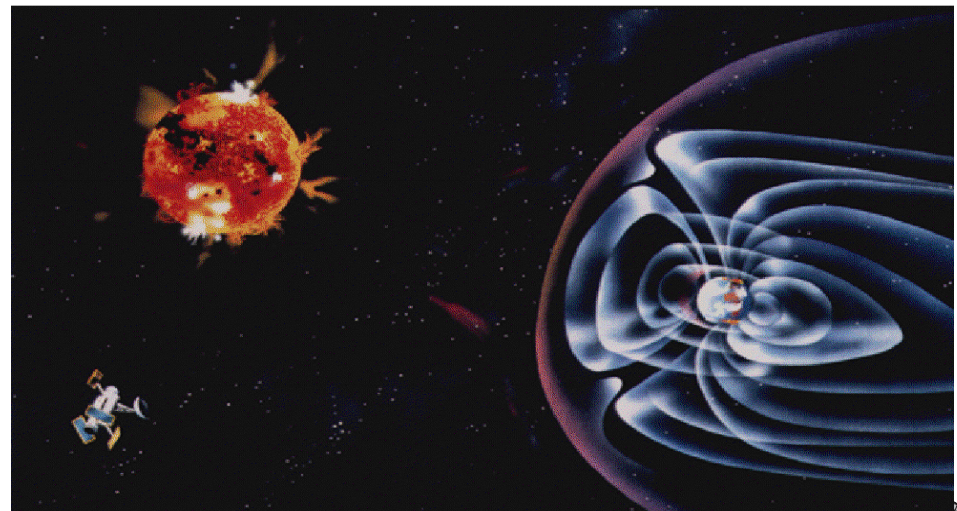
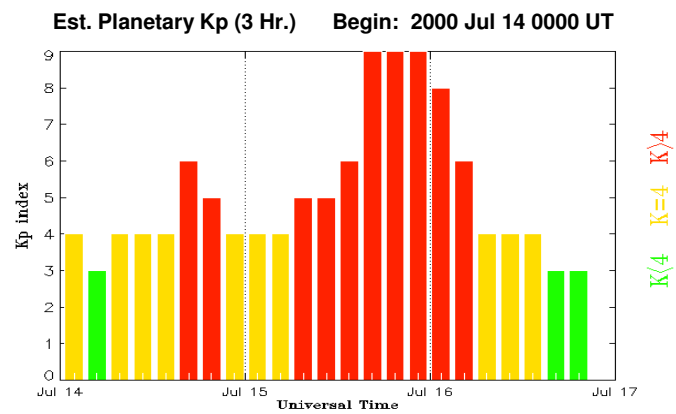
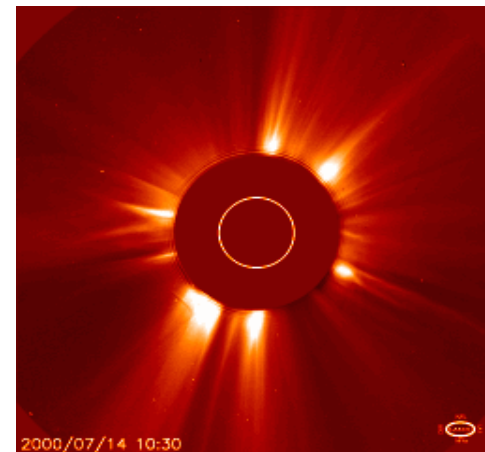
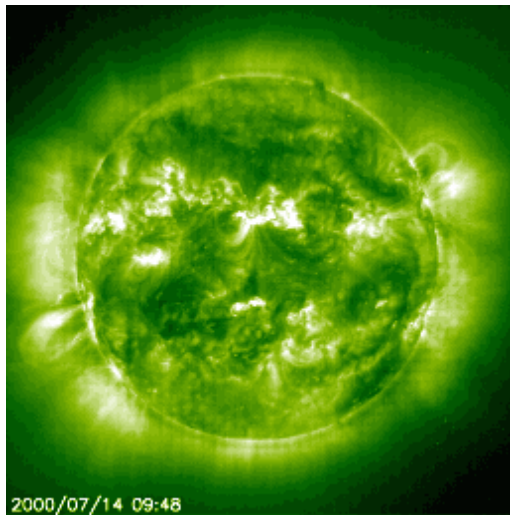


