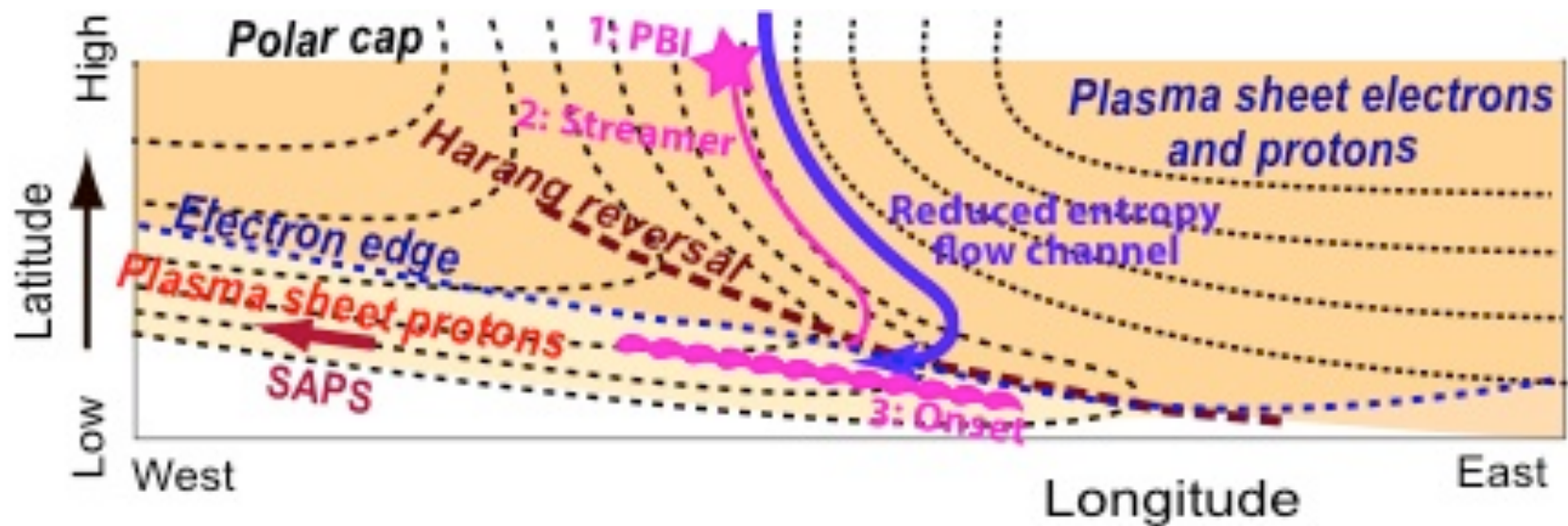
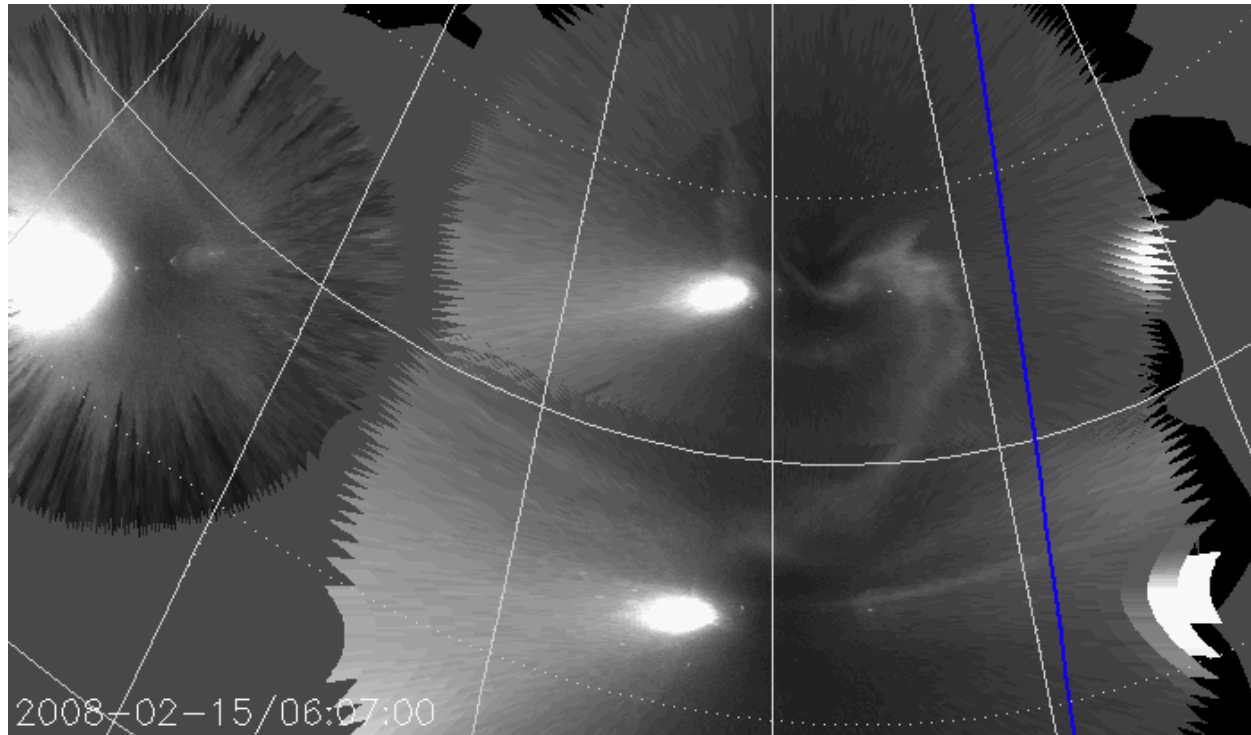


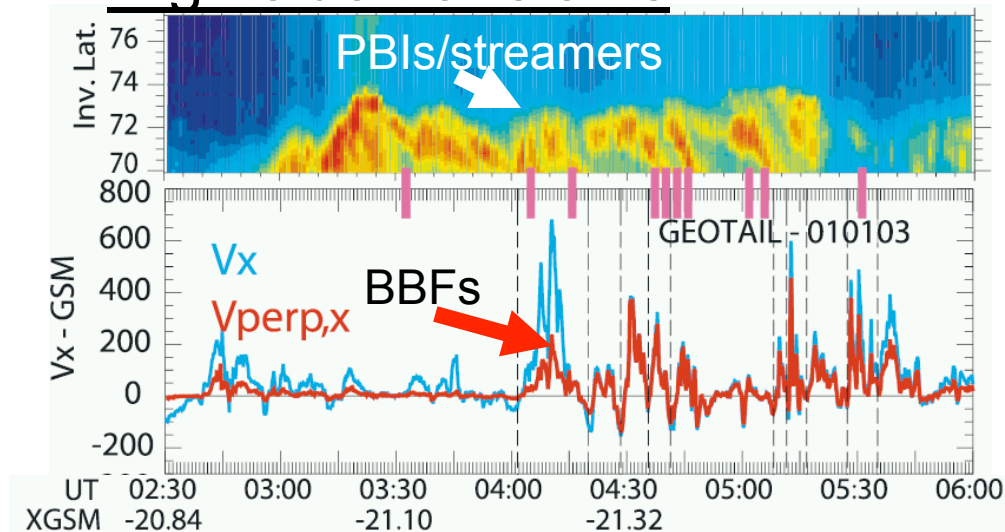
The day-night connection: Driving via meso-scale flow channels?

