Formation of a polar cap patch observed by GPS tomography, space-borne magnetometers and HF backscatter

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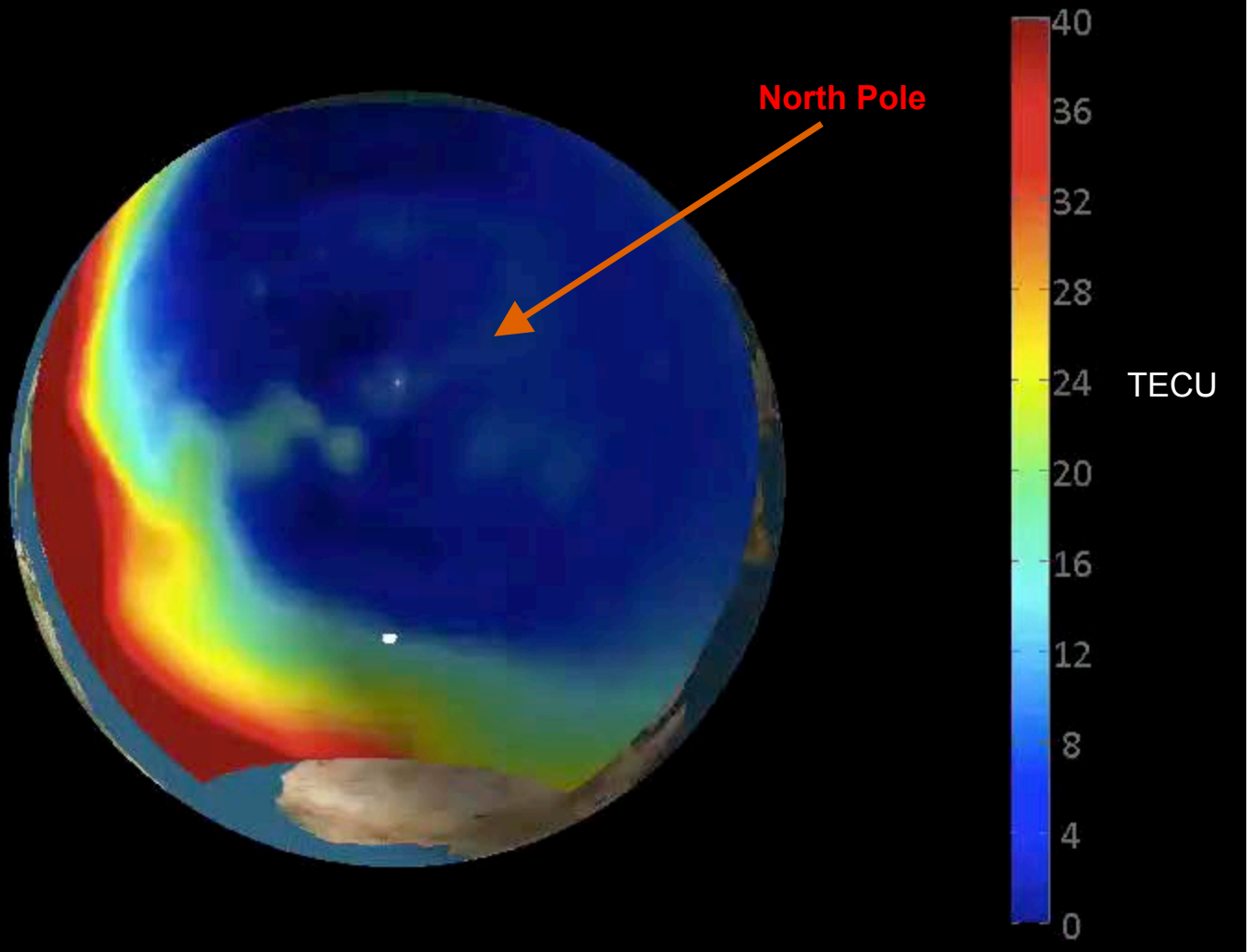
Patches in MIDAS TEC

4D ground GPS ionospheric tomography

TEC is height-integrated electron density

Plasma is convected across the polar cap from the sunlit dayside

The tongue of ionization breaks up into patches



Formation mechanisms *(under southward IMF)*

Flux transfer events. *Lockwood and Carlson* [1992]

