IS Coordinated Science at High Latitudes

by
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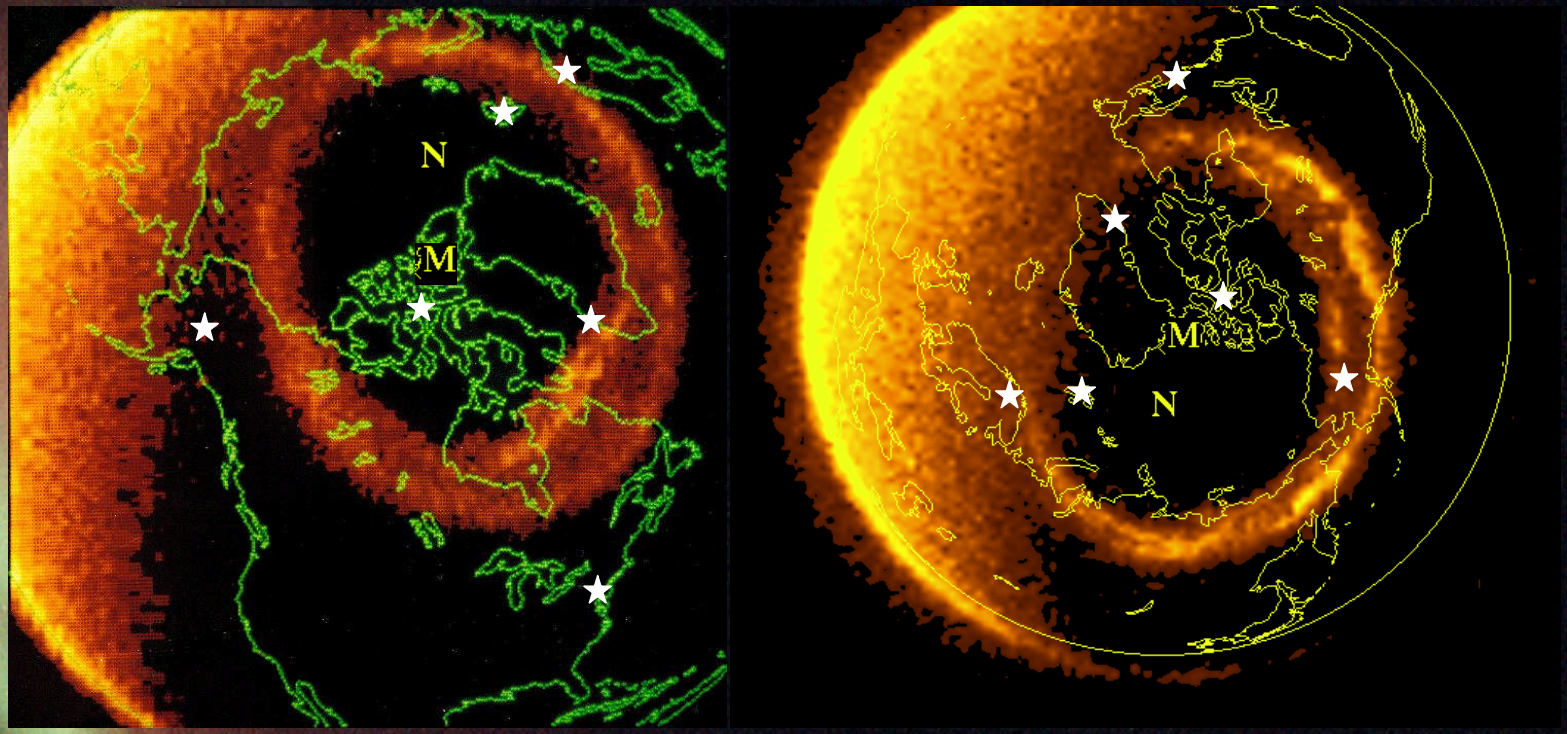
Thanks to:
Rick Doe
Josh Semeter
Craig Heinselman
Eric Donovan
Tony van Eyken

A Broad Perspective from a Narrow View

Background photos by Craig Heinselman

The Broad Perspective



2 UT ★IS Radars 14 UT

The Narrow View

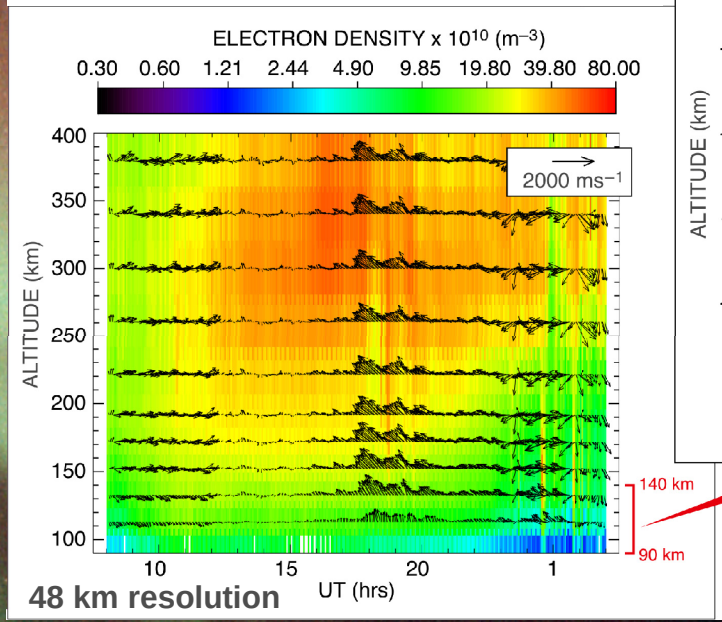
Sondrestrom Radar
Antenna Diameter: 32 meters
Beam width: 0.6 degrees
E-region spot size: 1 km

IS Radar Measurements

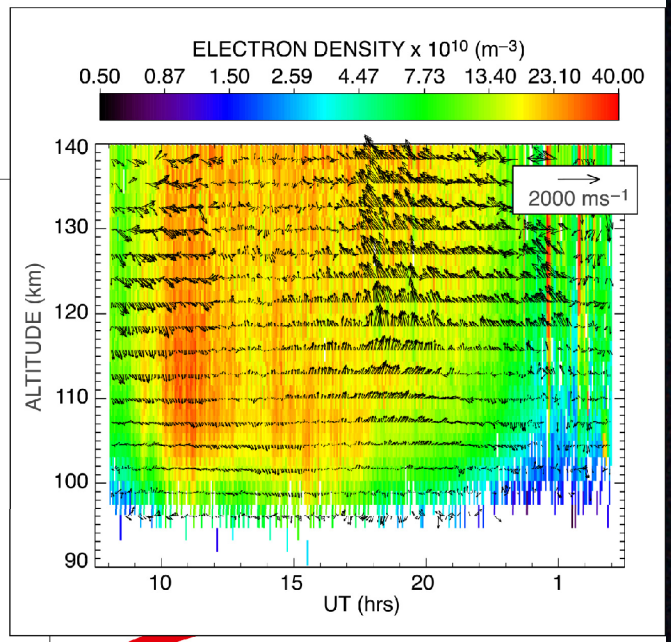
Most Comprehensive Measurement of the Earth's Ionosphere