L. Lyons, Y. Nishimura, Y. Zou, B. Wang, B. Gallardo-Lacourt

For movies like this: see
Nishimura et al. [2010];
doi:
10.1029/2009JA015166



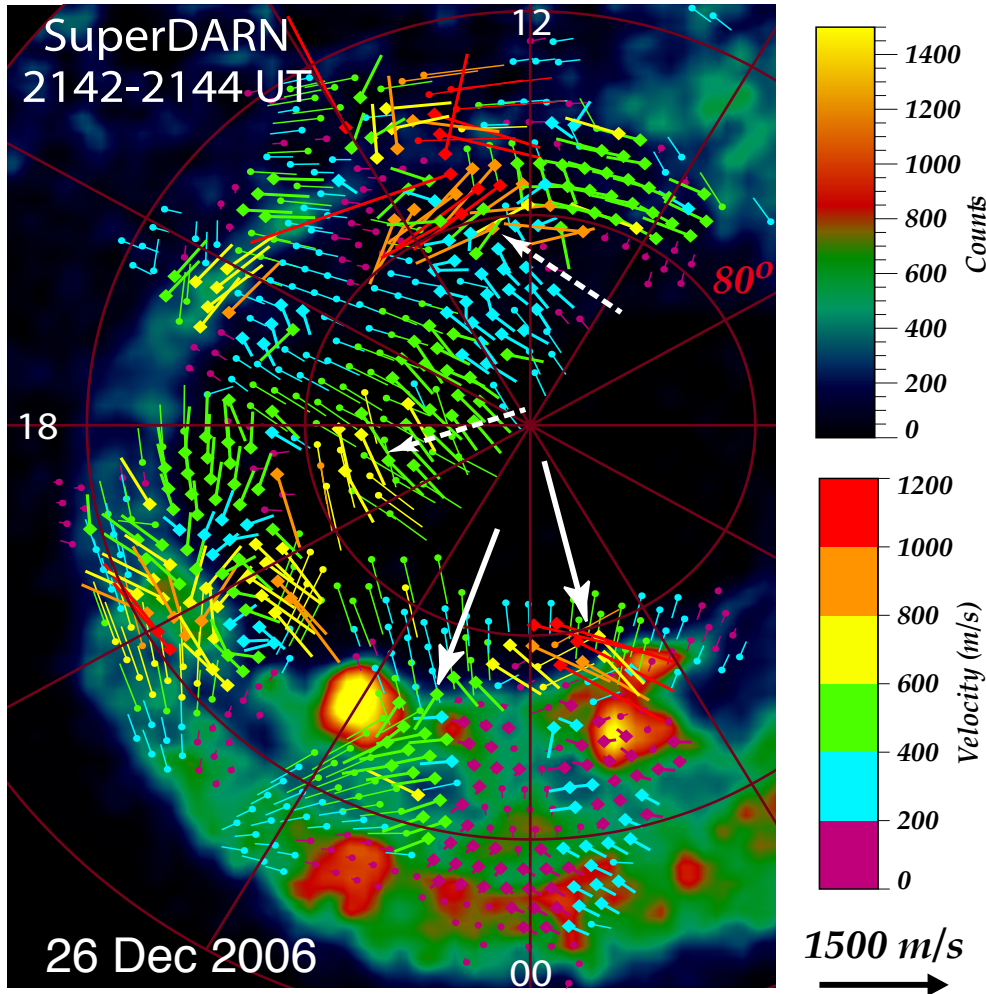
Nightside transients



PBI: poleward boundary intensification
[Lyons et al., 1999; Sergeev et al., 1999;
Zesta et al., 2006]

- The plasma sheet and auroral oval are full of transient, localized bursts.

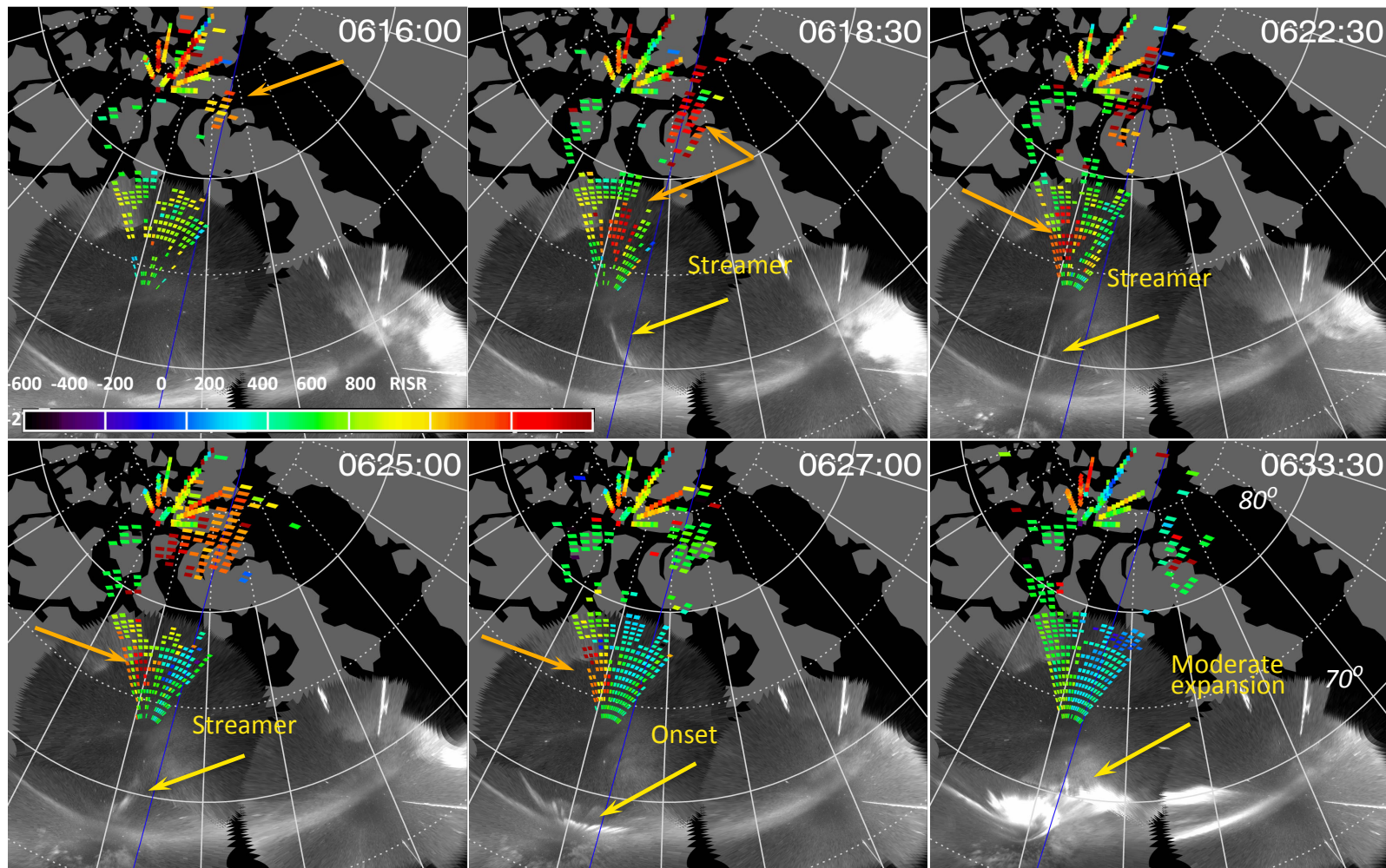
SuperDARN / IMAGE-WIC [Shi et al., 2012]



