WIDE-AREA AUGMENTATION SYSTEM
PERFORMANCE ANALYSIS REPORT

Report #35

Reporting Period: October 1 to December 31, 2010

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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-fifth such WAAS quarterly report. This report covers WAAS performance during the period from October 1, 2010 to December 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	Grand Forks 1.81 meters	Oklahoma City 0.578 meters	Cold Bay 0.784 meters	Fairbanks 0.495 meters
95% Vertical Accuracy	Grand Forks 2.394 meters	Minneapolis 0.744 meters	Barrow 1.229 meters	Juneau 0.888 meters
LPV Availability (HPL < 40 meters & VPL < 50 meters)	Seattle 100%	Arcata 99.99%	Anchorage 100%	Barrow 64.60%
LPV 200 Availability (HPL < 40 meters & VPL < 35 meters)	New York 100%	Arcata 98.89%	Anchorage 99.98%	Barrow 57.10%
95% HPL	Arcata 15.578 meters	Memphis 10.464 meters	Cold Bay 26.538 meters	Fairbanks 13.317 meters
95% VPL	Oakland 27.29 meters	Dallas 18.018 meters	Barrow 38.333 meters	Juneau 22.073 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), PRN#138 (CRE) and PRN#133(AMR) are used in the evaluation. For this evaluation period, only CRE GEO provides a ranging capability for enroute through NPA and PA service. CRW GEO provided only NPA ranging service until it was voluntarily taken out of service on 12/16/2010 due to orbit drift. AMR GEO came into operational service on 11/11/2010 and is expected to provide NPA ranging service in a future upgrade to the WAAS.

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 October 1, 2010 to December 31, 2010.

Table 1-1 PA Sites

	Number of Days Evaluated	Number of Samples
NSTB:		
Arcata	86	7412225
Grand Forks	90	7785581
Oklahoma City	83	7192475
WAAS:		
Albuquerque	92	7947307
Anchorage	92	7946872
Atlanta	92	7947707
Barrow	92	7939013
Bethel	92	7935381
Billings	92	7947104
Boston	92	7947556
Chicago	92	7947610
Cleveland	92	7943825
Cold Bay	92	7944365
Dallas	92	7942178
Denver	92	7947341
Fairbanks	92	7943570
Gander	92	7947122
Goose Bay	92	7934136
Houston	92	7947149
Iqaluit	92	7937290
Jacksonville	92	7947289
Juneau	92	7938246
Kansas City	92	7947306
Kotzebue	91	7899047
Los Angeles	92	7947429
Memphis	92	7947515
Merida	92	7910295
Mexico City	92	7945619
Miami	92	7947362
Minneapolis	92	7947514
New York	92	7943856
Oakland	92	7943712
Puerto Vallarta	92	7941928
Salt Lake City	92	7947483
San Jose Del Cabo	92	7911993
Seattle	92	7946783
Tapachula	29	2536152
Washington DC	92	7947489
Winnipeg	92	7947575

Table 1-2 NPA Sites

Location	Number of Days Evaluated	Number of Samples
Albuquerque	92	7944536
Anchorage	92	7944694
Atlanta	92	7945774
Barrow	92	7940141
Bethel	88	7636250
Billings	92	7945127
Boston	87	7477220
Cleveland	92	7944609
Cold Bay	92	7936194
Fairbanks	92	7940848
Gander	92	7932438
Honolulu	92	7941485
Houston	92	7945733
Iqaluit	92	7938302
Juneau	92	7930576
Kansas City	92	7945581
Kotzebue	92	7909843
Los Angeles	92	7945773
Merida	92	7925850
Miami	92	7945742
Minneapolis	92	7945774
Oakland	86	7438707
Salt Lake City	92	7945813
San Jose Del Cabo	92	7910691
San Juan	92	7932920
Seattle	92	7942875
Tapachula	29	2536282
Washington DC	92	7944000

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 2A upgrades that happened this quarter. Table 1.6 lists events related to GUS switchovers.

Table 1-4 Test Events

Start Date	End Date	Location/Satellite	Service Affected	Event Description
4/3/2010	12/31/2010	PRN 135	LPV200_Alaska, LPV_Alaska	Loss control of CRW on 4/3/10 and GEO started to drift. Beginning 6/4/10, UDREi was bumped up to 11 due to CRW orbit drift. UDREi was intermittently bumped to 12 on 7/7/10. UDREi at 13 starting on 9/12/10. CRW was voluntarily taken out of service on 12/16/2010 due to instability. On 12/23/2010, Intel Sat was able to communicate with CRW for possible restoration.
06/19/10	12/02/10	Tapachula(Q9D1), Tapachula(Q9D2), Tapachula (Q9D3)	Local	Power and lightning strike issues. WRE-A and WRE-B came into service on 12/2/10. WRE-C is waiting for a new antenna before it can be placed back into service.
09/30/10	10/01/10	PRN30	LPV200_Alaska	NANU 2010130.

Start Date	End Date	Location/Satellite	Service Affected	Event Description
10/04/10	10/04/10	Brewster (BRE-B), GEO138	LPV200_Alaska	Manual GUS Switchover from Brewster to Woodbine.
10/07/10	10/07/10	Littleton (APA), GEO135	Alaska	Power supply failure (SGS A2 PCU) at Littleton caused faulted mode. C&V directed a GUS Switch from Littleton to Napa.
10/14/10	10/14/10	Brewster (BRE-B), GEO138	Canada	Brewster fault caused GUS Switchover to Woodbine. Power cycling the KPA cleared the problem. Total down time was 58 minutes (12 seconds gap longer than normal).
10/17/10	10/17/10	Boston (ZBW1), Boston (ZBW2), Boston (ZBW3)	Local	Local RFI caused LPV outage. See DR #99 Boston LPV outage caused by RFI.
10/18/10	12/31/10	Barrow (ZBRW1), Barrow (ZBRW2), Barrow (ZBRW3), GEO 135	Local	Barrow no longer tracked CRW. CRW fell below the 5 degree elevation cutoff angle due to satellite drift
10/19/10	10/19/10	Washington D.C. (CnV), Atlanta (CnV), Los Angeles (CnV), PRN138	Alaska, Canada	GEO orbit mismatch across C&V caused different UDREi to be broadcasted for PRN 138 (CRW). Napa and Littleton (CRW) switched to ZLA C&V. Woodbine (CRE) used ZTL C&V. PRN 138 range error of 6-7 meter broadcasted by CRW and 1-2 meters broadcasted by CRE.
10/22/10	10/22/10	Napa (APC), GEO135	Alaska	Napa GUS faulted causing GUS Switch to Littleton. The cause of the fault was a sequence of multiple communication failures between the SGS GUS Processor and the WAAS Receiver.
10/31/10	11/01/10	PRN22	LPV200_CONUS	NANU 2010134; Observed changes in SQM PRN bias after maintenance.
11/9/10	12/31/10	Kotzebue (OTZ1), Kotzebue (OTZ1), Kotzebue (OTZ1), GEO 135	Local	Kotzebue no longer tracked CRW. CRE fell below the 5 degree elevation cutoff angle due to satellite drift
11/11/10	11/11/10	GEO133	None	The AMR GEO PRN 133 went into operational service today at 03:35:35 UTC.
11/19/10	11/19/10	PRN31	LPV200_CONUS, LPV200_Alaska	NANU 2010142
11/24/10	11/24/10	Washington DC (ZDC1), Washington DC (ZDC2), Washington DC (ZDC3)	Local	WAAS LPV200 Service outage caused by L1 radio frequency interference (RFI). See DR #98 WAAS LPV200 Service Outage at Washington DC WRE-A caused by L1 Radio Frequency Interference (RFI).
12/10/10	12/10/10	PRN32	LPV200_CONUS, LPV200_Alaska	NANU 2010149.
12/11/10	12/11/10	PRN138	LPV200_CONUS, LPV200_Alaska	PRN 138 went to DNU due to CCC trip.

Start Date	End Date	Location/Satellite	Service Affected	Event Description
12/12/10	12/12/10	Washington D.C. (CnV), PRN138	LPV200_CONUS	PRN138 went to DNU due to CCC trip. PA Ranging availability down to 47%.
12/14/10	12/14/10	PRN32	LPV200_CONUS, LPV200_Alaska, LPV200_Canada	NANU 2010150
12/15/10	12/15/10	GEO138, Woodbine (QWE)	LPV200_Alaska	GUS Switchover initiated by operator. GEO CRE switched from Woodbine to Brewster.
12/20/10	12/20/10	Brewster (BRE-B)	LPV200_Alaska	Brewster faulted, GEO CRE switched to Woodbine.

Table 1-5 WAAS Release 2A Upgrades

Start Date	End Date	Event Description
11/11/2010	11/11/2010	The AMR GEO (PRN 133) went into operational service today at 03:35:35 UTC (time of first type 2 message). This GEO had been broadcasting in test mode since Spring 2010. SSM-WAAS-024 (Release 2A).

Table 1-6 GUS Switchovers

Start Date	End Date	GUS Switch	Location/Satellite	Service Affected	Event Description
10/04/10	10/04/10	Manual	Brewster (BRE-B), GEO138	LPV200_Alaska	Manual GUS Switchover from Brewster to Woodbine.
10/06/10	10/06/10	Manual	Woodbine (QWE), GEO138	None	Manual GUS Switch from Woodbine to Brewster.
10/07/10	10/07/10	Faulted	Littleton (APA), GEO135	Alaska	Power supply failure at Littleton caused faulted mode. C&V detected and directed switchover to Napa.
10/14/10	10/14/10	Faulted	Brewster (BRE-B), GEO138	Canada	Brewster fault caused GUS Switchover to Woodbine. Power cycling the KPA cleared the problem. Total down time was 58 minutes (12 seconds gap longer than normal).
10/19/10	10/19/10	Satellite Orbit Determination (SOD)	Washington D.C. (CnV), Atlanta (CnV), Los Angeles (CnV), PRN138	Alaska, Canada	GEO orbit mismatch across C&V caused different UDREi to be broadcasted for PRN 138 (CRW). Napa and Littleton (CRW) switched to ZLA C&V. Woodbine (CRE) used ZTL C&V. PRN 138 range error of 6-7 meter broadcasted by CRW and 1-2 meters broadcasted by CRE.
10/22/10	10/22/10	Faulted	Napa (APC), GEO135	Alaska	Napa fault caused GUS switch to Littleton. The cause of the fault was a sequence of multiple communication failures between the

Start Date	End Date	GUS Switch	Location/Satellite	Service Affected	Event Description
					SGS GUS processor and the WAAS receiver.
10/26/10	10/26/10	CnV Source Switch (Manual)	Littleton (APA), Woodbine (QWE), Los Angeles (CnV), Atlanta (CnV)	None	Selected source manual switches Littleton from ZLA TO ZTL, Woodbine from ZTL to ZDC.
10/30/10	10/30/10	Manual	Woodbine (QWE), GEO138	Canada	Manual GUS Switchover from Woodbine to Brewster.
11/02/10	11/02/10	Manual	GEO135, Littleton (APA)	None	Preparation for maintenance. No effect on Alaska coverage due to location of CRW.
11/24/10	11/24/10	Faulted	GEO133, Pamalu (HDH)	None	Receiver SCAF.
12/01/10	12/01/10	Faulted	GEO135, NAPA (APC)	None	Napa fault caused GUS switchover to Littleton. The cause was a SIGGEN fault (10 seconds gap).
12/02/10	12/02/10	Manual	GEO135, Littleton (APA)	None	Operator command.
12/13/10	12/13/10	Manual	GEO138, Brewster (BRE-B)	None	Manual GUS Switchover due to CCC alarm.
12/15/10 12/20/10	12/15/10 12/20/10	Manual Faulted	GEO138, Woodbine (QWE) Brewster (BRE-B)	LPV200_Alaska LPV200_Alaska	GUS Switchover initiated by operator. GEO CRE switched from Woodbine to Brewster. Brewster faulted, GEO CRE switched to Woodbine.

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, CRW, and AMR.

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.

Section 13 compares GPS broadcast orbits verse IGS precise orbits.

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 1.81 meters and 2.394 meters both at Oakland, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.578 meters at Oklahoma City and 0.744 meters at Minneapolis, respectively. The maximum 95% and 99.999% NPA horizontal errors are 3.883 meters and 8.638 meters, both at Honolulu, respectively. The minimum 95% and 99.999% horizontal errors are 0.786 meters and 1.959 meters, both at Barrow, respectively. Low PA and NPA availability in Table 2.2 and Table 2.3 at Barrow and Kotzebue are due to CRW GEO orbit drift as expected. CRW went below the 5 degree elevation cutoff angle at Barrow on 10/18/2010 and at Kotzebue on 11/9/10.

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	0.956	0.956	1.280	100	*	*
Grand Forks	1.810	1.810	2.394	100	*	*
Oklahoma City	0.578	0.578	1.188	100	*	*
Albuquerque	0.646	0.646	0.941	100	1.941	3.837
Anchorage	0.566	0.566	1.210	100	*	*
Atlanta	0.656	0.656	1.371	100	2.249	4.031
Barrow	0.523	0.523	1.229	7.57311	*	*
Bethel	0.546	0.546	1.053	99.99717	1.894	4.510
Billings	0.696	0.696	0.857	100	2.151	3.780
Boston	0.725	0.725	0.933	100	2.430	3.711
Chicago	0.968	0.968	0.842	100	*	*
Cleveland	0.670	0.670	0.866	100	2.312	3.721
Cold Bay	0.784	0.784	1.147	100	*	*
Dallas	0.655	0.655	1.523	100	*	*
Denver	0.583	0.583	0.753	100	*	*
Fairbanks	0.495	0.495	1.107	100	1.786	4.552
Gander	0.824	0.825	1.074	100	*	*
Goose Bay	0.703	0.704	0.999	100	*	*
Houston	0.620	0.620	1.673	100	1.953	4.115
Iqaluit	0.959	0.962	1.525	99.97390	*	*
Jacksonville	0.641	0.641	1.632	100	*	*
Juneau	0.619	0.619	0.888	100	*	*
Kansas City	0.640	0.640	0.886	100	2.170	3.929
Kotzebue	0.597	0.597	1.227	33.55396	1.793	4.546
Los Angeles	0.795	0.795	1.117	100	1.953	4.403
Memphis	0.622	0.622	1.217	100	*	*
Merida	0.685	0.685	1.948	100	*	*
Mexico City	0.709	0.709	2.054	100	*	*
Miami	0.840	0.840	1.929	100	2.287	4.192
Minneapolis	0.735	0.735	0.744	100	2.219	3.728
New York	0.833	0.833	1.004	100	*	*
Oakland	0.762	0.762	1.104	100	1.981	4.440
Puerto Vallarta	0.761	0.761	2.051	100	*	*
Salt Lake City	0.603	0.603	0.761	100	2.078	3.924
San Jose Del Cabo	0.652	0.652	2.006	100	*	*
Seattle	0.881	0.881	0.809	100	2.230	4.149
Tapachula	0.782	0.782	2.351	100	*	*
Washington DC	0.762	0.762	0.991	100	2.410	3.852
Winnipeg	0.692	0.692	0.892	100	*	*

*SPS Data not available.

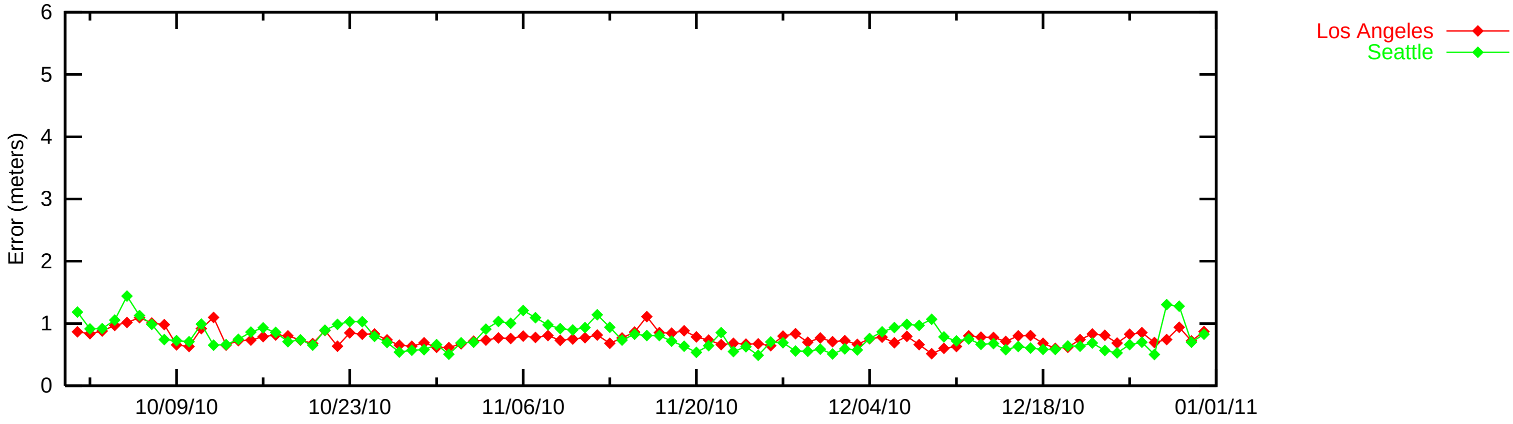
Table 2-3 NPA 95% and 99.999% Horizontal Accuracy

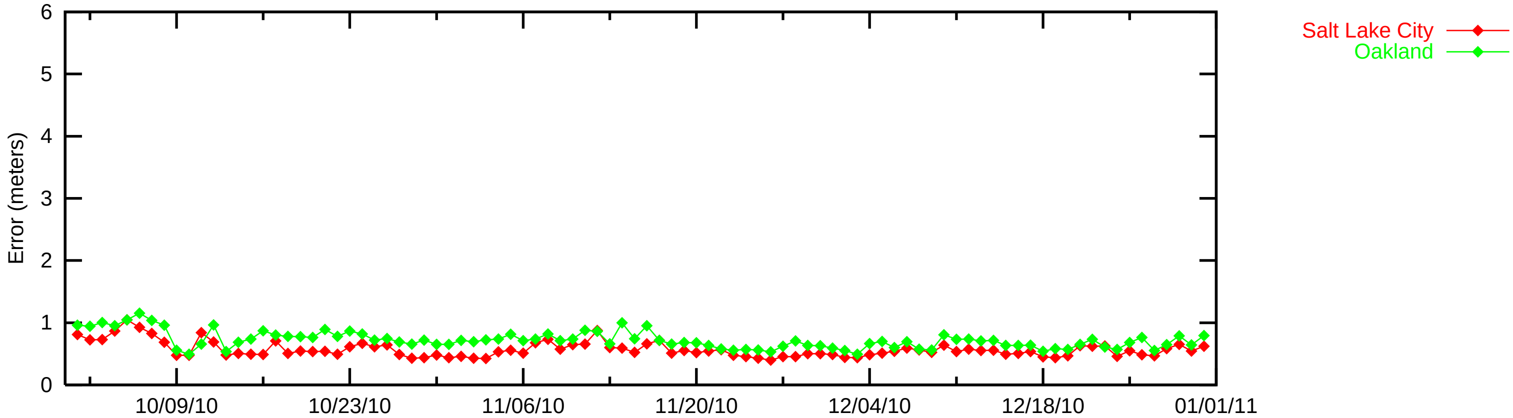
Location	95% Horizontal (meters)	99.999% Horizontal (meters)	Percentage in NPA mode (%)	Maximum Horizontal Error
Albuquerque	1.046	3.043	100	3.184
Anchorage	1.188	2.768	100	2.910
Atlanta	1.267	3.332	100	3.494
Barrow	0.786	1.959	7.57	2.453
Bethel	1.336	2.889	100	3.053
Billings	1.433	3.483	100	3.623
Boston	1.489	2.487	100	2.619
Cleveland	1.267	2.187	100	2.762
Cold Bay	1.543	3.077	100	3.464
Fairbanks	1.043	2.680	100	2.800
Gander	1.642	2.917	100	3.048
Honolulu	3.883	8.638	100	8.830
Houston	1.331	3.461	100	3.606
Iqaluit	1.321	3.274	100	5.719
Juneau	1.204	2.588	100	2.693
Kansas City	1.273	2.588	100	3.324
Kotzebue	1.138	2.383	33.52	2.972
Los Angeles	1.224	3.813	100	4.100
Merida	1.306	4.520	100	4.700
Miami	1.330	3.717	100	3.822
Minneapolis	1.445	2.514	100	3.309
Oakland	1.207	3.363	100	3.778
Salt Lake City	1.114	2.295	100	2.585
San Jose Del Cabo	1.176	4.518	100	5.091
San Juan	1.475	4.537	100	4.850
Seattle	1.535	3.244	100	3.472
Tapachula	1.362	3.710	100	3.819
Washington DC	1.544	2.693	100	2.807

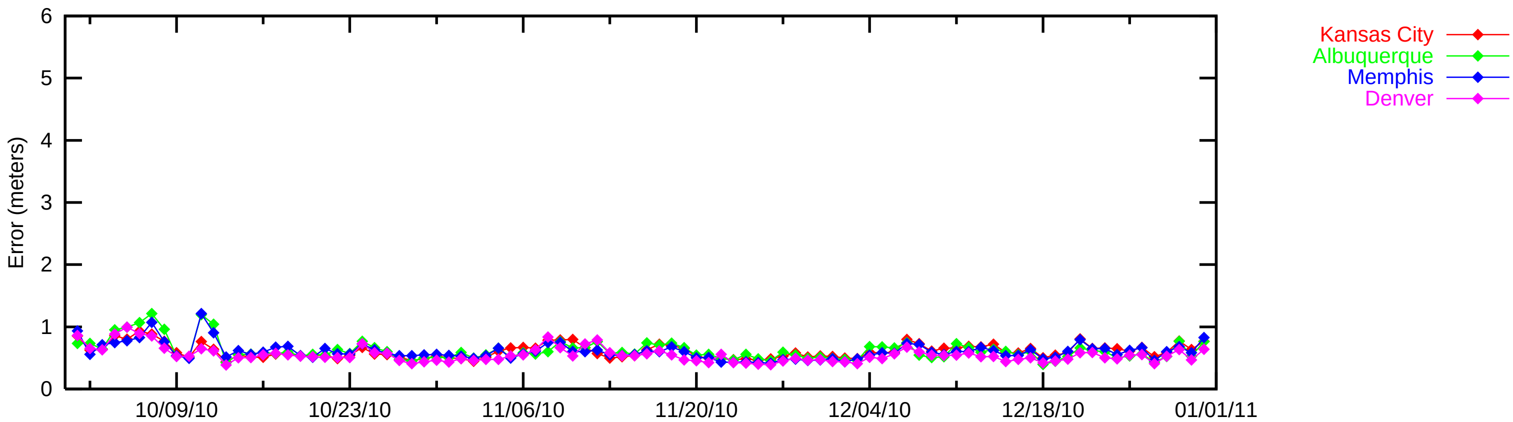
Table 2-4 Maximum Error Statistics

Location	Horizontal Error (m)	Horizontal Error/HPL	Horizontal Maximum Ratio	Vertical Error (m)	Vertical Error/VPL	Vertical Maximum Ratio
Arcata	2.869	0.134	0.163	6.023	0.160	0.185
Grand Forks	5.300	0.292	0.336	8.874	0.301	0.312
Oklahoma City	1.753	0.127	0.201	3.604	0.129	0.234
Albuquerque	1.927	0.082	0.222	3.205	0.203	0.203
Anchorage	1.835	0.134	0.144	2.963	0.127	0.150
Atlanta	1.442	0.127	0.160	2.854	0.124	0.179
Barrow	2.606	0.169	0.169	4.180	0.182	0.182
Bethel	1.313	0.088	0.095	2.684	0.076	0.119
Billings	1.820	0.181	0.181	2.764	0.135	0.171
Boston	1.665	0.108	0.159	2.863	0.124	0.144
Chicago	2.027	0.144	0.194	2.890	0.222	0.222
Cleveland	1.780	0.185	0.185	3.505	0.150	0.232
Cold Bay	2.368	0.082	0.111	2.915	0.098	0.123
Dallas	1.752	0.170	0.209	3.278	0.168	0.233
Denver	1.538	0.083	0.149	2.436	0.081	0.143
Fairbanks	2.550	0.226	0.226	5.530	0.304	0.304
Gander	2.173	0.057	0.126	2.995	0.088	0.119
Goose Bay	3.730	0.103	0.156	3.956	0.131	0.136
Houston	1.530	0.145	0.160	3.153	0.246	0.246
Iqaluit	2.654	0.099	0.160	6.963	0.171	0.217
Jacksonville	1.579	0.097	0.157	3.309	0.138	0.197
Juneau	1.730	0.161	0.161	2.508	0.134	0.157
Kansas City	1.463	0.141	0.153	2.694	0.177	0.190
Kotzebue	2.263	0.122	0.131	5.258	0.120	0.166
Los Angeles	1.984	0.129	0.191	3.224	0.148	0.170
Memphis	1.716	0.211	0.211	2.666	0.146	0.192
Merida	1.928	0.115	0.169	3.559	0.158	0.182
Mexico City	3.512	0.158	0.158	3.842	0.151	0.165
Miami	1.635	0.130	0.157	3.679	0.202	0.217
Minneapolis	1.464	0.161	0.162	2.270	0.105	0.144
New York	1.769	0.128	0.155	3.564	0.188	0.188
Oakland	2.911	0.214	0.220	3.429	0.146	0.171
Puerto Vallarta	3.658	0.165	0.165	4.004	0.099	0.176
Salt Lake City	1.646	0.173	0.186	2.963	0.195	0.222
San Jose Del Cabo	2.594	0.122	0.165	4.256	0.186	0.192
Seattle	2.666	0.286	0.286	3.429	0.136	0.235
Tapachula	2.662	0.105	0.133	5.244	0.201	0.201
Washington DC	1.819	0.136	0.176	2.860	0.089	0.184
Winnipeg	1.608	0.141	0.148	2.405	0.114	0.153

Figure 2-1 95% Horizontal Accuracy at LPV







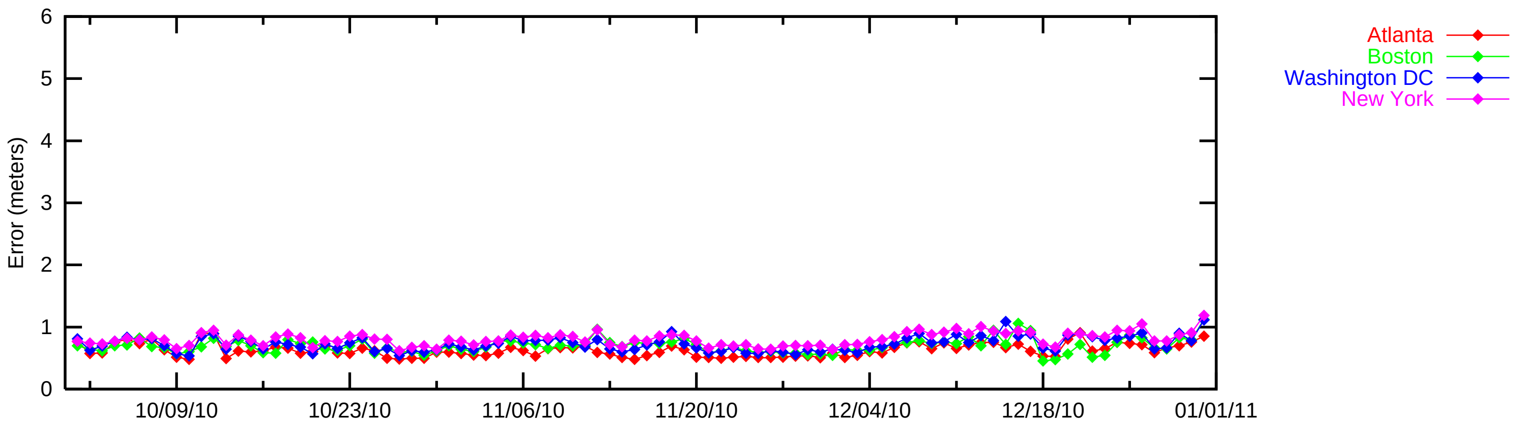
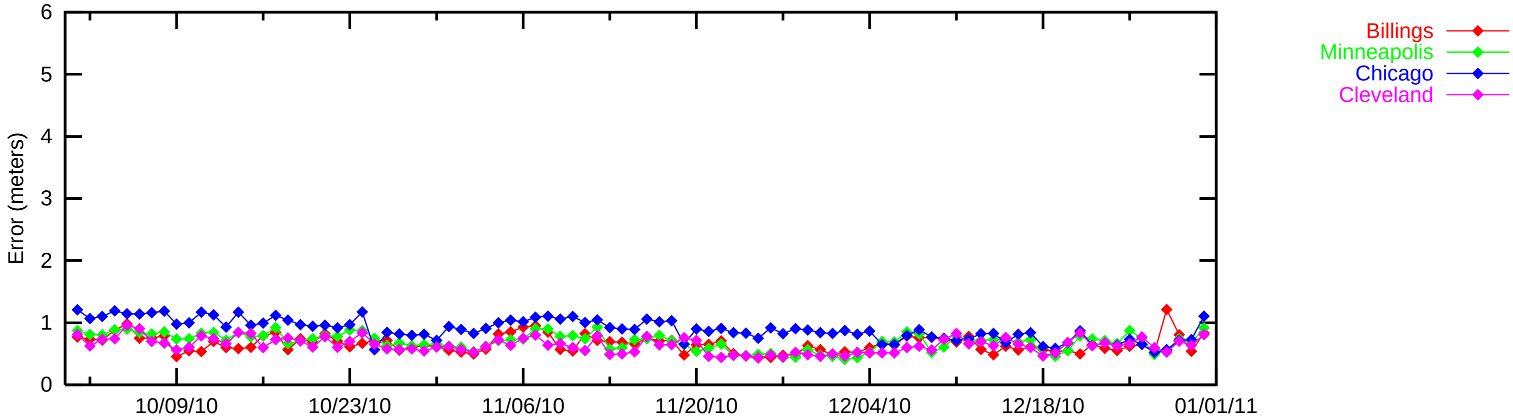
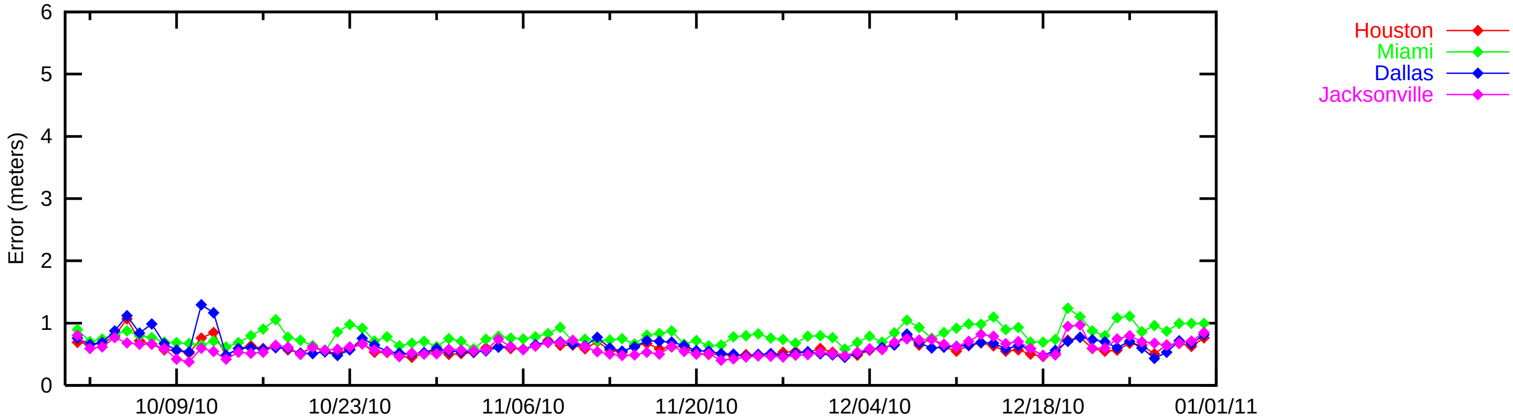
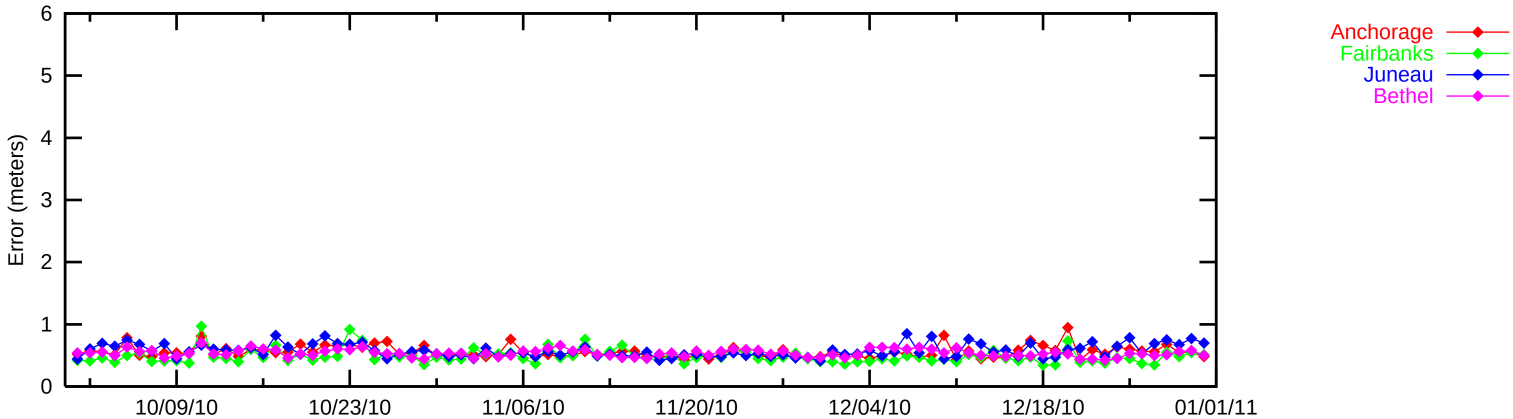


Figure 2-2 95% Horizontal Accuracy at LPV







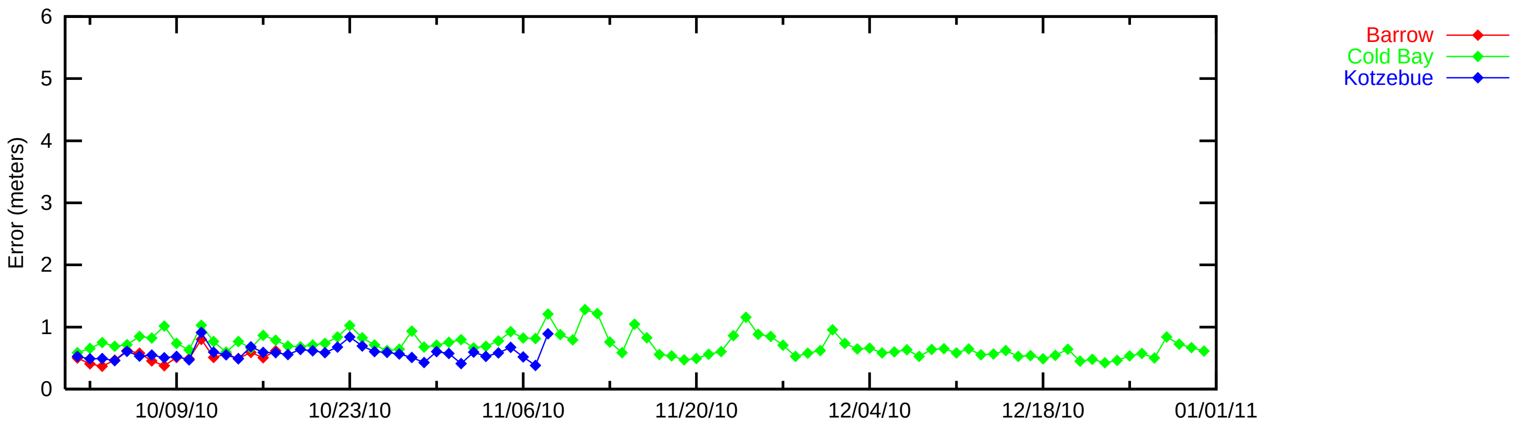


Figure 2-3 95% Horizontal Accuracy at LPV

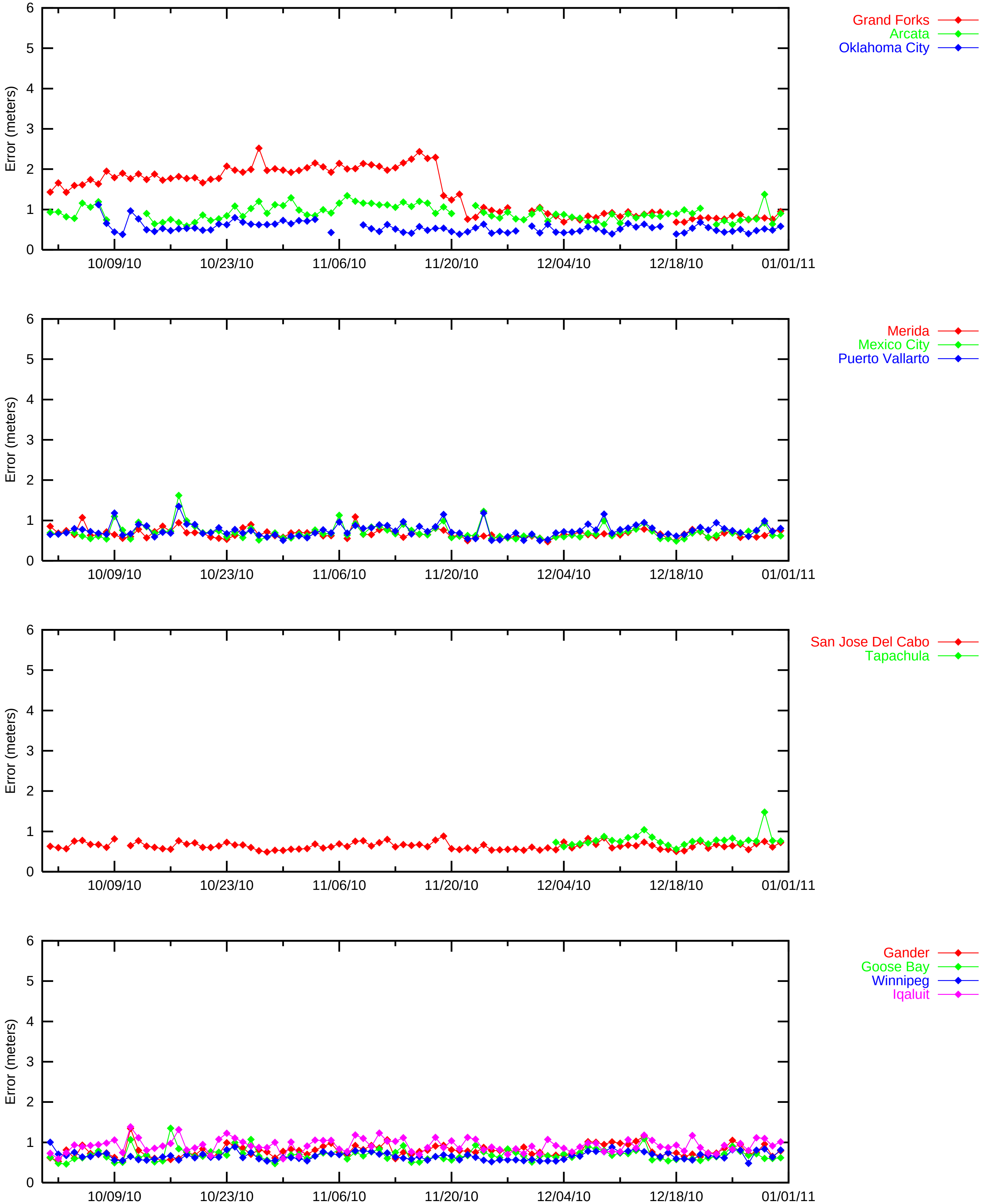


Figure 2-4 95% Vertical Accuracy at LPV

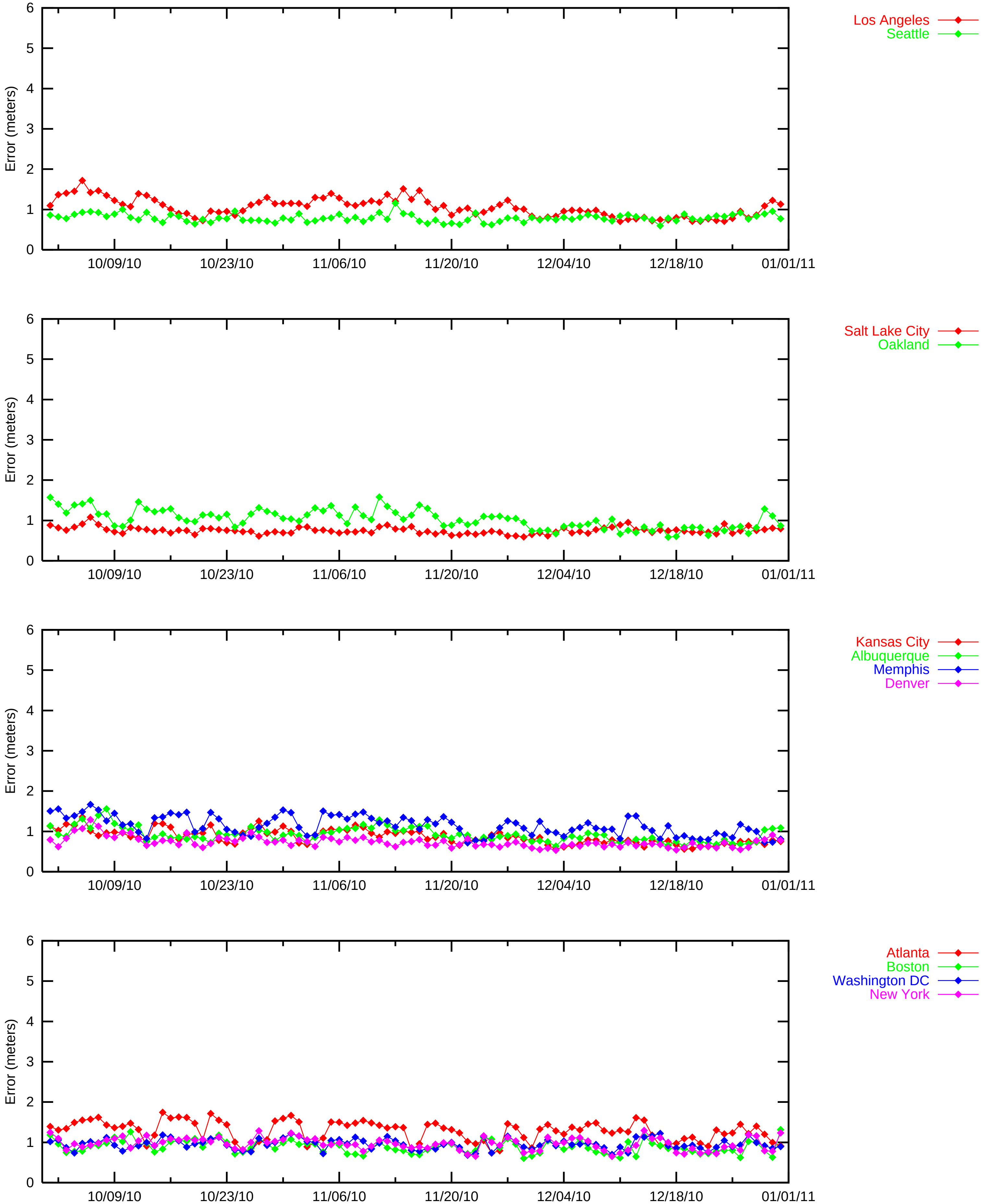


Figure 2-5 95% Vertical Accuracy at LPV

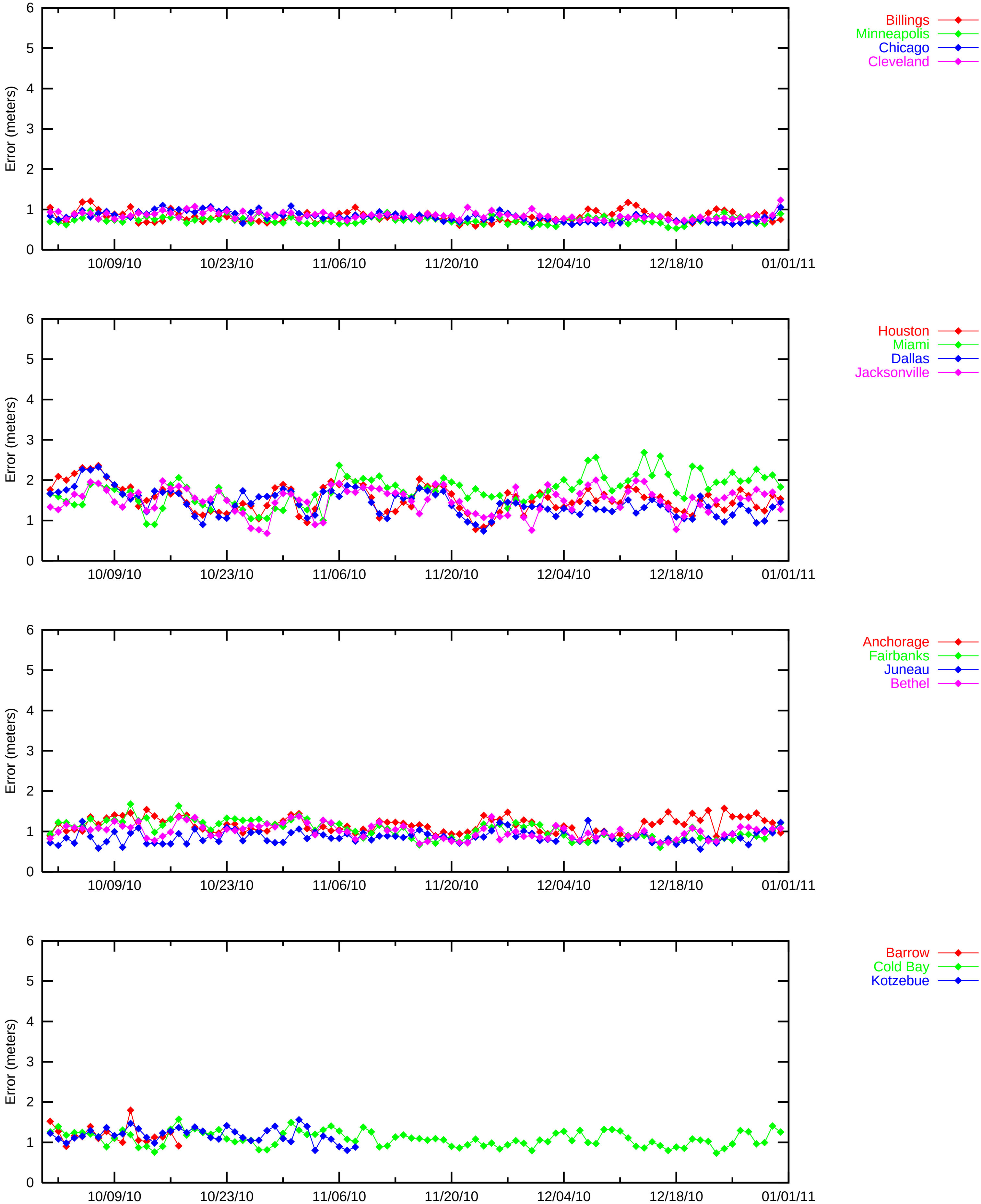


Figure 2-6 95% Vertical Accuracy at LPV

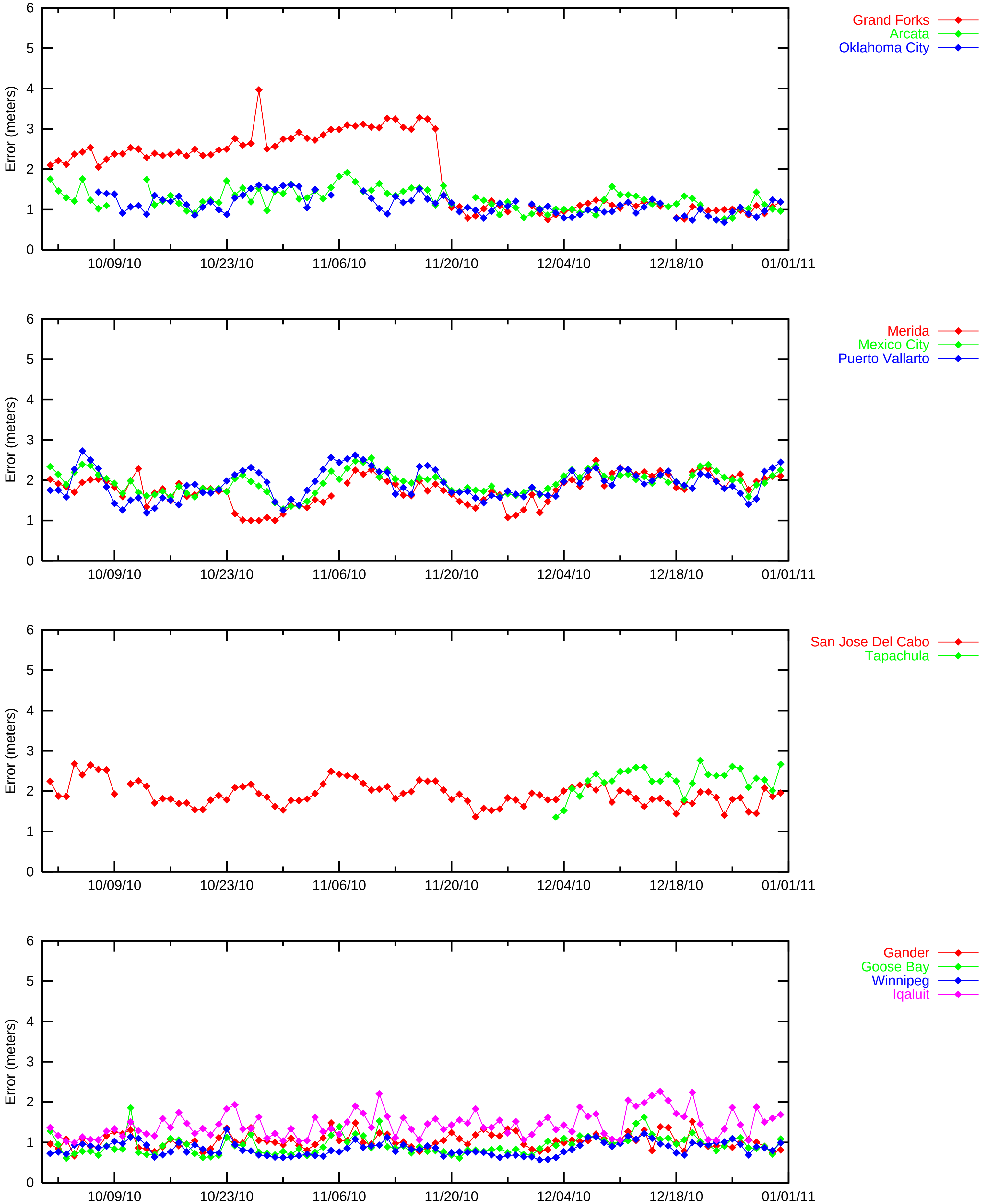


Figure 2-7 95% NPA Horizontal Accuracy

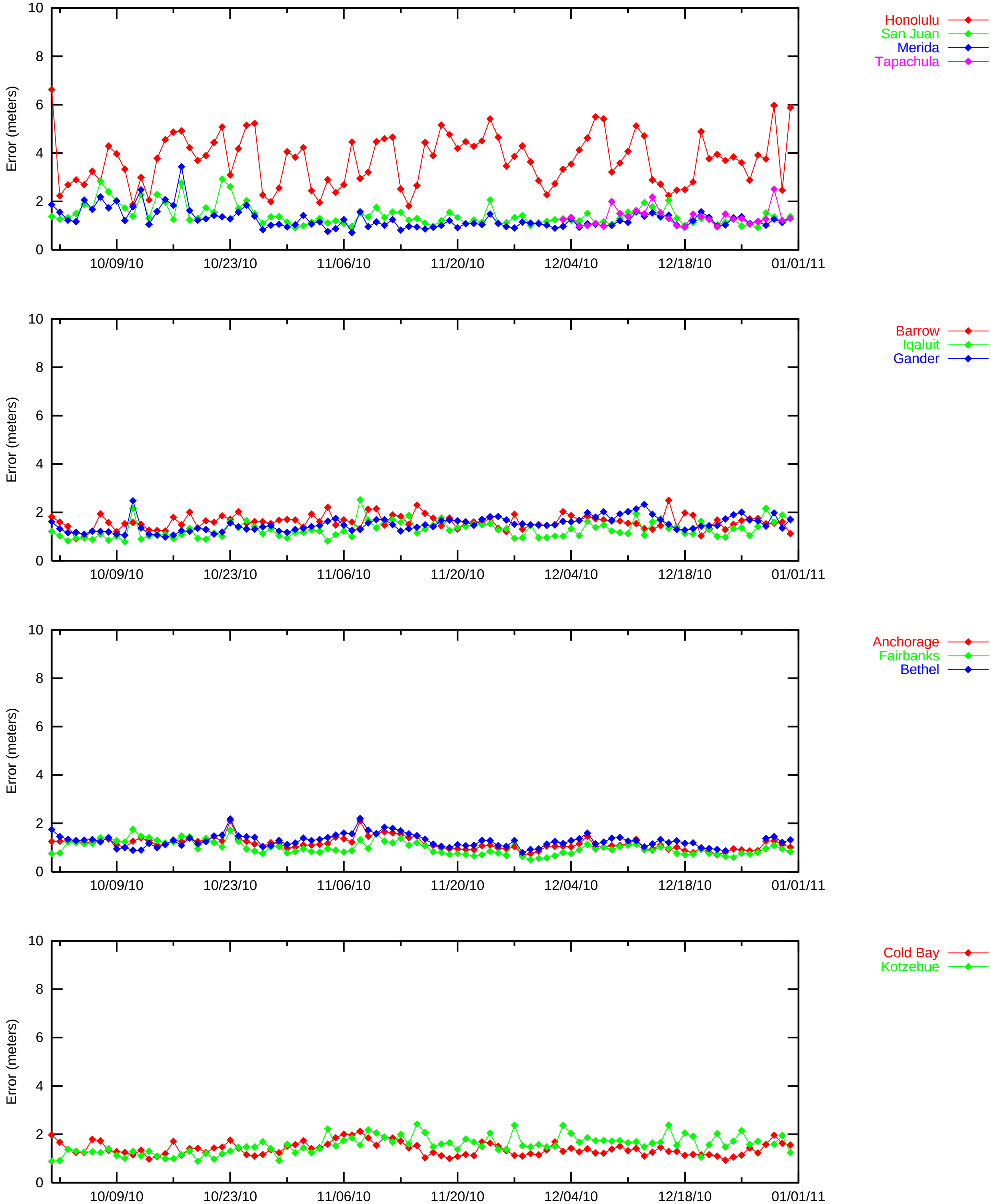


Figure 2-8 95% NPA Horizontal Accuracy

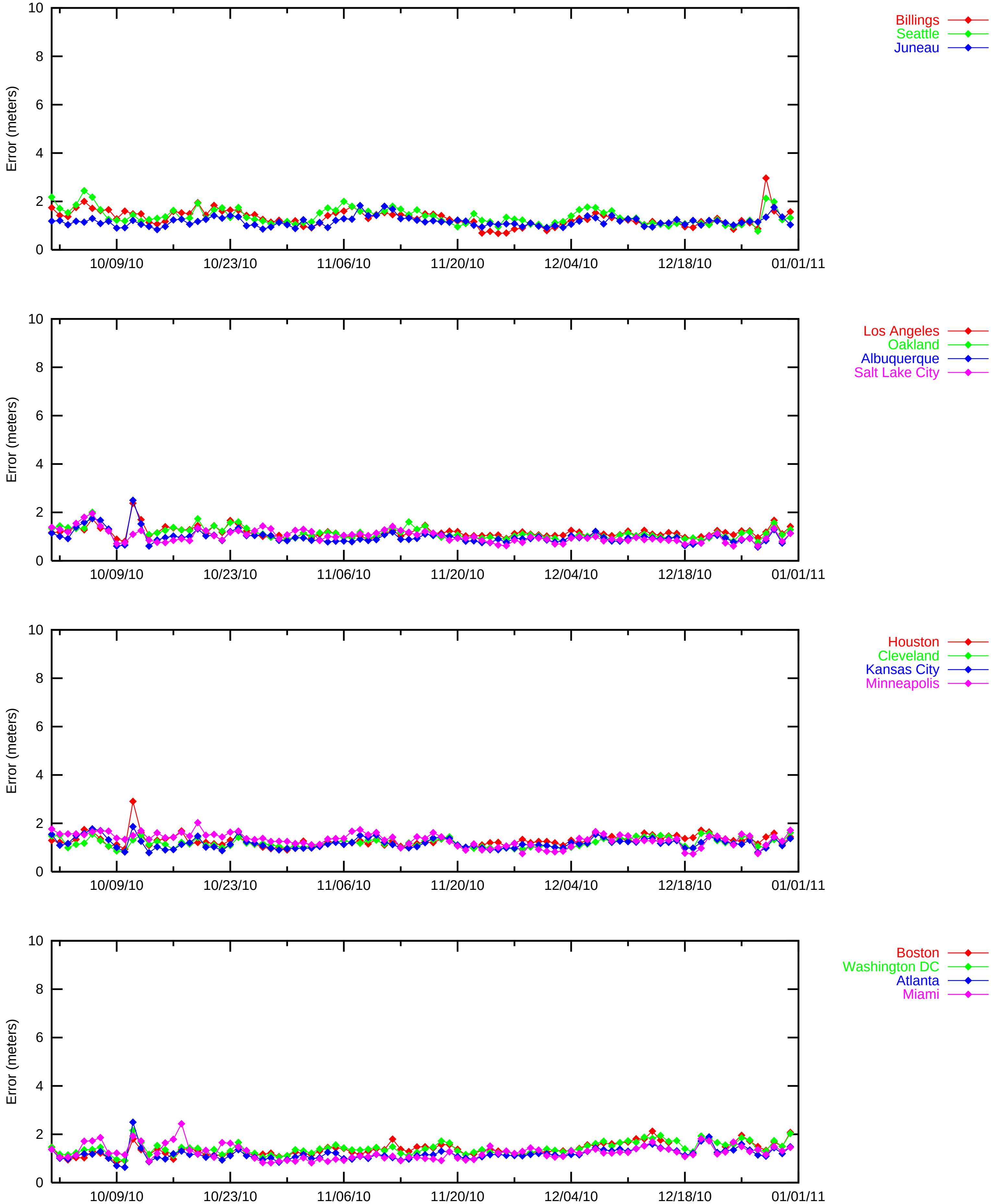


Figure 2-9 Horizontal Triangle Chart for the Quarter

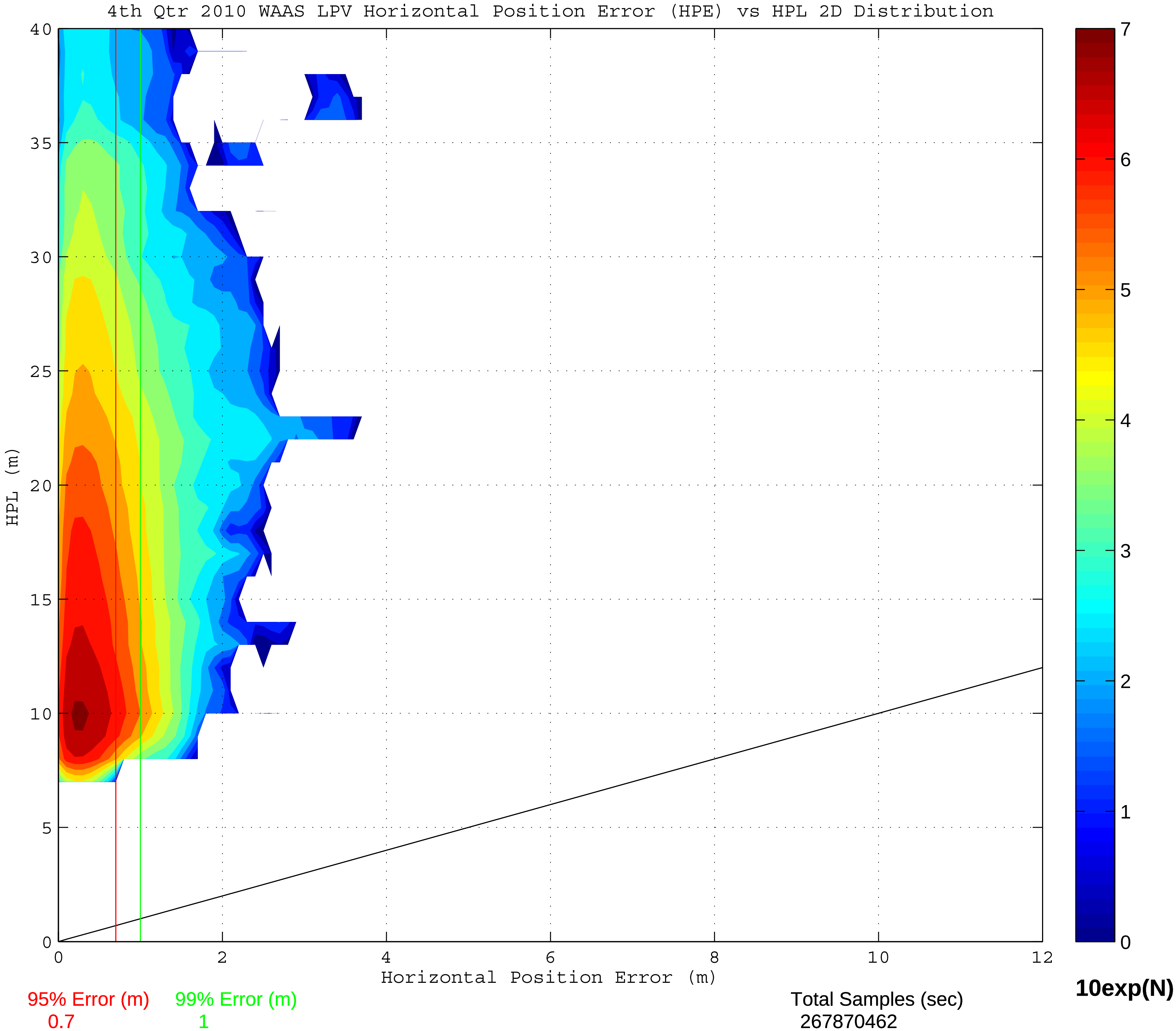


Figure 2-10 Vertical Triangle Chart for the Quarter

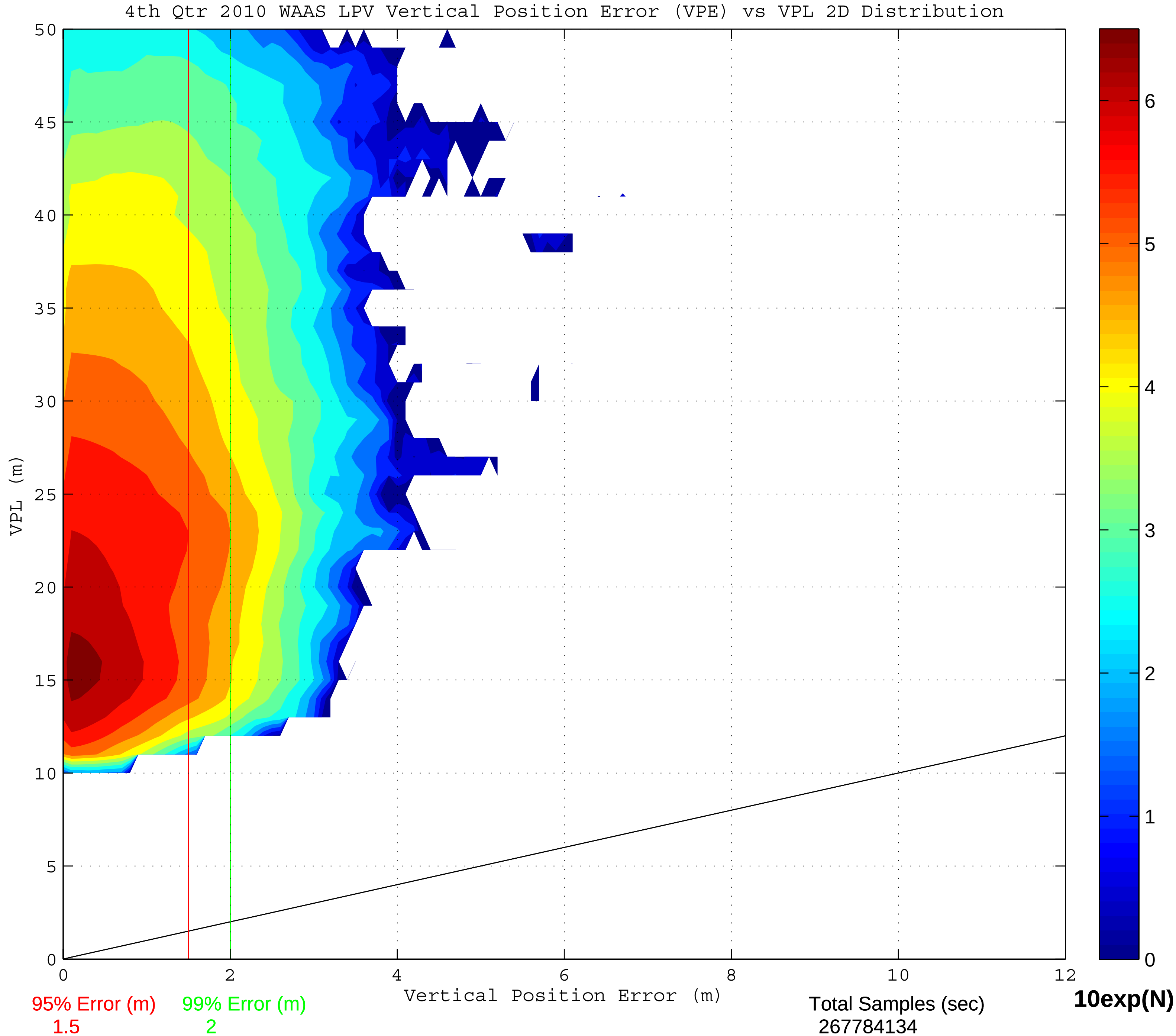


Figure 2-11 2-D Horizontal Histogram for the Quarter

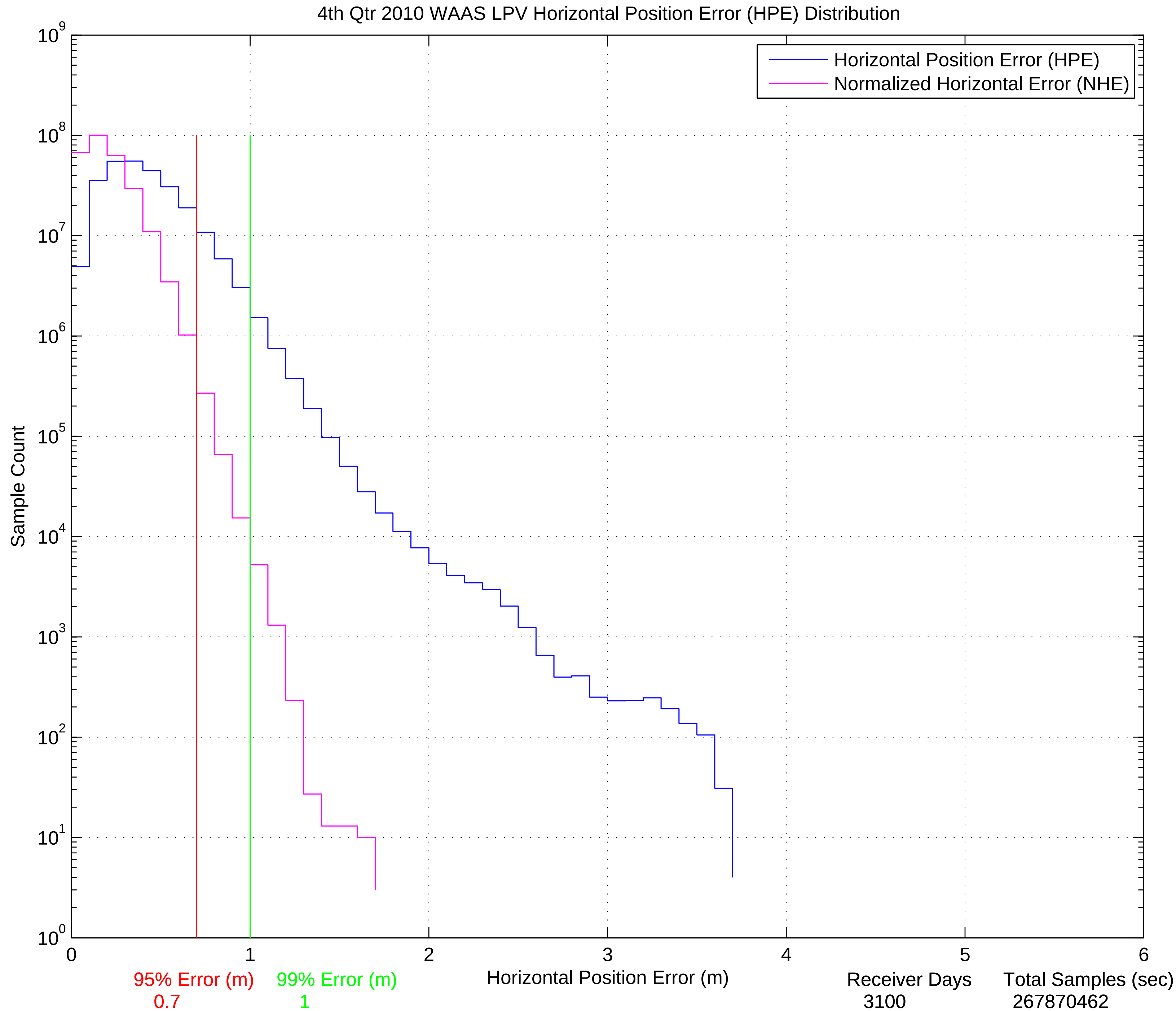
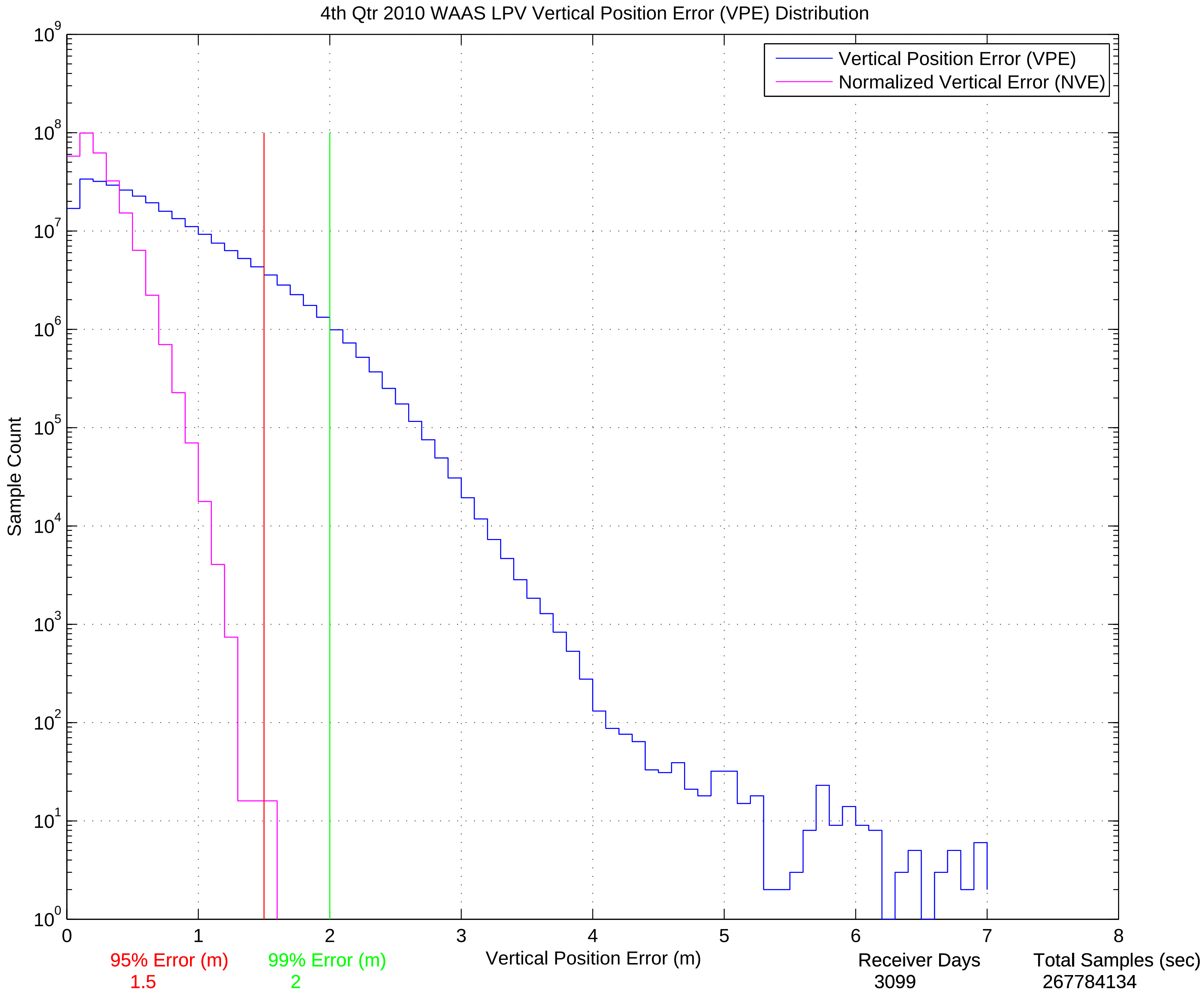


Figure 2-12 2-D Vertical Histogram for the Quarter



3.0 AVAILABILITY

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

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

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

Parameter	CONUS Site/Maximum	CONUS Site/Minimum	Alaska Site/Maximum	Alaska Site/Minimum
95% HPL	Arcata 15.578 meters	Memphis 10.464 meters	Cold Bay 26.538 meters	Fairbanks 13.317 meters
95% VPL	Oakland 27.29 meters	Dallas 18.018 meters	Barrow 38.333 meters	Juneau 22.073 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, low PA and NPA availability are mainly due to GPS satellite outages or GUS switchovers. Please refer to Table 1.4 for events that affect availability.

