CAWSES: Climate and Weather for Sun-Earth System– II http://www.cawses.org/wiki/index.php/Main_Page
Task Group4 : What is the geospace response to variable inputs from the lower atmosphere?

TG4 Newsletter Vol. 10, Nov. 2012

Inside this Issue

Article 1

Space environment study at the Institute of Ionosphere (Kazakhstan): Instrumentation and Science

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Gordienko Galina

We present a summary of current instrumentation operated at the Institute of Ionosphere (Almaty, Kazakhstan) and main parameters they measure.

Ionospheric sounding in Kazakhstan started in 1943 using the AIS ionosondes. There were 3 ionosondes in operation: at Novokazalinsk [NK246, 45.76N, 62.21E] from 1964 to 1993, at Karaganda [KR250, 49.82N, 73.08E] from 1964 to 1991, and at Almaty [Alma-Ata station AA343, 43.25N, 76.92E, L=1.4] since 1943. In 2003 this was replaced by a Russian advanced digital ionosonde PARUS (http//www.izmiran.rssi.ru). The ionosonde provides accuracy of 2.5 km for h'(f) and 0.05 MHz for the foF2(t). A local ionosonde data bank based on input of all available ionospheric data is currently under development. The main direction of the ionospheric research for the Institute over the past years is to measure changes (both natural and man-made) in the E- and F-regions, long-term trends and effects of vertically propagated atmospheric waves in the upper ionosphere, nighttime and day-to-day variability, and irregular events in the ionosphere during geomagnetic

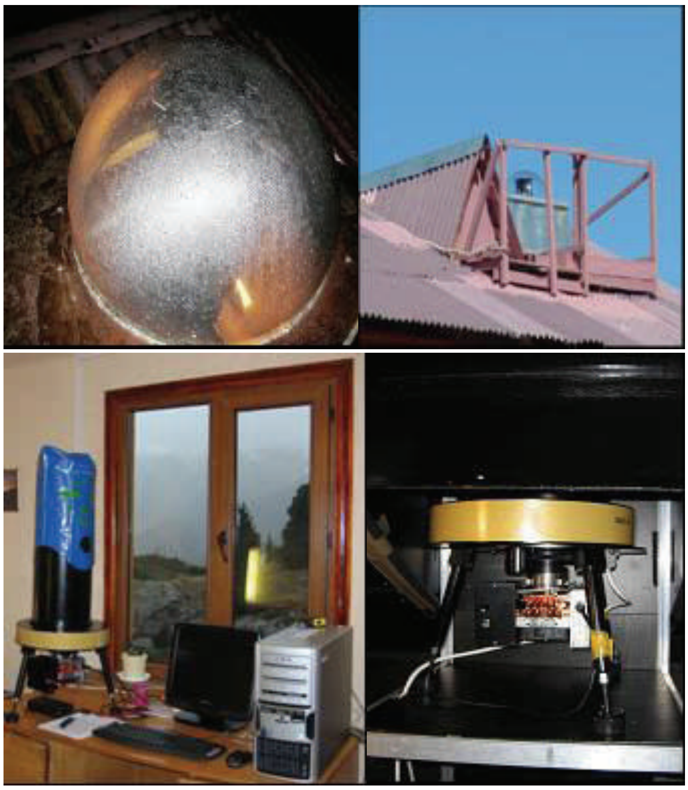

Figure 1. SATI spacing.

Figure 2. IDL-map of current distribution of Callisto instruments in Sept. 2012.

storms. For example, it was recently shown an anomalous formation of the E-, E2-, F2-layers and appearance of the auroral-type sporadic E-layers in the nighttime ionosphere observed at the midlalitude Alma-Ata station during the great geomagnetic storms of October-November 2003.

The SATI instrument developed in Canada and installed at the experimental base area of the Institute of Ionosphere "Orbita" [43°03'30''N, 76°58'24''E] at 2730m altitude above sea level in the absolute absence of the Almaty city light has been in regular operation since October 2009, Fig. 1. An observation run is about 8-10 hours; the temporal resolution is 2 min. The instrumental concept of the SATI instrument rests on spectral Fabry Perot interferometer adapted to measure the integral emission rate and rotational temperature of the O2 (0-1) nightglow atmospheric band emitted at 95 km height, and OH(6-2) Meinel band emitted at 87 km.

A new Callisto radio spectrometer (eC37) was installed at the "Orbita" base area in May 2011. It operates between 45 and 870 MHz (different types of solar radio bursts) having a frequency resolution of 62.5 KHz. Twenty five of the CALLISTO instruments have already been deployed including Kazakhstan. Through the IHY/UNBSSI instrument deployment program, CALLISTO is able to continuously observe the solar radio spectrum for 24h per day through all the year. All Callisto spectrometers together form the e-Callisto network (http://www.e-calisto.org), Fig. 2.

