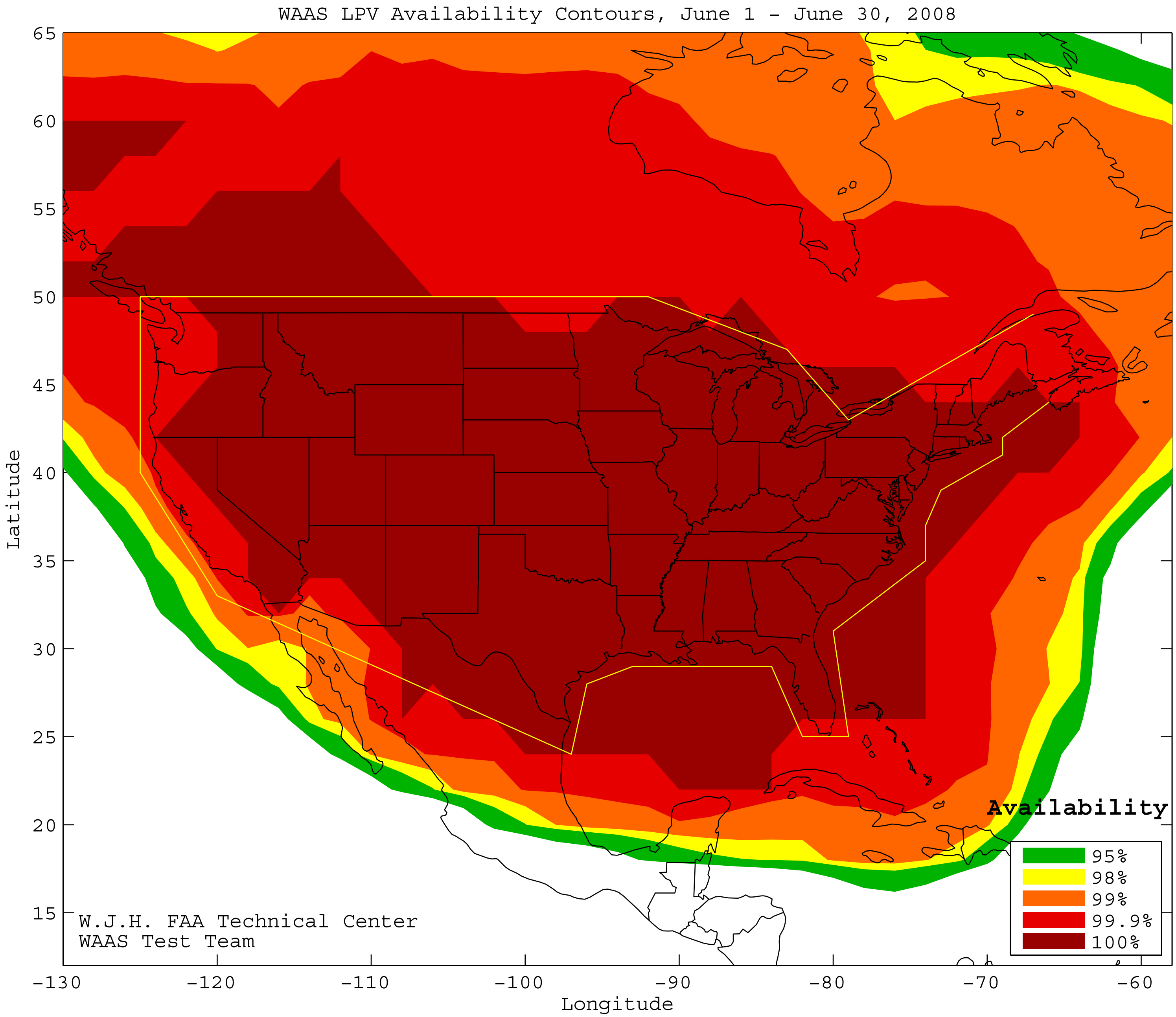


Figure 4-3 LPV CONUS Coverage - June



CONUS Coverage at 95% Availability = 100%
CONUS Coverage at 99% Availability = 100%
CONUS Coverage at 100% Availability = 93.12%

SL = LPV

Figure 4-4 LPV CONUS Coverage for the Quarter

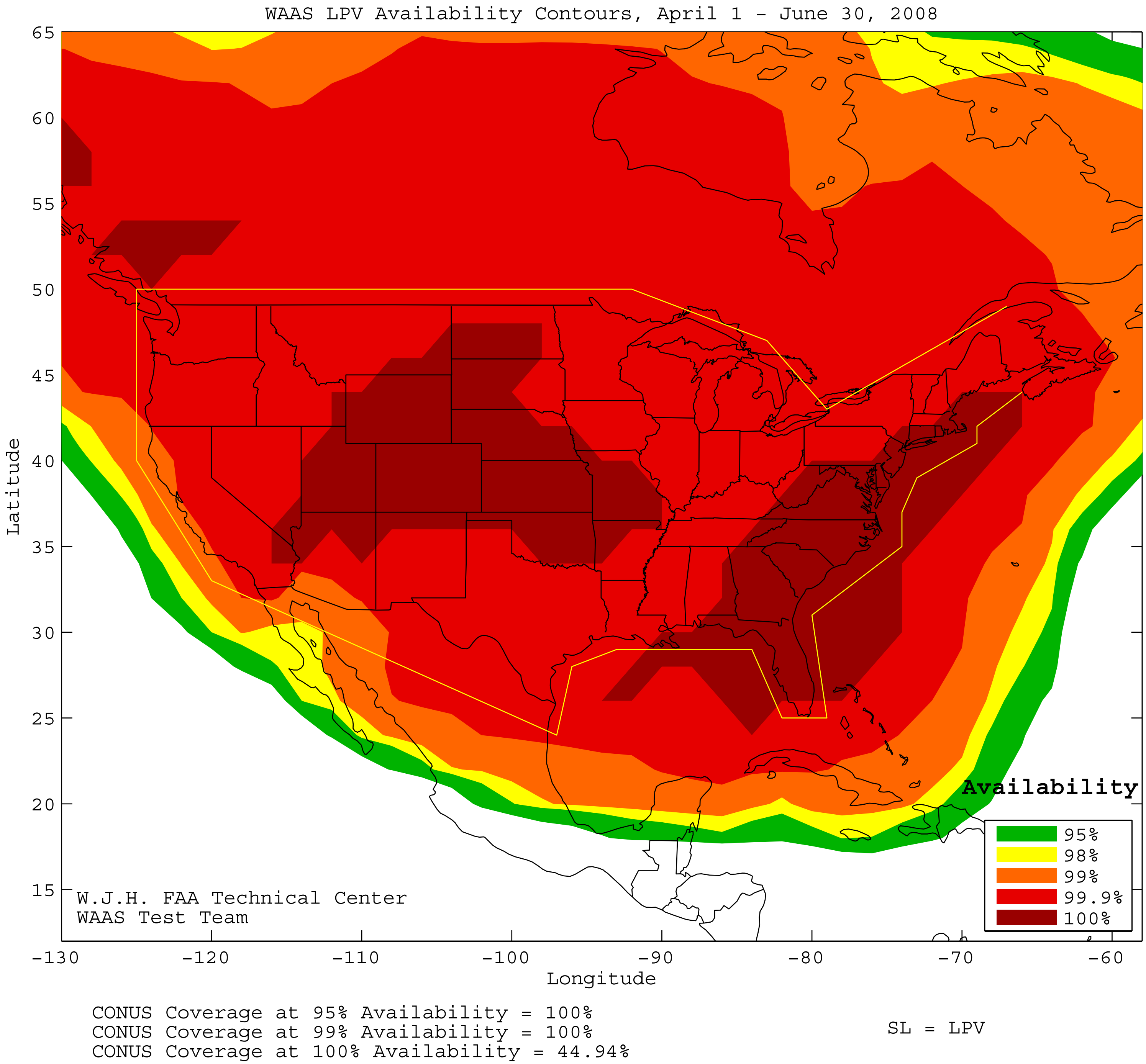


Figure 4-5 LPV Alaska Coverage - April

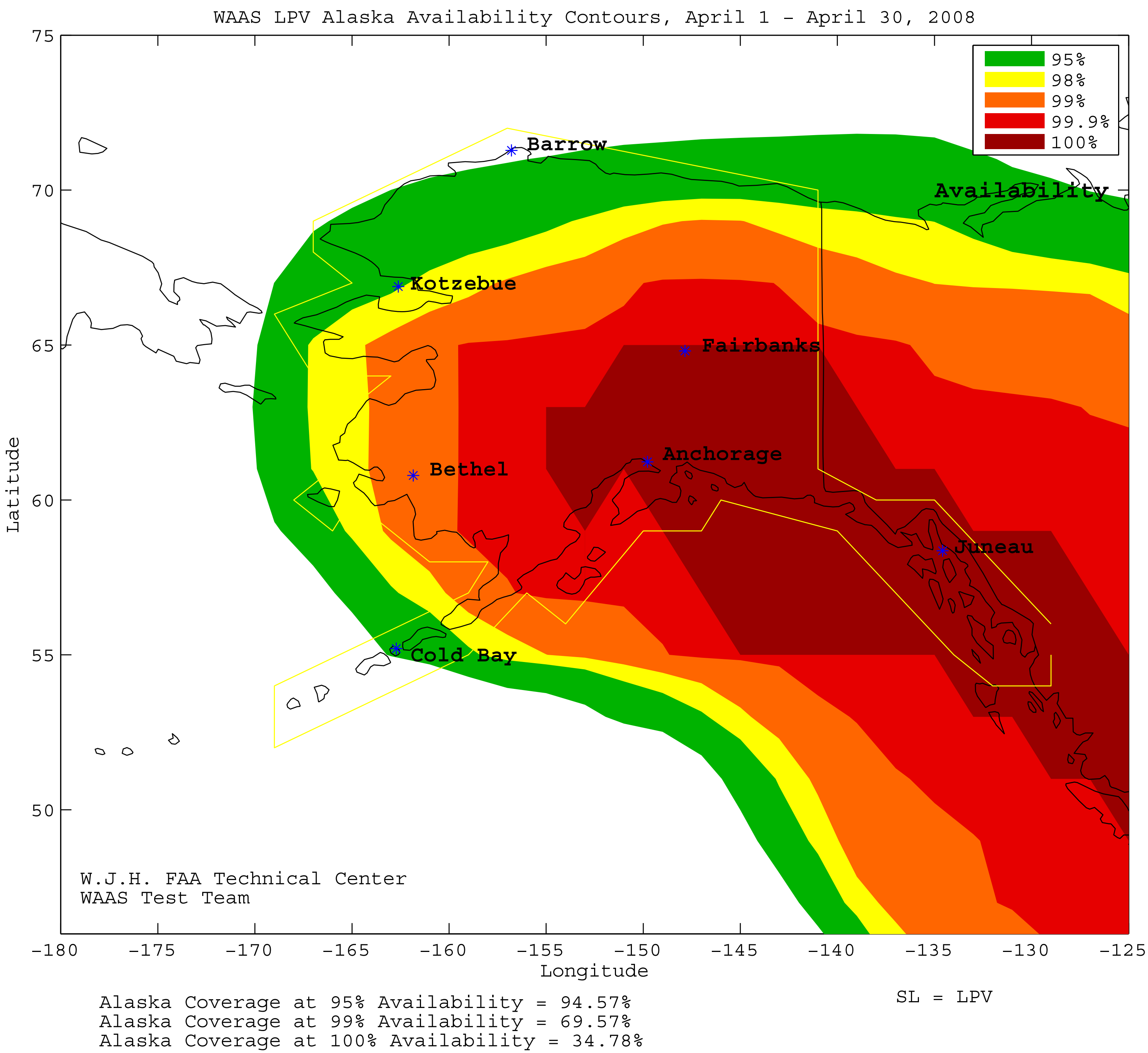


Figure 4-6 LPV Alaska Coverage - May

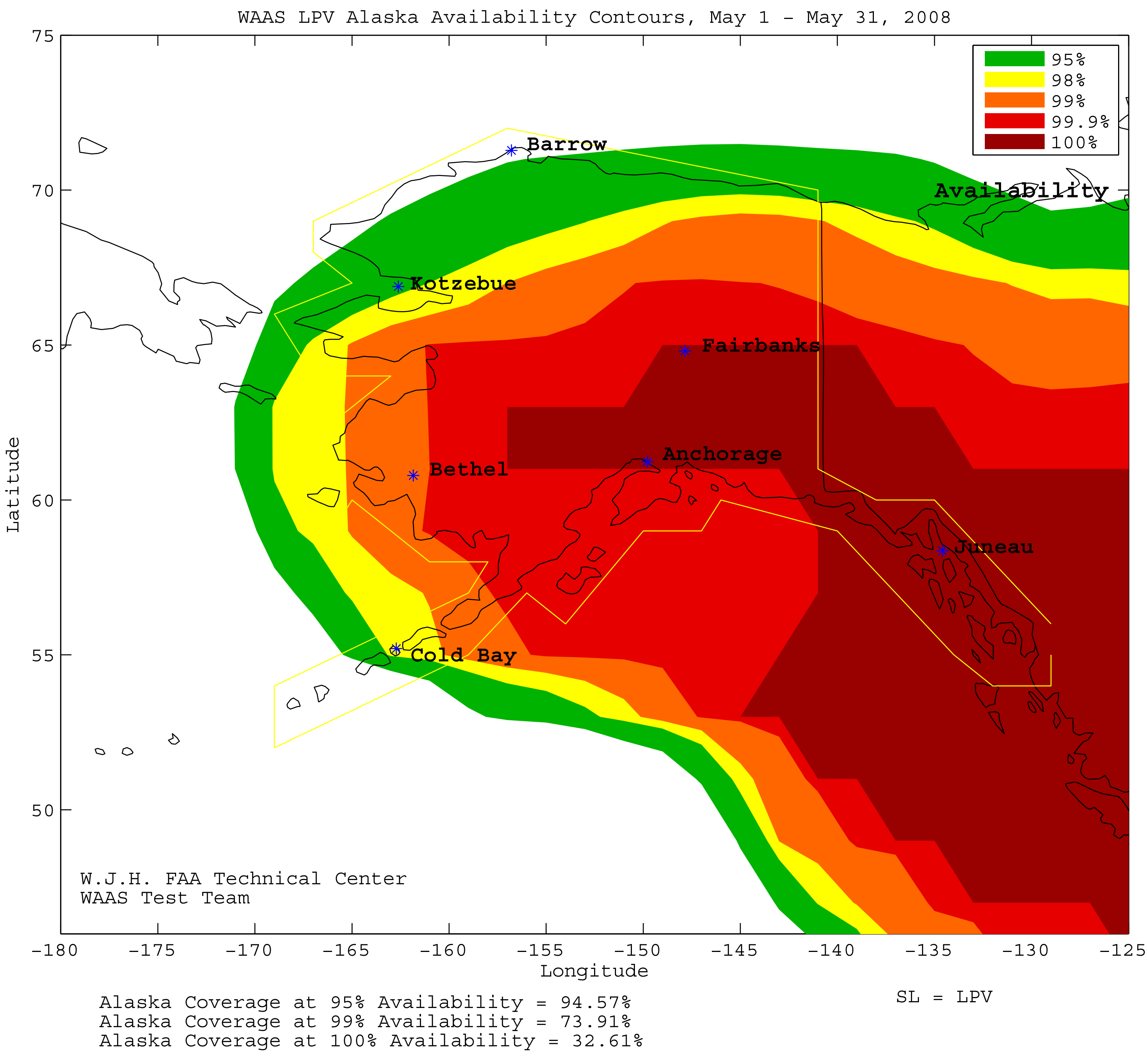


Figure 4-7 LPV Alaska Coverage - June

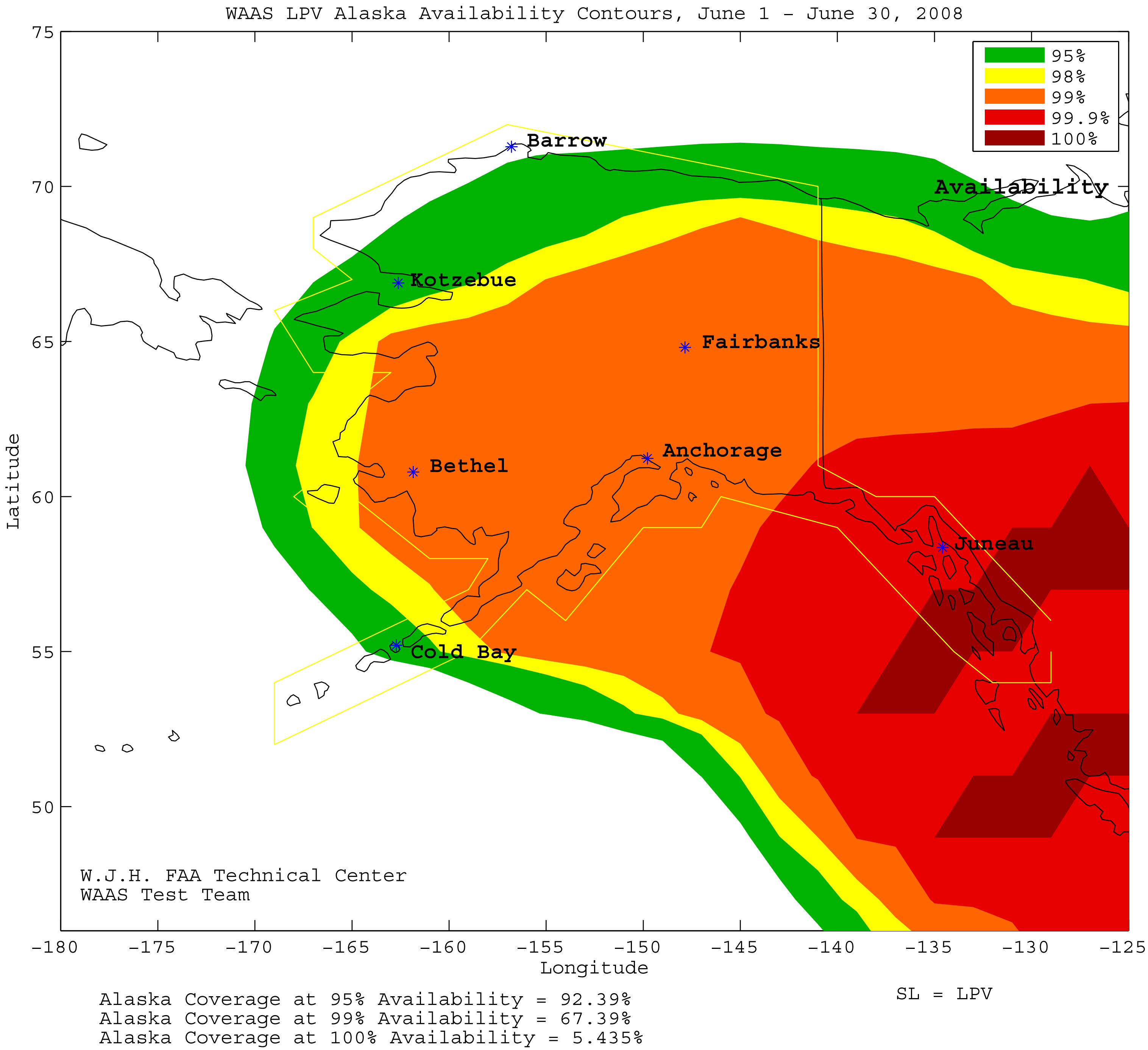


Figure 4-8 LPV Alaska Coverage for the Quarter

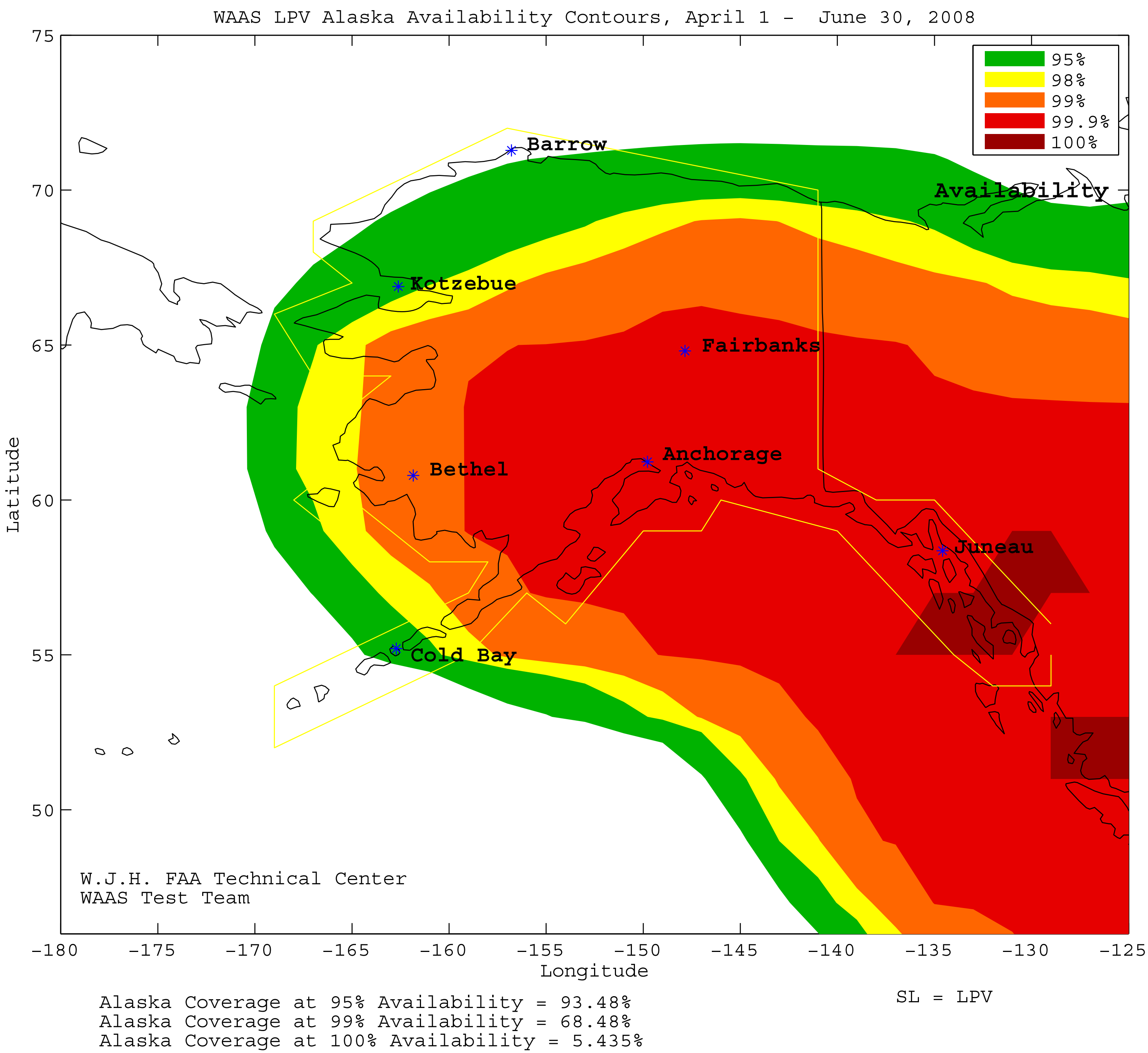


Figure 4-9 LPV 200 CONUS Coverage - April

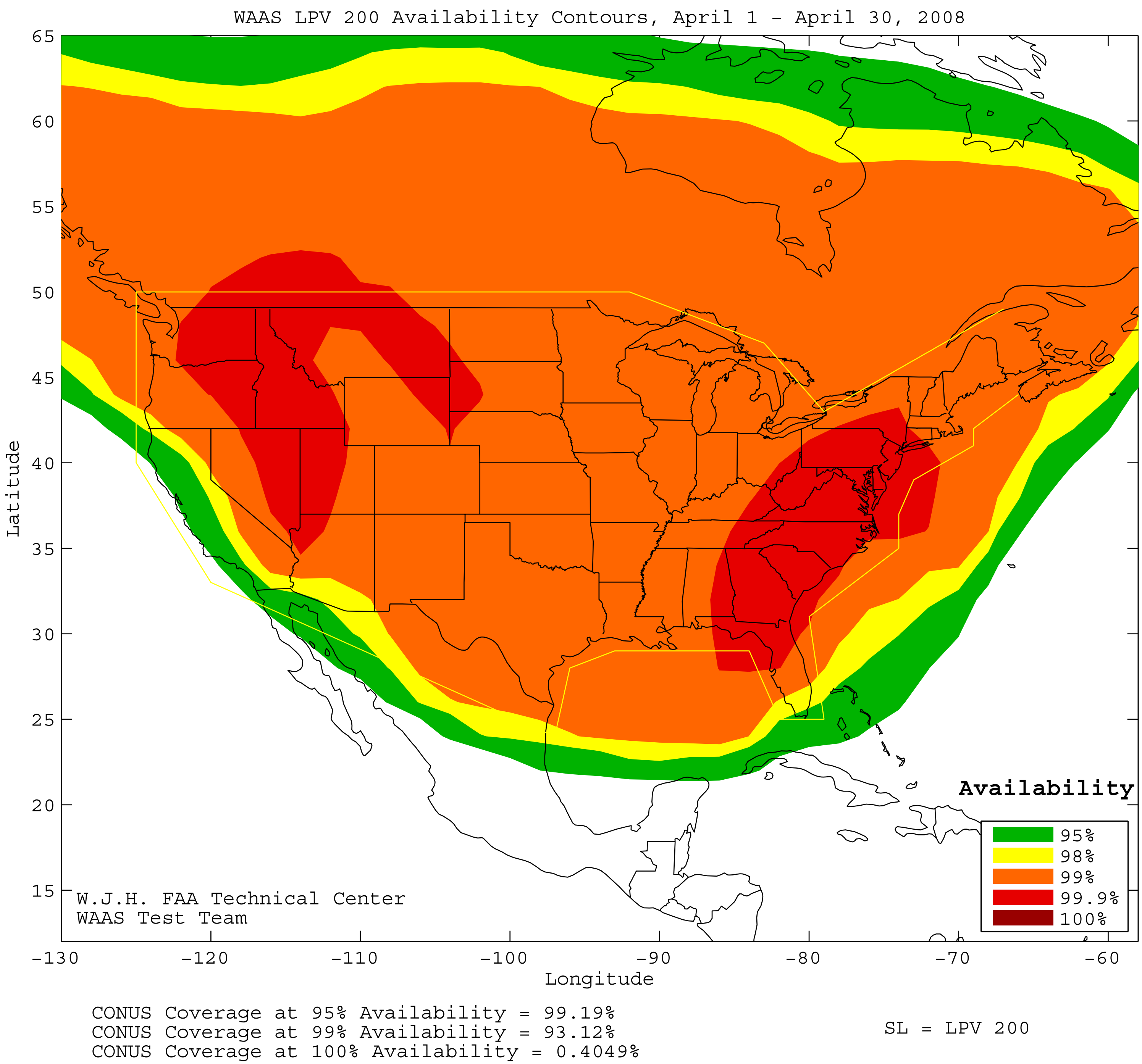


Figure 4-10 LPV 200 CONUS Coverage - May

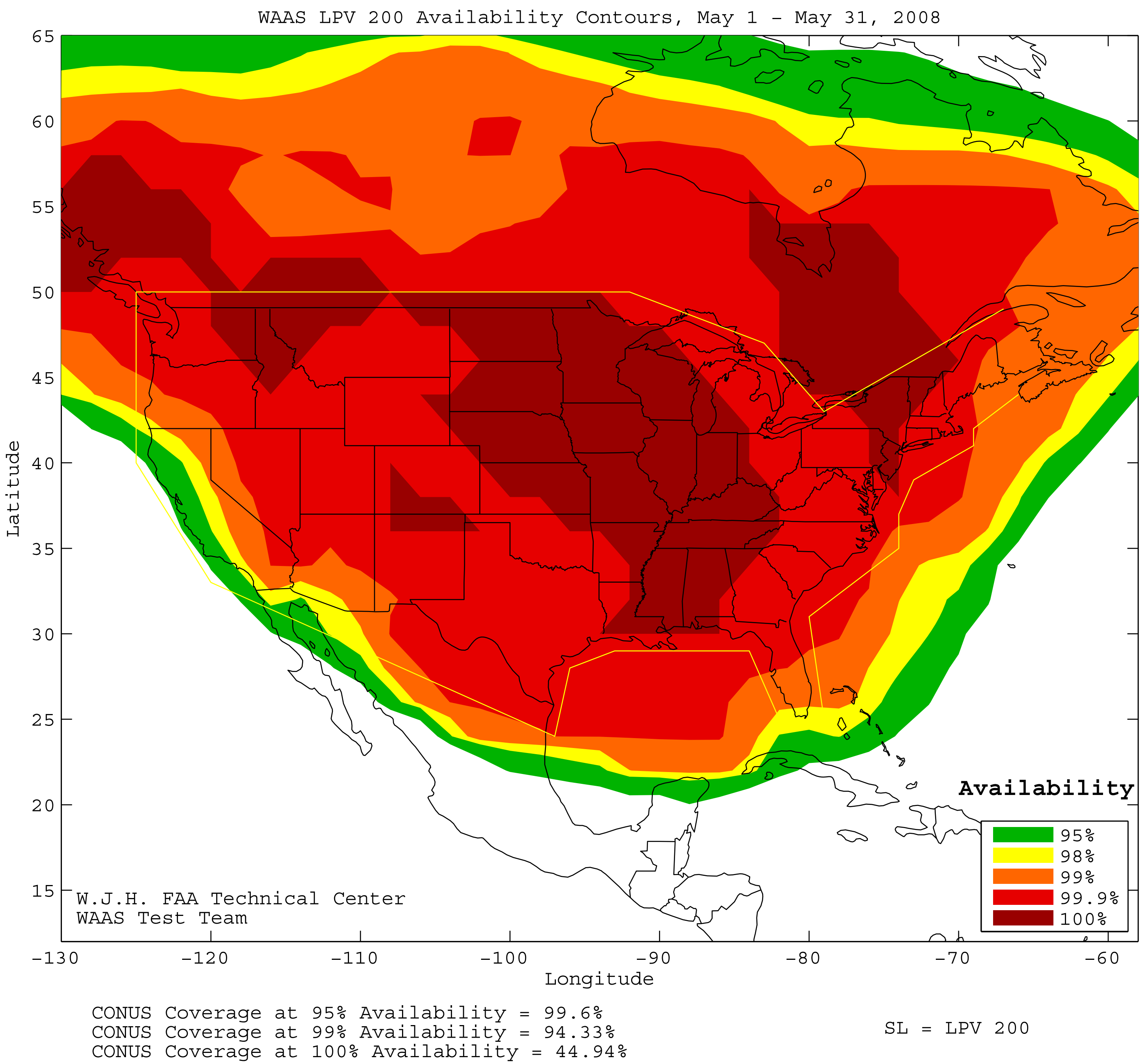
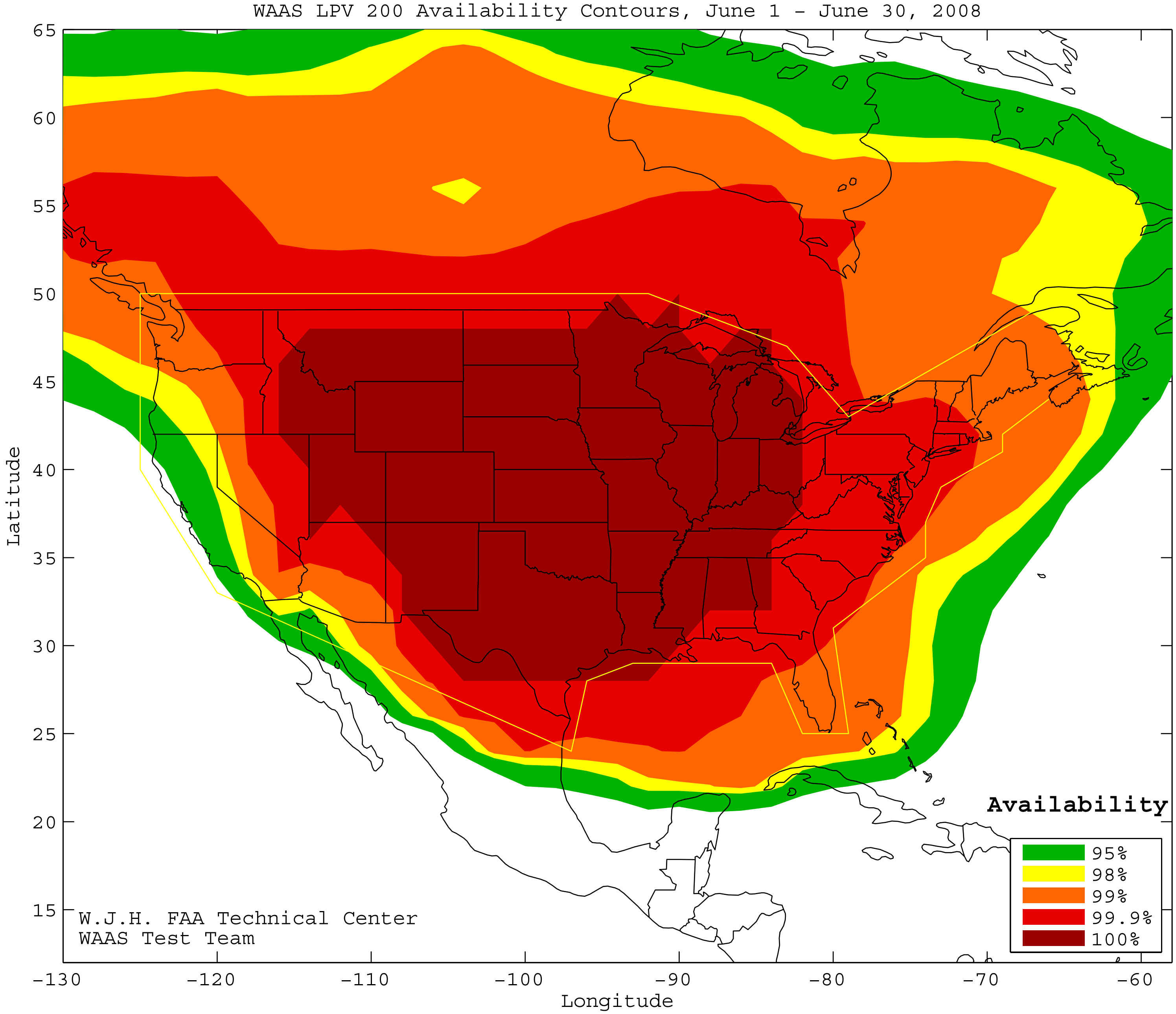


Figure 4-11 LPV 200 CONUS Coverage - June



CONUS Coverage at 95% Availability = 99.19%
CONUS Coverage at 99% Availability = 93.52%
CONUS Coverage at 100% Availability = 62.75%

