



# Polar Cap Patches? Auroral Streamers? & Substorms with EISCAT

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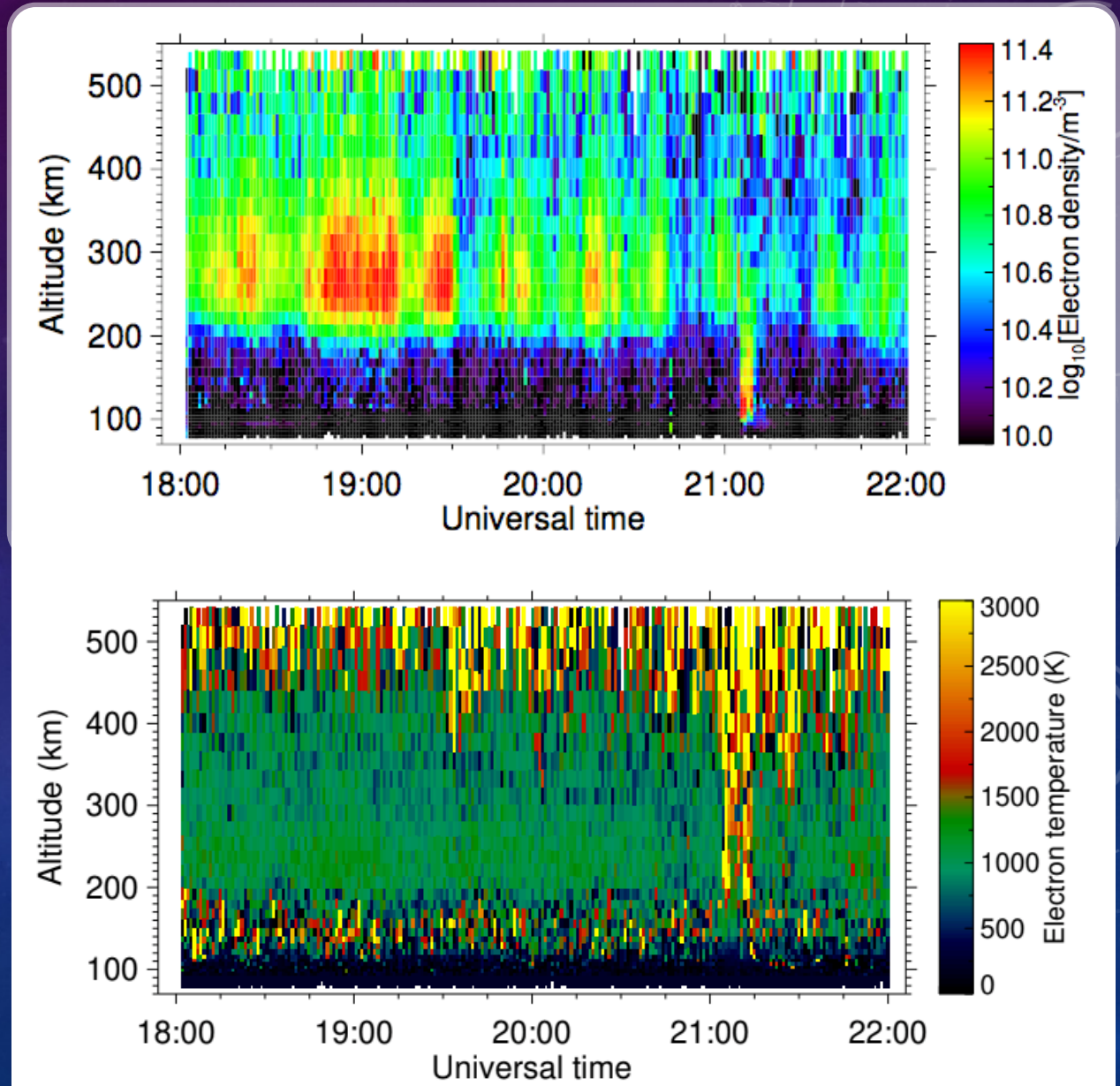


# OUTLINE

- Scientific Objective and Polar Cap Patches
- Instruments and data sources
- Features and structures observed
- Conclusion

# SCIENTIFIC OBJECTIVE- POLAR CAP PATCHES

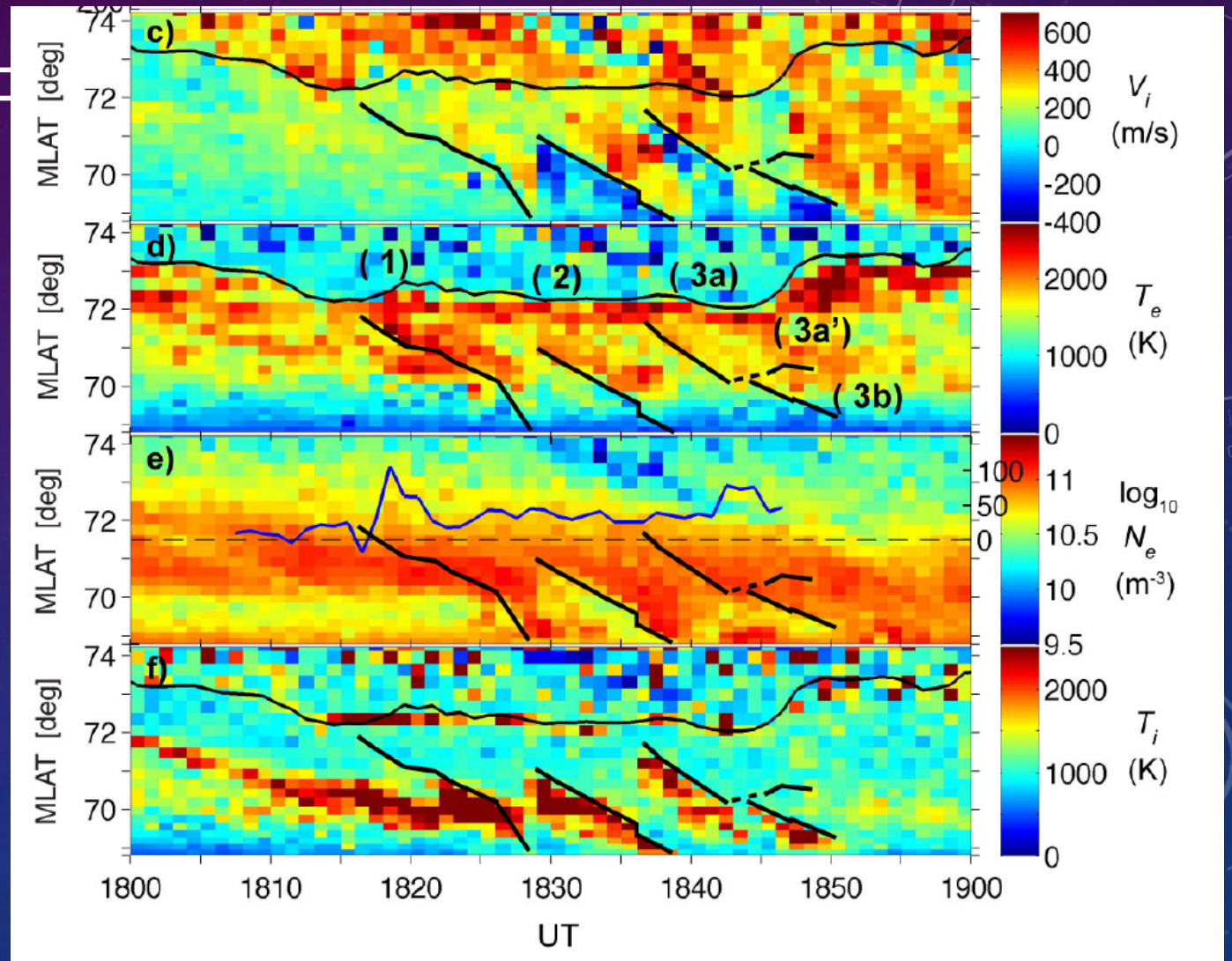
- Islands of high density plasma with spatial scales of 100 - 1000 km (Weber et al. 1984)
- Double the electron density of surrounding regions
- Usually observable from September to March (easier to detect during winter)
- Between 12 and 24 MLT
- Approximately  $82^\circ$  MLAT
- Found in F region between 200 and 450 km
- Driven by southward IMF- $B_z$





