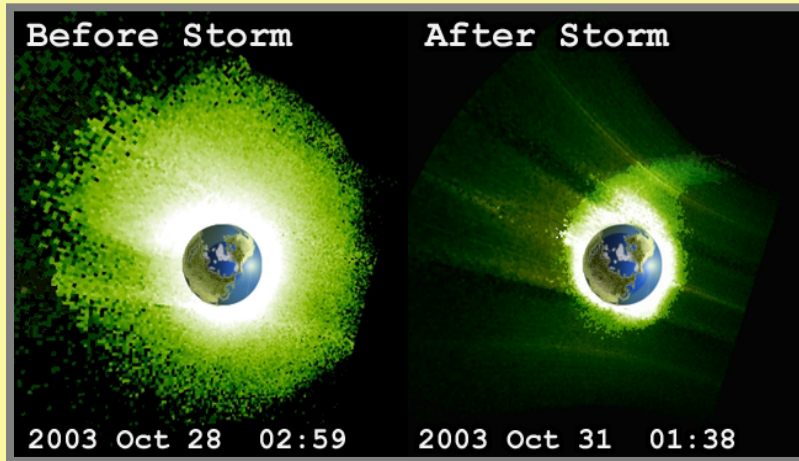
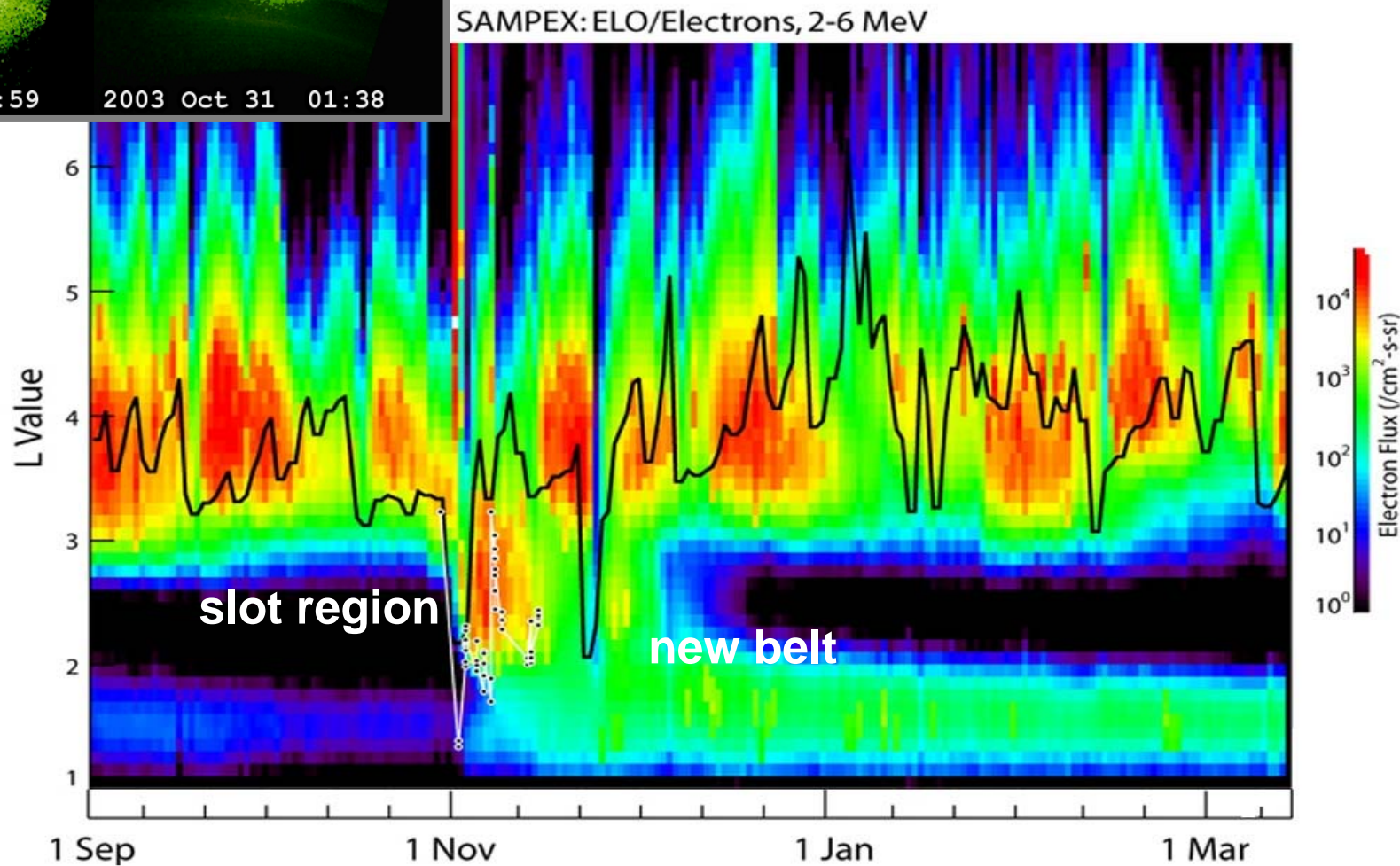


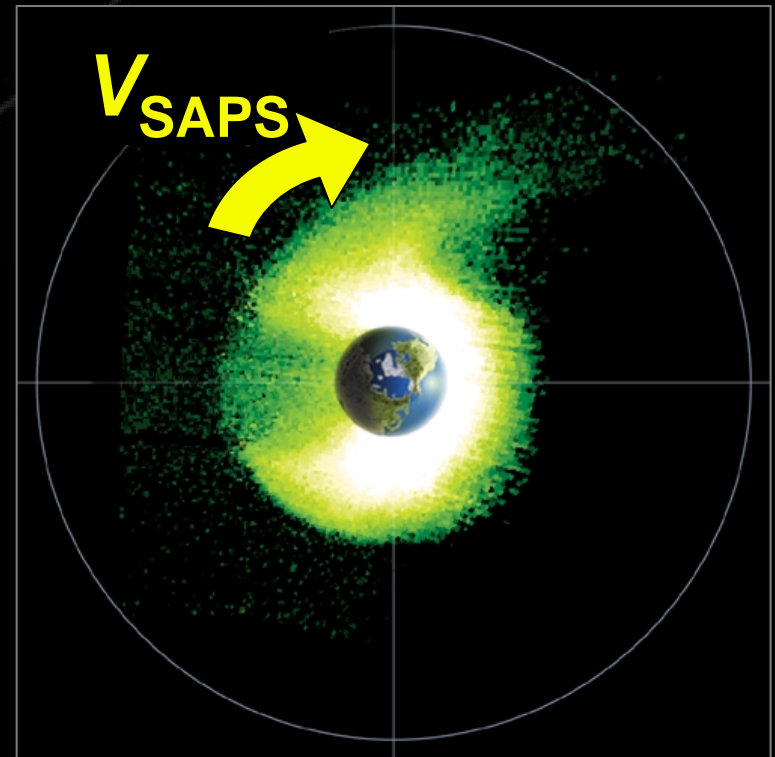
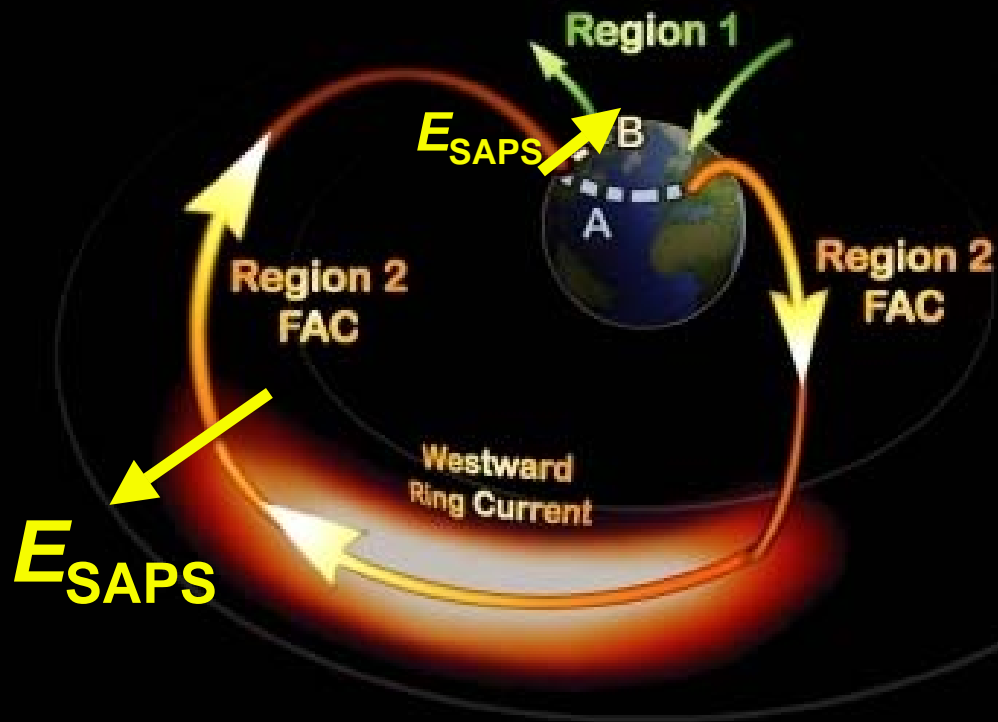
Halloween 2003 MEGA-storm



