

# ISS FPMU Observations of Ionospheric Irregularities

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# International Space Station Floating Potential Measurement Unit

- Orbital inclination of  $\sim 51$  degrees
- Altitude of  $\sim 400$ km
- 92 minute orbit
- Measures electron density and temperature
- **Under-utilized dataset**

Image credit: NASA via  
<https://www.nasa.gov/image-feature/the-floating-potential-measurement-unit-is-mounted-to-a-truss-on-the-international>



# International Space Station Floating Potential Measurement Unit

- Compared with TEC from GNSS and Swarm (polar LEO) EFI electron density observations



Image credit: NASA via <https://www.nasa.gov/image-feature/the-floating-potential-measurement-unit-is-mounted-to-a-truss-on-the-international>

# Equatorial Plasma Bubbles

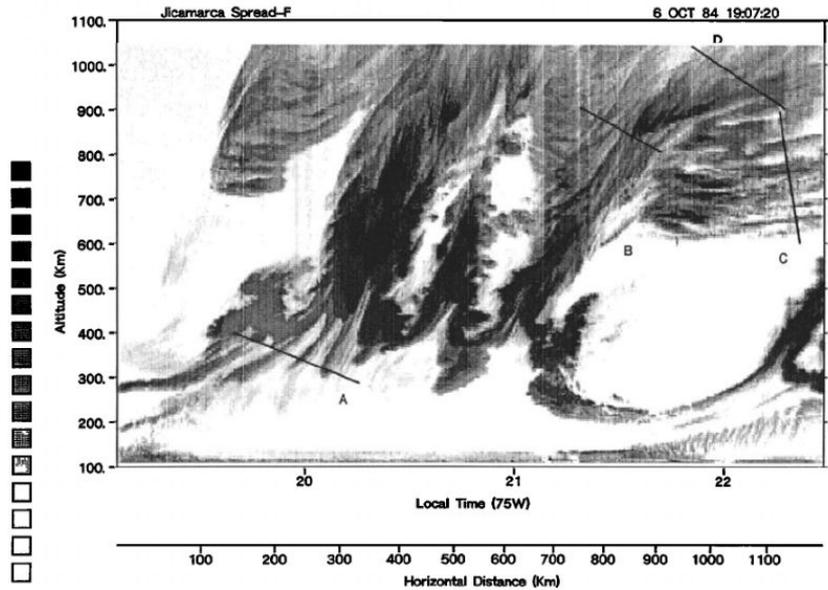
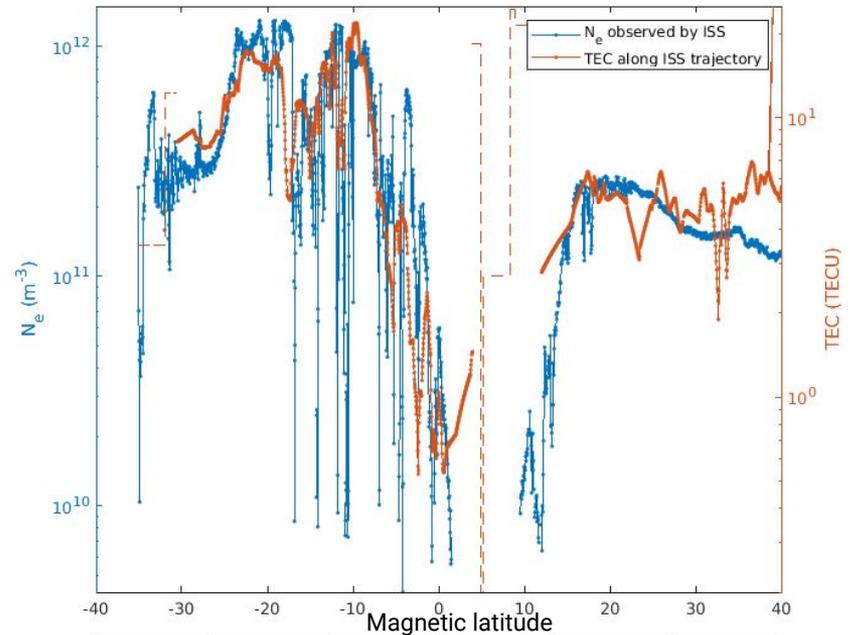