SL = LPV 200

Figure 4-12 LPV 200 CONUS Coverage for the Quarter

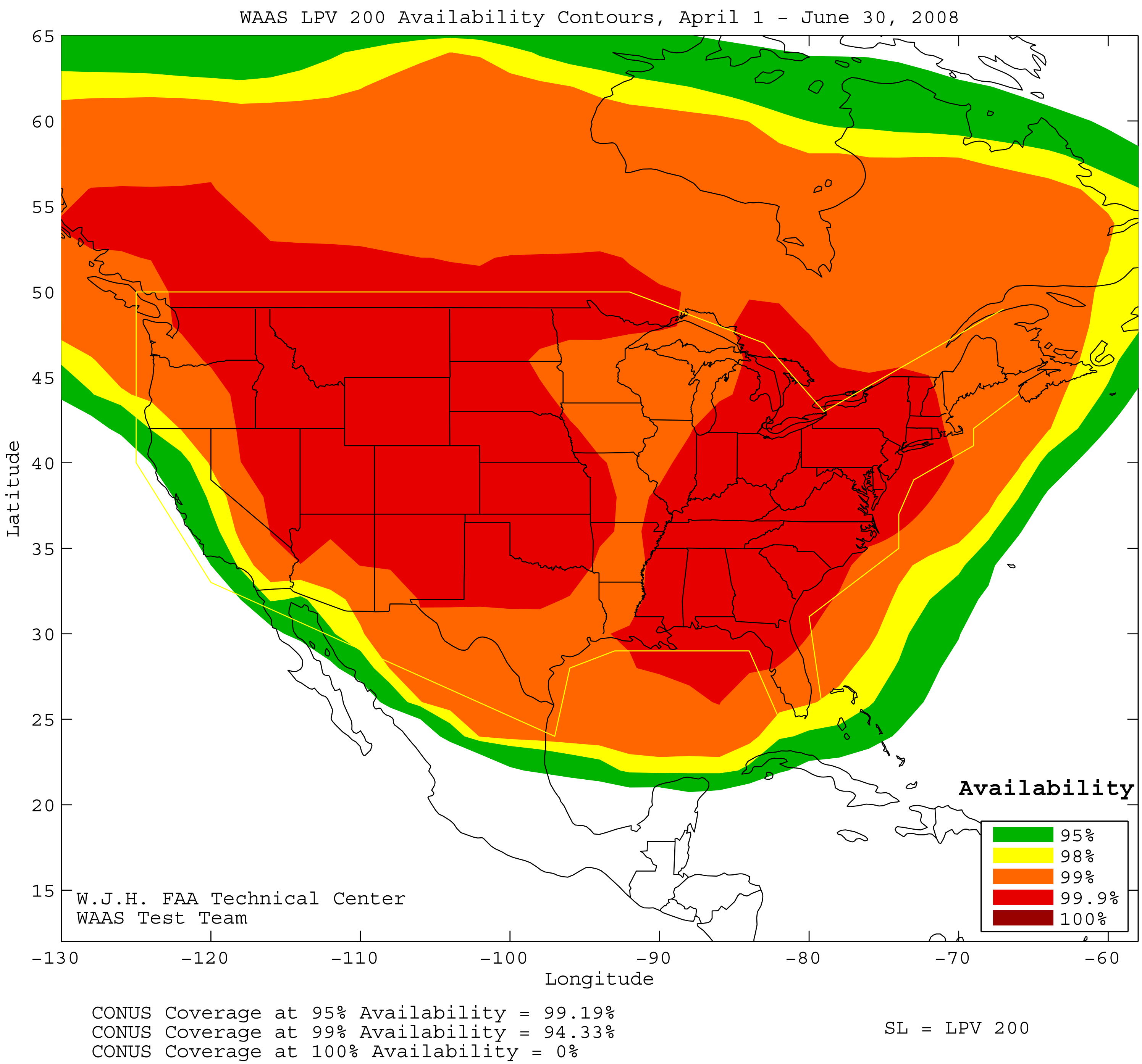


Figure 4-13 LPV 200 Alaska Coverage - April

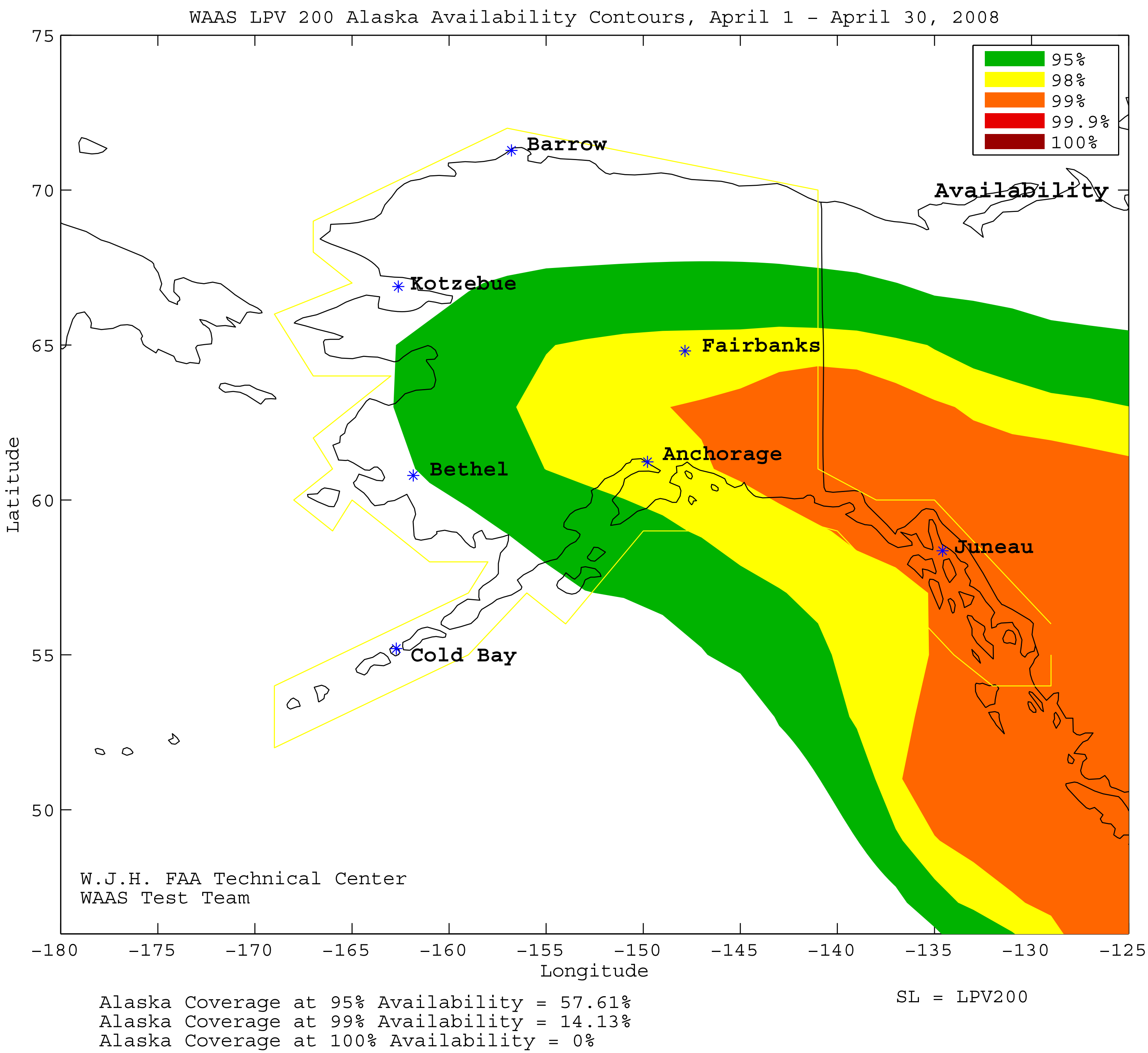


Figure 4-14 LPV 200 Alaska Coverage - May

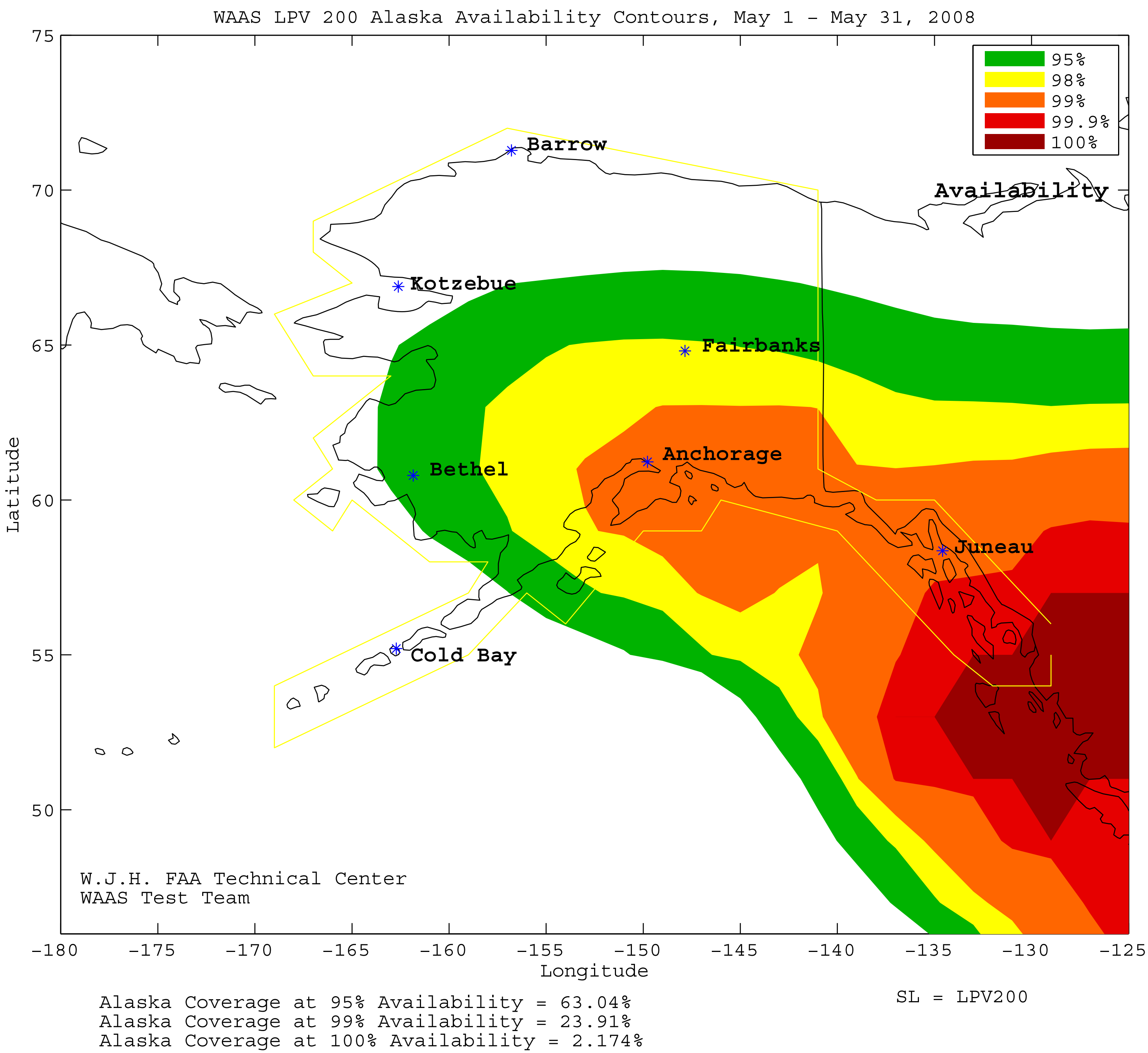


Figure 4-15 LPV 200 Alaska Coverage - June

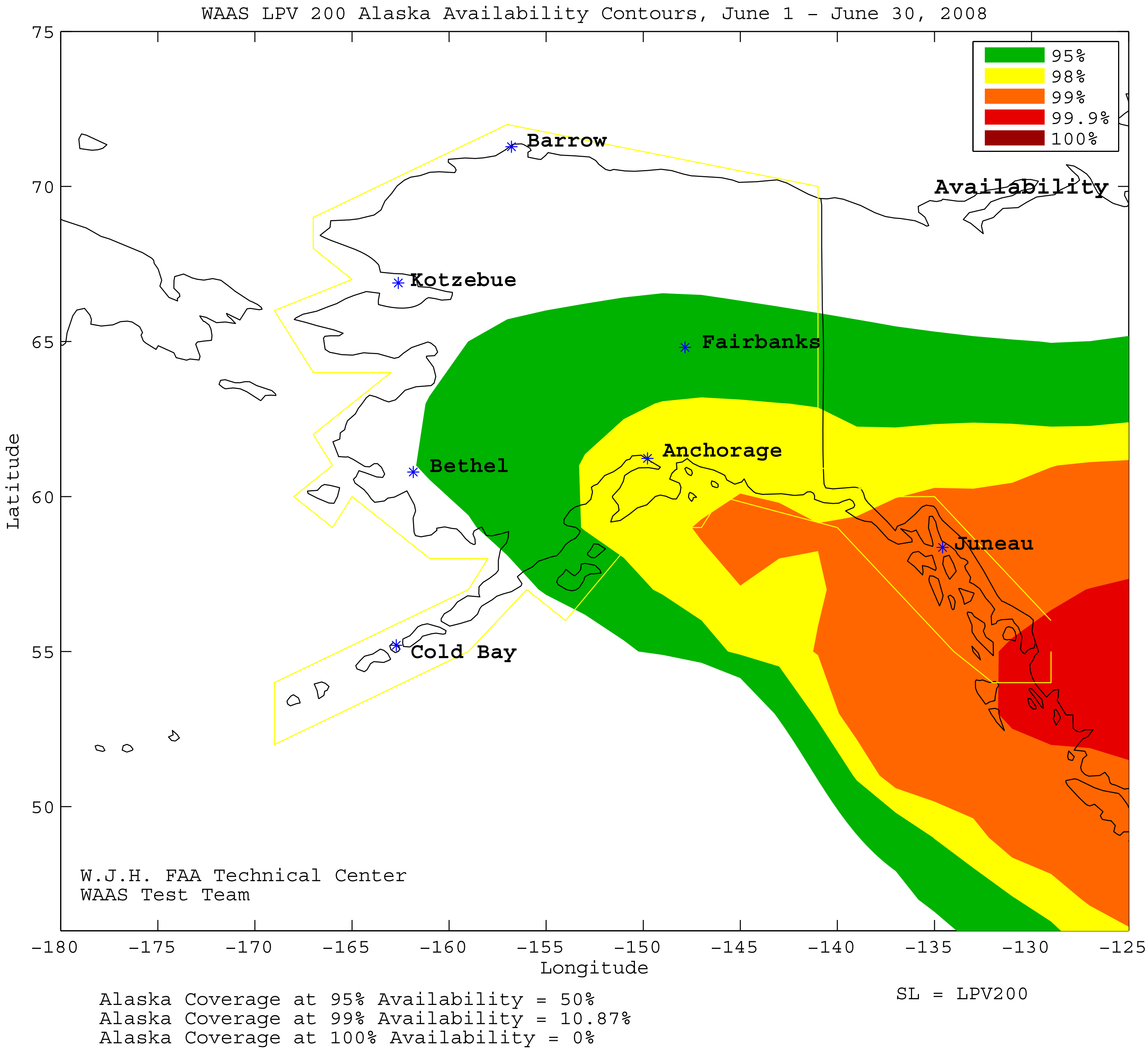
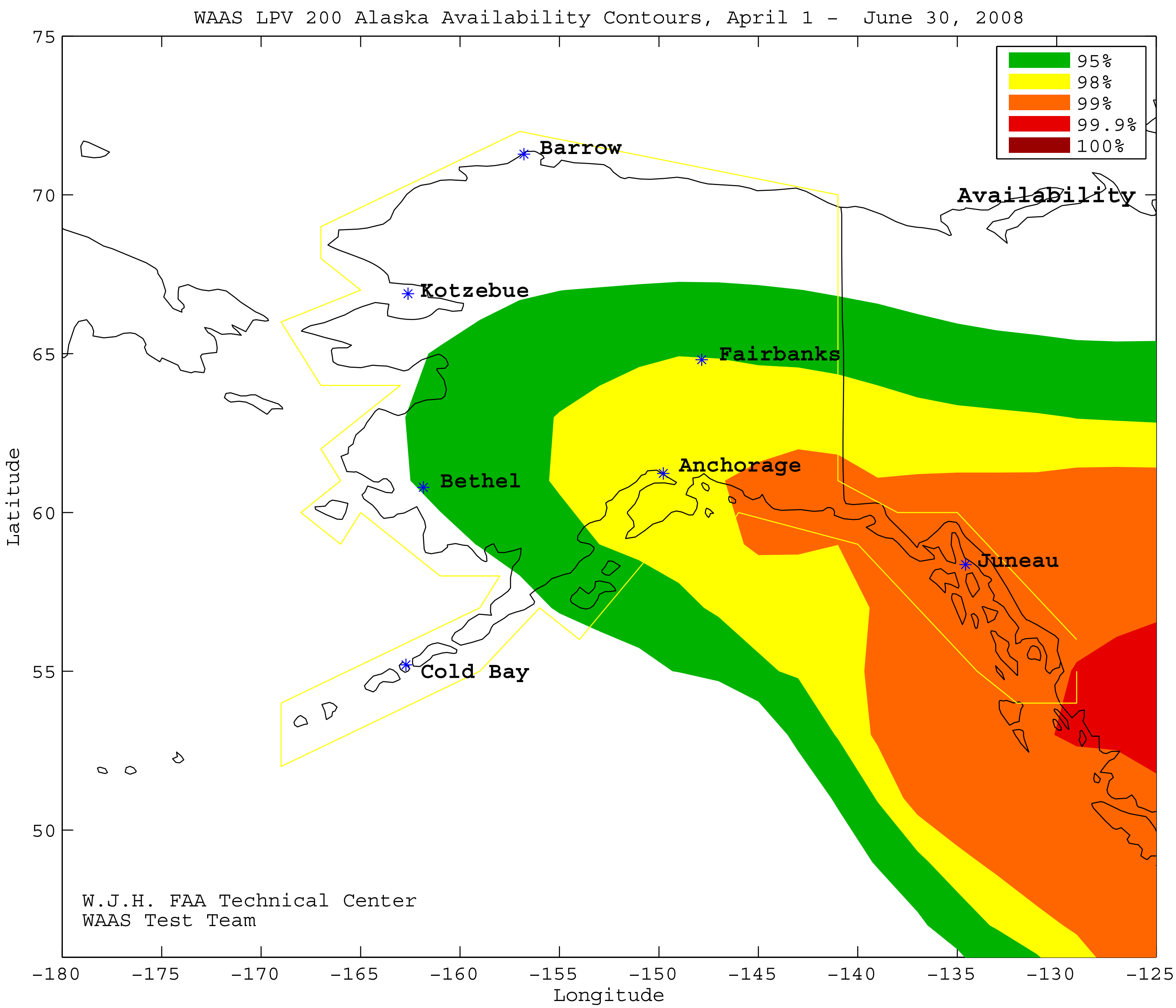


Figure 4-16 LPV 200 Alaska Coverage for the Quarter



Alaska Coverage at 95% Availability = 58.7%
Alaska Coverage at 99% Availability = 11.96%
Alaska Coverage at 100% Availability = 0%

Figure 4-17 NPA Coverage - April

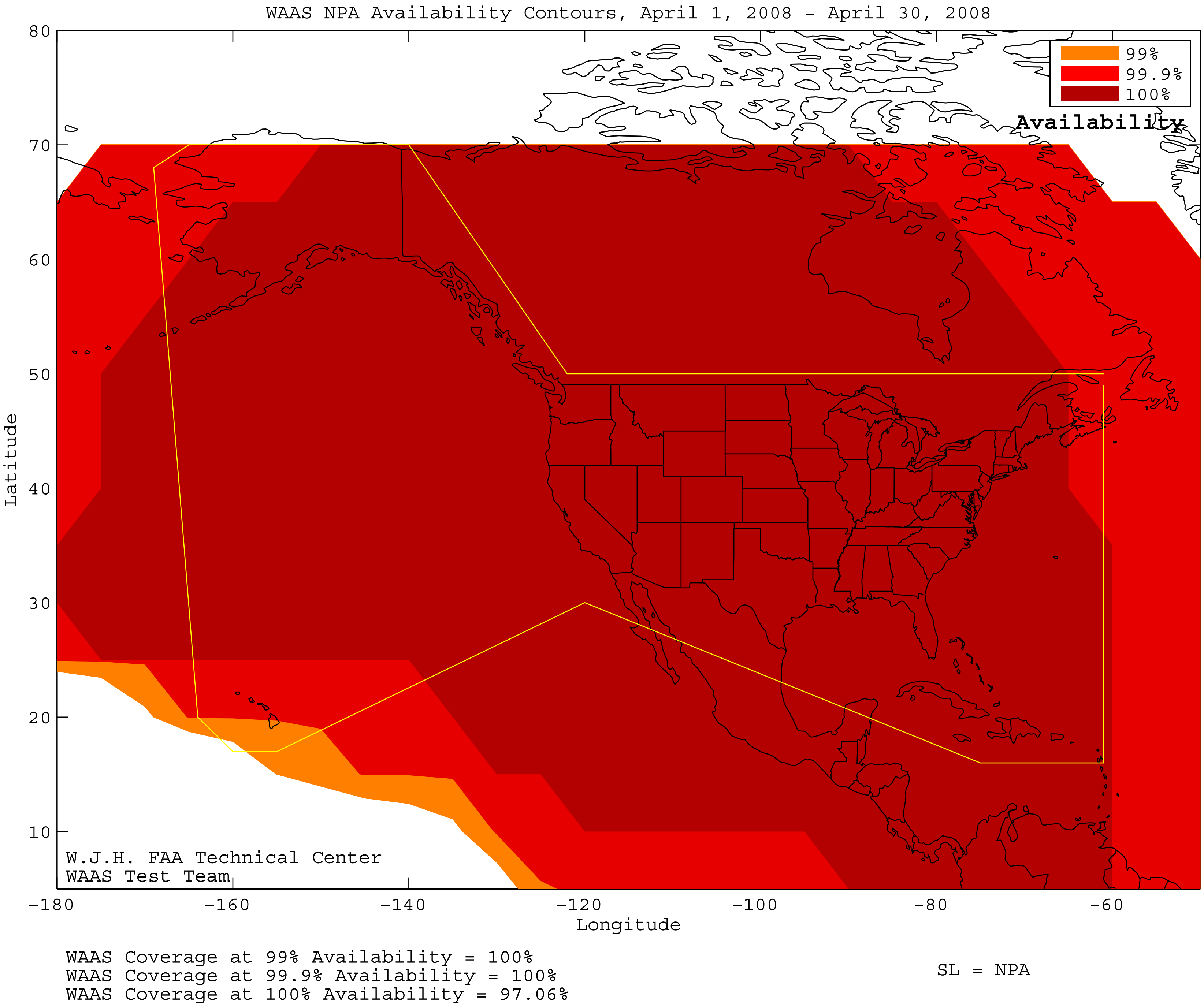


Figure 4-18 NPA Coverage - May

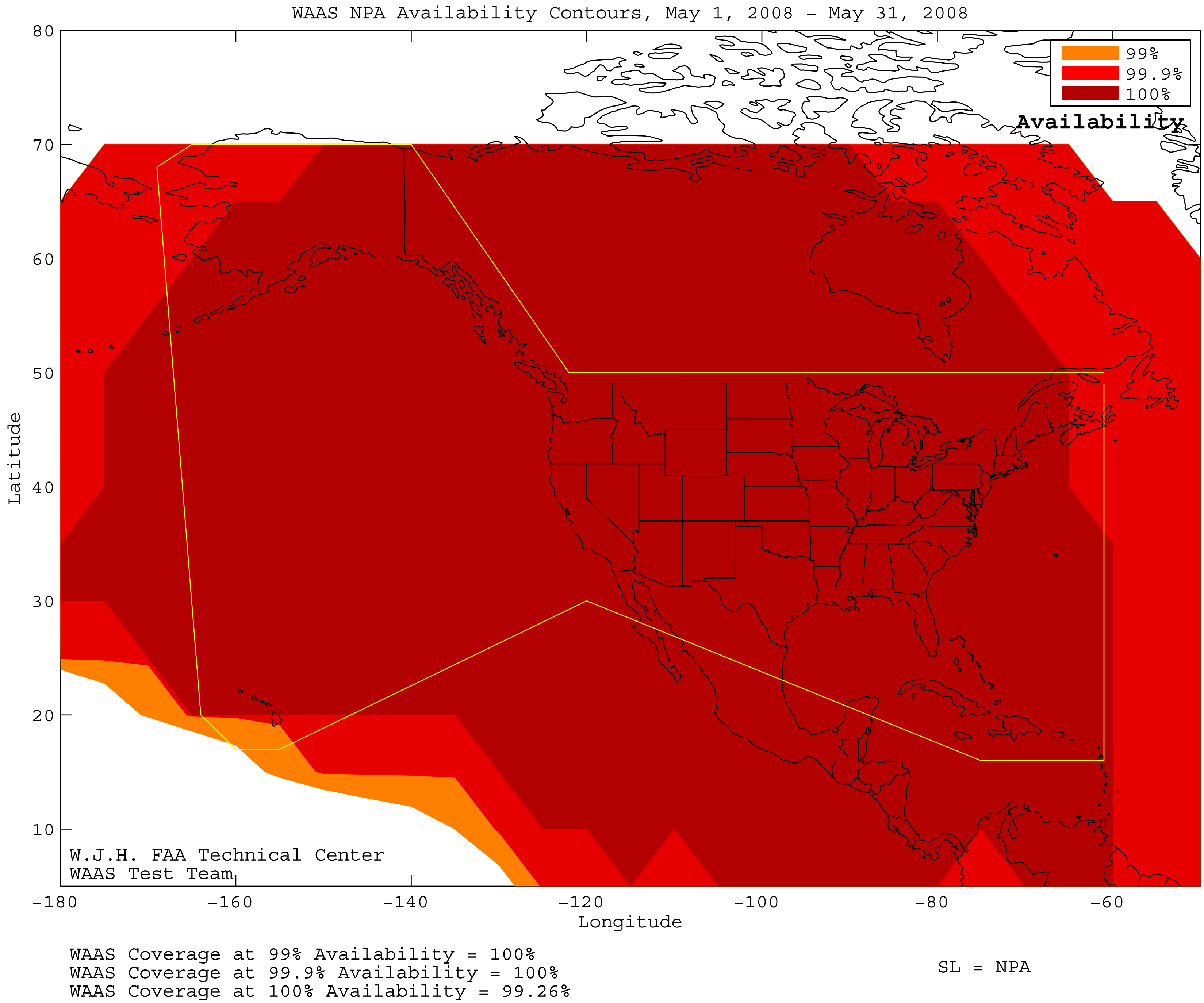


Figure 4-19 NPA Coverage - June

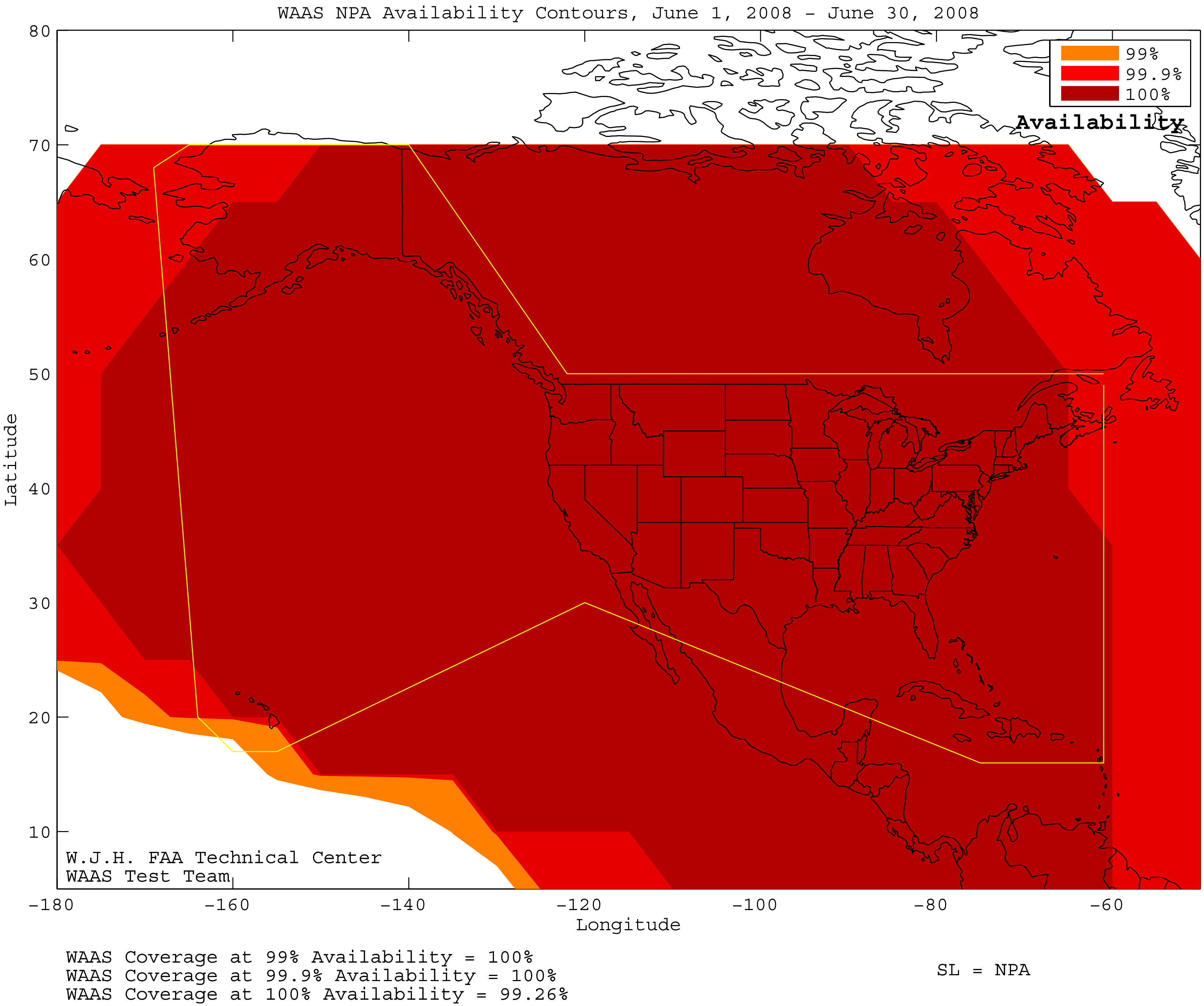


Figure 4-20 NPA Coverage for the Quarter

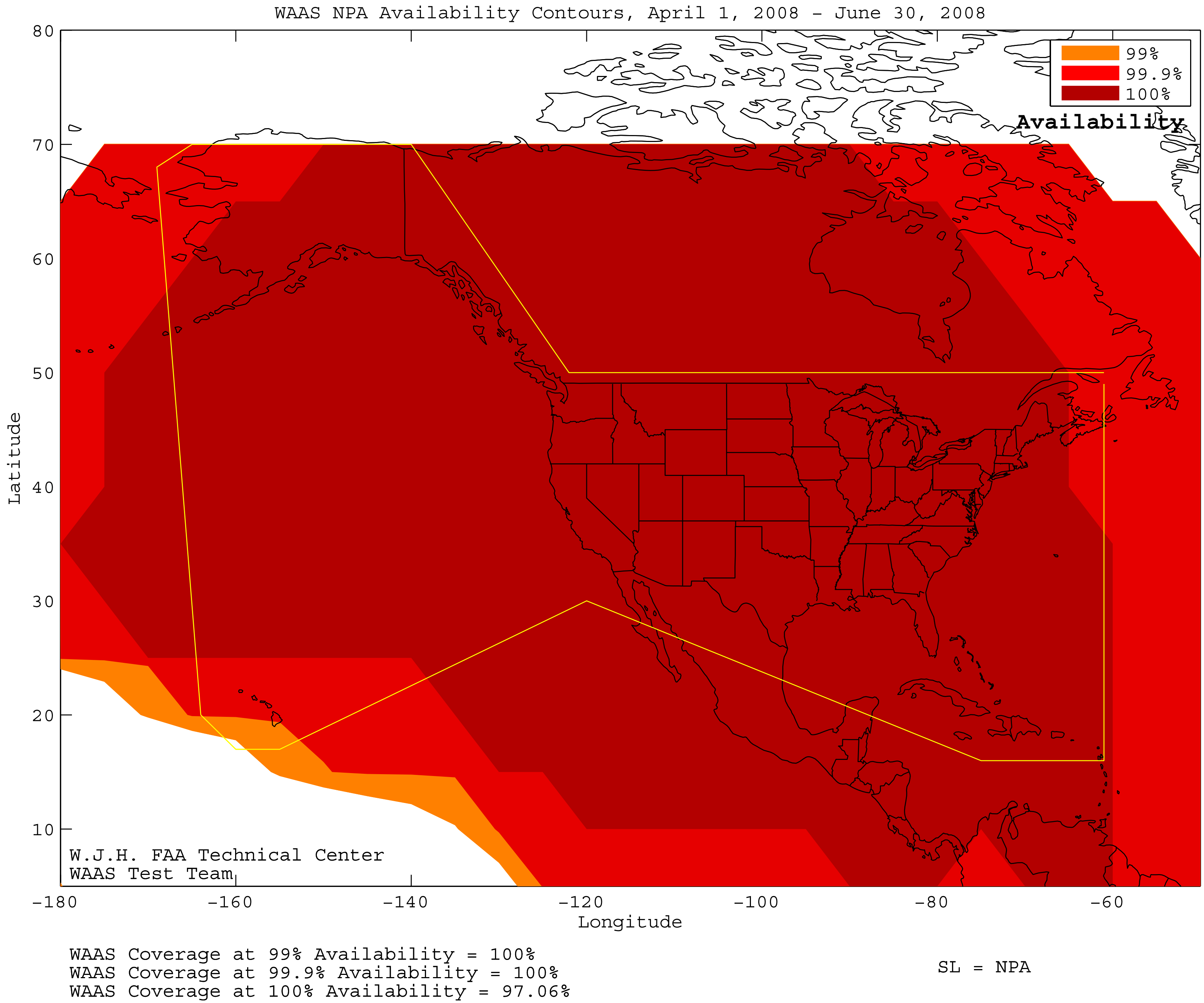


Figure 4-21 Daily LPV and LPV 200 CONUS Coverage

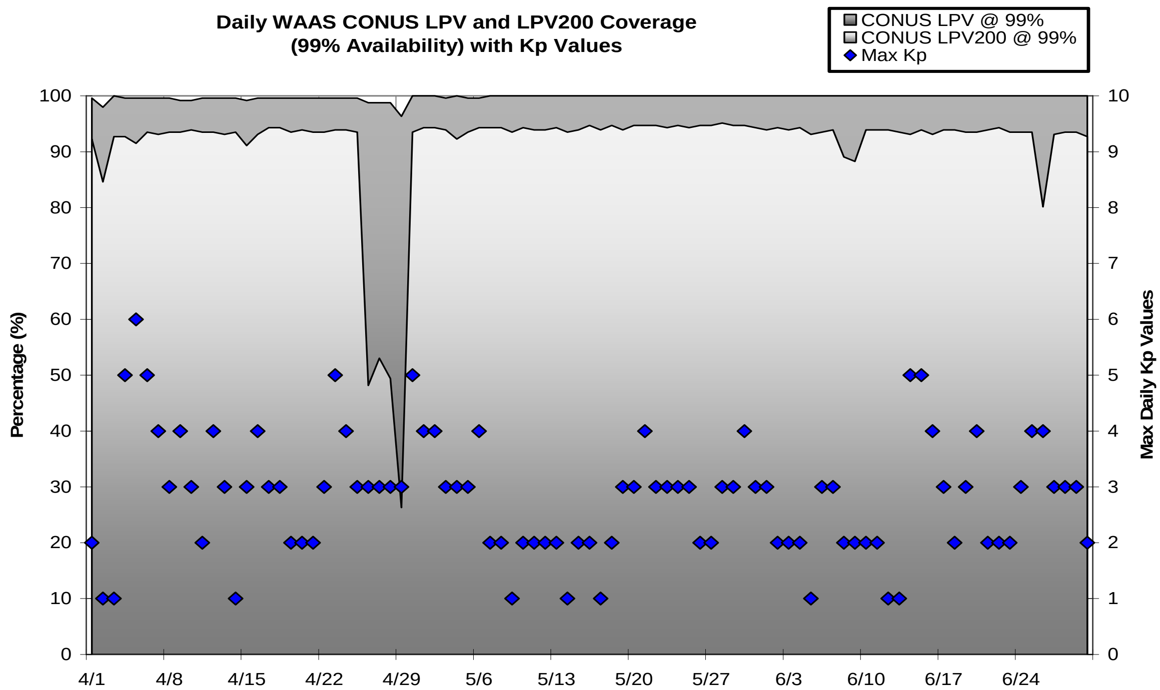


Figure 4-22 Daily LPV Alaska Coverage

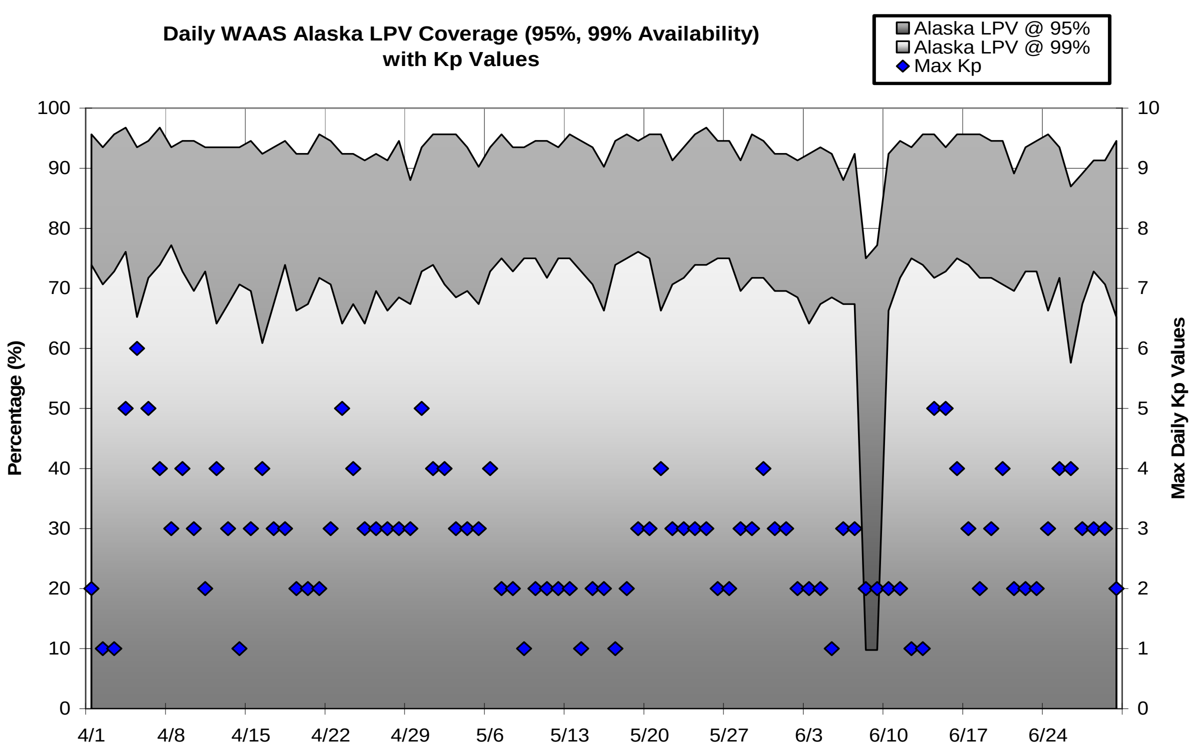
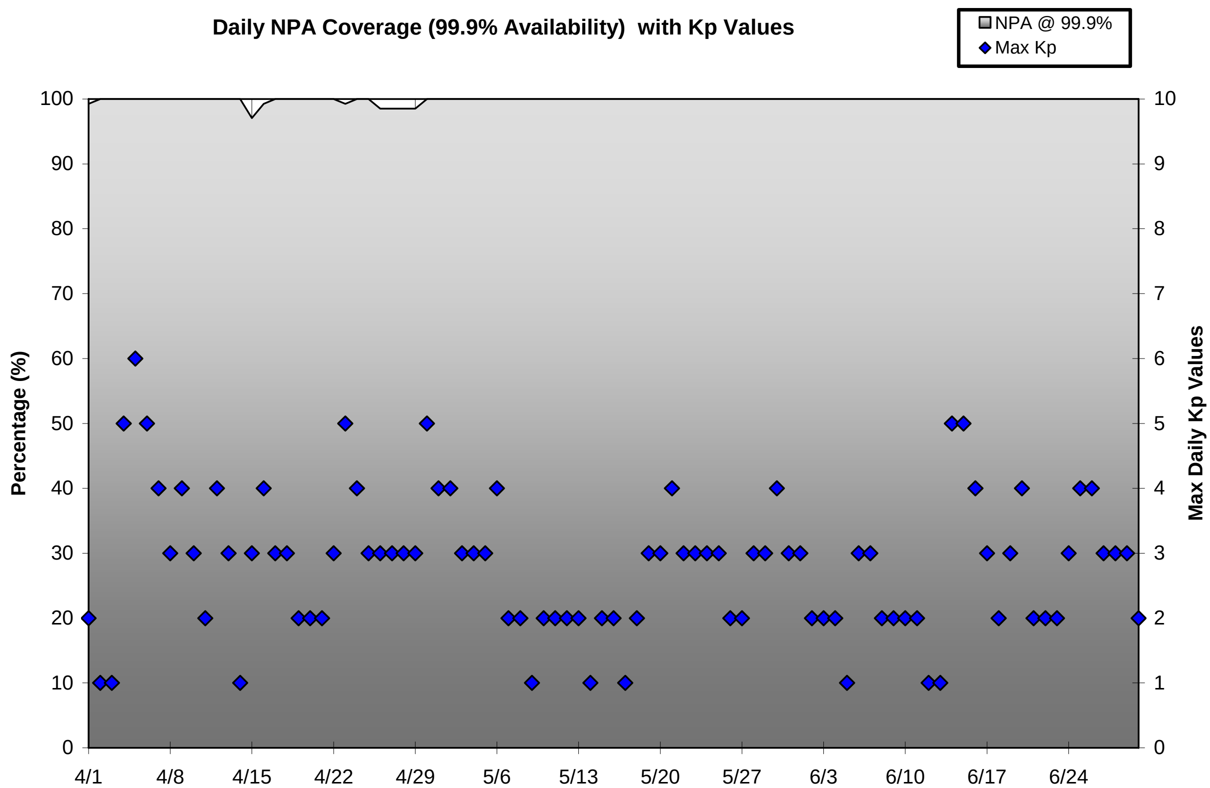