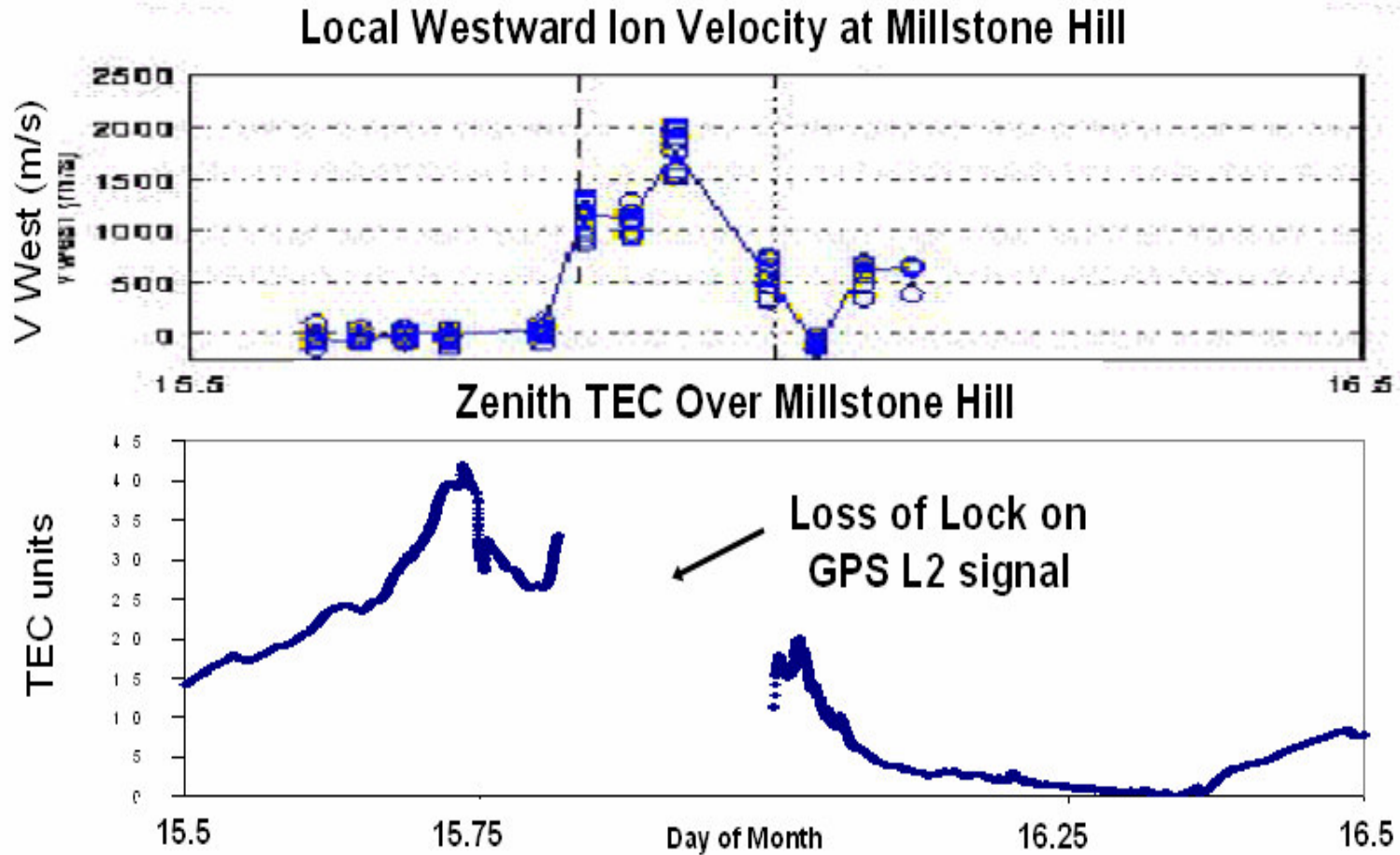
Solar Flare of 14 July 2000

Biggest Solar Storm in Nine Years Strikes Earth

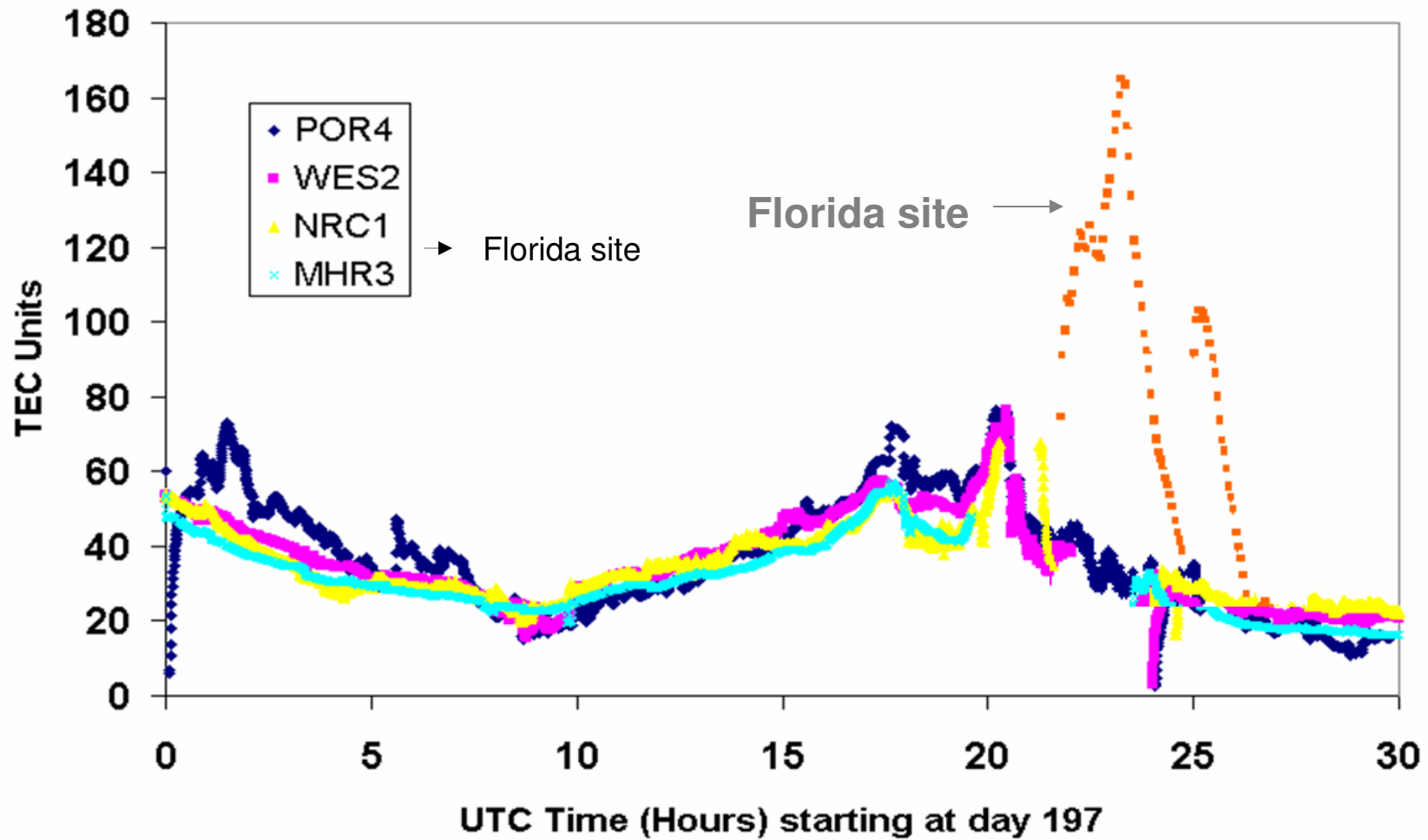


AGU Fall 2007 SA44A-06

GPS Loss of Lock at Millstone Hill

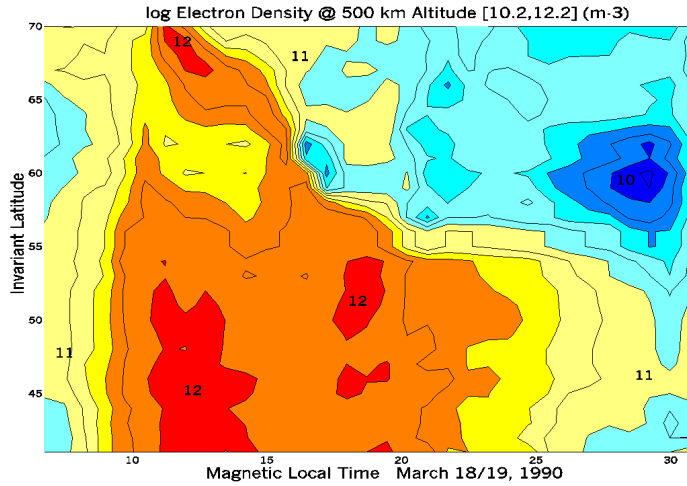


TEC Disturbances on 15 July 2000

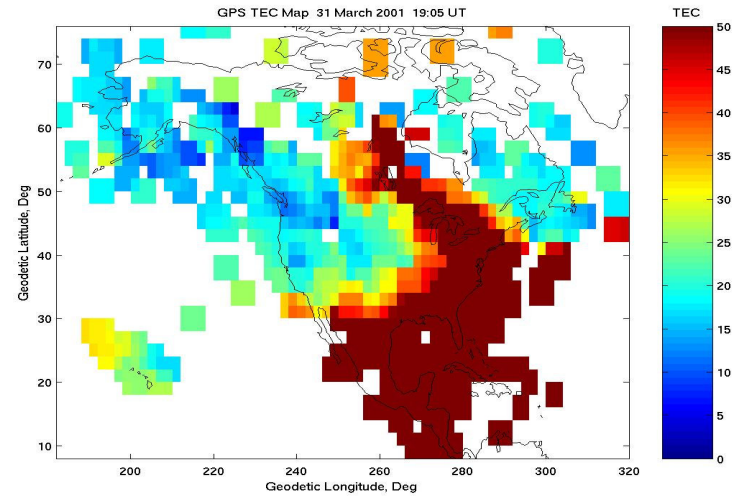


A Decade Of Storm Enhanced Density

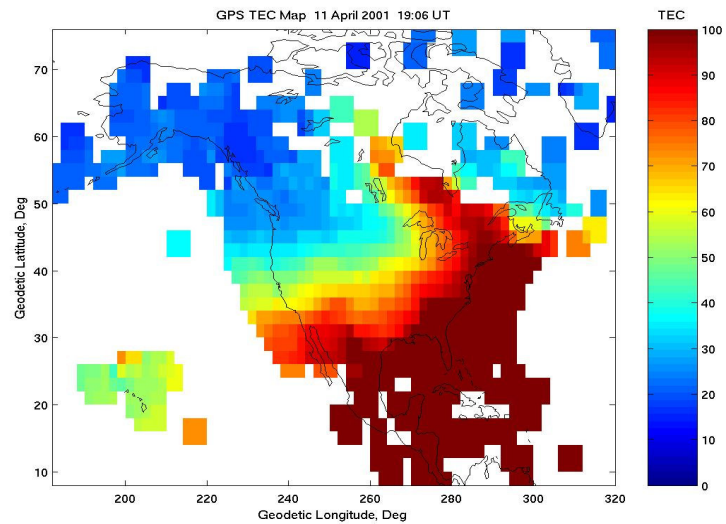
Day 77, 1990



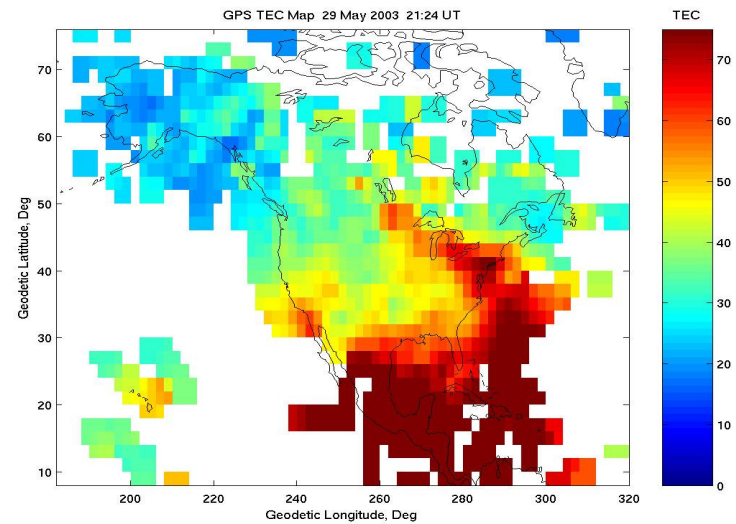
Day 90, 2001



Day 101, 2001



Day 149, 2003

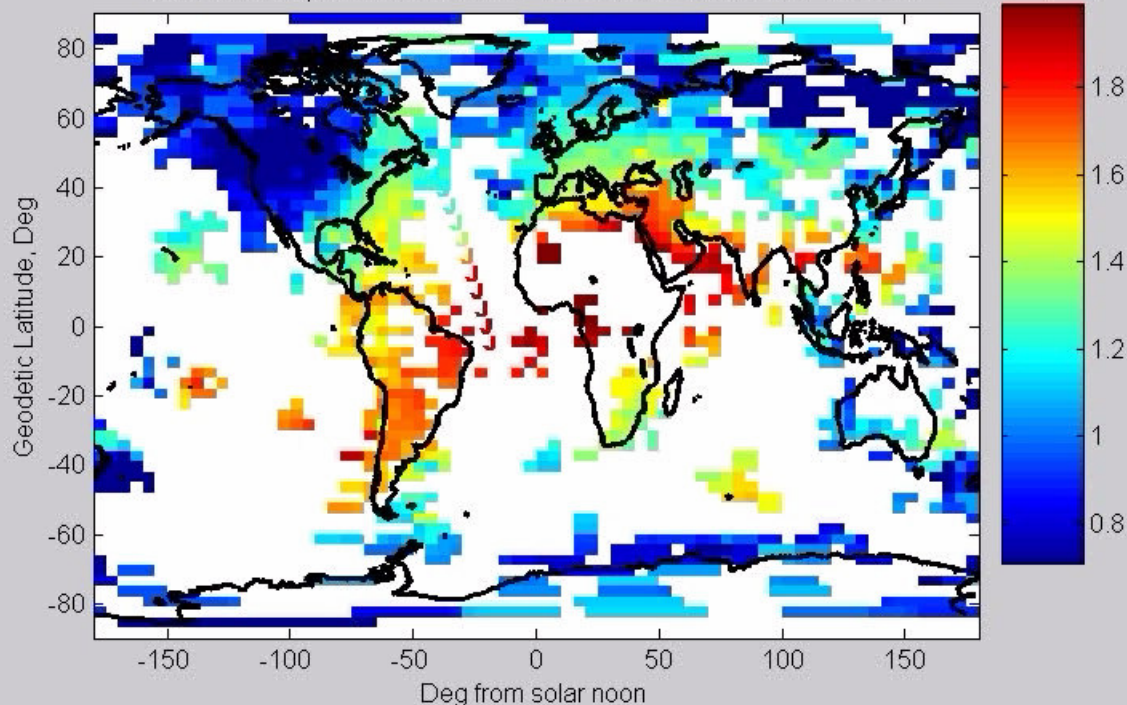


Global TEC (Noon in center)

Day303  PM

 **MIT Haystack Observatory**

GPS TEC Map from 30-Oct-2003 12:30:00 to 30-Oct-2003 12:40:00 Log10(TEC)

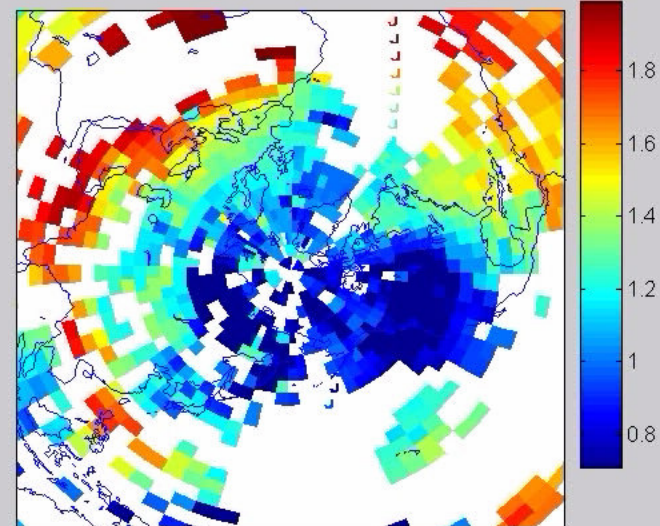


Northern Hemisphere

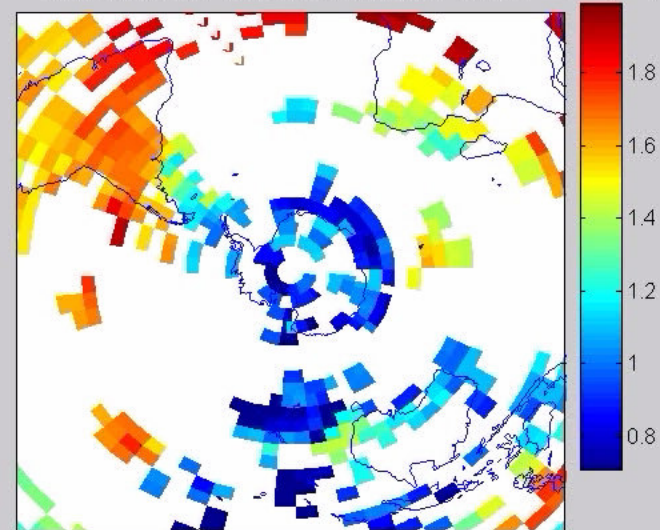
Day303  PM

 **MIT Haystack Observatory**

Geodetic GPS TEC Map from 30-Oct-2003 12:30:00 to 30-Oct-2003 12:40:00 Log10(TEC)



from 30-Oct-2003 12:30:00 to 30-Oct-2003 12:40:00 Log10(TEC)



Southern Hemisphere

October 29/30, 2003 Storm
Global Thermal Plasma
Redistribution

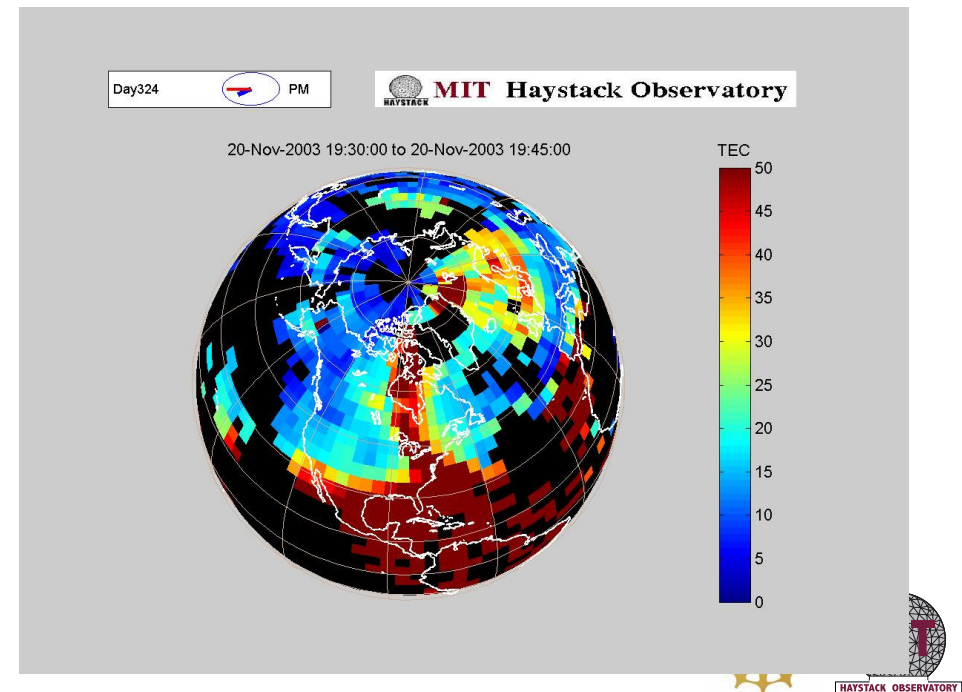
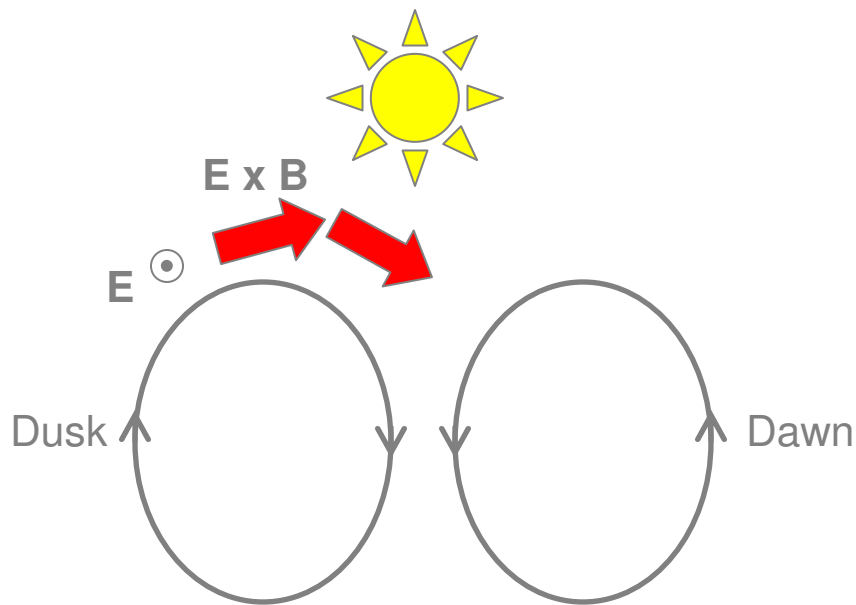


Massachusetts Institute of Technology

AGU Fall 2003

Polar Convection

- The SAPS electric field produces a westward plasma flow at subauroral latitudes
- Some plasma travels through dayside cusp into polar regions where it becomes entrained in the polar convection and carried over the pole