A neutron monitor settled at the altitude of 3340 m above sea level in Tien Shan Mountains (Fig. 3) is used to investigate and forecast dangerous situations in the Space. Almaty cosmic ray station is included in the world-wide neutron monitor network and European Database NMDB for real-time monitoring of the space weather conditions (www.nmdb.eu). The complex system ("ELIS-TS") for registration of the atmospheric electric field is installed at the experimental base area. The instrument consists of two detectors: detector of the high frequency component of the electric field (*dEz* component), and detector of the quasistatic electric field (*Ez* component). Measurement ranges are ±50 kV/m and 1000 V/m correspondingly, sensitivity is 10V/m and 0.2V/m, time resolution is 0.05 sec and 0.00005 sec (for the mode "fast" operation). These experimental data are used to study effects related with the earthquake and thunderstorm events.

The magnetic observatory «Alma-Ata» is a member of INTERMAGNET programme, contributing data for computation of the *Dst* index (http://dcx.oulu.fi).

Figure 3. The Tein Shan experimental base area at the altitude of 3340 m above sea level.

Article 2

An overview of scientific activities under CAWSES-India program

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S. Gurubaran

The CAWSES-India program was conceived as a national initiative in line with the international programme of Climate and Weather of the Sun Earth System (CAWSES). CAWSES provides a platform to the Indian aeronomy and space science community to come together and pursue scientific activities towards achieving common science goals. CAWSES-India Phase II (2009 – 2013) is being pursued as a logical extension to Phase I to cover the increasing phase of the solar cycle 24 with three specific science themes: (1) Solar Influence on Climate, (2) Space Weather: Science and Applications, and (3) Atmospheric Coupling Processes.

Nearly forty scientific projects are being executed under the three themes addressing the following broad science questions.

THEME 1:
(1.1) What are the linkages between the Indian Summer Monsoon (ISM) and solar variability?
(1.2) How does solar variability influence tropical tropopause dynamics over long time scales?
(1.3) What is the influence of solar variability on the tropical middle atmospheric chemical climate?

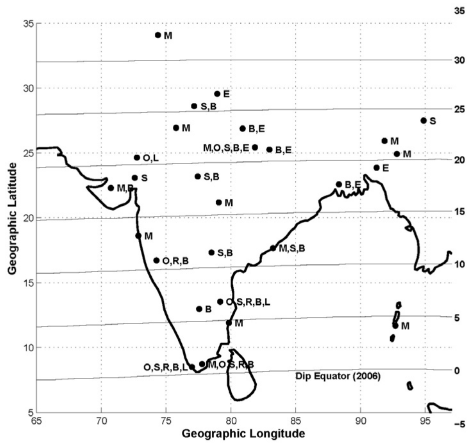

Figure 1. Map showing observational sites of relevance to TG4 activities.

THEME 2:
(2.1) How well can we predict a geomagnetic storm?
(2.2) What are the triggers for the generation of equatorial plasma irregularities?
(2.3) How well can we nowcast / forecast scintillation occurrences?
(2.4) How are the particle and electromagnetic energy

Table 1. Scientific instruments and the sites in India hosting them. The map shown separately indicates the locations of these sites (only the labels indicating the instruments below are shown against respective locations in the map).

Experiment	Stations
Magnetometer (M)	Tirunelveli, Port Blair, Pondicherry, Visakhapatnam, Alibag, Nagpur, Rajkot, Silchar, Shillong, Allahabad, Jaipur, Gulmarg
Ionosonde (S)	Trivandrum, Tirunelveli, Gadanki, Hyderabad, Ahmedabad, Bhopal, Allahabad, Dibrugarh, Delhi
Radars (MST / MLT) (R)	Trivandrum (Meteor Radar), Tirunelveli (MF Radar), Gadanki (MST Radar), Kolhapur (MF Radar)
Airglow photometers / imagers (O)	Trivandrum, Tirunelveli, Gadanki, Kolhapur, Mt. Abu
Lidars (Rayleigh / sodium) (L)	Trivandrum, Gadanki, Mt. Abu
Scintillation-TEC (only a few stations hosting GPS/CRABEX receivers shown) (B)	Trivandrum, Tirunelveli, Gadanki, Bangalore, Hyderabad, Visakhapatnam, Bhopal, Kolkata, Allahabad, Varanasi, Lucknow, Delhi
ELF/VLF Receivers (E)	Kolkata, Allahabad, Varanasi, Nainital, Jammu, Agartala

inputs incident from the Sun distributed in various regions of the Earth's atmosphere-ionosphere-magnetosphere system?

THEME 3:

(3.1) What is the role of Stratosphere-Troposphere Exchange processes in the long-term variabilities of trace gases like ozone and water vapour?

(3.2) How does the tropical tropopause vary and what are the forcing mechanisms for the tropopause dynamics in the tropics?

(3.3) What wave forcings drive the structure and dynamics of the middle atmospheric and lower thermospheric / ionospheric regions?

The scientific activities are monitored by a National Steering Committee. Indian Space Research Organization is the primary funding and the nodal agency for all CAWSES activities in India.