- transient magnetopause reconnection
- equatorward boundary of convection pattern migrates equatorward and back poleward
- Flow convergence concentrates plasma into patches
- Period on the order of 2 - 20 minutes [*Elphic,* 1988]

Flow channel events. *Rodger et al.* [1994]

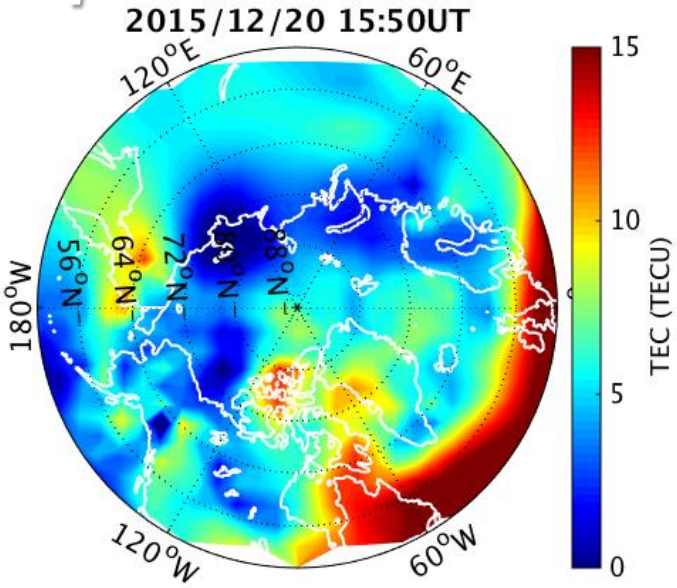
- plasma jets in dayside cusp cause depletions in TOI
- short-lived (~2 min), latitudinally narrow (~100 km), longitudinally extended (~900 km), velocities up to ~3 km/s
- azimuthal flow changes in the convection pattern

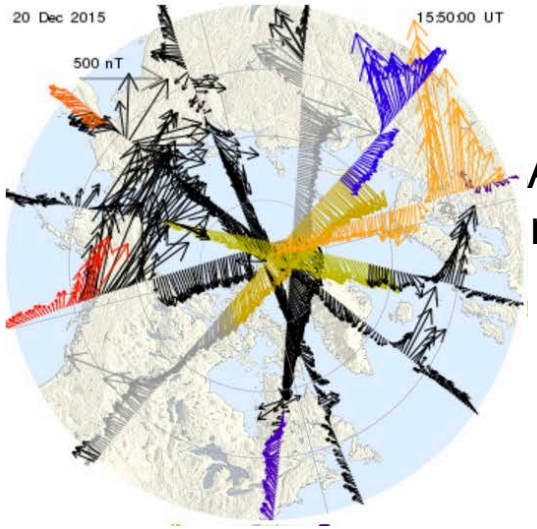
Contorted TOI. *Sojka et al.* [1993]

- Steady southward IMF Bz causes TOI to form
- By variations cause azimuthal variations of convection pattern
- TOI becomes contorted into structures that appear to be patches to many instruments

