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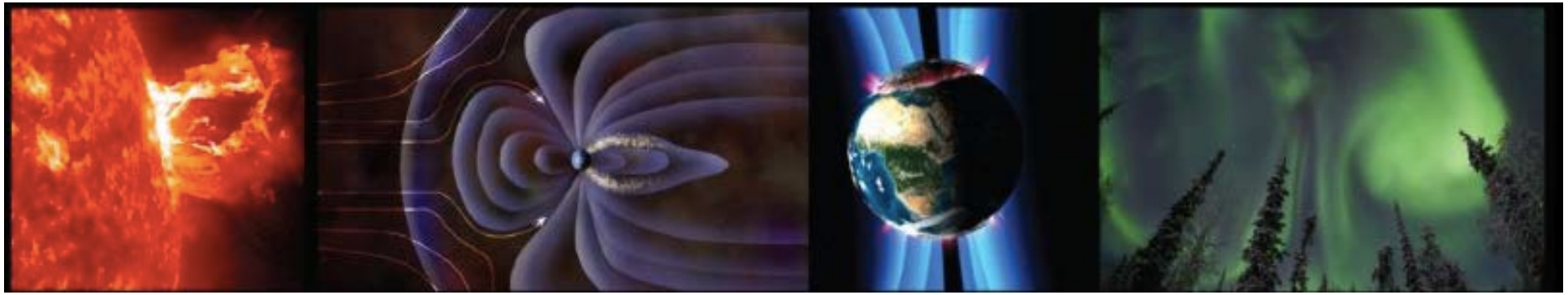
Space Weather Operations and Research Infrastructure: A Workshop in Two Parts

Ground-based Measurements Panel:

Introductory Remarks
Anthea Coster



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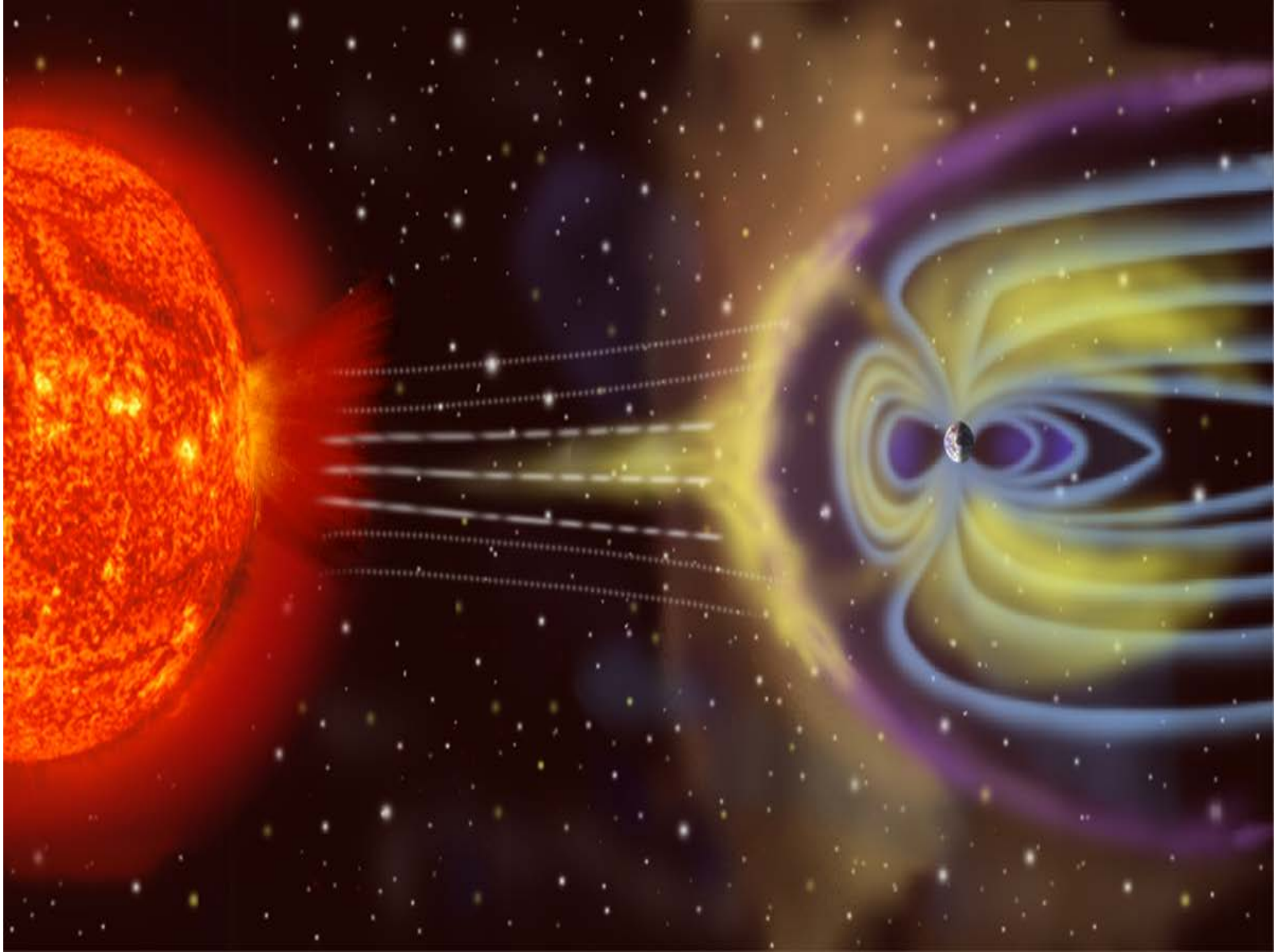
Ground-Based Measurements need to be an ***integral*** part of SPx Architecture for both research and operations

Ground-Based Measurements need an “operational” home; they need support for real-time operations



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04:30 David Boteler, Head, Canadian Space Weather Forecasts Centre (CSWFC)