# AURORAL STREAMERS

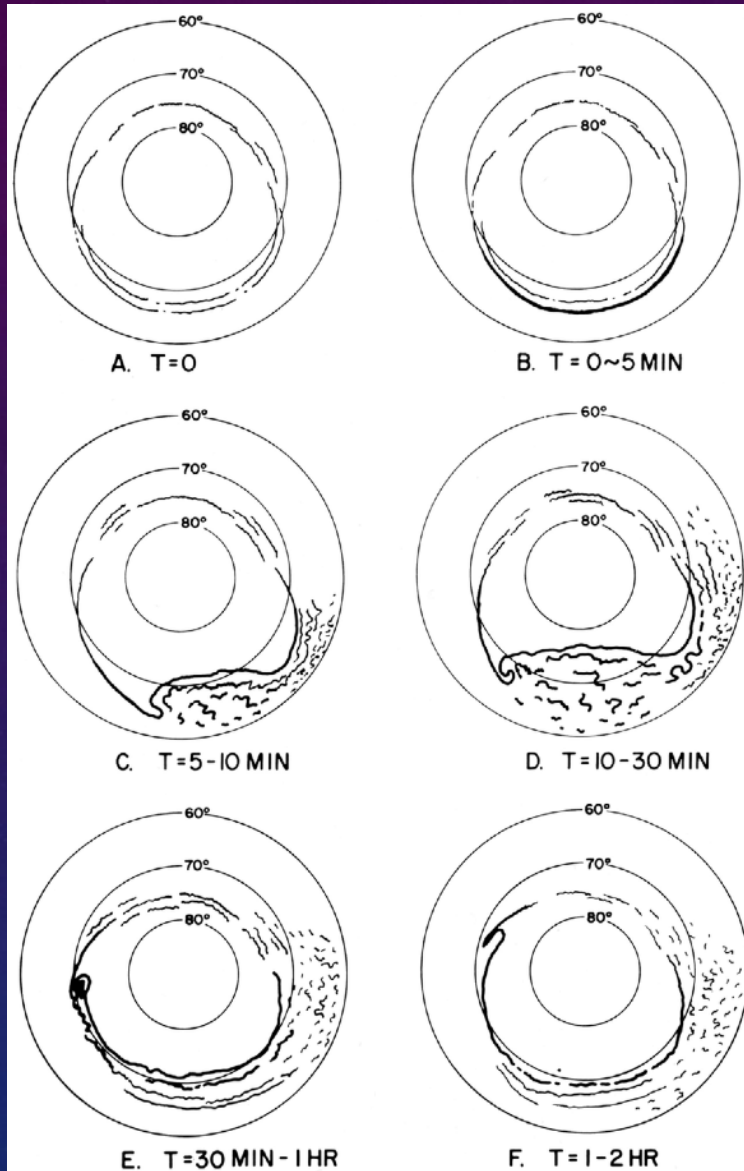
- Auroral layer aligned north-south
- Transient stream created in auroral oval and headed southward
- Must be confirmed with optical data



Pitkänen et al. 2011



# SUBSTORMS

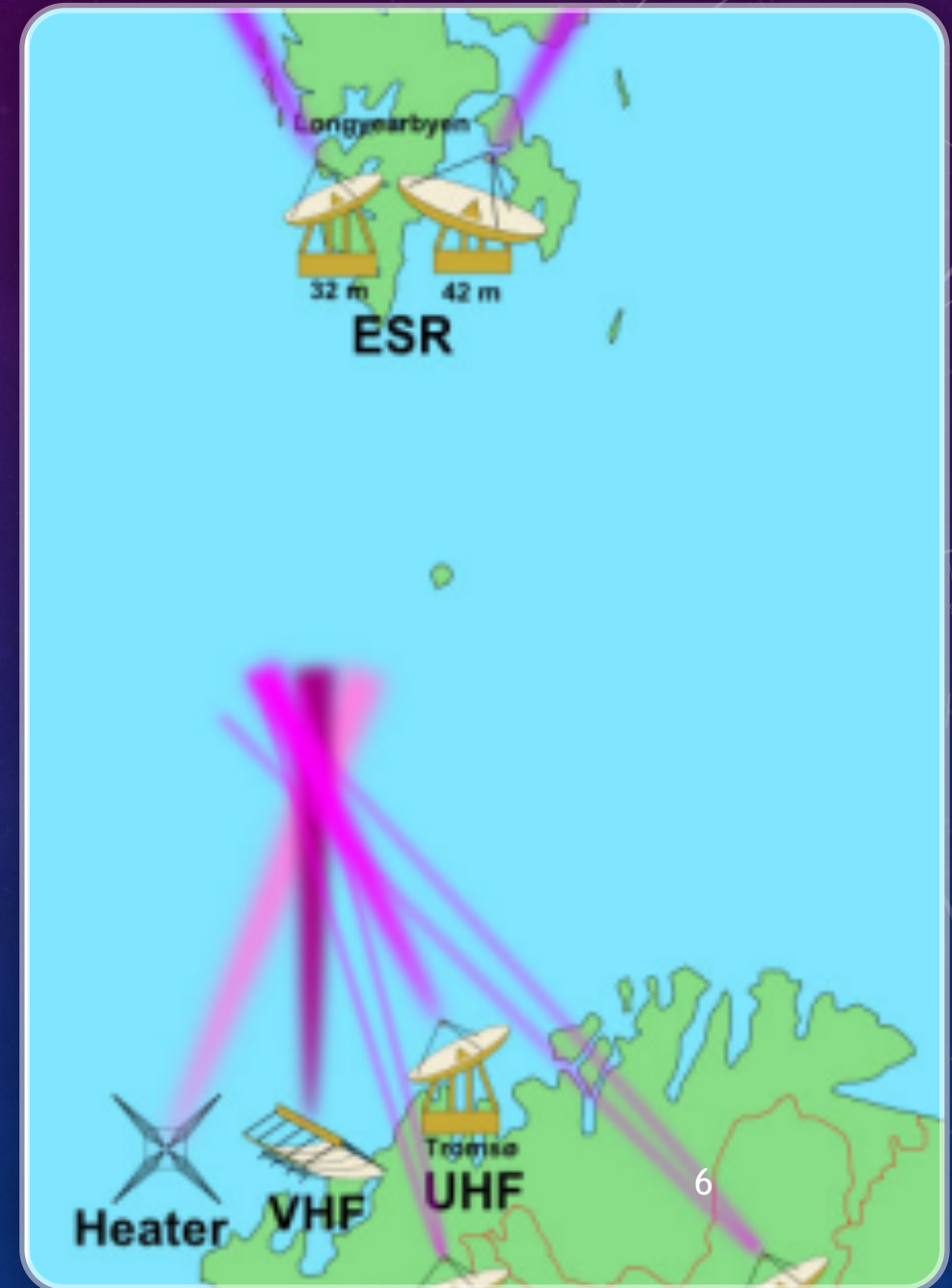


- Disturbance in the magnetospheric tail causes particles to precipitate into the ionosphere
- Disturbance is driven by a change in the IMF, mainly southward IMF- $B_z$  in the dayside
- Signatures include expanding the auroral oval, enhanced electron temperatures and enhanced electron densities



