

Dayside transients:

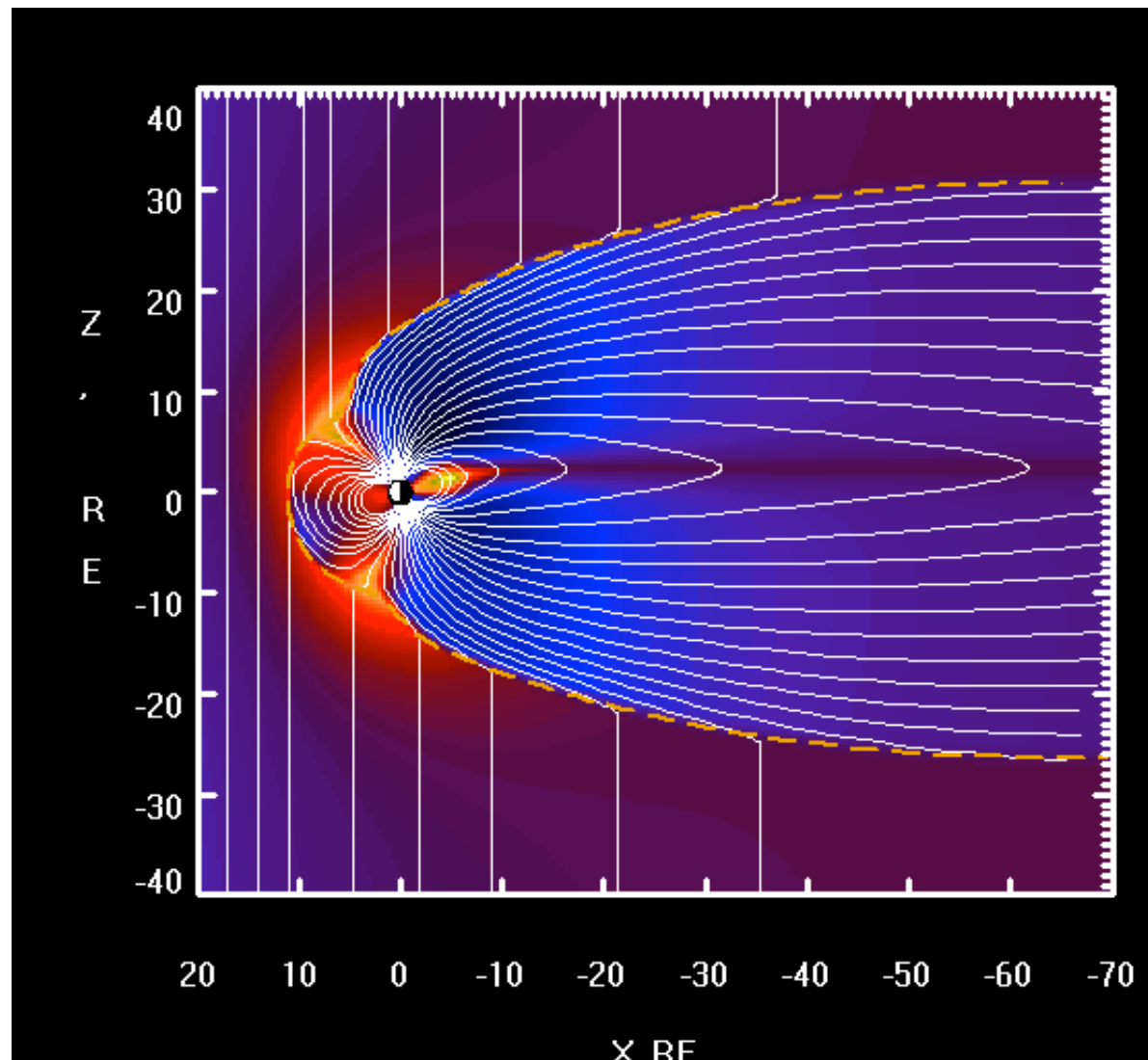
Their importance and observational campaigns and missions to address them

D. G. Sibeck
NASA/GSFC

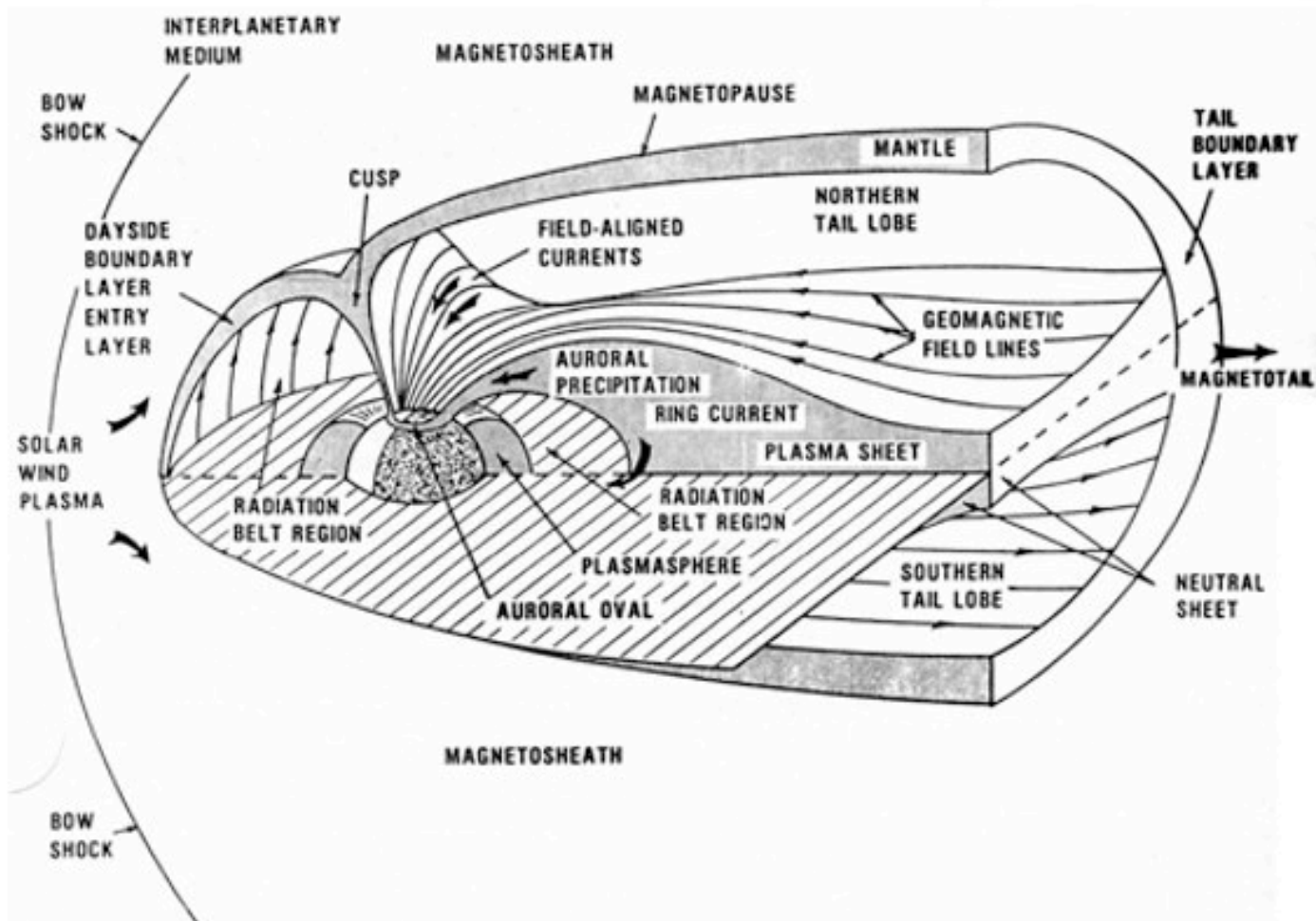
Outline

- 1. Steady and unsteady solar wind-magnetosphere interactions
- 2. Possible interpretations and their significance
- 3. Global Measurements for a Global Problem
- 4. Conclusion