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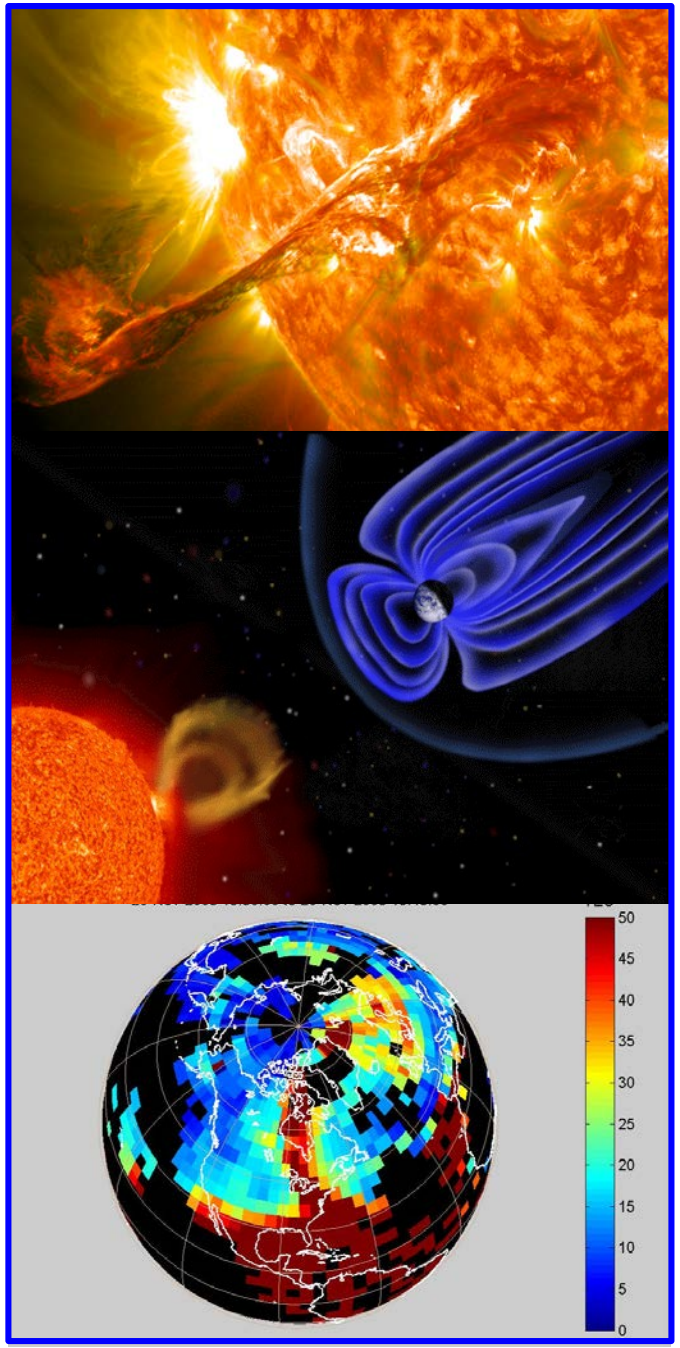

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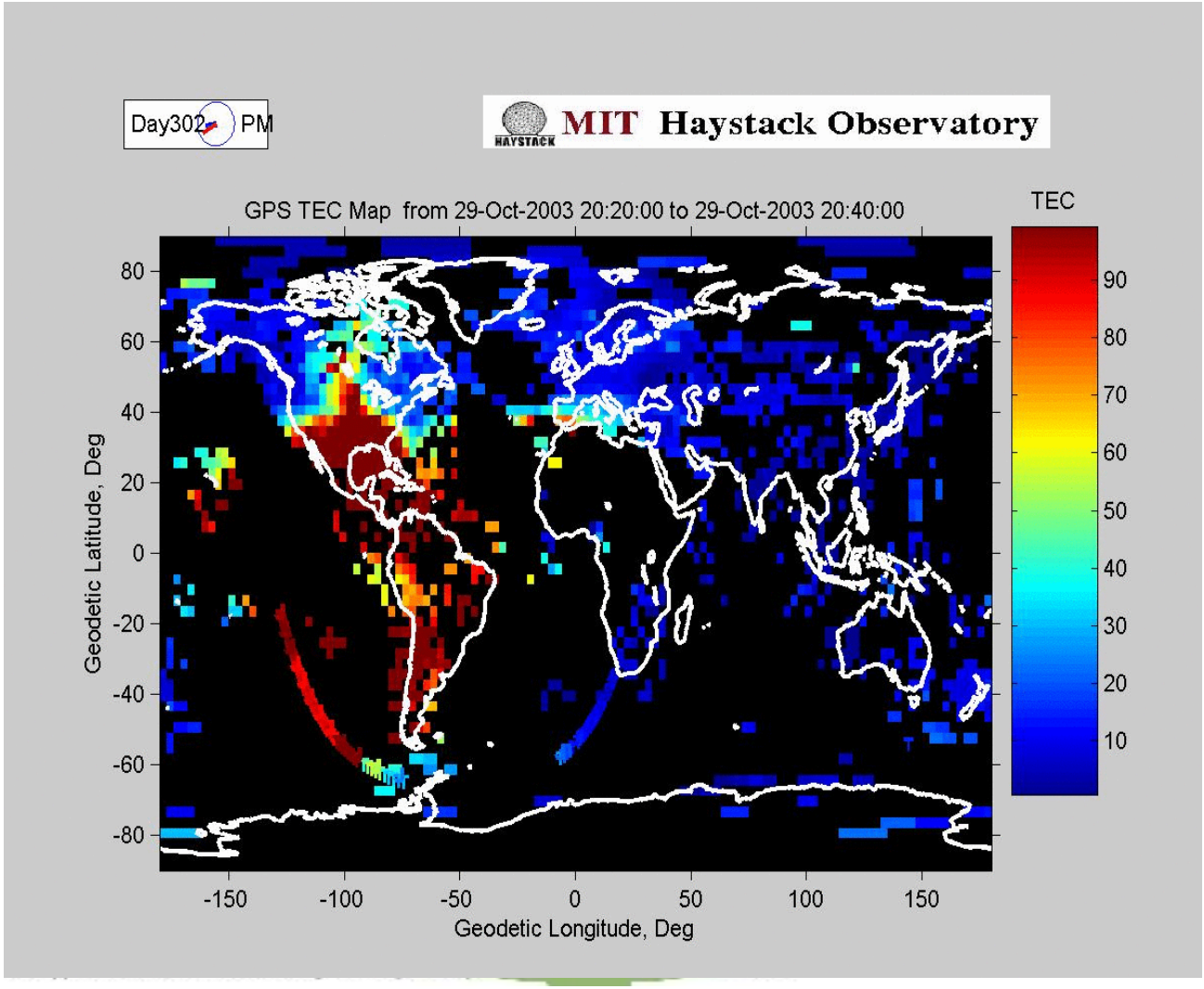
Distributed vs. single point measurements

