

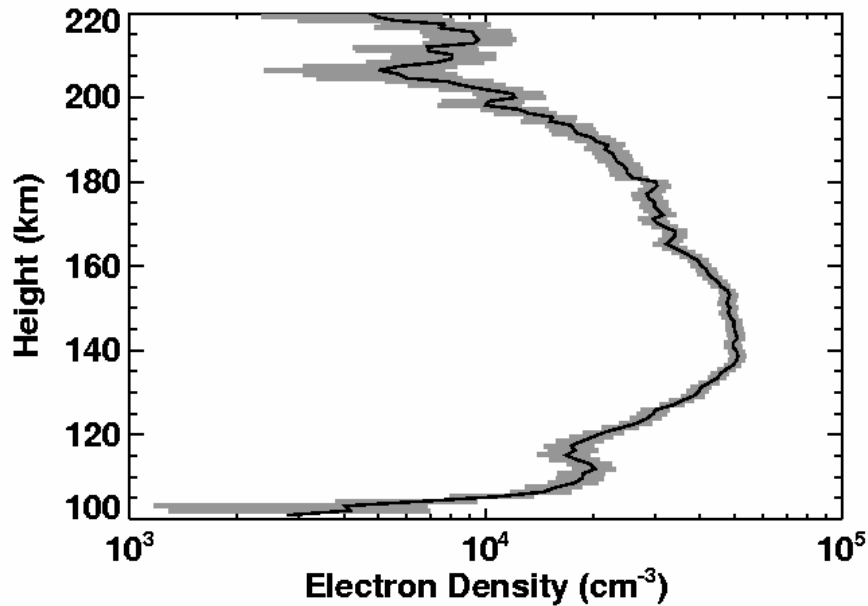
# The Martian Ionosphere in Regions of Crustal Magnetic Fields

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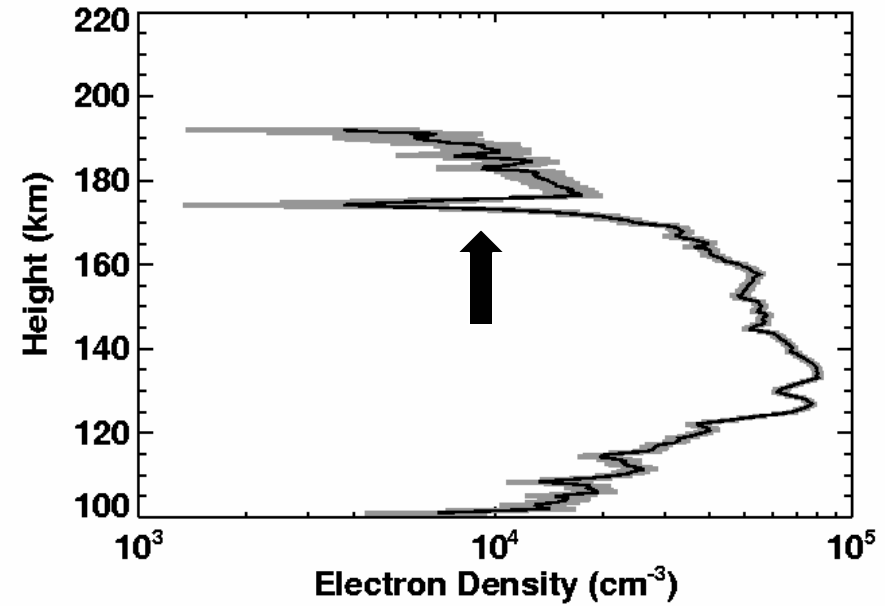
DPS 2004, Louisville, Kentucky, 2004.11.11

- Abnormal electron density profiles are found over crustal magnetic anomalies in the southern hemisphere
- How does the martian magnetic field affect the ionosphere?

## Normal Profile



## Abnormal Profile

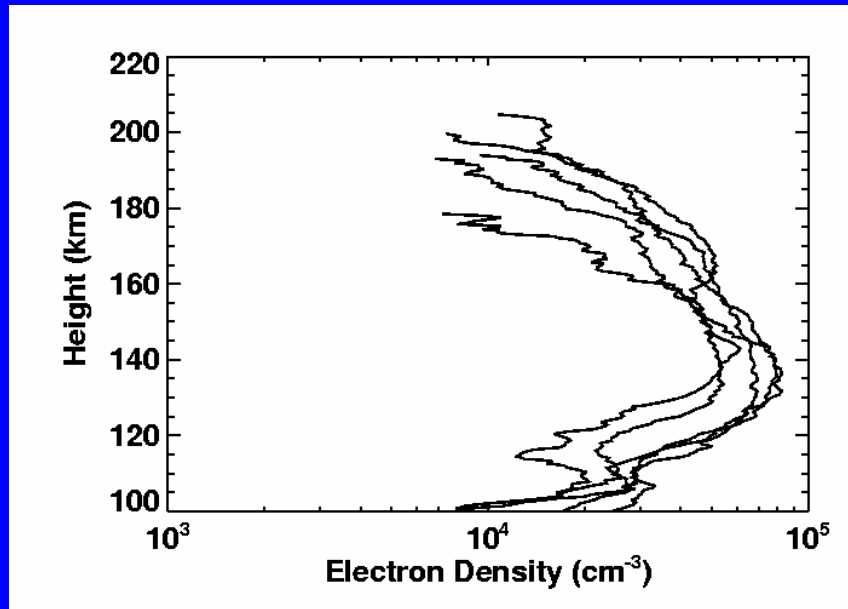


“Abnormal” defined as:  $\max |dN_e/dz| / \max (N_e) > 1 / 6 \text{ km}$

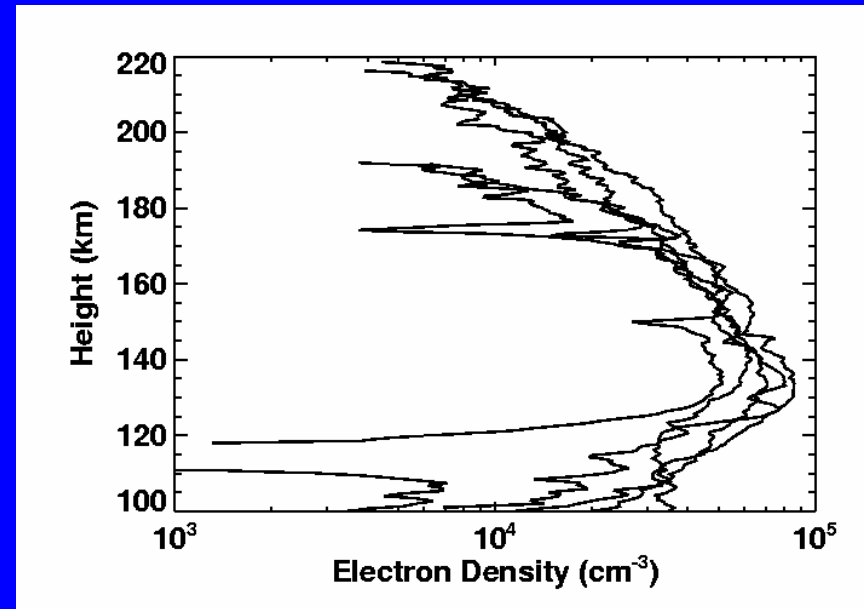
Aim is to identify profiles with large changes in  $n$  over a short distance – **extreme waviness**. Exact definition is subjective and will probably be improved.

Horizontal scale of measurement,  $\sqrt{H R}$ , is  $\sim 200 \text{ km}$

## 5 Normal Profiles



## 5 Abnormal Profiles

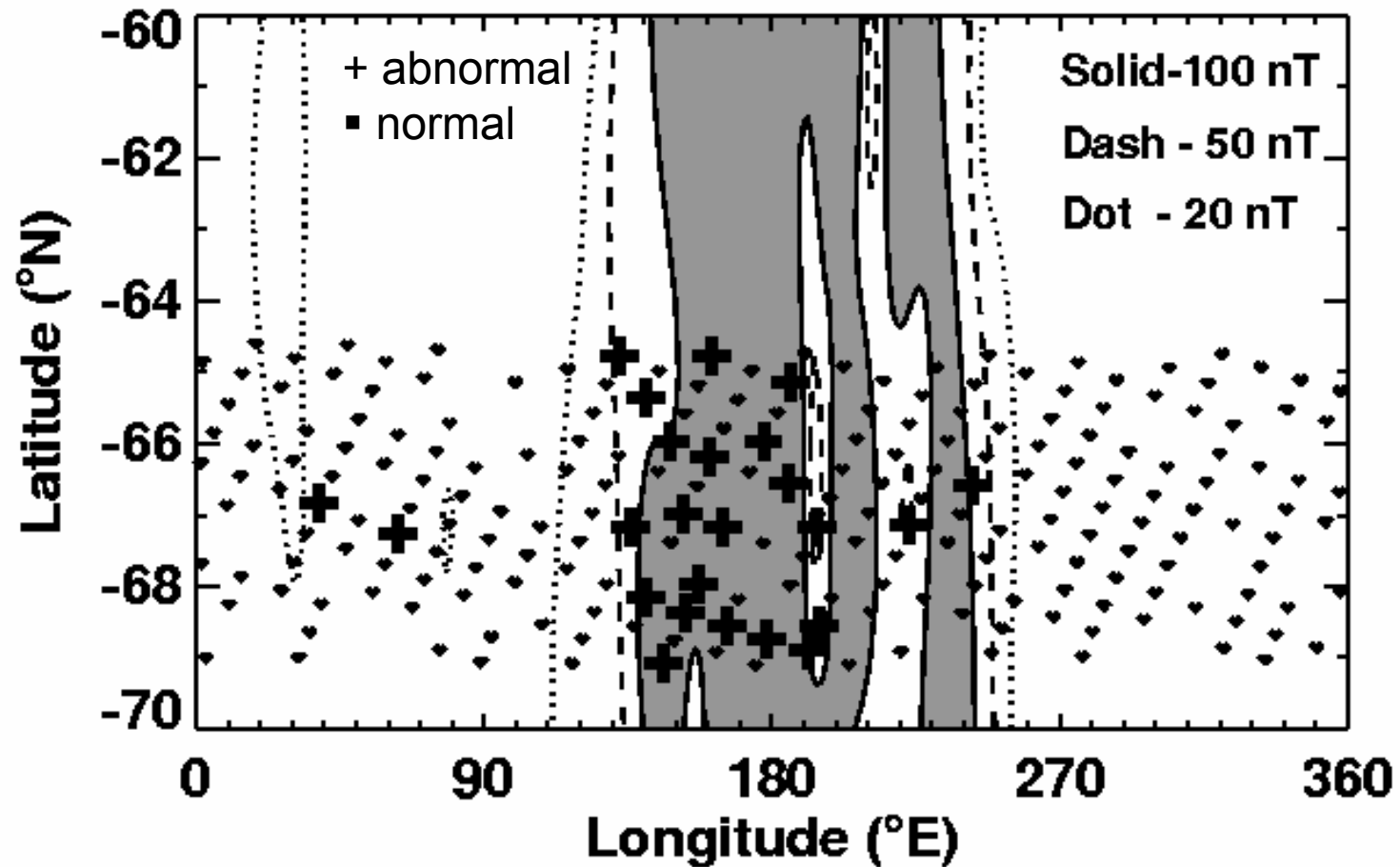


Compare 5 abnormal profiles to 5 normal profiles from same latitude/SZA/time population

Much more variation exists within the abnormal subset

Are abnormal profiles associated with geographic regions?

## Distribution of Abnormal Profiles And $|B|$ at 200 km

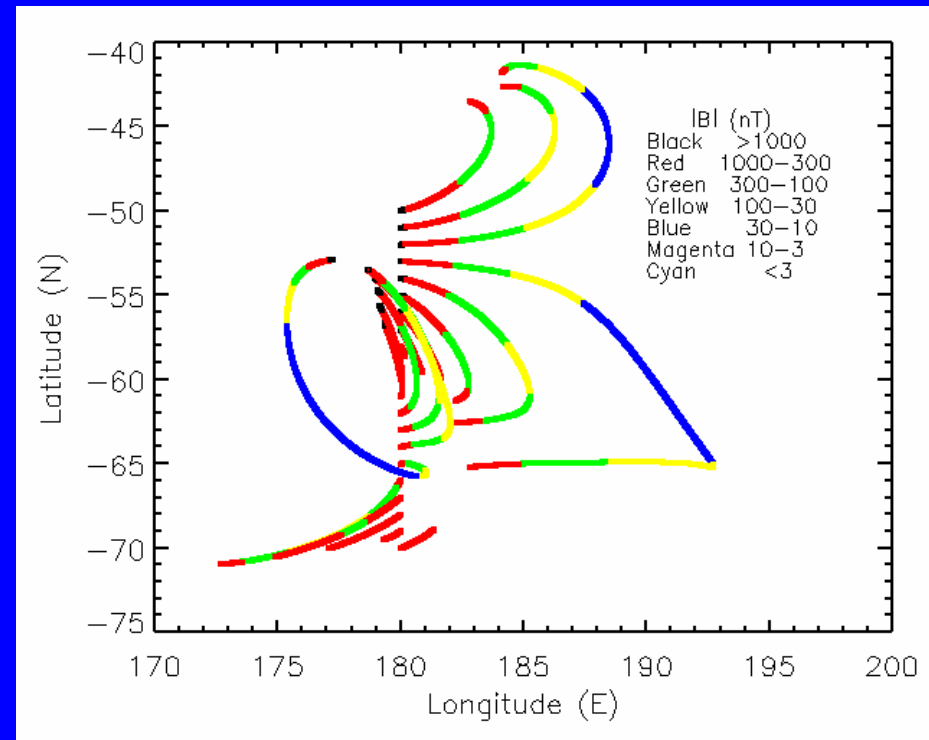
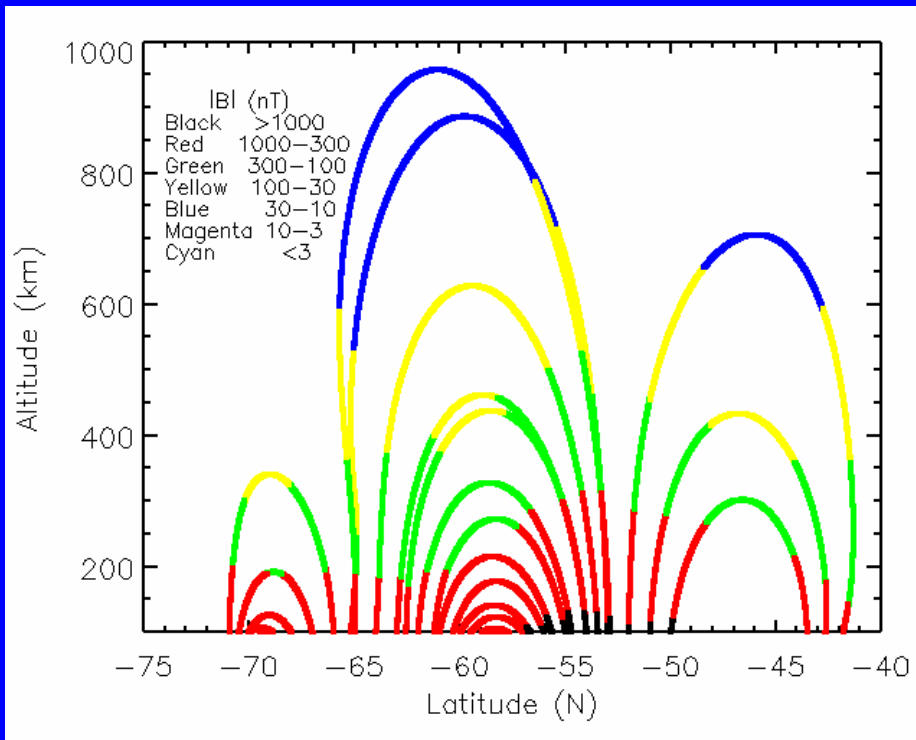


We thank to Jafar Arkani-Hamed for his magnetic field model

# Magnetic Fields Can ...

- Modify influx of energetic particles
- Modify plasma diffusion due to gravity, pressure
- Modify plasma transport by winds
  
- Relative size of ion-neutral collision frequency and ion gyrofrequency is critical –  $eB/m_i v_{in}$
- What happens when  $eB/m_i v_{in}$  is  $\sim 1$ ?
  
- We are developing models to simulate these interactions

# Some Fieldlines



- Regions of vertical fieldlines
- Regions of horizontal fieldlines
- Note that solar wind field is neglected
- Geometry changes over short distances

# Conclusions

- Some ionospheric profiles over crustal magnetic anomalies are abnormal due to their extreme waviness
- It is important to understand interactions between the ionosphere and magnetic field because
  - The topology of the magnetic field of Mars is unique, having a small characteristic length scale
  - How have interactions between the ionosphere and magnetic field affected the loss of volatiles?
  - Do these interactions affect the energy and momentum balances of the neutral atmosphere?

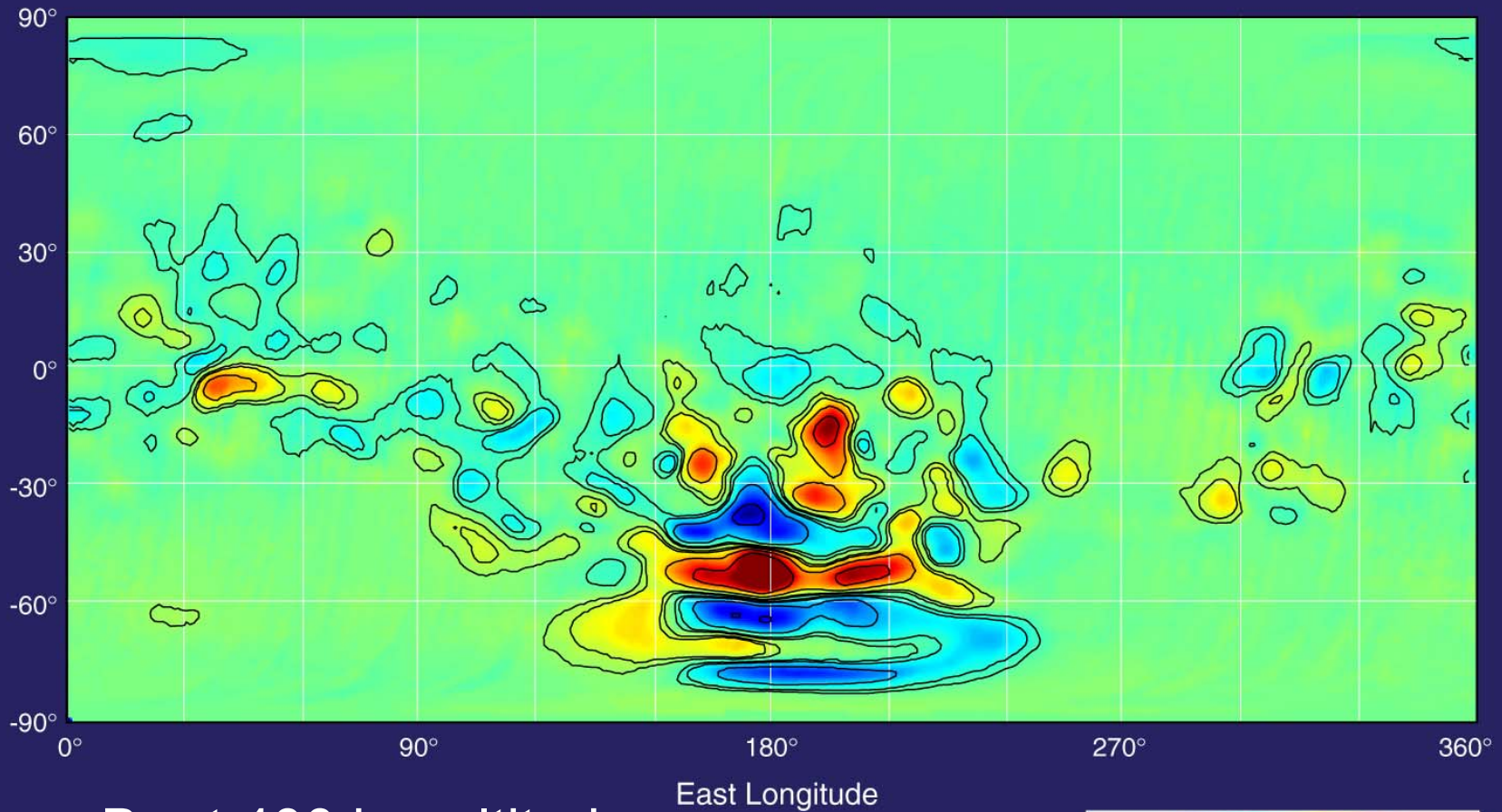




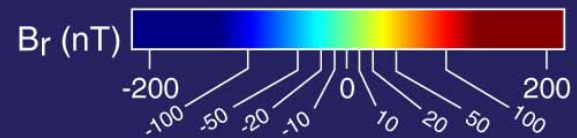
# Mars Crustal Magnetism

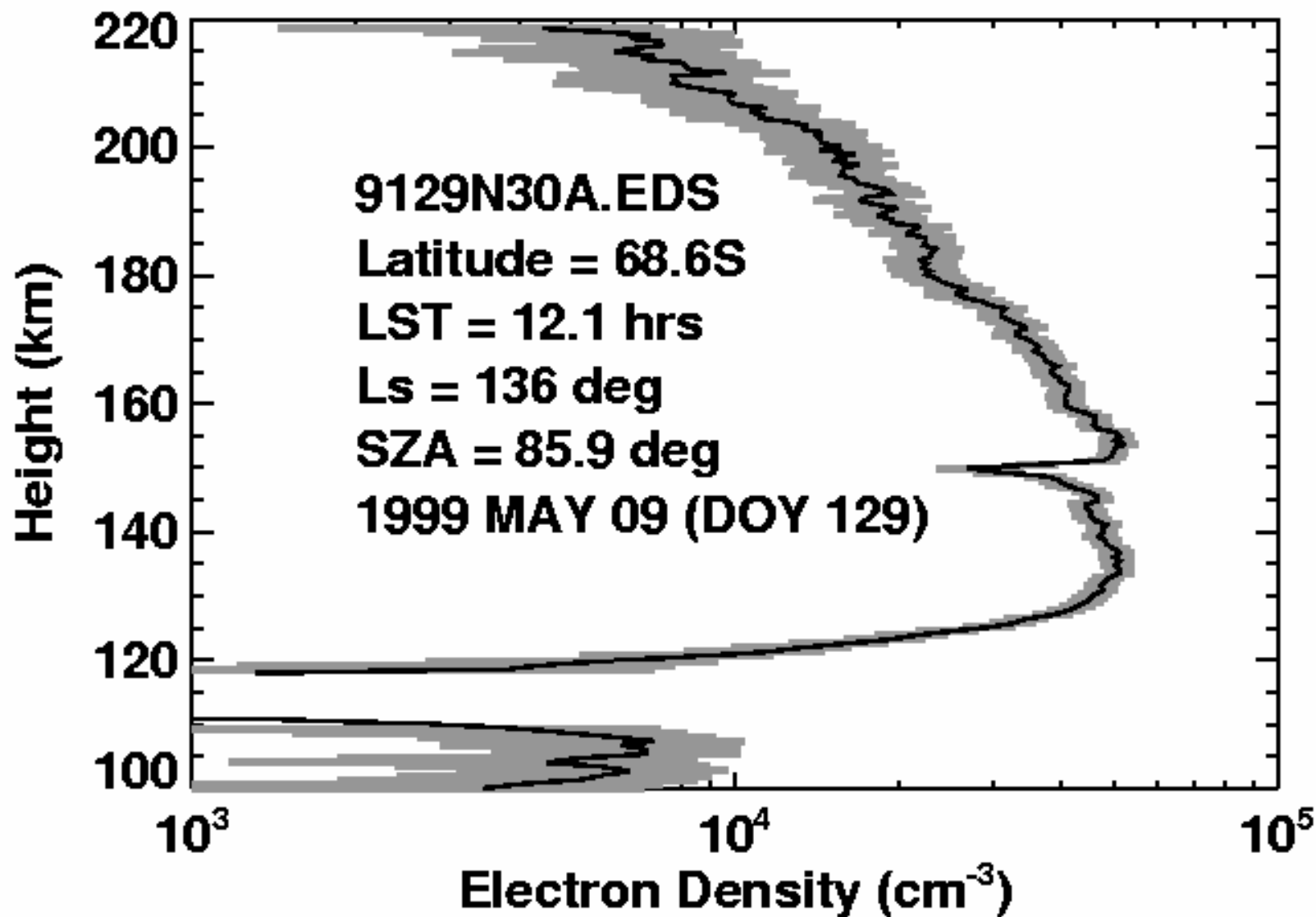
# Mars Global Surveyor

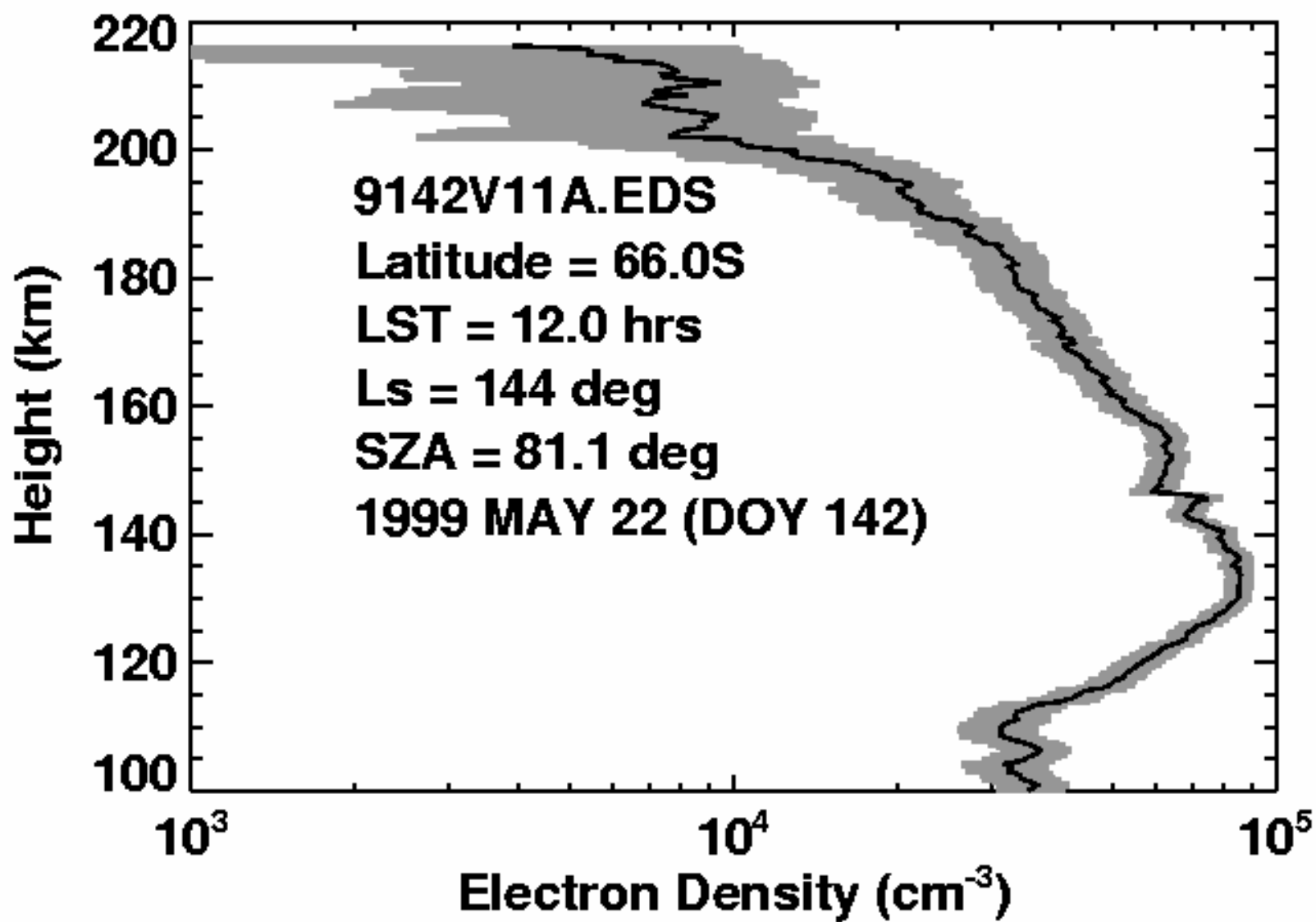
# MAG/ER

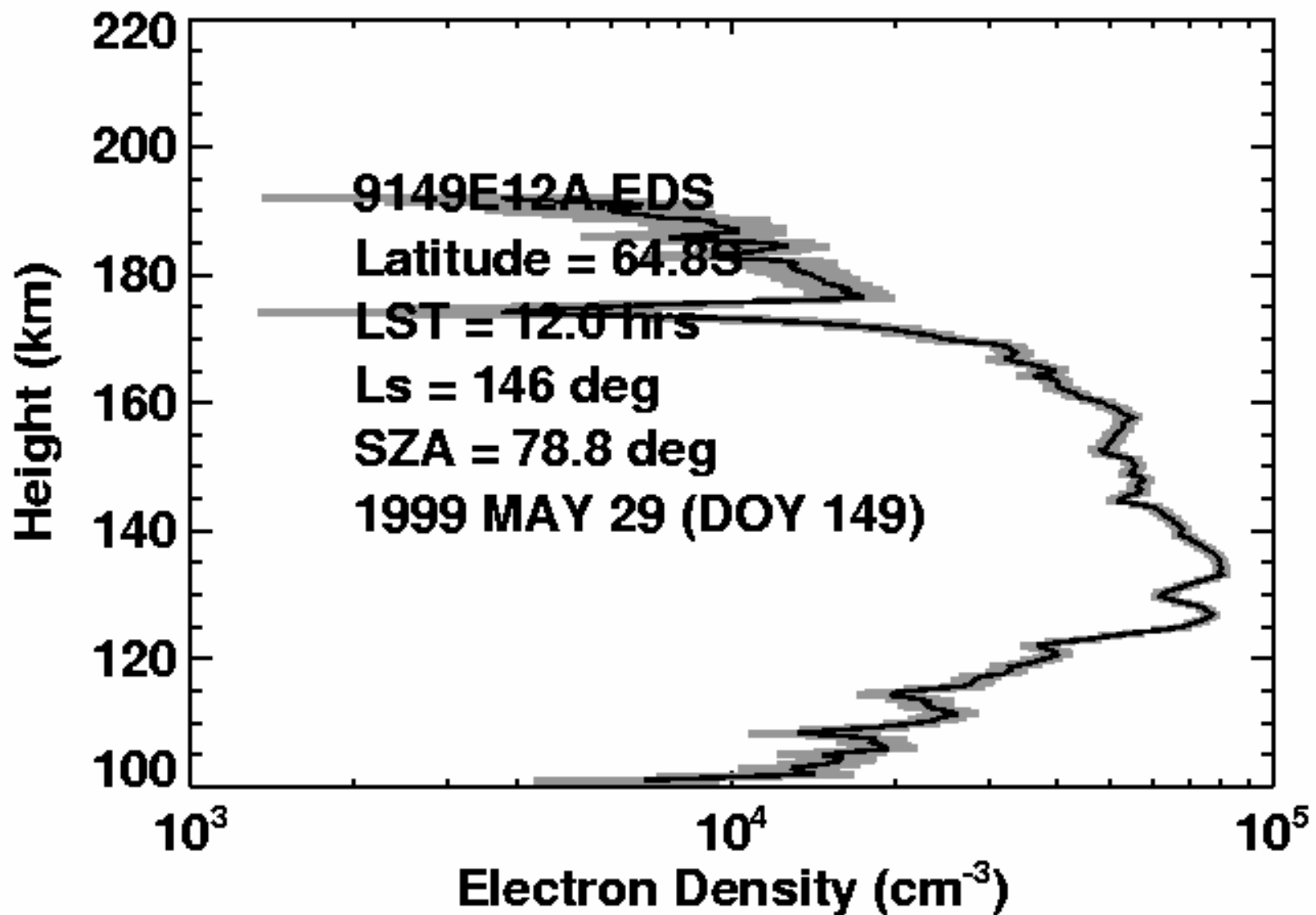


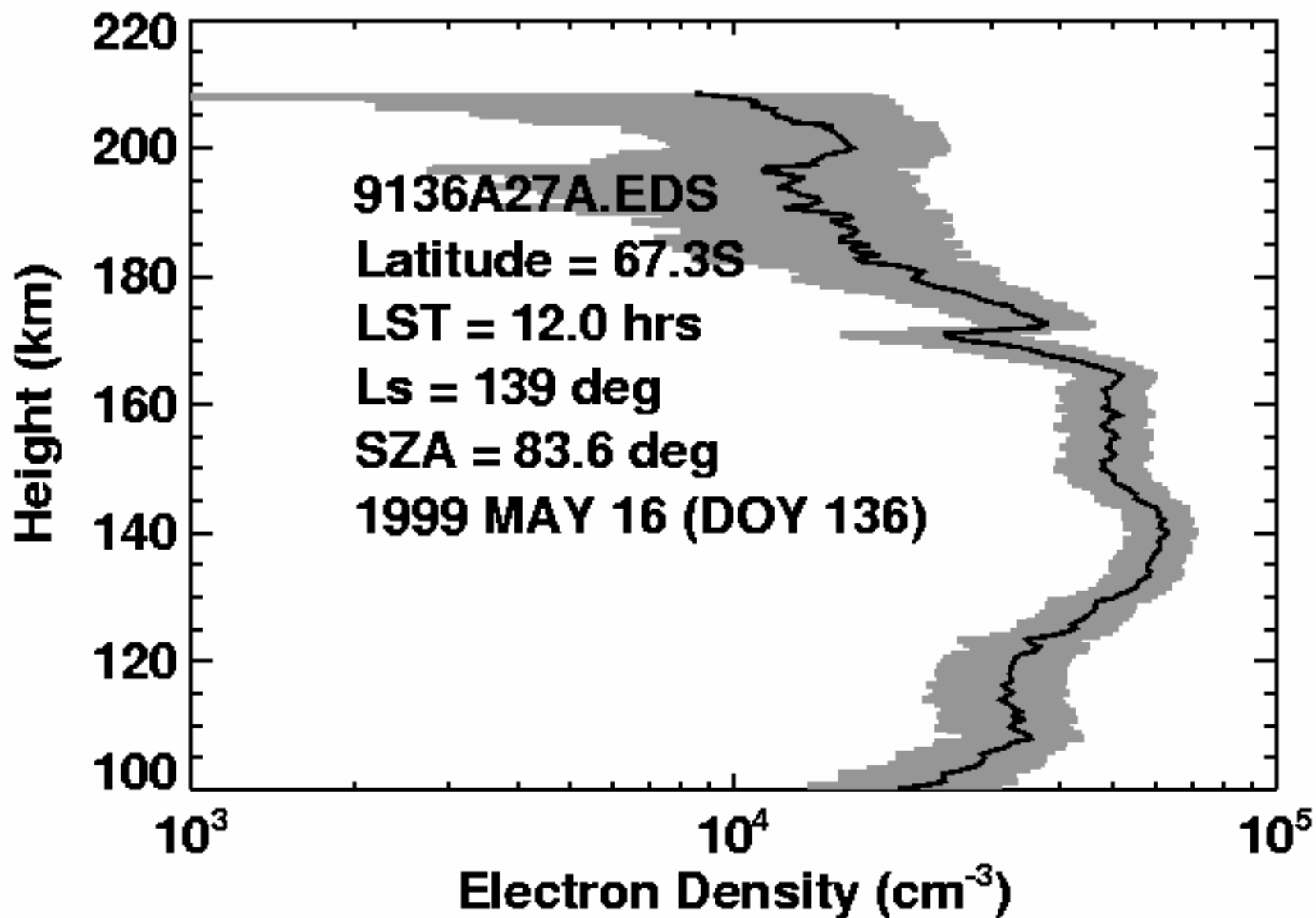
Br at 400 km altitude,  
max value ~ 200 nT

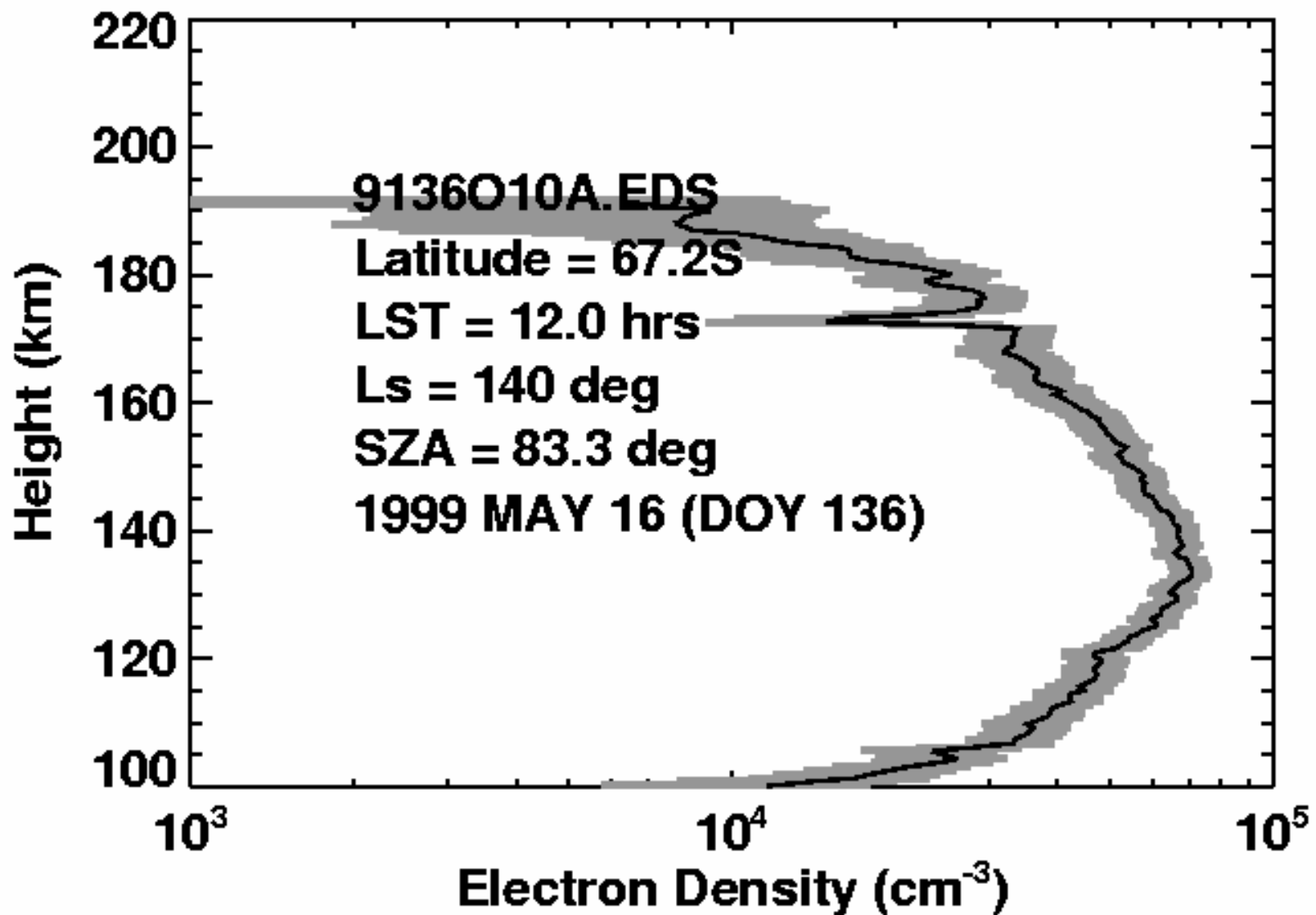




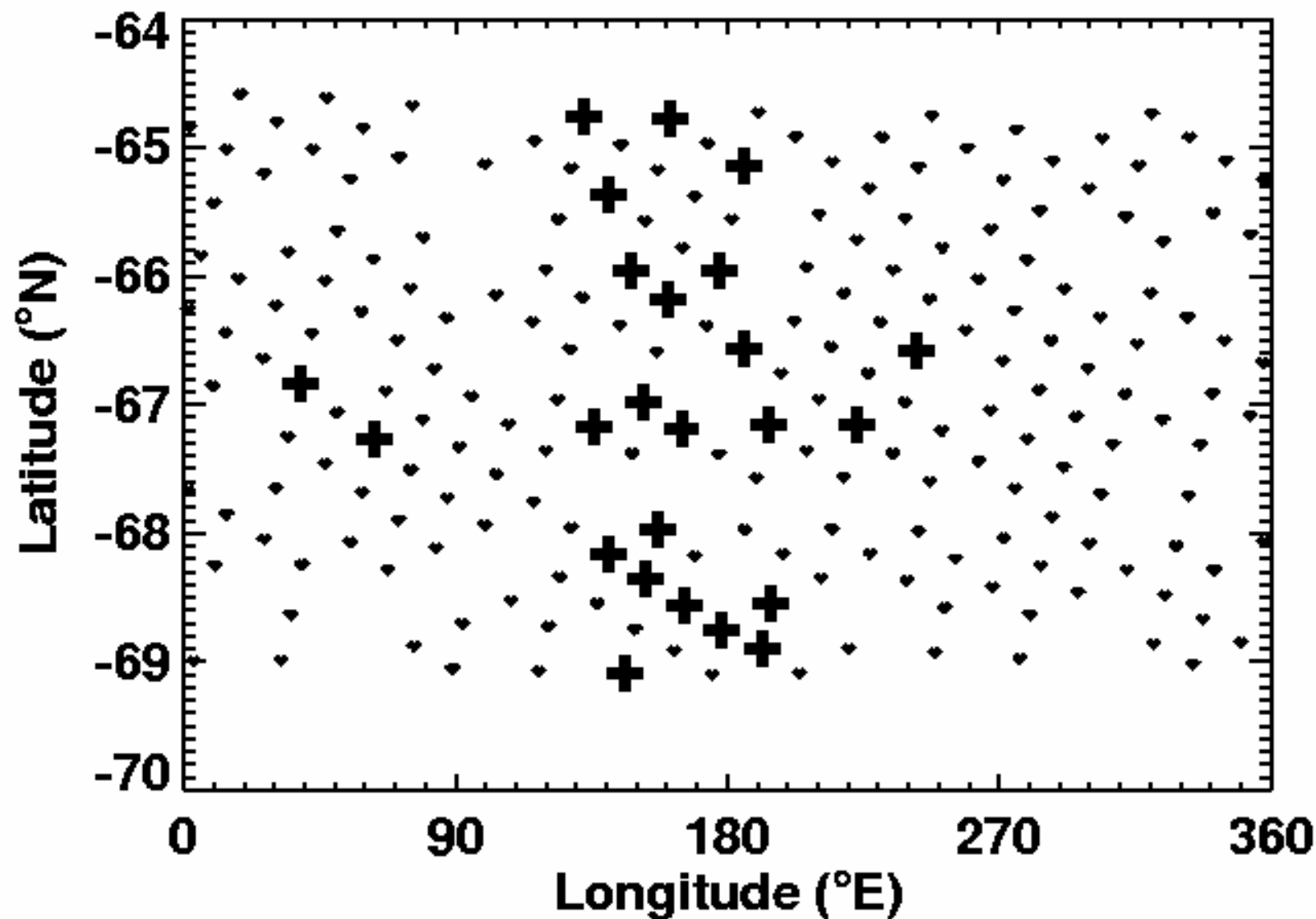


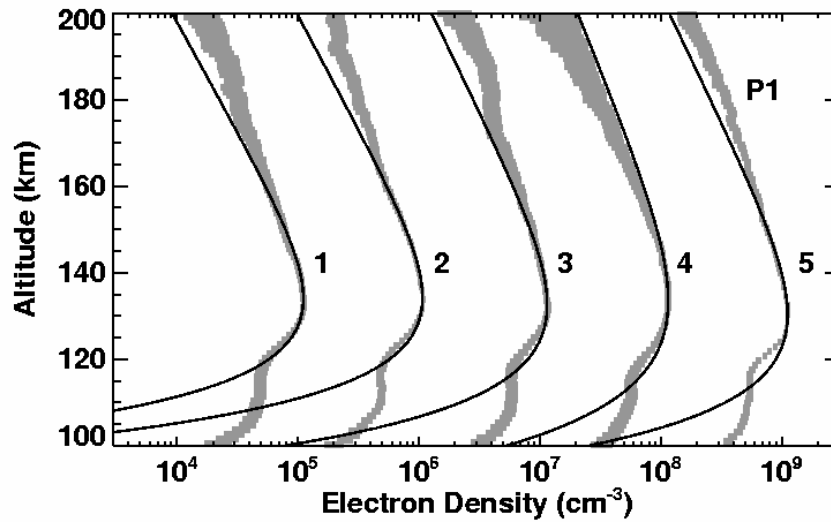




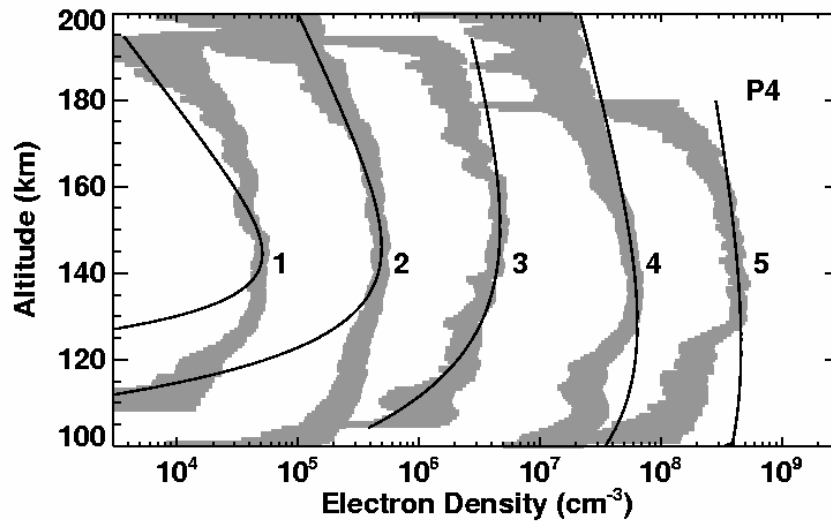


# Distribution of Unusual Profiles





NH examples, Chapman fit is good



SH examples, Chapman fit is not good  
 65S, 12 noon, 80 SZA,  
 strong winds close to  
 boundary of winter polar night

What are dynamics doing?