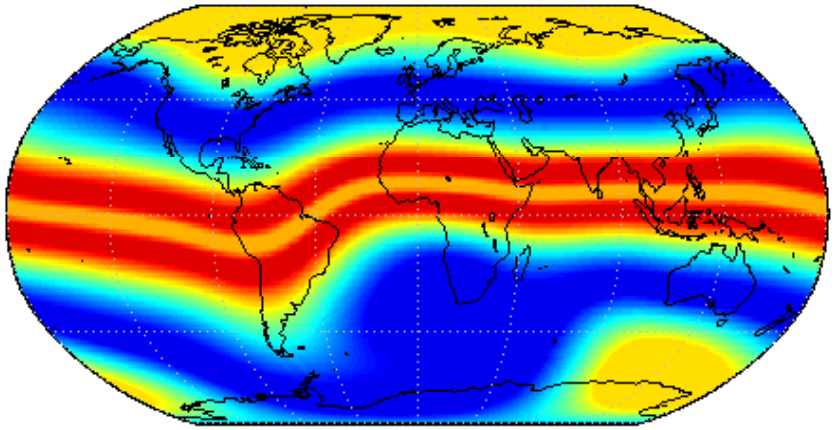


Space Weather and GPS (GNSS)

Prof. Paul M. Kintner Jr.