Wide Area Distribution of 'Raw' Information

Distributed networks of sensors yield global physics unattainable with single-point measurements

Example :
Global GPS-derived ionospheric mapping during geomagnetic disturbances



[Coster et al, 2003]

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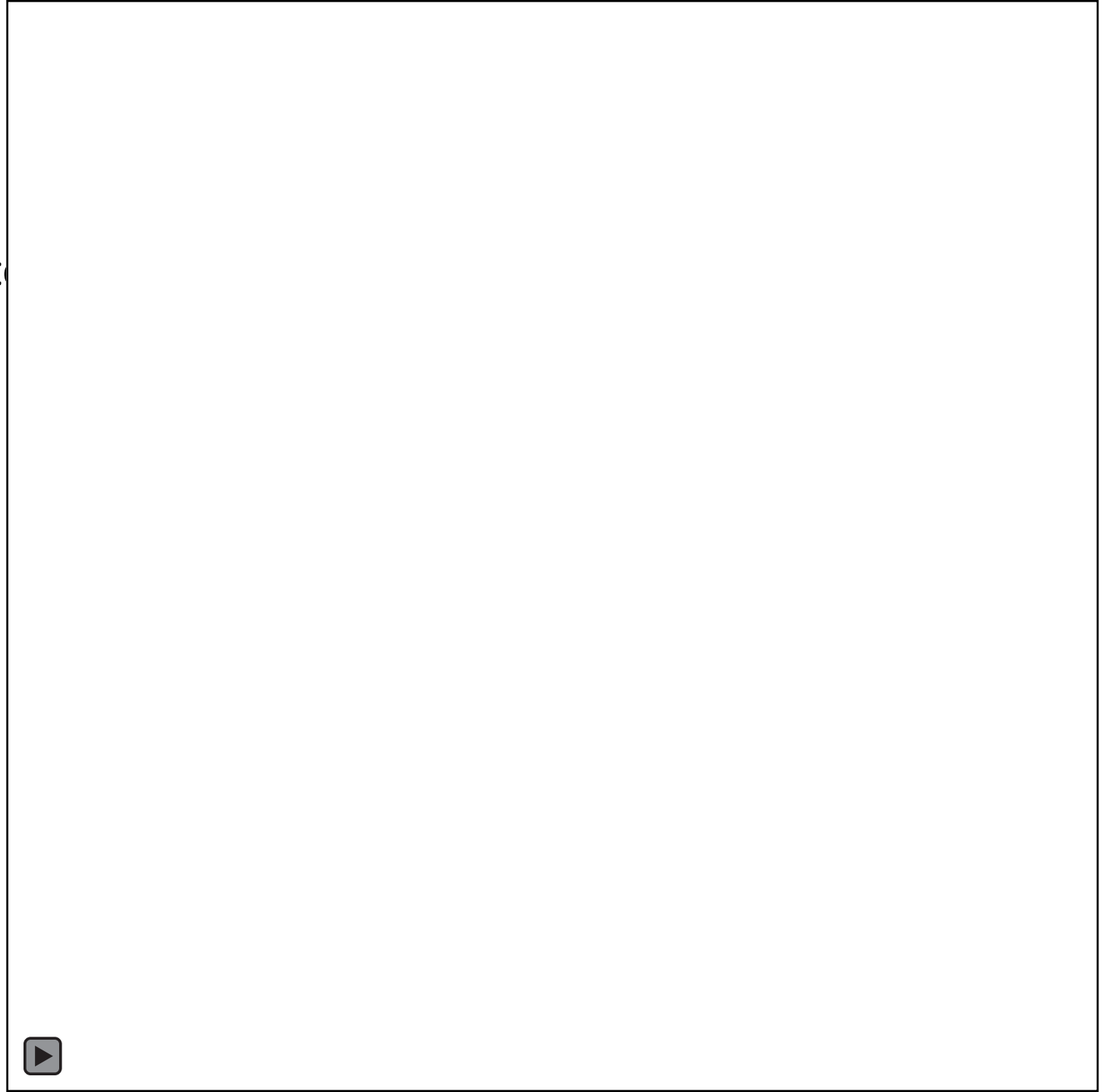
Example of Differential TEC showing response t Solar Flare X9.3 on 6 Sep 2017



