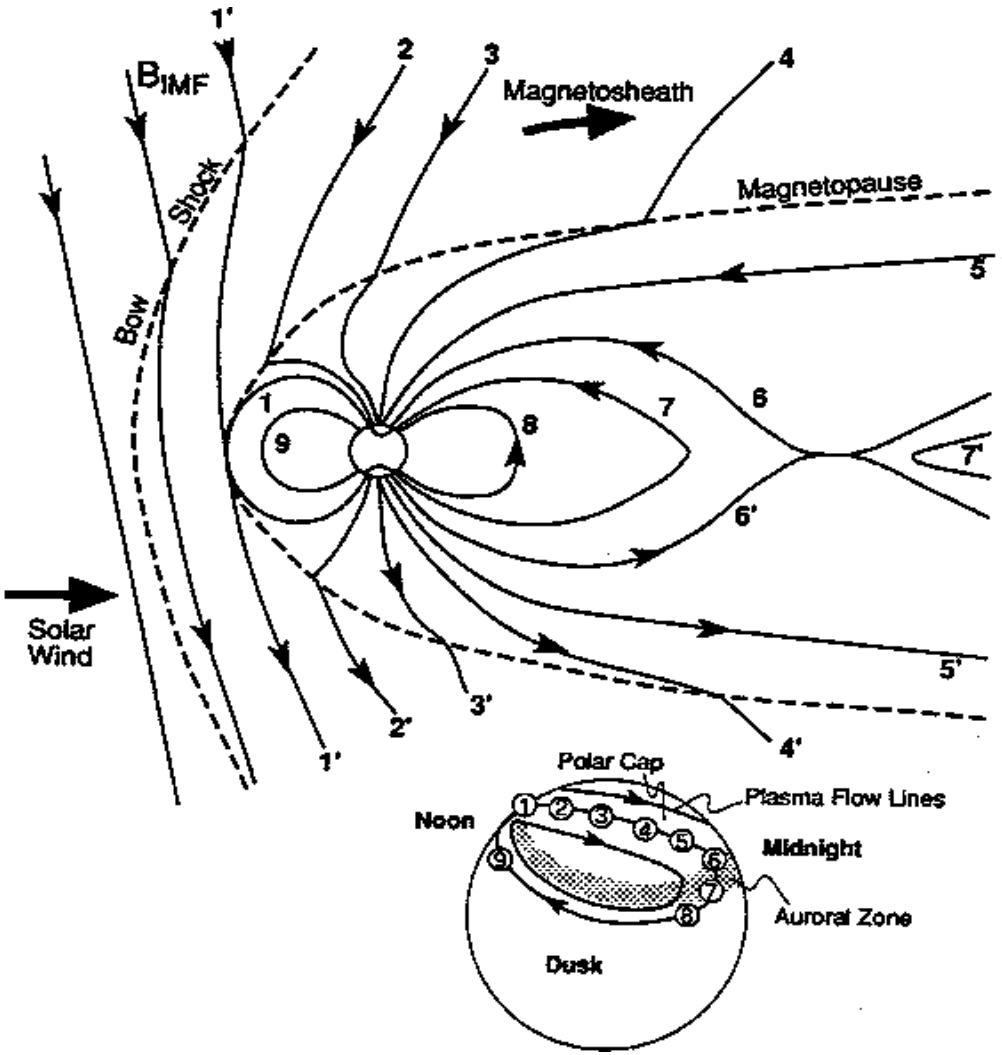
Evolution of Cusp plasma flow and Convection Vortex

Kumiko Hashimoto, T. Kikuchi [1)],
M. Ruohoniemi [2)], T. Ogino [3)]
A. Ridley[4)] and P. Stauning [5)]

1)CRL, 2) APL, 3) Nagoya Univ.,
4)Univ. of Michigan, 5)DMI

Ionospheric Convection as Projection of the Magnetospheric Convection



Transfer of newly reconnected magnetic flux takes several tens of minute from dayside to the nightside ionosphere.

Observations and Analysis

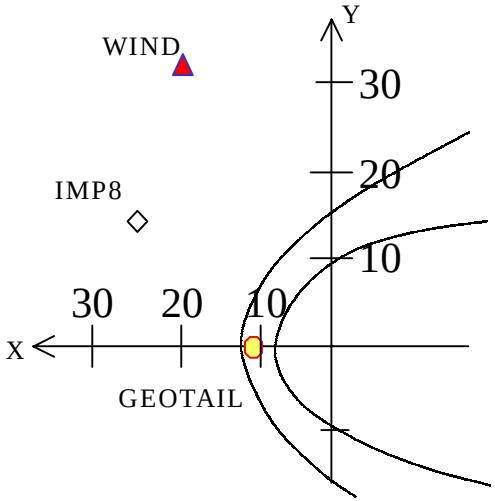
- Selected Event :
  November 17, 1996, 18-20UT
  Gradual southward turning of the IMF at 1838 UT

- SuperDARN HF radar : Saskatoon, Kapuskasing,
  Goose bay, Stokkseyri, Pykkvybaer
  APL potential map model

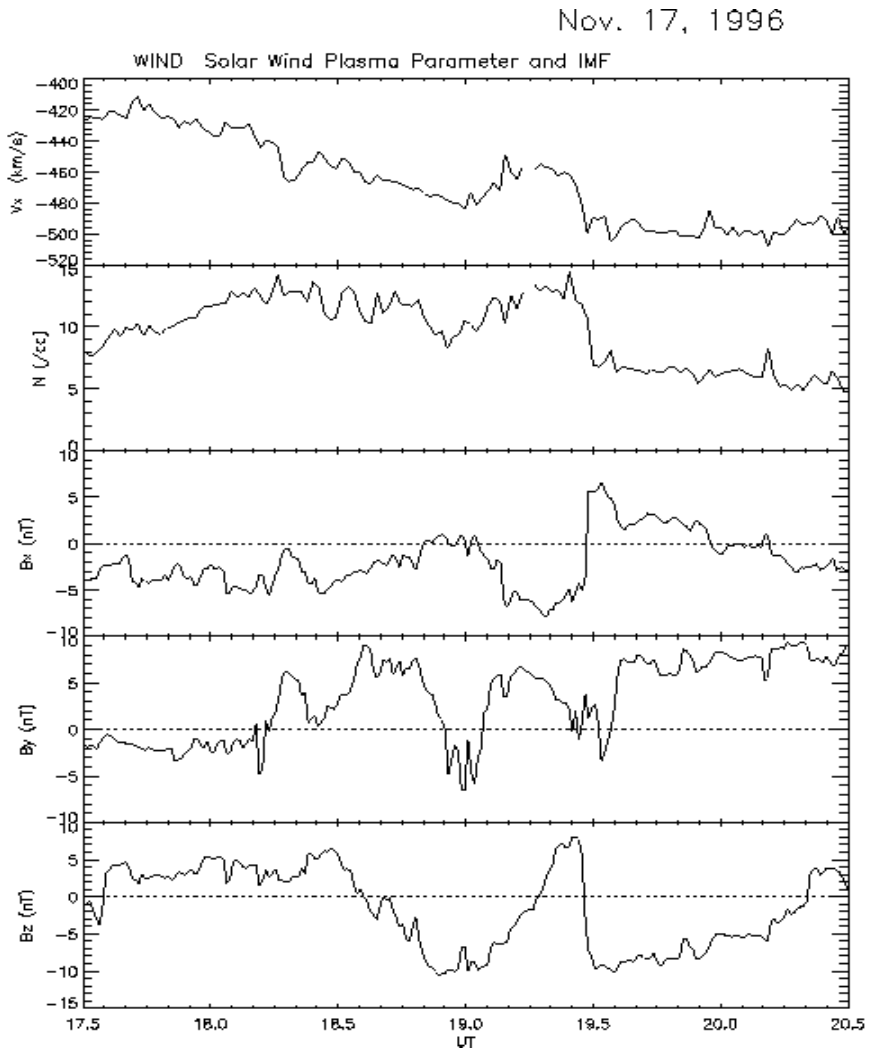
- Magnetometer chain :
  CANOPUS, West Greenland
  AMIE technique