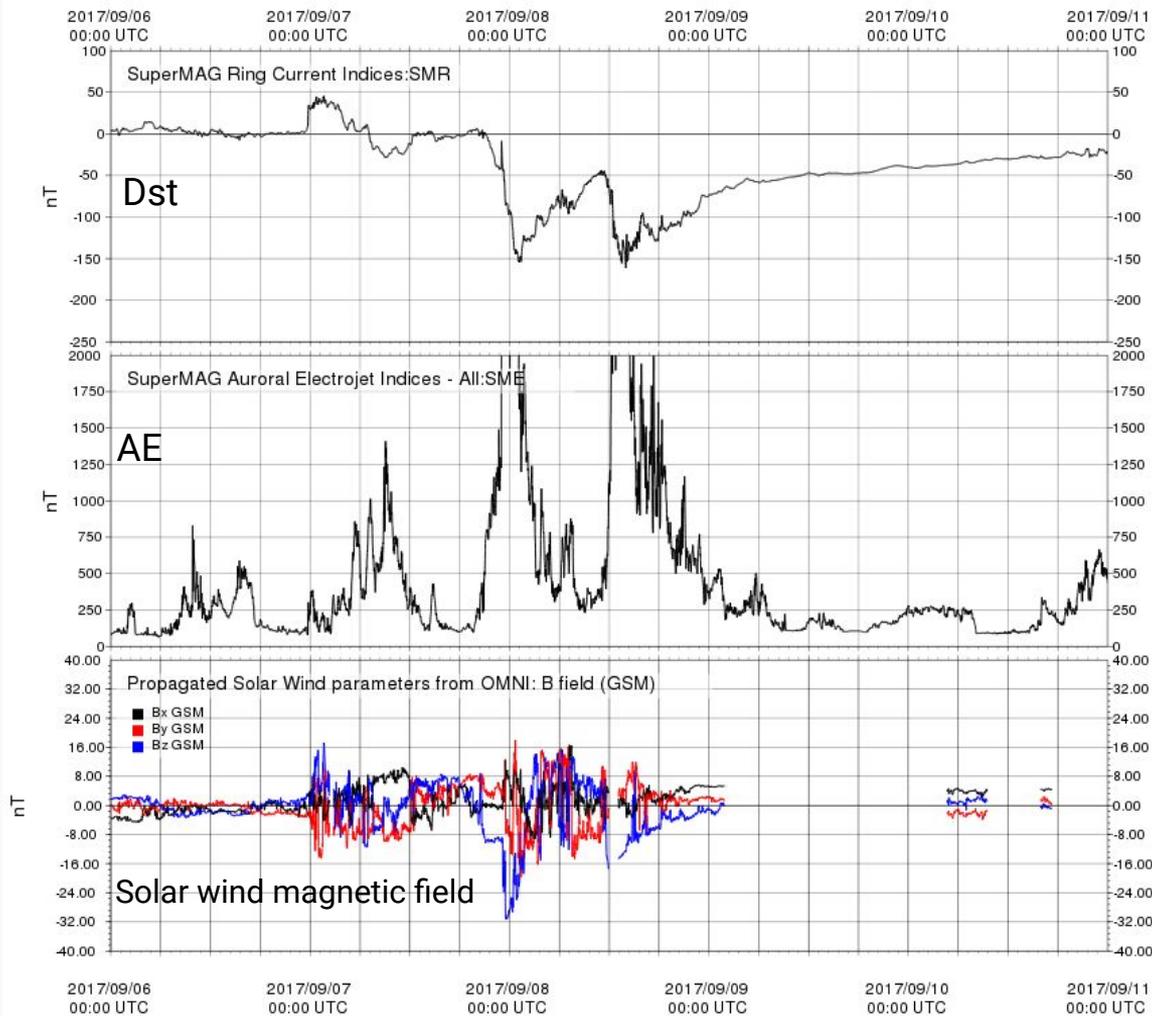
Fig. 1. Backscatter power versus time during the spread *F* event. A crude spatial scale has been added to the time axis, assuming a linear drift rate. The strips mark cuts taken perpendicularly to contours of regular structure.

(Hysell et al, 1990)



# Sept. 2017 Geomagnetic Storm

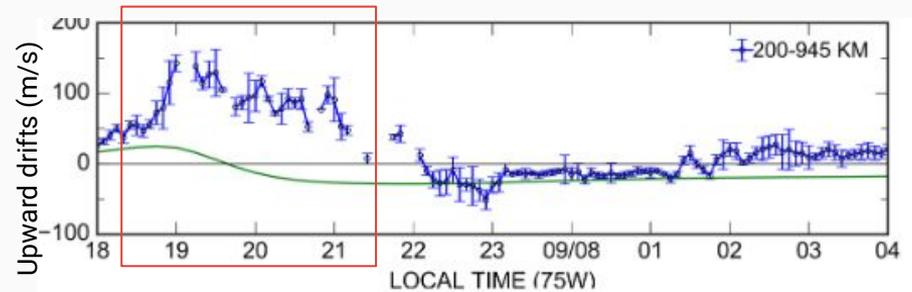
- Major geomagnetic storm with a minimum Dst of  $\sim -150\text{nT}$
- Double main phase beginning on 9/8/2017
- Many irregularities and unusual features



