WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

Report #32

Reporting Period: January 1 to March 31, 2010

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Website: http://www.nstb.tc.faa.gov/

Executive Summary

Since 1999 the WAAS Test Team at the William J. Hughes Technical Center has reported GPS performance as measured against the GPS Standard Positioning Service (SPS) Signal Specification. These quarterly reports are known as the PAN (Performance Analysis Network) Report. In addition to that report, the WAAS Test Team reports on the performance of the Wide-Area Augmentation System (WAAS). This report is the thirty-second such WAAS quarterly report. This report covers WAAS performance during the period from January 1, 2010 to March 31, 2010.

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

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	Alaska Site/Maximum	Alaska Site/Minimum
95% Horizontal Accuracy	Arcata 1.85 meters	Denver 0.644 meters	Cold Bay 0.706 meters	Bethel 0.518 meters
95% Vertical Accuracy	Miami 2.005 meters	Albuquerque 0.84 meters	Barrow 1.305 meters	Bethel 0.928 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Seattle 100%	Oakland 99.97%	Juneau 100%	Barrow 99.48%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	Minneapolis 100%	Oakland 96.15%	Juneau 99.96%	Cold Bay 90.38%
95% HPL	Arcata 16.28 meters	Memphis 11.041 meters	Cold Bay 25.85 meters	Juneau 13.603 meters
95% VPL	Arcata 29.91 meters	Chicago 19.323 meters	Cold Bay 36.65 meters	Juneau 22.04 meters

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1.0 INTRODUCTION

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

Objectives of this report are:

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

The WAAS data transmitted from Geostationary satellites (GEO) PRN#135 (CRW) and PRN#138 (CRE) were used in the evaluation. For this evaluation period, both CRW and CRE GEOs provide a ranging capability for enroute through NPA and PA service.

Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from January 1, 2010 to March 31, 2010.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	83	7188952
Oklahoma City	77	6637189
WAAS:		
Albuquerque	90	7738559
Anchorage	90	7772938
Atlanta	90	7771453
Barrow	89	7685885
Bethel	90	7769657
Billings	90	7750708
Boston	90	7736607
Chicago	88	7583412
Cleveland	88	7564235
Cold Bay	90	7772107
Dallas	89	7721248
Denver	89	7654530
Fairbanks	90	7772638
Gander	90	7770493
Goose Bay	90	7771927
Houston	89	7729902
Iqaluit	90	7742419
Jacksonville	89	7709194
Juneau	89	7732669
Kansas City	90	7732812
Kotzebue	90	7772693
Los Angeles	88	7574430
Memphis	89	7703072
Merida	90	7771249
Mexico City	90	7748680
Miami	89	7687197
Minneapolis	89	7728263
New York	89	7728522
Oakland	89	7714216
Puerto Vallarta	90	7769836
Salt Lake City	89	7718060
San Jose Del Cabo	90	7773033
San Juan	88	7612550
Seattle	90	7773050
Tapachula	89	7724637
Washington DC	90	7773087
Winnipeg	90	7773728

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	90	7741600
Anchorage	90	7774582
Atlanta	90	7773533
Barrow	90	7771212
Bethel	86	7467057
Billings	90	7759379
Boston	87	7550549
Cleveland	88	7565520
Cold Bay	90	7774076
Fairbanks	88	7621718
Gander	90	7772555
Honolulu	88	7611213
Houston	89	7732514
Iqaluit	90	7744704
Juneau	89	7731699
Kansas City	90	7733284
Kotzebue	90	7774728
Los Angeles	88	7572713
Merida	90	7771532
Miami	90	7737784
Minneapolis	89	7728093
Oakland	80	6900130
Salt Lake City	89	7717899
San Jose Del Cabo	90	7774768
San Juan	88	7632539
Seattle	90	7774889
Tapachula	89	7728232
Washington DC	90	7774953

The report is divided in the performance categories listed below. This report also includes WAAS LPV and LPV 200 Service Availability at Selected Airports, WAAS Deterministic Code Noise and Multipath (CNMP) Bounding Analysis, WAAS reference station survey validation and SQM type and PRN bias monitoring.

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

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

Table 1-3 WAAS Performance Parameters

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

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

1.1 Event Summary

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

Table 1.5 lists events related to Release 1 upgrades that happened this quarter.

Table 1-4 Test Events

Start Date	End Date	Location/ Satellite	Service Affected	Event Description
01/05/10	01/05/10	Napa, Littleton	RNP3 All, RNP1 All, LPV200 Alaska	Manual GUS switchover (3s gap), Napa to Littleton. Planned maintenance on Napa FT1 rack. Alaska LPV200 coverage drop (91% to 78%).
01/09/10	01/09/10	Brewster, Woodbine	None	GUS switchover (12s gap), Brewster to Woodbine. Brewster faulted.
01/14/10	01/14/10	Brewster, Woodbine	None	GUS manual switchover (3s gap), Woodbine to Brewster.
01/15/10	01/15/10	Brewster, Woodbine	None	GUS switchover (9s gap), Brewster to Woodbine. Brewster faulted.
01/19/10	01/19/10	PRN30	LPV CONUS, LPV200 Alaska	NANU 2010006, Forecast Delta-V for PRN30. Drop in CONUS LPV and Alaska LPV200 coverage.
01/20/10	01/20/10	Napa, Littleton	RNP3 All, RNP1 All, LPV200 Alaska	Two manual GUS switchovers (2 - 3s gaps). Littleton to Napa to Littleton. Alaska LPV200 coverage drop.
01/21/10	01/21/10	Napa, Littleton	RNP3 All, RNP1 All	Manual GUS switchover (3s gap). Littleton to Napa.

Start Date	End Date	Location/ Satellite	Service Affected	Event Description
01/26/10	01/26/10	PRN4	LPV CONUS, LPV200 CONUS	PRN 4 outage, NANU201009, caused a significant loss of CONUS LPV and LPV200 coverage. PRN 4 is a critical satellite to the geometry in CONUS. There was negligible effect on Alaska LPV and LPV200. See DR 89 PRN 4 NANU Affects WAAS Coverage.
01/26/10	01/26/10	Brewster, Woodbine	None	Manual GUS switchover (3s gap). Brewster to Woodbine. No effect on coverage.
01/26/10	01/26/10	Brewster, Woodbine	None	Manual GUS switchover (3s gap), Woodbine to Brewster. No effect on coverage.
01/28/10	01/28/10	Brewster, Woodbine	None	Manual GUS switchover (3s gap). Woodbine to Brewster
01/28/10	01/28/10	PRN7	LPV Alaska, LPV200 Alaska	Planned maintenance outage, NANU2010013. Affected Alaska LPV/LPV200 coverage.
02/01/10	02/01/10	Barrow)	Local	Barrow High VPE all threads. Barrow dropped PRN12 and PRN135 prior to the Max VPE of 6.722m due to Iono Scintillation.
02/02/10	02/02/10	PRN17	LPV CONUS, LPV Canada, LPV200 CONUS, LPV200 Canada	Planned Delta-V, NANU2010014. PRN17 was set to DNU over West Coast CONUS on through Canada. Iqaluit, Gander, Goose Bay, Boston, and Oakland had LPV outages.
02/02/10	02/02/10	Iqaluit	Local	Iqaluit High VPE all threads. Thread A dropped 4 SV's from the solution prior to the Max VPE of 6.996m due to Iono scintillation.
02/06/10	02/06/10	Littleton	RNP1 Alaska	There was an extended outage of the CRW SIS due to a known WAAS issue and an error made during the maintenance at the Littleton GUS. A WAAS user in extreme northwest and western Alaska lost WAAS service because of the outage of the CRW SIS. See DR 90 Extended SIS Outage on CRW (PRN 135)
02/15/10	02/15/10	PRN20	RNP1 All	NANU 2010029 UNUSABLE BEGINNING 0806 ZULU UNTIL FURTHER NOTICE
02/16/10	02/16/10	PRN2	LPV200 CONUS	NANU 2010030 UNUSABLE ON JDAY 047 (16 FEB 2010) BEGINNING 1438 ZULU UNTIL JDAY 047 (16 FEB 2010) ENDING 1810 ZULU
02/23/10	02/23/10	Brewster, PRN 30	LPV CONUS LPV Alaska	PRN 30 outage, NANU2010035, affected Alaska and West Coast CONUS LPV and LPV200 coverage.
03/03/10	03/03/10	PRN15	LPV200 CONUS	NANU2010044 Planned Maintenance affected LPV200 Coverage!
03/09/10	03/09/10	Brewster	Canada	C&V commanded switchover due to comm issues between C&V and Brewster.
03/11/10	03/11/10	PRN135, PRN138	LPV CONUS, LPV200 CONUS	Both GUS switched
03/13/10	03/13/10	Alaska, PRN135	RNP3 All, RNP1 All	Source selection switch from ZTL to ZLA. ZTL CP1 and CP2 faulted. PRN135 broadcast type 0's. Alaska service area affected.

Start Date	End Date	Location/Satellite	Service Affected	Event Description
03/16/10	03/16/10	PRN32	LPV200 Alaska	NANU 2010046. PRN 32 went to DNU affected Alaska LPV 200.
03/18/10	03/31/10	Brewster, Woodbine, PRN138	None	A ZDC C&V fault occurred, followed by CRE GUS switches and a ZTL C&V fault. ZDC returned to service and was set as the selected source. From 3/18/10 to 3/28/10 when ZDC was the selected source for CRE, the CRW UDRE reported by CRE was set to Not Monitored for most of the period causing low CRW PA ranging availability. This problem was corrected on 3/28/10 when the selected source for CRE was changed from ZDC to ZTL. No Type 0 was transmitted and no effect on coverage. See DR 91 CRE Reports High UDREs for CRW.
03/19/10	03/19/10	CONUS, Denver	LPV200 CONUS	Loss of expected LPV 200 coverage, in CONUS near Denver. The UDREi's that were broadcast from the GEO CRE set ranging on CRW and CRE to NPA mode causing a LPV200 outage at Denver.
03/30/10	03/30/10	Napa, Littleton	LPV Alaska, LPV200 Alaska	Two GUS switchovers (9s, 3s gaps). First switchover, Littleton faulted. Second switchover, manual, Woodbine to Littleton. Alaska LPV/LPV200 coverage drop.
03/30/10	03/30/10	PRN12	LPV Alaska, LPV200 Alaska	NANU2010056, Forecast Summary for PRN12. Outage impacted Alaska LPV/LPV200.
03/31/10	03/31/10	PRN22	RNP1 All	NANU 2010057 Planned Maintenance outage. Affected RNP .1 Coverage.

Table 1-5 WAAS Release 1 Upgrades

Start Date	End Date	Event Description
01/06/2010	01/08/2010	Chicago WRS down for maintenance. Update/field new routers and software.
01/07/2010	01/07/2010	Albuquerque WRS down for maintenance. Update/field new routers and software.
01/11/2010	01/14/2010	Cleveland WRS down for maintenance. Update/field new routers and software
01/14/2010	01/15/2010	Denver WRS down for maintenance. Update/field new routers and software.
01/20/2010	01/21/2010	Jacksonville WRS down for maintenance. Update/field new routers and software.
01/21/2010	01/22/2010	Houston WRS down for maintenance. Update/field new routers and software.
01/25/2010	01/26/2010	Dallas WRS down for maintenance. Update/field new routers and software.
01/27/2010	01/27/2010	Kansas City WRS down for maintenance. Update/field new routers and software.
02/02/2010	02/04/2010	Los Angeles WRS down for maintenance. Update HW/SW.
02/04/2010	02/06/2010	Honolulu WRS down for maintenance. Update/field new routers and software.
02/12/2010	02/12/2010	Miami WRS down for maintenance. Update/field new routers and software.
02/16/2010	02/17/2010	Minneapolis WRS down for maintenance. Update/field new routers and software.
02/17/2010	02/18/2010	New York WRS down for maintenance. Update/field new routers and software.
02/21/2010	02/21/2010	Boston WRS down for maintenance. Update/field new routers and software.
02/22/2010	02/23/2010	Memphis WRS down for maintenance. Update/field new routers and software.
02/24/2010	02/25/2010	Oakland WRS down for maintenance. Update/field new routers and software.
03/03/2010	03/04/2010	Salt Lake City WRS down for maintenance. Update/field new routers and software.
03/22/2010	03/23/2010	Juneau WRS software upgrade for WFO release 1.

1.2 Report Overview

Section 2 provides the vertical and horizontal position accuracies from data collected, on a daily basis, at one-second intervals. The 95% accuracy index and the maximum accuracy for the reporting period are tabulated. The daily 95% accuracy index is plotted graphically for each receiver. Histograms of the vertical and horizontal error distribution are provided for the combined 38 WAAS receiver location within the WAAS service area.

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

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

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

Section 6 provides the UDRE and GIVE bounding percentage and the 95% index of the range and ionospheric accuracy for each satellite tracked by the WAAS receiver at 12 locations.

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

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

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

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

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

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

2.0 WAAS POSITION ACCURACY

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

Table 2-1 Operational Service Levels

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

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

During this reporting period, the maximum 95% CONUS horizontal and vertical LPV errors are 1.85 meters at Arcata and 2.005 meters at Miami, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.644 meters at Denver and 0.84 meters at Albuquerque, respectively. The maximum 95% and 99.999% NPA horizontal errors are 3.429 meters at Honolulu and 7.942 meters at Miami, respectively. The minimum 95% and 99.999% horizontal errors are 1.065 meters at Fairbanks and 2.339 meters both at Barrow, respectively.

Table 2.4 shows the maximum horizontal and vertical position errors while the calculated HPL and VPL met the LPV service levels. The column marked 'Horizontal (or Vertical) Error/HPL (or VPL)' is the ratio of position error to protection level at the time the maximum error occurred. The column marked 'Horizontal (or Vertical) Maximum Ratio' is the maximum position error to protection level ratio for the quarter.

Figures 2.9 to 2.12 show the distributions of the vertical and horizontal errors at all 38 WAAS receiver locations combined in triangle charts and 2-D histogram plots for the quarter. The triangle charts in Figure 2.9 and 2.10 show the distributions of vertical position errors (VPE) versus vertical protection levels (VPL) and horizontal position errors (HPE) versus horizontal protection levels (HPL). The horizontal axis is the position error and the vertical axis is the WAAS protection levels. Lower protection levels equate to better availability. The diagonal line shows the point where error equals protection level. Above and to the left of the diagonal line in the chart, errors are bounded (WAAS is providing integrity in the position domain); below and to the right, errors are not bounded (HMI could be present). The 2-D histogram plots in Figure 2.11 and 2.12 show the distributions of vertical and horizontal position errors and normalized position errors. The blue trace shows the distributions of the actual vertical and horizontal errors. The horizontal axis is the position errors and the vertical axis is the total count of data samples (log scale) in each 0.1-meter bin. The magenta trace show the distributions of the actual vertical and horizontal errors normalized by one-sigma value of the protection level; vertical - (VPL/5.33) and horizontal - (HPL/6.0). The horizontal axis is the standard units and vertical axis is the observed distribution of normalized errors data samples in each 0.1-sigma bin. Narrowness of the normalized error distributions shows very good observed safety performance.

Table 2-2 PA 95% Horizontal and Vertical Accuracy

Location	Horizontal (HAL=40m) (Meters)	Horizontal (HAL=556m) (Meters)	Vertical (VAL=50m) (Meters)	Percentage in PA mode (%)	SPS Accuracy	
					95% Horizontal (Meters)	95% Vertical (Meters)
Arcata	1.850	1.850	1.906	100	*	*
Oklahoma City	0.778	0.778	1.132	100	*	*
Albuquerque	0.649	0.649	0.840	100	1.998	3.769
Anchorage	0.600	0.600	1.114	100	1.724	4.513
Atlanta	0.810	0.810	1.318	100	2.376	4.171
Barrow	0.618	0.618	1.305	99.67499	1.516	4.679
Bethel	0.518	0.518	0.928	100	1.741	4.572
Billings	0.851	0.851	0.994	100	2.098	3.626
Boston	0.820	0.820	1.176	100	2.504	3.661
Chicago	0.863	0.863	0.924	100	*	*
Cleveland	0.751	0.751	1.001	100	2.350	3.761
Cold Bay	0.706	0.706	1.179	100	2.046	4.666
Dallas	0.724	0.724	1.201	100	*	*
Denver	0.644	0.644	1.014	100	*	*
Fairbanks	0.533	0.533	0.995	100	1.595	4.633
Gander	0.888	0.888	1.203	99.96637	2.450	3.574
Goose Bay	0.738	0.738	1.175	99.96834	*	*
Houston	0.818	0.818	1.344	100	2.129	4.151
Iqaluit	0.866	0.866	1.869	99.97435	1.804	3.670
Jacksonville	0.812	0.812	1.543	100	*	*
Juneau	0.635	0.635	0.971	100	1.798	4.177
Kansas City	0.704	0.704	0.848	100	2.328	3.809
Kotzebue	0.616	0.616	1.152	99.67966	1.614	4.580
Los Angeles	0.818	0.818	1.013	100	1.942	4.215
Memphis	0.748	0.748	1.039	100	*	*
Merida	0.701	0.701	1.553	100	2.538	4.437
Mexico City	0.707	0.707	1.203	100	*	*
Miami	0.942	0.942	2.005	100	2.299	4.561
Minneapolis	0.764	0.764	0.974	100	2.307	3.657
New York	1.003	1.003	1.112	100	*	*
Oakland	0.947	0.947	0.986	100	2.024	4.309
Puerto Vallarta	0.703	0.703	1.667	100	*	*
Salt Lake City	0.700	0.700	0.851	100	2.074	3.770
San Jose Del Cabo	0.645	0.645	1.720	100	2.321	4.286
San Juan	1.129	1.299	1.993	99.97337	2.614	4.736
Seattle	0.802	0.802	0.901	100	2.124	3.798
Tapachula	0.883	0.886	1.657	100	3.552	5.356
Washington DC	0.873	0.873	1.215	100	2.522	3.826
Winnipeg	0.761	0.761	1.065	100	*	*

*SPS Data not available.

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

Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	1.071	2.784	100	2.970
Anchorage	1.230	3.151	100	3.462
Atlanta	1.385	2.523	100	2.638
Barrow	1.160	2.339	99.69	3.020
Bethel	1.231	3.208	100	3.778
Billings	1.666	3.854	100	4.087
Boston	1.589	2.940	100	3.069
Cleveland	1.367	2.795	100	3.074
Cold Bay	1.482	2.801	100	3.019
Fairbanks	1.065	2.508	100	2.670
Gander	1.662	2.860	99.99	3.728
Honolulu	3.429	7.566	100	7.830
Houston	1.595	3.937	100	4.532
Iqaluit	1.085	2.561	99.99	4.226
Juneau	1.194	2.741	100	2.993
Kansas City	1.358	2.439	100	2.828
Kotzebue	1.183	3.370	99.69	5.905
Los Angeles	1.239	3.108	100	3.351
Merida	1.526	3.701	100	3.942
Miami	1.486	7.942	100	8.079
Minneapolis	1.461	2.735	100	2.930
Oakland	1.455	3.145	100	3.675
Salt Lake City	1.271	3.140	100	3.532
San Jose Del Cabo	1.308	5.864	100	6.201
San Juan	1.551	4.911	100	5.128
Seattle	1.363	2.441	100	4.318
Tapachula	1.897	4.464	100	4.715
Washington DC	1.771	2.956	100	3.115

Table 2-4 LPV Available

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Arcata	4.638	0.218	0.309	6.032	0.138	0.229
Oklahoma City	2.690	0.213	0.213	3.745	0.141	0.192
Albuquerque	1.870	0.120	0.164	2.598	0.072	0.139
Anchorage	1.861	0.141	0.141	2.998	0.136	0.163
Atlanta	1.932	0.145	0.177	3.058	0.176	0.176
Barrow	3.414	0.237	0.237	6.722	0.178	0.221
Bethel	1.331	0.064	0.088	3.246	0.087	0.124
Billings	1.959	0.192	0.192	2.980	0.086	0.143
Boston	1.946	0.165	0.165	2.953	0.131	0.157
Chicago	1.718	0.136	0.159	2.869	0.131	0.155
Cleveland	2.541	0.199	0.199	4.143	0.146	0.175
Cold Bay	2.266	0.106	0.106	2.985	0.090	0.114
Dallas	1.836	0.126	0.170	3.214	0.191	0.217
Denver	1.625	0.160	0.165	4.140	0.205	0.205
Fairbanks	1.424	0.109	0.139	2.695	0.076	0.129
Gander	2.453	0.090	0.103	3.144	0.087	0.110
Goose Bay	2.503	0.101	0.127	2.892	0.107	0.113
Houston	2.019	0.143	0.175	2.812	0.174	0.174
Iqaluit	3.880	0.144	0.144	8.106	0.180	0.180
Jacksonville	1.896	0.160	0.165	3.619	0.139	0.207
Juneau	2.440	0.202	0.202	3.003	0.104	0.146
Kansas City	1.955	0.078	0.160	2.968	0.146	0.151
Kotzebue	1.757	0.110	0.119	3.465	0.111	0.154
Los Angeles	2.143	0.140	0.146	2.859	0.066	0.130
Memphis	1.759	0.161	0.180	3.093	0.156	0.177
Merida	1.660	0.112	0.130	4.436	0.129	0.173
Mexico City	2.090	0.073	0.111	3.077	0.099	0.112
Miami	2.164	0.137	0.172	4.738	0.178	0.192
Minneapolis	2.144	0.160	0.160	2.986	0.108	0.166
New York	2.264	0.122	0.166	3.045	0.135	0.141
Oakland	3.488	0.281	0.281	2.986	0.173	0.173
Puerto Vallarta	2.195	0.105	0.108	4.791	0.108	0.144
Salt Lake City	2.139	0.174	0.174	2.655	0.078	0.150
San Jose Del Cabo	1.871	0.113	0.113	4.059	0.092	0.134
San Juan	2.927	0.079	0.093	4.903	0.110	0.111
Seattle	2.973	0.244	0.244	3.412	0.190	0.230
Tapachula	2.532	0.074	0.118	5.309	0.112	0.128
Washington DC	2.172	0.136	0.160	2.990	0.120	0.165
Winnipeg	1.767	0.127	0.133	2.546	0.140	0.147

Figure 2-1 95% Horizontal Accuracy at LPV

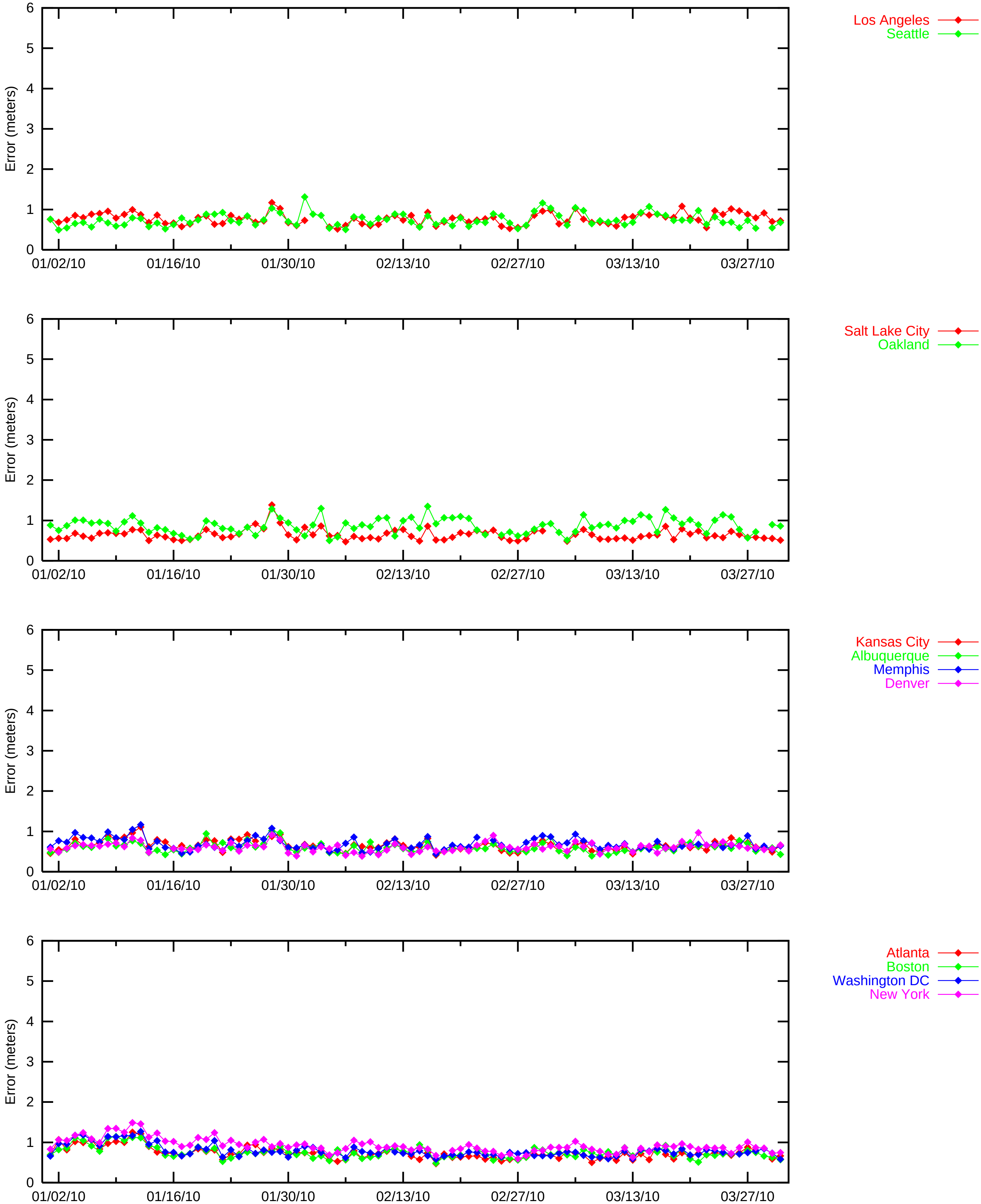
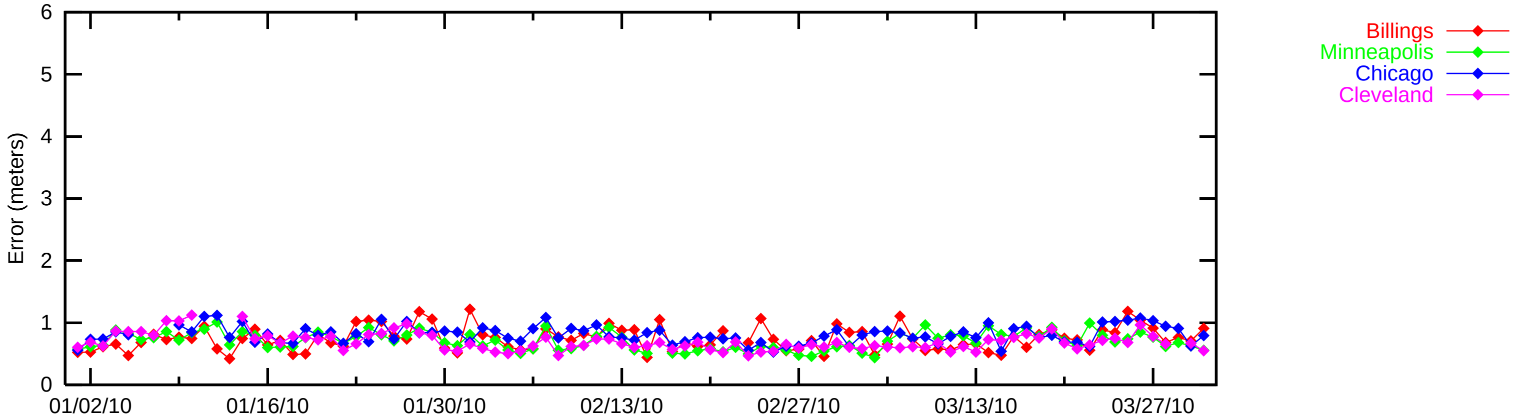
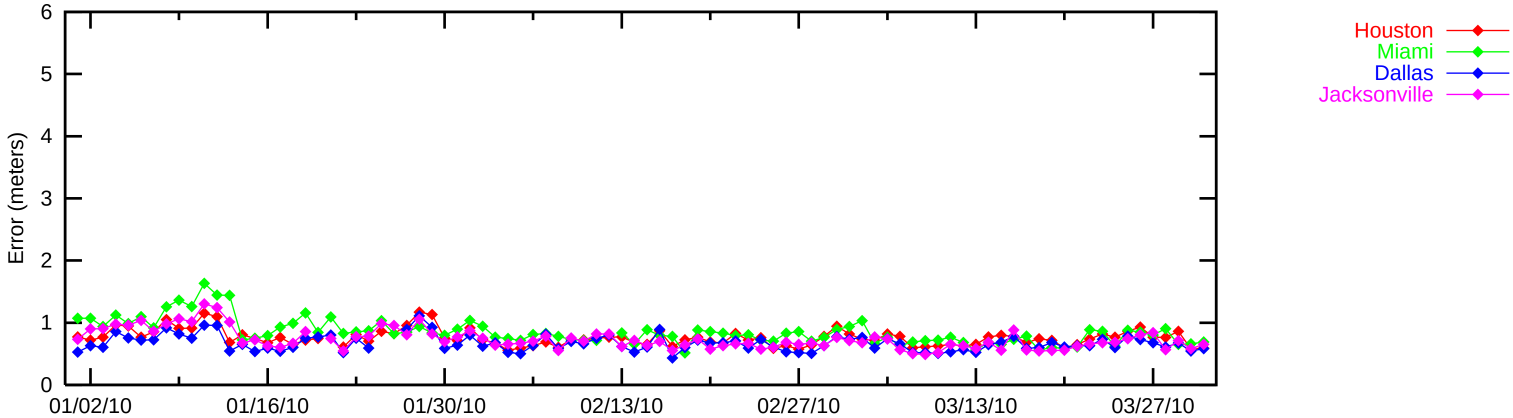
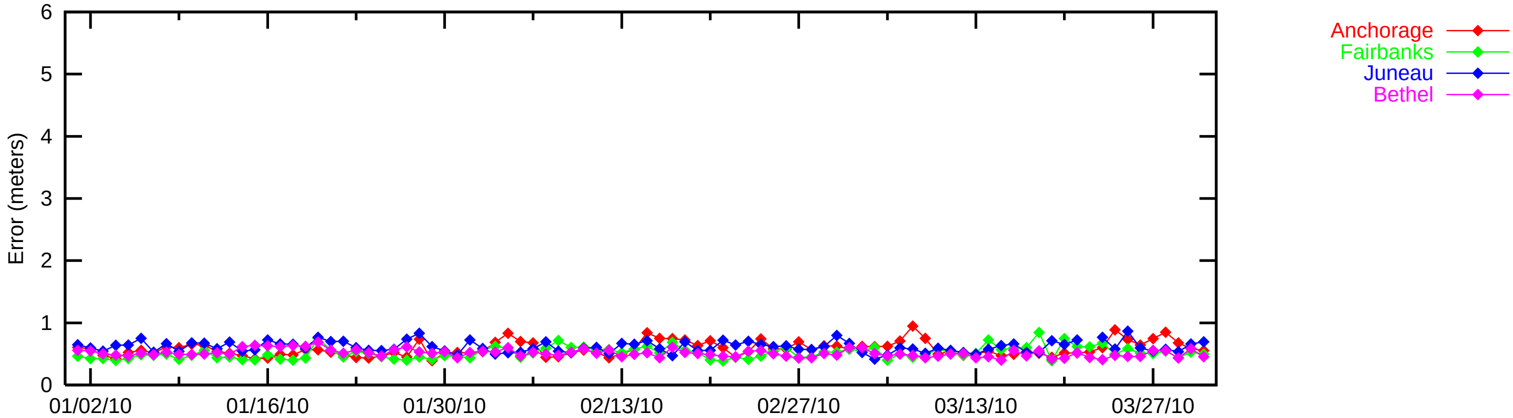


Figure 2-2 95% Horizontal Accuracy at LPV







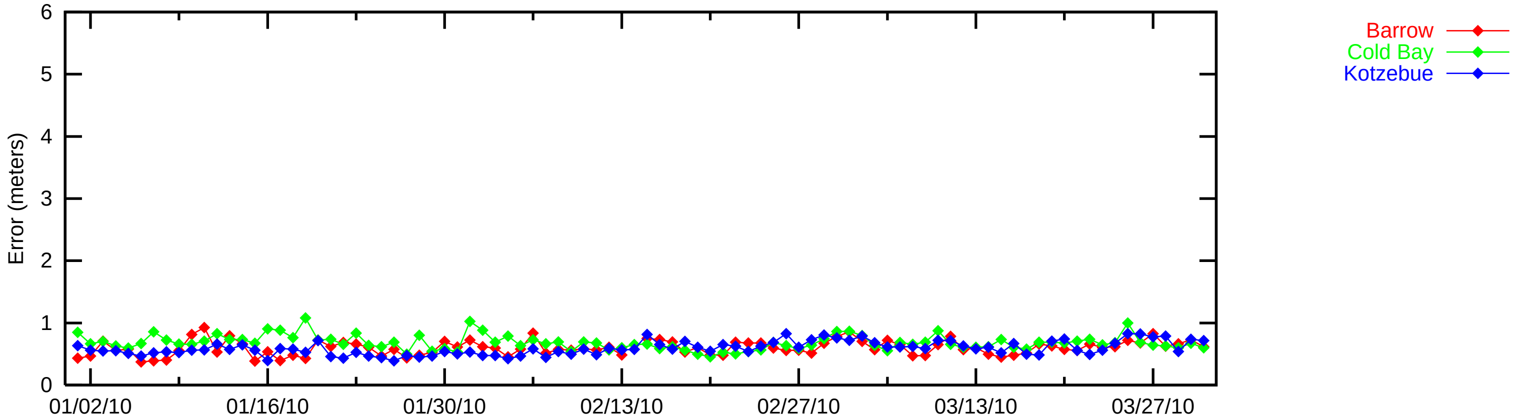
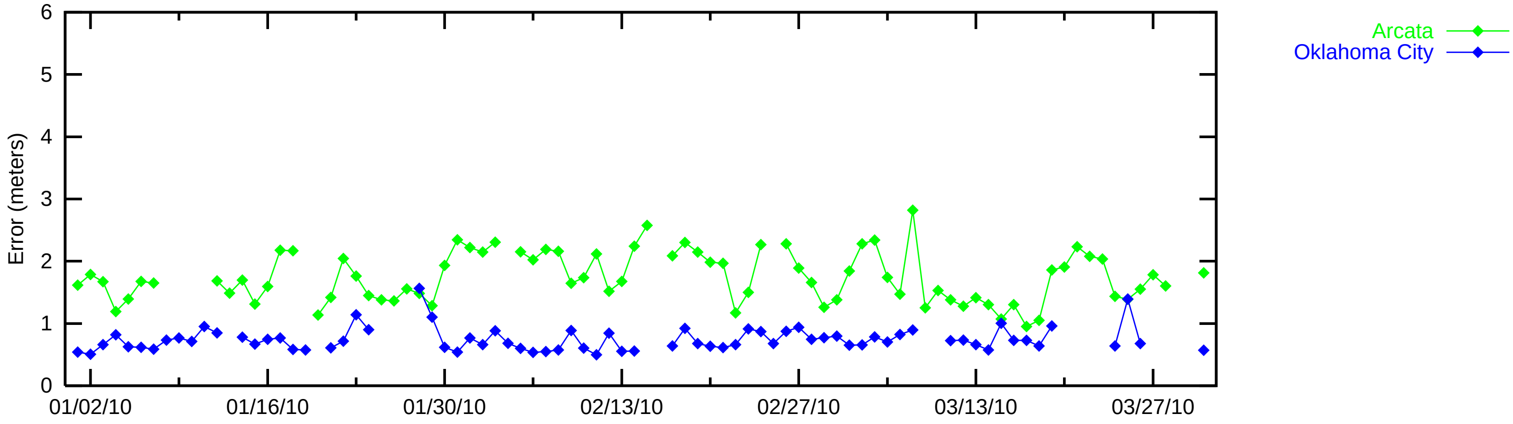
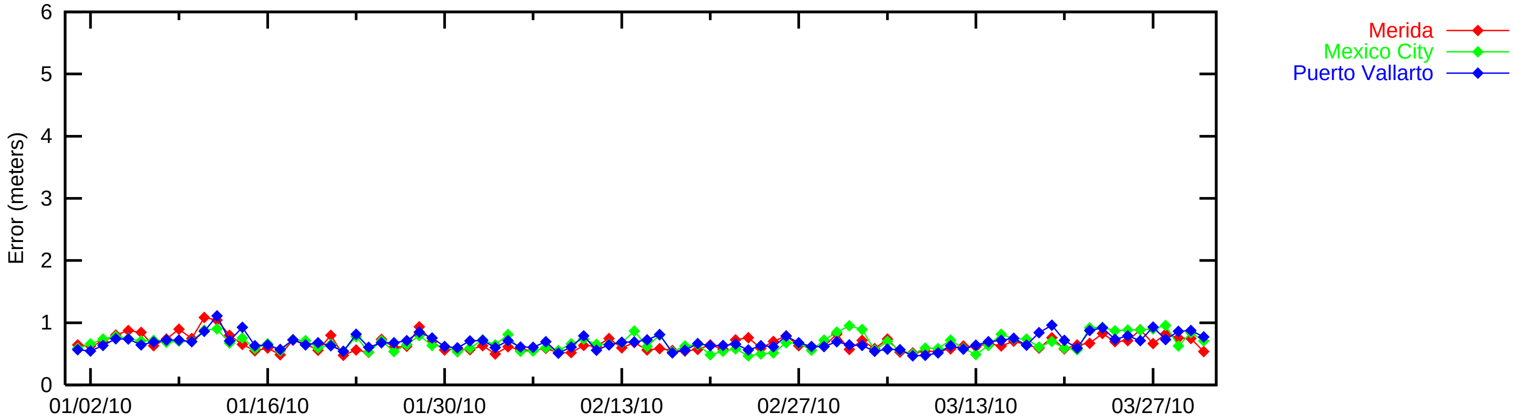
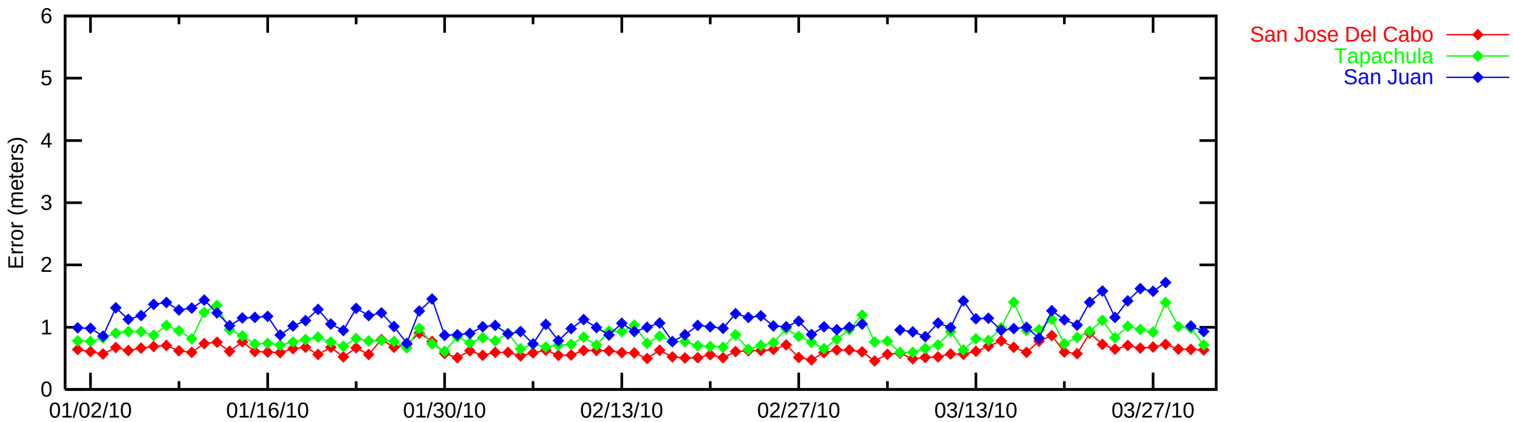


Figure 2-3 95% Horizontal Accuracy at LPV







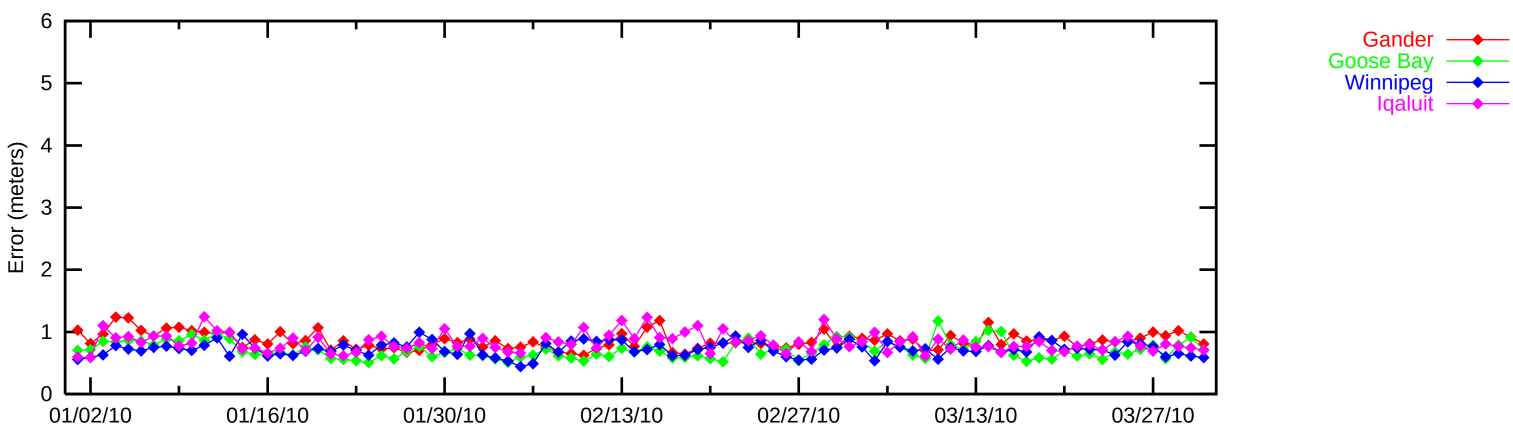


Figure 2-4 95% Vertical Accuracy at LPV

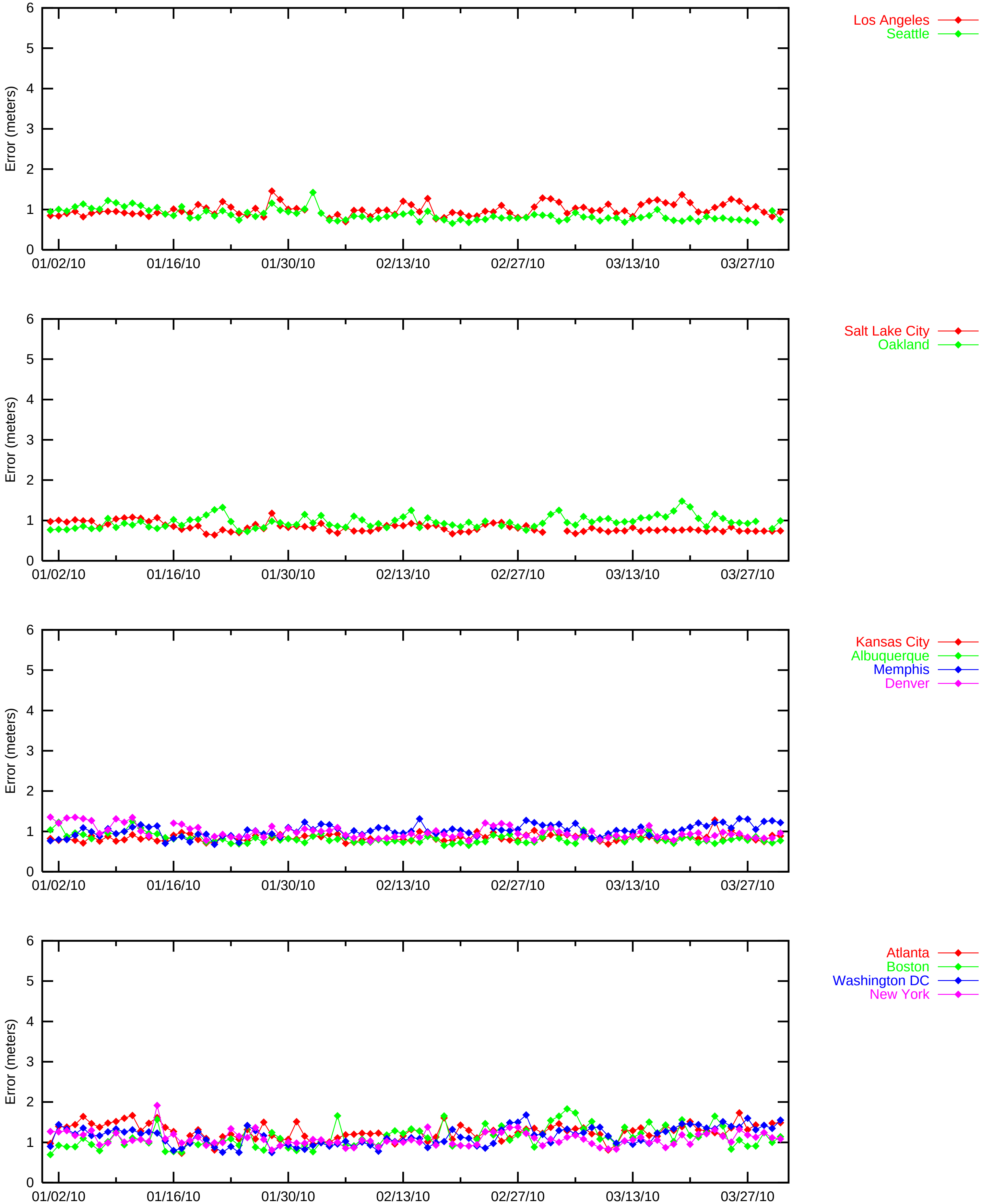
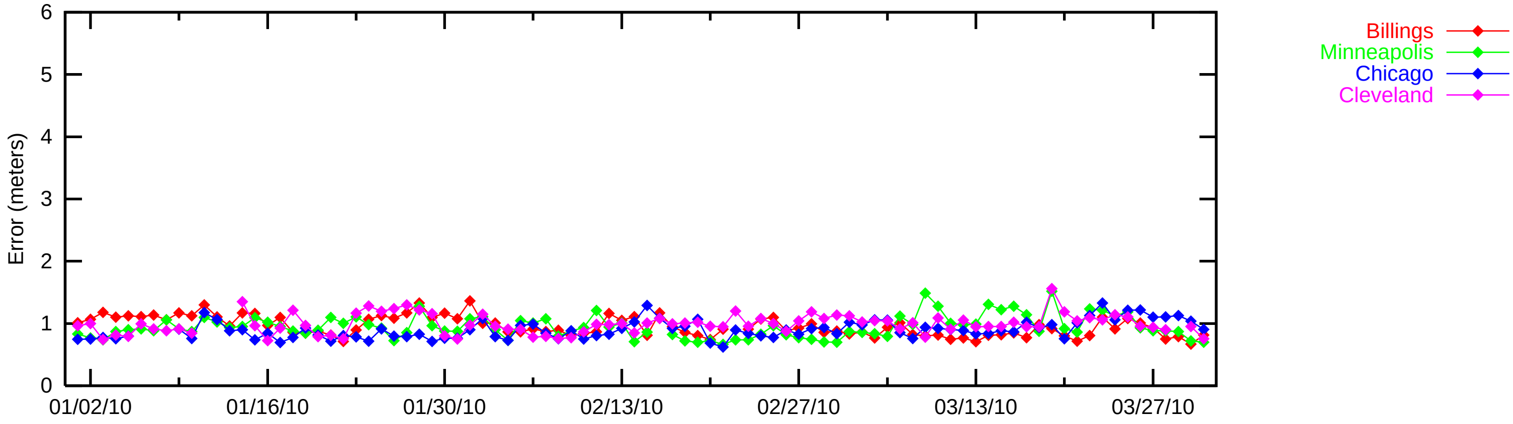
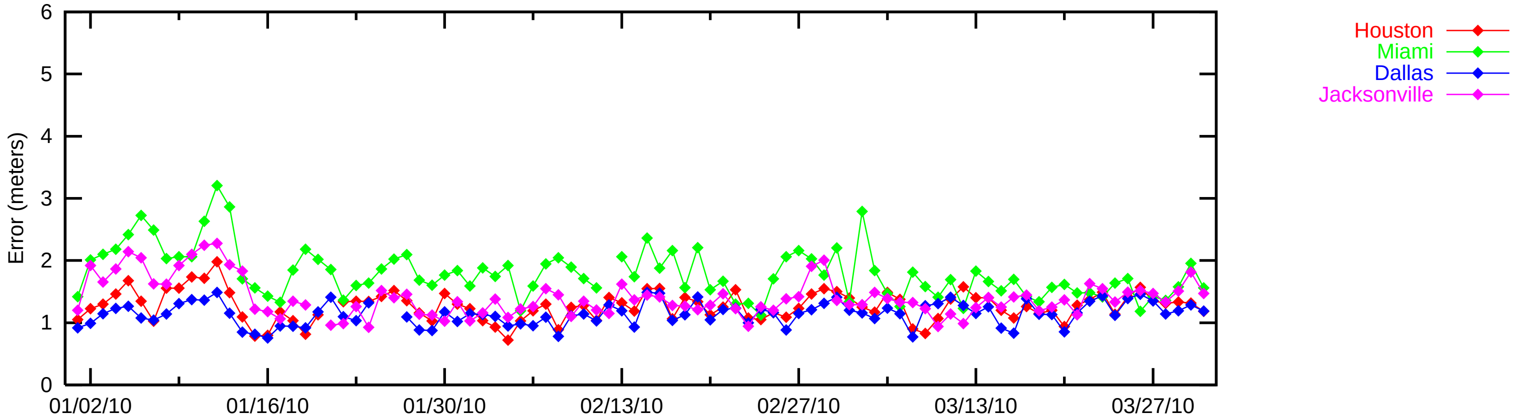
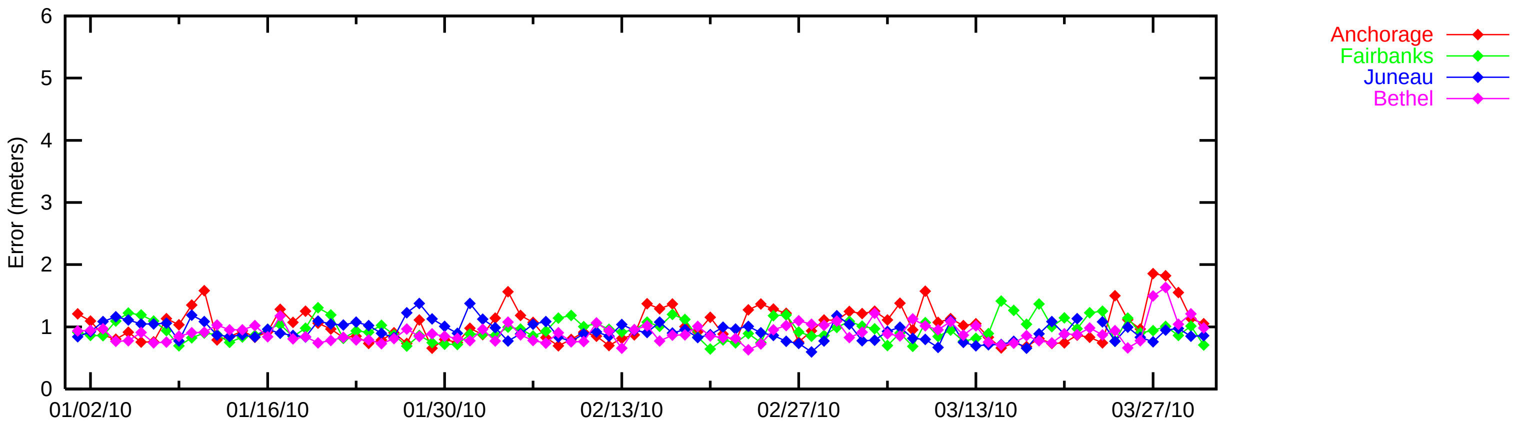


Figure 2-5 95% Vertical Accuracy at LPV







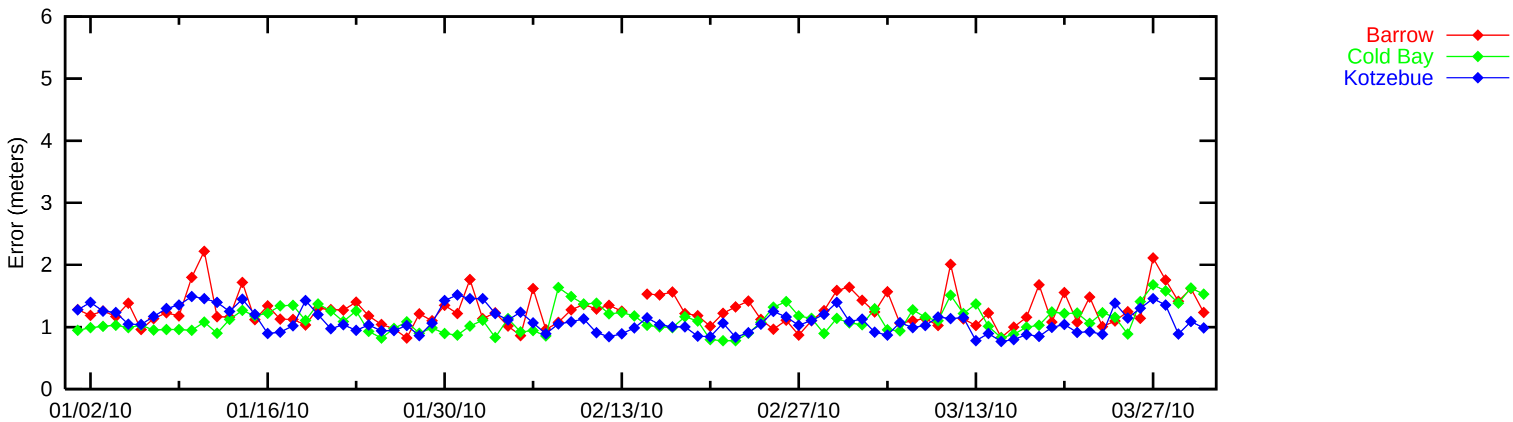
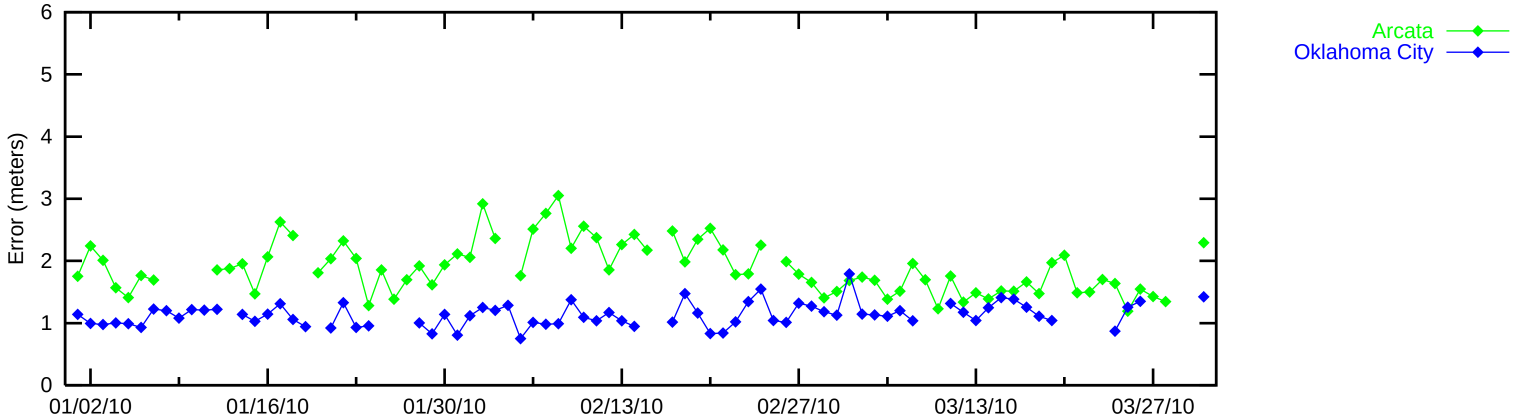
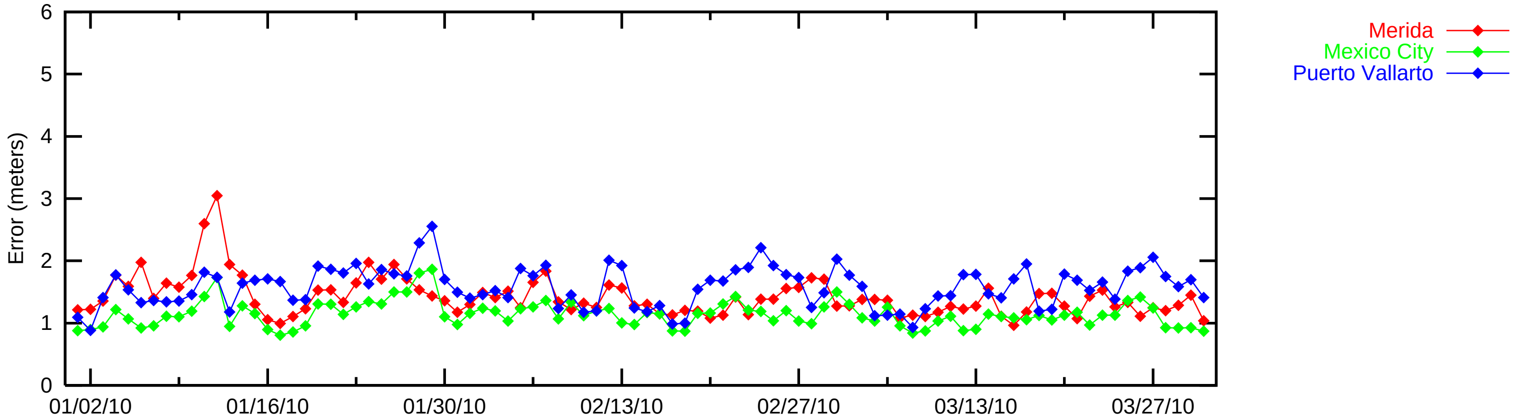
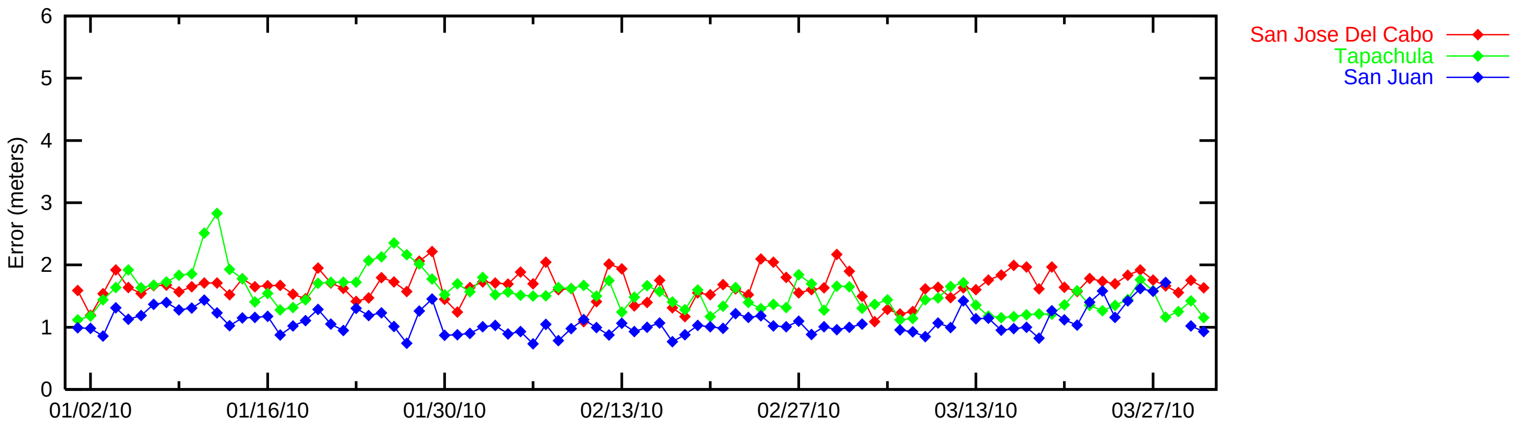