- Comparison with three-dimensional MHD simulation for this event

IMF and Solar Wind Plasma Parameters by WIND

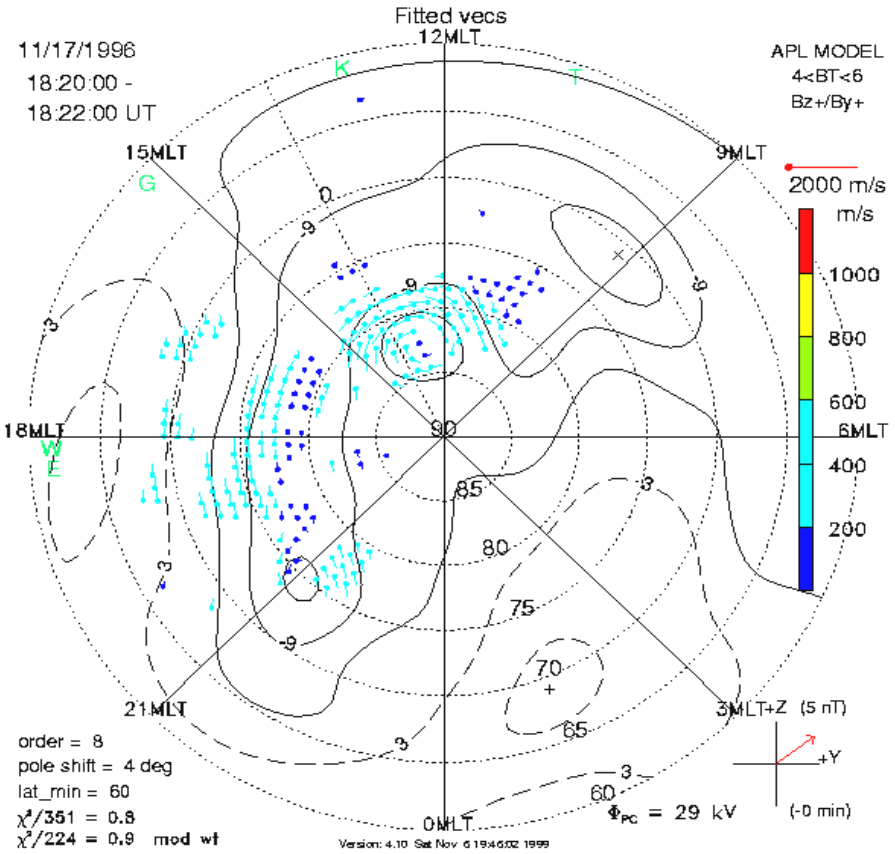


Positions of the three satellites at 1830 UT

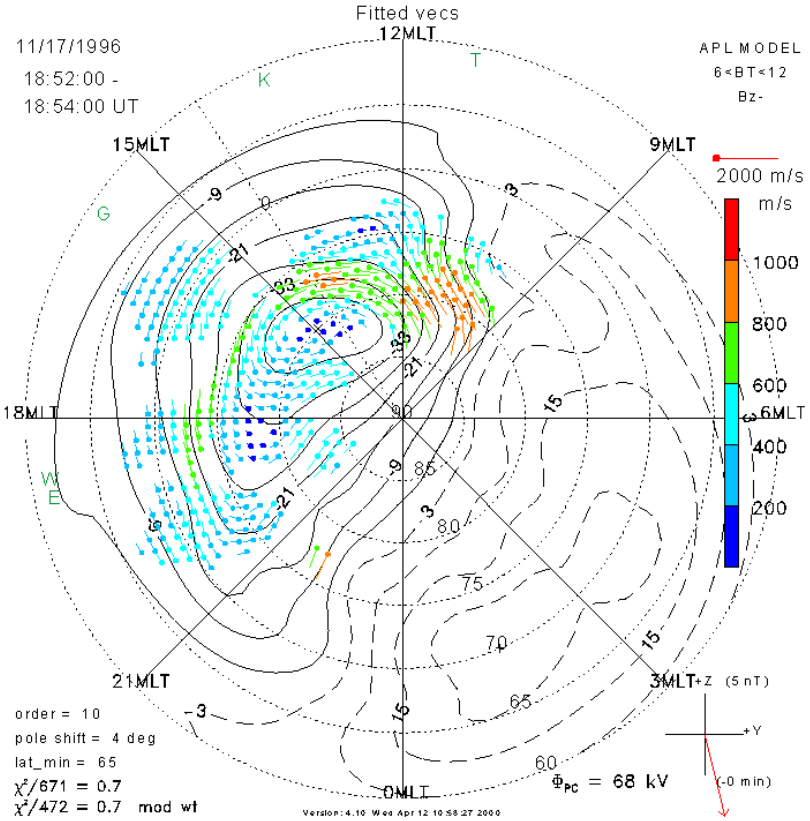


What is the relation between the Cusp Plasma Flow and Convection Vortex in the afternoon sector?

