WAAS Technical Report
William J. Hughes Technical Center
Atlantic City International Airport, NJ
January 7, 2015

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DR #126: Effect on WAAS from Iono Activity on January 7, 2015

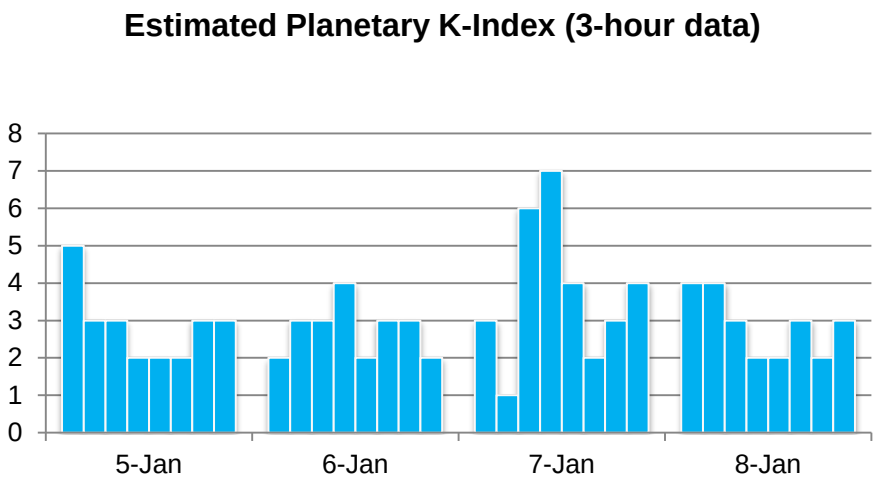
GPS Week/Day: Week 1826 Day 3 (01/07/2015)

Background

- **This presentation shows the effects on WAAS aviation users from the solar event on January 7, 2015**
- **During the week of January 5, 2015, there were more LPV-200 outages in Alaska and Canada than normal that are attributable to a disturbance in the ionosphere**
  - This presentation focus on the event on January 7 for Alaska since the effect on WAAS availability was highest on that day
  - No iono events during this week affected coverage in CONUS

Kp Index

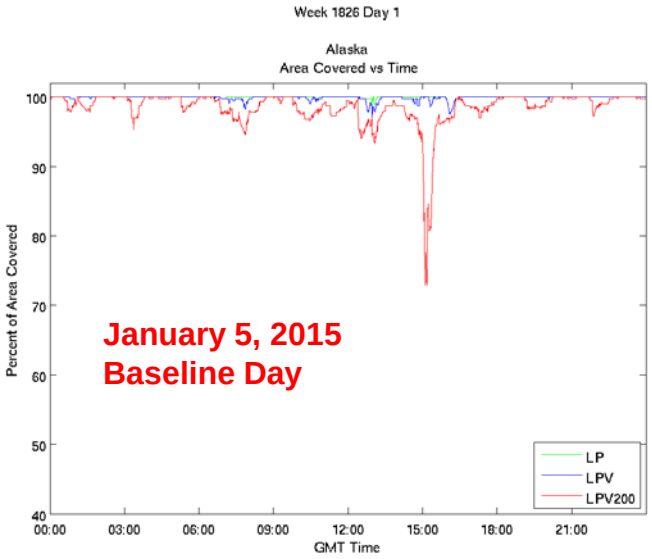
- **The Kp Index is a worldwide weighted average metric that is used to help define the magnitude of a geomagnetic storm**
  - The higher the value the more intense the storm
  - A value of 5 or more generally indicates a storm
- **The maximum Kp value on January 7 was 7**