# INSTRUMENTS AND DATA SOURCES

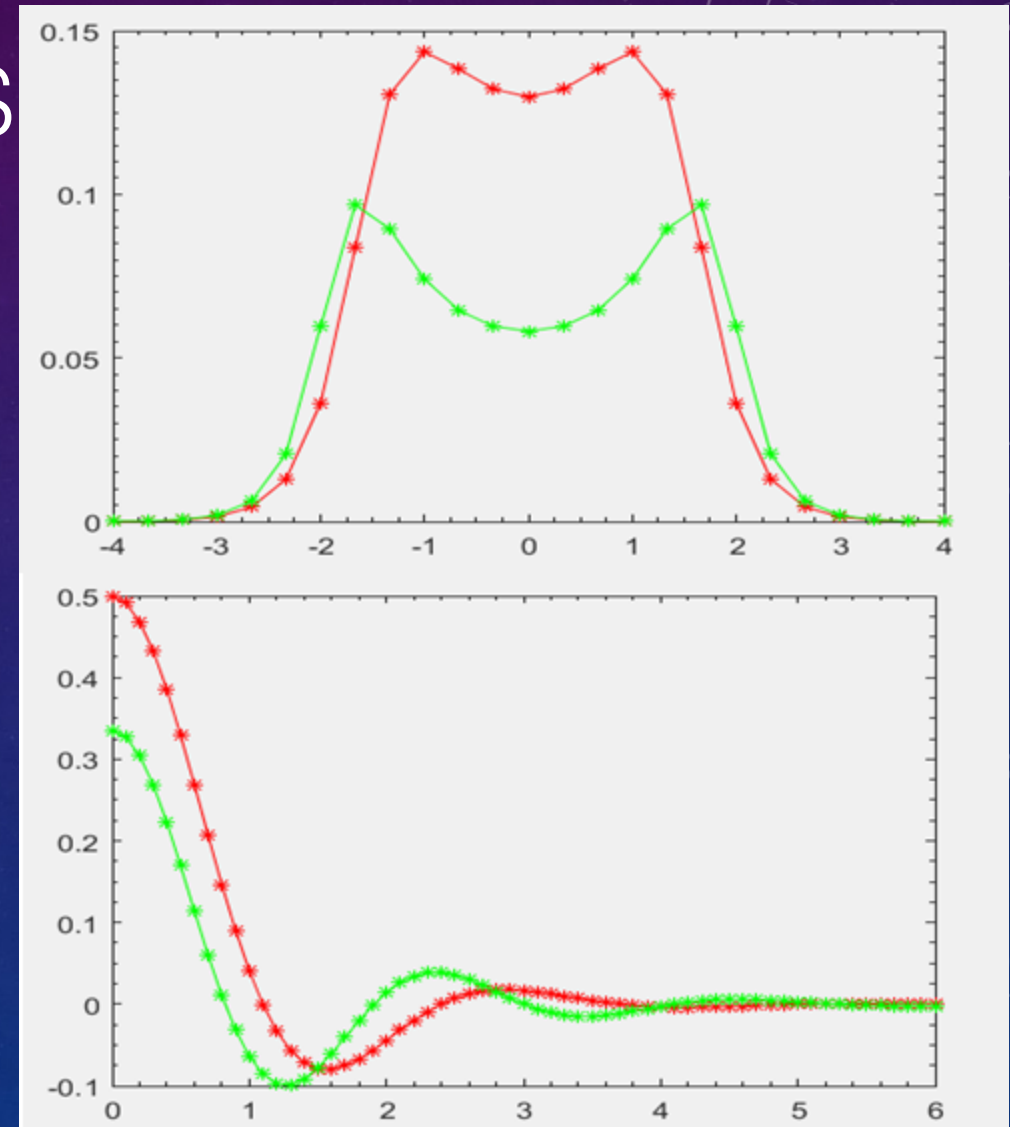
- ESR (32m meridional scanning and 42m magnetic North) operating ip3, folke mode (500 MHz)
- Tromsø-VHF (224 MHz)
- DMSP-SUSSI data
- Magnetometers, ACE-solar wind data
- Analyzed RISR data initially for evolution of polar cap patches, but none appeared





# ANALYSIS AND LIMITATIONS

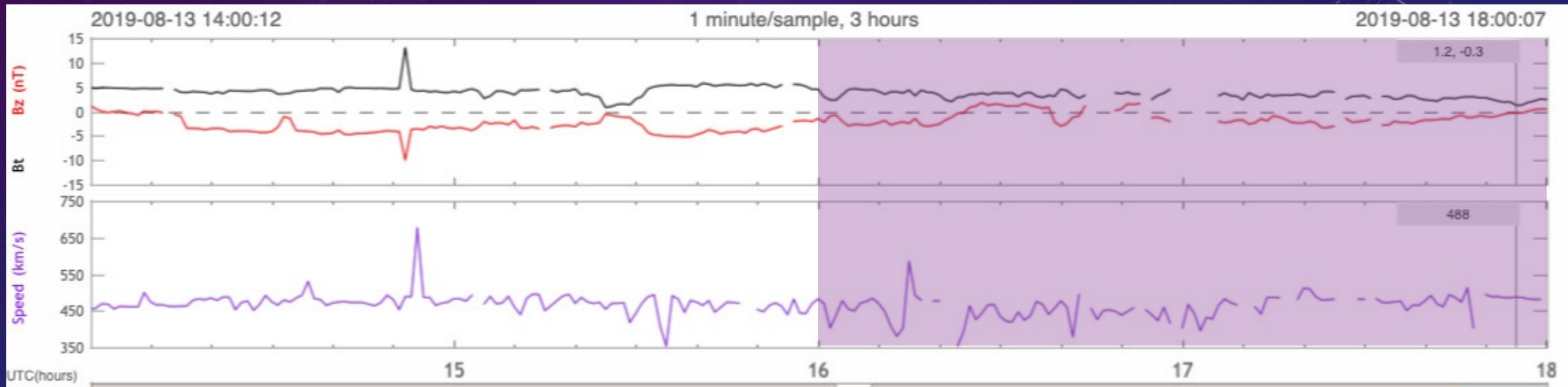
- Madrigal database
- GUIDAP used for EISCAT radar analysis
  - 32m uses 6.4 second (smallest) integration to find small scale structures
- The figure shows the theory spectrum and the corresponding autocorrelation function with different  $T_i/T_e$ . The data fitting between the measurement ACF and the spectrum was finished by Levenberg-Marquart(LM) in GUIDAP.