Northward IMF

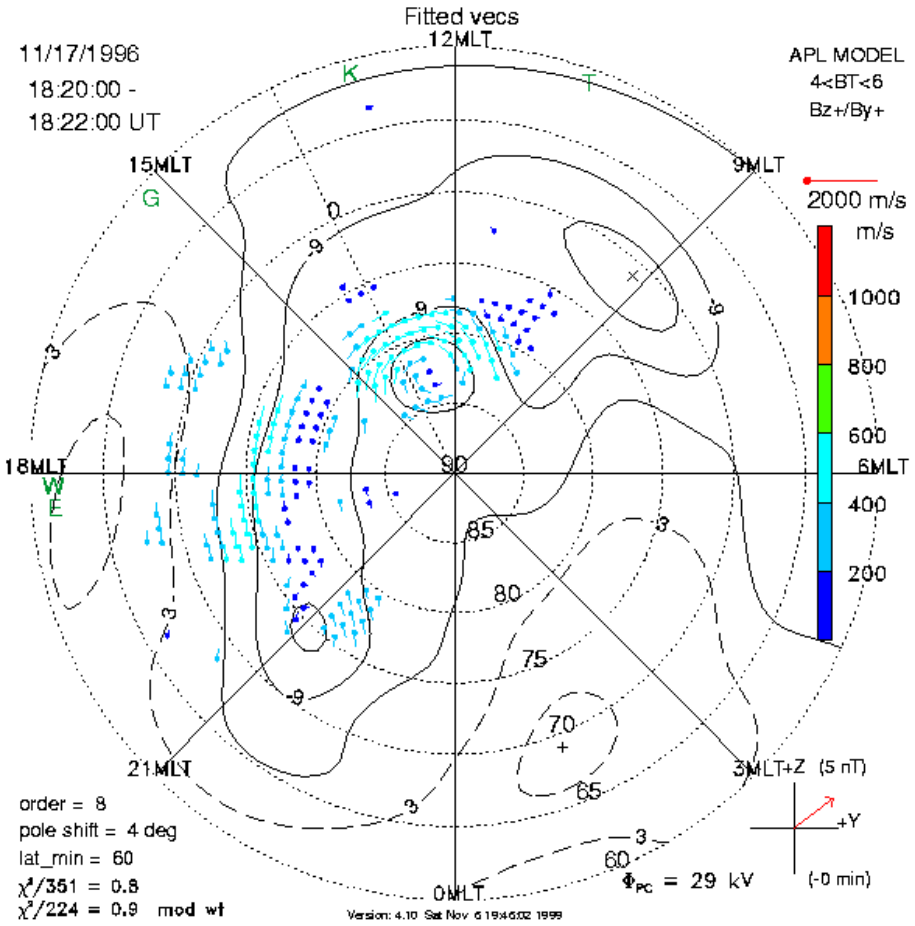


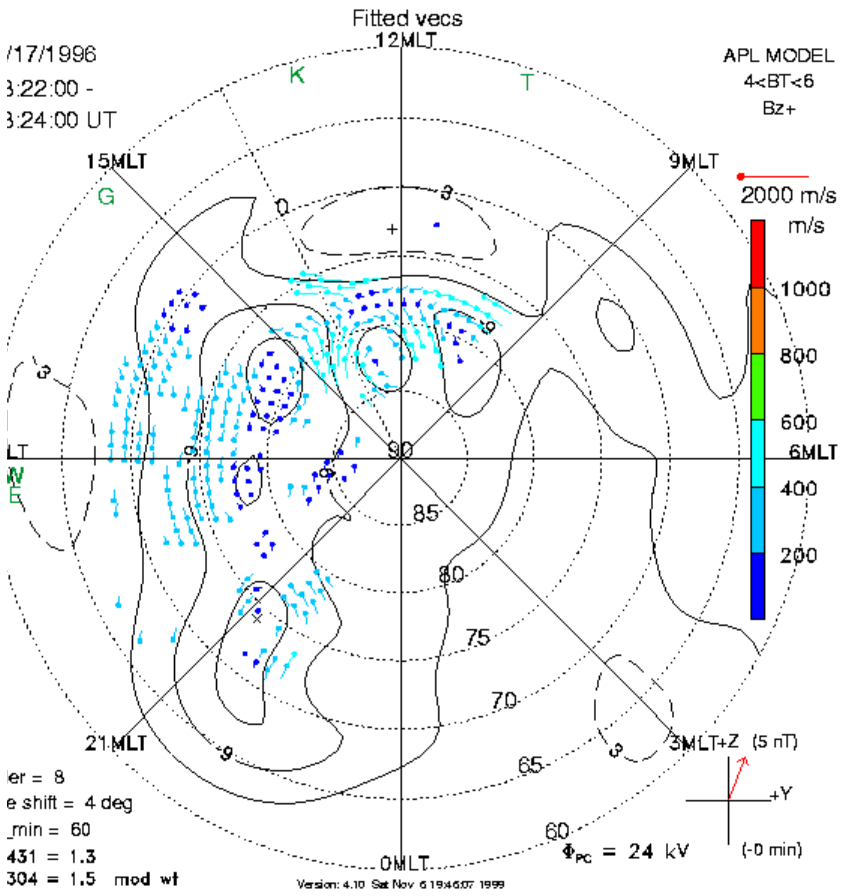
Southward IMF



18:20 UT and 1852 UT on November 17, 1996

Convection Map during Bz >0

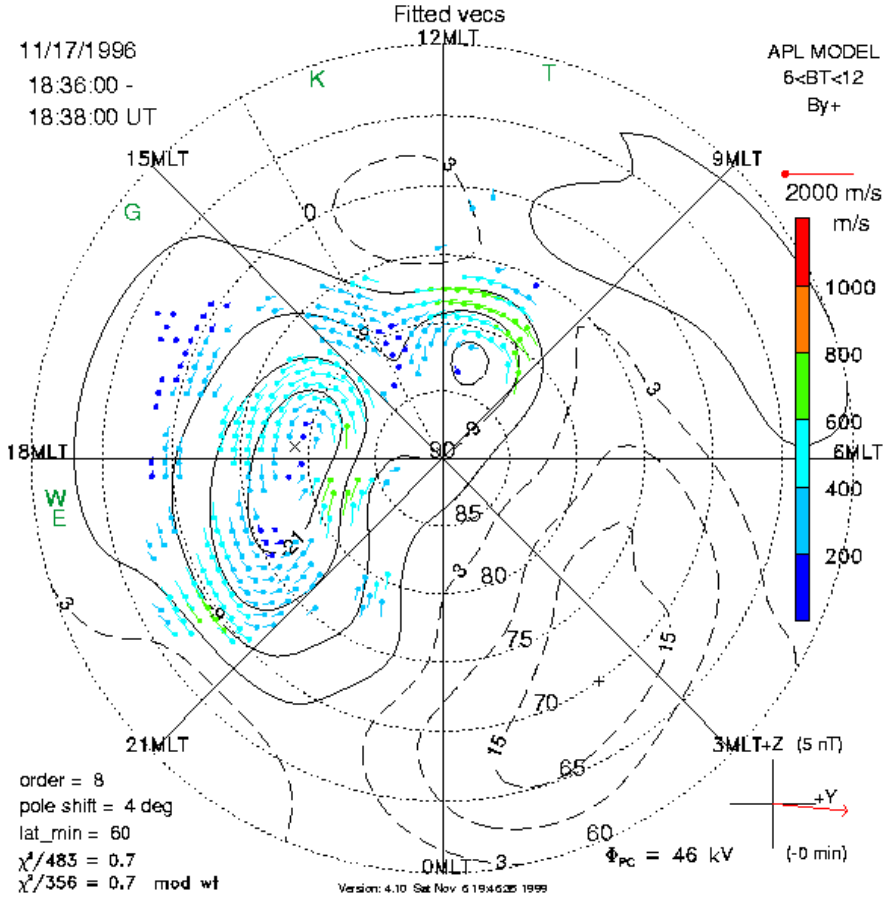




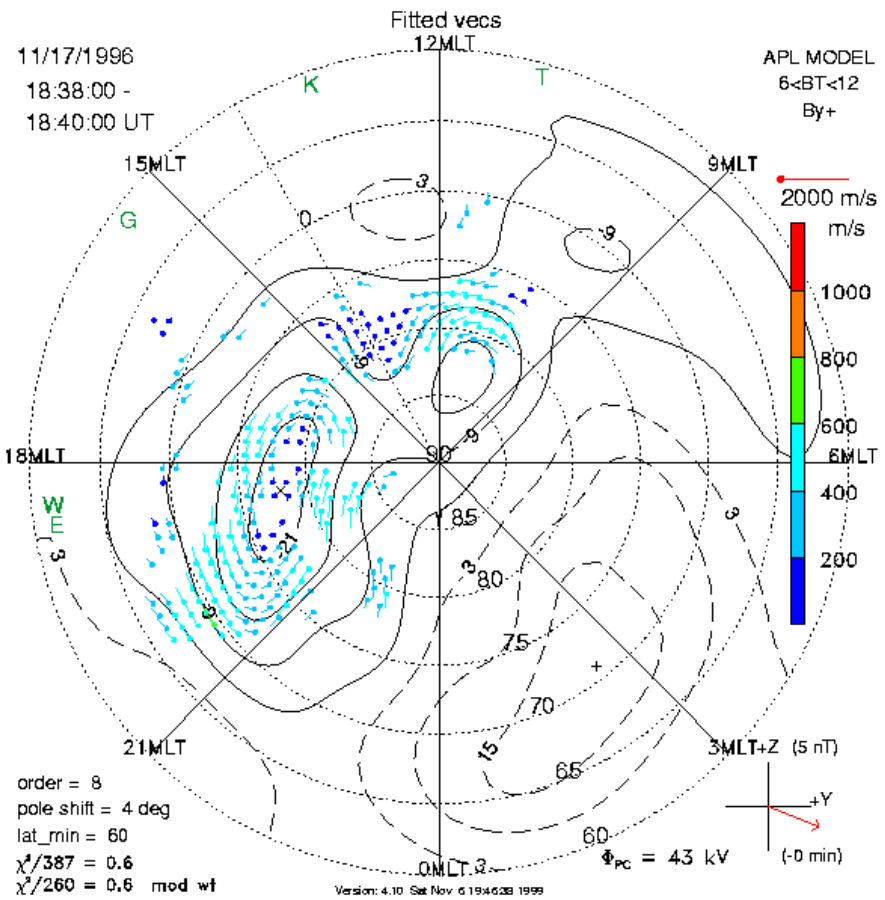
18:20-18:22 UT

18:22-18:24 UT

Convection Map at Southward Turning of the IMF