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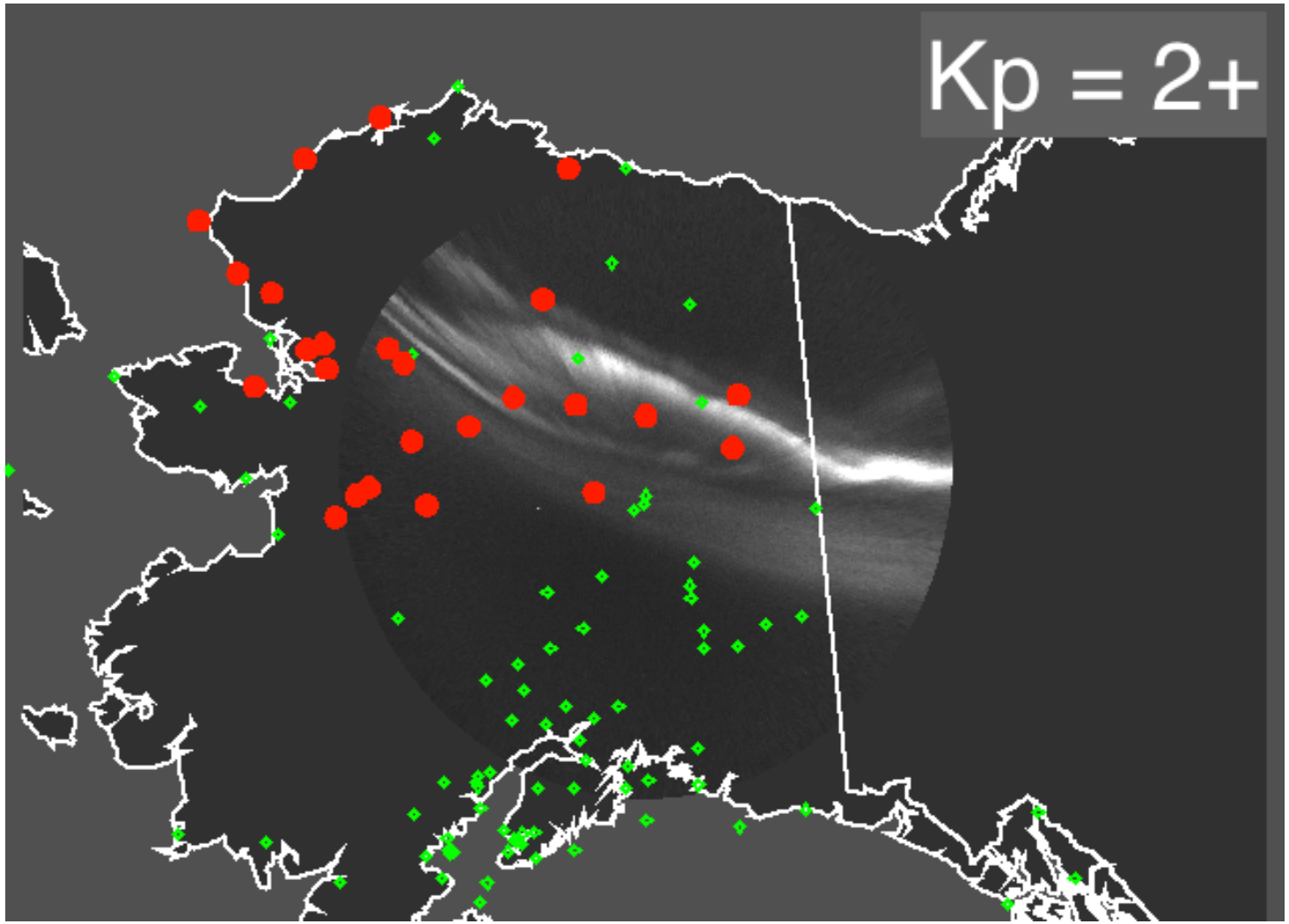
Need to invest in Operational Infrastructure for Space Weather



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Need to invest in communications - Alaska Field Test Campaign

- Multiple receiver deployment
- Self-contained “box”:
  - GNSS receiver
  - Antenna
  - Solar panel
  - Interface computer
  - WiFi Antenna
- Connect to boxes from phone app
- Upload files to DropBox

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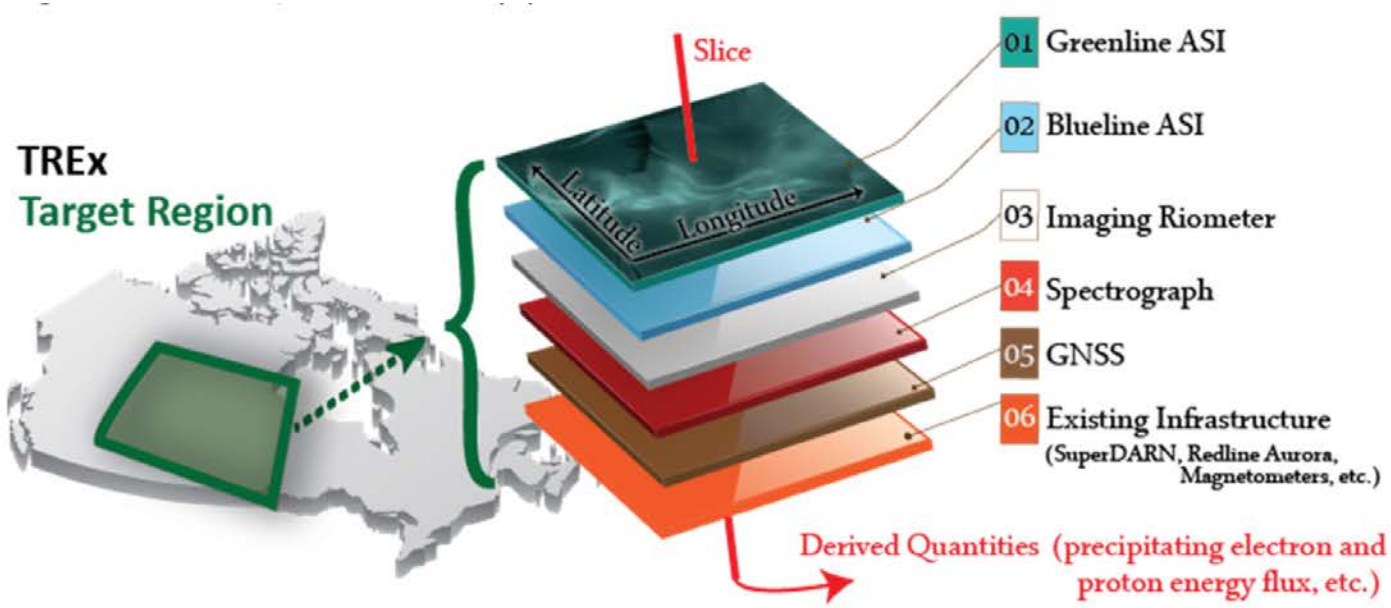
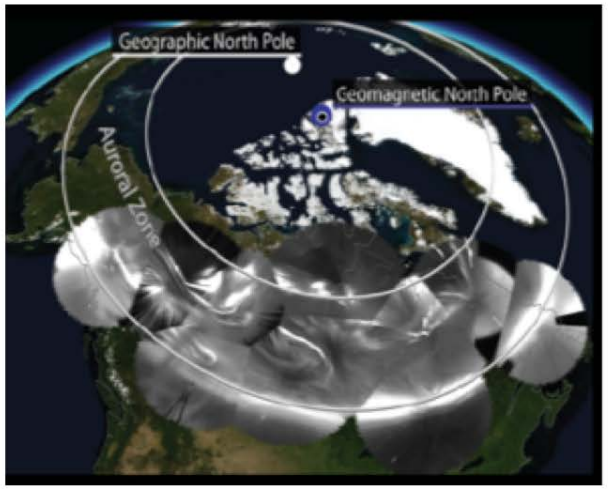
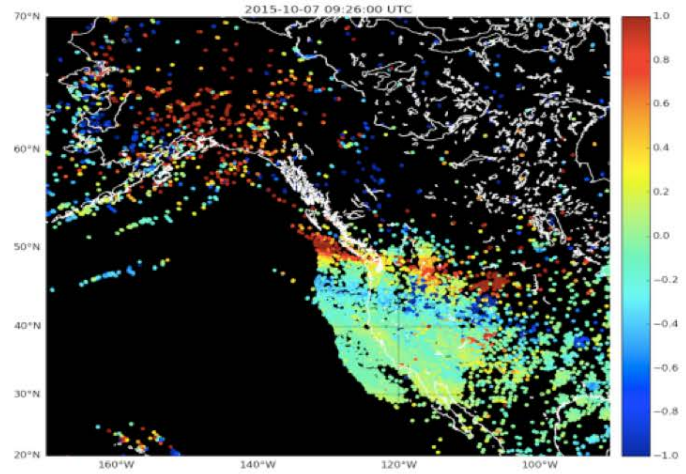
Big Data: Example - Transition Region Explorer (TREx) sites