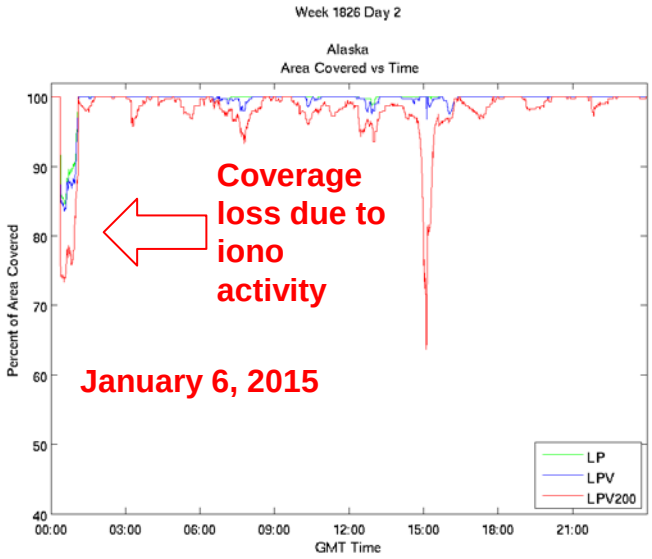


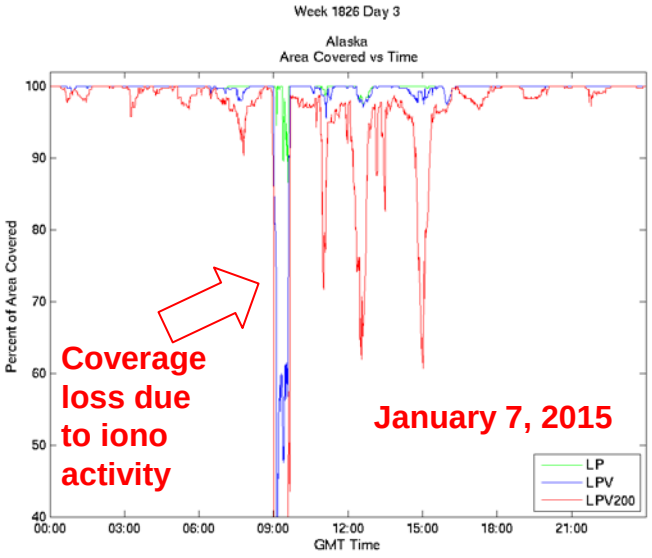
Coverage vs. Time Charts

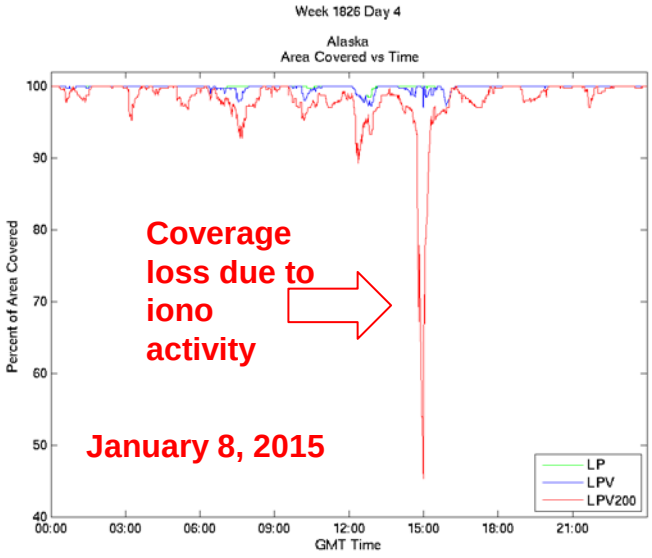
- **The next slide shows Time vs. Coverage charts for Alaska**
  - January 5 was a baseline day
    - Baseline days occur when there is no event (GUS switchover, WRS outage, iono activity, GPS satellite outage, etc) that affects WAAS coverage – basically steady state performance for WAAS
  - January 6, 7, and 8 each had outages attributable to iono activity
    - Higher than normal GIVEs observed