Patch formation in MIDAS, AMPERE and SuperDARN

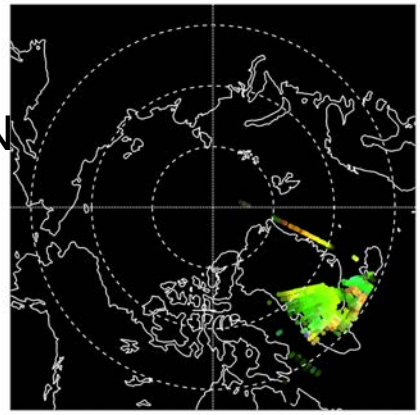
MIDAS

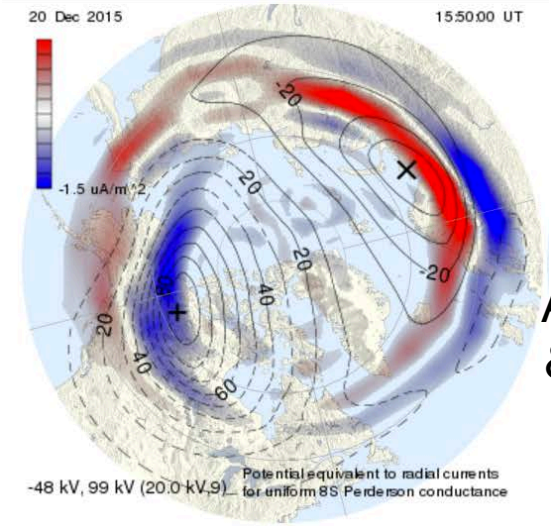




AMPERE
raw vectors

SuperDARN
backscatter
Doppler





AMPERE FAC
& convection

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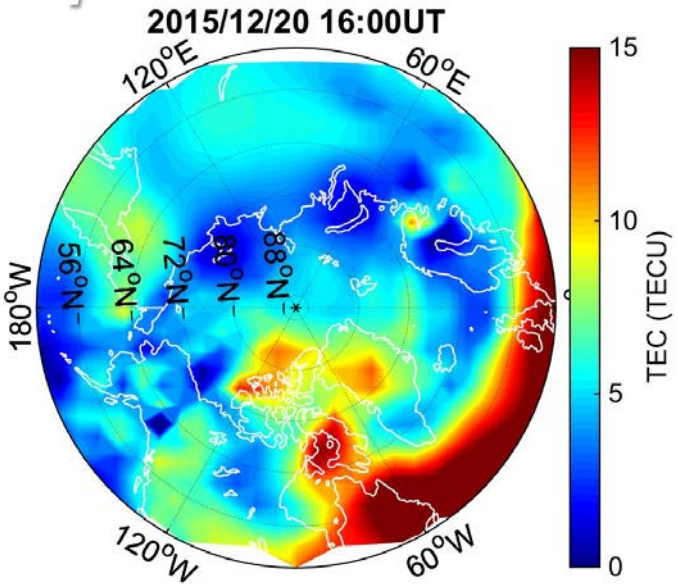

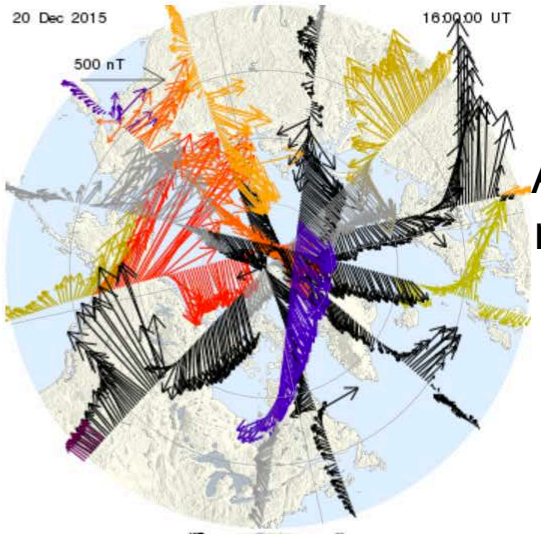

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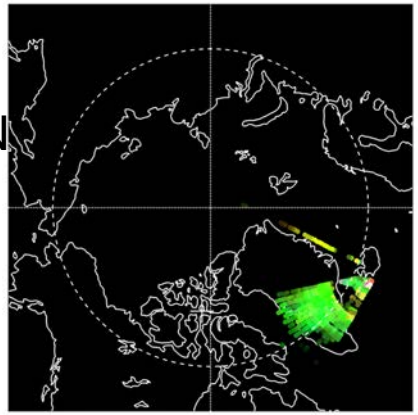

