ATMOSPHERIC & SPACE TECHNOLOGY RESEARCH ASSOCIATES

SCIENCE + TECHNOLOGY + APPLICATIONS // *Bringing it all together*

Interpreting NOAA Space Weather Alerts from a Mapping/Surveying Perspective

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Portland
November 19, 2015

SWPC G2 Alert, 11/10/2015

- Space Weather Message Code: ALTK06
- Serial Number: 383
- Issue Time: 2015 Nov 10 1430 UTC

- ALERT: Geomagnetic K-index of 6
- Threshold Reached: 2015 Nov 10 1430 UTC
- Synoptic Period: 1200-1500 UTC
-
- Active Warning: Yes
- NOAA Scale: G2 - Moderate

- NOAA Space Weather Scale descriptions can be found at
- www.swpc.noaa.gov/noaa-scales-explanation

- Potential Impacts: Area of impact primarily poleward of 55 degrees Geomagnetic Latitude.
- Induced Currents - Power grid fluctuations can occur. High-latitude power systems may experience voltage alarms.
- Spacecraft - Satellite orientation irregularities may occur; increased drag on low Earth-orbit satellites is possible.
- Radio - HF (high frequency) radio propagation can fade at higher latitudes.
- Aurora - Aurora may be seen as low as New York to Wisconsin to Washington state.

Impacts (Continued)

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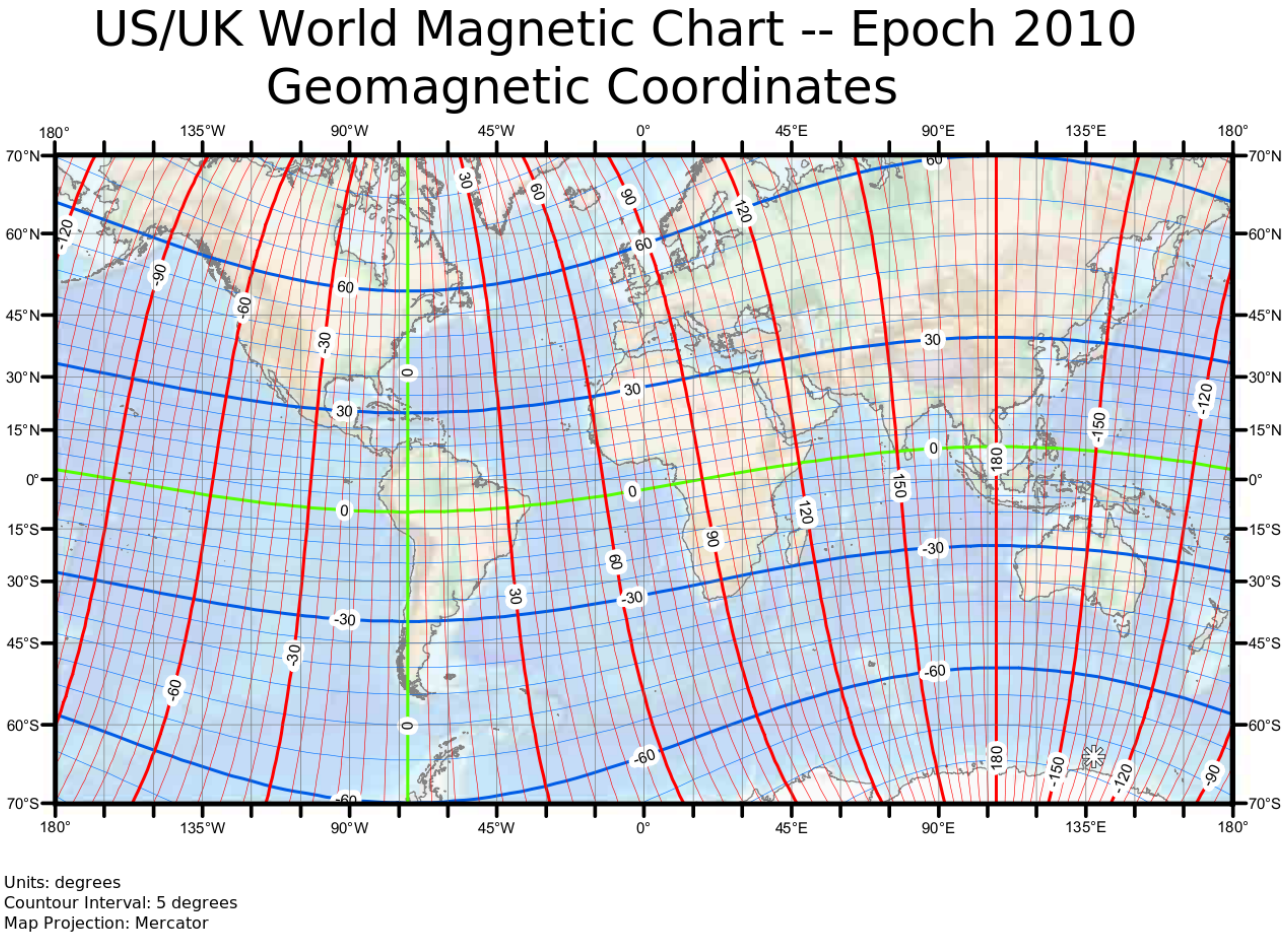
Geomagnetic Coordinates



CMEs in Interplanetary Space

- CMEs send out
  - Magnetic field and plasma
  - Energetic particles
  - Sometimes associated with flares

The CME disturbances propagate away from the Sun but their paths are modified by the background solar wind and the Sun's magnetic field

