Panel Discussion:
Transitioning Research to Operations

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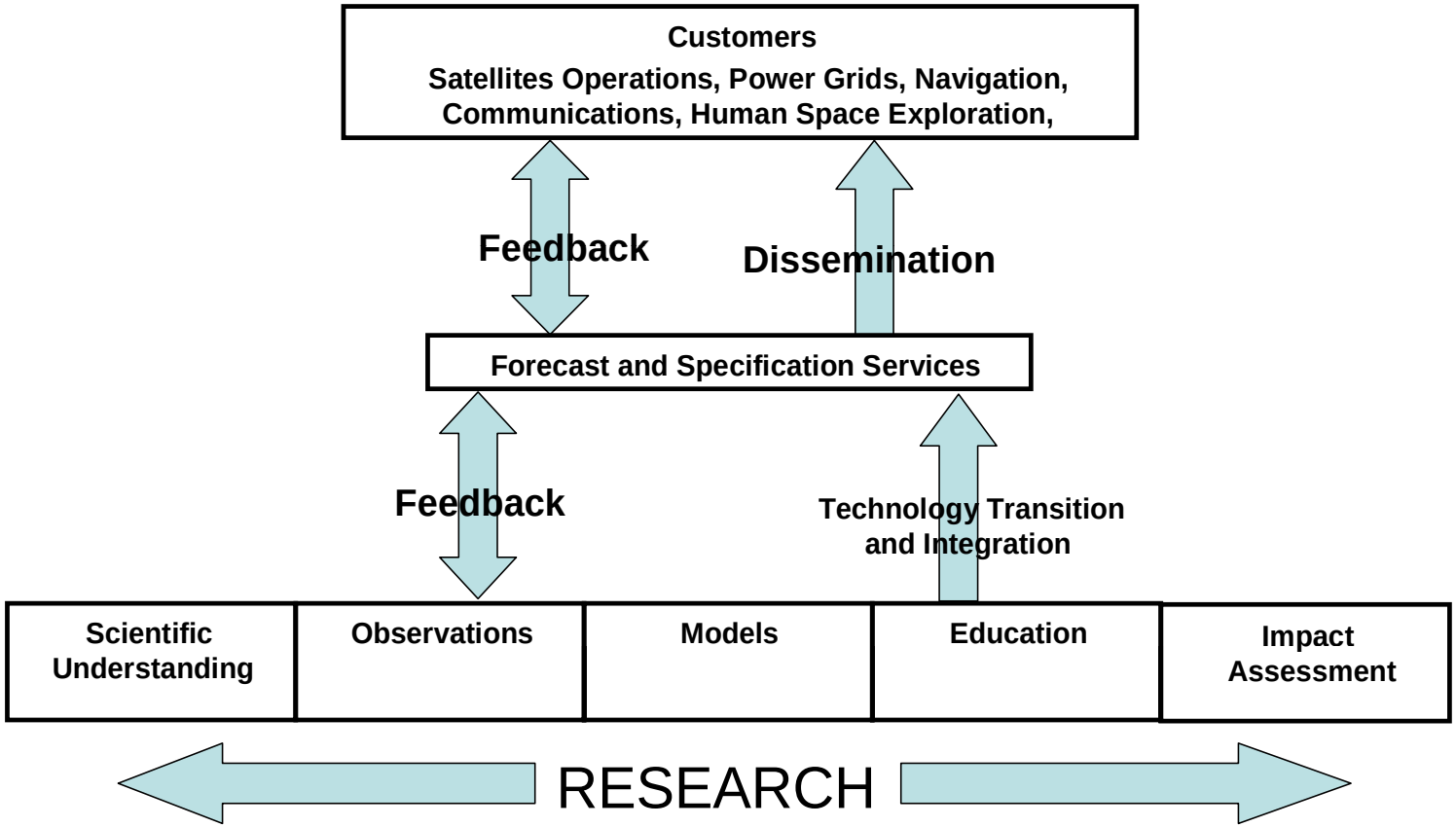
National Space Weather Program

