

Observation of Aurora Particle Precipitation

Group 6

Tomi Teppo

Walker Zhan

Theresa Rexer

Steven Brown

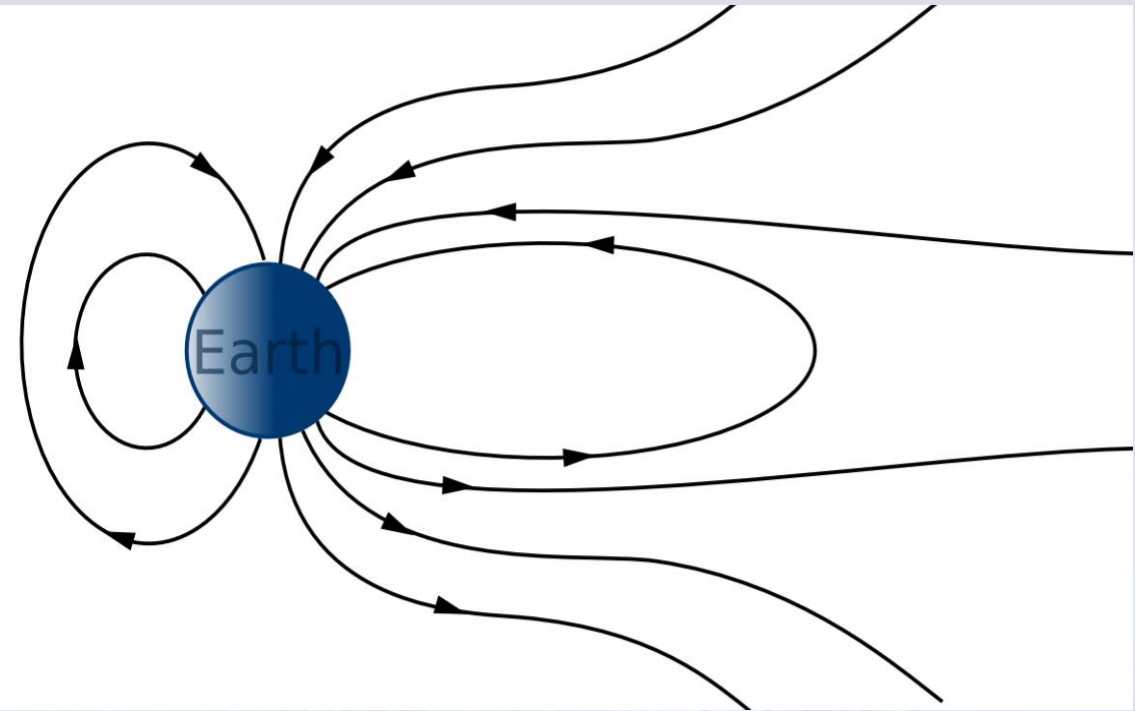
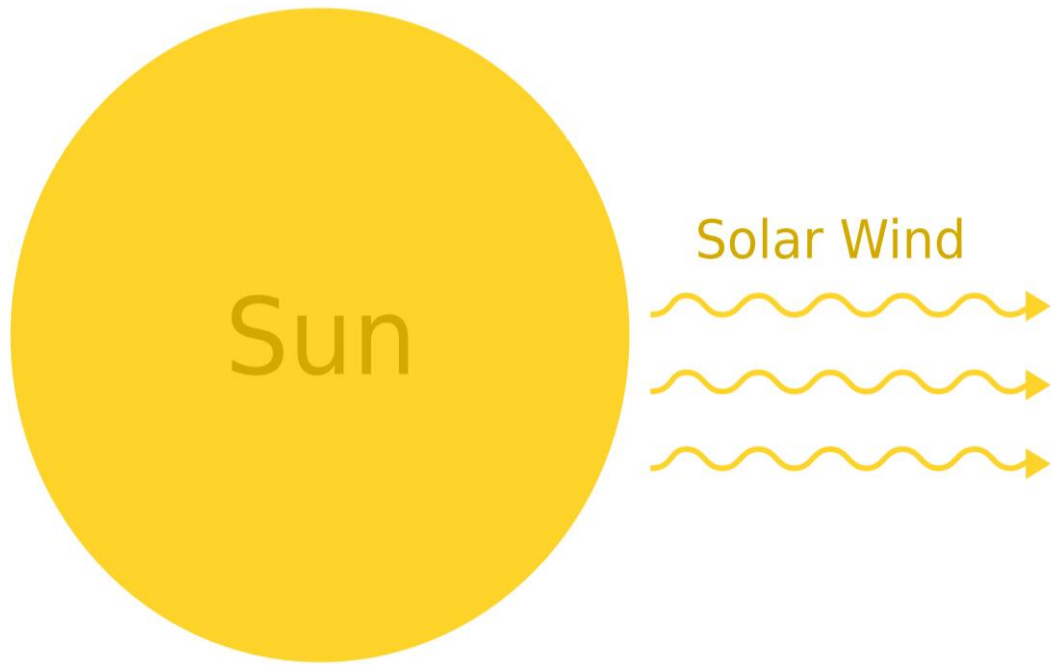
Toru Takahashi

SGO ISR School, 2016

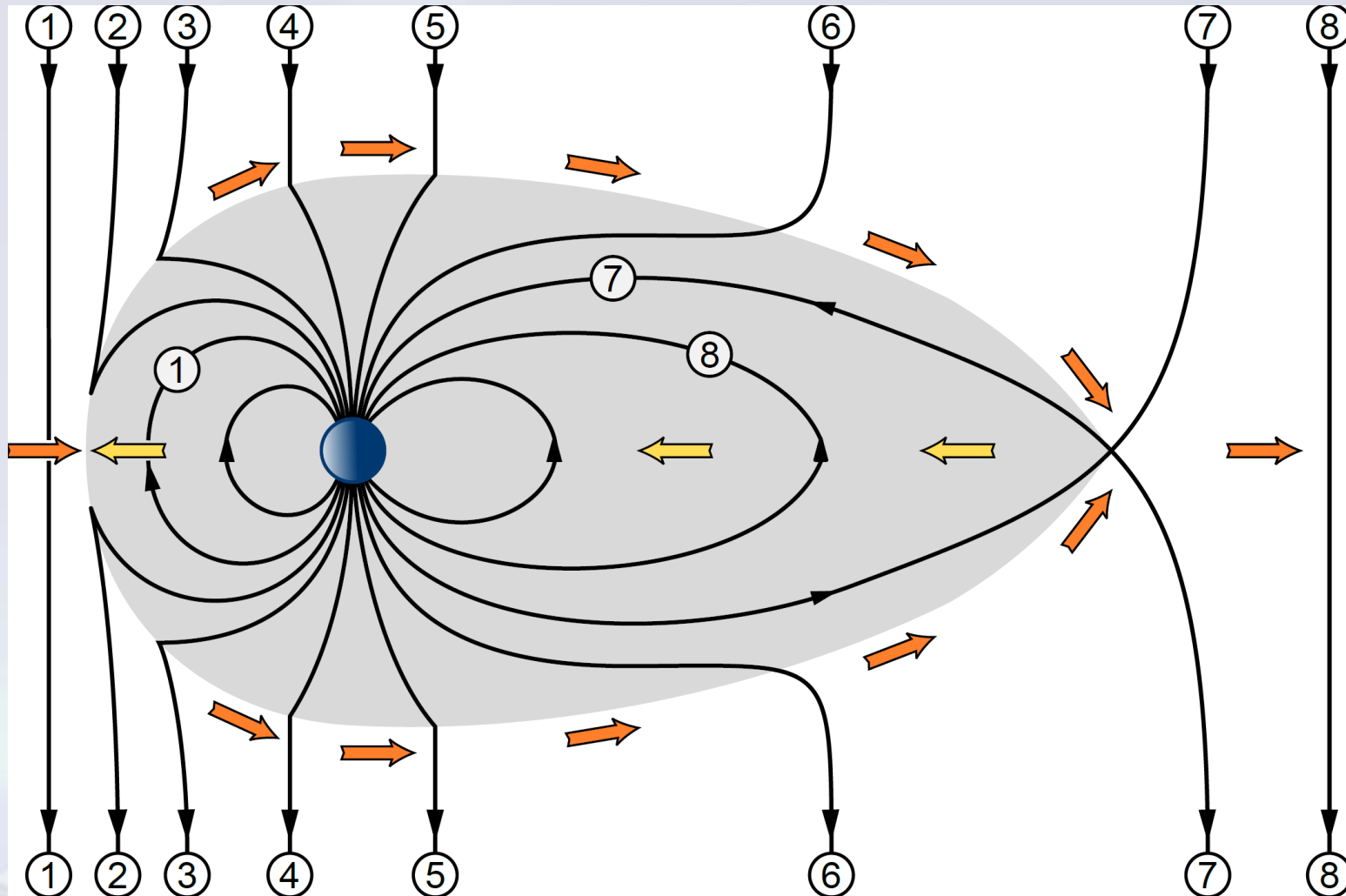
Outline

- Introduction
- Science Objective, Experimental Set-Up
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 - Additional ionospheric results
- Discussion
- Concluding Remarks

