Current status and future plans of CAWSES-II in Japan

Japanese SCOSTEP Committee
Tatsuki Ogino and Takuji Nakamura

http://www.stelab.nagoya-u.ac.jp/cawses2/index_e.html
CAWSES-II co-chairs: Joseph M. Davila & Toshitaka Tsuda

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: Ishii, Nakamura

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, Shimizu

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

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

ISWI (International Space Weather Initiative)

Japanese STPP Committee: Chair K. Yumoto

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.
Calendar of Events

2010

• Japanese CAWSES-II Kickoff Symposium, June 16-17, 2010, Uji, Japan

2012

• Japan Geoscience Union Assembly, CAWSES-II/ISWI international session: May 20-25, 2012, Makuhari, Japan (and 2011) convener: M. Hirahara and T. Obara, 14 oral and 2 poster presentations
• COSPAR 2012, July 14-22, 2012, Mysore, India
• International Symposium on Solar-Terrestrial Physics (ISSTP2012), A highlight session on CAWSES, November 6-9, 2012, Pune India

2013～

• IAGA 2013 August 26-31, 2013, Yucatan Mexico
• STP-13 : August 25-28, 2014, Xian China
• ICS-12 : Fall in 2014, STEL, Nagoya Japan
CAWSES-II

(Climate And Weather of the Sun-Earth System -II)

Towards Solar Maximum,
2009 —2013

Japanese CAWSES-II Activities
SCOSTEP: Understanding the Climate and Weather of the Sun-Earth System

CAWSES II
Climate and Weather of the Earth-Sun System

A two-year (2009-2011) international program sponsored by SCOSTEP (Scientific Committee on Solar-Terrestrial Physics) established with the aim of significantly enhancing the understanding of the Earth-Sun system and its impacts on life and society. The main functions of CAWSES are to help coordinate international activities in observations and modeling, and applications crucial to achieving this understanding, to involve scientists in both developing and developed countries, and to provide educational opportunities for students of all levels.

CAWSES II is organized into four task groups:

1. Task Group 1: What is the solar influence on climate?
2. Task Group 2: How will greenhouse gases respond to a changing climate?
3. Task Group 3: How does short-term solar variability affect the greenhouse environment?
4. Task Group 4: How is the greenhouse response to variable inputs from the lower atmosphere?

What is the solar influence on climate?
The group studies the effect of transient solar events on the middle and lower atmosphere, quantifying the direct and indirect solar effects upon climate over timescales ranging from minutes to years, and the interaction of the upper atmosphere with the climate system.

Science-related Goals

1. To enhance our understanding of the Earth-Sun system
2. To coordinate international activities in observations and modeling
3. To provide educational opportunities for students of all levels

TG1 : What is the solar influence on climate?

Domestic Co-leaders:
Toshihiko Hirooka (Kyushu Univ.) and Yukihiro Takahashi (Hokkaido Univ.)

- What is the effect of transient solar events on the middle and lower atmosphere?
- What are the uncertainties in establishing the long-term direct solar effect upon climate?
- How to quantify and numerically test indirect solar effects upon climate?
- The influence of this solar variability on Earth’s climate is a key issue of the Intergovernmental Panel on Climate Change, and one that continues to be highlighted by policy makers, climate change skeptics, and the media.
Four scenarios to explain solar effects upon climate

1. Galactic Cosmic Ray (GCR)
   - Magnetic field in solar wind
     - GCR
     - Ionization of atmosphere
     - Cloud nuclei
   - Cloud cover increase
     - Analogy from mist chamber, but natural oversaturation seems to small
     - Experiment by CERN
     - Numerical modeling with the earth simulator
     - Progress in annual ring study

2. Total Solar Irradiance
   - Precise monitoring with earth orbiting satellites
   - Amplitude: order of 0.1%
   - Still not negligible
   - Total Solar Irradiance (TSI)

3. Heating stratosphere by UV
   - Heating stratosphere by UV
     - Modulation of thermal field in stratosphere
   - Modulation of wind field including vertical circulation
     - Modulation in troposphere
     - Variation of UV is larger than that of visible
     - No significant energy required