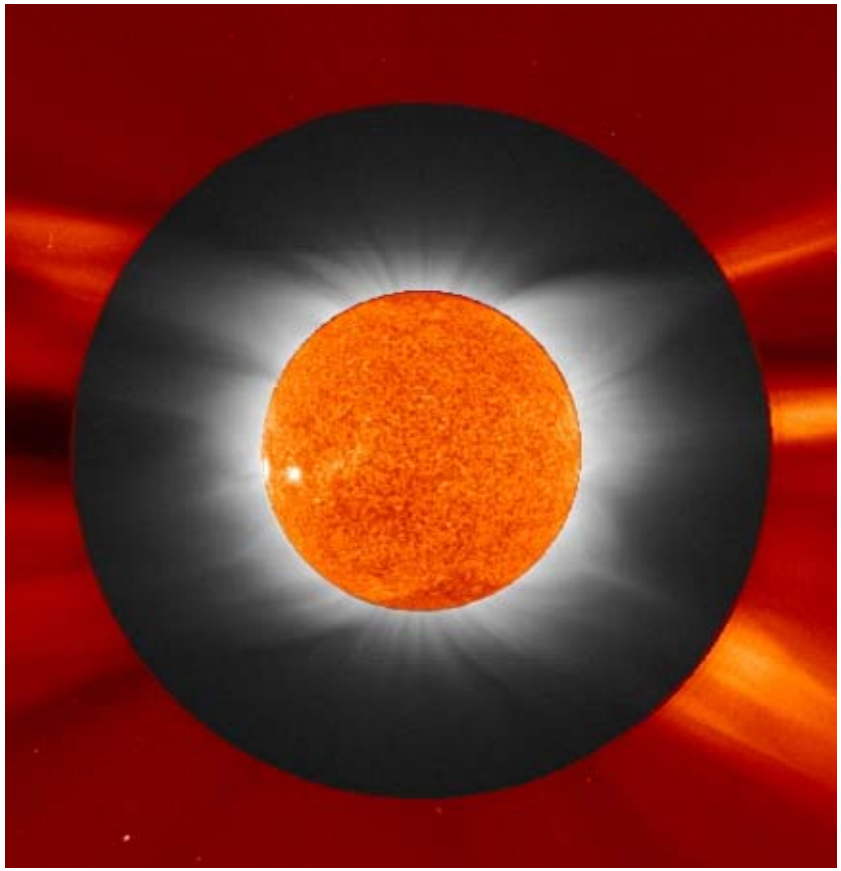
Program Elements



National Space Weather Program

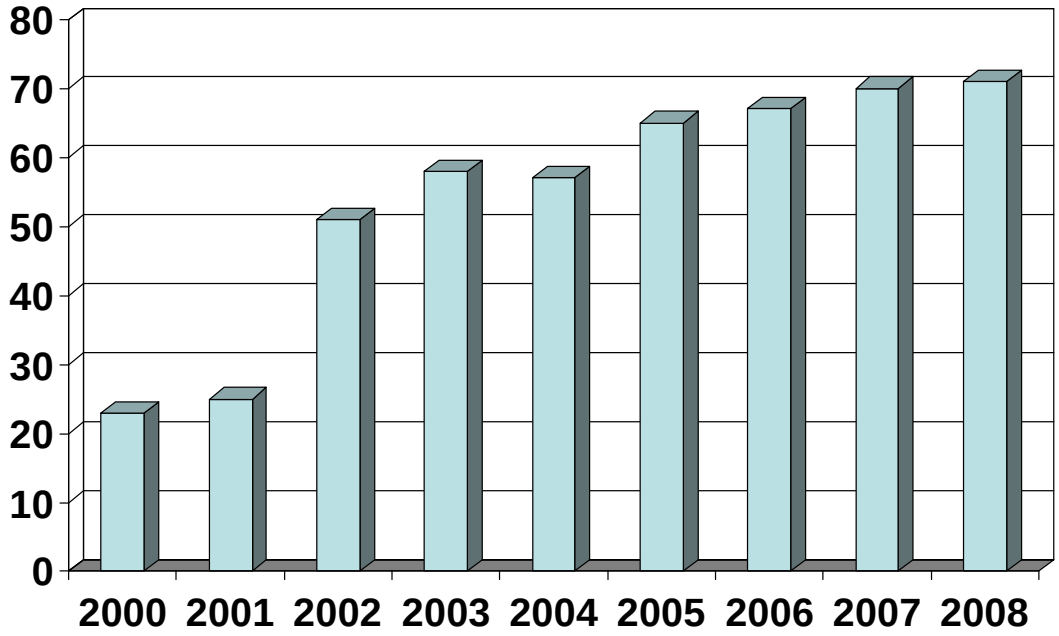
NSF Role:

- Fundamental research
- Ground-based facilities
- Modeling
- Education
- Catalyst for interagency collaboration



Space Weather Research at NSF

- The great majority of our core aeronomy, magnetospheric, and solar physics research now deals with space weather.

