Thermospheric Variability MCDP Work

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What's the weather like at 150 km?

- Climate = What you expect (predictions from models)
- Weather = What you get (less predictable from numerical models)
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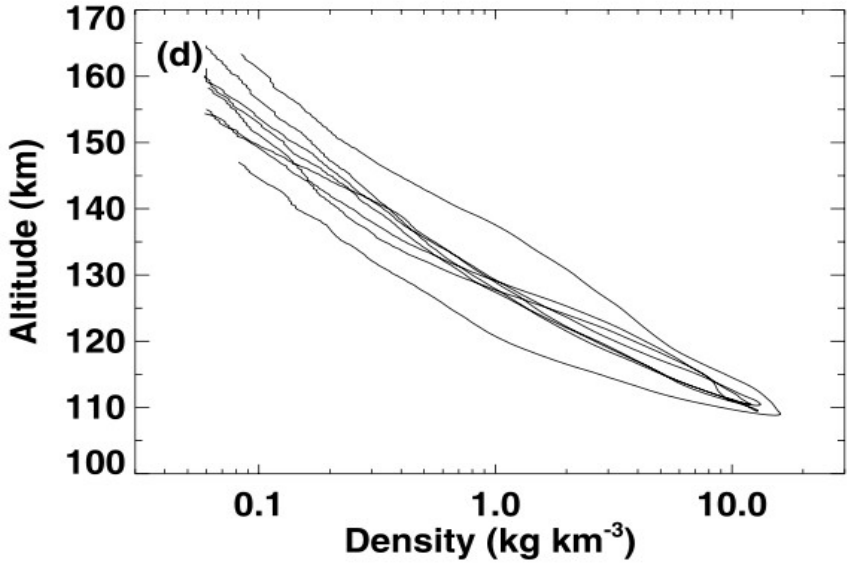
- Operations need predictions of both
- I'm working on some data products associated with empirical measurements of thermospheric variability

Aerobraking accelerometers

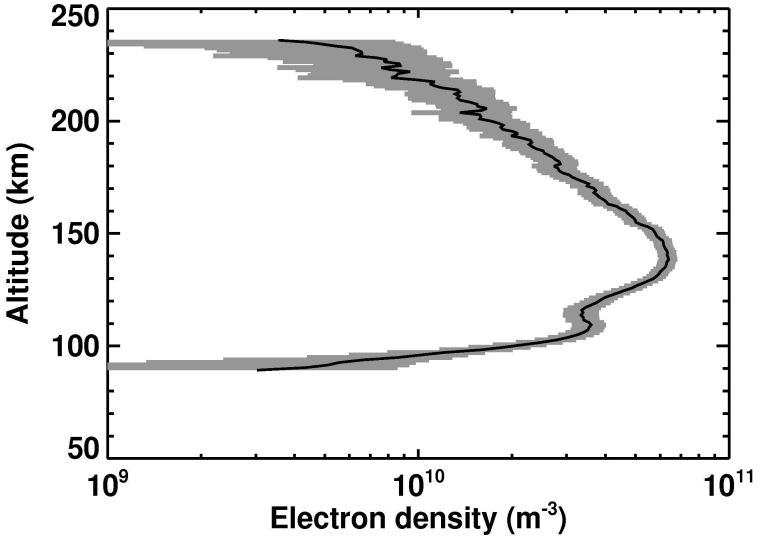
- MGS, ODY, MRO sampled range of seasons, locations, times of day, solar cycle, etc
- Density profiles, as well as density scale heights

