NOAA NCEI-Boulder Real-Time Magnetopause Location

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NOAA

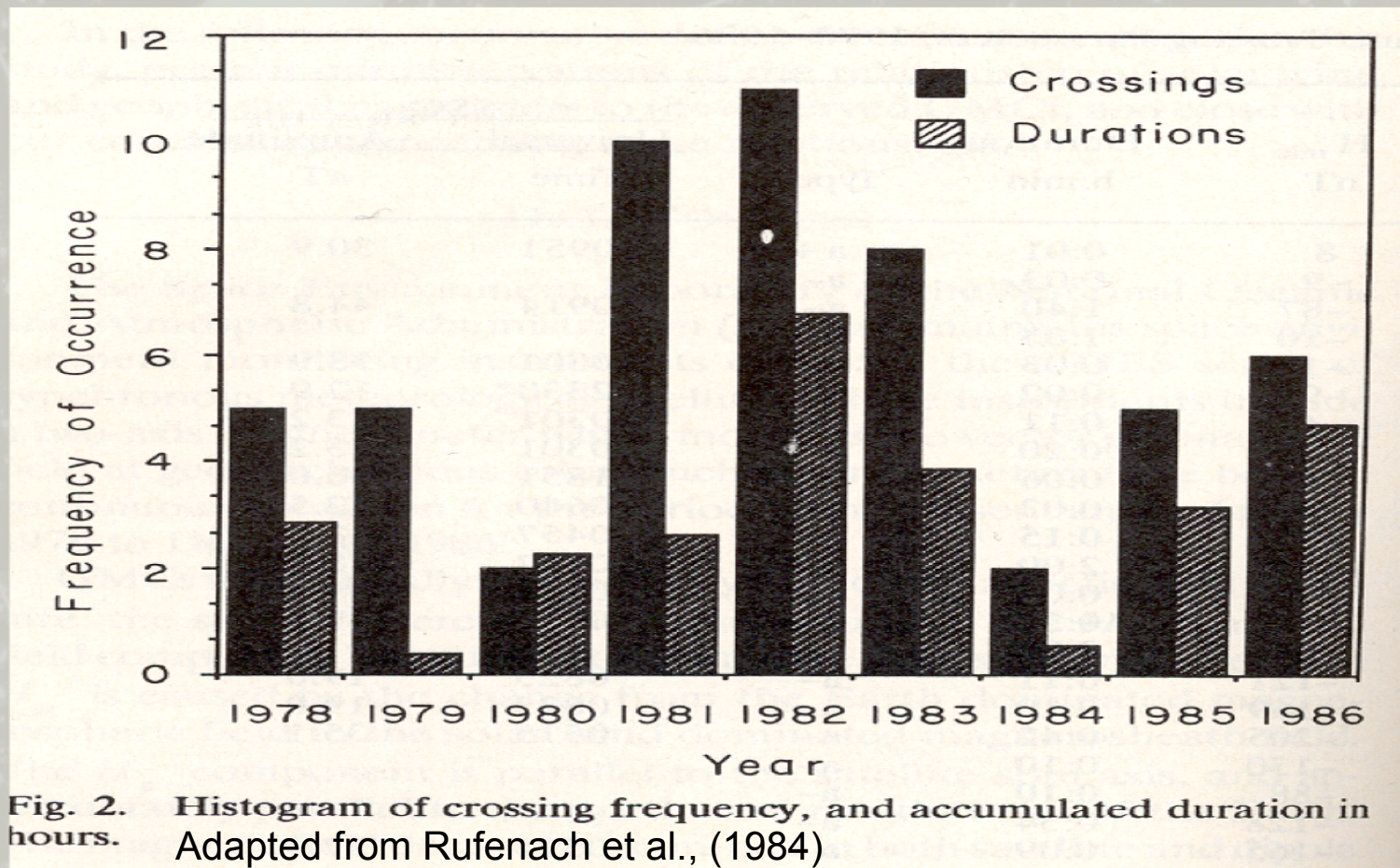[1]**NCEI**

[2]**SWPC**

Outline

- Motivation for Real-Time tracking
- Model methodologies (subset)
- NOAA's Current Capability
- Future with GOES-R
- February 27-28, 2014 storm
- St. Patrick's Day storm of March 2015