- Some of these disturbances reach Earth

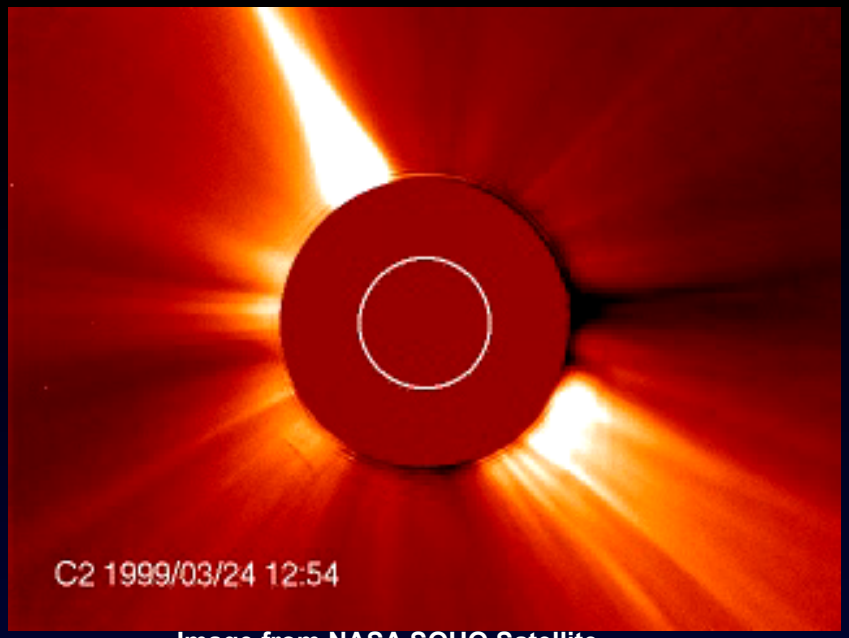


Image from NASA SOHO Satellite

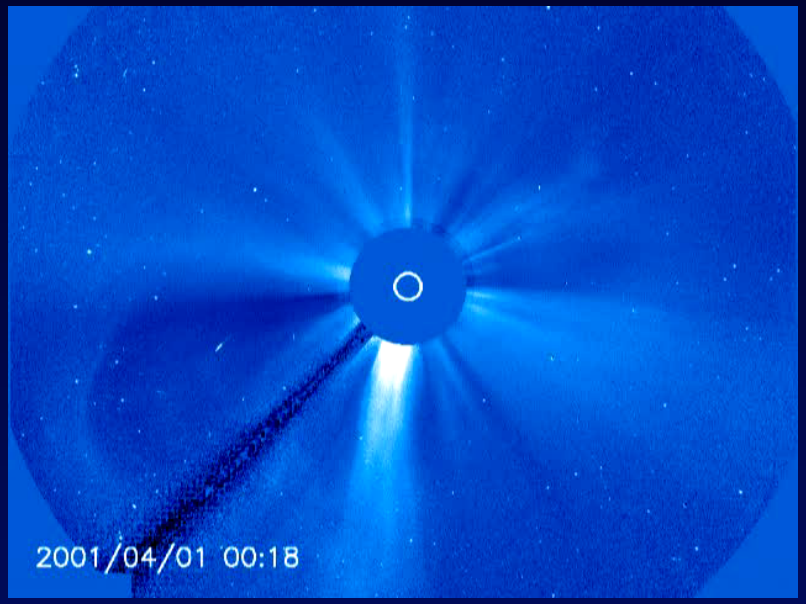


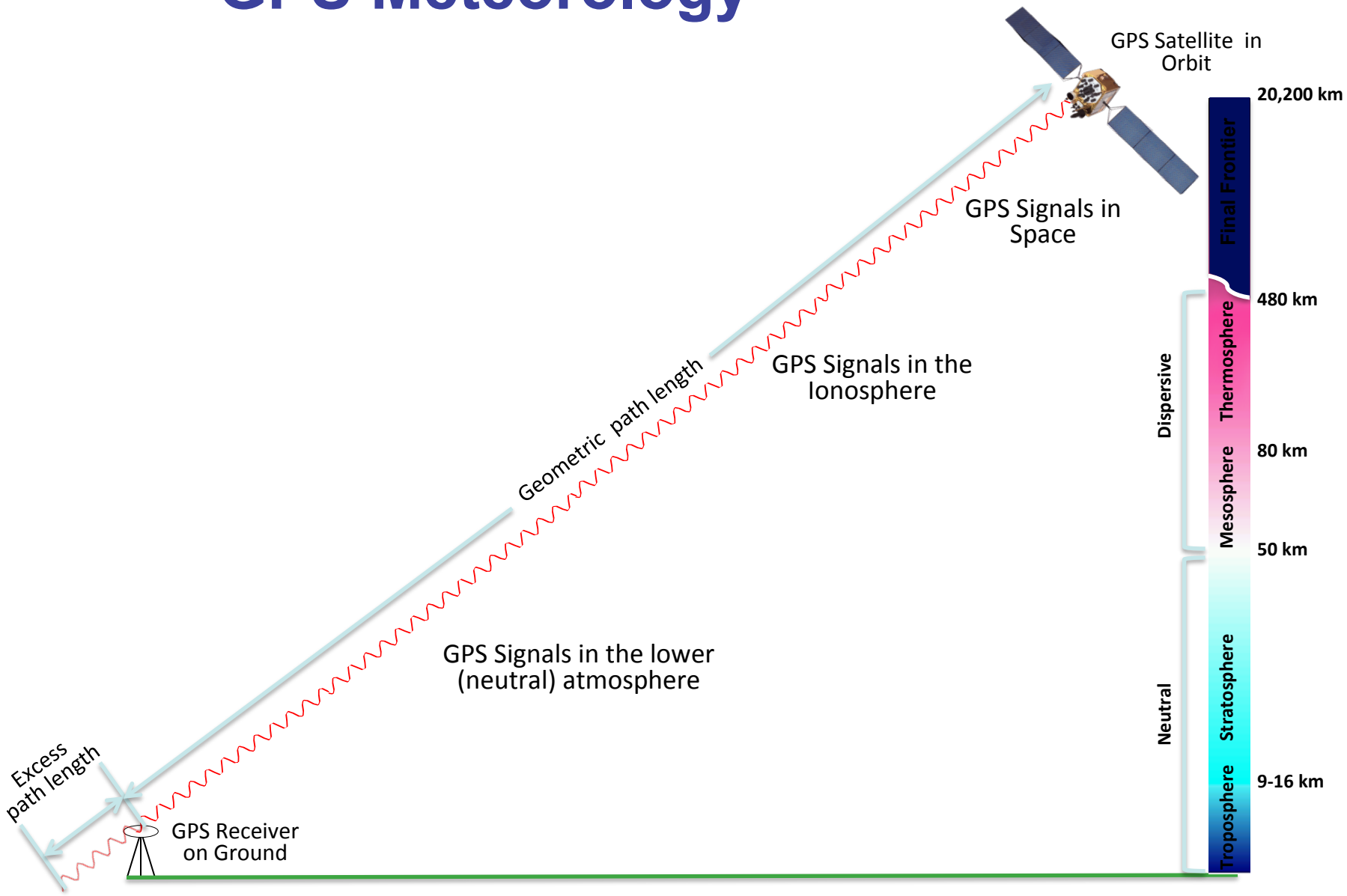
Image from NASA SOHO Satellite

Ionosphere