Figure 2-6 95% Vertical Accuracy at LPV







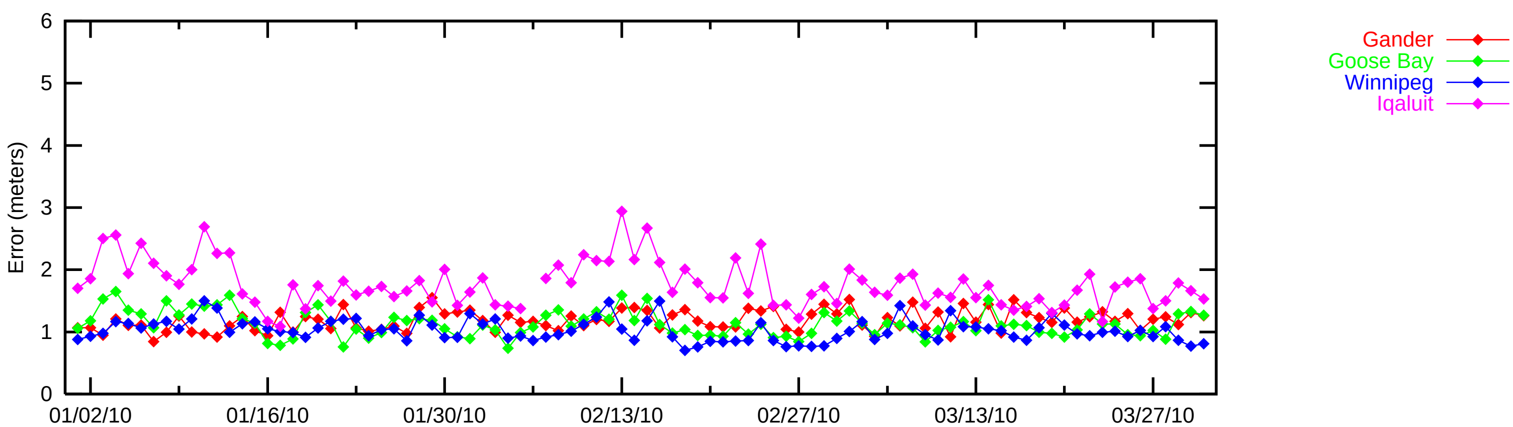


Figure 2-7 95% NPA Horizontal Accuracy

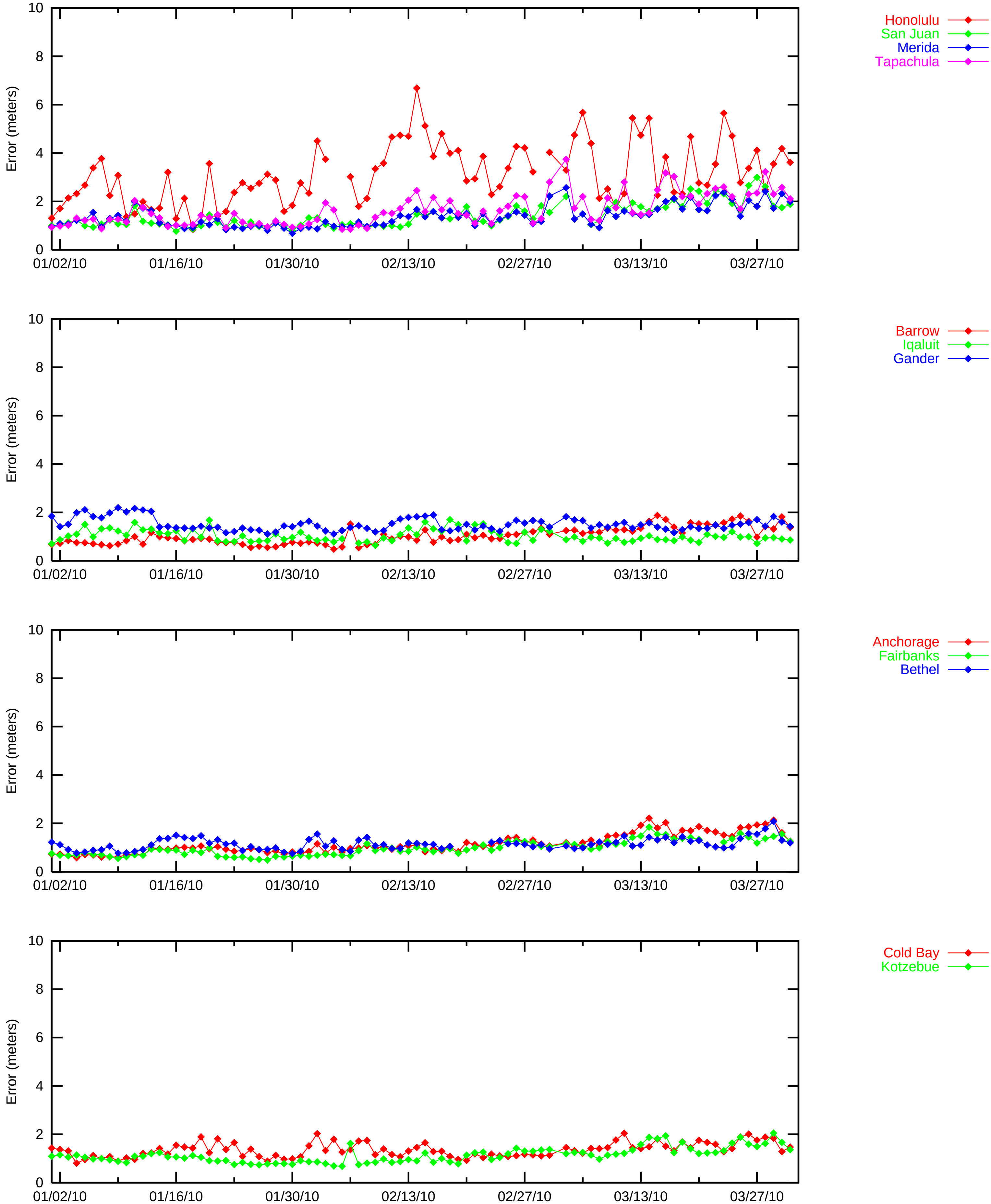


Figure 2-8 95% NPA Horizontal Accuracy

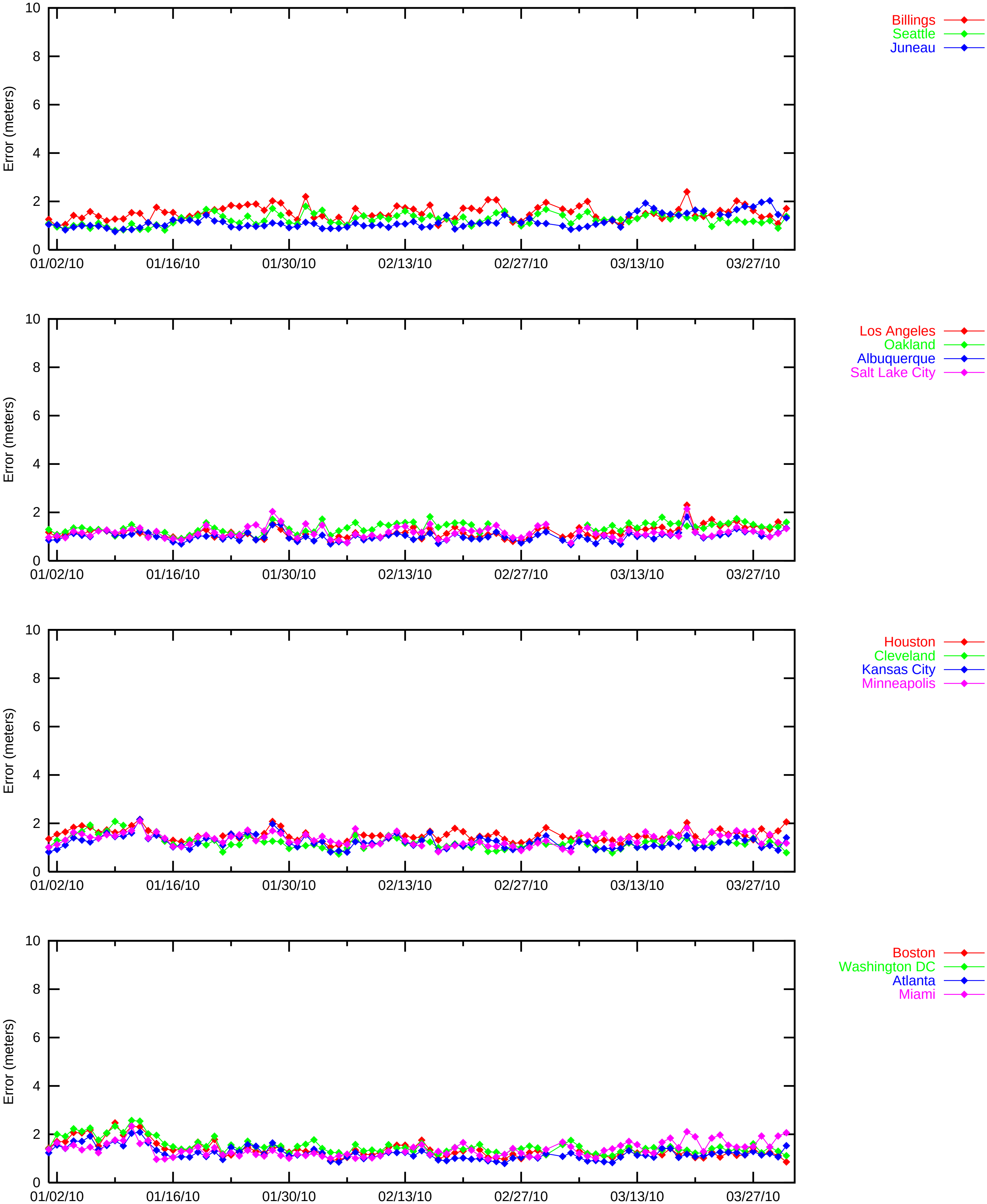


Figure 2-9 Horizontal Triangle Chart for the Quarter

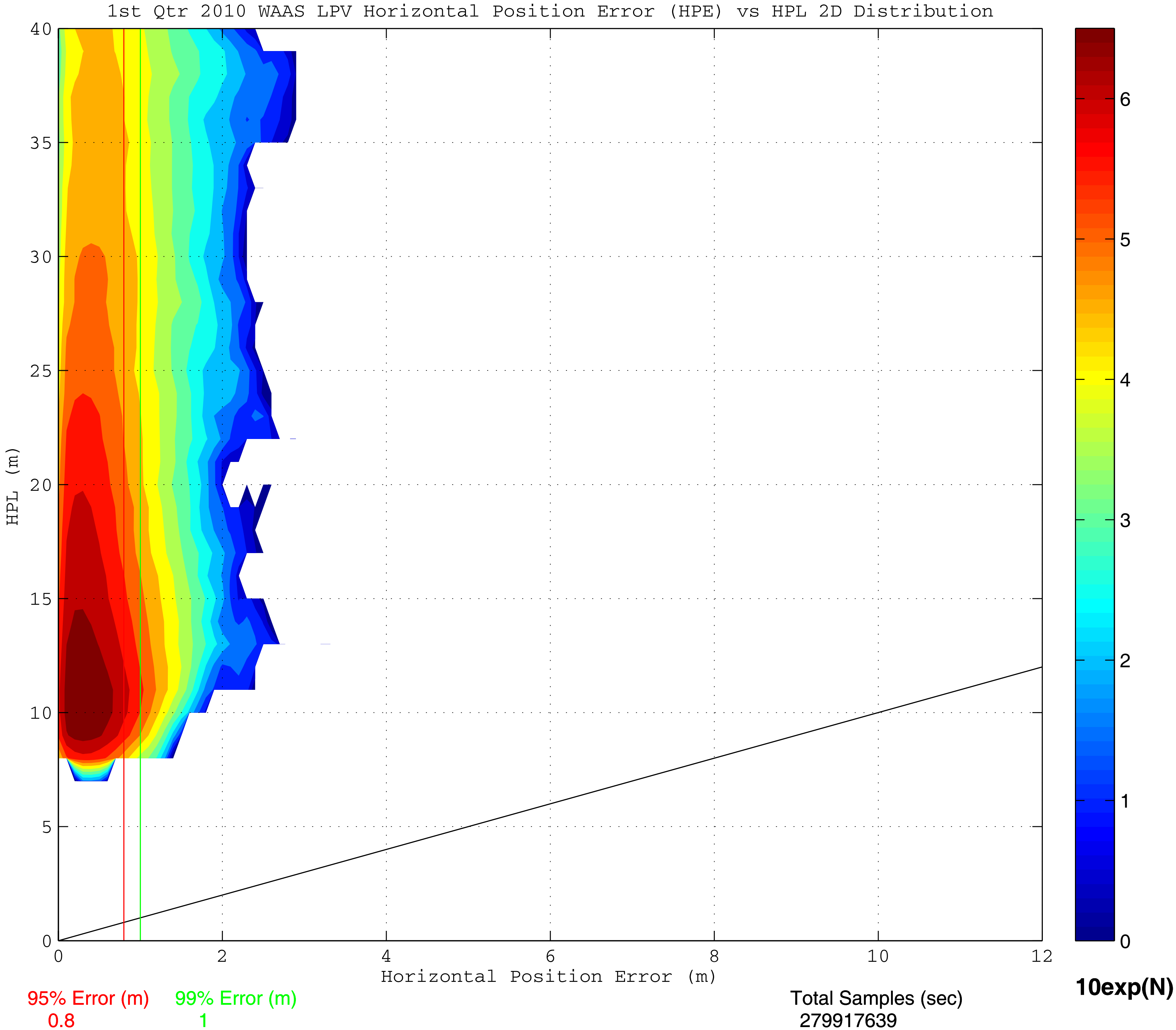


Figure 2-10 Vertical Triangle Chart for the Quarter

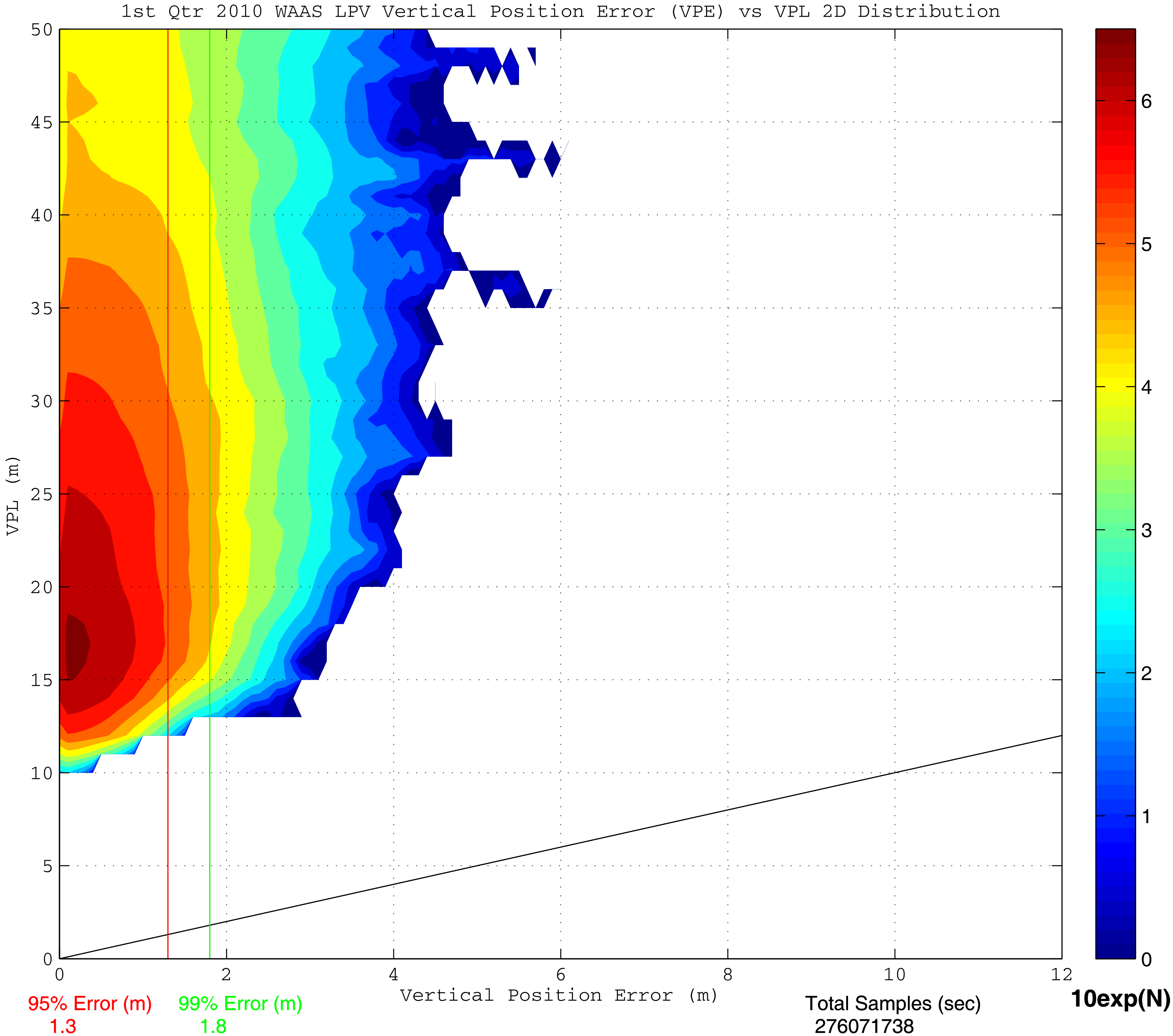


Figure 2-11 2-D Horizontal Histogram for the Quarter

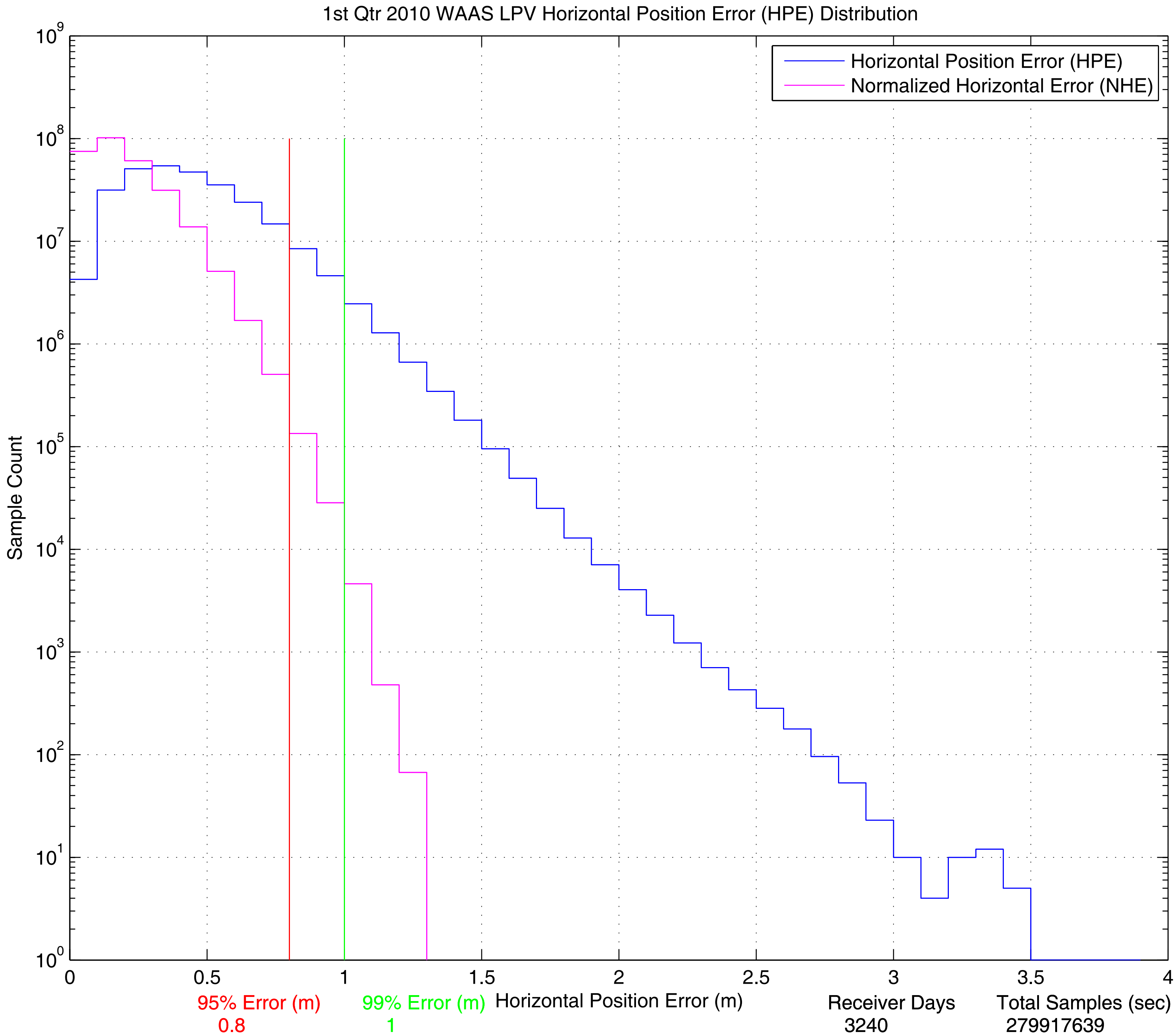
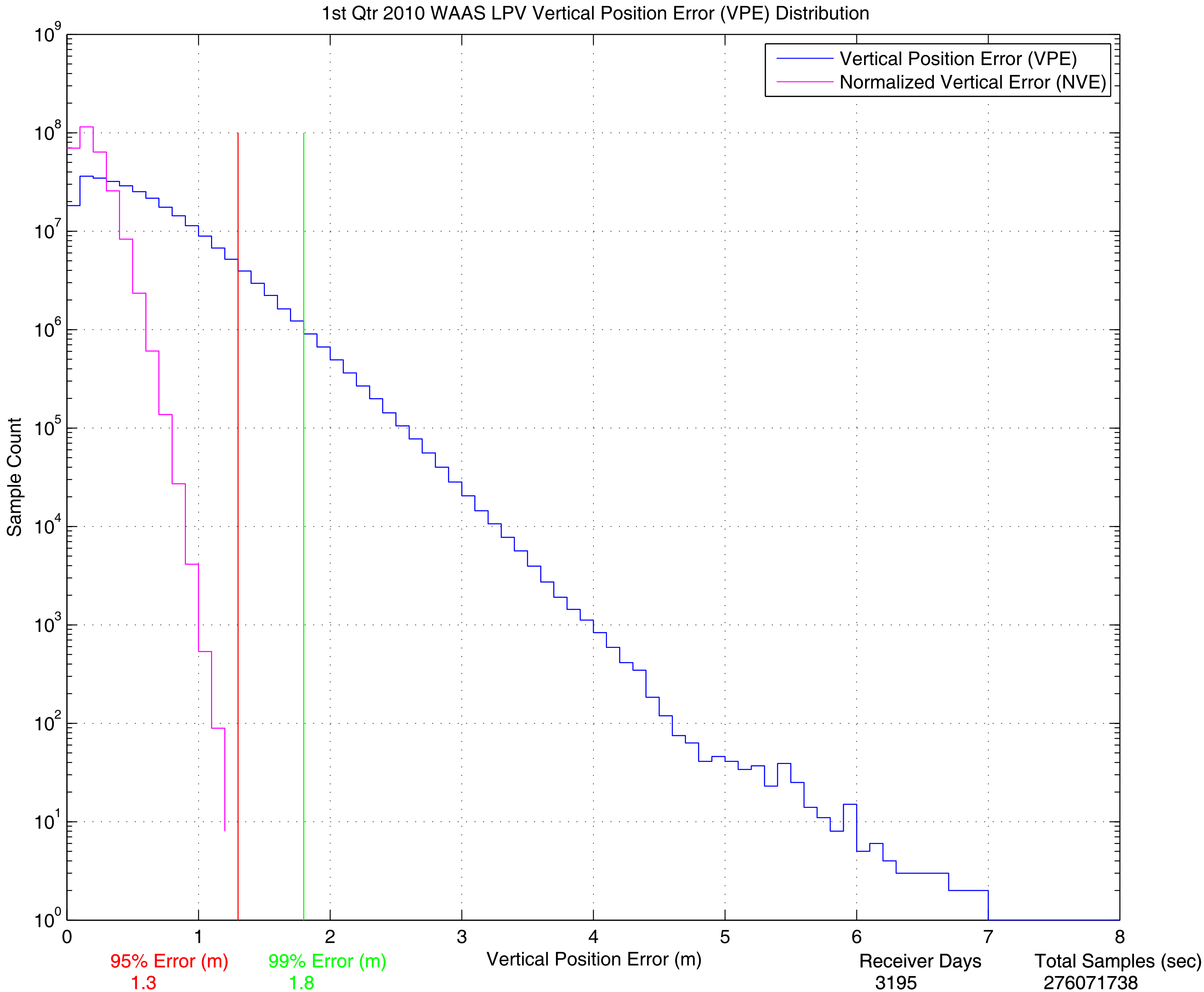


Figure 2-12 2-D Vertical Histogram for the Quarter



3.0 AVAILABILITY

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

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

The following table shows the maximum and minimum 95% HPL and VPL observed at the evaluated CONUS and Alaska sites this evaluation period. The international sites are excluded from this table, but can be found in Table 3.1.

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	Alaska Site/Maximum	Alaska Site/Minimum
95% HPL	Arcata 16.28 meters	Memphis 11.041 meters	Cold Bay 25.85 meters	Juneau 13.603 meters
95% VPL	Arcata 29.91 meters	Chicago 19.323 meters	Cold Bay 36.65 meters	Juneau 22.04 meters

Availability of NPA service is evaluated by monitoring the WAAS horizontal protection level at receiver locations throughout the test period. If the horizontal protection level is not greater than the horizontal alert limit (HAL = 556m) then the service is available. If the horizontal protection level exceeds the required alert level or if WAAS navigation message is not received then the NPA service at that location is considered unavailable and an outage in service is recorded with its duration. The NPA service is not considered available again until the horizontal protection level is within the alert limit for at least 15 minutes. The percent of time that NPA service is available using the fifteen-minute window criteria is presented in Table 3.3. The NPA service outages and associated outage rate for this period is presented in Table 3.5. The outage rate is the percent of NPA approaches that theoretically would be interrupted by a loss of operational service once the approach had started.

During this evaluation period, reduced PA and NPA availability are mainly due to satellite outages and GUS switchovers. Please refer to Table 1.4 for events that affected availability. NPA outages at Iqaluit and Gander are due to CRE GUS switchovers; NPA outages at Barrow and Kotzebue are due to CRW GUS switchovers. GUS switchovers on 1/5/10 and 1/20/10 to 1/22/10 reduced Alaska availability. PRN 30 outage on 1/19/10 caused a reduction in Alaska PA and NPA availability. PRN 4 outage on 1/26/10 affected mainly CONUS PA availability (see DR #89.) PRN 7 outage on 1/28/10 affected Alaska PA availability. PRN 26 outage on 2/8/10 reduced mainly CONUS LPV 200 availability. PRN 20 outage from 2/15/10 to 2/19/10 reduced RNP and LPV availability. PRN 30 outage from 2/23/10 to 2/24/10 reduced LPV availability. PRN 32 outage on 3/16/10 affected mainly Alaska LPV200 availability. PRN 22 outage on 3/31/10 affected RNP and Alaska availability. A combination of PRN 32 outage and maintenance at Littleton GUS on 2/26/10 caused 3 SIS outages that affected availability (see DR #90).

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	16.283	29.912	100
Oklahoma City	11.721	20.778	100
Albuquerque	12.813	22.887	100
Anchorage	14.392	23.156	100
Atlanta	11.808	21.162	100
Barrow	17.581	35.232	99.674990
Bethel	17.558	28.044	100
Billings	12.562	21.719	100
Boston	14.815	21.537	100
Chicago	12.151	19.323	100
Cleveland	12.762	21.035	100
Cold Bay	25.858	36.656	100
Dallas	11.391	21.445	100
Denver	11.738	21.746	100
Fairbanks	13.607	23.788	100
Gander	24.702	37.459	99.966370
Goose Bay	19.475	29.231	99.968340
Houston	11.634	21.652	100
Iqaluit	29.651	41.309	99.974350
Jacksonville	12.469	23.045	100
Juneau	13.603	22.040	100
Kansas City	11.456	19.644	100
Kotzebue	16.516	31.478	99.679660
Los Angeles	16.078	28.250	100
Memphis	11.041	19.447	100
Merida	16.884	32.666	100
Mexico City	21.400	36.499	100
Miami	14.052	27.022	100
Minneapolis	12.083	19.586	100
New York	14.243	21.317	100
Oakland	16.053	33.254	100
Puerto Vallarta	23.995	37.254	100
Salt Lake City	12.060	21.784	100
San Jose Del Cabo	23.493	37.393	100
San Juan	73.478	98.009	99.973370
Seattle	13.643	23.371	100
Tapachula	32.673	60.927	100
Washington DC	13.195	21.403	100
Winnipeg	13.788	21.346	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	1	0.97928730
Oklahoma City	1	1
Albuquerque	1	0.99935777
Anchorage	1	0.99970692
Atlanta	1	0.99995680
Barrow	0.99485982	0.92515545
Bethel	0.99996473	0.99749391
Billings	1	0.99998317
Boston	0.99997621	0.99986106
Chicago	1	0.99996693
Cleveland	1	1
Cold Bay	0.99854057	0.90366524
Dallas	0.99999843	0.99996787
Denver	1	0.99986022
Fairbanks	1	0.99955341
Gander	0.99779933	0.84713928
Goose Bay	0.99930528	0.99544428
Houston	1	0.99991981
Iqaluit	0.98452643	0.79506587
Jacksonville	1	0.99988549
Juneau	1	0.99961606
Kansas City	1	0.9999999
Kotzebue	0.99623708	0.98161679
Los Angeles	0.99998558	0.98934650
Memphis	1	1
Merida	0.99786733	0.96365851
Mexico City	0.98235812	0.91392982
Miami	1	0.99929658
Minneapolis	1	1
New York	1	0.99992215
Oakland	0.99978398	0.96150436
Puerto Vallarta	0.99131862	0.89545906
Salt Lake City	1	0.99998336
San Jose Del Cabo	0.99621824	0.87018520
San Juan	0.18425786	0.00184412
Seattle	1	0.99847167
Tapachula	0.86438780	0.42497185
Washington DC	1	0.99986316
Winnipeg	1	0.9999999

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	1
Anchorage	1
Atlanta	1
Barrow	0.99688699
Bethel	1
Billings	1
Boston	1
Cleveland	1
Cold Bay	1
Fairbanks	1
Gander	0.99992034
Honolulu	1
Houston	1
Iqaluit	0.99992121
Juneau	1
Kansas City	1
Kotzebue	0.99688762
Los Angeles	1
Merida	1
Miami	1
Minneapolis	1
Oakland	1
Salt Lake City	1
San Jose Del Cabo	1
San Juan	1
Seattle	1
Tapachula	1
Washington DC	1

Table 3-4 LPV and LPV 200 Outage Rate

Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	0	0.0	113	0.002437
Oklahoma City	0	0.0	0	0.0
Albuquerque	0	0.0	18	0.000353
Anchorage	0	0.0	4	0.000078
Atlanta	0	0.0	1	0.000020
Barrow	37	0.000734	573	0.012224
Bethel	2	0.000039	43	0.000842
Billings	0	0.0	1	0.000020
Boston	1	0.000020	2	0.000039
Chicago	0	0.0	1	0.000020
Cleveland	0	0.0	0	0.0
Cold Bay	10	0.000195	629	0.013583
Dallas	1	0.000020	3	0.000059
Denver	0	0.0	12	0.000238
Fairbanks	0	0.0	4	0.000078
Gander	39	0.000763	857	0.019746
Goose Bay	9	0.000176	48	0.000941
Houston	0	0.0	2	0.000039
Iqaluit	202	0.004019	1150	0.028336
Jacksonville	0	0.0	2	0.000039
Juneau	0	0.0	2	0.000039
Kansas City	0	0.0	1	0.000020
Kotzebue	22	0.000431	240	0.004771
Los Angeles	1	0.000020	137	0.002774
Memphis	0	0.0	0	0.0
Merida	74	0.001447	238	0.004820
Mexico City	91	0.001813	539	0.011544
Miami	0	0.0	17	0.000336
Minneapolis	0	0.0	0	0.0
New York	0	0.0	2	0.000039
Oakland	3	0.000059	360	0.007362
Puerto Vallarta	92	0.001812	605	0.013189
Salt Lake City	0	0.0	1	0.000020
San Jose Del Cabo	127	0.002487	582	0.013050
San Juan	738	0.081579	28	0.309256
Seattle	0	0.0	49	0.000958
Tapachula	797	0.018108	1269	0.058643
Washington DC	0	0.0	2	0.000039
Winnipeg	0	0.0	1	0.000020

Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Atlanta	0	0
Barrow	9	0.00017432
Bethel	0	0
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	9	0.00017376
Honolulu	0	0
Houston	0	0
Iqaluit	9	0.00017438
Juneau	0	0
Kansas City	0	0
Kotzebue	9	0.00017424
Los Angeles	0	0
Merida	0	0
Miami	0	0
Minneapolis	0	0
Oakland	0	0
Salt Lake City	0	0
San Jose Del Cabo	0	0
San Juan	0	0
Seattle	0	0
Tapachula	0	0
Washington DC	0	0

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

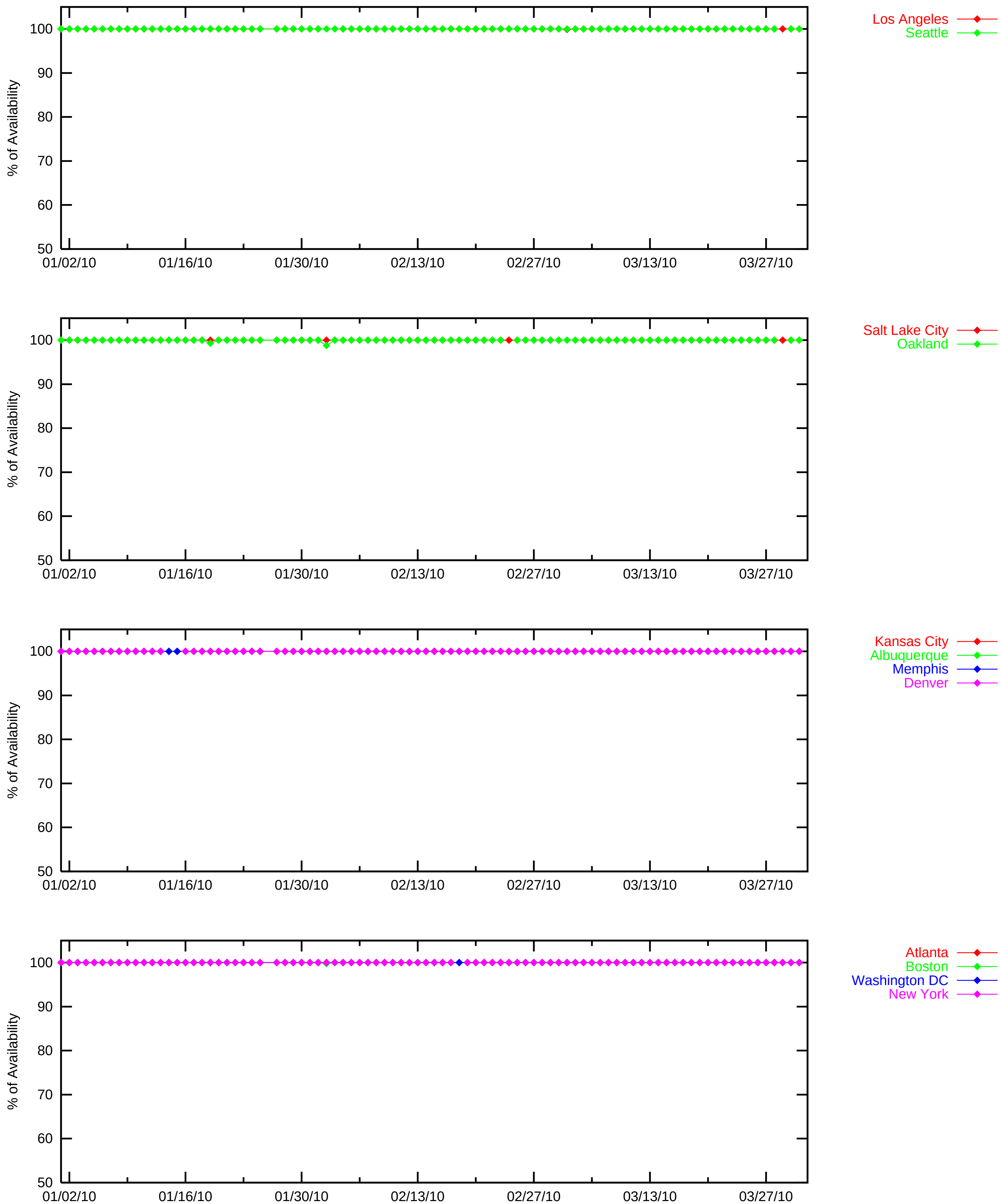
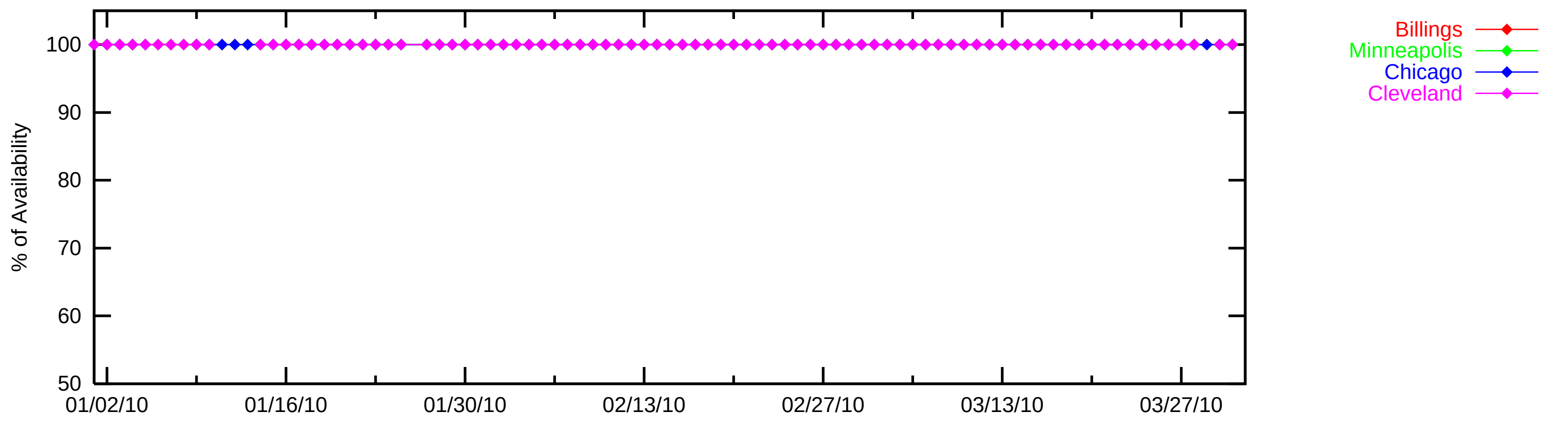
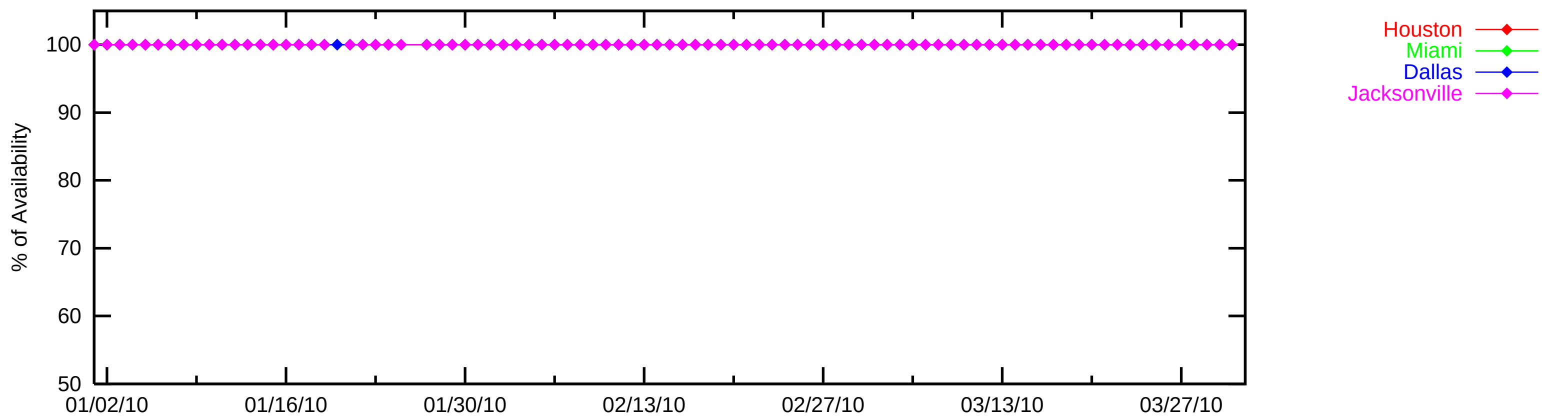
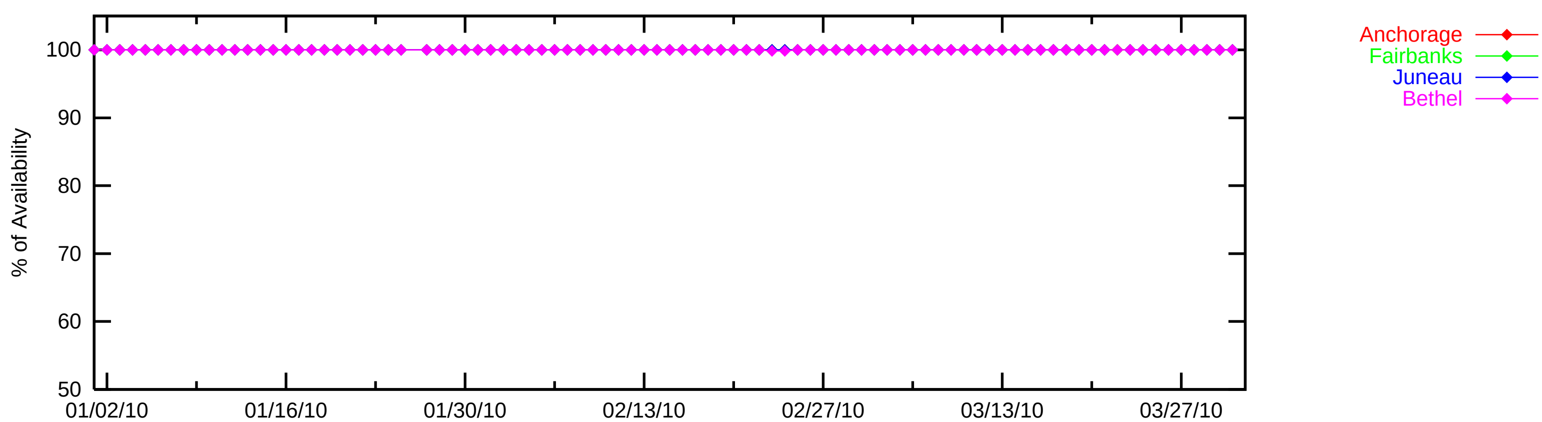


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)







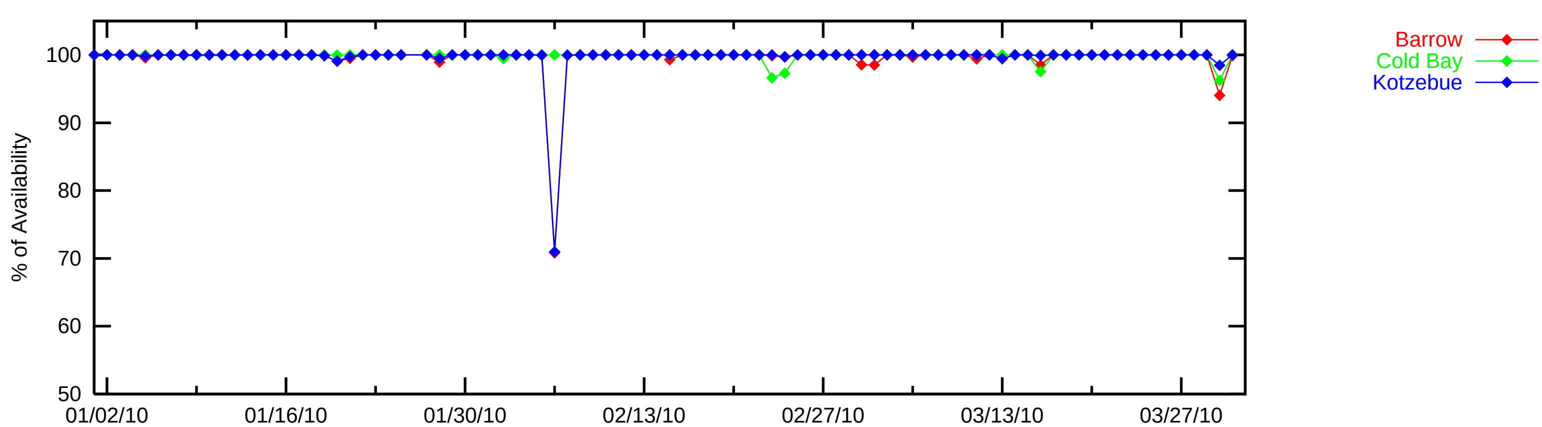


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

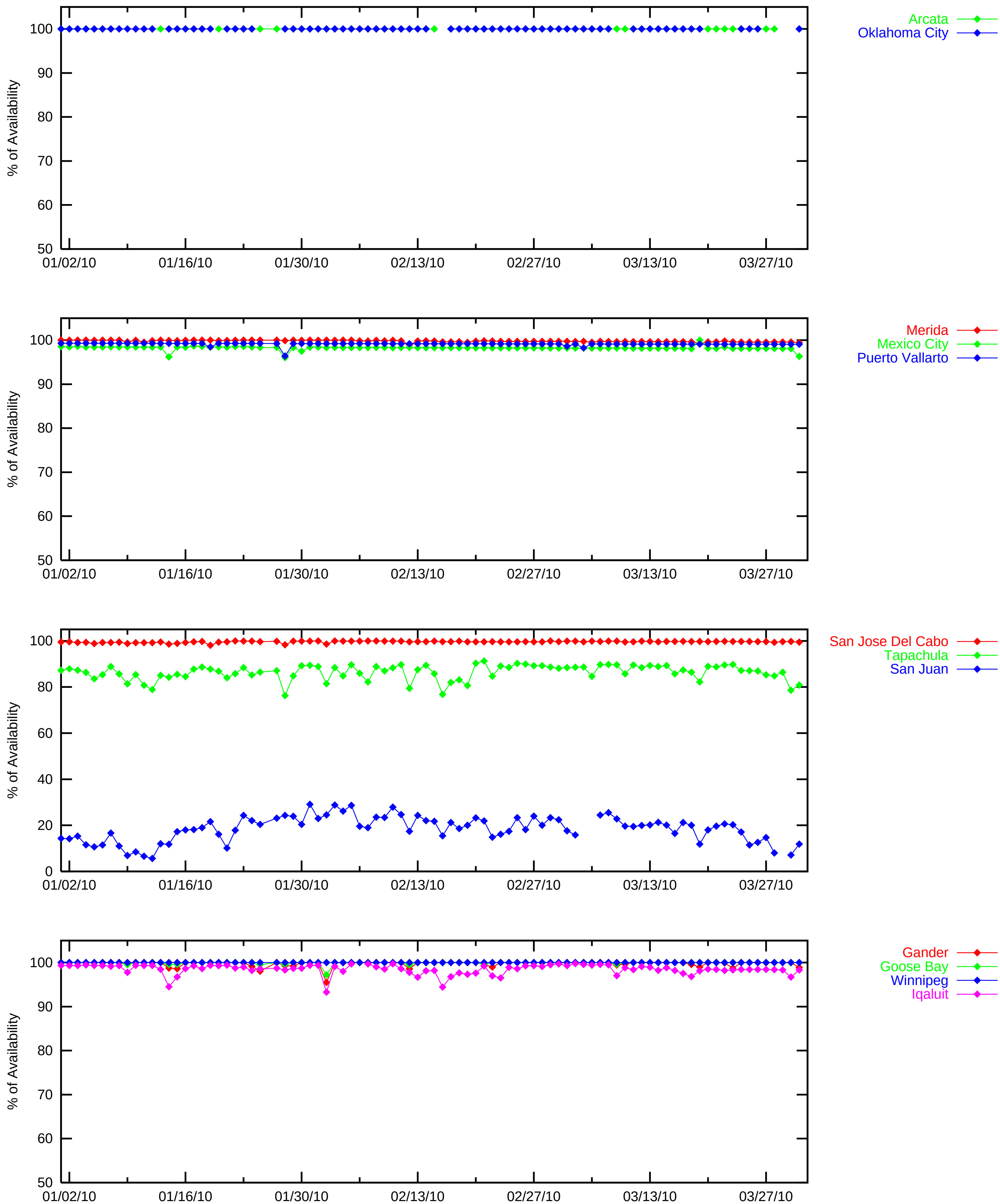
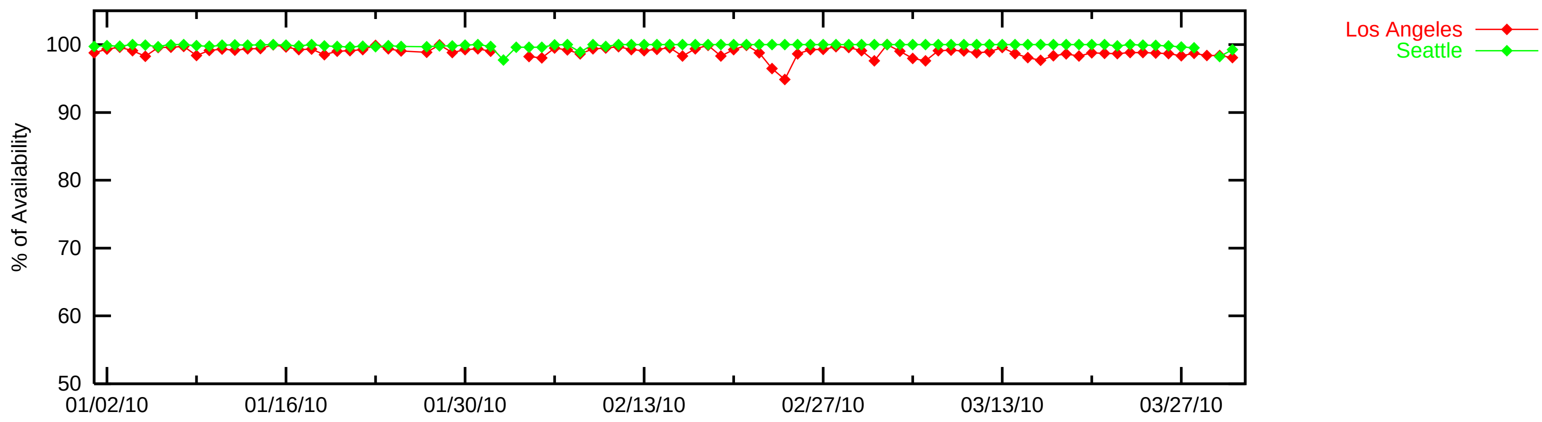
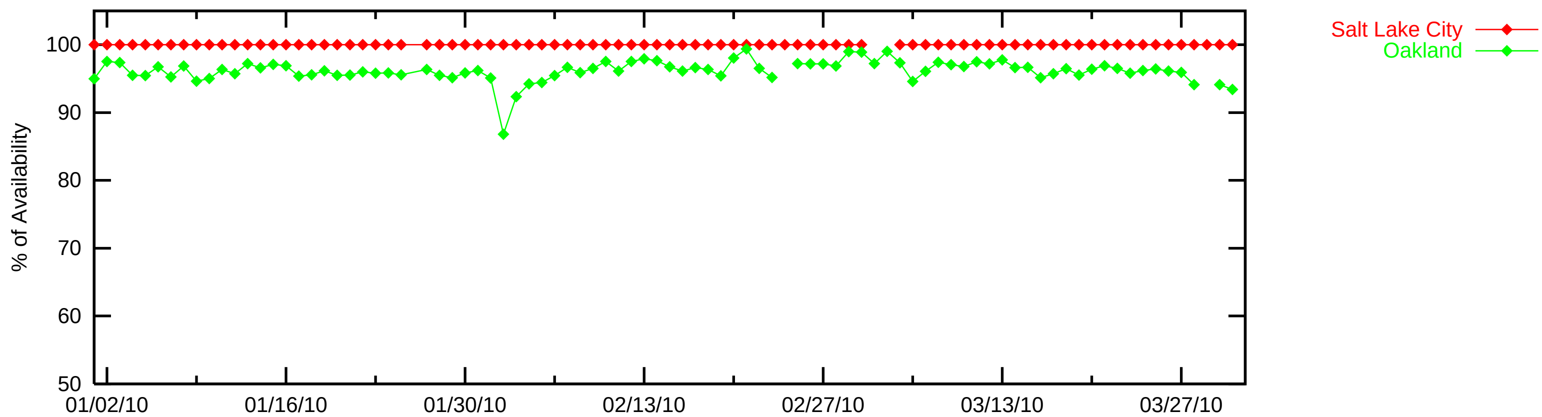
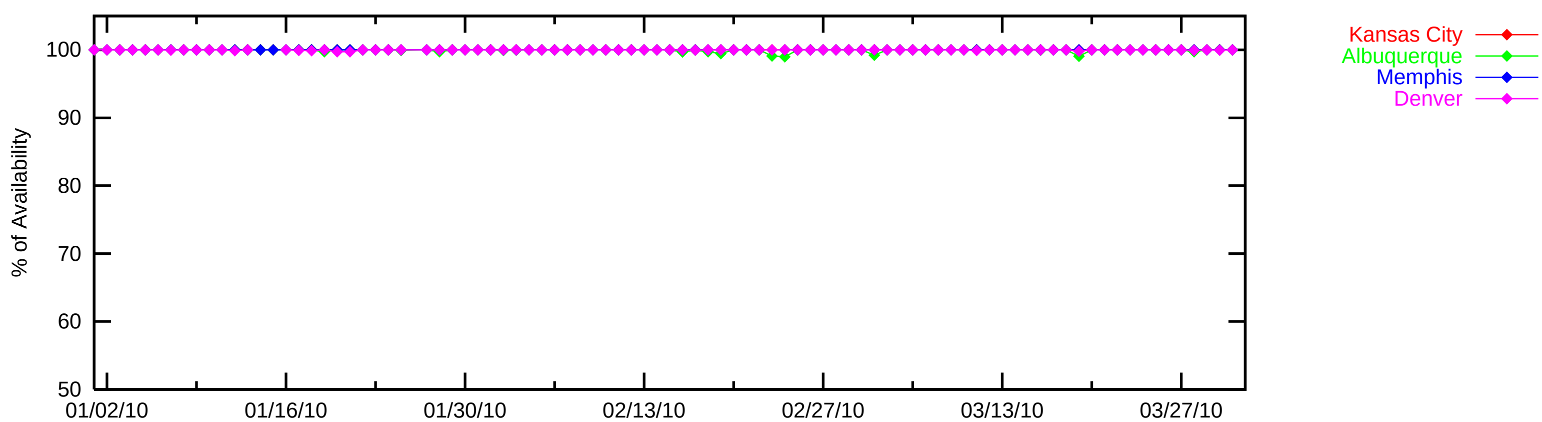