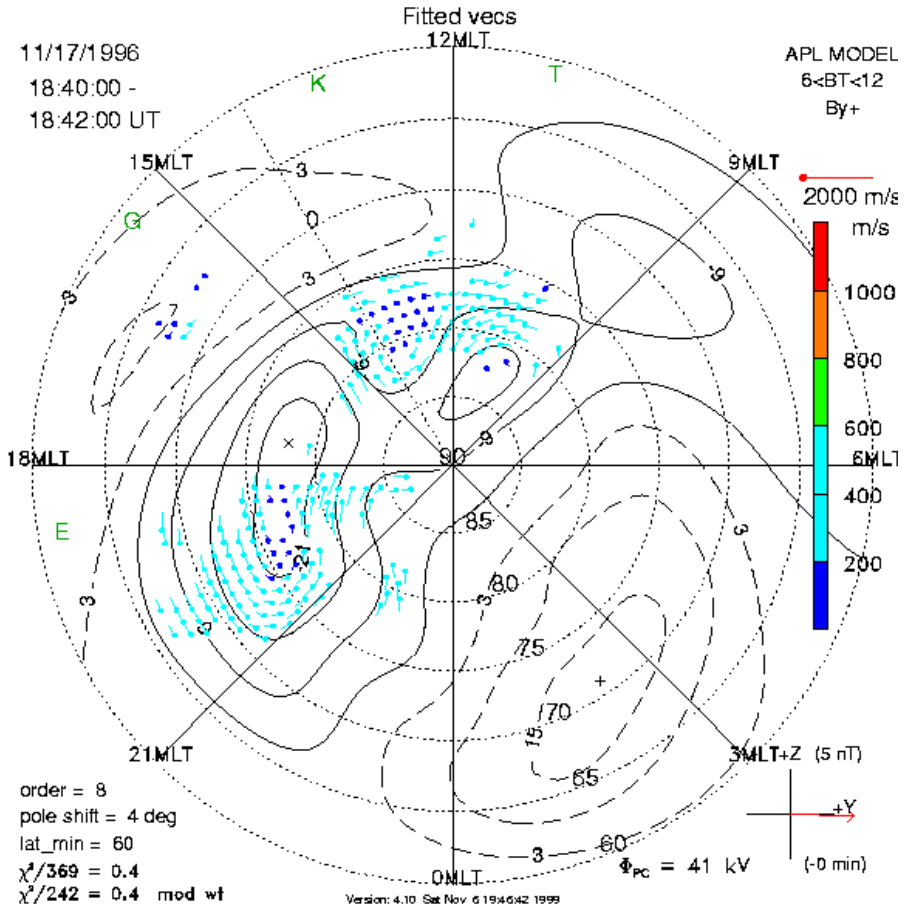


18:36-18:38 UT

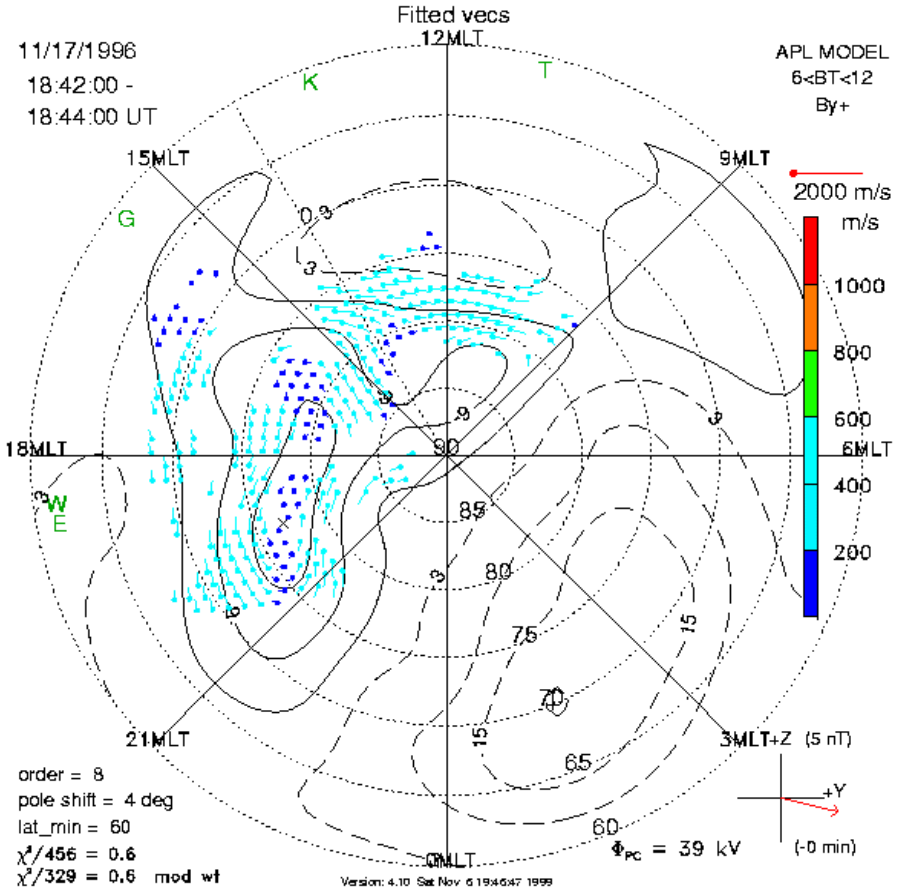


18:38-18:40 UT

After the Southward Turning of the IMF 1



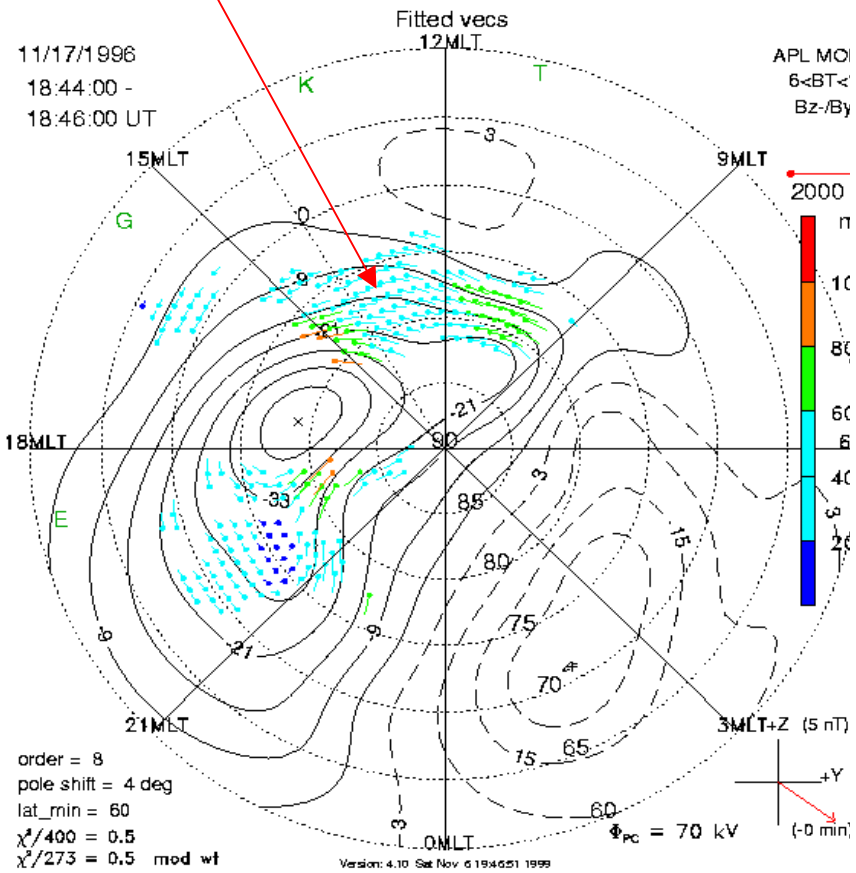
18:40-18:42 UT



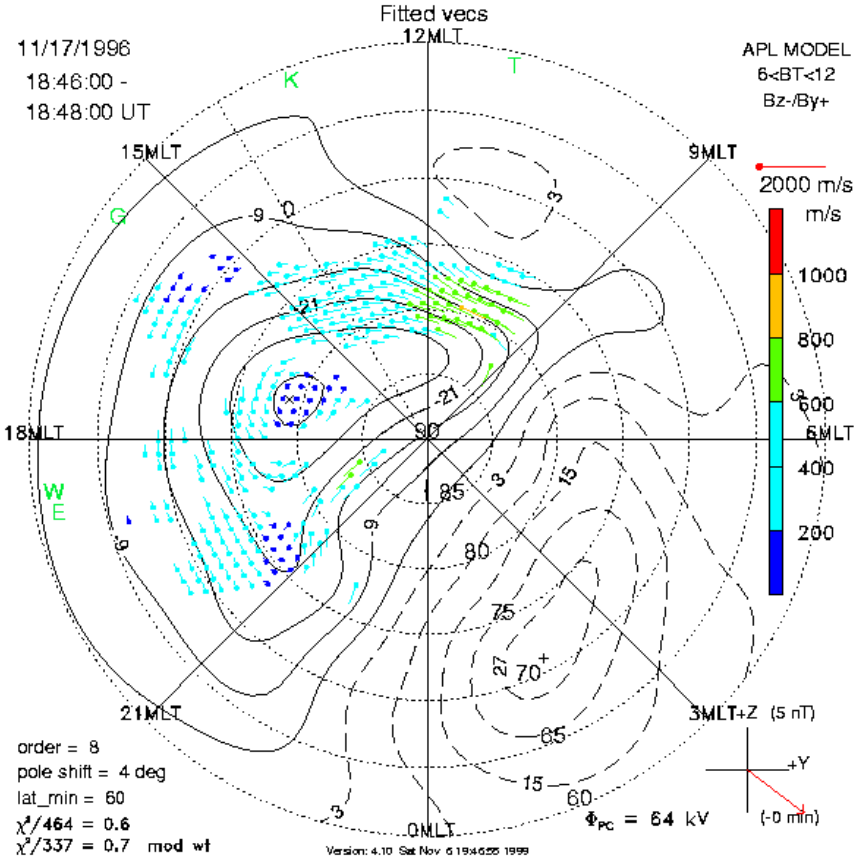
18:42-18:44 UT

After the Southward Turning of the IMF 2

Small-scale twin vortex disappeared at 1844 UT.