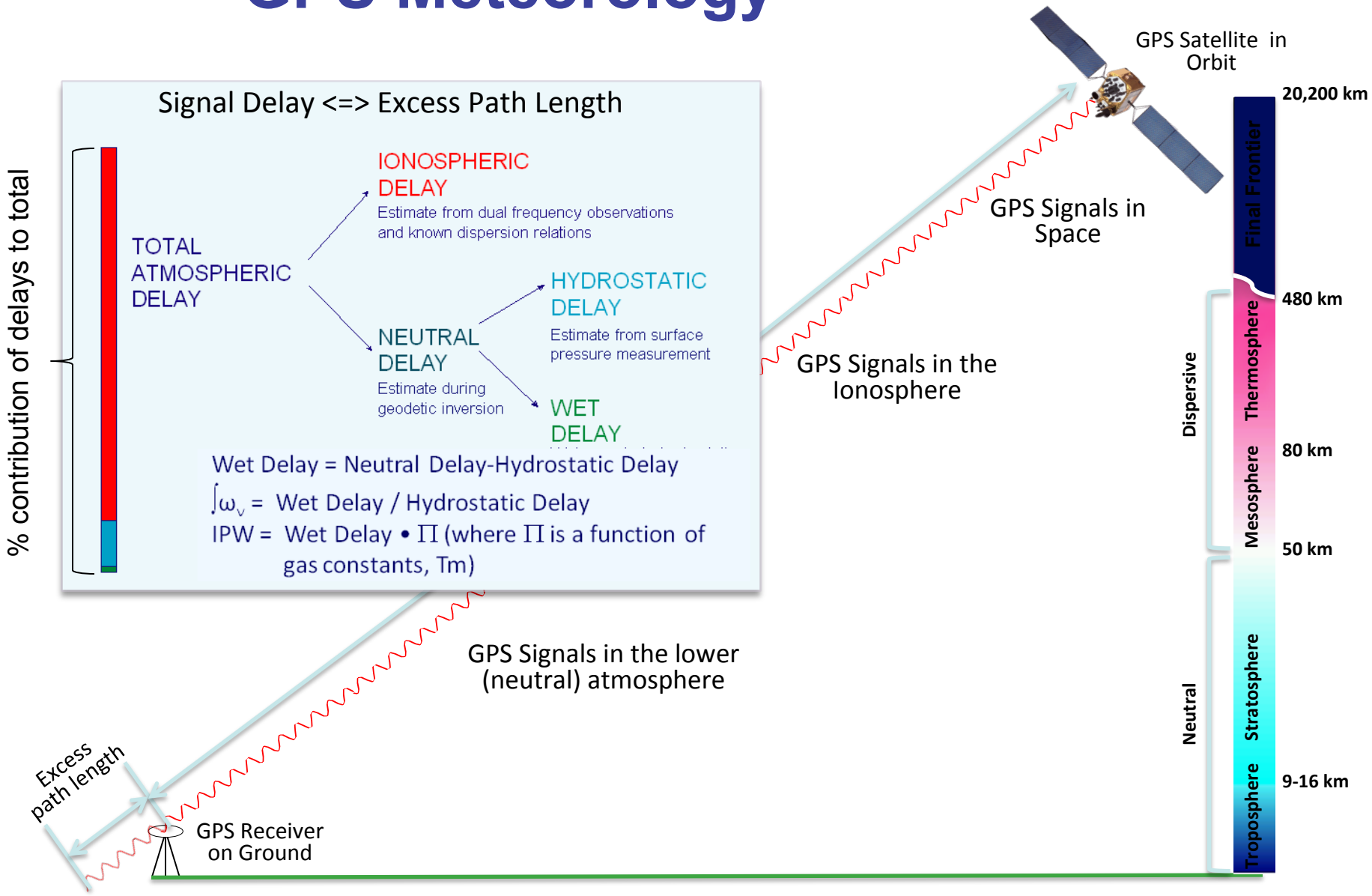
- The particles collide with the atmosphere and produce the Aurora and currents in the ionosphere.
- As geomagnetic activity increases, the Aurora gets brighter, more active, and moves away from the polar regions.

