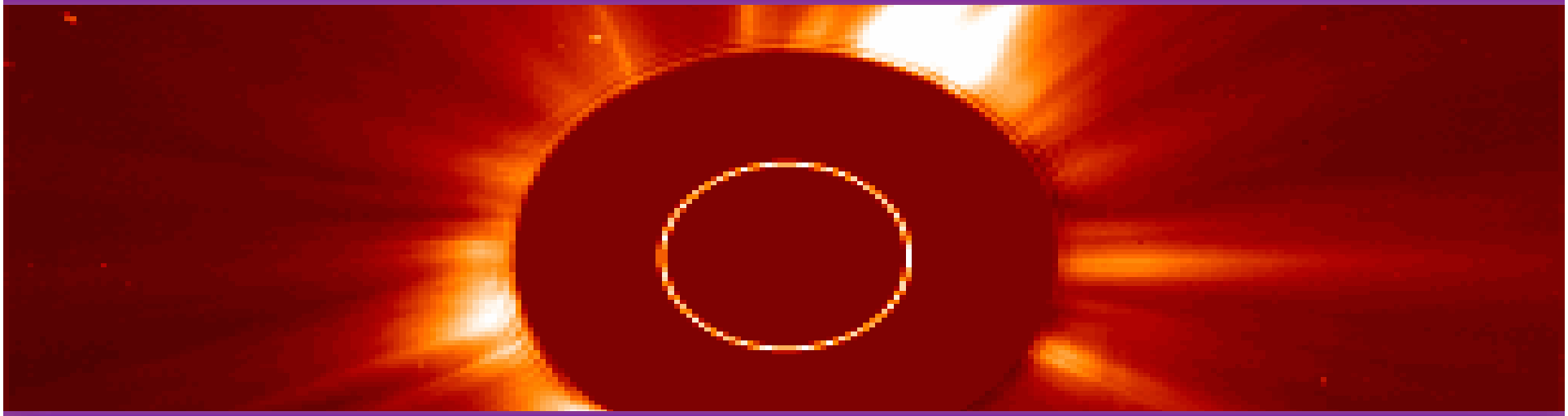
Multi-instrument observations of inner-magnetospheric density structures and dynamics



Endawoke Yizengaw and Mark B. Moldwin

Institute of Geophysics and Planetary Physics (IGPP)
University of California, Los Angeles (UCLA)

CEDAR-DASI Workshop, Santa Fe, New Mexico, 25 June 2007

Talk Outline

- Introduction
- What is the correlation between mid-latitude trough and plasmapause?
- What does the structure of ion outflows look like as a function of altitude?
- What is the potential opportunities of COSMIC GPS TEC to better understand MI coupling phenomenon?
- What is the global signature of SED TEC plumes?
- What is the storm aftermath response of the plasmasphere inside the plasmapause?
- Conclusion

UCLA

Plasmasphere-Ionosphere Coupling

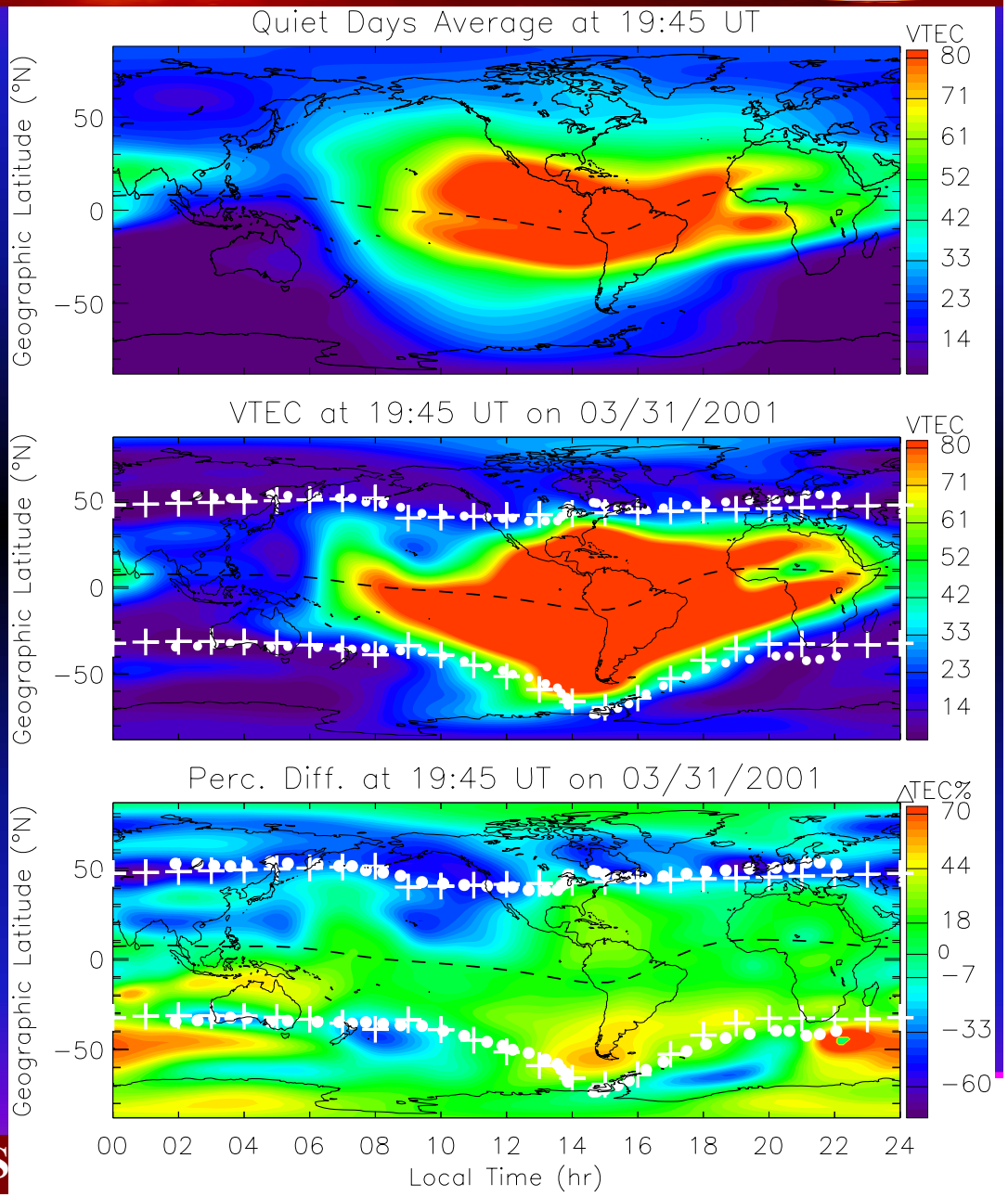
Yizengaw et al., GRL, 2005

Empirical Model estimation of Mid-latitude trough!

$$\Lambda_T = 65.2^\circ - 2.1K_P - 0.5t$$

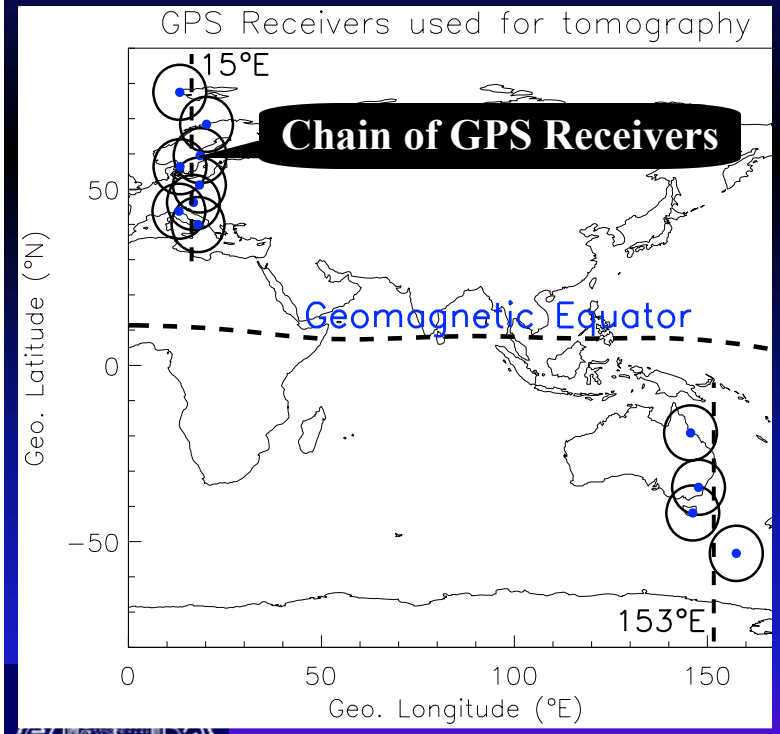
$$-15 \le t < 9 \text{ hours}$$

Moffett and Ouegan [1983]