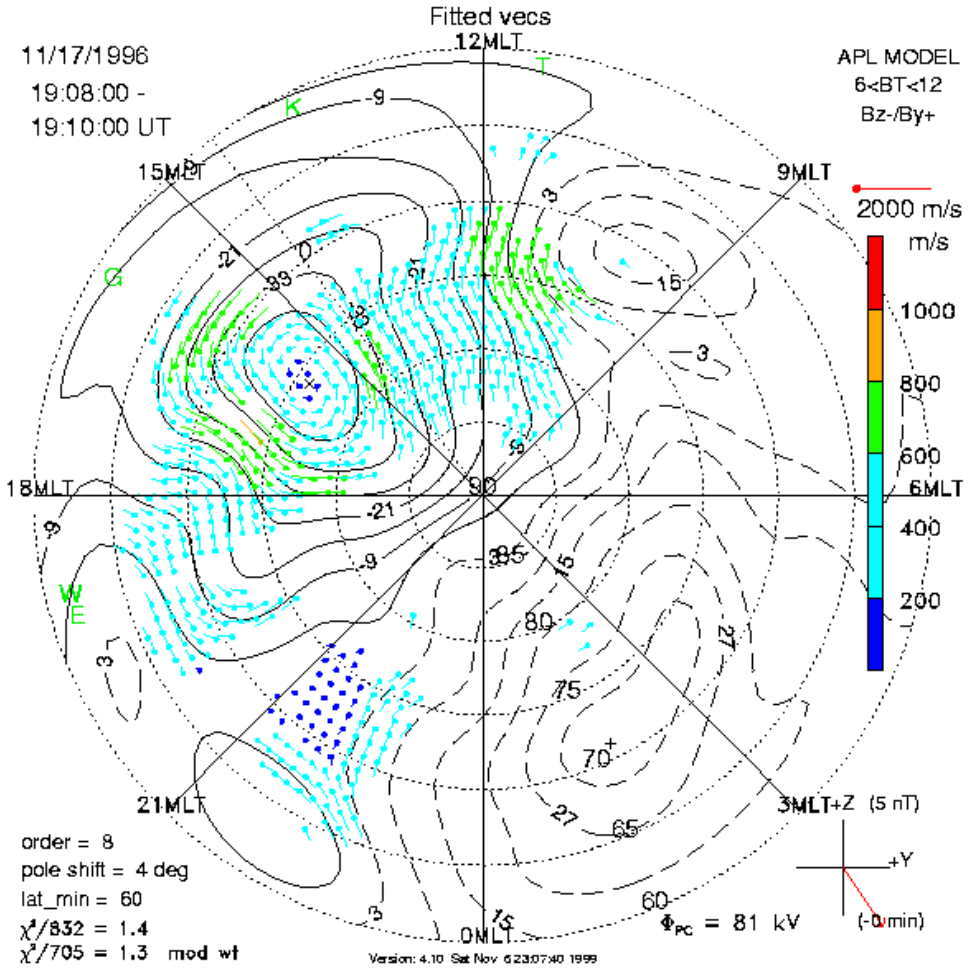
18:44-18:46 UT



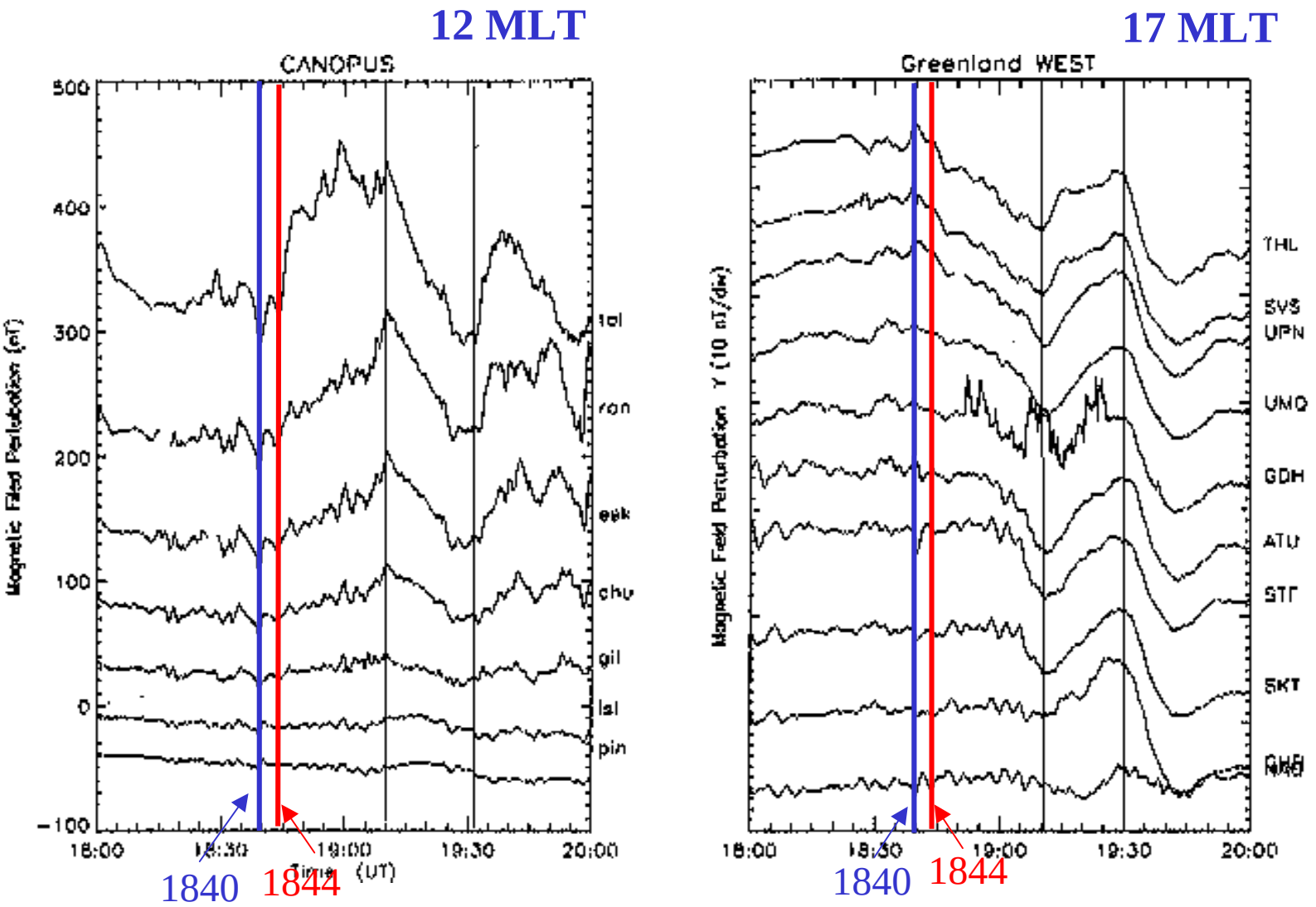
18:46-18:48 UT

Enhanced Convection Vortex in the Afternoon Sector at 1910UT

Southward IMF

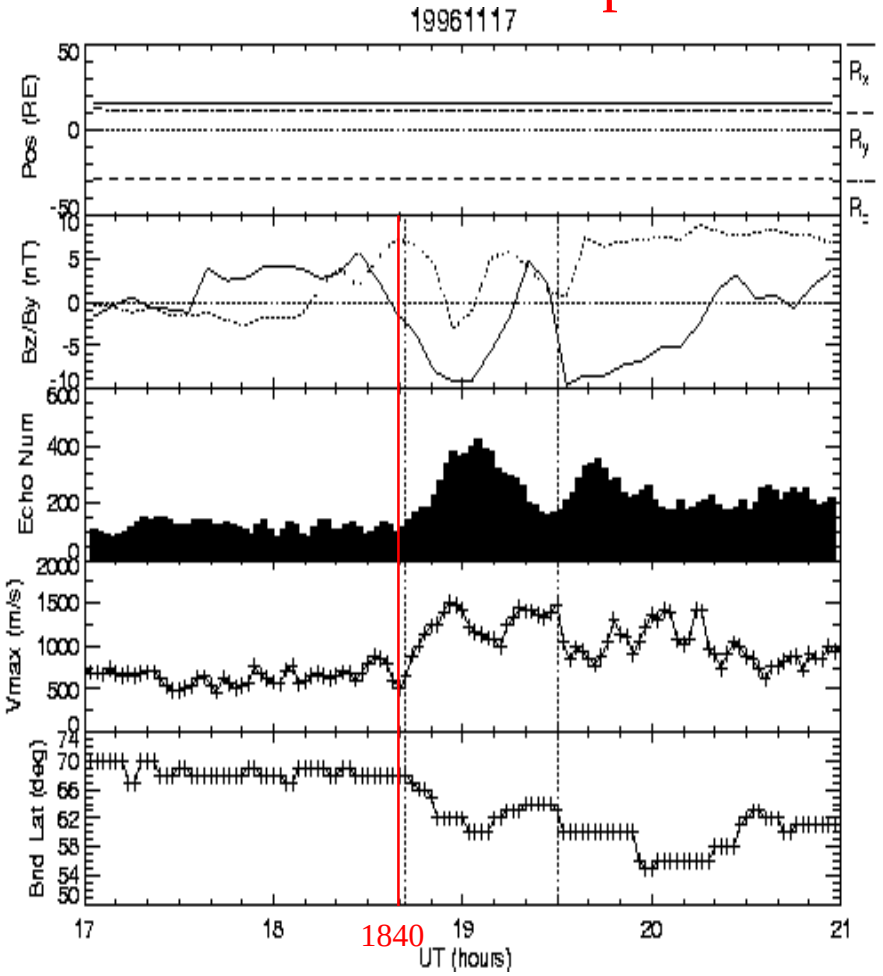


DP 2 Magnetic Fluctuations on November 17, 1996



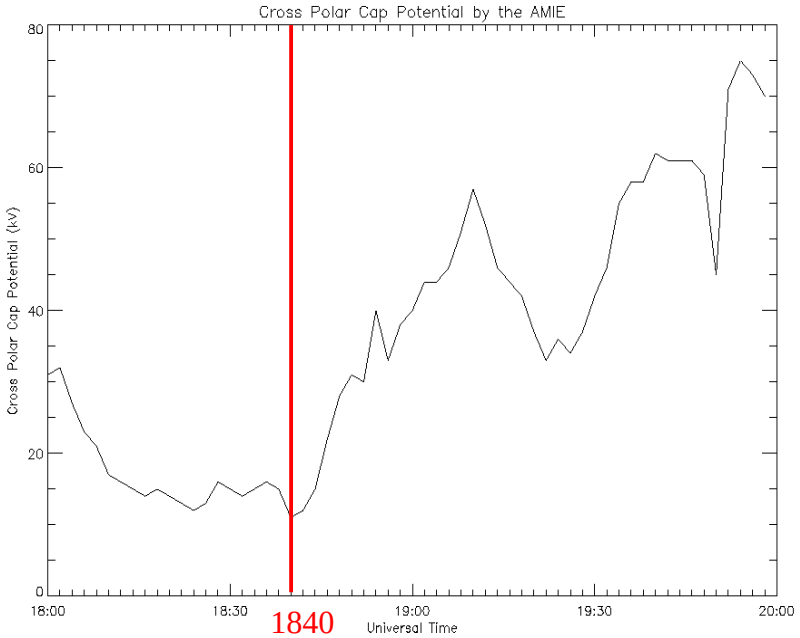
Time Variations of Ionospheric Convection Parameters