Image from NASA IMAGE Satellite

GPS Meteorology

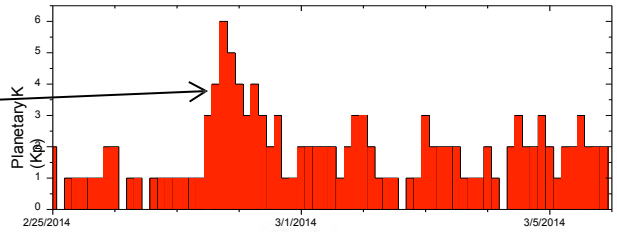


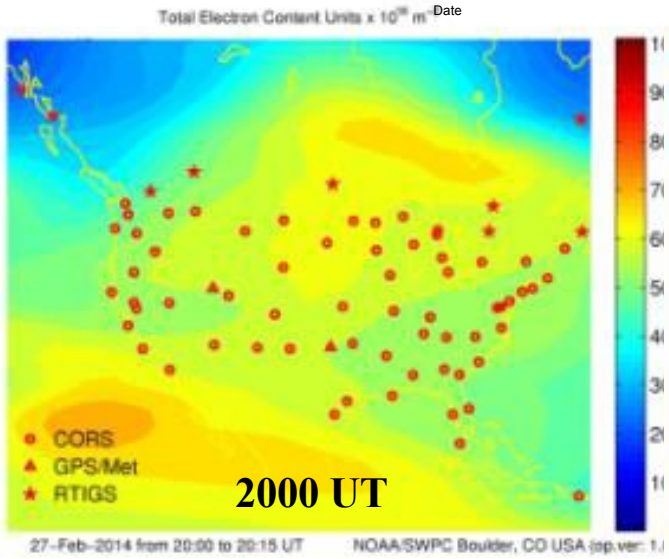
GPS Meteorology

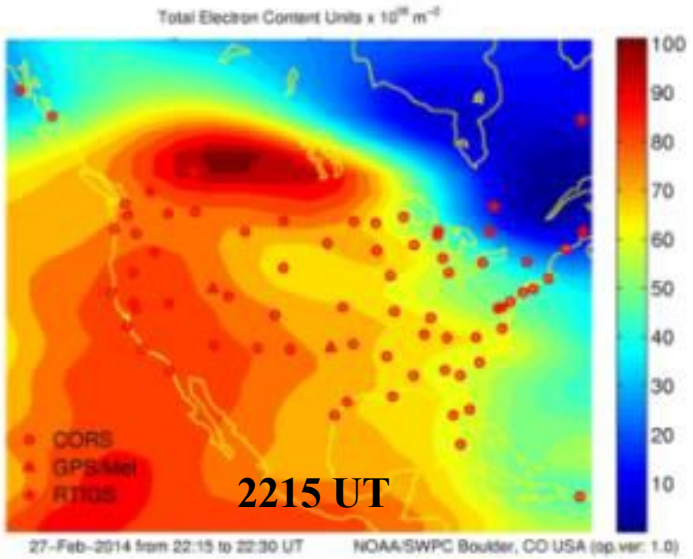


Impact of a Moderate Geomagnetic Storm

Moderate Geomagnetic Storm:
Kp of 6 on a scale of 0-9







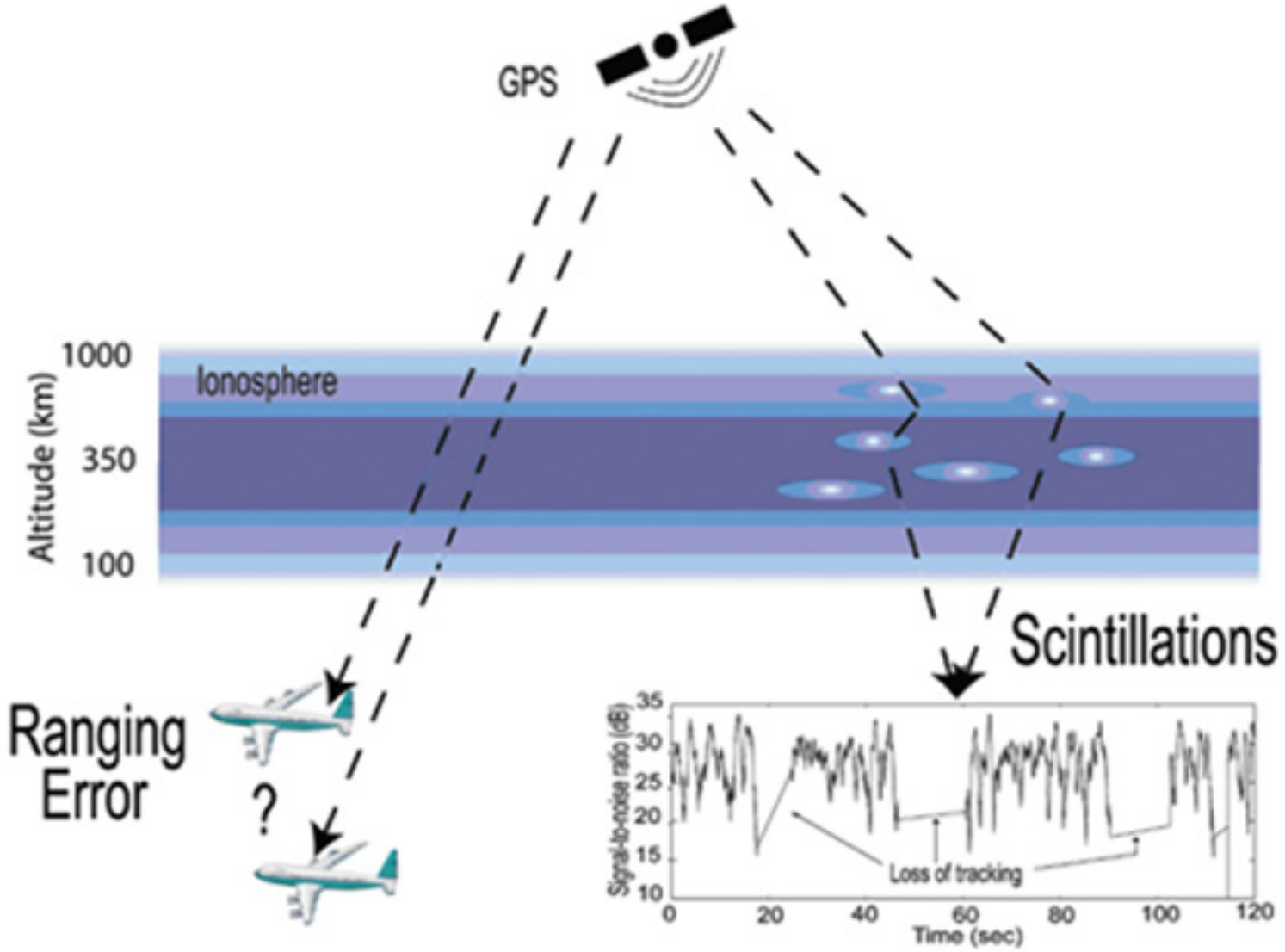
FAA Msg to SWPC

"An Ionospheric Storm began on 2/27/14. The Satellite Operations Specialists were alerted at the WAAS O&M by a Significant Event 757 at 