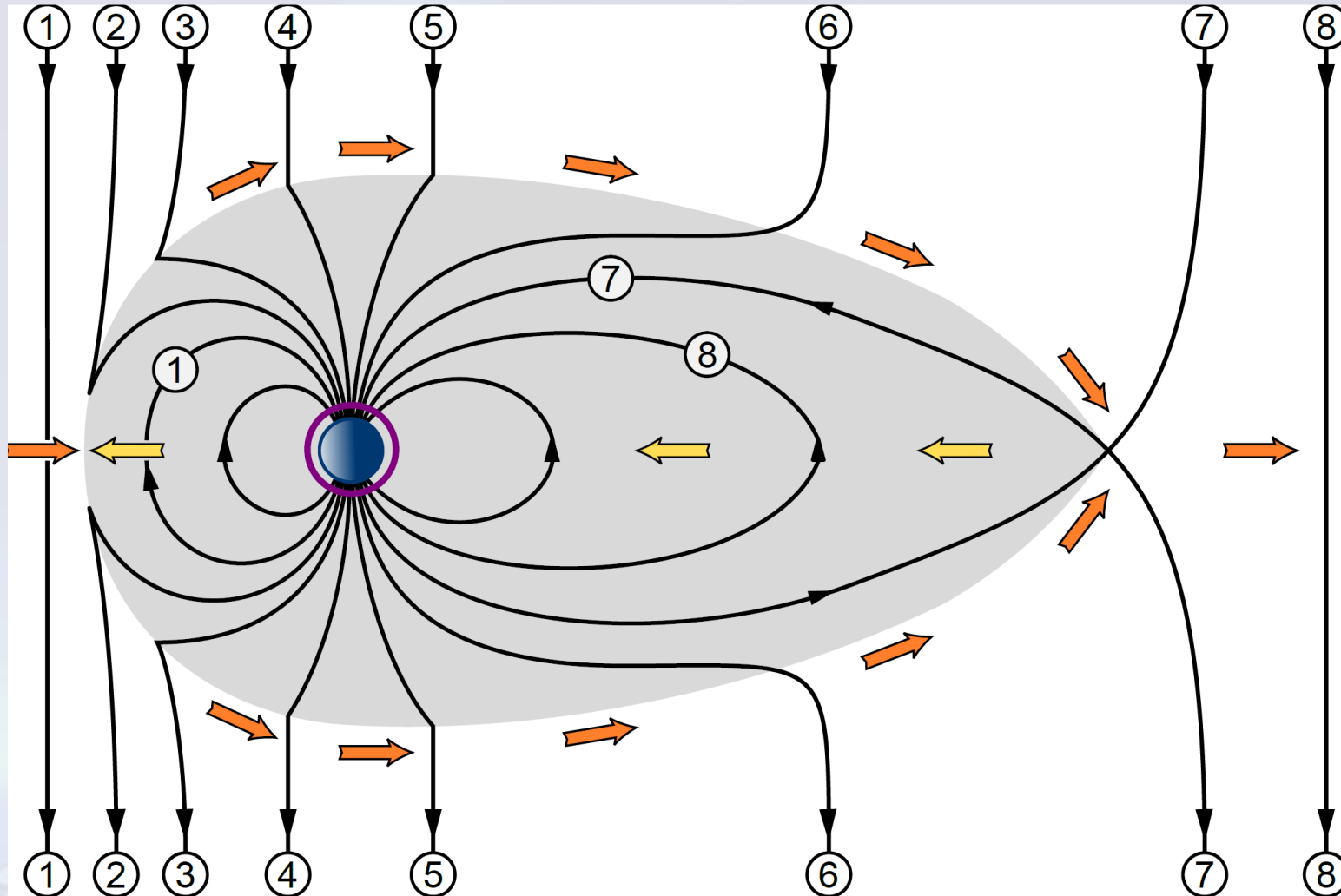
Introduction



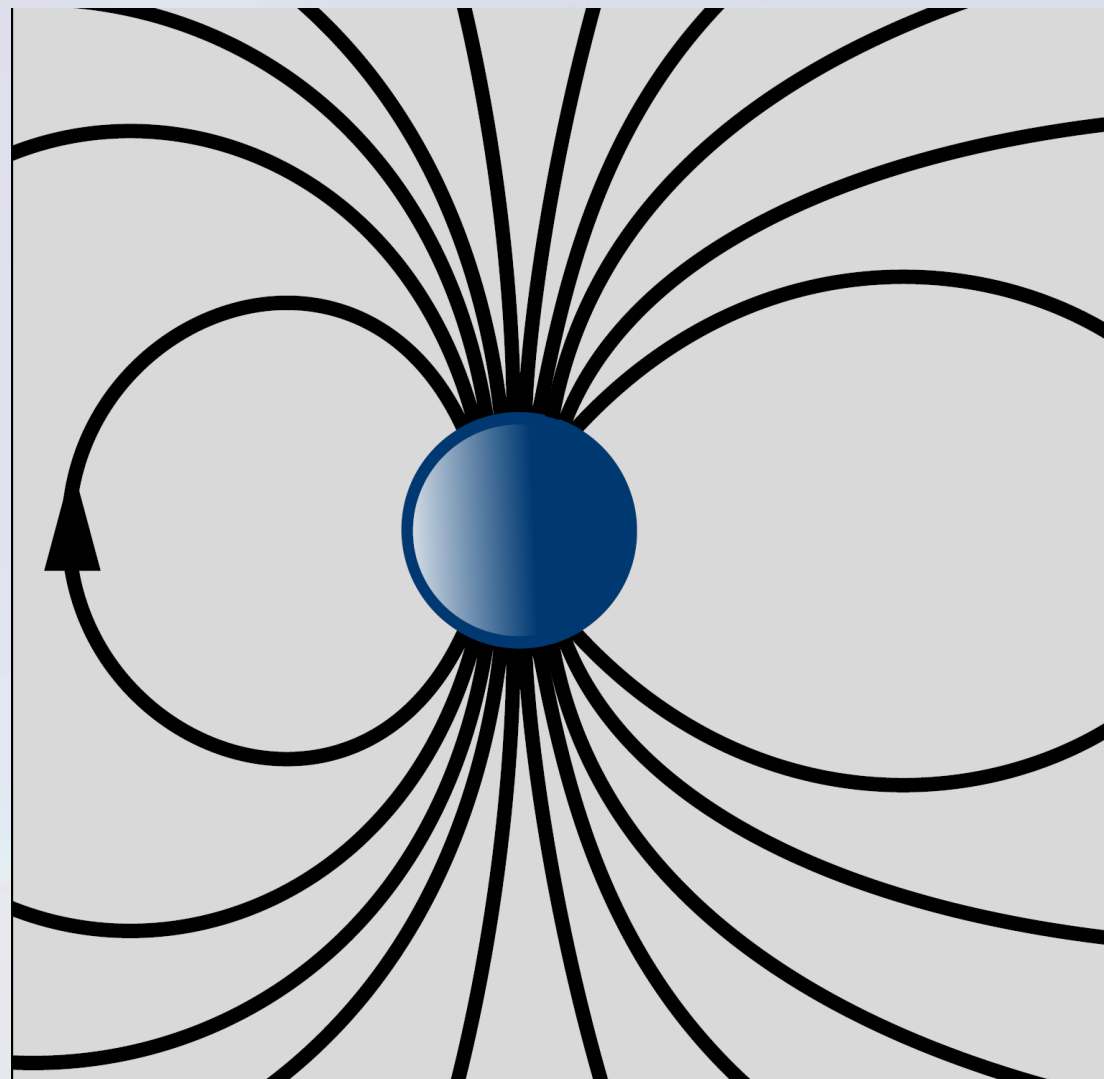
Introduction



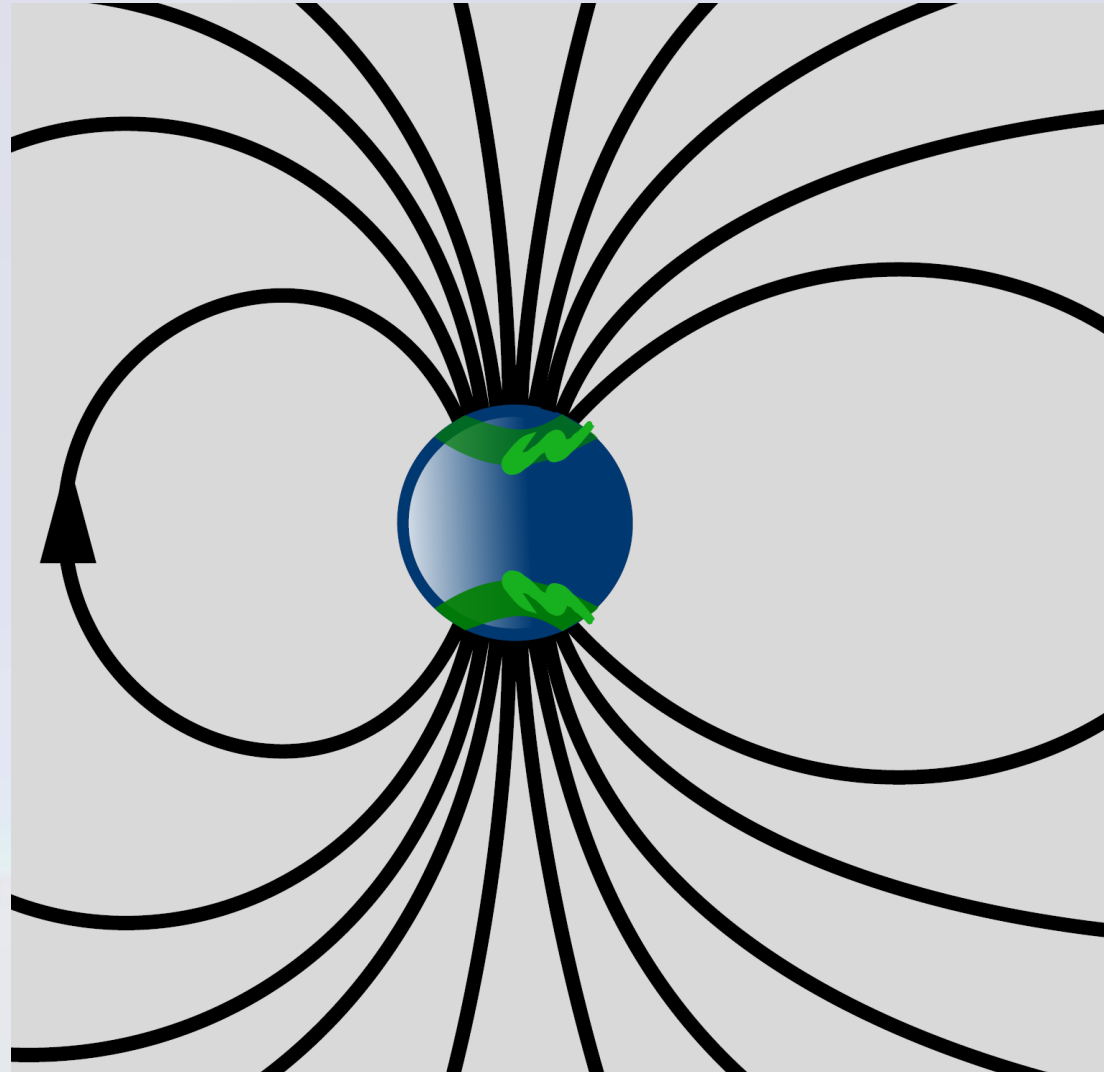
Introduction



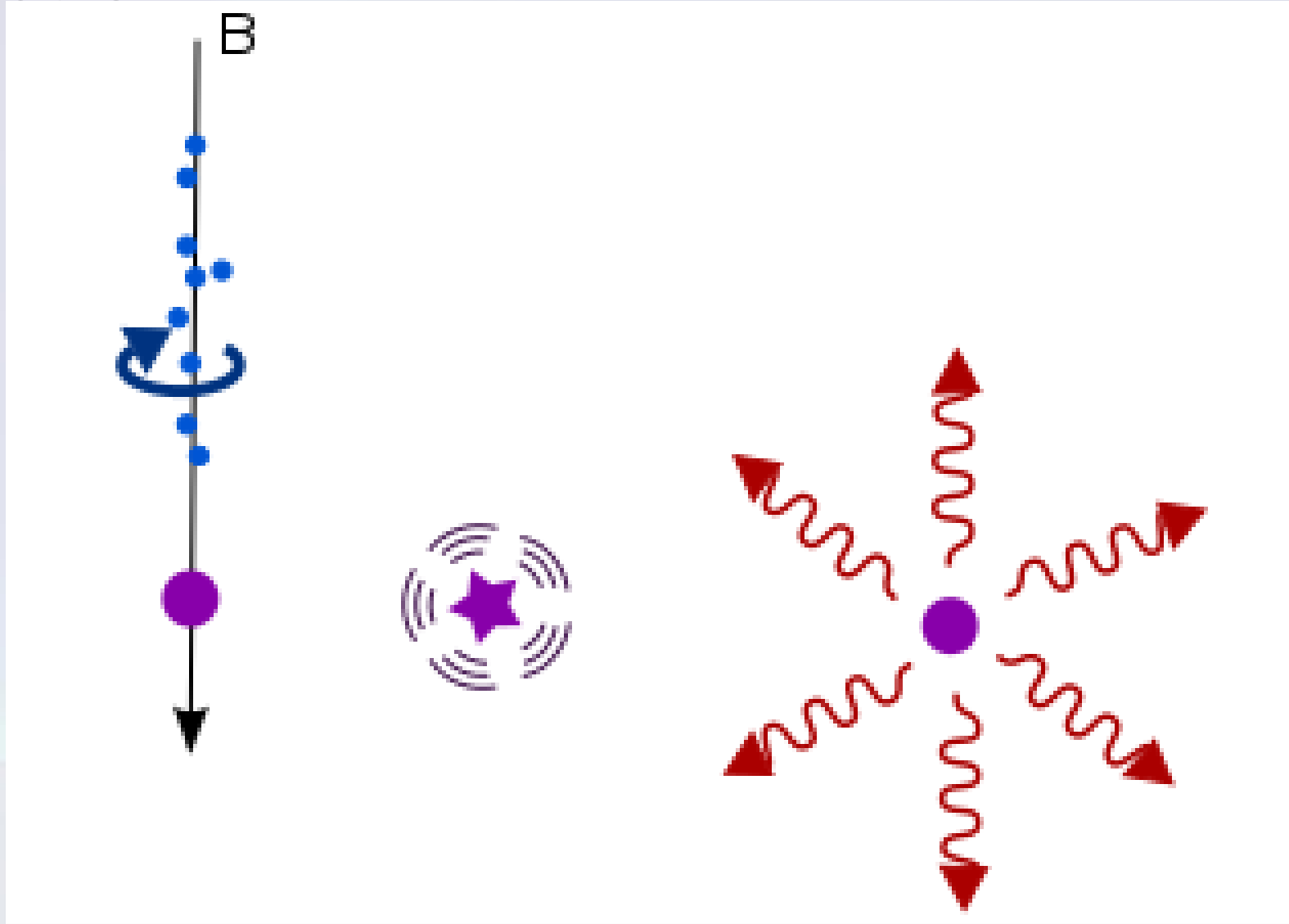
Introduction



Introduction



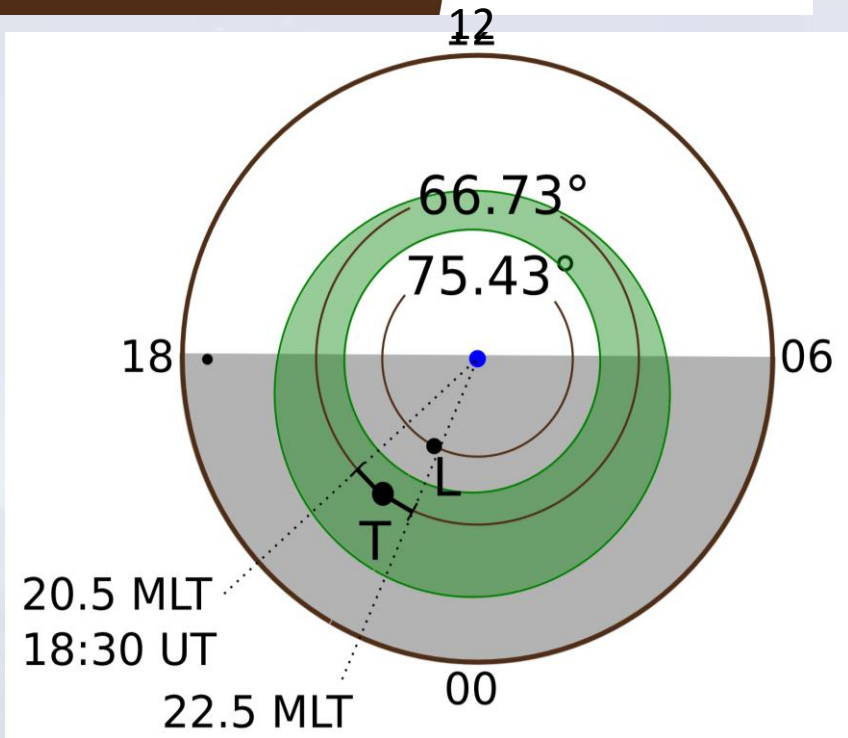
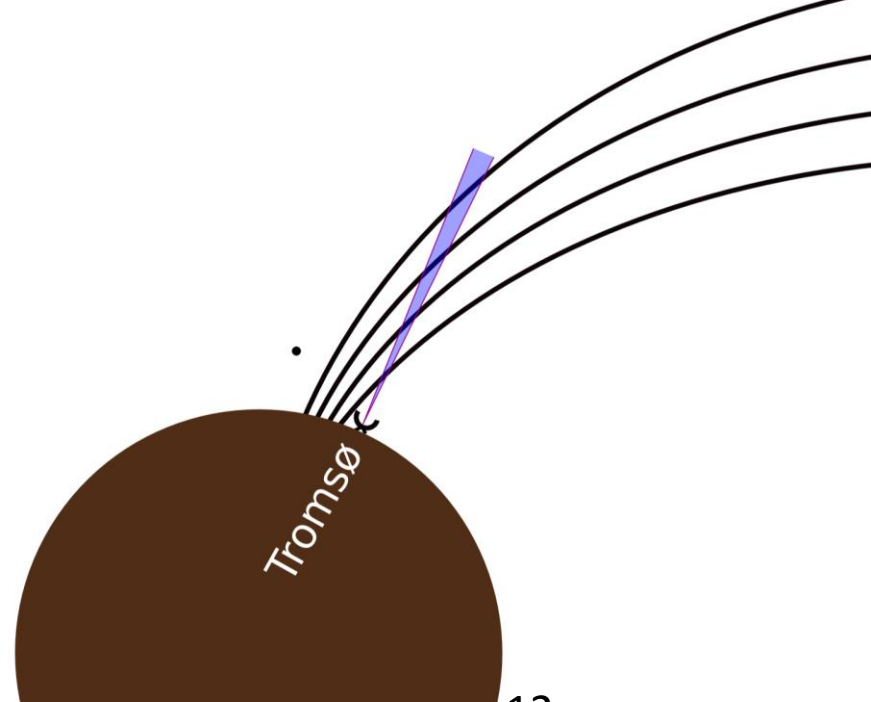
Introduction





Science Objective

- Goal is to observe signatures of aurora at Tromsø VHF:
 - electron density and temperature variation
