The Enterprise* of Space Environment Education

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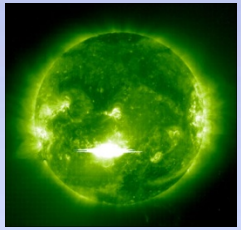
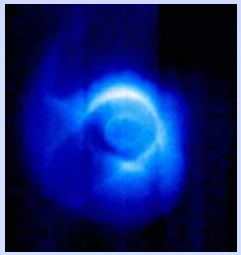
*Enterprise: a project undertaken or to be undertaken, especially one that is important or difficult or that requires boldness or energy

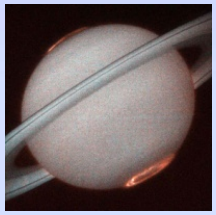
Space Environment Science "Family"

Meteorology



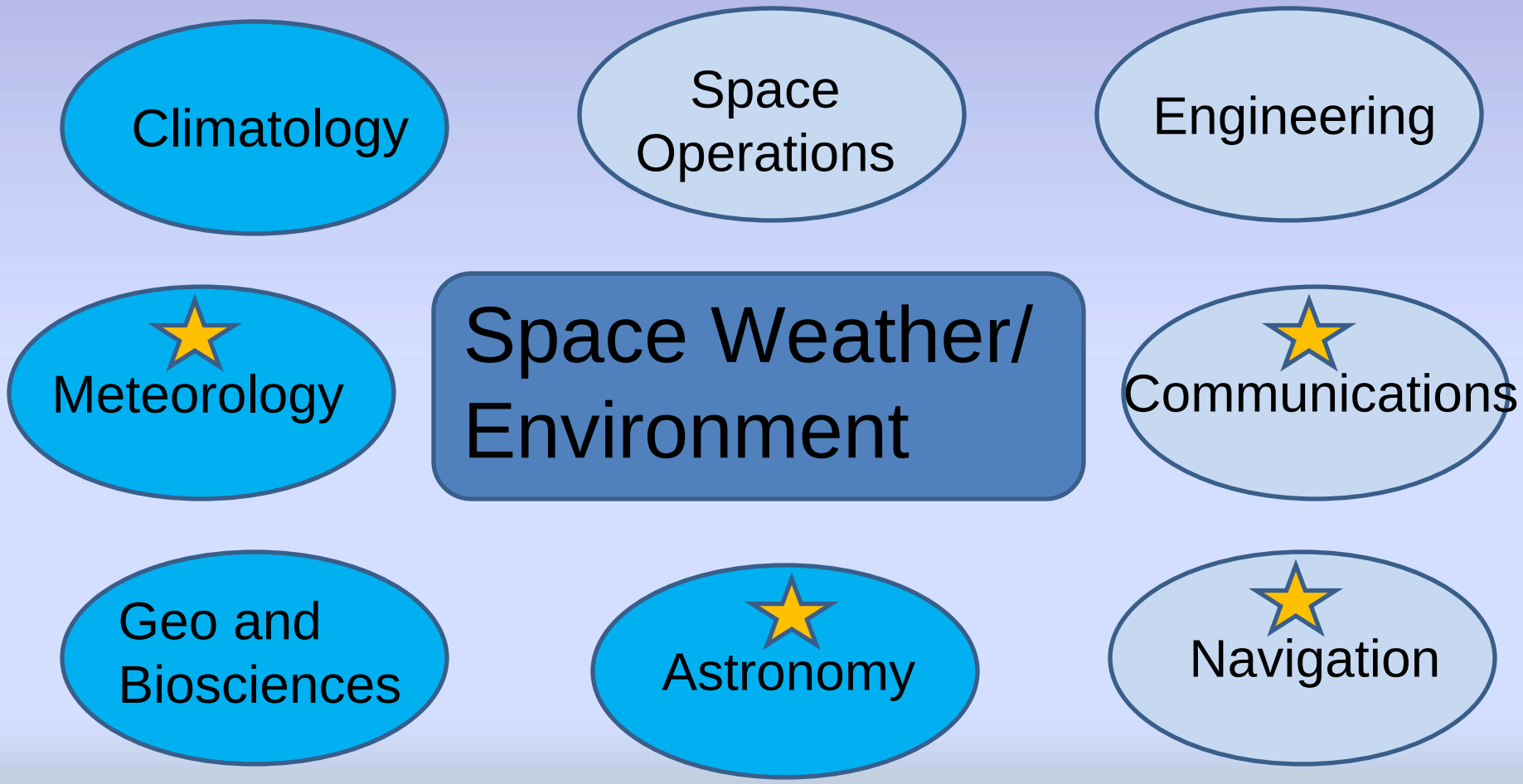


Space Weather/ Environment



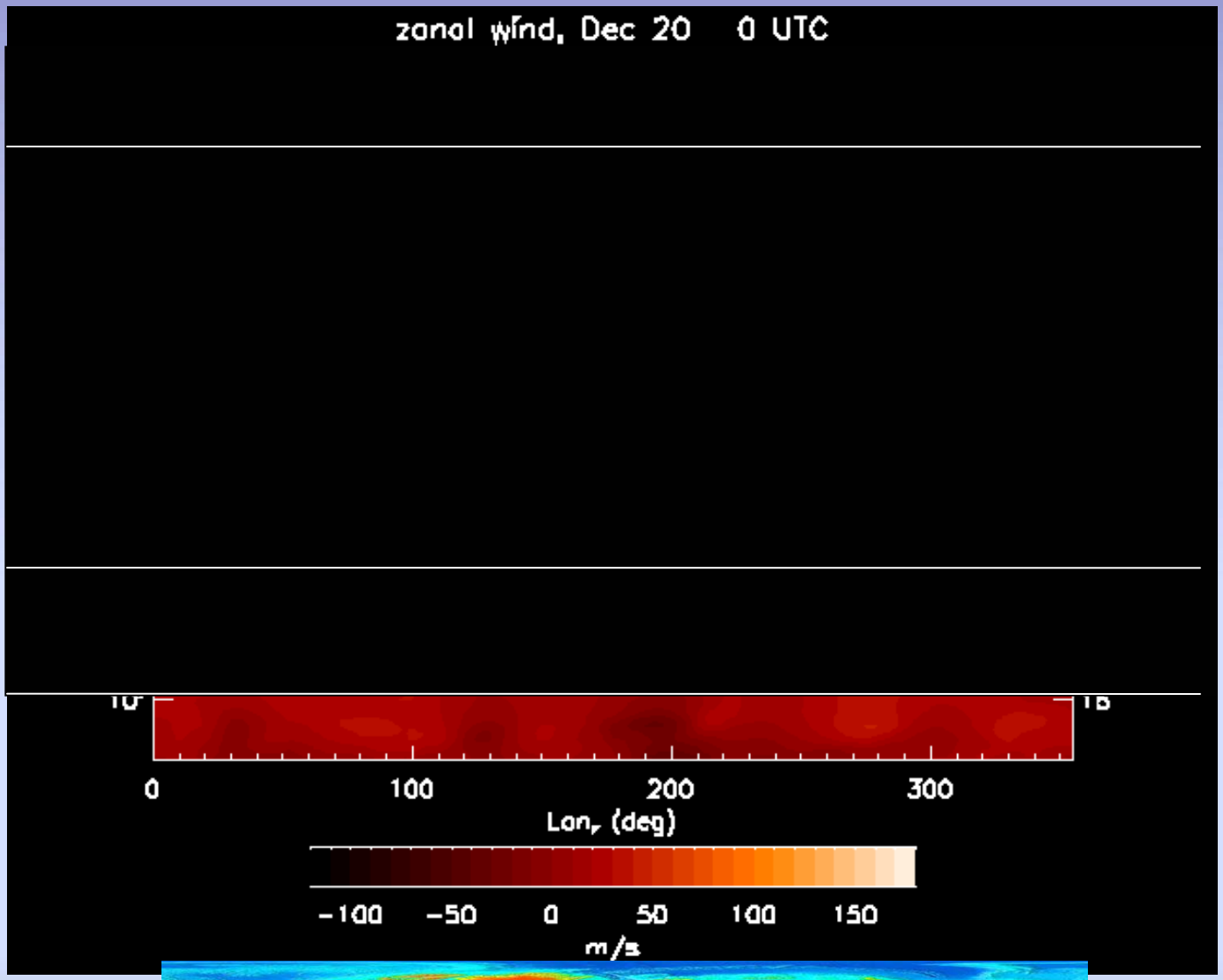
Astronomy

Professional/Academic Connections



10 days of east-west wind flow at 52 N

Atmosphere