Observables: Ne, Te, Ti, Vi, (mi, νin) per LOS

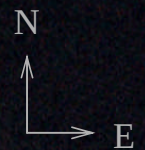
Derivables: σp, σh, Σp, Σh, E, J, Un, qj, Qj, qp, Qp, Φ, E0



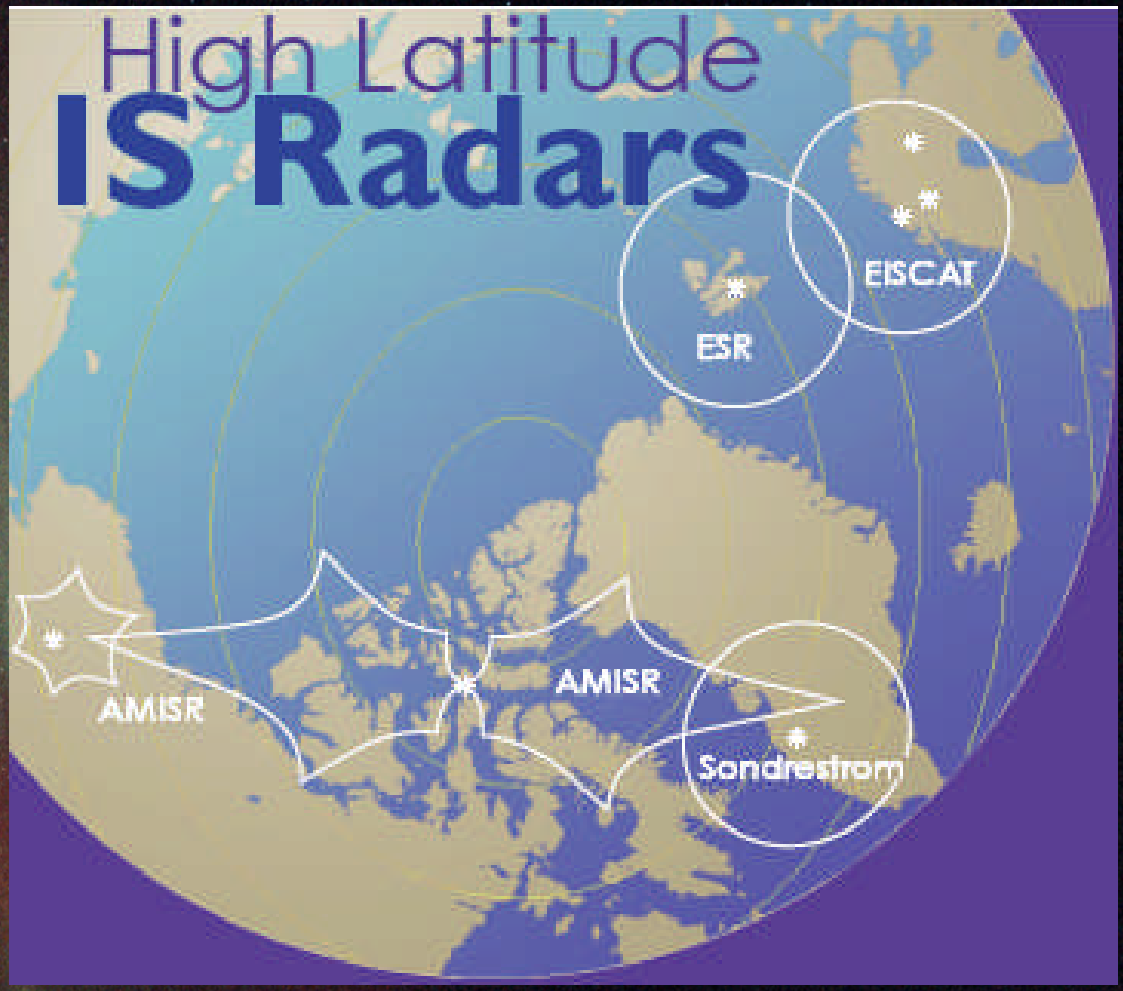
48 km resolution



3 km resolution



IS Radar Coverage



IS Radar: High Latitude Science

- **Geoeffectiveness of storms and substorms**
  - Polar cap absorption events
  - Magnetic clouds
- **Magnetosphere-Ionosphere coupling**
  - Ion Outflow
  - Field-aligned currents
- **Ionosphere-thermosphere coupling**
  - Ion and neutral momentum transfer
  - Ion and neutral chemistry
- **Electrodynamics and Energetics**
  - Current closure
  - Joule and particle heating
- **Plasma structures and forms**
  - Auroral physics
  - Sporadic E layers
- **Mesosphere / Lower Thermosphere Phenomena**
  - Polar Mesospheric Summer Echoes
  - Sporadic sodium layers

IS Radar: Coordinated Science

1. With Collocated Instruments
2. With Spacecraft
3. With Distributed Instruments
4. With Proxy Relationships

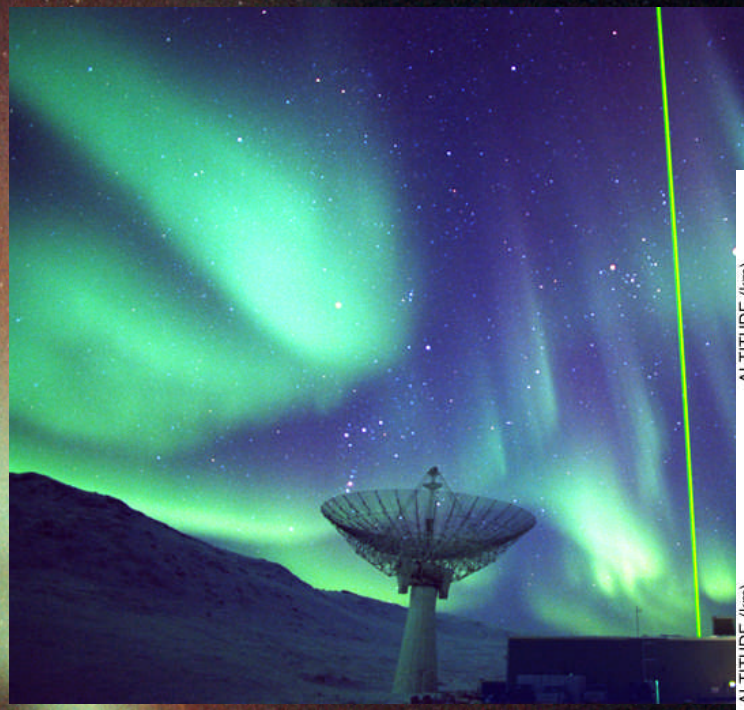
General Issues to Consider:

•Spatial / Temporal Sampling of Instruments

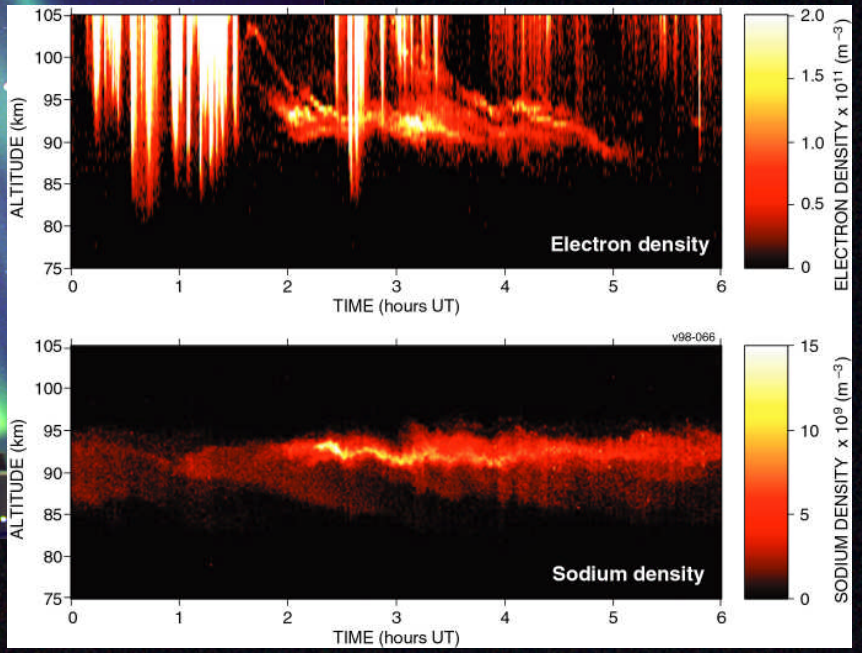
•Spatial / Temporal Scales of the geophysical feature

IS Radar w/ Collocated Instruments

IS Radar and Sodium Lidar

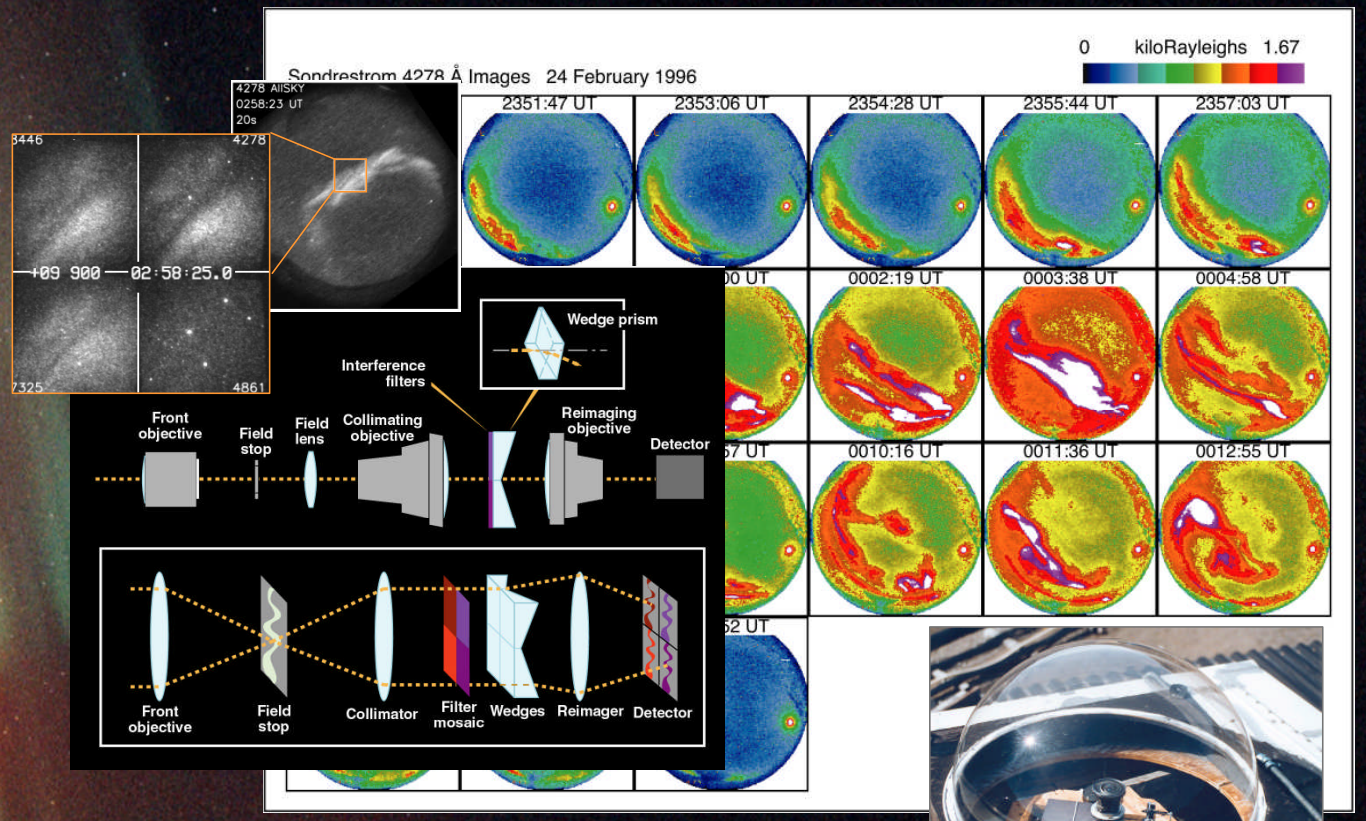


Investigation of sporadic sodium layers at auroral latitudes



IS Radar w/ Collocated Instruments

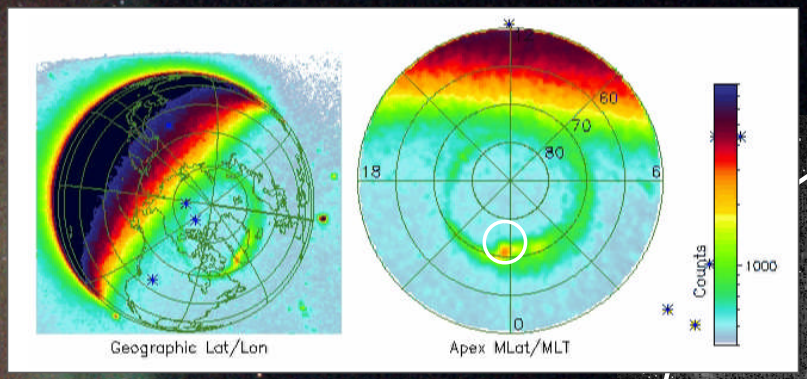
Allsky Imager (Rick Doe)



Multispectral Imager (Josh Semeter)

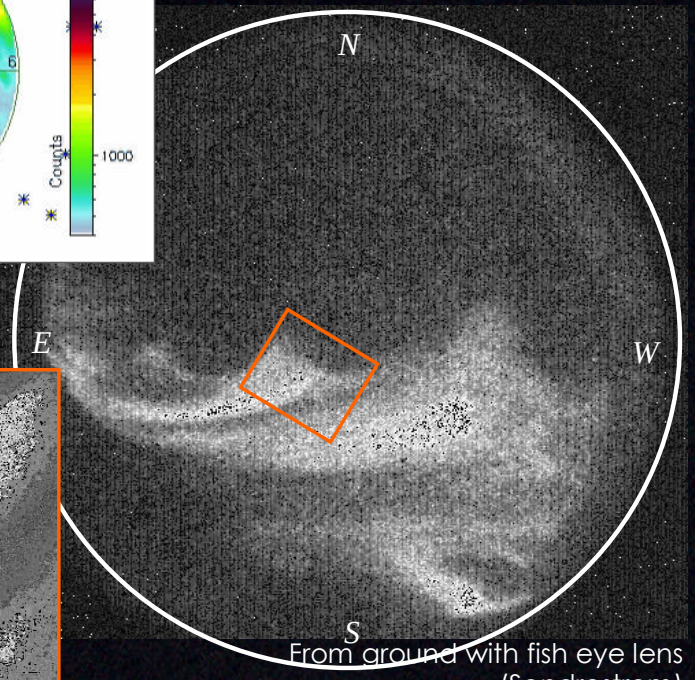
IS Radar w/ Collocated Instruments

Four different perspectives of the aurora



From space (IMAGE satellite)