2120 Zulu. So far, LPV and LPV200 service has not been available in Eastern Alaska and Northeastern CONUS. At times, North Central CONUS and all of Alaska have lost LPV and LPV200 Service."

Note: LPV is Localizer Performance with Vertical Guidance which takes the aircraft down to 250 ft altitude

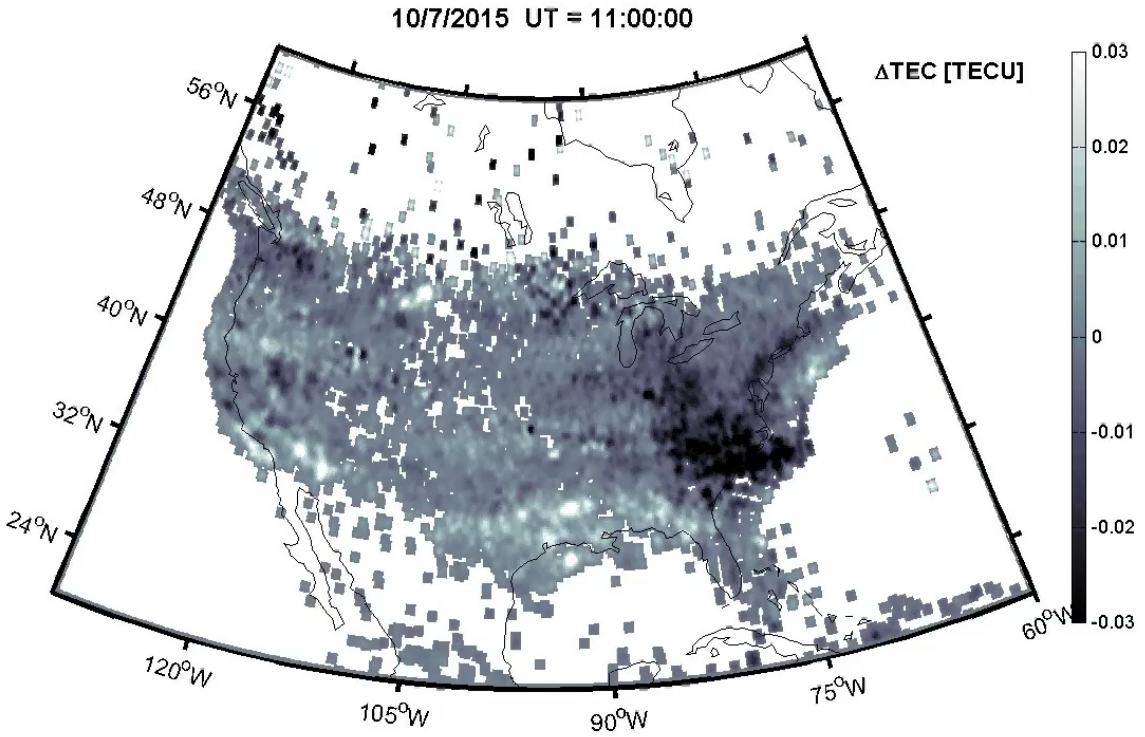
9 Sept 2014

GNSS in a Turbulent Ionosphere



Courtesy P. Kintner, Cornell

Why Don't the NOAA Alerts Better Capture What Happens in the Pacific NW?