Development of a sensor web







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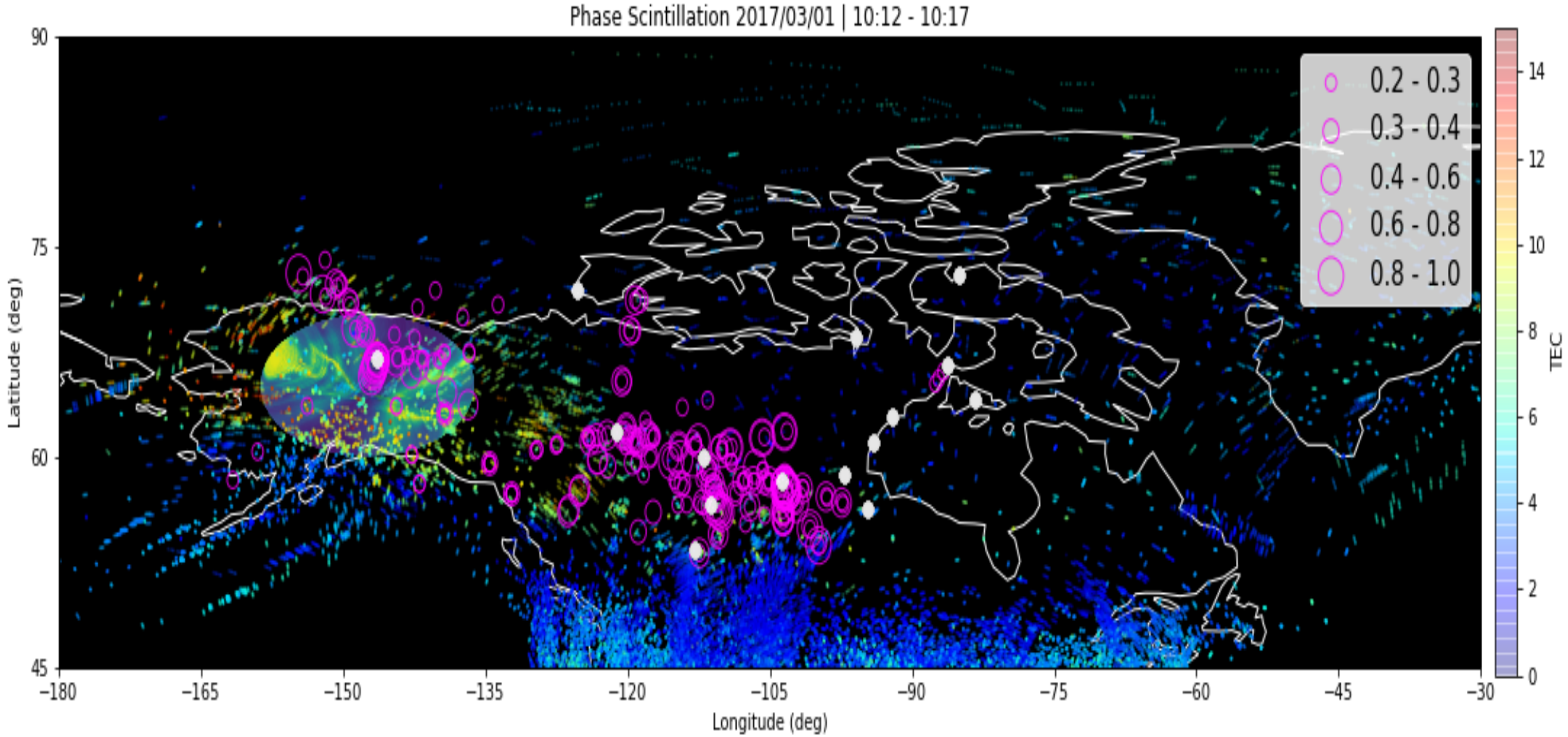