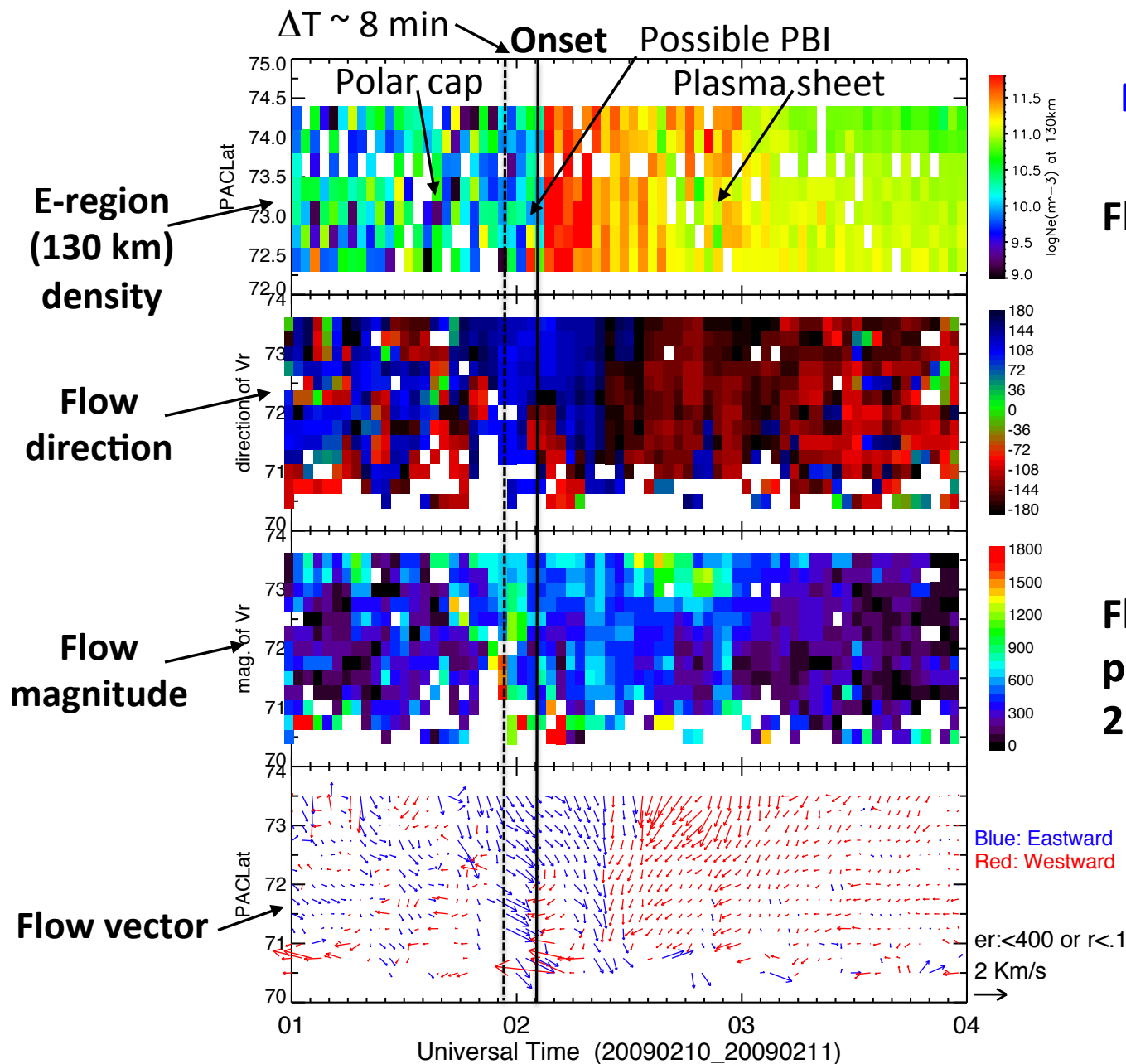
Polar Cap Convection:

- **Generally considered as smooth**
- **2-4 cells, $\Delta\phi_{pc}$**
- **But localized flow enhancements**

2009 Sept 21 0626:30 UT onset



- **Flow channels leading to PBLs and streamers can extend from deep within polar cap towards PC boundary**
 - **Includes PBLs and streamers leading to substorm onset**
[Nishimura et al., 2010]
- **Flows must cross open-closed boundary (driven reconnection)**



Sondrestrom ISR: Poleward Boundary Flow Observations

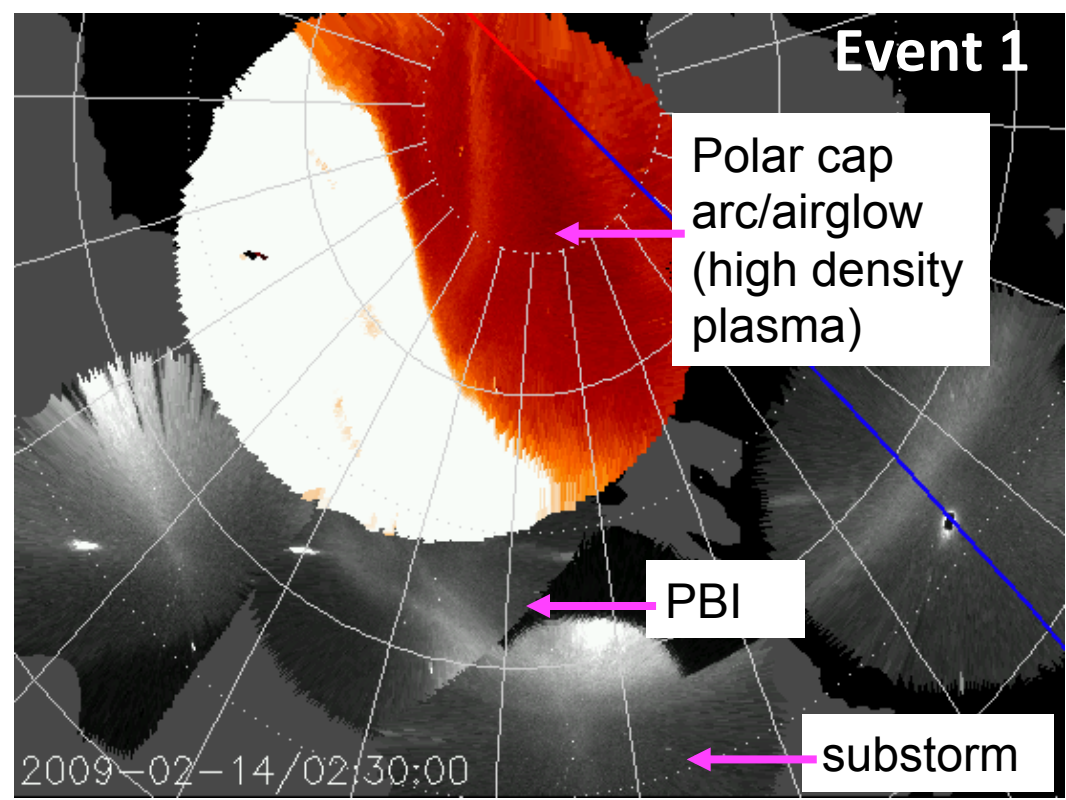
Flow enhancement

- *~8 min before onset*
- *Appears to move from polar cap to p-sheet*
- *Possibly associated with PBI*

Flow enhancement: new
plasma to plasma sheet
22/36 onsets

- *Localized reconnection rate enhancement before onset*
- *Also, seen with THEMIS*
[Angelopoulos et al., 2008;
Lyons et al. 2010]

Precursor of nightside reconnection

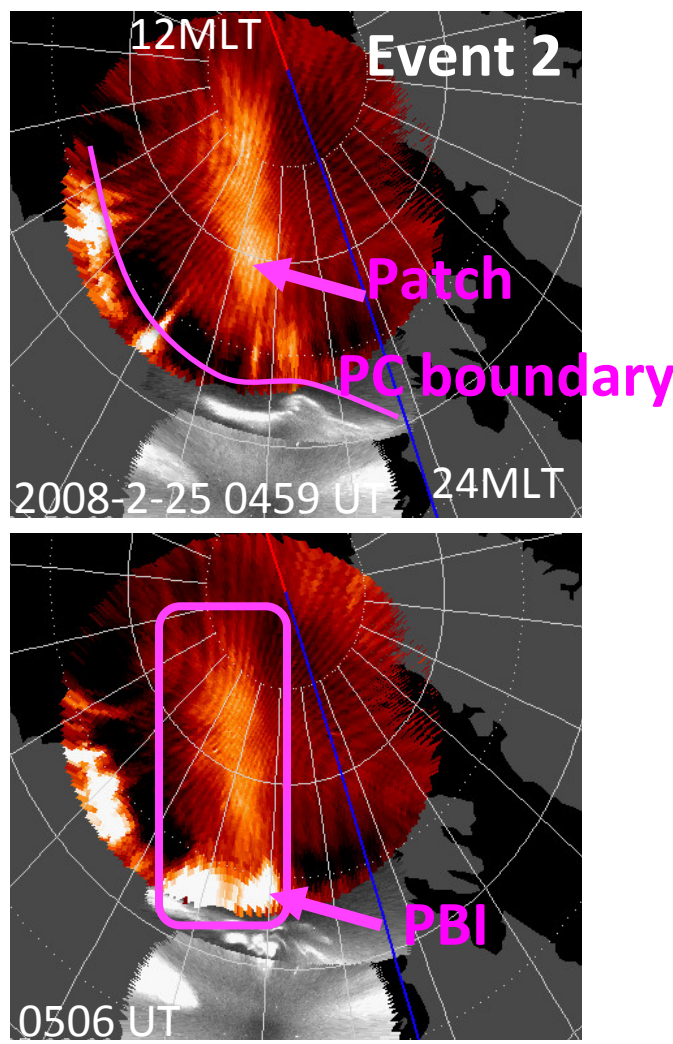


For movie: see Nishimura et al. [2013];
doi[10.1002/jgra.50279](https://doi.org/10.1002/jgra.50279) [Nishimura et al., JGR, 2013]