Motivation

- MP location is an important index for the state of the global space environment.
  - Compressed magnetosphere is often the first indicator of an impending geomagnetic storm.
  - Large geomag storms may result in satellite anomalies, communications, navigations and ground electrical systems.
- Space weather forecasters at SWPC and other centers want 24 UT specification of the dayside magnetopause boundary.
  - Several models exist for filling in the LT and UT times not covered by real-time observations.
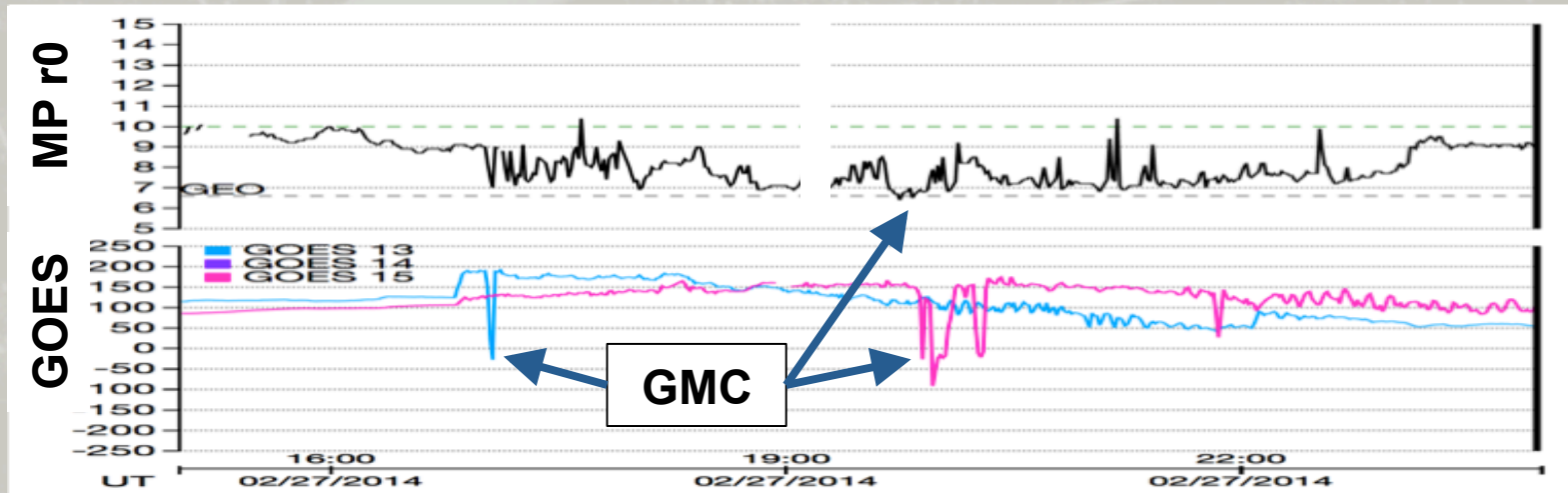 - Currently we will focus on near equatorial latitudes.

Motivation

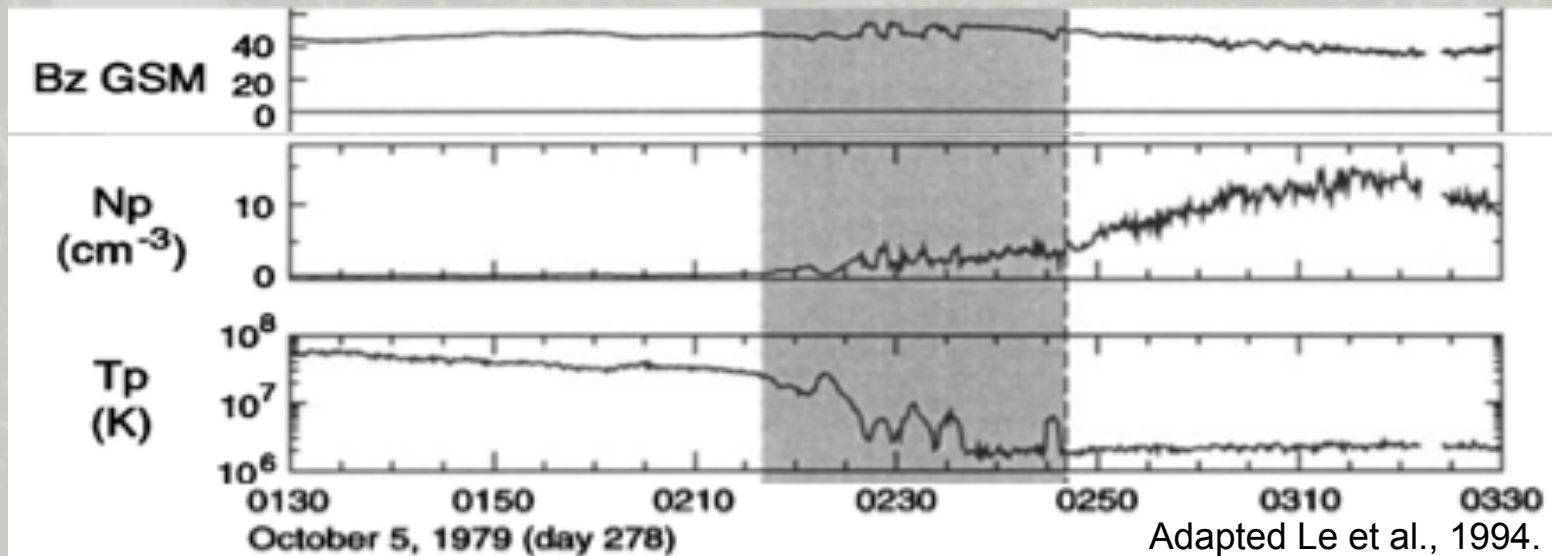## Geosynchronous Magnetopause Crossing Statistics

