CAWSES News

Climate And Weather of the Sun-Earth System

Volume 3, Number 2 September 2006

CAWSES is an international program sponsored by SCOSTEP (Scientific Committee on Solar-Terrestrial Physics) and has been established with the aim of significantly enhancing our understanding of the space environment and its impacts on life and society. The main functions of CAWSES are to help coordinate international activities in observations, modeling and theory crucial to achieving this understanding, to involve scientists in both developed and developing countries, and to provide educational opportunities for students at all levels.

Message from the Chair

Susan Avery (susan.avery@colorado.edu)

It is a somewhat daunting task to assume the Chair of CAWSES after Sunanda Basu. But she has done an excellent job in initiating CAWSES that I know that collectively we will be able to carry on. And of course, we all expect to see Sunanda at CAWSES workshops and conferences. I would also like to take this opportunity to thank the Science Steering Group (SSG) that was created by SCOSTEP to launch CAWSES. Under their guidance we now have four active Science Themes as well as a Capacity Building effort. Although the CAWSES start-up need has been accomplished we have much more to do. I would like to now explore how we can further utilize the outstanding talent of the Steering Group members in conjunction with the Science Theme leaders – through engagement in the Science Themes, for their leadership in developing new opportunities nationally and internationally, and for their guidance in the evolution of CAWSES. Stay tuned for more developments.

As you can see from this *CAWSES News,* CAWSES activities continue to grow and gain momentum. Several workshops have been held on specific science topics and we have used opportunities at CAWSES sessions in large national and international meetings to present results and have follow-up discussions. I was able to attend the 11th SCOSTEP Quadrennial Symposium which had several CAWSES related sessions that were well-received. Many more workshops are in planning stages but I'd like to draw particular attention to the 1st CAWSES Virtual Conference focused on the new observed structures of the auroral oval to be held during November 13-17 and being organized by Janet Kozyra and colleagues. Virtual Conferences are a way to reach out and stay connected without the need for international travel. They provide a means to engage scientists and students who might not be able to physically attend other workshops and conferences and they can provide a locus for a national activity centered in a given location. I see the Virtual Conference as a way to enhance CAWSES Science and I encourage you all to sign-up, log-in, and participate!

Finally, I draw your attention to the International CAWSES Symposium to be held in Kyoto, Japan, in October 23 – 27, 2007. This is the opportunity to get all Science Themes together for a focused symposium on CAWSES Science and I look forward to a great participation from all of the Themes. So mark your calendars and watch for future information.

Message from SCOSTEP President

Marvin Geller (Marvin.Geller@sunysb.edu)

Last year, I was very distressed when I received word from Dr. Sunanda Basu that she wished to step down from her position as Chair of the CAWSES Science Steering Group (SSG). After all, Sunanda served on the original Long-Range Planning Group (LRPG) that began in 2001, and developed the preliminary plans for CAWSES. The SCOSTEP Bureau established this LRPG while Dr. C.-H. Liu was SCOSTEP President, and I sat in on its deliberations at its meetings after I was elected as SCOSTEP President since there was no issue of greater importance than SCOSTEP's future scientific directions. Dr. Robert Vincent, who was then SCOSTEP Vice-President, thought that my most outstanding achievement as SCOSTEP President was to convince Sunanda to serve as the initial Chair of the CAWSES SSG, and he may be right. She has been the CAWSES Chair for over two and one-half years, over half of its existence. In addition to her efforts before the formal beginning of CAWSES, Sunanda's achievements in chairing CAWSES were many. She successfully obtained funding from the US National Science Foundation to establish the CAWSES Office at Boston University. She coordinated the formation of the CAWSES Themes and Working Groups. She literally traveled around the world to make presentations on CAWSES, interact with national CAWSES groups, and participate in CAWSES Science activities. The fact that CAWSES is perceived as being so successful now is very largely due to Sunanda's efforts.

SCOSTEP is very fortunate that as of August 1, 2006, Dr. Susan Avery will be the chair of CAWSES. We know that she will do very well in this position, but SCOSTEP and CAWSES will never forget the crucial role that Sunanda Basu played in getting CAWSES started. We wish you well, and we look forward to seeing you at future SCOSTEP and CAWSES meetings. Thank you, Sunanda.

Inside this issue:

Update on CAWSES activities since March 2006

D. Pallamraju (raju@cawses.bu.edu)

We have now crossed the half-way mark of the initially planned 5 years of CAWSES program. As you will notice in this issue of *CAWSES News*, research efforts being carried out under all CAWSES Science Themes have matured significantly and are yielding many exciting results.

Several special CAWSES sessions were held in European General Union meeting, in Austria, Joint Assembly in USA, and COSPAR Assembly and Western Pacific Geophysics Meeting, both in China. Further, a CAWSES workshop and the Ice layers workshop were held at IAP Kuhlungsborn, Germany. The workshop on Long-term trends was held in Finland. J. Kozyra and D. Pallamraju were invited to make presentations on CAWSES activities and on the Virtual Conference (described below) at the Joint Assembly in USA and at the COSPAR Assembly in Beijing. D. Pallamraju was also invited to give a talk on CAWSES Science at the Physical Research Laboratory, Ahmedabad, in India.

Present and previous CAWSES Chairs, Susan Avery and Sunanda Basu addressing the gathering of over 40 scientists during the 3rd CAWSES Science Planning meeting on July 23, 2006 in Beijing, China.

The 3rd CAWSES Science Planning meeting was held on July 23rd in Beijing, where results and developments from some of the aforementioned workshops were summarized, progress of science under CAWSES Themes was discussed and activities for the near future were laid out. During that meeting representatives from Brazil, China, France, Germany, India, Japan and Russia presented the work being done in their country under CAWSES Science Themes. The major activity for the near future is the Sun-Earth Connection Virtual Conference which will be held during November 13 – 17, 2006. Please read the announcement from J. Kozyra below for information. This is a novel experiment in which scientists from around the globe will be able to register online and submit their poster on results from some of the previous observational campaigns that showed exceptional sun-earth effects. It is hoped that this experiment will foster global collaborations by enabling sharing of ideas, knowledge of availability of databases, etc. to address and answer key issues on Sun-Earth interactions, investigation of which needs global participation. In addition, it is hoped that this Virtual Conference will provide both, an opportunity for students worldwide who generally face difficulty in traveling out of their country to attend meetings, and much needed respite from traveling for senior scientists who travel a lot! I invite you all to participate in this novel experience by registering and submitting your poster online by visiting the conference website at: http://workshops.jhuapl.edu/s1/index.html

Several CAWSES Science related activities are scheduled for the near future. They are International School on Atmospheric Radar in Taiwan (October), Virtual Conference and CAWSES International Space Weather Modeling Workshop in Japan (both in November), CAWSES related sessions in Fall AGU in USA and MST-11 workshop in India (both in December) , and CPEA conferences in Japan (March 2007). We greatly look forward to your participation in all these activities related to CAWSES Science.