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)







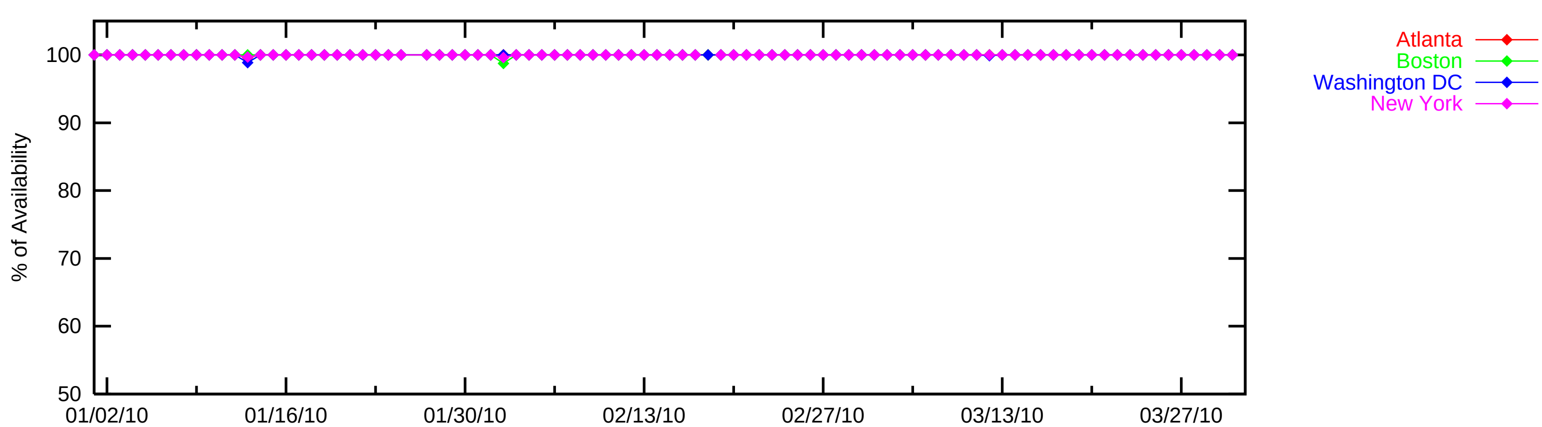


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

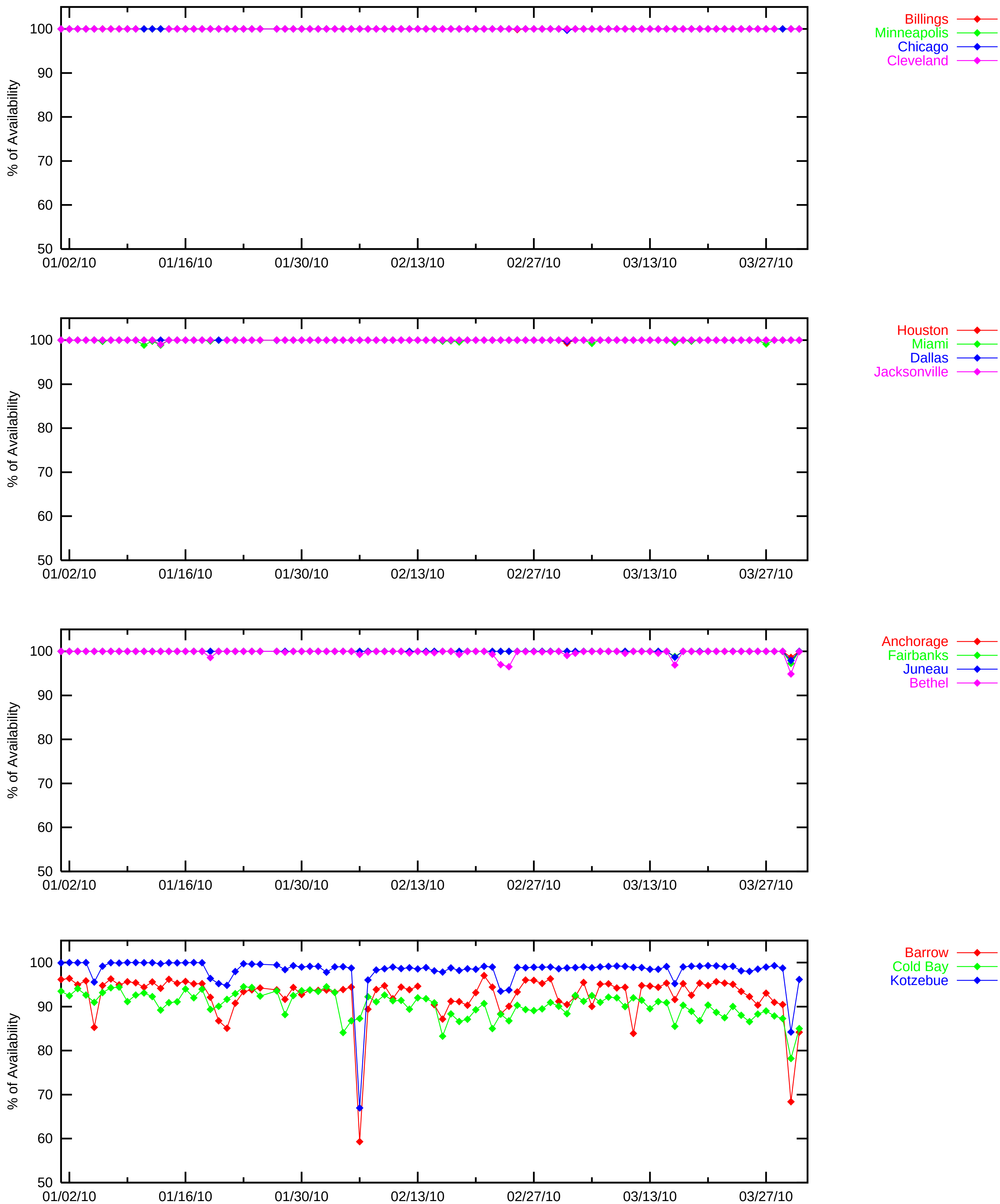


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

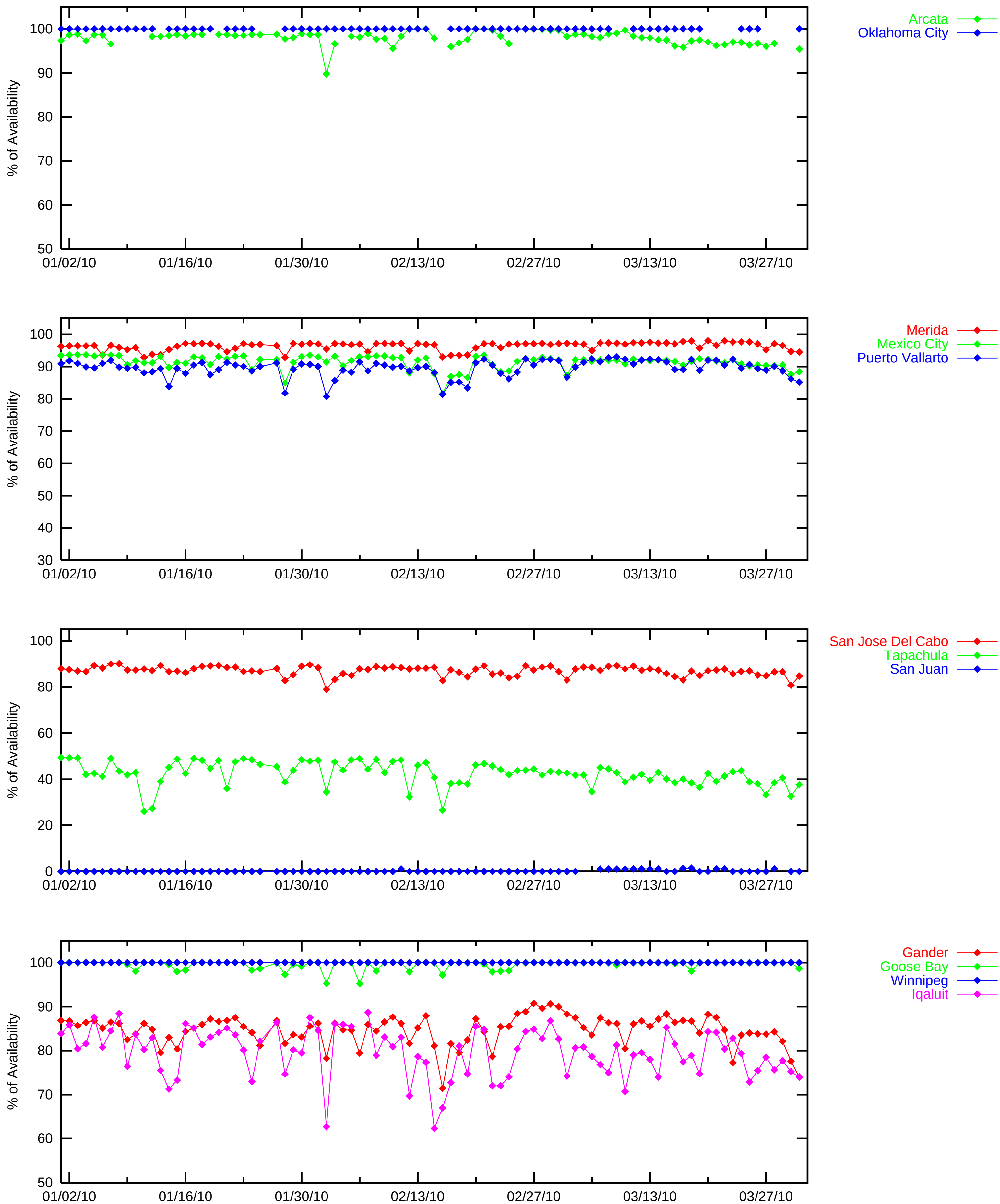


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

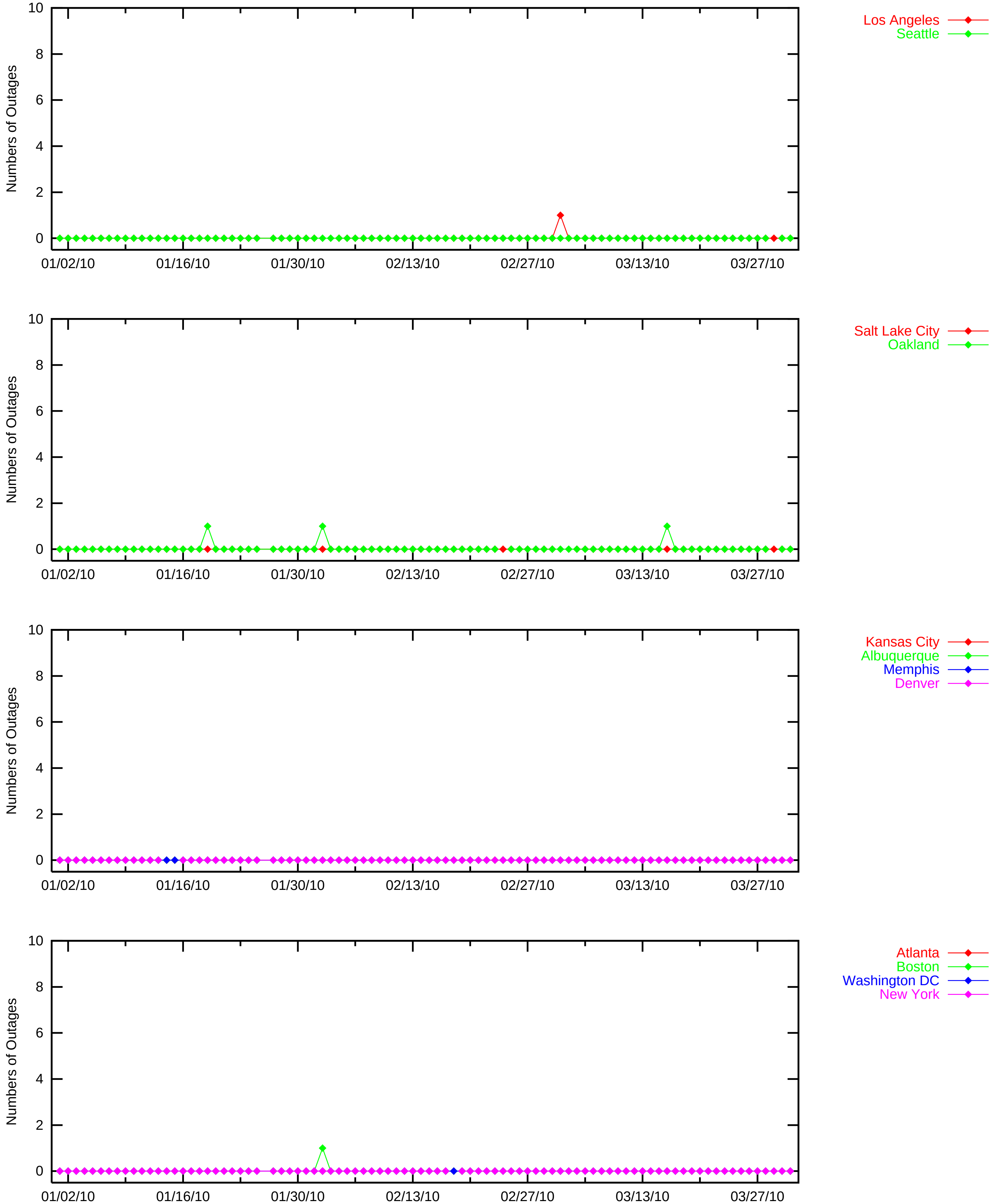
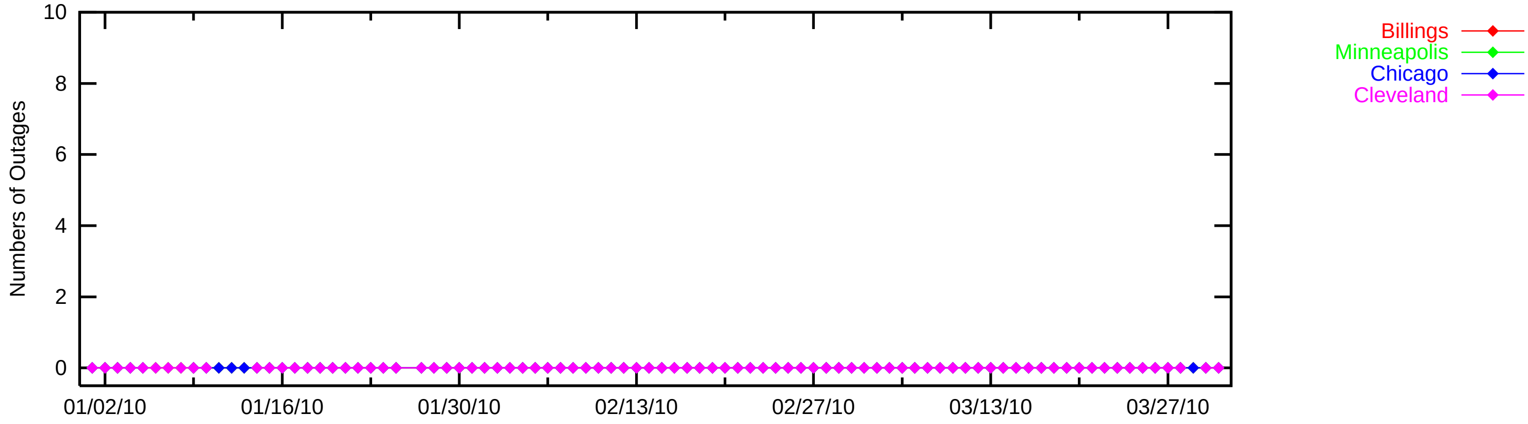
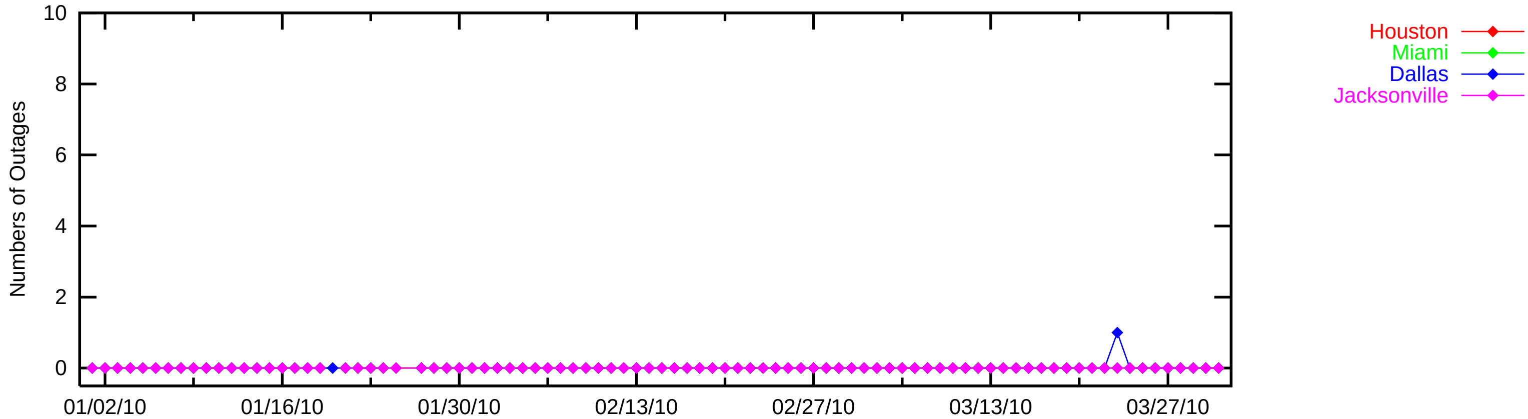
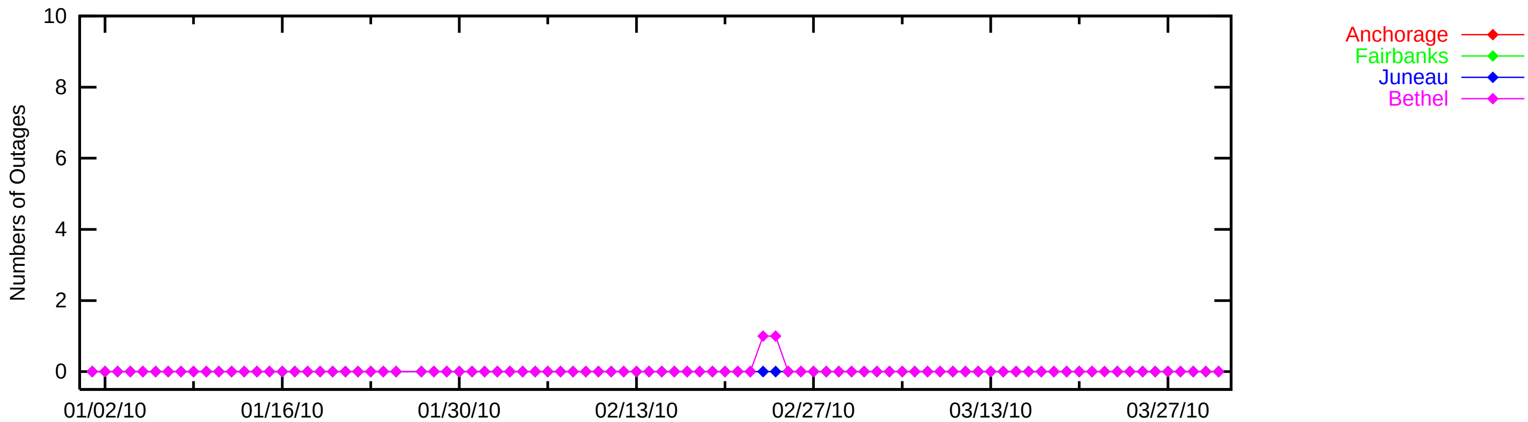


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)







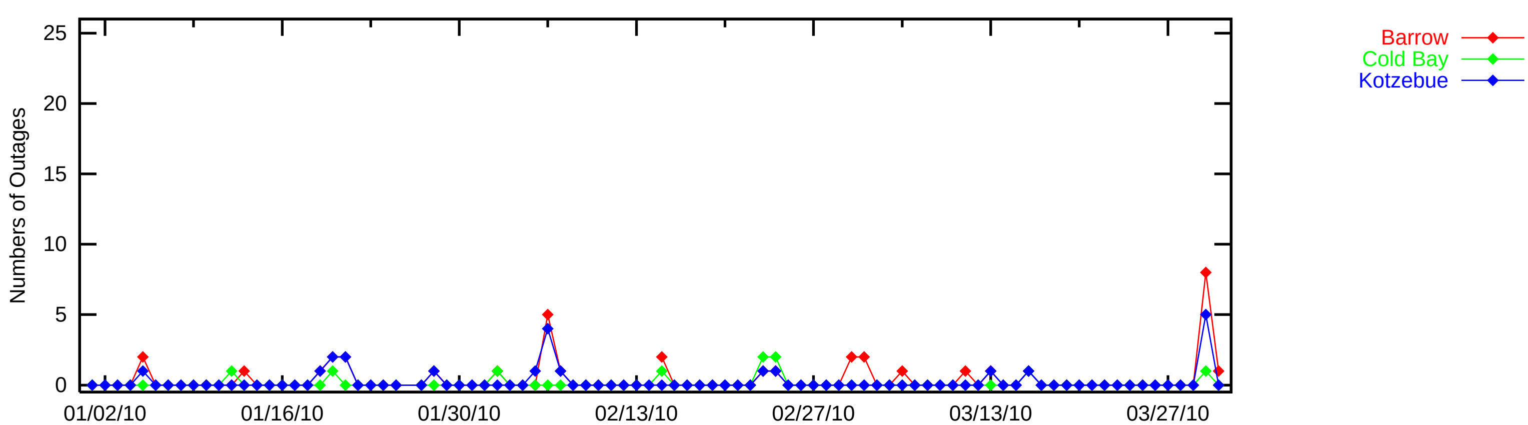


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

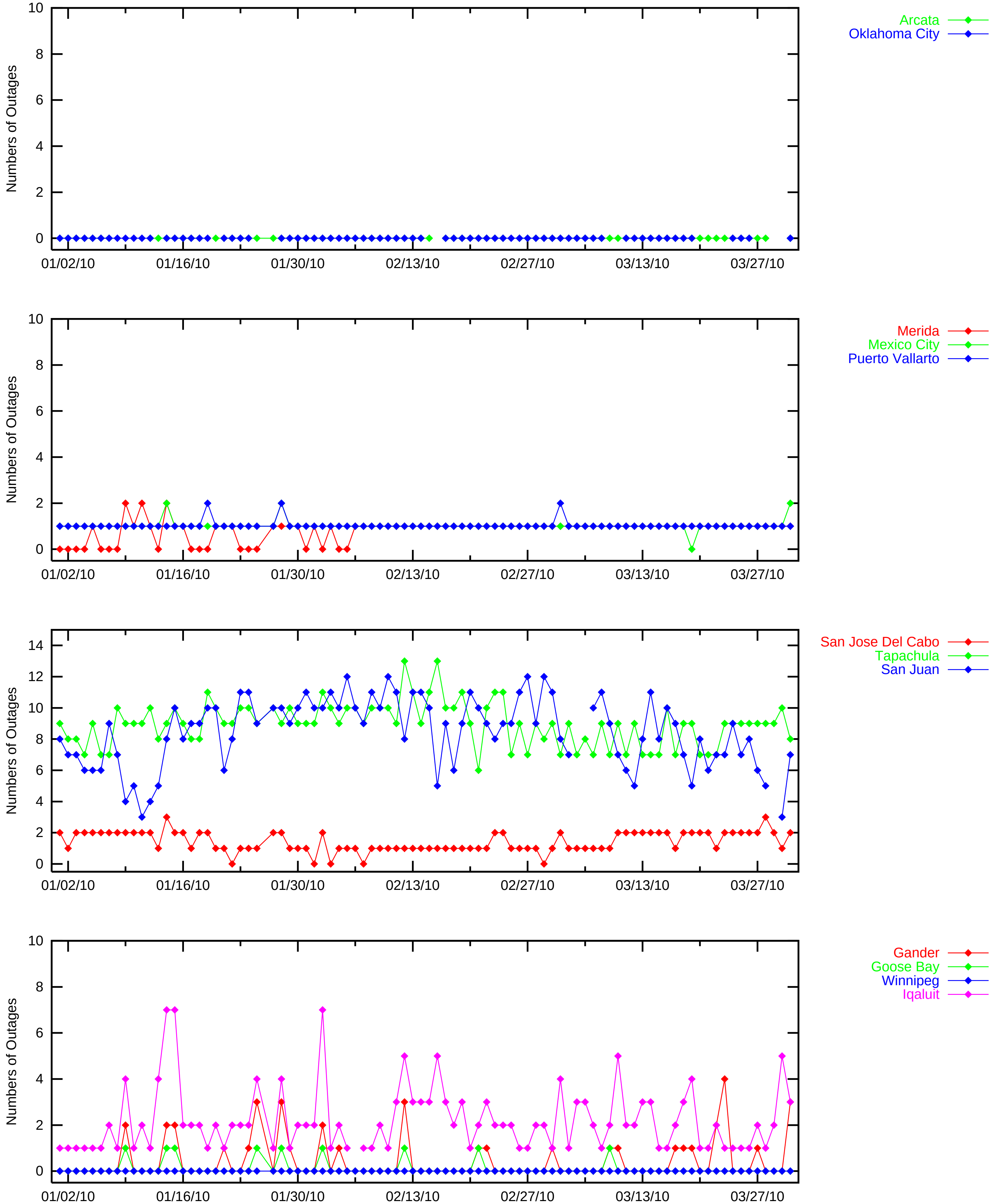
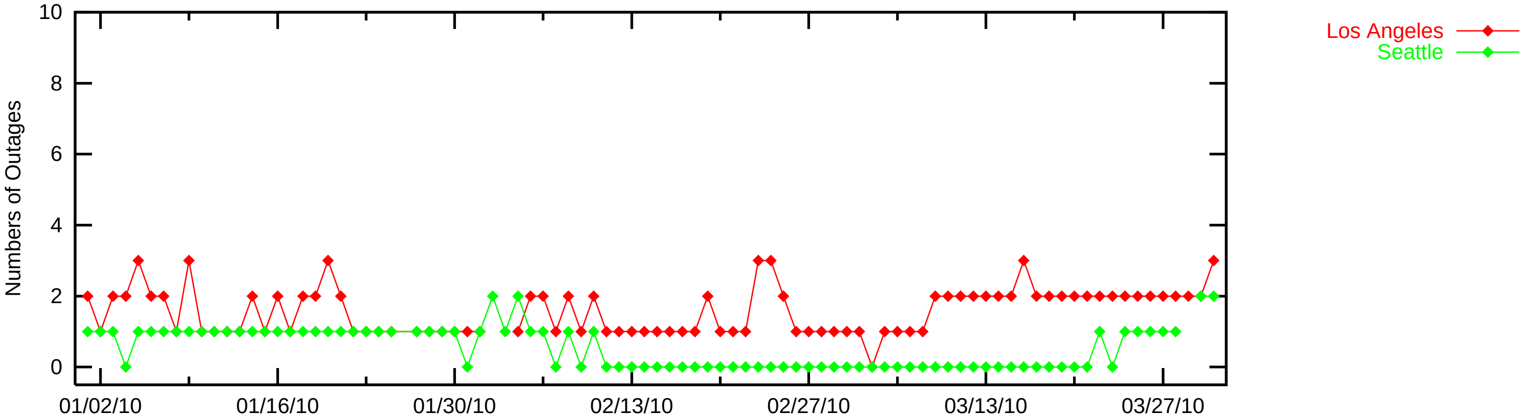
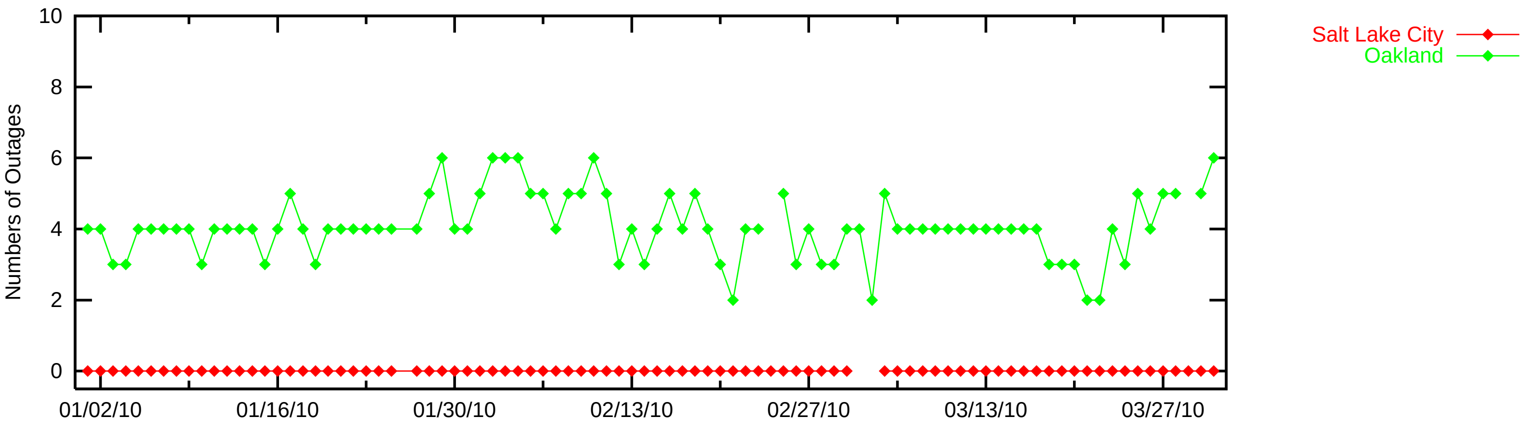
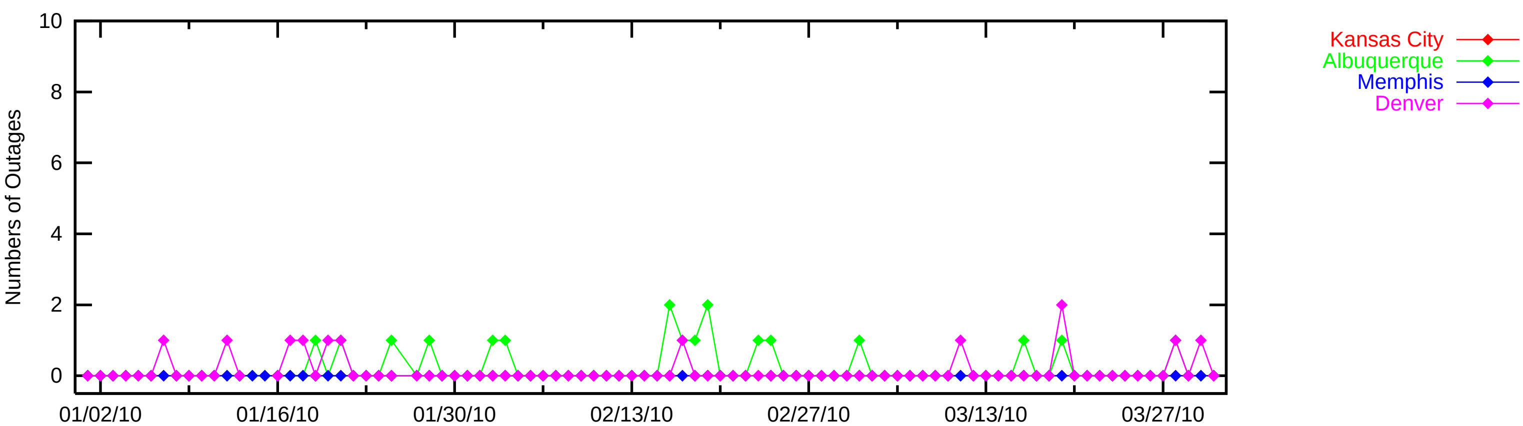


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)







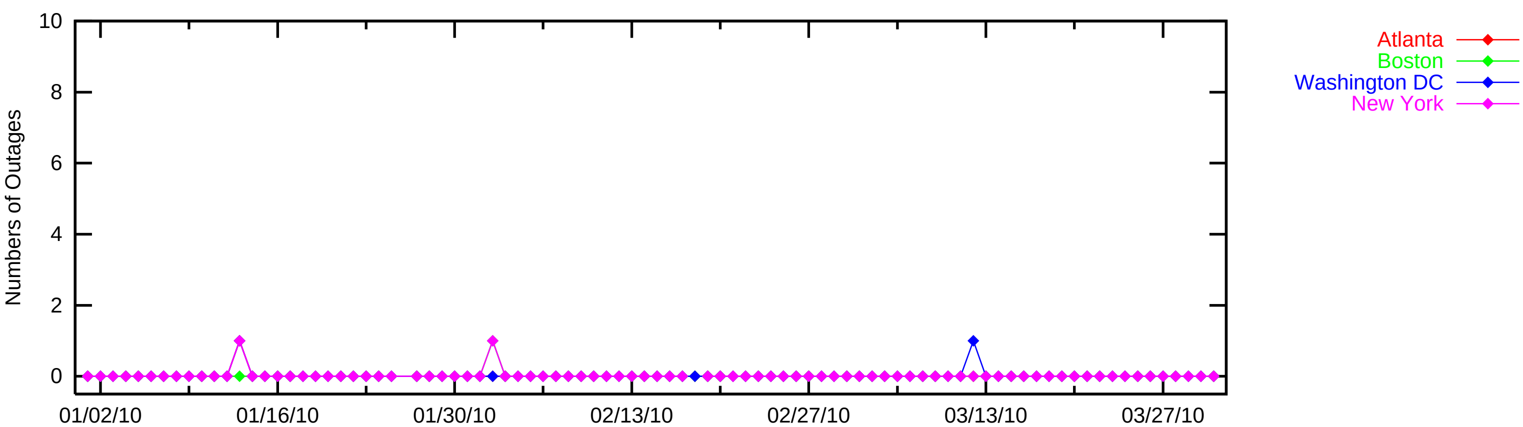
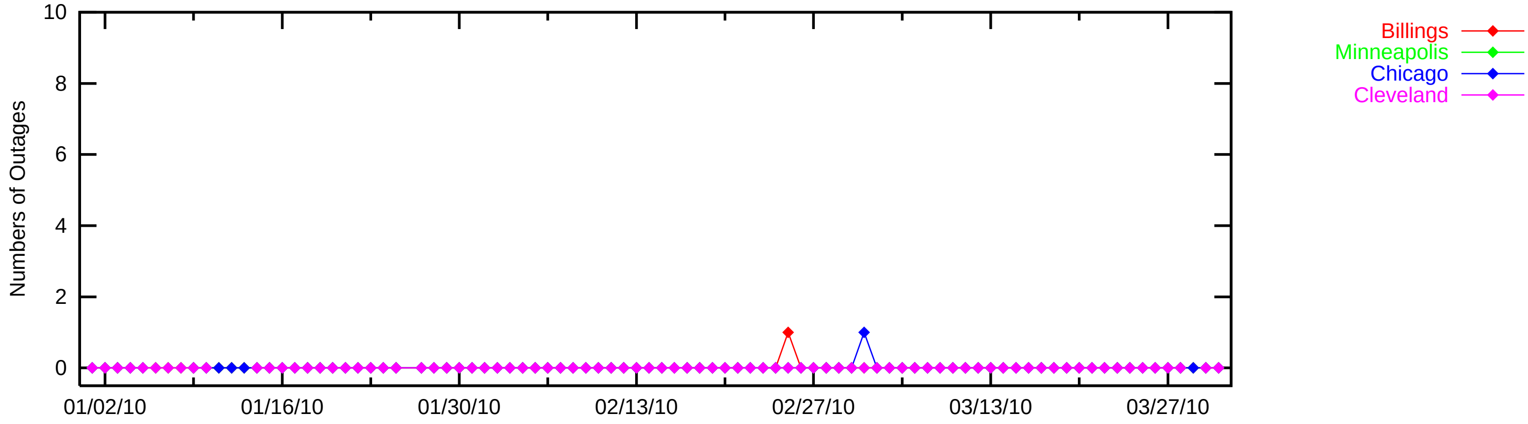
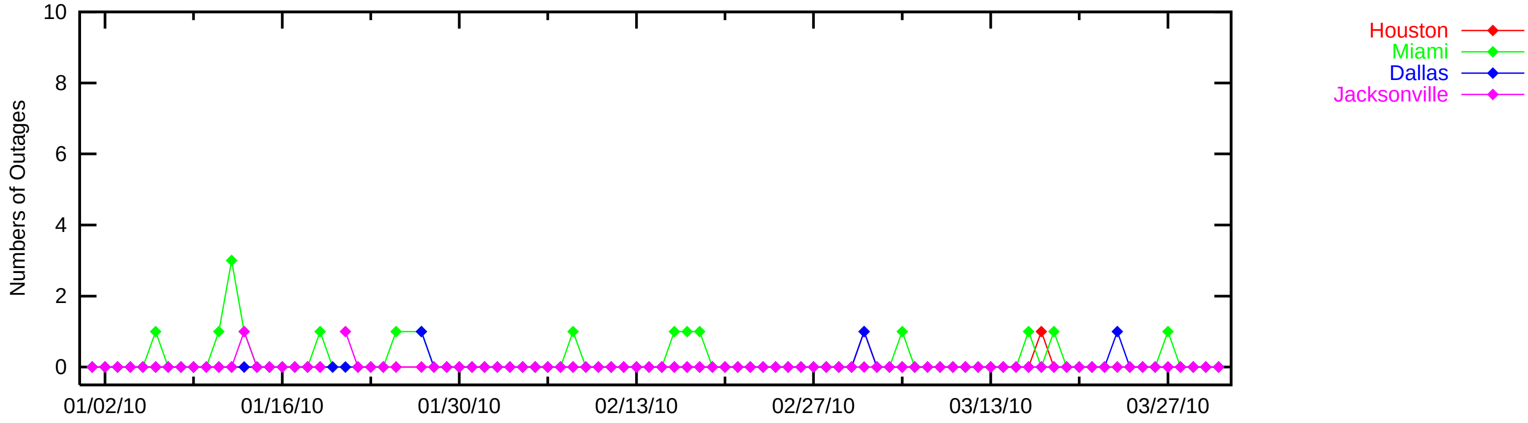
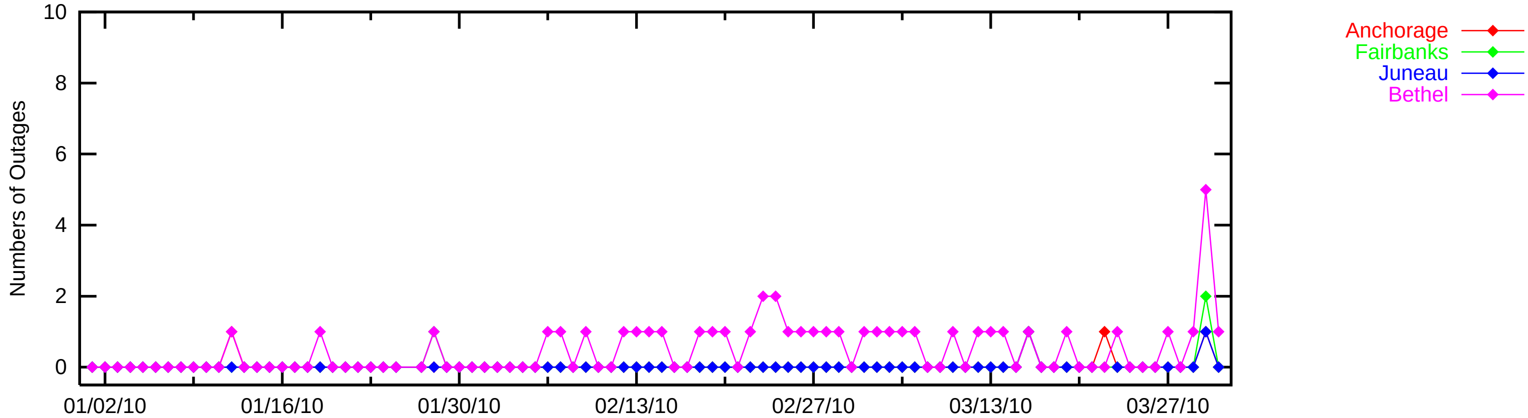


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)







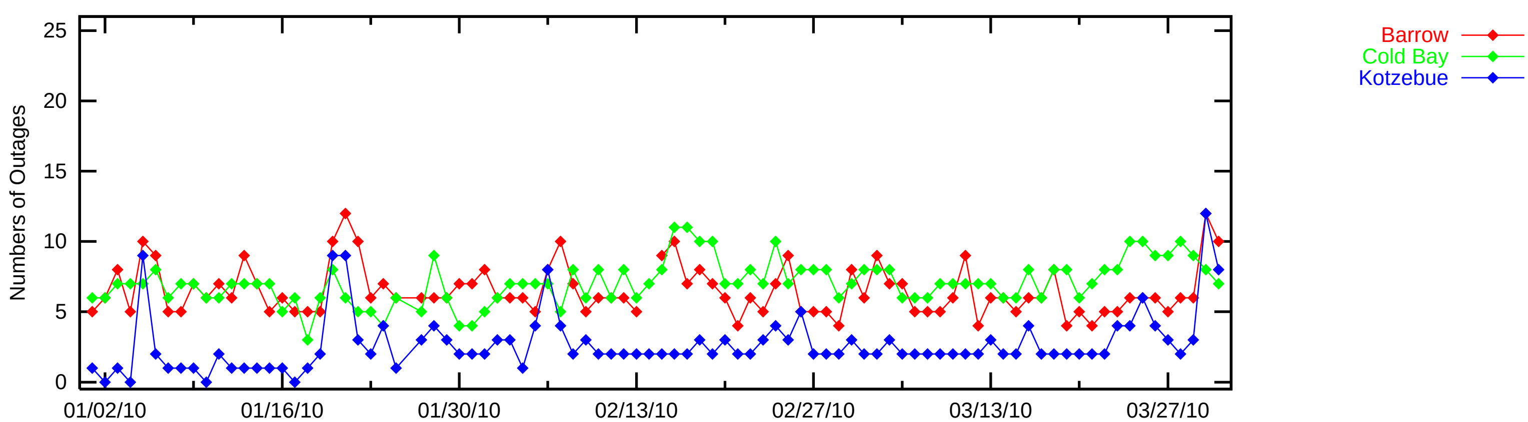
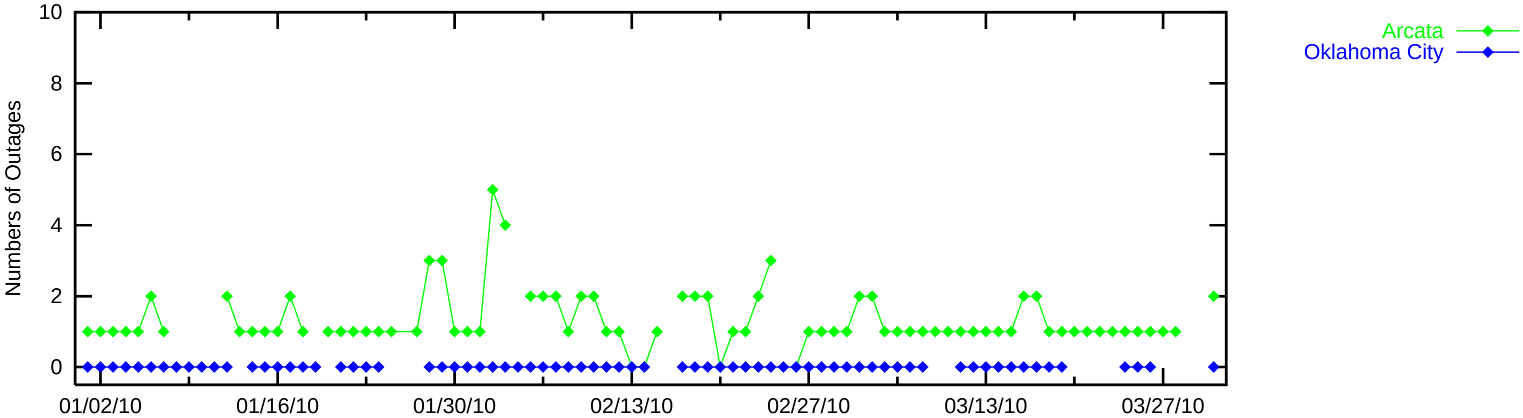
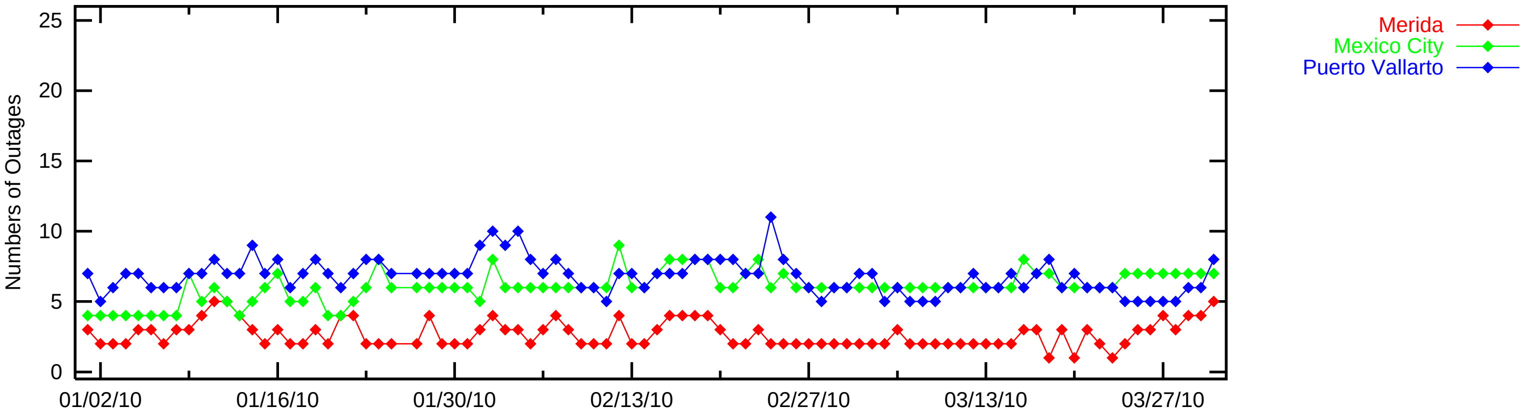
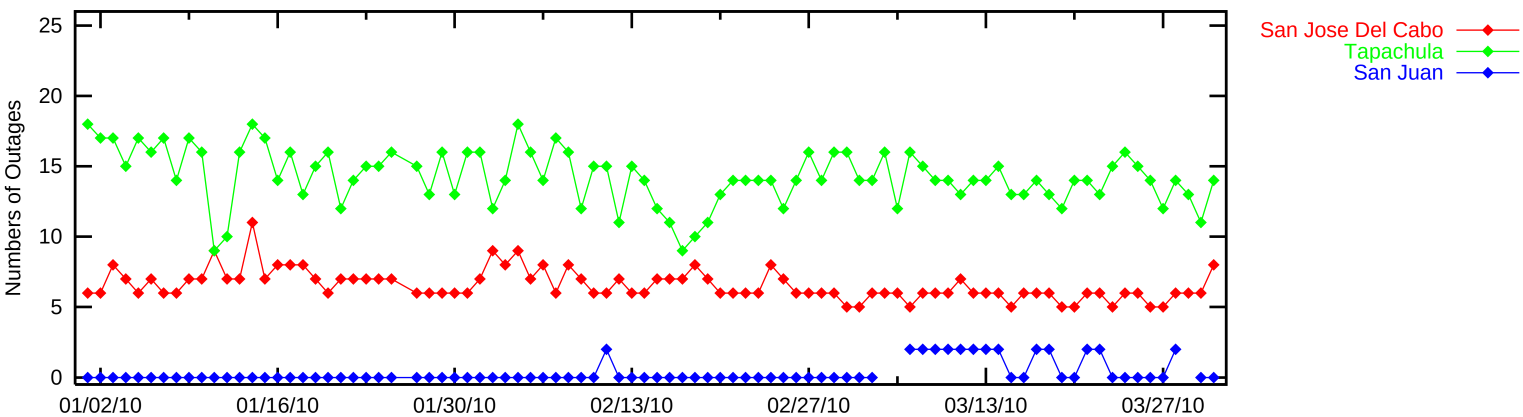
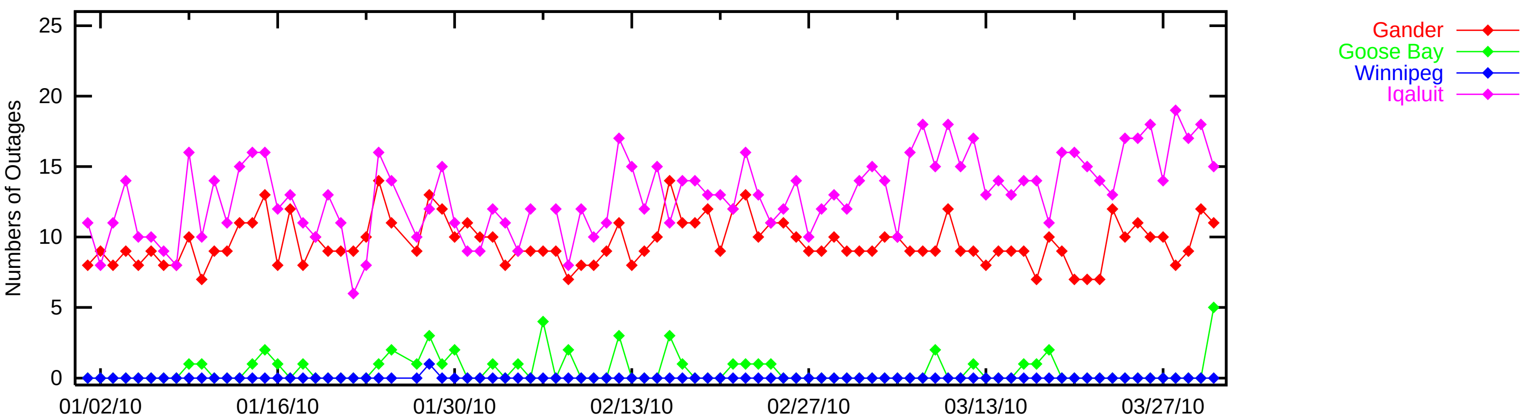


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)









4.0 COVERAGE

WAAS coverage area evaluation estimates the percent of service volume where WAAS is providing LPV, LPV 200, and NPA services. The WAAS message and the GPS/GEO satellite status are used to determine WAAS availability across North America. For PA coverage, protection levels were calculated at 30-sec intervals and at one degree spacing over the PA service volume, while NPA coverage were calculated at 30-sec intervals and five degree spacing over the NPA service volume.

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

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

During this evaluation period, low PA and NPA coverage are mainly due to satellite outages and GUS switchovers. Please refer Table 1.4 for events that affected coverage. GUS switchovers on 1/5/10 and 1/20/10 to 1/22/10 affected Alaska and RNP coverage. PRN 30 outage on 1/19/10 affected mostly Alaska LPV200 coverage. PRN 4 outage on 1/26/10 affected mainly CONUS LPV coverage (see DR #89.). PRN 7 outage on 1/28/10 affected Alaska coverage. PRN 26 outage on 2/8/10 affected CONUS LPV200 coverage. PRN 20 outage from 2/15/10 to 2/19/10 affected RNP and LPV coverage. PRN 30 outage from 2/23/10 to 2/24/10 affected LPV coverage. PRN 32 outage on 3/16/10 affected mainly Alaska LPV200 coverage. PRN 22 outage on 3/31/10 affected RNP and Alaska coverage. A combination of PRN 32 outage and maintenance at Littleton GUS on 2/26/10 caused 3 SIS outages that affected coverage (see DR #90).