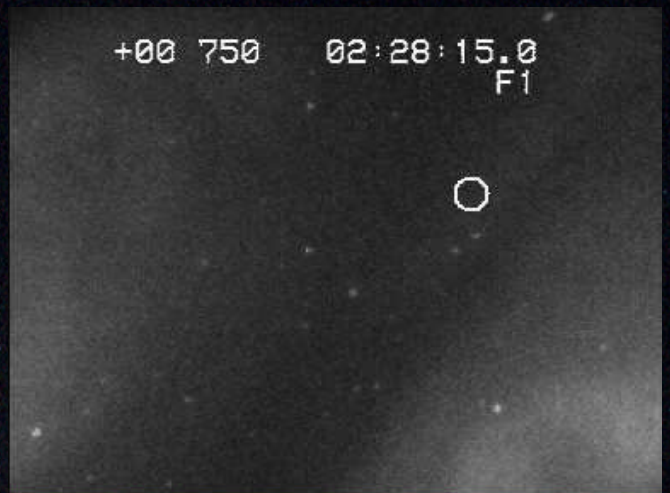
From ground with narrow field lens



From ground with fish eye lens (Sondrestrom)

Radar and Optical Aurora

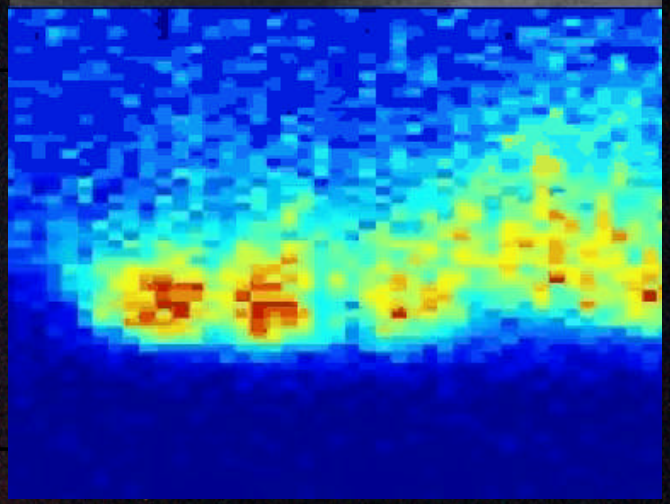
Narrow-field camera, 25 frames/sec >640 nm



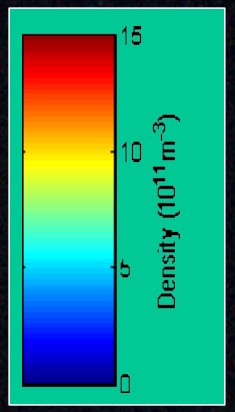
21 km

150 km

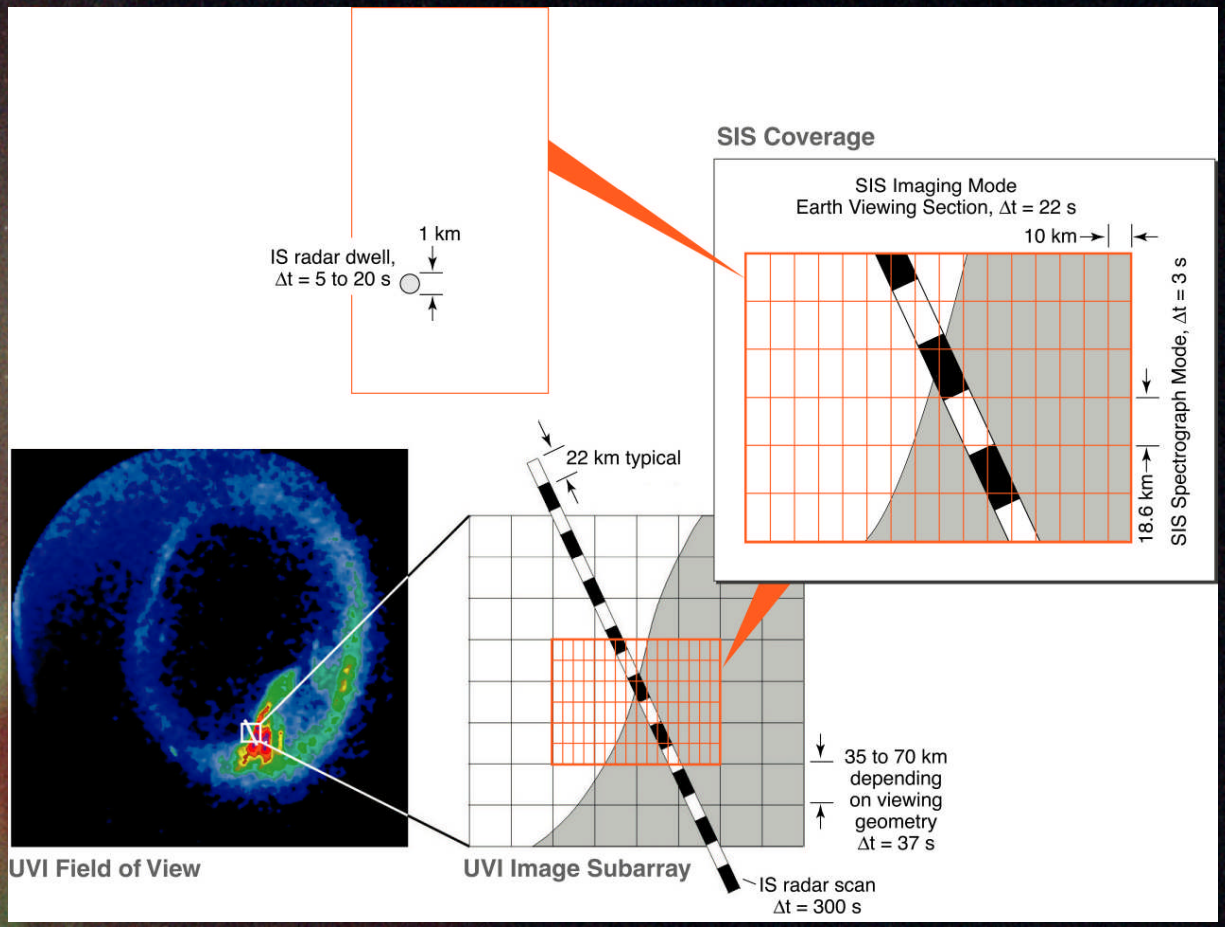
Sondrestrom IS radar electron density 1km X 1.2 sec resolution