APL Convection Map Model



AMIE Technique

Cross Polar Cap Potential

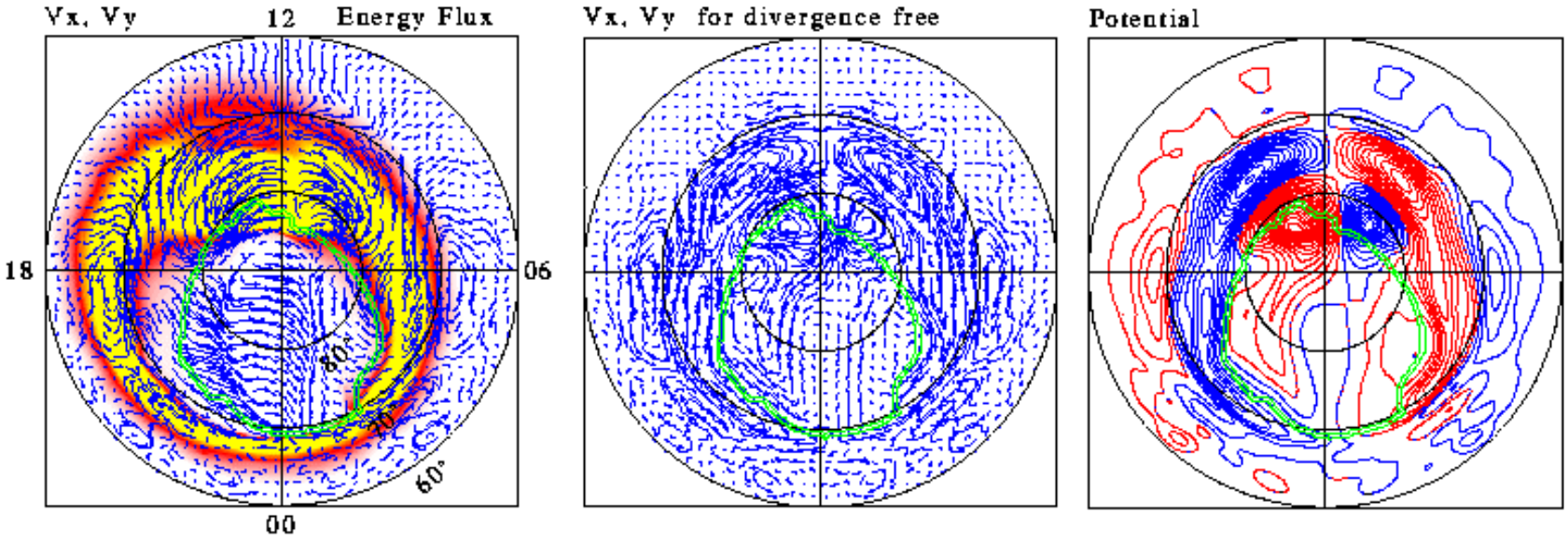


Summary of Observation

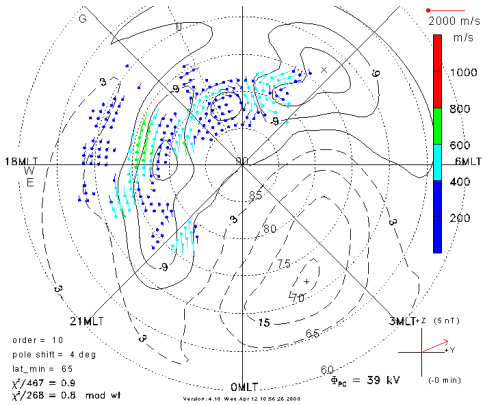
1. The convection electric field starts to develop in a few minutes after the southward tuning of the IMF in the magnetosheath.
2. Small-scale vortices in the cusp region associated with the northward IMF remains for the first 4 minutes while the convection electric field is increasing.
3. The convection vortex intensifies at around 16 MLT in the 78-80 deg magnetic latitude.