An isolated polar cap arc/airglow,

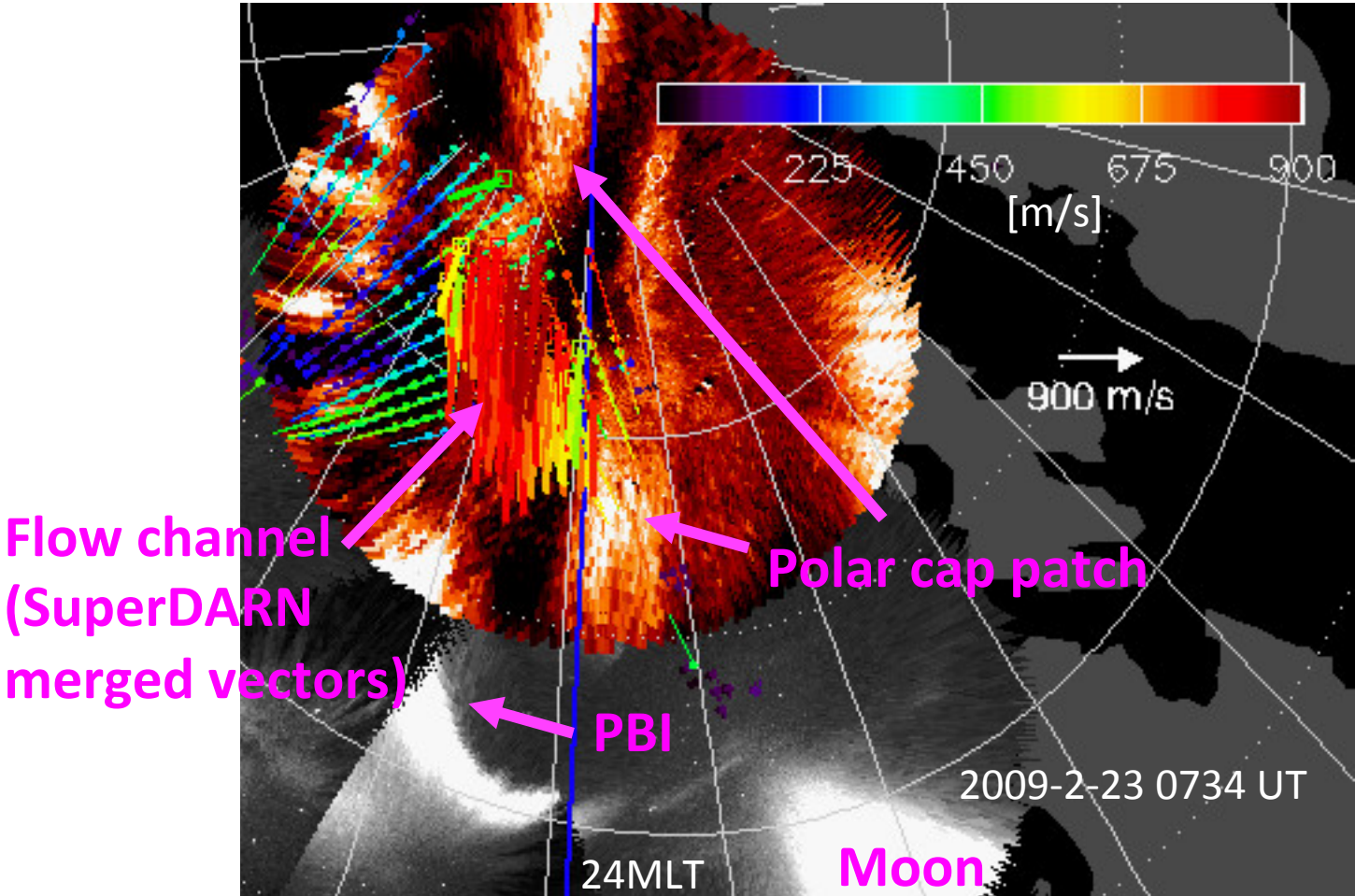
- propagated from the dayside polar region,
- and was followed by a PBI, subsequent streamer, and onset.

Suggesting that the PBI (reconnection) was triggered by a localized polar cap structure (lobe flows)



Are these associated with localized, fast flows?
Are these propagating from the dayside oval?

Radar echo regions are generally limited, but a radar-imager combination can highlight structure and evolution of flow channels.



A fast flow channel colocated with an airglow patch.

Flow channel and patch directed toward a PBI.

Polar cap convection can be more structured than two cell.

Polar cap flow channels feed energy into nightside auroral intensifications.

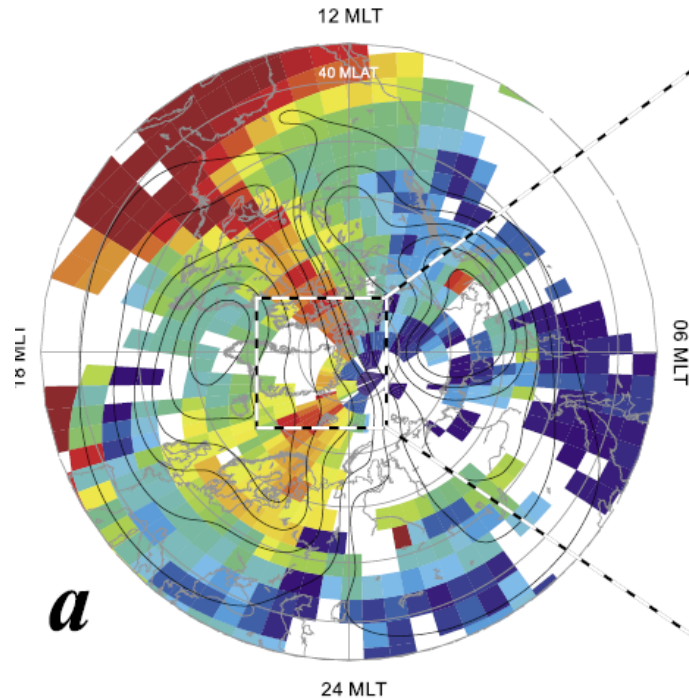
[Y. Zou et al., 2015]

November 20, 2003

19:45:00 UT

Foster et al., 2005

GPS-TEC Observations

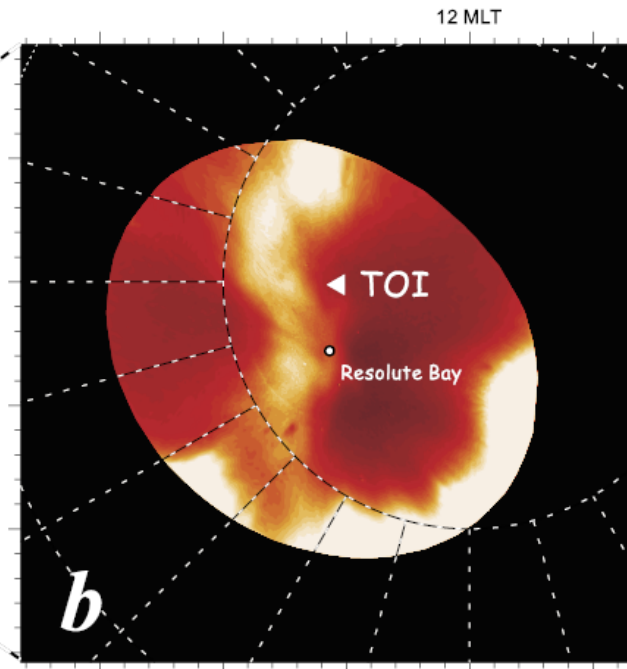


December 15, 2006

03:24:37 UT

Hosokawa et al., 2009

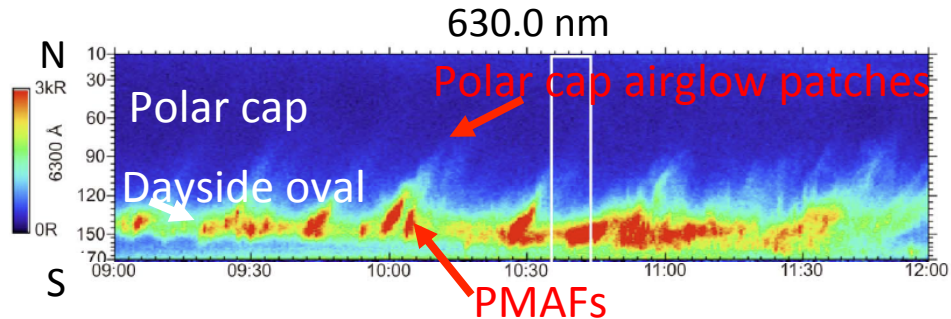
All-sky Airglow Observations



[Hosokawa et al., 2010]