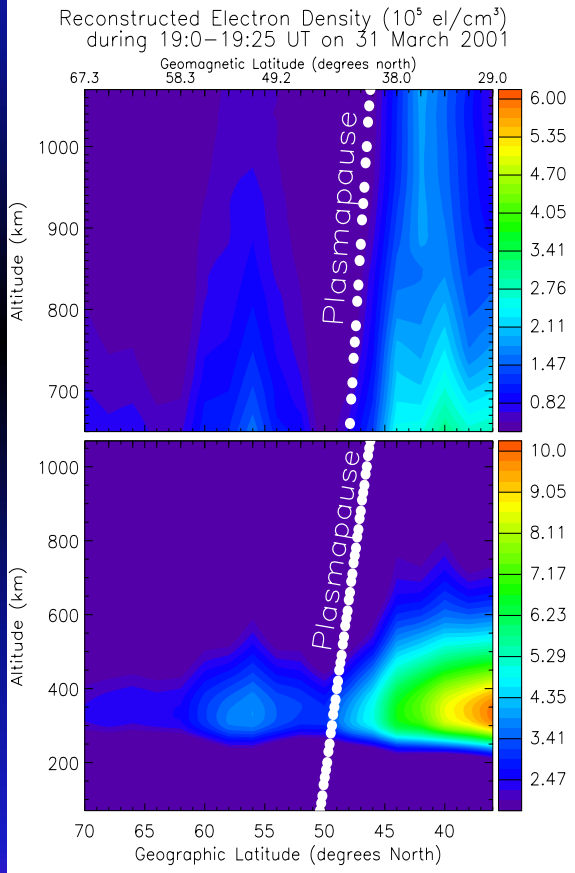
Filling the ga

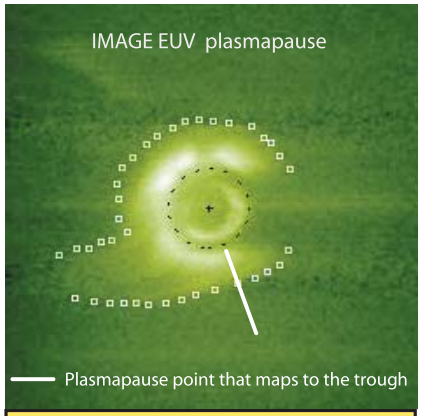
Tomographic approach

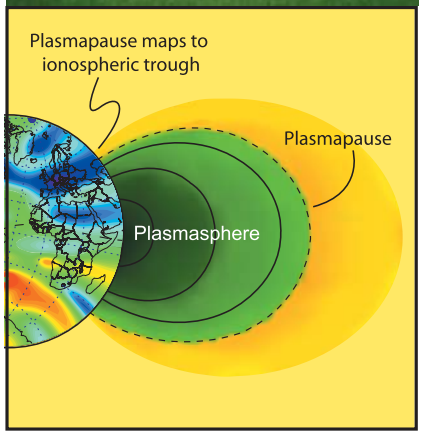


Geophysical Research Letters

16 MAY 2005
Volume 32 Number 9
American Geophysical Union





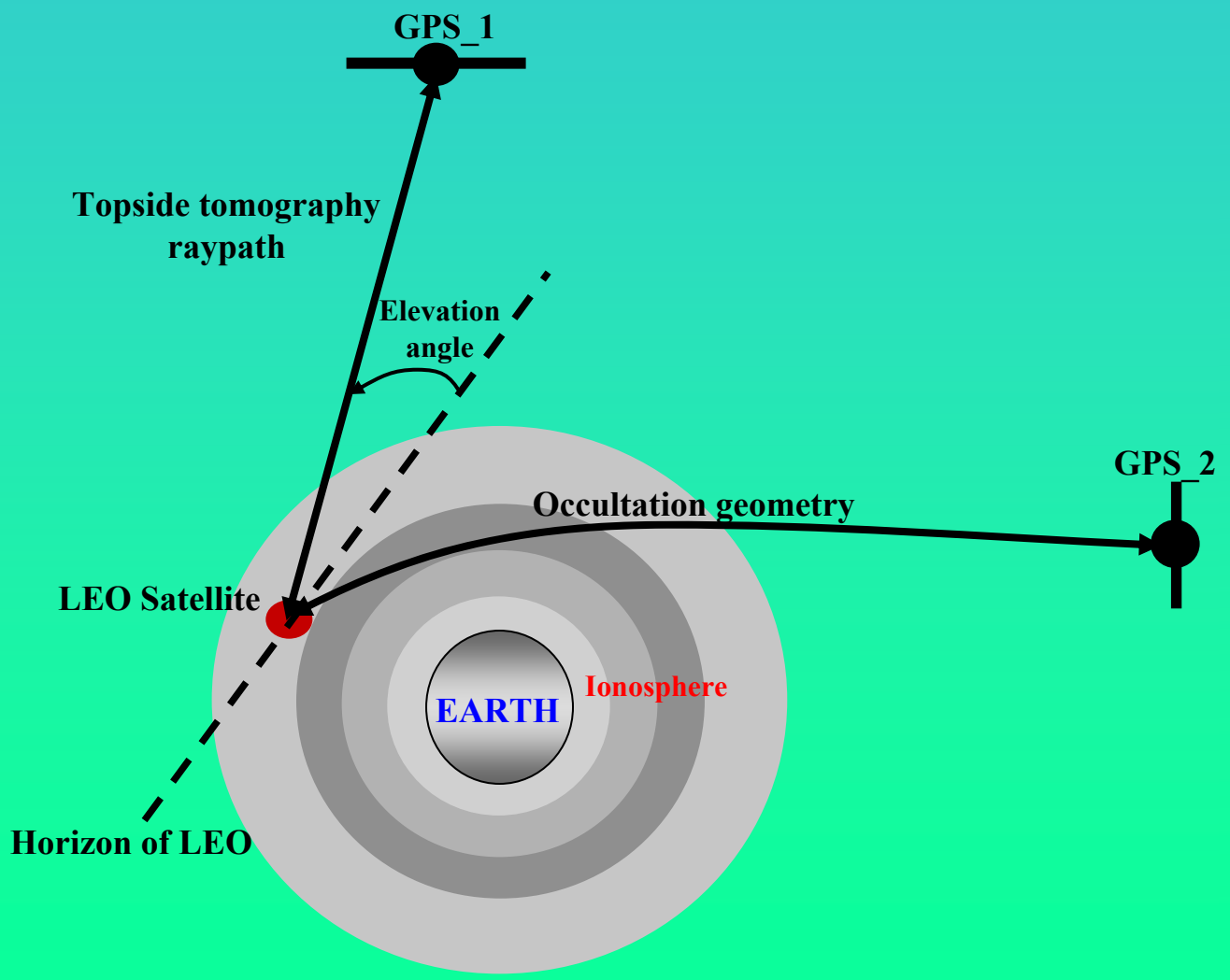


CEDAR-DASI Worksho

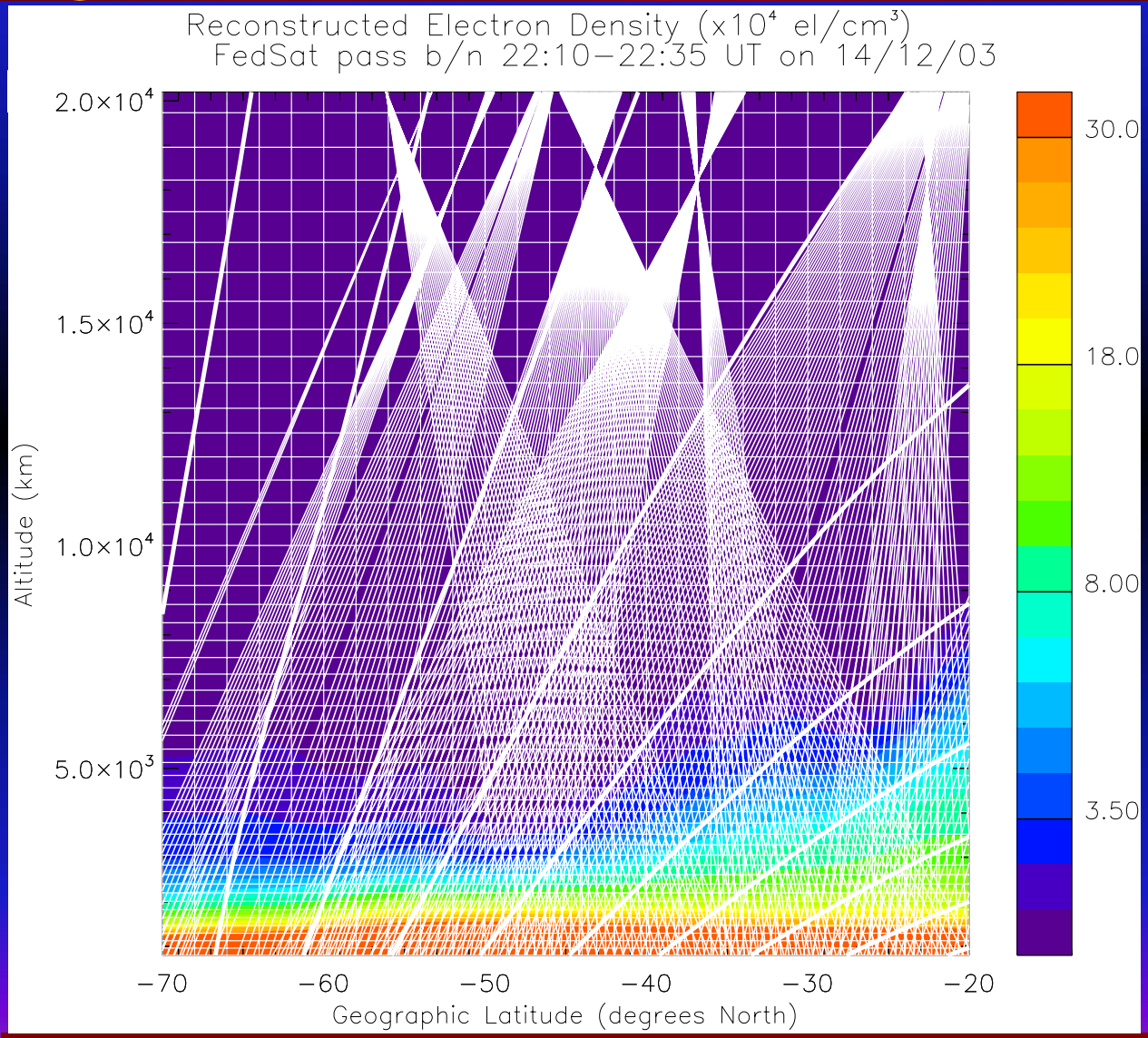
Connecting outer space to the edge of Earth's atmosphere • Tsunami warning system for the Indian Ocean • Saharan dust gives clues to weather patterns