The MHD Simulation of Magnetospheric Convection by T. Ogino

MHD Simulation for 1996 Nov, 17 event 18:20 UT

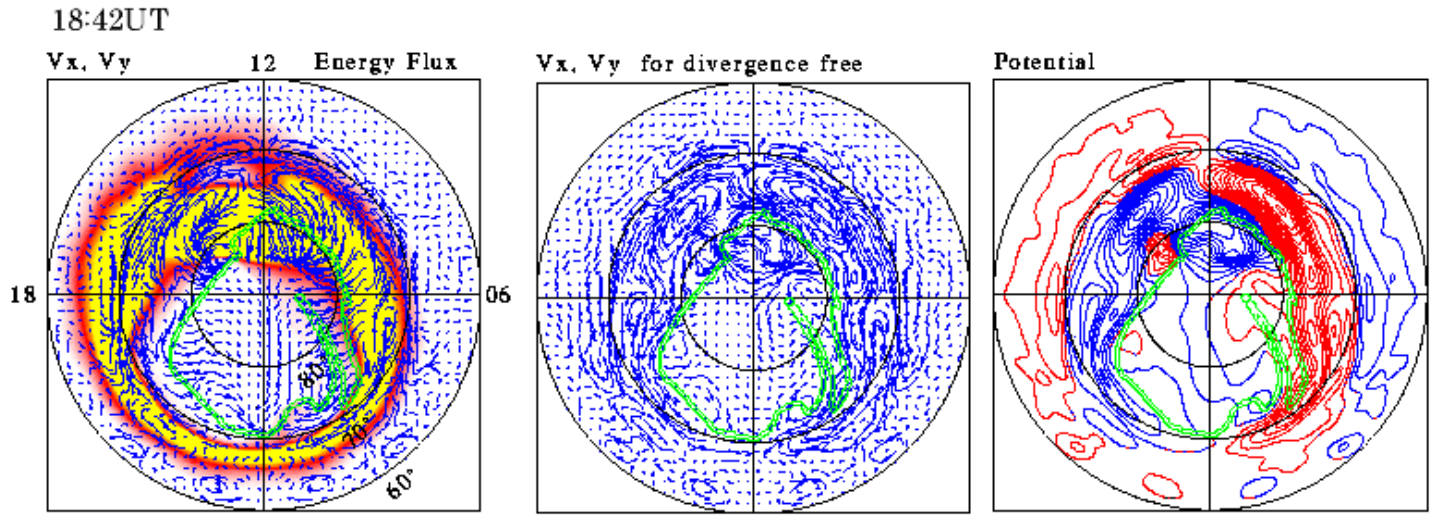


18:20 UT during Bz>0

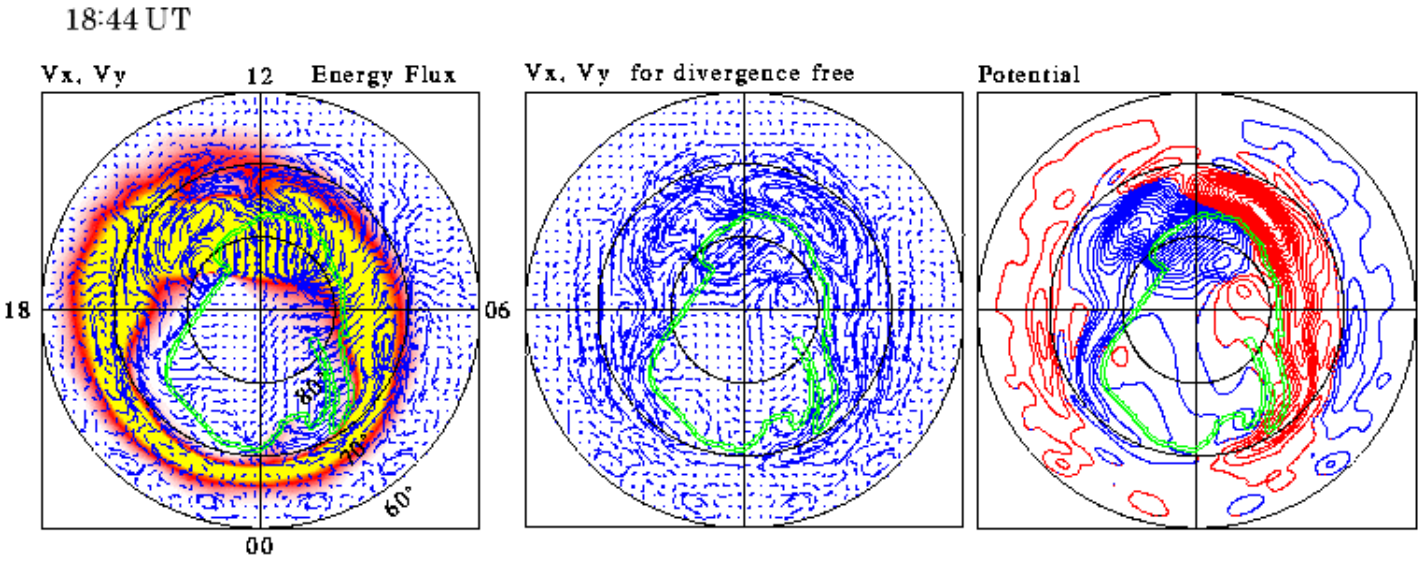


Magnetospheric Convection at Southward Turning of the IMF

18:42UT

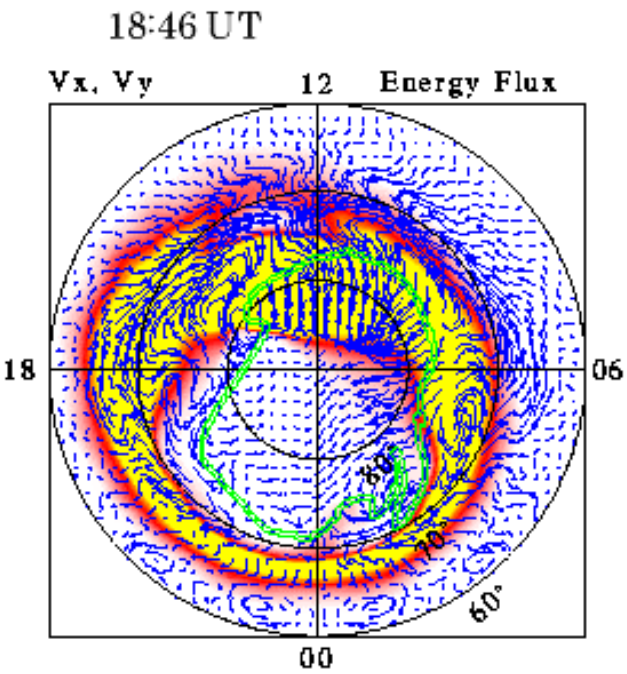


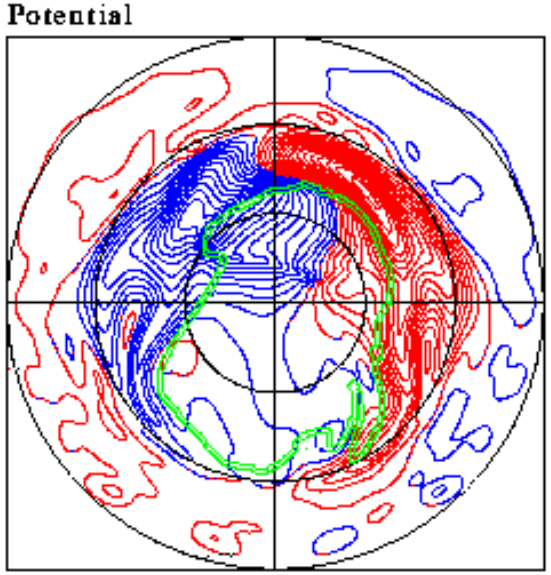
18:44UT

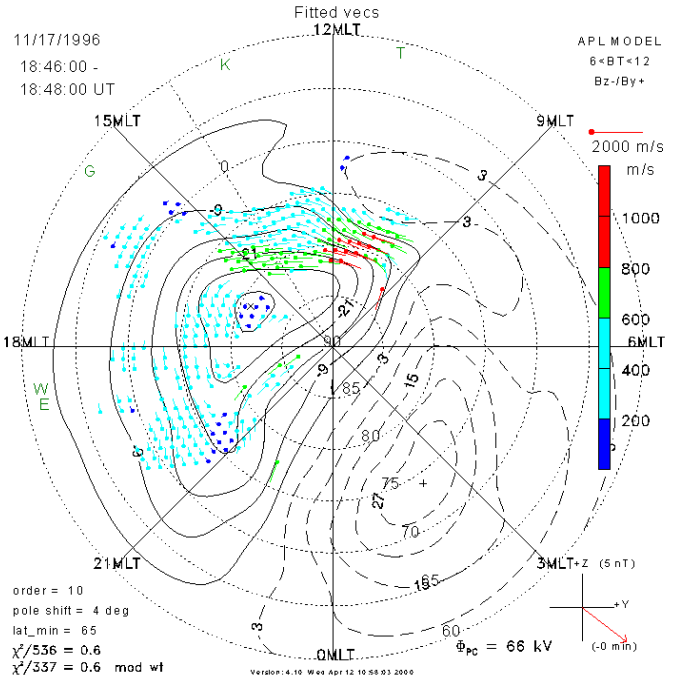


2 minutes later

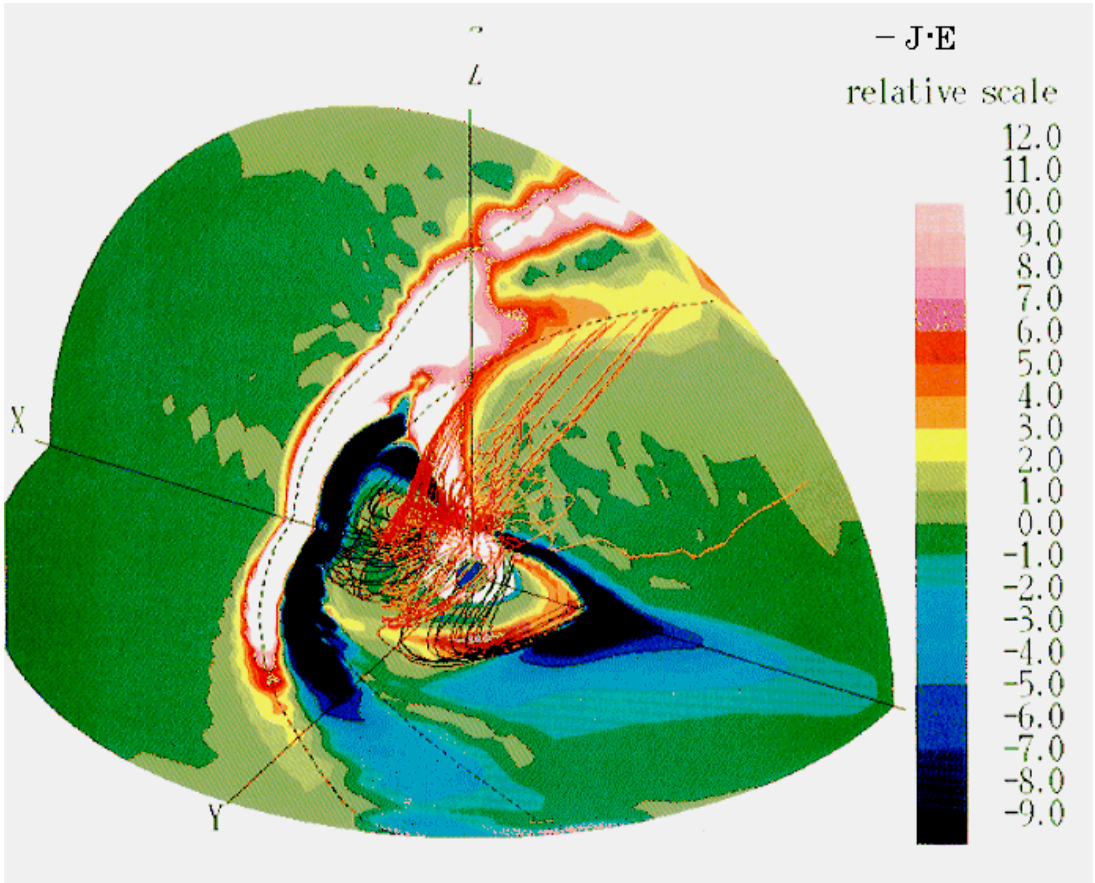
18:46 UT





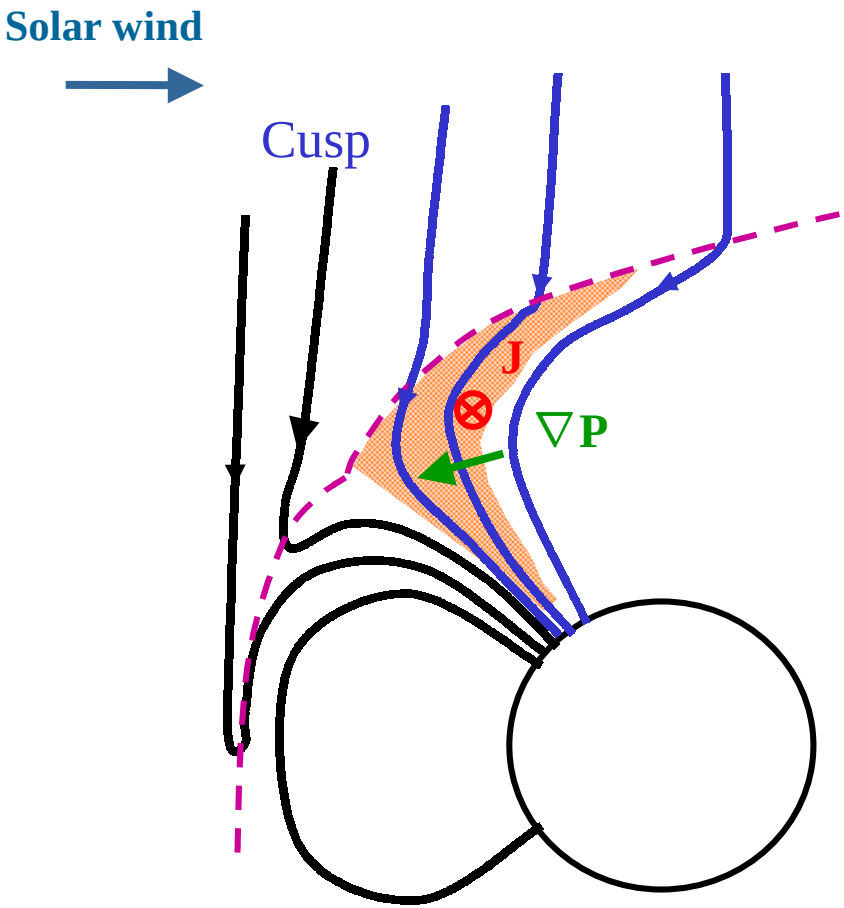


Magnetosphere-Ionosphere Current in the S-M-I Coupling System



- For southward IMF, strong current generator (**J**·**E** <0) is in the high-latitude part of the cusp [Tanaka, 1995].