The CRW GEO satellite was taken out of service on 12/16/2010 due to instability. This instability was expected at some point after CRW began drifting in April. Because of this drift, the Barrow and Kotzebue reference stations no longer tracked CRW since it fell below the 5 degree elevation cutoff angle. The reference stations at Barrow stopped tracking CRW on 10/18/10 and at the reference stations at Kotzebue stopped tracking CRW on 11/9/10.

The AMR GEO satellite (PRN 133) came into service on November 11, 2011. This GEO does not provide a ranging service yet, though it is expected to provide NPA ranging service (UDRE => 50 meters) in a future upgrade to the WAAS.

Radio frequency interference (RFI) caused localized loss of LPV availability at Boston on 10/17/10 (See DR #99 Boston LPV outage caused by RFI) and at Washington D.C on 11/24/10 (See DR #98 WAAS LPV200 Service Outage at Washington DC). This local RFI had no effect on WAAS service.

Table 3-1 95% Protection Level

Location	95% HPL (meters)	95% VPL (meters)	Percentage in PA mode
Arcata	15.578	26.910	100
Grand Forks	11.937	19.816	100
Oklahoma City	10.669	18.088	100
Albuquerque	11.856	20.162	100
Anchorage	13.870	22.580	100
Atlanta	11.242	19.300	100
Barrow	17.047	38.333	7.573110
Bethel	16.833	27.024	99.997170
Billings	11.621	20.520	100
Boston	13.597	20.650	100
Chicago	10.514	18.729	100
Cleveland	10.933	19.337	100
Cold Bay	26.538	34.896	100
Dallas	10.640	18.018	100
Denver	10.904	21.186	100
Fairbanks	13.317	23.834	100
Gander	21.033	32.256	100
Goose Bay	16.095	25.537	100
Houston	11.331	18.629	100
Iqaluit	24.713	38.241	99.973900
Jacksonville	11.429	20.138	100
Juneau	14.034	22.073	100
Kansas City	10.542	18.171	100
Kotzebue	16.787	34.677	33.553960
Los Angeles	15.118	25.662	100
Memphis	10.464	18.449	100
Merida	16.762	26.061	100
Mexico City	20.564	31.572	100
Miami	13.184	23.083	100
Minneapolis	11.124	19.102	100
New York	13.249	20.798	100
Oakland	15.562	27.290	100
Puerto Vallarta	21.155	34.105	100
Salt Lake City	11.323	20.996	100
San Jose Del Cabo	20.012	32.483	100
Seattle	13.567	22.246	100
Tapachula	29.922	43.382	100
Washington DC	11.793	19.843	100
Winnipeg	12.557	20.385	100

Table 3-2 Quarterly Availability Statistics

Location	LPV WAAS *With 15 minute window*	LPV 200 WAAS *With 15 minute window*
Arcata	0.9999891	0.9889808
Grand Forks	1	0.9993754
Oklahoma City	1	1
Albuquerque	1	0.9978760
Anchorage	1	0.9998530
Atlanta	1	1
Barrow	0.6460190	0.5710089
Bethel	0.9999641	0.9975646
Billings	1	1
Boston	0.9999921	0.9999918
Chicago	1	1
Cleveland	1	1
Cold Bay	0.9997844	0.9322268
Dallas	1	1
Denver	1	0.9989726
Fairbanks	1	0.9997865
Gander	0.9997876	0.9752635
Goose Bay	0.9992073	0.9986059
Houston	1	1
Iqaluit	0.9880940	0.8702032
Jacksonville	1	0.9997840
Juneau	1	0.9997308
Kansas City	1	1
Kotzebue	0.9187383	0.8684423
Los Angeles	1	0.9991772
Memphis	1	1
Merida	1	0.9994928
Mexico City	0.9999366	0.9898752
Miami	1	0.9995653
Minneapolis	1	1
New York	1	1
Oakland	1	0.9907964
Puerto Vallarta	0.9999612	0.9526726
Salt Lake City	1	1
San Jose Del Cabo	0.9998952	0.9638906
Seattle	1	0.9999704
Tapachula	0.9834735	0.6240192
Washington DC	1	0.9999887
Winnipeg	1	1

Table 3-3 NPA Availability

Location	NPA Availability (Excluding RAIM/FDE)
Albuquerque	1
Anchorage	1
Atlanta	1
Barrow	0.64639025
Bethel	0.99998507
Billings	1
Boston	1
Cleveland	1
Cold Bay	1
Fairbanks	1
Gander	1
Honolulu	1
Houston	1
Iqaluit	1
Juneau	1
Kansas City	1
Kotzebue	0.91523260
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

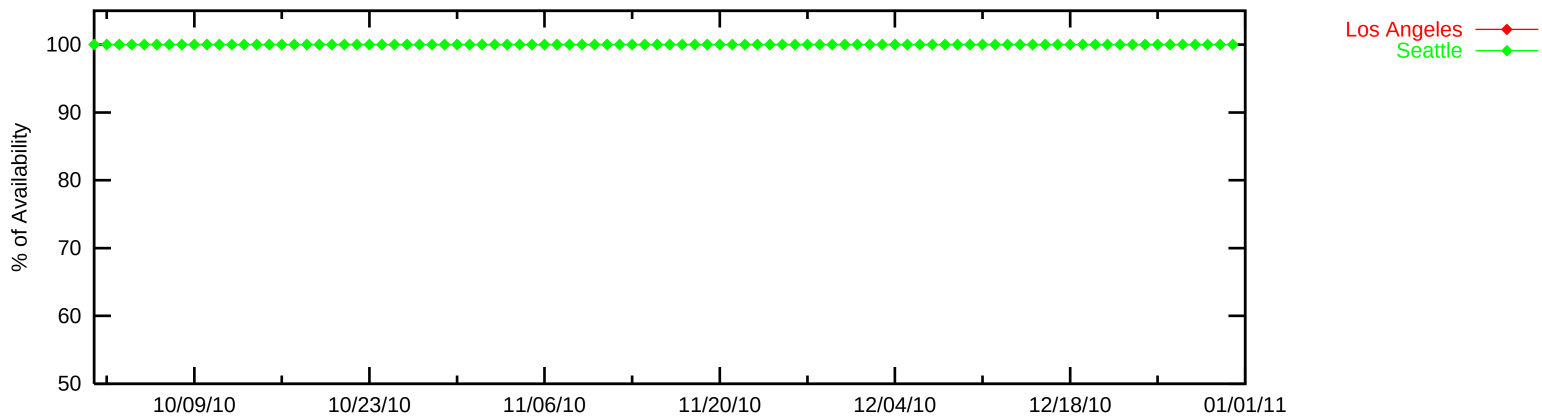
Table 3-4 LPV and LPV 200 Outage Rate

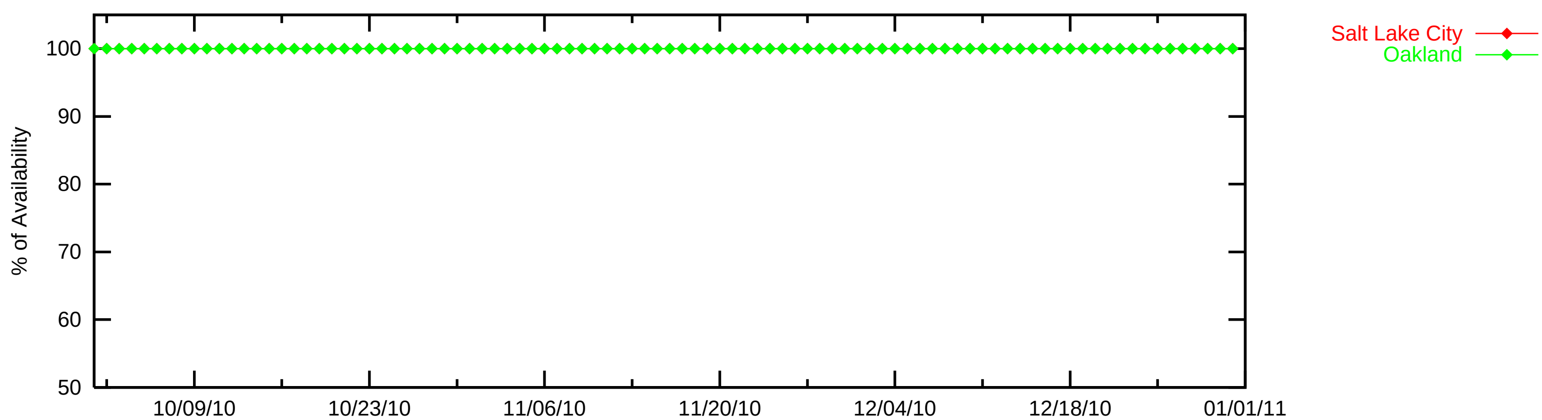
Location	LPV Outages	LPV Outage Rates	LPV 200 Outages	LPV 200 Outage Rates
Arcata	3	0.000061	129	0.002640
Grand Forks	0	0	3	0.000058
Oklahoma City	0	0	0	0
Albuquerque	0	0	32	0.000605
Anchorage	0	0	3	0.000057
Atlanta	0	0	0	0
Barrow	21	0.005241	82	0.023154
Bethel	1	0.000019	46	0.000872
Billings	0	0	0	0
Boston	1	0.000019	1	0.000019
Chicago	0	0	0	0
Cleveland	0	0	0	0
Cold Bay	6	0.000113	501	0.010147
Dallas	0	0	0	0
Denver	0	0	25	0.000472
Fairbanks	0	0	5	0.000094
Gander	2	0.000038	244	0.004722
Goose Bay	1	0.000019	14	0.000265
Houston	0	0	0	0
Iqaluit	88	0.001683	1067	0.023172
Jacksonville	0	0	3	0.000057
Juneau	0	0	2	0.000038
Kansas City	0	0	0	0
Los Angeles	0	0	28	0.000529
Memphis	0	0	0	0
Merida	0	0	12	0.000228
Mexico City	1	0.000019	161	0.003070
Miami	0	0.000000	2	0.000038
Minneapolis	0	0	0	0
New York	0	0	0	0
Oakland	0	0	93	0.001772
Puerto Vallarta	1	0.000019	374	0.007415
Salt Lake City	0	0	0	0
San Jose Del Cabo	1	0.000019	327	0.006432
Seattle	0	0	3	0.000057
Tapachula	107	0.006435	419	0.039714
Washington DC	0	0	1	0.000019
Winnipeg	0	0	0	0

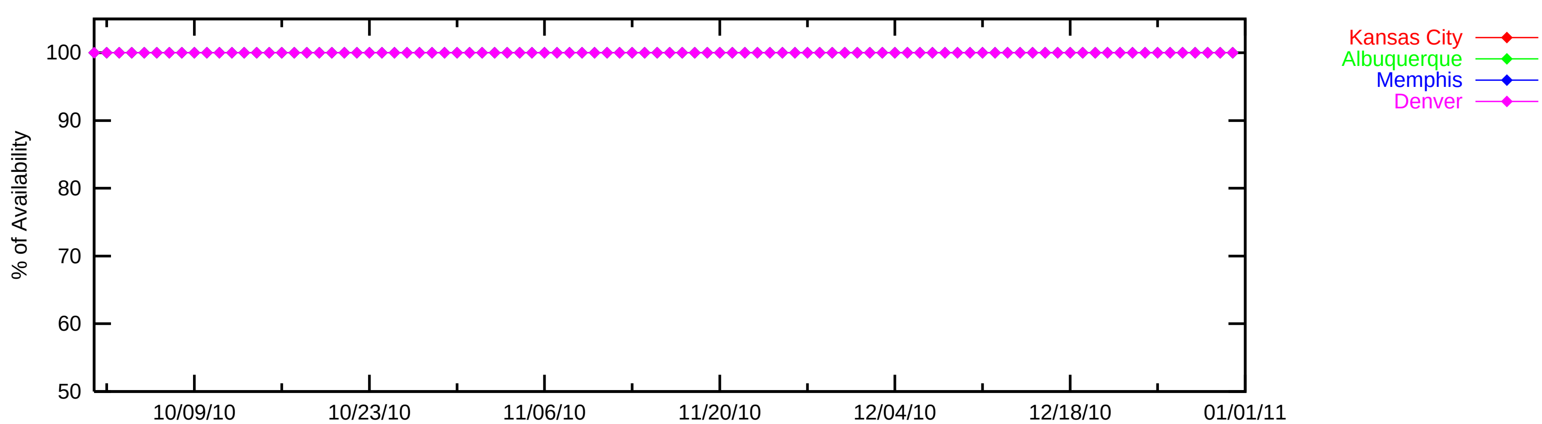
Table 3-5 NPA Outage Rates

Location	NPA Outages	NPA Outage Rate
Albuquerque	0	0
Anchorage	0	0
Atlanta	0	0
Barrow	19	0.00473923
Bethel	1	0.00001964
Billings	0	0
Boston	0	0
Cleveland	0	0
Cold Bay	0	0
Fairbanks	0	0
Gander	0	0
Honolulu	0	0
Houston	0	0
Iqaluit	0	0
Juneau	0	0
Kansas City	0	0
Kotzebue	19	0.00107502
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)







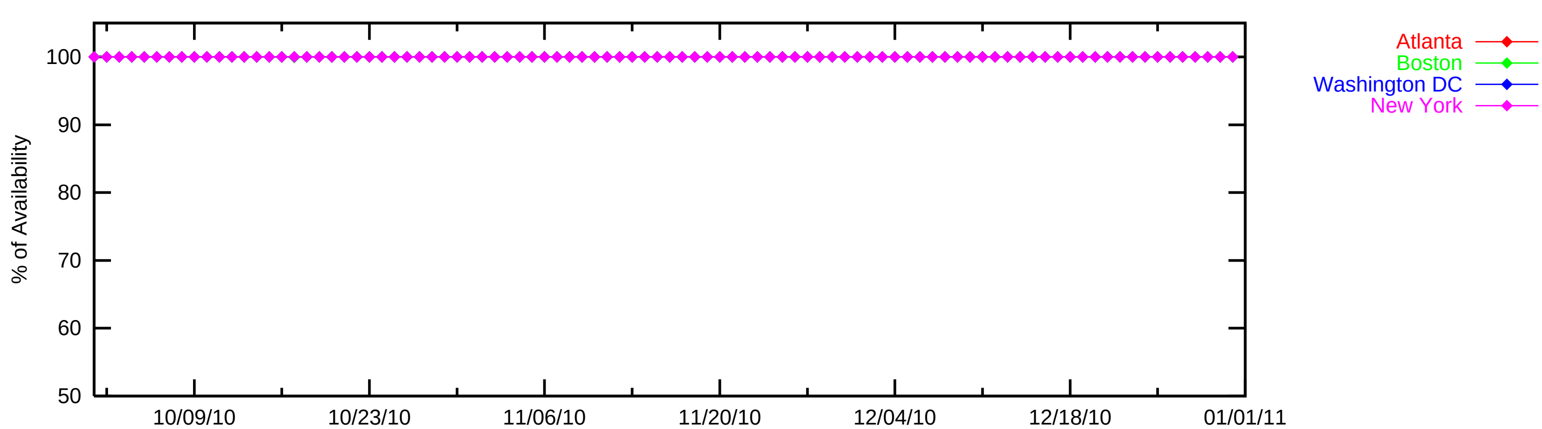


Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

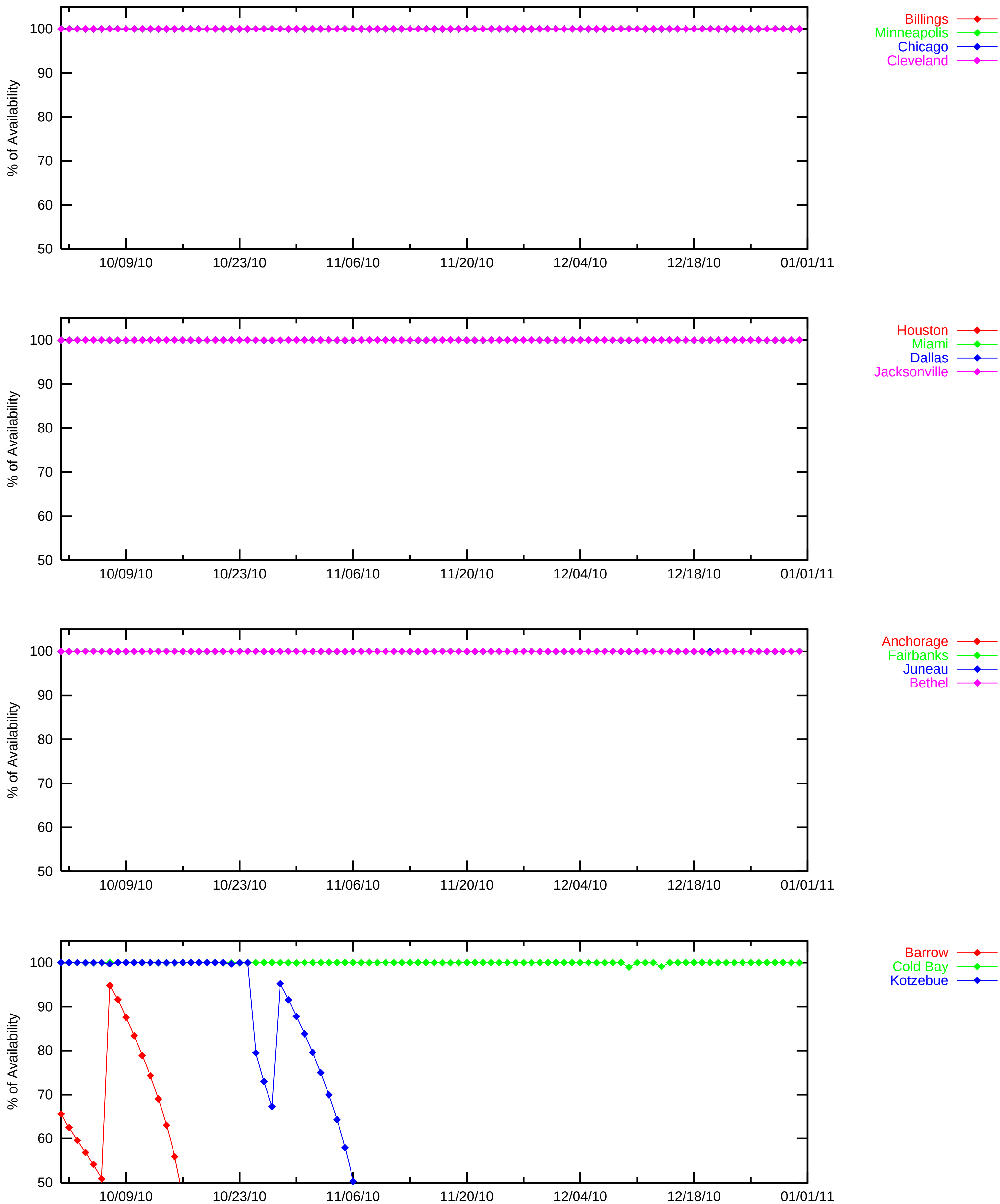


Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

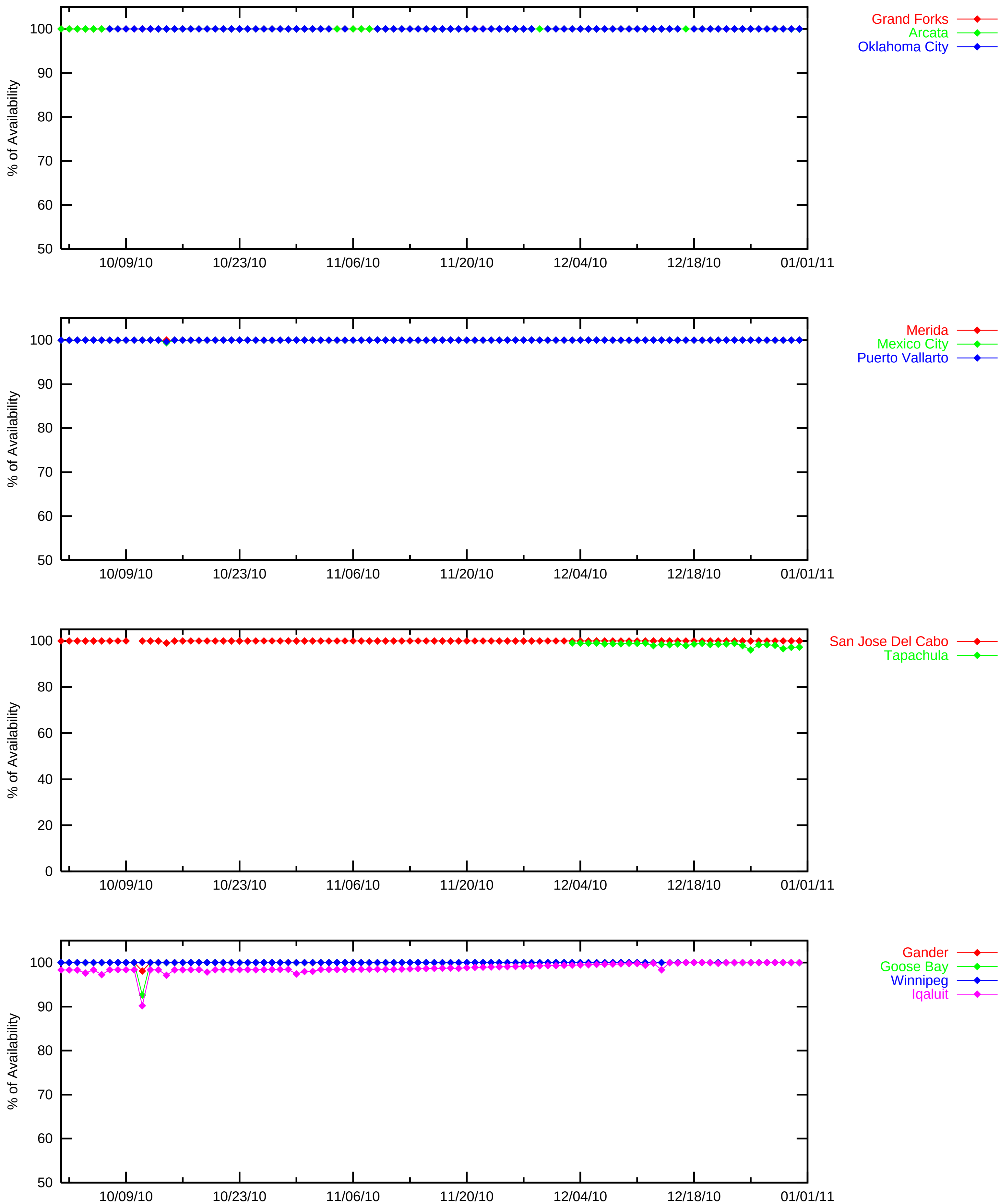


Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

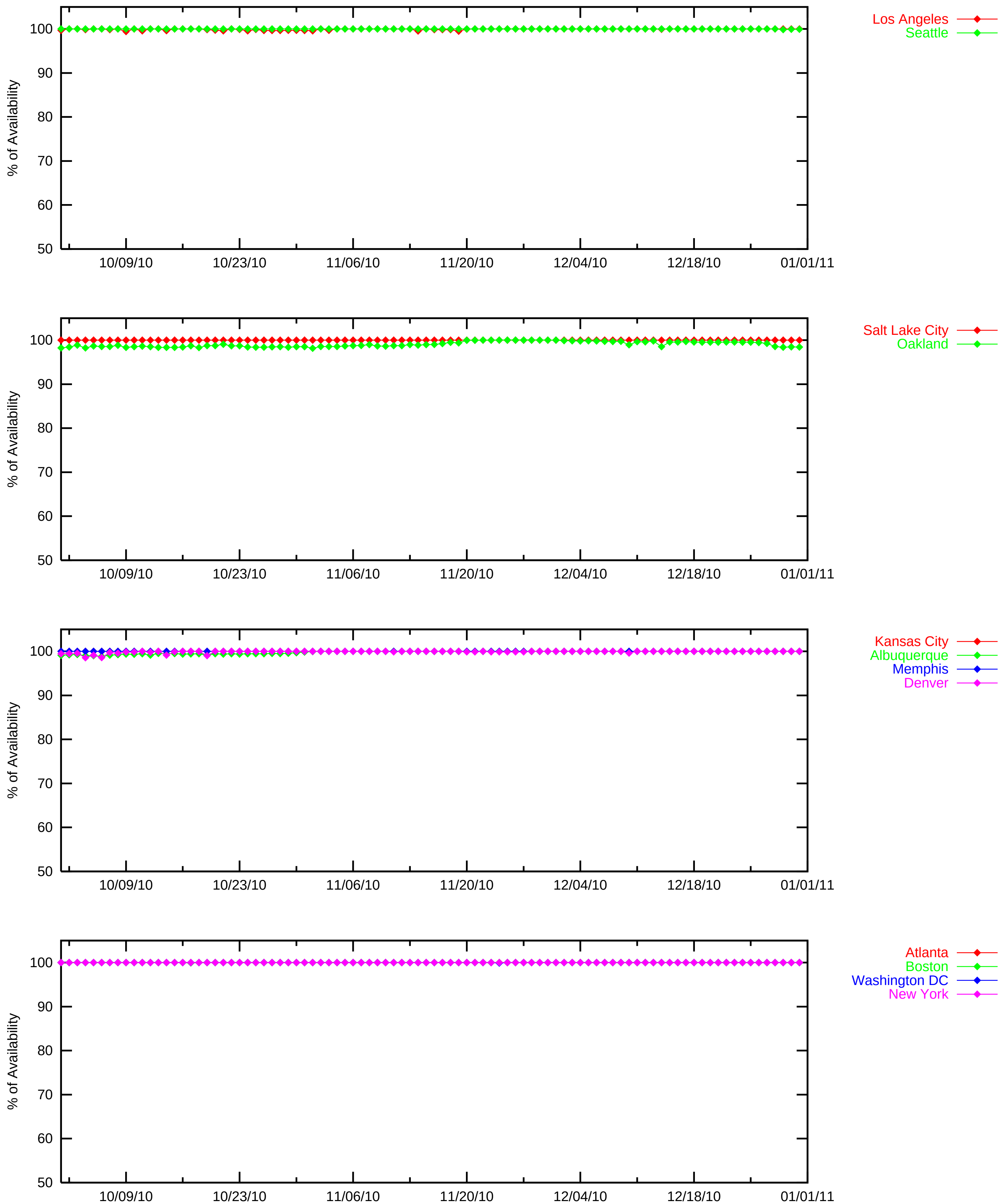


Figure 3-5 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)

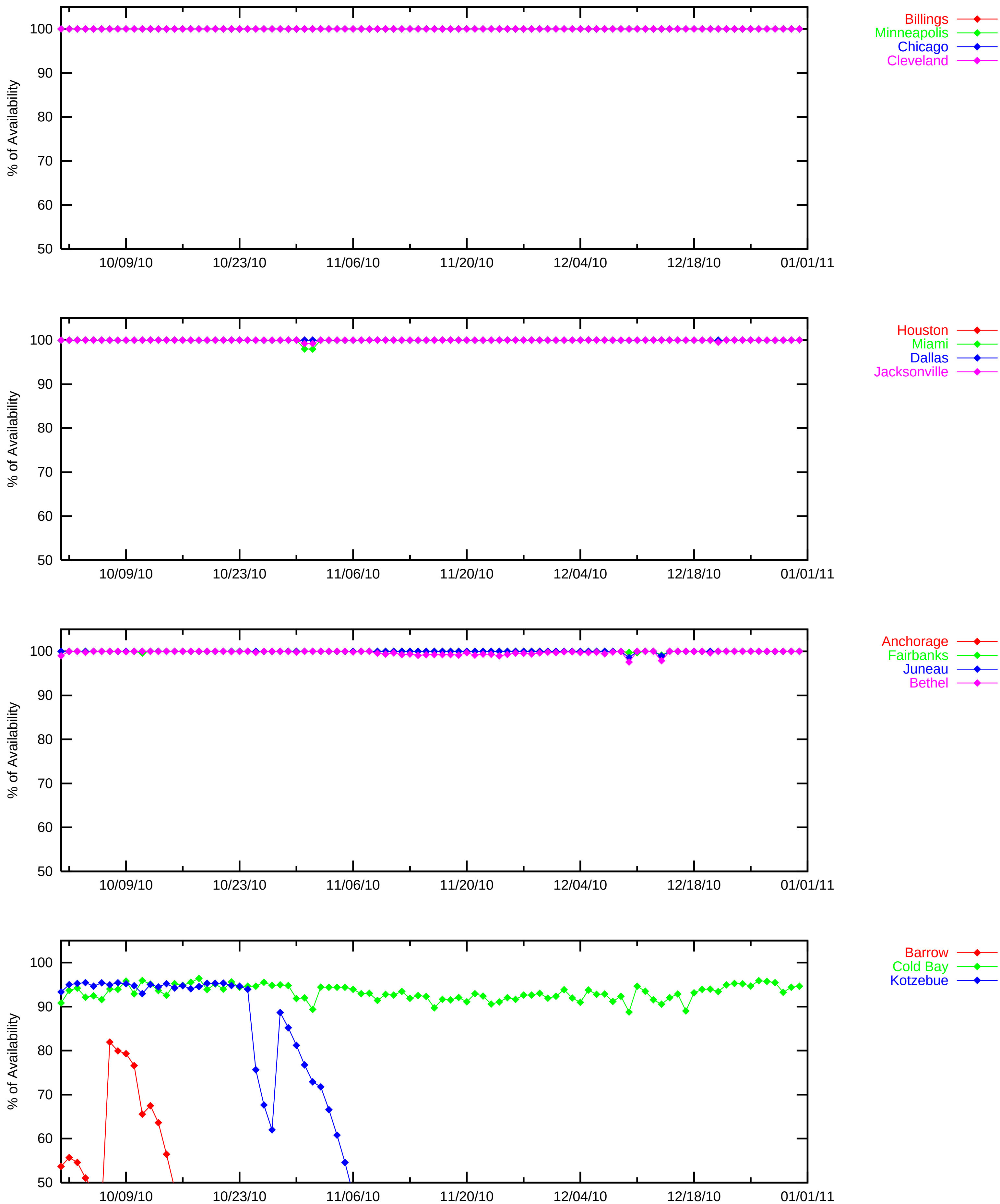
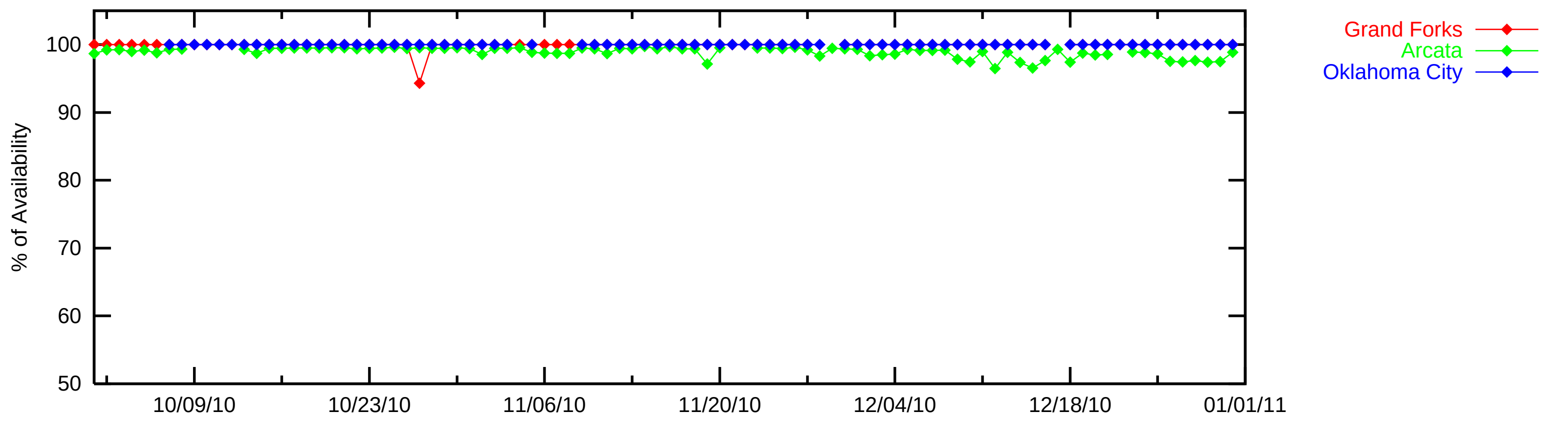
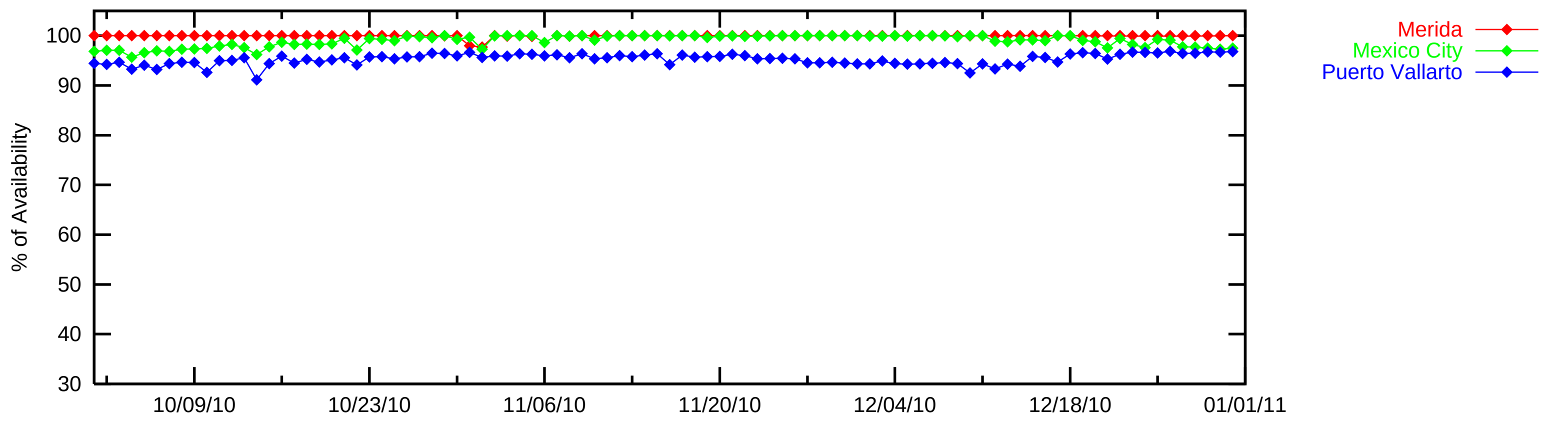
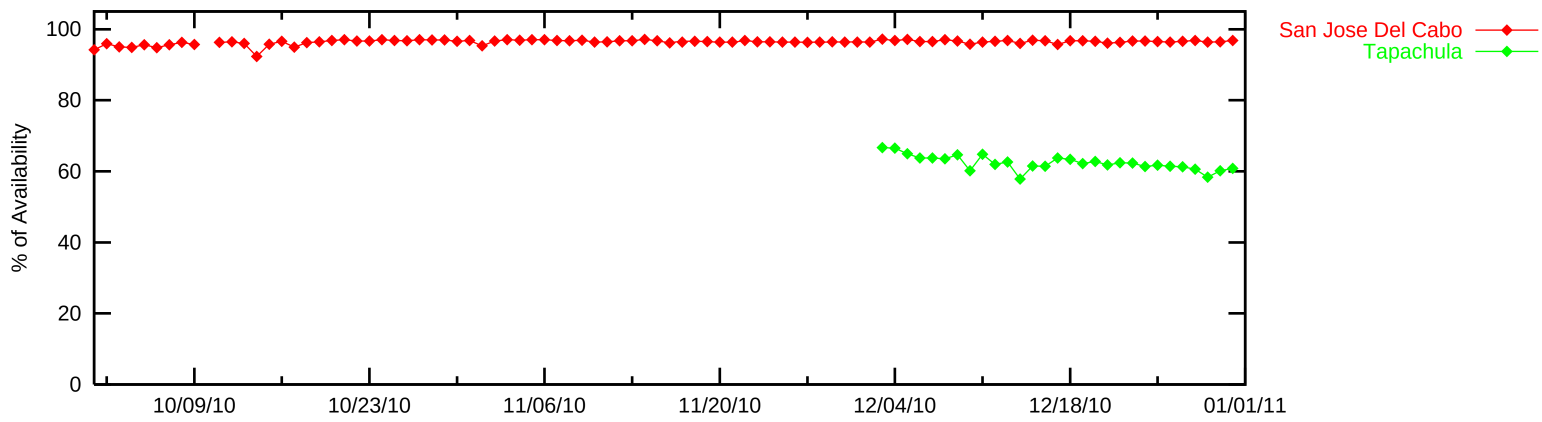


Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)







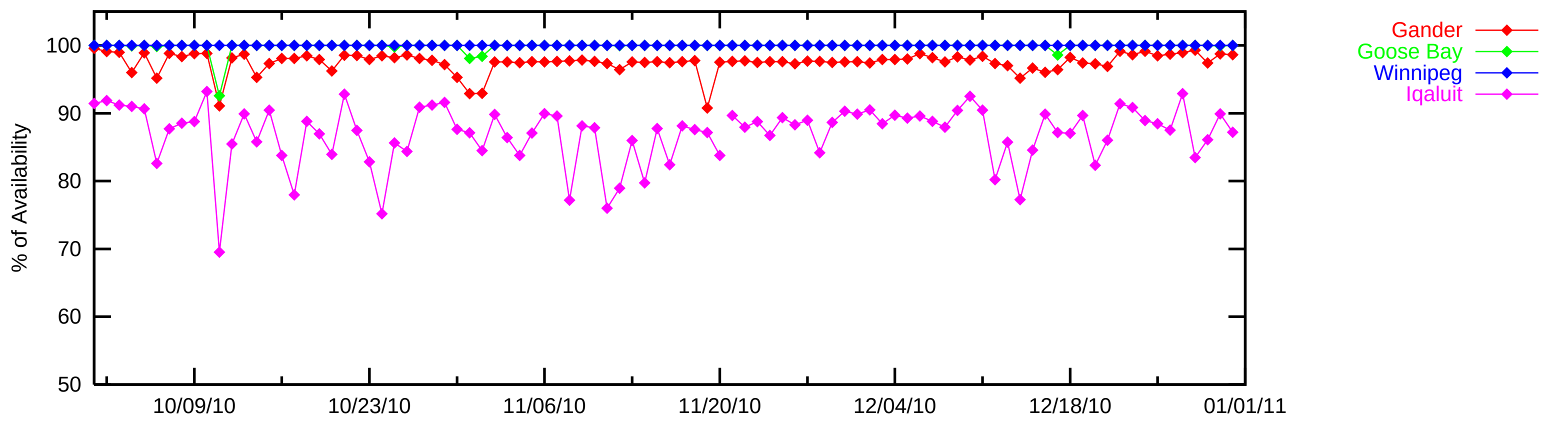


Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)

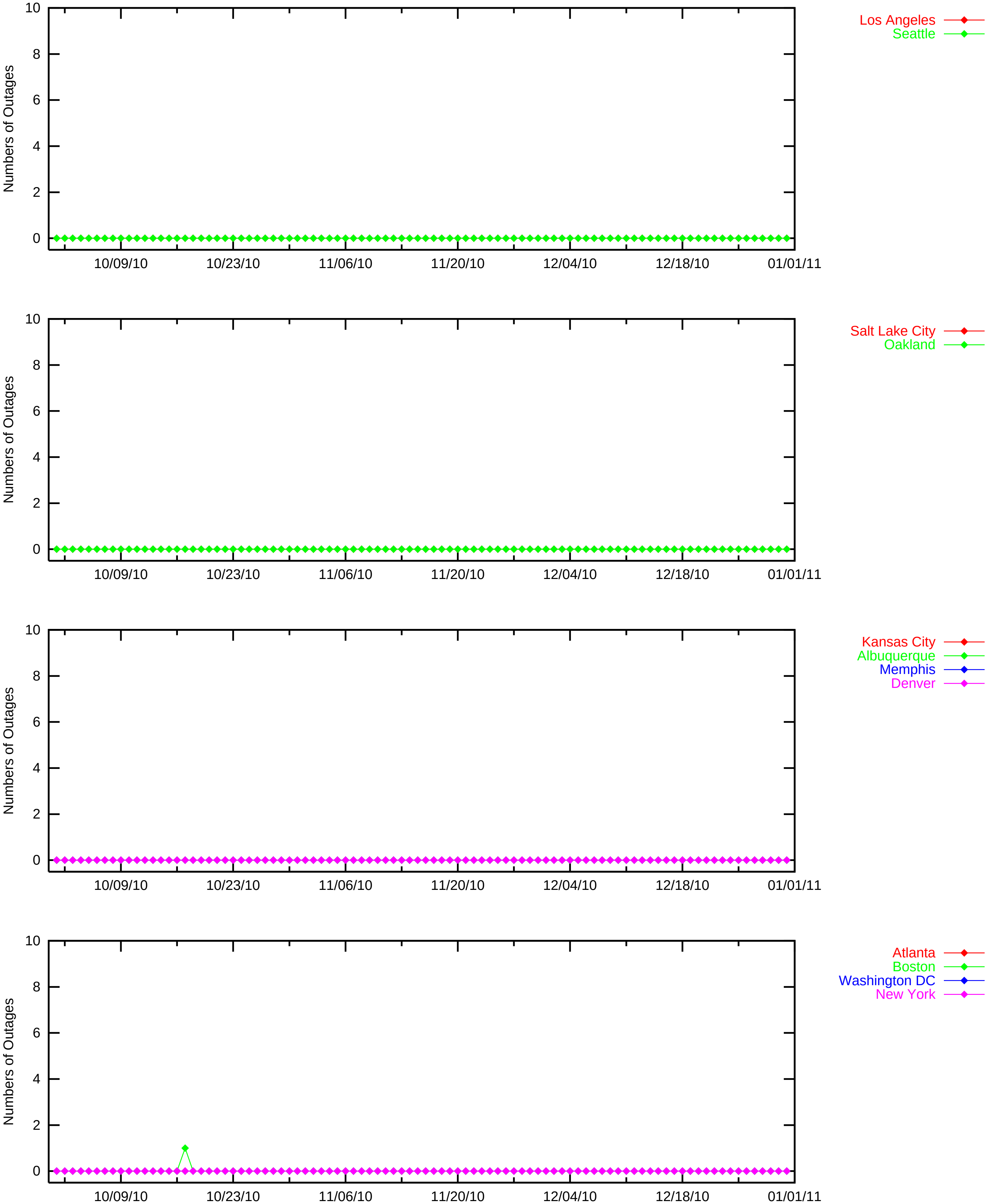


Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)

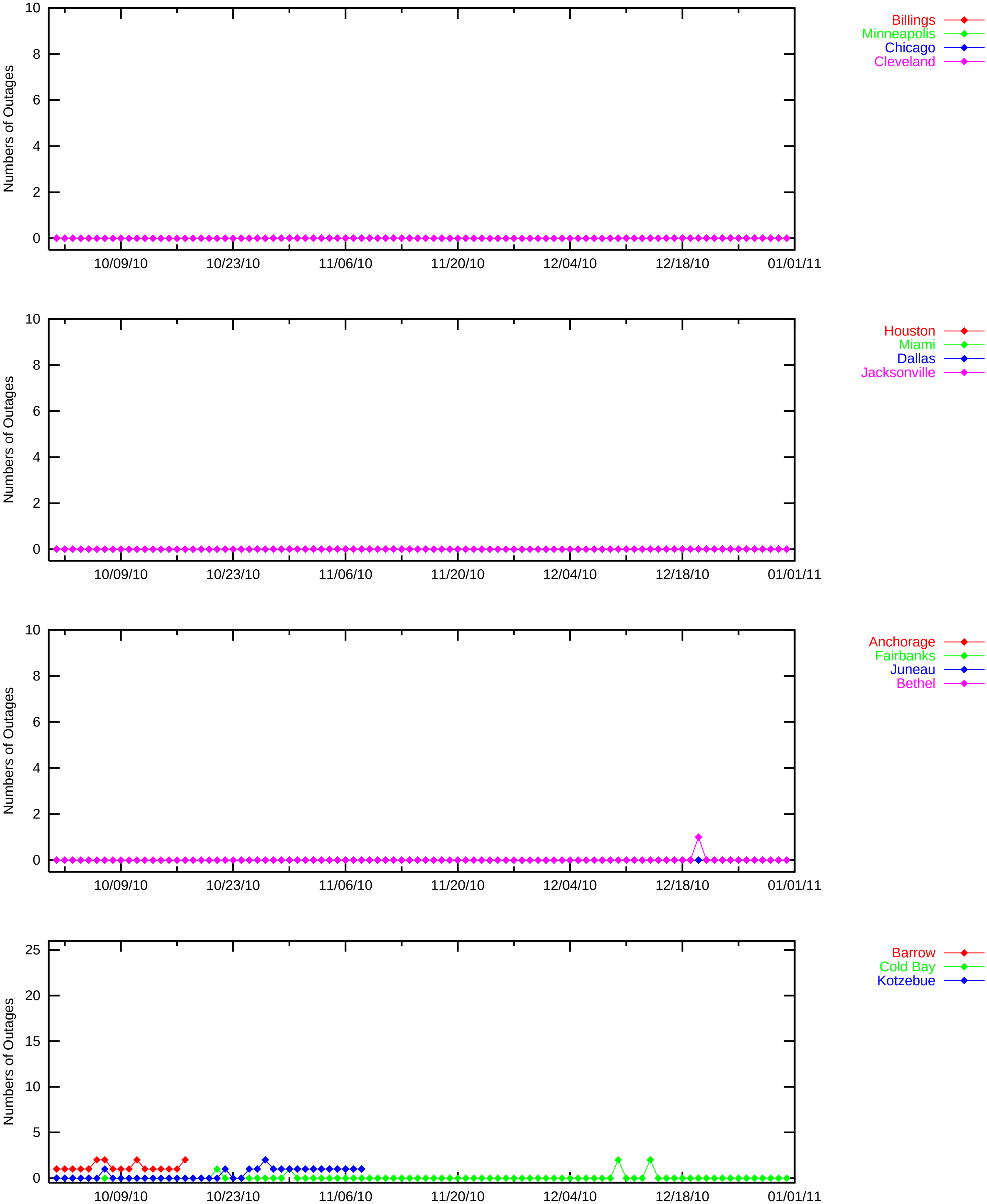


Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)

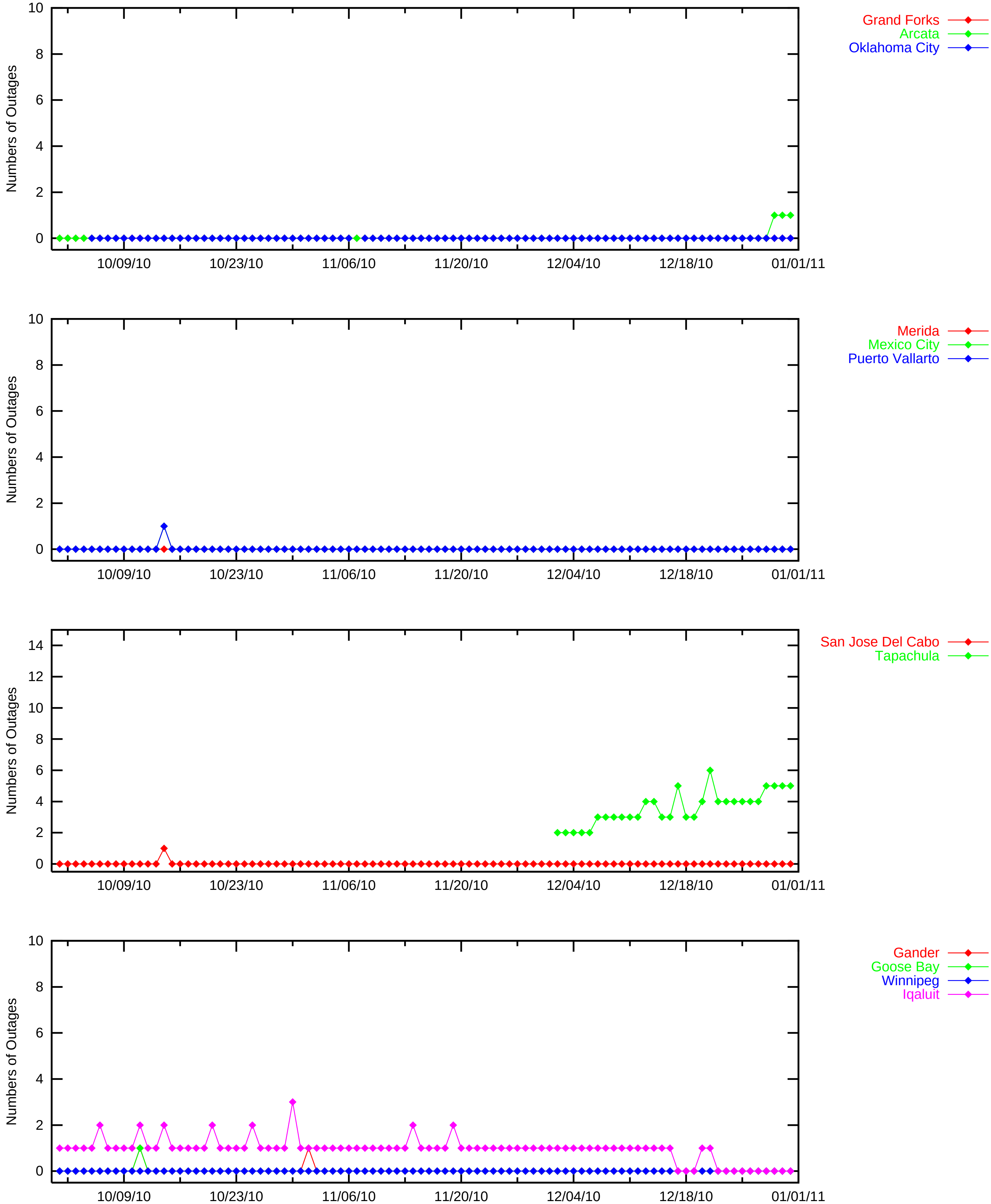


Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)

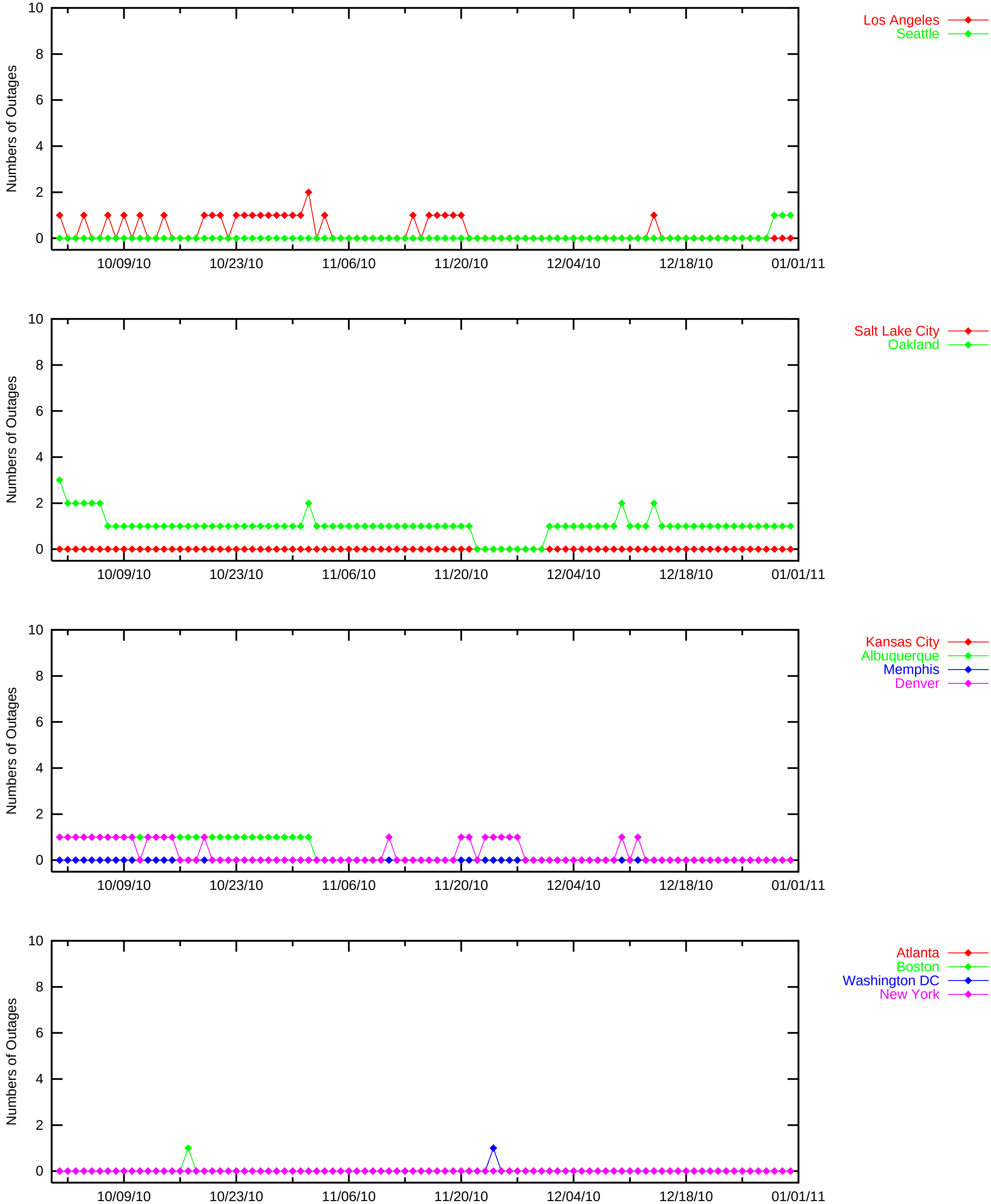


Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)

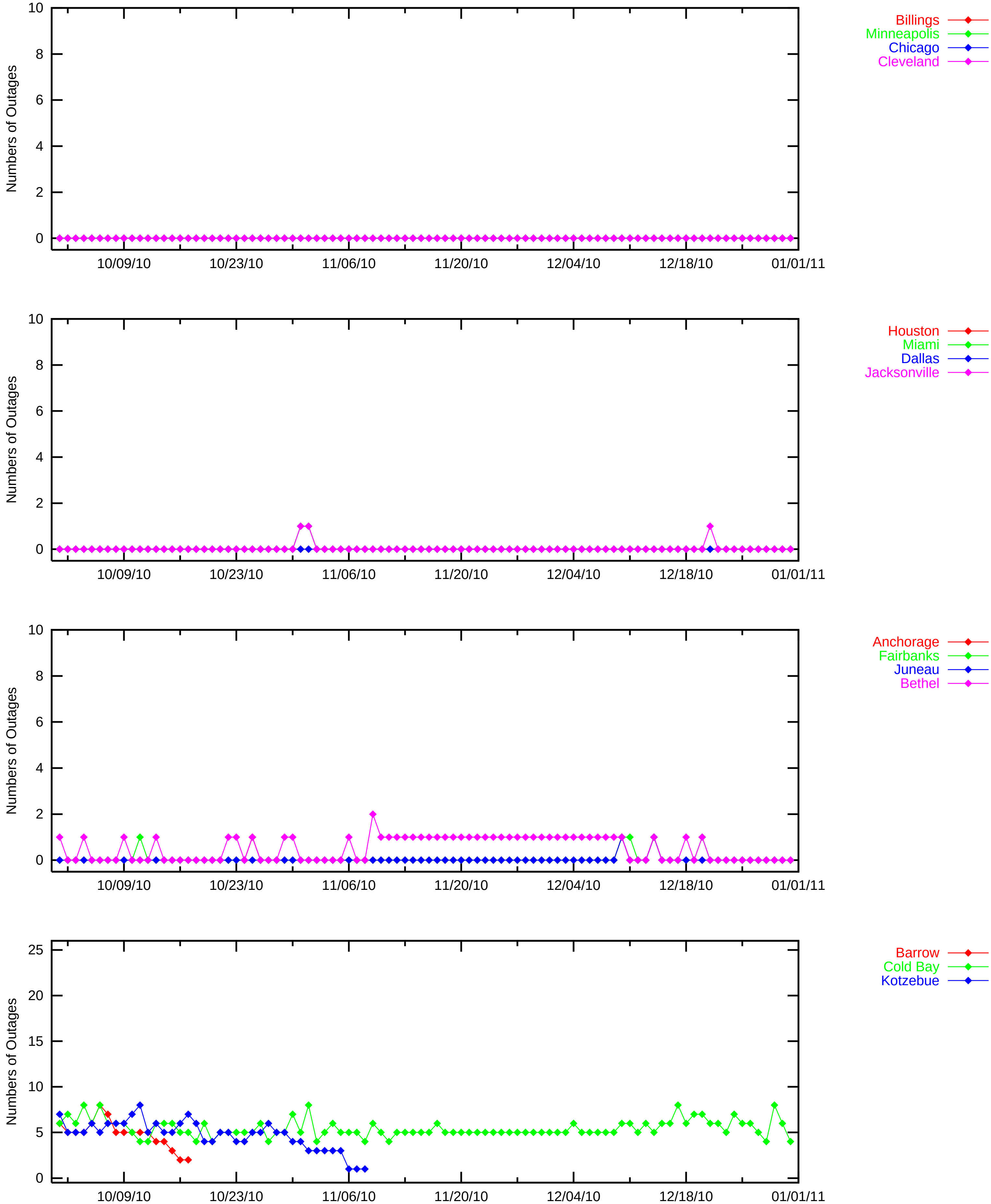
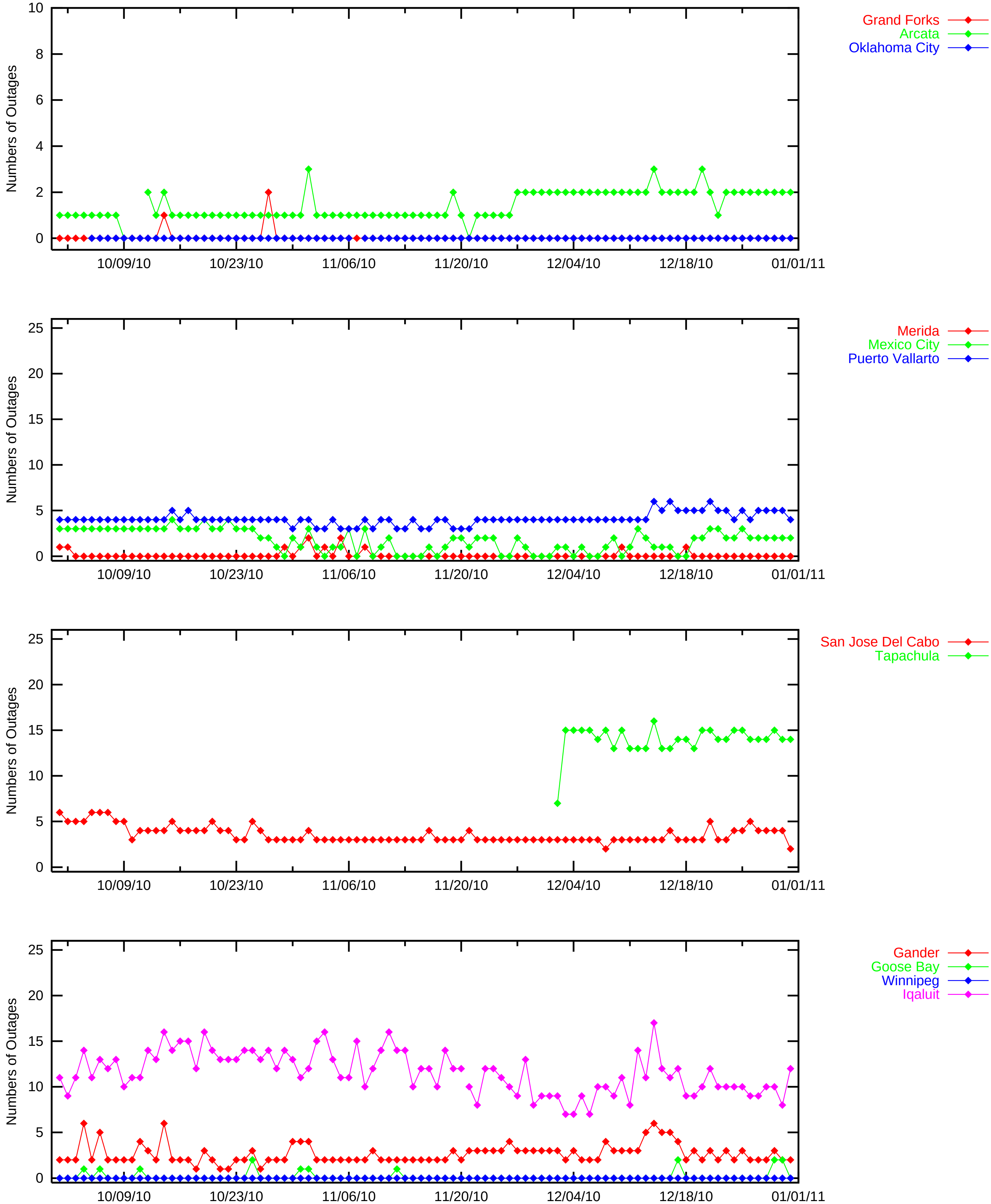


Figure 3-12 LPV 200 Outages (HAL = 40m & VAL=35m)



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. Significant Alaska LPV200 coverage reduction on 12/10/20 and 12/14/10 are due to PRN 32 out for service. Reduced Alaska coverage for the quarter is expected due to CRW GEO orbit drift. CRW was taken out of service on 12/16/2010 due to instability. This instability was expected at some point after CRW began drifting in April. CRW fell below the 5 degree elevation cutoff angle and was no longer tracked by the reference stations at Barrow on 10/18/10 and at Kotzebue on 11/9/10.

The AMR GEO satellite (PRN 133) came into service on November 11, 2011. This GEO does not provide a ranging service yet, though it is expected to provide NPA ranging service (UDRE => 50 meters) in a future upgrade to the WAAS.