80 km

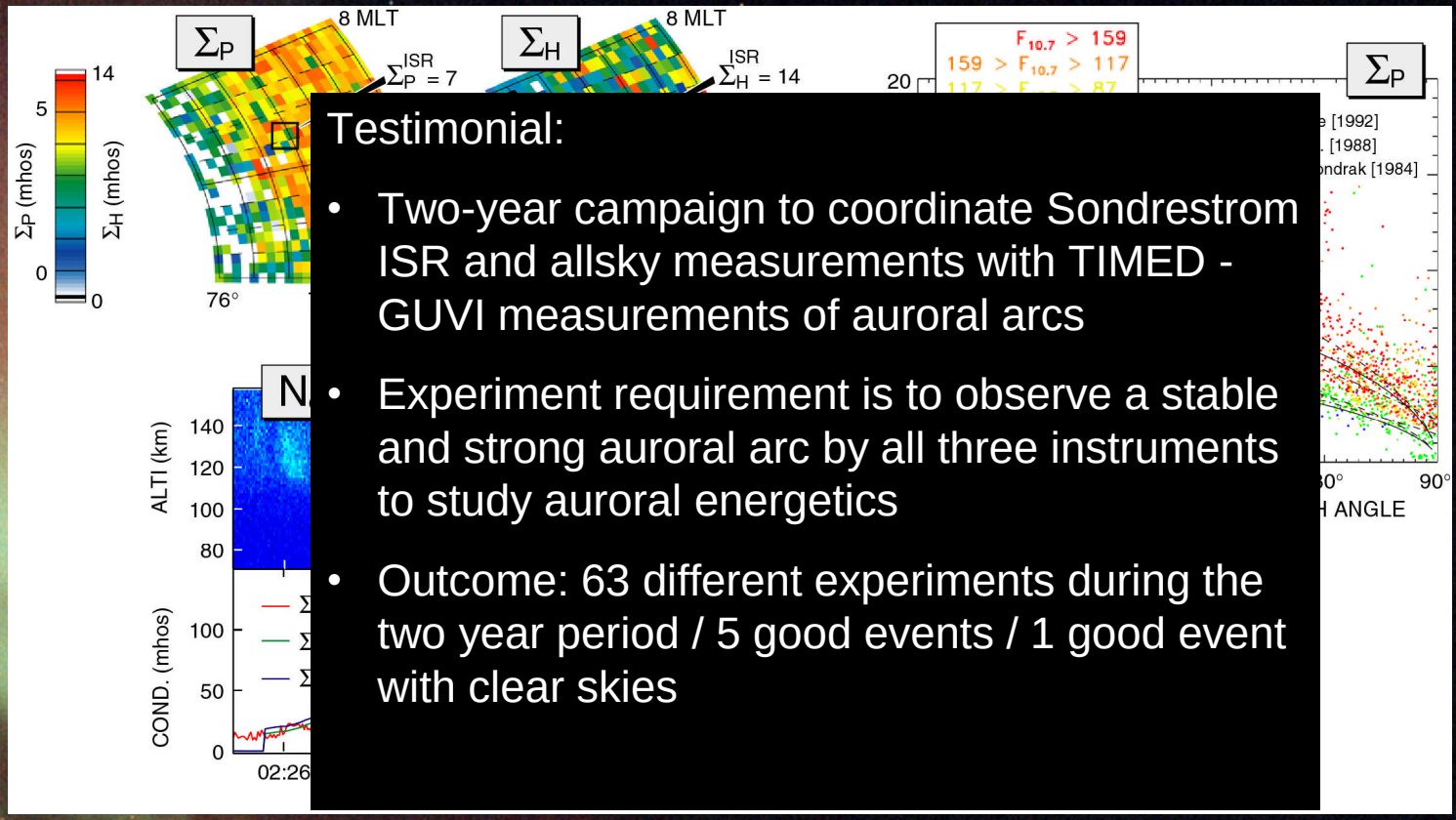


IS Radar w/ Spacecraft



IS Radar w/ Spacecraft

Ionospheric conductance study

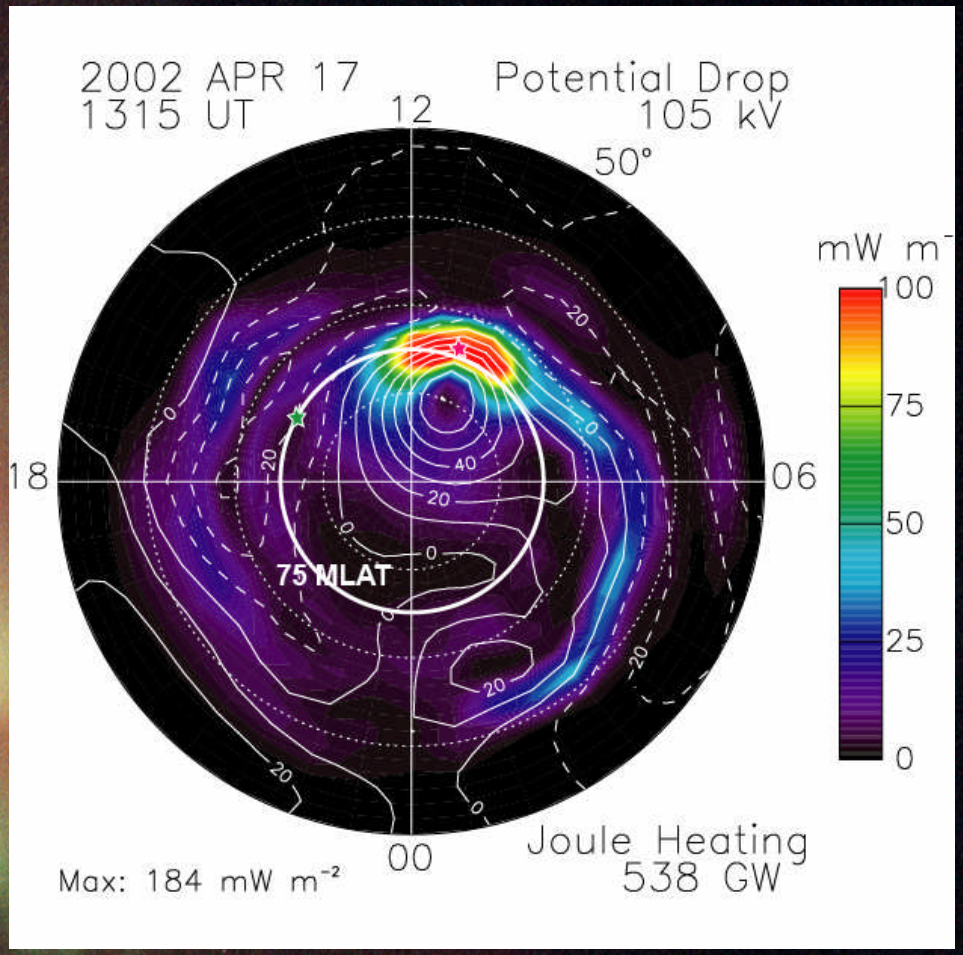


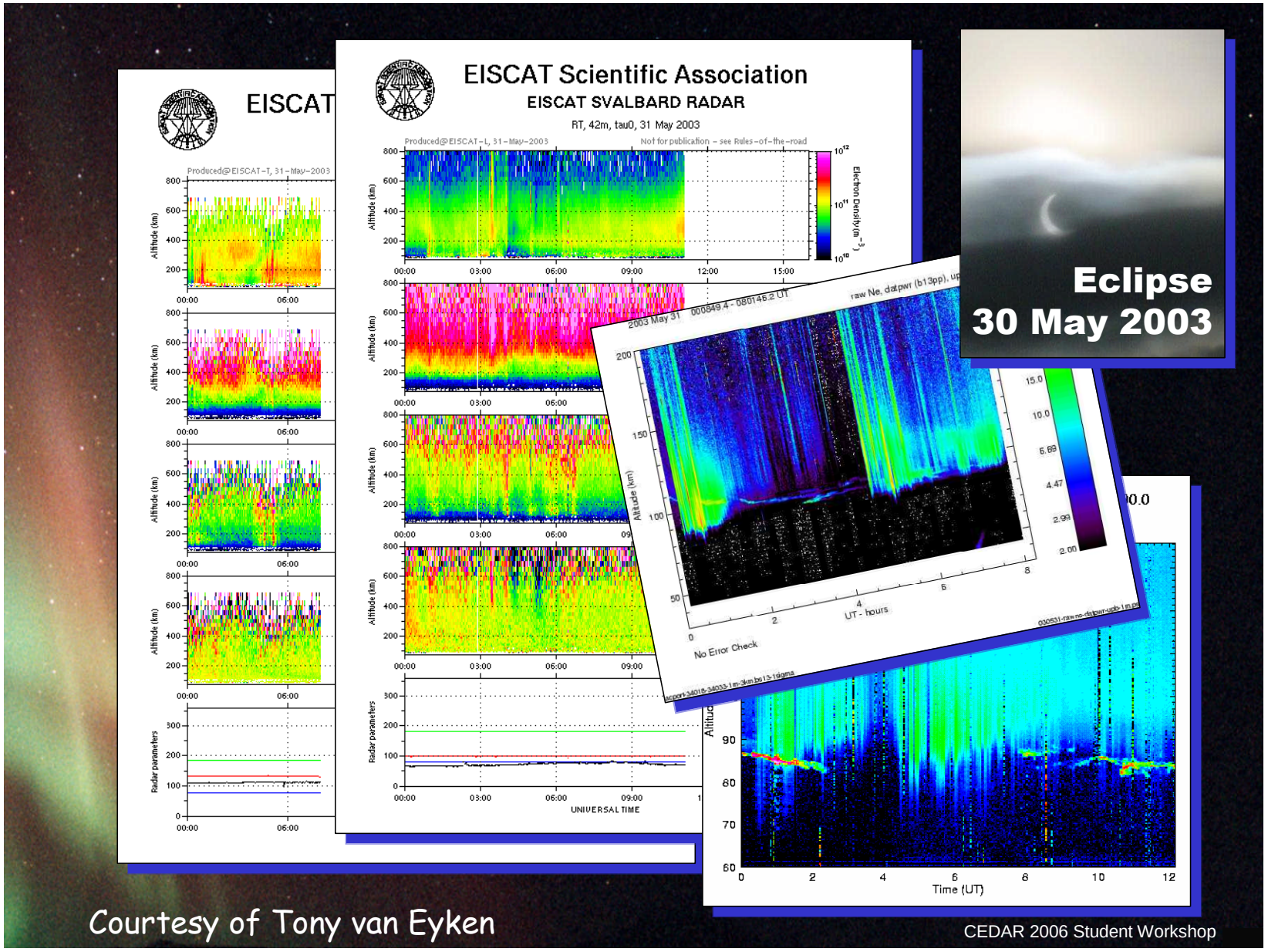
Testimonial:

- Two-year campaign to coordinate Sondrestrom ISR and allsky measurements with TIMED - GUVI measurements of auroral arcs
- Experiment requirement is to observe a stable and strong auroral arc by all three instruments to study auroral energetics
- Outcome: 63 different experiments during the two year period / 5 good events / 1 good event with clear skies