Coverage vs. Time Charts





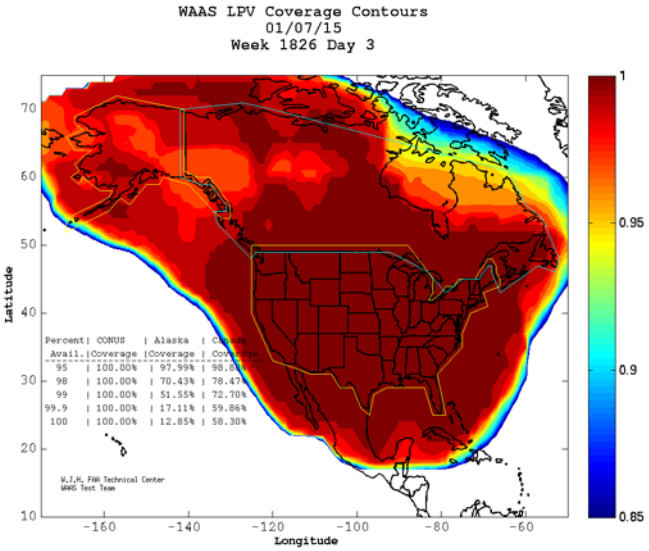


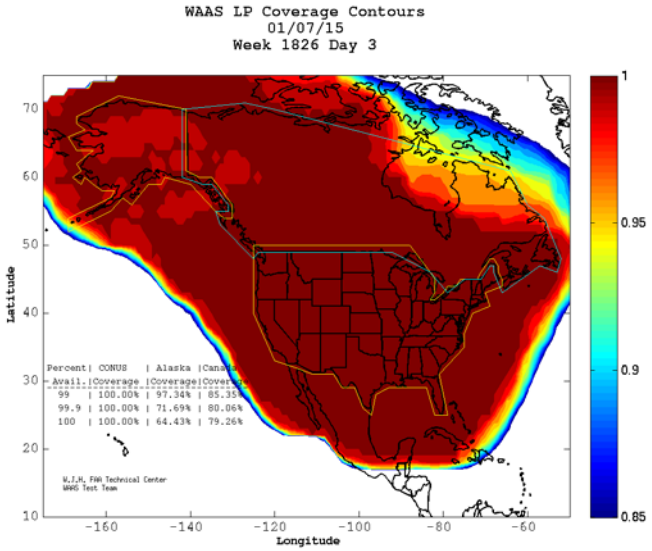


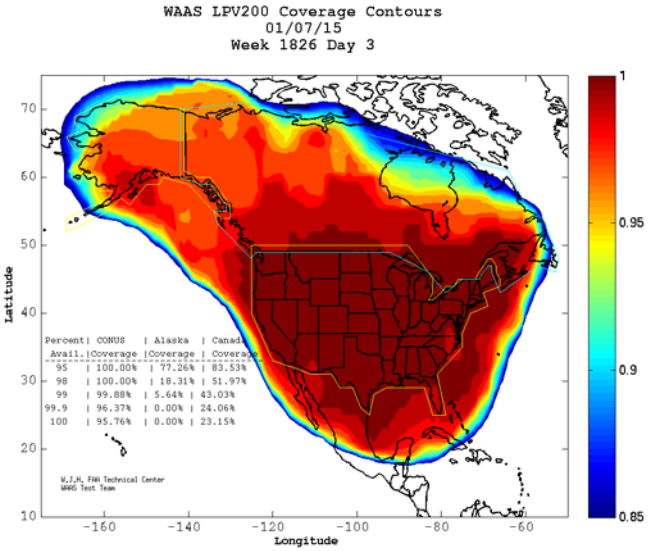
Coverage Charts

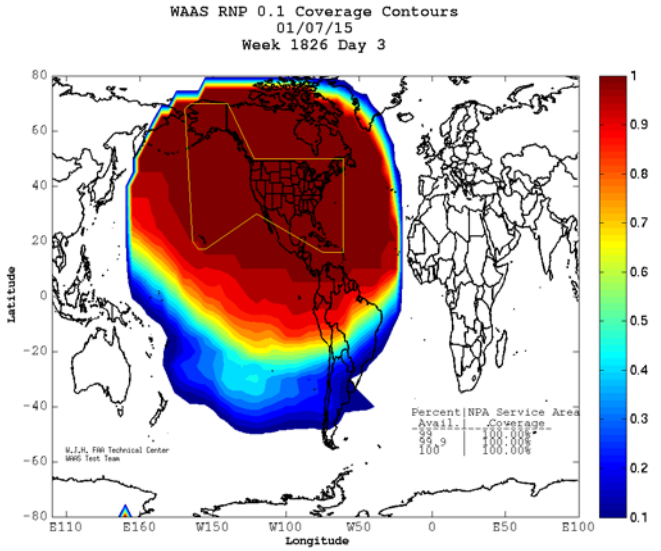
- **The next two slides show the LP, LPV, LPV-200, and RNP 0.1 coverage for January 7, 2015**
  - Only RNP 0.1 coverage was unaffected by this event