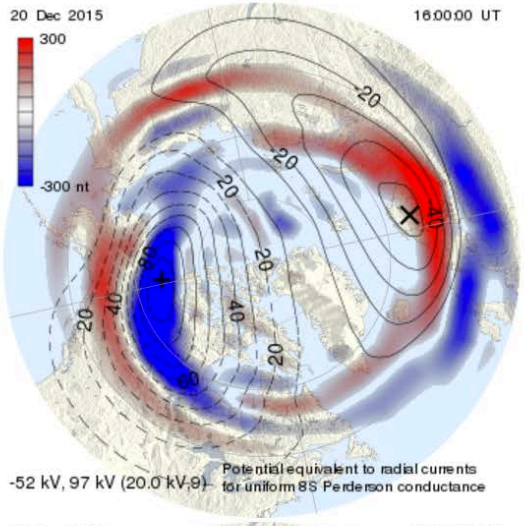

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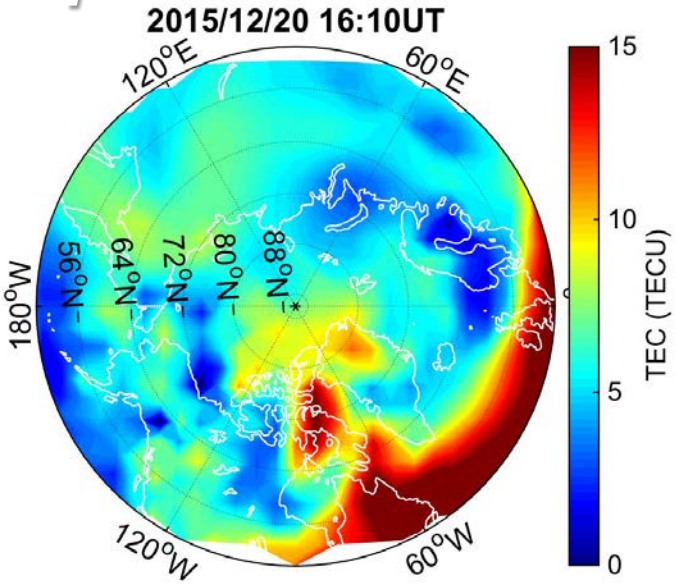

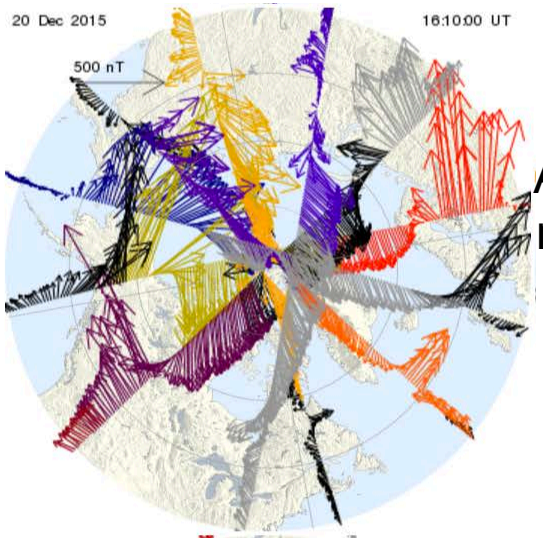

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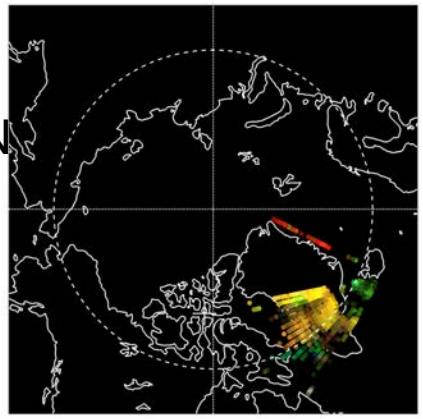
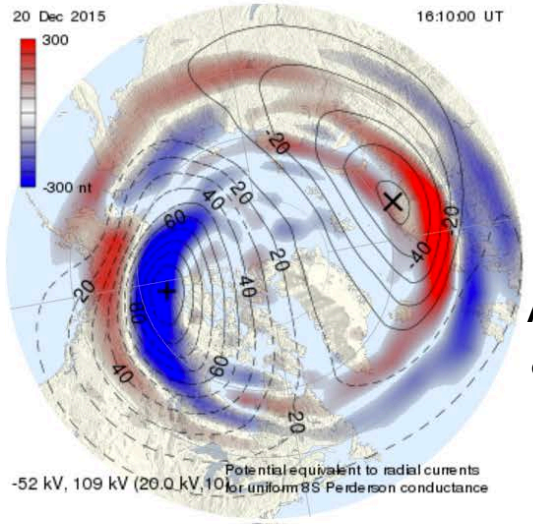
SuperDARN backscatter Doppler





