Introduction of CAWSES-II

SCOSTEP
Scientific Committee on Solar-Terrestrial Physics

Japanese SCOSTEP Committee
Tatsuki Ogino, Kazuo Shiokawa, Masafumi Hirahara
CAWSES-II
(Climate And Weather of the Sun-Earth System - II)
http://www.cawses.org/wiki/index.php/Main_Page

International Collaboration Program by SCOSTEP

1976-1979: IMS (International Magnetosphere Study)
1982-1985: MAP (Middle Atmosphere Program)
1998-2002: Post-STEP (S-RAMP, PSMOS, EPIC, and ISCS)
2004-2008: CAWSES (Climate and Weather of the Sun-Earth System)
2009-2013: CAWSES-II (Climate and Weather of the Sun-Earth System-II)
CAWSES: Past, Present, and Future
New Science for Global Problems

Chairman: Susan K. Avery
(Woods Hole Oceanographic Institution
Alan Rodger
British Antarctic Survey

CAWSES: Climate and Weather of Sun-Earth System

SCOSTEP

CAWSES

Towards Solar Maximum
Four themes under CAWSES
S. Basu, (S. Avery), Chair; D. Pallamraju, Coordinator

Solar Influence on Climate
M. Lockwood, L. Gray

Space Weather: Science and Applications J. Kozyra, K. Shibata

Atmospheric Coupling Processes
F.-J. Luebken, J. Alexander

Climatology of the Sun-Earth System
C. Froehlich, J. Soika
The Sun & Earth form a complex system which has characteristic properties

**SYSTEM SCIENCE** focuses on the connections between components drawing together and completing research on individual physical processes. The requirements for success are driven by the properties of the complex systems we study.

- **Prediction is difficult based on components**: The system behavior at times is contained in the coupling and not in the components.
- **History Matters**: Previous history can change the system behavior.
- **Emergence Occurs**: New features appear as components interact.
- **Feedbacks are key**: They can amplify or totally mask the original response to an external driver.
- **The whole is greater than the sum of the parts**: Sand creature from "The Mummy".
- **The Butterfly Effect**: Systems cannot be broken into digestible pieces.

**Breakthroughs require new ways of asking questions**: Interdisciplinary collaborations hold the key to accelerating progress.

- **Responses are nonlinear**: Small perturbations in one region can produce large responses in another.
- **Simple Cause & Effect are Rare.**
CAWSES II: Grand challenge system questions

TG1
Solar Influences on Earth’s Climate

TG2
Geospace Response to Altered Climate

TG3
Effects of Geospace Environment by Solar Variability

TG4
Geospace Response from Lower Atmosphere

Synthesis question: Assessment of solar-terrestrial climate influences
TG1. What are the solar influences on climate?
Int. co-leader: Joanna Haigh and Ilya Usoskin
Jap. Leader: Horooka, Takahashi

TG2. How will geospace respond to an altered climate?
Int. co-leader: Dan Marsh and Jan Lastovicka
Jap. Leader: Tsuda, Ishii

TG3. How does short-term solar variability affect the geospace environment?
Int. co-leader: Kazunari Shibata and D. Nandy (solar) and Joe Borovsky and Dominique Fontaine (interplanetary))
Jap. Leader: Shibata, Ogino, Hirahara, Hoshino, Omura

TG4. What is the geospace response to variable inputs from the lower atmosphere?
Int. co-leader: Jens Oberheide and Kazuo Shiokawa
Jap. Leader: Shiokawa, Yamamoto
TG4  Example of Science (Influence of tides and planetary waves to the ionosphere in lower atmosphere)

F-region (250-450 km)

E-region dynamo modulation

MLT/E-region (80-140 km)

T, u, v, p
Forbes et al., 2006-25
Oberheide et al., 2005

Tropical troposphere

"wave-4" ↔ DE3
nonmigrating tides

Neutral zonal wind
Häusler et al., 2007

FUV @ 135.6 nm
Frumel et al., 2006

Nitric oxide
Oberheide and Forbes, 2008

Deep convective clouds
ISCCP

Weather satellites
Capacity building (collaboration with ISWI)
Int. co-leader: Robert Vincent, Brigitte Schmieder, and Gang Lu
Jap. Leader: Yumoto, Ueno

Escience and informatics (Virtual Institute)
Int. co-leader: Peter Fox and Janet Kozyra
Jap. Leader: Iyemori, Shinohara

ISWI
International Space Weather Initiative

As the successive international program of the International Heliophysical Year – IHY for 2007-2009, ISWI was begun in joint program with the United Nations Basic Space Science Initiative – UNBSS.
CAWSES-II Worldwide Virtual Institute

- e-Workshops, e-Conferences
- Face-to-face sessions at int’l conferences
- Interdisciplinary focus groups
- CAWSES-II International Committees & Projects
- WIKI: News & information from national CAWSES-II programs
- Campaign & workshop archive
- Internet Hub
- New global analysis tools & data maps
- Solar time series
- Model runs
- Virtual observatories
- Space missions
- Tool kit
- Schools in Sun-Earth science
- Science infrastructure
- Capacity building opportunities
- Graduate student opportunities & network
- Local Organizing Committee - Host Institutions
- Information Commons
- Wiki containing:
  - Worldwide ground based facilities
  - Worldwide space-based assets
  - Modeling centers
  - Outreach efforts
- CAWSES-II e-Library
- Living reviews online
- CAWSES-II systems science book
- White papers identifying grand challenge studies
- Interdisciplinary journal articles from campaigns
Collaboration by Virtual Information Center

Development to the other Earth Science field

Extension to satellite, simulation data

Other institutes and universities in Japan, Overseas researchers

SERC, Kyushu Univ.

Geomagnetic research community

PPARC, Tohoku Univ.

Magnetospheric research community

Hida Obs., Kyoto Univ.

Solar research community

STE Lab., Nagoya Univ.

Ionospheric and magnetospheric research community

NIPR

Metadata DB

Virtual Information Center for upper atmospheric sci.

WDC for Geomag, Kyoto Univ.

IUGONET

RISH, Kyoto Univ.

Atmospheric research community

Database (+Analysis software)
Integration of Simulation and Observation Data

Sun

Solar Soft X-ray Images

Solar Wind

Magnetosphere

High Energy Particle in Magnetosphere

Atmosphere

Solar Wind

Thermosphere

Ionosphere

Aurora in South Antarctica

Atmosphere

Solar Soft X-ray Images

High Energy Particle in Magnetosphere

Atmosphere

Solar Wind

Thermosphere

Ionosphere

Aurora in South Antarctica

Atmosphere

Solar Wind

Thermosphere

Ionosphere

Aurora in South Antarctica
Anomaly of this Solar Minimum?

23 Cycle

11 year period?
Sun spot appeared in May, 2009

24 Cycle

NASA/MSFC/Hathaway

CAWSIS

CAWSIS-II
400 Year History of Sun Spot Number and Temperature (Δ^{14}C)

Average Temperature (Δ^{14}C)

Maunder Minimum
1645-1715

Dalton Minimum
1790-1820

Oort Minimum

400 year history of sun spot number

Maunder Minimum
1645-1715

Dalton Minimum
1790-1820

Wolf Minimum

Spörer Minimum

Modern Max.
Hadley Atmospheric Circulation

A: Tropopause in arctic zone
B: Tropopause in temperate zone

Polar cell

Mid-latitude cell

Westerlies

Northeasterly Trades

Subtropical jet

Tropopause

Polar Jet

Ferrel Cell

Hadley Cell

N° Pole

60°N

30°N

E. Equator

0° Intertropical convergence zone

30°S

60°S

HIGH

50°N

10 0 5 15 Altitude (km)
CAWSES II: Reaching Out

• Developing content for new website: www.cawses.org
• Letter to community and/or EOS article
• Presentations: CEDAR, GEM, IAGA 2009, STP-12 (2010)...
• Why participate?
  – Attack grand challenge questions
  – New levels of communication between disciplines produces:
    • New questions
    • Broader views of system
    • Information on coupling and feedbacks
    • Insights into historical context
    • Global data products
  – International component to national science programs
CAWSES II: The next step forward

- **Planning meetings:** Community, SCOSTEP Bureau

- **Goal:** Provide structure for sun-earth community to make progress on sun-earth system science issues that cannot be done without interdisciplinary, international collaboration

- **Scientific strategy and framework that provides focus for the development of support in member nations:**
  
  - International collaboration in integrating observations from various ground-based, in-situ, and satellite-based systems to provide a global view of the sun-earth system
  
  - Engagement of researchers across the disciplines to attack Sun-to-Earth science issues in a way that funding agencies & universities tend to discourage by their structures
  
  - Use of international collaboration and interdisciplinary efforts for capacity building and graduate student education worldwide
CAWSIS-II and ISWI Symposium
T. Obara, N. Sato, T. Sakao
S. Avery, B. Rabiu and N. Gopalswamy

CAWSES-II Kick-Off Symposium
June 16-17, 2010
Uji Oubaku Plaza, Kyoto University
Oral (40) and Poster (120) presentation
Call for Papers: deadline 5/31
SCOSTEP Symposium STP 12
12-16 July 2010 in Berlin, Germany

www.iap-kborn.de/SCOSTEP2010