Figure 4-23 Daily NPA Coverage



5.0 INTEGRITY

5.1 HMI Analysis

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

Table 5.1 lists the safety index and the number of HMIs. For this evaluation period, the lowest safety margin index is 1.97 at Tapachula. 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	
Atlantic City	4.35	4.55	0
Arcata	18.27	10.14	0
Oklahoma City	21.97	7.58	0
Albuquerque	14.26	8.33	0
Anchorage	9.91	8.42	0
Atlanta	17.47	7.21	0
Barrow	5.34	5.97	0
Bethel	18.96	15.31	0
Billings	11.22	7.70	0
Boston	7.58	11.24	0
Chicago	19.35	8.83	0
Cleveland	8.65	6.52	0
Cold Bay	14.60	14.18	0
Dallas	11.79	5.80	0
Denver	13.10	8.21	0
Fairbanks	7.85	7.01	0
Gander	12.00	13.05	0
Goose Bay	18.89	15.35	0
Houston	9.09	13.09	0
Iqaluit	6.97	7.80	0
Jacksonville	11.01	8.69	0
Juneau	10.77	8.77	0
Kansas City	15.77	8.35	0
Kotzebue	9.10	5.41	0
Los Angeles	4.40	12.40	0
Memphis	17.48	10.43	0
Merida	10.28	8.48	0
Mexico City	10.86	14.71	0
Miami	8.62	10.58	0
Minneapolis	3.09	5.67	0
New York	9.72	11.87	0
Oakland	11.37	14.80	0
Puerto Vallarta	10.40	8.02	0
Salt Lake City	10.13	8.17	0
San Jose Del Cabo	6.08	9.43	0
San Juan	10.00	5.45	0
Seattle	3.96	5.10	0
Tapachula	11.19	11.37	0
Washington DC	22.86	15.54	0
Winnipeg	7.65	8.00	0

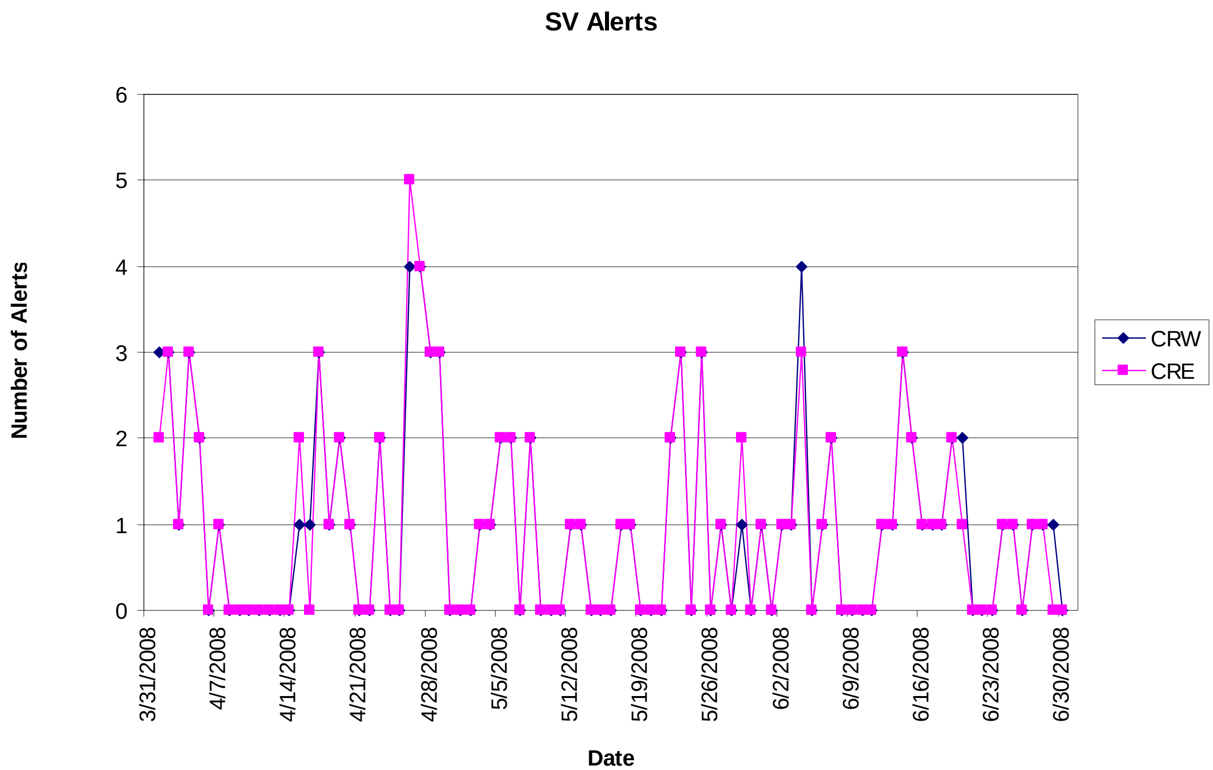
5.2 Broadcast Alerts

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	28	28	0.3077	0.3077
3	40	40	0.4396	0.4396
4	21	19	0.2308	0.2088
5	0	0	0	0
6	0	0	0	0
24	0	0	0	0
26	0	0	0	0
Total Alerts	89	87	0.9780	0.9560

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	115990	83	168
2	1310397	49	29
3	1310451	40	26
4	1310383	51	23
7	104608	199	191
9	92137	0	0
10	104672	210	175
17	31901	24	343

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

SV	On Time	Late	Max Late Length (seconds)
2	44212	0	0
3	50671	0	0
4	47290	0	0
5	50615	0	0
6	51903	0	0
7	46619	0	0
8	45053	0	0
9	48744	0	0
10	46456	0	0
11	50742	0	0
12	48847	0	0
13	47377	0	0
14	47511	0	0
15	49207	0	0
16	47916	0	0
17	47213	0	0
18	46191	0	0
19	48846	0	0
20	50003	0	0
21	44893	0	0
22	46620	0	0
23	45903	0	0
24	47613	0	0
25	47282	0	0
26	48794	0	0
27	46327	0	0
28	47339	0	0
29	47460	0	0
30	50677	0	0
31	47808	0	0
32	46962	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	40965	0	0
3	47162	0	0
4	44081	0	0
5	47346	1	182
6	48344	0	0
7	43263	0	0
8	41830	0	0
9	45499	0	0
10	43157	0	0
11	47493	0	0
12	45659	0	0
13	44106	0	0
14	44340	0	0
15	45549	0	0
16	44576	0	0
17	43692	0	0
18	42712	0	0
19	44260	0	0
20	44993	0	0
21	40400	0	0
22	41919	0	0
23	41289	0	0
24	42827	0	0
25	42621	0	0
26	43992	0	0
27	41686	0	0
28	42441	0	0
29	42779	1	192
30	45589	0	0
31	43080	0	0
32	42216	0	0
135	82666	0	0
138	82254	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27210	68	323
0	1	27210	60	322
0	2	27204	58	314
0	3	27228	50	312
1	0	27213	65	318
1	1	27209	69	317
1	2	27228	46	318
1	3	27233	53	318
1	4	27199	67	311
2	0	27211	62	312
2	1	27220	53	319
2	2	27213	56	314
2	3	27222	47	317
2	4	27216	45	312
2	5	27212	53	312
3	0	27213	72	318
3	1	27239	58	312
3	2	27211	58	312
9	0	27226	51	312
9	1	27223	50	316
9	2	27214	55	318
9	3	27218	55	317
9	4	27202	55	312

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

Band	On Time	Late	Max Late Length (seconds)
0	81828	0	0
1	81835	0	0
2	81937	0	0
3	81843	0	0
9	81797	0	0

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

Message Type	On Time	Late	Max Late Length (seconds)
1	116120	95	180
2	1310397	49	27
3	1310455	38	24
4	1310372	53	26
7	104567	214	174
9	92129	2	353
10	104689	188	192
17	31906	32	365

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

SV	On Time	Late	Max Late Length (seconds)
2	44208	0	0
3	50661	1	179
4	47290	0	0
5	50609	0	0
6	51895	0	0
7	46619	0	0
8	45053	0	0
9	48745	0	0
10	46454	0	0
11	50738	0	0
12	48848	0	0
13	47371	0	0
14	47509	0	0
15	49203	0	0
16	47910	0	0
17	47211	0	0
18	46196	0	0
19	48853	0	0
20	50000	0	0
21	44897	0	0
22	46626	0	0
23	45924	0	0
24	47619	0	0
25	47299	0	0
26	48783	0	0
27	46322	0	0
28	47344	0	0
29	47455	0	0
30	50674	0	0
31	47797	0	0
32	46967	1	179

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

SV	On Time	Late	Max Late Length (seconds)
2	40966	0	0
3	47165	0	0
4	44082	0	0
5	47351	0	0
6	48343	0	0
7	43261	0	0
8	41827	1	184
9	45499	0	0
10	43155	0	0
11	47490	1	169
12	45658	0	0
13	44101	1	181
14	44339	0	0
15	45550	0	0
16	44578	0	0
17	43693	0	0
18	42707	0	0
19	44253	0	0
20	44989	0	0
21	40400	0	0
22	41919	0	0
23	41289	0	0
24	42827	0	0
25	42619	0	0
26	43989	0	0
27	41690	0	0
28	42444	0	0
29	42783	1	196
30	45587	0	0
31	43079	0	0
32	42215	0	0
135	82668	0	0
138	82261	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27204	57	317
0	1	27242	47	312
0	2	27215	51	313
0	3	27209	61	319
1	0	27215	59	323
1	1	27222	52	317
1	2	27216	58	317
1	3	27197	73	317
1	4	27223	55	317
2	0	27227	51	312
2	1	27210	52	317
2	2	27216	62	312
2	3	27210	56	319
2	4	27222	56	312
2	5	27226	60	317
3	0	27199	59	312
3	1	27216	49	311
3	2	27237	56	318
9	0	27207	62	318
9	1	27200	61	318
9	2	27210	75	316
9	3	27213	60	312
9	4	27230	47	322

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

Band	On Time	Late	Max Late Length (seconds)
0	81715	0	0
1	81817	0	0
2	81752	0	0
3	81791	0	0
9	81728	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	
SV ↓	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.008	100.00	1.505	100.00	1.505	100.00	1.225	100.00	3.154	100.00	1.352	100.00
3	1.624	100.00	0.972	100.00	0.972	100.00	1.008	100.00	1.286	100.00	1.028	100.00
4	1.770	100.00	1.620	100.00	1.620	100.00	1.261	100.00	1.690	100.00	1.511	100.00
5	1.036	100.00	1.118	100.00	1.118	100.00	0.793	100.00	1.277	100.00	1.055	100.00
6	1.499	100.00	1.105	100.00	1.105	100.00	1.190	100.00	1.344	100.00	1.550	100.00
7	1.964	100.00	1.850	100.00	1.850	100.00	2.160	100.00	2.324	100.00	2.144	100.00
8	1.182	100.00	0.813	100.00	0.813	100.00	0.873	100.00	0.929	100.00	1.040	100.00
9	1.166	100.00	1.175	100.00	1.175	100.00	1.145	100.00	1.238	100.00	1.514	100.00
10	0.756	100.00	1.411	100.00	1.411	100.00	0.996	100.00	1.035	100.00	1.479	100.00
11	0.912	100.00	1.502	100.00	1.502	100.00	1.274	100.00	1.083	100.00	1.060	100.00
12	1.457	100.00	1.519	100.00	1.519	100.00	1.064	100.00	1.079	100.00	1.727	100.00
13	1.408	100.00	1.005	100.00	1.005	100.00	0.819	100.00	1.457	100.00	1.208	100.00
14	1.842	100.00	0.877	100.00	0.877	100.00	0.813	100.00	1.118	100.00	1.922	100.00
15	1.513	100.00	1.365	100.00	1.365	100.00	1.409	100.00	1.419	100.00	1.477	100.00
16	0.939	100.00	0.983	100.00	0.983	100.00	1.121	100.00	1.212	100.00	0.921	100.00
17	1.732	100.00	1.233	100.00	1.233	100.00	0.966	100.00	1.185	100.00	1.246	100.00
18	0.580	100.00	0.835	100.00	0.835	100.00	1.267	100.00	1.633	100.00	1.349	100.00
19	1.856	100.00	2.327	100.00	2.327	100.00	2.424	100.00	2.924	100.00	2.205	100.00
20	0.666	100.00	1.246	100.00	1.246	100.00	1.026	100.00	1.545	100.00	1.412	100.00
21	1.336	100.00	1.439	100.00	1.439	100.00	1.455	100.00	1.219	100.00	1.236	100.00
22	0.863	100.00	0.868	100.00	0.868	100.00	1.398	100.00	1.254	100.00	1.134	100.00
23	0.904	100.00	1.557	100.00	1.557	100.00	1.652	100.00	2.342	100.00	1.567	100.00
24	1.596	100.00	1.489	100.00	1.489	100.00	1.316	100.00	1.400	100.00	1.481	100.00
25	1.305	100.00	0.898	100.00	0.898	100.00	0.850	100.00	1.284	100.00	1.091	100.00
26	2.048	100.00	1.371	100.00	1.371	100.00	1.341	100.00	1.465	100.00	1.605	100.00
27	1.232	100.00	0.898	100.00	0.898	100.00	1.153	100.00	0.980	100.00	1.126	100.00
28	0.537	100.00	0.699	100.00	0.699	100.00	1.094	100.00	1.207	100.00	0.986	100.00
29	1.676	100.00	1.213	100.00	1.213	100.00	1.231	100.00	1.281	100.00	1.414	100.00
30	2.141	100.00	1.338	100.00	1.338	100.00	1.397	100.00	1.453	100.00	1.784	100.00
31	2.385	100.00	1.097	100.00	1.097	100.00	0.956	100.00	1.393	100.00	1.358	100.00
32	1.452	100.00	1.125	100.00	1.125	100.00	0.767	100.00	1.022	100.00	1.150	100.00
135	-	-	-	-	-	-	-	-	-	-	-	-
138	-	-	-	-	-	-	-	-	-	-	-	-

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding	95% Range Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	2.025	100.00	1.927	100	1.782	100.00	1.273	100.00	1.197	100.00	1.054	100.00
3	0.780	100.00	0.862	100	1.390	100.00	1.331	100.00	1.065	100.00	1.263	100.00
4	1.108	100.00	1.467	100	2.290	100.00	1.529	100.00	1.628	100.00	1.795	100.00
5	1.435	100.00	1.118	100	1.054	100.00	1.290	100.00	0.888	100.00	1.441	100.00
6	1.170	100.00	1.118	100	1.551	100.00	1.329	100.00	1.523	100.00	1.841	100.00
7	2.327	100.00	1.790	100	3.594	100.00	1.748	100.00	2.027	100.00	1.647	100.00
8	0.613	100.00	0.714	100	1.194	100.00	1.426	100.00	1.099	100.00	1.365	100.00
9	1.081	100.00	0.893	100	1.166	100.00	0.964	100.00	1.176	100.00	1.269	100.00
10	1.275	100.00	0.859	100	0.813	100.00	0.913	100.00	0.782	100.00	0.970	100.00
11	1.705	100.00	1.418	100	0.836	100.00	0.817	100.00	1.053	100.00	0.992	100.00
12	1.029	100.00	1.056	100	1.443	100.00	1.475	100.00	1.577	100.00	1.558	100.00
13	0.727	100.00	0.863	100	1.858	100.00	1.354	100.00	1.419	100.00	1.535	100.00
14	0.989	100.00	0.842	100	1.195	100.00	1.030	100.00	0.930	100.00	0.997	100.00
15	1.787	100.00	1.016	100	1.236	100.00	1.427	100.00	1.618	100.00	1.753	100.00
16	1.250	100.00	0.893	100	1.109	100.00	0.739	100.00	0.861	100.00	0.753	100.00
17	0.857	100.00	0.837	100	1.135	100.00	1.005	100.00	1.128	100.00	1.348	100.00
18	1.604	100.00	2.227	100	1.407	100.00	1.145	100.00	1.081	100.00	0.714	100.00
19	3.314	100.00	2.207	100	2.244	100.00	1.927	100.00	2.445	100.00	2.086	100.00
20	1.535	100.00	1.320	100	1.259	100.00	0.943	100.00	0.902	100.00	0.789	100.00
21	2.018	100.00	1.307	100	1.526	100.00	1.055	100.00	1.052	100.00	0.952	100.00
22	1.465	100.00	1.168	100	1.590	100.00	1.039	100.00	1.125	100.00	0.809	100.00
23	1.935	100.00	1.537	100	1.761	100.00	1.400	100.00	1.528	100.00	0.939	100.00
24	1.010	100.00	1.206	100	1.402	100.00	1.552	100.00	1.517	100.00	1.827	100.00
25	1.131	100.00	0.909	100	1.426	100.00	1.147	100.00	1.060	100.00	1.511	100.00
26	0.888	100.00	1.192	100	1.863	100.00	1.485	100.00	1.557	100.00	1.792	100.00
27	0.831	100.00	0.848	100	1.046	100.00	1.189	100.00	1.112	100.00	1.478	100.00
28	1.167	100.00	0.782	100	1.974	100.00	0.661	100.00	0.903	100.00	0.818	100.00
29	0.775	100.00	1.140	100	1.729	100.00	1.314	100.00	1.332	100.00	1.644	100.00
30	1.208	100.00	1.213	100	2.189	100.00	1.703	100.00	1.659	100.00	1.892	100.00
31	1.224	100.00	1.239	100	1.981	100.00	1.128	100.00	1.037	100.00	1.443	100.00
32	0.767	100.00	0.878	100	1.266	100.00	1.208	100.00	1.068	100.00	1.461	100.00
135	-	-	-	-	-	-	-	-	-	-	-	-
138	-	-	-	-	-	-	-	-	-	-	-	-

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	0.831	100.00	1.081	100.00	0.916	100.00	0.990	100.00	1.703	100.00	0.968	100.00
3	0.639	100.00	0.454	100.00	0.402	100.00	0.332	100.00	0.734	100.00	0.420	100.00
4	1.036	100.00	1.192	100.00	1.246	100.00	0.848	100.00	1.408	100.00	0.943	100.00
5	0.404	100.00	0.652	100.00	0.507	100.00	0.283	100.00	0.628	100.00	0.426	100.00
6	0.710	100.00	0.591	100.00	0.650	100.00	0.443	100.00	0.603	100.00	0.596	100.00
7	1.121	100.00	1.401	100.00	1.334	100.00	1.768	100.00	1.554	100.00	1.616	100.00
8	0.597	100.00	0.407	100.00	0.520	100.00	0.375	100.00	0.520	100.00	0.471	100.00
9	0.639	100.00	0.688	100.00	0.502	100.00	0.379	100.00	0.551	100.00	0.630	100.00
10	0.375	100.00	0.832	100.00	0.414	100.00	0.462	100.00	0.584	100.00	0.767	100.00
11	0.200	100.00	0.775	100.00	0.385	100.00	0.651	100.00	0.519	100.00	0.588	100.00
12	0.727	100.00	0.756	100.00	0.616	100.00	0.403	100.00	0.470	100.00	0.703	100.00
13	0.589	100.00	0.571	100.00	0.592	100.00	0.333	100.00	0.845	100.00	0.547	100.00
14	0.979	100.00	0.335	100.00	0.689	100.00	0.293	100.00	0.657	100.00	0.617	100.00
15	0.859	100.00	0.904	100.00	0.585	100.00	0.747	100.00	0.682	100.00	0.754	100.00
16	0.326	100.00	0.495	100.00	0.362	100.00	0.612	100.00	0.540	100.00	0.381	100.00
17	1.066	100.00	0.866	100.00	0.803	100.00	0.563	100.00	0.703	100.00	0.709	100.00
18	0.369	100.00	0.652	100.00	0.675	100.00	0.783	100.00	0.879	100.00	0.773	100.00
19	1.147	100.00	1.627	100.00	1.486	100.00	1.617	100.00	1.929	100.00	1.530	100.00
20	0.286	100.00	0.575	100.00	0.604	100.00	0.492	100.00	0.736	100.00	0.675	100.00
21	0.684	100.00	0.869	100.00	0.919	100.00	1.070	100.00	0.781	100.00	0.773	100.00
22	0.422	100.00	0.578	100.00	0.901	100.00	0.901	100.00	0.693	100.00	0.693	100.00
23	0.800	100.00	1.232	100.00	1.157	100.00	1.378	100.00	1.856	100.00	1.229	100.00
24	0.869	100.00	1.023	100.00	0.918	100.00	0.637	100.00	0.755	100.00	0.807	100.00
25	0.666	100.00	0.443	100.00	0.606	100.00	0.345	100.00	0.612	100.00	0.430	100.00
26	0.902	100.00	0.898	100.00	0.662	100.00	0.588	100.00	0.836	100.00	0.782	100.00
27	0.553	100.00	0.448	100.00	0.589	100.00	0.429	100.00	0.492	100.00	0.482	100.00
28	0.383	100.00	0.430	100.00	0.494	100.00	0.758	100.00	0.647	100.00	0.561	100.00
29	0.978	100.00	0.826	100.00	0.792	100.00	0.575	100.00	0.834	100.00	0.822	100.00
30	1.136	100.00	0.723	100.00	0.899	100.00	0.639	100.00	0.720	100.00	0.768	100.00
31	1.427	100.00	0.553	100.00	0.404	100.00	0.667	100.00	0.900	100.00	0.741	100.00
32	0.572	100.00	0.418	100.00	0.532	100.00	0.382	100.00	0.536	100.00	0.474	100.00

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding	95% Iono Error	3.29% Sigma Bounding
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.359	100.00	1.265	100.00	0.927	100.00	0.934	100.00	0.765	100.00	0.833	100.00
3	0.369	100.00	0.350	100.00	0.567	100.00	0.523	100.00	0.426	100.00	0.634	100.00
4	0.811	100.00	0.886	100.00	1.360	100.00	0.978	100.00	1.069	100.00	1.141	100.00
5	0.531	100.00	0.522	100.00	0.434	100.00	0.359	100.00	0.364	100.00	0.558	100.00
6	0.529	100.00	0.488	100.00	0.746	100.00	0.574	100.00	0.649	100.00	0.906	100.00
7	1.589	100.00	1.466	100.00	2.258	100.00	1.526	100.00	1.482	100.00	1.245	100.00
8	0.376	100.00	0.406	100.00	0.806	100.00	0.469	100.00	0.566	100.00	0.784	100.00
9	0.453	100.00	0.502	100.00	0.573	100.00	0.518	100.00	0.586	100.00	0.698	100.00
10	0.754	100.00	0.408	100.00	0.373	100.00	0.387	100.00	0.300	100.00	0.418	100.00
11	0.841	100.00	0.526	100.00	0.398	100.00	0.454	100.00	0.504	100.00	0.707	100.00
12	0.486	100.00	0.519	100.00	0.809	100.00	0.641	100.00	0.762	100.00	0.837	100.00
13	0.532	100.00	0.429	100.00	0.918	100.00	0.668	100.00	0.696	100.00	0.806	100.00
14	0.574	100.00	0.469	100.00	0.765	100.00	0.340	100.00	0.268	100.00	0.445	100.00
15	0.664	100.00	0.566	100.00	0.547	100.00	0.738	100.00	0.844	100.00	1.076	100.00
16	0.697	100.00	0.434	100.00	0.484	100.00	0.347	100.00	0.278	100.00	0.368	100.00
17	0.675	100.00	0.507	100.00	0.752	100.00	0.535	100.00	0.613	100.00	0.745	100.00
18	0.943	100.00	1.204	100.00	0.733	100.00	0.775	100.00	0.609	100.00	0.522	100.00
19	1.830	100.00	1.489	100.00	1.325	100.00	1.438	100.00	1.473	100.00	1.375	100.00
20	0.746	100.00	0.753	100.00	0.754	100.00	0.570	100.00	0.398	100.00	0.367	100.00
21	1.168	100.00	0.850	100.00	1.039	100.00	0.895	100.00	0.679	100.00	0.703	100.00
22	0.928	100.00	0.781	100.00	0.975	100.00	0.783	100.00	0.692	100.00	0.578	100.00
23	1.266	100.00	1.214	100.00	1.372	100.00	1.214	100.00	1.215	100.00	0.761	100.00
24	0.882	100.00	0.989	100.00	0.787	100.00	1.015	100.00	0.912	100.00	1.435	100.00
25	0.444	100.00	0.464	100.00	0.743	100.00	0.497	100.00	0.594	100.00	0.970	100.00
26	0.601	100.00	0.642	100.00	0.953	100.00	0.795	100.00	0.818	100.00	1.083	100.00
27	0.374	100.00	0.401	100.00	0.682	100.00	0.489	100.00	0.580	100.00	0.843	100.00
28	0.608	100.00	0.517	100.00	1.006	100.00	0.531	100.00	0.459	100.00	0.415	100.00
29	0.624	100.00	0.795	100.00	0.989	100.00	0.779	100.00	0.870	100.00	1.090	100.00
30	0.707	100.00	0.727	100.00	1.101	100.00	0.872	100.00	0.830	100.00	1.070	100.00
31	0.616	100.00	0.534	100.00	1.222	100.00	0.523	100.00	0.526	100.00	0.773	100.00
32	0.420	100.00	0.354	100.00	0.674	100.00	0.463	100.00	0.534	100.00	0.772	100.00

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

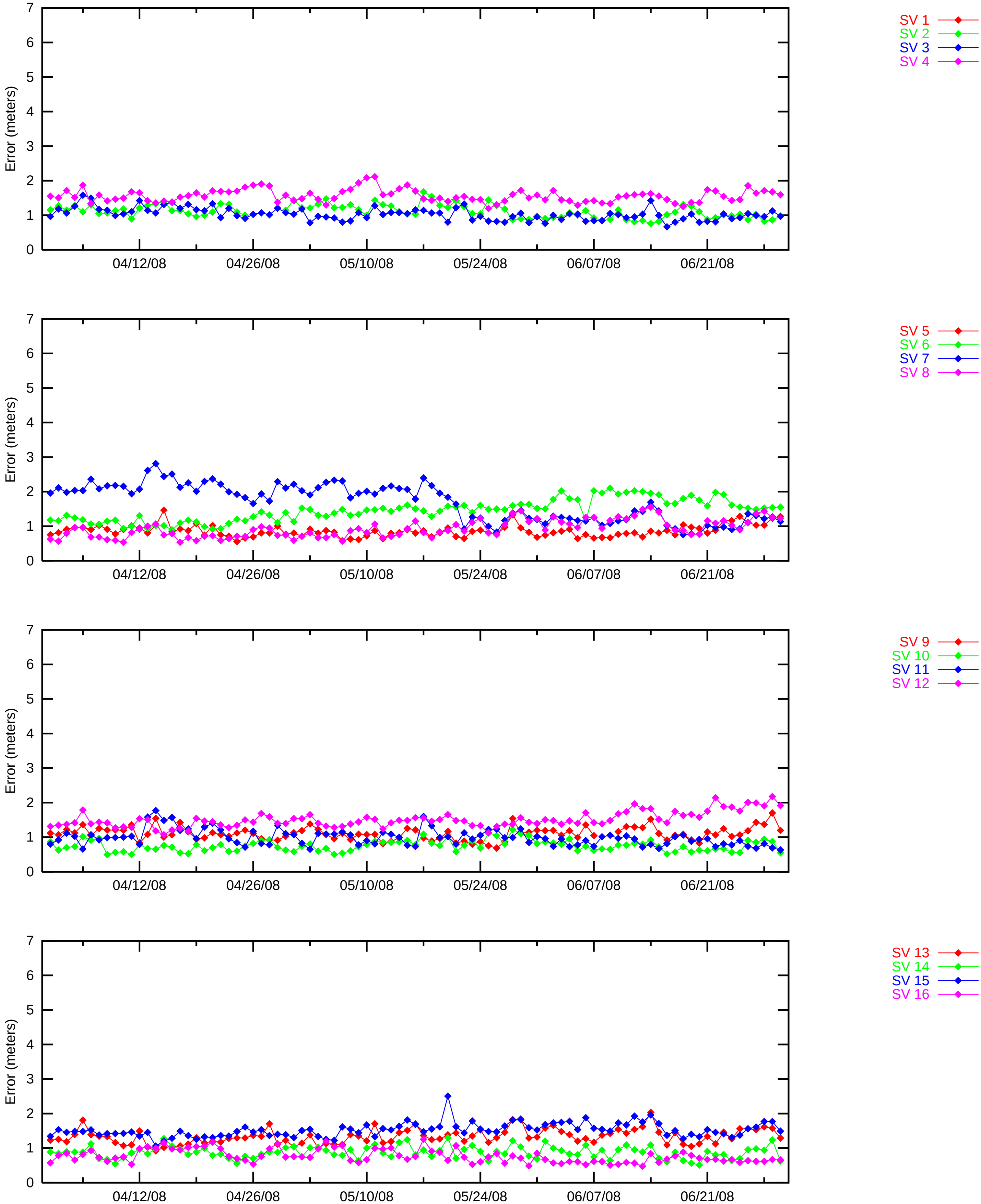
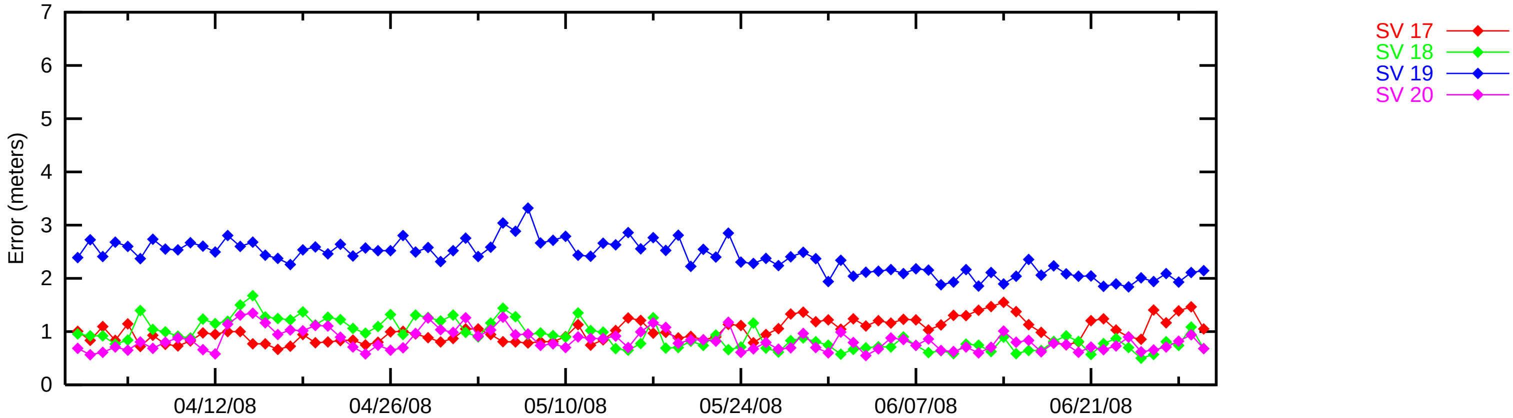
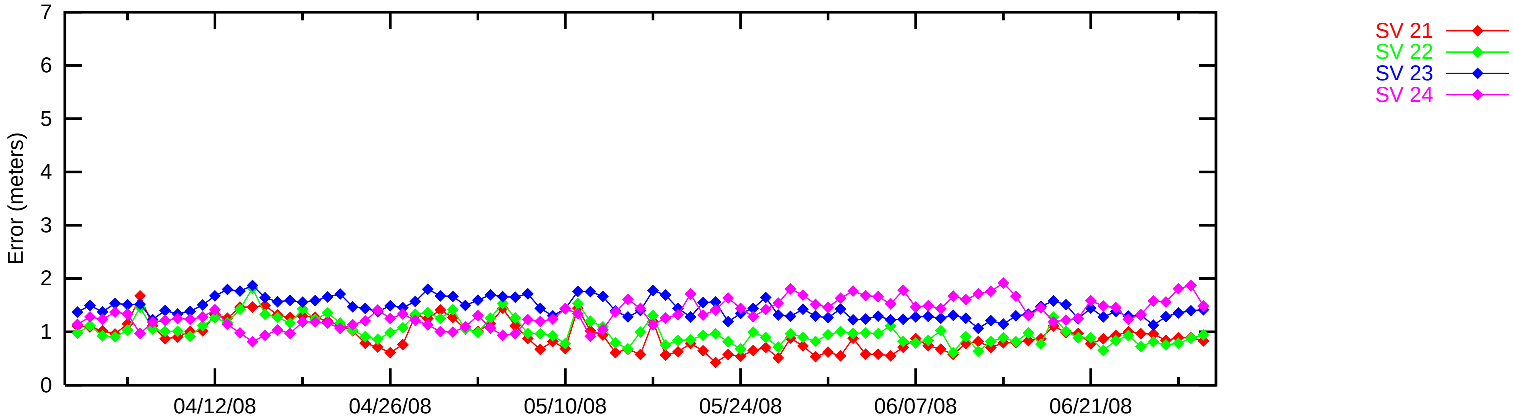
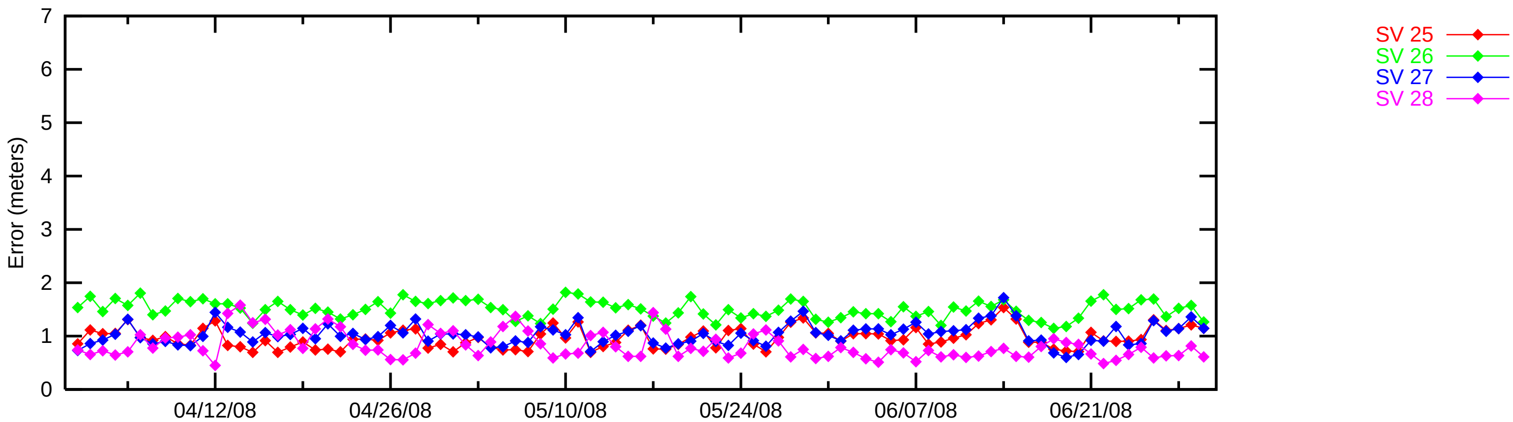