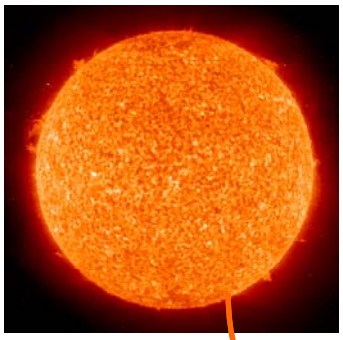


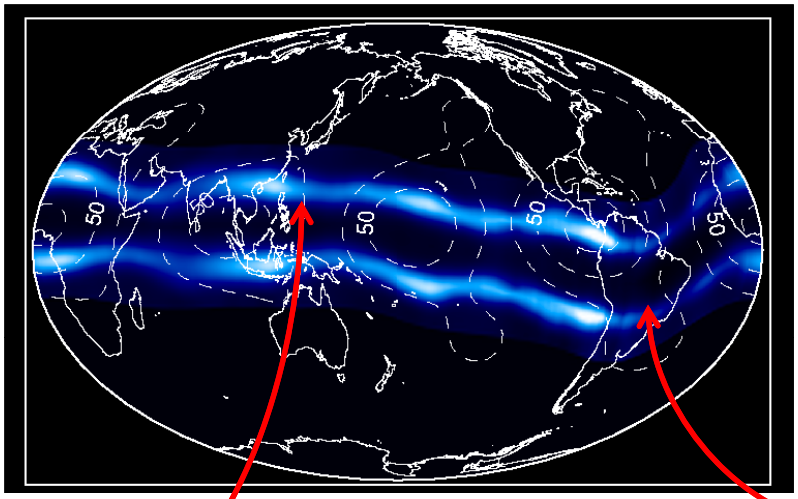
Fundamental space weather research

- Focus on understanding the processes in the the Sun-Earth system that cause space weather effects
- Particular focus on new discoveries linking the different regions

Tropospheric Clouds and Thermosphere / Ionosphere Structure

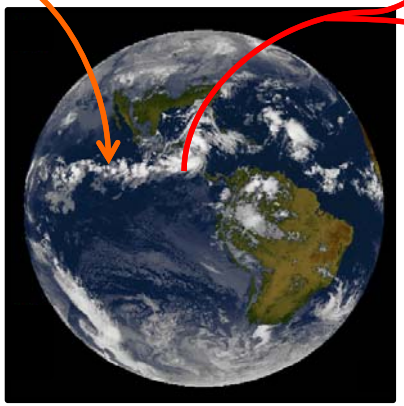
Provided by Maura Hagan





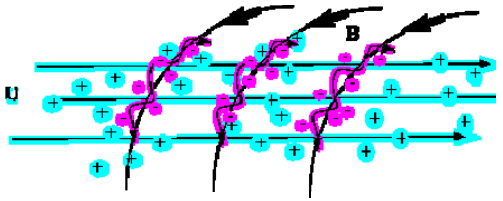
(1) raindrops form in deep tropical clouds

(2) releasing diurnally varying latent heat on the global scale



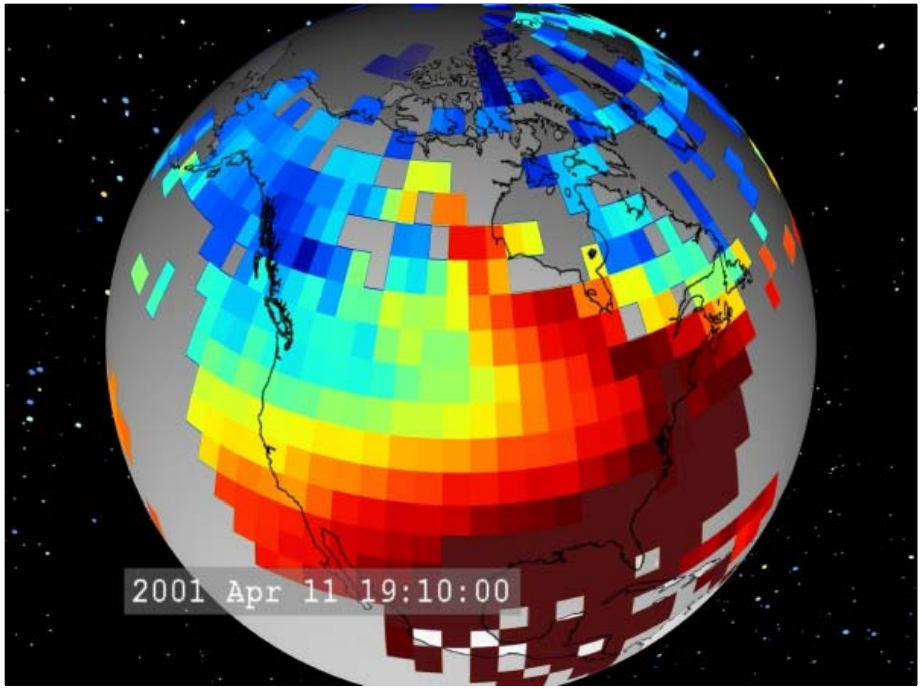
(3) exciting a spectrum of upward propagating nonmigrating tides

