



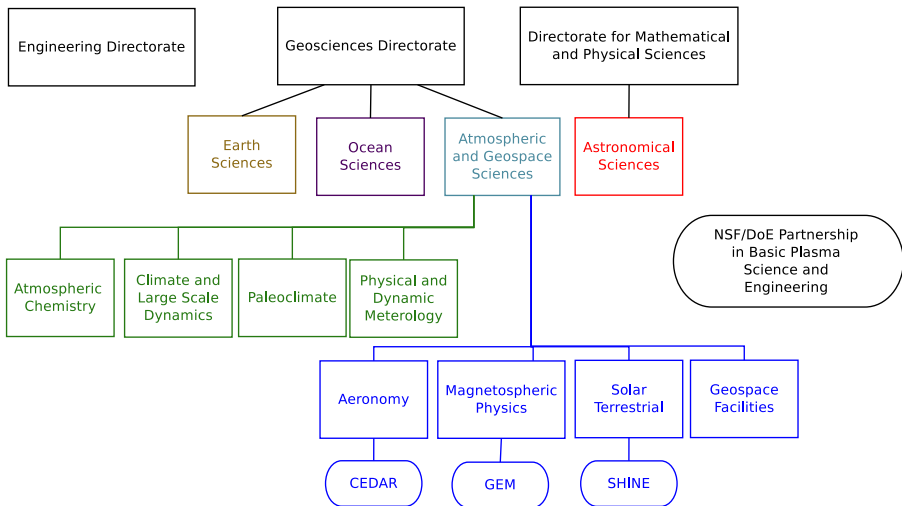
# Coupling, Energetics, and Dynamics of Atmospheric Regions

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# Location of CEDAR and Related Programs in the NSF



# Goals and Activities of the CEDAR Program

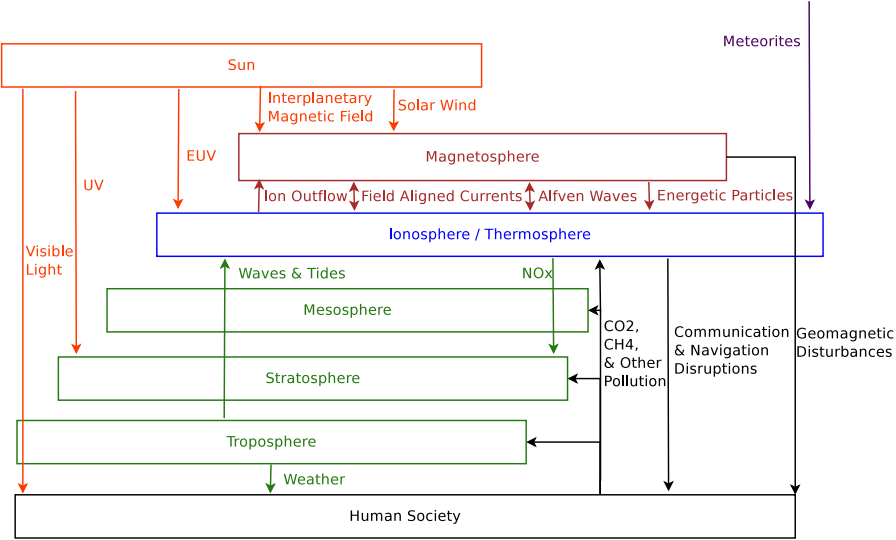
## Goals:

- ▶ Understand the dynamics, chemistry, energetics, and coupling of atmospheric regions from the middle atmosphere upwards through the thermosphere and ionosphere into the exosphere
- ▶ Understand how these regions are impacted by disturbances propagating up from the lower atmosphere, energetic particle inputs from the magnetosphere, and radiation from the sun
- ▶ Develop and improve observational and modeling techniques relevant to these regions
- ▶ Encourage collaboration and cooperation between upper atmospheric scientists

## Activities:

- ▶ Awards grants to individual researchers each year
- ▶ Appoints a science steering committee to guide the aeronomy community
- ▶ Hosts an annual workshop each summer

