WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #12

Reporting Period: January 1 to March 31, 2005

May 2005

FAA/William J. Hughes Technical Center
NSTB/WAAS T&E Team
Atlantic City International Airport, NJ 08405

Executive Summary

Since 1999 the WAAS Group 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/NSTB Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the twelfth such WAAS quarterly report. This report covers WAAS performance during the period from January 1, 2005 to March 31, 2005.

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 Approach 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.

Parameter	Site/Maximum	Site/Minimum
95% Horizontal Accuracy	Los Angeles 1.040 meters	Chicago 0.691 meters
95% Vertical Accuracy	Los Angeles 1.676 meters	Washington DC 1.008 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Billings 99.94%	Boston 96.61%
95% HPL	Oakland 27.644 meters	Chicago 16.482 meters
95% VPL	Boston 43.622 meters	Billings 27.545 meters

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX

1.0 INTRODUCTION

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

Objectives of this report are:

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

The WAAS data transmitted from GEO satellite PRN#122 (AORW) and PRN#134 (POR) were used in the evaluation. Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from January 1, 2005 to March 31, 2005.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Anderson	61	5267254
Grand Forks	82	7058532
Great Falls	87	7542976
Greenwood	83	7167302
Oklahoma City	80	6873963
WAAS:		
Albuquerque	84	7237755
Atlanta	88	7598882
Billings	80	6906715
Boston	88	7585424
Chicago	88	7589935
Cleveland	84	7297551
Dallas	88	7570914
Denver	88	7591793
Houston	88	7591595
Jacksonville	88	7583191
Kansas City	88	7598397
Los Angeles	88	7598766
Memphis	88	7575261
Miami	88	7590241
Minneapolis	88	7598295
New York	88	7594468
Oakland	88	7594367
Salt Lake City	82	7073802
Seattle	88	7597772
Washington DC	88	7597039

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Bangor	88	7582541
Mauna Loa	85	7357812
Kotzebue	88	7572674
Albuquerque	84	7257599
Anchorage	88	7594454
Atlanta	88	7595693
Billings	81	6974327
Boston	88	7588503
Cleveland	85	7363127
Cold Bay	88	7571353
Honolulu	88	7591377
Houston	88	7588450
Juneau	87	7516548
Kansas City	88	7595451
Los Angeles	88	7598801
Miami	88	7591671
Minneapolis	88	7595905
Oakland	88	7594985
Salt Lake City	82	7109477
San Juan	88	7595458
Seattle	88	7596891
Washington DC	88	7594358

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, and WAAS Equipment Outage Report.

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

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

Table 1-3 WAAS Performance Parameters

Performance Parameter	Expected WAAS Performance
PA Accuracy Horizontal	≤ 7.6m error 95% of the time
PA Accuracy Vertical	≤ 7.6m error 95% of the time
NPA Accuracy Horizontal	≤ 100m error 95% of the time ≤ 556m error 99.999% of the time
Availability LPV*	Not Defined for Current WAAS phase
Availability LNAV/VNAV*	Not Defined for Current WAAS phase
LPV and LNAV/VNAV Outages and outage rate	Not Defined for Current WAAS phase
LNAV Outages and outage rates	Not Defined for Current WAAS phase
Coverage LPV	Not Defined for Current WAAS phase For this report - 95% availability of 75% of CONUS
Coverage LNAV/VNAV	95% availability of 75% of CONUS
Coverage NPA	99.9% availability of 75% of service volume
LPV Availability	≥ 95% of the time within the service volume
LNAV/VNAV Availability	≥ 95% of the time within the service volume
Integrity	≤ 4 X 10e-8 HMI's 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.

Table 1-4 Test Events

GPS Week	Date	Sites	Events
1298 day 2 to 1304 day 3	11/23/04 to 1/5/05	Greenwood	Greenwood outage.
1303 day 3 to 1307 day 4	12/29/04 to 1/27/05	Anderson	Anderson outage.
1305 day 1 to 1305 day 5	1/10/05 to 1/14/05	Albuquerque	Albuquerque outage.
1305 day 2	1/11/05	All WAAS Sites	WEI outage. (160 & 152 sec common network outages.)
1306 day 1 to 1306 day 3	1/17/05 to 1/19/05	Cleveland	Cleveland outage.
1306 day 4 to 1307 day 4	1/20/05 to 1/27/05	Oklahoma City	Oklahoma City outage.
1306 day 5	1/21/05	Grand Forks, Chicago, Boston, DC, Minneapolis, NY, Cleveland	Ionospheric storm. Max Kp = 8. Caused substantial coverage loss.
1307 day 0 to 1307 day 5	1/23/05 to 1/28/05	SLC	SLC outage.
1308 day 6 to 1309 day 5	2/5/05 to 2/11/05	Billings	Billings outage.
1309 day 2 to 1311 day 2	2/8/05 to 2/22/05	All AORW sites	Problems with Santa Paula GUS signal generator and Clarksburg GUS phase noise enhancer caused the following issues: Many AORW gaps / switchovers. Many Type 6 alerts were broadcast, raising UDREi of all satellites in view to 14 (not monitored), resulting in loss of service availability (LPV, LNAV/VNAV, and NPA).
1309 day 4	2/10/05	All POR sites	14 POR Gaps: (SIS outage noted below; others 1-36 seconds).
1309 day 4	2/10/05	All	Signal in Space outage: AORW, 1743 seconds: GPS Time 397506 – 399251. POR, 2622 seconds: GPS Time 367506 – 400128.
1309 day 4	2/10/05	Denver, Ft. Worth, KC, LA, SLC, Oakland, Seattle	Network outages. Occurred within the same timeframe as the SIS outages recorded above.
1312 day 4 to 1313 day 2	3/4/05 to 3/8/05	Grand Forks	Grand Forks outage.

1.2 Report Overview

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

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 Houston.

Section 7 provides the GEO ranging performance for AORW and POR.

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 75 WAAS receivers.

Section 11 summarizes WAAS equipment outages and GUS switchovers.

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 two operational service levels: WAAS LPV, 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

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 2.4 show the daily horizontal and vertical 95% accuracy for LNAV/VNAV 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 2.5 shows the daily horizontal 95% accuracy for NPA.

During the evaluated period, the 95% horizontal and vertical accuracy at all evaluated sites were less than 2 meters for both WAAS operational service levels. The maximum 95% horizontal and vertical LPV errors are 1.040 meters and 1.676 meters, both at Los Angeles. The minimum 95% horizontal and vertical LPV errors are 0.691 meters at Chicago and 1.008 meters at Washington DC, respectively. The maximum 95% and 99.999% NPA horizontal errors are 5.971 meters and 11.311 meters both at Mauna Loa. The minimum 95% and 99.999% horizontal errors are 1.303 meters at Juneau and 3.269 meters at Kansas City.

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 2.6 to 2.15 show the distributions of the vertical and horizontal errors in triangle charts and 2-D histogram plots for the quarter at three locations, Oklahoma 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 GLS/APV2/LPV (HAL=40m) (Meters)	Horizontal APV-1(LNAV) (HAL=556m) (Meters)	Vertical LPV/VNAV (VAL=50m) (Meters)	Percentage in PA mode (%)	SPS Accuracy	
					95% Horizontal (Meters)	95% Vertical (Meters)
Anderson	0.717	0.719	1.128	99.92918	*	*
Grand Forks	0.893	0.899	1.370	99.93891	*	*
Great Falls	0.851	0.853	1.366	99.95535	*	*
Greenwood	0.796	0.798	1.175	99.94009	*	*
Oklahoma City	0.791	0.792	1.204	99.94096	*	*
Albuquerque	0.758	0.760	1.149	99.94276	2.794	4.936
Atlanta	0.704	0.705	1.117	99.94791	2.893	5.320
Billings	0.841	0.842	1.266	99.97455	2.864	4.902
Boston	0.816	0.819	1.197	99.95717	2.881	4.881
Chicago	0.691	0.694	1.050	99.94772	*	*
Cleveland	0.740	0.744	1.219	99.94871	2.943	4.880
Dallas	0.896	0.897	1.298	99.95207	*	*
Denver	0.817	0.819	1.475	99.95229	*	*
Houston	0.802	0.804	1.294	99.94485	2.799	5.166
Jacksonville	0.915	0.916	1.228	99.94787	*	*
Kansas City	0.741	0.742	1.010	99.95179	2.882	5.192
Los Angeles	1.040	1.041	1.676	99.98030	2.844	5.324
Memphis	0.704	0.705	1.151	99.94482	*	*
Miami	0.897	0.898	1.562	99.94771	3.026	5.630
Minneapolis	0.825	0.828	1.213	99.94486	2.865	4.996
New York	0.841	0.845	1.099	99.94711	*	*
Oakland	0.791	0.791	1.558	99.99597	2.748	5.264
Salt Lake City	0.774	0.775	1.155	99.96993	2.872	4.967
Seattle	0.971	0.972	1.373	99.98032	2.885	5.066
Washington DC	0.708	0.710	1.008	99.94734	2.885	5.123

* 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
Bangor	2.324	9.769	96.9150	10.873
Mauna Loa	5.971	11.311	99.4129	18.689
Kotzebue	2.250	4.826	99.5247	9.830
Albuquerque	1.412	3.983	96.8270	12.418
Anchorage	1.387	3.413	99.5263	9.588
Atlanta	1.426	3.881	97.0128	24.064
Billings	1.494	5.299	97.3684	11.270
Boston	1.671	5.865	97.0100	25.482
Cleveland	1.458	6.328	97.0186	20.601
Cold Bay	1.735	5.735	99.5245	9.114
Honolulu	4.497	10.209	99.4787	10.536
Houston	1.534	4.040	97.0100	39.671
Juneau	1.303	4.048	99.5211	9.454
Kansas City	1.457	3.269	97.0142	16.075
Los Angeles	1.610	4.791	99.8105	7.984
Miami	1.514	4.306	97.0128	24.642
Minneapolis	1.707	8.631	97.0156	15.575
Oakland	1.362	4.892	99.8104	6.389
Salt Lake City	1.495	4.245	97.2658	9.672
San Juan	2.118	7.917	97.0128	24.758
Seattle	1.757	5.261	99.8104	6.793
Washington DC	1.505	5.682	96.9683	36.425

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
Anderson	3.501	0.189	0.200	5.074	0.150	0.150
Grand Forks	6.800	0.265	0.265	7.476	0.164	0.251
Great Falls	3.370	0.119	0.214	6.039	0.184	0.184
Greenwood	3.620	0.166	0.194	4.567	0.133	0.206
Oklahoma City	6.578	0.275	0.275	4.940	0.102	0.132
Albuquerque	4.126	0.138	0.192	6.620	0.169	0.229
Atlanta	4.695	0.246	0.246	3.728	0.131	0.154
Billings	4.184	0.186	0.250	6.209	0.133	0.194
Boston	7.337	0.261	0.261	5.767	0.146	0.185
Chicago	4.758	0.229	0.229	5.560	0.176	0.218
Cleveland	4.900	0.216	0.216	6.349	0.239	0.239
Dallas	4.342	0.182	0.208	9.301	0.276	0.276
Denver	4.016	0.174	0.204	7.587	0.248	0.248
Houston	5.063	0.144	0.168	5.042	0.183	0.183
Jacksonville	3.509	0.177	0.195	5.350	0.107	0.134
Kansas City	4.511	0.220	0.223	5.425	0.214	0.275
Los Angeles	6.109	0.175	0.175	6.643	0.152	0.163
Memphis	4.393	0.222	0.233	4.949	0.129	0.203
Miami	4.291	0.185	0.196	5.573	0.122	0.182
Minneapolis	5.666	0.240	0.240	7.577	0.187	0.222
New York	5.184	0.202	0.210	4.782	0.102	0.134
Oakland	6.461	0.250	0.250	6.462	0.185	0.185
Salt Lake City	3.841	0.166	0.236	8.581	0.179	0.185
Seattle	6.457	0.234	0.284	5.330	0.114	0.209
Washington DC	4.598	0.259	0.259	4.321	0.098	0.178

Figure 2_1 95% Horizontal Accuracy at LNAV/VNAV

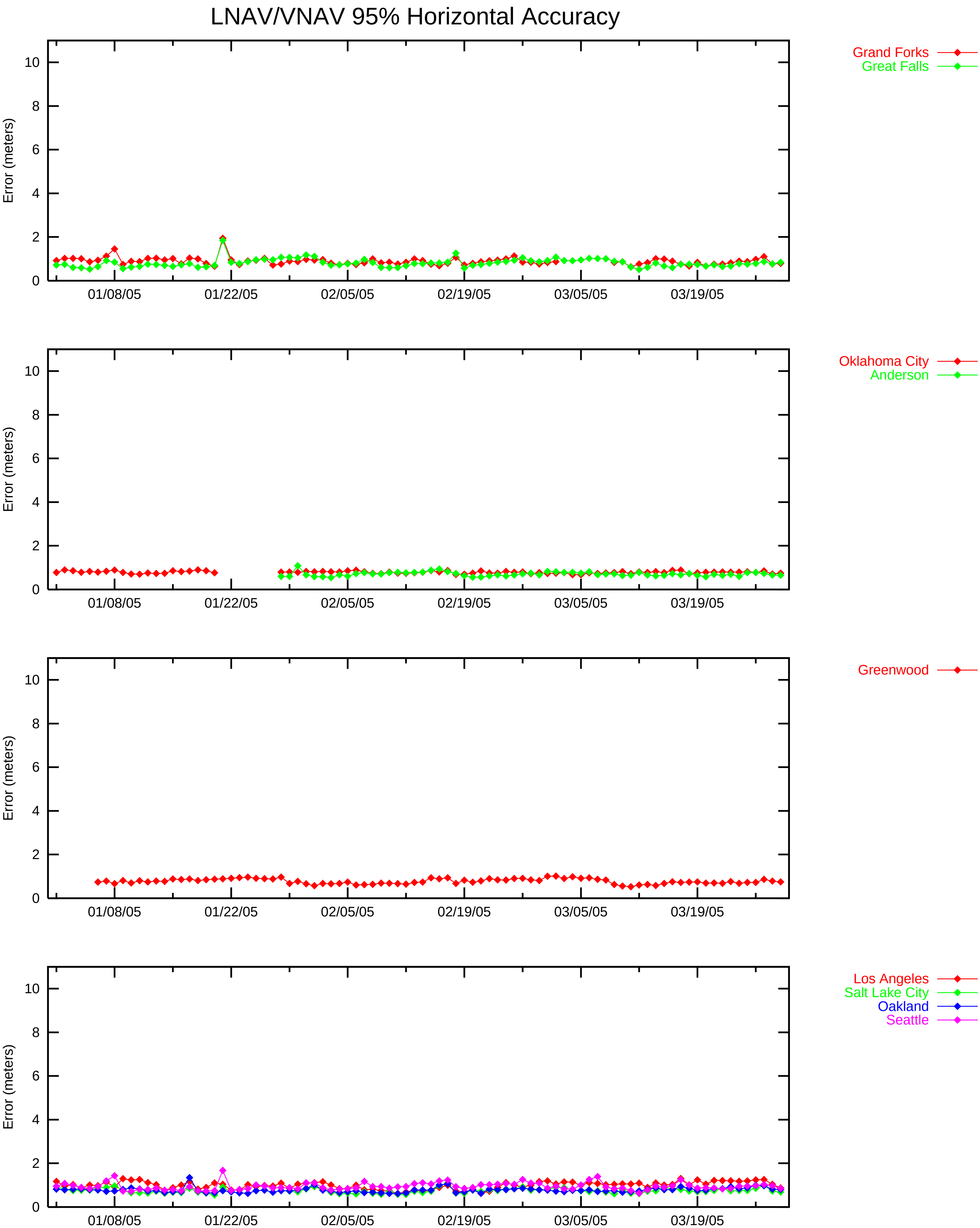


Figure 2_2 95% Horizontal Accuracy at LNAV/VNAV

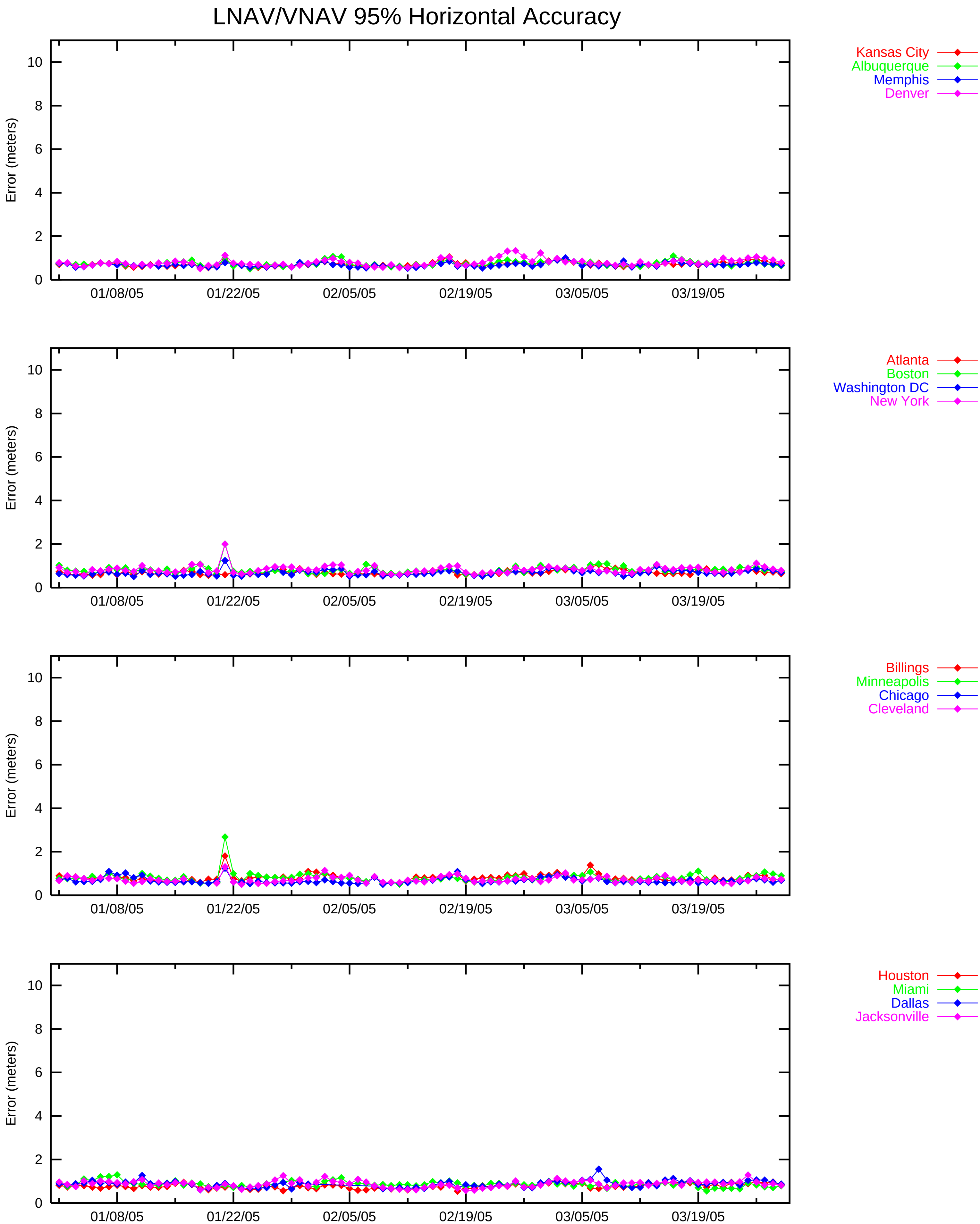


Figure 2_3 95% Vertical Accuracy at LNAV/VNAV

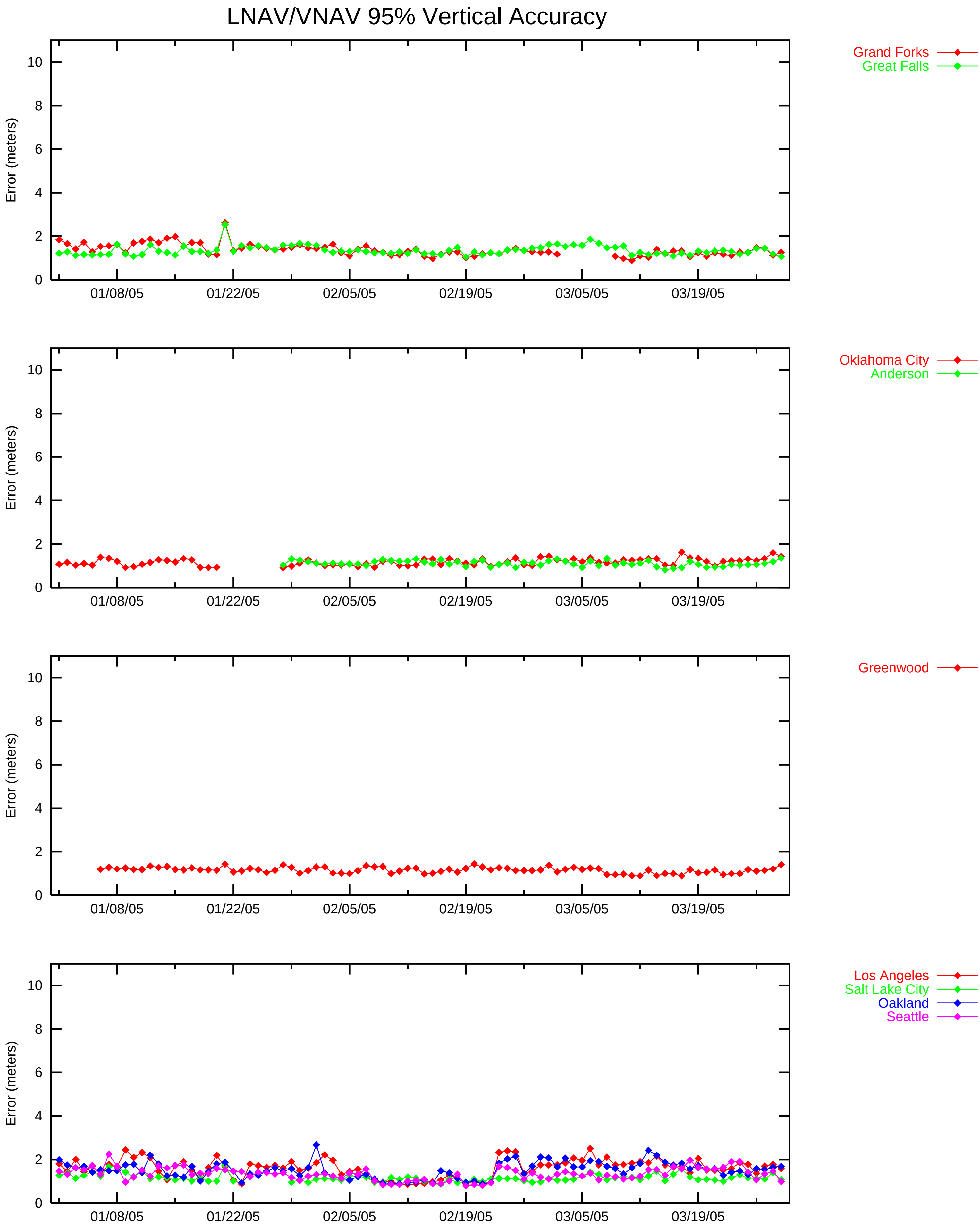


Figure 2_4 95% Vertical Accuracy at LNAV/VNAV

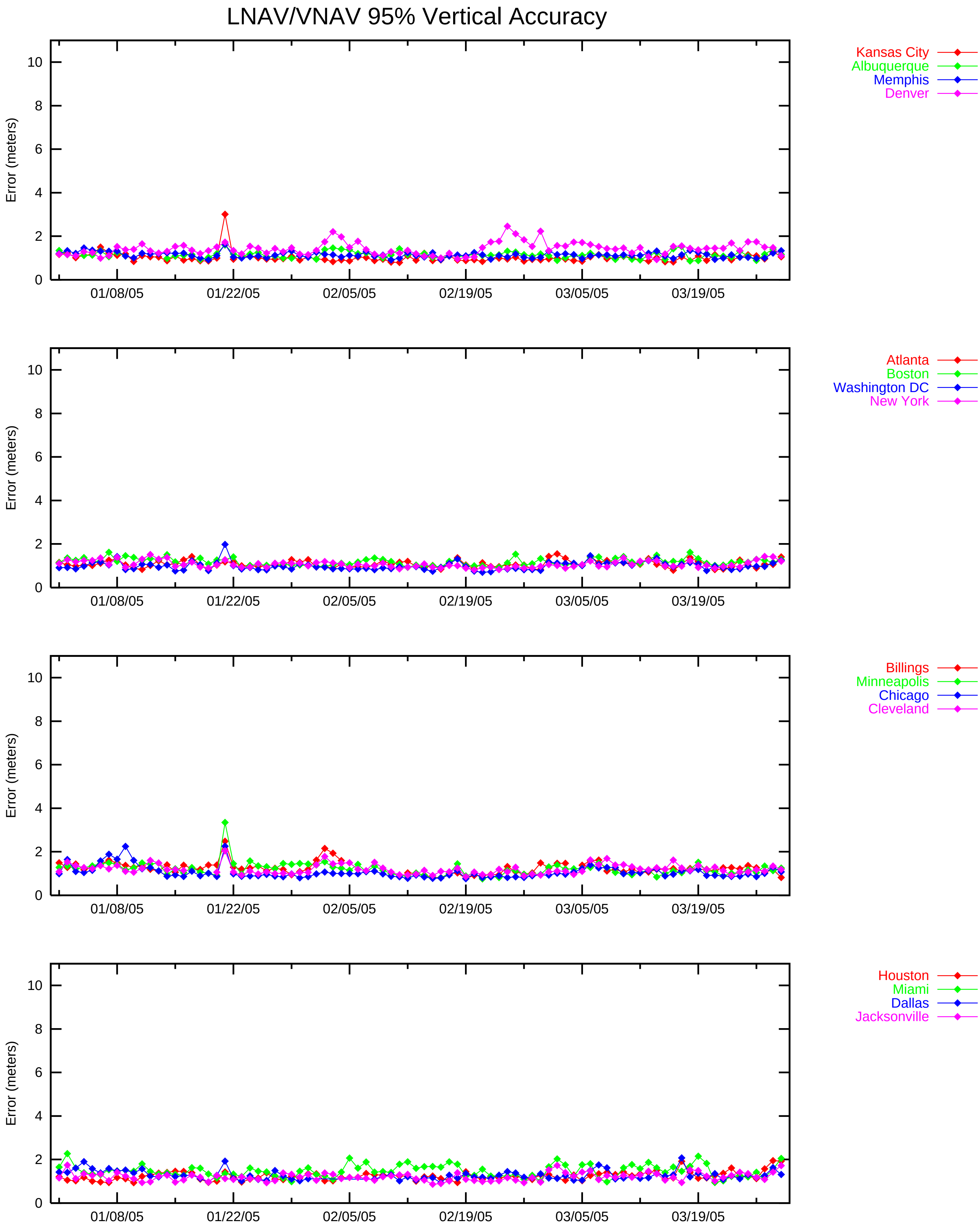


Figure 2_5 NPA 95% Horizontal Accuracy

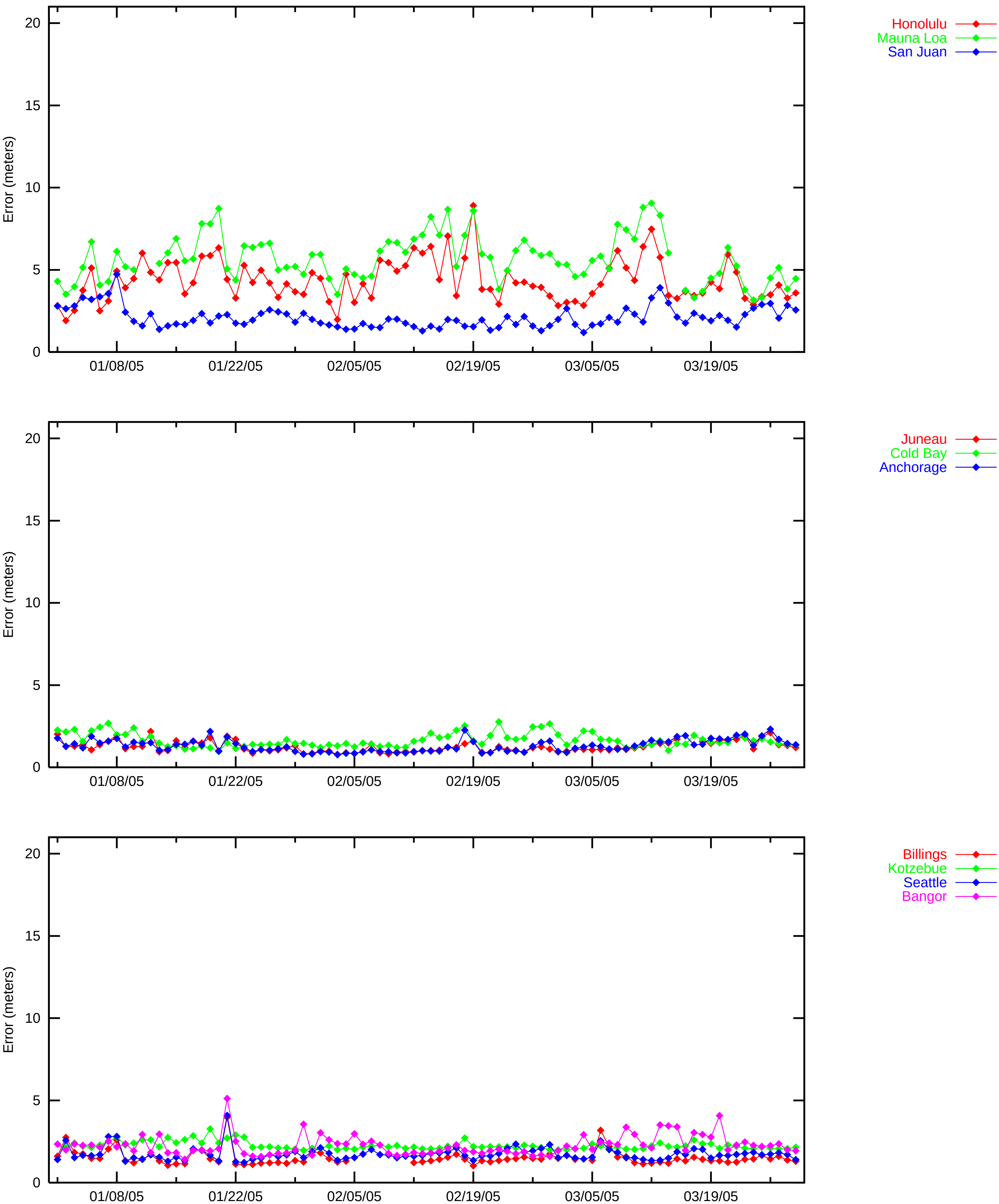
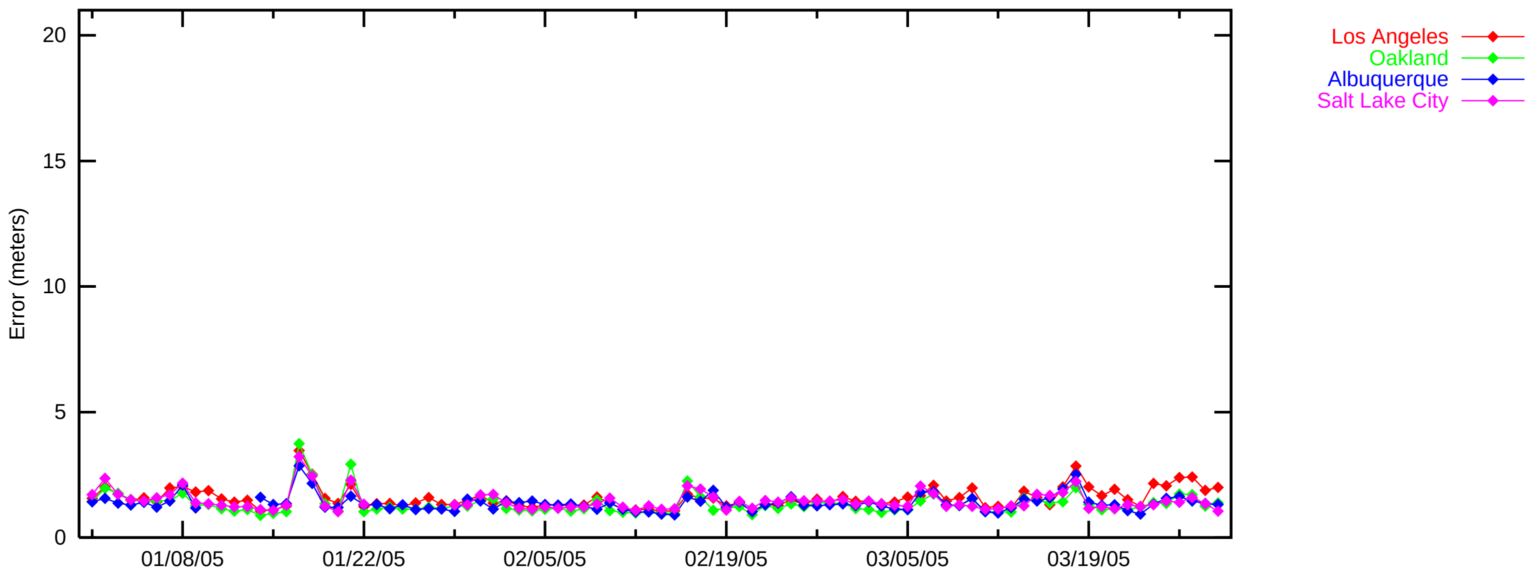
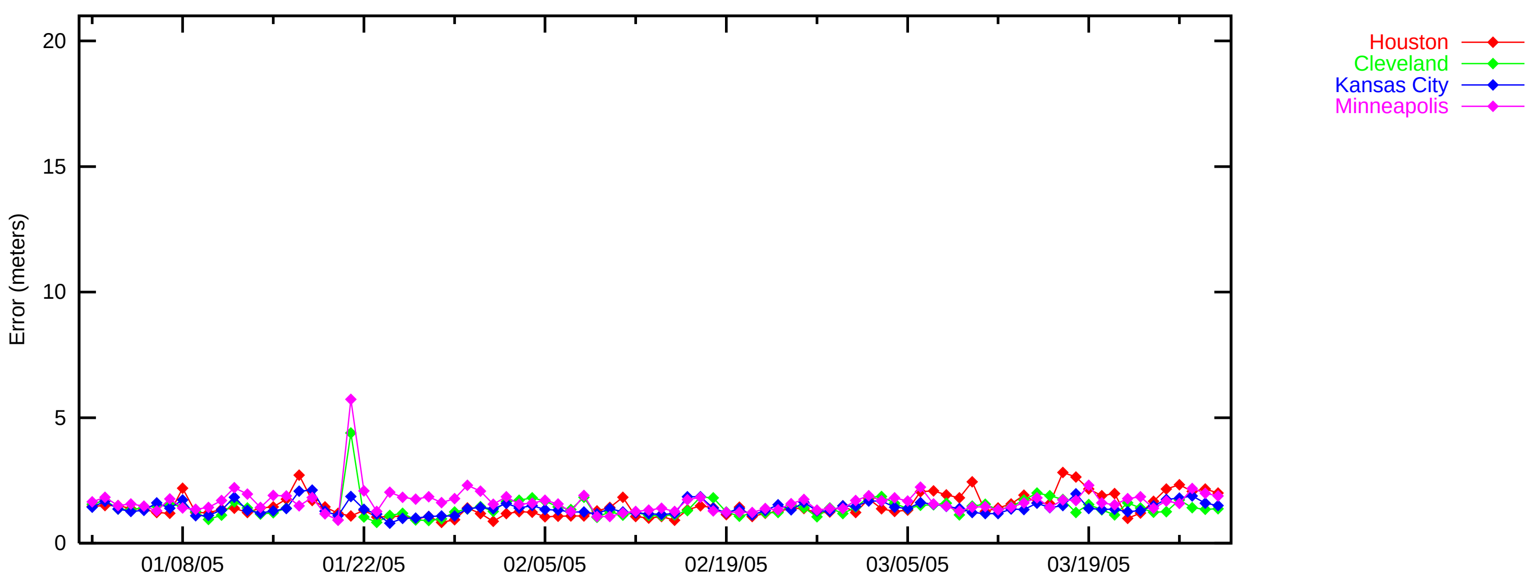