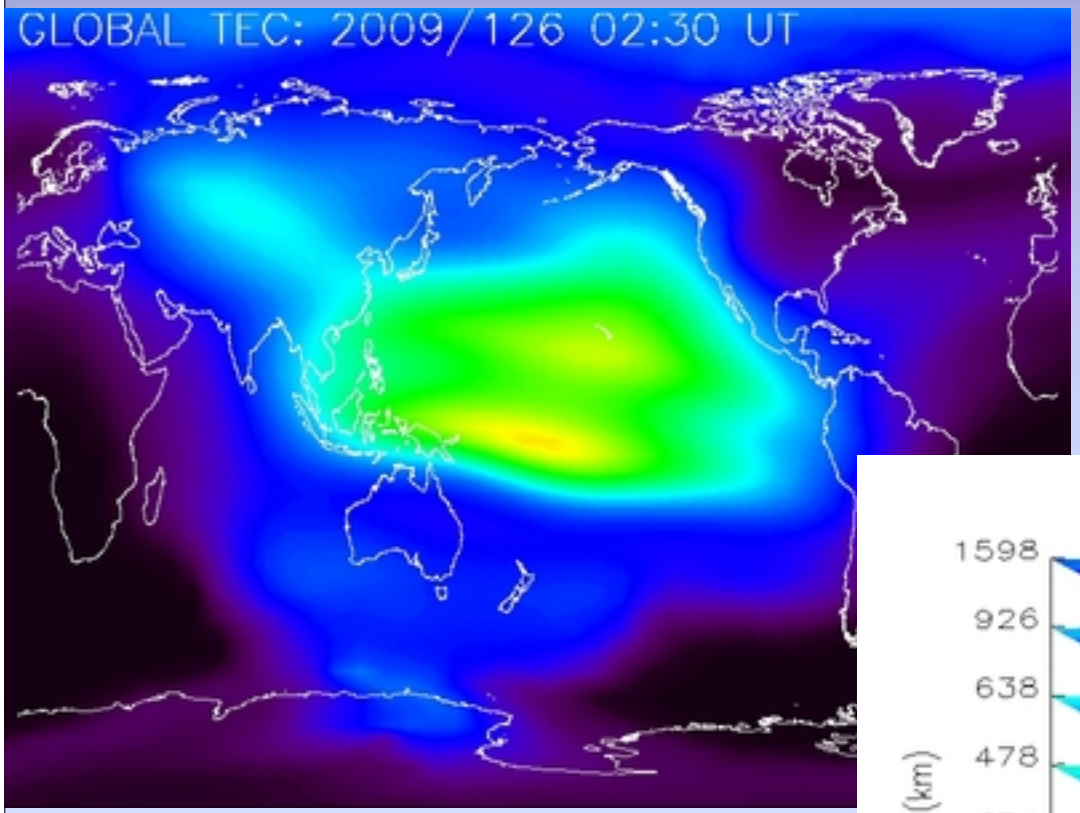


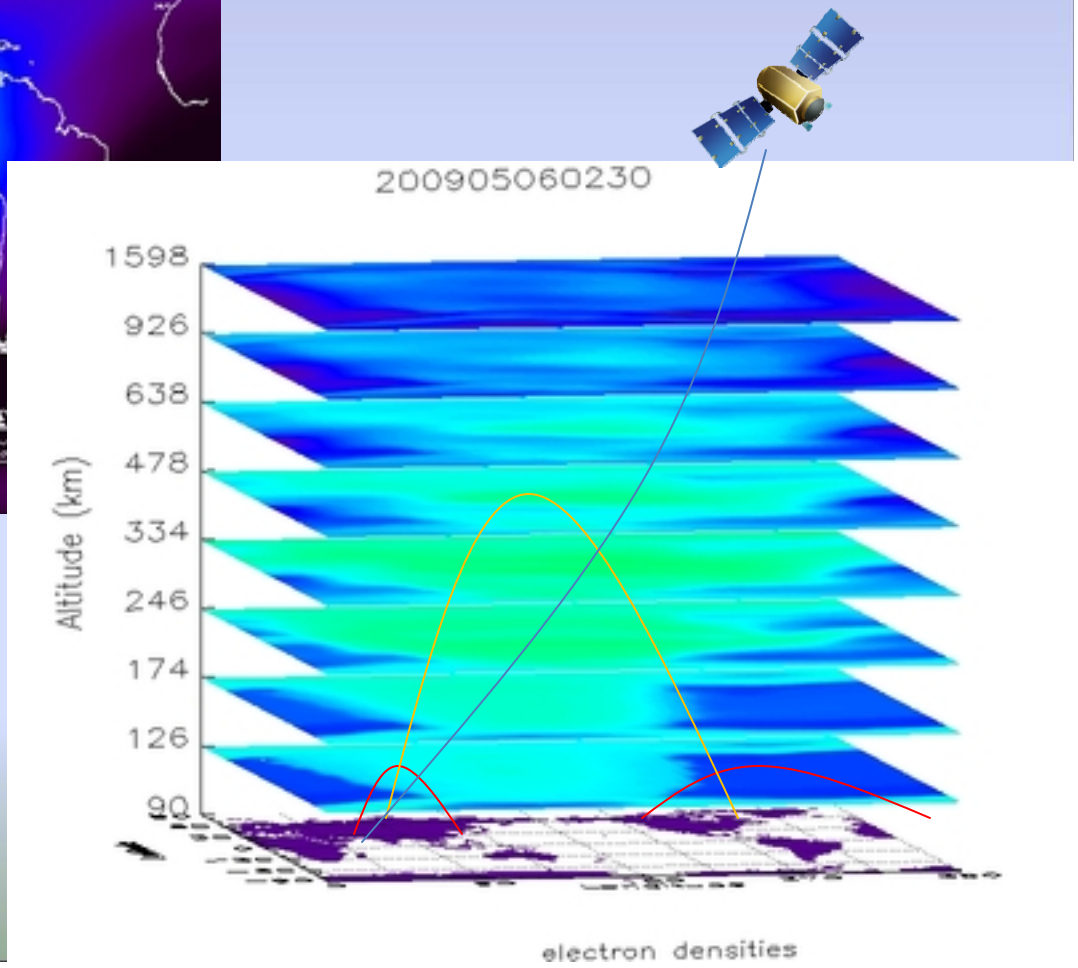
ISS

Ozone Layer

Courtesy of H. Liu, NCAR

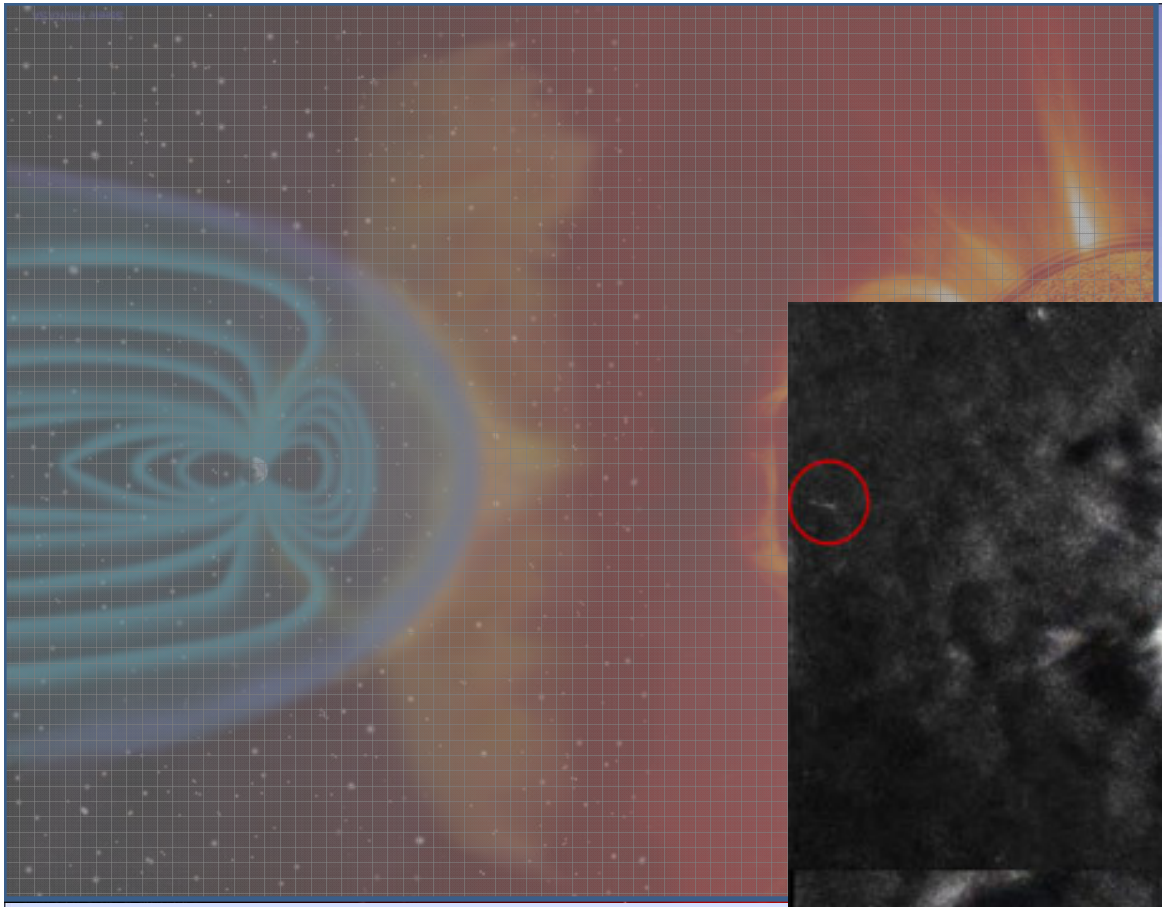
Iono (radio)sphere

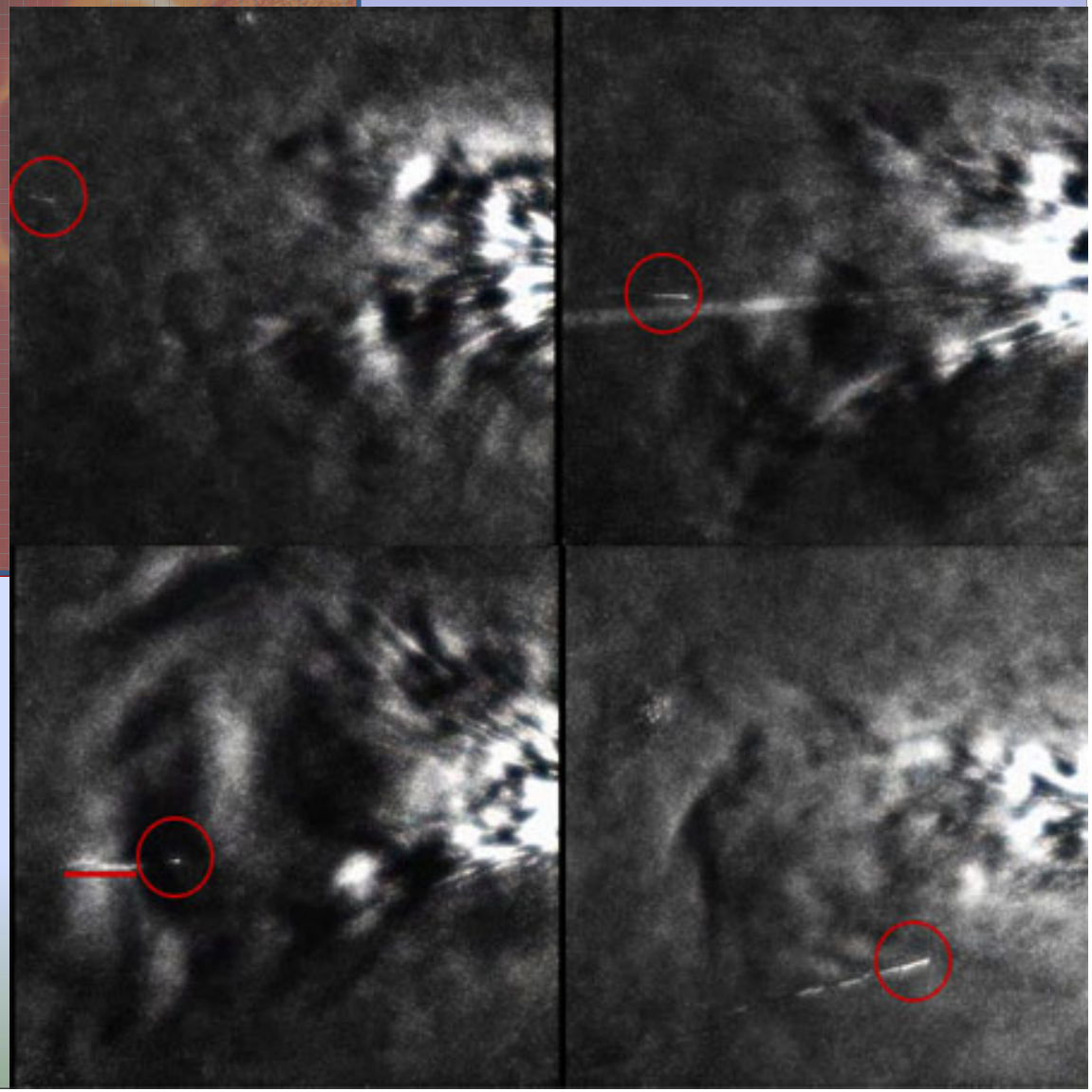




Courtesy K Tobiska, Space Wx

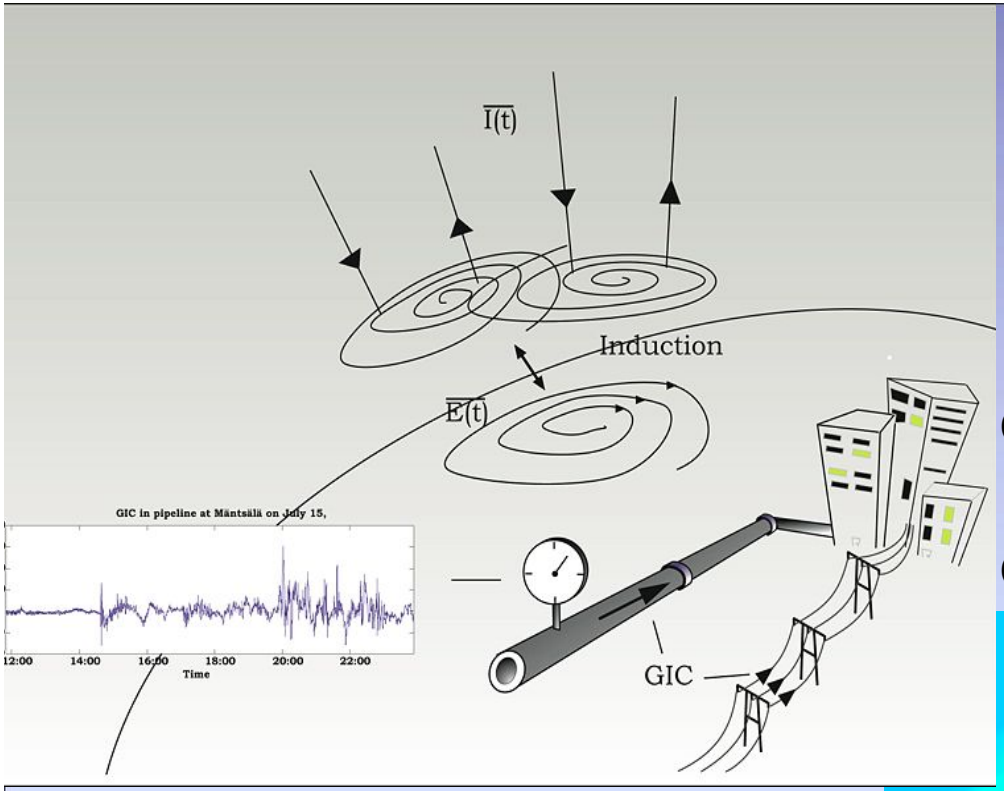
Heliosphere/ Magnetosphere





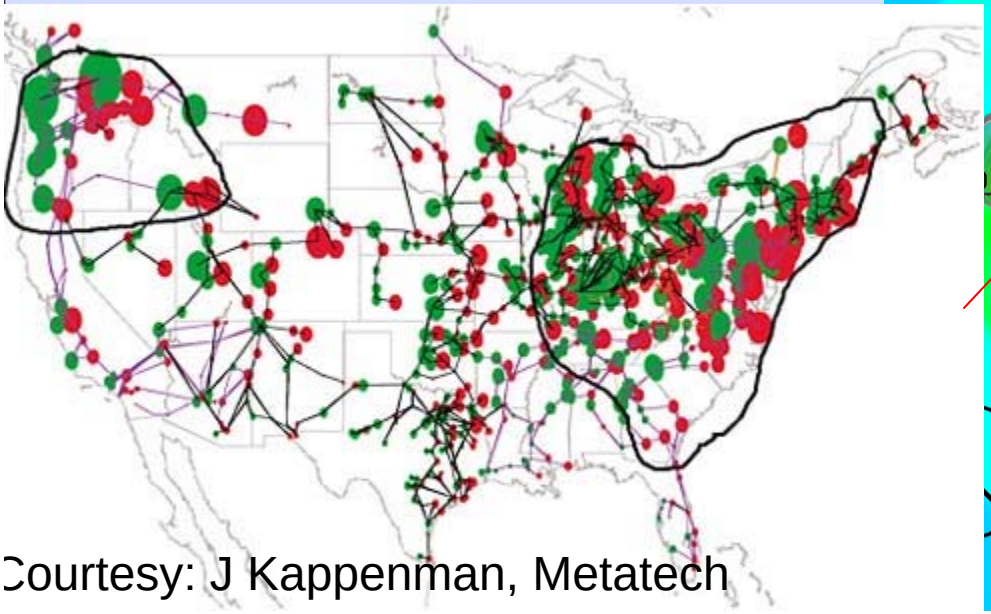
Courtesy NASA Comet Encke

Magnetosphere and the Surface

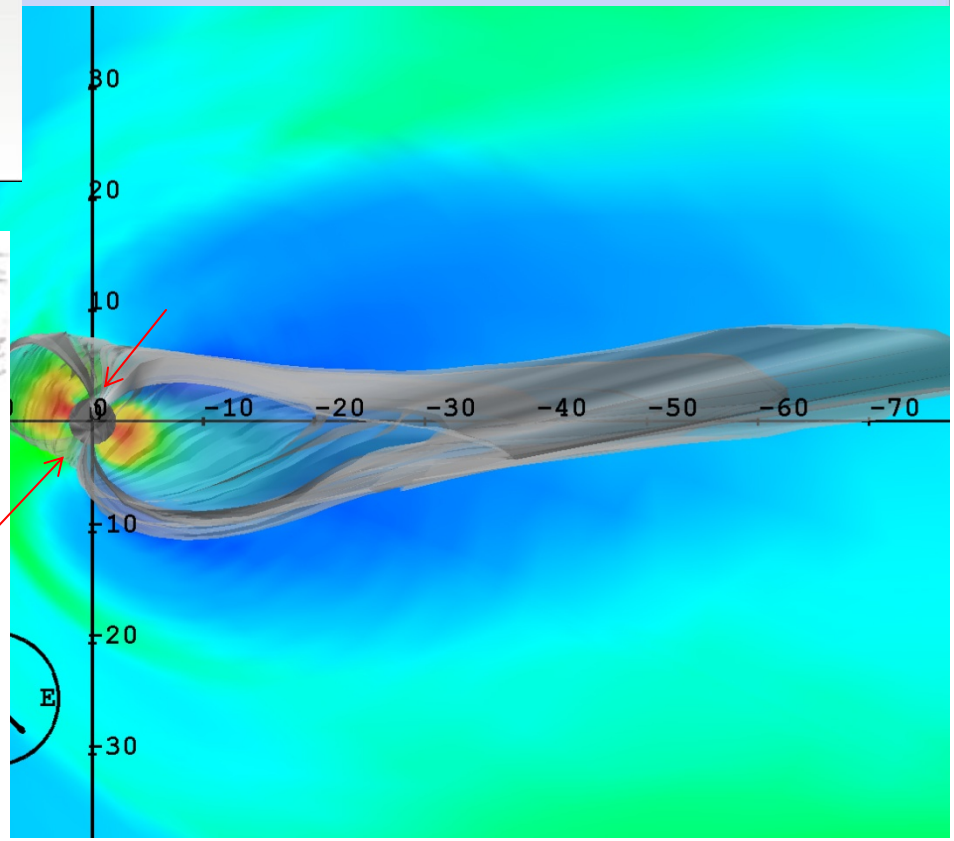


Courtesy: A. Pullkinen NASA

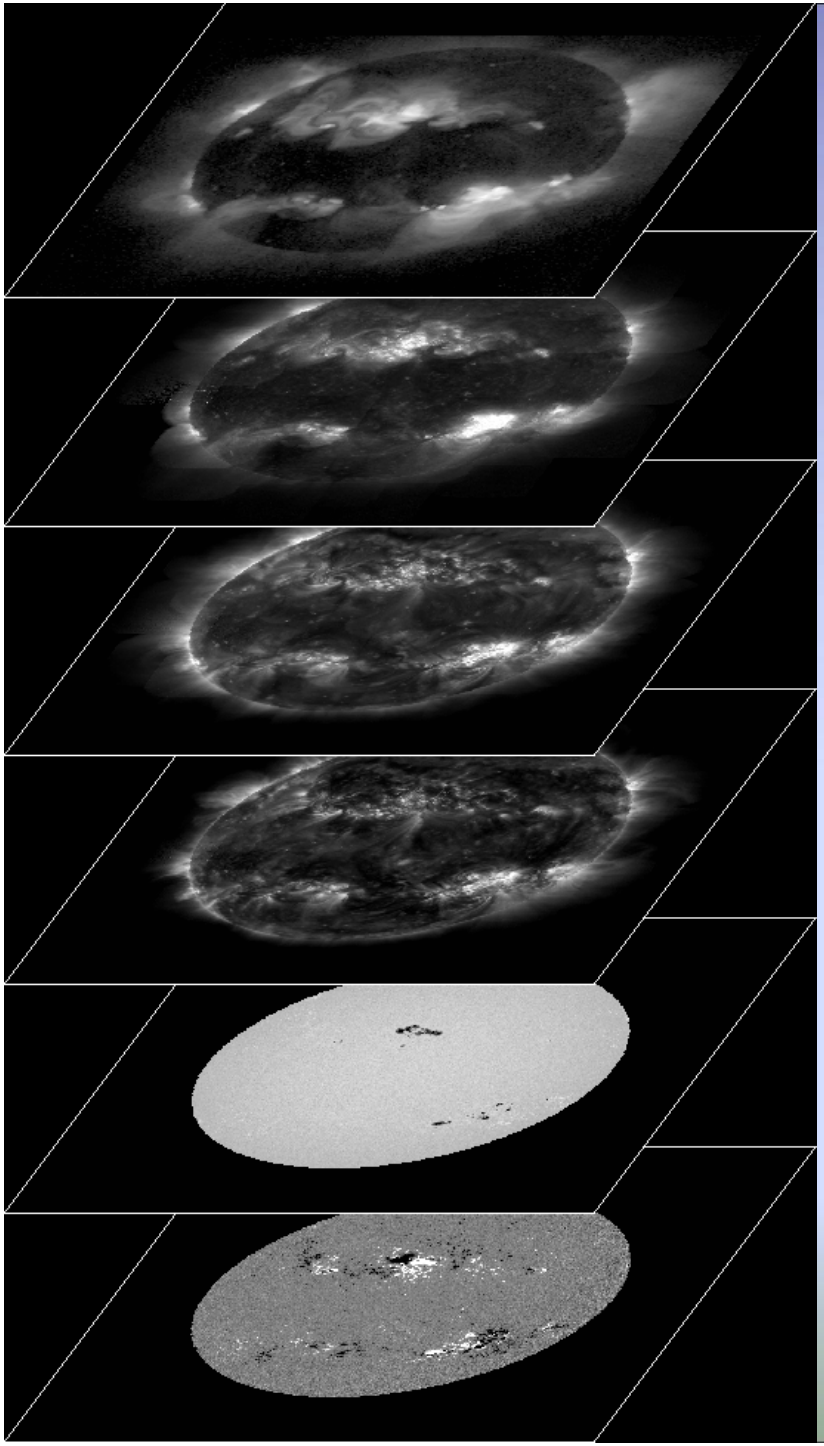
Courtesy: C. Goodrich Univ of Maryland

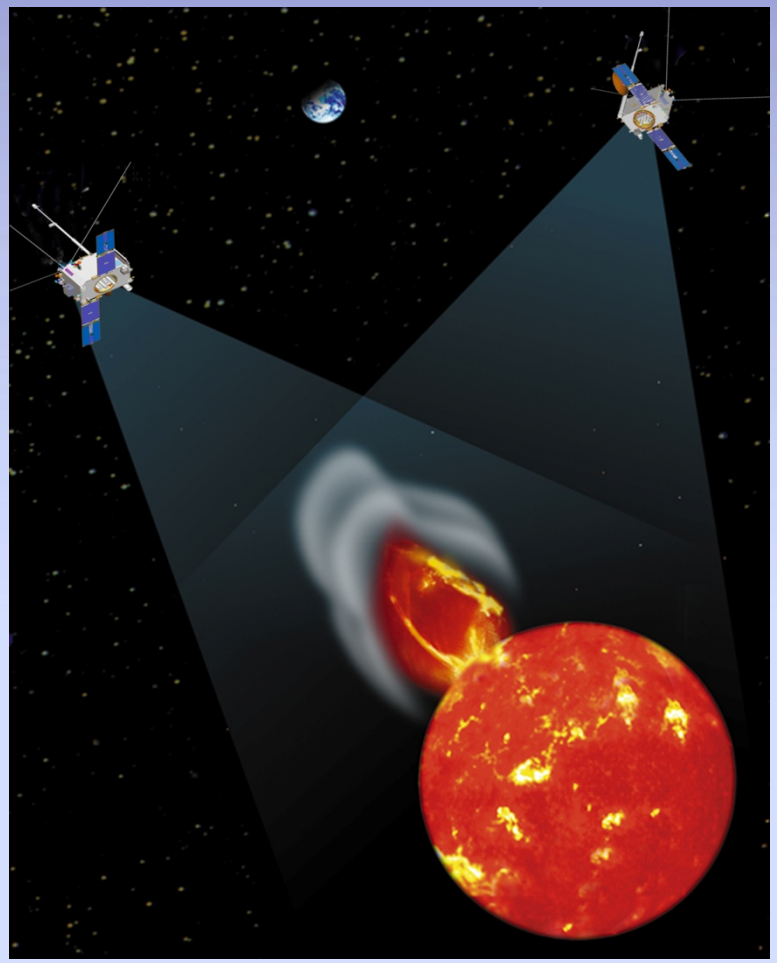


Courtesy: J Kappenman, Metatech