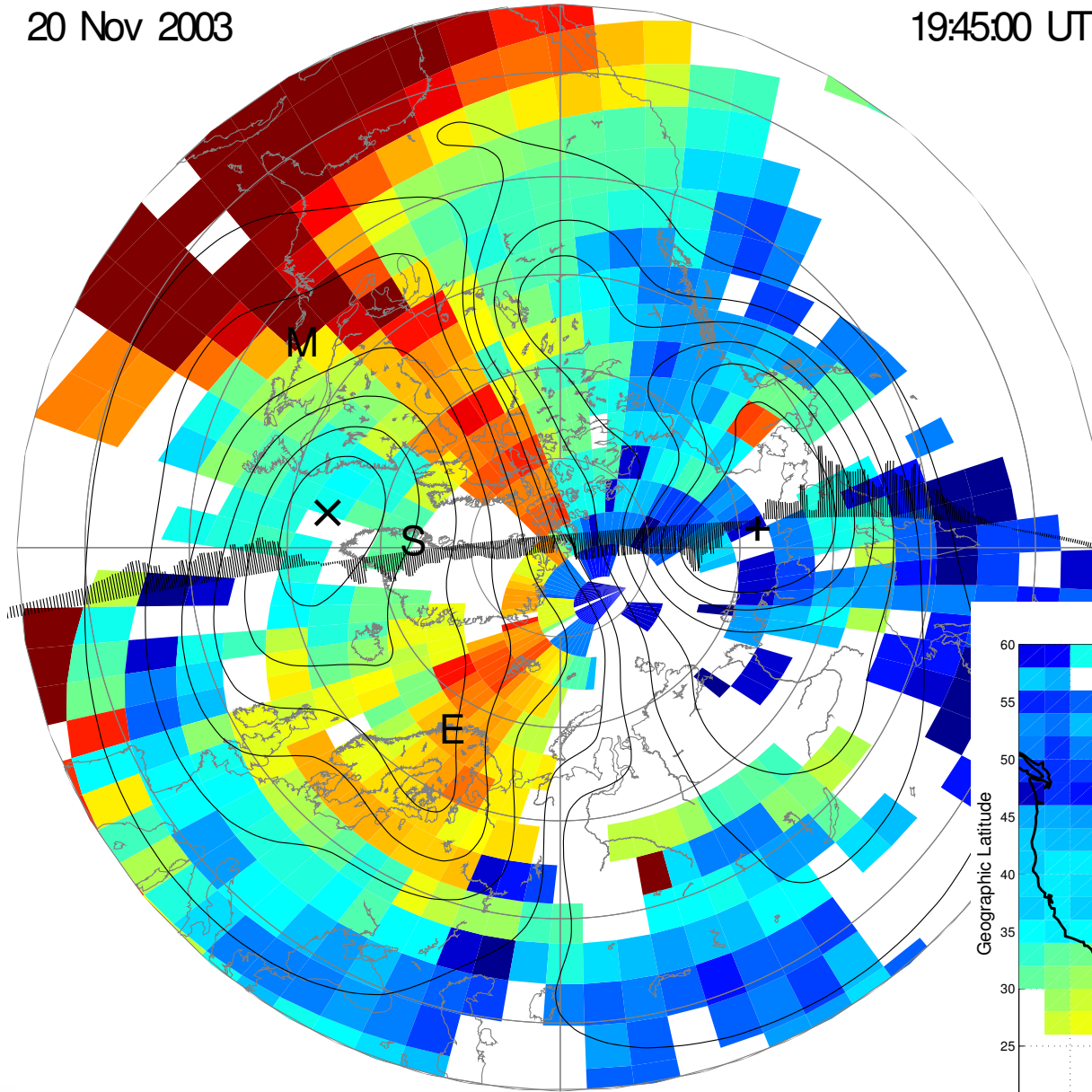


SuperDARN HF Radars



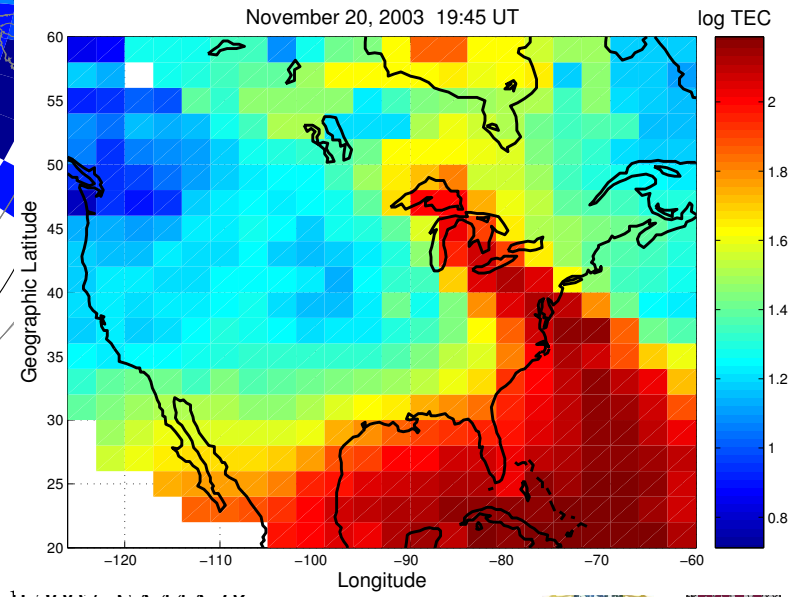
20 Nov 2003

19:45:00 UT



SED Plume forms Polar Tongue of Ionization

GPS TEC Map



Massachusetts Institute of Technology
Merged SuperDARN/DMSP Convection

AGU Fall 2007 SA44A-06

[Foster et al., JGR 2005]

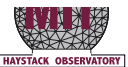
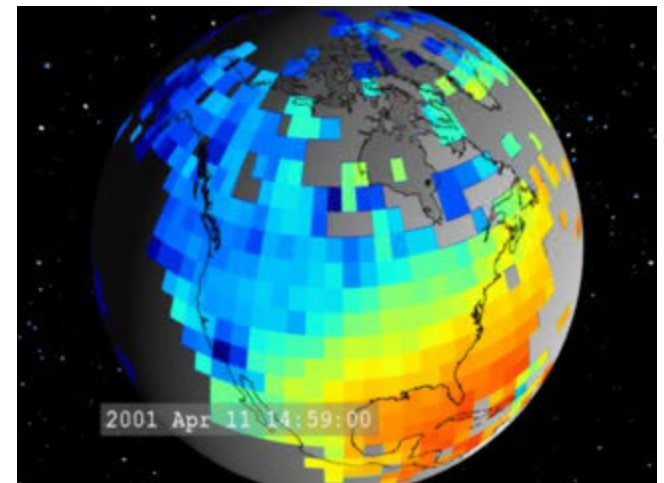
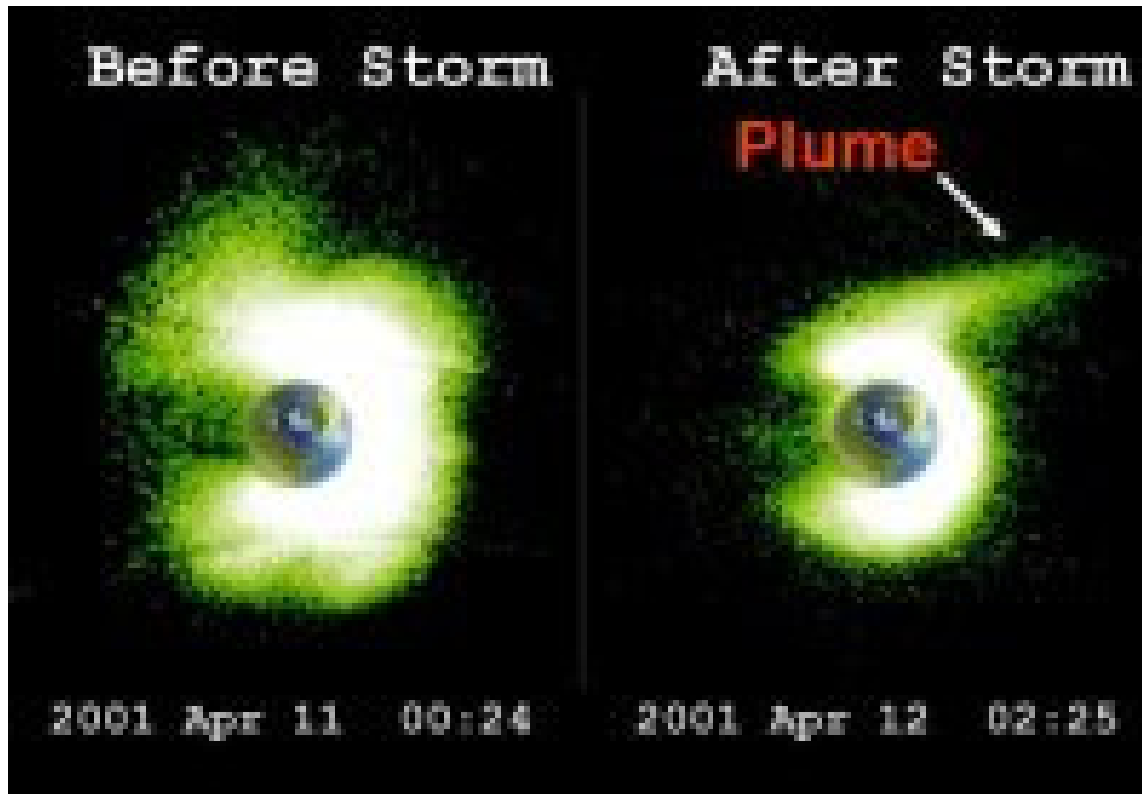
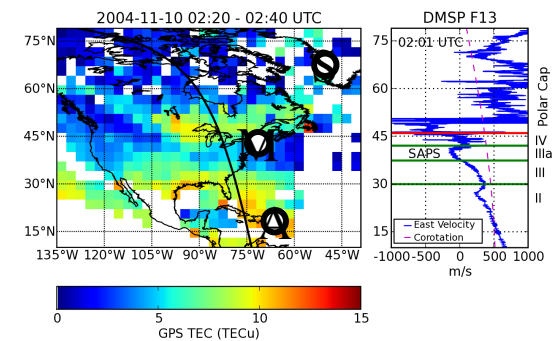
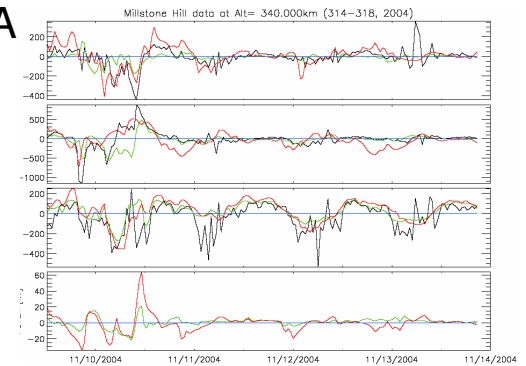
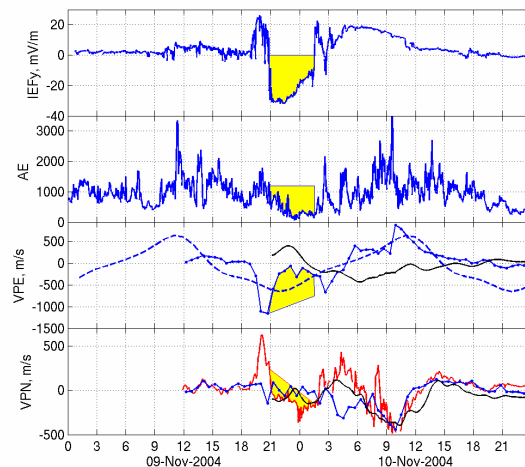
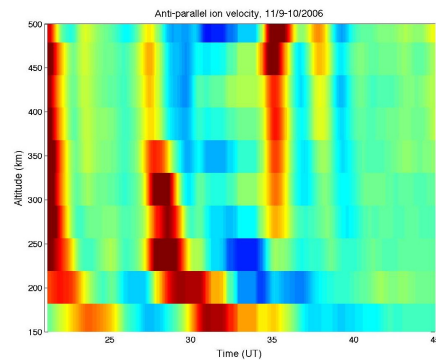
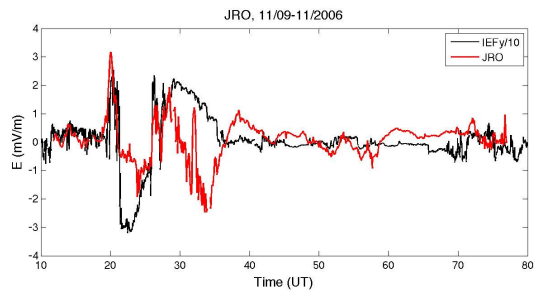


IMAGE Data of Plasmasphere



Dynamics of American Sector Mid and Low Latitude Ionospheric and Thermospheric Response During the November 2004 Superstorm

P. J. Erickson, L. P. Goncharenko
 MIT Haystack Observatory, Westford, MA USA
 M. J. Nicolls
 SRI International, Menlo Park, CA USA
 G. Crowley
 ASTRA, San Antonio, TX USA
 M. C. Kelley
 Cornell University, Ithaca, NY USA



