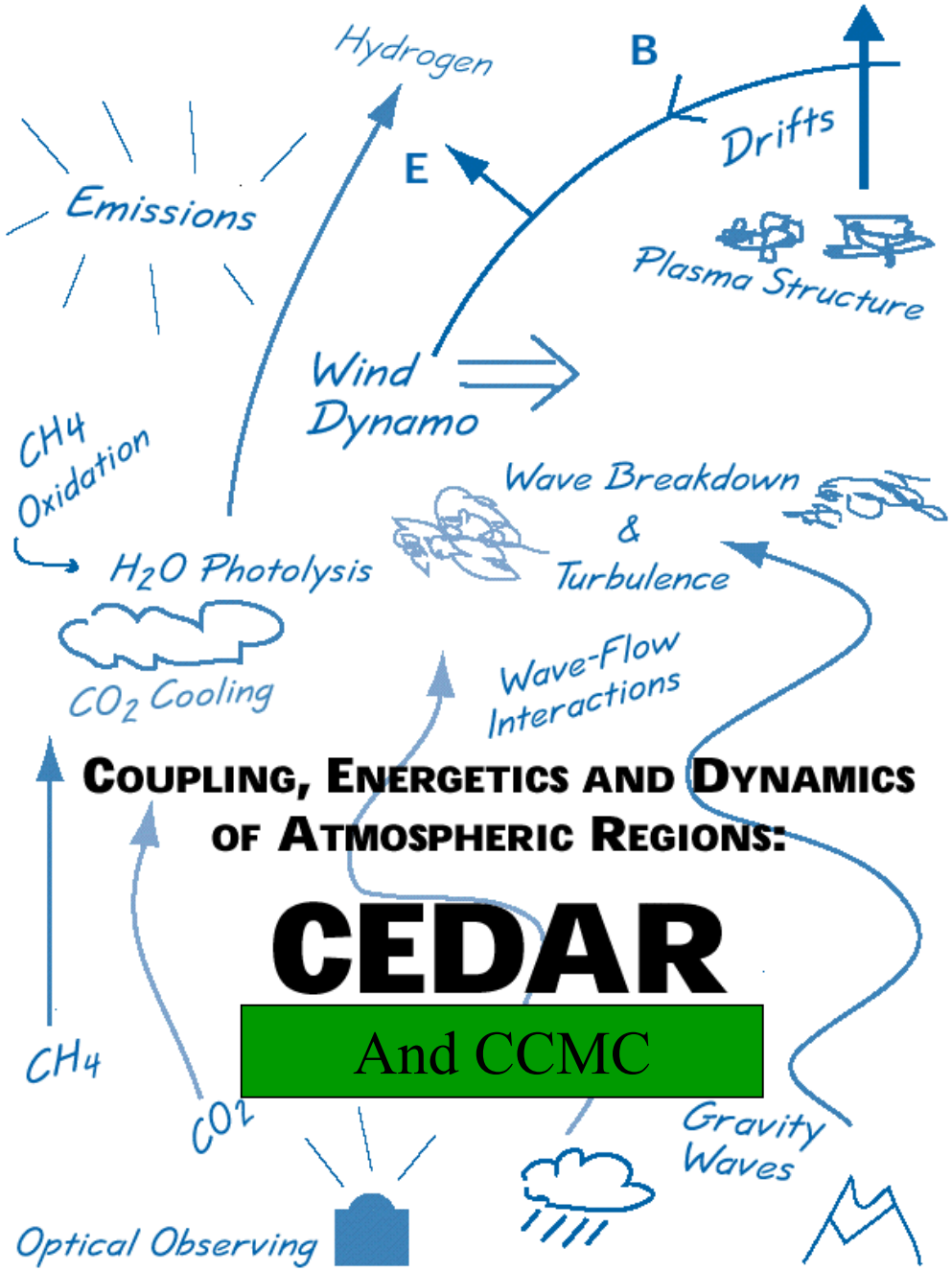
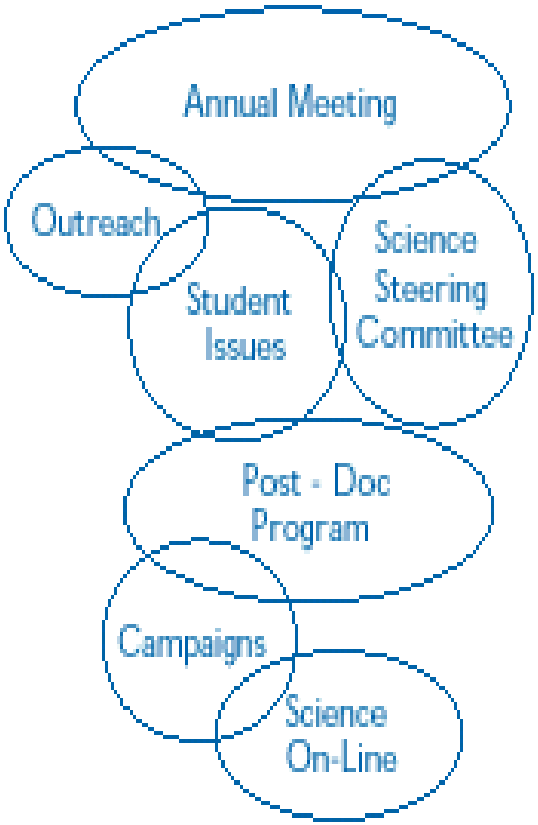
# CEDAR PROGRAM