Fig. 2. Histogram of crossing frequency, and accumulated duration in hours. Adapted from Rufenach et al., (1984)

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Some Challenges at GEO

Ex 1: GOES Hp and Shue Model (1998) during February 2014 storm:

Ex 2: GMC in ions, not in Bz on ISEE-2:

Adapted Le et al., 1994.

Models

- We have looked at these models:
  - Petrinec and Russell (1996)
  - Shue et al. (1998)
  - Chao et al. (2001)
- We performed a validation similar to Yang et al. (2002). PoDs were separately calculated for events inside and outside of each models reported range of validity.
  - NCEI's initial version will use the Shue (1998) model.
- Several other models exist and will be considered later through NOAA's R2O efforts.
  - Examples include the Lin et al. (2010) 3D asymmetric magnetopause and the Dmitriev et al. (2011) GMC predictor.

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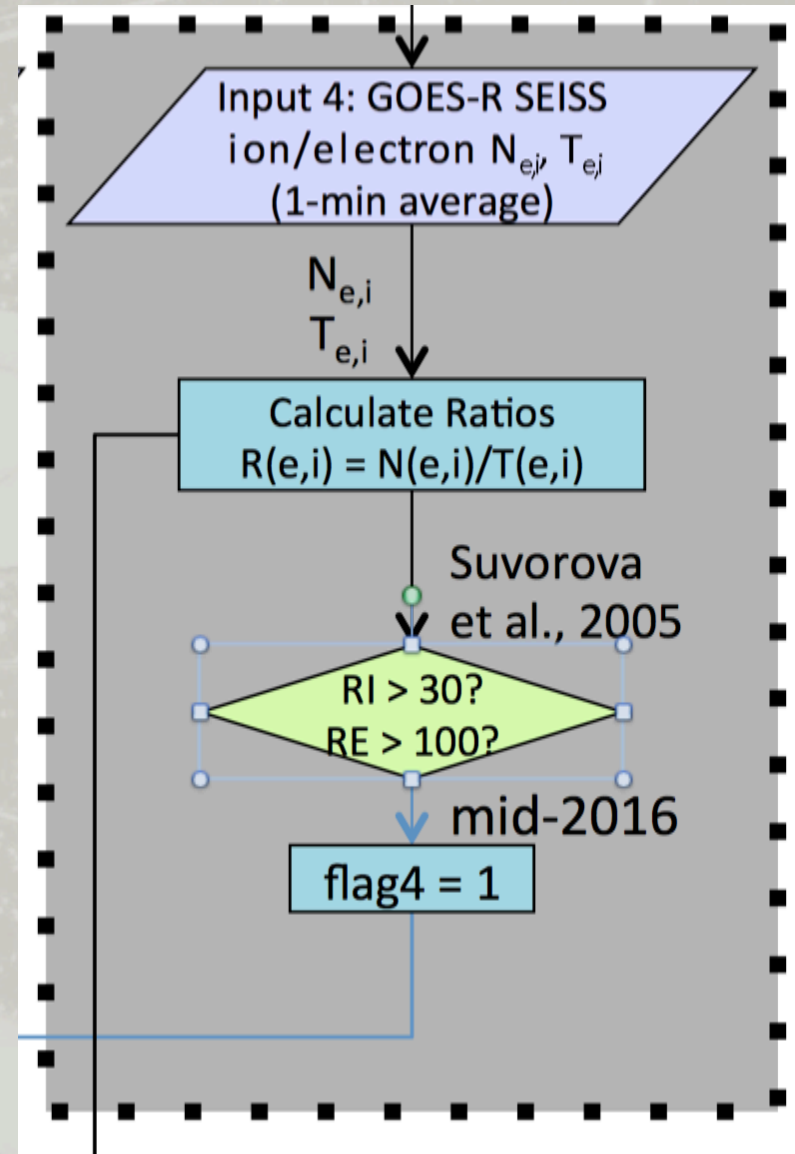# NOAA Current and Future