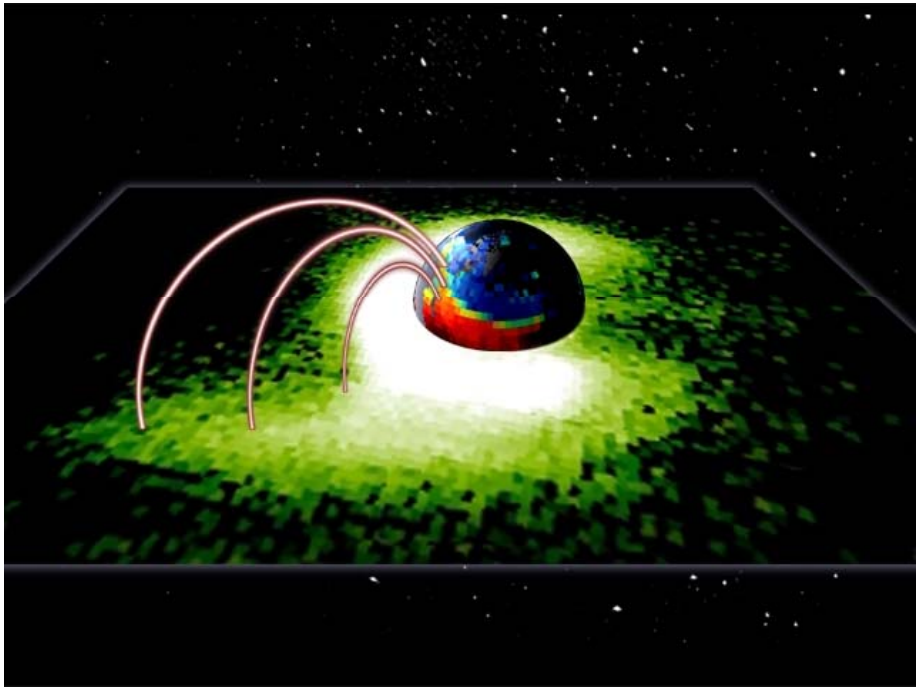
(4) that both directly penetrate and indirectly affect the thermosphere and ionosphere



E-region dynamo process

Coupling between the Ionosphere and the Plasmasphere (Foster et al.)





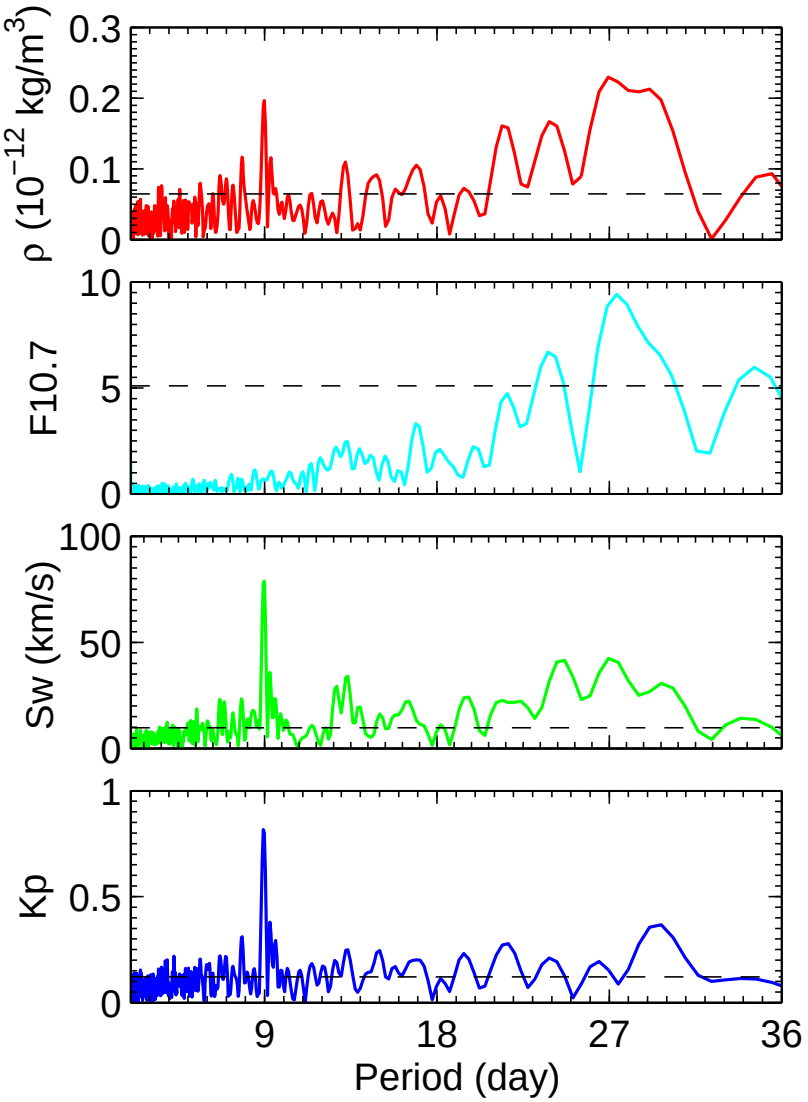
Coupling between the ionosphere and the solar wind (Thayer et al.)