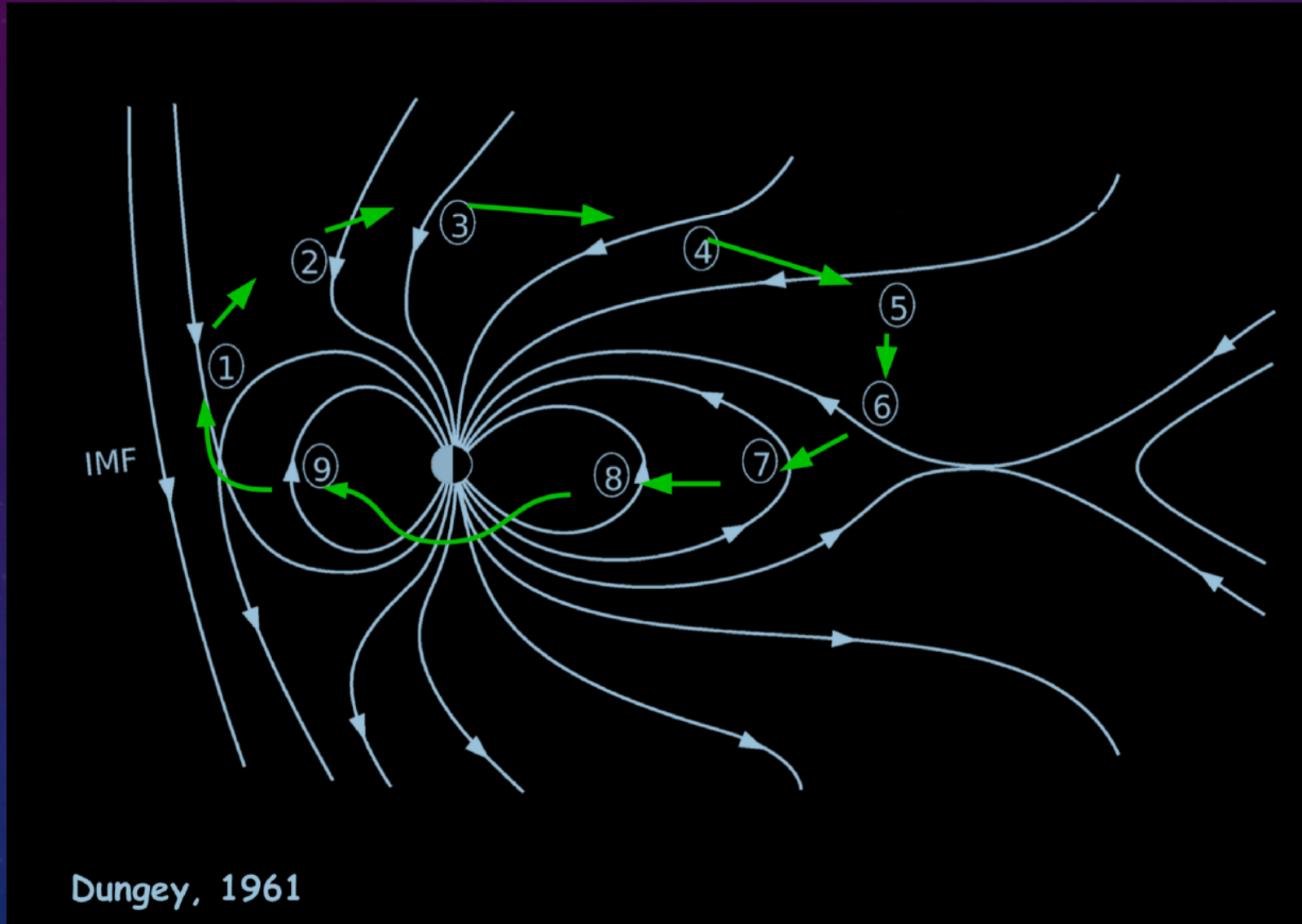


# SOLAR WIND CONDITIONS

- ACE solar wind data (steady Vsw)
- Persistent southward IMF before observation



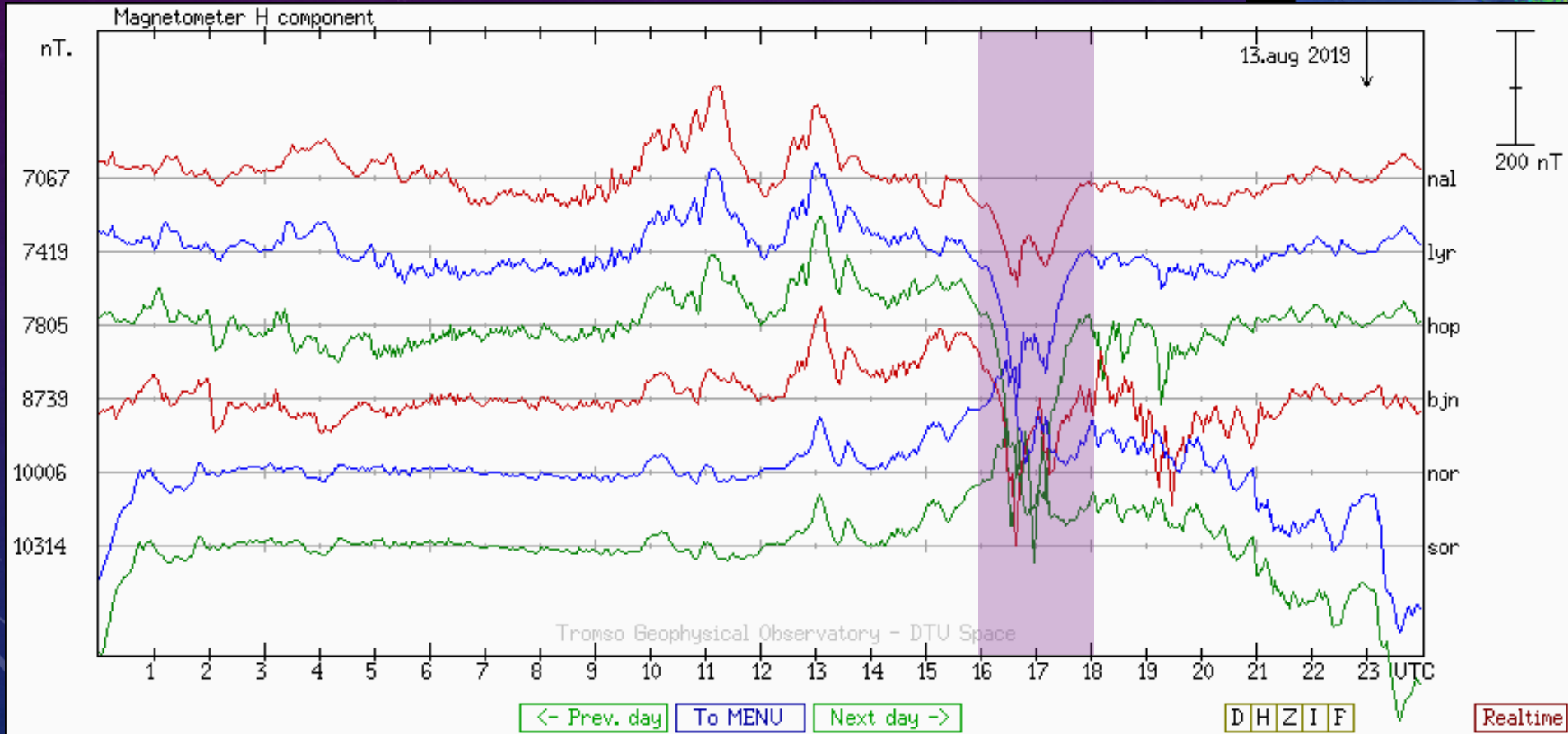
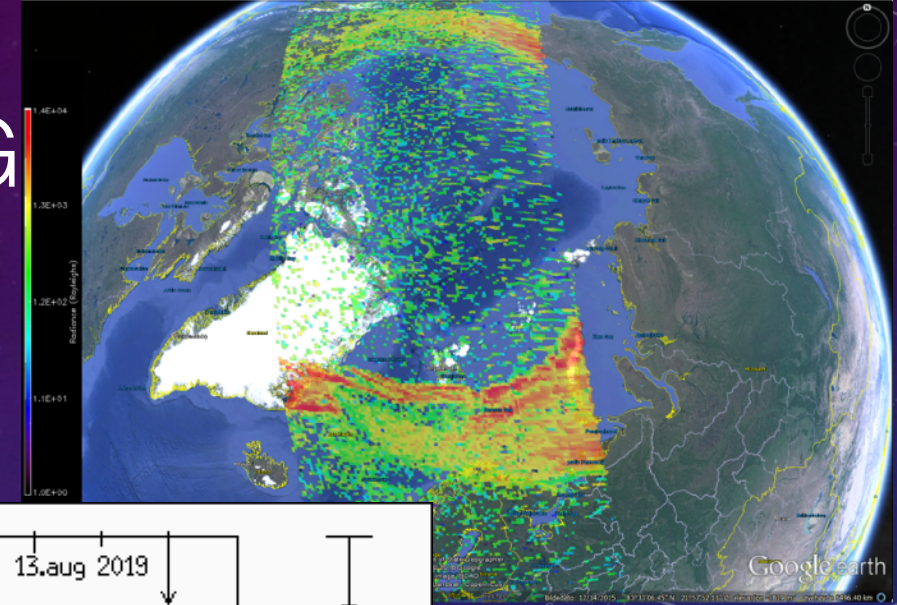
# DUNGEY CYCLE