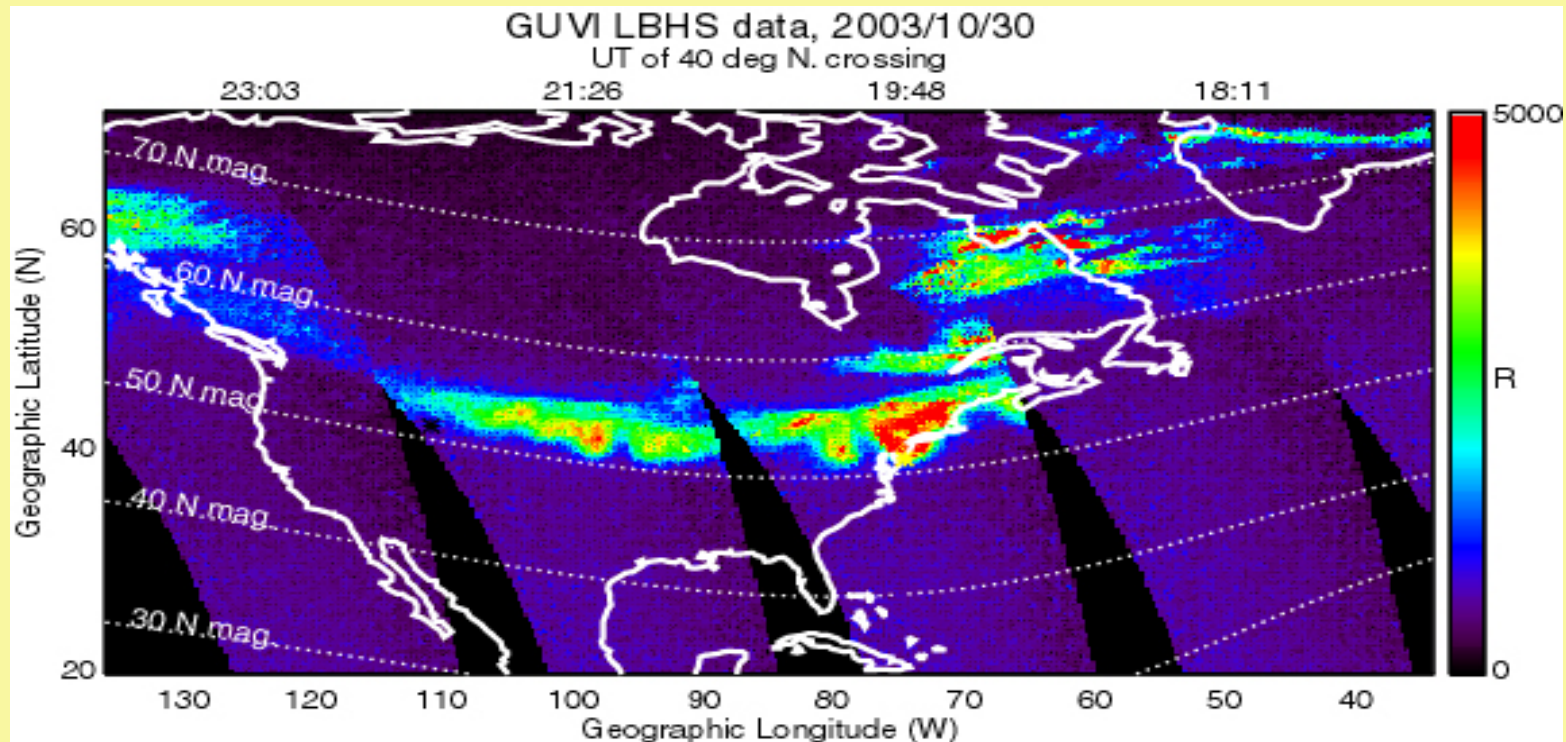
[*Baker et al., 2004, Nature*]



Effect of SAPS



TIMED GUVI Observations of the Aurora During the October 30, 2003 Magnetic Storms