# Coupling and Complexity in the Geospace System

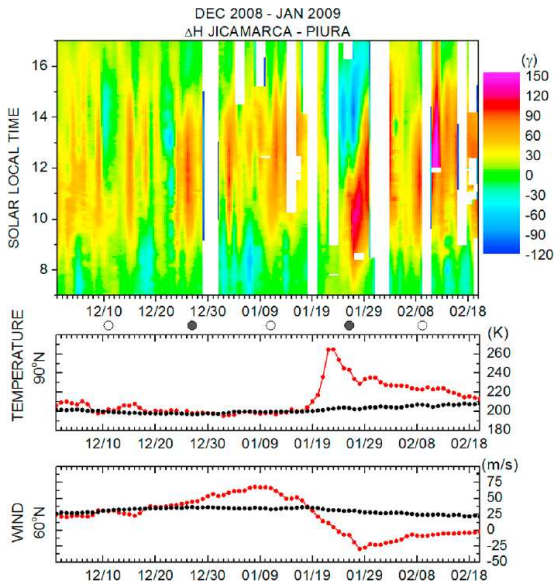


# Coupling to the Magnetosphere: Aurora



Sondreström Research Facility. Photo Credit: Craig Heinselmann

# Coupling to the Lower Atmosphere: Sudden Stratospheric Warming



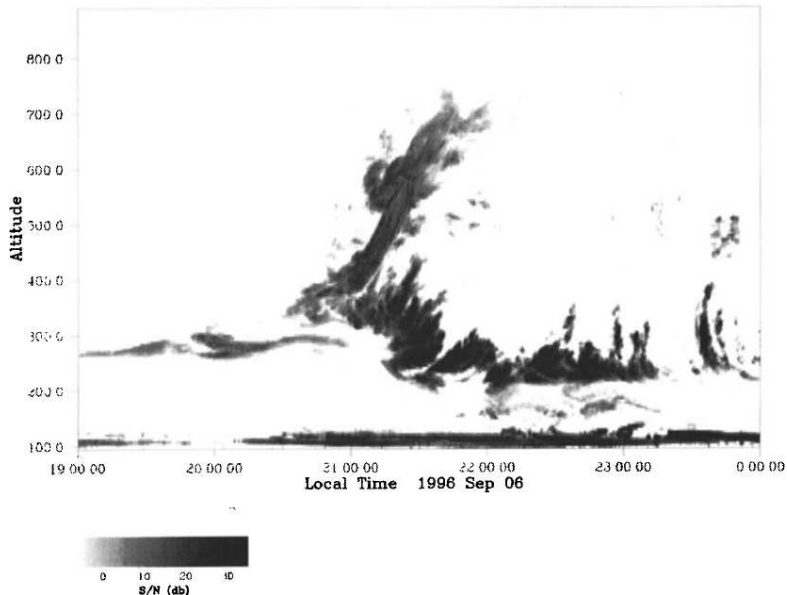
[Fejer et al.  
(2010). *J. Geophys. Res.*  
**115** A00G03.]

# Coupling to Human Activity: Noctilucent Clouds



Photo Credit: M. J. Taylor and C. D. Burton

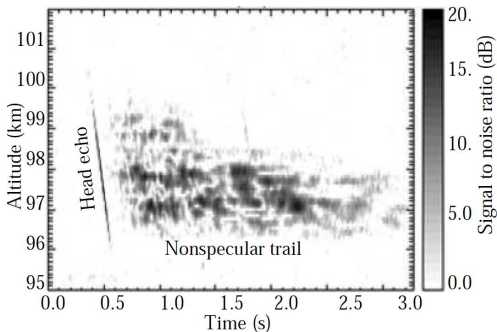
## Plasma Physics: Equatorial Spread F



[Hysell and Burcham (1998). *J. Geophys. Res.* **103** 29,155.]