At the CAWSES office at BU, we have a new Program Administrator, Ms. Julia Barsky. Please feel free to contact Julia (jbarsky@bu-ast.bu.edu) on issues related to CAWSES.

3rd CAWSES Science Planning Meeting on July 23, 2006 in Beijing, China.

Announcement of the Sun-Earth Connection Virtual Conference Series, Session 1

Submitted by J. Kozyra (jukozyra@engin.umich.edu)

Explore the state of the Sun-Earth system during extreme space weather. Join us online and "Return to the Auroral Oval* for the 50th Anniversary of the International Geophysical Year". (*taken broadly as an indicator of the state of the geospace system)

Schedule:

Nov. 13-17 **Part 1:** International Data 2006 Exchange and First Look at Sun-to-Earth Science Issues.
Joint Sessions with: CAWSES International Workshop on Space Weather Modeling (CSWM),

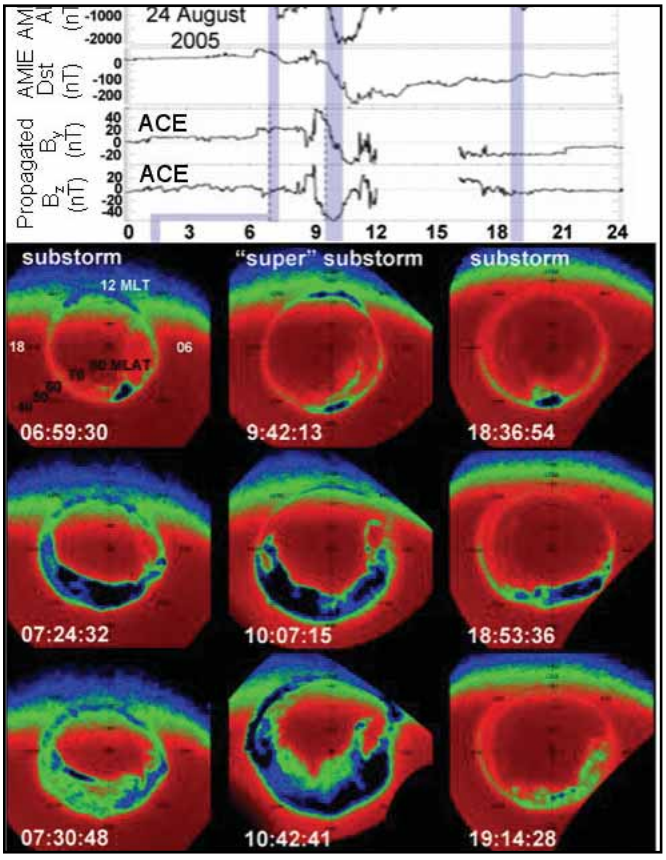
November 14-17 2006, Yokohama, Japan.

TBD 2007 **Part 2:** New Findings from Theory and Modeling.

Conference URL: http://workshops.jhuapl.edu/s1/index.html
(Please check back frequently as more feature are being added.)
Registration is now open.
Sponsors: CAWSES, IHY, eGY, ICESTAR, NASA/LWS, NSF Atmospheric Sciences, and originators of the Solar Extreme Events (SEE) workshop series.

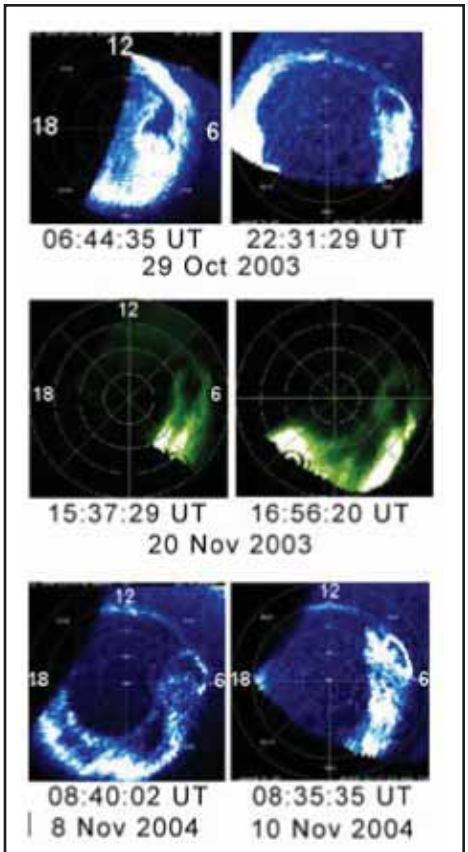
What's New?

The IMAGE spacecraft observed the development of a large-scale auroral spiral in the southern hemisphere on the dawnside of the auroral oval and a long-duration finger-like structure on the duskside during intense substorms in the main phase of severe magnetic storms on 15 May and 24 August 2005. Consecutive images of the auroral emissions for each event, at times, give indications of vortical motion in the spiral. The unusual features, reported here, are absent during substorms occurring at other phases of the storms, which do not show any dramatic activity in the dawn to noon sector.



Comparison of features among substorms within and outside of the main phase of a severe magnetic storm on 24 August 2005. [After *Kozyra, J.U., M.W. Liemohn, X. Cai, L.J. Paxton, S.B. Mende, R.A.Heelis, M.S. Hairston, W.R.Coley, C.R.Clauer, A.Ridley, M.G.Henderson, M.F.Thomsen, A,DeJong, M. Kuznetsova, manuscript in preparation, 2006*].

To our knowledge, neither of these structures has been previously reported as a feature of auroral *substorms*. However, Anger and Lui, [*Planet. Space Sci., Vol. 21*, 873-878, 1973] did describe a similar spiral structure during the severe magnetic *storm* of 17-18 December 1971 based on auroral oval images from ISIS-2, constructed over ~12 minutes from 1400 km altitude, with ~ 2 hrs. elapsed between images.



Similar auroral spiral strctures observed by IMAGE SI13 on the dawnside during severe storms in 2003-2004. [*After Kozyra, J.U., M.W. Lie,ohn, X. Cai, L.J. Paxton, S.B. Mende, R.A. Heelis, M.R. Hairston, W.R. Coley, C.R. Clauer, A. Ridley, M.G. Henderson, M. F. Thomsen, A. DeJong, M. Kusnetsova, manuscript in preparation*, 2006].

Similar structures have now been found on the dawnside in 4 other superstorms in 2003-2004 (29-30 October 2003, 20 November 2003, 07-08 November 2004 and 09-10 November 2004). **Join us in an international collaboration to find out what this means for the state of the Sun-Earth system.** Possible implications are described below.

