# WIDE-AREA AUGMENTATION SYSTEM PERFORMANCE ANALYSIS REPORT

**Report #30**

**Reporting Period: July 1 to September 30, 2009**

**October 2009**

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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 thirtieth such WAAS quarterly report. This report covers WAAS performance during the period from July 1, 2009 to September 30, 2009.

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

| Parameter | CONUS Site/Maximum | CONUS Site/Minimum | Alaska Site/Maximum | Alaska Site/Minimum |
|---|---|---|---|---|
| 95% Horizontal Accuracy | Arcata<br>1.489 meters | Jacksonville<br>0.562 meters | Fairbanks<br>0.803 meters | Barrow<br>0.528 meters |
| 95% Vertical Accuracy | Arcata<br>2.058 meters | Jacksonville<br>0.941 meters | Fairbanks<br>1.315 meters | Barrow<br>0.897 meters |
| LPV Availability (HPL < 40 meters & VPL < 50 meters) | Seattle<br>99.99 | Arcata<br>99.98% | Juneau<br>100% | Barrow<br>99.88% |
| LPV 200 Availability (HPL < 40 meters & VPL < 35 meters) | Seattle<br>99.99 | Arcata<br>99.11% | Fairbanks<br>99.98% | Barrow<br>90.88% |
| 95% HPL | Arcata<br>16.182 meters | Memphis<br>11.293 meters | Cold Bay<br>25.441 meters | Fairbanks<br>13.361 meters |
| 95% VPL | Oakland<br>30.407 meters | Memphis<br>19.443 meters | Cold Bay<br>36.194 meters | Juneau<br>21.959 meters |

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## 1.0 INTRODUCTION

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

Objectives of this report are:

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

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

Table 1.1 and Table 1.2 list NSTB and WAAS reference station receivers used in Precision Approach (PA) and Non-Precision Approach (NPA) evaluation process, respectively. This report presents results from three months of data, collected from June 1, 2009 to September 30, 2009.

**Table 1-1 PA Sites**

| | Number of Days Evaluated | Number of Samples |
|---|---|---|
| **NSTB:** | | |
| Arcata | 92 | 7928003 |
| Oklahoma City | 73 | 6338661 |
| **WAAS:** | | |
| Albuquerque | 92 | 7946089 |
| Anchorage | 92 | 7945929 |
| Atlanta | 92 | 7947314 |
| Barrow | 92 | 7946366 |
| Bethel | 92 | 7946477 |
| Billings | 92 | 7945985 |
| Boston | 92 | 7947316 |
| Chicago | 92 | 7947343 |
| Cleveland | 92 | 7947215 |
| Cold Bay | 72 | 6212478 |
| Dallas | 92 | 7946143 |
| Denver | 92 | 7947302 |
| Fairbanks | 92 | 7945881 |
| Gander | 92 | 7946869 |
| Goose Bay | 92 | 7943703 |
| Houston | 92 | 7944961 |
| Iqaluit | 92 | 7942024 |
| Jacksonville | 92 | 7947303 |
| Juneau | 92 | 7945314 |
| Kansas City | 92 | 7947487 |
| Kotzebue | 92 | 7937374 |
| Los Angeles | 92 | 7947150 |
| Memphis | 92 | 7947311 |
| Merida | 92 | 7944229 |
| Mexico City | 92 | 7947497 |
| Miami | 92 | 7947104 |
| Minneapolis | 92 | 7947086 |
| New York | 92 | 7947317 |
| Oakland | 92 | 7944926 |
| Puerto Vallarta | 92 | 7947150 |
| Salt Lake City | 92 | 7947294 |
| San Jose Del Cabo | 91 | 7885769 |
| San Juan | 91 | 7900741 |
| Seattle | 92 | 7947304 |
| Tapachula | 87 | 7522664 |
| Washington DC | 92 | 7947503 |

**Table 1-2 NPA Sites**

| Location | Number of Days Evaluated | Number of Samples |
|---|---|---|
| Albuquerque | 92 | 7941913 |
| Anchorage | 92 | 7940600 |
| Atlanta | 92 | 7929623 |
| Barrow | 92 | 7940122 |
| Bethel | 90 | 7750978 |
| Billings | 92 | 7941260 |
| Boston | 92 | 7938109 |
| Cleveland | 92 | 7938715 |
| Cold Bay | 72 | 6201605 |
| Fairbanks | 92 | 7941190 |
| Gander | 92 | 7942158 |
| Honolulu | 92 | 7936217 |
| Houston | 92 | 7940531 |
| Iqaluit | 92 | 7939868 |
| Juneau | 92 | 7937643 |
| Kansas City | 92 | 7937638 |
| Kotzebue | 92 | 7931408 |
| Los Angeles | 92 | 7940831 |
| Merida | 92 | 7939957 |
| Miami | 92 | 7933830 |
| Minneapolis | 92 | 7932969 |
| Oakland | 92 | 7940164 |
| Salt Lake City | 92 | 7941573 |
| San Jose Del Cabo | 91 | 7877482 |
| San Juan | 92 | 7916679 |
| Seattle | 92 | 7941278 |
| Tapachula | 87 | 7515836 |
| Washington DC | 88 | 7572562 |

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 1-4 Test Events**

| GPS Week | Date | Sites | Events |
|---|---|---|---|
| 1538 day 3 | 7/1/2009 | Alaska | CRW manual GUS switchover, 3-sec gap. PRN25 outage (NANU2009039). Alaska LPV/LPV200 Coverage decreased. |
| 1538 day 5 | 7/3/2009 | Alaska | CRW manual GUS switchover, 3-sec gap. Alaska LPV/LPV200 Coverage decreased. |
| 1540 day 1 | 7/13/2009 | Alaska | CRW GUS switchover, Littleton faulted, Napa to Primary, 11 gaps, 25-sec gap total. Alaska LPV200 Coverage decreased. |
| 1540 day 2 | 7/13/2009 | Alaska | CRE GUS switchover, Woodbine faulted, Brewster to Primary, 12-sec gap. Alaska LPV200 Coverage decreased. |
| 1540 day 2 | 7/14/2009 | Alaska | CRE manual GUS switchover, Brewster to Woodbine, 3-sec gap. Alaska LPV200 Coverage decreased. |
| 1541 day 3 | 7/22/2009 | Alaska | Fairbank and Iqaluit observed high VPE due to scintillation. Alaska LPV/LPV200 Coverage decreased. |
| 1541 day 5 | 7/24/2009 | Alaska | PRN21 outage (NANU2009044). Alaska LPV200 Coverage decreased. |
| 1541 day 6 to 1542 day 0 | 7/25/2009 | Alaska | PRN18 outage (NANU2009047). Alaska LPV200 Coverage decreased. |
| 1542 day 0 to 1543 day 5 | 7/26/2009 to 8/07/2009 | All Sites | PRN 18 signal distortion. PRN 18 came back after the outage with higher than normal PRN biases and type biases and remained at that high level until 8/7/09 when it abruptly returned to normal level. See DR 86 SVN 54 PRN 18 Signal Distortion. |

| GPS Week | Date | Sites | Events |
|---|---|---|---|
| 1542 day 4 | 7/30/2009 | CONUS | PRN20 outage (NANU2009050). CONUS west coast LPV coverage decreased. |
| 1542 day 5 | 7/31/2009 | Barrow | Scintillation event. Barrow observed high HPE. |
| 1542 day 3 | 8/5/2009 | Alaska | PRN 30 outage (NANU2009051) affected Alaska LPV coverage. |
| 1543 day 4 | 8/6/2009 | Kotzebue | Scintillation event. Kotzebue observed high VPE. |
| 1544 day 1 | 8/10/2009 | All Sites | CRW CNV fault and GUS switchover caused a WAAS service outage, loss of CONUS LPV coverage, 0.0% at 100% Avail. See DR 82 ZDC CNV Faults Upon Receipt of QWE Garbled Message. |
| 1544 day 2 to 1545 day 6 | 8/11/09 to 8/22/09 | Alaska | CRW (ZLA CNV) and CRE (ZTL CNV) sent out different UDREI values for PRN135. See DR 83 ZTL Bad Orbit Determination for PRN135. |
| 1544 day 4 | 8/14/2009 | Alaska | Manual GUS switchover, Napa to Littleton, 3-sec gap. Alaska LPV200 Coverage decreased. |
| 1544 day 5 | 8/15/2009 | Alaska | Manual GUS switchover, Littleton to Napa, 3-sec gap. Alaska LPV200 Coverage decreased. |
| 1545 day 0 | 8/16/2009 | Alaska | CRW UDREI of 11 for the first part of day. Alaska LPV200 Coverage decreased. |
| 1545 day 3 | 8/19/2009 | | CRE Switchover. |
| 1545 day 4 | 8/20/2009 | None | NANU 2009054, PRN 25 is set to unusable. |
| 1546 day 4 | 8/27/2009 | None | NANU 2009055, PRN 5 is set active for new satellite SVN 50. |
| 1547 day 1 | 8/31/2009 | Iqaluit | Scintillation event. Iqaluit observed high VPE. |
| 1547 day 2 | 9/1/2009 | All Sites | WEI Outages: 185163 to 185370, 188617 to 188819 |
| 1547 day 3 | 9/2/2009 | All Sites | PRN 26 outage (NANU2009056) affected coverage. |
| 1547 day 2 to 1547 day 5 | 9/1/09 to 9/4/09 | Tapachula | Tapachula was taken out of service for T.S. Jimenez. |
| 1548 day 5 | 9/11/2009 | Alaska | PRN31 outage (NANU2009063). NANU 2009065, PRN 25 is set to usable. Alaska LPV200 Coverage decreased. |
| 1548 day 6 | 9/12/2008 | Cold Bay | Cold Bay was taken out of service. |
| 1549 day 0 | 9/13/2009 | All Sites | WEI Outages: 61258 to 61497, 68801 to 68997 |
| 1549 day 3 | 9/16/2009 | Iqaluit | Scintillation event. Iqaluit observed high VPE. |
| 1549 day 4 | 9/17/2009 | Alaska | CRE GUS switchover and lower PA ranging availability of CRW and CRE caused lower Alaska availability. See DR 84 Reduced Precision Approach GEO Ranging Caused WAAS Coverage Loss. |
| 1549 day 5 | 9/18/2009 | Alaska | PRN23 Outage, NANU2009072. Alaska LPV/LPV200 Coverage decreased. See DR 85 PRN 23 NANU Affects WAAS Coverage. |
| 1550 day 1 | 9/20/2009 | Barrow | Scintillation event. Barrow observed high VPE. |
| 1550 day 3 | 9/23/2009 | Alaska | Poor geometry in Alaska along with lower PA ranging availability of CRE caused lower Alaska availability. |
| 1550 day 5 | 9/25/2009 | All Sites | NANU2009074, PRN 10 outage affected coverage. |
| 1551 day 0 | 9/27/2009 | Barrow | Scintillation event. Barrow observed high VPE. |

### 1.2 Report Overview

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

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

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

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

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

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

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

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

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

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

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

## 2.0 WAAS POSITION ACCURACY

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

**Table 2-1 Operational Service Levels**

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

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

During this reporting period, the maximum 95% CONUS horizontal and vertical LPV errors are 1.489 meters and 2.058 meters both at Arcata, respectively. The minimum 95% CONUS horizontal and vertical LPV errors are 0.562 meters and 0.941 meters both at Jacksonville, respectively. The maximum 95% and 99.999% NPA horizontal errors are 1.983 meters at Honolulu and 5.394 meters at Tapachula, respectively. The minimum 95% and 99.999% horizontal errors are 0.654 meters and 1.718 meters both at Barrow, respectively.

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

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

**Table 2-2 PA 95% Horizontal and Vertical Accuracy**

| Location | Horizontal (HAL=40m) (Meters) | Horizontal (HAL=556m) (Meters) | Vertical (VAL=50m) (Meters) | Percentage in PA mode (%) | SPS Accuracy | |
|---|---|---|---|---|---|---|
| | | | | | 95% Horizontal (Meters) | 95% Vertical (Meters) |
| Arcata | 1.489 | 1.489 | 2.038 | 99.99720 | * | * |
| Oklahoma City | 0.763 | 0.763 | 1.181 | 99.99576 | * | * |
| Albuquerque | 0.591 | 0.591 | 1.126 | 99.99673 | 1.975 | 3.193 |
| Anchorage | 0.570 | 0.571 | 1.148 | 99.99628 | * | * |
| Atlanta | 0.594 | 0.594 | 1.137 | 99.99619 | 1.947 | 3.695 |
| Barrow | 0.528 | 0.528 | 1.293 | 99.97520 | * | * |
| Bethel | 0.577 | 0.577 | 0.958 | 99.99658 | 2.022 | 3.796 |
| Billings | 0.841 | 0.841 | 1.056 | 99.99695 | 2.004 | 3.275 |
| Boston | 0.658 | 0.658 | 1.421 | 99.99605 | 1.868 | 3.744 |
| Chicago | 0.860 | 0.860 | 0.941 | 99.99620 | * | * |
| Cleveland | 0.682 | 0.682 | 1.391 | 99.99611 | 1.960 | 3.635 |
| Cold Bay | 0.663 | 0.663 | 0.949 | 99.99688 | * | * |
| Dallas | 0.608 | 0.608 | 1.001 | 99.99658 | * | * |
| Denver | 0.622 | 0.622 | 1.190 | 99.99673 | * | * |
| Fairbanks | 0.803 | 0.803 | 1.226 | 99.99628 | 1.548 | 3.584 |
| Gander | 0.772 | 0.773 | 1.121 | 99.97680 | * | * |
| Goose Bay | 0.595 | 0.595 | 1.067 | 99.97705 | * | * |
| Houston | 0.740 | 0.740 | 1.020 | 99.99658 | 1.978 | 3.345 |
| Iqaluit | 0.787 | 0.787 | 1.731 | 99.97775 | * | * |
| Jacksonville | 0.562 | 0.562 | 1.219 | 99.99619 | * | * |
| Juneau | 0.566 | 0.566 | 1.134 | 99.99617 | * | * |
| Kansas City | 0.639 | 0.639 | 1.220 | 99.99658 | 2.004 | 3.513 |
| Kotzebue | 0.597 | 0.597 | 1.561 | 99.97548 | 1.512 | 3.617 |
| Los Angeles | 0.745 | 0.745 | 1.162 | 99.99704 | 2.058 | 3.987 |
| Memphis | 0.576 | 0.576 | 1.315 | 99.99620 | * | * |
| Merida | 0.597 | 0.597 | 1.074 | 99.99597 | * | * |
| Mexico City | 0.651 | 0.651 | 1.006 | 99.99658 | * | * |
| Miami | 0.637 | 0.637 | 1.129 | 99.99597 | 2.007 | 3.855 |
| Minneapolis | 0.769 | 0.769 | 1.184 | 99.99620 | 1.991 | 3.481 |
| New York | 0.783 | 0.783 | 1.155 | 99.99611 | * | * |
| Oakland | 0.850 | 0.850 | 1.183 | 99.99704 | 2.085 | 4.060 |
| Puerto Vallarta | 0.658 | 0.658 | 1.075 | 99.99696 | * | * |
| Salt Lake City | 0.685 | 0.685 | 0.897 | 99.99696 | 2.028 | 3.458 |
| San Jose Del Cabo | 0.614 | 0.614 | 1.023 | 99.99490 | * | * |
| San Juan | 1.002 | 1.135 | 1.628 | 99.97403 | * | * |
| Seattle | 0.861 | 0.861 | 0.985 | 99.99704 | 2.062 | 3.446 |
| Tapachula | 0.778 | 0.784 | 1.186 | 99.99383 | * | * |
| Washington DC | 0.679 | 0.679 | 1.124 | 99.99611 | 1.894 | 3.741 |
| Winnipeg | 0.642 | 0.642 | 1.136 | 99.99657 | * | * |

*SPS Data not available.

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

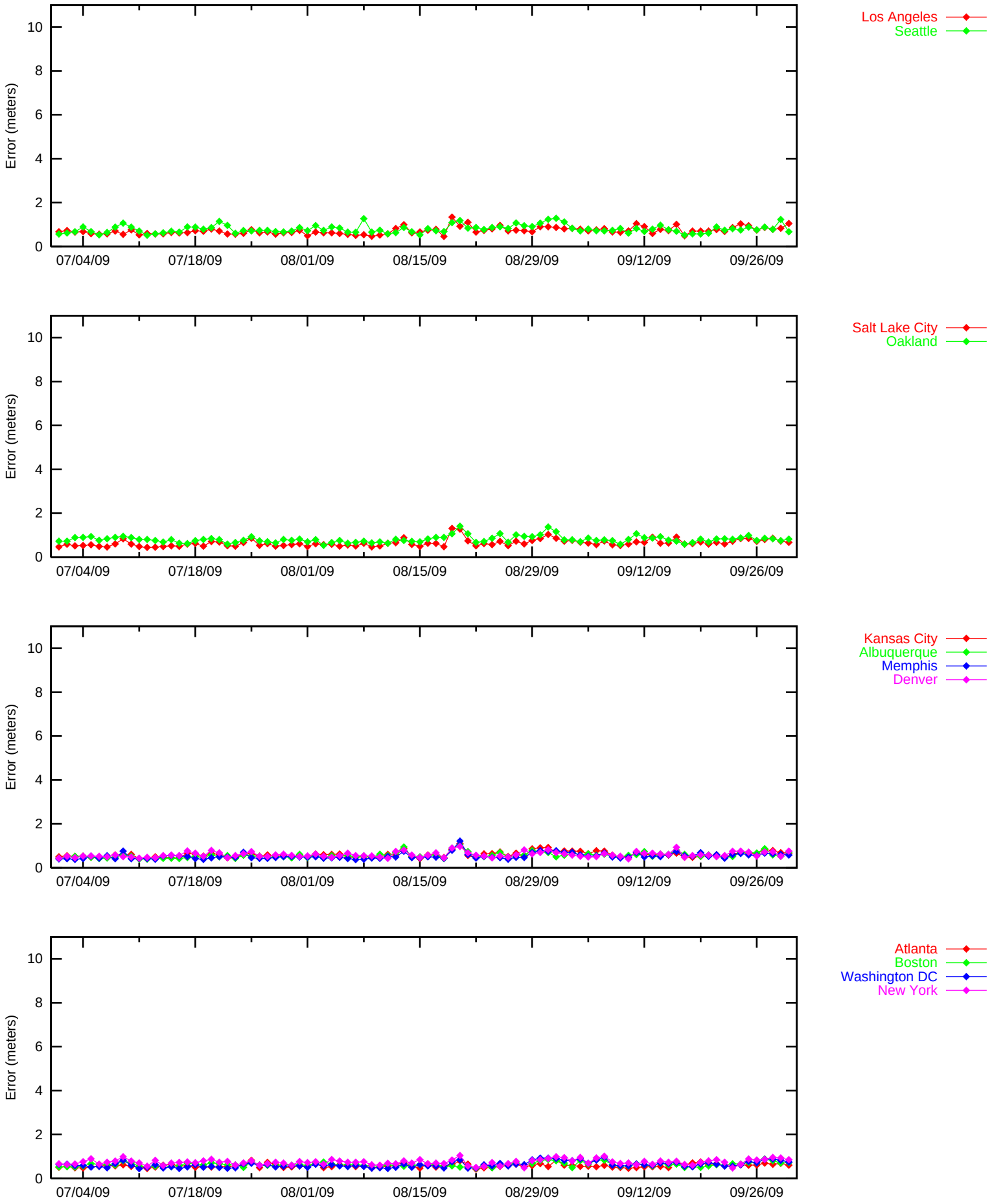
| Location | 95% Horizontal (meters) | 99.999% Horizontal (meters) | Percentage in NPA mode (%) | Maximum Horizontal Error |
|---|---|---|---|---|
| Albuquerque | 0.909 | 2.303 | 99.99834 | 3.655 |
| Anchorage | 0.973 | 2.131 | 99.99906 | 2.376 |
| Atlanta | 0.906 | 1.918 | 99.99931 | 2.172 |
| Barrow | 0.654 | 1.718 | 99.99563 | 3.100 |
| Bethel | 1.357 | 5.350 | 99.99903 | 5.503 |
| Billings | 1.615 | 3.152 | 99.99834 | 3.616 |
| Boston | 1.034 | 1.909 | 99.99931 | 2.605 |
| Cleveland | 1.013 | 1.868 | 99.99931 | 3.140 |
| Cold Bay | 1.244 | 2.593 | 99.99879 | 2.974 |
| Fairbanks | 1.095 | 2.445 | 99.99906 | 3.883 |
| Gander | 1.026 | 2.368 | 99.99328 | 2.625 |
| Honolulu | 1.983 | 4.345 | 99.99906 | 5.253 |
| Houston | 1.124 | 2.463 | 99.99846 | 2.800 |
| Iqaluit | 0.698 | 2.241 | 99.99398 | 4.308 |
| Juneau | 0.953 | 1.941 | 99.99906 | 2.848 |
| Kansas City | 1.081 | 2.130 | 99.99846 | 2.716 |
| Kotzebue | 0.936 | 2.059 | 99.99563 | 2.277 |
| Los Angeles | 1.083 | 2.540 | 99.99834 | 3.553 |
| Merida | 1.299 | 3.026 | 99.99833 | 3.219 |
| Miami | 1.089 | 2.399 | 99.99906 | 2.658 |
| Minneapolis | 1.301 | 4.029 | 99.99871 | 4.382 |
| Oakland | 1.280 | 2.880 | 99.99834 | 3.693 |
| Salt Lake City | 1.151 | 2.634 | 99.99834 | 3.294 |
| San Jose Del Cabo | 1.271 | 2.446 | 99.99832 | 2.776 |
| San Juan | 1.317 | 4.736 | 99.99905 | 4.945 |
| Seattle | 1.447 | 3.057 | 99.99834 | 4.564 |
| Tapachula | 1.630 | 5.394 | 99.99824 | 5.571 |
| Washington DC | 1.102 | 2.001 | 99.99927 | 2.867 |

**Table 2-4 Maximum Position Errors and Position Error/Protection Level Ratio**

| Location | Horizontal Error (m) | Horizontal Error/HPL | Horizontal Maximum Ratio | Vertical Error (m) | Vertical Error/VPL | Vertical Maximum Ratio |
|---|---|---|---|---|---|---|
| Arcata | 3.873 | 0.138 | 0.249 | 5.941 | 0.219 | 0.242 |
| Oklahoma City | 2.703 | 0.139 | 0.187 | 4.823 | 0.106 | 0.178 |
| Albuquerque | 1.991 | 0.159 | 0.172 | 3.700 | 0.226 | 0.226 |
| Anchorage | 2.224 | 0.072 | 0.125 | 3.546 | 0.162 | 0.162 |
| Atlanta | 2.077 | 0.074 | 0.137 | 2.923 | 0.136 | 0.159 |
| Barrow | 3.192 | 0.095 | 0.146 | 5.896 | 0.174 | 0.178 |
| Bethel | 1.597 | 0.106 | 0.116 | 2.418 | 0.095 | 0.110 |
| Billings | 2.229 | 0.103 | 0.195 | 3.502 | 0.189 | 0.189 |
| Boston | 2.298 | 0.065 | 0.117 | 2.971 | 0.152 | 0.156 |
| Chicago | 2.957 | 0.103 | 0.170 | 2.955 | 0.154 | 0.157 |
| Cleveland | 2.216 | 0.209 | 0.209 | 3.506 | 0.229 | 0.243 |
| Cold Bay | 2.614 | 0.092 | 0.119 | 2.810 | 0.097 | 0.109 |
| Dallas | 2.326 | 0.075 | 0.159 | 4.459 | 0.089 | 0.157 |
| Denver | 2.044 | 0.106 | 0.168 | 3.888 | 0.155 | 0.161 |
| Fairbanks | 2.212 | 0.093 | 0.157 | 3.521 | 0.083 | 0.146 |
| Gander | 2.624 | 0.096 | 0.100 | 2.795 | 0.068 | 0.107 |
| Goose Bay | 2.863 | 0.133 | 0.135 | 3.674 | 0.121 | 0.122 |
| Houston | 2.159 | 0.174 | 0.176 | 2.855 | 0.128 | 0.150 |
| Iqaluit | 4.574 | 0.285 | 0.285 | 9.768 | 0.232 | 0.265 |
| Jacksonville | 1.791 | 0.058 | 0.141 | 3.260 | 0.137 | 0.156 |
| Juneau | 1.532 | 0.053 | 0.121 | 3.255 | 0.153 | 0.153 |
| Kansas City | 2.088 | 0.112 | 0.185 | 3.001 | 0.125 | 0.162 |
| Kotzebue | 1.619 | 0.092 | 0.124 | 4.608 | 0.150 | 0.161 |
| Los Angeles | 2.291 | 0.146 | 0.146 | 3.506 | 0.125 | 0.143 |
| Memphis | 2.532 | 0.258 | 0.258 | 3.804 | 0.195 | 0.196 |
| Merida | 2.152 | 0.142 | 0.142 | 3.925 | 0.129 | 0.145 |
| Mexico City | 1.790 | 0.056 | 0.090 | 2.905 | 0.059 | 0.112 |
| Miami | 2.104 | 0.154 | 0.157 | 3.926 | 0.152 | 0.152 |
| Minneapolis | 2.110 | 0.187 | 0.217 | 4.409 | 0.202 | 0.202 |
| New York | 1.759 | 0.122 | 0.146 | 4.080 | 0.127 | 0.177 |
| Oakland | 2.402 | 0.186 | 0.204 | 2.966 | 0.123 | 0.144 |
| Puerto Vallarta | 2.130 | 0.091 | 0.097 | 4.036 | 0.113 | 0.145 |
| Salt Lake City | 2.228 | 0.100 | 0.189 | 2.866 | 0.193 | 0.193 |
| San Jose Del Cabo | 2.157 | 0.099 | 0.107 | 3.424 | 0.140 | 0.140 |
| San Juan | 2.777 | 0.081 | 0.093 | 5.677 | 0.114 | 0.119 |
| Seattle | 2.515 | 0.199 | 0.242 | 3.354 | 0.193 | 0.210 |
| Tapachula | 3.091 | 0.086 | 0.104 | 3.426 | 0.119 | 0.119 |
| Washington DC | 2.405 | 0.075 | 0.147 | 4.589 | 0.139 | 0.170 |
| Winnipeg | 2.489 | 0.129 | 0.150 | 3.500 | 0.161 | 0.163 |

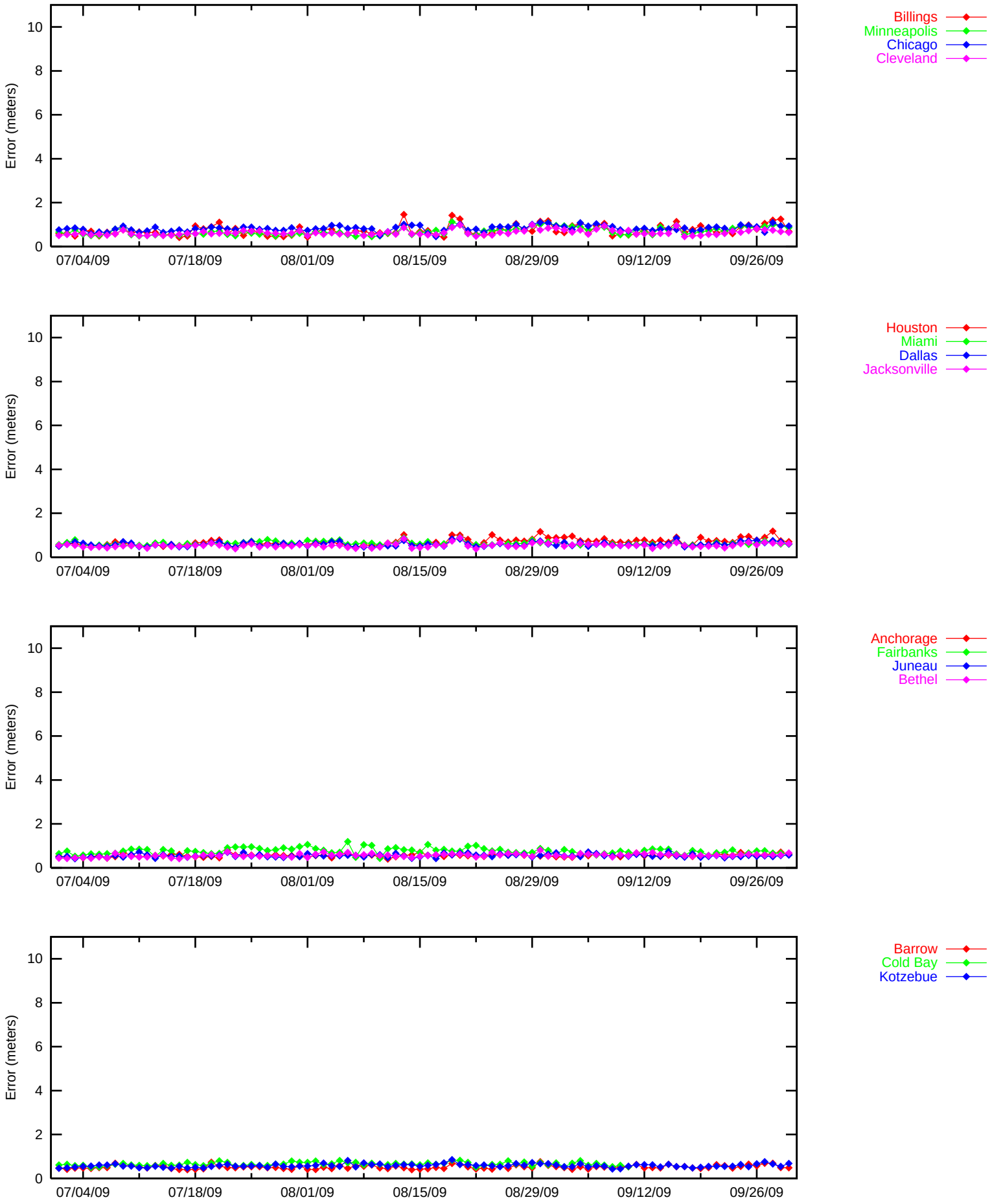
# Figure 2-1 95% Horizontal Accuracy at LPV





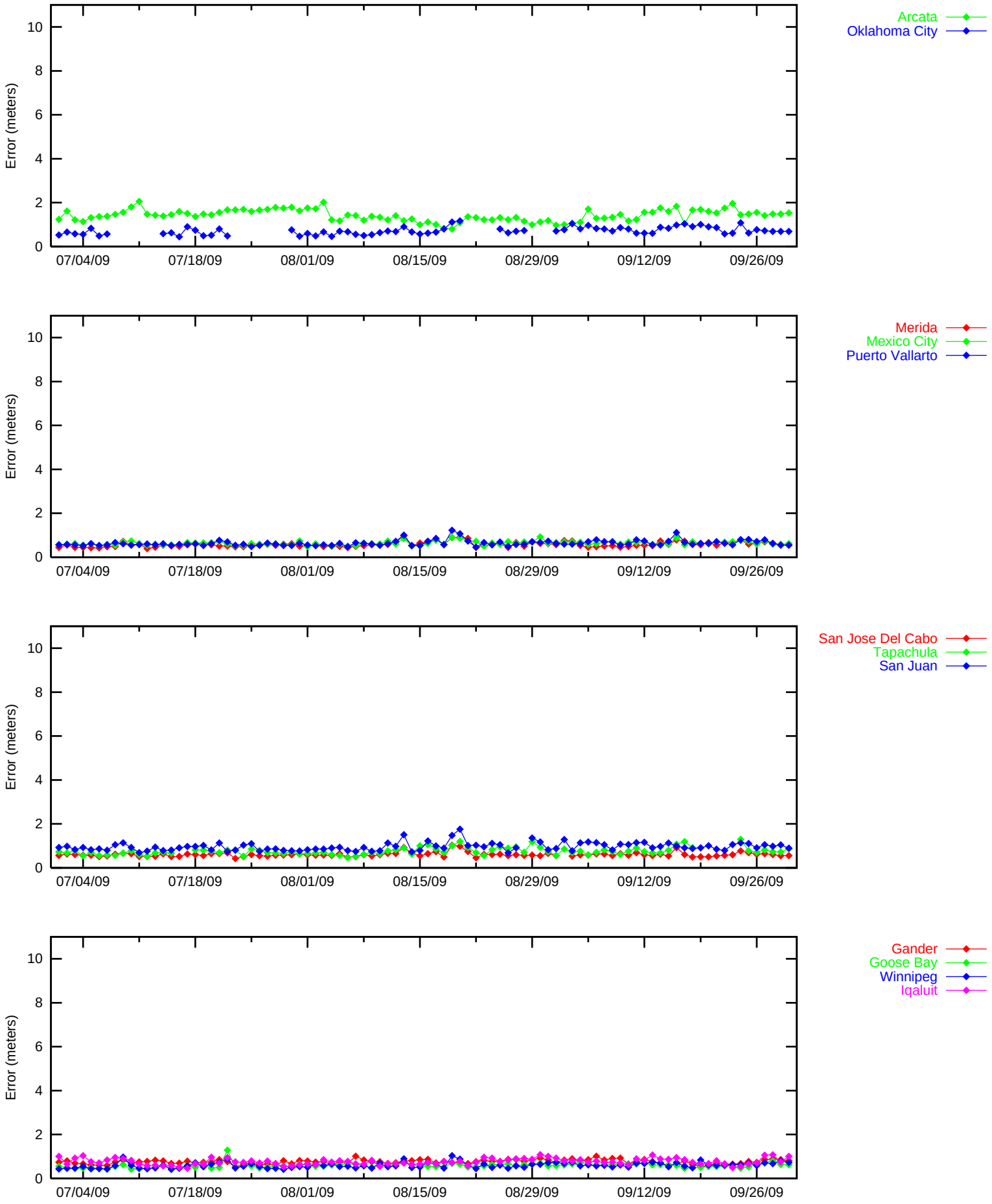
# Figure 2-2 95% Horizontal Accuracy at LPV





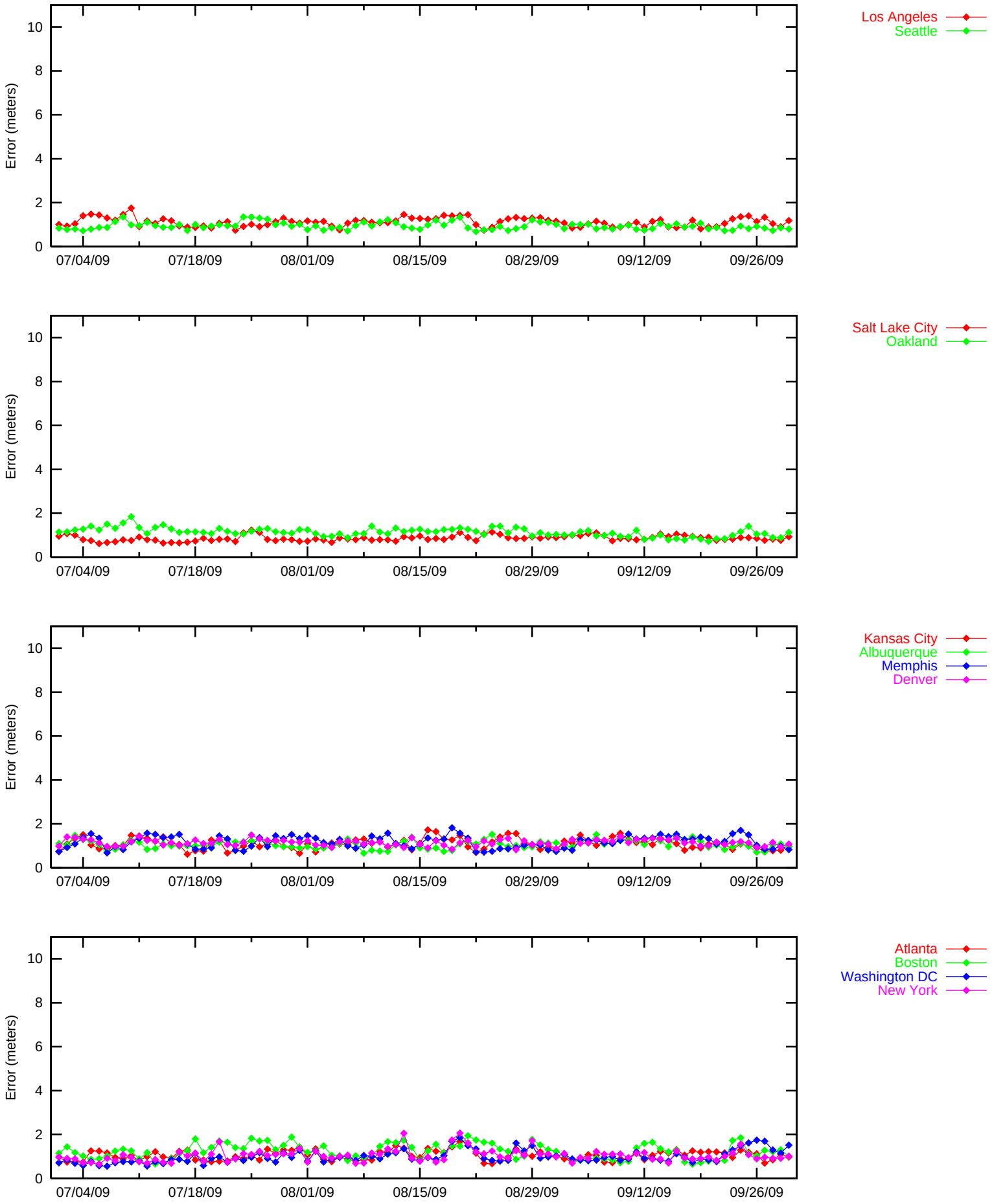
# Figure 2-3 95% Horizontal Accuracy at LPV





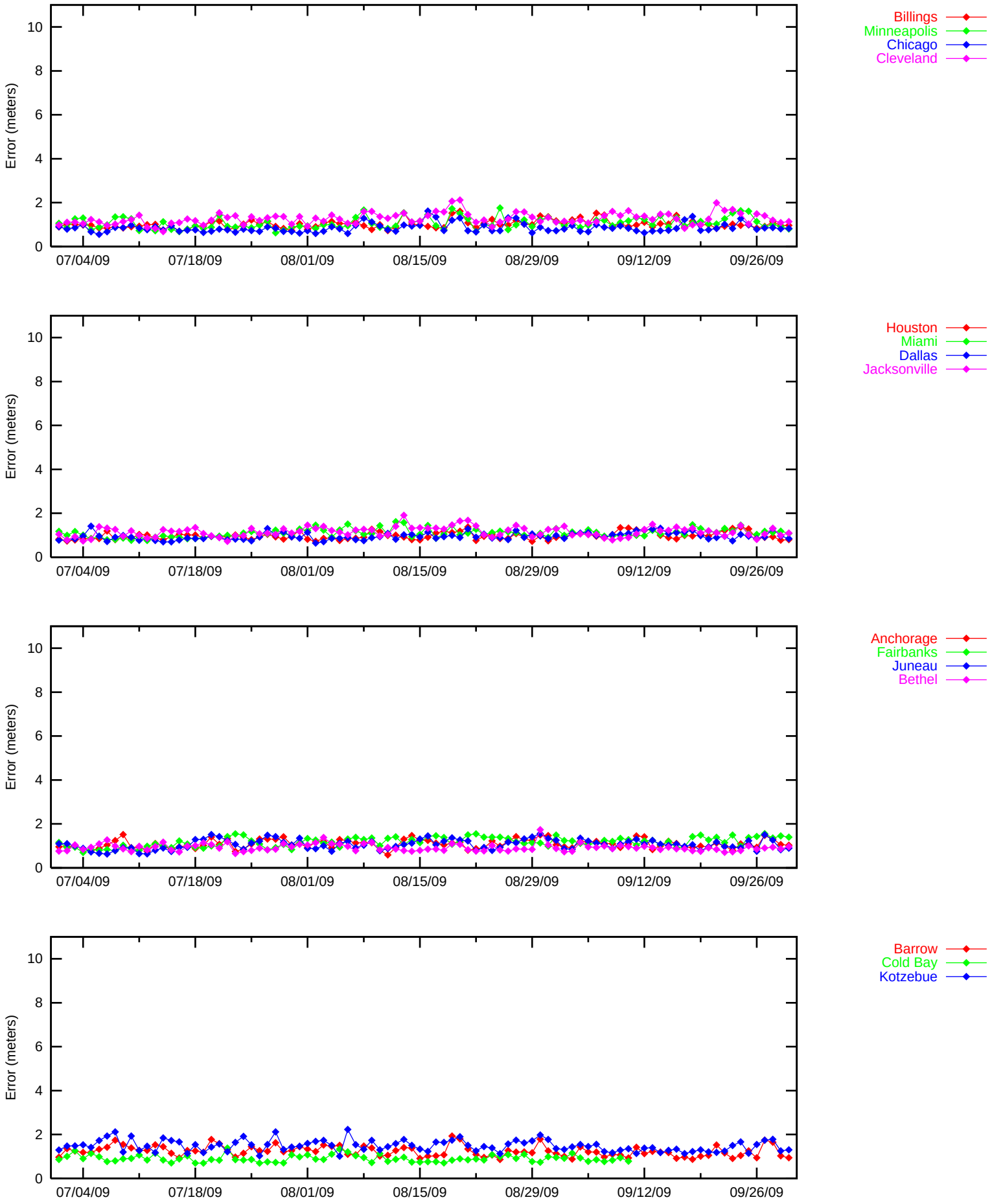
# Figure 2-4 95% Vertical Accuracy at LPV





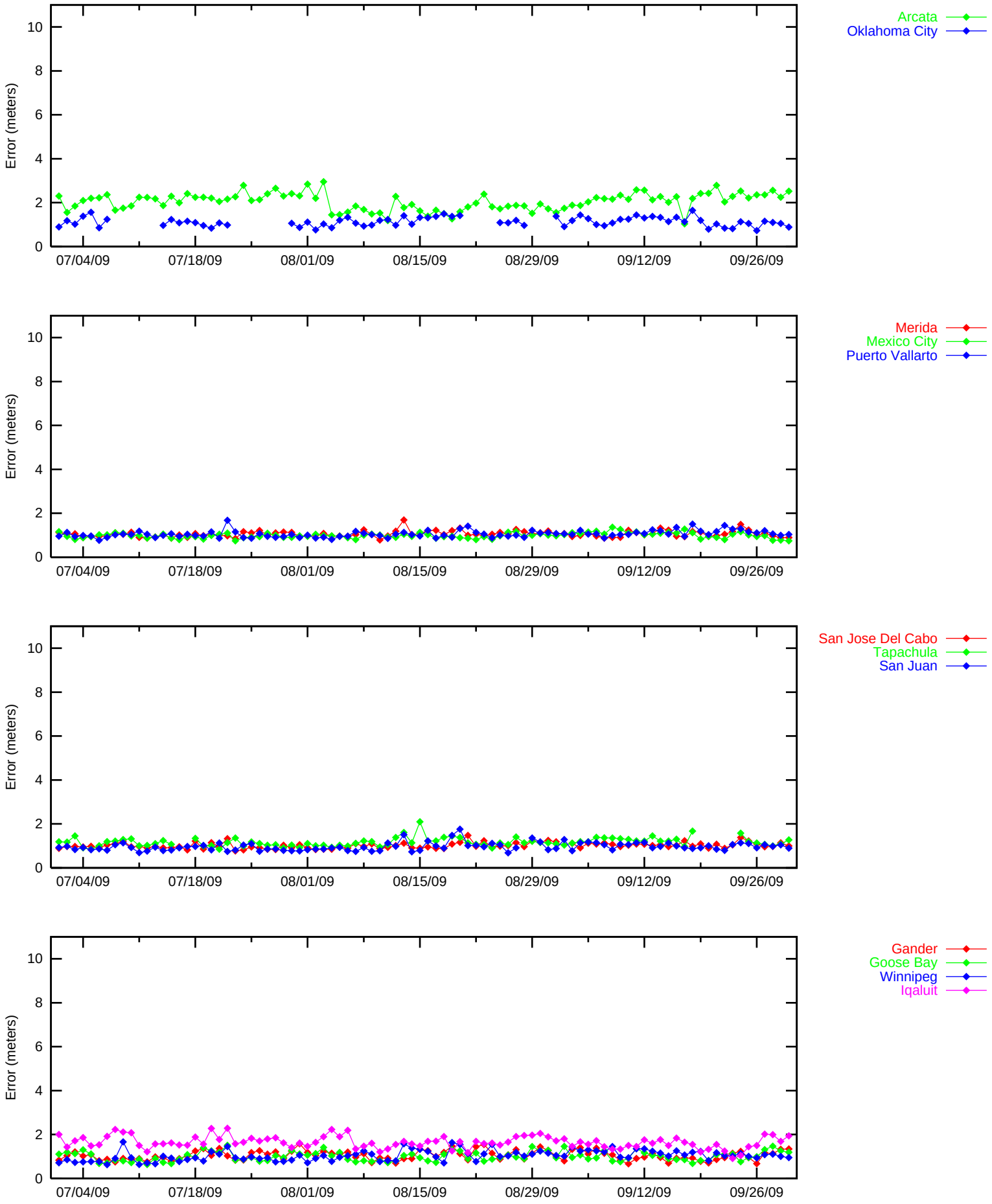
# Figure 2-5 95% Vertical Accuracy at LPV





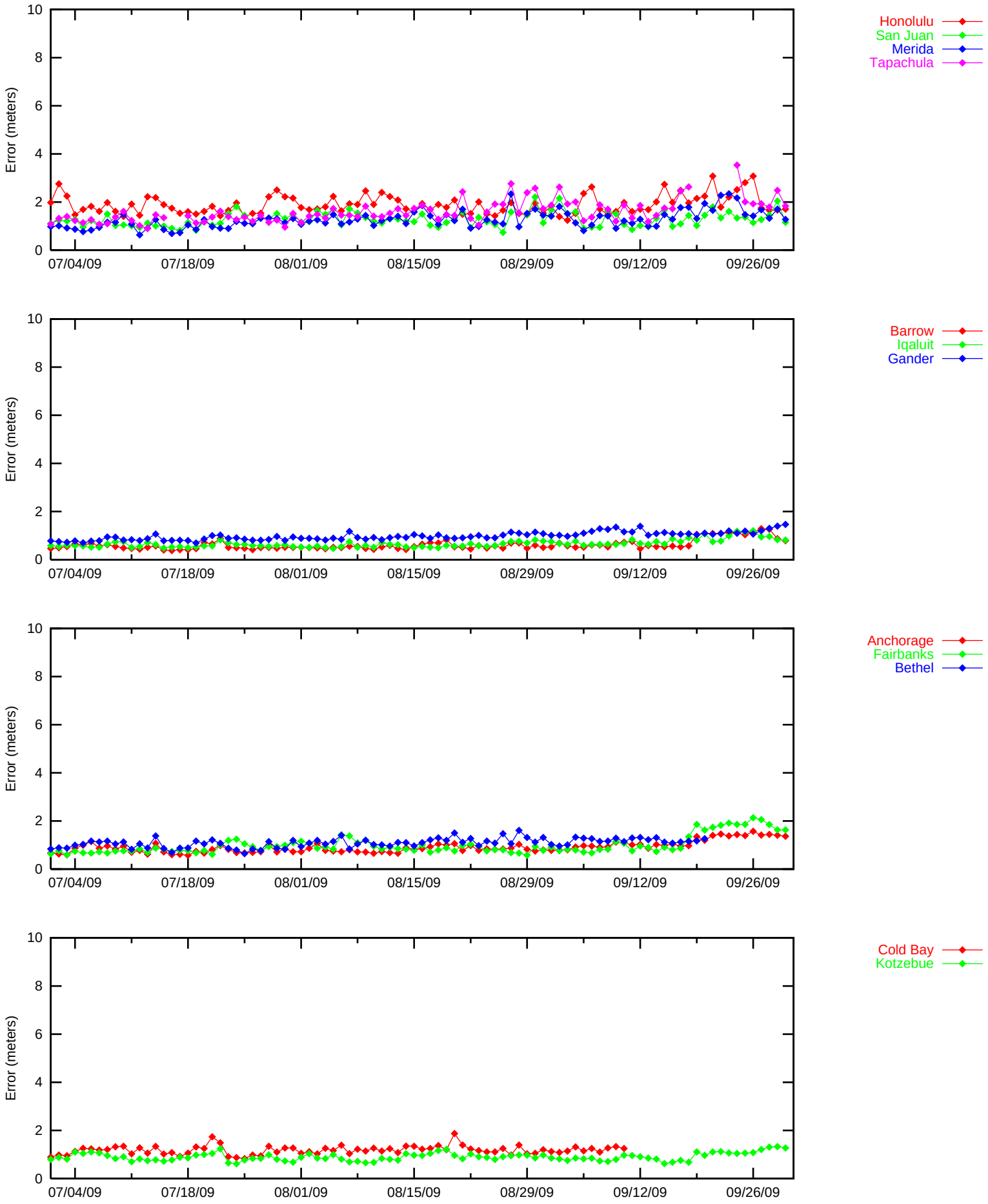
# Figure 2-6 95% Vertical Accuracy at LPV