Yizengaw and Moldwin, GRL, 2005

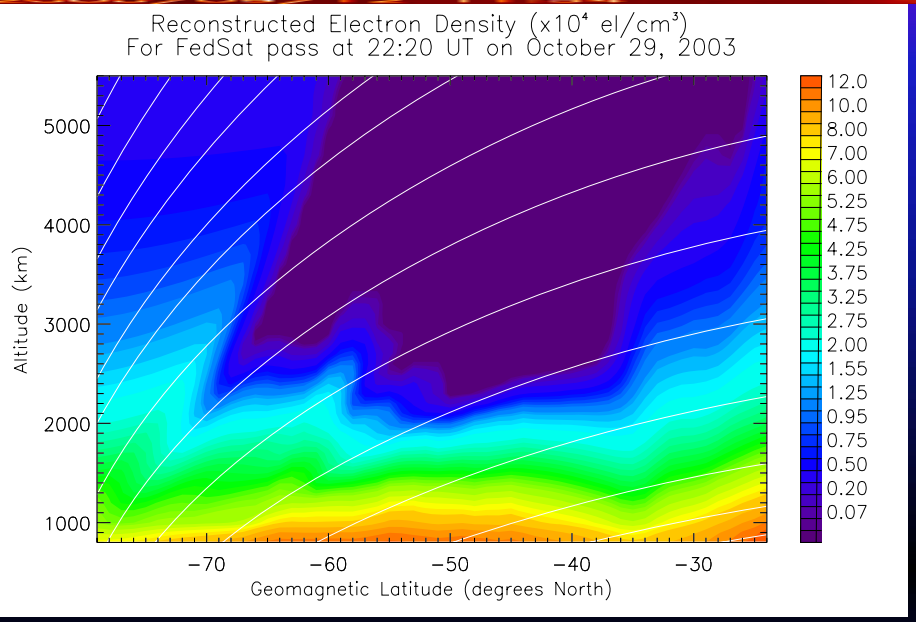
Application of Tomography to Low Earth Orbit (LEO) GPS data

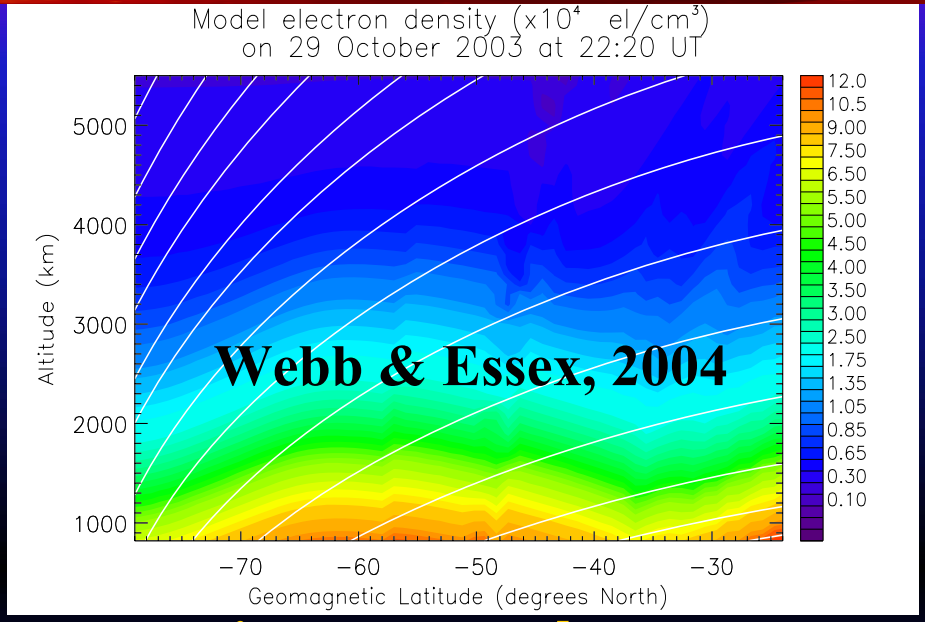


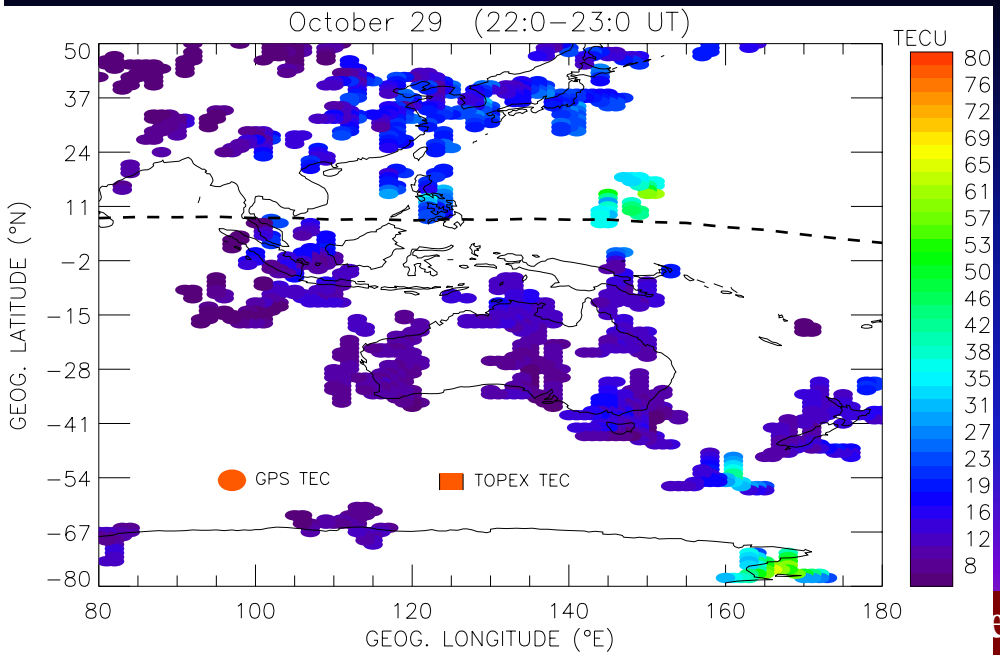
Application of Tomography to LEO-GPS TEC