Figure 2_6 NPA 95% Horizontal Accuracy





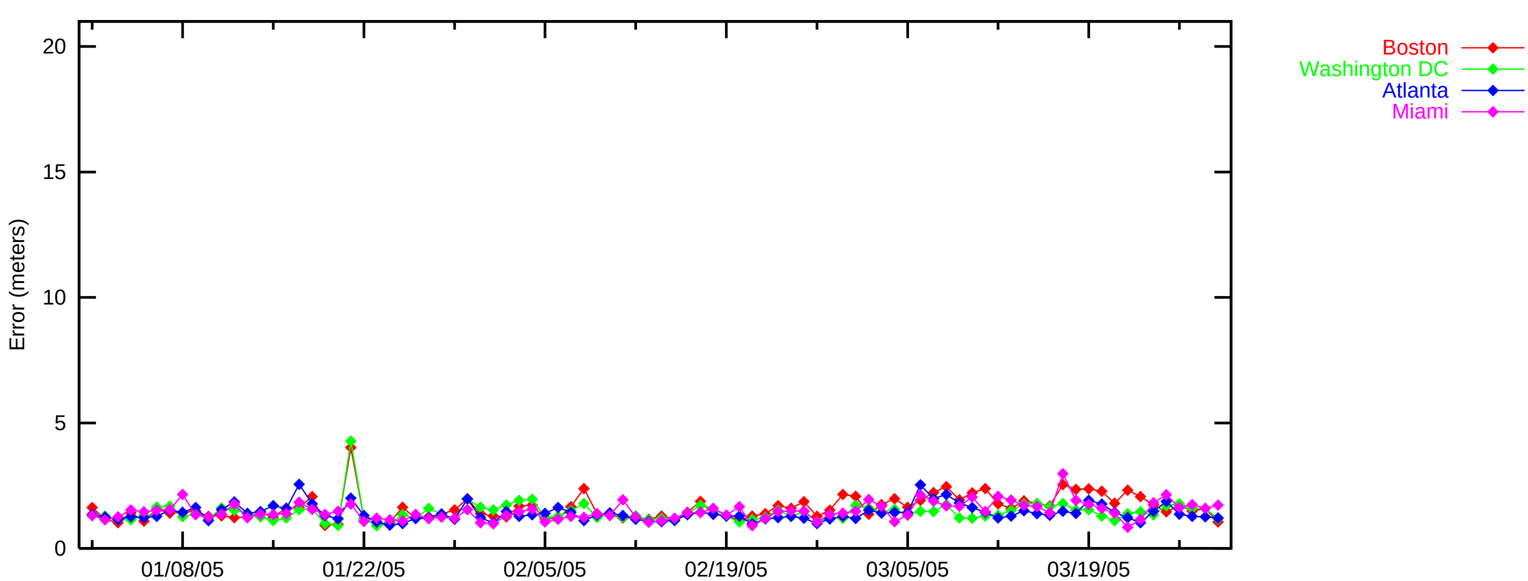


Figure 2_7 Horizontal Triangle Chart for Oklahoma City

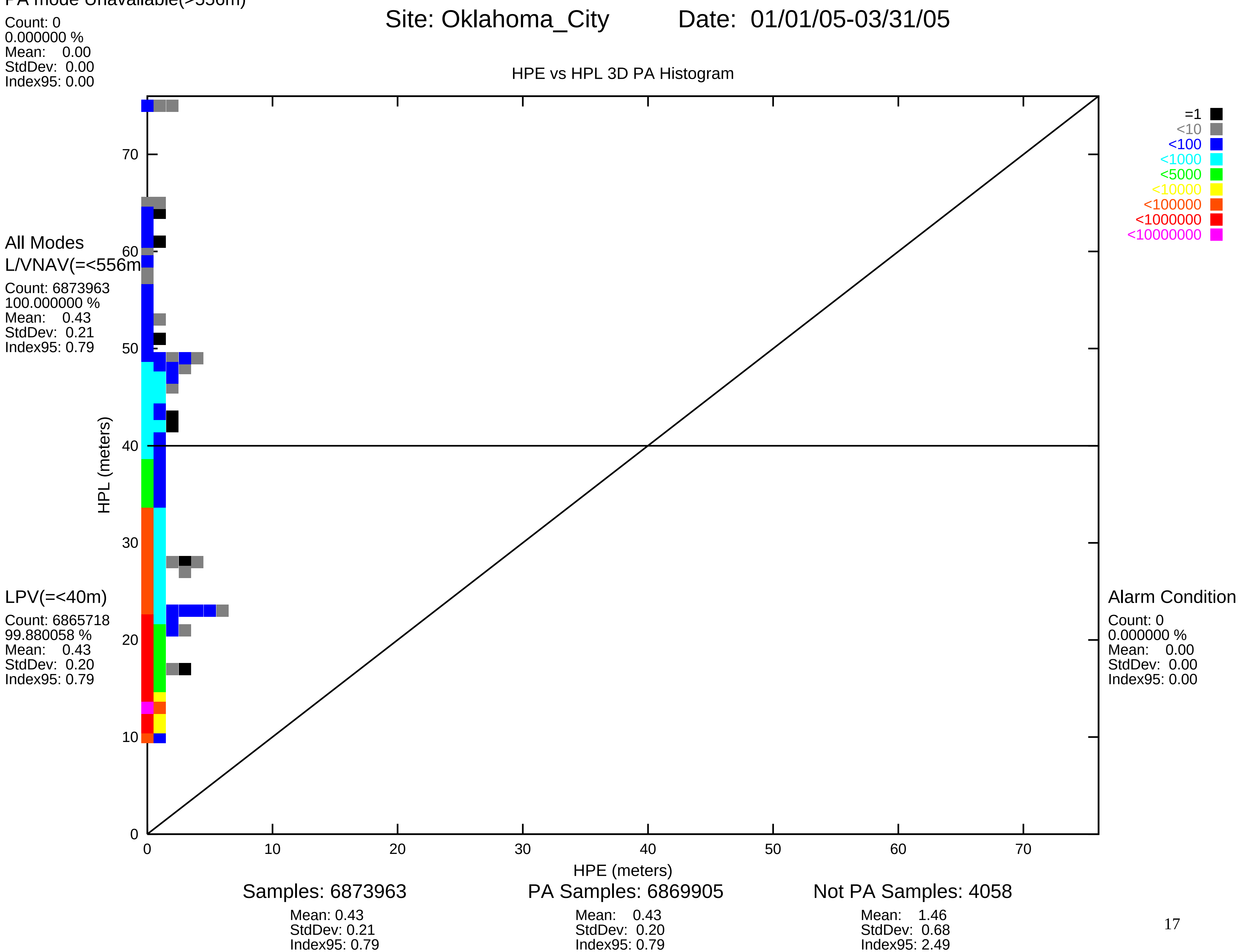


Figure 2_8 Vertical Triangle Chart for Oklahoma City

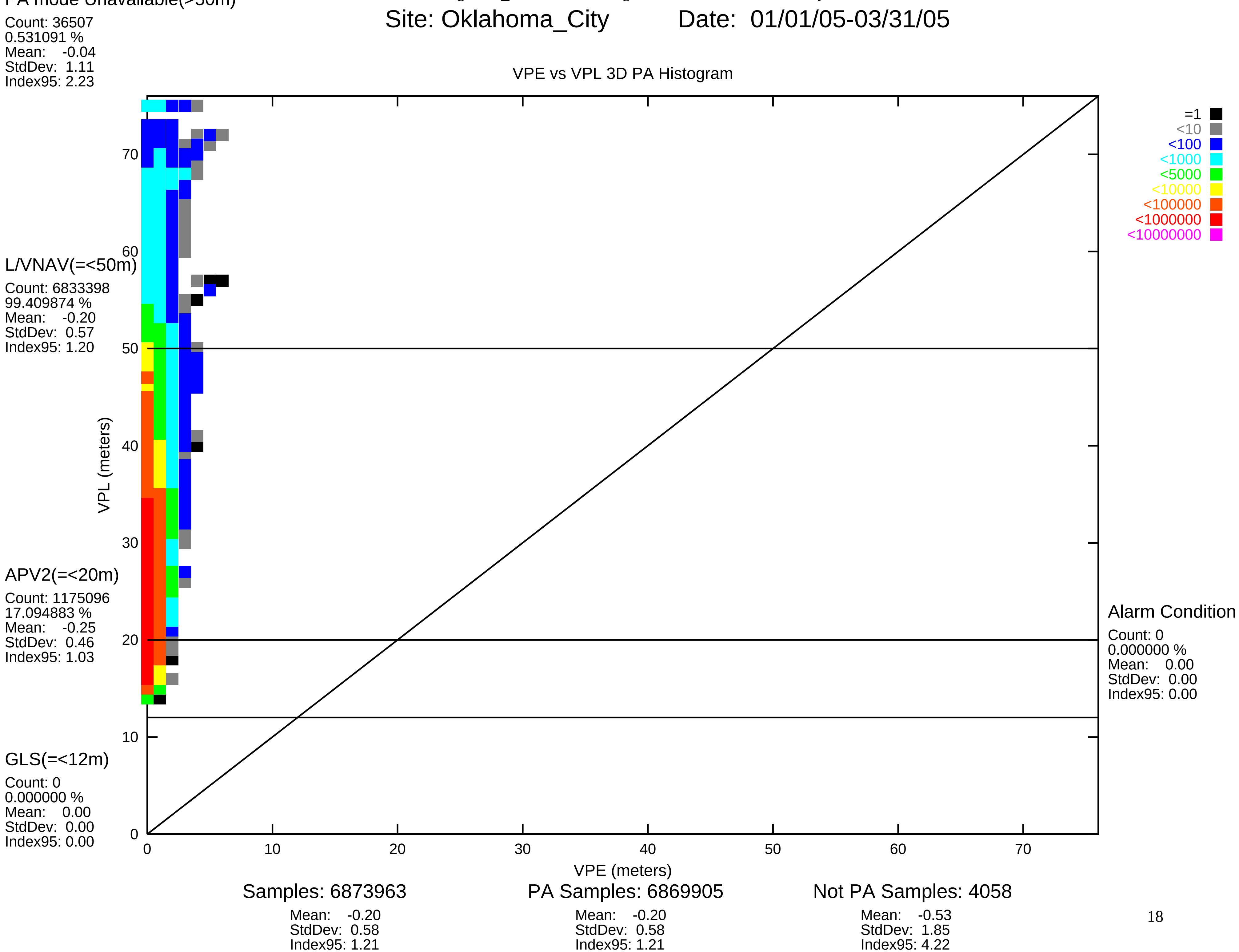


Figure 2_9 2-D Histogram for Oklahoma City

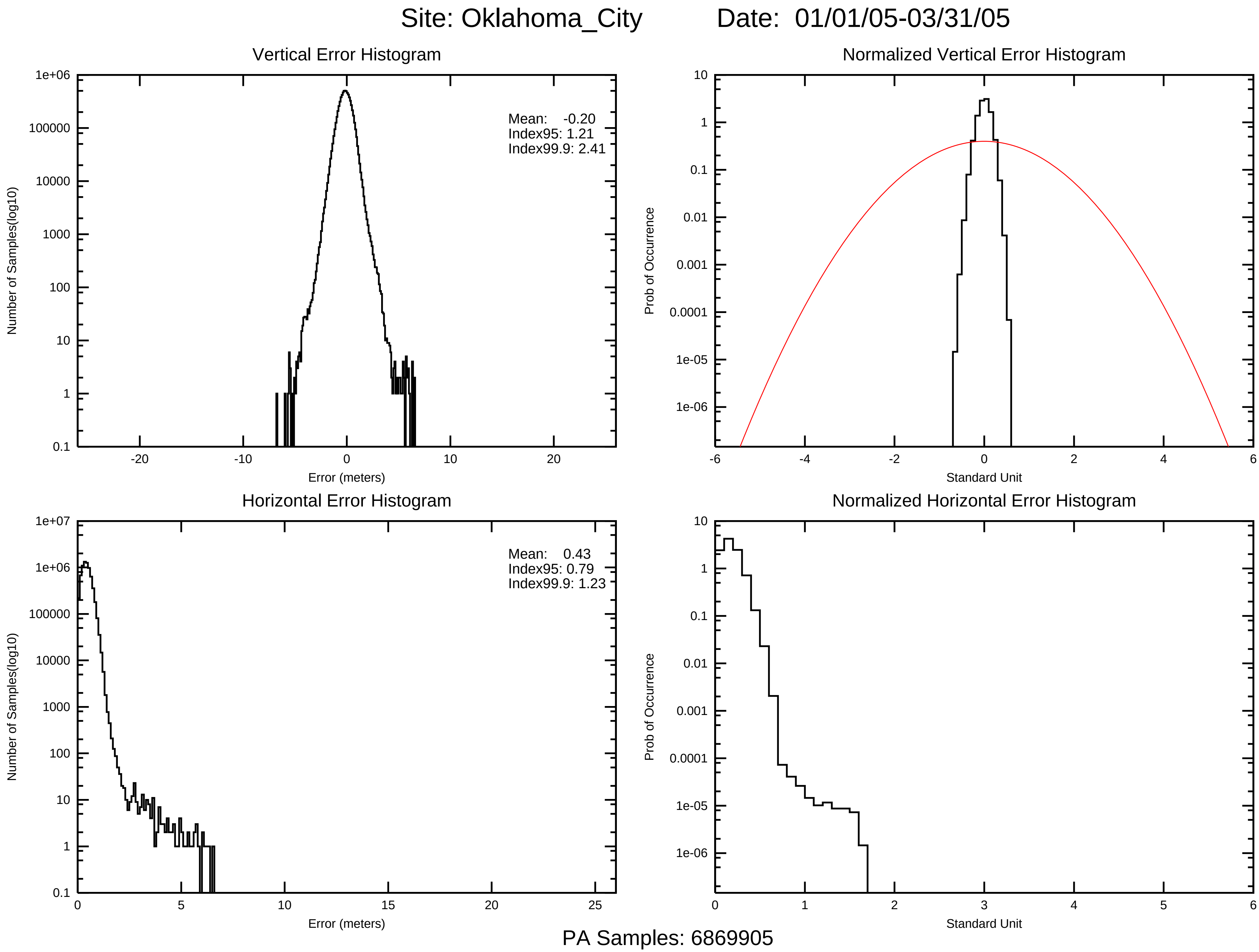


Figure 2_10 Horizontal Triangle Chart for Washington, DC

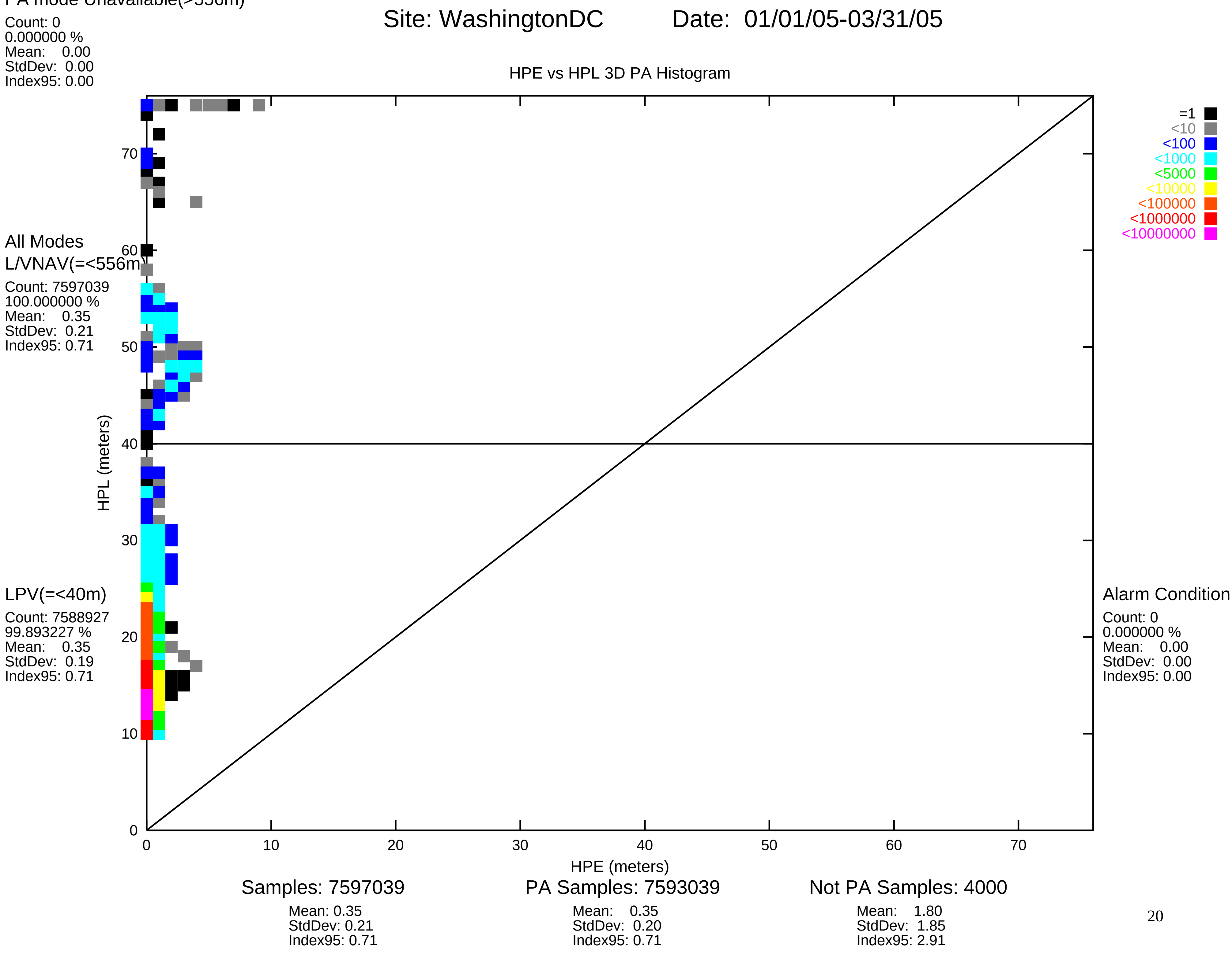


Figure 2_11 Vertical Triangle Chart for Washington, DC

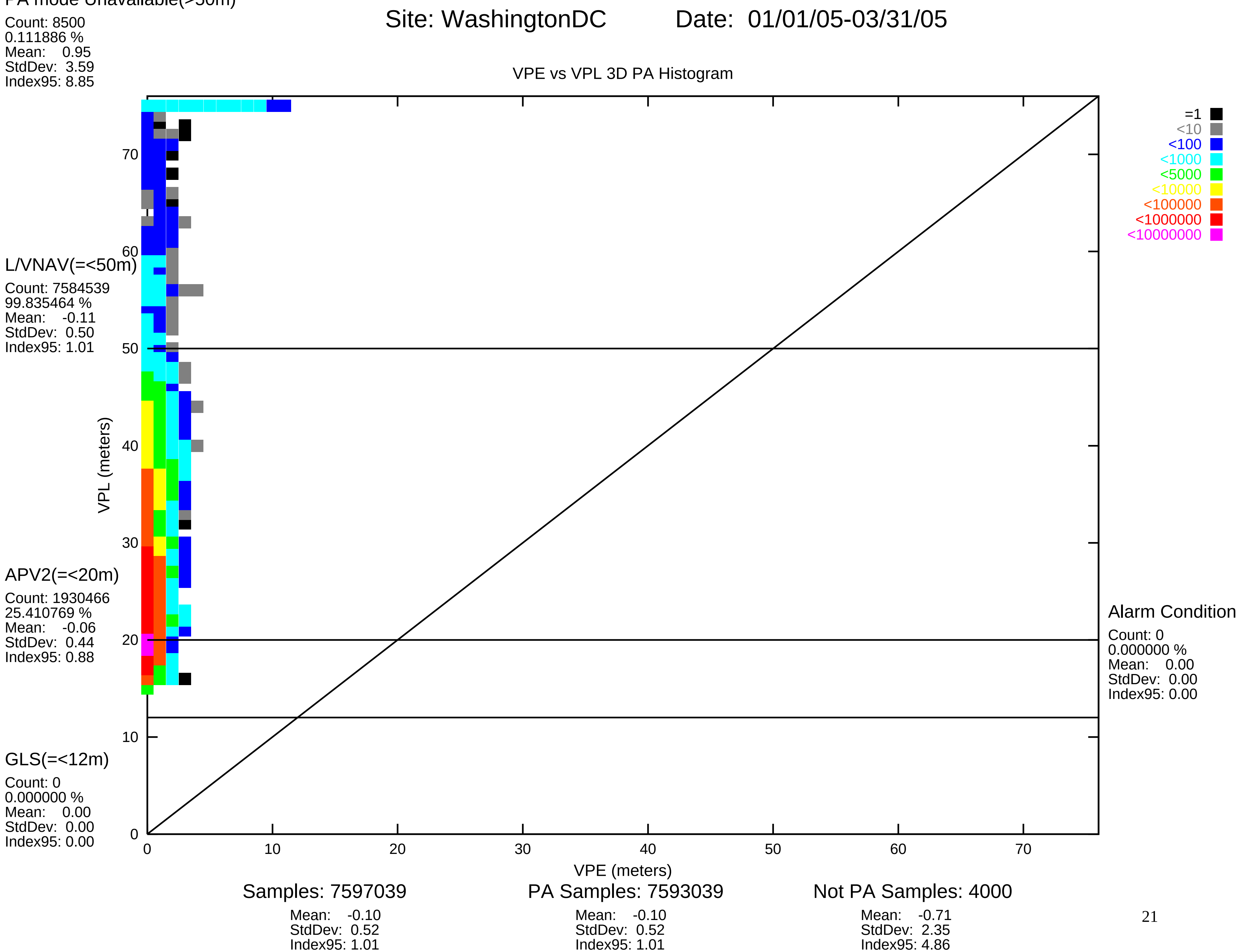


Figure 2_12 2-D Histogram for Washington, DC

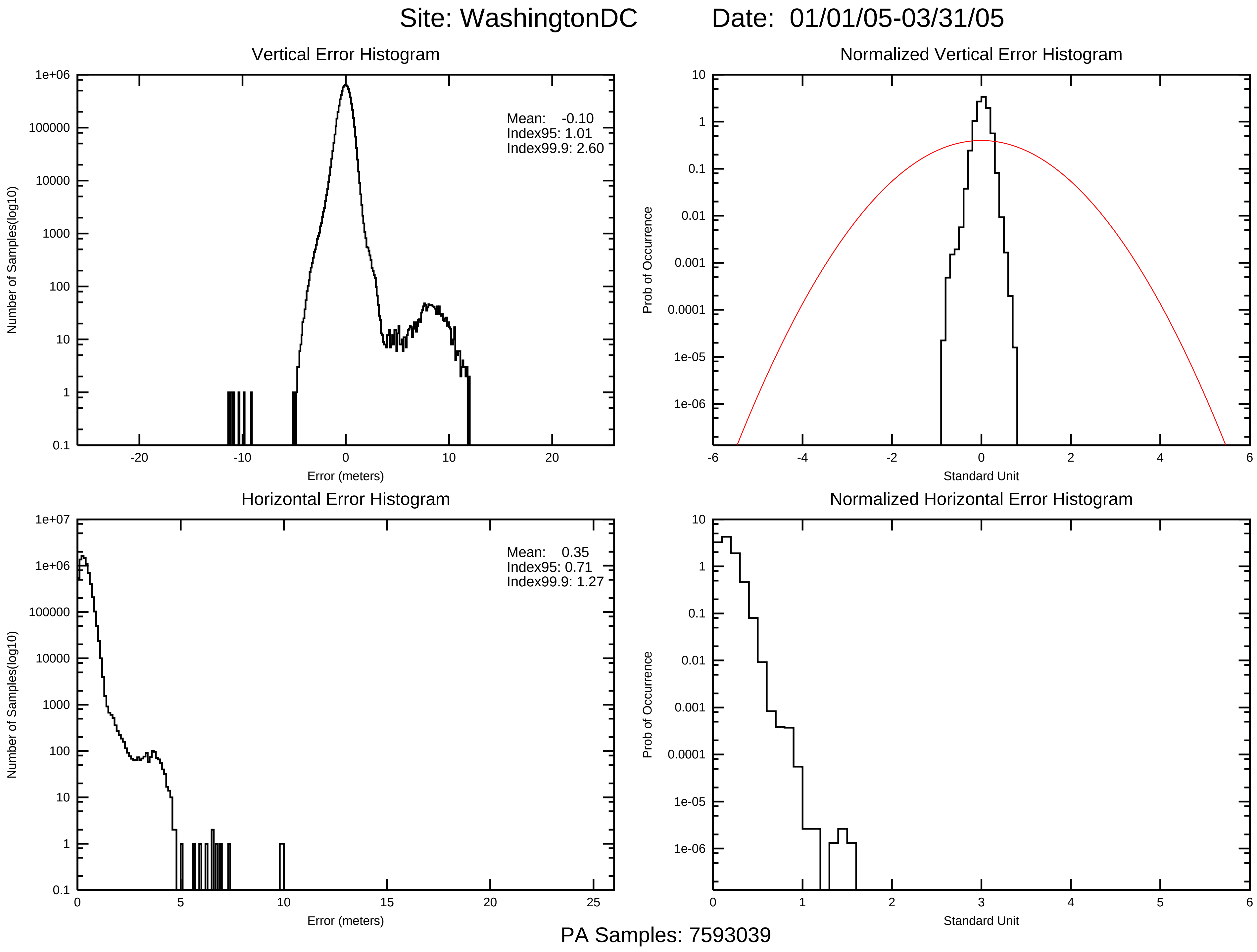
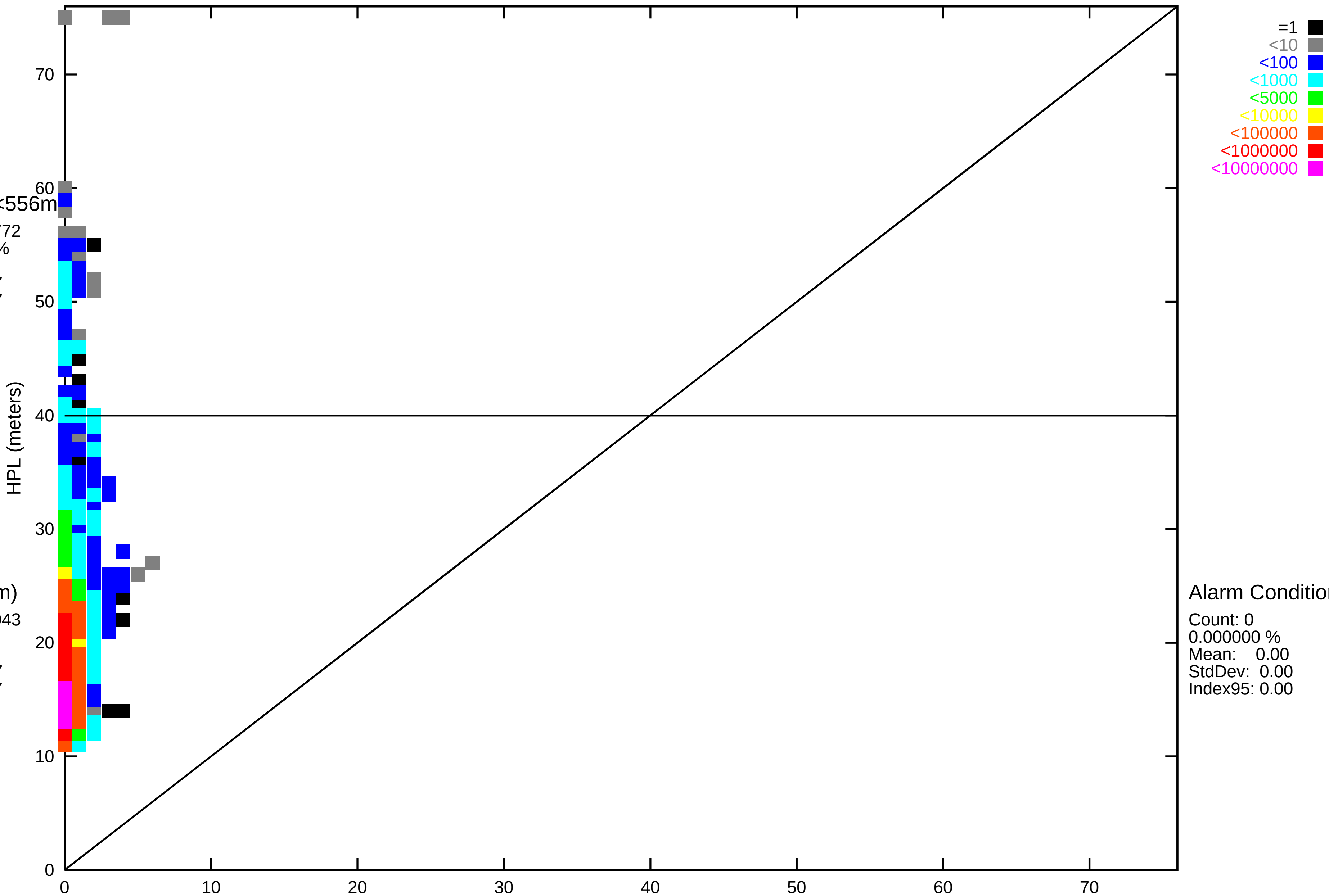


Figure 2_13 Horizontal Triangle Chart for Seattle

Site: Seattle Date: 01/01/05-03/31/05

PA mode Unavailable(>556m)
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00

HPE vs HPL 3D PA Histogram



All Modes
L/VNAV(=<556m)
Count: 7597772
100.000000 %
Mean: 0.49
StdDev: 0.27
Index95: 0.97