View on CCMC


Hydrogen
B
E
Drifts
Emissions
Plasma Structure
Wind
Dynamo
CH4
Oxidation
Wave Breakdown
&
Turbulence
H2O Photolysis
CO2 Cooling
Wave-Flow
Interactions
COUPLING, ENERGETICS AND DYNAMICS
OF ATMOSPHERIC REGIONS:
CEDAR
And CCMC
CH4
CO2
Gravity
Waves
Optical Observing


Annual Meeting
Outreach
Student
Issues
Science
Steering
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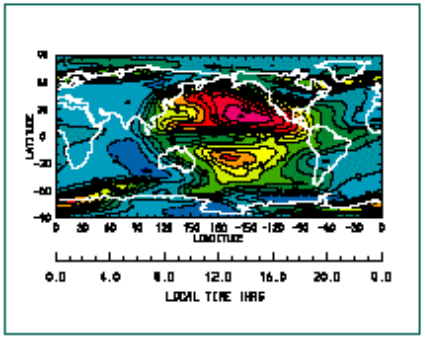
Program
Campaigns
Science
On-Line

# Four Pronged Program

- Coupling with lower altitudes
  - Study of tidal, gravity and planetary waves
- Solar Terrestrial Interactions
  - Understand the response of the global ITM system to solar variations and disturbances over a multitude of time scales
- Polar Aeronomy
  - Understand the fundamental processes that govern the polar atmosphere
- Long term variations
  - Identify secular atmospheric variations which can be interpreted through atmospheric models.

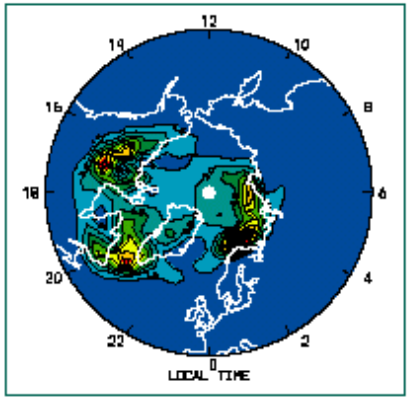
# An Aeronomic Community Model: The NCAR Thermosphere-Ionosphere-Mesosphere Electrodynamics General Circulation Model (TIME-GCM)

## Solar-Terrestrial Interactions



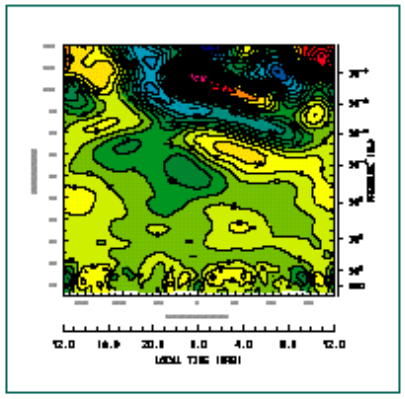

Modeled difference in total electron content (TEC) with respect to quiet-day background at the peak of the substorm on 18 October 1995, illustrating enhancements in the equatorial Appleton anomaly and in the high-latitude auroral regions.

## Polar Aeronomy



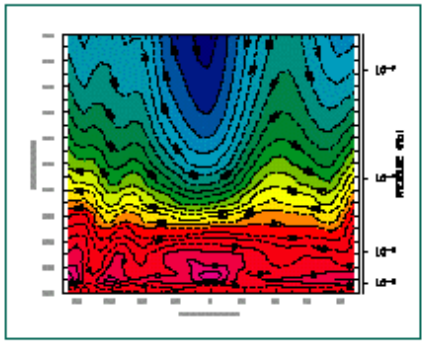

Model Joule heating rate (mW/m$^2$) at the peak of the substorm on 18 October 1995. The heating rates are derived through assimilation of various ground-based and satellite data.

## Coupling With Lower Altitudes




Modeled neutral meridional wind (m/s) at 17.5 °N. In this simulation the TIME-GCM is flux-coupled to the NCAR Community Climate Model (CCM3) near 30 km altitude, thus introducing lower atmospheric variability into the upper atmospheric system.

## Long-Term Variations



Modeled difference in temperature resulting from a doubling of global $CO_2$ concentrations. Note the 5–10 K warming below 130 km and the 30–80 K cooling above about 160 km. This is one demonstration of the model's capabilities to explore the effects of anthropogenic change on the Earth's upper atmosphere.