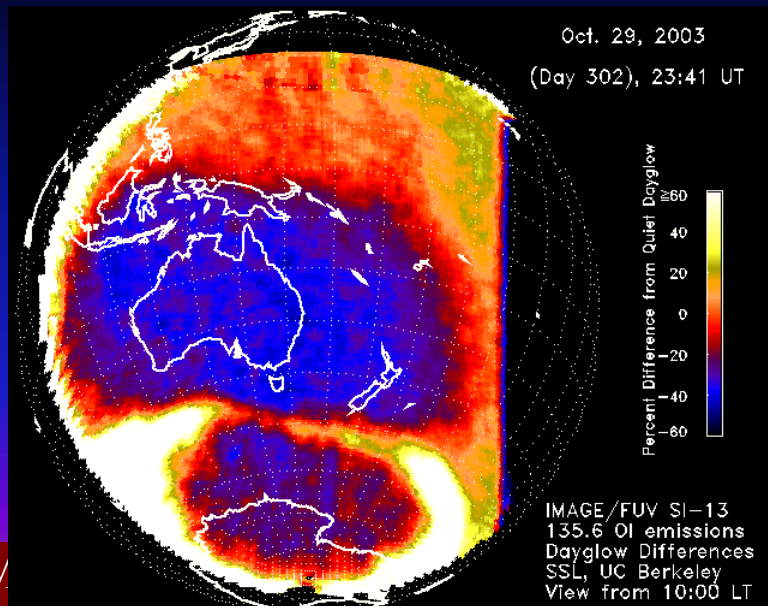
FedSat-GPS Tomography







Yizengaw et al., JGR, 2005



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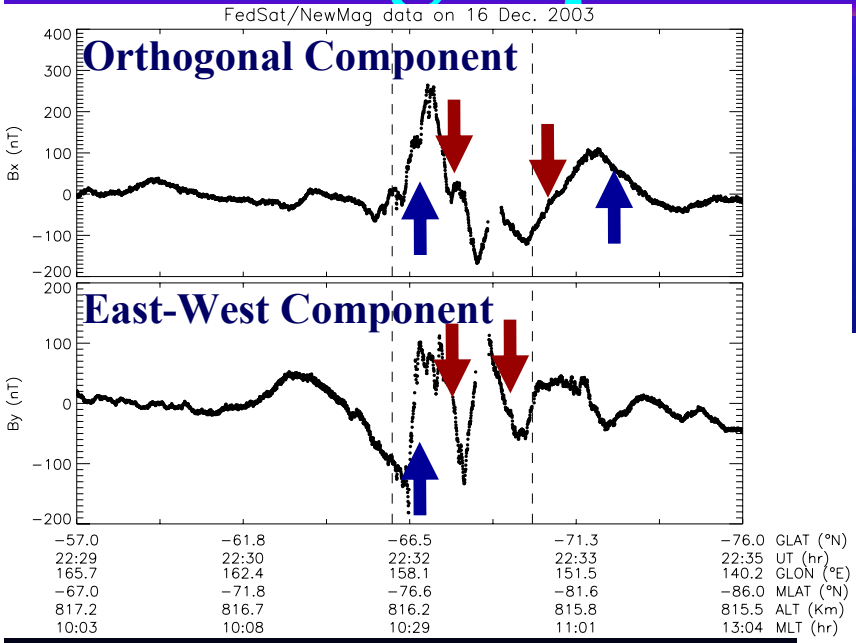
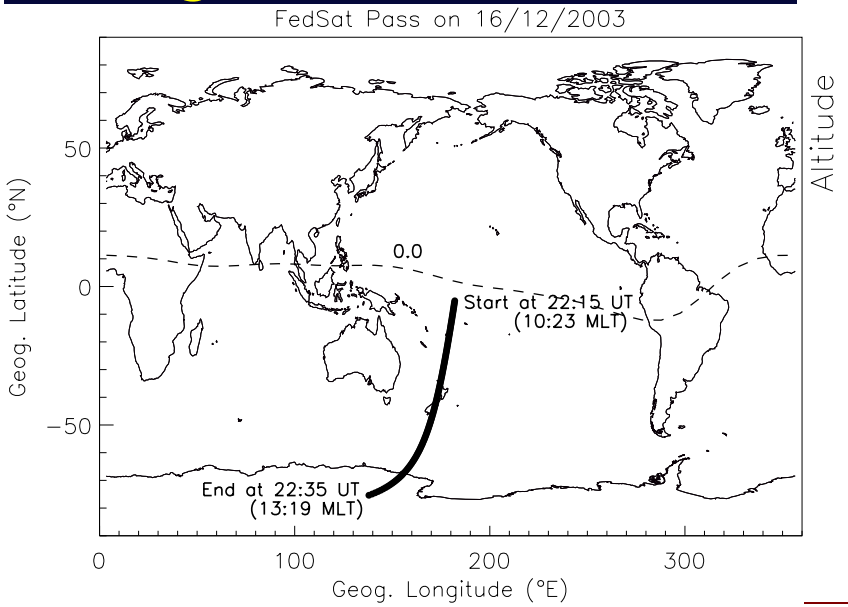
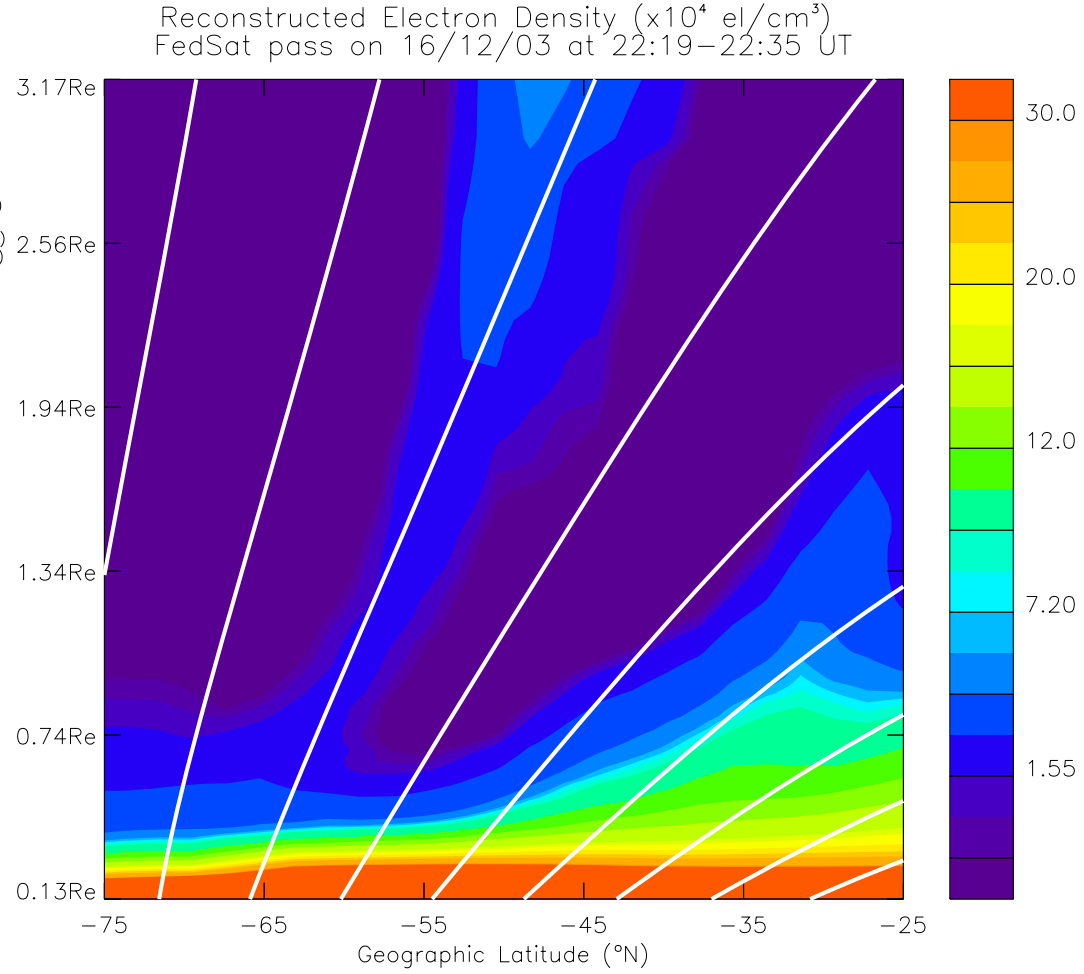
Tomographic image of Ion outflow



The presence of upward FAC sheets indicate the existence of precipitated electron in the cusp region where the ion outflows occurred.

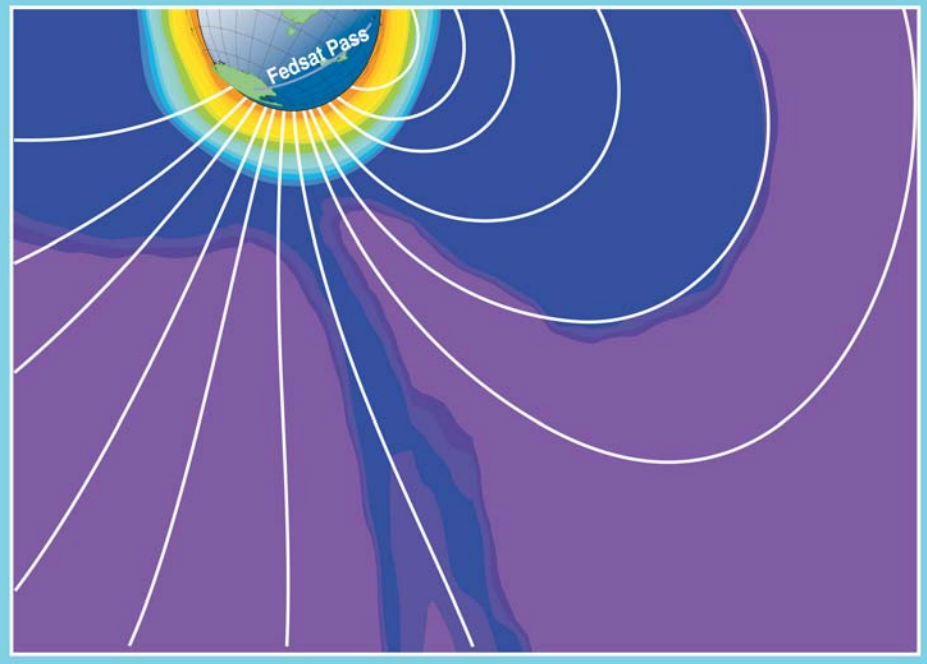
Yizengaw et al.,GRL, 2006b





Geophysical Research Letters

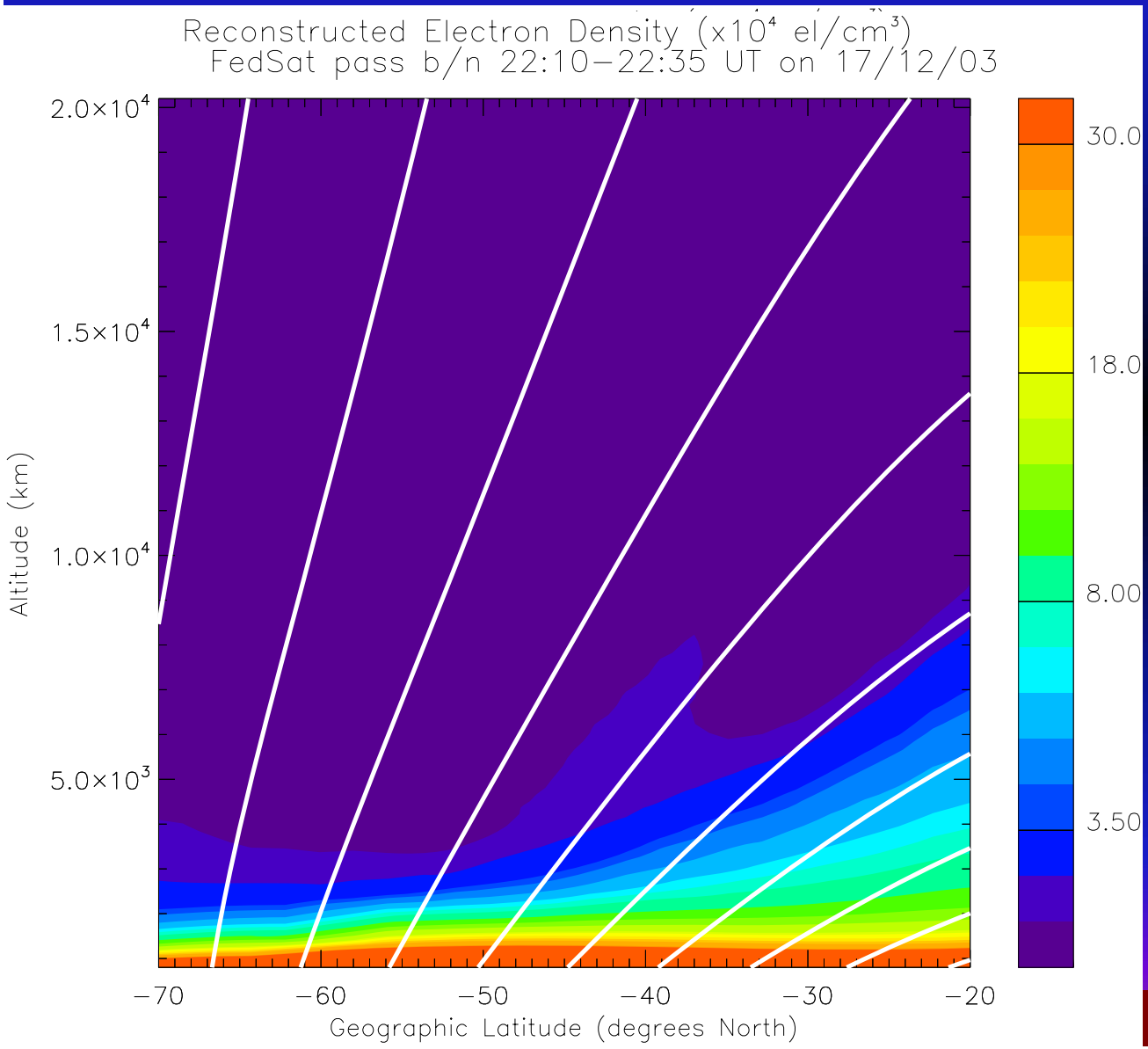
28 OCTOBER 2006
Volume 33 Number 20
American Geophysical Union



