Ionization due to particle precipitation during the August 2011 storm

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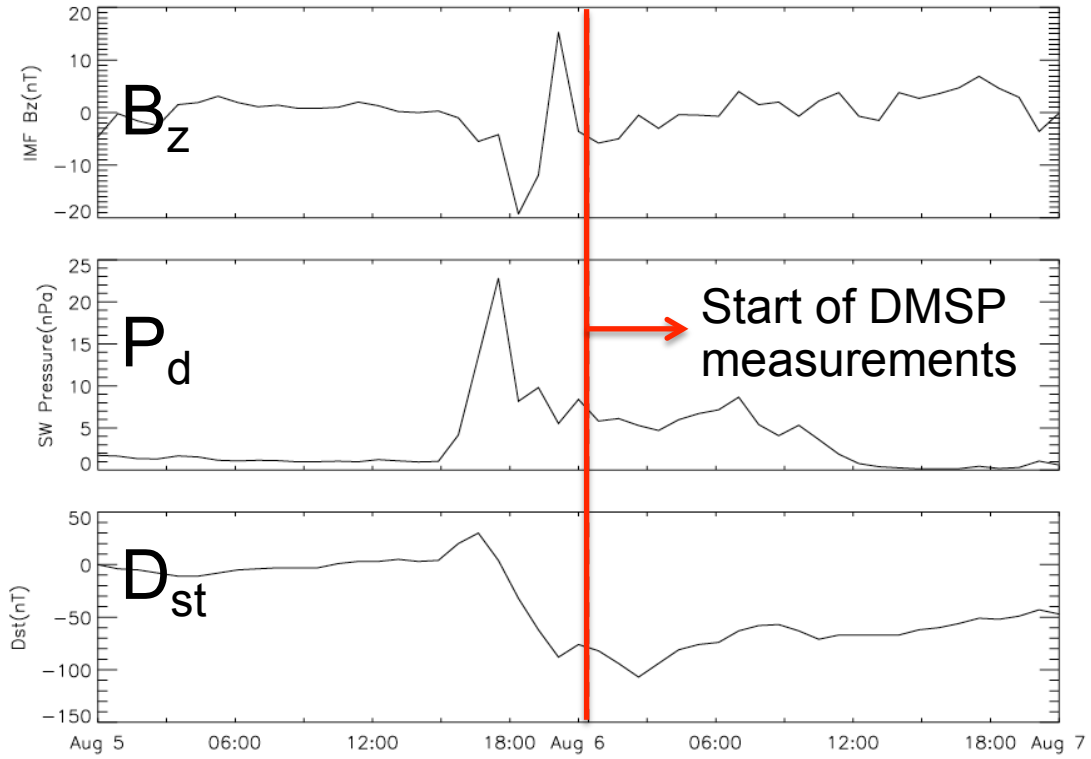
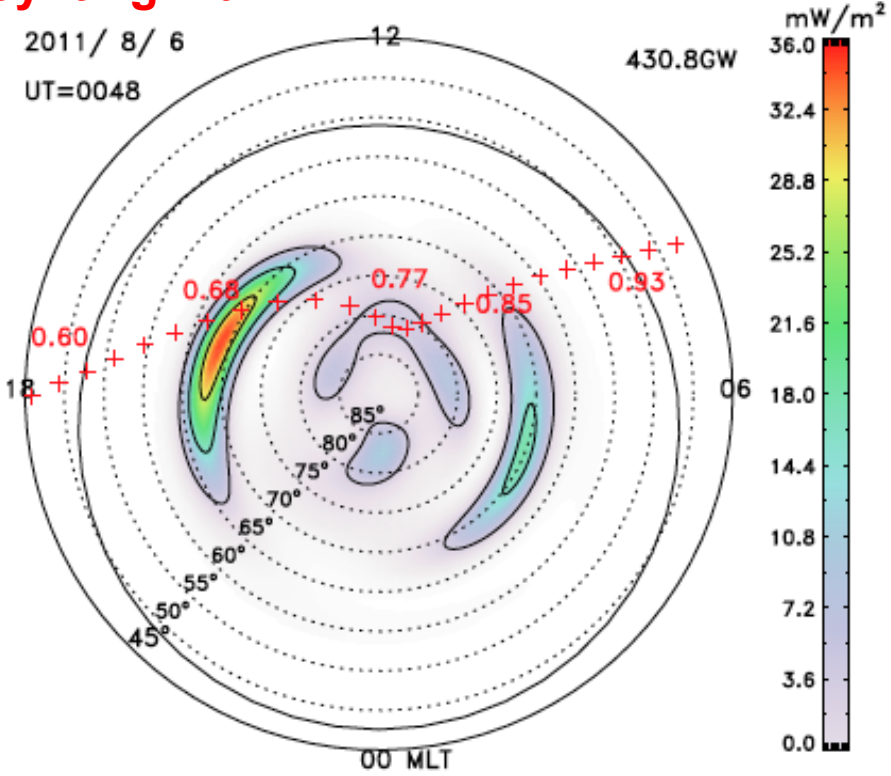
Data and models

