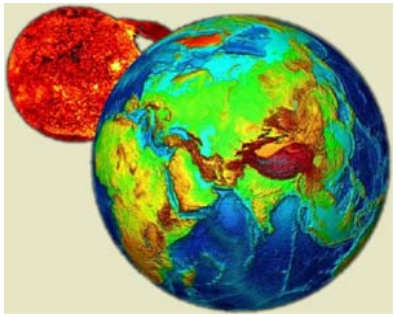
Climate
And
Weather
of the
Sun-
Earth
System

CAWSES



Courtesy Peter Sloss, NOAA NGDC

CAWSES-
SCOSTEP's program
for 2004-2008

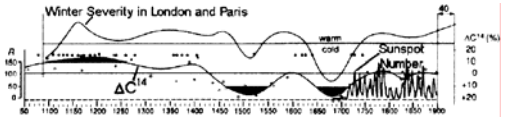
During 2004-2008, CAWSES, SCOSTEP's new international scientific program, will link the world's scientists in a cooperative effort to study the entire interactive Sun-Earth system. SCOSTEP recognizes the very impressive past, present, and planned space missions; ground-based observations; and theory, modeling, and data analysis efforts aimed at understanding aspects of the Sun-Earth system. Its new program, CAWSES, seeks to mobilize the international solar-terrestrial science community to fully utilize past, present, and future data; to produce improvements in space weather forecasting, design of space- and Earth-based technological systems, and understanding the role of solar-terrestrial influences on Global Change. The CAWSES Science Steering Group (SSG) has organized around four themes:

- Solar Influence on Climate
- Space Weather: Science and Applications
- Atmospheric Coupling Processes
- Space Climatology

Solar Influence on Climate

Chair: M. Lockwood

The aim of this project is to investigate the effects of solar variability on the climate of the lower and middle atmosphere. Variations in solar spectral irradiance, as well as solar energetic particles and galactic cosmic rays, will be considered along with their impacts on the thermodynamic, dynamical, chemical, and microphysical structure of the atmosphere. Emphasis will be placed on physical processes involved, and the study of paleoclimates will provide a historical context within the broader domain of extreme environments pertinent to the Sun-Earth system. The project will include an ongoing assessment of the state of the science in this area as it evolves.

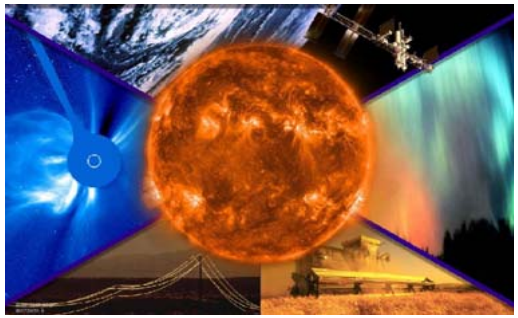


Courtesy J. Eddy, *Science*, 192, 1189, 1976

Space Weather: Science and Applications

Co-chair: J. Kozyra
Co-chair: K. Shibata

"Space Weather" is a term that encompasses the science and applications arising from short-term variations of the Sun, propagation of energetic particles and electromagnetic emissions through interplanetary space, and effects on technology and humans orbiting in geospace and on the Earth's surface. It includes rapid phenomena such as solar flares and coronal mass ejections, effects of shock waves at the magnetopause, short-lived magnetic substorms at auroral latitudes and longer-lasting global magnetic storms, as well as large and small scale ionospheric structures driven by internal atmospheric processes. These can affect satellites and humans in orbit, interrupt telecommunications, and degrade power distribution systems. The goals of the project are to develop dependable, robust deterministic end-to-end models that predict conditions in geospace from a quantitative understanding of the observed phenomena including multi-scale coupling between different plasma regions of the Sun-Earth system. A desired outcome will be identification of critical inputs to specify the geospace environment to minimize impacts of solar disturbances and geomagnetic storms on technology, on human society, and all life.



Courtesy NASA SEC Roadmap

Atmospheric Coupling Processes

Chair: F-J. Luebken

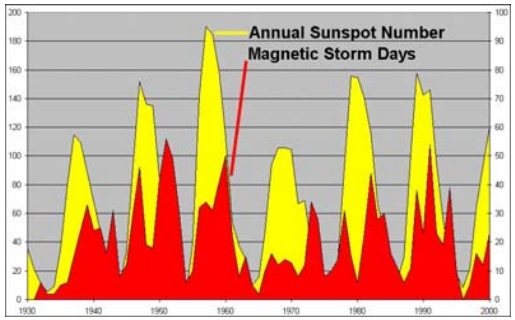
Solar and magnetospheric inputs propagate downward through the atmosphere while tropospheric effects propagate upward to the thermosphere-ionosphere system. The propagation can occur through dynamic, radiative, and/or electrodynamic coupling or through the transport of atmospheric constituents. This project will seek to gain greater understanding of atmospheric coupling processes by means of observations, theory, and modeling. Such coupling processes can be an important consideration of Space Weather and Space Climatology as well as for Solar Influences on Climate.

Wave structures in atomic oxygen 5577 Å image
Courtesy CEDAR-III Report

Space Climatology

Co-chair: C. Froehlich
Co-chair: J. Sojka

As the range and amount of solar-terrestrial data grow, detailed analyses of the climatology of the Sun-Earth system become feasible. Climatology includes a description and understanding of the average properties and regular variations of the system; description and analysis of probabilities of extreme events; and evaluation of long-term trends. CAWSES will facilitate compilation of climatologies of the Sun, interplanetary medium, magnetosphere, ionosphere, and upper and middle atmosphere; it will assess long-terms trends in these system components; and it will seek to understand the underlying processes that influence the climate. It will assemble and evaluate relevant data sets and help make them available to solar-terrestrial scientists worldwide. It will assess the characteristics of each data type (accuracy, precision, etc.) and bring them onto a common space-time domain so that individual variations may be interpreted in terms of different causes.



Courtesy J.H. Allen, Personal Communication

For each component of the Sun-Earth system, this project will represent the average conditions, the regular variations, the long-term trends, and the statistical properties of irregular variations with the aid of models. It will quantify the probabilities of extreme events. It will analyze relations among the variables of the system components. It will carry out a critical assessment of long-term trends in the system, joining with SPARC (Stratospheric Processes and their Role in Climate) for the assessment of middle- and upper-atmosphere trends. It will interact closely with the other CAWSES projects in achieving its goals.

Capacity Building and Education

SCOSTEP Bureau

One measure of the success of any scientific program is the residual legacy it leaves behind in the lives of its participants and within participating institutions and nations. It is SCOSTEP's intention to reach out to involve Developing Nations of the world in CAWSES and to disseminate material to educate the public about the solar-terrestrial science that CAWSES will be addressing. CAWSES science is relevant to all nations, developing and industrialized, through solar-terrestrial influences on technological systems and on the global environment. A significant portion of the SCOSTEP resources devoted to CAWSES will go toward involving scientists from Developing Nations in the program and for education. We will also look to expand upon these resources by developing external support for these efforts. CAWSES will hold meetings, identify scientists from Developing Nations to do CAWSES science, and help supply those scientists with computational and data resources to carry out their research. Partnerships will be established between Developing Nation scientists and scientists having better access to data and technology. CAWSES will develop material to educate the public from all nations about solar-terrestrial science and the relevance of solar-terrestrial processes upon their lives.

Visitor Center at Arecibo Observatory, Puerto Rico
Courtesy Su. Basu, Personal Communication

CAWSES SSG

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C.-H. Liu (China-Taipei)
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