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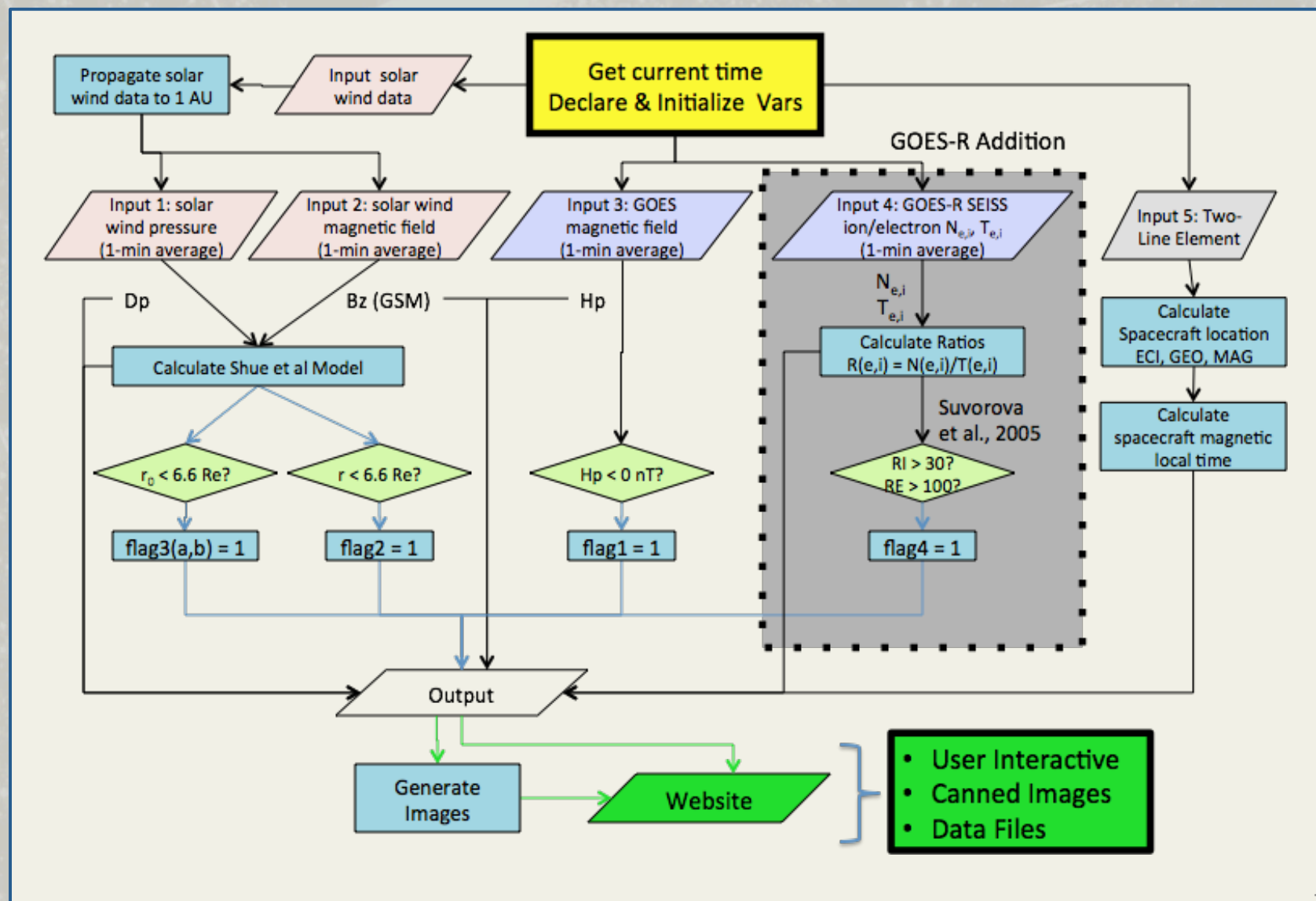
NOAA Future: GOES-R

NCEI's Next Phase → GOES-R

- GOES-R new MPS-LO will provide lower energy particle observations (30eV - 30keV) and derived number density (D) and temperature moments (T)
- Suvorova et al. (2005) provide a robust magnetosheath entry criteria:
  - Density (N) to Temperature (T) ratios:
    Ions: RI = Ni/Ti,
    Electrons: RE = Ne/Te

    where T = (2$T_{perpendicular}$ + $T_{parallel}$)/3

  - Magnetosheath entry when:
    RI > 30
    RE > 100

Input 4: GOES-R SEISS ion/electron $N_{e,i}$, $T_{e,i}$ (1-min average)