The aurora moves 10 degrees equatorward between 18:11 and 19:48 UT

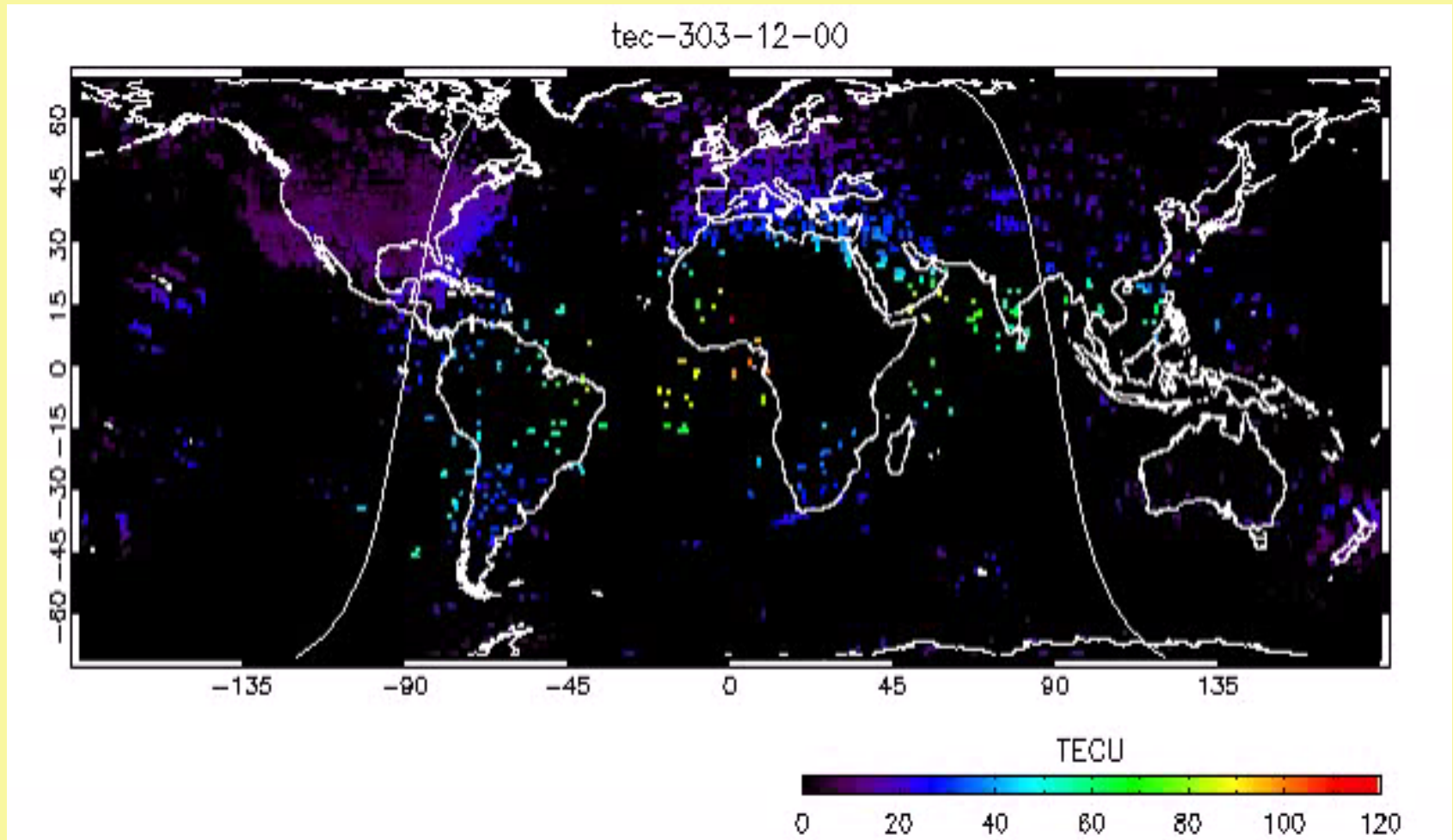


Aurora

Cumberland, Maine

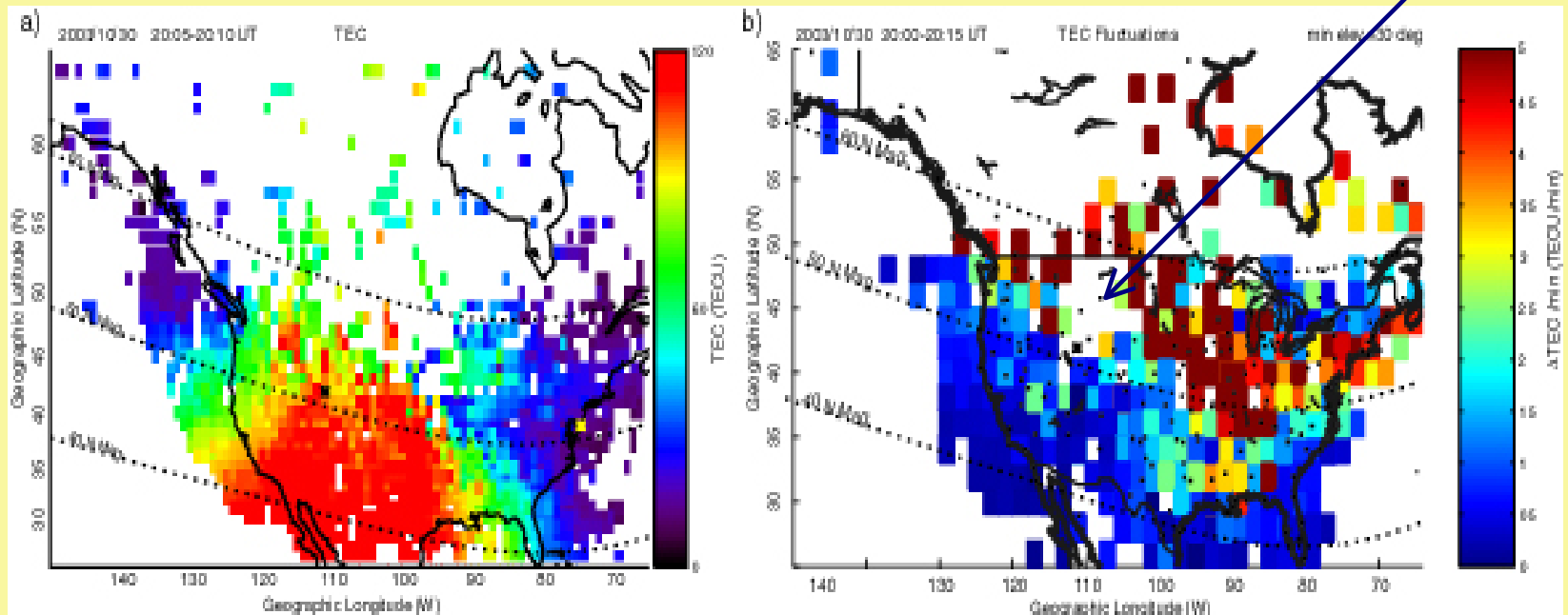
Copyright Paul Howell

Movie of Global Total Electron Content on Oct 30, 2003



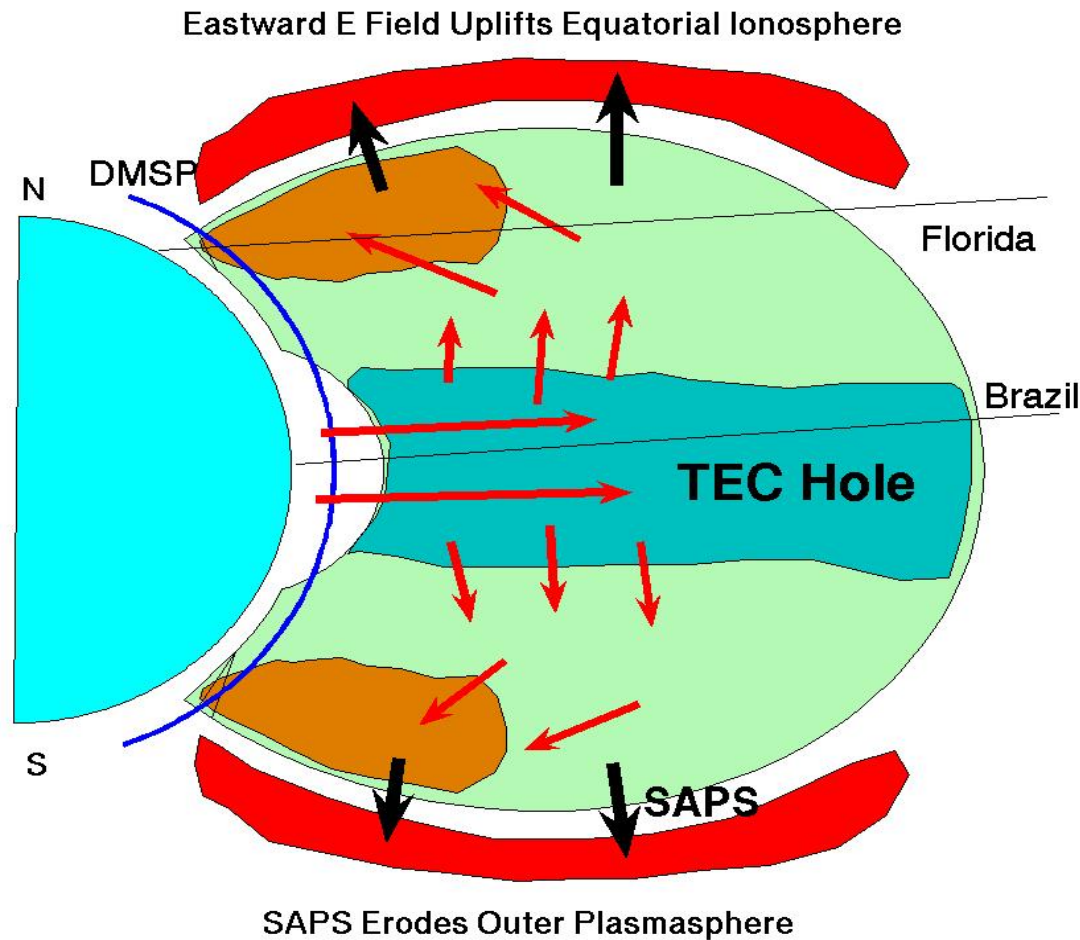
Highly Enhanced Total Electron Content and GPS Phase Fluctuations During October 30, 2003 Storm