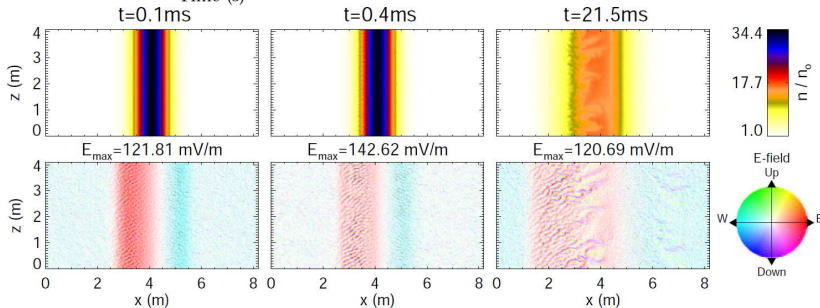


# Plasma Physics: Meteor Trails

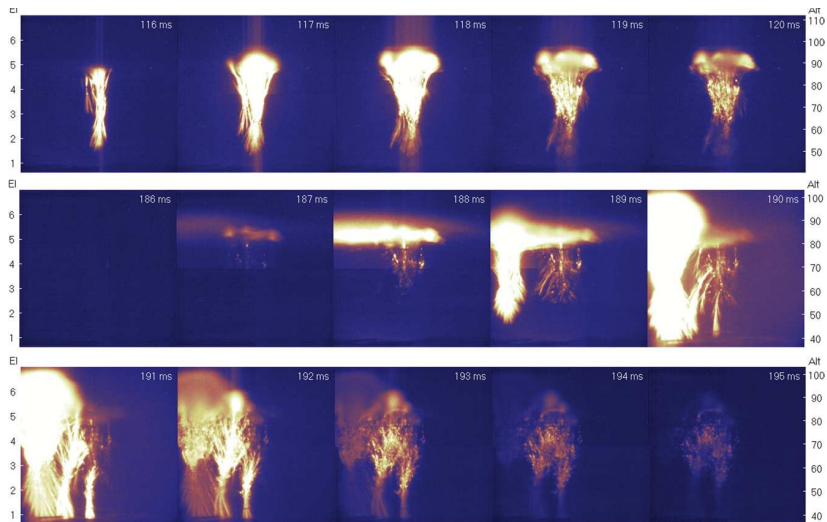


Left:[Dimant and Oppenheim (2006). *J. Geophys. Res.* **111** A12312.]

Bottom:[Oppenheim, Dyruud and vom Endt (2003). *J. Geophys. Res.* **108** 1064.]



# Plasma Physics: Upper Atmospheric Lightning



[Stenbaek-Nielsen and McHarg (2008). *J. Phys. D* **41** 234,009.]

