

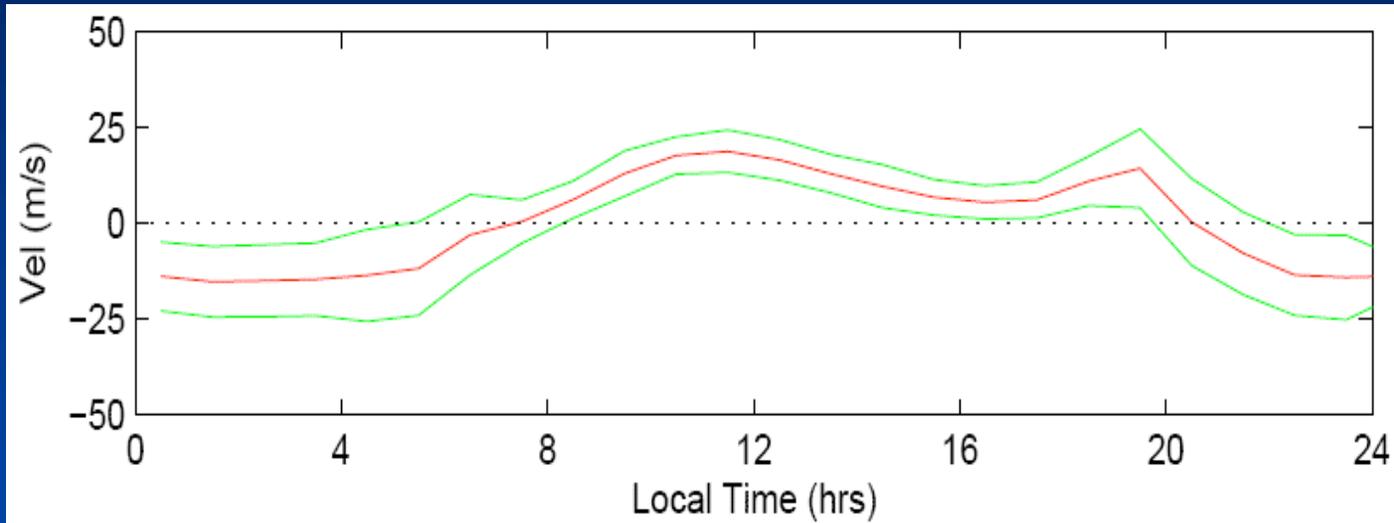
Early Morning Upward Ion Drifts at the Geomagnetic Equator

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What in the World are Ion Drifts?



- In the ionosphere, particles are subject to forces exerted by electric and magnetic fields, and their motion is influenced.
- This study focuses on the vertical motions of the ions in the ionosphere. Velocities are averaged over 360 km.

HANSON AND MOFFETT

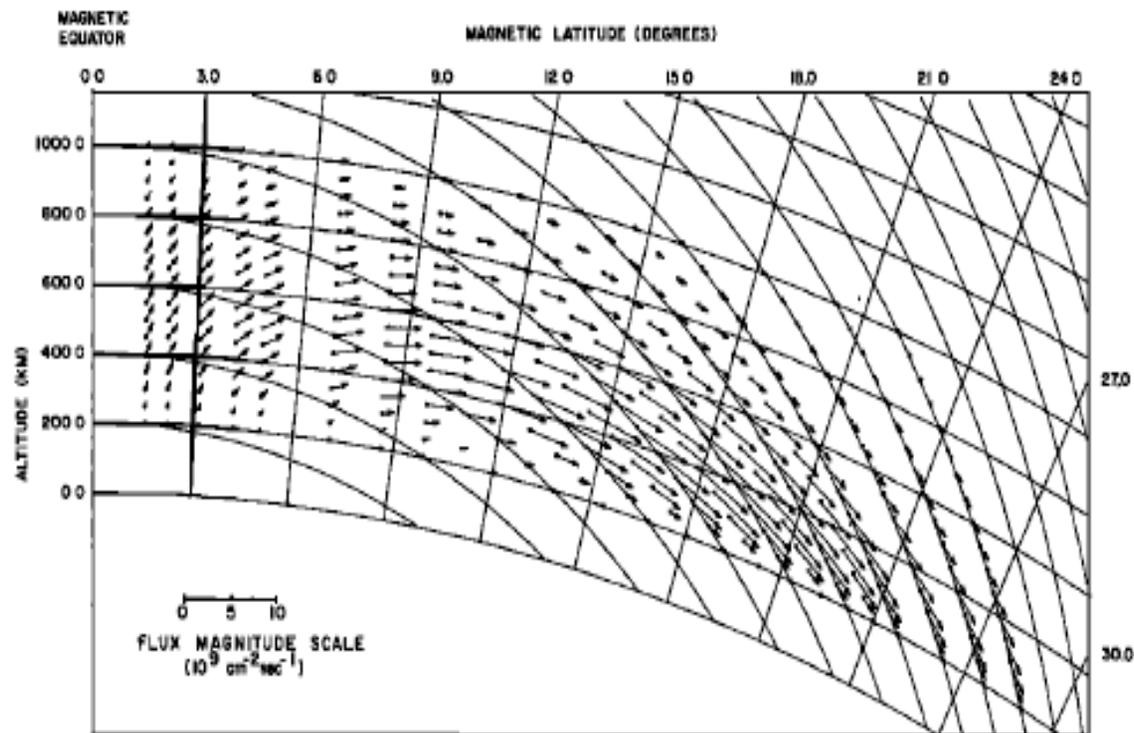


Fig. 2. A vector plot of electron fluxes that are associated with the electron concentration profiles shown in Figure 1b. Magnetic field lines are shown every 200 km.