Yizengaw et al., GRL, 2006b

First tomographic image of ionospheric outflows • Detailed analyses of the October 2005 Pakistan earthquake • China's surface temperatures to increase despite decrease in insolation

Tomographic images of Ion outflows

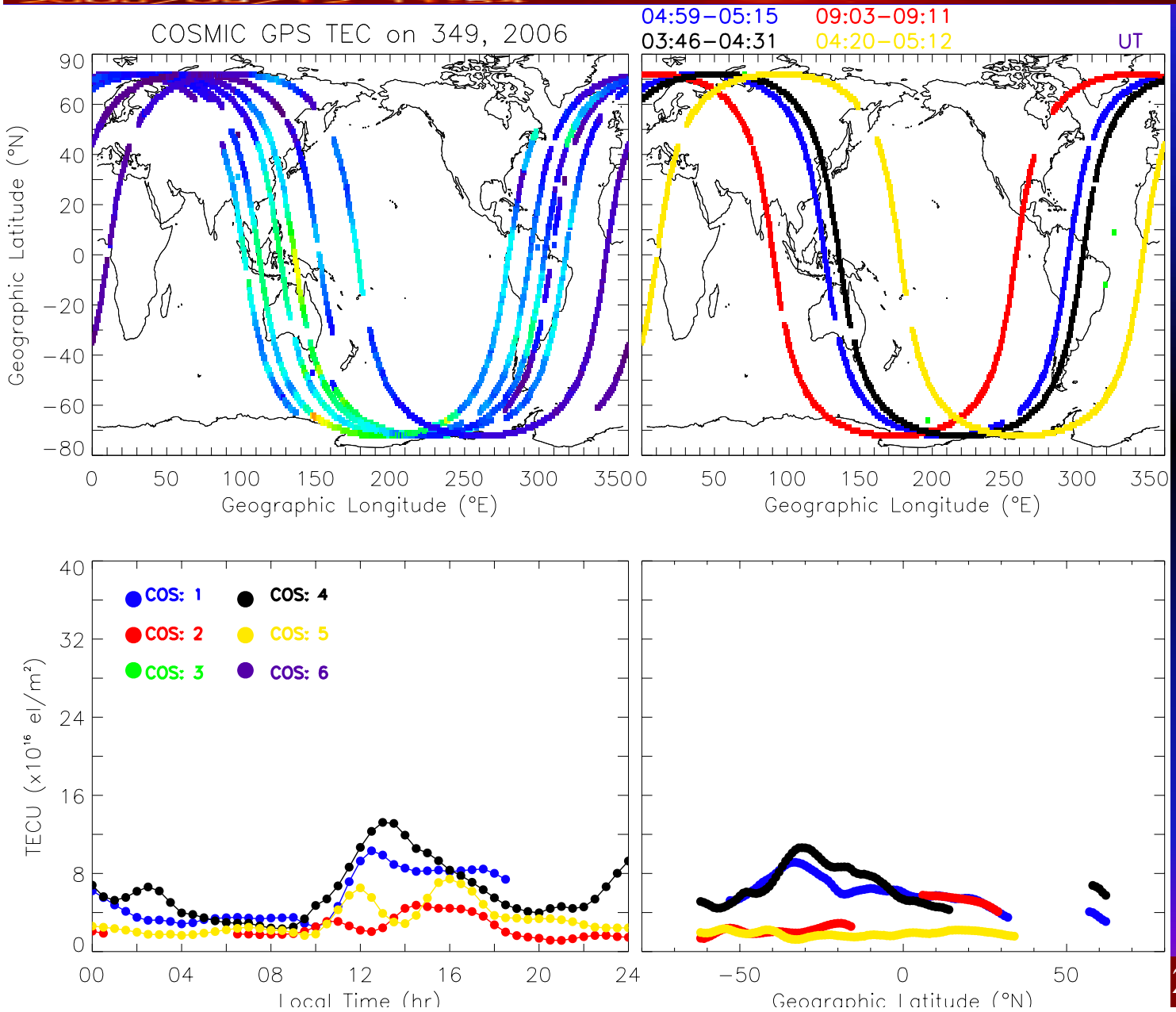


At the same time next day

25 June 2007

UCLA

Opportunities of COSMIC TEC



COSMIC GPS TEC data coverage

COS 1, 3, & 4 were at ~500 km

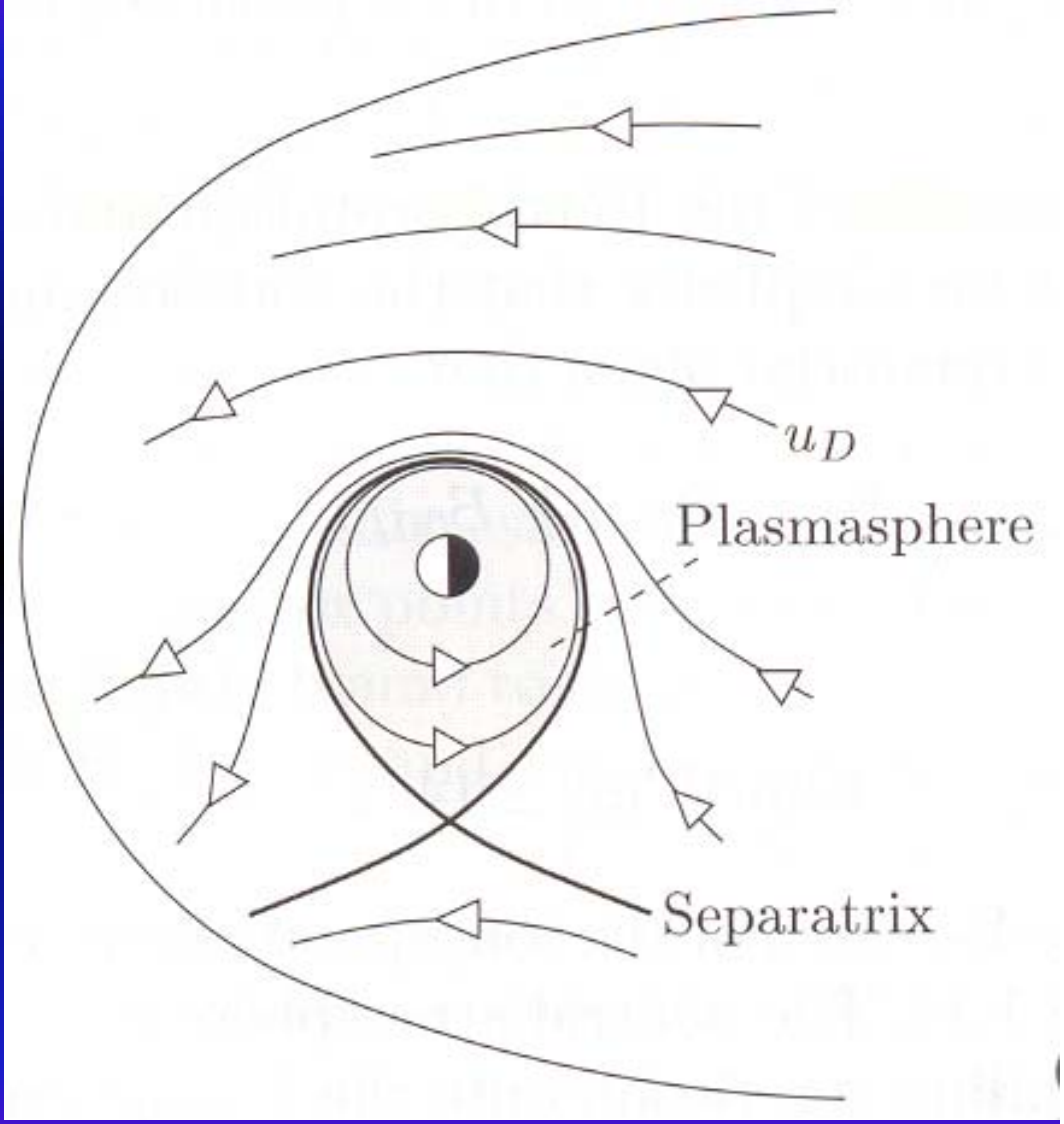
COS 2, 5, & 6 were at ~800 km

2007

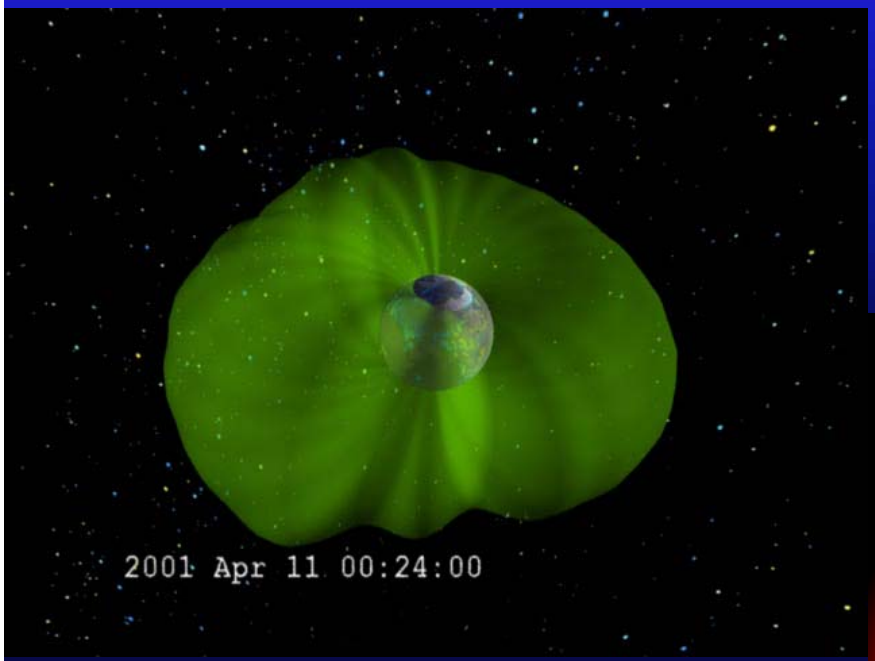