Helio(Solar atmo)sphere





STEREO (NASA)

SOHO (ESA and NASA)

Space Environmental Awareness and Education

Category	Level	Total US Institutions	# or % w Related Ed
Space Physics	Grad- Post Doc	~400 Ph D	~25
Observations, Modeling, Prediction			
Deep Understanding			
Space Environment Situational Awareness Education (Gen & Tech)	Jr College-Undergrad	~2000 Assoc ~2400 BS/BA	~0 ~10
Meteorology, Space Physics			
Engineering, Space Ops			
Bio, Geosciences			
Astronomy/Physics			
Climatology/Environemntal Sci			
Near Space Awareness (conceptual)	Middle School- Junior College	1000's	Few %
	Semi Formal	100's	Few %

Notable Programs and Steps Forward

- NSF:development of 8 new tenure track positions in US universities and colleges
- NSF and NASA support several EPO supplements to mainline research grants
- Several institutions supported International Heliophysical Year (IHY) initiatives
- NSF Center for Integrated Space Weather Modeling Summer School in 7th year of teaching 30+ students per year in two-week summer school
- NSF supports Teacher Education and Outreach Programs within National Center for Atmospheric Research
  http://www.windows.ucar.edu/tour/link=/teacher_resources/main/activity.html#sun2
- American Meteorological Society(AMS) has an official Policy Statement that encourages Universities (to) broaden their meteorology curricula to include space weather and its effects.
  http://www.ametsoc.org/policy/2008spaceweather_amsstatement.html
- Some states have educational standards for magnetism and Sun-related science
- Some organizations developing educational post secondary web content
  http://www.spaceweathercenter.org/our_protective_shield/01/minigolf.htmla
- Some universities have /are developing full space weather/space environment curricula

Improving Background and Focus in Space Environment Education

Middle School-Undergrad

- Math
- Motion
- Magnetics (Electro-)

Situational Awareness

- Statistics
- Seasonality
- Situation/Circumstances

Focused Course Work

- Particles/Plasmas
- Photons
- Fields

Space Environment Education Solutions 2010-2020

- Informal
  - Educational Gaming
  - Observatory/Planetarium Programs
- Mid, High School, Undergrad Teacher Development
  - Finding the Fit in General and Earth Science Courses
  - Prof Dev /Cont Ed for Middle-High School Teachers
- Semi-formal-Formal Education
  - Summer School (Under grad/Grad)
  - Accredited Undergrad Course for Intersessions (3 week)
  - Continuing Education Short Courses
  - Professional Seminars (1-2 days)

Summary

- Space Weather
  - While Unfamiliar to Most it Has Societal Impacts
- Knowledge and Education Gaps are Significant
- Plenty of Opportunity and Challenge in the Enterprise of Space Environment Education

Back-Ups

Teaching Size and Scale

- **SESSION 8. Education and outreach questions:**

- Q1. Does the public have sufficient awareness and understanding of space weather and its effects? The more direct stakeholders in corporations and government? Where has the enterprise achieved its best successes and where do we have the biggest challenges?
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- Q2. What successful approaches have you seen in outreach to the public? To decision makers and policy makers? Can you offer examples?
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- Q3. What can we learn from education and outreach efforts in other disciplines?
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- Q4. What other education and outreach efforts could we leverage for mutual benefit? In the physical sciences? Social sciences? Decision theory? Economics?
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- Q5. What do you see as the major challenges in developing future space weather researchers? In developing required expertise for the service providers? For the private sector?