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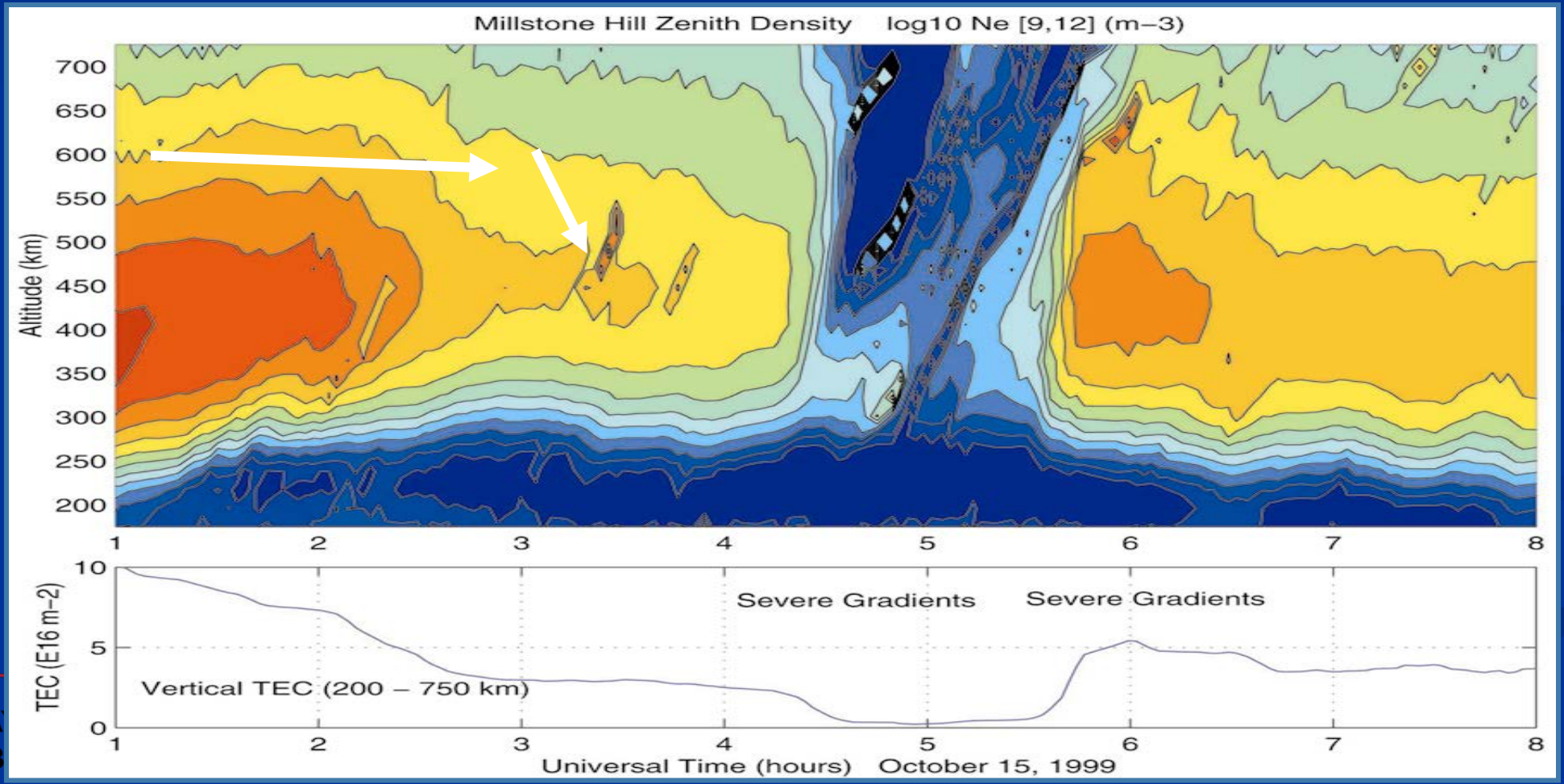
Global Network of Incoherent Scatter Radars

- *Can Measure Physical Properties of the Space Environment as a function of altitude:*
  electron density, electron temperature, ion temperature, plasma velocity
- *Can Infer:*
  electric field strength, conductivity, current, neutral air temperature, wind speed