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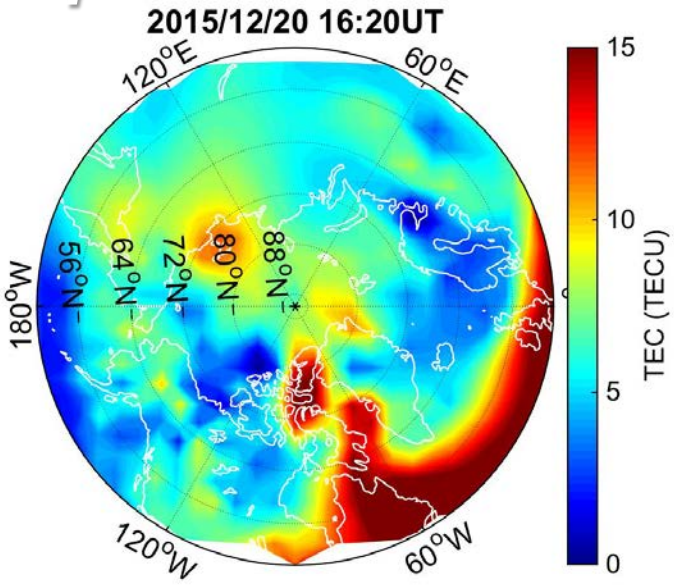

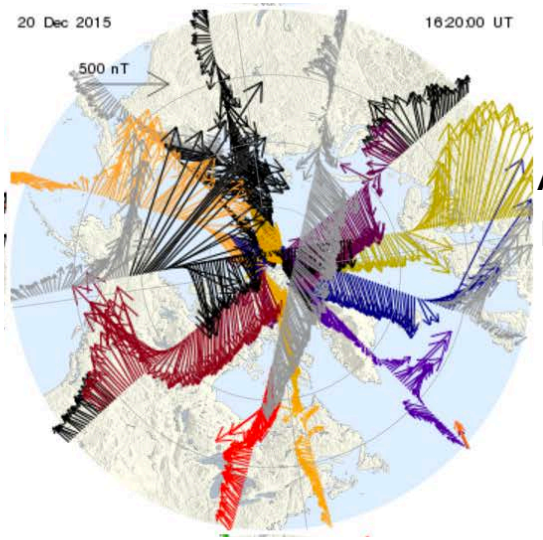

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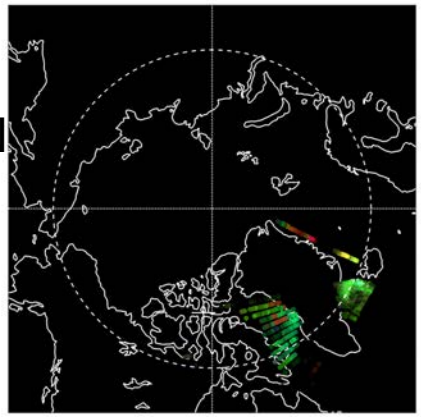