Figure 4-1 LP North America Coverage for the Quarater

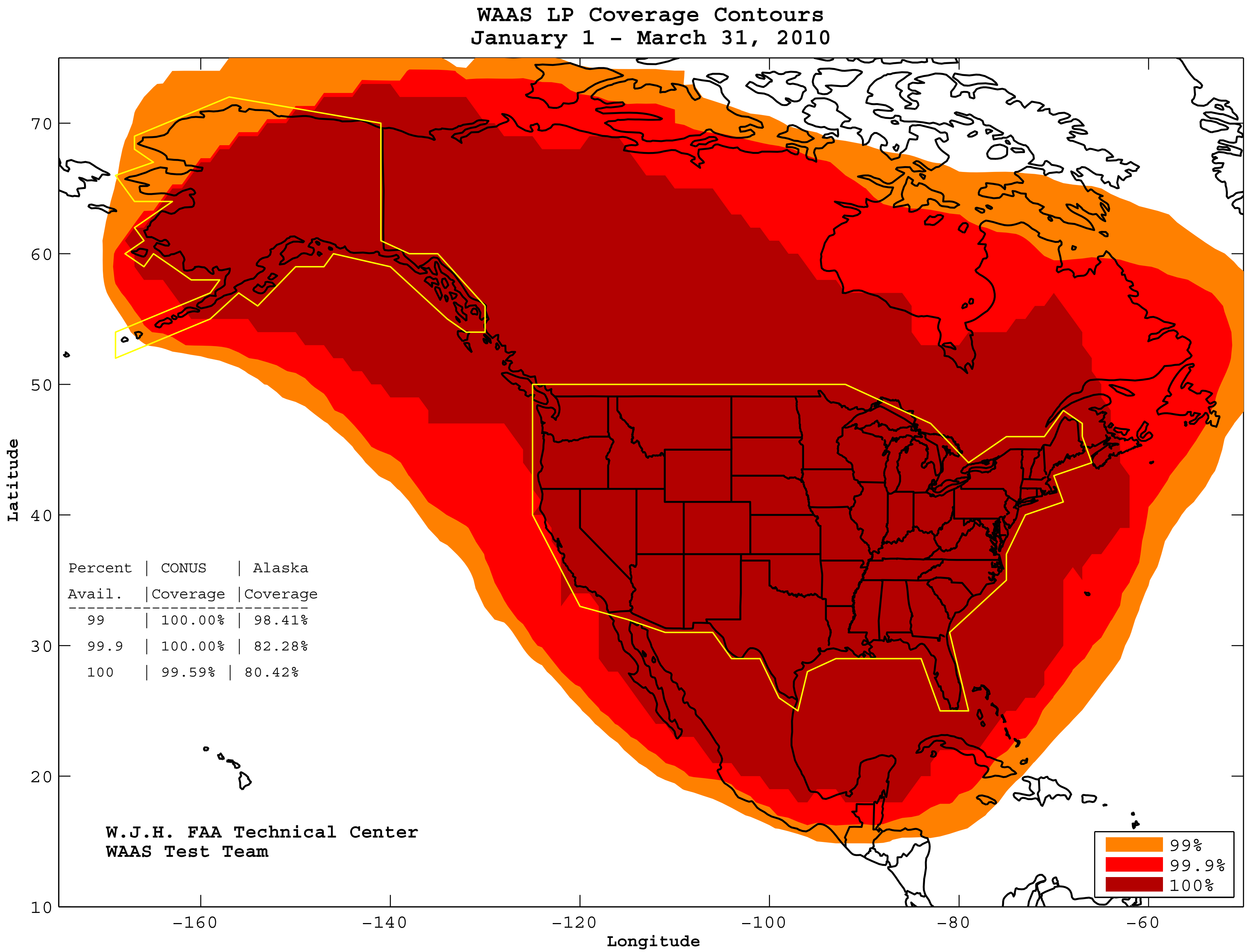


Figure 4-2 LPV North America Coverage for the Quarter

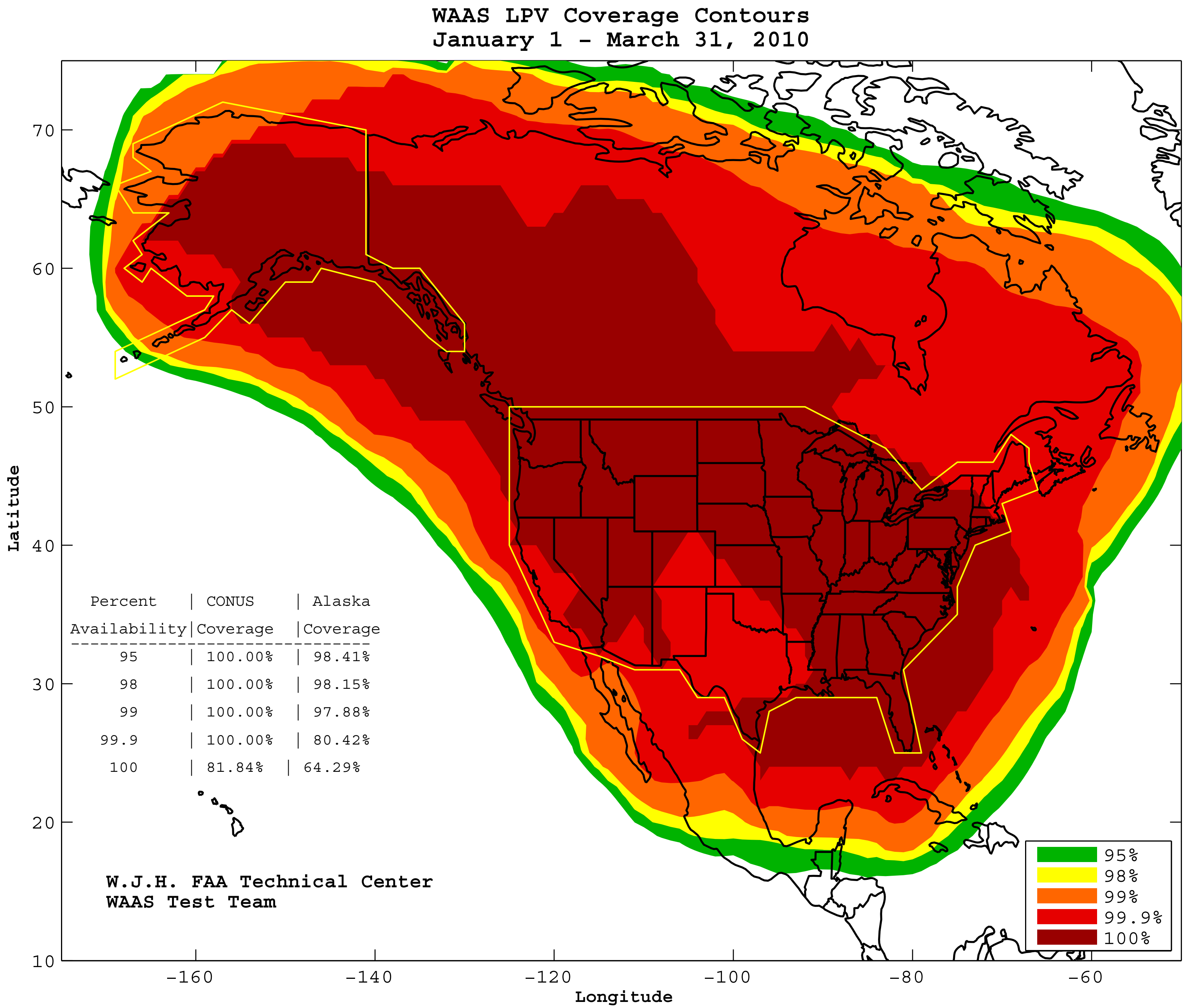


Figure 4-3 LPV 200 North America Coverage for the Quarter

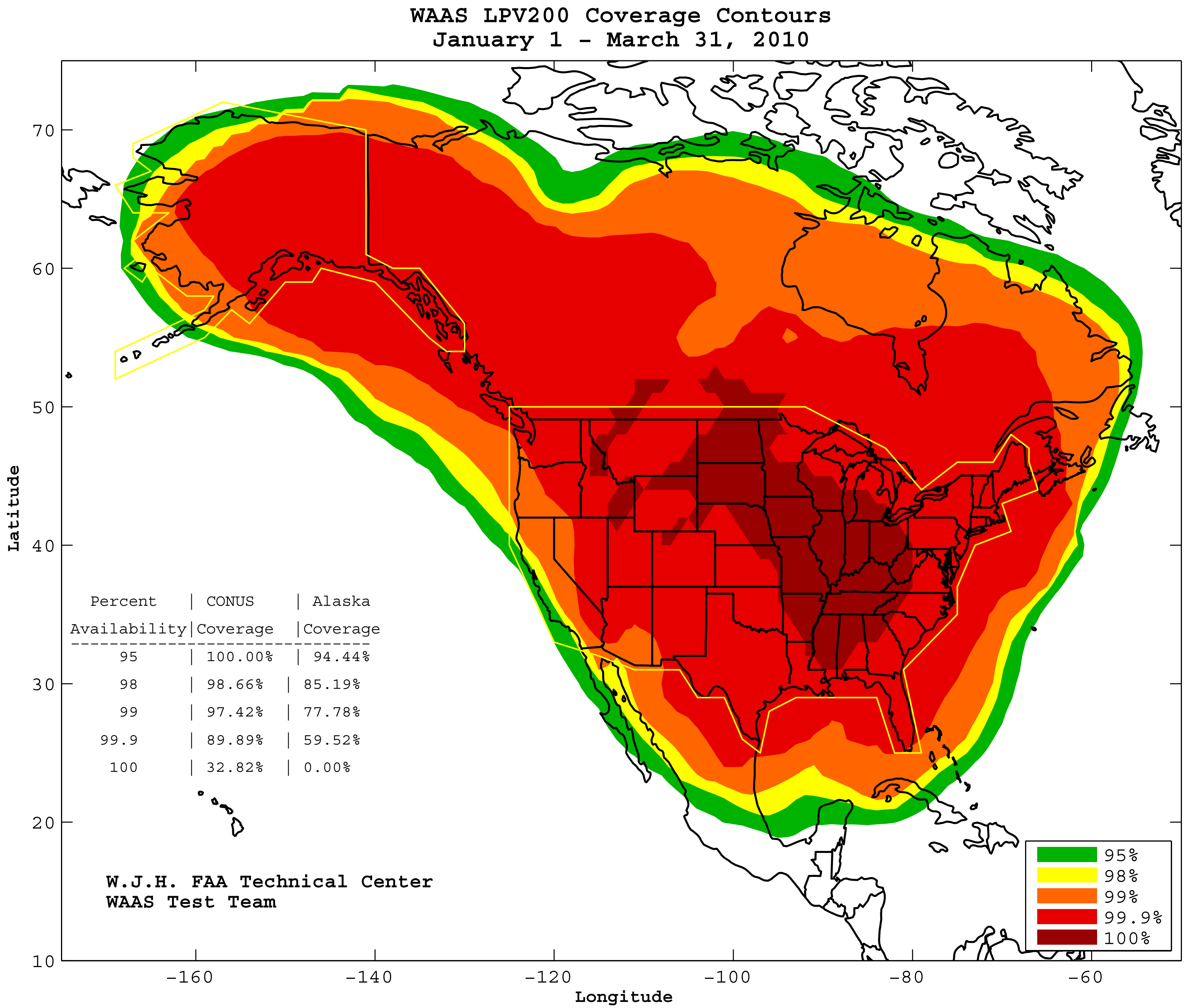


Figure 4-4 RNP 0.1 World Coverage for the Quarter

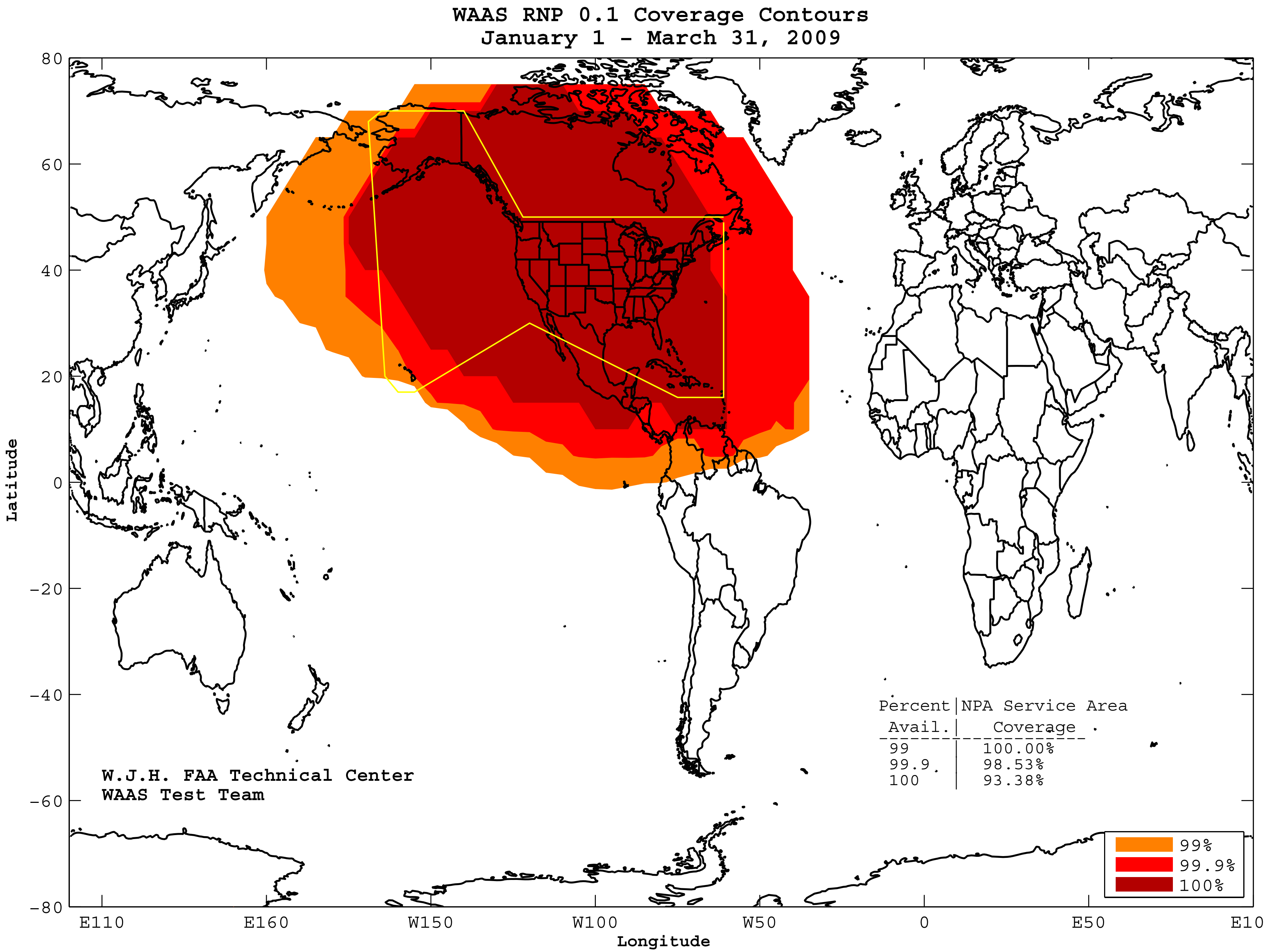


Figure 4-5 RNP 0.3 World Coverage for the Quarter

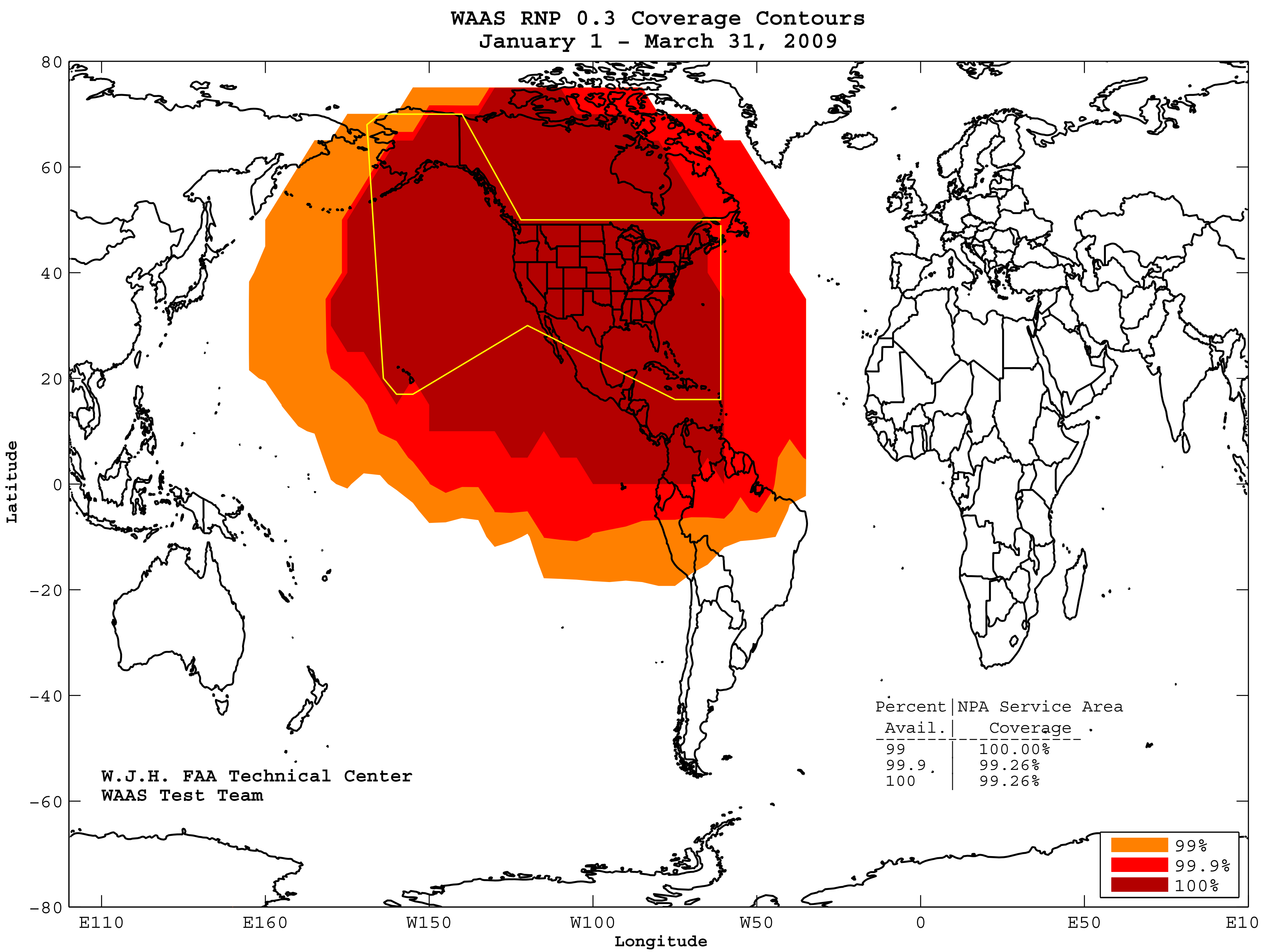


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

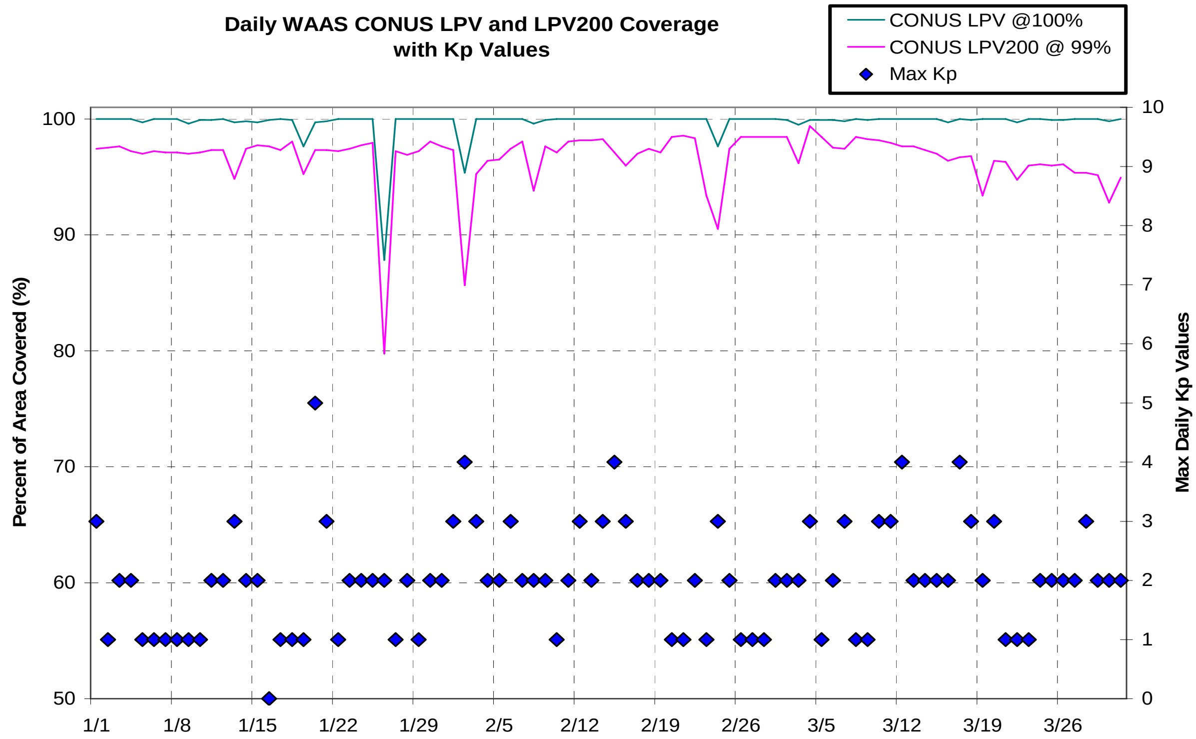


Figure 4-7 Daily LPV Alaska Coverage

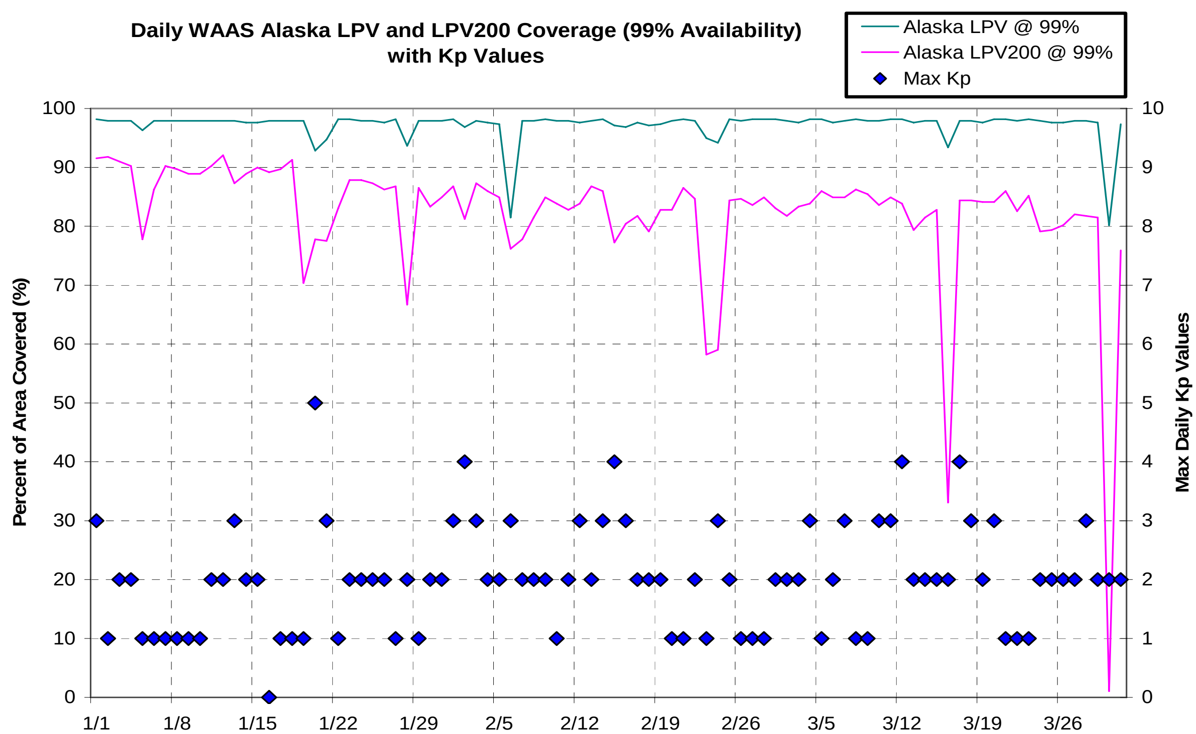
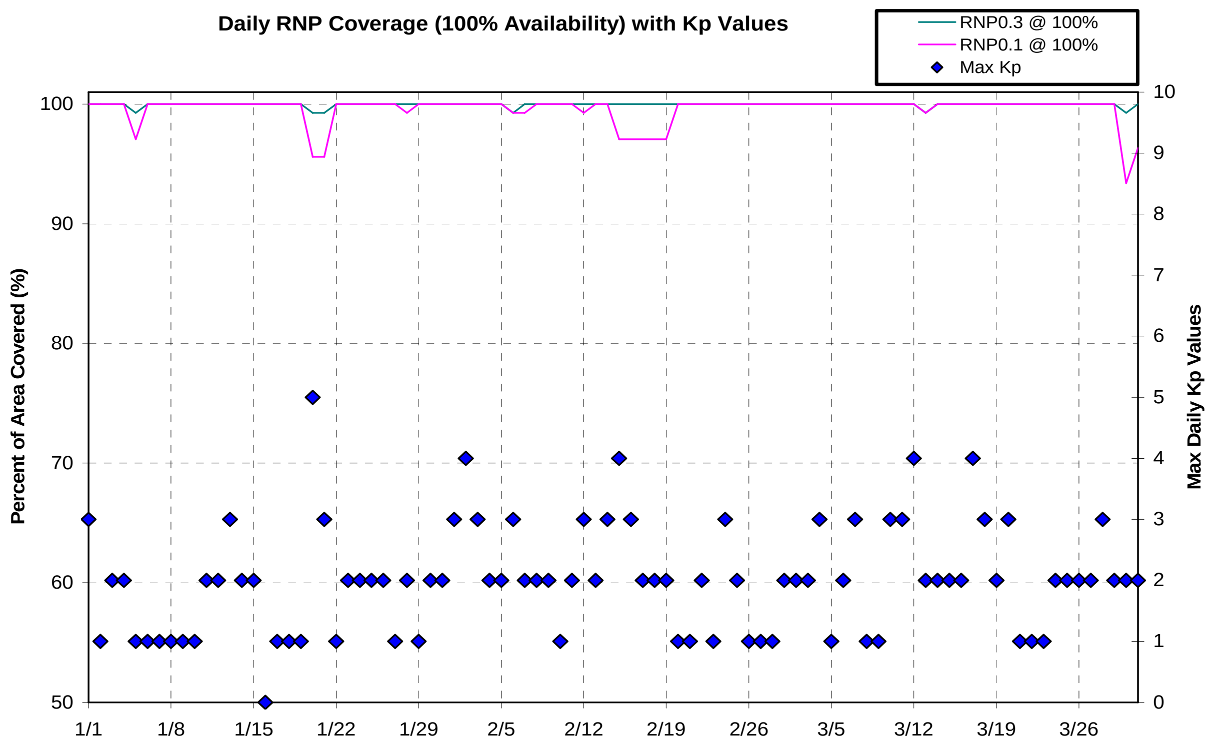


Figure 4-8 Daily RNP Coverage



5.0 INTEGRITY

5.1 HMI Analysis

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

Table 5.1 lists the safety index and the number of HMIs. For this evaluation period, the lowest safety margin index is 3.56 at Oakland. There was no HMI event. Since WAAS was made available to the public in August 2000 there has not been an HMI event. WAAS was commissioned by the FAA for safety of life services in July 2003.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		
	Horizontal	Vertical	Number of HMIs
Arcata	4.59	7.24	0
Oklahoma City	4.69	7.09	0
Albuquerque	8.32	13.89	0
Anchorage	7.09	7.36	0
Atlanta	6.89	5.69	0
Barrow	4.22	5.63	0
Bethel	15.64	11.49	0
Billings	5.21	11.64	0
Boston	6.05	7.62	0
Chicago	7.34	7.65	0
Cleveland	5.03	6.85	0
Cold Bay	9.45	11.12	0
Dallas	7.94	5.24	0
Denver	6.26	4.88	0
Fairbanks	9.17	13.09	0
Gander	11.12	11.47	0
Goose Bay	9.88	9.32	0
Houston	7.00	5.75	0
Iqaluit	6.94	5.57	0
Jacksonville	6.23	7.20	0
Juneau	4.95	9.63	0
Kansas City	12.88	6.84	0
Kotzebue	9.07	8.98	0
Los Angeles	7.13	15.12	0
Memphis	6.20	6.40	0
Merida	8.91	7.75	0
Mexico City	13.79	10.11	0
Miami	7.31	5.61	0
Minneapolis	6.27	9.28	0
New York	8.17	7.43	0
Oakland	3.56	5.78	0
Puerto Vallarta	9.55	9.24	0
Salt Lake City	5.74	12.75	0
San Jose Del Cabo	8.84	10.83	0
San Juan	12.71	9.09	0
Seattle	4.10	5.25	0
Tapachula	13.47	8.93	0
Washington DC	7.34	8.33	0
Winnipeg	7.85	7.15	0

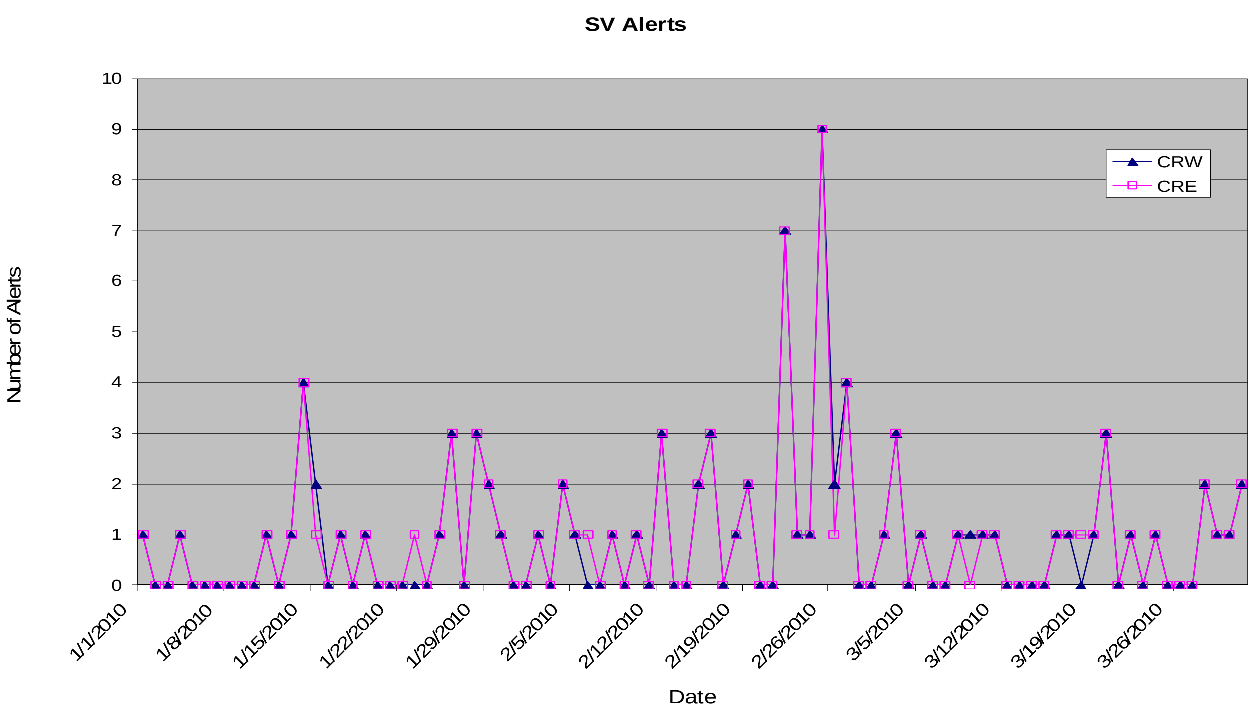
5.2 Broadcast Alerts

The WAAS transmits alert messages to protect the users from satellite degradation or severe ionospheric activity, both of which can cause unsafe conditions for a user. Space Vehicle (SV) alerts increase the User Differential Range Error (UDRE) of satellites, which can reduce the weighting of the satellite in the navigation solution, or completely exclude it from the navigation solution. An increase in UDRE's after an alert effectively increases the user protection levels (HPL and VPL), which affect the availability. Additionally, if an alert message sequence lasts for more than 12 seconds, WAAS fast corrections can time out, causing a loss of continuity. Table 5.2 shows the total number of alerts and the average number of alerts per day. Figure 5.1 shows the number of SV alerts that occurred daily during the reporting period. Often the number of alerts on one GEO is the same as the number of alerts on the other GEO. Therefore, lines tend to overlap in most points on this plot.

Table 5-2 WAAS SV Alert

	Number of Alerts		Average Alerts Per Day	
Message Type	**CRW**	**CRE**	**CRW**	**CRE**
2	24	24	0.2667	0.2667
3	48	47	0.5333	0.5222
4	14	15	0.1556	0.1667
5	0	0	0	0
6	0	0	0	0
24	0	0	0	0
26	0	0	0	0
Total Alerts	86	86	0.9556	0.9556

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (CRE and CRW)

For an accurate and current user position to be calculated, the content of the WAAS message must be broadcast and received within precise time specifications. This aspect of the WAAS is critical to maintaining integrity requirements. Each message type in the WAAS SIS has a specific amount of time for which it must be received anew. Although the content of every message is relevant to the functionality of the system, the importance of different messages varies along with the frequency with which they must be received. Table 5.3 lists the maximum intervals at which each message must broadcast to meet system requirements.

GUS switchovers or broadcast WAAS alerts can interrupt the normal broadcast message stream. If these events occur at a time when the maximum interval of a specific message is approaching, that message may be delayed, resulting in its late transmittal.

Late messages statistics reported during the quarter were mainly caused by GEO SIS outages, GUS switchovers and SV alerts except message type 7 and 10. Occasionally, message type 7 and 10 were late and they were not caused by GEO SIS outages, GUS switchovers or SV alerts. The lateness of type 7 and type 10 messages has little or no impact on user performance and safety.

Tables 5.4 to 5.8 show fast correction, long correction, ephemeris covariance, ionosphere correction, and ionospheric mask message rates statistics broadcasted on CRW. Table 5.9 to 5.13 show message rates statistics broadcasted on CRE.

Table 5-3 Update Rates for WAAS Messages

Data	**Associated Message Types**	**Maximum Update Interval** (seconds)	**En Route, Terminal, NPA Timeout** (seconds)	**Precision Approach Timeout** (seconds)
WAAS in Test Mode	0	6	N/A	N/A
PRN Mask	1	60	None	None
UDREI	2-6, 24	6	18	12
Fast Corrections	2-5, 24	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C	See Table A-8 in RTCA DO-229C
Long Term Corrections	24, 25	120	360	240
GEO Nav. Data	9	120	360	240
Fast Correction Degradation	7	120	360	240
Weighting Factors	8	120	240	240
Degradation Parameters	10	120	360	240
Ionospheric Grid Mask	18	300	None	None
Ionospheric Corrections	26	300	600	600
UTC Timing Data	12	300	None	None
Almanac Data	17	300	None	None

Table 5-4 WAAS Fast Correction and Degradation Message Rates – CRW

Message Type	On Time	Late	Max Late Length (seconds)
1	105443	4	19162
2	1292154	52	19117
3	1292255	34	19114
4	1292129	55	19114
7	97881	8	19150
9	90849	3	19276
10	97879	7	19155
17	30900	4	19193

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

SV	On Time	Late	Max Late Length (seconds)
2	46846	1	121
3	50115	2	156
4	47642	2	168
5	47915	0	0
6	50715	0	0
7	47056	0	0
8	46567	0	0
9	45390	0	0
10	48004	0	0
11	51482	0	0
12	48607	1	768
13	47116	1	137
14	47997	1	138
15	50026	0	0
16	48235	0	0
17	46841	1	164
18	47116	0	0
19	50319	1	168
20	47595	1	151
21	46446	0	0
22	47807	0	0
23	46671	1	144
24	47042	0	0
26	46790	0	0
27	51698	0	0
28	47721	0	0
29	47087	2	3158
30	48948	0	0
31	48405	0	0
32	47656	1	139

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

SV	On Time	Late	Max Late Length (seconds)
2	38456	1	829
3	41150	2	3225
4	39123	0	0
5	39337	0	0
6	41625	2	3224
7	38596	1	3224
8	38252	0	0
9	37255	0	0
10	39404	0	0
11	42237	0	0
12	39943	2	829
13	38710	0	0
14	39426	1	935
15	41049	1	936
16	39644	0	0
17	38492	0	0
18	38668	0	0
19	41282	2	153
20	39085	0	0
21	38095	0	0
22	39265	0	0
23	38328	1	3224
24	38604	1	128
26	38431	1	128
27	42490	1	936
28	39199	1	935
29	38705	1	3224
30	40239	0	0
31	39698	0	0
32	39142	2	3122
135	74245	1	135
138	73753	3	19239

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26916	6	19310
0	1	26906	5	19310
0	2	26894	11	19312
1	0	26910	11	19325
1	1	26914	6	19316
1	2	26920	7	19310
1	3	26918	5	19306
1	4	26903	5	19648
2	0	26907	10	19653
2	1	26910	7	19646
2	2	26912	5	19642
2	3	26911	6	19639
2	4	26936	6	19359
2	5	26914	7	19341
3	0	26909	8	19317
3	1	26913	8	19337
3	2	26916	9	19352
9	0	26909	8	19330
9	1	26915	10	19328
9	2	26915	7	19317
9	3	26897	8	19317
9	4	26913	8	19310
9	5	26921	8	19299
9	6	26914	11	19305

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

Band	On Time	Late	Max Late Length (seconds)
0	35255	3	19425
1	35221	4	19281
2	35239	4	19312
3	35198	3	19330
9	35189	3	19366

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

Message Type	On Time	Late	Max Late Length (seconds)
0	76	8	442289
1	105579	1	121
2	1295965	55	31
3	1296067	33	27
4	1295940	57	28
7	98163	7	172
9	91121	0	0
10	98213	1	121
17	31017	3	519

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

SV	On Time	Late	Max Late Length (seconds)
2	46945	0	0
3	50329	1	165
4	47742	1	182
5	48074	0	0
6	50910	0	0
7	47322	0	0
8	46807	0	0
9	45473	1	127
10	48172	0	0
11	51707	0	0
12	48620	0	0
13	47341	1	181
14	48039	1	138
15	50206	0	0
16	48386	0	0
17	46983	0	0
18	47226	1	165
19	50545	2	186
20	47737	0	0
21	46604	0	0
22	47903	3	168
23	46849	0	0
24	47161	1	127
26	46844	0	0
27	51809	0	0
28	47935	1	134
29	47138	1	181
30	49001	0	0
31	48465	0	0
32	47773	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	38542	0	0
3	41328	1	169
4	39203	0	0
5	39464	0	0
6	41788	1	121
7	38818	0	0
8	38446	0	0
9	37333	1	152
10	39527	1	206
11	42422	2	171
12	39957	2	169
13	38891	1	121
14	39452	3	176
15	41187	0	0
16	39754	1	207
17	38605	2	129
18	38756	3	181
19	41470	2	208
20	39215	2	129
21	38211	0	0
22	39344	2	208
23	38463	2	211
24	38721	2	206
26	38459	1	128
27	42569	4	176
28	39382	1	171
29	38753	0	0
30	40256	1	123
31	39762	2	169
32	39225	1	124
135	65752	2	211
138	74023	2	170

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	26995	6	546
0	1	26993	4	543
0	2	26977	6	576
1	0	26988	4	537
1	1	27010	3	535
1	2	26993	5	529
1	3	26998	1	301
1	4	27004	2	390
2	0	26995	3	384
2	1	26994	3	379
2	2	27004	1	360
2	3	26997	4	372
2	4	27007	6	383
2	5	26993	4	337
3	0	26993	4	348
3	1	27003	2	372
3	2	26995	6	383
9	0	26992	5	361
9	1	26997	3	531
9	2	26998	6	525
9	3	26996	4	578
9	4	26993	4	482
9	5	26989	4	576
9	6	26999	3	500

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

Band	On Time	Late	Max Late Length (seconds)
0	35344	3	373
1	35326	2	446
2	35354	1	342
3	35337	1	409
9	35358	1	364

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.

Satellite PRN 18 range errors at Miami reference receiver were not bounded for short periods of time on three different days during the evaluation period. The PRN 18 signal mulipath and receiver measurement noise on L1 and L2 frequencies at Miami contributed to increase the estimated range error to 4 meters which exceeded the UDRE threshold for 1124 seconds on 1/11/2010, 2 seconds on 1/12/2010 and 168 seconds on 3/4/2010. Local environmental affects at the antenna location in Miami is the suspected cause of the multipath and range unbounding since the range errors for PRN 18 were continuously bounded at all other locations at the times of the events.

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.599	100	1.099	100	1.734	100	1.673	100	2.499	100	1.246	100
3	0.885	100	1.392	100	1.403	100	0.966	100	0.946	100	1.225	100
4	1.571	100	1.840	100	1.491	100	1.323	100	1.899	100	1.677	100
5	1.926	100	1.536	100	1.042	100	1.073	100	1.545	100	1.067	100
6	1.792	100	1.522	100	1.395	100	1.225	100	1.942	100	1.264	100
7	1.607	100	1.450	100	1.510	100	0.864	100	1.100	100	1.148	100
8	1.224	100	1.197	100	1.086	100	1.053	100	0.946	100	1.165	100
9	1.271	100	1.404	100	0.977	100	0.877	100	1.157	100	1.084	100
10	0.943	100	1.025	100	0.898	100	0.979	100	1.381	100	1.068	100
11	0.754	100	1.189	100	0.997	100	1.268	100	1.926	100	1.084	100
12	1.233	100	1.443	100	1.430	100	1.005	100	1.963	100	1.570	100
13	1.682	100	1.296	100	1.443	100	1.013	100	1.652	100	1.418	100
14	1.070	100	0.949	100	1.046	100	1.449	100	1.226	100	1.124	100
15	1.390	100	1.681	100	0.931	100	1.757	100	1.949	100	1.747	100
16	0.902	100	0.956	100	0.973	100	1.644	100	1.554	100	1.228	100
17	1.707	100	1.714	100	1.236	100	0.835	100	1.295	100	0.989	100
18	1.338	100	0.749	100	1.718	100	1.853	100	1.331	100	1.209	100
19	2.060	100	2.040	100	2.233	100	2.413	100	2.631	100	1.943	100
20	1.015	100	1.563	100	1.711	100	1.405	100	1.782	100	1.412	100
21	1.246	100	0.949	100	1.566	100	1.812	100	1.305	100	1.326	100
22	1.422	100	0.884	100	1.904	100	2.059	100	1.944	100	1.420	100
23	1.501	100	1.452	100	2.097	100	2.232	100	2.155	100	1.836	100
24	2.112	100	1.901	100	1.922	100	1.036	100	1.733	100	1.512	100
25	-	-	-	-	-	-	-	-	-	-	-	-
26	1.639	100	1.658	100	0.930	100	0.923	100	2.076	100	1.627	100
27	1.209	100	1.443	100	0.922	100	1.115	100	1.380	100	1.493	100
28	0.848	100	0.879	100	1.084	100	1.339	100	1.864	100	0.921	100
29	1.383	100	1.647	100	1.068	100	1.120	100	1.543	100	1.488	100
30	1.422	100	1.575	100	1.299	100	1.151	100	1.595	100	2.041	100
31	1.283	100	1.453	100	1.146	100	1.019	100	2.476	100	1.333	100
32	1.258	100	0.934	100	1.136	100	1.359	100	1.364	100	1.218	100
135	2.268	100	1.595	100	2.690	100	1.937	100	2.340	100	1.548	100
138	1.380	100	1.420	100	1.574	100	1.613	100	2.759	100	1.590	100

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

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	2.158	100	1.417	100	1.993	100	1.553	100	1.160	100	1.523	100
3	0.886	100	1.047	100	1.018	100	1.596	100	1.229	100	1.115	100
4	1.606	100	1.359	100	2.004	100	1.472	100	1.906	100	1.435	100
5	0.922	100	1.711	100	1.271	100	1.869	100	1.577	100	1.212	100
6	1.484	100	1.653	100	1.384	100	1.275	100	1.604	100	1.420	100
7	1.123	100	1.477	100	2.133	100	1.532	100	1.468	100	1.416	100
8	0.863	100	1.094	100	1.404	100	1.678	100	1.344	100	1.092	100
9	1.204	100	1.726	100	1.323	100	1.175	100	1.851	100	1.336	100
10	0.995	100	0.847	100	1.490	100	0.973	100	1.082	100	0.950	100
11	1.071	100	1.034	100	1.510	100	1.199	100	0.975	100	1.368	100
12	0.877	100	1.076	100	1.748	100	1.621	100	1.538	100	1.046	100
13	0.930	100	1.774	100	1.249	100	1.310	100	1.534	100	1.294	100
14	1.084	100	1.089	100	2.092	100	0.893	100	0.942	100	0.824	100
15	1.233	100	1.227	100	1.042	100	1.305	100	1.866	100	1.409	100
16	1.439	100	1.047	100	2.353	100	1.216	100	1.054	100	0.938	100
17	1.054	100	0.948	100	1.295	100	0.974	100	1.377	100	0.966	100
18	1.206	100	1.100	100	2.630	99.9830	1.222	100	1.269	100	1.131	100
19	2.457	100	2.333	100	2.768	100	2.615	100	2.040	100	2.621	100
20	1.249	100	1.350	100	1.885	100	1.192	100	1.127	100	1.099	100
21	1.483	100	0.985	100	2.500	100	1.284	100	1.201	100	1.159	100
22	1.666	100	1.621	100	2.834	100	1.218	100	1.410	100	1.433	100
23	1.814	100	1.753	100	2.760	100	1.499	100	1.581	100	1.661	100
24	1.359	100	1.743	100	1.298	100	1.732	100	1.775	100	1.651	100
25	-	-	-	-	-	-	-	-	-	-	-	-
26	1.206	100	1.304	100	2.174	100	1.316	100	1.370	100	1.301	100
27	1.396	100	1.570	100	1.219	100	1.257	100	1.673	100	1.378	100
28	0.984	100	0.902	100	2.408	100	0.790	100	0.852	100	0.730	100
29	0.908	100	1.778	100	1.563	100	1.645	100	1.567	100	1.415	100
30	1.657	100	1.364	100	1.399	100	1.642	100	2.328	100	1.454	100
31	0.941	100	0.926	100	1.971	100	0.817	100	1.122	100	1.008	100
32	0.891	100	1.045	100	1.451	100	1.220	100	1.145	100	0.976	100
135	1.813	100	1.451	100	1.784	100	2.067	100	2.123	100	1.576	100
138	2.189	100	1.637	100	2.466	100	1.590	100	1.453	100	1.541	100

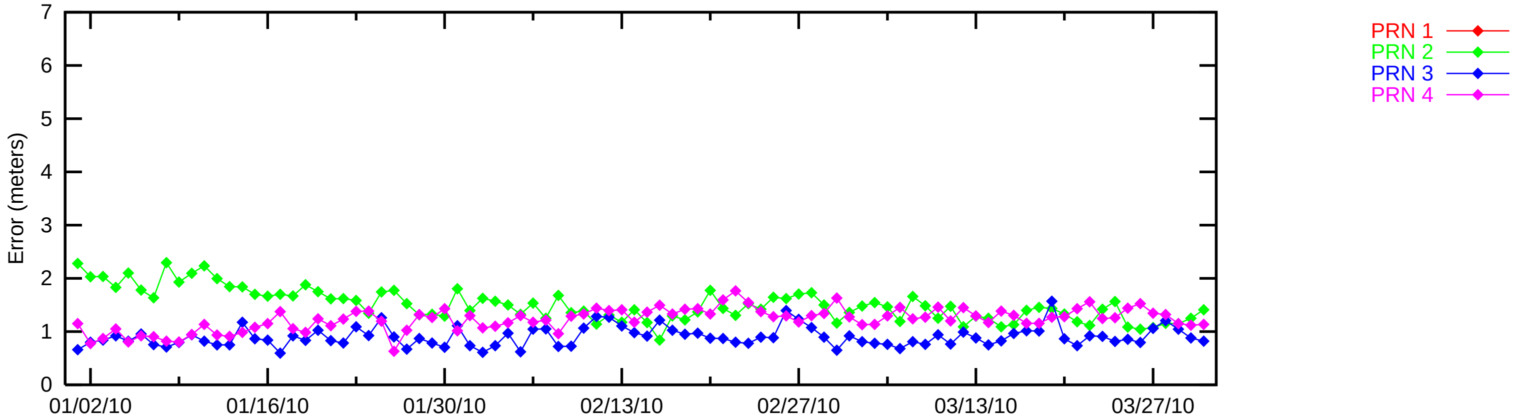
Table 6-3 Ionospheric Error 95% index and 3.29 Sigma Bounding

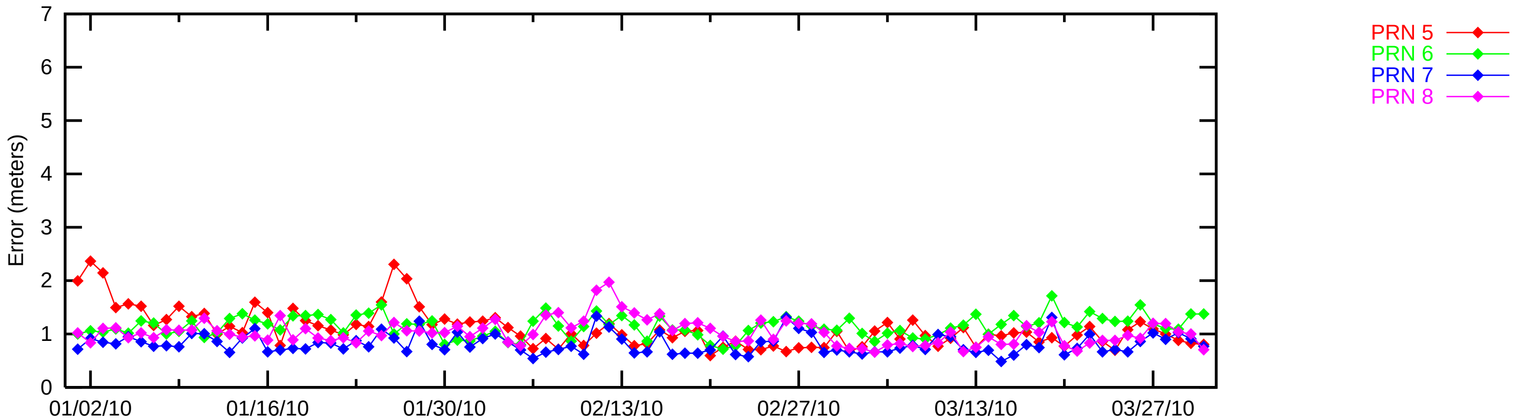
Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.327	100	0.819	100	1.254	100	1.129	100	1.282	100	0.878	100
3	0.302	100	0.667	100	0.583	100	0.427	100	0.591	100	0.614	100
4	0.935	100	1.271	100	1.144	100	1.112	100	1.350	100	1.408	100
5	0.927	100	0.879	100	0.621	100	0.517	100	0.907	100	0.616	100
6	0.653	100	0.769	100	0.535	100	0.727	100	1.151	100	0.610	100
7	0.882	100	0.845	100	0.729	100	0.684	100	0.688	100	0.718	100
8	0.452	100	0.648	100	0.597	100	0.485	100	0.580	100	0.661	100
9	0.587	100	0.752	100	0.521	100	0.393	100	0.619	100	0.497	100
10	0.476	100	0.491	100	0.450	100	0.515	100	0.887	100	0.485	100
11	0.429	100	0.399	100	0.509	100	0.597	100	0.866	100	0.524	100
12	0.511	100	0.737	100	0.630	100	0.335	100	0.749	100	0.720	100
13	0.660	100	0.784	100	0.622	100	0.537	100	0.842	100	0.753	100
14	0.546	100	0.385	100	0.442	100	0.467	100	0.468	100	0.376	100
15	0.688	100	1.013	100	0.644	100	1.150	100	0.877	100	1.129	100
16	0.648	100	0.449	100	0.547	100	0.659	100	0.971	100	0.582	100
17	0.968	100	0.963	100	0.628	100	0.570	100	0.937	100	0.617	100
18	1.111	100	0.502	100	0.822	100	0.917	100	0.728	100	0.624	100
19	1.630	100	1.311	100	1.607	100	1.627	100	1.700	100	1.447	100
20	0.671	100	0.790	100	0.907	100	0.613	100	0.968	100	0.587	100
21	1.150	100	0.564	100	1.081	100	1.109	100	0.877	100	0.738	100
22	1.147	100	0.549	100	0.924	100	1.065	100	1.067	100	0.774	100
23	1.294	100	1.092	100	1.646	100	1.518	100	1.265	100	1.155	100
24	1.178	100	1.206	100	1.003	100	0.869	100	1.147	100	1.036	100
25	-	-	-	-	-	-	-	-	-	-	-	-
26	1.008	100	1.085	100	0.738	100	0.812	100	1.445	100	1.090	100
27	0.478	100	0.773	100	0.509	100	0.613	100	0.620	100	0.699	100
28	0.730	100	0.372	100	0.907	100	0.677	100	0.915	100	0.415	100
29	0.593	100	1.005	100	0.532	100	0.548	100	0.793	100	0.856	100
30	0.612	100	0.887	100	0.748	100	0.715	100	0.749	100	0.925	100
31	0.592	100	0.910	100	0.308	100	0.425	100	1.102	100	0.844	100
32	0.521	100	0.598	100	0.486	100	0.467	100	0.761	100	0.659	100

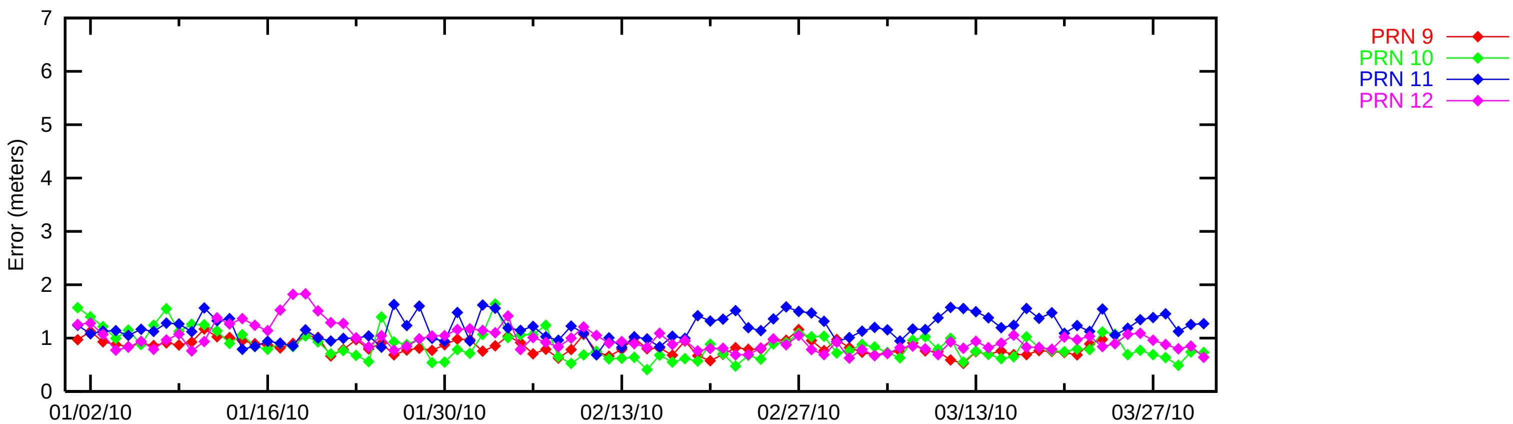
Table 6-4 Ionospheric Error 95% index and 3.29 Sigma Bounding

Site →	Los Angeles		Salt Lake City		Miami		Minneapolis		Atlanta		Juneau	
SV ↓	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.181	100	1.037	100	1.031	100	0.981	100	0.659	100	1.040	100
3	0.386	100	0.454	100	0.646	100	0.721	100	0.729	100	0.430	100
4	0.949	100	0.872	100	1.329	100	1.005	100	1.225	100	0.785	100
5	0.568	100	0.838	100	0.816	100	0.711	100	0.877	100	0.693	100
6	0.680	100	0.701	100	0.627	100	0.492	100	0.853	100	0.610	100
7	0.671	100	0.815	100	1.057	100	0.792	100	1.130	100	0.759	100
8	0.574	100	0.536	100	0.739	100	0.782	100	0.941	100	0.535	100
9	0.640	100	0.762	100	0.655	100	0.621	100	0.934	100	0.564	100
10	0.501	100	0.345	100	0.507	100	0.380	100	0.492	100	0.377	100
11	0.494	100	0.426	100	0.530	100	0.545	100	0.468	100	0.882	100
12	0.565	100	0.462	100	0.691	100	0.728	100	0.832	100	0.559	100
13	0.628	100	0.863	100	0.882	100	0.663	100	0.895	100	0.558	100
14	0.416	100	0.603	100	0.759	100	0.384	100	0.510	100	0.553	100
15	0.690	100	0.729	100	0.806	100	0.748	100	1.031	100	0.702	100
16	0.714	100	0.589	100	0.684	100	0.575	100	0.387	100	0.498	100
17	0.719	100	0.516	100	0.730	100	0.609	100	0.842	100	0.379	100
18	0.682	100	0.752	100	1.058	100	0.811	100	0.519	100	0.988	100
19	1.547	100	1.491	100	1.400	100	1.788	100	1.383	100	1.760	100
20	0.482	100	0.728	100	0.926	100	0.697	100	0.460	100	0.556	100
21	0.727	100	0.752	100	1.303	100	0.967	100	0.626	100	0.832	100
22	0.951	100	1.039	100	1.429	100	0.846	100	0.641	100	0.899	100
23	1.091	100	1.284	100	1.673	100	1.140	100	1.007	100	1.191	100
24	1.021	100	1.042	100	1.025	100	1.140	100	1.316	100	1.065	100
25	-	-	-	-	-	-	-	-	-	-	-	-
26	0.790	100	0.830	100	0.884	100	0.771	100	0.994	100	0.712	100
27	0.744	100	0.684	100	0.686	100	0.730	100	0.836	100	0.687	100
28	0.440	100	0.444	100	1.221	100	0.476	100	0.419	100	0.546	100
29	0.741	100	1.004	100	0.955	100	0.857	100	0.975	100	0.771	100
30	0.921	100	0.751	100	0.896	100	0.823	100	1.120	100	0.748	100
31	0.591	100	0.540	100	0.600	100	0.307	100	0.751	100	0.438	100
32	0.543	100	0.526	100	0.640	100	0.543	100	0.719	100	0.455	100