Figure 4-1 LP North America Coverage for the Quarater

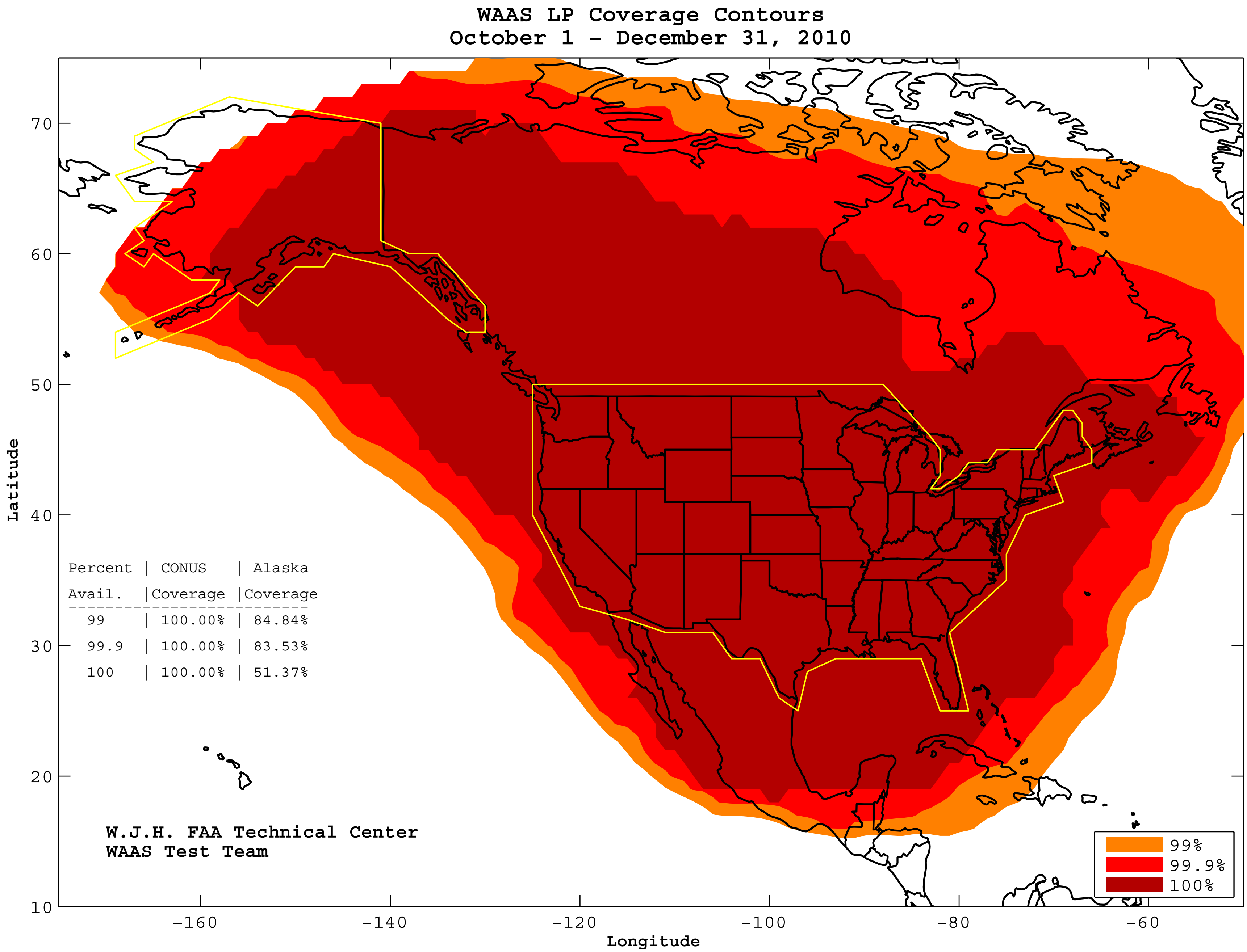


Figure 4-2 LPV North America Coverage for the Quarter

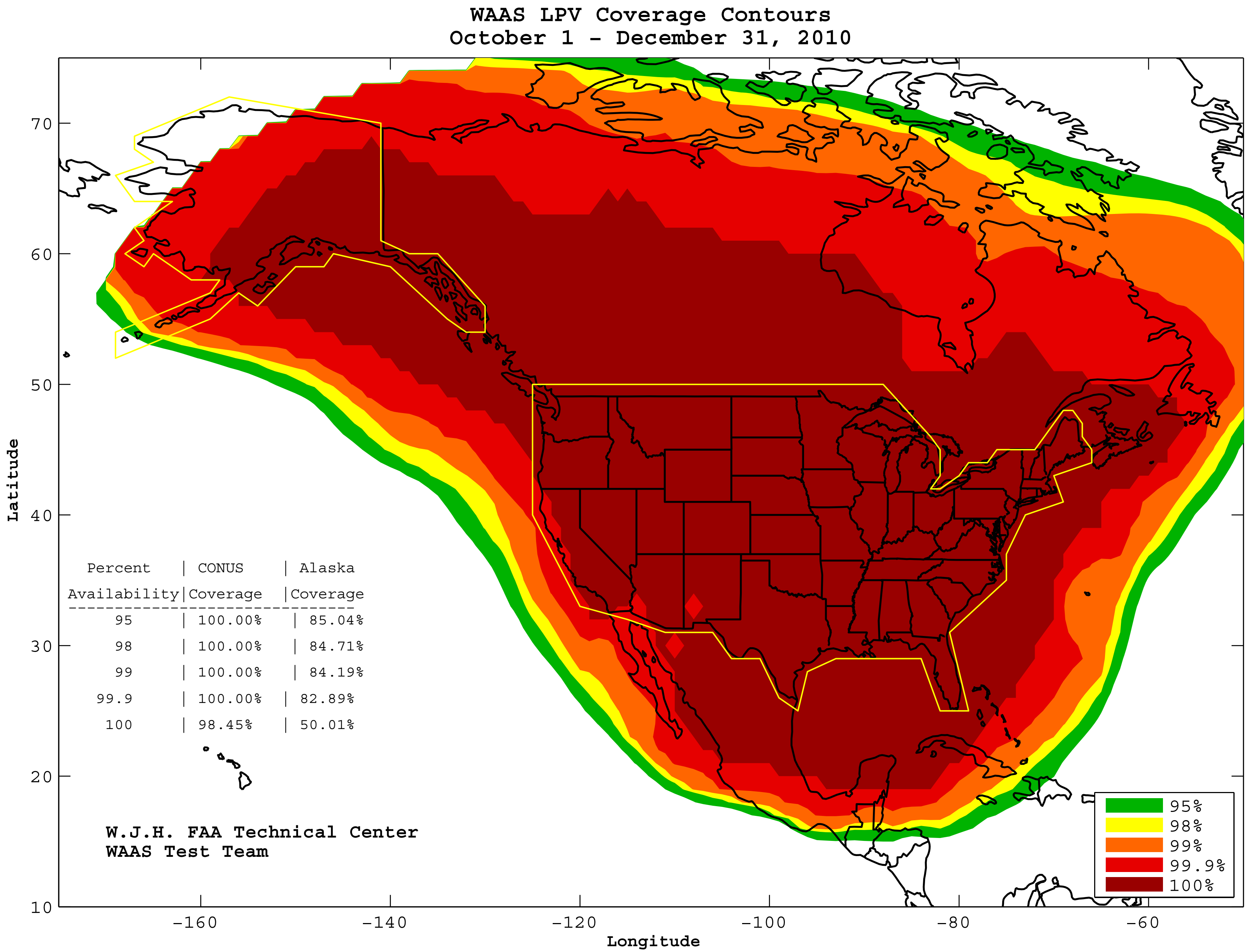


Figure 4-3 LPV 200 North America Coverage for the Quarter

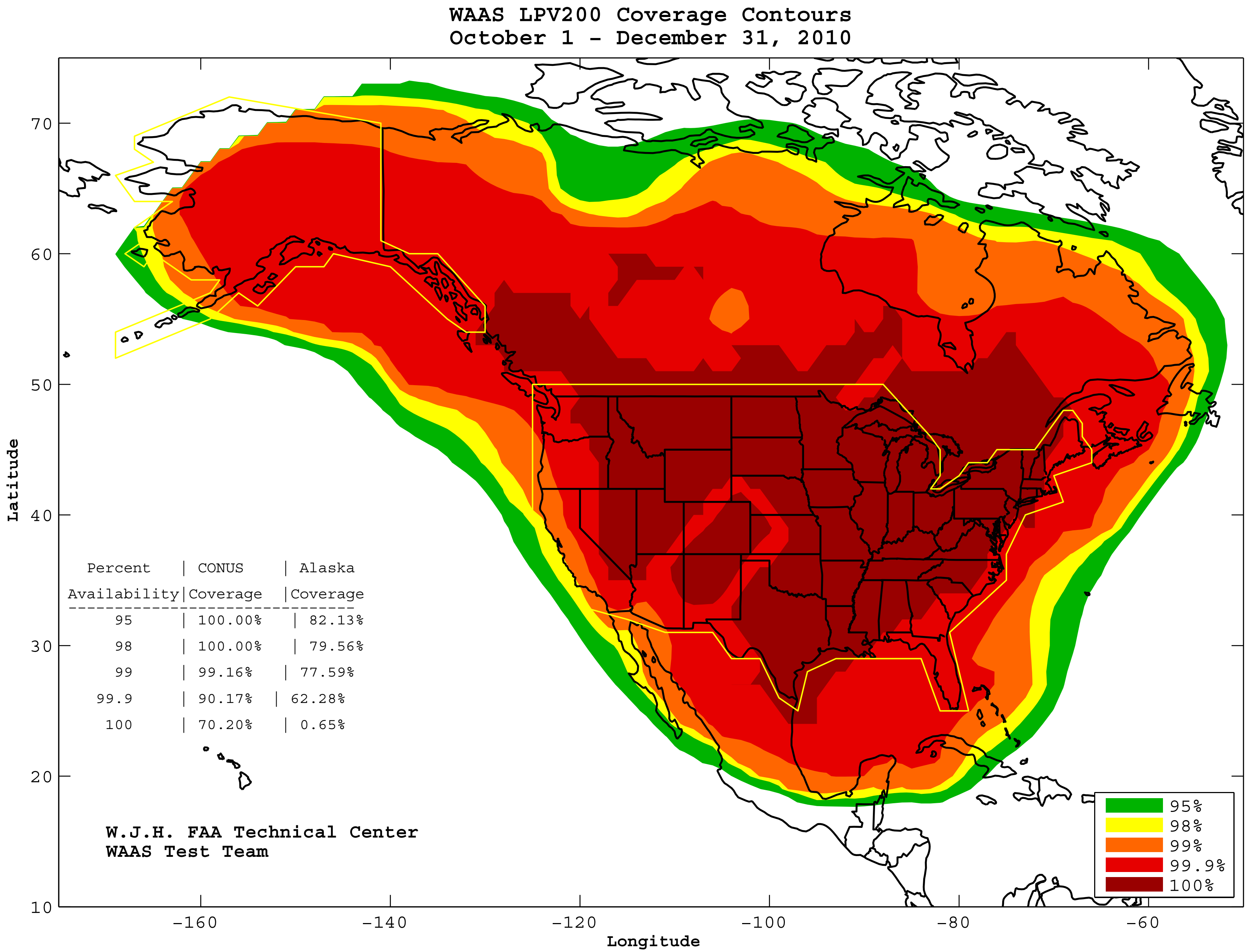


Figure 4-4 RNP 0.1 World Coverage for the Quarter

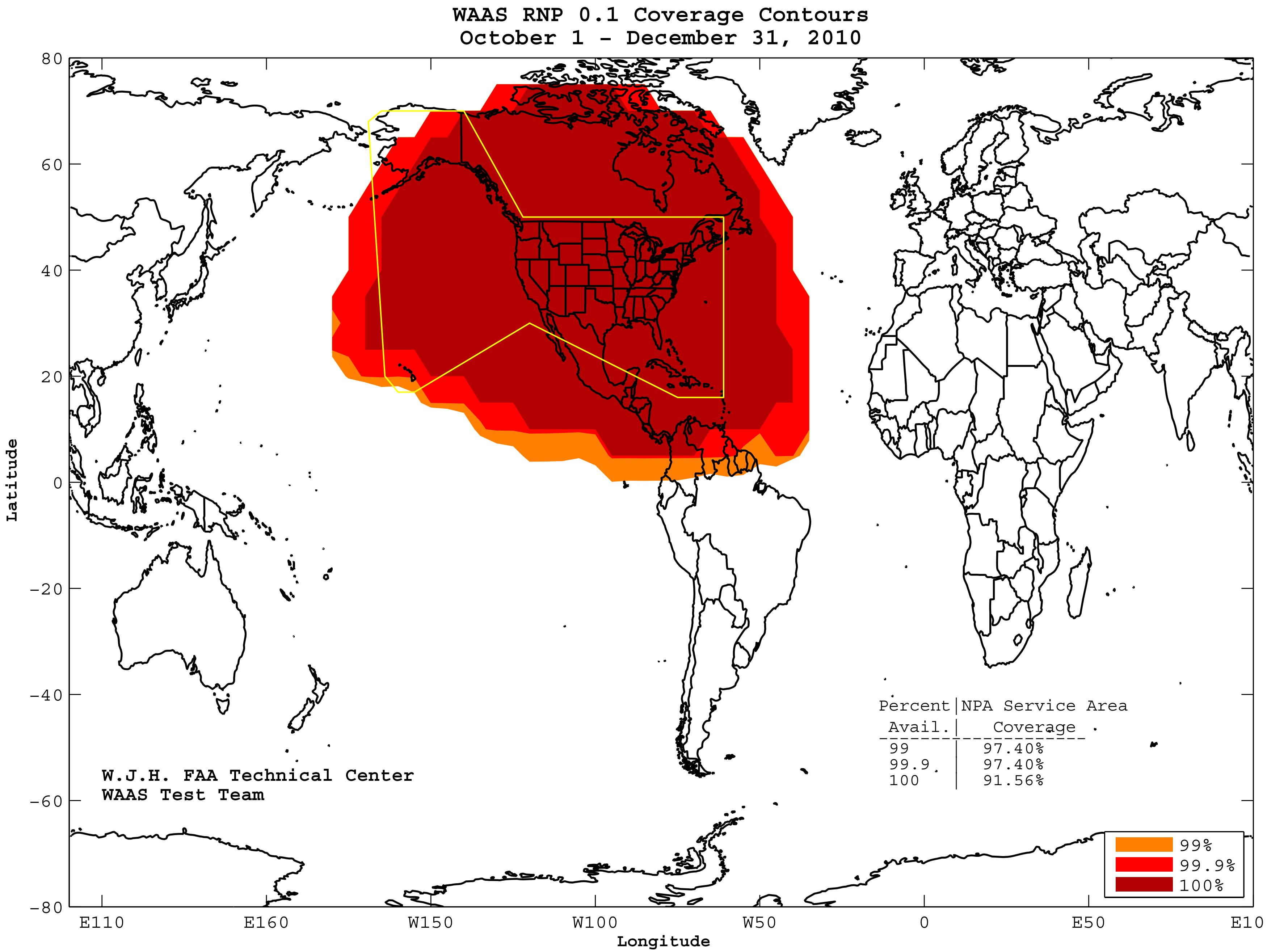


Figure 4-5 RNP 0.3 World Coverage for the Quarter

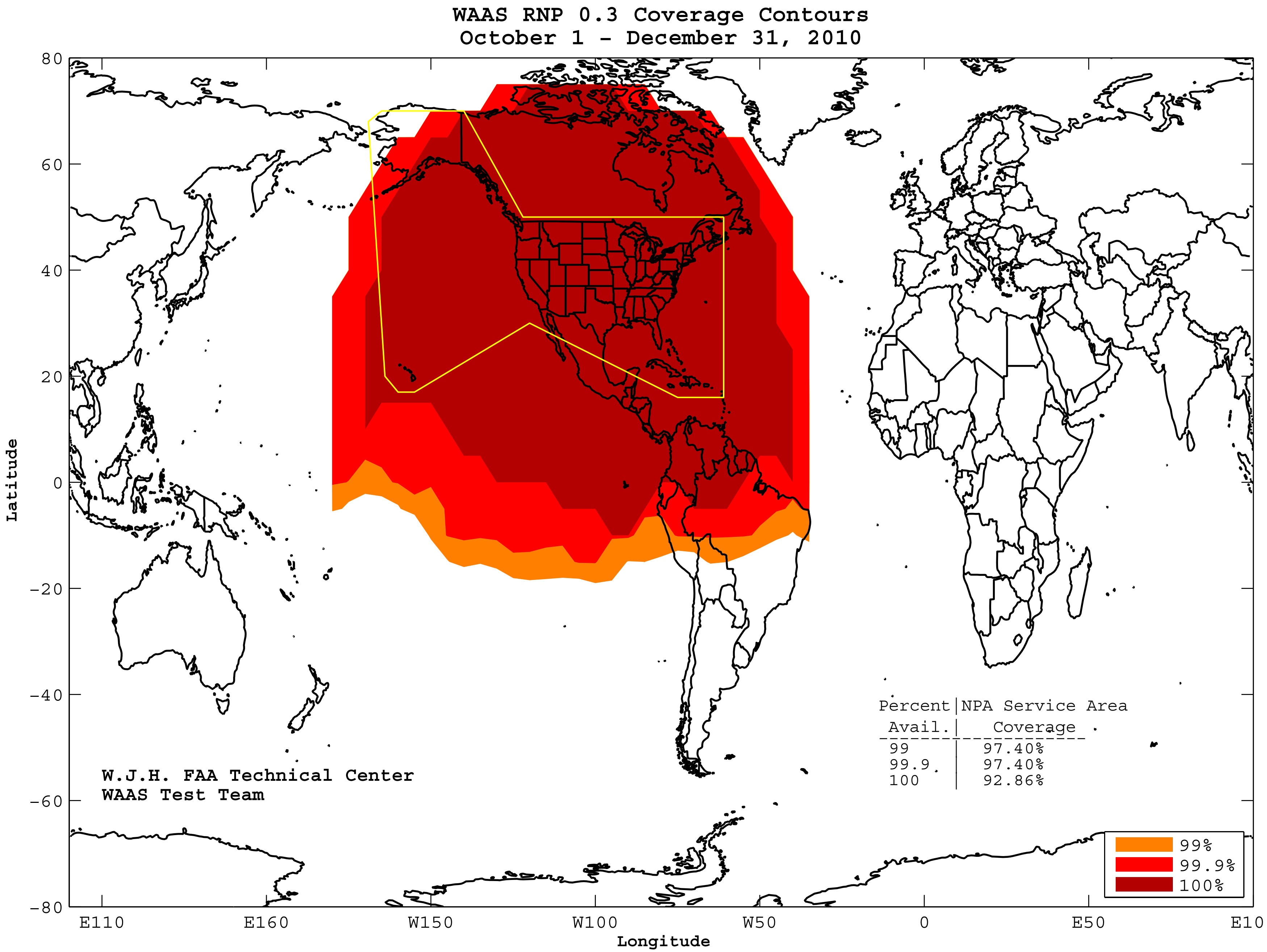


Figure 4-6 Daily LPV and LPV 200 CONUS Coverage

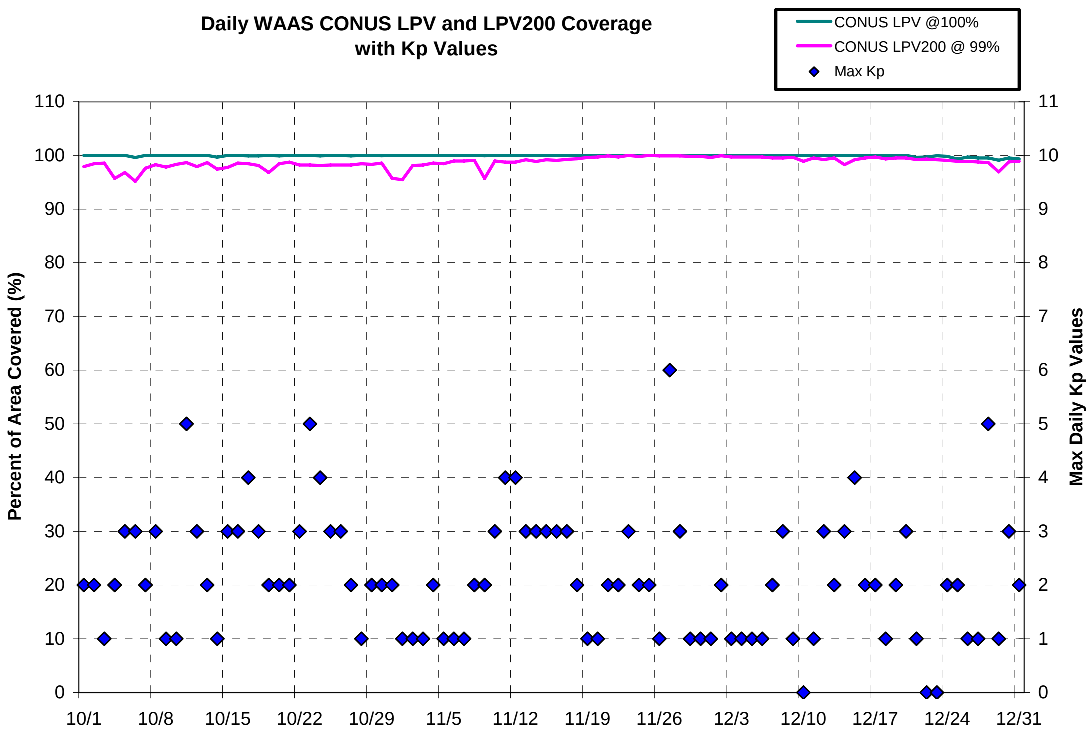


Figure 4-7 Daily LPV Alaska Coverage

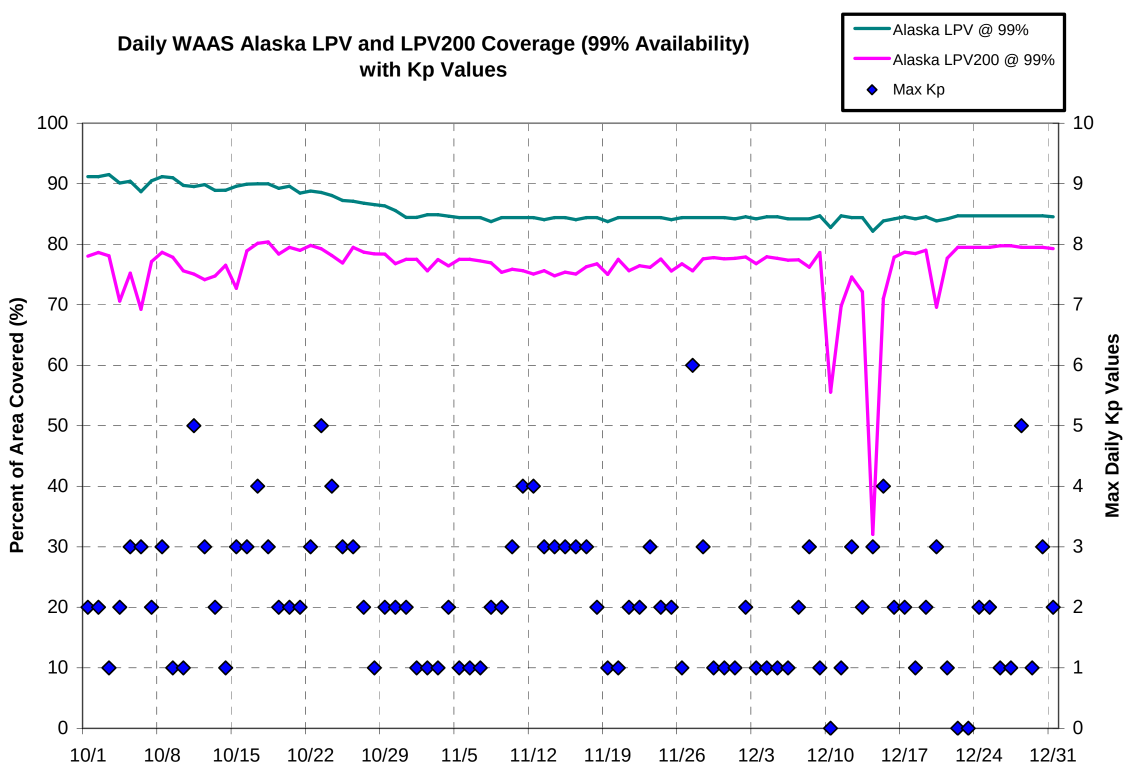
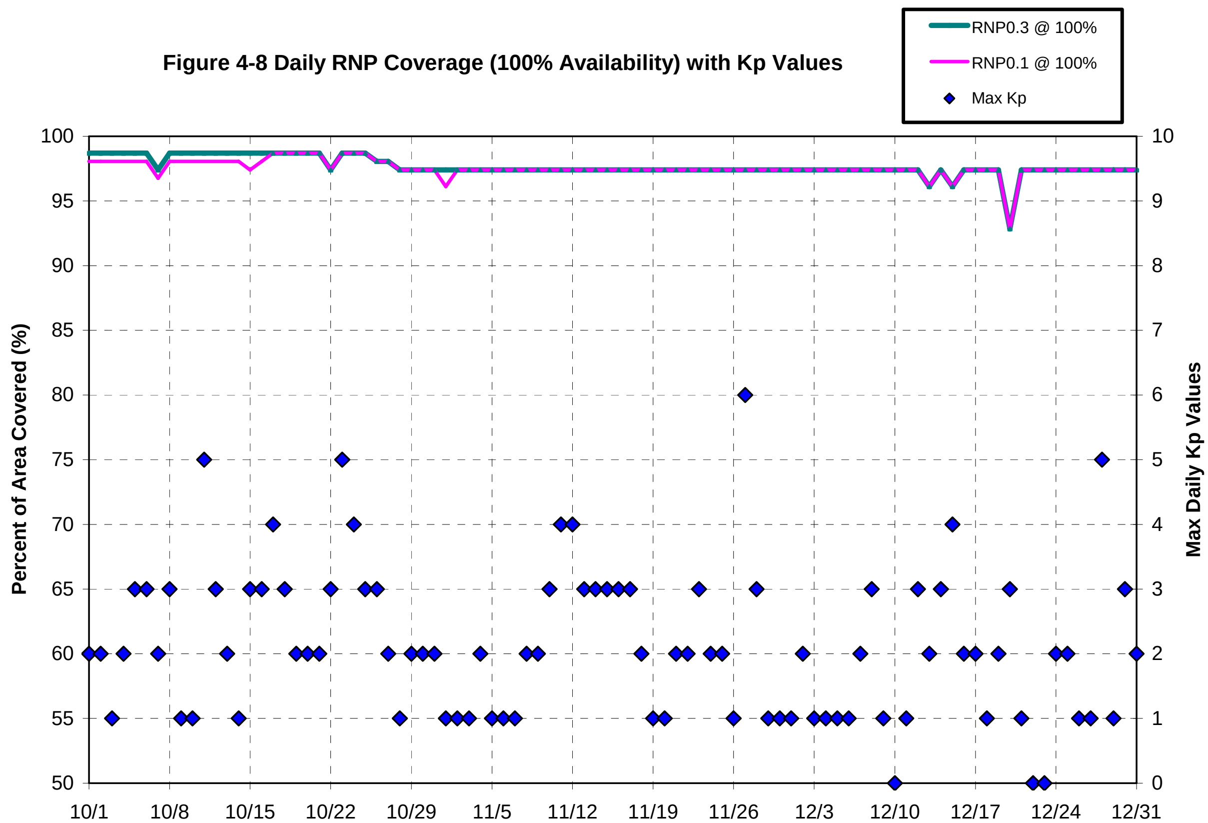


Figure 4-8 Daily RNP Coverage



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 3.29 at Fairbanks. There was no HMI event. Since WAAS was made available to the public in August 2000 there has not been an HMI event. WAAS was commissioned by the FAA for safety of life services in July 2003.

Table 5-1 Safety Margin Index and HMI Statistics

Location	Safety Index		
	Horizontal	Vertical	Number of HMIs
Arcata	7.47	6.24	0
Grand Forks	3.42	3.32	0
Oklahoma City	7.88	7.73	0
Albuquerque	12.14	4.92	0
Anchorage	7.45	7.85	0
Atlanta	7.87	8.05	0
Barrow	5.92	5.51	0
Bethel	11.35	13.07	0
Billings	5.53	7.38	0
Boston	9.27	8.09	0
Chicago	6.93	4.50	0
Cleveland	5.41	6.67	0
Cold Bay	12.17	10.15	0
Dallas	5.89	5.95	0
Denver	12.08	12.34	0
Fairbanks	4.43	3.29	0
Gander	17.66	11.32	0
Goose Bay	9.66	7.65	0
Houston	6.92	4.07	0
Iqaluit	10.10	5.84	0
Jacksonville	10.36	7.27	0
Juneau	6.21	7.47	0
Kansas City	7.07	5.65	0
Kotzebue	8.20	8.31	0
Los Angeles	7.77	6.75	0
Memphis	4.73	6.83	0
Merida	8.68	6.32	0
Mexico City	6.32	6.64	0
Miami	7.71	4.95	0
Minneapolis	6.21	9.50	0
New York	7.81	5.33	0
Oakland	4.68	6.87	0
Puerto Vallarta	6.06	10.10	0
Salt Lake City	5.80	5.12	0
San Jose Del Cabo	8.21	5.37	0
Seattle	3.50	7.37	0
Tapachula	9.51	4.98	0
Washington DC	7.36	11.18	0
Winnipeg	7.10	8.75	0

5.2 Broadcast Alerts

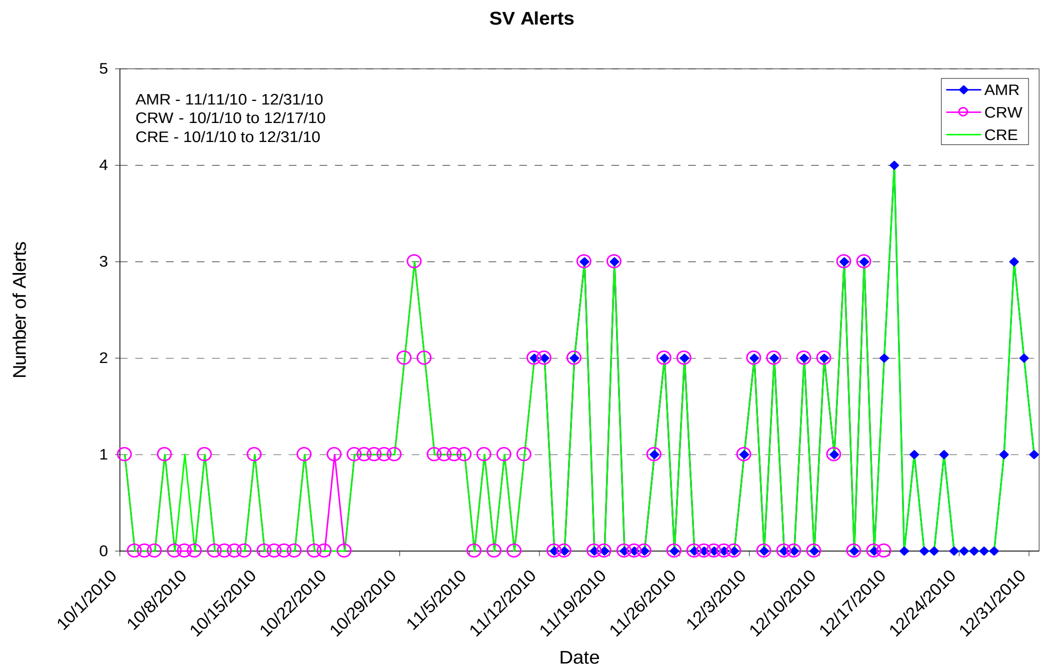
The WAAS transmits alert messages to protect the users from satellite degradation or severe ionospheric activity, both of which can cause unsafe conditions for a user. Space Vehicle (SV) alerts increase the User Differential Range Error (UDRE) of satellites, which can reduce the weighting of the satellite 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.

For this reporting period, CRW was voluntarily taken out of service on 12/16/10 due to instability of orbit drift. AMR GEO came into operational service on 11/11/2010.

Table 5-2 WAAS SV Alert

	Number of Alerts			Average Alerts Per Day		
Message Type	**AMR**	**CRW**	**CRE**	**AMR**	**CRW**	**CRE**
2	12	5	17	0.2353	0.0649	0.1848
3	18	8	22	0.3529	0.1039	0.2391
4	18	16	34	0.3529	0.2078	0.3696
5	0	0	0	0.0000	0.0000	0.0000
6	0	0	0	0.0000	0.0000	0.0000
24	0	0	0	0.0000	0.0000	0.0000
26	0	0	0	0.0000	0.0000	0.0000
Total Alerts	48	29	73	0.9412	0.3766	0.7935
Days in Service	51	77	92			

Figure 5-1 SV Daily Alert Trends



5.3 Availability of WAAS Messages (CRE , CRW, and AMR)

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 AMR. Table 5.9 to 5.13 show message rates statistics broadcasted on CRW. Table 5.14 to 5.18 show message rates statistics 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 – AMR

Message Type	On Time	Late	Max Late Length (seconds)
1	58694	3	277
2	732173	27	204
3	734352	23	204
4	734351	25	204
7	54206	7	306
9	51629	3	276
10	54215	8	299
17	17479	2	514

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

SV	On Time	Late	Max Late Length (seconds)
2	26736	2	335
3	28566	2	346
4	26963	2	346
5	27338	0	0
6	29018	2	264
7	26832	1	330
8	26726	0	0
9	28026	0	0
10	28333	2	349
11	29083	1	240
12	27404	0	0
13	26770	2	346
14	26969	2	343
15	27794	1	151
16	27495	2	263
17	26808	0	0
18	26856	0	0
19	28693	0	0
20	28275	2	264
21	26795	0	0
22	27405	0	0
23	26496	2	330
24	28857	1	334
25	28762	2	349
26	27887	0	0
27	29189	0	0
28	27418	0	0
29	26925	2	343
30	28194	2	266
31	27139	2	263
32	26616	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	21958	2	312
3	23453	2	314
4	22135	2	312
5	22437	0	0
6	23834	2	312
7	22007	1	312
8	21967	0	0
9	23022	0	0
10	23279	2	314
11	23910	1	312
12	22516	0	0
13	21978	2	312
14	22168	2	312
15	22835	0	0
16	22565	2	312
17	22024	0	0
18	22001	0	0
19	23487	1	205
20	23219	2	312
21	21996	2	205
22	22513	1	224
23	21752	2	312
24	23714	1	312
25	23601	2	312
26	22887	1	210
27	23987	1	210
28	22508	1	205
29	22159	2	312
30	23173	2	312
31	22266	2	312
32	21830	0	0
135	14223	1	312
138	41668	2	312

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	15296	3	576
0	1	15300	3	576
0	2	15301	2	576
1	0	15292	3	576
1	1	15297	2	576
1	2	15291	4	576
1	3	15304	3	576
1	4	15293	5	576
2	0	15298	5	576
2	1	15282	9	576
2	2	15290	9	576
2	3	15287	8	576
2	4	15296	4	576
2	5	15298	5	576
3	0	15296	3	576
3	1	15298	5	576
3	2	15295	4	576
9	0	15294	1	576
9	1	15301	2	576
9	2	15295	4	576
9	3	15296	6	576
9	4	15287	7	576
9	5	15293	5	576
9	6	15296	3	576

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

Band	On Time	Late	Max Late Length (seconds)
0	19886	1	479
1	19858	2	424
2	19879	2	479
3	19853	2	466
9	19889	2	456

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

Message Type	On Time	Late	Max Late Length (seconds)
1	51155	0	0
2	633567	24	31
3	633582	22	27
4	633619	16	26
7	47509	4	136
9	44547	0	0
10	47496	7	196
17	15112	1	377

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

SV	On Time	Late	Max Late Length (seconds)
2	23233	0	0
3	24576	0	0
4	23411	1	183
5	23693	0	0
6	24987	0	0
7	23179	0	0
8	23037	0	0
9	24053	0	0
10	24462	0	0
11	24687	0	0
12	23762	0	0
13	23177	0	0
14	23124	1	187
15	24194	0	0
16	23753	0	0
17	23129	0	0
18	23180	0	0
19	24534	0	0
20	24329	1	179
21	23018	0	0
22	22609	0	0
23	22932	0	0
24	24816	0	0
25	24918	0	0
26	24032	0	0
27	25275	0	0
28	23539	0	0
29	23265	1	187
30	24538	1	166
31	23627	0	0
32	23461	0	0

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

SV	On Time	Late	Max Late Length (seconds)
2	19059	0	0
3	20191	0	0
4	19227	1	121
5	19402	0	0
6	20529	0	0
7	19004	0	0
8	18920	0	0
9	19778	0	0
10	20081	0	0
11	20290	1	160
12	19531	0	0
13	19028	1	212
14	19002	0	0
15	19847	0	0
16	19486	2	211
17	19002	0	0
18	19007	1	211
19	20127	1	174
20	19984	0	0
21	18919	1	164
22	18566	1	148
23	18824	1	121
24	20378	0	0
25	20451	0	0
26	19746	2	178
27	20783	0	0
28	19316	0	0
29	19143	0	0
30	20190	1	212
31	19390	0	0
32	19258	0	0
135	36267	0	0
138	35918	0	0

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

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	13191	2	303
0	1	13197	4	308
0	2	13197	4	305
1	0	13195	2	304
1	1	13195	2	303
1	2	13191	6	306
1	3	13185	4	304
1	4	13195	6	306
2	0	13185	7	501
2	1	13183	6	505
2	2	13198	3	494
2	3	13196	1	493
2	4	13195	2	497
2	5	13190	3	488
3	0	13198	3	470
3	1	13186	3	473
3	2	13189	4	469
9	0	13206	0	0
9	1	13197	1	301
9	2	13191	2	301
9	3	13199	2	303
9	4	13194	3	301
9	5	13186	6	508
9	6	13190	2	511

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

Band	On Time	Late	Max Late Length (seconds)
0	17210	0	0
1	17194	1	364
2	17191	1	314
3	17216	0	0
9	17218	0	0

Table 5-14 WAAS Fast Correction and Degradation Message Rates – CRE

Message Type	On Time	Late	Max Late Length (seconds)
1	105310	3	159
2	1324763	46	33
3	1324781	47	28
4	1324834	36	26
7	97817	10	146
9	93147	0	0
10	97954	9	134
17	31476	3	447

Table 5-15 WAAS Long Correction Message Rates (Type 24 and 25) – CRE

SV	On Time	Late	Max Late Length (seconds)
2	48404	2	170
3	51466	0	0
4	48796	0	0
5	49430	0	0
6	52300	1	134
7	48438	0	0
8	48194	0	0
9	50425	0	0
10	51140	0	0
11	52074	0	0
12	49562	0	0
13	48378	1	160
14	48520	1	170
15	50349	0	0
16	49631	1	128
17	48365	0	0
18	48468	0	0
19	51563	1	171
20	50946	1	171
21	48249	1	134
22	48382	0	0
23	47874	0	0
24	51974	0	0
25	51990	0	0
26	50261	1	139
27	52721	0	0
28	49341	1	160
29	48618	1	170
30	51071	0	0
31	49181	0	0
32	48492	1	170

Table 5-16 WAAS Ephemeris Covariance Message Rates (Type 28) – CRE

SV	On Time	Late	Max Late Length (seconds)
2	39715	1	208
3	42279	3	160
4	40069	0	0
5	40523	1	179
6	42975	2	208
7	39729	1	125
8	39602	3	192
9	41436	2	149
10	41994	1	179
11	42812	0	0
12	40758	0	0
13	39717	1	161
14	39878	1	123
15	41317	0	0
16	40732	0	0
17	39734	1	159
18	39711	1	194
19	42249	2	207
20	41842	2	159
21	39640	4	196
22	39752	2	160
23	39315	1	147
24	42692	1	129
25	42654	3	203
26	41274	2	176
27	43347	0	0
28	40505	1	192
29	39984	1	135
30	42004	1	184
31	40338	2	203
32	39791	0	0
135	47640	1	160
138	75447	3	160

Table 5-17 WAAS Ionospheric Correction Message Rates (Type 26) – CRE

Band	Block	On Time	Late	Max Late Length (seconds)
0	0	27580	9	577
0	1	27598	8	339
0	2	27595	7	342
1	0	27586	8	320
1	1	27584	6	327
1	2	27590	8	561
1	3	27602	4	456
1	4	27579	7	452
2	0	27595	7	446
2	1	27588	6	446
2	2	27580	6	462
2	3	27601	10	457
2	4	27585	8	545
2	5	27596	9	540
3	0	27592	9	536
3	1	27585	8	521
3	2	27594	4	432
9	0	27585	5	431
9	1	27585	5	422
9	2	27605	6	427
9	3	27596	4	312
9	4	27594	6	308
9	5	27584	11	304
9	6	27589	6	315

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

Band	On Time	Late	Max Late Length (seconds)
0	35732	3	429
1	35790	0	0
2	35791	0	0
3	35735	0	0
9	35771	1	411

6.0 SV RANGE ACCURACY

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

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

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

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

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

Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)	95% Range Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.387	100	1.322	100	2.033	100	1.765	100	2.358	100	1.803	100
3	0.959	100	1.378	100	1.032	100	0.967	100	1.042	100	1.083	100
4	1.978	100	1.755	100	0.973	100	1.098	100	1.266	100	1.391	100
5	1.897	100	1.527	100	0.997	100	0.951	100	1.057	100	1.325	100
6	1.323	100	1.227	100	1.076	100	0.994	100	1.137	100	0.996	100
7	1.051	100	1.206	100	0.817	100	1.019	100	0.908	100	0.916	100
8	0.992	100	0.954	100	0.896	100	0.873	100	1.350	100	0.994	100
9	1.051	100	1.162	100	0.817	100	1.374	100	0.978	100	0.961	100
10	0.746	100	1.014	100	1.169	100	1.154	100	1.277	100	0.866	100
11	0.917	100	1.028	100	1.049	100	0.897	100	1.255	100	1.010	100
12	1.017	100	1.135	100	1.282	100	1.386	100	1.242	100	0.866	100
13	1.306	100	0.970	100	1.068	100	1.039	100	1.023	100	1.090	100
14	1.967	100	0.721	100	0.932	100	1.103	100	1.537	100	0.888	100
15	1.170	100	1.605	100	0.891	100	1.047	100	1.062	100	1.263	100
16	1.186	100	1.150	100	1.629	100	1.391	100	1.676	100	1.265	100
17	1.143	100	1.146	100	1.402	100	0.990	100	0.979	100	0.701	100
18	0.991	100	1.173	100	1.716	100	1.394	100	2.117	100	1.253	100
19	2.328	100	1.962	100	2.103	100	2.216	100	2.621	100	2.291	100
20	0.916	100	1.174	100	1.406	100	1.141	100	2.040	100	1.389	100
21	1.321	100	1.318	100	1.387	100	1.301	100	1.547	100	1.765	100
22	1.671	100	2.030	100	2.422	100	2.349	100	2.418	100	2.269	100
23	1.567	100	1.786	100	2.145	100	2.026	100	2.715	100	2.004	100
24	1.655	100	1.688	100	1.543	100	1.596	100	1.324	100	1.719	100
25	2.363	100	2.183	100	1.792	100	2.215	100	3.007	100	2.127	100
26	1.319	100	1.541	100	1.121	100	1.744	100	1.775	100	1.070	100
27	1.248	100	1.525	100	1.206	100	1.320	100	1.459	100	0.883	100
28	0.724	100	0.850	100	1.300	100	0.908	100	1.881	100	0.815	100
29	1.562	100	1.563	100	0.813	100	1.016	100	1.008	100	0.909	100
30	1.548	100	1.673	100	1.200	100	1.425	100	1.360	100	1.246	100
31	1.733	100	1.198	100	0.775	100	0.804	100	1.218	100	1.236	100
32	1.135	100	1.013	100	0.901	100	0.827	100	1.274	100	0.978	100
135	1.560	100	0.599	100	1.473	100	0.828	100	0.877	100	1.011	100
138	1.420	100	1.416	100	1.487	100	1.718	100	1.917	100	1.356	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	1.906	100	1.703	100	1.881	100	1.574	100	1.321	100	1.565	100
3	1.251	100	0.952	100	1.034	100	1.892	100	1.379	100	1.356	100
4	1.421	100	1.746	100	2.179	100	1.317	100	1.802	100	1.421	100
5	1.155	100	1.441	100	0.840	100	1.530	100	1.535	100	1.269	100
6	0.907	100	1.314	100	1.000	100	1.080	100	1.750	100	1.169	100
7	1.030	100	0.871	100	1.565	100	1.128	100	1.510	100	1.135	100
8	0.865	100	0.609	100	1.014	100	1.093	100	1.201	100	1.000	100
9	0.848	100	1.120	100	0.978	100	0.968	100	1.574	100	1.087	100
10	1.199	100	1.051	100	1.309	100	0.797	100	0.981	100	0.791	100
11	1.454	100	0.971	100	1.106	100	1.016	100	0.950	100	0.965	100
12	0.899	100	1.086	100	1.139	100	1.552	100	1.674	100	0.929	100
13	0.885	100	2.331	100	1.006	100	0.903	100	1.433	100	1.156	100
14	0.872	100	1.014	100	1.506	100	0.737	100	0.945	100	0.736	100
15	1.368	100	1.151	100	0.947	100	1.410	100	1.524	100	1.395	100
16	1.303	100	0.992	100	1.568	100	1.136	100	1.196	100	0.879	100
17	0.807	100	1.698	100	0.976	100	1.032	100	1.226	100	0.972	100
18	1.206	100	1.560	100	1.788	100	1.159	100	1.352	100	1.345	100
19	2.603	100	2.296	100	2.439	100	2.002	100	1.962	100	2.052	100
20	1.195	100	1.253	100	1.304	100	1.065	100	1.146	100	0.888	100
21	1.240	100	1.035	100	2.667	100	1.057	100	1.266	100	1.141	100
22	2.084	100	2.137	100	2.721	99.9994	2.235	100	2.060	100	1.929	100
23	1.964	100	1.739	100	2.166	100	1.524	100	1.716	100	1.515	100
24	1.423	100	1.547	100	1.544	100	1.847	100	2.182	100	1.525	100
25	1.990	100	1.923	100	2.546	100	2.069	100	2.660	100	2.197	100
26	2.078	100	1.250	100	1.091	100	1.737	100	1.914	100	1.210	100
27	1.145	100	1.335	100	1.520	100	1.594	100	1.639	100	1.028	100
28	0.942	100	1.019	100	1.880	100	0.803	100	0.925	100	0.843	100
29	0.863	100	2.187	100	1.307	100	1.141	100	1.328	100	1.254	100
30	1.247	100	1.415	100	1.164	100	1.497	100	1.910	100	1.457	100
31	0.931	100	0.868	100	2.227	100	0.827	100	1.063	100	0.961	100
32	0.775	100	1.134	100	1.112	100	1.035	100	1.237	100	0.969	100
135	1.258	100	3.266	100	1.287	100	0.687	100	1.107	100	0.610	100
138	1.995	100	1.806	100	2.507	100	1.726	100	1.567	100	1.849	100

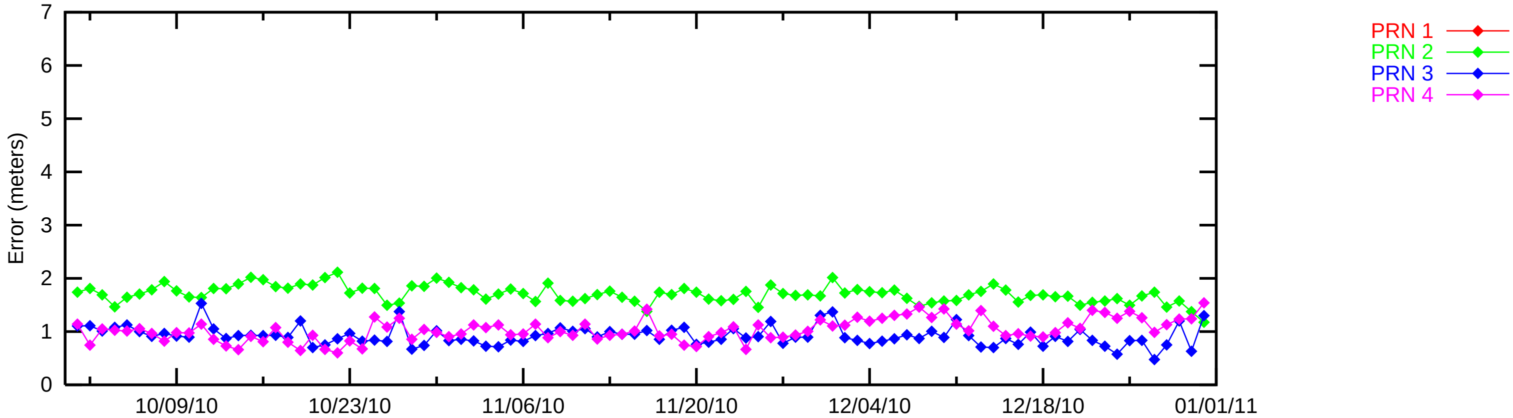
Table 6-3 Ionospheric Error 95% index and 3.29 Sigma Bounding

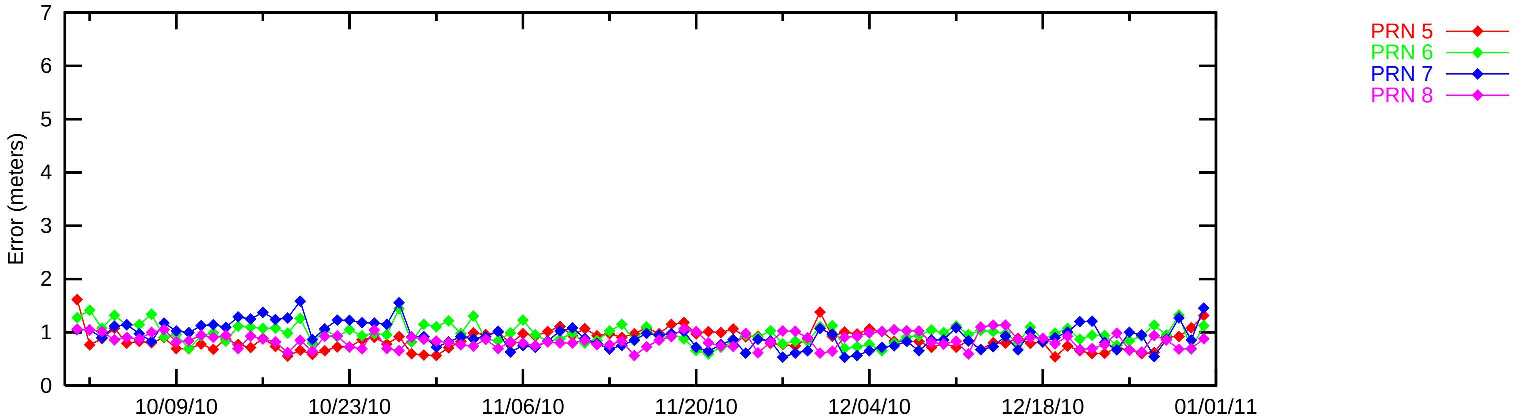
Site →	Billings		Albuquerque		Boston		Washington DC		Houston		Kansas City	
SV ↓	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)	95% Iono Error	3.29 Sigma Bounding(%)
1	-	-	-	-	-	-	-	-	-	-	-	-
2	1.085	100	0.749	100	1.231	100	1.086	100	1.180	100	1.120	100
3	0.429	100	0.729	100	0.596	100	0.531	100	0.761	100	0.601	100
4	1.261	100	1.207	100	0.784	100	0.950	100	1.138	100	1.034	100
5	1.075	100	1.038	100	0.639	100	0.706	100	0.954	100	1.032	100
6	0.672	100	0.684	100	0.646	100	0.444	100	0.742	100	0.440	100
7	0.597	100	0.788	100	0.478	100	0.688	100	0.540	100	0.580	100
8	0.471	100	0.527	100	0.597	100	0.514	100	0.615	100	0.495	100
9	0.495	100	0.605	100	0.464	100	0.691	100	0.652	100	0.541	100
10	0.466	100	0.471	100	0.424	100	0.401	100	0.498	100	0.404	100
11	0.540	100	0.450	100	0.471	100	0.423	100	0.592	100	0.549	100
12	0.428	100	0.619	100	0.617	100	0.662	100	0.585	100	0.424	100
13	0.687	100	0.738	100	0.528	100	0.575	100	0.596	100	0.591	100
14	1.244	100	0.463	100	0.583	100	0.474	100	0.615	100	0.370	100
15	0.561	100	0.936	100	0.517	100	0.791	100	0.877	100	0.794	100
16	0.772	100	0.496	100	0.593	100	0.554	100	0.864	100	0.596	100
17	0.596	100	0.714	100	0.987	100	0.639	100	0.581	100	0.485	100
18	0.784	100	0.547	100	1.059	100	0.812	100	0.979	100	0.742	100
19	1.586	100	1.310	100	1.463	100	1.472	100	1.948	100	1.604	100
20	0.679	100	0.524	100	0.737	100	0.523	100	0.838	100	0.695	100
21	0.882	100	0.615	100	1.066	100	0.779	100	0.800	100	1.043	100
22	1.457	100	1.322	100	1.682	100	1.566	100	1.444	100	1.541	100
23	1.332	100	1.155	100	1.619	100	1.589	100	1.721	100	1.302	100
24	0.853	100	1.104	100	0.961	100	0.872	100	0.843	100	0.863	100
25	1.274	100	1.412	100	1.193	100	1.388	100	1.733	100	1.174	100
26	0.717	100	0.887	100	0.673	100	0.889	100	0.916	100	0.608	100
27	0.673	100	0.773	100	0.667	100	0.700	100	0.582	100	0.502	100
28	0.670	100	0.400	100	0.844	100	0.392	100	0.765	100	0.554	100
29	0.741	100	1.031	100	0.569	100	0.593	100	0.750	100	0.656	100
30	0.688	100	0.940	100	0.728	100	0.690	100	0.784	100	0.655	100
31	1.189	100	0.833	100	0.364	100	0.714	100	0.829	100	0.606	100
32	0.672	100	0.741	100	0.514	100	0.468	100	0.480	100	0.579	100

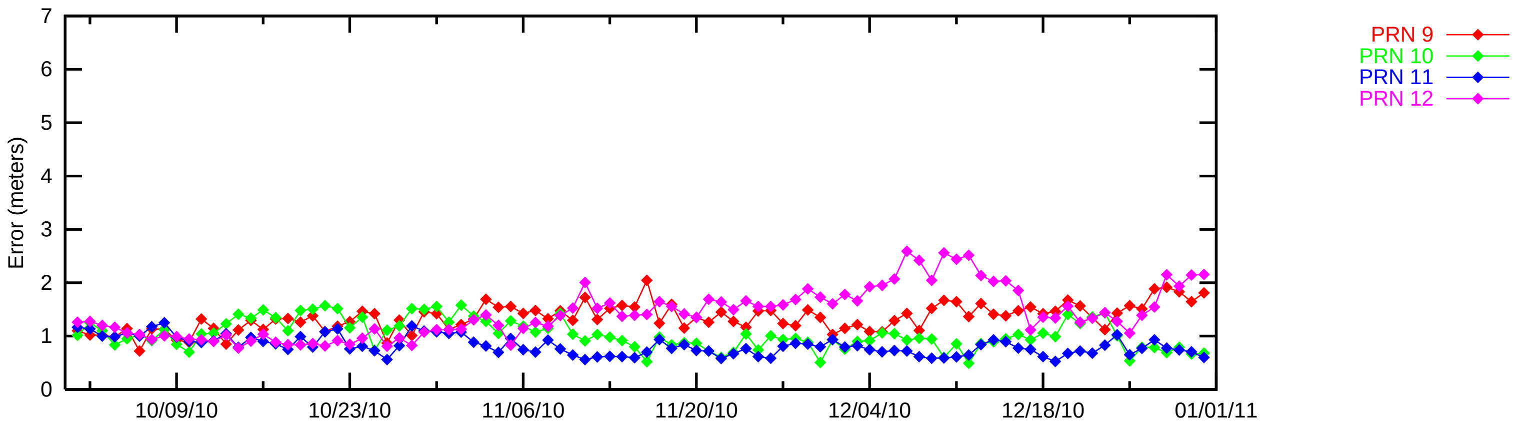
Table 6-4 Ionospheric Error 95% index and 3.29 Sigma Bounding

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	1.090	100	1.177	100	0.839	100	1.037	100	0.613	100	1.126	100
3	0.628	100	0.462	100	0.732	100	0.760	100	0.881	100	0.562	100
4	0.875	100	1.031	100	1.469	100	0.928	100	1.453	100	0.908	100
5	0.728	100	0.837	100	0.965	100	0.756	100	1.237	100	0.785	100
6	0.491	100	0.578	100	0.585	100	0.580	100	1.013	100	0.571	100
7	0.733	100	0.477	100	0.893	100	0.630	100	1.138	100	0.570	100
8	0.451	100	0.336	100	0.553	100	0.525	100	0.794	100	0.492	100
9	0.380	100	0.470	100	0.650	100	0.507	100	1.011	100	0.510	100
10	0.534	100	0.518	100	0.486	100	0.406	100	0.583	100	0.481	100
11	0.547	100	0.424	100	0.406	100	0.474	100	0.534	100	0.619	100
12	0.535	100	0.580	100	0.655	100	0.744	100	1.021	100	0.476	100
13	0.592	100	1.106	100	0.731	100	0.581	100	0.915	100	0.549	100
14	0.403	100	0.558	100	0.704	100	0.419	100	0.718	100	0.499	100
15	0.783	100	0.618	100	0.822	100	0.794	100	1.115	100	0.757	100
16	0.670	100	0.633	100	0.509	100	0.606	100	0.569	100	0.703	100
17	0.443	100	0.826	100	0.700	100	0.637	100	0.903	100	0.389	100
18	0.584	100	1.135	100	0.664	100	0.667	100	0.601	100	1.021	100
19	1.541	100	1.531	100	1.281	100	1.463	100	1.180	100	1.492	100
20	0.441	100	0.588	100	0.755	100	0.690	100	0.561	100	0.648	100
21	0.673	100	0.705	100	1.527	100	0.657	100	0.546	100	0.756	100
22	1.403	100	1.625	100	1.553	100	1.673	100	1.171	100	1.574	100
23	1.197	100	1.309	100	1.380	100	1.159	100	0.969	100	1.329	100
24	0.998	100	0.869	100	1.063	100	0.998	100	1.289	100	0.821	100
25	1.379	100	1.215	100	1.756	100	1.269	100	1.868	100	1.403	100
26	0.941	100	0.642	100	0.744	100	1.056	100	1.223	100	0.673	100
27	0.615	100	0.602	100	0.819	100	0.778	100	1.047	100	0.508	100
28	0.437	100	0.552	100	0.954	100	0.482	100	0.511	100	0.645	100
29	0.624	100	1.140	100	0.987	100	0.715	100	1.130	100	0.690	100
30	0.759	100	0.702	100	0.923	100	0.805	100	1.175	100	0.716	100
31	0.692	100	0.534	100	0.856	100	0.469	100	0.881	100	0.502	100
32	0.579	100	0.646	100	0.873	100	0.615	100	0.987	100	0.474	100

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







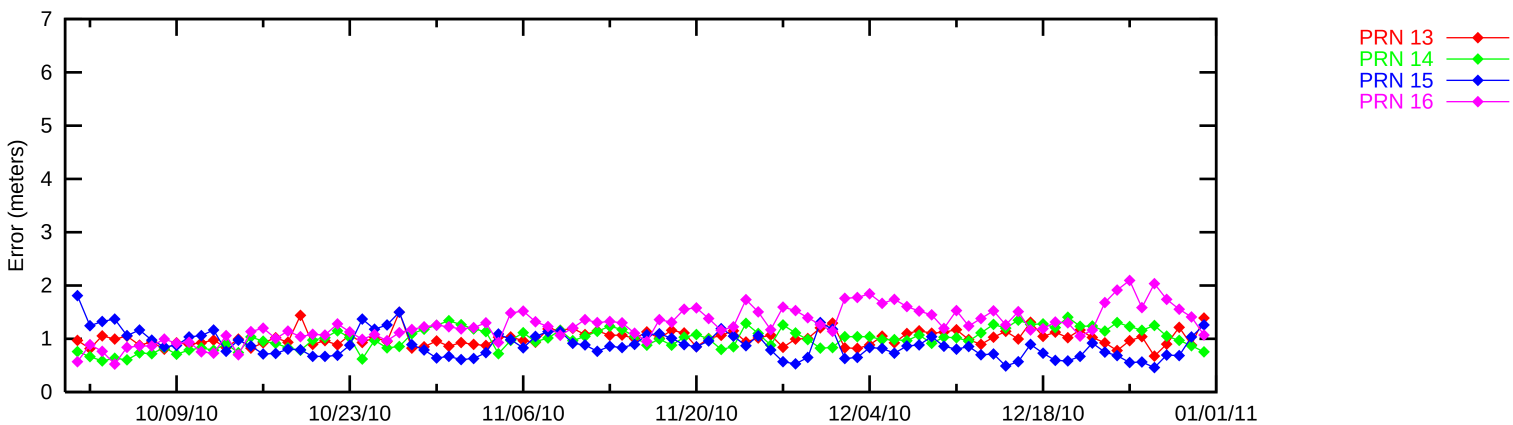


Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Washington DC

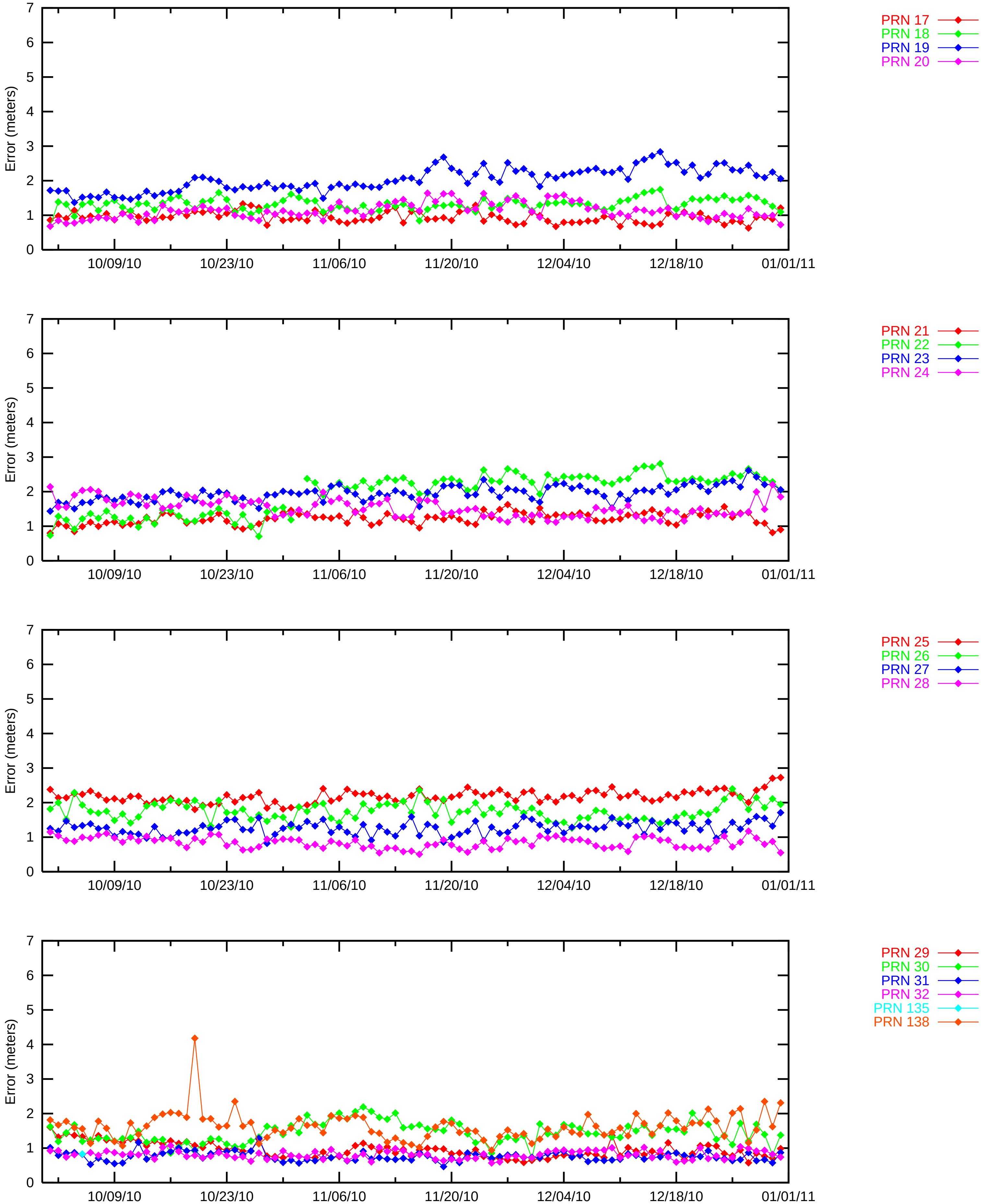
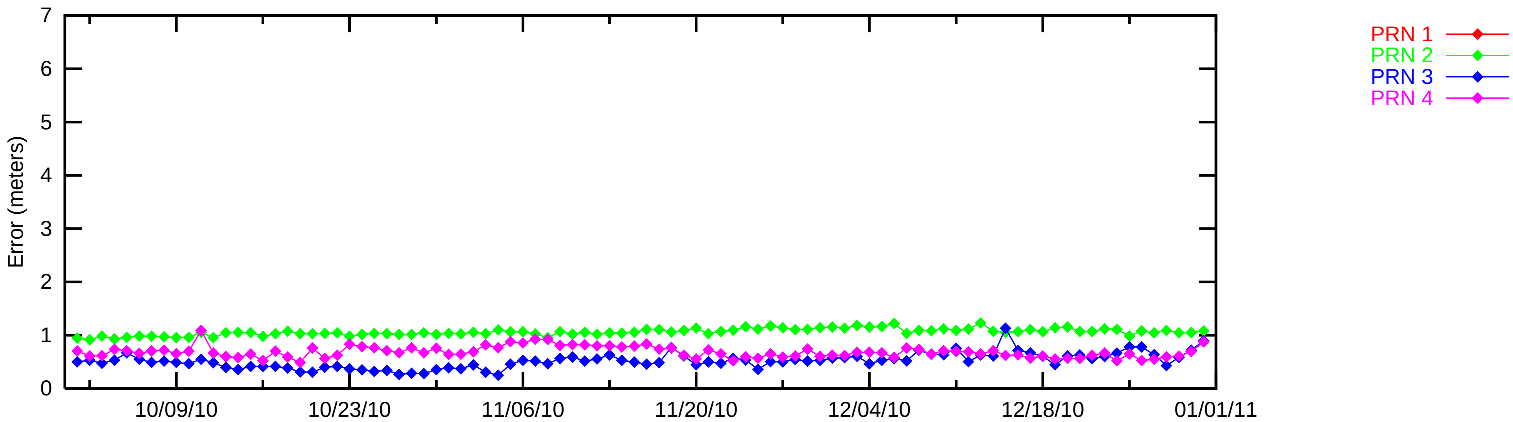
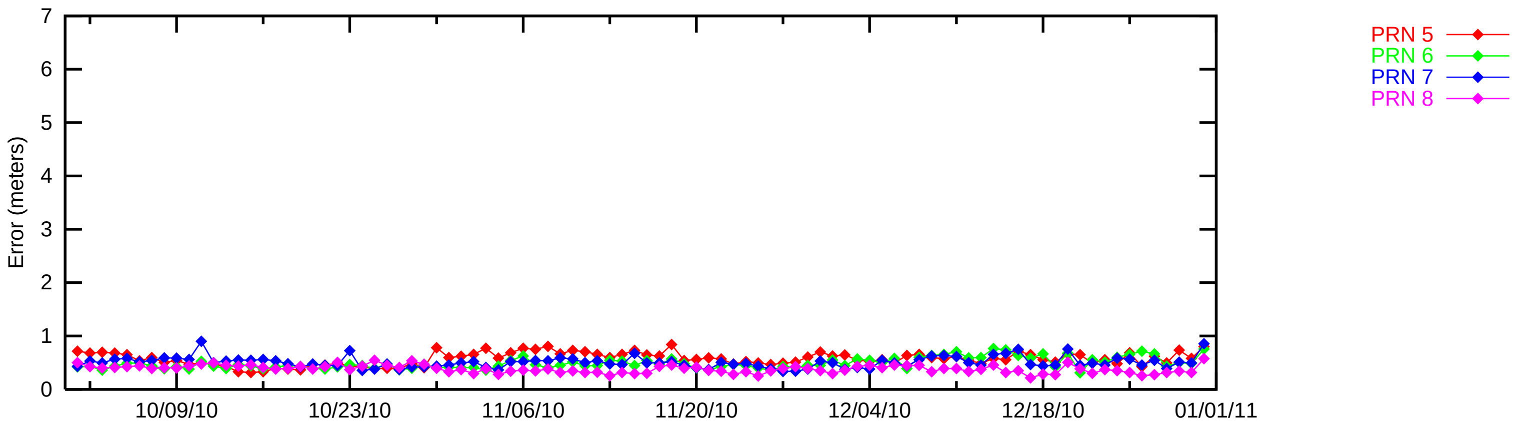
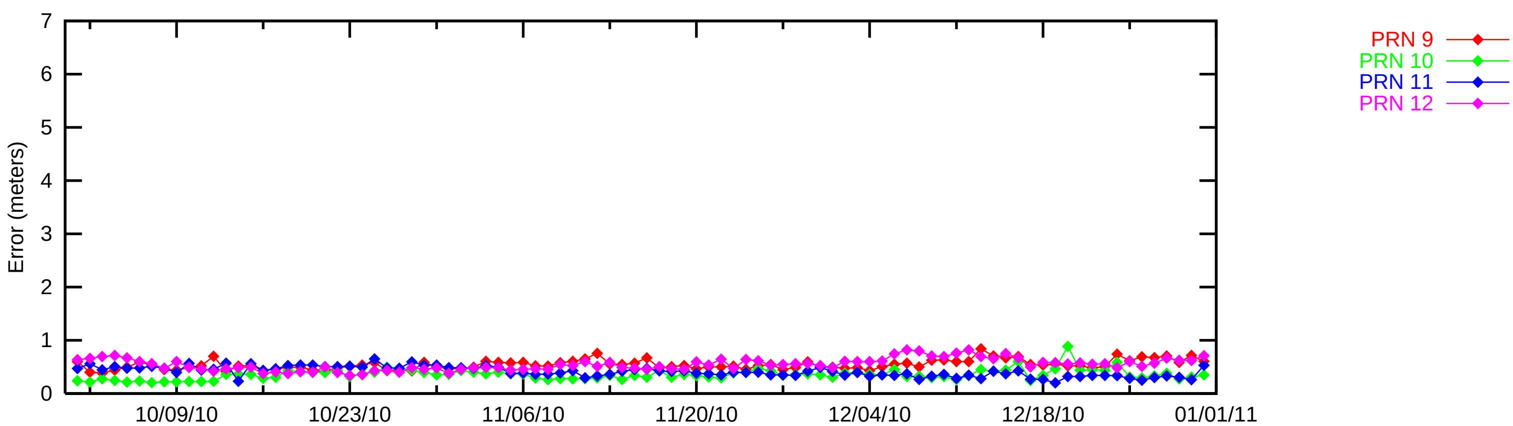


Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Washington DC







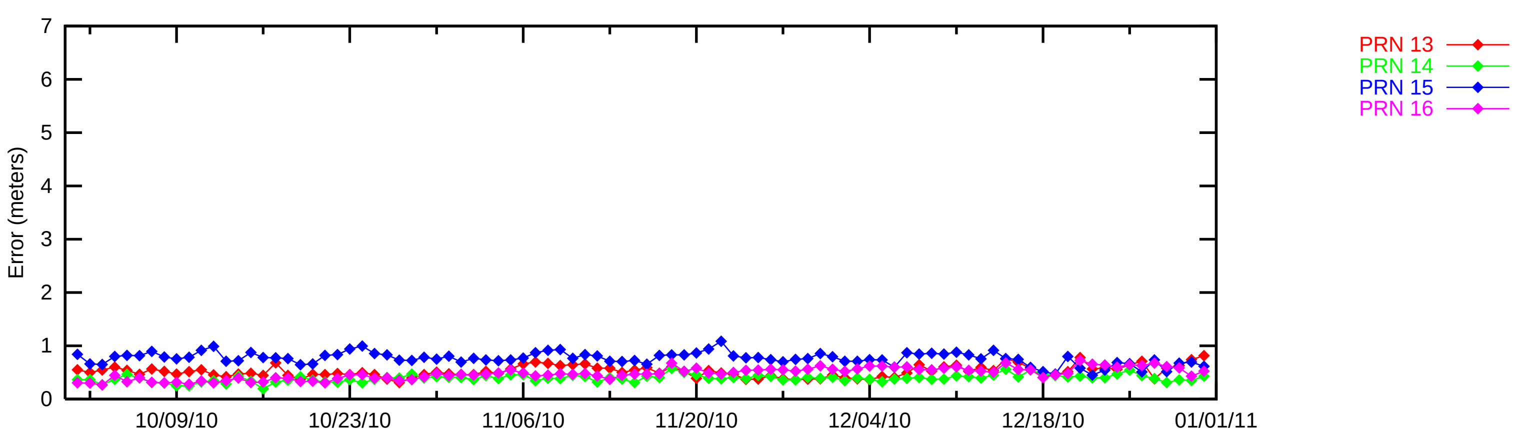
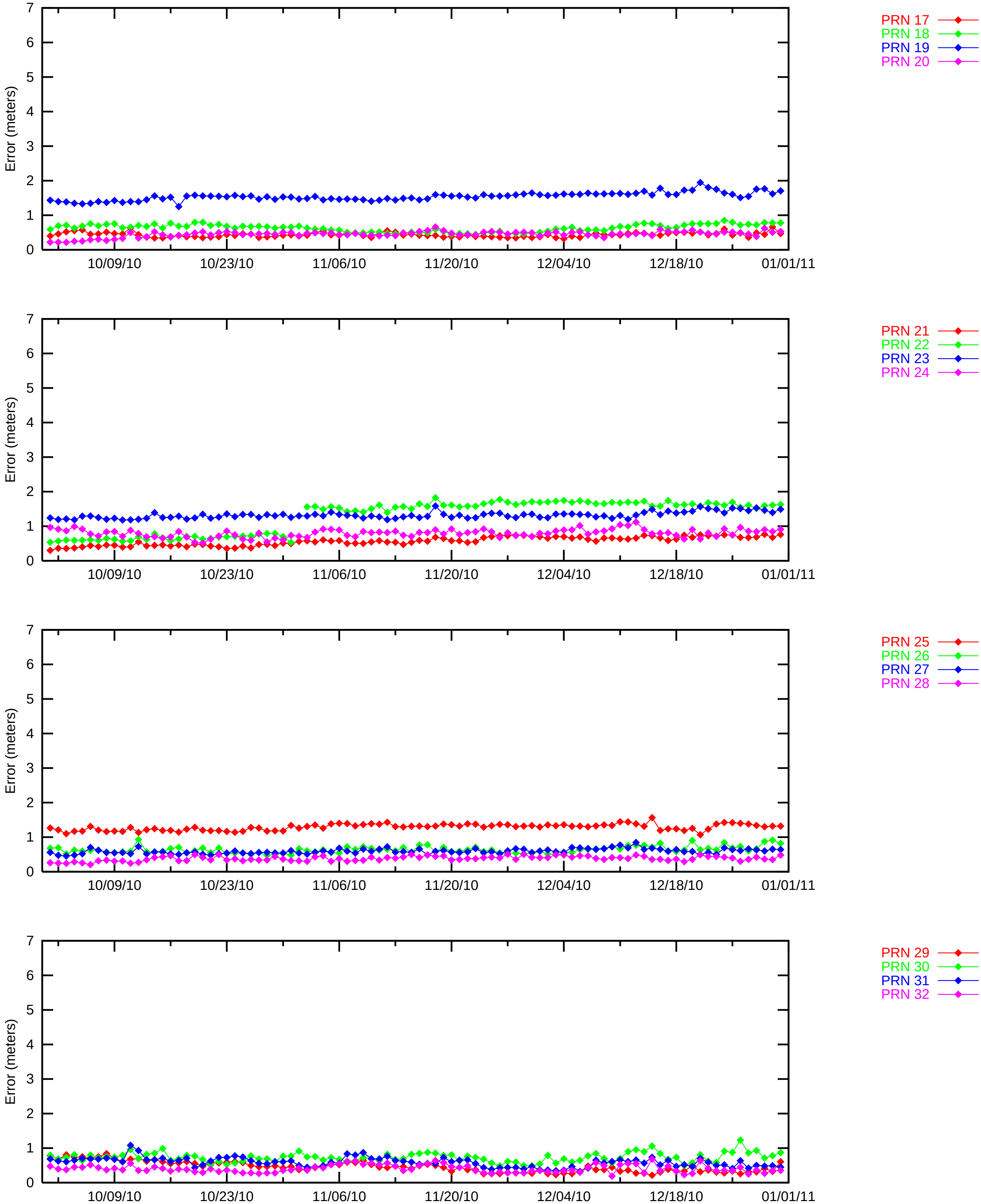


Figure 6-4 95% Ionospheric (PRN 17 - PRN 32) - Washington DC



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 this reporting period, only CRE GEO provided PA ranging service. CRW GEO provided only NPA ranging service until it was voluntarily taken out of service on 12/16/2010 due to drifting. AMR GEO came into operational service on 11/11/2010 and is expected to provide NPA ranging service in a future upgrade to the WAAS.

Table 7.1 shows the GEO-Ranging performance. 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.

Table 7-1 GEO Ranging Availability

GEO Source	GEO	PA (%)	NPA (%)	Not Monitored (%)	Do Not Use (%)
CRW 135	CRW	0.003	99.146	0.842	0
CRW 135	CRE	96.693	1.499	1.590	0.209
CRE 138	CRW	0.001	62.286	21.633	16.077
CRE 138	CRE	97.366	1.270	0.434	0.928
AMR133	CRW	0	47.893	51.969	0
AMR 133	CRE	96.539	0.935	0.303	2.085

Figure 7-1 Daily PA CRW GEO Ranging Availability Trend

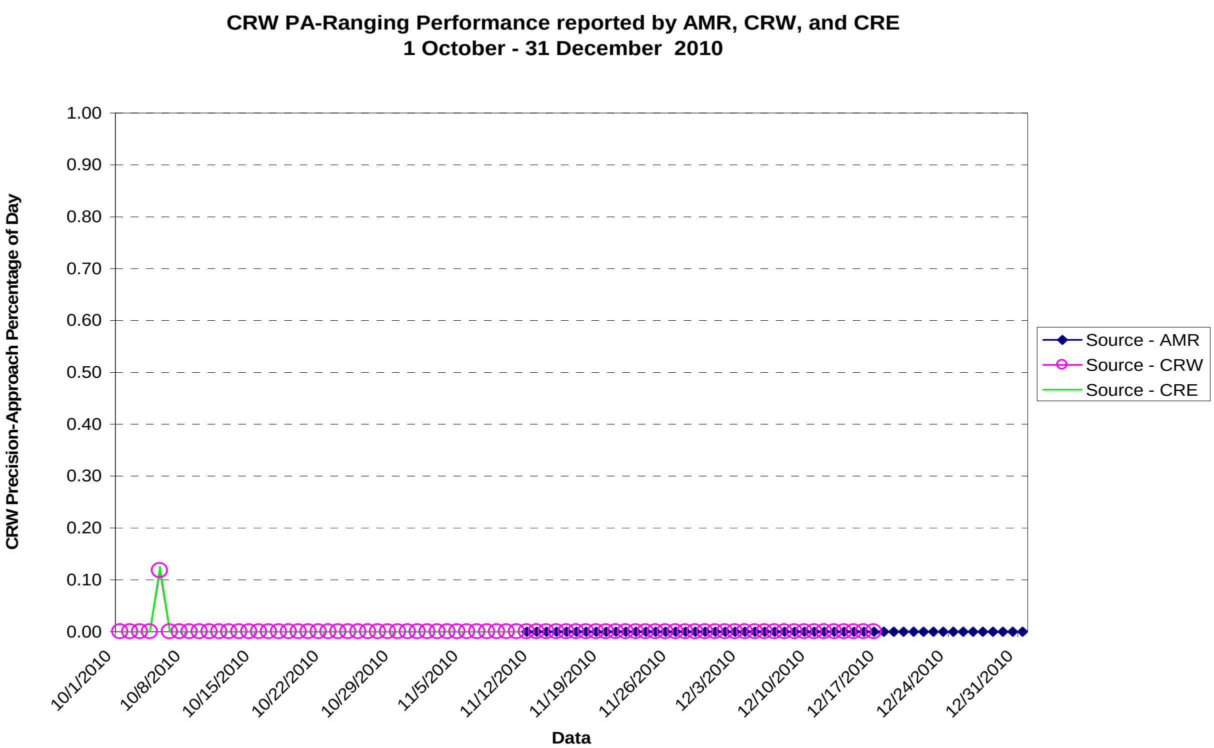
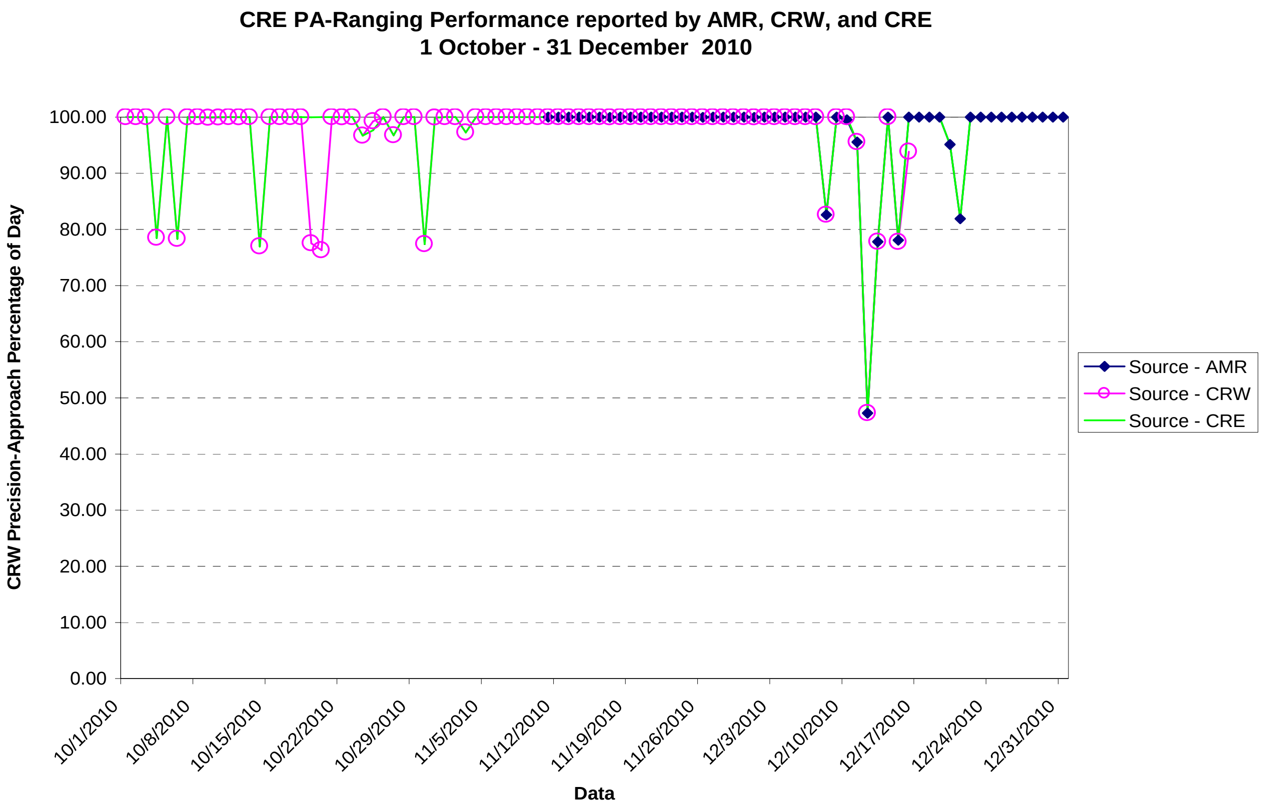


Figure 7-2 Daily PA CRE GEO Ranging Availability Trend



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
10/17/10	Local RFI caused localized LPV outage at Boston. See DR #99 Boston LPV outage caused by RFI .
11/24/10	Local RFI caused localized LPV200 service outage at Washington D.C. See DR #98 WAAS LPV200 Service Outage at Washington DC WRE-A caused by L1 Radio Frequency Interference (RFI).

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.