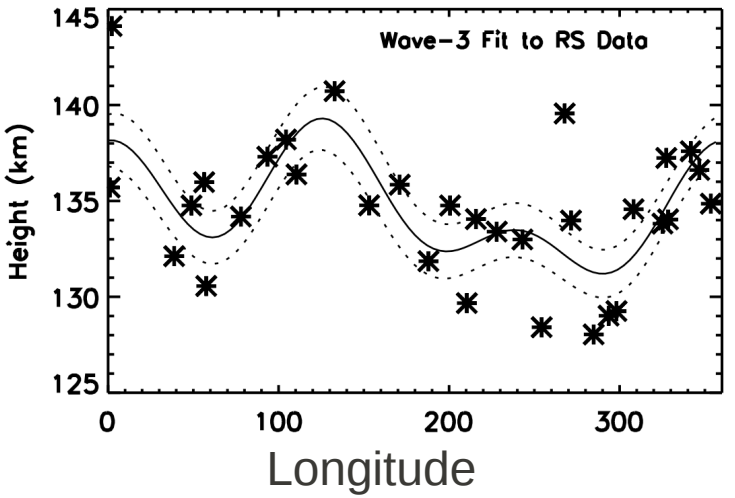


These four profiles should be identical

MGS RS ionospheric data

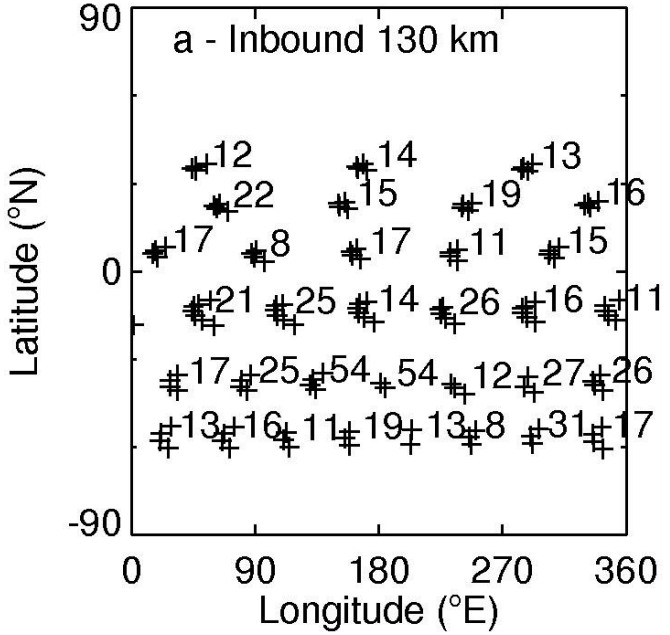
- 5600 profiles of electron density vs altitude
- Altitude of peak occurs at predictable pressure level
- Width of peak indicates neutral temperature





Task 1 (Intrinsic variability)

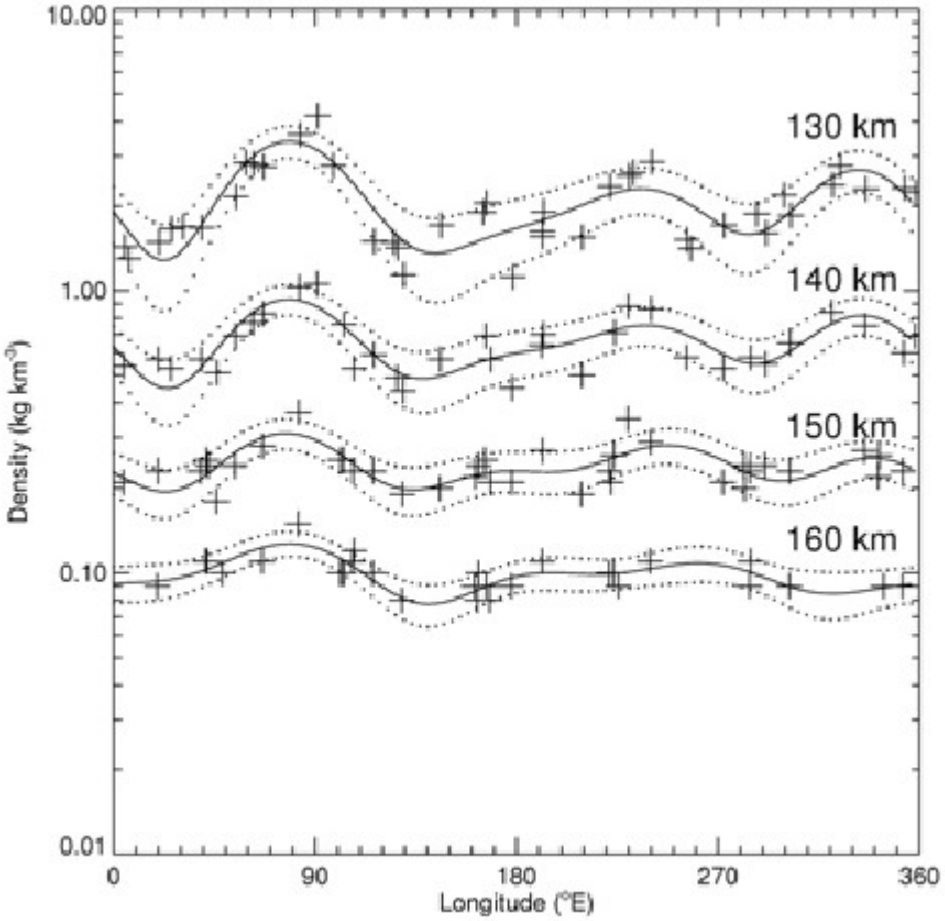
- Variability at same Ls, latitude, longitude, LST, altitude (everything but day-to-day)
- Occurs for aerobraking when period x N = sol