UCLA

Plasmaspheric driving forces

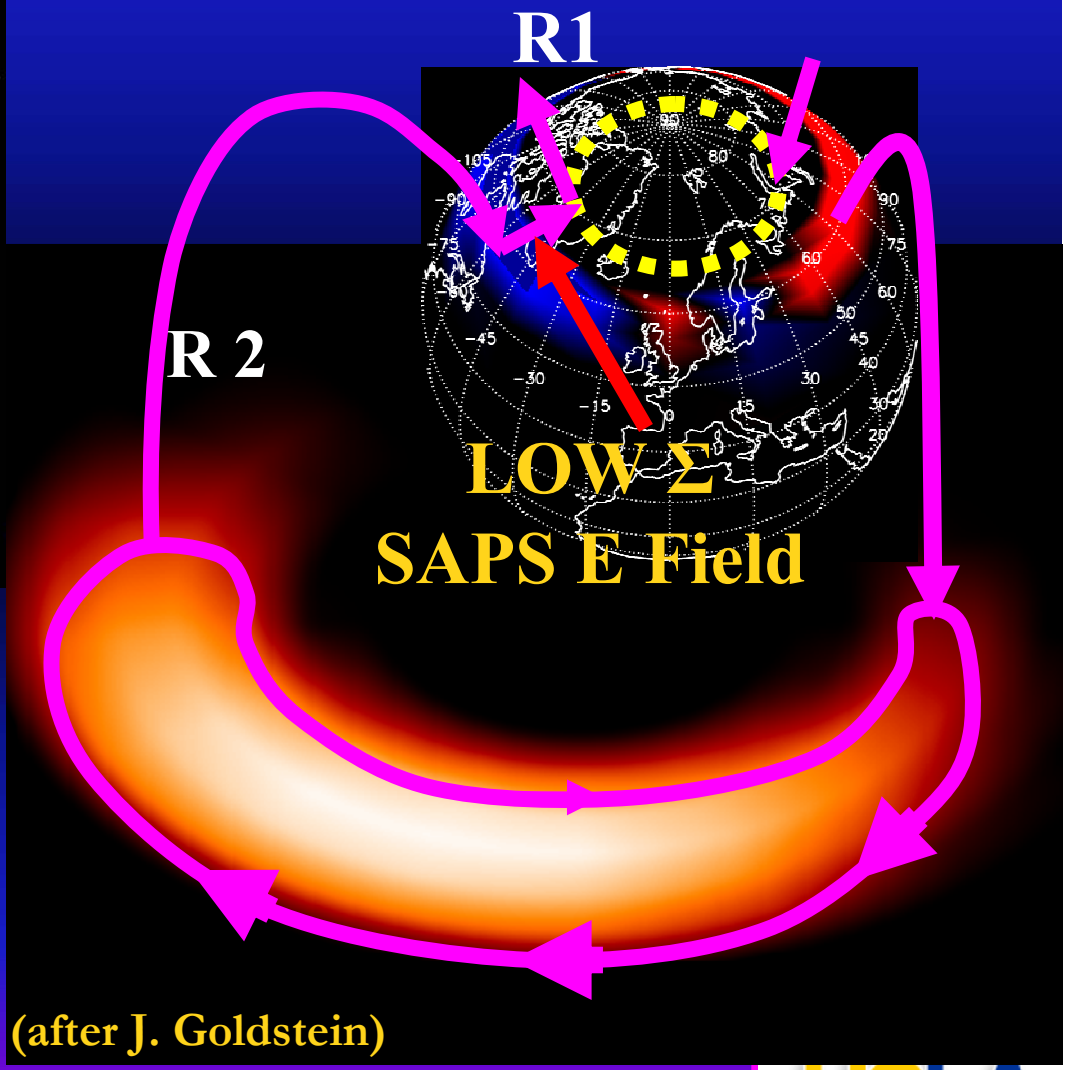
- Corotational E-field (produced in the ionospheric E-layer and conveyed into the plasmasphere along the B-field), which is weak.
- Convection E-field (applied to the magnetosphere by its interaction with the solar wind), which is large.
- The two then superimposed and form SAPS E-field that creates a drift pattern, forming plasmaspheric plume.



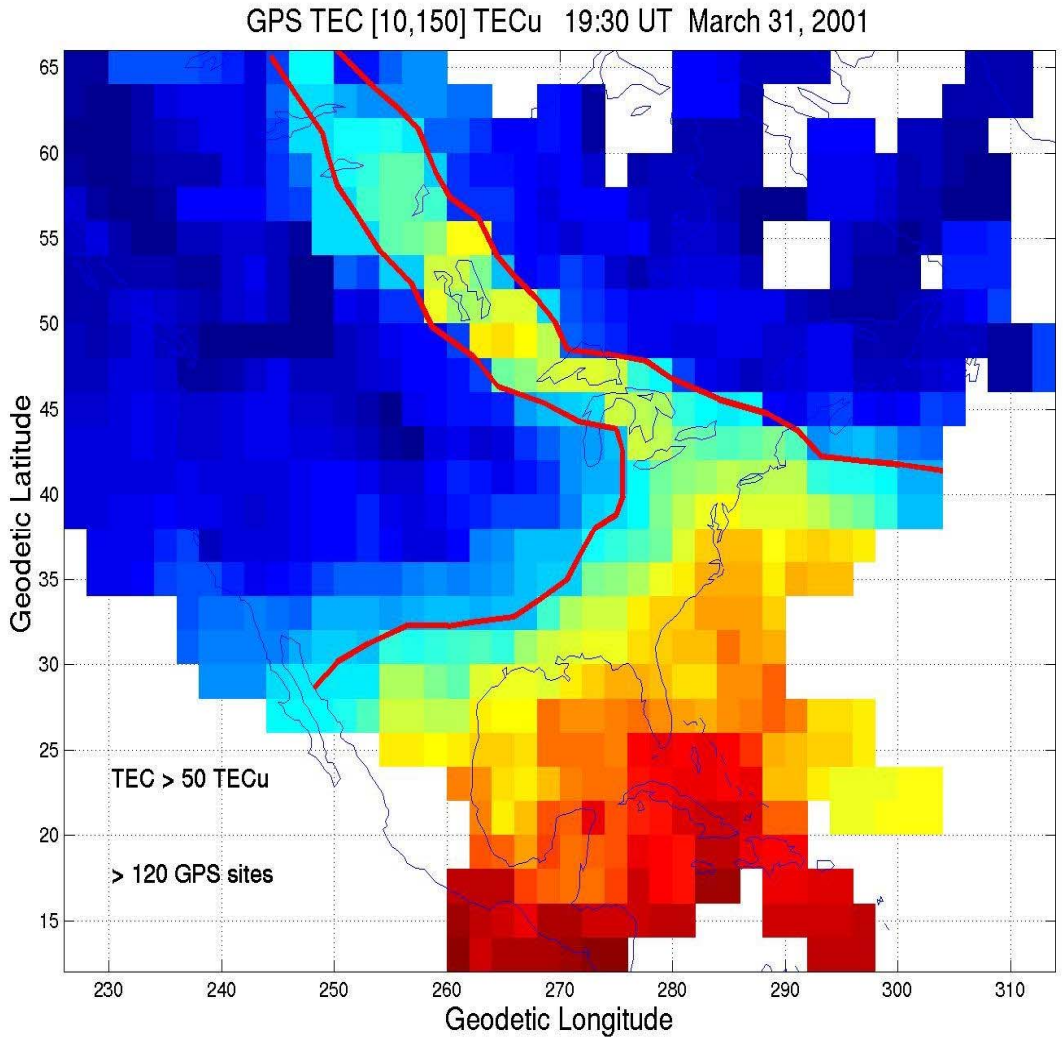
SAPS effect on the ionosphere



How does this come down to the ionosphere?