School of Electrical and Computer Engineering

Cornell University

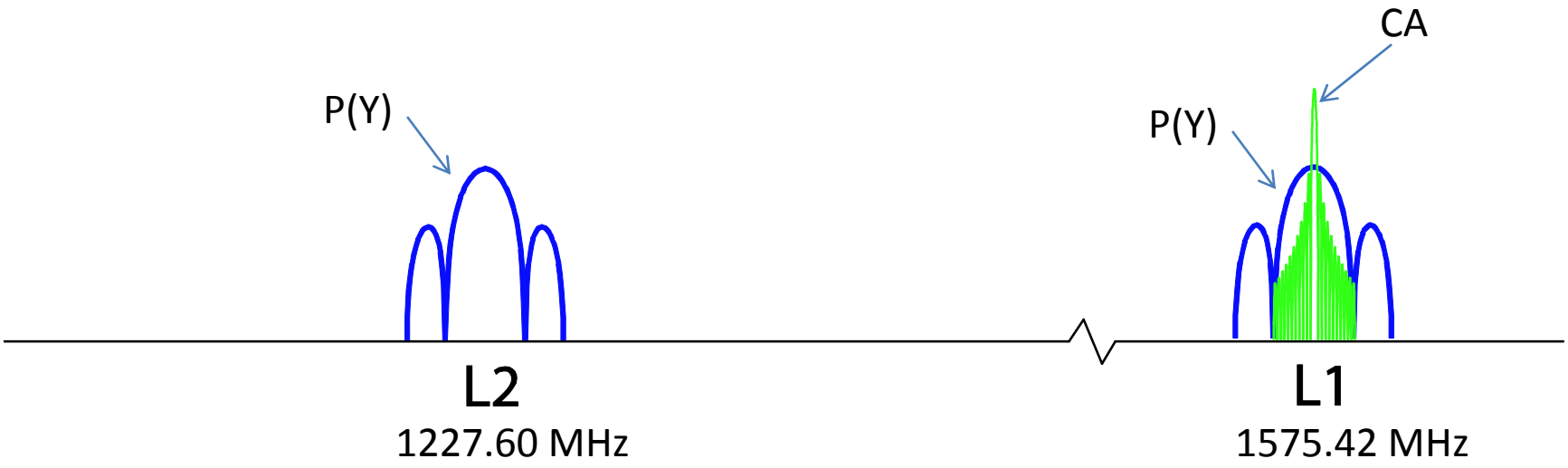
http://gps.ece.cornell.edu/

Cornell University

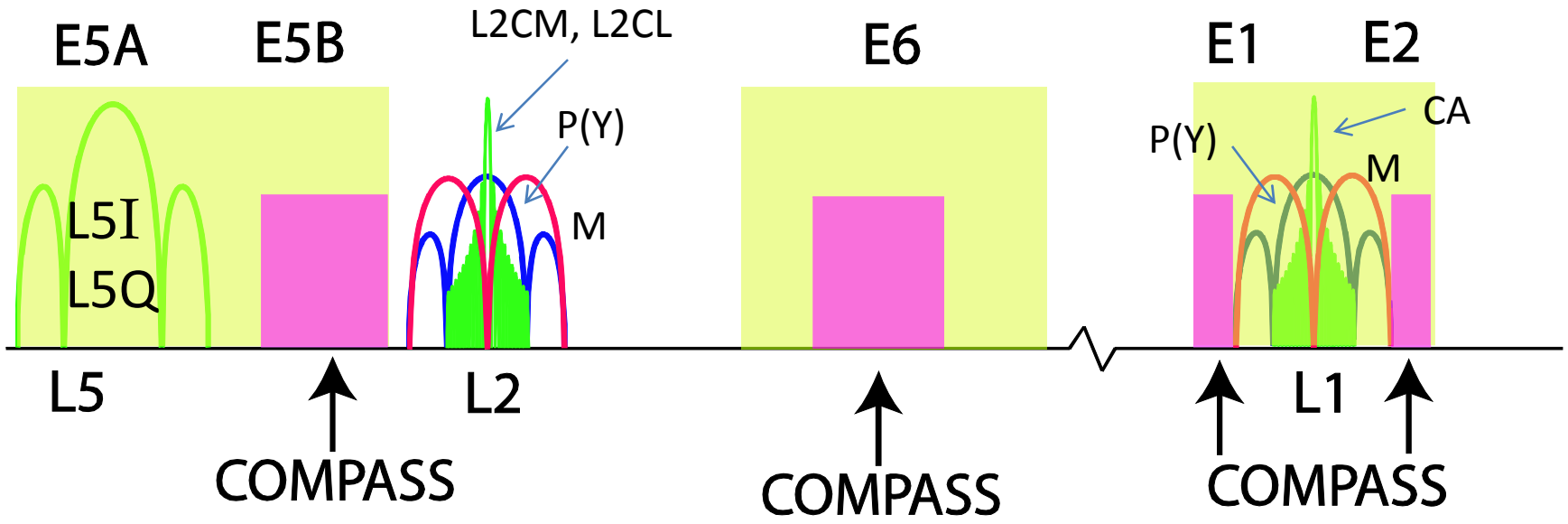
Main Points

- GPS is becoming GNSS (Global Navigation Satellite Systems) and is becoming complex
- Scintillation is worse than we thought
- Mid-latitude space weather is not well understood
- Solar Radio Bursts are a wild card

GPS is now GNSS
Signals during Past Solar Maximum



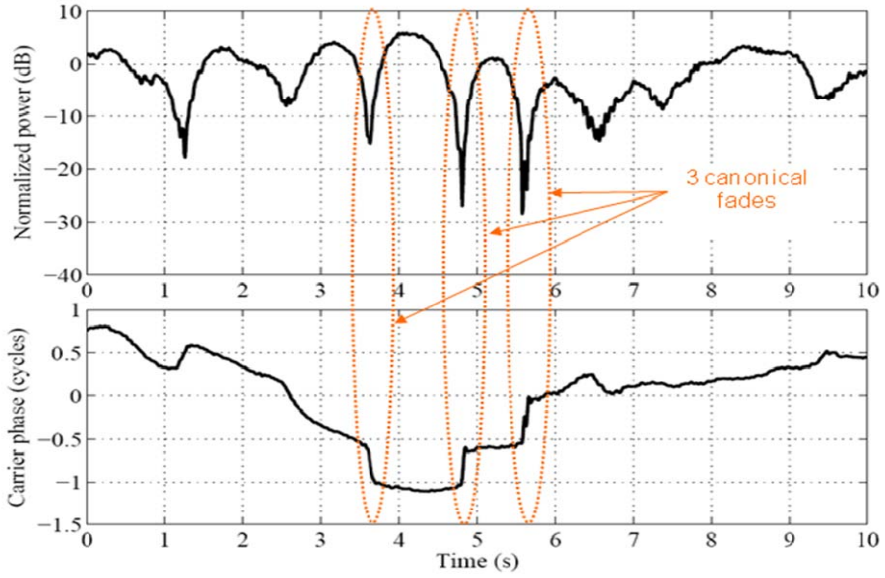
GPS is now GNSS
Signals at end of next Solar Maximum