Numbers are standard deviation of selected density measurements relative to mean

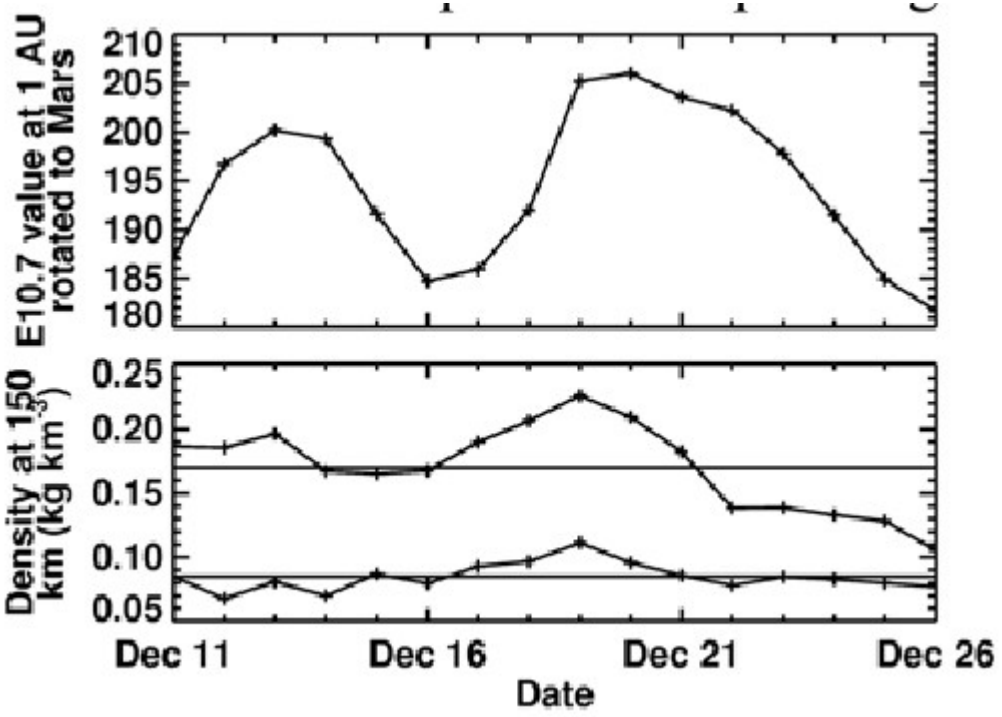
Task 2 (Variations with longitude)

- Longitude has a surprisingly large effect on thermospheric densities and temperatures
- Report standard deviation of density, etc, at fixed Ls, latitude, longitude, LST, altitude
- Identify conditions where thermal tides are strong



Task 3 (Response to extreme solar events)

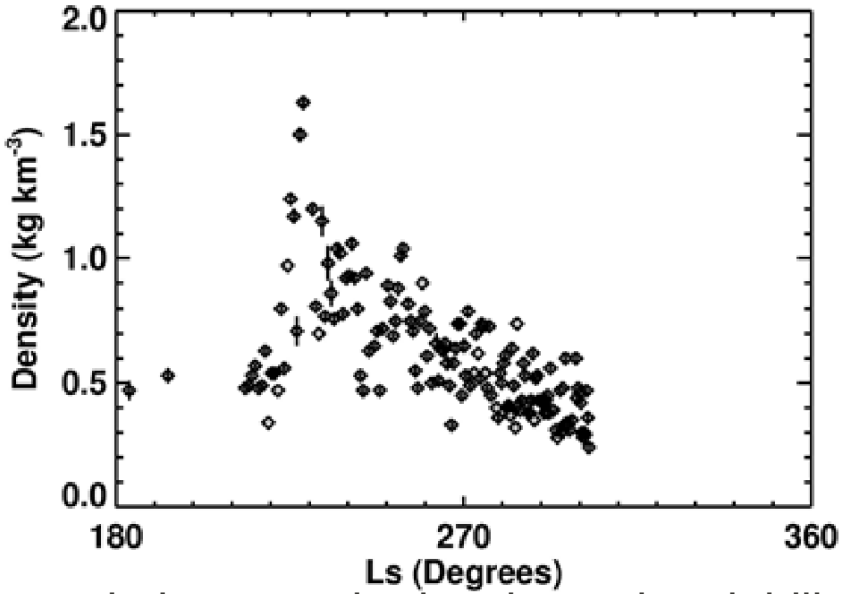
- Solar flares
- CMEs
- <u>Want</u> database of solar storms at Mars during aerobraking (MGS ER, others)
- Responses not well-known, may be small and hard to measure
- May be large at times



Densities at 150 km increase during period of high solar EUV flux

Task 4 (Response to dust storms)

- Could be very exciting
- Look at past dust storms and report how conditions changed
- Deliverables here are less well-defined
- Want TES/THEMIS dust opacities (Mike Smith)



Big increase in density and variability at 150 km in Noachis dust storm at Ls=220

Usefulness of products

- That's what I proposed
- What do you want? Need?
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- Primary challenge will be extrapolating from previously observed conditions to trends that can be used to estimate variability in new Ls, latitude, LST, etc

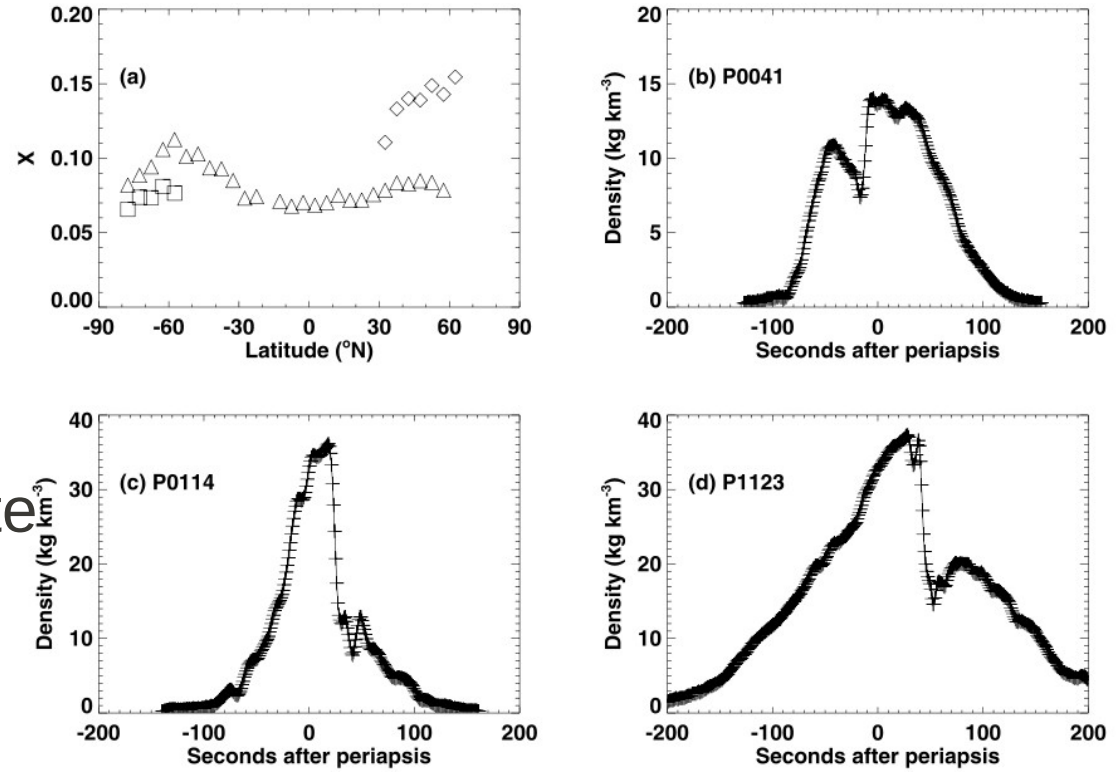
Other potential contributions

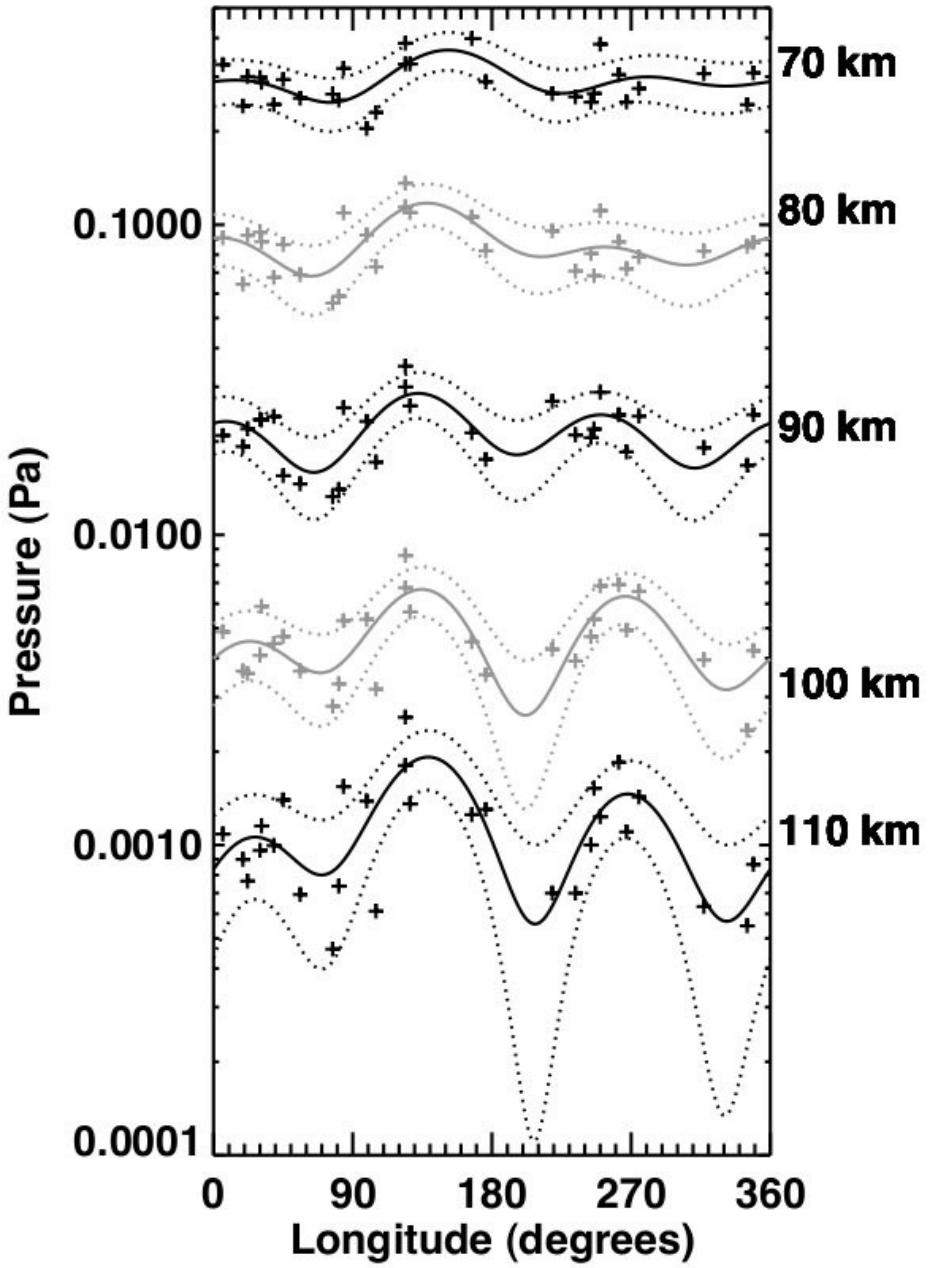
- Thermosphere and ionosphere
  - The environment from which escape occurs
- Less familiar with magnetosphere and zoo of escape processes

Aerobraking operations

- MGS and ODY aerobraking operations experience
- Data processing (accelerations to densities)
- Archiving (ODY density data products at PDS)
- Scientific analysis

- Not just accelerometer
  - VEX finds reaction wheel torque to be sensitive density-ometer
  - Orbital changes also indicate density (perhaps winds?)



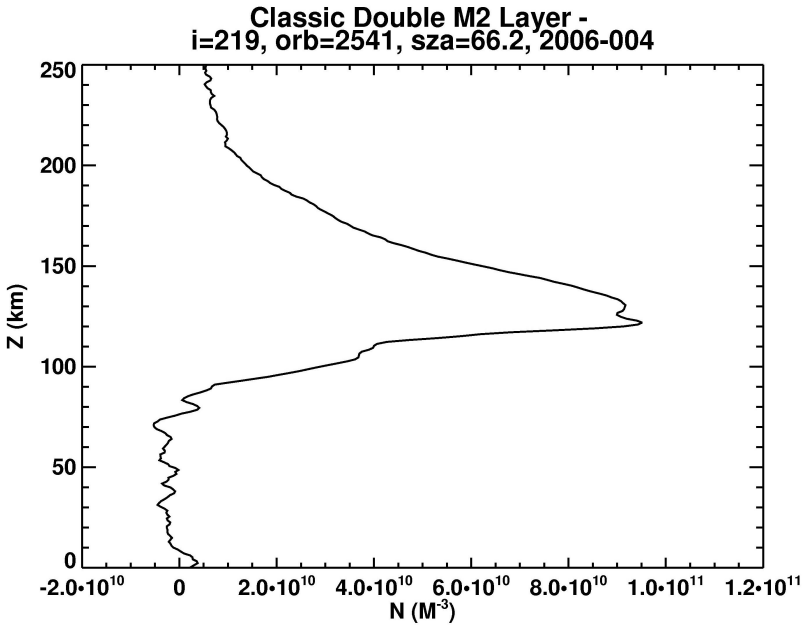


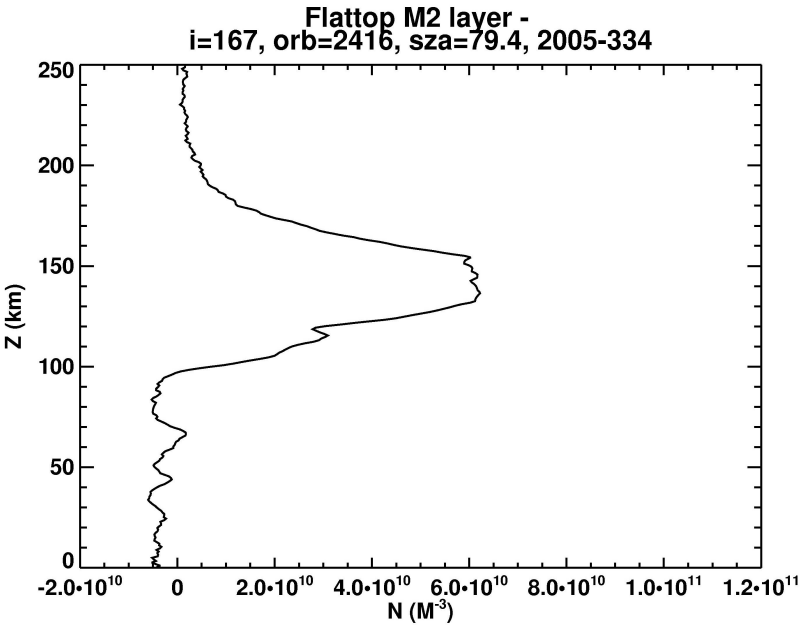
Atmospheric structure and dynamics

- Thermal tides visible in pressure and temperature profiles from SPICAM UV stellar occultations
- IUVS?

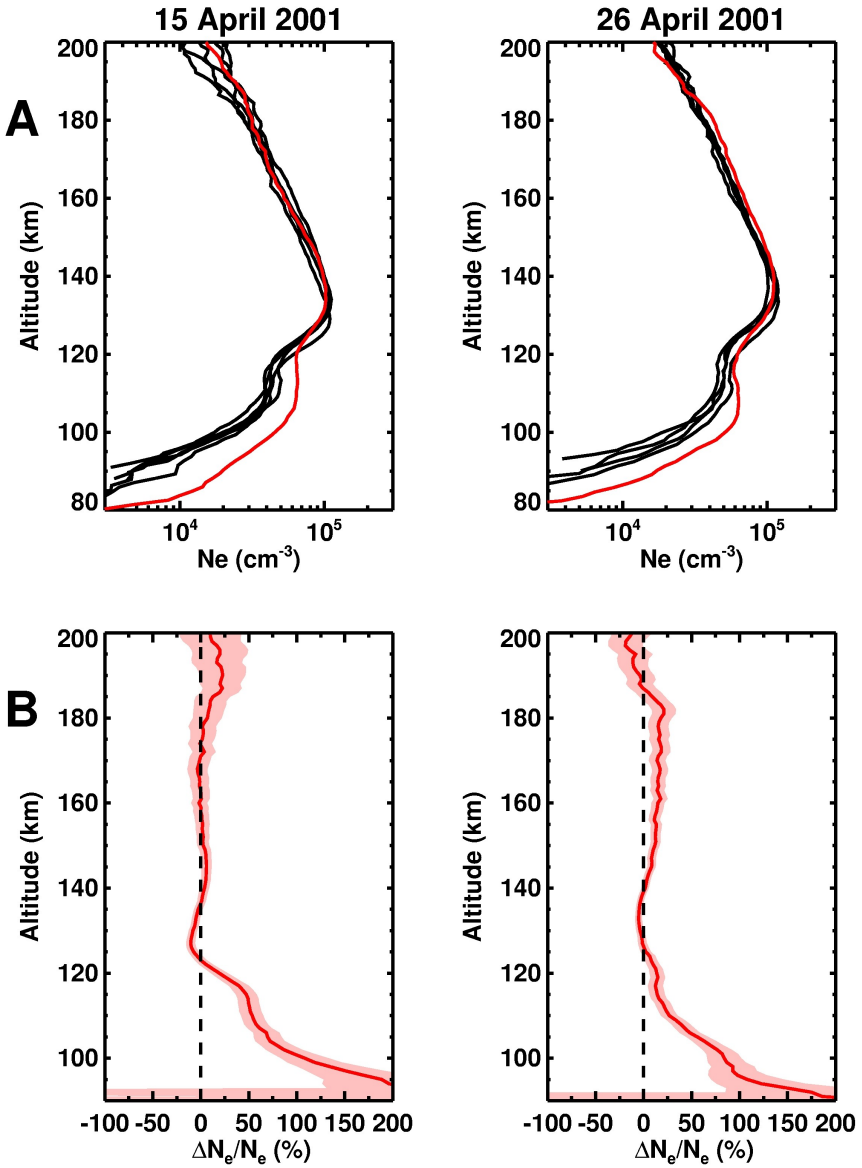
Ionospheric structure

- Why is the main layer, which is usually boringly smooth, showing these funny shapes?





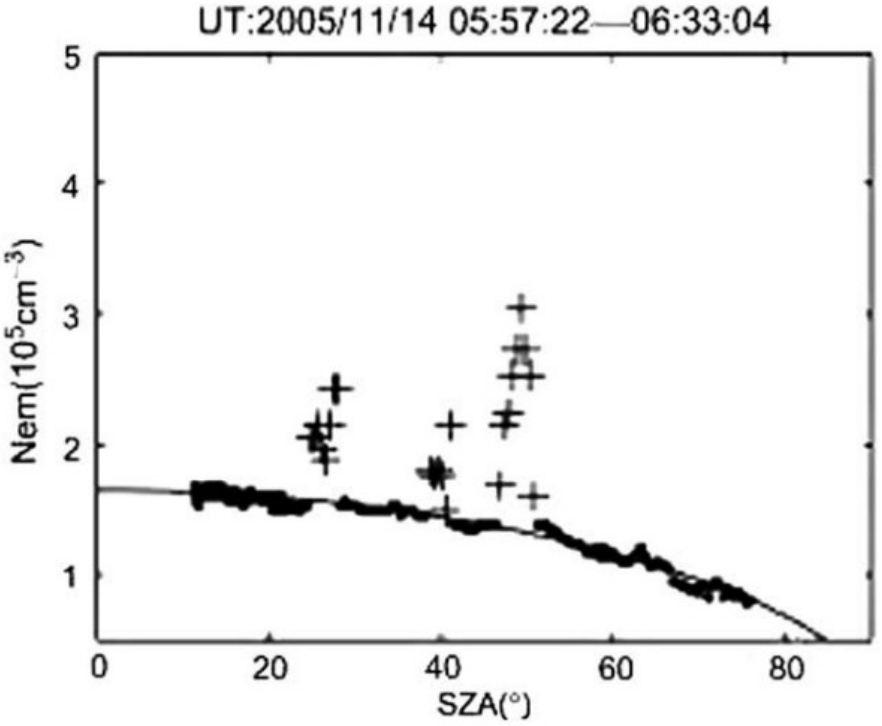
Ionospheric response to forcing

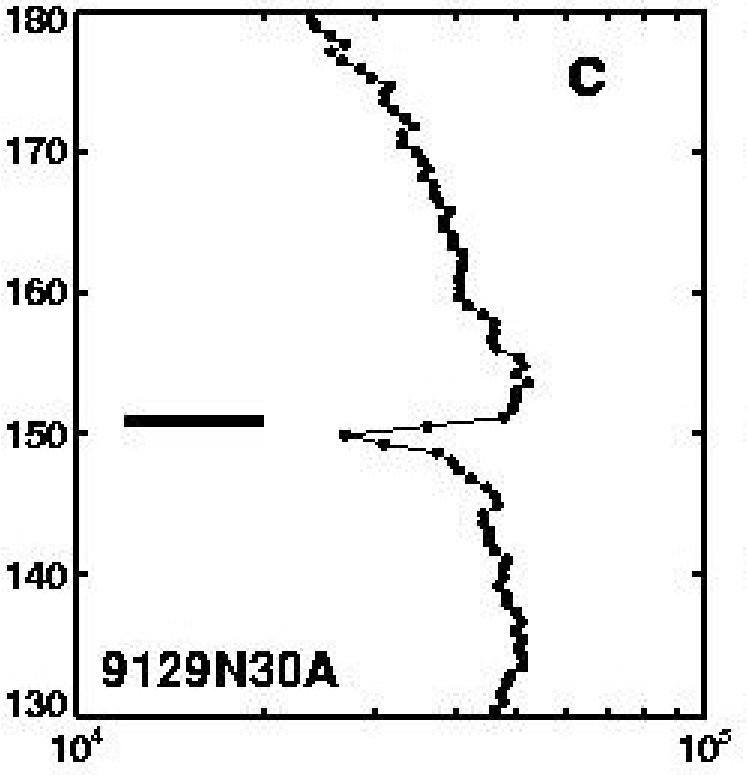


- How does the rest of the ionosphere respond to a solar flare?
- Or other kinds of forcing?

Ionosphere and magnetic field

- Magnetic environment important for escape, coupling to solar wind
- But what about basic ionospheric processes?





Archiving

- I love the PDS
- Experience producing and archiving several datasets
  - ODY aerobraking, MER entry, PHX entry
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- Some PDS formatting tools developed, but MAVEN probably has equivalent tools
- Perhaps work to archive useful, but not pipelined, high-level data products