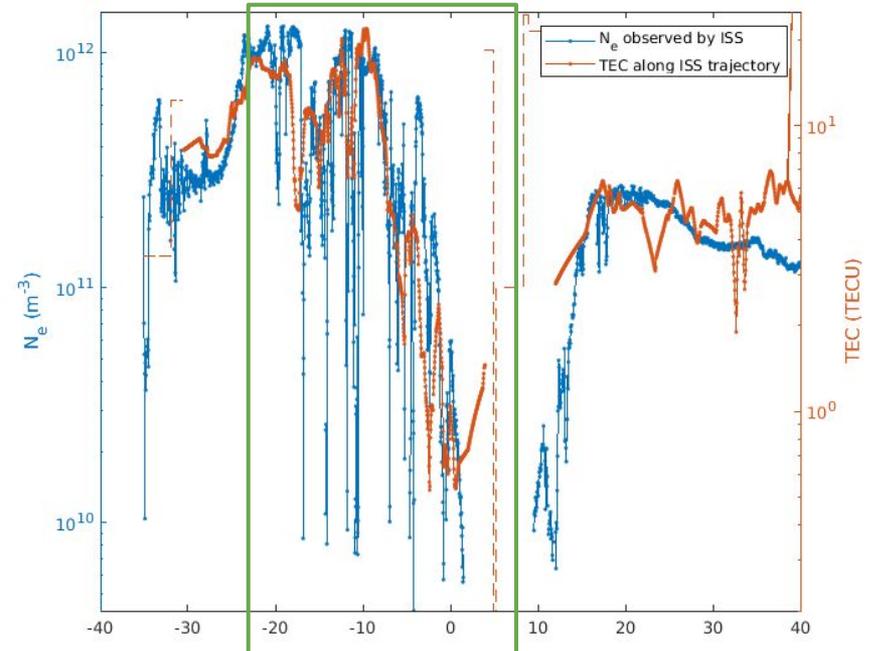
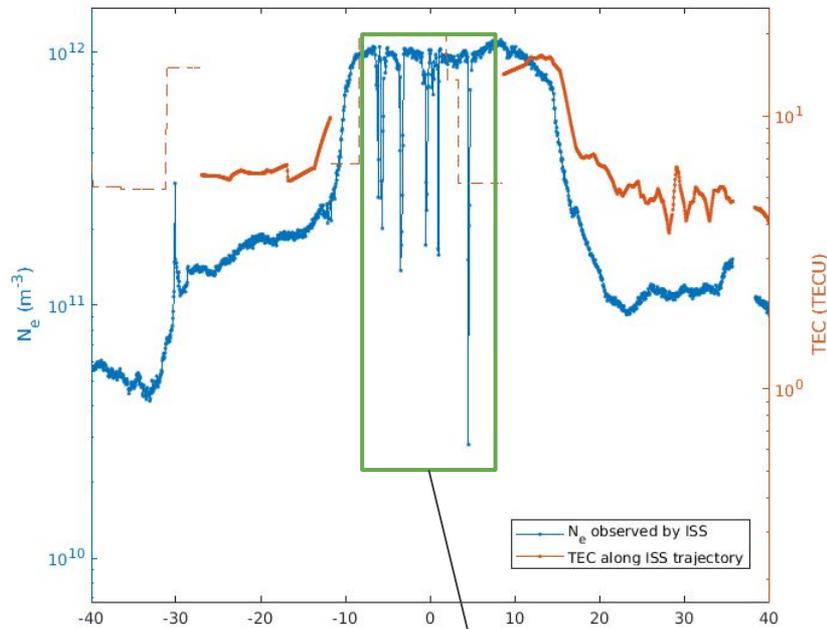
# Jicamarca ISR Drift Velocities

- Equatorial observations of ion velocity (electric field induced drift)
- At dusk

Prompt penetration and substorm effects over Jicamarca during the September 2017 geomagnetic storm, Fejer et al 2021