- **DMSP F16 measurements**:
  - Particle energy spectra
  - Poynting flux
  - Plasma drift velocity
- **Thermosphere model**: NRLMSISE-00 [Picone et al., 2002]
- **Parameterizations for particle impact ionization rates**:
  - Fang et al. [2010] (Fang2010): electron
  - Fang et al. [2013] (Fang2013): ion
    - first parameterizations based on first-principles models
    - Integrate the contributions of individual monoenergetic components
    - 100 eV to 1 MeV

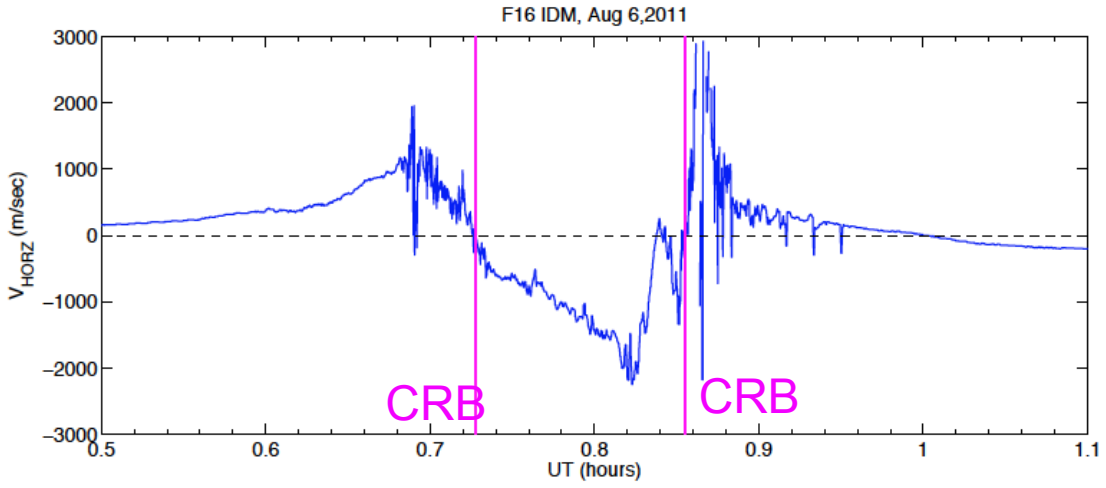
August 6th, 2011 storm

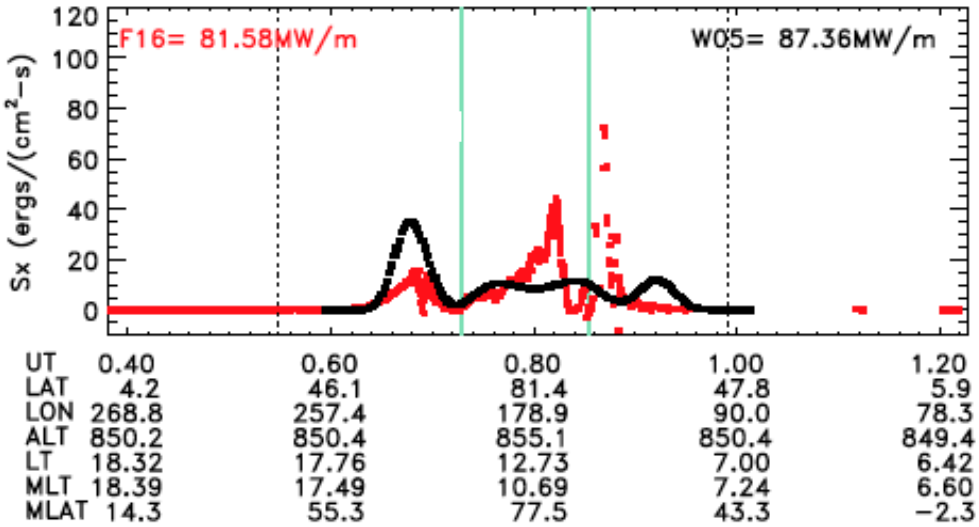


Poynting Flux

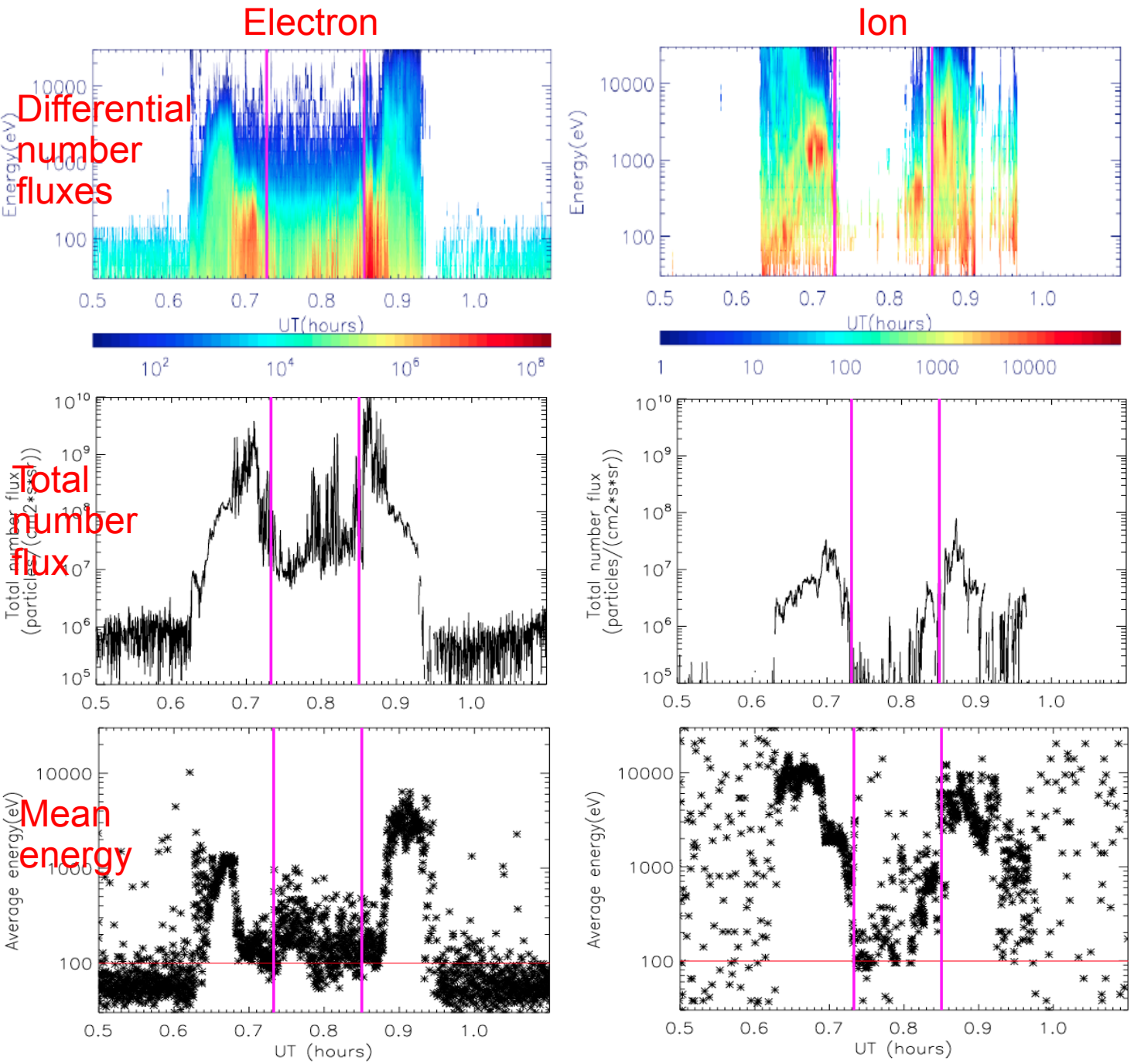


Cross-Track plasma drift velocity (IDM)