Figure 6-2 95% Range Error (SV17 - SV 32) - Atlanta







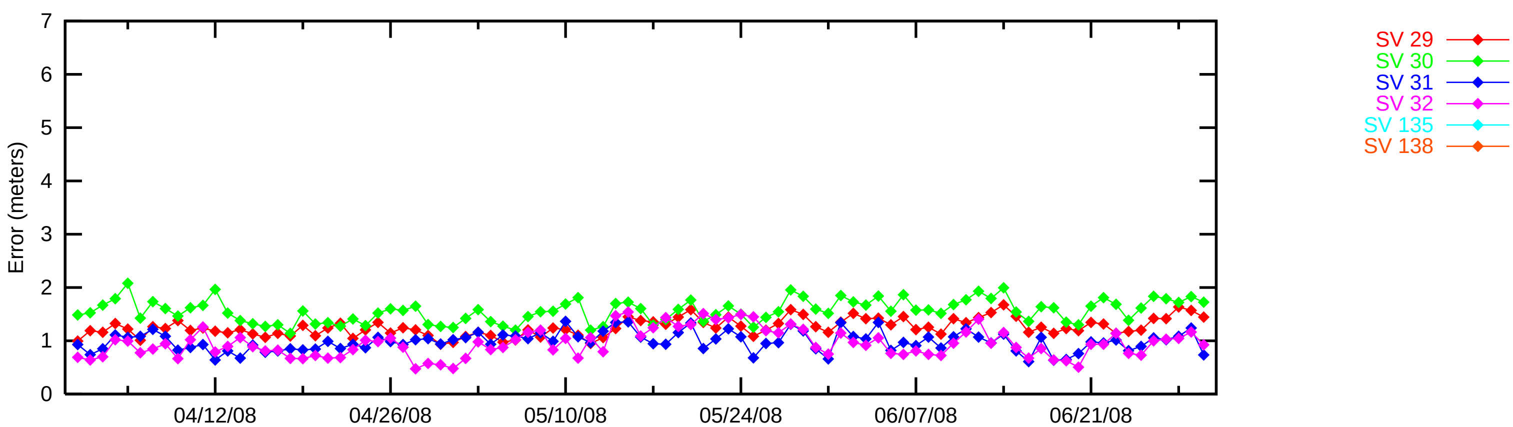


Figure 6-3 95% Ionospheric (SV 1 - SV 16) - Atlanta

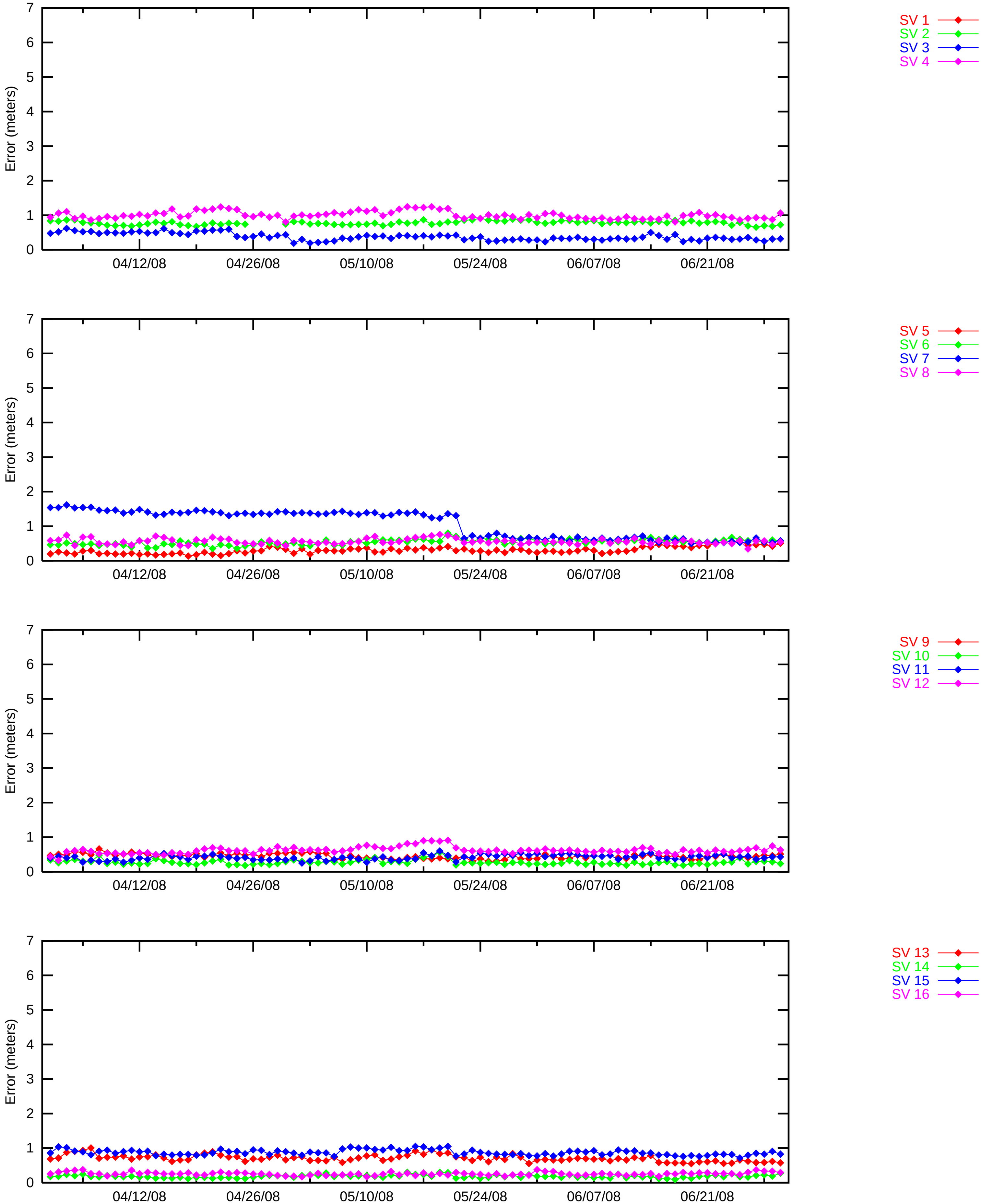
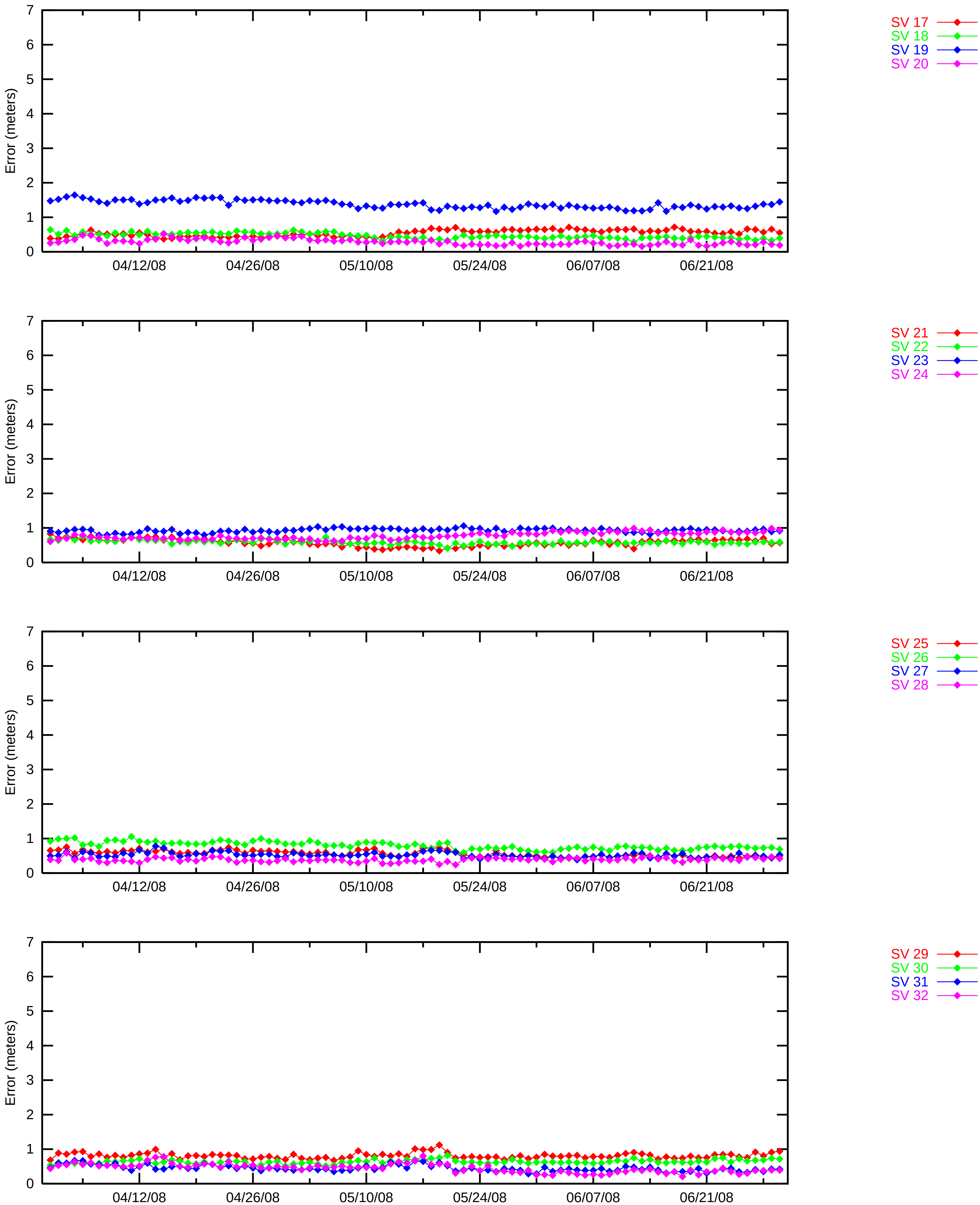


Figure 6-4 95% Ionospheric (SV 17 - SV 32) - Atlanta



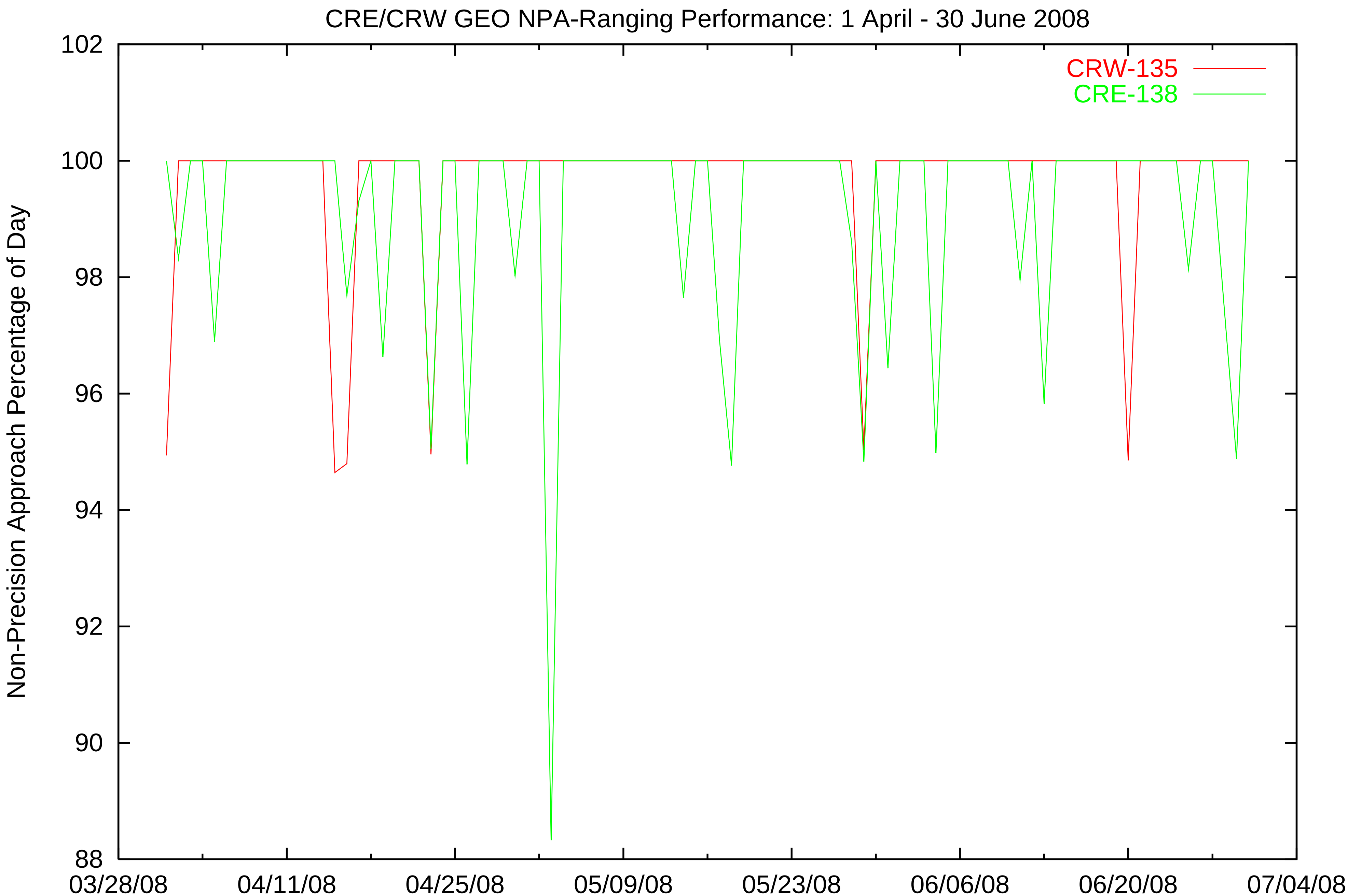
7.0 GEO RANGING PERFORMANCE

For the evaluation period, both CRW and CRE GEO satellites provide ranging capability for enroute through NPA service, but not for 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	0	99.661	0.337	0.001
CRE	0	99.158	0.591	0.250

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
4/2/08	See DR#68, "Satellite Outages Caused Loss of Availability in CONUS Region"
6/8/08 to 6/9/08	See DR#72 , "Loss of Availability in Alaska due to Satellite Maintenance" on PRN9

9.0 WAAS AIRPORT AVAILABILITY

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

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	Outages	Availability
PANC	ANCHORAGE INTL	AK	2	0.999441
PAEN	EMMONAK	AK	2	0.999427
PAFA	FAIRBANKS INTL	AK	4	0.999326
PAHO	HOMER	AK	4	0.999400
PAEN	KENAI MUNICIPAL	AK	2	0.999427
PASK	SELAWIK	AK	266	0.980293
PAMK	ST MICHAEL	AK	87	0.992397
AUO	AUBURN-OPELIKA ROBERT G. PITTS	AL	0	1.000000
EKY	BESSEMER	AL	0	1.000000
BHM	BIRMINGHAM INTL	AL	0	1.000000
SEM	CRAIG FIELD	AL	0	1.000000
DHN	DOTHAN REGIONALIONAL	AL	0	1.000000
HSV	HUNTSVILLE INTL - CARL T. JONES FIELD	AL	1	0.999977
JKA	JACK EDWARDS	AL	0	1.000000
MDQ	MADISON COUNTY EXECUTIVE/TOM SHARP JR FIELD	AL	1	0.999978
BFM	MOBILE DOWNTOWN	AL	0	1.000000
MOB	MOBILE REGIONAL	AL	0	1.000000
MGM	MONTGOMERY REGIONAL (DANNELLY FIELD)	AL	0	1.000000
MSL	NORTHWEST ALABAMA REGIONAL	AL	1	0.999971
DCU	PRYOR FIELD REGIONAL	AL	1	0.999975
79J	SOUTH ALABAMA REGIONAL AT BILL BENTON FIELD	AL	0	1.000000
PLR	ST CLAIR COUNTY	AL	0	1.000000
8A0	THE ALBERTVILLE MUNICIPAL-THOMAS J. BRUMLIK FIELD	AL	0	1.000000
LIT	ADAMS FIELD	AR	0	1.000000
M73	ALMYRA MUNICIPAL	AR	1	0.999972
BYH	ARKANSAS INTL	AR	0	1.000000
VBT	BENTONVILLE MUNICIPAL/LOUISE M. THADEN FIELD	AR	0	1.000000
HRO	BOONE COUNTY	AR	0	1.000000
FSM	FORT SMITH REGIONAL	AR	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
PBF	GRIDER FIELD	AR	1	0.999970
XNA	NORTHWEST ARKANSAS REGIONAL	AR	0	1.000000
BPK	OZARK REGIONAL	AR	0	1.000000
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1.000000
RUE	RUSSELLVILLE REGIONAL	AR	0	1.000000
SRC	SEARCY MUNICIPAL	AR	0	1.000000
SLG	SMITH FIELD	AR	0	1.000000
ELD	SOUTH ARKANSAS REGIONAL AT GOODWIN FIELD	AR	1	0.999944
ASG	SPRINGDALE MUNICIPAL	AR	0	1.000000
SGT	STUGGART MUNICIPAL	AR	0	1.000000
ARG	WALNUT RIDGE REGIONAL	AR	0	1.000000
PRC	ERNEST A. LOVE FIELD	AZ	1	0.999984
GEU	GLENDALE MUNICIPAL	AZ	4	0.999881
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1.000000
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1.000000
DVT	PHOENIX DEER VALLEY	AZ	3	0.999921
PHX	PHOENIX SKY HARBOR INTL	AZ	3	0.999900
SJN	ST JOHNS INDUSTRIAL AIRPARK	AZ	0	1.000000
TUS	TUCSON INTL	AZ	51	0.998040
IWA	WILLIAMS GATEWAY	AZ	3	0.999898
APV	APPLE VALLEY	CA	0	1.000000
ACV	ARCATA	CA	76	0.995745
BFL	BAKERSFIELD/MEADOWS FIELD	CA	15	0.999420
DAG	BARSTOW-DAGGETT	CA	0	1.000000
C83	BYRON	CA	25	0.998652
CMA	CAMARILLO	CA	30	0.998673
CNO	CHINO	CA	8	0.999732
FAT	FRESNO YOSEMITE INTL	CA	15	0.999447
WJF	GENERAL WM J FOX AIRFIELD	CA	11	0.999644
HAF	HALF MOON BAY	CA	42	0.997228
SNA	JOHN WAYNE AIRPORT-ORANGE COUNTY	CA	15	0.999497
LGB	LONG BEACH (DAUGHERTY FIELD)	CA	20	0.999323
LAX	LOS ANGELES INTL	CA	22	0.999208
CRQ	MCCLELLAN-PALOMAR	CA	12	0.999640
OAK	METROPOLITAN OAKLAND INTL	CA	36	0.997793
MRY	MONTEREY PENINSULA	CA	46	0.997242
APC	NAPA COUNTY	CA	30	0.998111
O02	NERVINO	CA	6	0.999766
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	35	0.997886
VCB	NUT TREE	CA	26	0.998564
ONT	ONTARIO INTL	CA	8	0.999754
OXR	OXNARD	CA	33	0.998479
PMD	PALMDALE PRODUCTION FLIGHT	CA	11	0.999670
RDD	REDDING MUNICIPAL	CA	16	0.999344
RAL	RIVERSIDE MUNICIPAL	CA	7	0.999791
SMF	SACRAMENTO INTL	CA	20	0.999035
MHR	SACRAMENTO MATHER	CA	18	0.999151
SFO	SAN FRANCISCO INTL	CA	38	0.997497
TCY	TRACY MUNICIPAL	CA	25	0.998713
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	0	1.000000
AKO	COLORADO PLAINS REGIONAL	CO	0	1.000000
CEZ	CORTEZ MUNICIPAL	CO	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
DEN	DENVER INTL	CO	0	1.000000
GXY	GREELEY-WELD COUNTY	CO	0	1.000000
ITR	KIT CARSON COUNTY	CO	0	1.000000
LAA	LAMAR MUNICIPAL	CO	0	1.000000
PUB	PUEBLO MEMORIAL	CO	0	1.000000
ALS	SAN LUIS VALLEY REGIONAL/BERGMAN FIELD	CO	0	1.000000
HDN	YAMPA VALLEY	CO	0	1.000000
BDL	BRADLEY INTL	CT	0	1.000000
GON	GROTON-NEW LONDON	CT	0	1.000000
HVN	TWEED-NEW HAVEN	CT	0	1.000000
OXC	WATERBURY-OXFORD	CT	0	1.000000
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	0	1.000000
EVY	SUMMIT	DE	0	1.000000
GED	SUSSEX COUNTY	DE	0	1.000000
AAF	APALACHICOLA MUNICIPAL	FL	0	1.000000
CEW	BOB SIKES	FL	0	1.000000
BCT	BOCA RATON	FL	0	1.000000
BKV	BROOKSVILLE	FL	0	1.000000
DAB	DAYTONA BEACH INTL	FL	0	1.000000
DED	DELAND MUNICIPAL-SIDNEY H. TAYLOR FIELD	FL	0	1.000000
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1.000000
FLL	FORT LAUDERDALE-HOLLYWOOD INTL	FL	0	1.000000
GNV	GAINESVILLE REGIONAL	FL	0	1.000000
JAX	JACKSONVILLE INTL	FL	0	1.000000
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	0	1.000000
EYW	KEY WEST INTL	FL	1	0.999983
ISM	KISSIMMEE GATEWAY	FL	0	1.000000
LAL	LAKELAND LINDER REGIONAL	FL	0	1.000000
LEE	LEESBURG INTL	FL	0	1.000000
MLB	MELBOURNE INTL	FL	0	1.000000
COI	MERRITT ISLAND	FL	0	1.000000
MIA	MIAMI INTL	FL	0	1.000000
APF	NAPLES MUNICIPAL	FL	0	1.000000
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1.000000
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1.000000
MCO	ORLANDO INTL	FL	0	1.000000
PBI	PALM BEACH INTL	FL	0	1.000000
PFN	PANAMA CITY-BAY COUNTY INTL	FL	0	1.000000
PNS	PENSACOLA REGIONAL	FL	0	1.000000
PMP	POMPANO BEACH AIRPARK	FL	0	1.000000
SRQ	SARASOTA/BRADENTON INTL	FL	0	1.000000
RSW	SOUTHWEST FLORIDA INTL	FL	0	1.000000
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1.000000
TLH	TALLAHASSEE REGIONAL	FL	0	1.000000
TPA	TAMPA INTL	FL	0	1.000000
MTH	THE FLORIDA KEYS MARATHON	FL	0	1.000000
VDF	VANDENBURG	FL	0	1.000000
GIF	WINTER HAVEN'S GILBERT	FL	0	1.000000
AGS	AUGUSTA REGIONAL AT BUSH FIELD	GA	0	1.000000
BQK	BRUNSWICK GOLDEN ISLE	GA	0	1.000000
VPC	CARTERSVILLE	GA	0	1.000000
RYY	COBB COUNTY-MCCOLLUM FIELD	GA	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
CSG	COLUMBUS METROPOLITAN	GA	0	1.000000
CKF	CRISP COUNTY-CORDELE	GA	0	1.000000
DNN	DALTON MUNICIPAL	GA	0	1.000000
SBO	EMANUEL COUNTY	GA	0	1.000000
FTY	FULTON COUNTY AIRPORT-BROWN FIELD	GA	0	1.000000
ATL	HARTSFIELD-JACKSON ATLANTA INTL	GA	0	1.000000
EZM	HEART OF GEORGIA REGIONAL	GA	0	1.000000
19A	JACKSON COUNTY	GA	0	1.000000
GVL	LEE GILMER MEMORIAL	GA	0	1.000000
MCN	MIDDLE GEORGIA REGIONAL	GA	0	1.000000
MGR	MOULTRIE MUNICIPAL	GA	0	1.000000
CCO	NEWNAN COWETA COUNTY	GA	0	1.000000
FFC	PEACHTREE CITY-FALCON FIELD	GA	0	1.000000
PXE	PERRY-HOUSTON COUNTY	GA	0	1.000000
JZP	PICKENS COUNTY	GA	0	1.000000
JYL	PLANTATION AIRPARK	GA	0	1.000000
SAV	SAVANNAH INTL	GA	0	1.000000
ACJ	SOUTHER FIELD	GA	0	1.000000
ABY	SOUTHWEST GEORGIA REGIONAL	GA	0	1.000000
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1.000000
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1.000000
VLD	VALDOSTA REGIONAL	GA	0	1.000000
AYS	WAYCROSS-WARE COUNTY	GA	0	1.000000
CTJ	WEST GEORGIA REGIONAL-O V GRAY FIELD	GA	0	1.000000
WDR	WINDER-BARROW	GA	0	1.000000
IKV	ANKENY	IA	1	0.999959
DVN	DAVENPORT MUNICIPAL	IA	1	0.999936
DSM	DES MOINES INTL	IA	1	0.999968
DBQ	DUBUQUE REGIONAL	IA	1	0.999933
EST	ESTHERVILLE MUNICIPAL	IA	1	0.999955
FFL	FAIRFIELD MUNICIPAL	IA	1	0.999957
EOK	KEOKUK MUNICIPAL	IA	1	0.999958
MCW	MASON CITY MUNICIPAL	IA	1	0.999936
MXO	MONTICELLO REGIONAL	IA	1	0.999934
MUT	MUSCATINE MUNICIPAL	IA	1	0.999955
TNU	NEWTON MUNICIPAL	IA	1	0.999958
OTM	OTTUMWA INDUSTRIAL	IA	1	0.999959
SDA	SHENANDOAH MUNICIPAL	IA	0	1.000000
SLB	STORM LAKE MUNICIPAL	IA	1	0.999966
CID	THE EASTERN IOWA	IA	1	0.999955
ALO	WATERLOO MUNICIPAL	IA	1	0.999942
BOI	BOISE AIR TERMINAL/GOWEN FIELD	ID	1	0.999935
IDA	IDAHO FALLS REGIONAL	ID	0	1.000000
LWS	LEWISTON-NEZ PERCE COUNTY	ID	1	0.999963
S67	NAMPA MUNICIPAL	ID	1	0.999935
PIH	POCATELLO REGIONAL	ID	0	1.000000
SPI	ABRAHAM LINCOLN CAPITAL	IL	1	0.999954
FEP	ALBERTUS	IL	1	0.999931
ARR	AURORA MUNICIPAL	IL	1	0.999930
BMI	CENTRAL IL REGIONAL ARPT AT BLOOMINGTON-NORMAL	IL	1	0.999935
ENL	CENTRALIA MUNICIPAL	IL	1	0.999955
MDW	CHICAGO MIDWAY	IL	1	0.999925

Airport Id	Airport Name	State	Outages	Availability
ORD	CHICAGO O'HARE INTL	IL	1	0.999924
RFD	CHICAGO/ROCKFORD INTL	IL	1	0.999930
DEC	DECATUR	IL	1	0.999939
FOA	FLORA MUNICIPAL	IL	1	0.999948
IKK	GREATER KANKAKEE	IL	1	0.999930
PIA	GREATER PEORIA REGIONAL	IL	1	0.999946
IGQ	LANSING MUNICIPAL	IL	1	0.999925
LOT	LEWIS UNIVERSITY	IL	1	0.999930
3LF	LITCHFIELD MUNICIPAL	IL	1	0.999955
PPQ	PITTSFILED-PENSTONE MUNICIPAL	IL	1	0.999958
MLI	QUAD CITY INTL	IL	1	0.999944
UIN	QUINCY REGIONAL-BALDWIN FIELD	IL	1	0.999959
TIP	RANTOUL NATL AVIATION CENTER-FRANK ELLIOT FIELD	IL	1	0.999933
SLO	SALEM-LECKRONE	IL	1	0.999955
ALN	ST LOUIS REGIONAL	IL	1	0.999957
DNV	VERMILLION COUNTY	IL	1	0.999932
UGN	WAUKEGAN REGIONAL	IL	1	0.999912
MWA	WILLIAMSON COUNTY REGIONAL	IL	1	0.999956
BAK	COLUMBUS MUNICIPAL	IN	1	0.999937
GWB	DEKALB COUNTY	IN	1	0.999913
MIE	DELAWARE COUNTY-JOHNSON FIELD	IN	1	0.999924
EKM	ELKHART MUNICIPAL	IN	1	0.999909
FWA	FORT WAYNE	IN	1	0.999915
SER	FREEMAN MUNICIPAL	IN	1	0.999942
HFY	GREENWOOD MUNICIPAL	IN	1	0.999930
IND	INDIANAPOLIS INTL	IN	1	0.999928
GGP	LOGANSPORT/CASS COUNTY	IN	1	0.999924
MZZ	MARION MUNICIPAL	IN	1	0.999917
CEV	METTEL FIELD	IN	1	0.999935
BMG	MONROE COUNTY	IN	1	0.999931
LAF	PURDUE UNIVERSITY	IN	1	0.999930
GEZ	SHELBYVILLE MUNICIPAL	IN	1	0.999934
SBN	SOUTH BEND	IN	1	0.999909
ANQ	TRI-STATE STEUBEN COUNTY	IN	1	0.999908
PTS	ATKINSON MUNICIPAL	KS	0	1.000000
AAO	COLONEL JAMES JABARA	KS	0	1.000000
DDC	DODGE CITY REGIONAL	KS	0	1.000000
EMP	EMPORIA MUNICIPAL	KS	0	1.000000
FOE	FORBES FIELD	KS	0	1.000000
FSK	FORT SCOTT MUNICIPAL	KS	0	1.000000
GCK	GARDEN CITY REGIONAL	KS	0	1.000000
HYS	HAYS REGIONAL	KS	0	1.000000
HQG	HUGOTON MUNICIPAL	KS	0	1.000000
OJC	JOHNSON COUNTY EXECUTIVE	KS	0	1.000000
LWC	LAWRENCE MUNICIPAL	KS	0	1.000000
LBL	LIBERAL MID-AMERICA REGIONAL	KS	0	1.000000
MHK	MANHATTAN REGIONAL	KS	0	1.000000
MPR	MCPHERSON	KS	0	1.000000
IXD	NEW CENTURY AIRCENTER	KS	0	1.000000
EWK	NEWTON-CITY-COUNTY	KS	0	1.000000
OEL	OAKLEY MUNICIPAL	KS	0	1.000000
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
GLD	RENNER FIELD/GOODLAND MUNICIPAL	KS	0	1.000000
RSL	RUSSELL MUNICIPAL	KS	0	1.000000
SLN	SALINA MUNICIPAL	KS	0	1.000000
TQK	SCOTT CITY MUNICIPAL	KS	0	1.000000
CBK	SHALZ FIELD	KS	0	1.000000
WLD	STROTHER FIELD	KS	0	1.000000
ULS	ULYSSES	KS	0	1.000000
EGT	WELLINGTON MUNICIPAL	KS	0	1.000000
ICT	WICHITA MID-CONTINENT	KS	0	1.000000
EKX	ADDINGTON FIELD	KY	1	0.999960
PAH	BARKLEY REGIONAL	KY	0	1.000000
K22	BIG SANDY REGIONAL	KY	0	1.000000
LEX	BLUE GRASS	KY	1	0.999970
LOU	BOWMAN FIELD	KY	1	0.999955
CVG	CINCINNATI/NORTHERN KENTUCKY INTL	KY	1	0.999950
LOZ	LONDON-CORBIN AIRPORT-MAGEE FIELD	KY	0	1.000000
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	1	0.999956
OWB	OWENSBORO-DAVIESS COUNTY	KY	1	0.999945
SME	SOMERSET-PULASKI COUNTY-J.T. WILSON FIELD	KY	1	0.999985
W38	WILLIAMSBURG-WHITLEY COUNTY	KY	0	1.000000
ARA	ACADIANA REGIONAL	LA	1	0.999958
AEX	ALEXANDRIA INTL	LA	1	0.999921
BTR	BATON ROUGE METROPOLITAN	LA	1	0.999956
DRI	BEAUREGARD REGIONAL	LA	1	0.999909
CWF	CHENNAULT INTL	LA	1	0.999921
ESF	ESLER REGIONAL	LA	1	0.999924
LFT	LAFAYETTE REGIONAL	LA	1	0.999949
LCH	LAKE CHARLES REGIONAL	LA	1	0.999922
NEW	LAKEFRONT	LA	0	1.000000
MSY	NEW ORLEANS INTL	LA	0	1.000000
PTN	PATTERSON	LA	1	0.999983
DTN	SHREVEPORT DOWNTOWN	LA	1	0.999932
SHV	SHREVEPORT REGIONAL	LA	1	0.999931
TVR	VICKSBURG TALLULAH REGIONAL	LA	1	0.999938
BAF	BARNES MUNICIPAL	MA	0	1.000000
HYA	BARNSTABLE MUNICIPAL-BOARDMAN/POLANDO FLD	MA	0	1.000000
BOS	GEN EDWARD LAWRENCE LOGAN INTL	MA	0	1.000000
BED	LAURENCE G. HANSCOM FIELD	MA	0	1.000000
MVY	MARTHAS VINEYARD	MA	0	1.000000
OWD	NORWOOD	MA	0	1.000000
PVC	PROVINCETOWN MUNICIPAL	MA	0	1.000000
ORH	WORCESTER REGIONAL	MA	0	1.000000
BWI	BALTIMORE-WASHINGTON INTL	MD	0	1.000000
DMW	CARROLL COUNTY REGIONAL/JACK B POAGE FIELD	MD	0	1.000000
ESN	EASTON/NEWNAM FIELD	MD	0	1.000000
FDK	FREDERICK	MD	0	1.000000
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1.000000
2W6	ST MARY'S COUNTY REGIONAL	MD	0	1.000000
LEW	AUBURN/LEWISTON MUNICIPAL	ME	1	0.999984
AUG	AUGUSTA STATE	ME	1	0.999983
BHB	HANCOCK COUNTY-BAR HARBOR	ME	0	1.000000
PQI	NORTHERN MAINE REGIONAL ARPT AT PRESQUE IS	ME	6	0.999812