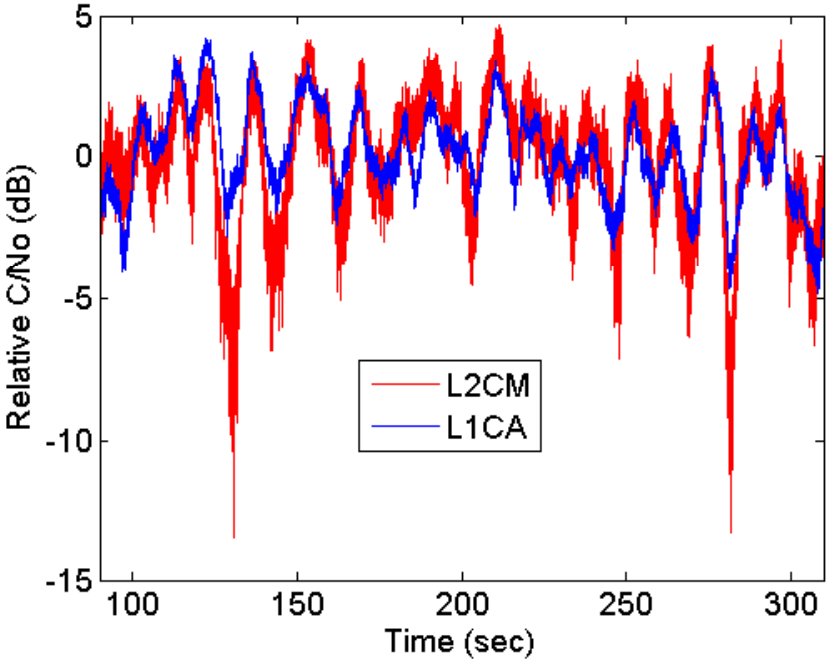


Plus space based augmentation systems (WAAS, EGNOS etc.) and GLONASS and Iridium(???) and L1C

Scintillation is worse than we thought

- Amplitude and phase scintillation are not independent
- L1 and L2 fades are not independent
- L2 fades are larger