Courtesy of Rick Doe

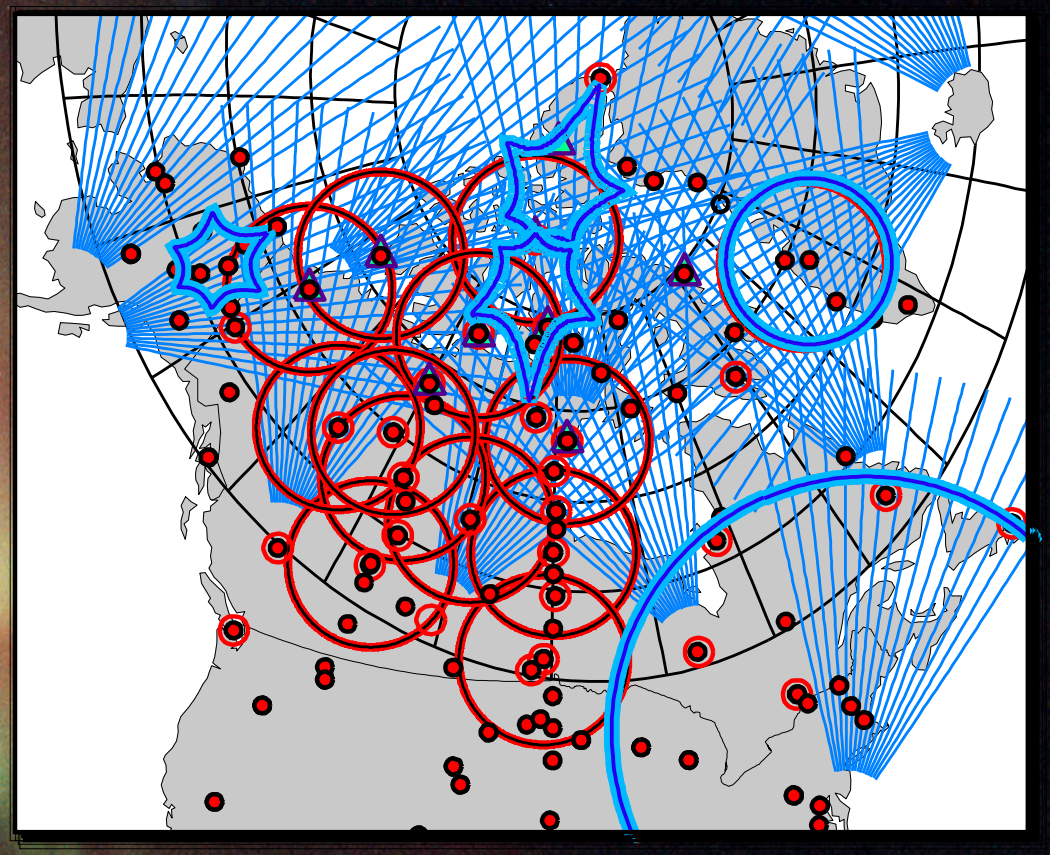
IS Radar w/ Distributed Instruments





Courtesy of Tony van Eyken

IS Radar w/ Distributed Instruments



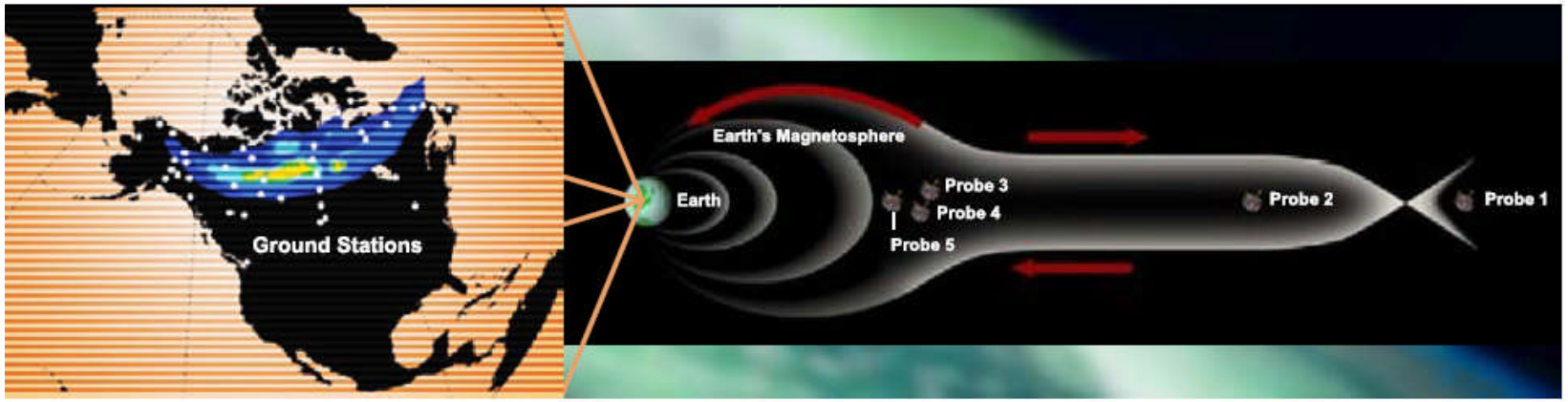
Maps courtesy of the Canadian Ground-Based Community