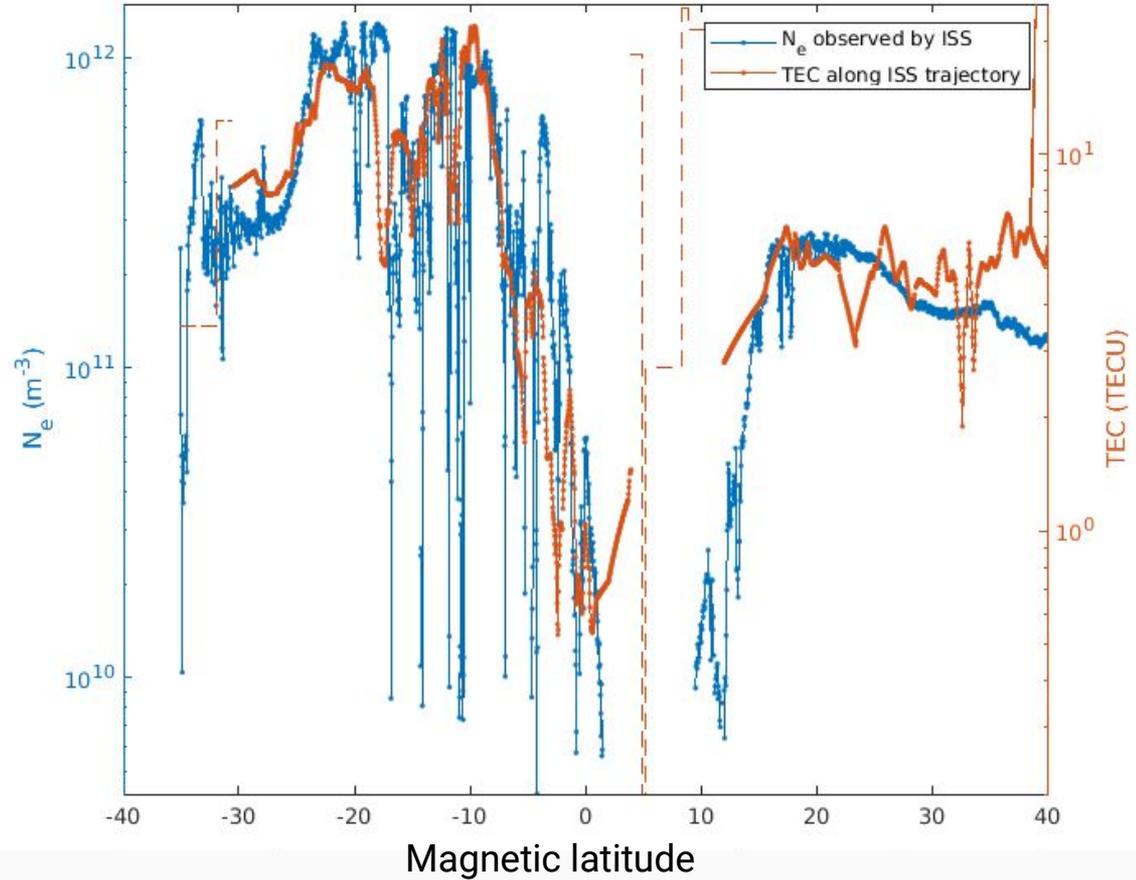
# EPBs Observed by the FPMU, Sept. 2017



> order of magnitude density fluctuations

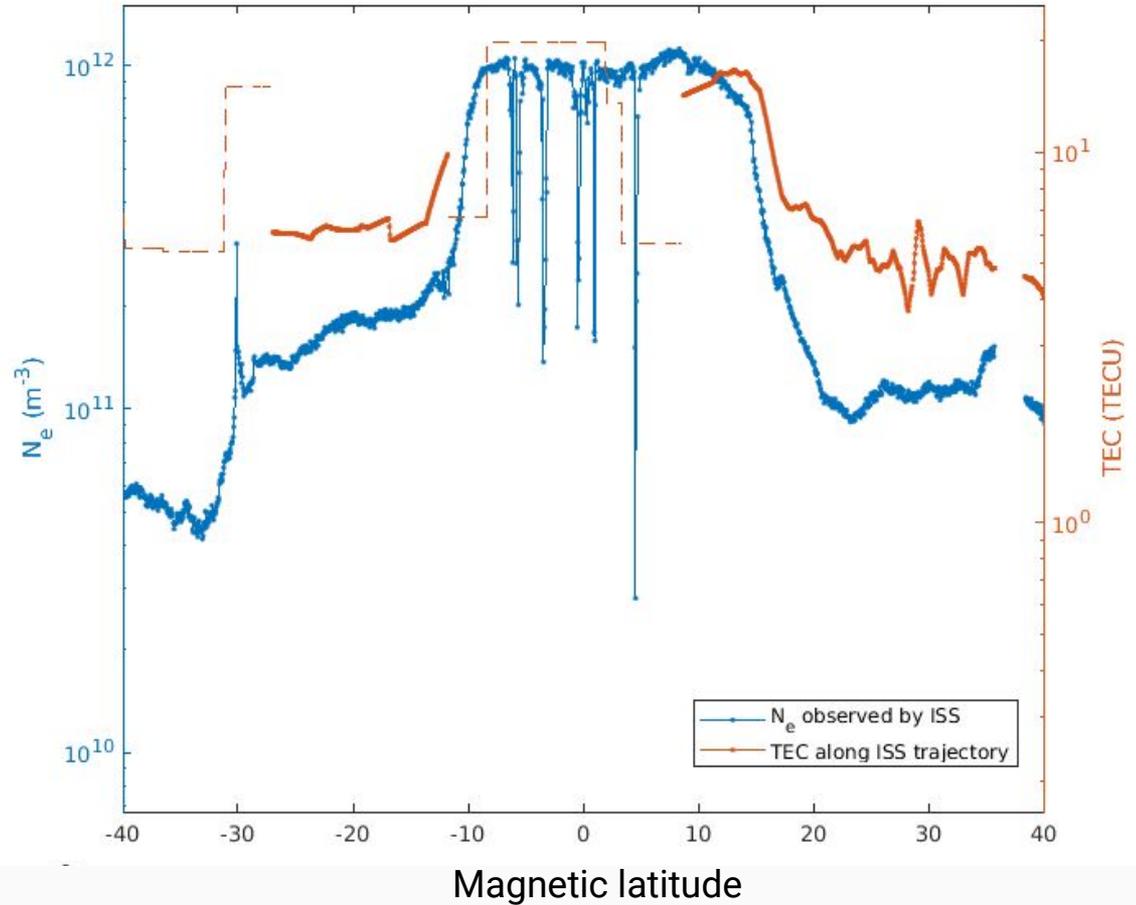
# EPBs observed by the FPMU

- Occurred at 2:27-2:45 UT  
9/8/2017
  - Beginning of main phase
- **Huge bubble** extending all the way to mid-latitude
- TEC also shows bubble