LPV(=<40m)
Count: 7594043
99.950920 %
Mean: 0.49
StdDev: 0.27
Index95: 0.97

Alarm Condition
Count: 0
0.000000 %
Mean: 0.00
StdDev: 0.00
Index95: 0.00

Samples: 7597772
Mean: 0.49
StdDev: 0.27
Index95: 0.97

PA Samples: 7596277
Mean: 0.49
StdDev: 0.27
Index95: 0.97

Not PA Samples: 1495
Mean: 1.84
StdDev: 0.64
Index95: 2.70

Figure 2_14 Vertical Triangle Chart for Seattle

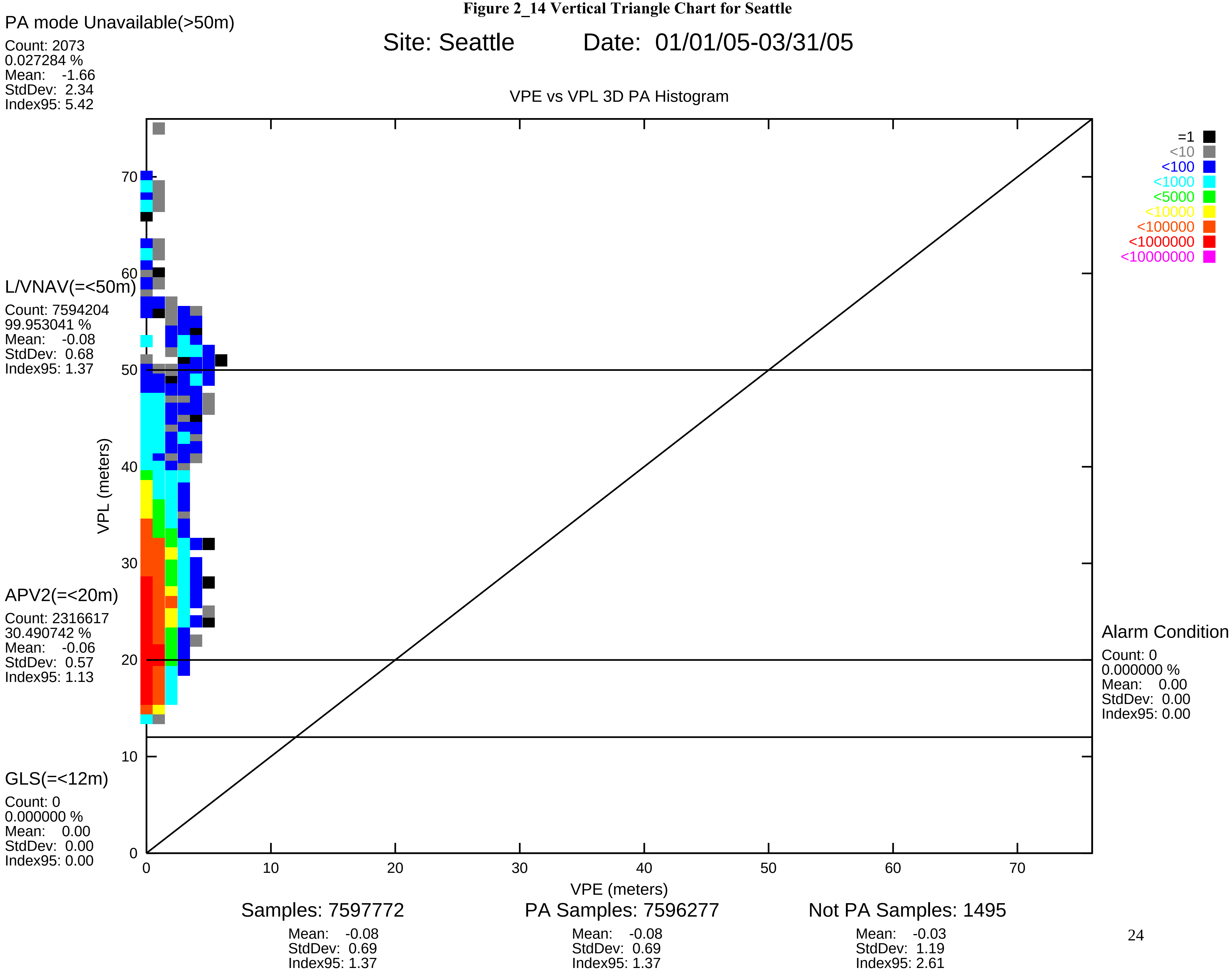
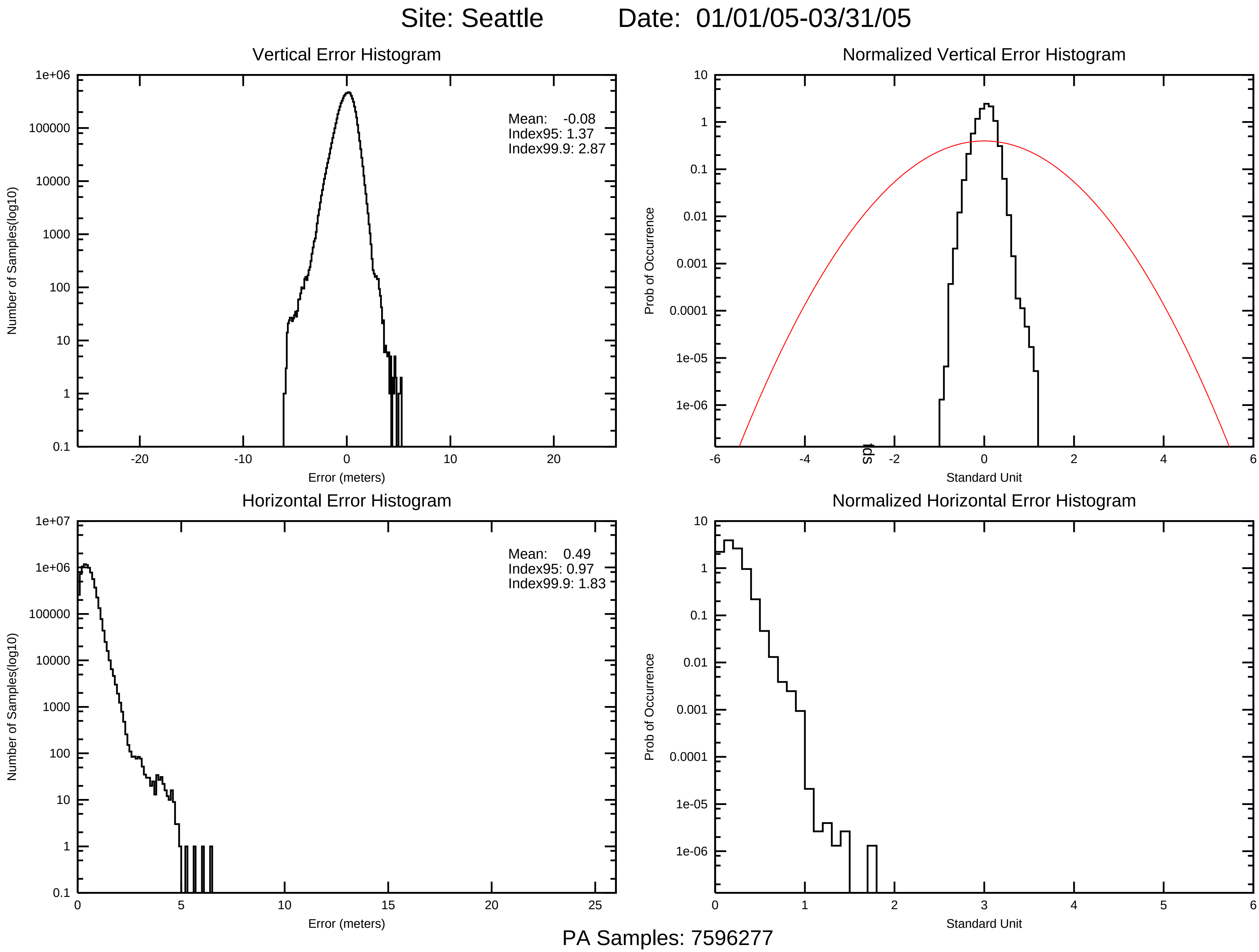


Figure 2_15 2-D Histogram for Seattle



3.0 AVAILABILITY

WAAS availability evaluation estimates the probability that the WAAS can provide service for the operational service levels (LPV and LNAV/VNAV) 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. The first two columns of Table 3.2 presents the average portion of time that WAAS operational service levels are available at each receiver location.

Availability of LPV and LNVA/VNAV 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 LNVA/VNAV service is available using the fifteen-minute window criteria is presented in the last two columns in Table 3.2. The LPV and LNVA/VNAV 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 3.4 show the daily availability of LNAV/VNAV and LPV service levels for the evaluated period. Figures 3.5 through 3.8 show the daily interruptions of LNAV/VNAV and LPV service levels for the evaluated period.

The geographic location of each receiver evaluated is depicted in Figure 3.9 and 3.10, along with the 95% VPL value, the WAAS LPV and the LNAV/VNAV instantaneous availability percentage at each location for the quarter

Availability of NPA service is evaluated by monitoring the WAAS horizontal protection level at receiver locations throughout the test period. If the horizontal protection level is not greater than the horizontal alert limit (HAL = 556m) then the service is available. If the horizontal protection level exceeds the required alert level or if WAAS navigation message is not received then the NPA service at that location is considered unavailable and an outage in service is recorded with its duration. The NPA service is not considered available again until the horizontal protection level is within the alert limit for at least 15 minutes. The percent of time that NPA service is available using the fifteen-minute window criteria is presented in Table 3.3. The NPA service outages and associated outage rate for the test 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.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Anderson	17.411	28.178	99.929184
Grand Forks	25.407	33.343	99.938911
Great Falls	22.567	35.027	99.955353
Greenwood	18.046	29.920	99.940094
Oklahoma City	23.078	37.544	99.940964
Albuquerque	20.546	32.512	99.942757
Atlanta	17.306	28.506	99.947914
Billings	19.593	27.545	99.974548
Boston	24.365	43.622	99.957169
Chicago	16.482	28.605	99.947723
Cleveland	17.244	29.035	99.948708
Dallas	18.973	31.380	99.952065
Denver	19.919	30.222	99.952293
Houston	23.188	36.040	99.944847
Jacksonville	18.468	31.611	99.947868
Kansas City	17.193	27.805	99.951790
Los Angeles	27.407	39.989	99.980301
Memphis	16.950	29.593	99.944817
Miami	22.941	40.757	99.947708
Minneapolis	18.229	29.256	99.944855
New York	21.098	37.745	99.947105
Oakland	27.644	38.827	99.995972
Salt Lake City	19.488	28.575	99.969933
Seattle	21.916	29.054	99.980324
Washington DC	17.372	29.750	99.947342

Table 3-2 Quarterly Availability Statistics

Location	LPV *Average Availability Percentage of time*	LNAV/VNAV *Average Availability Percentage of time*	LPV WAAS *With 15 minute window*	LNAV/VNAV *With 15 minute window*
Anderson	0.99917585	0.99918914	0.99862775	0.99864171
Grand Forks	0.99357712	0.99364287	0.98980156	0.98987306
Great Falls	0.99845445	0.99856275	0.99796140	0.99809677
Greenwood	0.99927032	0.99927753	0.99894172	0.99894903
Oklahoma City	0.99405426	0.99409872	0.99238913	0.99243703
Albuquerque	0.99936777	0.99937177	0.99906171	0.99906505
Atlanta	0.99943173	0.99943662	0.99919526	0.99920019
Billings	0.99964440	0.99970794	0.99938896	0.99946099
Boston	0.97743607	0.97750354	0.96610030	0.96612231
Chicago	0.99832636	0.99832952	0.99801822	0.99802155
Cleveland	0.99842155	0.99842602	0.99818194	0.99818648
Dallas	0.99943125	0.99943465	0.99900239	0.99900544
Denver	0.99890435	0.99891394	0.99849894	0.99850800
Houston	0.99800014	0.99800569	0.99743420	0.99743913
Jacksonville	0.99927855	0.99928510	0.99899822	0.99900608
Kansas City	0.99935895	0.99936038	0.99883987	0.99884133
Los Angeles	0.99061704	0.99669343	0.98655287	0.99322530
Memphis	0.99904609	0.99904847	0.99871324	0.99871604
Miami	0.99039316	0.99041927	0.98644115	0.98651980
Minneapolis	0.99810642	0.99810773	0.99778438	0.99778572
New York	0.99002063	0.99004775	0.98464203	0.98476475
Oakland	0.99862790	0.99925709	0.99773406	0.99857728
Salt Lake City	0.99961859	0.99961931	0.99914459	0.99914530
Seattle	0.99937654	0.99953038	0.99908844	0.99935669
Washington DC	0.99834925	0.99835461	0.99801244	0.99801844

During the evaluated period, the maximum 95% HPL and VPL are 27.644 meters at Oakland and 43.622 meters at Boston. The minimum 95% HPL and VPL are 16.482 meters at Chicago and 27.545 meters at Billings.

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	0.99922952
Anchorage	0.99955660
Atlanta	0.99926650
Billings	0.99950744
Boston	0.99936128
Cleveland	0.99927451
Cold Bay	0.99962738
Honolulu	0.99955176
Houston	0.99926712
Juneau	0.99955236
Kansas City	0.99933779
Los Angeles	0.99982256
Miami	0.99927063
Minneapolis	0.99926546
Oakland	0.99995205
Puerto Rico	0.99926688
Salt Lake City	0.99958099
Seattle	0.99982119
Washington DC	0.99926730

Table 3-4 LPV and LNAV/VNAV Outage Rate

Location	LPV Outages	LPV Outage Rates	LNAV/VNAV Outages	LNAV/VNAV Outage Rates
Anderson	77	0.002181	75	0.002125
Grand Forks	128	0.002757	123	0.002649
Great Falls	90	0.001815	85	0.001714
Greenwood	76	0.001606	74	0.001564
Oklahoma City	249	0.005531	243	0.005397
Albuquerque	78	0.001632	75	0.001570
Atlanta	68	0.001359	68	0.001359
Billings	62	0.001351	57	0.001242
Boston	276	0.005716	272	0.005633
Chicago	74	0.001481	73	0.001461
Cleveland	71	0.001467	70	0.001446
Dallas	83	0.001806	81	0.001762
Denver	85	0.001702	84	0.001682
Houston	99	0.001985	98	0.001964
Jacksonville	74	0.001480	73	0.001460
Kansas City	74	0.001480	73	0.001460
Los Angeles	213	0.004313	110	0.002212
Memphis	79	0.001581	79	0.001581
Miami	245	0.004967	242	0.004905
Minneapolis	79	0.001582	78	0.001562
New York	230	0.004669	228	0.004627
Oakland	93	0.001863	61	0.001221
Salt Lake City	69	0.001475	67	0.001433
Seattle	15	0.000300	11	0.000220
Washington DC	85	0.001702	84	0.001682

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	64	0.00133905
Anchorage	10	0.00019982
Atlanta	64	0.00127890
Bangor	67	0.00134097
Billings	51	0.00111109
Boston	64	0.00128013
Cleveland	60	0.00123729
Cold Bay	10	0.00020041
Honolulu	11	0.00021989
Houston	64	0.00128014
Juneau	10	0.00020191
Kansas City	64	0.00127894
Kotzebue	10	0.00020040
Los Angeles	4	0.00007988
Mauna Loa	12	0.00024756
Miami	64	0.00127959
Minneapolis	64	0.00127887
Oakland	4	0.00007992
Puerto Rico	64	0.00127894
Salt Lake City	55	0.00117508
Seattle	4	0.00007990
Washington DC	64	0.00127913