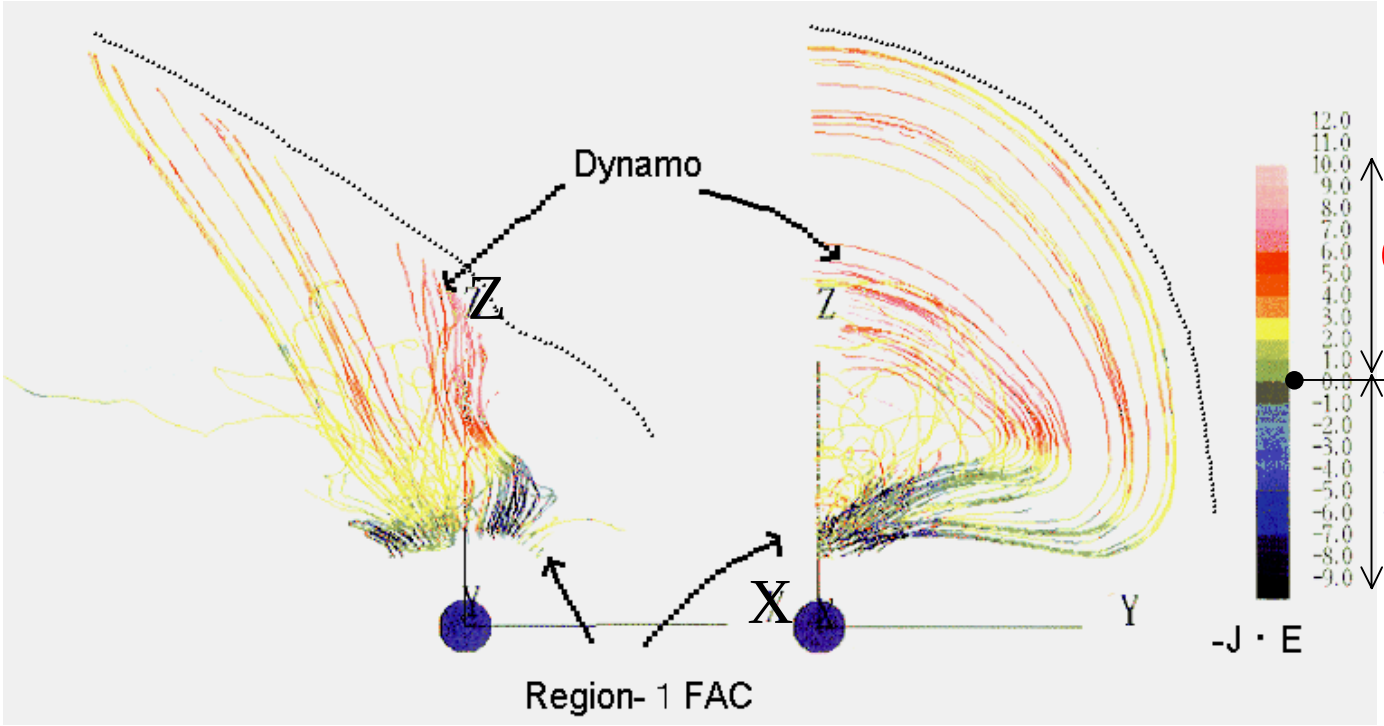
Generation Mechanism of Region-1 FAC for Bz < 0
[Tanaka, 1995]



Current Generator
(J・E < 0)

The dynamical energy is converted to internal energy, then to electromagnetic energy.

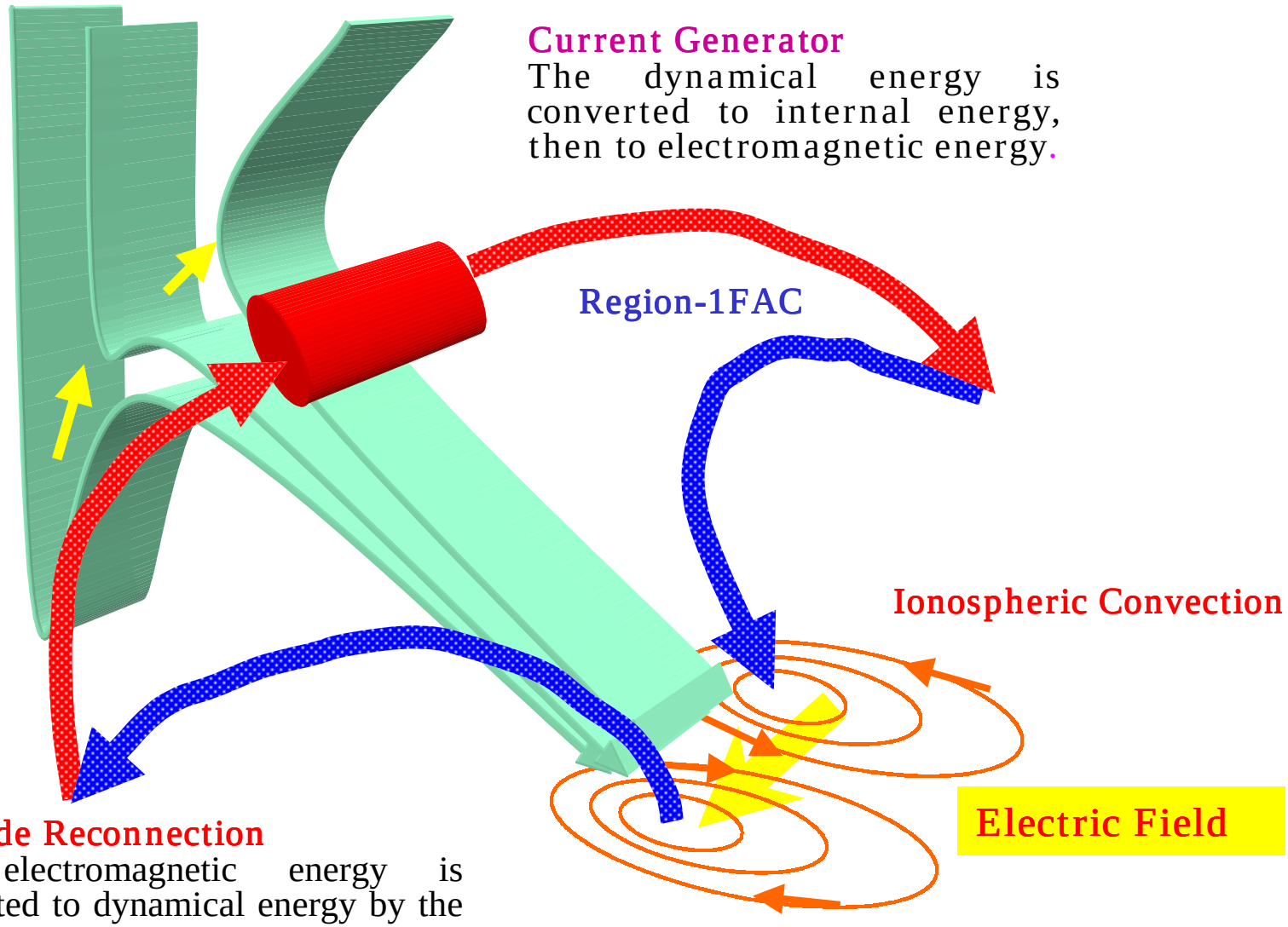
Configuration of Region 1 Current for the Southward IMF



[Tanaka, 1995]

- The dynamo in high-latitude side of the cusp becomes a driver of the dayside part of Region-1 current.

Ionospheric Convection Electric Field caused by the Region-1 FAC Intensification for Bz<0



Conclusion

- SuperDARN observations and MHD simulations indicate that the ionospheric convection is developed by an intensification of the Region 1 FAC centered at 16 MLT, rather than by magnetic flux transfer.