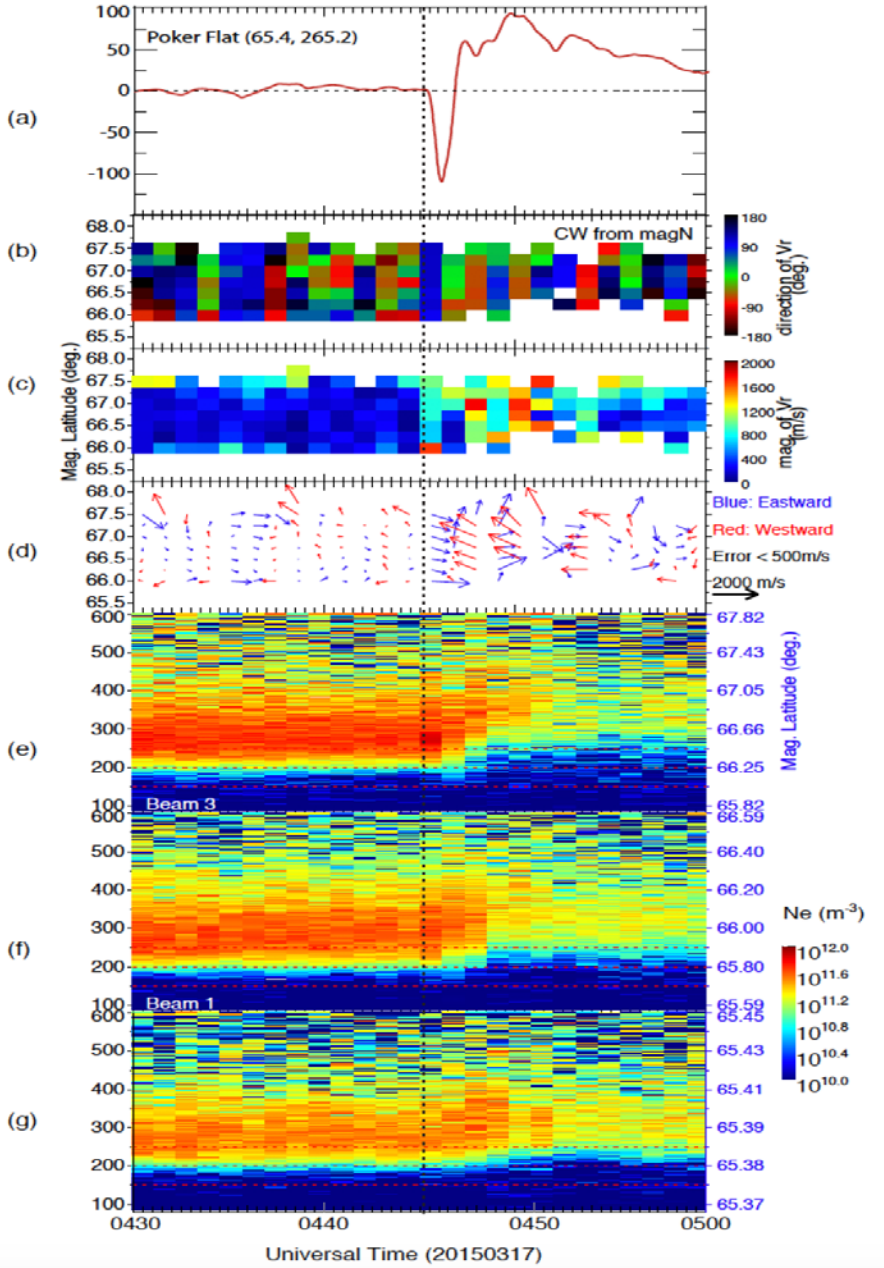
Using ISRs to Measure Space Weather Effects