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	9	0.999789	509	0.927197
PAGA	EDWARD G. PITKA SR	AK	1	0.999971	8	0.999730
PAEM	EMMONAK	AK	4	0.999925	154	0.990532
PAFA	FAIRBANKS INTL	AK	0	1	6	0.999796
PAGB	GALBRAITH LAKE	AK	1	0.999964	44	0.998650
PAGK	GULKANA	AK	0	1	5	0.999852
PAHO	HOMER	AK	0	1	4	0.999729
PAHL	HUSLIA	AK	1	0.999971	12	0.999654
PAEN	KENAI MUNICIPAL	AK	0	1	3	0.999806
PAKT	KETCHIKAN INTL	AK	0	1	2	0.999984
PAKN	KING SALMON	AK	0	1	5	0.999544
PARY	RUBY	AK	1	0.999971	7	0.999733
PASK	SELAWIK	AK	4	0.999915	45	0.998273
PASM	ST MARY'S	AK	4	0.999918	115	0.994418
PAMK	ST MICHAEL	AK	4	0.999925	27	0.998718
PANC	TED STEVENS ANCHORAGE INTL	AK	0	1	3	0.999823
PAYA	YAKUTAT	AK	0	1	5	0.999690
8A0	ALBERTVILLE RGNL-THOMAS J BRUM	AL	0	1	0	1
ANB	ANNISTON METROPOLITAN	AL	0	1	0	1
AUO	AUBURN-OPELIKA ROBERT G PITTS	AL	0	1	0	1
EKY	BESSEMER	AL	0	1	0	1
BHM	BIRMINGHAM INTL	AL	0	1	0	1
SEM	CRAIG FIELD	AL	0	1	0	1
DHN	DOTHAN RGNL	AL	0	1	0	1
HSV	HUNTSVILLE INTL-CARL T JONES FIELD	AL	0	1	0	1
JKA	JACK EDWARDS	AL	0	1	1	0.999994
MDQ	MADISON COUNTY EXECUTIVE/TOM S	AL	0	1	0	1
BFM	MOBILE DOWNTOWN	AL	0	1	0	1
MOB	MOBILE RGNL	AL	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MGM	MONTGOMERY RGNL DANNELLY FIELD	AL	0	1	0	1
GAD	NORTHEAST ALABAMA RGNL	AL	0	1	0	1
MSL	NORTHWEST ALABAMA RGNL	AL	0	1	0	1
DCU	PRYOR FIELD RGNL	AL	0	1	0	1
79J	SOUTH ALABAMA RGNL AT BILL BEN	AL	0	1	0	1
PLR	ST CLAIR COUNTY	AL	0	1	0	1
2R5	ST ELMO	AL	0	1	0	1
ASN	TALLADEGA MUNICIPAL	AL	0	1	0	1
TOI	TROY MUNICIPAL	AL	0	1	0	1
TCL	TUSCALOOSA RGNL	AL	0	1	0	1
LIT	ADAMS FIELD	AR	0	1	0	1
M73	ALMYRA MUNICIPAL	AR	0	1	0	1
BYH	ARKANSAS INTL	AR	0	1	0	1
VBT	BENTONVILLE MUNICIPAL/ LOUISE M THAD	AR	0	1	0	1
HRO	BOONE COUNTY	AR	0	1	0	1
FSM	FORT SMITH RGNL	AR	0	1	0	1
PBF	GRIDER FIELD	AR	0	1	0	1
JBR	JONESBORO MUNICIPAL	AR	0	1	0	1
M19	NEWPORT MUNICIPAL	AR	0	1	0	1
ORK	NORTH LITTLE ROCK MUNICIPAL	AR	0	1	0	1
XNA	NORTHWEST ARKANSAS RGNL	AR	0	1	0	1
BPK	OZARK RGNL	AR	0	1	0	1
ROG	ROGERS MUNICIPAL-CARTER FIELD	AR	0	1	0	1
RUE	RUSSELLVILLE RGNL	AR	0	1	0	1
SUZ	SALINE COUNTY RGNL	AR	0	1	0	1
SRC	SEARCY MUNICIPAL	AR	0	1	0	1
SLG	SMITH FIELD	AR	0	1	0	1
ELD	SOUTH ARKANSAS RGNL AT GOODWIN	AR	0	1	0	1
ASG	SPRINGDALE MUNICIPAL	AR	0	1	0	1
SGT	STUTTGART MUNICIPAL	AR	0	1	0	1
ARG	WALNUT RIDGE RGNL	AR	0	1	0	1
PRC	ERNEST A. LOVE FIELD	AZ	0	1	16	0.999799
GEU	GLENDALE MUNICIPAL	AZ	1	0.999995	41	0.999191
GCN	GRAND CANYON NATIONAL PARK	AZ	0	1	0	1
IFP	LAUGHLIN/BULLHEAD INTL	AZ	0	1	0	1
PGA	PAGE MUNICIPAL	AZ	0	1	1	1
DVT	PHOENIX DEER VALLEY	AZ	1	0.999999	33	0.999362
PHX	PHOENIX SKY HARBOR INTL	AZ	1	0.999997	36	0.999293
IWA	PHOENIX-MESA GATEWAY	AZ	0	1	25	0.999299
SJN	ST JOHNS INDUSTRIAL AIR PARK	AZ	0	1	42	0.998231
TUS	TUCSON INTL	AZ	1	0.999999	22	0.999369
APV	APPLE VALLEY	CA	0	1	10	0.999887
ACV	ARCATA	CA	7	0.999936	119	0.995278
DAG	BARSTOW-DAGGETT	CA	0	1	1	0.999991
C83	BYRON	CA	0	1	85	0.992021
CMA	CAMARILLO	CA	0	1	98	0.992592
CNO	CHINO	CA	0	1	29	0.998912
FAT	FRESNO YOSEMITE INTL	CA	0	1	53	0.997988
WJF	GENERAL WM J FOX AIRFIELD	CA	0	1	26	0.998929
HAF	HALF MOON BAY	CA	4	0.999941	137	0.987855

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
HWD	HAYWARD EXECUTIVE	CA	2	0.999975	97	0.989898
CVH	HOLLISTER MUNICIPAL	CA	0	1	90	0.990306
SNA	JOHN WAYNE AIRPORT-ORANGE COUN	CA	0	1	58	0.997253
LGB	LONG BEACH /DAUGHERTY FIELD	CA	0	1	64	0.996416
LAX	LOS ANGELES INTL	CA	0	1	66	0.995693
MAE	MADERA MUNICIPAL	CA	0	1	62	0.996708
CRQ	MC CLELLAN-PALOMAR	CA	0	1	48	0.997713
BFL	MEADOWS FIELD	CA	0	1	62	0.997458
MCE	MERCED MUNICIPAL/ MACREADY FIELD	CA	0	1	66	0.995580
OAK	METROPOLITAN OAKLAND INTL	CA	2	0.999970	99	0.989723
MOD	MODESTO CITY-CO- HARRY SHAM FIELD	CA	0	1	75	0.994551
MRY	MONTEREY PENINSULA	CA	4	0.999971	108	0.987754
APC	NAPA COUNTY	CA	1	0.999993	93	0.990952
O02	NERVINO	CA	0	1	15	0.999676
SJC	NORMAN Y. MINETA SAN JOSE INTL	CA	2	0.999983	94	0.989812
VCB	NUT TREE	CA	0	1	84	0.992827
ONT	ONTARIO INTL	CA	0	1	25	0.999250
OXR	OXNARD	CA	0	1	104	0.991726
PMD	PALMDALE RGNL/USAF PLANT 42	CA	0	1	25	0.999010
RBL	RED BLUFF MUNICIPAL	CA	0	1	57	0.998115
RDD	REDDING MUNICIPAL	CA	0	1	57	0.998019
RAL	RIVERSIDE MUNICIPAL	CA	0	1	21	0.999313
SMF	SACRAMENTO INTL	CA	0	1	63	0.996888
MHR	SACRAMENTO MATHER	CA	0	1	60	0.997396
SFO	SAN FRANCISCO INTL	CA	3	0.999952	103	0.988934
SBA	SANTA BARBARA MUNICIPAL	CA	0	1	113	0.988719
TCY	TRACY MUNICIPAL	CA	0	1	83	0.992473
APA	CENTENNIAL	CO	0	1	27	0.997717
COS	CITY OF COLORADO SPRINGS MUNICIPAL	CO	0	1	29	0.997476
AKO	COLORADO PLAINS RGNL	CO	0	1	27	0.997547
CEZ	CORTEZ MUNICIPAL	CO	0	1	31	0.997881
DEN	DENVER INTL	CO	0	1	27	0.997787
FTG	FRONT RANGE	CO	0	1	28	0.997709
RIL	GARFIELD COUNTY RGNL	CO	0	1	2	0.999970
GXY	GREELEY-WELD COUNTY	CO	0	1	25	0.997952
ITR	KIT CARSON COUNTY	CO	0	1	34	0.997483
LAA	LAMAR MUNICIPAL	CO	0	1	36	0.997823
PUB	PUEBLO MEMORIAL	CO	0	1	30	0.997371
ALS	SAN LUIS VALLEY RGNL/BERGMAN F	CO	0	1	31	0.997271
HDN	YAMPA VALLEY	CO	0	1	1	0.999985
BDL	BRADLEY INTL	CT	0	1	0	1
GON	GROTON-NEW LONDON	CT	0	1	0	1
HVN	TWEED-NEW HAVEN	CT	0	1	0	1
OXC	WATERBURY-OXFORD	CT	0	1	0	1
DCA	RONALD REAGAN WASHINGTON NATIONAL	DC	0	1	2	0.999953
EVY	SUMMIT	DE	0	1	1	0.999997
GED	SUSSEX COUNTY	DE	0	1	4	0.999786
AAF	APALACHICOLA MUNICIPAL	FL	0	1	2	0.999847

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
CEW	BOB SIKES	FL	0	1	0	1
BCT	BOCA RATON	FL	0	1	5	0.999480
PGD	CHARLOTTE COUNTY	FL	0	1	4	0.999588
DAB	DAYTONA BEACH INTL	FL	0	1	14	0.999542
DED	DELAND MUNICIPAL-SIDNEY H TAYLOR FIELD	FL	0	1	11	0.999541
XFL	FLAGLER COUNTY	FL	0	1	7	0.999514
FXE	FORT LAUDERDALE EXECUTIVE	FL	0	1	5	0.999464
FLL	FORT LAUDERDALE/ HOLLYWOOD INTL	FL	0	1	6	0.999458
GNV	GAINESVILLE RGNL	FL	0	1	6	0.999496
BKV	HERNANDO COUNTY	FL	0	1	7	0.999673
JAX	JACKSONVILLE INTL	FL	0	1	6	0.999457
TMB	KENDALL-TAMIAMI EXECUTIVE	FL	0	1	5	0.999434
EYW	KEY WEST INTL	FL	0	1	7	0.999384
ISM	KISSIMMEE GATEWAY	FL	0	1	22	0.999541
X14	LA BELLE MUNICIPAL	FL	0	1	4	0.999573
LCQ	LAKE CITY MUNICIPAL	FL	0	1	6	0.999517
LAL	LAKELAND LINDER RGNL	FL	0	1	11	0.999611
LEE	LEESBURG INTL	FL	0	1	9	0.999583
MLB	MELBOURNE INTL	FL	0	1	18	0.999519
COI	MERRITT ISLAND	FL	0	1	39	0.999489
MIA	MIAMI INTL	FL	0	1	5	0.999447
APF	NAPLES MUNICIPAL	FL	0	1	5	0.999551
EVB	NEW SMYRNA BEACH MUNICIPAL	FL	0	1	17	0.999550
OCF	OCALA INTL-JIM TAYLOR FIELD	FL	0	1	7	0.999545
MCO	ORLANDO INTL	FL	0	1	20	0.999511
SFB	ORLANDO SANFORD INTL	FL	0	1	17	0.999547
PHK	PALM BEACH CO GLADES	FL	0	1	4	0.999574
PBI	PALM BEACH INTL	FL	0	1	6	0.999564
PFN	PANAMA CITY-BAY CO INTL	FL	0	1	2	0.999920
PNS	PENSACOLA RGNL	FL	0	1	1	0.999994
PMP	POMPANO BEACH AIRPARK	FL	0	1	6	0.999468
SRQ	SARASOTA/BRADENTON INTL	FL	0	1	4	0.999624
RSW	SOUTHWEST FLORIDA INTL	FL	0	1	4	0.999574
FPR	ST LUCIE COUNTY INTL	FL	0	1	13	0.999549
PIE	ST PETERSBURG-CLEARWATER INTL	FL	0	1	4	0.999646
TLH	TALLAHASSEE RGNL	FL	0	1	2	0.999852
TPA	TAMPA INTL	FL	0	1	6	0.999646
MTH	THE FLORIDA KEYS MARATHON	FL	0	1	7	0.999373
VDF	VANDENBERG	FL	0	1	6	0.999644
GIF	WINTER HAVEN'S GILBERT	FL	0	1	15	0.999571
AGS	AUGUSTA RGNL AT BUSH FIELD	GA	0	1	1	0.999998
BQK	BRUNSWICK GOLDEN ISLES	GA	0	1	6	0.999456
VPC	CARTERSVILLE	GA	0	1	0	1
47A	CHEROKEE COUNTY	GA	0	1	0	1
RYY	COBB COUNTY-MC COLLUM FIELD	GA	0	1	0	1
CSG	COLUMBUS METROPOLITAN	GA	0	1	0	1
15J	COOK COUNTY	GA	0	1	4	0.999867
CKF	CRISP COUNTY-CORDELE	GA	0	1	0	1
DNN	DALTON MUNICIPAL	GA	0	1	0	1
SBO	EMANUEL COUNTY	GA	0	1	1	0.999987

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
18A	FRANKLIN COUNTY	GA	0	1	0	1
FTY	FULTON COUNTY AIRPORT-BROWN FIELD	GA	0	1	0	1
ATL	HARTSFIELD - JACKSON ATLANTA	GA	0	1	0	1
EZM	HEART OF GEORGIA RGNL	GA	0	1	1	0.999988
19A	JACKSON COUNTY	GA	0	1	0	1
GVL	LEE GILMER MEMORIAL	GA	0	1	0	1
MCN	MIDDLE GEORGIA RGNL	GA	0	1	0	1
MGR	MOULTRIE MUNICIPAL	GA	0	1	3	0.999893
CCO	NEWNAN COWETA COUNTY	GA	0	1	0	1
FFC	PEACHTREE CITY-FALCON FIELD	GA	0	1	0	1
PXE	PERRY-HOUSTON COUNTY	GA	0	1	0	1
JZP	PICKENS COUNTY	GA	0	1	0	1
JYL	PLANTATION ARPK	GA	0	1	4	0.999965
SAV	SAVANNAH/HILTON HEAD INTL	GA	0	1	5	0.999691
ACJ	SOUTHER FIELD	GA	0	1	0	1
ABY	SOUTHWEST GEORGIA RGNL	GA	0	1	2	0.999968
TBR	STATESBORO-BULLOCH COUNTY	GA	0	1	4	0.999936
MQW	TELFAIR-WHEELER	GA	0	1	2	0.999983
TVI	THOMASVILLE RGNL	GA	0	1	4	0.999883
TOC	TOCCOA RG LETOURNEAU FIELD	GA	0	1	0	1
VLD	VALDOSTA RGNL	GA	0	1	6	0.999694
VDI	VIDALIA RGNL	GA	0	1	3	0.999948
IIY	WASHINGTON-WILKES COUNTY	GA	0	1	0	1
AYS	WAYCROSS-WARE COUNTY	GA	0	1	6	0.999665
CTJ	WEST GEORGIA RGNL – O V GRAY FIELD	GA	0	1	0	1
WDR	WINDER-BARROW	GA	0	1	0	1
IKV	ANKENY RGNL	IA	0	1	0	1
CBF	COUNCIL BLUFFS MUNICIPAL	IA	0	1	0	1
DVN	DAVENPORT MUNICIPAL	IA	0	1	0	1
DNS	DENISON MUNICIPAL	IA	0	1	0	1
DSM	DES MOINES INTL	IA	0	1	0	1
DBQ	DUBUQUE RGNL	IA	0	1	0	1
EST	ESTHERVILLE MUNICIPAL	IA	0	1	0	1
FFL	FAIRFIELD MUNICIPAL	IA	0	1	0	1
GGI	GRINNELL RGNL	IA	0	1	0	1
EOK	KEOKUK MUNICIPAL	IA	0	1	0	1
MCW	MASON CITY MUNICIPAL	IA	0	1	0	1
MXO	MONTICELLO RGNL	IA	0	1	0	1
MUT	MUSCATINE MUNICIPAL	IA	0	1	0	1
TNU	NEWTON MUNICIPAL	IA	0	1	0	1
OTM	OTTUMWA INDUSTRIAL	IA	0	1	0	1
PRO	PERRY MUNICIPAL	IA	0	1	0	1
SDA	SHENANDOAH MUNICIPAL	IA	0	1	0	1
SLB	STORM LAKE MUNICIPAL	IA	0	1	0	1
CID	THE EASTERN IOWA	IA	0	1	0	1
ALO	WATERLOO RGNL	IA	0	1	0	1
BOI	BOISE AIR TERMINAL/GOWEN FLD	ID	0	1	1	1
EUL	CALDWELL INDUSTRIAL	ID	0	1	1	1
GNG	GOODING MUNICIPAL	ID	0	1	1	1
IDA	IDAHO FALLS RGNL	ID	0	1	1	1

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

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
SBN	SOUTH BEND RGNL	IN	0	1	0	1
OXI	STARKE COUNTY	IN	0	1	0	1
ANQ	TRI-STATE STEUBEN COUNTY	IN	0	1	0	1
PTS	ATKINSON MUNICIPAL	KS	0	1	0	1
AAO	COLONEL JAMES JABARA	KS	0	1	0	1
DDC	DODGE CITY RGNL	KS	0	1	30	0.999361
EMP	EMPORIA MUNICIPAL	KS	0	1	0	1
FOE	FORBES FIELD	KS	0	1	0	1
FSK	FORT SCOTT MUNICIPAL	KS	0	1	0	1
GCK	GARDEN CITY RGNL	KS	0	1	49	0.998693
HYS	HAYS RGNL	KS	0	1	31	0.998917
HQG	HUGOTON MUNICIPAL	KS	0	1	44	0.999153
OJC	JOHNSON COUNTY EXECUTIVE	KS	0	1	0	1.000000
LWC	LAWRENCE MUNICIPAL	KS	0	1	0	1
LBL	LIBERAL MID-AMERICA RGNL	KS	0	1	37	0.999530
MHK	MANHATTAN RGNL	KS	0	1	0	1
MPR	MC PHERSON	KS	0	1	0	1
IXD	NEW CENTURY AIRCENTER	KS	0	1	0	1
EWK	NEWTON-CITY-COUNTY	KS	0	1	0	1
OEL	OAKLEY MUNICIPAL	KS	0	1	45	0.997744
TOP	PHILIP BILLARD MUNICIPAL	KS	0	1	0	1
PTT	PRATT INDUSTRIAL	KS	0	1	0	1
GLD	RENNER FLD /GOODLAND MUNICIPAL	KS	0	1	38	0.997541
RSL	RUSSELL MUNICIPAL	KS	0	1	3	0.999994
SLN	SALINA MUNICIPAL	KS	0	1	0	1
TQK	SCOTT CITY MUNICIPAL	KS	0	1	48	0.998087
CBK	SHALZ FIELD	KS	0	1	43	0.997585
WLD	STROTHER FIELD	KS	0	1	0	1
PPF	TRI-CITY	KS	0	1	0	1
ULS	ULYSSES	KS	0	1	49	0.998641
EGT	WELLINGTON MUNICIPAL	KS	0	1	0	1
ICT	WICHITA MID-CONTINENT	KS	0	1	0	1
EKX	ADDINGTON FIELD	KY	0	1	0	1
PAH	BARKLEY RGNL	KY	0	1	0	1
K22	BIG SANDY RGNL	KY	0	1	0	1
LEX	BLUE GRASS	KY	0	1	0	1
LOU	BOWMAN FIELD	KY	0	1	0	1
CVG	CINCINNATI/NORTHERN KENTUCKY	KY	0	1	0	1
27K	GEORGETOWN SCOTT COUNTY - MARS	KY	0	1	0	1
GLW	GLASGOW MUNICIPAL	KY	0	1	0	1
EHR	HENDERSON CITY-COUNTY	KY	0	1	0	1
SME	LAKE CUMBERLAND RGNL	KY	0	1	0	1
LOZ	LONDON-CORBIN ARPT-MAGEE FLD	KY	0	1	0	1
SDF	LOUISVILLE INTL-STANDIFORD FLD	KY	0	1	0	1
OWB	OWENSBORO-DAVIESS COUNTY	KY	0	1	0	1
DVK	STUART POWELL FIELD	KY	0	1	0	1
W38	WILLIAMSBURG-WHITLEY COUNTY	KY	0	1	0	1
ARA	ACADIANA RGNL	LA	0	1	0	1
AEX	ALEXANDRIA INTL	LA	0	1	0	1
BTR	BATON ROUGE METROPOLITAN` RYAN	LA	0	1	0	1
DRI	BEAUREGARD RGNL	LA	0	1	0	1
CWF	CHENNAULT INTL	LA	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
ESF	ESLER RGNL	LA	0	1	0	1
HZR	FALSE RIVER RGNL	LA	0	1	0	1
PTN	HARRY P WILLIAMS MEMORIAL	LA	0	1	0	1
LFT	LAFAYETTE RGNL	LA	0	1	0	1
LCH	LAKE CHARLES RGNL	LA	0	1	0	1
NEW	LAKEFRONT	LA	0	1	0	1
MSY	LOUIS ARMSTRONG NEW ORLEANS	LA	0	1	0	1
BQP	MOREHOUSE MEMORIAL	LA	0	1	0	1
DTN	SHREVEPORT DOWNTOWN	LA	0	1	0	1
SHV	SHREVEPORT RGNL	LA	0	1	0	1
GAO	SOUTH LAFOURCHE LEONARD MILLER	LA	0	1	0	1
TVR	VICKSBURG TALLULAH RGNL	LA	0	1	0	1
BAF	BARNES MUNICIPAL	MA	0	1	0	1
HYA	BARNSTABLE MUNICIPAL-BOARDMAN/POLAN	MA	0	1	1	0.999956
BOS	GENERAL EDWARD LAWRENCE LOGAN	MA	0	1	0	1
BED	LAURENCE G HANSCOM FLD	MA	0	1	0	1
MVY	MARTHAS VINEYARD	MA	0	1	1	0.999965
OWD	NORWOOD MEMORIAL	MA	0	1	0	1
PVC	PROVINCETOWN MUNICIPAL	MA	0	1	1	0.999958
ORH	WORCESTER RGNL	MA	0	1	0	1
BWI	BALTIMORE/WASHINGTON INTL	MD	0	1	2	0.999930
DMW	CARROLL COUNTY RGNL/JACK B POA	MD	0	1	2	0.999959
ESN	EASTON/NEWNAM FIELD	MD	0	1	4	0.999851
FDK	FREDERICK MUNICIPAL	MD	0	1	0	1
GAI	MONTGOMERY COUNTY AIRPARK	MD	0	1	1	1
2W6	ST. MARY'S COUNTY RGNL	MD	0	1	3	0.999893
LEW	AUBURN/LEWISTON MUNICIPAL	ME	0	1	1	0.999988
AUG	AUGUSTA STATE	ME	0	1	1	0.999976
BGR	BANGOR INTL	ME	0	1	1	0.999958
BHB	HANCOCK COUNTY-BAR HARBOR	ME	0	1	1	0.999931
PQI	NORTHERN MAINE RGNL ARPT AT PR	ME	0	1	2	0.999989
PWM	PORTLAND INTL JETPORT	ME	0	1	1	0.999986
WVL	WATERVILLE ROBERT LAFLEUR	ME	0	1	1	0.999978
ARB	ANN ARBOR MUNICIPAL	MI	0	1	0	1
ACB	ANTRIM COUNTY	MI	0	1	0	1
FNT	BISHOP INTL	MI	0	1	0	1
OEB	BRANCH COUNTY MEMORIAL	MI	0	1	0	1
CVX	CHARLEVOIX MUNICIPAL	MI	0	1	0	1
CIU	CHIPPEWA COUNTY INTL	MI	0	1	0	1
TTF	CUSTER	MI	0	1	0	1
DTW	DETROIT METROPOLITAN WAYNE 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	0	1
BAX	HURON COUNTY MEMORIAL	MI	0	1	0	1
AZO	KALAMAZOO/BATTLE CREEK INTL	MI	0	1	0	1
ADG	LENAWEE COUNTY	MI	0	1	0	1
OZW	LIVINGSTON COUNTY SPENCER J. H	MI	0	1	0	1
LDM	MASON COUNTY	MI	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MBS	MBS INTL	MI	0	1	0	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	0	1
AUM	AUSTIN MUNICIPAL	MN	0	1	0	1
BDE	BAUDETTE INTL	MN	0	1	0	1
BRD	BRAINERD LAKES RGNL	MN	0	1	0	1
AXN	CHANDLER FIELD	MN	0	1	0	1
HIB	CHISHOLM-HIBBING	MN	0	1	0	1
CKN	CROOKSTON MUNICIPAL KIRKWOOD FLD	MN	0	1	0	1
DTL	DETROIT LAKES-WETHING FIELD	MN	0	1	0	1
DLH	DULUTH INTL	MN	0	1	0	1
INL	FALLS INTL	MN	0	1	0	1
MSP	MINNEAPOLIS-ST PAUL INTL	MN	0	1	0	1
RGK	RED WING RGNL	MN	0	1	0	1
RST	ROCHESTER INTL	MN	0	1	0	1
ROX	ROSEAU MUNICIPAL/ RUDY BILLBERG FIELD	MN	0	1	0	1
MML	SOUTHWEST MINNESOTA RGNL MARSH	MN	0	1	0	1
STC	ST CLOUD RGNL	MN	0	1	0	1
JYG	ST JAMES MUNICIPAL	MN	0	1	0	1
STP	ST PAUL DOWNTOWN HOLMAN FLD	MN	0	1	0	1
RRT	WARROAD INTL MEMORIAL	MN	0	1	0	1
BDH	WILLMAR MUNICIPAL- JOHN L RICE FIELD	MN	0	1	0	1
M17	BOLIVAR MUNICIPAL	MO	0	1	0	1
CGI	CAPE GIRARDEAU RGNL	MO	0	1	0	1
M05	CARUTHERSVILLE MEMORIAL	MO	0	1	0	1
MKC	CHARLES B. WHEELER DOWNTOWN	MO	0	1	0	1
COU	COLUMBIA RGNL	MO	0	1	0	1
1H0	CREVE COEUR	MO	0	1	0	1
DXE	DEXTER MUNICIPAL	MO	0	1	0	1
LBO	FLOYD W. JONES LEBANON	MO	0	1	0	1
K57	GOULD PETERSON MUNICIPAL	MO	0	1	0	1
HIG	HIGGINSVILLE INDUSTRIAL MUNICIPAL	MO	0	1	0	1
JEF	JEFFERSON CITY MEMORIAL	MO	0	1	0	1
VER	JESSE VIERTEL MEMORIAL	MO	0	1	0	1
JLN	JOPLIN RGNL	MO	0	1	0	1
MCI	KANSAS CITY INTL	MO	0	1	0	1
TKX	KENNETT MEMORIAL	MO	0	1	0	1
IRK	KIRKSVILLE RGNL	MO	0	1	0	1
STL	LAMBERT-ST LOUIS INTL	MO	0	1	0	1
LRY	LAWRENCE SMITH MEMORIAL	MO	0	1	0	1
AIZ	LEE C FINE MEMORIAL	MO	0	1	0	1
LXT	LEE'S SUMMIT MUNICIPAL	MO	0	1	0	1
6M6	LEWIS COUNTY RGNL	MO	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MHL	MARSHALL MEMORIAL MUNICIPAL	MO	0	1	0	1
MYJ	MEXICO MEMORIAL	MO	0	1	0	1
GPH	MIDWEST NATIONAL AIR CENTER	MO	0	1	0	1
M58	MONETT MUNICIPAL	MO	0	1	0	1
EOS	NEOSHO HUGH ROBINSON	MO	0	1	0	1
POF	POPLAR BLUFF MUNICIPAL	MO	0	1	0	1
STJ	ROSECRANS MEMORIAL	MO	0	1	0	1
DMO	SEDALIA MEMORIAL	MO	0	1	0	1
SIK	SIKESTON MEMORIAL MUNICIPAL	MO	0	1	0	1
RCM	SKYHAVEN	MO	0	1	0	1
SGF	SPRINGFIELD-BRANSON NATIONAL	MO	0	1	0	1
TBN	WAYNESVILLE RGNL ARPT AT FORNE	MO	0	1	0	1
UNO	WEST PLAINS MUNICIPAL	MO	0	1	0	1
STF	GEORGE M BRYAN	MS	0	1	0	1
GTR	GOLDEN TRIANGLE RGNL	MS	0	1	0	1
GWO	GREENWOOD-LEFLORE	MS	0	1	0	1
GNF	GRENADA MUNICIPAL	MS	0	1	0	1
GPT	GULFPORT-BILOXI INTL	MS	0	1	0	1
HEZ	HARDY-ANDERS FIELD NATCHEZ-ADA	MS	0	1	0	1
HBG	HATTIESBURG BOBBY L CHAIN MUNICIPAL	MS	0	1	0	1
PIB	HATTIESBURG-LAUREL RGNL	MS	0	1	0	1
LUL	HESLER-NOBLE FIELD	MS	0	1	0	1
JAN	JACKSON-EVERS INTL	MS	0	1	0	1
M16	JOHN BELL WILLIAMS	MS	0	1	0	1
MEI	KEY FIELD	MS	0	1	0	1
MCB	MC COMB/PIKE COUNTY/JOHN E LEW	MS	0	1	0	1
M40	MONROE COUNTY	MS	0	1	0	1
OLV	OLIVE BRANCH	MS	0	1	0	1
MJD	PICAYUNE MUNICIPAL	MS	0	1	0	1
M43	PRENTISS-JEFFERSON DAVIS COUNTY	MS	0	1	0	1
CRX	ROSCOE TURNER	MS	0	1	0	1
HSA	STENNIS INTL	MS	0	1	0	1
PQL	TRENT LOTT INTL	MS	0	1	0	1
UTA	TUNICA MUNICIPAL	MS	0	1	0	1
UOX	UNIVERSITY-OXFORD	MS	0	1	0	1
BTM	BERT MOONEY	MT	0	1	1	1
BIL	BILLINGS LOGAN INTL	MT	0	1	0	1
MLS	FRANK WILEY FIELD	MT	0	1	0	1
GPI	GLACIER PARK INTL	MT	0	1	1	1
GTF	GREAT FALLS INTL	MT	0	1	1	1
HLN	HELENA RGNL	MT	0	1	1	1
LWT	LEWISTOWN MUNICIPAL	MT	0	1	0	1
OAJ	ALBERT J ELLIS	NC	0	1	4	0.999664
AFP	ANSON COUNTY	NC	0	1	0	1
HBI	ASHEBORO RGNL	NC	0	1	0	1
AVL	ASHEVILLE RGNL	NC	0	1	0	1
CLT	CHARLOTTE/DOUGLAS INTL	NC	0	1	0	1
JQF	CONCORD RGNL	NC	0	1	0	1
EWN	CRAVEN COUNTY RGNL	NC	0	1	4	0.999670
ECG	ELIZABETH CITY CG AIR STATION	NC	0	1	4	0.999705
FAY	FAYETTEVILLE RGNL/GRANNIS FIELD	NC	0	1	2	0.999939

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
LHZ	FRANKLIN COUNTY	NC	0	1	2	0.999998
AKH	GASTONIA MUNICIPAL	NC	0	1	0	1
GWW	GOLDSBORO-WAYNE MUNICIPAL	NC	0	1	3	0.999883
HRJ	HARNETT RGNL JETPORT	NC	0	1	2	0.999985
HNZ	HENDERSON-OXFORD	NC	0	1	0	1
ISO	KINSTON RGNL JETPORT AT STALLI	NC	0	1	4	0.999890
EQY	MONROE RGNL	NC	0	1	0	1
EDE	NORTHEASTERN RGNL	NC	0	1	4	0.999723
GSO	PIEDMONT TRIAD INTL	NC	0	1	0	1
PGV	PITT-GREENVILLE	NC	0	1	4	0.999890
RDU	RALEIGH-DURHAM INTL	NC	0	1	0	1
RWI	ROCKY MOUNT-WILSON RGNL	NC	0	1	3	0.999893
RUQ	ROWAN COUNTY	NC	0	1	0	1
TTA	SANFORD-LEE COUNTY RGNL	NC	0	1	0	1
SVH	STATESVILLE RGNL	NC	0	1	0	1
ILM	WILMINGTON INTL	NC	0	1	4	0.999642
BIS	BISMARCK MUNICIPAL	ND	0	1	0	1
5N8	CASSELTON ROBERT MILLER RGNL	ND	0	1	0	1
DVL	DEVILS LAKE RGNL	ND	0	1	0	1
DIK	DICKINSON - THEODORE ROOSEVELT	ND	0	1	0	1
GFK	GRAND FORKS INTL	ND	0	1	0	1
FAR	HECTOR INTL	ND	0	1	0	1
JMS	JAMESTOWN RGNL	ND	0	1	0	1
MOT	MINOT INTL	ND	0	1	0	1
ANW	AINSWORTH MUNICIPAL	NE	0	1	0	1
BVN	ALBION MUNICIPAL	NE	0	1	0	1
AIA	ALLIANCE MUNICIPAL	NE	0	1	18	0.999632
AUH	AURORA MUNICIPAL – AL POTTER FIELD	NE	0	1	0	1
BIE	BEATRICE MUNICIPAL	NE	0	1	0	1
FNB	BRENNER FIELD	NE	0	1	0	1
HDE	BREWSTER FIELD	NE	0	1	0	1
BBW	BROKEN BOW MUNICIPAL	NE	0	1	0	1
GRI	CENTRAL NEBRASKA RGNL	NE	0	1	0	1
CDR	CHADRON MUNICIPAL	NE	0	1	1	0.999978
OLU	COLUMBUS MUNICIPAL	NE	0	1	0	1
CZD	COZAD MUNICIPAL	NE	0	1	0	1
CEK	CRETE MUNICIPAL	NE	0	1	0	1
OMA	EPPLEY AIRFIELD	NE	0	1	0	1
FBY	FAIRBURY MUNICIPAL	NE	0	1	0	1
FET	FREMONT MUNICIPAL	NE	0	1	0	1
OKS	GARDEN COUNTY	NE	0	1	21	0.999055
GRN	GORDON MUNICIPAL	NE	0	1	0	1
GGF	GRANT MUNICIPAL	NE	0	1	28	0.998885
HSI	HASTINGS MUNICIPAL	NE	0	1	0	1
IML	IMPERIAL MUNICIPAL	NE	0	1	34	0.997826
LXN	JIM KELLY FIELD	NE	0	1	0	1
OFK	KARL STEFAN MEMORIAL	NE	0	1	0	1
EAR	KEARNEY RGNL	NE	0	1	0	1
IBM	KIMBALL MUNICIPAL/ ROBERT E ARRAJ FIELD	NE	0	1	26	0.997912
LNK	LINCOLN	NE	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
MCK	MC COOK RGNL	NE	0	1	21	0.999393
MLE	MILLARD	NE	0	1	0	1
VTN	MILLER FIELD	NE	0	1	0	1
AFK	NEBRASKA CITY MUNICIPAL	NE	0	1	0	1
LBF	NORTH PLATTE RGNL AIRPORT LEE	NE	0	1	0	1
PMV	PLATTSMOUTH MUNICIPAL	NE	0	1	0	1
SCB	SCRIBNER STATE	NE	0	1	0	1
OGA	SEARLE FIELD	NE	0	1	25	0.999430
SWT	SEWARD MUNICIPAL	NE	0	1	0	1
SNY	SIDNEY MUNICIPAL/ LLOYD W. CARR FIEL	NE	0	1	26	0.997721
ONL	THE O'NEILL MUNICIPAL- JOHN L BAKER	NE	0	1	0	1
AHQ	WAHOO MUNICIPAL	NE	0	1	0	1
LCG	WAYNE MUNICIPAL	NE	0	1	0	1
BFF	WESTERN NEB. RGNL/WILLIAM B. H	NE	0	1	18	0.999595
JYR	YORK MUNICIPAL	NE	0	1	0	1
ASH	BOIRE FIELD	NH	0	1	0	1
CON	CONCORD MUNICIPAL	NH	0	1	0	1
EEN	DILLANT-HOPKINS	NH	0	1	0	1
LCI	LACONIA MUNICIPAL	NH	0	1	0	1
MHT	MANCHESTER	NH	0	1	0	1
PSM	PORTSMOUTH INTL AT PEASE	NH	0	1	0	1
ACY	ATLANTIC CITY INTL	NJ	0	1	1	0.999995
WWD	CAPE MAY COUNTY	NJ	0	1	4	0.999929
MIV	MILLVILLE MUNICIPAL	NJ	0	1	1	0.999979
EWR	NEWARK LIBERTY INTL	NJ	0	1	0	1
TEB	TETERBORO	NJ	0	1	0	1
ABQ	ALBUQUERQUE INTL SUNPORT	NM	0	1	36	0.997590
CVN	CLOVIS MUNICIPAL	NM	0	1	9	0.999967
AEG	DOUBLE EAGLE II	NM	0	1	35	0.997475
FMN	FOUR CORNERS RGNL	NM	0	1	34	0.997369
SVC	GRANT COUNTY	NM	0	1	27	0.999719
LRU	LAS CRUCES INTL	NM	0	1	17	0.999730
ROW	ROSWELL INTL AIR CENTER	NM	0	1	27	0.999487
LAS	MC CARRAN INTL	NV	0	1	0	1
4SD	RENO/STEAD	NV	0	1	12	0.999809
RNO	RENO/TAHOE INTL	NV	0	1	13	0.999837
WMC	WINNEMUCCA MUNICIPAL	NV	0	1	1	1
9G3	AKRON	NY	0	1	0	1
ALB	ALBANY INTL	NY	0	1	0	1
HWV	BROOKHAVEN	NY	0	1	0	1
BUF	BUFFALO NIAGARA INTL	NY	0	1	0	1
OLE	CATTARAUGUS COUNTY-OLEAN	NY	0	1	0	1
JHW	CHAUTAUQUA COUNTY/JAMESTOWN	NY	0	1	0	1
ELM	ELMIRA/CORNING RGNL	NY	0	1	0	1
FOK	FRANCIS S GABRESKI	NY	0	1	0	1
BGM	GREATER BINGHAMTON/EDWIN A LIN	NY	0	1	0	1
ROC	GREATER ROCHESTER INTL	NY	0	1	0	1
JFK	JOHN F KENNEDY INTL	NY	0	1	0	1
LGA	LA GUARDIA	NY	0	1	0	1
MSS	MASSENA INTL-RICHARDS FIELD	NY	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
N66	ONEONTA MUNICIPAL	NY	0	1	0	1
PEO	PENN YAN	NY	0	1	0	1
PBG	PLATTSBURGH INTL	NY	0	1	0	1
44N	SKY ACRES	NY	0	1	0	1
SWF	STEWART INTL	NY	0	1	0	1
SYR	SYRACUSE HANCOCK INTL	NY	0	1	0	1
ELZ	WELLSVILLE MUNICIPAL ARPT`TARANTINE	NY	0	1	0	1
HPN	WESTCHESTER COUNTY	NY	0	1	0	1
SDC	WILLIAMSON-SODUS	NY	0	1	0	1
HAO	BUTLER CO RGNL	OH	0	1	0	1
CXY	CAPITAL CITY	OH	0	1	0	1
LUK	CINCINNATI MUNICIPAL AIRPORT LUNKEN	OH	0	1	0	1
CLE	CLEVELAND-HOPKINS INTL	OH	0	1	0	1
MGY	DAYTON-WRIGHT BROTHERS	OH	0	1	0	1
DLZ	DELAWARE MUNICIPAL	OH	0	1	0	1
LHQ	FAIRFIELD COUNTY	OH	0	1	0	1
FDY	FINDLAY	OH	0	1	0	1
PMH	GREATER PORTSMOUTH RGNL	OH	0	1	0	1
I19	GREENE COUNTY-LEWIS A. JACKSON	OH	0	1	0	1
DAY	JAMES M COX DAYTON INTL	OH	0	1	0	1
1G3	KENT STATE UNIV	OH	0	1	0	1
I68	LEBANON-WARREN COUNTY	OH	0	1	0	1
UYF	MADISON COUNTY	OH	0	1	0	1
MNN	MARION MUNICIPAL	OH	0	1	0	1
AXV	NEIL ARMSTRONG	OH	0	1	0	1
OSU	OHIO STATE UNIVERSITY	OH	0	1	0	1
UNI	OHIO UNIVERSITY SNYDER FIELD	OH	0	1	0	1
CMH	PORT COLUMBUS INTL	OH	0	1	0	1
RZT	ROSS COUNTY	OH	0	1	0	1
TOL	TOLEDO EXPRESS	OH	0	1	0	1
1G0	WOOD COUNTY	OH	0	1	0	1
YNG	YOUNGSTOWN-WARREN RGNL	OH	0	1	0	1
AVK	ALVA RGNL	OK	0	1	0	1
BVO	BARTLESVILLE MUNICIPAL	OK	0	1	0	1
CQB	CHANDLER RGNL	OK	0	1	0	1
CHK	CHICKASHA MUNICIPAL	OK	0	1	0	1
GCM	CLAREMORE RGNL	OK	0	1	0	1
F29	CLARENCE E PAGE MUNICIPAL	OK	0	1	0	1
1K4	DAVID JAY PERRY	OK	0	1	0	1
MKO	DAVIS FIELD	OK	0	1	0	1
DUA	EAKER FIELD	OK	0	1	0	1
ELK	ELK CITY RGNL BUSINESS	OK	0	1	0	1
GMJ	GROVE MUNICIPAL	OK	0	1	0	1
GOK	GUTHRIE-EDMOND RGNL	OK	0	1	0	1
2O8	HINTON MUNICIPAL	OK	0	1	0	1
HBR	HOBART RGNL	OK	0	1	0	1
MLC	MC ALESTER RGNL	OK	0	1	0	1
MIO	MIAMI MUNICIPAL	OK	0	1	0	1
MDF	MOORELAND MUNICIPAL	OK	0	1	0	1
OKM	OKMULGEE RGNL	OK	0	1	0	1

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PVJ	PAULS VALLEY MUNICIPAL	OK	0	1	0	1
PNC	PONCA CITY RGNL	OK	0	1	0	1
RVS	RICHARD LLOYD JONES JR	OK	0	1	0	1
2K4	SCOTT FIELD	OK	0	1	0	1
SNL	SHAWNEE RGNL	OK	0	1	0	1
SWO	STILLWATER RGNL	OK	0	1	0	1
TQH	TAHLEQUAH MUNICIPAL	OK	0	1	0	1
TUL	TULSA INTL	OK	0	1	0	1
OUN	UNIVERSITY OF OKLAHOMA WESTHEI	OK	0	1	0	1
OKC	WILL ROGERS WORLD	OK	0	1	0	1
UAO	AURORA STATE	OR	0	1	22	0.999218
BDN	BEND MUNICIPAL	OR	0	1	17	0.999587
LMT	KLAMATH FALLS	OR	0	1	27	0.999120
LGD	LA GRANDE/UNION COUNTY	OR	0	1	1	1
EUG	MAHLON SWEET FIELD	OR	0	1	25	0.998772
MMV	MC MINNVILLE MUNICIPAL	OR	0	1	23	0.999063
SLE	MCNARY FLD	OR	0	1	23	0.999051
ONP	NEWPORT MUNICIPAL	OR	0	1	30	0.998442
ONO	ONTARIO MUNICIPAL	OR	0	1	1	1
PDX	PORTLAND INTL	OR	0	1	20	0.999371
AGC	ALLEGHENY COUNTY	PA	0	1	0	1
AOO	ALTOONA-BLAIR COUNTY	PA	0	1	0	1
LBE	ARNOLD PALMER RGNL	PA	0	1	0	1
BFD	BRADFORD RGNL	PA	0	1	0	1
BTP	BUTLER COUNTY/K W SCHOLTER FIE	PA	0	1	0	1
MQS	CHESTER COUNTY G O CARLSON	PA	0	1	0	1
AXQ	CLARION COUNTY	PA	0	1	0	1
9D4	DECK	PA	0	1	0	1
DUJ	DUBOIS RGNL	PA	0	1	0	1
WAY	GREENE COUNTY	PA	0	1	0	1
HZL	HAZLETON MUNICIPAL	PA	0	1	0	1
JST	JOHN MURTHA JOHNSTOWN-CAMBRIA	PA	0	1	0	1
LNS	LANCASTER	PA	0	1	0	1
ABE	LEHIGH VALLEY INTL	PA	0	1	0	1
RVL	MIFFLIN COUNTY	PA	0	1	0	1
UCP	NEW CASTLE MUNICIPAL	PA	0	1	0	1
PNE	NORTHEAST PHILADELPHIA	PA	0	1	0	1
PHL	PHILADELPHIA INTL	PA	0	1	0	1
PIT	PITTSBURGH INTL	PA	0	1	0	1
FWQ	ROSTRAVER	PA	0	1	0	1
2G9	SOMERSET COUNTY	PA	0	1	0	1
OYM	ST MARYS MUNICIPAL	PA	0	1	0	1
UNV	UNIVERSITY PARK	PA	0	1	0	1
FKL	VENANGO RGNL	PA	0	1	0	1
BID	BLOCK ISLAND STATE	RI	0	1	0	1
OQU	QUONSET STATE	RI	0	1	0	1
PVD	THEODORE FRANCIS GREEN STATE	RI	0	1	0	1
AIK	AIKEN MUNICIPAL	SC	0	1	1	0.999998
AND	ANDERSON RGNL	SC	0	1	0	1
CHS	CHARLESTON AFB/INTL	SC	0	1	6	0.999692
JZI	CHARLESTON EXECUTIVE	SC	0	1	6	0.999531
CAE	COLUMBIA METROPOLITAN	SC	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
UDG	DARLINGTON COUNTY JETPORT	SC	0	1	0	1
GYH	DONALDSON CENTER	SC	0	1	0	1
GGE	GEORGETOWN COUNTY	SC	0	1	6	0.999567
GSP	GREENVILLE SPARTANBURG INTL	SC	0	1	0	1
MYR	MYRTLE BEACH INTL	SC	0	1	6	0.999613
CEU	OCONEE COUNTY RGNL	SC	0	1	0	1
CDN	WOODWARD FIELD	SC	0	1	0	1
ABR	ABERDEEN RGNL	SD	0	1	0	1
BKX	BROOKINGS RGNL	SD	0	1	0	1
YKN	CHAN GURNEY MUNICIPAL	SD	0	1	0	1
HON	HURON RGNL	SD	0	1	0	1
FSD	JOE FOSS FIELD	SD	0	1	0	1
MHE	MITCHELL MUNICIPAL	SD	0	1	0	1
PIR	PIERRE RGNL	SD	0	1	0	1
RAP	RAPID CITY RGNL	SD	0	1	0	1
ATY	WATERTOWN RGNL	SD	0	1	0	1
PVE	BEECH RIVER RGNL	TN	0	1	0	1
SYI	BOMAR FIELD-SHELBYVILLE MUNICIPAL	TN	0	1	0	1
UCY	EVERETT-STEWART RGNL	TN	0	1	0	1
CHA	LOVELL FIELD	TN	0	1	0	1
TYS	MC GHEE TYSON	TN	0	1	0	1
MEM	MEMPHIS INTL	TN	0	1	0	1
NQA	MILLINGTON RGNL JETPORT	TN	0	1	0	1
BNA	NASHVILLE INTL	TN	0	1	0	1
SZY	ROBERT SIBLEY	TN	0	1	0	1
TRI	TRI-CITIES RGNL TN/VA	TN	0	1	0	1
BGF	WINCHESTER MUNICIPAL	TN	0	1	0	1
ABI	ABILENE RGNL	TX	0	1	0	1
ADS	ADDISON	TX	0	1	0	1
ALI	ALICE INTL	TX	0	1	0	1
LFK	ANGELINA COUNTY	TX	0	1	0	1
GKY	ARLINGTON MUNICIPAL	TX	0	1	0	1
AUS	AUSTIN-BERGSTROM INTL	TX	0	1	0	1
LBX	BRAZORIA COUNTY	TX	0	1	0	1
BWD	BROWNWOOD RGNL	TX	0	1	0	1
E30	BRUCE FIELD	TX	0	1	0	1
TKI	COLLIN COUNTY RGNL AT MC KINNE	TX	0	1	0	1
CRP	CORPUS CHRISTI INTL	TX	0	1	0	1
CFD	COULTER FIELD	TX	0	1	0	1
PRX	COX FIELD	TX	0	1	0	1
BBD	CURTIS FIELD	TX	0	1	0	1
RBD	DALLAS EXECUTIVE	TX	0	1	0	1
DAL	DALLAS LOVE FIELD	TX	0	1	0	1
DFW	DALLAS/FORT WORTH INTL	TX	0	1	0	1
DWH	DAVID WAYNE HOOKS MEMORIAL	TX	0	1	0	1
LUD	DECATUR MUNICIPAL	TX	0	1	0	1
DRT	DEL RIO INTL	TX	0	1	2	0.999975
TPL	DRAUGHON-MILLER CENTRAL TEXAS	TX	0	1	0	1
GGG	EAST TEXAS RGNL	TX	0	1	0	1
CLL	EASTERWOOD FIELD	TX	0	1	0	1
ELP	EL PASO INTL	TX	0	1	25	0.999649

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
AFW	FORT WORTH ALLIANCE	TX	0	1	0	1
FWS	FORT WORTH SPINKS	TX	0	1	0	1
IAH	GEORGE BUSH INTERCONTINENTAL/H	TX	0	1	0	1
PVW	HALE COUNTY	TX	0	1	0	1
INJ	HILLSBORO MUNICIPAL	TX	0	1	0	1
TME	HOUSTON EXECUTIVE	TX	0	1	0	1
AXH	HOUSTON-SOUTHWEST	TX	0	1	0	1
ERV	KERRVILLE MUNICIPAL/ LOUIS SCHREINER	TX	0	1	0	1
LNC	LANCASTER	TX	0	1	0	1
LRD	LAREDO INTL	TX	0	1	0	1
CXO	LONE STAR EXECUTIVE	TX	0	1	0	1
LBB	LUBBOCK PRESTON SMITH INTL	TX	0	1	0	1
GVT	MAJORS	TX	0	1	0	1
5T9	MAVERICK COUNTY MEMORIAL INTL	TX	0	1	2	1
MFE	MC ALLEN MILLER INTL	TX	0	1	0	1
HQZ	MESQUITE METRO	TX	0	1	0	1
MAF	MIDLAND INTL	TX	0	1	0	1
OSA	MOUNT PLEASANT RGNL	TX	0	1	0	1
RAS	MUSTANG BEACH	TX	0	1	0	1
BAZ	NEW BRAUNFELS MUNICIPAL	TX	0	1	0	1
PIL	PORT ISABEL-CAMERON COUNTY	TX	0	1	0	1
AMA	RICK HUSBAND AMARILLO INTL	TX	0	1	0	1
SJT	SAN ANGELO RGNL/MATHIS FIELD	TX	0	1	0	1
SAT	SAN ANTONIO INTL	TX	0	1	0	1
HYI	SAN MARCOS MUNICIPAL	TX	0	1	0	1
GLS	SCHOLES INTL AT GALVESTON	TX	0	1	0	1
SPS	SHEPPARD AFB/ WICHITA FALLS MUNICIPAL	TX	0	1	0	1
EBG	SOUTH TEXAS INTL AT EDINBURG	TX	0	1	0	1
SGR	SUGAR LAND RGNL	TX	0	1	0	1
TFP	T P MC CAMPBELL	TX	0	1	0	1
TRL	TERRELL MUNICIPAL	TX	0	1	0	1
TYR	TYLER POUNDS RGNL	TX	0	1	0	1
HRL	VALLEY INTL	TX	0	1	0	1
IWS	WEST HOUSTON	TX	0	1	0	1
HOU	WILLIAM P HOBBY	TX	0	1	0	1
CDC	CEDAR CITY RGNL	UT	0	1	1	1
KNB	KANAB MUNICIPAL	UT	0	1	1	1
LGU	LOGAN-CACHE	UT	0	1	1	1
OGD	OGDEN-HINCKLEY	UT	0	1	1	1
PVU	PROVO MUNICIPAL	UT	0	1	1	1
SLC	SALT LAKE CITY INTL	UT	0	1	1	1
SGU	ST GEORGE MUNICIPAL	UT	0	1	0	1
MFV	ACCOMACK COUNTY	VA	0	1	4	0.999812
MTV	BLUE RIDGE	VA	0	1	0	1
CHO	CHARLOTTESVILLE-ALBEMARLE	VA	0	1	0	1
FCI	CHESTERFIELD COUNTY	VA	0	1	2	1
CJR	CULPEPER RGNL	VA	0	1	0	1
PTB	DINWIDDIE COUNTY	VA	0	1	2	0.999978
OFP	HANOVER COUNTY MUNICIPAL	VA	0	1	0	1
JYO	LEESBURG EXECUTIVE	VA	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
LNP	LONESOME PINE	VA	0	1	0	1
LYH	LYNCHBURG RGNL/PRESTON GLENN F	VA	0	1	0	1
HEF	MANASSAS RGNL/HARRY P. DAVIS F	VA	0	1	0	1
MKJ	MOUNTAIN EMPIRE	VA	0	1	0	1
PSK	NEW RIVER VALLEY	VA	0	1	0	1
PHF	NEWPORT NEWS/WILLIAMSBURG INTL	VA	0	1	4	0.999872
ORF	NORFOLK INTL	VA	0	1	4	0.999825
RIC	RICHMOND INTL	VA	0	1	2	0.999952
RMN	STAFFORD RGNL	VA	0	1	0	1
XSA	TAPPAHANNOCK-ESSEX COUNTY	VA	0	1	2	0.999923
BCB	VIRGINIA TECH/ MONTGOMERY EXECUTIVE	VA	0	1	0	1
IAD	WASHINGTON DULLES INTL	VA	0	1	0	1
BTV	BURLINGTON INTL	VT	0	1	0	1
FSO	FRANKLIN COUNTY STATE	VT	0	1	0	1
BLI	BELLINGHAM INTL	WA	0	1	3	0.999973
HQM	BOWERMAN	WA	0	1	19	0.999330
PWT	BREMERTON NATIONAL	WA	0	1	13	0.999826
DEW	DEER PARK	WA	0	1	1	1
FHR	FRIDAY HARBOR	WA	0	1	4	0.999964
MWH	GRANT CO INTL	WA	0	1	1	1
OLM	OLYMPIA	WA	0	1	14	0.999653
PUW	PULLMAN/MOSCOW RGNL	WA	0	1	1	1
RLD	RICHLAND	WA	0	1	1	1
SEA	SEATTLE-TACOMA INTL	WA	0	1	9	0.999898
BVS	SKAGIT RGNL	WA	0	1	3	0.999976
PAE	SNOHOMISH COUNTY (PAINE FLD)	WA	0	1	4	0.999965
GEG	SPOKANE INTL	WA	0	1	1	1
TIW	TACOMA NARROWS	WA	0	1	12	0.999826
PSC	TRI-CITIES	WA	0	1	1	1
ALW	WALLA WALLA RGNL	WA	0	1	1	1
CLM	WILLIAM R FAIRCHILD INTL	WA	0	1	10	0.999877
GRB	AUSTIN STRAUBEL INTL	WI	0	1	0	1
DLL	BARABOO WISCONSIN DELLS	WI	0	1	0	1
OVS	BOSCOBEL	WI	0	1	0	1
CWA	CENTRAL WISCONSIN	WI	0	1	0	1
EAU	CHIPPEWA VALLEY RGNL	WI	0	1	0	1
MSN	DANE COUNTY RGNL-TRUAX FIELD	WI	0	1	0	1
UNU	DODGE COUNTY	WI	0	1	0	1
SUE	DOOR COUNTY CHERRYLAND	WI	0	1	0	1
EGV	EAGLE RIVER UNION	WI	0	1	0	1
FLD	FOND DU LAC COUNTY	WI	0	1	0	1
MKE	GENERAL MITCHELL INTL	WI	0	1	0	1
ASX	JOHN F KENNEDY MEMORIAL	WI	0	1	0	1
LSE	LA CROSSE MUNICIPAL	WI	0	1	0	1
MTW	MANITOWOC COUNTY	WI	0	1	0	1
MFI	MARSHFIELD MUNICIPAL	WI	0	1	0	1
LUM	MENOMONIE MUNICIPAL-SCORE FIELD	WI	0	1	0	1
RRL	MERRILL MUNICIPAL	WI	0	1	0	1
C29	MIDDLETON MUNICIPAL – MOREY FIELD	WI	0	1	0	1
ATW	OUTAGAMIE COUNTY RGNL	WI	0	1	0	1

Airport Id	Airport Name	State	LPV Outages	LPV Availability	LPV 200 Outages	LPV 200 Availability
PBH	PRICE COUNTY	WI	0	1	0	1
RHI	RHINELANDER-ONEIDA COUNTY	WI	0	1	0	1
RPD	RICE LAKE RGNL - CARL'S FIELD	WI	0	1	0	1
HYR	SAWYER COUNTY	WI	0	1	0	1
SBM	SHEBOYGAN COUNTY MEMORIAL	WI	0	1	0	1
JVL	SOUTHERN WISCONSIN RGNL	WI	0	1	0	1
TKV	TOMAHAWK RGNL	WI	0	1	0	1
LNR	TRI-COUNTY RGNL	WI	0	1	0	1
OSH	WITTMAN RGNL	WI	0	1	0	1
MRB	EASTERN WV RGNL/SHEPHERD FLD	WV	0	1	0	1
PKB	MID-OHIO VALLEY RGNL	WV	0	1	0	1
HTS	TRI-STATE/MILTON J. FERGUSON F	WV	0	1	0	1
CYS	CHEYENNE RGNL/JERRY OLSON FIEL	WY	0	1	5	0.999795
EVW	EVANSTON-UINTA COUNTY BURNS FI	WY	0	1	1	1
GCC	GILLETTE-CAMPBELL COUNTY	WY	0	1	0	1
JAC	JACKSON HOLE	WY	0	1	0	1
LAR	LARAMIE RGNL	WY	0	1	2	0.999932
CPR	NATRONA COUNTY INTL	WY	0	1	0	1
RIW	RIVERTON RGNL	WY	0	1	0	1
RKS	ROCK SPRINGS-SWEETWATER COUNTY	WY	0	1	0	1
SHR	SHERIDAN COUNTY	WY	0	1	0	1
COD	YELLOWSTONE RGNL	WY	0	1	0	1

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	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10	Oct 10	Nov 10	Dec 10
Albuquerque	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Good	Excellent
Anchorage	A	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent	Excellent	Good	Good	Good
	C	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Good	Excellent
Atlanta	A	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Fair
	C	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Barrow	A	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Fair	Fair	Good	Excellent	Fair
	C	Excellent	Excellent	Excellent	Fair	Fair	Fair	Fair	Good	Excellent	Excellent	Excellent	Excellent
Bethel	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Billings	A	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Good
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Fair	Excellent	Excellent
	C	Good	Good	Excellent	Good	Fair	Excellent	Fair	Fair	Excellent	Excellent	Good	Excellent
Boston	A	Excellent	Fair	Fair	Fair	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Excellent
Chicago	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Good	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Fair
Cleveland	A	Good	Excellent	Excellent	Poor	Fair	Fair	Excellent	Excellent	Excellent	Good	Poor	Excellent
	B	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fair
	C	Excellent	Fair	Good	Good	Excellent	Excellent	Excellent	Good	Excellent	Fair	Excellent	Good
Cold Bay	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Good	Excellent	Excellent	Excellent
	B	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Poor	Good	Good	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Dallas	A	Excellent	Poor	Excellent	Fair	Excellent	Excellent	Fair	Fair	Fair	Excellent	Poor	Good
	B	Good	Poor	Excellent	Good	Fair	Good	Good	Fair	Poor	Fair	Good	Excellent
	C	Excellent	Excellent	Good	Fair	Excellent	Excellent	Good	Excellent	Poor	Good	Good	Fair
Denver	A	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Good	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Good	Good	Excellent	Excellent	Good	Fair	Good	Excellent	Excellent	Excellent	Excellent
Fairbanks	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Fair	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Fair	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good
Gander	A	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Goose Bay	A	Excellent	Excellent	Good	Excellent	Excellent	Fair	Fair	Excellent	Excellent	Fair	Fair	Excellent
	B	Excellent	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Good
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Excellent
Honolulu	A	Good	Good	Excellent	Fair	Excellent	Excellent	Poor	Fair	Fair	Excellent	Fair	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Fair	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent
Houston	A	Excellent	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Good	Excellent
	B	Excellent	Fair	Fair	Fair	Good	Fair	Good	Good	Fair	Fair	Poor	Good
	C	Excellent	Fair	Fair	Fair	Fair	Excellent	Poor	Poor	Poor	Good	Good	Poor
Iqaluit	A	Excellent	Fair	Excellent	Excellent	Excellent	Good	Fair	Good	Fair	Good	Fair	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Poor	Poor	Fair	Good	Excellent	Fair	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Poor	Poor	Good	Good	Fair	Excellent	Excellent
Jacksonville	A	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	B	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
	C	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent

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

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

🔵 **Excellent** - 3.29σ bounded 100%
🟢 **Good** - 4σ bounded 100%
🟡 **Fair** - 4σ bounded 100% with one worst satellite excluded (Requires manual review if symptoms repeat from month to month)
🔴 **Poor** – Requires manual review
– No data available

11.0 WAAS REFERENCE STATION SURVEY VALIDATION

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

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

Antenna L1 phase center position surveys were preformed for the WAAS antennas using a 25 hour set of data from 23:00 on 12/27/10 to 23:59:30 on 12/28/10 for all of the WAAS receivers except Tapachula Mexico thread C (MTP-C) and Bethel-A. Tapachula A and B have been restored, but C is still off line pending delivery of replacements for the lightning arrestors. The Bethel-A data set started on 12/28/10 at 00:27 and had a couple short data gaps during the day. The overall RMS quality reported for BET-A was still very good, 0.01 meters.

Surveys were performed using the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) and the Canadian Spatial Reference System (CSRS) Precise Point Positioning (PPP) service. The overall RMS qualities reported by OPUS were all less than or equal to 2.3 cm. The CSRS survey's RSSs of the reported ECEF sigma's were all less than equal to 1.5 cm. The OPUS and CSRS surveys agreed to 5 cm or better except for Los Angeles and Houston. Los Angeles agreed to 6.3 cm and Houston agreed to 5.6 cm.

The positions were compared to the positions in the current WAAS software build 6.012 that was fielded during November 2009 and the next release, build 6.075, which will be fielded this fall 2011. The build 6.012 positions have been interpolated to 8/1/10. The build 6.075 positions have been interpolated forward to 4/1/2011.

The OPUS surveys agree with the build 6.012 positions to better than or equal to 7 cm, with the expected exception of Mexico City which was 10 cm. The OPUS surveys agree with the build 6.075 positions to better or equal 7.5 cm with the exceptions of Los Angeles which was 9 cm.

Table 11.1 lists the WAAS antenna L1 phase center positions as of 12/27/10. The positions are in IRTF-2000 and are the OPUS estimated positions. OPUS is using GEOID 09.

Figure 11.1 to 11.3 show the RSS of the ECEF difference between the 12/27/10 OPUS survey antenna phase center locations and the locations in the build 6.012 software which was fielded 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(A). The next two bars in the chart are Bethel string 2(B) and Bethel string 3(C). Figure 11.4 to 11.6 show the OPUS overall RMS quality indications.

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

Figure 11.13 to 11.15 show the RSS of the ECEF difference between the 12/27/10 OPUS survey antenna phase center locations and the locations in the build 6.075 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	-2965385.012	-972576.641	5543892.950	60.787915902778	-161.841724444444	52.216
BET2	-2965385.780	-972580.360	5543891.897	60.787896497222	-161.841663961111	52.218
BET3	-2965388.346	-972577.493	5543891.028	60.787880591667	-161.841728658333	52.214
BIL1	-1416445.861	-4223577.047	4550862.171	45.803706822222	-108.539722713889	1112.273
BIL2	-1416449.931	-4223574.903	4550862.890	45.803716094444	-108.539781111111	1112.273
BIL3	-1416441.555	-4223574.312	4550866.021	45.803756519444	-108.539681391667	1112.271
BRW1	-1886758.881	-809058.683	6018494.534	71.282765350000	-156.789923797222	15.616
BRW2	-1886756.293	-809055.945	6018495.705	71.282798066667	-156.789965561111	15.616
BRW3	-1886755.204	-809059.726	6018495.533	71.282793419444	-156.789856600000	15.610
CDB1	-3484099.012	-1084748.830	5213678.687	55.192374616667	-162.706403786111	49.730
CDB2	-3484105.656	-1084741.621	5213675.735	55.192328500000	-162.706542872222	49.704
CDB3	-3484111.929	-1084734.857	5213672.987	55.192285066667	-162.706673555556	49.719
FAI1	-2304741.755	-1448715.285	5748843.713	64.809630475000	-147.847340138889	149.942
FAI2	-2304741.282	-1448706.480	5748846.099	64.809680863889	-147.847491741667	149.936
FAI3	-2304732.750	-1448707.414	5748849.250	64.809747486111	-147.847379530556	149.924
HNL1	-5508637.100	-2234493.435	2303722.140	21.312989677778	-157.920826394444	24.694
HNL2	-5508656.255	-2234483.747	2303686.902	21.312646872222	-157.920982322222	25.030
HNL3	-5508647.677	-2234497.688	2303694.000	21.312715486111	-157.920826730556	25.086
JNU1	-2354254.863	-2388549.667	5407043.111	58.362574663889	-134.585706458333	16.093
JNU2	-2354252.765	-2388565.767	5407036.924	58.362469138889	-134.585487852778	16.068
JNU3	-2354239.556	-2388568.625	5407041.399	58.362545530556	-134.585292858333	16.082
MMD1	35070.439	-5959686.719	2264365.764	20.931909072222	-89.662840508333	29.167
MMD2	35065.519	-5959687.092	2264364.983	20.931901372222	-89.662887827778	29.209
MMD3	35065.178	-5959685.300	2264369.633	20.931946388889	-89.662891005556	29.195
MMX1	-948701.152	-5943935.966	2109212.811	19.431653333333	-99.068389611111	2235.973
MMX2	-948696.722	-5943935.790	2109215.232	19.431676572222	-99.068348233333	2235.956
MMX3	-948705.582	-5943936.158	2109210.386	19.431630013889	-99.068430963889	2236.004
MPR1	-1570142.217	-5759530.641	2238184.754	20.679003197222	-105.249203083333	11.010
MPR2	-1570139.395	-5759530.149	2238188.803	20.679041294444	-105.249178194444	11.301
MPR3	-1570143.505	-5759528.026	2238190.568	20.679059294444	-105.249221611111	11.019
MSD1	-1979519.675	-5523223.137	2493106.761	23.160446430556	-109.717647361111	104.332
MSD2	-1979521.239	-5523225.471	2493100.360	23.160383613889	-109.717654047222	104.320
MSD3	-1979525.694	-5523222.208	2493104.033	23.160419677778	-109.717705752778	104.322
MTP1	-254854.342	-6162909.208	1617805.096	14.791366166667	-92.367999061111	54.990
MTP2	-254850.736	-6162910.244	1617801.669	14.791334175000	-92.367965197222	54.972
MTP3	-254855.506	-6162910.340	1617800.127	14.791320025	-92.368009431	54.861
OTZ1	-2396055.997	-750356.182	5843502.556	66.887332441667	-162.611372302778	10.916
OTZ2	-2396052.823	-750354.353	5843504.075	66.887367277778	-162.611390486111	10.910
OTZ3	-2396052.803	-750358.292	5843503.588	66.887356013889	-162.611304572222	10.917
YFB1	1035381.488	-2634289.655	5696539.525	63.731490233333	-68.543182766667	10.026
YFB2	1035372.279	-2634296.061	5696538.165	63.731463972222	-68.543403694444	9.954
YFB3	1035366.206	-2634306.815	5696534.388	63.731386333333	-68.543597738889	10.014

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
YQX1	2430424.657	-3419640.399	4788223.811	48.966489755556	-54.597631958333	146.875
YQX2	2430432.625	-3419639.055	4788220.754	48.966447830556	-54.597532627778	146.880
YQX3	2430440.524	-3419637.687	4788217.752	48.966406633333	-54.597433872222	146.888
YWG1	-520164.323	-4083475.893	4855842.975	49.900574333333	-97.259396972222	222.016
YWG2	-520150.458	-4083468.835	4855850.347	49.900677219444	-97.259217950000	222.017
YWG3	-520152.322	-4083477.953	4855842.534	49.900568155556	-97.259227650000	222.019
YYR1	1885341.454	-3321428.371	5091171.621	53.308646744444	-60.419467988889	37.833
YYR2	1885344.414	-3321419.890	5091176.038	53.308713072222	-60.419366563889	37.841
YYR3	1885340.128	-3321413.075	5091182.045	53.308803269444	-60.419372011111	37.853
ZAB1	-1488636.810	-5003946.566	3654557.695	35.173575213889	-106.567349350000	1620.131
ZAB2	-1488631.484	-5003948.258	3654557.684	35.173574597222	-106.567288027778	1620.209
ZAB3	-1488632.260	-5003950.845	3654553.828	35.173532175000	-106.567288097222	1620.195
ZAN1	-2659536.587	-1549114.827	5567750.775	61.229202052778	-149.780249427778	80.699
ZAN2	-2659548.341	-1549110.872	5567746.287	61.229118433333	-149.780423180556	80.696
ZAN3	-2659541.292	-1549106.743	5567750.761	61.229202016667	-149.780423552778	80.686
ZAU1	138704.147	-4761244.182	4227763.954	41.782657955556	-88.331336327778	195.934
ZAU2	138704.407	-4761248.788	4227758.789	41.782595616667	-88.331334813889	195.931
ZAU3	138711.109	-4761248.529	4227758.873	41.782596561111	-88.331254141667	195.940
ZBW1	1490299.264	-4448983.203	4306010.488	42.735720175000	-71.480425477778	39.142
ZBW2	1490304.368	-4448981.182	4306010.822	42.735724186111	-71.480358538889	39.151
ZBW3	1490306.079	-4448984.813	4306006.516	42.735671363889	-71.480352811111	39.157
ZDC1	1069125.800	-4839599.005	4001126.501	39.101595708333	-77.542746158333	80.079
ZDC2	1069128.188	-4839603.660	4001120.308	39.101523672222	-77.542730808333	80.101
ZDC3	1069124.092	-4839602.739	4001122.498	39.101549108333	-77.542774750000	80.098
ZDV1	-1273628.591	-4711375.612	4094890.127	40.187303202778	-105.127224002778	1541.390
ZDV2	-1273622.891	-4711377.127	4094890.148	40.187303491667	-105.127154763889	1541.384
ZDV3	-1273624.892	-4711380.320	4094885.856	40.187253027778	-105.127167658333	1541.368
ZFW1	-659983.183	-5324060.812	3438276.473	32.830649577778	-97.066471575000	155.647
ZFW2	-659988.450	-5324063.378	3438271.490	32.830596208333	-97.066524027778	155.630
ZFW3	-659983.478	-5324063.897	3438271.699	32.830598263889	-97.066470650000	155.662
ZHU1	-513864.452	-5506451.801	3166720.499	29.961896136111	-95.331425980556	10.943
ZHU2	-513867.100	-5506455.194	3166714.332	29.961831608333	-95.331450030556	11.003
ZHU3	-513873.377	-5506457.834	3166708.732	29.961773372222	-95.331512238889	10.989
ZJX1	772646.461	-5434462.234	3237231.734	30.698859369444	-81.908185000000	2.172
ZJX2	772649.793	-5434463.789	3237228.336	30.698823766667	-81.908152850000	2.164
ZJX3	772645.735	-5434466.214	3237225.233	30.698791275000	-81.908198350000	2.154
ZKC1	-415247.489	-4954556.415	3982161.118	38.880159291667	-94.790833486111	305.918
ZKC2	-415231.095	-4954557.736	3982161.183	38.880160044444	-94.790643952778	305.917
ZKC3	-415237.213	-4954561.084	3982155.982	38.880101822222	-94.790710988889	305.648
ZLA1	-2474409.904	-4637294.758	3602183.539	34.603517927778	-118.083894508333	763.581
ZLA2	-2474404.623	-4637297.560	3602183.550	34.603518080556	-118.083829341667	763.576
ZLA3	-2474411.241	-4637297.234	3602179.567	34.603474055556	-118.083894661111	763.642
ZLC1	-1808273.175	-4486410.838	4145303.022	40.786043313889	-111.952177058333	1287.434
ZLC2	-1808274.576	-4486414.451	4145298.537	40.785989952778	-111.952176450000	1287.438

WRE	X(m)	Y(m)	Z(m)	Latitude	Longitude	H(m)
ZLC3	-1808270.366	-4486416.156	4145298.525	40.785989825000	-111.952122650000	1287.436
ZMA1	966042.318	-5662999.862	2761581.498	25.824612025000	-80.319189686111	-7.551
ZMA2	966029.343	-5662999.153	2761585.979	25.824659761111	-80.319316061111	-8.192
ZMA3	966037.431	-5662998.005	2761586.330	25.824661713889	-80.319234619444	-7.833
ZME1	4070.924	-5226189.305	3644028.416	35.067394019445	-89.955369638889	68.606
ZME2	4070.953	-5226186.766	3644032.529	35.067437511111	-89.955369300000	68.891
ZME3	4064.754	-5226186.643	3644032.692	35.067439375000	-89.955437258333	68.880
ZMP1	-249978.341	-4539297.536	4458955.063	44.637463122222	-93.152084950000	262.686
ZMP2	-249972.541	-4539297.871	4458955.057	44.637462986111	-93.152011730556	262.693
ZMP3	-249973.643	-4539302.161	4458950.591	44.637406922222	-93.152022625000	262.646
ZNY1	1406144.682	-4627344.004	4144322.064	40.784328436111	-73.097165225000	6.479
ZNY2	1406146.468	-4627347.048	4144317.286	40.784275672222	-73.097155463889	5.956
ZNY3	1406140.915	-4627348.702	4144317.329	40.784276152778	-73.097224105556	5.960
ZOA1	-2684436.839	-4293337.508	3865351.836	37.543053302778	-122.015946858333	-3.463
ZOA2	-2684433.826	-4293341.583	3865349.400	37.543025700000	-122.015893505556	-3.474
ZOA3	-2684438.205	-4293342.482	3865345.557	37.542981313889	-122.015930125000	-3.371
ZOB1	650770.214	-4754715.709	4187420.766	41.297154316667	-82.206444433333	223.722
ZOB2	650777.891	-4754714.882	4187422.773	41.297166575000	-82.206352286111	225.213
ZOB3	650776.224	-4754719.714	4187414.992	41.297086836111	-82.206379827778	223.505
ZSE1	-2308930.243	-3668169.707	4663526.495	47.286993291667	-122.188372302778	82.120
ZSE2	-2308934.636	-3668175.245	4663520.086	47.286907750000	-122.188382450000	82.178
ZSE3	-2308935.697	-3668179.528	4663516.153	47.286856061111	-122.188364161111	82.130
ZSU1	2462589.364	-5529371.568	2003724.618	18.431338530556	-65.993475280556	-28.560
ZSU2	2462587.294	-5529377.326	2003711.629	18.431214577778	-65.993515355556	-28.476
ZSU3	2462593.927	-5529375.116	2003709.569	18.431194980556	-65.993449488889	-28.482
ZTL1	529840.429	-5305248.840	3489342.845	33.379688394444	-84.296725763889	261.159
ZTL2	529846.807	-5305248.012	3489343.136	33.379691527778	-84.296656680556	261.161
ZTL3	529847.486	-5305251.439	3489337.896	33.379634827778	-84.296653077778	261.182