# MAGNETOMETER AND SPECTROG

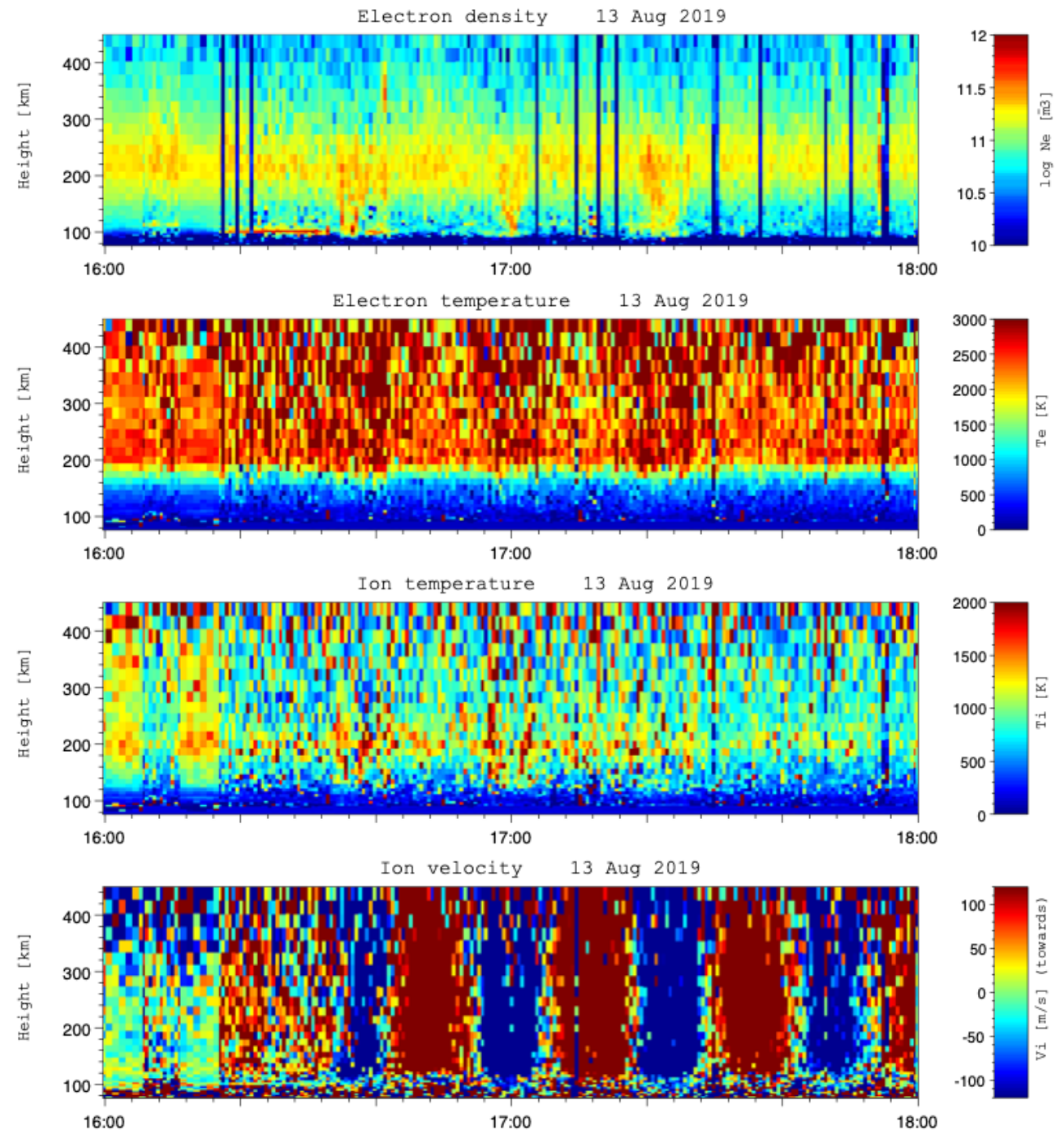
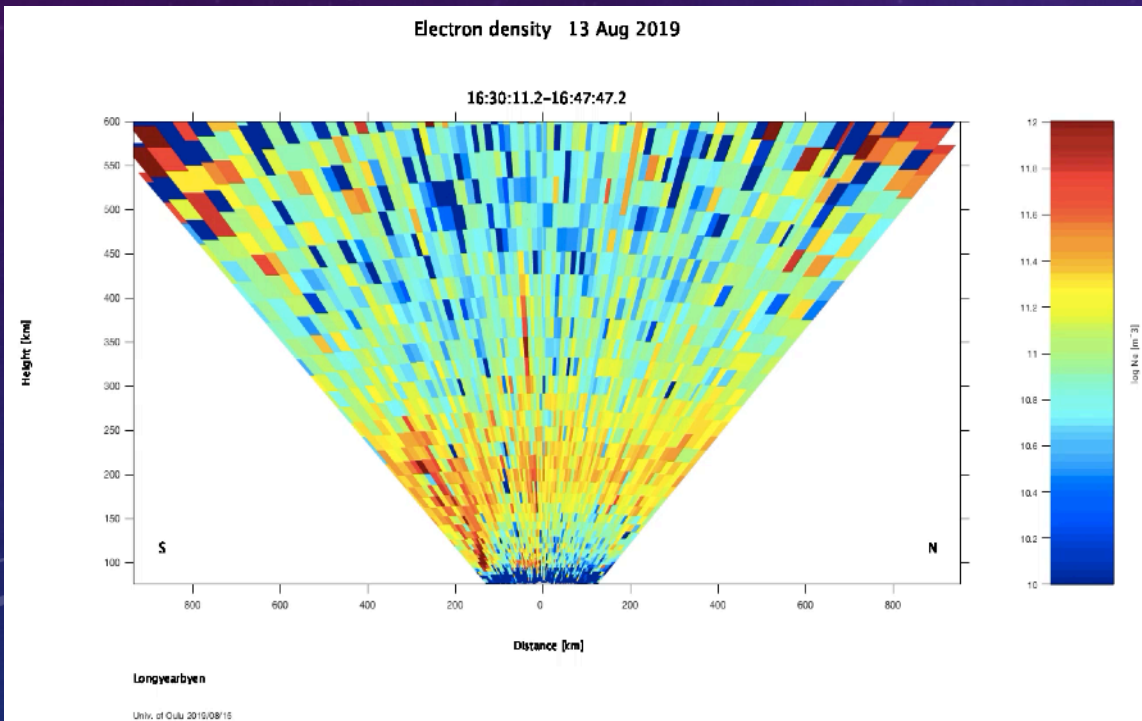
- Signatures of geomagnetic disturbances (below)
- Location of auroral oval (right)



SUSSI Data  
13/8/19  
17 UT

# ESR 32 M MERIDIONAL SCANS

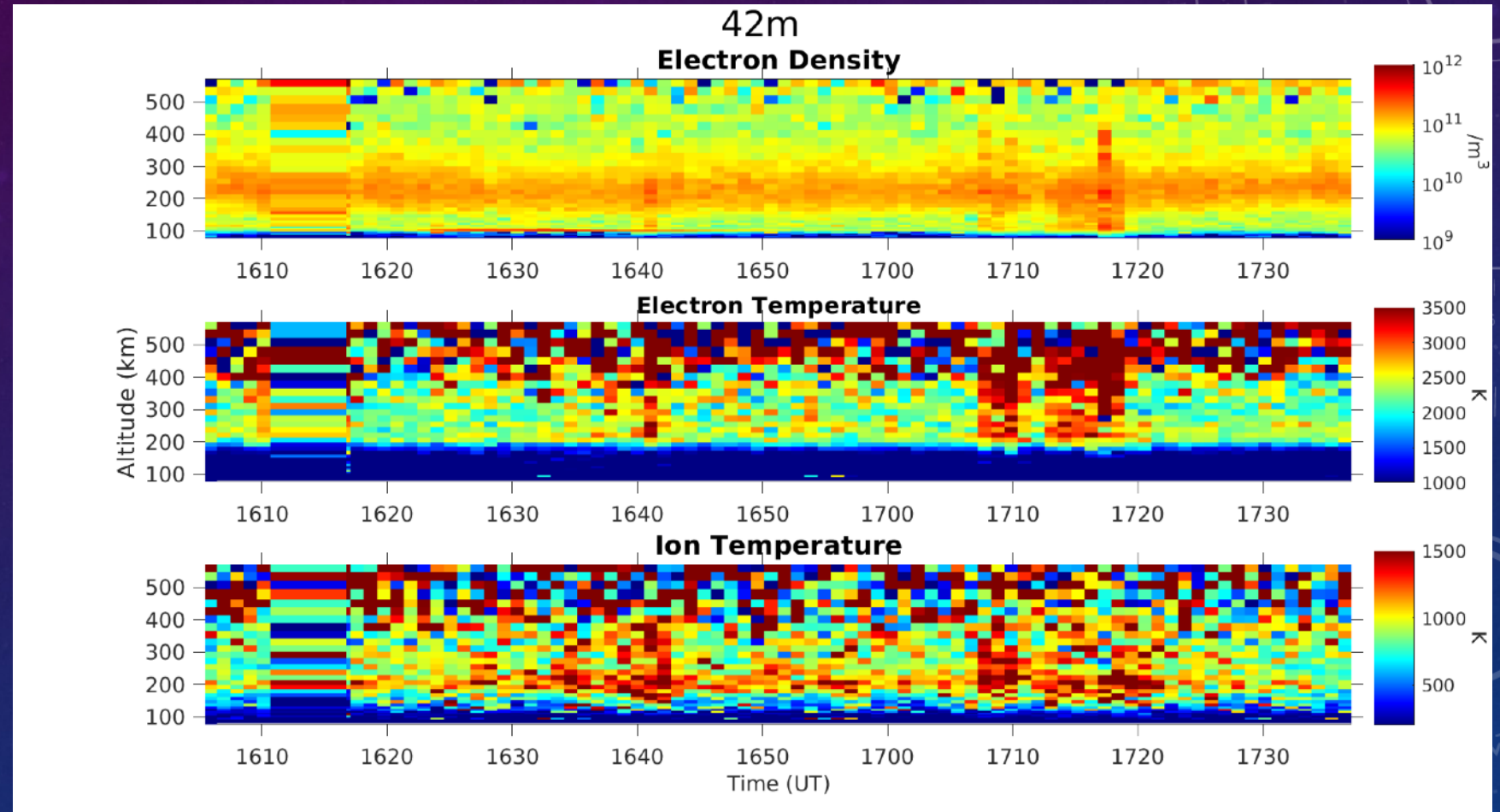
- See auroral oval when pointing southward, possible precipitation