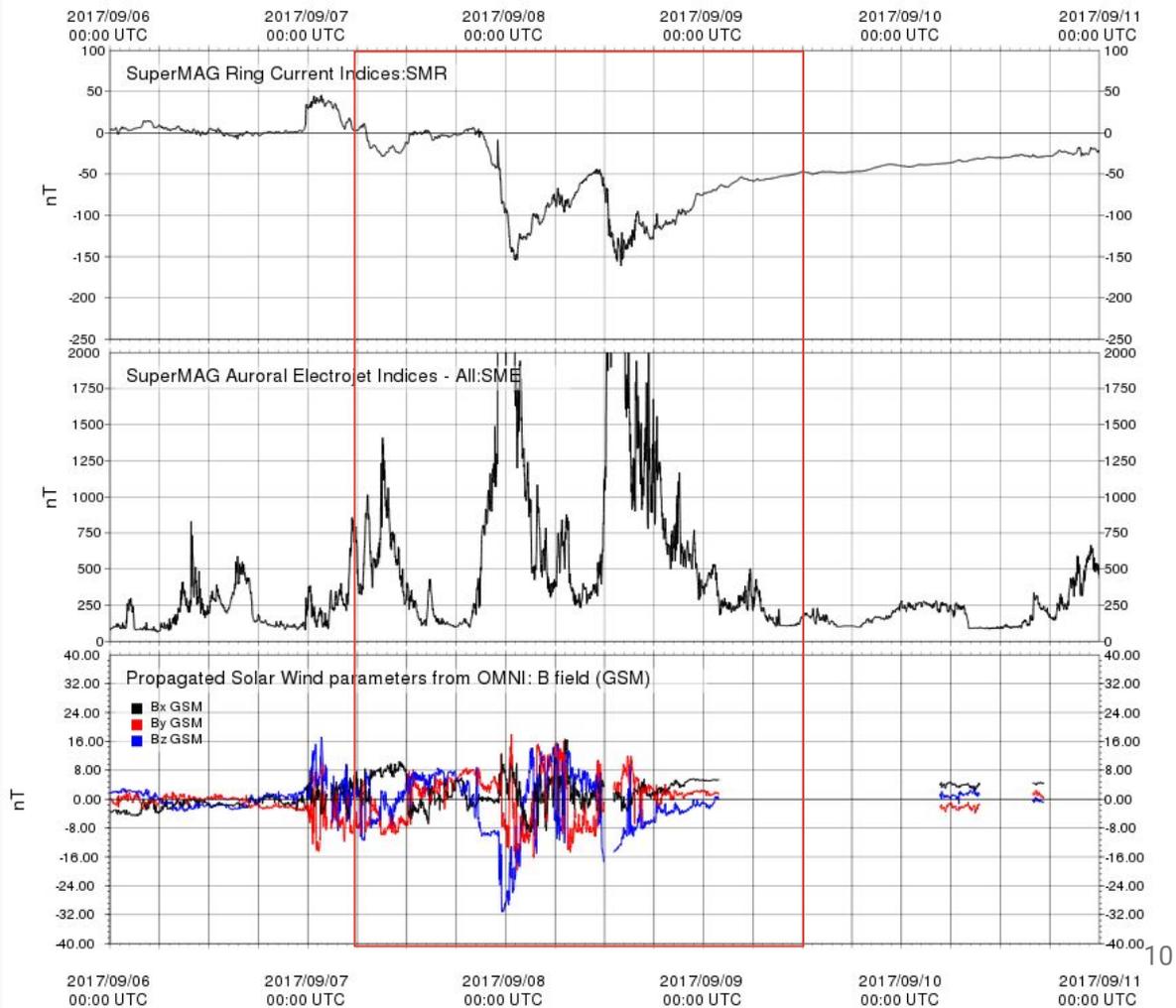
# EPBs observed by the FPMU

- Occurred at 6:23-6:33 UT on 9/9/2017
- Less dramatic example

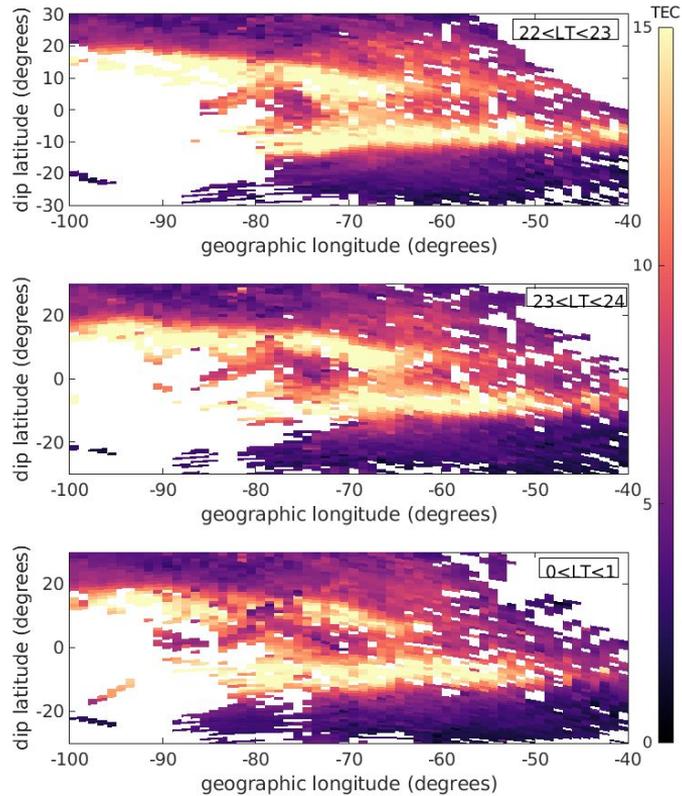


# EPBs During the Sept. 2017 Storm

- In