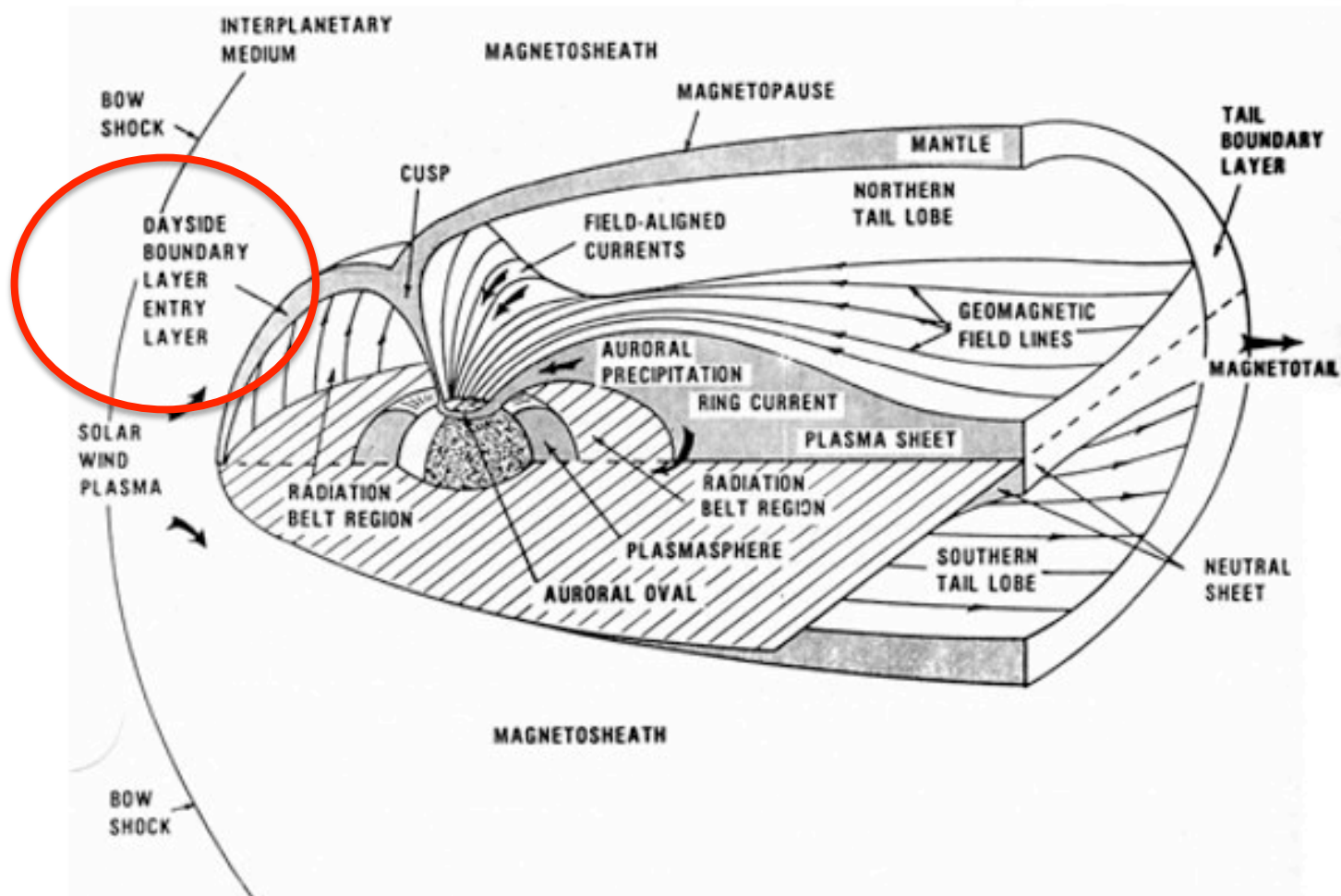
Steady Reconnection



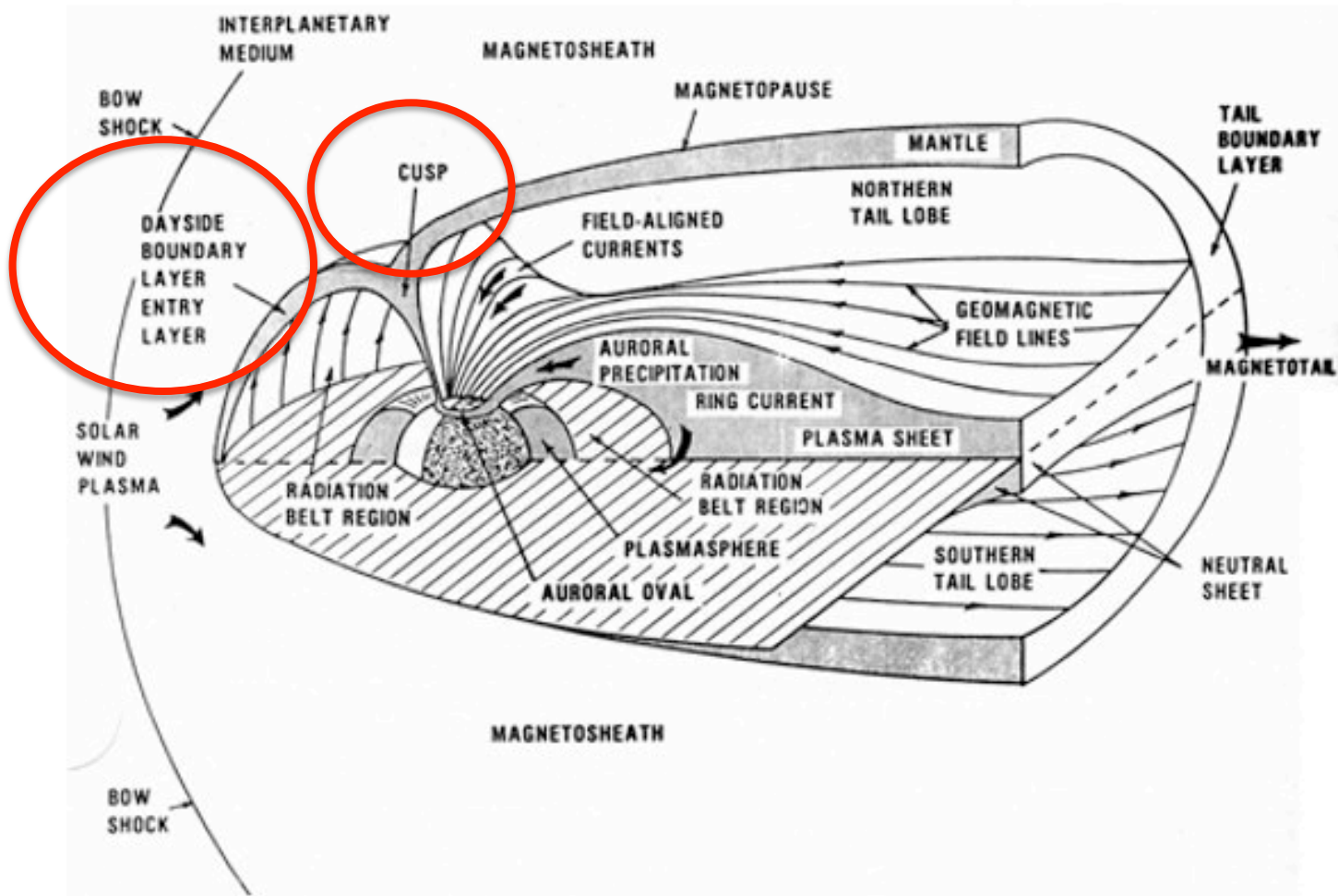
Steady-State Magnetosphere



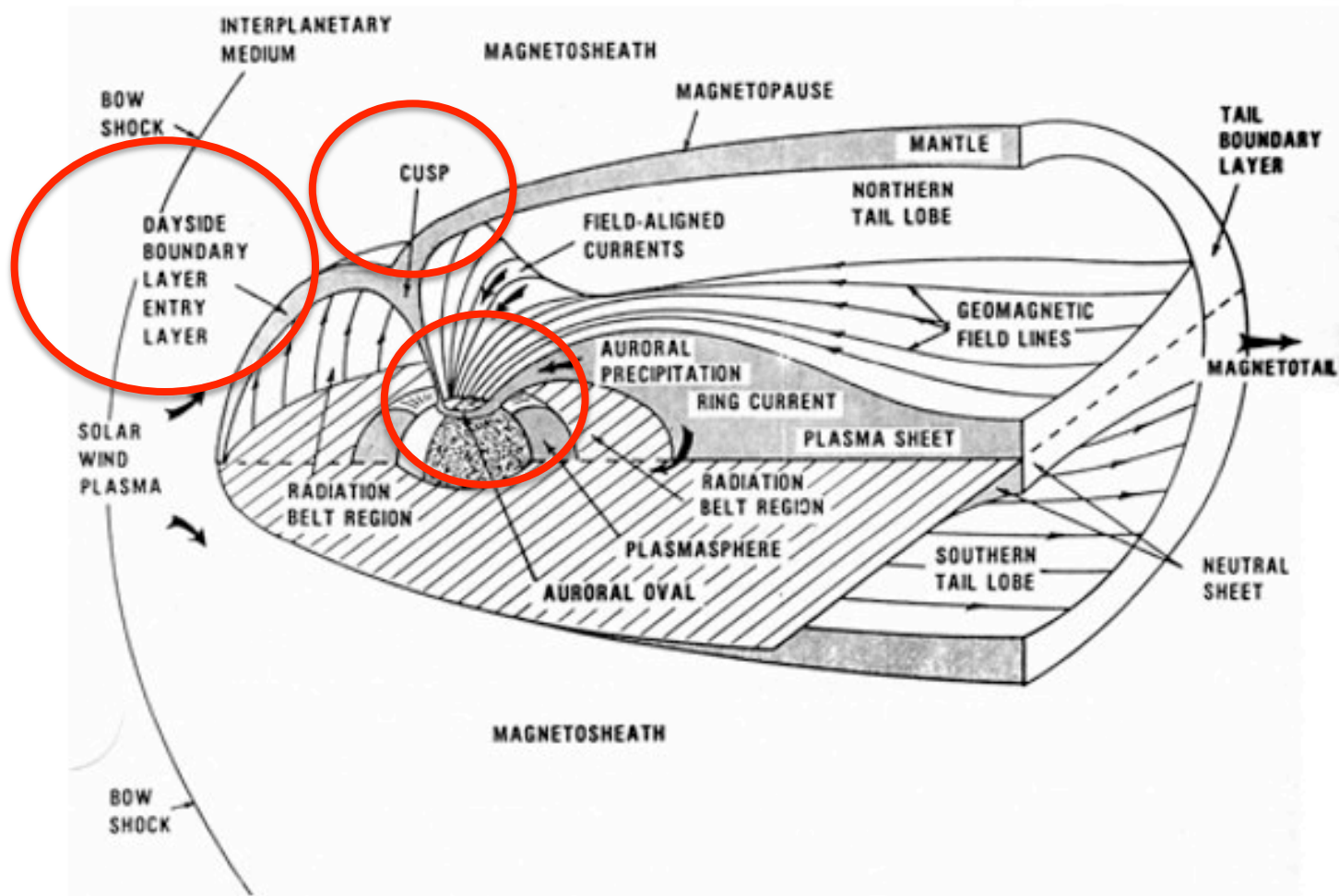
Steady-State Boundary Layers



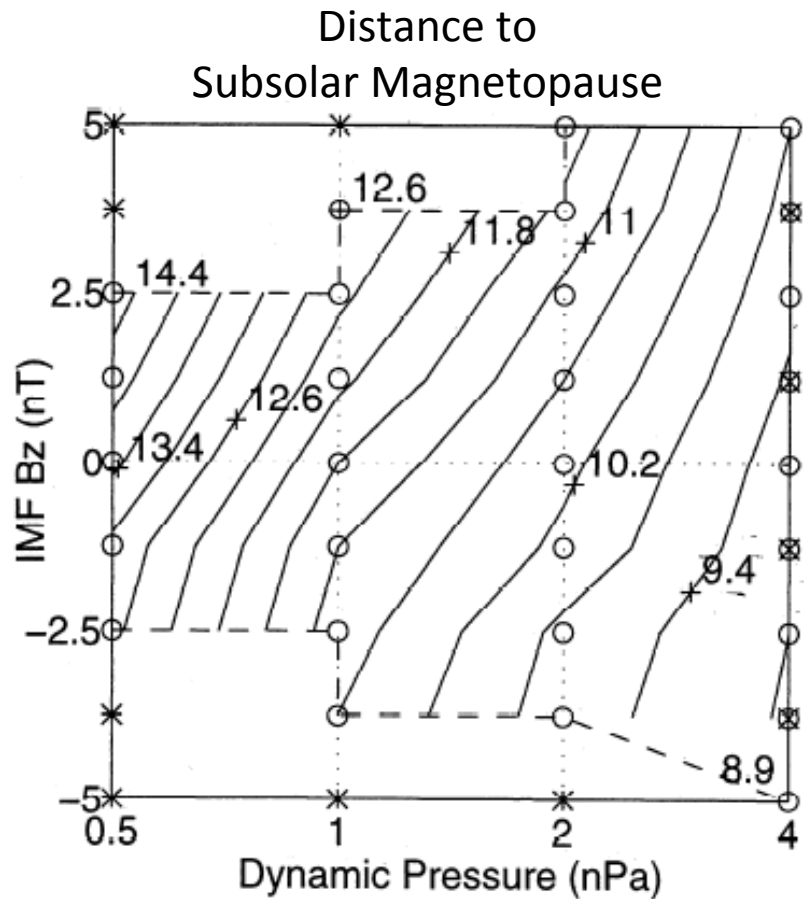