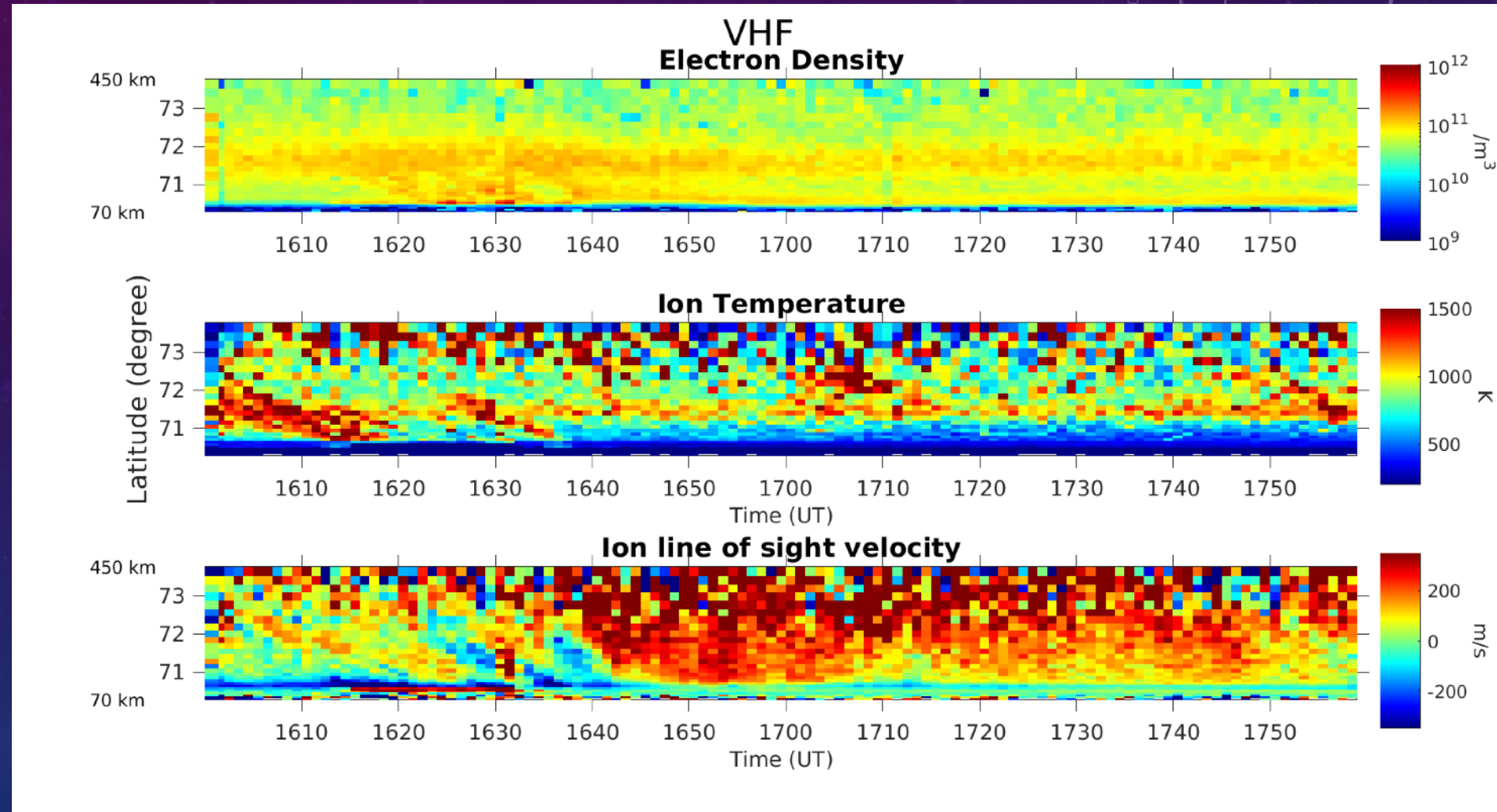
# ELECTRON PRECIPITATION FROM ESR 42 M

- Field aligned measurements
- Precipitation consistent with magnetic signatures



# STRUCTURES FOUND IN TROMSØ VHF

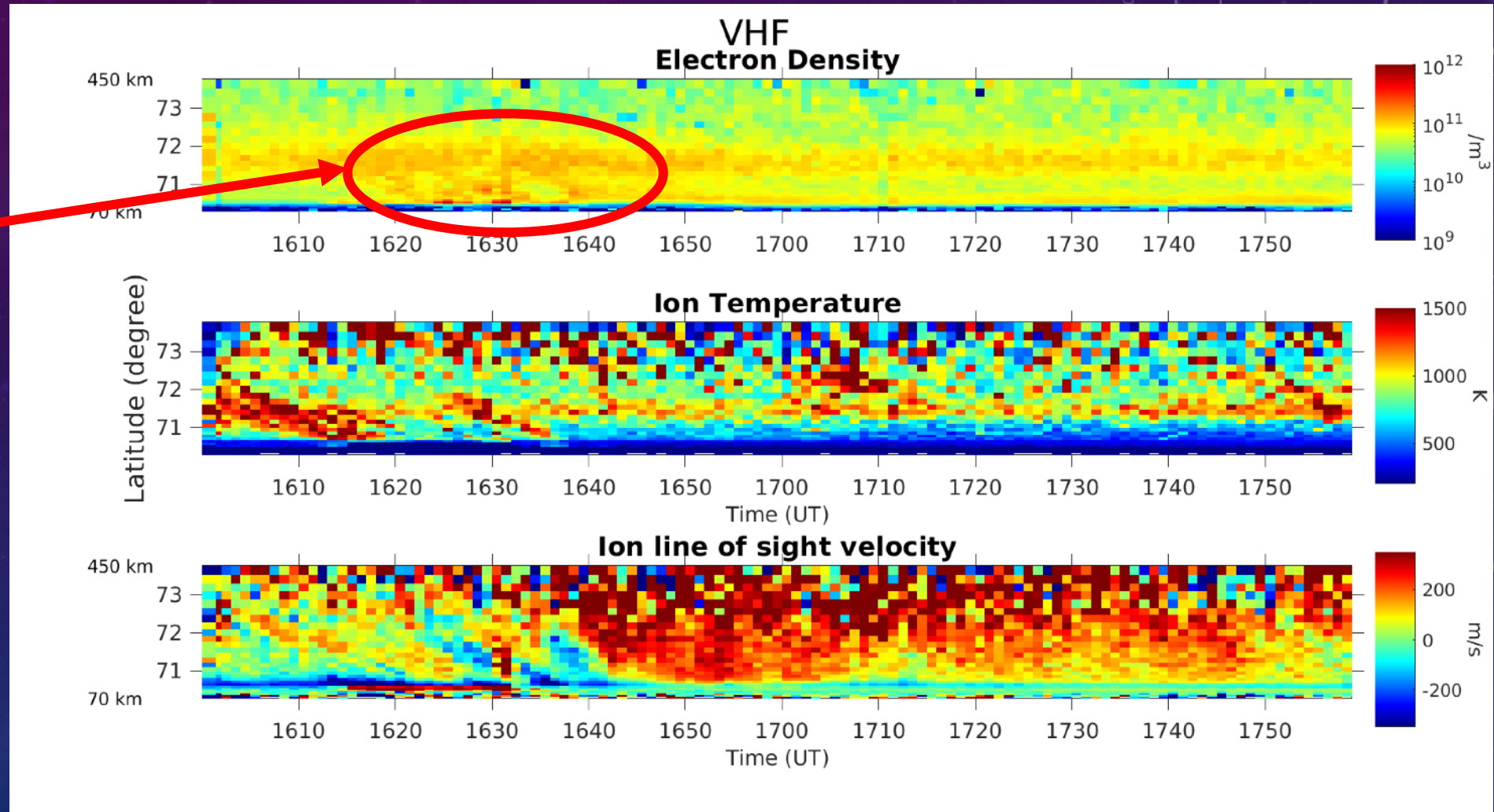
- Southward moving precipitating electrons
- Increase in Ne corresponding to increased Ti