Figure 3_1 LPV Instantaneous Availability

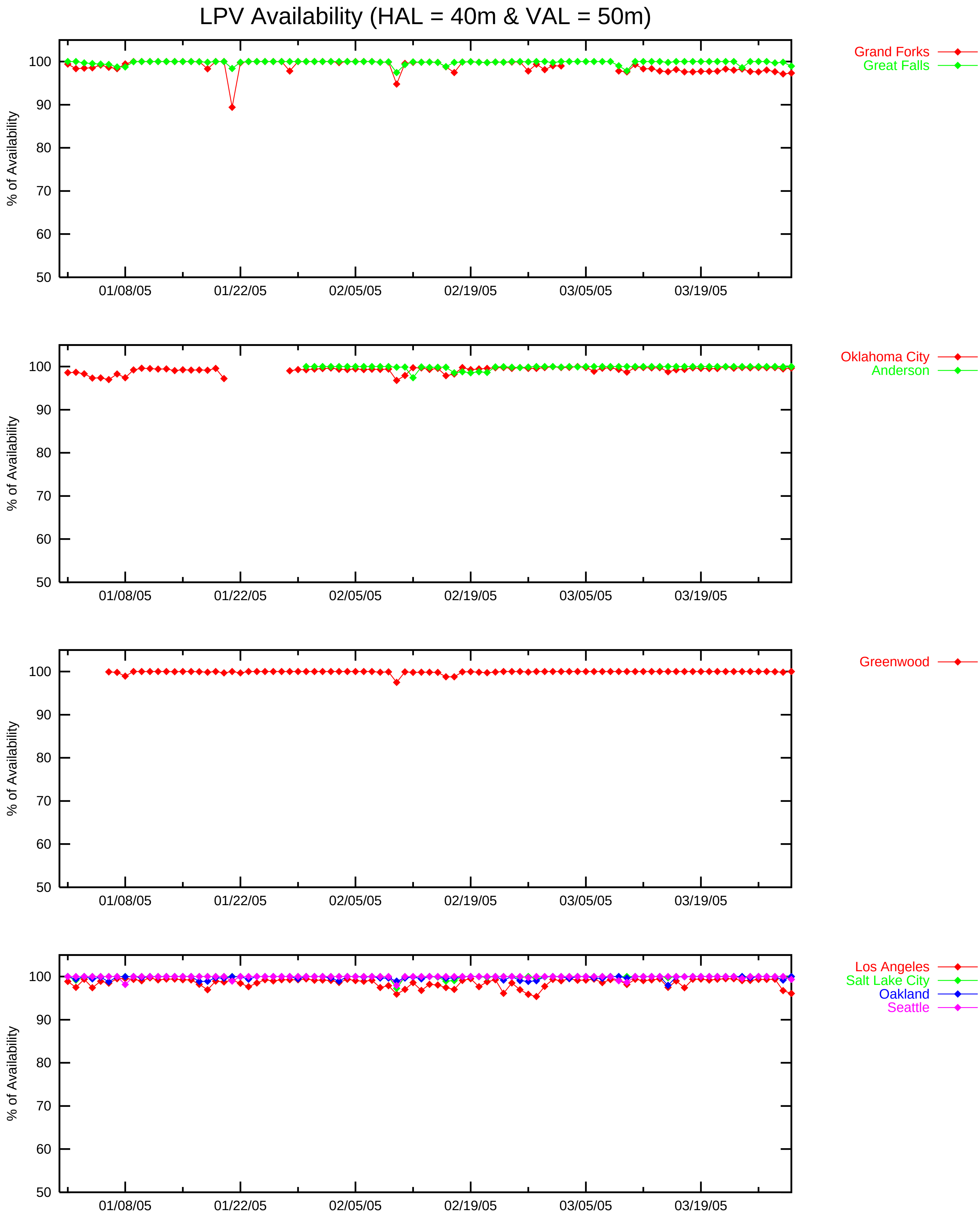


Figure 3_2 LPV Instantaneous Availability

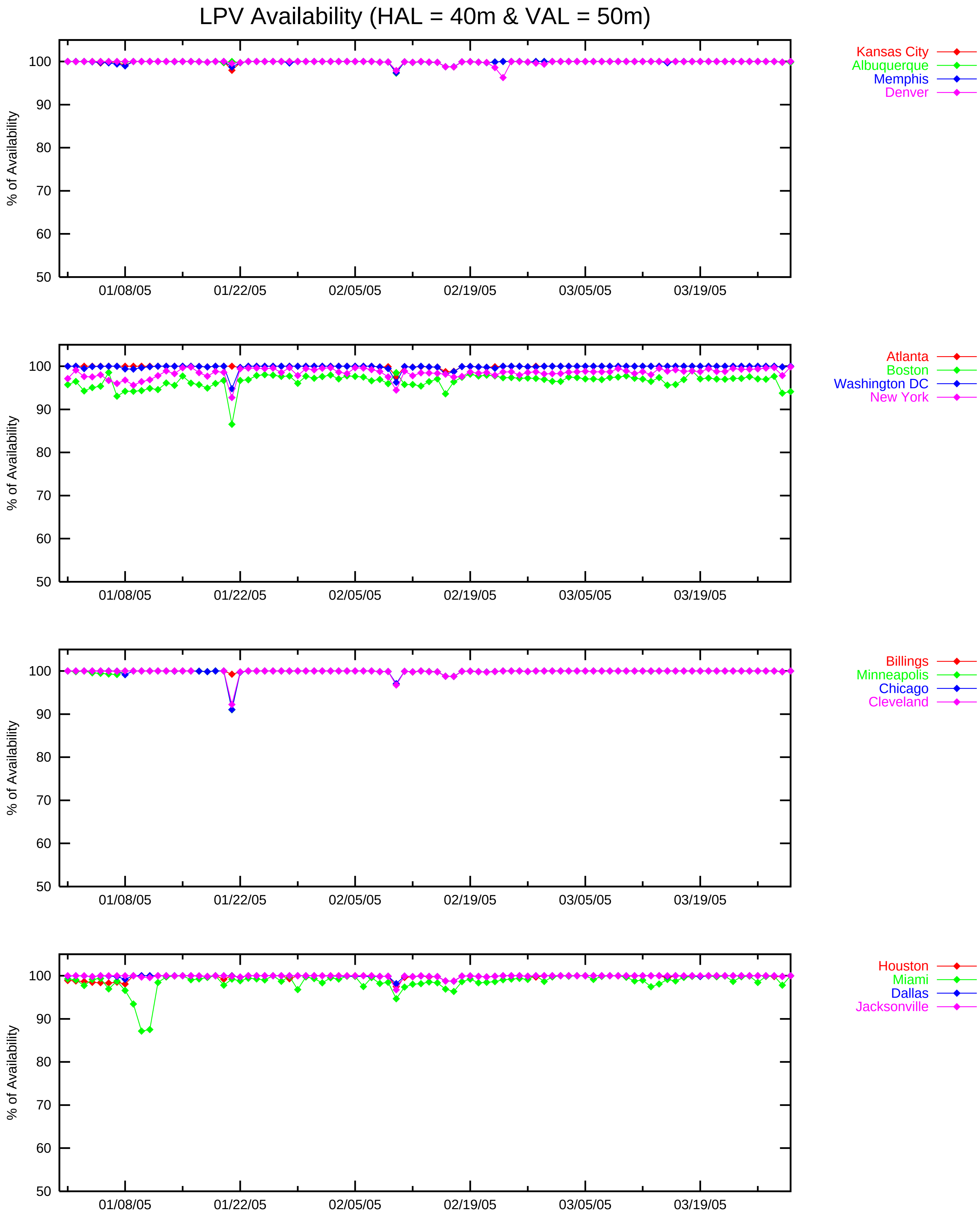


Figure 3_3 LNAV/VNAV Instantaneous Availability

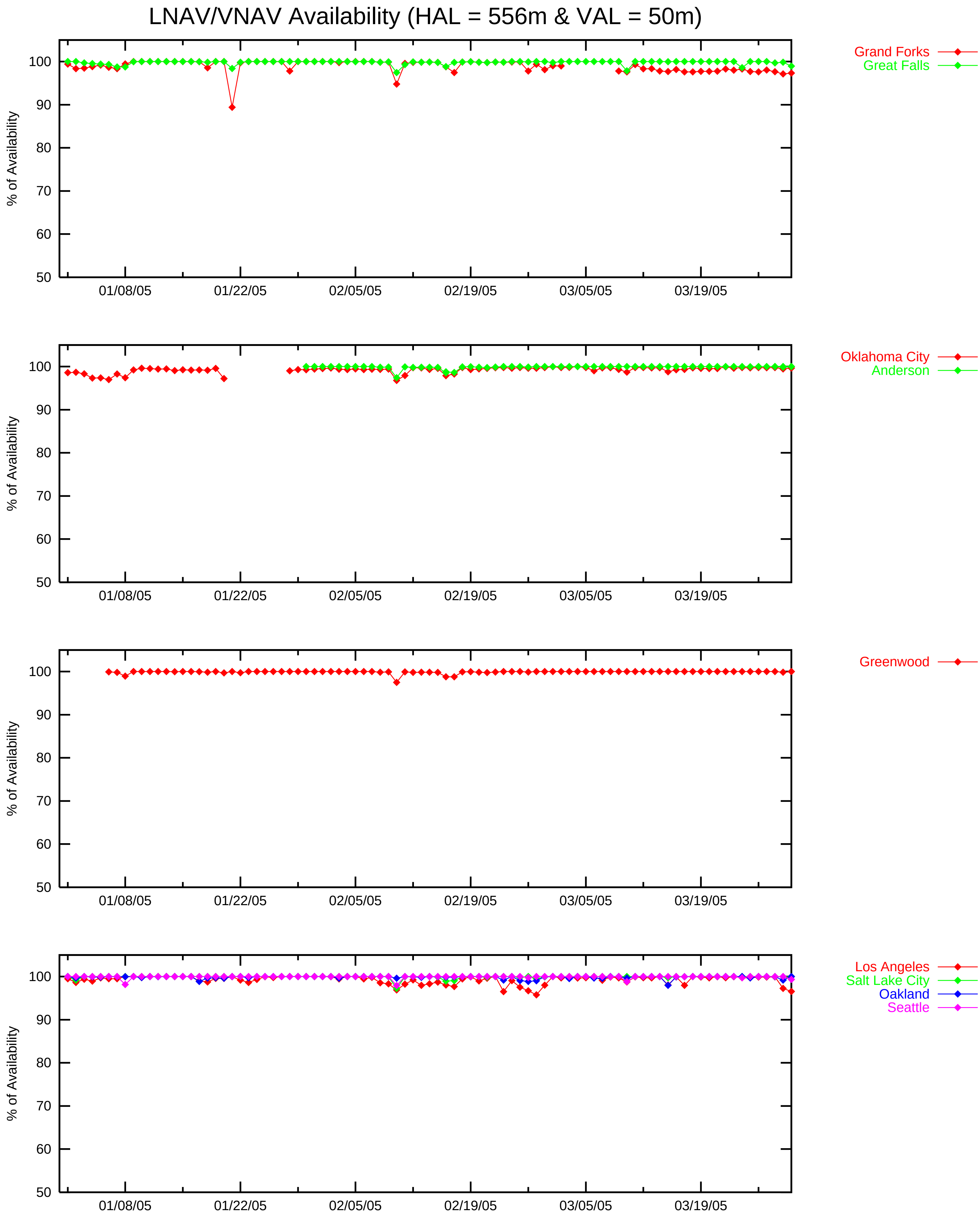


Figure 3_4 LNAV/VNAV Instantaneous Availability

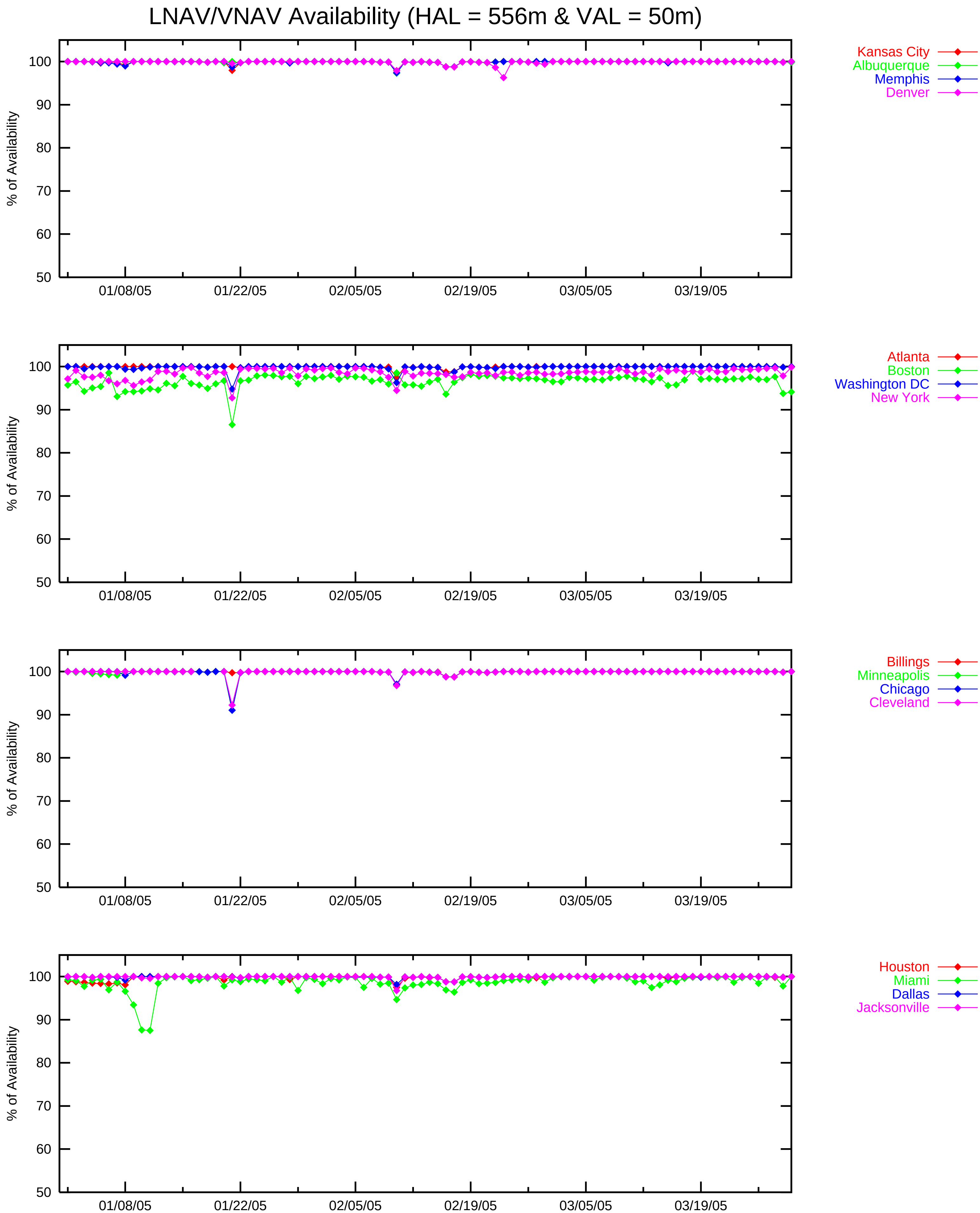


Figure 3_5 LPV Outages

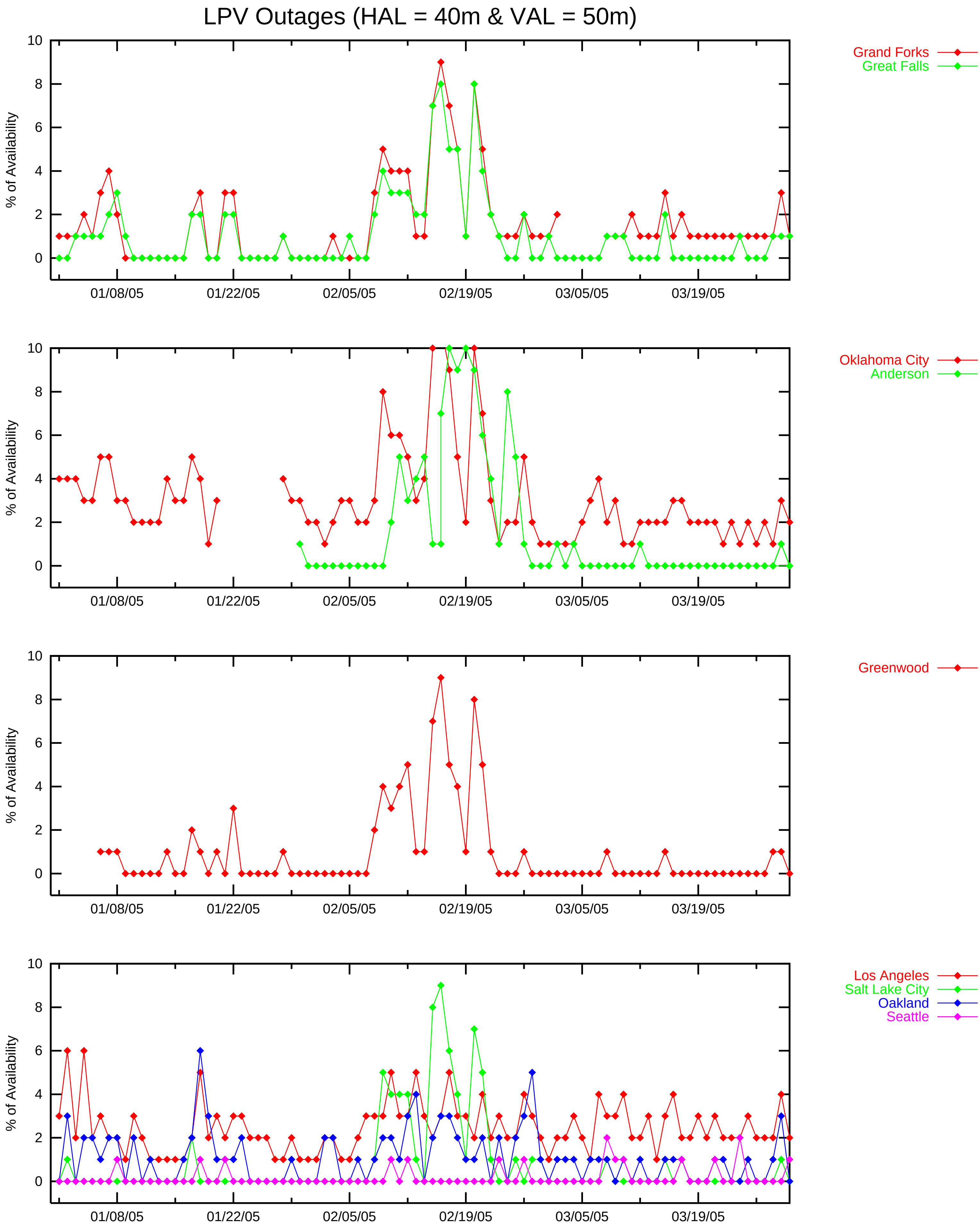


Figure 3_6 LPV Outages

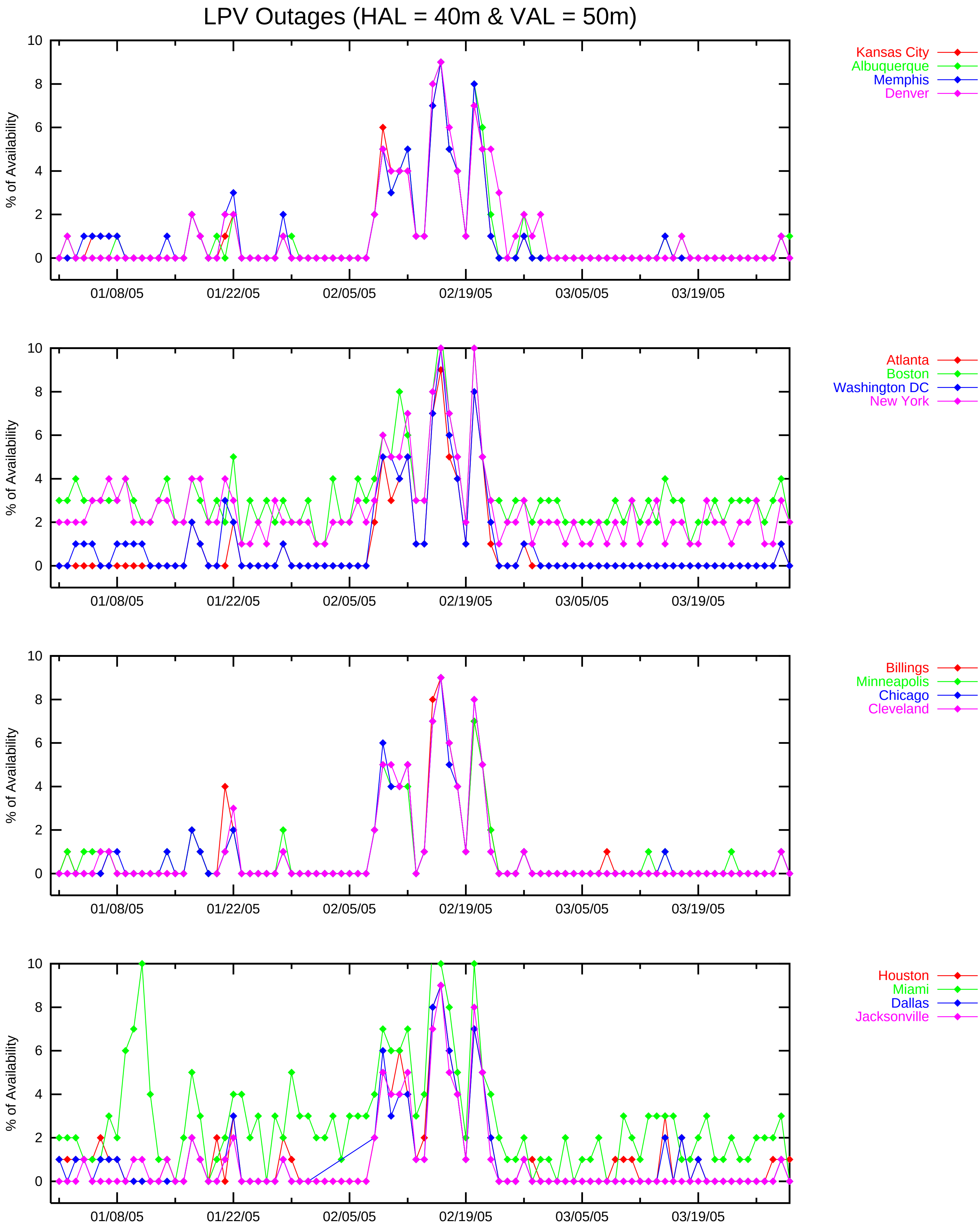


Figure 3_7 LNAV/VNAV Outages

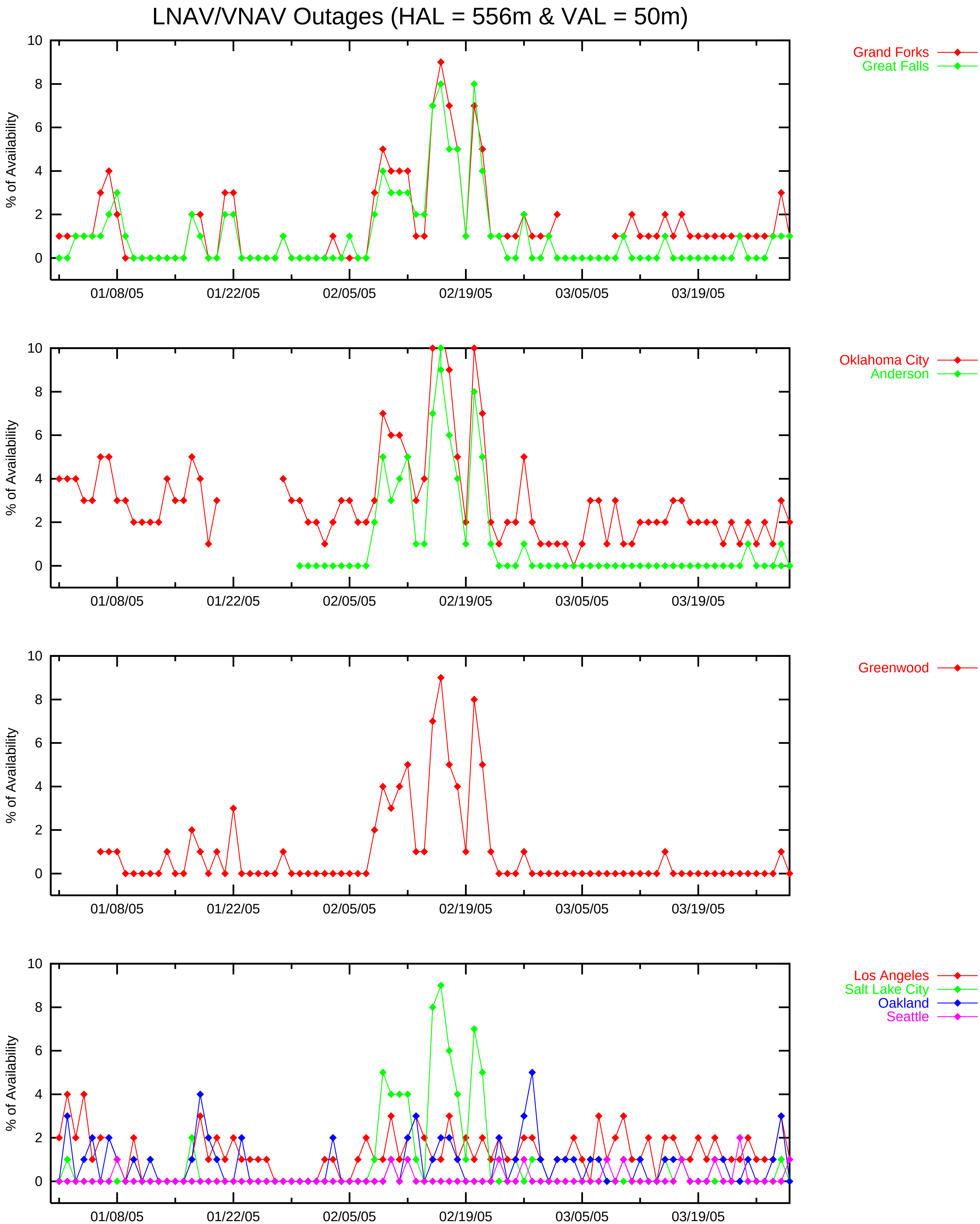


Figure 3_8 LNAV/VNAV Outages

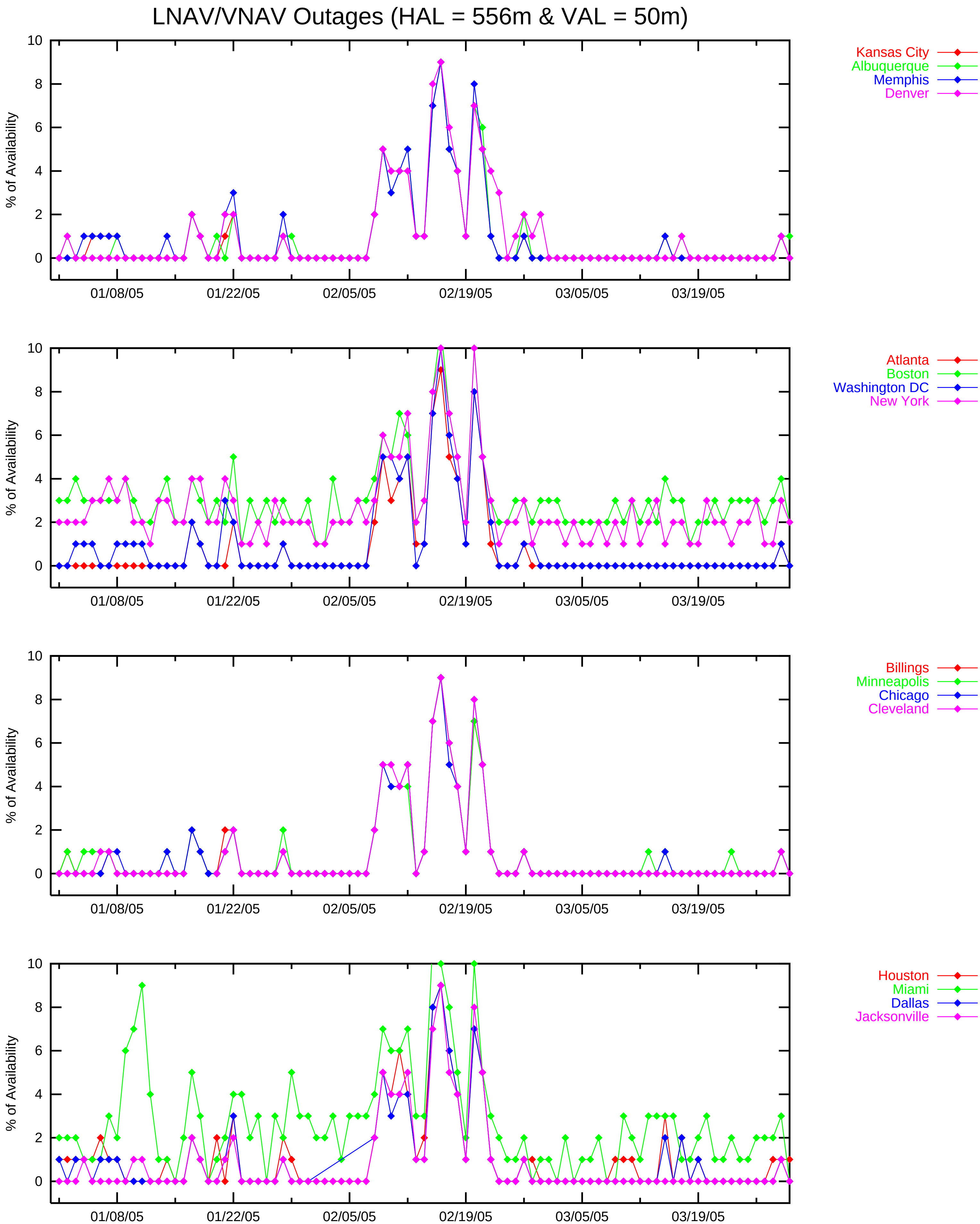


Figure 3_9 95% VPL, LPV and LNAV/VNAV Availability - NSTB sites

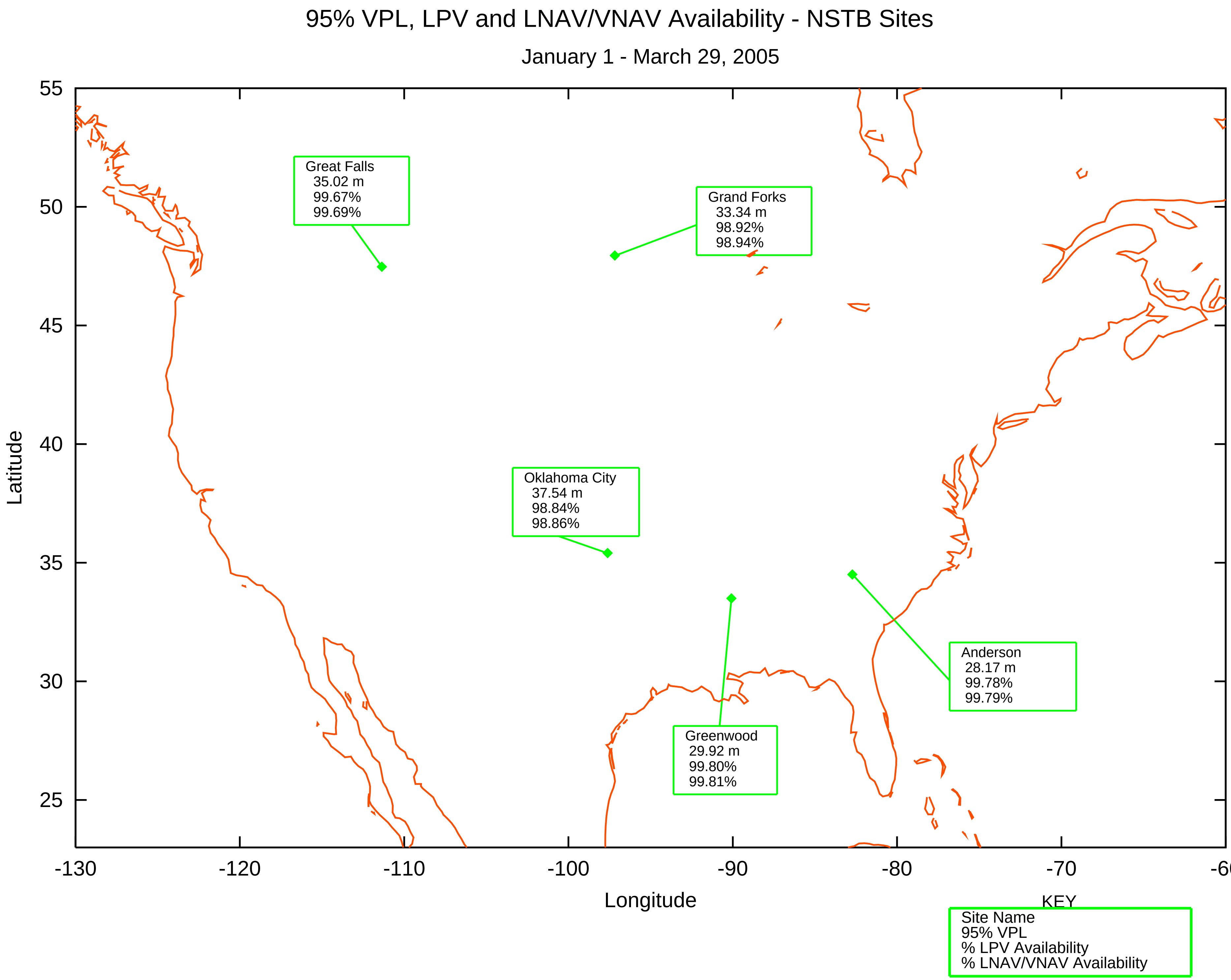
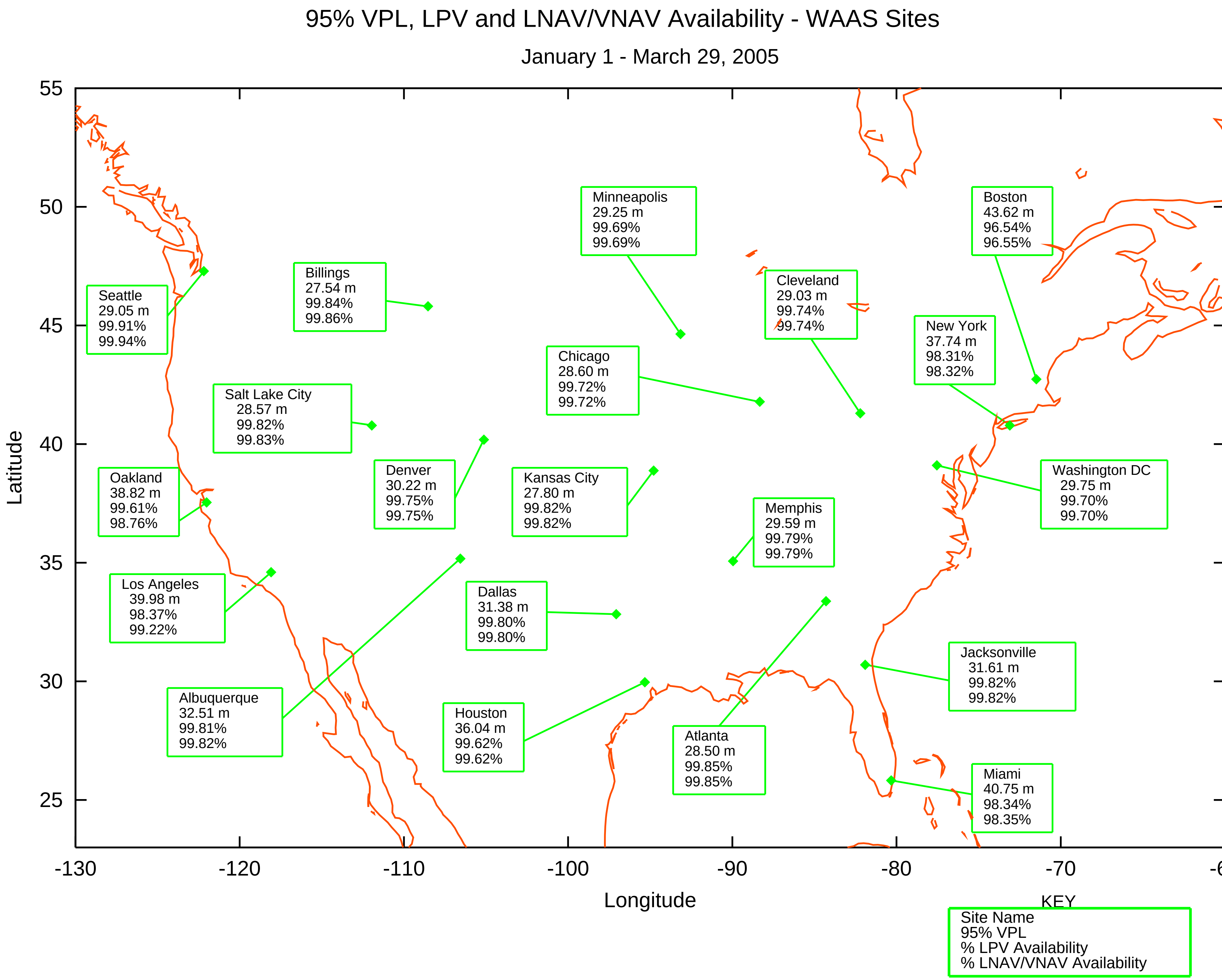


Figure 3_10 95% VPL, LPV and LNAV/VNAV Availability - WAAS sites



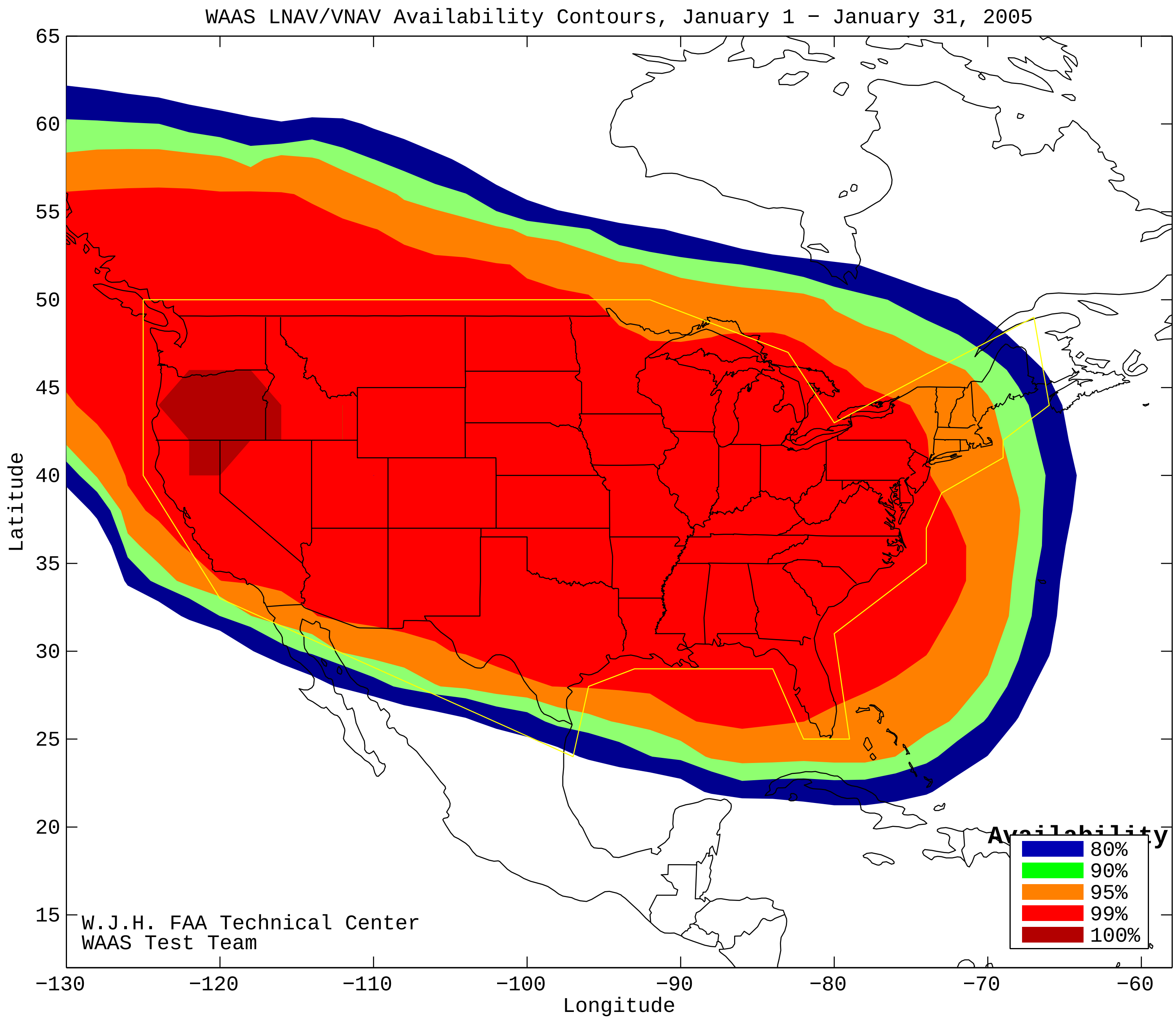
4.0 COVERAGE

WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LNAV/VNAV 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 two-minute intervals and at two degree spacing over the PA service volume, while NPA coverage was calculated at two-minute intervals and five degree spacing over the NPA service volume.

Daily analysis for PA was conducted for both LPV and LNAV/VNAV service levels. Figures 4.1 to 4.3 and 4.5 to 4.7 show the WAAS LNAV/VNAV and LPV coverage area for each month for this quarter, respectively. Figures 4.4 and 4.8 show the rollup WAAS LNAV/VNAV and LPV coverage for the quarter. The coverage plots also provide 100, 99, 95, 90 and 80% availability contours. Figure 4.13 shows the daily WAAS LNAV/VNAV and LPV coverage at 99% availability and ionosphere KP index values for this quarter.

Figure 4.9 to 4.11 show the NPA coverage area of each month and Figure 4.12 shows the rollup NPA coverage for the quarter. Daily analysis for NPA was based on a 99.9% availability requirement. The NPA coverage plots also provide 100, 99.9 and 99% availability contours. Figure 4.14 shows the daily NPA coverage at 99.9% availability and ionosphere Kp index values for this quarter.

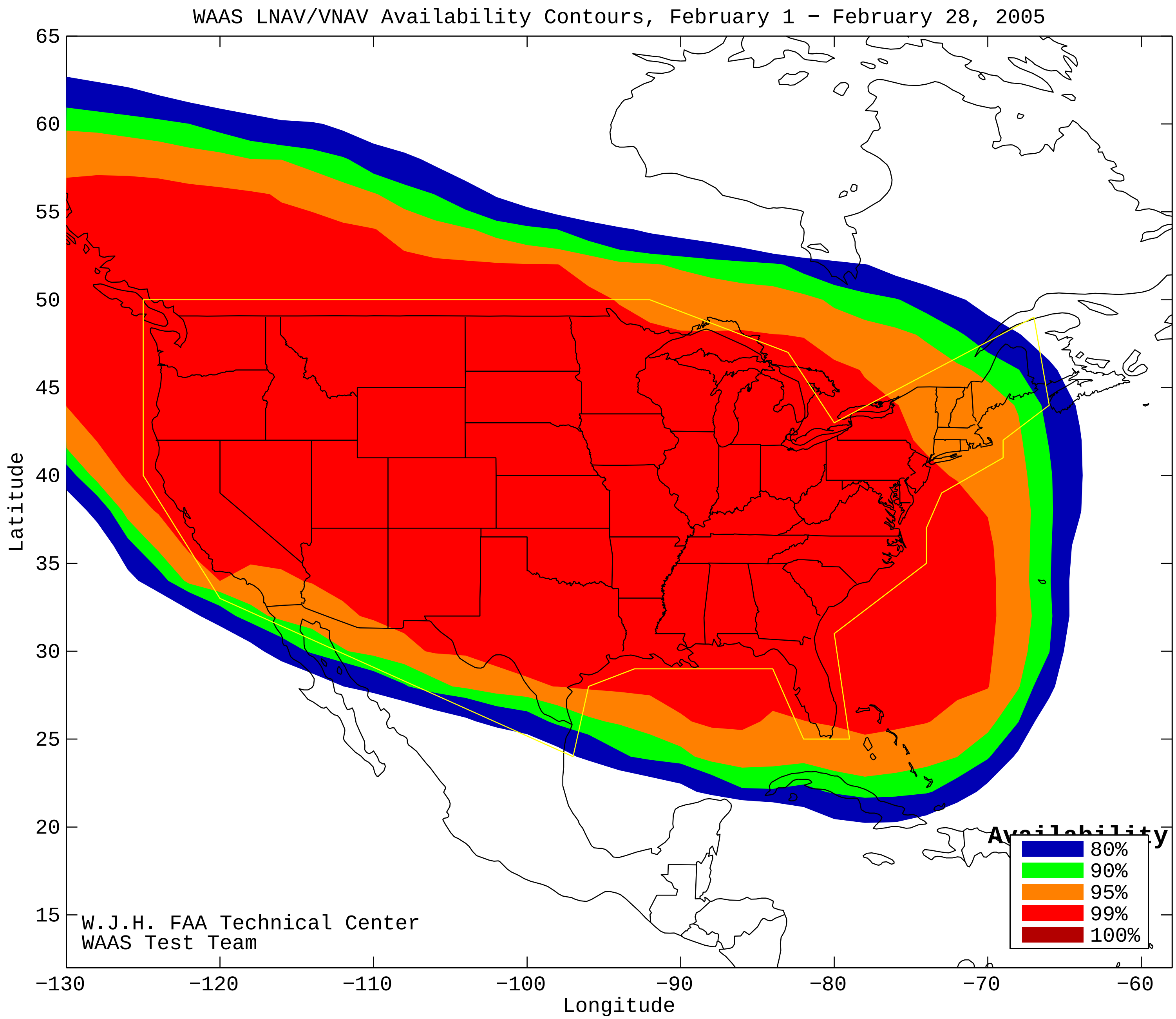
Figure 4_1 WAAS LNAV/VNAV Coverage -January



CONUS Coverage at 95% Availability = 96.76
CONUS Coverage at 99% Availability = 88.26
CONUS Coverage at 100% Availability = 6.883

SL = LNAV/VNAV

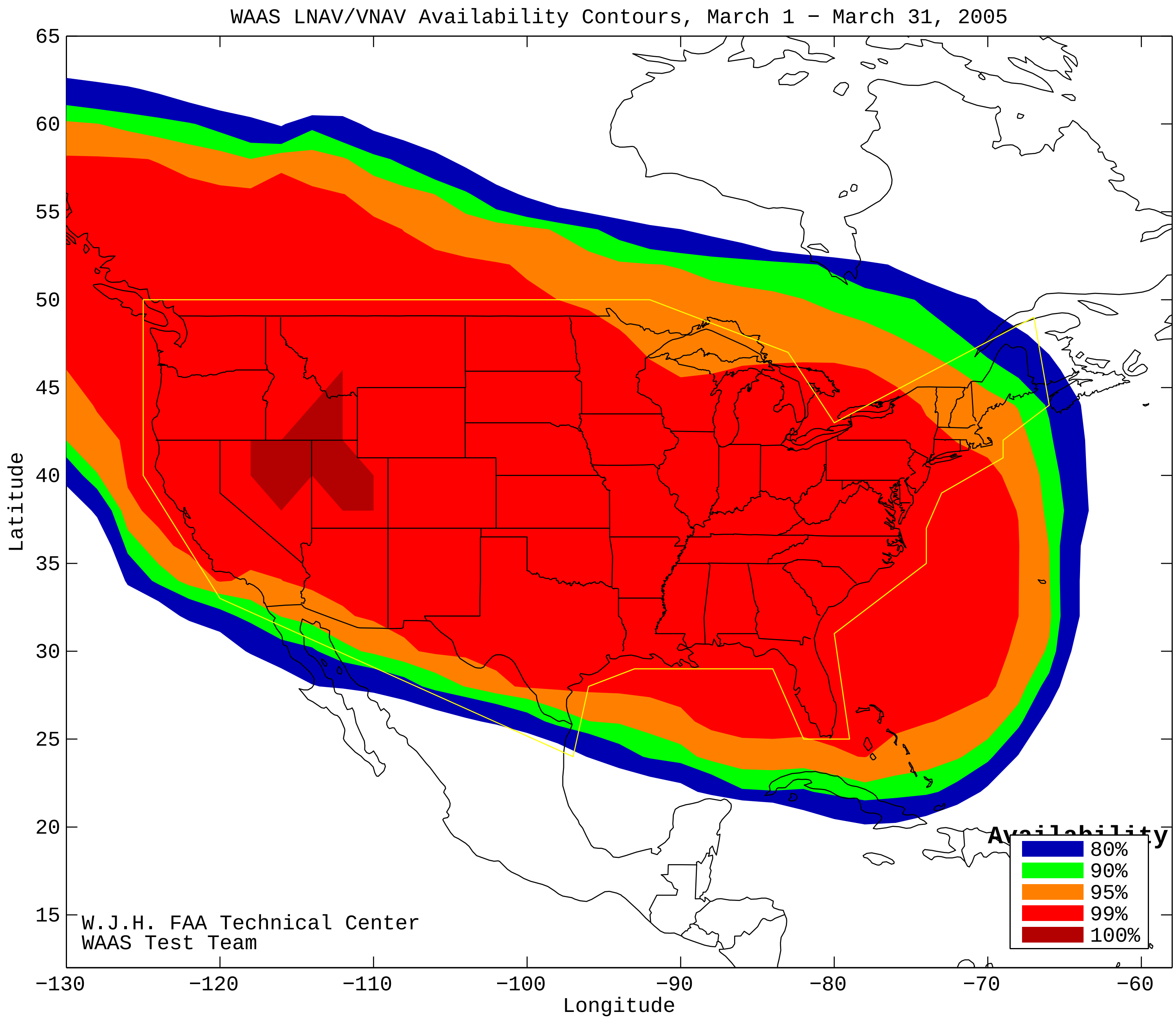
Figure 4_2 WAAS LNAV/VNAV Coverage -February



CONUS Coverage at 95% Availability = 96.36
CONUS Coverage at 99% Availability = 88.66
CONUS Coverage at 100% Availability = 0

SL = LNAV/VNAV

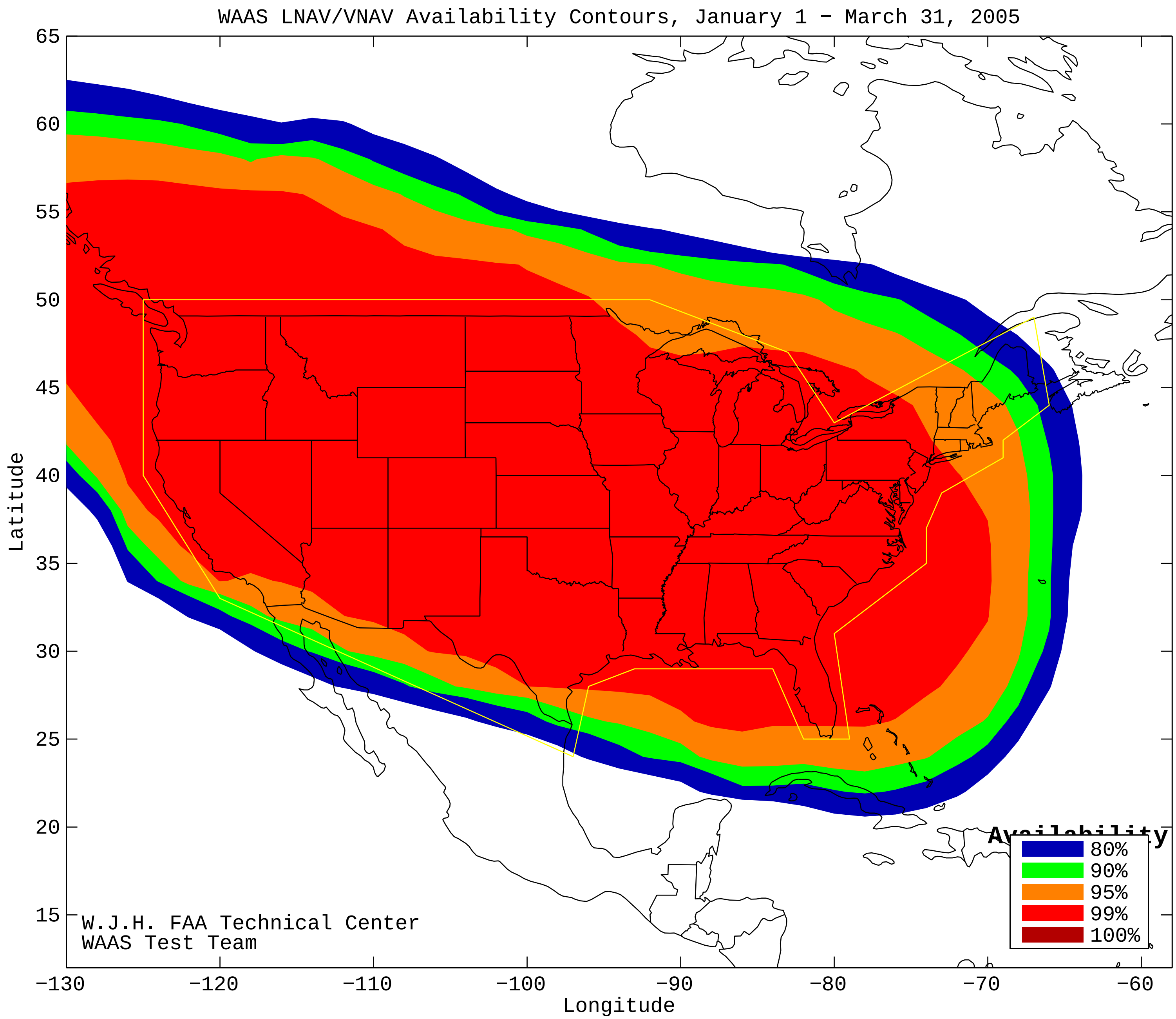
Figure 4_3 WAAS LNAV/VNAV Coverage -March



CONUS Coverage at 95% Availability = 96.36
CONUS Coverage at 99% Availability = 88.26
CONUS Coverage at 100% Availability = 6.073

SL = LNAV/VNAV

Figure 4_4 WAAS LNAV/VNAV Coverage for the Quarter



CONUS Coverage at 95% Availability = 96.36
CONUS Coverage at 99% Availability = 89.07
CONUS Coverage at 100% Availability = 0