# Figure 2-7 95% NPA Horizontal Accuracy





# Figure 2-8 95% NPA Horizontal Accuracy



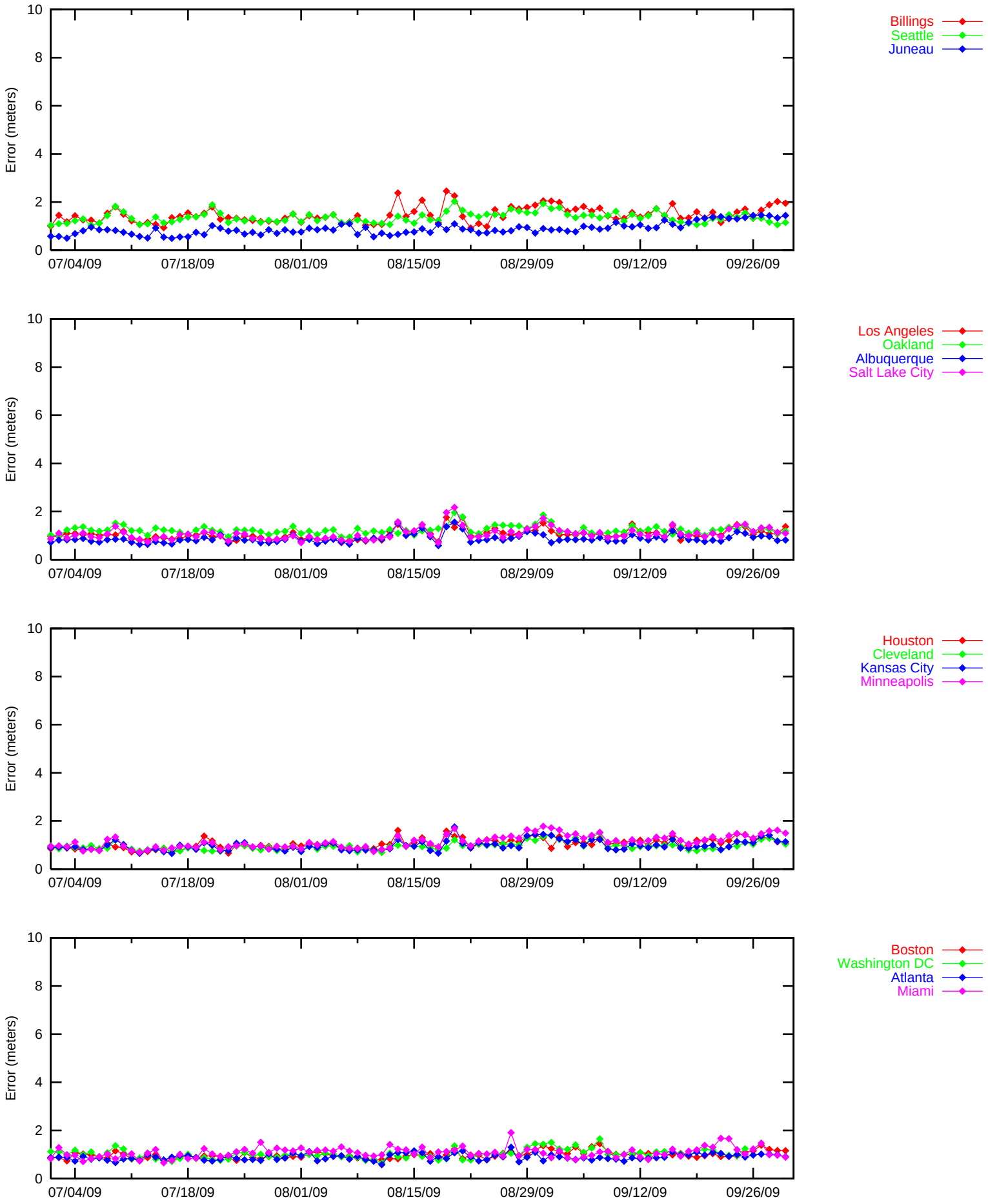


**Figure 2-9 Horizontal Triangle Chart for the Quarter**

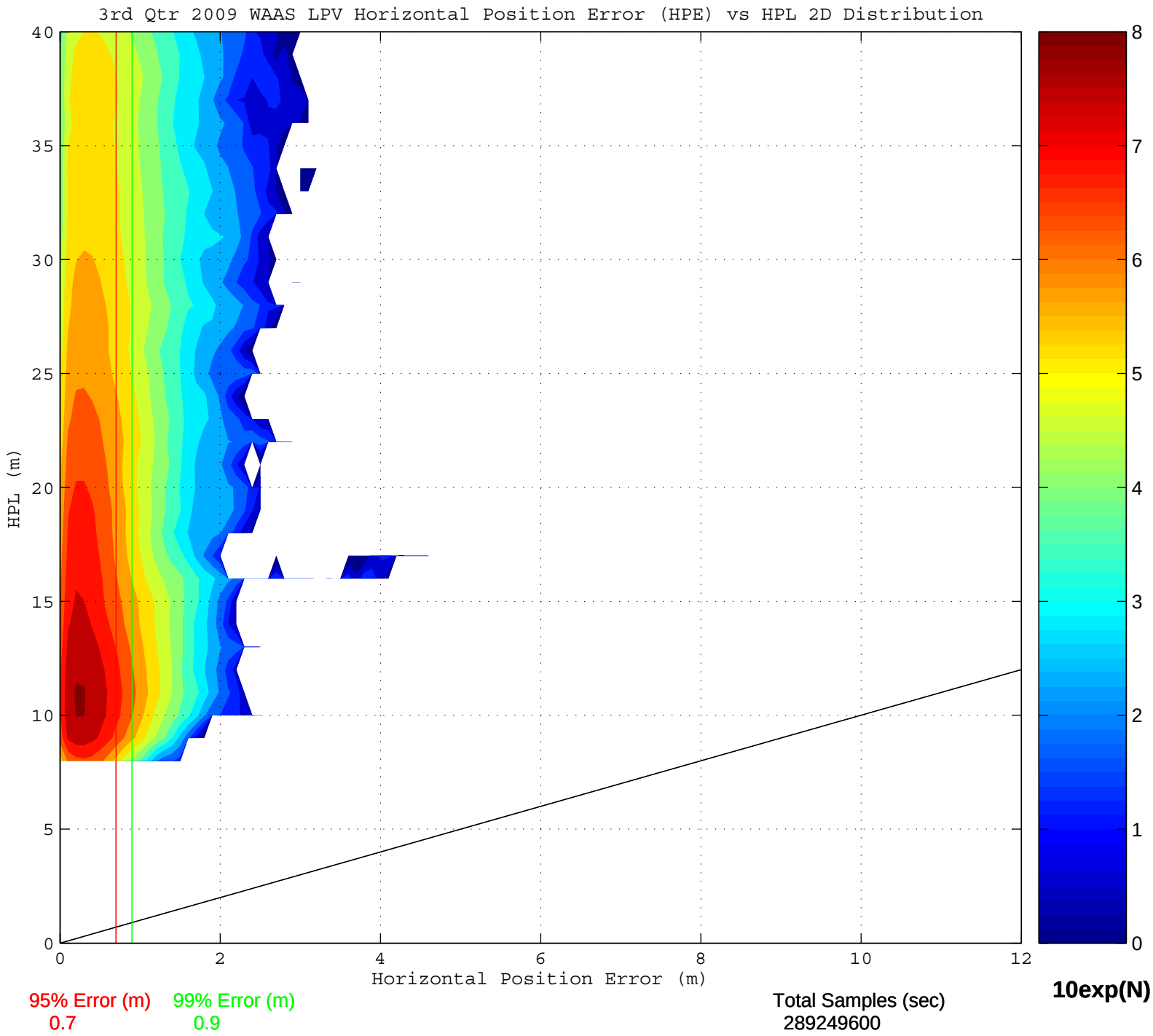


**Figure 2-10 Vertical Triangle Chart for the Quarter**

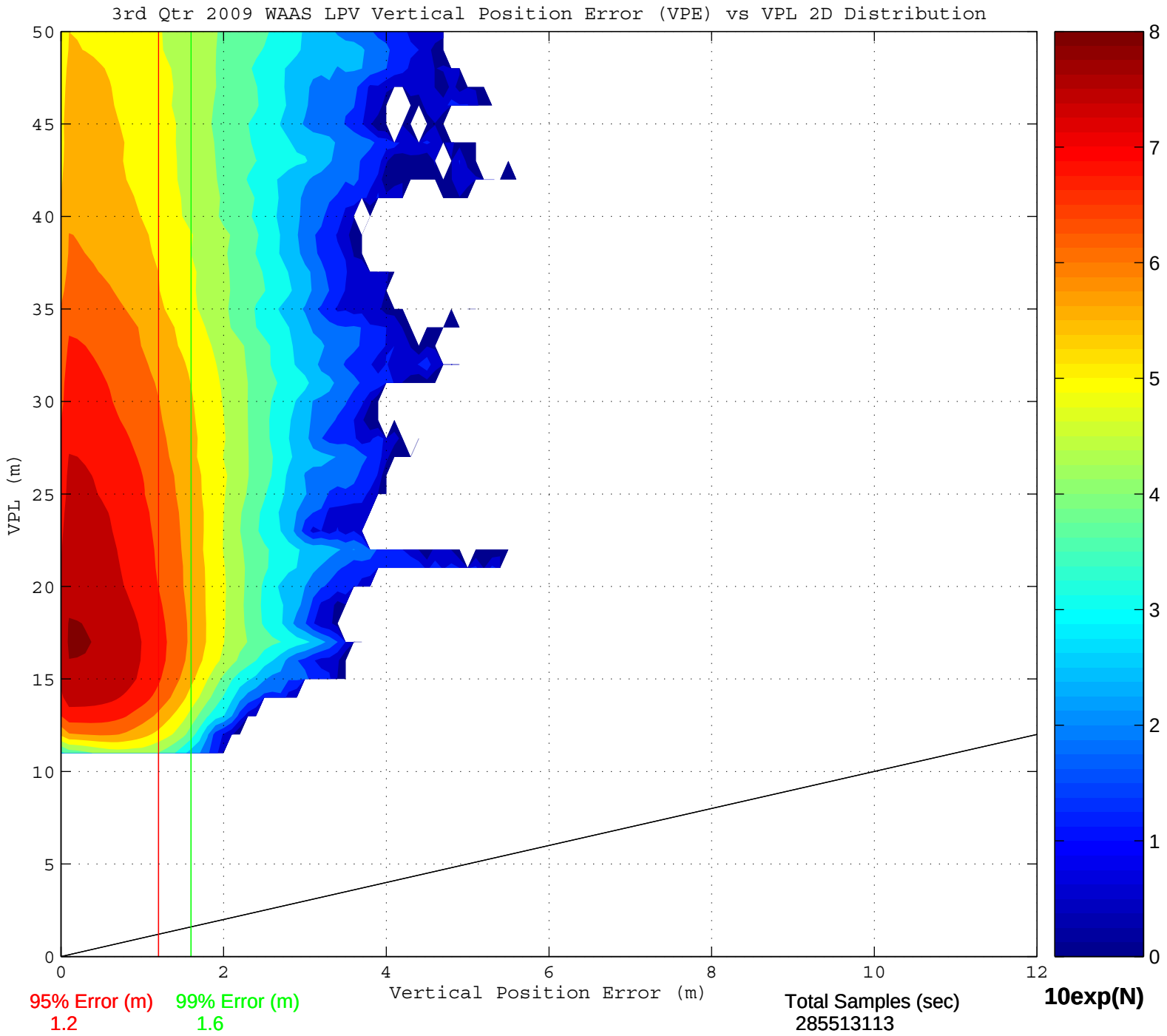


**Figure 2-11 2-D Horizontal Histogram for the Quarter**

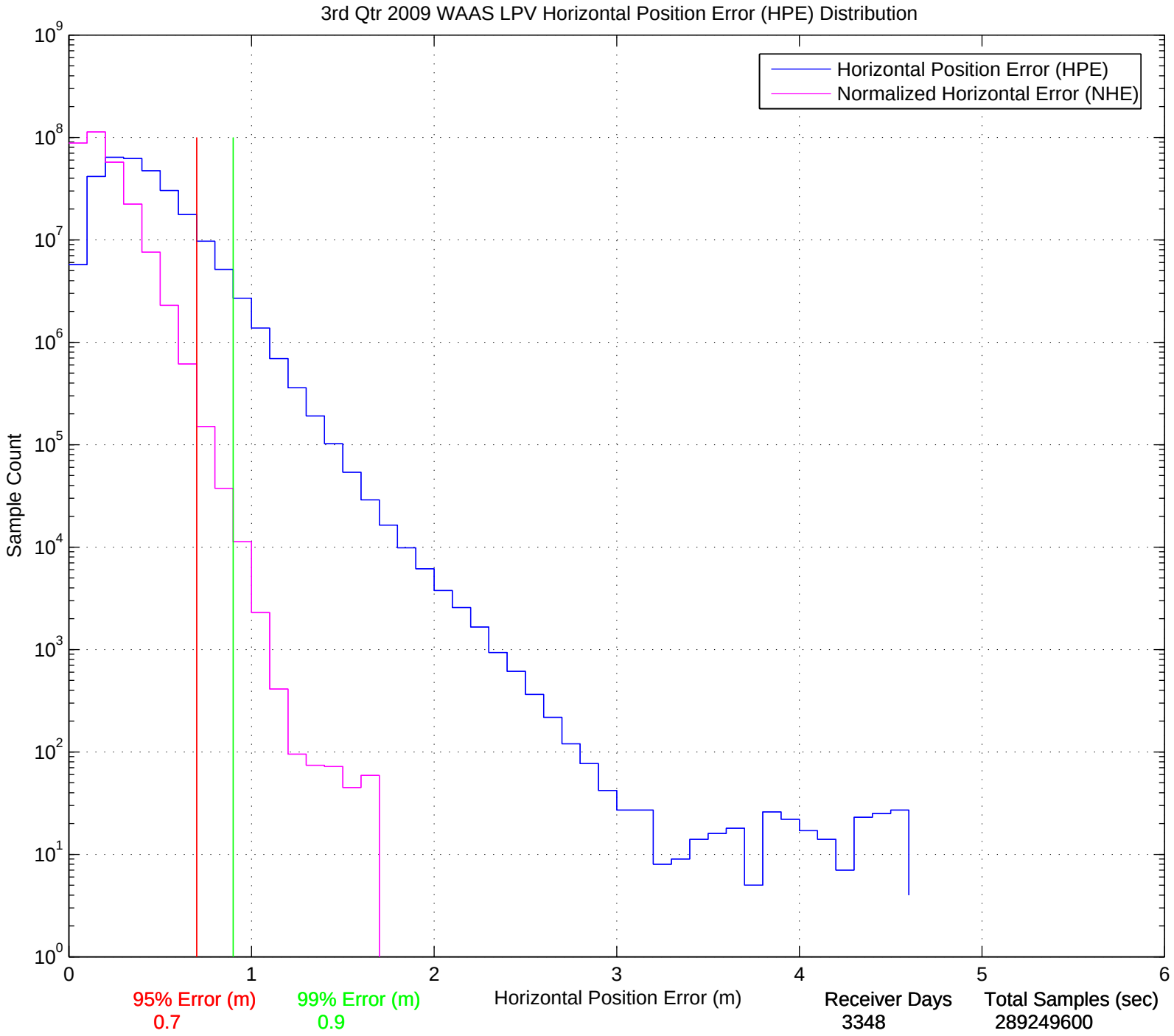
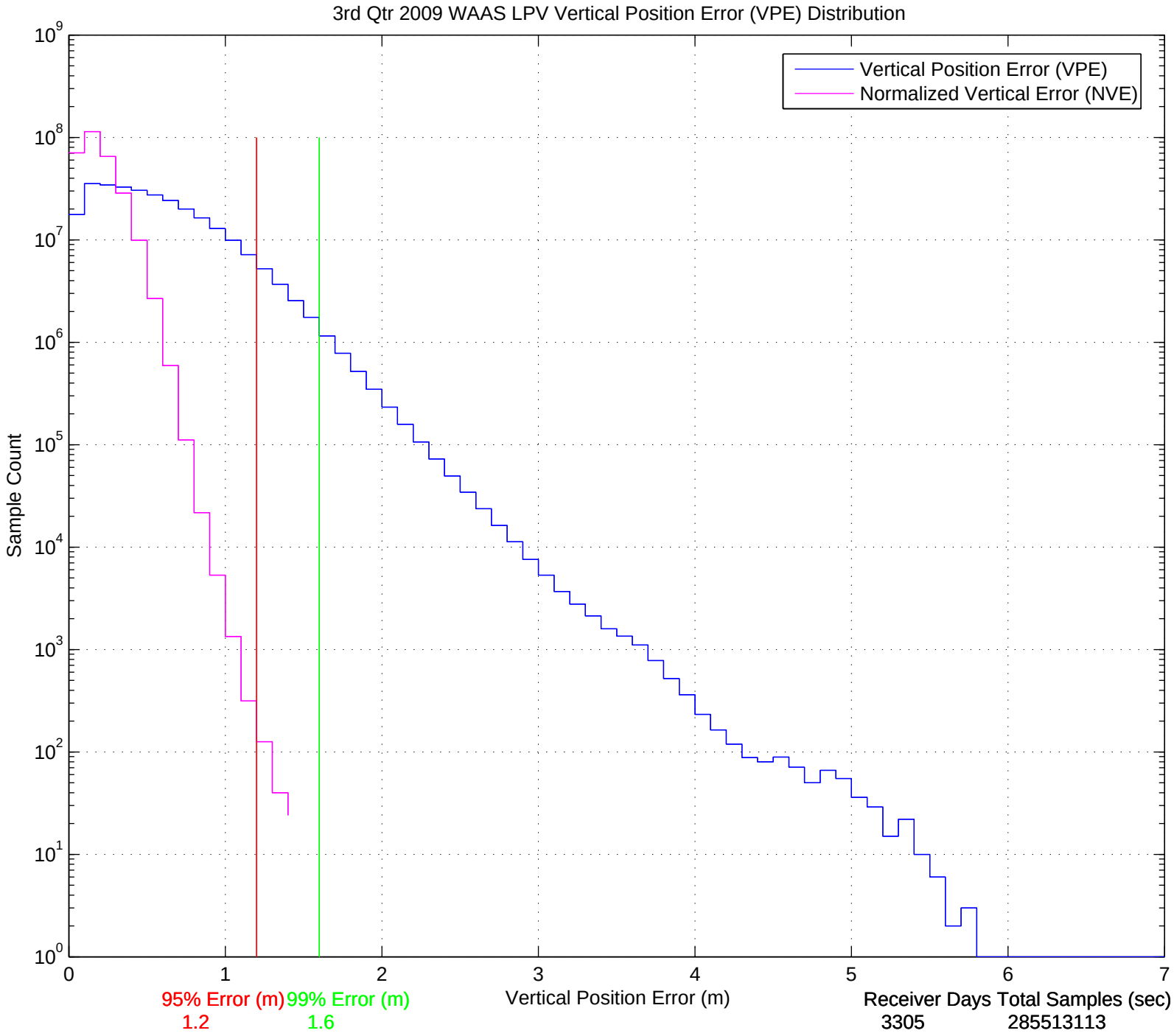


**Figure 2-12 2-D Vertical Histogram for the Quarter**



## 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<br>16.182 meters | Memphis<br>11.293 meters | Cold Bay<br>25.441 meters | Fairbanks<br>13.361 meters |
| 95% VPL | Oakland<br>30.407 meters | Memphis<br>19.443 meters | Cold Bay<br>36.194 meters | Juneau<br>21.959 meters |

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

During this evaluation period, reduced PA and NPA availability are mainly due to satellite outages and GUS switchovers. Please refer to Table 1.4 for events that affected availability. NPA outages at Iqaluit and Gander are due to CRE GUS switchovers; NPA outages at Barrow and Kotzebue are due to CRW GUS switchovers. Reduced availability on 7/24/09, 7/26/09, 8/5/09, 9/2/09, 9/11/09, and 9/18/09 are due to satellite outages. Reduced Fairbank and Iqaluit availability on 7/22/09 are due to localized scintillation. CRW GEO C&V faulted on 8/10/09 caused a WAAS service outage (see DR#82). Reduced Alaska availability on 8/14/09 and 8/15/09 are due to manual GUS switchovers. Reduced Alaska availability on 8/16/09 is due to CRW GEO low ranging availability (see DR#83). Reduced Alaska availability on 9/17/09 is due to low PA GEO ranging availability (see DR#84). Reduced Alaska availability on 9/18/09 is due to PRN 23 outage (see DR#85).

**Table 3-1 95% Protection Level**

| Location | 95% HPL (meters) | 95% VPL (meters) | Percentage in PA mode |
|---|---|---|---|
| Arcata | 16.182 | 28.304 | 99.99720 |
| Oklahoma City | 11.666 | 21.068 | 99.99576 |
| Albuquerque | 12.602 | 22.619 | 99.99673 |
| Anchorage | 14.310 | 23.227 | 99.99628 |
| Atlanta | 11.528 | 20.802 | 99.99619 |
| Barrow | 17.397 | 33.963 | 99.97520 |
| Bethel | 18.091 | 28.510 | 99.99658 |
| Billings | 12.591 | 21.391 | 99.99695 |
| Boston | 14.614 | 20.776 | 99.99605 |
| Chicago | 12.800 | 19.986 | 99.99620 |
| Cleveland | 13.445 | 20.803 | 99.99611 |
| Cold Bay | 25.441 | 36.194 | 99.99688 |
| Dallas | 11.531 | 21.384 | 99.99658 |
| Denver | 11.620 | 21.625 | 99.99673 |
| Fairbanks | 13.361 | 23.477 | 99.99628 |
| Gander | 24.311 | 35.619 | 99.97680 |
| Goose Bay | 19.580 | 28.064 | 99.97705 |
| Houston | 11.668 | 21.785 | 99.99658 |
| Iqaluit | 27.858 | 41.197 | 99.97775 |
| Jacksonville | 12.552 | 22.685 | 99.99619 |
| Juneau | 13.491 | 21.959 | 99.99617 |
| Kansas City | 12.113 | 19.839 | 99.99658 |
| Kotzebue | 16.464 | 30.825 | 99.97548 |
| Los Angeles | 15.603 | 27.473 | 99.99704 |
| Memphis | 11.293 | 19.443 | 99.99620 |
| Merida | 17.574 | 31.905 | 99.99597 |
| Mexico City | 21.159 | 35.273 | 99.99658 |
| Miami | 13.839 | 26.578 | 99.99597 |
| Minneapolis | 12.490 | 20.789 | 99.99620 |
| New York | 14.032 | 20.555 | 99.99611 |
| Oakland | 15.771 | 30.407 | 99.99704 |
| Puerto Vallarta | 23.865 | 39.298 | 99.99696 |
| Salt Lake City | 11.995 | 21.829 | 99.99696 |
| San Jose Del Cabo | 21.720 | 38.241 | 99.99490 |
| San Juan | 64.368 | 93.045 | 99.97403 |
| Seattle | 14.131 | 22.616 | 99.99704 |
| Tapachula | 33.073 | 53.884 | 99.99383 |
| Washington DC | 13.077 | 20.624 | 99.99611 |
| Winnipeg | 14.565 | 21.662 | 99.99657 |

**Table 3-2 Quarterly Availability Statistics**

| Location | LPV WAAS *With 15 minute window* | LPV 200 WAAS *With 15 minute window* |
|---|---|---|
| Arcata | 0.99980247 | 0.98293278 |
| Oklahoma City | 0.99994321 | 0.99984729 |
| Albuquerque | 0.99996728 | 0.99968513 |
| Anchorage | 0.99970903 | 0.99930505 |
| Atlanta | 0.99996187 | 0.99987493 |
| Barrow | 0.99887735 | 0.95256436 |
| Bethel | 0.99926005 | 0.99118263 |
| Billings | 0.99996728 | 0.99980959 |
| Boston | 0.99996049 | 0.99991909 |
| Chicago | 0.99996187 | 0.99990727 |
| Cleveland | 0.99996112 | 0.99993193 |
| Cold Bay | 0.99931412 | 0.90472224 |
| Dallas | 0.99995986 | 0.99989152 |
| Denver | 0.99996728 | 0.99974545 |
| Fairbanks | 0.99996275 | 0.99943140 |
| Gander | 0.99942468 | 0.90885756 |
| Goose Bay | 0.99971499 | 0.99894294 |
| Houston | 0.99995985 | 0.99990812 |
| Iqaluit | 0.98595862 | 0.78912552 |
| Jacksonville | 0.99996187 | 0.99979880 |
| Juneau | 0.99993581 | 0.99964080 |
| Kansas City | 0.99995986 | 0.99987229 |
| Kotzebue | 0.99937133 | 0.98605660 |
| Los Angeles | 0.99996678 | 0.99796518 |
| Memphis | 0.99996187 | 0.99989456 |
| Merida | 0.99995116 | 0.97470667 |
| Mexico City | 0.99131776 | 0.93601737 |
| Miami | 0.99995898 | 0.99971424 |
| Minneapolis | 0.99996200 | 0.99984586 |
| New York | 0.99996049 | 0.99996024 |
| Oakland | 0.99984959 | 0.97859212 |
| Puerto Vallarta | 0.99461463 | 0.87582760 |
| Salt Lake City | 0.99996955 | 0.99956627 |
| San Jose Del Cabo | 0.99910063 | 0.90917503 |
| San Juan | 0.22173010 | 0.01002244 |
| Seattle | 0.99997043 | 0.99944132 |
| Tapachula | 0.88127372 | 0.47430810 |
| Washington DC | 0.99996112 | 0.99996099 |
| Winnipeg | 0.99995983 | 0.99980001 |

**Table 3-3 NPA Availability**

| Location | NPA Availability (Excluding RAIM/FDE) |
|---|---|
| Albuquerque | 0.99998 |
| Anchorage | 0.99999 |
| Atlanta | 0.99999 |
| Barrow | 0.99996 |
| Bethel | 0.99999 |
| Billings | 0.99998 |
| Boston | 0.99999 |
| Cleveland | 0.99999 |
| Cold Bay | 0.99999 |
| Fairbanks | 0.99999 |
| Gander | 0.99993 |
| Honolulu | 0.99999 |
| Houston | 0.99998 |
| Iqaluit | 0.99994 |
| Juneau | 0.99999 |
| Kansas City | 0.99998 |
| Kotzebue | 0.99996 |
| Los Angeles | 0.99998 |
| Merida | 0.99998 |
| Miami | 0.99999 |
| Minneapolis | 0.99999 |
| Oakland | 0.99998 |
| Salt Lake City | 0.99998 |
| San Jose Del Cabo | 0.99998 |
| San Juan | 0.99999 |
| Seattle | 0.99998 |
| Tapachula | 0.99998 |
| Washington DC | 0.99999 |

**Table 3-4 LPV and LPV 200 Outage Rate**

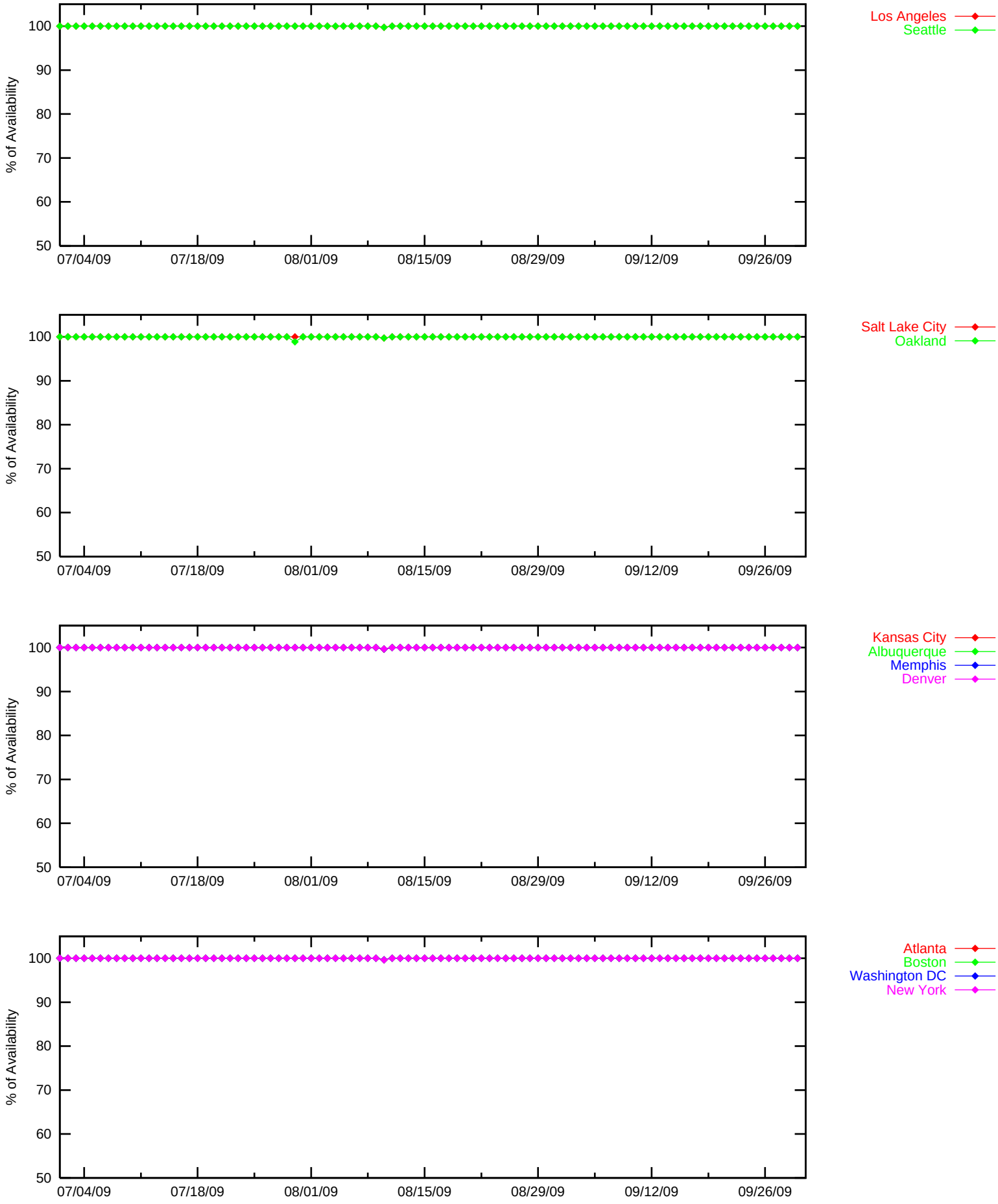
| Location | LPV Outages | LPV Outage Rates | LPV 200 Outages | LPV 200 Outage Rates |
|---|---|---|---|---|
| Arcata | 6 | 0.000114 | 140 | 0.002695 |
| Oklahoma City | 2 | 0.000047 | 7 | 0.000166 |
| Albuquerque | 1 | 0.000019 | 7 | 0.000132 |
| Anchorage | 2 | 0.000038 | 7 | 0.000132 |
| Atlanta | 1 | 0.000019 | 2 | 0.000038 |
| Barrow | 32 | 0.000605 | 576 | 0.011414 |
| Bethel | 8 | 0.000151 | 65 | 0.001238 |
| Billings | 1 | 0.000019 | 4 | 0.000076 |
| Boston | 1 | 0.000019 | 3 | 0.000057 |
| Chicago | 1 | 0.000019 | 3 | 0.000057 |
| Cleveland | 1 | 0.000019 | 2 | 0.000038 |
| Cold Bay | 6 | 0.000145 | 411 | 0.010969 |
| Dallas | 1 | 0.000019 | 5 | 0.000094 |
| Denver | 1 | 0.000019 | 6 | 0.000113 |
| Fairbanks | 1 | 0.000019 | 9 | 0.000170 |
| Gander | 17 | 0.000321 | 731 | 0.015182 |
| Goose Bay | 8 | 0.000151 | 28 | 0.000529 |
| Houston | 1 | 0.000019 | 3 | 0.000057 |
| Iqaluit | 144 | 0.002758 | 1134 | 0.027141 |
| Jacksonville | 1 | 0.000019 | 2 | 0.000038 |
| Juneau | 2 | 0.000038 | 4 | 0.000076 |
| Kansas City | 1 | 0.000019 | 3 | 0.000057 |
| Kotzebue | 16 | 0.000303 | 204 | 0.003910 |
| Los Angeles | 2 | 0.000038 | 54 | 0.001021 |
| Memphis | 1 | 0.000019 | 2 | 0.000038 |
| Merida | 4 | 0.000076 | 224 | 0.004339 |
| Mexico City | 101 | 0.001923 | 473 | 0.009538 |
| Miami | 1 | 0.000019 | 3 | 0.000057 |
| Minneapolis | 1 | 0.000019 | 2 | 0.000038 |
| New York | 1 | 0.000019 | 2 | 0.000038 |
| Oakland | 2 | 0.000038 | 253 | 0.004881 |
| Puerto Vallarta | 102 | 0.001936 | 590 | 0.012715 |
| Salt Lake City | 1 | 0.000019 | 6 | 0.000113 |
| San Jose Del Cabo | 29 | 0.000552 | 462 | 0.009666 |
| San Juan | 882 | 0.081547 | 98 | 0.200455 |
| Seattle | 1 | 0.000019 | 18 | 0.000340 |
| Tapachula | 701 | 0.015904 | 1320 | 0.055642 |
| Washington DC | 1 | 0.000019 | 2 | 0.000038 |
| Winnipeg | 1 | 0.000019 | 3 | 0.000057 |

**Table 3-5 NPA Outage Rates**

| Location | NPA Outages | NPA Outage Rate |
|---|---|---|
| Albuquerque | 1 | 0.00001889 |
| Anchorage | 1 | 0.00001889 |
| Atlanta | 1 | 0.00001892 |
| Barrow | 6 | 0.00011335 |
| Bethel | 1 | 0.00001935 |
| Billings | 1 | 0.00001889 |
| Boston | 1 | 0.00001890 |
| Cleveland | 1 | 0.00001890 |
| Cold Bay | 1 | 0.00002419 |
| Fairbanks | 1 | 0.00001889 |
| Gander | 6 | 0.00011333 |
| Honolulu | 1 | 0.00001890 |
| Houston | 1 | 0.00001889 |
| Iqaluit | 6 | 0.00011336 |
| Juneau | 1 | 0.00001890 |
| Kansas City | 1 | 0.00001890 |
| Kotzebue | 6 | 0.00011348 |
| Los Angeles | 1 | 0.00001889 |
| Merida | 1 | 0.00001889 |
| Miami | 1 | 0.00001891 |
| Minneapolis | 1 | 0.00001891 |
| Oakland | 1 | 0.00001889 |
| Salt Lake City | 1 | 0.00001889 |
| San Jose Del Cabo | 1 | 0.00001904 |
| San Juan | 1 | 0.00001895 |
| Seattle | 1 | 0.00001889 |
| Tapachula | 1 | 0.00001996 |
| Washington DC | 1 | 0.00001981 |

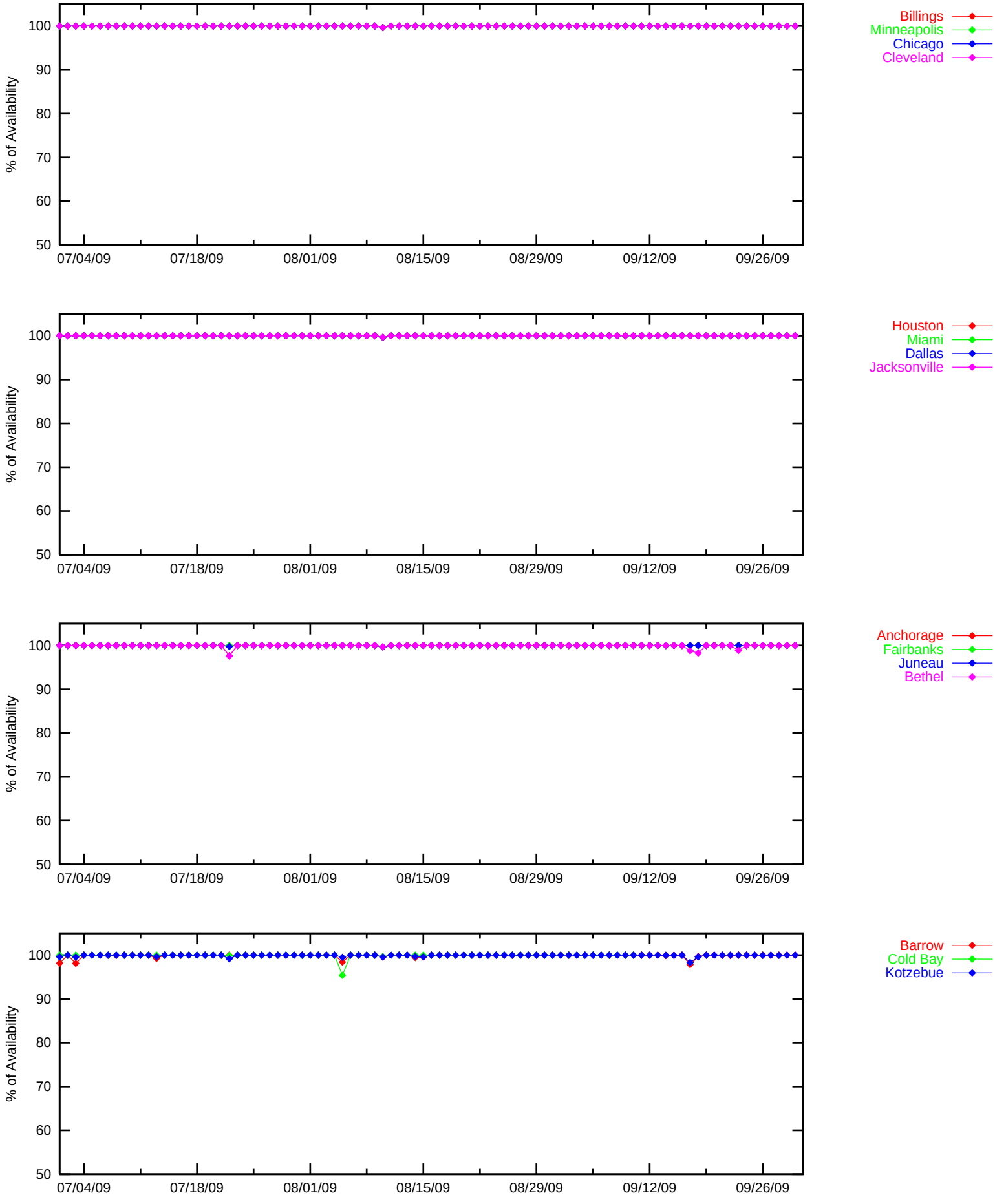
# Figure 3-1 LPV Instantaneous Availability (HAL = 40m & VAL=50m)



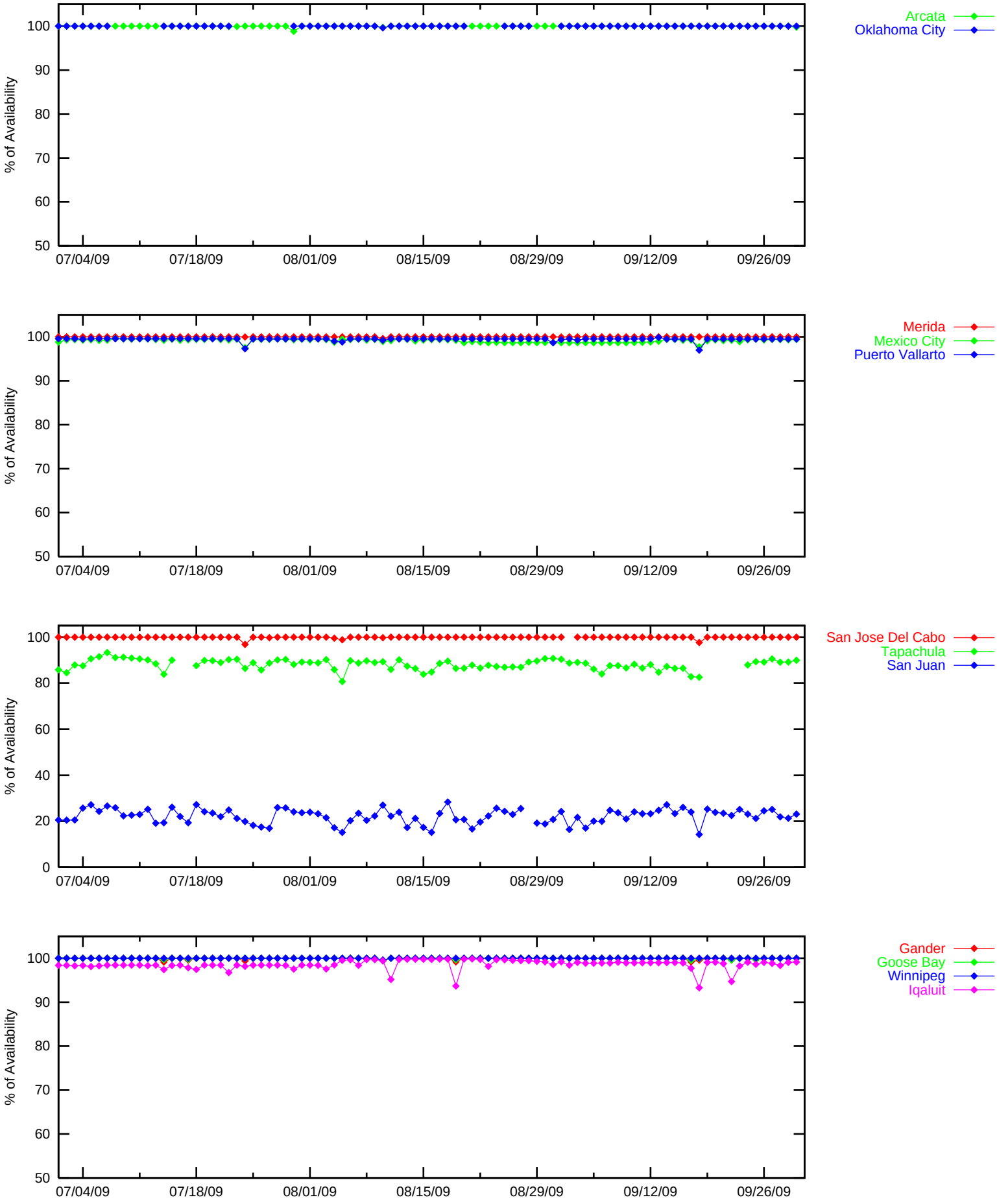


# Figure 3-2 LPV Instantaneous Availability (HAL = 40m & VAL=50m)

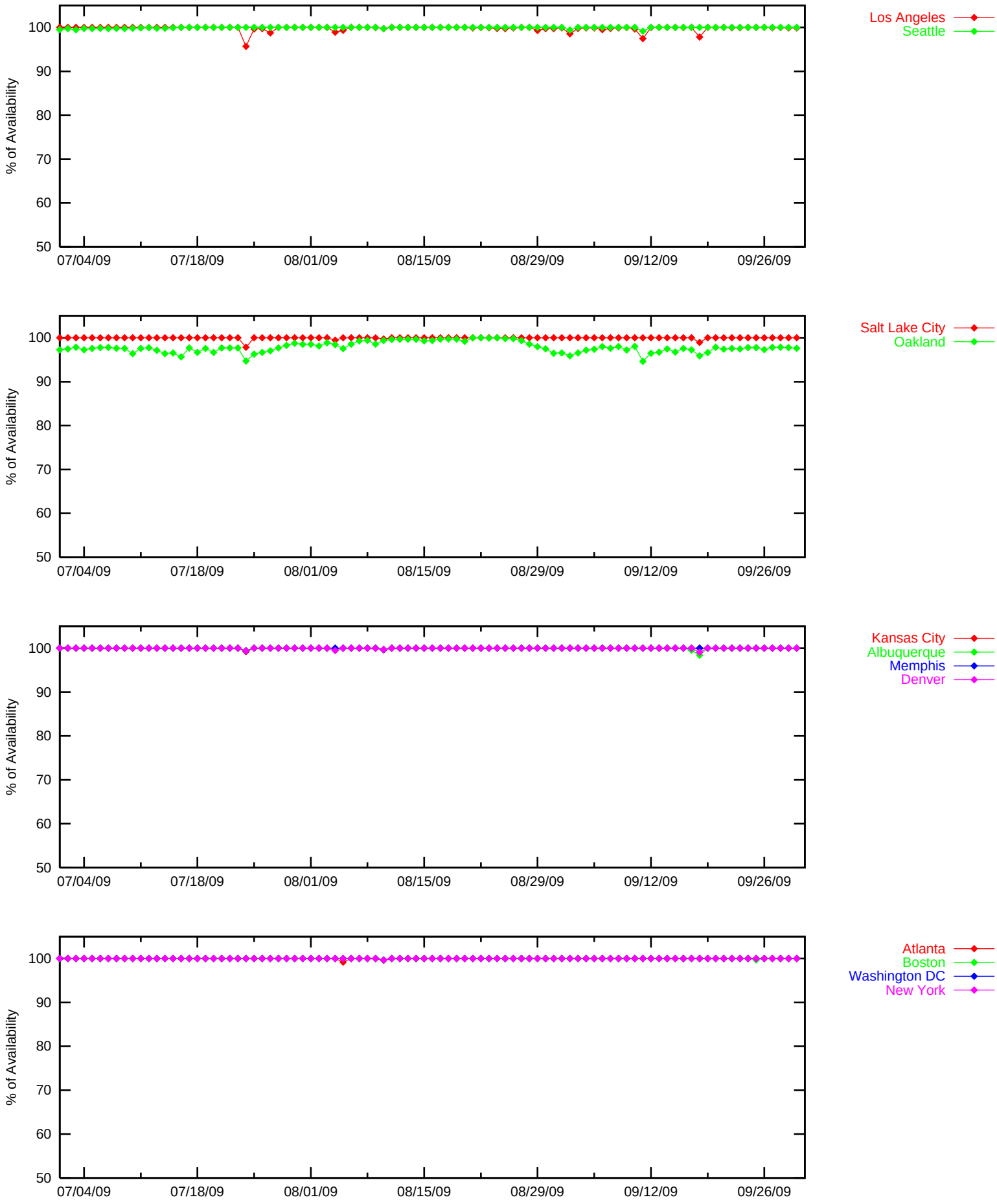




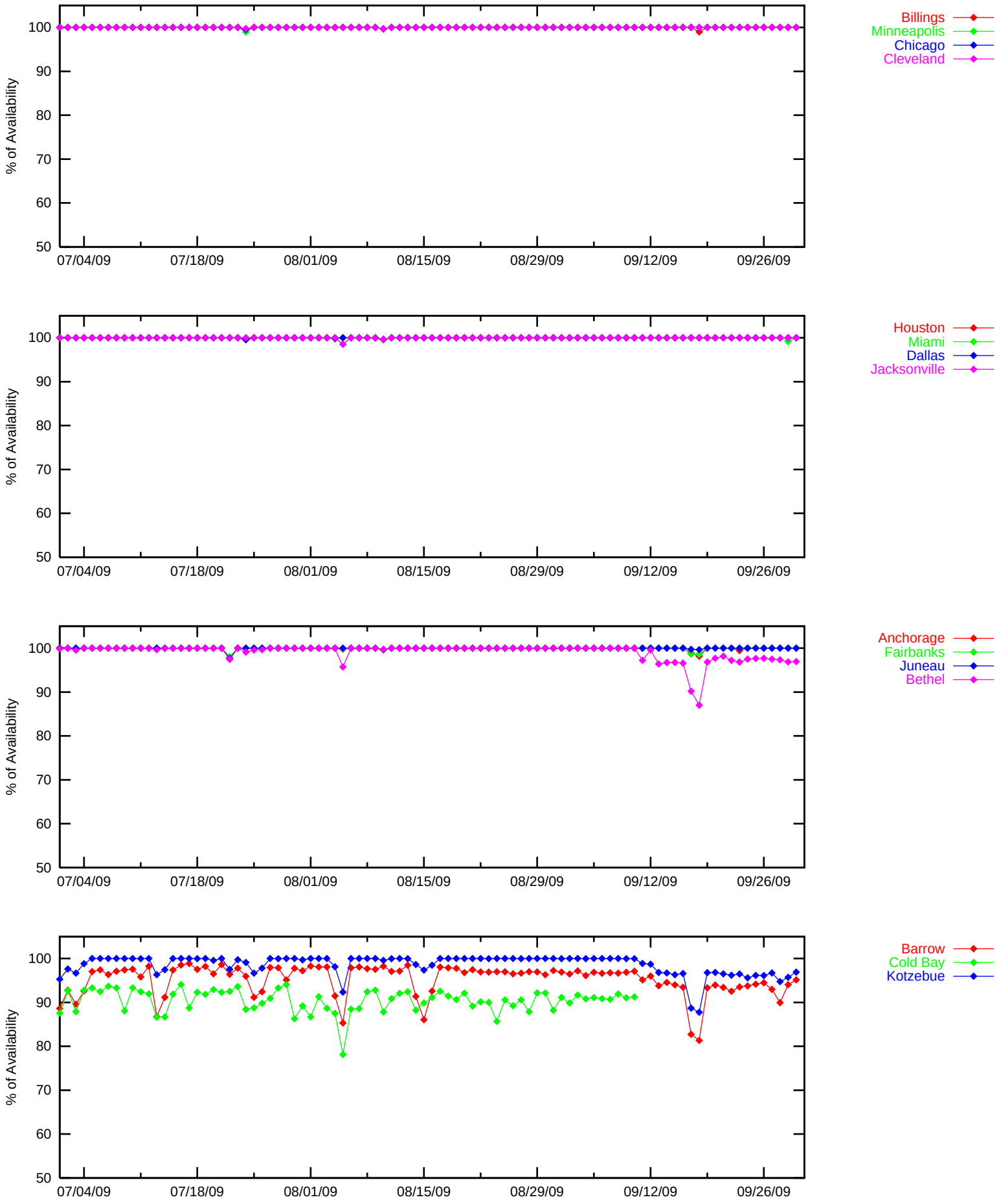
# Figure 3-3 LPV Instantaneous Availability (HAL = 40m & VAL=50m)



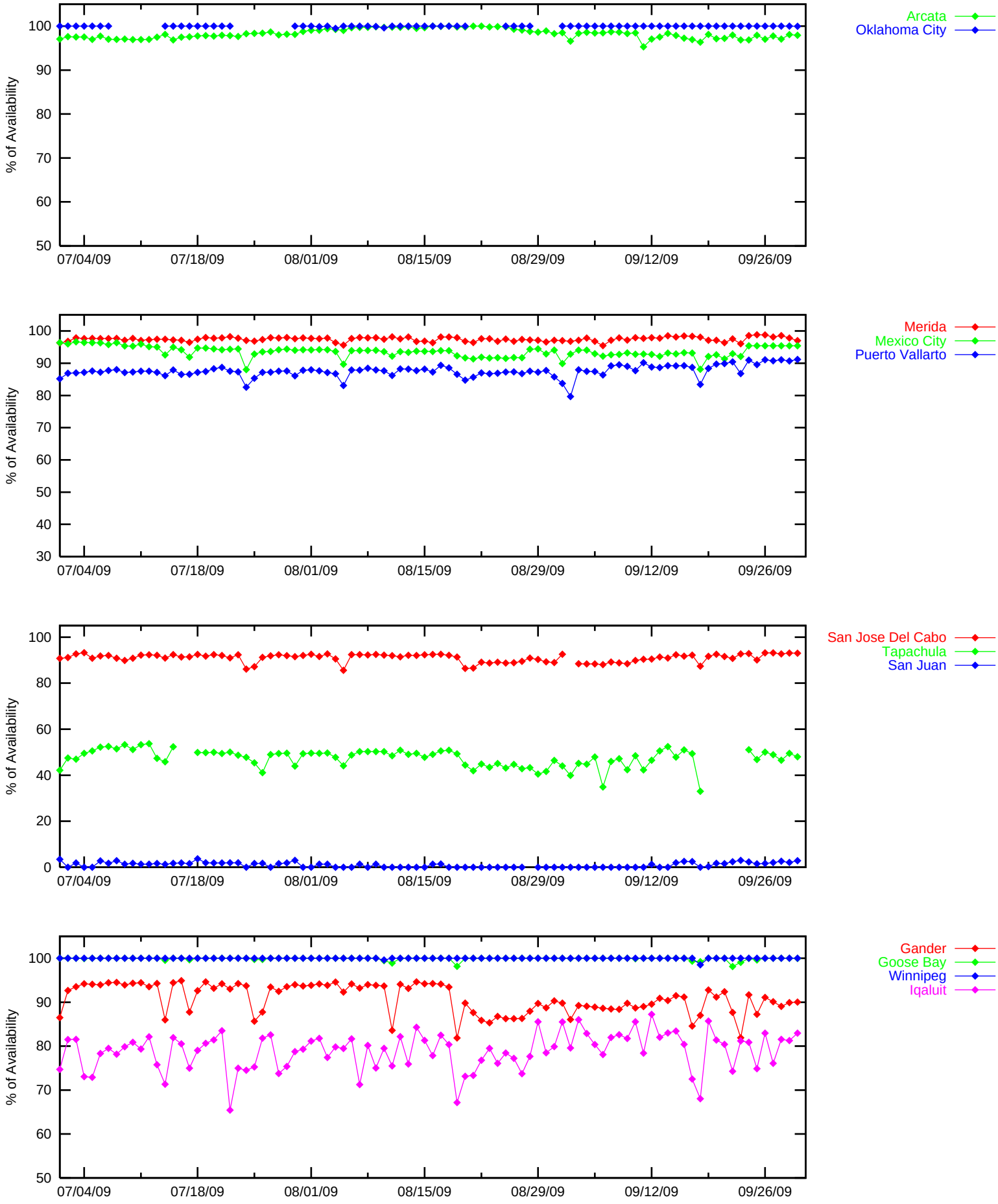
# Figure 3-4 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)



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

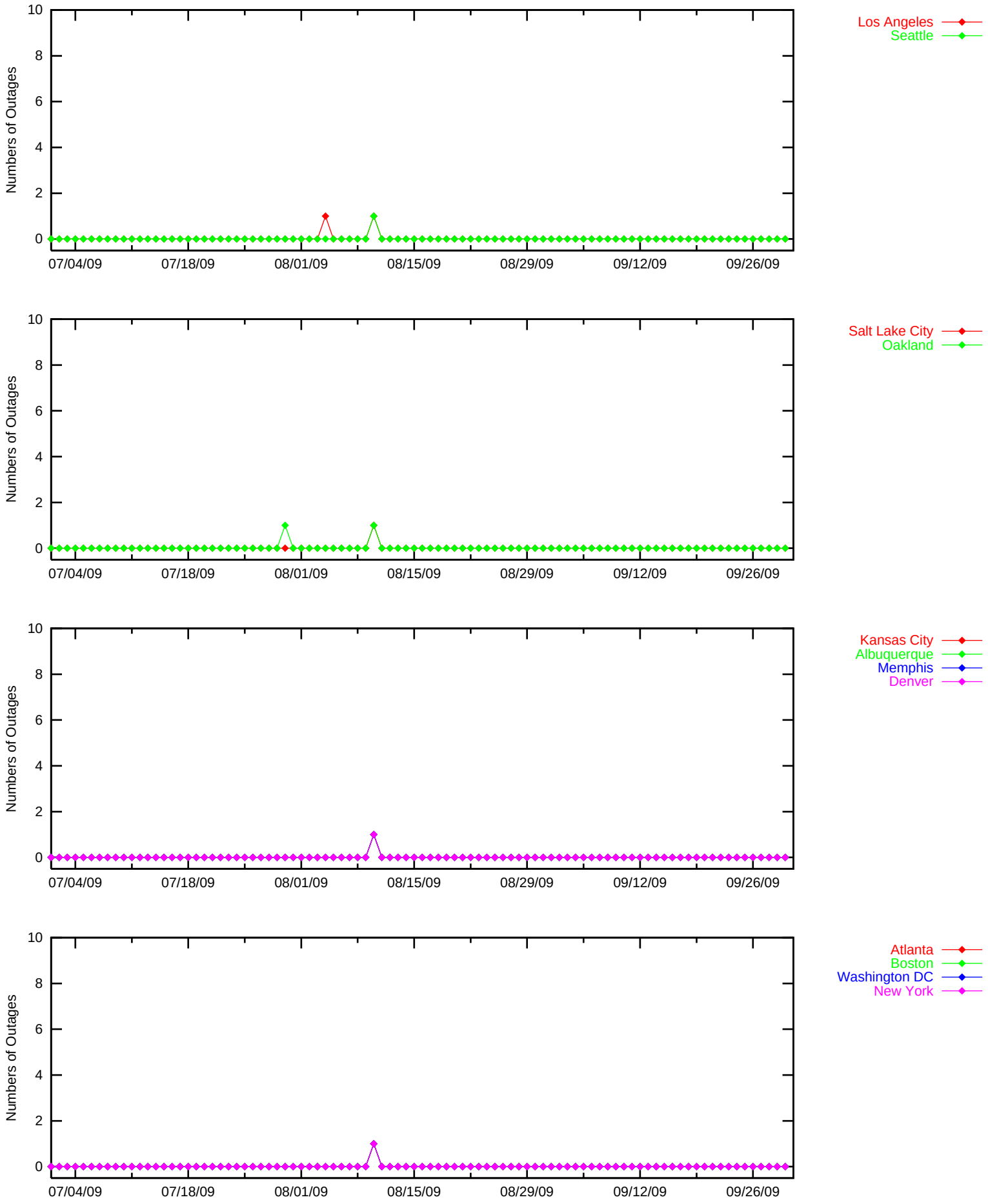


# Figure 3-6 LPV 200 Instantaneous Availability (HAL = 40m & VAL=35m)



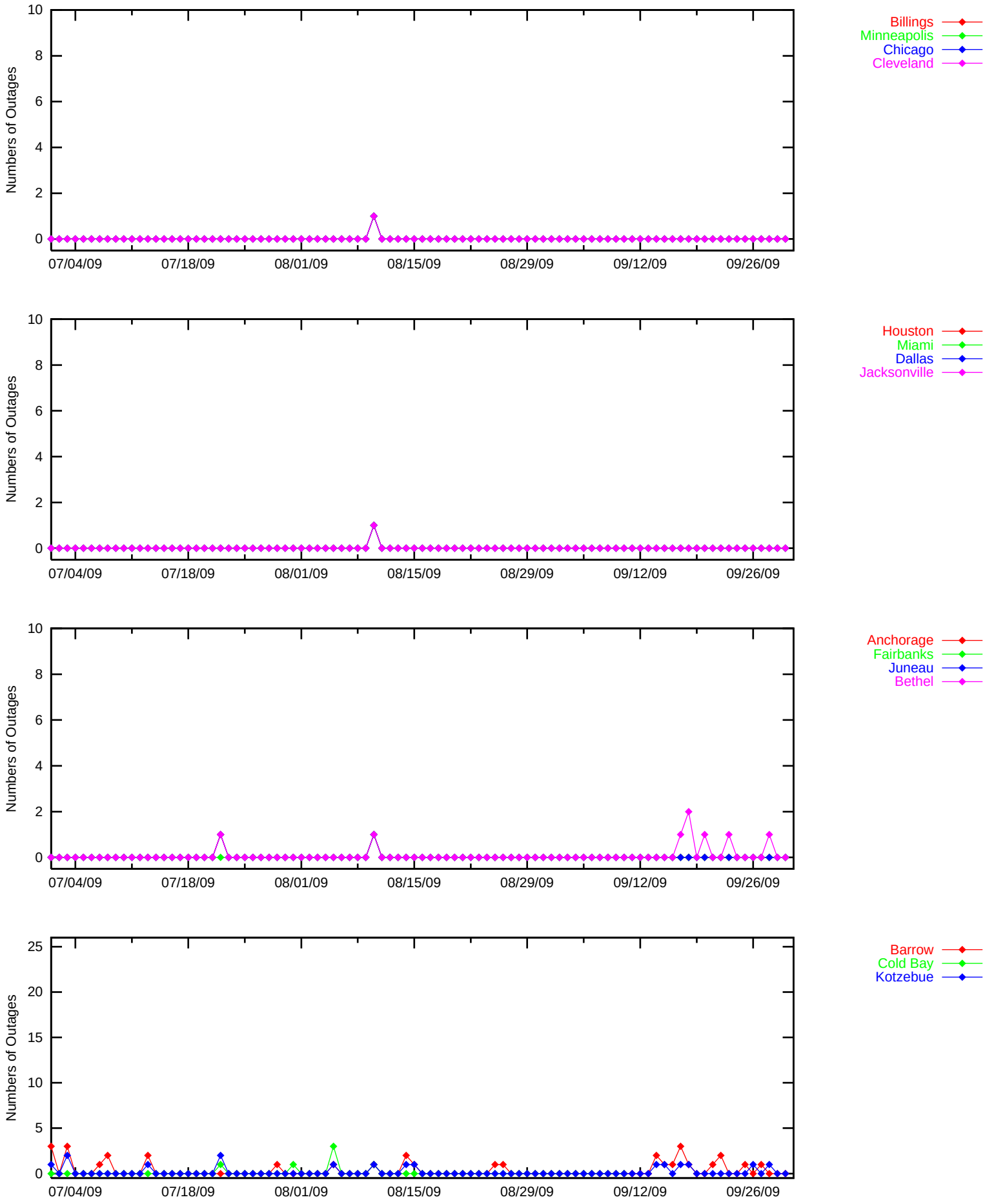
# Figure 3-7 LPV Outages (HAL = 40m & VAL=50m)