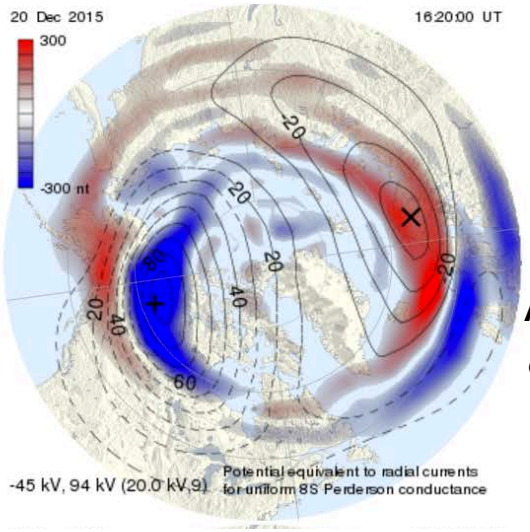

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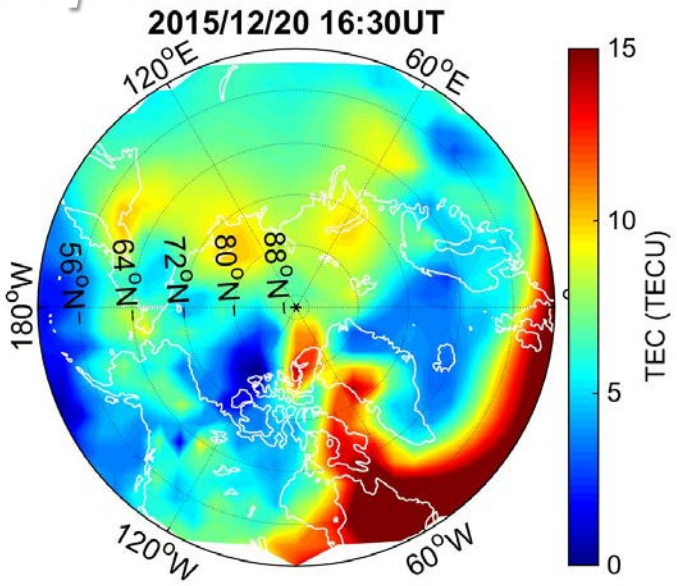

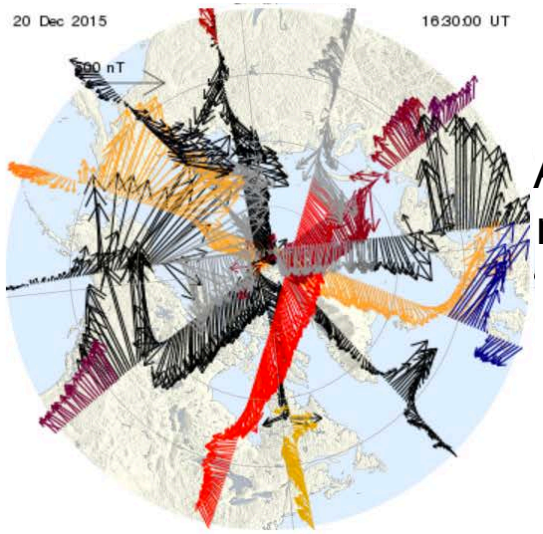

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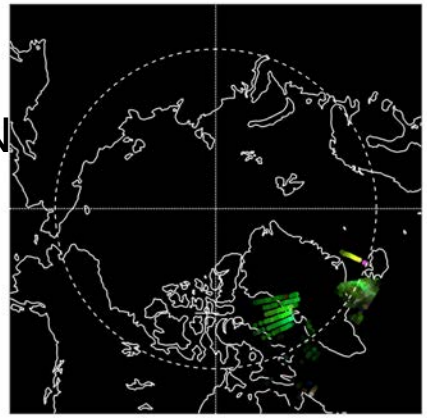