iazeem@astraspace.net 17-Oct-2015 7:50 AM

Ionospheric Storm Studies

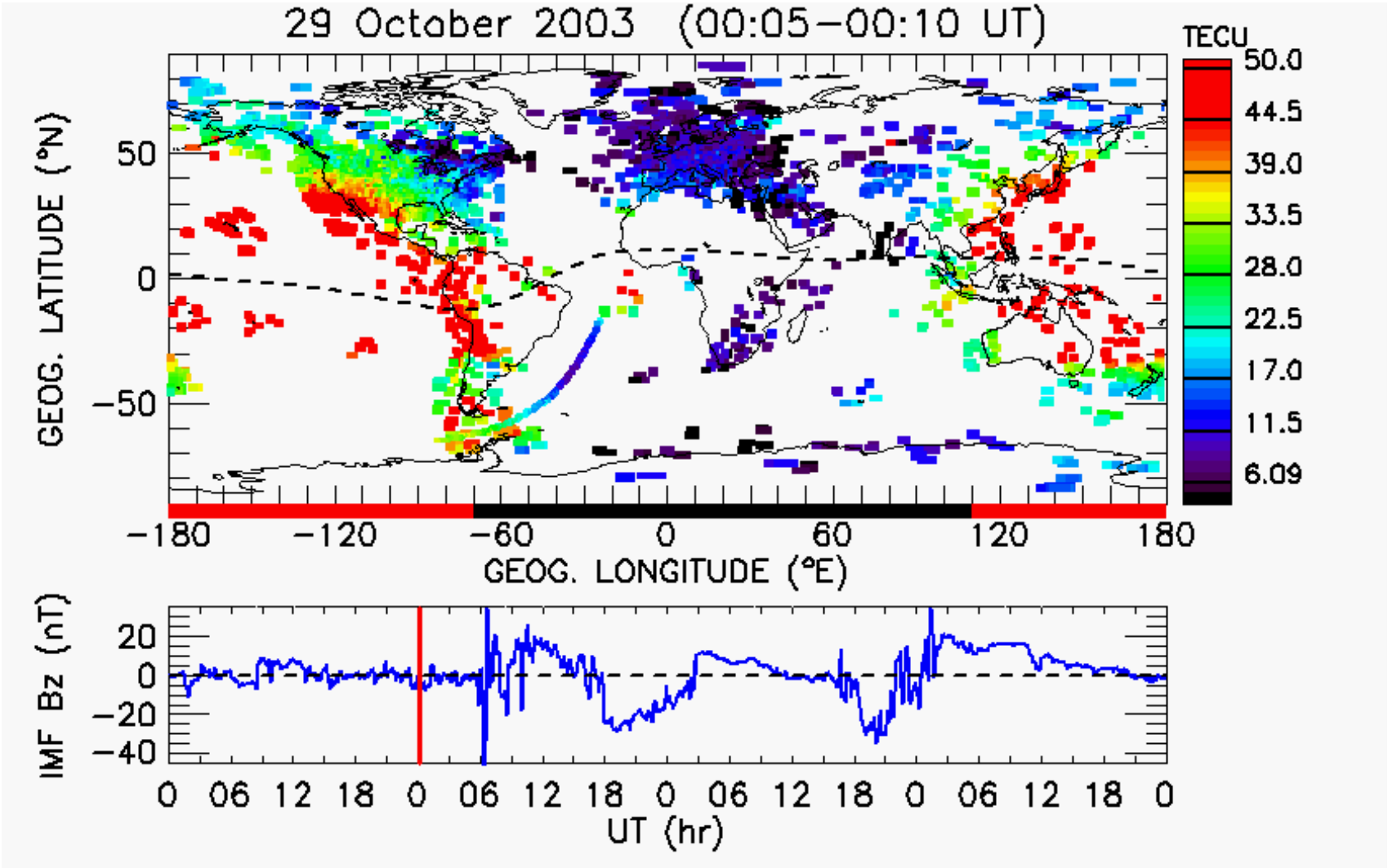


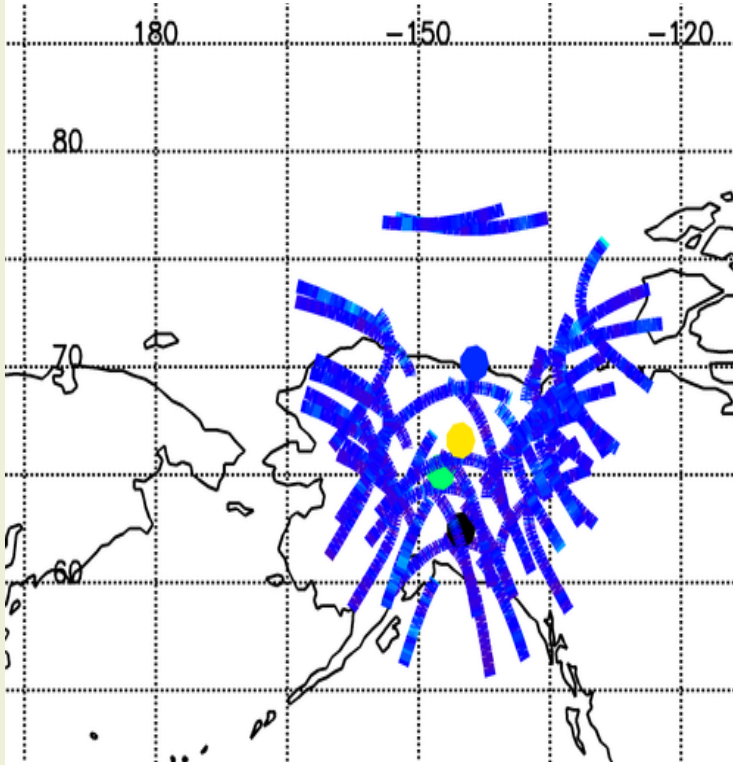
Figure courtesy of E. Yizengaw, BC

Real Time Alaska Scintillation Data

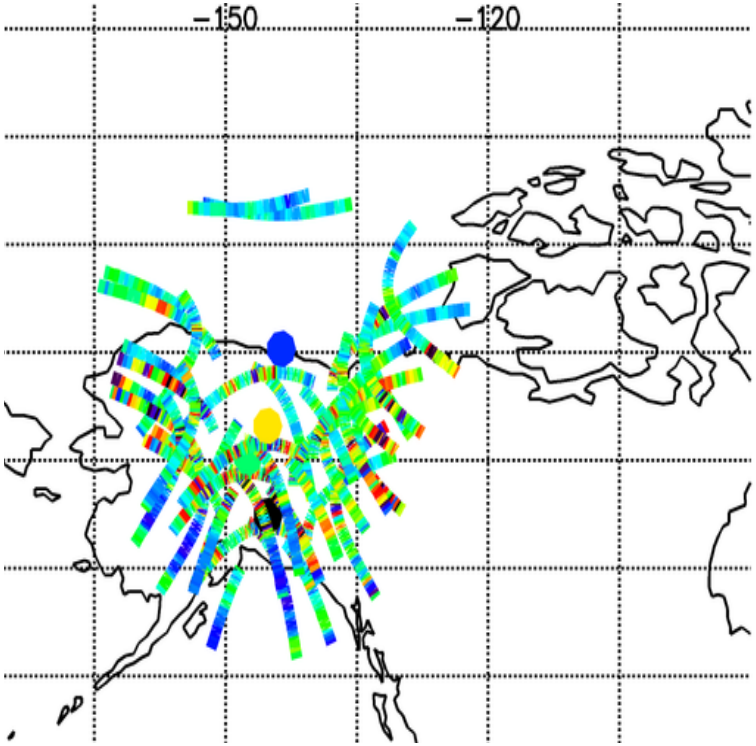
❖Science
❖ Technology
❖ Applications
Bringing It All Together