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







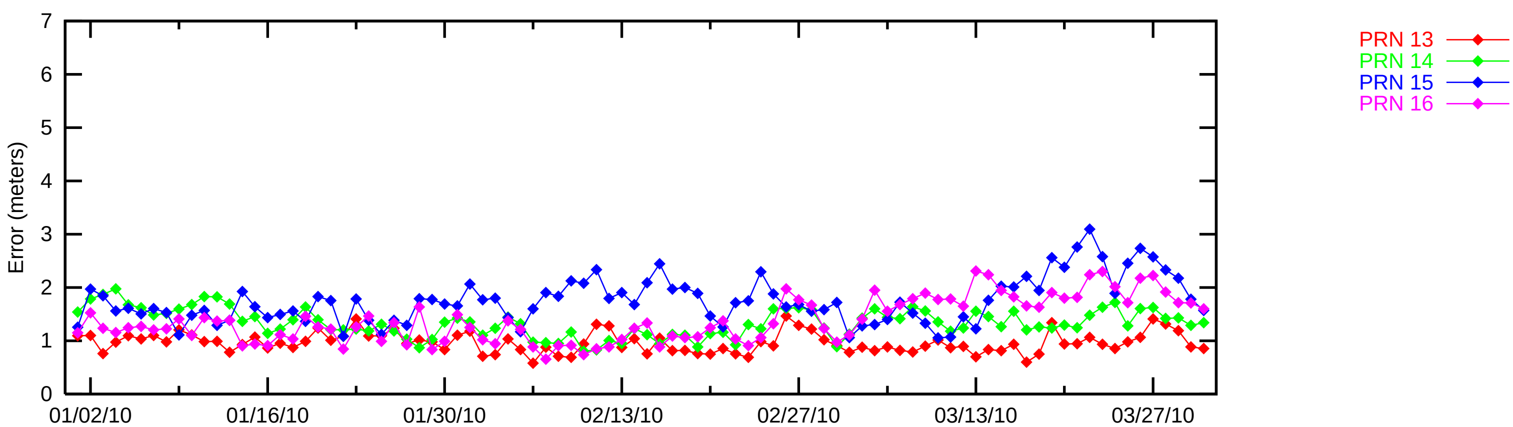


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Washington DC

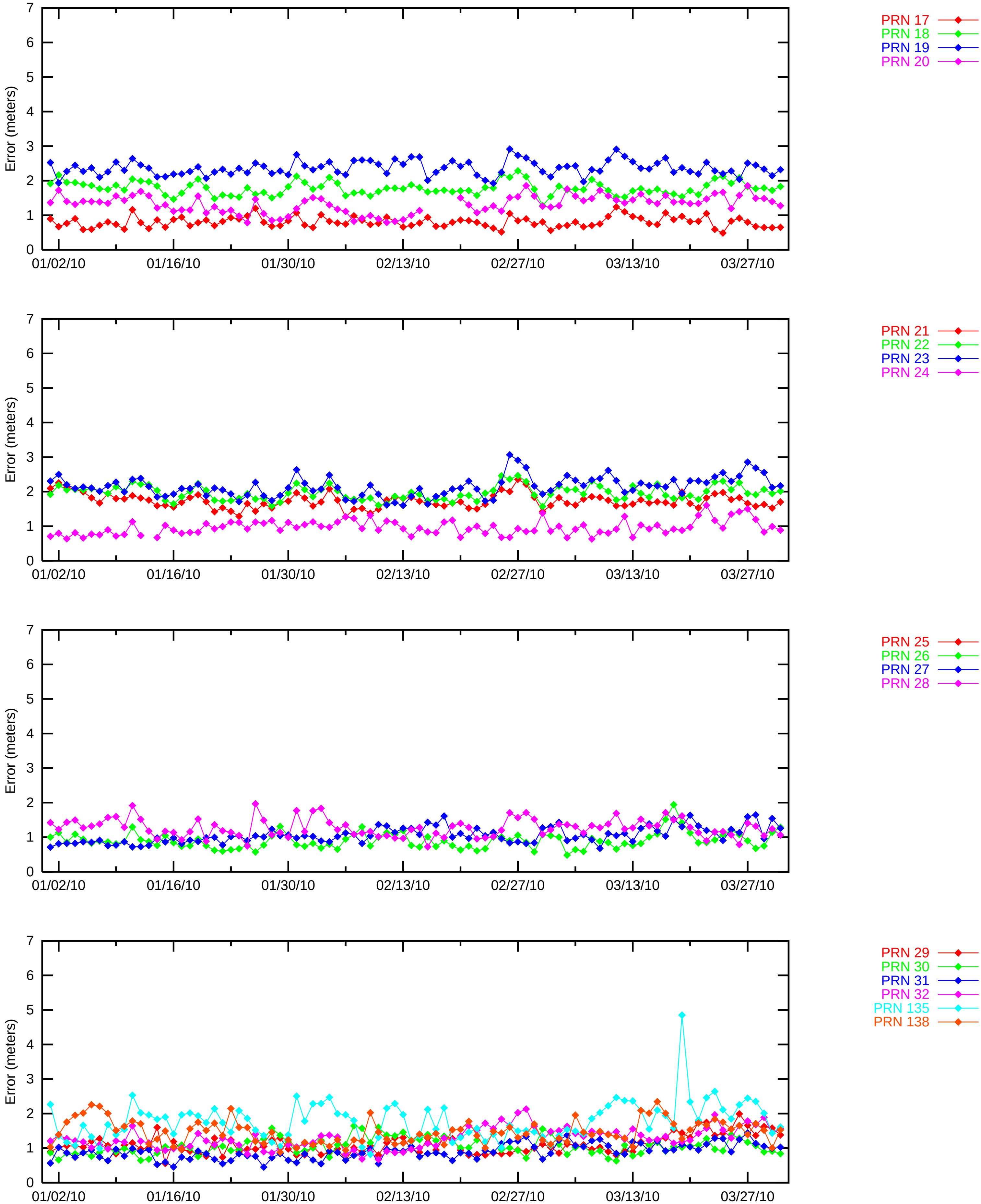
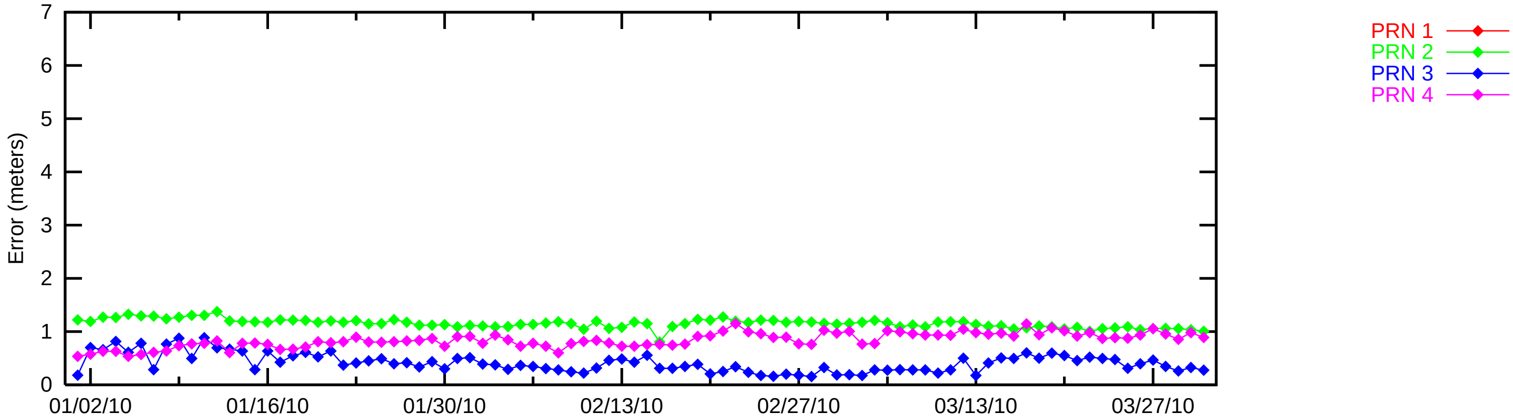
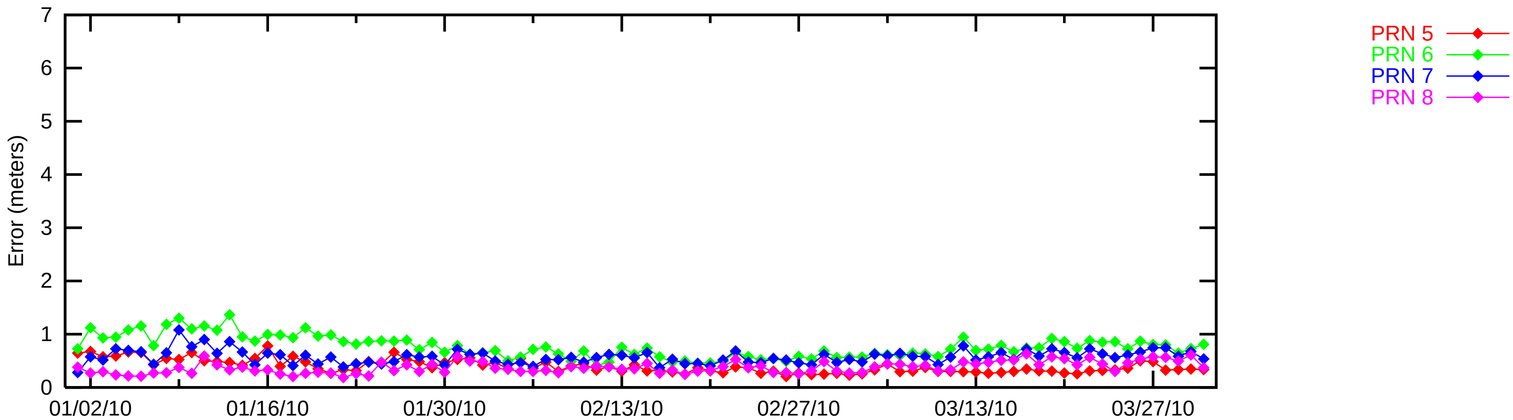
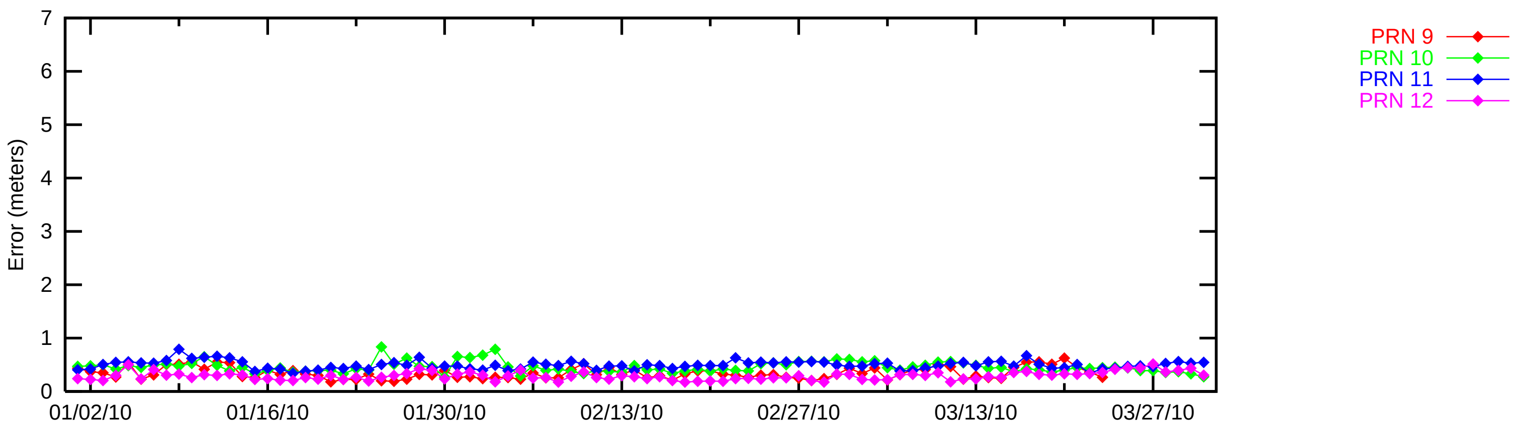


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Washington DC







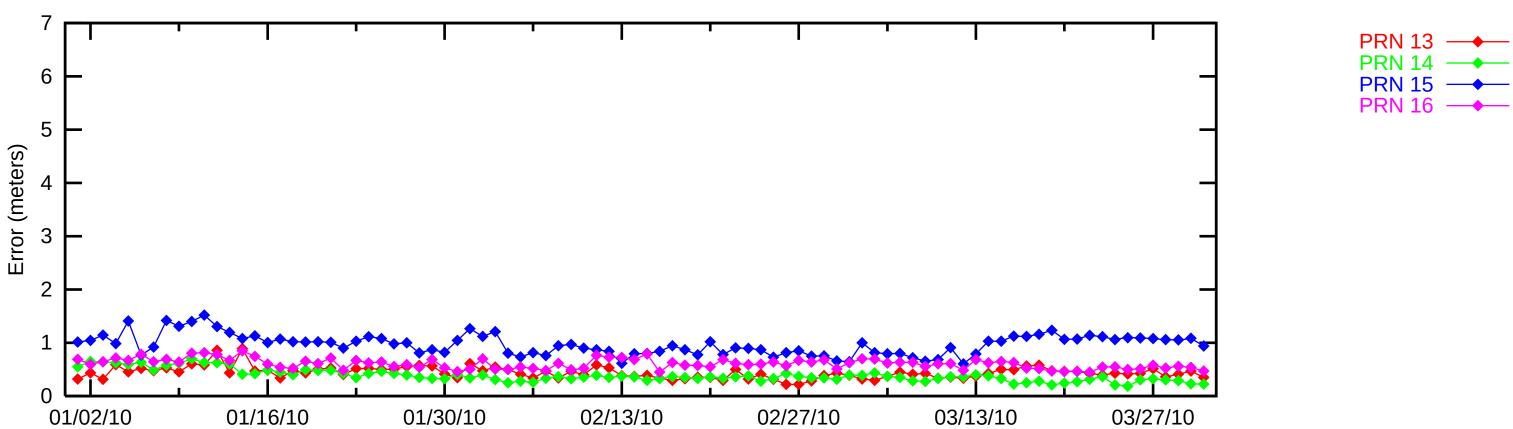
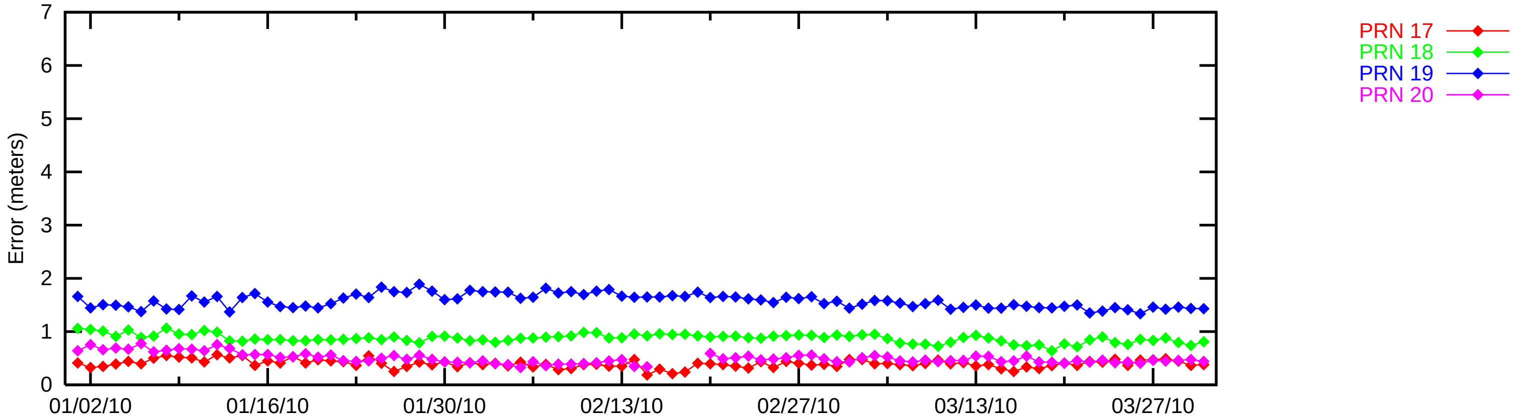
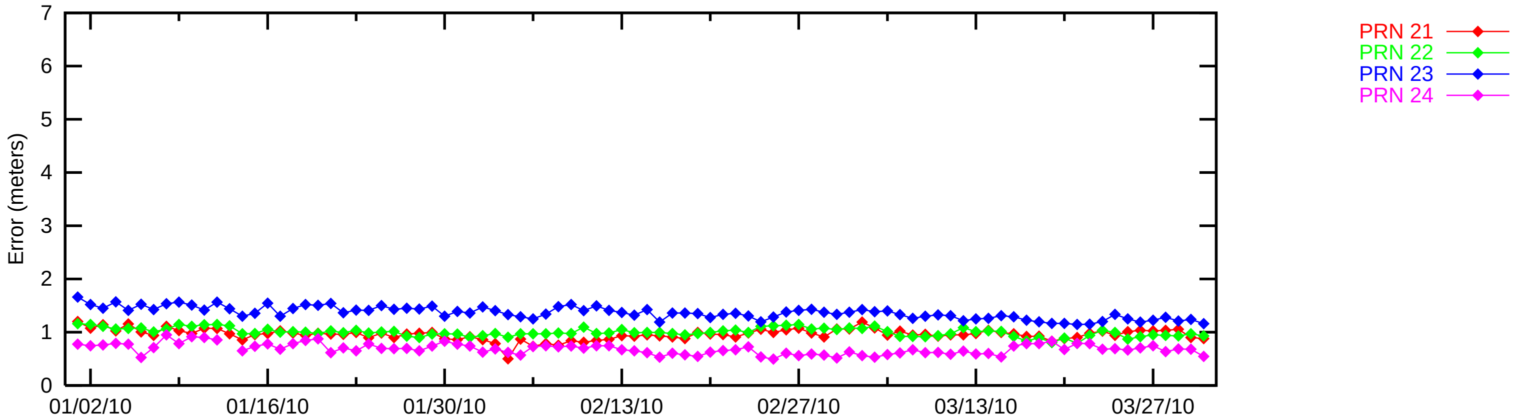
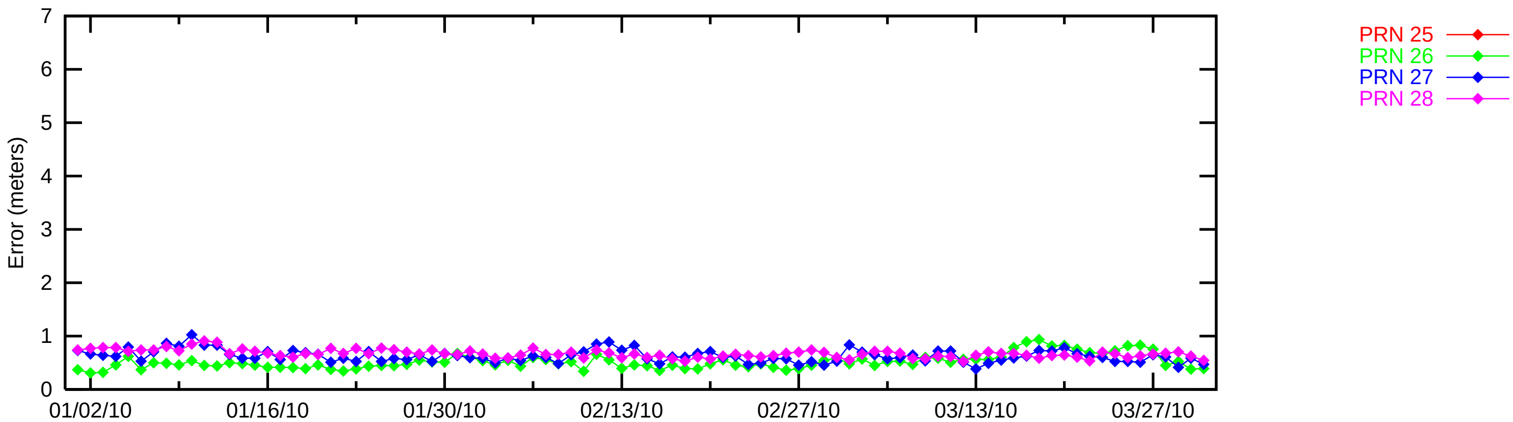
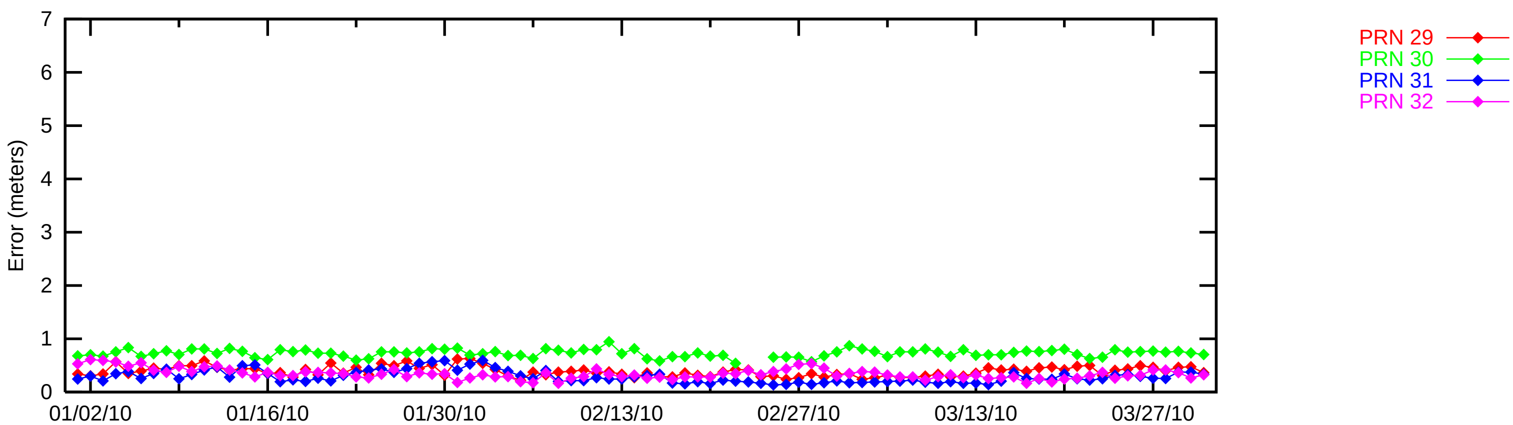


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Washington DC









7.0 GEO RANGING PERFORMANCE

WAAS GEO navigation messages provide corrections and UDRE values for each satellite. The GEO ranging availability from each GEO navigation message source was evaluated separately to determine the quality of service provided. For the evaluation period, both CRW (PRN 135) and CRE (PRN 138) GEO satellites provide ranging capability for enroute through NPA and PA service. Table 7.1 shows the GEO-Ranging performance for CRE and CRW GEO satellites throughout the evaluation period. Figure 7.1 shows the trend of CRW GEO PA Ranging Availability and Figure 7.2 shows the trend of CRE GEO PA Ranging Availability.

On 3/18/10, a ZDC C&V fault occurred, followed by CRE GUS switches and a ZTL C&V fault. ZDC returned to service and was set as the selected source. From 3/18/10 to 3/28/10 when ZDC was the selected source for CRE, the CRW UDRE reported by CRE was set to Not Monitored for most of the period causing low CRW PA ranging availability. This problem was corrected on 3/28/10 when the selected source for CRE was changed from ZDC to ZTL. See DR 91 CRE Reports High UDREs for CRW for more details.

Table 7-1 GEO Ranging Availability

GEO Source	GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
CRW 135	CRW	97.906	1.312	0.484	0
CRW135	CRE	96.593	1.918	0.672	0.519
CRE 138	CRW	86.313	1.539	12.144	0
CRE 138	CRE	96.965	1.911	0.603	0.517

Figure 7-1 Daily PA CRW GEO Ranging Availability Trend

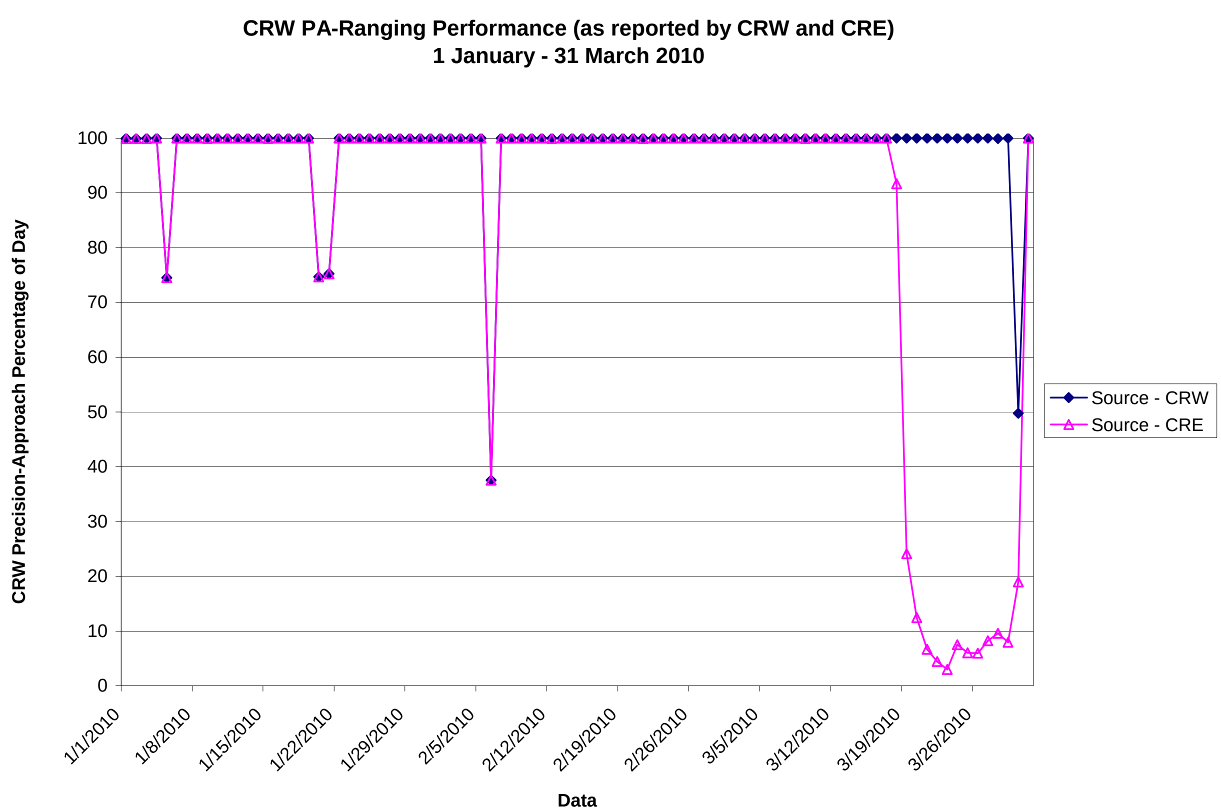
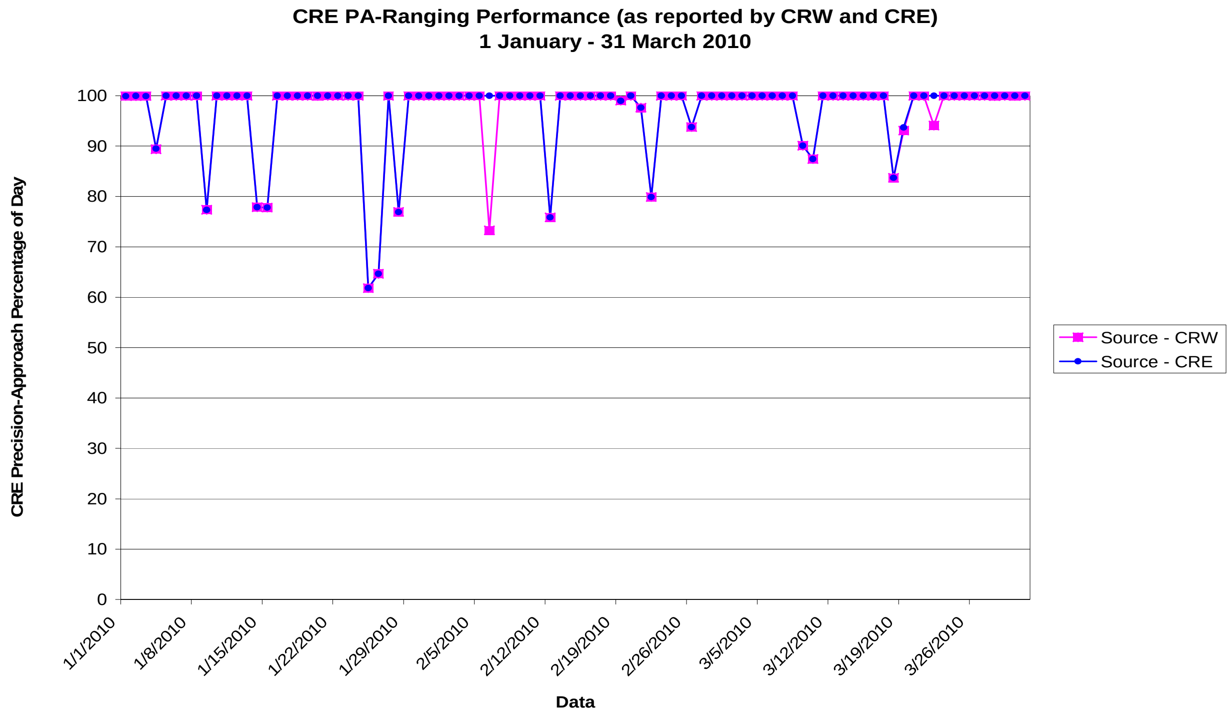


Figure 7-2 Daily PA CRE GEO Ranging Availability Trend



8.0 WAAS PROBLEM SUMMARY

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

Table 8-1 WAAS Problem Summary

Date	Event Description
1/26/10	PRN 4 outage, NANU201009, caused a significant loss of CONUS LPV and LPV200 coverage. PRN 4 is a critical satellite to the geometry in CONUS. There was negligible effect on Alaska LPV and LPV200. See DR 89 PRN 4 NANU Affects WAAS Coverage.
2/06/10	There was an extended outage of the CRW SIS due to a known WAAS issue and an error made during the maintenance at the Littleton GUS. A WAAS user in extreme northwest and western Alaska lost WAAS service because of the outage of the CRW SIS. See DR 90 Extended SIS Outage on CRW (PRN 135).
3/18/10 to 3/31/10	A ZDC C&V fault occurred, followed by CRE GUS switches and a ZTL C&V fault. ZDC returned to service and was set as the selected source. From 3/18/10 to 3/28/10 when ZDC was the selected source for CRE, the CRW UDRE reported by CRE was set to Not Monitored for most of the period causing low CRW PA ranging availability. This problem was corrected on 3/28/10 when the selected source for CRE was changed from ZDC to ZTL. No Type 0 was transmitted and no effect on coverage. See DR 91 CRE Reports High UDREs for CRW.

9.0 WAAS AIRPORT AVAILABILITY

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

Table 9-1 WAAS LPV Outages and Availability

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PACD	COLD BAY	AK	10	0.998575	645	0.898971
PAGA	EDWARD G. PITKA SR	AK	0	1	7	0.999263
PAEM	EMMONAK	AK	1	1	40	0.996722
PAFA	FAIRBANKS INTL	AK	0	1	4	0.999418
PAGB	GALBRAITH LAKE	AK	0	1	12	0.998903
PAGK	GULKANA	AK	0	1	3	0.999686
PAHO	HOMER	AK	0	1	7	0.999519
PAHL	HUSLIA	AK	0	1	8	0.999220
PAEN	KENAI MUNICIPAL	AK	0	1	7	0.999584
PAKT	KETCHIKAN INTL	AK	0	1	2	0.999750
PAKN	KING SALMON	AK	3	0.999981	20	0.998496
PARY	RUBY	AK	0	1	7	0.999348
PASK	SELAWIK	AK	0	1	27	0.998003
PASM	ST MARY'S	AK	1	1	30	0.997202
PAMK	ST MICHAEL	AK	1	1	11	0.998332
PANC	TED STEVENS ANCHORAGE INTL	AK	0	1	4	0.999680
PAYA	YAKUTAT	AK	0	1	3	0.999706
8A0	ALBERTVILLE RGNL-THOMAS J BRUM	AL	0	1	0	1
ANB	ANNISTON METROPOLITAN	AL	0	1	0	1
AUO	AUBURN-OPELIKA ROBERT G PITTS	AL	0	1	2	0.999955
EKY	BESSEMER	AL	0	1	0	1
BHM	BIRMINGHAM INTL	AL	0	1	0	1
SEM	CRAIG FIELD	AL	0	1	1	0.999998
DHN	DOTHAN RGNL	AL	0	1	2	0.999906
HSV	HUNTSVILLE INTL-CARL T JONES F	AL	0	1	0	1
JKA	JACK EDWARDS	AL	0	1	2	0.999958
MDQ	MADISON COUNTY EXECUTIVE/TOM S	AL	0	1	0	1
BFM	MOBILE DOWNTOWN	AL	0	1	2	0.999960
MOB	MOBILE RGNL	AL	0	1	2	0.999954
MGM	MONTGOMERY RGNL (DANNELLY FIEL	AL	0	1	1	0.999995

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
GAD	NORTHEAST ALABAMA RGNL	AL	0	1	0	1
MSL	NORTHWEST ALABAMA RGNL	AL	0	1	0	1
DCU	PRYOR FIELD RGNL	AL	0	1	0	1
79J	SOUTH ALABAMA RGNL AT BILL BEN	AL	0	1	2	0.999956
PLR	ST CLAIR COUNTY	AL	0	1	0	1
2R5	ST ELMO	AL	0	1	2	0.999959
ASN	TALLADEGA MUNICIPAL	AL	0	1	0	1
TOI	TROY MUNICIPAL	AL	0	1	2	0.999949
TCL	TUSCALOOSA RGNL	AL	0	1	0	1
LIT	ADAMS FIELD	AR	0	1	0	1
M73	ALMYRA MUNICIPAL	AR	0	1	0	1
BYH	ARKANSAS INTL	AR	0	1	0	1
VBT	BENTONVILLE MUNICIPAL/LOUISE M THAD	AR	0	1	0	1
HRO	BOONE COUNTY	AR	0	1	0	1
FSM	FORT SMITH RGNL	AR	0	1	0	1
PBF	GRIDER FIELD	AR	0	1	0	1
JBR	JONESBORO MUNICIPAL	AR	0	1	0	1
M19	NEWPORT MUNICIPAL	AR	0	1	0	1
ORK	NORTH LITTLE ROCK MUNICIPAL	AR	0	1	0	1
XNA	NORTHWEST ARKANSAS RGNL	AR	0	1	0	1
BPK	OZARK RGNL	AR	0	1	0	1
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1	0	1
RUE	RUSSELLVILLE RGNL	AR	0	1	0	1
SUZ	SALINE COUNTY RGNL	AR	0	1	0	1
SRC	SEARCY MUNICIPAL	AR	0	1	0	1
SLG	SMITH FIELD	AR	0	1	0	1
ELD	SOUTH ARKANSAS RGNL AT GOODWIN	AR	1	0.999998	1	0.999998
ASG	SPRINGDALE MUNICIPAL	AR	0	1	0	1
SGT	STUTTGART MUNICIPAL	AR	0	1	0	1
ARG	WALNUT RIDGE RGNL	AR	0	1	0	1
PRC	ERNEST A. LOVE FIELD	AZ	0	1	8	0.999650
GEU	GLENDALE MUNICIPAL	AZ	0	1	25	0.997974
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1	4	0.999821
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1	9	0.999350
PGA	PAGE MUNICIPAL	AZ	0	1	2	0.999877
DVT	PHOENIX DEER VALLEY	AZ	0	1	25	0.997975
PHX	PHOENIX SKY HARBOR INTL	AZ	1	0.999972	48	0.996254
IWA	PHOENIX-MESA GATEWAY	AZ	2	0.999938	63	0.995162
SJN	ST JOHNS INDUSTRIAL AIR PARK	AZ	0	1	15	0.999097
TUS	TUCSON INTL	AZ	2	0.999910	70	0.992876
APV	APPLE VALLEY	CA	0	1	29	0.997917
ACV	ARCATA	CA	1	0.999870	125	0.979648
DAG	BARSTOW-DAGGETT	CA	0	1	18	0.998615
C83	BYRON	CA	4	0.999649	220	0.977719
CMA	CAMARILLO	CA	5	0.999724	254	0.966700
CNO	CHINO	CA	1	0.999993	182	0.981967
FAT	FRESNO YOSEMITE INTL	CA	2	0.999860	139	0.990069
WJF	GENERAL WM J FOX AIRFIELD	CA	2	0.999978	163	0.986232
HAF	HALF MOON BAY	CA	6	0.999396	421	0.947295

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
HWD	HAYWARD EXECUTIVE	CA	5	0.999494	374	0.957619
CVH	HOLLISTER MUNICIPAL	CA	4	0.999552	376	0.958523
SNA	JOHN WAYNE AIRPORT-ORANGE COUNTY	CA	4	0.999964	226	0.978231
LGB	LONG BEACH /DAUGHERTY FIELD/	CA	4	0.999940	239	0.976430
LAX	LOS ANGELES INTL	CA	4	0.999927	243	0.974189
MAE	MADERA MUNICIPAL	CA	2	0.999828	169	0.987639
CRQ	MC CLELLAN-PALOMAR	CA	3	0.999947	171	0.979319
BFL	MEADOWS FIELD	CA	1	0.999941	145	0.988888
MCE	MERCED MUNICIPAL/ MACREADY FIELD	CA	2	0.999791	171	0.986165
OAK	METROPOLITAN OAKLAND INTL	CA	5	0.999515	377	0.956443
MOD	MODESTO CITY-CO-HARRY SHAM FLD	CA	2	0.999754	173	0.984341
MRY	MONTEREY PENINSULA	CA	6	0.999422	421	0.945352
APC	NAPA COUNTY	CA	4	0.999554	333	0.968009
O02	NERVINO	CA	0	1	87	0.993032
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	5	0.999498	388	0.955415
VCB	NUT TREE	CA	2	0.999691	203	0.978577
ONT	ONTARIO INTL	CA	1	0.999997	171	0.982652
OXR	OXNARD	CA	5	0.999705	265	0.964799
PMD	PALMDALE RGNL/USAF PLANT 42	CA	2	0.999984	164	0.985655
RBL	RED BLUFF MUNICIPAL	CA	1	0.999929	108	0.987452
RDD	REDDING MUNICIPAL	CA	1	0.999930	97	0.989462
RAL	RIVERSIDE MUNICIPAL	CA	1	0.999998	165	0.983003
SMF	SACRAMENTO INTL	CA	2	0.999809	144	0.984770
MHR	SACRAMENTO MATHER	CA	2	0.999800	139	0.986546
SFO	SAN FRANCISCO INTL	CA	5	0.999450	396	0.951603
SBA	SANTA BARBARA MUNICIPAL	CA	8	0.999586	289	0.958387
TCY	TRACY MUNICIPAL	CA	3	0.999667	207	0.978798
APA	CENTENNIAL	CO	1	0.999955	4	0.999661
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	1	0.999958	4	0.999596
AKO	COLORADO PLAINS RGNL	CO	1	0.999998	3	0.999787
CEZ	CORTEZ MUNICIPAL	CO	0	1	7	0.999566
DEN	DENVER INTL	CO	1	0.999949	4	0.999682
FTG	FRONT RANGE	CO	1	0.999947	3	0.999652
RIL	GARFIELD COUNTY RGNL	CO	0	1	3	0.999902
GXY	GREELEY-WELD COUNTY	CO	1	0.999957	3	0.999882
ITR	KIT CARSON COUNTY	CO	2	0.999995	5	0.999679
LAA	LAMAR MUNICIPAL	CO	2	0.999948	5	0.999496
PUB	PUEBLO MEMORIAL	CO	1	0.999959	4	0.999592
ALS	SAN LUIS VALLEY RGNL/ BERGMAN FIELD	CO	1	0.999961	7	0.999541
HDN	YAMPA VALLEY	CO	0	1	2	0.999927
BDL	BRADLEY INTL	CT	0	1	1	0.999911
GON	GROTON-NEW LONDON	CT	0	1	1	0.999921
HVN	TWEED-NEW HAVEN	CT	0	1	2	0.999935
OXC	WATERBURY-OXFORD	CT	0	1	2	0.999930
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	0	1	3	0.999790
EVY	SUMMIT	DE	0	1	2	0.999661
GED	SUSSEX COUNTY	DE	0	1	2	0.999637

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
AAF	APALACHICOLA MUNICIPAL	FL	0	1	9	0.999724
CEW	BOB SIKES	FL	0	1	2	0.999945
BCT	BOCA RATON	FL	0	1	15	0.999185
PGD	CHARLOTTE COUNTY	FL	0	1	6	0.999645
DAB	DAYTONA BEACH INTL	FL	0	1	4	0.999609
DED	DELAND MUNICIPAL-SIDNEY H TAYLOR FI	FL	0	1	4	0.999619
XFL	FLAGLER COUNTY	FL	0	1	4	0.999613
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1	16	0.999061
FLL	FORT LAUDERDALE/ HOLLYWOOD INTL	FL	0	1	16	0.998978
GNV	GAINESVILLE RGNL	FL	0	1	3	0.999676
BKV	HERNANDO COUNTY	FL	0	1	2	0.999667
JAX	JACKSONVILLE INTL	FL	0	1	4	0.999663
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	0	1	18	0.998736
EYW	KEY WEST INTL	FL	0	1	28	0.997834
ISM	KISSIMMEE GATEWAY	FL	0	1	3	0.999626
X14	LA BELLE MUNICIPAL	FL	0	1	9	0.999571
LCQ	LAKE CITY MUNICIPAL	FL	0	1	3	0.999690
LAL	LAKELAND LINDER RGNL	FL	0	1	3	0.999656
LEE	LEESBURG INTL	FL	0	1	3	0.999647
MLB	MELBOURNE INTL	FL	0	1	5	0.999592
COI	MERRITT ISLAND	FL	0	1	4	0.999600
MIA	MIAMI INTL	FL	0	1	17	0.998787
APF	NAPLES MUNICIPAL	FL	0	1	9	0.999472
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1	5	0.999606
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1	3	0.999662
MCO	ORLANDO INTL	FL	0	1	3	0.999621
SFB	ORLANDO SANFORD INTL	FL	0	1	4	0.999625
PHK	PALM BEACH CO GLADES	FL	0	1	10	0.999503
PBI	PALM BEACH INTL	FL	0	1	14	0.999244
PFN	PANAMA CITY-BAY CO INTL	FL	0	1	3	0.999883
PNS	PENSACOLA RGNL	FL	0	1	1	0.999964
PMP	POMPANO BEACH AIRPARK	FL	0	1	16	0.999083
SRQ	SARASOTA/BRADENTON INTL	FL	0	1	5	0.999687
RSW	SOUTHWEST FLORIDA INTL	FL	0	1	9	0.999550
FPR	ST LUCIE COUNTY INTL	FL	0	1	8	0.999517
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1	8	0.999663
TLH	TALLAHASSEE RGNL	FL	0	1	6	0.999751
TPA	TAMPA INTL	FL	0	1	2	0.999678
MTH	THE FLORIDA KEYS MARATHON	FL	0	1	29	0.997755
VDF	VANDENBERG	FL	0	1	2	0.999669
GIF	WINTER HAVEN'S GILBERT	FL	0	1	3	0.999643
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	0	1	2	0.999841
BQK	BRUNSWICK GOLDEN ISLES	GA	0	1	4	0.999713
VPC	CARTERSVILLE	GA	0	1	1	1
47A	CHEROKEE COUNTY	GA	0	1	1	0.999997
RYY	COBB COUNTY-MC COLLUM FIELD	GA	0	1	1	0.999982
CSG	COLUMBUS METROPOLITAN	GA	0	1	2	0.999927
15J	COOK COUNTY	GA	0	1	6	0.999753
CKF	CRISP COUNTY-CORDELE	GA	0	1	2	0.999837
DNN	DALTON MUNICIPAL	GA	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
SBO	EMANUEL COUNTY	GA	0	1	2	0.999804
18A	FRANKLIN COUNTY	GA	0	1	1	0.999943
FTY	FULTON COUNTY AIRPORT-BROWN FI	GA	0	1	1	0.999971
ATL	HARTSFIELD - JACKSON ATLANTA I	GA	0	1	1	0.999965
EZM	HEART OF GEORGIA RGNL	GA	0	1	2	0.999825
19A	JACKSON COUNTY	GA	0	1	1	0.999961
GVL	LEE GILMER MEMORIAL	GA	0	1	1	0.999972
MCN	MIDDLE GEORGIA RGNL	GA	0	1	2	0.999877
MGR	MOULTRIE MUNICIPAL	GA	0	1	6	0.999755
CCO	NEWNAN COWETA COUNTY	GA	0	1	1	0.999970
FFC	PEACHTREE CITY-FALCON FIELD	GA	0	1	2	0.999965
PXE	PERRY-HOUSTON COUNTY	GA	0	1	2	0.999867
JZP	PICKENS COUNTY	GA	0	1	1	0.999999
JYL	PLANTATION ARPK	GA	0	1	2	0.999781
SAV	SAVANNAH/HILTON HEAD INTL	GA	0	1	2	0.999751
ACJ	SOUTHER FIELD	GA	0	1	2	0.999862
ABY	SOUTHWEST GEORGIA RGNL	GA	0	1	2	0.999845
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1	2	0.999780
MQW	TELFAIR-WHEELER	GA	0	1	2	0.999795
TVI	THOMASVILLE RGNL	GA	0	1	6	0.999753
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1	1	0.999976
VLD	VALDOSTA RGNL	GA	0	1	6	0.999743
VDI	VIDALIA RGNL	GA	0	1	2	0.999783
IIY	WASHINGTON-WILKES COUNTY	GA	0	1	2	0.999918
AYS	WAYCROSS-WARE COUNTY	GA	0	1	2	0.999750
CTJ	WEST GEORGIA RGNL - O V GRAY F	GA	0	1	1	0.999987
WDR	WINDER-BARROW	GA	0	1	1	0.999956
IKV	ANKENY RGNL	IA	0	1	0	1
CBF	COUNCIL BLUFFS MUNICIPAL	IA	0	1	0	1
DVN	DAVENPORT MUNICIPAL	IA	0	1	1	0.999987
DNS	DENISON MUNICIPAL	IA	0	1	0	1
DSM	DES MOINES INTL	IA	0	1	0	1
DBQ	DUBUQUE RGNL	IA	0	1	1	0.999993
EST	ESTHERVILLE MUNICIPAL	IA	0	1	1	1
FFL	FAIRFIELD MUNICIPAL	IA	0	1	0	1
GGI	GRINNELL RGNL	IA	0	1	0	1
EOK	KEOKUK MUNICIPAL	IA	0	1	0	1
MCW	MASON CITY MUNICIPAL	IA	0	1	0	1
MXO	MONTICELLO RGNL	IA	0	1	1	0.999994
MUT	MUSCATINE MUNICIPAL	IA	0	1	0	1
TNU	NEWTON MUNICIPAL	IA	0	1	0	1
OTM	OTTUMWA INDUSTRIAL	IA	0	1	0	1
PRO	PERRY MUNICIPAL	IA	0	1	0	1
SDA	SHENANDOAH MUNICIPAL	IA	0	1	0	1
SLB	STORM LAKE MUNICIPAL	IA	0	1	0	1
CID	THE EASTERN IOWA	IA	0	1	0	1
ALO	WATERLOO RGNL	IA	0	1	1	0.999994
BOI	BOISE AIR TERMINAL/GOWEN FLD	ID	0	1	2	0.999970
EUL	CALDWELL INDUSTRIAL	ID	0	1	13	0.999855
GNG	GOODING MUNICIPAL	ID	0	1	1	0.999944
IDA	IDAHO FALLS RGNL	ID	0	1	1	0.999974
LWS	LEWISTON-NEZ PERCE COUNTY	ID	0	1	8	0.999902

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
S67	NAMPA MUNICIPAL	ID	0	1	12	0.999908
PIH	POCATELLO RGNL	ID	0	1	1	0.999973
SPI	ABRAHAM LINCOLN CAPITAL	IL	0	1	0	1
FEP	ALBERTUS	IL	0	1	1	0.999993
ARR	AURORA MUNICIPAL	IL	0	1	1	0.999983
BMI	CENTRAL IL REGL ARPT AT BLOOMI	IL	0	1	0	1
ENL	CENTRALIA MUNICIPAL	IL	0	1	0	1
MDW	CHICAGO MIDWAY INTL	IL	0	1	1	0.999988
ORD	CHICAGO O'HARE INTL	IL	0	1	1	0.999992
RFD	CHICAGO/ROCKFORD INTL	IL	0	1	1	0.999994
DKB	DE KALB TAYLOR MUNICIPAL	IL	0	1	1	0.999987
DEC	DECATUR	IL	0	1	0	1
FOA	FLORA MUNICIPAL	IL	0	1	0	1
IKK	GREATER KANKAKEE	IL	0	1	1	0.999967
PIA	GREATER PEORIA RGNL	IL	0	1	0	1
IGQ	LANSING MUNICIPAL	IL	0	1	1	0.999981
LOT	LEWIS UNIVERSITY	IL	0	1	1	0.999980
3LF	LITCHFIELD MUNICIPAL	IL	0	1	0	1
C15	PEKIN MUNICIPAL	IL	0	1	0	1
PPQ	PITTSFIELD PENSTONE MUNICIPAL	IL	0	1	0	1
PNT	PONTIAC MUNICIPAL	IL	0	1	1	0.999998
MLI	QUAD CITY INTL	IL	0	1	0	1
UIN	QUINCY RGNL-BALDWIN FIELD	IL	0	1	0	1
TIP	RANTOUL NATL AVN CNTR-FRANK EL	IL	0	1	0	1
RSV	ROBINSON MUNICIPAL	IL	0	1	0	1
SLO	SALEM-LECKRONE	IL	0	1	0	1
ALN	ST LOUIS RGNL	IL	0	1	0	1
DNV	VERMILION COUNTY	IL	0	1	0	1
UGN	WAUKEGAN RGNL	IL	0	1	0	1
MWA	WILLIAMSON COUNTY RGNL	IL	0	1	0	1
BAK	COLUMBUS MUNICIPAL	IN	0	1	0	1
GWB	DE KALB COUNTY	IN	0	1	0	1
MIE	DELAWARE COUNTY - JOHNSON FIEL	IN	0	1	0	1
EYE	EAGLE CREEK AIRPARK	IN	0	1	0	1
EKM	ELKHART MUNICIPAL	IN	0	1	1	0.999993
FWA	FORT WAYNE INTL	IN	0	1	0	1
SER	FREEMAN MUNICIPAL	IN	0	1	0	1
RCR	FULTON COUNTY	IN	0	1	1	0.999984
GSH	GOSHEN MUNICIPAL	IN	0	1	1	0.999994
HFY	GREENWOOD MUNICIPAL	IN	0	1	0	1
TYQ	INDIANAPOLIS EXECUTIVE	IN	0	1	0	1
IND	INDIANAPOLIS INTL	IN	0	1	0	1
GGP	LOGANSPORT/CASS COUNTY	IN	0	1	1	0.999983
IMS	MADISON MUNICIPAL	IN	0	1	0	1
MZZ	MARION MUNICIPAL	IN	0	1	0	1
CEV	METTEL FIELD	IN	0	1	0	1
BMG	MONROE COUNTY	IN	0	1	0	1
VPZ	PORTER COUNTY MUNICIPAL	IN	0	1	1	0.999981
LAF	PURDUE UNIVERSITY	IN	0	1	1	0.999972
4I7	PUTNAM COUNTY	IN	0	1	0	1
GEZ	SHELBYVILLE MUNICIPAL	IN	0	1	0	1
SBN	SOUTH BEND RGNL	IN	0	1	1	0.999991

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
OXI	STARKE COUNTY	IN	0	1	1	0.999978
ANQ	TRI-STATE STEUBEN COUNTY	IN	0	1	0	1
PTS	ATKINSON MUNICIPAL	KS	0	1	0	1
AAO	COLONEL JAMES JABARA	KS	0	1	9	0.999773
DDC	DODGE CITY RGNL	KS	2	0.999994	9	0.999395
EMP	EMPORIA MUNICIPAL	KS	0	1	1	0.999973
FOE	FORBES FIELD	KS	0	1	0	1
FSK	FORT SCOTT MUNICIPAL	KS	0	1	0	1
GCK	GARDEN CITY RGNL	KS	2	0.999964	9	0.999480
HYS	HAYS RGNL	KS	0	1	8	0.999436
HQG	HUGOTON MUNICIPAL	KS	2	0.999948	9	0.999378
OJC	JOHNSON COUNTY EXECUTIVE	KS	0	1	0	1
LWC	LAWRENCE MUNICIPAL	KS	0	1	0	1
LBL	LIBERAL MID-AMERICA RGNL	KS	2	0.999947	9	0.999315
MHK	MANHATTAN RGNL	KS	0	1	1	0.999998
MPR	MC PHERSON	KS	0	1	9	0.999630
IXD	NEW CENTURY AIRCENTER	KS	0	1	0	1
EWK	NEWTON-CITY-COUNTY	KS	0	1	8	0.999745
OEL	OAKLEY MUNICIPAL	KS	1	0.999998	8	0.999557
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1	0	1
PTT	PRATT INDUSTRIAL	KS	1	0.999998	10	0.999503
GLD	RENNER FLD /GOODLAND MUNICIPAL/	KS	1	0.999998	7	0.999674
RSL	RUSSELL MUNICIPAL	KS	0	1	9	0.999439
SLN	SALINA MUNICIPAL	KS	0	1	8	0.999656
TQK	SCOTT CITY MUNICIPAL	KS	1	0.999998	7	0.999525
CBK	SHALZ FIELD	KS	0	1	6	0.999581
WLD	STROTHER FIELD	KS	0	1	7	0.999898
PPF	TRI-CITY	KS	0	1	0	1
ULS	ULYSSES	KS	2	0.999948	8	0.999392
EGT	WELLINGTON MUNICIPAL	KS	0	1	8	0.999799
ICT	WICHITA MID-CONTINENT	KS	0	1	9	0.999744
EKX	ADDINGTON FIELD	KY	0	1	0	1
PAH	BARKLEY RGNL	KY	0	1	0	1
K22	BIG SANDY RGNL	KY	0	1	0	1
LEX	BLUE GRASS	KY	0	1	0	1
LOU	BOWMAN FIELD	KY	0	1	0	1
CVG	CINCINNATI/NORTHERN KENTUCKY I	KY	0	1	0	1
27K	GEORGETOWN SCOTT COUNTY - MARS	KY	0	1	0	1
GLW	GLASGOW MUNICIPAL	KY	0	1	0	1
EHR	HENDERSON CITY-COUNTY	KY	0	1	0	1
SME	LAKE CUMBERLAND RGNL	KY	0	1	0	1
LOZ	LONDON-CORBIN ARPT-MAGEE FLD	KY	0	1	0	1
SDF	LOUISVILLE INTL-STANDIFORD FIELD	KY	0	1	0	1
OWB	OWENSBORO-DAVIESS COUNTY	KY	0	1	0	1
DVK	STUART POWELL FIELD	KY	0	1	0	1
W38	WILLIAMSBURG-WHITLEY COUNTY	KY	0	1	0	1
ARA	ACADIANA RGNL	LA	0	1	1	0.999920
AEX	ALEXANDRIA INTL	LA	1	0.999972	2	0.999917
BTR	BATON ROUGE METROPOLITAN` RYAN	LA	0	1	1	0.999926
DRI	BEAUREGARD RGNL	LA	1	0.999973	2	0.999896
CWF	CHENNAULT INTL	LA	1	1	2	0.999915