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

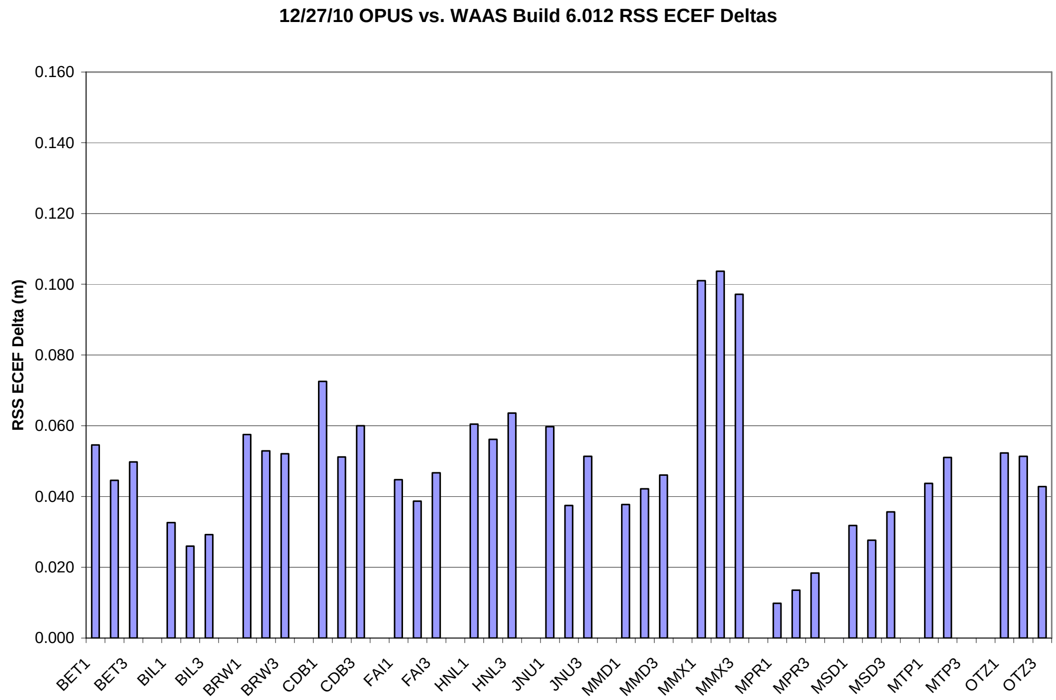


Figure 11-2 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

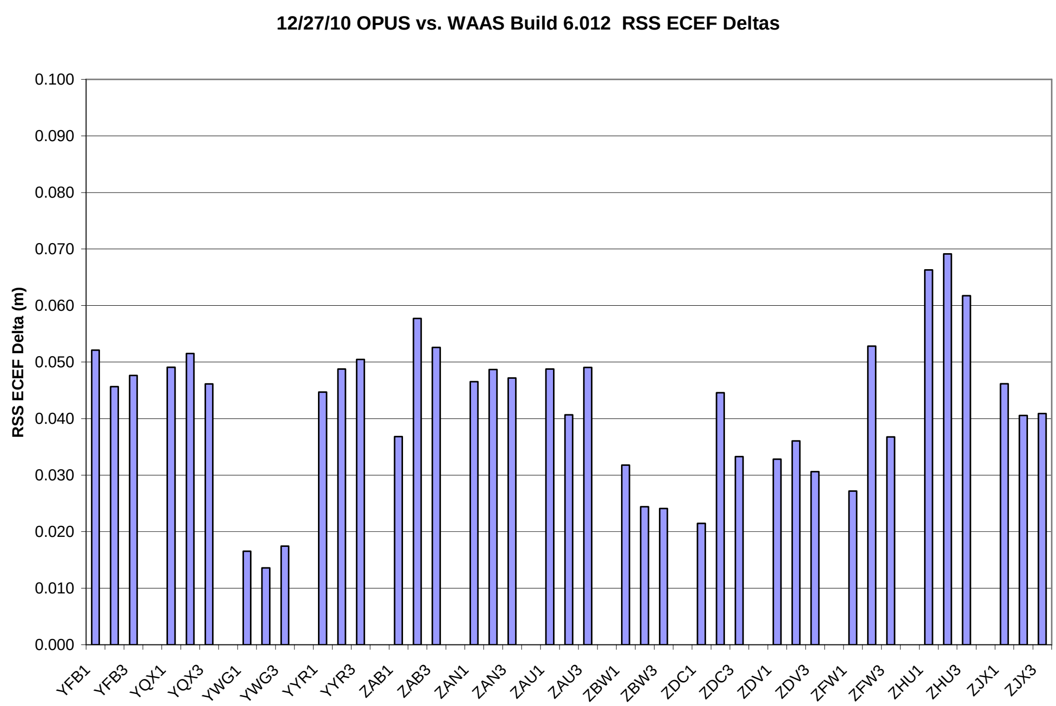


Figure 11-3 WAAS Build 6.012 Antenna Positions Deltas from OPUS Survey

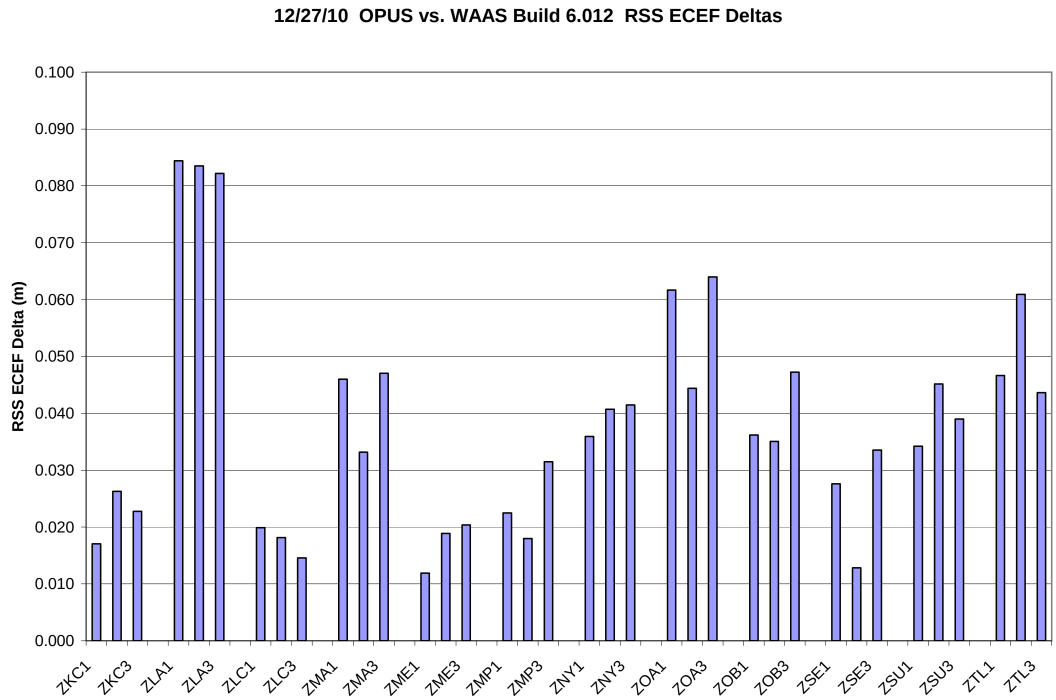


Figure 11-4 OPUS Overall RMS Qualitites

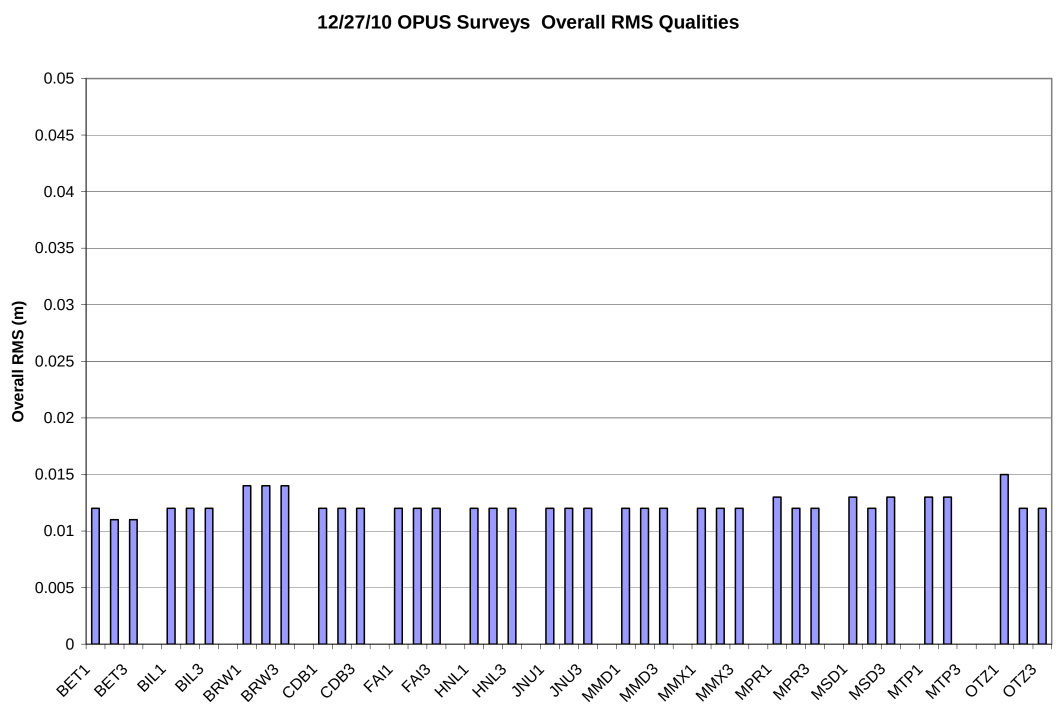


Figure 11-5 OPUS Survey Overall RMS Qualities

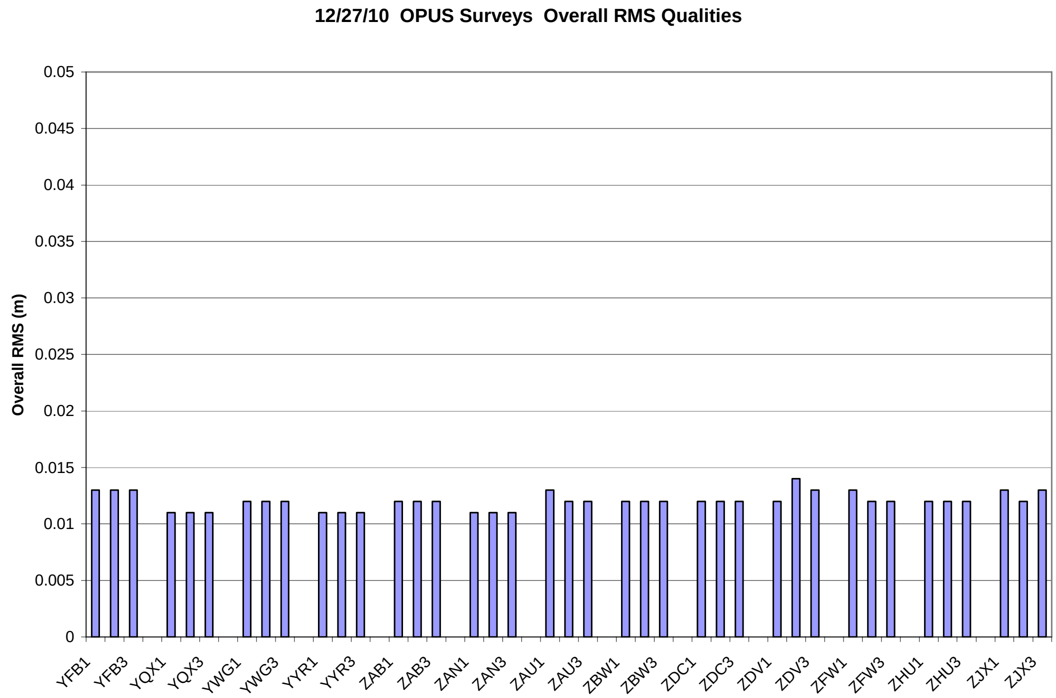


Figure 11-6 OPUS Survey Overall RMS Qualities

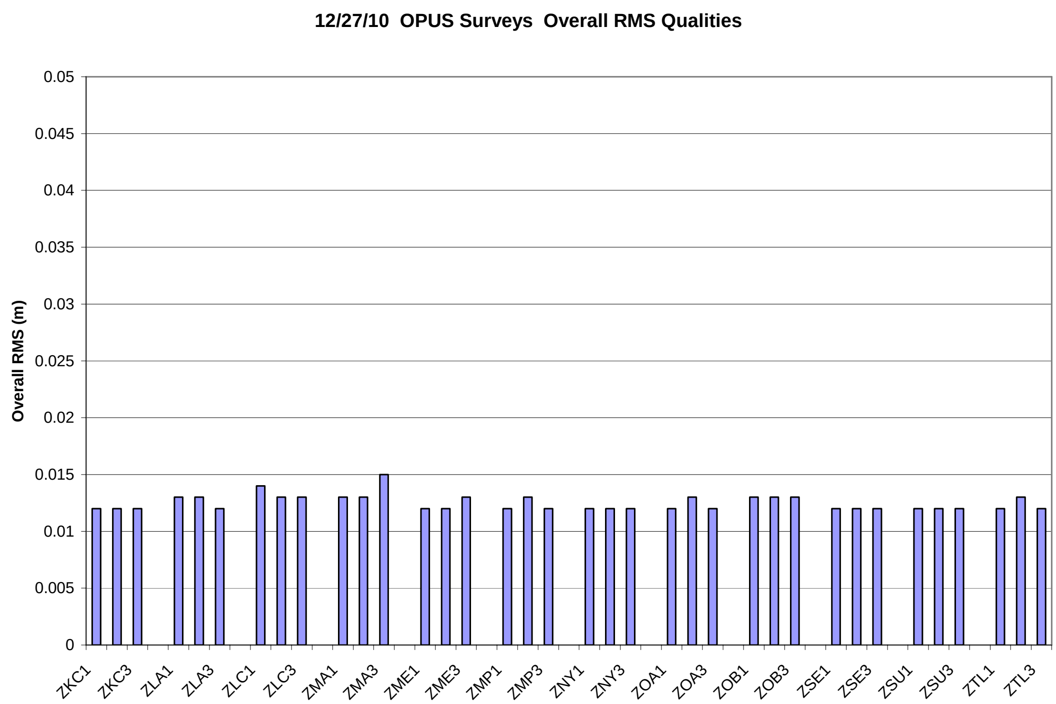


Figure 11-7 OPUS vs. CSRS RSS ECEF Deltas

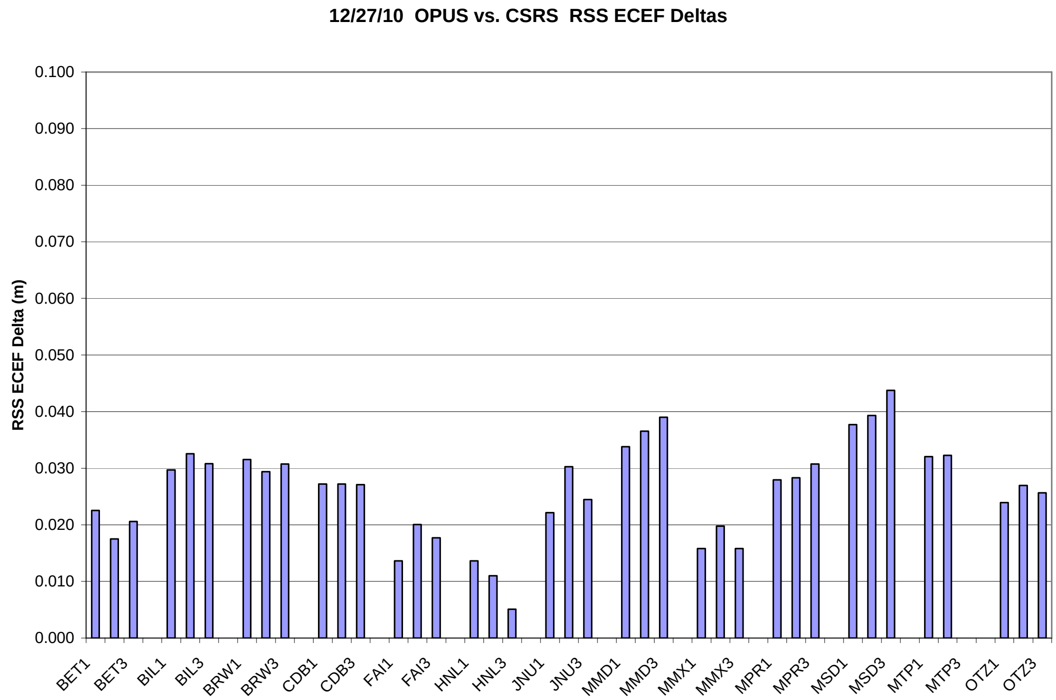


Figure 11-8 OPUS vs. CSRS RSS ECEF Deltas

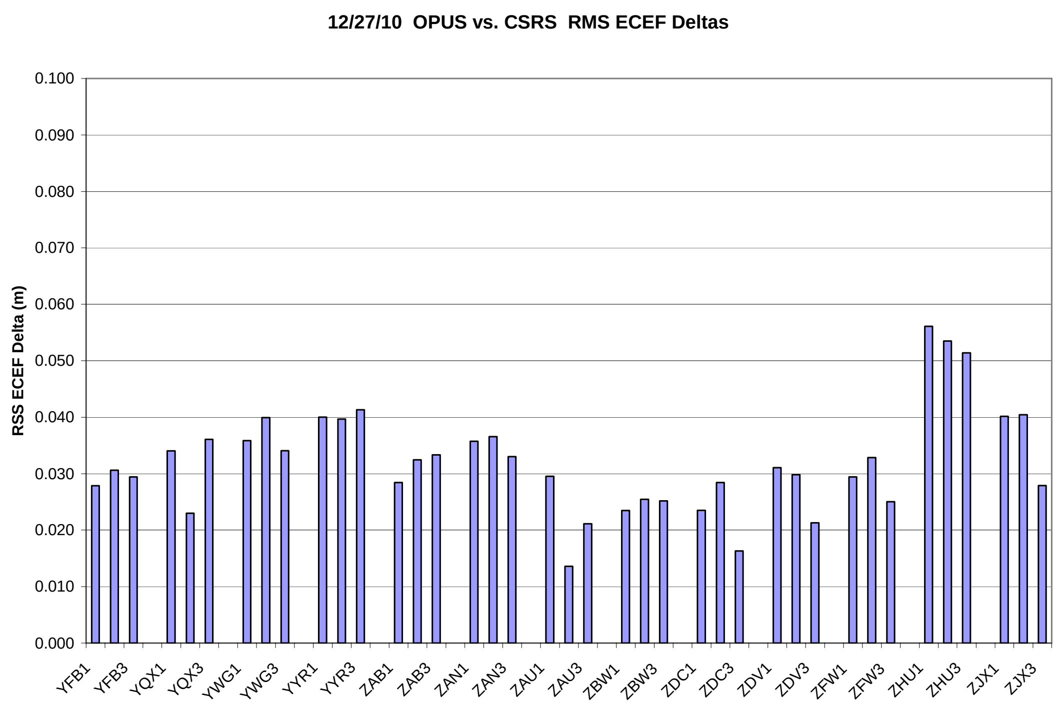


Figure 11-9 OPUS vs. CSRS RSS ECEF Deltas

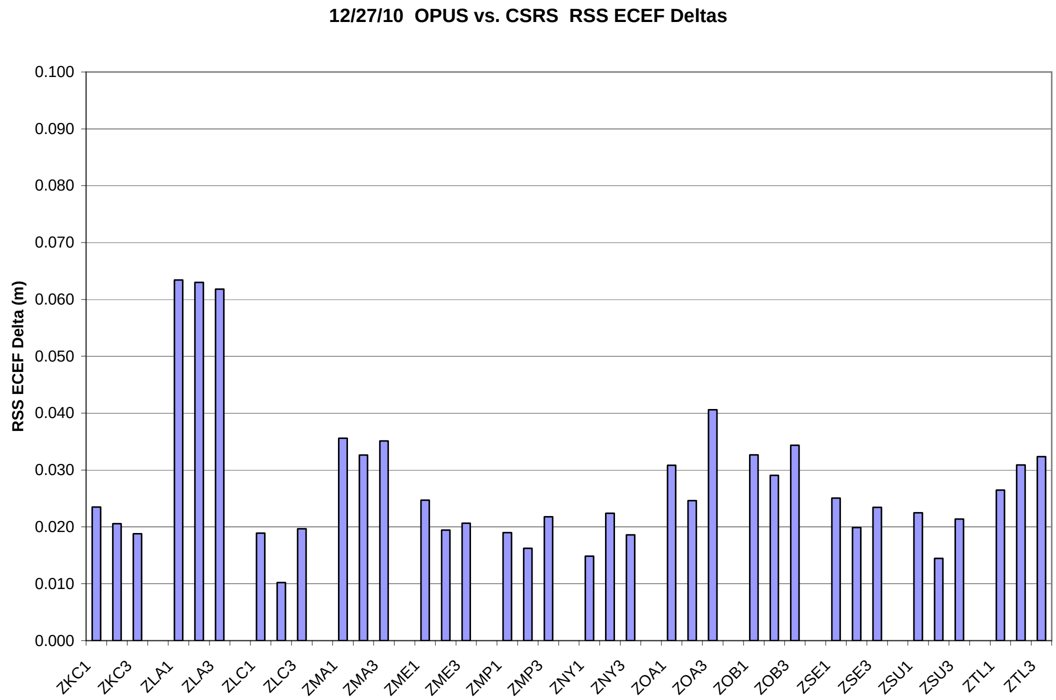


Figure 11-10 CSRS Survey Qualities

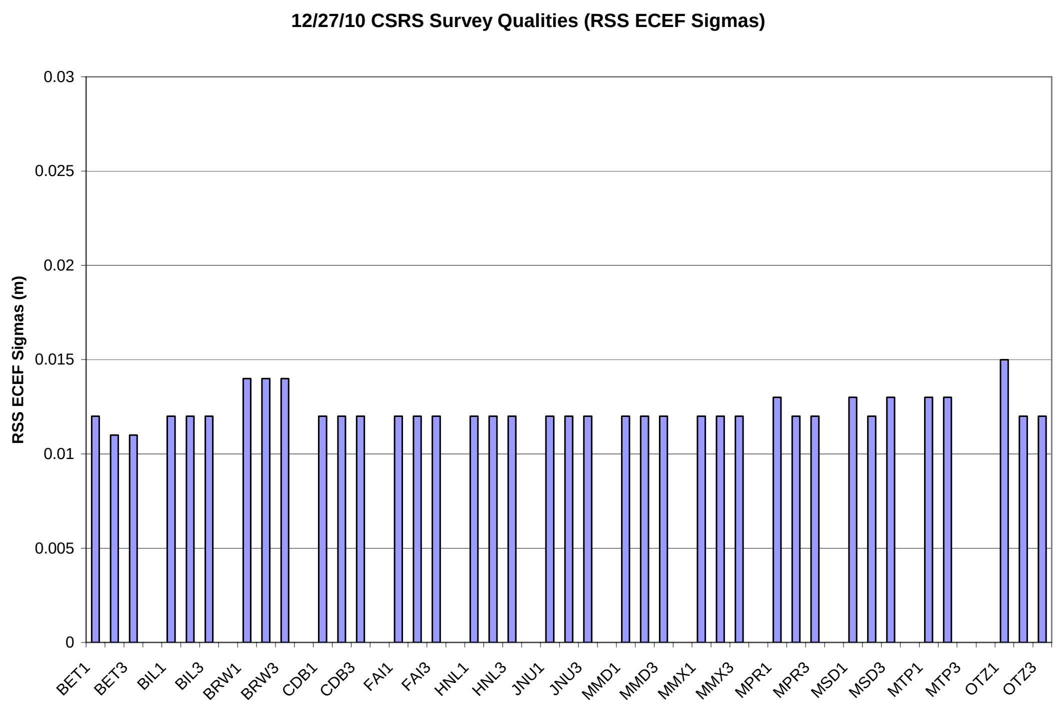


Figure 11-11 CSRS Survey Qualities

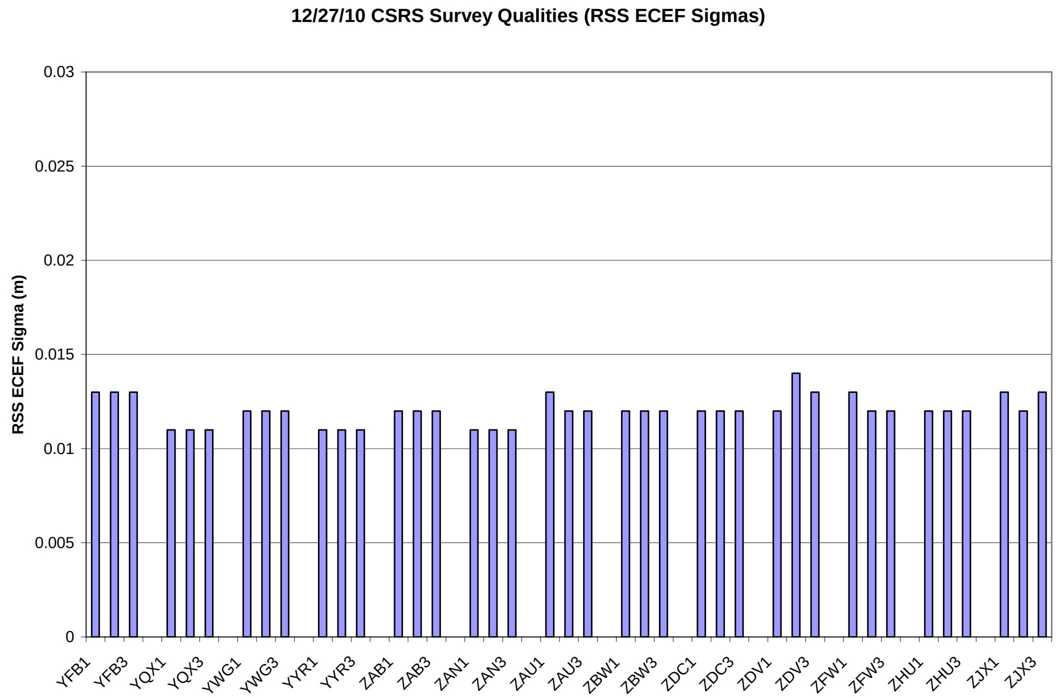


Figure 11-12 CSRS Survey Qualities

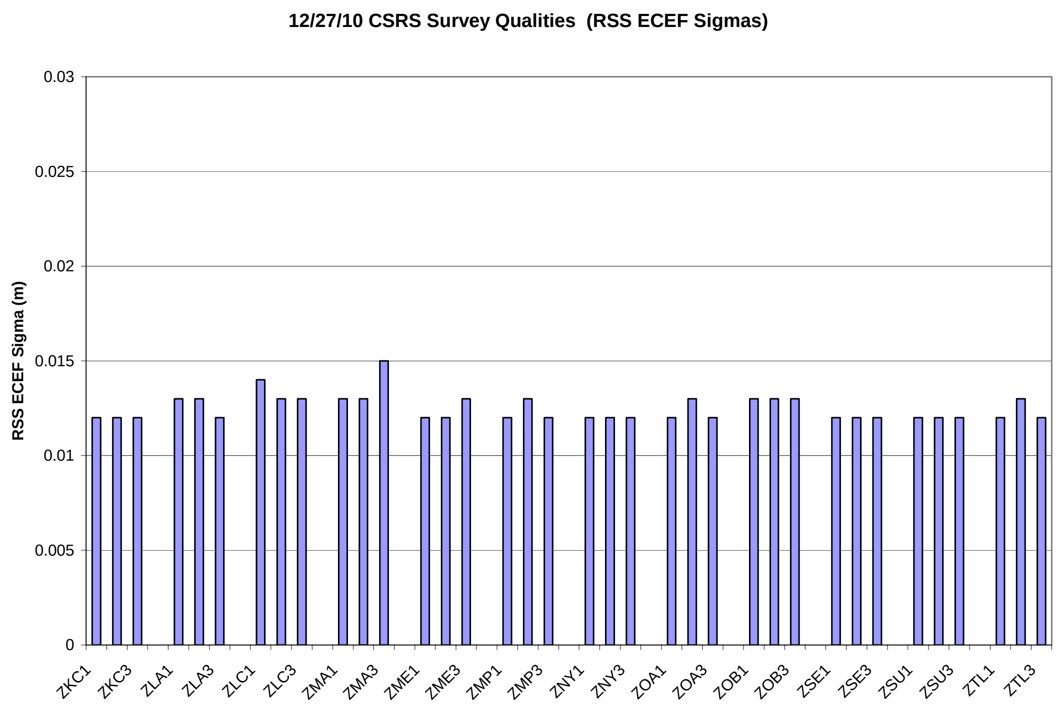


Figure 11-13 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey

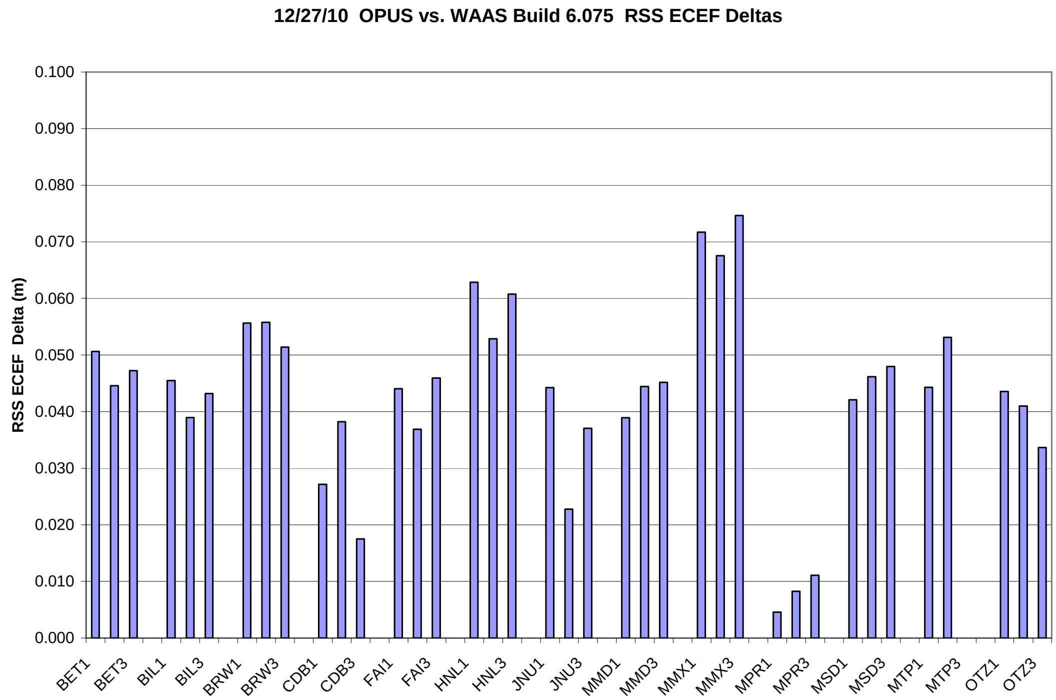


Figure 11-14 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey

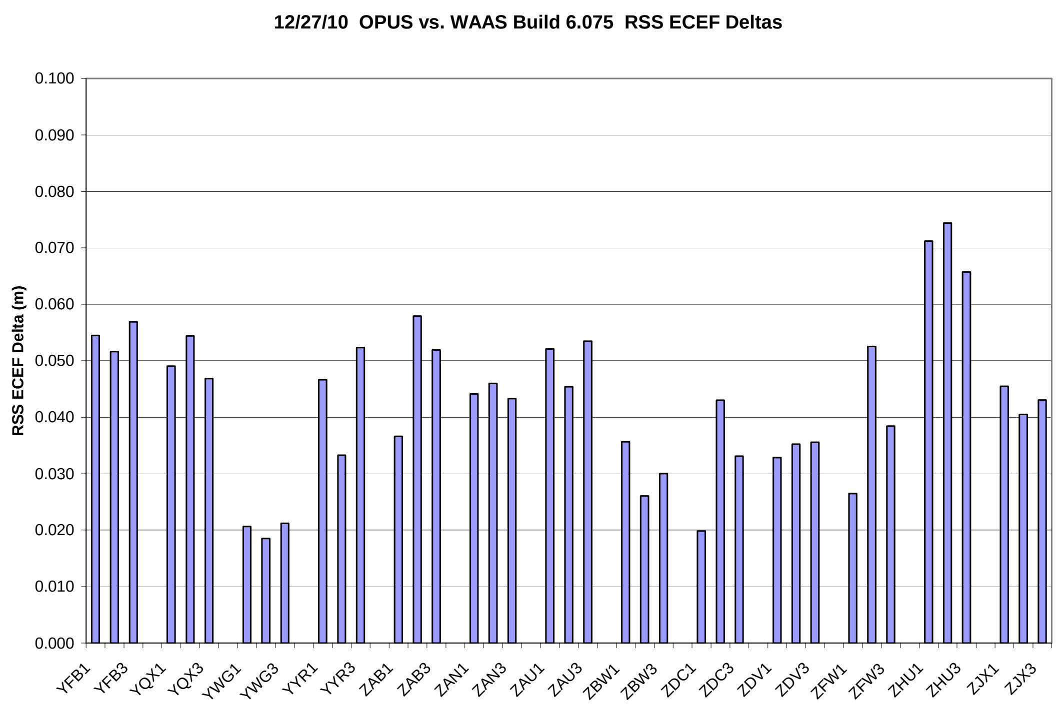
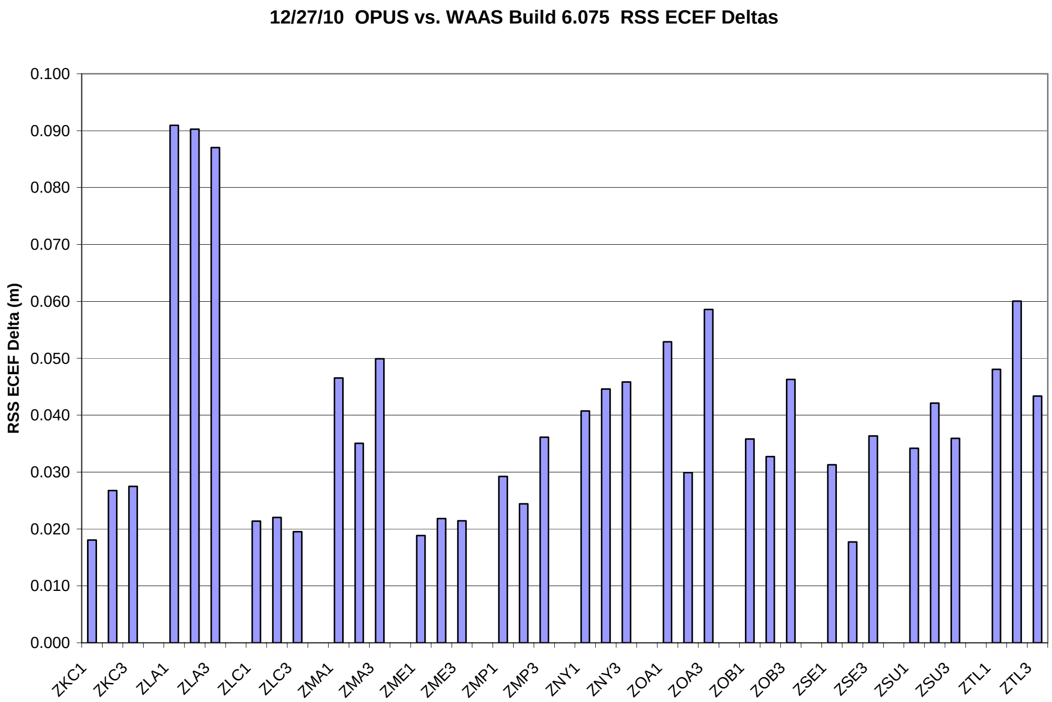


Figure 11-15 WAAS Build 6.071Antenna Positions Deltas from OPUS Survey



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. A slight drop in Type 0 type bias, more noticeable on DM1 and DM4, starting on 11/1/10 is due to PRN 22. Since PRN 22 came back from maintenance on 11/1/10, all 4 detection metrics have shifted slightly.

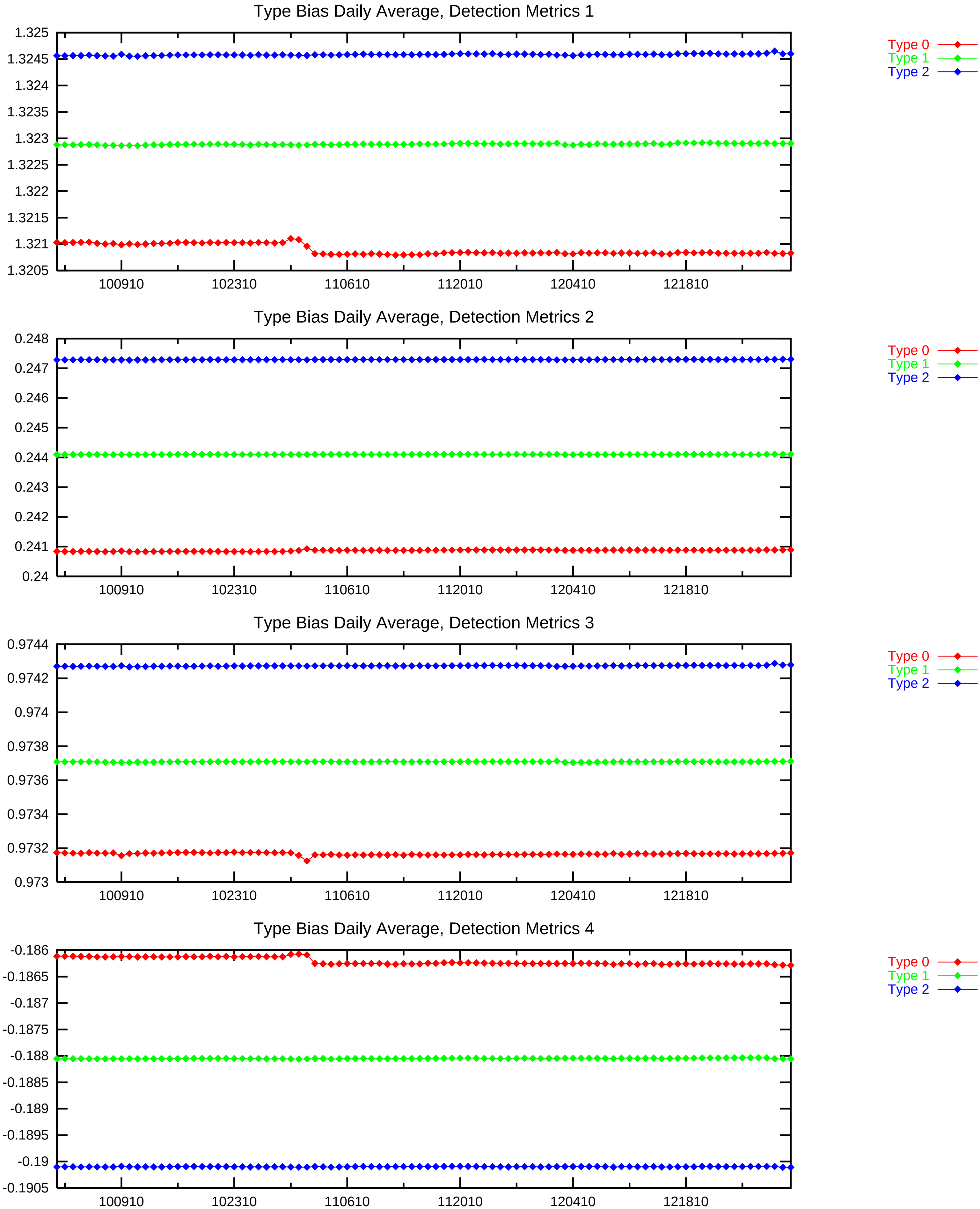
Table 12-2 Type Bias Average for the Quarter

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32089	1.32289	1.32458
DM 2	0.240868	0.2441	0.247289
DM 3	0.973166	0.973708	0.974274
DM 4	-0.186209	-0.188049	-0.190097

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

Detection Metric	Type 0	Type 1	Type 2
DM 1	1.32105	1.32292	1.32462
DM 2	0.240838	0.244109	0.247283
DM 3	0.973178	0.973714	0.974276
DM 4	-0.186128	-0.188053	-0.190083

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 12.4 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.5 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 0.00095182. The maximum average for DM2 is PRN 11 at 0.00018728. The maximum average for DM3 is PRN 10 at 0.00026674 and the maximum average for DM4 is PRN 23 at 0.00042054.

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. A shift in PRN 22 bias started on 11/1/10 when it was taken out for service. All 4 detection metrics shifted slightly after PRN 22 came back from service.

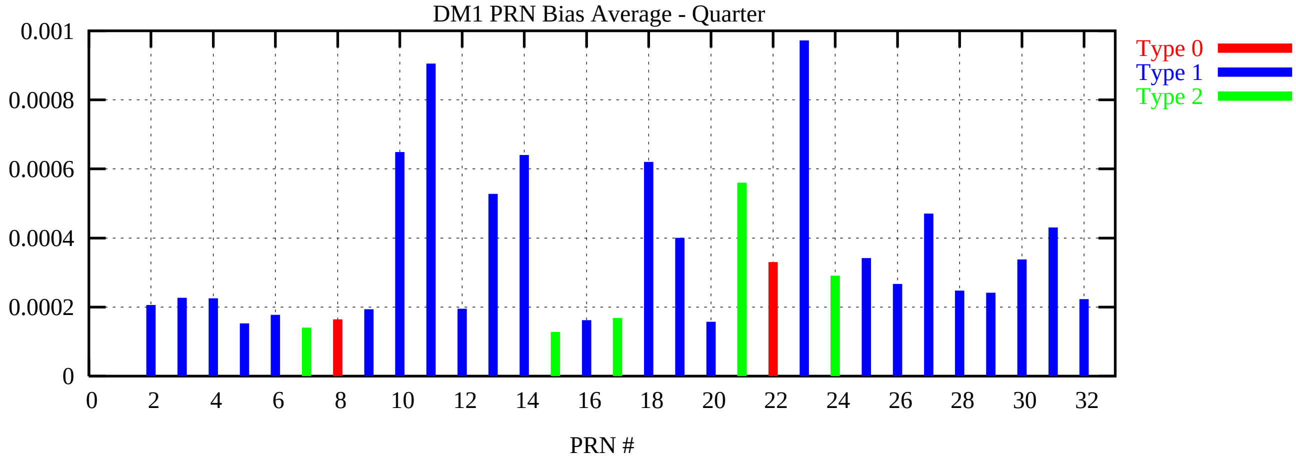
Table 12-4 PRN Bias Average for the Quarter

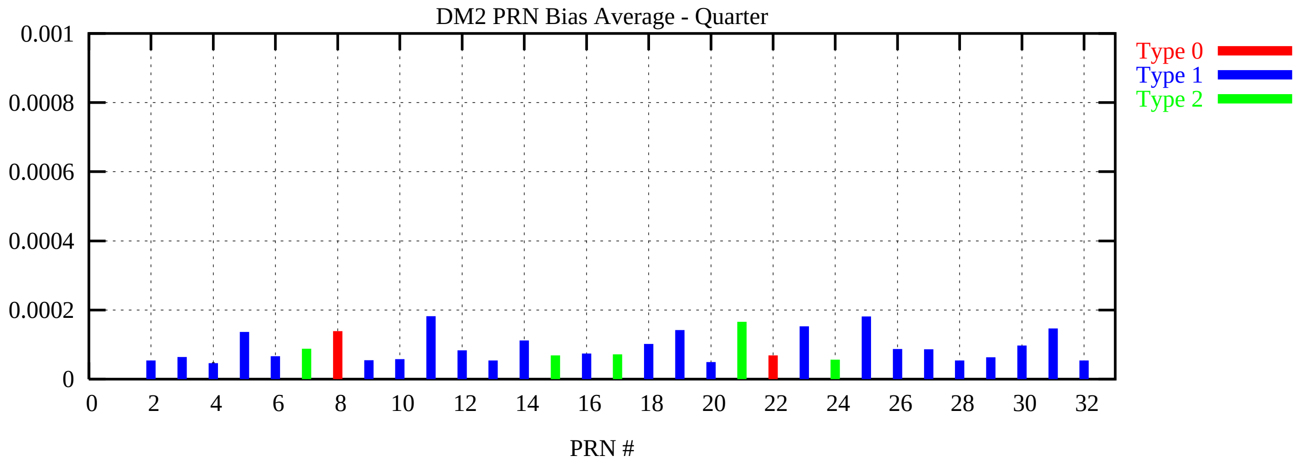
PRN	DM1	DM2	DM3	DM4
2	0.00020638	0.00005407	0.00002593	0.00009345
3	0.00022649	0.00006399	0.00009982	0.00037272
4	0.00022555	0.00004599	0.00006853	0.00013401
5	0.00015313	0.00013679	0.00006357	0.00010233
6	0.00017716	0.00006657	0.00005717	0.00012985
7	0.00014014	0.00008829	0.00003458	0.00012529
8	0.00016399	0.00013857	0.00004488	0.00010658
9	0.00019333	0.00005449	0.00006401	0.00010995
10	0.00064904	0.00005789	0.00025437	0.00009762
11	0.00090522	0.00018228	0.00005179	0.00024976
12	0.00019524	0.00008367	0.00009953	0.00007873
13	0.00052790	0.00005403	0.00006905	0.00015224
14	0.00064008	0.00011168	0.00011275	0.00012104
15	0.00012825	0.00006855	0.00002461	0.00013269
16	0.00016195	0.00007425	0.00012036	0.00034281
17	0.00016785	0.00007186	0.00004270	0.00013822
18	0.00062073	0.00010223	0.00004232	0.00021282
19	0.00040014	0.00014167	0.00004267	0.00008473
20	0.00015765	0.00004962	0.00003394	0.00016336
21	0.00055989	0.00016555	0.00019586	0.00009914
22	0.00032992	0.00006887	0.00008963	0.00027012
23	0.00097196	0.00015287	0.00003463	0.00042063
24	0.00029102	0.00005611	0.00003440	0.00011946
25	0.00034161	0.00018122	0.00008661	0.00011556
26	0.00026677	0.00008734	0.00014686	0.00009299
27	0.00047049	0.00008612	0.00006093	0.00033428
28	0.00024738	0.00005401	0.00003442	0.00009512
29	0.00024175	0.00006311	0.00009914	0.00028216
30	0.00033791	0.00009730	0.00002580	0.00012643
31	0.00043028	0.00014696	0.00003371	0.00025456
32	0.00022287	0.00005430	0.00010259	0.00008322

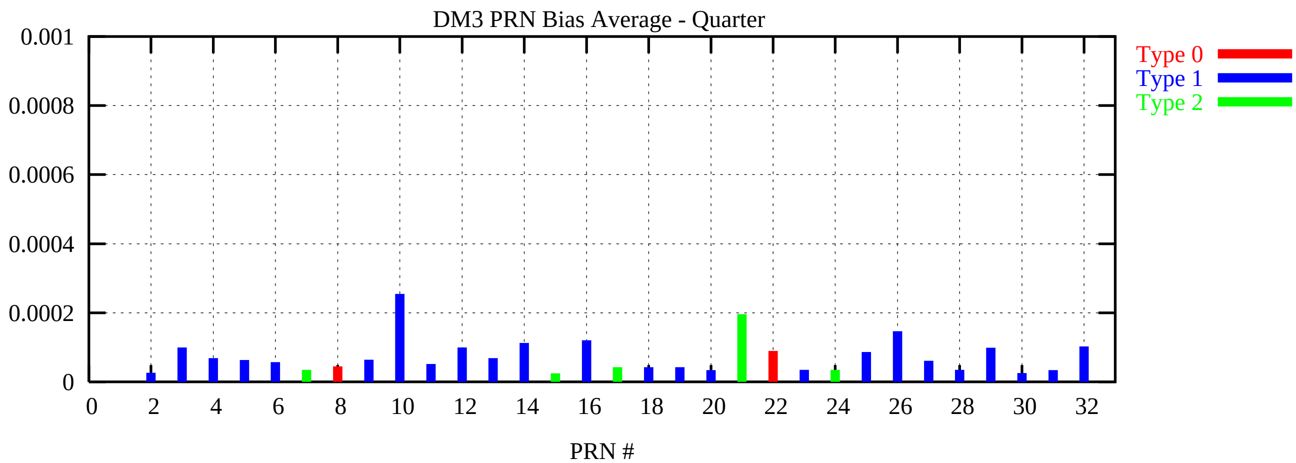
Table 12-5 PRN Bias Average Since January 1, 2008

PRN	DM1	DM2	DM3	DM4
1	0.00013788	0.00004337	0.00007352	0.00007985
2	0.00018193	0.00005704	0.00002287	0.00009224
3	0.00021864	0.00005572	0.00008894	0.00035387
4	0.00024033	0.00004468	0.00007383	0.00013304
5	0.00027111	0.00010460	0.00008812	0.00012276
6	0.00015673	0.00005580	0.00004561	0.00012639
7	0.00013157	0.00008992	0.00003551	0.00012132
8	0.00016019	0.00012518	0.00004433	0.00010032
9	0.00022229	0.00005381	0.00006803	0.00011194
10	0.00065984	0.00006790	0.00026674	0.00009378
11	0.00089967	0.00018297	0.00005710	0.00023389
12	0.00023503	0.00008736	0.00010527	0.00008110
13	0.00050996	0.00005509	0.00006007	0.00015663
14	0.00064541	0.00012092	0.00011240	0.00012193
15	0.00012058	0.00006844	0.00002757	0.00013189
16	0.00016447	0.00007361	0.00010982	0.00034223
17	0.00012593	0.00007694	0.00003408	0.00011998
18	0.00060908	0.00010325	0.00004062	0.00021177
19	0.00037764	0.00013486	0.00003505	0.00008237
20	0.00016011	0.00004759	0.00003965	0.00013214
21	0.00061867	0.00018728	0.00020219	0.00008818
22	0.00015775	0.00009134	0.00010112	0.00011557
23	0.00095182	0.00014342	0.00003479	0.00042054
24	0.00030632	0.00004779	0.00003569	0.00010633
25	0.00019009	0.00012457	0.00008225	0.00027385
26	0.00027133	0.00008968	0.00015236	0.00008811
27	0.00048108	0.00008133	0.00006499	0.00032939
28	0.00024144	0.00005337	0.00003298	0.00008933
29	0.00022199	0.00006590	0.00010593	0.00028781
30	0.00029691	0.00009514	0.00002794	0.00011571
31	0.00047149	0.00015721	0.00003841	0.00025610
32	0.00029979	0.00004820	0.00011108	0.00010012

Figure 12-2 PRN Bias Average for the Quarter







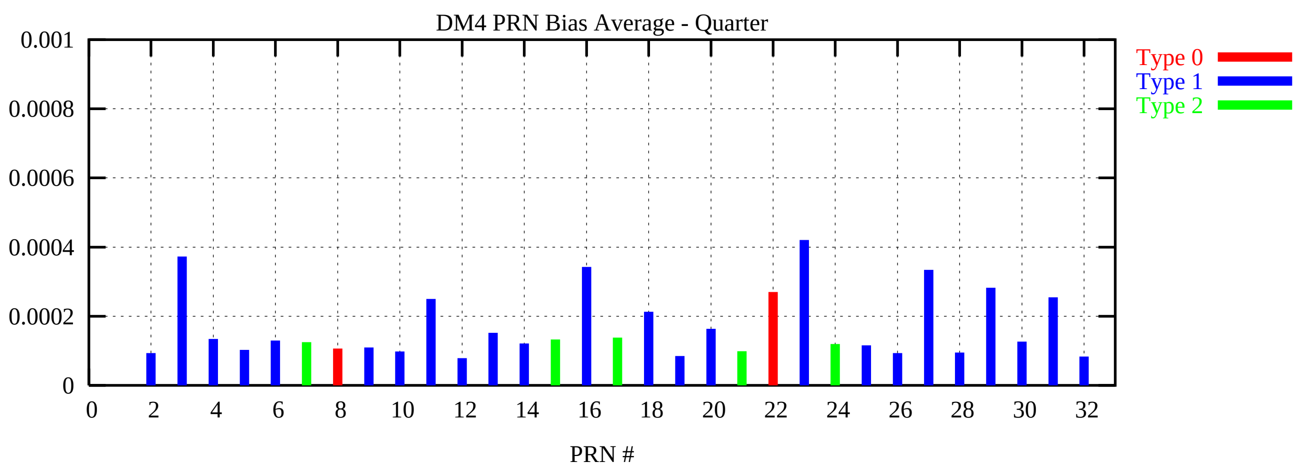
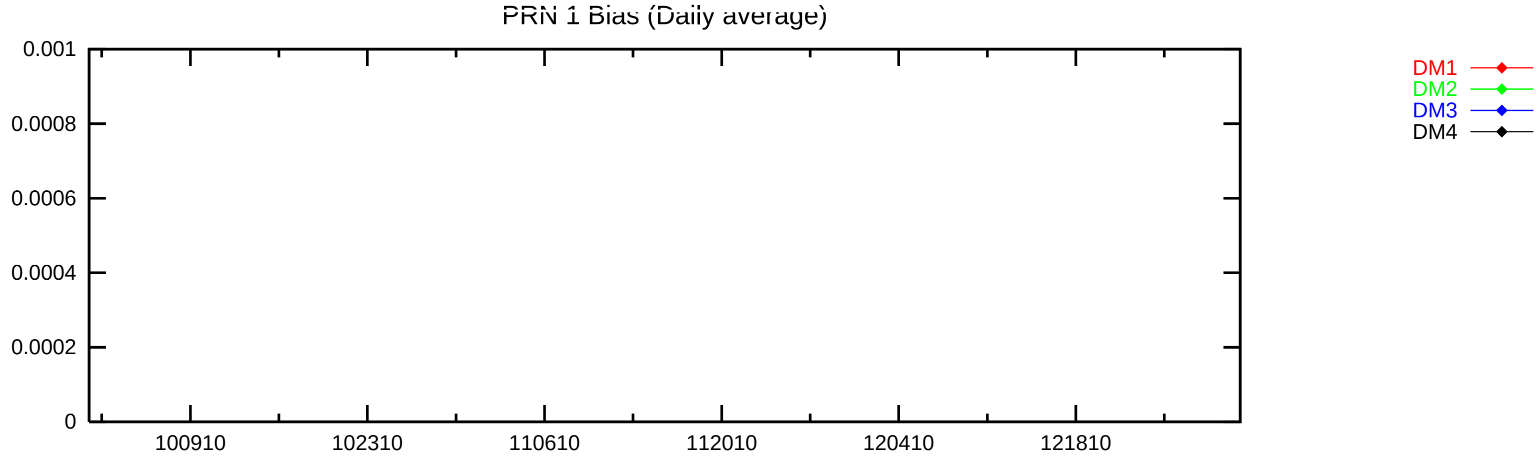
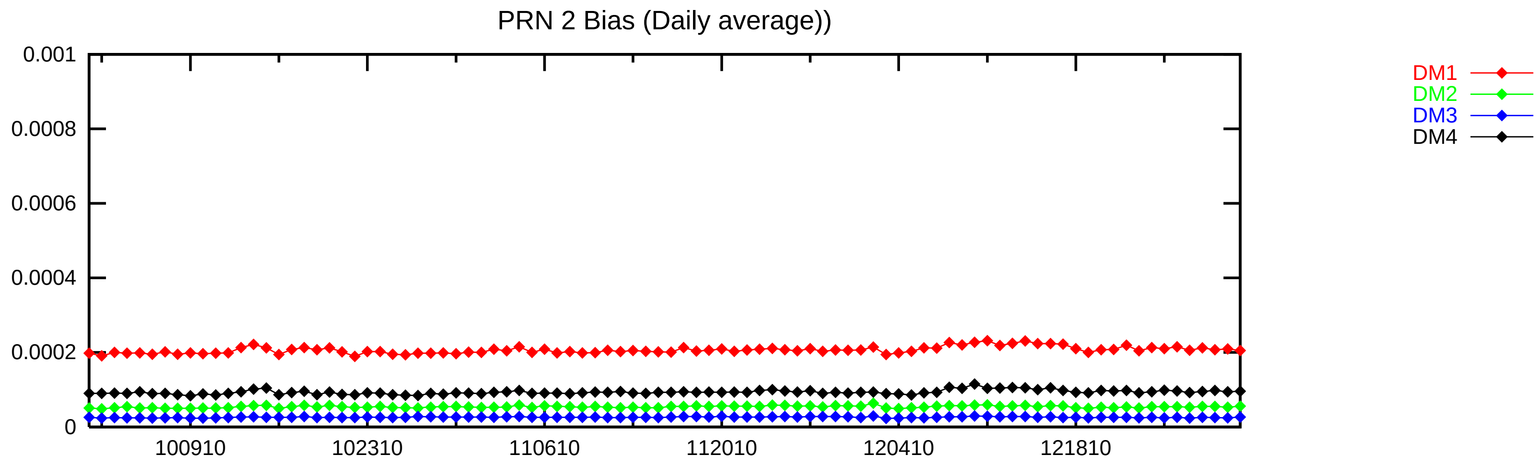
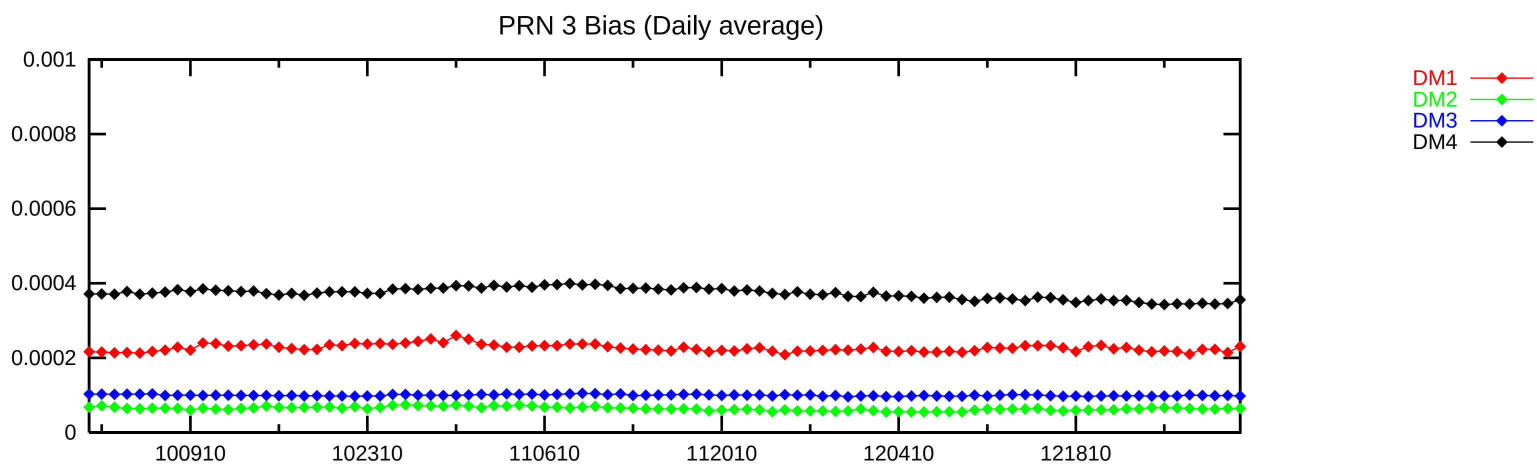


Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)







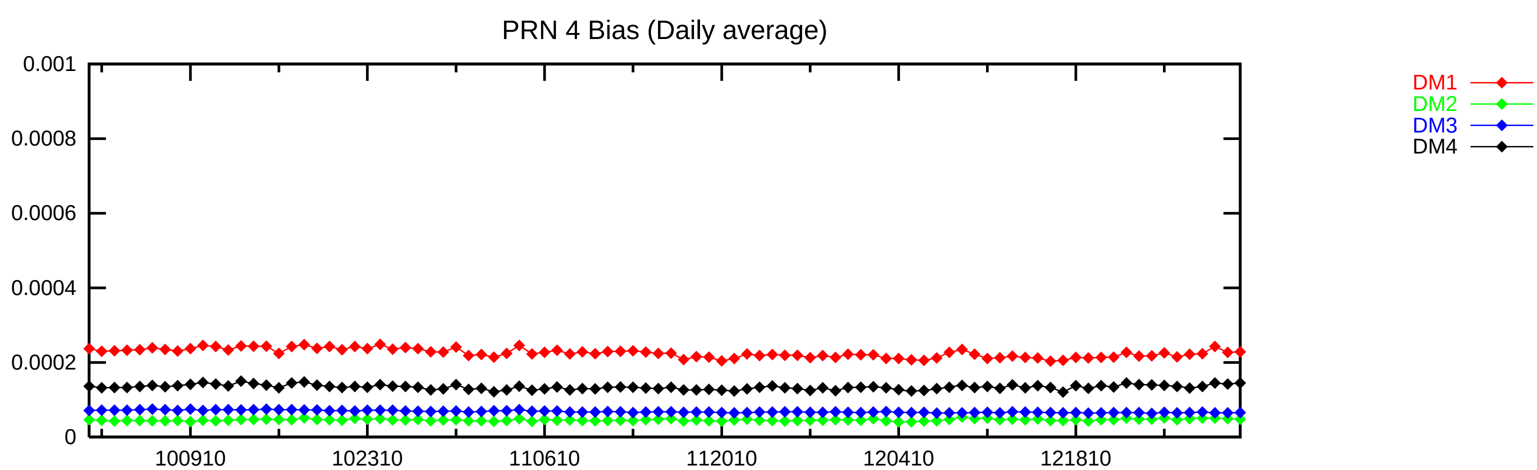
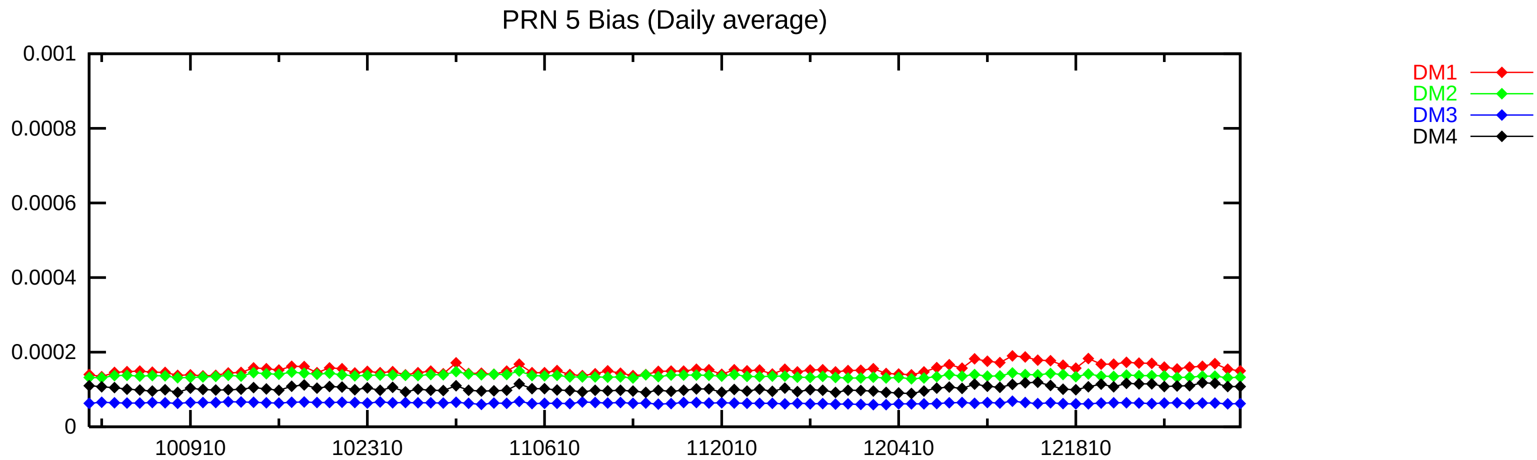
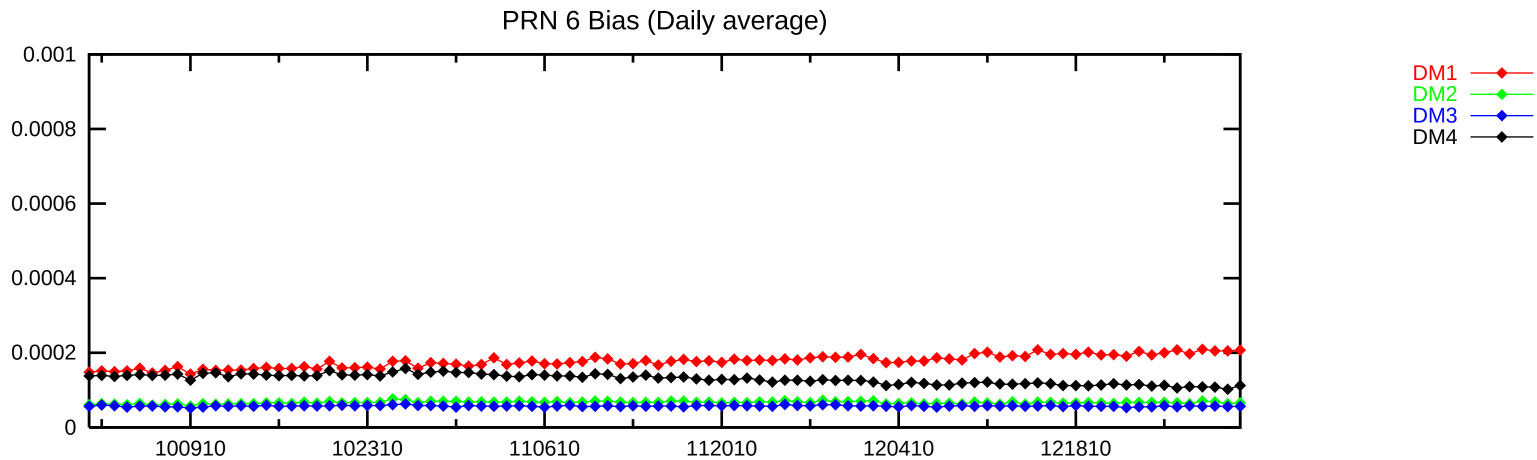
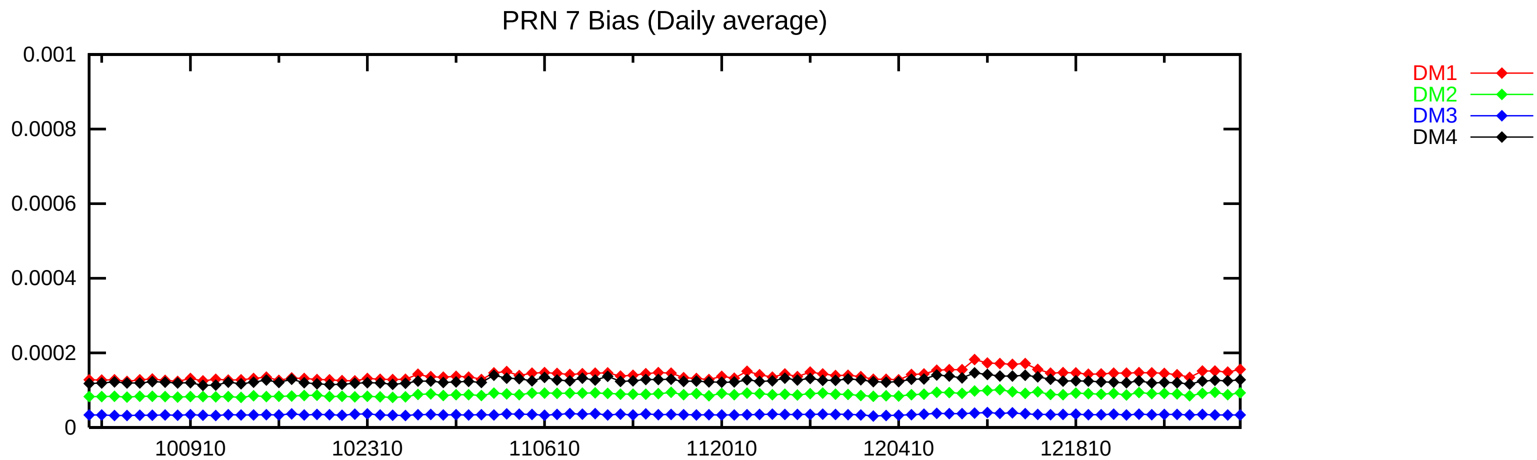


Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)







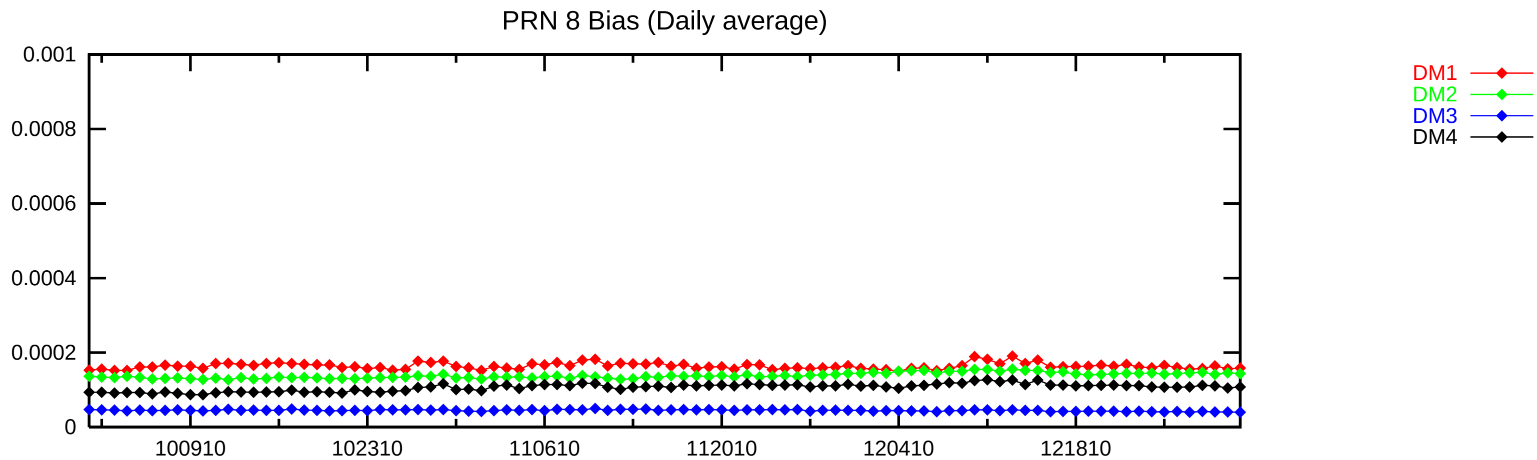
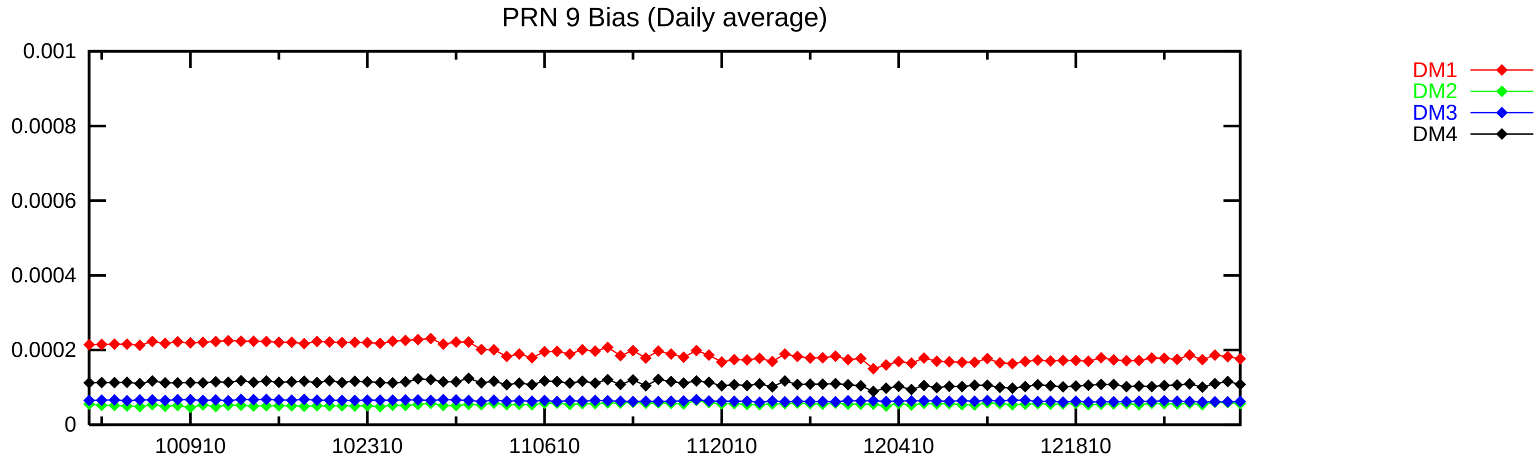
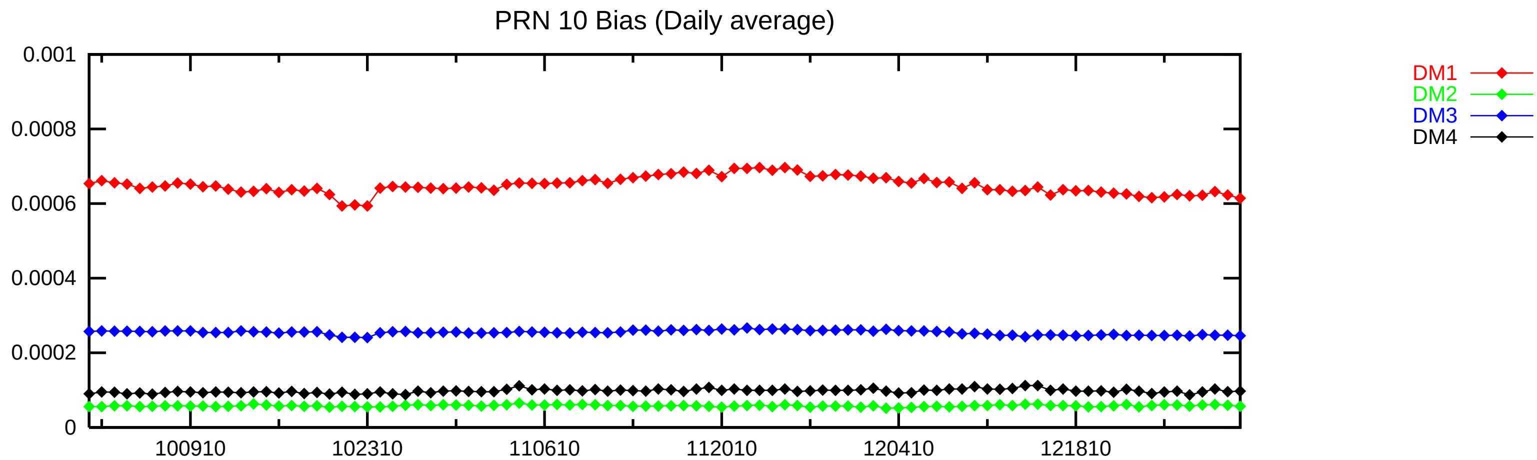
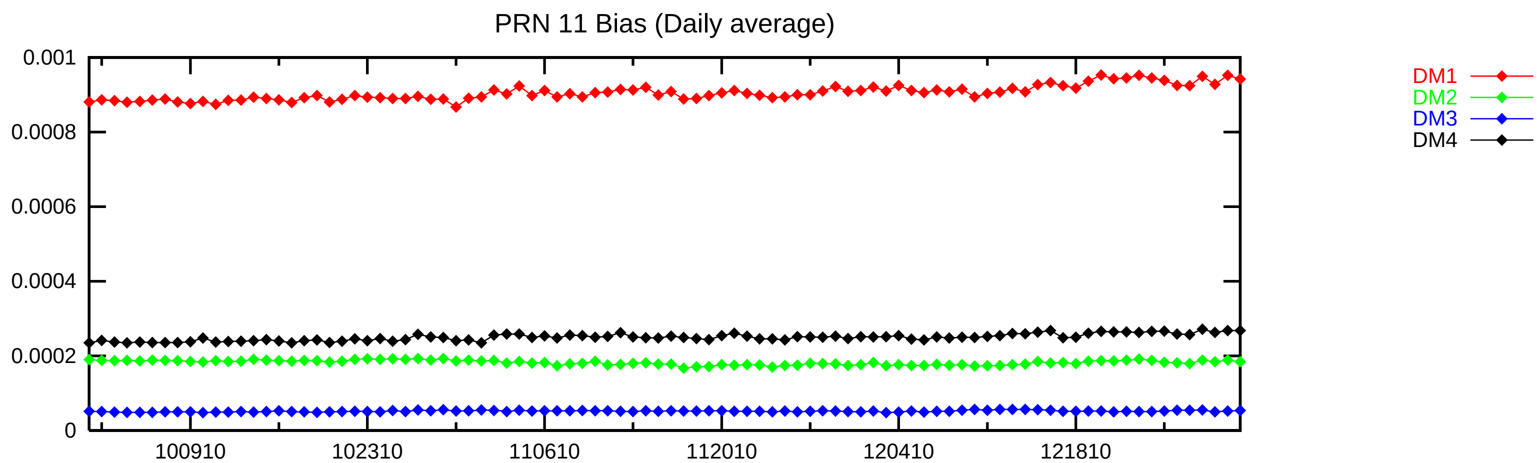


Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)







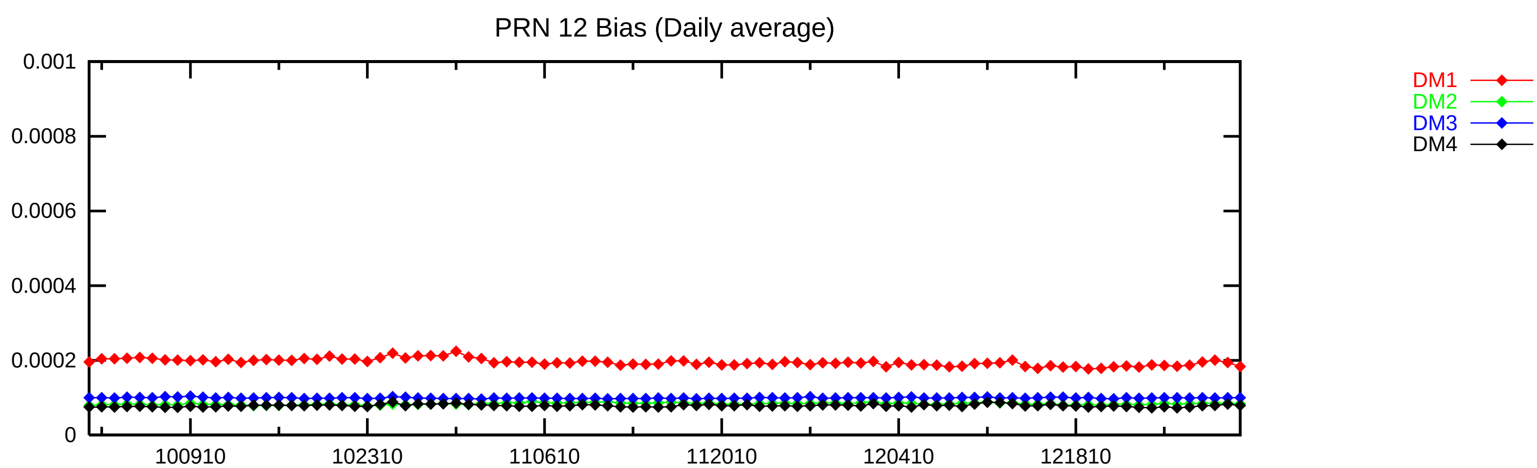


Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)

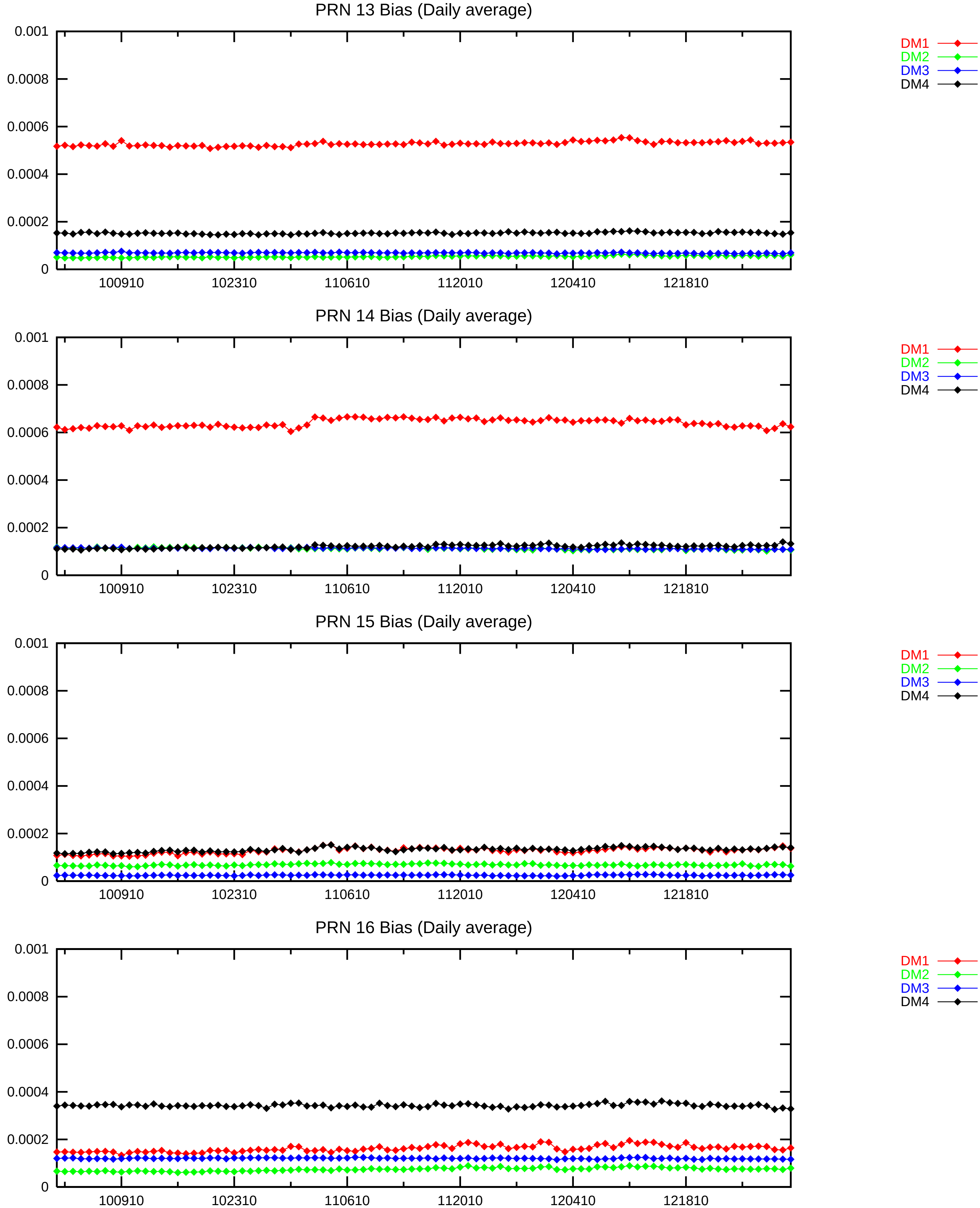


Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)

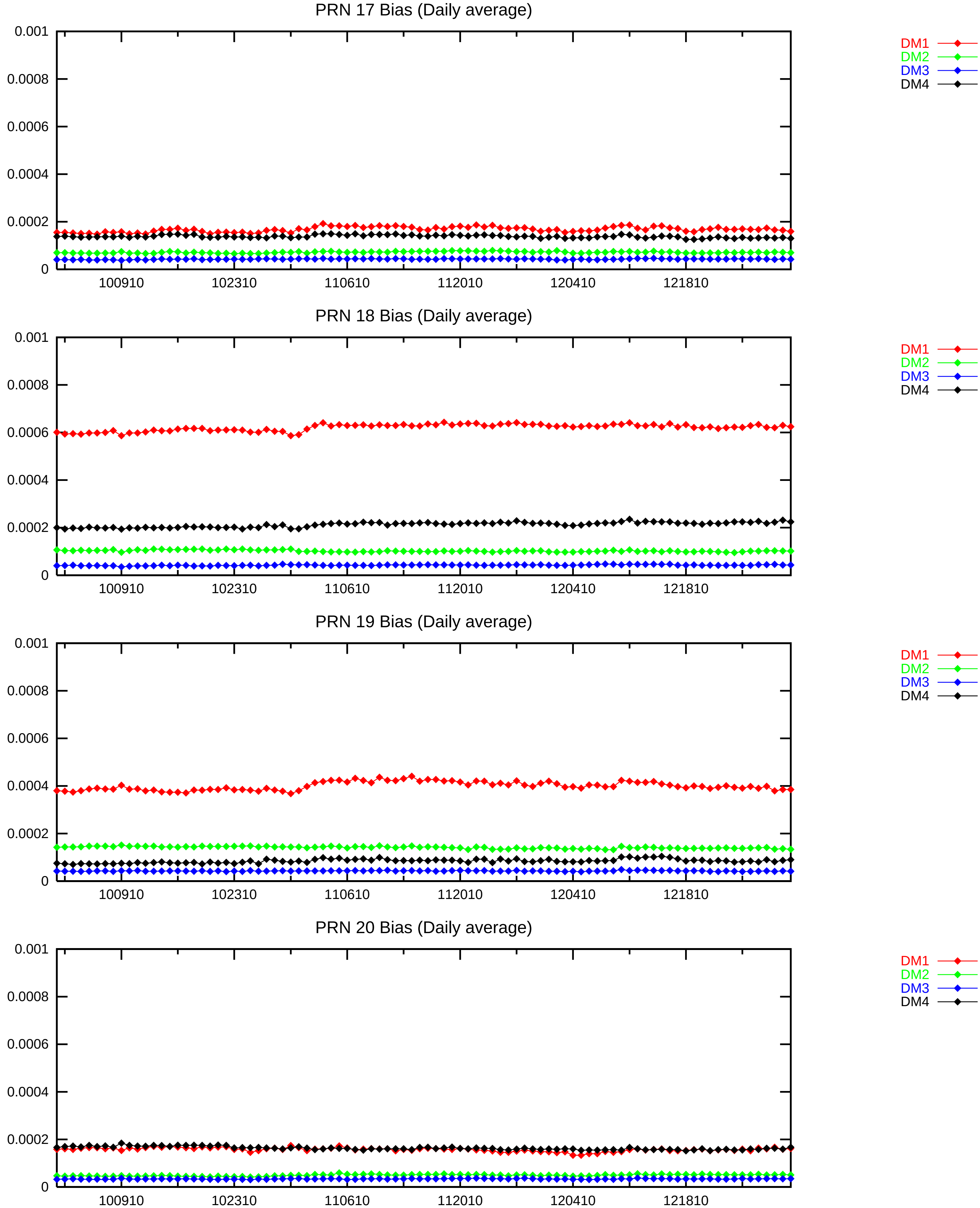


Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)

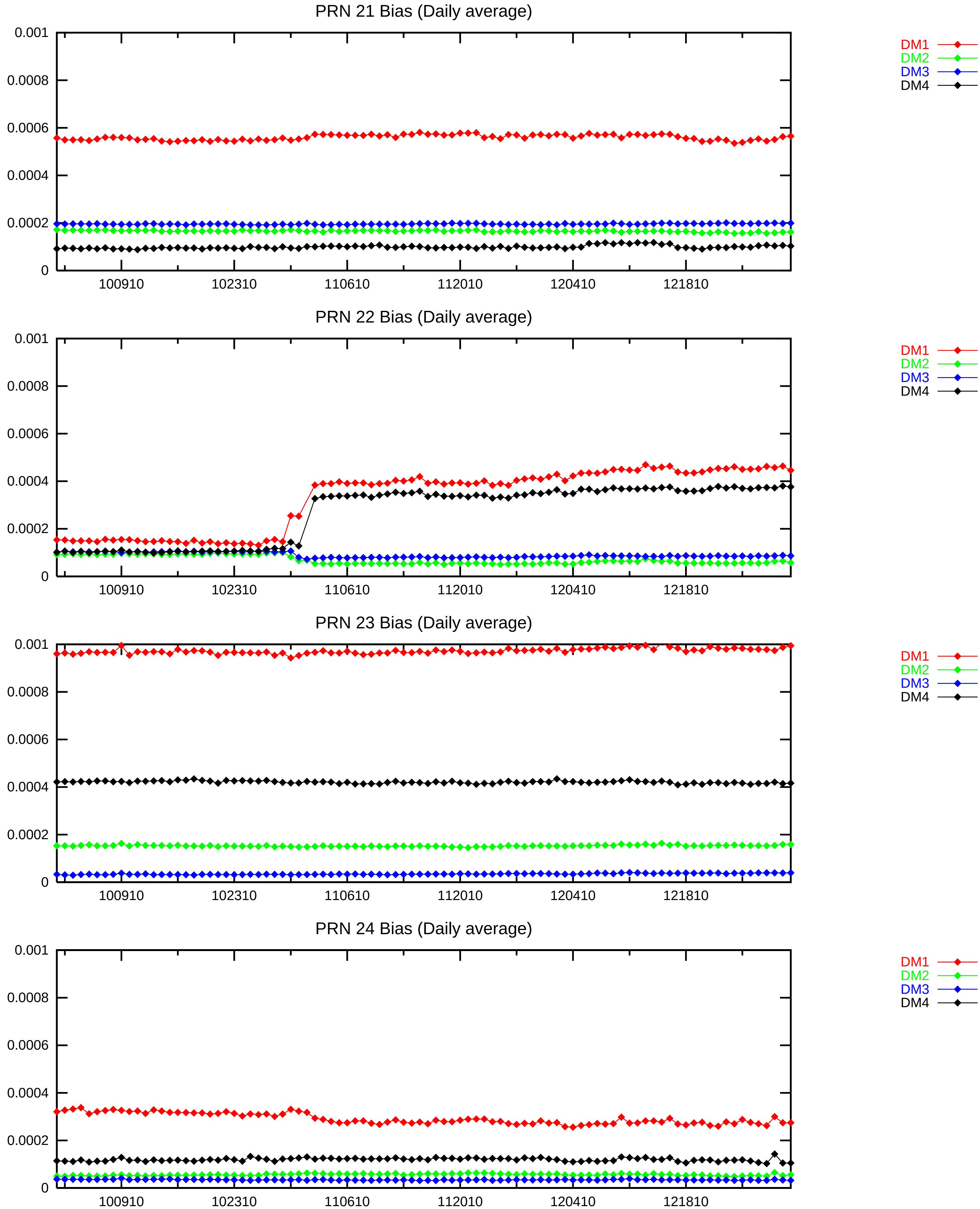
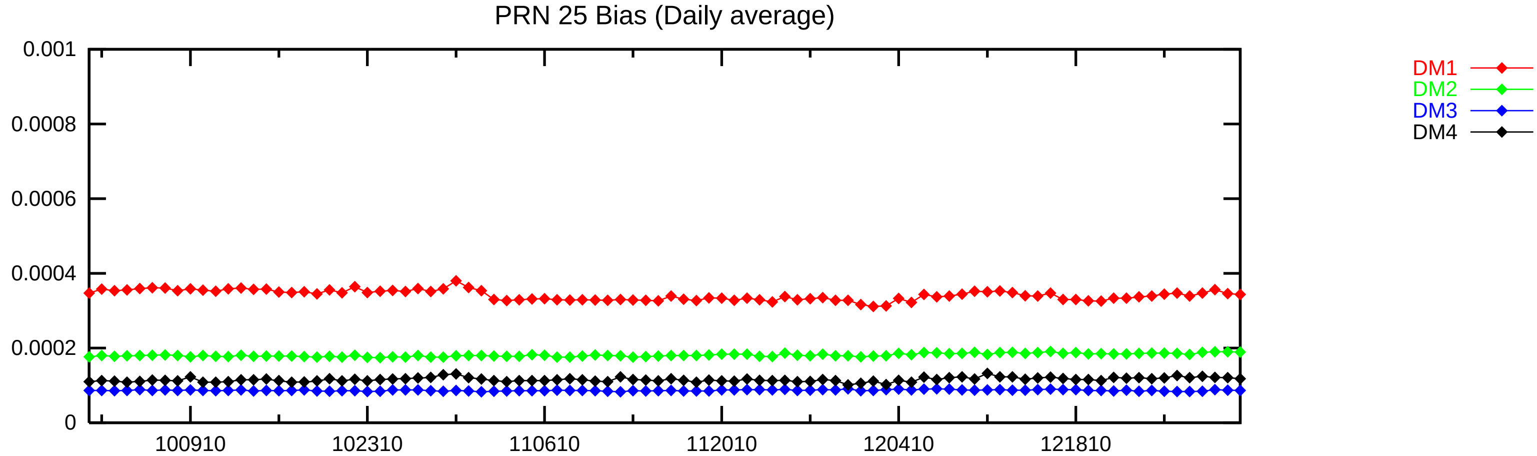
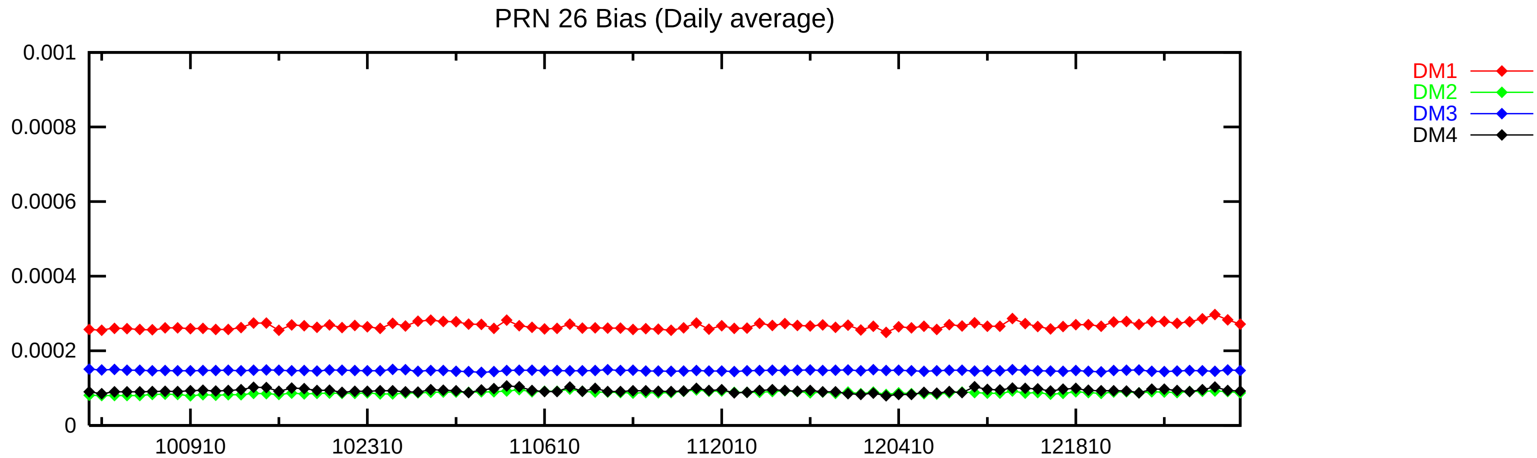
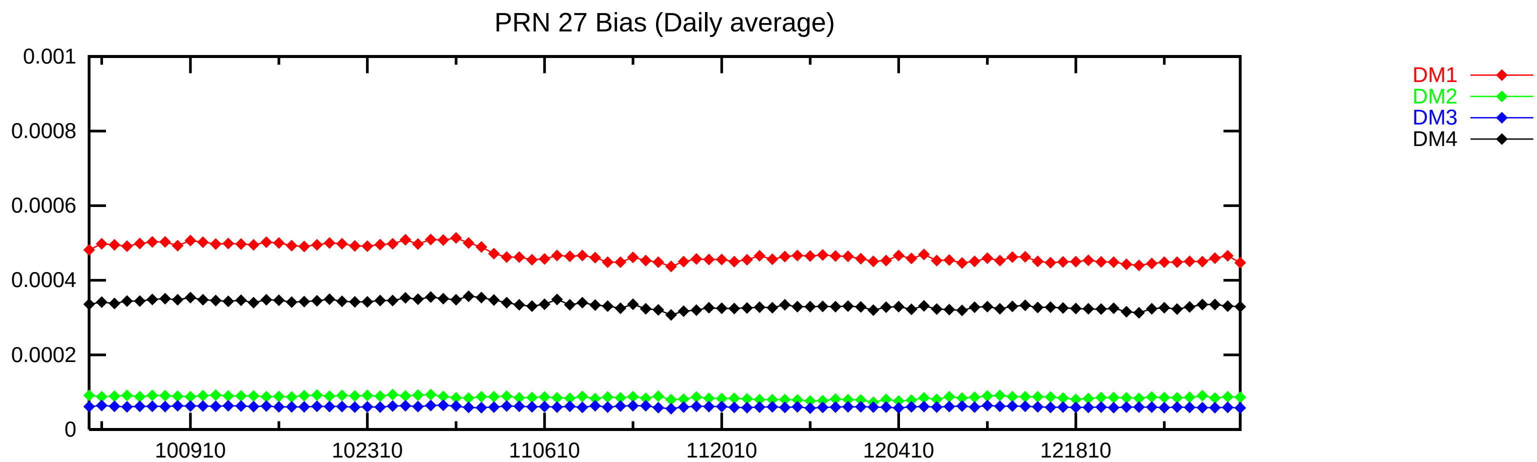


Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)







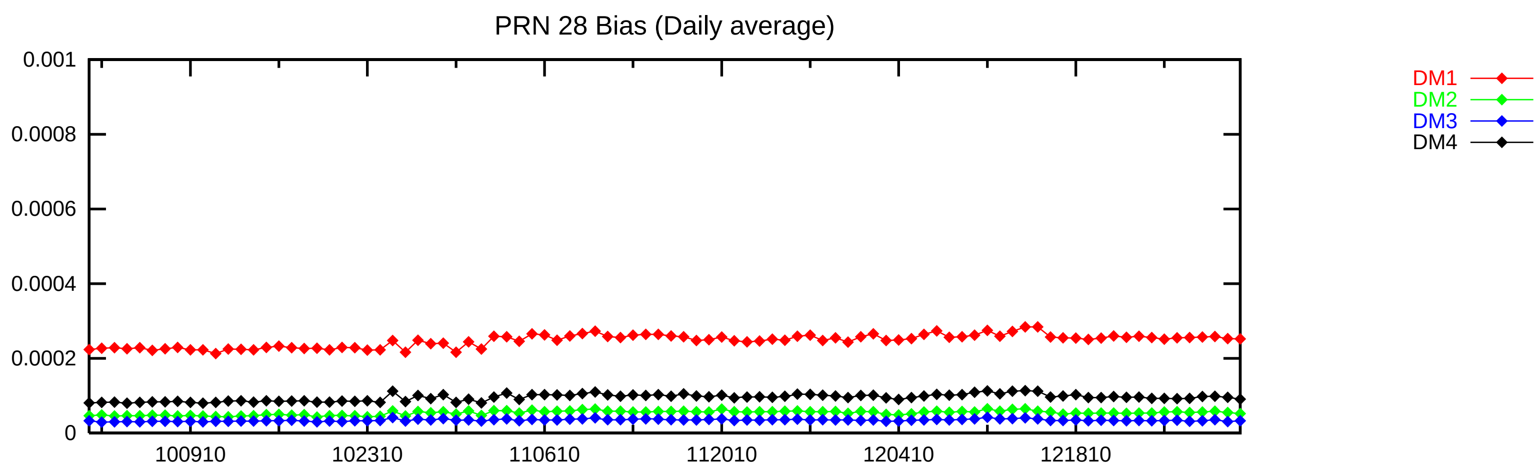
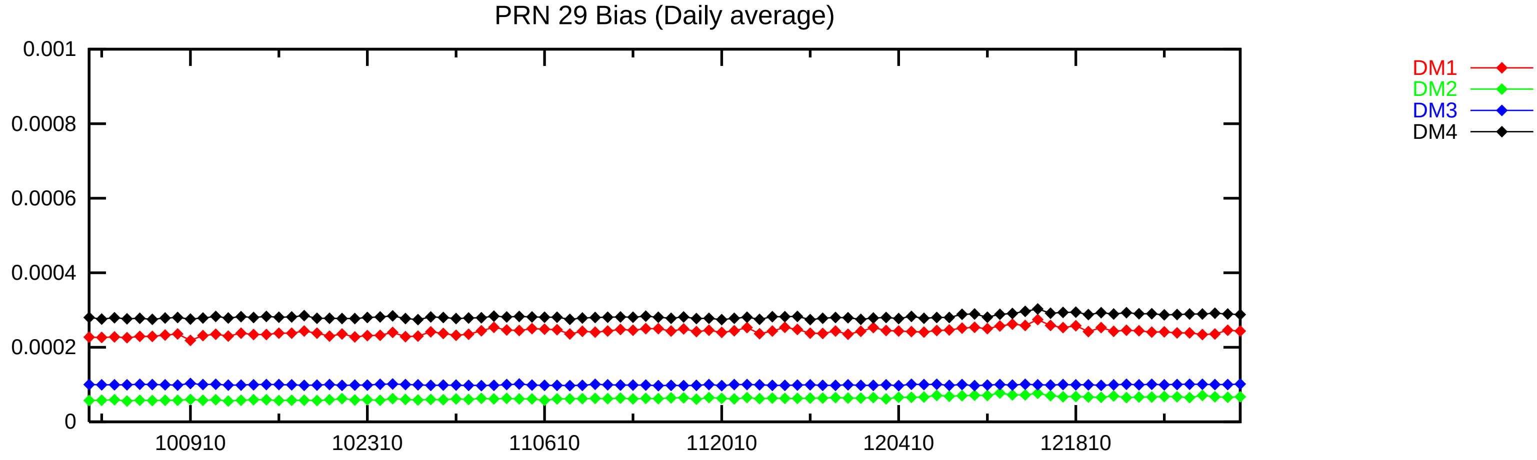
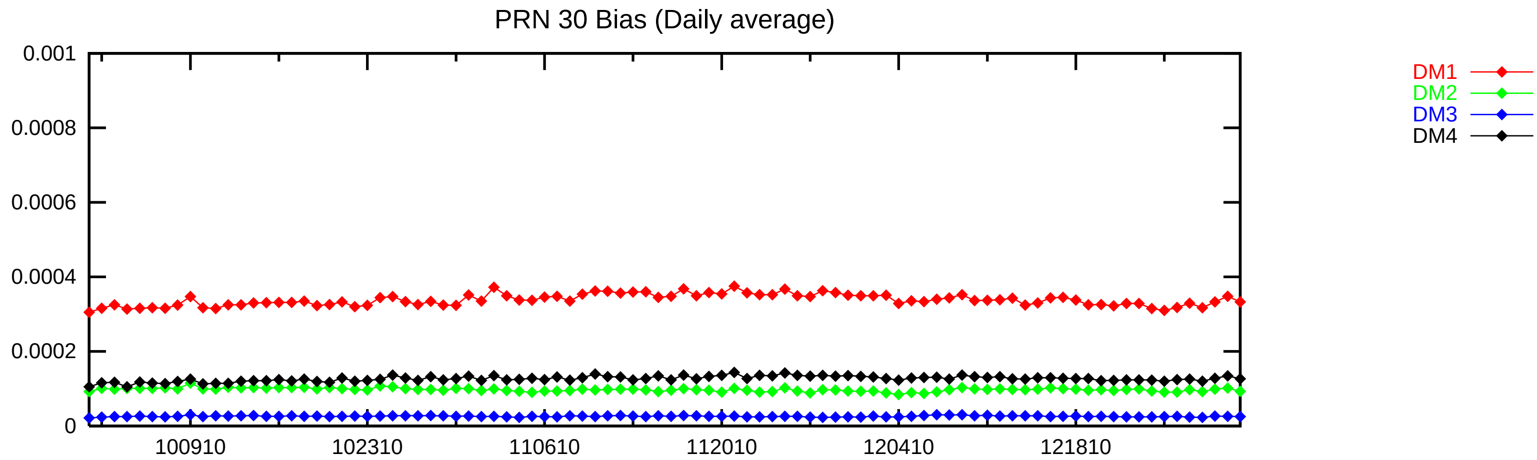
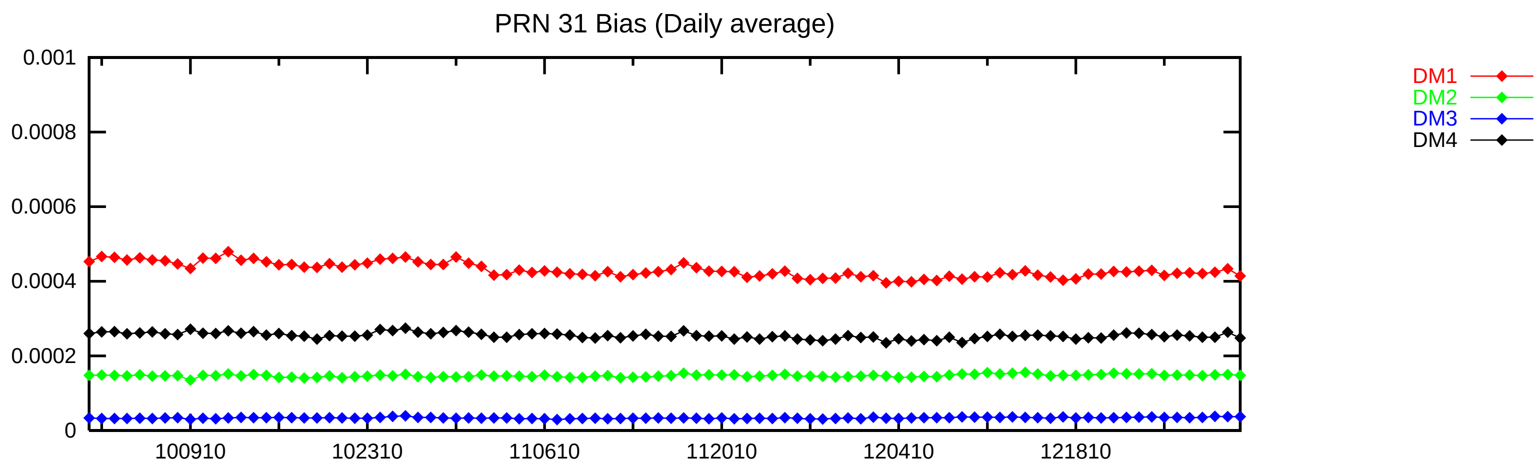
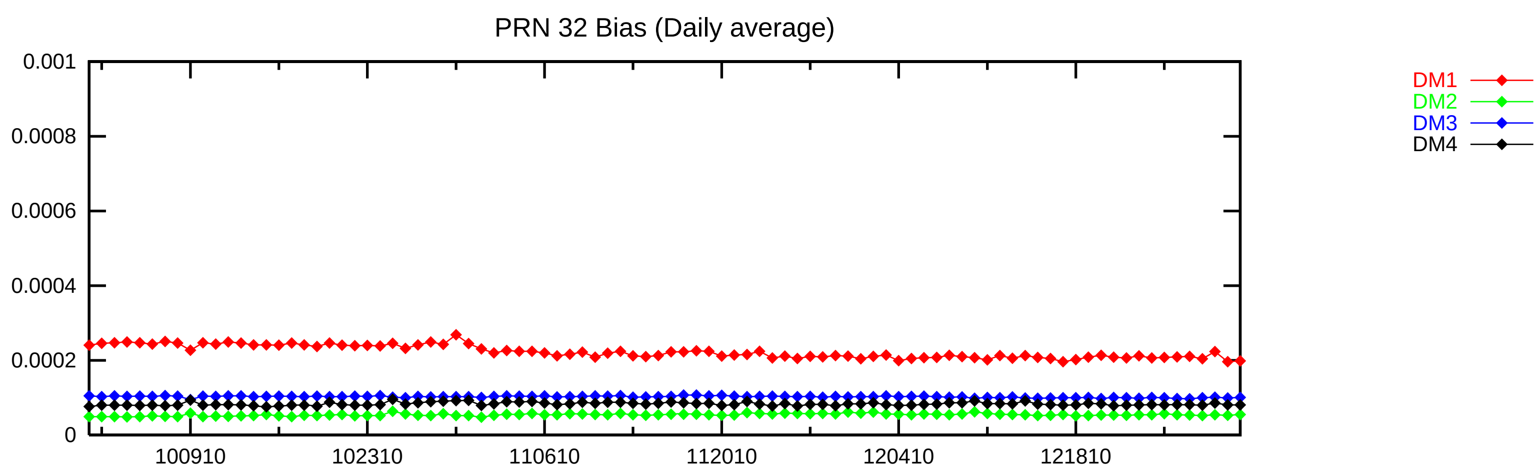


Figure 12-10 PRN Bias Average Trend (PRN 29 - PRN 32)









12.4 SQM Trips

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

13.0 GPS Broadcast Orbit vs. IGS Precise Orbits Analysis

As part of the WAAS off-line monitoring process, the accuracy of the GPS broadcast ephemeris is periodically compared to the NGA precise orbit information to monitor the validity of an a priori assumption concerning the accuracy of the GPS broadcast ephemeris information that is part of a brute force computer simulation analysis utilized as part of the safety proof of the WAAS MT-28 functionality. That brute force analysis searches a simulated error sphere around a GPS satellite for a worst-case projection of post correction ephemeris error to any user. A pessimistic extrapolation of historical data was used as an a priori to limit the radius of the searched sphere to a finite distance. This periodic off-line monitoring verifies that the original logic of the a priori assumption remains sound.

The assumption being validated is:

Height Error:	+/- 15 meters (standard deviation < 2.8 m),
Along Track Error:	+/- 65 meters (standard deviation < 12.2 m)
Cross Track Error:	+/- 30 meters (standard deviation < 5.6 m)

All IGS high rate 15 minute broadcast navigation data RINEX format files are downloaded and merged into 24 hour broadcast navigation data files. A majority voting algorithm is used to screen the high rate data after a LSB recovery algorithm is applied. NGA precise ephemeris referenced to the GPS satellite antenna phase center is downloaded from the NGA site. GPS satellite positions are computed every 15 minutes and differenced with the precise orbits. The resulting error information is then segregated into the Height, Along Track, and Cross Track (HAC) error data. The standard deviation of the error is then computed for each dimension for each satellite.

The assumption is valid if a 5.33 scaling of the standard deviation across all satellites is within the a priori. Only data points where GPS is healthy and valid precise data is available are considered. Figure 13-3 shows the availability of data. There were no points where GPS was healthy and the NGA data was missing.

One year of data from 1/1/10 to 12/31/10 is presented. Figure 13-1 is a plot of the standard deviations. Figure 13-2 is a plot of the error means. The worst case standard deviations meet the criteria, therefore the assumption is validated.

The sign convention for this analysis is error = broadcast ECEF - precise ECEF. Along track is positive in the direction of the velocity vector. Cross track completes a right hand system with height and along track.

Figures 13-4 through 13-34 are plots of the height, along track, and cross track error relative to NGA precise orbits by PRN number. These plots do not include clock error. PRN-1 SVN-49 is not included because it was never healthy in 2010.

Figures 13-35 through 13-42 are Quantiles-Quantiles (QQ) plots of the largest URA normalized total range error (height, along track, cross track, and clock) projected onto the surface of the earth. +/- 13.8° from the boresight of the satellite is used to approximate the surface of the earth. The QQ plot axis's have been fixed at +/- 5 causing data to be not displayed for PRN-16 and PRN-30. Full scale QQ plots for PRN-16 and PRN-30 are included as figures 13-74 and 13-75.

Figures 13-43 through 13-73 are histograms of the height error, along track error, cross track error, and URA normalized range error. The histograms were bin'ed -5 to +5, this causes larger errors to be forced into the "bed posts" at +/- 5. See the figures 13-4 to 13-34 and the full scale QQ plots for the full magnitudes.

Figure 13-1 GPS Broadcast Orbit Accuracy Standard Deviations

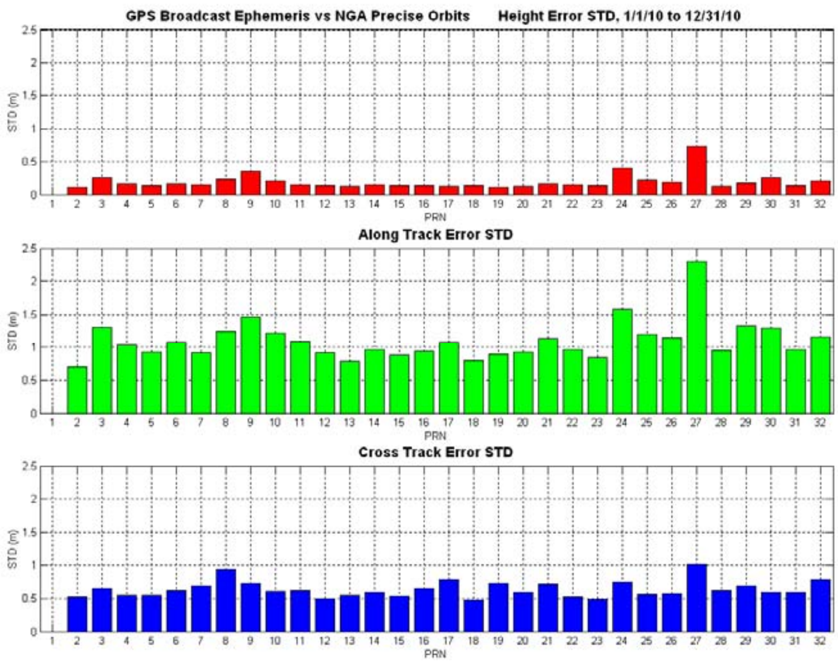


Figure 13-2 GPS Broadcast Orbit Error Means

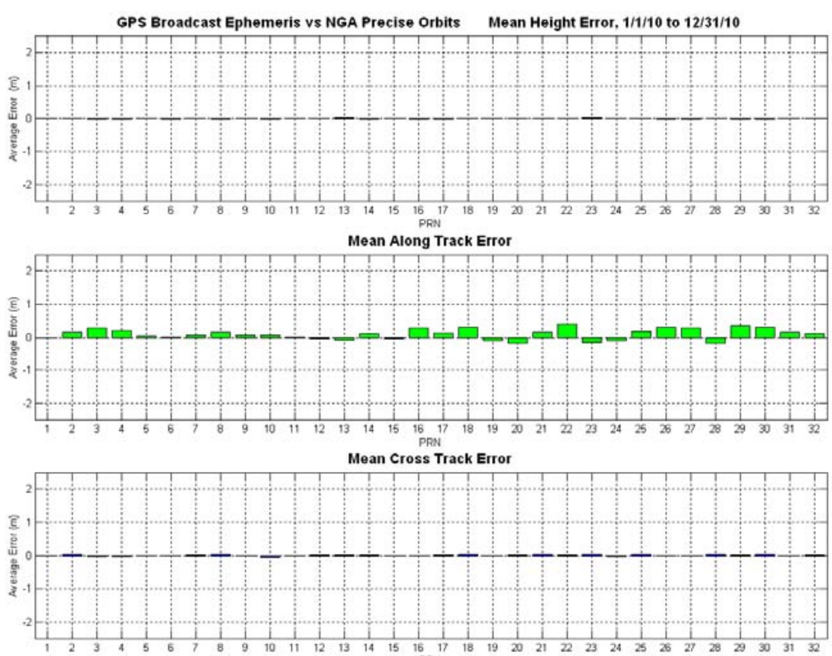


Figure 13-3 Broadcast Ephemeris vs. NGA Precise Data Availability

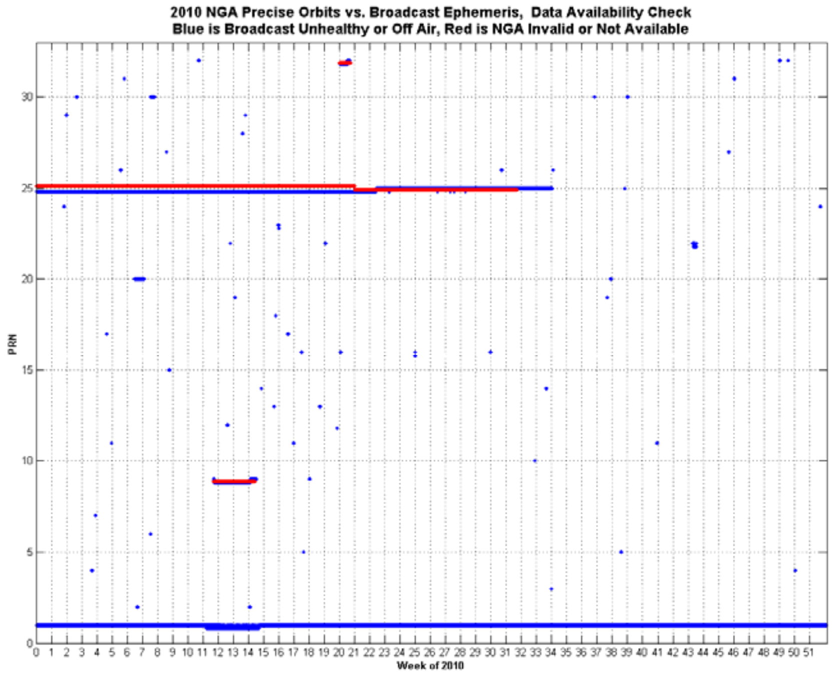


Figure 13-4 Orbit Error PRN 2 (SVN-61)

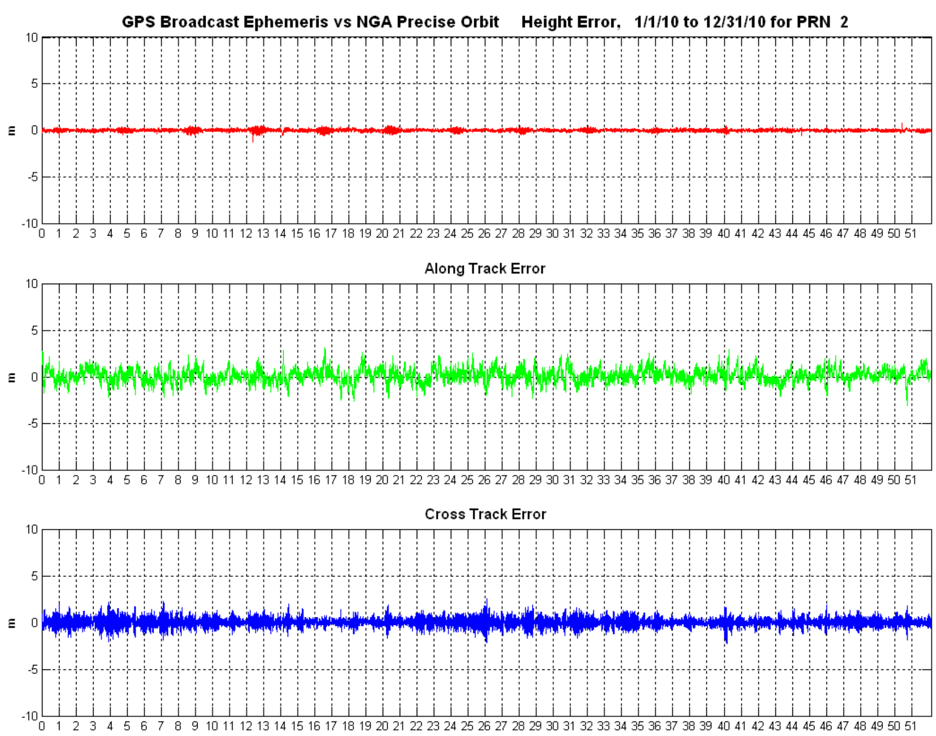


Figure 13-5 Orbit Error PRN 3 (SVN-33)

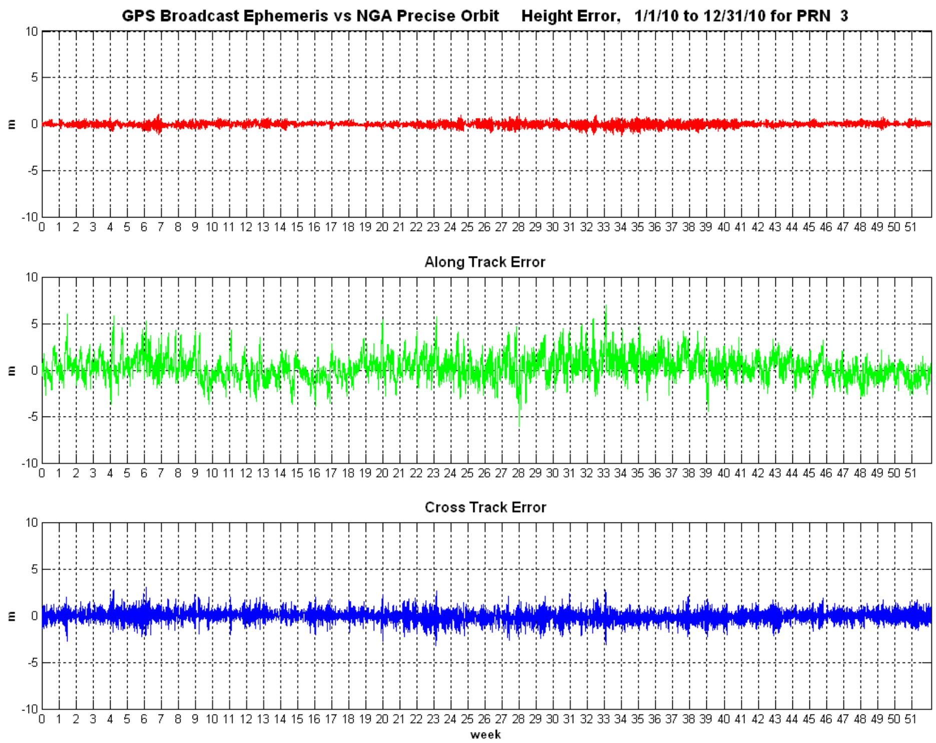


Figure 13-6 Orbit Error PRN 4 (SVN-34)

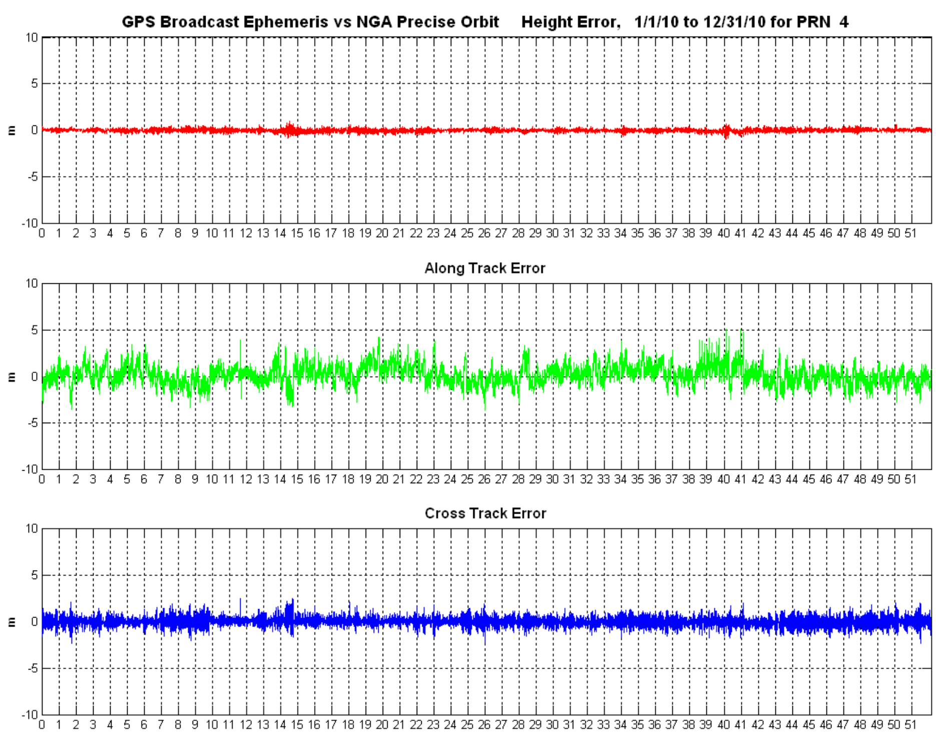


Figure 13-7 Orbit Error PRN 5 (SVN-50)

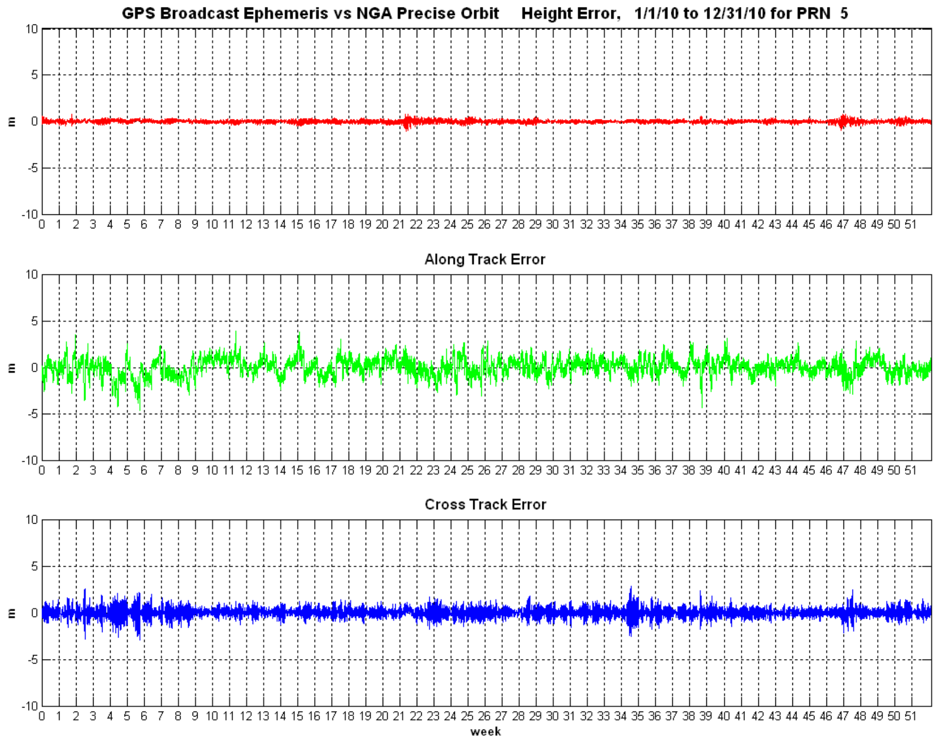


Figure 13-8 Orbit Error PRN 6 (SVN-36)

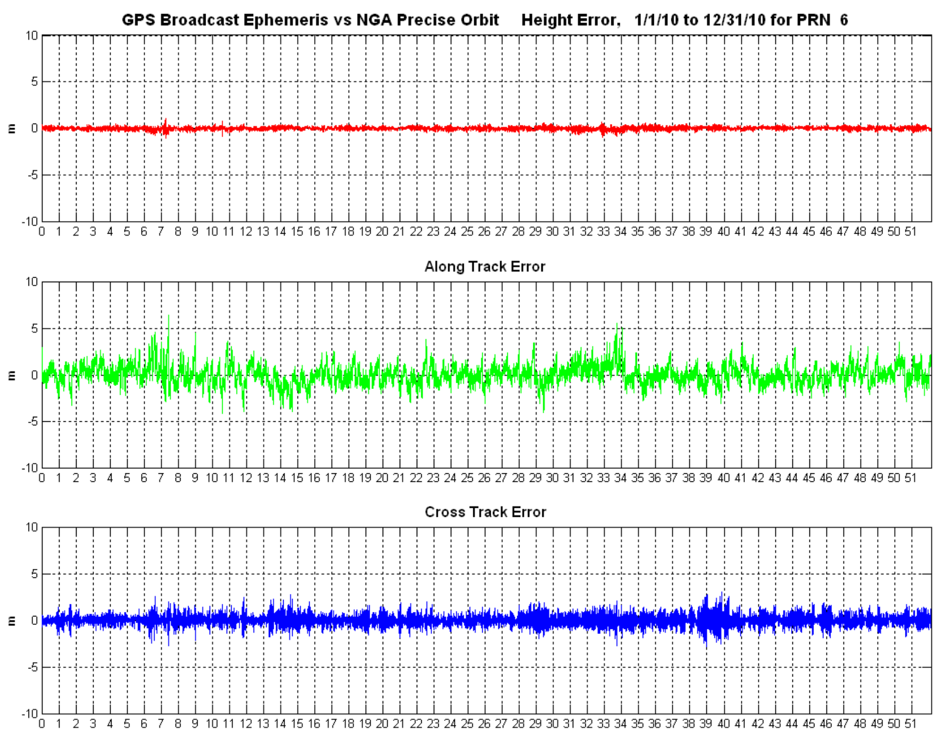


Figure 13-9 Orbit Error PRN 7 (SVN-48)

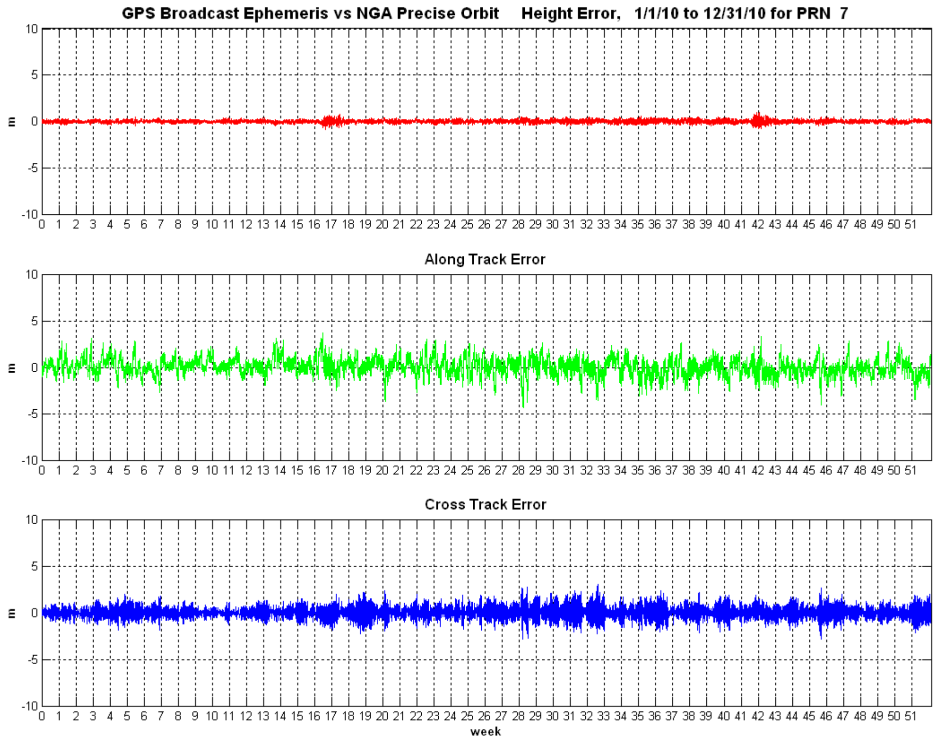


Figure 13-10 Orbit Error PRN 8 (SVN-38)

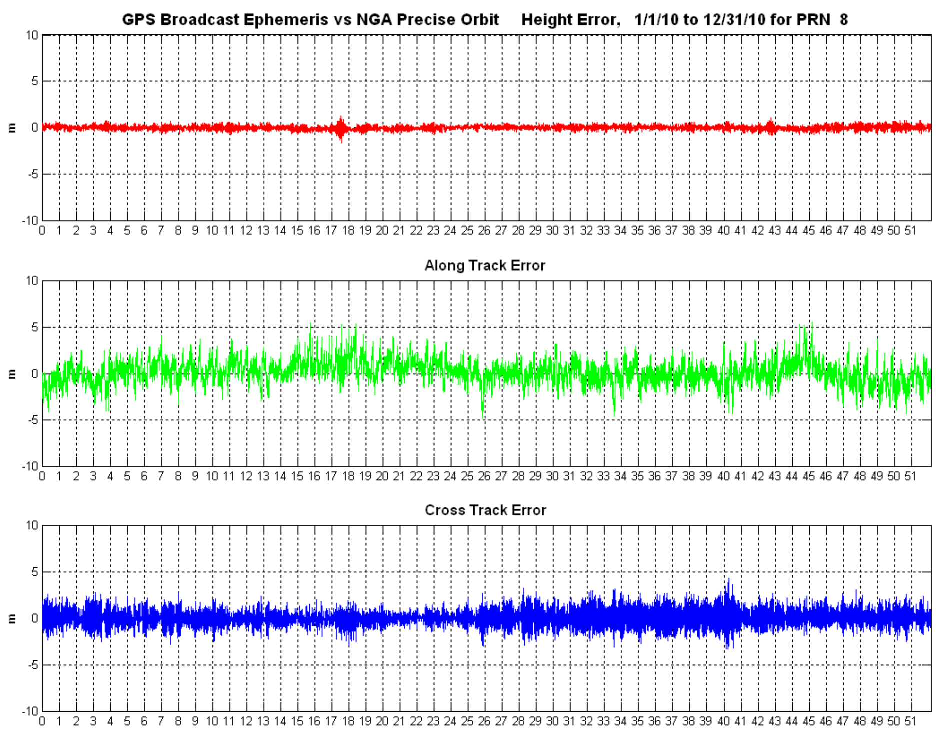


Figure 13-11 Orbit Error PRN 9 (SVN-39)

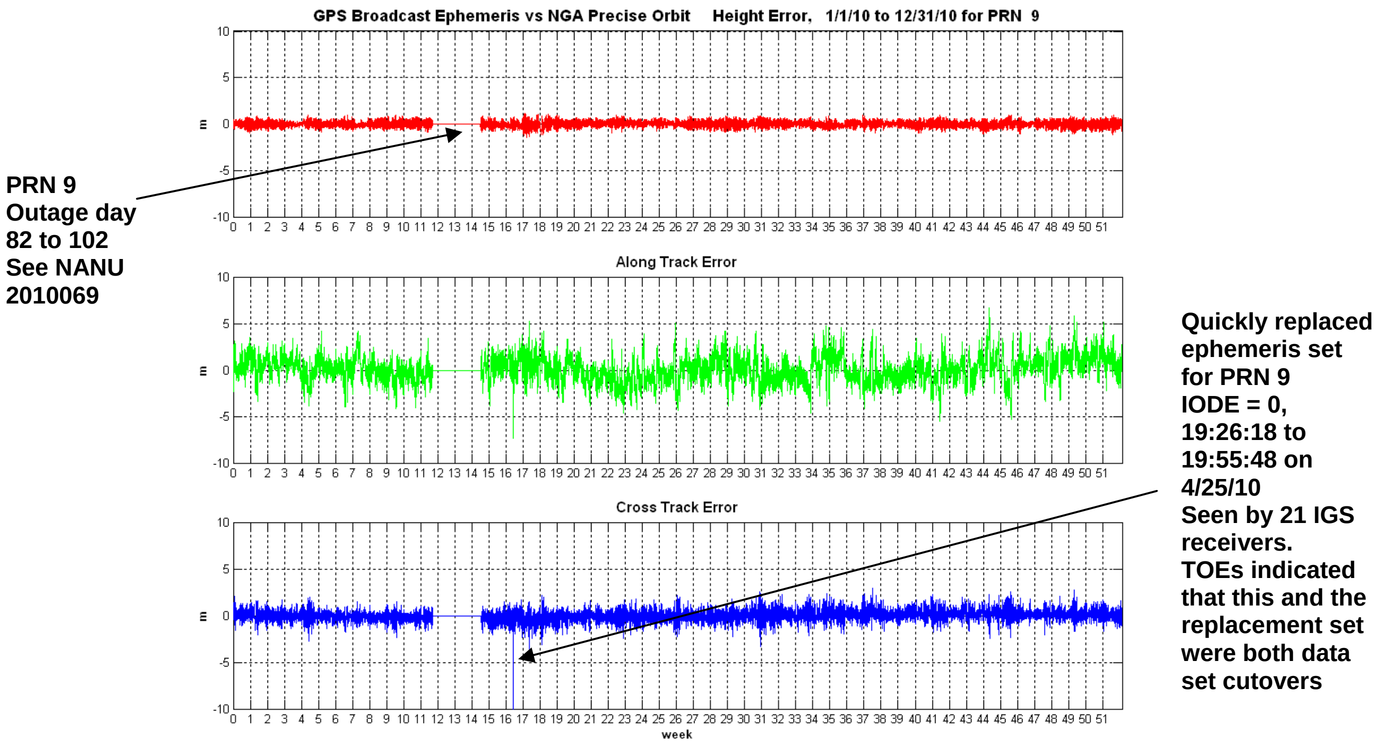


Figure 13-12 Orbit Error PRN 10 (SVN-40)

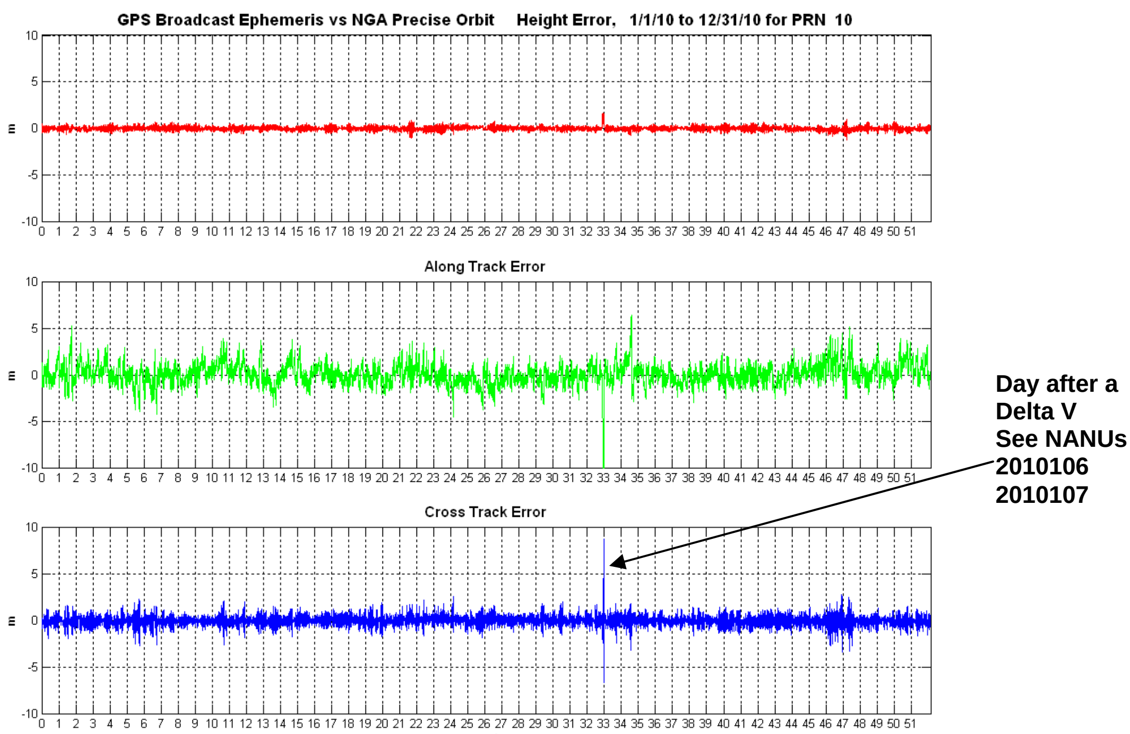


Figure 13-13 Orbit Error PRN 11 (SVN-46)

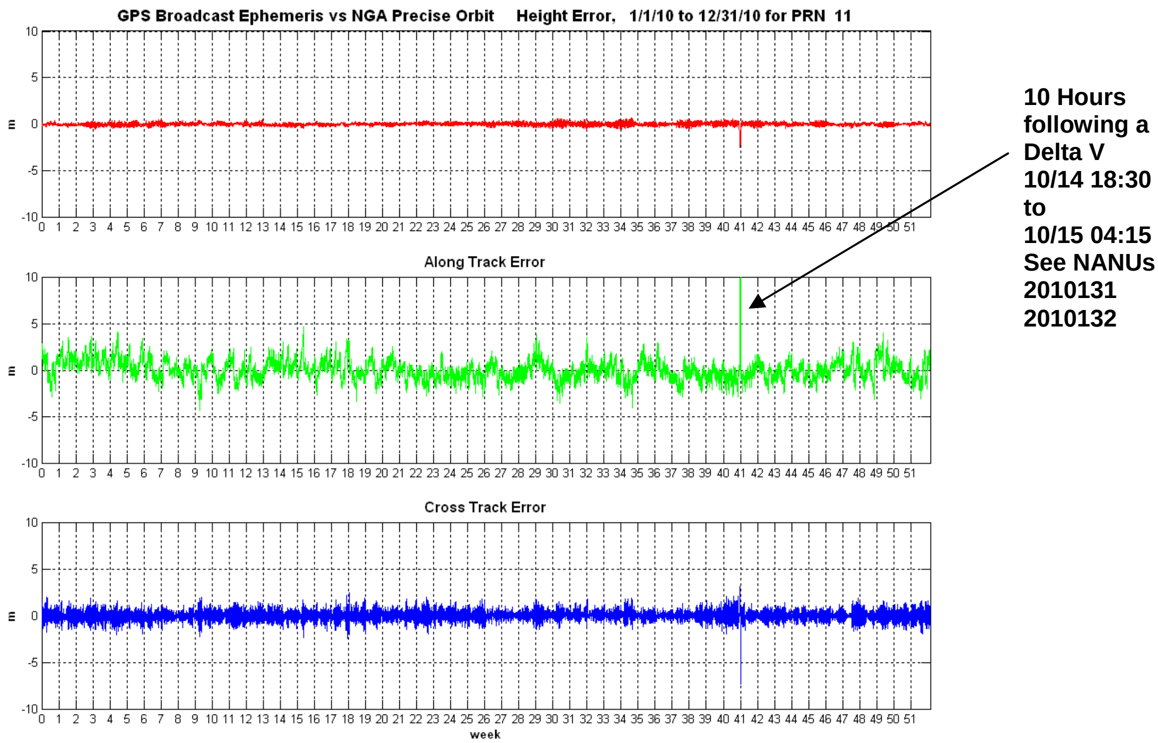


Figure 13-14 Orbit Error PRN 12 (SVN-58)

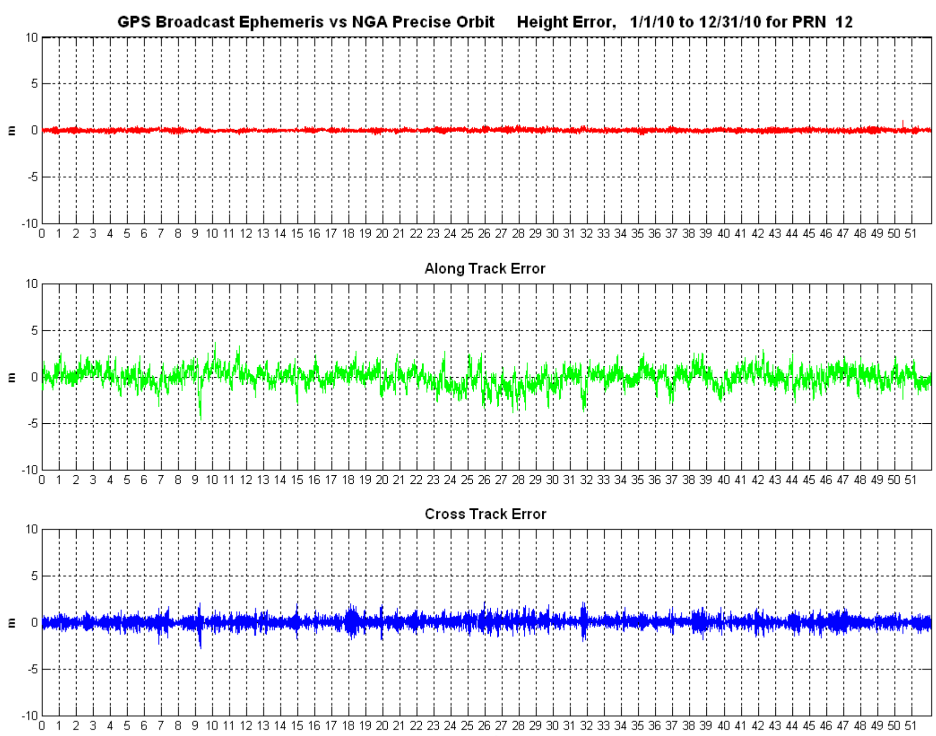


Figure 13-15 Orbit Error PRN 13 (SVN-43)

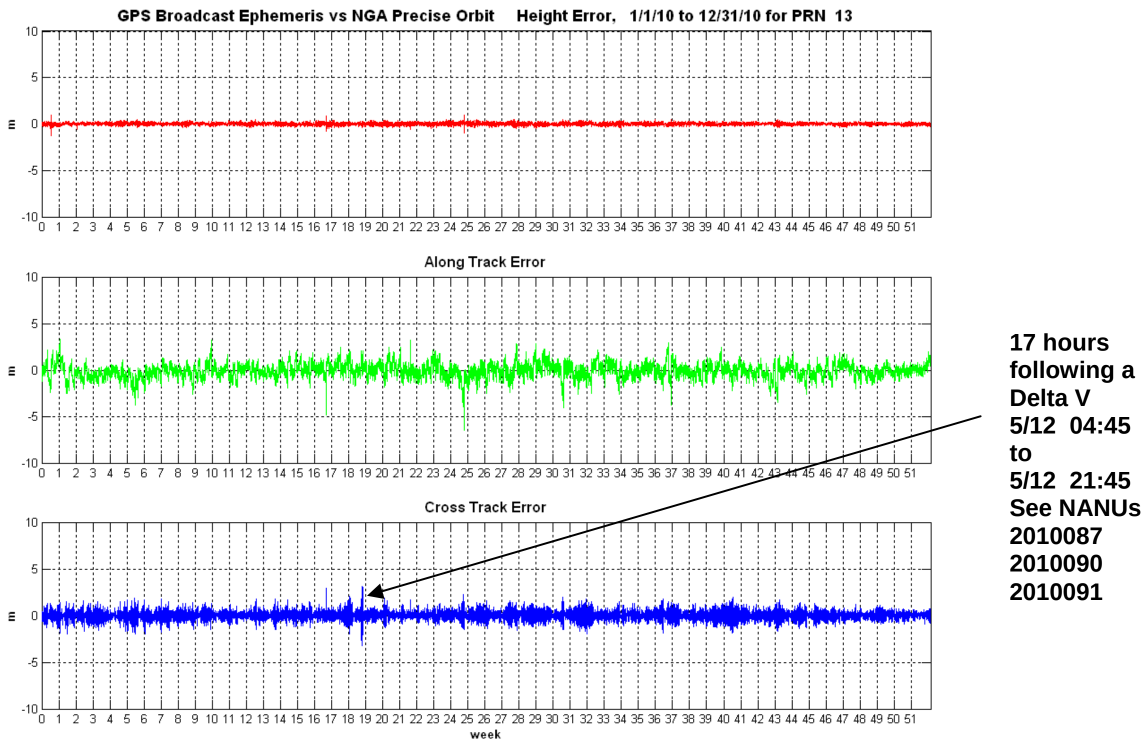


Figure 13-16 Orbit Error PRN 14 (SVN-41)

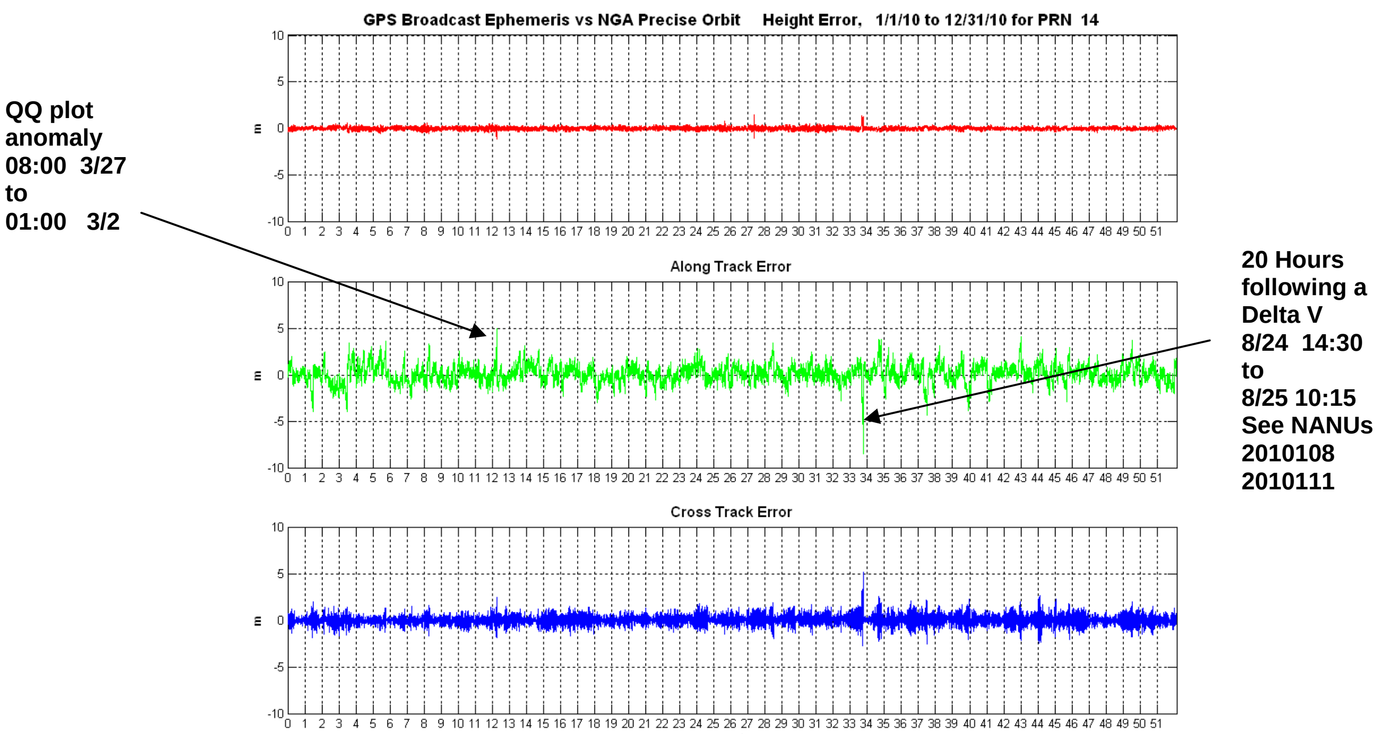


Figure 13-17 Orbit Error PRN 15 (SVN-55)