1. Availability of real-time data
2. Historical data
3. Can ISRs work as a coordinated sensor network?

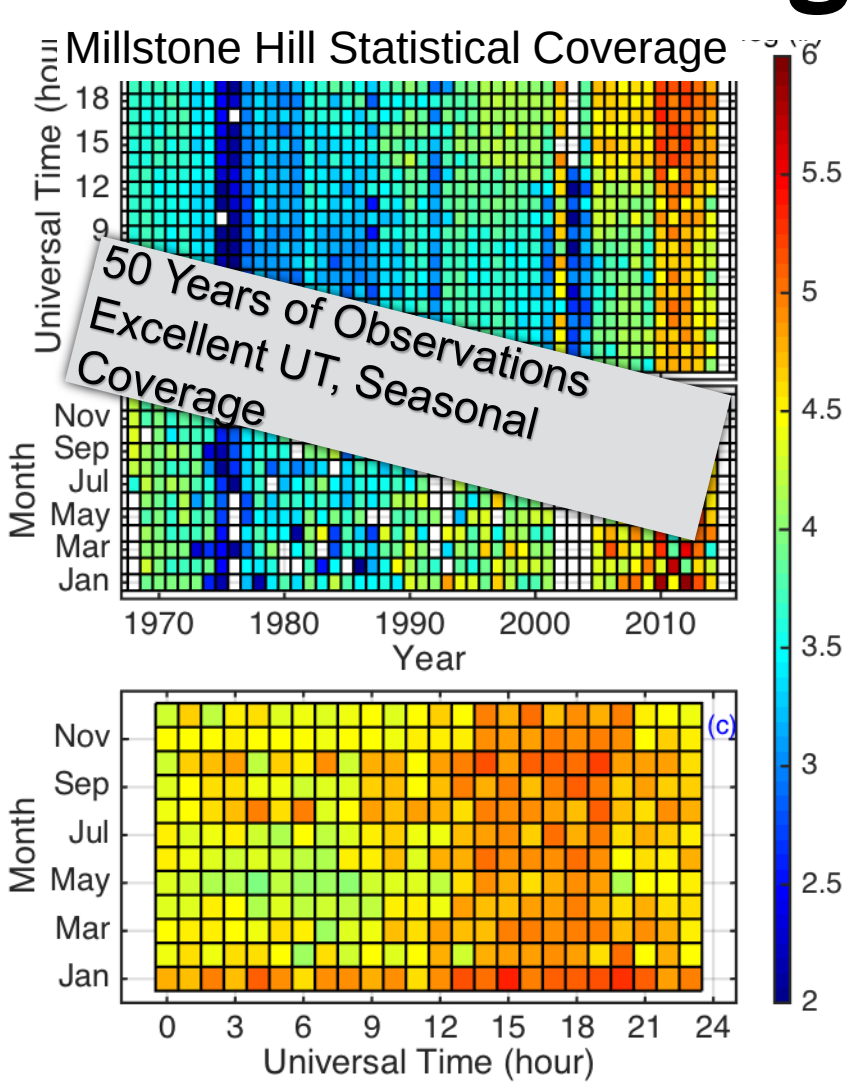


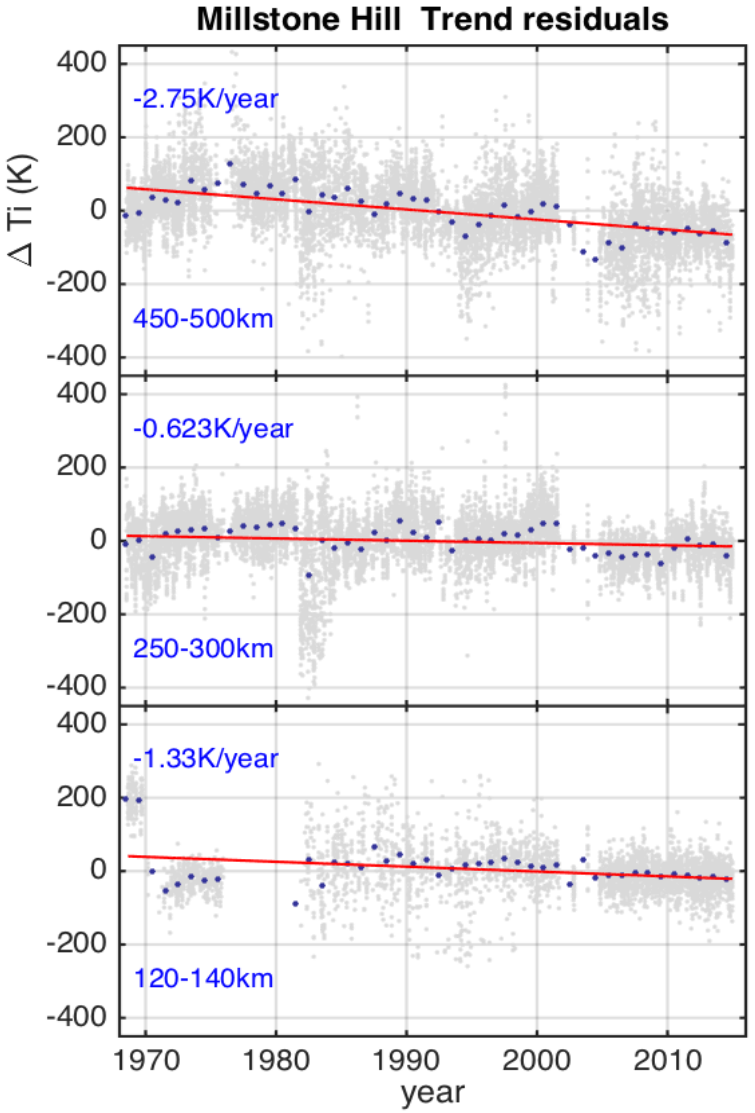
Benefits of Continuous Operations

- Continuous operations allow the radar to catch space weather events that are not necessarily well predicted.
- For example, the PFISR IPY mode serendipitously captured to the ionospheric response to the solar wind pressure pulse preceding the 2015-03-17 "St. Patrick's Day" geomagnetic storm [Zou et al., 2017, GRL].



Space Weather: Long Term Trends





Ion Temperature Trends at Millstone Hill

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IS Radar provides comprehensive statistical database on temperature in Earth's upper atmosphere

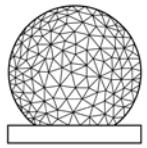
Space Weather Architecture needs:

Observations that collect and provide ***critical, real-time, continuous, operationally-dedicated space weather data and imagery*** for alert, watch, and warning services, and predictive modeling systems.

Ground Based Observations are an important component of these observations for:

Validation of models and space-based observations
Real-timing Monitoring – now-casting
Data assimilation into new forecast models

Secure funding for operational support of ground-based systems needs to be identified



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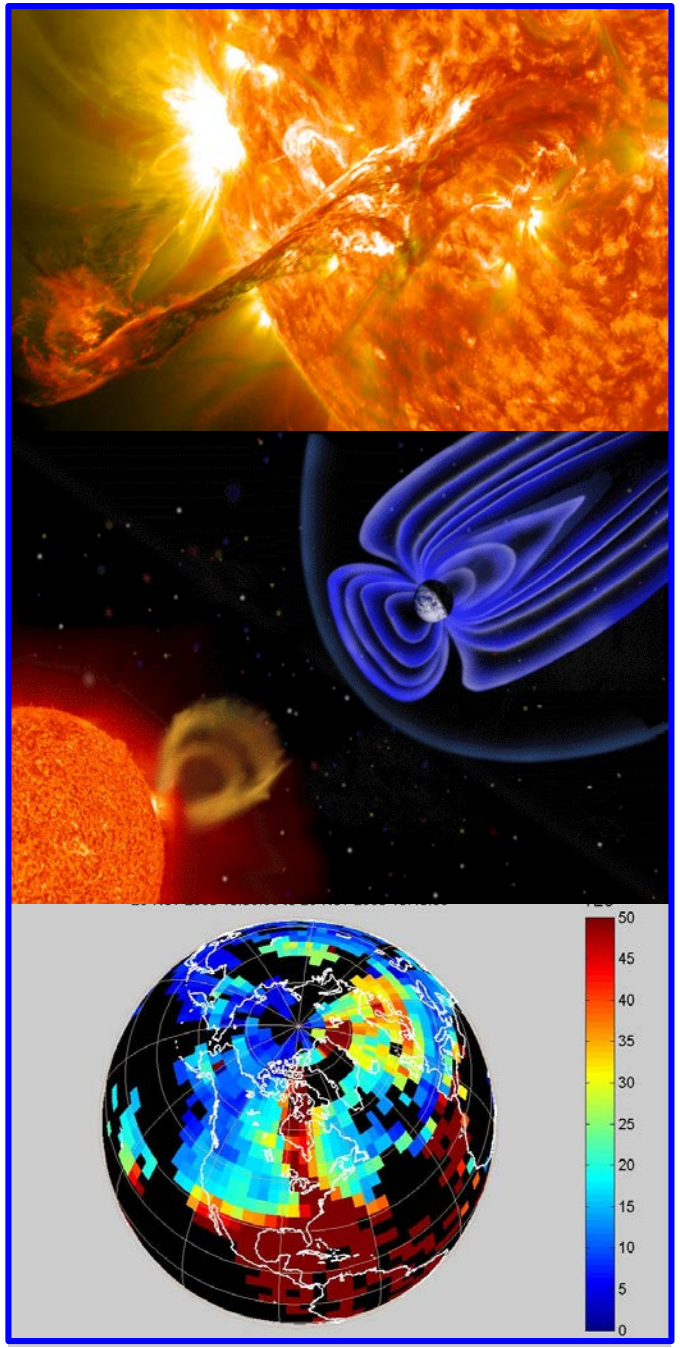

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