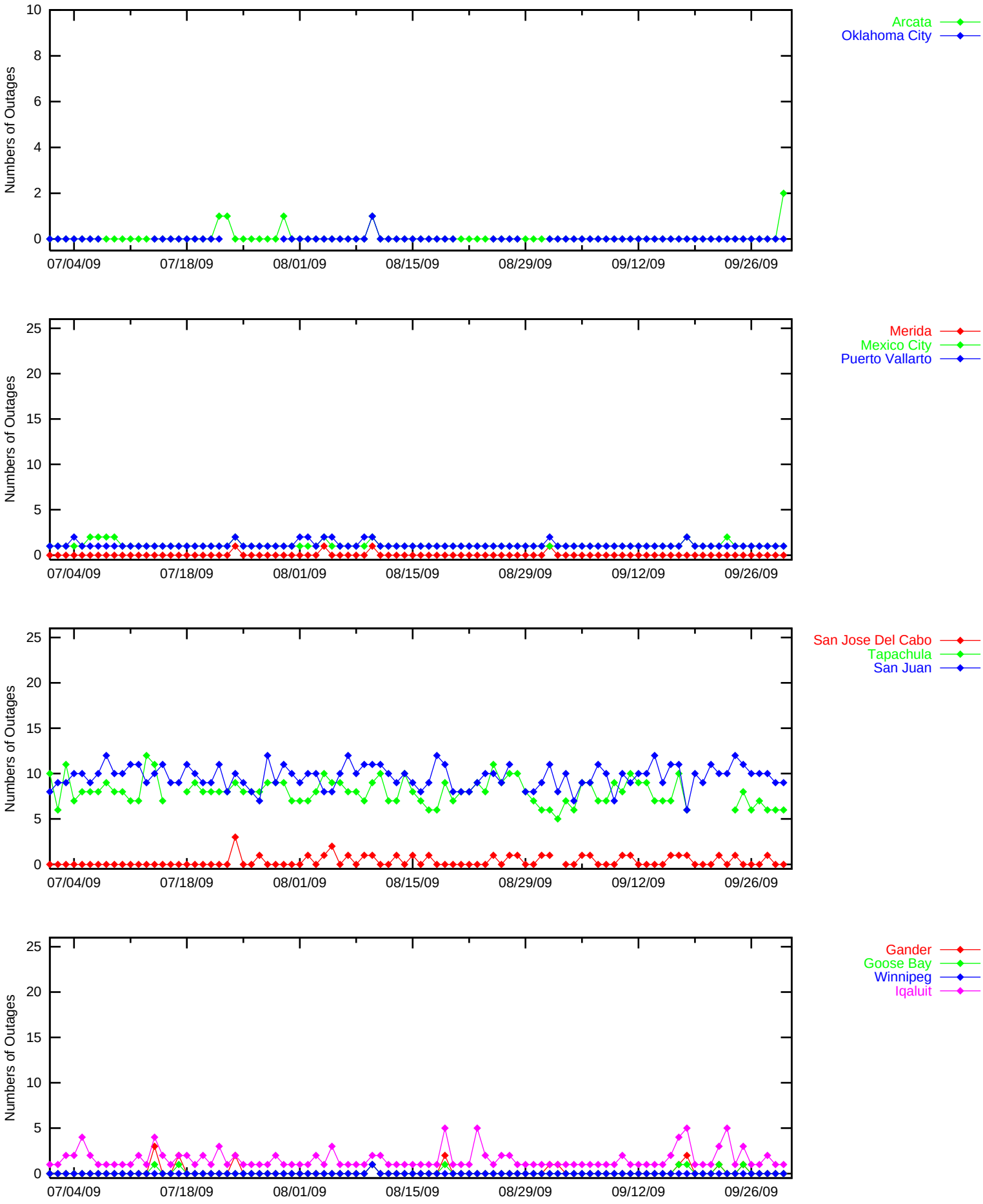
# Figure 3-8 LPV Outages (HAL = 40m & VAL=50m)





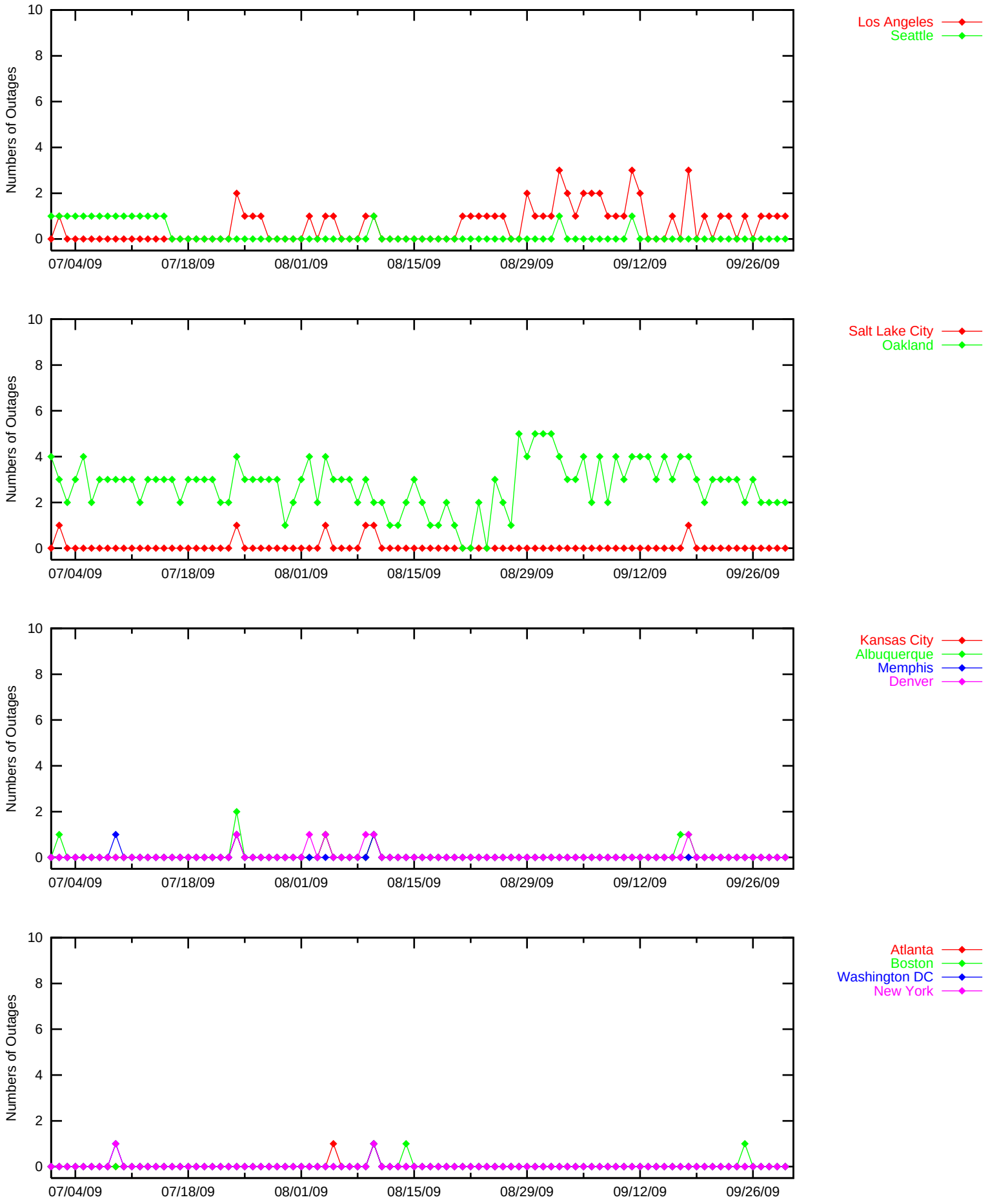
# Figure 3-9 LPV Outages (HAL = 40m & VAL=50m)





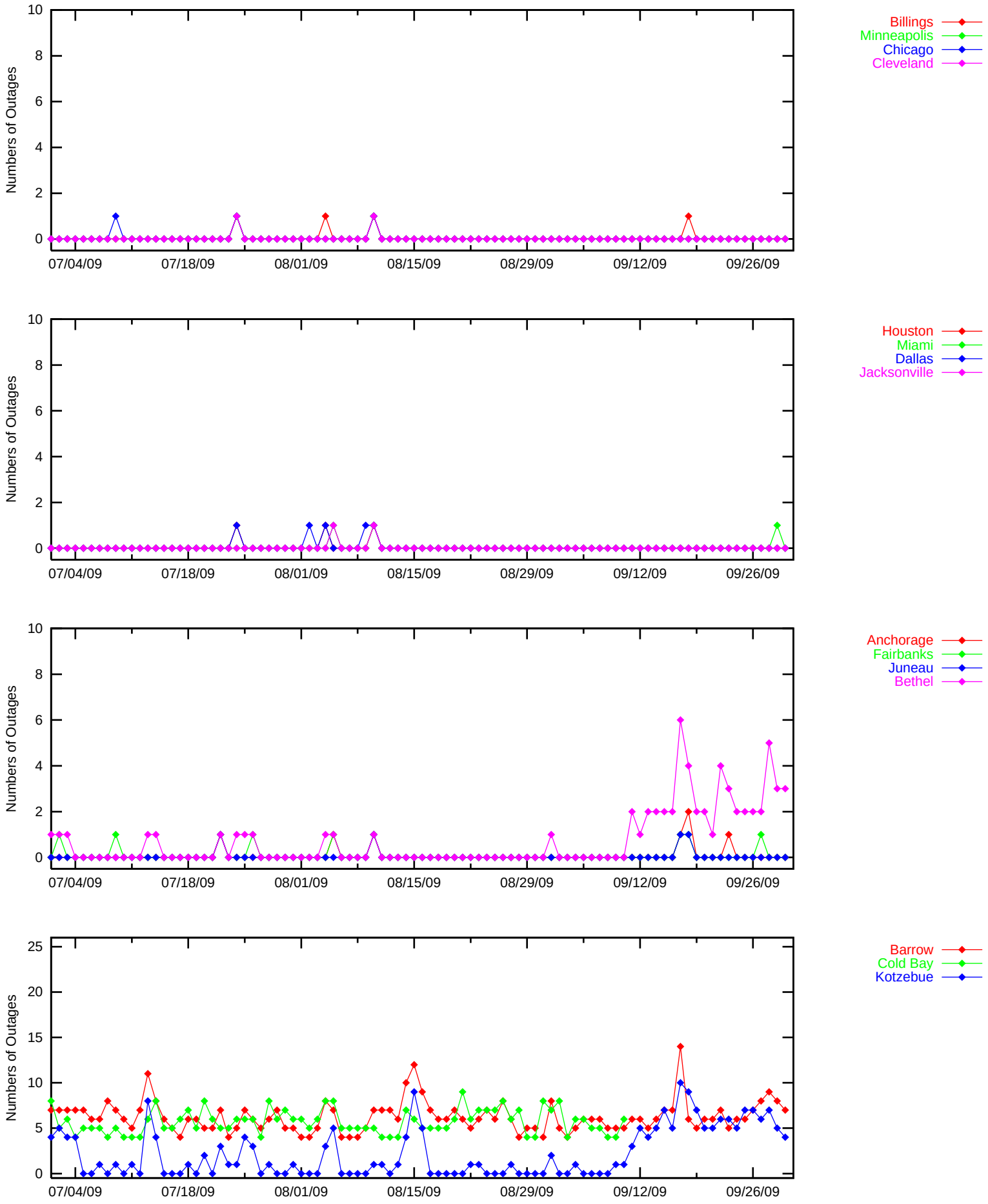
# Figure 3-10 LPV 200 Outages (HAL = 40m & VAL=35m)





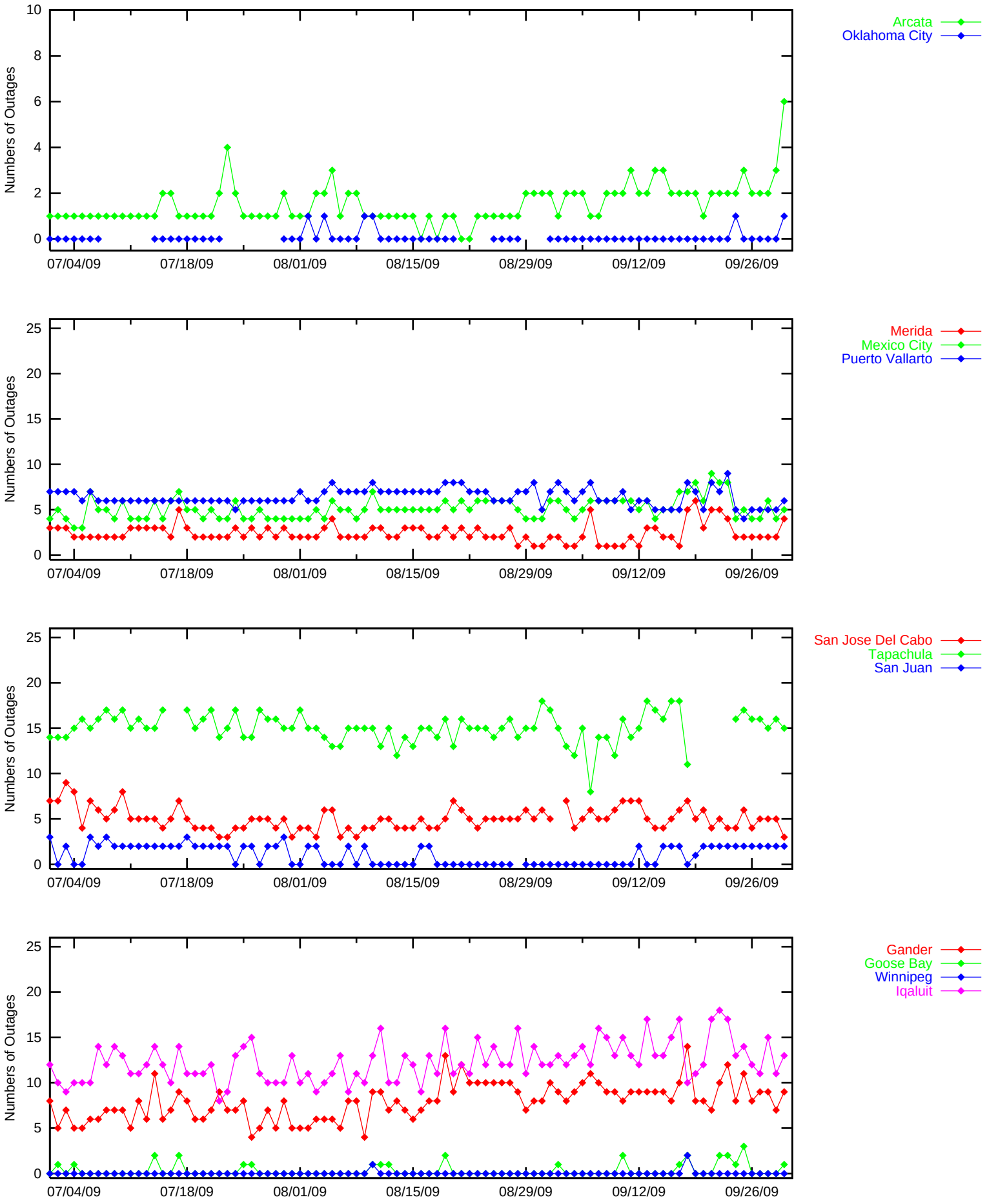
# Figure 3-11 LPV 200 Outages (HAL = 40m & VAL=35m)





# 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.

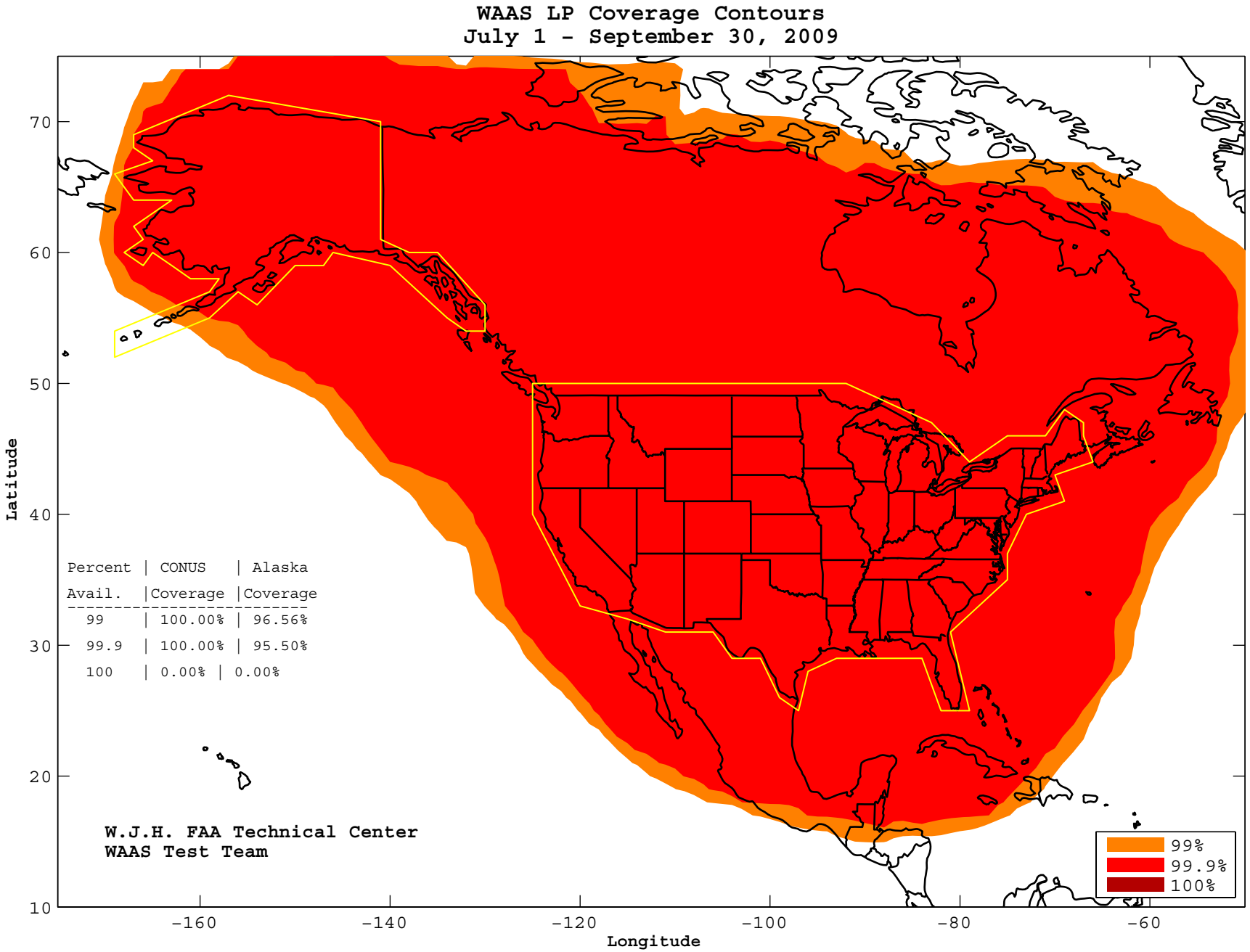
Daily analysis for PA was conducted for LP, LPV and LPV 200 service levels. LP service is available when HPL is less than 40 meters. LPV service is available when HPL is less than 40 metes and VPL is less than 50 meters. LPV 200 service is available when HPL is less than 40 metes and VPL is less than 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 to Table 1.4 for events that affected coverage. CRW GEO C&V faulted on 8/10/09 caused a WAAS service outage (see DR#82). Low CONUS LPV and LPV200 coverage on 7/24/09, 9/2/09, 9/11/09 and 9/18/09 are due to satellite outages, PRN 21, PRN 26, PRN 31, and PRN 23, respectively. Low Alaska LPV and LPV200 coverage on 7/26/09, 8/5/09, 9/11/09 and 9/18/09 are due to satellite outages, PRN 18, PRN 30, PRN 31, and PRN 23, respectively. A drop in Alaska LPV coverage on 7/22/09 is due to scintillation observed at Fairbank and Iqaluit. Low Alaska coverage on 8/14/09 and 8/15/09 are due to manual GUS switchovers. Low Alaska coverage on 8/16/09 is due to low CRW GEO ranging availability (see DR#83). Low Alaska coverage from 9/12/09 to the end of the quarter is due to Cold Bay out of service. Low Alaska coverage on 9/17/09 is due to low PA GEO ranging availability (see DR#84). A significant drop in Alaska LPV200 coverage on 9/18/09 is due to a combination of Cold Bay outage and PRN 23 outage (see DR#85).

# Figure 4-1 LP North America Coverage for the Quarater





## Figure 4-2 LPV North America Coverage for the Quarter



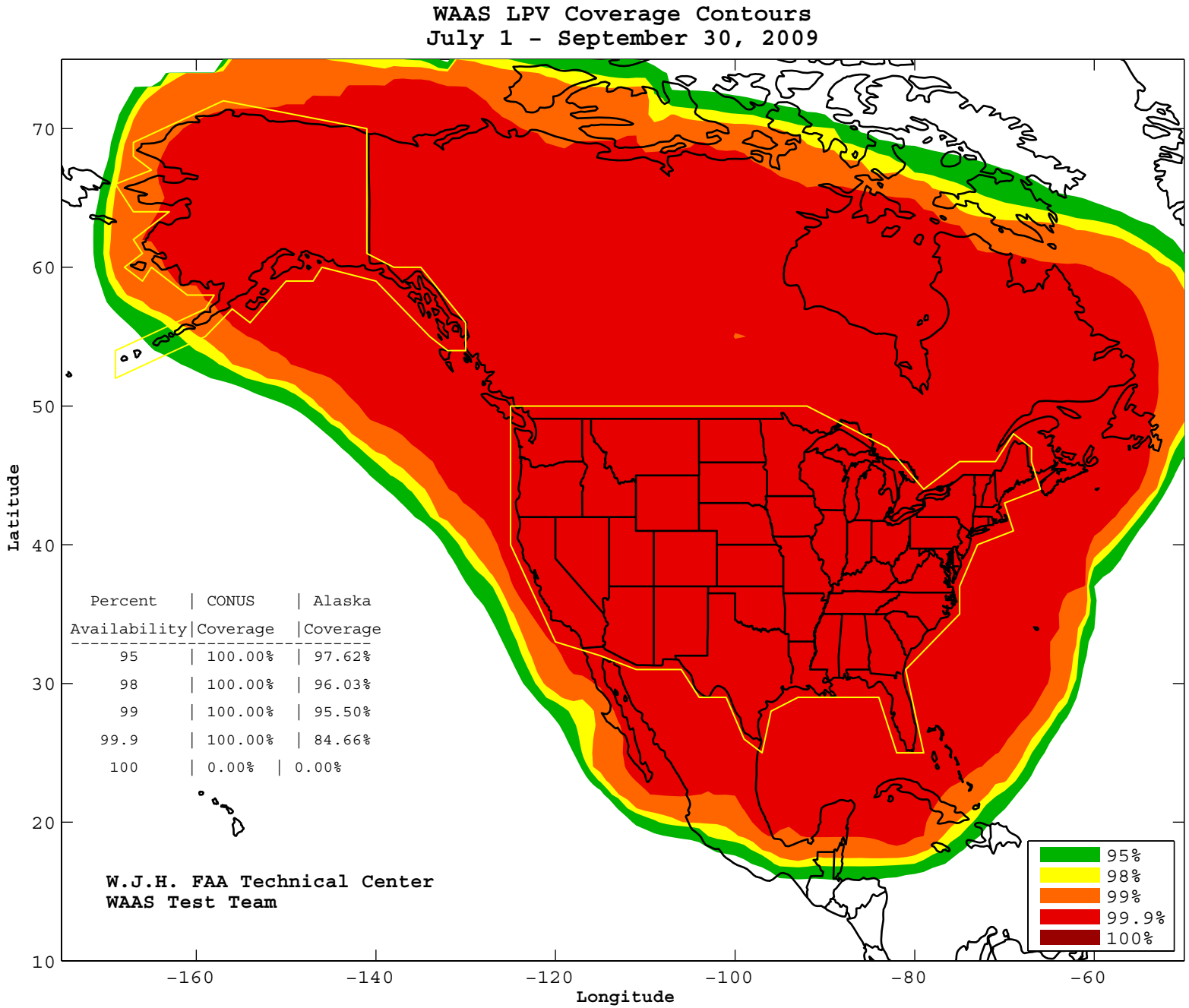


**Figure 4-3 LPV 200 North America Coverage for the Quarter**



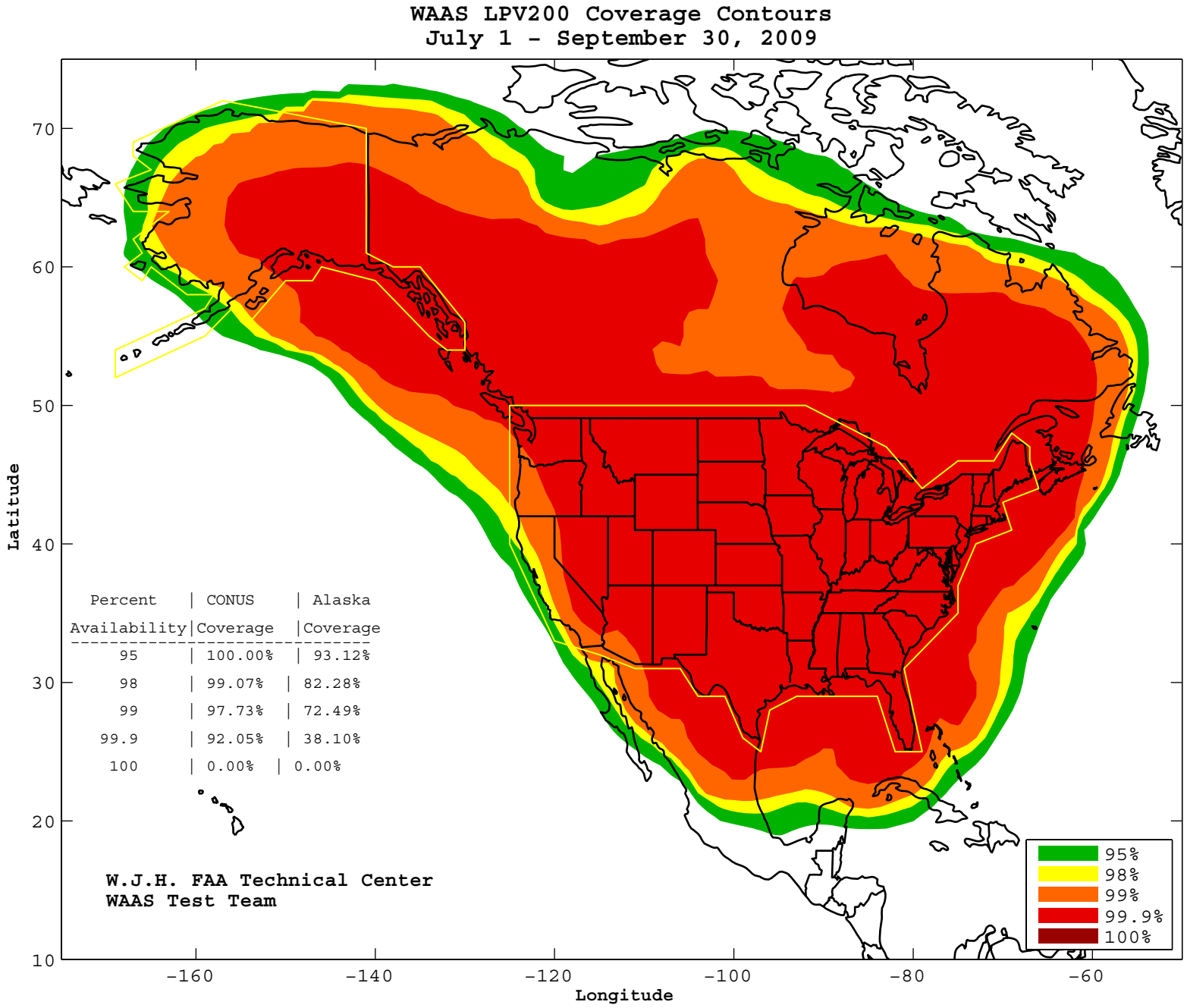
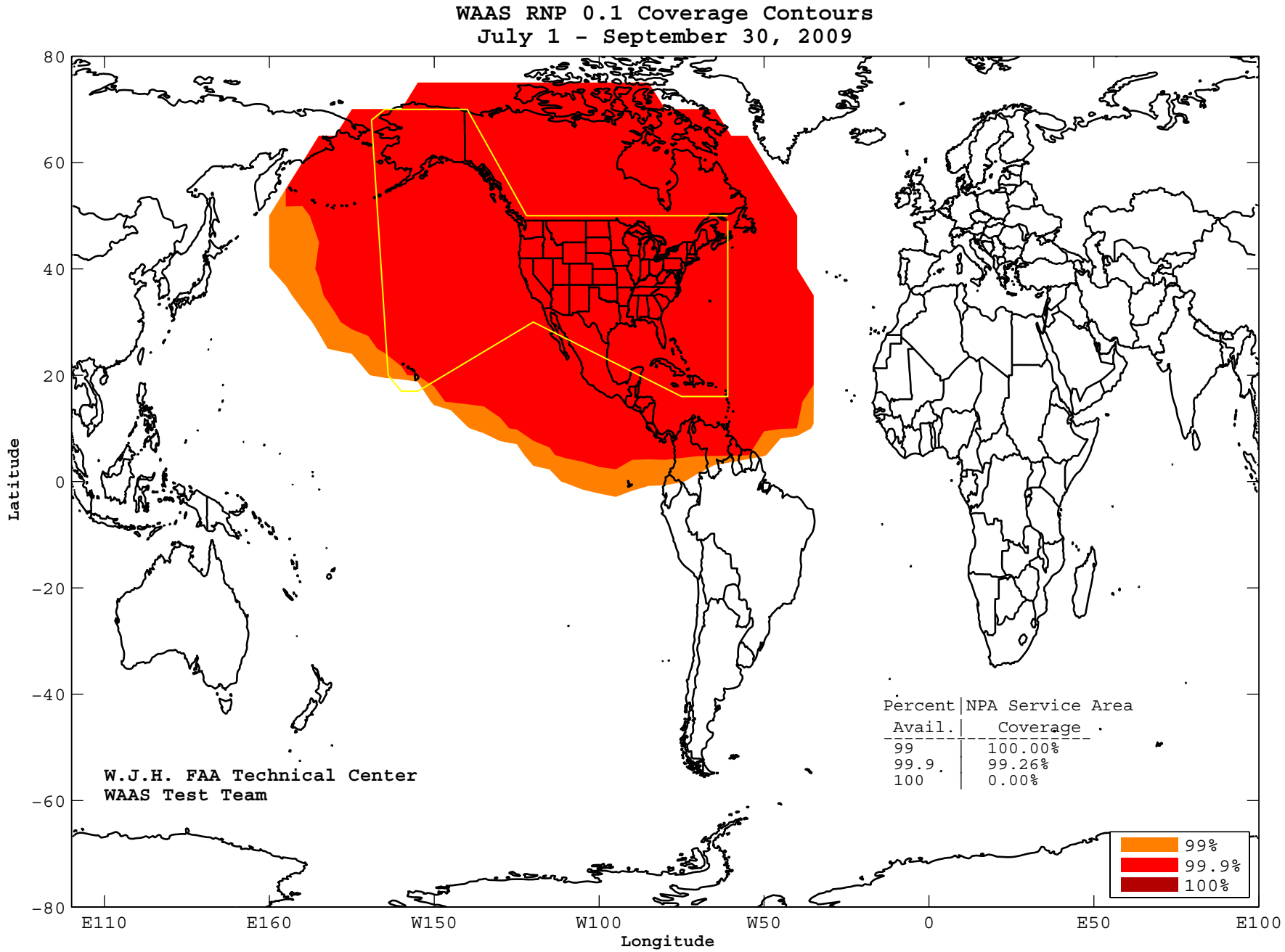


**Figure 4-4 RNP 0.1 World Coverage for the Quarter**





## Figure 4-5 RNP 0.3 World Coverage for the Quarter



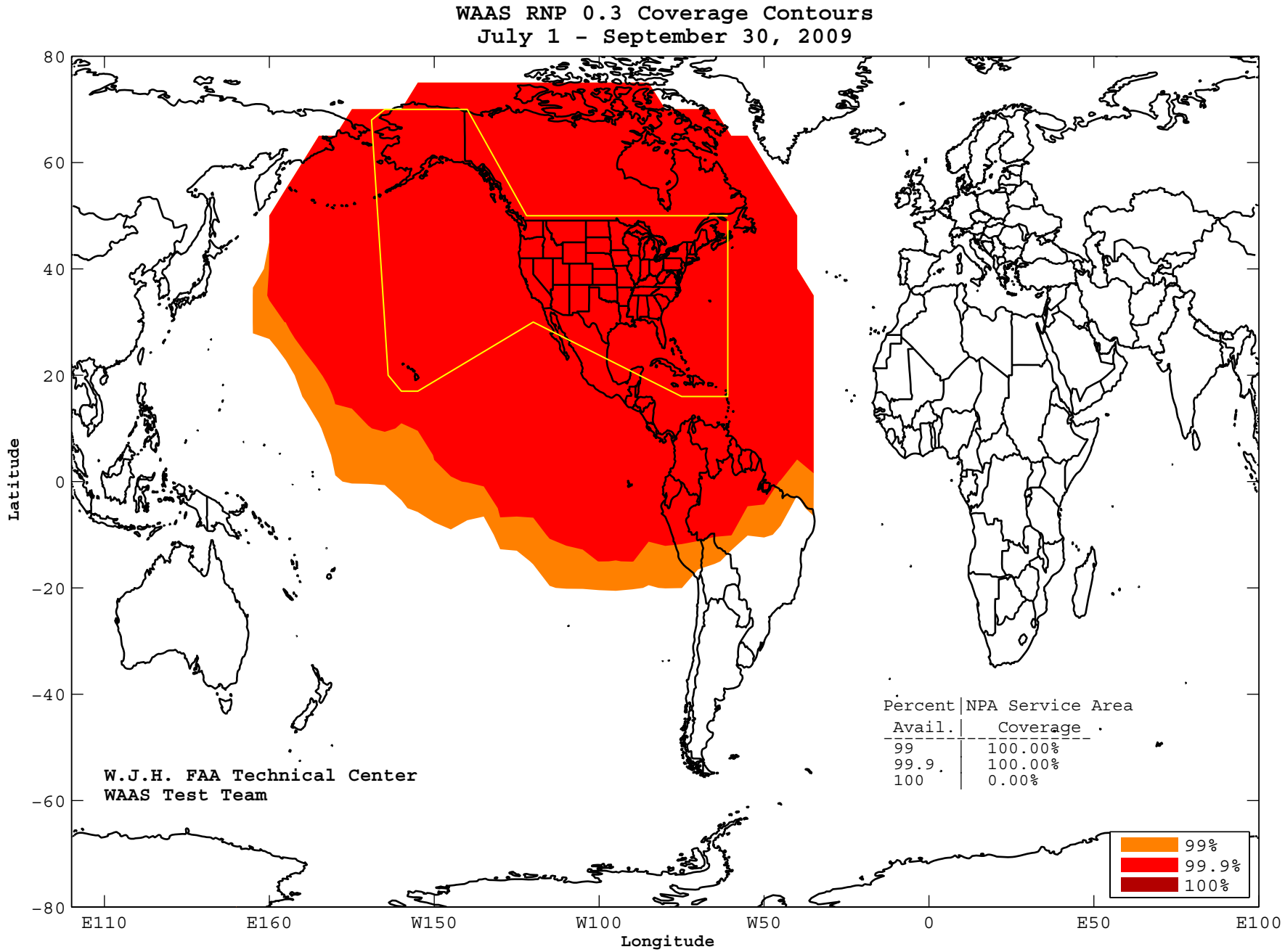


**Figure 4-6 Daily LPV and LPV 200 CONUS Coverage**

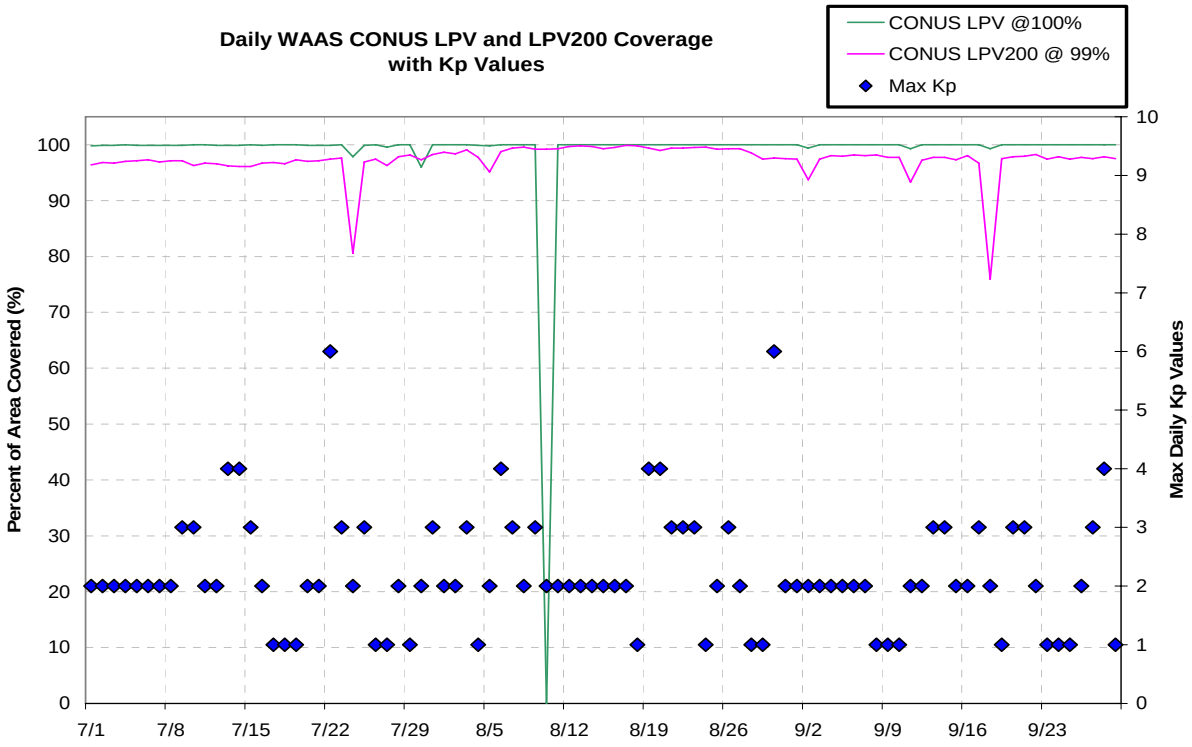



**Figure 4-7 Daily LPV Alaska Coverage**

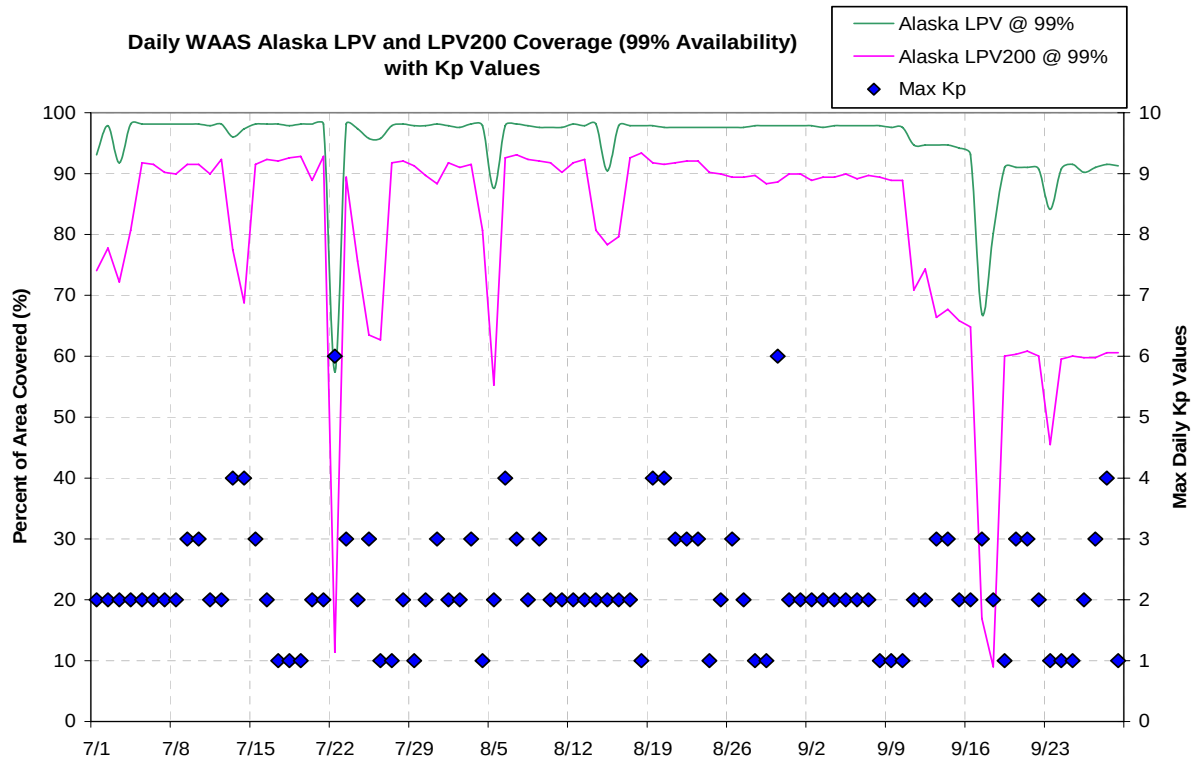
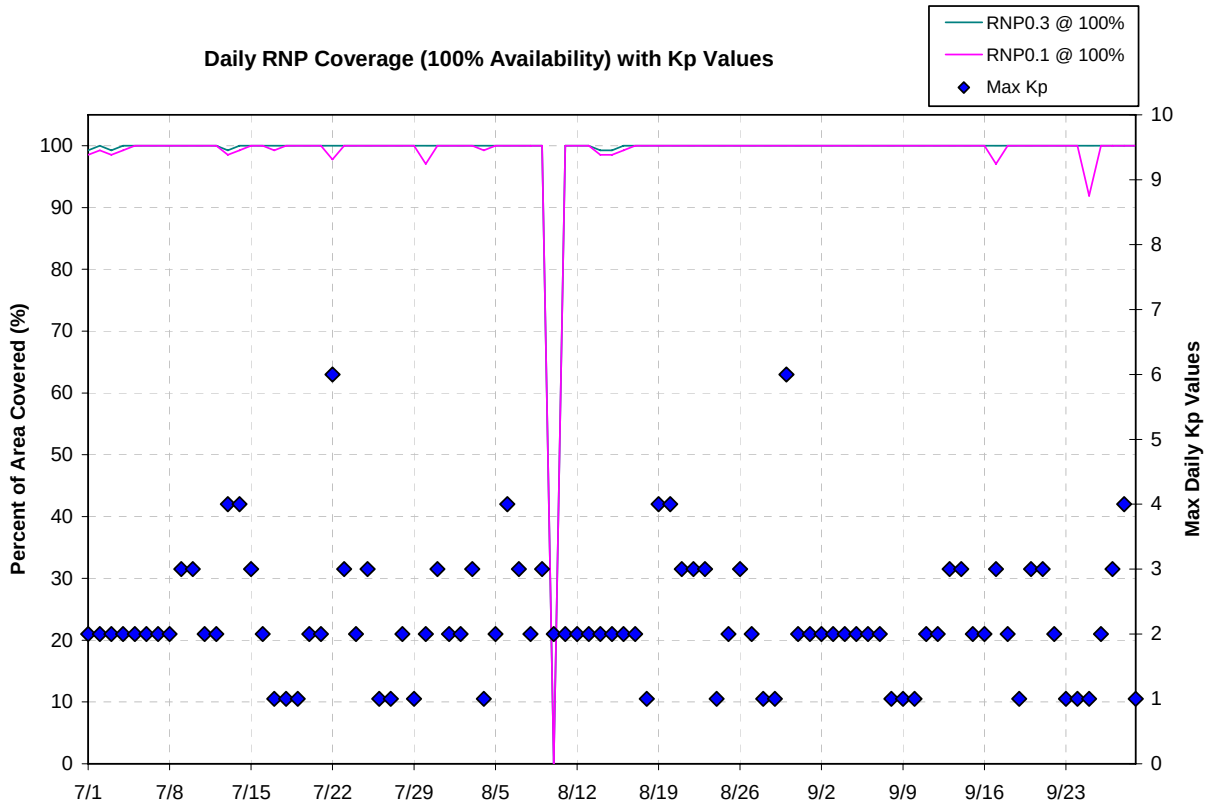


**Figure 4-8 Daily RNP Coverage**




## 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 3.51 at Iqaluit. 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 | 7.25 | 4.56 | 0 |
| Oklahoma City | 7.17 | 9.42 | 0 |
| Albuquerque | 6.30 | 4.43 | 0 |
| Anchorage | 13.81 | 6.17 | 0 |
| Atlanta | 13.50 | 7.37 | 0 |
| Barrow | 10.56 | 5.74 | 0 |
| Bethel | 9.43 | 10.53 | 0 |
| Billings | 9.70 | 5.29 | 0 |
| Boston | 15.32 | 6.58 | 0 |
| Chicago | 9.68 | 6.50 | 0 |
| Cleveland | 4.78 | 4.37 | 0 |
| Cold Bay | 10.91 | 10.35 | 0 |
| Dallas | 13.42 | 11.20 | 0 |
| Denver | 13.96 | 6.44 | 0 |
| Fairbanks | 10.73 | 12.01 | 0 |
| Gander | 10.42 | 14.79 | 0 |
| Goose Bay | 7.51 | 8.28 | 0 |
| Houston | 5.75 | 7.82 | 0 |
| Iqaluit | 3.51 | 4.32 | 0 |
| Jacksonville | 17.37 | 7.29 | 0 |
| Juneau | 19.02 | 6.52 | 0 |
| Kansas City | 8.94 | 7.99 | 0 |
| Kotzebue | 10.84 | 6.65 | 0 |
| Los Angeles | 6.84 | 7.99 | 0 |
| Memphis | 3.87 | 5.13 | 0 |
| Merida | 7.02 | 7.74 | 0 |
| Mexico City | 17.98 | 16.92 | 0 |
| Miami | 6.48 | 6.59 | 0 |
| Minneapolis | 5.36 | 4.95 | 0 |
| New York | 8.20 | 7.89 | 0 |
| Oakland | 5.38 | 8.15 | 0 |
| Puerto Vallarta | 10.95 | 8.89 | 0 |
| Salt Lake City | 10.01 | 5.18 | 0 |
| San Jose Del Cabo | 10.14 | 7.16 | 0 |
| San Juan | 12.31 | 8.76 | 0 |
| Seattle | 5.02 | 5.17 | 0 |
| Tapachula | 11.68 | 8.43 | 0 |
| Washington DC | 13.38 | 7.17 | 0 |
| Winnipeg | 7.73 | 6.20 | 0 |

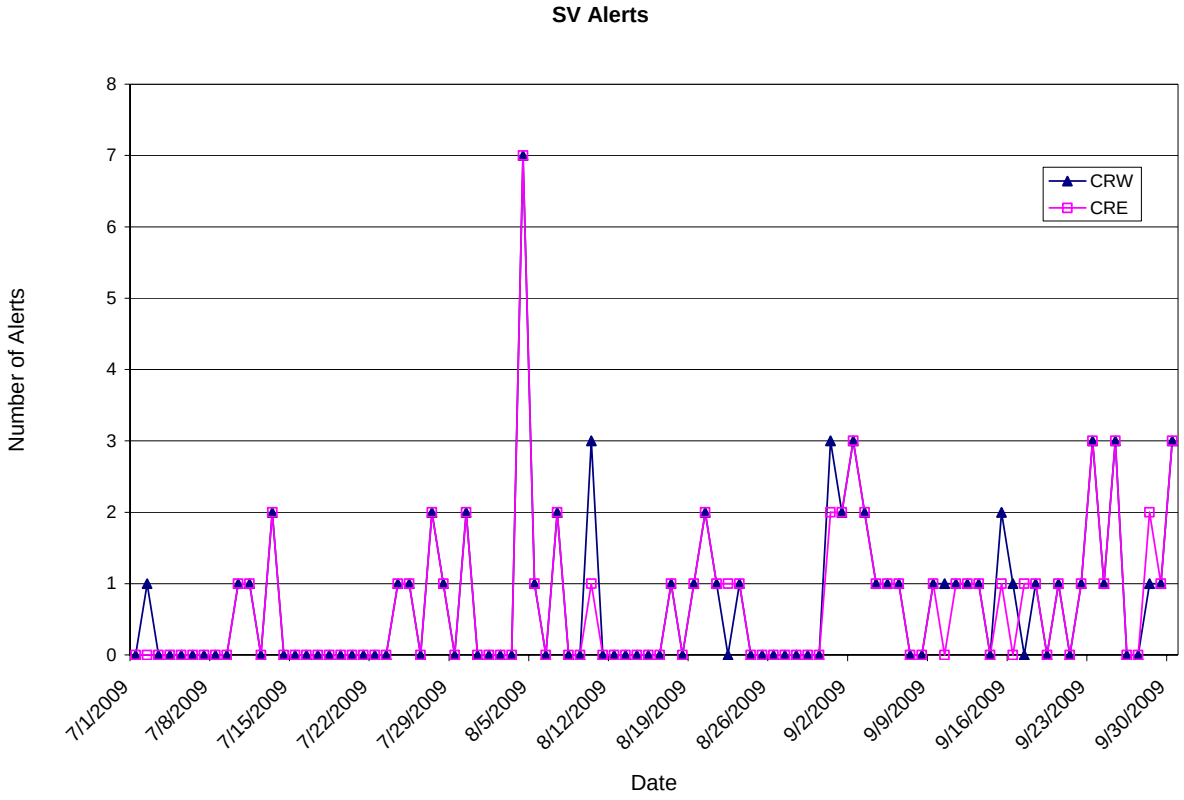
## 5.2 Broadcast Alerts

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

**Table 5-2 WAAS SV Alert**

| | Number of Alerts | | Average Alerts Per Day | |
|---|---|---|---|---|
| **Message Type** | **CRW** | **CRE** | **CRW** | **CRE** |
| T2 | 15 | 0 | 0.1648 | 0 |
| T3 | 40 | 12 | 0.4396 | 0.1319 |
| T4 | 12 | 41 | 0.1319 | 0.4505 |
| T5 | 0 | 10 | 0 | 0.1099 |
| T6 | 0 | 0 | 0 | 0 |
| T24 | 0 | 0 | 0 | 0 |
| T26 | 0 | 0 | 0 | 0 |
| **Total Alerts** | 67 | 63 | 0.7363 | 0.6923 |