total, ISS FPMU observed 13 EPB/depletion type irregularities during the storm
- Occurred during primarily during the main phase

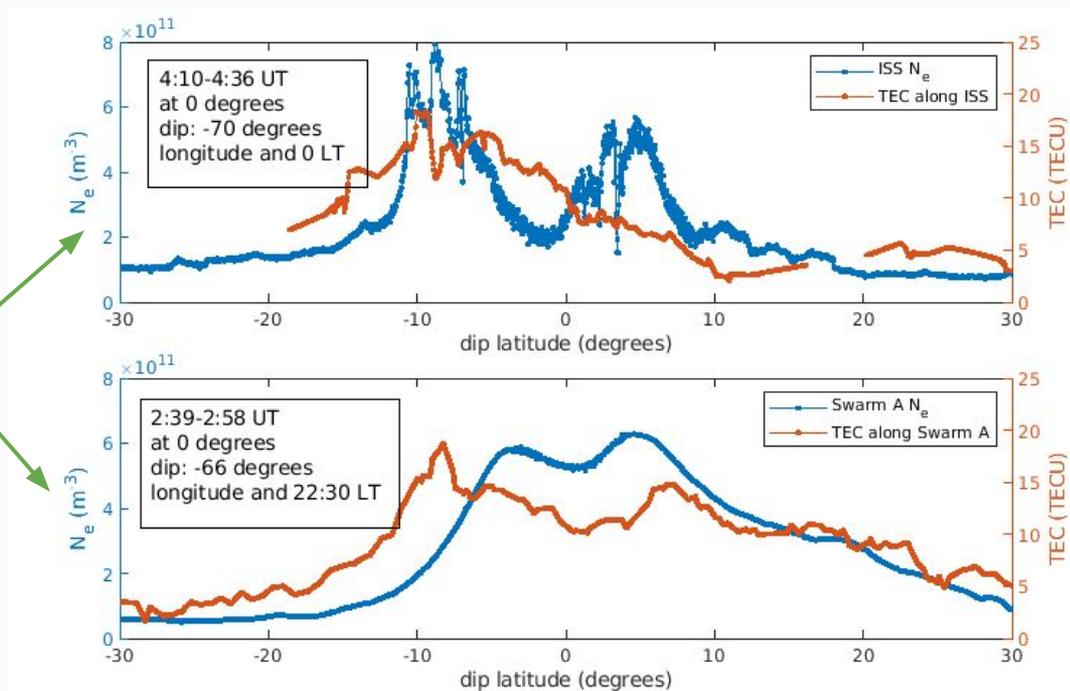
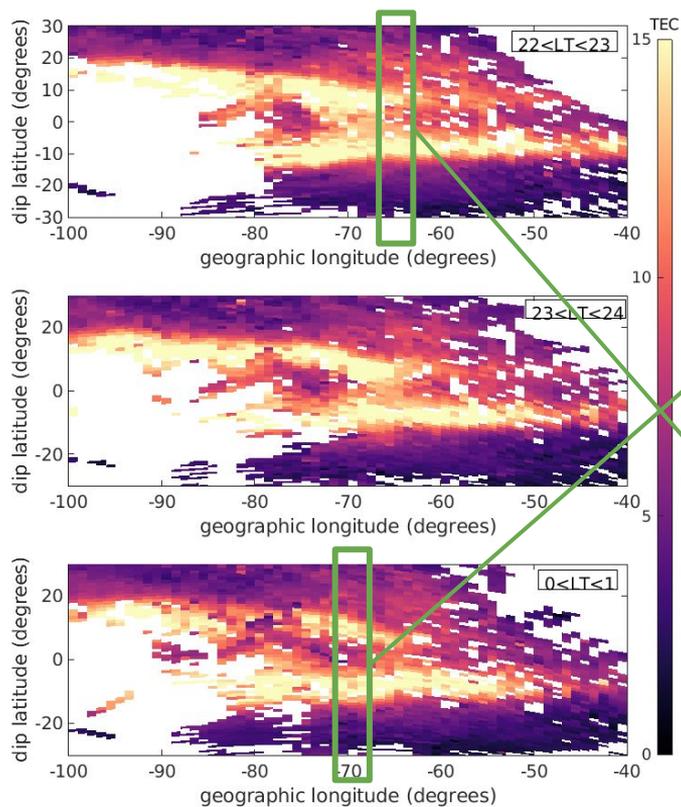