Airport Id	Airport Name	State	Outages	Availability
PWM	PORTLAND INTL JETPORT	ME	1	0.999983
WVL	WATERVILLE ROBERT LAFLEUR	ME	1	0.999981
ARB	ANN ARBOR MUNICIPAL	MI	1	0.999913
ACB	ANTRIM COUNTY	MI	1	0.999896
FNT	BISHOP INTL	MI	1	0.999900
CIU	CHIPPEWA COUNTY INTL	MI	2	0.999868
DTW	DETROIT METRO WAYNE COUNTY	MI	1	0.999917
3FM	FREMONT MUNICIPAL	MI	1	0.999902
GRR	GERALD R. FORD INTL	MI	1	0.999904
CMX	HOUGHTON COUNTY MEMORIAL	MI	2	0.999866
BAX	HURON COUNTY	MI	1	0.999892
AZO	KALAMAZOO/BATTLE CREEK INTL	MI	1	0.999907
ADG	LENAWEE COUNTY	MI	1	0.999915
OZW	LIVINGSTON COUNTY SPENCER J. HARDY	MI	1	0.999904
MBS	MBS INTL	MI	1	0.999891
MKG	MUSKEGON COUNTY	MI	1	0.999904
HYX	SAGINAW CO H.W. BROWNE	MI	1	0.999891
BIV	TULIP CITY	MI	1	0.999907
YIP	WILLOW RUN	MI	1	0.999915
AEL	ALBERT LEA MUNICIPAL	MN	1	0.999933
ANE	ANOKA CO-BLAINE ARPT (JANES FIELD)	MN	1	0.999917
BDE	BAUDETTE INTL	MN	1	0.999943
BRD	BRAINERD LAKES REGIONAL	MN	1	0.999914
AXN	CHANDLER FIELD	MN	1	0.999919
HIB	CHISHOLM-HIBBING	MN	1	0.999912
CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	1	0.999958
DTL	DETROIT LAKES-WETHING FIELD	MN	1	0.999933
DLH	DULUTH INTL	MN	1	0.999906
MSP	MINNEAPOLIS-ST PAUL INTL	MN	1	0.999918
RGK	RED WING REGIONAL	MN	1	0.999918
RST	ROCHESTER INTL	MN	1	0.999931
ROX	ROSEAU MUNICIPAL/RUDY BILLBERG FIELD	MN	1	0.999947
STC	ST CLOUD REGIONAL	MN	1	0.999917
JYG	ST JAMES MUNICIPAL	MN	1	0.999934
STP	ST PAUL DOWNTOWN HOLMAN FIELD	MN	1	0.999917
BDH	WILLMAR MUNICIPAL	MN	1	0.999930
M17	BOLIVAR MUNICIPAL	MO	0	1.000000
CGI	CAPE GIRARDEAU REGIONAL	MO	1	0.999960
MKC	CHARLES B. WHEELER DOWNTOWN	MO	0	1.000000
COU	COLUMBIA REGIONAL	MO	0	1.000000
1H0	CREVE COEUR	MO	1	0.999960
LBO	FLOYD W. JONES LEBANON	MO	0	1.000000
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	0	1.000000
JEF	JEFFERSON CITY MEMORIAL	MO	0	1.000000
VER	JESSE VIERTEL MEMORIAL	MO	0	1.000000
JLN	JOPLIN REGIONAL	MO	0	1.000000
MCI	KANSAS CITY INTL	MO	0	1.000000
TKX	KENNETT MEMORIAL	MO	0	1.000000
IRK	KIRKSVILLE REGIONAL	MO	1	0.999985
STL	LAMBERT-ST LOUIS INTL	MO	1	0.999959
AIZ	LEE C FINE MEMORIAL	MO	0	1.000000
LXT	LEE'S SUMMIT MUNICIPAL	MO	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
6M6	LEWIS COUNTY REGIONAL	MO	1	0.999960
MYJ	MEXICO MEMORIAL	MO	0	1.000000
GPH	MIDWEST NATIONAL AIR CENTER	MO	0	1.000000
M58	MONETT MUNICIPAL	MO	0	1.000000
EOS	NEOSHO HUGH ROBINSON	MO	0	1.000000
POF	POPLAR BLUFF MUNICIPAL	MO	0	1.000000
STJ	ROSECRANS MEMORIAL	MO	0	1.000000
DMO	SEDALIA	MO	0	1.000000
SIK	SIKESTON MEMORIAL MUNICIPAL	MO	1	0.999980
RCM	SKYHAVEN	MO	0	1.000000
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	0	1.000000
TBN	WAYNESVILLE REGIONAL ARPT AT FORNEY FIELD	MO	0	1.000000
UNO	WEST PLAINS MUNICIPAL	MO	0	1.000000
STF	GEORGE M BRYAN	MS	1	0.999961
GTR	GOLDEN TRIANGLE REGIONAL	MS	1	0.999964
GWO	GREENWOOD-LEFLORE	MS	1	0.999947
GNF	GRENADA MUNICIPAL	MS	1	0.999949
GPT	GULFPORT-BILOXI INTL	MS	0	1.000000
HEZ	HARDY-ANDERS FLD NATCHEZ-ADAMS COUNTY	MS	1	0.999938
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	1	0.999970
PIB	HATTIESBURG-LAUREL REGIONAL	MS	1	0.999966
LUL	HESLER-NOBLE FIELD	MS	1	0.999967
JAN	JACKSON-EVERS INTL	MS	1	0.999952
M16	JOHN BELL WILLIAMS	MS	1	0.999948
MEI	KEY FIELD	MS	1	0.999971
M40	MONROE COUNTY	MS	1	0.999962
OLV	OLIVE BRANCH	MS	1	0.999966
CRX	ROSCOE TURNER	MS	1	0.999958
PQL	TRENT LOTT INTL	MS	0	1.000000
UTA	TUNICA MUNICIPAL	MS	1	0.999959
UOX	UNIVERSITY-OXFORD	MS	1	0.999949
BTM	BERT MOONEY	MT	1	0.999955
BIL	BILLINGS LOGAN INTL	MT	0	1.000000
MLS	FRANK WILEY FIELD	MT	0	1.000000
GPI	GLACIER PARK INTL	MT	1	0.999960
GTF	GREAT FALLS INTL	MT	1	0.999948
HLN	HELENA REGIONAL	MT	1	0.999951
LWT	LEWISTOWN MUNICIPAL	MT	2	0.999929
HBI	ASHEBORO MUNICIPAL	NC	0	1.000000
AVL	ASHEVILLE REGIONAL	NC	0	1.000000
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1.000000
JQF	CONCORD REGIONAL	NC	0	1.000000
EWN	CRAVEN COUNTY REGIONAL	NC	0	1.000000
ECG	ELIZABETH CITY CG AIR STATION/REGIONAL	NC	0	1.000000
FAY	FAYETTEVILLE REGIONAL/GRANNIS FIELD	NC	0	1.000000
LHZ	FRANKLIN COUNTY	NC	0	1.000000
AKH	GASTONIA MUNICIPAL	NC	0	1.000000
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	0	1.000000
HRJ	HARNETT REGIONAL JETPORT	NC	0	1.000000
ISO	KINSTON REGIONAL JETPORT AT STALLINGS FLD	NC	0	1.000000
EQY	MONROE REGIONAL	NC	0	1.000000
EDE	NORTHEASTERN REGIONAL	NC	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
GSO	PIEDMONT-TRIAD INTL	NC	0	1.000000
PGV	PITT-GREENVILLE	NC	0	1.000000
RDU	RALEIGH-DURHAM INTL	NC	0	1.000000
RWI	ROCKY MOUNT-WILSON REGIONAL	NC	0	1.000000
RUQ	ROWAN COUNTY	NC	0	1.000000
TTA	SANFORD-LEE COUNTY REGIONAL	NC	0	1.000000
SVH	STATESVILLE REGIONAL	NC	0	1.000000
ILM	WILMINGTON INTL	NC	0	1.000000
BIS	BISMARCK MUNICIPAL	ND	0	1.000000
DIK	DICKINSON MUNICIPAL	ND	0	1.000000
GFK	GRAND FORKS INTL	ND	1	0.999959
FAR	HECTOR INTL	ND	1	0.999985
JMS	JAMESTOWN REGIONAL	ND	0	1.000000
MOT	MINOT INTL	ND	0	1.000000
ANW	AINSWORTH MUNICIPAL	NE	0	1.000000
AIA	ALLIANCE MUNICIPAL	NE	0	1.000000
BIE	BEATRICE MUNICIPAL	NE	0	1.000000
FNB	BRENNER FIELD	NE	0	1.000000
HDE	BRESWTER FIELD	NE	0	1.000000
GRI	CENTRAL NEBRASKA REGIONAL	NE	0	1.000000
CDR	CHADRON MUNICIPAL	NE	0	1.000000
OLU	COLUMBUS MUNICIPAL	NE	0	1.000000
OMA	EPPLEY AIRFIELD	NE	0	1.000000
FET	FREMONT MUNICIPAL	NE	0	1.000000
HSI	HASTINGS MUNICIPAL	NE	0	1.000000
IML	IMPERIAL MUNICIPAL	NE	0	1.000000
LXN	JIM KELLY FIELD	NE	0	1.000000
OFK	KARL STEFAN MEMORIAL	NE	0	1.000000
EAR	KEARNEY MUNICIPAL	NE	0	1.000000
IBM	KIMBALL MUNICIPAL/ROBERT E. ARRAJ FIELD	NE	0	1.000000
LNK	LINCOLN MUNICIPAL	NE	0	1.000000
MCK	MCCOOK MUNICIPAL	NE	0	1.000000
MLE	MILLARD	NE	0	1.000000
VTN	MILLER FIELD	NE	0	1.000000
LBF	NORTH PLATTE REGIONAL AIRPORT LEE BIRD FIELD	NE	0	1.000000
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1.000000
SCB	SCRIBNER STATE	NE	0	1.000000
OGA	SEARLE FIELD	NE	0	1.000000
SNY	SIDNEY MUNICIPAL	NE	0	1.000000
ONL	THE O'NEILL MUNICIPAL-JOHN L BAKER FIELD	NE	0	1.000000
LCG	WAYNE MUNICIPAL	NE	0	1.000000
BFF	WESTERN NEB. REGIONAL/WILLIAM B. HEILIG FIELD	NE	0	1.000000
JYR	YORK MUNICIPAL	NE	0	1.000000
ASH	BOIRE FIELD	NH	0	1.000000
CON	CONCORD MUNICIPAL	NH	1	0.999985
LCI	LACONIA MUNICIPAL	NH	1	0.999978
PSM	PORTSMOUTH INTL AT PEASE	NH	0	1.000000
ACY	ATLANTIC CITY INTL	NJ	0	1.000000
WWD	CAPE MAY COUNTY	NJ	0	1.000000
MIV	MILLVILLE MUNICIPAL	NJ	0	1.000000
EWR	NEWARK LIBERTY INTL	NJ	0	1.000000
ABQ	ALBUQUERQUE INTL SUNPORT	NM	1	0.999982

Airport Id	Airport Name	State	Outages	Availability
CVN	CLOVIS MUNICIPAL	NM	1	0.999958
AEG	DOUBLE EAGLE II	NM	1	0.999982
FMN	FOUR CORNERS REGIONAL	NM	0	1.000000
SVC	GRANT COUNTY	NM	5	0.999832
LRU	LAS CRUCES INTL	NM	5	0.999852
ROW	ROSWELL INTL AIR CENTER	NM	1	0.999940
LAS	MCCARRAN INTL	NV	0	1.000000
4SD	RENO/STEAD	NV	4	0.999841
WMC	WINNEMUCCA MUNICIPAL	NV	1	0.999930
9G3	AKRON	NY	4	0.999847
ALB	ALBANY INTL	NY	1	0.999979
HWV	BROOKHAVEN	NY	0	1.000000
BUF	BUFFALO NIAGARA INTL	NY	4	0.999849
OLE	CATTARAUGUS COUNTY-OLEAN	NY	2	0.999940
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	2	0.999935
ELM	ELMIRA/CORNING REGIONAL	NY	1	0.999969
BGM	GREATER BINGHAMTON/EDWIN A LINK FIELD	NY	1	0.999976
ROC	GREATER ROCHESTER INTL	NY	4	0.999871
JFK	JOHN F. KENNEDY INTL	NY	0	1.000000
LGA	LA GUARDIA	NY	0	1.000000
MSS	MASSENA INTL-RICHARDS FIELD	NY	2	0.999915
PBG	PLATTSBURGH INTL	NY	1	0.999947
SWF	STEWART INTL	NY	0	1.000000
SYR	SYRACUSE HANCOCK INTL	NY	3	0.999909
ELZ	WELLSVILLE MUNICIPAL/TARANTINE FIELD	NY	1	0.999961
HPN	WESTCHESTER COUNTY	NY	0	1.000000
FOK	WESTHAMPTON	NY	0	1.000000
HAO	BUTLER COUNTY REGIONAL	OH	1	0.999947
CXY	CAPITAL CITY	OH	0	1.000000
LUK	CINCINNATI MUNICIPAL ARPT-LUNKEN FIELD	OH	1	0.999952
CLE	CLEVELAND-HOPKINS INTL	OH	1	0.999944
MGY	DAYTON-WRIGHT BROTHERS	OH	1	0.999947
FDY	FINDLAY	OH	1	0.999933
I19	GREENE COUNTY-LEWIS A. JACKSON REGIONAL	OH	1	0.999948
DAY	JAMES M COX DAYTON INTL	OH	1	0.999942
1G3	KENT STATE UNIVERSITY	OH	1	0.999953
I68	LEBANON-WARREN COUNTY	OH	1	0.999948
MNN	MARION MUNICIPAL	OH	1	0.999946
OSU	OHIO STATE UNIVERSITY	OH	1	0.999954
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	1	0.999976
CMH	PORT COULMBUS INTL	OH	1	0.999957
RZT	ROSS COUNTY	OH	1	0.999964
TOL	TOLEDO EXPRESS	OH	1	0.999922
1G0	WOOD COUNTY	OH	1	0.999927
AVK	ALVA REGIONAL	OK	0	1.000000
BVO	BARTLESVILLE MUNICIPAL	OK	0	1.000000
CQB	CHANDLER MUNICIPAL	OK	0	1.000000
CHK	CHICKASHA	OK	0	1.000000
GCM	CLAREMORE REGIONAL	OK	0	1.000000
F29	CLARENCE E. PAGE MUNICIPAL	OK	0	1.000000
1K4	DAVID J PERRY	OK	0	1.000000
MKO	DAVIS FIELD	OK	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
DUA	EAKER FIELD	OK	0	1.000000
2O8	HINTON MUNICIPAL	OK	0	1.000000
HBR	HOBART	OK	0	1.000000
MLC	MCALESTER REGIONAL	OK	0	1.000000
MIO	MIAMI	OK	0	1.000000
MDF	MOORELAND MUNICIPAL	OK	0	1.000000
OKM	OKMULGEE REGIONAL	OK	0	1.000000
PVJ	PAULS VALLEY MUNICIPAL	OK	0	1.000000
PNC	PONCA CITY REGIONAL	OK	0	1.000000
RVS	RICHARD LLOYD JONES JR	OK	0	1.000000
2K4	SCOTT FIELD	OK	0	1.000000
SNL	SHAWNEE	OK	0	1.000000
SWO	STILLWATER REGIONAL	OK	0	1.000000
TQH	TAHLEQUAH	OK	0	1.000000
TUL	TULSA INTL	OK	0	1.000000
OUN	UNIVERSITY OF OKALAHOMA WESTHEIMER	OK	0	1.000000
OKC	WILL ROGERS WORLD	OK	0	1.000000
UAO	AURORA STATE	OR	2	0.999943
LMT	KLAMATH FALLS	OR	3	0.999869
LGD	LA GRANDE/UNION COUNTY	OR	1	0.999962
EUG	MAHLON SWEET FIELD	OR	1	0.999969
SLE	MCNARY FIELD	OR	2	0.999953
ONP	NEWPORT MUNICIPAL	OR	3	0.999881
PDX	PORTLAND INTL	OR	3	0.999915
AGC	ALLEGHENY COUNTY	PA	1	0.999978
ABE	ALLENTOWN	PA	0	1.000000
AOO	ALTOONA-BLAIR COUNTY	PA	0	1.000000
LBE	ARNOLD PLAMER REGIONAL	PA	1	0.999984
BFD	BRADFORD REGIONAL	PA	1	0.999962
BTP	BUTLER COUNTY/K W SCHOLTER FIELD	PA	1	0.999971
9D4	DECK	PA	0	1.000000
HZL	HAZELTON MUNICIPAL	PA	0	1.000000
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA COUNTY	PA	0	1.000000
LNS	LANCASTER	PA	0	1.000000
UCP	NEW CASTLE MUNICIPAL	PA	1	0.999962
PNE	NORTHEAST PHILADELPHIA	PA	0	1.000000
PHL	PHILADELPHIA INTL	PA	0	1.000000
PIT	PITTSBURGH INTL	PA	1	0.999973
FWQ	ROSTRAVER	PA	1	0.999981
2G9	SOMERSET COUNTY	PA	0	1.000000
OYM	ST MARYS MUNICIPAL	PA	1	0.999970
UNV	UNIVERSITY PARK	PA	0	1.000000
FKL	VENANGO REGIONAL	PA	1	0.999961
BID	BLOCK ISLAND STATE	RI	0	1.000000
OQU	OUONSET STATE	RI	0	1.000000
PVD	THEODORE FRANCIS GREEN STATE	RI	0	1.000000
AIK	AIKEN MUNICIPAL	SC	0	1.000000
AND	ANDERSON REGIONAL	SC	0	1.000000
CHS	CHARLESTON AFB/INTL	SC	0	1.000000
JZI	CHARLESTON EXECUTIVE	SC	0	1.000000
CAE	COLUMBIA METROPOLITAN	SC	0	1.000000
UDG	DARLINGTON COUNTY JETPORT	SC	0	1.000000

Airport Id	Airport Name	State	Outages	Availability
GYH	DONALDSON CENTER	SC	0	1.000000
GSP	GREENVILLE-SPARTANBURG INTL-ROGER MILLIKEN	SC	0	1.000000
MYR	MYRTLE BEACH INTL	SC	0	1.000000
CEU	OCONEE COUNTY REGIONAL	SC	0	1.000000
CDN	WOODWARD FIELD	SC	0	1.000000
ABR	ABERDEEN REGIONAL	SD	1	0.999982
BKX	BROOKINGS MUNICIPAL	SD	1	0.999955
YKN	CHAN GURNEY MUNICIPAL	SD	1	0.999984
HON	HURON REGIONAL	SD	1	0.999956
MHE	MITCHELL MUNICIPAL	SD	1	0.999959
PIR	PIERRE REGIONAL	SD	0	1.000000
RAP	RAPID CITY REGIONAL	SD	0	1.000000
FSD	SIOUX FALLS	SD	1	0.999958
ATY	WATERTOWN REGIONAL	SD	1	0.999935
PVE	BEECH RIVER REGIONAL	TN	1	0.999963
UCY	EVERETT-STEWART	TN	1	0.999959
CHA	LOVELL FIELD	TN	0	1.000000
TYS	MCGHEE TYSON	TN	0	1.000000
MEM	MEMPHIS INTL	TN	1	0.999970
NQA	MILLINGTON MUNICIPAL	TN	0	1.000000
BNA	NASHVILLE INTL	TN	1	0.999972
TRI	TRI-CITIES REGIONAL TN/VA	TN	0	1.000000
ABI	ABILENE REGIONAL	TX	1	0.999932
ADS	ADDISON	TX	1	0.999959
ALI	ALICE	TX	4	0.999791
AMA	AMARILLO INTL	TX	1	0.999950
LFK	ANGELINA COUNTY	TX	1	0.999909
GKY	ARLINGTON MUNICIPAL	TX	1	0.999949
AUS	AUSTIN-BERGSTROM INTL	TX	1	0.999886
LBX	BRAZORIA COUNTY	TX	1	0.999902
BWD	BROWNWOOD REGIONAL	TX	1	0.999916
E30	BRUCE FIELD	TX	1	0.999919
TKI	COLLIN COUNTY REGIONAL AT MCKINNEY	TX	1	0.999972
CRP	CORPUS CHRISTI INTL	TX	4	0.999796
CFD	COULTER FIELD	TX	1	0.999892
PRX	COX FIELD	TX	0	1.000000
RBD	DALLAS EXECUTIVE	TX	1	0.999949
DAL	DALLAS LOVE FIELD	TX	1	0.999953
DFW	DALLAS/FORT WORTH INTL	TX	1	0.999956
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	1	0.999879
DRT	DEL RIO INTL	TX	2	0.999851
TPL	DRAUGHTON-MILLER CENTRAL TEXAS REGIONAL	TX	1	0.999903
GGG	EAST TEXAS REGIONAL	TX	1	0.999932
CLL	EASTERWOOD FIELD	TX	1	0.999890
EBG	EDINGBURG INTL	TX	4	0.999785
ELP	EL PASO INTL	TX	1	0.999926
AFW	FORT WORTH ALLIANCE	TX	1	0.999963
FWS	FORT WORTH SPINKS	TX	1	0.999939
IAH	GEORGE BUSH INTERCONTINENTAL/HOUSTON	TX	1	0.999881
PVW	HALE COUNTY	TX	1	0.999942
TME	HOUSTON EXECUTIVE	TX	1	0.999882
AXH	HOUSTON-SOUTHWEST	TX	1	0.999888

Airport Id	Airport Name	State	Outages	Availability
ERV	KERRVILLE MUNICIPAL/LOUIS SCHREINER FIELD	TX	1	0.999885
LNC	LANCASTER	TX	1	0.999943
LRD	LAREDO INTL	TX	5	0.999769
CXO	LONE STAR EXECUTIVE	TX	1	0.999890
LBB	LUBBOCK INTL	TX	1	0.999939
GVT	MAJORS	TX	1	0.999959
MFE	MCALLEN MILLER INTL	TX	4	0.999764
HQZ	MESQUITE METRO	TX	1	0.999950
MAF	MIDLAND INTL	TX	1	0.999928
OSA	MOUNT PLEASANT MUNICIPAL	TX	1	0.999954
RAS	MUSTANG BEACH	TX	4	0.999795
BAZ	NEW BRAUNFELS	TX	1	0.999875
GRK	ROBERT GRAY AAF	TX	1	0.999902
SJT	SAN ANGELO REGIONAL/MATHIS FIELD	TX	1	0.999915
SAT	SAN ANTONIO INTL	TX	1	0.999875
HYI	SAN MARCOS	TX	1	0.999881
GLS	SCHOLES INTL AT GALVESTON	TX	1	0.999913
SPS	SHEPPARD AFB/WICHITA FALLS MUNICIPAL	TX	0	1.000000
SGR	SUGARLAND MUNICIPAL/HULL FIELD	TX	1	0.999885
TFP	T P MCCAMPBELL	TX	4	0.999799
TRL	TERRELL MUNICIPAL	TX	1	0.999949
TYR	TYLER POUNDS FIELD	TX	1	0.999933
HRL	VALLEY INTL	TX	4	0.999786
IWS	WEST HOUSTON	TX	1	0.999882
HOU	WILLIAM P HOBBY	TX	1	0.999887
CDC	CEDAR CITY REGIONAL	UT	0	1.000000
KNB	KANAB MUNICIPAL	UT	0	1.000000
LGU	LOGAN-CACHE	UT	0	1.000000
OGD	OGDEN-HINCKLEY	UT	0	1.000000
PVU	PROVO MUNICIPAL	UT	0	1.000000
SGU	SAINT GEORGE MUNICIPAL	UT	0	1.000000
SLC	SALT LAKE CITY INTL	UT	0	1.000000
MFV	ACCOMACK COUNTY	VA	0	1.000000
MTV	BLUE RIDGE	VA	0	1.000000
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1.000000
FCI	CHESTERFIELD COUNTY	VA	0	1.000000
CJR	CULPEPER REGIONAL	VA	0	1.000000
PTB	DINWIDDIE COUNTY	VA	0	1.000000
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1.000000
HEF	HARRY P. DAVIS FIELD	VA	0	1.000000
JYO	LEESBURG EXECUTIVE	VA	0	1.000000
LNP	LONESOME PINE	VA	0	1.000000
LYH	LYNCHBURG REGIONAL/PRESTON GLENN FLD	VA	0	1.000000
MKJ	MOUNTAIN EMPIRE	VA	0	1.000000
PSK	NEW RIVER VALLEY	VA	0	1.000000
PHF	NEWPORT NEWS/WMSBURG INTL	VA	0	1.000000
ORF	NORFOLK INTL	VA	0	1.000000
RIC	RICHMOND	VA	0	1.000000
RMN	STAFFORD REGIONAL	VA	0	1.000000
BCB	VIRGINIA RECH/MONTGOMERY EXECUTIVE	VA	0	1.000000
IAD	WASHINGTON DULLES INTL	VA	0	1.000000
BTV	BURLINGTON INTL	VT	1	0.999953

Airport Id	Airport Name	State	Outages	Availability
FSO	FRANKLIN COUNTY STATE	VT	1	0.999954
BLI	BELLINGHAM INTL	WA	4	0.999842
HQM	BOWERMAN	WA	4	0.999832
FHR	FRIDAY HARBOR	WA	4	0.999821
MWH	GRANT CO INTL	WA	1	0.999976
OLM	OLYMPIA	WA	4	0.999851
PUW	PULLMAN/MOSCOW REGIONAL	WA	1	0.999976
RLD	RICHLAND	WA	1	0.999976
SEA	SEATTLE-TACOMA INTL	WA	3	0.999917
BVS	SKAGIT REGIONAL	WA	3	0.999875
PAE	SNOHOMISH COUNTY (PAINE FIELD)	WA	0	1.000000
GEG	SPOKANE INTL	WA	1	0.999976
PSC	TRI-CITIES	WA	1	0.999976
ALW	WALLA WALLA REGIONAL	WA	1	0.999976
CLM	WILLIAM R FAIRCHILD INTL	WA	4	0.999829
GRB	AUSTIN STRAUBLE INTL	WI	1	0.999906
DLL	BARABOO WISCONSIN DELLS	WI	1	0.999914
OVS	BOSCOBEL	WI	1	0.999930
CWA	CENTRAL WISCONSIN	WI	1	0.999908
MSN	DANE COUNTY REGIONAL-TRAUX FIELD	WI	1	0.999914
SUE	DOOR COUNTY CHERRYLAND	WI	1	0.999899
EGV	EAGLE RIVER UNION	WI	2	0.999883
FLD	FOND DU LAC COUNTY	WI	1	0.999908
MKE	GENERAL MITCHELL INTL	WI	1	0.999908
MTW	MANITOWOC COUNTY	WI	1	0.999906
MFI	MARSHFIELD MUNICIPAL	WI	1	0.999908
LUM	MENOMONIE MUNICIPAL-SCORE FIELD	WI	1	0.999913
RRL	MERRILL MUNICIPAL	WI	1	0.999907
C29	MIDDLETON MUNICIPAL-MOREY FIELD	WI	1	0.999924
ATW	OUTGAMIE COUNTY REGIONAL	WI	1	0.999908
PBH	PRICE COUNTY	WI	1	0.999907
RHI	RHINELANDER - ONEIDA COUNTY	WI	1	0.999904
RPD	RICE LAKE REGIONAL-CARL'S FIELD	WI	1	0.999908
HYR	SAWYER COUNTY	WI	1	0.999908
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	1	0.999908
JVL	SOUTHERN WISCONSIN REGIONAL	WI	1	0.999926
OSH	WITTMAN REGIONAL	WI	1	0.999908
PKB	MID-OHIO VALLEY REGIONAL	WV	1	0.999981
HTS	TRI-STATE/MILTON J. FERGUSON FIELD	WV	1	0.999984
CYS	CHEYENNE REGIONAL/ JERRY OLSON FIELD	WY	0	1.000000
EVW	EVANSTON-UINTA COUNTY BURNS FIELD	WY	0	1.000000
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1.000000
JAC	JACKSON HOLE	WY	0	1.000000
LAR	LARAMIE REGIONAL	WY	0	1.000000
CPR	NATRONA COUNTY INTL	WY	0	1.000000
RIW	RIVERTON REGIONAL	WY	0	1.000000
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1.000000
SHR	SHERIDAN COUNTY	WY	0	1.000000
COD	YELLOWSTONE REGIONAL	WY	0	1.000000

Figure 9-1 WAAS LPV Availability

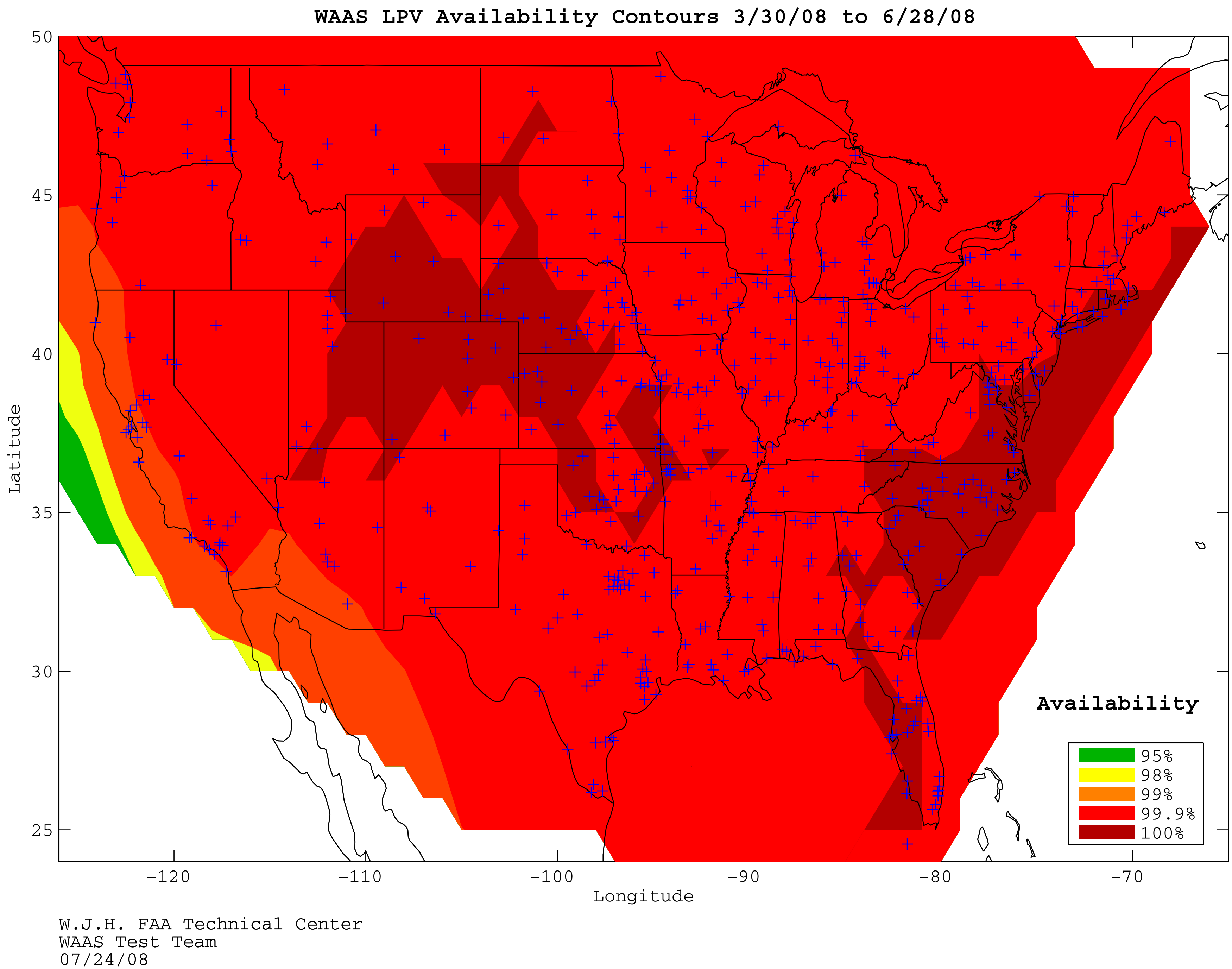
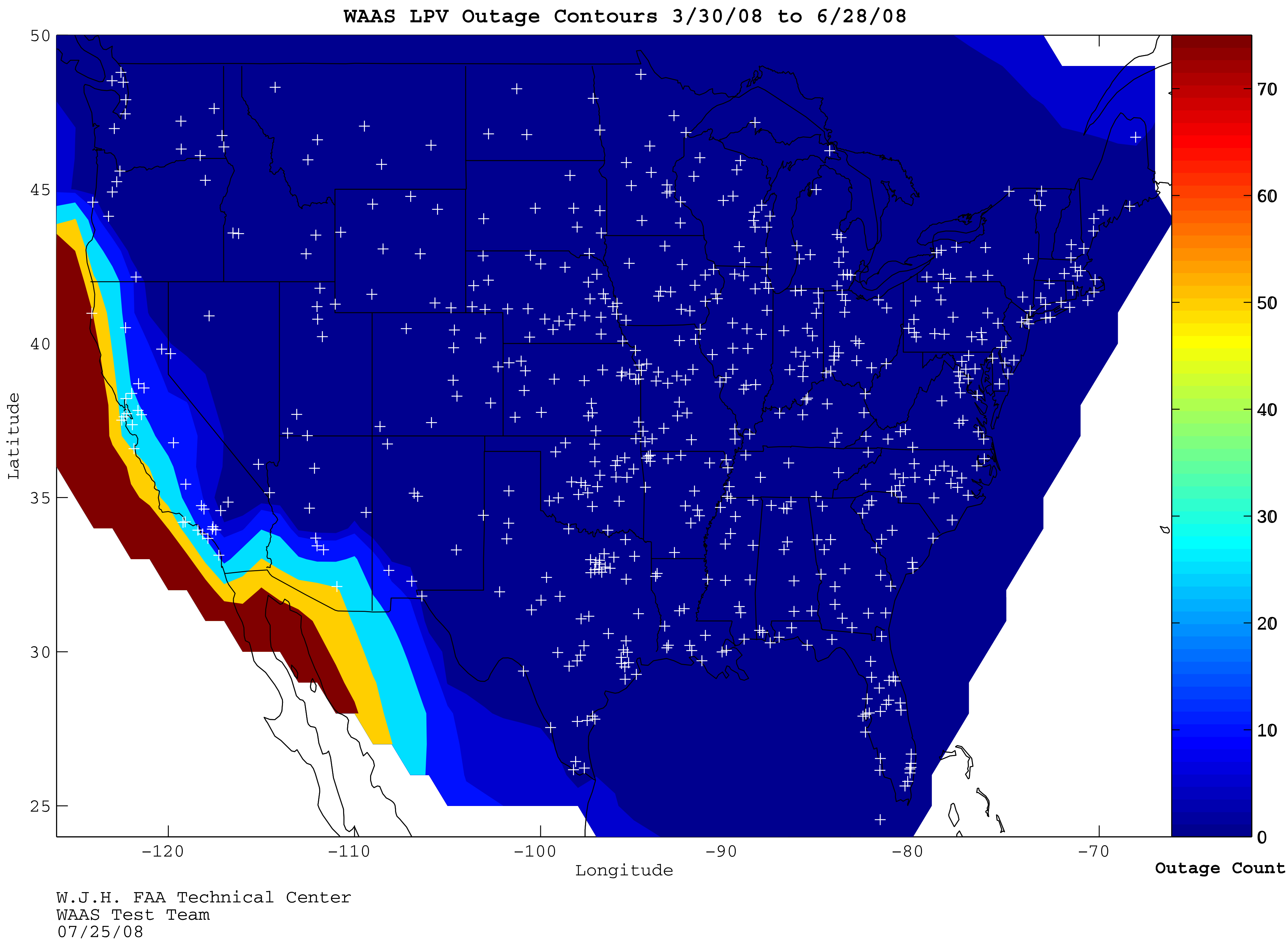


Figure 9-2 WAAS LPV Outage



10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

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

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

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

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08
Albuquerque	A	blue	blue	blue	blue	blue	yellow	blue	blue	blue	blue	blue	blue
	B	green	yellow	blue	blue	blue	blue	yellow	blue	green	blue	green	blue
	C	blue	blue	blue	blue	green	blue	green	blue	blue	blue	blue	blue
Anchorage	A	green	blue	blue	yellow	–	–	green	green	blue	blue	blue	blue
	B	green	blue	green	green	–	blue	blue	green	green	blue	green	green
	C	yellow	blue	yellow	yellow	–	–	green	blue	blue	blue	yellow	blue
Atlanta	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	green
Barrow	A	*	*	*	blue	blue	yellow	green	blue	green	green	blue	blue
	B				green	blue	blue	green	blue	blue	blue	blue	blue
	C				blue	blue	blue	yellow	green	blue	blue	green	green
Bethel	A	*	*	*	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B				blue	blue	blue	blue	blue	blue	blue	blue	blue
	C				blue	blue	blue	blue	blue	blue	blue	blue	blue
Billings	A	green	green	blue	yellow	blue	blue	blue	yellow	blue	yellow	green	blue
	B	blue	blue	green	yellow	green	blue	blue	blue	blue	blue	blue	yellow
	C	blue	green	green	blue	blue	green	green	green	blue	blue	blue	blue
Boston	A	yellow	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow
	B	blue	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	yellow	blue	blue	blue
Chicago	A	blue	blue	blue	green	blue	green	blue	blue	blue	blue	blue	blue
	B	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	red	blue	blue	blue	blue	blue	blue	blue	blue
Cleveland	A	green	blue	yellow	yellow	blue	blue	yellow	blue	green	green	green	blue
	B	blue	blue	green	blue	blue	yellow	blue	yellow	blue	blue	yellow	blue
	C	yellow	green	blue	yellow	green	blue	blue	blue	yellow	blue	blue	green
Cold Bay	A	yellow	blue	green	yellow	green	blue	blue	yellow	blue	green	blue	blue
	B	red	green	yellow	blue	yellow	blue	blue	blue	yellow	blue	blue	blue
	C	green	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue
Dallas	A	yellow	yellow	blue	yellow	blue	green	yellow	blue	blue	blue	blue	blue
	B	yellow	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	green
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	yellow
Denver	A	blue	blue	blue	blue	yellow	blue	blue	yellow	yellow	blue	blue	blue
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	green	blue	blue	blue	blue	blue	blue	blue	blue	green	green	blue
Fairbanks	A	*	*	*	blue	blue	–	green	blue	blue	blue	blue	blue
	B				blue	blue	blue	green	blue	blue	blue	blue	green
	C				blue	blue	–	blue	yellow	yellow	green	green	blue
Gander	A	*	*	*	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B				blue	blue	blue	yellow	green	blue	blue	blue	green
	C				blue	blue	blue	blue	blue	blue	blue	blue	blue
Goose Bay	A	*	*	*	blue	blue	blue	blue	blue	yellow	green	green	blue
	B				yellow	blue	blue	blue	blue	blue	blue	blue	blue
	C				blue	blue	blue	blue	blue	blue	blue	blue	blue
Honolulu	A	yellow	blue	blue	red	yellow	blue	blue	yellow	yellow	blue	blue	green
	B	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	yellow
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	red	yellow	red

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

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

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

11.0 WAAS REFERENCE STATION SURVEY VALIDATION

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

The surveys calculate the L1 phase center positions (ECEF X, Y, and Z) of each WRS antenna in IRTF-2000. The latitude, longitude, and height are in WGS-84 computed from the IRTF ECEF using a GraftNet utility after interpolation. The results are cross-checked against OPUS (USA and Mexico) or CSRS (Canada) using 24 hours worth of data. OPUS (US and Mexico) and CSRS (Canada) antenna position surveys were performed for the WAAS antennas using a 24 hour set of data from 7/1/08. Twenty four hour 30 second rate RINEX files were created from recorded WAAS data. Billings 1 and 2 used data from 7/5/08 because OPUS rejected the 7/1/08 data for those 2 WRE. Salt Lake City 1 used data from 6/4/08 because that WRE was off line pending an atomic clock replacement.