4. Global Electric Circuit (GEC)
   - Magnetospheric and ionospheric currents generated by solar wind, modulated by cosmic ray and radiation particle
     - Modulation of GEC
     - Modulation of ion distribution and E-field
   - Cloud generation and modulation of lifetime
     - Thunderstorm generation
     - Life time of lower cloud
   - Global Electric Circuit (GEC)

Examples of Japanese contribution

**WPWP:**
one of the highest sea surface temp. areas in the world

Power of ~28-days variation in OLR

In WPWP (Western Pacific Warm Pool), an important area related to El Nino or MJO, and Eastern Indian Ocean OLR shows ~28-day periodicity.

Comparison of solar activity (total solar irradiance [TSI]) in blue and δ18O from Dongge cave, China, in green representing changes of the Asian climate, possibly the Asian monsoon (AM). (A) Time series of solar activity (TSI) and δ18O. (B) Wavelet of solar activity (TSI). (C) Wavelet coherence of solar activity (TSI) and δ18O.

Averaged spectra for all max. and min. periods

Max years:
~27 and 50-60 day
a kind of resonance?

Min years: ~35 day

F10.7, proxy of solar activity, always shows a peak around 27-day.

Locally statistically significant (at the 0.95 two-tailed level) correlation coefficients (at zero lag) plotted between 60° N–60° S. Panels A – D (E – H) display correlations between cloud anomalies and the total solar irradiance (TSI) (galactic cosmic rays (GCR)), at all total, high (<440 mb), middle (440 – 680 mb) and low (>680 mb) altitude levels.
TG2 : How will geospace respond to a changing climate?

Domestic Co-leaders: Mamoru Ishii (NICT) and Takuji Nakamura (NIPR)

Task Group 2 will focus on answering:
1. How do changes in tropospheric wave generation and their propagation through a changing atmosphere affect the dynamics of the MLT?
2. By how much is the anthropogenic effect on the ionosphere/thermosphere enhanced during a quiet sun period?
3. Are PMC/NLC characteristics trending?

TG-2 Co-leaders: Jan Lastovicka (CZ) Daniel Marsh (US)
Projects and leaders:
- Project 1.1 Changes in wave sources
  Jadwiga (Yaga) Richter (US), Kaoru Sato (JP)
- Project 1.2 Changes in filtering
  Elisa Manzini (IT), S. Eckermann (US)
- Project 1.3 Changes in MLTI dynamics and composition
  G. Beig (IN), C. Jacobi (DE)
- Project 2 The enhancement of the anthropogenic effect on the ionosphere/thermosphere during a quiet sun period.
  J. Emmert (US), L. Qian (US)
- Project 3 PMC/NLC altitude, frequency and brightness changes related to changes in dynamics and chemical composition
  G.E. Thomas (US), U. Berger (DE)
Winter zonal prevailing wind over Collm (52N, 15E), with piecewise linear trends

Summary of observed and simulated thermospheric density trends at a height of 400 km, as a function of the F10.7 solar activity

(From CAWSES-II Wiki) Emmert et al. [2008].
Longterm variation of ion temperature at 310-340 km height
@ Tromso, Norway (69.2 deg N), 1981-2012

From EISCAT radar observation data  Courtesy: Yasunobu Ogawa et al.

Long term variation of PMSE by SuperDARN radar
(from Hosokawa et al., AGU fall meeting, 2006)

Courtesy: Keisuke Hosokawa
TG3: How does short-term solar variability affect the geospace environment?

Domestic Co-leaders: Kazunari Shibata (Kyoto Univ.), Tatsuki Ogino (Nagoya Univ.), Masafumi Hirahara (Nagoya Univ.), Masahiro Hoshino (Tokyo Univ.), Yoshiharu Omura (Kyoto Univ.) and Toshifumi Shimizu (ISAS/JAXA)

The solar activity is increasing toward the maximum of Solar Cycle 24 and therefore, now is the best time for space weather research.

Sunspot number variation (the maximum of Solar Cycle 24 is predicted to be in the spring of 2013)
We investigated convective motions seen in solar prominences based on the numerical simulation and clarified the mechanism.

Coronal Disturbances associated with Solar Flares

Associated with large flares, we often observe coronal disturbances, like shocks, MHD waves, and so on. We have examined these phenomena based on ground-based and space-borne observations.

CME Modeling by 3D MHD Simulation

We investigated the evolution of a CME on 2005 August by using 3D MHD simulation. The CME was originated from an anemone-shaped active region, and generated a large geomagnetic storm.

Magneto-Convection in Solar Prominences

We investigated convective motions seen in solar prominences based on the numerical simulation and clarified the mechanism.
Super Flares Observed on Solar-Type Stars

We analyzed brightness changes of solar-type stars taken by the Kepler spacecraft, and found that superflare (one thousand times or more that of large solar flares) can occur even on solar-type stars. On such flare-productive starts, large sunspots are expected.

Publication Activity

*Sousetsu Uchutenki (Review of Space Weather)*
K. Shibata, Y. kamide eds.
(May 2011)
The first comprehensive textbook on space weather in Japan

K. Shibata, R. Kitai, M. Katoda, et al. (Feb. 2011)
*Written in Japanese and English*
Summary of solar Hα observations by FMT at Hida Observatory, Kyoto University.

Website of TG3: http://cawses-ii-wg3.blogspot.jp/
TG4 : What is the geospace response to variable inputs from the lower atmosphere?

Domestic Co-leaders:
Kazuo Shiokawa (Nagoya Univ.) and Mamoru Yamamoto (Kyoto Univ.)

It is getting clearer that atmospheric waves at various frequencies penetrate into the ionosphere and cause plasma disturbances.

Sound waves and atmospheric gravity waves from Tsunami penetrate into the ionosphere and cause plasma disturbances.
Development of the whole atmosphere-ionosphere coupled model to investigate nonmigrating tidal waves penetration into the ionosphere.

Thermospheric neutral density drastically decreases during stratospheric sudden warming.

Liu et al. (GRL, 2011)

Jin et al. (JGR, 2011)
In order to encourage communication between atmospheric and geospace scientists, we issue TG4 newsletter every 3-4 months.

Website of TG4: http://www.cawses.org/wiki/index.php/Task_4
Capacity building:
Promotion of researches on the space science by supporting researchers in developing countries and young researchers

Domestic Co-leaders: Kiyohumi Yumoto (Kyushu Univ.) and Satoru UeNo (Kyoto Univ.)

Japanese CAWSES-II has continued to organize and cosponsor international science meetings and workshops. Particular emphasis is placed on the support of scientists from developing nations as well as graduate students and young scientists. Japanese CAWSES-II works with such researchers to provide access to data and research tools, and to develop an international network of scientists.

The members of Japanese capacity-building group have progressed different kinds of international cooperating programs, respectively. Here, we introduce various capacity-building activities under such Japanese projects.
**MAGDAS: Yumoto et al. (Kyushu Univ.)**
Studies of dynamics of changes of geospace plasma during magnetic storms and auroral substorms, the electromagnetic response of iono-magnetosphere to various solar wind changes, and the penetration and propagation mechanisms of DP2-ULF range disturbances, by arranging many magnetometers all over the world.

Lecture circuits in host-countries where magneto-meters were installed or are planned to be installed.

Cooperative data analysis, studies and publishing especially with many African countries.

**CHAIN: UeNo et al. (Kyoto Univ.)**
Investigation of time variation and 3D velocity field of solar activity, flares, filament eruptions and shock waves (Moreton waves), by distributing multi-wavelength full-disk solar H-alpha imaging telescopes all over the world.

Lecture circuits about space weather researches and solar observations in current and future host-countries. Exchange of researchers with such countries and training.

Cooperative data analysis and studies, international data analysis workshop, presentation of the results in international meetings.

**SARINET: Makita et al. (Takushoku Univ.)**
Examination of the environment of the upper atmosphere in the Geomagnetic Hole (GH) around South America, by distributing imaging Riometers (IRIS) and 1ch or polarization Riometers in this region.

Cooperative research with Brazilian students and meetings about instruments with related institutes.

Cooperative installation of Riometers with staffs and students of host universities in Brazil, Argentina and Chile.
**GMDN: Munakata et al. (Shinshu Univ.)**

To identify the precursory decrease of cosmic ray intensity that takes place more than one day prior to the Earth-arrival of shock driven by an interplanetary coronal mass ejection (CME), by distributing Muon Detectors all over the world.

Muon Detectors were installed at 6 stations and observations of cosmic rays and cooperative researches are running through the collaboration with 9 institutes from 7 countries.

**NDACC: Mizuno et al. (Nagoya Univ.)**

Investigation of composition's change of middle atmosphere and elucidation of the mechanism by expanding millimetre-wave & lidar-observation network. Improvement of the scientific North-South problem.

Since there are large blank-regions of the observation around South-America and Africa, they have focused on distributing detectors and cooperative researches around South America, especially Argentina and Chile.

**Ground-based Atmosphere Observation Network in Equatorial Asia: Tsuda et al. (Kyoto Univ.)**

Research collaboration on the behavior of the equatorial atmosphere and ionosphere, by using their ground-based observation network and satellite observations, especially with torropical Asian nations.

Exchange of scientists, on-job training and seminars on measurement techniques, data analysis and scientific interpretation in Indonesia, Thailand, Vietnam and India.

Holding international scientific workshops and publishing the results.
The method of “e-Science”, which is often called “the fourth paradigm” after the theoretical, the experimental and the computer simulation methods, should be developed and utilized during CAWSES-II for the inter-disciplinary research.

The Inter-university Upper atmosphere Global Observation NETwork, IUGONET, is a research project of the National Institute of Polar Research (NIPR), Tohoku, Nagoya, Kyoto and Kyushu Universities to build a metadata database (MDB) of ground-based observations of the upper atmosphere. ([http://www.iugonet.org/en/index.html](http://www.iugonet.org/en/index.html))

We have various kinds of observational data acquired so far by a global network of radars, magnetometers, optical sensors, helioscopes, etc. By developing the MDB, we intend to provide researchers with a seamless data environment linking databases spread across the member institutions.
The IUGONET: A virtual institute to promote the collaborations among scientists in various research fields

The five universities and institutes are collaborating to form a virtual institute with interdisciplinary database system. The MDB system will significantly facilitate the analyses of a variety of observational data, which will lead to comprehensive studies of the mechanisms of long-term variations in the upper atmosphere.

The project contributes to the monitoring and prediction of global warming and thereby lead to further evolution of the Earth and planetary science.

This project builds a monitoring system of the plasma environment in the upper atmosphere.

This monitoring framework contributes to the security and safe operation of space-based social infrastructure, such as satellites, communication/broadcasting, and global positioning systems (GPS).
Access to the observational data through metadata

The IUGONET will create the metadata of ground-based observational data in the project and build the database system for handling them, which is called IUGONET Metadata Database (IUGONET-MDB). It provides the service for cross-searching observational data distributed across the IUGONET institutions. Users will be able to easily access the data by using the search results of the metadata.

Common software to promote the use of observational data

The IUGONET Data Analysis Software (UDAS) is the plug-in software for THEMIS Data Analysis Software suite (TDAS). With the UDAS, the IUGONET data (e.g., geomagnetic data, aurora data, radar data, and so forth), satellite data (THEMIS, GOES, WIND, and ACE) can be handled.
"CAWSES-II Space Weather International Collaborative Research Database in Japan" has been constructed as an infrastructure of national cooperative research as our country positively participates in October, 2012. 46 database

URL: http://center.stelab.nagoya-u.ac.jp/cawses/cw2/index_e.html
International CAWSES-II Symposium 2013

Nagoya, Japan
November 18-22, 2013

Conveners:
T. Nakamura, K. Shiokawa, M. Yamamoto,
and N. Gopalswamy

http://www.stelab.nagoya-u.ac.jp/cawses2013/