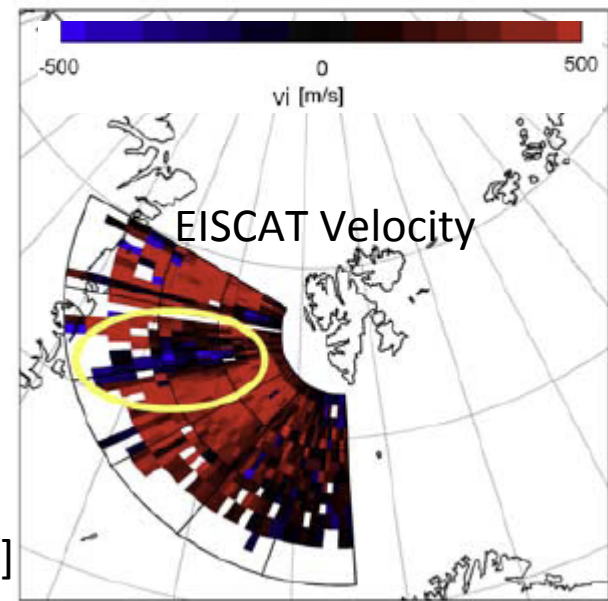
- Dayside enhanced density is known to propagate across the polar cap.
 - TOIs, Polar cap patches
- It is technically possible that dayside phenomena influence on nightside aurora.
- However, they are thought to passively drift under large-scale two-cell convection.
- Do we see any evidence of active day-night connection across the polar cap?

Dayside transients

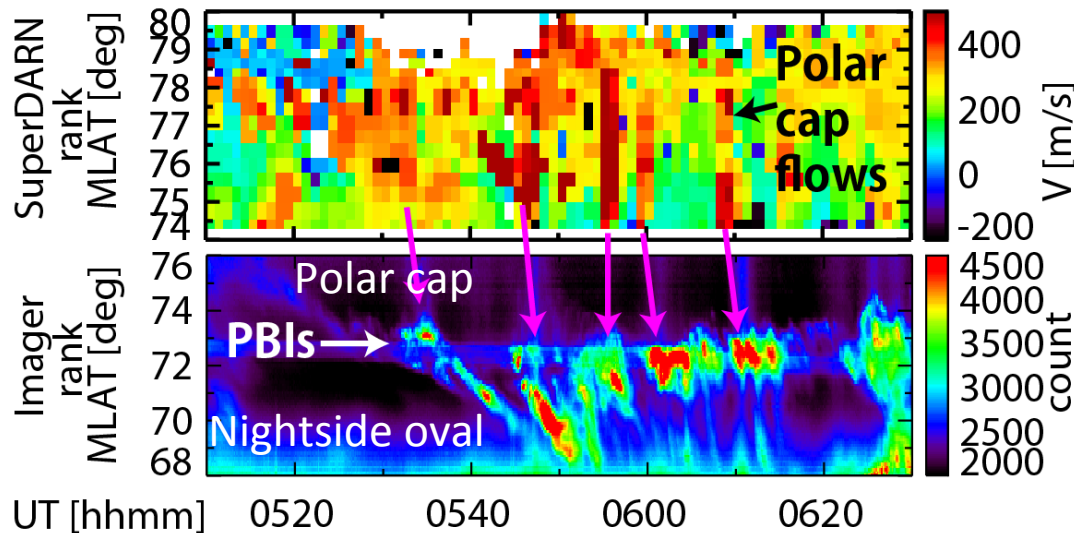


[Lorentzen et al., 2010]

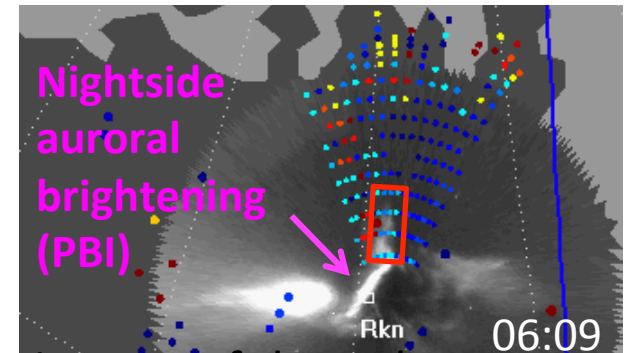
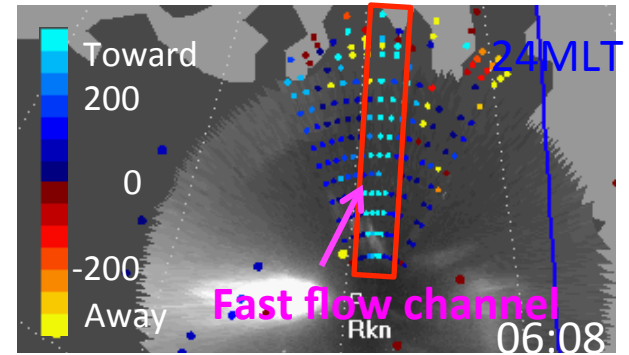
[Rinne et al., 2007]



Nightside transients



[Nishimura et al., 2010; Lyons et al., 2011; Y. Zou et al., 2014]