Massachusetts Institute of Technology

AGU Fall 2007 SA44A-06

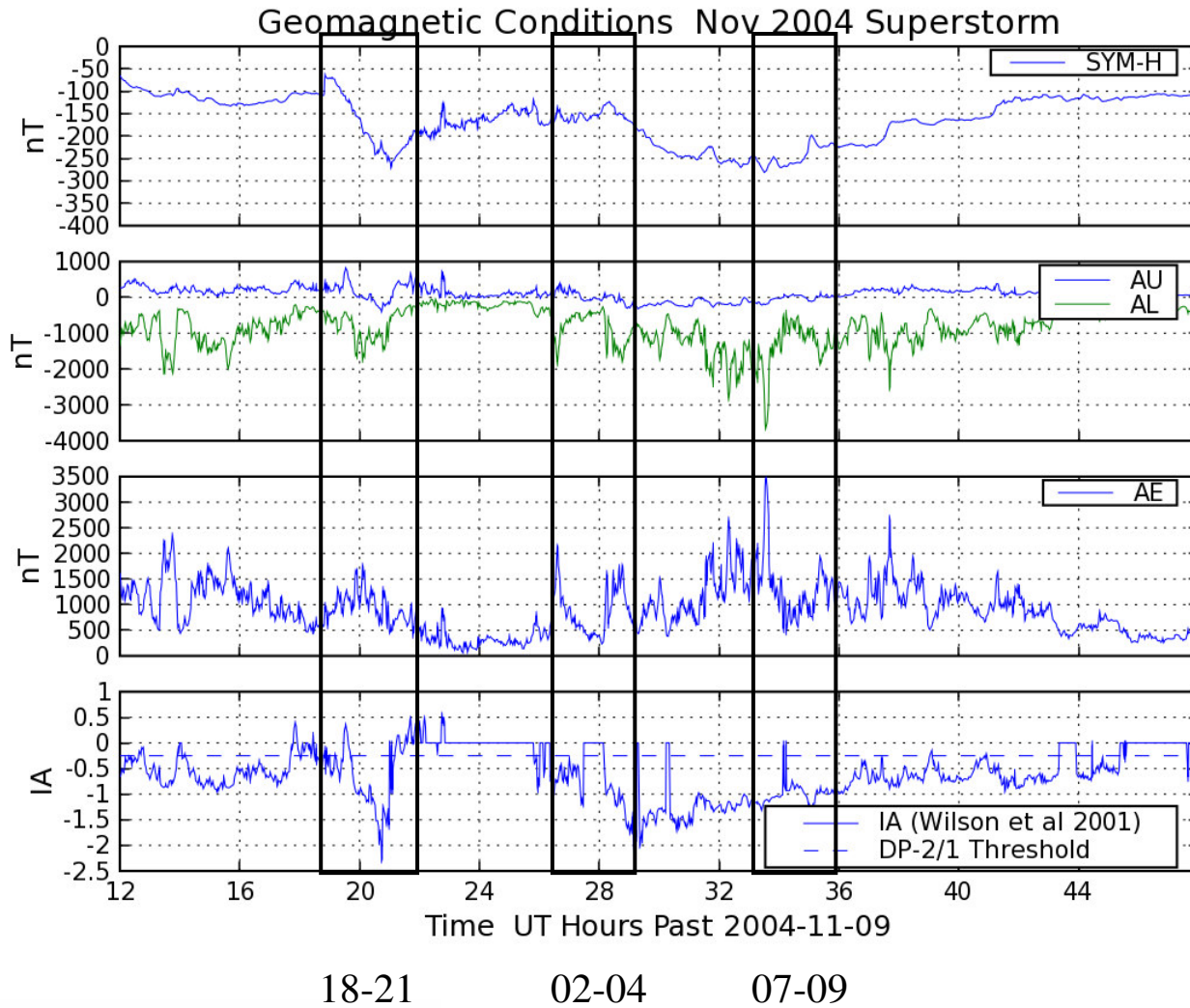


Outline

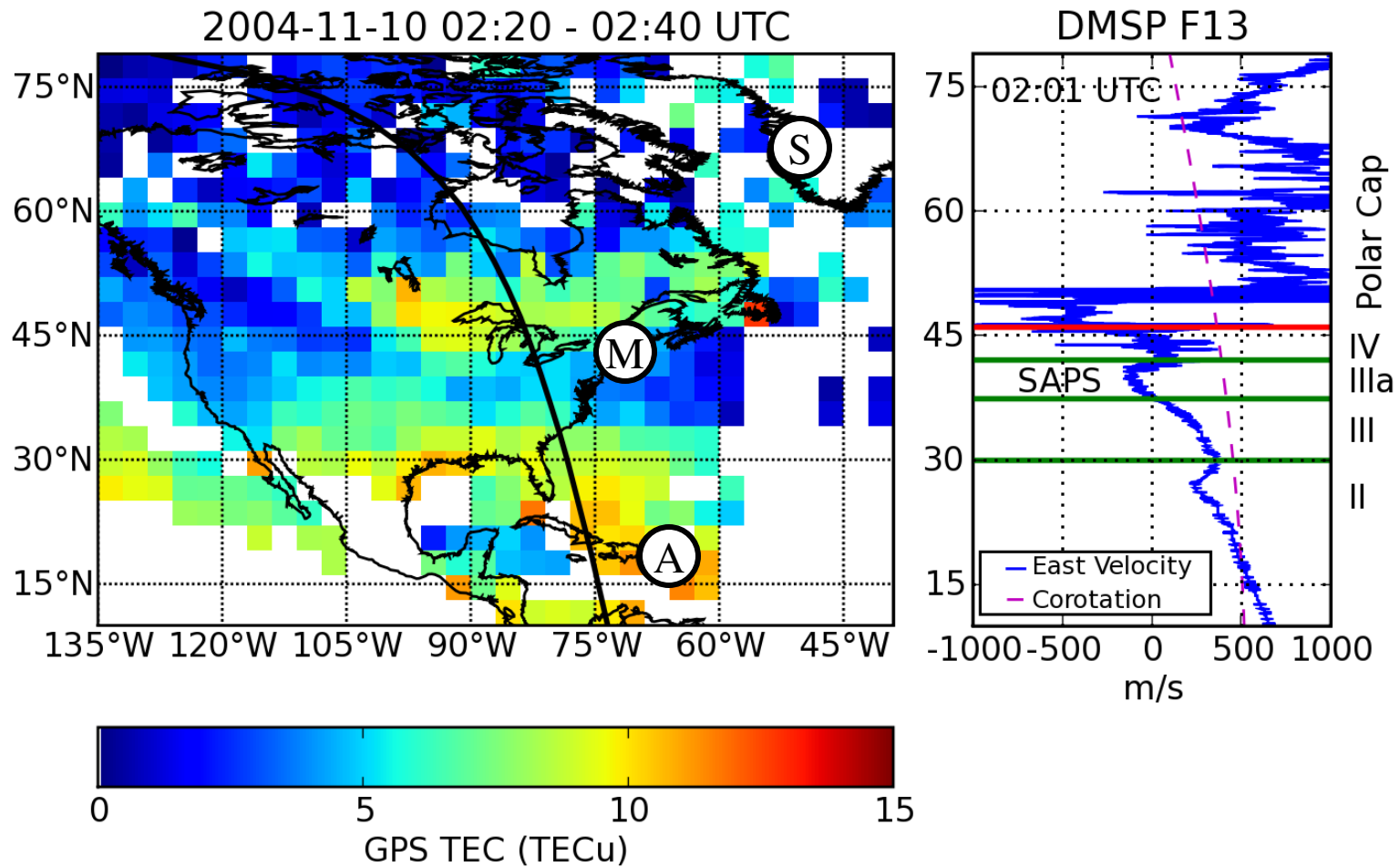
- Geomagnetic Conditions
- Context and Boundaries
- Auroral Stations: Millstone Hill and Sondrestrom
- Millstone Hill Dusk Sector Dynamics
- Millstone Hill, Arecibo Neutral Wind Surges / Dynamios
- TIMEGCM
- Summary



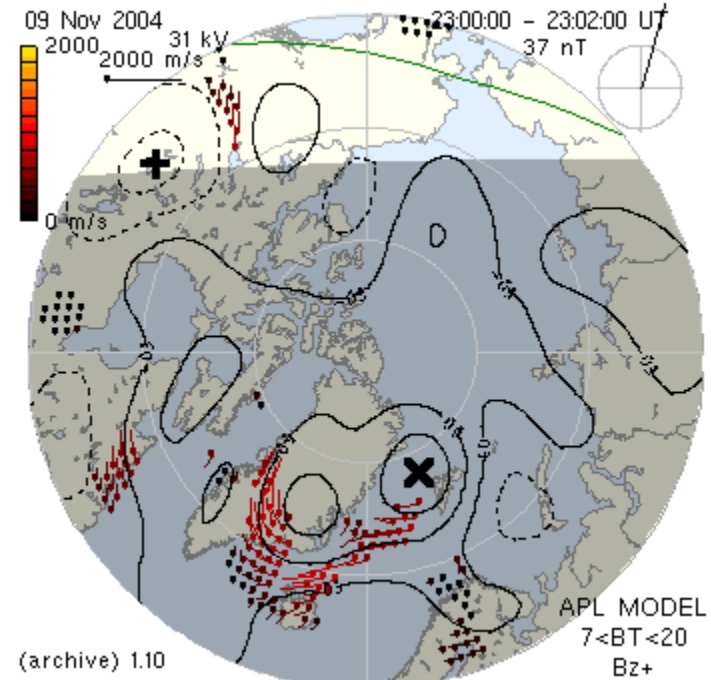
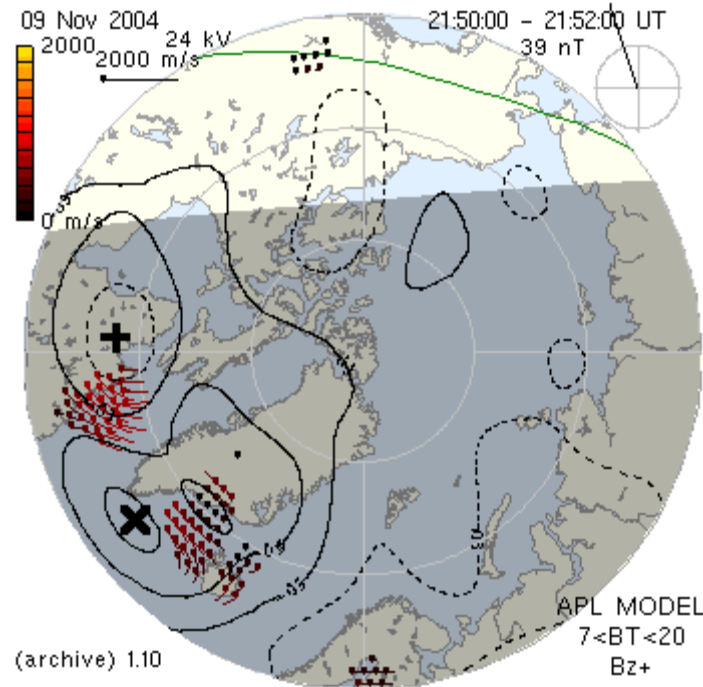
Geomagnetic Conditions: November, 2004