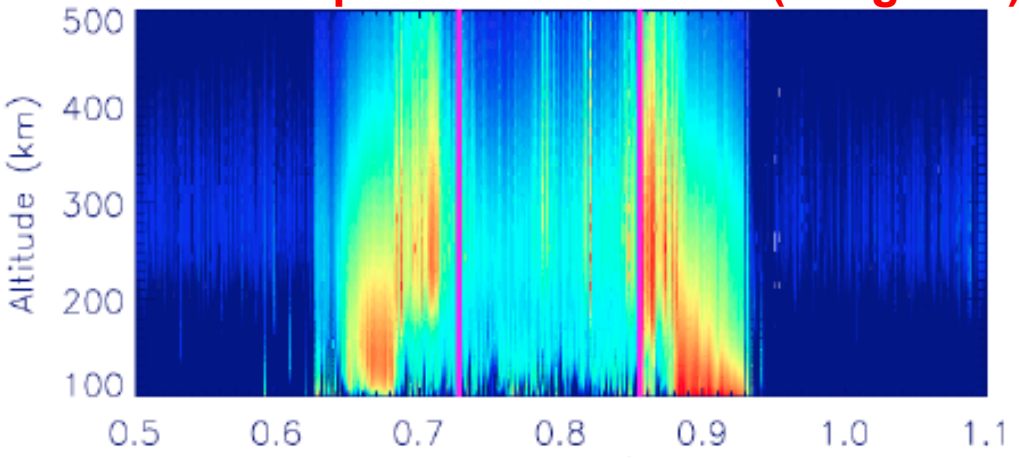
Energy spectrum (DMSP F16)



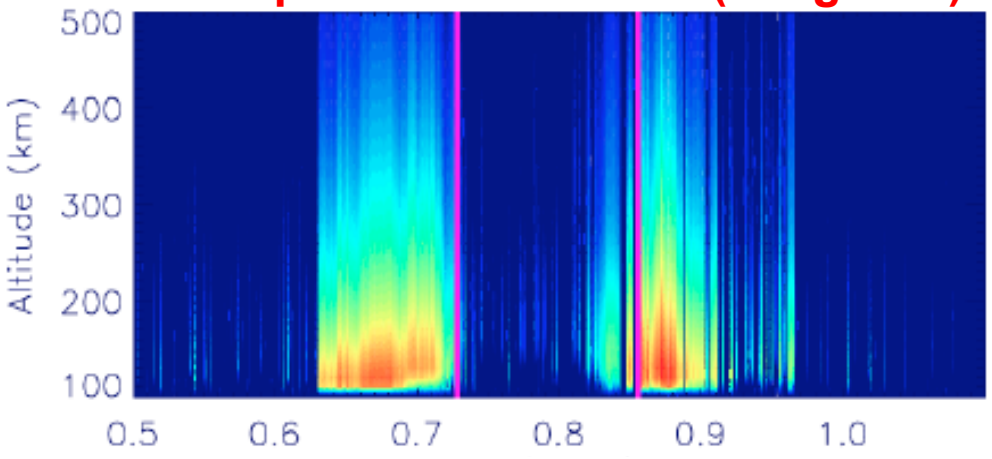
- Polar rain region (0.73 ~0.82 UT) identified with low accompanying ion precipitation
- Clear enhancement of soft electron flux in the polar cap as strong as in auroral zone.
- Mean electron energy:
  - polar cap: mostly >100eV
  - auroral zone: >1 keV
  - at lower latitudes: mainly <100eV

Particle impact ionization rates

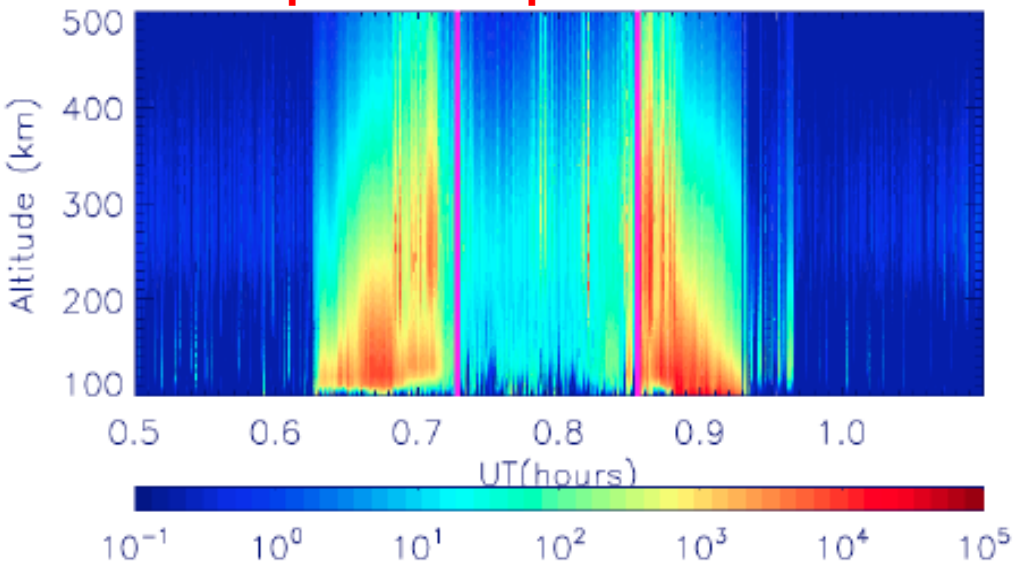
Electron impact Ionization rate(Fang2010)



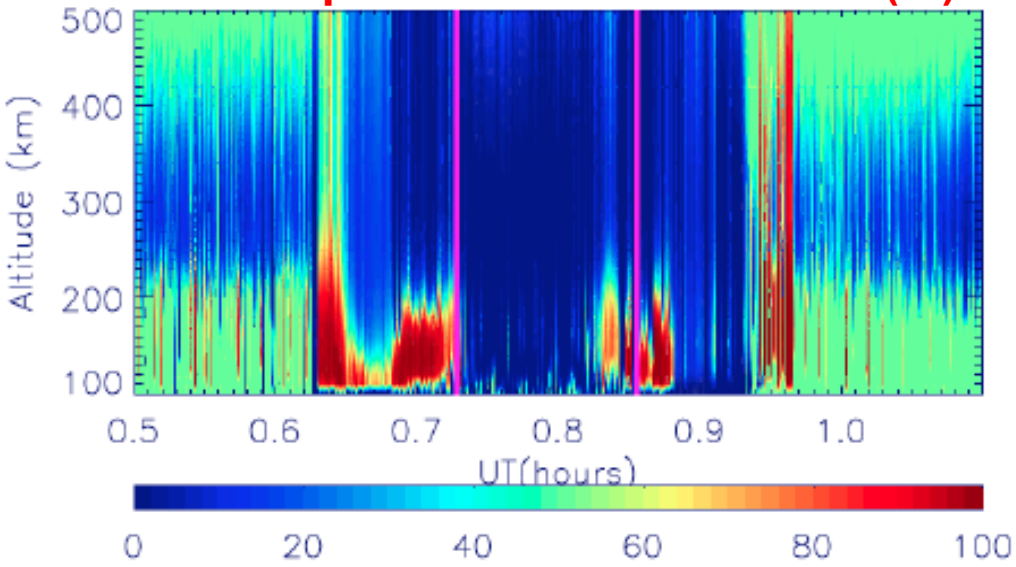
Ion impact Ionization rate(Fang2013)



Total particle impact Ionization rate



Ion impact/Total Ionization rate(%)



- In polar cap, majority of ionization is at F-region altitudes from soft electrons.
- Most of the ion impact ionization is in auroral zone with peaks under 200 km.

Summary

- We focus on a DMSP F16 pass over northern polar region during the main phase of the moderate storm occurred on August 6, 2011.
- Clear enhancement of electron fluxes in the polar cap besides the strong enhancement in the auroral zone.
- Mean energy in polar cap is mostly above 100 eV, while the mean energy of aurora zone is above 1 keV, and those in the lower latitudes are mostly below 100 eV.
- Strong Poynting flux enhancement in polar cap is associated with the low-energy electron precipitation.
- Clear particle impact ionization enhancement at F-region altitude in polar cap region is mainly due to low-energy electrons precipitated.
- Importance of widely distributed polar rain and localized cusp soft particle precipitation.

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