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
ESF	ESLER RGNL	LA	1	0.999986	2	0.999936
HZR	FALSE RIVER RGNL	LA	0	1	1	0.999938
PTN	HARRY P WILLIAMS MEMORIAL	LA	0	1	1	0.999929
LFT	LAFAYETTE RGNL	LA	0	1	1	0.999920
LCH	LAKE CHARLES RGNL	LA	0	1	1	0.999915
NEW	LAKEFRONT	LA	0	1	1	0.999944
MSY	LOUIS ARMSTRONG NEW ORLEANS IN	LA	0	1	1	0.999939
BQP	MOREHOUSE MEMORIAL	LA	1	0.999998	1	0.999998
DTN	SHREVEPORT DOWNTOWN	LA	2	0.999953	3	0.999926
SHV	SHREVEPORT RGNL	LA	2	0.999945	3	0.999918
GAO	SOUTH LAFOURCHE LEONARD MILLER	LA	0	1	1	0.999937
TVR	VICKSBURG TALLULAH RGNL	LA	1	0.999998	1	0.999998
BAF	BARNES MUNICIPAL	MA	0	1	1	0.999904
HYA	BARNSTABLE MUNICIPAL-BOARDMAN/POLAN	MA	1	0.999972	1	0.999872
BOS	GENERAL EDWARD LAWRENCE LOGAN	MA	1	0.999969	1	0.999869
BED	LAURENCE G HANSCOM FLD	MA	1	0.999972	1	0.999871
MVY	MARTHAS VINEYARD	MA	1	0.999983	1	0.999895
OWD	NORWOOD MEMORIAL	MA	1	0.999980	1	0.999878
PVC	PROVINCETOWN MUNICIPAL	MA	1	0.999959	1	0.999861
ORH	WORCESTER RGNL	MA	1	0.999989	1	0.999887
BWI	BALTIMORE/WASHINGTON INTL THUR	MD	1	1	3	0.999766
DMW	CARROLL COUNTY RGNL/JACK B POA	MD	0	1	3	0.999795
ESN	EASTON/NEWNAM FIELD	MD	0	1	2	0.999718
FDK	FREDERICK MUNICIPAL	MD	0	1	3	0.999807
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1	3	0.999797
2W6	ST. MARY'S COUNTY RGNL	MD	0	1	2	0.999720
LEW	AUBURN/LEWISTON MUNICIPAL	ME	1	0.999908	1	0.999797
AUG	AUGUSTA STATE	ME	1	0.999898	1	0.999779
BGR	BANGOR INTL	ME	1	0.999880	1	0.999753
BHB	HANCOCK COUNTY-BAR HARBOR	ME	1	0.999881	1	0.999757
PQI	NORTHERN MAINE RGNL ARPT AT PR	ME	1	0.999853	1	0.999700
PWM	PORTLAND INTL JETPORT	ME	1	0.999916	1	0.999809
WVL	WATERVILLE ROBERT LAFLEUR	ME	1	0.999895	1	0.999773
ARB	ANN ARBOR MUNICIPAL	MI	0	1	0	1
ACB	ANTRIM COUNTY	MI	0	1	1	0.999966
FNT	BISHOP INTL	MI	0	1	0	1
OEB	BRANCH COUNTY MEMORIAL	MI	0	1	0	1
CVX	CHARLEVOIX MUNICIPAL	MI	0	1	1	0.999959
CIU	CHIPPEWA COUNTY INTL	MI	0	1	1	0.999932
TTF	CUSTER	MI	0	1	0	1
DTW	DETROIT METROPOLITAN WAYNE COUNTY	MI	0	1	0	1
FFX	FREMONT MUNICIPAL	MI	0	1	0	1
GRR	GERALD R. FORD INTL	MI	0	1	0	1
CMX	HOUGHTON COUNTY MEMORIAL	MI	0	1	1	0.999938
BAX	HURON COUNTY MEMORIAL	MI	0	1	1	0.999980
AZO	KALAMAZOO/BATTLE CREEK INTL	MI	0	1	0	1
ADG	LENAWEE COUNTY	MI	0	1	0	1
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
LDM	MASON COUNTY	MI	0	1	0	1
MBS	MBS INTL	MI	0	1	1	1
MKG	MUSKEGON COUNTY	MI	0	1	0	1
RNP	OWOSSO COMMUNICIPALTY	MI	0	1	0	1
HYX	SAGINAW COUNTY H.W. BROWNE	MI	0	1	0	1
BIV	TULIP CITY	MI	0	1	0	1
YIP	WILLOW RUN	MI	0	1	0	1
AEL	ALBERT LEA MUNICIPAL	MN	0	1	0	1
ANE	ANOKA COUNTY-BLAINE ARPT	MN	0	1	1	0.999979
AUM	AUSTIN MUNICIPAL	MN	0	1	0	1
BDE	BAUDETTE INTL	MN	0	1	1	0.999984
BRD	BRAINERD LAKES RGNL	MN	0	1	2	0.999947
AXN	CHANDLER FIELD	MN	0	1	1	0.999942
HIB	CHISHOLM-HIBBING	MN	0	1	2	0.999909
CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	0	1	0	1
DTL	DETROIT LAKES-WETHING FIELD	MN	0	1	1	0.999987
DLH	DULUTH INTL	MN	0	1	2	0.999942
INL	FALLS INTL	MN	0	1	1	0.999978
MSP	MINNEAPOLIS-ST PAUL INTL	MN	0	1	1	0.999987
RGK	RED WING RGNL	MN	0	1	0	1
RST	ROCHESTER INTL	MN	0	1	0	1
ROX	ROSEAU MUNICIPAL/RUDY BILLBERG FIELD	MN	0	1	1	0.999993
MML	SOUTHWEST MINNESOTA RGNL MARSH	MN	0	1	1	0.999957
STC	ST CLOUD RGNL	MN	0	1	1	0.999960
JYG	ST JAMES MUNICIPAL	MN	0	1	1	0.999972
STP	ST PAUL DOWNTOWN HOLMAN FLD	MN	0	1	1	0.999987
RRT	WARROAD INTL MEMORIAL	MN	0	1	1	0.999988
BDH	WILLMAR MUNICIPAL-JOHN L RICE FIELD	MN	0	1	1	0.999956
M17	BOLIVAR MUNICIPAL	MO	0	1	0	1
CGI	CAPE GIRARDEAU RGNL	MO	0	1	0	1
M05	CARUTHERSVILLE MEMORIAL	MO	0	1	0	1
MKC	CHARLES B. WHEELER DOWNTOWN	MO	0	1	0	1
COU	COLUMBIA RGNL	MO	0	1	0	1
1H0	CREVE COEUR	MO	0	1	0	1
DXE	DEXTER MUNICIPAL	MO	0	1	0	1
LBO	FLOYD W. JONES LEBANON	MO	0	1	0	1
K57	GOULD PETERSON MUNICIPAL	MO	0	1	0	1
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	0	1	0	1
JEF	JEFFERSON CITY MEMORIAL	MO	0	1	0	1
VER	JESSE VIERTEL MEMORIAL	MO	0	1	0	1
JLN	JOPLIN RGNL	MO	0	1	0	1
MCI	KANSAS CITY INTL	MO	0	1	0	1
TKX	KENNETT MEMORIAL	MO	0	1	0	1
IRK	KIRKSVILLE RGNL	MO	0	1	0	1
STL	LAMBERT-ST LOUIS INTL	MO	0	1	0	1
LRY	LAWRENCE SMITH MEMORIAL	MO	0	1	0	1
AIZ	LEE C FINE MEMORIAL	MO	0	1	0	1
LXT	LEE'S SUMMIT MUNICIPAL	MO	0	1	0	1

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6M6	LEWIS COUNTY RGNL	MO	0	1	0	1
MHL	MARSHALL MEMORIAL MUNICIPAL	MO	0	1	0	1
MYJ	MEXICO MEMORIAL	MO	0	1	0	1
GPH	MIDWEST NATIONAL AIR CENTER	MO	0	1	0	1
M58	MONETT MUNICIPAL	MO	0	1	0	1
EOS	NEOSHO HUGH ROBINSON	MO	0	1	0	1
POF	POPLAR BLUFF MUNICIPAL	MO	0	1	0	1
STJ	ROSECRANS MEMORIAL	MO	0	1	0	1
DMO	SEDALIA MEMORIAL	MO	0	1	0	1
SIK	SIKESTON MEMORIAL MUNICIPAL	MO	0	1	0	1
RCM	SKYHAVEN	MO	0	1	0	1
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	0	1	0	1
TBN	WAYNESVILLE RGNL ARPT AT FORNE	MO	0	1	0	1
UNO	WEST PLAINS MUNICIPAL	MO	0	1	0	1
STF	GEORGE M BRYAN	MS	0	1	0	1
GTR	GOLDEN TRIANGLE RGNL	MS	0	1	0	1
GWO	GREENWOOD-LEFLORE	MS	0	1	0	1
GNF	GRENADA MUNICIPAL	MS	0	1	0	1
GPT	GULFPORT-BILOXI INTL	MS	0	1	1	0.999951
HEZ	HARDY-ANDERS FIELD NATCHEZ-ADA	MS	0	1	1	0.999973
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	0	1	1	0.999958
PIB	HATTIESBURG-LAUREL RGNL	MS	0	1	1	0.999959
LUL	HESLER-NOBLE FIELD	MS	0	1	1	0.999960
JAN	JACKSON-EVERS INTL	MS	0	1	0	1
M16	JOHN BELL WILLIAMS	MS	1	0.999998	1	0.999998
MEI	KEY FIELD	MS	0	1	1	1
MCB	MC COMB/PIKE COUNTY/ JOHN E LEWIS	MS	0	1	1	0.999933
M40	MONROE COUNTY	MS	0	1	0	1
OLV	OLIVE BRANCH	MS	0	1	0	1
MJD	PICAYUNE MUNICIPAL	MS	0	1	1	0.999946
M43	PRENTISS-JEFFERSON DAVIS COUNTY	MS	0	1	1	0.999986
CRX	ROSCOE TURNER	MS	0	1	0	1
HSA	STENNIS INTL	MS	0	1	1	0.999945
PQL	TRENT LOTT INTL	MS	0	1	1	0.999949
UTA	TUNICA MUNICIPAL	MS	0	1	0	1
UOX	UNIVERSITY-OXFORD	MS	0	1	0	1
BTM	BERT MOONEY	MT	0	1	1	0.999953
BIL	BILLINGS LOGAN INTL	MT	0	1	1	0.999982
MLS	FRANK WILEY FIELD	MT	0	1	0	1
GPI	GLACIER PARK INTL	MT	0	1	1	0.999965
GTF	GREAT FALLS INTL	MT	0	1	1	0.999944
HLN	HELENA RGNL	MT	0	1	1	0.999947
LWT	LEWISTOWN MUNICIPAL	MT	0	1	2	0.999955
OAJ	ALBERT J ELLIS	NC	0	1	3	0.999718
AFP	ANSON COUNTY	NC	0	1	2	0.999836
HBI	ASHEBORO RGNL	NC	0	1	2	0.999890
AVL	ASHEVILLE RGNL	NC	0	1	1	0.999987
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1	2	0.999908
JQF	CONCORD RGNL	NC	0	1	2	0.999907

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EWN	CRAVEN COUNTY RGNL	NC	1	1	4	0.999694
ECG	ELIZABETH CITY CG AIR STATION/	NC	0	1	2	0.999680
FAY	FAYETTEVILLE RGNL/GRANNIS FIELD	NC	0	1	2	0.999777
LHZ	FRANKLIN COUNTY	NC	0	1	2	0.999788
AKH	GASTONIA MUNICIPAL	NC	0	1	2	0.999919
GWW	GOLDSBORO- WAYNE MUNICIPAL	NC	0	1	2	0.999734
HRJ	HARNETT RGNL JETPORT	NC	0	1	2	0.999785
HNZ	HENDERSON-OXFORD	NC	0	1	2	0.999797
ISO	KINSTON RGNL JETPORT	NC	0	1	2	0.999729
EQY	MONROE RGNL	NC	0	1	2	0.999904
EDE	NORTHEASTERN RGNL	NC	0	1	2	0.999691
GSO	PIEDMONT TRIAD INTL	NC	0	1	2	0.999892
PGV	PITT-GREENVILLE	NC	0	1	3	0.999719
RDU	RALEIGH-DURHAM INTL	NC	0	1	2	0.999797
RWI	ROCKY MOUNT-WILSON RGNL	NC	0	1	2	0.999744
RUQ	ROWAN COUNTY	NC	0	1	2	0.999907
TTA	SANFORD-LEE COUNTY RGNL	NC	0	1	2	0.999800
SVH	STATESVILLE RGNL	NC	0	1	1	0.999924
ILM	WILMINGTON INTL	NC	0	1	2	0.999714
BIS	BISMARCK MUNICIPAL	ND	0	1	0	1
5N8	CASSELTON ROBERT MILLER RGNL	ND	0	1	0	1
DVL	DEVILS LAKE RGNL	ND	0	1	0	1
DIK	DICKINSON - THEODORE ROOSEVELT	ND	0	1	0	1
GFK	GRAND FORKS INTL	ND	0	1	0	1
FAR	HECTOR INTL	ND	0	1	0	1
JMS	JAMESTOWN RGNL	ND	0	1	0	1
MOT	MINOT INTL	ND	0	1	0	1
ANW	AINSWORTH MUNICIPAL	NE	0	1	1	0.999969
BVN	ALBION MUNICIPAL	NE	0	1	1	0.999972
AIA	ALLIANCE MUNICIPAL	NE	0	1	0	1
AUH	AURORA MUNICIPAL – AL POTTER FIELD	NE	0	1	1	0.999973
BIE	BEATRICE MUNICIPAL	NE	0	1	0	1
FNB	BRENNER FIELD	NE	0	1	0	1
HDE	BREWSTER FIELD	NE	0	1	7	0.999473
BBW	BROKEN BOW MUNICIPAL	NE	0	1	1	0.999970
GRI	CENTRAL NEBRASKA RGNL	NE	0	1	1	0.999972
CDR	CHADRON MUNICIPAL	NE	0	1	1	0.999979
OLU	COLUMBUS MUNICIPAL	NE	0	1	1	0.999999
CZD	COZAD MUNICIPAL	NE	0	1	7	0.999534
CEK	CRETE MUNICIPAL	NE	0	1	0	1
OMA	EPPLEY AIRFIELD	NE	0	1	0	1
FBY	FAIRBURY MUNICIPAL	NE	0	1	1	0.999989
FET	FREMONT MUNICIPAL	NE	0	1	0	1
OKS	GARDEN COUNTY	NE	0	1	2	0.999819
GRN	GORDON MUNICIPAL	NE	0	1	1	0.999981
GGF	GRANT MUNICIPAL	NE	0	1	5	0.999729
HSI	HASTINGS MUNICIPAL	NE	0	1	1	0.999971
IML	IMPERIAL MUNICIPAL	NE	0	1	5	0.999701
LXN	JIM KELLY FIELD	NE	0	1	7	0.999506
OFK	KARL STEFAN MEMORIAL	NE	0	1	1	0.999979

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
EAR	KEARNEY RGNL	NE	0	1	4	0.999932
IBM	KIMBALL MUNICIPAL/ ROBERT E ARRAJ FIELD	NE	0	1	1	0.999977
LNK	LINCOLN	NE	0	1	0	1
MCK	MC COOK RGNL	NE	0	1	7	0.999542
MLE	MILLARD	NE	0	1	0	1
VTN	MILLER FIELD	NE	0	1	1	0.999987
AFK	NEBRASKA CITY MUNICIPAL	NE	0	1	0	1
LBF	NORTH PLATTE RGNL AIRPORT LEE	NE	0	1	6	0.999579
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1	0	1
SCB	SCRIBNER STATE	NE	0	1	0	1
OGA	SEARLE FIELD	NE	0	1	5	0.999715
SWT	SEWARD MUNICIPAL	NE	0	1	0	1
SNY	SIDNEY MUNICIPAL/ LLOYD W. CARR FIELD	NE	0	1	1	0.999907
ONL	THE O'NEILL MUNICIPAL- JOHN L BAKER	NE	0	1	1	0.999959
AHQ	WAHOO MUNICIPAL	NE	0	1	0	1
LCG	WAYNE MUNICIPAL	NE	0	1	1	0.999979
BFF	WESTERN NEB. RGNL/WILLIAM B. H	NE	0	1	1	0.999998
JYR	YORK MUNICIPAL	NE	0	1	1	0.999998
ASH	BOIRE FIELD	NH	1	0.999967	1	0.999864
CON	CONCORD MUNICIPAL	NH	1	0.999948	1	0.999844
EEN	DILLANT-HOPKINS	NH	1	0.999979	1	0.999872
LCI	LACONIA MUNICIPAL	NH	1	0.999937	1	0.999827
MHT	MANCHESTER	NH	1	0.999961	1	0.999851
PSM	PORTSMOUTH INTL AT PEASE	NH	1	0.999939	1	0.999835
ACY	ATLANTIC CITY INTL	NJ	0	1	2	0.999664
WWD	CAPE MAY COUNTY	NJ	0	1	2	0.999642
MIV	MILLVILLE MUNICIPAL	NJ	0	1	2	0.999650
EWR	NEWARK LIBERTY INTL	NJ	0	1	3	0.999778
TEB	TETERBORO	NJ	0	1	3	0.999802
ABQ	ALBUQUERQUE INTL SUNPORT	NM	1	0.999976	13	0.999152
CVN	CLOVIS MUNICIPAL	NM	1	0.999933	12	0.999202
AEG	DOUBLE EAGLE II	NM	1	0.999979	12	0.999211
FMN	FOUR CORNERS RGNL	NM	1	0.999994	8	0.999409
SVC	GRANT COUNTY	NM	0	1	47	0.998501
LRU	LAS CRUCES INTL	NM	1	0.999981	21	0.999413
ROW	ROSWELL INTL AIR CENTER	NM	1	0.999932	13	0.999162
LAS	MC CARRAN INTL	NV	0	1	7	0.999513
4SD	RENO/STEAD	NV	1	1	81	0.993814
RNO	RENO/TAHOE INTL	NV	1	0.999997	82	0.993934
WMC	WINNEMUCCA MUNICIPAL	NV	0	1	36	0.998656
9G3	AKRON	NY	0	1	3	0.999881
ALB	ALBANY INTL	NY	0	1	1	0.999901
HWV	BROOKHAVEN	NY	0	1	3	0.999912
BUF	BUFFALO NIAGARA INTL	NY	0	1	3	0.999894
OLE	CATTARAUGUS COUNTY-OLEAN	NY	0	1	3	0.999884
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	0	1	2	0.999919
ELM	ELMIRA/CORNING RGNL	NY	0	1	3	0.999754
FOK	FRANCIS S GABRESKI	NY	0	1	3	0.999933
BGM	GREATER BINGHAMTON/EDWIN A LIN	NY	0	1	3	0.999733

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
ROC	GREATER ROCHESTER INTL	NY	0	1	3	0.999823
JFK	JOHN F KENNEDY INTL	NY	0	1	3	0.999813
LGA	LA GUARDIA	NY	0	1	3	0.999815
MSS	MASSENA INTL-RICHARDS FIELD	NY	1	0.999959	1	0.999843
N66	ONEONTA MUNICIPAL	NY	0	1	3	0.999840
PEO	PENN YAN	NY	0	1	3	0.999771
PBG	PLATTSBURGH INTL	NY	1	0.999945	1	0.999825
44N	SKY ACRES	NY	0	1	3	0.999895
SWF	STEWART INTL	NY	0	1	3	0.999850
SYR	SYRACUSE HANCOCK INTL	NY	0	1	3	0.999797
ELZ	WELLSVILLE MUNICIPAL ARPT`TARANTINE	NY	0	1	3	0.999873
HPN	WESTCHESTER COUNTY	NY	0	1	3	0.999854
SDC	WILLIAMSON-SODUS	NY	0	1	3	0.999787
HAO	BUTLER CO RGNL	OH	0	1	0	1
CXY	CAPITAL CITY	OH	0	1	2	0.999791
LUK	CINCINNATI MUNICIPAL AIRPORT LUNKEN	OH	0	1	0	1
CLE	CLEVELAND-HOPKINS INTL	OH	0	1	1	0.999983
MGY	DAYTON-WRIGHT BROTHERS	OH	0	1	0	1
DLZ	DELAWARE MUNICIPAL	OH	0	1	0	1
LHQ	FAIRFIELD COUNTY	OH	0	1	0	1
FDY	FINDLAY	OH	0	1	0	1
PMH	GREATER PORTSMOUTH RGNL	OH	0	1	0	1
I19	GREENE COUNTY-LEWIS A. JACKSON	OH	0	1	0	1
DAY	JAMES M COX DAYTON INTL	OH	0	1	0	1
1G3	KENT STATE UNIV	OH	0	1	1	0.999973
I68	LEBANON-WARREN COUNTY	OH	0	1	0	1
UYF	MADISON COUNTY	OH	0	1	0	1
MNN	MARION MUNICIPAL	OH	0	1	0	1
AXV	NEIL ARMSTRONG	OH	0	1	0	1
OSU	OHIO STATE UNIVERSITY	OH	0	1	0	1
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	0	1	0	1
CMH	PORT COLUMBUS INTL	OH	0	1	0	1
RZT	ROSS COUNTY	OH	0	1	0	1
TOL	TOLEDO EXPRESS	OH	0	1	0	1
1G0	WOOD COUNTY	OH	0	1	0	1
YNG	YOUNGSTOWN-WARREN RGNL	OH	0	1	1	0.999959
AVK	ALVA RGNL	OK	2	0.999984	10	0.999580
BVO	BARTLESVILLE MUNICIPAL	OK	0	1	1	0.999984
CQB	CHANDLER RGNL	OK	2	0.999996	2	0.999922
CHK	CHICKASHA MUNICIPAL	OK	2	0.999925	2	0.999803
GCM	CLAREMORE RGNL	OK	0	1	1	0.999990
F29	CLARENCE E PAGE MUNICIPAL	OK	2	0.999927	2	0.999853
1K4	DAVID JAY PERRY	OK	2	0.999922	2	0.999857
MKO	DAVIS FIELD	OK	1	0.999998	2	0.999977
DUA	EAKER FIELD	OK	2	0.999918	3	0.999850
ELK	ELK CITY RGNL BUSINESS	OK	2	0.999935	9	0.999568
GMJ	GROVE MUNICIPAL	OK	0	1	0	1
GOK	GUTHRIE-EDMOND RGNL	OK	2	0.999978	2	0.999898
2O8	HINTON MUNICIPAL	OK	2	0.999932	3	0.999805
HBR	HOBART RGNL	OK	2	0.999933	8	0.999698

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MLC	MC ALESTER RGNL	OK	2	0.999988	2	0.999938
MIO	MIAMI MUNICIPAL	OK	0	1	0	1
MDF	MOORELAND MUNICIPAL	OK	2	0.999935	10	0.999473
OKM	OKMULGEE RGNL	OK	1	0.999998	2	0.999956
PVJ	PAULS VALLEY MUNICIPAL	OK	2	0.999919	3	0.999844
PNC	PONCA CITY RGNL	OK	1	0.999998	3	0.999941
RVS	RICHARD LLOYD JONES JR	OK	1	0.999998	2	0.999965
2K4	SCOTT FIELD	OK	2	0.999933	8	0.999641
SNL	SHAWNEE RGNL	OK	2	0.999967	2	0.999901
SWO	STILLWATER RGNL	OK	1	0.999998	2	0.999926
TQH	TAHLEQUAH MUNICIPAL	OK	0	1	1	0.999997
TUL	TULSA INTL	OK	0	1	1	0.999974
OUN	UNIVERSITY OF OKLAHOMA WESTHEI	OK	2	0.999929	2	0.999863
OKC	WILL ROGERS WORLD	OK	2	0.999933	2	0.999863
UAO	AURORA STATE	OR	0	1	58	0.996194
BDN	BEND MUNICIPAL	OR	0	1	58	0.996758
LMT	KLAMATH FALLS	OR	0	1	74	0.995265
LGD	LA GRANDE/UNION COUNTY	OR	0	1	19	0.999376
EUG	MAHLON SWEET FIELD	OR	0	1	69	0.994856
MMV	MC MINNVILLE MUNICIPAL	OR	0	1	61	0.995928
SLE	MCNARY FLD	OR	0	1	63	0.995883
ONP	NEWPORT MUNICIPAL	OR	0	1	72	0.992683
ONO	ONTARIO MUNICIPAL	OR	0	1	16	0.999669
PDX	PORTLAND INTL	OR	0	1	58	0.996627
AGC	ALLEGHENY COUNTY	PA	0	1	1	0.999939
AOO	ALTOONA-BLAIR COUNTY	PA	0	1	2	0.999883
LBE	ARNOLD PALMER RGNL	PA	0	1	1	0.999912
BFD	BRADFORD RGNL	PA	0	1	3	0.999903
BTP	BUTLER COUNTY/ K W SCHOLTER FIELD	PA	0	1	1	0.999940
MQS	CHESTER COUNTY G O CARLSON	PA	0	1	2	0.999678
AXQ	CLARION COUNTY	PA	0	1	1	0.999920
9D4	DECK	PA	0	1	2	0.999703
DUJ	DUBOIS RGNL	PA	0	1	1	0.999910
WAY	GREENE COUNTY	PA	0	1	1	0.999939
HZL	HAZLETON MUNICIPAL	PA	0	1	3	0.999700
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	0	1	1	0.999902
LNS	LANCASTER	PA	0	1	2	0.999690
ABE	LEHIGH VALLEY INTL	PA	0	1	3	0.999688
RVL	MIFFLIN COUNTY	PA	0	1	2	0.999850
UCP	NEW CASTLE MUNICIPAL	PA	0	1	1	0.999953
PNE	NORTHEAST PHILADELPHIA	PA	0	1	2	0.999670
PHL	PHILADELPHIA INTL	PA	0	1	2	0.999667
PIT	PITTSBURGH INTL	PA	0	1	1	0.999945
FWQ	ROSTRAVER	PA	0	1	1	0.999936
2G9	SOMERSET COUNTY	PA	0	1	1	0.999903
OYM	ST MARYS MUNICIPAL	PA	0	1	2	0.999898
UNV	UNIVERSITY PARK	PA	0	1	2	0.999869
FKL	VENANGO RGNL	PA	0	1	1	0.999929
BID	BLOCK ISLAND STATE	RI	0	1	1	0.999918
OQU	QUONSET STATE	RI	0	1	1	0.999902
PVD	THEODORE FRANCIS GREEN STATE	RI	0	1	1	0.999898

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AIK	AIKEN MUNICIPAL	SC	0	1	2	0.999851
AND	ANDERSON RGNL	SC	0	1	1	0.999942
CHS	CHARLESTON AFB/INTL	SC	0	1	2	0.999747
JZI	CHARLESTON EXECUTIVE	SC	0	1	2	0.999746
CAE	COLUMBIA METROPOLITAN	SC	0	1	2	0.999842
UDG	DARLINGTON COUNTY JETPORT	SC	0	1	2	0.999805
GYH	DONALDSON CENTER	SC	0	1	1	0.999937
GGE	GEORGETOWN COUNTY	SC	0	1	2	0.999743
GSP	GREENVILLE SPARTANBURG INTL	SC	0	1	1	0.999934
MYR	MYRTLE BEACH INTL	SC	0	1	3	0.999739
CEU	OCONEE COUNTY RGNL	SC	0	1	1	0.999955
CDN	WOODWARD FIELD	SC	0	1	2	0.999832
ABR	ABERDEEN RGNL	SD	0	1	0	1
BKX	BROOKINGS RGNL	SD	0	1	1	0.999957
YKN	CHAN GURNEY MUNICIPAL	SD	0	1	1	0.999959
HON	HURON RGNL	SD	0	1	1	0.999959
FSD	JOE FOSS FIELD	SD	0	1	1	0.999958
MHE	MITCHELL MUNICIPAL	SD	0	1	1	0.999959
PIR	PIERRE RGNL	SD	0	1	0	1
RAP	RAPID CITY RGNL	SD	0	1	0	1
ATY	WATERTOWN RGNL	SD	0	1	1	0.999957
PVE	BEECH RIVER RGNL	TN	0	1	0	1
SYI	BOMAR FIELD-SHELBYVILLE MUNICIPAL	TN	0	1	0	1
UCY	EVERETT-STEWART RGNL	TN	0	1	0	1
CHA	LOVELL FIELD	TN	0	1	0	1
TYS	MC GHEE TYSON	TN	0	1	0	1
MEM	MEMPHIS INTL	TN	0	1	0	1
NQA	MILLINGTON RGNL JETPORT	TN	0	1	0	1
BNA	NASHVILLE INTL	TN	0	1	0	1
SZY	ROBERT SIBLEY	TN	0	1	0	1
TRI	TRI-CITIES RGNL TN/VA	TN	0	1	1	1
BGF	WINCHESTER MUNICIPAL	TN	0	1	0	1
ABI	ABILENE RGNL	TX	2	0.999911	3	0.999718
ADS	ADDISON	TX	2	0.999914	3	0.999786
ALI	ALICE INTL	TX	0	1	4	0.999765
LFK	ANGELINA COUNTY	TX	1	0.999955	2	0.999847
GKY	ARLINGTON MUNICIPAL	TX	2	0.999916	3	0.999767
AUS	AUSTIN-BERGSTROM INTL	TX	1	0.999971	3	0.999816
LBX	BRAZORIA COUNTY	TX	1	0.999995	2	0.999924
BWD	BROWNWOOD RGNL	TX	2	0.999930	3	0.999724
E30	BRUCE FIELD	TX	2	0.999928	4	0.999705
TKI	COLLIN COUNTY RGNL AT MC KINNE	TX	2	0.999916	3	0.999786
CRP	CORPUS CHRISTI INTL	TX	0	1	6	0.999756
CFD	COULTER FIELD	TX	1	0.999963	2	0.999826
PRX	COX FIELD	TX	2	0.999923	3	0.999903
BBD	CURTIS FIELD	TX	2	0.999944	4	0.999718
RBD	DALLAS EXECUTIVE	TX	2	0.999917	3	0.999771
DAL	DALLAS LOVE FIELD	TX	2	0.999914	3	0.999790
DFW	DALLAS/FORT WORTH INTL	TX	2	0.999914	3	0.999783
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	1	0.999976	2	0.999879
LUD	DECATUR MUNICIPAL	TX	2	0.999915	3	0.999760

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DRT	DEL RIO INTL	TX	1	0.999972	4	0.999605
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	1	0.999954	2	0.999786
GGG	EAST TEXAS RGNL	TX	2	0.999930	3	0.999846
CLL	EASTERWOOD FIELD	TX	1	0.999966	2	0.999830
ELP	EL PASO INTL	TX	1	0.999973	8	0.999556
AFW	FORT WORTH ALLIANCE	TX	2	0.999914	3	0.999774
FWS	FORT WORTH SPINKS	TX	2	0.999918	3	0.999764
IAH	GEORGE BUSH INTERCONTINENTAL	TX	1	0.999979	2	0.999887
PVW	HALE COUNTY	TX	2	0.999934	10	0.999363
INJ	HILLSBORO MUNICIPAL	TX	2	0.999931	3	0.999784
TME	HOUSTON EXECUTIVE	TX	1	0.999982	2	0.999884
AXH	HOUSTON-SOUTHWEST	TX	1	0.999988	2	0.999909
ERV	KERRVILLE MUNICIPAL/ LOUIS SCHREINER	TX	1	0.999971	4	0.999765
LNC	LANCASTER	TX	2	0.999920	3	0.999779
LRD	LAREDO INTL	TX	0	1	5	0.999497
CXO	LONE STAR EXECUTIVE	TX	1	0.999971	2	0.999861
LBB	LUBBOCK PRESTON SMITH INTL	TX	1	0.999918	11	0.999405
GVT	MAJORS	TX	2	0.999915	3	0.999805
5T9	MAVERICK COUNTY MEMORIAL INTL	TX	1	0.999986	4	0.999595
MFE	MC ALLEN MILLER INTL	TX	0	1	7	0.999446
HQZ	MESQUITE METRO	TX	2	0.999917	3	0.999801
MAF	MIDLAND INTL	TX	1	0.999910	10	0.999578
OSA	MOUNT PLEASANT RGNL	TX	2	0.999916	3	0.999906
RAS	MUSTANG BEACH	TX	0	1	5	0.999787
BAZ	NEW BRAUNFELS MUNICIPAL	TX	1	0.999978	4	0.999810
PIL	PORT ISABEL-CAMERON COUNTY	TX	0	1	6	0.999363
AMA	RICK HUSBAND AMARILLO INTL	TX	2	0.999945	11	0.999263
SJT	SAN ANGELO RGNL/MATHIS FIELD	TX	2	0.999933	4	0.999695
SAT	SAN ANTONIO INTL	TX	1	0.999980	4	0.999790
HYI	SAN MARCOS MUNICIPAL	TX	1	0.999976	4	0.999816
GLS	SCHOLES INTL AT GALVESTON	TX	1	0.999999	2	0.999934
SPS	SHEPPARD AFB/WICHITA FALLS MUN	TX	2	0.999924	3	0.999732
EBG	SOUTH TEXAS INTL AT EDINBURG	TX	0	1	7	0.999483
SGR	SUGAR LAND RGNL	TX	1	0.999986	2	0.999899
TFP	T P MC CAMPBELL	TX	0	1	6	0.999731
TRL	TERRELL MUNICIPAL	TX	2	0.999919	3	0.999808
TYR	TYLER POUNDS RGNL	TX	2	0.999930	3	0.999817
HRL	VALLEY INTL	TX	0	1	7	0.999406
IWS	WEST HOUSTON	TX	1	0.999982	2	0.999887
HOU	WILLIAM P HOBBY	TX	1	0.999986	2	0.999905
CDC	CEDAR CITY RGNL	UT	0	1	2	0.999915
KNB	KANAB MUNICIPAL	UT	0	1	2	0.999878
LGU	LOGAN-CACHE	UT	0	1	2	0.999993
OGD	OGDEN-HINCKLEY	UT	0	1	1	0.999991
PVU	PROVO MUNICIPAL	UT	0	1	1	0.999972
SLC	SALT LAKE CITY INTL	UT	0	1	1	0.999984
SGU	ST GEORGE MUNICIPAL	UT	0	1	4	0.999852
MFV	ACCOMACK COUNTY	VA	0	1	2	0.999691
MTV	BLUE RIDGE	VA	0	1	2	0.999906
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1	2	0.999875
FCI	CHESTERFIELD COUNTY	VA	0	1	2	0.999782

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CJR	CULPEPER RGNL	VA	0	1	2	0.999821
PTB	DINWIDDIE COUNTY	VA	0	1	2	0.999777
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1	2	0.999782
JYO	LEESBURG EXECUTIVE	VA	0	1	3	0.999808
LNP	LONESOME PINE	VA	0	1	0	1
LYH	LYNCHBURG RGNL/ PRESTON GLENN FIELD	VA	0	1	2	0.999885
HEF	MANASSAS RGNL/HARRY P. DAVIS F	VA	0	1	2	0.999808
MKJ	MOUNTAIN EMPIRE	VA	0	1	1	0.999970
PSK	NEW RIVER VALLEY	VA	0	1	1	0.999946
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	0	1	2	0.999713
ORF	NORFOLK INTL	VA	0	1	2	0.999692
RIC	RICHMOND INTL	VA	0	1	2	0.999768
RMN	STAFFORD RGNL	VA	0	1	2	0.999795
XSA	TAPPAHANNOCK-ESSEX COUNTY	VA	0	1	2	0.999738
BCB	VIRGINIA TECH/ MONTGOMERY EXECU	VA	0	1	1	0.999941
IAD	WASHINGTON DULLES INTL	VA	0	1	2	0.999807
BTV	BURLINGTON INTL	VT	1	0.999944	1	0.999827
FSO	FRANKLIN COUNTY STATE	VT	1	0.999930	1	0.999805
BLI	BELLINGHAM INTL	WA	0	1	24	0.999286
HQM	BOWERMAN	WA	0	1	62	0.996507
PWT	BREMERTON NATIONAL	WA	0	1	53	0.998004
DEW	DEER PARK	WA	0	1	1	0.999802
FHR	FRIDAY HARBOR	WA	0	1	37	0.998822
MWH	GRANT CO INTL	WA	0	1	11	0.999395
OLM	OLYMPIA	WA	0	1	56	0.997389
PUW	PULLMAN/MOSCOW RGNL	WA	0	1	6	0.999923
RLD	RICHLAND	WA	0	1	21	0.999389
SEA	SEATTLE-TACOMA INTL	WA	0	1	52	0.998351
BVS	SKAGIT RGNL	WA	0	1	29	0.999147
PAE	SNOHOMISH COUNTY (PAINE FLD)	WA	0	1	9	0.991921
GEG	SPOKANE INTL	WA	0	1	7	0.999867
TIW	TACOMA NARROWS	WA	0	1	53	0.997900
PSC	TRI-CITIES	WA	0	1	20	0.999419
ALW	WALLA WALLA RGNL	WA	0	1	17	0.999464
CLM	WILLIAM R FAIRCHILD INTL	WA	0	1	54	0.998012
GRB	AUSTIN STRAUBEL INTL	WI	0	1	0	1
DLL	BARABOO WISCONSIN DELLS	WI	0	1	0	1
OVS	BOSCOBEL	WI	0	1	0	1
CWA	CENTRAL WISCONSIN	WI	0	1	0	1
EAU	CHIPPEWA VALLEY RGNL	WI	0	1	0	1
MSN	DANE COUNTY RGNL-TRUAX FIELD	WI	0	1	0	1
UNU	DODGE COUNTY	WI	0	1	0	1
SUE	DOOR COUNTY CHERRYLAND	WI	0	1	1	0.999987
EGV	EAGLE RIVER UNION	WI	0	1	1	0.999977
FLD	FOND DU LAC COUNTY	WI	0	1	0	1
MKE	GENERAL MITCHELL INTL	WI	0	1	0	1
ASX	JOHN F KENNEDY MEMORIAL	WI	0	1	2	0.999959
LSE	LA CROSSE MUNICIPAL	WI	0	1	0	1
MTW	MANITOWOC COUNTY	WI	0	1	0	1
MFI	MARSHFIELD MUNICIPAL	WI	0	1	0	1

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LUM	MENOMONIE MUNICIPAL-SCORE FIELD	WI	0	1	0	1
RRL	MERRILL MUNICIPAL	WI	0	1	1	0.999996
C29	MIDDLETON MUNICIPAL – MOREY FIELD	WI	0	1	0	1
ATW	OUTAGAMIE COUNTY RGNL	WI	0	1	0	1
PBH	PRICE COUNTY	WI	0	1	1	0.999990
RHI	RHINELANDER-ONEIDA COUNTY	WI	0	1	1	0.999985
RPD	RICE LAKE RGNL - CARL'S FIELD	WI	0	1	0	1
HYR	SAWYER COUNTY	WI	0	1	2	0.999983
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	0	1	0	1
JVL	SOUTHERN WISCONSIN RGNL	WI	0	1	0	1
TKV	TOMAHAWK RGNL	WI	0	1	1	0.999991
LNR	TRI-COUNTY RGNL	WI	0	1	0	1
OSH	WITTMAN RGNL	WI	0	1	0	1
MRB	EASTERN WV RGNL/SHEPHERD FLD	WV	0	1	2	0.999860
PKB	MID-OHIO VALLEY RGNL	WV	0	1	0	1
HTS	TRI-STATE/ MILTON J. FERGUSON FIELD	WV	0	1	0	1
CYS	CHEYENNE RGNL/ JERRY OLSON FIELD	WY	0	1	2	0.999988
EVW	EVANSTON-UINTA COUNTY BURNS FIELD	WY	0	1	1	0.999980
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1	0	1
JAC	JACKSON HOLE	WY	0	1	1	0.999987
LAR	LARAMIE RGNL	WY	0	1	1	0.999947
CPR	NATRONA COUNTY INTL	WY	0	1	1	0.999980
RIW	RIVERTON RGNL	WY	0	1	1	0.999986
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1	1	0.999962
SHR	SHERIDAN COUNTY	WY	0	1	0	1
COD	YELLOWSTONE RGNL	WY	0	1	1	0.999995

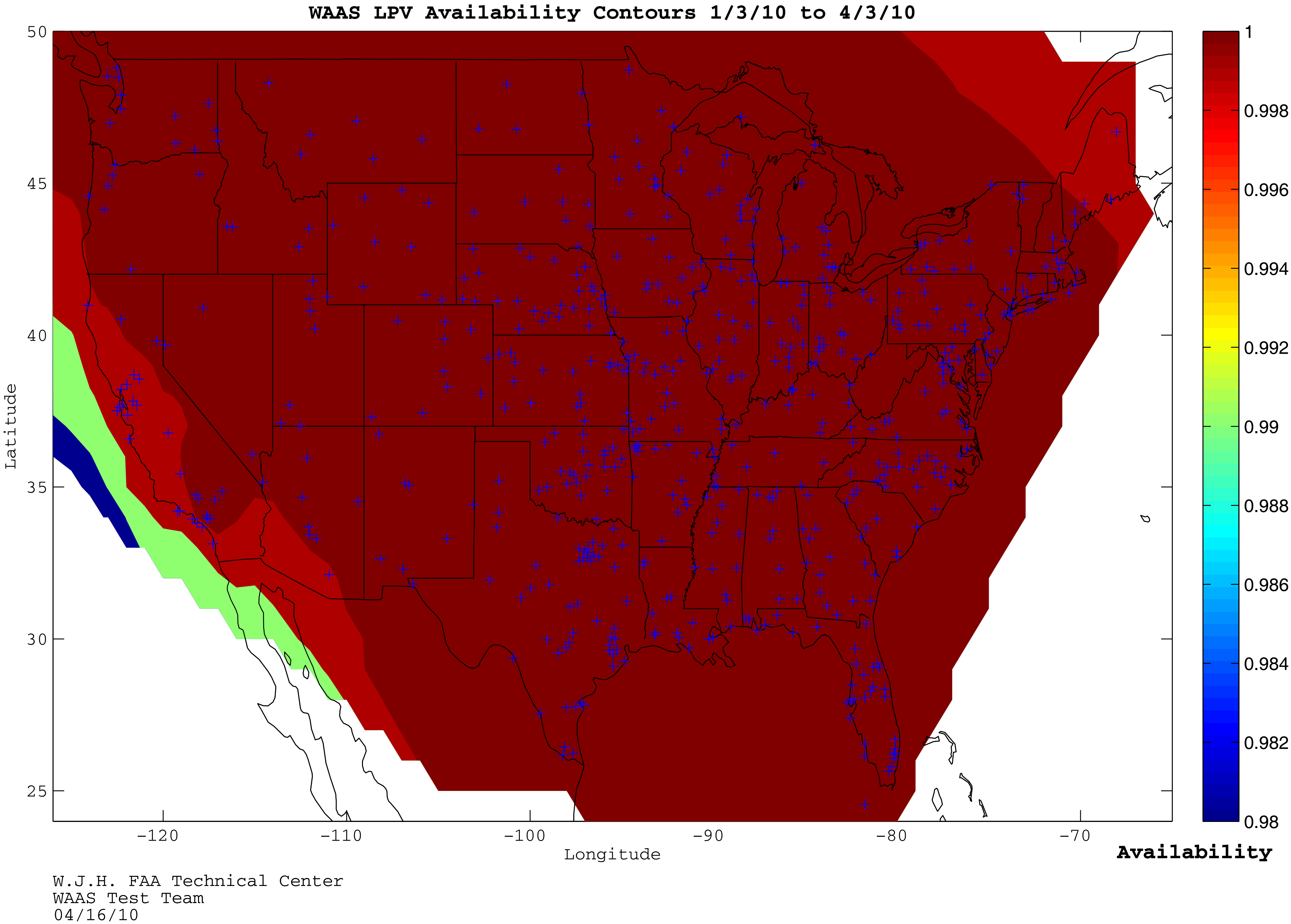
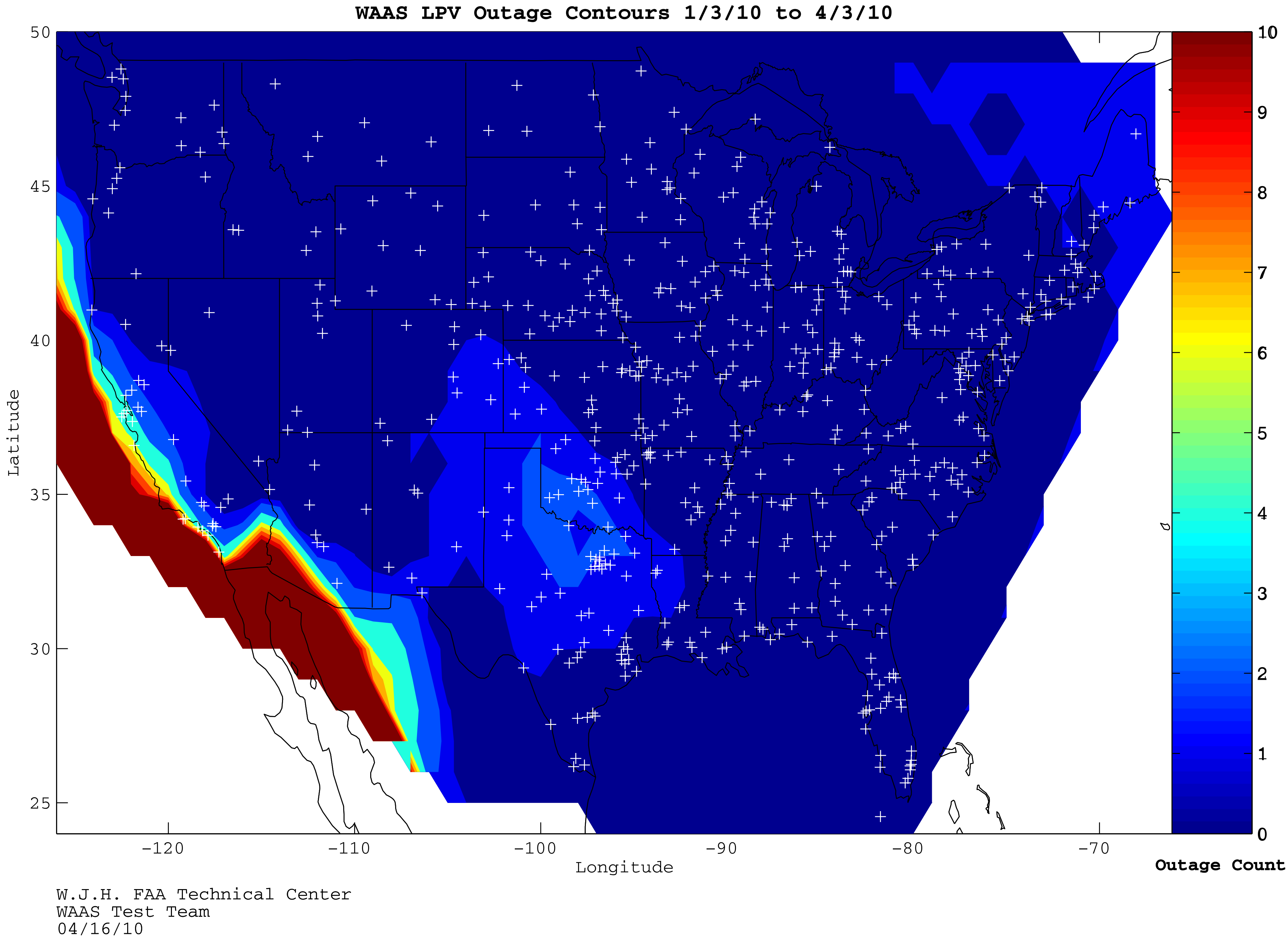

WAAS LPV Availability Contours 1/3/10 to 4/3/10
Latitude
Longitude
50
45
40
35
30
25
−120
−110
−100
−90
−80
−70
Availability
1
0.998
0.996
0.994
0.992
0.99
0.988
0.986
0.984
0.982
0.98
W.J.H. FAA Technical Center
WAAS Test Team
04/16/10

Figure 9-2 WAAS LPV Outage



10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

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

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

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

Table 10-1 CNMP Bounding Statistics

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

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

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

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

11.0 WAAS REFERENCE STATION SURVEY VALIDATION

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

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

Antenna L1 phase center position surveys were preformed for the WAAS antennas using a 25 hour set of data from 23:00 on 3/28/10 to 23:59:30 on 3/19/10 for all of the WAAS receivers.

Surveys were performed using the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) and the Canadian Spatial Reference System (CSRS) Precise Point Positioning (PPP) service. The overall RMS qualities reported by OPUS were all less than or equal to 2.2 cm. The RSS of the ECEF sigma's were all less than 21 mm for the CSRS surveys. The OPUS and CSRS surveys agreed to 5.8 cm or better..

The positions were then compared to the positions in the current WAAS software build, WFO release 1, build 6.012 that was fielded during November 2009. The WFO Release 1 antenna positions have been interpolated forward to 8/1/10.

The OPUS surveys agree with the WFO RLS1 positions to better than or equal to 6 cm with the exceptions of Mexico City (10.1 cm), Mexico City is high movement because it is sinking due to depletion of water from an underground lake. The Mexico City WFO Release 1 offsets have been approved by the WIPP.

Table 11.1 lists the WAAS antenna L1 phase center positions as of 3/29/10. The positions are in IRTF-2000 and are the OPUS estimated positions. OPUS is now using GEOID 09.

Figure 11.1 to 11.3 show the RSS of the ECEF difference between the 3/29/10 OPUS survey antenna phase center locations and the locations in the current WFO release 1 software which was fielded this November 2009. Each reference station has three independent strings of WAAS receiving equipment (WRE). A surveyed antenna phase center location is required for each WRE. All three strings of a reference station are shown in the three figures. For example, BET1 identifies the RSS delta for the Bethel WRS string 1. The next two bars in the chart are Bethel string 2 and Bethel string 3. Figure 11.4 to 11.6 shows the OPUS overall RMS quality indications.

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

Figure 11.13 to 11.15 show the RSS of the ECEF difference between the 3/29/10 OPUS survey antenna phase center locations and the locations in the future WFO release 2 software which will be fielded about November 2010. The antenna phase center information in WFO release 2 has been interpolated forward in time to 4/1/11.

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

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
BET1	-2965384.983	-972576.634	5543892.936	60.78791608	-161.8417244	52.189
BET2	-2965385.752	-972580.353	5543891.878	60.78789664	-161.8416639	52.188
BET3	-2965388.319	-972577.487	5543891.008	60.78788072	-161.8417286	52.183
BIL1	-1416445.849	-4223577.035	4550862.168	45.8037069	-108.5397226	1112.26
BIL2	-1416449.921	-4223574.892	4550862.892	45.80371619	-108.539781	1112.265
BIL3	-1416441.541	-4223574.299	4550866.018	45.80375661	-108.5396813	1112.257
BRW1	-1886758.859	-809058.695	6018494.522	71.28276545	-156.7899232	15.6
BRW2	-1886756.271	-809055.954	6018495.688	71.28279816	-156.7899651	15.594
BRW3	-1886755.181	-809059.735	6018495.517	71.28279352	-156.7898561	15.589
CDB1	-3484098.98	-1084748.823	5213678.678	55.19237481	-162.7064037	49.704
CDB2	-3484105.635	-1084741.614	5213675.737	55.19232868	-162.7065429	49.693
CDB3	-3484111.906	-1084734.858	5213672.977	55.19228518	-162.7066734	49.699
FAI1	-2304741.727	-1448715.278	5748843.7	64.80963065	-147.84734	149.918
FAI2	-2304741.254	-1448706.467	5748846.089	64.80968108	-147.8474917	149.914
FAI3	-2304732.72	-1448707.402	5748849.231	64.80974767	-147.8473794	149.894
HNL1	-5508637.062	-2234493.483	2303722.102	21.31298941	-157.9208258	24.664
HNL2	-5508656.235	-2234483.797	2303686.856	21.31264648	-157.9209818	25.014
HNL3	-5508647.639	-2234497.737	2303693.948	21.3127151	-157.9208262	25.052
JNU1	-2354254.827	-2388549.661	5407043.082	58.36257475	-134.5857061	16.053
JNU2	-2354252.741	-2388565.766	5407036.914	58.36246923	-134.5854876	16.05
JNU3	-2354239.524	-2388568.618	5407041.371	58.36254561	-134.5852926	16.043
MMD1	35070.448	-5959686.706	2264365.76	20.93190908	-89.66284042	29.153
MMD2	35065.52	-5959687.057	2264364.971	20.93190138	-89.66288782	29.172
MMD3	35065.183	-5959685.281	2264369.632	20.93194644	-89.66289096	29.177
MMX1	-948701.168	-5943936.148	2109212.872	19.43165331	-99.06838949	2236.166
MMX2	-948696.74	-5943935.972	2109215.295	19.43167656	-99.06834813	2236.15
MMX3	-948705.597	-5943936.341	2109210.447	19.43162998	-99.06843083	2236.197
MPR1	-1570142.207	-5759530.628	2238184.752	20.67900323	-105.249203	10.995
MPR2	-1570139.385	-5759530.135	2238188.805	20.67904136	-105.2491781	11.287
MPR3	-1570143.493	-5759528.013	2238190.568	20.67905934	-105.2492215	11.005
MSD1	-1979519.632	-5523223.133	2493106.738	23.16044631	-109.717647	104.306
MSD2	-1979521.202	-5523225.462	2493100.337	23.1603835	-109.7176537	104.291
MSD3	-1979525.649	-5523222.191	2493104.008	23.16041958	-109.7177054	104.283
MTP1	-254854.361	-6162909.197	1617805.09	14.79136614	-92.36799924	54.978
MTP2	-254850.736	-6162910.229	1617801.654	14.79133408	-92.3679652	54.953
MTP3	-254855.509	-6162910.345	1617800.131	14.79132005	-92.36800946	54.867
OTZ1	-2396055.95	-750356.178	5843502.541	66.88733277	-162.6113721	10.884
OTZ2	-2396052.779	-750354.351	5843504.067	66.8873676	-162.6113902	10.886
OTZ3	-2396052.761	-750358.287	5843503.578	66.88735632	-162.6113044	10.891
YFB1	1035381.52	-2634289.644	5696539.503	63.73149014	-68.54318208	10.007
YFB2	1035372.304	-2634296.046	5696538.154	63.73146397	-68.54340311	9.942
YFB3	1035366.23	-2634306.809	5696534.373	63.73138625	-68.54359724	10.002

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
YQX1	2430424.672	-3419640.396	4788223.783	48.96648955	-54.59763177	146.858
YQX2	2430432.632	-3419639.048	4788220.722	48.96644765	-54.59753249	146.855
YQX3	2430440.532	-3419637.682	4788217.726	48.96640648	-54.59743374	146.868
YWG1	-520164.306	-4083475.878	4855842.957	49.90057434	-97.25939676	221.992
YWG2	-520150.441	-4083468.821	4855850.341	49.90067729	-97.25921774	222.002
YWG3	-520152.304	-4083477.938	4855842.521	49.9005682	-97.25922743	221.998
YYR1	1885341.462	-3321428.359	5091171.599	53.30864667	-60.4194678	37.812
YYR2	1885344.421	-3321419.877	5091176.012	53.30871299	-60.41936638	37.816
YYR3	1885340.133	-3321413.059	5091182.017	53.3088032	-60.41937183	37.823
ZAB1	-1488636.799	-5003946.553	3654557.696	35.1735753	-106.5673493	1620.119
ZAB2	-1488631.469	-5003948.244	3654557.684	35.17357469	-106.5672879	1620.194
ZAB3	-1488632.243	-5003950.824	3654553.83	35.17353232	-106.567288	1620.176
ZAN1	-2659536.549	-1549114.823	5567750.751	61.22920222	-149.7802491	80.662
ZAN2	-2659548.308	-1549110.869	5567746.263	61.22911857	-149.7804229	80.66
ZAN3	-2659541.256	-1549106.746	5567750.736	61.22920214	-149.7804232	80.649
ZAU1	138704.151	-4761244.167	4227763.938	41.78265794	-88.33133628	195.912
ZAU2	138704.414	-4761248.776	4227758.767	41.78259554	-88.33133473	195.908
ZAU3	138711.119	-4761248.516	4227758.86	41.78259655	-88.33125402	195.921
ZBW1	1490299.264	-4448983.18	4306010.474	42.73572022	-71.48042539	39.116
ZBW2	1490304.379	-4448981.173	4306010.823	42.73572422	-71.48035838	39.148
ZBW3	1490306.086	-4448984.794	4306006.507	42.7356714	-71.48035266	39.14
ZDC1	1069125.819	-4839599.014	4001126.492	39.10159557	-77.54274597	80.084
ZDC2	1069128.205	-4839603.651	4001120.299	39.10152364	-77.54273059	80.091
ZDC3	1069124.103	-4839602.737	4001122.489	39.10154904	-77.54277462	80.093
ZDV1	-1273628.577	-4711375.601	4094890.121	40.18730324	-105.1272239	1541.375
ZDV2	-1273622.873	-4711377.113	4094890.134	40.1873035	-105.1271546	1541.361
ZDV3	-1273624.88	-4711380.305	4094885.845	40.18725305	-105.1271676	1541.348
ZFW1	-659983.176	-5324060.792	3438276.469	32.83064965	-97.06647153	155.628
ZFW2	-659988.436	-5324063.342	3438271.469	32.83059623	-97.06652393	155.587
ZFW3	-659983.469	-5324063.882	3438271.688	32.83059826	-97.06647057	155.643
ZHU1	-513864.444	-5506451.778	3166720.5	29.96189625	-95.33142592	10.923
ZHU2	-513867.094	-5506455.178	3166714.342	29.96183176	-95.33144998	10.994
ZHU3	-513873.375	-5506457.815	3166708.74	29.96177352	-95.33151224	10.977
ZJX1	772646.466	-5434462.221	3237231.741	30.69885948	-81.90818493	2.165
ZJX2	772649.799	-5434463.767	3237228.33	30.69882382	-81.90815276	2.143
ZJX3	772645.73	-5434466.185	3237225.233	30.69879141	-81.90819836	2.128
ZKC1	-415247.472	-4954556.398	3982161.115	38.88015937	-94.79083331	305.901
ZKC2	-415231.083	-4954557.715	3982161.167	38.88016006	-94.79064384	305.89
ZKC3	-415237.202	-4954561.076	3982155.978	38.88010184	-94.79071087	305.638
ZLA1	-2474409.871	-4637294.709	3602183.494	34.60351789	-118.0838944	763.507
ZLA2	-2474404.593	-4637297.506	3602183.502	34.60351804	-118.0838293	763.498
ZLA3	-2474411.205	-4637297.197	3602179.52	34.60347396	-118.0838945	763.574