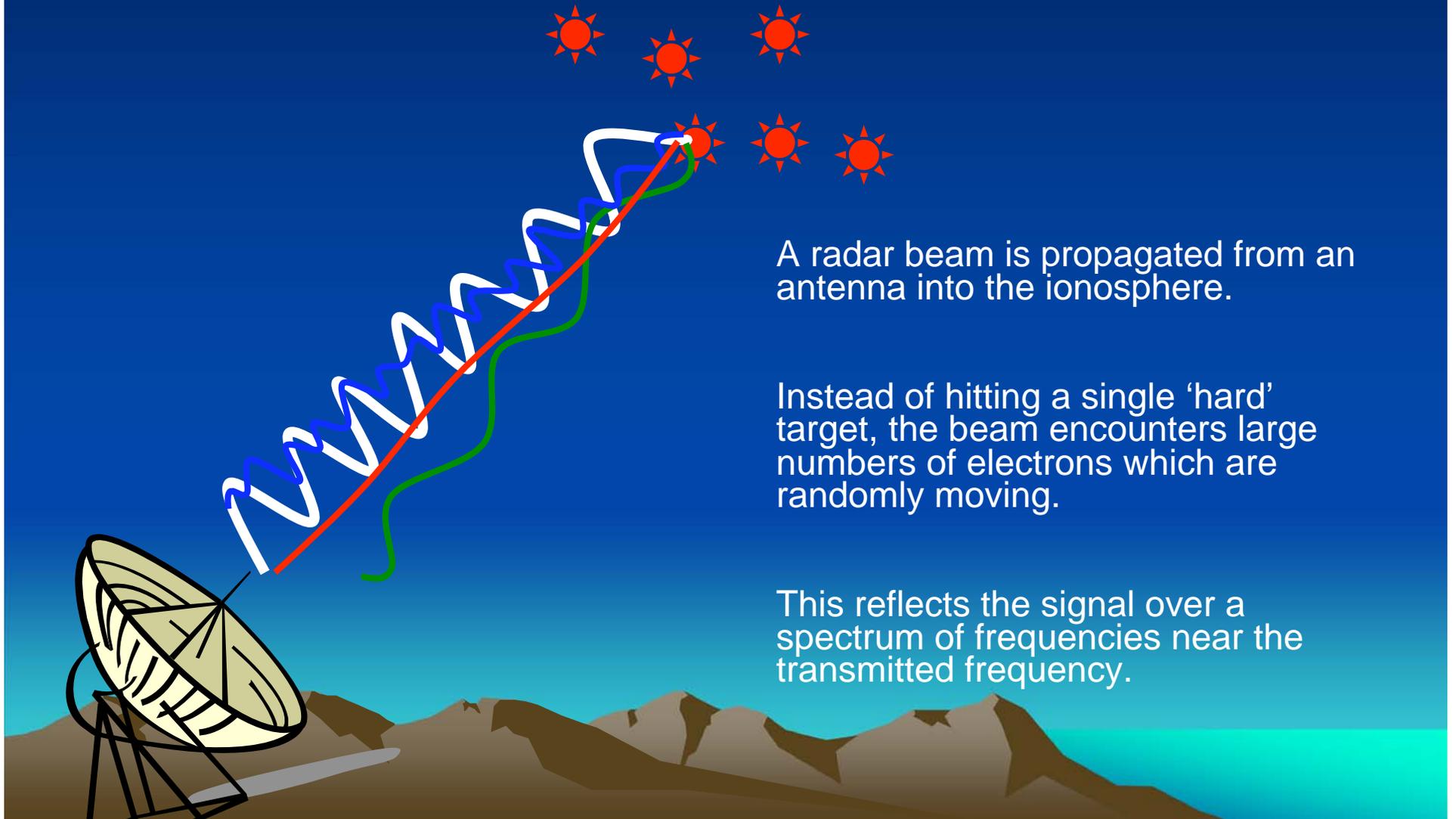
How do we measure drifts?

- Through the use of ISR, vertical motions of the ions can be measured.
- Data from Jicamarca (pictured right) was used for this correlation study.
- Data was taken from CEDAR database and analyzed for drifts.



<http://jicamarca.ece.cornell.edu>

ISR...Horribly Simplified



A radar beam is propagated from an antenna into the ionosphere.

Instead of hitting a single 'hard' target, the beam encounters large numbers of electrons which are randomly moving.

This reflects the signal over a spectrum of frequencies near the transmitted frequency.

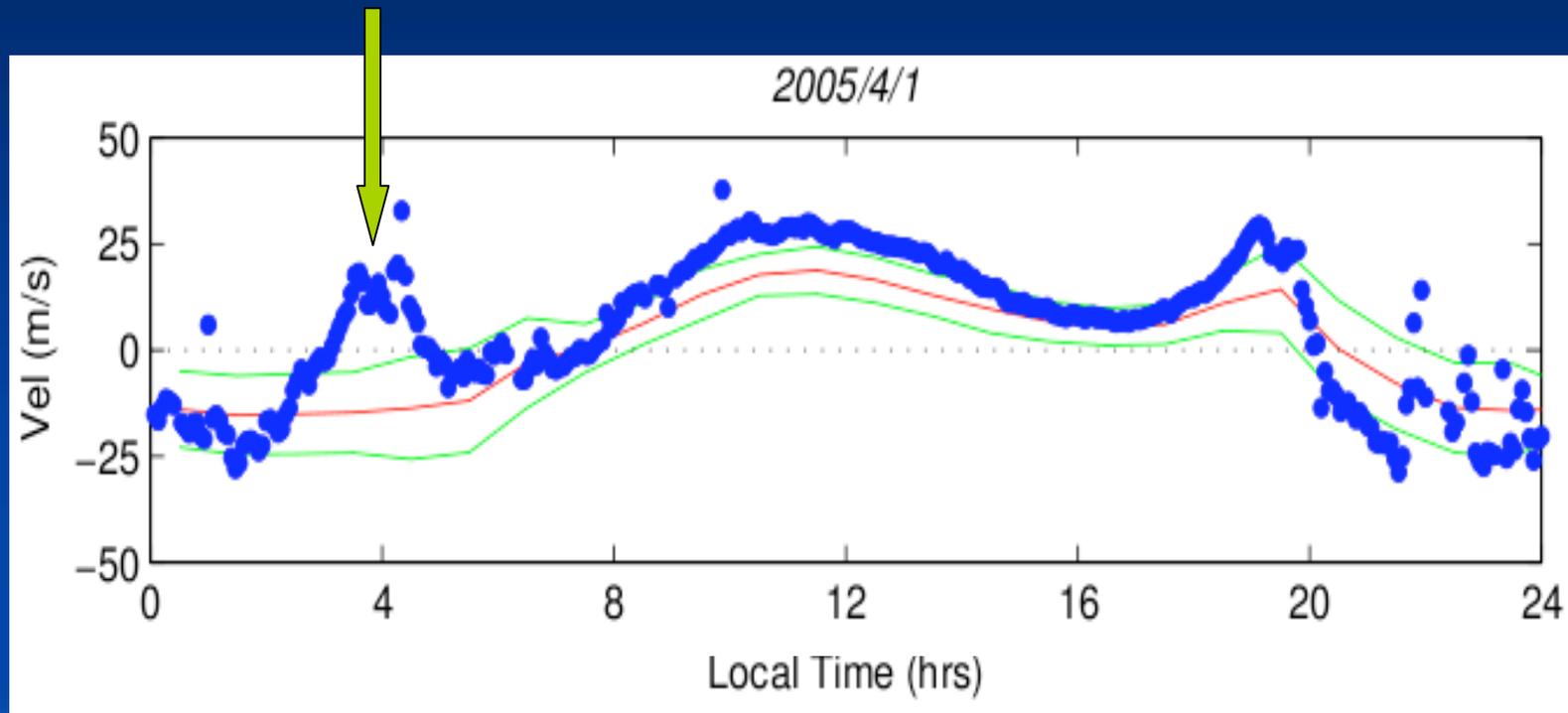
ISR

- Incoherent Scatter Radar tells us the following information about the ionosphere:
 - Electron Density
 - Electron/Ion Temperature
 - Ion composition
 - Vertical, Zonal Electric Fields
(in the equatorial ionosphere)
 - Motion of Ions.

You're
Welcome.