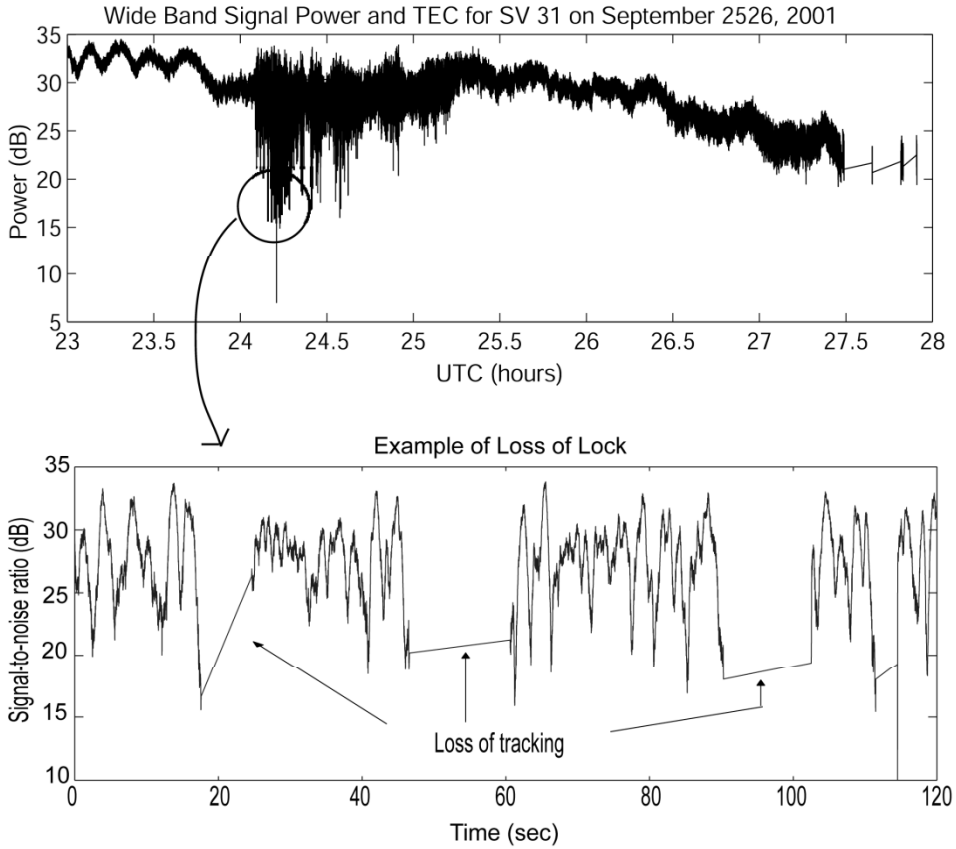




Mid-latitude Space Weather

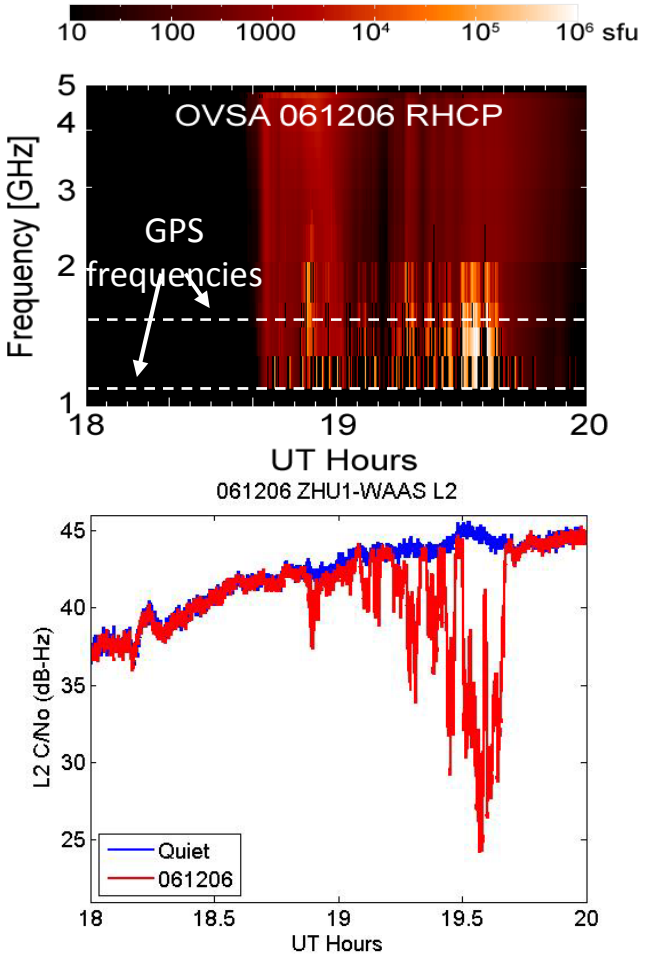
- Very, very few resources were devoted to understanding ionospheric space weather at mid-latitudes during the past solar maximum
- We are not much better prepared for the next solar maximum