Coverage Plots – January 7, 2014





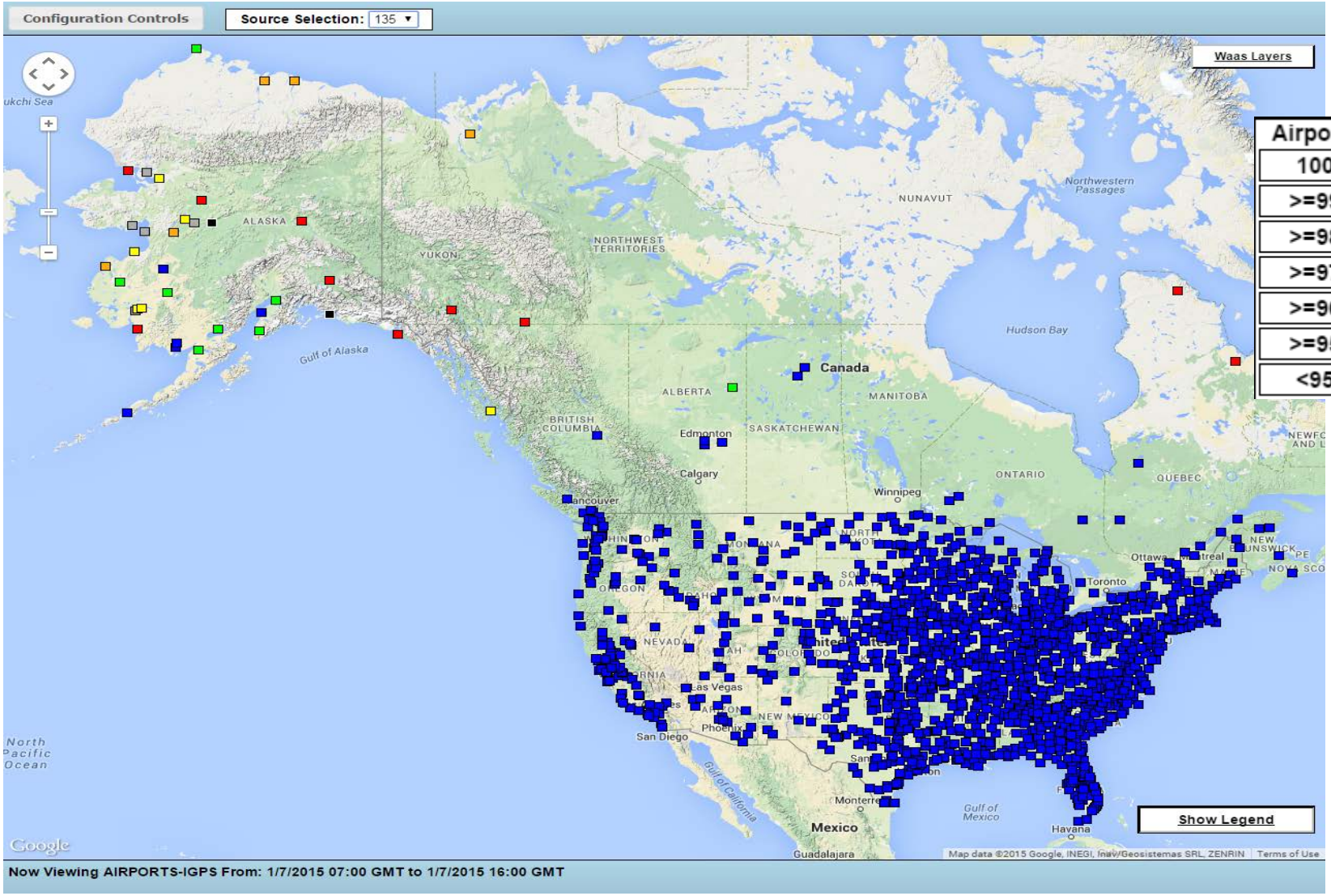




Airport Outages

- **Each airport is represented by a square on the map**
  - The legend on the map shows the availability percentage for each airport
  - Time period is on 1/7/2015 from 07:00:00 GMT to 16:00:00 GMT
  - There are two separate maps
    - One for LPV airports and the other for LPV-200 airports
  - No airports in CONUS had an LPV outage on this day though many airports in Alaska and Canada did have outages