Context and Boundaries: GPS TEC, DMSP

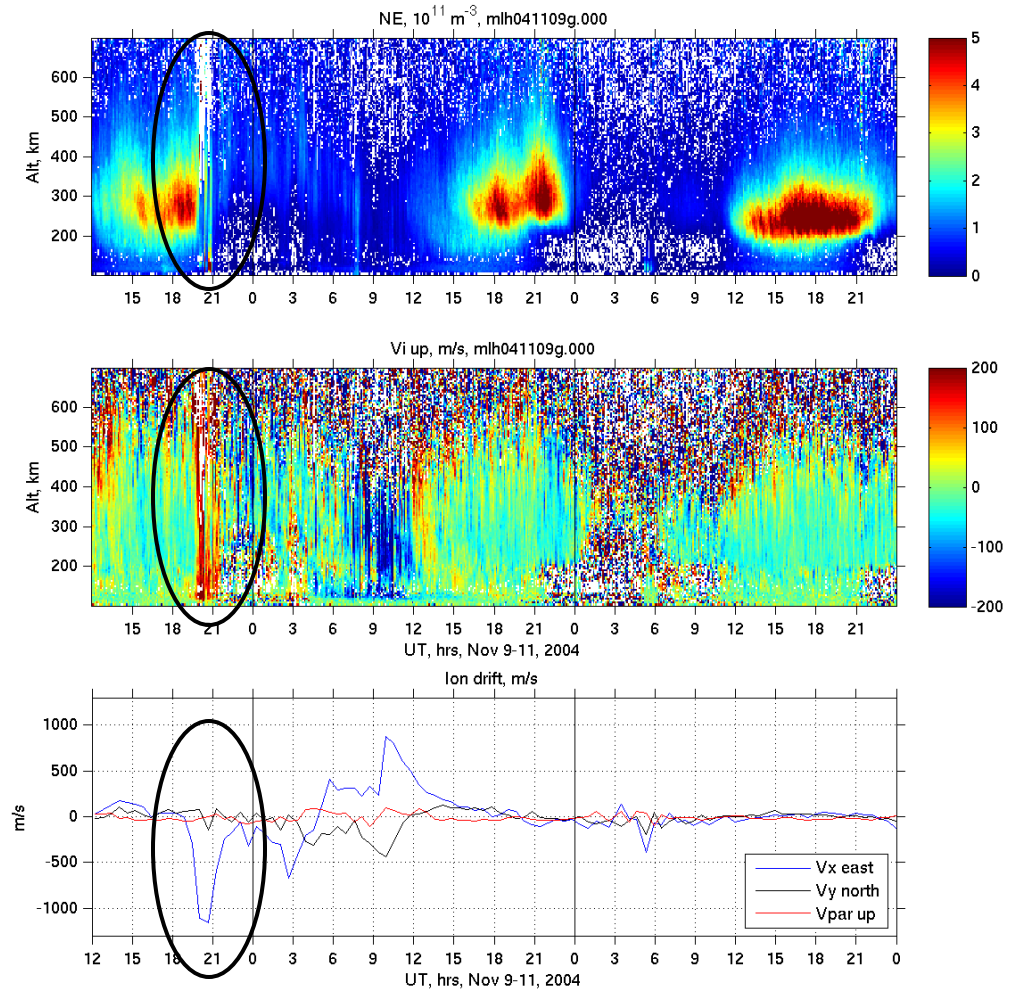


Millstone Hill , Sondrestrom: Auroral Stations



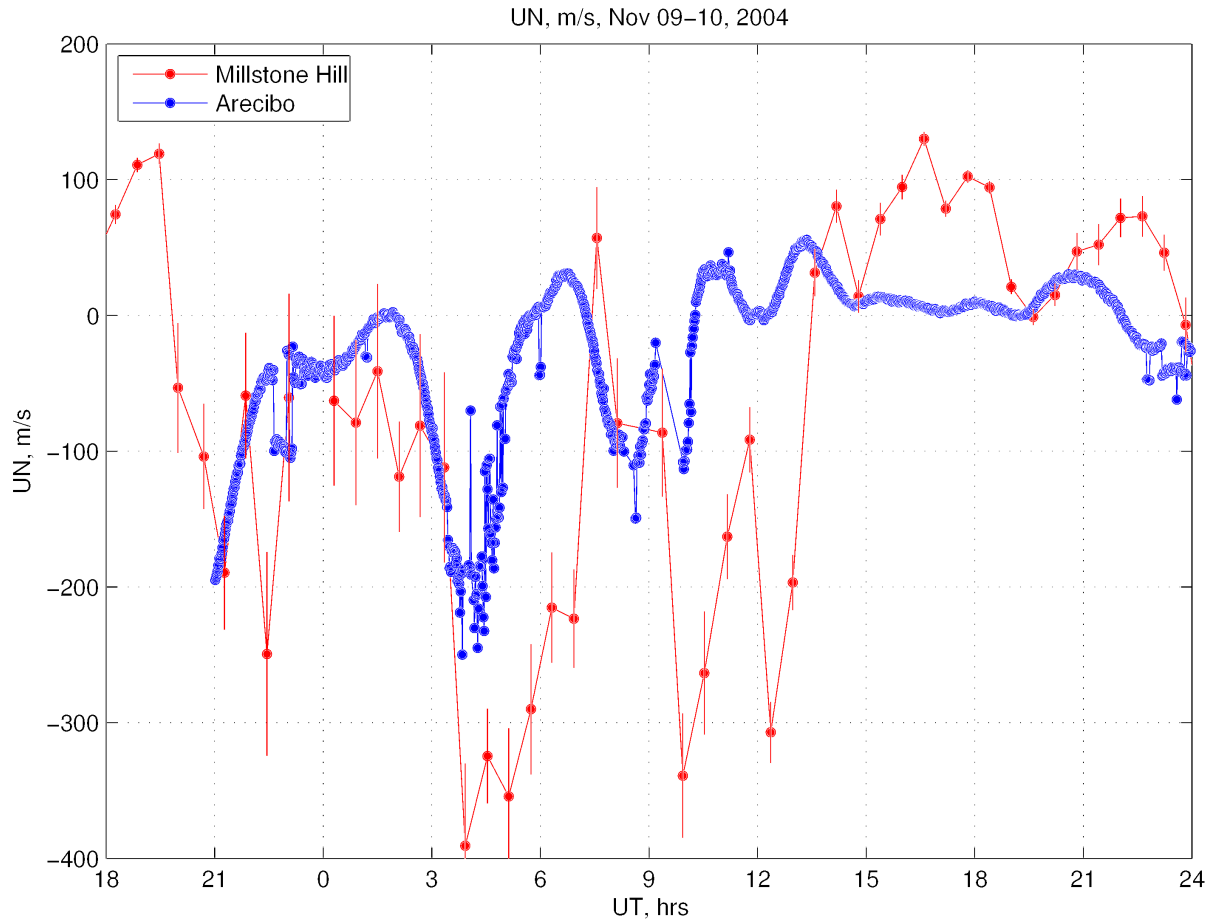
- SuperDARN shows complicated convection pattern
- Millstone V_{pe} should be compared with Sondrestrom V_{pn} – both consistent with convection

Millstone Hill Plasma Parameters: Dusk Sector



- Initial dusk sector penetration E (19-21 UTC) strongly eastward but not much V_{pn} , V_{ap} seen unlike Arecibo
- Simultaneous strong poleward SAPS E leads to strong westward flow
- American sector declination: westward flow gives upward velocity – major contributor to upwards V_i @ MHO
- Equatorward wind would also contribute

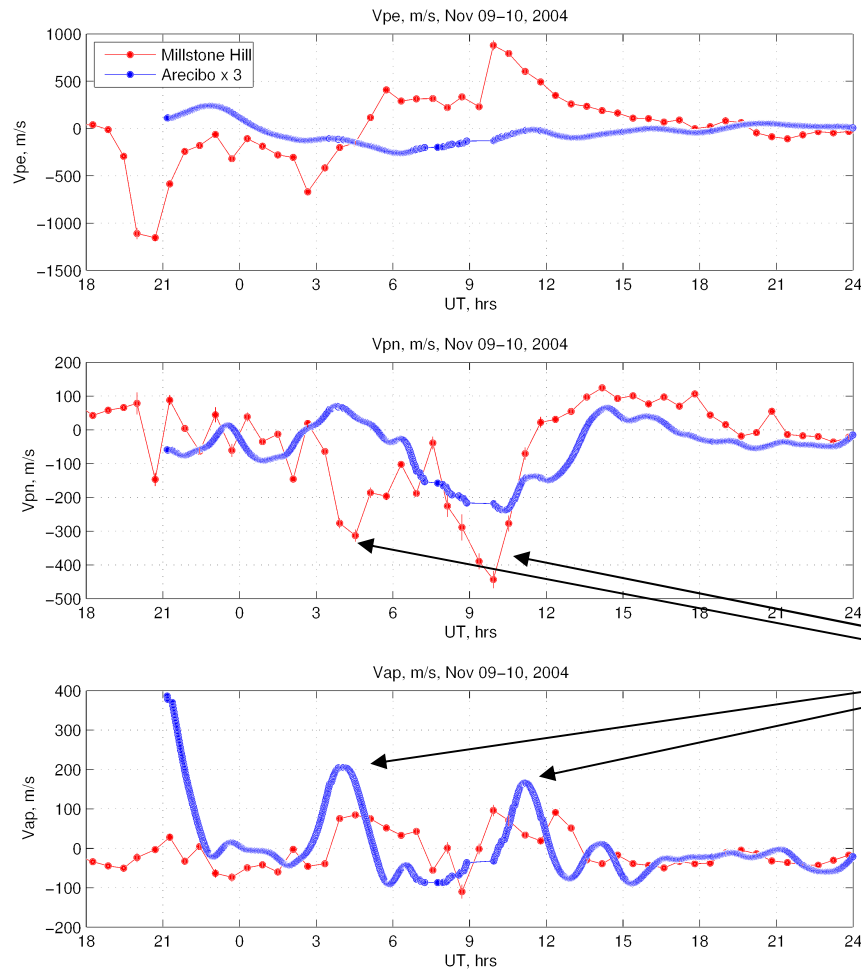
Meridional Neutral Wind: Millstone Hill and Arecibo



- Strong equatorial wind surges seen at 21 UTC, 03-04 UTC, 08-09 UTC
- Millstone winds larger than Arecibo
- Chain timing not consistent with propagating TID pole to equator (but consider context)



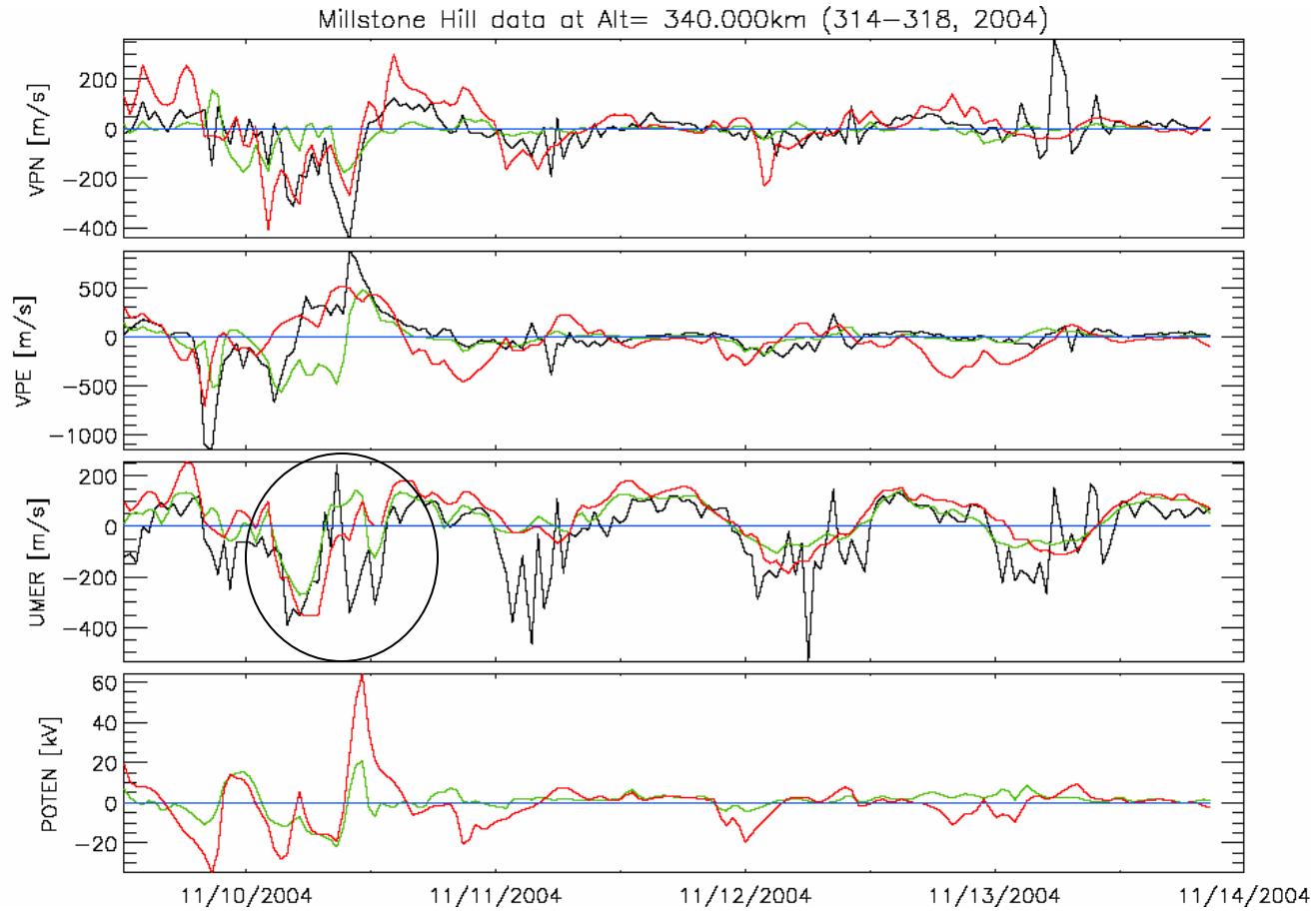
Millstone Hill, Arecibo Ion Drift Vectors



Ion drifts maximize following wind increases (Dynamo effects)



TIMEGCM



Millstone Hill Data TGCM Run # 2 @ 42.6 Lat TGCM Run # 2 @ 52.6 Lat



Summary

- Very low TEC (< 20 TECU) throughout the night with deep midlatitude trough
- Plasmasphere boundary layer located between MHO and AO at ~ 23 UTC onwards; MHO and Sonde are both auroral radar stations during the night (cf. Apr 14, 1978 event)
- Equatorward neutral wind surges of ~ 300 m/s driven locally by substorms at MHO, AO at 02-04 and 07-09 UTC: dynamo effect creates prompt electric fields and large F layer downdrafts. Substorm timing consistent with Millstone neutral winds (local effects).
- TIMEGCM correctly predicts radar chain effects sometimes (02 UTC) but not other times (07-09 UTC); details of energy inputs are critical
- Detailed model and data investigation of neutral wind surges launched by substorms will follow

Buonsanto, M. J., S. González, X. Pi, J. M. Ruohoniemi, M. Sulzer, W. Swartz, J. Thayer, and D. N. Yuan, Radar chain study of the May, 1995 storm, *J. Atmos. Solar-Terr. Phys*, 61 , 233-248, 1999.