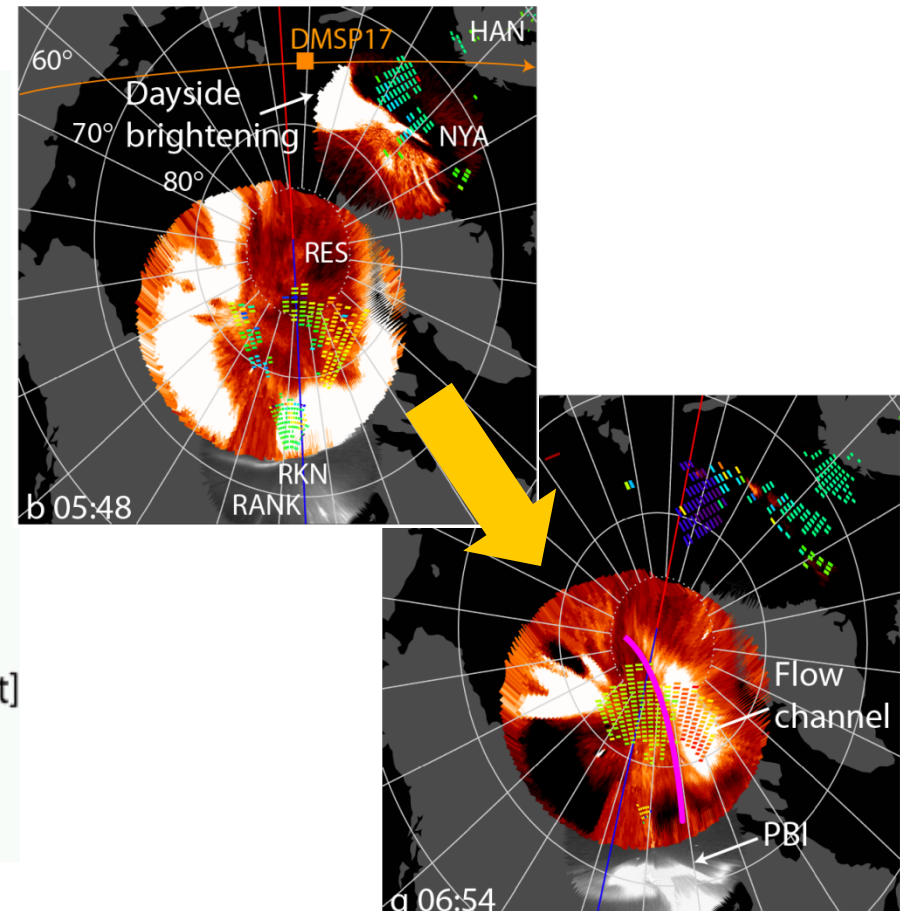
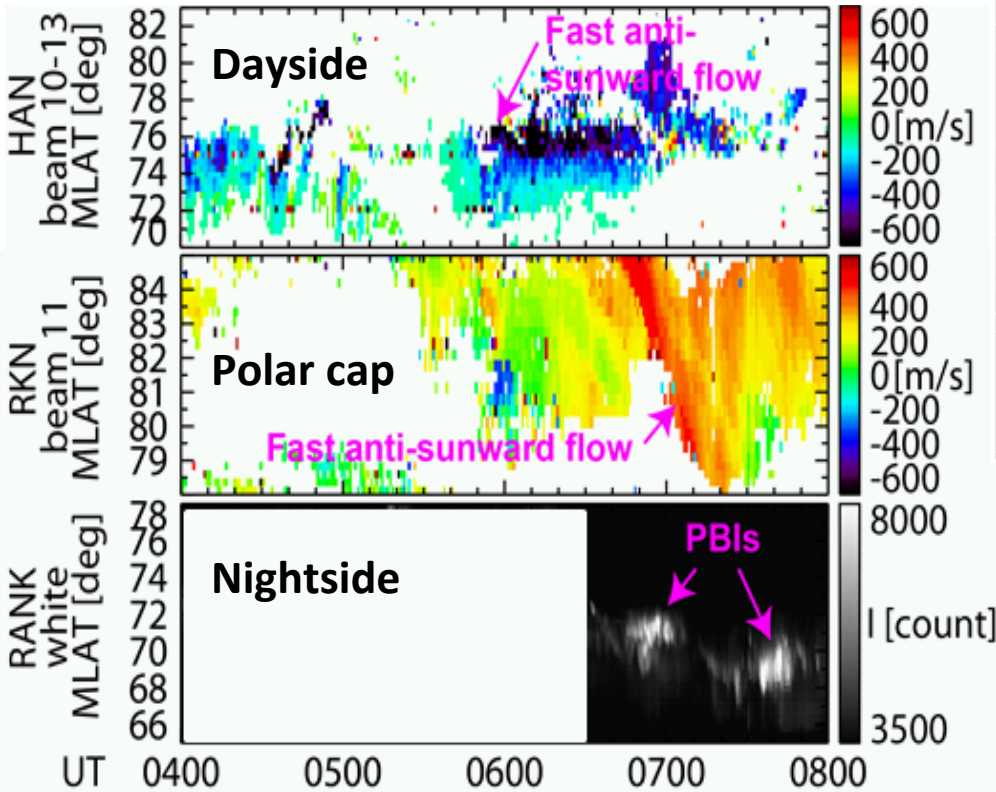
Dayside: moving into the polar cap. Nightside: moving out of the polar cap.

Are these related to each other through the polar cap?

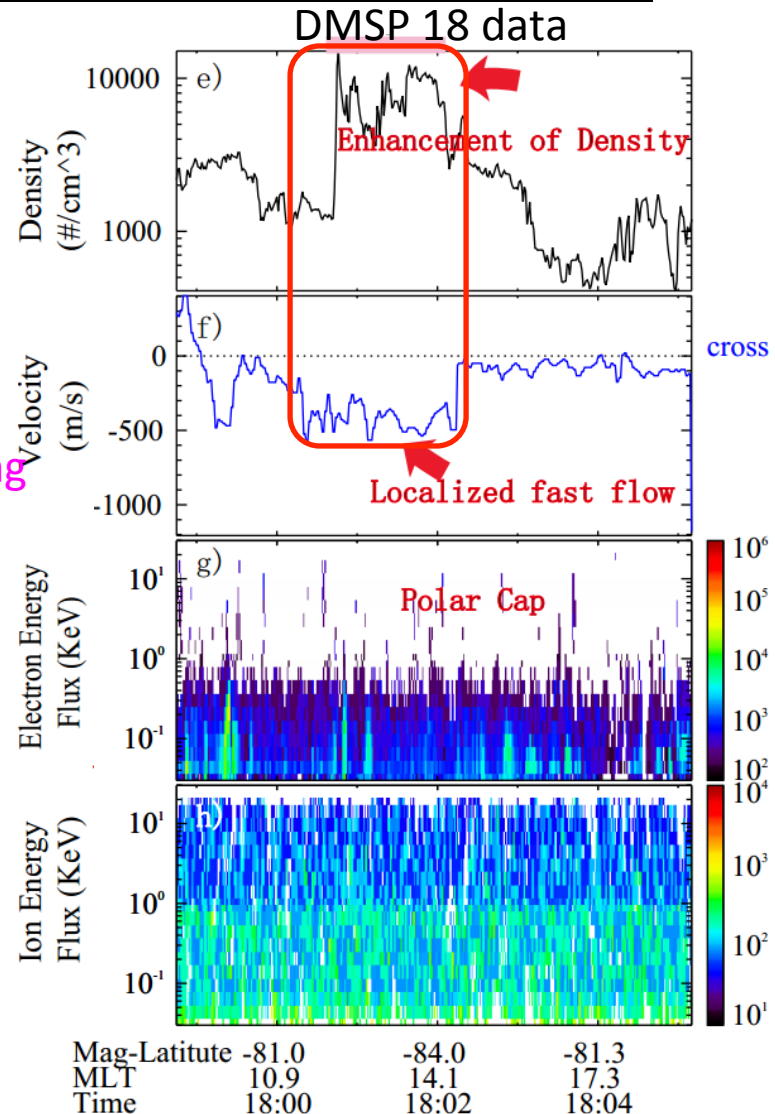
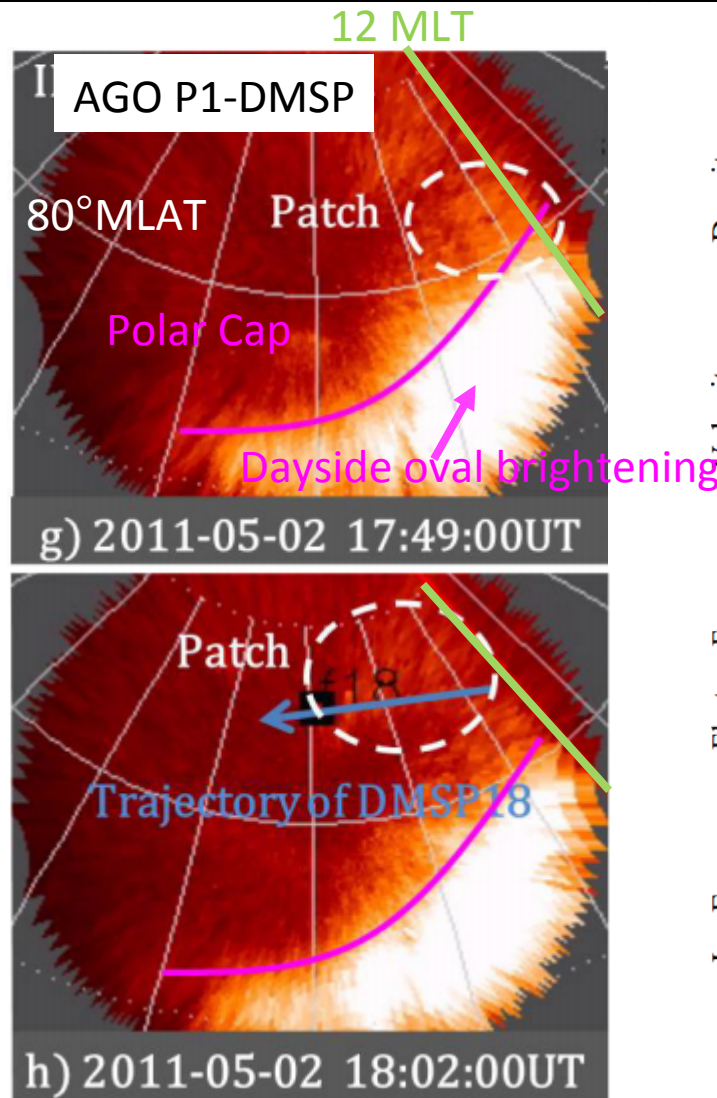
- How do flow channels get into polar caps?
- Idea is day-night coupling via flow channels across the polar cap
- Can be visualized by polar cap patch propagation