 - ion temperature variation
 - line of sight ion velocity variation

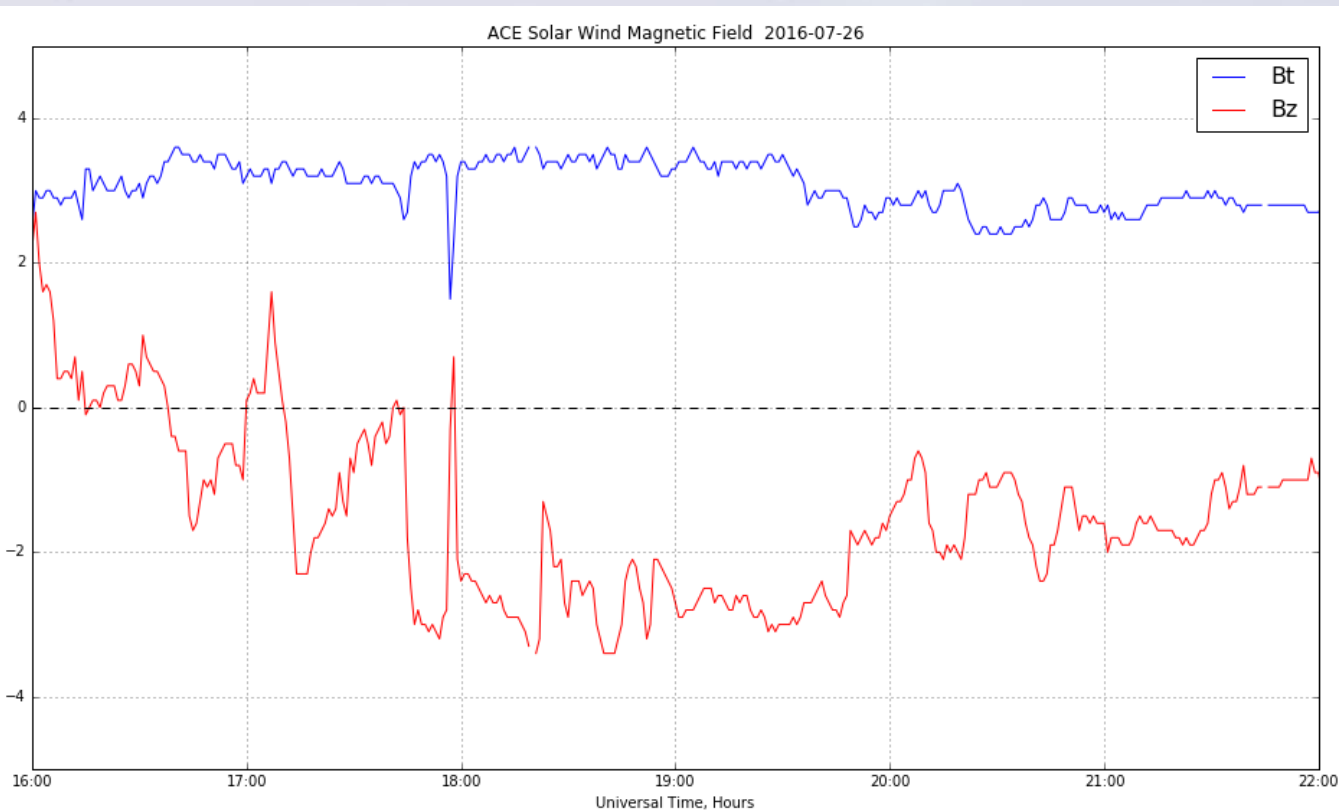


Experimental Set Up

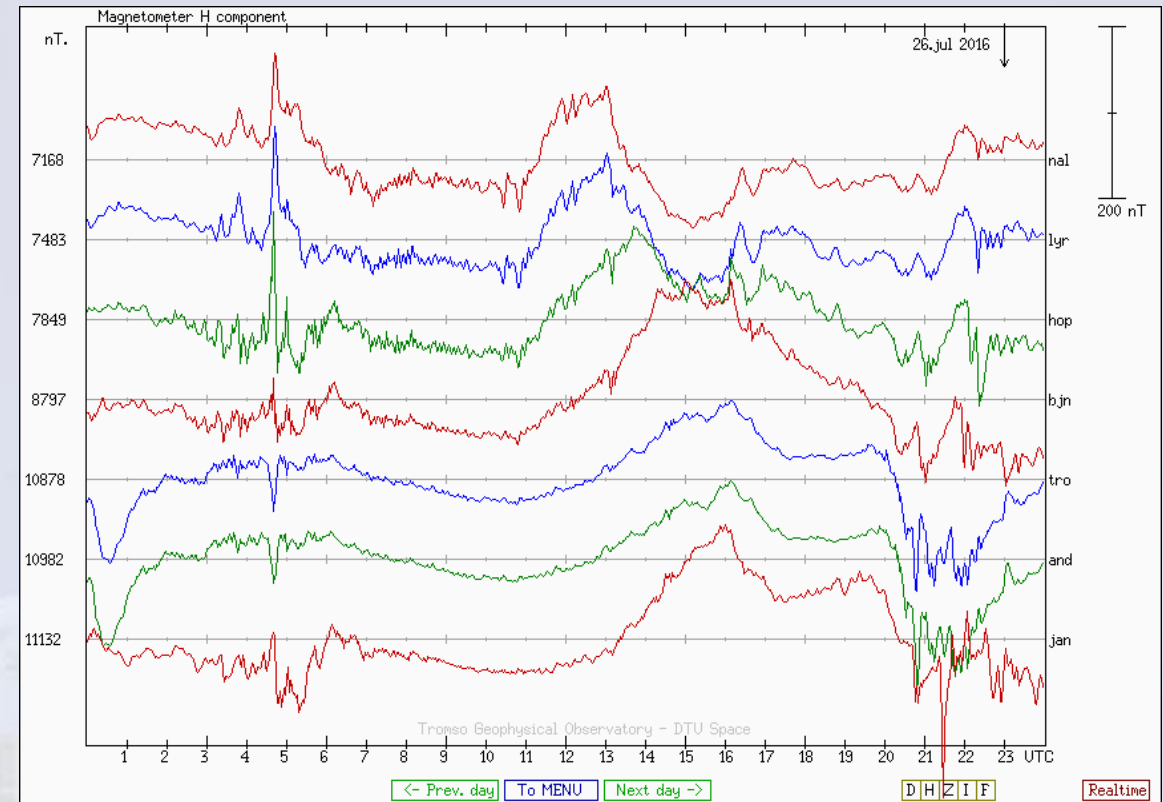
- GLAT: 69.58° , GLON: 19.23°
- Altitude: 86m
- Pointing direction: vertical
- Mode: beata
- Frequency: 223.2MHz
- Integration time: 5.0s
- Code: Alternating 32 bit, 64 subcycles
- Baud length: 20us
- Sampling rate 10us
- Subcycle length 5.58ms
- Duty cycle: 0.115
- Date: 26 July 2016
- Time: 16:30-18:30 (UT)