SL = LNAV/VNAV

Figure 4_5 WAAS LPV Coverage -January

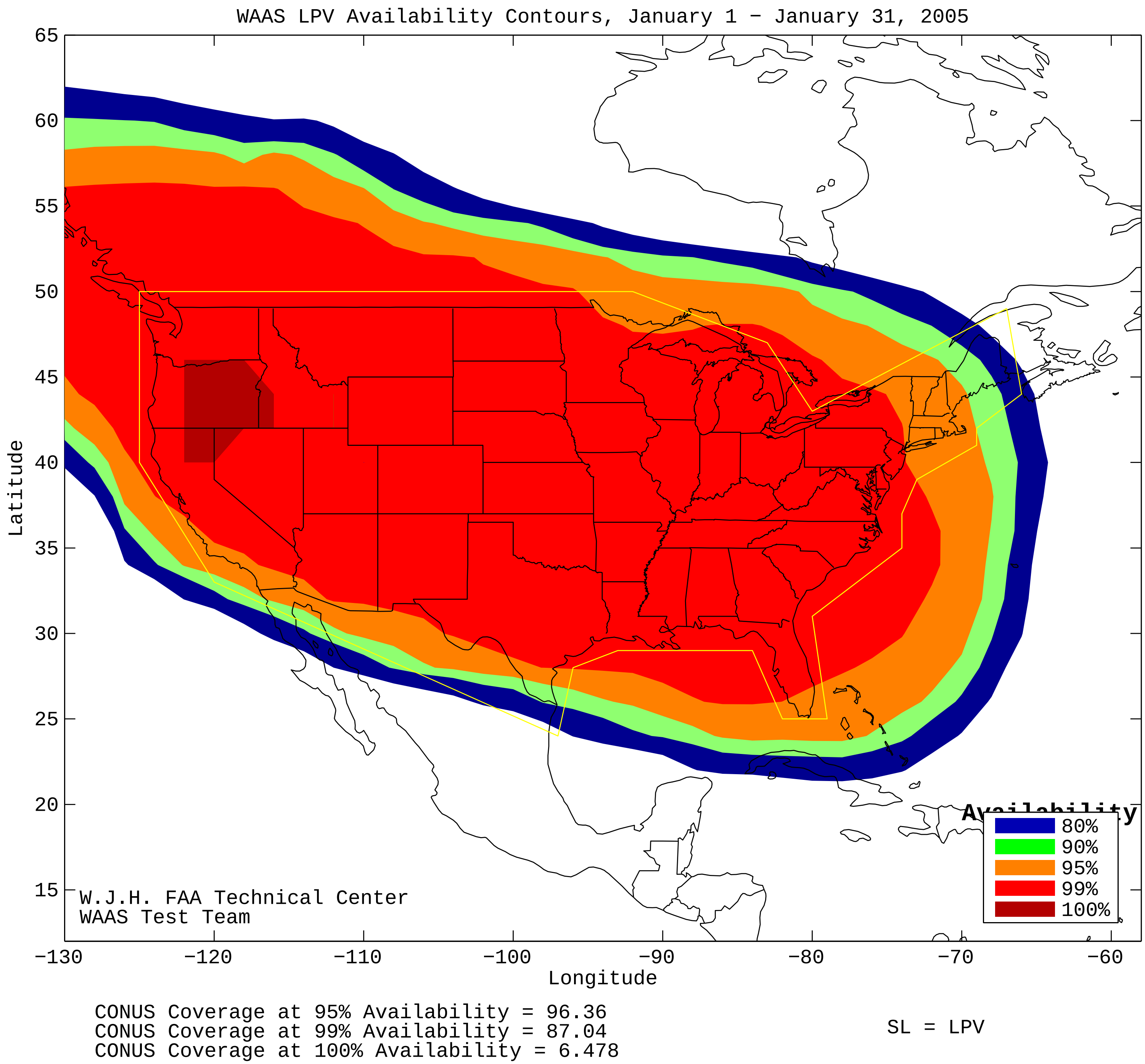


Figure 4_6 WAAS LPV Coverage -February

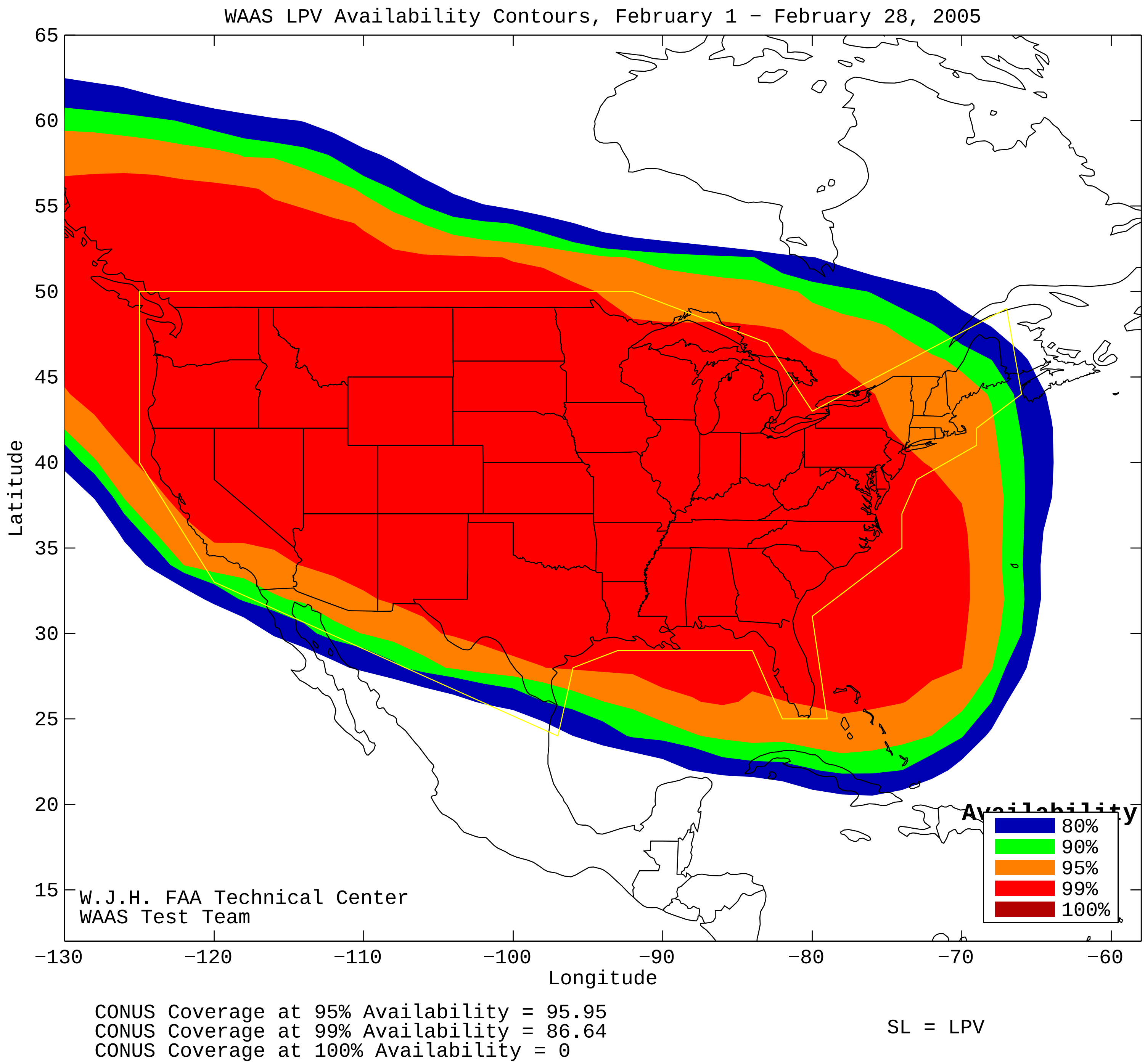
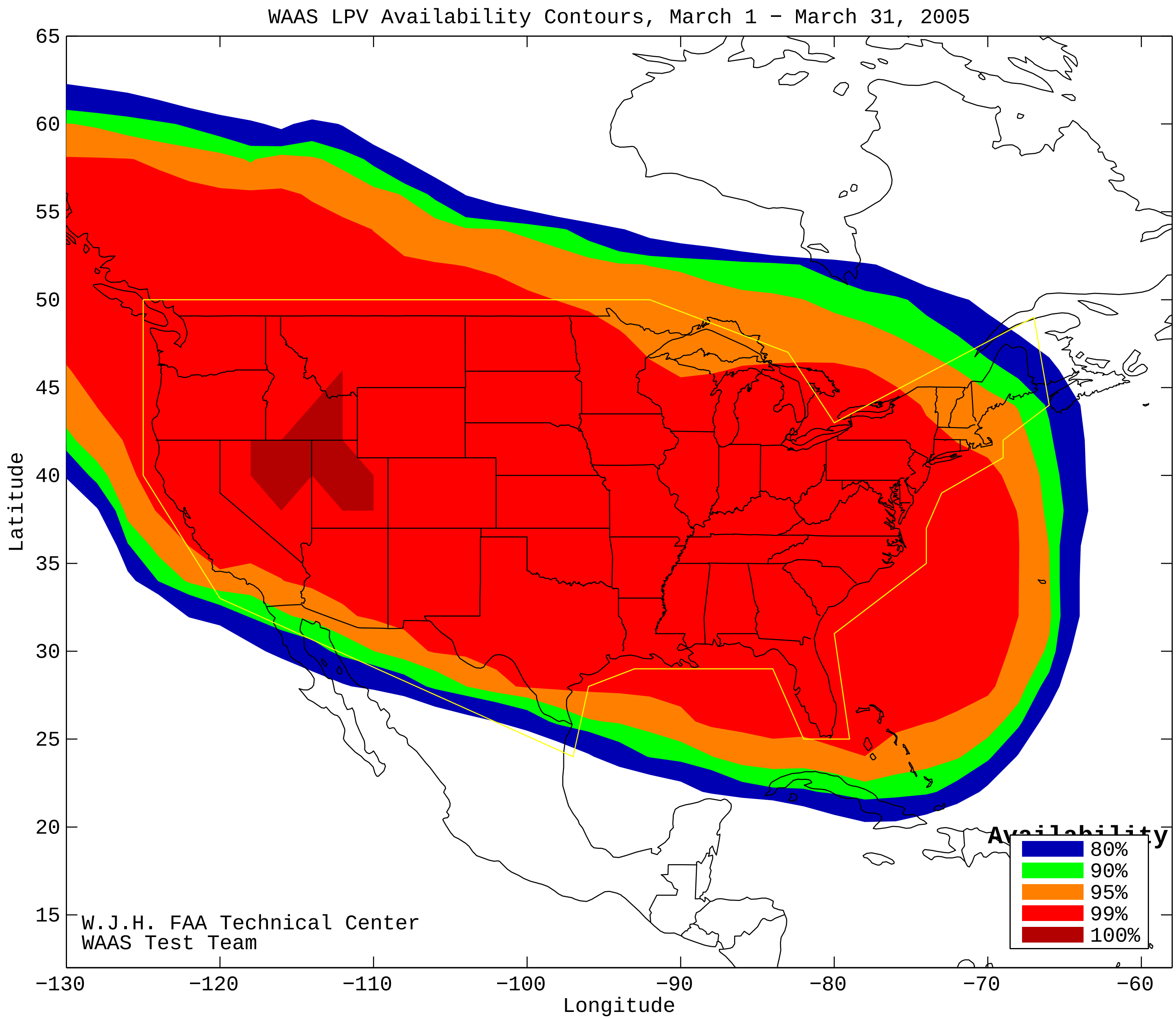


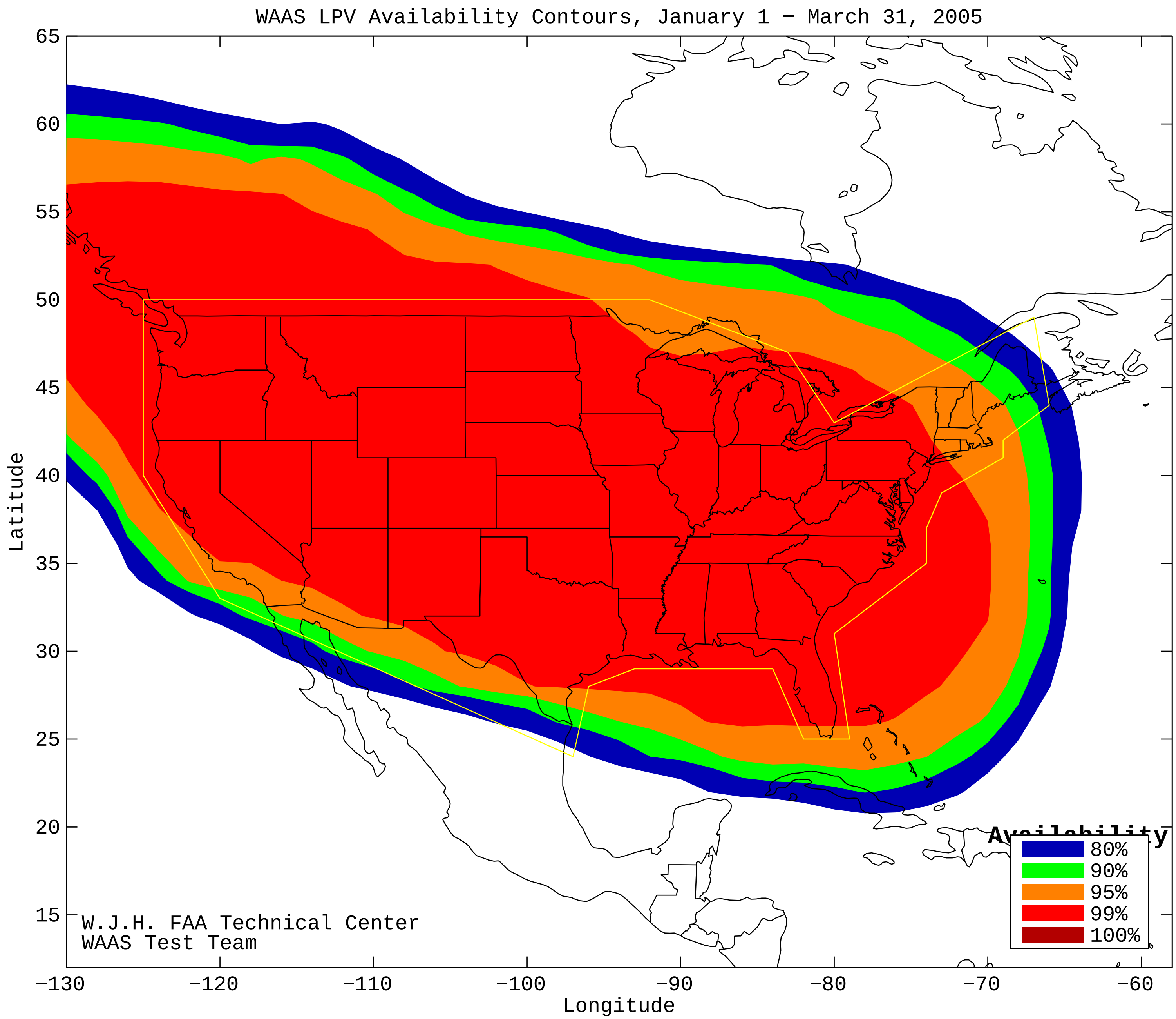
Figure 4_7 WAAS LPV Coverage -March



CONUS Coverage at 95% Availability = 95.14
CONUS Coverage at 99% Availability = 87.85
CONUS Coverage at 100% Availability = 6.073

SL = LPV

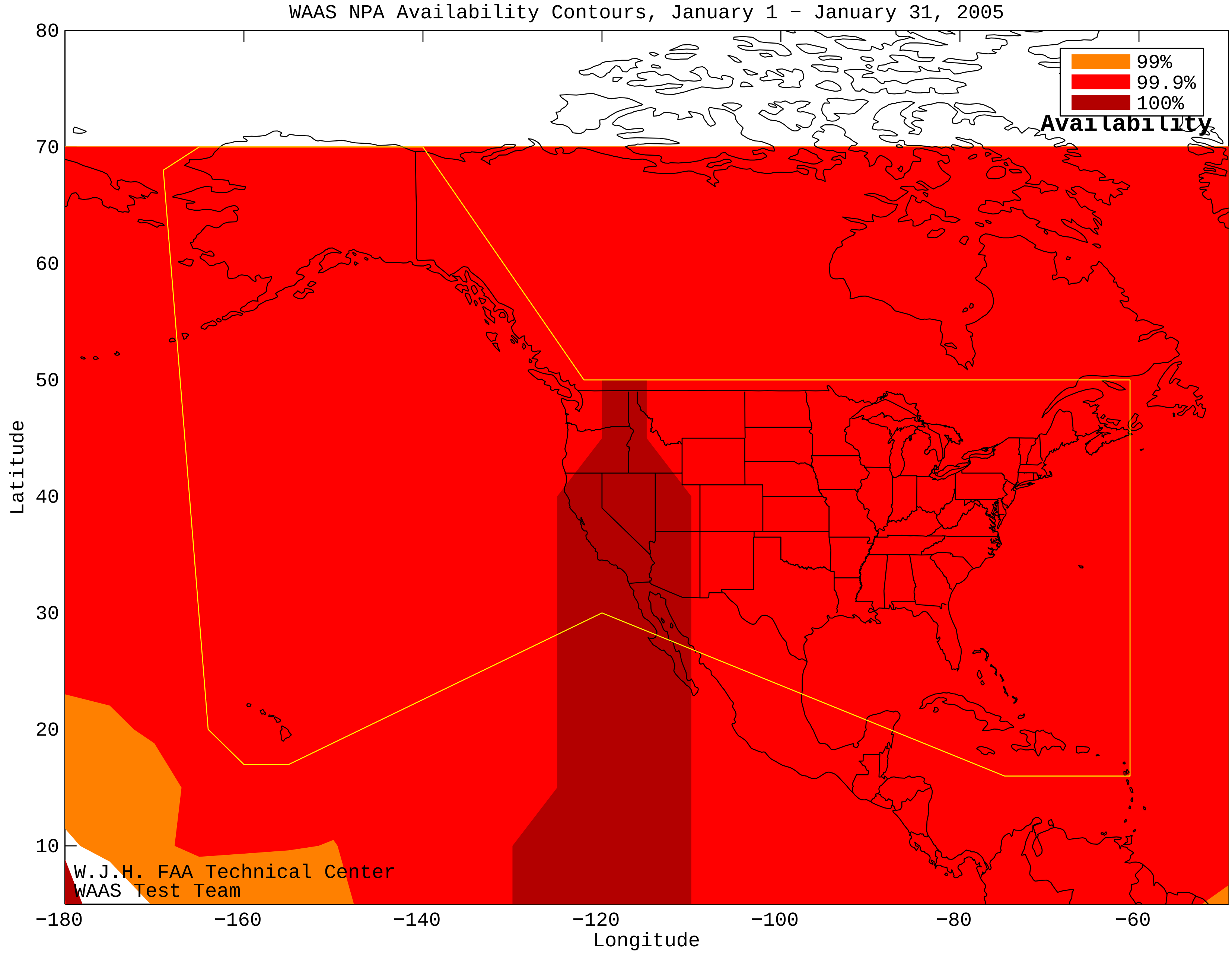
Figure 4_8 WAAS LPV Coverage for the Quarter



CONUS Coverage at 95% Availability = 95.95
CONUS Coverage at 99% Availability = 87.45
CONUS Coverage at 100% Availability = 0

SL = LPV

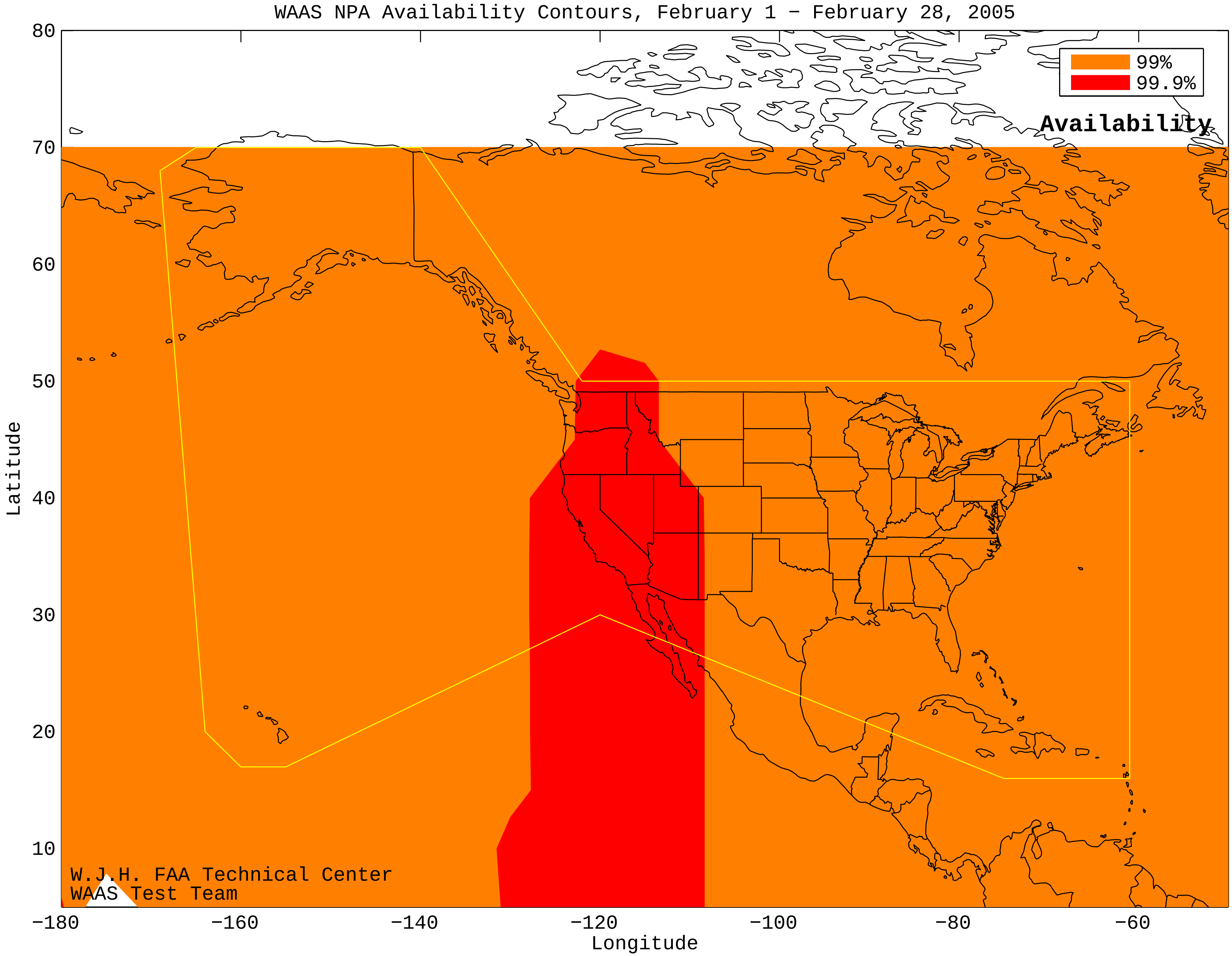
Figure 4_9 WAAS NPA Coverage -January



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 100
WAAS Coverage at 100% Availability = 10.29

SL = NPA

Figure 4_10 WAAS NPA Coverage -February



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 10.29
WAAS Coverage at 100% Availability = 0

SL = NPA

Figure 4_11 WAAS NPA Coverage -March

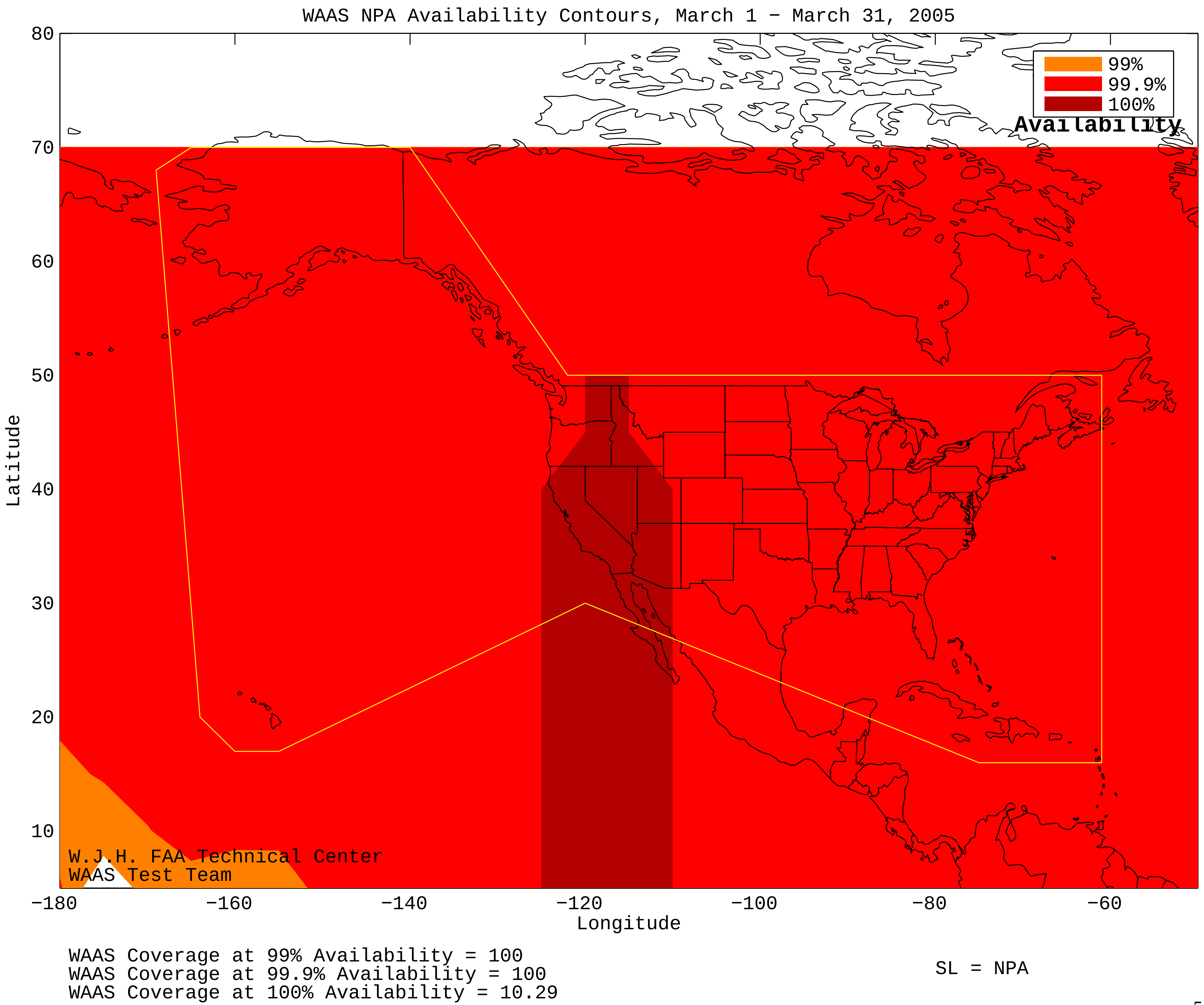
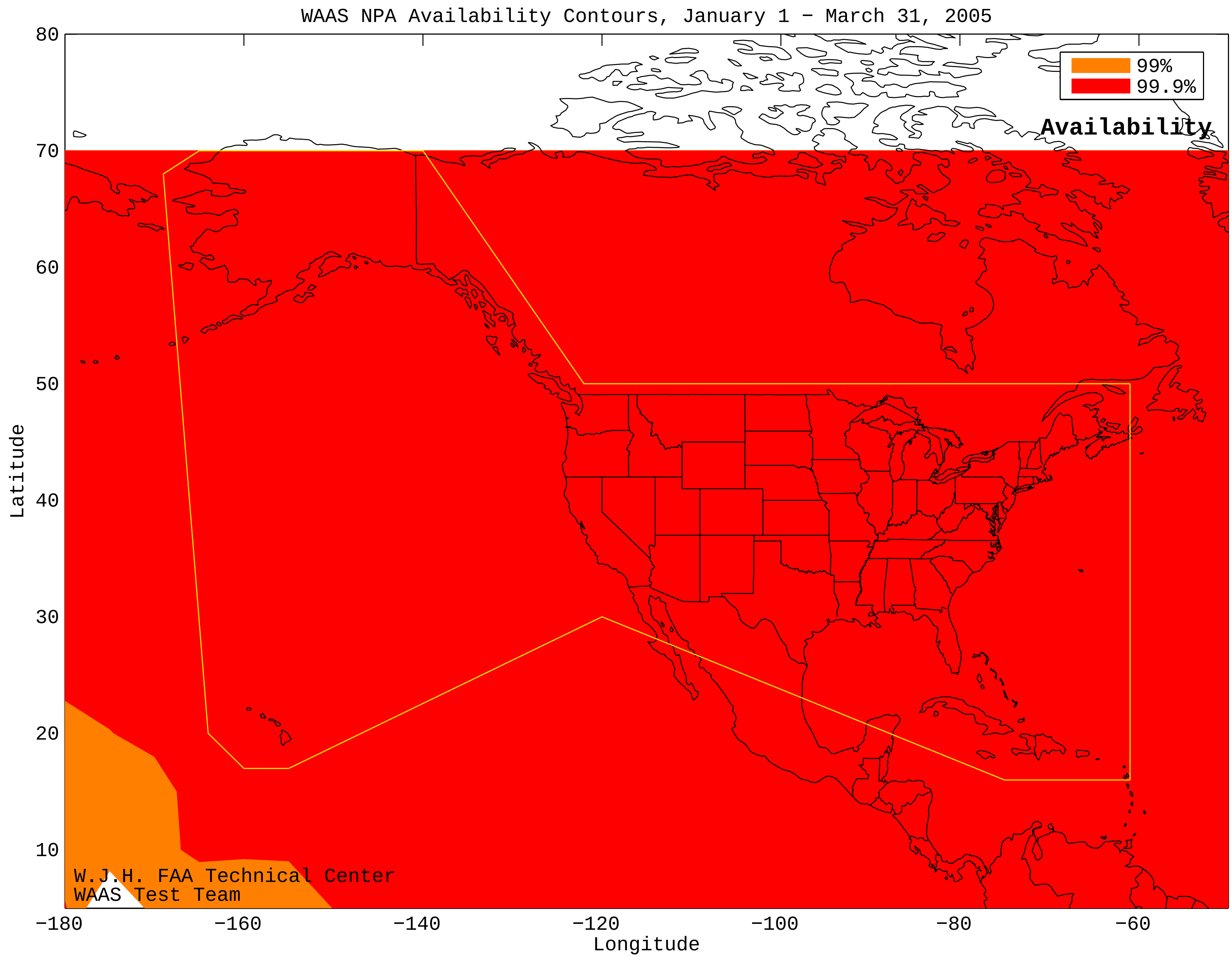


Figure 4_12 WAAS NPA Coverage for the Quarter



WAAS Coverage at 99% Availability = 100
WAAS Coverage at 99.9% Availability = 100
WAAS Coverage at 100% Availability = 0

SL = NPA

Figure 4-13 Daily WAAS LNAV/VNAV and LPV Coverage

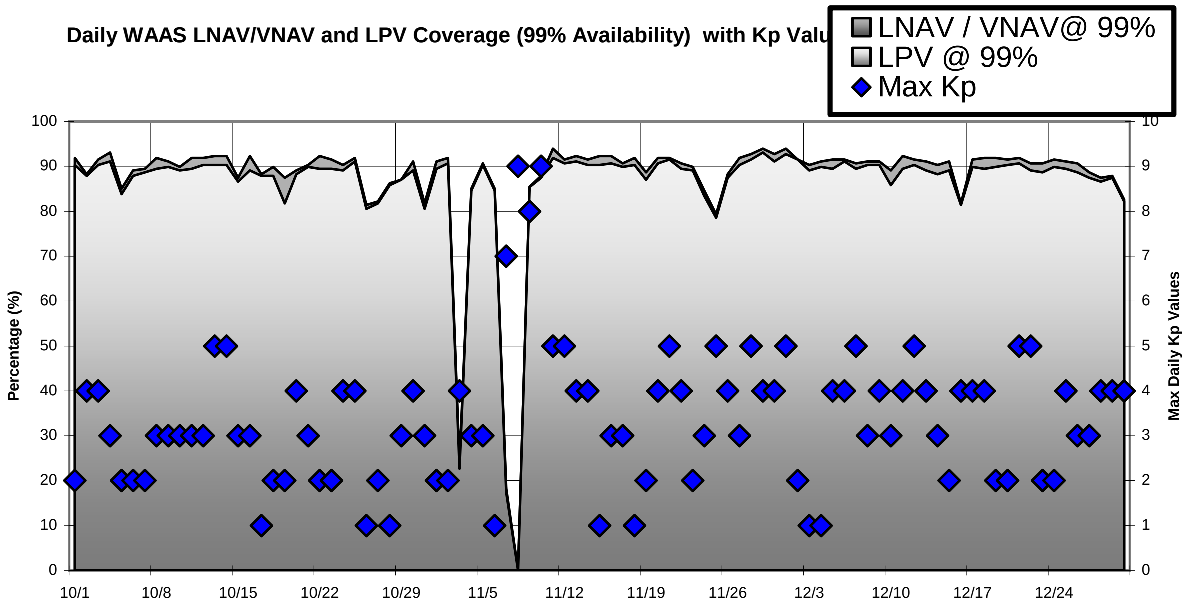
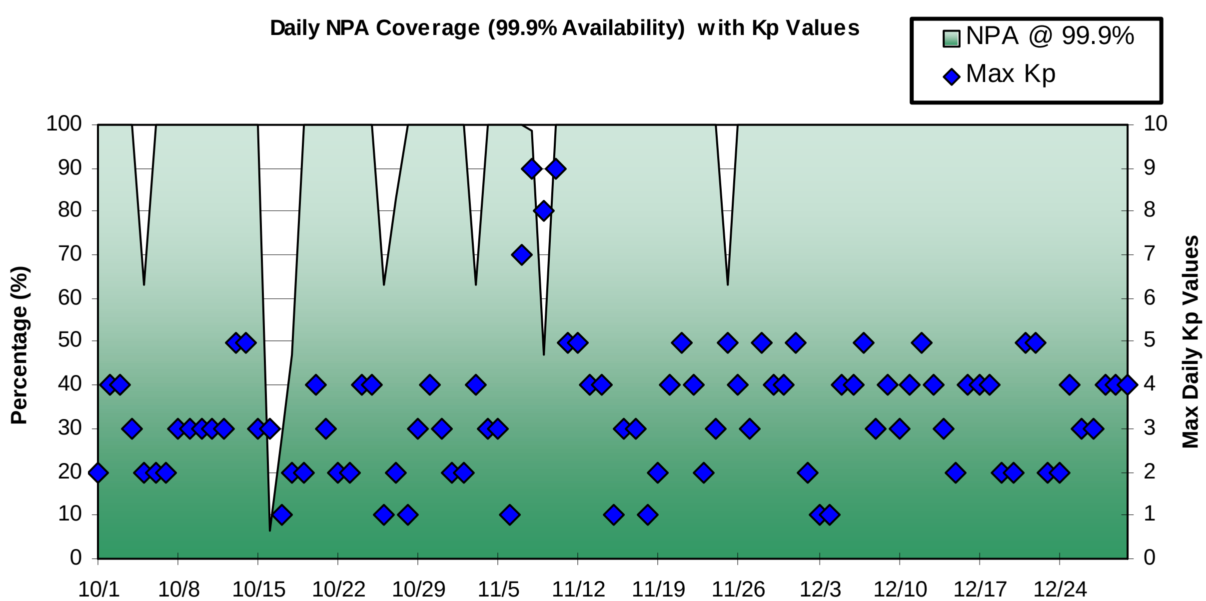


Figure 4-14 Daily NPA Coverage



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 margin index (shown in Table 5.1) is a metric that shows how well the protection levels are bounding the maximum observed error. The process for determining this index involves normalizing the largest error observed at a site. This is accomplished by dividing this maximum observed error by the WAAS estimated standard deviation of the error. The safety margin requirement, 5.33 standard units for vertical and 6 standard units for horizontal, is then divided by this maximum normalized error.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		Number of HMIs
	Horizontal	Vertical	
Anderson	5.00	6.66	0
Grand Forks	4.00	4.10	0
Great Falls	5.00	5.33	0
Greenwood	5.45	4.85	0
Oklahoma City	3.75	7.61	0
Albuquerque	5.45	4.44	0
Atlanta	4.29	6.66	0
Billings	4.29	5.33	0
Boston	4.00	5.33	0
Chicago	4.62	4.44	0
Cleveland	5.00	4.10	0
Dallas	5.00	3.55	0
Denver	5.00	4.10	0
Houston	6.00	5.33	0
Jacksonville	5.45	7.61	0
Kansas City	4.62	3.55	0
Los Angeles	6.00	5.92	0
Memphis	4.62	4.85	0
Miami	5.45	5.33	0
Minneapolis	4.29	4.44	0
New York	5.00	7.61	0
Oakland	4.00	5.33	0
Salt Lake City	4.29	5.33	0
Seattle	3.53	4.85	0
Washington DC	4.00	5.92	0

An observed safety margin 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. As evidenced by the statistics in the above table, the lowest safety margin index is 3.53 at Seattle. Also, Table 5.1 shows the number of HMIs that occurred during the quarter, of which there were none. 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.