With the 2-min cadence in auroral images provided by IMAGE FUV in one hemisphere, the supporting observations of the auroral region by TIMED in both hemispheres, and the coverage from Sun to Earth by currently operating missions along with ground-based observations, the potential for new discoveries on the state of the Sun-Earth system during extreme events is high. Collaborations during the IHY can accelerate the pace of these discoveries.

Implications:

Since auroral emissions mirror the structure and movement of source regions in the geospace, these new auroral structures in the main phase of severe magnetic storms imply possible:

- New features in the geospace configuration,
- Changes in stormtime energy dissipation mechanism, and
- New forms of storm-substorm coupling.

Tracing backwards up through the Sun-Earth system allows us to:

- Identify the special features of the solar sources that are responsible for such extreme space weather at Earth,
- Examine the effects of propagation and the background state of the heliosphere in modifying existing geoeffective features or introducing new ones in the solar wind disruption before reaching the Earth, and
- Search for associated features throughout the geospace,

in connected magnetospheric regions, and in the ionosphere-atmosphere from pole to equator.

Conference Events:

- Focus Events: 15 May 2005, 24 August 2005.
- Supporting Superstorm Events: 6-7 April 2000, 15-16 July 2006, 31 March–1 April 2001, 11-12 April 2001, 6-7 November 2001, 29-21 October 2003, 20-31 November 2003, 7-10 November 2004.
- Other Interesting Events: Other occurrences of auroral spirals and vortices not in the main phase of superstorms (i.e. smaller substorms, steady convection events, etc.)

Basic Information on the focus events and the unusual auroral oval features along with an incomplete list of associated Sun-Earth system science questions can be found on the conference website at http://workshops.jhuapl.edu/s1/index.html

4 Ways to Participate:

(1) Upload a presentation providing a high-level interpretation of satellite and/or ground-based observations. Answer questions on the attached message board for your presentation throughout the conference.

(2) View presentations, ask questions of authors and contribute to discussions on message boards to:
   a) Identify important interdisciplinary science questions in Sun-to-Earth regime,
   b) Identify data products needed for theory, simulations and modeling efforts to follow,
   c) Make contact with instrument teams and observers for collaborative studies to follow, etc.

(3) Contribute to conference global data products and suggest additional data products needed for the conference. Current efforts are planned to construct:
   a) Detailed convection, potential, and field-aligned current patterns,
   b) Global TEC,
   c) Neutral wind map,
   d) ULF wave maps, etc.,

(4) Contribute to the development of the Virtual Conference as an effective medium for worldwide scientific collaboration by testing and evaluating tools and features.

Updates since the SCOSTEP Bureau meeting in Rio, Brazil in March 2006

Report by G. Lu (ganglu@ucar.edu)

The SCOSTEP Bureau members met in March 2006 in Rio de Janeiro, Brazil, during the 11th SCOSTEP Quadrennial Symposium on "Sun, Space Physics and Climate". Minutes of the meeting are now available at http://www.scostep.ucar.edu. The Bureau meeting resulted in several action items highlighted below:

1. Changes in CAWSES leadership

Dr. Sunanda Basu expressed her desire to step down as the Chair of the CAWSES Science Steering Group (SSG). Dr. Susan Avery accepted the Bureau's nomination to be the new program leader. Dr. Avery assumed this leadership role on August 1, 2006. As recommended by the Bureau, the SSG members are dismissed while a new CAWSES Phase-2 Planning Committee consisting of Marvin Geller, Brigitte Schmieder, Lev Zelenyi, Chi Wang, and Susan Avery is being formed. Dr. D. Pallamraju will continue to serve as the CAWSES Scientific Coordinator.

The Bureau expressed its deepest appreciation to Dr. Basu for her extraordinary leadership and broad scientific vision in establishing the CAWSES program. Since its inauguration in 2004, CAWSES has become a very successful international program involving scientists from 19 countries. Regional CAWSES program offices are now established in Brazil, France, Germany, India, Japan, and Taiwan. In order to honor Dr. Basu's invaluable contribution to the CAWSES program, the Bureau recommended that SCOSTEP present her with an official certificate signed by the SCOSTEP President and the Vice President.

2a. Sponsorship for Workshops/Symposia

SCOSTEP continues with its role in promoting international solar-terrestrial research activities. More specifically, SCOSTEP has issued official sponsorship to the following workshops and symposia:

- Ice Layer Workshop held in Kuhlungsborn, Germany on March 15-17, 2006,
- CAWSES Tidal Workshop held in Beijing on July 2006,
- International School on Atmospheric Radar to be held at the National Central University in Taiwan, in October 2006,
- Coupling Processes in the Equatorial Atmosphere (CPEA) Symposium to be held in Kyoto, Japan, in March 2007, and
- International CAWSES Symposium to be held in Kyoto, Japan, in October 2007.

2b. SCOSTEP's strong support for several international programs

- Letters were sent to William Liu of Canadian Space Agency to indicate that SCOSTEP is willing and interested in collaborating with the International Living with a Star (ILWS) program on matters related to ground-based data management and services. To facilitate such a collaboration, SCOSTEP has appointed an ad-hoc committee which consists of Christian Hanuise, Maurizio Candidi, and Janet Kozyra, to provide ILWS with scientific advice regarding data management issues. David Sibeck (representing ILWS) and Gang Lu (representing SCOSTEP) are the designated contact points,
- Letters of Support were also sent to the Electronic Geophysical Year (eGY) and the International Heliophysical Year (IHY) to show SCOSTEP's strong endorsement to both programs, and
- A letter was sent to the Russian Academy of Science in support of the proposal to extend the Super Dual Auroral Radar Network (SuperDARN) by building and deploying HF radars in Siberia.

3. 2007 Bureau meeting in Perugia and STP-12 in 2009

The next Bureau meeting will be held in Perugia during the IUGG meeting. It is tentatively scheduled for July 13-15, 2007. Planning for STP-12 is still in the very preliminary stage. Some preliminary discussions have been held with IAGA about holding STP-12 in conjunction with their meeting in Hungary in 2009. Further, an offer to host this meeting in St. Petersburg, Russia has been received. As yet, no conclusive action has been taken on this issue.

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WG 2.6 Models, Simulations and Data Assimilation

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WG 2.7 Coordinated Data Analysis

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Capacity Building and Education

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Awards in CAWSES/SCOSTEP Community

Marvin Geller has been awarded the NASA Distinguished Public Service medal for the year 2006. We congratulate him on his well-deserved recognition.

CAWSES / SCOSTEP community mourns the loss of:

James A. Van Allen, a physicist and space pioneer who discovered the bands of radiation that surround the Earth, died onWednesday, August 9, in Iowa City at the age of 91.

Toyohisa Kamei (1948 - 2006), who served as an assistant professor of Kyoto University, died on 3 September. He worked for over two and a half decades on deriving AE and Dst indices at the World Data Center for Geomagnetism, which is operated by Kyoto University. For this contribution IAGA Executive Committee had decided, in this July, to award him with the " IAGA's Long Service Medal" at next IUGG in Perugia.