Table 11.1 shows the WAAS antenna positions as of 4/29/08 (US and MX are IRTF-2000 from OPUS, Canadian sites are IRTF 2005 from CSRS, for WAAS purposes the difference between IRTF-2000 and IRTF-2005 is negligible).

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

The survey from the current software is from the 'Release 8/9' version of the WAAS operational software. The Release 8/9 positions have been interpolated forward to 6/30/09 to account for tectonic plate movement in order to minimize how often the software needs to be updated. All of the OPUS "Overall RMS" quality indications were smaller than 3 cm and all but San Juan, Merida, and Barrow were smaller than 2.5 cm. These qualities were achieved with IGS rapid orbits. Since these qualities are satisfactory, the surveys do not need to be rechecked later with precise orbits.

All sites except Mexico City were below the 10 cm take action threshold. Mexico City is currently off by 23 cm as of 7/1/08. This is a known issue with subsidence at Mexico City and will be addressed by an out of sequence antenna position update towards the end of the year.

Table 11-1 WAAS Survey Positions as of 4/29/2008

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

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

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

Figure 11-1 Survey Delta for OPUS

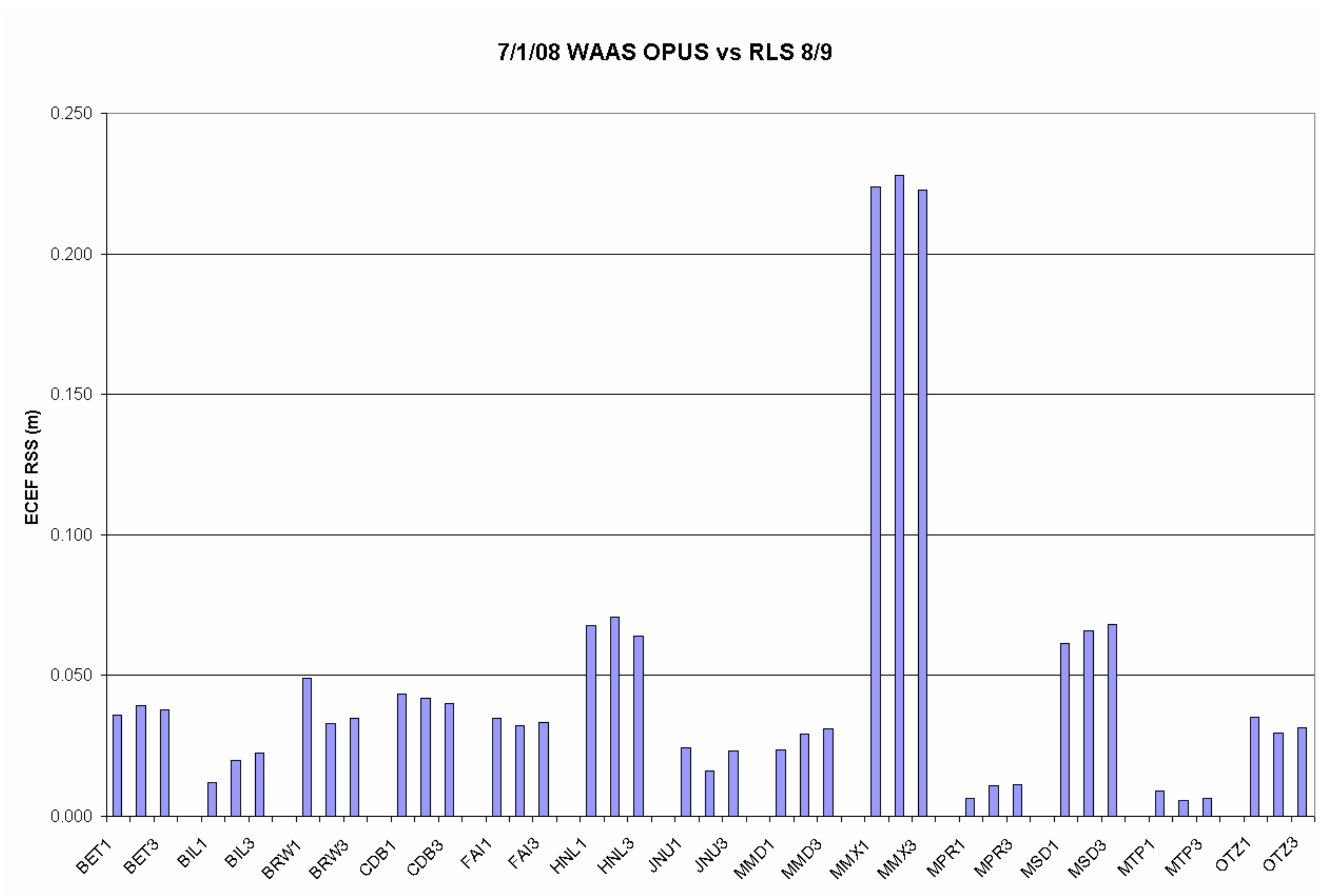


Figure 11-2 Survey Delta for CSRS and OPUS

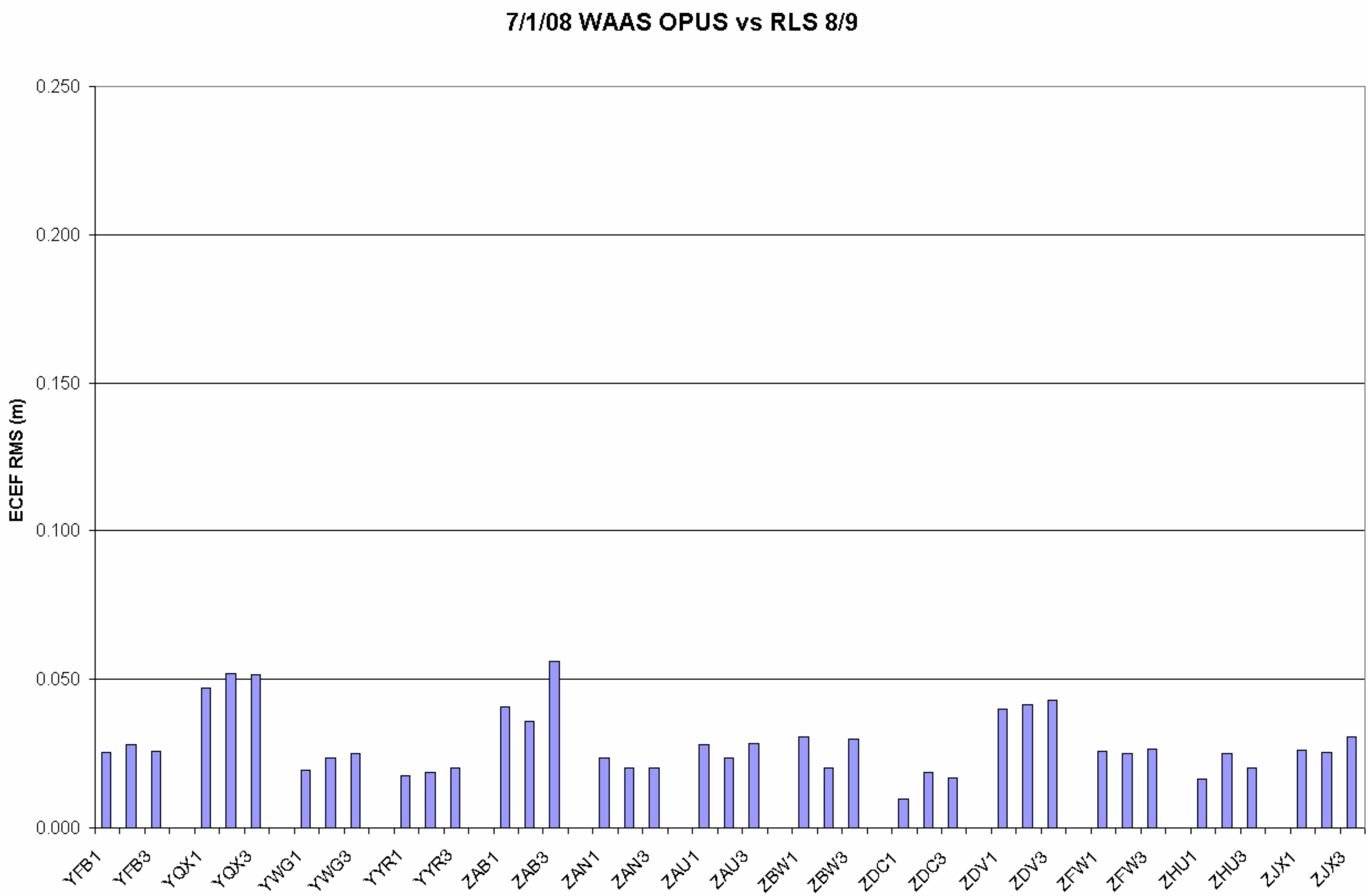


Figure 11-3 Survey Delta for OPUS

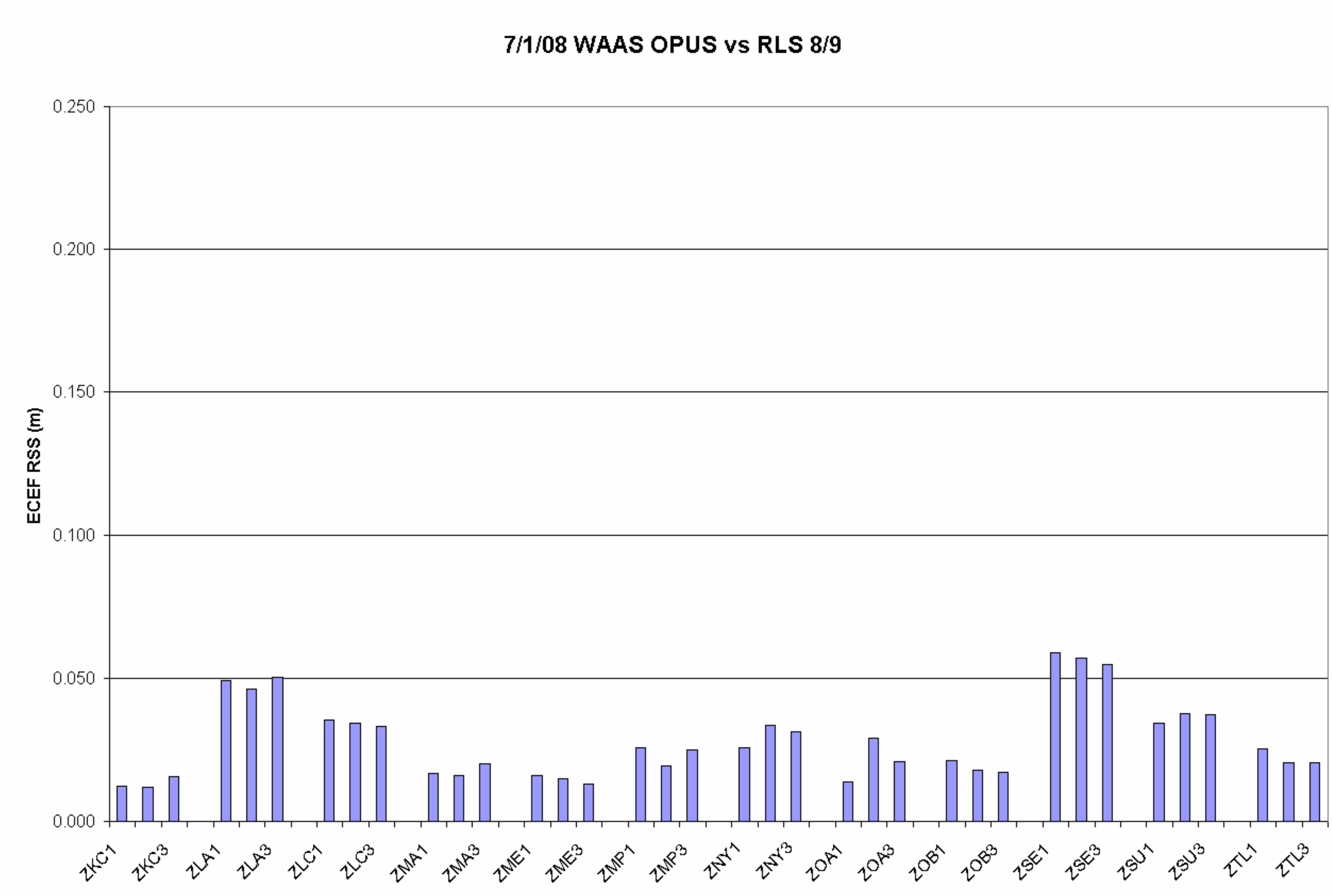
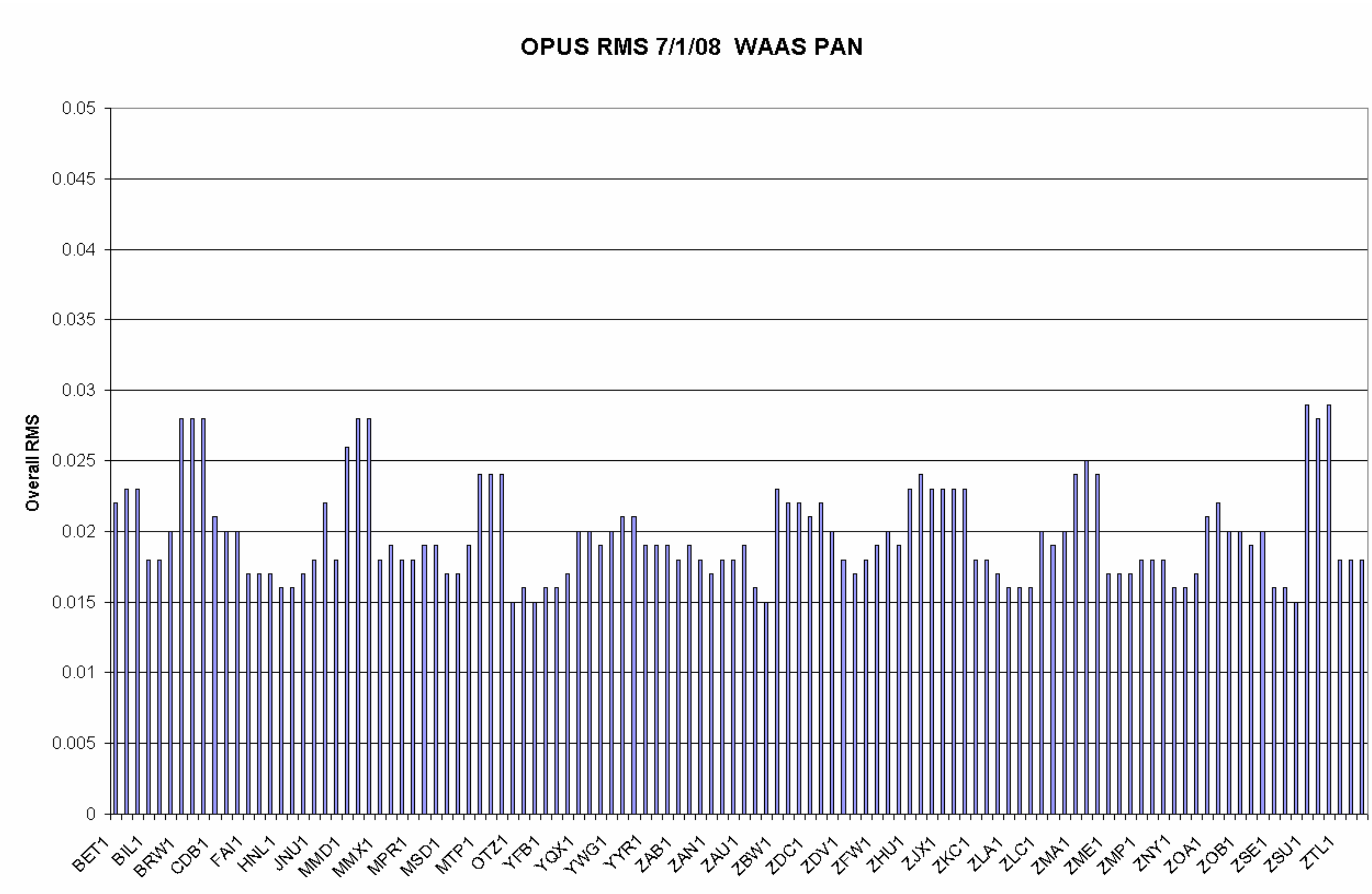


Figure 11-4 Survey RMS for OPUS



12.0 SIGNAL QUALITY MONITOR (SQM)

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

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

12.1 Alpha Metrics

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

Table 12-1 Alpha Metrics

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

12.2 Event Summary

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

Table 12-2 Event Summary

GPS Week	Date	Events
Week 1474 Day 6 to Week 1475 Day 1	4/12/2008 to 4/14/2008	Loss of data due to a workstation hard drive failure.
Week 1476 Day 2	4/22/2008	SQM application restarted due to software upgrade. Partial data is excluded.
Week 1477 Day 0 to Week 1477 Day 1	4/27/2008 to 4/28/2008	Loss of data due to workstation failure.
Week 1478 Day 0	5/4/2008	Loss of data due to workstation hard drive full.
Week 1482 Day 1	6/2/2008	Software upgrade. Station down very briefly.

12.3 Type Bias

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

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

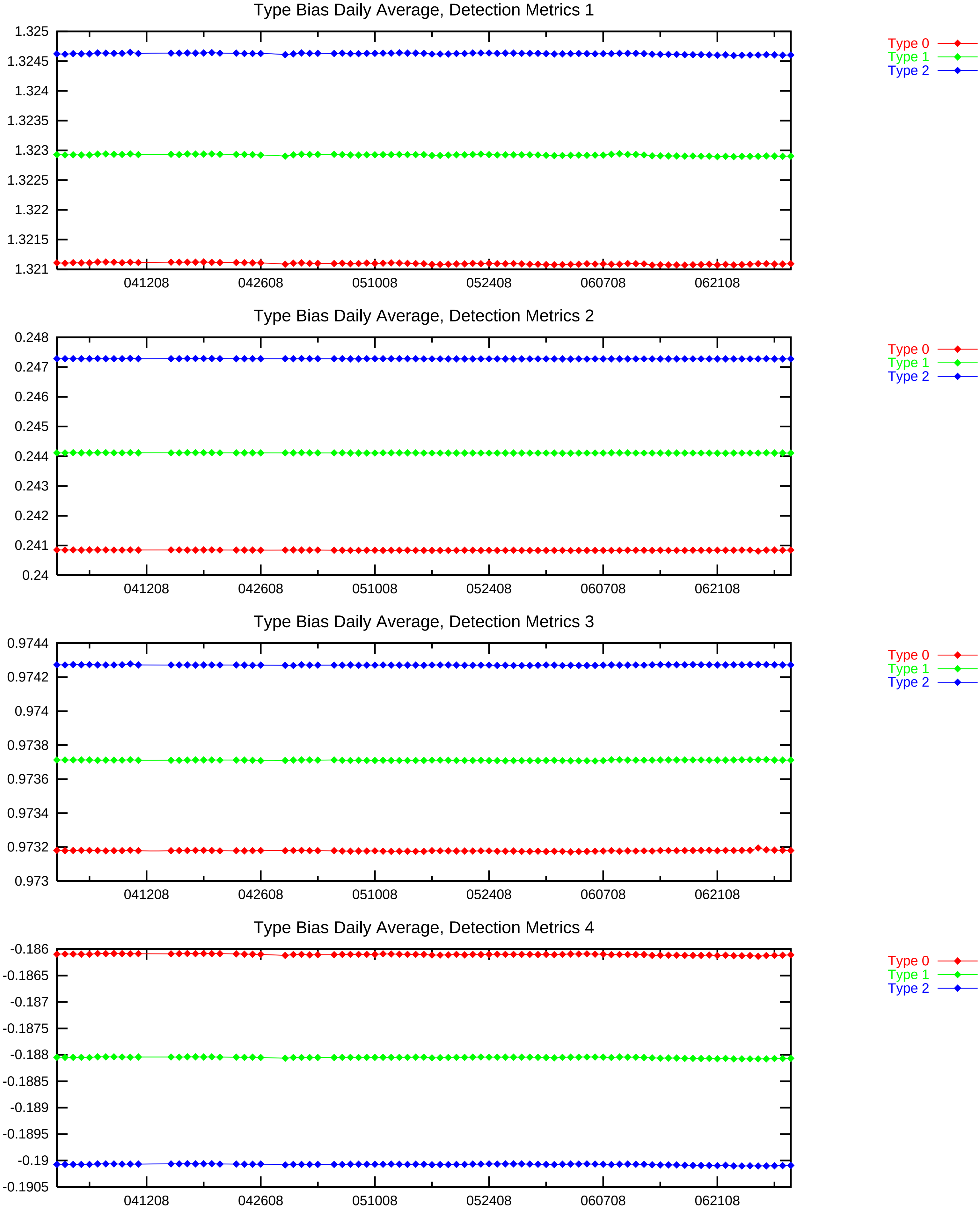
Table 12-3 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.3211	1.32292	1.32463
DM 2	0.24084	0.244112	0.247277
DM 3	0.973179	0.973711	0.974272
DM 4	-0.186102	-0.188051	-0.190074

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

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.3211	1.32293	1.32464
DM 2	0.240847	0.244115	0.247292
DM 3	0.973179	0.973713	0.974278
DM 4	-0.1861	-0.18805	-0.19008

Figure 12-1 PRN Type Bias Average Trend



12.4 PRN Bias

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

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

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 0.00096367. The maximum average for DM2 is PRN 21 at 0.00018710. The maximum average for DM3 is PRN 10 at 0.00026709. The maximum average for DM4 is PRN 23 at 0.00042876.

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. There are a couple noticeable trends this quarter. PRN 6 shows trend of decreasing bias while PRN 11 and 13 show trend of slightly increasing bias.

Table 12-5 PRN Bias Average for the Quarter

PRN	DM1	DM2	DM3	DM4
2	0.00018726	0.00005910	0.00002208	0.00009647
3	0.00021602	0.00005426	0.00008442	0.00034356
4	0.00023106	0.00004635	0.00007487	0.00012440
5	0.00043445	0.00006343	0.00011728	0.00016752
6	0.00017253	0.00005371	0.00004431	0.00012406
7	0.00012672	0.00009594	0.00003634	0.00013381
8	0.00016385	0.00011691	0.00004275	0.00009903
9	0.00023992	0.00005256	0.00007077	0.00011326
10	0.00064314	0.00007205	0.00026709	0.00009576
11	0.00092108	0.00018390	0.00006534	0.00023137
12	0.00023372	0.00008441	0.00010487	0.00007975
13	0.00052772	0.00005993	0.00005980	0.00016885
14	0.00067705	0.00013014	0.00011484	0.00013389
15	0.00012405	0.00007076	0.00002855	0.00013681
16	0.00015646	0.00007686	0.00010819	0.00034045
17	0.00011480	0.00007852	0.00003050	0.00011646
18	0.00059848	0.00009922	0.00004179	0.00021116
19	0.00038596	0.00013363	0.00003148	0.00008978
20	0.00015513	0.00004875	0.00004531	0.00010205
21	0.00062606	0.00018710	0.00020169	0.00008685
22	0.00017134	0.00008110	0.00010601	0.00010494
23	0.00096367	0.00013898	0.00003599	0.00042876
24	0.00030323	0.00004505	0.00003525	0.00010486
25	0.00015364	0.00011581	0.00008296	0.00031758
26	0.00026100	0.00009232	0.00015164	0.00009397
27	0.00046929	0.00007773	0.00007157	0.00031705
28	0.00025855	0.00005416	0.00003065	0.00009333
29	0.00023947	0.00006371	0.00010407	0.00029694
30	0.00029640	0.00010264	0.00002854	0.00011389
31	0.00045490	0.00015313	0.00003844	0.00025251
32	0.00033524	0.00005013	0.00011488	0.00011308

Figure 12-2 PRN Bias Average for the Quarter

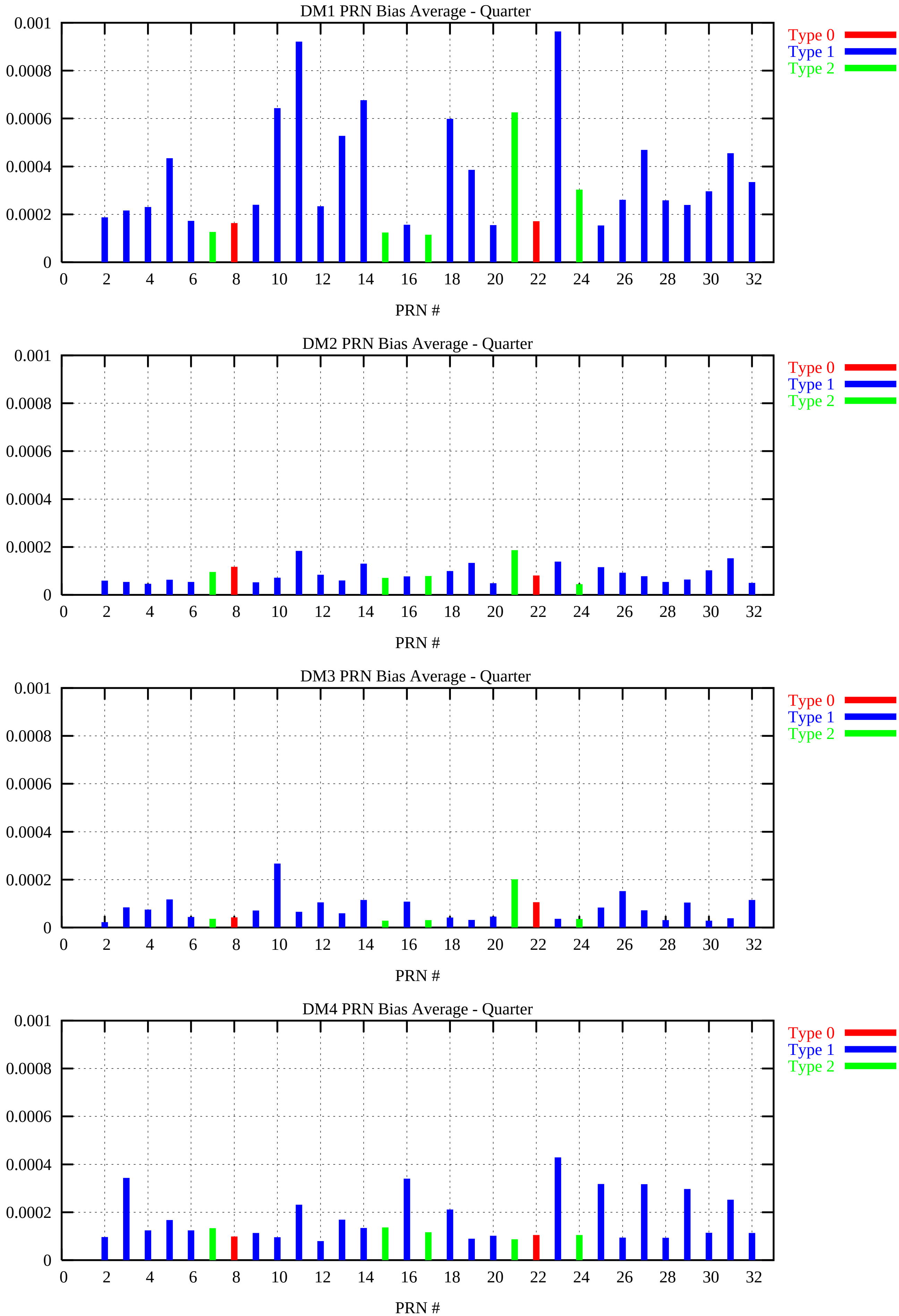
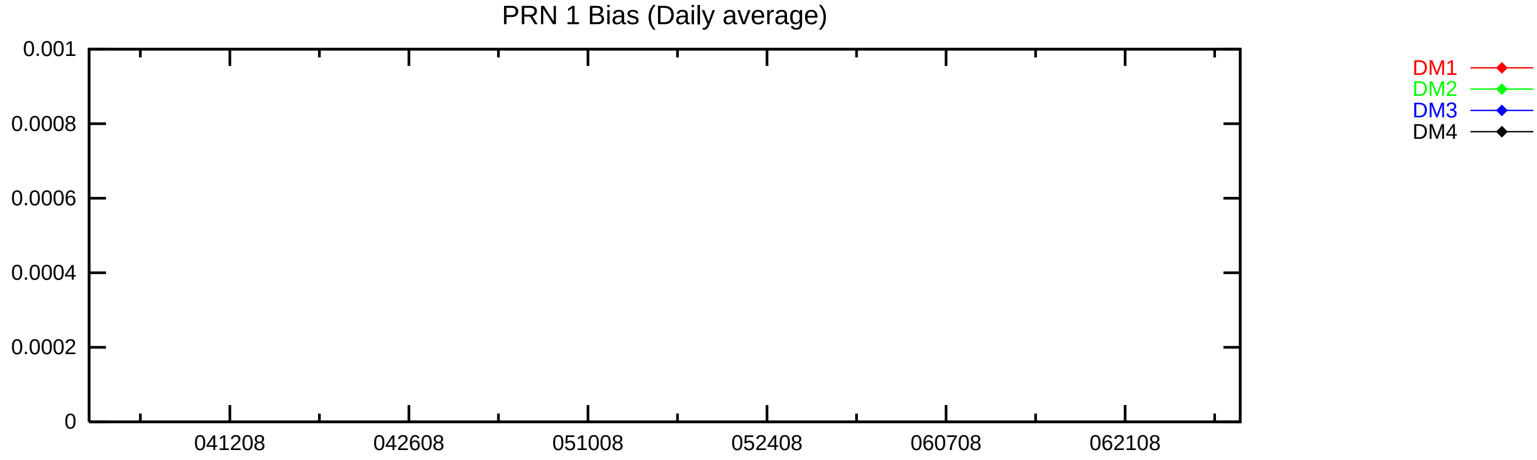
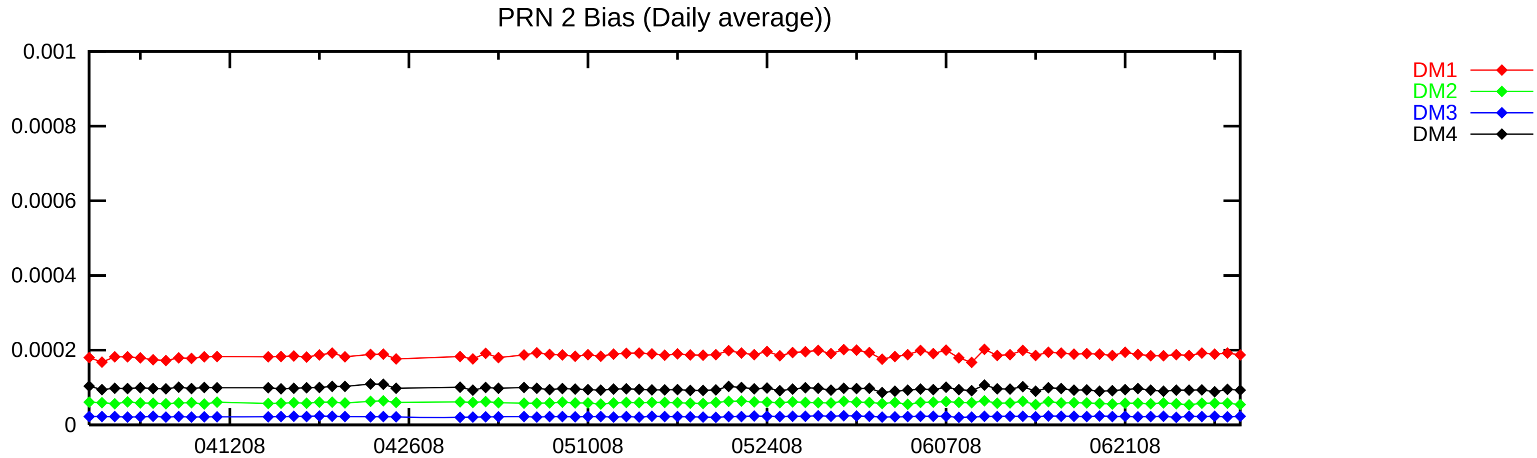
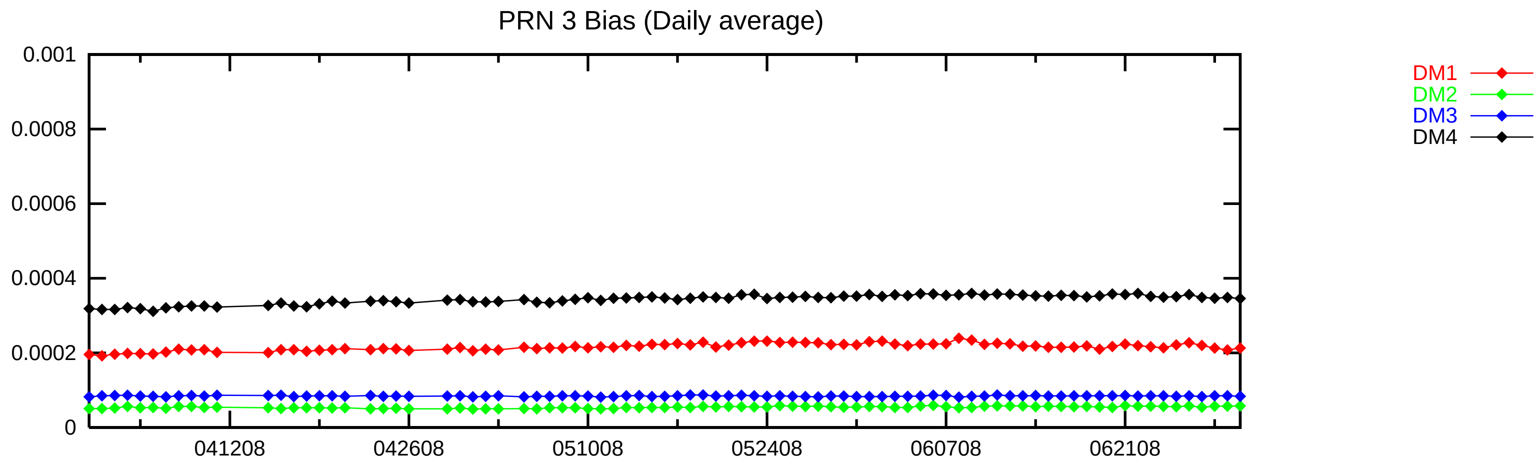