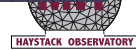


Pointer 66°16'01.58" N 57°02'39.56" W

Massachusetts Institute of Technology

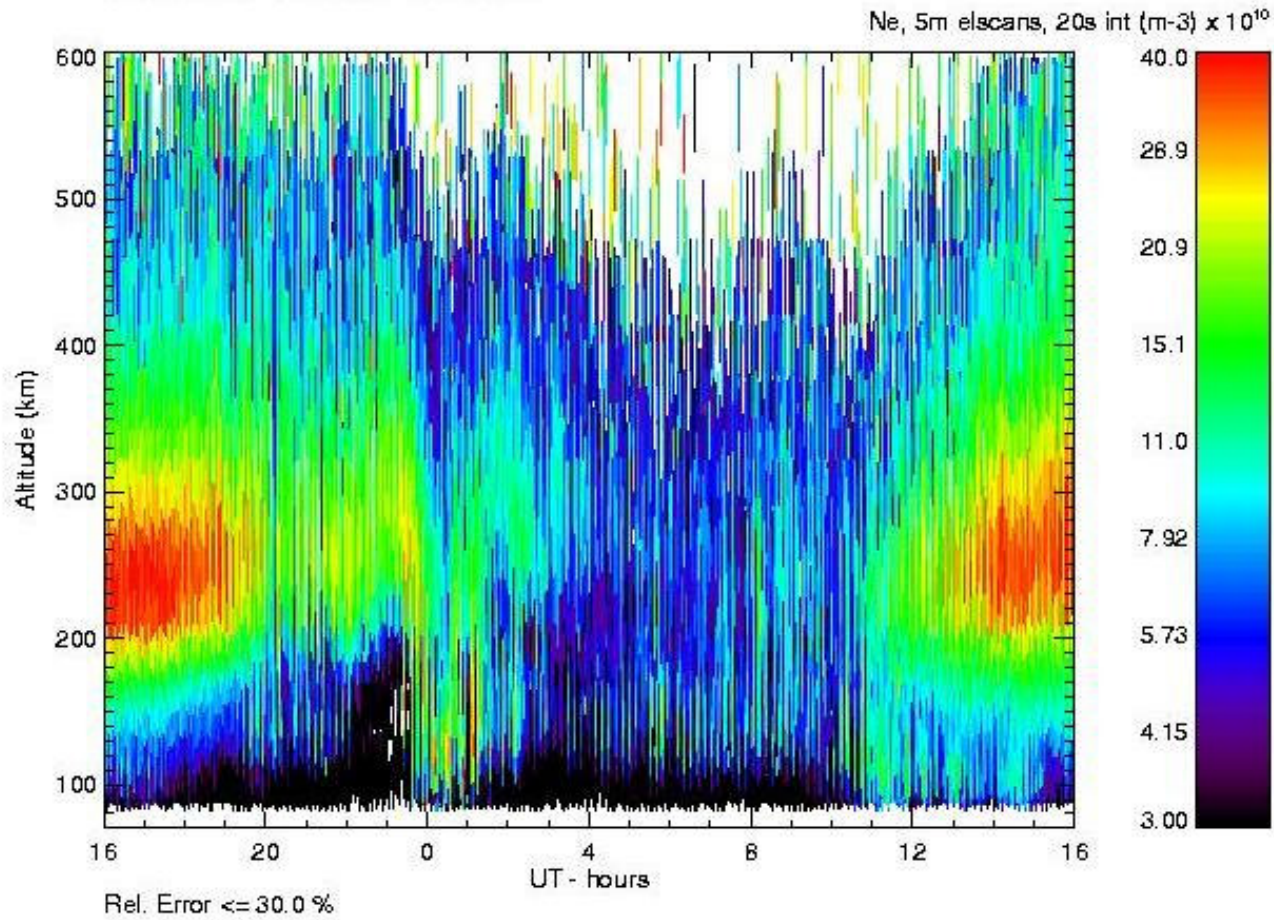
Streaming 100%

Eye alt 2202.69 mi



nain

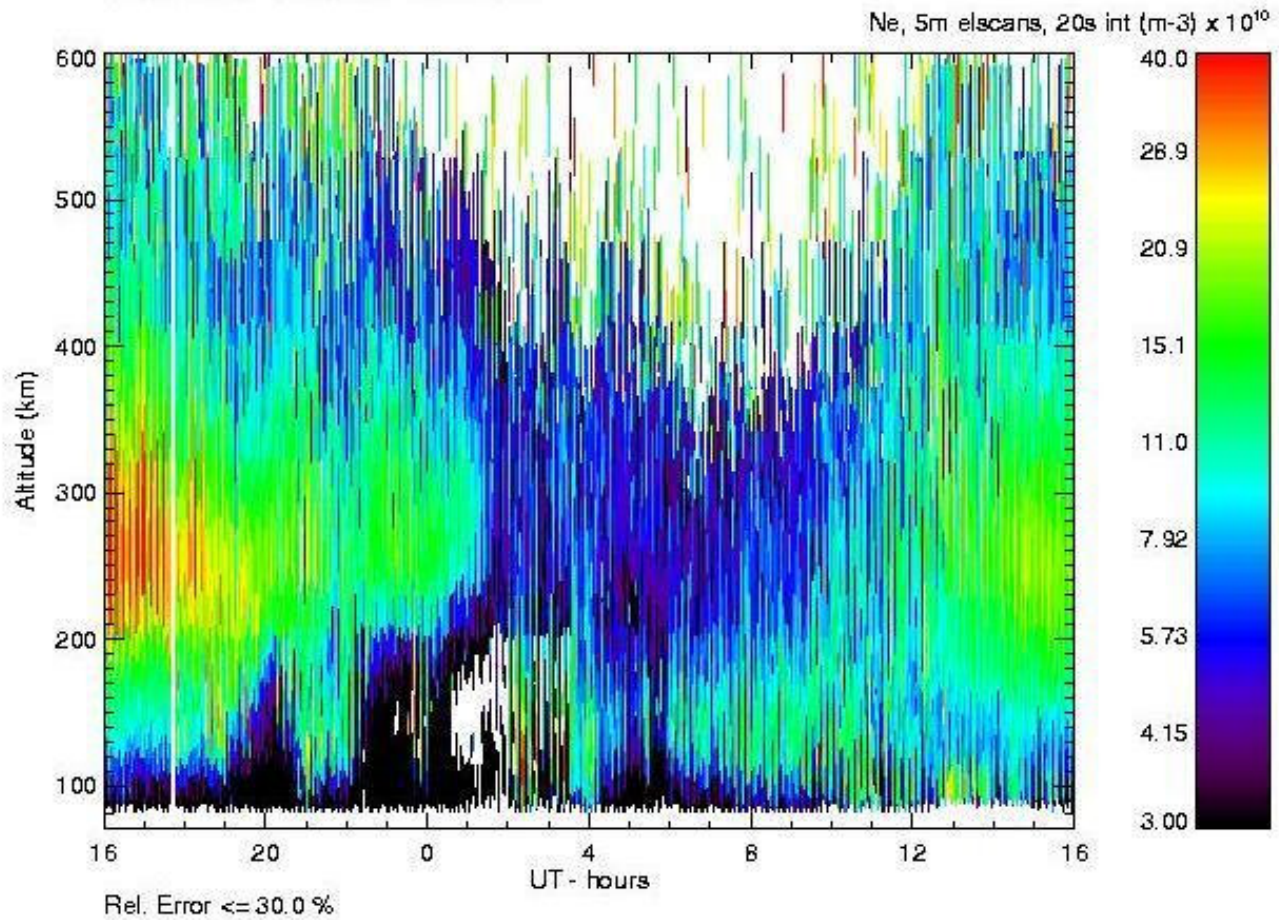
2007 Mar 04 160004.9 - 155958.5 UT



acport-50010-50293-20s.mrg-1sigma

070304-05-1600-1600-ne-all-20s.pe

2007 Mar 05 160019.6 - 160000.1 UT

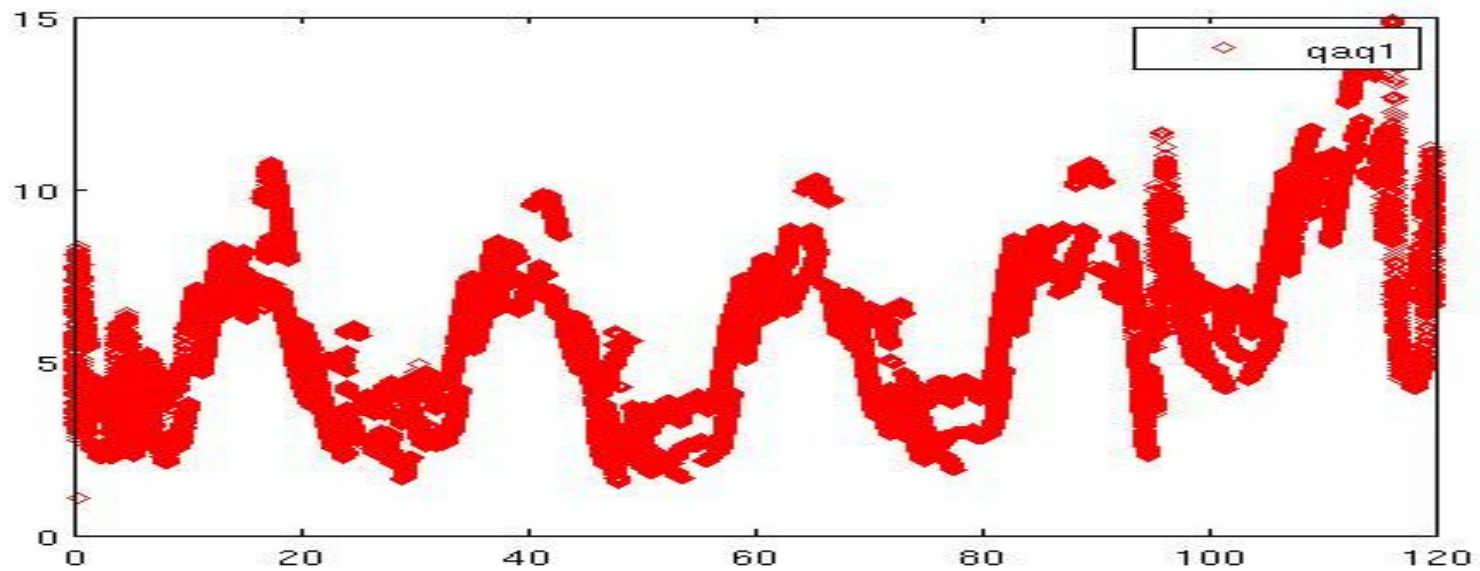
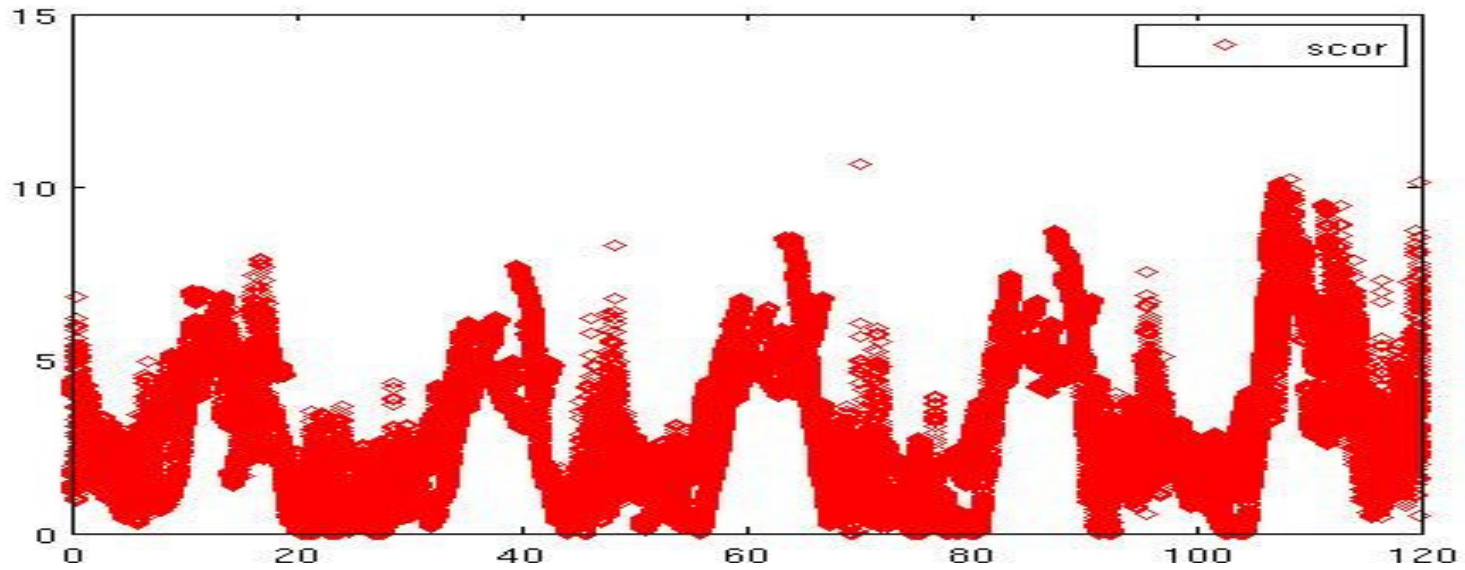