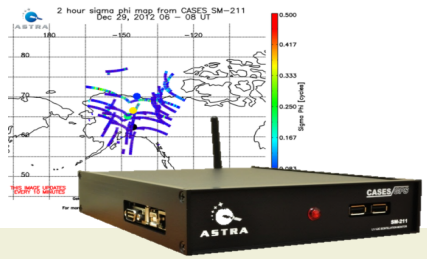
ASTRA

Quiet Conditions

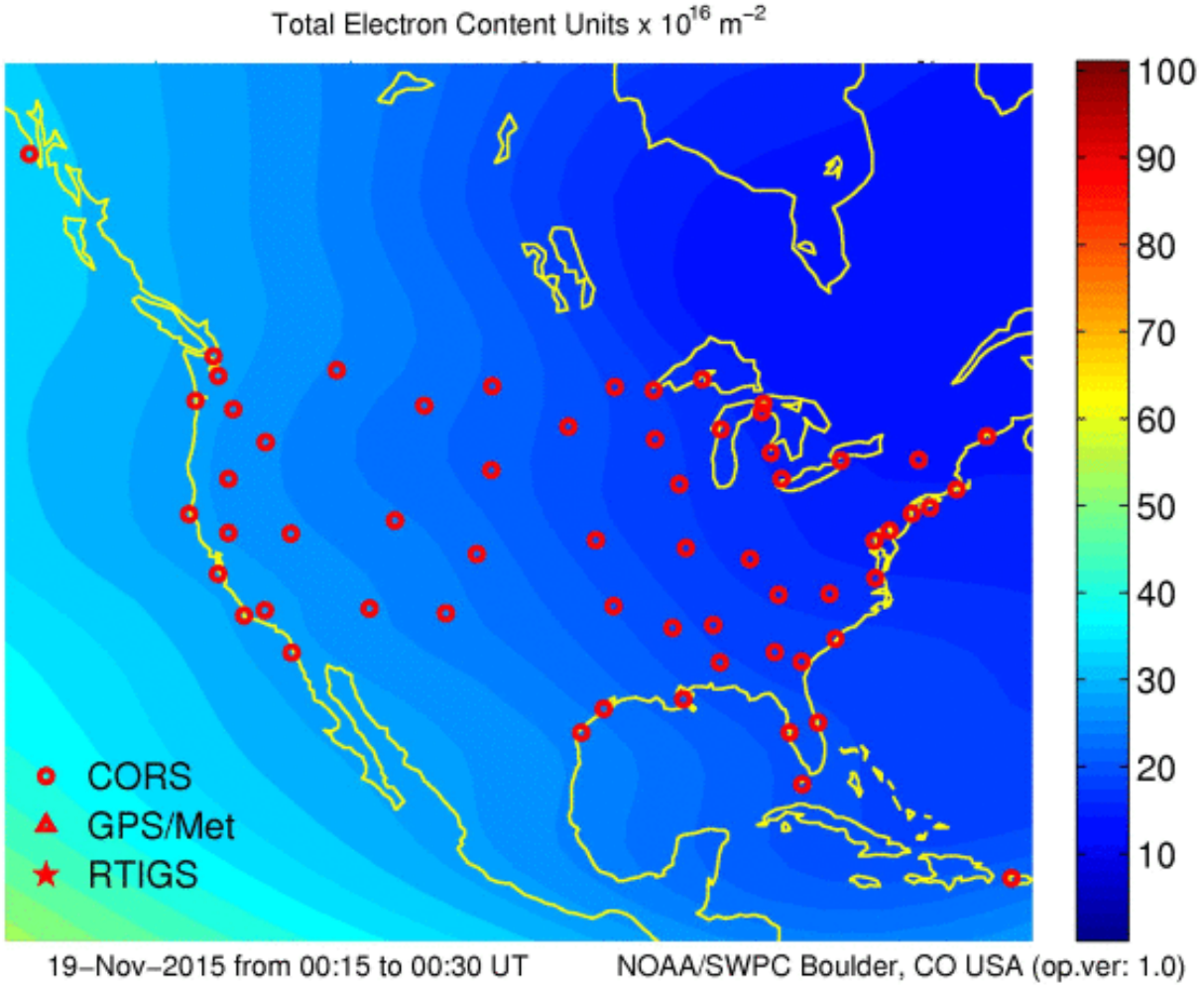


Active Conditions

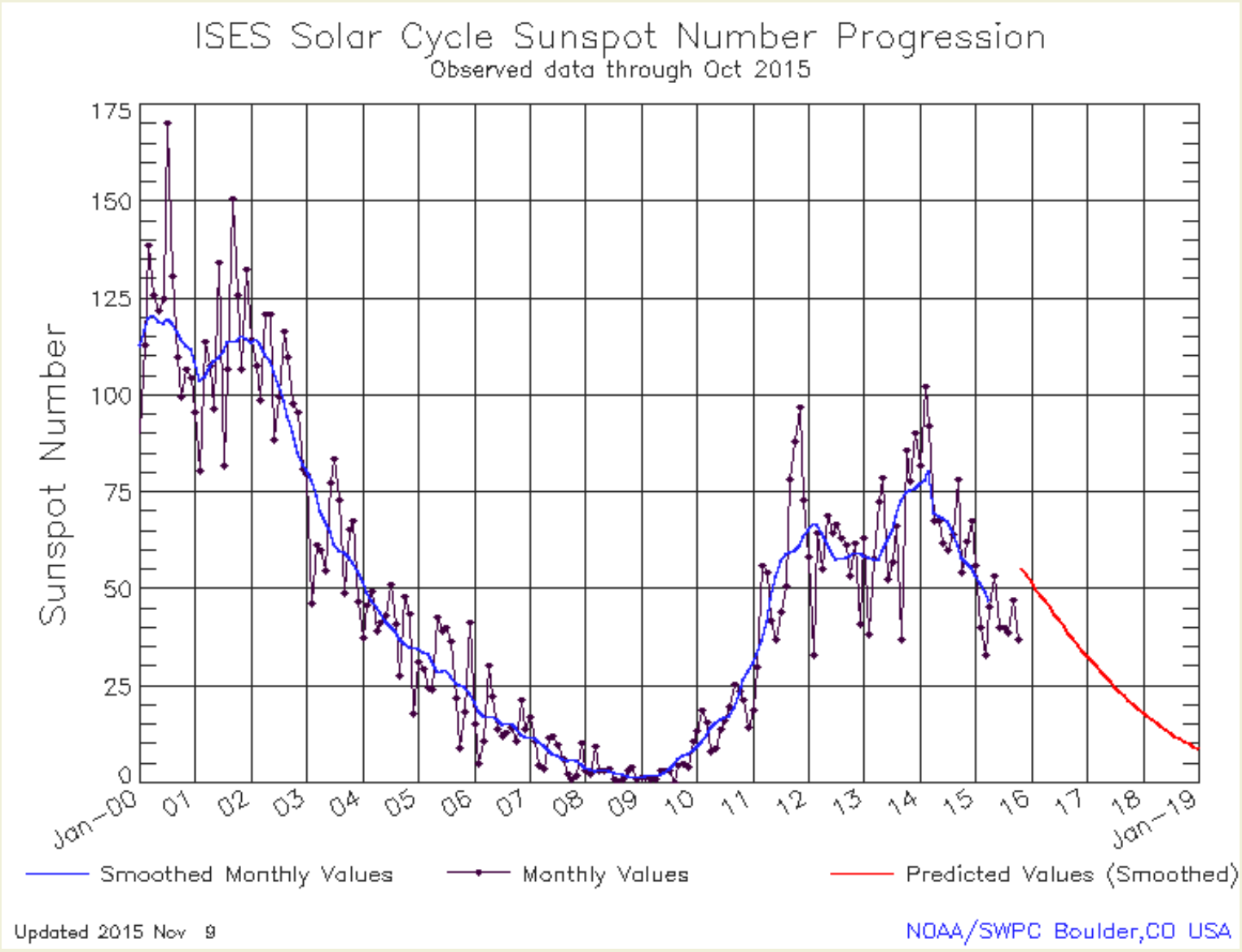




NOAA Ionospheric Map



- http://services.swpc.noaa.gov/images/animations/us-tec/latest.png


ISES Solar Cycle Sunspot Number Progression
Observed data through Oct 2015
Sunspot Number
175
150
125
100
75
50
25
0
Jan-00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
Jan-19
Smoothed Monthly Values
Monthly Values
Predicted Values (Smoothed)
Updated 2015 Nov 9
NOAA/SWPC Boulder,CO USA

Summary

- NOAA Alerts should be used for situational awareness
- More localized information is required for good decision-making
  - Ground-based ionospheric receivers
  - Real-time network information (ala Oregon GPS Users Group)
  - Near real-time NOAA N. American maps.