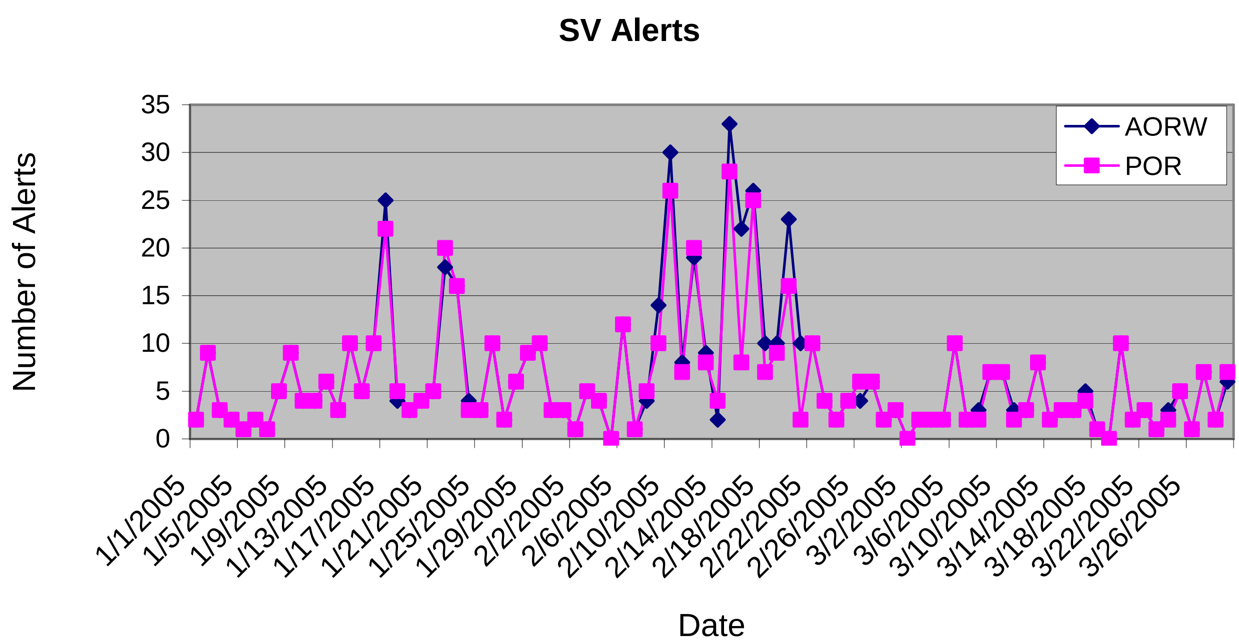
5.2 Broadcast Alerts

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	**AORW**	**POR**	**AORW**	**POR**
2	172	172	1.9545	1.9545
3	113	120	1.2840	1.3636
6	67	17	0.7613	0.1931
24	331	361	3.7613	4.1022
26	0	0	0	0
Total Alerts	683	670	7.7613	7.6136

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (AORW & POR)

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.

All late messages statistics reported during the quarter were 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 AORW. The message rates statistics for POR are shown in table 5.9 to 5.13.

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 - AORW

Message Type	On Time	Late	Max Late Length (seconds)
1	134822	5	180
2	1266140	684	33
3	1265972	714	31
7	71960	133	313
9	89026	23	344
10	71959	143	226
17	28673	8	540
24	1266696	566	28

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

SV	On Time	Late	Max Late Length (seconds)
1	38609	14	178
2	39614	24	176
3	43900	19	178
4	43367	16	187
5	44688	25	186
6	42192	13	180
7	43272	28	182
8	40932	15	181
9	44635	22	187
10	44173	19	182
11	45722	14	178
13	41667	17	187
14	43050	22	184
15	41489	23	181
16	44672	16	184
17	25875	26	177
18	42080	16	182
19	43952	25	185
20	44148	24	185
21	35909	11	177
22	38192	19	188
23	41062	20	252
24	43883	20	187
25	43303	25	188
26	43004	16	182
27	38720	16	183
28	36893	18	182
29	43219	19	182
30	44577	32	182

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

SV	On Time	Late	Max Late Length (seconds)
1	36912	33	251
2	37629	31	195
3	41939	26	210
4	40931	25	193
5	42406	34	194
6	39967	31	204
7	41063	23	192
8	38784	19	343
9	42254	24	198
10	41841	19	288
11	43309	14	193
13	39246	22	194
14	40506	15	196
15	39379	11	192
16	41690	24	196
17	23819	17	288
18	39213	17	193
19	40073	17	196
20	39962	21	193
21	33061	17	193
22	34800	10	193
23	37072	24	360
24	39583	25	194
25	39022	19	198
26	39044	19	192
27	35282	24	317
28	33768	18	227
29	39397	19	194
30	40317	28	195
122	79015	45	194
134	69616	42	288

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26388	19	584
1	0	26372	21	587
1	1	26397	15	587
1	2	26378	20	579
1	3	26367	16	580
1	4	26390	13	587
2	0	26393	14	588
2	1	26372	18	576
2	2	26391	19	581
2	3	26371	24	579
2	4	26395	14	578
2	5	26385	12	578
3	0	26355	20	586

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

Band	On Time	Late	Max Late Length (seconds)
0	65172	0	0
1	65174	0	0
2	65161	0	0
3	65152	0	0

Table 5-9 WAAS Fast Correction and Degradation Message Rates - POR

Message Type	On Time	Late	Max Late Length (seconds)
1	133292	0	0
2	1266721	338	48
3	1266540	380	42
7	71280	102	214
9	89068	2	179
10	71268	96	140
17	28589	1	347
24	1267286	221	60

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

SV	On Time	Late	Max Late Length (seconds)
1	38631	1	169
2	39664	0	0
3	43939	1	179
4	43386	0	0
5	44746	0	0
6	42225	0	0
7	43323	0	0
8	40965	0	0
9	44663	0	0
10	44227	0	0
11	45740	0	0
13	41703	0	0
14	43111	0	0
15	41517	0	0
16	44718	0	0
17	25931	0	0
18	42113	0	0
19	43991	0	0
20	44188	0	0
21	35952	0	0
22	38201	2	179
23	41129	0	0
24	43913	0	0
25	43361	0	0
26	43022	0	0
27	38732	0	0
28	36922	0	0
29	43243	1	177
30	44640	0	0

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

SV	On Time	Late	Max Late Length (seconds)
1	36965	2	188
2	37682	0	0
3	41963	2	336
4	40967	1	133
5	42470	0	0
6	40026	2	134
7	41099	0	0
8	38811	3	360
9	42291	1	163
10	41884	0	0
11	43325	0	0
13	39288	2	163
14	40535	0	0
15	39417	2	184
16	41745	1	131
17	23854	1	121
18	39238	3	144
19	40082	2	192
20	39996	0	0
21	33088	3	138
22	34844	2	198
23	37097	4	188
24	39653	0	0
25	39067	0	0
26	39096	2	152
27	35261	4	318
28	33823	1	122
29	39393	0	0
30	40383	0	0
122	79102	0	0
134	69632	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26414	3	306
0	1	26390	6	517
0	2	26389	5	578
1	0	26411	1	305
1	1	26441	2	308
1	2	26402	5	335
1	3	26392	3	335
1	4	26431	5	319
2	0	26390	4	401
2	1	26401	5	408
2	2	26403	1	371
2	3	26390	6	374

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

Band	On Time	Late	Max Late Length (seconds)
0	64814	0	0
1	64824	0	0
2	64798	0	0

6.0 SV RANGE ACCURACY

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

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

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

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

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding	95% Range Error	3.29 Sigma Bounding
1	1.2690	100	1.5290	100	1.6050	100	2.3620	100	1.2440	100	1.6880	100
2	2.0120	99.9846	2.0790	100	2.2830	100	3.1450	99.7726	1.7680	100	1.7750	100
3	1.2220	100	1.1750	100	1.5450	100	2.7350	99.9721	1.4840	100	1.5650	100
4	1.8480	100	1.8030	100	1.9580	100	2.3440	99.9154	2.2050	100	2.2260	100
5	1.2750	100	1.3950	100	1.8040	100	2.4690	99.9667	1.6180	100	1.2710	100
6	1.7160	100	2.1030	100	1.7540	100	2.6050	99.9998	1.3490	100	1.9720	100
7	1.2720	100	1.0900	100	1.5160	100	2.2230	99.9569	1.3600	100	1.1210	100
8	1.2800	100	1.1640	100	1.5360	100	2.4530	100	1.4040	100	1.6410	100
9	1.4560	100	1.7130	100	1.9400	100	2.6950	99.9441	2.0040	100	1.5420	100
10	1.2850	100	1.6190	100	1.6090	100	2.4430	99.9683	1.6400	100	1.5090	100
11	1.3050	100	1.5200	100	1.7080	100	2.6390	99.7405	1.3580	100	1.0780	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.3050	100	1.4030	100	1.4180	100	2.3970	99.9636	1.2450	100	1.4420	100
14	1.0120	100	1.0830	100	1.6020	100	2.5300	100	1.5480	100	1.3230	100
15	1.1550	100	1.2330	100	1.5540	100	2.5300	100	1.3450	100	1.7720	100
16	1.2730	100	1.3150	100	1.3830	100	2.1580	100	1.3300	100	1.5600	100
17	1.5510	100	1.7500	100	1.3040	100	2.7100	99.7903	2.1190	100	1.9770	100
18	1.0930	100	1.0440	100	1.6210	100	2.5230	100	1.7420	100	1.6630	100
19	2.8090	100	2.6650	100	2.8430	100	3.4570	98.5762	2.5430	100	2.6670	99.9972
20	1.5210	100	1.3580	100	1.6610	100	2.4220	100	2.1010	100	1.2090	100
21	1.4690	100	1.5600	100	1.6660	100	2.7930	100	2.1210	100	1.5360	100
22	1.3150	100	1.1850	100	1.6890	100	2.5060	100	1.8920	100	1.4460	100
23	2.9520	99.94095	2.7580	100	3.3340	100	3.3470	99.8617	3.0880	99.9037	2.6100	99.9988
24	1.7970	100	1.8710	100	1.8640	100	2.3210	99.8762	2.2190	100	2.2060	100
25	1.1390	100	1.3980	100	1.4970	100	2.1970	99.9998	1.8100	100	1.5810	100
26	1.5980	100	2.0100	100	1.8640	100	3.1260	99.7373	1.7370	100	1.8760	100
27	1.4310	100	1.1560	100	1.3630	100	2.4830	100	1.3150	100	1.5810	100
28	1.7120	99.9758	1.6420	100	1.5740	100	2.8810	99.9840	1.7200	100	1.2660	100
29	1.1560	100	2.2730	100	1.4630	100	2.6540	99.9623	1.4910	100	1.6830	100
30	1.7460	100	1.8510	100	1.5920	100	2.9310	99.6822	1.9580	100	1.8450	100
31	-	-	-	-	-	-	-	-	-	-	-	-
122	4.6300	100	2.8450	100	3.2490	100	2.6310	100	2.7420	100	3.1840	100
134	-	-	-	-	-	-	-	-	-	-	-	-

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	2.2280	100	1.1220	100	1.4640	100	1.6940	100	1.4490	100	1.6760	100
2	2.1110	100	1.9200	100	2.1700	100	1.7090	99.8148	1.7940	100	1.2230	100
3	2.4120	100	1.2230	100	1.1750	100	1.3670	100	1.8100	100	1.3820	100
4	2.9250	100	2.0730	100	2.0570	100	1.7070	100	1.8080	100	2.1360	100
5	2.6900	99.9665	1.8950	100	1.3820	100	1.4320	100	1.2100	100	1.1580	100
6	3.7840	99.7418	1.4650	100	1.5280	100	1.6680	100	1.8560	100	1.8110	100
7	2.0060	100	1.1300	100	1.2470	100	1.1820	100	1.2380	100	1.3000	100
8	1.5430	100	1.3020	100	1.3610	100	1.6210	100	1.3310	100	1.2570	100
9	2.8090	99.9966	1.6040	100	1.2060	100	1.5540	100	1.7770	100	1.6250	100
10	2.3630	100	1.2310	100	1.7650	100	1.9600	99.8384	1.1760	100	1.0290	100
11	1.5470	100	1.3440	100	1.5060	100	1.2770	100	1.2110	100	1.0820	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.8080	100	1.0570	100	1.3780	100	1.5160	100	1.3420	100	1.5350	100
14	1.7270	100	1.0900	100	1.5460	100	1.2710	100	1.3330	100	0.9960	100
15	2.0470	100	1.1720	100	1.3040	100	1.3310	100	1.3310	100	1.2900	100
16	1.8810	100	1.2670	100	1.9210	100	1.3210	100	1.2390	100	0.9750	100
17	3.4450	99.9996	1.5460	100	1.3890	100	1.5180	99.8276	1.4420	100	1.6840	100
18	1.6120	100	1.5850	100	2.0500	100	1.1020	100	1.1210	100	1.2640	100
19	2.4250	100	2.6160	100	2.8340	100	2.5280	99.9683	2.2530	100	2.0080	100
20	1.3670	100	1.3420	100	1.8570	100	1.3540	100	1.3370	100	1.1070	100
21	1.8170	100	1.6870	100	1.9340	100	1.7600	100	1.4240	100	1.4250	100
22	1.4440	100	1.4970	100	2.2660	100	1.1460	100	1.2090	100	1.0640	100
23	2.3410	100	2.6000	100	2.8180	100	2.6960	99.9999	2.4350	100	2.2410	100
24	2.9920	100	2.2120	100	1.7080	100	2.4060	100	2.0100	100	2.1420	100
25	2.0460	100	1.5460	100	1.3710	100	1.3600	100	1.5420	100	1.6110	100
26	2.5770	100	2.0250	100	1.3260	100	2.2810	100	2.1930	100	2.0280	100
27	1.8330	100	1.4800	100	1.3100	100	1.2410	100	1.6900	100	1.4810	100
28	1.4750	100	1.6820	100	1.7910	100	1.2100	100	1.0920	100	1.2340	100
29	2.3910	100	1.4580	100	1.0540	100	1.6380	100	1.8430	100	1.7920	100
30	3.4050	99.1126	1.8680	100	1.4970	100	1.7950	100	1.8430	100	1.9140	100
31	-	-	-	-	-	-	-	-	-	-	-	-
122	4.9700	100	3.9260	100	2.6520	100	4.7070	100	3.6320	100	-	-
134	6.8140	100	4.9330	100	-	-	-	-	-	-	4.0820	100

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	0.7235	100	0.8941	100	0.9595	100	1.2195	100	0.7326	100	0.8701	100
2	1.2256	100	1.2724	100	1.4868	100	1.9718	99.6211	1.2531	100	1.1606	100
3	0.5423	100	0.5451	100	0.7264	100	1.2716	100	0.8668	100	0.9030	100
4	1.0584	100	1.0345	100	1.2792	100	1.6262	100	1.5511	100	1.5166	100
5	0.4935	100	0.6030	100	0.8434	100	1.2471	100	0.7842	100	0.5457	100
6	0.7655	100	1.0771	100	1.0156	100	1.5637	100	0.7964	100	1.0853	100
7	0.7555	100	0.6639	100	0.8932	100	1.4774	100	0.8571	100	0.6149	100
8	0.7026	100	0.4335	100	0.8814	100	1.5156	100	0.7152	100	1.0647	100
9	0.5976	100	0.7944	100	1.0980	100	1.3068	100	1.0354	100	0.7357	100
10	0.7272	100	0.7730	100	0.9073	100	1.6646	100	0.9529	100	0.7972	100
11	0.5419	100	0.7339	100	0.7616	100	1.1593	100	0.7229	100	0.5541	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	0.5296	100	0.5244	100	0.8700	100	1.2195	100	0.7798	100	0.8046	100
14	0.7049	100	0.6493	100	1.1373	100	1.5810	100	0.9755	100	0.8033	100
15	0.4647	100	0.5954	100	0.8322	100	1.3067	100	0.6647	100	0.8472	100
16	0.6254	100	0.6791	100	0.8719	100	1.1196	100	0.7801	100	0.8576	100
17	0.9188	100	0.8236	100	0.8864	100	1.7461	100	1.2144	100	1.0500	100
18	0.8052	100	0.6543	100	1.1630	100	1.7043	100	1.0504	100	1.0345	100
19	1.7685	100	1.6482	100	1.8661	100	2.2124	99.6254	1.8522	100	1.8065	100
20	0.7341	100	0.5968	100	1.0388	100	1.0939	100	1.1316	100	0.6186	100
21	1.0704	100	0.8346	100	1.1849	100	1.6084	100	1.4523	100	1.0727	100
22	1.0142	100	0.7800	100	1.2361	100	1.5497	100	1.2591	100	1.0037	100
23	2.0088	100	2.0475	100	2.5893	100	2.3021	99.8905	2.3278	100	1.8544	100
24	1.0670	100	1.1605	100	1.2378	100	1.7275	100	1.6154	100	1.5154	100
25	0.6181	100	0.6315	100	0.9914	100	1.3995	100	1.4327	100	0.8112	100
26	0.9180	100	1.1521	100	1.0726	100	1.5966	99.9770	1.0738	100	1.1144	100
27	0.8013	100	0.5402	100	0.7850	100	1.5900	100	0.9108	100	0.9956	100
28	0.8530	100	0.8820	100	1.0487	100	1.7512	99.9262	1.1971	100	0.6639	100
29	0.5809	100	1.0388	100	0.8860	100	1.3911	100	0.8144	100	0.9250	100
30	0.7577	100	0.8079	100	0.8503	100	1.3970	100	0.8111	100	0.8390	100
31	-	-	-	-	-	-	-	-	-	-	-	-

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding	95% Iono Error	3.29 Sigma Bounding
1	1.3360	100	0.5373	100	0.7994	100	0.8546	100	0.9688	100	0.7389	100
2	0.5889	100	1.1642	100	1.2564	100	1.0662	100	1.0621	100	0.9850	100
3	0.9748	100	0.6296	100	0.7590	100	0.6360	100	1.0840	100	0.7272	100
4	1.5936	100	1.1604	100	1.2412	100	1.0952	100	1.1520	100	1.1060	100
5	0.8120	100	0.9090	100	0.6332	100	0.6249	100	0.7073	100	0.5493	100
6	1.5887	100	0.8856	100	0.9825	100	1.0000	100	1.1231	100	0.9321	100
7	1.2582	100	0.5224	100	0.7149	100	0.6211	100	0.7993	100	0.7671	100
8	1.0702	100	0.6712	100	0.8517	100	0.8429	100	0.8581	100	0.6100	100
9	1.1435	100	0.6554	100	0.7361	100	0.7277	100	1.1590	100	0.7585	100
10	0.6044	100	0.5286	100	0.8193	100	0.8647	100	0.6922	100	0.5651	100
11	0.5095	100	0.4722	100	0.6776	100	0.6036	100	0.5748	100	0.6113	100
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.1741	100	0.4607	100	1.0025	100	0.7837	100	0.8773	100	0.7887	100
14	0.8825	100	0.6663	100	0.7514	100	0.7480	100	0.5963	100	0.6411	100
15	0.8704	100	0.5214	100	0.6580	100	0.6470	100	0.7109	100	0.6016	100
16	0.7235	100	0.6112	100	0.6560	100	0.6113	100	0.5723	100	0.5447	100
17	1.5935	100	0.7844	100	0.6619	100	0.9698	100	0.9424	100	0.9684	100
18	0.5275	100	0.9334	100	1.0925	100	0.7527	100	0.6217	100	0.7511	100
19	1.1238	100	1.6392	100	1.5340	100	1.6727	100	1.3336	100	1.4955	100
20	0.5508	100	0.7467	100	0.9450	100	0.7905	100	0.6688	100	0.7145	100
21	0.4279	100	1.0739	100	1.0834	100	1.1501	100	0.8796	100	0.9063	100
22	0.4726	100	0.9985	100	1.3161	100	0.8968	100	0.6420	100	0.8722	100
23	1.3624	100	1.9834	100	1.9646	100	1.9182	100	1.6212	100	1.8318	100
24	1.7778	100	1.2217	100	1.2629	100	1.2091	100	1.4189	100	1.2280	100
25	1.1535	100	0.7373	100	1.0155	100	0.6999	100	1.0101	100	0.6745	100
26	1.1931	100	1.1279	100	0.8834	100	1.0758	100	1.3575	100	0.8742	100
27	1.1739	100	0.8167	100	0.8251	100	0.6163	100	1.1221	100	0.6970	100
28	0.6420	100	0.8376	100	0.8816	100	0.6718	100	0.5574	100	0.7777	100
29	1.0758	100	0.7838	100	0.6878	100	0.7562	100	1.1561	100	0.7932	100
30	1.2816	100	0.8754	100	0.9068	100	0.9127	100	1.0980	100	0.8858	100
31	-	-	-	-	-	-	-	-	-	-	-	-

Figure 6_1 95% Range Error (SV 1 --SV 16) - Washington, DC

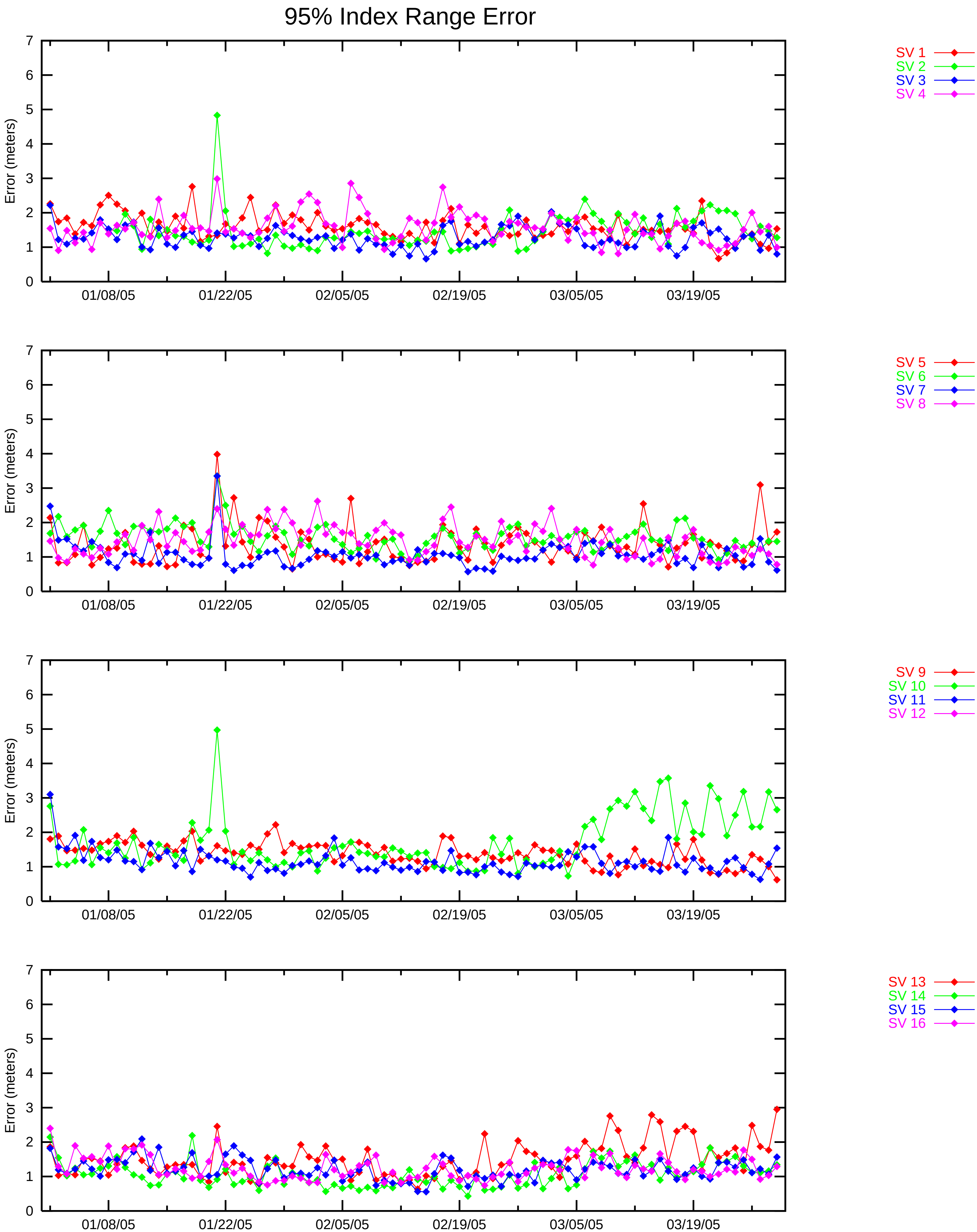


Figure 6_2 95% Range Error (SV 17 --SV 31 and SV 122) - Washington, DC

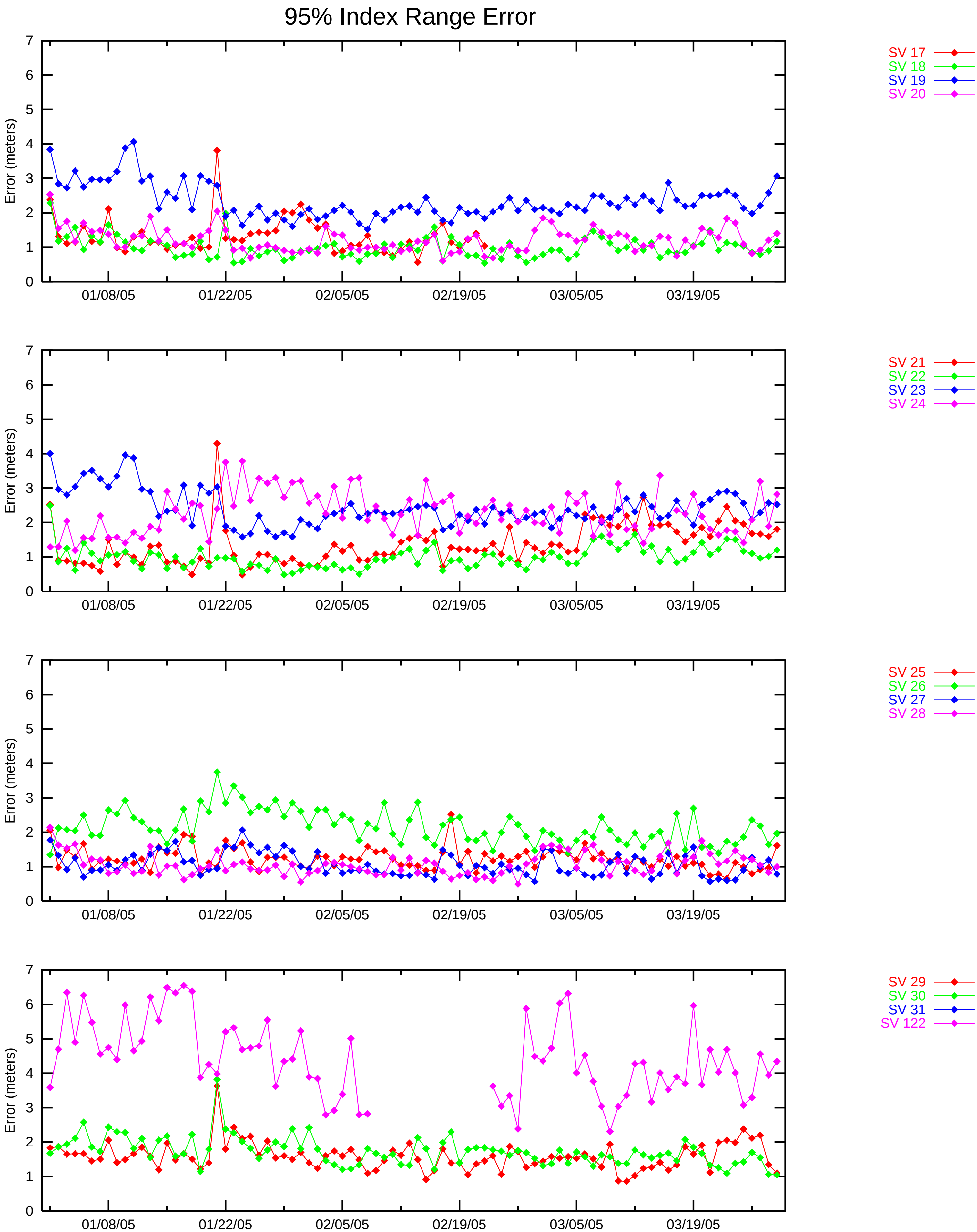


Figure 6_3 95% Ionospheric Error (SV 1 --SV 16) - Washington, DC

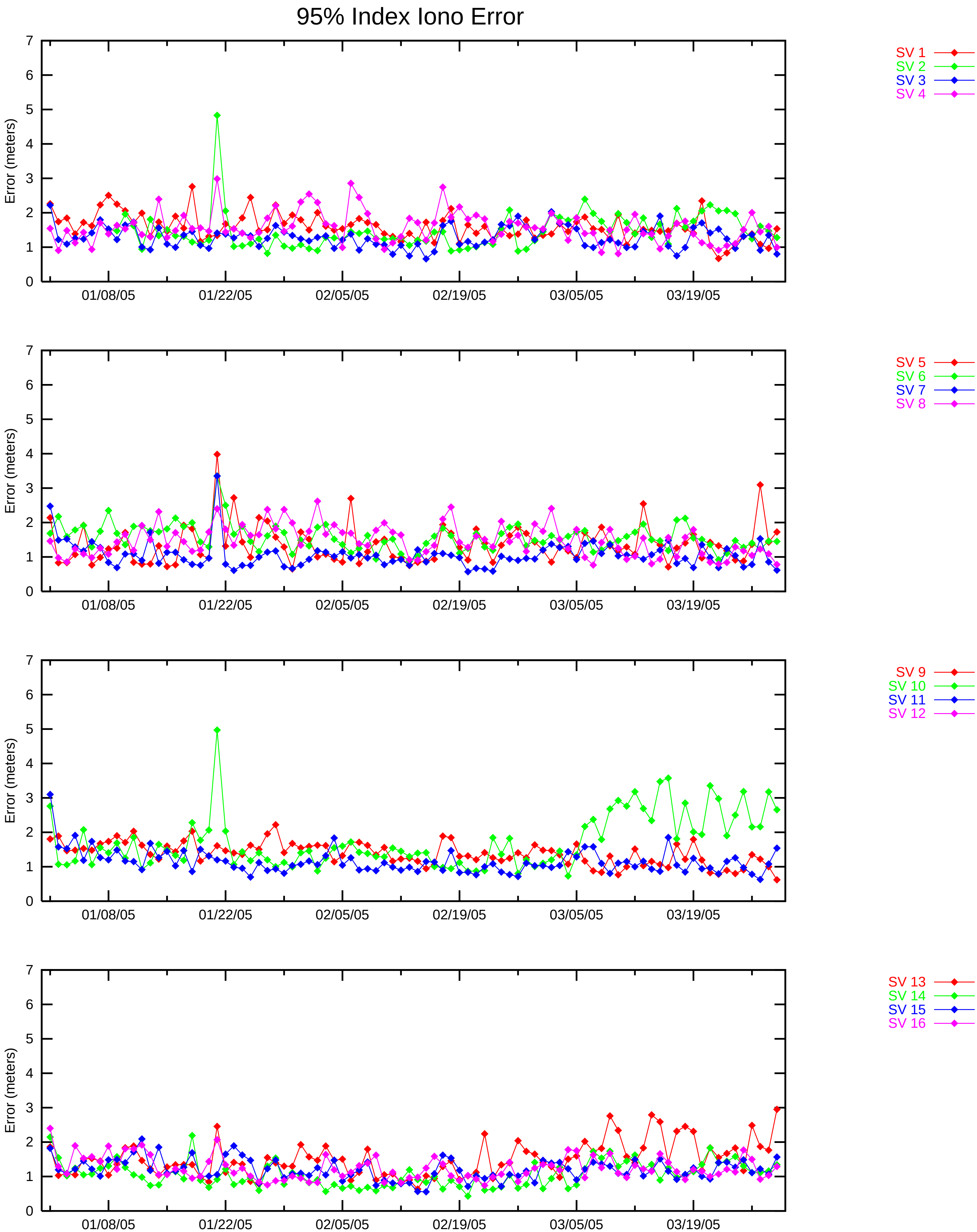
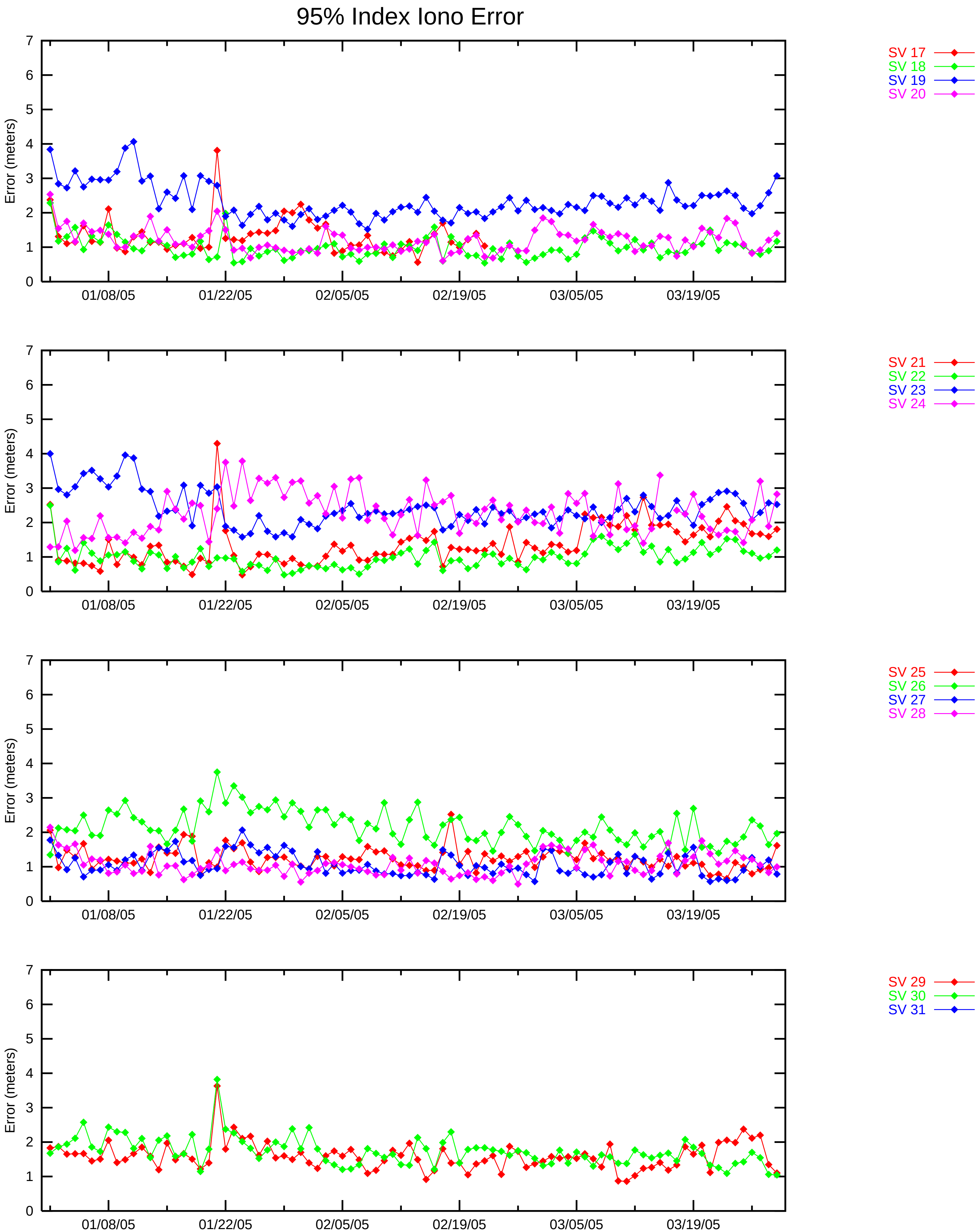