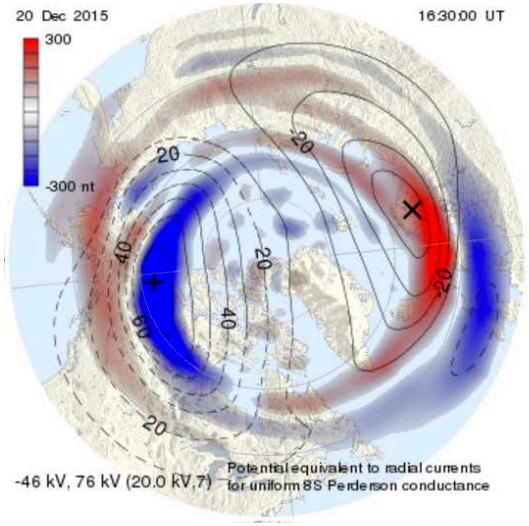

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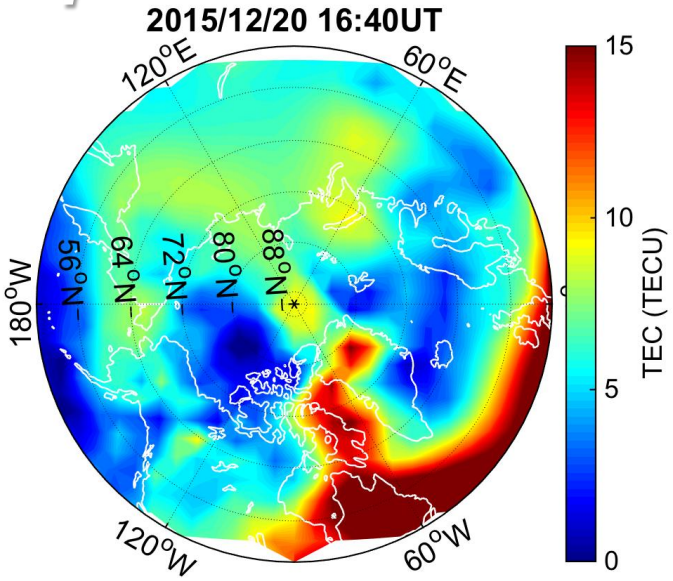