GPS outage region

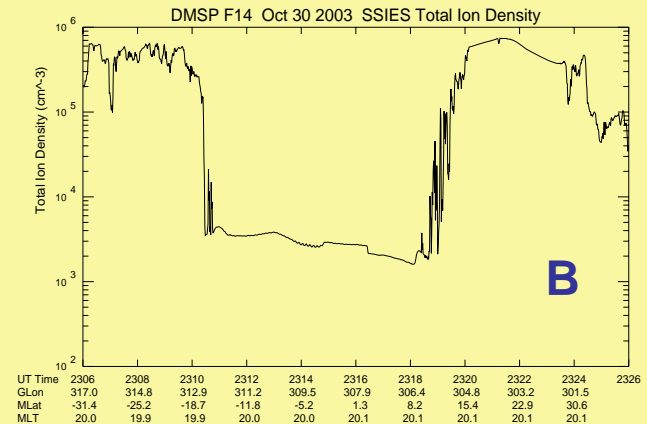
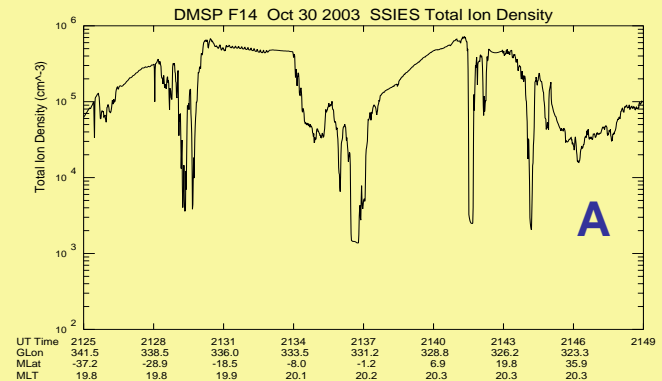
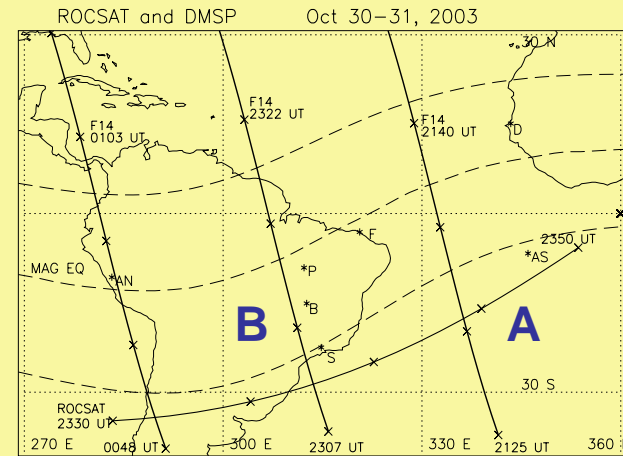
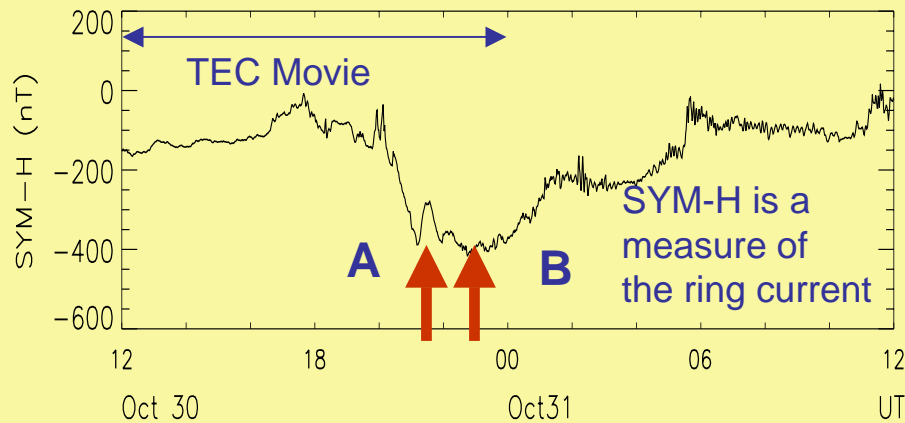
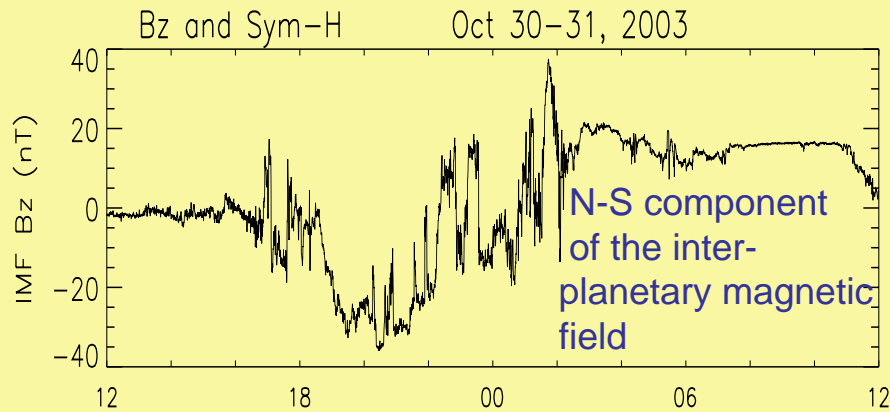


Intense GPS Phase Fluctuations ($\Delta \text{TEC}/\text{MIN}$) Occur in the Auroral Region and along the Storm Enhanced Total Electron Content (TEC) Gradient. GPS outage caused WAAS to be non-operational for 11 hours.

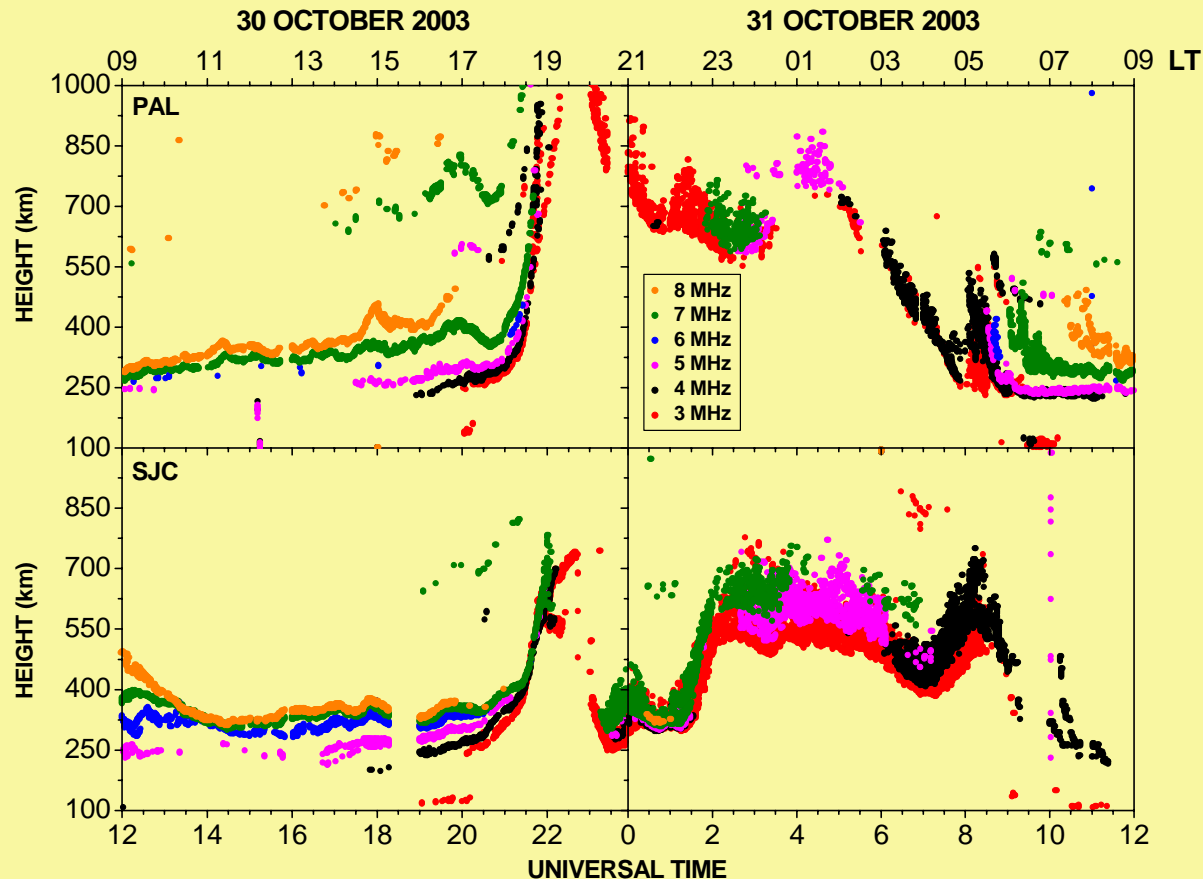
Cartoon representation of the effects of penetration E-fields on the M-I System



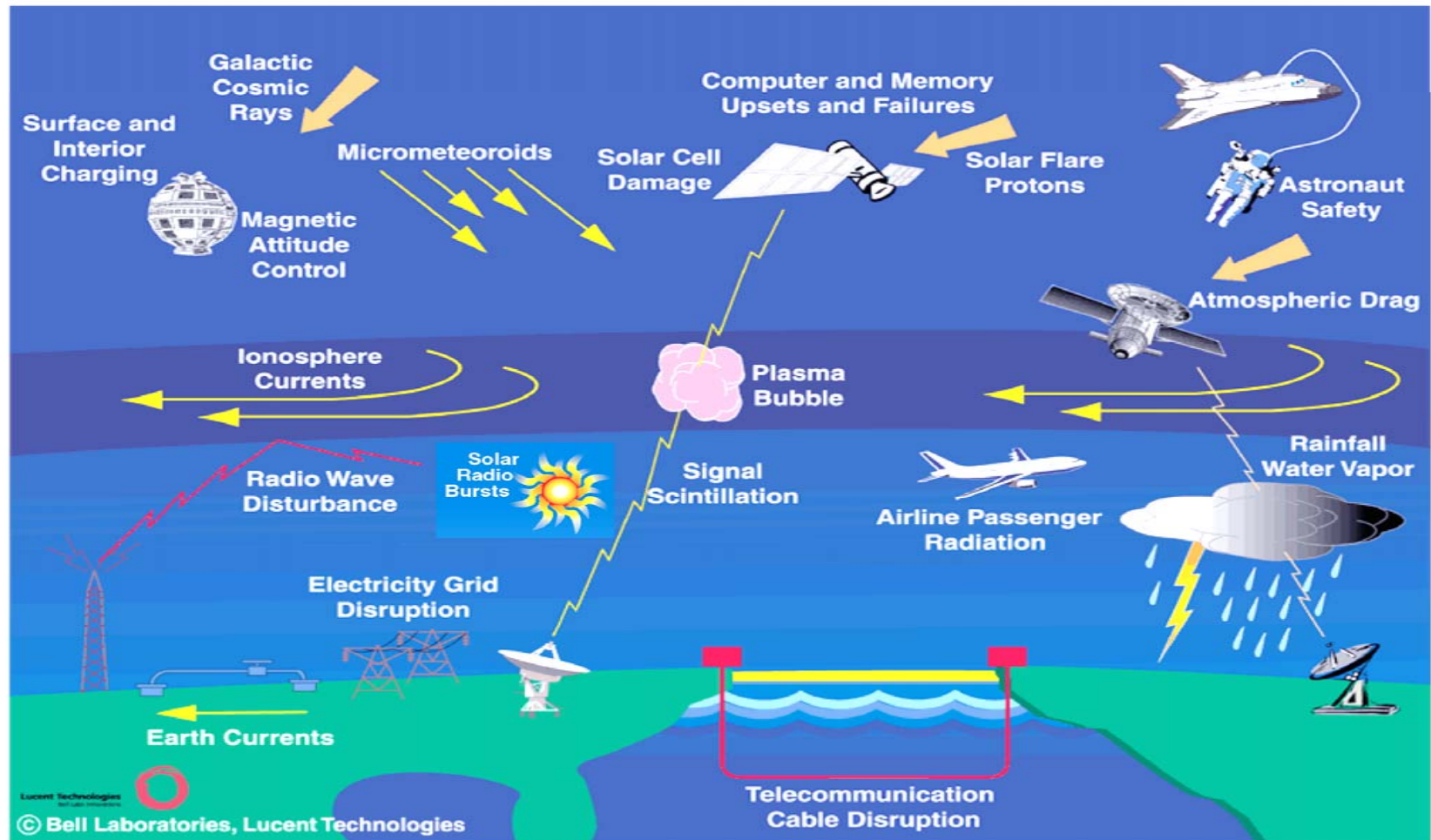
IMF Bz, SYM-H & DMSP during Oct 30, 2003 Storm



Spectacular Increase of Ionospheric Height at Magnetic Equator and Anomaly Locations in Brazil



Summary of Impacts on Technological Systems



CISM

CENTER FOR INTEGRATED SPACE WEATHER MODELLING

NSF Science and Technology Center (STC): Established at Boston University and funded in September 2002 for 5 years

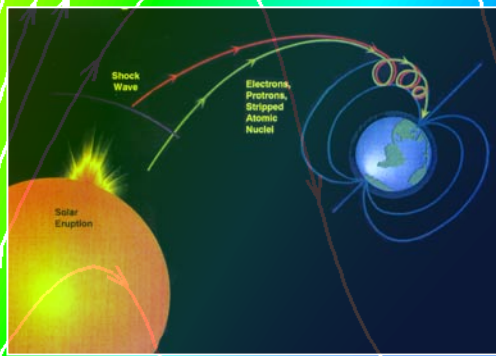
GOAL: Develop a series of ever-improving versions of a comprehensive physics-based numerical model that describes the space environment from the Sun to the Earth.

USES:

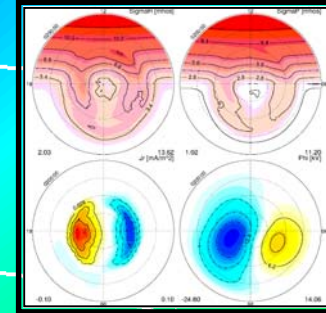
- Scientific tool for increased understanding of the complex space environment.
- Specification and forecast tool for space weather prediction.
- Education tool for teaching about the space environment.

MANDATE: in the US National Space Weather Program.

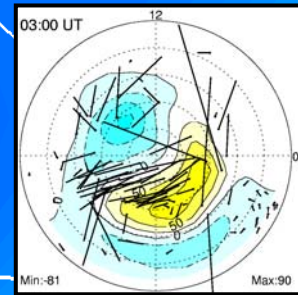
Energetic
Solar Particles



Ionospheric
Electrodynamics

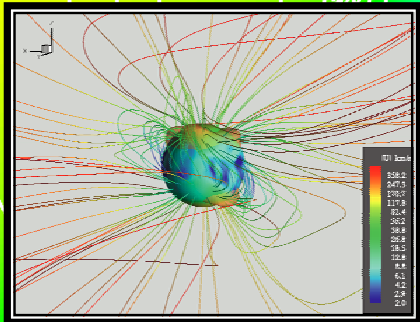


Inner Heliosphere

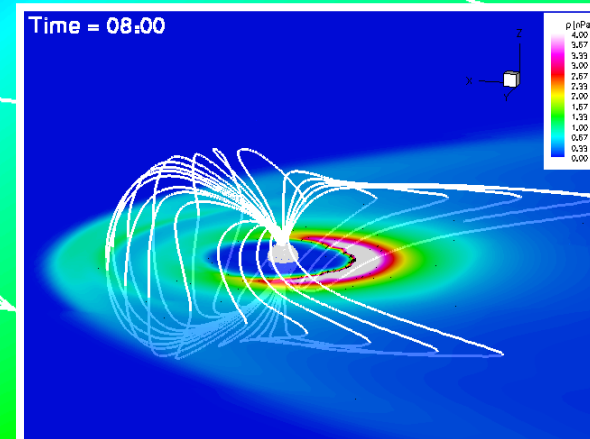


Data Assimilation

Solar Magnetogram
Driven Heliosphere

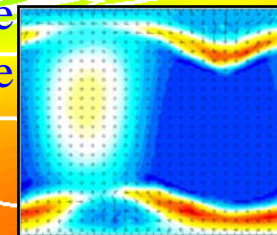


Radiation Belts

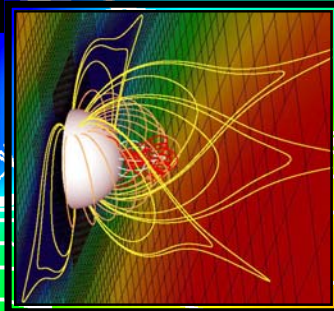


Global
Magnetosphere

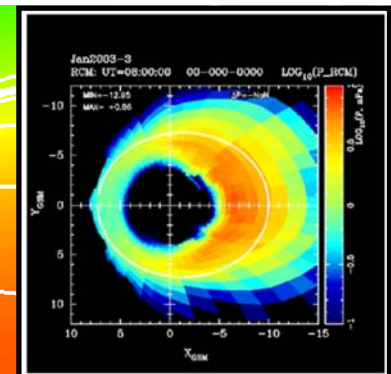
Global Ionosphere
& Thermosphere



Eruptive Event
Generator



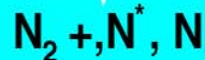
Inner Magnetosphere



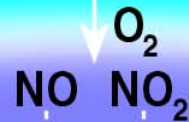
Particle-Induced Atmospheric Chemistry

Thermosphere

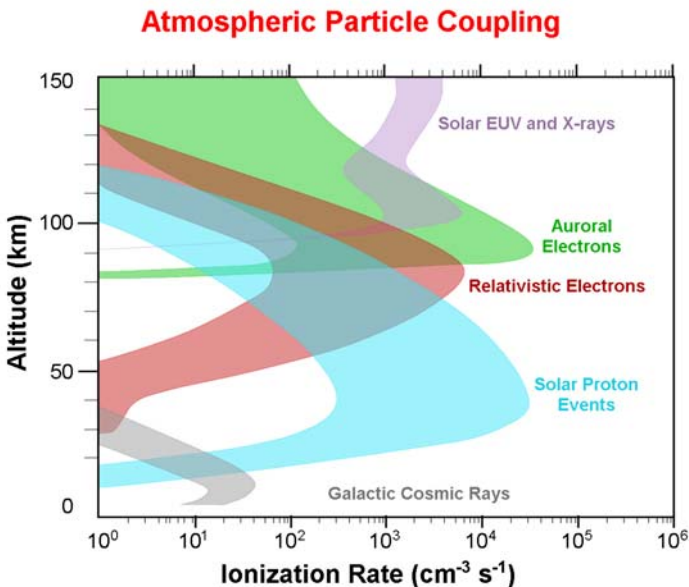
NO_y Production



NO_y Transport

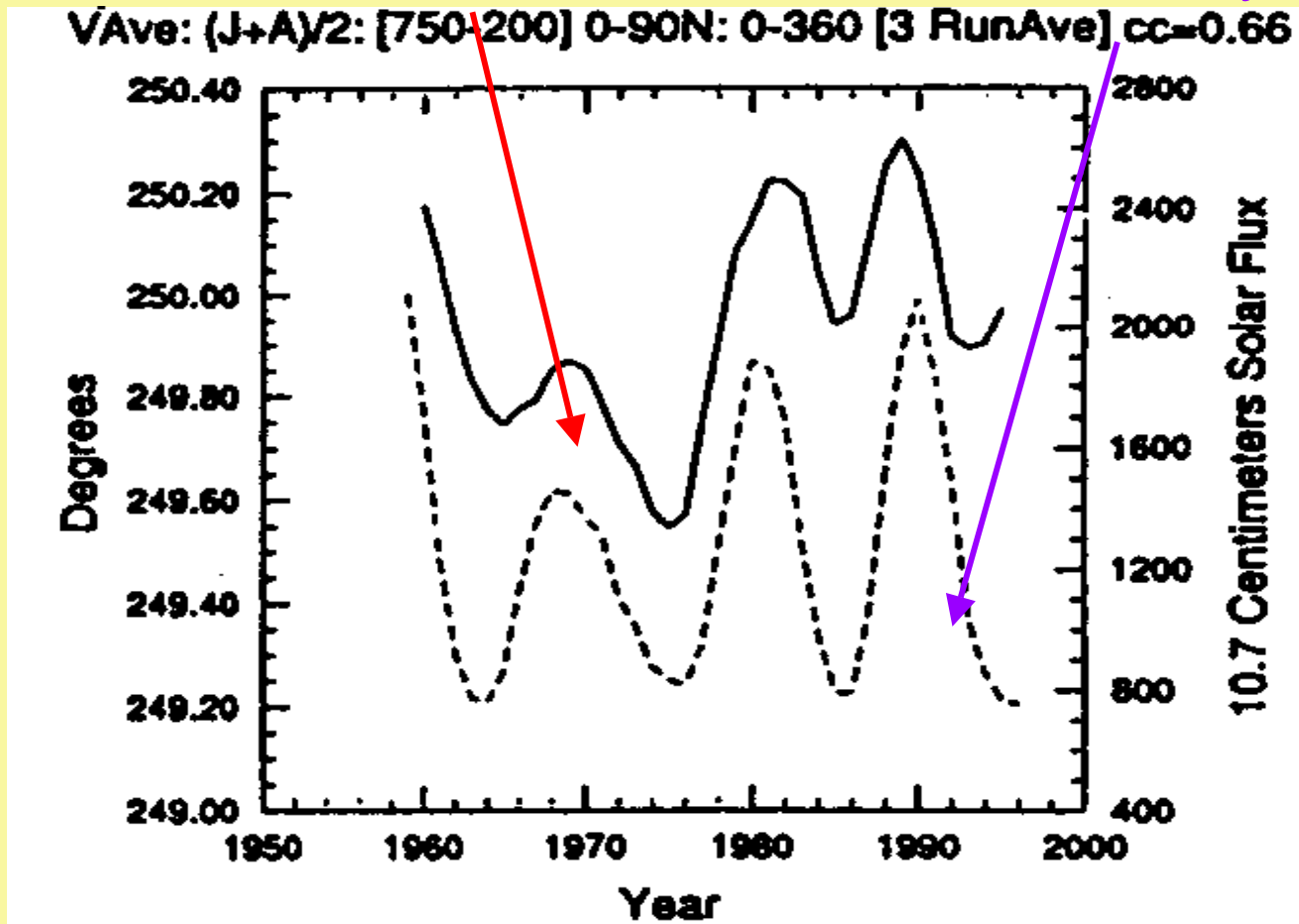


Catalytic O_3 destruction by NO_y

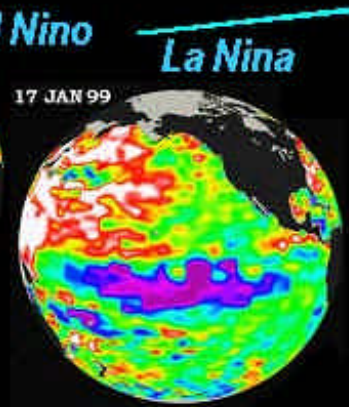
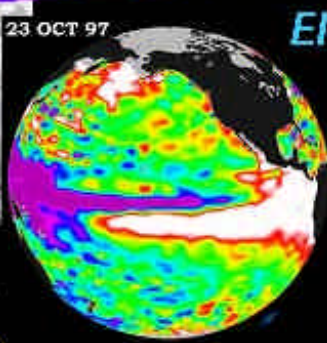
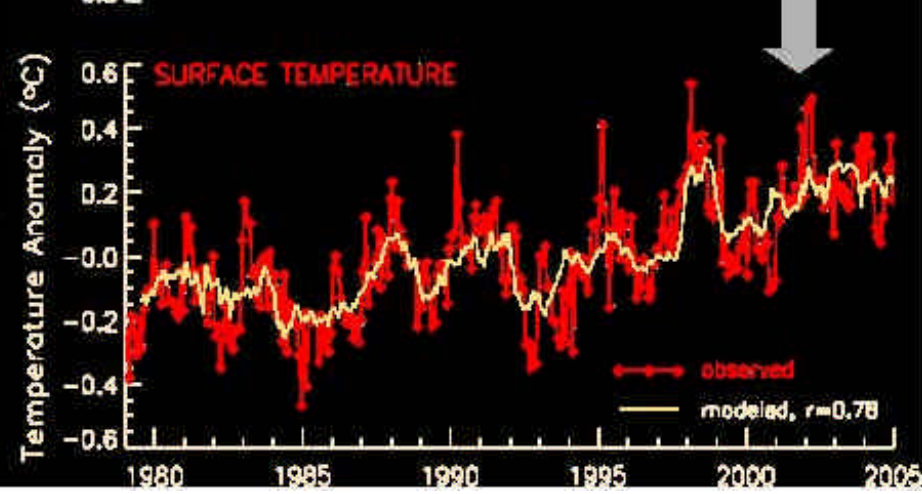
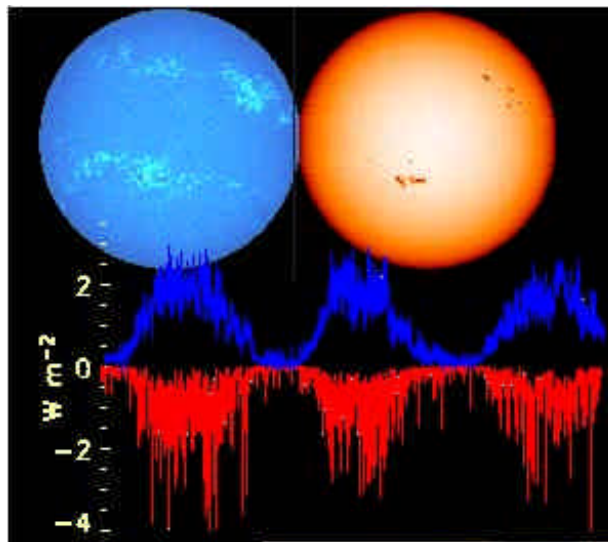


Northern Hemisphere summer temperatures (altitude 3-12km)

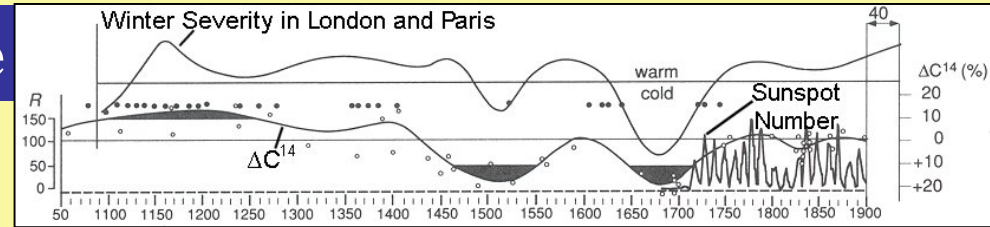
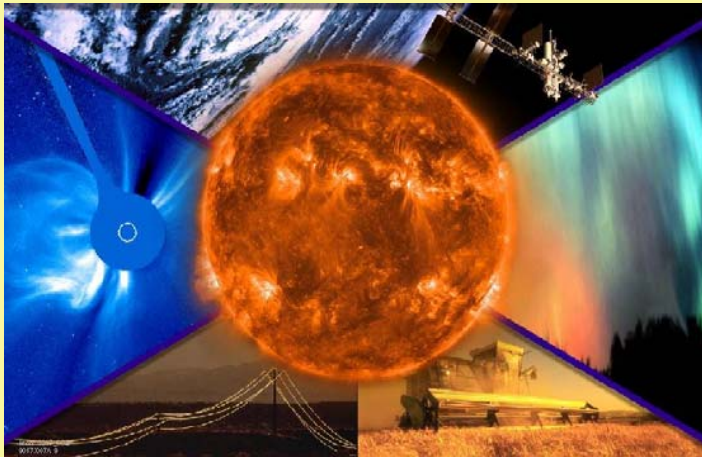
11-year solar cycle effects



Climate in Recent Decades

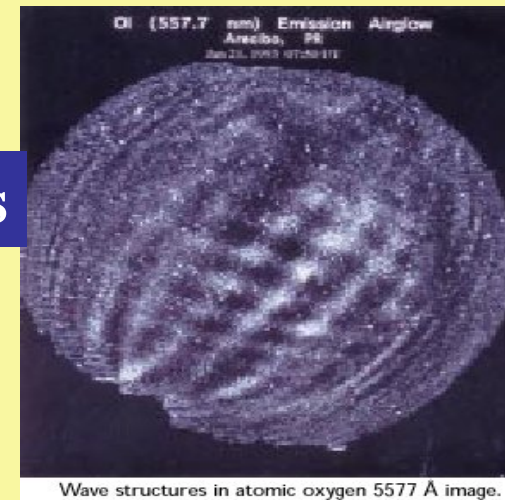
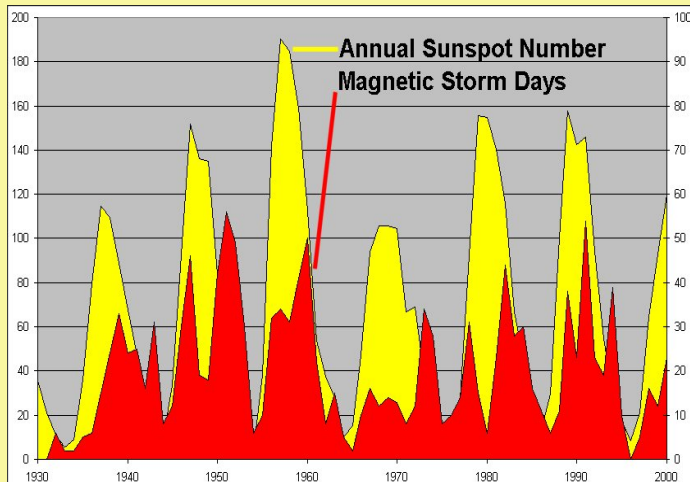


Solar Influence on Climate



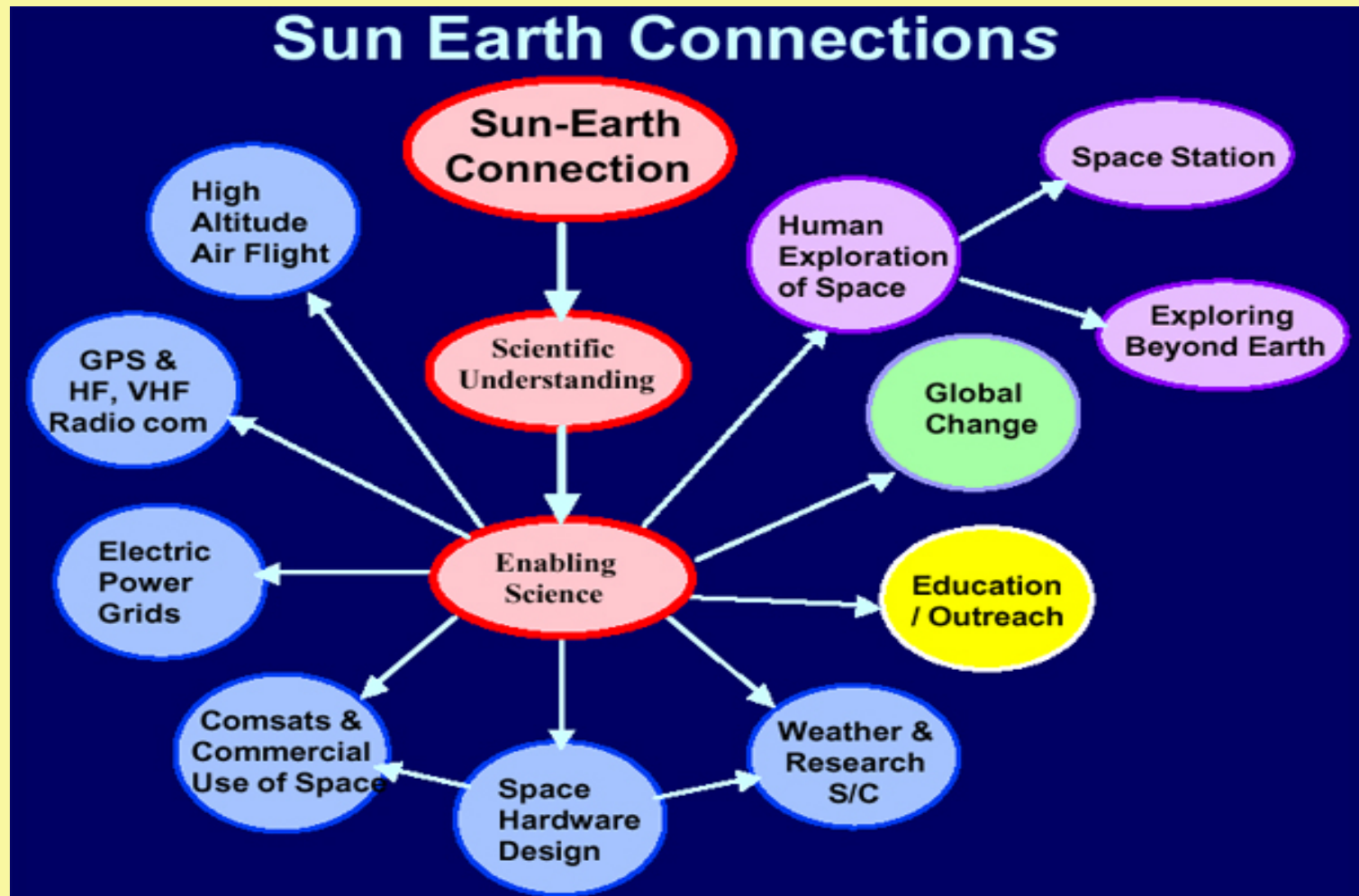
Space Weather: Science and Applications

Atmospheric Coupling Processes



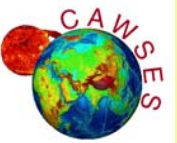
Space Climatology

International Living with a Star



I*Y 2007 – Celebrations of IGY + 50

- IPY** - The International Polar Year concentrates its attention on the high latitude zones of Earth.
- IHY** - The International Heliophysical Year expands the frontier of the IGY to the boundary of the heliosphere with a focus on fundamental processes.
- eGY** - The Electronic Geophysical Year is a cross-cutting program aimed at the development of optimized and interoperable data and processing systems that can serve the needs of an interdisciplinary research environment.



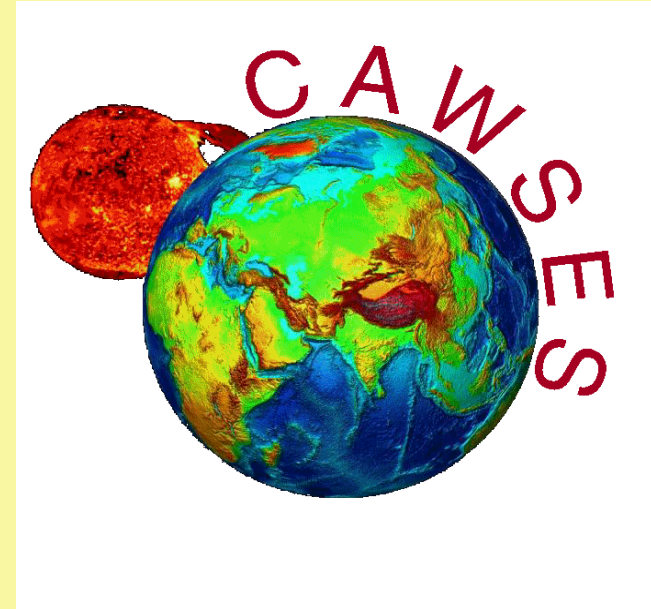
Value of CAWSES to IHY, eGY, IPY

- Progressively develop a set of new international data analysis tools
 - Valuable asset for space research
 - Combined with satellite data they give new ways of investigating important science questions
 - Lasting legacy after I*Y celebrations
- Collect & preserve comprehensive sets of international sun-to-Earth observations
 - Valuable for developing assimilative space weather models
 - Important for testing understanding and predictive capabilities of Sun-to-Earth models
 - Worldwide resource for Sun-Earth system science during and after I*Y
- Build up an international community familiar with campaign tools & collaborative analysis ready to participate in the I*Y
- Help refine science questions and needs for worldwide campaigns over 2 years in preparation for the I*Y celebration.



Please join one of the exciting programs involved with Sun-Earth System Science

- More information on CAWSES at <http://www.bu.edu/cawses>
- ILWS information on <http://ilws.gsfc.nasa.gov>
- Various I*Ys have their own web pages



Many thanks for your attention!