# Equatorial Ionization Anomaly Results: Sept. 6th 2017

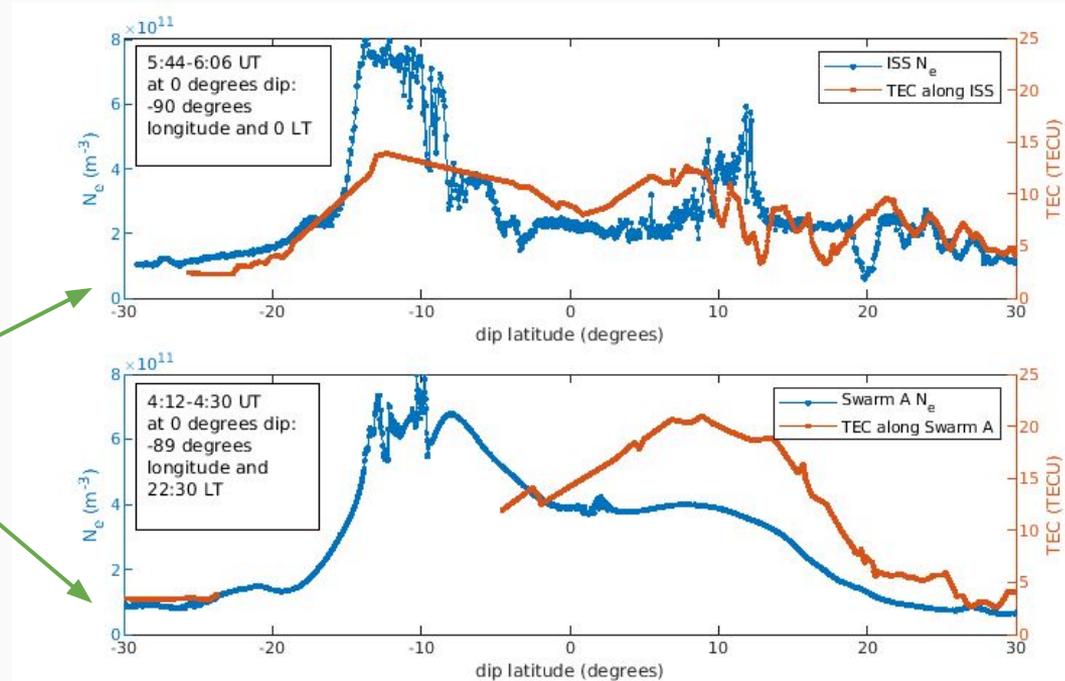
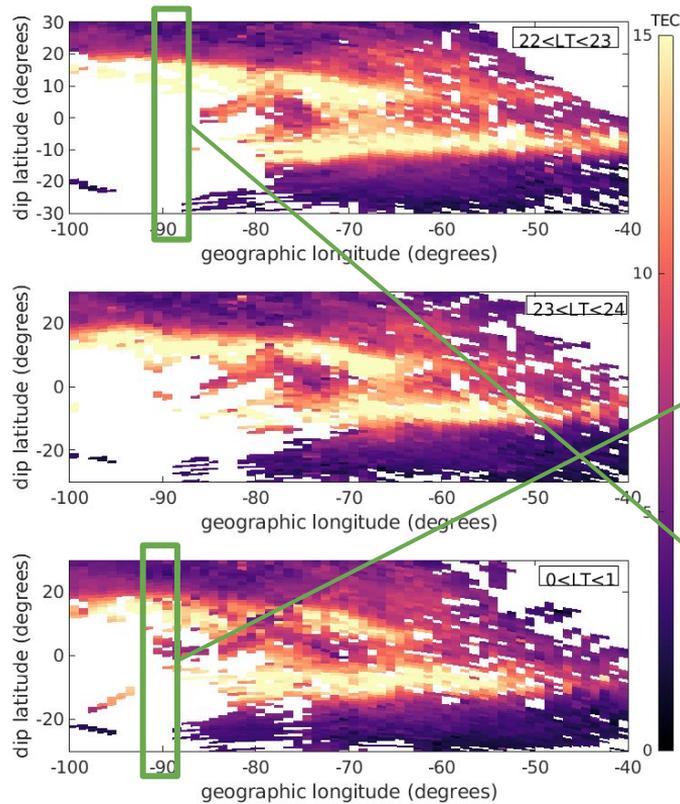