Density - 400km altitude

Solar EUV flux index

Solar wind speed

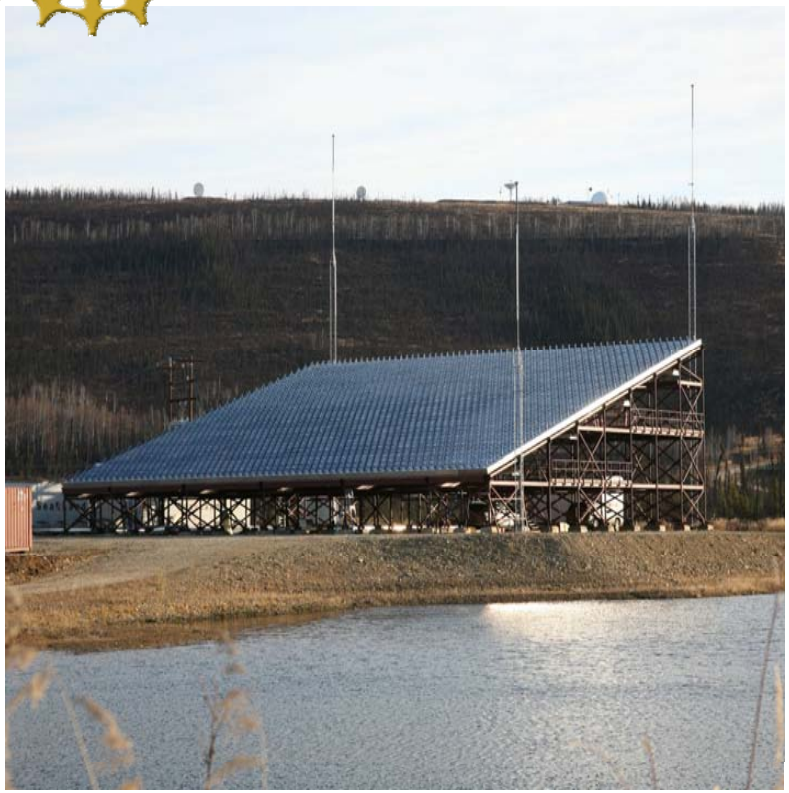
Geomagnetic Activity Index



Ground-based facilities (and more)

- World class radars and optical instruments
- New ISRs in Alaska and Resolute Bay
- Fledgling space program – COSMIC, AMPERE, Cubesats
- ATST on track

The Advanced Modular Incoherent Scatter Radar



The Poker Flat, Alaska Incoherent Scatter Radar (PFISR)