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)







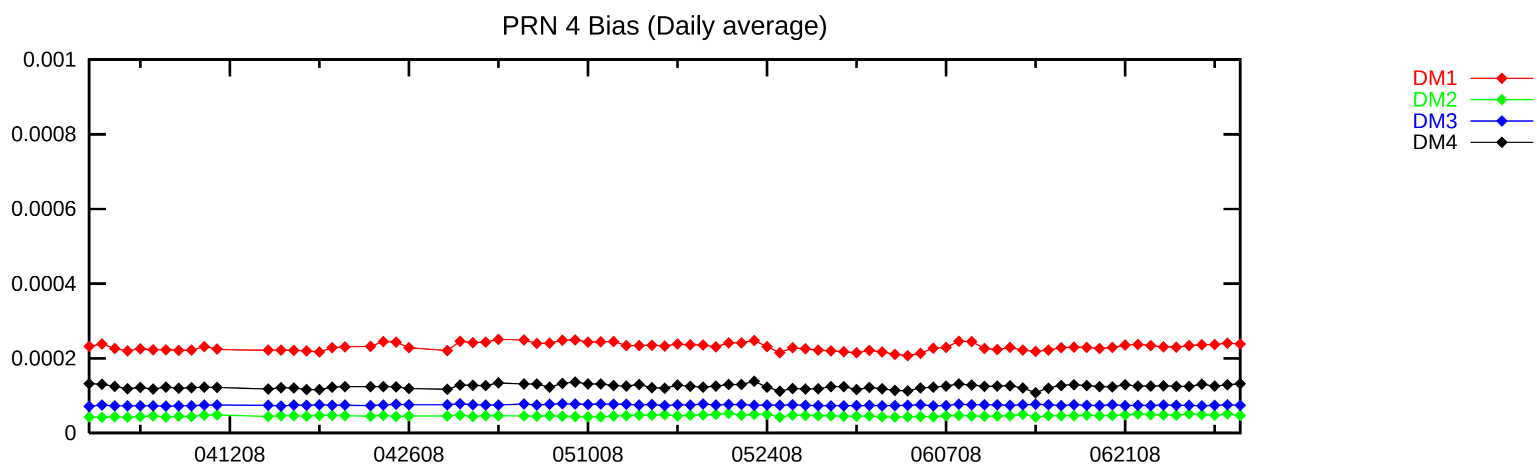


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)

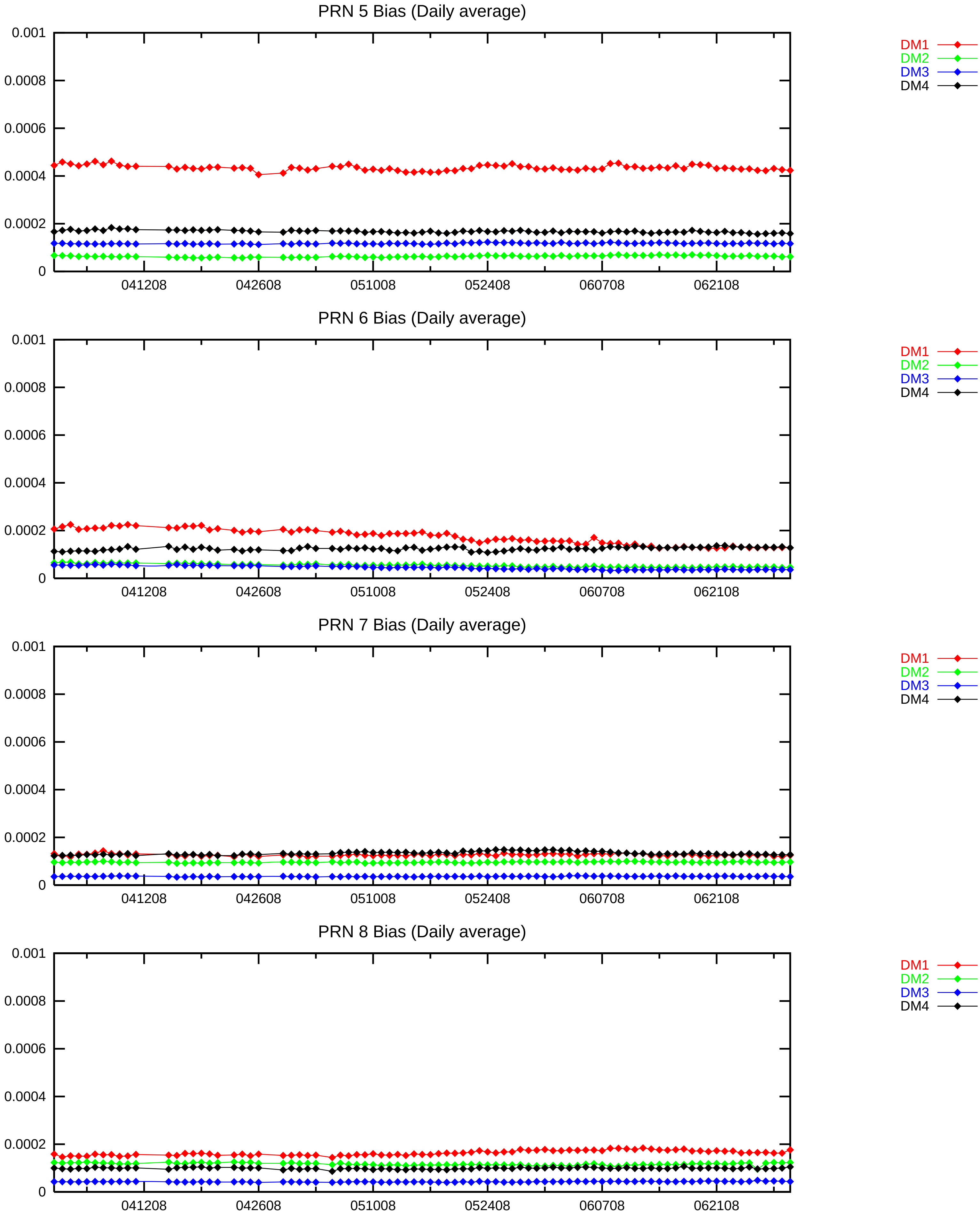
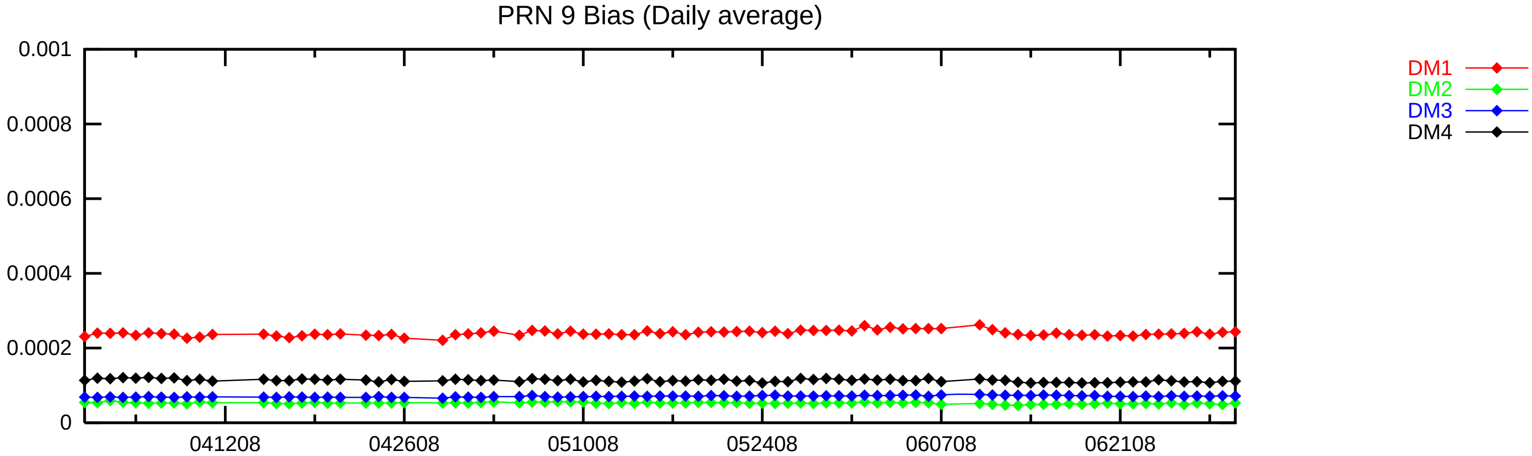
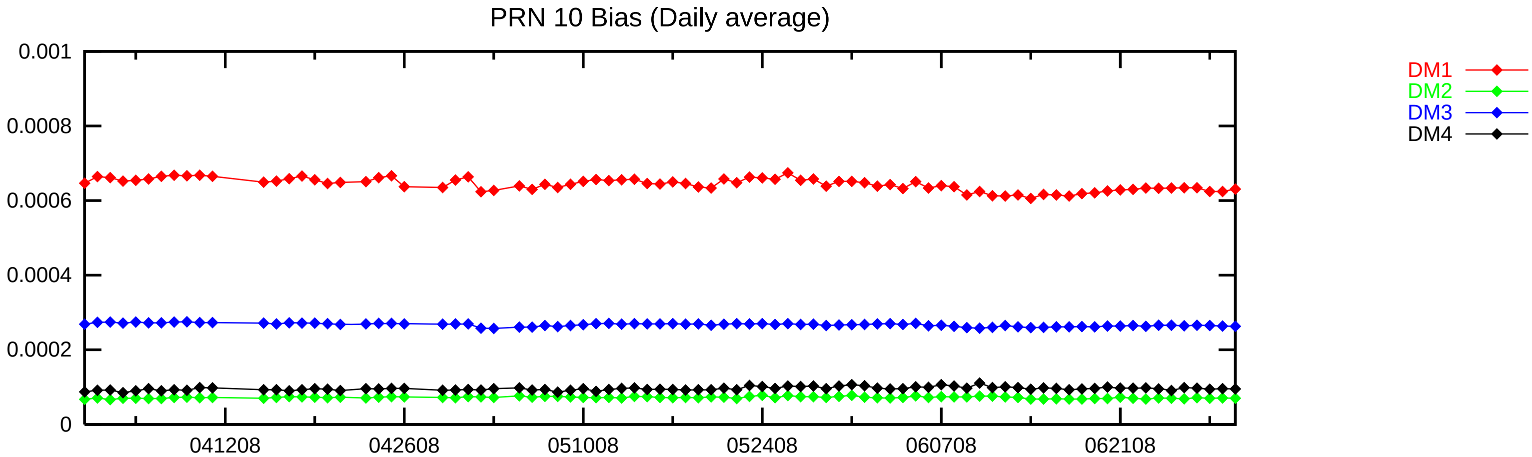
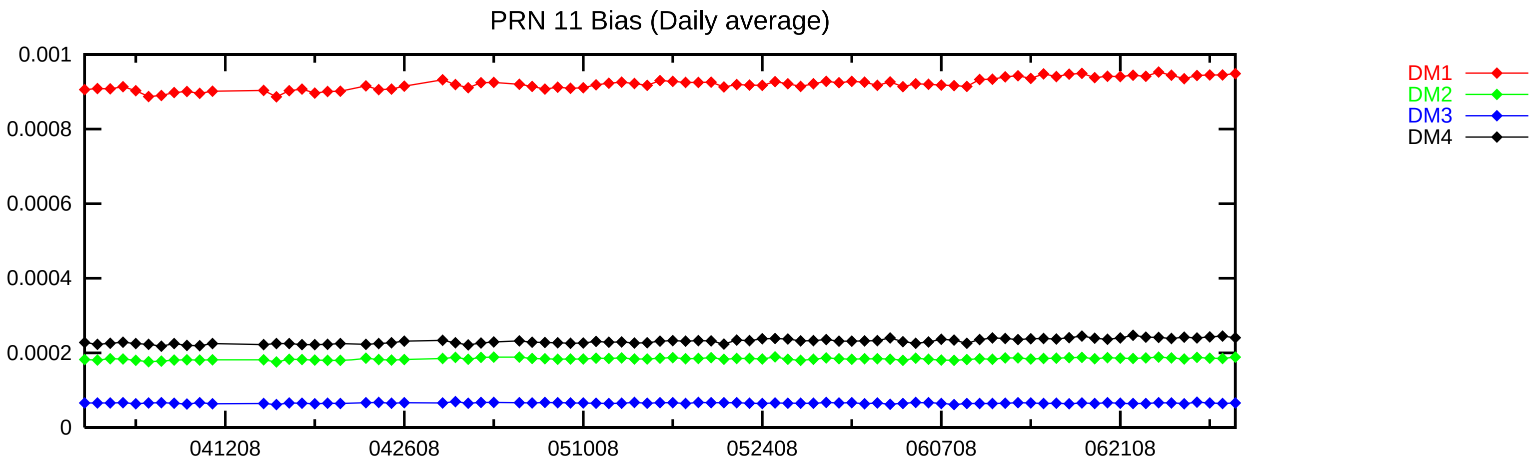


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)







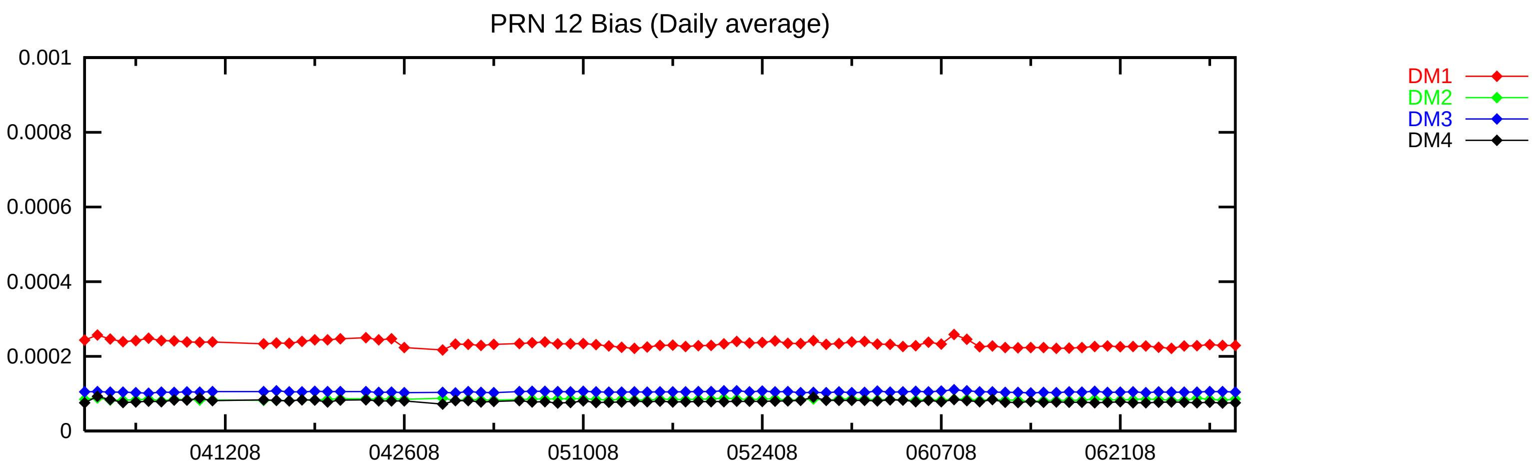
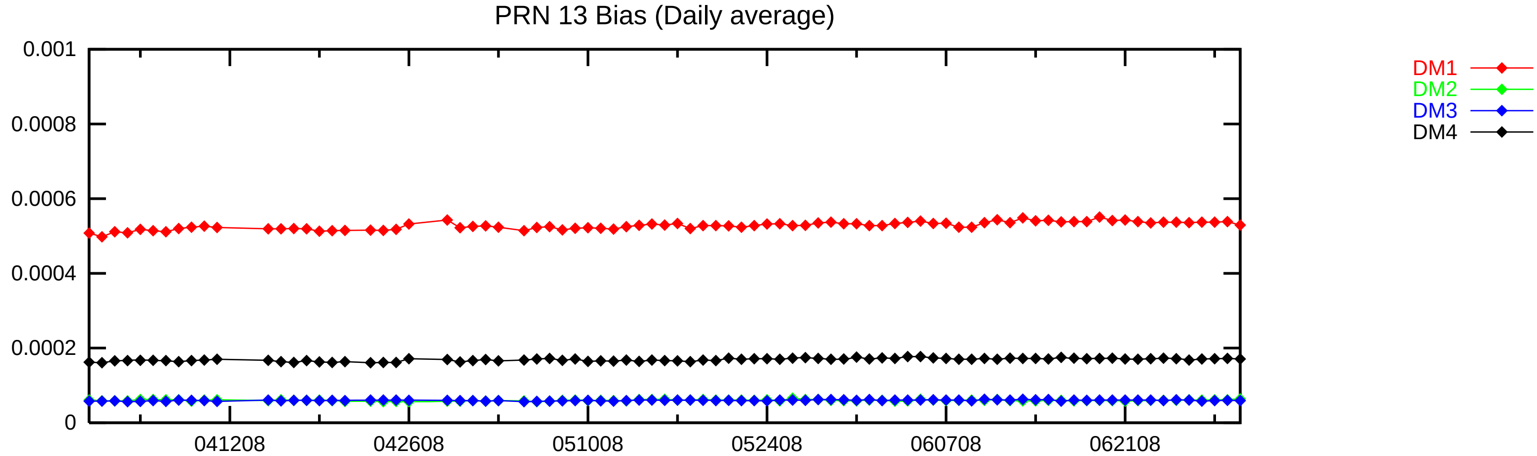
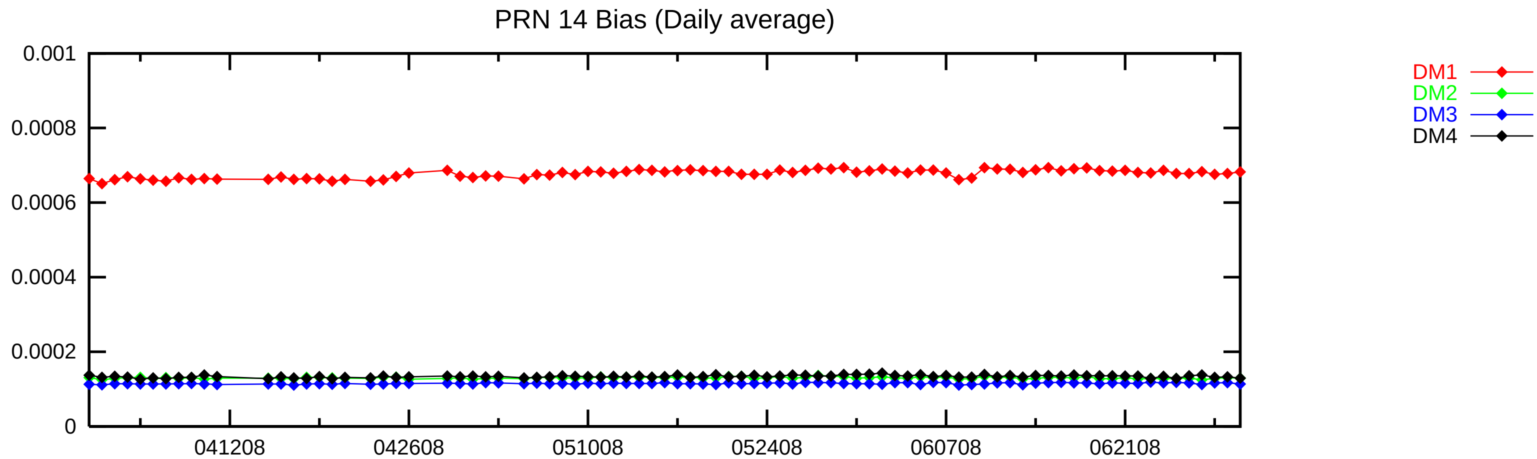
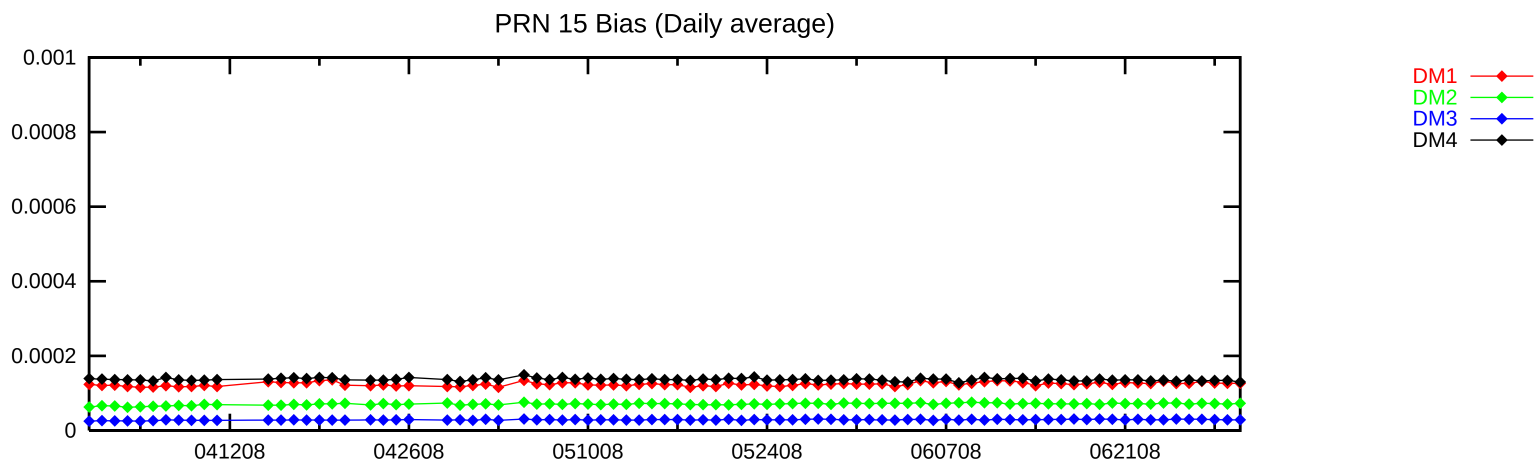


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)







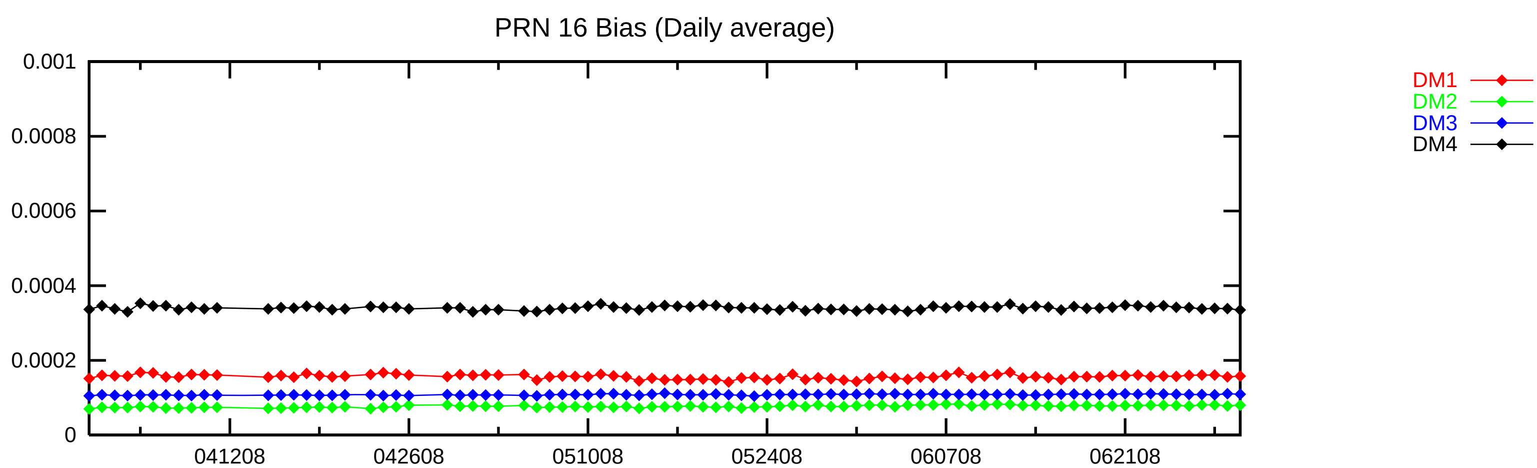


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)

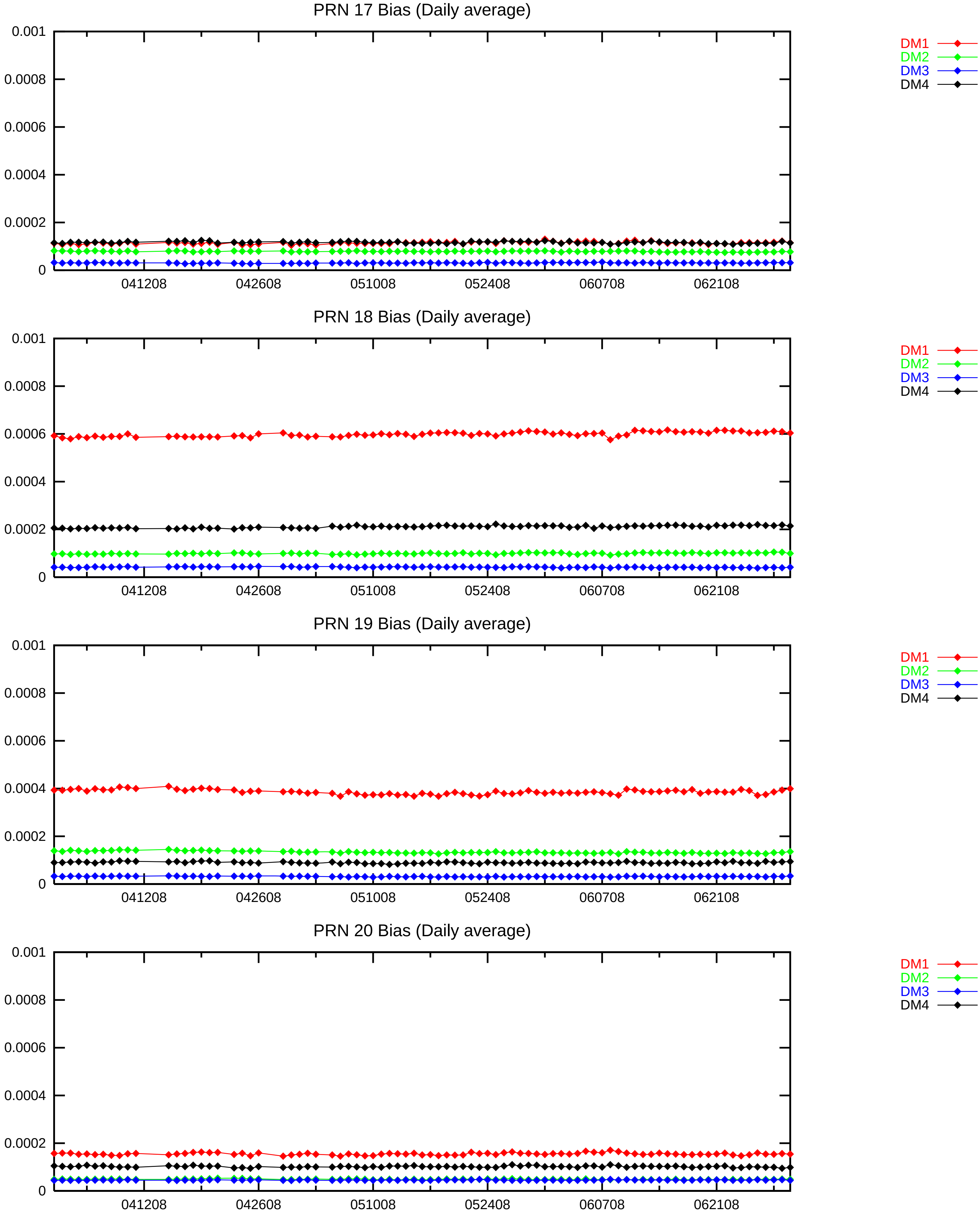
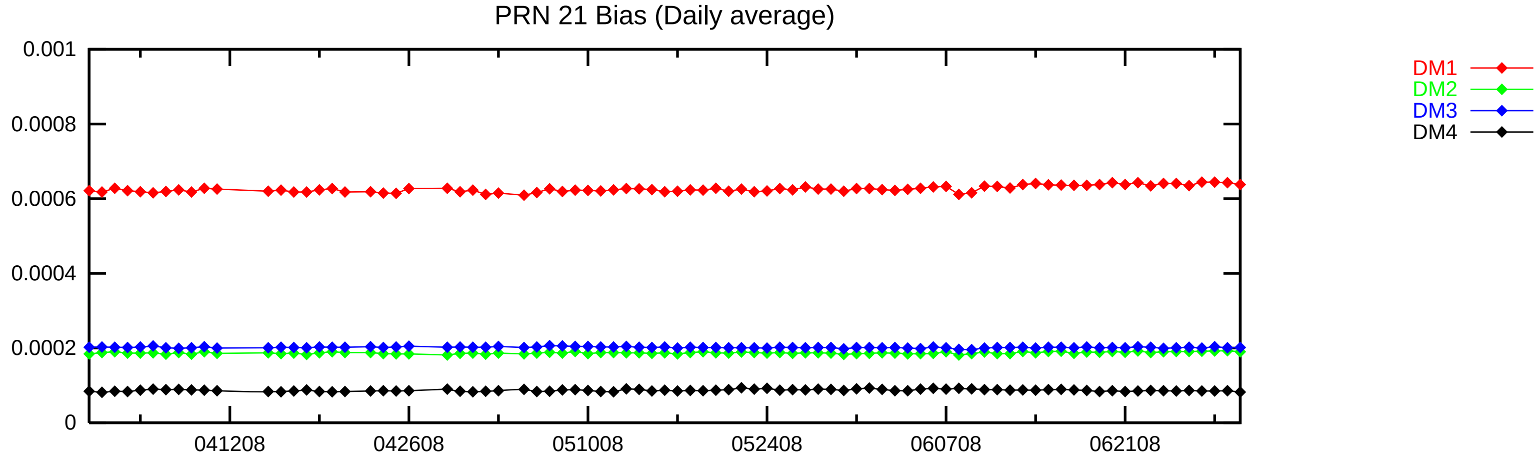
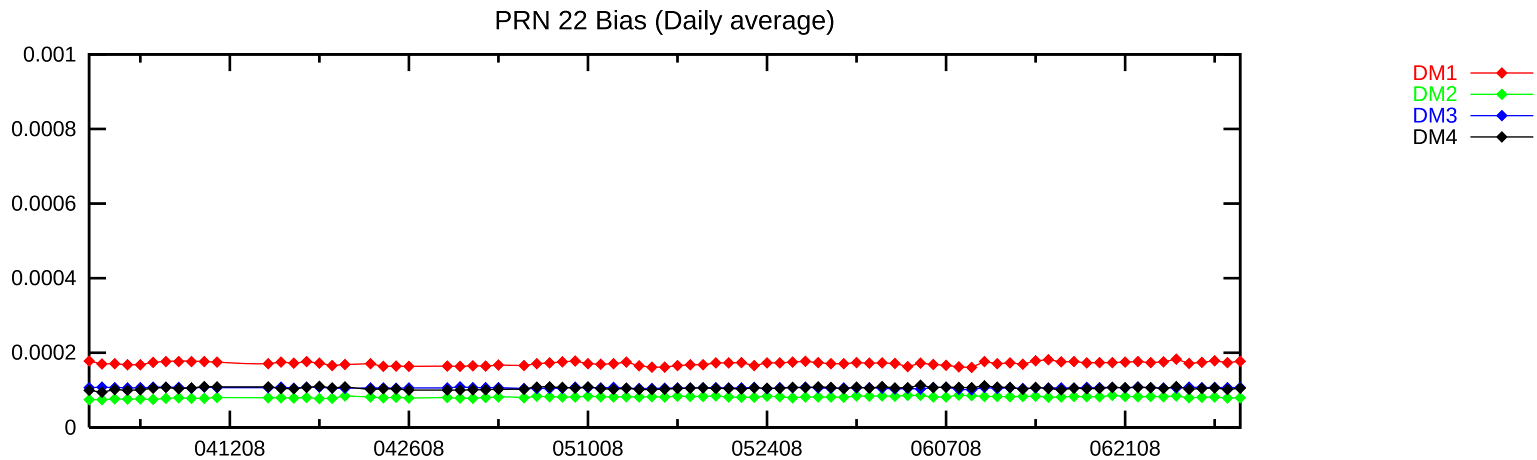
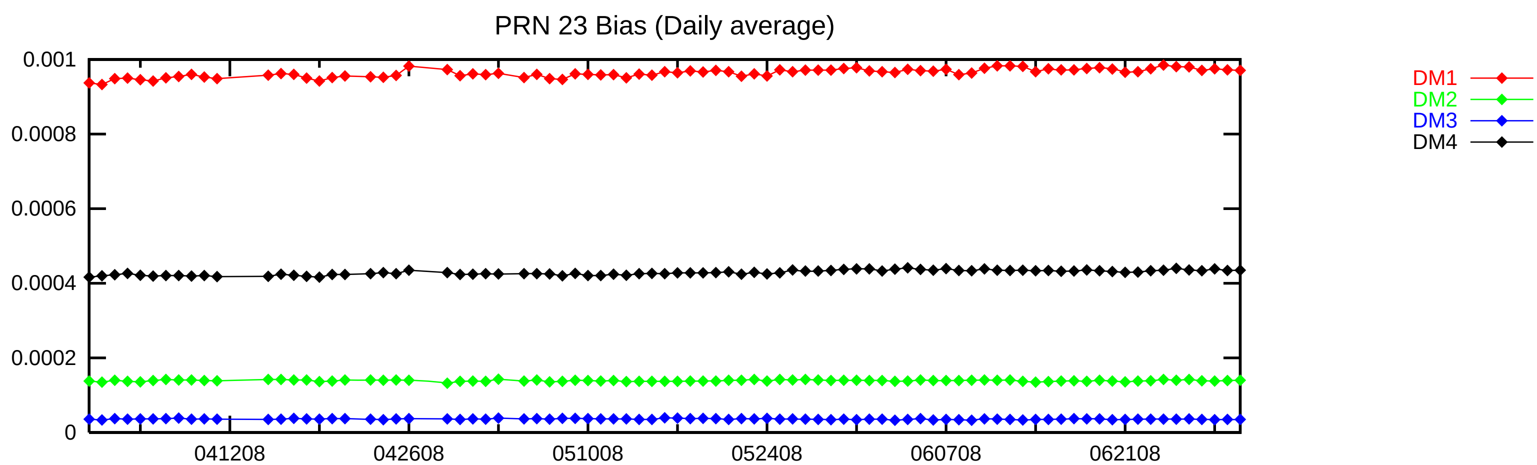