Progress under CAWSES Themes

Theme 1: Solar Influences on Climate

Major Midwinter Warming in Stratosphere in 2005/2006

Report by K. Labitzke and M. Kunze (labitzke@strat01.met.fu-berlin.de)

Stratospheric Mid Winter Warmings (MMWs) (sometimes also called "sudden stratospheric warmings") are connected with very strong circulation changes over the Arctic. They occur mostly in January-February. In addition to warming of the Arctic and reversal of the temperature gradients between the middle and the high latitudes, they are also associated with a breakdown of the polar westerly vortex, which is replaced by an anticyclone. This leads to a change of the Arctic Oscillation (AO) throughout the atmosphere from positive to negative values. Concurrent with the warming over the Arctic, significant cooling is observed as far as 30°S, reflecting adiabatic cooling/upwelling as a dynamical response to the adiabatic warming/downwelling over the Arctic. Figure 1 shows time series of daily temperatures (°C) over the

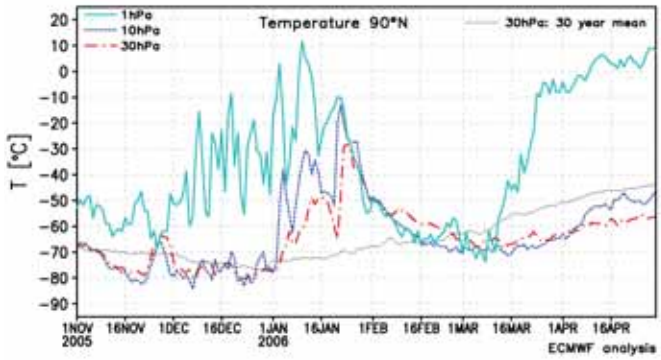

Figure 1 Time series of the daily temperatures (°C) over the North Pole at different pressure levels, November 2005 till April 2006. (ECMWF analyses)

North Pole at different pressure levels. At the stratopause level (~ 1 hPa) the warming reached its maximum in the first half of January 2006, penetrating to the middle (~ 10 hPa) and lower (~ 30 hPa) stratosphere during the second half of January. At the 10-hPa level, the reversal of the zonal wind over the Arctic (one of the criteria for the definition of a MMW) took place on the 20th of January (not shown).

The time series of the monthly mean 30-hPa temperatures over the North Pole in January (Figure 2) shows clearly a very large interannual variability (sigma is 8.5 K), as well as the fact that the temperature trend is positive (+ 0.9 K/decade). The MMW in the stratosphere during the winter 2005/2006 was number four in intensity compared with the full set of 59 Januaries which are now available for a comparison of temperatures (NCEP/NCAR re-analyses, Kalnay et al., 1996).

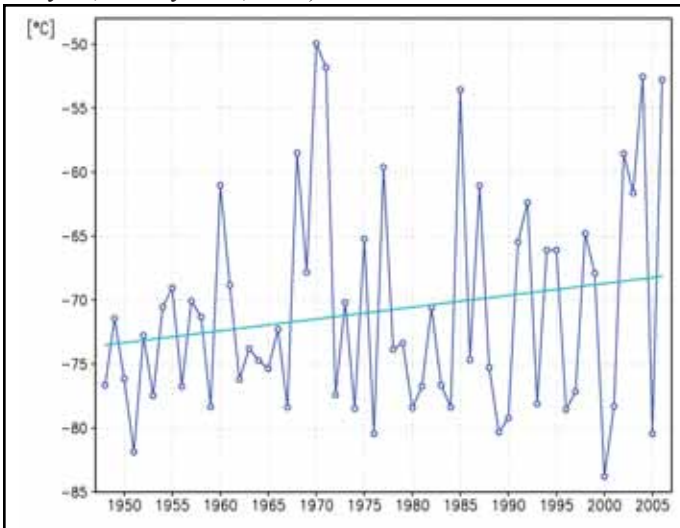

Figure 2 Time series of monthly mean temperatures at 30-hPa (°C) in January over the North Pole, from 1948 through 2006. (NCEP/NCAR re-analyses).

We have shown in earlier studies that the size of the changes in the lower stratosphere can be attributed to the 11-year sunspot cycle (SSC). We showed further that in order to detect the solar signal it is necessary to group the data according to the phase of the Quasi-Biennial Oscillation (QBO), (Labitzke, 1987; Labitzke and van Loon, 1988). Meanwhile, 65 years of geopotential heights analysis confirm the earlier studies based on only 30 years (Labitzke et al., 2006). In Figure 3 below, the last winter (February 2006) fits very well with other winters in the **east phase** of the QBO in solar minima which are most of the time connected with MMWs, i.e. a negative correlation with the solar cycle. Because the warming was so intense, the breakdown of the polar vortex inhibited the propagation of wave energy upwards for the rest of the winter (not shown) and therefore the stratosphere remained warm and the heights in February 2006 are again among the four highest observed in 65 winters.

During the **west phase** of the QBO (Figure 3 below) the MMWs occur during solar maxima and the correlation with the solar cycle is significantly positive. The value for February 2005 (a cold winter, see Figure 2) is found in the lower left part of the scatter diagram for the **west phase and solar minimum**. So far, no MMWs have been observed during the west phase/solar minimum conditions.

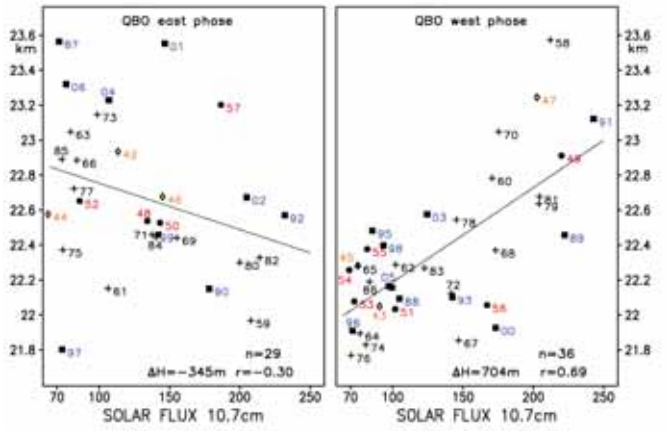

Figure 3 Scatter diagrams of the monthly mean geopotential heights (geopot. km) in February at the North Pole (1942 – 2006), plotted against the 10.7 cm solar flux. Left: years in the east phase of the QBO; right: years in the west phase. The numbers indicate the respective years. (Figure 3 in Labitzke et al., 2006)

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Progress in Assessment of Evidence for the Solar Influence on Climate (WG 1.1)

Report by I. Usoskin (Ilya.Usoskin@oulu.fi)

Overall relation between the solar variability and terrestrial effects is well established and has been widely explored by empirical/statistical methods, and qualitative mechanisms have been suggested. However, in order to understand the real causes responsible for these relations, the scientific community needs quantitative physical models applicable on different temporal and spatial scales. Some steps in this direction have been performed, within the CAWSES framework, by our group. The main direction of the work was to take a step from statistical/empirical regressions to physics-based numerical models allowing for not only qualitative but also quantitative studies of the solar-terrestrial effects. The following results have been obtained by the group in the framework of CAWSES.

1. A model of the galactic cosmic ray flux impinging on the Earth for the last 55 years: Using a verified model of cosmic ray transport in the heliosphere, solar modulation of galactic cosmic rays (in the form of the modulation potential) has been consistently and systematically reconstructed since 1951. The reconstruction was performed by systematic fitting of the model results to the available records of ground-based worldwide neutron monitors as well as to fragmentary direct space- and balloon-borne measurements of cosmic ray spectra. The results including a digital table of the monthly modulation potential values for 1951-2004 have been published in ref.[1] (updated values are available at http://cosmicrays.oulu.fi/phi). These results, based on the whole bulk of experimental data, provide a basis for quantitative studies of cosmic ray variability at the Earth for the last decades.

2. Full numerical model of cosmic ray induced ionization (CRII) of the atmosphere: A full numerical CRII model has been developed by the group [2,3]. The model is based on Monte-Carlo simulations, using CORSIKA simulation package, of the atmospheric cascade induced by energetic cosmic rays in the atmosphere. The model allows computing CRII at any location (geographical and altitude) and at any given moment. In combination with the reconstructed cosmic ray modulation (see point 1 above) and the known changes in the geomagnetic field, it is now possible to quantitatively evaluate CRII in the past. Therefore, these results provide a useful and easy-to-use quantitative tool to study outer space effects on the atmospheric properties on different time scales and in different geographical regions.

3. Long-term reconstructions of solar activity: Using a physics-based model, our group has participated in quantitative reconstruction of the level of solar activity on the millennial and multi-millennial time scales from cosmogenic isotope data [4-6]. In particular, it has been shown that the contemporary high level of solar activity is a rare episode indicating the unusually high activity after the 1930's. These data provide a solid basis for quantitative studies of very long-term relations between the solar variability and terrestrial environment. A possible signature of very strong solar energetic particle events has been also studied for the last centuries [7].

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Theme 2: Space Weather: Science and Applications

Progress on CAWSES Theme 2 Activities

Report by J. Kozyra and K. Shibata, Co-Chairs (jukozyra@engin.umich.edu and shibata@kwasan.kyoto-u.ac.jp)

Activities continue in preparation for the CAWSES International Workshop on Space Weather Modeling (CSWM) to be held at the Earth Simulator Center, Yokohama, Japan during 14-17 November 2006. The purpose of the workshop is to review recent progress and scientific challenges in space weather modeling research. The scientific program consists of sessions on the following topics: (1) the Sun and the solar corona (including a special session on the recently launched Solar-B mission; named HINODE), (2) CMEs, heliosphere, and the solar wind, (3) the magnetosphere and ionosphere, and (4) novel numerical modeling techniques. In addition, joint sessions between the CSWM face-to-face workshop and the 1st CAWSES Virtual Conference focusing on the state of the Sun-Earth system during extreme space weather events (described in the announcement on Virtual Conference) will be used to bring modelers into contact with observers. This combined approach is expected to begin the process of identifying Sun-Earth system science questions, the model improvements needed, and data analysis products to use global simulations as a tool to explore cutting-edge system science questions. More information on the CSWM workshop, important dates and scientific program can be found at http://www.es.jamstec.go.jp/cswm/. For more information, contact Kanya Kusano (CSWM_esc@jamstec.go.jp).

Further, progress under Theme 2 working groups and workshops are underway. They are described below:

1) **Working Group report on the CAWSES Continuous $H\alpha$ Imaging Network (CHAIN) – Courtesy of *H. Kurokawa* (WG2.4 Leader)**:
The purpose of this working group is to bring together representatives of solar observatories worldwide to construct a new CAWSES data analysis tool – continuous high-resolution $H\alpha$ observations of the Sun. Initial steps combine the Global H_α Network observations maintained by the Big Bear Solar Observatory at (http://www.bbso.njit.edu/Research/Halpha/) with the Solar Magnetic Activity Research Telescope (SMART) at the Hida Observatory of Kyoto University. SMART observes full disc H_α and vector magnetic fields every minute. SMART observations can be viewed at http://www.hida.kyoto-u.ac.jp/. Work continues.

2) **CAWSES Space Weather Workshop in March 2007 in Alaska:**
Initial planning activities are underway in anticipation of a workshop that explores the comparative study of flares and magnetospheric substorms as a basis for space weather research. The workshop is designed to encourage communication between solar- and geo-physicists and to provide both groups a view of the real aurora. The workshop is expected to host between 30 and 50 international participants. More details will be available in the coming months.

3) **International CAWSES Symposium, featuring all 4 CAWSES Themes, during 23-27 October 2007 in Kyoto, Japan:**
This symposium will provide a venue to exchange new information and discuss the results of CAWSES-related science campaigns and initiatives focusing on the short-term (Space Weather) and long-term (Space Climate) variability of the integrated solar-terrestrial environment. For more details about the symposium please visit the website: http://www.stelab.nagoya-u.ac.jp/cawses/.

Theme 3: Atmospheric Coupling Processes

CAWSES Theme 3 activities during the steering committee meeting in Beijing, July 23, 2006

Report by F-J Lübken and J. Alexander (alexand@cora.nwra.com and luebken@iap-kborn.de)

Theme 3 has organized its science topics within four working groups, whereas coordinated activities take place within 'projects' (see CAWSES homepage http://www.bu.edu/cawses for more details). Currently there are eight projects in Theme 3 covering a wide range of atmospheric coupling issues. Five project leaders provided inputs to this Theme 3 report. Alan Manson and his team have analyzed, in detail, the dynamical status of the upper atmosphere prior to and during a SSW (sudden stratospheric warming) in winter 2004/5 (Campaign 1). Significant disturbances occurred in the circulation patterns and the thermal structure of the stratosphere and mesosphere/lower thermosphere (MLT) regions. They show that the characterization of cyclones and anti-cyclones in terms of rigid rotation versus strain and stretching (0-50 km) is crucial for the understanding of winds in the mesopause region; in this winter, European and Canadian sectors experienced dramatically different scenarios. The analysis included upper atmosphere winds (65-100 km) from the hemispheric radar network throughout the winter, which demonstrated the upward extension of the vortex. Results from the 2005/6 winter polar vortex (Campaign 2) are now almost complete. Being centered on the pole, the SSW had a very different character from the previous year. For the 2006/7 Campaign, data from the new Canadian PEARL laboratory (80°N) will enable richer assessment of longitudinal variations in the vortical winds, temperatures, chemistry, and wave activity.

William Ward provided details on the status of data collection and further planning for several campaigns to characterize tides from the troposphere to the thermosphere. A large group of institutions with various ground based and satellite borne observations as well as theoretical analysis participated in this campaign (see report on the global tidal campaign workshop in this newsletter).

Franz-Josef Lübken and his team showed experimental and model results on ice layers in the polar upper atmosphere. Satellite observations of polar mesosphere clouds are now available spanning more than 20 years that show trends in the cloud brightness

with solar cycle. Lidar observations of noctilucent clouds (NLC) are available for the last 10 years wich show some unexpected variation with solar cycle. For example, the observations do not show a steady increase of NLC occurrence rates in recent years, which was expected because solar activity decreases. The interhemispheric comparison of ice layers from satellites, lidars, and radars shows some differences, but also some similarities. For example, satellites clearly show that ice layers are less frequent and bright in the southern hemisphere compared to the northern hemisphere (both in summer). On the other hand, lidar and radar observations show that the NH/SH altitude difference is rather small (few hundred meters only). Comprehensive global circulation models comprising of chemistry, radiation, etc. have recently been expanded to include ice particle physics. These models are used to explain the morphology of ice layer related phenomena. They also show that ice particle generation and sublimation can lead to a major redistribution of water vapor in the MLT region poleward of approximately 50˚ in latitude. Satellite measurements of trace gases (in particular water vapor) are used to study the background environment for ice particles and their influence on trace gas concentration.

Mamuro Yamamoto and his colleagues provided a summary of the CPEA campaign (coupling processes in the equatorial atmosphere). Archana Bhattacharyya and her team have participated in a combined Theme 2/Theme 3 multi-instrument observational campaign in India during the period from March 15 – April 30, 2006. They studied ionospheric scintillations related to equatorial plasma bubbles (EPBs) at two locations: near the dip equator and close to the equatorial ionization anomaly, simultaneously with coherent scatter radar observations at a dip latitude region between the above two locations. These observations are expected to yield information about the influence of electrodynamic coupling between the equatorial *F* region and the off-equatorial ionosphere, on the evolution of EPBs.

Further input was provided from Theme 3 working group members on new results from high resolution mesospheric echoes at low latitudes which show remarkable details on dynamical instabilities and turbulence. Clusters of optical imagers are installed at low and middle latitudes to study small-scale gravity waves in the MLT region, including statistics on their propagation direction and relation to potential sources in the lower atmosphere.

Several workshops and sessions were organized by Theme 3 members, including an ice layer workshop in Kühlungsborn, Germany (see report in this newsletter) and a CAWSES session during the EGU assembly in Vienna. Similar sessions are scheduled in upcoming international symposia such as the EGU (Vienna, 15-20 April 2007) and COSPAR (2008 in Montreal).

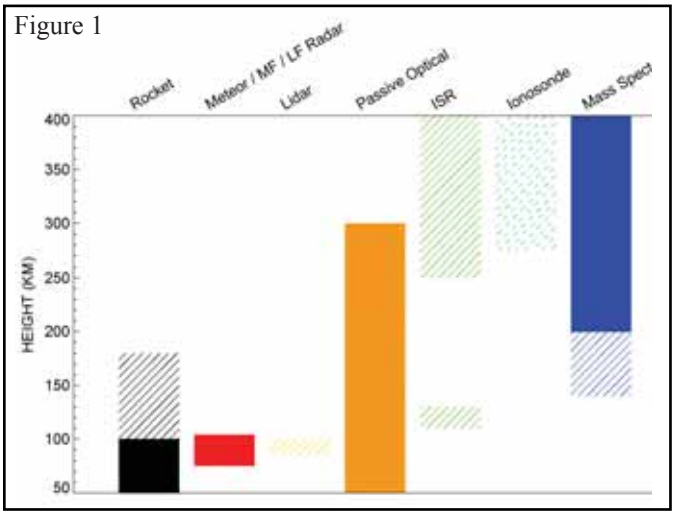
Theme 4: Space Climatology

Climatological Variations of the Ionosphere and Upper Atmosphere

Report by J. Emmert (emmert@uap2.nrl.navy.mil)

A key component of upper atmospheric research is the climatological analysis of data, which requires extensive data sets spanning the range of all parameters (height, solar activity, etc.) that influence the mean behavior of the system. In addition, there is an increasing evidence that the upper atmosphere and ionosphere

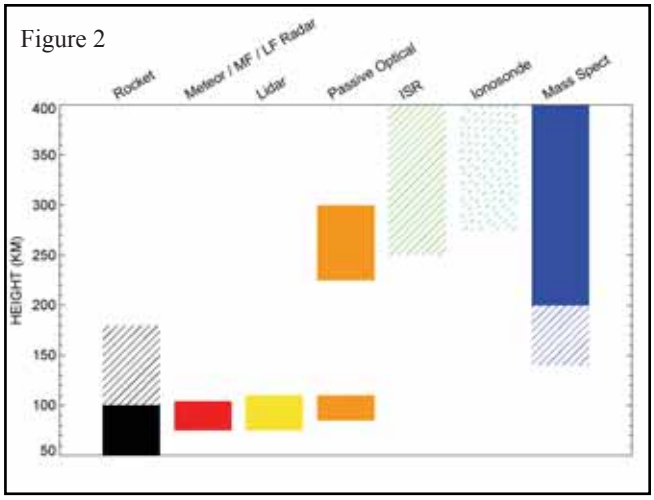
Figure 1



are undergoing secular changes; identification and interpretation of these trends require continuous monitoring of multiple properties (temperature, density, composition, etc.) of the system.

One of the goals of CAWSES WG 4.4 is to identify gaps in the climatological record. To that end, we are working on a comprehensive survey of upper atmospheric (50-1000 km) data coverage, and highlight areas where new or continued measurements

Figure 2



would have a major impact on our understanding of this region.

Survey Considerations: (i) Height coverage of proven or promising measurement techniques, (ii) Temporal coverage of existing data, (iii) Geographic coverage of ground-based measurements, (iv) What climatological gaps require the development of new measurement techniques? and (v) What gaps could be filled with new or continued measurements? Our full initial survey will be presented in a future report, but we present here our survey results for neutral wind data coverage. Figures 1 and 2 respectively show the daytime and nighttime height coverage of techniques available for measurement of neutral winds. The diagonal stripes indicate that the technique is either a very indirect measurement, or the horizontal wind vector is only partially determined (e.g., meridional winds only), or it is difficult to make routine measurements, or the technique is under development. Figure 3 shows the temporal and height coverage of wind measurements from various instruments. Our initial survey results highlight the need for techniques for measuring nighttime neutral winds in the

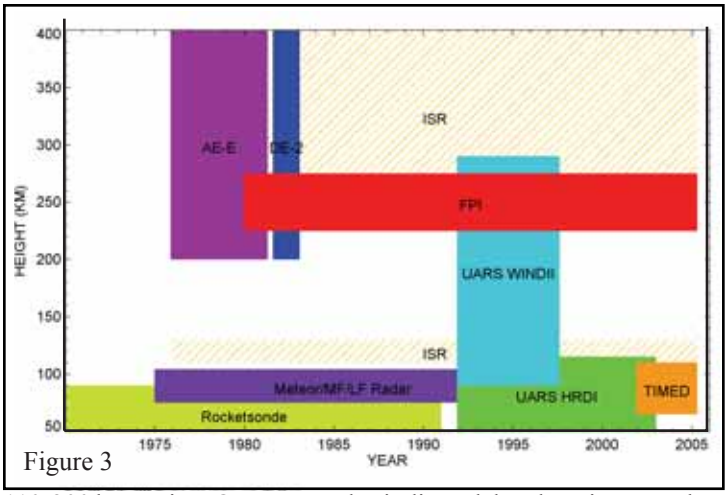


Figure 3

110-200 km region. Our survey also indicated that there is currently very little monitoring of daytime upper thermospheric winds, and that the geographical coverage of nighttime upper thermospheric wind measurements is quite sparse.

Capacity Building and Education

2nd Capacity building workshop by CAWSES AOPR

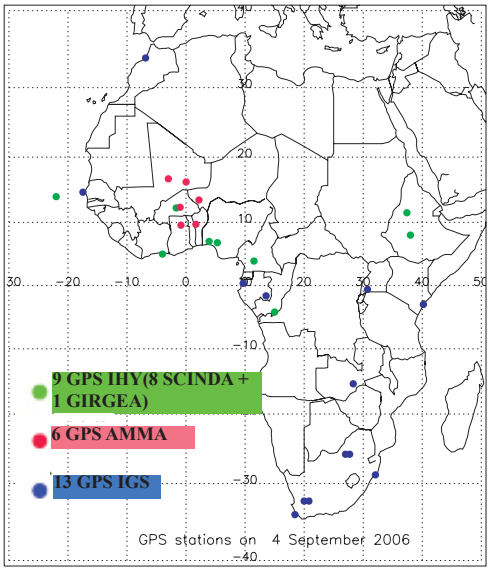
Report by Shin-Yi Su (sysu@jupiter.ss.ncu.edu.tw)

CAWSES-AOPR Coordinating Office at National Central University (NCU), Chung-Li, Taiwan would like to invite scientists from Southeast Asian countries to participate in the Second Capacity Building Workshop of Space Science to be held from October 30 to November 7, 2006 on the campus of NCU, Chung-Li, Taiwan. This workshop is sponsored by the National Science Council of the Republic of China with funds to support participants' travel and living costs for the workshop. The theme of this workshop is to introduce the mission of FORMOSAT-3/COSMIC constellation satellites for ionospheric, atmospheric, and meteorological observations. Emphasis will be on data utilization processes from FORMOSAT-3/COSMIC observations as well as coincident observational studies with regional ground observations at participants' countries. The workshop schedule and application form can be downloaded from http://csrsdcc.csrs.ncu.edu.tw. For further information contact Prof. S. –Y. Su.

GPS Receivers in Sub-Saharan Africa

Report by Sunanda Basu (sbasu@bu.edu)

This is to inform the CAWSES community that we have been successful in introducing several receivers into Sub-Saharan Africa for the measurement of TEC from GPS satellites, as well as scintillations from GPS and geostationary satellites. This became possible through the untiring efforts of our colleagues from the Air Force Research Laboratory, Keith Groves and Santimay Basu (member of CAWSES Theme 2). The map shown below gives the locations of the new stations within the SCINDA (Scintillation Network Decision Aid) network, which will provide TEC/scintillation information across that belt of Sub-Saharan Africa. Two of the stations are currently operational while the others are awaiting deployment. This new map was generated by Christine Mazaudier, Monique Petit-Didier and Paul Vila, CETP, France who are also connected to the AMMA (African Monsoon Multidisciplinary Analysis) and IGRGEA (International Geophysical Research Group Europe Africa) Programs. The IGS (International GPS Service) receivers are part of a multi-agency global network.



Readers of *CAWSES News* may recall the huge gap in global TEC maps that existed in this part of Africa prior to this time (Coster, Anthea, Vol. 2, No. 1, March 2005). The new instrumentation will allow the countries in this region of Africa to participate in ionospheric space weather studies and become part of the global communication and navigation network. A small focused Workshop was held last July in Cape Verde to acquaint the recipients of these instruments with the information needed to operate and obtain scientific data.

The science emanating from this network and the introduction of several magnetometers will be discussed at a Workshop to be held in Ethiopia, probably during the last quarter of 2007. The Workshop will be organized by the IHY program among others. More information on the Workshop will be provided in the next issue of *CAWSES News*.

Reports from the CAWSES Community

Ice Layer Workshop

Report by F-J. Luebken (luebken@iap-kborn.de)

A CAWSES ice layer workshop was held from May 14 -17, 2006, at our institute here in Kühlungsborn. A total of 60 scientists were present and reported about recent developments in ice layer related observations from the ground (lidar, radar, microwave) and from space. Results from modern models and interpretations regarding ice particle properties and long term variations (solar cycle, trends) were presented. Dedicated working groups were formed to discuss specific topics, e.g. the derivation of particle size distribution and shape from measurements. We greatly appreciate the financial support extended by SCOSTEP that was used to support travel for young scientists.

CAWSES Tidal Campaign Workshop

Report by Willam Ward (wward@unb.ca)

The first CAWSES Tidal Campaign Project workshop was held in Beijing, on July 21, 2006. Tides and their effects dominate the dynamics and constituent signatures in the mesosphere and lower thermosphere. In addition, the source mechanisms and variability are still poorly understood. The tidal campaigns are intended to collect tidal information throughout the atmosphere, so that their full evolution can be studied.

The purpose of this Theme 3 project is to organize several global

observing campaigns of tides and their effects throughout the atmosphere, to coordinate the analysis of these observations, and to stimulate modelling and theoretical work. The first CAWSES Global Tidal Campaign took place during September and October, 2005 and two more campaigns are planned for March 1 - April 1, 2007 and June 15 - August 15, 2007.

This workshop provided an overview of the complexity of these waves and an opportunity to prepare for future campaigns. Jens Oberheide presented an analysis of non-migrating tides using TIDI wind data from the TIMED mission. He showed that non-migrating tides (westward, wavenumber 2 and eastward wavenumber 3 diurnal and westward, wavenumber 3 semidiurnal) achieved significant amplitudes during the first tidal campaign. William Ward presented results from the extended Canadian Middle Atmosphere model which also indicated the presence of a number of components with significant amplitude. Ground based Fabry-Perot results from Resolute Bay were presented by Qian Wu showing the semidiurnal tide dominating their observation with a maximum amplitude of 50 m/s during the campaign. M. Gerding showed some examples of lidar temperature observations from the Institute of Atmospheric Physics in Kuhlungsborn indicating the presence of tides and noted that they had over 250 hours of observations during the first tidal campaign. Franz-Josef Luebken presented observations from Alomar indicating that NLC brightness, layer height and occurrence frequency all showed variations at tidal periods. Results from the Leibniz Institute of Middle Atmosphere (LIMA) model were able to produce variations of a similar form to those observed. Finally, results from Joe She's lidar observations from Colorado State University, were presented showing both diurnal and semi-diurnal variations over their site. In addition to these presentations, observations from a number of other radars, lidars, imagers and satellites were noted as being available during the first campaign.

These results confirmed the current thinking that what is typically observed from any ground station is the superposition of a number of tidal modes. In order to resolve the components present, ground based networks along with satellite observations are needed. To facilitate activity associated with the next two campaigns, contacts for various types of observations were identified. Confirmed contacts include Werner Singer for meteor and MF radar, Michael Gerding, Phillipe Keckhut and D. Narayana Rao for lidar, Juergen Scheer for ground based optical instrumentation, Jens Oberheide for dynamical measurements from satellite, and William Ward for models. Additional contacts for other observations areas are being confirmed. Future activities include organizing the two new campaigns in 2007 as mentioned above, work on analysing the data from the first campaign with publication of these results in a special issue, and the organization of meetings for these campaigns in 2007 and 2008 (with the 2008 meeting possibly being a Chapman conference). In addition, sessions are being planned in major meetings over the next two years.

" An expert is a man who has made all the mistakes which can be made in a very narrow field."
-**Niels Bohr**, (1885-1962)

IAGA/ICMA/CAWSES Workshop Long Term Changes and Trends in the Atmosphere

Report by Jan Lastovicka (jla@ufa.cas.cz)

This workshop, jointly organized by the IAGA/ICMA working group "Long-term trends in the mesosphere, thermosphere and ionosphere", the CAWSES panel on long-term trends and the Sodankylä Geophysical Observatory of the University of Oulu, was held in Sodankylä, Finland during 4-7 September 2006. Increasing concentration of greenhouse gases in the atmosphere, stratospheric ozone depletion, as well as long-term changes of solar and geomagnetic activity can result in long-term changes and trends in the stratosphere, mesosphere, thermosphere, and ionosphere. The main goal of this workshop was to discuss progress in the field, evaluate our current knowledge of observational and model-simulation and to understand the trends in the atmospheric parameters. The workshop was attended by 40 scientists from four continents. Altogether 42 papers were presented; among them 7 orals and 1 poster were presented by young scientists (age below 35 years). Three topical discussions were organized on topics concerning key unresolved problems in trend investigations as determined by the Program Committee of the workshop. The three topics were trends in dynamics, in water-related phenomena and in the ionospheric F_2 region.

Papers dealing with methods of trend determination stressed the problem of data quality and methods of its testing, and the correct approach of eliminating strong solar cycle, seasonal cycle and diurnal cycle effects on trend determination. Several papers treated present-day development of ozone layer: there are some signatures of ozone recovery as a consequence of the Montreal Protocol, but several more years of data are necessary to be able to see statistically significant chemical recovery of ozone on the background of large ozone variations of meteorological origin. Trends in winds, tides and planetary wave activity in the mesopause region (80-100 km) do not show a clear pattern; changes of zonal and meridional component are even opposite for some parameters. Information on the program and abstracts of papers may be found at: http://www.sgo.fi/Events/ltt-2006/. Proceedings of the workshop will be published on CD-ROM. Selected papers will be published in Annales Geophysicae after undergoing the refereeing process. The next workshop will be held in 2008; place and date have not yet been determined.

CAWSES activity in France

Report by Christian Hanuise (christian.hanuise@cnrs-orleans.fr)

As described in the CAWSES website, activities in France are performed mostly under the auspices of the National Program for Solar-Terrestrial physics (PNST, Programme National Soleil – Terre). Most of the laboratories involved in solar or magnetospheric / ionospheric physics are participating in this program. The French community participates in various international satellites, or ground-based programs, e.g. SOHO, Cluster/Double Star, EISCAT, SuperDARN. In addition, the Nancay observatory performs multi-wavelength radio observation of the Sun, complemented by the ARTEMIS cooperative VHF radio telescope in Greece. One example of the studies performed within PNST is given by the

working group chaired by Christian Hanuise. It is devoted to the global study of the Sun – Earth system in order to understand the physical processes and the links between the various regions. One aim is to define proxies to be able to characterize the state of key regions, and their coupling, from the solar surface to the Earth's ionosphere and thermosphere. This includes not only intense perturbations and space weather effects but also moderate and quiet conditions. Scientist from most French laboratories, including CETP, CESR, IAS, LESIA at Paris-Meudon Observatory, LPCE and LPG participate in this working group.

The Electronic Geophysical Year (eGY)

Submitted by Bill Peterson (bill.peterson@lasp.colorado.edu)

Charlie Barton (Chair of the International eGY Committee), Bill Peterson (eGY Secretary) and Peter Fox (Chair of the eGY Working Group on Virtual Observatories) met with Gang Lu, (SCOSTEP Scientific Secretary), on March 30, 2006 to discuss ways in which SCOSTEP and eGY could profitably interact. This informal meeting was prompted by the decision made at the SCOSTEP Bureau meeting following the STP-11 conference to foster a close collaboration with eGY.

eGY provides a focus and an international framework for cooperation to help improve geoscientific data availability and access worldwide using the capabilities offered by modern digital communications and information management technologies. eGY seeks to promote the growth of e-Science and virtual information systems (virtual observatories) that access distributed data and services to complement in cyberspace the contribution from physical observatories. Close links exist with other "IGY+50" initiatives - the International Polar Year 2007-2008, the International Year of Planet Earth, and the International Heliophysical Year. The eGY Declaration (http://www.egy.org/declaration.html) has been endorsed by major International Organizations including SCOSTEP, IUGG, IAGA, and ICSU. The eGY program is implemented through working groups. Information about them and eGY can be found at http://www.egy.org. CAWSES participants

Announcement: Sun-Earth Connection Virtual Conference Series: Session 1

You all are encouraged to participate in this Virtual Conference scheduled for November 13-17, 2006. **Workshop URL:** http://workshops.jhuapl.edu/s1/index.html. Explore the state of the sun-Earth system during extreme space weather. "Return to the Auroral Oval for the 50th Anniversary of the International Geophysical Year". Sponsors: CAWSES, IHY, eGY, ICESTAR, NASA/LWS, NSF, and the SEE organizers **Registration is open now!!**

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CAWSES International Coordination office at B.U. is supported by US NSF