# Magnetosphere – Ionosphere Coupling

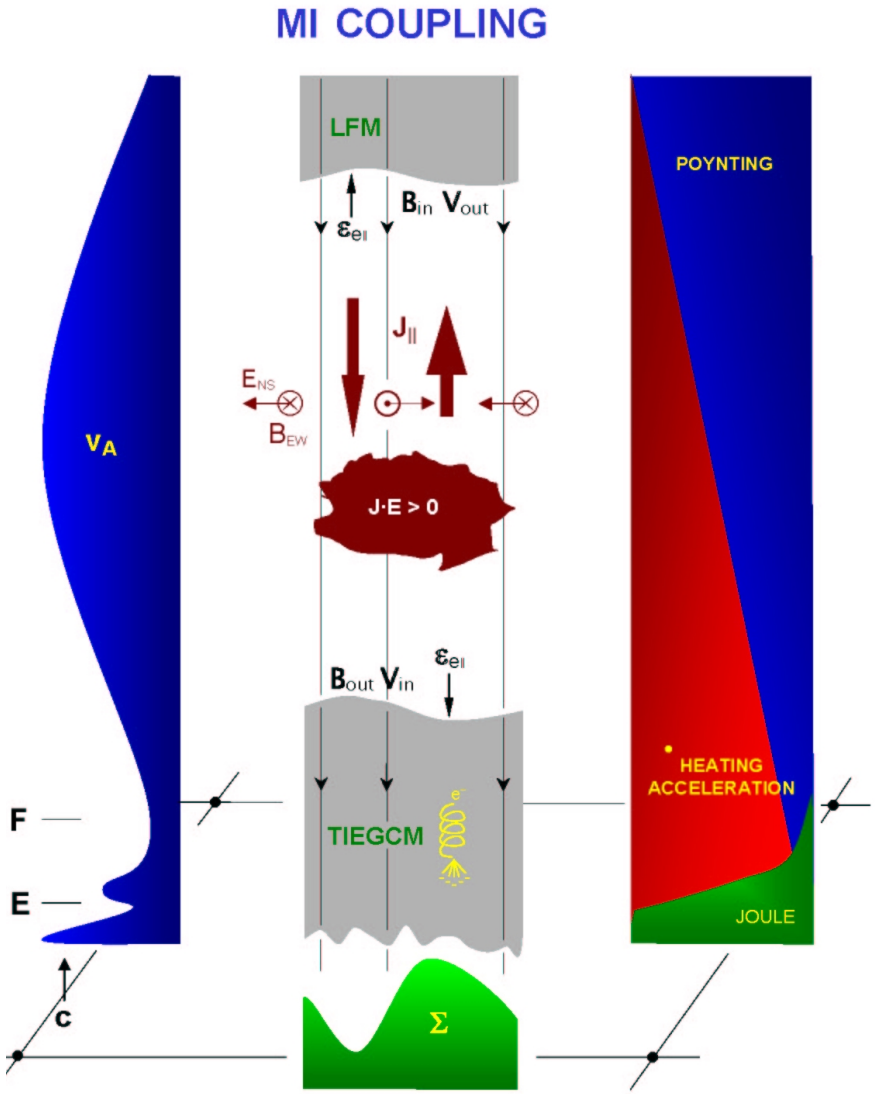
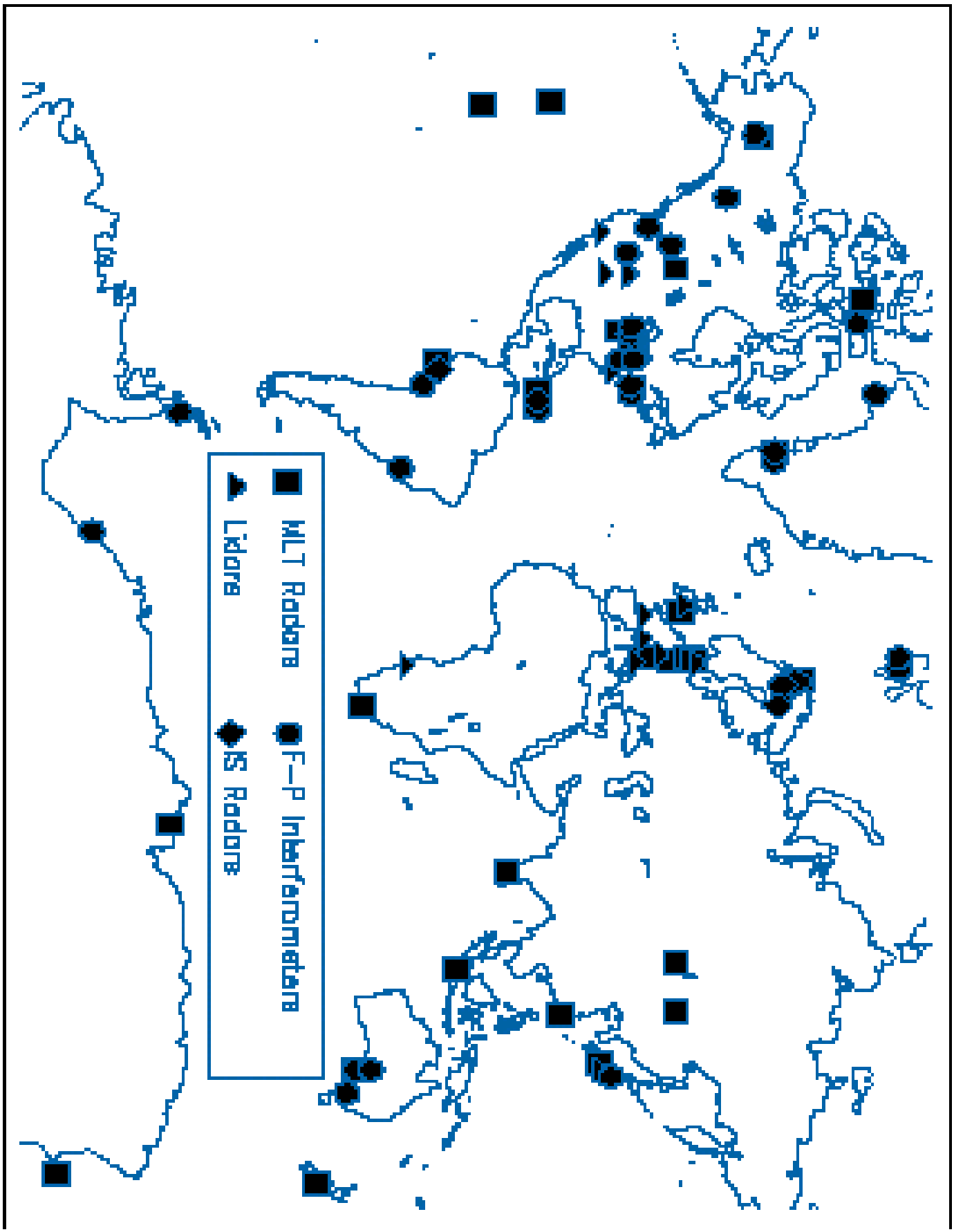


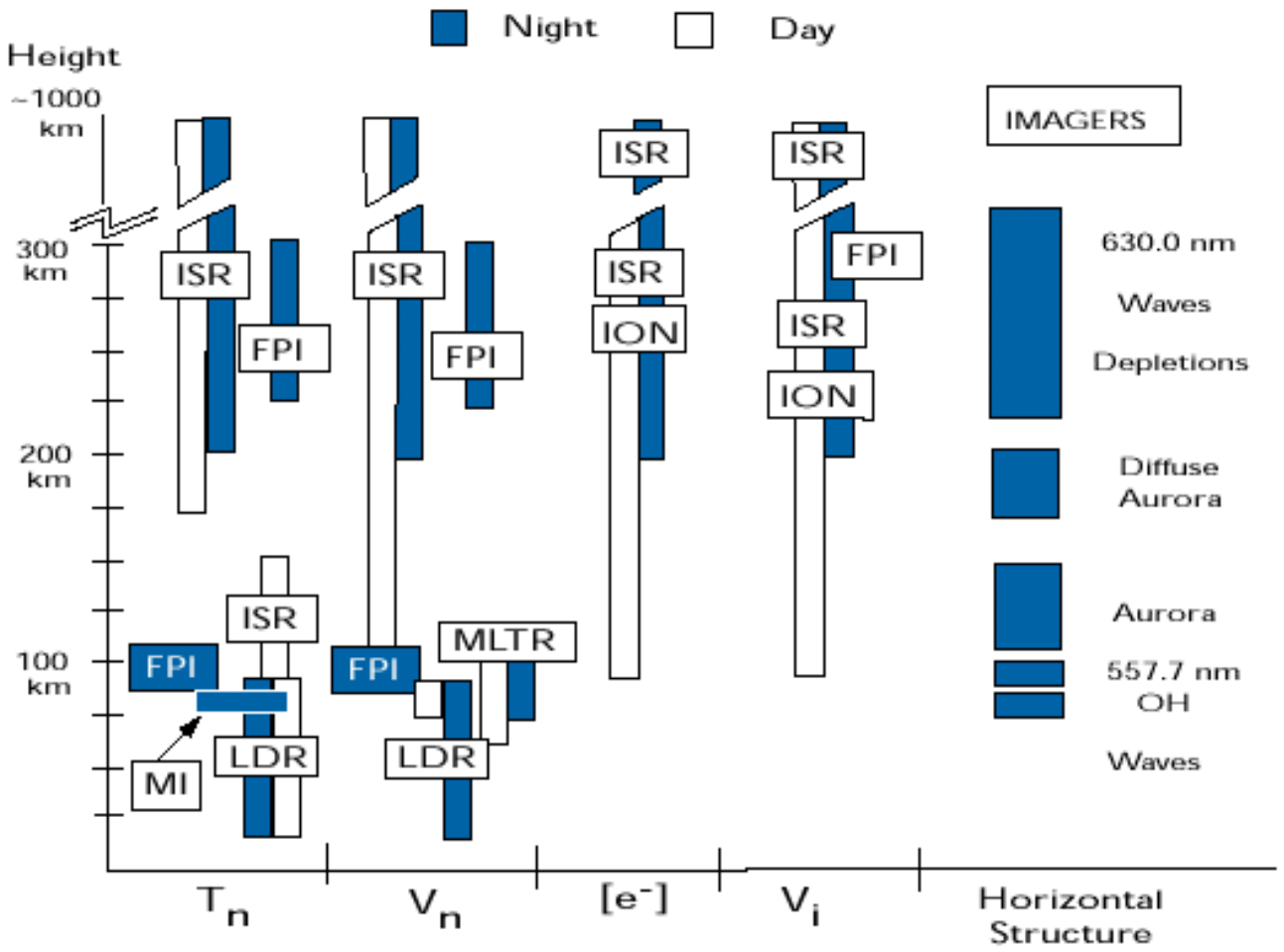

Figure by Bill Lotko


MLT Radars
F–P Interferometers
Lidars
IS Radars

# Instruments at UAF/CEDAR Facilities

| Site | Radar: IS / MLT | Lidar | Ionosonde | Imager | Spectrometer | FPI | Magnetometer |
|---|---|---|---|---|---|---|---|
| EPCO | ✗ | | ✗ | ✗ | VIS IR | ✗ (6300 Å) | ✗ |
| Sondrestrom | ✗ | ✗ (Rayleigh)<br>✗ (Na Resonance) | ✗ | ✗ | UV VIS IR | ✗ (6300 Å) | ✗ |
| Millstone Hill | ✗ ✗ (Durham) | | ✗ | ✗ | | ✗ (6300 Å)<br>✗ (6300 Å for all-sky)<br>✗ (6300 Å for dayglow, other)<br>✗ (5577 Å) | |
| Arecibo | ✗ ✗ (Aguadilla) | ✗ (Rayleigh)<br>✗ (Na & K Resonance) | ✗ | | VIS | ✗ (6300 Å)<br>✗ (6563 Å, or other) | |
| Jicamarca | ✗ ✗ | | ✗ | ✗ (Arequipa) | | ✗ (6300 Å) (Arequipa) | ✗ (Huancayo) |

# Selected Ground-Based Measurement Capabilities




FPI Fabry-Perot Interferometer

ION Ionosonde

ISR Incoherent Scatter Radar

MI Michelson Interferometer

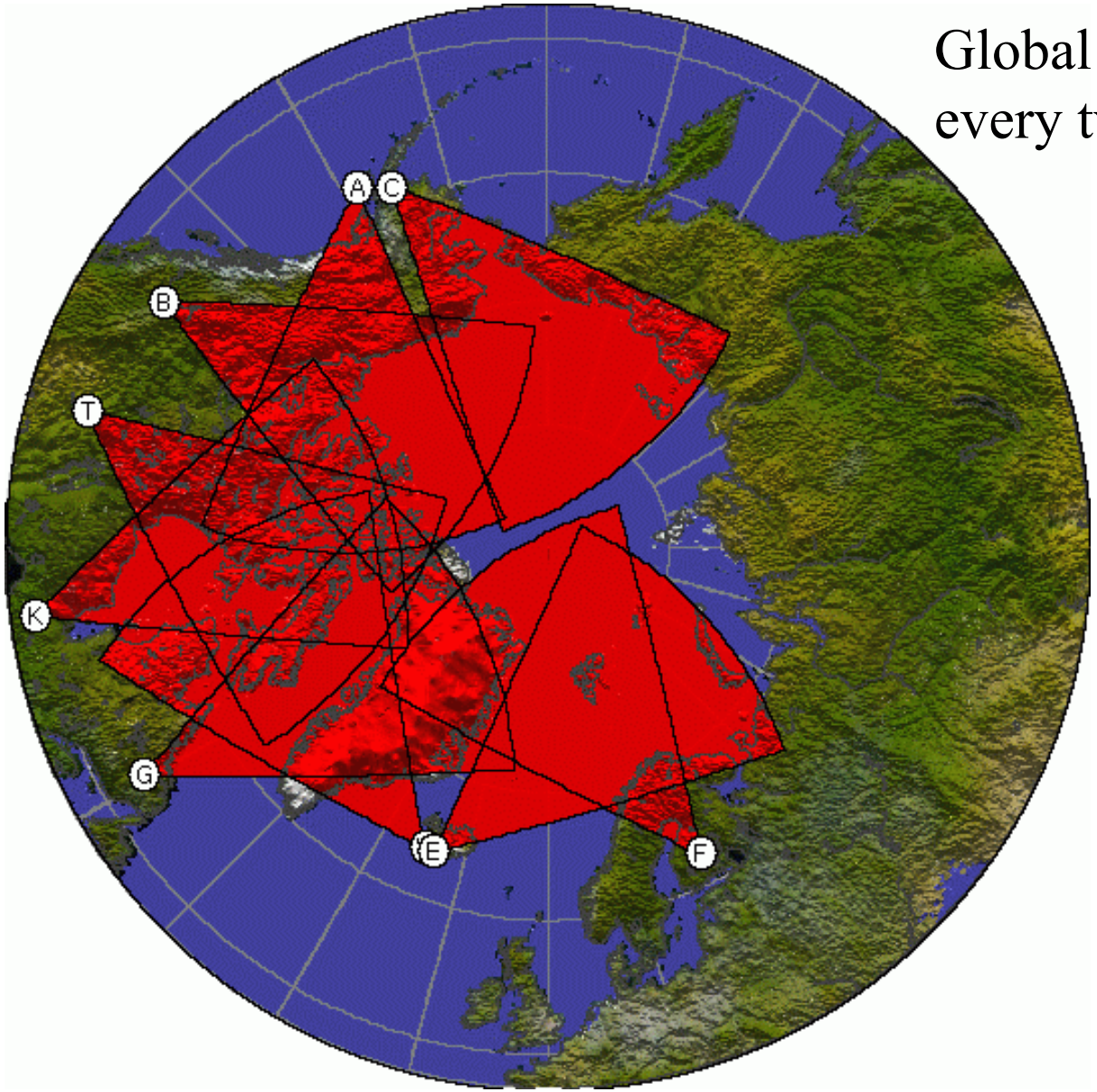
LDR Lidars (Rayleigh, Sodium)

MLTR Mesosphere/Lower Thermosphere Radars (MF, Meteor, MST)

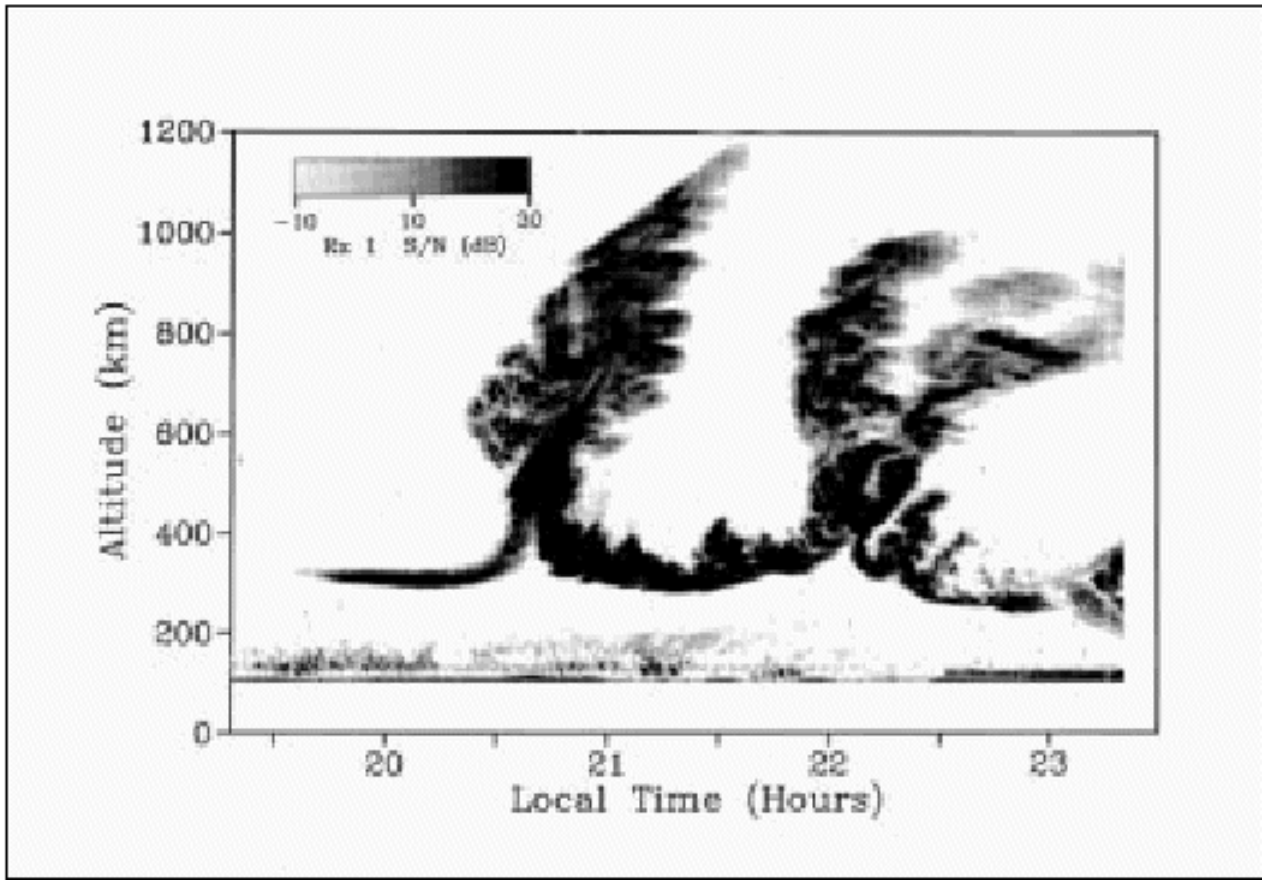
Sondrestrom Class I Facility.

# SuperDARN (North)

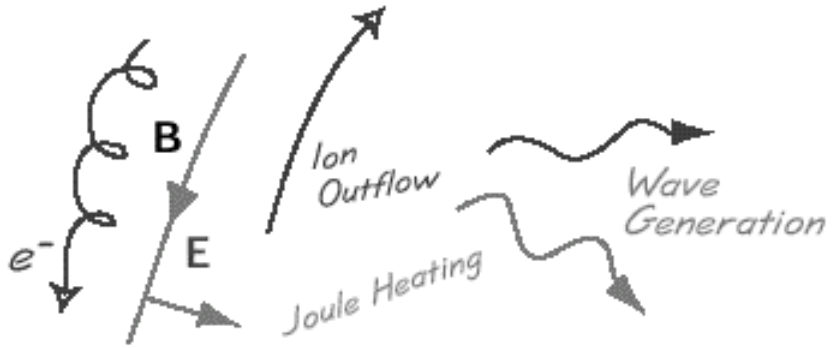
Global convection estimates every two minutes.



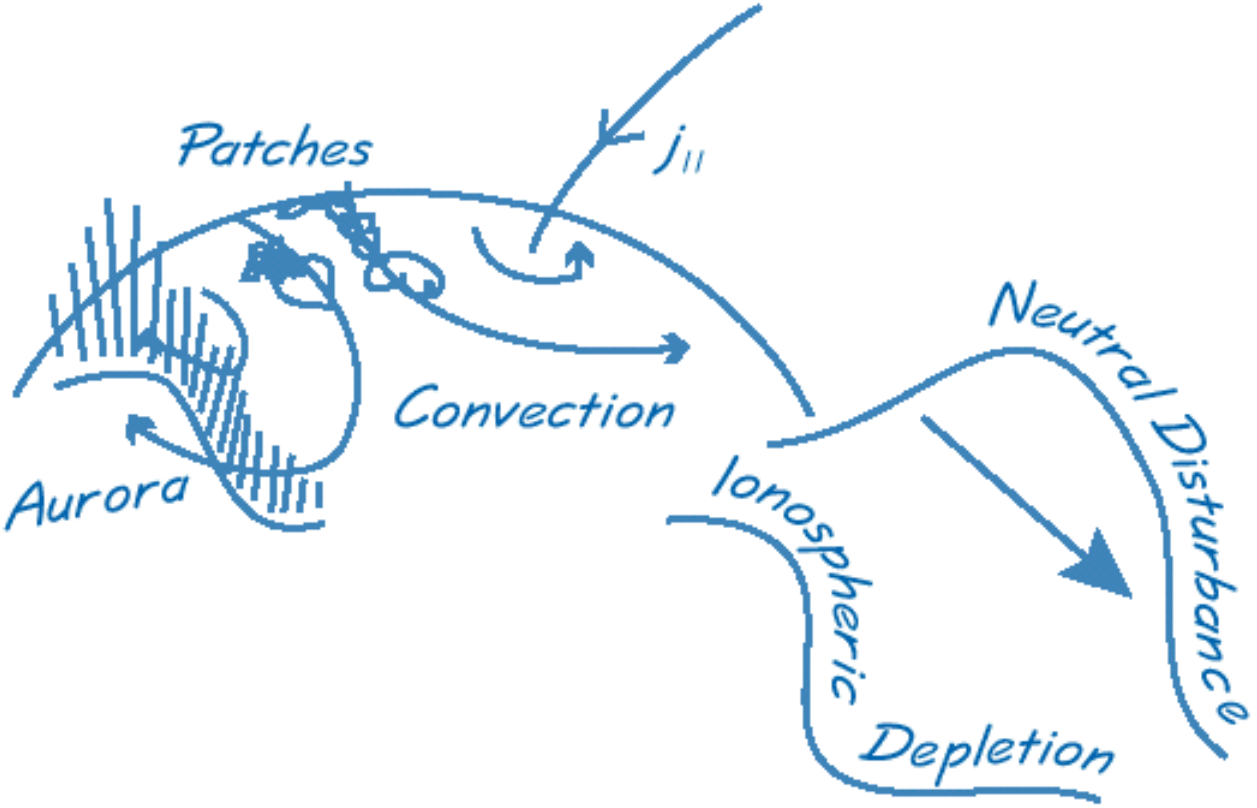
# Equatorial Phenomena



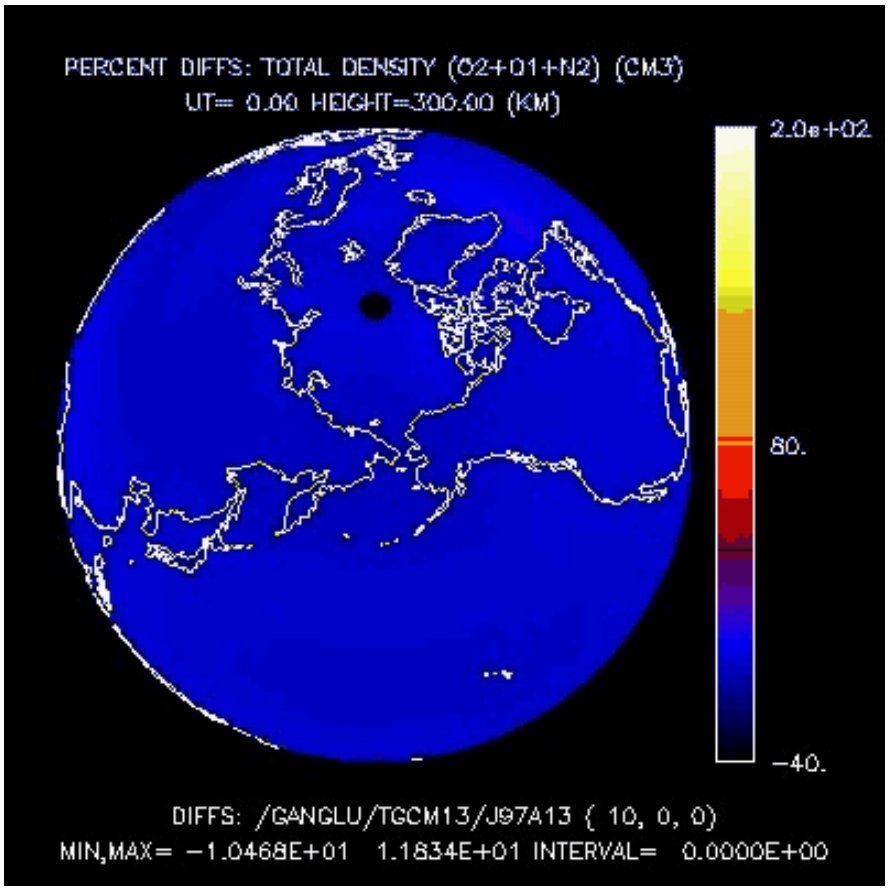
# Field-Aligned Phenomena



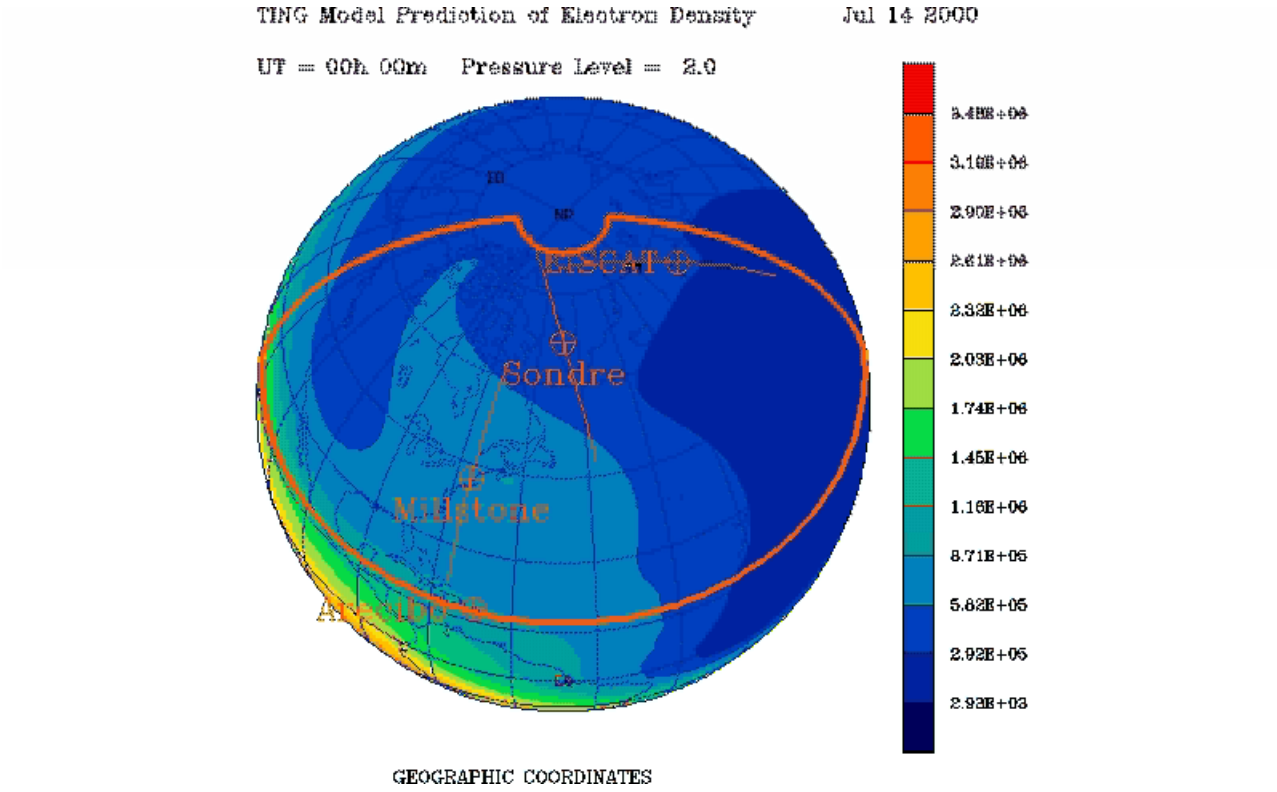
# High Latitude Ionosphere



# Pressure waves



# TING Model Applicaions



# Summary

- CEDAR has strong modeling interests which are relevant to CCMC.
- CEDAR has an extensive ground-based observational program with data relevant to CCMC validations and metric computation.
- Magnetosphere-Ionosphere coupling is a major emphasis within the CEDAR program and also very important to CCMC.