# Engineering: Radars Big and Small



Arecibo Observatory. Photo Credit: Craig Heinselman

# Engineering: Radars Big and Small



St. Croix imaging radar interferometer. Photo Credit: Eliana Nossa

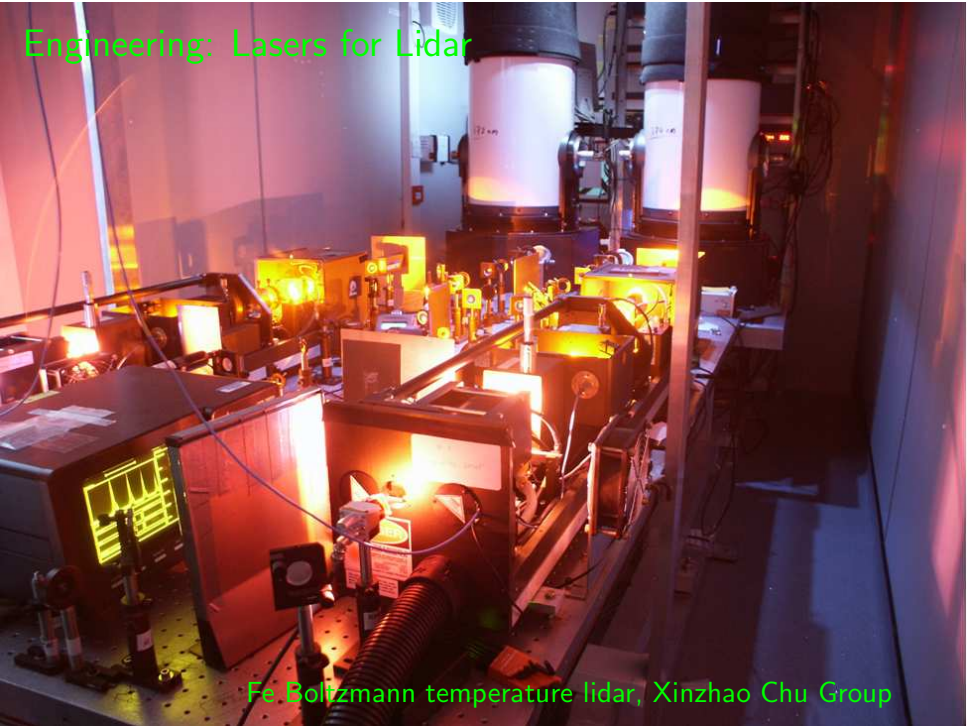
# Engineering: Radars Big and Small



Movie Courtesy of David Hysell



# Engineering: Lasers for Lidar



Fe Boltzmann temperature lidar, Xinzhao Chu Group

# Engineering: GPS Receivers

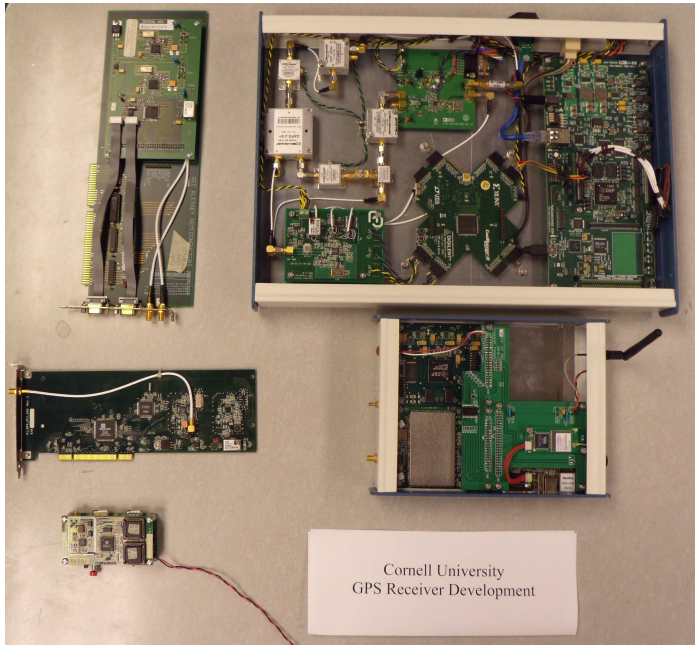
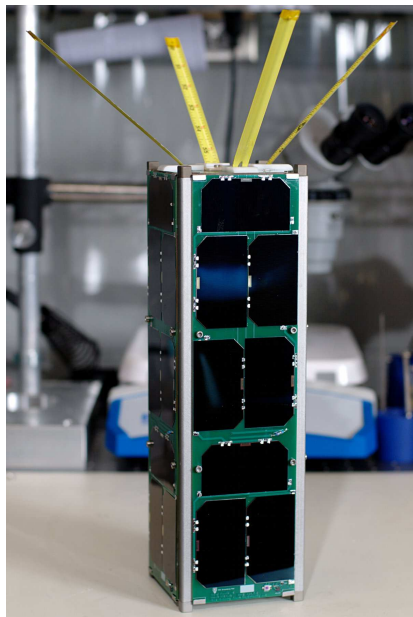


Photo  
courtesy  
of Brady  
O'Hanlon

## Engineering: CubeSats



Radio Aurora eXplorer. Photo Credits: Tanner Beck



# Strategic Thrusts in the New Strategic Plan

1. Encourage and Undertake a Systems Perspective of Geospace
2. Explore Exchange Processes at Boundaries and Transitions in Geospace
3. Explore Processes Related to Geospace Evolution
4. Develop Observational and Instrumentation Strategies for Geospace Systems Studies
5. Fuse Knowledge Base Across Disciplines
6. Manage, Mine and Manipulate Geoscience Data and Models