acport-50010-50293-20s.mrg-1sigma

070304-06-1600-1600-ne-alt-20s.ps



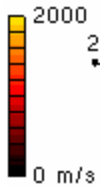
Enhanced TEC measured at ~ 24 UT



05 Mar 2007

62 kV

00:02:00 - 00:04:00 UT



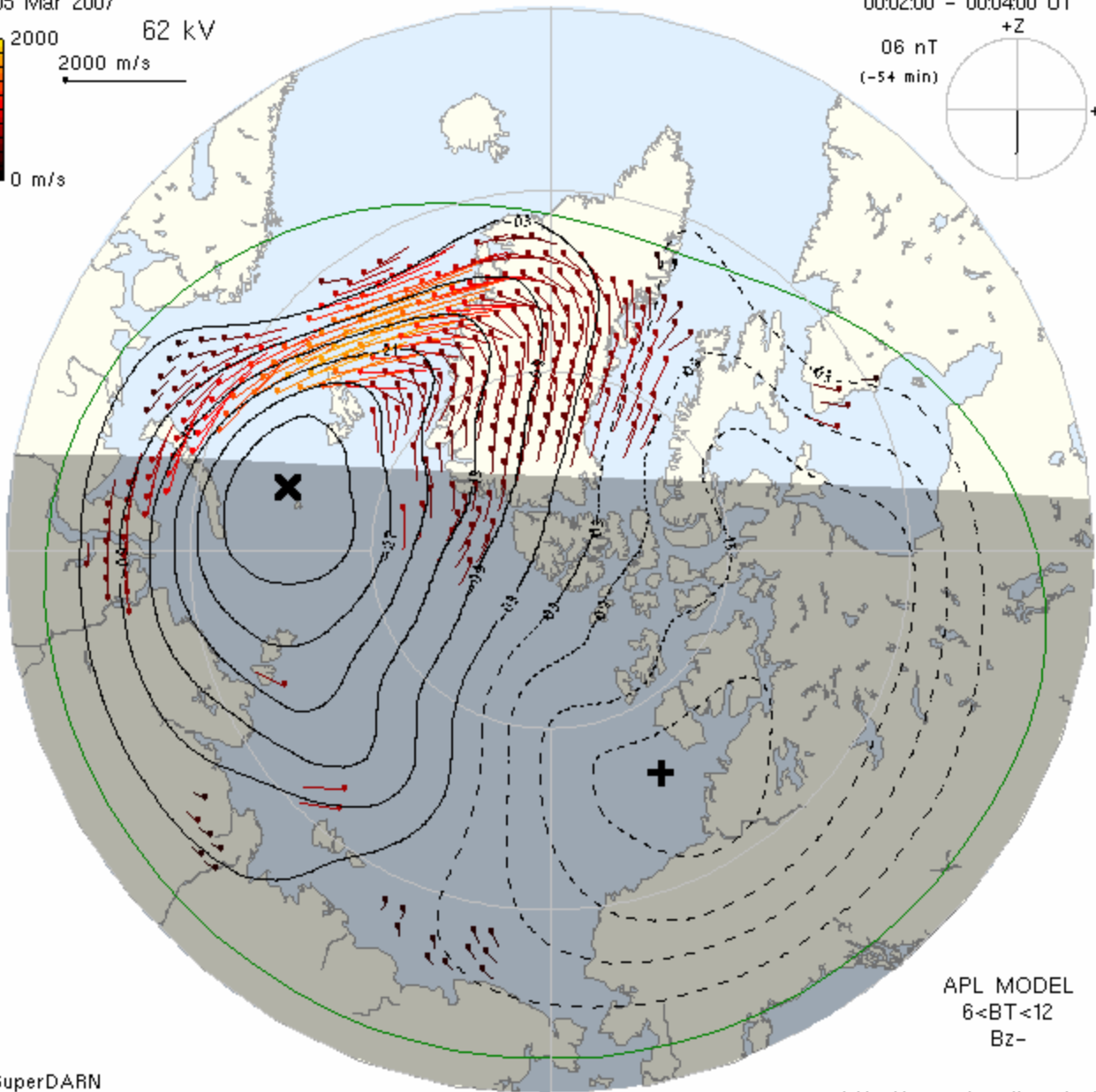
2000 m/s

2000 m/s

←

0 m/s

06 nT
(-54 min)



Massac

SuperDARN
JHU/APL Software by R.J.Barnes

APL MODEL
6 < BT < 12
Bz -

<http://superdarn.jhuapl.edu>



05 Mar 2007

62 kV

00:02:00 - 00:04:00 UT



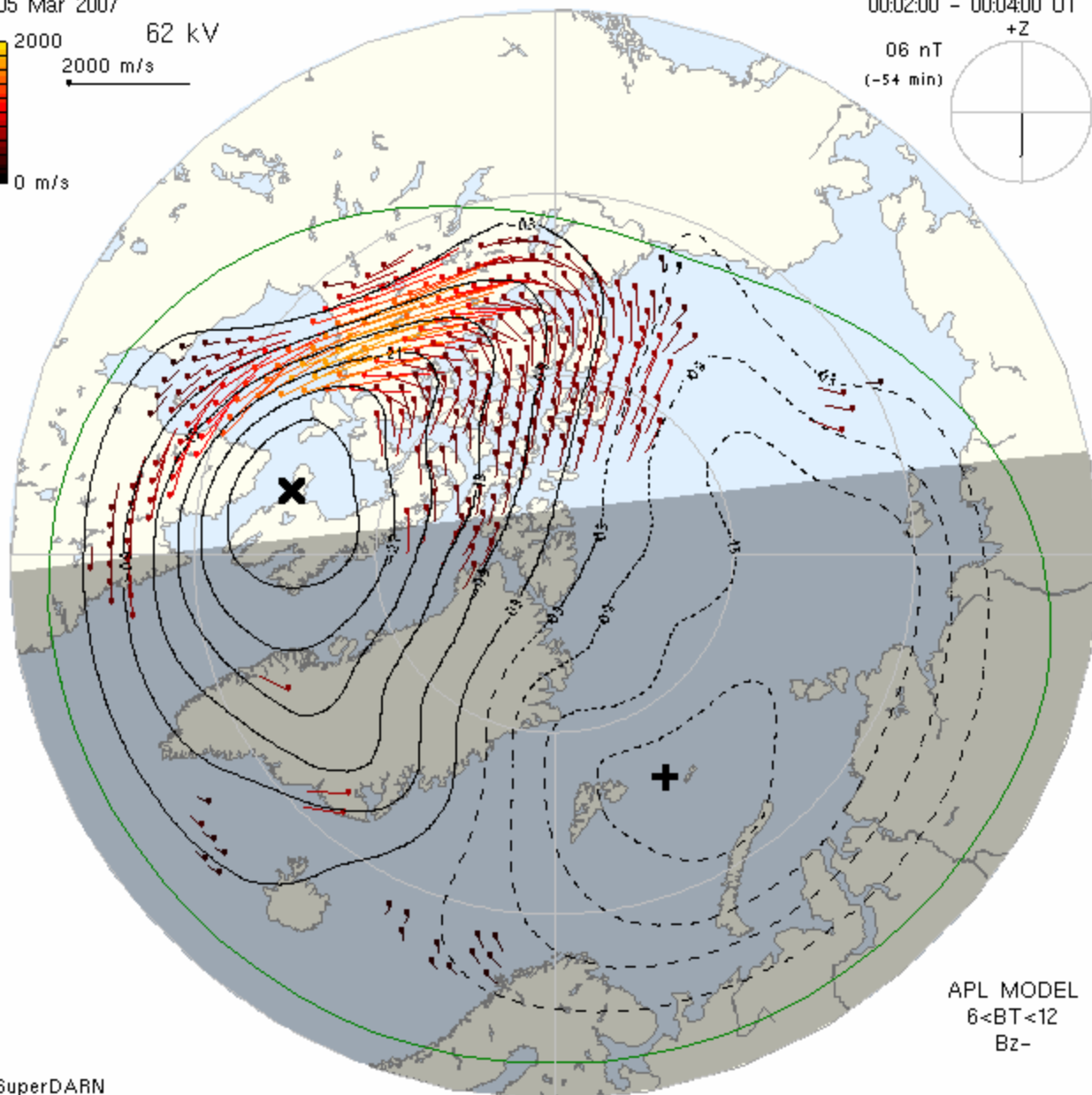
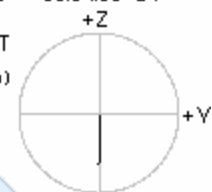
2000 m/s

2000 m/s

2000 m/s

0 m/s

06 nT
(-54 min)



Massac

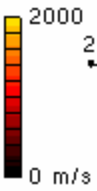
SuperDARN
JHU/APL Software by R.J.Barnes

APL MODEL
6 < BT < 12
Bz -

<http://superdarn.jhuapl.edu>



05 Mar 2007

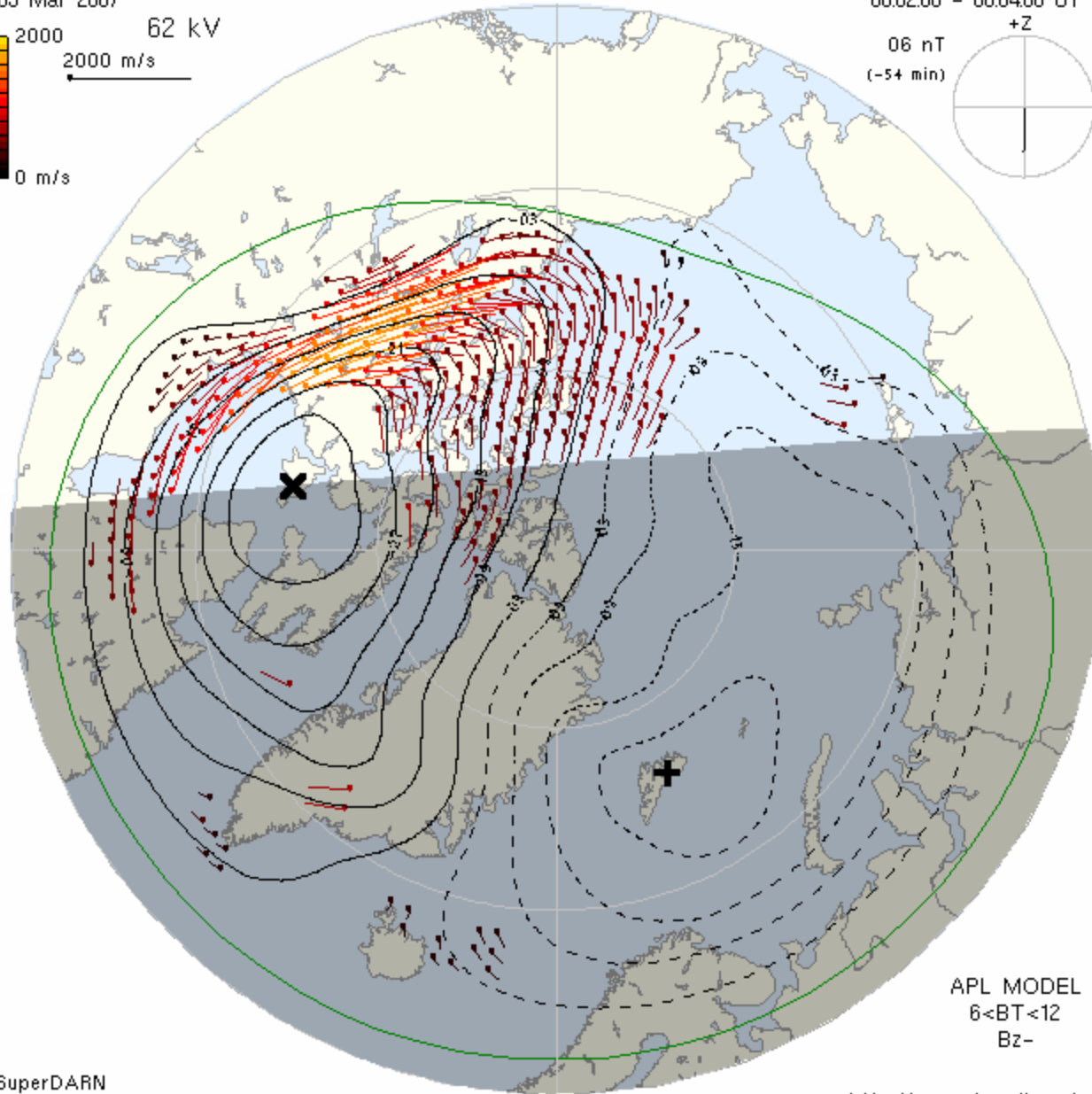
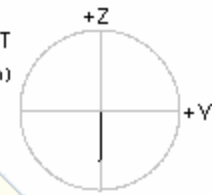


62 kV

2000 m/s

00:02:00 - 00:04:00 UT

06 nT
(-54 min)