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
ZLC1	-1808273.158	-4486410.833	4145303.02	40.78604336	-111.9521769	1287.424
ZLC2	-1808274.552	-4486414.433	4145298.524	40.78599001	-111.9521763	1287.41
ZLC3	-1808270.343	-4486416.143	4145298.519	40.78598991	-111.9521225	1287.416
ZMA1	966042.331	-5662999.846	2761581.48	25.82461193	-80.31918953	-7.571
ZMA2	966029.355	-5662999.138	2761585.968	25.82465972	-80.31931592	-8.208
ZMA3	966037.439	-5662997.979	2761586.317	25.8246617	-80.3192345	-7.861
ZME1	4070.933	-5226189.316	3644028.414	35.06739395	-89.95536954	68.613
ZME2	4070.963	-5226186.767	3644032.53	35.06743751	-89.95536919	68.892
ZME3	4064.768	-5226186.647	3644032.691	35.06743935	-89.95543711	68.882
ZMP1	-249978.337	-4539297.523	4458955.053	44.63746314	-93.15208491	262.67
ZMP2	-249972.532	-4539297.87	4458955.058	44.637463	-93.15201162	262.693
ZMP3	-249973.628	-4539302.144	4458950.582	44.63740698	-93.15202245	262.627
ZNY1	1406144.683	-4627344.001	4144322.044	40.78432832	-73.0971652	6.464
ZNY2	1406146.481	-4627347.043	4144317.27	40.78427557	-73.0971553	5.945
ZNY3	1406140.93	-4627348.7	4144317.308	40.784276	-73.09722393	5.948
ZOA1	-2684436.815	-4293337.519	3865351.824	37.54305324	-122.0159466	-3.473
ZOA2	-2684433.801	-4293341.587	3865349.389	37.54302568	-122.0158932	-3.488
ZOA3	-2684438.18	-4293342.477	3865345.534	37.54298125	-122.0159299	-3.398
ZOB1	650770.225	-4754715.705	4187420.762	41.2971543	-82.2064443	223.718
ZOB2	650777.902	-4754714.888	4187422.786	41.29716662	-82.20635216	225.228
ZOB3	650776.235	-4754719.701	4187414.99	41.29708689	-82.20637968	223.495
ZSE1	-2308930.233	-3668169.687	4663526.48	47.28699335	-122.1883723	82.094
ZSE2	-2308934.629	-3668175.244	4663520.078	47.28690773	-122.1883824	82.169
ZSE3	-2308935.678	-3668179.517	4663516.121	47.28685599	-122.188364	82.093
ZSU1	2462589.353	-5529371.556	2003724.599	18.43133841	-65.99347533	-28.581
ZSU2	2462587.267	-5529377.308	2003711.607	18.43121447	-65.99351552	-28.509
ZSU3	2462593.912	-5529375.095	2003709.548	18.43119487	-65.99344954	-28.513
ZTL1	529840.434	-5305248.834	3489342.841	33.37968839	-84.29672571	261.152
ZTL2	529846.828	-5305247.992	3489343.137	33.37969162	-84.29665643	261.146
ZTL3	529847.504	-5305251.433	3489337.9	33.37963488	-84.29665288	261.18

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

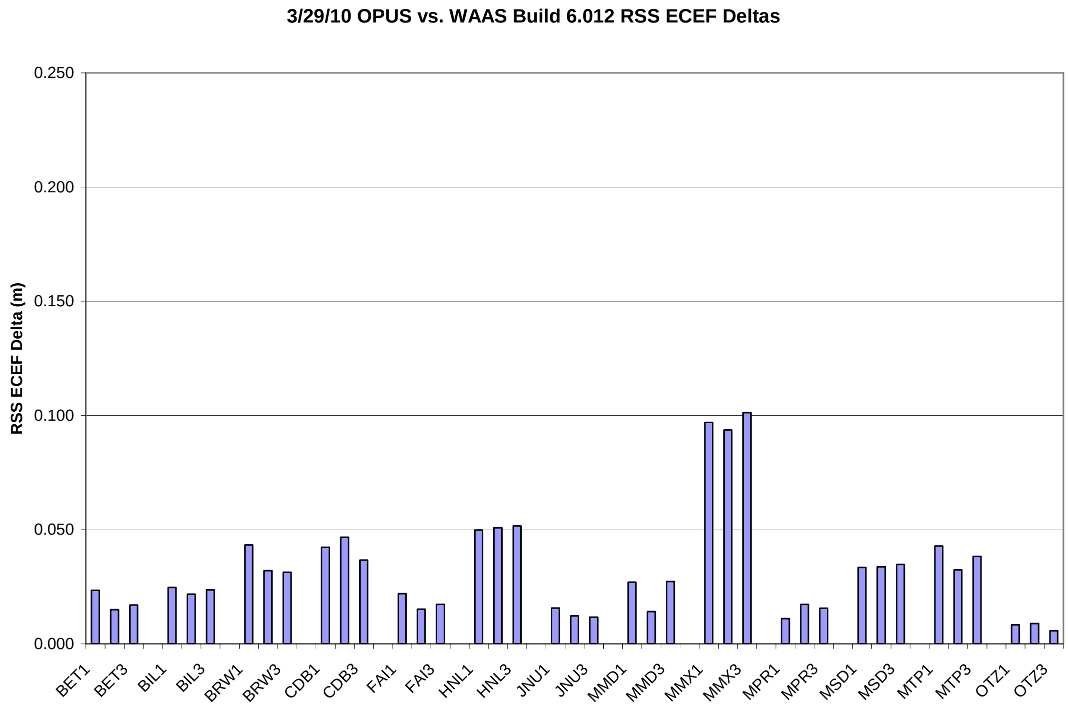


Figure 11-2 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

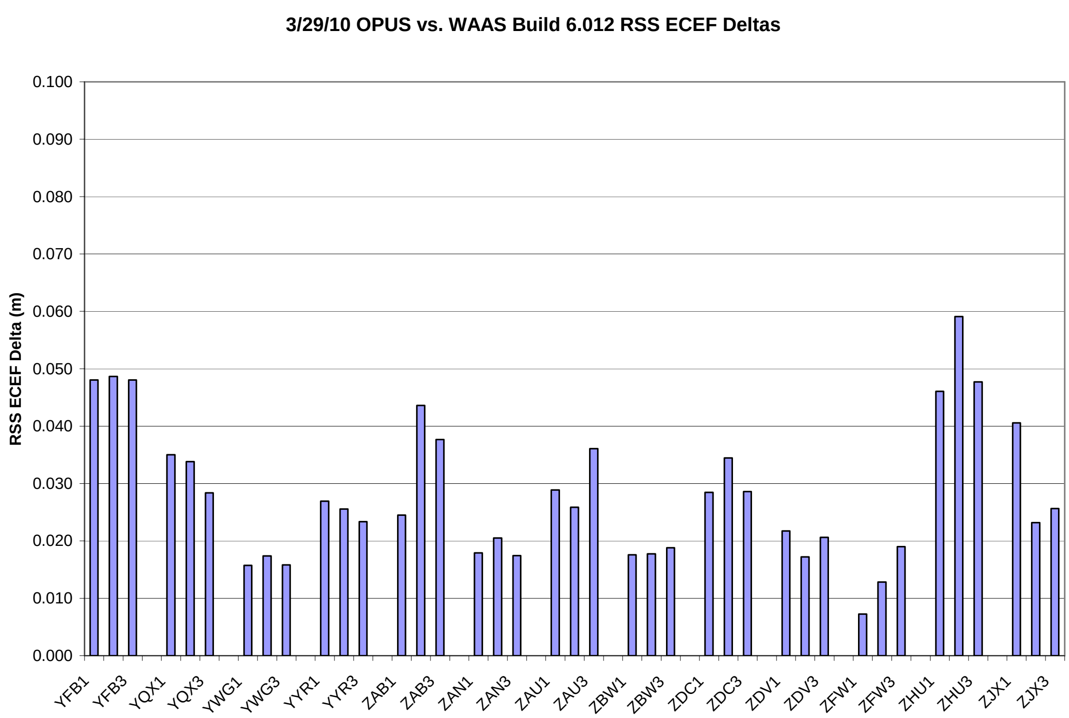


Figure 11-3 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

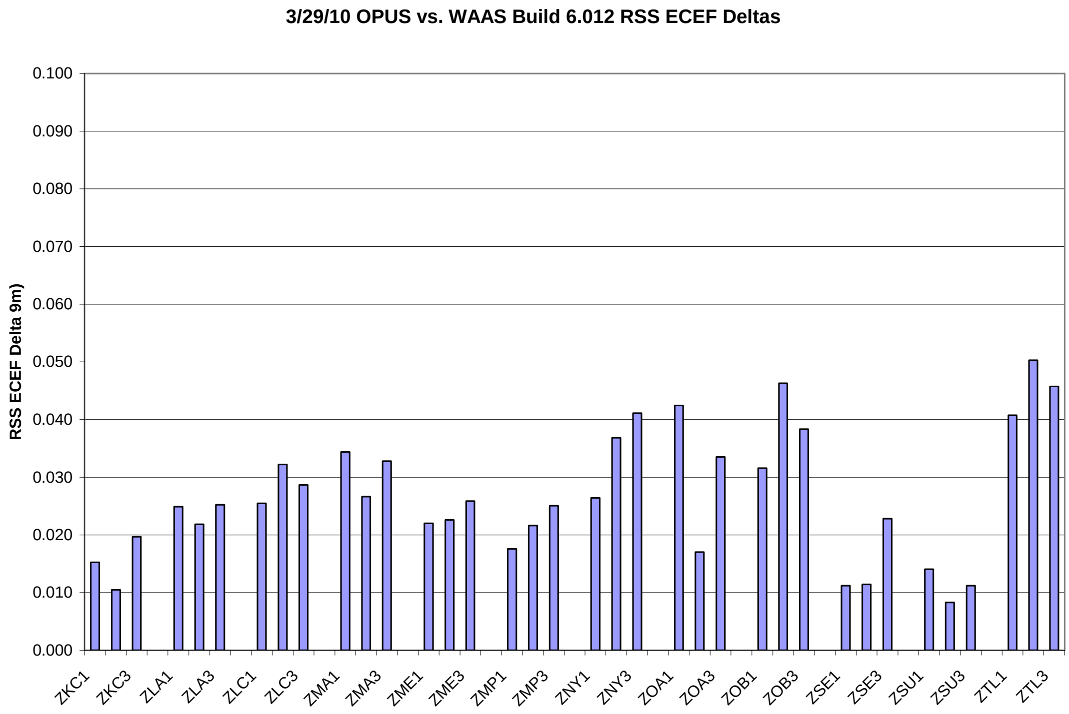


Figure 11-4 OPUS Overall RMS Qualitites

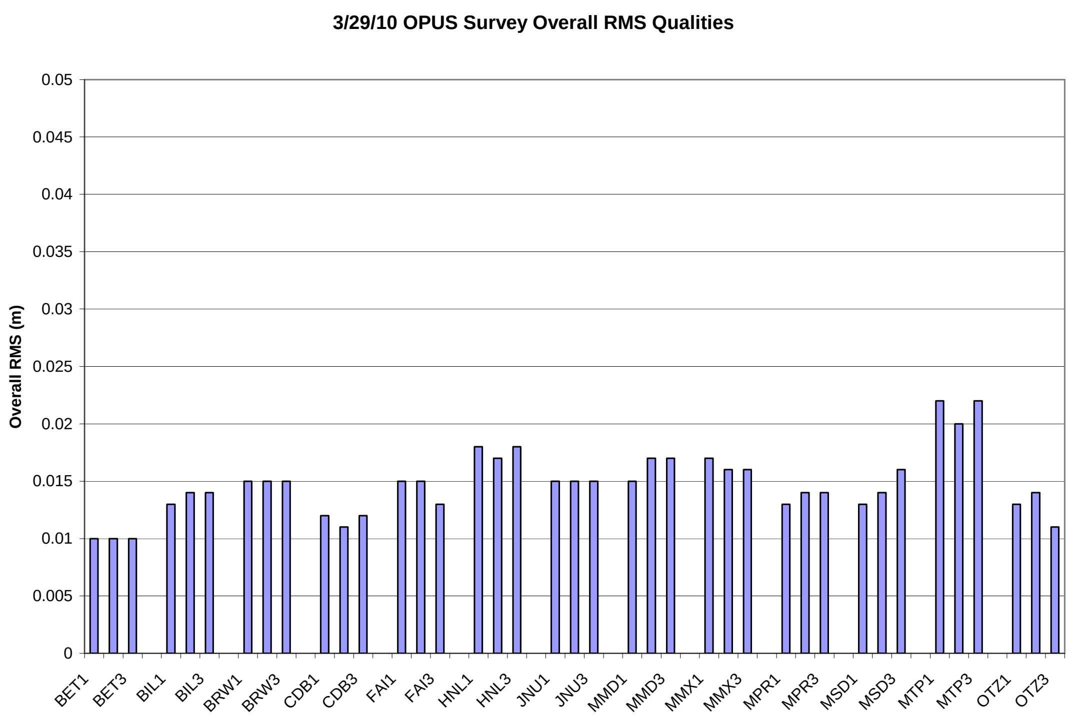


Figure 11-5 OPUS Survey Overall RMS Qualities

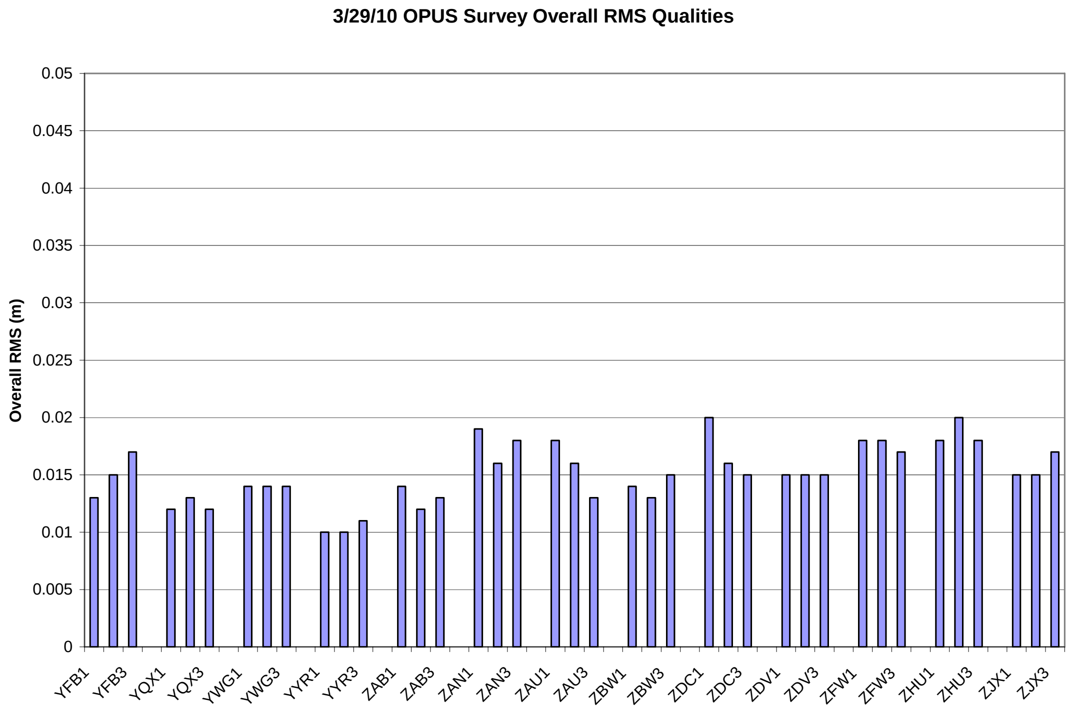


Figure 11-6 OPUS Survey Overall RMS Qualities

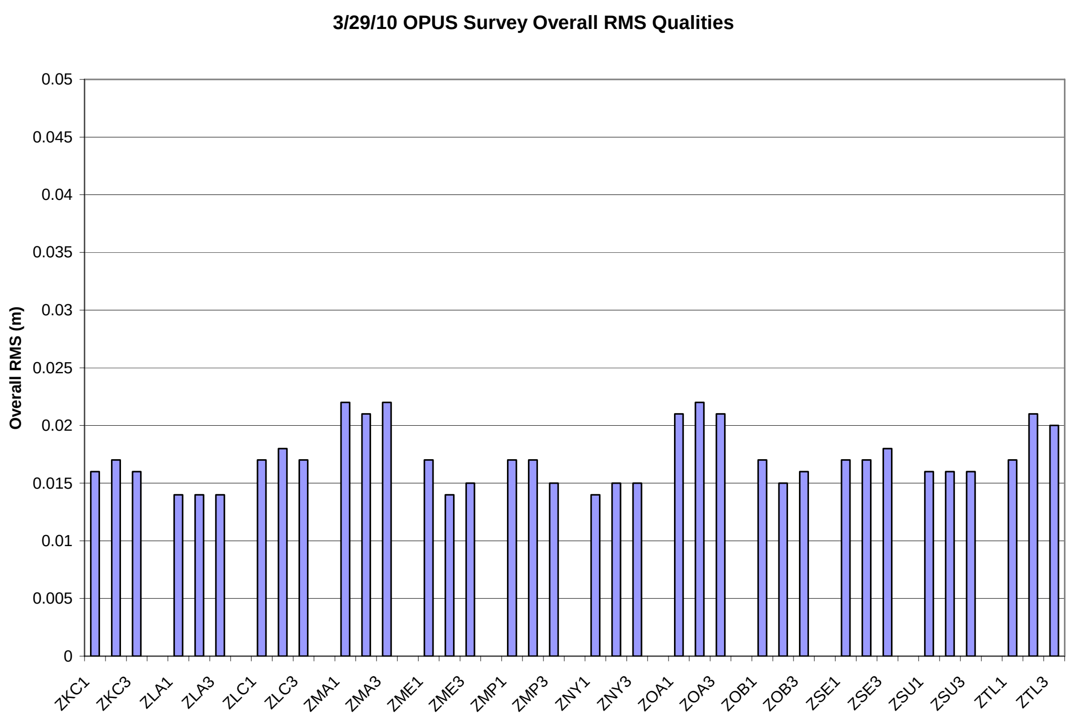


Figure 11-7 OPUS vs. CSRS RSS ECEF Deltas

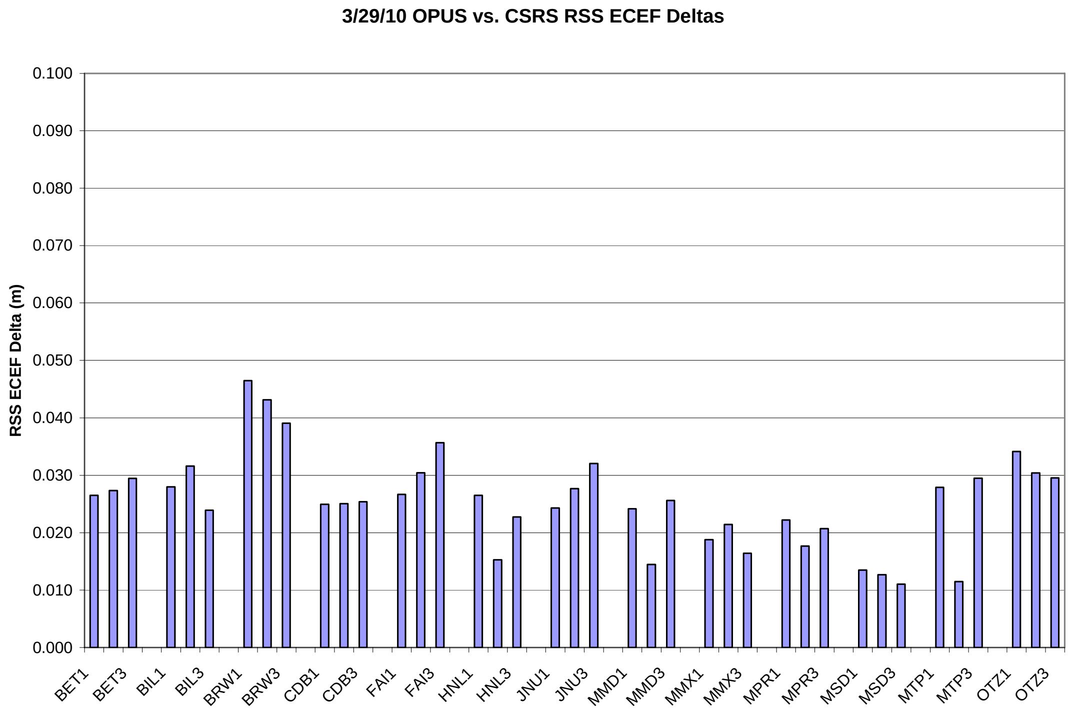


Figure 11-8 OPUS vs. CSRS RSS ECEF Deltas

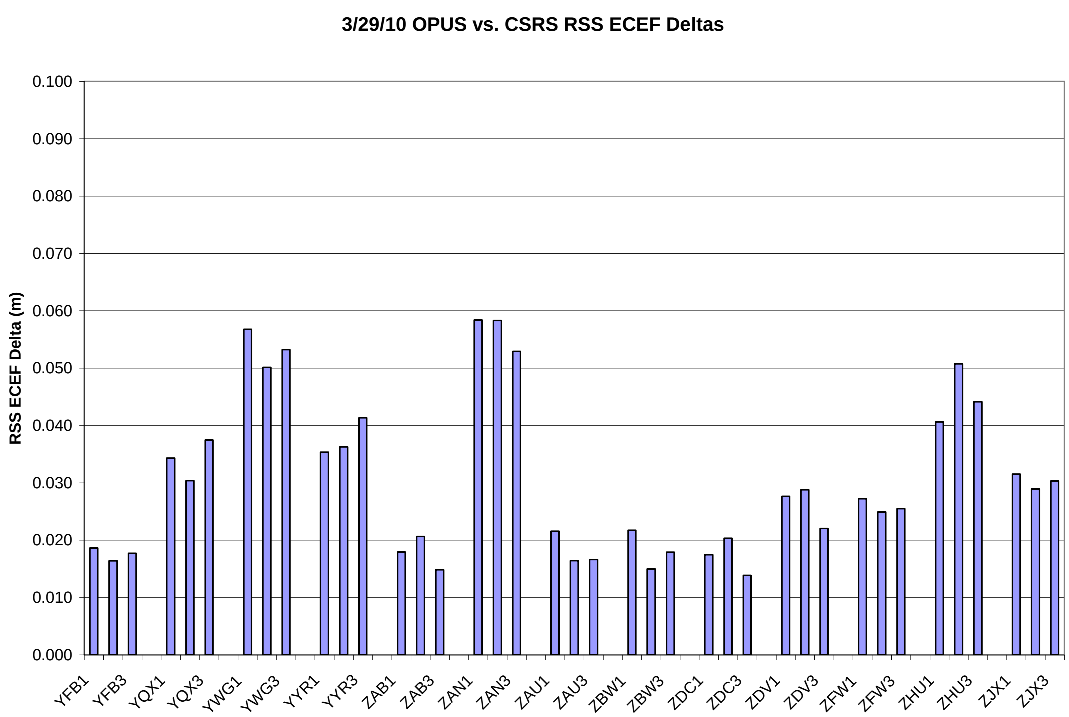


Figure 11-9 OPUS vs. CSRS RSS ECEF Deltas

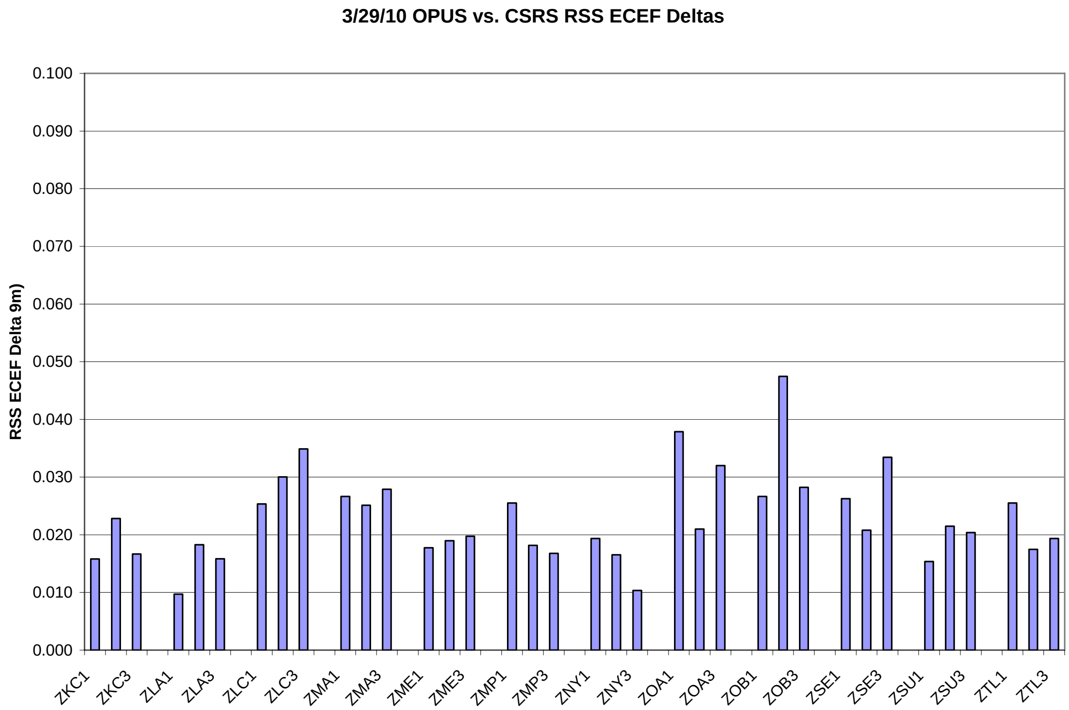


Figure 11-10 CSRS Survey Qualities

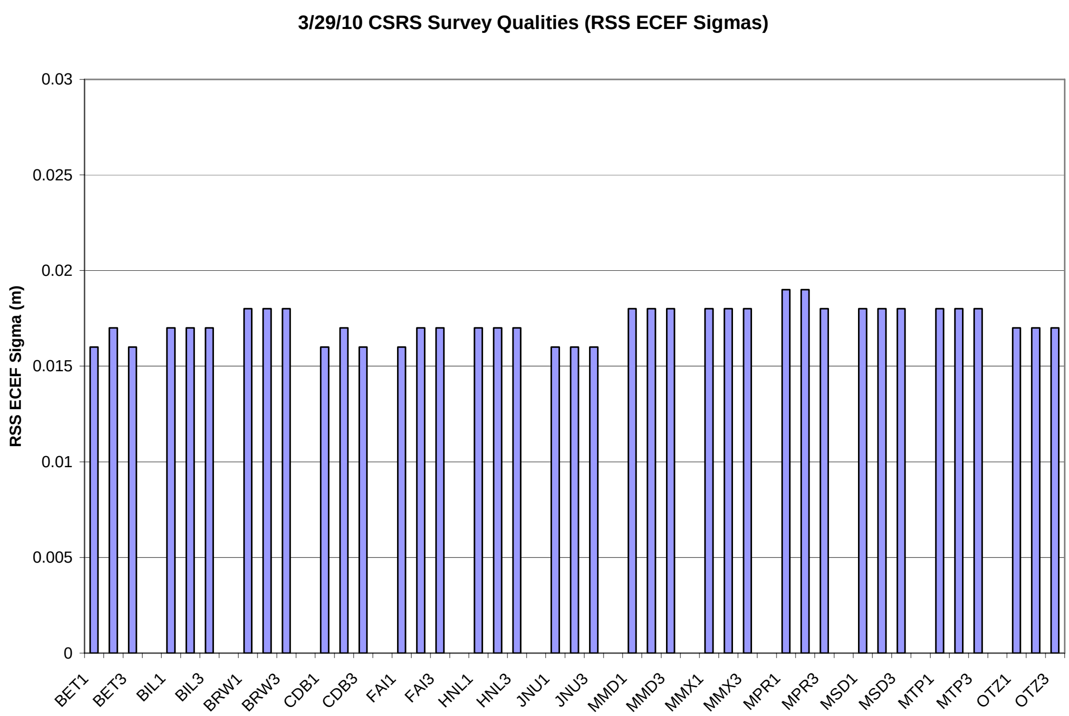


Figure 11-11 CSRS Survey Qualities

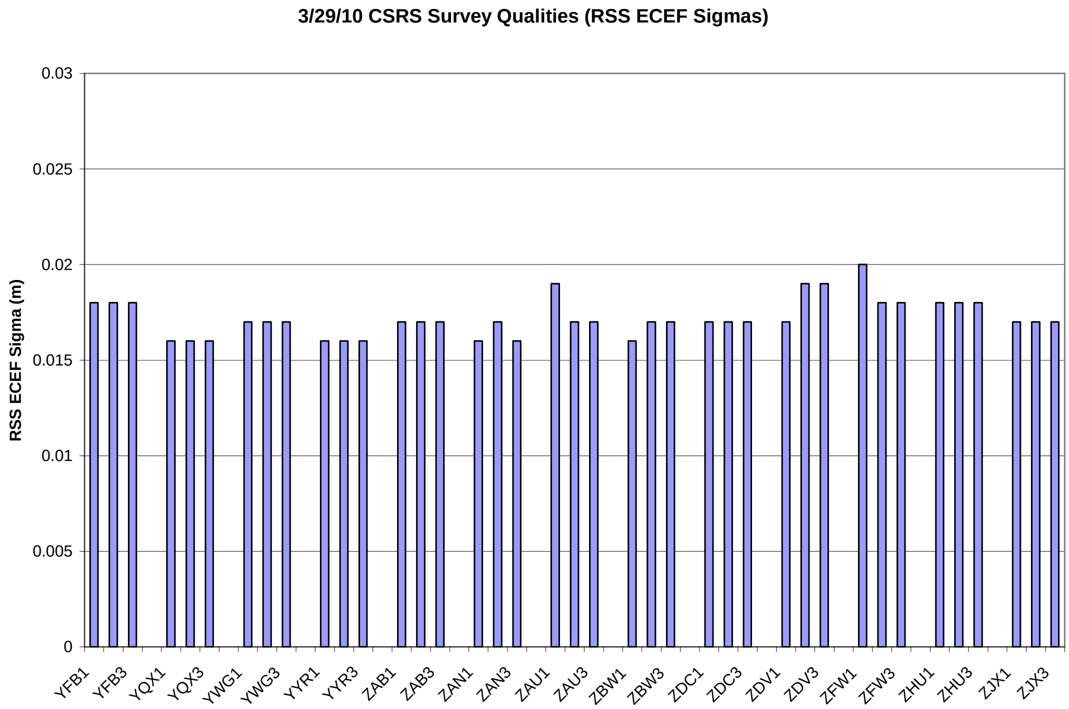
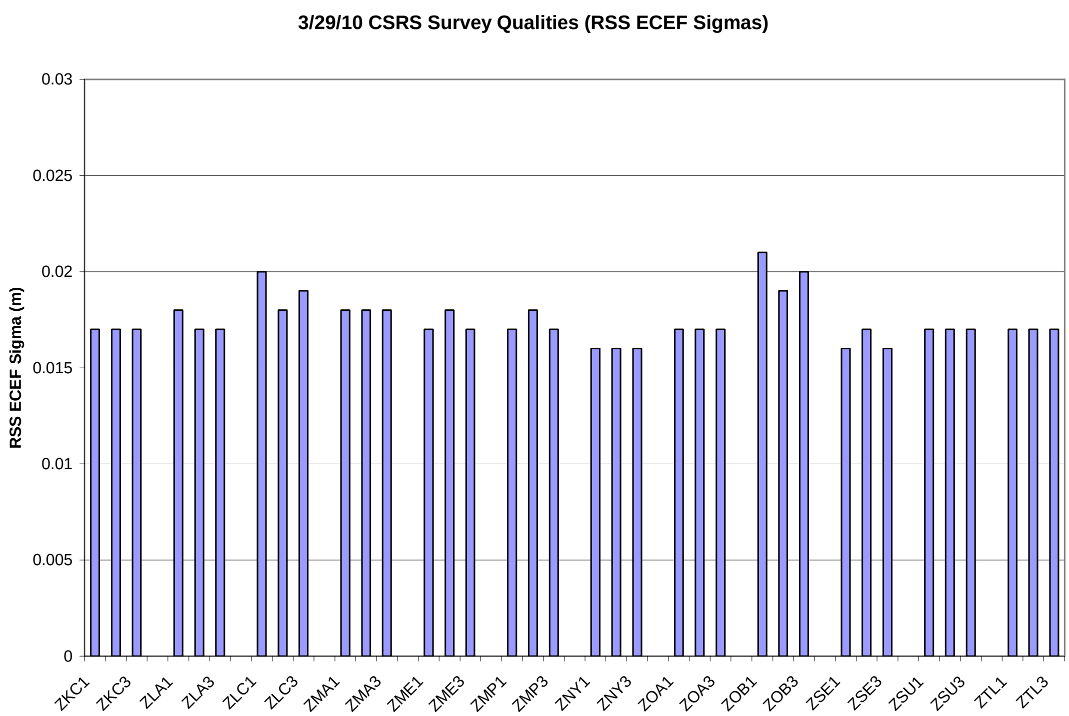


Figure 11-12 CSRS Survey Qualities



12.0 SIGNAL QUALITY MONITOR (SQM)

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

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

12.1 Alpha Metrics

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

Table 12-1 Alpha Metrics

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

12.2 Type Bias

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

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

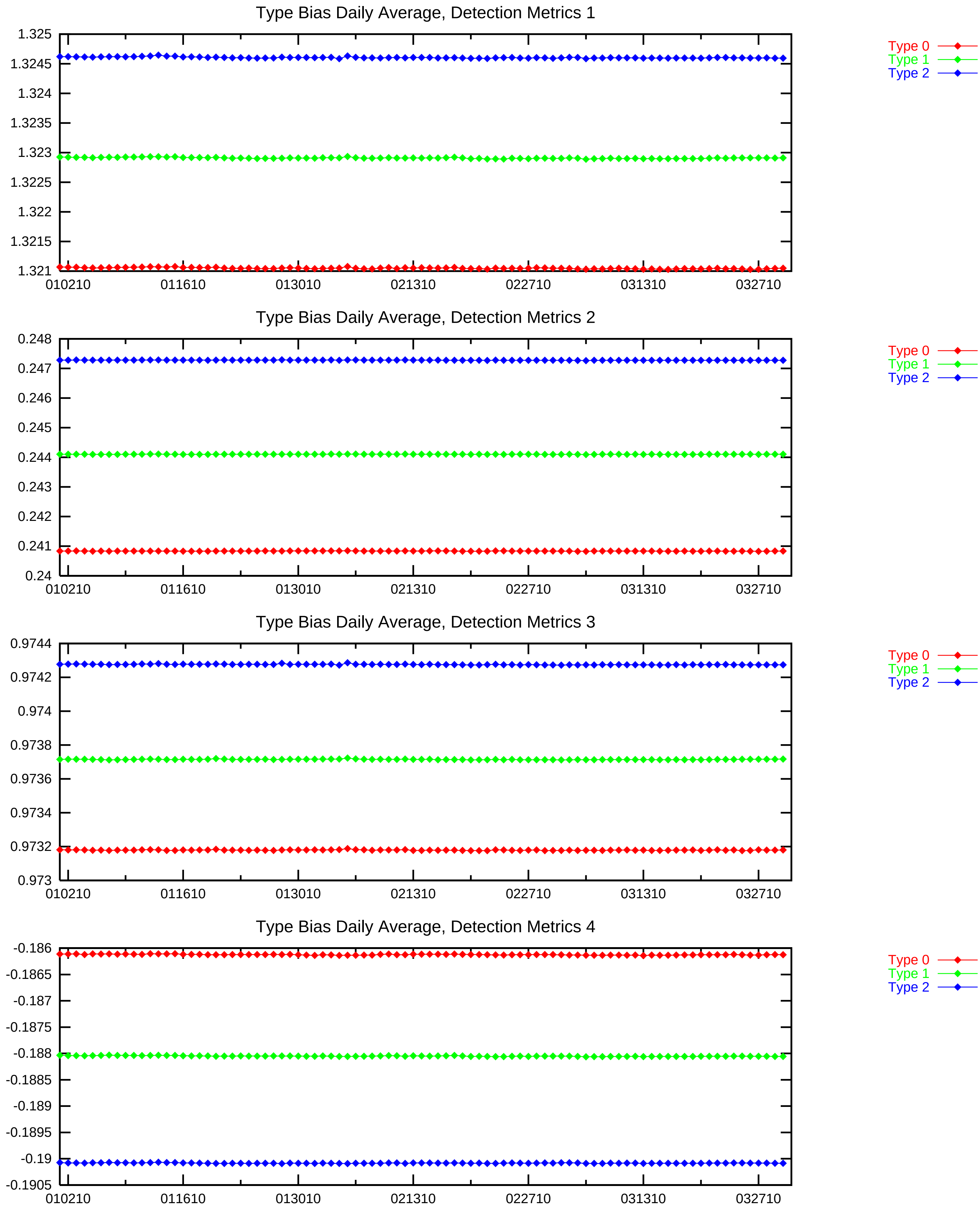
Table 12-2 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.321050	1.322910	1.324600
DM 2	0.240834	0.244102	0.247278
DM 3	0.973179	0.973715	0.974276
DM 4	-0.186124	-0.188050	-0.190082

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

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.321080	1.322930	1.324630
DM 2	0.240835	0.244112	0.247284
DM 3	0.973179	0.973714	0.974277
DM 4	-0.186115	-0.188051	-0.190078

Figure 12-1 PRN Type Bias Average Trend



12.3 PRN Bias

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

Table 12.5 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.6 shows the rollup PRN bias average since January 1, 2008. Figure 12.3 to 12.10 show the PRN bias average trend for each SV. The maximum average for DM1 for this quarter is PRN 23 at 0.0009327. The maximum average for DM2 is PRN 21 at 0.00019286. The maximum average for DM3 is PRN 10 at 0.00026097 and the maximum average for DM4 is PRN 23 at 0.0004046.

For this reporting period, geostationary satellite biases are not evaluated. Please refer to Table 1.4 for events that may have an impact on PRN bias statistics. Small spikes in PRN bias daily average are due to satellite outages.

Table 12-4 PRN Bias Average for the Quarter

PRN	DM1	DM2	DM3	DM4
2	0.00017434	0.00005205	0.00002204	0.00008519
3	0.00023158	0.00005355	0.00009138	0.00036055
4	0.00024109	0.00004183	0.00007096	0.00013717
5	0.00015062	0.00013162	0.00006202	0.00008781
6	0.00015791	0.00005865	0.00004733	0.00011380
7	0.00013755	0.00008207	0.00003354	0.00011794
8	0.00015921	0.00013431	0.00004004	0.00009699
9	0.00020311	0.00005166	0.00006325	0.00011160
10	0.00066816	0.00005841	0.00026097	0.00008863
11	0.00084956	0.00017814	0.00004755	0.00022742
12	0.00023590	0.00008678	0.00010495	0.00008303
13	0.00049147	0.00005029	0.00005930	0.00014446
14	0.00059862	0.00011066	0.00010921	0.00010534
15	0.00011905	0.00006365	0.00002487	0.00012442
16	0.00016970	0.00006385	0.00011007	0.00035072
17	0.00012134	0.00006923	0.00003604	0.00011515
18	0.00056946	0.00009474	0.00003824	0.00019855
19	0.00036703	0.00014132	0.00003658	0.00007660
20	0.00017639	0.00004746	0.00003612	0.00017389
21	0.00062168	0.00019286	0.00020498	0.00008620
22	0.00013634	0.00009687	0.00010326	0.00010151
23	0.00093270	0.00014904	0.00003416	0.00040460
24	0.00031478	0.00004783	0.00003423	0.00011404
26	0.00027862	0.00008468	0.00015109	0.00007494
27	0.00049590	0.00008412	0.00005980	0.00034824
28	0.00021185	0.00005306	0.00003260	0.00008012
29	0.00020397	0.00006364	0.00010546	0.00028054
30	0.00030437	0.00009437	0.00002925	0.00011479
31	0.00047397	0.00015374	0.00003843	0.00026210
32	0.00030085	0.00004672	0.00010671	0.00010849

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

PRN	DM1	DM2	DM3	DM4
1	0.00013788	0.00004337	0.00007352	0.00007985
2	0.00018020	0.00005785	0.00002269	0.00009263
3	0.00021712	0.00005278	0.00008619	0.00034842
4	0.00023790	0.00004453	0.00007412	0.00013049
5	0.00032627	0.00008987	0.00009942	0.00013340
6	0.00015840	0.00005429	0.00004374	0.00012158
7	0.00013172	0.00009160	0.00003609	0.00012053
8	0.00015572	0.00012141	0.00004441	0.00010032
9	0.00022675	0.00005408	0.00006886	0.00011162
10	0.00065746	0.00007105	0.00026946	0.00009276
11	0.00090712	0.00018393	0.00006052	0.00023105
12	0.00023862	0.00008802	0.00010599	0.00008048
13	0.00050884	0.00005666	0.00005834	0.00015757
14	0.00065724	0.00012464	0.00011297	0.00012442
15	0.00011935	0.00006938	0.00002778	0.00013278
16	0.00016327	0.00007429	0.00010775	0.00034020
17	0.00011839	0.00007841	0.00003238	0.00011615
18	0.00060899	0.00010281	0.00004029	0.00021245
19	0.00037425	0.00013277	0.00003346	0.00008278
20	0.00015714	0.00004751	0.00004156	0.00012090
21	0.00062393	0.00018807	0.00020211	0.00008643
22	0.00014274	0.00009307	0.00010157	0.00010082
23	0.00095205	0.00014134	0.00003533	0.00042059
24	0.00030265	0.00004549	0.00003511	0.00010336
25	0.00015833	0.00011328	0.00008136	0.00030547
26	0.00027047	0.00009145	0.00015343	0.00008681
27	0.00047575	0.00007919	0.00006662	0.00032378
28	0.00024367	0.00005328	0.00003315	0.00008826
29	0.00022061	0.00006708	0.00010730	0.00029075
30	0.00029461	0.00009376	0.00002825	0.00011658
31	0.00047187	0.00015779	0.00003890	0.00025306
32	0.00031466	0.00004712	0.00011289	0.00010338

Figure 12-2 PRN Bias Average for the Quarter

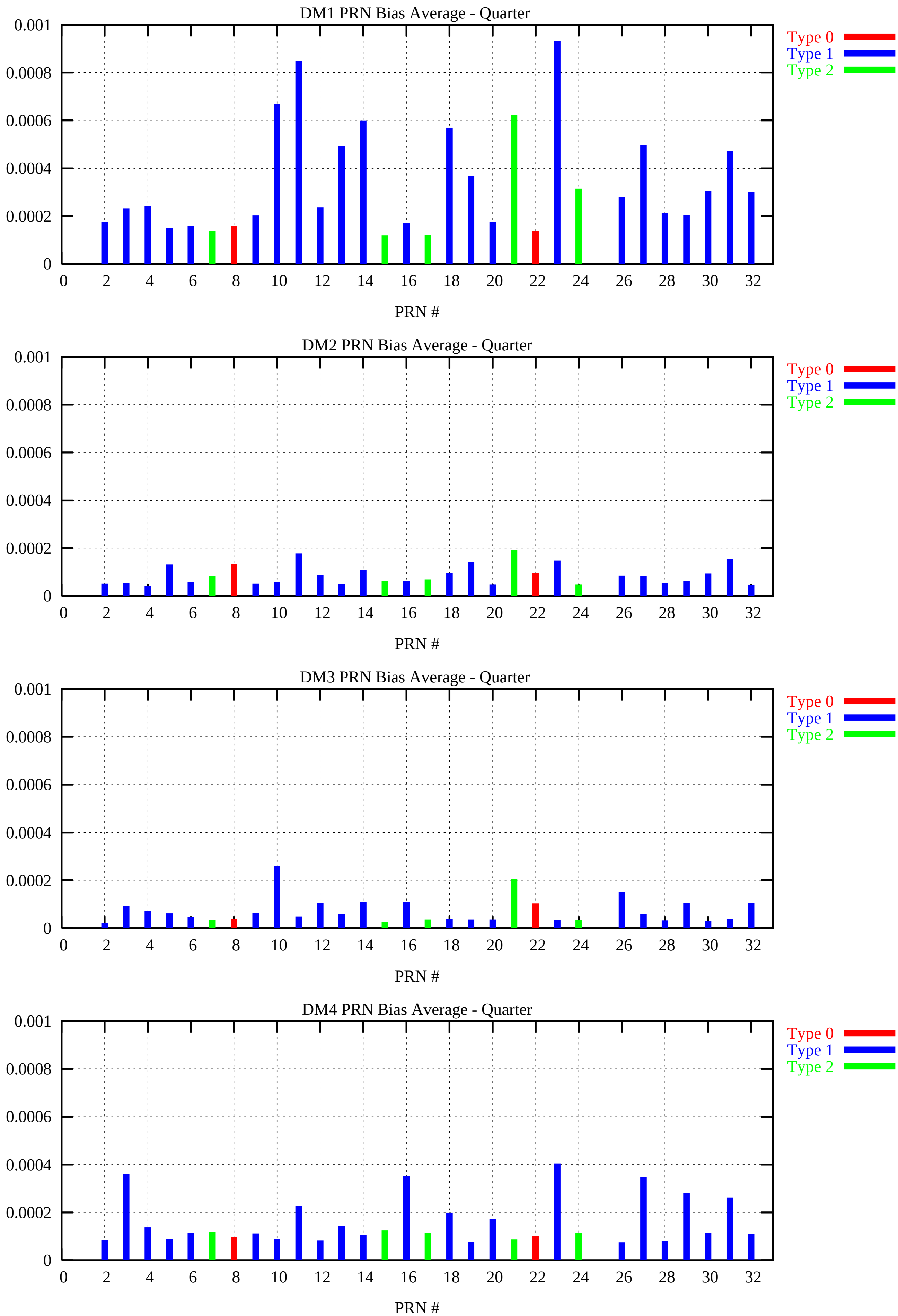
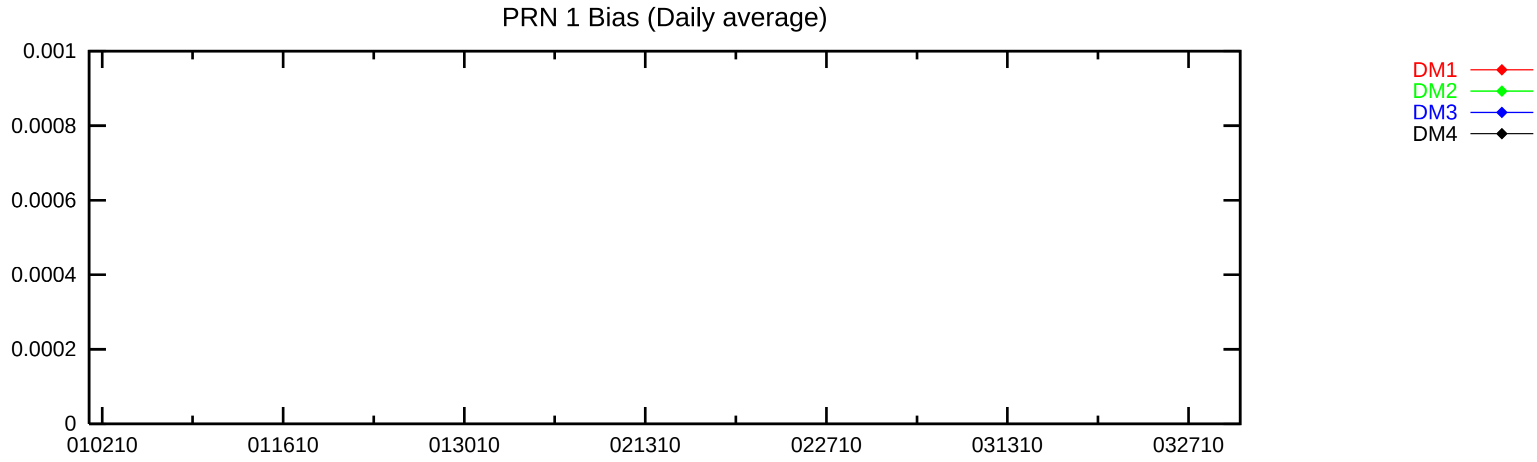
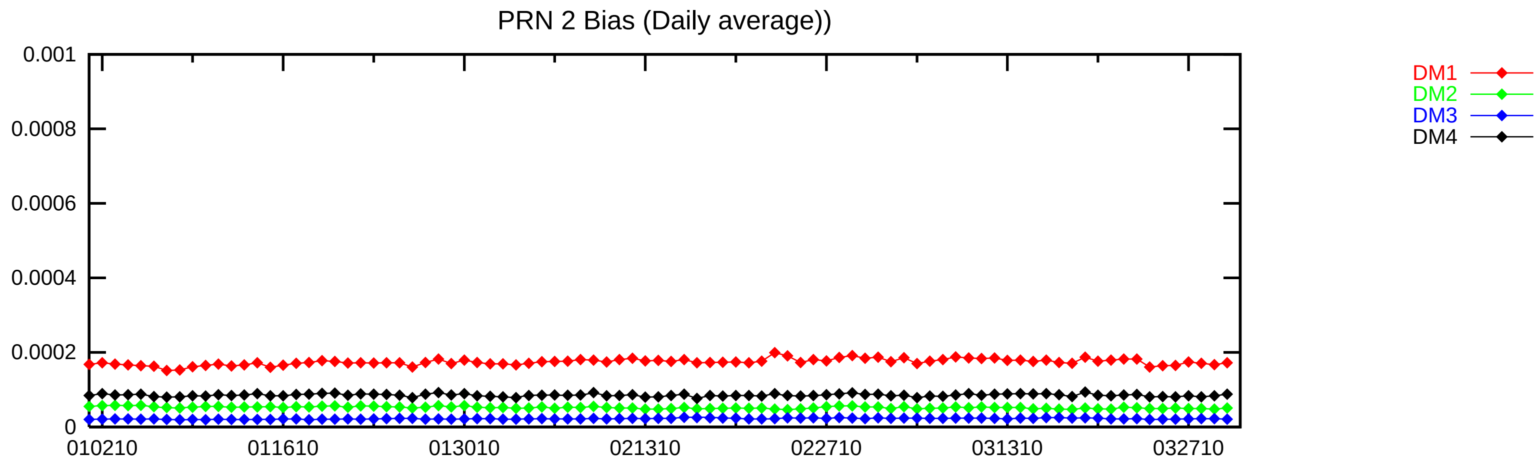
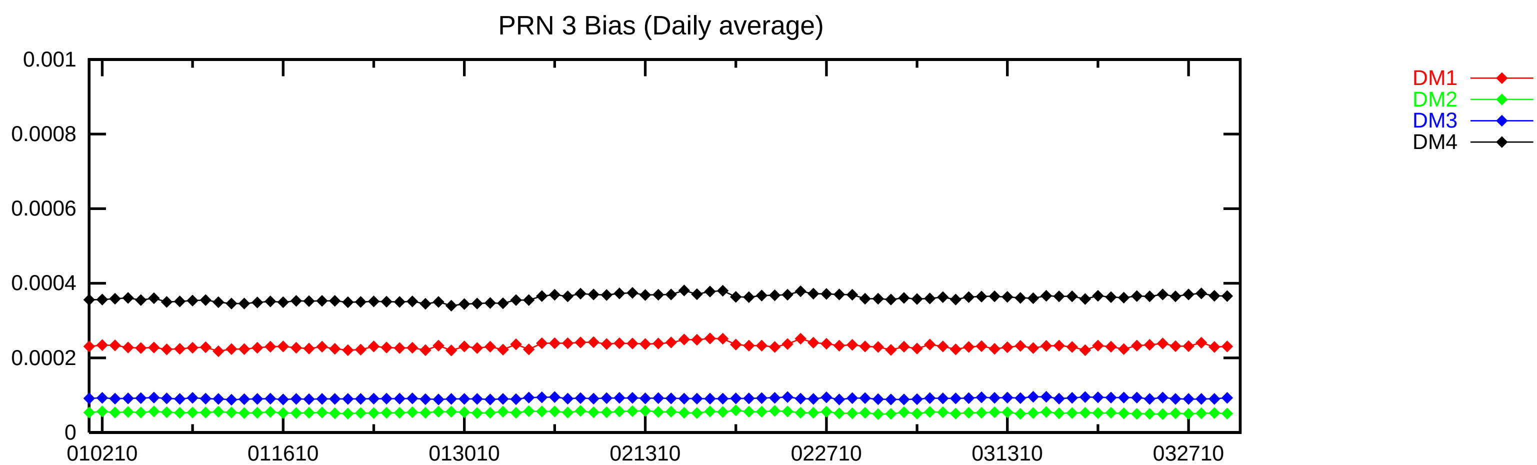


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)







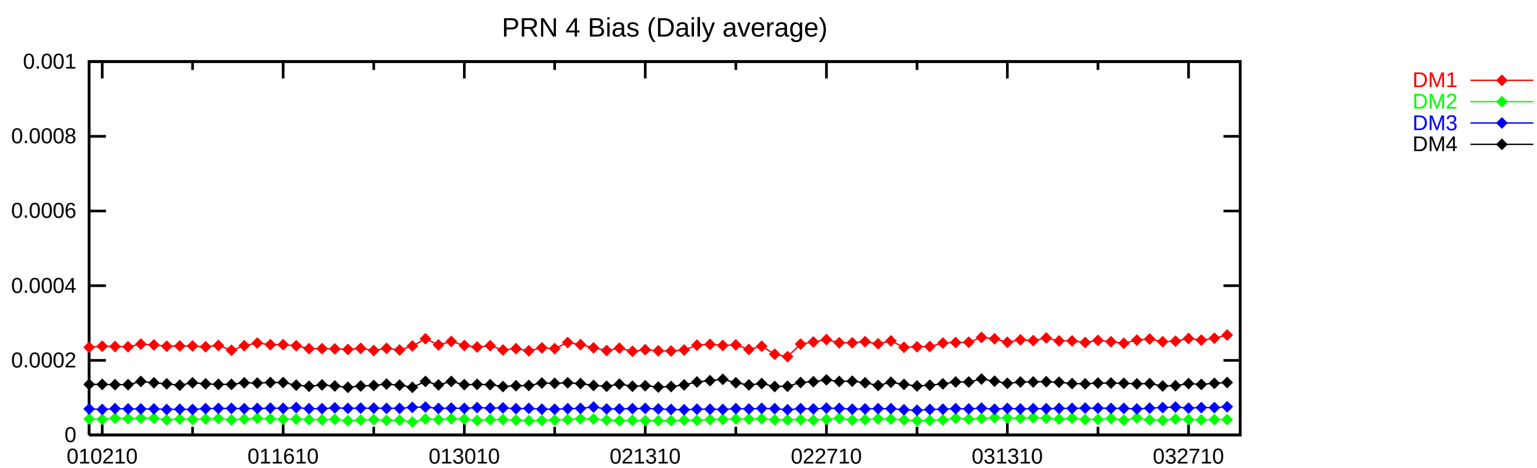
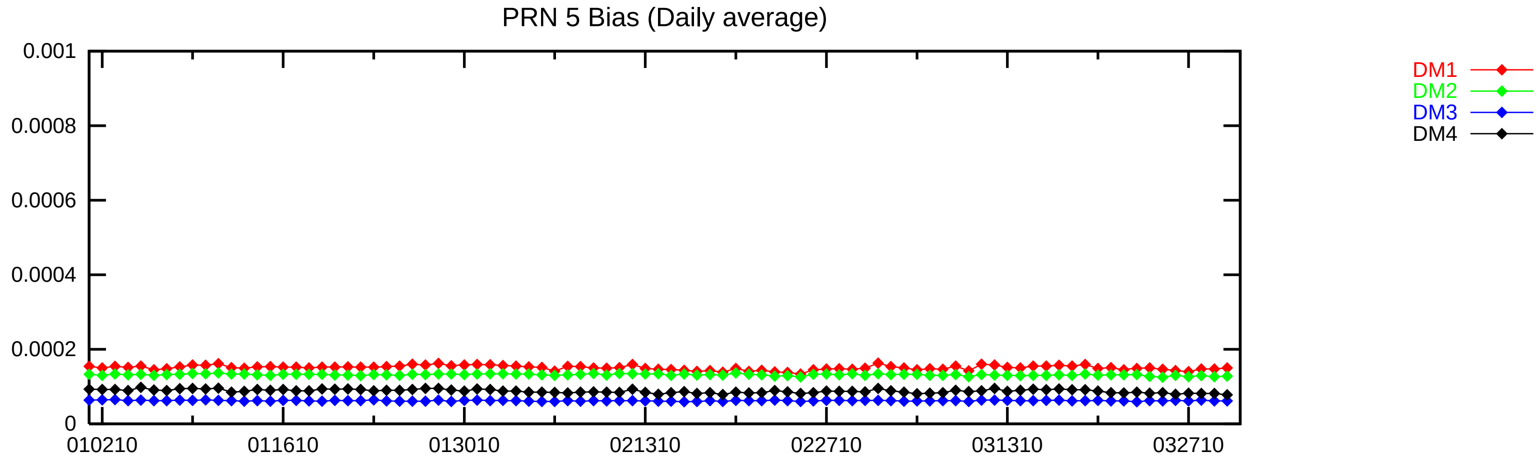
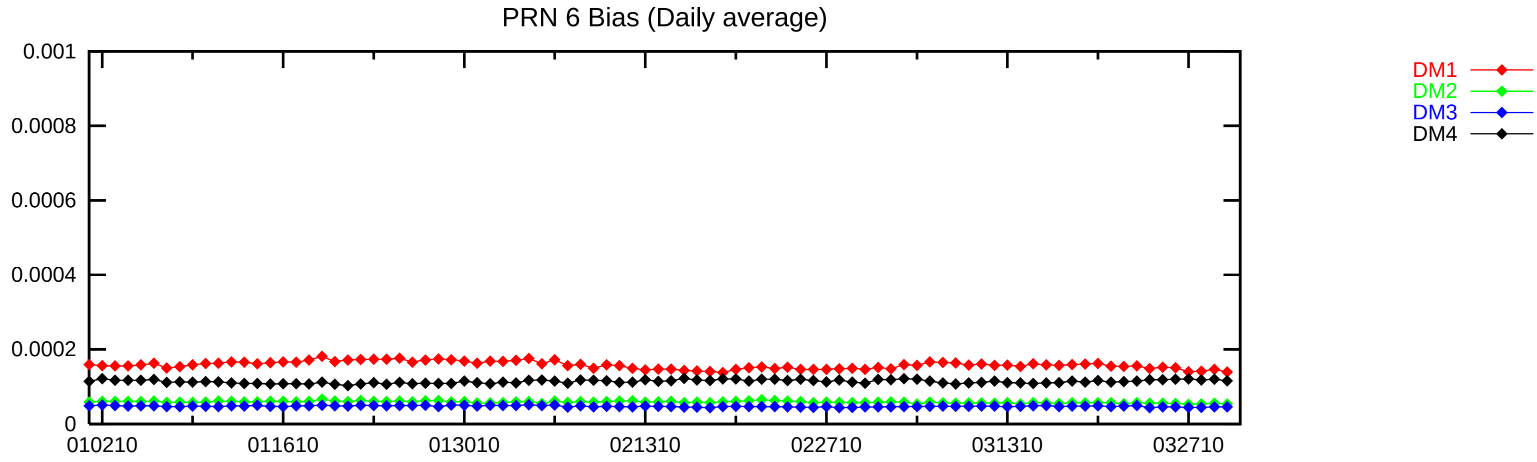
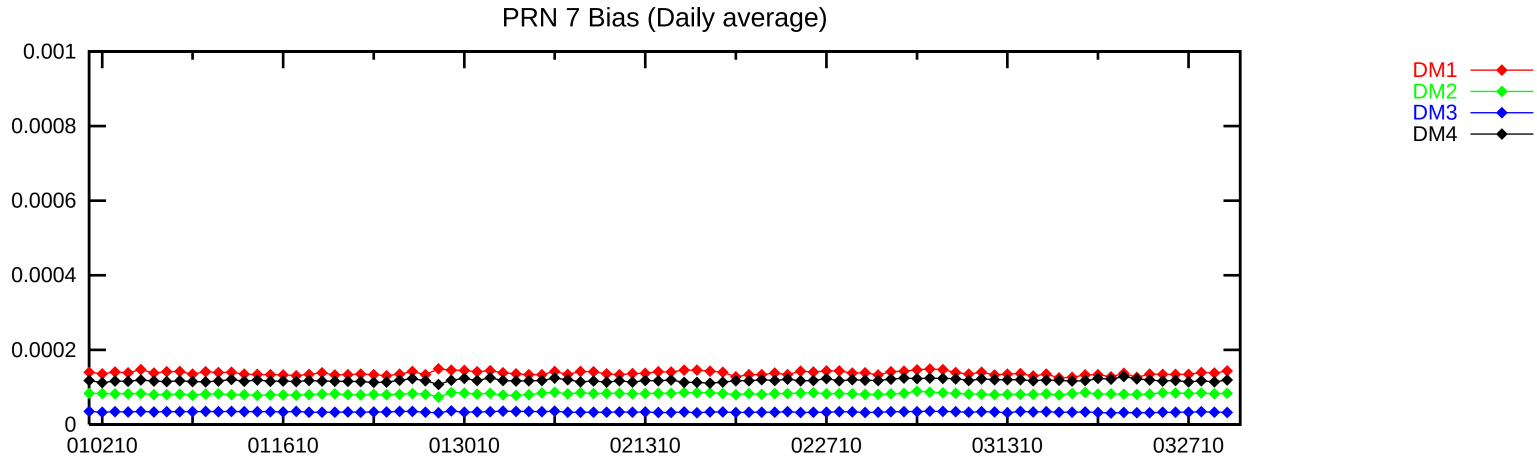


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)







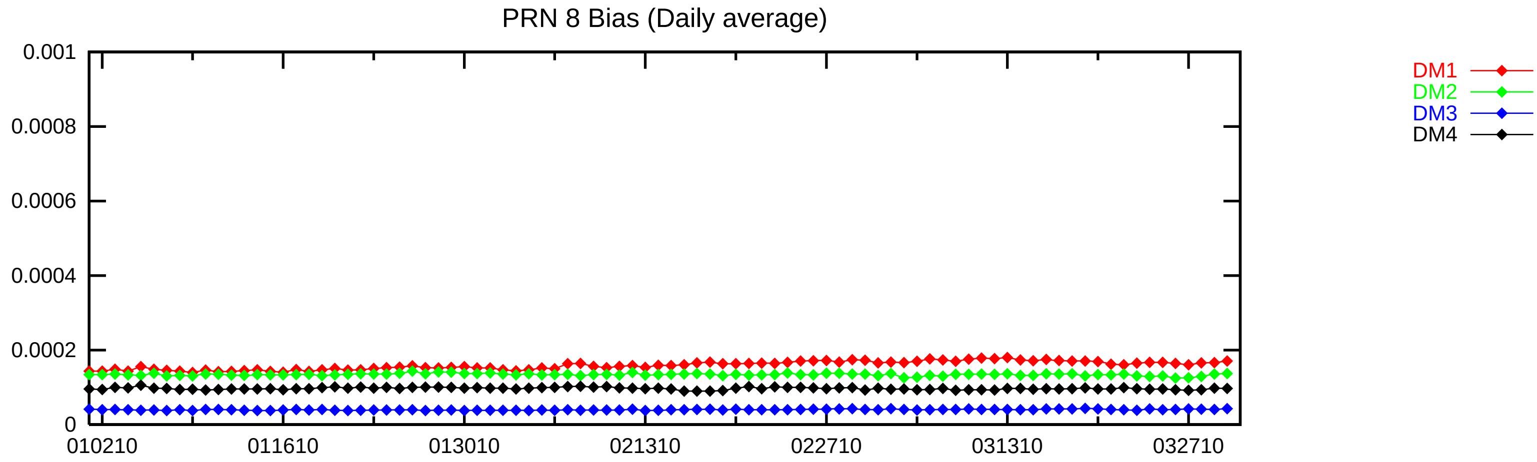


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)

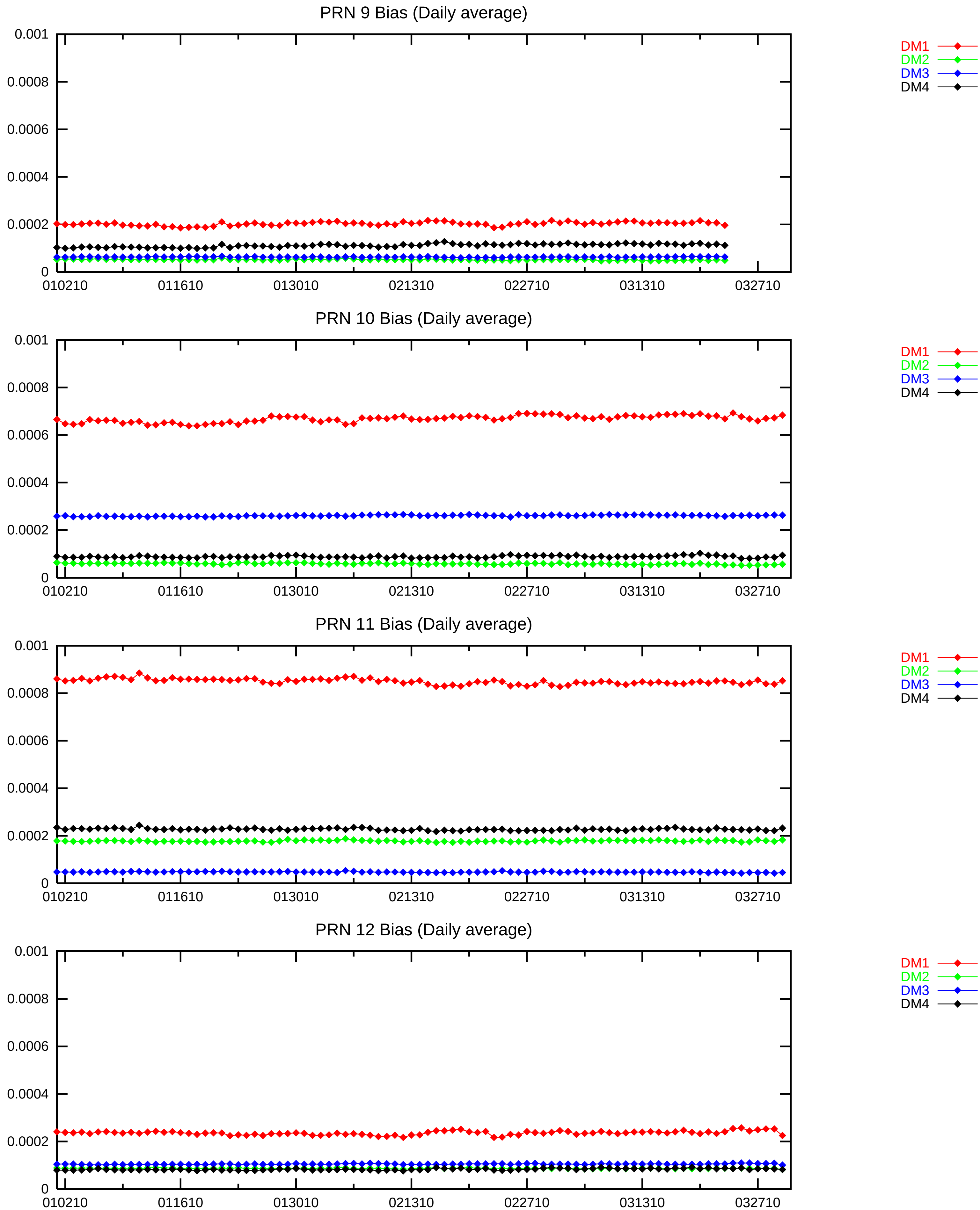


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)

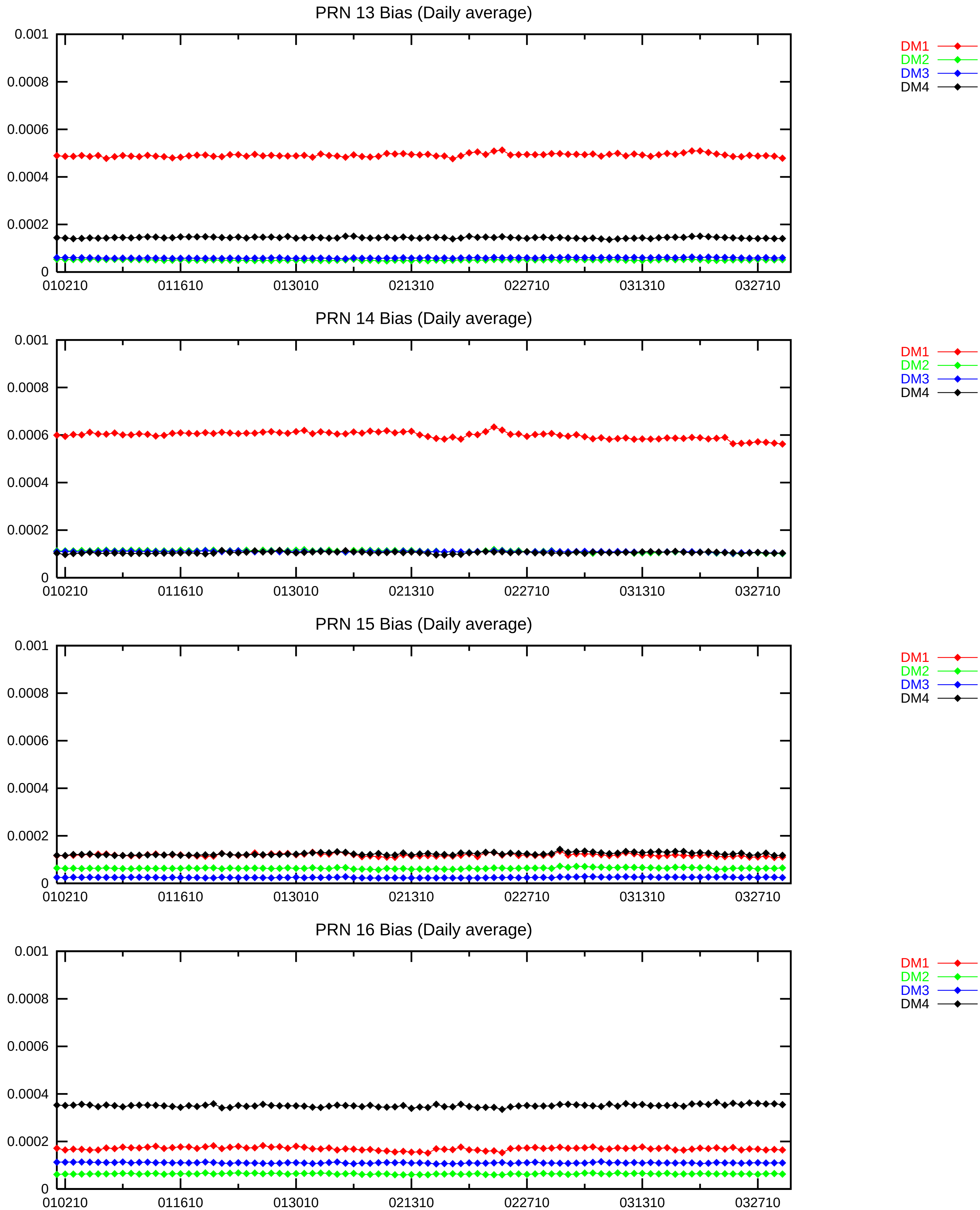
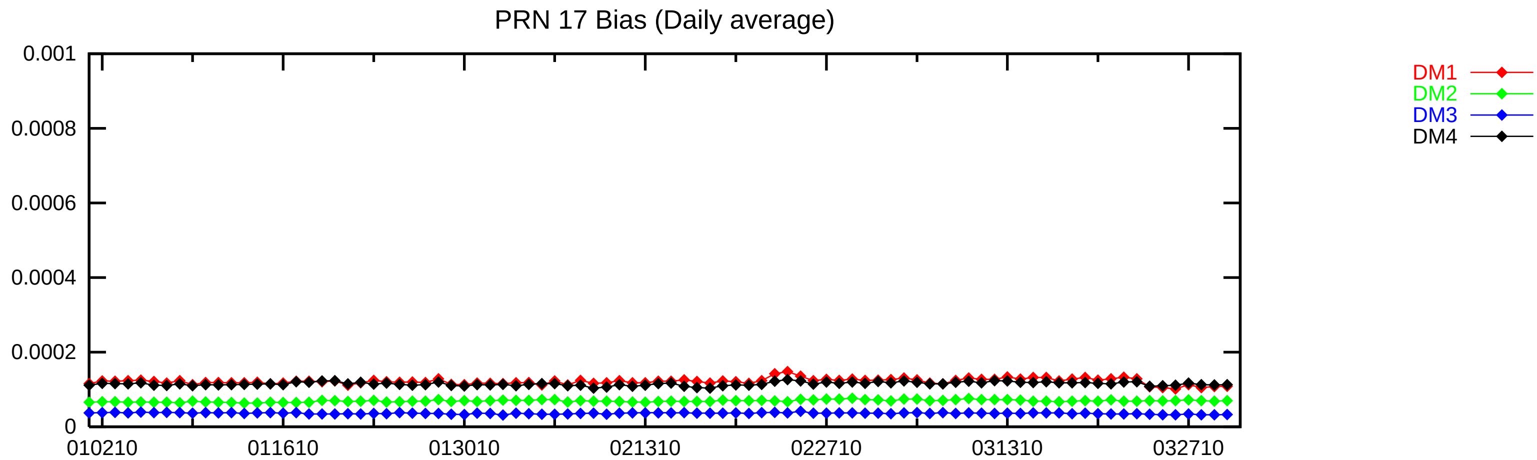
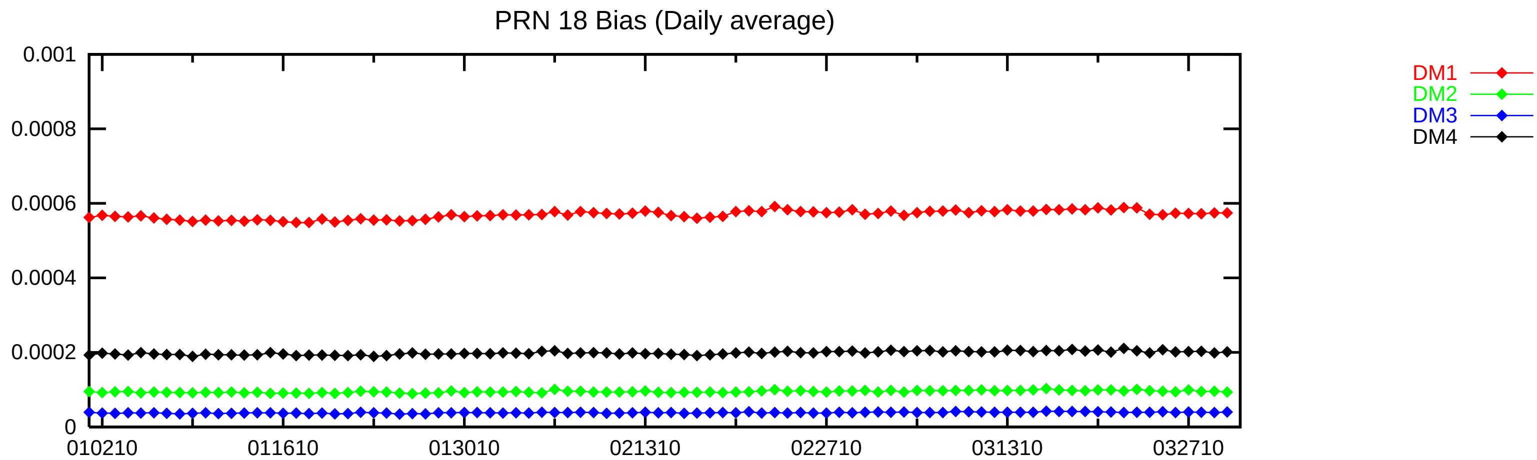
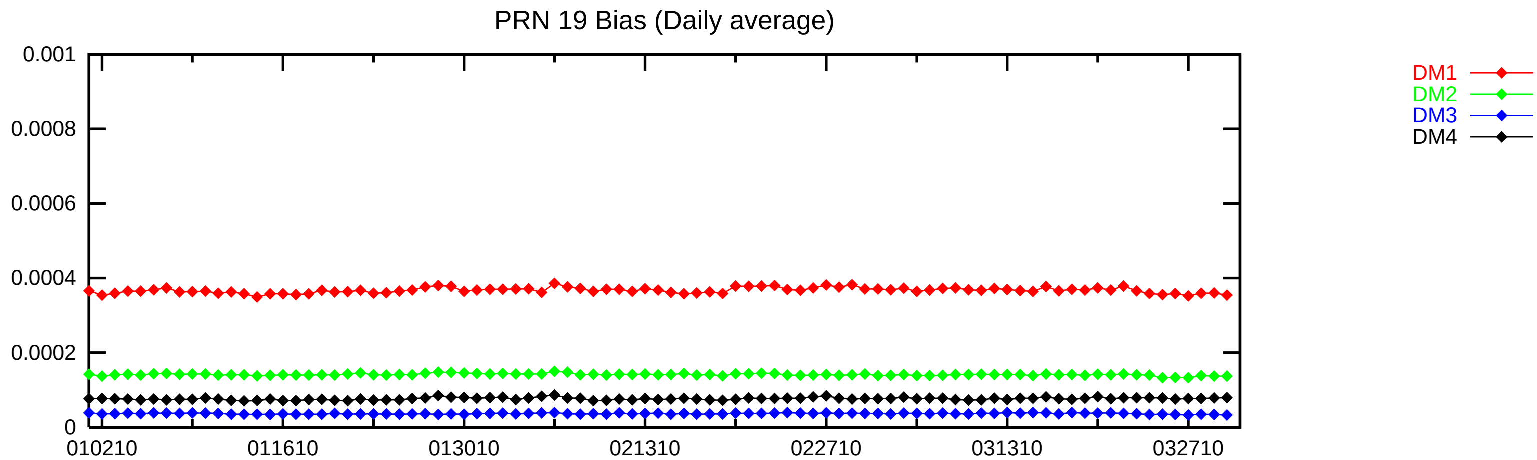


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)







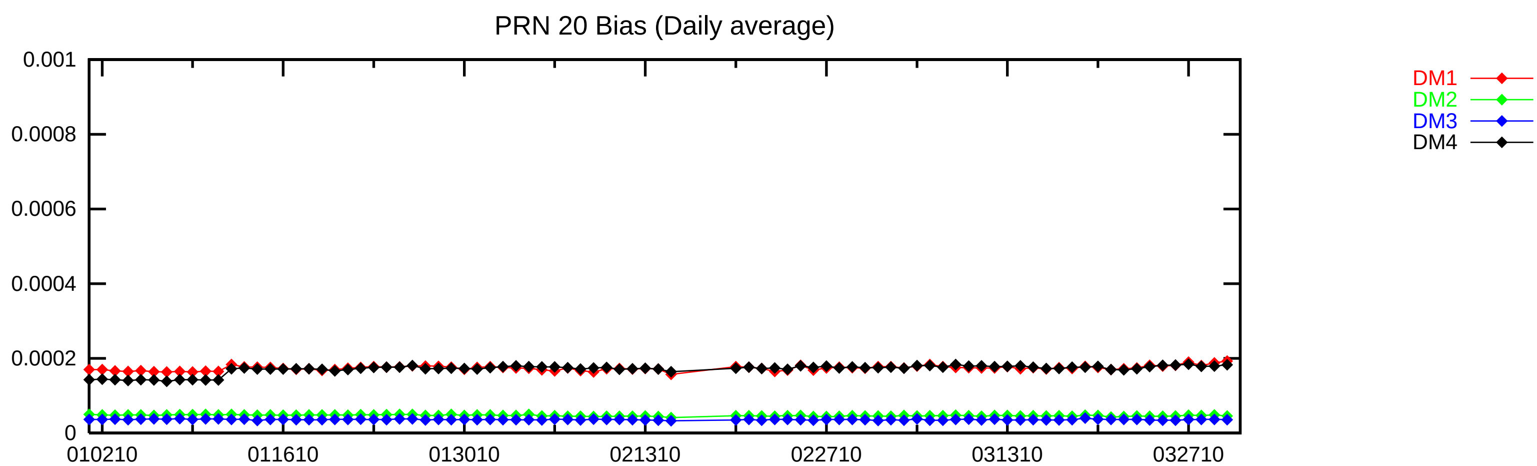
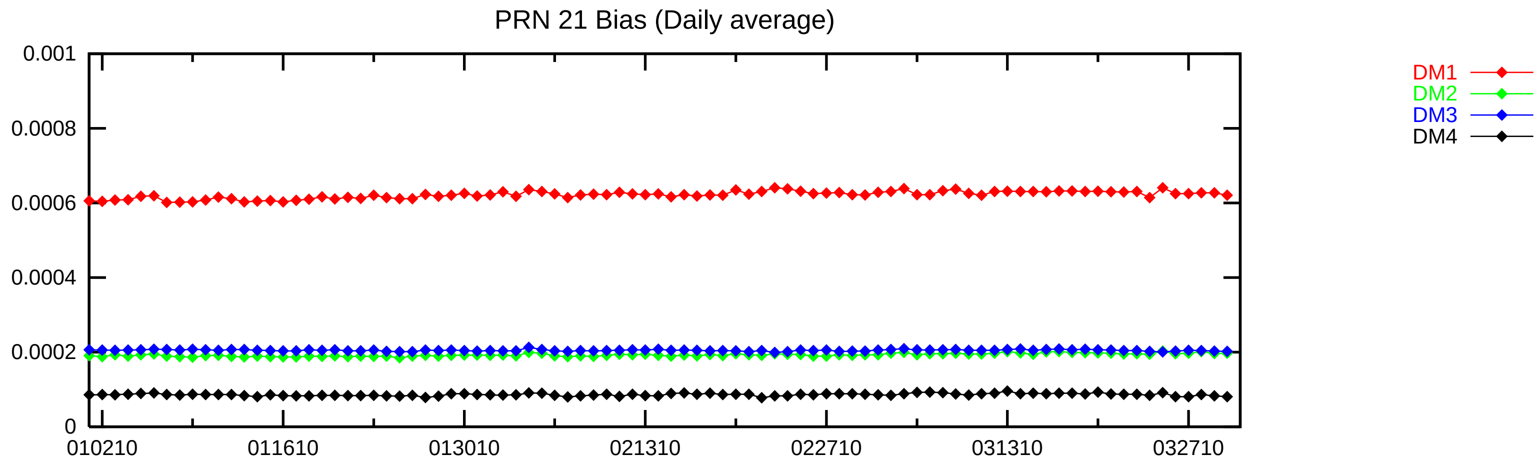
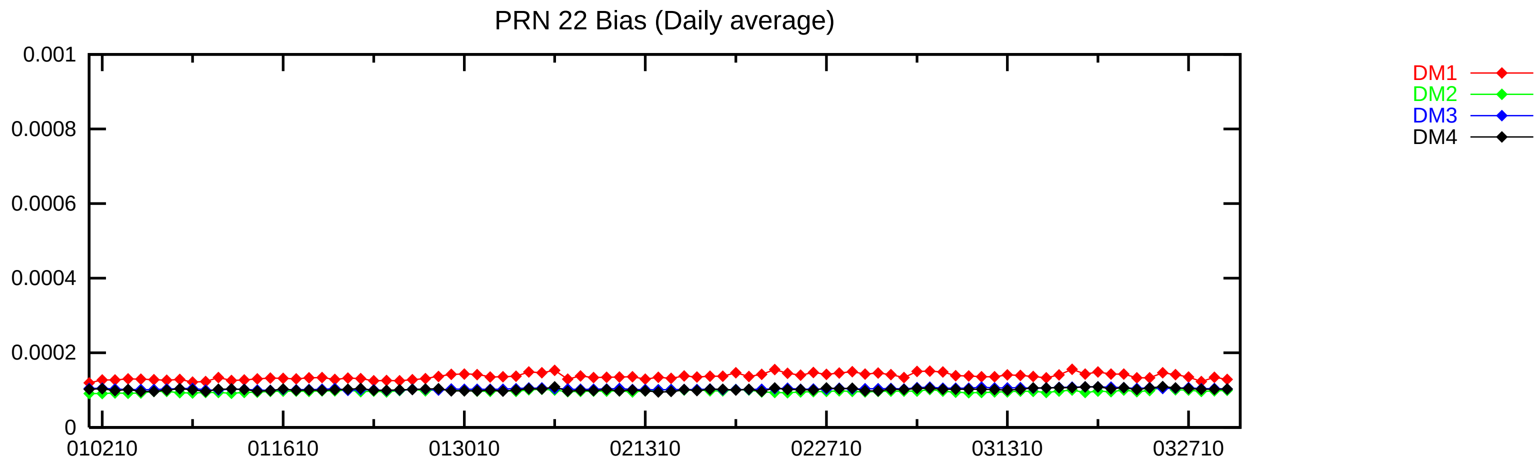
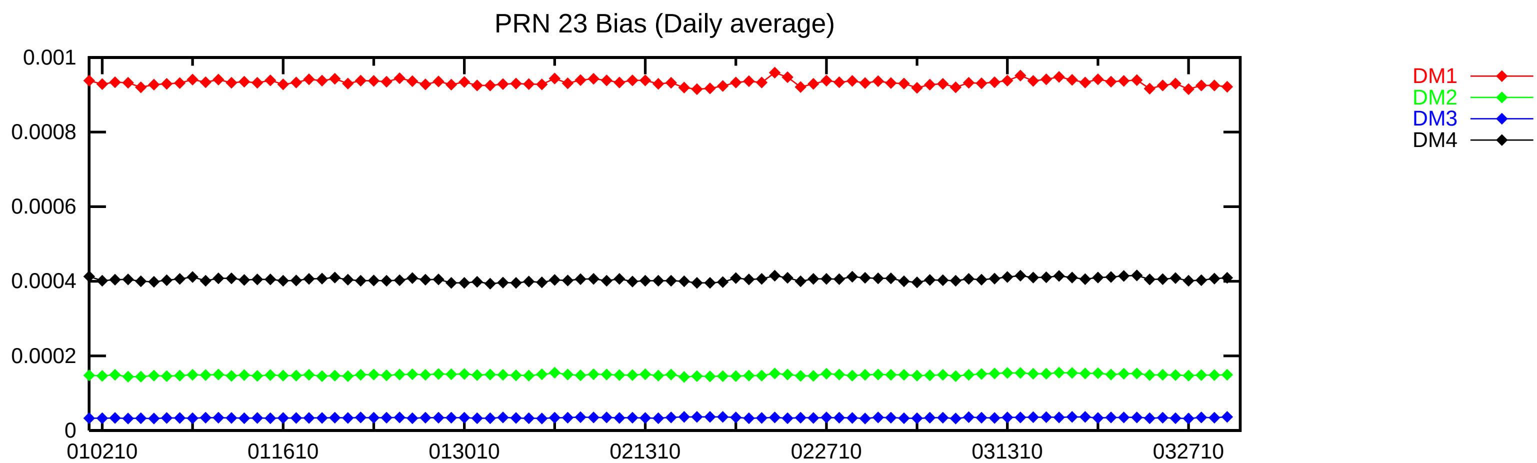


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)







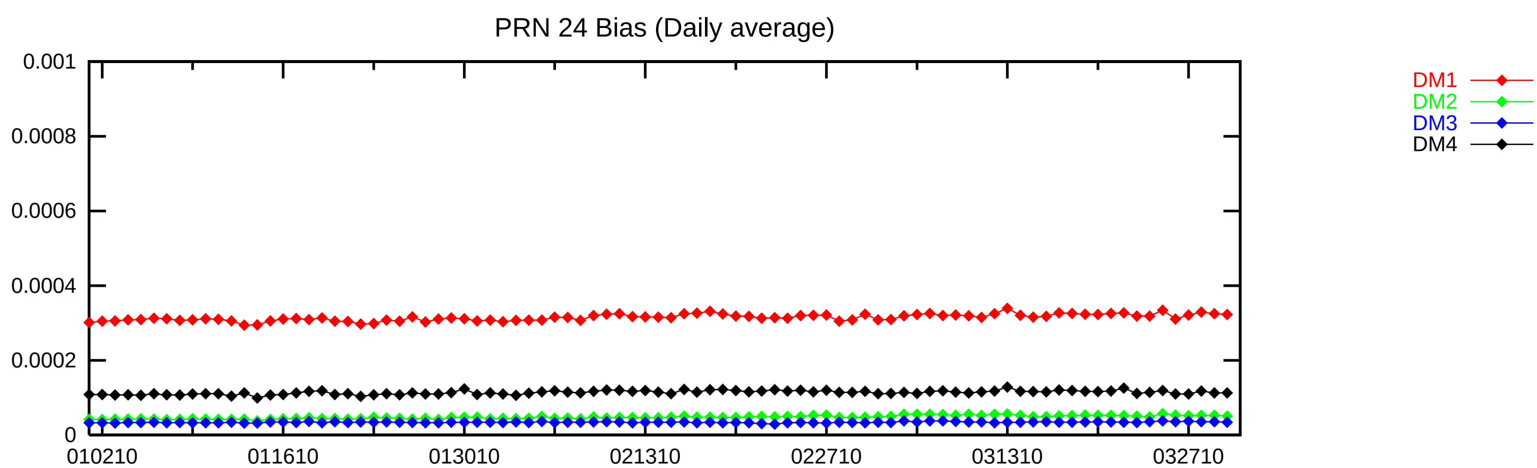
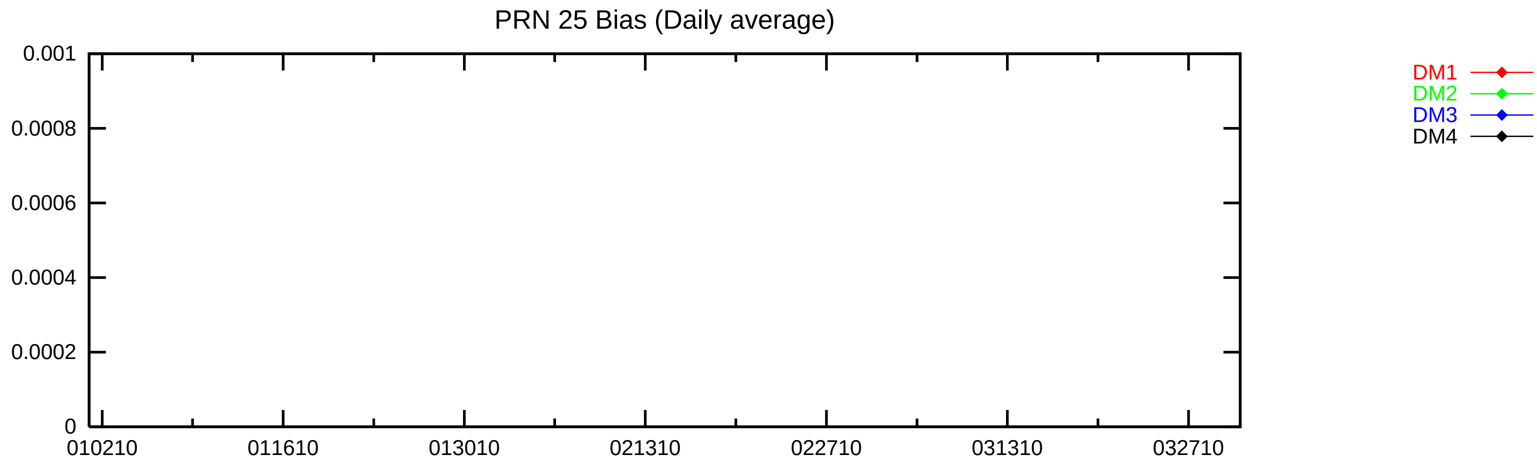
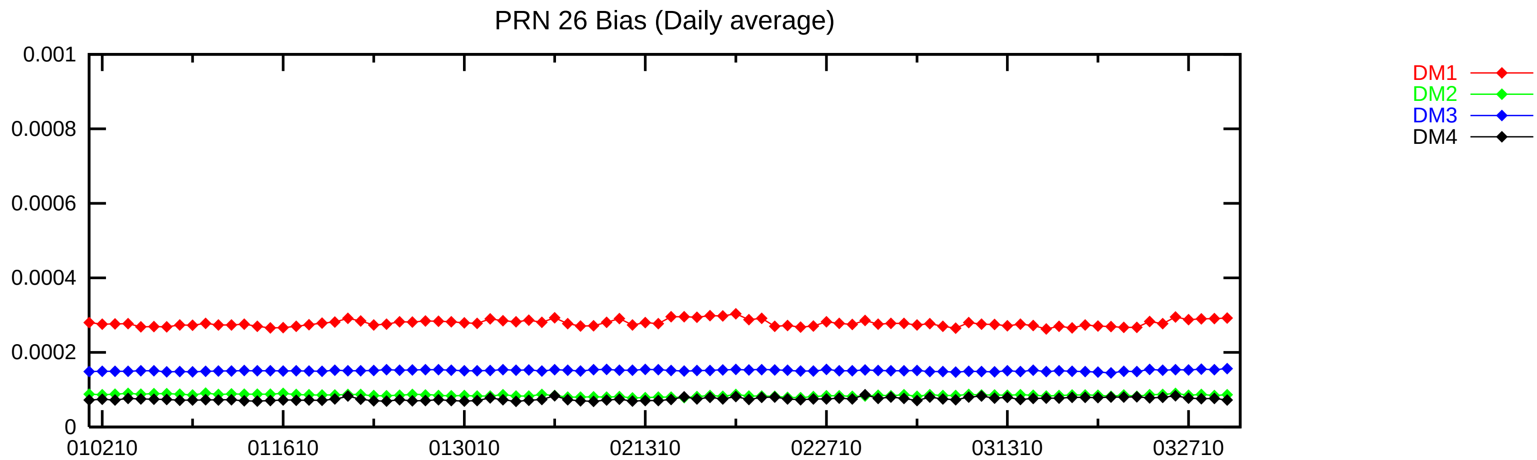
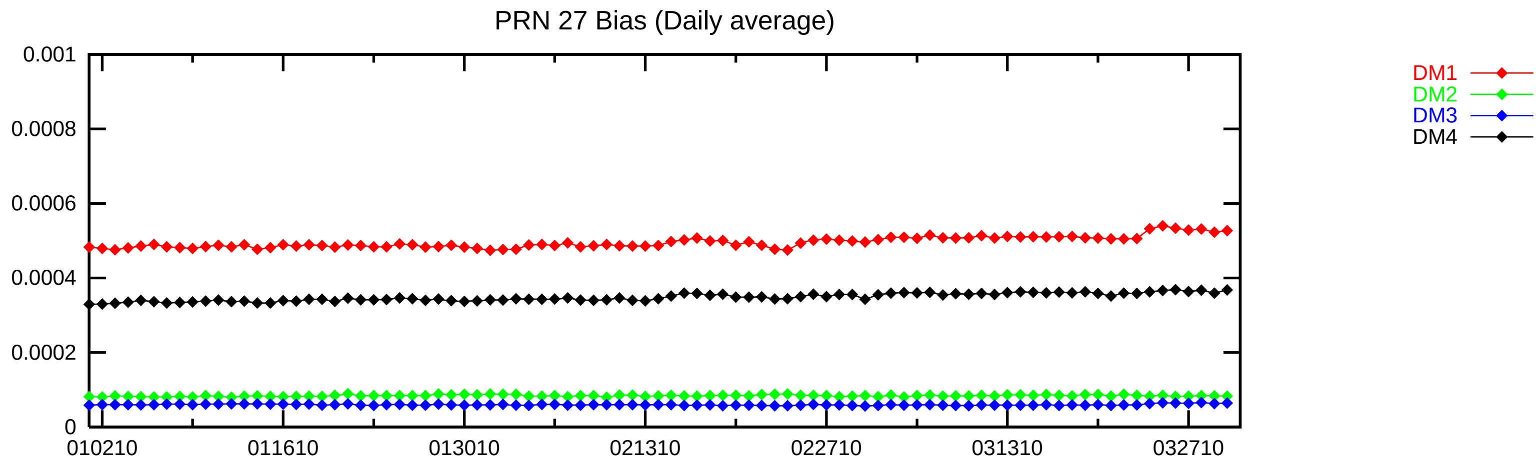


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)







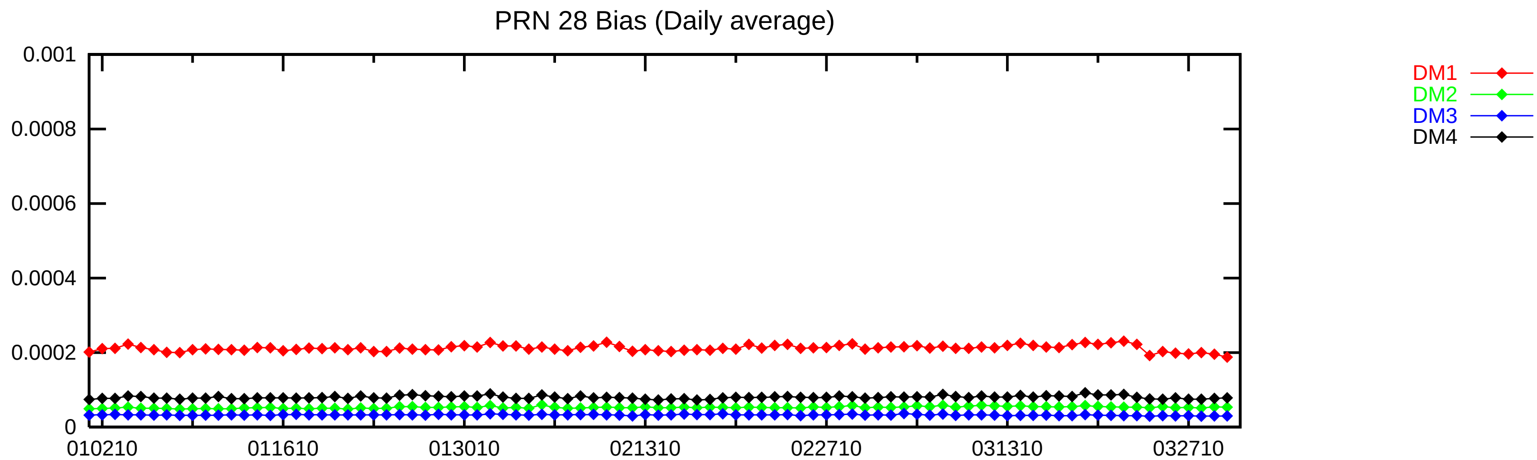
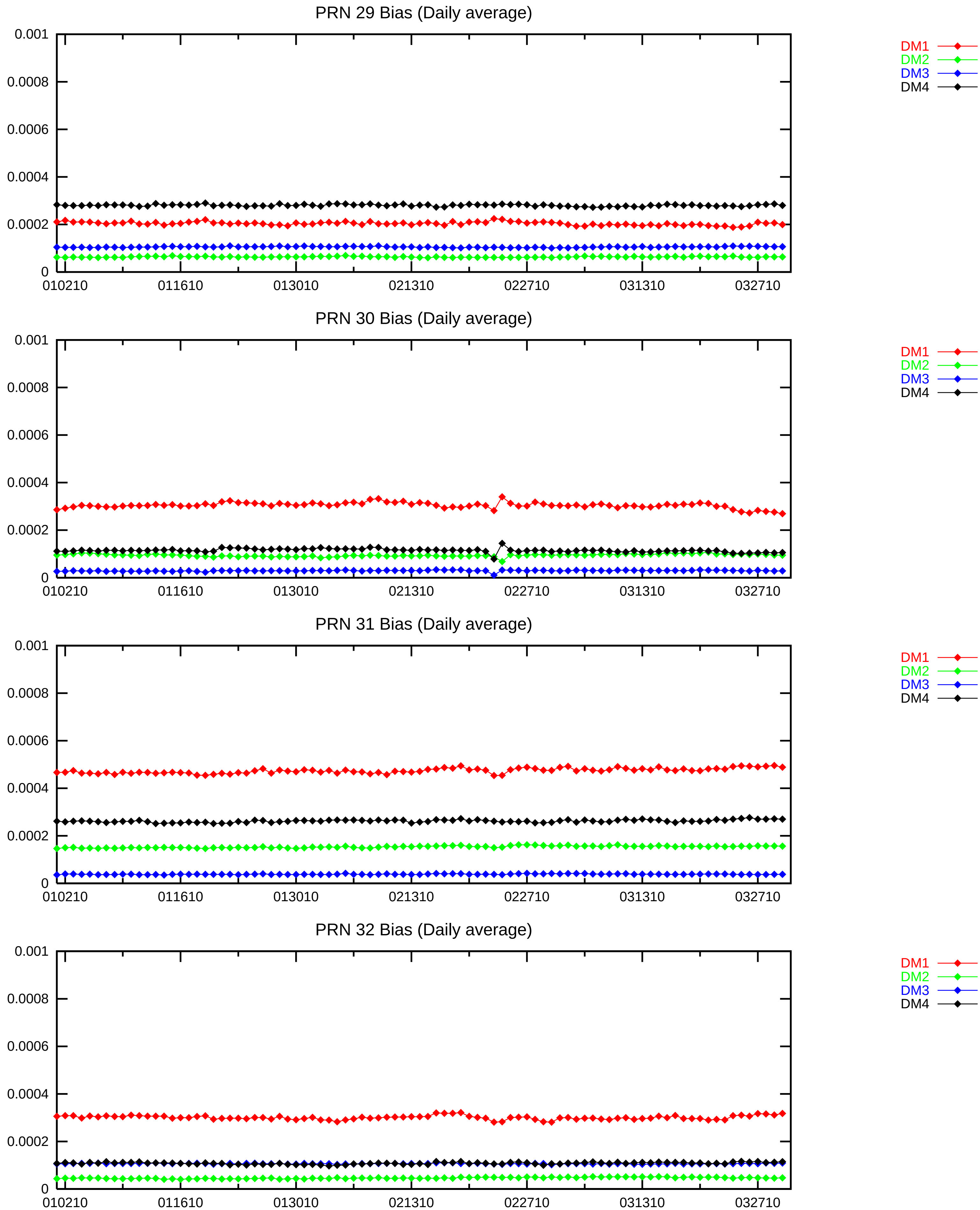


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN 32)



12.4 SQM Trips

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

Appendix A: Glossary

General Terms and Definitions

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

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

C&V. The Correction and Verification Subsystem.

CONUS. Continental United States.

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

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

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

DR. Discrepancy Report

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

GEO. Geostationary Satellite.

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

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

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

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

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

IGS. International GPS Service.

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

LNAV. Lateral Navigation.

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

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

MOPS. Minimum Operational Performance Standards.

Navigation Message. Message structure designed to carry navigation data.

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

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

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

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

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

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

SV. Space Vehicle.

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

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

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

VNAV. Vertical Navigation.

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

Appendix B: Additional Coverage Plots

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

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

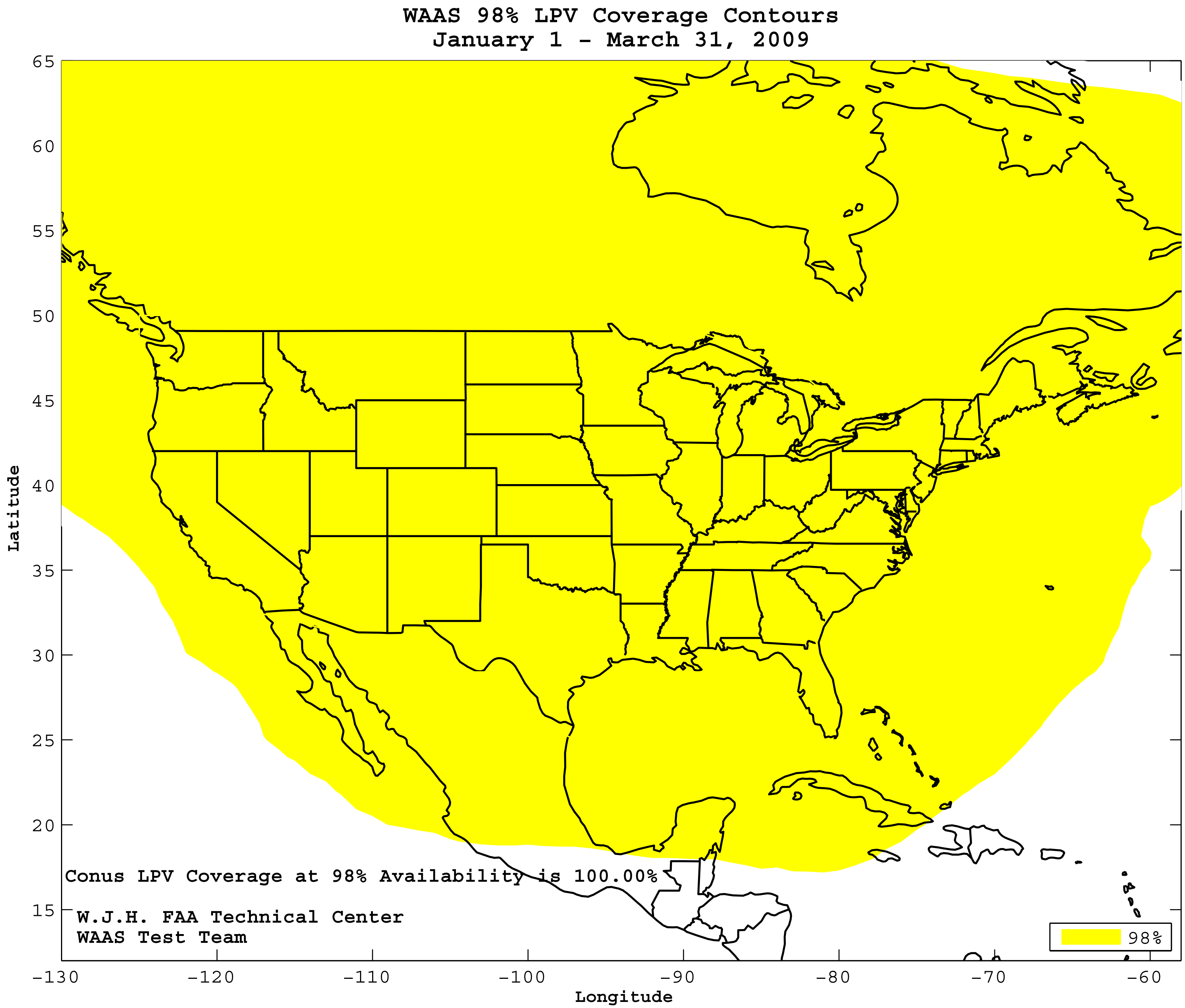


Figure B-2 98% Alaska LPV Availability Contour for the Quarter

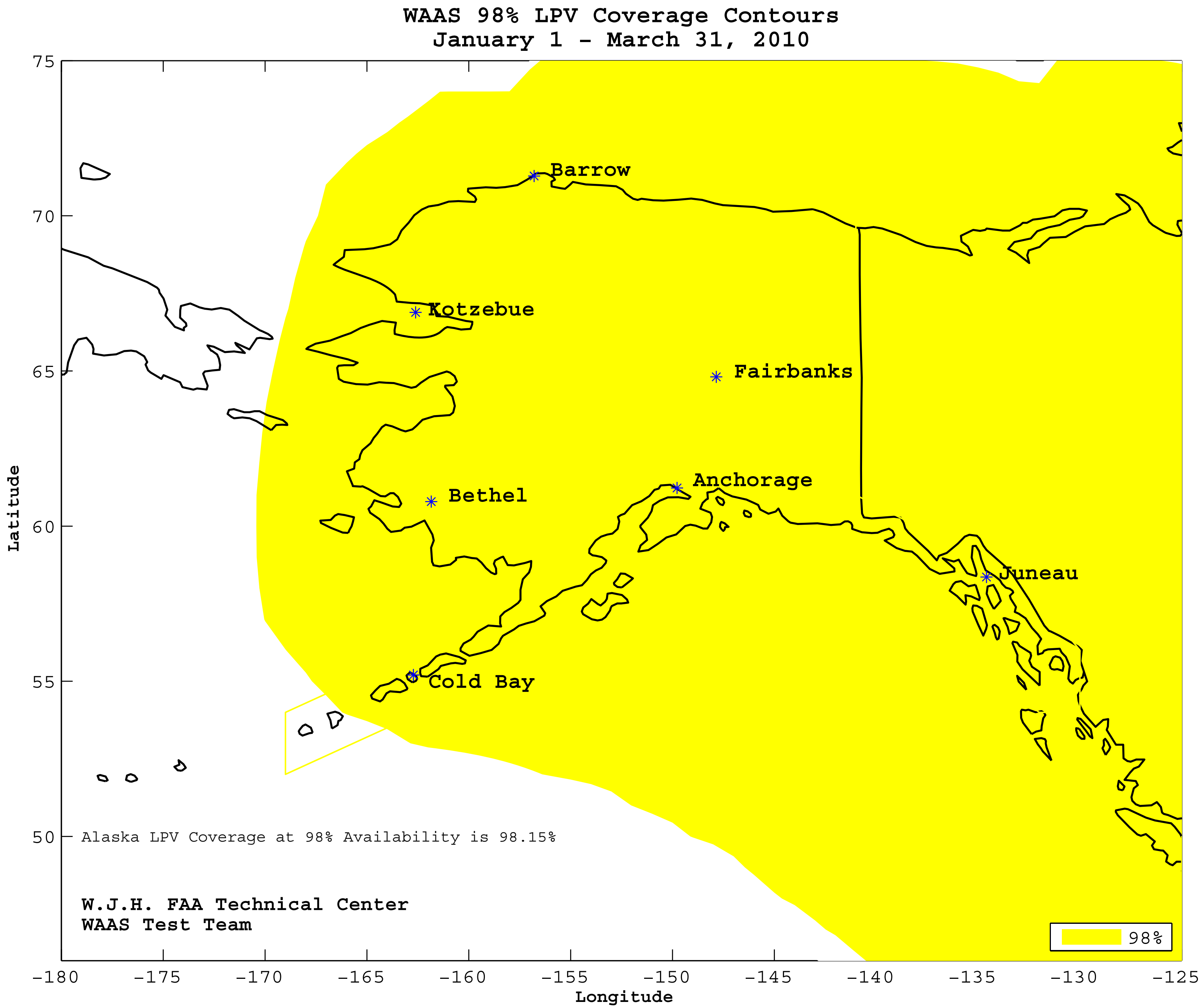


Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter

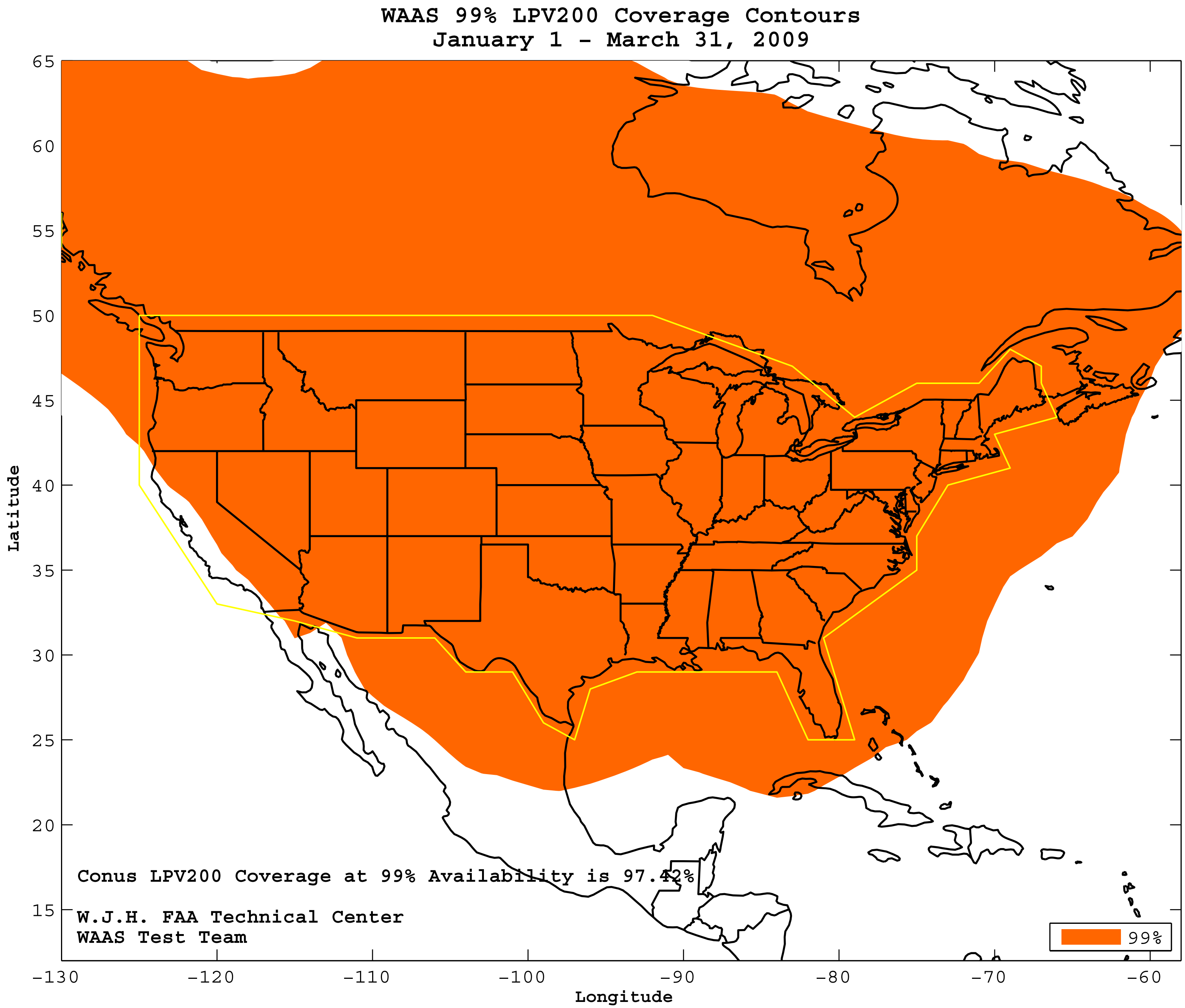


Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter