Mars Upper Atmosphere Network

Paul Withers[1], Olivier Witasse[2], Hermann Opgenoorth[3], and the Mars Upper Atmosphere Network

1-Boston University, USA, 2-ESA, 3-IRF, Sweden

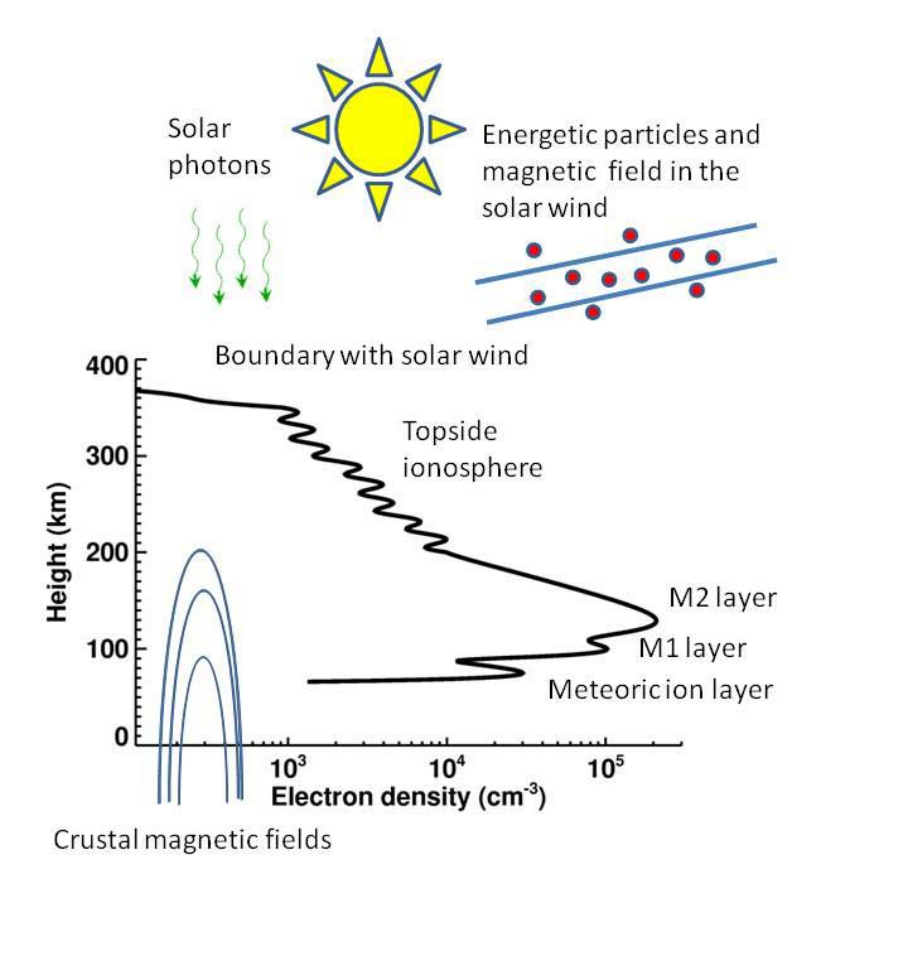
EPSC2010-289 (P96)

Tuesday 2010.09.21 17:30-19:00

European Planetary Science Congress

Rome, Italy

Mars



- The ionosphere and space environment of Mars form a unique plasma laboratory due to Mars's intense, small-scale crustal magnetic fields
- They are involved in many atmospheric loss processes

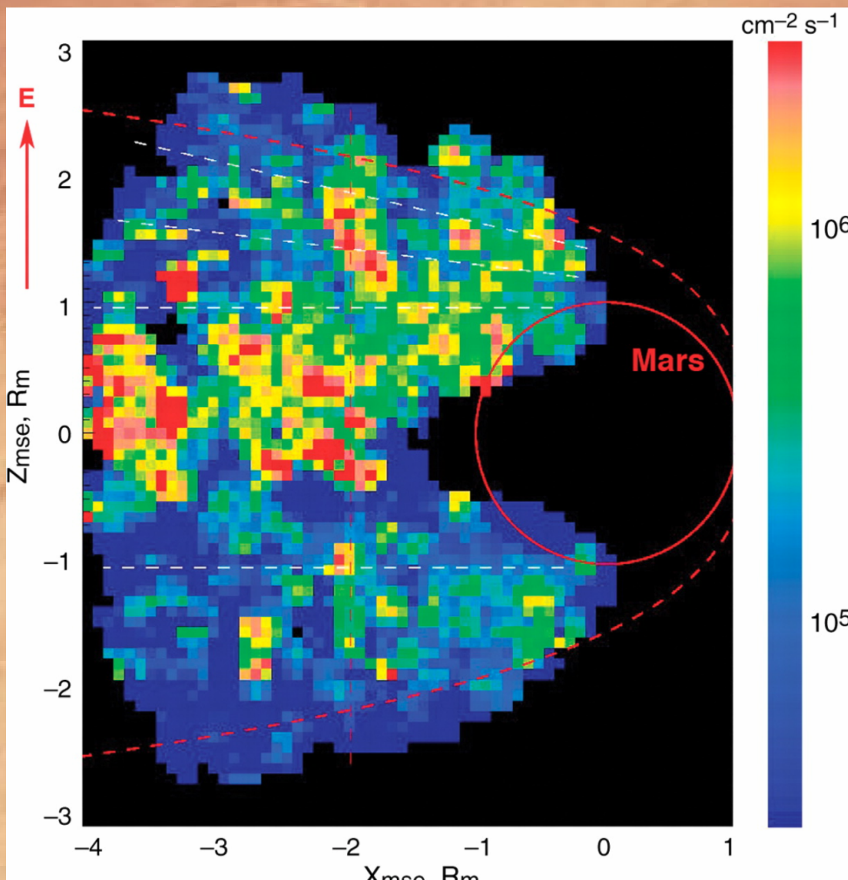
Background

- Mars Express and other spacecraft obtain a wide range of measurements of the complex upper atmosphere, ionosphere, and space environment of Mars
- Collaborations that bring together instrument teams, modellers and others are powerful mechanisms for studying Mars with a broad range of tools, enabling discoveries that cannot be made by isolated groups
- This Network was created as a self-sustaining scientific enterprise in early 2009

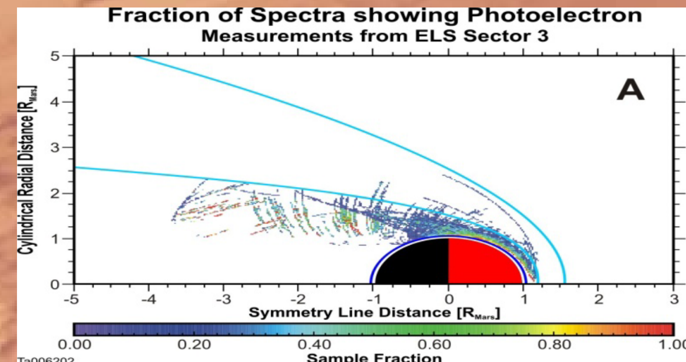
Participants

- Convened by Hermann Opgenoorth
- ESA (Olivier Witasse)
- BIRA, Belgium (Cyril Simon)
- LATMOS, France (Francois Leblanc)
- LMD, France (Jean-Yves Chaufray)
- University of Grenoble, France (Wlodek Kofman)
- Cologne University, Germany (Martin Paetzold, Kerstin Peter)
- Max Planck, Germany (Edik Dubinin, Markus Fraenz, Erling Nielsen)
- University of Rome, Italy (Roberto Orosei, Giovanni Picardi)
- IAA, Spain (Francisco Gonzalez-Galindo)
- IRF, Sweden (Stas Barabash, Niklas Edberg, Hermann Opgenoorth, Lisa Rosenqvist)
- University of Lancaster, UK (Mathew Beharrell)
- University of Leicester , UK (Ranvir Dhillon, Mark Lester, Steve Milan)
- Boston University, USA (Majd Matta, Paul Withers)
- University of California, Berkeley, USA (Dave Brain, Matt Fillingim, Rob Lillis)
- University of Iowa, USA (Firdevs Duru, Dave Morgan)

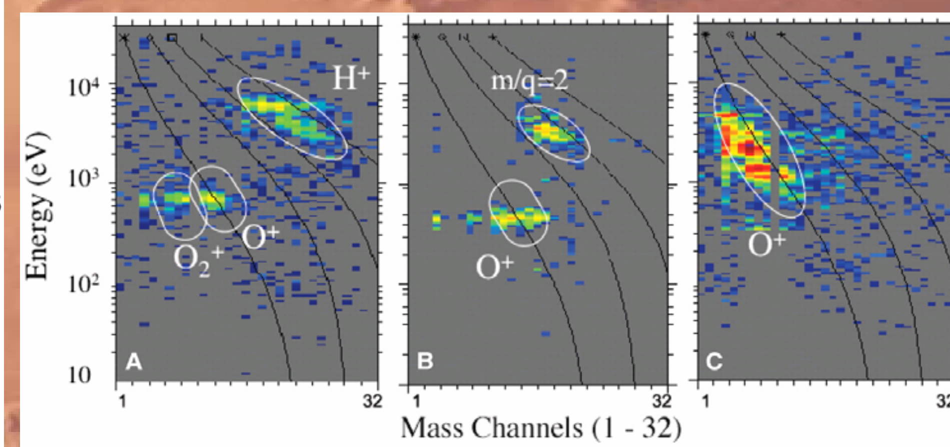
MEX ASPERA (Energetic particles)



Escape fluxes of O^+, O_2^+, CO_2^+

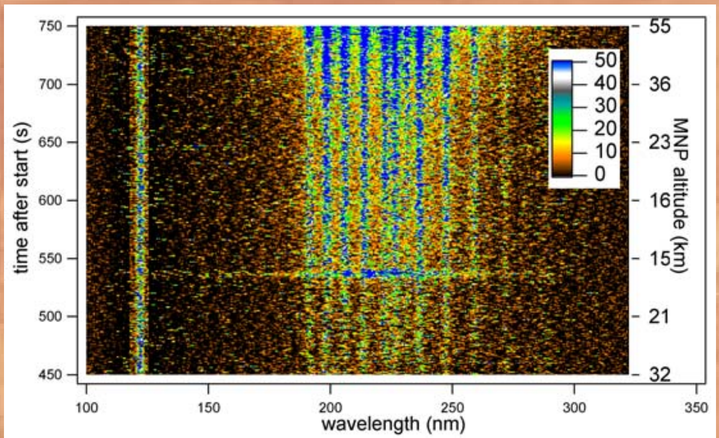


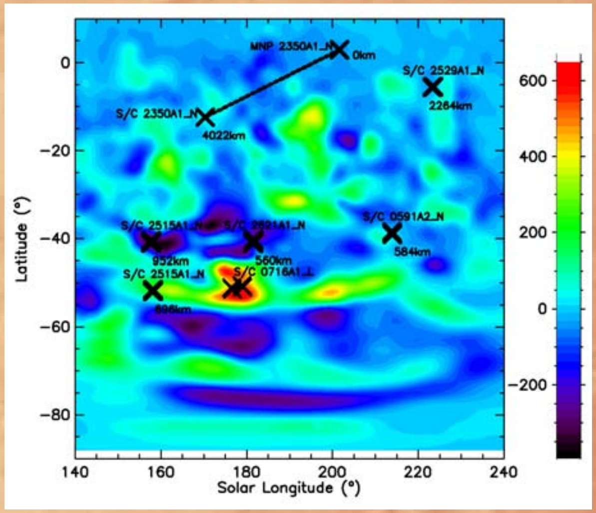
Photoelectron measurements



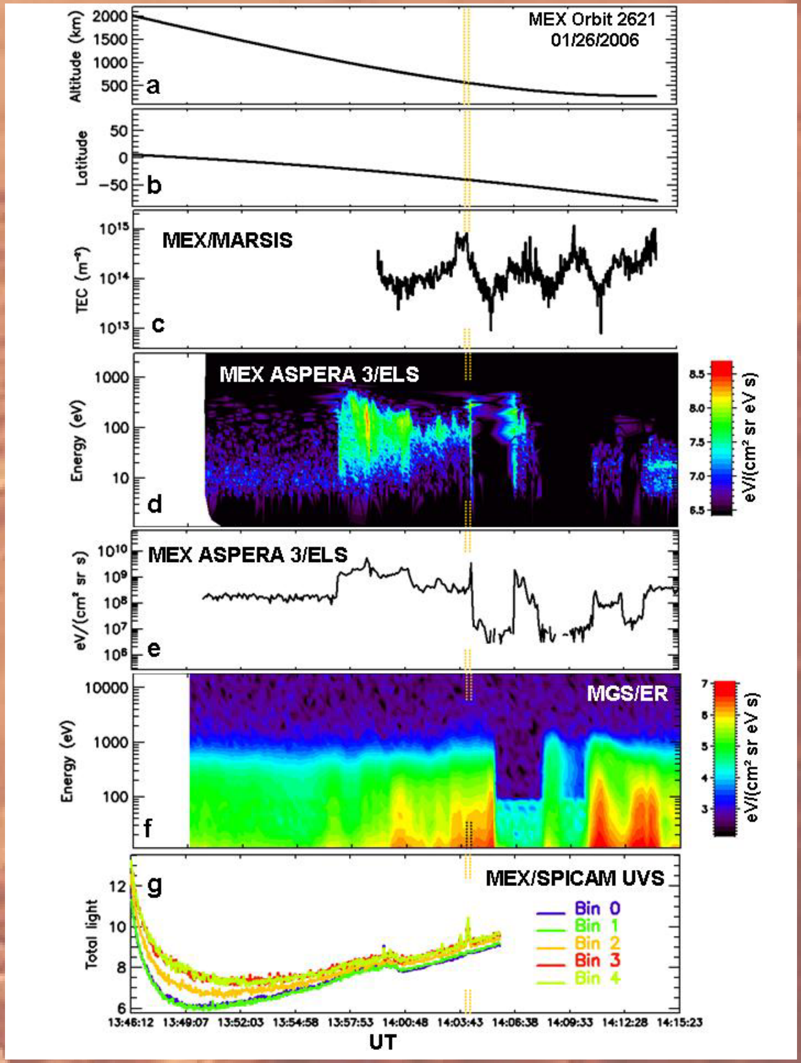
Three example energy spectra

MEX SPICAM (UV spectrometer)



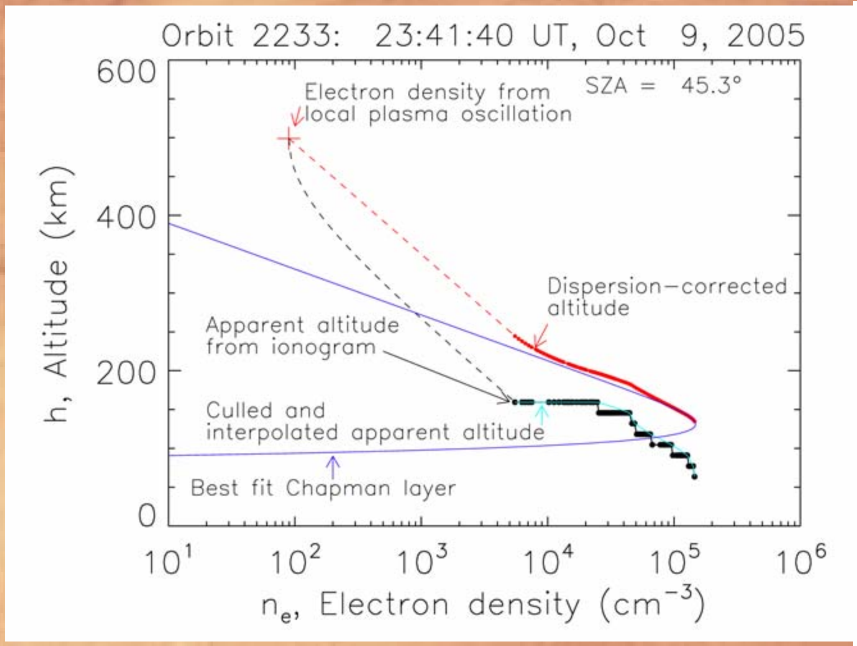


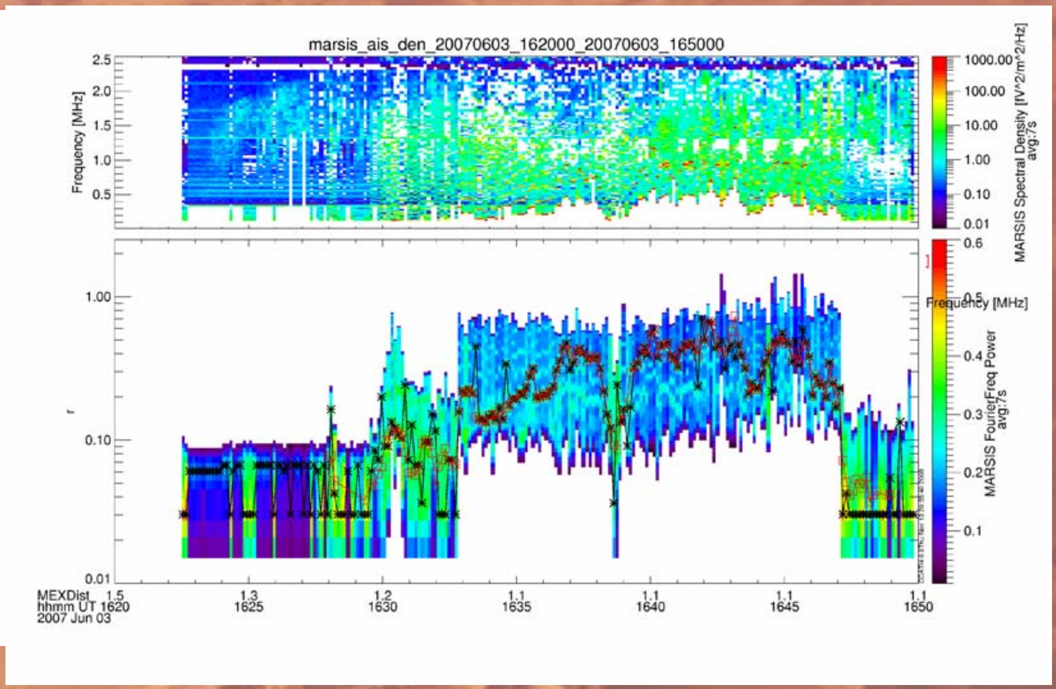
Observations of aurora at magnetic cusps



Observational context

MEX MARSIS (Radar sounder)

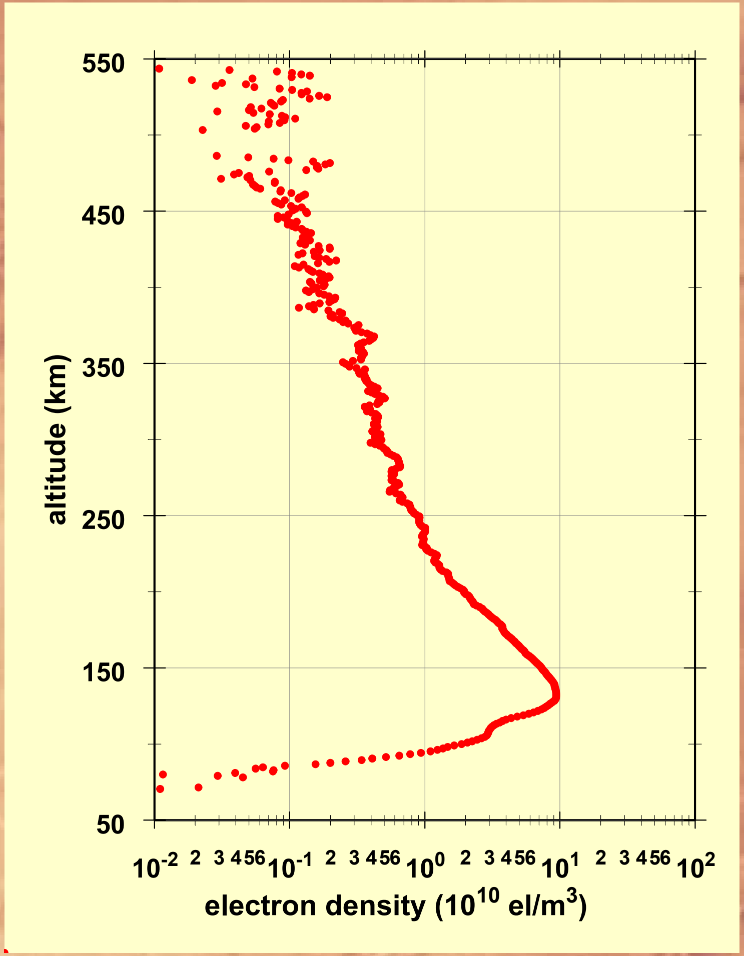


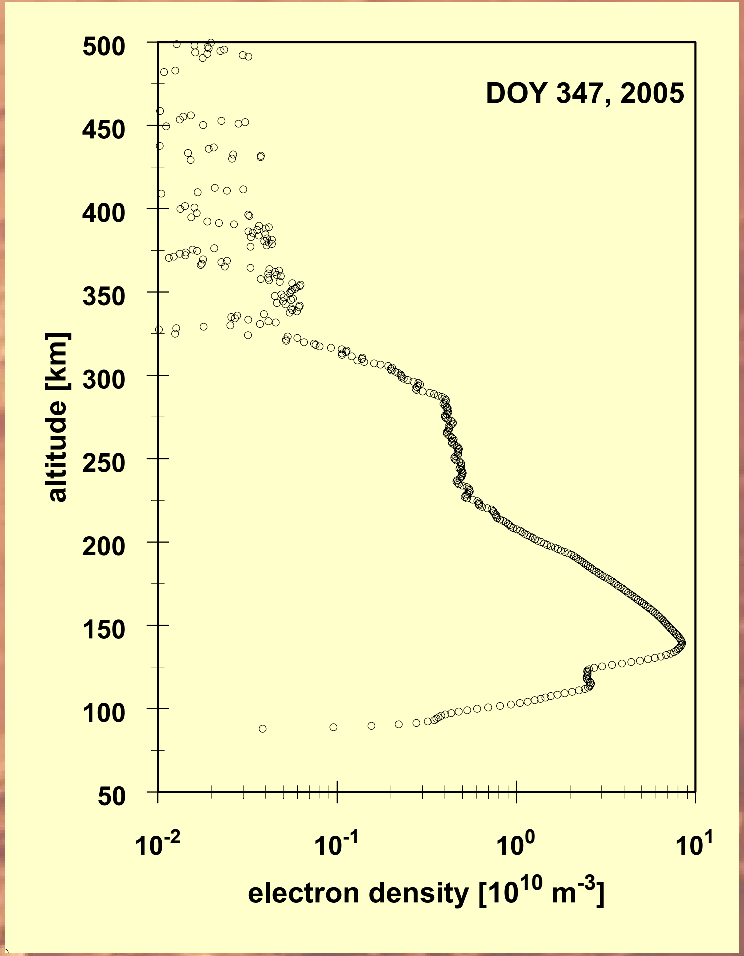


Many topside ionospheric profiles

Local measurements of plasma density and magnetic field strength

MEX MaRS (Radio science)

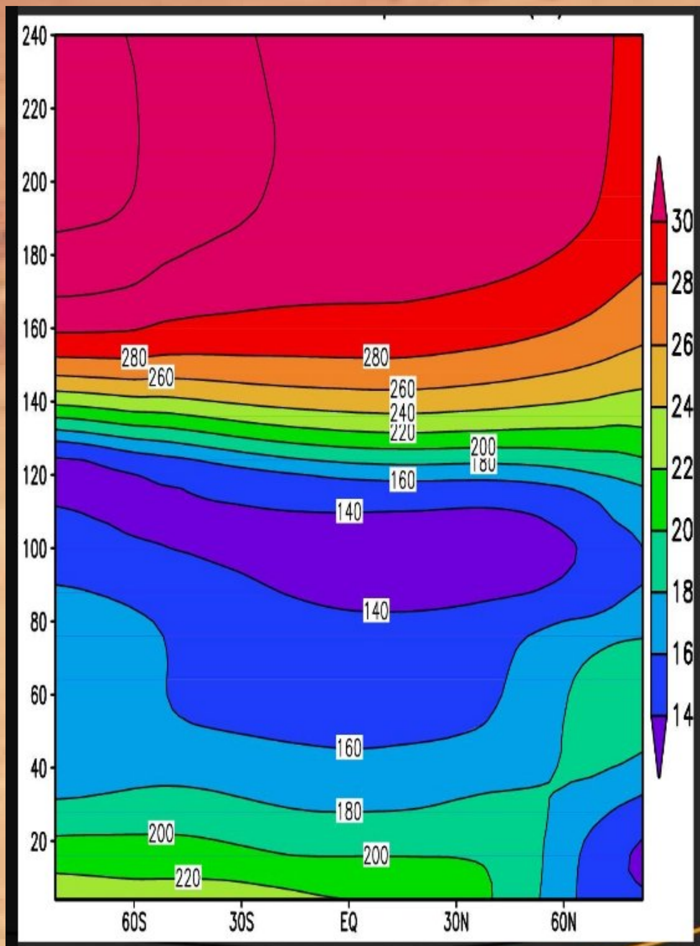




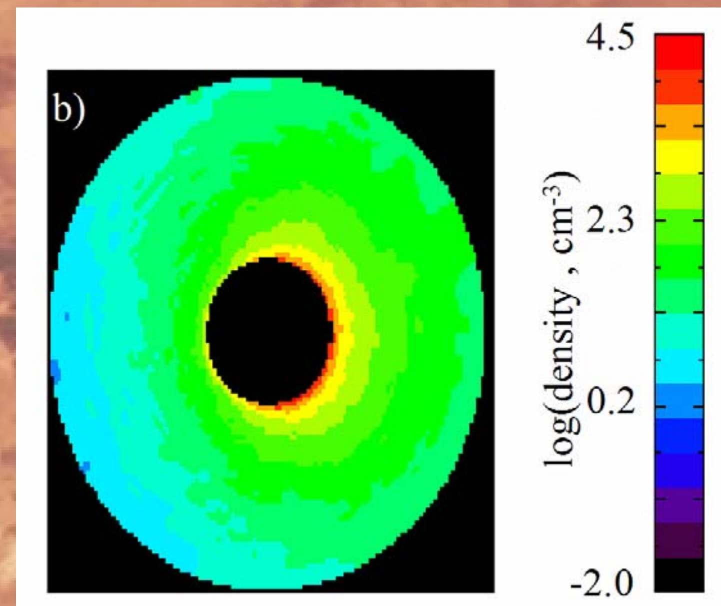
High resolution profiles of entire ionosphere

Variable ionopause

Thermosphere/exosphere simulations



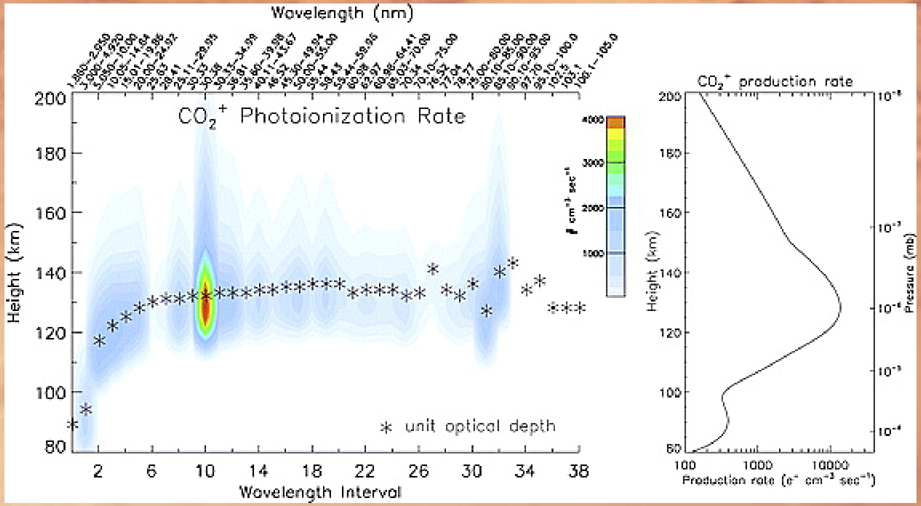
Temperatures from general circulation model

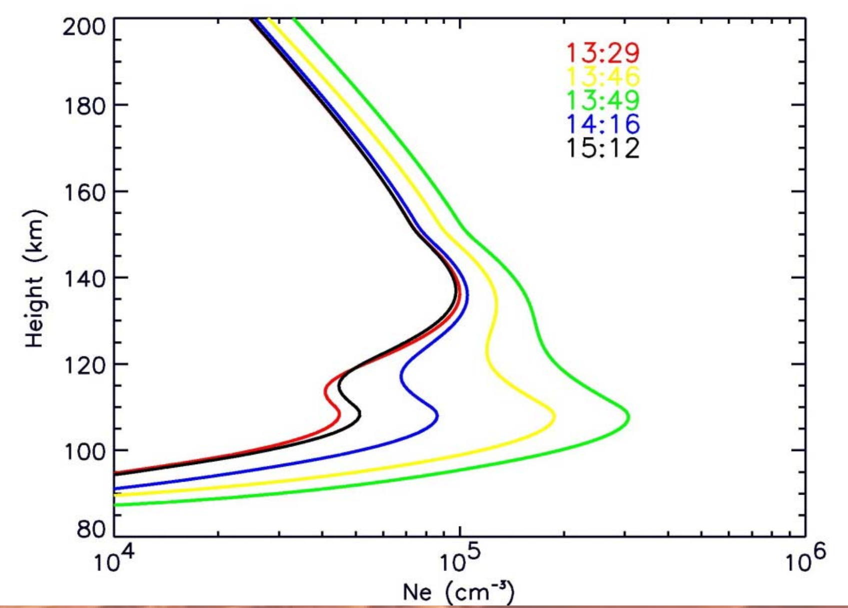


Hot oxygen densities in equatorial plane at solar maximum

Ionospheric simulations

Peak of solar flare at
13:49 on 15 April 2001

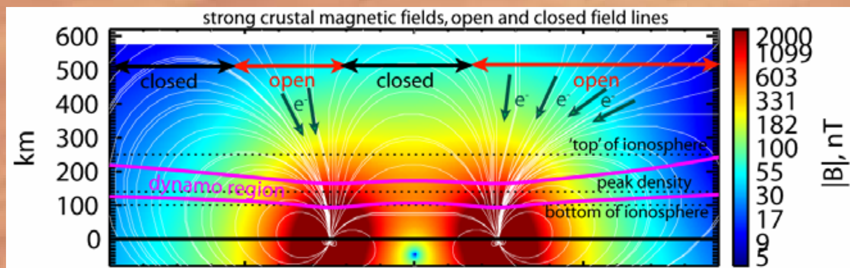




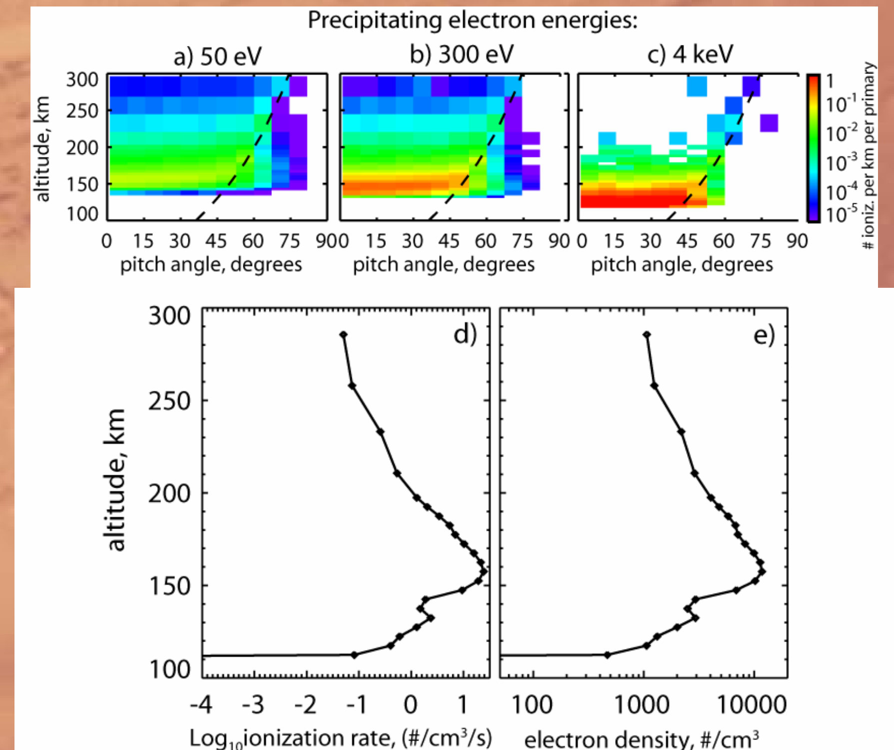
1-D simulations with ion photochemistry and ion transport

Simulating ionospheric response to a solar flare using time-dependent solar irradiance

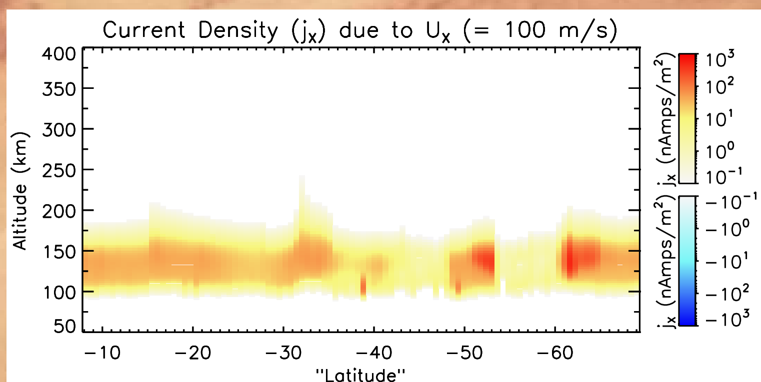
Electron transport models

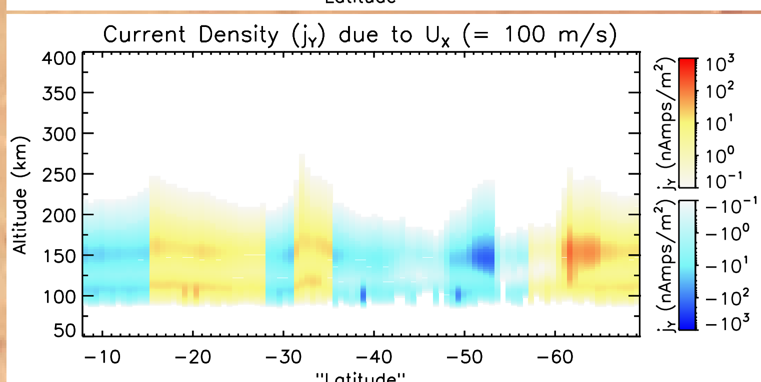


Complex dynamo region predicted



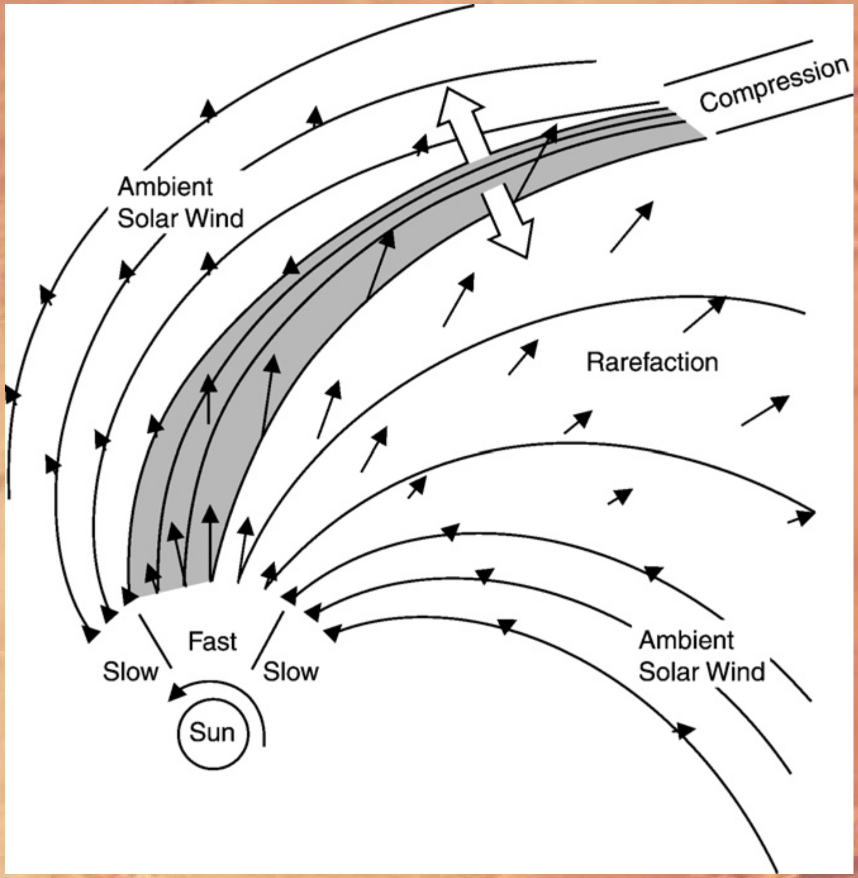
Formation of nightside ionosphere due to precipitating electrons



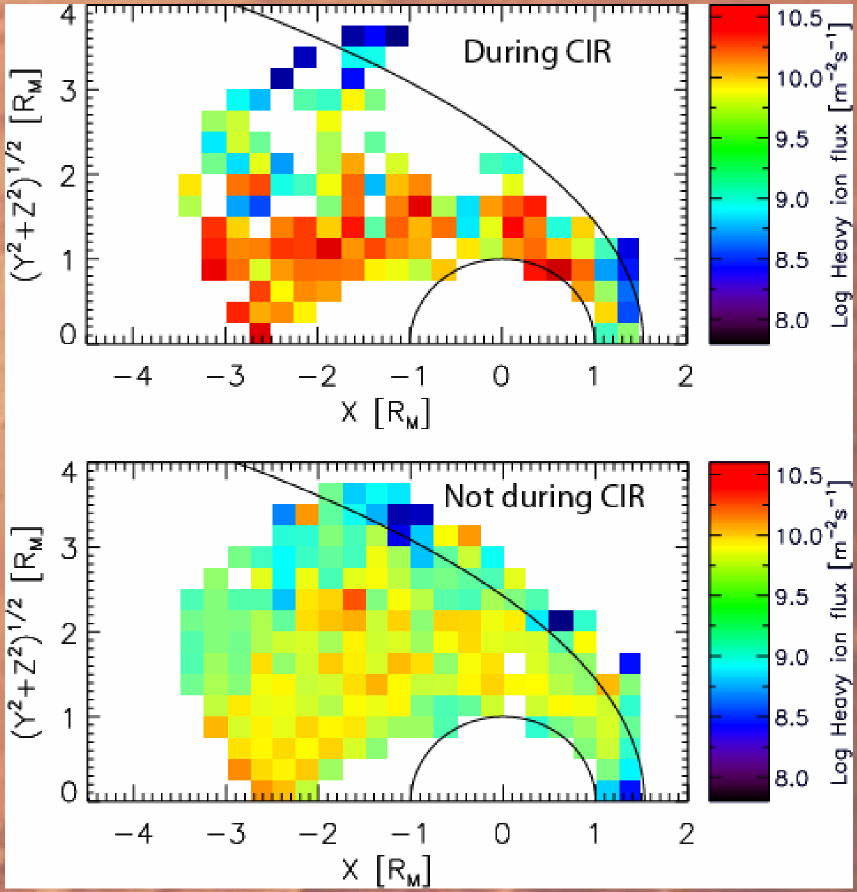


Ionospheric currents due to neutral winds and complex magnetic field morphology

Atmospheric escape

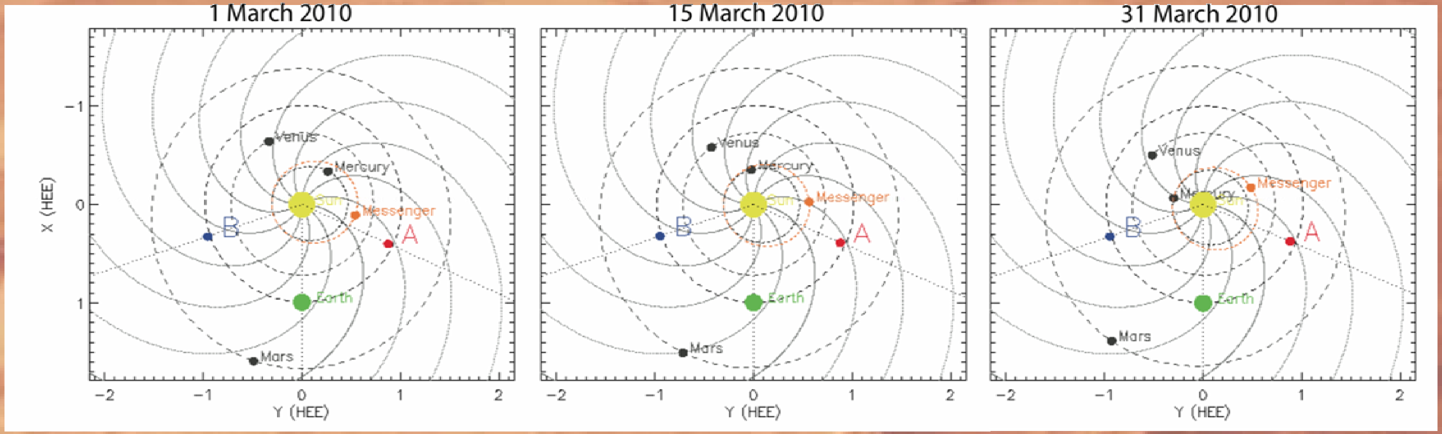


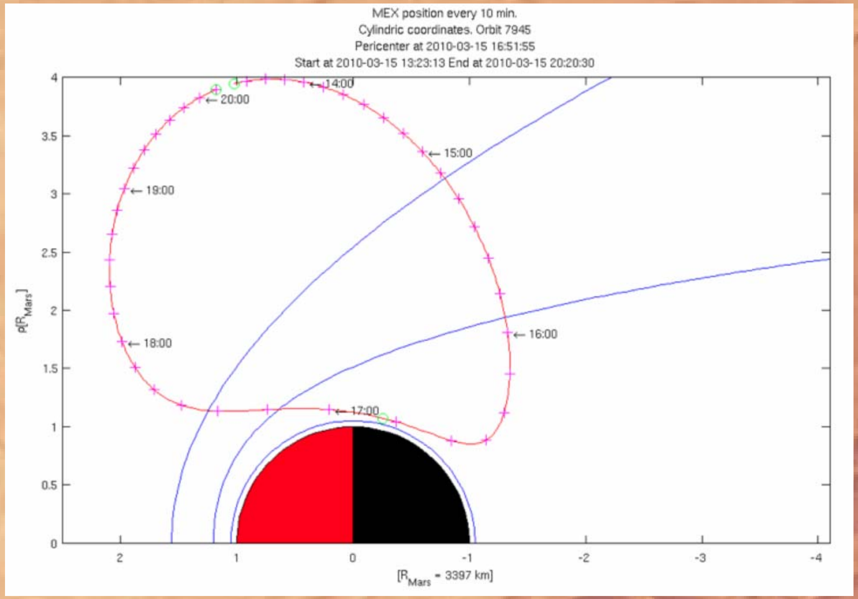
Corotating interaction region (CIR)
in solar wind



Heavy ion escape flux doubles during CIRs

MEX Campaign – March 2010

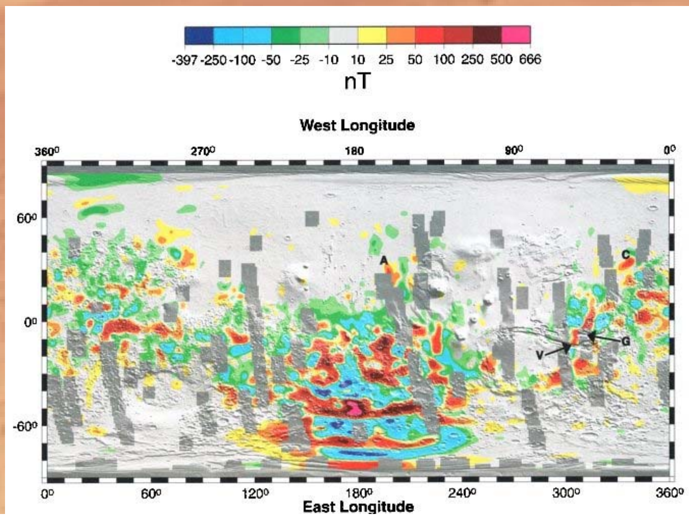




Earth and Mars on same arm of Parker spiral

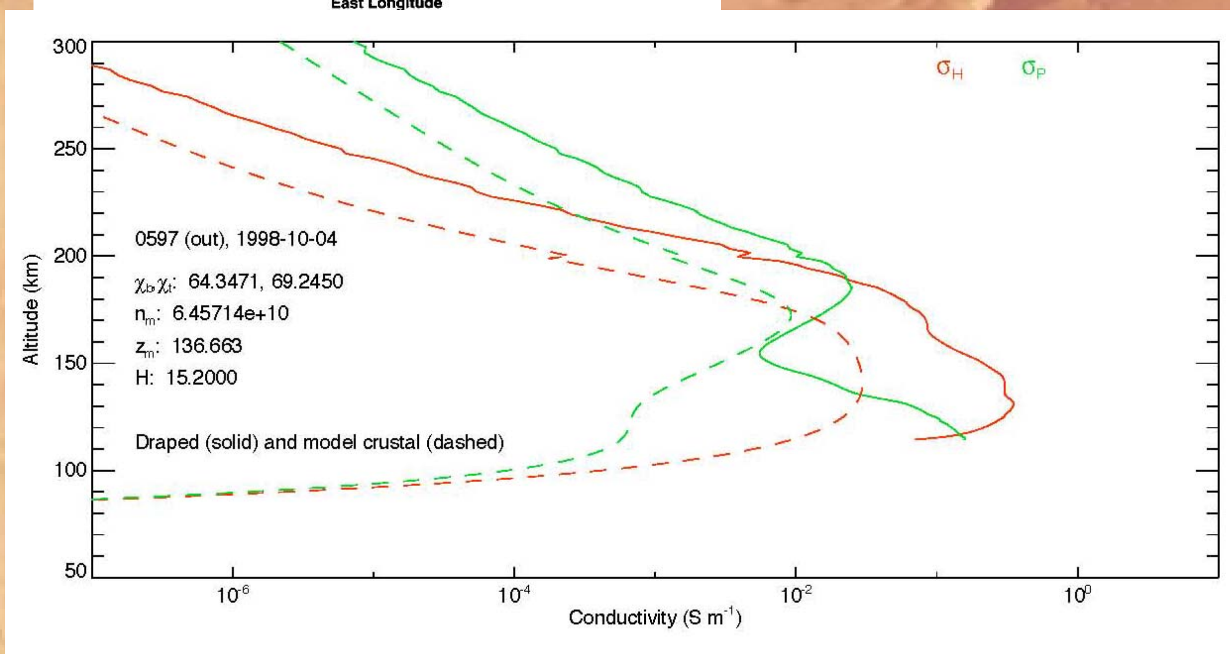
Extensive and coordinated MEX observations of upper atmosphere, Ionosphere and space enviornment are planned

Focus - Electrodynamics



Crustal magnetic fields at 200 km altitude

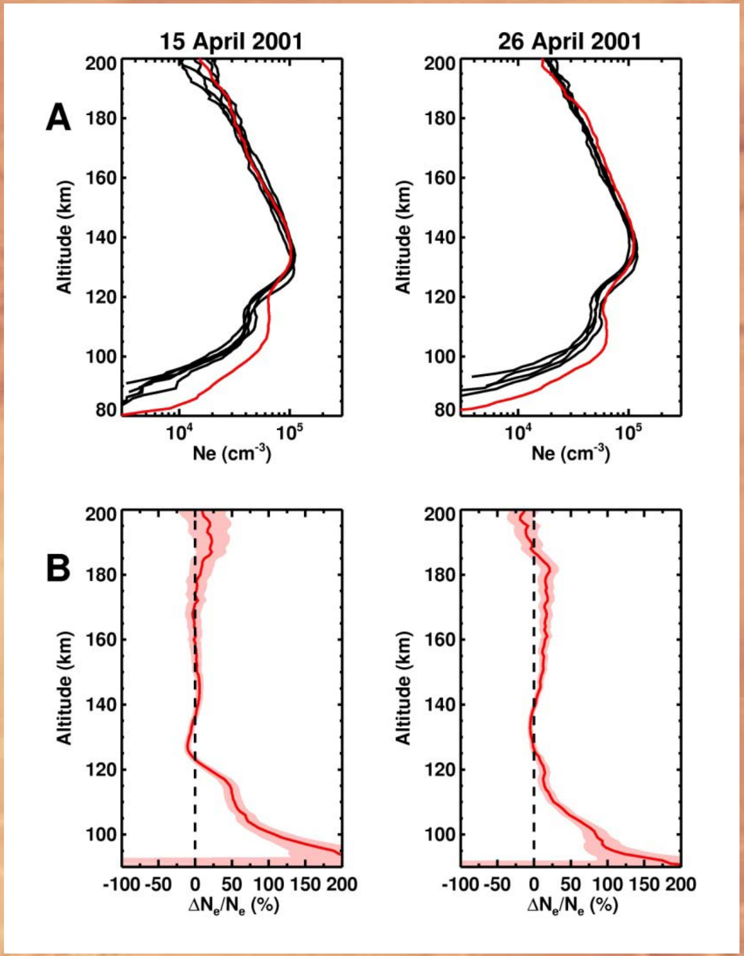
Field strength, local field direction, and topology (connection with solar wind) vary over short distances, which creates complexity.



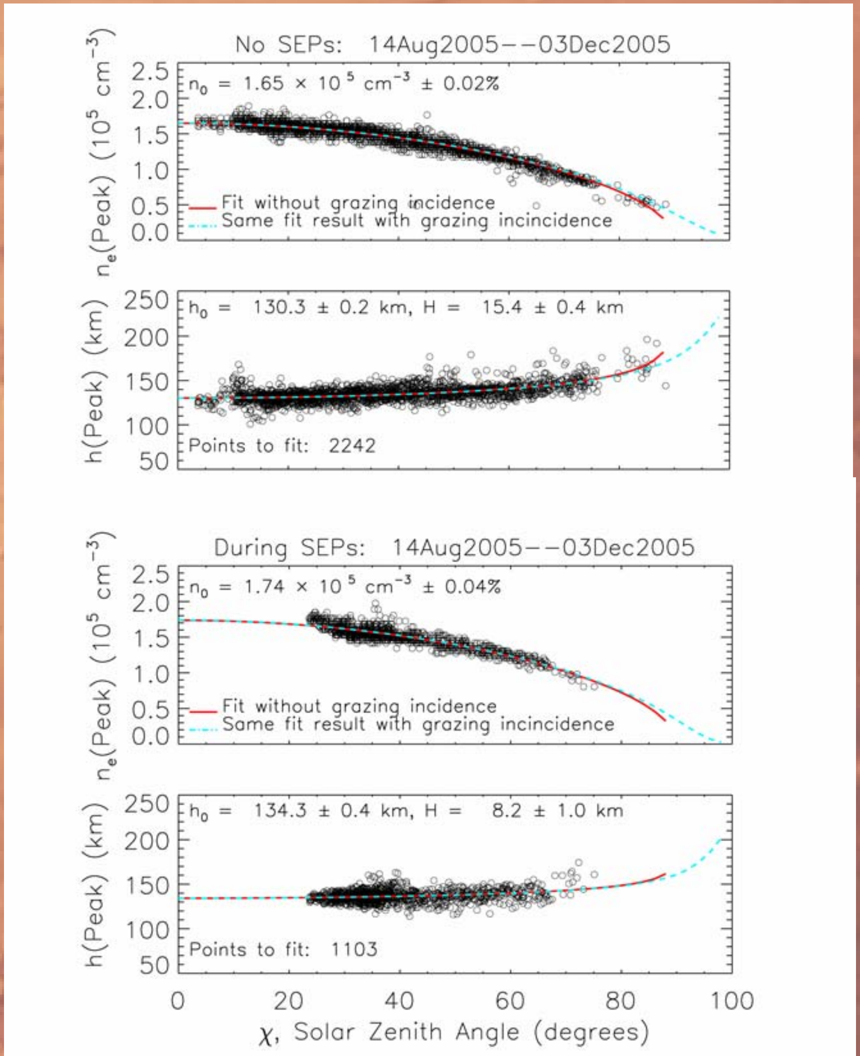
Hall (red) and Pedersen (green) conductivities change between strong field regions (dashed lines) and weak field regions (solid lines)

Variable ionospheric conductivity leads to variable ionospheric currents and field aligned currents.

Focus – Solar variations



Ionospheric profiles shortly after a solar flare show enhanced electron densities below 120 km



Ionospheric properties change during solar energetic particle (SEP) events

For more information

- This is an open network, other participants are welcome
- Please contact Hermann Opgenoorth (opg@irfu.se) or Olivier Witasse (owitasse@rssd.esa.int)