(Newheart et al, 2022 submitted to JGR)

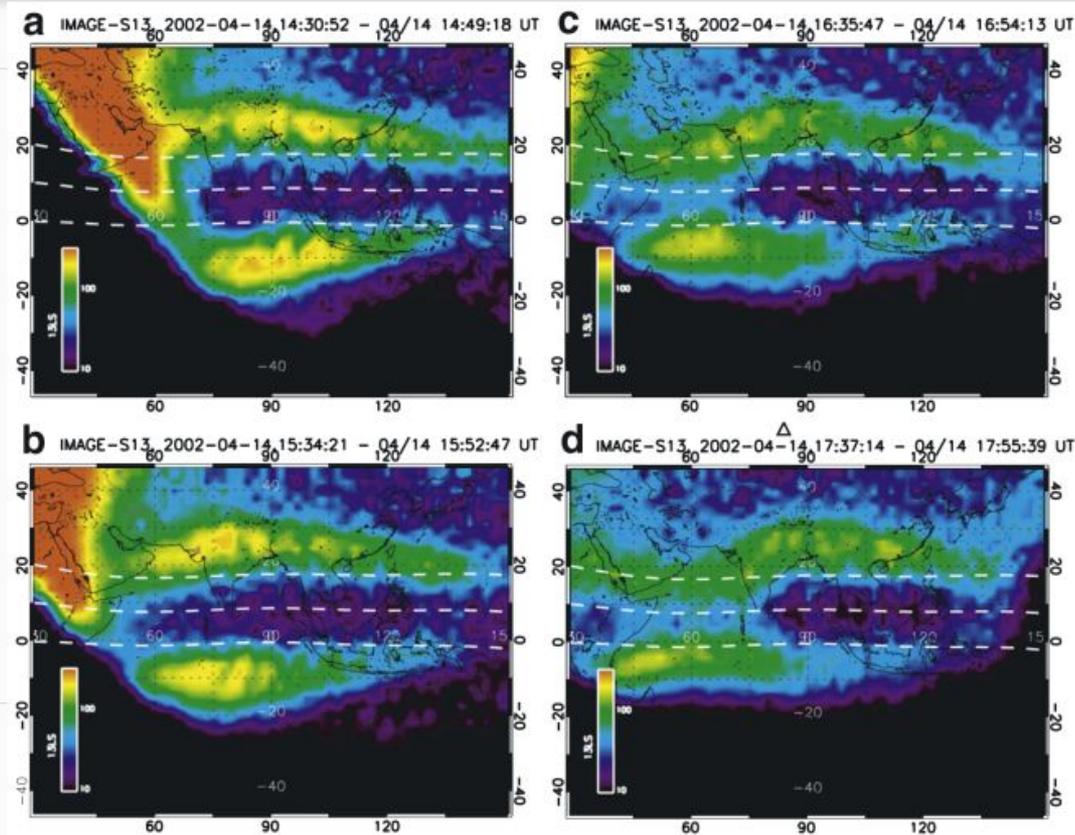
# Equatorial Ionization Anomaly Results: Sept. 6th 2017



# Equatorial Ionization Anomaly Results: Sept. 6th 2017



# Equatorial Ionization Anomaly



- During two geomagnetically quiet time periods, the equatorial ionization anomaly was observed at local times as late as post-midnight.
- The peak density of the equatorial ionization anomaly at night appears to exhibit a 3-wave pattern in longitude.
- This variation in longitude is consistent with previous observations from IMAGE.

# Conclusion

ISS FPMU is an underutilized dataset that is valuable for observing equatorial structure and irregularities, especially when compared to other datasets.