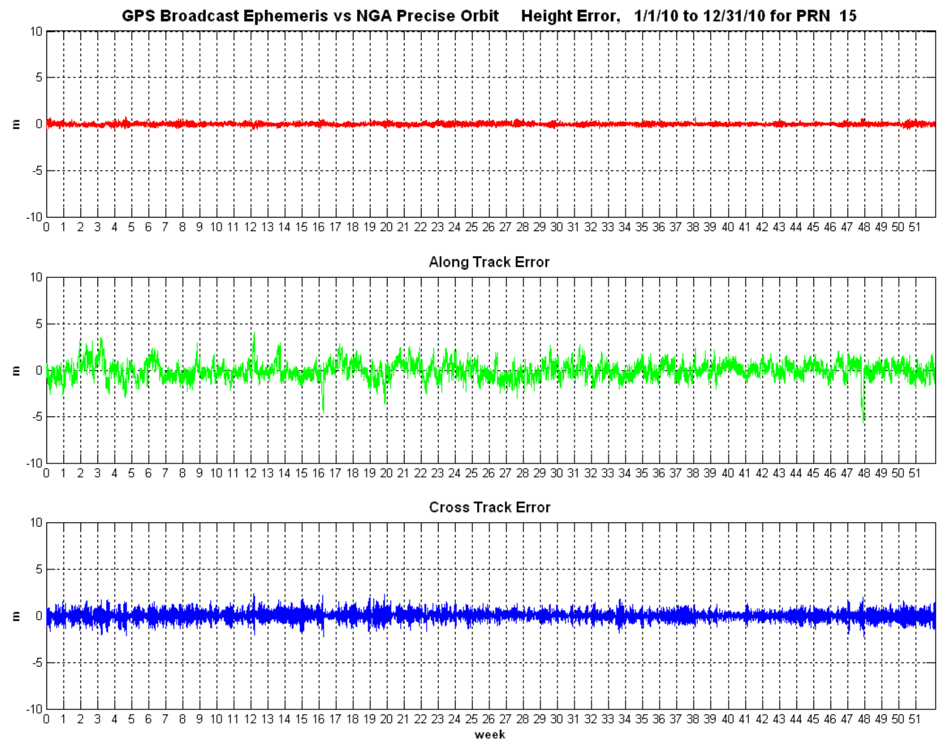


Figure 13-18 Orbit Error PRN 16 (SVN-56)

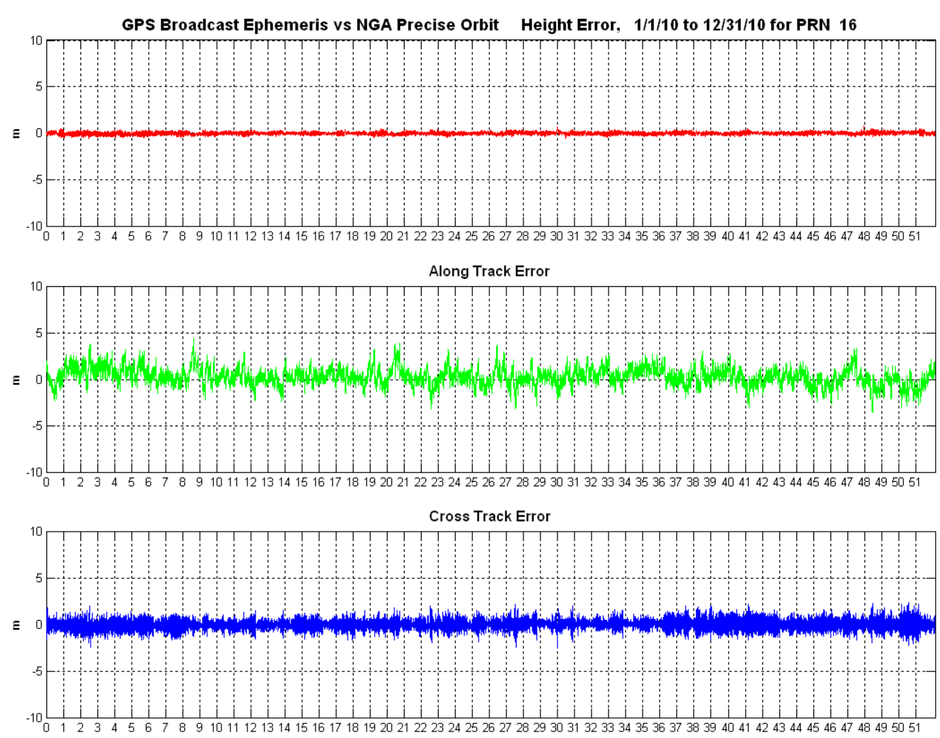


Figure 13-19 Orbit Error PRN 17 (SVN-53)

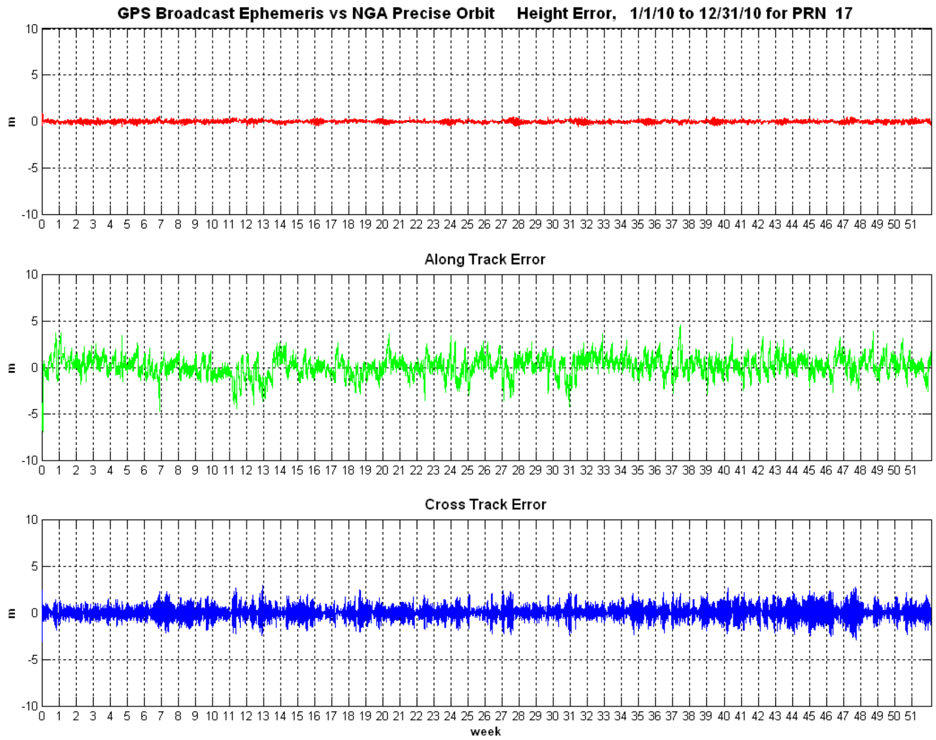


Figure 13-20 Orbit Error PRN 18 (SVN-54)

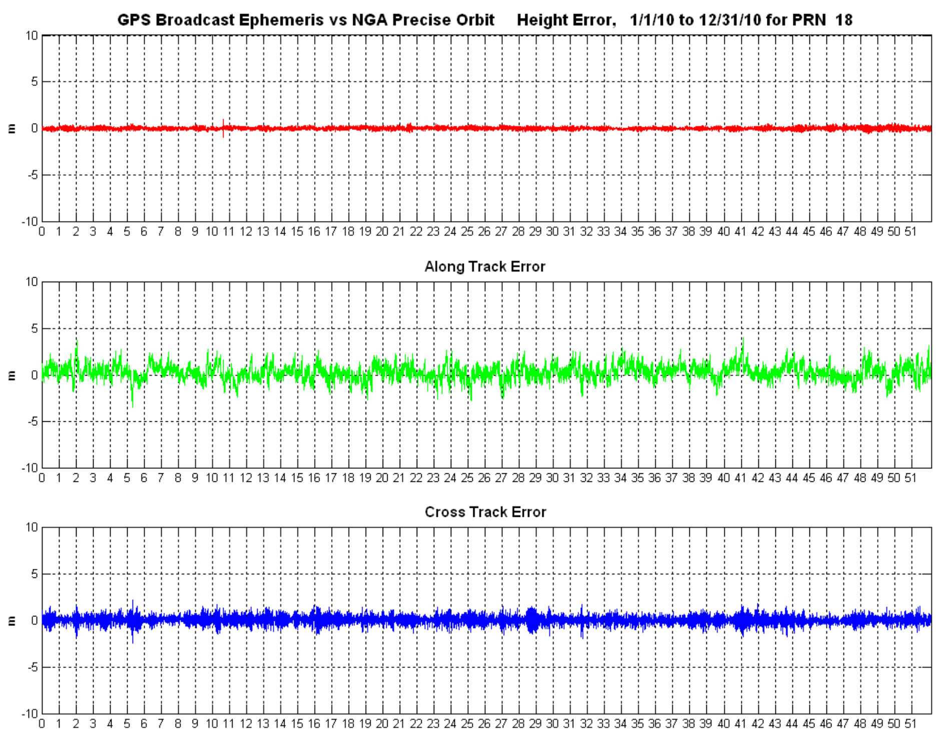


Figure 13-21 Orbit Error PRN 19 (SVN-59)

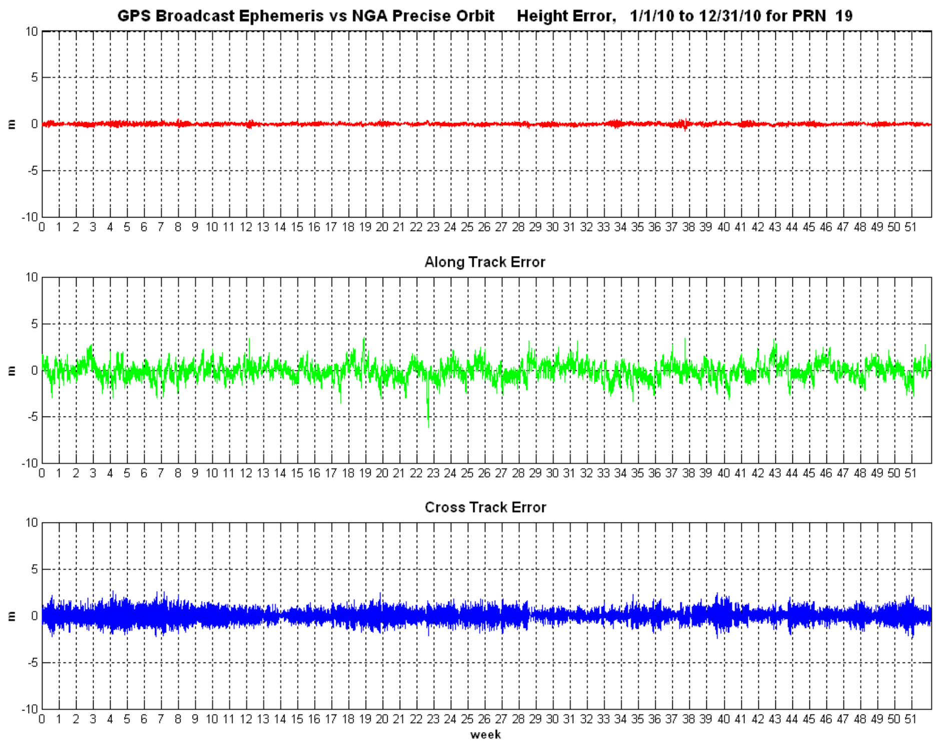


Figure 13-22 Orbit Error PRN 20 (SVN-51)

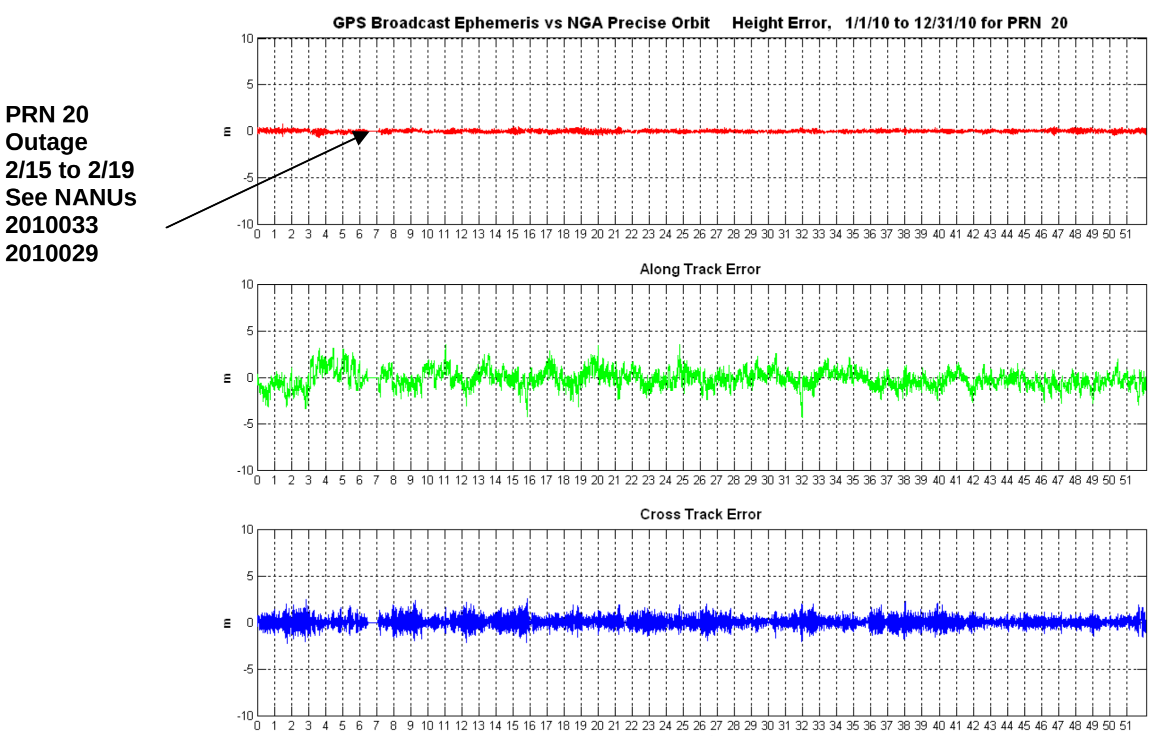


Figure 13-23 Orbit Error PRN 21 (SVN-45)

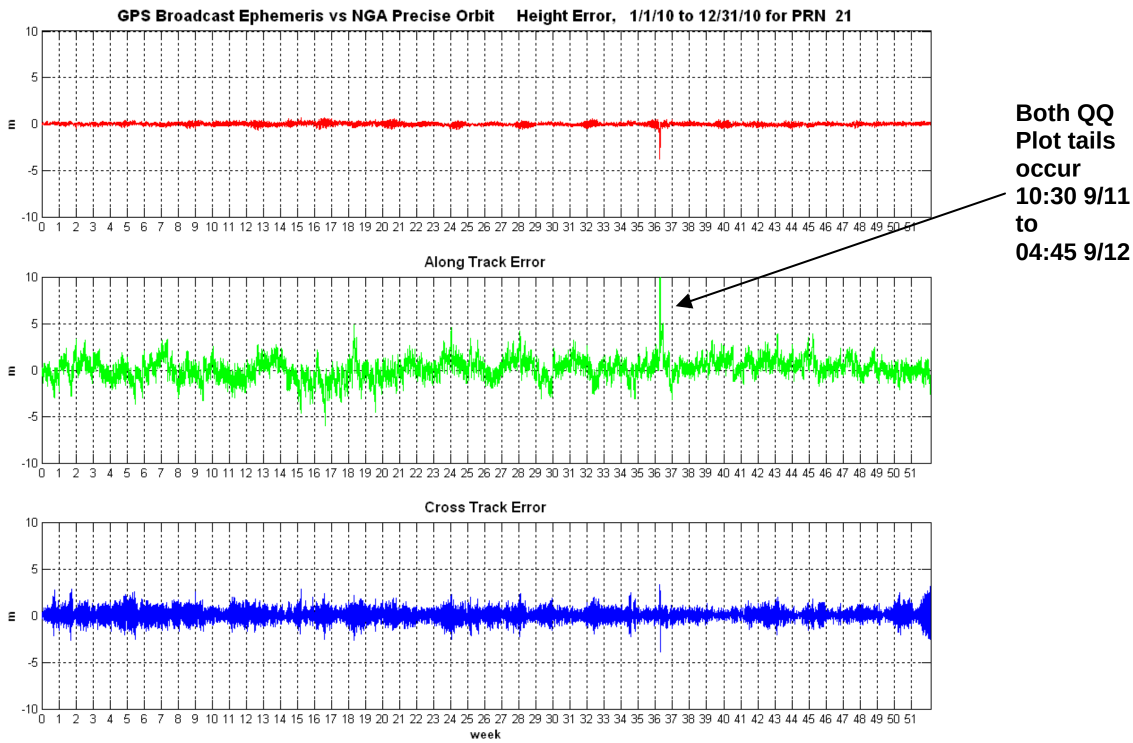


Figure 13-24 Orbit Error PRN 22 (SVN-47)

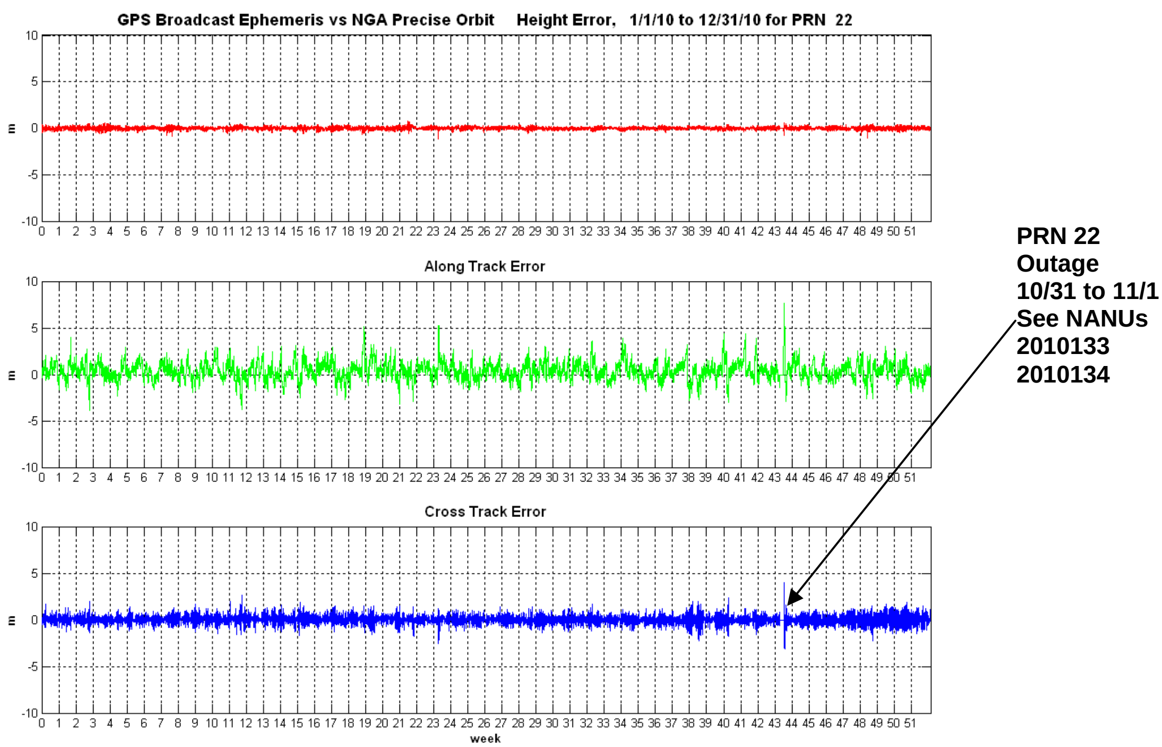


Figure 13-25 Orbit Error PRN 23 (SVN-60)

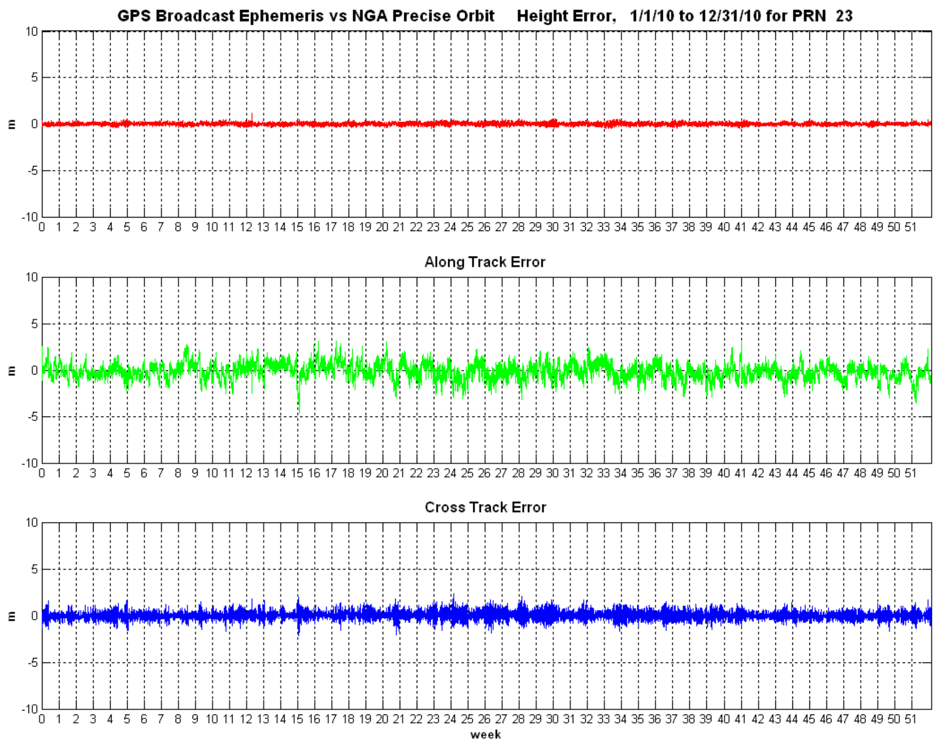


Figure 13-26 Orbit Error PRN 24 (SVN-24)

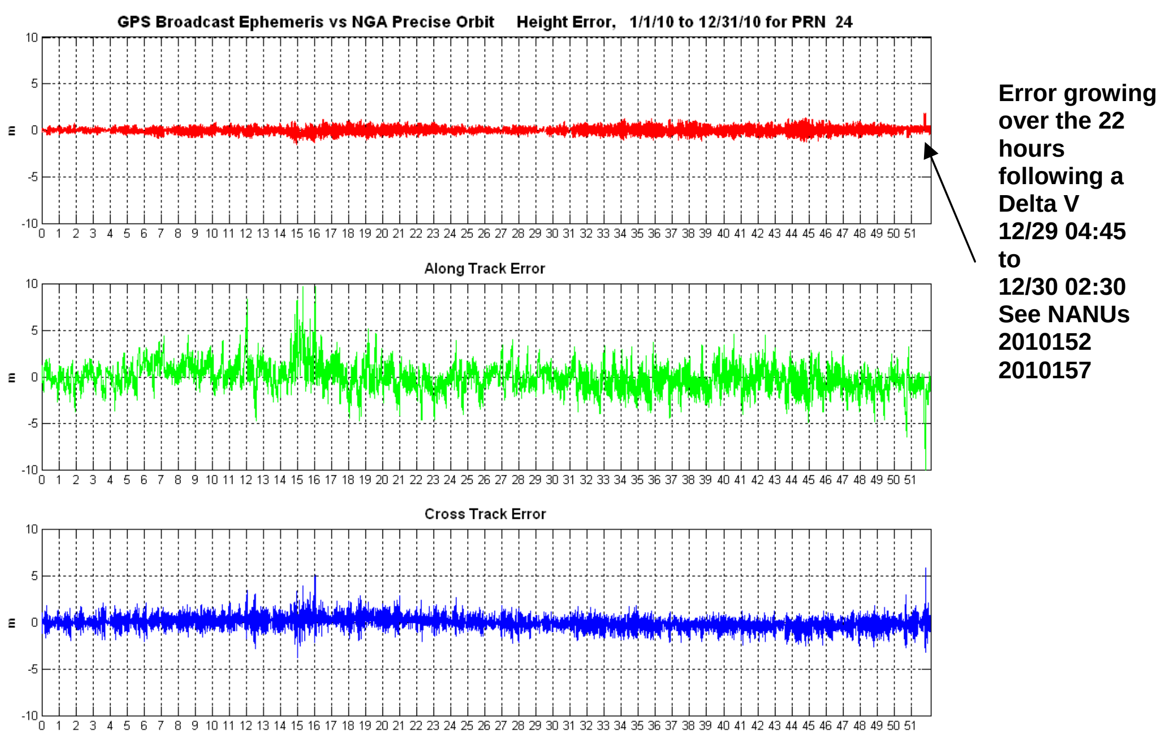


Figure 13-27 Orbit Error PRN 25 (SVN-62)

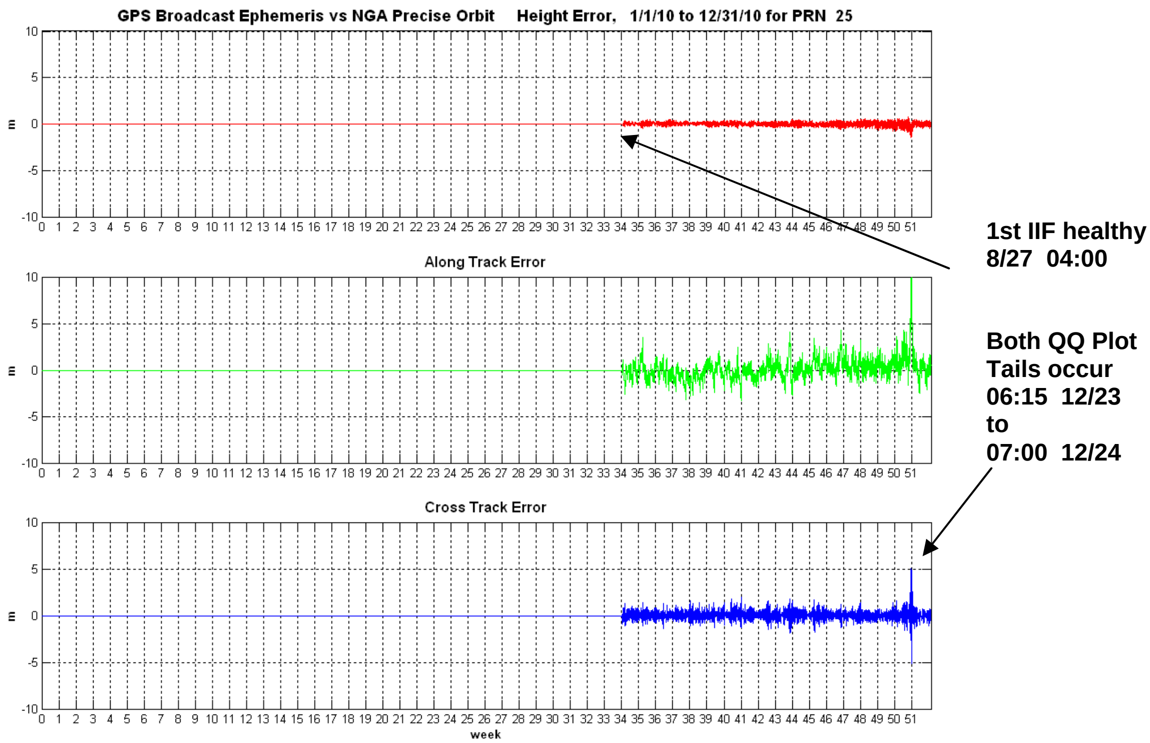


Figure 13-28 Orbit Error PRN 26 (SVN-26)

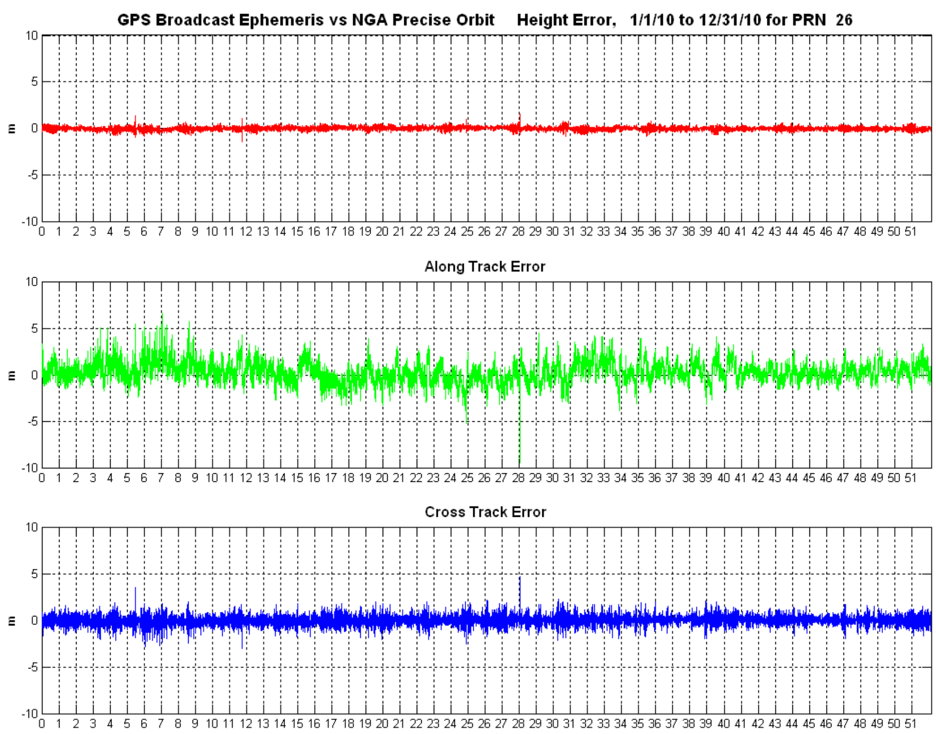


Figure 13-29 Orbit Error PRN 27 (SVN-27)

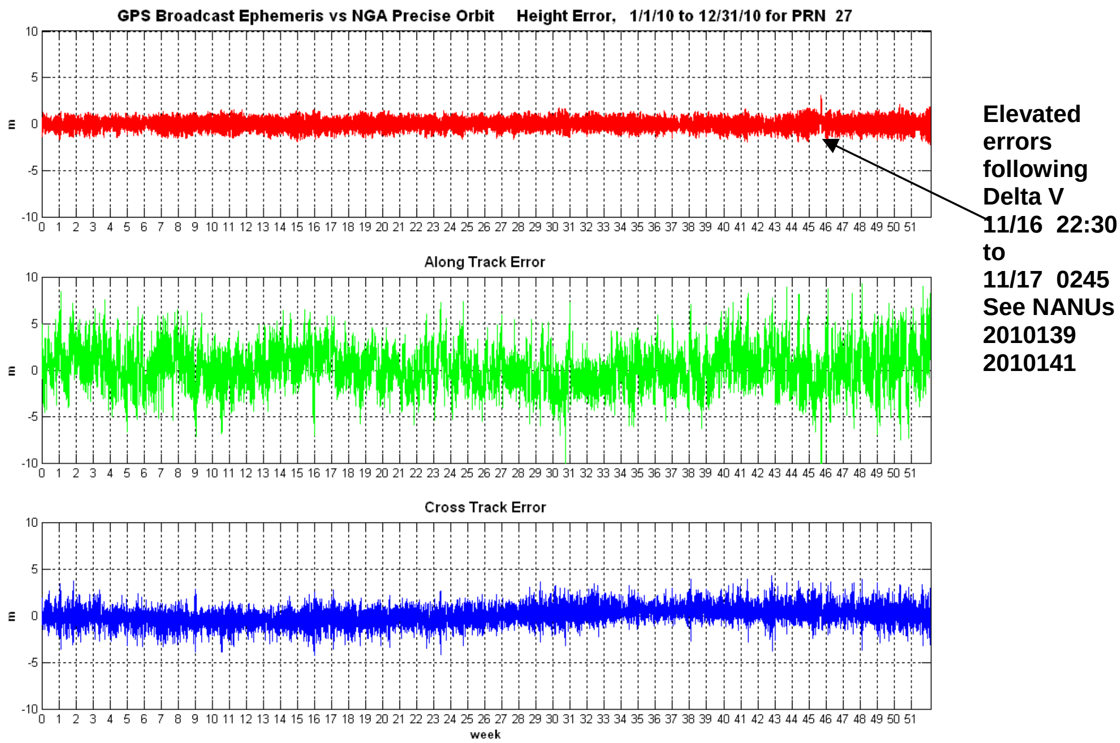


Figure 13-30 Orbit Error PRN 28 (SVN-44)

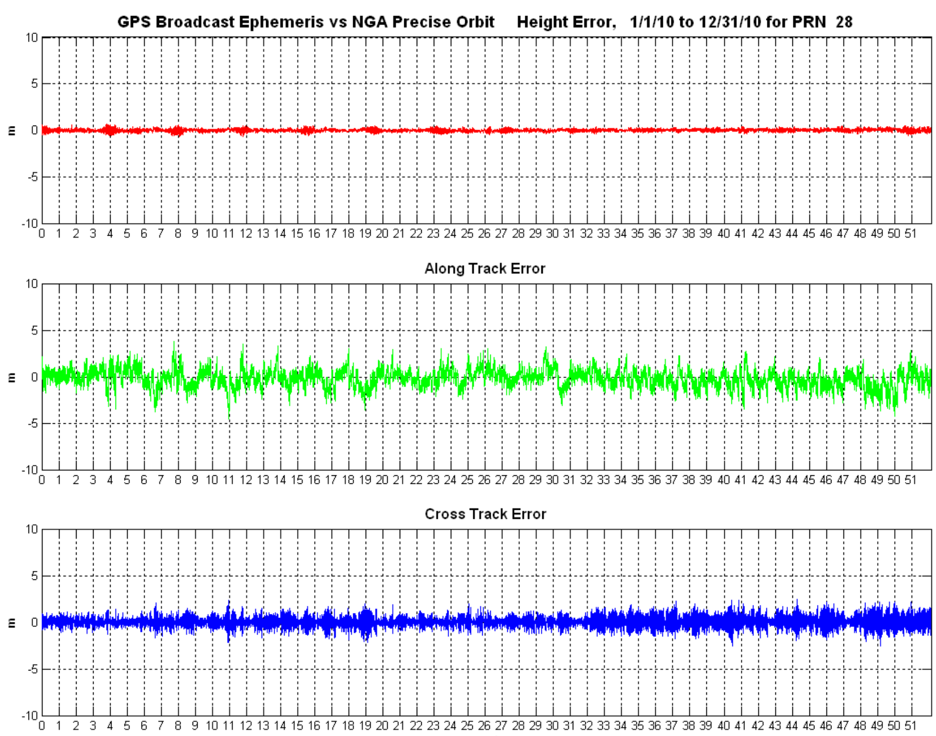


Figure 13-31 Orbit Error PRN 29 (SVN-57)

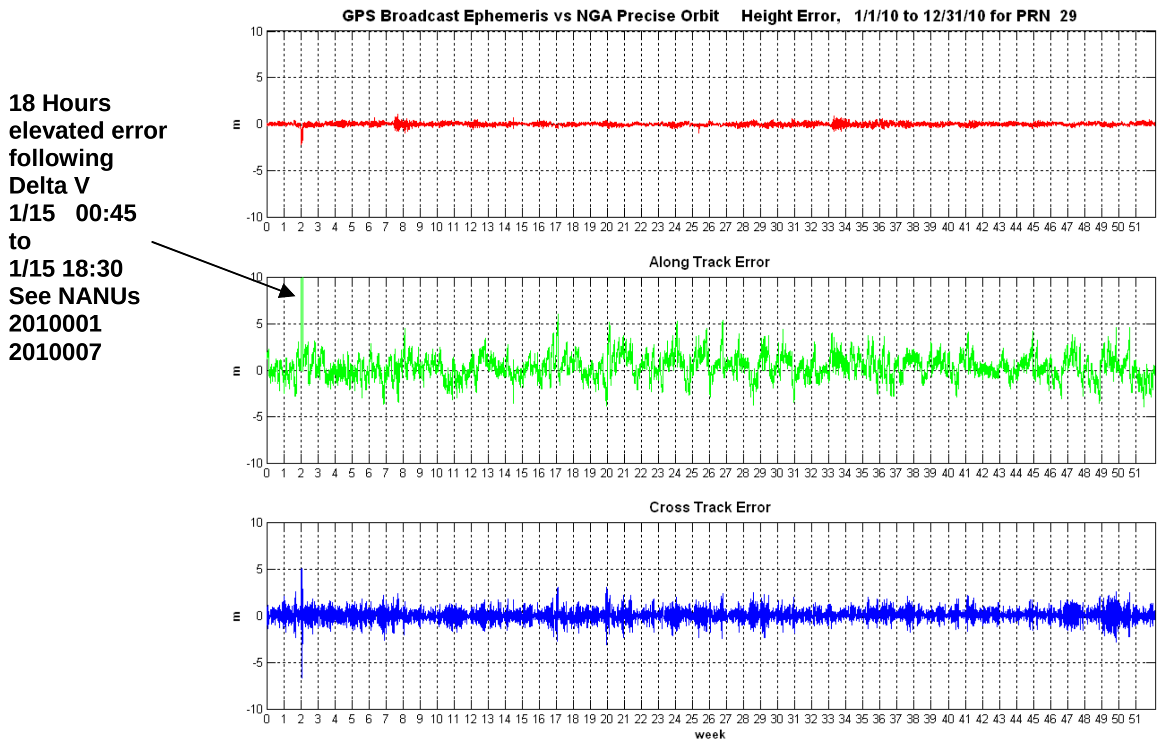


Figure 13-32 Orbit Error PRN 30 (SVN-30)

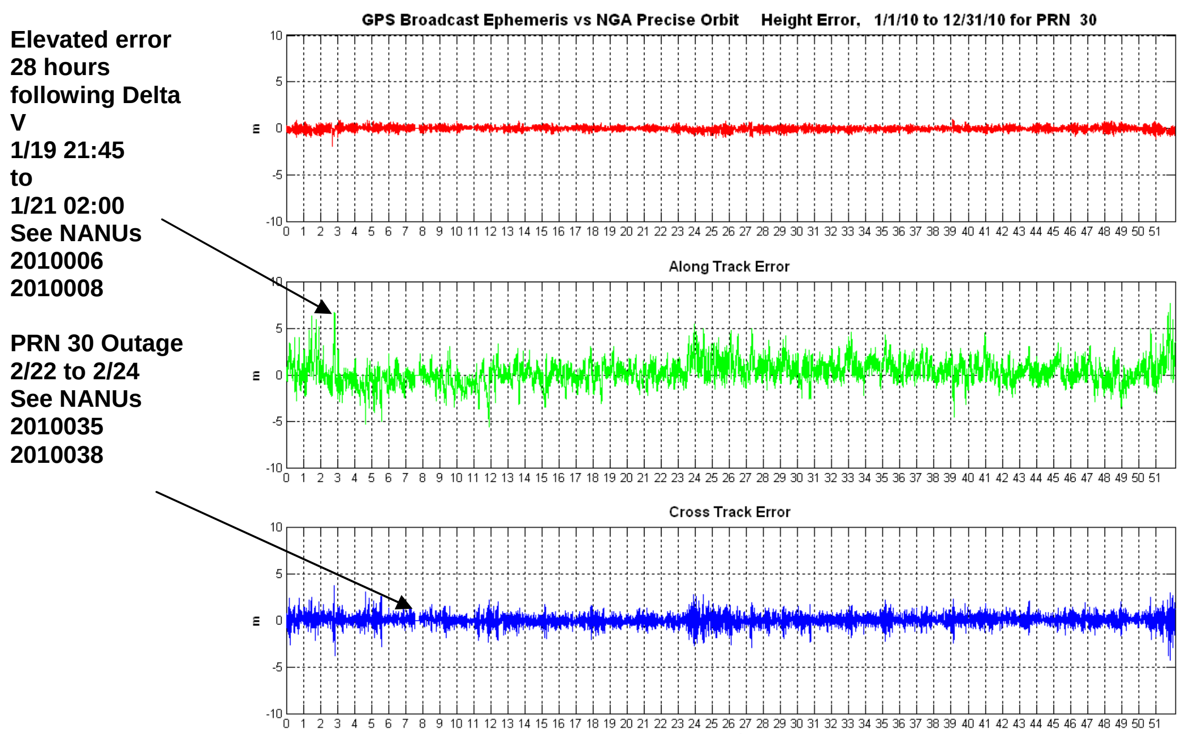


Figure 13-33 Orbit Error PRN 31 (SVN-52)

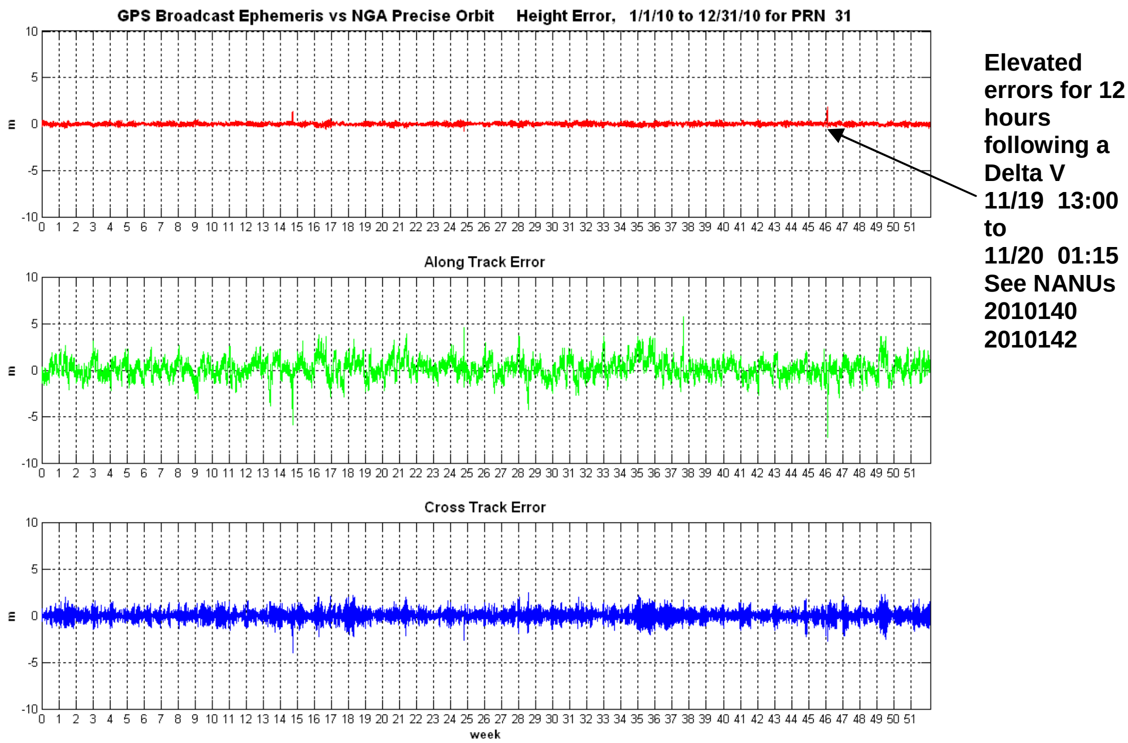


Figure 13-34 Orbit Error PRN 32 (SVN-23)

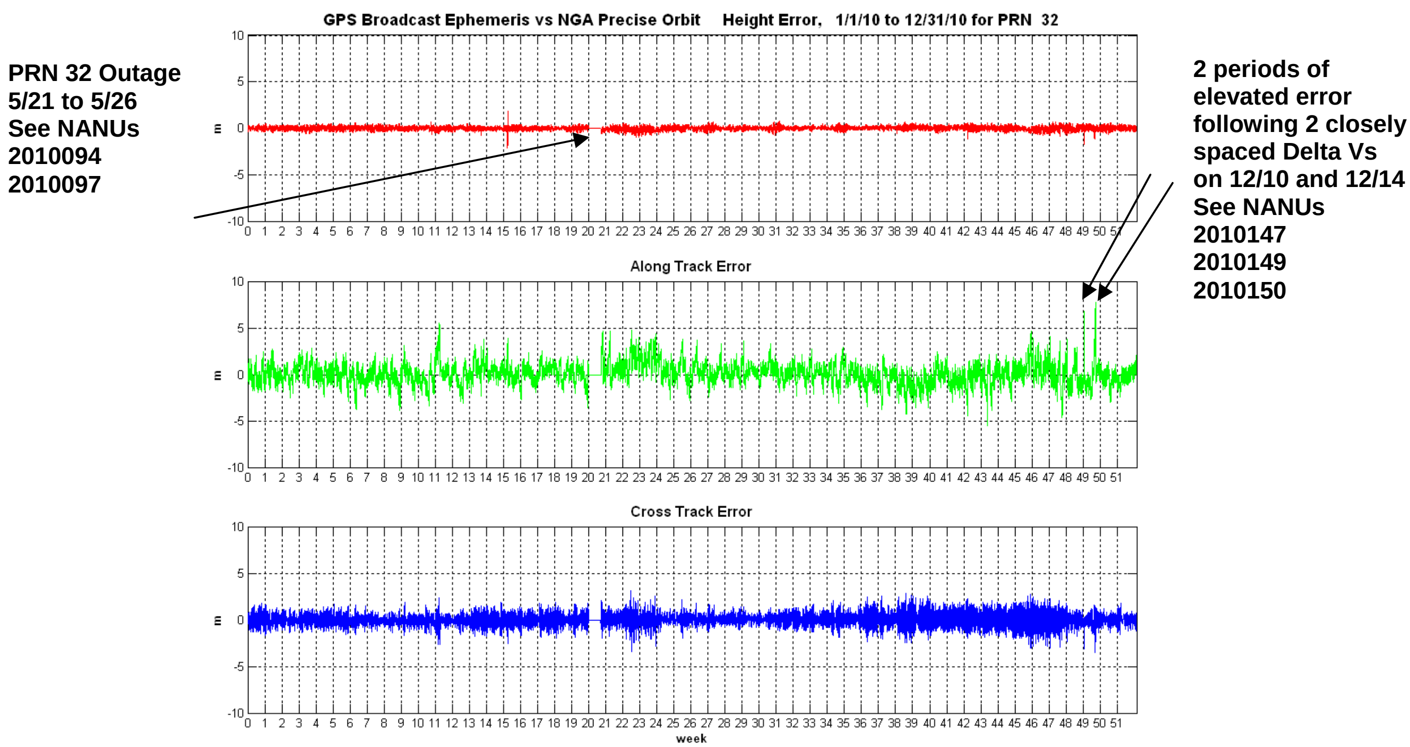


Figure 13-35 QQ Plots of Range Error PRN 2 to PRN 5

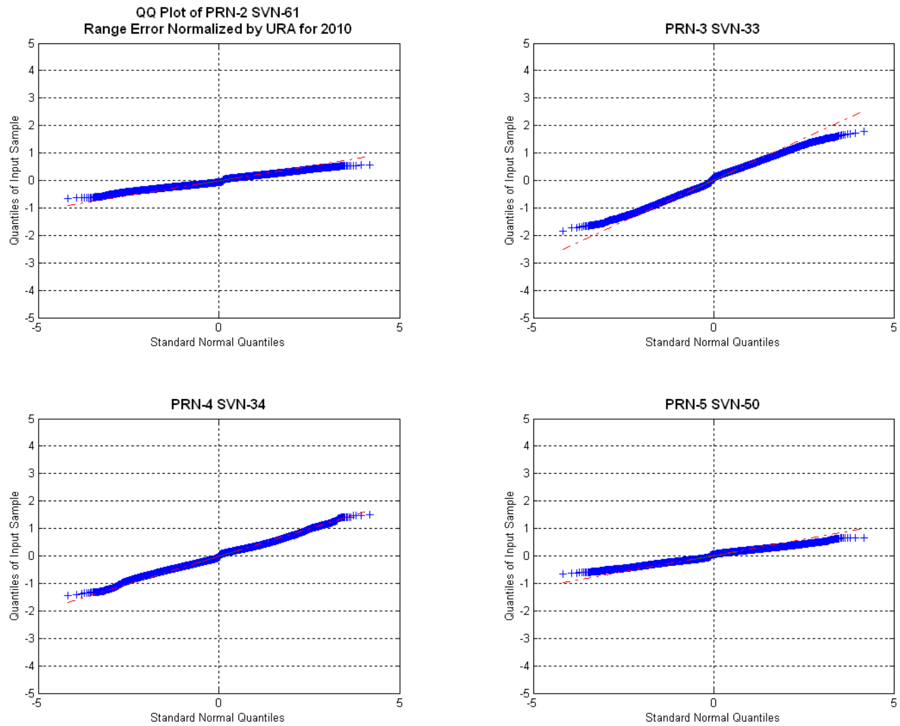


Figure 13-36 QQ Plots of Range Error PRN 6 to PRN 9

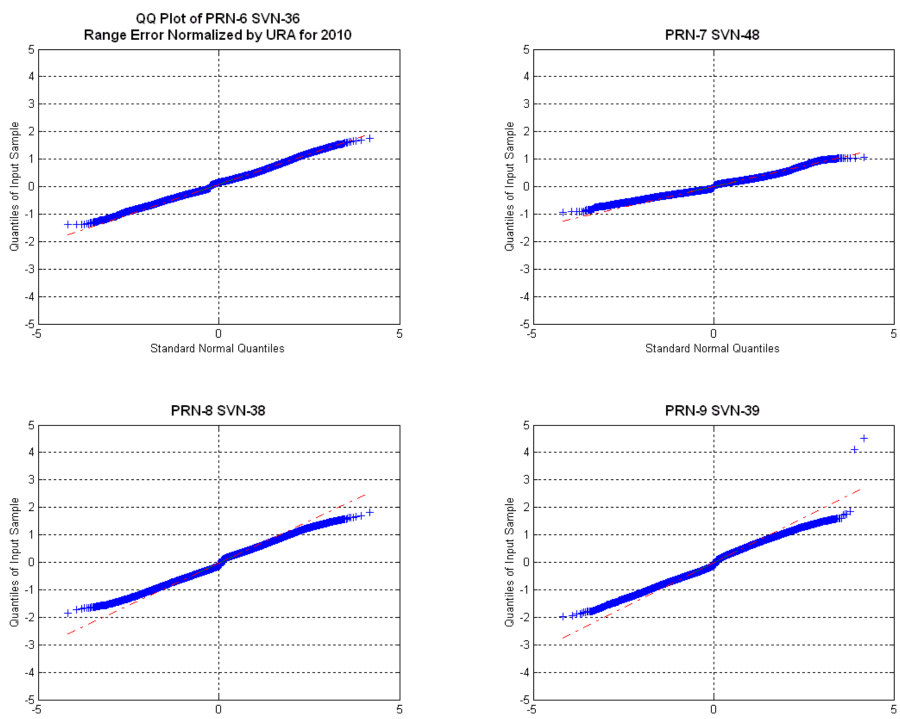


Figure 13-37 QQ Plots of Range Error PRN 10 to PRN 13

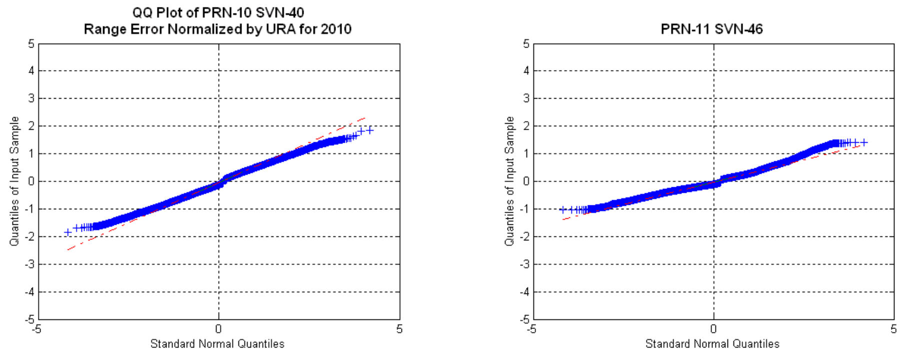


Figure 13-38 QQ Plots of Range Error PRN 14 to PRN 17

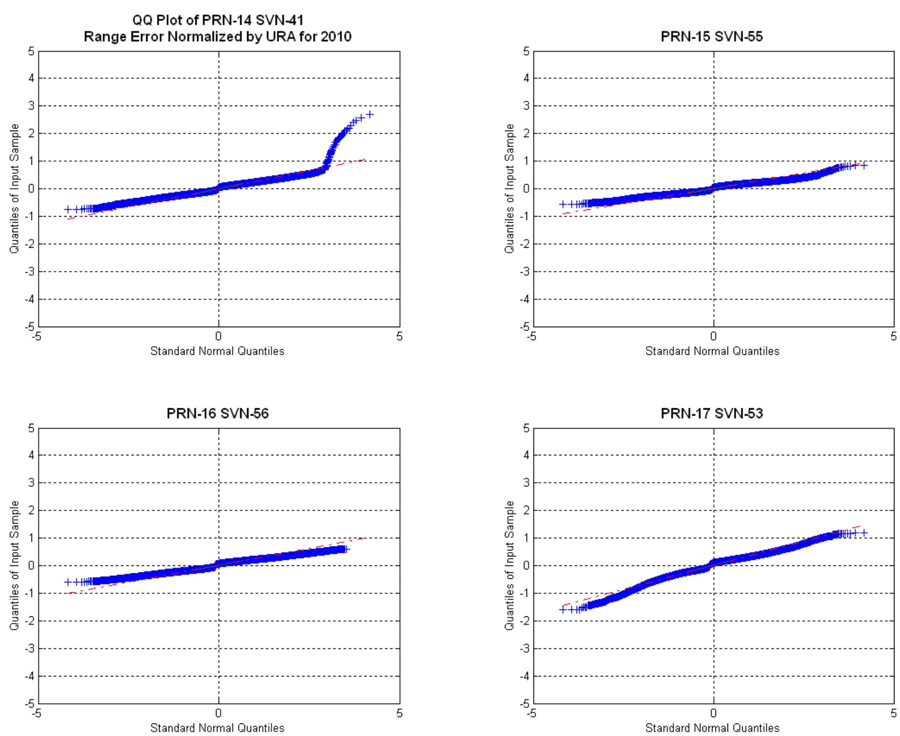


Figure 13-39 QQ Plots of Range Error PRN 18 to PRN 21

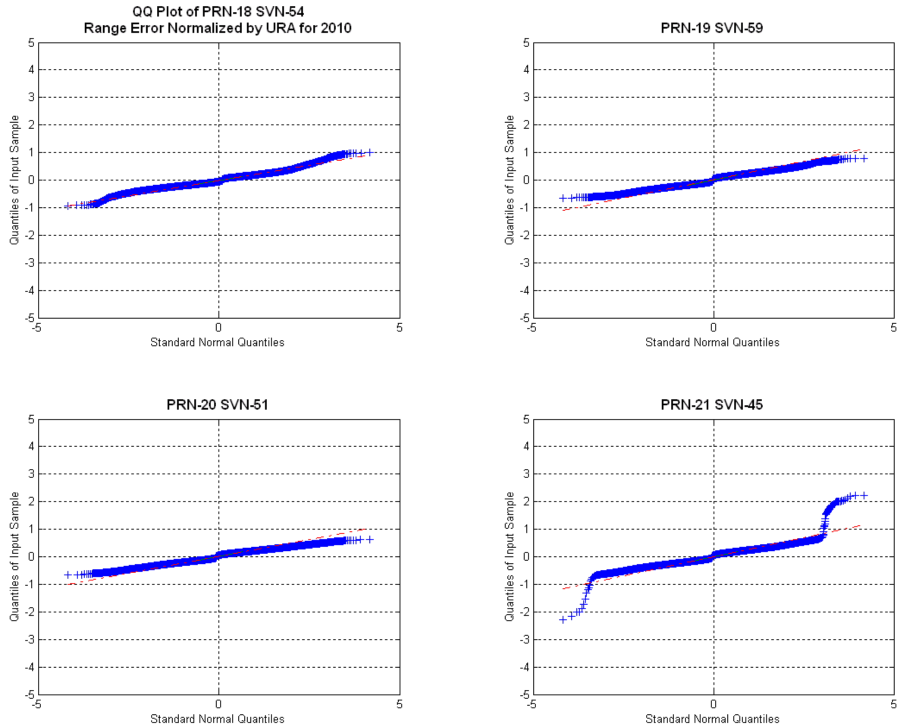


Figure 13-40 QQ Plots of Range Error PRN 22 to PRN 25

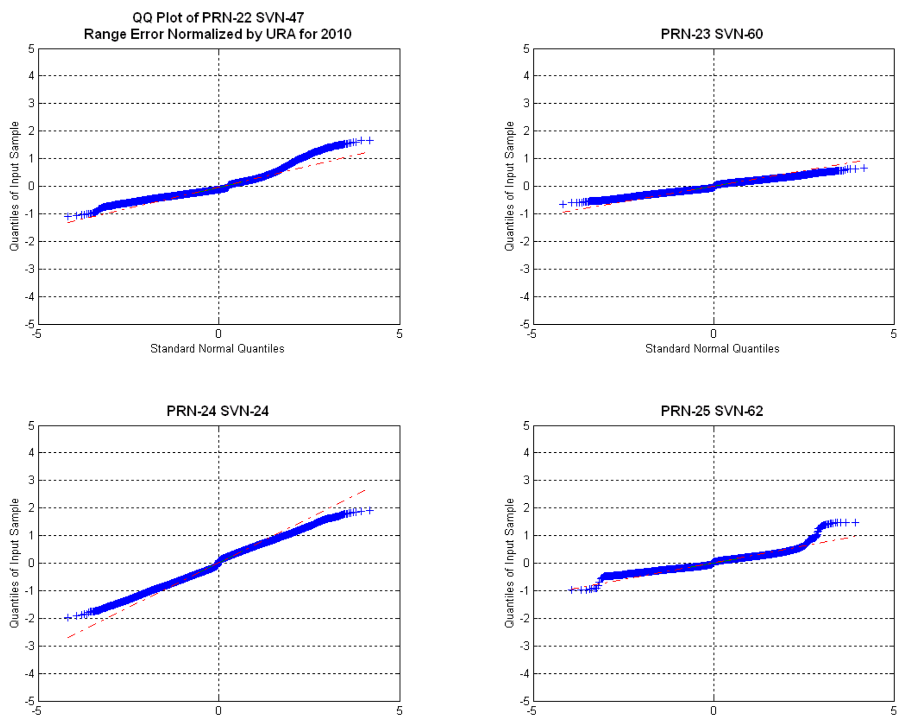


Figure 13-41 QQ Plots of Range Error PRN 26 to PRN 29

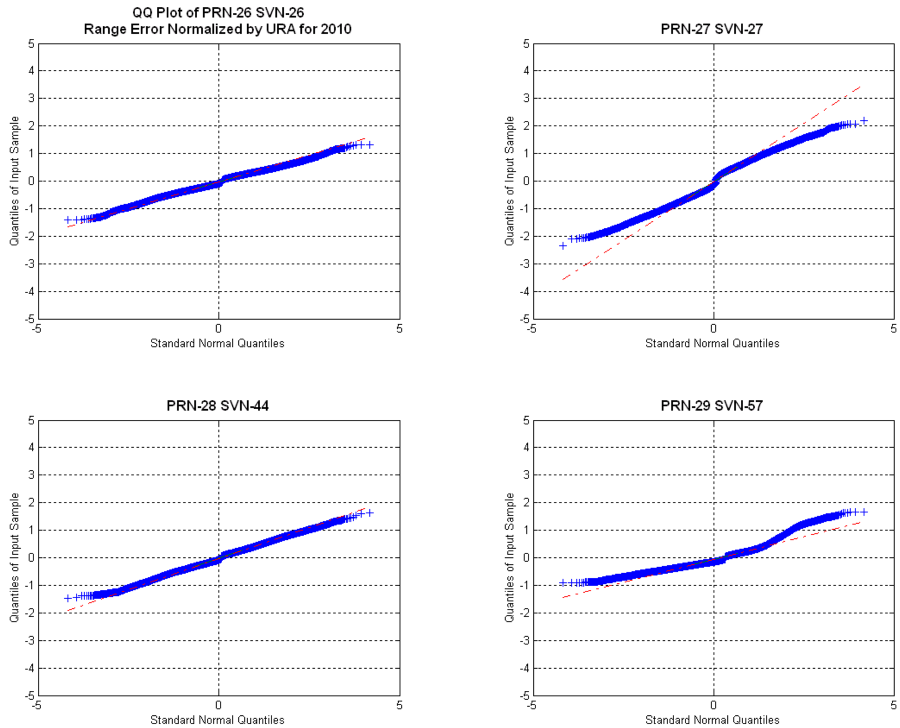


Figure 13-42 QQ Plots of Range Error PRN 30 to PRN 32, and PRN 2 to PRN 32 combined