Geomagnetic Condition

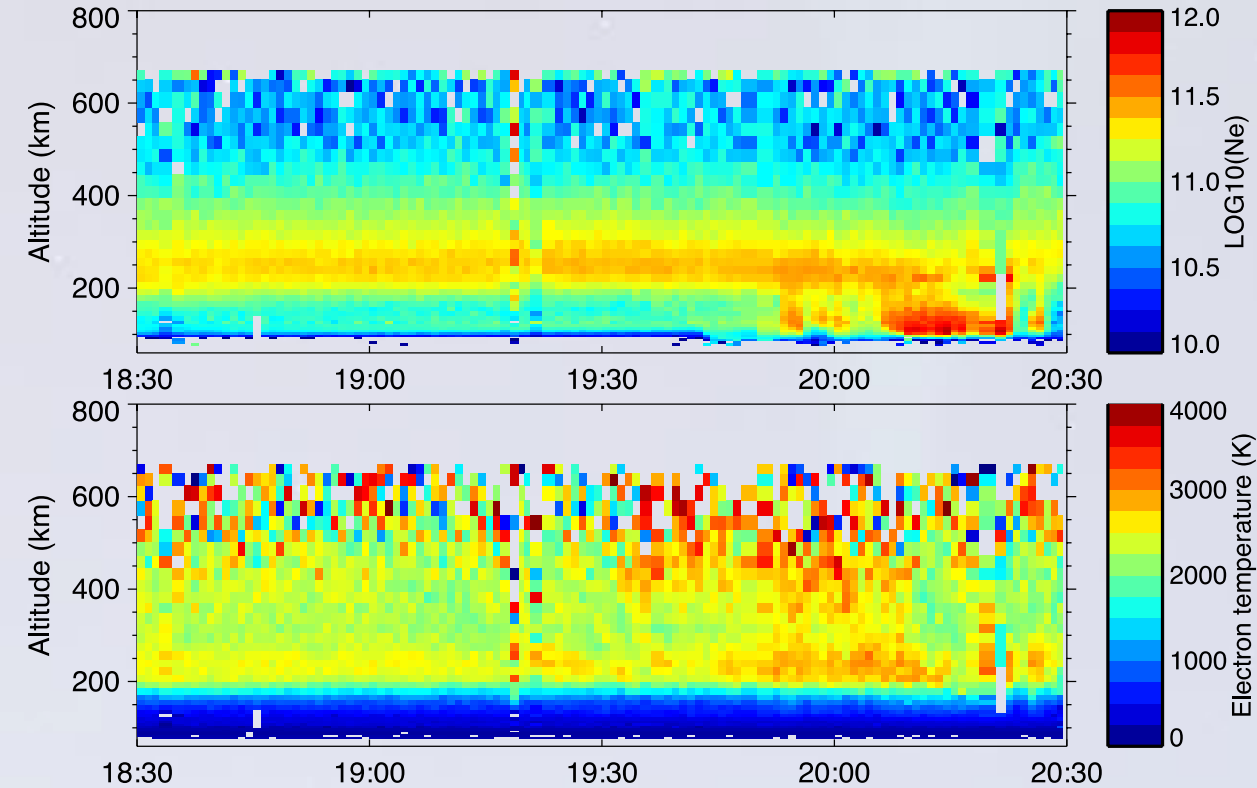
Solar Wind, ACE



Geomagnetic Field, Magnetometer

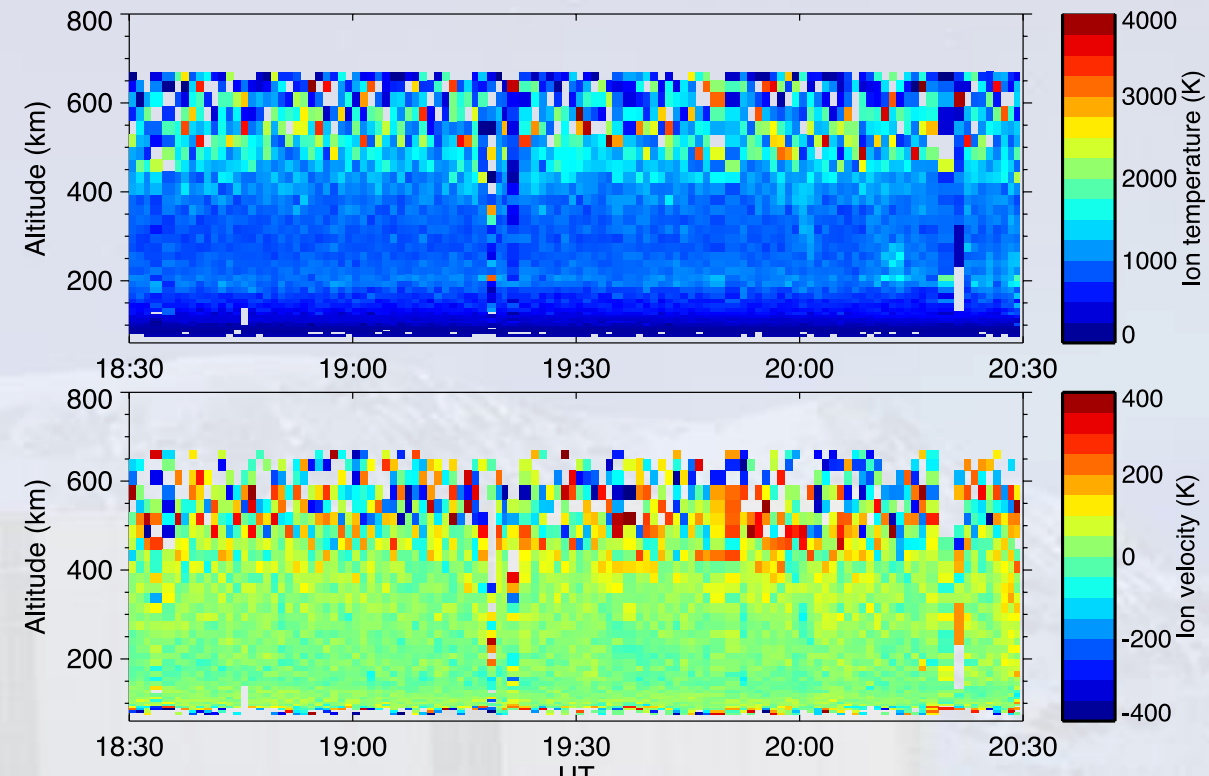


Tromsø VHF Results



- Auroral activity is high during this observation interval
- Precipitation started 19:43 UT.
- Hard auroral precipitation 20:20 UT.

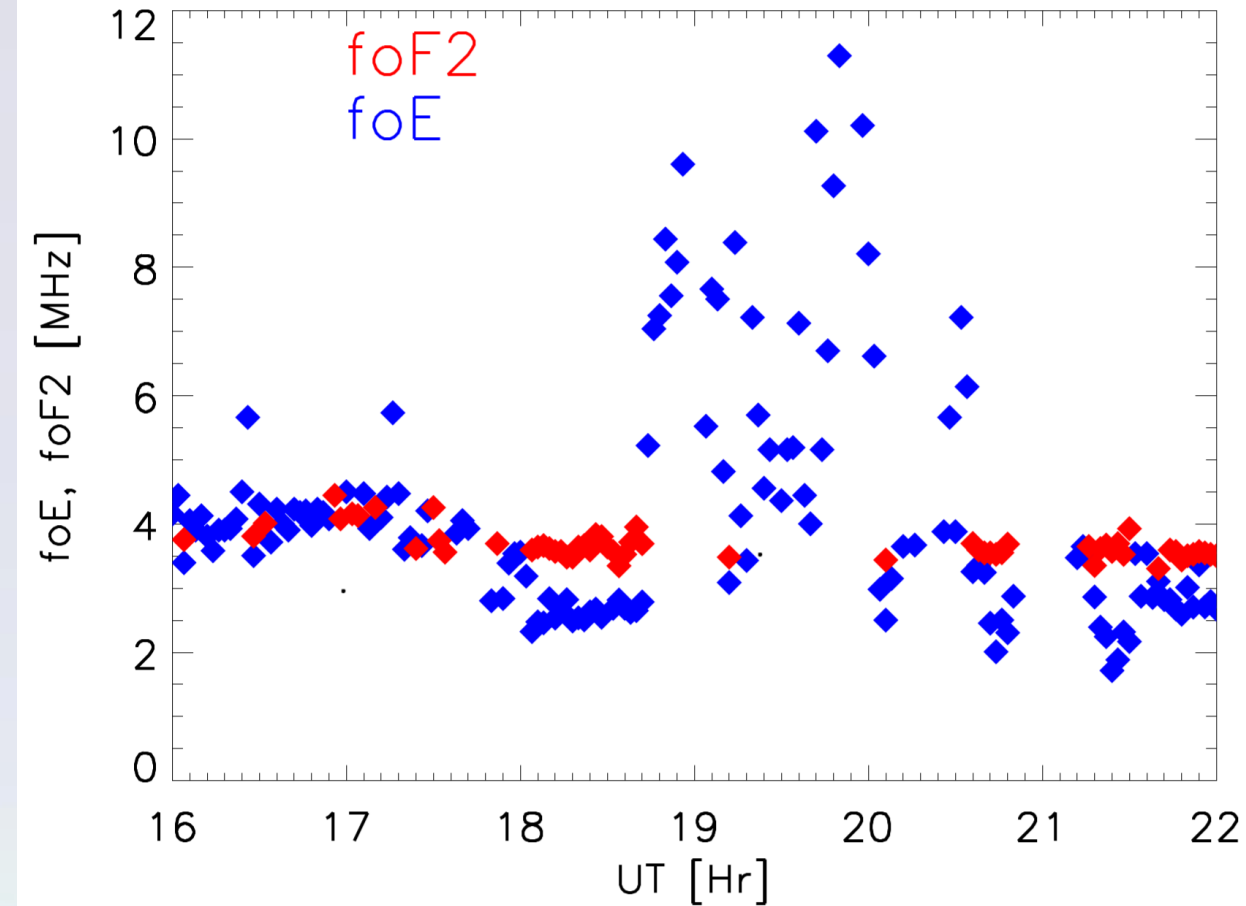
- Ion temperature is low during this interval indicating weak electric field.
- There is no remarkable variation seen in ion velocity data



Additional Ionospheric Measurements

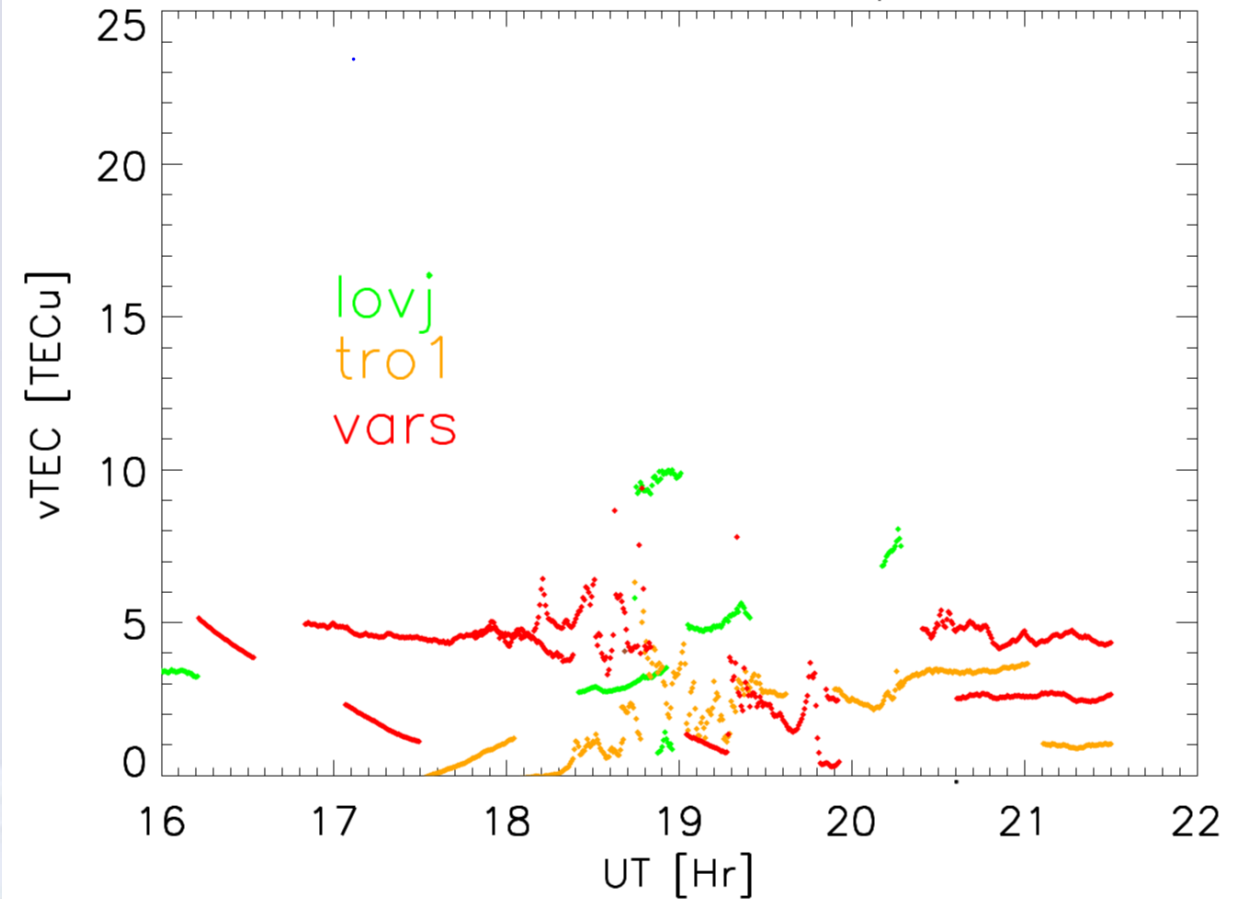
foF2

EISCAT Tromsøe

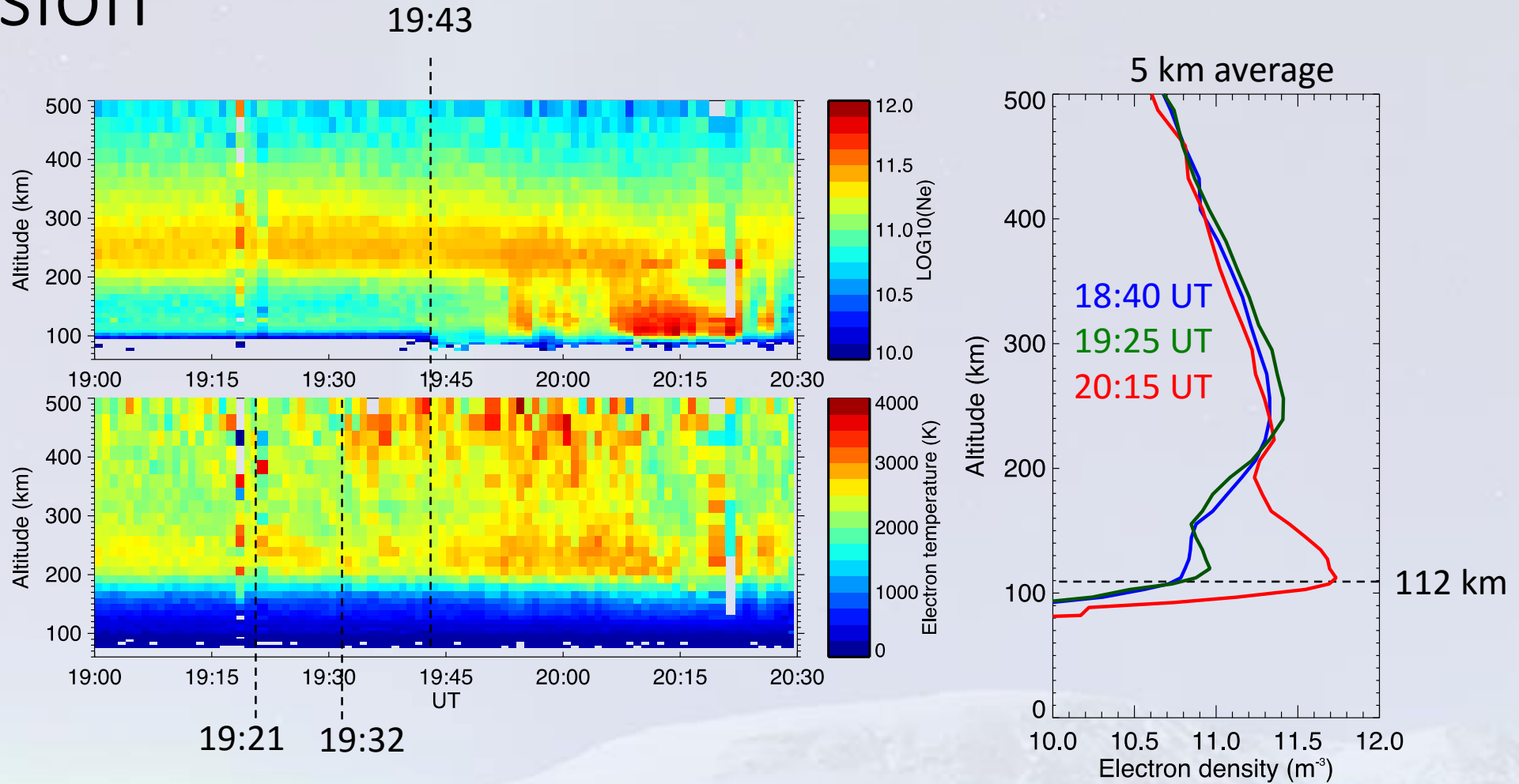


TEC

GNSS Derived TEC, Multiple Sites



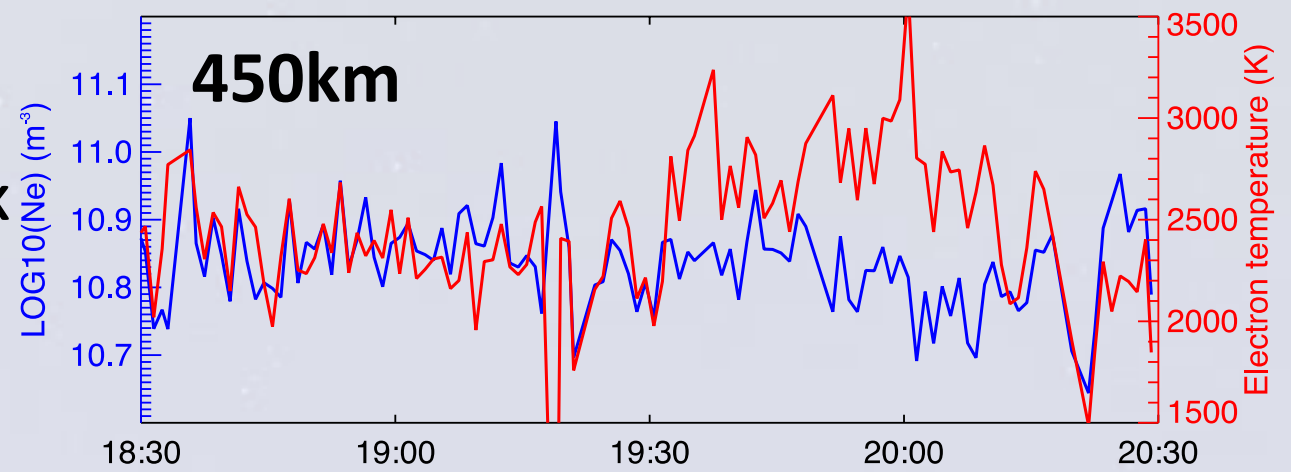
Discussion



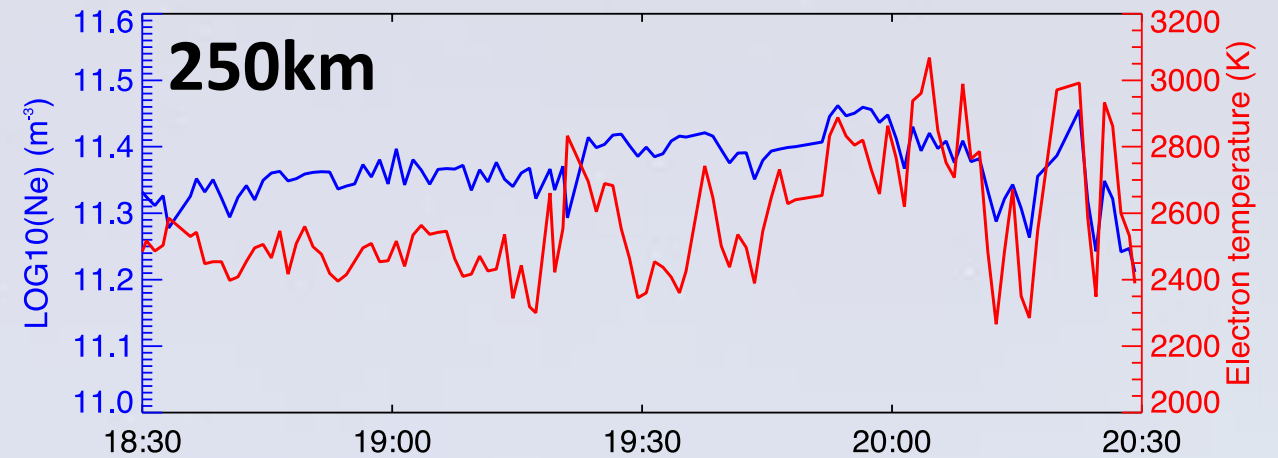
The electron density was increased by the high energetic particle (~ 10 keV) precipitation. The electron temperature was enhanced before start of the auroral precipitation. At that time, there are no remarkable enhancements in the electron density, ion temperature and ion velocity.

Discussion

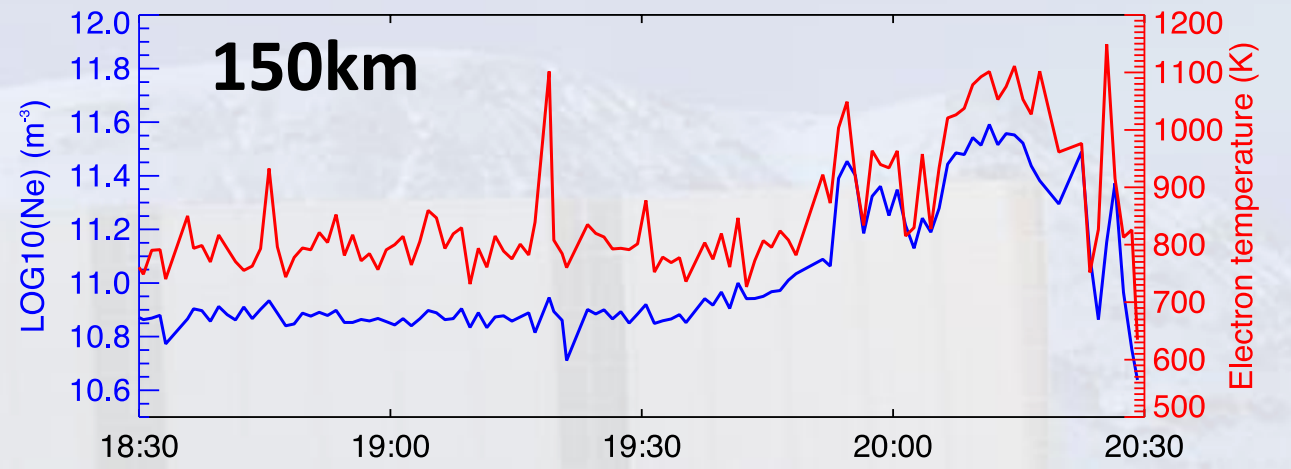
Not Similar trend
Ti increase 2300 -> 2800 K
@19:32



Not sSimilar trend
Ti increase 2400 -> 2800 K
@19:21

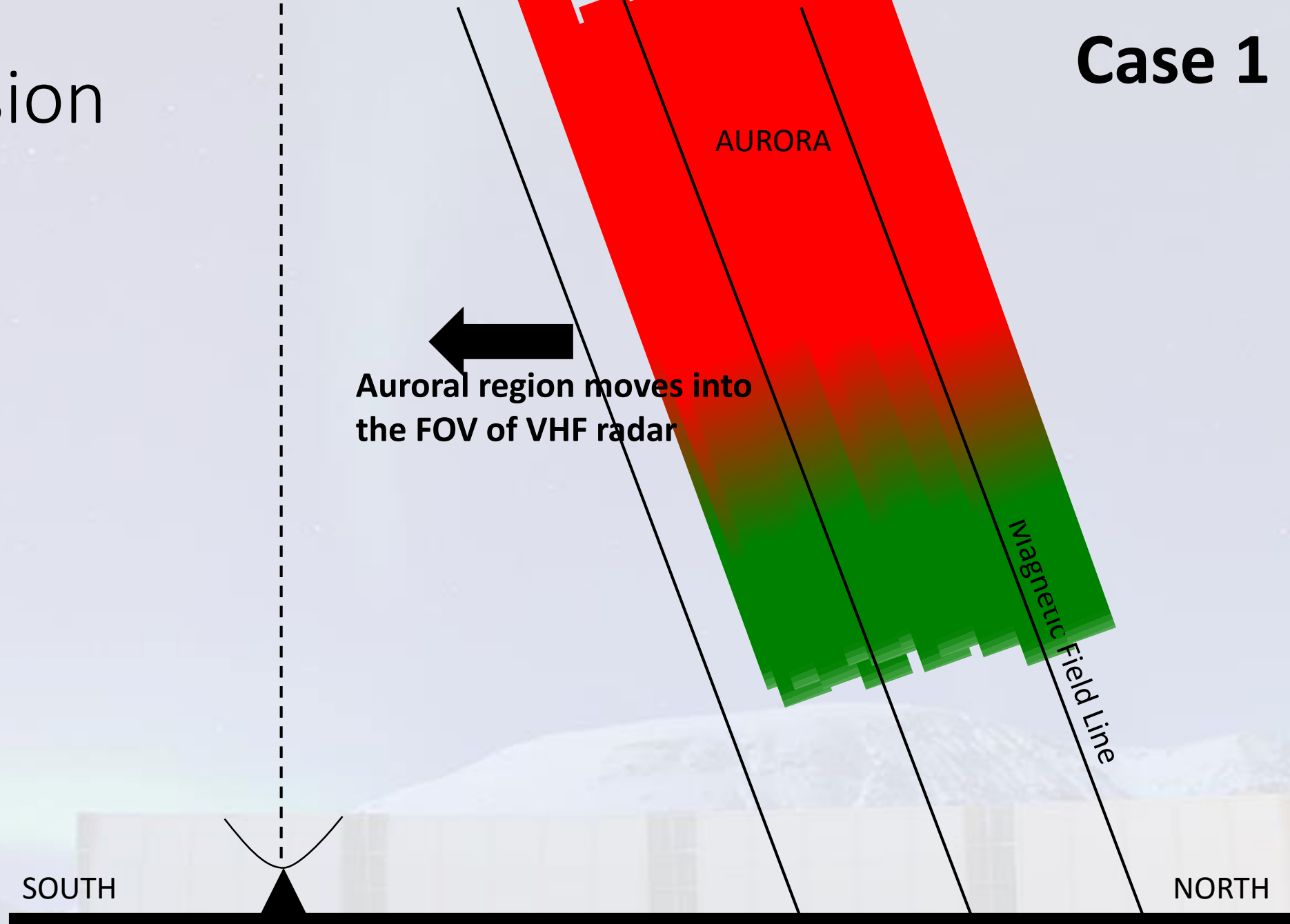


Similar trend



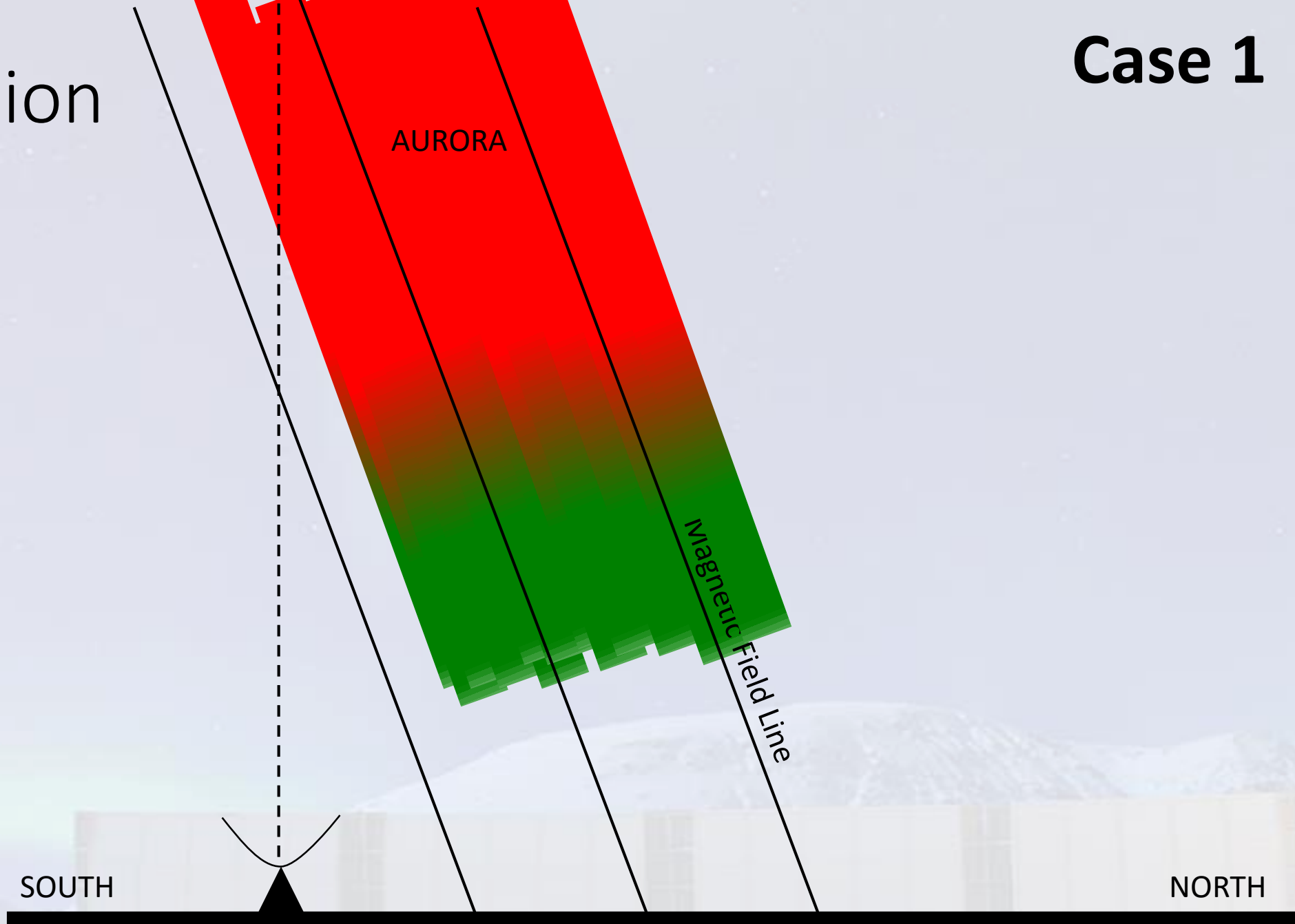
Discussion

Case 1



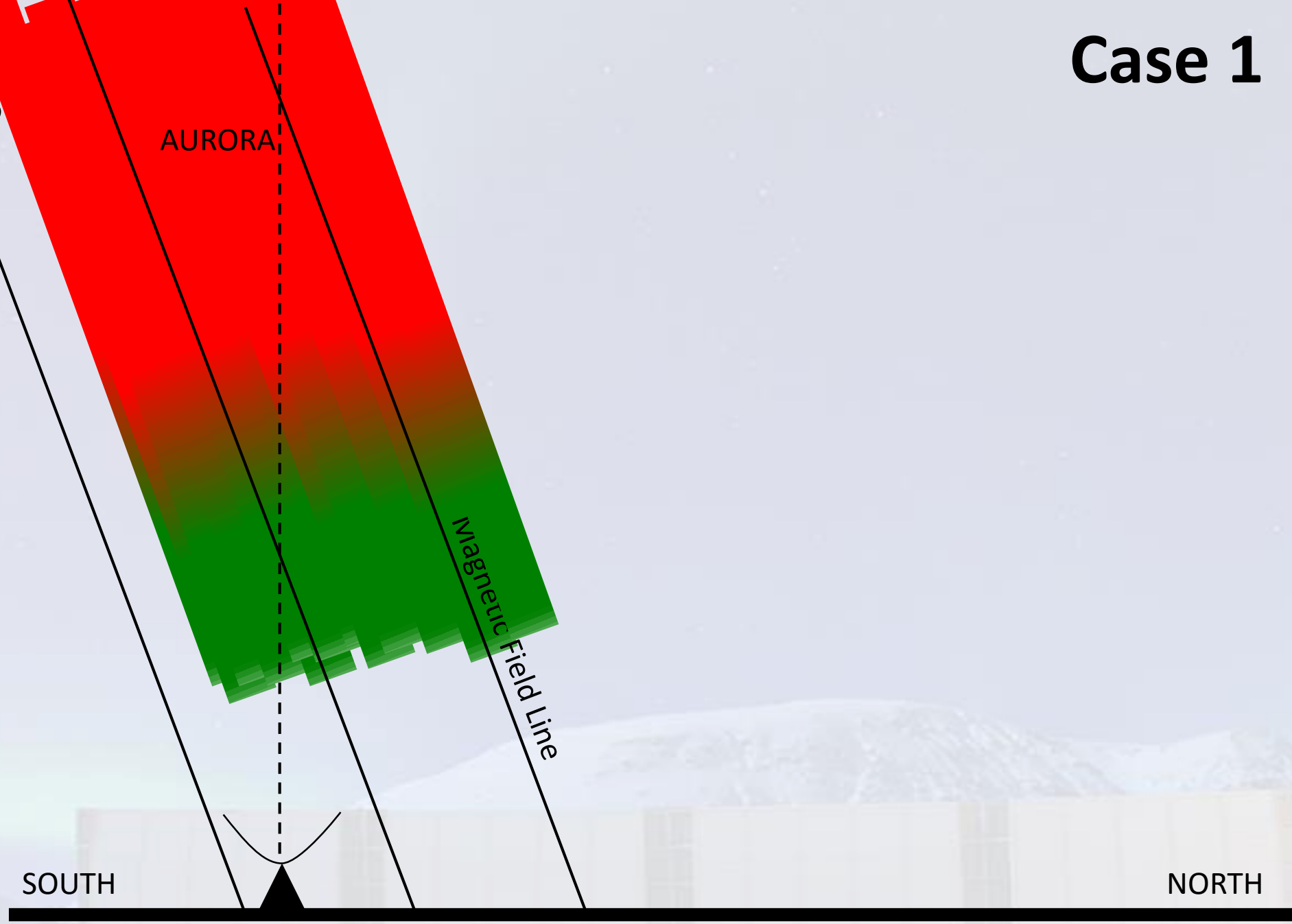
Discussion

Case 1



Case 1

Discuss



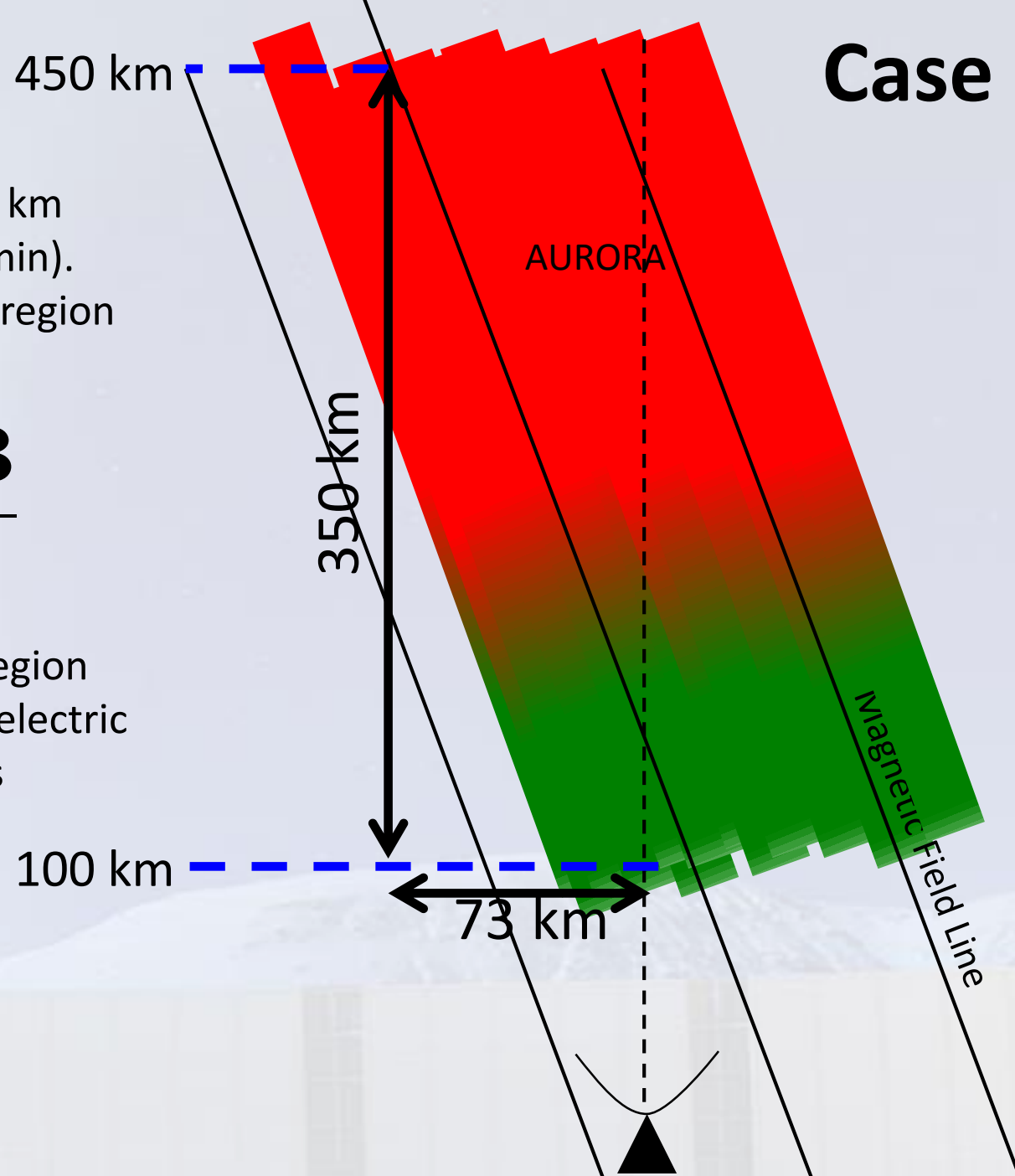
Discussion

The aurora region drift 73 km from 19:32 to 19:43 (11 min). Thus, the velocity auroral region is 110 km/s.

$$V = \frac{\mathbf{E} \times \mathbf{B}}{B^2}$$

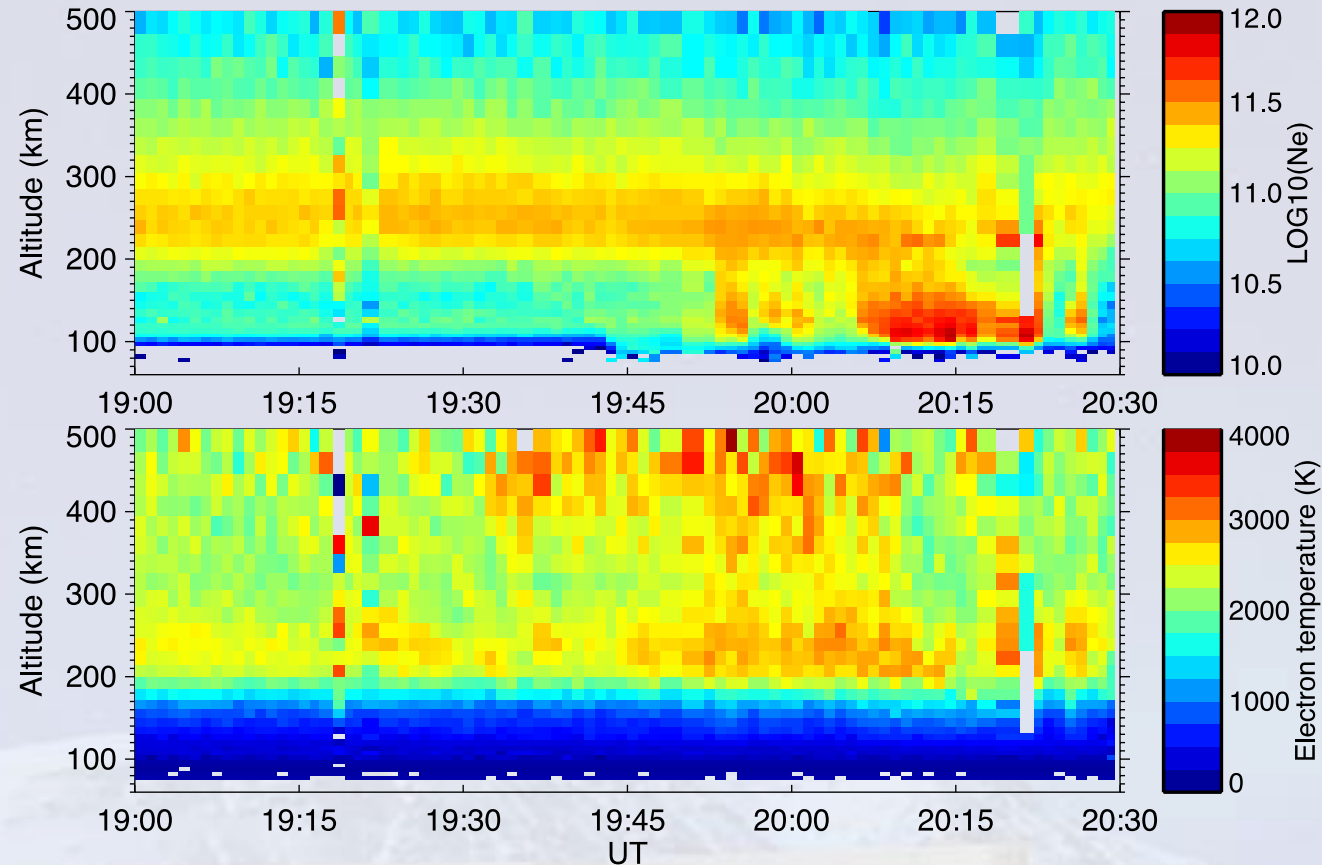
The velocity of auroral region corresponds to 5 mV/m electric field. This electric field is typically observed.

Case 1



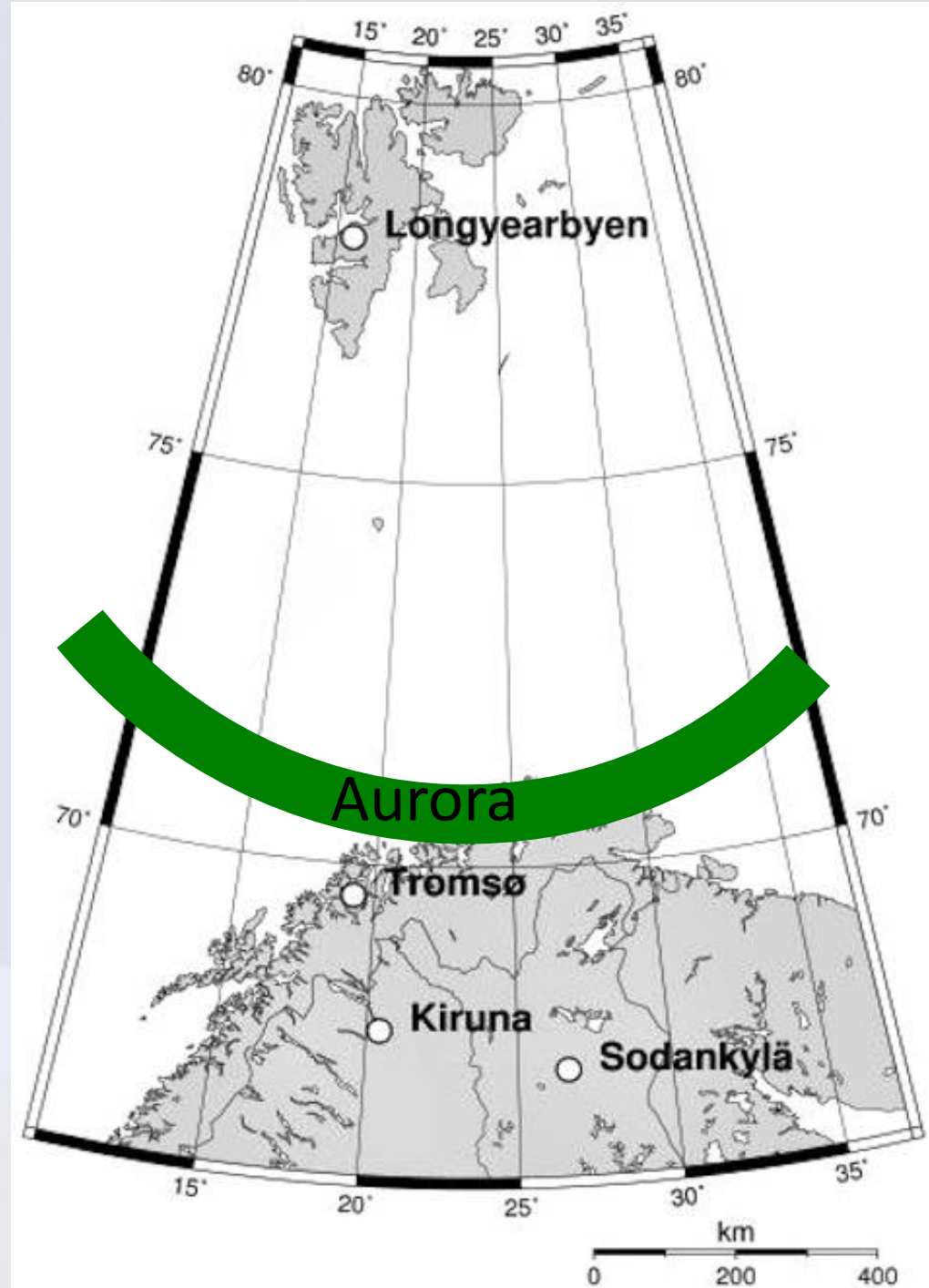
Case 1

- We can explain:
 - The high electron temperature was seen around 450 km altitude.
 - The electron temperature around 250 km increases but the electron density doesn't change too much.
- We can NOT explain:
 - The electron density did not increase with the electron temperature.

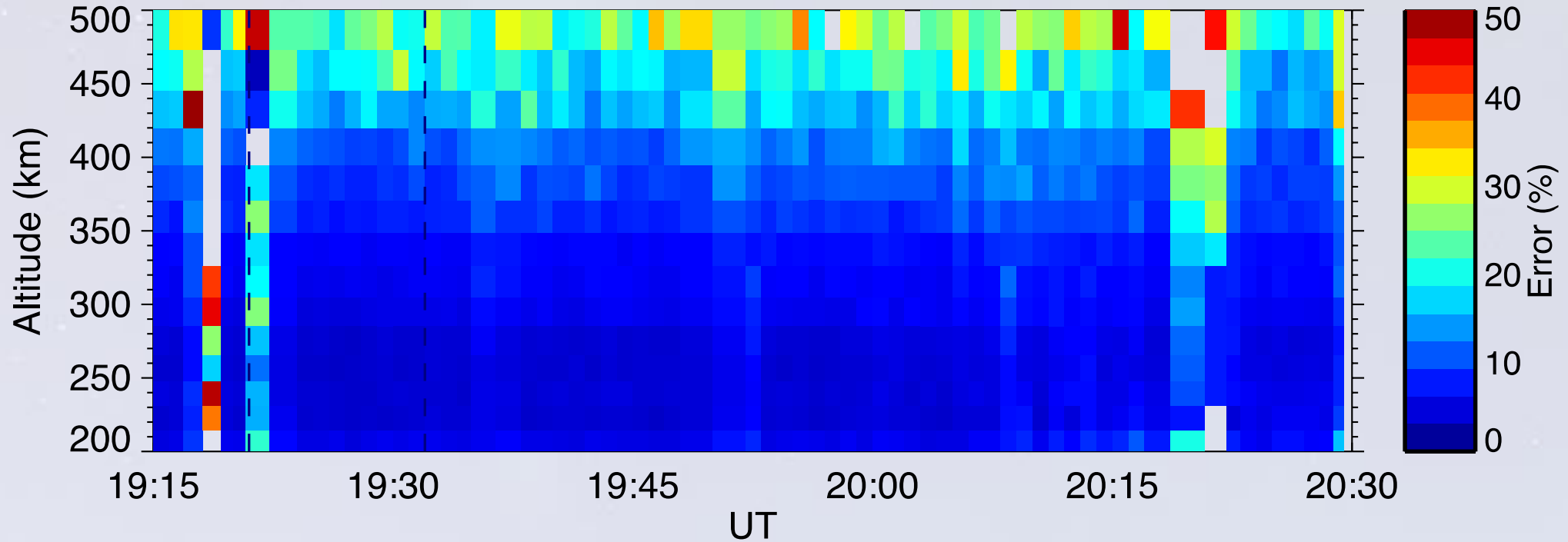


Case 2

- The auroral precipitation causes the electron temperature enhancement.
- If the high electron temperature region were near Tromsø, the high temperature electrons would flow into the FOV of VHF radar.
- However, since the electron temperature immediately decrease, there is a low probability of this cause.



Case 3

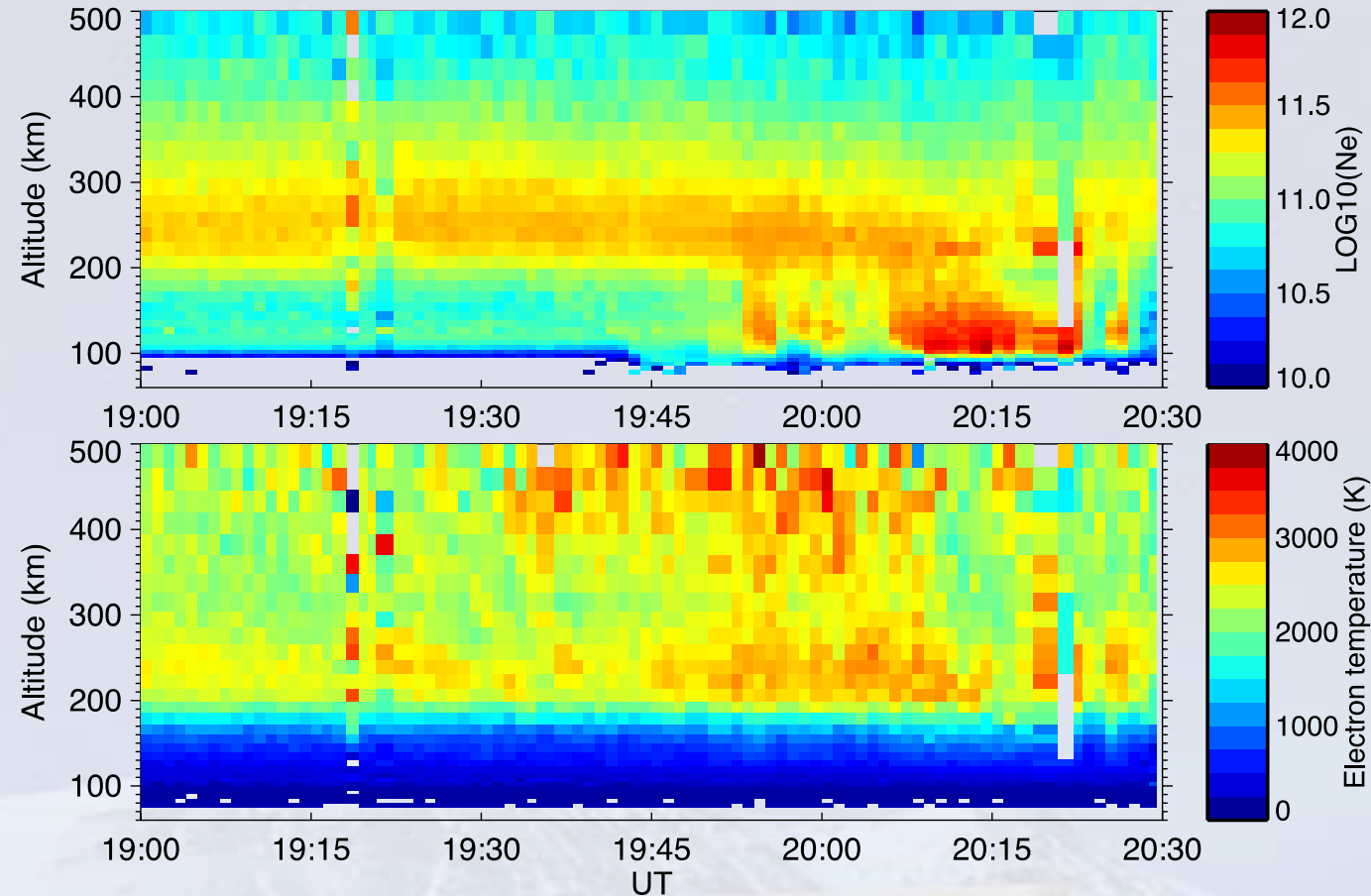


The error value of T_e is large from 400 to 450 km (20~35 %).

Thus, the electron temperature enhancement around 450 km was likely to be within measurement error value. On the other hand, the T_e around 250 km was derived with high accuracy.

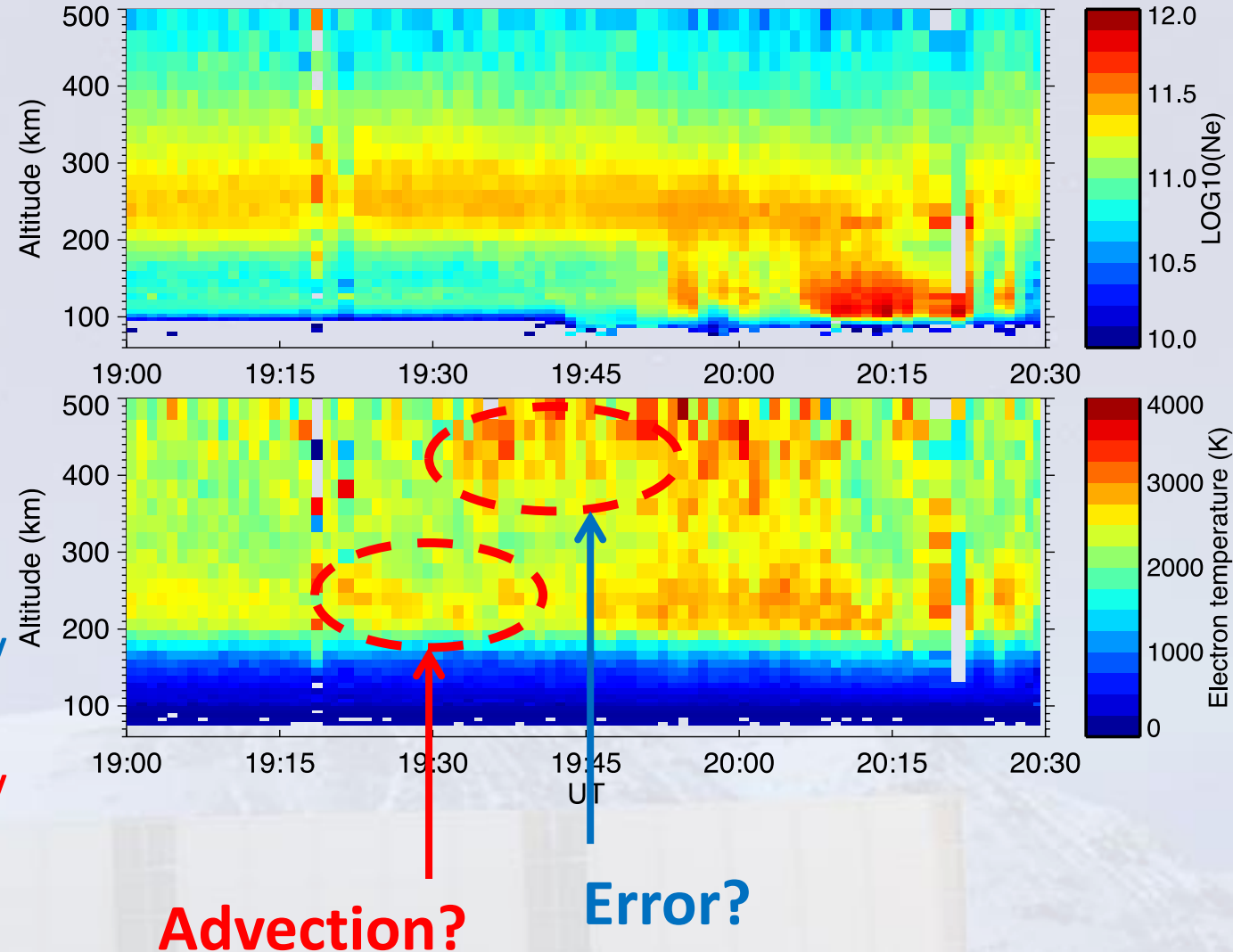
Case 1

- We conducted observations from 18:30 to 20:30 UT on 26 July 2016.
 - EISCAT VHF, beata, Vertical alignment
- Auroral precipitation occurred from 19:43 to 20:30.
- We found that the electron temperature (T_e) enhancements before the start of auroral precipitation. **Interesting!!**
- We considered three cases.



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- Auroral precipitation occurred from 19:43 to 20:30.
- We found that the electron temperature (T_e) enhancements before the start of auroral precipitation. **Interesting!!**
- We considered three cases.
- Te enhancement around 400 km was likely to be caused by measurement error.
- Te enhancement around 250 km was likely to be caused by the advection.



Future Study

- The spatial resolved observation is needed to identify the location of auroral arcs.
 - Satellite (DMSP)
 - All-sky camera (only winter season)
 - Meridional scan observation
 - EISCAT 3D
- More time
 - We took a lot of time to handle the EISCAT data



A night sky with a green aurora borealis over a snowy mountain range and a building.

Thank You