Ithaca, NY

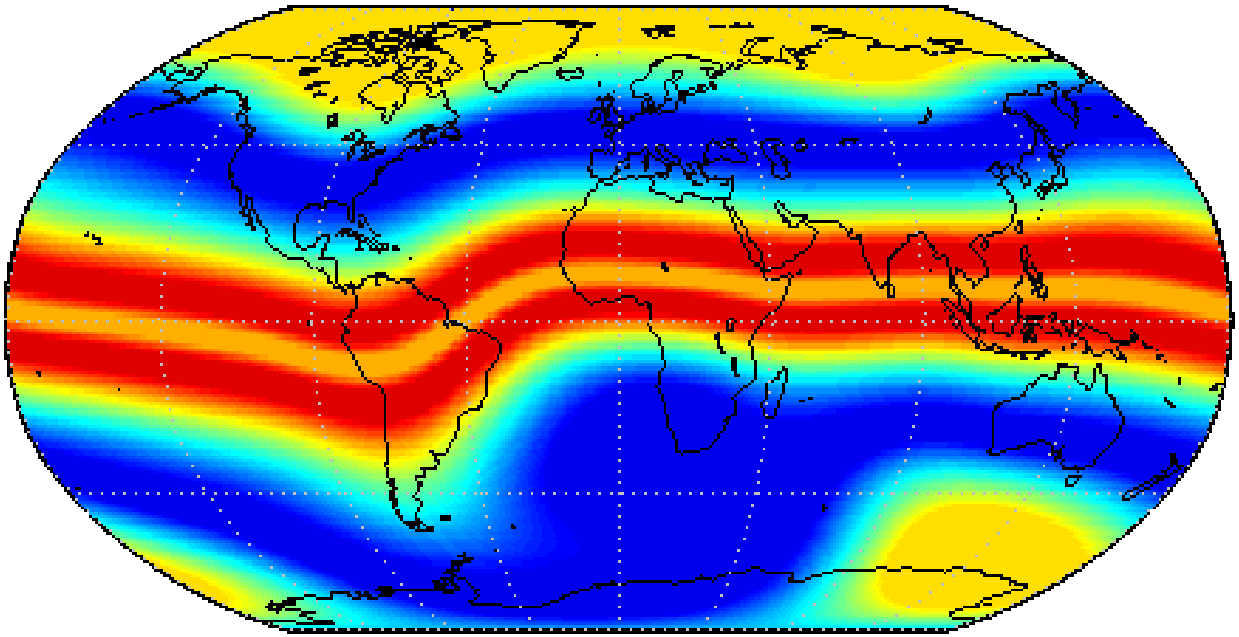


Solar Radio Bursts

- Dec 6, 2006 event ten times larger than any *known* previous event at solar maximum and 100 times larger than solar minimum (10^6 SFU)
- Searching for previous SRB reveals flaw in Radio Solar Telescope Network
  - Insensitive above 10^5 SFU

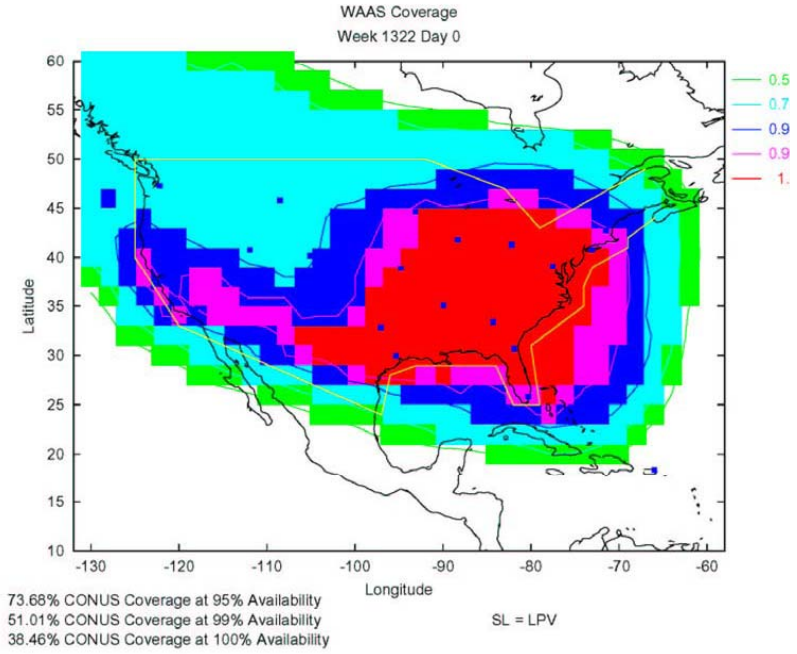


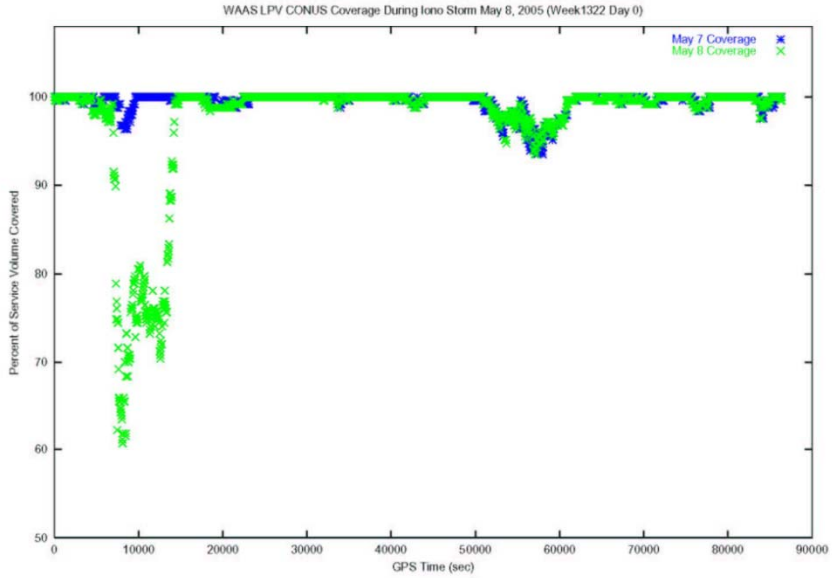
Questions?