**Figure 5-1 SV Daily Alert Trends**




## 5.3 Availability of WAAS Messages (CRE and CRW)

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

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

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

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

**Table 5-3 Update Rates for WAAS Messages**

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

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

| **Message Type** | **On Time** | **Late** | **Max Late Length (seconds)** |
|---|---|---|---|
| 1 | 107680 | 2 | 134 |
| 2 | 1324762 | 47 | 29 |
| 3 | 1324866 | 27 | 26 |
| 4 | 1324755 | 51 | 26 |
| 7 | 99899 | 4 | 133 |
| 9 | 93146 | 0 | 0 |
| 10 | 99805 | 10 | 160 |
| 17 | 31650 | 4 | 527 |

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

| PRN | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 2 | 48300 | 0 | 0 |
| 3 | 51405 | 0 | 0 |
| 4 | 49071 | 0 | 0 |
| 5 | 17613 | 0 | 0 |
| 6 | 52180 | 1 | 180 |
| 7 | 48672 | 1 | 180 |
| 8 | 47987 | 0 | 0 |
| 9 | 50530 | 0 | 0 |
| 10 | 48769 | 1 | 170 |
| 11 | 52904 | 0 | 0 |
| 12 | 49787 | 0 | 0 |
| 13 | 48355 | 0 | 0 |
| 14 | 48904 | 0 | 0 |
| 15 | 51560 | 0 | 0 |
| 16 | 49397 | 1 | 169 |
| 17 | 48523 | 0 | 0 |
| 18 | 47419 | 0 | 0 |
| 19 | 51619 | 0 | 0 |
| 20 | 50825 | 0 | 0 |
| 21 | 47881 | 0 | 0 |
| 22 | 49096 | 0 | 0 |
| 23 | 47457 | 0 | 0 |
| 24 | 38786 | 0 | 0 |
| 25 | 36424 | 0 | 0 |
| 26 | 47835 | 0 | 0 |
| 27 | 53160 | 0 | 0 |
| 28 | 49423 | 0 | 0 |
| 29 | 48454 | 0 | 0 |
| 30 | 51160 | 0 | 0 |
| 31 | 49320 | 2 | 178 |
| 32 | 49149 | 0 | 0 |

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

| PRN | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 2 | 39641 | 0 | 0 |
| 3 | 42209 | 0 | 0 |
| 4 | 40284 | 2 | 211 |
| 5 | 14468 | 0 | 0 |
| 6 | 42867 | 0 | 0 |
| 7 | 39973 | 1 | 149 |
| 8 | 39403 | 0 | 0 |
| 9 | 41496 | 0 | 0 |
| 10 | 40034 | 0 | 0 |
| 11 | 43422 | 2 | 125 |
| 12 | 40899 | 0 | 0 |
| 13 | 39773 | 0 | 0 |
| 14 | 40179 | 0 | 0 |
| 15 | 42293 | 1 | 135 |
| 16 | 40560 | 1 | 122 |
| 17 | 39862 | 1 | 172 |
| 18 | 38927 | 1 | 135 |
| 19 | 42365 | 1 | 172 |
| 20 | 41744 | 0 | 0 |
| 21 | 39348 | 0 | 0 |
| 22 | 40366 | 2 | 125 |
| 23 | 38950 | 1 | 122 |
| 24 | 31864 | 0 | 0 |
| 25 | 29929 | 0 | 0 |
| 26 | 39254 | 1 | 143 |
| 27 | 43677 | 2 | 144 |
| 28 | 40557 | 2 | 125 |
| 29 | 39875 | 0 | 0 |
| 30 | 42053 | 0 | 0 |
| 31 | 40442 | 1 | 211 |
| 32 | 40341 | 0 | 0 |
| 135 | 76256 | 2 | 153 |
| 138 | 76143 | 2 | 153 |

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

| Band | Block | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|---|
| 0 | 0 | 27602 | 3 | 360 |
| 0 | 1 | 27590 | 3 | 350 |
| 0 | 2 | 27589 | 8 | 306 |
| 1 | 0 | 27608 | 5 | 304 |
| 1 | 1 | 27591 | 6 | 315 |
| 1 | 2 | 27606 | 4 | 306 |
| 1 | 3 | 27599 | 3 | 307 |
| 1 | 4 | 27588 | 7 | 533 |
| 2 | 0 | 27584 | 7 | 544 |
| 2 | 1 | 27603 | 5 | 531 |
| 2 | 2 | 27591 | 5 | 539 |
| 2 | 3 | 27595 | 5 | 513 |
| 2 | 4 | 27593 | 7 | 502 |
| 2 | 5 | 27593 | 4 | 320 |
| 3 | 0 | 27604 | 5 | 463 |
| 3 | 1 | 27598 | 4 | 472 |
| 3 | 2 | 27589 | 4 | 444 |
| 9 | 0 | 27592 | 5 | 448 |
| 9 | 1 | 27597 | 8 | 463 |
| 9 | 2 | 27587 | 10 | 460 |
| 9 | 3 | 27598 | 4 | 472 |
| 9 | 4 | 27585 | 6 | 577 |
| 9 | 5 | 27595 | 5 | 474 |
| 9 | 6 | 27593 | 4 | 306 |

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

| Band | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 0 | 36077 | 2 | 475 |
| 1 | 36049 | 1 | 358 |
| 2 | 36084 | 1 | 371 |
| 3 | 36083 | 1 | 327 |
| 9 | 36071 | 2 | 354 |

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

| Message Type | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 0 | 42 | 4 | 470519 |
| 1 | 105713 | 3 | 182 |
| 2 | 1324740 | 50 | 35 |
| 3 | 1324871 | 22 | 29 |
| 4 | 1324745 | 49 | 26 |
| 7 | 98090 | 4 | 127 |
| 9 | 93146 | 0 | 0 |
| 10 | 98099 | 5 | 174 |
| 17 | 31500 | 1 | 405 |

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

| PRN | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 2 | 48294 | 0 | 0 |
| 3 | 51404 | 0 | 0 |
| 4 | 49068 | 1 | 175 |
| 5 | 17617 | 0 | 0 |
| 6 | 52181 | 0 | 0 |
| 7 | 48670 | 1 | 174 |
| 8 | 47998 | 1 | 180 |
| 9 | 50522 | 2 | 180 |
| 10 | 48778 | 0 | 0 |
| 11 | 52907 | 2 | 171 |
| 12 | 49790 | 0 | 0 |
| 13 | 48361 | 0 | 0 |
| 14 | 48902 | 0 | 0 |
| 15 | 51546 | 1 | 166 |
| 16 | 49395 | 0 | 0 |
| 17 | 48518 | 0 | 0 |
| 18 | 47427 | 0 | 0 |
| 19 | 51609 | 1 | 175 |
| 20 | 50834 | 1 | 182 |
| 21 | 47879 | 0 | 0 |
| 22 | 49079 | 1 | 174 |
| 23 | 47458 | 0 | 0 |
| 24 | 38790 | 0 | 0 |
| 25 | 36424 | 0 | 0 |
| 26 | 47838 | 1 | 167 |
| 27 | 53151 | 0 | 0 |
| 28 | 49404 | 1 | 167 |
| 29 | 48460 | 0 | 0 |
| 30 | 51163 | 0 | 0 |
| 31 | 49309 | 0 | 0 |
| 32 | 49152 | 0 | 0 |

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

| PRN | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 2 | 39633 | 0 | 0 |
| 3 | 42212 | 0 | 0 |
| 4 | 40281 | 1 | 204 |
| 5 | 14463 | 0 | 0 |
| 6 | 42861 | 3 | 162 |
| 7 | 39968 | 1 | 210 |
| 8 | 39400 | 0 | 0 |
| 9 | 41530 | 2 | 210 |
| 10 | 40032 | 0 | 0 |
| 11 | 43407 | 0 | 0 |
| 12 | 40882 | 1 | 127 |
| 13 | 39779 | 1 | 126 |
| 14 | 40190 | 0 | 0 |
| 15 | 42294 | 1 | 204 |
| 16 | 40563 | 0 | 0 |
| 17 | 39883 | 0 | 0 |
| 18 | 38928 | 0 | 0 |
| 19 | 42376 | 2 | 216 |
| 20 | 41735 | 0 | 0 |
| 21 | 39337 | 3 | 192 |
| 22 | 40350 | 3 | 169 |
| 23 | 38957 | 0 | 0 |
| 24 | 31875 | 1 | 126 |
| 25 | 29935 | 2 | 162 |
| 26 | 39252 | 0 | 0 |
| 27 | 43701 | 0 | 0 |
| 28 | 40540 | 0 | 0 |
| 29 | 39880 | 0 | 0 |
| 30 | 42051 | 0 | 0 |
| 31 | 40434 | 0 | 0 |
| 32 | 40335 | 1 | 125 |
| 135 | 68197 | 0 | 0 |
| 138 | 76156 | 0 | 0 |

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

| Band | Block | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|---|
| 0 | 0 | 27591 | 9 | 576 |
| 0 | 1 | 27602 | 7 | 394 |
| 0 | 2 | 27588 | 8 | 580 |
| 1 | 0 | 27597 | 11 | 576 |
| 1 | 1 | 27589 | 8 | 576 |
| 1 | 2 | 27588 | 10 | 358 |
| 1 | 3 | 27601 | 5 | 360 |
| 1 | 4 | 27589 | 5 | 338 |
| 2 | 0 | 27591 | 7 | 349 |
| 2 | 1 | 27604 | 6 | 355 |
| 2 | 2 | 27594 | 4 | 334 |
| 2 | 3 | 27592 | 3 | 327 |
| 2 | 4 | 27592 | 6 | 324 |
| 2 | 5 | 27590 | 6 | 579 |
| 3 | 0 | 27601 | 8 | 576 |
| 3 | 1 | 27585 | 8 | 579 |
| 3 | 2 | 27595 | 3 | 389 |
| 9 | 0 | 27606 | 7 | 378 |
| 9 | 1 | 27589 | 4 | 372 |
| 9 | 2 | 27604 | 8 | 576 |
| 9 | 3 | 27592 | 5 | 369 |
| 9 | 4 | 27585 | 8 | 375 |
| 9 | 5 | 27597 | 3 | 370 |
| 9 | 6 | 27594 | 4 | 396 |

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

| Band | On Time | Late | Max Late Length (seconds) |
|---|---|---|---|
| 1 | 35812 | 1 | 328 |
| 2 | 35860 | 0 | 0 |
| 3 | 35789 | 1 | 451 |
| 9 | 35805 | 1 | 324 |

## 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRN ↓ | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) |
| 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 1.372 | 100 | 1.359 | 100 | 1.144 | 100 | 1.308 | 100 | 3.025 | 100 | 1.644 | 100 |
| 3 | 0.896 | 100 | 1.438 | 100 | 1.163 | 100 | 1.346 | 100 | 1.617 | 100 | 1.454 | 100 |
| 4 | 1.657 | 100 | 1.716 | 100 | 1.737 | 100 | 1.578 | 100 | 1.814 | 100 | 1.817 | 100 |
| 5 | 1.497 | 100 | 1.614 | 100 | 1.943 | 100 | 1.800 | 100 | 1.723 | 100 | 1.656 | 100 |
| 6 | 1.590 | 100 | 1.520 | 100 | 1.255 | 100 | 1.505 | 100 | 1.810 | 100 | 1.519 | 100 |
| 7 | 1.353 | 100 | 1.526 | 100 | 1.367 | 100 | 1.141 | 100 | 1.257 | 100 | 1.423 | 100 |
| 8 | 1.230 | 100 | 1.219 | 100 | 1.155 | 100 | 0.924 | 100 | 1.120 | 100 | 1.176 | 100 |
| 9 | 1.079 | 100 | 1.304 | 100 | 1.309 | 100 | 1.133 | 100 | 1.365 | 100 | 1.164 | 100 |
| 10 | 1.067 | 100 | 1.485 | 100 | 1.210 | 100 | 0.890 | 100 | 0.872 | 100 | 1.315 | 100 |
| 11 | 0.823 | 100 | 0.874 | 100 | 1.061 | 100 | 1.207 | 100 | 0.963 | 100 | 0.806 | 100 |
| 12 | 1.008 | 100 | 1.258 | 100 | 1.498 | 100 | 1.253 | 100 | 1.358 | 100 | 1.737 | 100 |
| 13 | 1.076 | 100 | 1.419 | 100 | 1.208 | 100 | 1.054 | 100 | 1.763 | 100 | 1.655 | 100 |
| 14 | 0.953 | 100 | 1.098 | 100 | 1.123 | 100 | 1.032 | 100 | 2.015 | 100 | 0.971 | 100 |
| 15 | 1.125 | 100 | 1.353 | 100 | 1.928 | 100 | 1.706 | 100 | 1.712 | 100 | 1.751 | 100 |
| 16 | 1.012 | 100 | 0.886 | 100 | 0.979 | 100 | 0.992 | 100 | 1.460 | 100 | 1.069 | 100 |
| 17 | 2.215 | 100 | 1.423 | 100 | 1.547 | 100 | 1.084 | 100 | 1.373 | 100 | 1.037 | 100 |
| 18 | 1.413 | 100 | 1.238 | 100 | 1.496 | 100 | 1.465 | 100 | 1.976 | 100 | 1.522 | 100 |
| 19 | 2.778 | 100 | 2.049 | 100 | 2.325 | 100 | 2.126 | 100 | 2.718 | 100 | 2.017 | 100 |
| 20 | 1.107 | 100 | 1.345 | 100 | 1.160 | 100 | 1.034 | 100 | 1.381 | 100 | 1.752 | 100 |
| 21 | 1.084 | 100 | 1.011 | 100 | 1.309 | 100 | 0.999 | 100 | 1.214 | 100 | 0.828 | 100 |
| 22 | 0.814 | 100 | 0.930 | 100 | 1.433 | 100 | 1.058 | 100 | 1.189 | 100 | 0.907 | 100 |
| 23 | 1.632 | 100 | 1.287 | 100 | 1.654 | 100 | 1.726 | 100 | 1.756 | 100 | 1.613 | 100 |
| 24 | 1.681 | 100 | 1.531 | 100 | 1.908 | 100 | 1.399 | 100 | 1.486 | 100 | 1.702 | 100 |
| 25 | 1.166 | 100 | 1.309 | 100 | 1.514 | 100 | 1.198 | 100 | 1.307 | 100 | 1.296 | 100 |
| 26 | 2.021 | 100 | 1.708 | 100 | 1.687 | 100 | 1.764 | 100 | 1.988 | 100 | 2.073 | 100 |
| 27 | 1.308 | 100 | 1.549 | 100 | 1.506 | 100 | 1.493 | 100 | 1.484 | 100 | 1.432 | 100 |
| 28 | 0.874 | 100 | 1.035 | 100 | 0.991 | 100 | 1.027 | 100 | 1.039 | 100 | 0.899 | 100 |
| 29 | 1.626 | 100 | 1.774 | 100 | 1.442 | 100 | 1.467 | 100 | 1.324 | 100 | 1.798 | 100 |
| 30 | 1.344 | 100 | 1.458 | 100 | 1.937 | 100 | 2.229 | 100 | 2.001 | 100 | 2.200 | 100 |
| 31 | 2.331 | 100 | 1.445 | 100 | 0.969 | 100 | 1.324 | 100 | 1.463 | 100 | 1.689 | 100 |
| 32 | 1.237 | 100 | 1.170 | 100 | 1.439 | 100 | 0.921 | 100 | 1.271 | 100 | 1.723 | 100 |
| 135 | 1.903 | 100 | 2.039 | 100 | 2.914 | 100 | 1.832 | 100 | 1.582 | 100 | 1.979 | 100 |
| 138 | 1.478 | 100 | 1.702 | 100 | 1.639 | 100 | 1.362 | 100 | 1.522 | 100 | 1.619 | 100 |

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

| Site → | Los Angeles | | Salt Lake City | | Miami | | Minneapolis | | Atlanta | | Juneau | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRN ↓ | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) | 95% Range Error | 3.29 Sigma Bounding(%) |
| 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 2.349 | 100 | 1.714 | 100 | 2.275 | 100 | 1.753 | 100 | 1.762 | 100 | 1.707 | 100 |
| 3 | 0.711 | 100 | 1.226 | 100 | 1.567 | 100 | 1.549 | 100 | 1.070 | 100 | 1.389 | 100 |
| 4 | 1.325 | 100 | 1.477 | 100 | 2.177 | 100 | 1.447 | 100 | 1.456 | 100 | 1.289 | 100 |
| 5 | 0.975 | 100 | 1.627 | 100 | 1.615 | 100 | 1.968 | 100 | 1.344 | 100 | 1.491 | 100 |
| 6 | 1.228 | 100 | 1.357 | 100 | 1.524 | 100 | 1.633 | 100 | 1.151 | 100 | 1.547 | 100 |
| 7 | 0.803 | 100 | 1.203 | 100 | 2.530 | 100 | 1.378 | 100 | 1.069 | 100 | 1.266 | 100 |
| 8 | 0.842 | 100 | 1.104 | 100 | 1.025 | 100 | 1.152 | 100 | 1.147 | 100 | 0.884 | 100 |
| 9 | 1.168 | 100 | 1.501 | 100 | 1.232 | 100 | 1.668 | 100 | 1.050 | 100 | 1.171 | 100 |
| 10 | 1.037 | 100 | 1.082 | 100 | 1.080 | 100 | 1.222 | 100 | 1.427 | 100 | 0.744 | 100 |
| 11 | 1.294 | 100 | 1.190 | 100 | 1.051 | 100 | 0.898 | 100 | 1.181 | 100 | 1.291 | 100 |
| 12 | 0.974 | 100 | 0.998 | 100 | 1.231 | 100 | 1.636 | 100 | 1.181 | 100 | 1.043 | 100 |
| 13 | 0.671 | 100 | 1.201 | 100 | 1.728 | 100 | 1.187 | 100 | 1.115 | 100 | 1.032 | 100 |
| 14 | 1.265 | 100 | 0.874 | 100 | 1.244 | 100 | 0.999 | 100 | 1.082 | 100 | 0.849 | 100 |
| 15 | 0.892 | 100 | 1.064 | 100 | 1.655 | 100 | 1.423 | 100 | 1.294 | 100 | 1.346 | 100 |
| 16 | 1.507 | 100 | 1.075 | 100 | 1.030 | 100 | 0.854 | 100 | 1.591 | 100 | 0.836 | 100 |
| 17 | 1.061 | 100 | 1.412 | 100 | 1.399 | 100 | 0.903 | 100 | 1.014 | 100 | 1.121 | 100 |
| 18 | 1.997 | 100 | 1.601 | 100 | 1.324 | 100 | 1.547 | 100 | 1.523 | 100 | 1.612 | 100 |
| 19 | 2.389 | 100 | 2.146 | 100 | 2.338 | 100 | 2.058 | 100 | 2.563 | 100 | 2.482 | 100 |
| 20 | 1.428 | 100 | 1.836 | 100 | 1.607 | 100 | 1.048 | 100 | 1.457 | 100 | 0.968 | 100 |
| 21 | 1.988 | 100 | 0.883 | 100 | 2.280 | 100 | 0.888 | 100 | 1.349 | 100 | 0.964 | 100 |
| 22 | 1.880 | 100 | 1.428 | 100 | 2.042 | 100 | 1.045 | 100 | 1.270 | 100 | 1.245 | 100 |
| 23 | 1.924 | 100 | 1.535 | 100 | 1.726 | 100 | 1.495 | 100 | 2.170 | 100 | 1.654 | 100 |
| 24 | 0.921 | 100 | 1.554 | 100 | 1.712 | 100 | 1.731 | 100 | 1.537 | 100 | 1.602 | 100 |
| 25 | 0.654 | 100 | 0.966 | 100 | 1.465 | 100 | 1.220 | 100 | 1.164 | 100 | 1.490 | 100 |
| 26 | 1.048 | 100 | 1.541 | 100 | 2.109 | 100 | 1.794 | 100 | 1.586 | 100 | 1.734 | 100 |
| 27 | 0.867 | 100 | 1.154 | 100 | 1.390 | 100 | 1.484 | 100 | 1.038 | 100 | 1.125 | 100 |
| 28 | 1.355 | 100 | 0.845 | 100 | 1.396 | 100 | 0.799 | 100 | 1.050 | 100 | 0.965 | 100 |
| 29 | 0.755 | 100 | 1.385 | 100 | 1.804 | 100 | 1.452 | 100 | 1.279 | 100 | 1.309 | 100 |
| 30 | 1.057 | 100 | 1.497 | 100 | 1.843 | 100 | 1.954 | 100 | 1.791 | 100 | 1.620 | 100 |
| 31 | 0.907 | 100 | 1.312 | 100 | 1.722 | 100 | 1.318 | 100 | 1.158 | 100 | 1.066 | 100 |
| 32 | 0.809 | 100 | 1.340 | 100 | 1.389 | 100 | 1.517 | 100 | 1.569 | 100 | 1.197 | 100 |
| 135 | 2.157 | 100 | 1.621 | 100 | 2.609 | 100 | 1.897 | 100 | 2.536 | 100 | 1.591 | 100 |
| 138 | 1.873 | 100 | 1.596 | 100 | 1.475 | 100 | 1.524 | 100 | 1.986 | 100 | 1.334 | 100 |

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

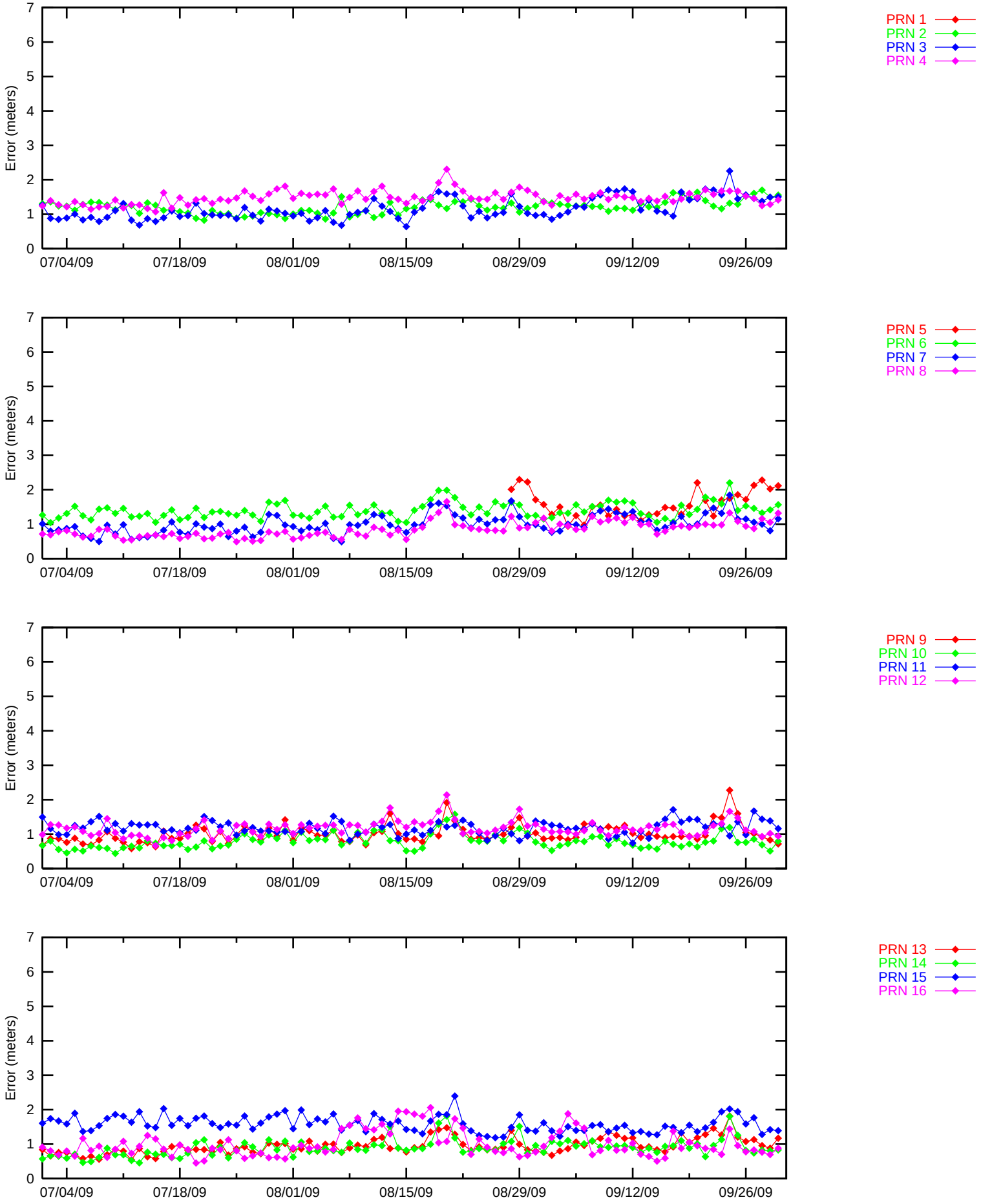
| Site → | Billings | | Albuquerque | | Boston | | Washington DC | | Houston | | Kansas City | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRN ↓ | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) |
| 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 1.060 | 100 | 0.906 | 100 | 1.092 | 100 | 0.906 | 100 | 1.977 | 100 | 0.903 | 100 |
| 3 | 0.289 | 100 | 0.560 | 100 | 0.318 | 100 | 0.344 | 100 | 0.674 | 100 | 0.617 | 100 |
| 4 | 1.059 | 100 | 1.058 | 100 | 0.787 | 100 | 1.049 | 100 | 1.285 | 100 | 1.335 | 100 |
| 5 | 0.701 | 100 | 0.862 | 100 | 0.731 | 100 | 0.893 | 100 | 1.163 | 100 | 1.096 | 100 |
| 6 | 0.593 | 100 | 0.702 | 100 | 0.414 | 100 | 0.616 | 100 | 0.928 | 100 | 0.656 | 100 |
| 7 | 0.673 | 100 | 0.542 | 100 | 0.404 | 100 | 0.502 | 100 | 0.501 | 100 | 0.679 | 100 |
| 8 | 0.456 | 100 | 0.418 | 100 | 0.473 | 100 | 0.461 | 100 | 0.538 | 100 | 0.519 | 100 |
| 9 | 0.407 | 100 | 0.669 | 100 | 0.349 | 100 | 0.354 | 100 | 0.544 | 100 | 0.465 | 100 |
| 10 | 0.622 | 100 | 0.718 | 100 | 0.427 | 100 | 0.309 | 100 | 0.400 | 100 | 0.399 | 100 |
| 11 | 0.460 | 100 | 0.390 | 100 | 0.561 | 100 | 0.513 | 100 | 0.415 | 100 | 0.318 | 100 |
| 12 | 0.378 | 100 | 0.599 | 100 | 0.498 | 100 | 0.411 | 100 | 0.562 | 100 | 0.744 | 100 |
| 13 | 0.472 | 100 | 0.551 | 100 | 0.362 | 100 | 0.385 | 100 | 0.734 | 100 | 0.764 | 100 |
| 14 | 0.440 | 100 | 0.427 | 100 | 0.538 | 100 | 0.307 | 100 | 1.081 | 100 | 0.317 | 100 |
| 15 | 0.434 | 100 | 0.678 | 100 | 0.652 | 100 | 0.905 | 100 | 1.053 | 100 | 0.859 | 100 |
| 16 | 0.756 | 100 | 0.430 | 100 | 0.561 | 100 | 0.556 | 100 | 0.727 | 100 | 0.552 | 100 |
| 17 | 1.371 | 100 | 0.626 | 100 | 0.791 | 100 | 0.568 | 100 | 0.517 | 100 | 0.572 | 100 |
| 18 | 1.426 | 100 | 1.055 | 100 | 1.243 | 100 | 1.201 | 100 | 1.344 | 100 | 1.201 | 100 |
| 19 | 1.817 | 100 | 1.470 | 100 | 1.676 | 100 | 1.463 | 100 | 1.796 | 100 | 1.380 | 100 |
| 20 | 0.712 | 100 | 0.585 | 100 | 0.757 | 100 | 0.557 | 100 | 0.688 | 100 | 0.806 | 100 |
| 21 | 1.030 | 100 | 0.588 | 100 | 1.195 | 100 | 0.812 | 100 | 0.860 | 100 | 0.474 | 100 |
| 22 | 0.927 | 100 | 0.594 | 100 | 0.999 | 100 | 0.839 | 100 | 0.829 | 100 | 0.615 | 100 |
| 23 | 1.305 | 100 | 1.115 | 100 | 1.481 | 100 | 1.399 | 100 | 1.429 | 100 | 1.085 | 100 |
| 24 | 1.051 | 100 | 0.957 | 100 | 0.699 | 100 | 0.803 | 100 | 0.948 | 100 | 0.998 | 100 |
| 25 | 0.407 | 100 | 0.495 | 100 | 0.737 | 100 | 0.390 | 100 | 0.500 | 100 | 0.503 | 100 |
| 26 | 0.975 | 100 | 0.950 | 100 | 0.763 | 100 | 0.927 | 100 | 1.325 | 100 | 1.247 | 100 |
| 27 | 0.534 | 100 | 0.652 | 100 | 0.464 | 100 | 0.525 | 100 | 0.619 | 100 | 0.618 | 100 |
| 28 | 0.601 | 100 | 0.339 | 100 | 0.665 | 100 | 0.601 | 100 | 0.524 | 100 | 0.380 | 100 |
| 29 | 0.720 | 100 | 0.971 | 100 | 0.631 | 100 | 0.699 | 100 | 0.877 | 100 | 0.974 | 100 |
| 30 | 0.637 | 100 | 0.809 | 100 | 0.824 | 100 | 0.835 | 100 | 0.845 | 100 | 0.971 | 100 |
| 31 | 1.373 | 100 | 0.633 | 100 | 0.345 | 100 | 0.696 | 100 | 0.809 | 100 | 0.856 | 100 |
| 32 | 0.522 | 100 | 0.485 | 100 | 0.454 | 100 | 0.344 | 100 | 0.432 | 100 | 0.754 | 100 |

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

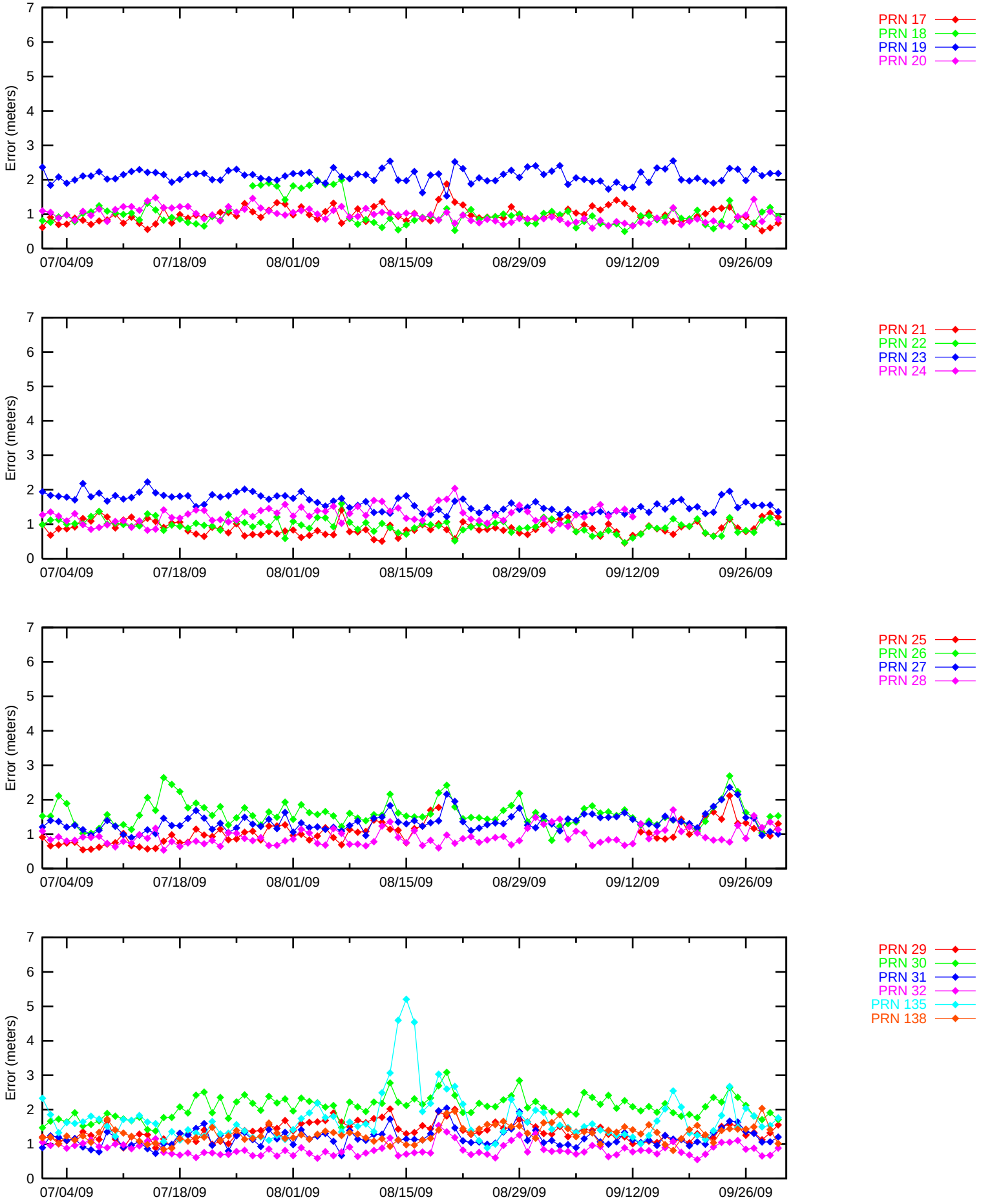
| Site → | Los Angeles | | Salt Lake City | | Miami | | Minneapolis | | Atlanta | | Juneau | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRN ↓ | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) | 95% Iono Error | 3.29 Sigma Bounding(%) |
| 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 1.197 | 100 | 1.069 | 100 | 1.154 | 100 | 1.056 | 100 | 1.166 | 100 | 1.230 | 100 |
| 3 | 0.346 | 100 | 0.489 | 100 | 0.593 | 100 | 0.664 | 100 | 0.387 | 100 | 0.476 | 100 |
| 4 | 0.883 | 100 | 0.965 | 100 | 1.425 | 100 | 0.864 | 100 | 0.809 | 100 | 0.767 | 100 |
| 5 | 0.662 | 100 | 0.899 | 100 | 1.014 | 100 | 1.043 | 100 | 0.685 | 100 | 0.746 | 100 |
| 6 | 0.650 | 100 | 0.617 | 100 | 0.575 | 100 | 0.605 | 100 | 0.443 | 100 | 0.585 | 100 |
| 7 | 0.395 | 100 | 0.598 | 100 | 0.865 | 100 | 0.707 | 100 | 0.487 | 100 | 0.624 | 100 |
| 8 | 0.292 | 100 | 0.613 | 100 | 0.557 | 100 | 0.561 | 100 | 0.461 | 100 | 0.438 | 100 |
| 9 | 0.549 | 100 | 0.614 | 100 | 0.537 | 100 | 0.683 | 100 | 0.357 | 100 | 0.572 | 100 |
| 10 | 0.520 | 100 | 0.381 | 100 | 0.268 | 100 | 0.473 | 100 | 0.731 | 100 | 0.444 | 100 |
| 11 | 0.617 | 100 | 0.580 | 100 | 0.335 | 100 | 0.460 | 100 | 0.540 | 100 | 0.483 | 100 |
| 12 | 0.461 | 100 | 0.427 | 100 | 0.689 | 100 | 0.679 | 100 | 0.511 | 100 | 0.521 | 100 |
| 13 | 0.453 | 100 | 0.522 | 100 | 0.844 | 100 | 0.421 | 100 | 0.459 | 100 | 0.456 | 100 |
| 14 | 0.597 | 100 | 0.453 | 100 | 0.596 | 100 | 0.293 | 100 | 0.504 | 100 | 0.373 | 100 |
| 15 | 0.567 | 100 | 0.573 | 100 | 0.827 | 100 | 0.620 | 100 | 0.623 | 100 | 0.638 | 100 |
| 16 | 0.690 | 100 | 0.746 | 100 | 0.408 | 100 | 0.483 | 100 | 0.733 | 100 | 0.579 | 100 |
| 17 | 0.588 | 100 | 0.644 | 100 | 0.927 | 100 | 0.410 | 100 | 0.424 | 100 | 0.484 | 100 |
| 18 | 1.184 | 100 | 1.135 | 100 | 0.905 | 100 | 1.184 | 100 | 1.294 | 100 | 1.405 | 100 |
| 19 | 1.588 | 100 | 1.507 | 100 | 1.262 | 100 | 1.546 | 100 | 1.656 | 100 | 1.931 | 100 |
| 20 | 0.650 | 100 | 0.727 | 100 | 0.712 | 100 | 0.766 | 100 | 0.809 | 100 | 0.730 | 100 |
| 21 | 0.840 | 100 | 0.666 | 100 | 1.262 | 100 | 0.767 | 100 | 0.998 | 100 | 0.829 | 100 |
| 22 | 0.974 | 100 | 0.856 | 100 | 1.073 | 100 | 0.847 | 100 | 0.927 | 100 | 1.010 | 100 |
| 23 | 1.239 | 100 | 1.218 | 100 | 1.038 | 100 | 1.165 | 100 | 1.326 | 100 | 1.286 | 100 |
| 24 | 1.060 | 100 | 1.125 | 100 | 1.131 | 100 | 1.075 | 100 | 0.950 | 100 | 1.027 | 100 |
| 25 | 0.439 | 100 | 0.436 | 100 | 0.654 | 100 | 0.522 | 100 | 0.499 | 100 | 0.709 | 100 |
| 26 | 0.746 | 100 | 0.818 | 100 | 1.084 | 100 | 0.859 | 100 | 0.750 | 100 | 0.818 | 100 |
| 27 | 0.464 | 100 | 0.572 | 100 | 0.701 | 100 | 0.726 | 100 | 0.452 | 100 | 0.544 | 100 |
| 28 | 0.630 | 100 | 0.419 | 100 | 0.704 | 100 | 0.509 | 100 | 0.748 | 100 | 0.630 | 100 |
| 29 | 0.691 | 100 | 0.796 | 100 | 1.160 | 100 | 0.770 | 100 | 0.684 | 100 | 0.705 | 100 |
| 30 | 0.789 | 100 | 0.887 | 100 | 1.121 | 100 | 0.921 | 100 | 0.919 | 100 | 0.812 | 100 |
| 31 | 0.591 | 100 | 0.638 | 100 | 0.959 | 100 | 0.495 | 100 | 0.473 | 100 | 0.378 | 100 |
| 32 | 0.452 | 100 | 0.525 | 100 | 0.691 | 100 | 0.503 | 100 | 0.516 | 100 | 0.348 | 100 |

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



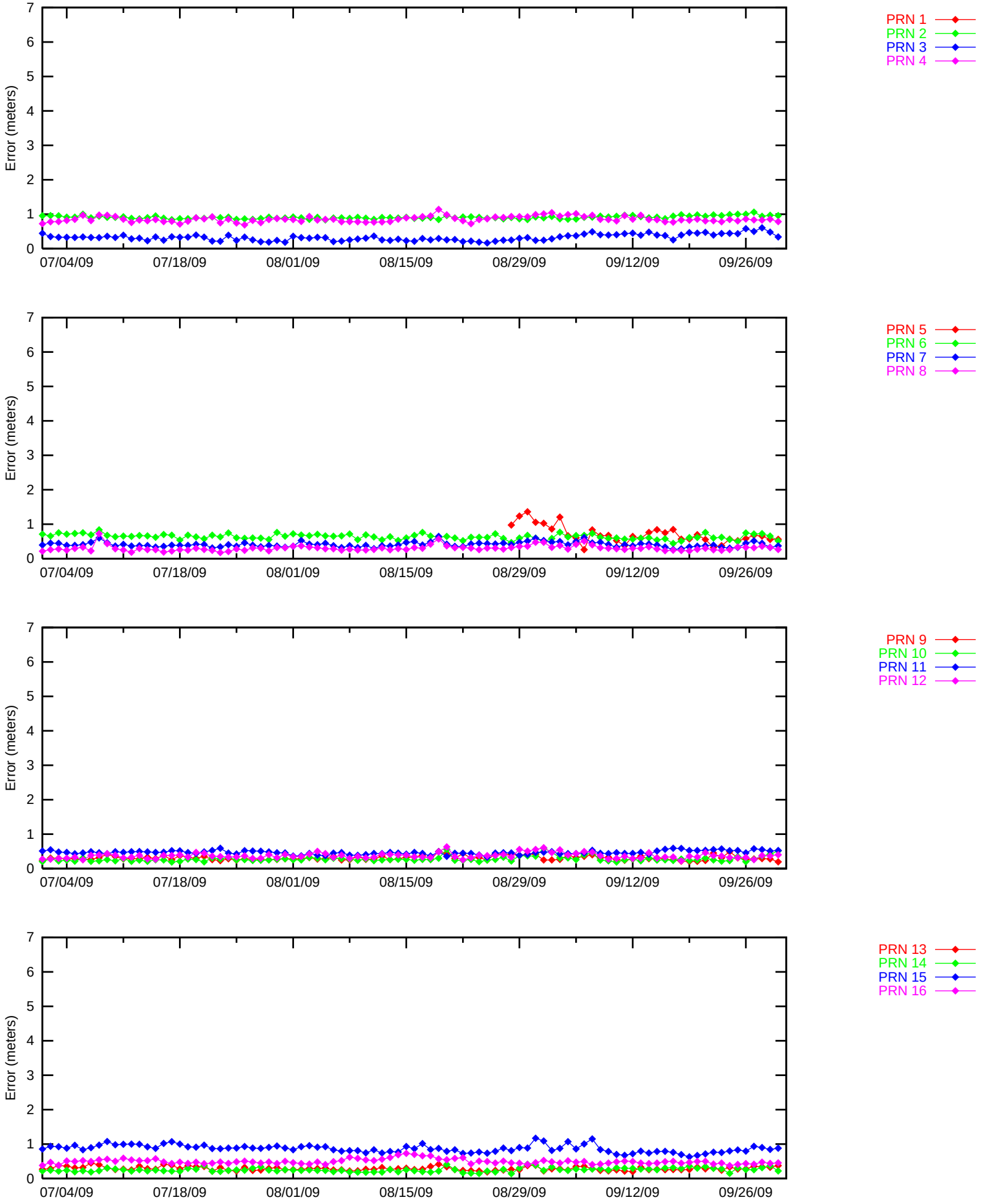


# Figure 6-2 95% Range Error (PRN 17 - PRN 32) - Washington DC



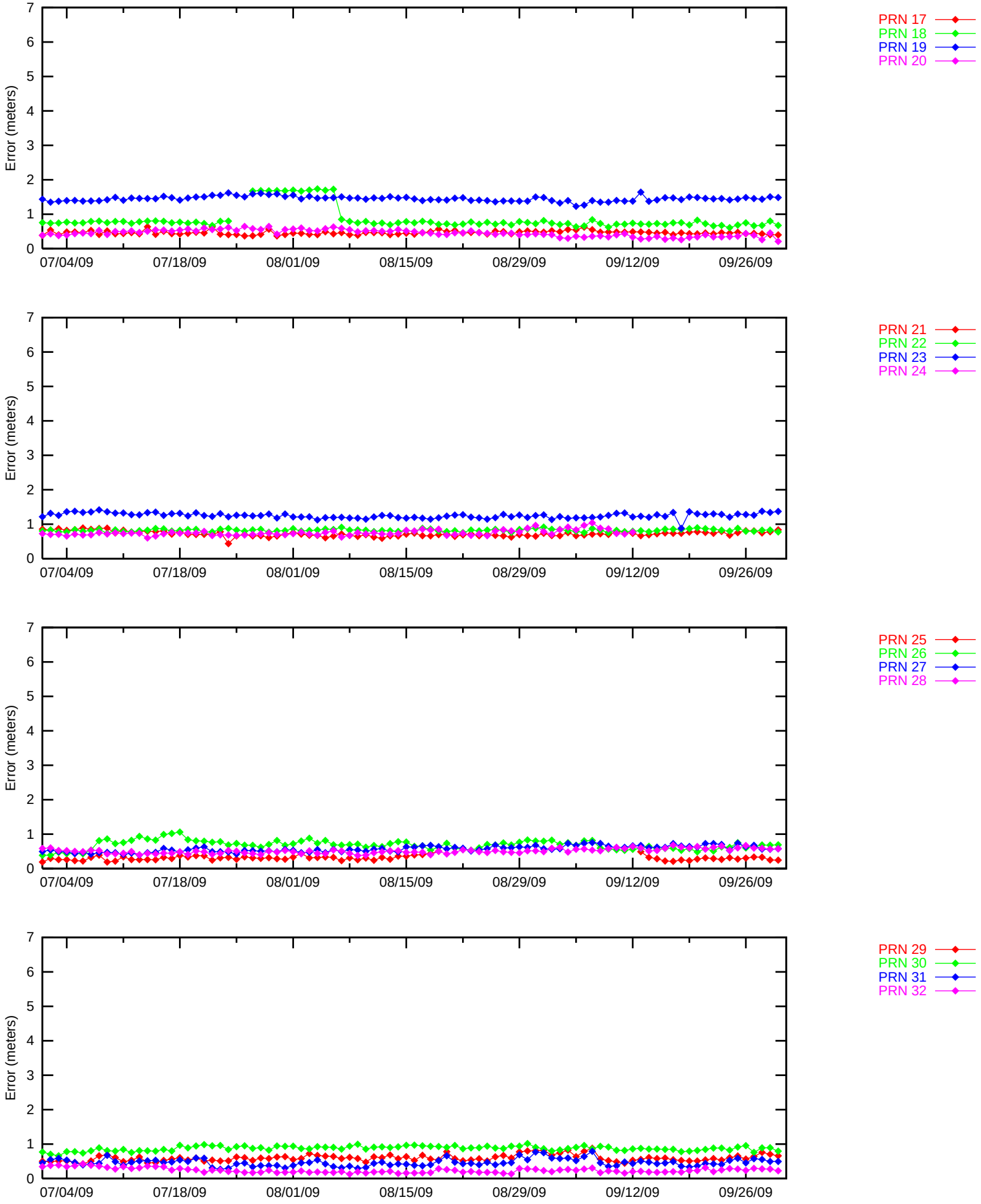
# Figure 6-3 95% Ionospheric (PRN 1 - PRN 16) - Washington DC





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





## 7.0 GEO RANGING PERFORMANCE

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

From 8/11/09 to 8/22/09, CRE GEO provided lower CRW GEO ranging availability compared to availability provided by CRW GEO. CRE GEO (with Atlanta C&V as its selected source) sent out higher UDREi values for CRW GEO than UDREi values provided by CRW GEO (with Los Angeles C&V as its selected source), see DR#83 .