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)







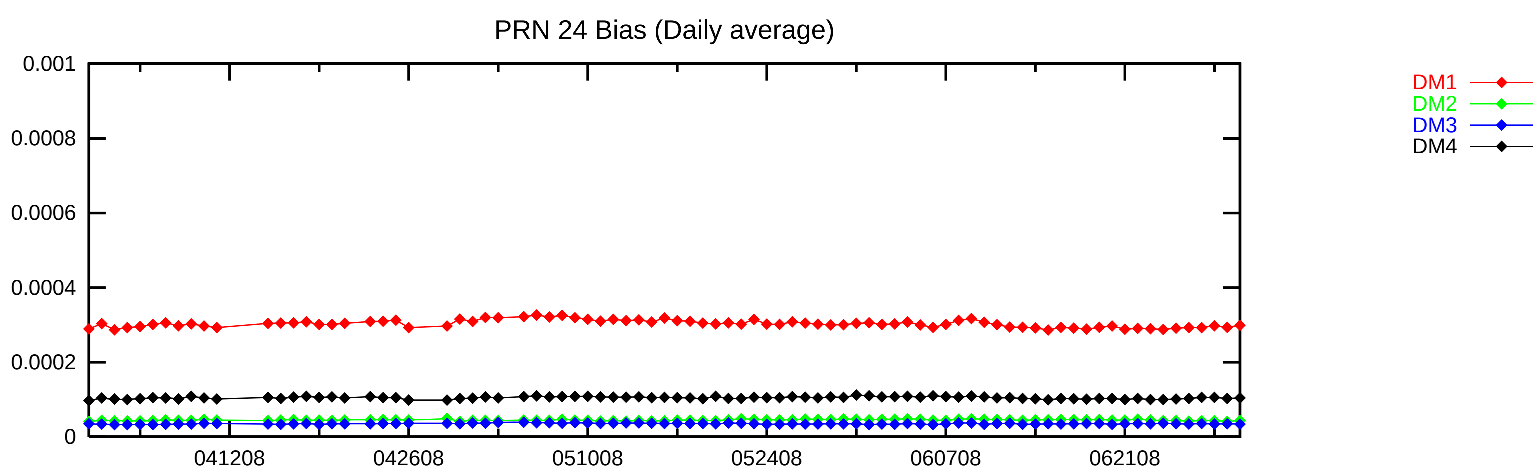
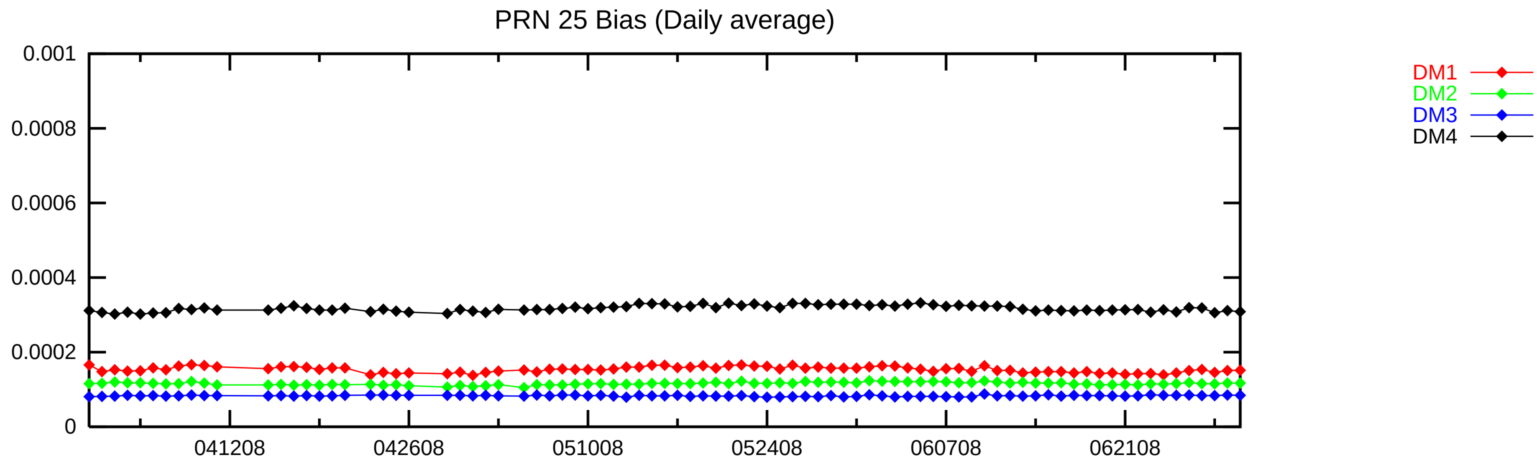
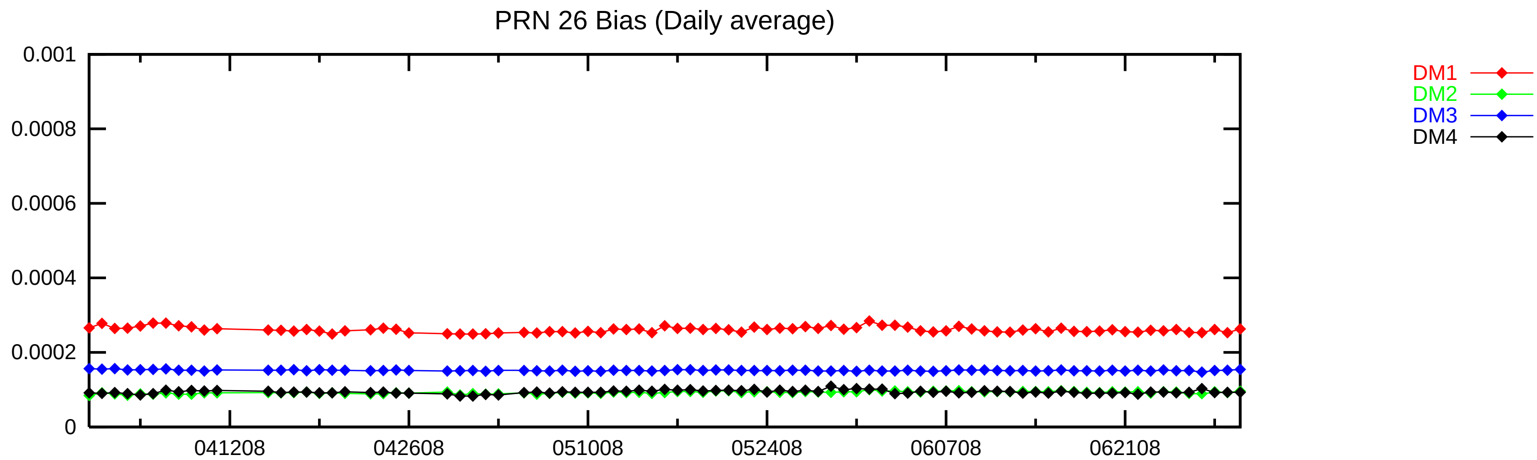
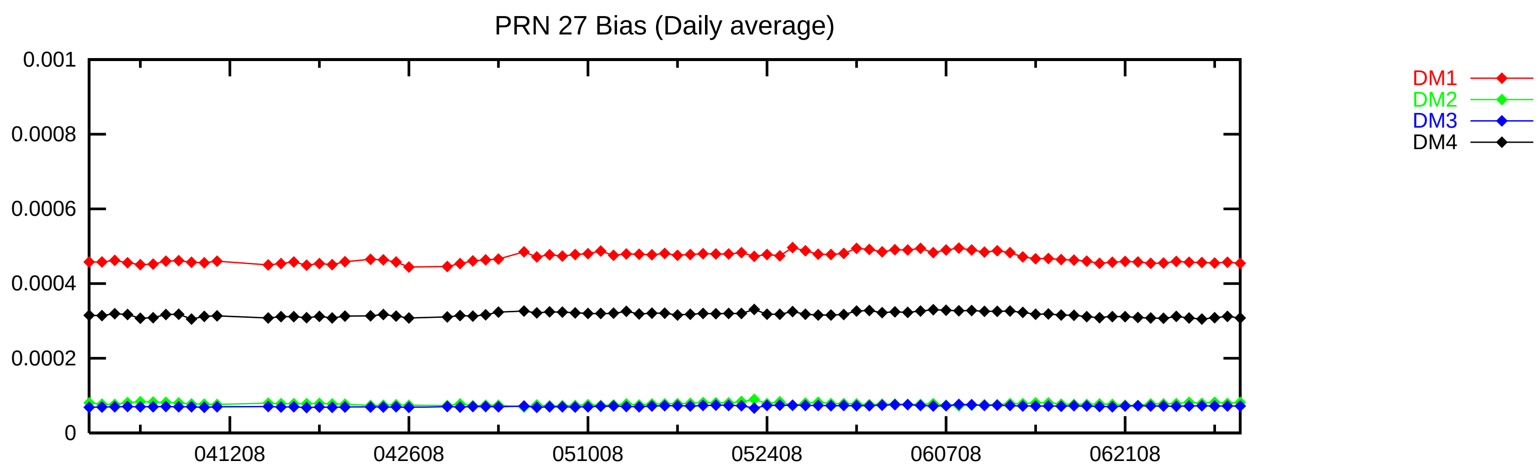


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)







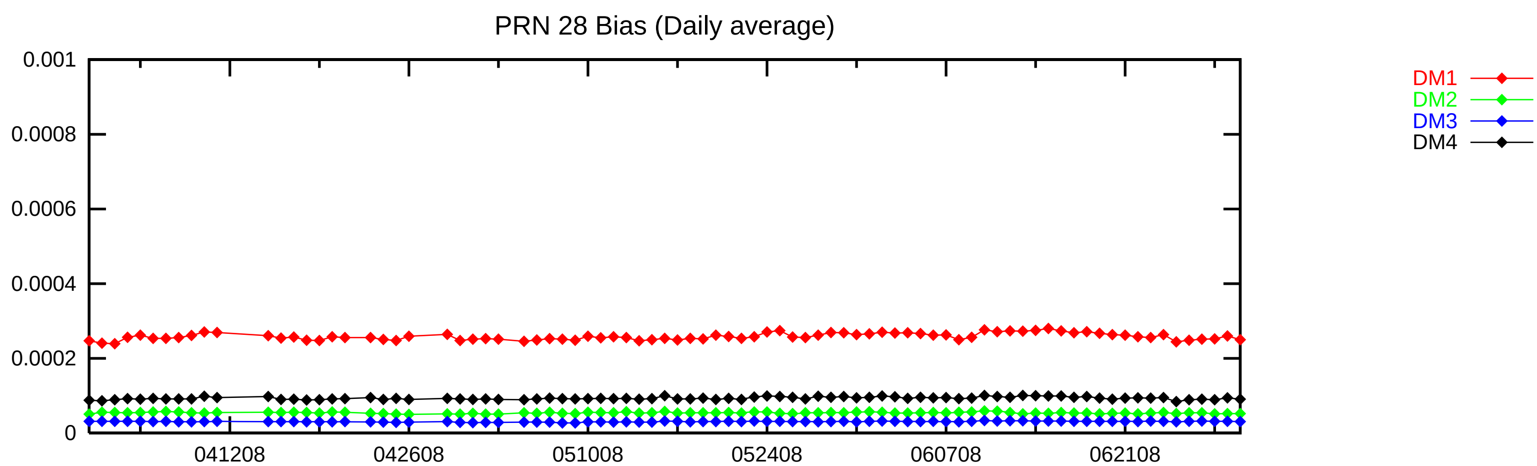
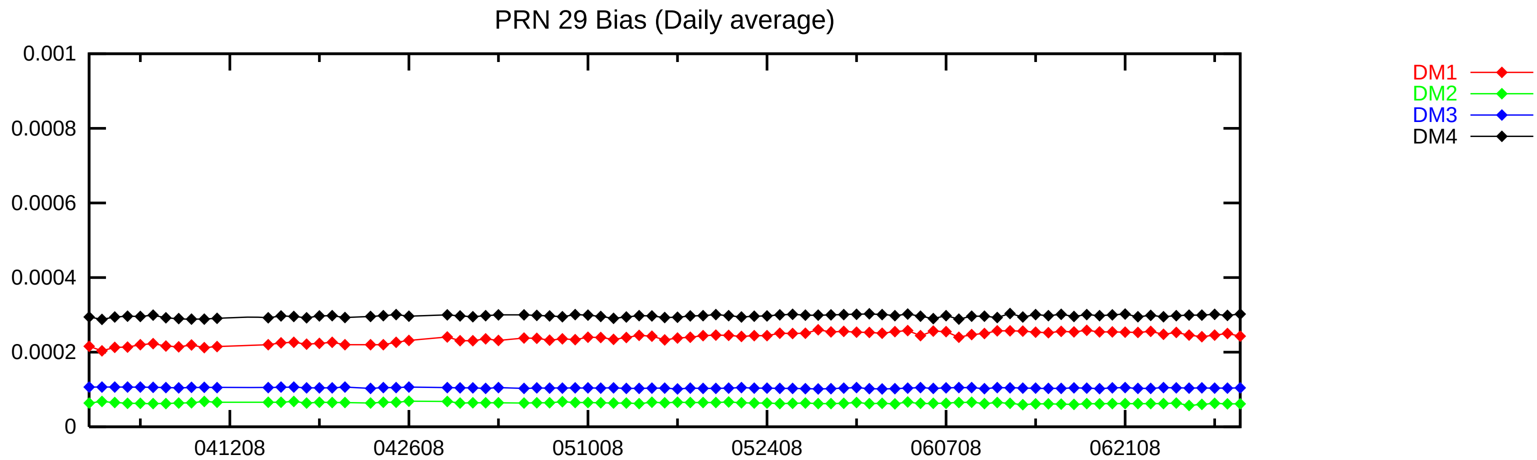
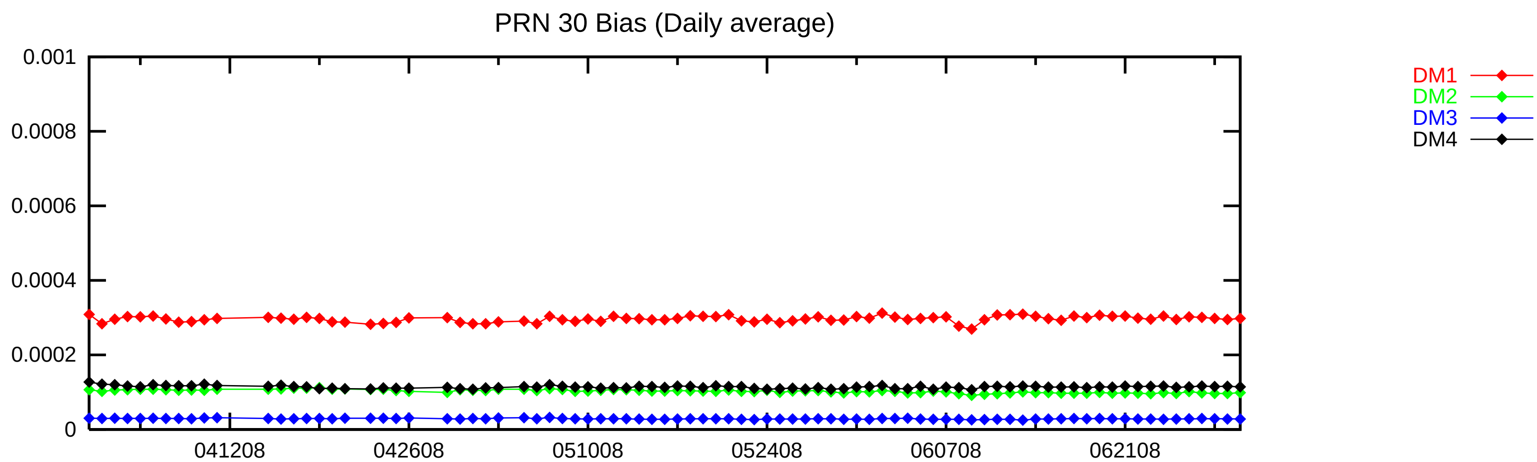
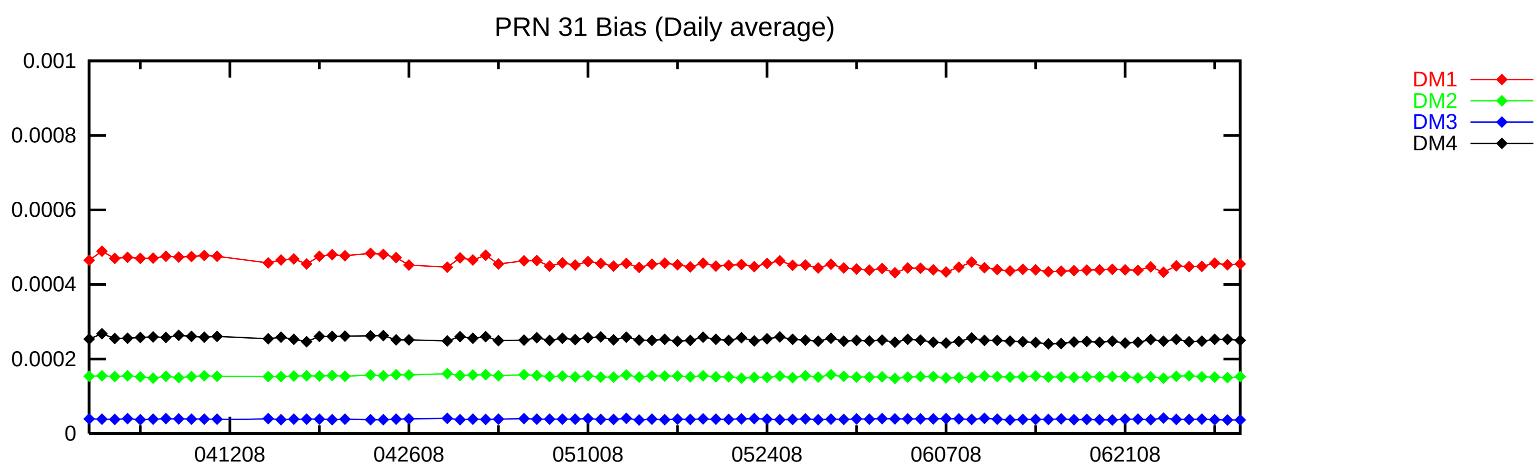
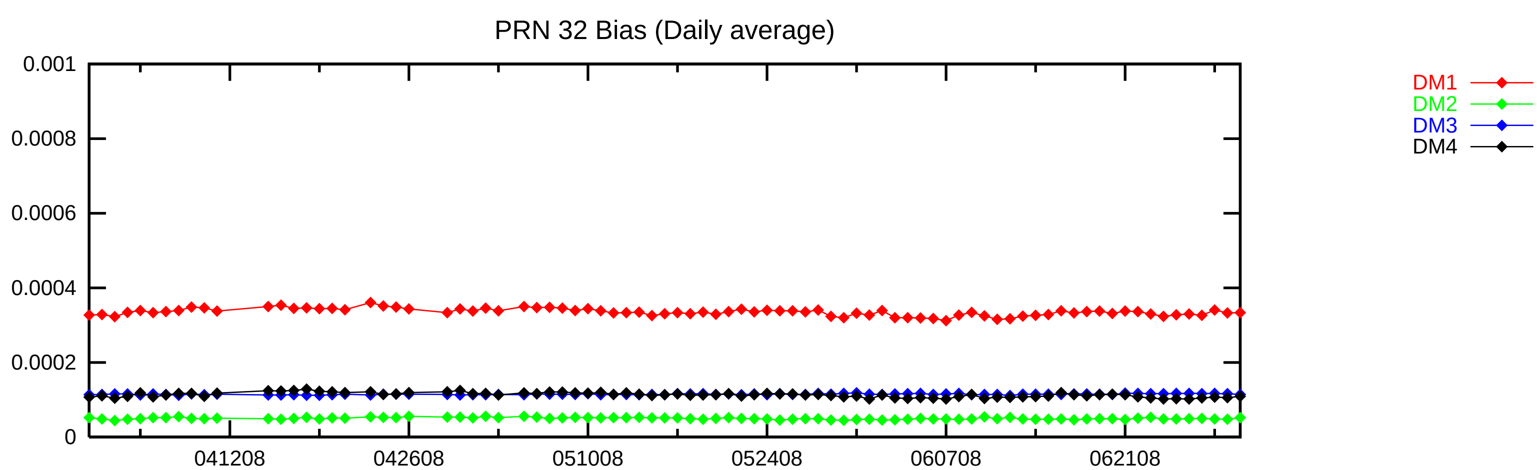


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN









12.5 SQM Trips

SQM trip occurs when the estimated deformation exceeds threshold. Table 12.6 lists all the trips monitored for this reporting period. All are false trips caused by data gap, partial data, or noisy data on rising satellite.

Table 12-6 SQM Trip Summary

GPS Week	Date	PRN#	DM#	Decription
Week 1473 Day 2	4/1/2008	32	4	False trip caused by 11-sec data gap
Week 1474 Day 0	4/6/2008	10	3	False trip caused by a 25-sec data gap followed by partial data (data from only 14 WREs instead of 82 WREs)
Week 1479 Day 1	5/12/2008	26	4	False trip occurred at the beginning of SV pass.

13.0 IGS SPS ACCURACY

GPS SPS accuracy performance was evaluated at a selection of high rate IGS stations (1). The IGS is a voluntary federation of many worldwide agencies that pool resources and permanent GNSS station data to generate precise GNSS products. High data rate (1 Hz) sites that had high availability in 2006, were outside of the WAAS service area, and provided a good geographic distribution were selected. To facilitate differentiating between GPS accuracy issues and receiver tracking problem, an automatic data screening function excluded errors greater than 500 meters and or times when VDOP or HDOP were greater than 10. The remaining receiver tracking issues are still included in the statistics and are believed to influence the outliers in the 99.99% statistics.

Table 13.1 and Figure 13.1 show the IGS site information and locations. Table 13.2 shows the GPS SPS Accuracy Performance observed at a selection of High Rate IGS sites. Figure 13.2 shows the 95% horizontal accuracy at these sites. Figure 13.3 shows the 95% vertical accuracy at these sites.

During the evaluation period, the maximum 95% horizontal and vertical SPS errors are 3.22 meters at Maspalomas and 6.0 meters at Usuda, respectively. The minimum 95% horizontal and vertical SPS errors are 1.77 meters at Norilsk and 4.30 meters at Tidbinbilla, respectively. The maximum 99.99% horizontal and vertical SPS errors are 50.01 meters and 50.01 meters, both at Kourou, respectively. The minimum 99.99% horizontal and vertical SPS errors are 3.81 meters at Dededo and 11.81 meters at Sutherland, respectively. GLPS and IISC are not evaluated this period due to no data available.

(1) J.M. Dow, R.E. Neilan, G. Gendt, "The International GPS Service (IGS): Celebrating the 10th Anniversary and Looking to the Next Decade," Adv. Space Res. 36 vol. 36, no. 3, pp. 320-326, 2005. doi:10.1016/j.asr.2005.05.125

Table 13-1 Selected IGS Site Information

ID	City	Country
GUAM	Dededo	Guam
KIRU	Kiruna	Sweden
KOUR	Kourou	French Guyana
MADR	Robledo	Spain
MALI	Malindi	Kenya
MAS1	Maspalomas	Spain
MOBN	Obninsk	Russian Federation
NNOR	New Norcia	Australia
NRIL	Norilsk	Russian Federation
PETS	Petropavlovsk-Kamchatka	Russian Federation
POL2	Bishkek	Kyrghyzstan
SANT	Santiago	Chile
SUTM	Sutherland	South Africa
TIDB	Tidbinbilla	Australia
USUD	Usuda	Japan

Figure 13-1 Selected IGS Site Locations

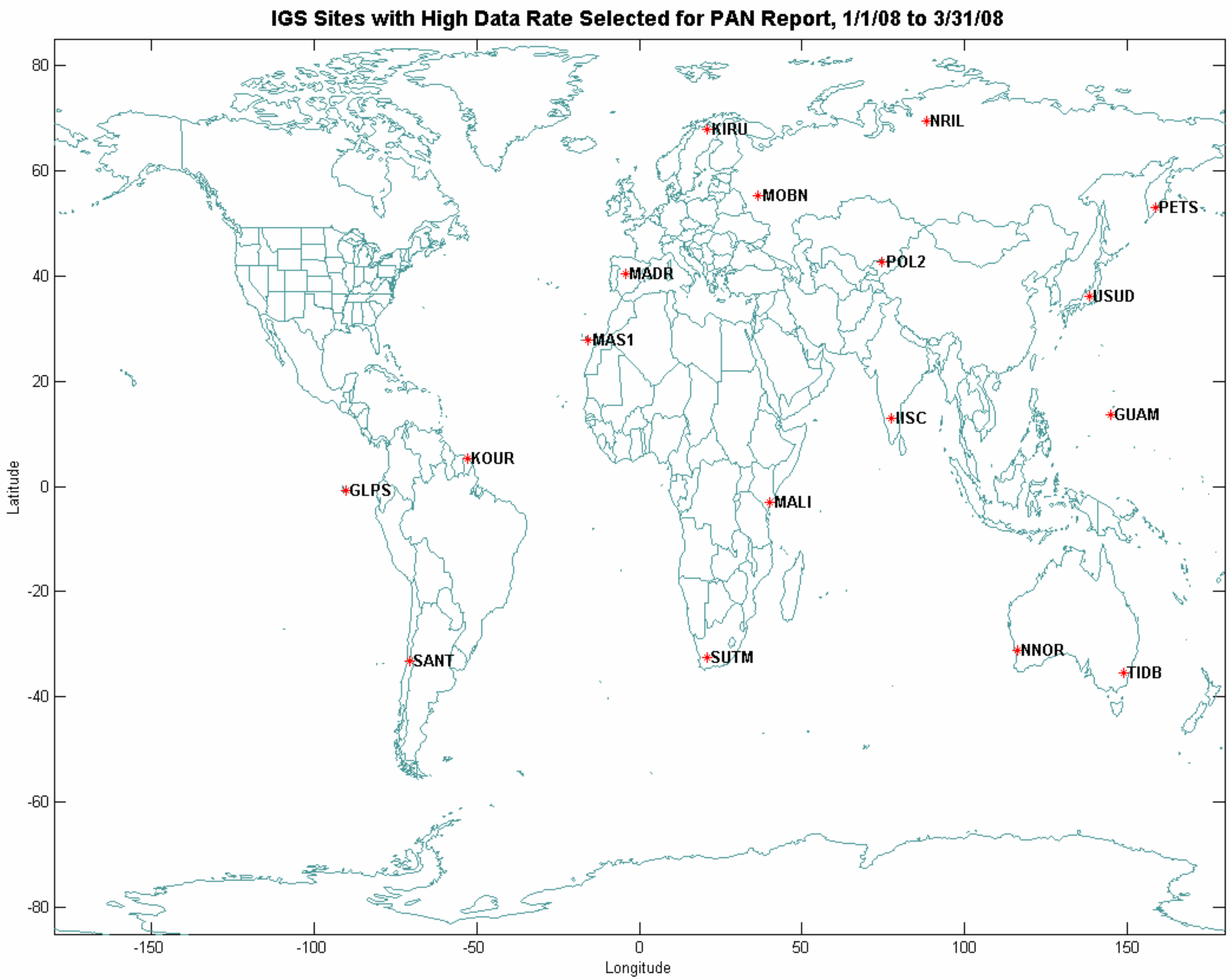


Table 13-2 GPS SPS Performance at a Selection of High Rate IGS Sites

Site	95% Horizontal Error (m)	95% Vertical Error (m)	99.99% Horizontal Error (m)	99.99% Vertical Error (m)	99.99% Horizontal Error (m)	Percent Data Processed
GUAM	2.03	5.17	3.81	16.74	7929786	99.76%
KIRU	2.04	4.52	9.69	21.52	7944948	99.95%
KOUR	2.12	4.54	50.01	50.01	7938822	99.87%
MADR	2.27	4.71	6.78	13.43	7718665	97.10%
MALI	2.56	4.76	23.97	13.72	7899817	99.38%
MAS1	3.22	5.81	8.26	15.99	7828628	98.49%
MATE	2.23	4.83	9.53	13.27	7796905	98.09%
MOBN	2.52	4.85	9.86	15.69	7869290	99.00%
NNOR	2.44	4.92	5.76	12.76	7945647	99.96%
NRIL	1.77	4.83	7.30	16.00	7634688	96.05%
PETS	2.52	5.72	8.53	13.15	7941826	99.91%
POL2	2.13	5.04	7.22	11.86	7820703	98.39%
SANT	2.71	4.78	7.09	12.47	7930070	99.76%
SUTM	2.25	4.35	6.76	11.81	7471462	93.99%
TIDB	2.70	4.30	9.46	16.45	7868508	98.99%
USUD	2.85	6.00	8.87	15.89	7802269	98.16%

Figure 13-2 95% Horizontal Accuracy Trend at Selected IGS Sites

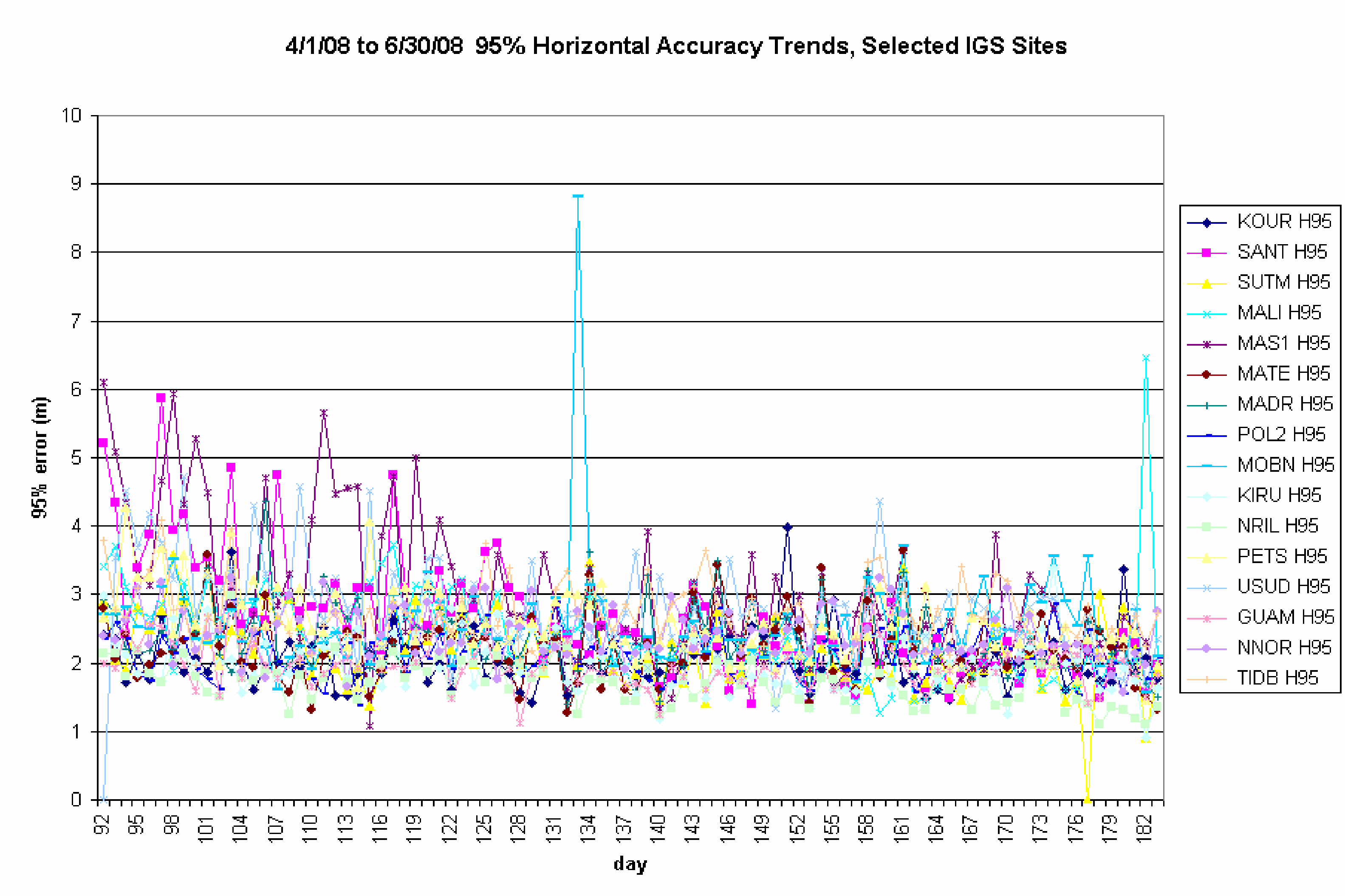
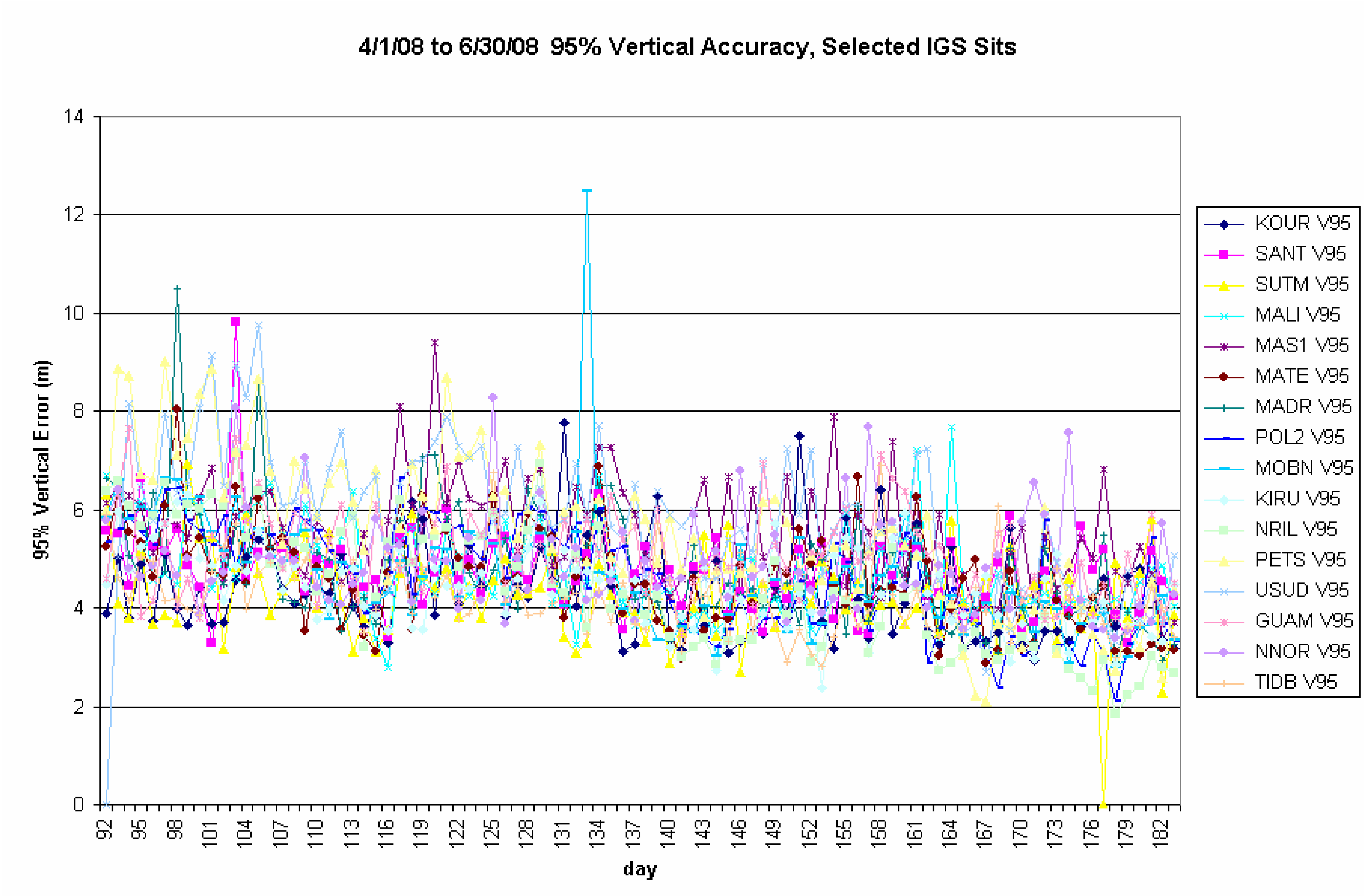


Figure 13-3 95% Vertical Accuracy Trend at Selected IGS Sites



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.