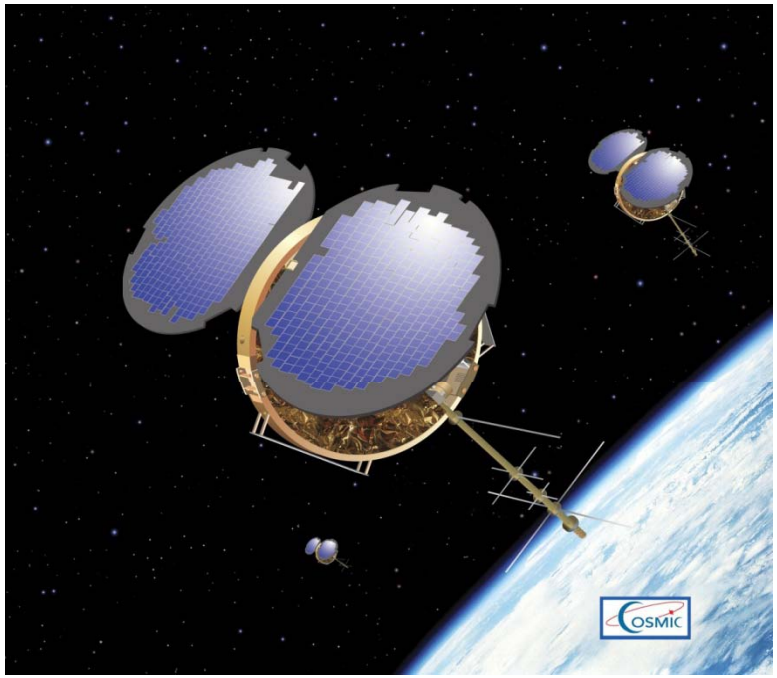
First Light: January 2007

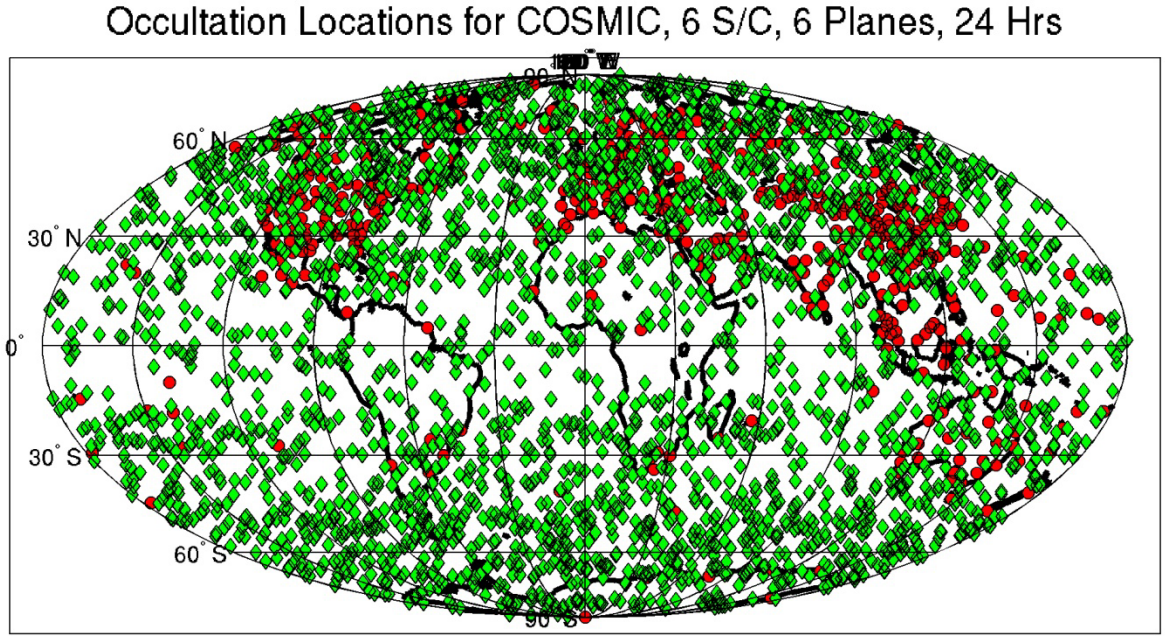
The Resolute Incoherent Scatter Radar (RISR)

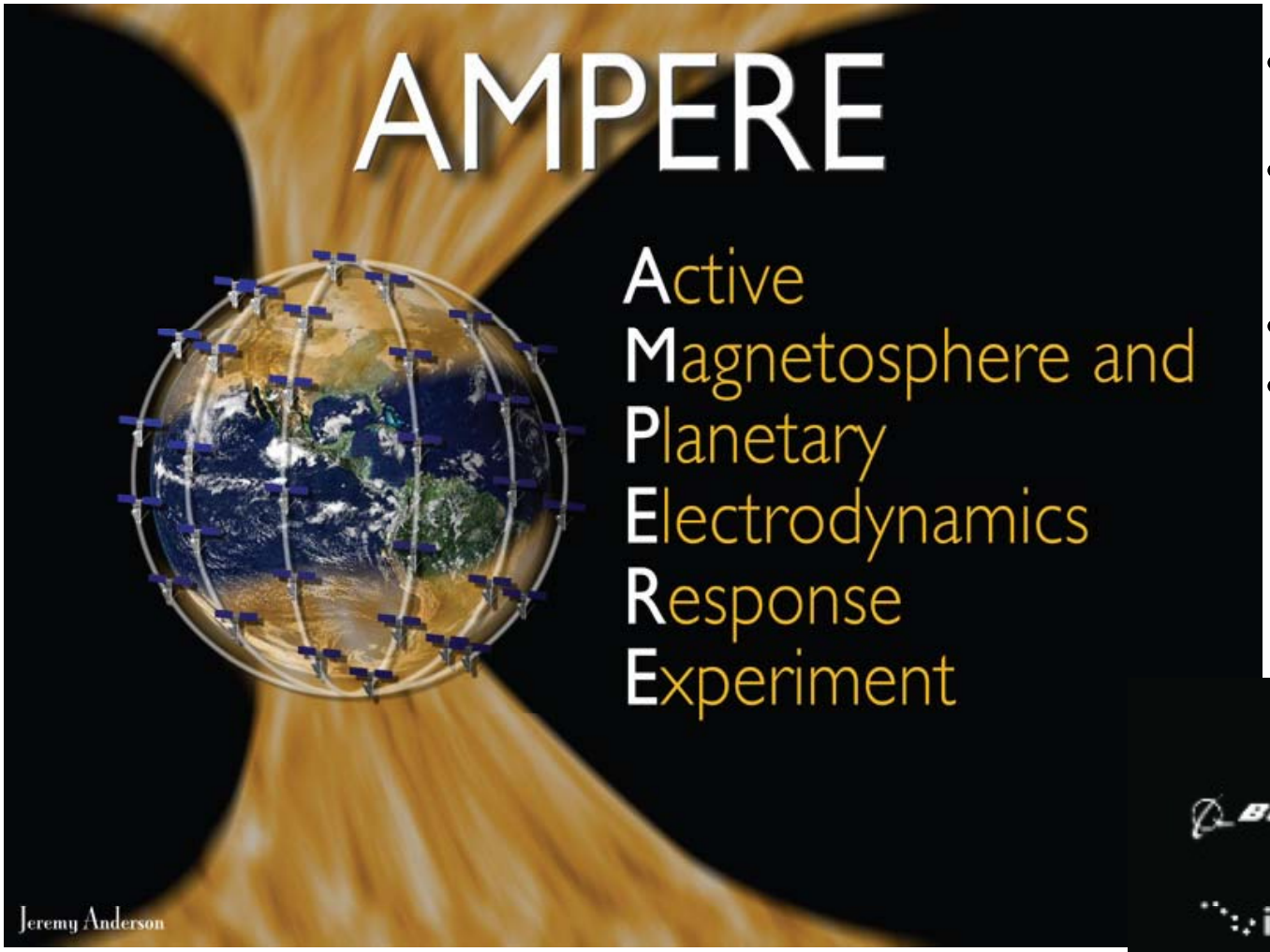
First Light: April 23, 2009

COSMIC

- **Taiwan-US Collaboration**
- **Six satellites record weather, climate, and space weather data**
- **NSF lead agency for science activities**