Nishimura et al. [2014]

Dayside-Polar cap-Nightside connection



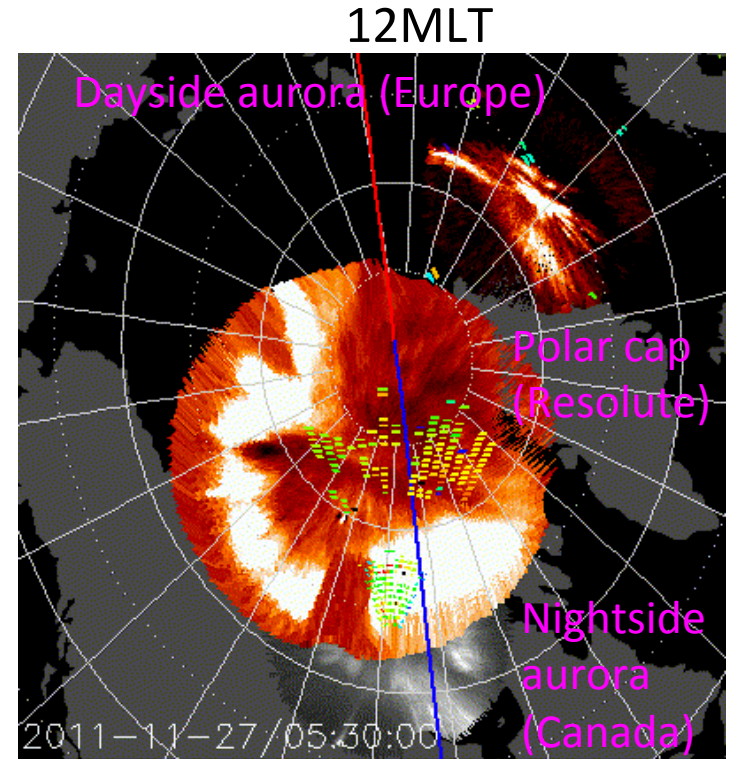
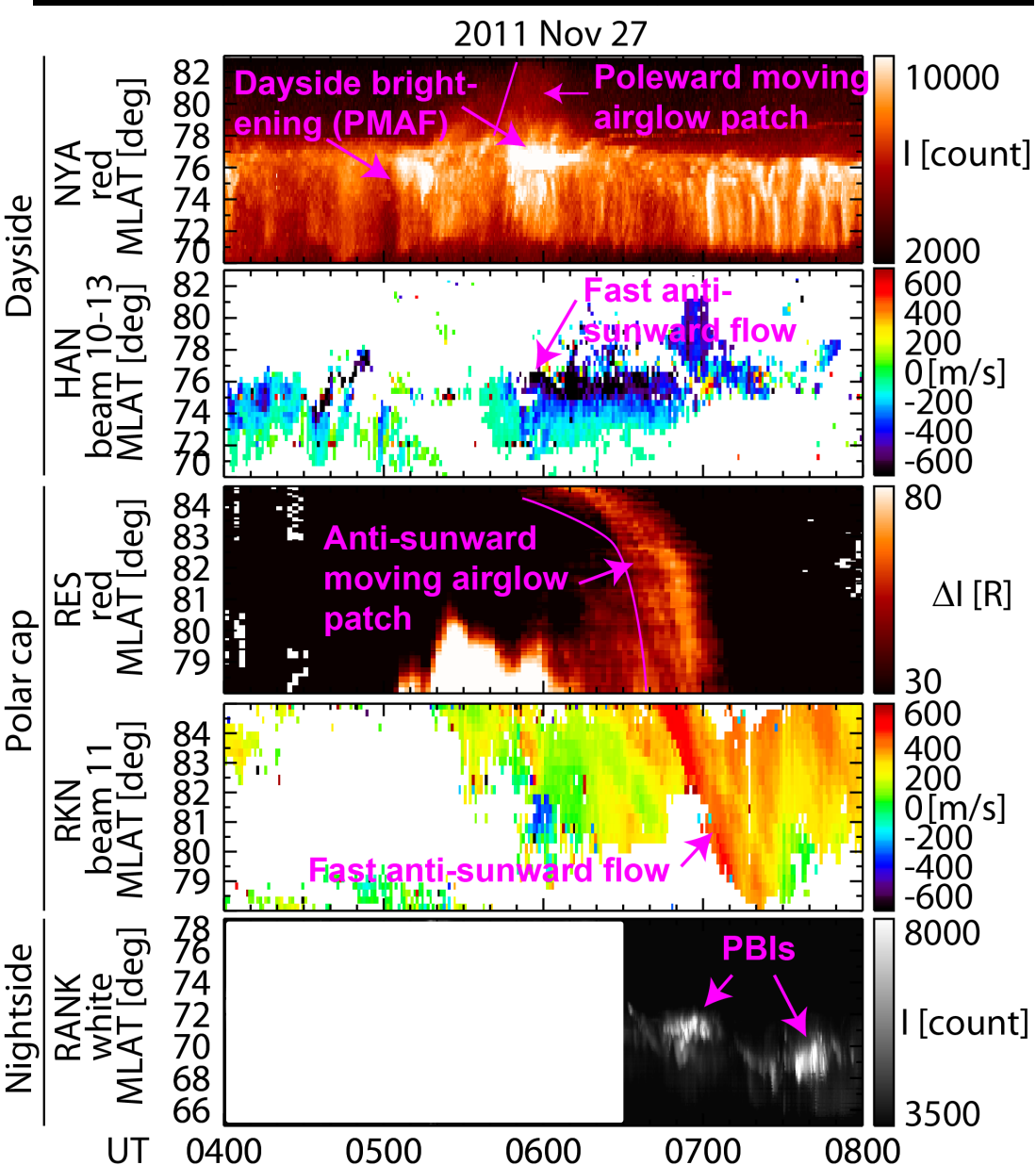
Are fast flow channels coming from the dayside cusp?



- A dayside polar cap patch detached from a dayside oval brightening.
 - The patch/high density plasma is associated with localized fast flow channel.
- Dayside fast flows may propagate deep into the polar cap.

[B. Wang et al., 2015, submitted]

Day-night connection by flow channel



Dayside 24MLT

Brightening and anti-sunward flow

Polar cap

Airglow patch and anti-sunward flow

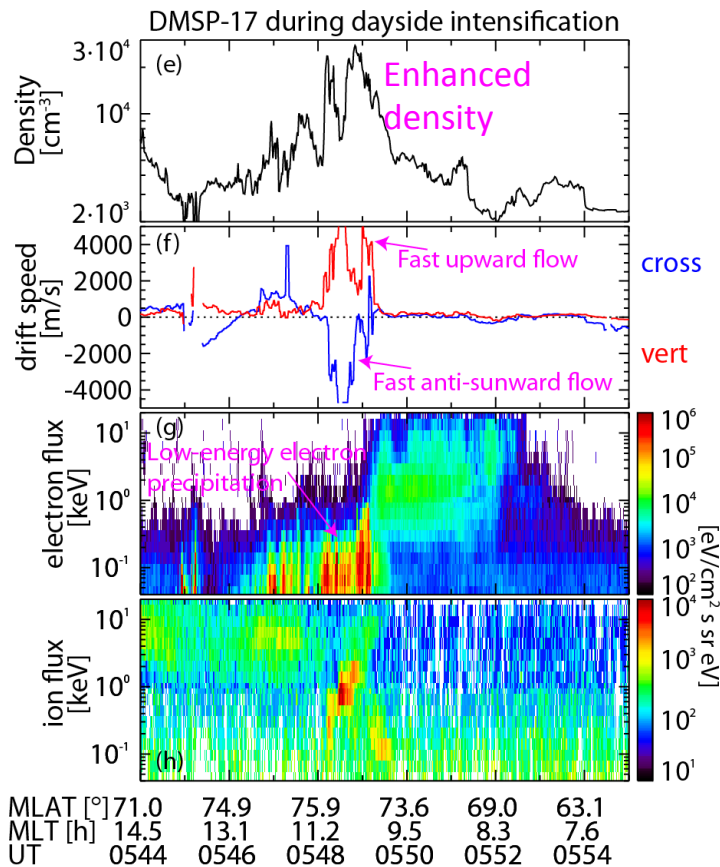
Nightside

Poleward boundary intensifications

[Nishimura et al., GRL, 2014]

Suggesting that a dayside transient propagated across the polar cap and triggered nightside aurora.