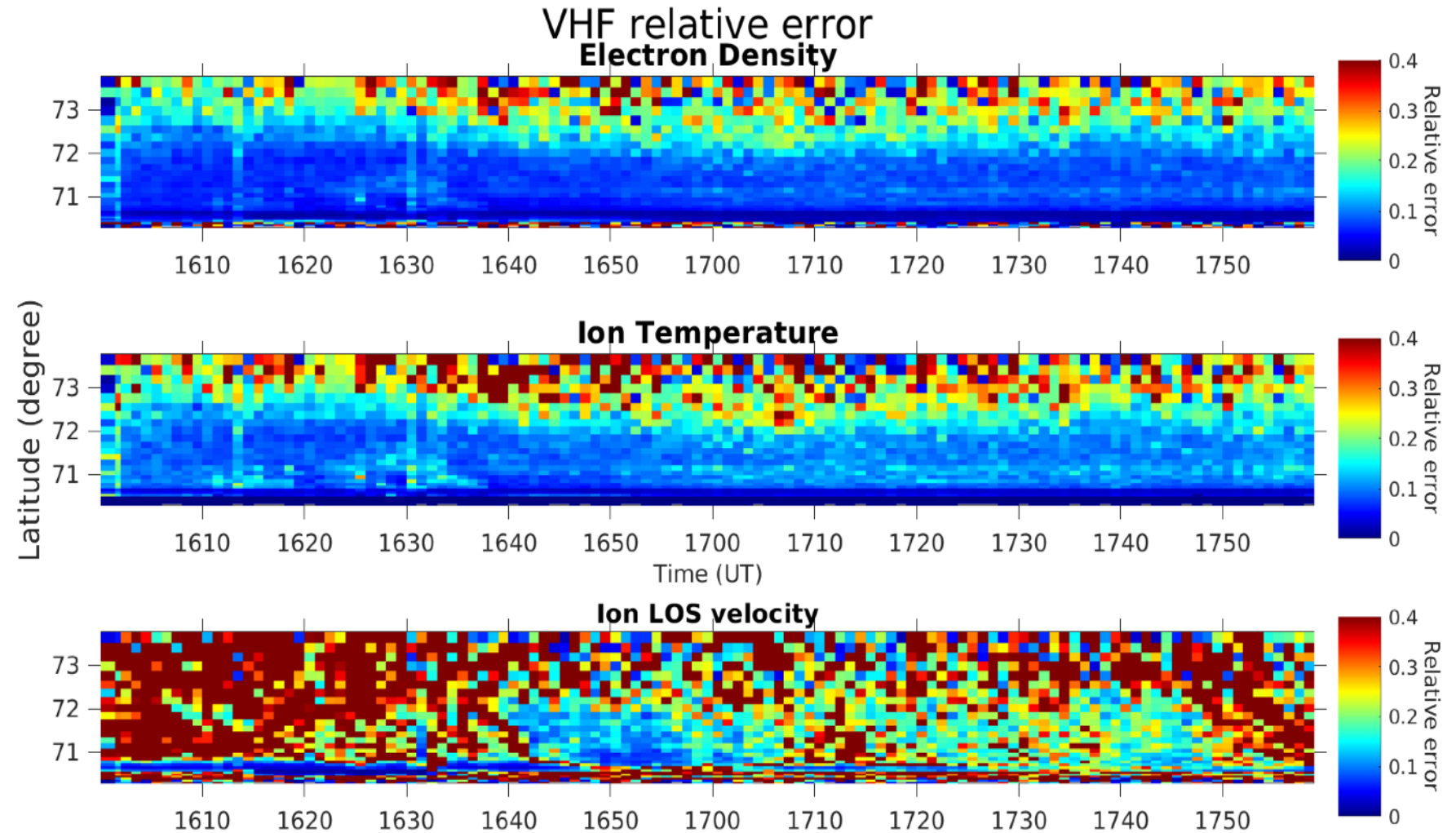


# STRUCTURES FOUND IN TROMSØ VHF

- Southward moving precipitating electrons
- Increase in  $N_e$  corresponding to increased  $T_i$