$N_{e,i}$
$T_{e,i}$

Calculate Ratios
R(e,i) = N(e,i)/T(e,i)

Suvorova et al., 2005

RI > 30?
RE > 100?

mid-2016

flag4 = 1

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Example 1: WAAS Event 2014

Summary of Space Weather

2014-02-25 X4.9 flare and CME

2014-02-27 UT

   16:45 CME glancing → G2 storm

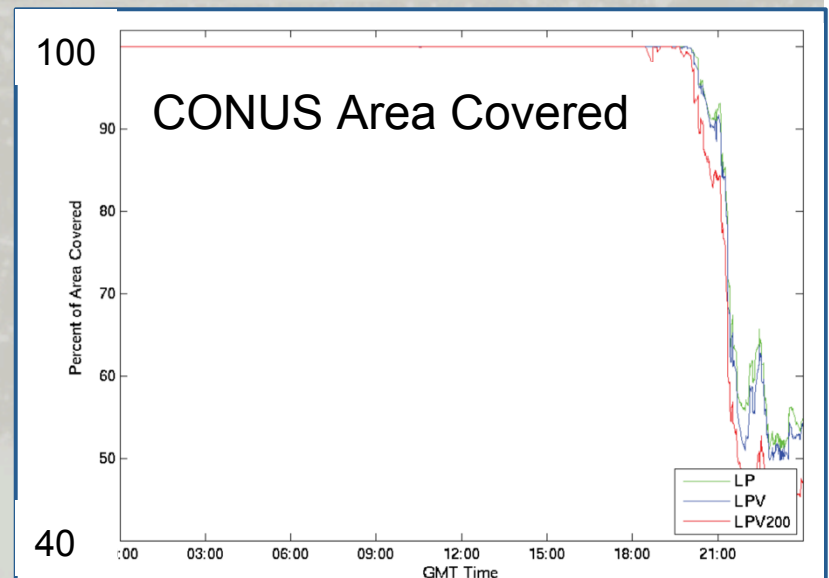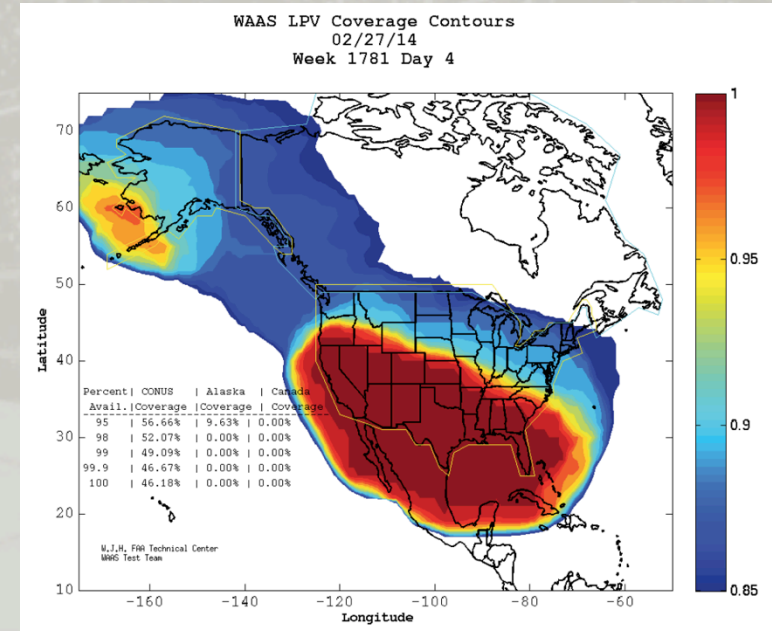   Kp reaches 7

17:04 (11.9 MLT) G13 GMC (weak)

19:54-20:03 (10.6MLT) G15 GMC

     Hp < 0 peaks at -123 nT

20:16-20:18 (11MLT) G15 GMC

21:20 - FAA 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."

Poster: Loto'aniu et al. (Tues night)

WAAS LPV Coverage Contours
02/27/14
Week 1781 Day 4

Percent Avail.	CONUS Coverage	Alaska Coverage	Canada Coverage
95	56.66%	9.63%	0.00%
98	52.07%	0.00%	0.00%
99	49.09%	0.00%	0.00%
99.9	46.67%	0.00%	0.00%
100	46.18%	0.00%	0.00%

W.J.H. FAA Technical Center
WAAS Test Team

CONUS Area Covered

Example 2: St. Patrick's 2015

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