DMSP observations



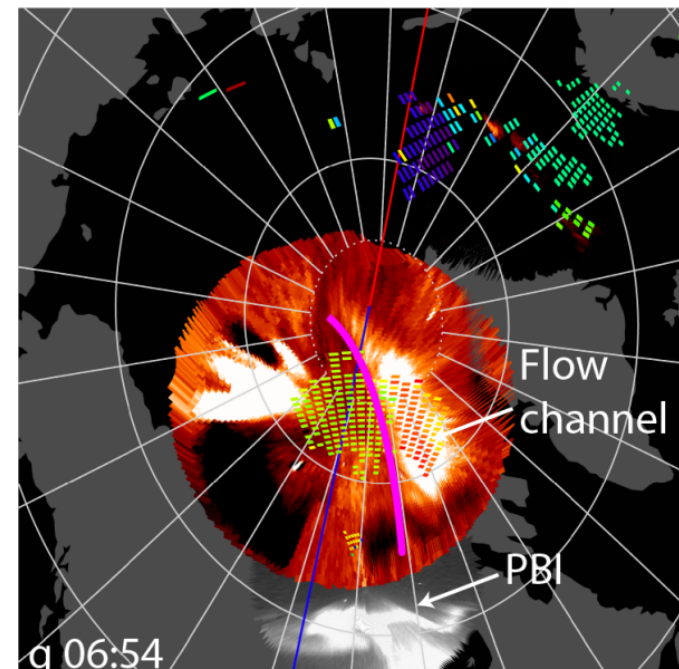
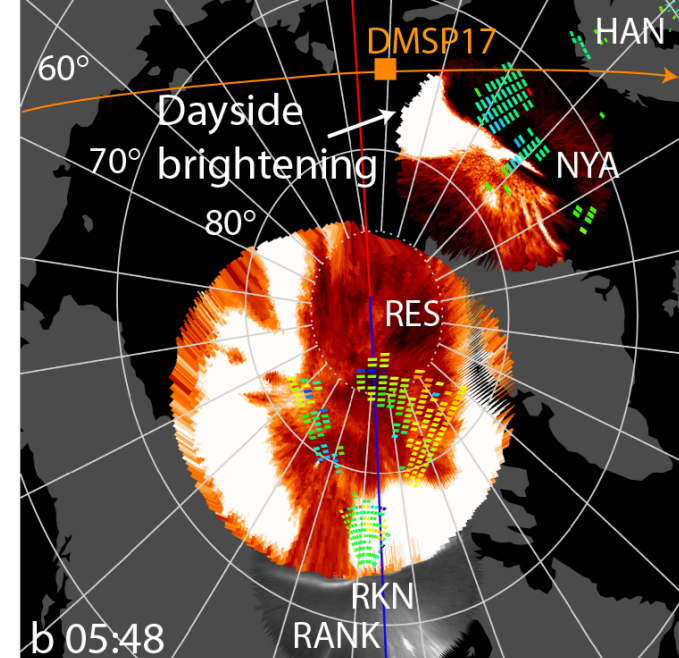
Fast upward flow at cusp

→ Slower recombination

Fast anti-sunward flow & Dayside enhanced density

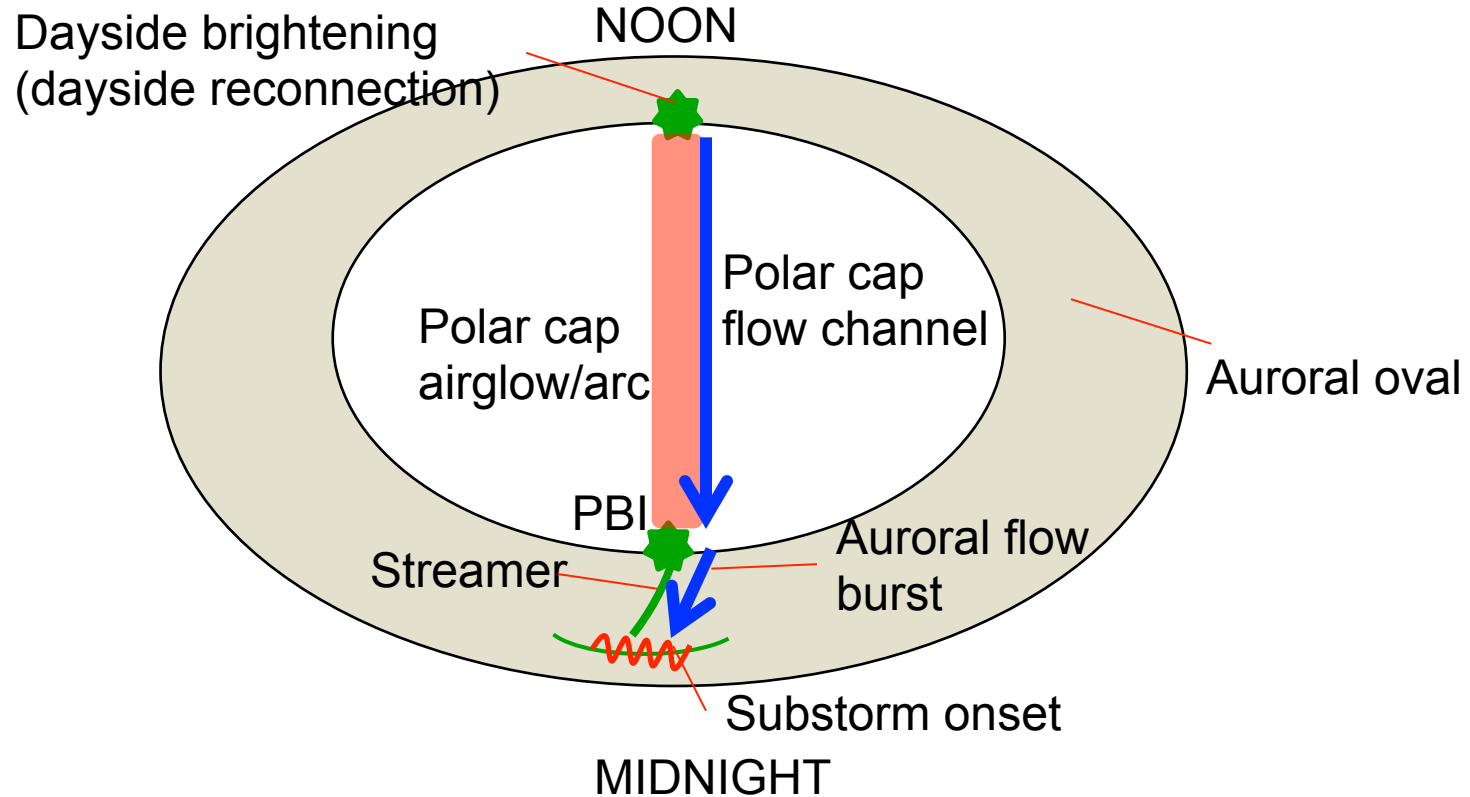
→ Transported to nightside across the polar cap

→ Triggered nightside aurora



Dayside flow channels/PMAFs could be the source of polar cap flows and nightside aurora.

Summary



- Localized fast flow channels propagate from dayside to nightside and could trigger nightside auroral brightening.
- The polar cap plays a major role in connecting the dayside and nightside transient phenomena.
- We suggest **dayside-polar cap-nightside interaction by flow channels**, having large impacts on the M-I coupling system.