Figure 6_4 95% Ionospheric Error (SV 17 --SV 31) - Washington, DC



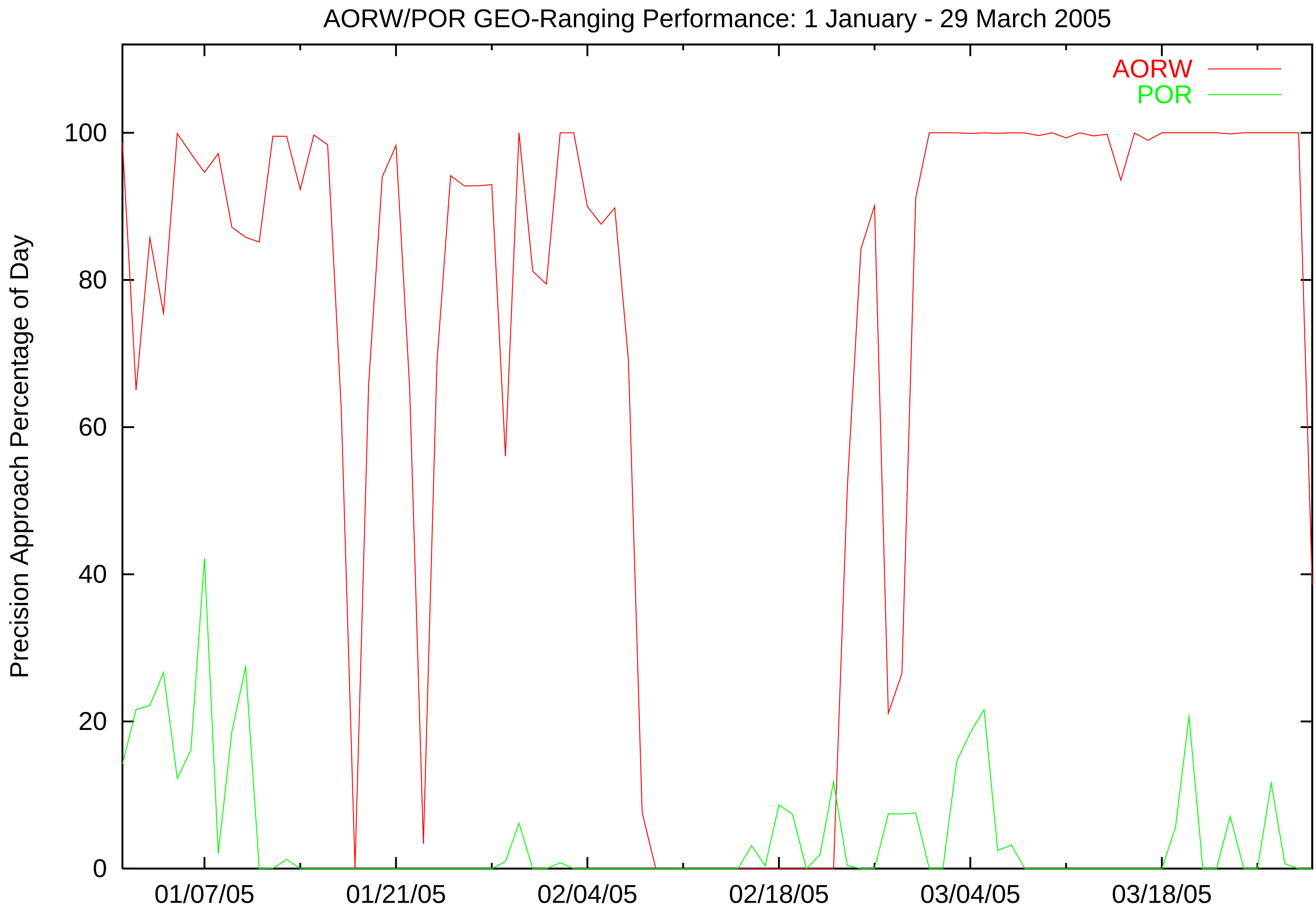
7.0 GEO RANGING PERFORMANCE

Table 7.1 shows the GEO-Ranging performance for AORW and POR satellites throughout the evaluated period. The percentage of PA ranging availability (i.e. the percentage of time a user receiver can use the GEO as a ranging source in a LNAV/VNAV or LPV position solution) for the AORW and POR is 83.915% and 2.111%, respectively. Figure 7.1 shows the trend of PA Ranging Availability for the AORW and POR satellite. The percentage of time the AOR-W GEO was available for PA ranging is lower this quarter than expected. The reason is thread switching by key WRSs and poor WRS receiver performance. The large drops in PA ranging availability for the AORW satellite is due to GUS switchovers. As in the past, the POR satellite as a ranging source has very low PA availability.

Table 7-1 GEO Ranging Availability

GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
AORW	72.129	25.840	0.630	1.350
POR	4.254	82.011	11.327	2.357

Figure 7_1 Daily PA GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

Title: AOR-W Gaps and switchovers

Description: During the period from February 8 to February 22 there were many GUS switchovers and small gaps in data from the AOR-W GEO satellite. The cause of these gaps was a faulty signal generator at the GUS in Santa Paula and the phase noise enhancer at the Clarksburg GUS. The effect was the transmission of type 6 alerts (causing all satellites to go to not monitored). This resulted in a loss of service availability.

Title: Loss of AOR-W and POR SIS

Description: On February 10 there was a loss of SIS for both the AOR-W and POR satellites. A combination of a loss of communications on the backbone network during the Release 1 activities and a latent fault at the Clarksburg GUS caused the loss of SIS for both GEOs. The SIS was out for ~30 minutes on AOR and ~45 minutes on POR.

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 both AORW and POR 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 the period from 10/3/04 to 1/1/05 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	City	State	Outages	Availability
YEG	EDMONTON INTL	EDMONTON	AB	130	0.992442
CGA	CRAIG	CRAIG	AK	220	0.983327
HYD	HKDER	HKDER	AK	207	0.985218
JNU	JUNEAU INTL AIRPORT	JUNEAU	AK	490	0.925049
KTN	KETCHIKAN AIRPORT	KETCHIKAN	AK	205	0.986194
PEC	PELICAN	PELICAN	AK	441	0.932318
PSG	PETERSBURG MUNICIPAL	PETERSBURG	AK	304	0.972963
SIT	SITKA AIRPORT	SITKA	AK	372	0.962613
EET	SHELBY COUNTY	ALABASTER	AL	69	0.998236
79J	ANDALUSIA-OPP	ANDALUSIA/OP	AL	71	0.998158
KBHM	BIRMINGHAM INTL	BIRMINGHAM	AL	69	0.998235
KDHN	DOTHAN REGIONAL	DOTHAN	AL	69	0.998257
HSV	HUNTSVILLE INTL – CARL T JONES FIELD	HUNTSVILLE	AL	70	0.998031
MOB	MOBILE REGIONAL	MOBILE	AL	76	0.997847
MGM	MONTGOMERY REGIONAL / DANNELLY FIELD	MONTGOMERY	AL	70	0.998217
MSL	MUSCLE SHOALS NORTWEST ALABAMA REGional	SHEFFIELD	AL	71	0.998012
LIT	ADAMS FIELD	LITTLE ROCK	AR	73	0.997923
M73	ALMYRA	ALMYRA	AR	74	0.997937
KVBT	BENTONVILLE MUNICIPAL / LM THADDEN FIELD	BENTONVILLE	AR	73	0.998120
BYH	BLYTHEVILLE	BLYTHEVILLE	AR	74	0.997574
CDH	HARRELL FIELD	CAMDEN	AR	74	0.998029
KXNA	NORTHWEST ARKANSAS RGNL	FAYETTEVILLE/ SPRINGDALE/ROGERS	AR	73	0.998120
KFSM	FORT SMITH REGIONAL	FORT SMITH	AR	73	0.998124
HRO	BOONE COUNTY AIRPORT	HARRISON	AR	76	0.997810
SRC	SEARCY MUNICIPAL	SEARCY	AR	74	0.997885
ASG	SPRINGDALE MUNICIPAL	SPRINGDALE	AR	73	0.998120

Airport ID	Airport Name	City	State	Outages	Availability
KARG	WALNUT RIDGE REGIONAL	WALNUT RIDGE	AR	72	0.997529
IFP	LAUGHLIN/BULLHEAD INTL	BULLHEAD CITY	AZ	33	0.997686
KGCN	GRAND CANYON NATL PARK	GRAND CANYON	AZ	18	0.998762
KPHX	PHOENIX SKY HARBOR INTL	PHOENIX	AZ	62	0.995631
KPRC	ERNEST A LOVE FIELD	PRESCOTT	AZ	37	0.997733
KTUS	TUCSON INTL	TUCSON	AZ	137	0.985818
RQE	WINDOW ROCK	WINDOW ROCK	AZ	16	0.999469
BFL	BAKERSFIELD/MEADOWS FIELD	BAKERSFIELD	CA	155	0.990803
KCRQ	MC CLELLAN-PALOMAR	CARLSBAD	CA	278	0.961345
O60	CLOVERDALE MUNICIPAL	CLOVERDALE	CA	81	0.997159
KDAG	BARSTOW-DAGGETT	DAGGETT	CA	110	0.993667
IYK	INYOKERN	INYOKERN	CA	48	0.998069
KLAX	LOS ANGELES INTL	LOS ANGELES	CA	271	0.968288
KOAK	METROPOLITAN OAKLAND INTL	OAKLAND	CA	90	0.996331
ONT	ONTARIO INTL	ONTARIO	CA	211	0.974212
KPMD	PALMDALE PROD FLT/ TEST INSTLN	PALMDALE	CA	215	0.982937
KSMF	SACRAMENTO INTL	SACRAMENTO	CA	54	0.998549
KMHR	SACRAMENTO MATHER	SACRAMENTO	CA	52	0.998617
SAN	SAN DIEGO INTL – LINDBERGH FIELD	SAN DIEGO	CA	352	0.948167
KSFO	SAN FRANCISCO INTL	SAN FRANCISCO	CA	118	0.995026
SJC	SAN JOSE INTL	SAN JOSE	CA	97	0.996045
SVE	SUSANVILLE MUNICIPAL	SUSANVILLE	CA	23	0.999439
TNP	TWENTYNINE PALMS	TWENTYNINE PALMS	CA	130	0.986274
AKO	AKRON-COLORADO PLAINS REGIONAL	AKRON	CO	72	0.998100
COS	COLORADO SPRINGS	COLORADO SPRINGS	CO	74	0.998123
CEZ	CORTEZ MUNICIPAL	CORTEZ	CO	75	0.998120
KDEN	DENVER INTL	DENVER	CO	74	0.998099
HDN	YAMPA VALLEY	HAYDEN	CO	75	0.998108
LHX	LA JUNTA MUNICIPAL	LA JUNTA	CO	75	0.998102
LAA	LAMAR MUNICIPAL	LAMAR	CO	77	0.998026
2V2	VANCE BRAND	LONGMONT	CO	75	0.998072
EEO	MEEKER	MEEKER	CO	75	0.998110
TAD	PERRY STOKES	TRINIDAD	CO	74	0.998128
2V5	WRAY	WRAY	CO	72	0.998097
KBDL	BRADLEY INTL	WINDSOR LOCKS	CT	241	0.974609
KDCA	RONALD REAGAN WASHINGTON INTL	WASHINGTON	DC	87	0.996741
KIAD	WASHINGTON DULLES INTL	WASHINGTON	DC	85	0.996856
FXE	FORT LAUDERDALE EXECUTIVE AIRPORT	FORT LAUDERDALE	FL	179	0.987311
KFLL	FORT LAUDERDALE / HOLLYWOOD INTL	FORT LAUDERDALE	FL	190	0.986292
KRSW	SOUTHWEST FLORIDA INTL	FORT MYERS	FL	148	0.990899
KGNV	GAINESVILLE REGIONAL	GAINESVILLE	FL	74	0.997951
KJAX	JACKSONVILLE INTL	JACKSONVILLE	FL	73	0.997950
KMIA	MIAMI INTL	MIAMI	FL	202	0.984269
KAPF	NAPLES MUNICIPAL	NAPLES	FL	180	0.987148
KOCF	OCALA INTL-JIM TAYLOR FIELD	OCALA	FL	77	0.997761
KMCO	ORLANDO INTL	ORLANDO	FL	86	0.996735

Airport ID	Airport Name	City	State	Outages	Availability
KPFN	PANAMA CITY-BAY COUNTY INTL	PANAMA CITY	FL	70	0.998240
KPNS	PENSACOLA REGIONAL	PENSACOLA	FL	74	0.997995
SRQ	SARASOTA/BRADENTON INTL	SARASOTA/BRADENTON	FL	97	0.996184
KPIE	ST PETERSBURG-CLEARWATER INTL	ST PETERSBURG-CLEARWATER	FL	91	0.996654
KTLH	TALLAHASSEE REGIONAL	TALLAHASSEE	FL	70	0.998196
TPA	TAMPA INTL	TAMPA	FL	86	0.996909
KVRB	VERO BEACH MUNICIPAL	VERO BEACH	FL	118	0.993687
KPBI	PALM BEACH INTL	WEST PALM BEACH	FL	155	0.989703
KACJ	SOUTHER FIELD	AMERICUS	GA	68	0.998277
KATL	WILLIAM B HARTSFIELD ATLANTA INTL	ATLANTA	GA	68	0.998273
KSAV	SAVANNAH INTL	SAVANNAH	GA	72	0.998041
KTBR	STATESBORO-BULLOCH COUNTY	STATESBORO	GA	70	0.998147
KIKV	ANKENY REGIONAL	ANKENY	IA	73	0.997291
CID	THE EASTERN IOWA	CEDAR RAPIDS	IA	75	0.996948
DSM	DES MOINES INTL	DES MOINES	IA	74	0.997423
KMXO	MONTICELLO REGIONAL	MONTICELLO	IA	74	0.996840
KBOI	BOISE AIR TERMINAL/ GOWEN FIELD	BOISE	ID	9	0.999745
EUL	CALDWELL INDUSTRIAL	CALDWELL	ID	9	0.999745
SUN	FRIEDMAN MEMORIAL	HAILEY	ID	8	0.999733
PIH	POCATELLO REGIONAL	POCATELLO	ID	9	0.999737
SZT	SANDPOINT	SANDPOINT	ID	13	0.998991
KENL	CENTRALIA MUNICIPAL	CENTRALIA	IL	73	0.997198
KORD	CHICAGO-O'HARE INTL	CHICAGO	IL	73	0.997001
MDW	CHICAGO MIDWAY	CHICAGO	IL	73	0.997122
KARR	AURORA MUNICIPAL	CHICAGO/AURORA	IL	74	0.996972
KFOA	FLORA MUNICIPAL	FLORA	IL	73	0.997223
MLI	QUAD-CITY	MOLINE	IL	75	0.996857
KPIA	GREATER PEORIA REGIONAL	PEORIA	IL	75	0.997104
KPPQ	PITTSFIELD PENSTONE MUNICIPAL	PITTSFIELD	IL	75	0.997361
KTIP	RANTOUL NATL AVN CTR/ FRANK ELLIOT FIELD	RANTOUL	IL	73	0.997205
KRFD	GREATER ROCKFORD	ROCKFORD	IL	75	0.996922
KSLO	SALEM-LECKRONE	SALEM	IL	73	0.997202
3CK	LAKE IN THE HILLS	UNKNOWN	IL	74	0.996974
KANQ	TRI-STATE STEUBEN COUNTY	ANGOLA	IN	72	0.997163
KBMG	MONROE COUNTY	BLOOMINGTON	IN	72	0.997232
0I2	BRAZIL CLAY COUNTY	BRAZIL	IN	71	0.997264
CEV	METTEL FIELD	CONNERSVILLE	IN	72	0.997215
FWA	FORT WAYNE INTL	FORT WAYNE	IN	72	0.997192
KIND	INDIANAPOLIS INTL	INDIANAPOLIS	IN	71	0.997224
SER	FREEMAN MUNICIPAL	SEYMOUR	IN	71	0.997245
SBN	MICHIANA REGIONAL TRANSPORTATION CENTER	SOUTH BEND	IN	72	0.997159
KCBK	SHALTZ FIELD	COLBY	KS	73	0.998075
EHA	ELKHART-MORTON COUNTY	ELKHART	KS	80	0.997657
GLD	RENNER FIELD/ GOODLAND MUNICIPAL	GOODLAND	KS	73	0.998077

Airport ID	Airport Name	City	State	Outages	Availability
KHYS	HAYS RGNL	HAYS	KS	74	0.998048
LWC	LAWRENCE MUNICIPAL	LAWRENCE	KS	71	0.997947
KMHK	MANHATTAN REGIONAL	MANHATTAN	KS	73	0.997908
KOJC	JOHNSON COUNTY EXECUTIVE	OLATHE	KS	73	0.997966
TOP	PHILIP BILLARD MUNICIPAL	TOPEKA	KS	71	0.997948
KULS	ULYSSES	ULYSSES	KS	80	0.997682
ICT	WICHITA MID-CONTINENT	WICHITA	KS	71	0.998153
KWLD	STROTHER FIELD	WINFIELD/ARKANSAS CITY	KS	71	0.998158
KCVG	CINCINNATI/NORTHERN KY INTL	COVINGTON/CINCINNATI	KY	72	0.997240
KLEX	BLUE GRASS	LEXINGTON	KY	69	0.997300
SDF	LOUISVILLE INTL-STANDIFORD FLD	LOUISVILLE	KY	70	0.997268
KK22	BIG SANDY REGIONAL	PRESTONBURG	KY	69	0.997365
KAEX	ALEXANDRIA INTL	ALEXANDRIA	LA	80	0.997373
L39	LEESVILLE	LEESVILLE	LA	84	0.997126
MSY	NEW ORLEANS INTL/ MOISANT FIELD	NEW ORLEANS	LA	84	0.997291
SHV	SHREVEPORT REGIONAL	SHREVEPORT	LA	81	0.997597
KBOS	GEN EDWARD LAWRENCE LOGAN INTL	BOSTON	MA	264	0.962816
MVY	VINEYARD HAVEN	MARTHA'S VINEYARD	MA	272	0.964333
OWD	NORWOOD MEMORIAL	NORWOOD	MA	262	0.964669
KPVC	PROVINCETOWN MUNICIPAL	PROVINCETOWN	MA	287	0.959600
YWG	WINNIPEG AIRPORT	WINNIPEG	MB	172	0.984917
KBWI	BALTIMORE-WASHINGTON INTL	BALTIMORE	MD	90	0.996372
FDK	FREDERICK MUNICIPAL	FREDERICK	MD	93	0.996380
GAI	MONTGOMERY COUNTY AIRPARK	GAITHERSBURG	MD	89	0.996580
W00	FREEWAY	MITCHELLVILLE	MD	88	0.996648
RJD	RIDGELY AIRPARK	RIDGELY	MD	102	0.995714
DMW	CARROLL CNTY REGIONAL/ JACK B. POAGE FLD	WESTMINSTER	MD	93	0.995778
PWM	PORTLAND INTL JETPORT	PORTLAND	ME	322	0.951386
KPQI	N MAINE REGIONAL AIRPORT AT PRESQUE I	PRESQUE ISLE	ME	645	0.817495
AMN	ALMA/GRATIOT COMMUNITY	ALMA	MI	74	0.997086
KARB	ANN ARBOR MUNICIPAL	ANN ARBOR	MI	73	0.997185
Y15	CHEBOYGAN COUNTY	CHEBOYGAN	MI	117	0.993557
KDTW	DETROIT METROPOLITAN WAYNE COUNTY	DETROIT	MI	73	0.997198
KFNT	BISHOP INTL	FLINT	MI	73	0.997127
KGRR	GERALD R FORD INTL	GRAND RAPIDS	MI	72	0.997131
KCMX	HOUGHTON COUNTY MEMORIAL	HANCOCK	MI	139	0.987180
BIV	TULIP CITY	HOLLAND	MI	73	0.997136
HTL	ROSCOMMON COUNTY	HOUGHTON LAKE	MI	77	0.996824
KMKG	MUSKEGON COUNTY	MUSKEGON	MI	73	0.997118
5D3	OWOSSO COMMUNITY	OWOSSO	MI	73	0.997120
KMBS	MBS INTL	SAGINAW	MI	74	0.997075
CIU	CHIPPEWA COUNTY INTL	SAULT STE. MARIE	MI	122	0.991529
HAI	THREE RIVERS MUNICIPAL DR. HAINES	UNKNOWN	MI	72	0.997155
HYX	SAGINAW CO H.W. BROWNE	UNKNOWN	MI	74	0.997087

Airport ID	Airport Name	City	State	Outages	Availability
KAXN	CHANDLER FIELD	ALEXANDRIA	MN	96	0.994977
KBDE	BAUDETTE INTL	BAUDETTE	MN	143	0.987297
KBRD	BRAINERD- CROW WING CO REGIONAL	BRAINERD	MN	99	0.994247
KDLH	DULUTH INTL	DULUTH	MN	123	0.991692
KMSP	MINNEAPOLIS-ST PAUL INTL/ WOLD CHAMBERLAIN	MINNEAPOLIS	MN	82	0.996344
KRGK	RED WING REGIONAL	RED WING	MN	82	0.996422
KRST	ROCHESTER INTL	ROCHESTER	MN	75	0.996876
STC	ST. CLOUD	SAINT CLOUD	MN	87	0.996063
KJYG	ST JAMES MUNICIPAL	ST JAMES	MN	73	0.997234
M05	CARUTHERSVILLE MEMORIAL	CARUTHERSVILLE	MO	74	0.997590
KMCI	KANSAS CITY INTL	KANSAS CITY	MO	74	0.997798
KLBO	FLOYD W JONES LEBANON	LEBANON	MO	76	0.997449
LXT	LEE'S SUMMIT MUNICIPAL	LEE'S SUMMIT	MO	76	0.997795
H41	MEXICO MEMORIAL	MEXICO	MO	75	0.997347
MYJ	MEXICO MEMORIAL	MEXICO	MO	75	0.997347
STJ	ROSECRANS MEMORIAL	ROSECRANS	MO	71	0.997933
KDMO	SEDALIA MEMORIAL	SEDALIA	MO	76	0.997267
SGF	SPRINGFIELD- BRANSON REGIONAL	SPRINGFIELD	MO	76	0.997577
KSTL	LAMBERT-ST LOUIS INTL	ST LOUIS	MO	74	0.997421
KMO6	WASHINGTON MEMORIAL	WASHINGTON	MO	74	0.997432
0M6	PANOLA COUNTY	BATESVILLE	MS	75	0.997916
GWO	GREENWOOD-LEFLORE	GREENWOOD	MS	73	0.998049
JAN	JACKSON INTL	JACKSON	MS	76	0.997936
MPE	PHILADELPHIA MUNICIPAL	PHILADELPHIA	MS	73	0.998090
CRX	ROSCOE TURNER	UNKNOWN	MS	73	0.997932
KBIL	BILLINGS LOGAN INTL	BILLINGS	MT	78	0.997978
6S5	RAVALLI COUNTY	HAMILTON	MT	12	0.999548
KHLN	HELENA REGIONAL	HELENA	MT	46	0.998545
KLWT	LEWISTOWN MUNICIPAL	LEWISTOWN	MT	81	0.997737
KMLS	FRANK WILEY FIELD	MILES CITY	MT	78	0.997846
KHBI	ASHEBORO MUNICIPAL	ASHEBORO	NC	71	0.997682
KAVL	ASHEVILLE REGIONAL	ASHEVILLE	NC	70	0.997962
MRH	MICHAEL J. SMITH FIELD	BEAUFORT	NC	81	0.997173
KCLT	CHARLOTTE/DOUGLAS INTL	CHARLOTTE	NC	70	0.997957
ECG	ELIZABETH CITY CGAS	ELIZABETH CITY	NC	85	0.996528
KFAY	FAYETTEVILLE REGIONAL/ GRANNIS FIELD	FAYETTEVILLE	NC	77	0.997721
GSO	PIEDMONT TRIAD INTL	GREENSBORO	NC	71	0.997602
PGV	PITT-GREENVILLE	GREENVILLE	NC	82	0.997173
HSE	BILLY MITCHELL	HATTERAS	NC	85	0.996833
HKY	HICKORY REGIONAL	HICKORY	NC	70	0.997801
KISO	KINSTON REGIONAL JETPORT AT STALLINGS FIELD	KINSTON	NC	80	0.997428
MEB	LAURINBURG	MAXTON	NC	76	0.997764
KEQY	MONROE	MONROE	NC	70	0.997951
KRDU	RALEIGH-DURHAM INTL	RALEIGH/DURHAM	NC	77	0.997474
RWI	ROCKY MOUNT- WILSON REGIONAL	ROCKY MOUNT	NC	81	0.997204
KRUQ	ROWAN COUNTY	SALISBURY	NC	70	0.997791

Airport ID	Airport Name	City	State	Outages	Availability
KTTA	SANFORD- LEE COUNTY REGIONAL	SANFORD	NC	74	0.997640
SUT	BRUNSWICK COUNTY	SOUTHPORT	NC	78	0.997581
OCW	WARREN FIELD	WASHINGTON	NC	83	0.996975
MCZ	MARTIN COUNTY	WILLIAMSTON	NC	82	0.997024
KILM	WILMINGTON INTL	WILMINGTON	NC	79	0.997489
W03	WILSON INDUSTRIAL AIR CENTER	WILSON	NC	80	0.997237
KFAR	HECTOR INTL	FARGO	ND	106	0.993324
MOT	MINOT INTL AIRPORT	MINOT	ND	130	0.993336
KANW	AINSWORTH MUNICIPAL	AINSWORTH	NE	70	0.997963
AUH	AURORA MUNICIPAL	AURORA	NE	71	0.997931
BIE	BEATRICE MUNICIPAL	BEATRICE	NE	71	0.997932
CSB	CAMBRIDGE MUNICIPAL	CAMBRIDGE	NE	72	0.997927
CEK	CRETE MUNICIPAL	CRETE	NE	70	0.997949
GRN	GORDON MUNICIPAL	GORDON	NE	72	0.997930
KEAR	KEARNEY MUNICIPAL	KEARNEY	NE	72	0.997918
KLBF	NORTH PLATTE REGIONAL LEE BIRD FIELD	NORTH PLATTE	NE	71	0.997953
OMA	EPPLEY AIRFIELD	OMAHA	NE	72	0.997661
OKS	GARDEN COUNTY	OSHKOSH	NE	72	0.998098
SCB	SCRIBNER STATE	SCRIBNER	NE	72	0.997676
SNY	SIDNEY MUNICIPAL	SIDNEY	NE	73	0.998081
VTN	MILLER FIELD	VALENTINE	NE	71	0.997946
MHT	MANCHESTER	MANCHESTER	NH	269	0.961907
KACY	ATLANTIC CITY INTL	ATLANTIC CITY	NJ	154	0.991649
KMMU	MORRISTOWN MUNICIPAL	MORRISTOWN	NJ	189	0.987527
KEWR	NEWARK INTL	NEWARK	NJ	202	0.986401
7N7	SPITFIRE AERODROM	PEDRICTOWN	NJ	130	0.993876
K3NJ6	INDUCTOTHERM HELIPORT	RANCOCAS	NJ	166	0.990747
KABQ	ALBUQUERQUE INTL SUNPORT	ALBUQUERQUE	NM	75	0.998110
KFMN	FOUR CORNERS REGIONAL	FARMINGTON	NM	75	0.998115
KLRU	LAS CRUCES INTL	LAS CRUCES	NM	112	0.995056
ELY	ELY AIRPORT/YELLAND FELD	ELY	NV	12	0.999565
KLAS	MC CARRAN INTL	LAS VEGAS	NV	23	0.998205
ALB	ALBANY INTL	ALBANY	NY	211	0.980626
BUF	BUFFALO NIAGARA INTL	BUFFALO	NY	120	0.994836
KELM	ELMIRA/CORNING REGIONAL	ELMIRA	NY	135	0.992779
LGA	LA GUARDIA	FLUSHING	NY	209	0.984529
GFL	FLOYD BENNETT MEMORIAL	GLENS FALLS	NY	212	0.977285
KJHW	CHAUTAUQUA COUNTY/ JAMESTOWN	JAMESTOWN	NY	98	0.996166
LKP	LAKE PLACID	LAKE PLACID	NY	213	0.975545
KJFK	JOHN F KENNEDY INTL	NEW YORK	NY	210	0.984290
KSWF	STEWART INTL	NEWBURGH	NY	203	0.984418
PBG	PLATTSGURGH INTL	PLATTSGURGH	NY	223	0.970236
ROC	GREATER ROCHESTER INTL	ROCHESTER	NY	139	0.993443
KSYR	SYRACUSE HANCOCK INTL	SYRACUSE	NY	163	0.990006
B16	WHITFORDS	WEEDSPORT	NY	154	0.991389
FOK	THE FRANCIS S. GABRESKI	WESTHAMPTON BEACH	NY	228	0.979713
HPN	WESTCHESTER COUNTY	WHITE PLAINS	NY	215	0.983366

Airport ID	Airport Name	City	State	Outages	Availability
4F5	BELLEFONTAINE MUNICIPAL AIRPORT	BELLEFONTAINE	OH	73	0.997217
KRZT	ROSS COUNTY	CHILLICOTHE	OH	72	0.997309
KCLE	CLEVELAND-HOPKINS INTL	CLEVELAND	OH	73	0.997206
KCMH	PORT COLUMBUS INTL	COLUMBUS	OH	72	0.997270
OSU	OHIO STATE UNIVERSITY	COLUMBUS	OH	72	0.997248
KDAY	JAMES M COX DAYTON INTL	DAYTON	OH	73	0.997218
1G5	MEDINA MUNICIPAL	MEDINA	OH	73	0.997206
KTOL	TOLEDO EXPRESS	TOLEDO	OH	72	0.997218
I68	LEBANON-WARREN COUNTY	UNKNOWN	OH	73	0.997222
KAVK	ALVA REGIONAL	ALVA	OK	76	0.997789
KCQB	CHANDLER MUNICIPAL	CHANDLER	OK	72	0.998150
CHK	CHICKASHA	CHICKASHA	OK	82	0.997801
GCM	CLAREMORE REGIONAL	CLAREMORE	OK	72	0.998152
DUA	EAKER FIELD AIRPORT	EAKER	OK	73	0.998154
2O8	HINTON MUNICIPAL	HINTON	OK	81	0.997722
KHBR	HOBART MUNICIPAL	HOBART	OK	83	0.997667
K2K4	SCOTT FIELD	MANGUM	OK	82	0.997638
MIO	MIAMI	MIAMI	OK	73	0.998131
MDF	MORELAND MUNIICIPAL	MORELAND	OK	81	0.997539
KMKO	DAVIS FIELD	MUSKOGEE	OK	73	0.998127
OKC	WILL ROGERS WORLD AIRPORT	OKLAHOMA CITY	OK	81	0.997806
PVJ	PAULS VALLEY MUNICIPAL AIRPORT	PAULS VALLEY	OK	73	0.998172
SNL	SHAWNEE	SHAWNEE	OK	79	0.998028
TQH	TAHLEQUAH	TAHLEQUAH	OK	73	0.998126
KTUL	TULSA INTL	TULSA	OK	71	0.998168
1K4	DAVID J PERRY	UNKNOWN	OK	84	0.997849
YOW	OTTAWA AIRPORT	OTTAWA	ON	213	0.978804
S07	BEND MUNICIPAL	BEND	OR	17	0.999430
HIO	PORTLAND-HILLSBORO	HILLSBORO	OR	18	0.999364
LGD	UNION COUNTY	LA GRANDE	OR	15	0.999535
KONP	NEWPORT MUNICIPAL	NEWPORT	OR	27	0.999065
PDX	PORTLAND INTL	PORTLAND	OR	18	0.999369
SLE	MCNARY FIELD	SALEM	OR	17	0.999411
S47	TILLAMOOK	TILLAMOOK	OR	21	0.999283
ABE	LEHIGH VALLEY INTL	ALLENTOWN	PA	142	0.991415
KBFD	BRADFORD REGIONAL	BRADFORD	PA	111	0.995164
MDT	HARRISBURG INTL	HARRISBURG	PA	109	0.995000
KJST	JOHN MURTHA JOHNSTOWN-CAMBRIA COUNTY	JOHNSTOWN	PA	99	0.995962
LNS	LANCASTER	LANCASTER	PA	121	0.994298
LHV	WILLIAM T. PIPER MEMORIAL	LOCK HAVEN	PA	119	0.994316
PHL	PHILADELPHIA INTL	PHILADELPHIA	PA	146	0.992886
KAGC	ALLEGHENY COUNTY	PITTSBURGH	PA	73	0.997106
KPIT	PITTSBURGH INTL	PITTSBURGH	PA	72	0.997117
PVD	THEODORE FRANCIS GREEN STATE	PROVIDENCE	RI	251	0.967908
AND	ANDERSON REGIONAL	ANDERSON	SC	69	0.998079
KCHS	CHARLESTON AFB/INTL	CHARLESTON	SC	77	0.997753
KCAE	COLUMBIA METROPOLITAN	COLUMBIA	SC	70	0.998064