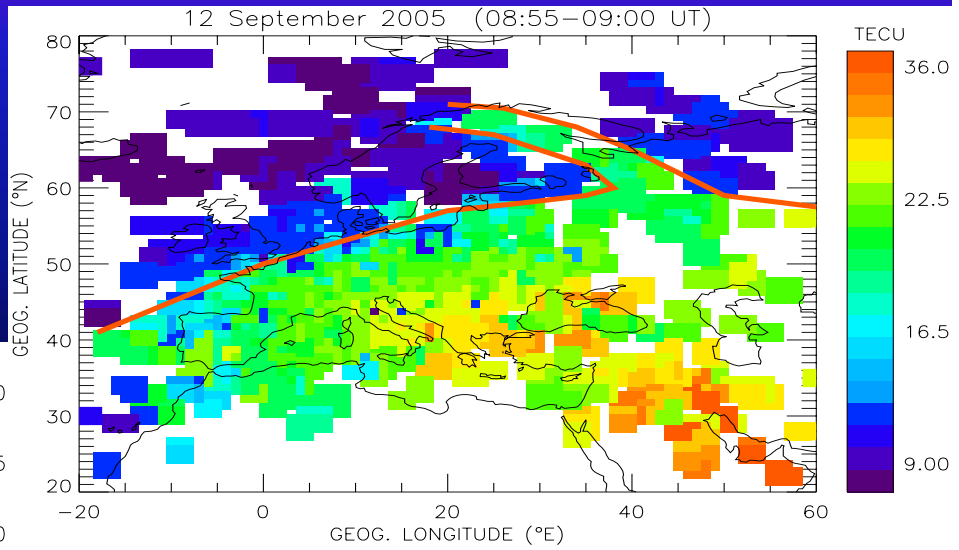
SAPS general effect on the ionosphere



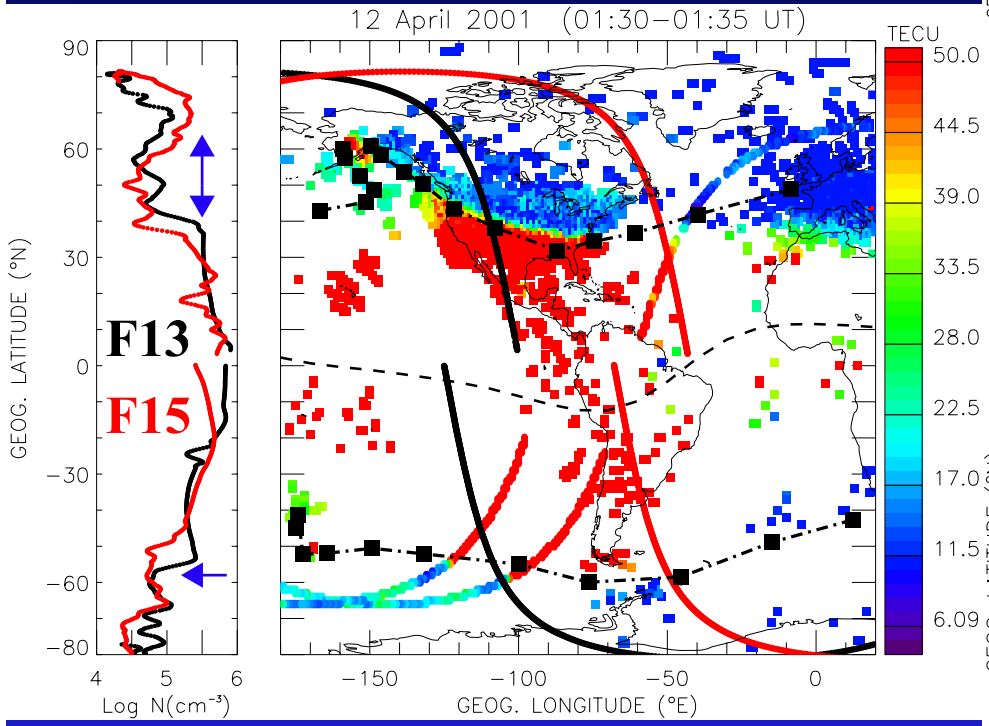
Foster et al., GRL, 2002

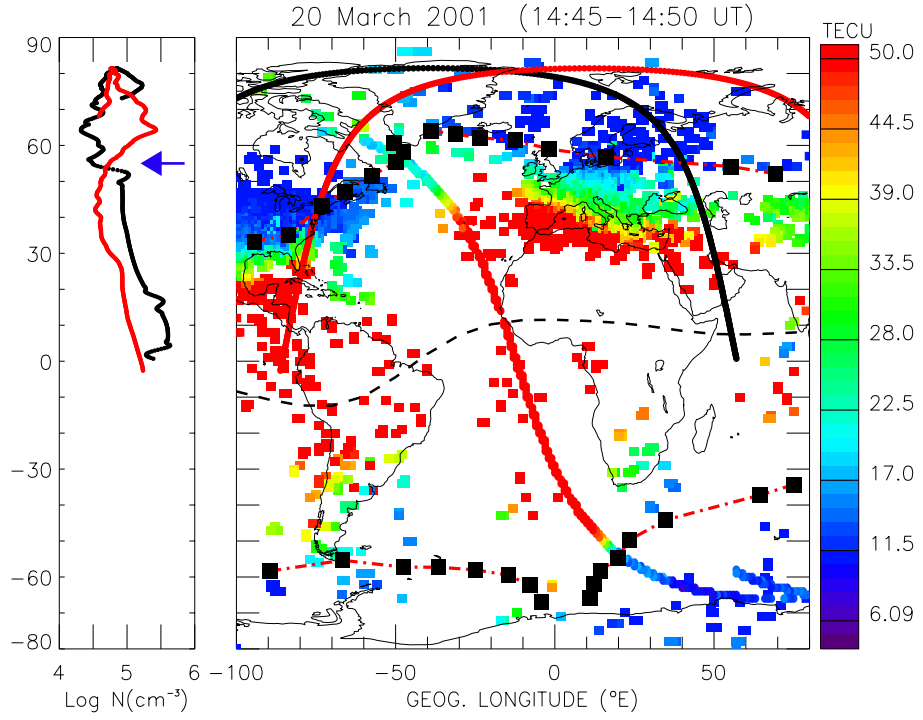
SAPS global effect on the ionosphere

Over Europe; Yizengaw et al., GRL, 2006a



Over North America



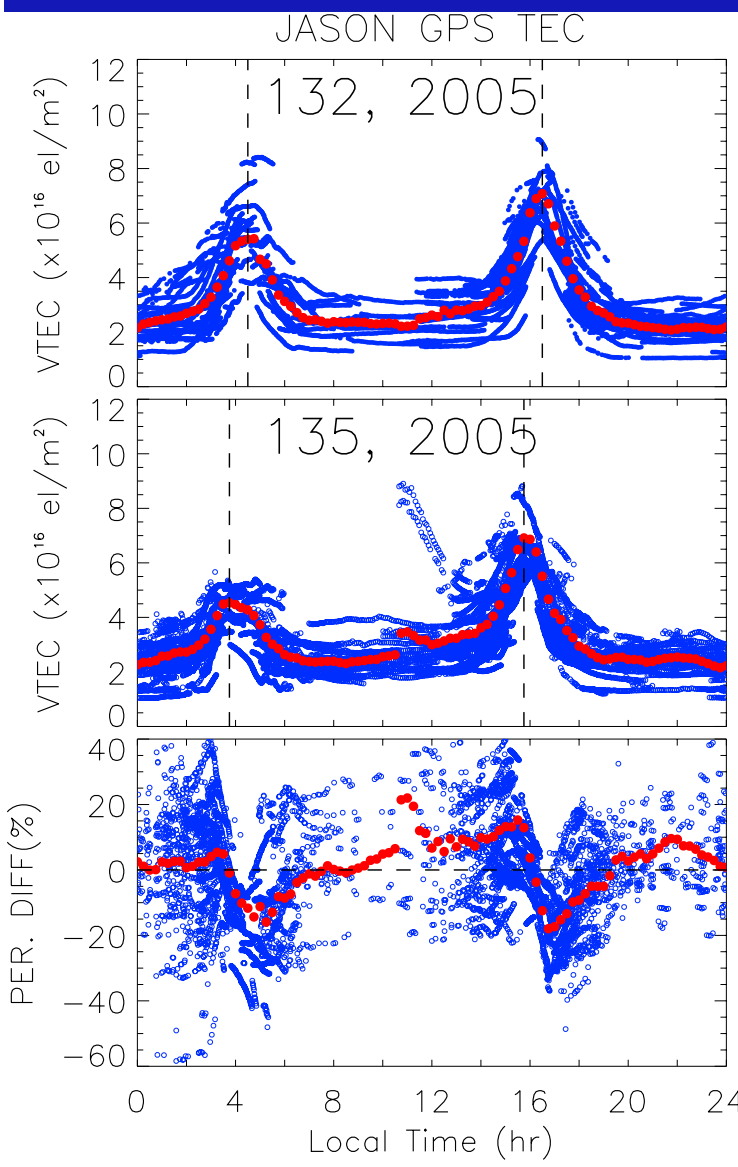


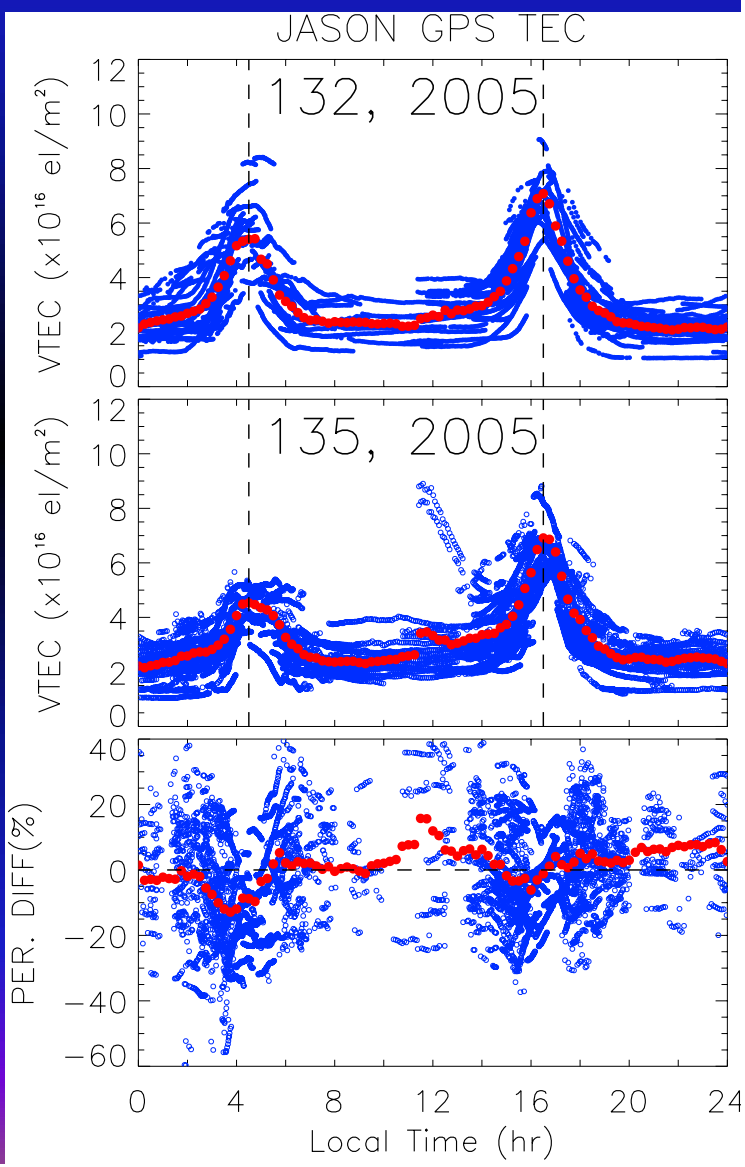
Over Atlantic Ocean

Yizengaw et al., JGR, 2007

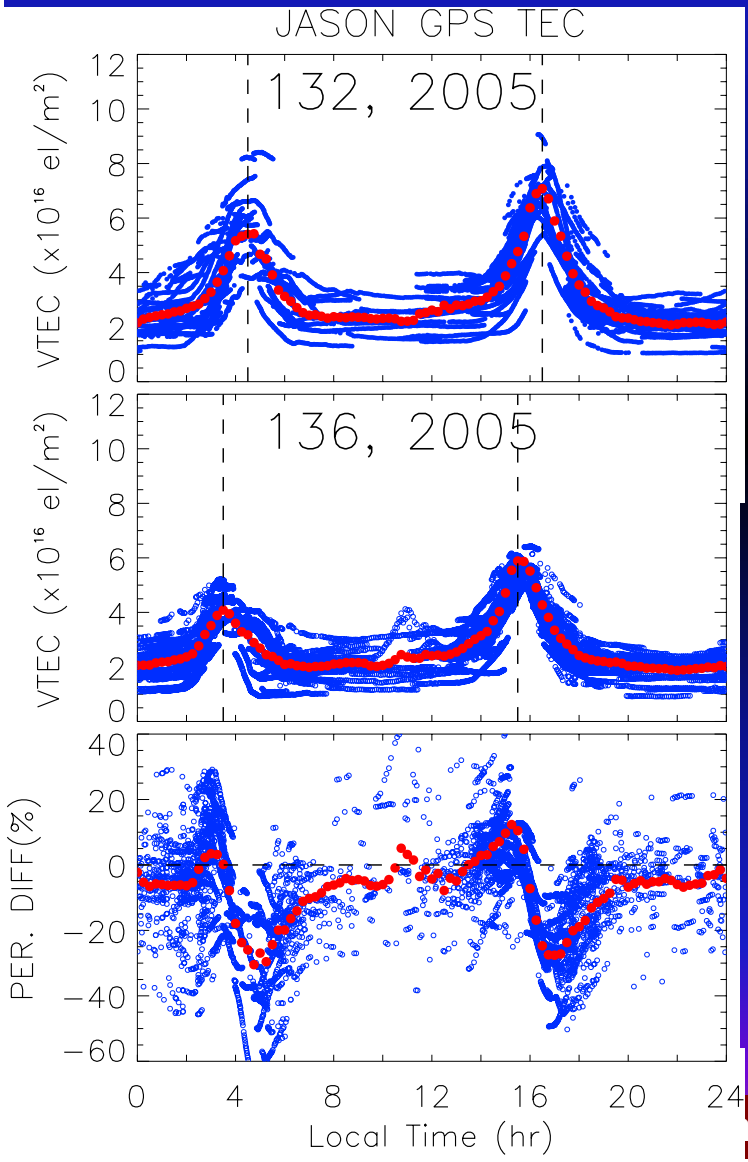
Storm aftermath response of plasmasphere inside the plasmapause

- **JASON orbits at ~ 1335 km altitude**
- **Provide plasmaspheric GPS TEC**

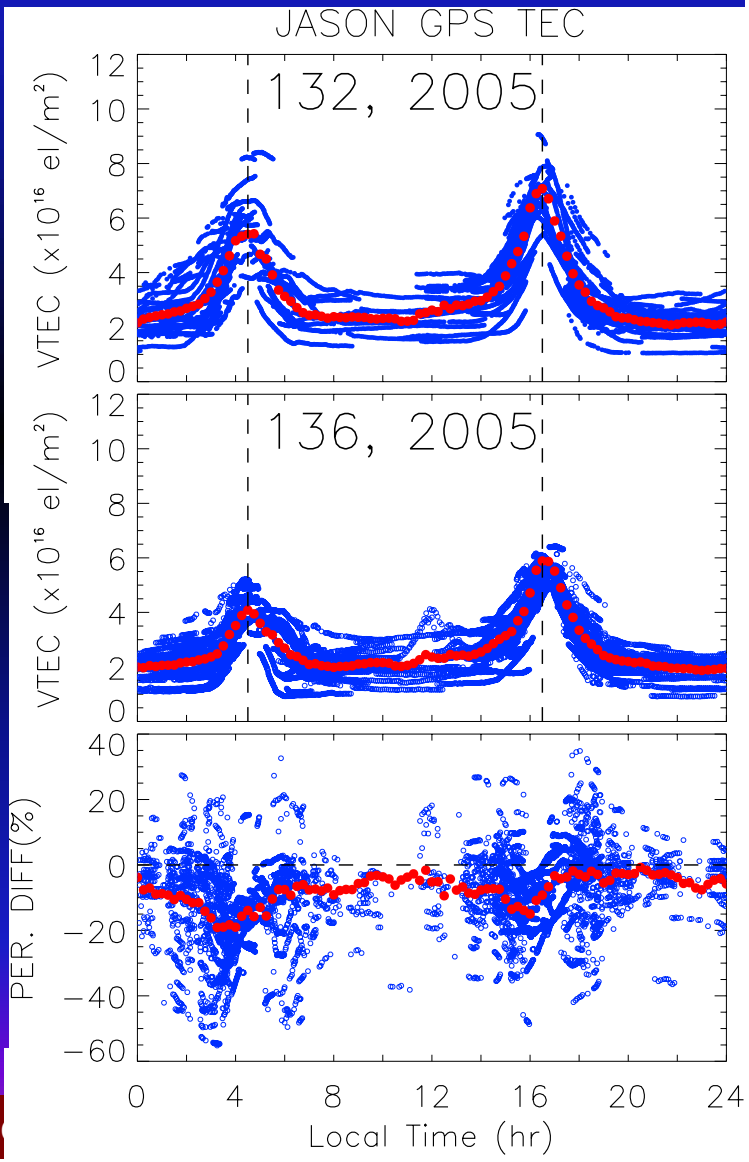




Storm aftermath response of plasmasphere inside the plasmapause



What is the depletion mechanism of the plasmasphere inside the plasmapause?



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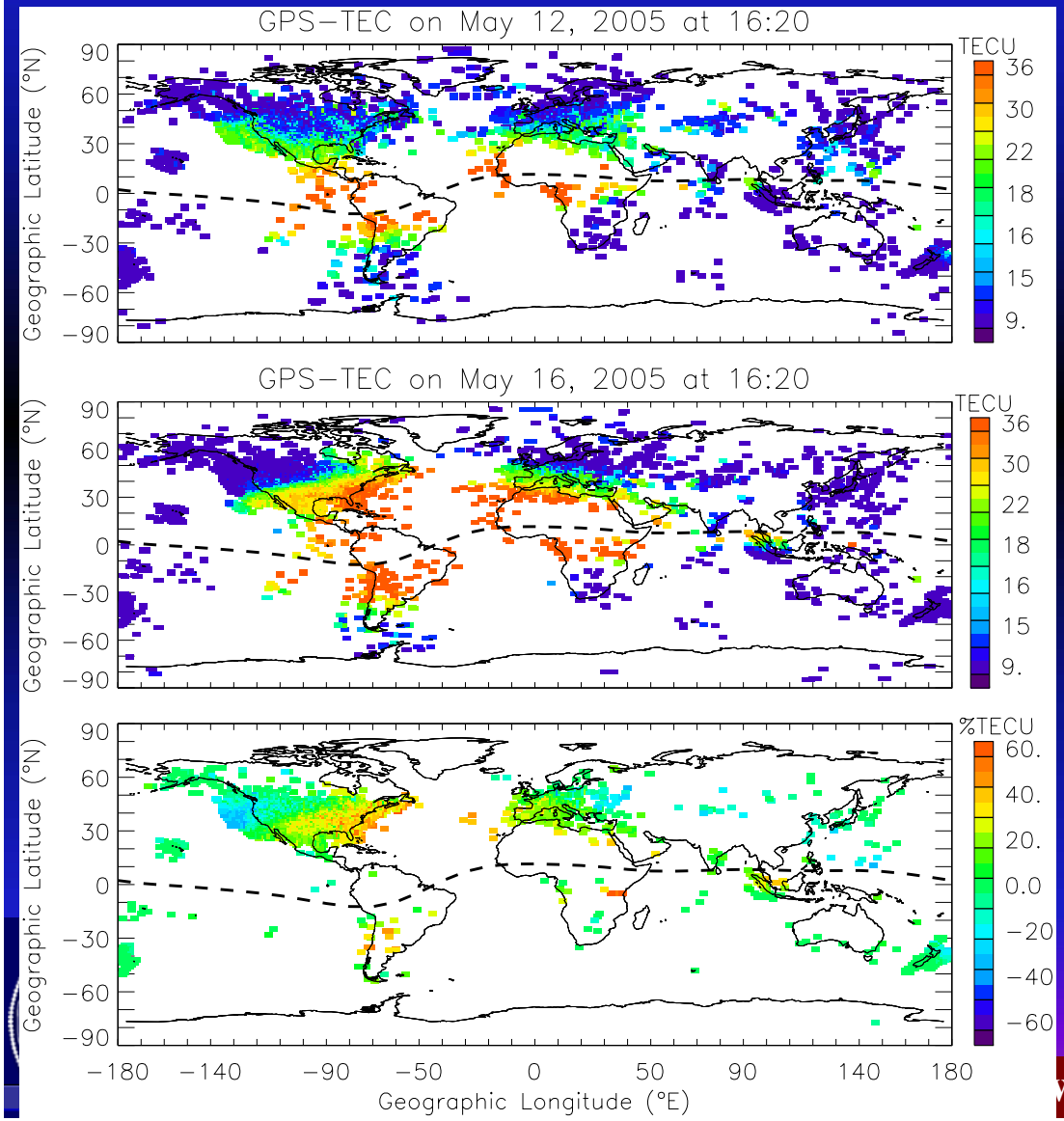
Storm aftermath response of plasmasphere inside the plasmapause



Quiet time Ground based GPS TEC

Storm time Ground based GPS TEC

Percentage difference between disturbed and quiet time Ground based GPS TEC

Conclusion

- The preliminary tomographic reconstruction approach to the space-based GPS TEC reveals a more complete picture of field-aligned ion outflow emanating from the cusp region, indicating its important advantages to show the plasma transport between the ionosphere and magnetosphere.
- For the first time a statistical study using multi-instrument observations clearly demonstrate that the ionospheric signatures of plasmaspheric plumes, which were previously often observed over North America, can be viewed in various sectors of the globe.
- Although dumping of plasma into the ionosphere is thought to be responsible, the depletion mechanism of plasmasphere inside the plasmapause remains unclear. However, this needs more attention to clearly understand the evolution of plasmaspheric density as a function of L-shell, local time, and geomagnetic storm phase.


Thank you!