**Table 7-1 GEO Ranging Availability**

| GEO Source | GEO | PA (%) | NPA (%) | Not Monitored (%) | Do Not Use (%) |
|---|---|---|---|---|---|
| CRW 135 | CRW | 98.157 | 1.546 | 0.295 | 0 |
| CRW135 | CRE | 98.309 | 1.242 | 0.361 | 0.085 |
| CRE 138 | CRW | 87.761 | 1.396 | 10.839 | 0 |
| CRE 138 | CRE | 98.424 | 1.133 | 0.354 | 0.085 |

**Figure 7-1 Daily PA CRW GEO Ranging Availability Trend**

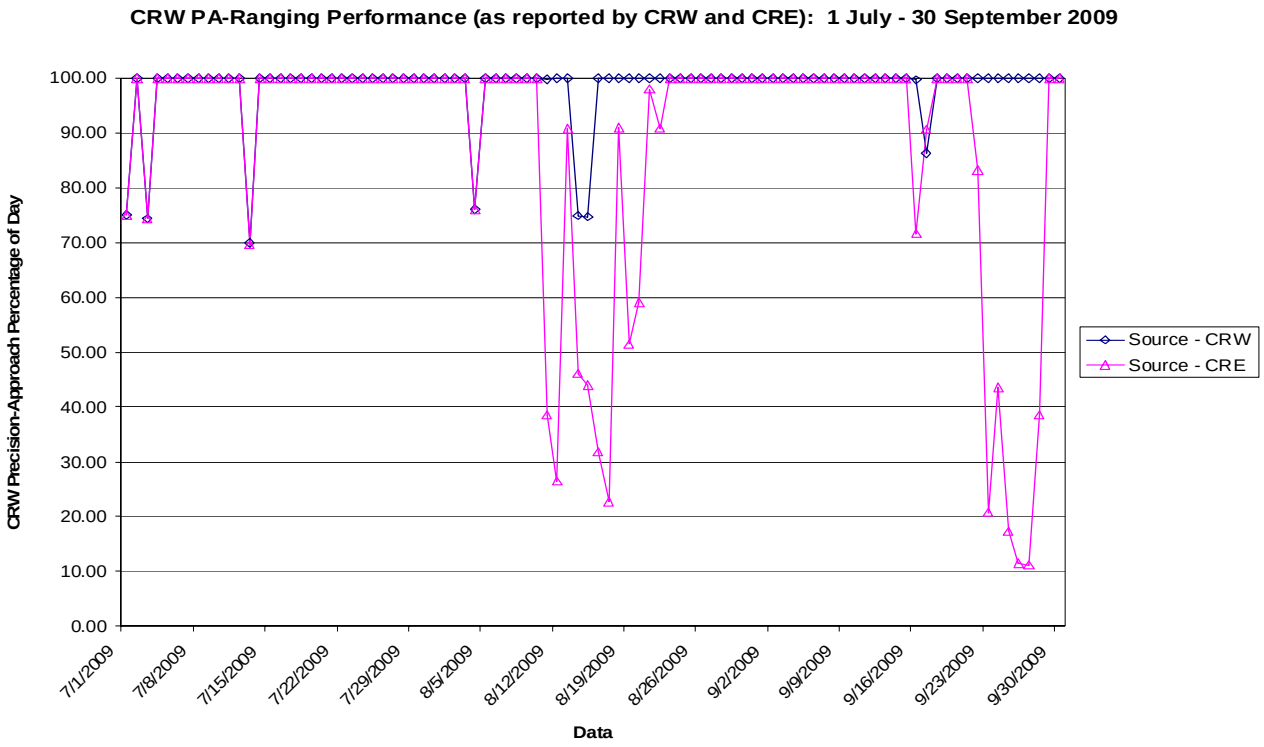
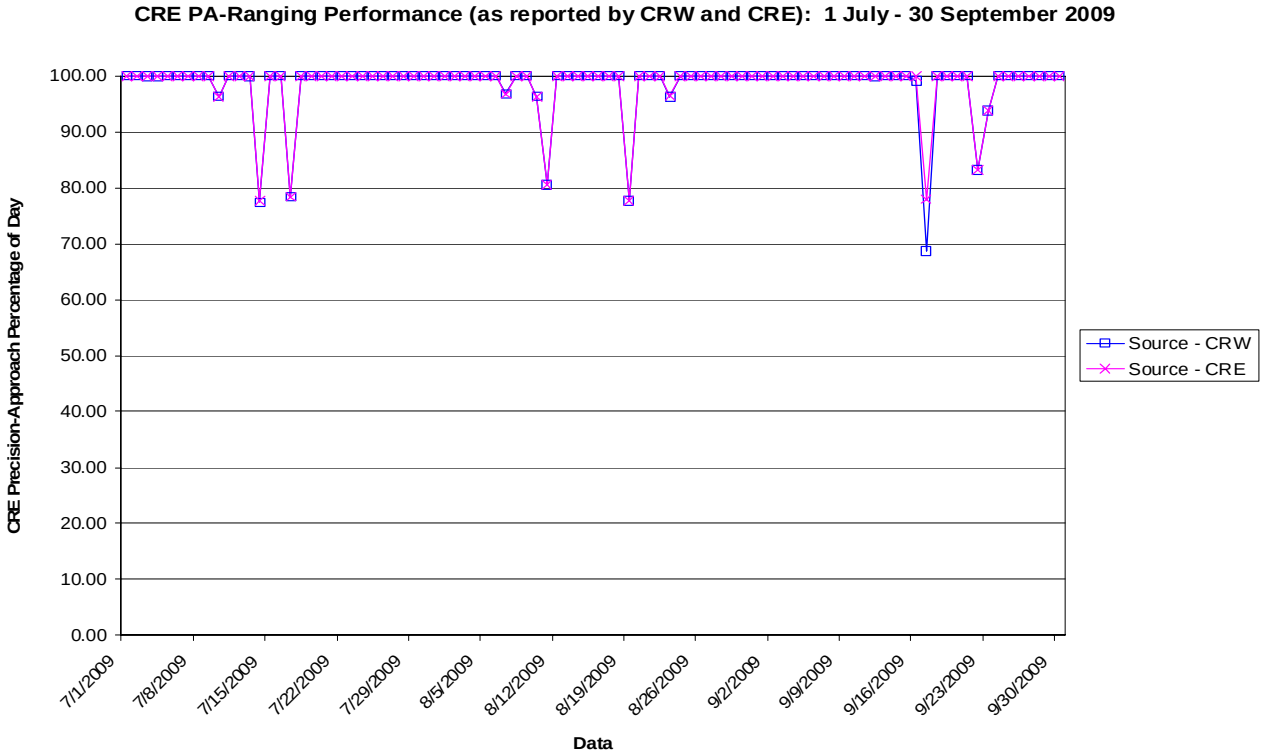



**Figure 7-2 Daily PA CRE GEO Ranging Availability Trend**



## 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**

| GPS Week | Date | Events |
|---|---|---|
| 1542 day 0 to 1543 day 5 | 7/26/2009 to 8/07/2009 | PRN 18 signal distortion. PRN 18 came back after an outage with higher than normal PRN biases and type biases and remained at that high level until 8/7/09 when it abruptly returned to normal level. See DR 86 SVN 54 PRN 18 Signal Distortion. |
| 1544 day 1 | 8/10/2009 | CRW CNV fault and GUS switchover caused a WAAS service outage, loss of CONUS LPV coverage, 0.0% at 100% Avail. See DR 82 ZDC CNV Faults Upon Receipt of QWE Garbled Message. |
| 1544 day 2 to 1545 day 6 | 8/11/09 to 8/22/09 | CRW (ZLA CNV) and CRE (ZTL CNV) sent out different UDREI values for PRN135. See DR 83 ZTL Bad Orbit Determination for PRN135. |
| 1549 day 4 | 9/17/2009 | CRE GUS switchover and lower PA ranging availability of CRW and CRE caused lower Alaska availability. See DR 84 Reduced Precision Approach GEO Ranging Caused WAAS Coverage Loss. |
| 1549 day 5 | 9/18/2009 | PRN23 Outage, NANU2009072. Alaska LPV/LPV200 Coverage decreased. See DR 85 PRN 23 NANU Affects WAAS Coverage. |

## 9.0 WAAS AIRPORT AVAILABILITY

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

**Table 9-1 WAAS LPV Outages and Availability**

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| PACD | COLD BAY | AK | 130 | 0.965302 | 648 | 0.806234 |
| PAGA | EDWARD G. PITKA SR | AK | 3 | 0.999671 | 21 | 0.998365 |
| PAEM | EMMONAK | AK | 6 | 0.999169 | 108 | 0.986418 |
| PAFA | FAIRBANKS INTL | AK | 1 | 0.999966 | 8 | 0.999383 |
| PAGB | GALBRAITH LAKE | AK | 2 | 0.999935 | 19 | 0.997983 |
| PAGK | GULKANA | AK | 2 | 0.999709 | 6 | 0.999438 |
| PAHO | HOMER | AK | 3 | 0.999695 | 23 | 0.998764 |
| PAHL | HUSLIA | AK | 3 | 0.999921 | 16 | 0.998574 |
| PAEN | KENAI MUNICIPAL | AK | 3 | 0.999688 | 11 | 0.999157 |
| PAKT | KETCHIKAN INTL | AK | 1 | 0.999962 | 3 | 0.999961 |
| PAKN | KING SALMON | AK | 6 | 0.999545 | 89 | 0.991299 |
| PARY | RUBY | AK | 3 | 0.999740 | 11 | 0.998833 |
| PASK | SELAWIK | AK | 4 | 0.999791 | 37 | 0.995040 |
| PASM | ST MARY'S | AK | 6 | 0.999241 | 97 | 0.988800 |
| PAMK | ST MICHAEL | AK | 5 | 0.999584 | 44 | 0.994387 |
| PANC | TED STEVENS ANCHORAGE INTL | AK | 2 | 0.999709 | 9 | 0.999268 |
| PAYA | YAKUTAT | AK | 2 | 0.999705 | 6 | 0.999500 |
| 8A0 | ALBERTVILLE RGNL-THOMAS J BRUM | AL | 1 | 0.999960 | 1 | 0.999960 |
| ANB | ANNISTON METROPOLITAN | AL | 1 | 0.999960 | 2 | 0.999928 |
| AUO | AUBURN-OPELIKA ROBERT G PITTS | AL | 1 | 0.999960 | 2 | 0.999924 |
| EKY | BESSEMER | AL | 1 | 0.999960 | 2 | 0.999949 |
| BHM | BIRMINGHAM INTL | AL | 1 | 0.999960 | 2 | 0.999955 |
| SEM | CRAIG FIELD | AL | 1 | 0.999960 | 2 | 0.999939 |
| DHN | DOTHAN RGNL | AL | 1 | 0.999960 | 2 | 0.999956 |
| HSV | HUNTSVILLE INTL-CARL T JONES | AL | 1 | 0.999960 | 1 | 0.999960 |
| JKA | JACK EDWARDS | AL | 1 | 0.999960 | 2 | 0.999937 |
| MDQ | MADISON COUNTY EXECUTIVE | AL | 1 | 0.999960 | 1 | 0.999960 |
| BFM | MOBILE DOWNTOWN | AL | 1 | 0.999960 | 2 | 0.999927 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| MOB | MOBILE RGNL | AL | 1 | 0.999960 | 2 | 0.999924 |
| MGM | MONTGOMERY RGNL | AL | 1 | 0.999960 | 2 | 0.999957 |
| GAD | NORTHEAST ALABAMA RGNL | AL | 1 | 0.999960 | 2 | 0.999958 |
| MSL | NORTHWEST ALABAMA RGNL | AL | 1 | 0.999960 | 2 | 0.999944 |
| DCU | PRYOR FIELD RGNL | AL | 1 | 0.999960 | 1 | 0.999960 |
| 79J | SOUTH ALABAMA RGNL | AL | 1 | 0.999960 | 2 | 0.999950 |
| PLR | ST CLAIR COUNTY | AL | 1 | 0.999960 | 2 | 0.999948 |
| 2R5 | ST ELMO | AL | 1 | 0.999960 | 2 | 0.999927 |
| ASN | TALLADEGA MUNICIPAL | AL | 1 | 0.999960 | 2 | 0.999932 |
| TOI | TROY MUNICIPAL | AL | 1 | 0.999960 | 1 | 0.999960 |
| TCL | TUSCALOOSA RGNL | AL | 1 | 0.999960 | 2 | 0.999930 |
| LIT | ADAMS FIELD | AR | 1 | 0.999960 | 3 | 0.999865 |
| M73 | ALMYRA MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999866 |
| BYH | ARKANSAS INTL | AR | 1 | 0.999960 | 2 | 0.999897 |
| VBT | BENTONVILLE MUNICIPAL/ LOUISE M THAD | AR | 1 | 0.999960 | 3 | 0.999874 |
| HRO | BOONE COUNTY | AR | 1 | 0.999960 | 3 | 0.999869 |
| FSM | FORT SMITH RGNL | AR | 1 | 0.999960 | 3 | 0.999827 |
| PBF | GRIDER FIELD | AR | 1 | 0.999960 | 3 | 0.999866 |
| JBR | JONESBORO MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999876 |
| M19 | NEWPORT MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999869 |
| ORK | NORTH LITTLE ROCK MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999864 |
| XNA | NORTHWEST ARKANSAS RGNL | AR | 1 | 0.999960 | 3 | 0.999876 |
| BPK | OZARK RGNL | AR | 1 | 0.999960 | 3 | 0.999867 |
| ROG | ROGERS MUNICIPAL-CARTER FIELD | AR | 1 | 0.999960 | 3 | 0.999872 |
| RUE | RUSSELLVILLE RGNL | AR | 1 | 0.999960 | 3 | 0.999818 |
| SUZ | SALINE COUNTY RGNL | AR | 1 | 0.999960 | 3 | 0.999817 |
| SRC | SEARCY MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999865 |
| SLG | SMITH FIELD | AR | 1 | 0.999960 | 3 | 0.999823 |
| ELD | SOUTH ARKANSAS RGNL AT GOODWIN | AR | 1 | 0.999960 | 4 | 0.999824 |
| ASG | SPRINGDALE MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999875 |
| SGT | STUTTGART MUNICIPAL | AR | 1 | 0.999960 | 3 | 0.999865 |
| ARG | WALNUT RIDGE RGNL | AR | 1 | 0.999960 | 3 | 0.999876 |
| PRC | ERNEST A. LOVE FIELD | AZ | 1 | 0.999970 | 10 | 0.999082 |
| GEU | GLENDALE MUNICIPAL | AZ | 2 | 0.999896 | 16 | 0.998765 |
| GCN | GRAND CANYON NATIONAL PARK | AZ | 1 | 0.999970 | 8 | 0.999374 |
| IFP | LAUGHLIN/BULLHEAD INTL | AZ | 1 | 0.999970 | 8 | 0.999234 |
| PGA | PAGE MUNICIPAL | AZ | 1 | 0.999970 | 7 | 0.999528 |
| DVT | PHOENIX DEER VALLEY | AZ | 2 | 0.999903 | 15 | 0.998839 |
| PHX | PHOENIX SKY HARBOR INTL | AZ | 2 | 0.999901 | 15 | 0.998827 |
| IWA | PHOENIX-MESA GATEWAY | AZ | 2 | 0.999908 | 14 | 0.998914 |
| SJN | ST JOHNS INDUSTRIAL AIR PARK | AZ | 1 | 0.999967 | 6 | 0.999483 |
| TUS | TUCSON INTL | AZ | 2 | 0.999903 | 28 | 0.998776 |
| APV | APPLE VALLEY | CA | 1 | 0.999970 | 11 | 0.998738 |
| ACV | ARCATA | CA | 3 | 0.999825 | 117 | 0.984462 |
| DAG | BARSTOW-DAGGETT | CA | 1 | 0.999970 | 12 | 0.999151 |
| C83 | BYRON | CA | 2 | 0.999874 | 174 | 0.983095 |
| CMA | CAMARILLO | CA | 2 | 0.999932 | 183 | 0.987575 |
| CNO | CHINO | CA | 1 | 0.999970 | 42 | 0.996837 |
| FAT | FRESNO YOSEMITE INTL | CA | 2 | 0.999948 | 103 | 0.993830 |
| WJF | GENERAL WM J FOX AIRFIELD | CA | 1 | 0.999970 | 59 | 0.997826 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| HAF | HALF MOON BAY | CA | 2 | 0.999841 | 323 | 0.971514 |
| HWD | HAYWARD EXECUTIVE | CA | 2 | 0.999848 | 275 | 0.976879 |
| CVH | HOLLISTER MUNICIPAL | CA | 2 | 0.999861 | 229 | 0.980619 |
| SNA | JOHN WAYNE AIRPORT-ORANGE COUNTY | CA | 1 | 0.999970 | 78 | 0.995844 |
| LGB | LONG BEACH /DAUGHERTY FIELD | CA | 1 | 0.999970 | 117 | 0.994801 |
| LAX | LOS ANGELES INTL | CA | 1 | 0.999970 | 130 | 0.993552 |
| MAE | MADERA MUNICIPAL | CA | 2 | 0.999932 | 112 | 0.991592 |
| CRQ | MC CLELLAN-PALOMAR | CA | 1 | 0.999970 | 98 | 0.995216 |
| BFL | MEADOWS FIELD | CA | 2 | 0.999960 | 108 | 0.994624 |
| MCE | MERCED MUNICIPAL/ MACREADY FIELD | CA | 2 | 0.999918 | 137 | 0.989841 |
| OAK | METROPOLITAN OAKLAND INTL | CA | 2 | 0.999847 | 280 | 0.976078 |
| MOD | MODESTO CITY-CO-HARRY SHAM FLD | CA | 2 | 0.999904 | 156 | 0.987302 |
| MRY | MONTEREY PENINSULA | CA | 2 | 0.999837 | 315 | 0.973078 |
| APC | NAPA COUNTY | CA | 2 | 0.999854 | 226 | 0.979314 |
| O02 | NERVINO | CA | 1 | 0.999970 | 64 | 0.996615 |
| SJC | NORMAN Y. MINETA SAN JOSE INTL | CA | 2 | 0.999846 | 269 | 0.977382 |
| VCB | NUT TREE | CA | 2 | 0.999873 | 175 | 0.981953 |
| ONT | ONTARIO INTL | CA | 1 | 0.999970 | 40 | 0.997201 |
| OXR | OXNARD | CA | 2 | 0.999924 | 196 | 0.986320 |
| PMD | PALMDALE RGNL/USAF PLANT 42 | CA | 1 | 0.999970 | 53 | 0.997957 |
| RBL | RED BLUFF MUNICIPAL | CA | 2 | 0.999908 | 85 | 0.991482 |
| RDD | REDDING MUNICIPAL | CA | 2 | 0.999957 | 79 | 0.991854 |
| RAL | RIVERSIDE MUNICIPAL | CA | 1 | 0.999970 | 39 | 0.997328 |
| SMF | SACRAMENTO INTL | CA | 2 | 0.999898 | 162 | 0.986617 |
| MHR | SACRAMENTO MATHER | CA | 2 | 0.999909 | 158 | 0.988538 |
| SFO | SAN FRANCISCO INTL | CA | 2 | 0.999844 | 300 | 0.973482 |
| SBA | SANTA BARBARA MUNICIPAL | CA | 4 | 0.999837 | 242 | 0.981218 |
| TCY | TRACY MUNICIPAL | CA | 2 | 0.999880 | 170 | 0.984069 |
| APA | CENTENNIAL | CO | 1 | 0.999967 | 6 | 0.999766 |
| COS | CITY OF COLORADO SPRINGS MUNICIPAL | CO | 1 | 0.999967 | 7 | 0.999763 |
| AKO | COLORADO PLAINS RGNL | CO | 1 | 0.999966 | 6 | 0.999759 |
| CEZ | CORTEZ MUNICIPAL | CO | 1 | 0.999967 | 6 | 0.999531 |
| DEN | DENVER INTL | CO | 1 | 0.999967 | 6 | 0.999738 |
| FTG | FRONT RANGE | CO | 1 | 0.999967 | 6 | 0.999740 |
| RIL | GARFIELD COUNTY RGNL | CO | 1 | 0.999967 | 7 | 0.999663 |
| GXY | GREELEY-WELD COUNTY | CO | 1 | 0.999967 | 6 | 0.999734 |
| ITR | KIT CARSON COUNTY | CO | 1 | 0.999966 | 6 | 0.999775 |
| LAA | LAMAR MUNICIPAL | CO | 1 | 0.999966 | 6 | 0.999805 |
| PUB | PUEBLO MEMORIAL | CO | 1 | 0.999966 | 7 | 0.999766 |
| ALS | SAN LUIS VALLEY RGNL/ BERGMAN FIELD | CO | 1 | 0.999967 | 5 | 0.999704 |
| HDN | YAMPA VALLEY | CO | 1 | 0.999967 | 7 | 0.999640 |
| BDL | BRADLEY INTL | CT | 2 | 0.999958 | 3 | 0.999950 |
| GON | GROTON-NEW LONDON | CT | 2 | 0.999958 | 3 | 0.999957 |
| HVN | TWEED-NEW HAVEN | CT | 2 | 0.999958 | 3 | 0.999958 |
| OXC | WATERBURY-OXFORD | CT | 2 | 0.999958 | 3 | 0.999958 |
| DCA | RONALD REAGAN WASHINGTON NATIONAL | DC | 1 | 0.999959 | 1 | 0.999959 |
| EVY | SUMMIT | DE | 2 | 0.999959 | 2 | 0.999959 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| GED | SUSSEX COUNTY | DE | 1 | 0.999959 | 1 | 0.999959 |
| AAF | APALACHICOLA MUNICIPAL | FL | 1 | 0.999960 | 2 | 0.999960 |
| CEW | BOB SIKES | FL | 1 | 0.999960 | 2 | 0.999942 |
| BCT | BOCA RATON | FL | 1 | 0.999959 | 5 | 0.999710 |
| PGD | CHARLOTTE COUNTY | FL | 1 | 0.999960 | 4 | 0.999881 |
| DAB | DAYTONA BEACH INTL | FL | 1 | 0.999960 | 3 | 0.999780 |
| DED | DELAND MUNICIPAL-SIDNEY H TAYLOR FIELD | FL | 1 | 0.999960 | 3 | 0.999795 |
| XFL | FLAGLER COUNTY | FL | 1 | 0.999960 | 3 | 0.999782 |
| FXE | FORT LAUDERDALE EXECUTIVE | FL | 1 | 0.999959 | 6 | 0.999711 |
| FLL | FORT LAUDERDALE/ HOLLYWOOD INTL | FL | 1 | 0.999959 | 6 | 0.999682 |
| GNV | GAINESVILLE RGNL | FL | 1 | 0.999960 | 2 | 0.999835 |
| BKV | HERNANDO COUNTY | FL | 1 | 0.999960 | 4 | 0.999872 |
| JAX | JACKSONVILLE INTL | FL | 1 | 0.999960 | 2 | 0.999788 |
| TMB | KENDALL-TAMIAMI EXECUTIVE | FL | 1 | 0.999959 | 6 | 0.999690 |
| EYW | KEY WEST INTL | FL | 1 | 0.999960 | 12 | 0.999800 |
| ISM | KISSIMMEE GATEWAY | FL | 1 | 0.999960 | 3 | 0.999819 |
| X14 | LA BELLE MUNICIPAL | FL | 1 | 0.999960 | 5 | 0.999774 |
| LCQ | LAKE CITY MUNICIPAL | FL | 1 | 0.999960 | 2 | 0.999841 |
| LAL | LAKELAND LINDER RGNL | FL | 1 | 0.999960 | 4 | 0.999859 |
| LEE | LEESBURG INTL | FL | 1 | 0.999960 | 3 | 0.999829 |
| MLB | MELBOURNE INTL | FL | 1 | 0.999959 | 3 | 0.999777 |
| COI | MERRITT ISLAND | FL | 1 | 0.999959 | 3 | 0.999774 |
| MIA | MIAMI INTL | FL | 1 | 0.999959 | 7 | 0.999682 |
| APF | NAPLES MUNICIPAL | FL | 1 | 0.999960 | 4 | 0.999887 |
| EVB | NEW SMYRNA BEACH MUNICIPAL | FL | 1 | 0.999960 | 3 | 0.999776 |
| OCF | OCALA INTL-JIM TAYLOR FIELD | FL | 1 | 0.999960 | 3 | 0.999844 |
| MCO | ORLANDO INTL | FL | 1 | 0.999960 | 3 | 0.999809 |
| SFB | ORLANDO SANFORD INTL | FL | 1 | 0.999960 | 3 | 0.999798 |
| PHK | PALM BEACH CO GLADES | FL | 1 | 0.999959 | 5 | 0.999732 |
| PBI | PALM BEACH INTL | FL | 1 | 0.999959 | 5 | 0.999704 |
| PFN | PANAMA CITY-BAY CO INTL | FL | 1 | 0.999960 | 3 | 0.999959 |
| PNS | PENSACOLA RGNL | FL | 1 | 0.999960 | 2 | 0.999939 |
| PMP | POMPANO BEACH AIRPARK | FL | 1 | 0.999959 | 6 | 0.999708 |
| SRQ | SARASOTA/BRADENTON INTL | FL | 1 | 0.999960 | 4 | 0.999902 |
| RSW | SOUTHWEST FLORIDA INTL | FL | 1 | 0.999960 | 4 | 0.999876 |
| FPR | ST LUCIE COUNTY INTL | FL | 1 | 0.999959 | 4 | 0.999755 |
| PIE | ST PETERSBURG-CLEARWATER INTL | FL | 1 | 0.999960 | 4 | 0.999898 |
| TLH | TALLAHASSEE RGNL | FL | 1 | 0.999960 | 2 | 0.999926 |
| TPA | TAMPA INTL | FL | 1 | 0.999960 | 4 | 0.999888 |
| MTH | THE FLORIDA KEYS MARATHON | FL | 1 | 0.999959 | 11 | 0.999483 |
| VDF | VANDENBERG | FL | 1 | 0.999960 | 4 | 0.999877 |
| GIF | WINTER HAVEN'S GILBERT | FL | 1 | 0.999960 | 4 | 0.999841 |
| AGS | AUGUSTA RGNL AT BUSH FIELD | GA | 1 | 0.999960 | 2 | 0.999817 |
| BQK | BRUNSWICK GOLDEN ISLES | GA | 1 | 0.999959 | 2 | 0.999761 |
| VPC | CARTERSVILLE | GA | 1 | 0.999960 | 2 | 0.999904 |
| 47A | CHEROKEE COUNTY | GA | 1 | 0.999960 | 2 | 0.999896 |
| RYY | COBB COUNTY-MC COLLUM FIELD | GA | 1 | 0.999960 | 2 | 0.999874 |
| CSG | COLUMBUS METROPOLITAN | GA | 1 | 0.999960 | 2 | 0.999903 |
| 15J | COOK COUNTY | GA | 1 | 0.999960 | 2 | 0.999864 |
| CKF | CRISP COUNTY-CORDELE | GA | 1 | 0.999960 | 2 | 0.999861 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| DNN | DALTON MUNICIPAL | GA | 1 | 0.999960 | 2 | 0.999955 |
| SBO | EMANUEL COUNTY | GA | 1 | 0.999960 | 2 | 0.999780 |
| 18A | FRANKLIN COUNTY | GA | 1 | 0.999960 | 2 | 0.999840 |
| FTY | FULTON COUNTY AIRPORT-BROWN FIELD | GA | 1 | 0.999960 | 2 | 0.999874 |
| ATL | HARTSFIELD – JACKSON ATLANTA INTERNATIONAL | GA | 1 | 0.999960 | 2 | 0.999873 |
| EZM | HEART OF GEORGIA RGNL | GA | 1 | 0.999960 | 2 | 0.999825 |
| 19A | JACKSON COUNTY | GA | 1 | 0.999960 | 2 | 0.999850 |
| GVL | LEE GILMER MEMORIAL | GA | 1 | 0.999960 | 2 | 0.999855 |
| MCN | MIDDLE GEORGIA RGNL | GA | 1 | 0.999960 | 2 | 0.999860 |
| MGR | MOULTRIE MUNICIPAL | GA | 1 | 0.999960 | 2 | 0.999883 |
| CCO | NEWNAN COWETA COUNTY | GA | 1 | 0.999960 | 2 | 0.999882 |
| FFC | PEACHTREE CITY-FALCON FIELD | GA | 1 | 0.999960 | 2 | 0.999878 |
| PXE | PERRY-HOUSTON COUNTY | GA | 1 | 0.999960 | 2 | 0.999863 |
| JZP | PICKENS COUNTY | GA | 1 | 0.999960 | 2 | 0.999903 |
| JYL | PLANTATION ARPK | GA | 1 | 0.999959 | 2 | 0.999745 |
| SAV | SAVANNAH/HILTON HEAD INTL | GA | 1 | 0.999959 | 2 | 0.999735 |
| ACJ | SOUTHER FIELD | GA | 1 | 0.999960 | 2 | 0.999878 |
| ABY | SOUTHWEST GEORGIA RGNL | GA | 1 | 0.999960 | 2 | 0.999891 |
| TBR | STATESBORO-BULLOCH COUNTY | GA | 1 | 0.999960 | 2 | 0.999752 |
| MQW | TELFAIR-WHEELER | GA | 1 | 0.999960 | 2 | 0.999815 |
| TVI | THOMASVILLE RGNL | GA | 1 | 0.999960 | 2 | 0.999891 |
| TOC | TOCCOA RG LETOURNEAU FIELD | GA | 1 | 0.999960 | 2 | 0.999842 |
| VLD | VALDOSTA RGNL | GA | 1 | 0.999960 | 2 | 0.999864 |
| VDI | VIDALIA RGNL | GA | 1 | 0.999960 | 2 | 0.999789 |
| IIY | WASHINGTON-WILKES COUNTY | GA | 1 | 0.999960 | 2 | 0.999794 |
| AYS | WAYCROSS-WARE COUNTY | GA | 1 | 0.999960 | 2 | 0.999809 |
| CTJ | WEST GEORGIA RGNL – O V GRAY FIELD | GA | 1 | 0.999960 | 2 | 0.999888 |
| WDR | WINDER-BARROW | GA | 1 | 0.999960 | 2 | 0.999854 |
| IKV | ANKENY RGNL | IA | 1 | 0.999960 | 2 | 0.999835 |
| CBF | COUNCIL BLUFFS MUNICIPAL | IA | 1 | 0.999960 | 3 | 0.999837 |
| DVN | DAVENPORT MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999854 |
| DNS | DENISON MUNICIPAL | IA | 1 | 0.999960 | 3 | 0.999827 |
| DSM | DES MOINES INTL | IA | 1 | 0.999960 | 2 | 0.999836 |
| DBQ | DUBUQUE RGNL | IA | 1 | 0.999960 | 2 | 0.999849 |
| EST | ESTHERVILLE MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999817 |
| FFL | FAIRFIELD MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999863 |
| GGI | GRINNELL RGNL | IA | 1 | 0.999960 | 2 | 0.999839 |
| EOK | KEOKUK MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999878 |
| MCW | MASON CITY MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999822 |
| MXO | MONTICELLO RGNL | IA | 1 | 0.999960 | 2 | 0.999849 |
| MUT | MUSCATINE MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999865 |
| TNU | NEWTON MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999838 |
| OTM | OTTUMWA INDUSTRIAL | IA | 1 | 0.999960 | 2 | 0.999849 |
| PRO | PERRY MUNICIPAL | IA | 1 | 0.999960 | 2 | 0.999835 |
| SDA | SHENANDOAH MUNICIPAL | IA | 1 | 0.999960 | 3 | 0.999841 |
| SLB | STORM LAKE MUNICIPAL | IA | 1 | 0.999960 | 3 | 0.999827 |
| CID | THE EASTERN IOWA | IA | 1 | 0.999960 | 2 | 0.999848 |
| ALO | WATERLOO RGNL | IA | 1 | 0.999960 | 2 | 0.999837 |
| BOI | BOISE AIR TERMINAL/GOWEN FLD | ID | 1 | 0.999970 | 1 | 0.999970 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| EUL | CALDWELL INDUSTRIAL | ID | 1 | 0.999970 | 1 | 0.999970 |
| GNG | GOODING MUNICIPAL | ID | 1 | 0.999970 | 4 | 0.999878 |
| IDA | IDAHO FALLS RGNL | ID | 1 | 0.999970 | 5 | 0.999706 |
| LWS | LEWISTON-NEZ PERCE COUNTY | ID | 1 | 0.999970 | 1 | 0.999970 |
| S67 | NAMPA MUNICIPAL | ID | 1 | 0.999970 | 1 | 0.999970 |
| PIH | POCATELLO RGNL | ID | 1 | 0.999970 | 6 | 0.999756 |
| SPI | ABRAHAM LINCOLN CAPITAL | IL | 1 | 0.999960 | 2 | 0.999931 |
| FEP | ALBERTUS | IL | 1 | 0.999960 | 2 | 0.999855 |
| ARR | AURORA MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999881 |
| BMI | CENTRAL IL REGL ARPT AT BLOOMI | IL | 1 | 0.999960 | 2 | 0.999916 |
| ENL | CENTRALIA MUNICIPAL | IL | 1 | 0.999960 | 1 | 0.999960 |
| MDW | CHICAGO MIDWAY INTL | IL | 1 | 0.999960 | 2 | 0.999890 |
| ORD | CHICAGO O'HARE INTL | IL | 1 | 0.999960 | 2 | 0.999888 |
| RFD | CHICAGO/ROCKFORD INTL | IL | 1 | 0.999960 | 2 | 0.999862 |
| DKB | DE KALB TAYLOR MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999878 |
| DEC | DECATUR | IL | 1 | 0.999960 | 1 | 0.999960 |
| FOA | FLORA MUNICIPAL | IL | 1 | 0.999960 | 1 | 0.999960 |
| IKK | GREATER KANKAKEE | IL | 1 | 0.999960 | 2 | 0.999916 |
| PIA | GREATER PEORIA RGNL | IL | 1 | 0.999960 | 2 | 0.999903 |
| IGQ | LANSING MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999895 |
| LOT | LEWIS UNIVERSITY | IL | 1 | 0.999960 | 2 | 0.999890 |
| 3LF | LITCHFIELD MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999947 |
| C15 | PEKIN MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999904 |
| PPQ | PITTSFIELD PENSTONE MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999904 |
| PNT | PONTIAC MUNICIPAL | IL | 1 | 0.999960 | 2 | 0.999906 |
| MLI | QUAD CITY INTL | IL | 1 | 0.999960 | 2 | 0.999868 |
| UIN | QUINCY RGNL-BALDWIN FIELD | IL | 1 | 0.999960 | 2 | 0.999891 |
| TIP | RANTOUL NATL AVN CNTR-FRANK EL | IL | 1 | 0.999960 | 2 | 0.999960 |
| RSV | ROBINSON MUNICIPAL | IL | 1 | 0.999960 | 1 | 0.999960 |
| SLO | SALEM-LECKRONE | IL | 1 | 0.999960 | 1 | 0.999960 |
| ALN | ST LOUIS RGNL | IL | 1 | 0.999960 | 2 | 0.999944 |
| DNV | VERMILION COUNTY | IL | 1 | 0.999960 | 1 | 0.999960 |
| UGN | WAUKEGAN RGNL | IL | 1 | 0.999960 | 2 | 0.999812 |
| MWA | WILLIAMSON COUNTY RGNL | IL | 1 | 0.999960 | 1 | 0.999960 |
| BAK | COLUMBUS MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| GWB | DE KALB COUNTY | IN | 1 | 0.999960 | 1 | 0.999960 |
| MIE | DELAWARE COUNTY - JOHNSON FIEL | IN | 1 | 0.999960 | 1 | 0.999960 |
| EYE | EAGLE CREEK AIRPARK | IN | 1 | 0.999960 | 1 | 0.999960 |
| EKM | ELKHART MUNICIPAL | IN | 1 | 0.999960 | 2 | 0.999917 |
| FWA | FORT WAYNE INTL | IN | 1 | 0.999960 | 1 | 0.999960 |
| SER | FREEMAN MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| RCR | FULTON COUNTY | IN | 1 | 0.999960 | 2 | 0.999960 |
| GSH | GOSHEN MUNICIPAL | IN | 1 | 0.999960 | 2 | 0.999929 |
| HFY | GREENWOOD MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| TYQ | INDIANAPOLIS EXECUTIVE | IN | 1 | 0.999960 | 1 | 0.999960 |
| IND | INDIANAPOLIS INTL | IN | 1 | 0.999960 | 1 | 0.999960 |
| GGP | LOGANSPORT/CASS COUNTY | IN | 1 | 0.999960 | 1 | 0.999960 |
| IMS | MADISON MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| MZZ | MARION MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| CEV | METTEL FIELD | IN | 1 | 0.999960 | 1 | 0.999960 |
| BMG | MONROE COUNTY | IN | 1 | 0.999960 | 1 | 0.999960 |
| VPZ | PORTER COUNTY MUNICIPAL | IN | 1 | 0.999960 | 2 | 0.999916 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| LAF | PURDUE UNIVERSITY | IN | 1 | 0.999960 | 1 | 0.999960 |
| 4I7 | PUTNAM COUNTY | IN | 1 | 0.999960 | 1 | 0.999960 |
| GEZ | SHELBYVILLE MUNICIPAL | IN | 1 | 0.999960 | 1 | 0.999960 |
| SBN | SOUTH BEND RGNL | IN | 1 | 0.999960 | 2 | 0.999906 |
| OXI | STARKE COUNTY | IN | 1 | 0.999960 | 2 | 0.999920 |
| ANQ | TRI-STATE STEUBEN COUNTY | IN | 1 | 0.999960 | 2 | 0.999865 |
| PTS | ATKINSON MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999871 |
| AAO | COLONEL JAMES JABARA | KS | 1 | 0.999960 | 3 | 0.999826 |
| DDC | DODGE CITY RGNL | KS | 1 | 0.999966 | 6 | 0.999819 |
| EMP | EMPORIA MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999870 |
| FOE | FORBES FIELD | KS | 1 | 0.999960 | 3 | 0.999868 |
| FSK | FORT SCOTT MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999872 |
| GCK | GARDEN CITY RGNL | KS | 1 | 0.999966 | 6 | 0.999807 |
| HYS | HAYS RGNL | KS | 1 | 0.999966 | 4 | 0.999835 |
| HQG | HUGOTON MUNICIPAL | KS | 1 | 0.999966 | 6 | 0.999830 |
| OJC | JOHNSON COUNTY EXECUTIVE | KS | 1 | 0.999960 | 3 | 0.999867 |
| LWC | LAWRENCE MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999863 |
| LBL | LIBERAL MID-AMERICA RGNL | KS | 1 | 0.999966 | 6 | 0.999837 |
| MHK | MANHATTAN RGNL | KS | 1 | 0.999960 | 3 | 0.999864 |
| MPR | MC PHERSON | KS | 1 | 0.999960 | 3 | 0.999823 |
| IXD | NEW CENTURY AIRCENTER | KS | 1 | 0.999960 | 3 | 0.999868 |
| EWK | NEWTON-CITY-COUNTY | KS | 1 | 0.999960 | 3 | 0.999827 |
| OEL | OAKLEY MUNICIPAL | KS | 1 | 0.999966 | 5 | 0.999805 |
| TOP | PHILIP BILLARD MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999865 |
| PTT | PRATT INDUSTRIAL | KS | 1 | 0.999960 | 4 | 0.999832 |
| GLD | RENNER FLD /GOODLAND MUNICIPAL | KS | 1 | 0.999966 | 6 | 0.999790 |
| RSL | RUSSELL MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999826 |
| SLN | SALINA MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999873 |
| TQK | SCOTT CITY MUNICIPAL | KS | 1 | 0.999966 | 6 | 0.999803 |
| CBK | SHALZ FIELD | KS | 1 | 0.999966 | 5 | 0.999799 |
| WLD | STROTHER FIELD | KS | 1 | 0.999960 | 3 | 0.999832 |
| PPF | TRI-CITY | KS | 1 | 0.999960 | 3 | 0.999875 |
| ULS | ULYSSES | KS | 1 | 0.999966 | 6 | 0.999830 |
| EGT | WELLINGTON MUNICIPAL | KS | 1 | 0.999960 | 3 | 0.999833 |
| ICT | WICHITA MID-CONTINENT | KS | 1 | 0.999960 | 3 | 0.999830 |
| EKX | ADDINGTON FIELD | KY | 1 | 0.999960 | 1 | 0.999920 |
| PAH | BARKLEY RGNL | KY | 1 | 0.999960 | 2 | 1.000000 |
| K22 | BIG SANDY RGNL | KY | 1 | 0.999959 | 1 | 0.999959 |
| LEX | BLUE GRASS | KY | 1 | 0.999960 | 1 | 0.999960 |
| LOU | BOWMAN FIELD | KY | 1 | 0.999960 | 1 | 0.999960 |
| CVG | CINCINNATI/ NORTHERN KENTUCKY INTL | KY | 1 | 0.999960 | 1 | 0.999960 |
| 27K | GEORGETOWN SCOTT COUNTY - MARS | KY | 1 | 0.999960 | 1 | 0.999960 |
| GLW | GLASGOW MUNICIPAL | KY | 1 | 0.999960 | 1 | 0.999960 |
| EHR | HENDERSON CITY-COUNTY | KY | 1 | 0.999960 | 1 | 0.999960 |
| SME | LAKE CUMBERLAND RGNL | KY | 1 | 0.999960 | 1 | 0.999960 |
| LOZ | LONDON-CORBIN ARPT-MAGEE FLD | KY | 1 | 0.999960 | 1 | 0.999960 |
| SDF | LOUISVILLE INTL-STANDIFORD FIELD | KY | 1 | 0.999960 | 1 | 0.999960 |
| OWB | OWENSBORO-DAVIESS COUNTY | KY | 1 | 0.999960 | 1 | 0.999960 |
| DVK | STUART POWELL FIELD | KY | 1 | 0.999960 | 1 | 0.999960 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| W38 | WILLIAMSBURG-WHITLEY COUNTY | KY | 1 | 0.999960 | 1 | 0.999960 |
| ARA | ACADIANA RGNL | LA | 1 | 0.999960 | 5 | 0.999833 |
| AEX | ALEXANDRIA INTL | LA | 1 | 0.999960 | 5 | 0.999822 |
| BTR | BATON ROUGE METROPOLITAN` RYAN | LA | 1 | 0.999960 | 3 | 0.999887 |
| DRI | BEAUREGARD RGNL | LA | 1 | 0.999960 | 5 | 0.999866 |
| CWF | CHENNAULT INTL | LA | 1 | 0.999960 | 5 | 0.999869 |
| ESF | ESLER RGNL | LA | 1 | 0.999960 | 5 | 0.999818 |
| HZR | FALSE RIVER RGNL | LA | 1 | 0.999960 | 4 | 0.999844 |
| PTN | HARRY P WILLIAMS MEMORIAL | LA | 1 | 0.999960 | 4 | 0.999857 |
| LFT | LAFAYETTE RGNL | LA | 1 | 0.999960 | 5 | 0.999825 |
| LCH | LAKE CHARLES RGNL | LA | 1 | 0.999960 | 5 | 0.999869 |
| NEW | LAKEFRONT | LA | 1 | 0.999960 | 3 | 0.999908 |
| MSY | LOUIS ARMSTRONG NEW ORLEANS IN | LA | 1 | 0.999960 | 3 | 0.999905 |
| BQP | MOREHOUSE MEMORIAL | LA | 1 | 0.999960 | 4 | 0.999833 |
| DTN | SHREVEPORT DOWNTOWN | LA | 1 | 0.999960 | 5 | 0.999829 |
| SHV | SHREVEPORT RGNL | LA | 1 | 0.999960 | 5 | 0.999830 |
| GAO | SOUTH LAFOURCHE LEONARD MILLER | LA | 1 | 0.999960 | 3 | 0.999912 |
| TVR | VICKSBURG TALLULAH RGNL | LA | 1 | 0.999960 | 3 | 0.999867 |
| BAF | BARNES MUNICIPAL | MA | 2 | 0.999958 | 3 | 0.999950 |
| HYA | BARNSTABLE MUNICIPAL-BOARDMAN/POLAN | MA | 2 | 0.999958 | 4 | 0.999924 |
| BOS | GENERAL EDWARD LAWRENCE LOGAN | MA | 2 | 0.999958 | 4 | 0.999924 |
| BED | LAURENCE G HANSCOM FLD | MA | 2 | 0.999958 | 3 | 0.999924 |
| MVY | MARTHAS VINEYARD | MA | 2 | 0.999958 | 3 | 0.999948 |
| OWD | NORWOOD MEMORIAL | MA | 2 | 0.999958 | 4 | 0.999924 |
| PVC | PROVINCETOWN MUNICIPAL | MA | 2 | 0.999958 | 5 | 0.999924 |
| ORH | WORCESTER RGNL | MA | 2 | 0.999958 | 3 | 0.999925 |
| BWI | BALTIMORE/WASHINGTON INTL THUR | MD | 2 | 0.999959 | 2 | 0.999959 |
| DMW | CARROLL COUNTY RGNL/JACK B POA | MD | 1 | 0.999959 | 1 | 0.999959 |
| ESN | EASTON/NEWNAM FIELD | MD | 2 | 0.999959 | 2 | 0.999959 |
| FDK | FREDERICK MUNICIPAL | MD | 1 | 0.999959 | 1 | 0.999959 |
| GAI | MONTGOMERY COUNTY AIRPARK | MD | 1 | 0.999959 | 1 | 0.999959 |
| 2W6 | ST. MARY'S COUNTY RGNL | MD | 2 | 0.999959 | 2 | 0.999959 |
| LEW | AUBURN/LEWISTON MUNICIPAL | ME | 2 | 0.999958 | 5 | 0.999924 |
| AUG | AUGUSTA STATE | ME | 2 | 0.999958 | 4 | 0.999923 |
| BGR | BANGOR INTL | ME | 2 | 0.999958 | 5 | 0.999923 |
| BHB | HANCOCK COUNTY-BAR HARBOR | ME | 2 | 0.999958 | 5 | 0.999923 |
| PQI | NORTHERN MAINE RGNL ARPT AT PR | ME | 1 | 0.999958 | 4 | 0.999924 |
| PWM | PORTLAND INTL JETPORT | ME | 2 | 0.999958 | 4 | 0.999924 |
| WVL | WATERVILLE ROBERT LAFLEUR | ME | 2 | 0.999958 | 4 | 0.999923 |
| ARB | ANN ARBOR MUNICIPAL | MI | 1 | 0.999959 | 2 | 0.999872 |
| ACB | ANTRIM COUNTY | MI | 1 | 0.999959 | 2 | 0.999822 |
| FNT | BISHOP INTL | MI | 1 | 0.999959 | 2 | 0.999856 |
| OEB | BRANCH COUNTY MEMORIAL | MI | 1 | 0.999960 | 2 | 0.999863 |
| CVX | CHARLEVOIX MUNICIPAL | MI | 1 | 0.999959 | 2 | 0.999833 |
| CIU | CHIPPEWA COUNTY INTL | MI | 1 | 0.999959 | 3 | 0.999837 |
| TTF | CUSTER | MI | 1 | 0.999959 | 2 | 0.999879 |
| DTW | DETROIT METROPOLITAN WAYNE COU | MI | 1 | 0.999959 | 2 | 0.999879 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| FFX | FREMONT MUNICIPAL | MI | 1 | 0.999960 | 2 | 0.999827 |
| GRR | GERALD R. FORD INTL | MI | 1 | 0.999960 | 2 | 0.999838 |
| CMX | HOUGHTON COUNTY MEMORIAL | MI | 1 | 0.999960 | 3 | 0.999890 |
| BAX | HURON COUNTY MEMORIAL | MI | 1 | 0.999959 | 2 | 0.999844 |
| AZO | KALAMAZOO/BATTLE CREEK INTL | MI | 1 | 0.999960 | 2 | 0.999852 |
| ADG | LENAWEE COUNTY | MI | 1 | 0.999959 | 2 | 0.999879 |
| OZW | LIVINGSTON COUNTY SPENCER J. H | MI | 1 | 0.999959 | 2 | 0.999865 |
| LDM | MASON COUNTY | MI | 1 | 0.999960 | 2 | 0.999806 |
| MBS | MBS INTL | MI | 1 | 0.999959 | 2 | 0.999846 |
| MKG | MUSKEGON COUNTY | MI | 1 | 0.999960 | 2 | 0.999824 |
| RNP | OWOSSO COMMUNITY | MI | 1 | 0.999959 | 2 | 0.999850 |
| HYX | SAGINAW COUNTY H.W. BROWNE | MI | 1 | 0.999959 | 2 | 0.999850 |
| BIV | TULIP CITY | MI | 1 | 0.999960 | 2 | 0.999832 |
| YIP | WILLOW RUN | MI | 1 | 0.999959 | 2 | 0.999876 |
| AEL | ALBERT LEA MUNICIPAL | MN | 1 | 0.999960 | 2 | 0.999821 |
| ANE | ANOKA COUNTY-BLAINE ARPT | MN | 1 | 0.999960 | 3 | 0.999845 |
| AUM | AUSTIN MUNICIPAL | MN | 1 | 0.999960 | 2 | 0.999822 |
| BDE | BAUDETTE INTL | MN | 1 | 0.999960 | 2 | 0.999872 |
| BRD | BRAINERD LAKES RGNL | MN | 1 | 0.999960 | 3 | 0.999870 |
| AXN | CHANDLER FIELD | MN | 1 | 0.999960 | 3 | 0.999868 |
| HIB | CHISHOLM-HIBBING | MN | 1 | 0.999960 | 4 | 0.999880 |
| CKN | CROOKSTON MUNICIPAL KIRKWOOD FIELD | MN | 1 | 0.999960 | 4 | 0.999920 |
| DTL | DETROIT LAKES-WETHING FIELD | MN | 1 | 0.999960 | 4 | 0.999856 |
| DLH | DULUTH INTL | MN | 1 | 0.999960 | 4 | 0.999871 |
| INL | FALLS INTL | MN | 1 | 0.999960 | 2 | 0.999892 |
| MSP | MINNEAPOLIS-ST PAUL INTL | MN | 1 | 0.999960 | 2 | 0.999841 |
| RGK | RED WING RGNL | MN | 1 | 0.999960 | 2 | 0.999827 |
| RST | ROCHESTER INTL | MN | 1 | 0.999960 | 2 | 0.999821 |
| ROX | ROSEAU MUNICIPAL/ RUDY BILLBERG FIELD | MN | 1 | 0.999960 | 2 | 0.999855 |
| MML | SOUTHWEST MINNESOTA RGNL MARSH | MN | 1 | 0.999960 | 2 | 0.999855 |
| STC | ST CLOUD RGNL | MN | 1 | 0.999960 | 3 | 0.999854 |
| JYG | ST JAMES MUNICIPAL | MN | 1 | 0.999960 | 2 | 0.999831 |
| STP | ST PAUL DOWNTOWN HOLMAN FLD | MN | 1 | 0.999960 | 2 | 0.999840 |
| RRT | WARROAD INTL MEMORIAL | MN | 1 | 0.999960 | 2 | 0.999857 |
| BDH | WILLMAR MUNICIPAL- JOHN L RICE FIELD | MN | 1 | 0.999960 | 3 | 0.999856 |
| M17 | BOLIVAR MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999868 |
| CGI | CAPE GIRARDEAU RGNL | MO | 1 | 0.999960 | 2 | 0.999920 |
| M05 | CARUTHERSVILLE MEMORIAL | MO | 1 | 0.999960 | 2 | 0.999915 |
| MKC | CHARLES B. WHEELER DOWNTOWN | MO | 1 | 0.999960 | 3 | 0.999864 |
| COU | COLUMBIA RGNL | MO | 1 | 0.999960 | 2 | 0.999880 |
| 1H0 | CREVE COEUR | MO | 1 | 0.999960 | 2 | 0.999918 |
| DXE | DEXTER MUNICIPAL | MO | 1 | 0.999960 | 2 | 0.999916 |
| LBO | FLOYD W. JONES LEBANON | MO | 1 | 0.999960 | 3 | 0.999864 |
| K57 | GOULD PETERSON MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999845 |
| HIG | HIGGINSVILLE INDUSTRIAL MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999864 |
| JEF | JEFFERSON CITY MEMORIAL | MO | 1 | 0.999960 | 2 | 0.999880 |
| VER | JESSE VIERTEL MEMORIAL | MO | 1 | 0.999960 | 3 | 0.999878 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| JLN | JOPLIN RGNL | MO | 1 | 0.999960 | 3 | 0.999868 |
| MCI | KANSAS CITY INTL | MO | 1 | 0.999960 | 3 | 0.999862 |
| TKX | KENNETT MEMORIAL | MO | 1 | 0.999960 | 2 | 0.999907 |
| IRK | KIRKSVILLE RGNL | MO | 1 | 0.999960 | 2 | 0.999865 |
| STL | LAMBERT-ST LOUIS INTL | MO | 1 | 0.999960 | 2 | 0.999919 |
| LRY | LAWRENCE SMITH MEMORIAL | MO | 1 | 0.999960 | 3 | 0.999865 |
| AIZ | LEE C FINE MEMORIAL | MO | 1 | 0.999960 | 3 | 0.999871 |
| LXT | LEE'S SUMMIT MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999864 |
| 6M6 | LEWIS COUNTY RGNL | MO | 1 | 0.999960 | 2 | 0.999888 |
| MHL | MARSHALL MEMORIAL MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999863 |
| MYJ | MEXICO MEMORIAL | MO | 1 | 0.999960 | 2 | 0.999890 |
| GPH | MIDWEST NATIONAL AIR CENTER | MO | 1 | 0.999960 | 3 | 0.999858 |
| M58 | MONETT MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999870 |
| EOS | NEOSHO HUGH ROBINSON | MO | 1 | 0.999960 | 3 | 0.999871 |
| POF | POPLAR BLUFF MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999902 |
| STJ | ROSECRANS MEMORIAL | MO | 1 | 0.999960 | 3 | 0.999857 |
| DMO | SEDALIA MEMORIAL | MO | 1 | 0.999960 | 3 | 0.999859 |
| SIK | SIKESTON MEMORIAL MUNICIPAL | MO | 1 | 0.999960 | 2 | 0.999920 |
| RCM | SKYHAVEN | MO | 1 | 0.999960 | 3 | 0.999861 |
| SGF | SPRINGFIELD-BRANSON NATIONAL | MO | 1 | 0.999960 | 3 | 0.999870 |
| TBN | WAYNESVILLE RGNL ARPT AT FORNE | MO | 1 | 0.999960 | 3 | 0.999872 |
| UNO | WEST PLAINS MUNICIPAL | MO | 1 | 0.999960 | 3 | 0.999864 |
| STF | GEORGE M BRYAN | MS | 1 | 0.999960 | 2 | 0.999890 |
| GTR | GOLDEN TRIANGLE RGNL | MS | 1 | 0.999960 | 2 | 0.999899 |
| GWO | GREENWOOD-LEFLORE | MS | 1 | 0.999960 | 3 | 0.999867 |
| GNF | GRENADA MUNICIPAL | MS | 1 | 0.999960 | 2 | 0.999865 |
| GPT | GULFPORT-BILOXI INTL | MS | 1 | 0.999960 | 2 | 0.999918 |
| HEZ | HARDY-ANDERS FIELD NATCHEZ-ADA | MS | 1 | 0.999960 | 4 | 0.999872 |
| HBG | HATTIESBURG BOBBY L CHAIN MUNICIPAL | MS | 1 | 0.999960 | 2 | 0.999905 |
| PIB | HATTIESBURG-LAUREL RGNL | MS | 1 | 0.999960 | 2 | 0.999901 |
| LUL | HESLER-NOBLE FIELD | MS | 1 | 0.999960 | 2 | 0.999900 |
| JAN | JACKSON-EVERS INTL | MS | 1 | 0.999960 | 3 | 0.999881 |
| M16 | JOHN BELL WILLIAMS | MS | 1 | 0.999960 | 3 | 0.999875 |
| MEI | KEY FIELD | MS | 1 | 0.999960 | 2 | 0.999896 |
| MCB | MC COMB/PIKE COUNTY | MS | 1 | 0.999960 | 3 | 0.999888 |
| M40 | MONROE COUNTY | MS | 1 | 0.999960 | 2 | 0.999907 |
| OLV | OLIVE BRANCH | MS | 1 | 0.999960 | 2 | 0.999878 |
| MJD | PICAYUNE MUNICIPAL | MS | 1 | 0.999960 | 2 | 0.999910 |
| M43 | PRENTISS-JEFFERSON DAVIS COUNT | MS | 1 | 0.999960 | 2 | 0.999893 |
| CRX | ROSCOE TURNER | MS | 1 | 0.999960 | 2 | 0.999907 |
| HSA | STENNIS INTL | MS | 1 | 0.999960 | 2 | 0.999914 |
| PQL | TRENT LOTT INTL | MS | 1 | 0.999960 | 2 | 0.999924 |
| UTA | TUNICA MUNICIPAL | MS | 1 | 0.999960 | 3 | 0.999864 |
| UOX | UNIVERSITY-OXFORD | MS | 1 | 0.999960 | 2 | 0.999874 |
| BTM | BERT MOONEY | MT | 1 | 0.999970 | 3 | 0.999822 |
| BIL | BILLINGS LOGAN INTL | MT | 1 | 0.999967 | 4 | 0.999727 |
| MLS | FRANK WILEY FIELD | MT | 1 | 0.999967 | 5 | 0.999782 |
| GPI | GLACIER PARK INTL | MT | 1 | 0.999970 | 2 | 0.999965 |
| GTF | GREAT FALLS INTL | MT | 1 | 0.999970 | 4 | 0.999804 |
| HLN | HELENA RGNL | MT | 1 | 0.999970 | 4 | 0.999812 |
| LWT | LEWISTOWN MUNICIPAL | MT | 1 | 0.999967 | 4 | 0.999750 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| OAJ | ALBERT J ELLIS | NC | 2 | 0.999959 | 2 | 0.999959 |
| AFP | ANSON COUNTY | NC | 1 | 0.999959 | 2 | 0.999945 |
| HBI | ASHEBORO RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| AVL | ASHEVILLE RGNL | NC | 1 | 0.999960 | 2 | 0.999945 |
| CLT | CHARLOTTE/DOUGLAS INTL | NC | 1 | 0.999959 | 2 | 0.999953 |
| JQF | CONCORD RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| EWN | CRAVEN COUNTY RGNL | NC | 2 | 0.999959 | 2 | 0.999959 |
| ECG | ELIZABETH CITY CG AIR STATION | NC | 1 | 0.999959 | 1 | 0.999959 |
| FAY | FAYETTEVILLE RGNL/GRANNIS FIELD | NC | 1 | 0.999959 | 2 | 0.999951 |
| LHZ | FRANKLIN COUNTY | NC | 1 | 0.999959 | 1 | 0.999959 |
| AKH | GASTONIA MUNICIPAL | NC | 1 | 0.999959 | 2 | 0.999951 |
| GWW | GOLDSBORO-WAYNE MUNICIPAL | NC | 1 | 0.999959 | 1 | 0.999959 |
| HRJ | HARNETT RGNL JETPORT | NC | 1 | 0.999959 | 1 | 0.999959 |
| HNZ | HENDERSON-OXFORD | NC | 1 | 0.999959 | 1 | 0.999959 |
| ISO | KINSTON RGNL JETPORT | NC | 2 | 0.999959 | 2 | 0.999959 |
| EQY | MONROE RGNL | NC | 1 | 0.999959 | 2 | 0.999950 |
| EDE | NORTHEASTERN RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| GSO | PIEDMONT TRIAD INTL | NC | 1 | 0.999959 | 1 | 0.999959 |
| PGV | PITT-GREENVILLE | NC | 2 | 0.999959 | 2 | 0.999959 |
| RDU | RALEIGH-DURHAM INTL | NC | 1 | 0.999959 | 1 | 0.999959 |
| RWI | ROCKY MOUNT-WILSON RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| RUQ | ROWAN COUNTY | NC | 1 | 0.999959 | 1 | 0.999959 |
| TTA | SANFORD-LEE COUNTY RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| SVH | STATESVILLE RGNL | NC | 1 | 0.999959 | 1 | 0.999959 |
| ILM | WILMINGTON INTL | NC | 2 | 0.999959 | 3 | 0.999937 |
| BIS | BISMARCK MUNICIPAL | ND | 1 | 0.999966 | 6 | 0.999836 |
| 5N8 | CASSELTON ROBERT MILLER RGNL | ND | 1 | 0.999960 | 5 | 0.999851 |
| DVL | DEVILS LAKE RGNL | ND | 1 | 0.999960 | 3 | 0.999902 |
| DIK | DICKINSON - THEODORE ROOSEVELT | ND | 1 | 0.999966 | 6 | 0.999810 |
| GFK | GRAND FORKS INTL | ND | 1 | 0.999960 | 3 | 0.999918 |
| FAR | HECTOR INTL | ND | 1 | 0.999960 | 5 | 0.999855 |
| JMS | JAMESTOWN RGNL | ND | 1 | 0.999960 | 5 | 0.999839 |
| MOT | MINOT INTL | ND | 1 | 0.999966 | 2 | 0.999879 |
| ANW | AINSWORTH MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999847 |
| BVN | ALBION MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999840 |
| AIA | ALLIANCE MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999760 |
| AUH | AURORA MUNICIPAL – AL POTTER FIELD | NE | 1 | 0.999960 | 3 | 0.999851 |
| BIE | BEATRICE MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999857 |
| FNB | BRENNER FIELD | NE | 1 | 0.999960 | 3 | 0.999852 |
| HDE | BREWSTER FIELD | NE | 1 | 0.999966 | 3 | 0.999871 |
| BBW | BROKEN BOW MUNICIPAL | NE | 1 | 0.999966 | 3 | 0.999863 |
| GRI | CENTRAL NEBRASKA RGNL | NE | 1 | 0.999960 | 3 | 0.999853 |
| CDR | CHADRON MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999751 |
| OLU | COLUMBUS MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999839 |
| CZD | COZAD MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999860 |
| CEK | CRETE MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999854 |
| OMA | EPPLEY AIRFIELD | NE | 1 | 0.999960 | 3 | 0.999837 |
| FBY | FAIRBURY MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999854 |
| FET | FREMONT MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999840 |
| OKS | GARDEN COUNTY | NE | 1 | 0.999966 | 4 | 0.999771 |
| GRN | GORDON MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999763 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| GGF | GRANT MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999784 |
| HSI | HASTINGS MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999859 |
| IML | IMPERIAL MUNICIPAL | NE | 1 | 0.999966 | 4 | 0.999787 |
| LXN | JIM KELLY FIELD | NE | 1 | 0.999966 | 4 | 0.999863 |
| OFK | KARL STEFAN MEMORIAL | NE | 1 | 0.999960 | 3 | 0.999839 |
| EAR | KEARNEY RGNL | NE | 1 | 0.999966 | 3 | 0.999867 |
| IBM | KIMBALL MUNICIPAL/ ROBERT E ARRAJ FIELD | NE | 1 | 0.999966 | 6 | 0.999748 |
| LNK | LINCOLN | NE | 1 | 0.999960 | 3 | 0.999850 |
| MCK | MC COOK RGNL | NE | 1 | 0.999966 | 4 | 0.999807 |
| MLE | MILLARD | NE | 1 | 0.999960 | 3 | 0.999840 |
| VTN | MILLER FIELD | NE | 1 | 0.999966 | 4 | 0.999838 |
| AFK | NEBRASKA CITY MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999847 |
| LBF | NORTH PLATTE RGNL AIRPORT LEE | NE | 1 | 0.999966 | 4 | 0.999797 |
| PMV | PLATTSMOUTH MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999842 |
| SCB | SCRIBNER STATE | NE | 1 | 0.999960 | 3 | 0.999839 |
| OGA | SEARLE FIELD | NE | 1 | 0.999966 | 4 | 0.999784 |
| SWT | SEWARD MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999844 |
| SNY | SIDNEY MUNICIPAL/ LLOYD W. CARR FIELD | NE | 1 | 0.999966 | 5 | 0.999761 |
| ONL | THE O'NEILL MUNICIPAL- JOHN L BAKER | NE | 1 | 0.999960 | 3 | 0.999835 |
| AHQ | WAHOO MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999844 |
| LCG | WAYNE MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999832 |
| BFF | WESTERN NEB. RGNL | NE | 1 | 0.999966 | 5 | 0.999746 |
| JYR | YORK MUNICIPAL | NE | 1 | 0.999960 | 3 | 0.999849 |
| ASH | BOIRE FIELD | NH | 2 | 0.999958 | 3 | 0.999924 |
| CON | CONCORD MUNICIPAL | NH | 2 | 0.999958 | 3 | 0.999924 |
| EEN | DILLANT-HOPKINS | NH | 2 | 0.999958 | 3 | 0.999925 |
| LCI | LACONIA MUNICIPAL | NH | 2 | 0.999958 | 3 | 0.999924 |
| MHT | MANCHESTER | NH | 2 | 0.999958 | 3 | 0.999924 |
| PSM | PORTSMOUTH INTL AT PEASE | NH | 2 | 0.999958 | 4 | 0.999924 |
| ACY | ATLANTIC CITY INTL | NJ | 1 | 0.999959 | 1 | 0.999959 |
| WWD | CAPE MAY COUNTY | NJ | 1 | 0.999959 | 1 | 0.999959 |
| MIV | MILLVILLE MUNICIPAL | NJ | 1 | 0.999959 | 1 | 0.999959 |
| EWR | NEWARK LIBERTY INTL | NJ | 2 | 0.999958 | 2 | 0.999958 |
| TEB | TETERBORO | NJ | 2 | 0.999958 | 2 | 0.999958 |
| ABQ | ALBUQUERQUE INTL SUNPORT | NM | 1 | 0.999967 | 5 | 0.999555 |
| CVN | CLOVIS MUNICIPAL | NM | 1 | 0.999966 | 4 | 0.999754 |
| AEG | DOUBLE EAGLE II | NM | 1 | 0.999967 | 5 | 0.999560 |
| FMN | FOUR CORNERS RGNL | NM | 1 | 0.999967 | 6 | 0.999541 |
| SVC | GRANT COUNTY | NM | 1 | 0.999967 | 7 | 0.999546 |
| LRU | LAS CRUCES INTL | NM | 1 | 0.999967 | 6 | 0.999513 |
| ROW | ROSWELL INTL AIR CENTER | NM | 1 | 0.999966 | 5 | 0.999484 |
| LAS | MC CARRAN INTL | NV | 1 | 0.999970 | 8 | 0.999391 |
| 4SD | RENO/STEAD | NV | 1 | 0.999970 | 57 | 0.997676 |
| RNO | RENO/TAHOE INTL | NV | 1 | 0.999970 | 57 | 0.997833 |
| WMC | WINNEMUCCA MUNICIPAL | NV | 1 | 0.999970 | 2 | 0.999933 |
| 9G3 | AKRON | NY | 1 | 0.999959 | 2 | 0.999926 |
| ALB | ALBANY INTL | NY | 1 | 0.999959 | 2 | 0.999926 |
| HWV | BROOKHAVEN | NY | 2 | 0.999958 | 2 | 0.999958 |
| BUF | BUFFALO NIAGARA INTL | NY | 1 | 0.999959 | 3 | 0.999917 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| OLE | CATTARAUGUS COUNTY-OLEAN | NY | 1 | 0.999959 | 3 | 0.999915 |
| JHW | CHAUTAUQUA COUNTY/JAMESTOWN | NY | 1 | 0.999959 | 3 | 0.999909 |
| ELM | ELMIRA/CORNING RGNL | NY | 1 | 0.999959 | 2 | 0.999925 |
| FOK | FRANCIS S GABRESKI | NY | 2 | 0.999958 | 3 | 0.999958 |
| BGM | GREATER BINGHAMTON | NY | 1 | 0.999959 | 2 | 0.999925 |
| ROC | GREATER ROCHESTER INTL | NY | 1 | 0.999959 | 2 | 0.999925 |
| JFK | JOHN F KENNEDY INTL | NY | 2 | 0.999958 | 2 | 0.999958 |
| LGA | LA GUARDIA | NY | 2 | 0.999958 | 2 | 0.999958 |
| MSS | MASSENA INTL-RICHARDS FIELD | NY | 1 | 0.999959 | 4 | 0.999925 |
| N66 | ONEONTA MUNICIPAL | NY | 1 | 0.999959 | 2 | 0.999925 |
| PEO | PENN YAN | NY | 1 | 0.999959 | 2 | 0.999925 |
| PBG | PLATTSBURGH INTL | NY | 1 | 0.999959 | 4 | 0.999924 |
| 44N | SKY ACRES | NY | 2 | 0.999958 | 3 | 0.999926 |
| SWF | STEWART INTL | NY | 2 | 0.999958 | 3 | 0.999951 |
| SYR | SYRACUSE HANCOCK INTL | NY | 1 | 0.999959 | 2 | 0.999925 |
| ELZ | WELLSVILLE MUNICIPAL ARPT`TARANTINE | NY | 1 | 0.999959 | 2 | 0.999926 |
| HPN | WESTCHESTER COUNTY | NY | 2 | 0.999958 | 2 | 0.999958 |
| SDC | WILLIAMSON-SODUS | NY | 1 | 0.999959 | 2 | 0.999925 |
| HAO | BUTLER CO RGNL | OH | 1 | 0.999960 | 1 | 0.999960 |
| CXY | CAPITAL CITY | OH | 1 | 0.999959 | 1 | 0.999959 |
| LUK | CINCINNATI MUNICIPAL AIRPORT LUNKEN | OH | 1 | 0.999960 | 1 | 0.999960 |
| CLE | CLEVELAND-HOPKINS INTL | OH | 1 | 0.999959 | 2 | 0.999911 |
| MGY | DAYTON-WRIGHT BROTHERS | OH | 1 | 0.999960 | 1 | 0.999960 |
| DLZ | DELAWARE MUNICIPAL | OH | 1 | 0.999960 | 1 | 0.999960 |
| LHQ | FAIRFIELD COUNTY | OH | 1 | 0.999959 | 1 | 0.999959 |
| FDY | FINDLAY | OH | 1 | 0.999960 | 2 | 0.999956 |
| PMH | GREATER PORTSMOUTH RGNL | OH | 1 | 0.999960 | 1 | 0.999960 |
| I19 | GREENE COUNTY-LEWIS A. JACKSON | OH | 1 | 0.999960 | 1 | 0.999960 |
| DAY | JAMES M COX DAYTON INTL | OH | 1 | 0.999960 | 1 | 0.999960 |
| 1G3 | KENT STATE UNIV | OH | 1 | 0.999959 | 2 | 0.999920 |
| I68 | LEBANON-WARREN COUNTY | OH | 1 | 0.999960 | 1 | 0.999960 |
| UYF | MADISON COUNTY | OH | 1 | 0.999960 | 1 | 0.999960 |
| MNN | MARION MUNICIPAL | OH | 1 | 0.999960 | 2 | 0.999958 |
| AXV | NEIL ARMSTRONG | OH | 1 | 0.999960 | 1 | 0.999960 |
| OSU | OHIO STATE UNIVERSITY | OH | 1 | 0.999960 | 1 | 0.999960 |
| UNI | OHIO UNIVERSITY SNYDER FIELD | OH | 1 | 0.999959 | 1 | 0.999959 |
| CMH | PORT COLUMBUS INTL | OH | 1 | 0.999960 | 1 | 0.999960 |
| RZT | ROSS COUNTY | OH | 1 | 0.999960 | 1 | 0.999960 |
| TOL | TOLEDO EXPRESS | OH | 1 | 0.999959 | 2 | 0.999938 |
| 1G0 | WOOD COUNTY | OH | 1 | 0.999959 | 2 | 0.999941 |
| YNG | YOUNGSTOWN-WARREN RGNL | OH | 1 | 0.999959 | 2 | 0.999921 |
| AVK | ALVA RGNL | OK | 1 | 0.999960 | 5 | 0.999836 |
| BVO | BARTLESVILLE MUNICIPAL | OK | 1 | 0.999960 | 3 | 0.999827 |
| CQB | CHANDLER RGNL | OK | 1 | 0.999960 | 4 | 0.999837 |
| CHK | CHICKASHA MUNICIPAL | OK | 1 | 0.999960 | 5 | 0.999879 |
| GCM | CLAREMORE RGNL | OK | 1 | 0.999960 | 3 | 0.999827 |
| F29 | CLARENCE E PAGE MUNICIPAL | OK | 1 | 0.999960 | 5 | 0.999841 |
| 1K4 | DAVID JAY PERRY | OK | 1 | 0.999960 | 5 | 0.999841 |
| MKO | DAVIS FIELD | OK | 1 | 0.999960 | 3 | 0.999829 |
| DUA | EAKER FIELD | OK | 1 | 0.999960 | 5 | 0.999877 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| ELK | ELK CITY RGNL BUSINESS | OK | 1 | 0.999966 | 6 | 0.999866 |
| GMJ | GROVE MUNICIPAL | OK | 1 | 0.999960 | 3 | 0.999876 |
| GOK | GUTHRIE-EDMOND RGNL | OK | 1 | 0.999960 | 5 | 0.999836 |
| 2O8 | HINTON MUNICIPAL | OK | 1 | 0.999960 | 5 | 0.999880 |
| HBR | HOBART RGNL | OK | 1 | 0.999966 | 6 | 0.999873 |
| MLC | MC ALESTER RGNL | OK | 1 | 0.999960 | 4 | 0.999836 |
| MIO | MIAMI MUNICIPAL | OK | 1 | 0.999960 | 3 | 0.999874 |
| MDF | MOORELAND MUNICIPAL | OK | 1 | 0.999966 | 6 | 0.999835 |
| OKM | OKMULGEE RGNL | OK | 1 | 0.999960 | 3 | 0.999833 |
| PVJ | PAULS VALLEY MUNICIPAL | OK | 1 | 0.999960 | 5 | 0.999846 |
| PNC | PONCA CITY RGNL | OK | 1 | 0.999960 | 3 | 0.999833 |
| RVS | RICHARD LLOYD JONES JR | OK | 1 | 0.999960 | 3 | 0.999830 |
| 2K4 | SCOTT FIELD | OK | 1 | 0.999966 | 6 | 0.999862 |
| SNL | SHAWNEE RGNL | OK | 1 | 0.999960 | 5 | 0.999836 |
| SWO | STILLWATER RGNL | OK | 1 | 0.999960 | 4 | 0.999835 |
| TQH | TAHLEQUAH MUNICIPAL | OK | 1 | 0.999960 | 3 | 0.999827 |
| TUL | TULSA INTL | OK | 1 | 0.999960 | 3 | 0.999832 |
| OUN | UNIVERSITY OF OKLAHOMA WESTHEI | OK | 1 | 0.999960 | 5 | 0.999840 |
| OKC | WILL ROGERS WORLD | OK | 1 | 0.999960 | 5 | 0.999840 |
| UAO | AURORA STATE | OR | 1 | 0.999970 | 43 | 0.997905 |
| BDN | BEND MUNICIPAL | OR | 1 | 0.999970 | 23 | 0.998735 |
| LMT | KLAMATH FALLS | OR | 1 | 0.999970 | 59 | 0.996375 |
| LGD | LA GRANDE/UNION COUNTY | OR | 1 | 0.999970 | 3 | 0.999941 |
| EUG | MAHLON SWEET FIELD | OR | 2 | 0.999946 | 62 | 0.994778 |
| MMV | MC MINNVILLE MUNICIPAL | OR | 1 | 0.999970 | 52 | 0.996954 |
| SLE | MCNARY FLD | OR | 2 | 0.999970 | 54 | 0.996629 |
| ONP | NEWPORT MUNICIPAL | OR | 2 | 0.999923 | 67 | 0.992765 |
| ONO | ONTARIO MUNICIPAL | OR | 1 | 0.999970 | 1 | 0.999970 |
| PDX | PORTLAND INTL | OR | 1 | 0.999970 | 28 | 0.998534 |
| AGC | ALLEGHENY COUNTY | PA | 1 | 0.999959 | 2 | 0.999940 |
| AOO | ALTOONA-BLAIR COUNTY | PA | 1 | 0.999959 | 3 | 0.999957 |
| LBE | ARNOLD PALMER RGNL | PA | 1 | 0.999959 | 2 | 0.999949 |
| BFD | BRADFORD RGNL | PA | 1 | 0.999959 | 3 | 0.999937 |
| BTP | BUTLER COUNTY/K W SCHOLTER FIE | PA | 1 | 0.999959 | 2 | 0.999936 |
| MQS | CHESTER COUNTY G O CARLSON | PA | 2 | 0.999959 | 2 | 0.999959 |
| AXQ | CLARION COUNTY | PA | 1 | 0.999959 | 2 | 0.999930 |
| 9D4 | DECK | PA | 1 | 0.999959 | 2 | 0.999958 |
| DUJ | DUBOIS RGNL | PA | 1 | 0.999959 | 3 | 0.999929 |
| WAY | GREENE COUNTY | PA | 1 | 0.999959 | 2 | 0.999952 |
| HZL | HAZLETON MUNICIPAL | PA | 1 | 0.999959 | 2 | 0.999931 |
| JST | JOHN MURTHA JOHNSTOWN-CAMBRIA | PA | 1 | 0.999959 | 2 | 0.999952 |
| LNS | LANCASTER | PA | 1 | 0.999959 | 1 | 0.999959 |
| ABE | LEHIGH VALLEY INTL | PA | 2 | 0.999959 | 3 | 0.999944 |
| RVL | MIFFLIN COUNTY | PA | 1 | 0.999959 | 2 | 0.999958 |
| UCP | NEW CASTLE MUNICIPAL | PA | 1 | 0.999959 | 2 | 0.999926 |
| PNE | NORTHEAST PHILADELPHIA | PA | 1 | 0.999959 | 2 | 0.999958 |
| PHL | PHILADELPHIA INTL | PA | 1 | 0.999959 | 2 | 0.999957 |
| PIT | PITTSBURGH INTL | PA | 1 | 0.999959 | 2 | 0.999935 |
| FWQ | ROSTRAVER | PA | 1 | 0.999959 | 2 | 0.999943 |
| 2G9 | SOMERSET COUNTY | PA | 1 | 0.999959 | 2 | 0.999958 |
| OYM | ST MARYS MUNICIPAL | PA | 1 | 0.999959 | 3 | 0.999944 |
| UNV | UNIVERSITY PARK | PA | 1 | 0.999959 | 2 | 0.999958 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| FKL | VENANGO RGNL | PA | 1 | 0.999959 | 2 | 0.999921 |
| BID | BLOCK ISLAND STATE | RI | 2 | 0.999958 | 3 | 0.999950 |
| OQU | QUONSET STATE | RI | 2 | 0.999958 | 3 | 0.999949 |
| PVD | THEODORE FRANCIS GREEN STATE | RI | 2 | 0.999958 | 3 | 0.999949 |
| AIK | AIKEN MUNICIPAL | SC | 1 | 0.999959 | 2 | 0.999838 |
| AND | ANDERSON RGNL | SC | 1 | 0.999960 | 2 | 0.999854 |
| CHS | CHARLESTON AFB/INTL | SC | 1 | 0.999959 | 2 | 0.999847 |
| JZI | CHARLESTON EXECUTIVE | SC | 1 | 0.999959 | 2 | 0.999837 |
| CAE | COLUMBIA METROPOLITAN | SC | 1 | 0.999959 | 2 | 0.999877 |
| UDG | DARLINGTON COUNTY JETPORT | SC | 1 | 0.999959 | 2 | 0.999922 |
| GYH | DONALDSON CENTER | SC | 1 | 0.999960 | 2 | 0.999890 |
| GGE | GEORGETOWN COUNTY | SC | 1 | 0.999959 | 2 | 0.999880 |
| GSP | GREENVILLE SPARTANBURG INTL | SC | 1 | 0.999960 | 2 | 0.999904 |
| MYR | MYRTLE BEACH INTL | SC | 1 | 0.999959 | 2 | 0.999900 |
| CEU | OCONEE COUNTY RGNL | SC | 1 | 0.999960 | 2 | 0.999859 |
| CDN | WOODWARD FIELD | SC | 1 | 0.999959 | 2 | 0.999906 |
| ABR | ABERDEEN RGNL | SD | 1 | 0.999960 | 4 | 0.999870 |
| BKX | BROOKINGS RGNL | SD | 1 | 0.999960 | 3 | 0.999860 |
| YKN | CHAN GURNEY MUNICIPAL | SD | 1 | 0.999960 | 3 | 0.999826 |
| HON | HURON RGNL | SD | 1 | 0.999960 | 3 | 0.999872 |
| FSD | JOE FOSS FIELD | SD | 1 | 0.999960 | 3 | 0.999840 |
| MHE | MITCHELL MUNICIPAL | SD | 1 | 0.999960 | 3 | 0.999855 |
| PIR | PIERRE RGNL | SD | 1 | 0.999966 | 4 | 0.999856 |
| RAP | RAPID CITY RGNL | SD | 1 | 0.999966 | 4 | 0.999761 |
| ATY | WATERTOWN RGNL | SD | 1 | 0.999960 | 3 | 0.999868 |
| PVE | BEECH RIVER RGNL | TN | 1 | 0.999960 | 2 | 0.999932 |
| SYI | BOMAR FIELD-SHELBYVILLE MUNICIPAL | TN | 1 | 0.999960 | 1 | 0.999960 |
| UCY | EVERETT-STEWART RGNL | TN | 1 | 0.999960 | 2 | 0.999920 |
| CHA | LOVELL FIELD | TN | 1 | 0.999960 | 1 | 0.999960 |
| TYS | MC GHEE TYSON | TN | 1 | 0.999960 | 1 | 0.999960 |
| MEM | MEMPHIS INTL | TN | 1 | 0.999960 | 2 | 0.999874 |
| NQA | MILLINGTON RGNL JETPORT | TN | 1 | 0.999960 | 2 | 0.999889 |
| BNA | NASHVILLE INTL | TN | 1 | 0.999960 | 1 | 0.999960 |
| SZY | ROBERT SIBLEY | TN | 1 | 0.999960 | 2 | 0.999915 |
| TRI | TRI-CITIES RGNL TN/VA | TN | 1 | 0.999959 | 1 | 0.999959 |
| BGF | WINCHESTER MUNICIPAL | TN | 1 | 0.999960 | 1 | 0.999960 |
| ABI | ABILENE RGNL | TX | 1 | 0.999966 | 4 | 0.999871 |
| ADS | ADDISON | TX | 1 | 0.999960 | 5 | 0.999885 |
| ALI | ALICE INTL | TX | 1 | 0.999966 | 8 | 0.999580 |
| LFK | ANGELINA COUNTY | TX | 1 | 0.999960 | 5 | 0.999877 |
| GKY | ARLINGTON MUNICIPAL | TX | 1 | 0.999960 | 5 | 0.999886 |
| AUS | AUSTIN-BERGSTROM INTL | TX | 1 | 0.999966 | 4 | 0.999910 |
| LBX | BRAZORIA COUNTY | TX | 1 | 0.999960 | 5 | 0.999815 |
| BWD | BROWNWOOD RGNL | TX | 1 | 0.999966 | 4 | 0.999886 |
| E30 | BRUCE FIELD | TX | 1 | 0.999966 | 5 | 0.999727 |
| TKI | COLLIN COUNTY RGNL | TX | 1 | 0.999960 | 5 | 0.999881 |
| CRP | CORPUS CHRISTI INTL | TX | 1 | 0.999966 | 8 | 0.999616 |
| CFD | COULTER FIELD | TX | 1 | 0.999966 | 3 | 0.999916 |
| PRX | COX FIELD | TX | 1 | 0.999960 | 5 | 0.999838 |
| BBD | CURTIS FIELD | TX | 1 | 0.999966 | 5 | 0.999765 |
| RBD | DALLAS EXECUTIVE | TX | 1 | 0.999960 | 5 | 0.999884 |