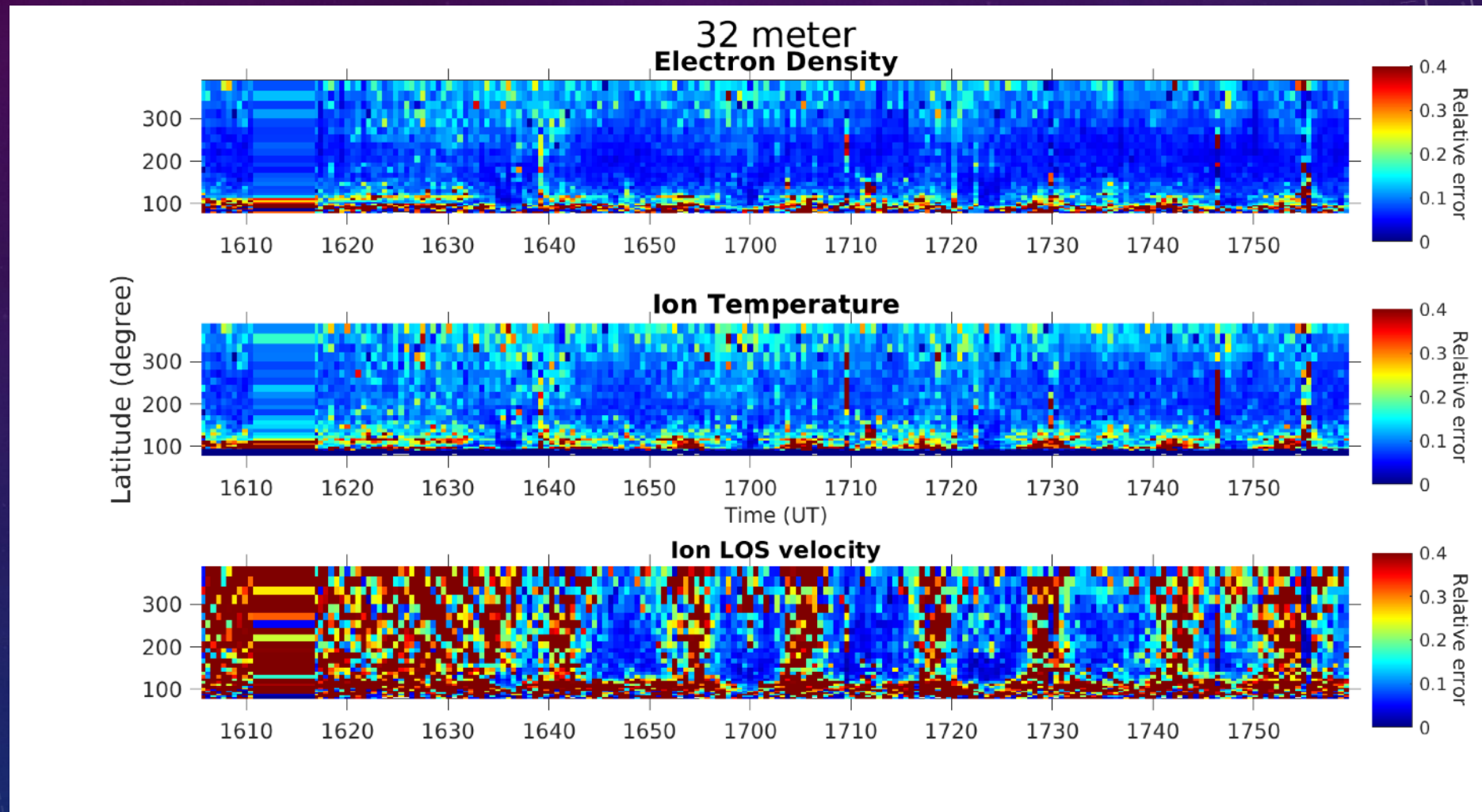


# TROMSØ VHF RELATIVE ERROR

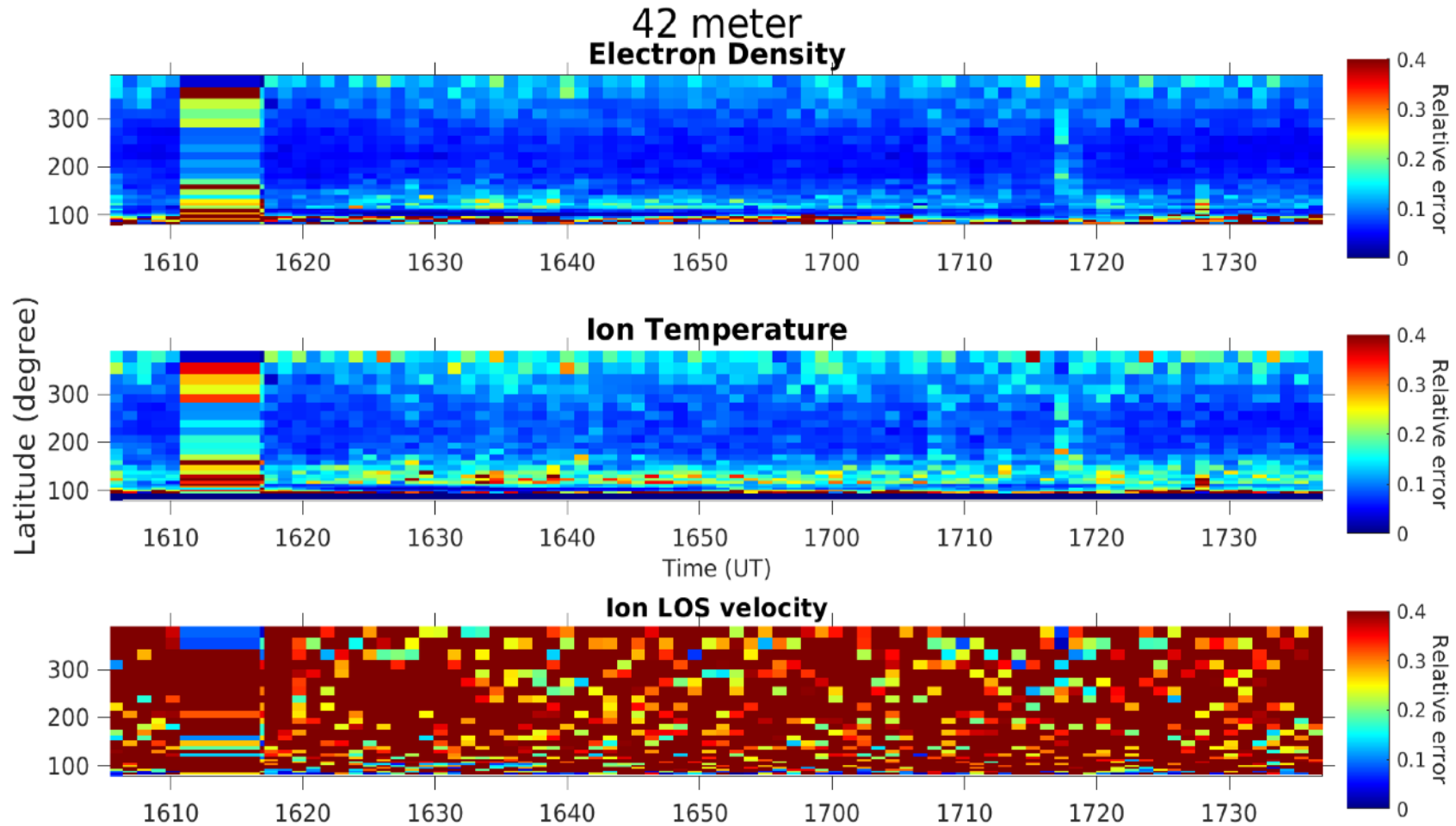




# 32 METER ESR RELATIVE ERROR



# 42 METER ESR RELATIVE ERROR



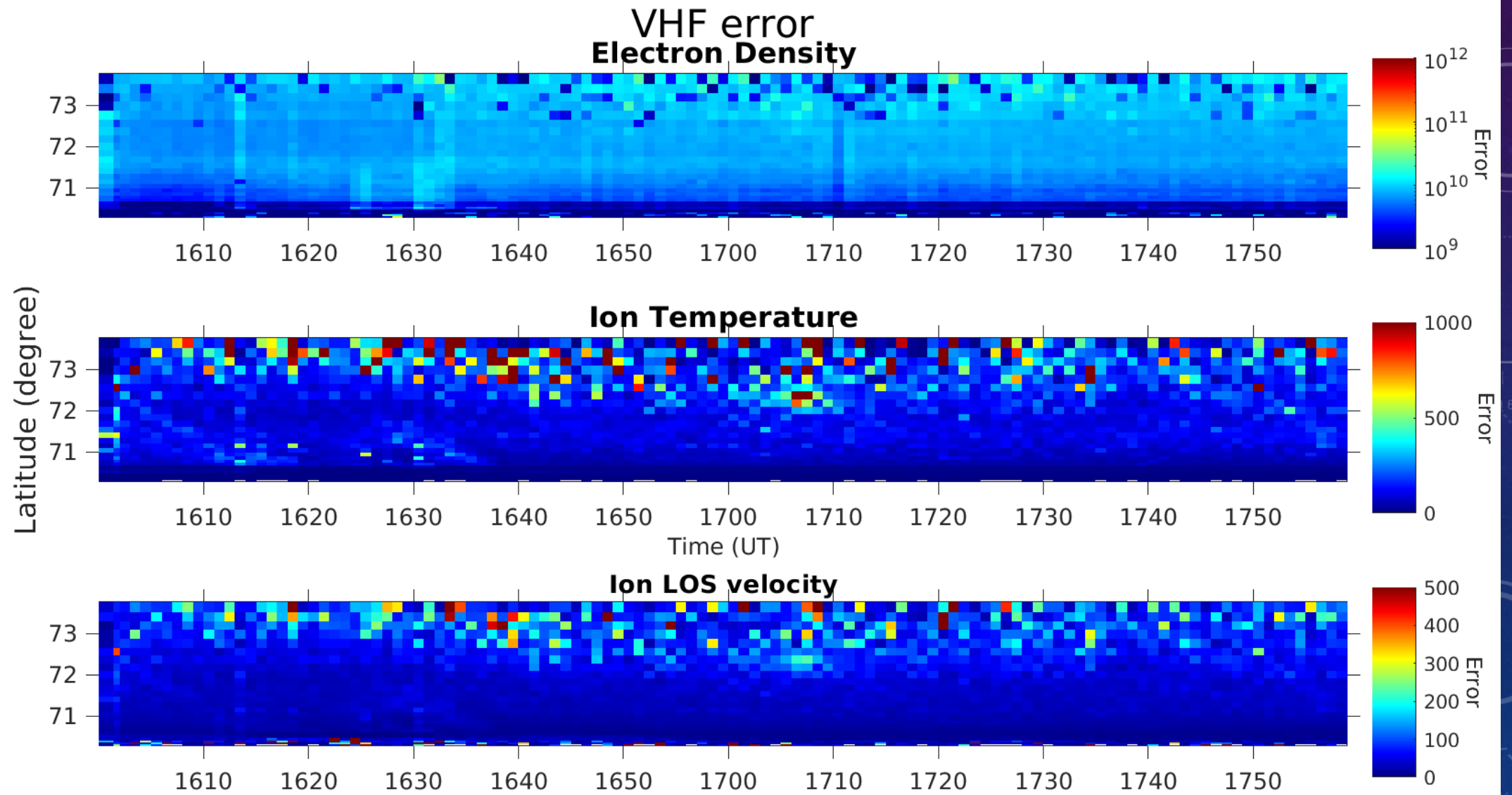


# CONCLUSIONS

- Likely no polar cap patches detected (previous studies showed that the patches are most often observed during winter, because of the easier detection due to better ionospheric background conditions)
- Short duration electron precipitation (substorm)
- Drift of plasma in southward direction (possibly auroral streamers, need optical data to confirm)

QUESTIONS?





MLT at 17° geo. long. for UT=0 as a function of geo. lat.