Entire Boundary Layer Maps to Cusp



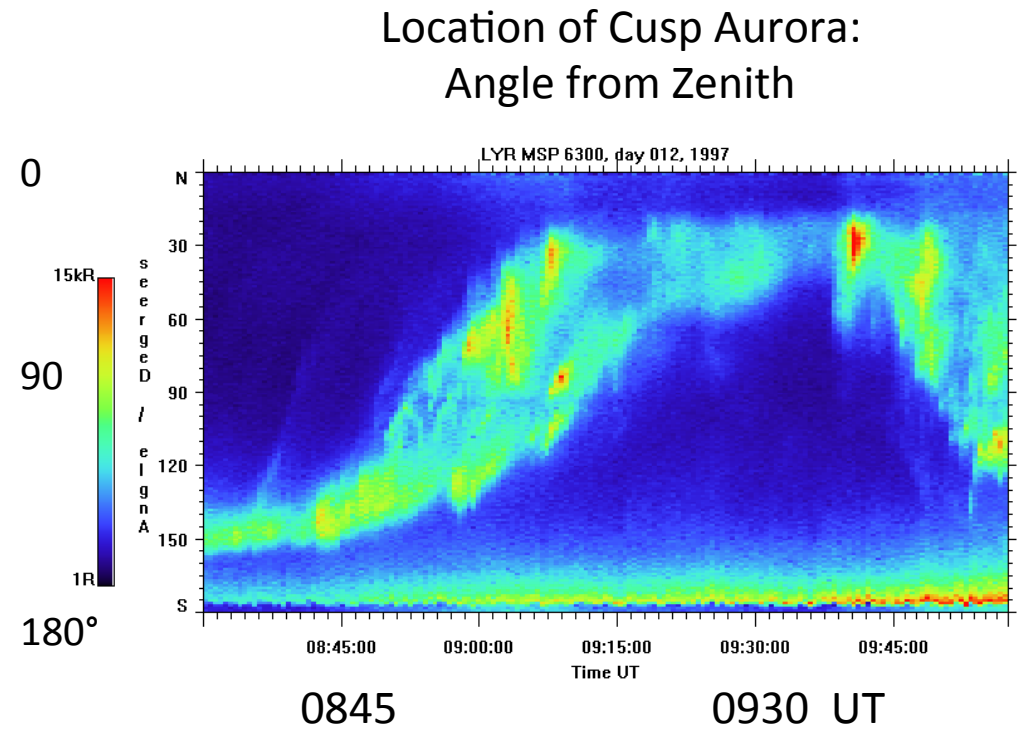
High Latitude Stations can Observe Cusp Remotely



Some features are quasi-steady: Responses to Variations in SW P and Bz



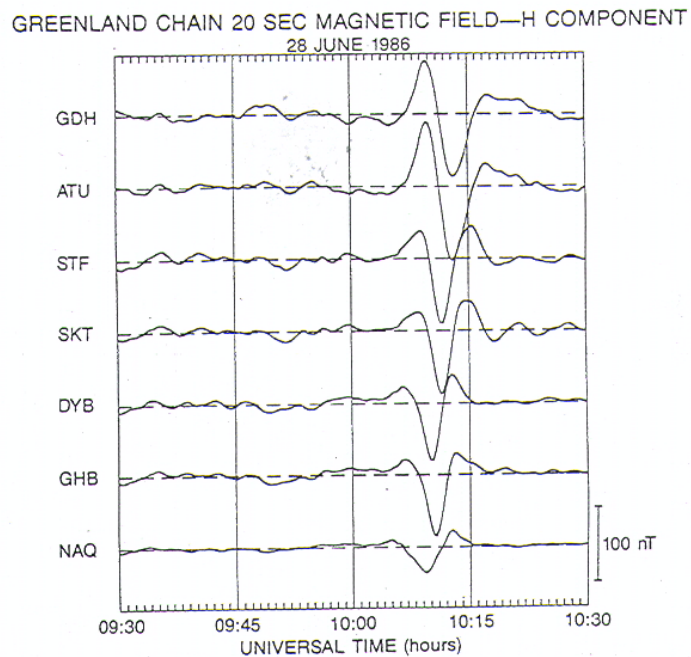
Elsen and Winglee [1997]