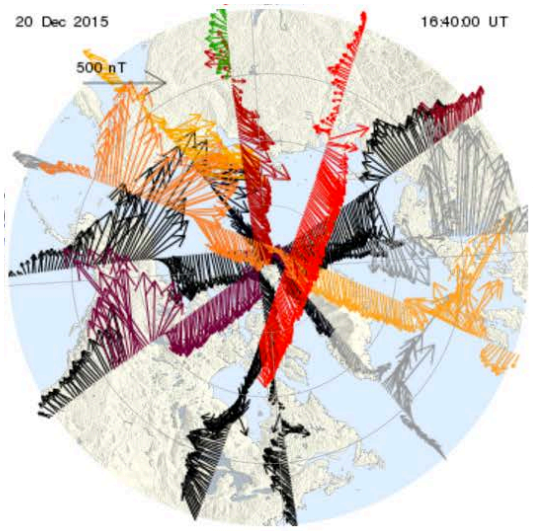

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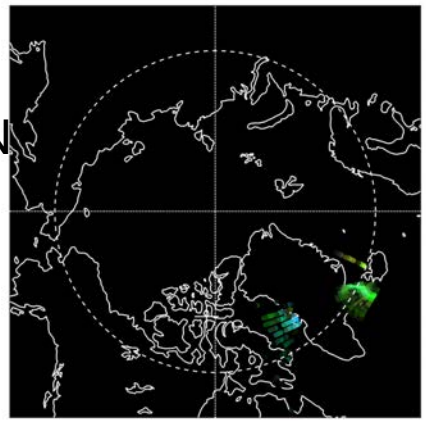
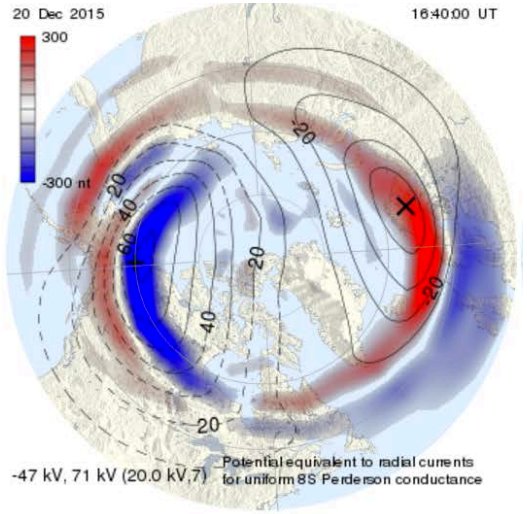
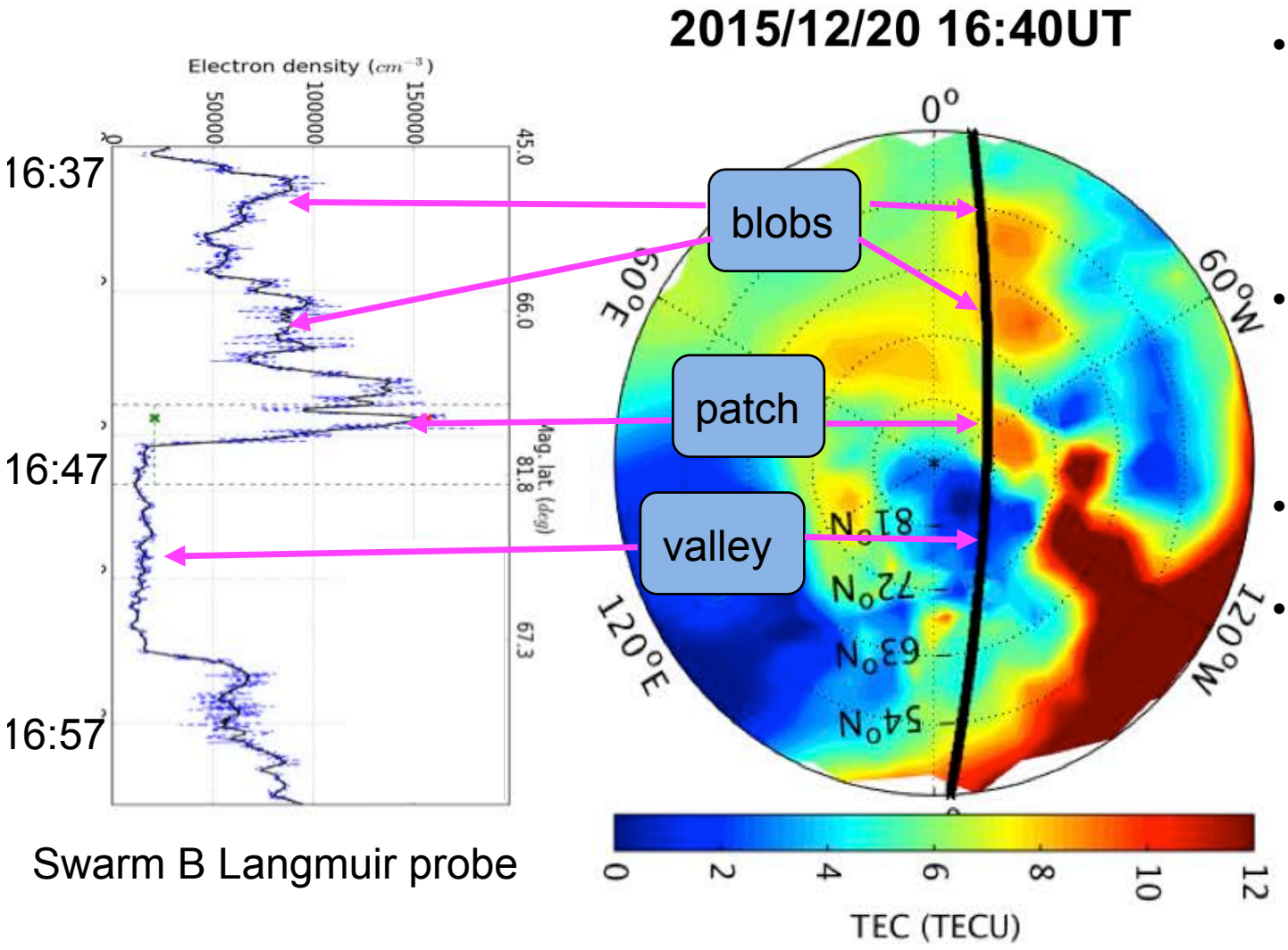




AMPERE FAC
& convection

Swarm Validation



Swarm B Langmuir probe

- Major features of Swarm densities match MIDAS image
- Swarm measures electron density ~500 km altitude
- MIDAS shows TEC
- Swarm pass takes ~20 min. Polar cap ionosphere is highly dynamic during this period

Summary

- Azimuthal flow variations linked to *By* transitions (proposed by *Sojka et al.* [1993]) are seen during formation of this patch
- No indication of expanding and contracting polar cap predicted during Flux Transfer Events [*Lockwood and Carlson,* 1992]
- No indication of longitudinally narrow km/s plasma jet predicted during Flow Channel Events [*Rodger et al.* 1994]