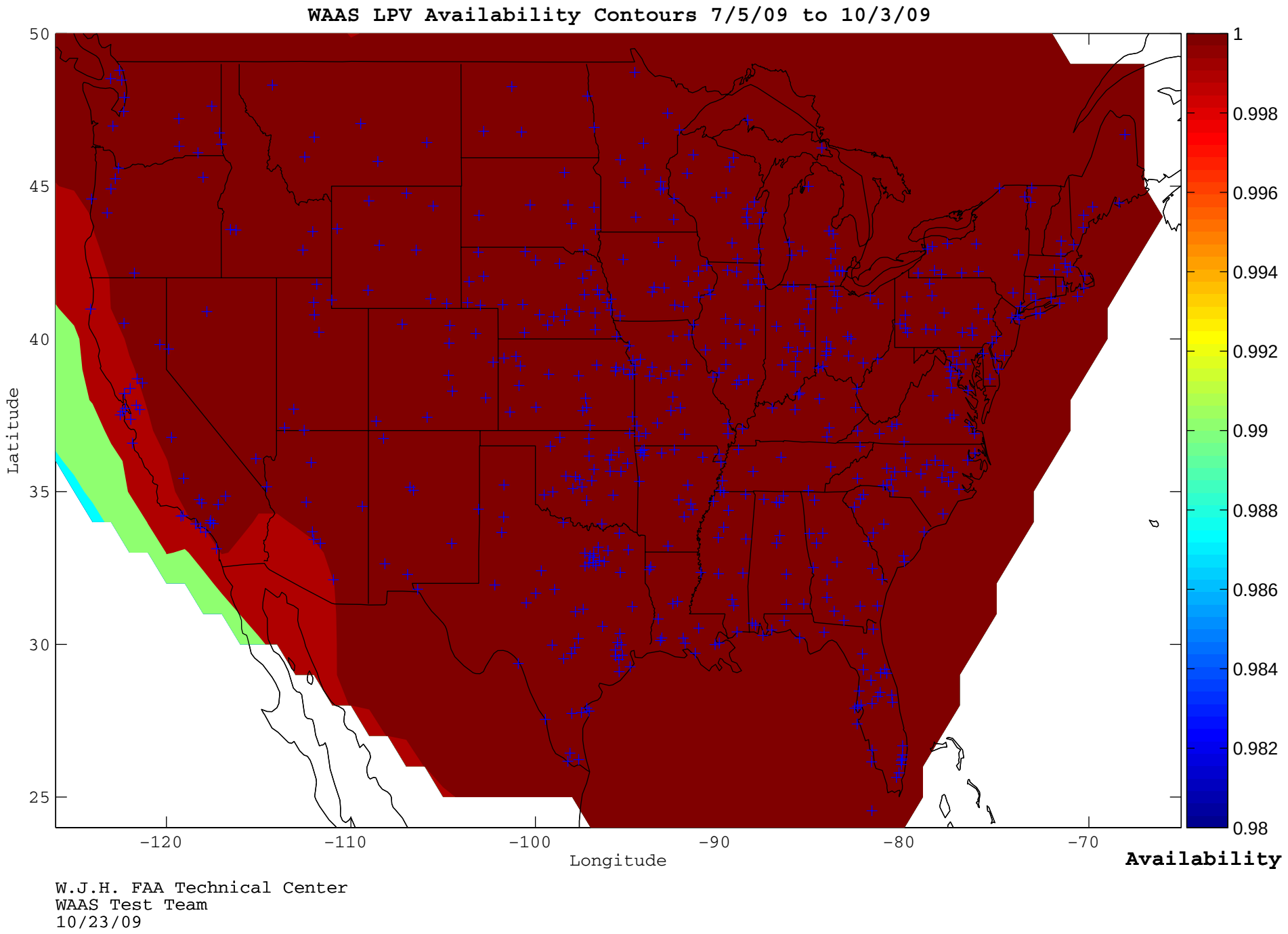
| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| DAL | DALLAS LOVE FIELD | TX | 1 | 0.999960 | 5 | 0.999886 |
| DFW | DALLAS/FORT WORTH INTL | TX | 1 | 0.999960 | 5 | 0.999883 |
| DWH | DAVID WAYNE HOOKS MEMORIAL | TX | 1 | 0.999960 | 3 | 0.999908 |
| LUD | DECATUR MUNICIPAL | TX | 1 | 0.999960 | 5 | 0.999889 |
| DRT | DEL RIO INTL | TX | 1 | 0.999966 | 5 | 0.999442 |
| TPL | DRAUGHON-MILLER CENTRAL TEXAS | TX | 1 | 0.999966 | 3 | 0.999919 |
| GGG | EAST TEXAS RGNL | TX | 1 | 0.999960 | 5 | 0.999872 |
| CLL | EASTERWOOD FIELD | TX | 1 | 0.999966 | 3 | 0.999920 |
| ELP | EL PASO INTL | TX | 1 | 0.999967 | 6 | 0.999481 |
| AFW | FORT WORTH ALLIANCE | TX | 1 | 0.999960 | 5 | 0.999885 |
| FWS | FORT WORTH SPINKS | TX | 1 | 0.999966 | 5 | 0.999897 |
| IAH | GEORGE BUSH INTERCONTINENTAL | TX | 1 | 0.999960 | 3 | 0.999906 |
| PVW | HALE COUNTY | TX | 1 | 0.999966 | 4 | 0.999802 |
| INJ | HILLSBORO MUNICIPAL | TX | 1 | 0.999966 | 4 | 0.999915 |
| TME | HOUSTON EXECUTIVE | TX | 1 | 0.999966 | 3 | 0.999852 |
| AXH | HOUSTON-SOUTHWEST | TX | 1 | 0.999960 | 4 | 0.999827 |
| ERV | KERRVILLE MUNICIPAL/ LOUIS SCHREINER | TX | 1 | 0.999966 | 5 | 0.999672 |
| LNC | LANCASTER | TX | 1 | 0.999960 | 5 | 0.999883 |
| LRD | LAREDO INTL | TX | 1 | 0.999966 | 7 | 0.999486 |
| CXO | LONE STAR EXECUTIVE | TX | 1 | 0.999960 | 4 | 0.999903 |
| LBB | LUBBOCK PRESTON SMITH INTL | TX | 1 | 0.999966 | 5 | 0.999782 |
| GVT | MAJORS | TX | 1 | 0.999960 | 5 | 0.999879 |
| 5T9 | MAVERICK COUNTY MEMORIAL INTL | TX | 1 | 0.999966 | 7 | 0.999437 |
| MFE | MC ALLEN MILLER INTL | TX | 1 | 0.999966 | 8 | 0.999484 |
| HQZ | MESQUITE METRO | TX | 1 | 0.999960 | 5 | 0.999884 |
| MAF | MIDLAND INTL | TX | 1 | 0.999966 | 5 | 0.999540 |
| OSA | MOUNT PLEASANT RGNL | TX | 1 | 0.999960 | 5 | 0.999836 |
| RAS | MUSTANG BEACH | TX | 1 | 0.999966 | 7 | 0.999652 |
| BAZ | NEW BRAUNFELS MUNICIPAL | TX | 1 | 0.999966 | 5 | 0.999730 |
| PIL | PORT ISABEL-CAMERON COUNTY | TX | 1 | 0.999966 | 8 | 0.999513 |
| AMA | RICK HUSBAND AMARILLO INTL | TX | 1 | 0.999966 | 5 | 0.999835 |
| SJT | SAN ANGELO RGNL/MATHIS FIELD | TX | 1 | 0.999966 | 5 | 0.999653 |
| SAT | SAN ANTONIO INTL | TX | 1 | 0.999966 | 5 | 0.999635 |
| HYI | SAN MARCOS MUNICIPAL | TX | 1 | 0.999966 | 5 | 0.999806 |
| GLS | SCHOLES INTL AT GALVESTON | TX | 1 | 0.999960 | 5 | 0.999852 |
| SPS | SHEPPARD AFB/WICHITA FALLS MUN | TX | 1 | 0.999966 | 6 | 0.999883 |
| EBG | SOUTH TEXAS INTL AT EDINBURG | TX | 1 | 0.999966 | 8 | 0.999514 |
| SGR | SUGAR LAND RGNL | TX | 1 | 0.999966 | 4 | 0.999841 |
| TFP | T P MC CAMPBELL | TX | 1 | 0.999966 | 7 | 0.999648 |
| TRL | TERRELL MUNICIPAL | TX | 1 | 0.999960 | 5 | 0.999882 |
| TYR | TYLER POUNDS RGNL | TX | 1 | 0.999960 | 5 | 0.999877 |
| HRL | VALLEY INTL | TX | 1 | 0.999966 | 8 | 0.999512 |
| IWS | WEST HOUSTON | TX | 1 | 0.999966 | 4 | 0.999905 |
| HOU | WILLIAM P HOBBY | TX | 1 | 0.999960 | 4 | 0.999892 |
| CDC | CEDAR CITY RGNL | UT | 1 | 0.999970 | 5 | 0.999602 |
| KNB | KANAB MUNICIPAL | UT | 1 | 0.999970 | 5 | 0.999567 |
| LGU | LOGAN-CACHE | UT | 1 | 0.999970 | 6 | 0.999600 |
| OGD | OGDEN-HINCKLEY | UT | 1 | 0.999970 | 5 | 0.999678 |
| PVU | PROVO MUNICIPAL | UT | 1 | 0.999970 | 5 | 0.999651 |
| SLC | SALT LAKE CITY INTL | UT | 1 | 0.999970 | 5 | 0.999668 |
| SGU | ST GEORGE MUNICIPAL | UT | 1 | 0.999970 | 6 | 0.999569 |

| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| MFV | ACCOMACK COUNTY | VA | 1 | 0.999959 | 1 | 0.999959 |
| MTV | BLUE RIDGE | VA | 1 | 0.999959 | 1 | 0.999959 |
| CHO | CHARLOTTESVILLE-ALBEMARLE | VA | 1 | 0.999959 | 1 | 0.999959 |
| FCI | CHESTERFIELD COUNTY | VA | 1 | 0.999959 | 1 | 0.999959 |
| CJR | CULPEPER RGNL | VA | 1 | 0.999959 | 1 | 0.999959 |
| PTB | DINWIDDIE COUNTY | VA | 1 | 0.999959 | 1 | 0.999959 |
| OFP | HANOVER COUNTY MUNICIPAL | VA | 1 | 0.999959 | 1 | 0.999959 |
| JYO | LEESBURG EXECUTIVE | VA | 1 | 0.999959 | 1 | 0.999959 |
| LNP | LONESOME PINE | VA | 1 | 0.999959 | 1 | 0.999959 |
| LYH | LYNCHBURG RGNL | VA | 1 | 0.999959 | 1 | 0.999959 |
| HEF | MANASSAS RGNL/ HARRY P. DAVIS FIELD | VA | 1 | 0.999959 | 1 | 0.999959 |
| MKJ | MOUNTAIN EMPIRE | VA | 1 | 0.999959 | 1 | 0.999959 |
| PSK | NEW RIVER VALLEY | VA | 1 | 0.999959 | 1 | 0.999959 |
| PHF | NEWPORT NEWS/WILLIAMSBURG INTL | VA | 2 | 0.999959 | 2 | 0.999959 |
| ORF | NORFOLK INTL | VA | 1 | 0.999959 | 1 | 0.999959 |
| RIC | RICHMOND INTL | VA | 1 | 0.999959 | 1 | 0.999959 |
| RMN | STAFFORD RGNL | VA | 1 | 0.999959 | 1 | 0.999959 |
| XSA | TAPPAHANNOCK-ESSEX COUNTY | VA | 2 | 0.999959 | 2 | 0.999959 |
| BCB | VIRGINIA TECH/ MONTGOMERY EXECUTIVE | VA | 1 | 0.999959 | 1 | 0.999959 |
| IAD | WASHINGTON DULLES INTL | VA | 1 | 0.999959 | 1 | 0.999959 |
| BTV | BURLINGTON INTL | VT | 1 | 0.999959 | 2 | 0.999925 |
| FSO | FRANKLIN COUNTY STATE | VT | 1 | 0.999959 | 4 | 0.999924 |
| BLI | BELLINGHAM INTL | WA | 1 | 0.999970 | 8 | 0.999835 |
| HQM | BOWERMAN | WA | 1 | 0.999970 | 40 | 0.998015 |
| PWT | BREMERTON NATIONAL | WA | 1 | 0.999970 | 18 | 0.999255 |
| DEW | DEER PARK | WA | 1 | 0.999970 | 1 | 0.999970 |
| FHR | FRIDAY HARBOR | WA | 1 | 0.999970 | 16 | 0.999687 |
| MWH | GRANT CO INTL | WA | 1 | 0.999970 | 2 | 0.999948 |
| OLM | OLYMPIA | WA | 1 | 0.999970 | 19 | 0.999031 |
| PUW | PULLMAN/MOSCOW RGNL | WA | 1 | 0.999970 | 1 | 0.999970 |
| RLD | RICHLAND | WA | 1 | 0.999970 | 7 | 0.999843 |
| SEA | SEATTLE-TACOMA INTL | WA | 1 | 0.999970 | 16 | 0.999420 |
| BVS | SKAGIT RGNL | WA | 1 | 0.999970 | 8 | 0.999822 |
| PAE | SNOHOMISH COUNTY (PAINE FLD) | WA | 1 | 0.999970 | 16 | 0.999420 |
| GEG | SPOKANE INTL | WA | 1 | 0.999970 | 1 | 0.999970 |
| TIW | TACOMA NARROWS | WA | 1 | 0.999970 | 18 | 0.999192 |
| PSC | TRI-CITIES | WA | 1 | 0.999970 | 6 | 0.999869 |
| ALW | WALLA WALLA RGNL | WA | 1 | 0.999970 | 3 | 0.999935 |
| CLM | WILLIAM R FAIRCHILD INTL | WA | 1 | 0.999970 | 23 | 0.999408 |
| GRB | AUSTIN STRAUBEL INTL | WI | 1 | 0.999960 | 2 | 0.999795 |
| DLL | BARABOO WISCONSIN DELLS | WI | 1 | 0.999960 | 2 | 0.999793 |
| OVS | BOSCOBEL | WI | 1 | 0.999960 | 2 | 0.999794 |
| CWA | CENTRAL WISCONSIN | WI | 1 | 0.999960 | 2 | 0.999807 |
| EAU | CHIPPEWA VALLEY RGNL | WI | 1 | 0.999960 | 2 | 0.999823 |
| MSN | DANE COUNTY RGNL-TRUAX FIELD | WI | 1 | 0.999960 | 2 | 0.999797 |
| UNU | DODGE COUNTY | WI | 1 | 0.999960 | 2 | 0.999796 |
| SUE | DOOR COUNTY CHERRYLAND | WI | 1 | 0.999960 | 2 | 0.999810 |
| EGV | EAGLE RIVER UNION | WI | 1 | 0.999960 | 2 | 0.999837 |
| FLD | FOND DU LAC COUNTY | WI | 1 | 0.999960 | 2 | 0.999782 |
| MKE | GENERAL MITCHELL INTL | WI | 1 | 0.999960 | 2 | 0.999808 |

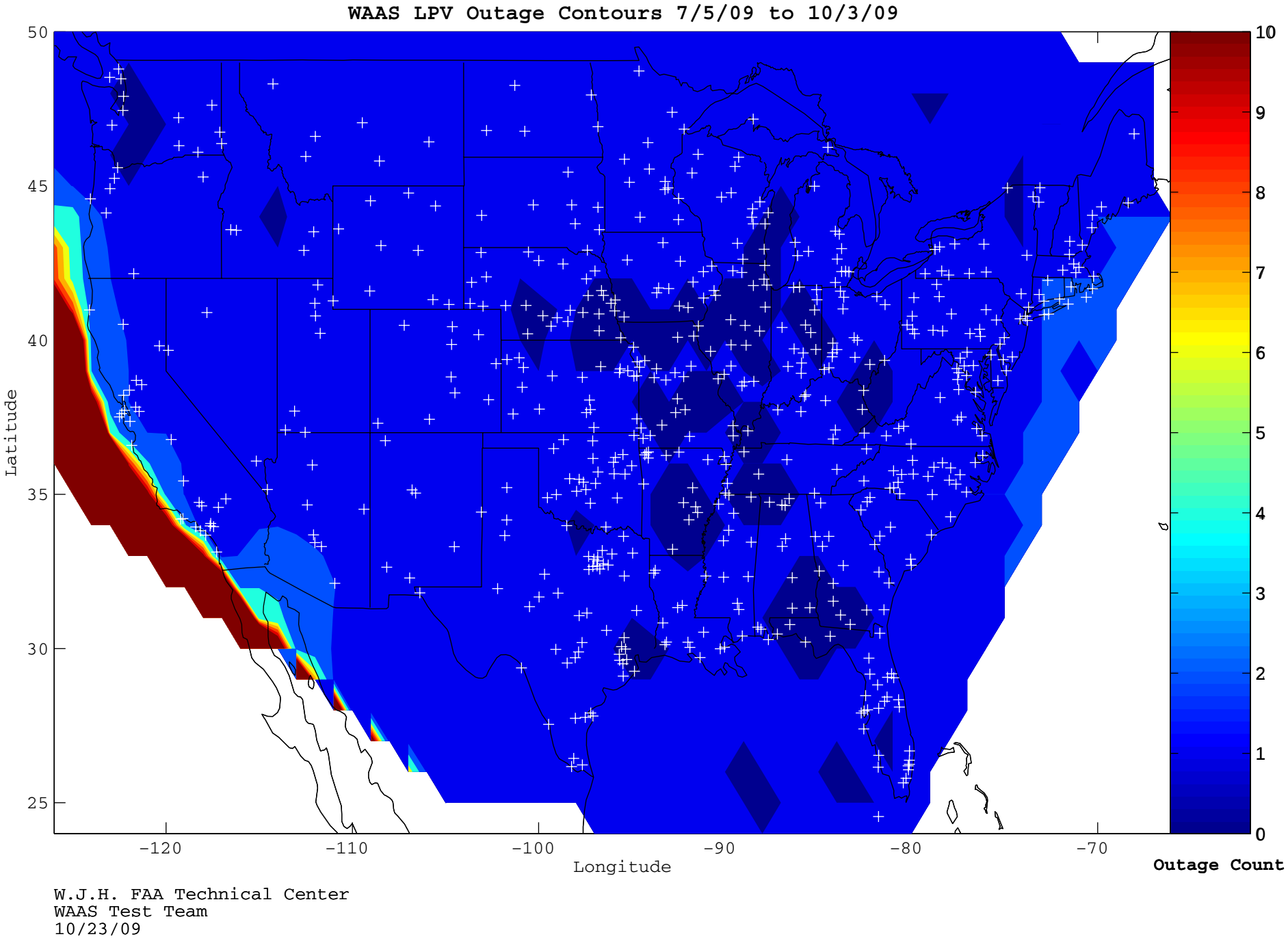
| Airport Id | Airport Name | State | LPV Outages | LPV Availability | LPV 200 Outages | LPV 200 Availability |
|---|---|---|---|---|---|---|
| ASX | JOHN F KENNEDY MEMORIAL | WI | 1 | 0.999960 | 3 | 0.999859 |
| LSE | LA CROSSE MUNICIPAL | WI | 1 | 0.999960 | 2 | 0.999798 |
| MTW | MANITOWOC COUNTY | WI | 1 | 0.999960 | 2 | 0.999795 |
| MFI | MARSHFIELD MUNICIPAL | WI | 1 | 0.999960 | 2 | 0.999809 |
| LUM | MENOMONIE MUNICIPAL-SCORE FIELD | WI | 1 | 0.999960 | 2 | 0.999827 |
| RRL | MERRILL MUNICIPAL | WI | 1 | 0.999960 | 2 | 0.999814 |
| C29 | MIDDLETON MUNICIPAL – MOREY FIELD | WI | 1 | 0.999960 | 2 | 0.999796 |
| ATW | OUTAGAMIE COUNTY RGNL | WI | 1 | 0.999960 | 2 | 0.999786 |
| PBH | PRICE COUNTY | WI | 1 | 0.999960 | 3 | 0.999829 |
| RHI | RHINELANDER-ONEIDA COUNTY | WI | 1 | 0.999960 | 2 | 0.999826 |
| RPD | RICE LAKE RGNL - CARL'S FIELD | WI | 1 | 0.999960 | 3 | 0.999836 |
| HYR | SAWYER COUNTY | WI | 1 | 0.999960 | 3 | 0.999840 |
| SBM | SHEBOYGAN COUNTY MEMORIAL | WI | 1 | 0.999960 | 2 | 0.999793 |
| JVL | SOUTHERN WISCONSIN RGNL | WI | 1 | 0.999960 | 2 | 0.999855 |
| TKV | TOMAHAWK RGNL | WI | 1 | 0.999960 | 2 | 0.999820 |
| LNR | TRI-COUNTY RGNL | WI | 1 | 0.999960 | 2 | 0.999794 |
| OSH | WITTMAN RGNL | WI | 1 | 0.999960 | 2 | 0.999781 |
| MRB | EASTERN WV RGNL/SHEPHERD FLD | WV | 1 | 0.999959 | 1 | 0.999959 |
| PKB | MID-OHIO VALLEY RGNL | WV | 1 | 0.999959 | 1 | 0.999959 |
| HTS | TRI-STATE/MILTON J. FERGUSON F | WV | 1 | 0.999959 | 1 | 0.999959 |
| CYS | CHEYENNE RGNL/JERRY OLSON FIEL | WY | 1 | 0.999967 | 6 | 0.999729 |
| EVW | EVANSTON-UINTA COUNTY BURNS FI | WY | 1 | 0.999970 | 6 | 0.999553 |
| GCC | GILLETTE-CAMPBELL COUNTY | WY | 1 | 0.999967 | 6 | 0.999747 |
| JAC | JACKSON HOLE | WY | 1 | 0.999970 | 6 | 0.999762 |
| LAR | LARAMIE RGNL | WY | 1 | 0.999967 | 6 | 0.999696 |
| CPR | NATRONA COUNTY INTL | WY | 1 | 0.999967 | 7 | 0.999694 |
| RIW | RIVERTON RGNL | WY | 1 | 0.999967 | 6 | 0.999713 |
| RKS | ROCK SPRINGS-SWEETWATER COUNTY | WY | 1 | 0.999967 | 7 | 0.999654 |
| SHR | SHERIDAN COUNTY | WY | 1 | 0.999967 | 6 | 0.999785 |
| COD | YELLOWSTONE RGNL | WY | 1 | 0.999967 | 6 | 0.999776 |

# Figure 9-1 WAAS LPV Availability





## Figure 9-2 WAAS LPV Outage



## 10.0 WAAS DETERMINISTIC CODE NOISE AND MULTIPATH BOUNDING ANALYSIS

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

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

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

## Table 10-1 CNMP Bounding Statistics

| WAAS Site | WRE | Oct 08 | Nov 08 | Dec 08 | Jan 09 | Feb 09 | Mar 09 | Apr 09 | May 09 | Jun 09 | Jul 09 | Aug 09 | Sep 09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albuquerque | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Anchorage | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Atlanta | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Barrow | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Bethel | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Billings | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Boston | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Chicago | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Cleveland | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Cold Bay | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | – |
| Dallas | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Denver | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Fairbanks | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Gander | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Goose Bay | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Honolulu | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Houston | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Iqaluit | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Jacksonville | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

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

| WAAS Site | WRE | Oct 08 | Nov 08 | Dec 08 | Jan 09 | Feb 09 | Mar 09 | Apr 09 | May 09 | Jun 09 | Jul 09 | Aug 09 | Sep 09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juneau | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Kansas City | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Kotzebue | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Los Angeles | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Memphis | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Merida | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Mexico City | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Miami | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Minneapolis | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| New York | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Oakland | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Puerto Vallarta | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Salt Lake City | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| San Jose Del Cabo | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| San Juan | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Seattle | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Tapachula | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Washington, DC | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Winnipeg | A | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | B | ● | ● | ● | ● | ● | – | ● | ● | ● | ● | ● | ● |
| | C | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

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

## 11.0 WAAS REFERENCE STATION SURVEY VALIDATION

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

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

Antenna L1 phase center position surveys were preformed for the WAAS antennas using a 25 hour set of data from 23:00 on 9/29/09 to 23:59:30 on 9/30/09 for all of the WAAS receivers except the Bethel A receiver (BET-1) and Cold Bay A/B/C. BET-1 was offline awaiting repair on 9/30/09 so data from 9/13/09 to 9/14/09 was used. The WAAS Cold Bay site is offline pending relocation. Cold Bay is expected to be back in service mid-November 2009.

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 2.4 cm. The RSS of the ECEF sigma's were all less than 15 mm for the CSRS surveys. The OPUS and CSRS surveys agreed to 4.7 cm or better.

The positions were then compared to the positions in the current WAAS software Release 8/9.2b and the WAAS Follow On (WFO) release 1 of software that will be fielded this November. The Release 8/9 positions had been interpolated forward to 6/30/09 to account for tectonic plate movement in order to minimize how often the software needs to be updated. The WFO Release 1 antenna positions have been interpolated forward to 8/1/10.

The OPUS surveys agree with the RLS 8/9.2b positions to better than or equal to 5.3 cm with the exception of Mexico City, which is in the 6.5 cm rage.

The OPUS surveys agree with the WFO RLS1 positions to better than or equal to 5.3 cm with the expected exceptions of Mexico City (22 cm), San Jose De Cabo (6.3 cm), and Honolulu (8.9 cm cm). These are the highest movement sites. Honolulu and San Jose De Cabo are high movement sites due to tectonic plate movement. Mexico City is high movement because it is sinking due to depletion of water from an underground lake. The Mexico City WFO Release 1 offsets have been approved by the WIPP.

Table 11.1 lists the WAAS antenna L1 phase center positions as of 9/30/09. The positions are in IRTF-2000 and are the OPUS estimated positions.

Figure 11.1 to 11.6 show the RSS of the ECEF difference between the 9/30/09 OPUS survey antenna phase center locations and the locations in the current RLS-8/9.2b software and in the future WFO release 1 software which will be fielded this fall. Each reference station has three independent strings of WAAS receiving equipment (WRE). A surveyed antenna phase center location is required for each WRE. All three strings of a reference station are shown in the three figures. For example, BET1 identifies the RSS delta for the Bethel WRS string 1. The next two bars in the chart are Bethel string 2 and Bethel string 3. Figure 11.7 to 11.9 shows the OPUS overall RMS quality indications.

Figure 11.10 to 11.12 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 11.13 to 11.15 show the RSS of ECEF sigma's report by CSRS.