IS Radar w/ Distributed Instruments

NASA Mission

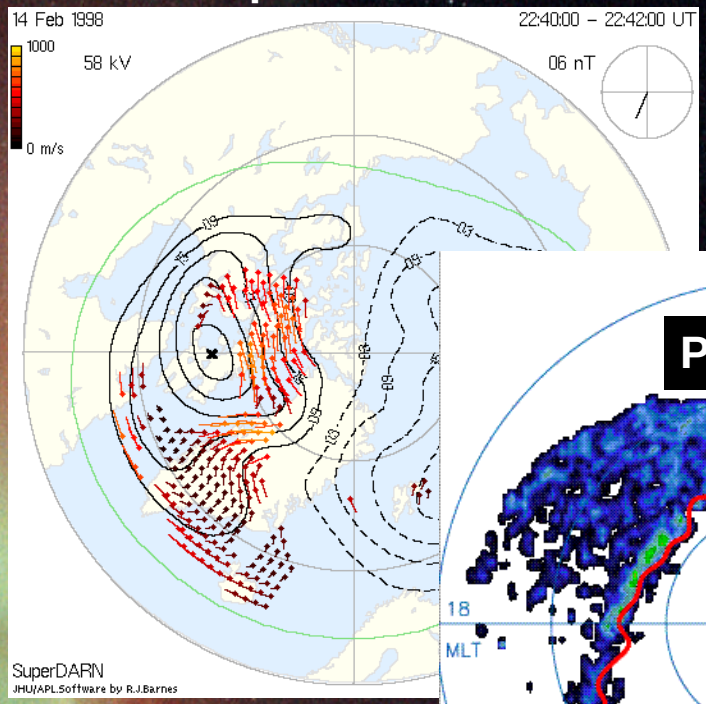
THEMIS

TIME HISTORY OF EVENTS AND MACROSCALE INTERACTIONS DURING SUBSTORMS

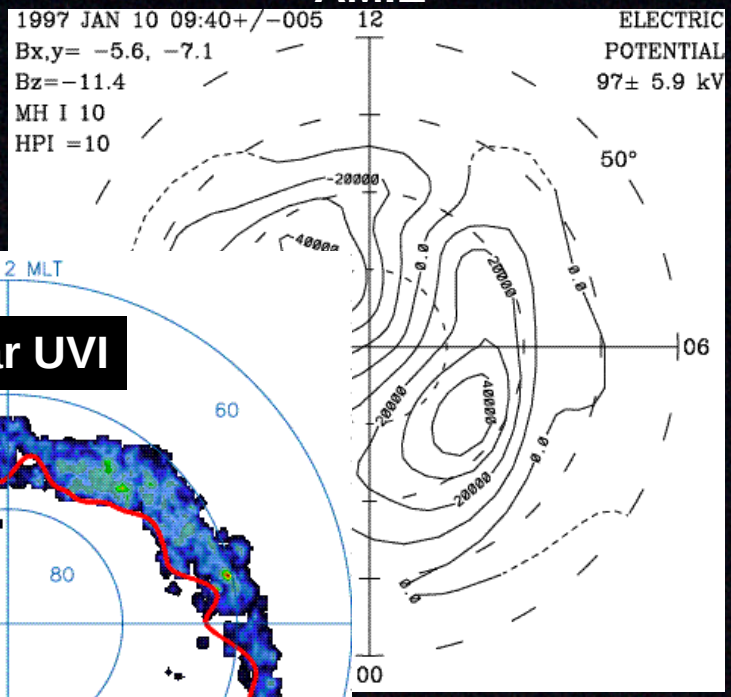


IS Radar w/ Distributed Instruments

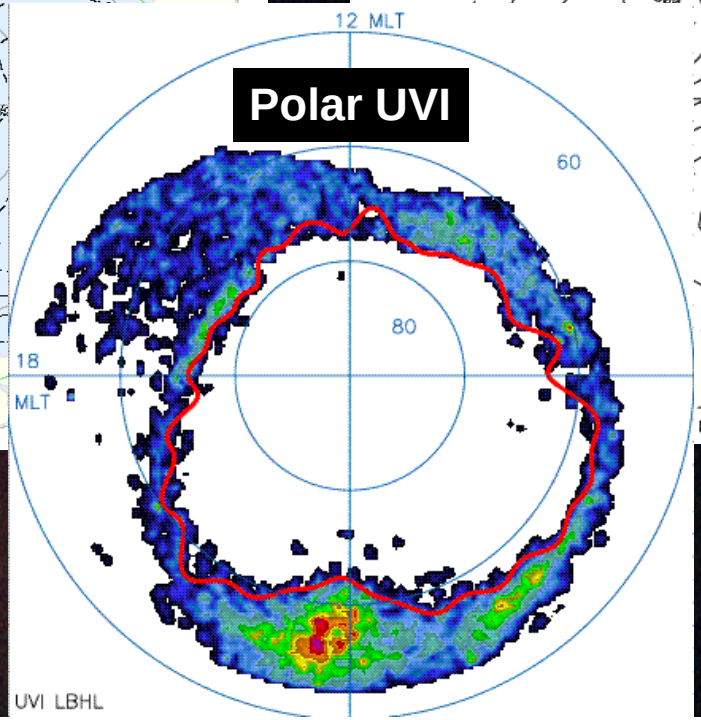
SuperDarn



AMIE

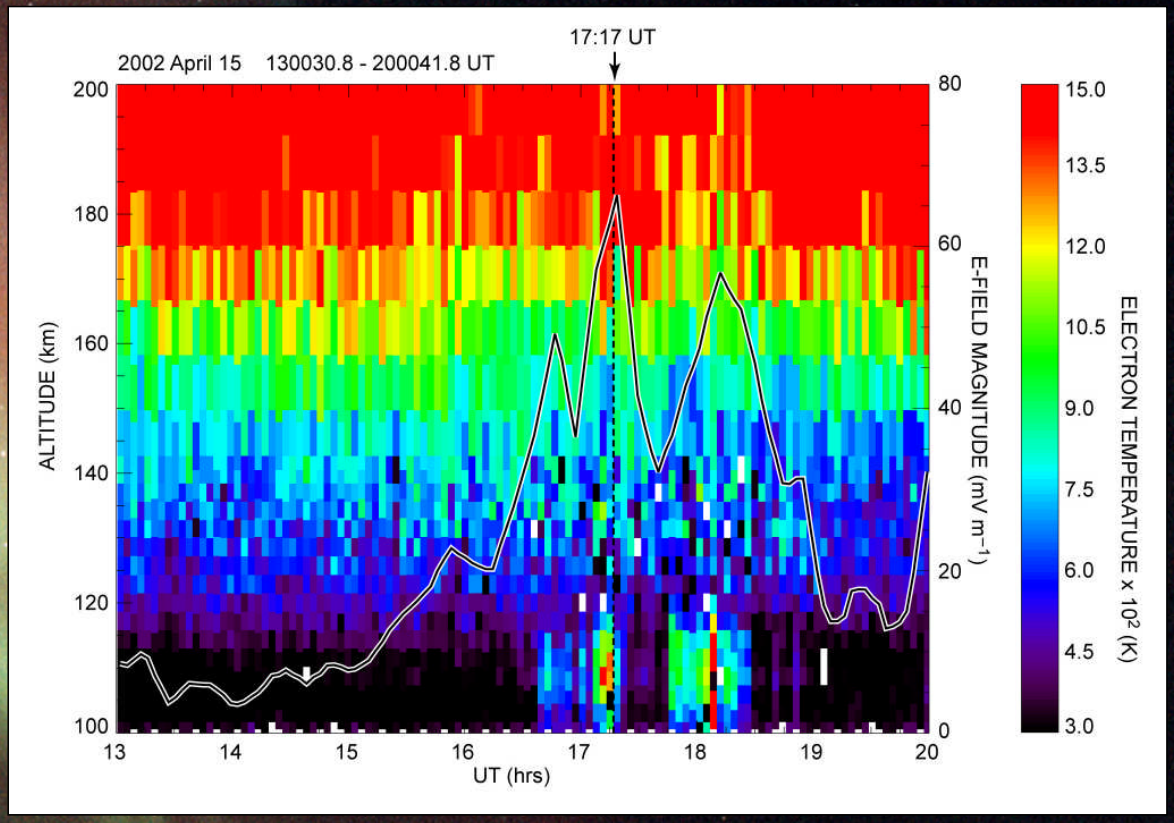


Polar UVI



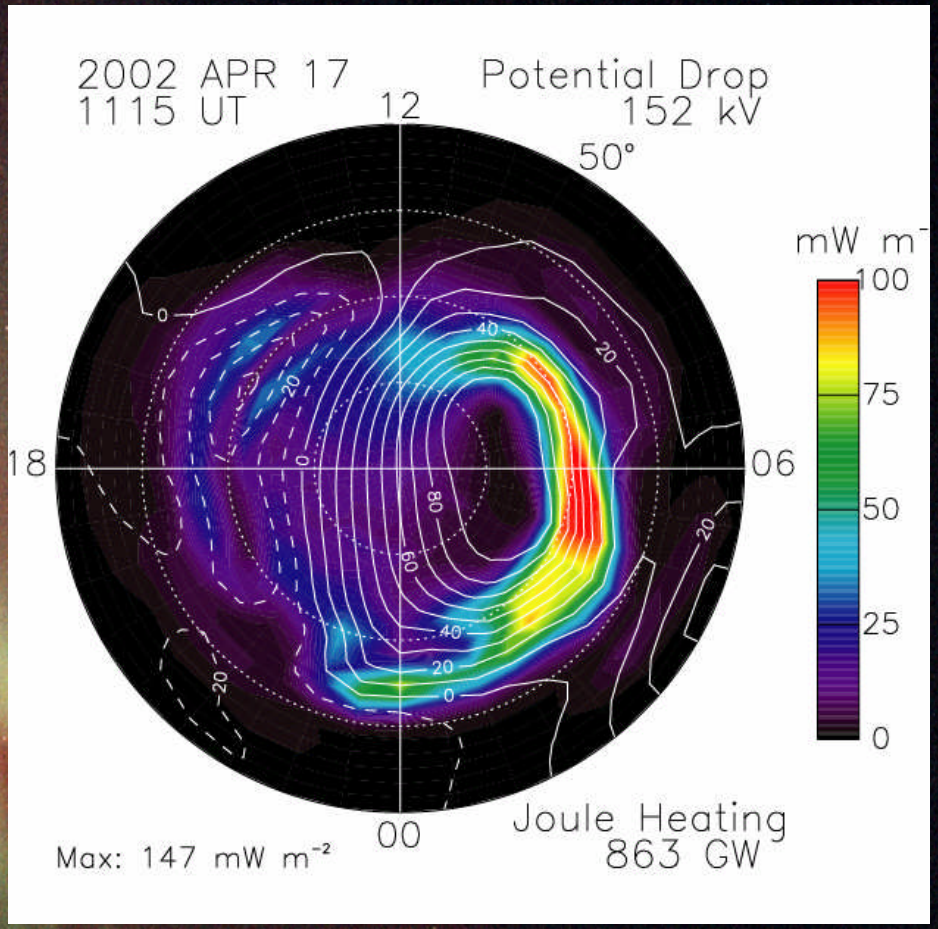
IS Radar w/ Proxy Relationships

IS Radar Electric Field and Electron Temperature Measurement



Electric fields in excess of 20 mV/m result in enhanced electron temperatures in the lower E-region. This leads to reduced electron recombination and greater electron density at the peak of the Hall conductivity layer

IS Radar w/ Proxy Relationships



Apply known relations found in ISR data to regions or times when no ISR data is available

AMIE Pattern courtesy of Gang Lu, NCAR

Phrases to avoid when working with or discussing other researchers' data

- **I would like to use your data to compare with my model data**
- **What are the error bars on your data**
  - not a bad question but be prepared for the follow-up diatribe
  - Similarly avoid the question: "How does your instrument work?"
- **Can I have all your data in ascii format**
- **I would like your data to provide contextual information for my analysis**
- **Is your data in the CEDAR database?**