- Upgrade to Iridium magnetometer data
- Global, 24/7, real-time, field-aligned-currents
- 9 minute cadence
- Commercial data-buy from Boeing & Iridium

Sponsor
National Science Foundation

BOEING
Data provider
Boeing Service Company

iridium
Data source
Iridium Satellite LLC

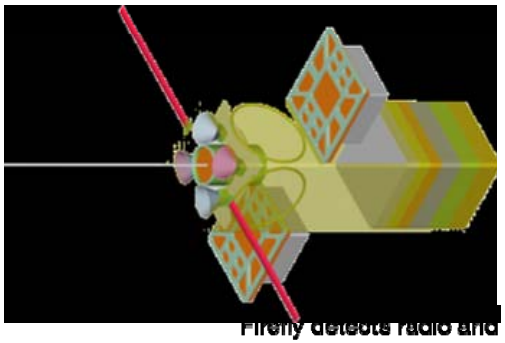
APL
PI Institution, Science Data Center
The Johns Hopkins University
Applied Physics Laboratory

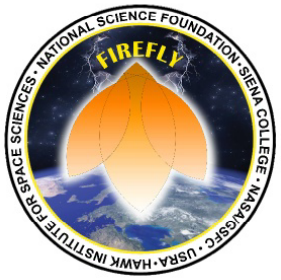
Data acquisition start	Q1 2010
First data product releases	Q1 2011
First real-time products	Q1 2012
Final product release	Q2 2013
Potential continuing ops.	2014 & beyond

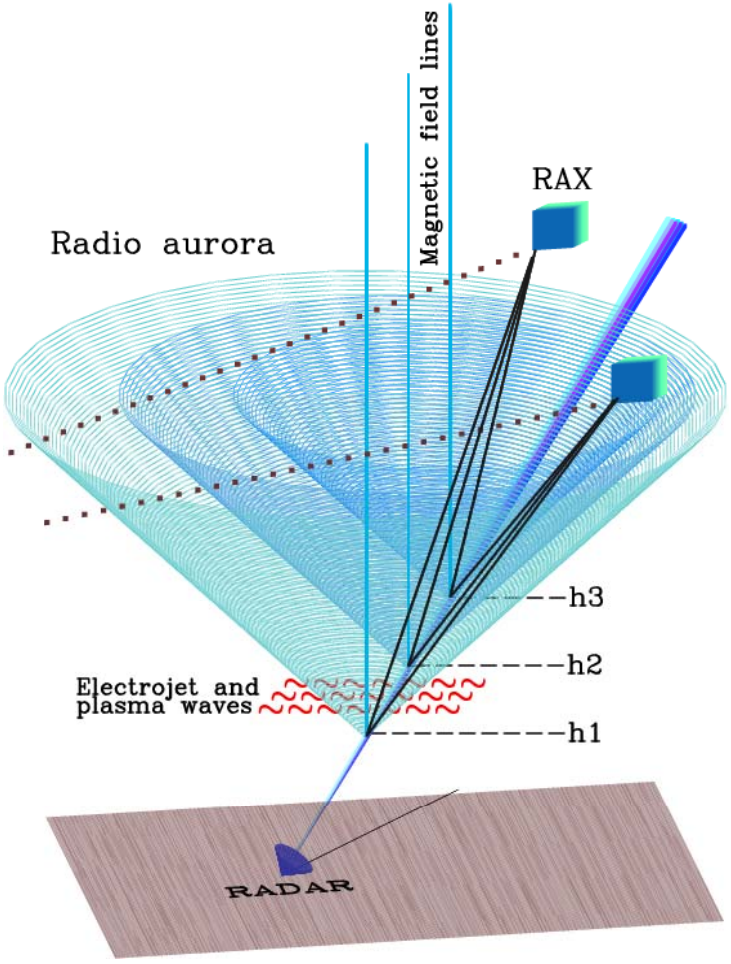
Project started August 2008, being led by

Brian Anderson, JHU/APL

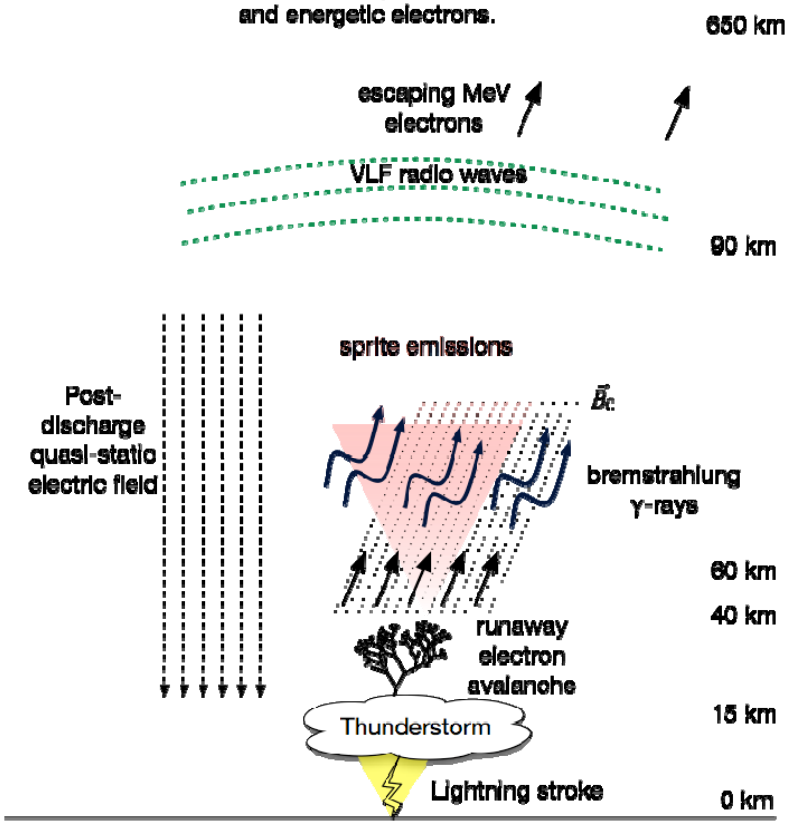
Two NSF Cubesat Missions







Firefly detects radio and optical signatures of lightning as well as the gamma-rays and energetic electrons.



Advanced Technology Solar Telescope

Advanced Modeling

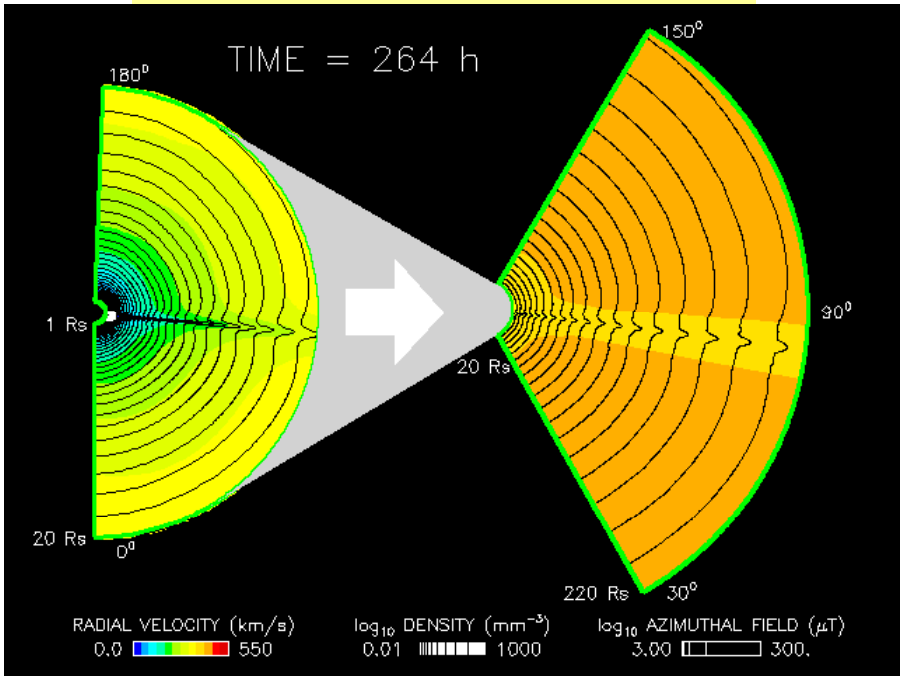
- Center for Integrated Space Weather Modeling (CISM), an NSF Science and Technology Center made up of a consortium of Universities led by Boston University
- Other major modeling efforts are being carried out by Michigan, New Hampshire, Utah State, and NCAR

CISM

CENTER FOR INTEGRATED SPACE WEATHER MODELLING

Education and Diversity

Space Weather Research and Model Development



Knowledge Transfer

The “Foundation” of the National Space Weather Program is healthy

- NSF is harvesting discovery science, developing new, powerful sensors and developing advanced models to push our understanding of Sun-Earth system to new levels.
- We are creating great opportunities for significant advancements of operational products

My view on what is required for successfully transitioning research to operations

- The key operational products need to be identified
- NOAA must work closely with the Community Coordinated Modeling Center
- Significant new resources must be identified for the Space Weather Prediction Center.