APL MODEL
6 < BT < 12
Bz -



Mass: SuperDARN
JHU/APL Software by R.J. Barnes

<http://superdarn.jhuapl.edu>



5 MAR 2007
7:53pm

5 MAR 2007
8:37pm

SVALBARD

SONDRESTROM

Image NASA
Image © 2007 TerraMetrics

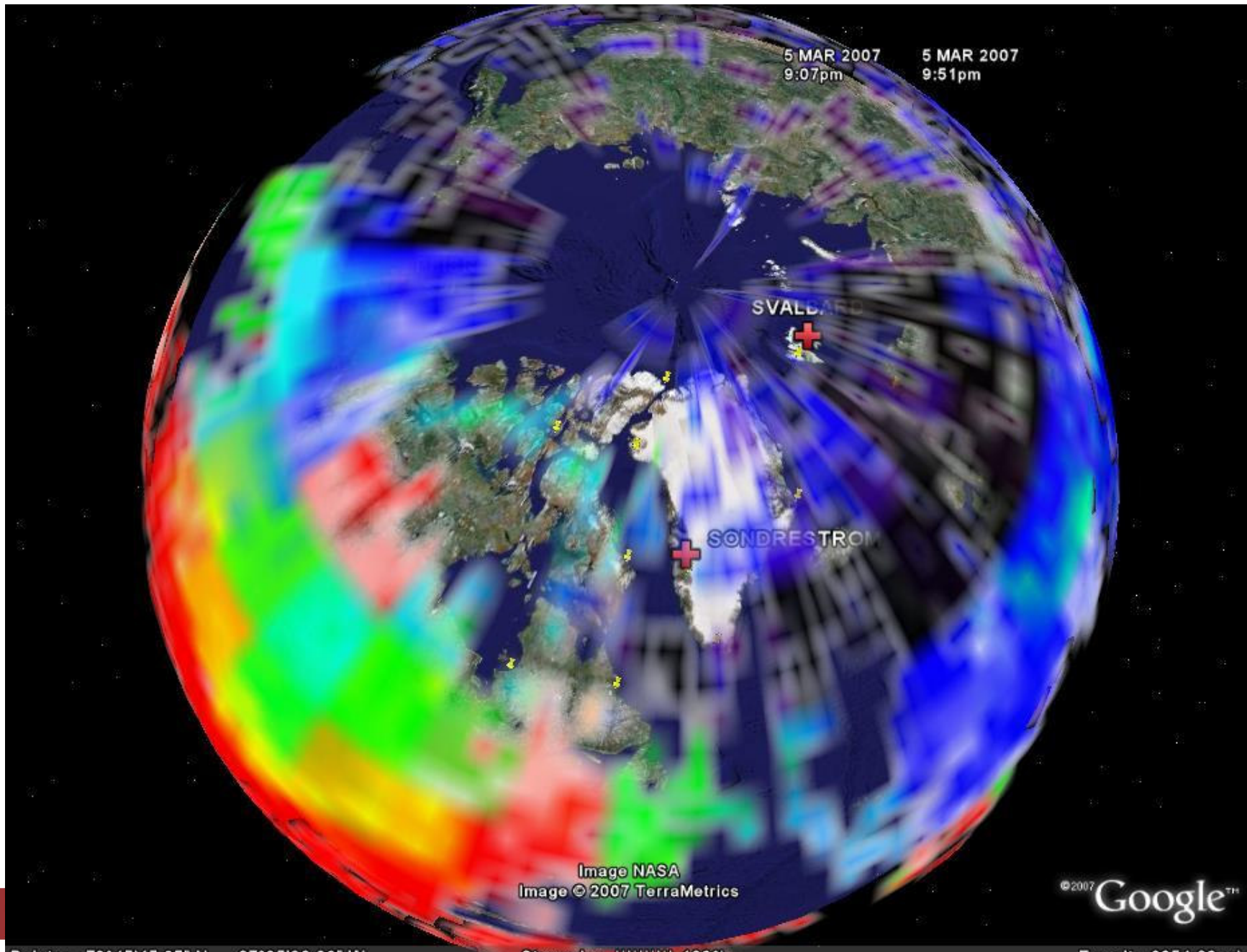
© 2007 Google™

Pointer 73°45'45.25" N 67°35'30.39" W

Streaming ||||| 100%

Eye alt 6054.60 mi





5 MAR 2007
9:07pm

5 MAR 2007
9:51pm

SVALBARD

SONDRSTROM

Image NASA
Image © 2007 TerraMetrics

© 2007 Google™

Pointer 73°45'45.25" N 67°35'30.39" W

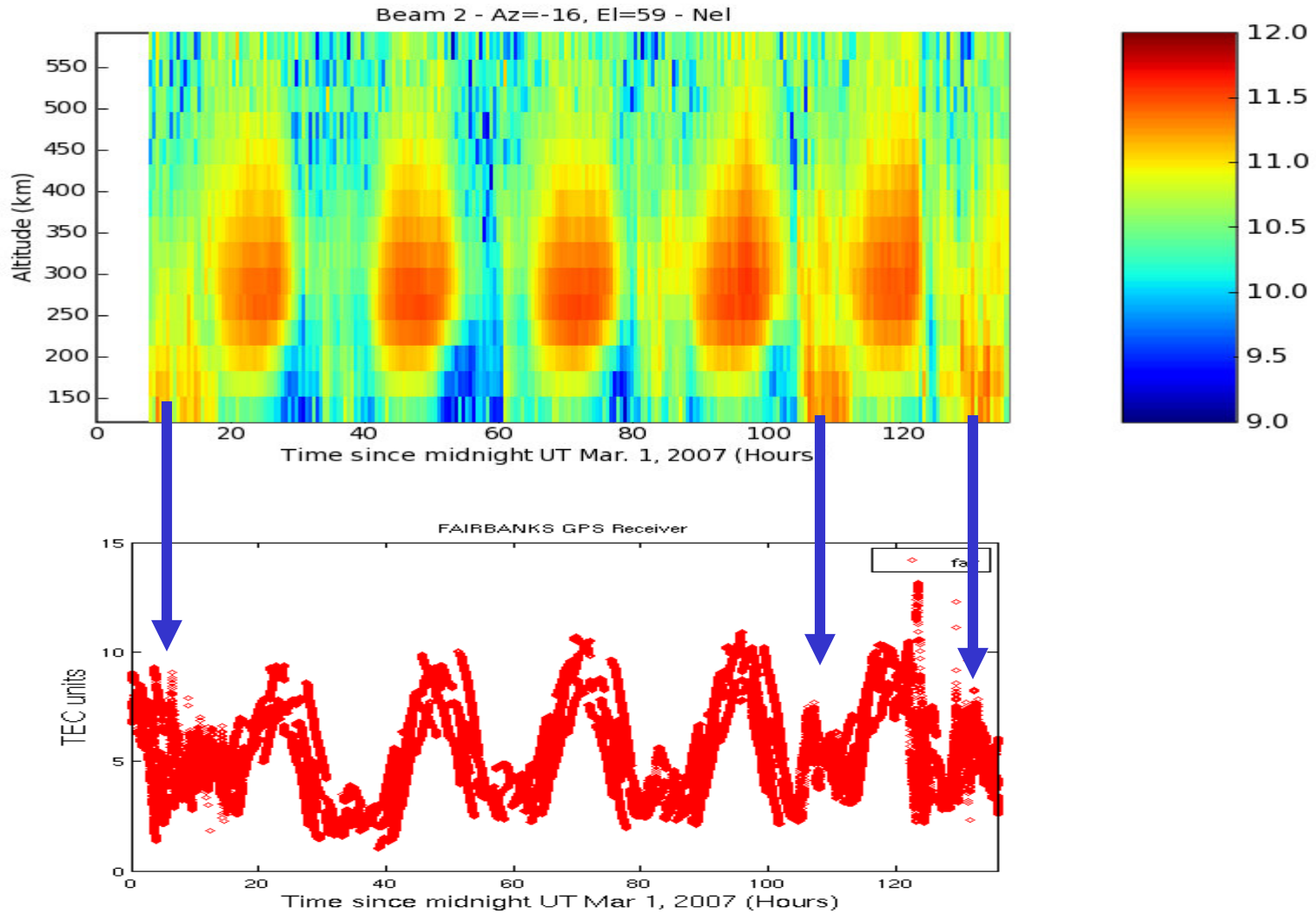
Streaming ||||| 100%

Eye alt 6054.60 mi



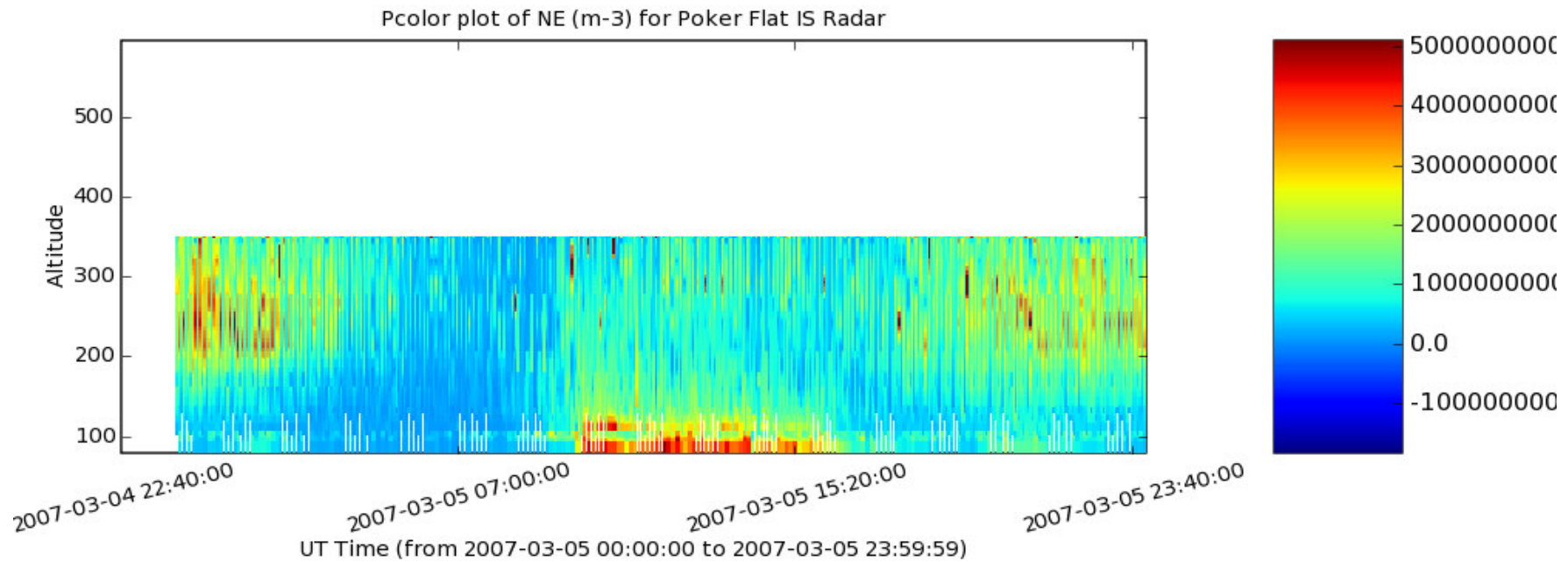


PFISR ISR Electron Density Profiles and GPS TEC

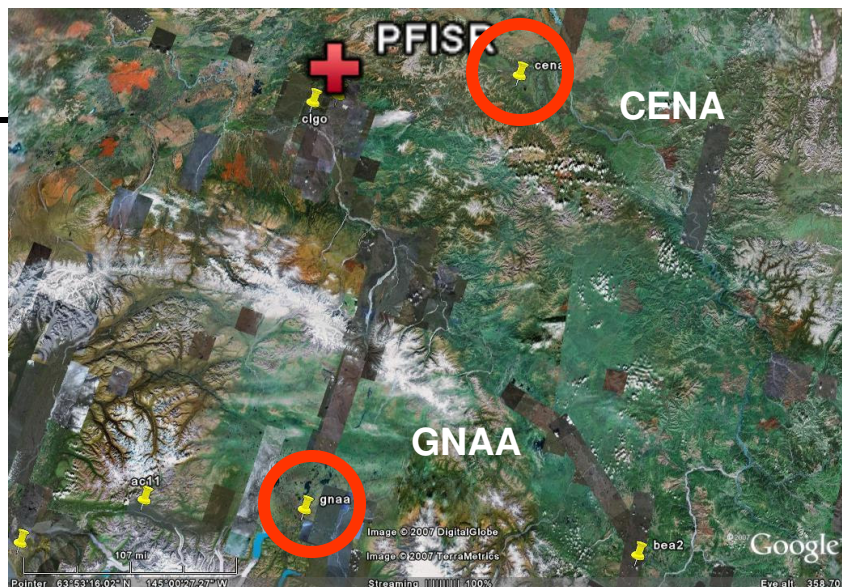


Auroral Arc observed

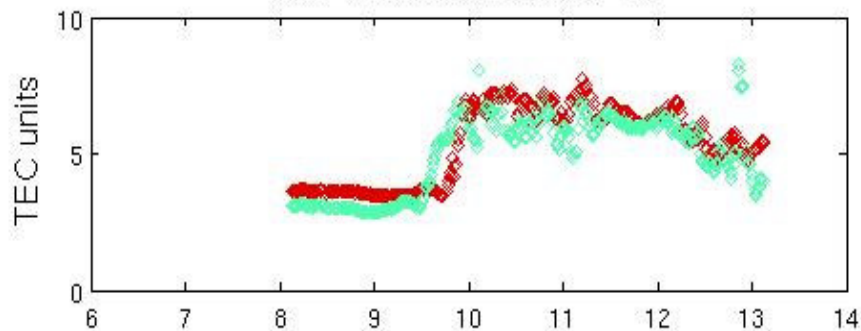
- Enhanced E region plasma



Comparison of measured TEC at three different sites: FAIR (PFISR Site), CENA, GNAA



FAIR-CENA 03-05-2007 satid = 28



FAIR-GNAA 03-05-2007 satid = 28