  - The airports shown on the map have published instrument approach procedures
    - Airports on the LPV map have approaches published to LPV minima
    - Airports on the LPV-200 map have approaches published to the LPV-200 minima

Airports with LPV Outages on January 7, 2015



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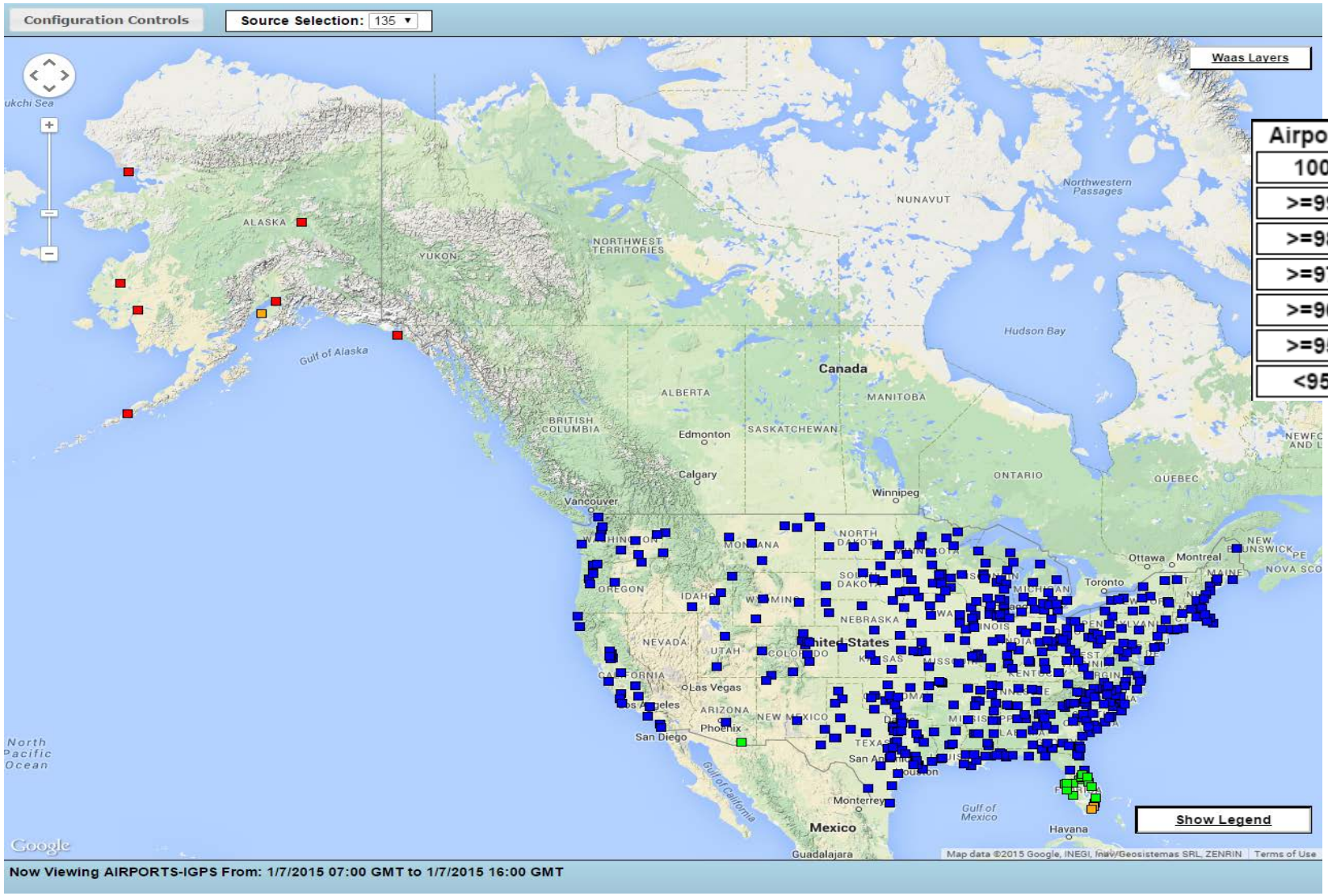
Airports with LPV-200 Outages on January 7, 2015