Peculiar Behaviors in the Drifts



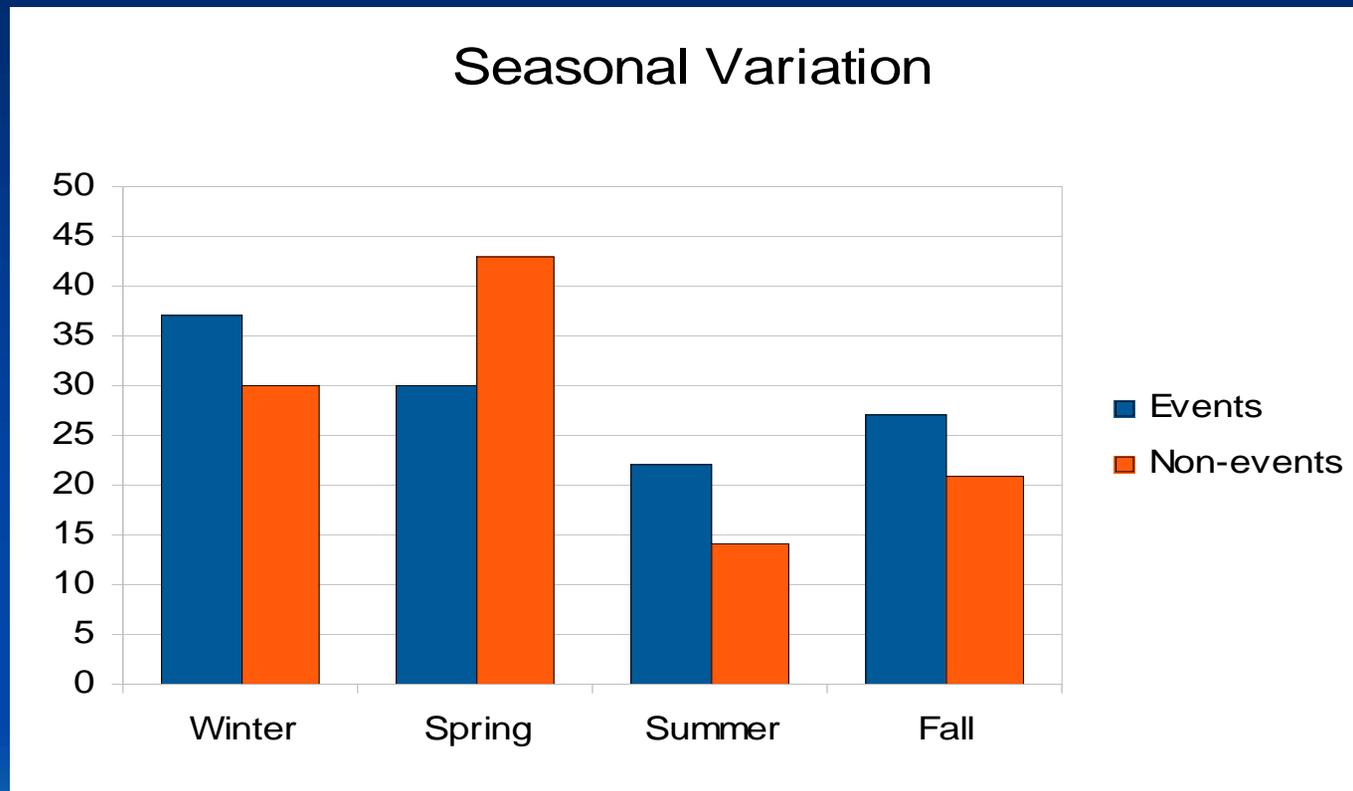
Out of 224 useful days of data spanning Jan. 1984 to Oct. 2008, there were 116 "Events" (displaying the behavior) and 108 Non-Events.

Finding a Correlation

- We are comparing the drift behaviors to certain geophysical parameters such as:
 - IMF (B_z , B_y)
 - K_p
 - F10.7
- Also looking for any seasonal dependence, effects from solar wind (speed and proton density), etc.

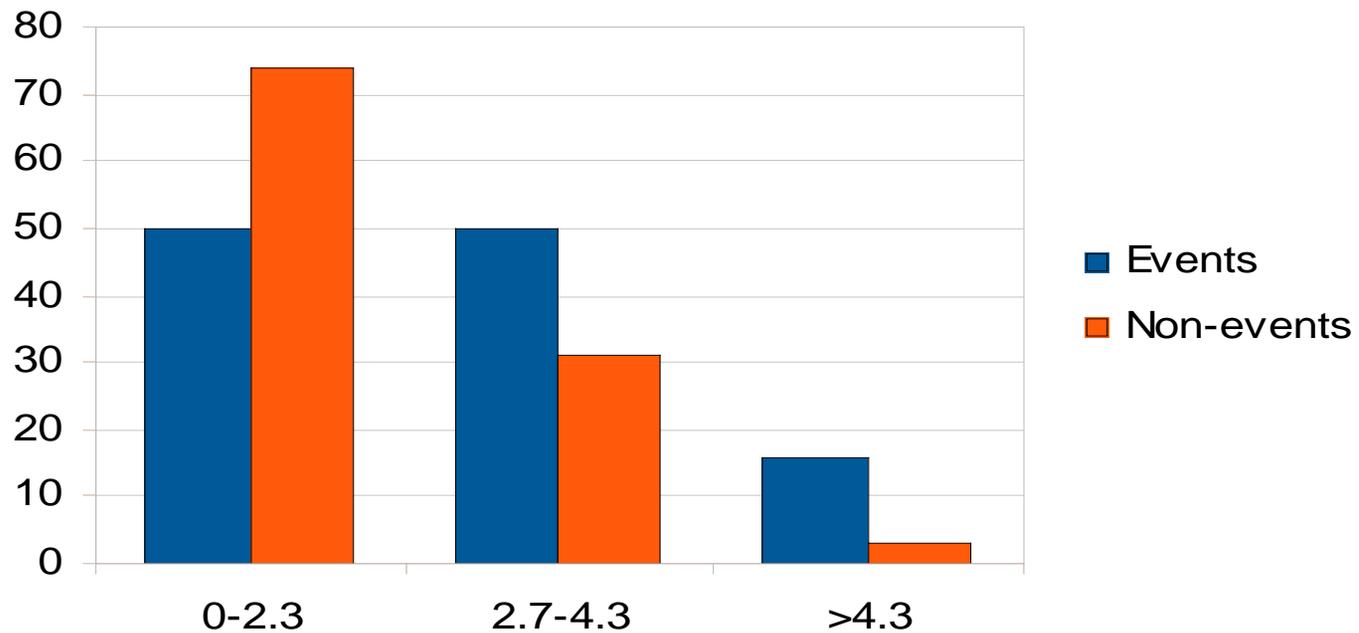


Is there a Seasonal Relationship?



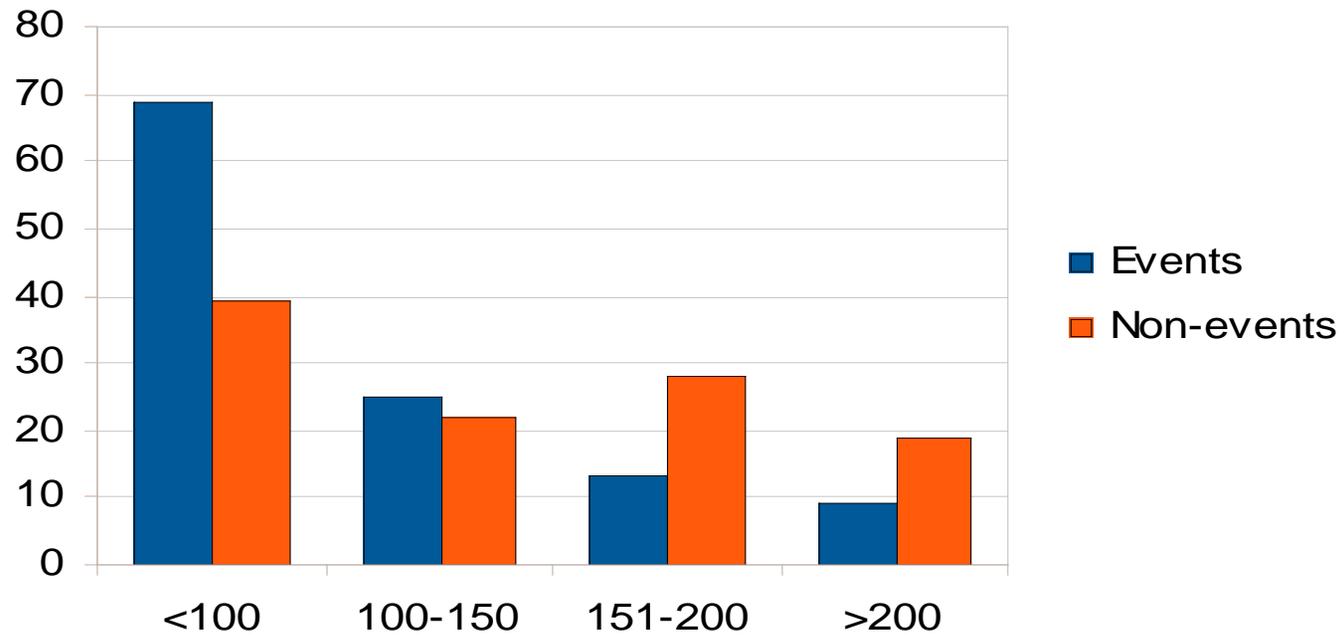
What about kp?

Dependence on kp-values

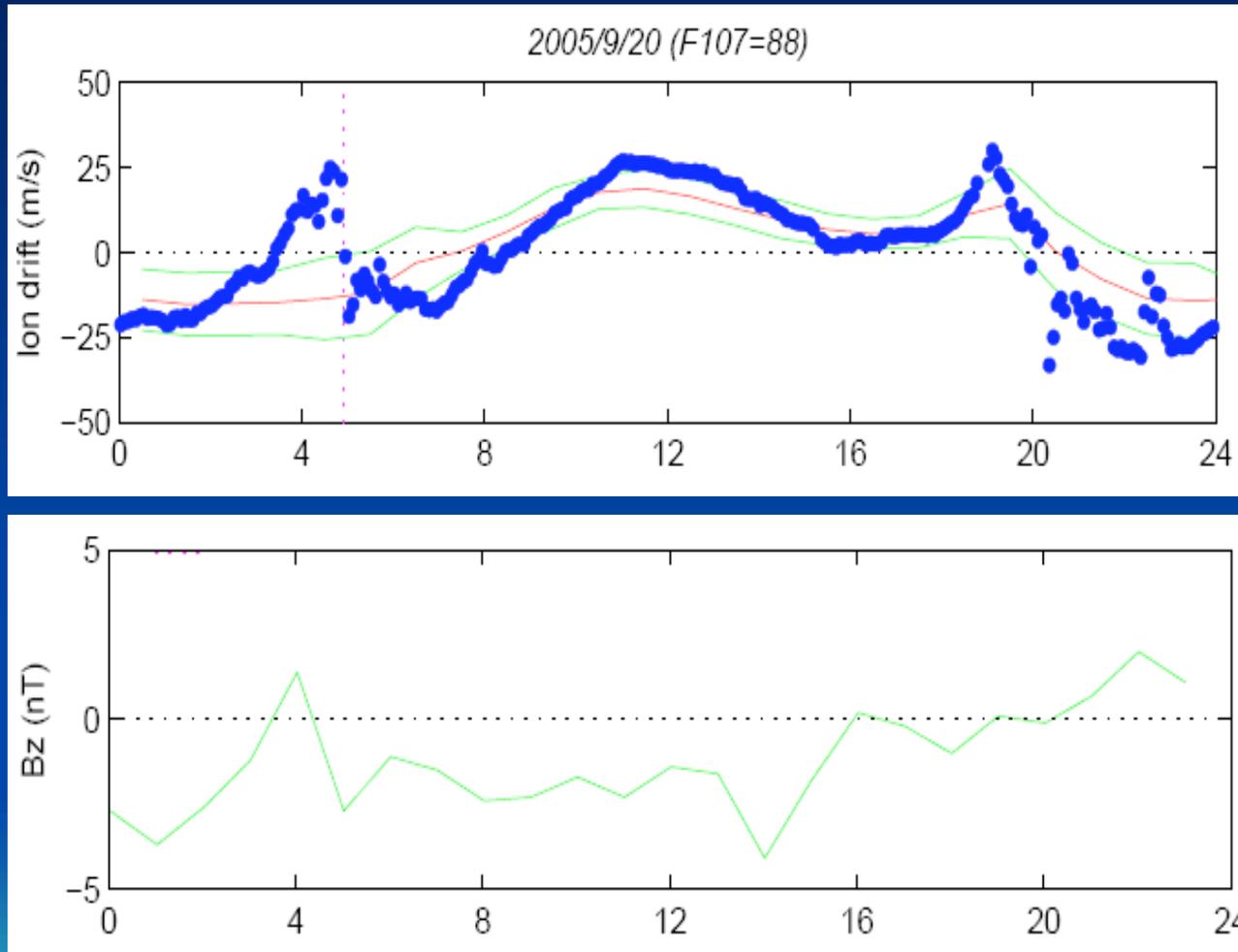


Or F10.7?

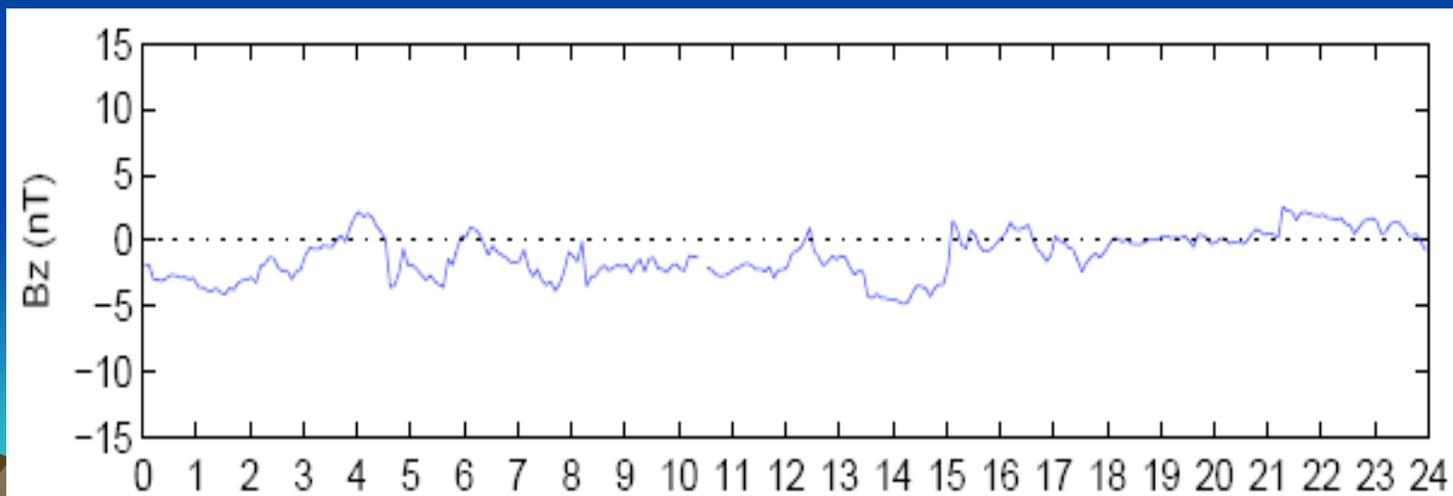
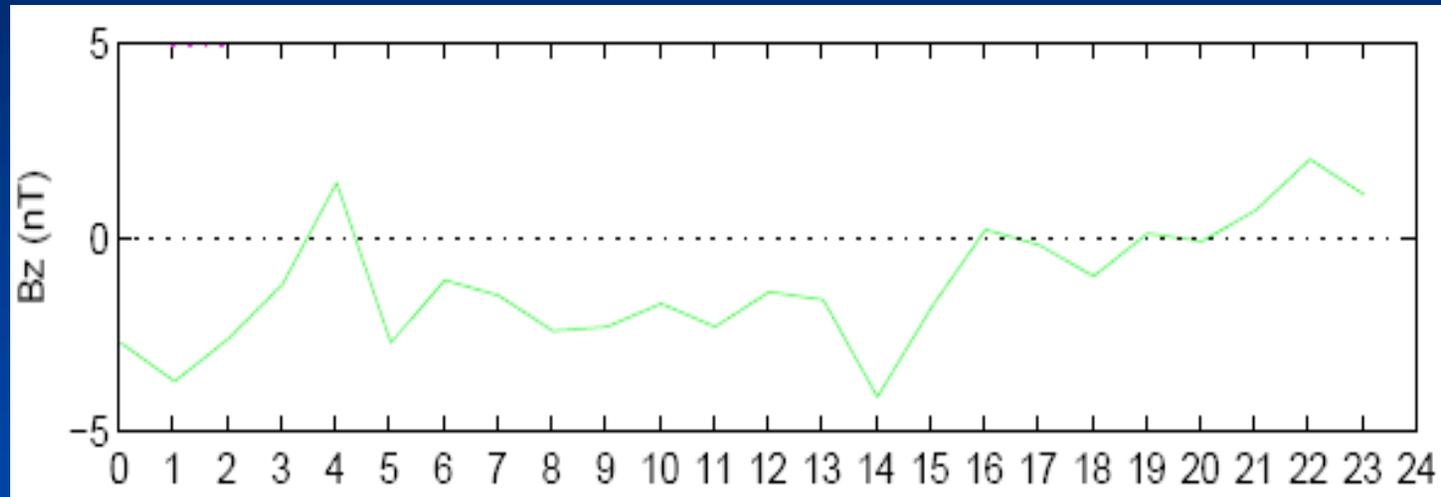
Dependence on f10.7 values



An interesting observation...



The Trouble with Timing.



Hourly Data



Do the Drifts Mimic Bz?

- Spanning the data, there are 177 days that contain Bz data that can be compared to the drift.
- Of these 177 days, 107 (60.5%) appear to follow the behavior of Bz.
- The remaining 70 days (39.5%) do not show a discernible similarity to Bz.



Relationships with Bz and f10.7

- Occurrences of the “events” decrease sharply with increasing F10.7 values, with the vast majority occurring at F10.7 values less than 100.
- There are 108 days of data with an F10.7 value less than 100.
- Of these, 89 days contain Bz data to compare.



Relationships with Bz and f10.7

- 37 Events that mimic Bz (41.6%)
- 18 Events that do not mimic Bz (20.2%)
- 19 Non-Events that mimic Bz (21.3%)
- 15 Non-events that do not mimic Bz (16.9%)



5-minute Data

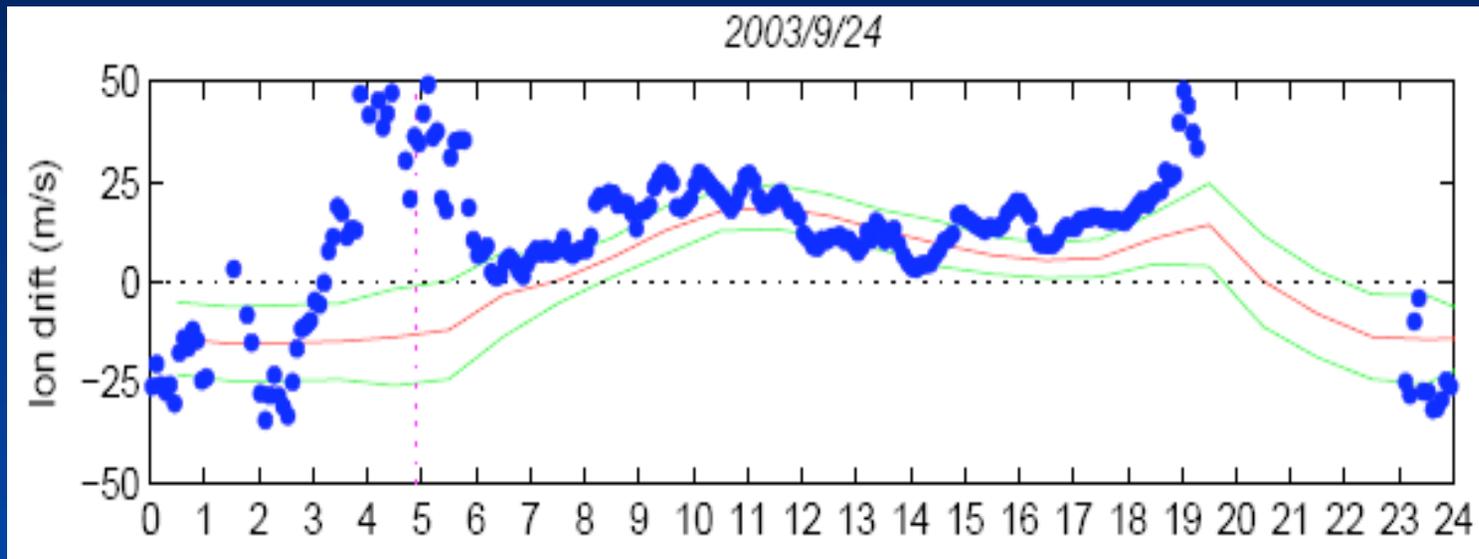


Using the 5-minute Data

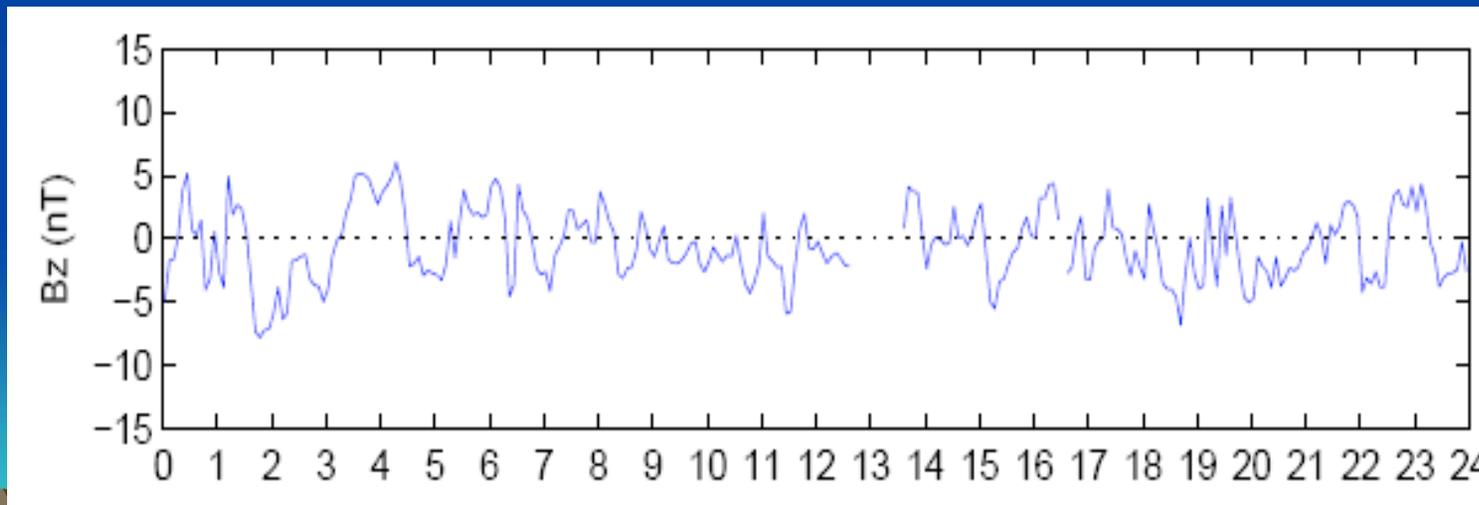
- OMNIweb has 5-minute data spanning back to 1995.
- At the last possible minute, this data was collected and plotted in anticipation of finding the same behaviors.
- There are now 4 distinct drift behaviors prevalent in the 5-minute data.



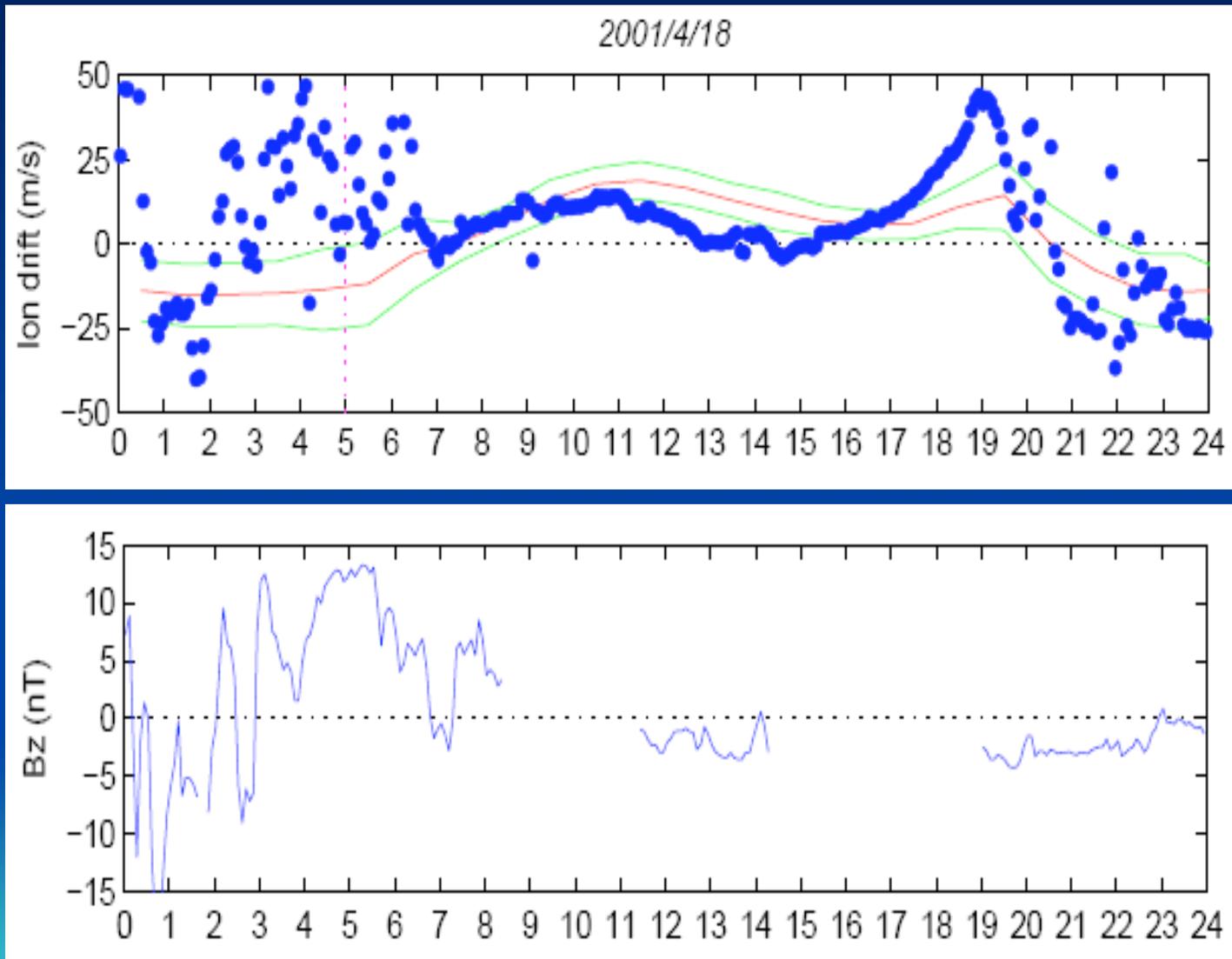
Case 1



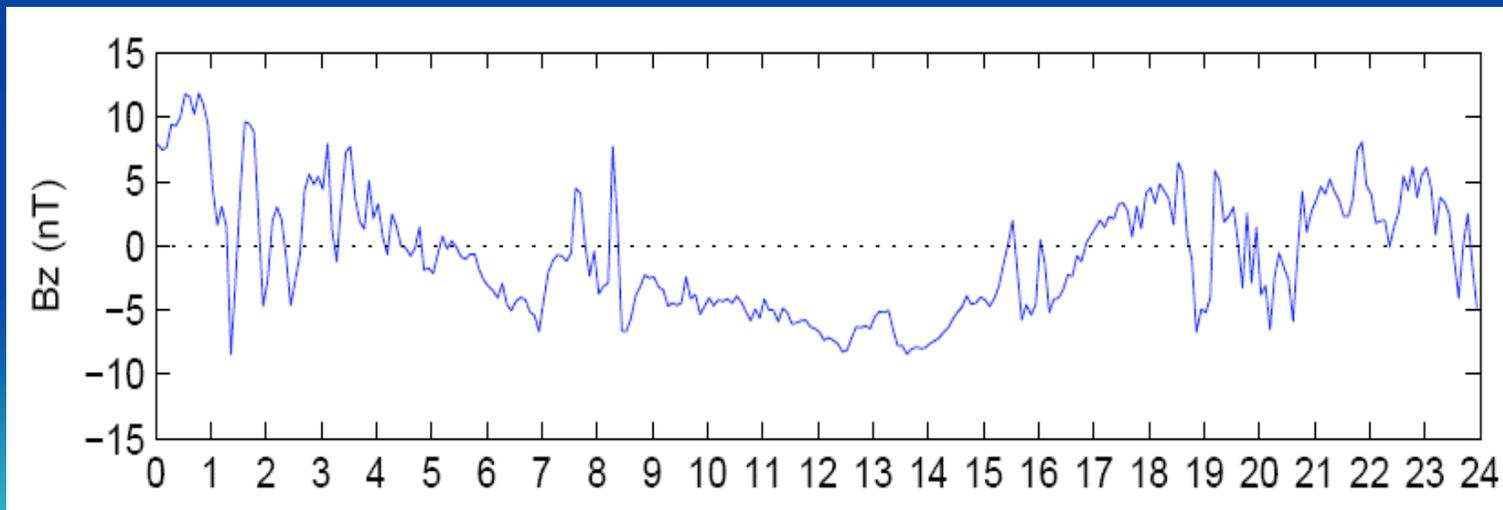
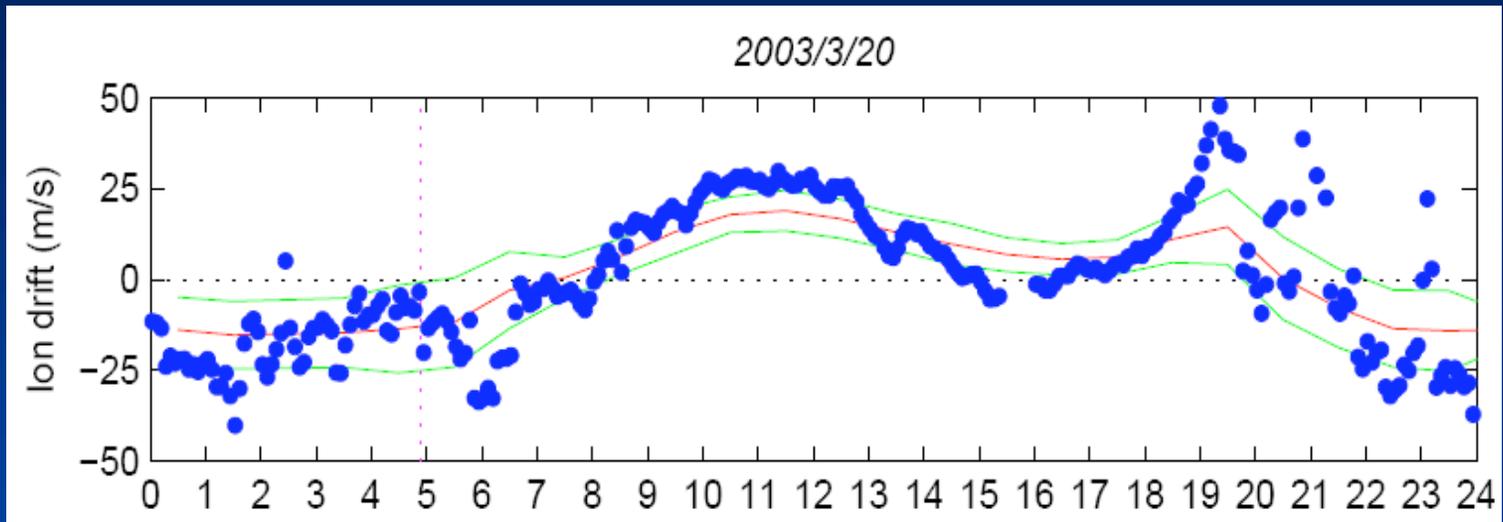
IMF (ACE)



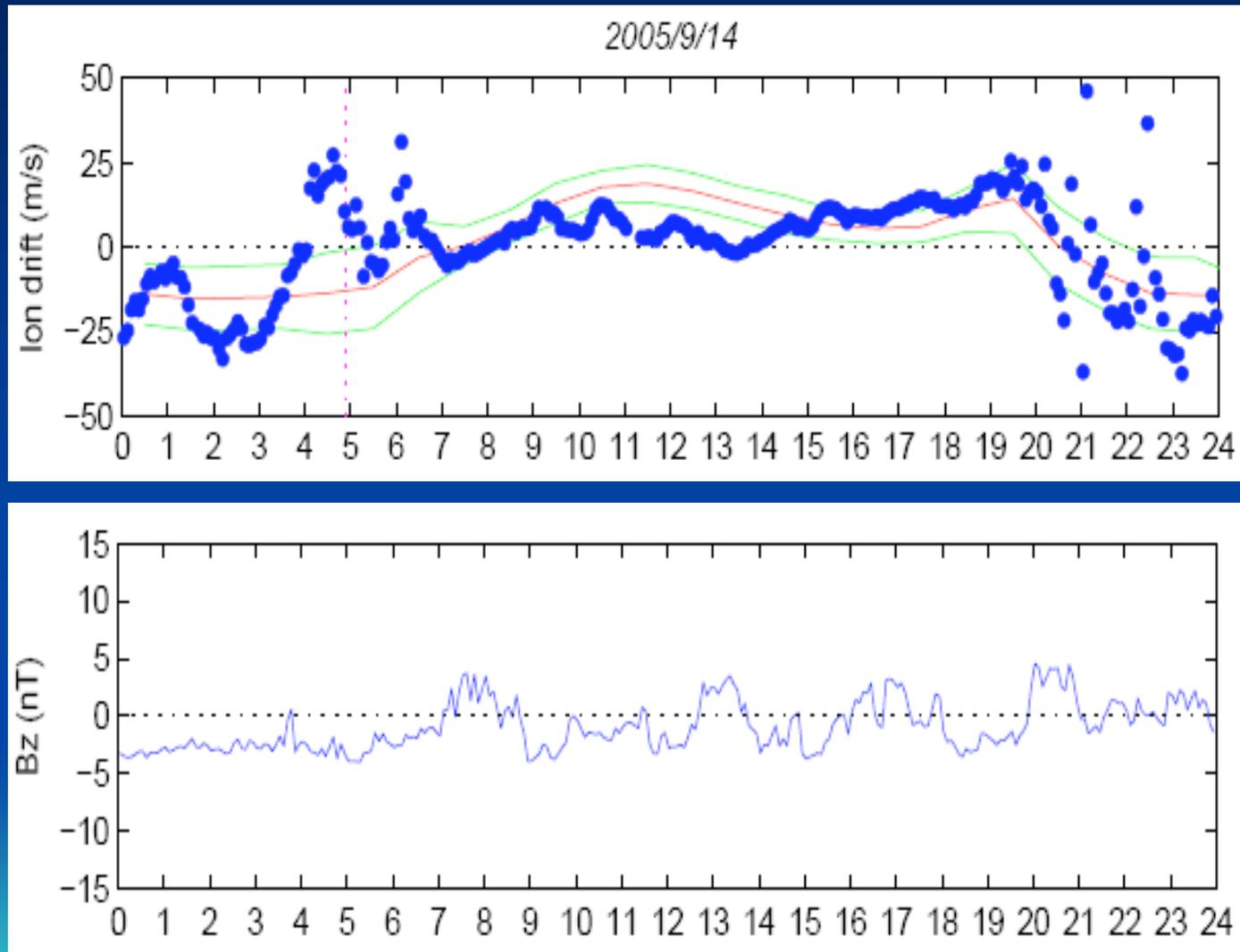
Case 2



Case 3



Case 4



Patterns

- When the change in B_z is around 5-10 nT, the upward drifts are usually noticed in conjunction.
- When the change in B_z is very small, sometimes the drifts occur, and sometimes they do not.
- Changes in B_z greater than ~ 10 nT seem to correspond with the appearance of “bubbles” in the drift data.
- Rarely, there is a significant change in B_z , but no noticeable shift in the behavior of the drifts.



Next Questions

- Electric field penetrations may be a likely cause for the drifts.
 - Why do they not occur all the time for smaller changes in B_z ?
 - F2 peak electron density may be too high or low to permit upward drifts.
 - The topside gradient may be too small or large.
 - Why do the penetrations appear to be most effective at night?
 - These can potentially be examined using CMIT.



Penetration Electric Fields

also Horribly Simplified



Convection Electric Field
(Magnetospheric)

Ionospheric Electric Field due to
dynamo action of neutral atmosphere

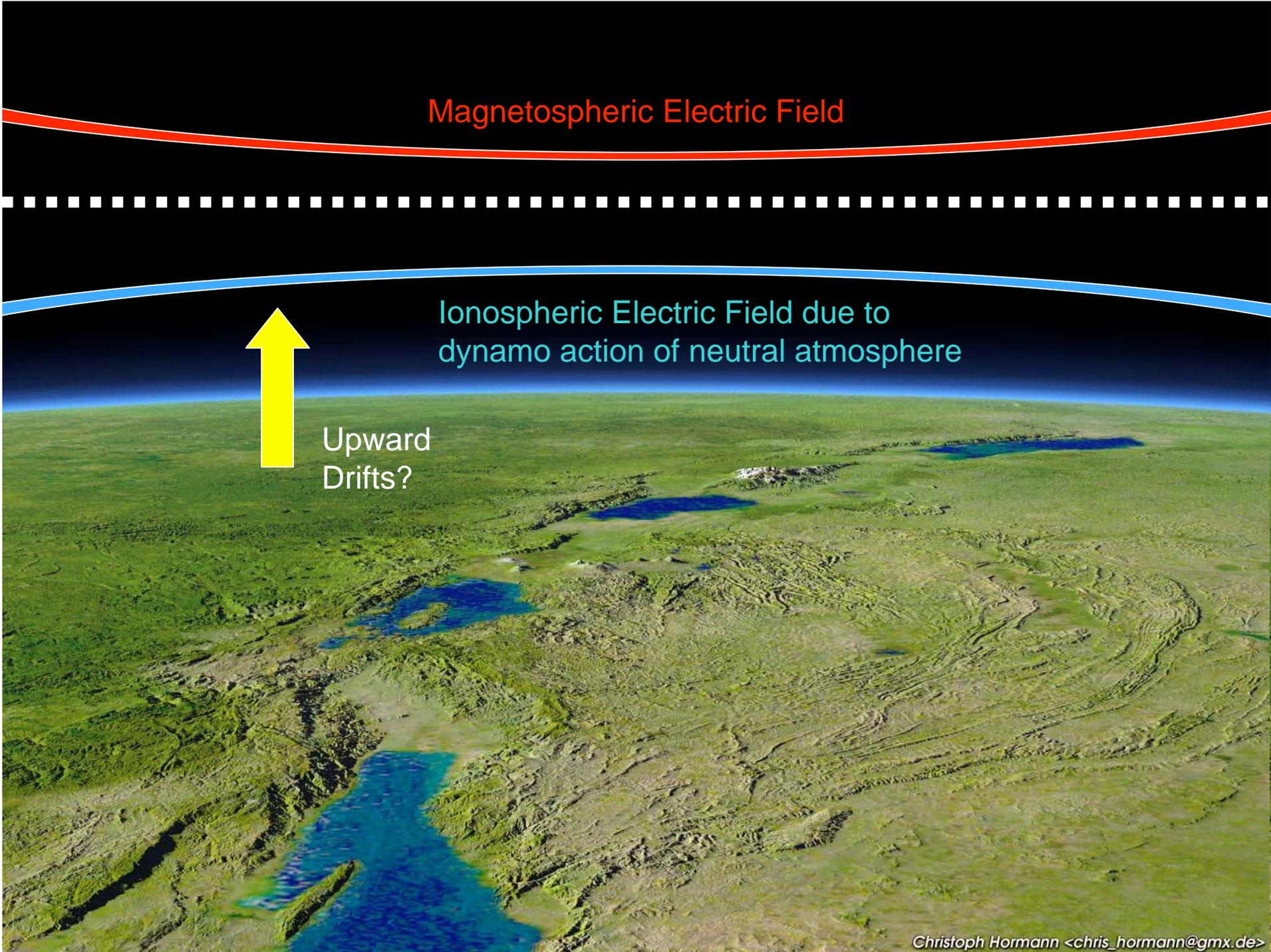


Magnetospheric Electric Field

Ionospheric Electric Field due to
dynamo action of neutral atmosphere



Upward
Drifts?



Next Steps...

- Compare the drift and Bz behaviors with the electron density profiles to discern any potential relationship.
- **Determining causality will require much more study.**
- Use CMIT to investigate the drifts and any influences on them from the magnetic field.