**Table 11-1 WAAS Survey Positions (OPUS ITRF-2000) as of 6/22/09**

| WRE | X(m) | Y(m) | Z(m) | Latitude | Longitude | H(m) |
|---|---|---|---|---|---|---|
| BET1 | -2965384.980 | -972576.629 | 5543892.964 | 60.78791623333330 | -161.84172447222200 | 52.211 |
| BET2 | -2965385.747 | -972580.349 | 5543891.907 | 60.78789681388890 | -161.84166396388900 | 52.210 |
| BET3 | -2965388.312 | -972577.481 | 5543891.034 | 60.78788090000000 | -161.84172867222200 | 52.201 |
| | | | | | | |
| BIL1 | -1416445.834 | -4223577.030 | 4550862.172 | 45.80370698611110 | -108.53972245277800 | 1112.256 |
| BIL2 | -1416449.904 | -4223574.885 | 4550862.894 | 45.80371628333330 | -108.53978085555600 | 1112.258 |
| BIL3 | -1416441.532 | -4223574.294 | 4550866.020 | 45.80375666944440 | -108.53968118333300 | 1112.253 |
| | | | | | | |
| BRW1 | -1886758.842 | -809058.698 | 6018494.517 | 71.28276555555560 | -156.78992298333300 | 15.591 |
| BRW2 | -1886756.261 | -809055.952 | 6018495.704 | 71.28279828888890 | -156.78996503055600 | 15.606 |
| BRW3 | -1886755.165 | -809059.732 | 6018495.516 | 71.28279365555560 | -156.78985601666700 | 15.583 |
| | | | | | | |
| FAI1 | -2304741.736 | -1448715.273 | 5748843.724 | 64.80963070000000 | -147.84734013888900 | 149.942 |
| FAI2 | -2304741.268 | -1448706.463 | 5748846.116 | 64.80968110000000 | -147.84749188611100 | 149.942 |
| FAI3 | -2304732.715 | -1448707.397 | 5748849.261 | 64.80974784444440 | -147.84737944166700 | 149.918 |
| | | | | | | |
| HNL1 | -5508637.068 | -2234493.505 | 2303722.096 | 21.31298931944440 | -157.92082565555600 | 24.675 |
| HNL2 | -5508656.229 | -2234483.823 | 2303686.843 | 21.31264636111110 | -157.92098154722200 | 25.013 |
| HNL3 | -5508647.652 | -2234497.771 | 2303693.941 | 21.31271496388890 | -157.92082589722200 | 25.073 |
| | | | | | | |
| JNU1 | -2354254.821 | -2388549.655 | 5407043.085 | 58.36257483333330 | -134.58570609166700 | 16.051 |
| JNU2 | -2354252.737 | -2388565.774 | 5407036.917 | 58.36246921944440 | -134.58548742777800 | 16.054 |
| JNU3 | -2354239.517 | -2388568.617 | 5407041.374 | 58.36254566388890 | -134.58529248055600 | 16.043 |
| | | | | | | |
| MMD1 | 35070.456 | -5959686.691 | 2264365.760 | 20.93190912777780 | -89.66284034166670 | 29.139 |
| MMD2 | 35065.533 | -5959687.058 | 2264364.970 | 20.93190137222220 | -89.66288769166670 | 29.173 |
| MMD3 | 35065.194 | -5959685.274 | 2264369.630 | 20.93194644722220 | -89.66289085000000 | 29.170 |
| | | | | | | |
| MMX1 | -948701.180 | -5943936.262 | 2109212.905 | 19.43165324444440 | -99.06838943055560 | 2236.284 |
| MMX2 | -948696.751 | -5943936.095 | 2109215.334 | 19.43167652222220 | -99.06834804722220 | 2236.279 |
| MMX3 | -948705.607 | -5943936.452 | 2109210.480 | 19.43162993055560 | -99.06843075833330 | 2236.313 |
| | | | | | | |
| MPR1 | -1570142.209 | -5759530.643 | 2238184.763 | 20.67900327500000 | -105.24920300555600 | 11.013 |
| MPR2 | -1570139.388 | -5759530.148 | 2238188.816 | 20.67904141388890 | -105.24917813333300 | 11.303 |
| MPR3 | -1570143.495 | -5759528.027 | 2238190.577 | 20.67905937500000 | -105.24922151666700 | 11.021 |
| | | | | | | |
| MSD1 | -1979519.609 | -5523223.145 | 2493106.730 | 23.16044622500000 | -109.71764672777800 | 104.306 |
| MSD2 | -1979521.176 | -5523225.468 | 2493100.325 | 23.16038340833330 | -109.71765347777800 | 104.284 |
| MSD3 | -1979525.626 | -5523222.208 | 2493104.003 | 23.16041951111110 | -109.71770512777800 | 104.289 |
| | | | | | | |
| MTP1 | -254854.351 | -6162909.189 | 1617805.093 | 14.79136618333330 | -92.36799915277780 | 54.971 |
| MTP2 | -254850.736 | -6162910.230 | 1617801.659 | 14.79133412222220 | -92.36796520277780 | 54.955 |
| MTP3 | -254855.500 | -6162910.338 | 1617800.137 | 14.79132011944440 | -92.36800937500000 | 54.862 |
| | | | | | | |
| OTZ1 | -2396055.951 | -750356.173 | 5843502.567 | 66.88733286666670 | -162.61137218611100 | 10.908 |
| OTZ2 | -2396052.774 | -750354.342 | 5843504.094 | 66.88736775833330 | -162.61139039166700 | 10.908 |
| OTZ3 | -2396052.758 | -750358.280 | 5843503.607 | 66.88735646388890 | -162.61130452500000 | 10.916 |
| | | | | | | |
| YFB1 | 1035381.516 | -2634289.644 | 5696539.484 | 63.73149007222220 | -68.54318215833330 | 9.989 |
| YFB2 | 1035372.311 | -2634296.054 | 5696538.148 | 63.73146386388890 | -68.54340304166670 | 9.941 |
| YFB3 | 1035366.234 | -2634306.805 | 5696534.376 | 63.73138627777780 | -68.54359713611110 | 10.004 |
| | | | | | | |
| YQX1 | 2430424.683 | -3419640.390 | 4788223.788 | 48.96648956666670 | -54.59763159722220 | 146.863 |
| YQX2 | 2430432.640 | -3419639.045 | 4788220.725 | 48.96644765555560 | -54.59753238055560 | 146.859 |
| YQX3 | 2430440.552 | -3419637.679 | 4788217.732 | 48.96640645000000 | -54.59743349722220 | 146.879 |

| WRE | X(m) | Y(m) | Z(m) | Latitude | Longitude | H(m) |
|---|---|---|---|---|---|---|
| YWG1 | -520164.308 | -4083475.887 | 4855842.976 | 49.90057439166670 | -97.25939677500000 | 222.012 |
| YWG2 | -520150.440 | -4083468.821 | 4855850.350 | 49.90067734722220 | -97.25921772500000 | 222.009 |
| YWG3 | -520152.306 | -4083477.950 | 4855842.536 | 49.90056820000000 | -97.25922743611110 | 222.017 |
| | | | | | | |
| YYR1 | 1885341.473 | -3321428.363 | 5091171.596 | 53.30864659444440 | -60.41946768333330 | 37.815 |
| YYR2 | 1885344.436 | -3321419.878 | 5091176.006 | 53.30871289722220 | -60.41936618888890 | 37.816 |
| YYR3 | 1885340.144 | -3321413.061 | 5091182.017 | 53.30880315000000 | -60.41937170000000 | 37.828 |
| | | | | | | |
| ZAB1 | -1488636.797 | -5003946.561 | 3654557.705 | 35.17357533055560 | -106.56734922777800 | 1620.130 |
| ZAB2 | -1488631.458 | -5003948.241 | 3654557.682 | 35.17357470555560 | -106.56728780833300 | 1620.188 |
| ZAB3 | -1488632.239 | -5003950.826 | 3654553.832 | 35.17353233055560 | -106.56728793611100 | 1620.178 |
| | | | | | | |
| ZAN1 | -2659536.550 | -1549114.819 | 5567750.775 | 61.22920233611110 | -149.78024921111100 | 80.682 |
| ZAN2 | -2659548.303 | -1549110.866 | 5567746.290 | 61.22911872777780 | -149.78042291944400 | 80.681 |
| ZAN3 | -2659541.259 | -1549106.741 | 5567750.769 | 61.22920228333330 | -149.78042327500000 | 80.678 |
| | | | | | | |
| ZAU1 | 138704.164 | -4761244.172 | 4227763.943 | 41.78265793888890 | -88.33133611944440 | 195.919 |
| ZAU2 | 138704.424 | -4761248.777 | 4227758.777 | 41.78259559722220 | -88.33133460833330 | 195.915 |
| ZAU3 | 138711.125 | -4761248.517 | 4227758.860 | 41.78259654444440 | -88.33125394722220 | 195.922 |
| | | | | | | |
| ZBW1 | 1490299.274 | -4448983.182 | 4306010.478 | 42.73572021111110 | -71.48042528055560 | 39.123 |
| ZBW2 | 1490304.386 | -4448981.168 | 4306010.819 | 42.73572421388890 | -71.48035827777780 | 39.144 |
| ZBW3 | 1490306.096 | -4448984.794 | 4306006.511 | 42.73567140833330 | -71.48035254166670 | 39.145 |
| | | | | | | |
| ZDC1 | 1069125.818 | -4839599.007 | 4001126.505 | 39.10159570555560 | -77.54274595833330 | 80.087 |
| ZDC2 | 1069128.211 | -4839603.649 | 4001120.297 | 39.10152362777780 | -77.54273052222220 | 80.089 |
| ZDC3 | 1069124.114 | -4839602.734 | 4001122.484 | 39.10154901111110 | -77.54277448888890 | 80.089 |
| | | | | | | |
| ZDV1 | -1273628.563 | -4711375.596 | 4094890.124 | 40.18730331388890 | -105.12722373333300 | 1541.370 |
| ZDV2 | -1273622.863 | -4711377.106 | 4094890.131 | 40.18730353333330 | -105.12715451111100 | 1541.352 |
| ZDV3 | -1273624.875 | -4711380.305 | 4094885.845 | 40.18725306111110 | -105.12716751111100 | 1541.347 |
| | | | | | | |
| ZFW1 | -659983.159 | -5324060.797 | 3438276.470 | 32.83064964166670 | -97.06647134166670 | 155.631 |
| ZFW2 | -659988.422 | -5324063.347 | 3438271.468 | 32.83059620833330 | -97.06652377222220 | 155.589 |
| ZFW3 | -659983.459 | -5324063.873 | 3438271.681 | 32.83059825555560 | -97.06647047777780 | 155.630 |
| | | | | | | |
| ZHU1 | -513864.437 | -5506451.759 | 3166720.498 | 29.96189632222220 | -95.33142586666670 | 10.905 |
| ZHU2 | -513867.081 | -5506455.153 | 3166714.330 | 29.96183178611110 | -95.33144987222220 | 10.966 |
| ZHU3 | -513873.362 | -5506457.794 | 3166708.734 | 29.96177357222220 | -95.33151212222220 | 10.955 |
| | | | | | | |
| ZJX1 | 772646.475 | -5434462.215 | 3237231.730 | 30.69885941666670 | -81.90818482777780 | 2.156 |
| ZJX2 | 772649.806 | -5434463.763 | 3237228.314 | 30.69882370555560 | -81.90815267777780 | 2.133 |
| ZJX3 | 772645.759 | -5434466.193 | 3237225.219 | 30.69879124722220 | -81.90819806944450 | 2.131 |
| | | | | | | |
| ZKC1 | -415247.475 | -4954556.402 | 3982161.113 | 38.88015933611110 | -94.79083333888890 | 305.903 |
| ZKC2 | -415231.077 | -4954557.725 | 3982161.171 | 38.88016003055560 | -94.79064375833330 | 305.900 |
| ZKC3 | -415237.203 | -4954561.078 | 3982155.976 | 38.88010181944440 | -94.79071088055560 | 305.638 |
| | | | | | | |
| ZLA1 | -2474409.859 | -4637294.722 | 3602183.495 | 34.60351787222220 | -118.08389426111100 | 763.513 |
| ZLA2 | -2474404.586 | -4637297.516 | 3602183.501 | 34.60351800555560 | -118.08382921111100 | 763.502 |
| ZLA3 | -2474411.195 | -4637297.194 | 3602179.527 | 34.60347405000000 | -118.08389442500000 | 763.572 |
| | | | | | | |
| ZLC1 | -1808273.161 | -4486410.829 | 4145303.025 | 40.78604341388890 | -111.95217694444400 | 1287.426 |
| ZLC2 | -1808274.558 | -4486414.436 | 4145298.530 | 40.78599002500000 | -111.95217631944400 | 1287.418 |
| ZLC3 | -1808270.340 | -4486416.135 | 4145298.522 | 40.78598997777780 | -111.95212245555600 | 1287.412 |

| WRE | X(m) | Y(m) | Z(m) | Latitude | Longitude | H(m) |
|---|---|---|---|---|---|---|
| ZMA1 | 966042.343 | -5662999.845 | 2761581.490 | 25.82461200833330 | -80.31918941111110 | -7.566 |
| ZMA2 | 966029.365 | -5662999.139 | 2761585.969 | 25.82465971944440 | -80.31931581944440 | -8.205 |
| ZMA3 | 966037.443 | -5662997.989 | 2761586.328 | 25.82466175277780 | -80.31923447222220 | -7.847 |
| | | | | | | |
| ZME1 | 4070.943 | -5226189.318 | 3644028.420 | 35.06739398055560 | -89.95536943055560 | 68.618 |
| ZME2 | 4070.969 | -5226186.781 | 3644032.537 | 35.06743749166670 | -89.95536912500000 | 68.907 |
| ZME3 | 4064.775 | -5226186.645 | 3644032.695 | 35.06743938611110 | -89.95543702777780 | 68.883 |
| | | | | | | |
| ZMP1 | -249978.320 | -4539297.515 | 4458955.052 | 44.63746319166670 | -93.15208470000000 | 262.663 |
| ZMP2 | -249972.519 | -4539297.860 | 4458955.054 | 44.63746304166670 | -93.15201146111110 | 262.682 |
| ZMP3 | -249973.621 | -4539302.148 | 4458950.586 | 44.63740698055560 | -93.15202235555560 | 262.633 |
| | | | | | | |
| ZNY1 | 1406144.693 | -4627344.005 | 4144322.046 | 40.78432828888890 | -73.09716510277780 | 6.470 |
| ZNY2 | 1406146.483 | -4627347.052 | 4144317.269 | 40.78427550833330 | -73.09715530833330 | 5.952 |
| ZNY3 | 1406140.929 | -4627348.699 | 4144317.303 | 40.78427596944440 | -73.09722393611110 | 5.944 |
| | | | | | | |
| ZOA1 | -2684436.796 | -4293337.535 | 3865351.816 | 37.54305315833330 | -122.01594628333300 | -3.475 |
| ZOA2 | -2684433.780 | -4293341.574 | 3865349.378 | 37.54302571944440 | -122.01589311666700 | -3.513 |
| ZOA3 | -2684438.147 | -4293342.486 | 3865345.527 | 37.54298125000000 | -122.01592954444400 | -3.411 |
| | | | | | | |
| ZOB1 | 650770.233 | -4754715.689 | 4187420.751 | 41.29715431666670 | -82.20644417500000 | 223.699 |
| ZOB2 | 650777.909 | -4754714.871 | 4187422.769 | 41.29716659722220 | -82.20635205555560 | 225.204 |
| ZOB3 | 650776.247 | -4754719.690 | 4187414.976 | 41.29708685000000 | -82.20637951666670 | 223.479 |
| | | | | | | |
| ZSE1 | -2308930.231 | -3668169.696 | 4663526.491 | 47.28699337222220 | -122.18837224722200 | 82.107 |
| ZSE2 | -2308934.621 | -3668175.247 | 4663520.083 | 47.28690777222220 | -122.18838226944400 | 82.171 |
| ZSE3 | -2308935.686 | -3668179.518 | 4663516.144 | 47.28685610277780 | -122.18836410833300 | 82.114 |
| | | | | | | |
| ZSU1 | 2462589.351 | -5529371.572 | 2003724.594 | 18.43133832777780 | -65.99347540833330 | -28.569 |
| ZSU2 | 2462587.269 | -5529377.318 | 2003711.598 | 18.43121436388890 | -65.99351554166670 | -28.502 |
| ZSU3 | 2462593.909 | -5529375.100 | 2003709.536 | 18.43119476111110 | -65.99344958333330 | -28.514 |
| | | | | | | |
| ZTL1 | 529840.450 | -5305248.831 | 3489342.840 | 33.37968838888890 | -84.29672553055550 | 261.151 |
| ZTL2 | 529846.827 | -5305247.996 | 3489343.124 | 33.37969150555560 | -84.29665644722220 | 261.142 |
| ZTL3 | 529847.510 | -5305251.425 | 3489337.889 | 33.37963483055560 | -84.29665280833330 | 261.168 |

**Figure 11-1 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey**

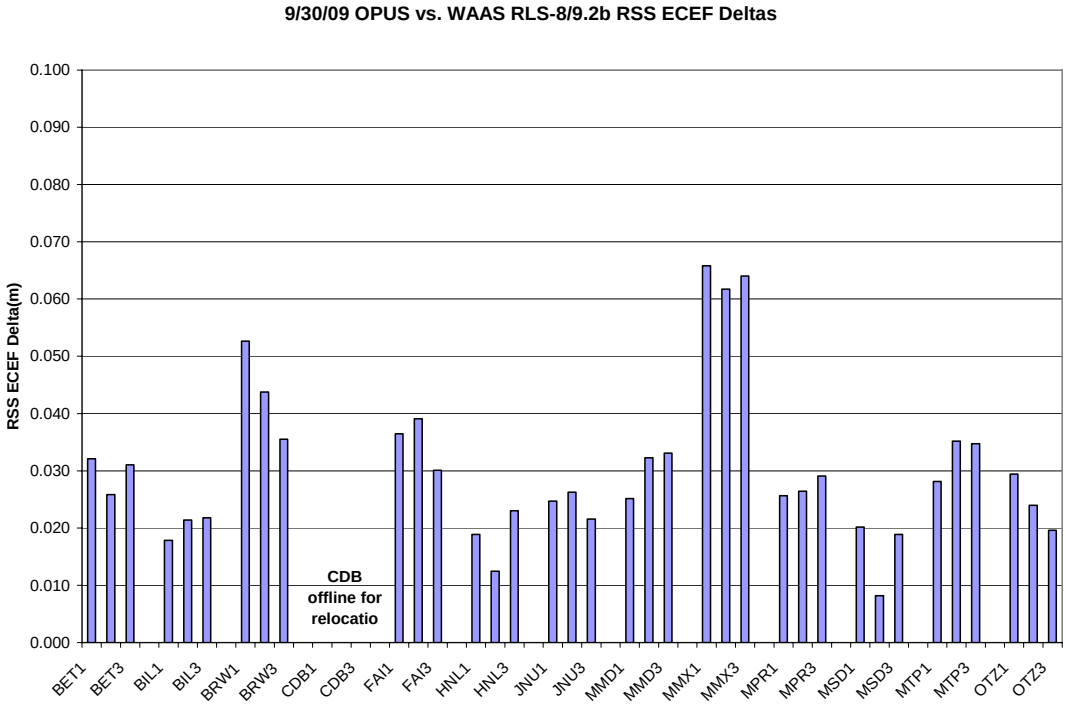



**Figure 11-2 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey**

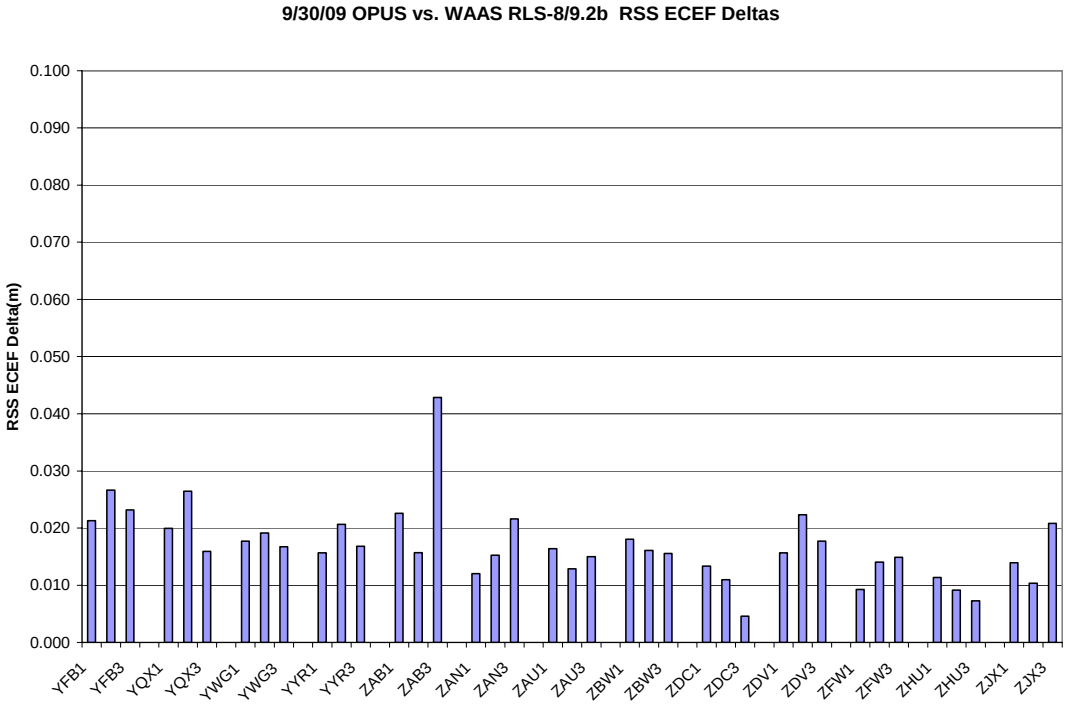


**Figure 11-3 WAAS RLS 8/9.2b Antenna Positions Deltas from OPUS Survey**

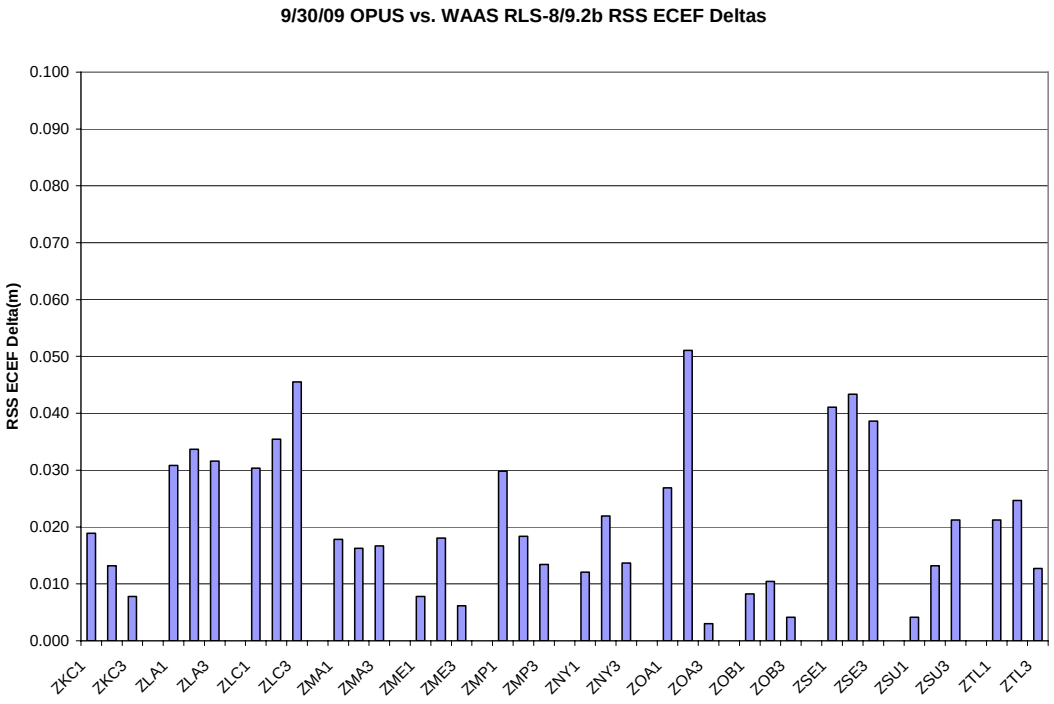



**Figure 11-4 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey**

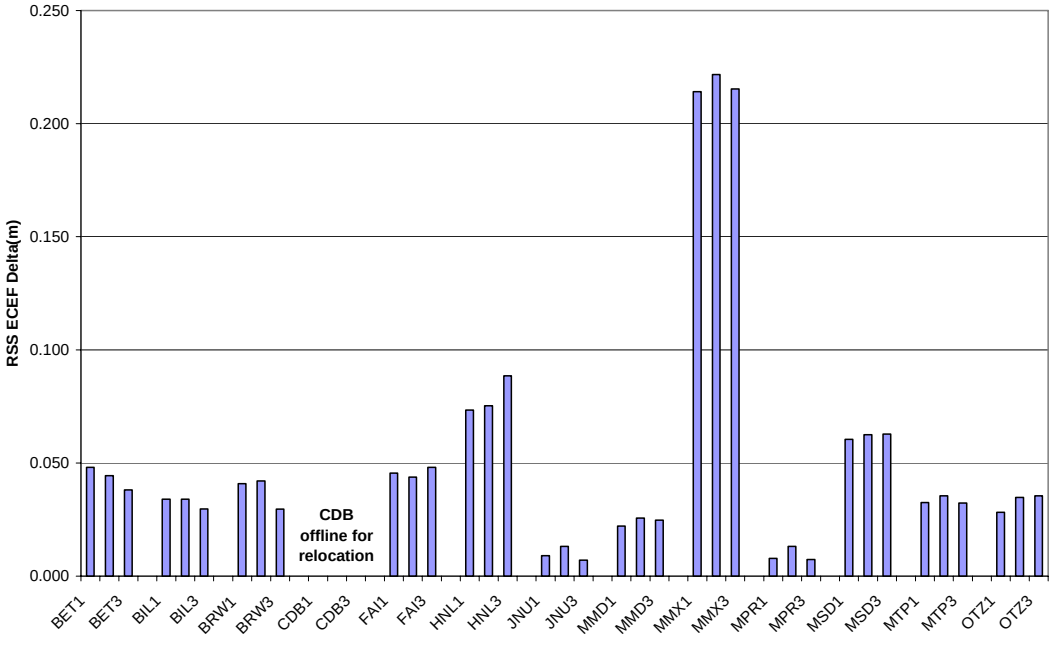


**Figure 11-5 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey**

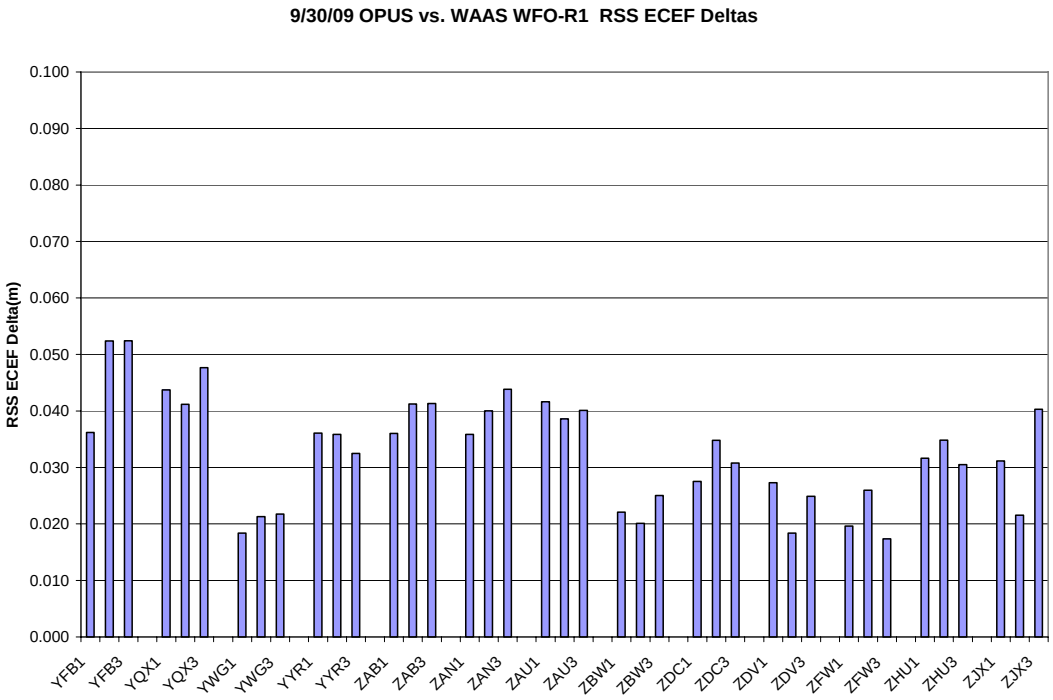



**Figure 11-6 WAAS WFO RLS1 Antenna Positions Deltas from OPUS Survey**

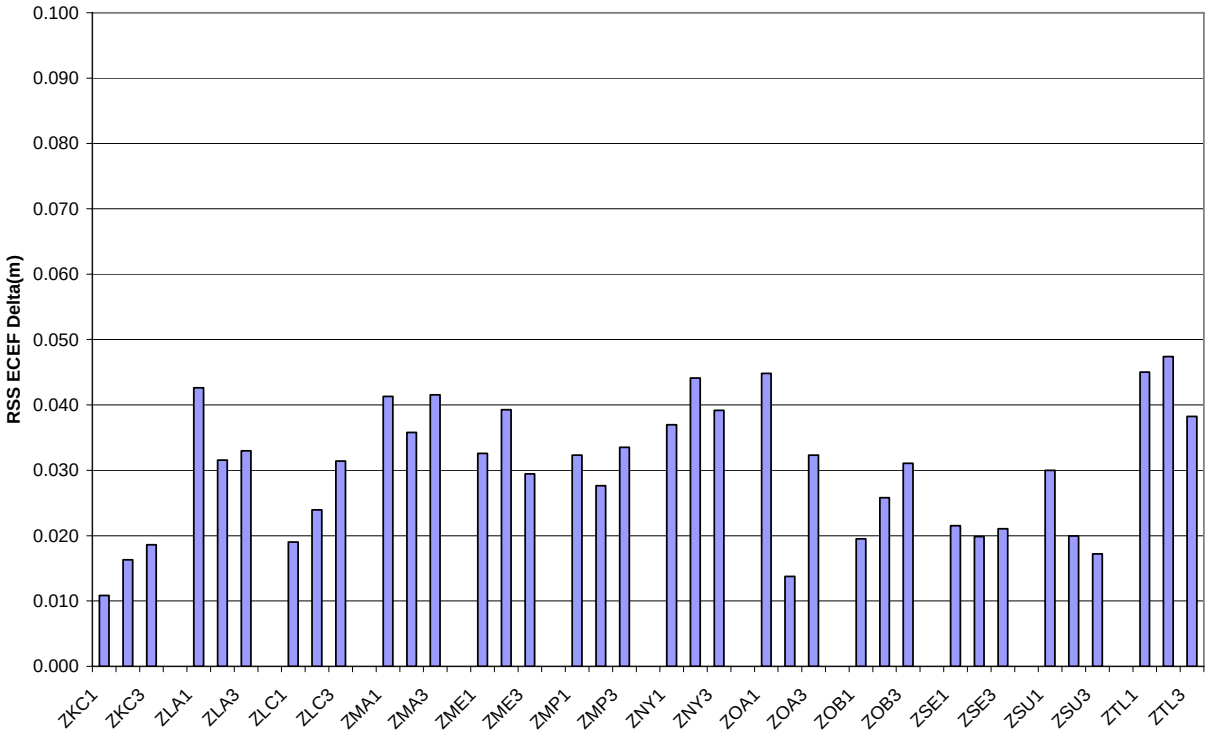


**Figure 11-7 OPUS Survey Overall RMS Qualities**

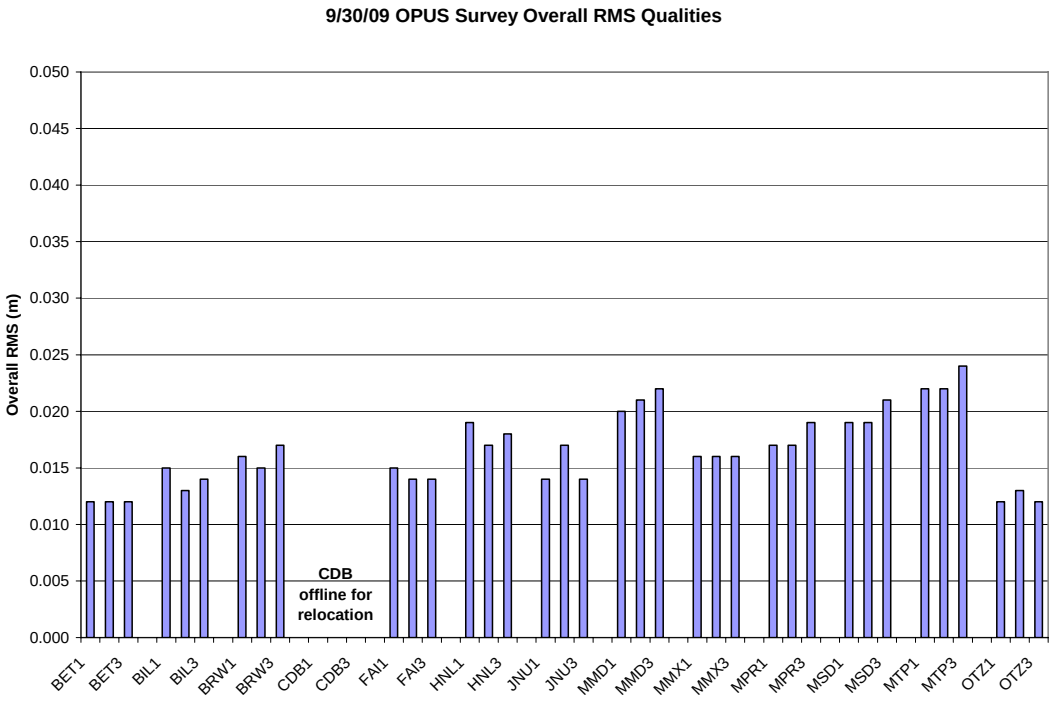



**Figure 11-8 OPUS Survey Overall RMS Qualities**

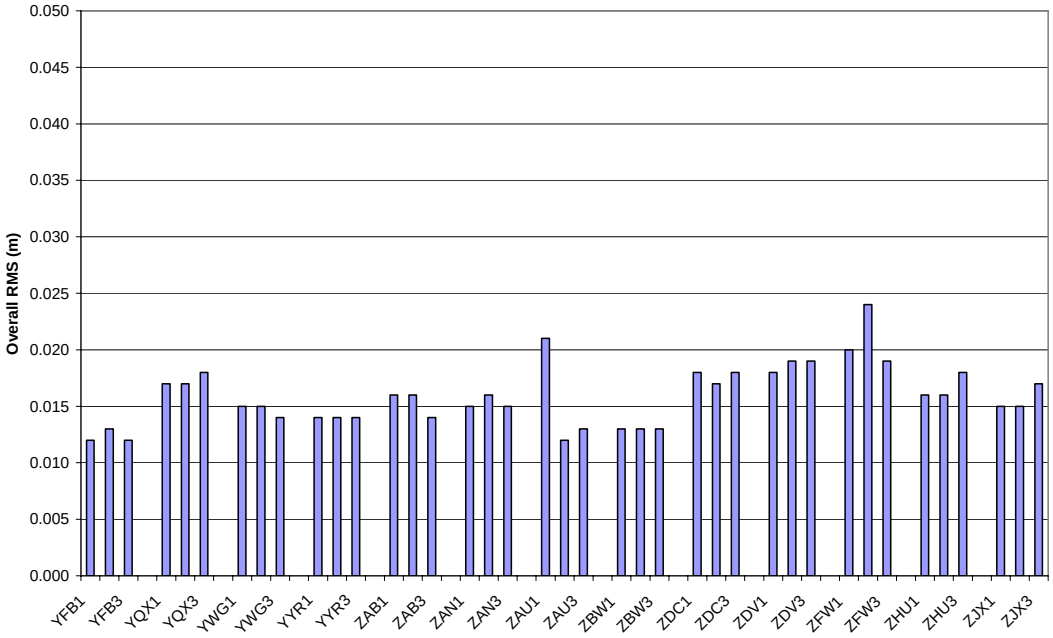


**Figure 11-9 OPUS Survey Overall RMS Qualities**

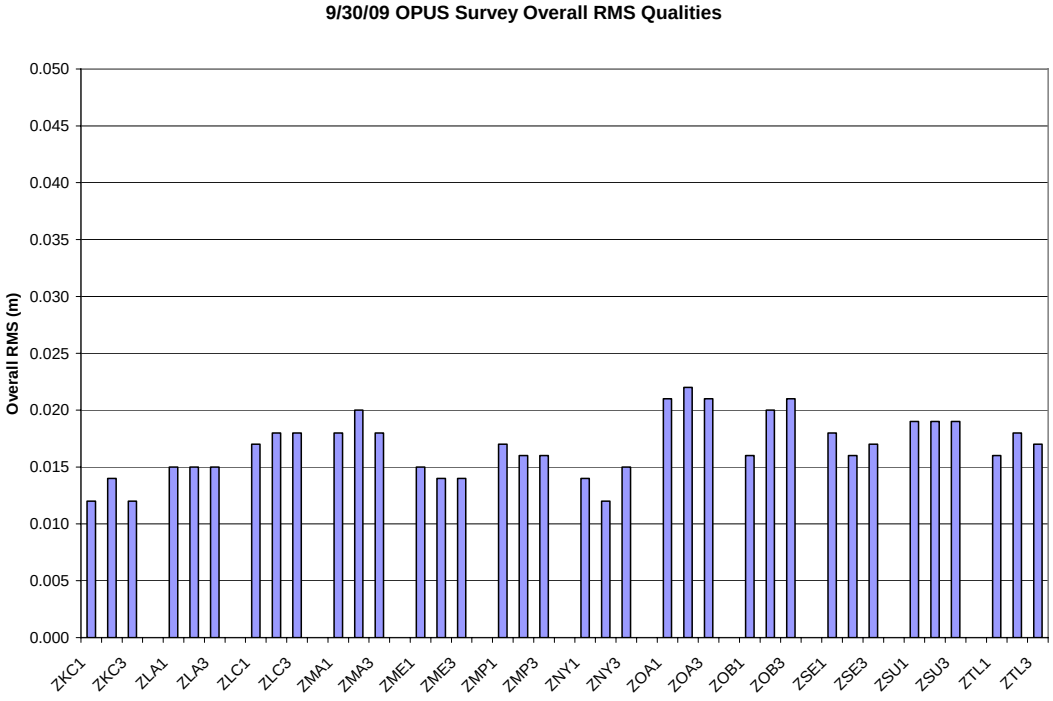



**Figure 11-10 OPUS vs. CSRS RSS ECEF Deltas**

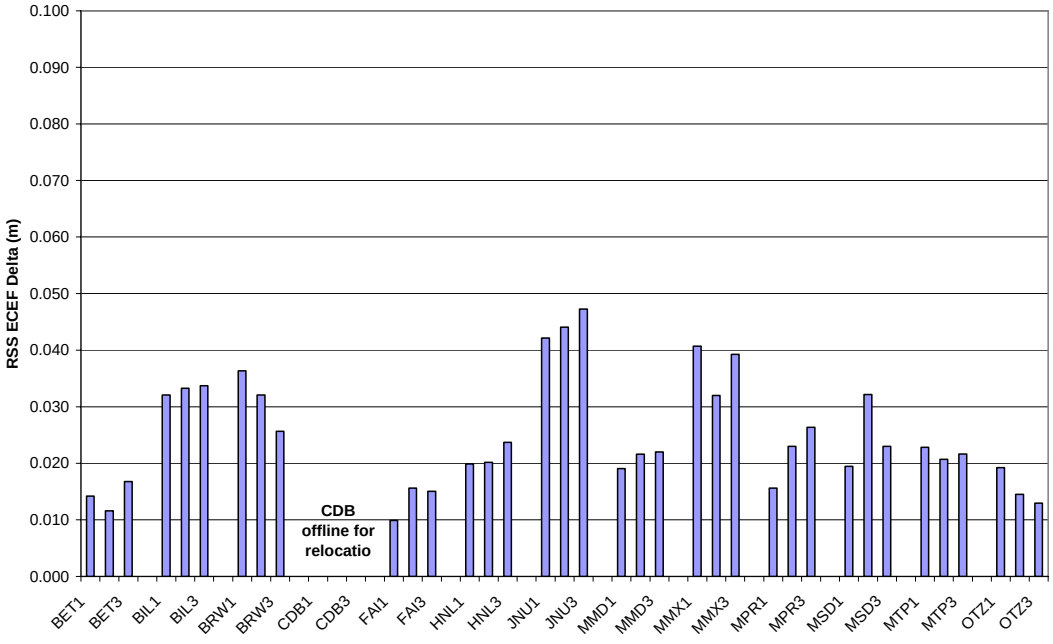


**Figure 11-11 OPUS vs. CSRS RSS ECEF Deltas**

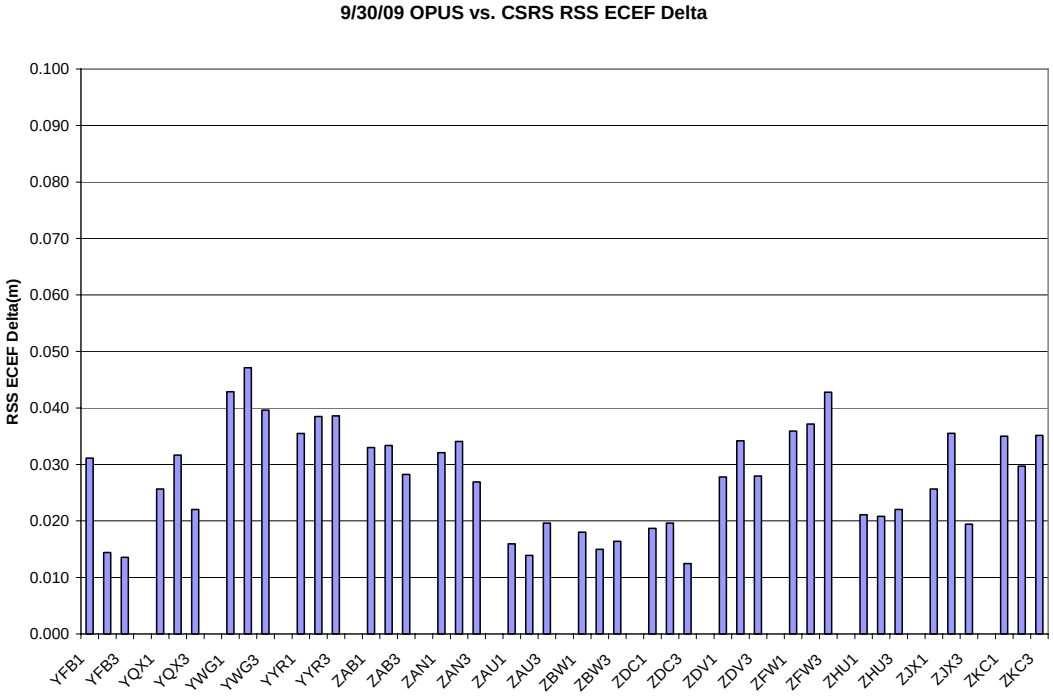



**Figure 11-12 OPUS vs. CSRS RSS ECEF Deltas**

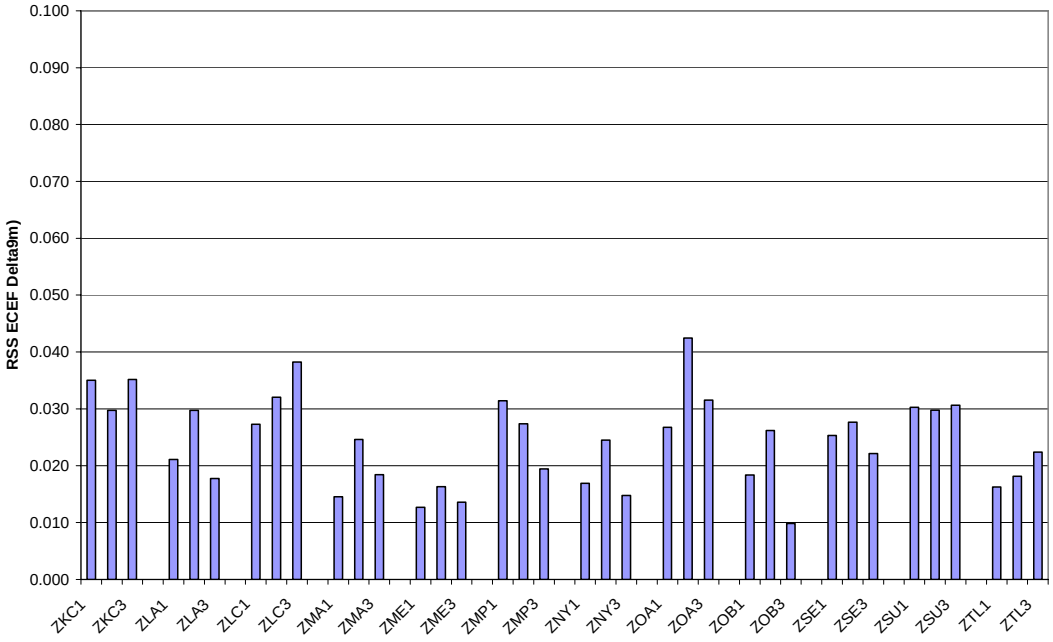


**Figure 11-13 OPUS CSRS RSS ECEF Qualities**

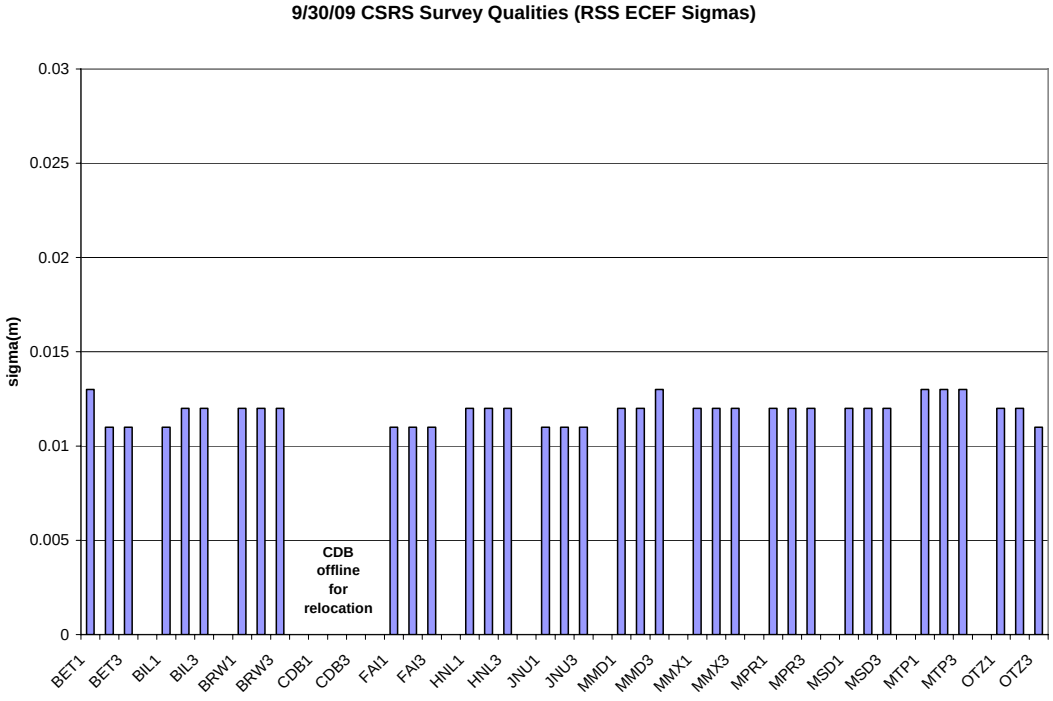



**Figure 11-14 OPUS CSRS RSS ECEF Qualities**

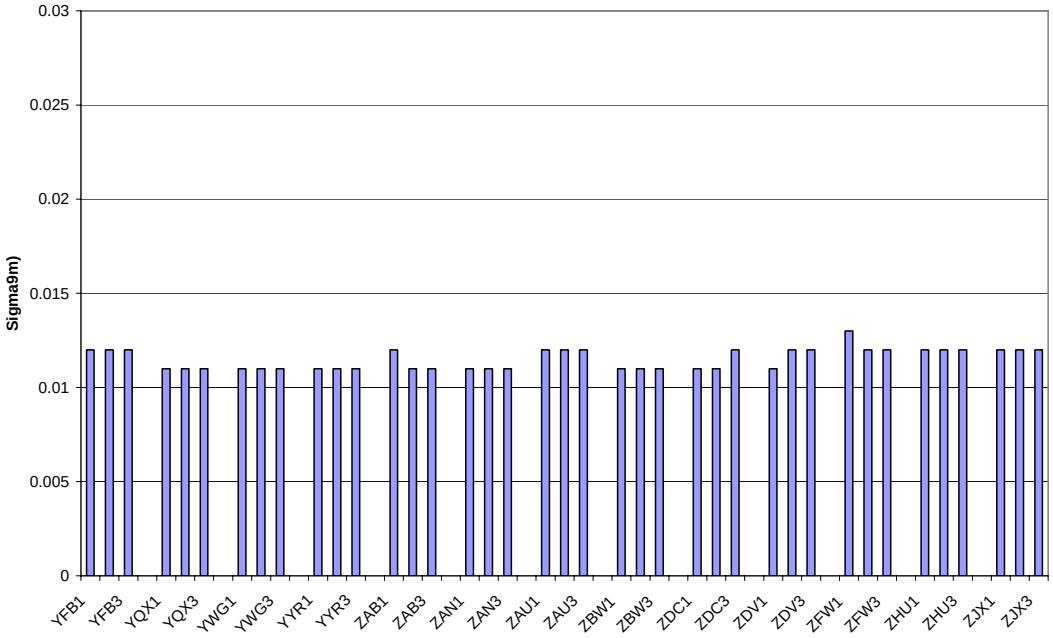
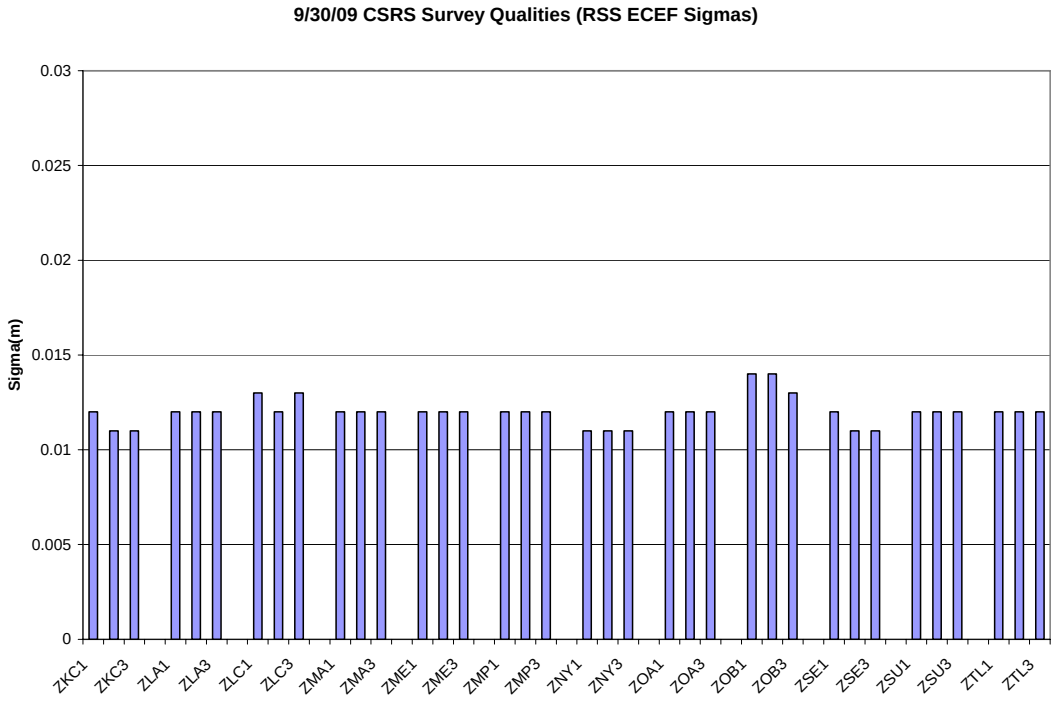


**Figure 11-15 OPUS CSRS RSS ECEF Qualities**



## 12.0 SIGNAL QUALITY MONITOR (SQM)

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

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

### 12.1 Alpha Metrics

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

**Table 12-1 Alpha Metrics**

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

### 12.2 Event Summary

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

**Table 12-2 Event Summary**

| GPS Week | Date | Events |
|---|---|---|
| Week 1541 Day 5 | 7/24/09 | NANU 2009040, PRN 21 outage caused a small spike in SQM PRN bias daily average. |
| Week 1541 Day 6 to Week 1543 Day 5 | 7/25/09 to 8/7/09 | NANU 2009048, PRN 18 outage occurred on 7/25/09. PRN 18 came back after the outage with higher than normal PRN biases and type biases and remained at that high level until 8/7/09 when it abruptly returned to normal level. See DR 86 SVN 54 PRN 18 Signal Distortion |
| Week 1545 Day 5 to Week 1548 Day 5 | 8/20/09 to 9/11/09 | NANU 2009054, PRN 25 is set to unusable<br>NANU 2009065, PRN 25 is set to usable. |
| Week 1546 Day 4 | 8/27/09 | NANU 2009055, PRN 5 is set active for new satellite SVN 50. |

| GPS Week | Date | Events |
|---|---|---|
| Week 1548 Day 2 | 9/8/09 | NANU 2009061, PRN 5 outage caused a small drop in SQM PRN Bias. |
| Week 1548 Day 6 | 9/12/09 | NANU 2009064, PRN 24 unusable until further notice. |
| Week 1550 Day 5 | 9/25/09 | NANU 2009074, PRN 10 outage caused a small spike in SQM PRN Bias daily average. |

## 12.3 Type Bias

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

For this reporting period, geostationary satellites type biases are not evaluated. Table12.3 shows the rollup average for the quarter. Table 12.4 shows the rollup average since January 1, 2008. Figure 12.1 shows the daily average for the four detection metrics for the quarter. Slight increase in daily Type 1 type bias average from 7/25/09 to 8/7/09 is due to PRN 18 event (see DR#86); slight increase in Type 2 type bias average from 9/12/09 to the end of the quarter is due to PRN 24 outage.

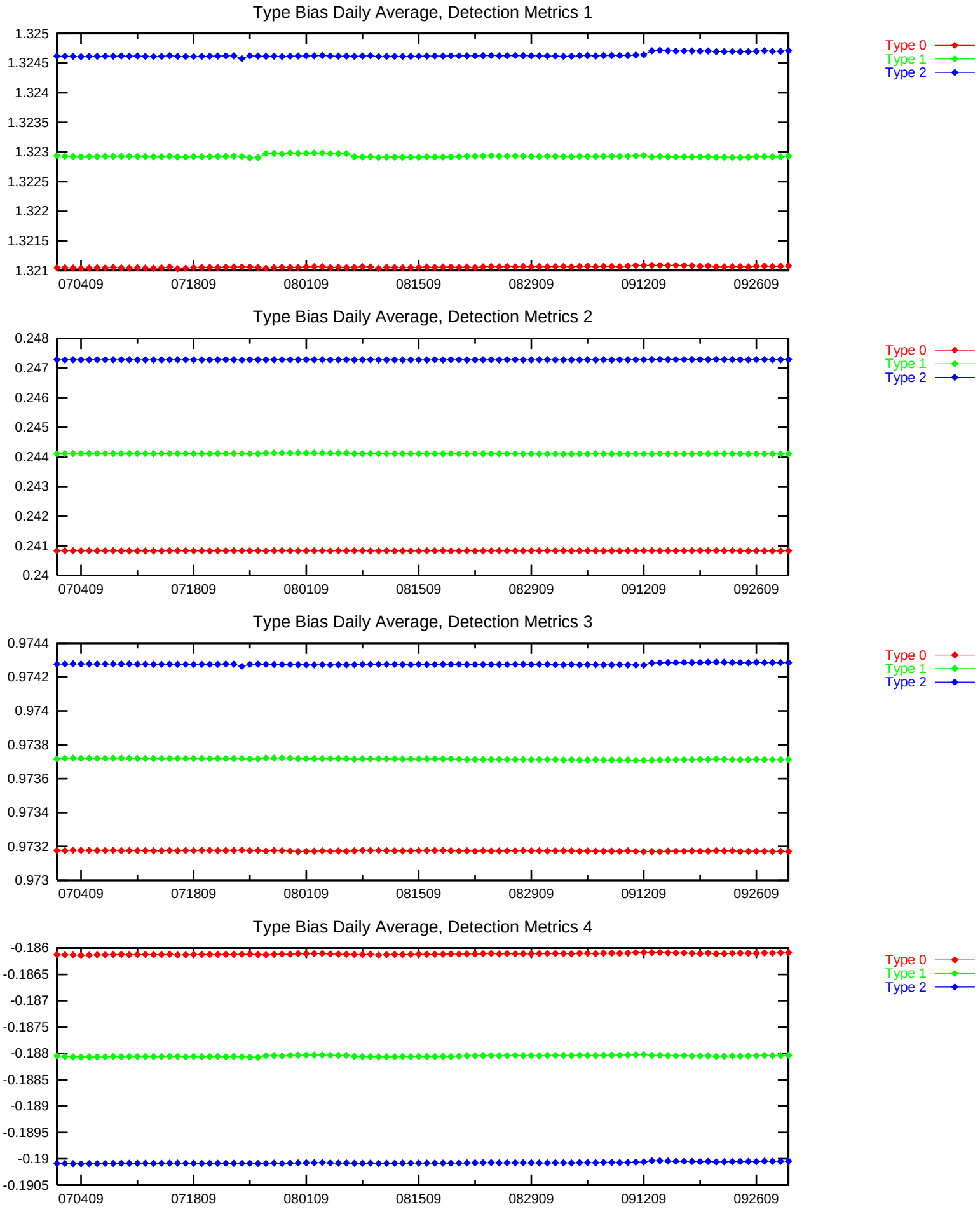
**Table 12-3 Type Bias Average for the Quarter**

| Detection Metric | Type 0 | Type 1 | Type 2 |
|---|---|---|---|
| DM 1 | 1.32106 | 1.32293 | 1.32464 |
| DM 2 | 0.240832 | 0.244111 | 0.247279 |
| DM 3 | 0.973174 | 0.973716 | 0.974276 |
| DM 4 | -0.186112 | -0.18805 | -0.190075 |

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

| Detection Metric | Type 0 | Type 1 | Type 2 |
|---|---|---|---|
| DM 1 | 1.32108 | 1.32293 | 1.32463 |
| DM 2 | 0.24084 | 0.244114 | 0.247283 |
| DM 3 | 0.973177 | 0.973714 | 0.974275 |
| DM 4 | -0.186112 | -0.188053 | -0.190081 |

# Figure 12-1 PRN Type Bias Average Trend



## 12.4 PRN Bias

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

Table 12.5 and Figure 12.2 show the rollup PRN bias average for the quarter. Table 12.6 shows the rollup PRN bias average since January 1, 2008. Figure 12.3 to 12.10 show the PRN bias average trend for each SV. The maximum average for DM1 for this quarter is PRN 23 at 0.00095563. The maximum average for DM2 is PRN 21 at 0.00018751. The maximum average for DM3 is PRN 10 at 0.00027041 and the maximum average for DM4 is PRN 23 at 0.00042364.