Airport ID	Airport Name	City	State	Outages	Availability
KGSP	GREENVILLE-SPARTANBURG INTL	GREER	SC	69	0.998050
KMYR	MYRTLE BEACH INTL	MYRTLE BEACH	SC	77	0.997775
KHON	HURON REGIONAL	HURON	SD	72	0.997479
1D1	MILBANK MUNICIPAL	MILBANK	SD	80	0.996624
KRAP	RAPID CITY REGIONAL	RAPID CITY	SD	72	0.997899
FSD	JOE FOSS FIELD	SIOUX FALLS	SD	71	0.997503
YXE	SASKATOON AIRPORT	SASKATOON	SK	161	0.982694
CHA	LOVELL FIELD	CHATTANOOGA	TN	69	0.998060
TYS	MC GHEE TYSON	KNOXVILLE	TN	70	0.997827
KMEM	MEMPHIS INTL	MEMPHIS	TN	76	0.997846
KBNA	NASHVILLE INTL	NASHVILLE	TN	72	0.997835
PHT	HENRY COUNTY	PARIS	TN	74	0.997634
TRI	TRI-CITIES REGIONAL TN/VA AIRPORT	UNKNOWN	TN	70	0.997624
KABI	ABILENE REGIONAL	ABILENE	TX	78	0.998044
ALI	ALICE	ALICE	TX	287	0.973495
AMA	AMARILLO INTL	AMARILLO	TX	81	0.997518
KLBX	BRAZORIA COUNTY	ANGLETON/LAKE JACKSON	TX	120	0.994404
AUS	AUSTIN-BERGSTROM INTL	AUSTIN	TX	92	0.996470
7F9	COMANCHE	COMANCHE	TX	82	0.997668
KCXO	MONTGOMERY COUNTY	CONROE	TX	90	0.996592
CRP	CORPUS CHRISTI INTL	CORPUS CHRISTI	TX	272	0.976818
KDAL	DALLAS LOVE FIELD	DALLAS	TX	80	0.997927
ADS	ADDISON	DALLAS	TX	79	0.997959
KDFW	DALLAS-FT WORTH INTL	DALLAS-FT WORTH	TX	78	0.997976
KDRT	DEL RIO INTL	DEL RIO	TX	112	0.994852
ELP	EL PASO INTL	EL PASO	TX	114	0.994338
KHRL	VALLEY INTL	HARLINGEN	TX	651	0.893124
KAXH	HOUSTON-SOUTHWEST	HOUSTON	TX	108	0.995574
KDWH	DAVID WAYNE HOOKS MEMORIAL	HOUSTON	TX	95	0.996335
KEFD	ELLINGTON FIELD	HOUSTON	TX	103	0.995877
KHOU	WILLIAM P HOBBY	HOUSTON	TX	103	0.995920
KIAH	GEORGE BUSH INTERCONTINENTAL/HOUSTON	HOUSTON	TX	96	0.996239
KIWS	WEST HOUSTON	HOUSTON	TX	98	0.996126
KSGR	SUGAR LAND MUNICIPAL/ HULL FIELD	HOUSTON	TX	102	0.995864
KLBB	LUBBOCK INTL	LUBBOCK	TX	83	0.997369
MAF	MIDLAND INTL	MIDLAND	TX	89	0.997360
OSA	MOUNT PLEASANT MUNICIPAL	MOUNT PLEASANT	TX	79	0.997933
KSJT	SAN ANGELO REGIONAL/ MATHIS FIELD	SAN ANGELO	TX	87	0.997449
KSAT	SAN ANTONIO INTL	SAN ANTONIO	TX	106	0.995636
SGR	SUGARLAND MUNICIPAL/ HULL FIELD	SUGAR LAND	TX	102	0.995864
KTYR	TYLER POUNDS REGIONAL	TYLER	TX	84	0.997601
BMC	BRIGHAM CITY	BRIGHAM CITY	UT	11	0.999663
KCDC	CEDAR CITY REGIONAL	CEDAR CITY	UT	15	0.999174
KKNB	KANAB MUNICIPAL	KANAB	UT	16	0.999027
LGU	LOGAN-CACHE	LOGAN	UT	10	0.999683

Airport ID	Airport Name	City	State	Outages	Availability
SLC	SALT LAKE CITY INTL	SALT LAKE CITY	UT	11	0.999484
KCHO	CHARLOTTESVILLE-ALBEMARLE	CHARLOTTESVILLE	VA	81	0.997003
FKN	FRANKLIN MUNICIPAL-JOHN BEVERLY ROSE	FRANKLIN	VA	83	0.996931
LVL	BRUNSWICK MUNICIPAL	LAWRENCEVILLE	VA	82	0.997034
JYO	LEESBURG MUNICIPAL/ GODFREY FIELD	LEESBURG	VA	85	0.996776
HEF	MANASSAS REGIONAL/ HARRY P. DAVIS FIELD	MANASSAS	VA	83	0.996835
MTV	BLUE RIDGE	MARTINSVILLE	VA	71	0.997552
KPHF	NEWPORT NEWS/ WILLIAMSBURG INTL	NEWPORT NEWS	VA	84	0.996722
KORF	NORFOLK INTL	NORFOLK	VA	85	0.996521
RIC	RICHMOND INTL	RICHMOND	VA	81	0.997101
AKQ	WAKEFIELD MUNICIPAL	WAKEFIELD	VA	84	0.996903
WAL	WALLOPS FLIGHT FACILITY	WALLOPS ISLAND	VA	91	0.995903
BTV	BURLINGTON INTL	BURLINGTON	VT	229	0.969572
FHR	FRIDAY HARBOR	FRIDAY HARBOR	WA	24	0.998624
KMWH	GRANT COUNTY INTL	MOSES LAKE	WA	20	0.999012
KSEA	SEATTLE-TACOMA INTL	SEATTLE	WA	20	0.998931
BFI	BOEING FIELD/ KING COUNTY INTL	SEATTLE	WA	20	0.998930
KGEG	SPOKANE INTL	SPOKANE	WA	12	0.999127
KATW	OUTAGAMIE COUNTY REGIONAL	APPLETON	WI	78	0.996730
3T3	BOYCEVILLE MUNICIPAL	BOYCEVILLE	WI	83	0.996399
FLD	FOND DU LAC COUNTY	FOND DU LAC	WI	76	0.996871
KGRB	AUTIN STRAUBEL INTL	GREEN BAY	WI	79	0.996644
JVL	SOUTHERN WISCONSIN REGIONAL AIRPORT	JANESVILLE	WI	75	0.996917
MSN	DANE COUNTY REGIONAL-TRUAX FIELD	MADISON	WI	76	0.996878
MTW	MANITOWOC COUNTY	MANITOWOC	WI	79	0.996724
MKE	GENERAL MITCHELL INTL	MILWAUKEE	WI	75	0.996966
KCWA	CENTRAL WISCONSIN	MOSINEE	WI	85	0.996484
OSH	WITTMAN REGIONAL	OSHKOSH	WI	77	0.996838
RHI	RHINELANDER-ONEIDA COUNTY	RHINELANDER	WI	124	0.992126
SUE	DOOR COUNTY CHERRYLAND	STURGEON BAY	WI	81	0.996389
RYV	WATERTOWN MUNICIPAL	WATERTOWN	WI	75	0.996922
ETB	WEST BEND MUNICIPAL	WEST BEND	WI	75	0.996946
KMGW	MORGANTOWN MUNICIPAL-WLB HART FIELD	MORGANTOWN	WV	72	0.997308
KPKB	WOOD CO- GILL ROBB WILSON FIELD	PARKERSBURG	WV	73	0.997290
KCPR	NATRONA COUNTY INTL	CASPER	WY	74	0.998056
EVW	EVANSTON-UNITA CNTY-BURNS FIELD	EVANSTON	WY	9	0.999718
SAA	SHIVELY FIELD	SARATOGA	WY	75	0.998049

Figure 9_1 WAAS LPV Availability

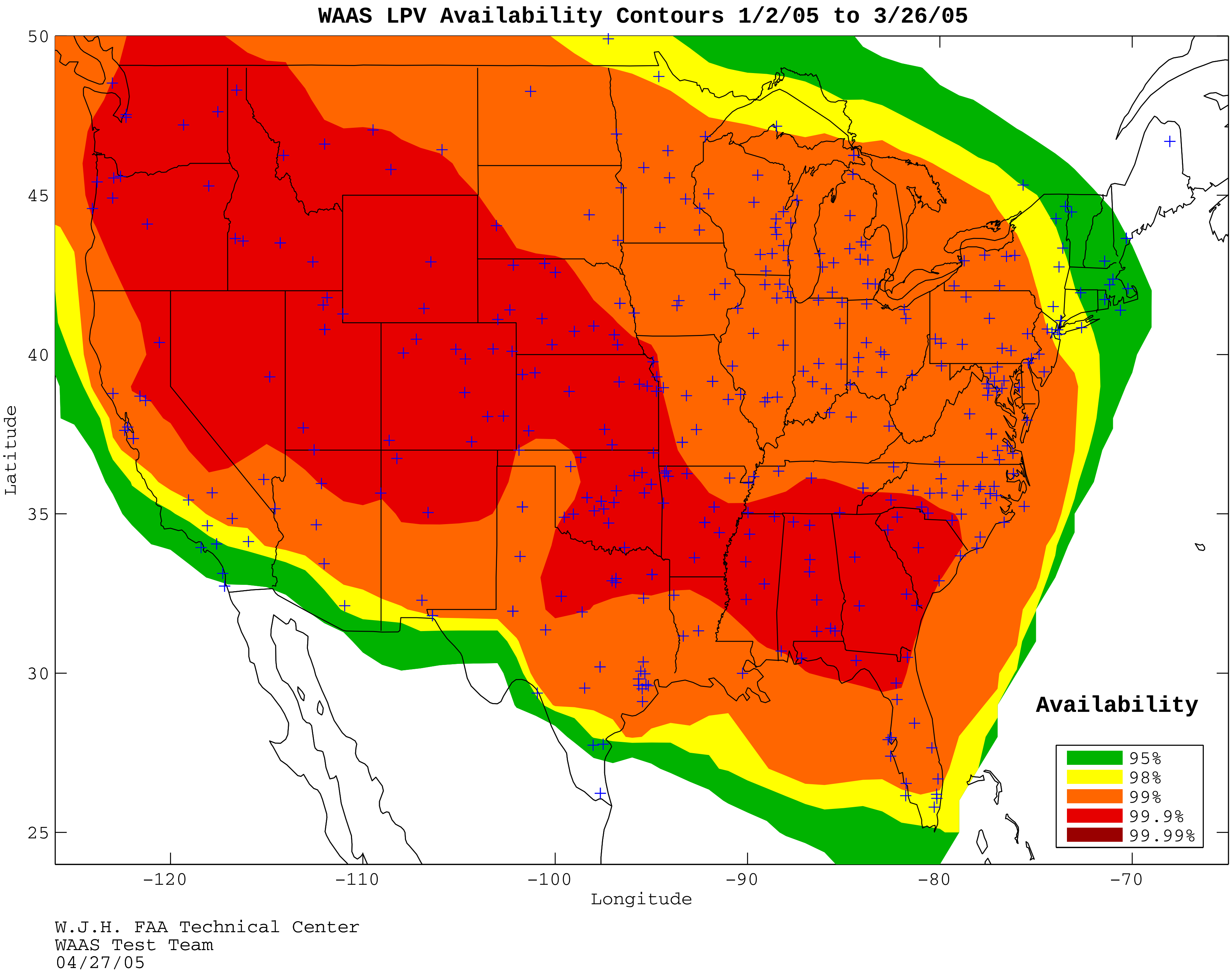
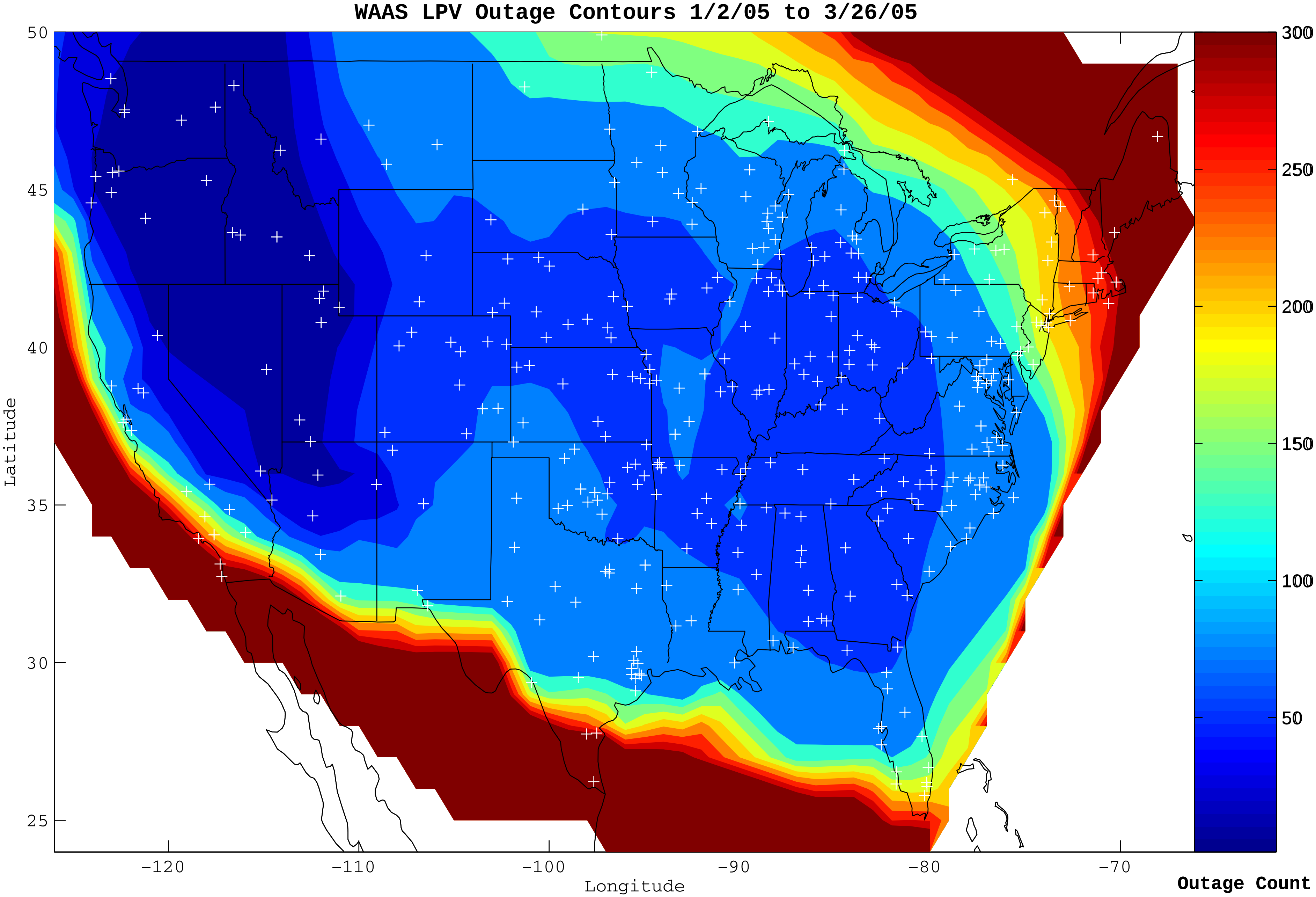


Figure 9_2 WAAS LPV Outage



W.J.H. FAA Technical Center
WAAS Test Team
05/04/05

10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

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

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

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

Table 10-1 CNMP Bounding Statistics

WAAS Site	WRE	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04	Oct 04	Nov 04	Dec 04	Jan 05	Feb 05	Mar 05
Albuquerque	A	yellow	blue	blue	blue	blue	blue	yellow	blue	green	blue	yellow	green
	B	yellow	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Anchorage	A	blue	yellow	blue	blue	yellow	green	green	blue	blue	green	blue	green
	B	blue	blue	green	blue	green	blue	green	green	blue	blue	blue	blue
	C	blue	blue	blue	yellow	blue	yellow	yellow	blue	blue	yellow	blue	blue
Atlanta	A	blue	green	blue	blue	green	green	blue	blue	blue	blue	blue	blue
	B	yellow	blue	green	green	blue	blue	blue	blue	blue	blue	blue	green
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	yellow	green	blue
Billings	A	blue	blue	blue	blue	blue	green	blue	blue	blue	blue	blue	blue
	B	yellow	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	C	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
Boston	A	blue	blue	blue	blue	blue	blue	green	blue	yellow	blue	blue	yellow
	B	blue	blue	blue	green	blue	blue	green	blue	blue	blue	blue	blue
	C	blue	blue	green	yellow	blue	green	blue	blue	blue	blue	blue	blue
Chicago	A	green	green	blue	blue	blue	blue	blue	blue	green	green	blue	blue
	B	green	green	green	blue	blue	blue	blue	green	blue	blue	blue	green
	C	yellow	yellow	blue	blue	green	yellow	yellow	blue	green	blue	blue	yellow
Cleveland	A	yellow	blue	yellow	blue	blue	green	blue	blue	blue	blue	green	blue
	B	green	green	blue	blue	blue	blue	blue	yellow	blue	blue	yellow	blue
	C	green	blue	green	blue	green	yellow	yellow	blue	blue	blue	blue	green
Cold Bay	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	green	blue	green	blue	blue	blue	blue	blue	green	blue	blue	blue
	C	blue	blue	blue	blue	yellow	blue	blue	blue	blue	blue	blue	blue
Dallas	A	red	yellow	green	green	green	blue	green	blue	blue	blue	blue	blue
	B	blue	yellow	blue	blue	blue	green	yellow	yellow	yellow	blue	blue	yellow
	C	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	blue
Denver	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	yellow	blue	blue	blue	blue	green	blue	blue	blue	blue	green	blue
	C	yellow	blue	blue	green	blue	blue	green	blue	red	blue	blue	blue
Honolulu	A	blue	green	red	yellow	red	green	red	red	yellow	green	yellow	yellow
	B	blue	blue	blue	blue	blue	yellow	green	green	blue	blue	blue	blue
	C	blue	blue	blue	blue	blue	blue	yellow	red	blue	yellow	blue	blue
Houston	A	red	yellow	yellow	red	yellow	red	red	yellow	blue	green	red	green
	B	red	red	red	red	red	yellow	green	green	red	green	red	red
	C	yellow	yellow	green	red	green	yellow	green	yellow	yellow	yellow	yellow	yellow
Jacksonville	A	blue	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	green	green	yellow	blue	green	yellow	blue
	C	blue	red	blue	blue	blue	blue	blue	blue	blue	green	blue	blue
Juneau	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	green	green	blue
	B	blue	yellow	green	green	yellow	blue	blue	blue	blue	red	blue	blue
	C	blue	blue	blue	green	blue	yellow	yellow	blue	blue	green	green	blue
Kansas City	A	yellow	blue	blue	green	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	blue	green	blue	blue	blue	blue	yellow	blue	blue	yellow	blue
	C	green	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Los Angeles	A	blue	blue	blue	green	blue	blue	yellow	blue	blue	blue	blue	blue
	B	blue	blue	blue	blue	blue	green	blue	blue	blue	blue	green	blue
	C	yellow	green	green	blue	blue	green	blue	green	yellow	blue	yellow	blue
Memphis	A	blue	blue	blue	blue	yellow	blue	green	blue	yellow	blue	blue	blue
	B	blue	blue	blue	blue	green	green	blue	blue	yellow	green	blue	blue
	C	blue	blue	blue	blue	blue	blue	blue	green	blue	blue	blue	blue
Miami	A	yellow	blue	blue	blue	blue	blue	green	green	green	green	blue	blue
	B	blue	green	blue	blue	blue	green	blue	green	blue	blue	green	blue
	C	yellow	yellow	green	blue	blue	yellow	blue	yellow	blue	green	green	green
Minneapolis	A	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
	B	blue	green	yellow	green	blue	blue	blue	blue	blue	blue	blue	blue
	C	green	green	yellow	blue	blue	blue	yellow	blue	blue	green	blue	blue

WAAS Site	**WRE**	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04	Oct 04	Nov 04	Dec 04	Jan 05	Feb 05	Mar 05
New York	A	• blue	• blue	• blue	• blue	• green	• blue	• green	• blue	• blue	• blue	• blue	• green
	B	• green	• blue	• blue	• green	• green	• blue	• yellow	• blue	• blue	• blue	• blue	• green
	C	• green	• blue	• blue	• blue	• yellow	• blue	• blue	• green	• blue	• blue	• blue	• blue
Oakland	A	• green	• blue	• green	• yellow	• yellow	• blue	• green	• red	• yellow	• blue	• red	• blue
	B	• blue	• yellow	• blue	• blue	• blue	• blue	• yellow	• yellow	• blue	• blue	• blue	• blue
	C	• green	• yellow	• green	• yellow	• yellow	• yellow	• yellow	• yellow	• red	• blue	• green	• green
Salt Lake City	A	• blue	• blue	• blue	• blue	• blue	• green	• blue	• blue	• blue	• blue	• blue	• green
	B	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue
	C	• blue	• blue	• blue	• blue	• green	• blue	• blue	• blue	• green	• blue	• blue	• blue
San Juan	A	• yellow	• blue	• blue	• green	• blue	• blue	• blue	• green	• green	• blue	• green	• blue
	B	• green	• blue	• blue	• blue	• blue	• yellow	• red	• blue	• blue	• yellow	• blue	• yellow
	C	• yellow	• yellow	• blue	• green	• blue	• yellow	• green	• red	• blue	• yellow	• green	• green
Seattle	A	• blue	• blue	• red	• blue	• green	• blue	• blue	• green	• blue	• blue	• blue	• blue
	B	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• green	• blue	• blue	• green
	C	• blue	• yellow	• blue	• green	• blue	• blue	• blue	• blue	• blue	• blue	• blue	• blue
Washington, DC	A	• blue	• blue	• blue	• yellow	• 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	• red	• blue	• blue	• blue	• blue	• green	• blue	• blue

Δ (blue) **Excellent** - 3.29σ bounded 100%
Δ (green) **Good** - 4σ bounded 100%
Δ (yellow) **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review)
Δ (red) **Poor** – Requires manual review

11.0 WAAS EQUIPMENT OUTAGE

To determine if outages of any WAAS assets affects the SIS performance, failures to WAAS equipment is tracked. Some events, such as a GUS switchover, definitely affect SIS performance. Other events, like multiple WRE outages at a single WRS, may or may not affect SIS performance.

Data was collected from all WAAS sites to determine if any failures occurred. This data is made available through the WAAS External Interface (WEI). WAAS Test Team developed software parses the data so it is available for analysis. Any equipment failures are confirmed with the WAAS operational community. Please note that during this quarter data was not collected on 9 days due to issues beyond the control of the WAAS Test Team.

During this reporting period there were a total of thirteen GUS switchovers. The dates and times of the switchovers are shown in Table 11.1. The reasons for the switchovers include maintenance action, preventative maintenance, and equipment failure. To further explain, each GEO satellite for the WAAS has two uplink locations. The AORW satellite's uplinks are located at Clarksburg MD and Santa Paula CA. The POR satellite's uplinks are located at Brewster WA and Santa Paula CA (note that this uplink is physically independent from the AORW Santa Paula uplink, they are just located at the same facility). An uplink is normally in one of two modes: primary or backup. The primary uplink transmits the WAAS information to the respective GEO satellite. The backup uplink is a hot standby. When a switchover occurs there is a loss of the WAAS signal, for that particular GEO satellite, for approximately 10 seconds while the backup GUS locks in the GEO signal. The number of switchovers continues to be a concern due to the negative impact on WAAS users. To reduce risk during the Release 1 WAAS Operators performed one switchover to get the system configuration in a desired state.

There were also a large number of WRE outages during this quarter. Once again this quarter, the primary reasons for WRE outages were replacement of faulty receivers, the three-card reset and WRE Bias Monitor trips. Table 11.2 lists all the outages that affected reference stations.

There were six outages at the National Operations Command Center (NOCC) and Pacific Operations Command Center (POCC). None of these outages affected the WAAS SIS or WAAS operations. Four of the six outages were to load the latest build of WAAS software on the O&M to support Release 1. Table 11.3 lists all the outages at the NOCC and POCC for this reporting period.

There were two outages of the ZLA Corrections and Verification subsystem. These outages were planned at the request of the FAA Operational Support Group so warm start data could be downloaded and the CnV restarted. Due to the redundant design of WAAS there was no interruption in the signal in space due to these outages.

NOTE: The tables below show dates and times according to GPS nomenclature. This quarter began on Week 1303, Day 6 (January 1, 2005) and ended Week 1316, Day 4 (March 31, 2005). Here is an explanation for the related column headings in all the following tables:

- *NSTB Week #: The GPS week begins 12:00:00 AM Sunday and ends 11:59:59 PM Saturday. The NSTB week is equal to the GPS week plus 1024.*
- *GPS Day: The first GPS day is Day 0 (Sunday) and Day 6 is Saturday.*
- *GPS Time: Number of seconds into the week since 12:00:00 AM Sunday.*

Table 11-1 WAAS GUS Switchovers from January 1, 2005 to March 31, 2005

NSTB Week Number	Day of Week	Site	Site Type	Start Outage
1311	6	STA-A	GUS	536682
1306	2	CLK	GUS	173005
1313	2	STA-B	GUS	194438
1316	1	STA-B	GUS	115270
1309	2	STA-A	GUS	235487
1315	4	BRE	GUS	374630
1310	4	CLK	GUS	394728
1310	4	STA-A	GUS	416912
1309	4	CLK	GUS	397516
1309	4	STA-B	GUS	398799
1315	2	STA-B	GUS	201726
1311	2	CLK	GUS	201700
1316	2	CLK	GUS	206122

Table 11-2 WRE Outages from January 1, 2005 to March 31, 2005

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1303	6	ZDC-A	WRS	576149	579245	3096
1303	6	ZDC-B	WRS	576345	595638	19293
1304	0	ZMA-A	WRS	15196	18178	2982
1304	1	ZDC-C	WRS	166822	172088	5266
1304	3	ZME-C	WRS	311972	320751	8779
1304	3	ZMP-C	WRS	332345	336746	4401
1304	4	ZLC-C	WRS	376424	378796	2372
1304	4	ZOB-C	WRS	398692	403149	4457
1304	4	ZAU-A	WRS	422863	425757	2894
1304	5	ZMP-B	WRS	451009	486946	35937
1304	6	ZSE-A	WRS	593894	596796	2902
1305	0	ZSU-C	WRS	28898	51629	22731
1305	0	ZTL-A	WRS	47553	50084	2531
1305	0	ZSU-C	WRS	53435	54302	867
1305	1	ZSU-C	WRS	94668	266048	171380
1305	1	ZAB-A	WRS	109716	150059	40343
1305	1	ZTL-C	WRS	129028	131954	2926
1305	3	ZOB-A	WRS	331558	334120	2562
1305	3	ZOB-B	WRS	331795	350111	18316
1305	5	ZAB-C	WRS	444112	447699	3587
1306	0	ZAN-B	WRS	9509	12606	3097
1306	1	ZOB-A	WRS	131787	132283	496

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1306	1	ZOB-A	WRS	132677	133131	454
1306	1	ZOB-A	WRS	141437	337804	196367
1306	5	ZJX-B	WRS	446749	448852	2103
1306	5	ZFW-C	WRS	464638	470153	5515
1307	5	ZOB-C	WRS	451303	455903	4600
1307	5	ZOB-A	WRS	455874	463838	7964
1307	6	ZLC-A	WRS	522547	529427	6880
1307	6	ZOB-C	WRS	544778	547244	2466
1307	6	ZOB-A	WRS	563833	566234	2401
1307	6	ZJX-A	WRS	604119	2123	2804
1308	0	ZJX-B	WRS	3910	6756	2846
1308	0	ZMP-B	WRS	5564	8397	2833
1308	0	ZOB-C	WRS	6669	9829	3160
1308	0	ZOB-C	WRS	28217	30614	2397
1308	0	ZOB-C	WRS	33517	35846	2329
1308	0	ZOB-C	WRS	41339	44174	2835
1308	0	ZOB-A	WRS	55863	56501	638
1308	0	ZKC-C	WRS	72248	75170	2922
1308	2	ZOA-C	WRS	179396	182464	3068
1308	2	ZHU-A	WRS	185227	188255	3028
1308	2	ZHU-B	WRS	185738	203156	17418
1308	2	ZOB-A	WRS	244292	246079	1787
1308	3	CDB-C	WRS	305931	310146	4215
1308	4	HNL-C	WRS	390284	394032	3748
1308	4	ZOB-A	WRS	425347	430242	4895
1308	5	ZHU-B	WRS	446921	449769	2848
1308	5	ZDV-A	WRS	486494	489362	2868
1308	6	ZOB-A	WRS	572350	576406	4056
1309	0	ZAN-A	WRS	80213	84147	3934
1309	0	JNU-C	WRS	84624	86640	2016
1309	2	ZOB-A	WRS	199409	202262	2853
1309	2	ZOB-A	WRS	216203	223796	7593
1309	2	ZFW-A	WRS	248571	249993	1422
1309	3	ZSU-A	WRS	316014	318406	2392
1309	4	JNU-B	WRS	369501	372375	2874
1309	5	ZHU-A	WRS	468349	471443	3094
1309	5	ZHU-B	WRS	468528	485112	16584
1309	5	BIL-A	WRS	499189	500599	1410
1310	2	ZOB-A	WRS	181053	183586	2533
1310	2	ZOB-B	WRS	181233	198438	17205
1310	2	ZDV-B	WRS	200483	204106	3623
1310	2	ZKC-B	WRS	216783	222147	5364
1310	3	ZFW-B	WRS	262937	265850	2913

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1310	3	ZTL-A	WRS	272073	311307	39234
1310	3	ZMA-C	WRS	308461	311025	2564
1310	3	ZNY-A	WRS	312153	313786	1633
1310	3	ZTL-B	WRS	312311	313800	1489
1310	4	ZOB-A	WRS	355804	357675	1871
1310	4	ZOB-B	WRS	356120	372118	15998
1310	6	ZMP-A	WRS	522398	525434	3036
1311	0	ZOA-B	WRS	42864	46890	4026
1311	0	ZDC-C	WRS	56901	60300	3399
1311	1	ZDV-A	WRS	143942	147059	3117
1311	2	ZLA-C	WRS	232278	235154	2876
1311	2	ZDV-A	WRS	251684	254567	2883
1311	4	ZOA-A	WRS	396243	399187	2944
1311	6	ZDC-C	WRS	521511	524498	2987
1312	0	CDV-C	WRS	82260	86976	4716
1312	1	ZDV-A	WRS	171657	176673	5016
1312	2	ZJX-B	WRS	229043	234890	5847
1312	5	ZSU-A	WRS	494506	494654	148
1313	2	ZSE-B	WRS	179163	182907	3744
1313	2	JNU-C	WRS	226243	229255	3012
1313	2	ZAU-B	WRS	231951	234494	2543
1313	3	BIL-C	WRS	264261	267902	3641
1313	3	ZBW-C	WRS	300091	303120	3029
1314	2	ZHU-A	WRS	176764	179576	2812
1314	2	ZHU-B	WRS	177031	194041	17010
1314	3	ZAN-C	WRS	260911	267432	6521
1314	3	ZHU-A	WRS	283101	284625	1524
1314	3	ZHU-B	WRS	283115	296904	13789
1314	3	BIL-B	WRS	313390	316232	2842
1314	4	ZBW-B	WRS	393707	396634	2927
1314	4	ZDC-C	WRS	414442	416791	2349
1314	4	ZOB-C	WRS	431879	436925	5046
1314	5	ZBW-A	WRS	478728	481619	2891
1314	6	ZOB-B	WRS	526999	531152	4153
1315	2	ZAN-A	WRS	190884	191271	387
1315	2	ZME-C	WRS	247108	249936	2828
1315	3	ZHU-A	WRS	264301	266420	2119
1315	3	ZHU-B	WRS	286019	286043	24
1315	3	ZTL-C	WRS	290026	143172	1062746
1315	5	ZHU-A	WRS	490563	493121	2558
1315	5	ZHU-B	WRS	490583	505701	15118
1316	0	ZHU-A	WRS	56499	59848	3349
1316	0	ZHU-B	WRS	56894	58986	2092

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1316	1	ZHU-B	WRS	159928	165046	5118
1316	1	JNU-A	WRS	164629	165610	981
1316	1	ZHU-C	WRS	166300	172418	6118
1316	2	CDB-B	WRS	211955	214818	2863
1316	2	ZDV-C	WRS	232536	235732	3196
1316	4	ZME-B	WRS	370009	372572	2563

Table 11-3 O&M Outages from January 1, 2005 to March 31, 2005

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1305	4	NOCC	O&M	412310	412353	43
1306	2	NOCC	O&M	223892	225863	1971
1309	1	POCC	O&M	128614	130838	2224
1309	1	NOCC	O&M	133733	135843	2110
1310	4	POCC	O&M	382983	385379	2396
1316	3	NOCC	O&M	288893	290716	1823

Table 11-4 CnV Outages from January 1, 2005 to March 31, 2005

NSTB Week Number	Day of Week	Site	Site Type	Start Outage	Finish Outage	Duration (Seconds)
1316	3	ZLA-CP1	C&V	304813	309026	4213
1316	3	ZLA-CP2	C&V	304814	309027	4213

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.

APV-ILNAV/VNAV. APV-I is a WAAS operational service level with an HAL equal to 556 meters and a VAL equal to 50 meters.

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.

AVP-II. APV-II is a WAAS operational service level with an HAL equal to 40 meters and a VAL equal to 20 meters.

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.

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.

GLS. GLS is a WAAS operational service level with HAL equal to 40 meters and VAL equal to 12 meters.

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.

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

LNAV. Lateral Navigation.

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.

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. Satellite 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.