Fasel, 2012

Others are More Transient: Cusp-Latitude Ground Magnetometers

Magnetic Impulse Event or
Traveling Convection Vortex

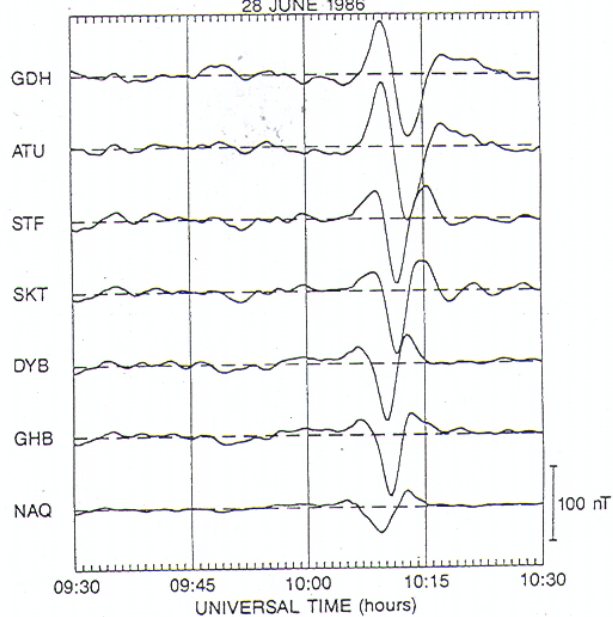


Friis-Christensen et al. [1988]

Transients are Common in Observations by Meridian Scanning Photometers

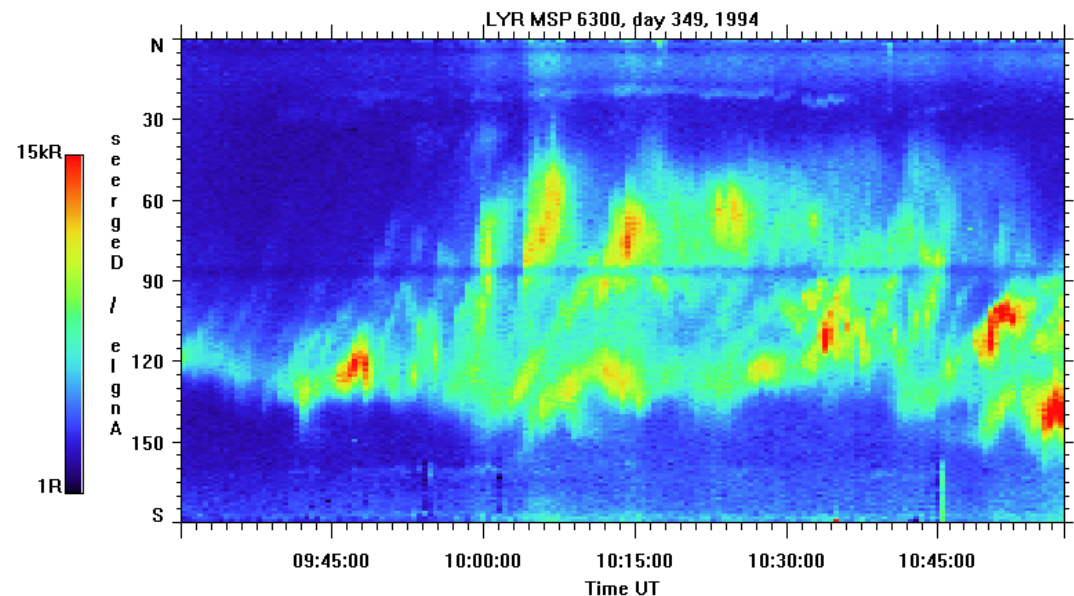
Magnetic Impulse Event or
Traveling Convection Vortex

GREENLAND CHAIN 20 SEC MAGNETIC FIELD—H COMPONENT
28 JUNE 1986



Friis-Christensen et al. [1988]

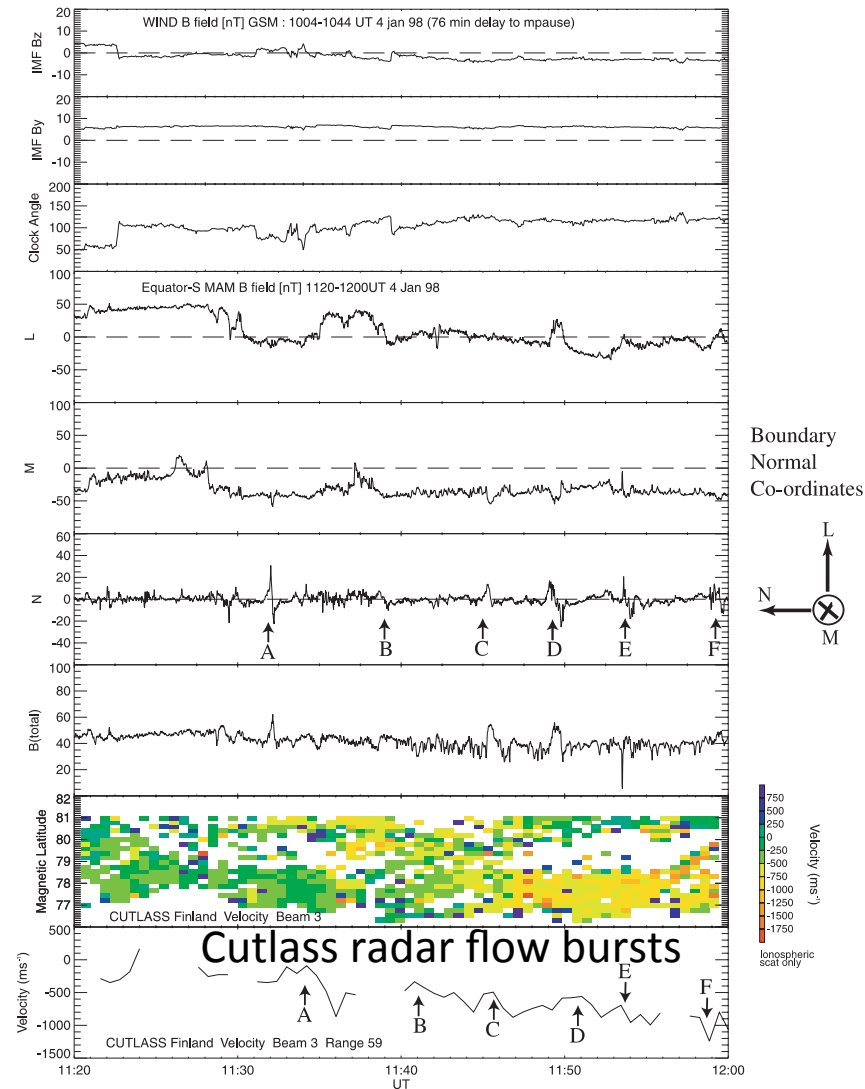
Poleward Moving Auroral Forms
(including rebrightening)



Fasel [2012]

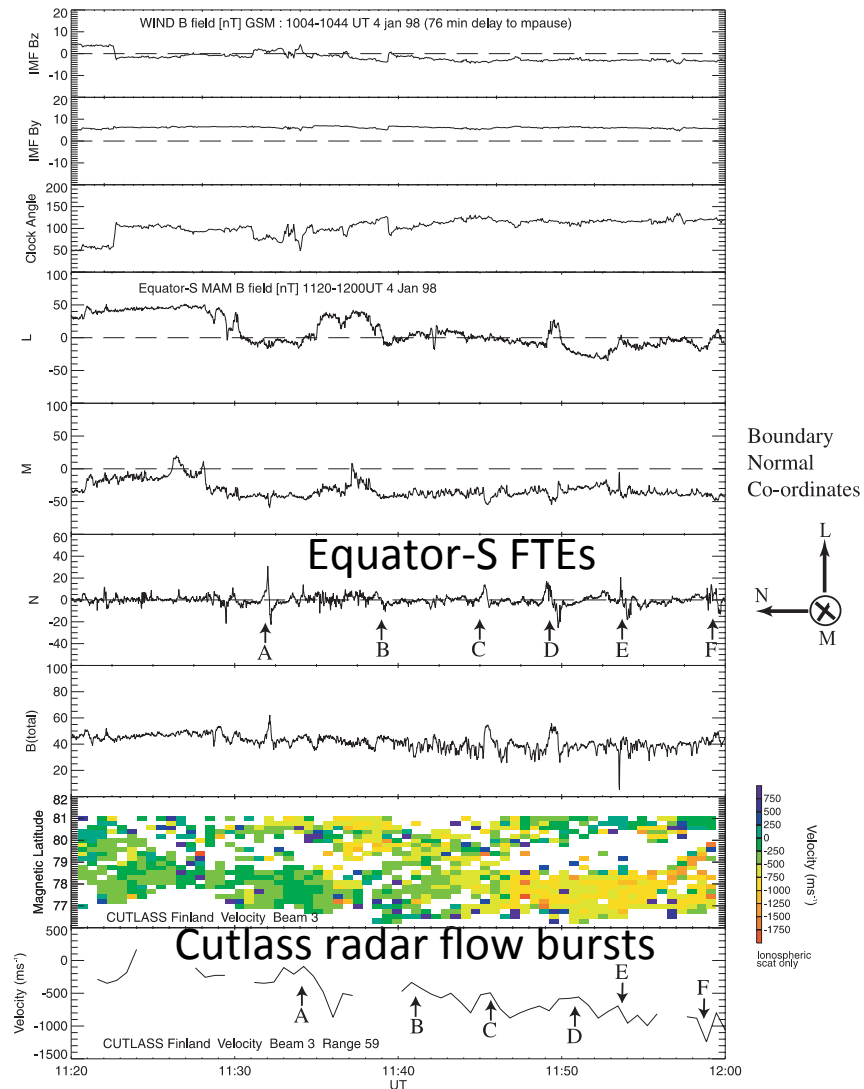
Transients are Common in Observations by Ground Radars

Neudegg
et al. [2000]

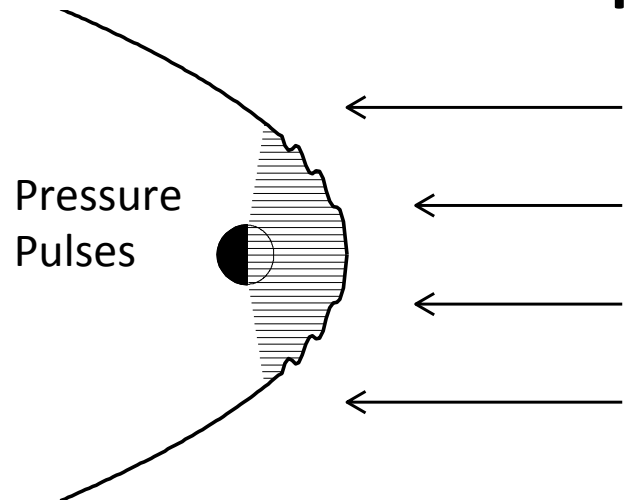


There Appears to Be a Magnetopause Connection

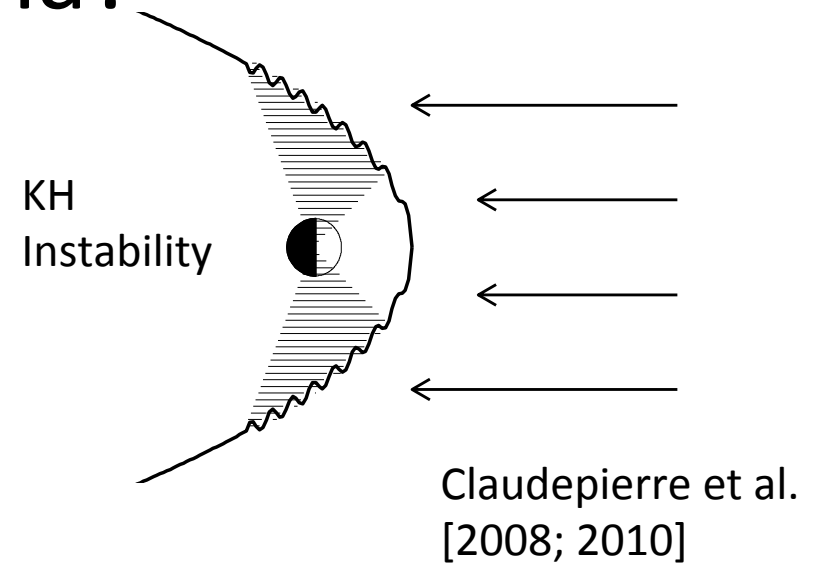
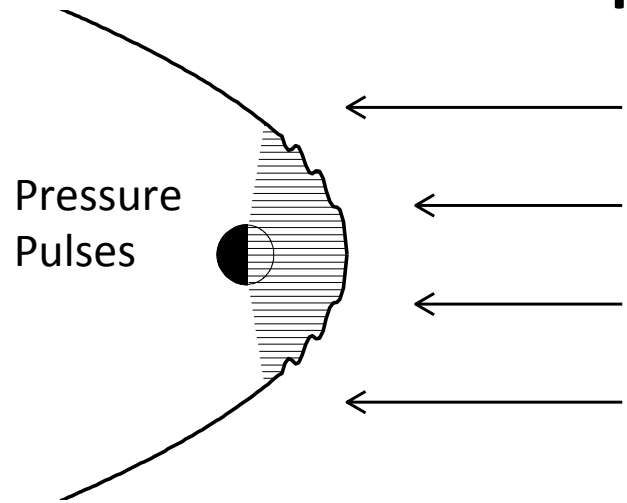
Neudegg
et al. [2000]



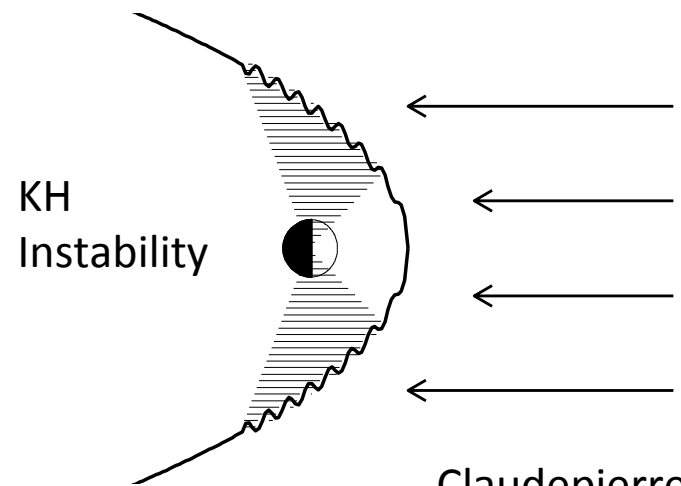
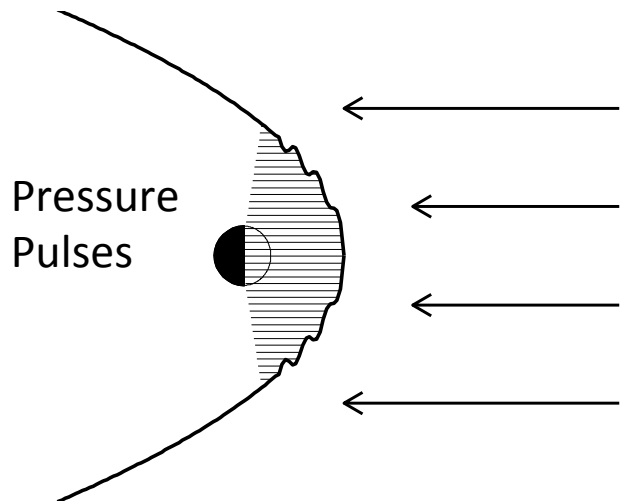
But to what Magnetopause Phenomena?



But to what Magnetopause Phenomena?



Magnetopause Phenomena



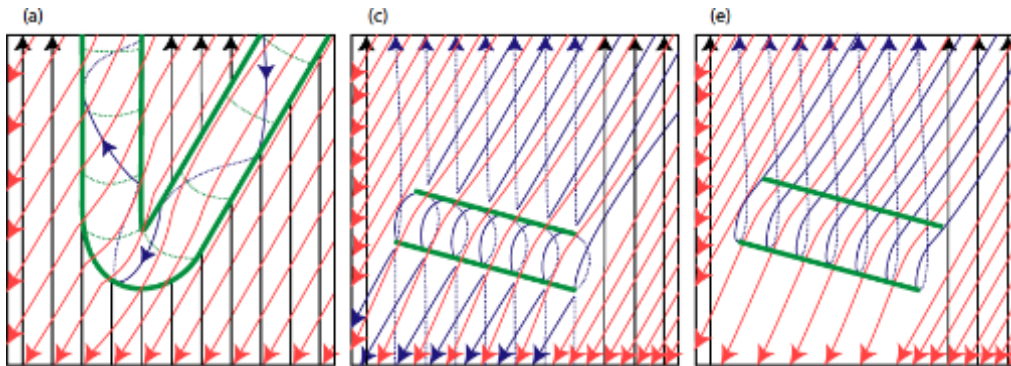
Claudepierre et al.
[2008; 2010]

Patchy Local

Reconnection
Extended Pair

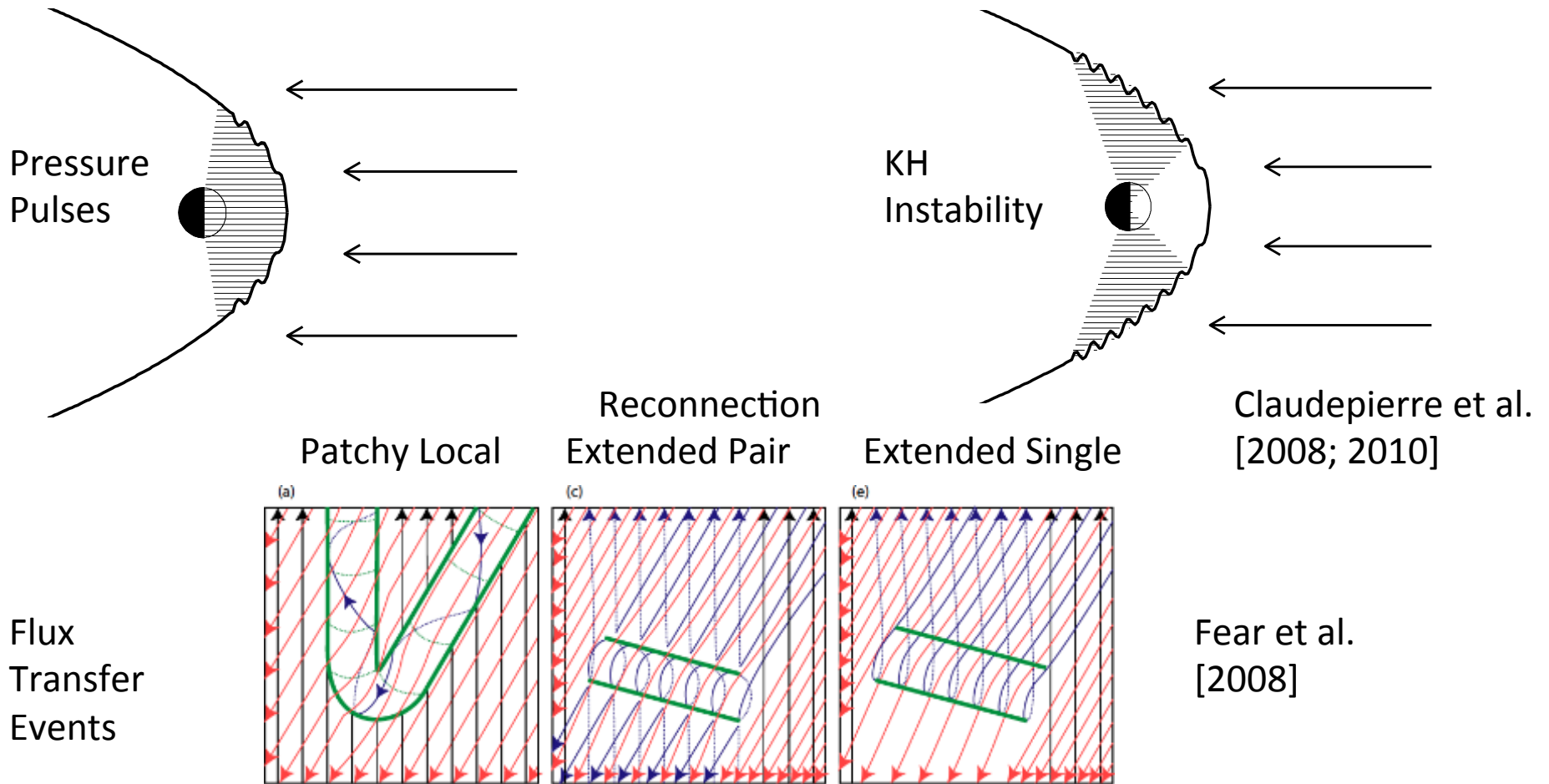
Extended Single

Flux
Transfer
Events



Fear et al.
[2008]

Why it Matters

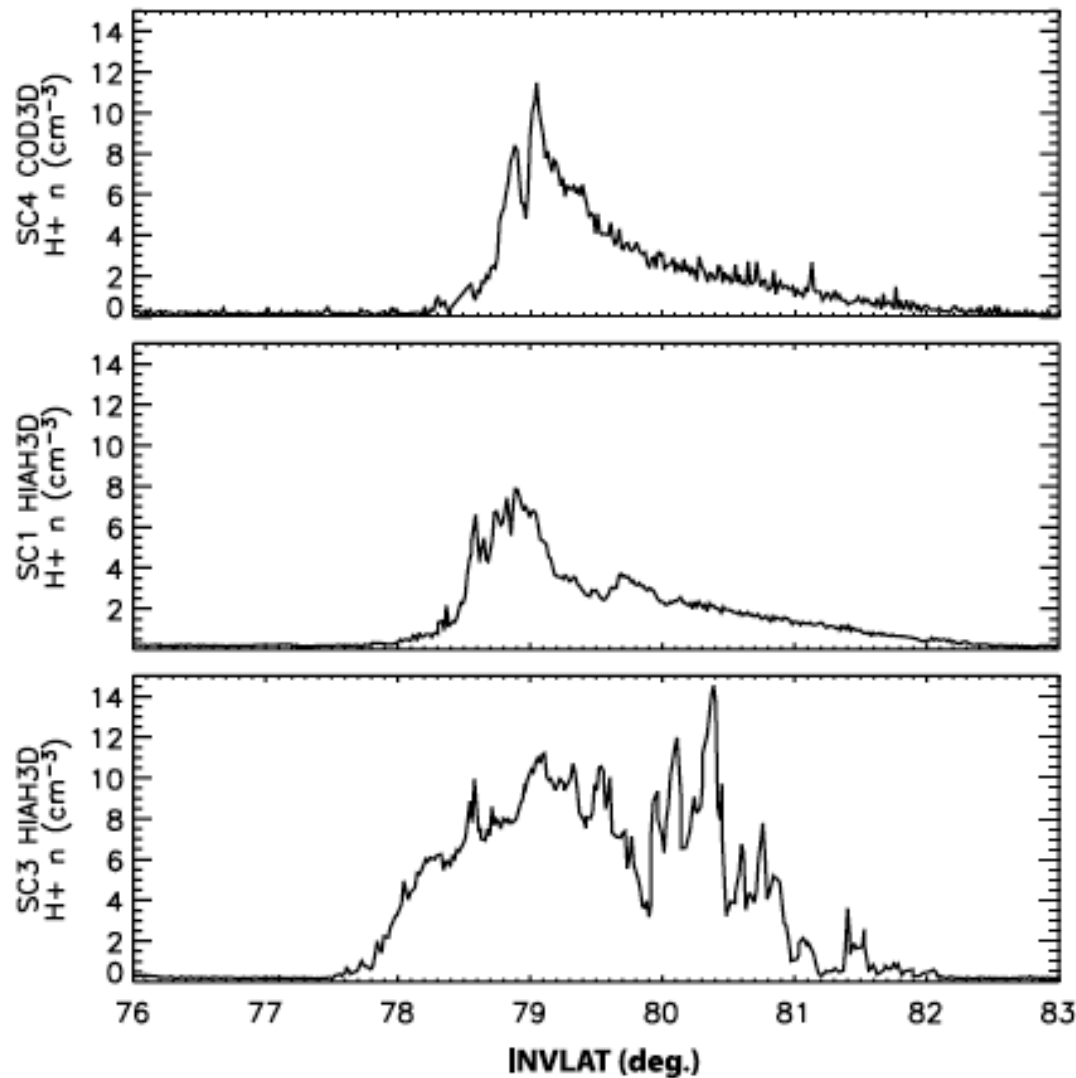


Significant: May dominate the solar wind-magnetosphere interaction
30% of the interaction [Lockwood et al., 1990]
100% of the interaction [Lockwood et al., 1995]

Whatever the Cause, There are IT Connections

- 1. Precipitating particles → heating, conductivity, cosmic noise absorption, aurora
- 2. Field-aligned currents → magnetometer perturbations
- 3. Electric fields → convection
- 4. VLF/ELF/EMIC wave entry path

The Mid-Altitude Cusp Connection



Plenty of evidence for Structures and/or Time-dependence:

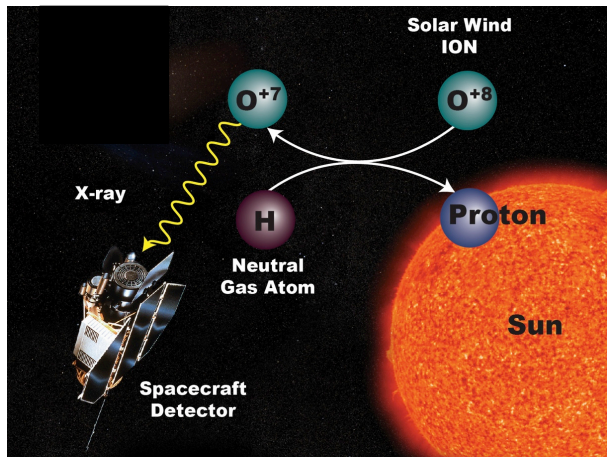
Density Profiles for Three Nearly Simultaneous Cluster Passes through the Cusp

Wanted

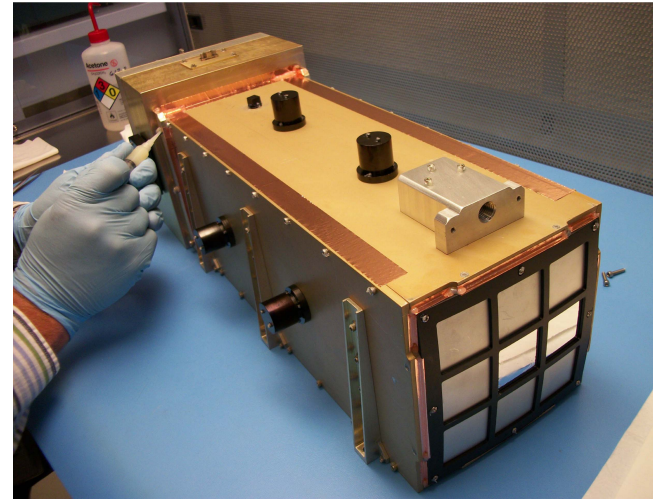
(to determine size, recurrence rates)

- 1. Global Images of the Magnetopause and Cusp
- 2. Global Images of the Dayside Auroral Oval
- 3. Extensive Arrays of Ground Observatories

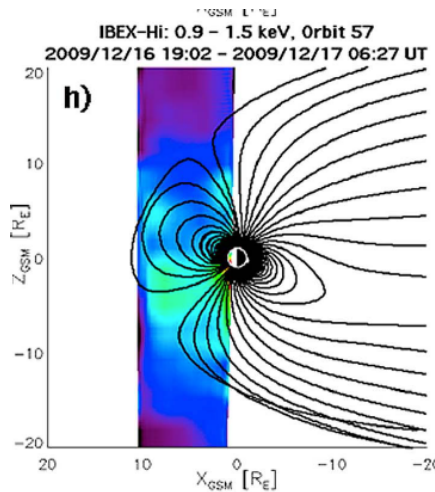
Global Imaging: Fact or Fiction?



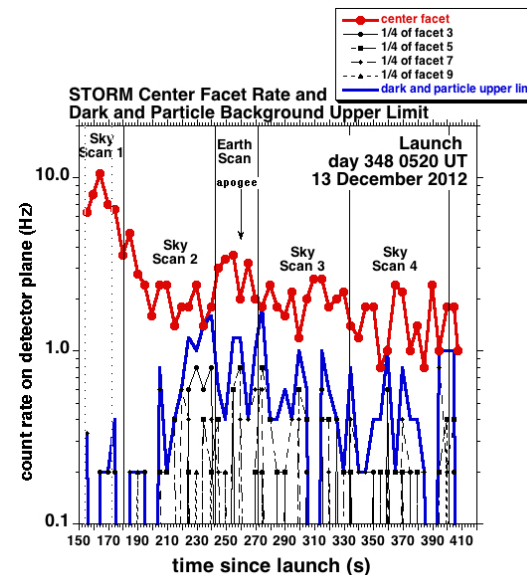
Charge Exchange Generates Neutral AND Soft x-rays



Prototype Soft X-Ray Imager flew on DXL rocket December 12, 2012



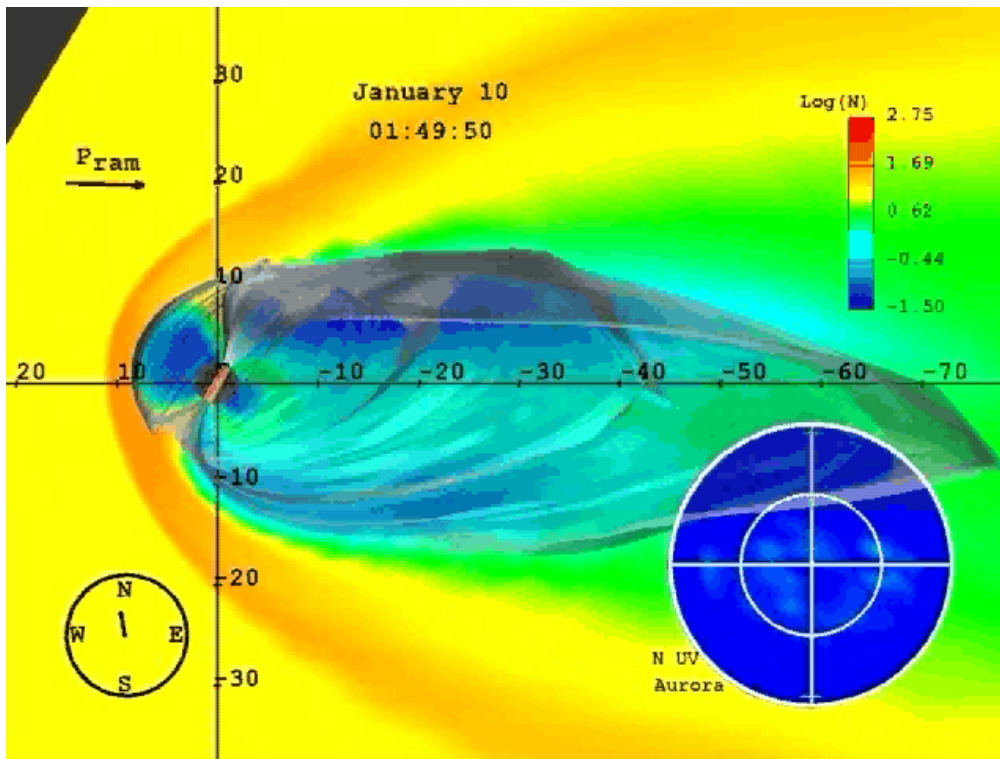
IBEX ENA Images of the Cusp
 Petrinec et al. [2011]



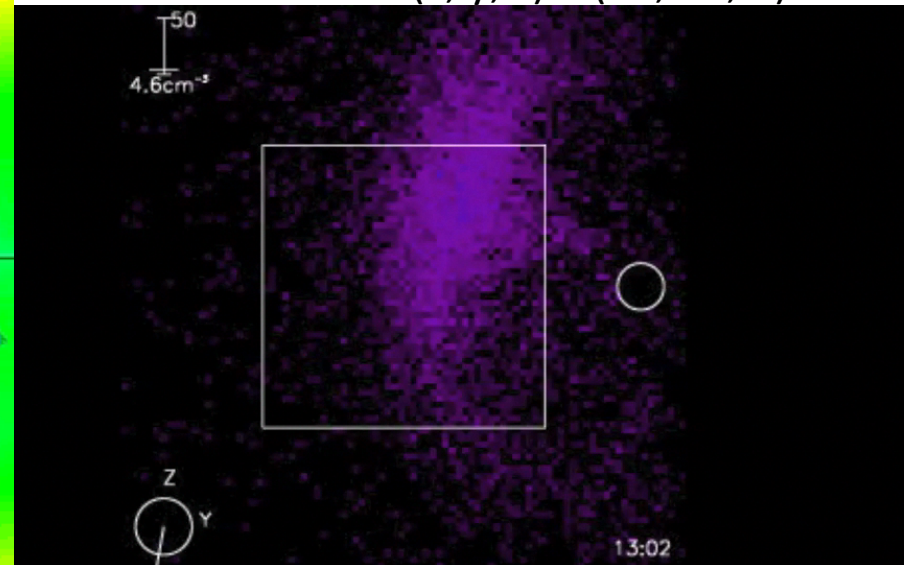
Light curve looking nearly along axis on spinning rocket (towards dawn terminator)

Soft X-Ray Simulation

Global MHD Simulation (C. Goodrich)

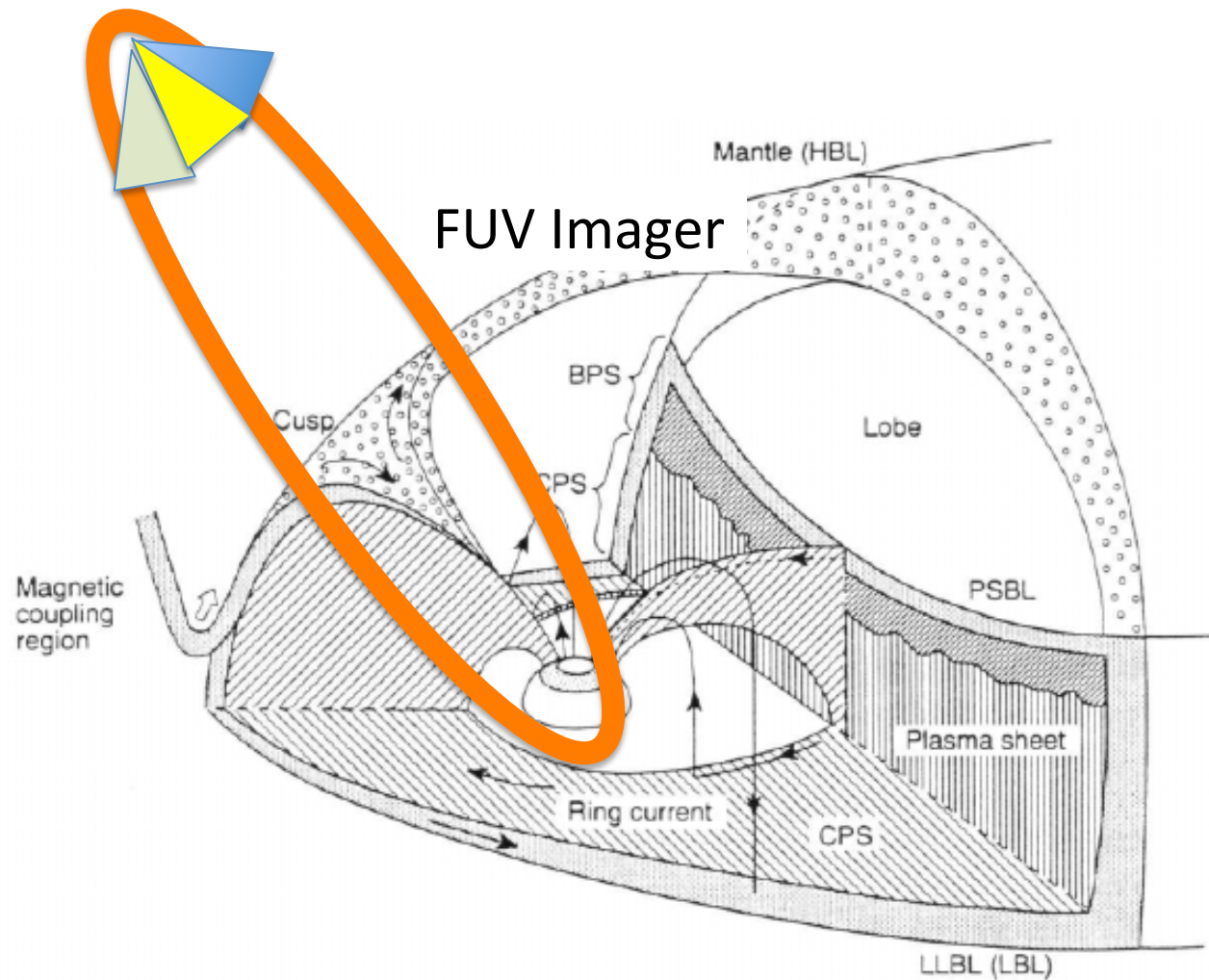
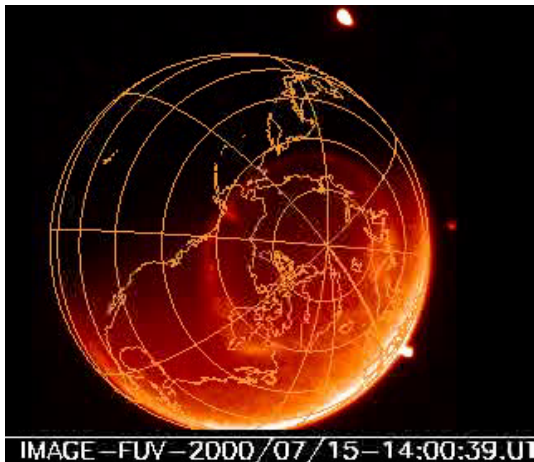


Soft X-Ray simulation
View from $(x, y, z) = (30, 10, 0)$ RE

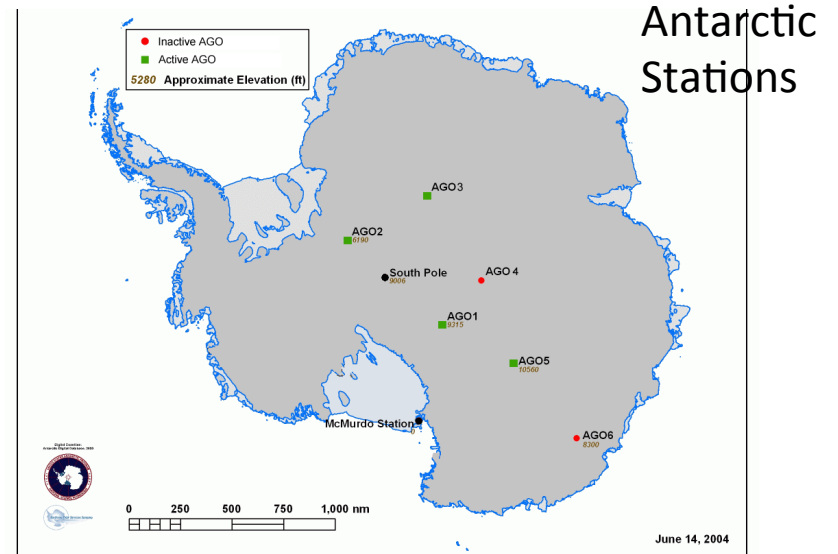
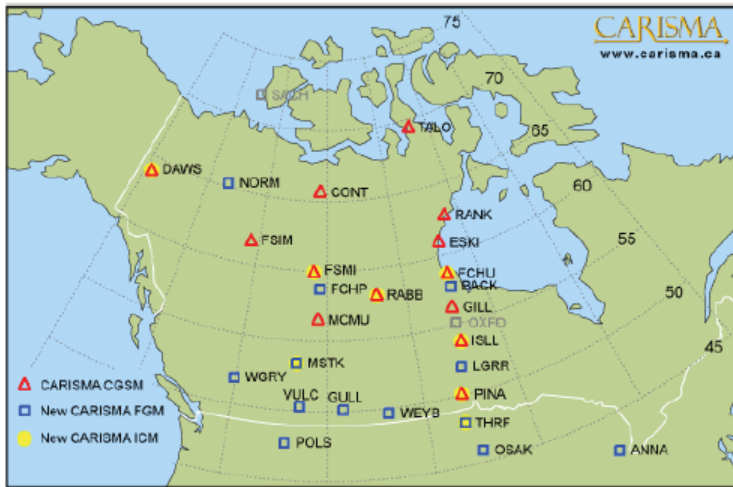


Magnetospheric Imaging from a High-Latitude High Inclination Orbit

Soft X-ray, ENA,
And FUV Imagers

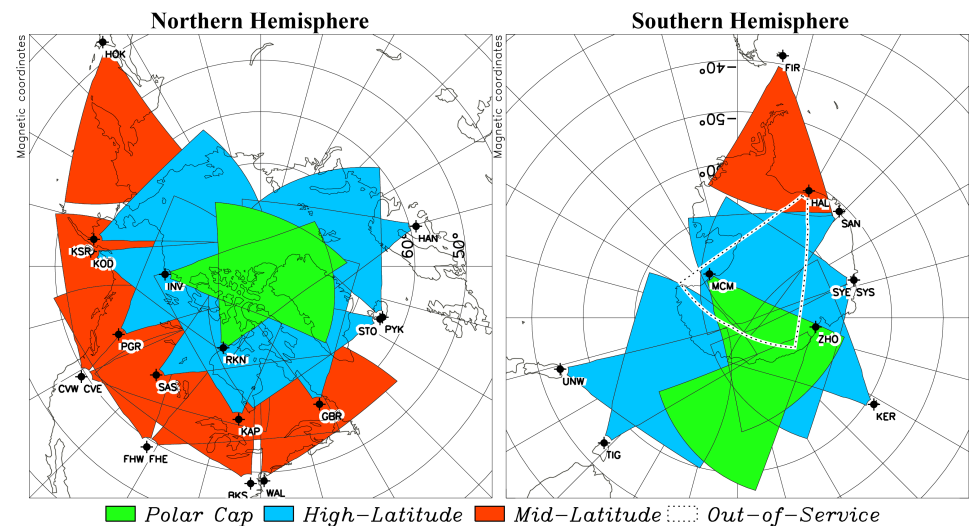


Relevant Ground-Based Observatories are in place



Canadian Ground-Based Arrays

SuperDARN
radar



Prognosis

- 1. Global images of the magnetosphere, cusp, and ionosphere
- +
- 2. Extensive Arrays of ground-based observatories
- =
- 3. Tremendous opportunities to determine the dimensions, recurrence rates, and therefore importance of the structures generated by the solar wind-magnetosphere interaction