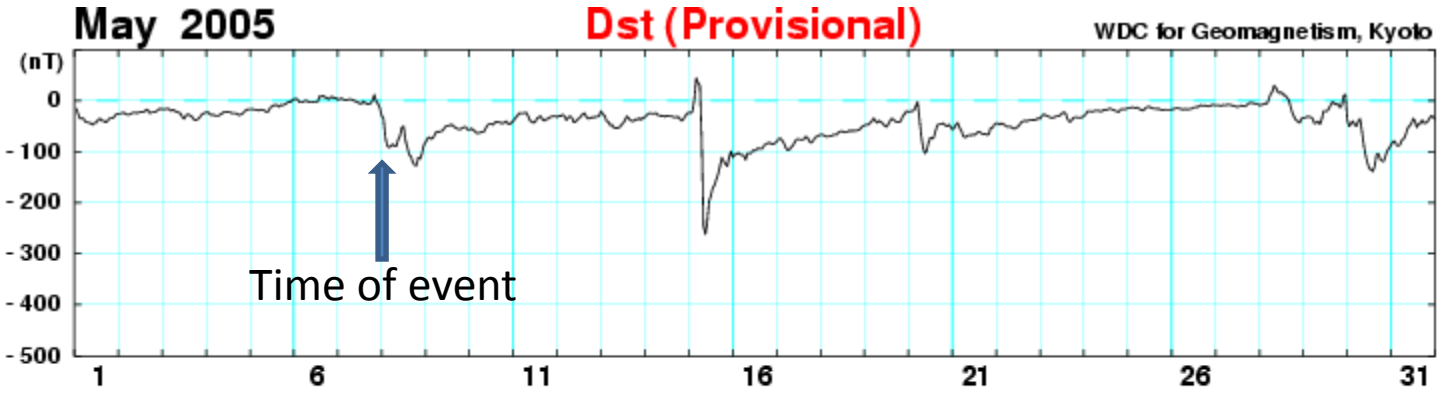


- Additional slides

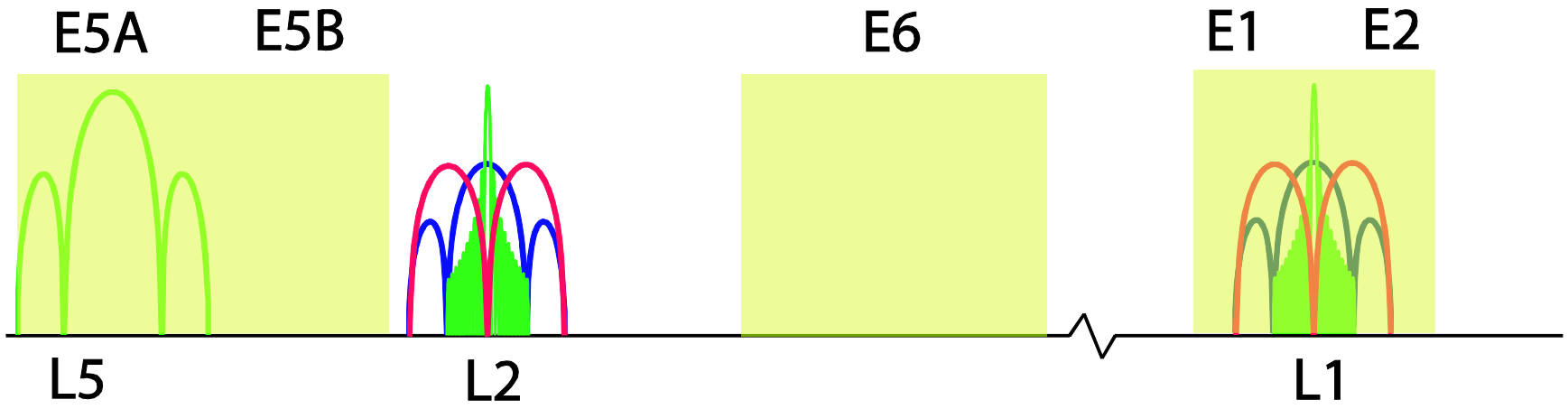
May 8. 2005


WAAS Coverage
Week 1322 Day 0
Latitude
Longitude
0.5
0.7
0.9
0.9
1.
73.68% CONUS Coverage at 95% Availability
51.01% CONUS Coverage at 99% Availability
38.46% CONUS Coverage at 100% Availability
SL = LPV


WAAS LPV CONUS Coverage During Iono Storm May 8, 2005 (Week1322 Day 0)
May 7 Coverage
May 8 Coverage
Percent of Service Volume Covered
GPS Time (sec)


May 2005
Dst (Provisional)
WDC for Geomagnetism, Kyoto
(nT)
Time of event

GPS is now GNSS
Next Solar Maximum Signals
Galileo



GPS is now GNSS
Current Signals