For this reporting period, geostationary satellite biases are not evaluated. Please refer to Table 1.4 and Table 12.2 for events that may have an impact on PRN bias statistics. Small spikes in PRN bias daily average are due to satellite outages. PRN 5 is set active for new satellite SVN 50 on 8/27/09. PRN 24 is set to unusable until further notice on 9/12/09. PRN 25 was offline from 8/20/09 to 9/11/09.

Significant increase in PRN bias daily average on PRN 18 and considerable decrease in PRN bias daily average on PRN 14 and PRN 21 are observed this quarter. From 7/26/09 to 8/7/09, PRN 18 PRN bias daily average jumped over 200% for all Detection Metrics. PRN 18 came back after an outage on 7/26/09 with higher than normal PRN bias and remained at that level until 8/7/09 when it abruptly dropped back down to normal level (see DR#86 for more details). On 7/27/09, PRN 14 PRN bias daily average decreased by approximately 15% for DM1, DM2, and DM4 and remained at that level for the rest of the quarter. On 7/31/09, PRN 11 PRN bias daily average decreased by approximately 10% for DM1 and remained at that level for the rest of the quarter.

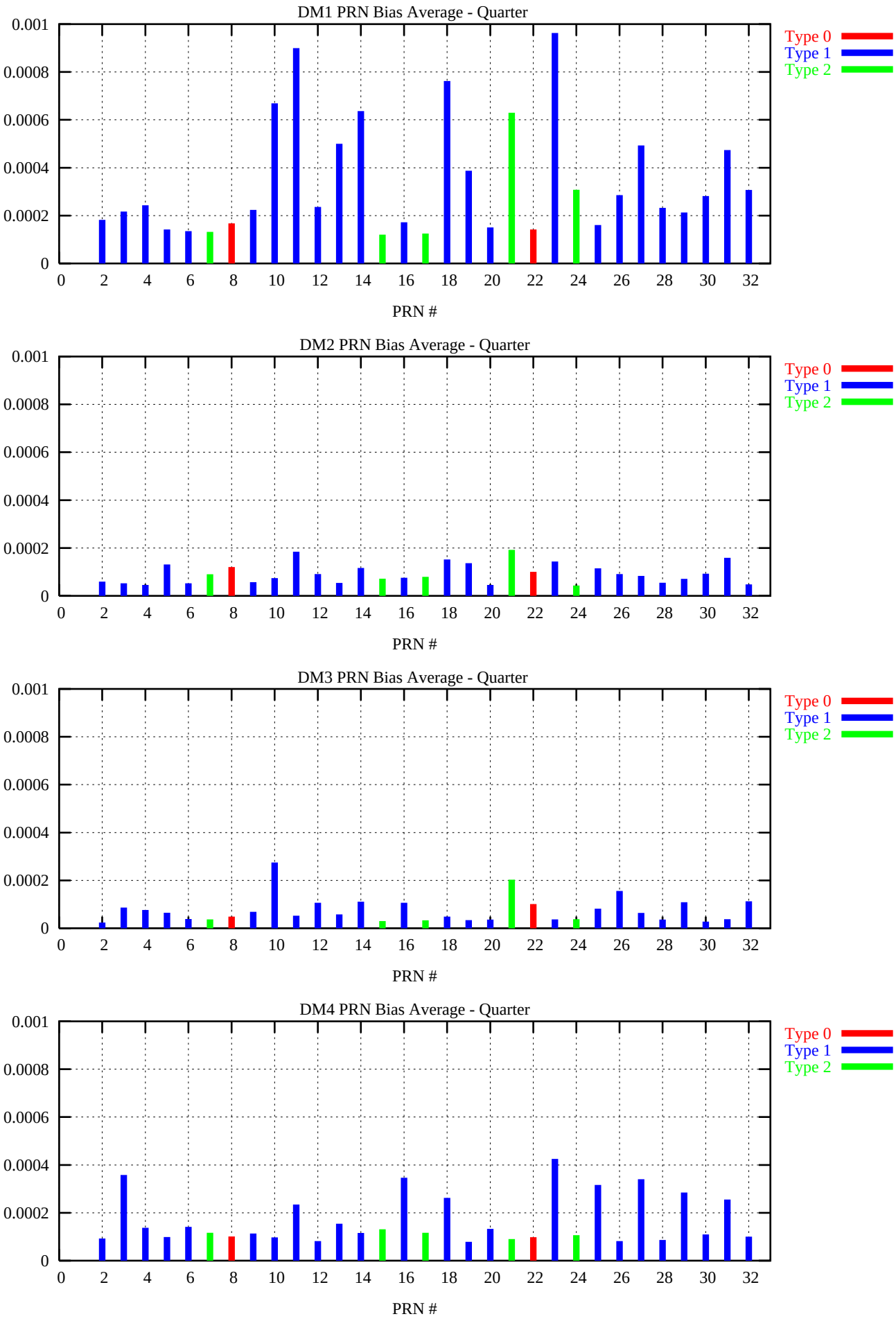
**Table 12-5 PRN Bias Average for the Quarter**

| PRN | DM1 | DM2 | DM3 | DM4 |
|---|---|---|---|---|
| 2 | 0.000182387 | 0.000059711 | 0.000023832 | 0.000092584 |
| 3 | 0.000217015 | 0.000052577 | 0.000086271 | 0.000358132 |
| 4 | 0.000243387 | 0.000045173 | 0.000076682 | 0.000137292 |
| 5 | 0.000142151 | 0.000130791 | 0.000064577 | 0.000098860 |
| 6 | 0.000135103 | 0.000052332 | 0.000038673 | 0.000141548 |
| 7 | 0.000132324 | 0.000090158 | 0.000037044 | 0.000116132 |
| 8 | 0.000167154 | 0.000120067 | 0.000048944 | 0.000100861 |
| 9 | 0.000223585 | 0.000056867 | 0.000068461 | 0.000113546 |
| 10 | 0.000669074 | 0.000074005 | 0.000274897 | 0.000096889 |
| 11 | 0.000899742 | 0.000184711 | 0.000052484 | 0.000234808 |
| 12 | 0.000236440 | 0.000090905 | 0.000106354 | 0.000081446 |
| 13 | 0.000499783 | 0.000053758 | 0.000057725 | 0.000154697 |
| 14 | 0.000636252 | 0.000116391 | 0.000110955 | 0.000115430 |
| 15 | 0.000120597 | 0.000071558 | 0.000030259 | 0.000131064 |
| 16 | 0.000172130 | 0.000075965 | 0.000106185 | 0.000346297 |
| 17 | 0.000125075 | 0.000079347 | 0.000033311 | 0.000116240 |
| 18 | 0.000762036 | 0.000152276 | 0.000048942 | 0.000261961 |
| 19 | 0.000387538 | 0.000136738 | 0.000034039 | 0.000079037 |
| 20 | 0.000150533 | 0.000045890 | 0.000036603 | 0.000132775 |
| 21 | 0.000629821 | 0.000192026 | 0.000202818 | 0.000090417 |
| 22 | 0.000142110 | 0.000100630 | 0.000100695 | 0.000098353 |
| 23 | 0.000963246 | 0.000143677 | 0.000036697 | 0.000424770 |
| 24 | 0.000308080 | 0.000043234 | 0.000038132 | 0.000106422 |
| 25 | 0.000160707 | 0.000114800 | 0.000081862 | 0.000316006 |
| 26 | 0.000285605 | 0.000091192 | 0.000155676 | 0.000081852 |
| 27 | 0.000492896 | 0.000083140 | 0.000063719 | 0.000340297 |
| 28 | 0.000232543 | 0.000054873 | 0.000035957 | 0.000086719 |
| 29 | 0.000212785 | 0.000071039 | 0.000109083 | 0.000284816 |
| 30 | 0.000281917 | 0.000092776 | 0.000027626 | 0.000109580 |
| 31 | 0.000473755 | 0.000158887 | 0.000037616 | 0.000255684 |
| 32 | 0.000307305 | 0.000047896 | 0.000112336 | 0.000100553 |

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

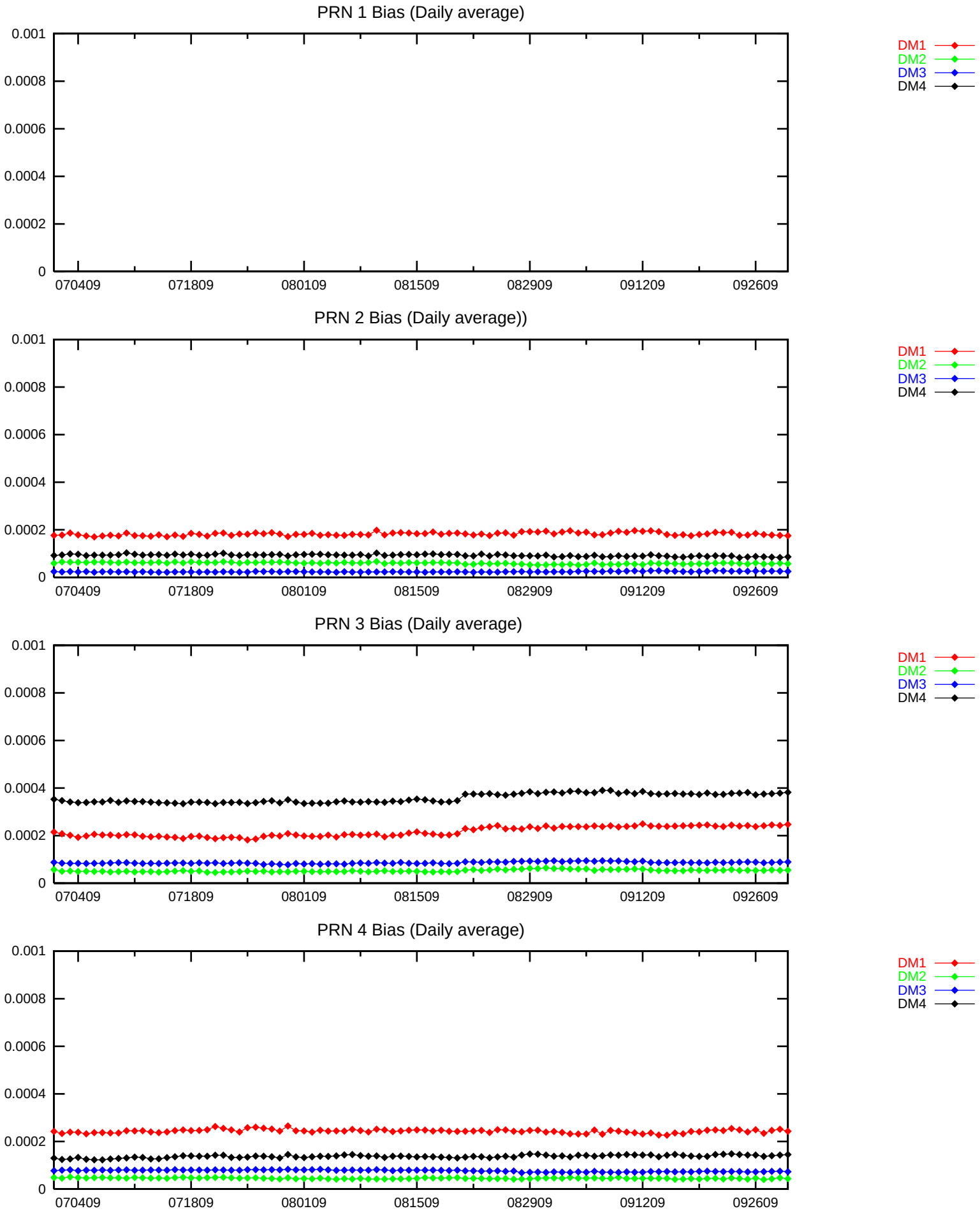
| PRN | DM1 | DM2 | DM3 | DM4 |
|---|---|---|---|---|
| 2 | 0.00018211 | 0.00005918 | 0.00002267 | 0.00009485 |
| 3 | 0.00021182 | 0.00005212 | 0.00008507 | 0.00034292 |
| 4 | 0.00023727 | 0.00004522 | 0.00007488 | 0.00012869 |
| 5 | 0.00014314 | 0.00013010 | 0.00006414 | 0.00009901 |
| 6 | 0.00016105 | 0.00005370 | 0.00004338 | 0.00012103 |
| 7 | 0.00012937 | 0.00009379 | 0.00003639 | 0.00012173 |
| 8 | 0.00015519 | 0.00011942 | 0.00004488 | 0.00010081 |
| 9 | 0.00023124 | 0.00005415 | 0.00006977 | 0.00011201 |
| 10 | 0.00065303 | 0.00007335 | 0.00027041 | 0.00009276 |
| 11 | 0.00092309 | 0.00018605 | 0.00006443 | 0.00023146 |
| 12 | 0.00023906 | 0.00008804 | 0.00010611 | 0.00008008 |
| 13 | 0.00051398 | 0.00005828 | 0.00005823 | 0.00016114 |
| 14 | 0.00067382 | 0.00012888 | 0.00011414 | 0.00012987 |
| 15 | 0.00012031 | 0.00007039 | 0.00002805 | 0.00013530 |
| 16 | 0.00016181 | 0.00007672 | 0.00010736 | 0.00033777 |
| 17 | 0.00011784 | 0.00008047 | 0.00003146 | 0.00011605 |
| 18 | 0.00062032 | 0.00010534 | 0.00004104 | 0.00021696 |
| 19 | 0.00037609 | 0.00013088 | 0.00003292 | 0.00008400 |
| 20 | 0.00015477 | 0.00004739 | 0.00004290 | 0.00011133 |
| 21 | 0.00062808 | 0.00018751 | 0.00020218 | 0.00008621 |
| 22 | 0.00014578 | 0.00009192 | 0.00010140 | 0.00010068 |
| 23 | 0.00095563 | 0.00013938 | 0.00003548 | 0.00042364 |
| 24 | 0.00030085 | 0.00004517 | 0.00003529 | 0.00010168 |
| 25 | 0.00015713 | 0.00011285 | 0.00008155 | 0.00030523 |
| 26 | 0.00026894 | 0.00009243 | 0.00015420 | 0.00008973 |
| 27 | 0.00047057 | 0.00007801 | 0.00006802 | 0.00031904 |
| 28 | 0.00025315 | 0.00005329 | 0.00003266 | 0.00009011 |
| 29 | 0.00022430 | 0.00006764 | 0.00010749 | 0.00029347 |
| 30 | 0.00029385 | 0.00009435 | 0.00002805 | 0.00011686 |
| 31 | 0.00047045 | 0.00015889 | 0.00003895 | 0.00025090 |
| 32 | 0.00031606 | 0.00004751 | 0.00011376 | 0.00010258 |

# Figure 12-2 PRN Bias Average for the Quarter

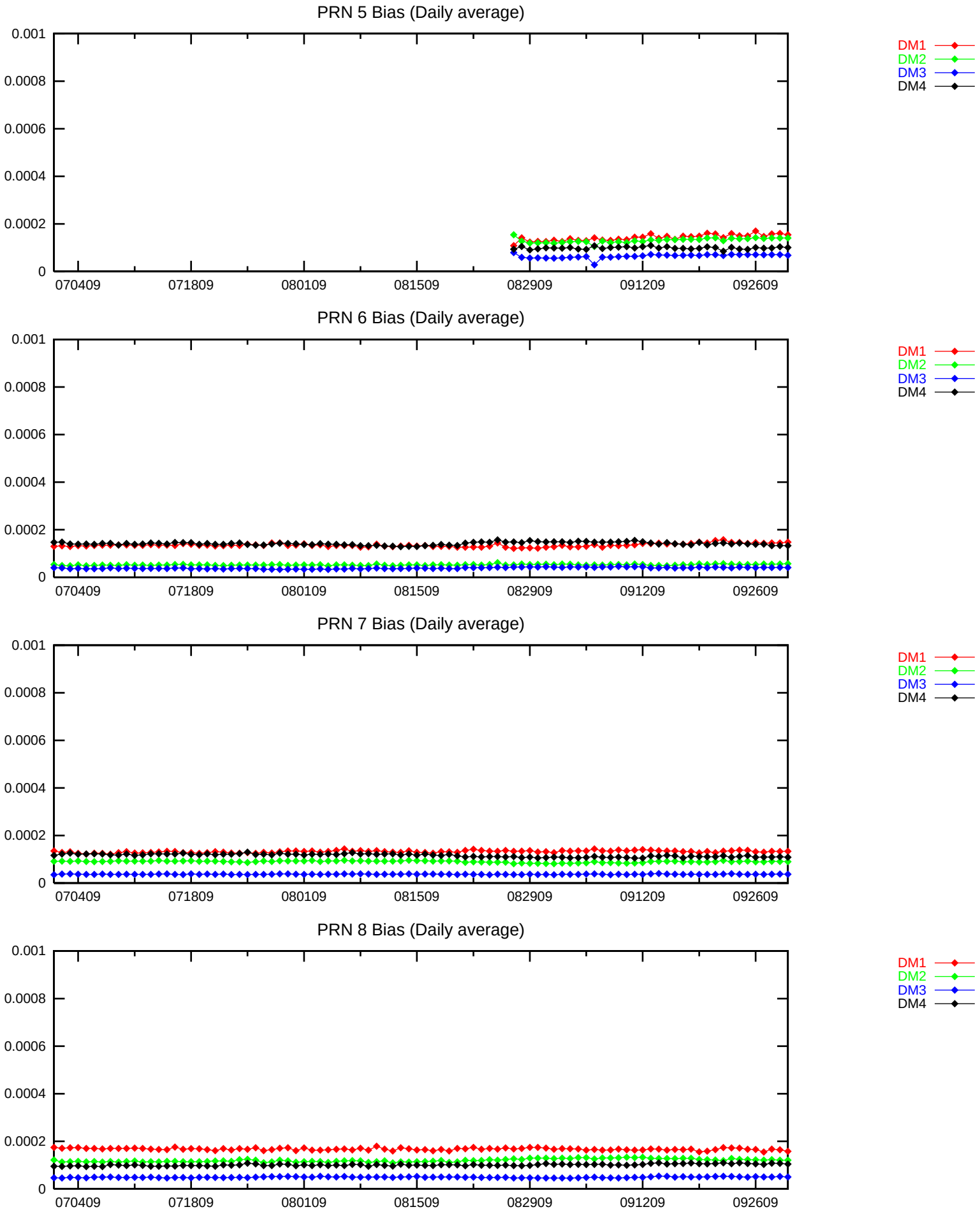


# Figure 12-3 PRN Bias Average Trend (PRN 1 - PRN 4)



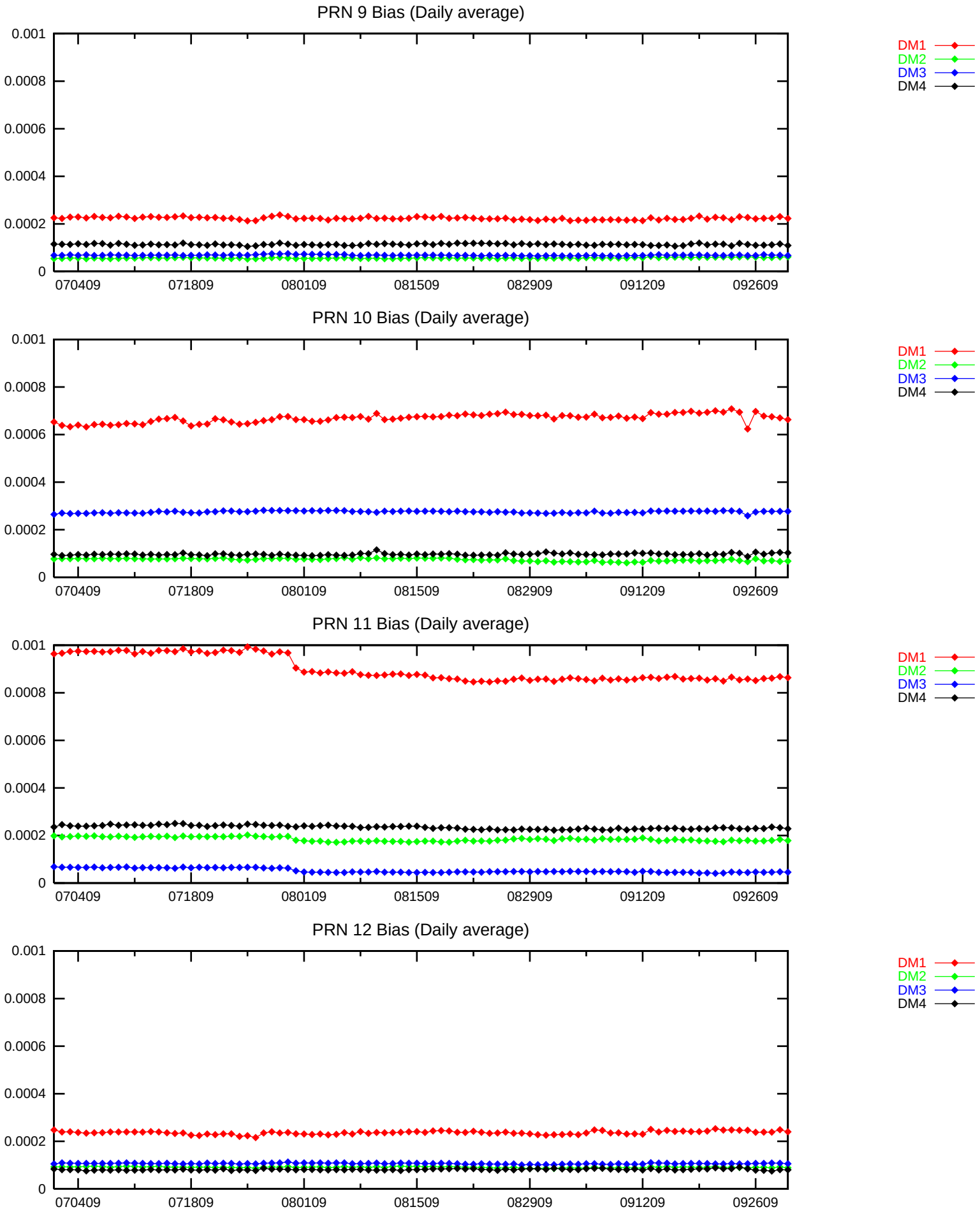


## Figure 12-4 PRN Bias Average Trend (PRN 5 - PRN 8)



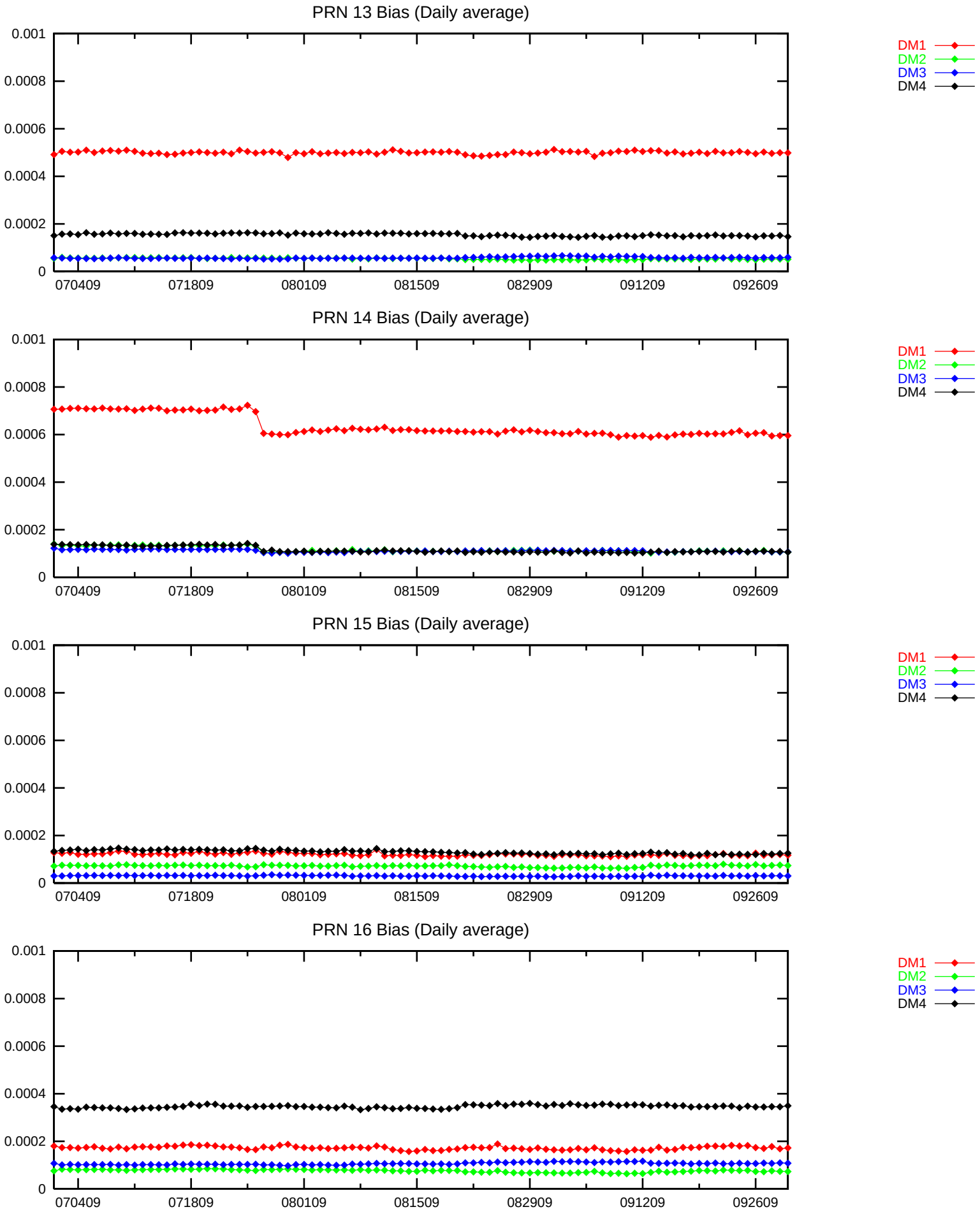
# Figure 12-5 PRN Bias Average Trend (PRN 9 - PRN 12)





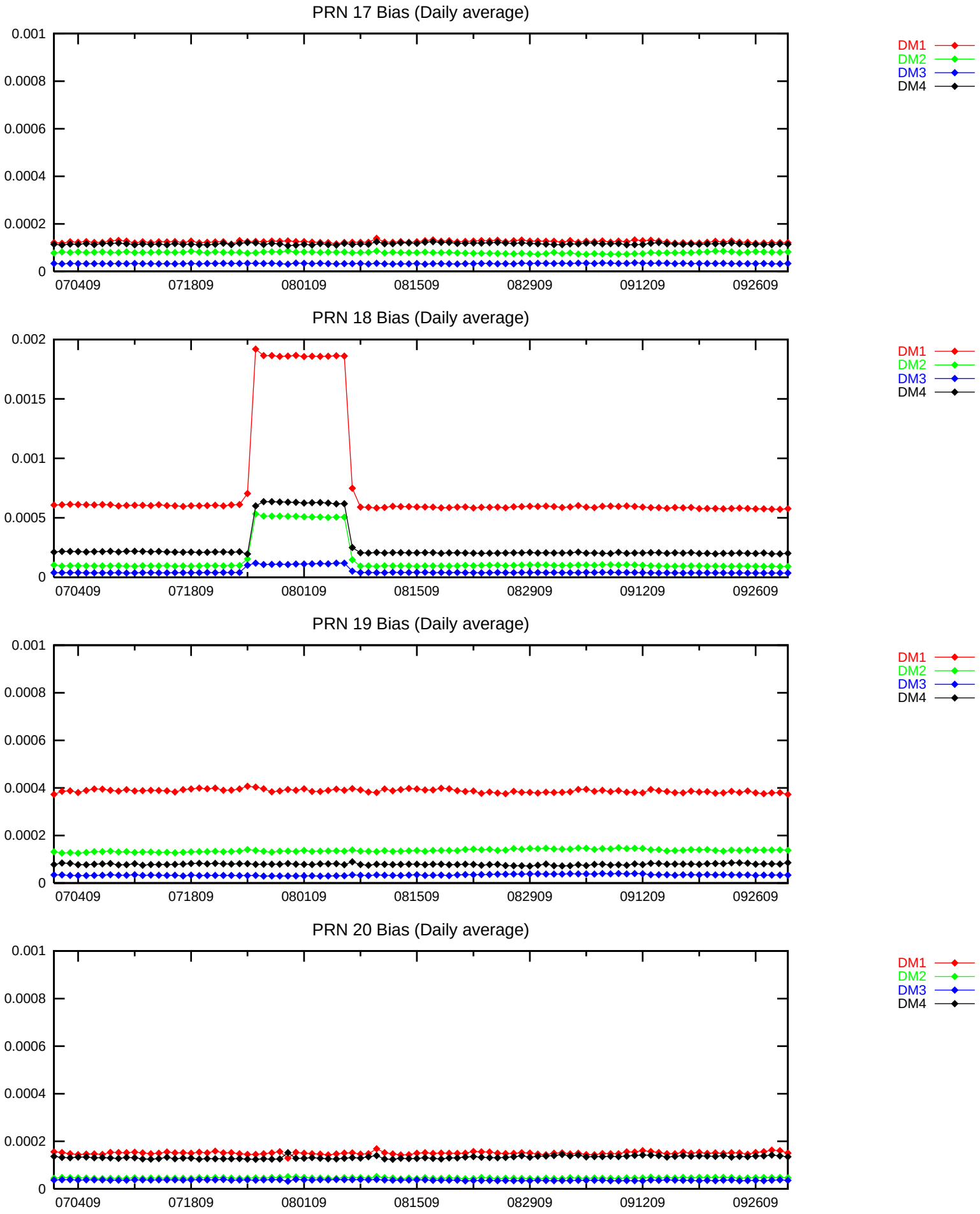
# Figure 12-6 PRN Bias Average Trend (PRN 13 - PRN 16)





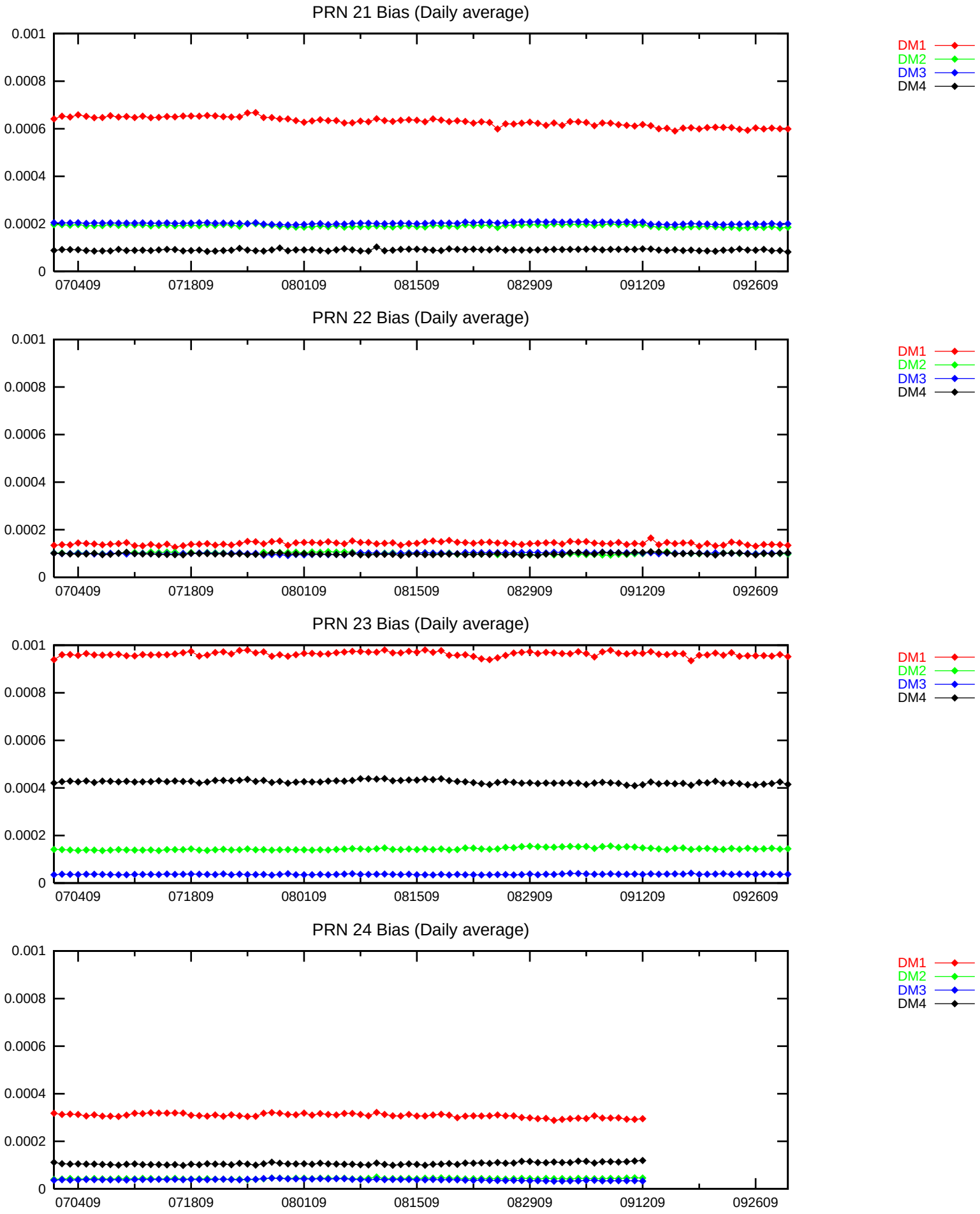
# Figure 12-7 PRN Bias Average Trend (PRN 17 - PRN 20)





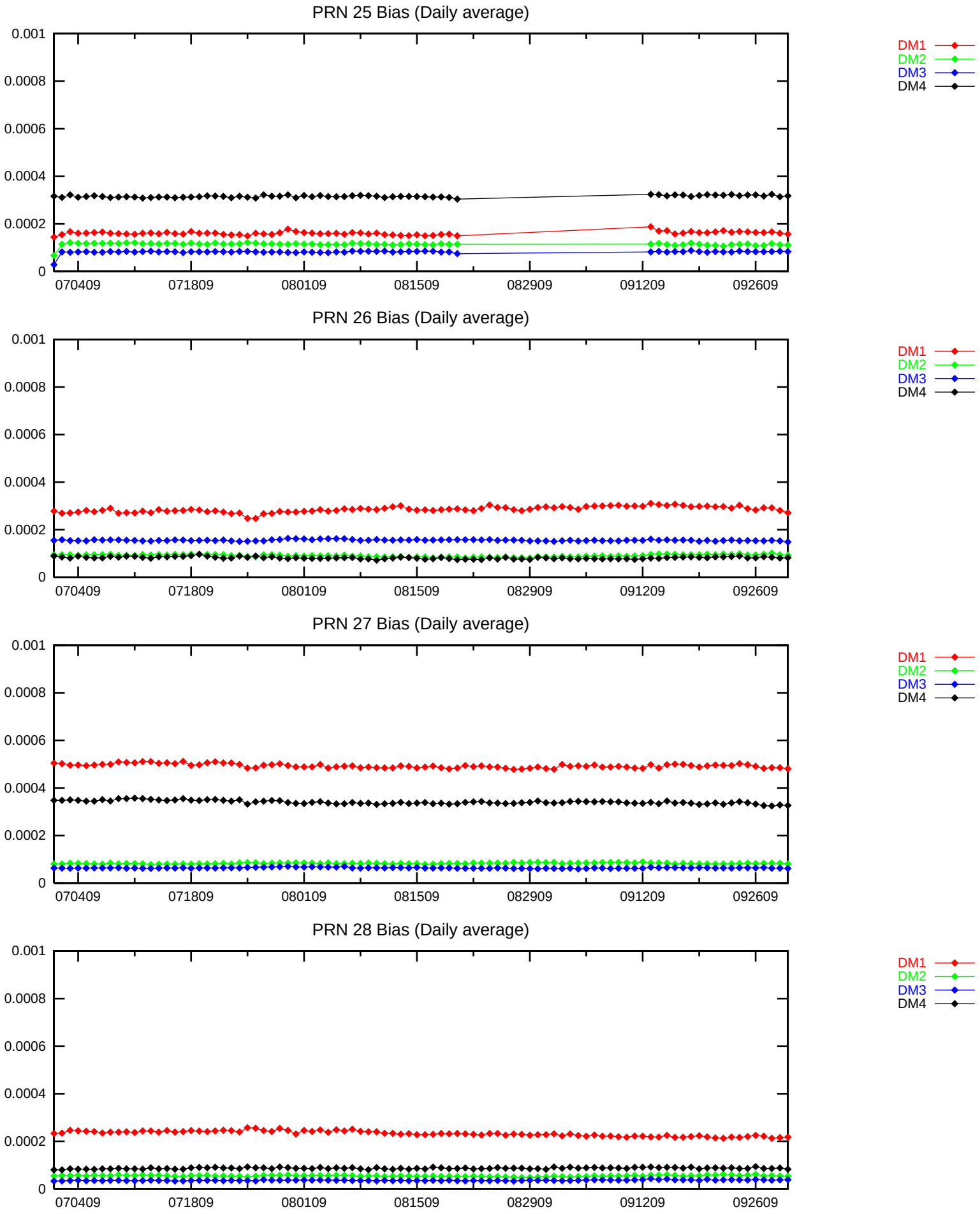
# Figure 12-8 PRN Bias Average Trend (PRN 21 - PRN 24)



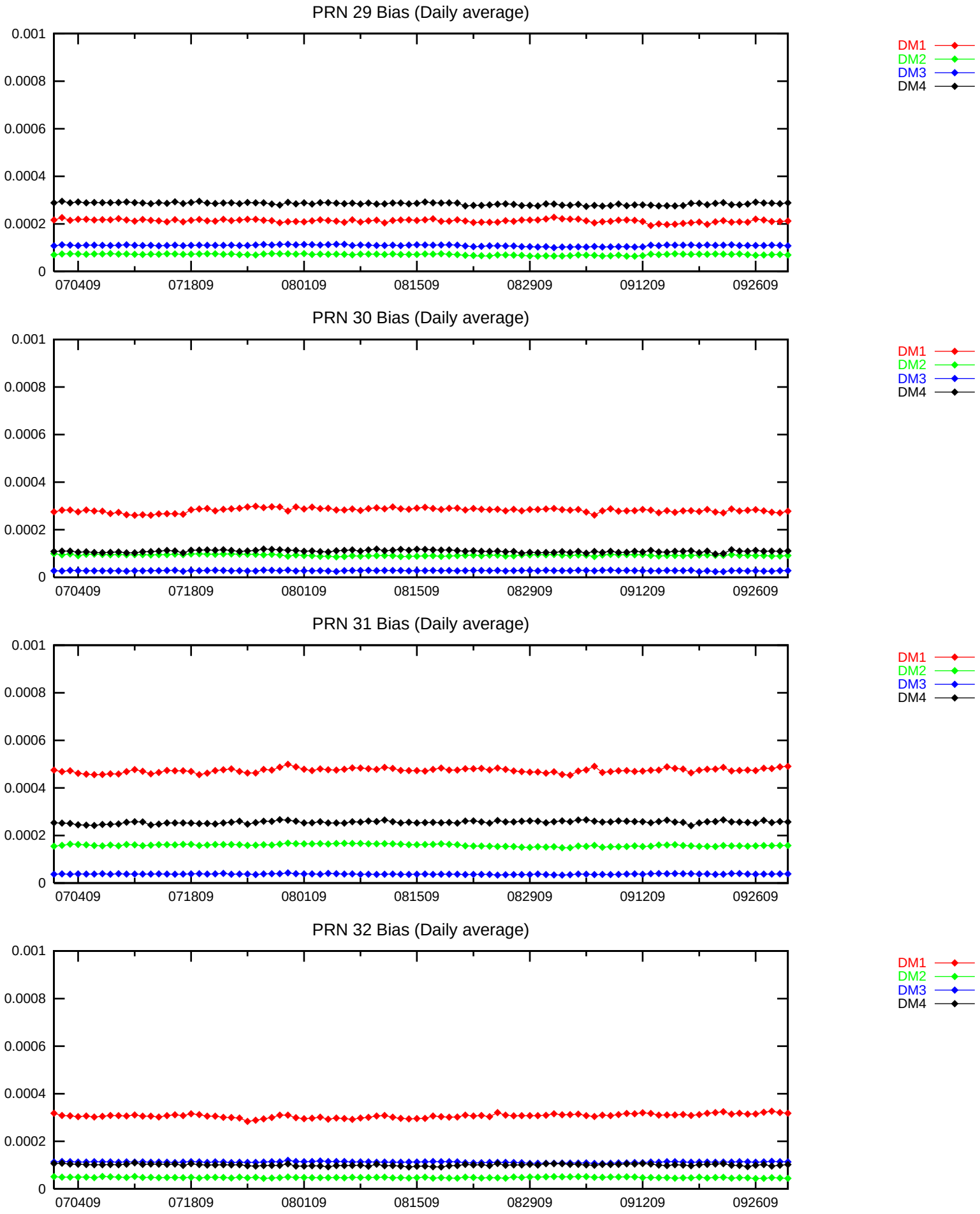


# Figure 12-9 PRN Bias Average Trend (PRN 25 - PRN 28)





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



### 12.5 SQM Trips

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

## Appendix A: Glossary

### General Terms and Definitions

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

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

**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**



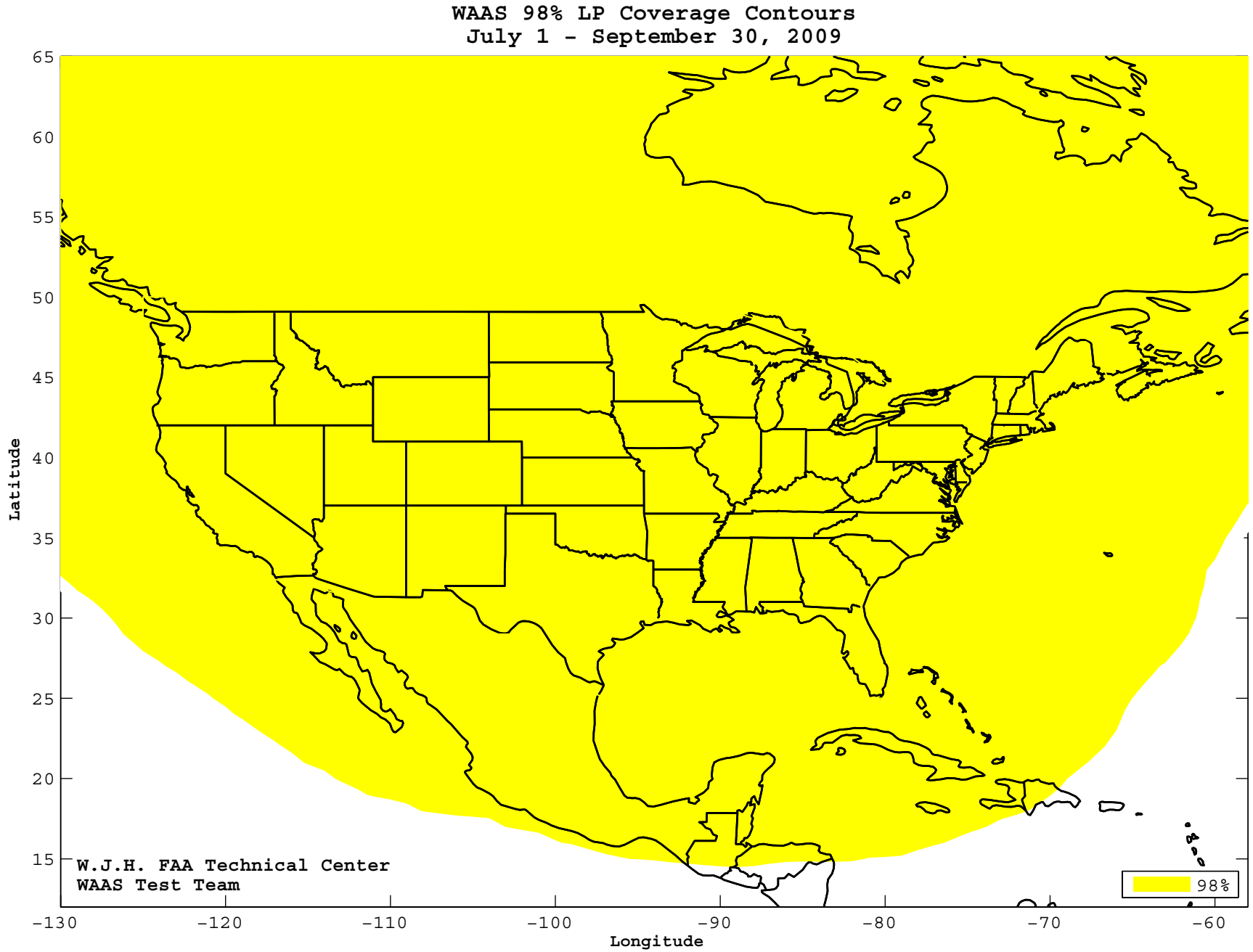


**Figure B-2 98% Alaska LPV Availability Contour for the Quarter**



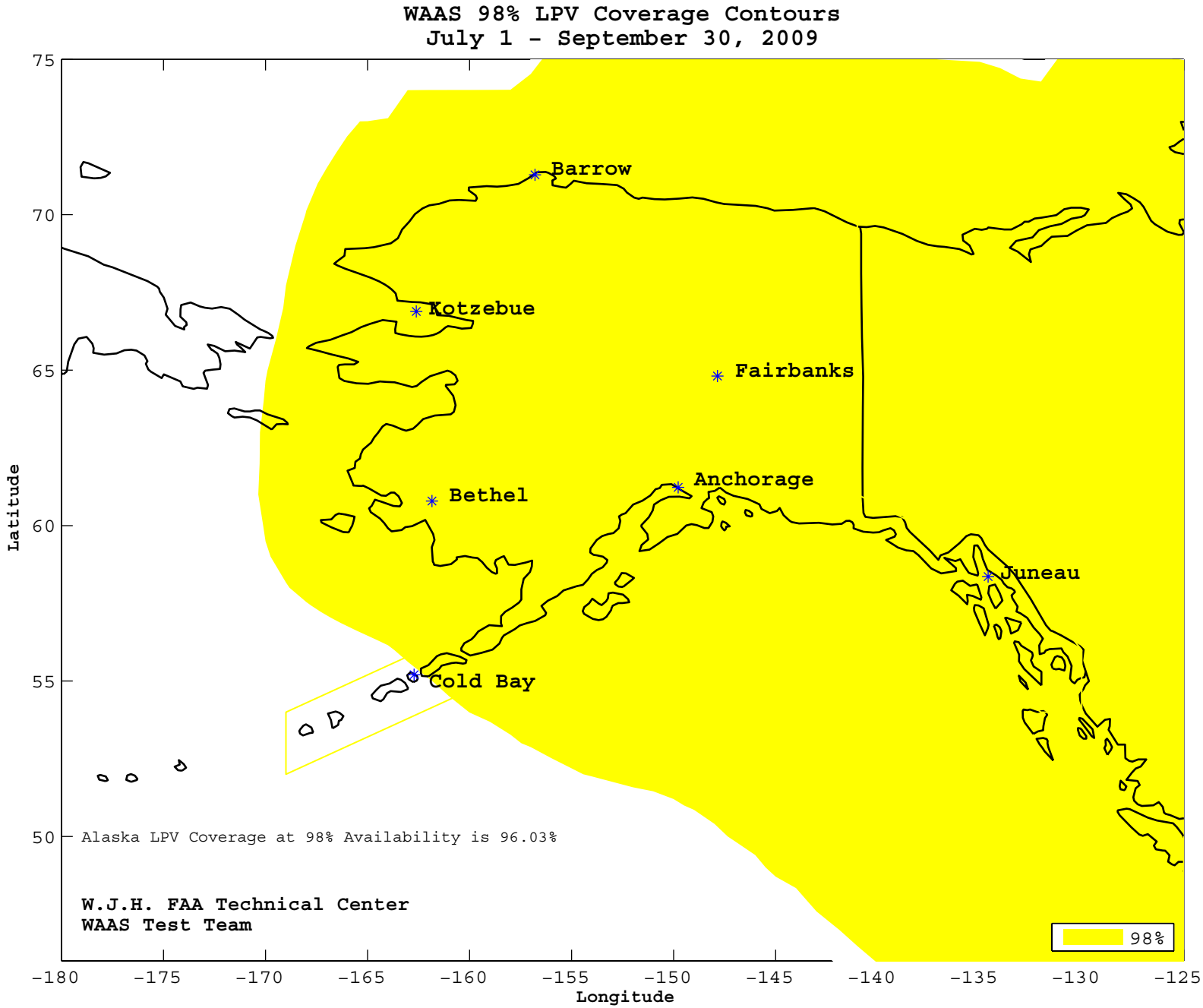


**Figure B-3 99% CONUS LPV 200 Availability Contour for the Quarter**



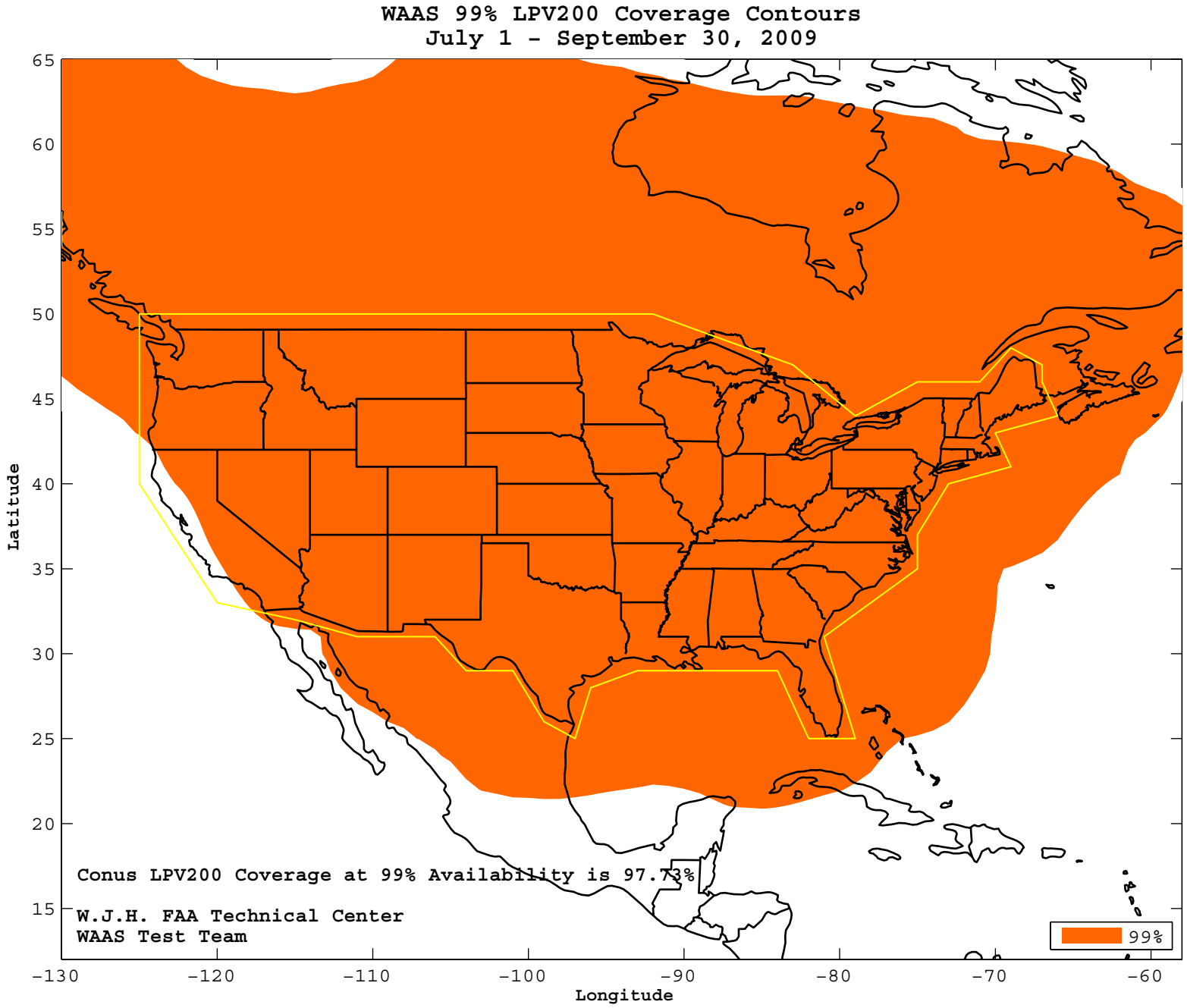


**Figure B-4 99% Alaska LPV 200 Availability Contour for the Quarter**