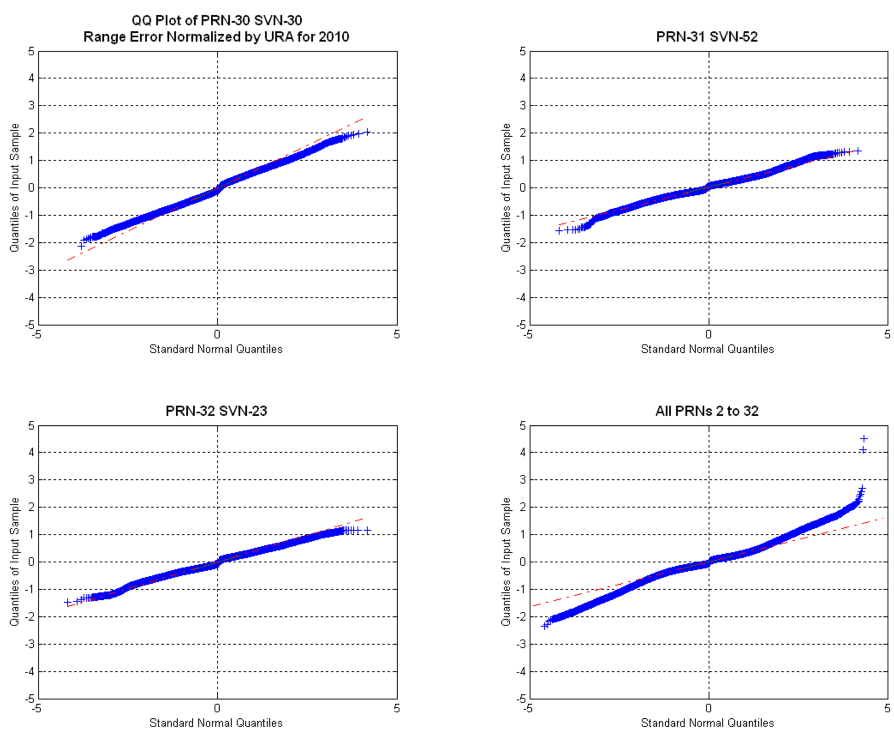


Figure 13-43 Histograms of H, A, C, and Range Error for PRN 2

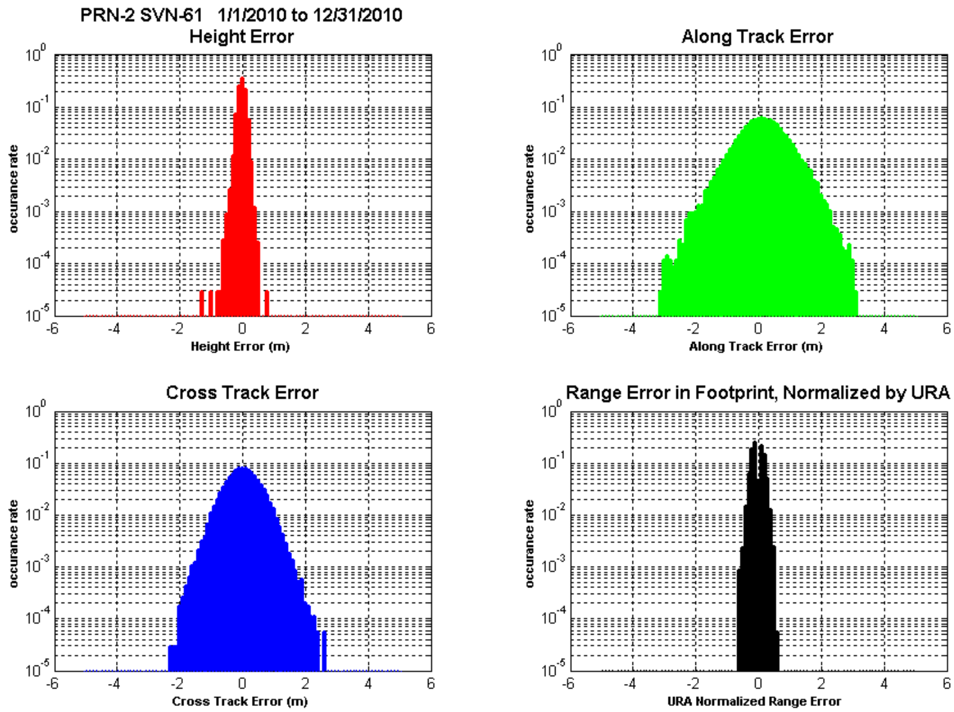


Figure 13-44 Histograms of H, A, C, and Range Error for PRN 3

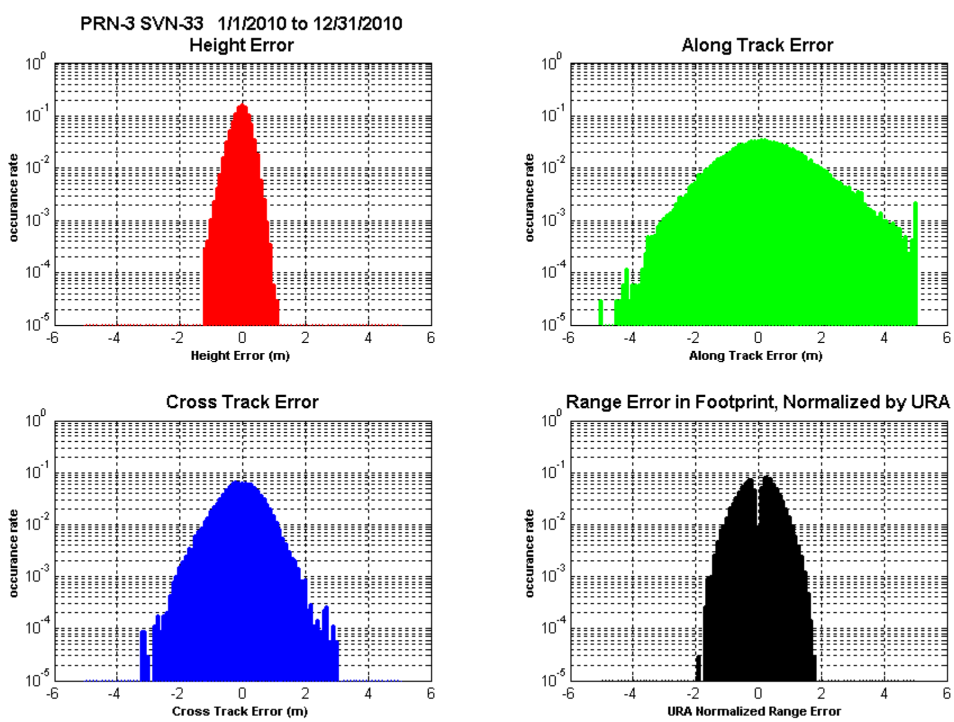


Figure 13-45 Histograms of H, A, C, and Range Error for PRN 4

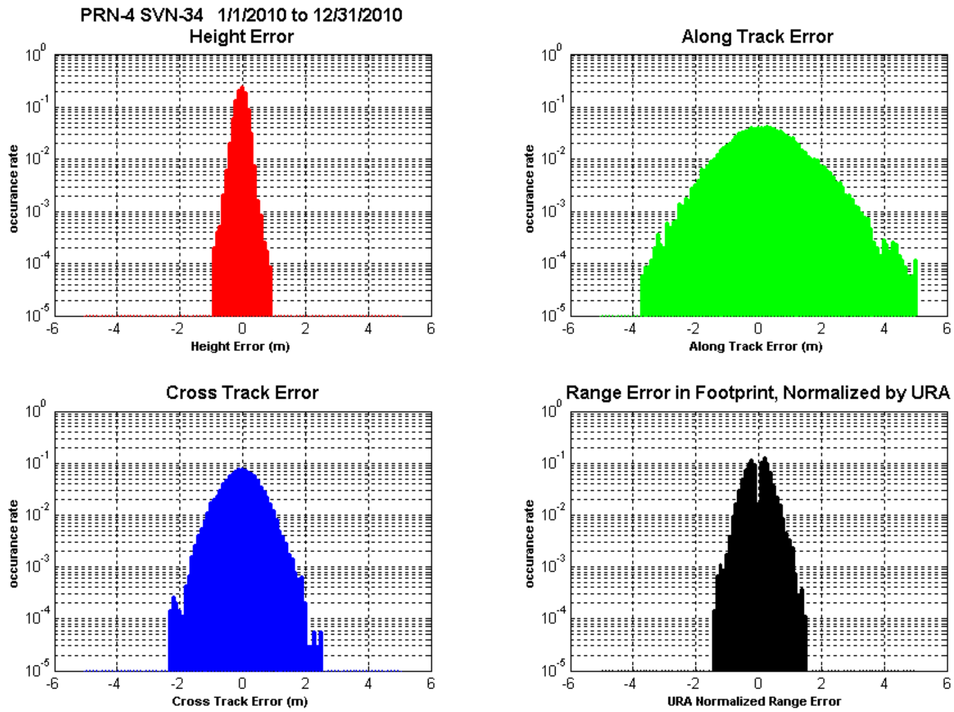


Figure 13-46 Histograms of H, A, C, and Range Error for PRN 5

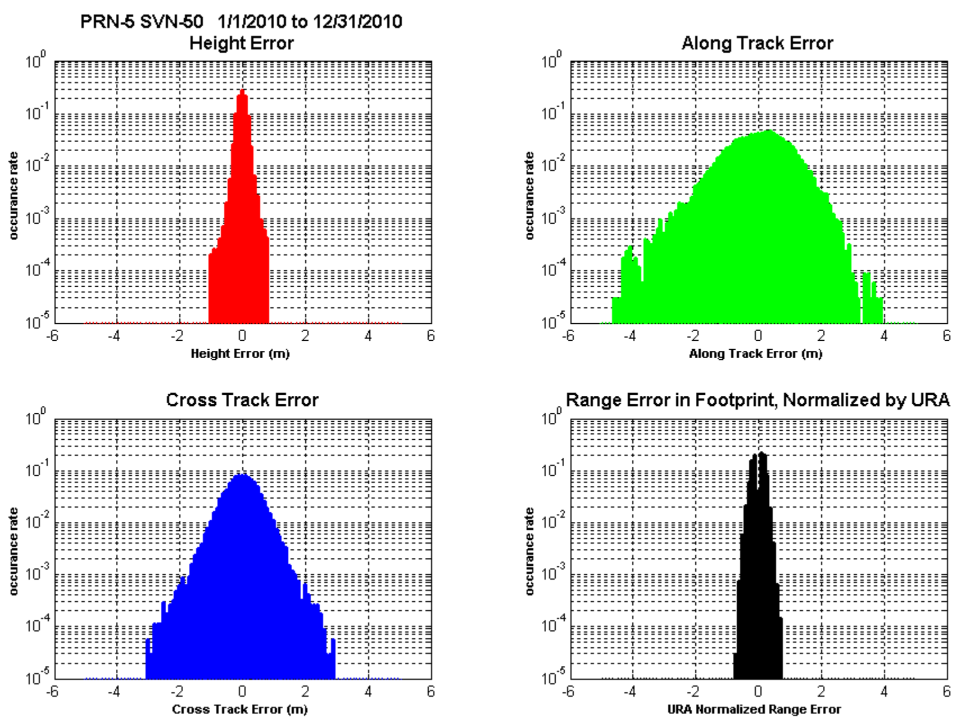


Figure 13-47 Histograms of H, A, C, and Range Error for PRN 6

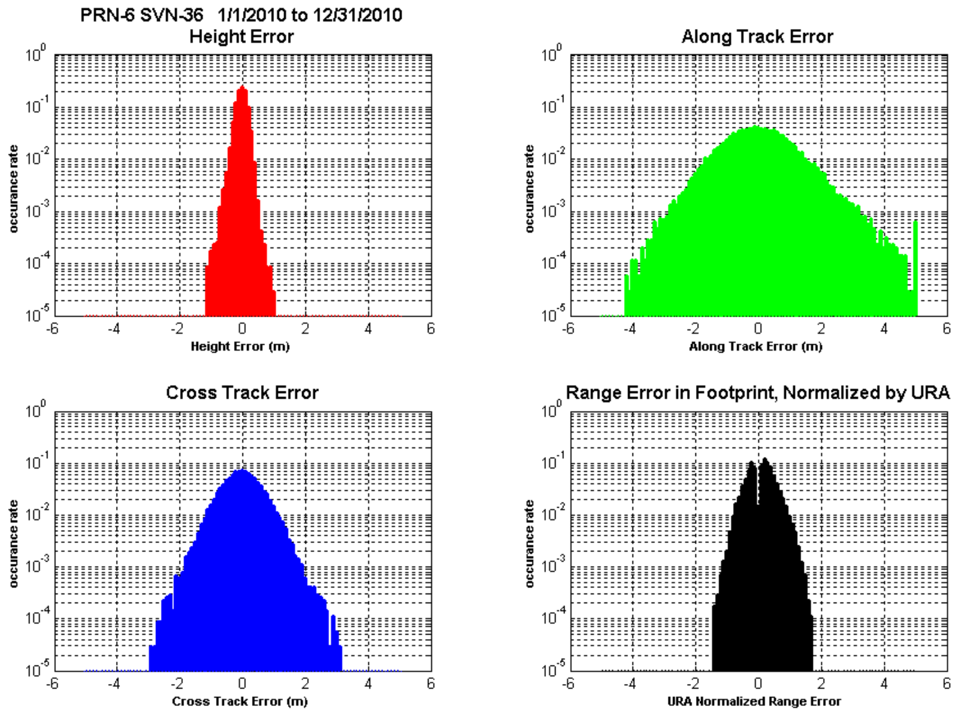


Figure 13-48 Histograms of H, A, C, and Range Error for PRN 7

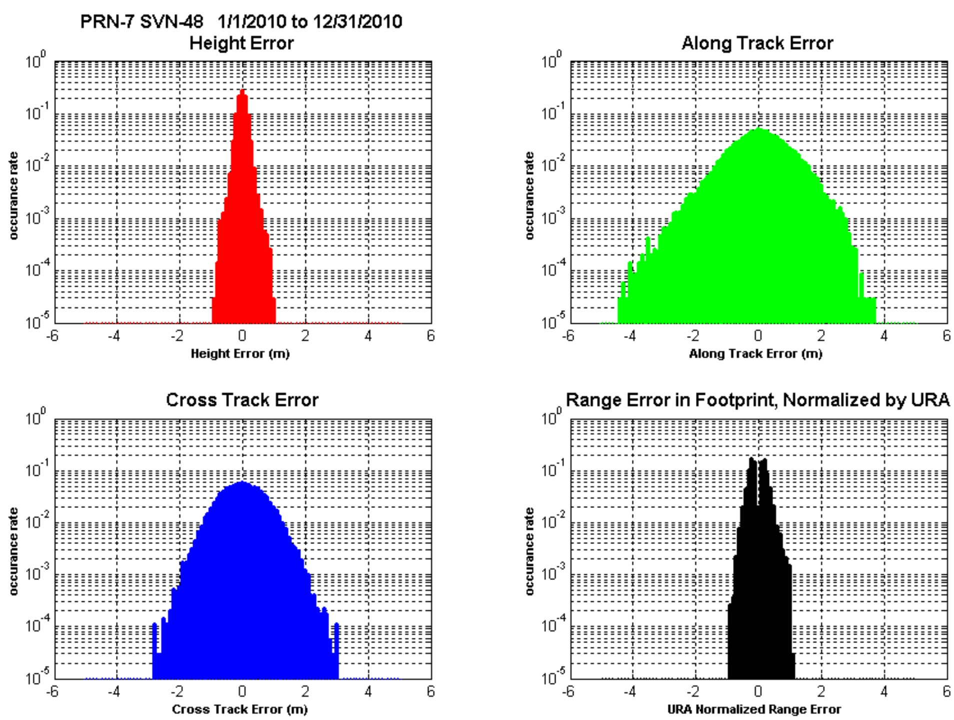


Figure 13-49 Histograms of H, A, C, and Range Error for PRN 8

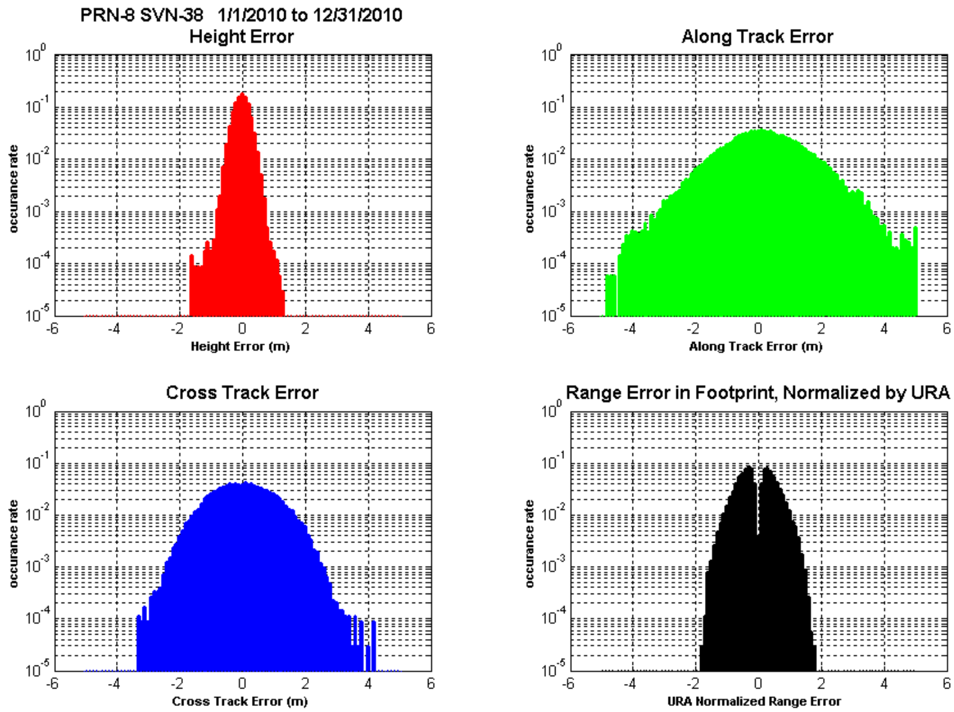


Figure 13-50 Histograms of H, A, C, and Range Error for PRN 9

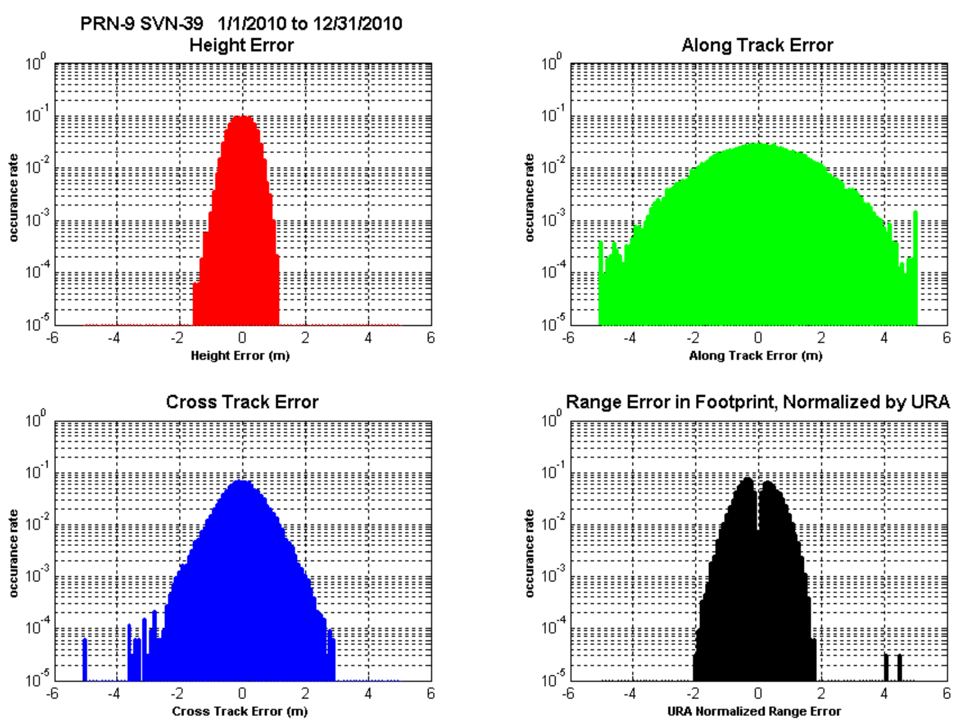


Figure 13-51 Histograms of H, A, C, and Range Error for PRN 10

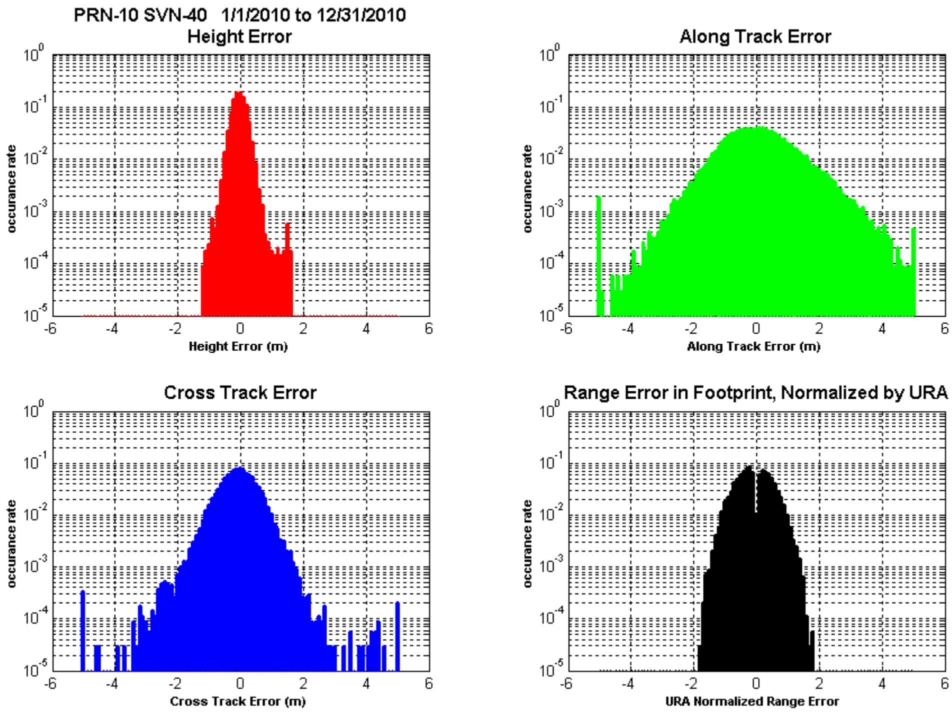


Figure 13-52 Histograms of H, A, C, and Range Error for PRN 11

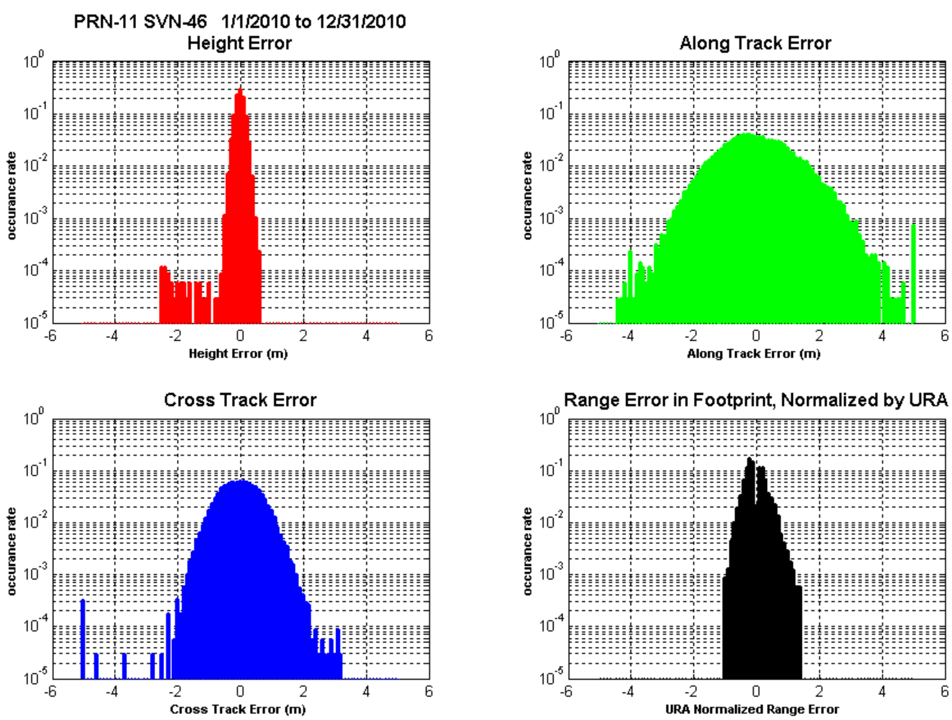


Figure 13-53 Histograms of H, A, C, and Range Error for PRN 12

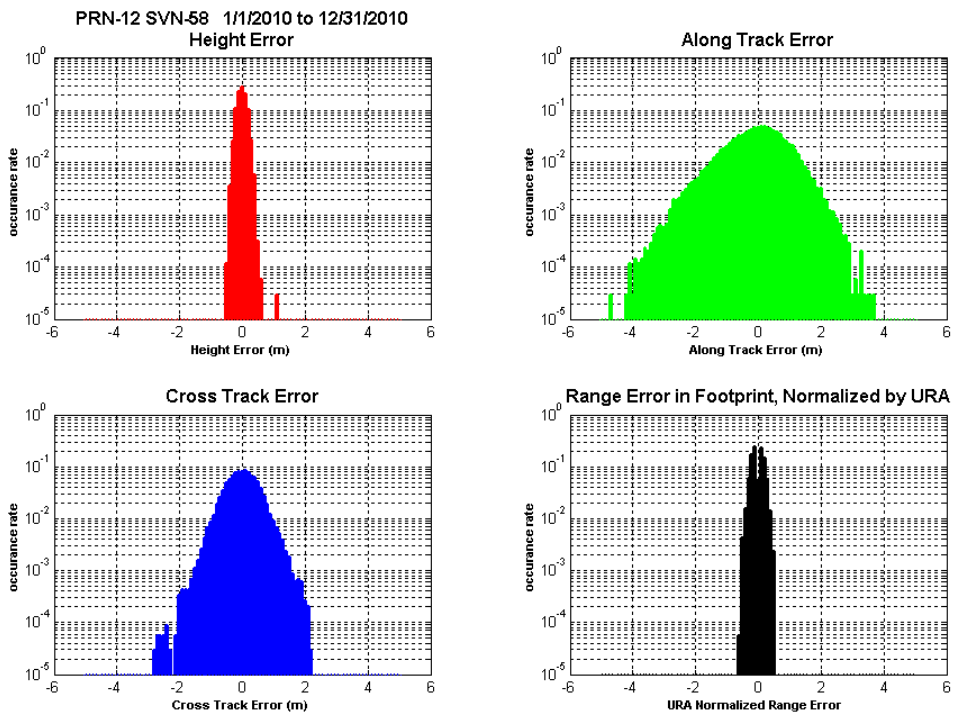


Figure 13-54 Histograms of H, A, C, and Range Error for PRN 13

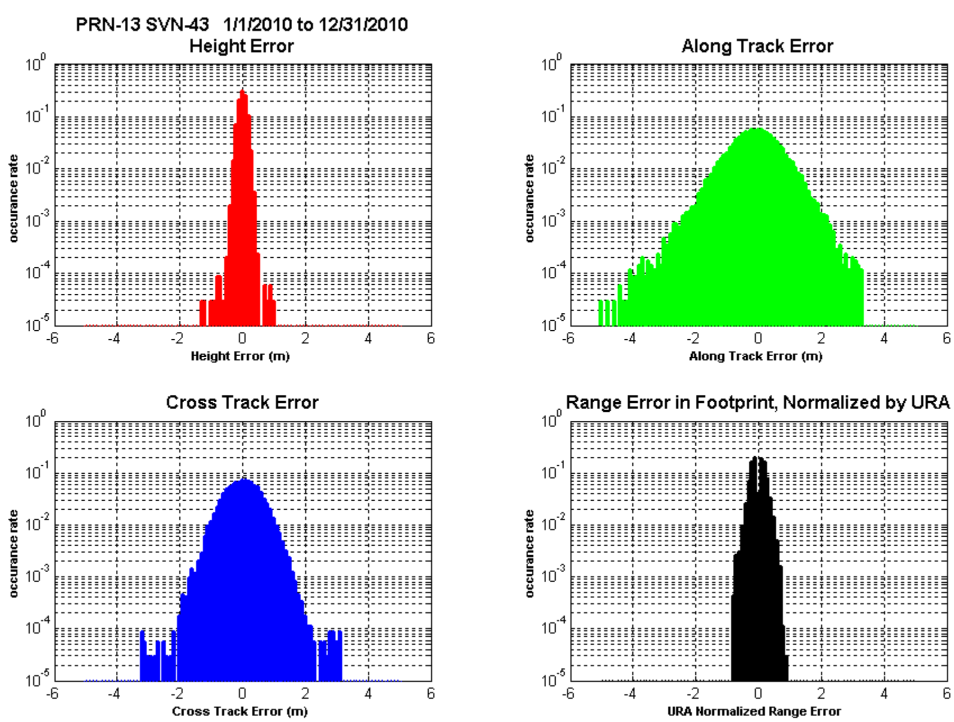


Figure 13-55 Histograms of H, A, C, and Range Error for PRN 14

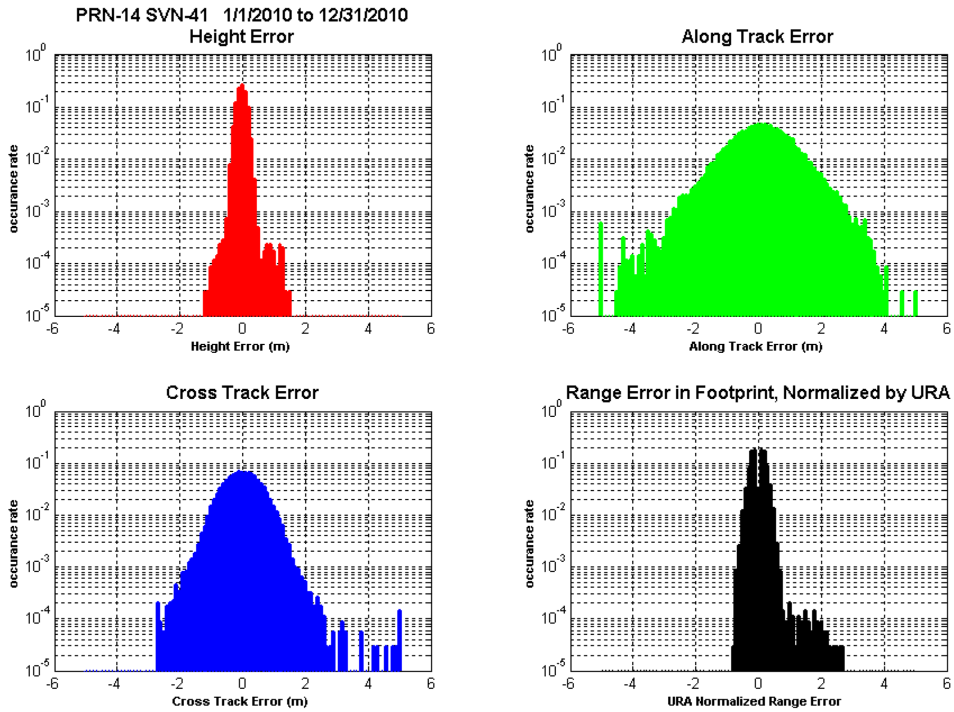


Figure 13-56 Histograms of H, A, C, and Range Error for PRN 15

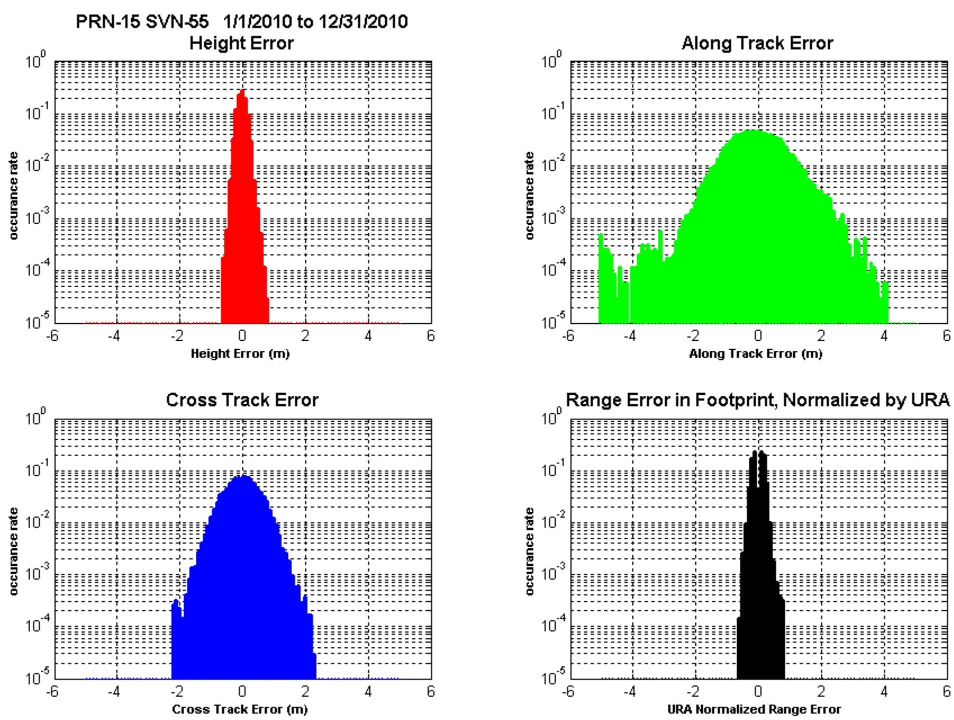


Figure 13-57 Histograms of H, A, C, and Range Error for PRN 16

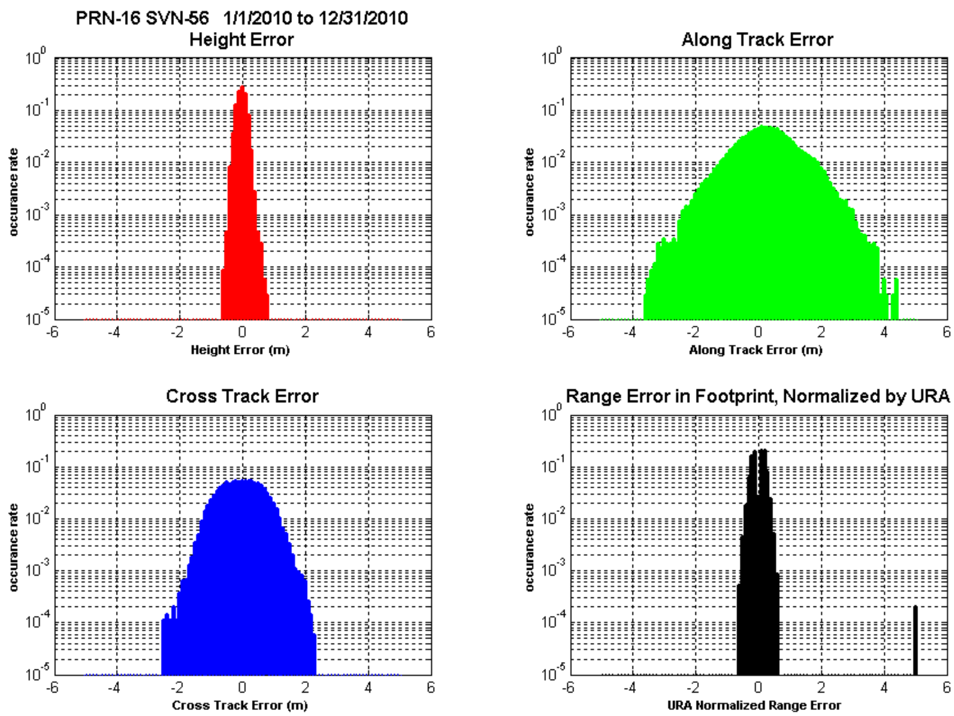


Figure 13-58 Histograms of H, A, C, and Range Error for PRN 17

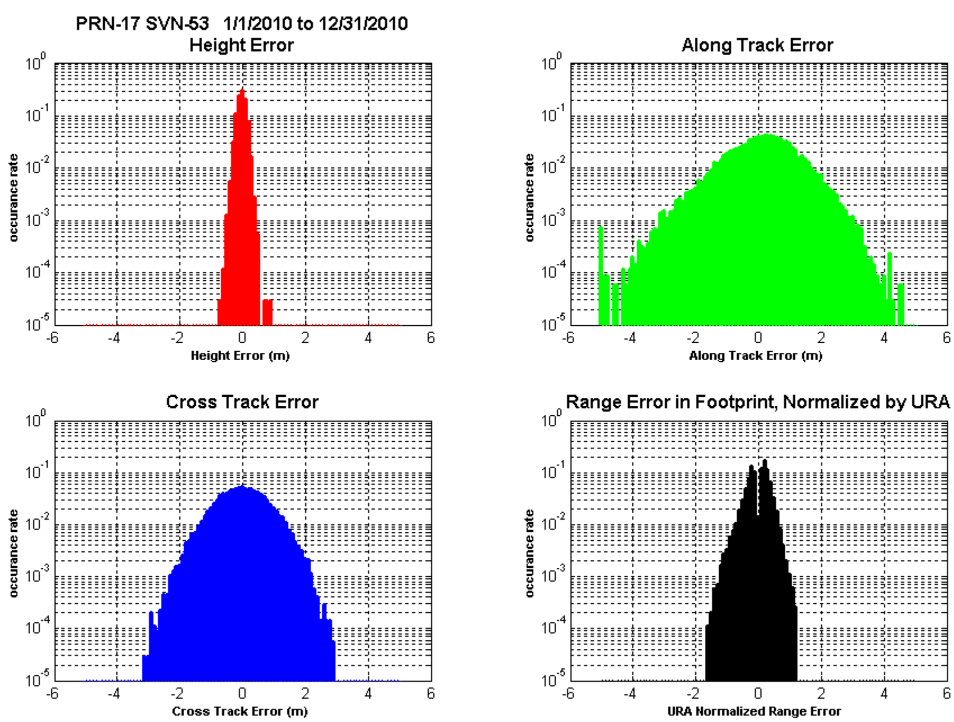


Figure 13-59 Histograms of H, A, C, and Range Error for PRN 18

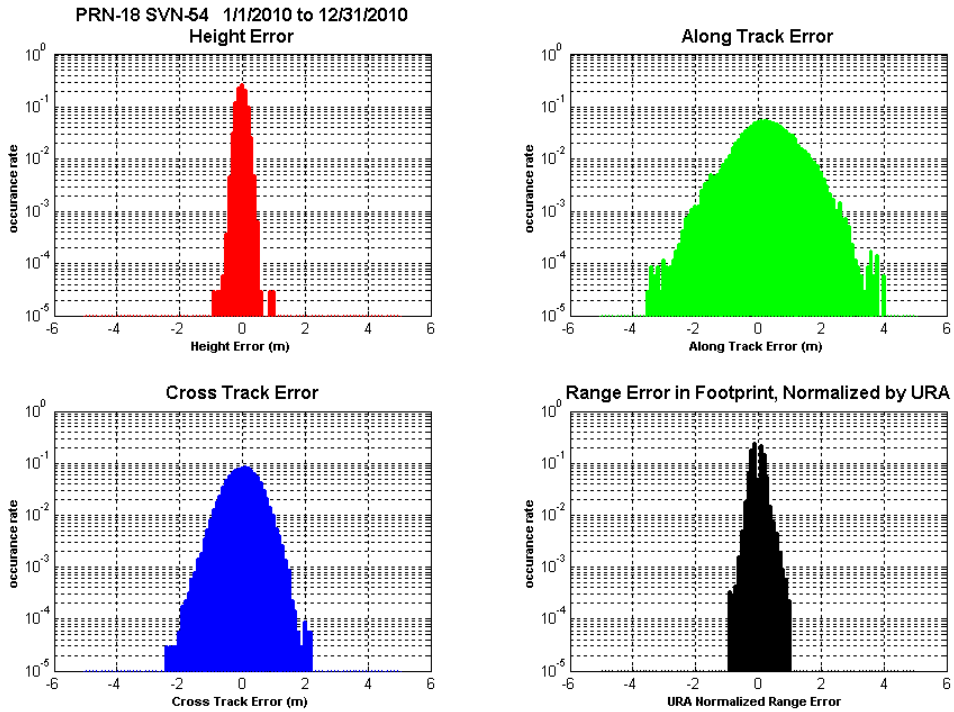


Figure 13-60 Histograms of H, A, C, and Range Error for PRN 19

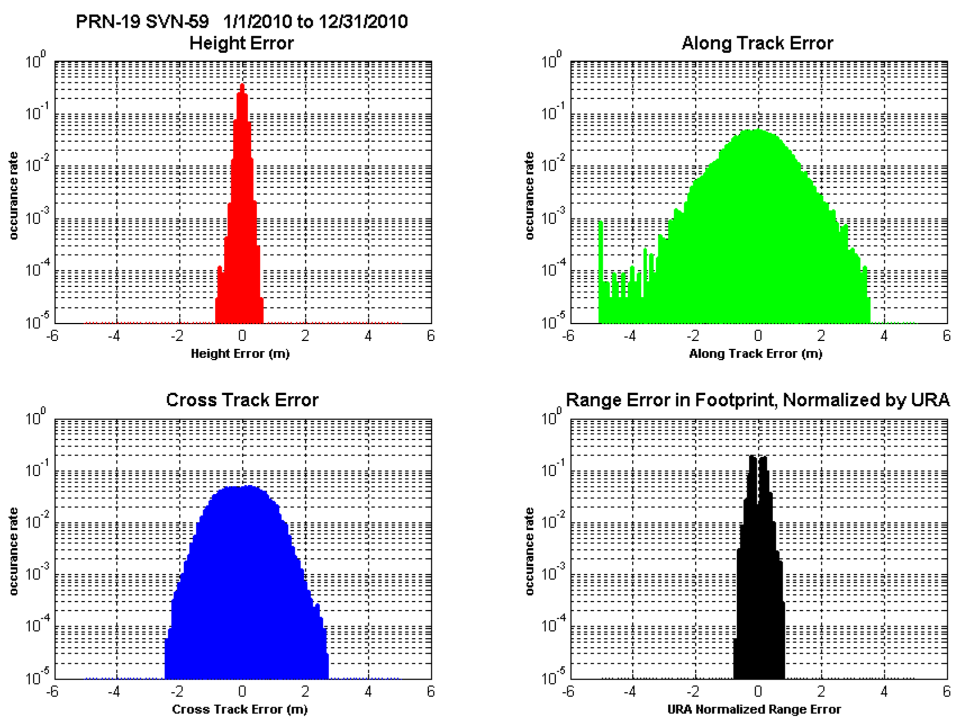


Figure 13-61 Histograms of H, A, C, and Range Error for PRN 20

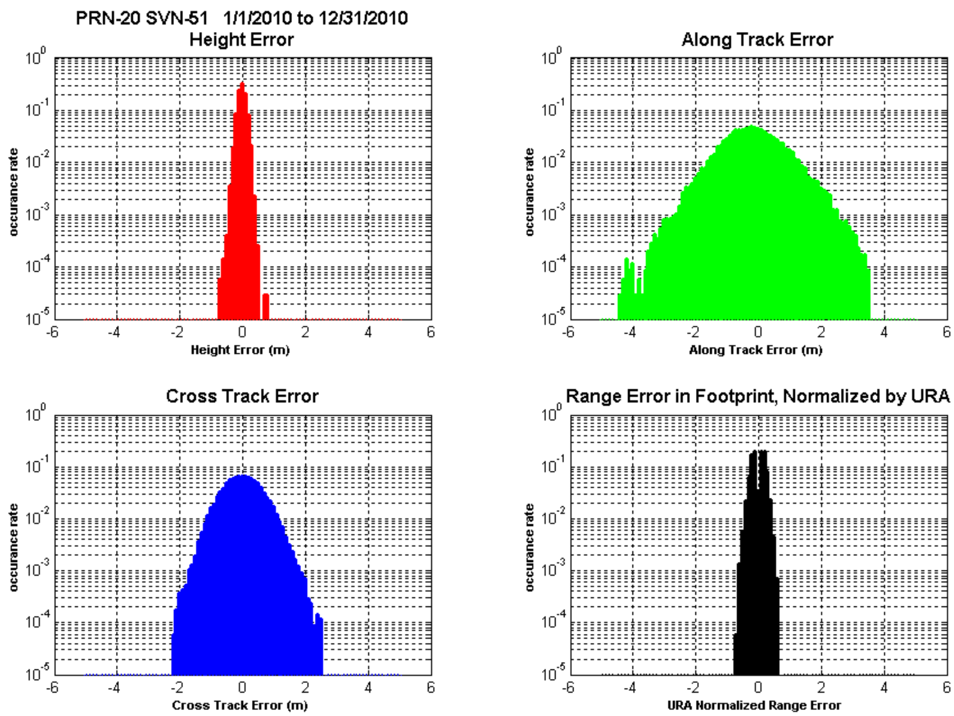


Figure 13-62 Histograms of H, A, C, and Range Error for PRN 21

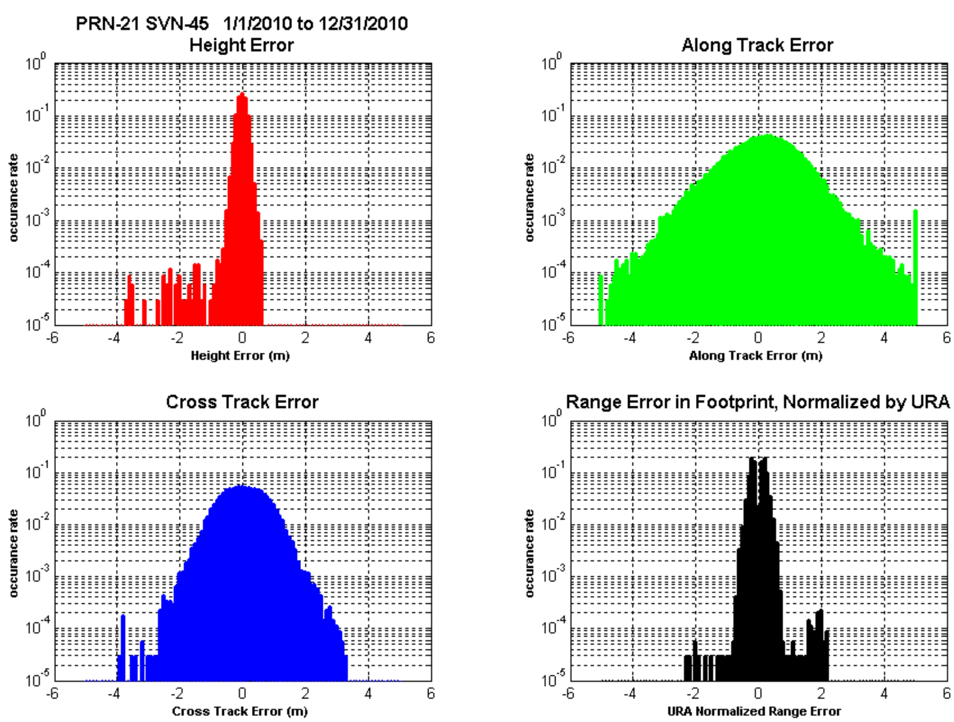


Figure 13-63 Histograms of H, A, C, and Range Error for PRN 22

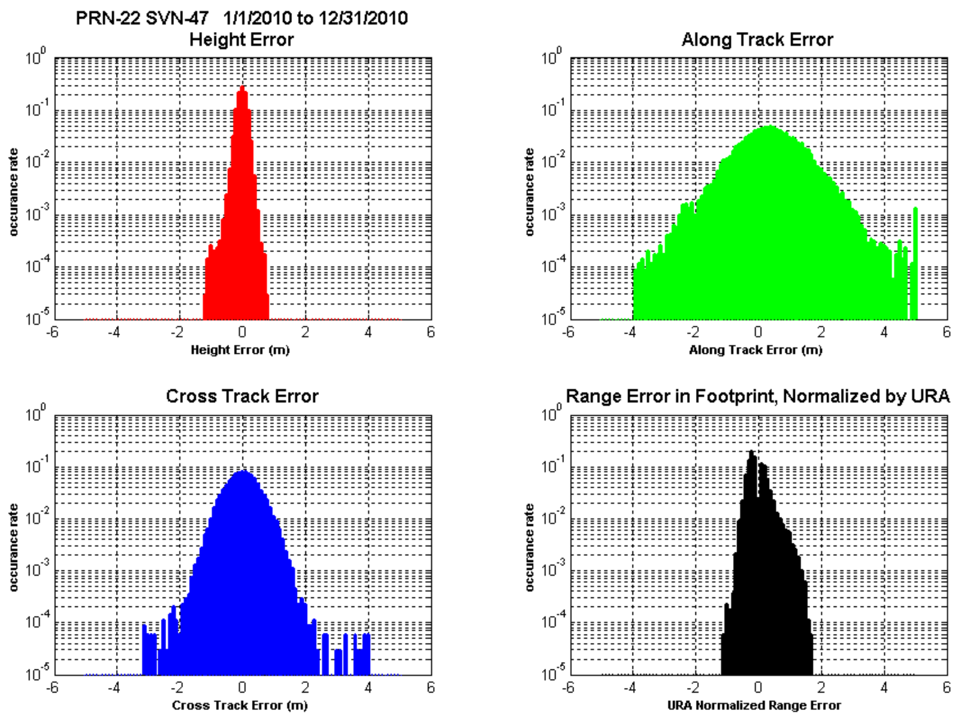


Figure 13-64 Histograms of H, A, C, and Range Error for PRN 23

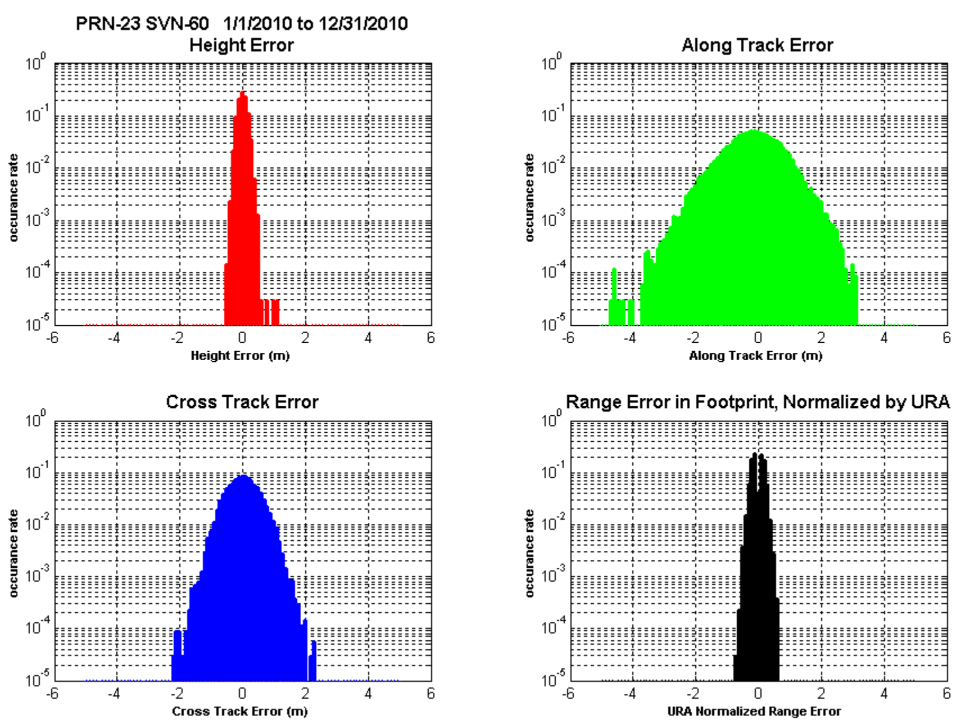


Figure 13-65 Histograms of H, A, C, and Range Error for PRN 24

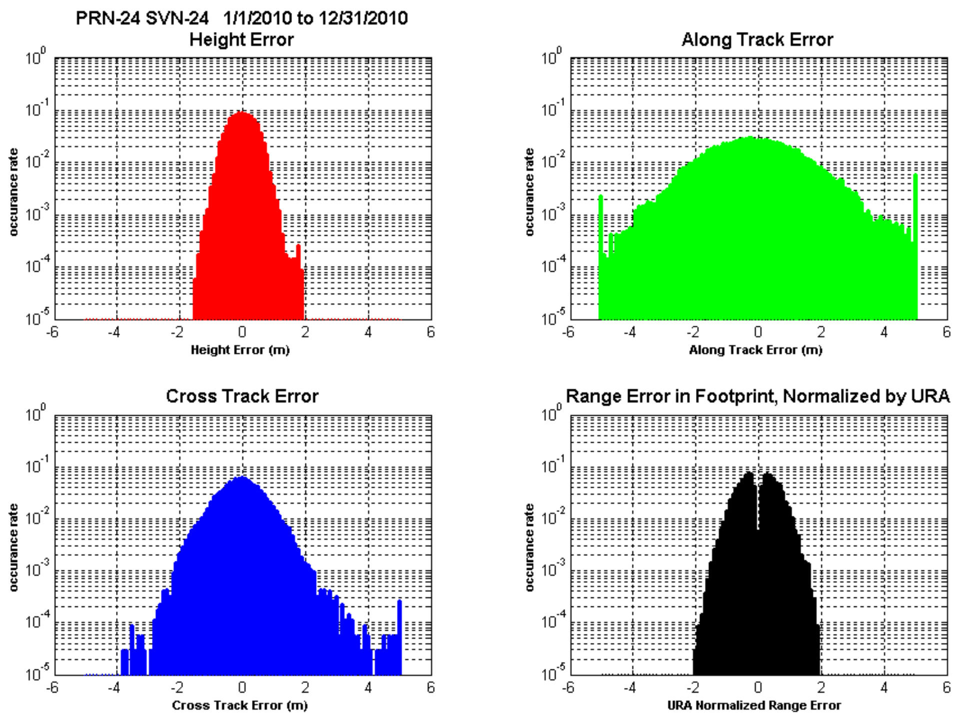


Figure 13-66 Histograms of H, A, C, and Range Error for PRN 25

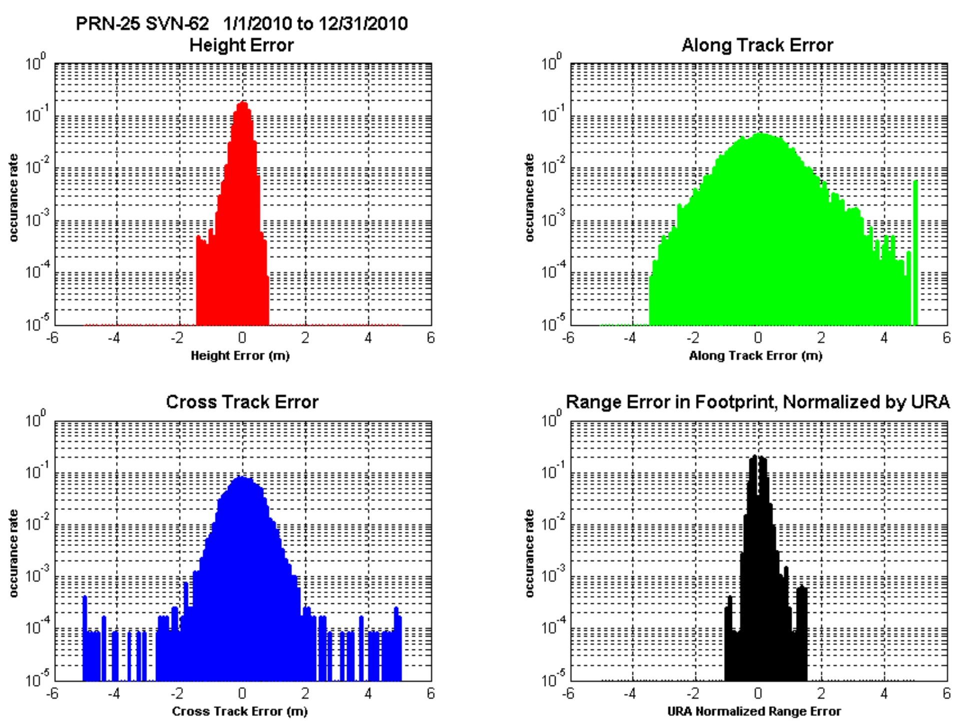


Figure 13-67 Histograms of H, A, C, and Range Error for PRN 26

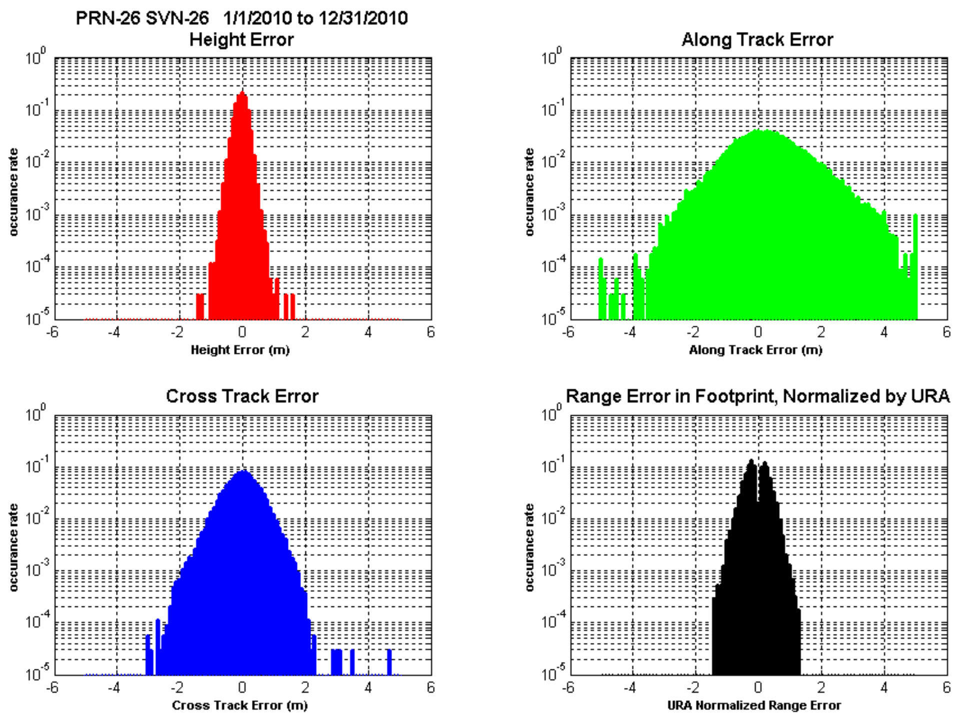


Figure 13-68 Histograms of H, A, C, and Range Error for PRN 27

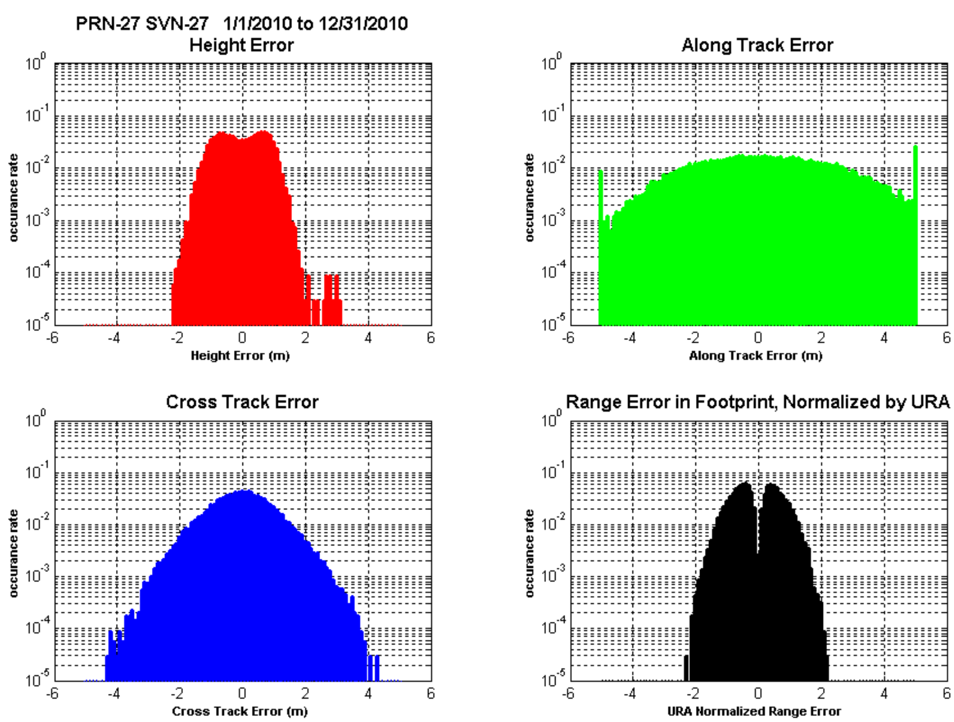


Figure 13-69 Histograms of H, A, C, and Range Error for PRN 28

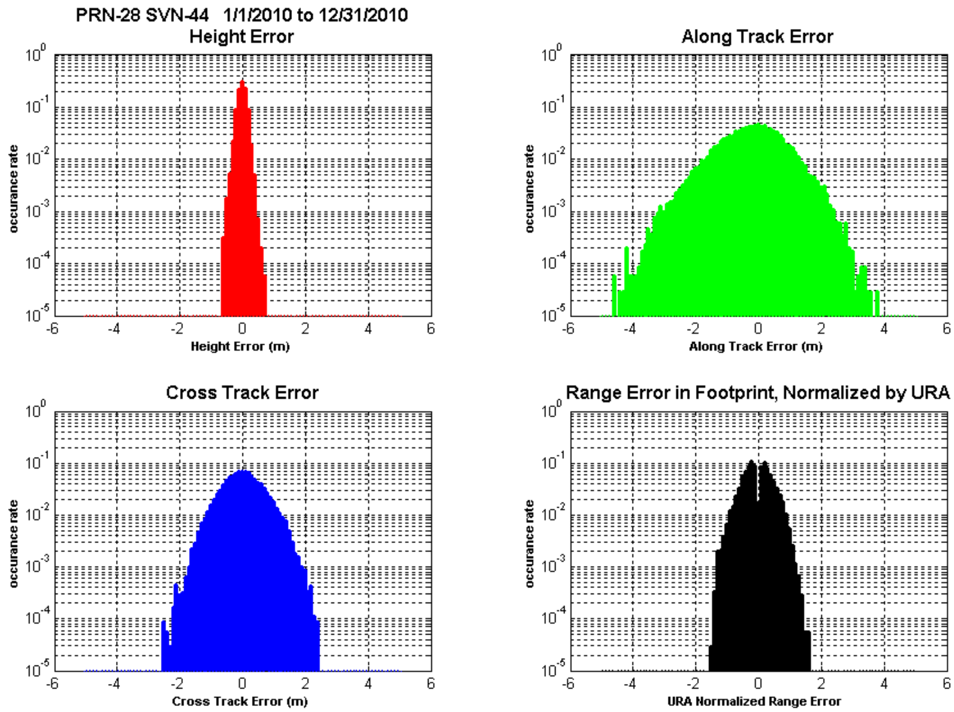


Figure 13-70 Histograms of H, A, C, and Range Error for PRN 29

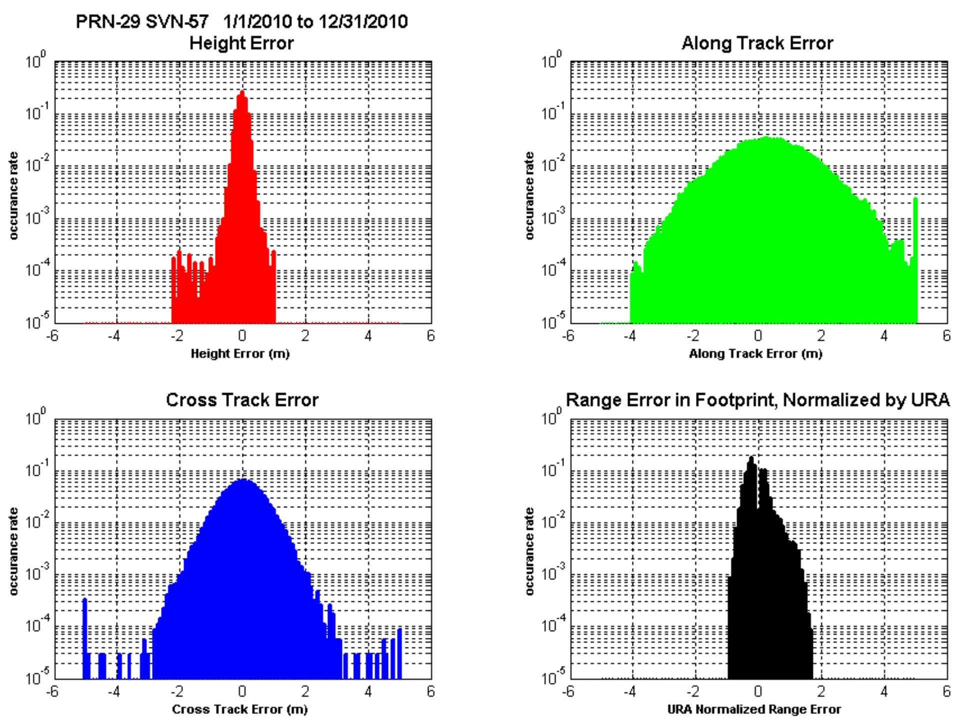


Figure 13-71 Histograms of H, A, C, and Range Error for PRN 30

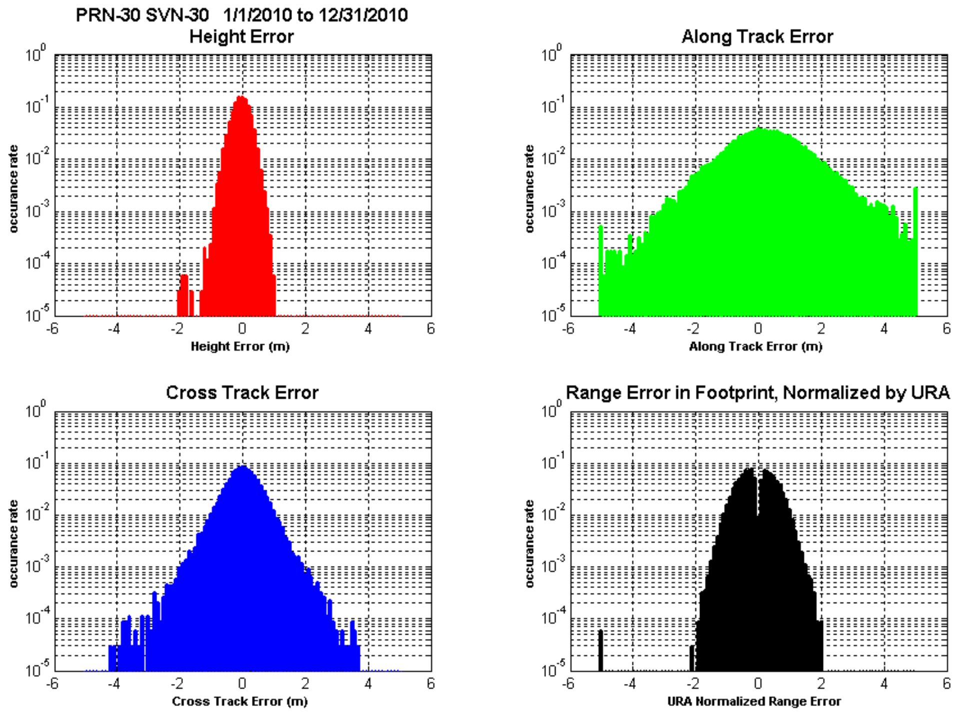


Figure 13-72 Histograms of H, A, C, and Range Error for PRN31

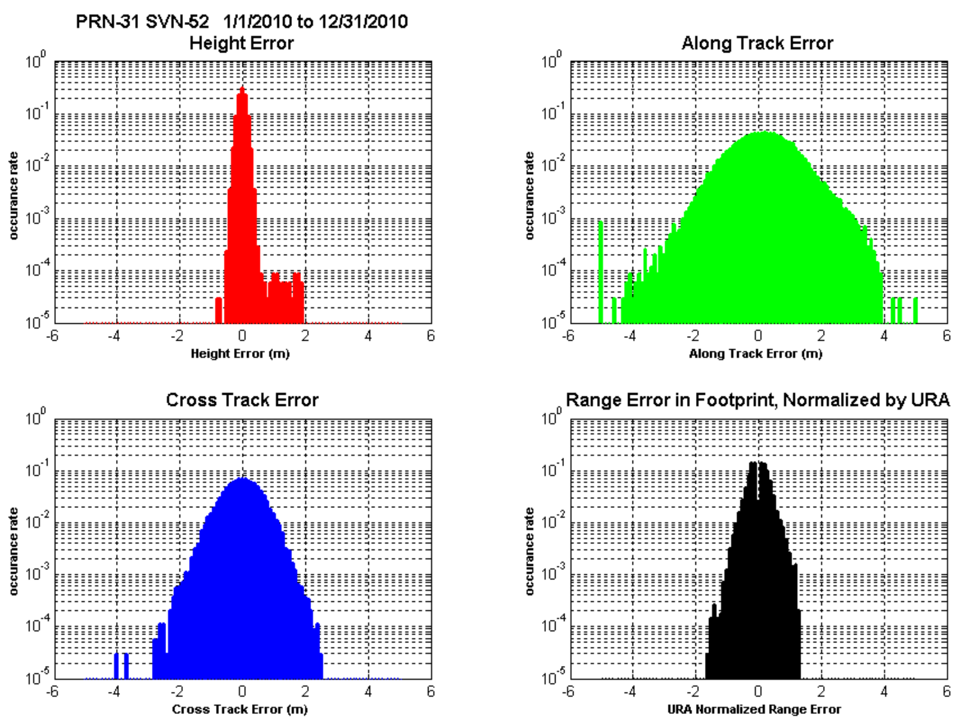


Figure 13-73 Histograms of H, A, C, and Range Error for PRN 32

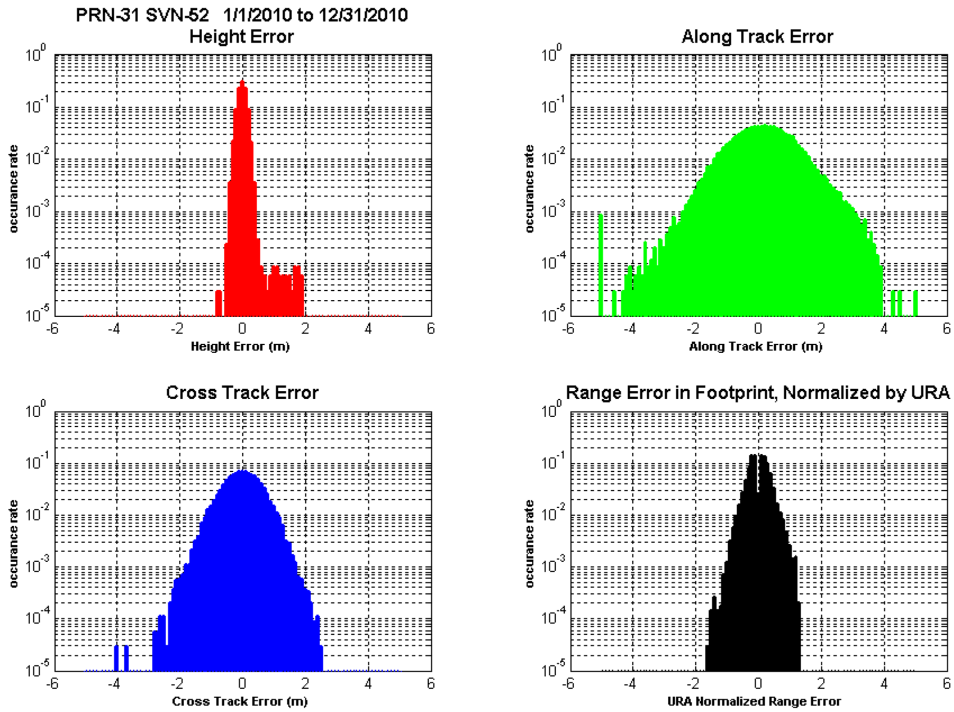


Figure 13-74 Full Scale QQ Plot for PRN 16

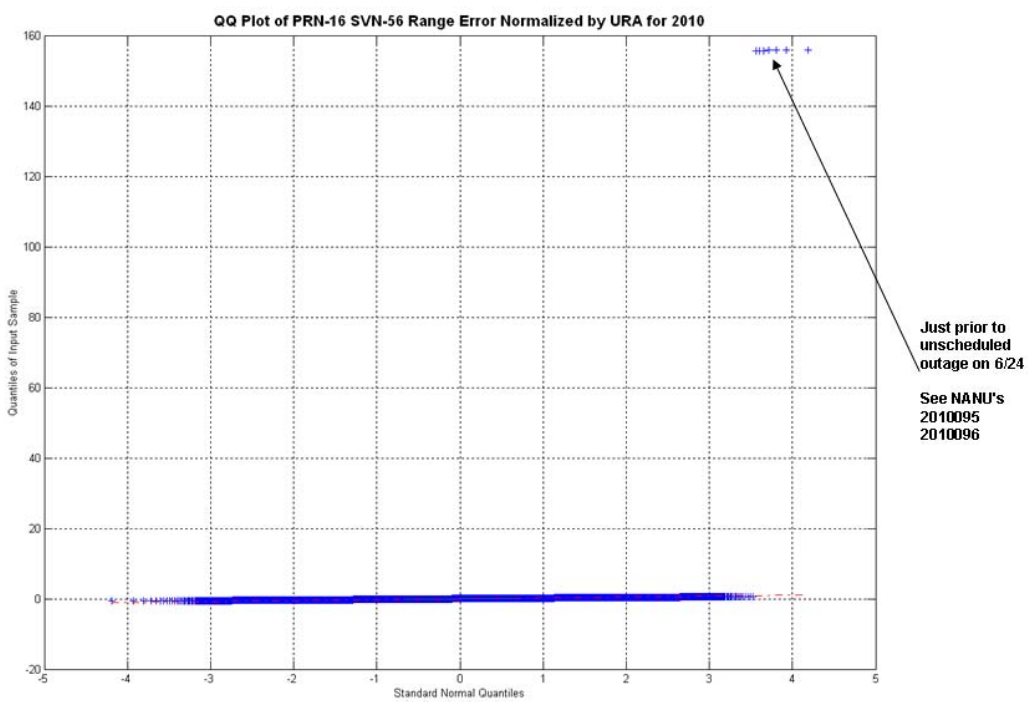
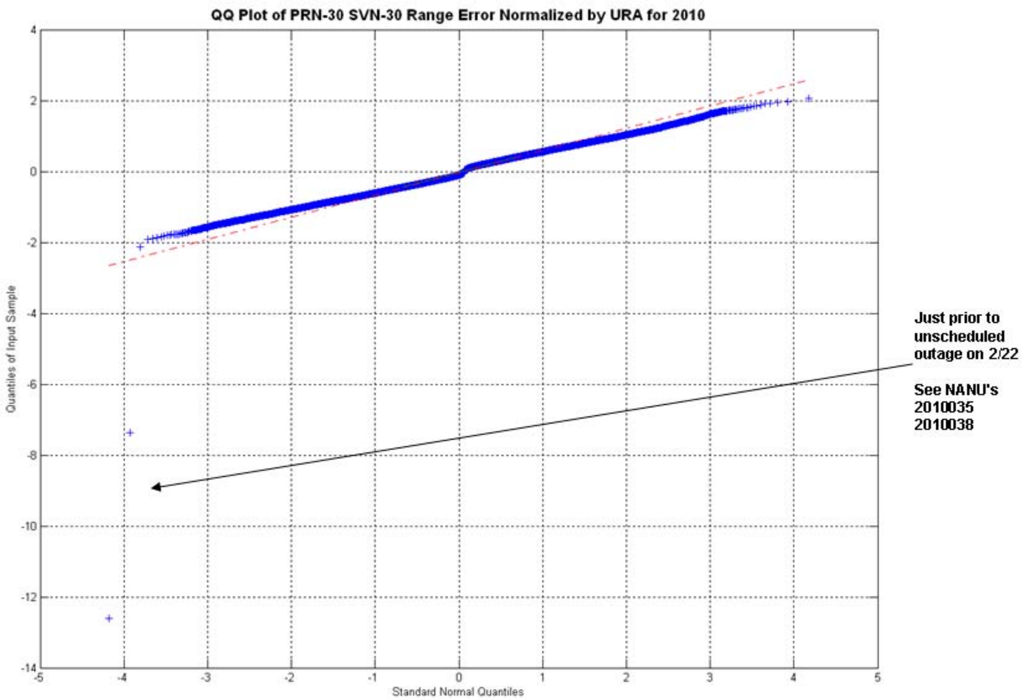


Figure 13-75 Full Scale QQ Plot for PRN 30



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.

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

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

SV. Space Vehicle.

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

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

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

VNAV. Vertical Navigation.

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

Appendix B: Additional Coverage Plots

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

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

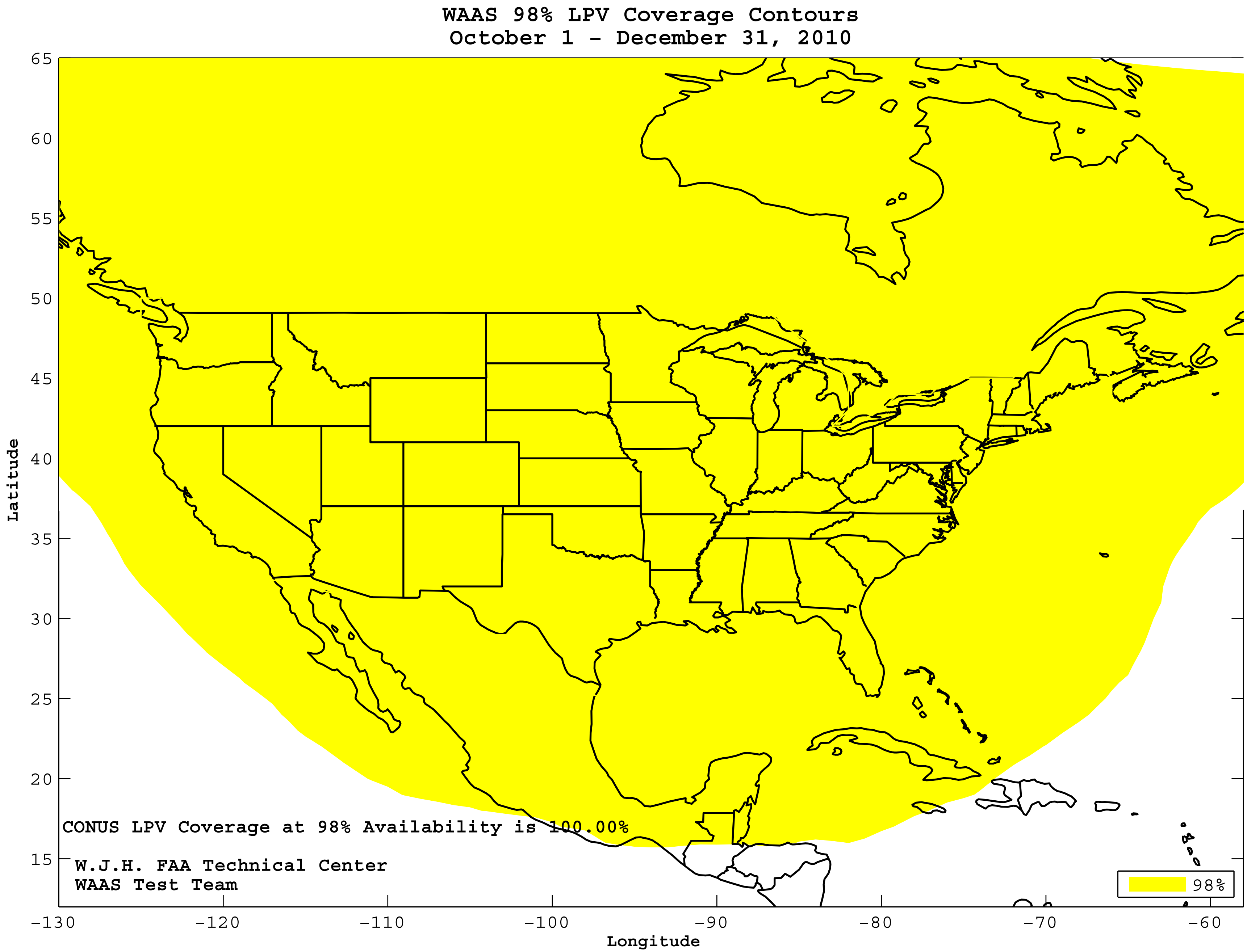


Figure B-2 98% Alaska LPV Availability Contour for the Quarter

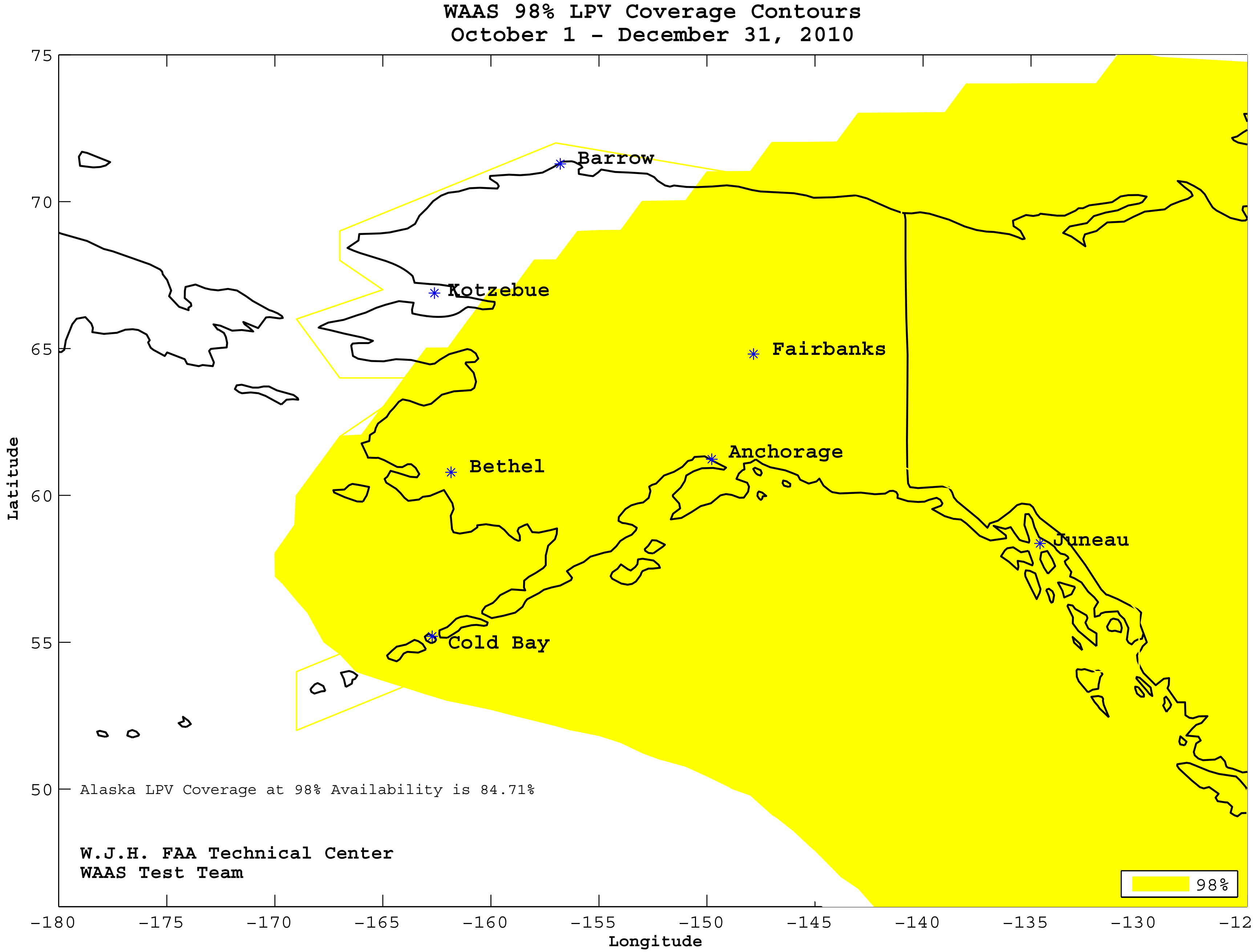


Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter

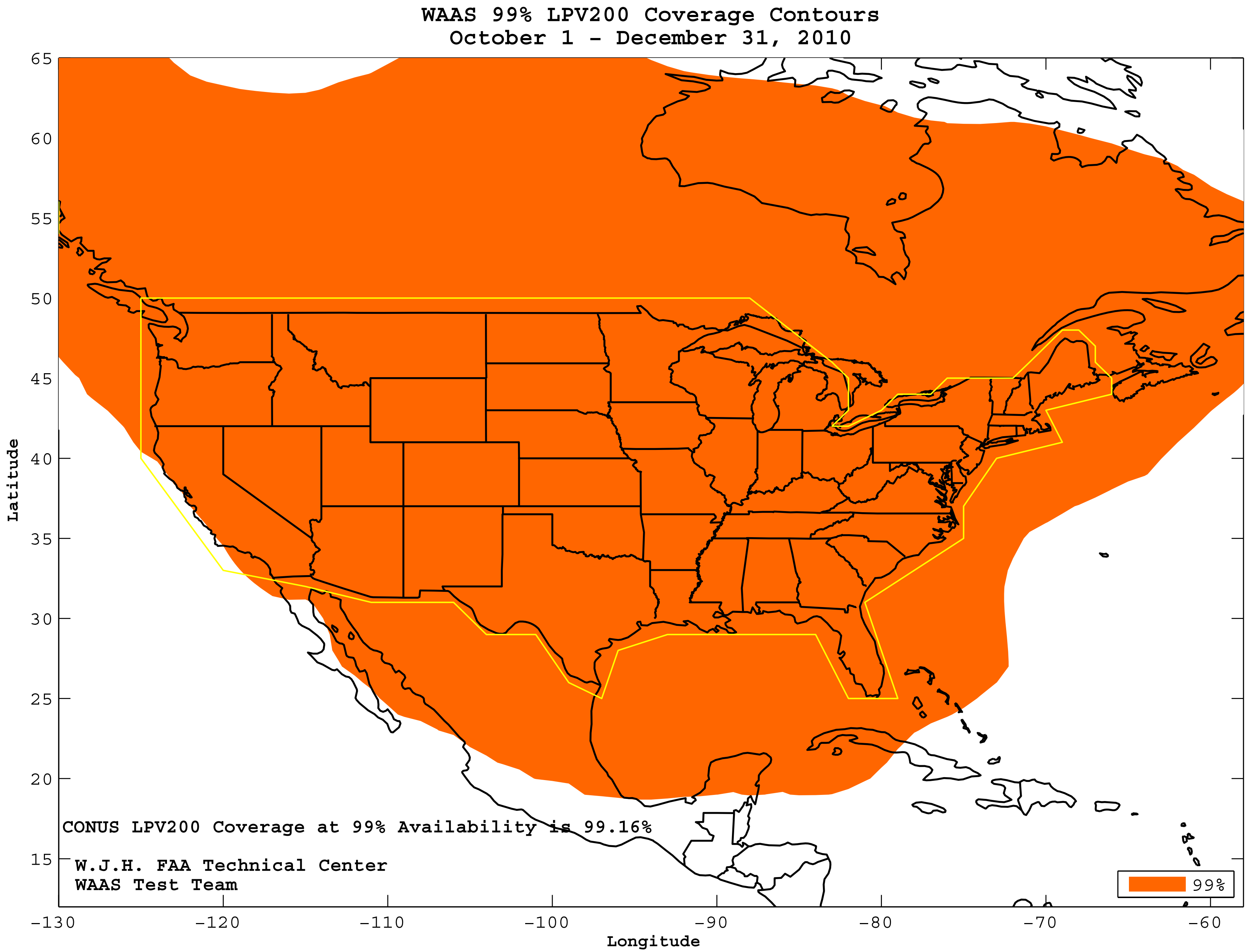


Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter