TBD: Contributions of MIT Coupling to Important Features…

What are the critical boundaries?

- Open-closed field line boundary
- Equatorward boundaries of particle precipitation
- Plasmapause
- More?

How do we map boundaries globally and instantaneously?

How do compare boundaries determined at different levels of the M-I system?

How do we validate boundary determinations across various techniques?

An AMPERE-derived proxy for the Open/Closed Field Line Boundary (OCB) in the Ionosphere

Lasse Clausen, Mike Ruohoniemi, Jo Baker, and coauthors

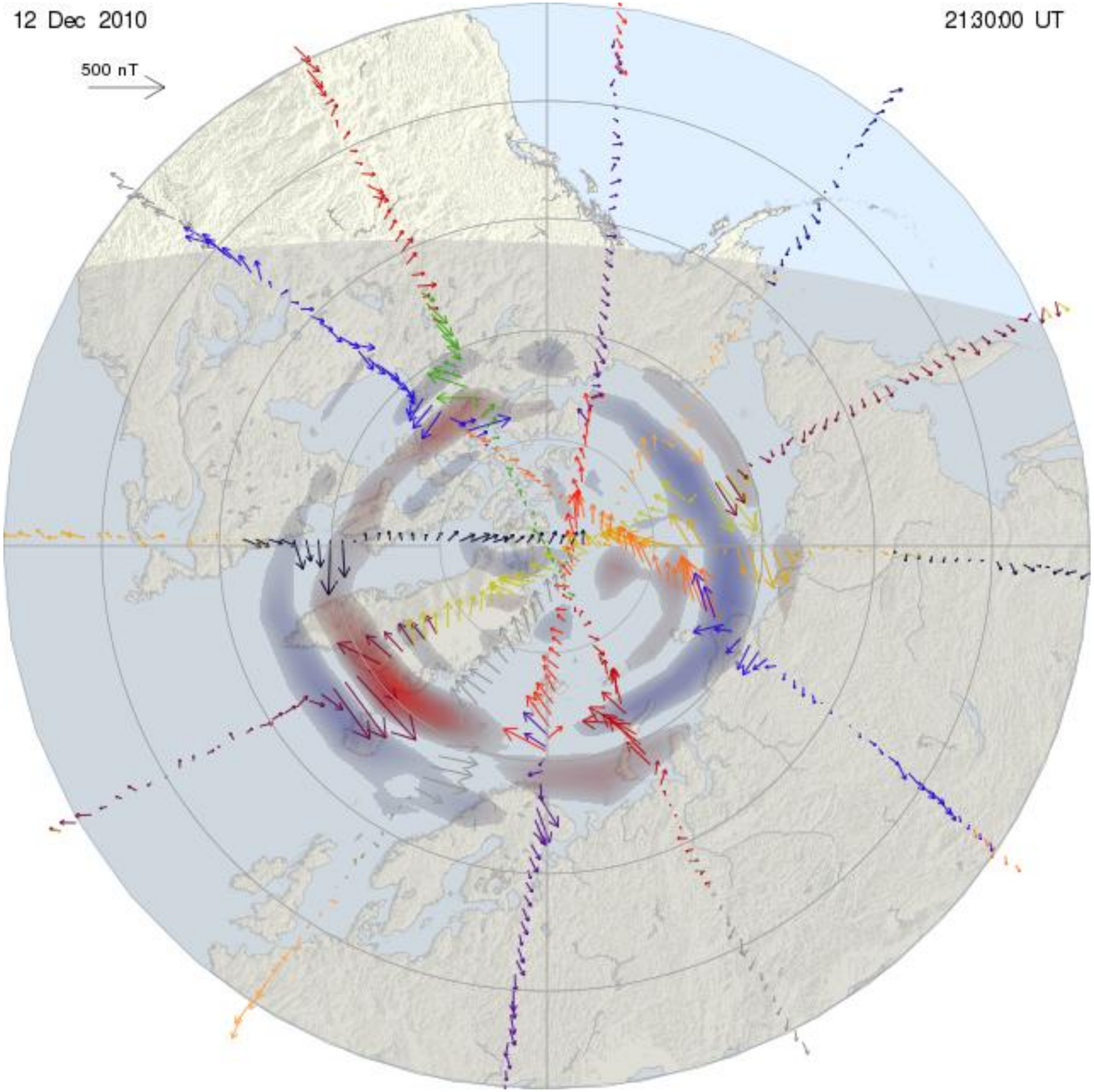
Virginia Tech

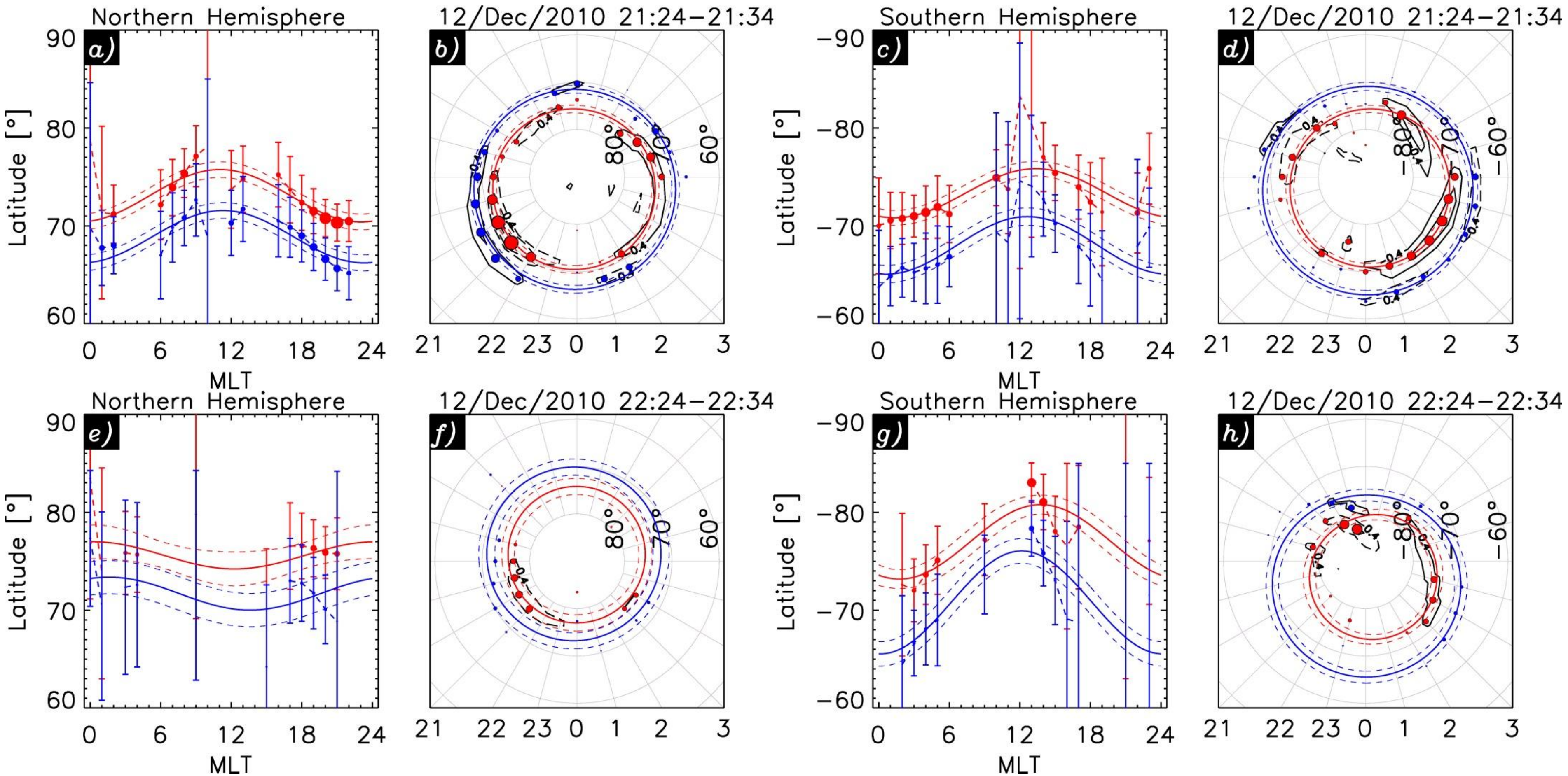
An AMPERE-derived proxy for the OCB

- The OCB marks a critical divide in magnetic field and particle properties

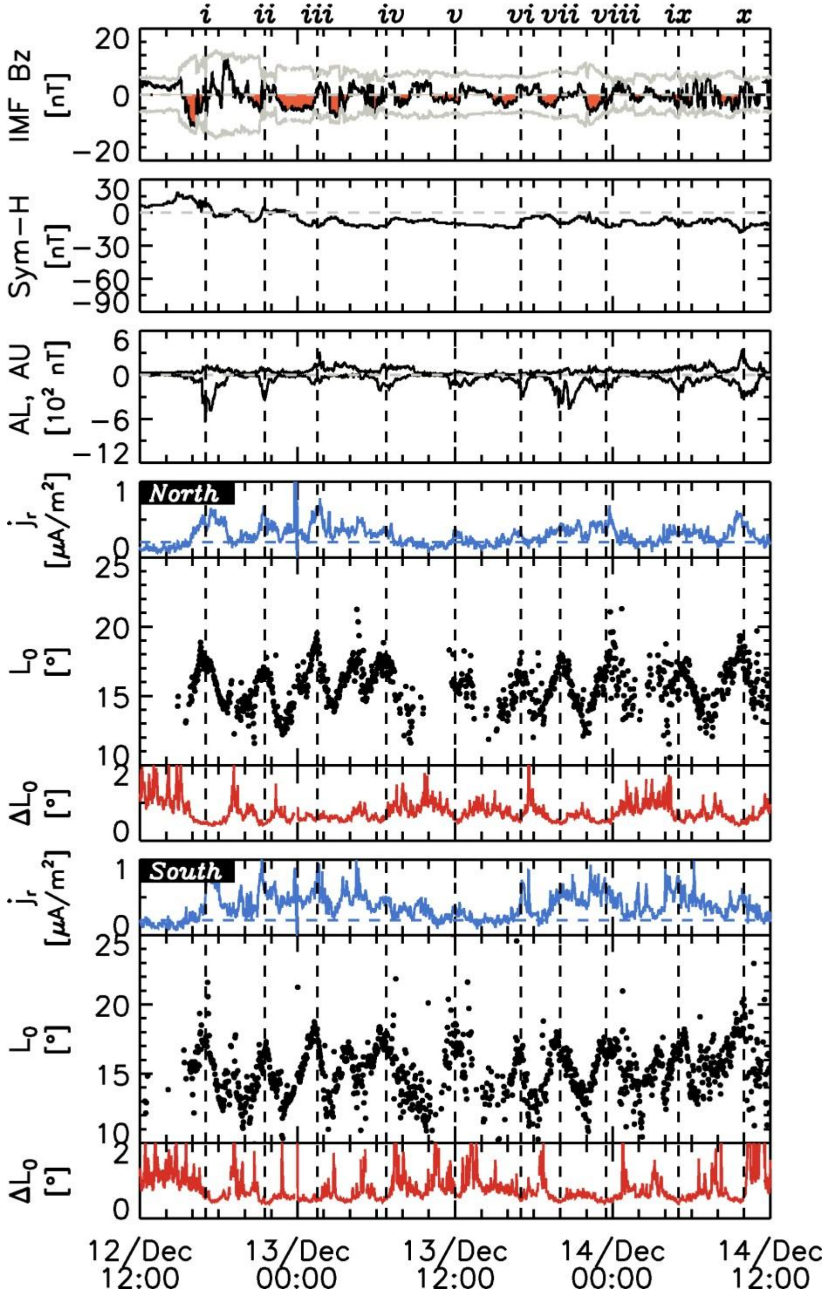
- We currently lack global auroral imaging capability for mapping the OCB

- In a series of recent papers, Clausen et al. [2012, 2013a, 2013b] demonstrated that current densities from AMPERE can be used to globally map the OCB, and to study the substorm cycle


12 Dec 2010
21:30:00 UT
500 nT



First, current densities are analyzed on individual MLT meridians to find the peak R1 and R2 current locations, then (shown) these locations are fit across all MLTs to determine R1 and R2 peak current ovals



IMF Bz

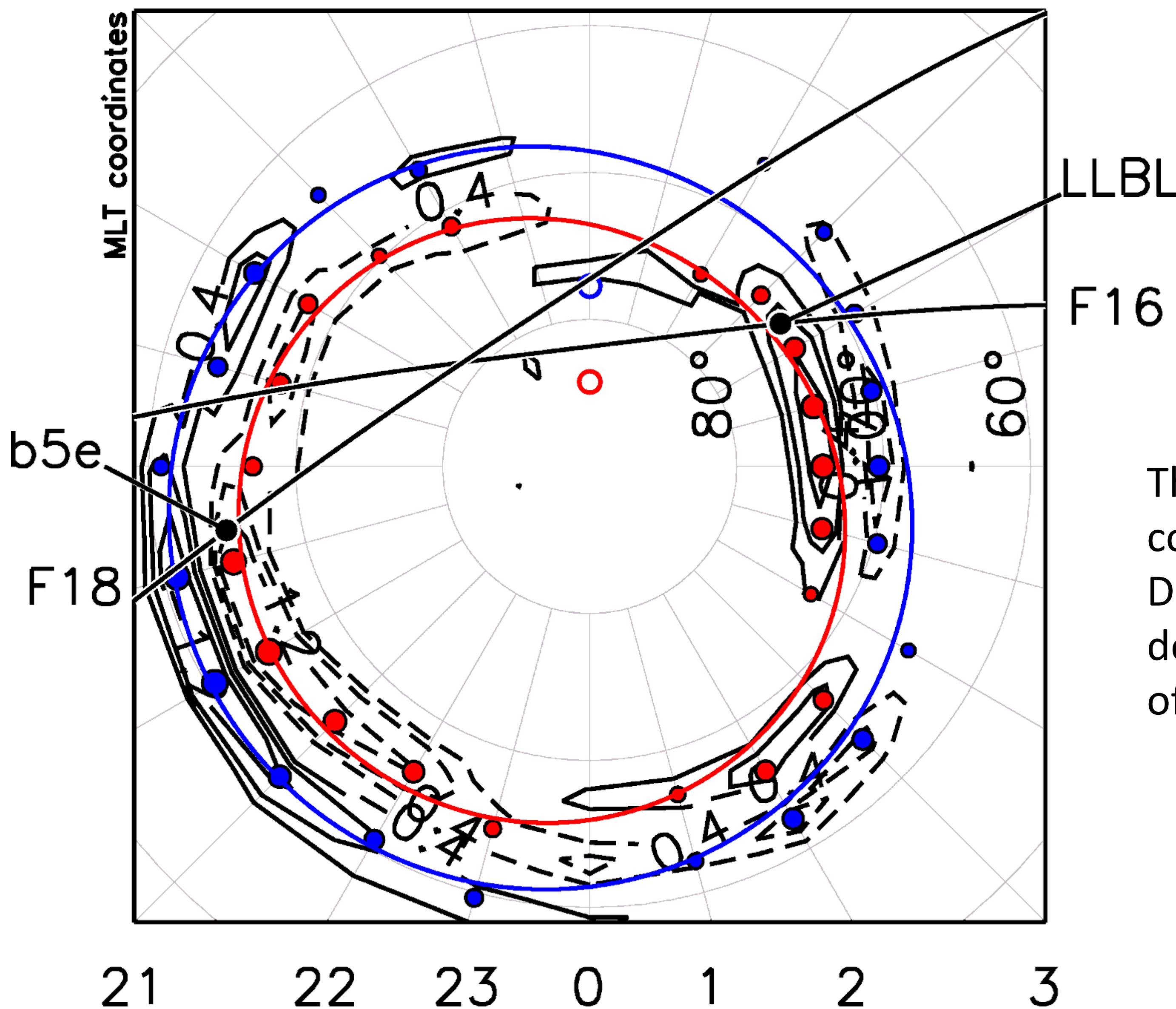
Stackplot of indices and R1 oval parameters over two days

AL, AU

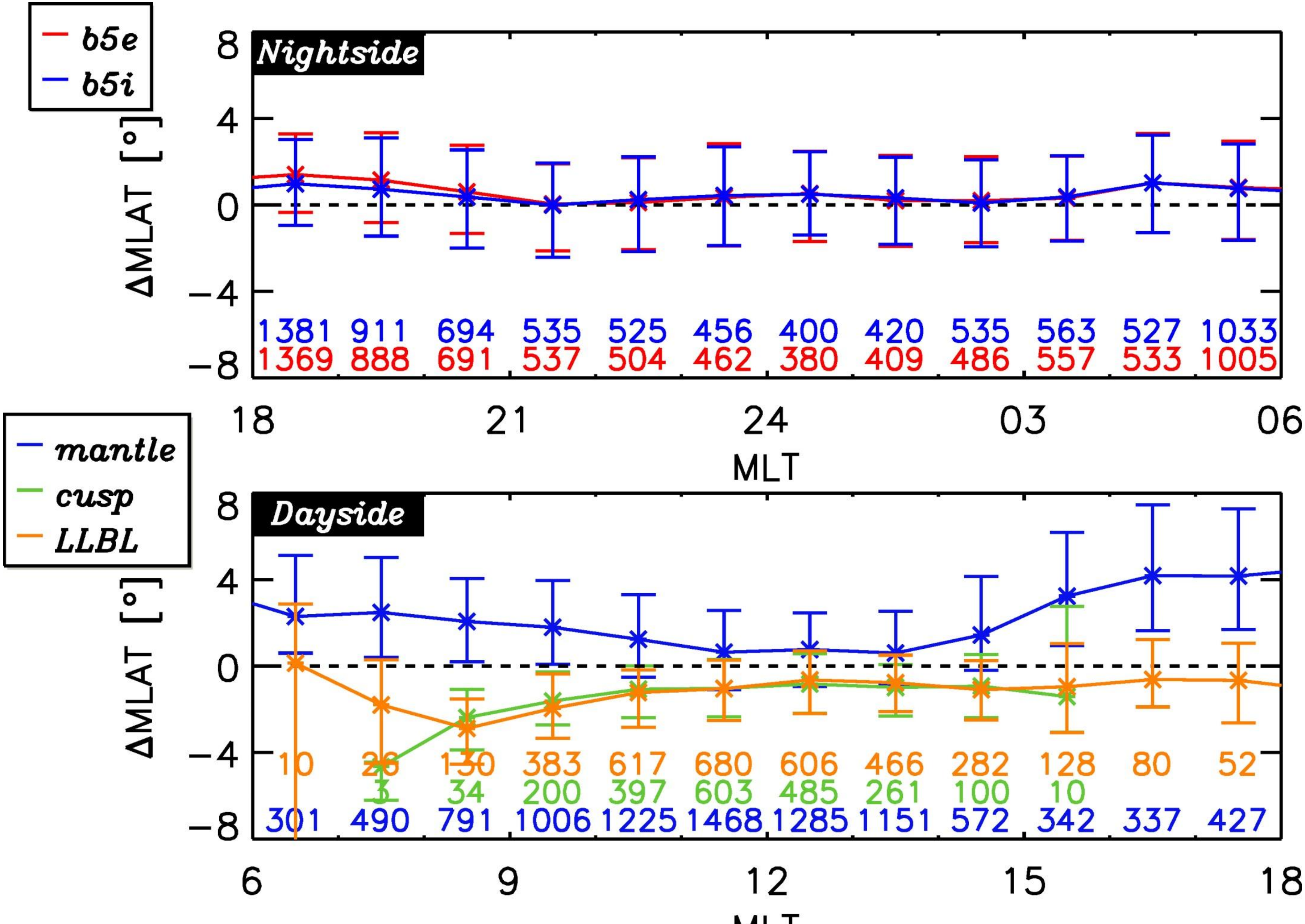
NH: Radius of R1 oval

Vertical guidelines are drawn through peaks in R1 oval size

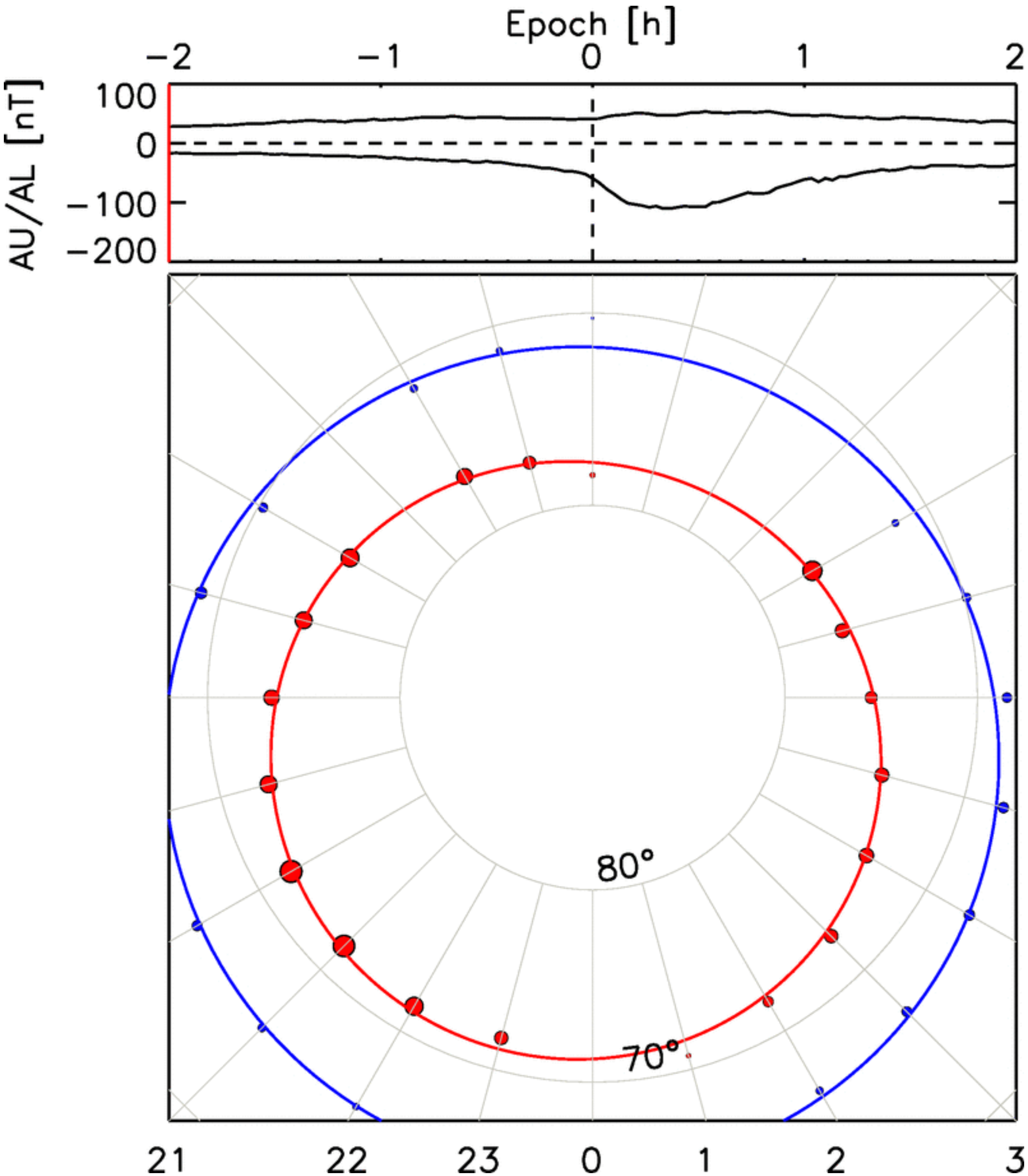
SH: Radius of R1 oval



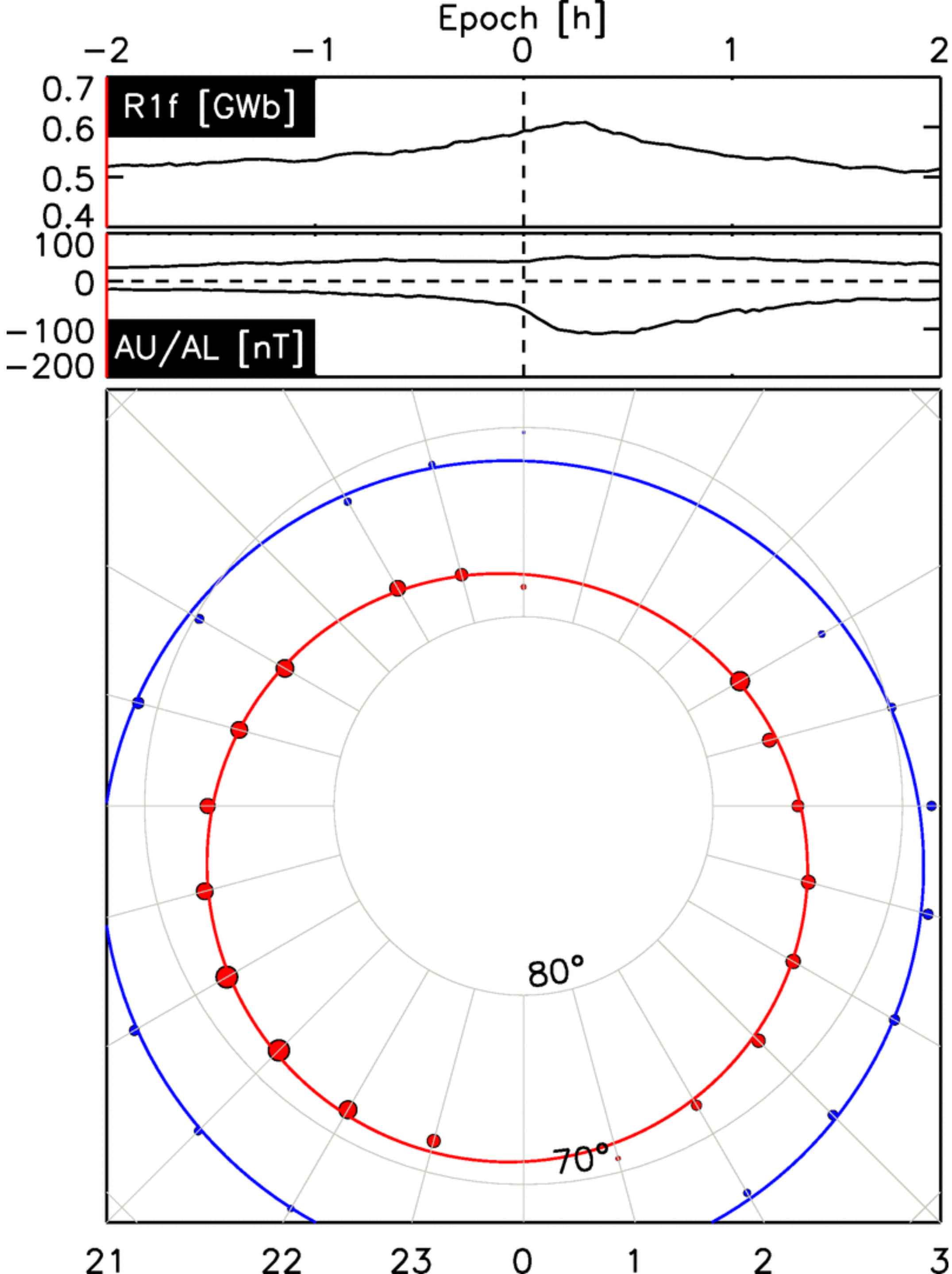
The R1 oval compared to DMSP determinations of the OCB



b5e
b5i
Nightside
ΔMLAT [°]
1381 911 694 535 525 456 400 420 535 563 527 1033
1369 888 691 537 504 462 380 409 486 557 533 1005
18 21 24 03 06
MLT
mantle
cusp
LLBL
Dayside
10 26 130 383 617 680 606 466 282 128 80 52
3 34 200 397 603 485 261 100 10
301 490 791 1006 1225 1468 1285 1151 572 342 337 427
6 9 12 15 18



Average situation of the R1 and R2 ovals at expansion phase onset, derived from superposed epoch analysis using 772 substorm events identified by THEMIS all-sky imagers.



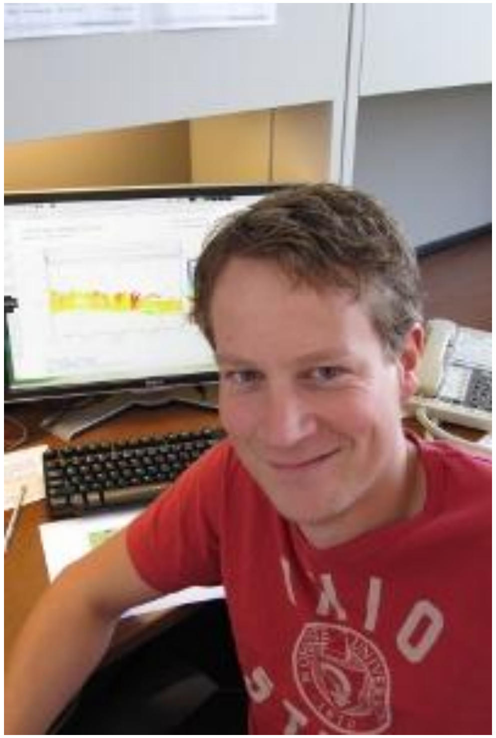
Epoch [h]
−2
−1
0
1
2
R1f [GWb]
0.7
0.6
0.5
0.4
100
0
−100
−200
AU/AL [nT]
80°
70°
21
22
23
0
1
2
3

An AMPERE-derived proxy for the OCB

Summary:

- The solution for the R1 oval from AMPERE current densities provides a serviceable proxy for the OCB (~ 1 deg)
- Information is available at 10 min cadence most of the time; calculation of the total amount of open magnetic flux is straightforward
- Valuable for characterizing the state of the coupled M-I system, especially through the substorm cycle
- Available directly from Lasse, and soon from a web site.

An AMPERE-derived proxy for the OCB



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Clausen, L.B.H., J.B.H. Baker, J. M. Ruohoniemi, S.E. Milan, and B. J. Anderson (2012), Dynamics of the region 1 Birkeland current oval derived from AMPERE, *J. Geophys. Res.*, 117, A06233, doi:10.1029/2012JA017666

Clausen, L.B.H., J.B.H. Baker, J. M. Ruohoniemi, S.E. Milan, J.C. Coxon, S. Wing, S. Ohtani, and B. J. Anderson (2013a), Temporal and spatial dynamics of the regions 1 and 2 Birkeland currents during substorms, *J. Geophys. Res.*, 118, 1-10, doi:10.1002/jgra.50288

Clausen, L.B.H., S.E. Milan, J.B.H. Baker, J. M. Ruohoniemi, K.-H. Glassmeier, J.C. Coxon, and B. J. Anderson (2013b), On the influence of open magnetic flux on substorm intensity: Ground- and space-based observations, *J. Geophys. Res.*, 118, 1-12, doi:10.1002/jgra.50308

Application of POES particle data to characterize subauroral flows seen by mid-latitude SuperDARN

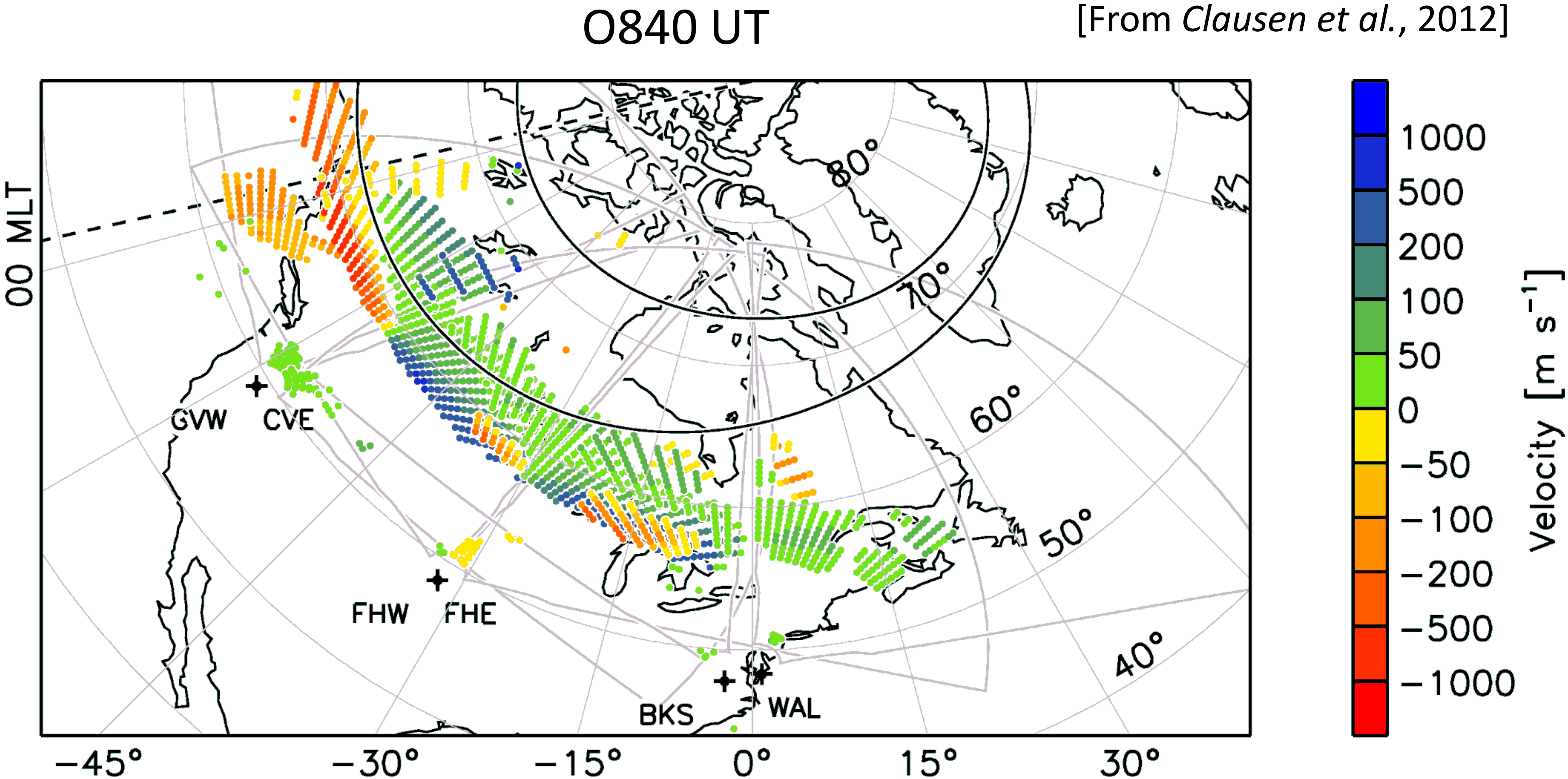
Mike Ruohoniemi, Jo Baker, Bharat Kunduri, and other VT SuperDARN students

Virginia Tech

Credit: Bill Denig, Janet Green and NOAA NGDC

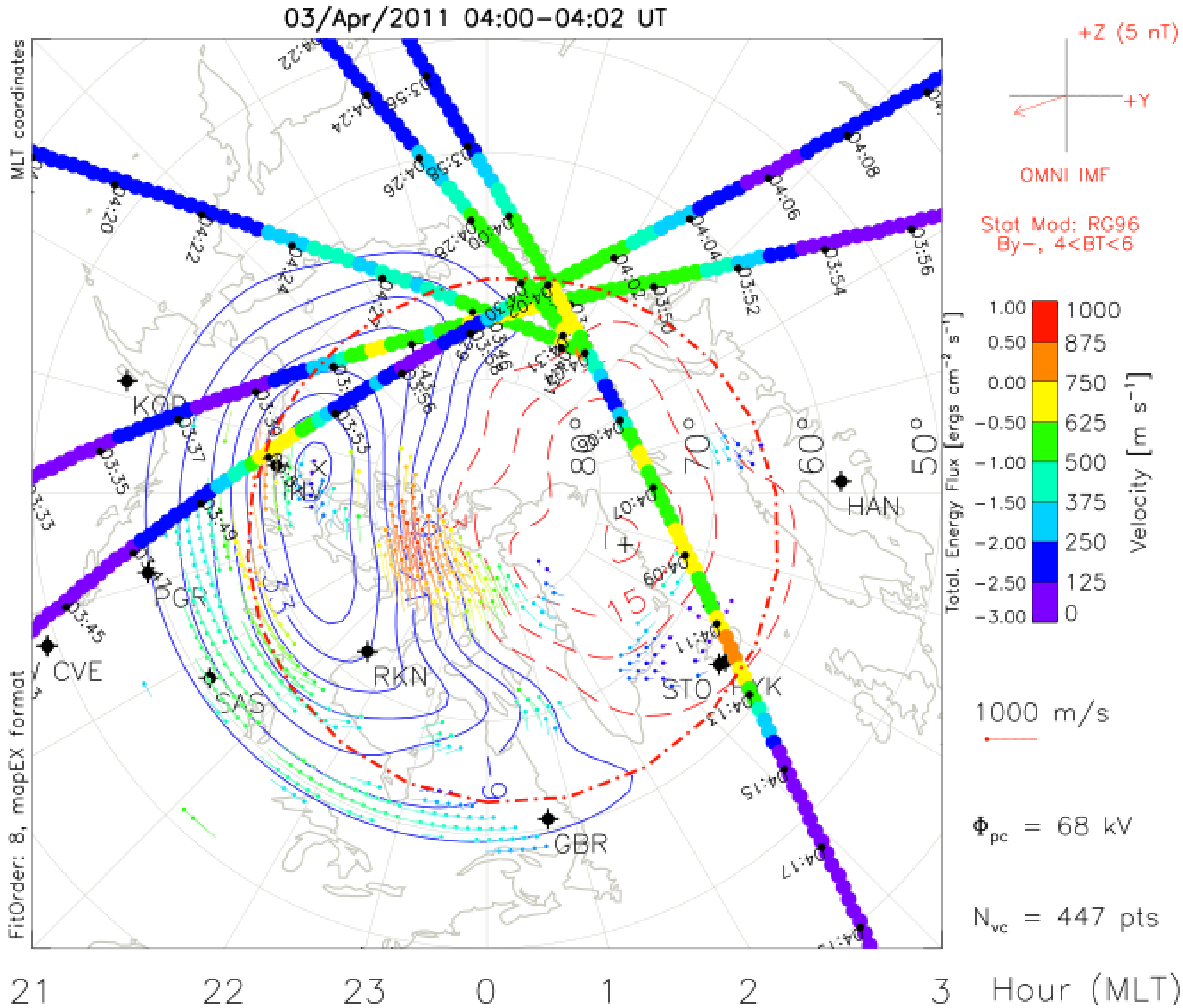
Large-Scale Map of SAPS Observations – April 9, 2011

[From *Clausen et al.*, 2012]



CVW/CVE – Christmas Valley E/W FHW/FHE – Fort Hays BKS/WAL – Blackstone/Wallops

Fitting POES data for an Equatorward Auroral Boundary

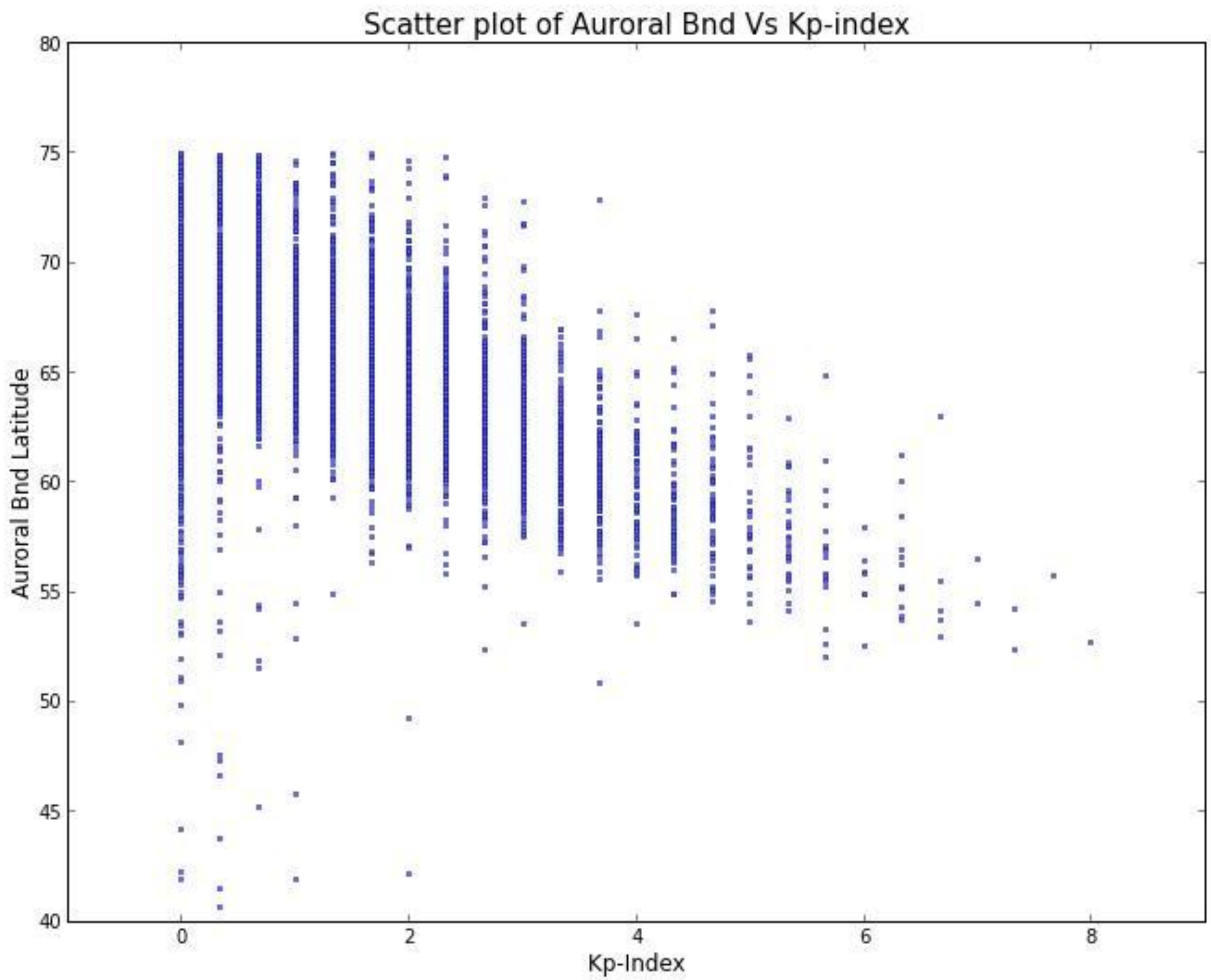


April 3, 2011
SAPS Event

Red dot-dash: Fitted equatorward auroral boundary

Background: Convection contours solved by fitting SuperDARN velocity data

Variation of POES Midnight Auroral Boundary with Kp



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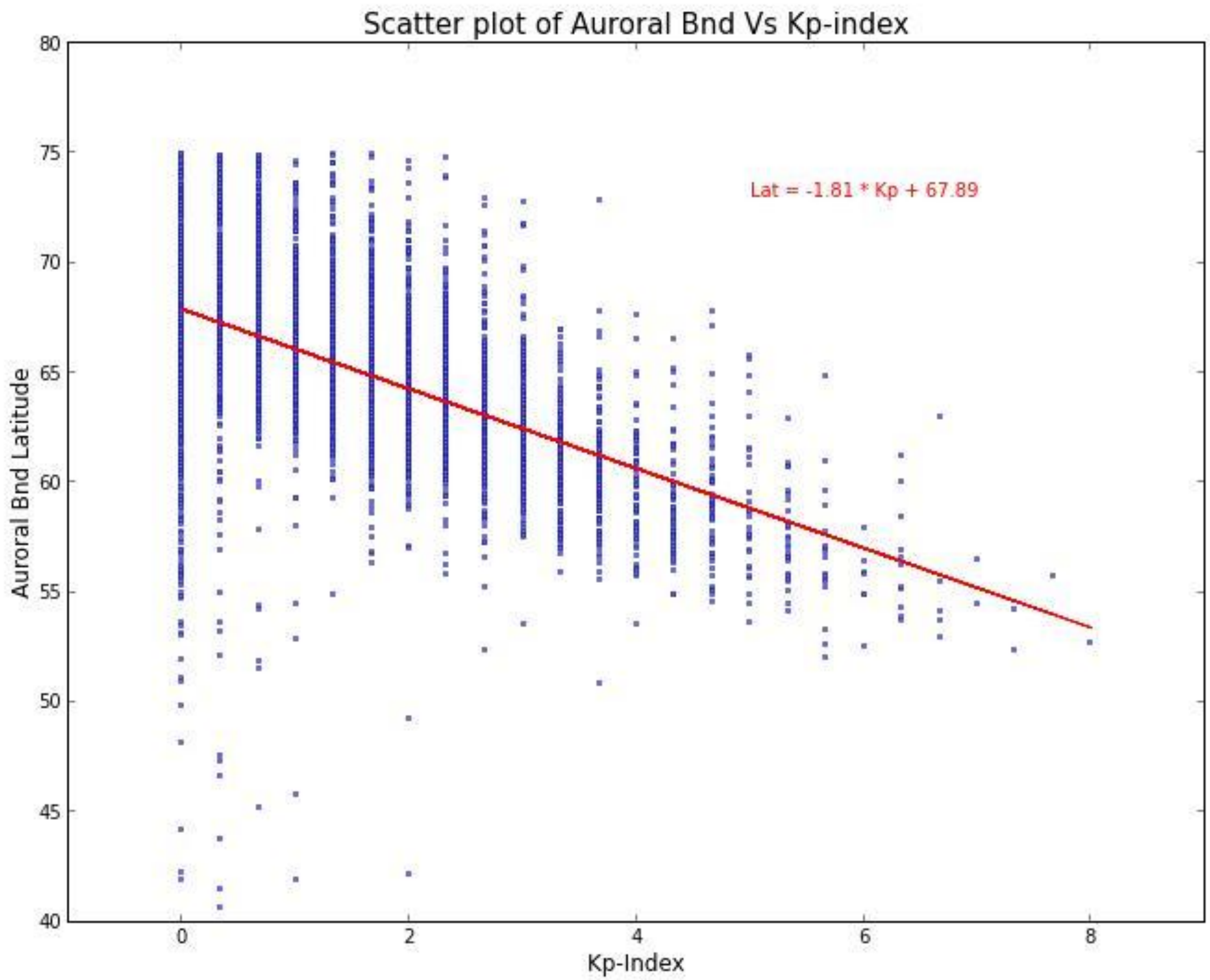
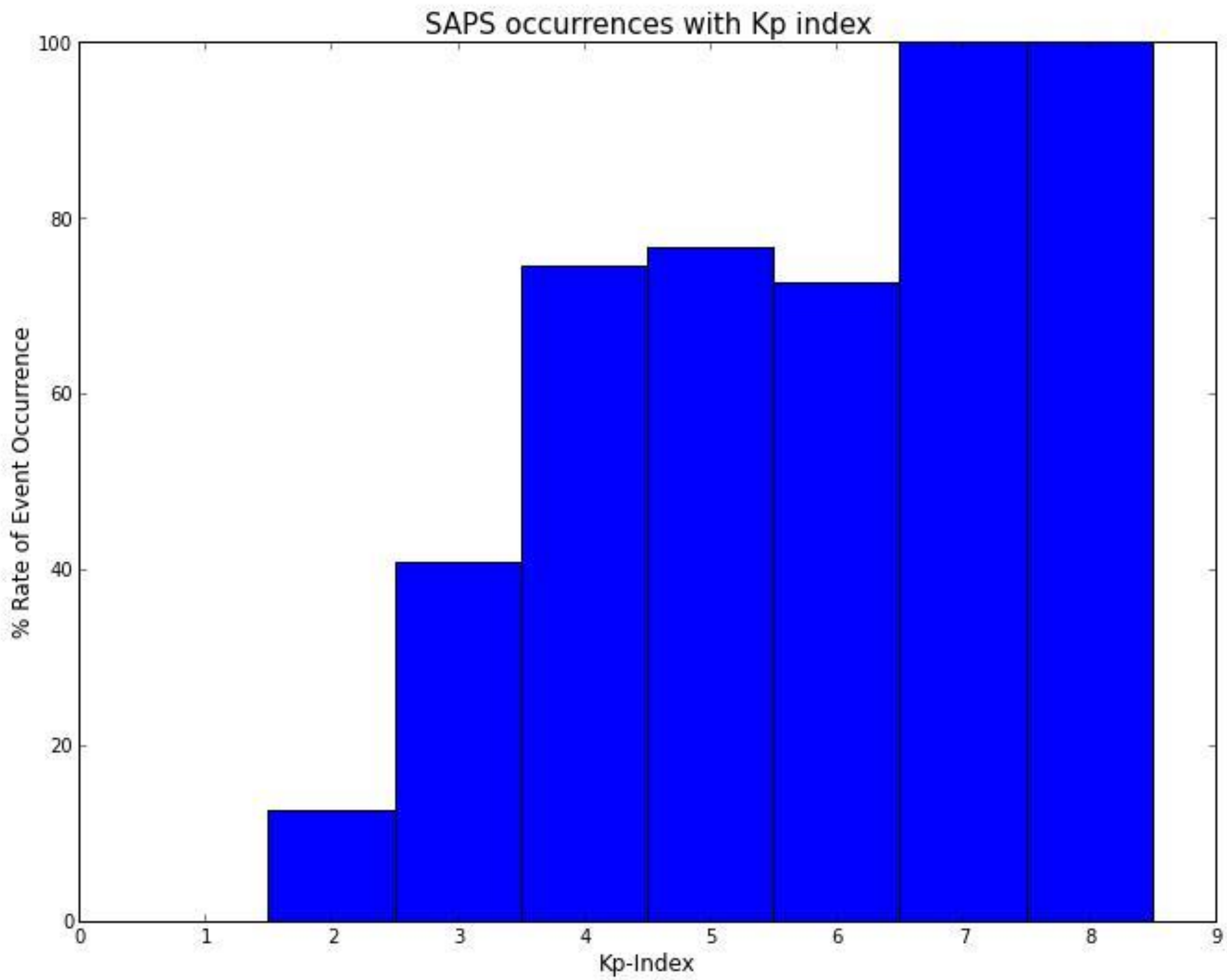


SuperDARN and SAPS

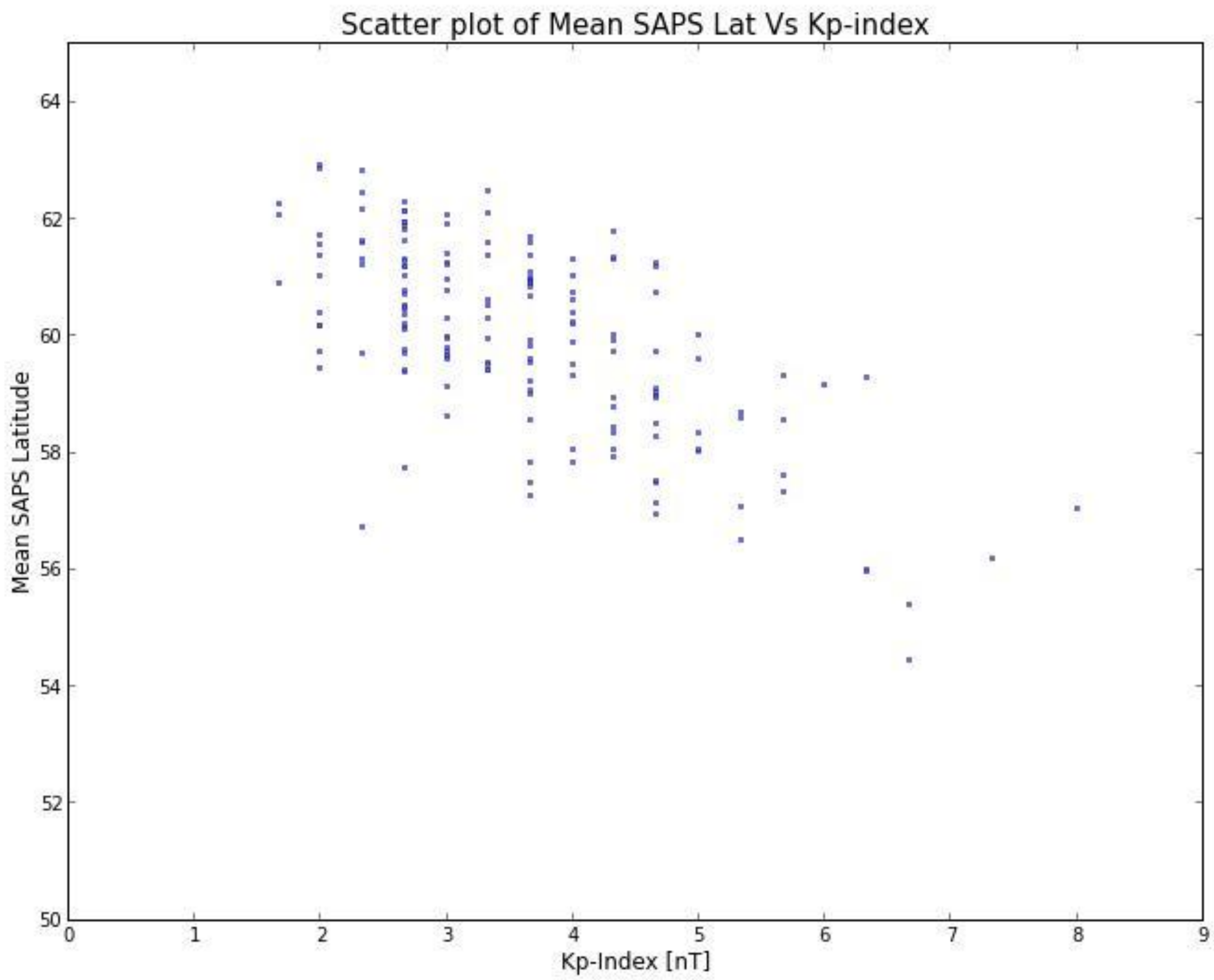
Analysis of SAPS Occurrence, January 2011 – October 2012

- ~ 160 event days identified
- Relations to Dst, Kp, and AE examined statistically
- Dst, Kp, and AE are characterized by their maximum value within the 0-12 UT interval

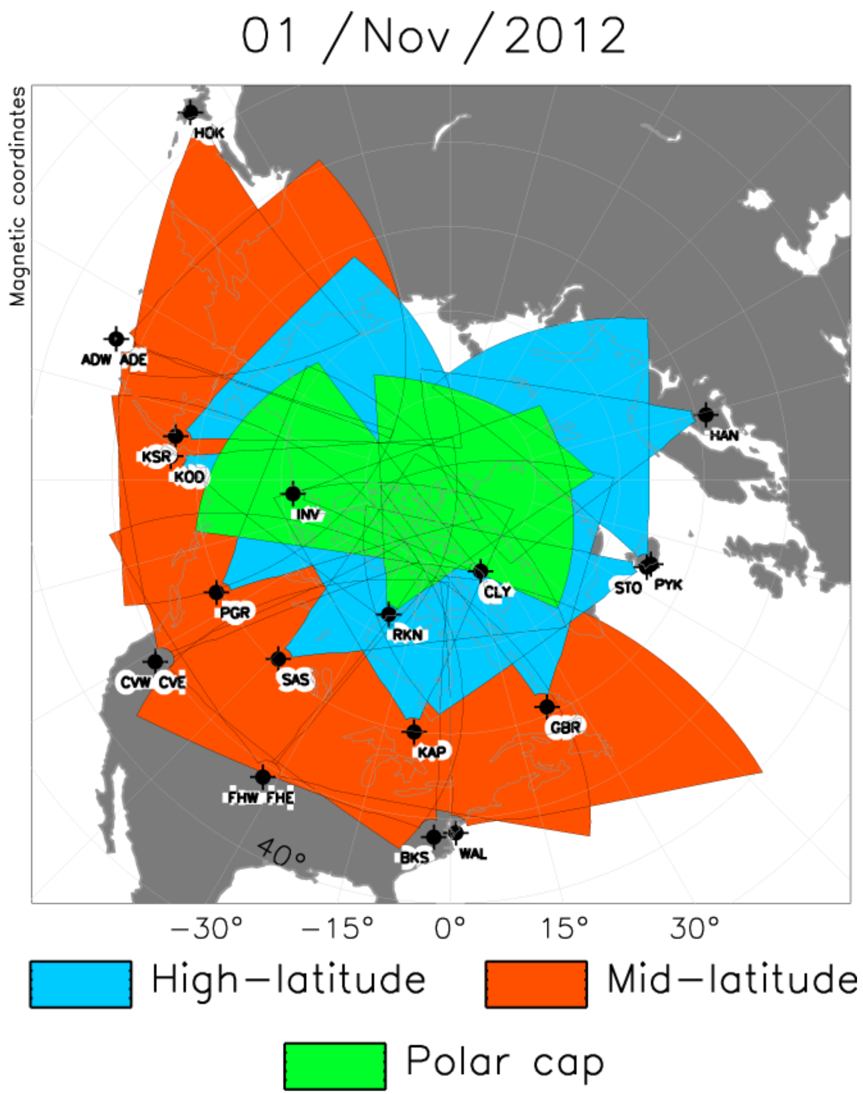
SAPS Occurrence Rate Versus Maximum Kp



Variation of Mean SAPS Latitude with Maximum Kp



Expansion of SuperDARN to Mid-Latitudes



Mid-latitude SuperDARN coverage now extends continuously across 12 hours of MLT

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- Open-closed field line boundary
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