Legend

Airport Availability (%)	
100%	
>=99%	
>=98%	
>=97%	
>=96%	
>=95%	
<95%	

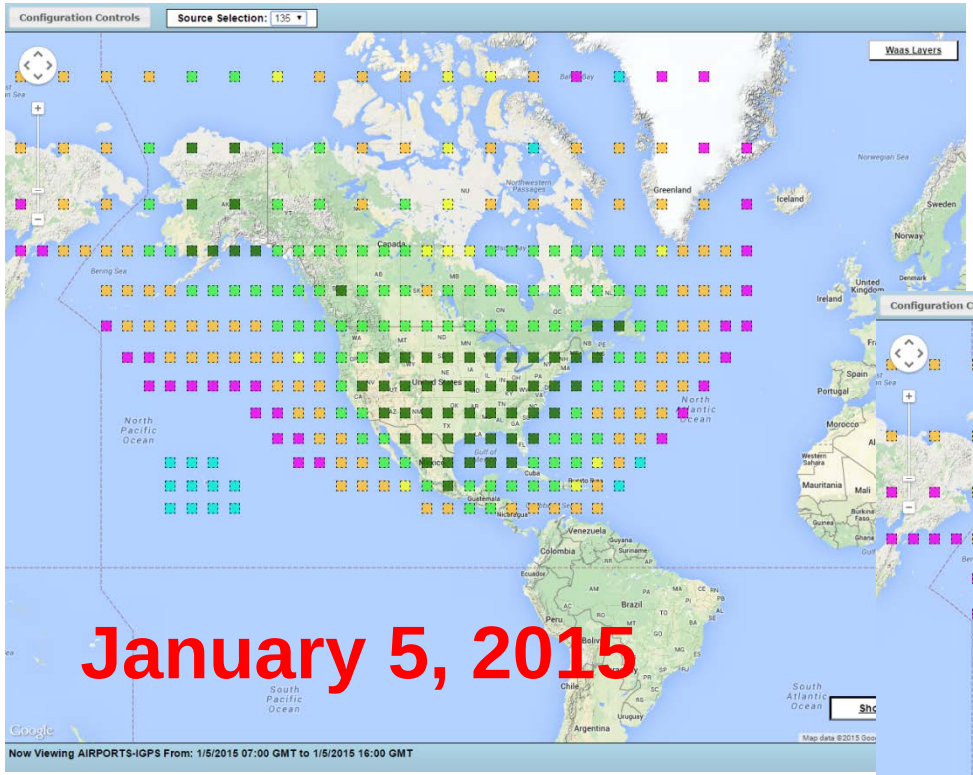
Ionosphere Grid Points

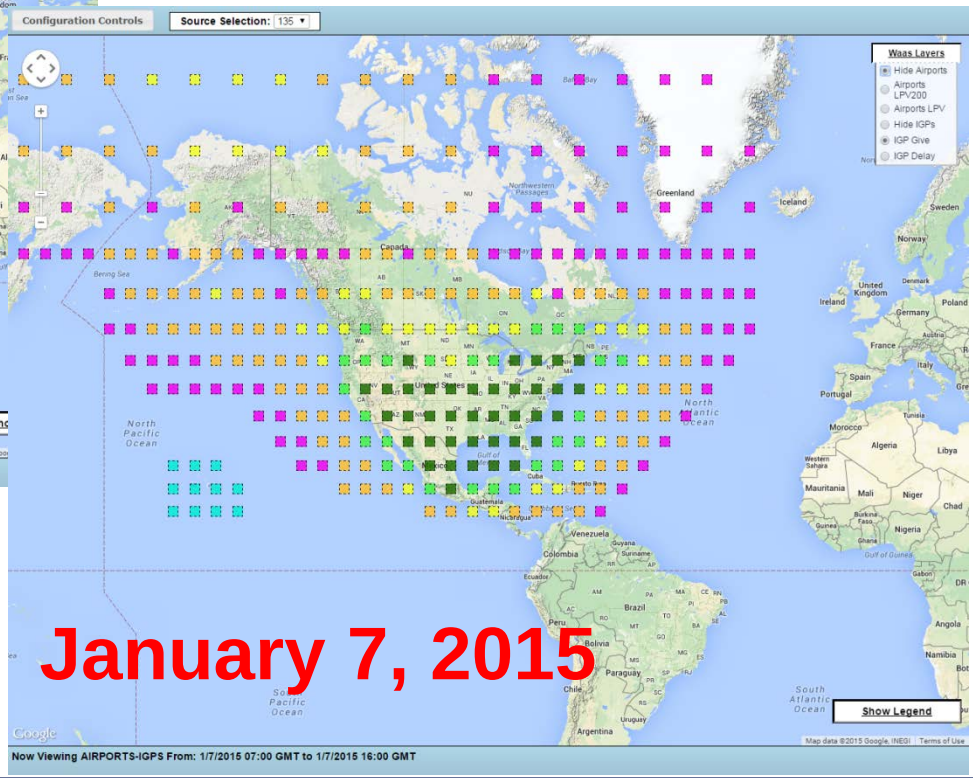
- **The next slide shows the maximum IGP GIVE**
  - The figure on the left is for September 12 18:00:00 to September 13 12:00:00
  - The figure on the right is for September 14 18:00:00 to September 15 12:00:00
    - The maximum Kp for September 14-15 was 1
    - The IGP GIVE values for this time period can be considered typical
- **IGP GIVE values are elevated on September 12-13 compared to September 14-15 in eastern Canada and north central CONUS**

IGP GIVE Values

Legend

IGP Gives	
3.6	
4.5	
6	
15	
25	
45	





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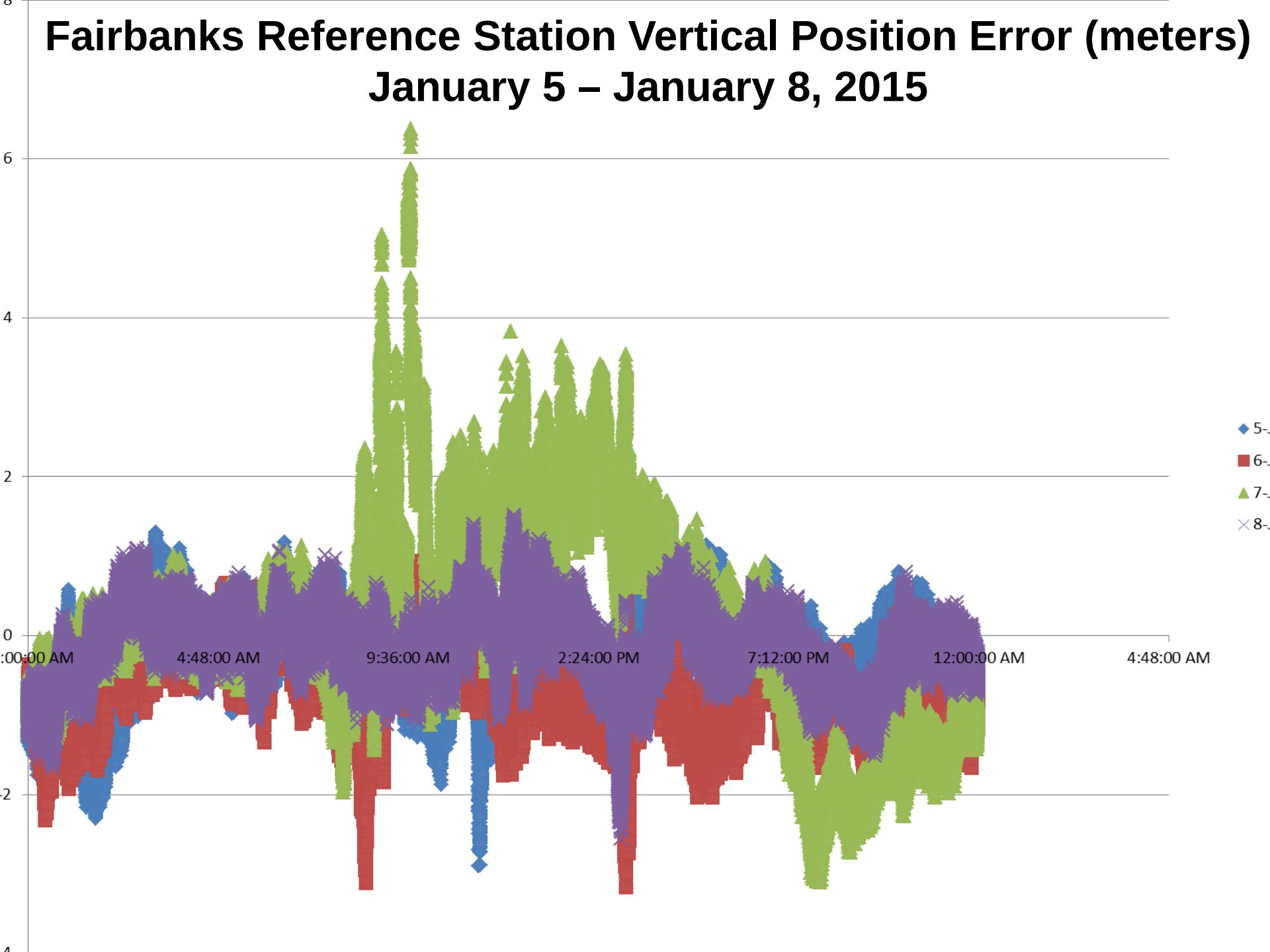
Position Error

- **During this event the position error increased above normal levels at some reference stations**
- **For example, the next slide shows the vertical position error at the Fairbanks WRE-A receiver**
  - Data from January 5 – 8 is shown
    - Highest vertical error occurs on January 7 at about 09:28 GMT at 6.37 meters.
    - Time of day is shown on the x-axis
- **Largest vertical error observed was at Iqaluit on January 7 at 9.82 meters**

Fairbanks Reference Station Vertical Position Error (meters)
January 5 – January 8, 2015



Conclusion

- **Iono activity affected WAAS coverage in Alaska and Canada for several days during the week of January 5**
- **This presentation focused on January 7**
  - Day most affected
  - LPV-200, LPV, and LP coverage was lower in Alaska and Canada
  - RNP 0.1 service was unaffected by this event
  - CONUS coverage was normal during this week