TG4 related activities are being pursued in India with the following observational networks spread across the country (see Table below as well as the map shown separately) –

* Ionosondes
* Magnetometers
* Atmospheric and Ionospheric Radars
* VHF & UHF / GPS scintillation receivers including those passive receiver network established for the CRABEX Ionospheric Tomography Experiment
* Optical Airglow Monitors
* Lidars
* ELF / VLF Receiver network monitoring Schumann resonances, sferics and whistlers

Article 3

CAWSES TG4 Project 5

Colin Price

Colin Price
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Here we introduce 3 different initiatives, which have recently started studying the linking between the lower and upper atmosphere, including the thunderstorm activity and atmospheric electricity, the main subjects of Project 5 /TG4. These are the European COST action ES1004 called TOSCA (http://www.**cost-tosca**.eu/), the European Science Foundation TEA-IS (http://www.esf.org/activities/research-networking-programmes/life-earth-and-environmental-sciences-lesc/current-esf-research-networking-programmes-in-life-earth-and-environmental-sciences/thunderstorm-effects-on-the-atmosphere-ionosphere-system-tea-is.html) and the European FP7 ARISE infrastructure project (http://arise-project.eu/). All these are involving the international community of atmospheric electricity, which contributes to the understanding of climate not only by investigating phenomena related to the electromagnetic force to the atmosphere/ ionosphere but also by providing the essential information of the atmosphere using thunderstorm and lightning discharge.

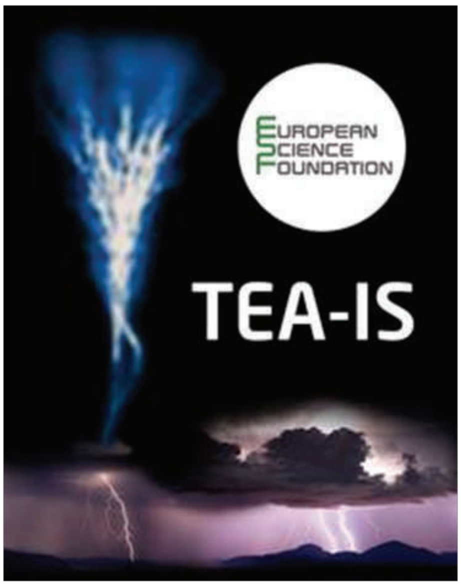

Figure 1. Logo of ESF TEA-IS project.

The TOSCA project is a multidisciplinary European network of scientists from more than 18 countries whose objective is to provide a better understanding of the hotly debated role of the Sun in climate change. This action aims at assessing the various contributions of solar variability to the Earth's climate by bringing together solar physicists, space scientists, atmospheric scientists, climate modelers, paleoclimatologists, and more. Working group 4 of TOSCA deals with the interfacing between upper and lower atmospheric layers

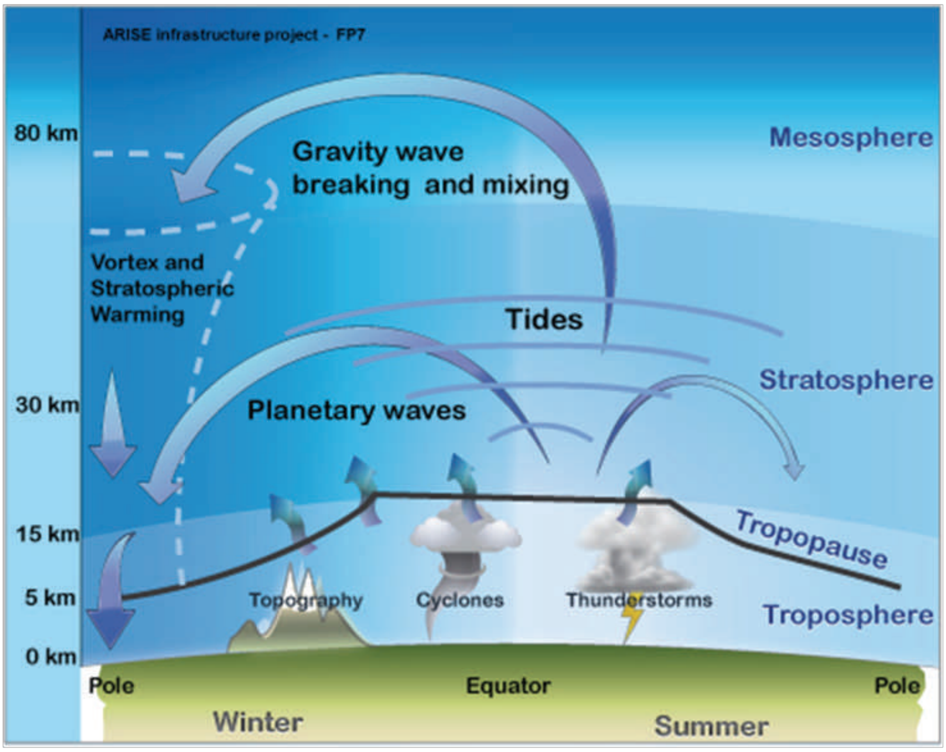

Figure 2. Dynamics of the troposphere-stratosphere-mesoshere exchanges (ARISE project).

and corresponding models, including the global atmospheric electric circuit. TOSCA is led by Thierry Dudok de Wit from France.

The TEA-IS project initiated as a result of two surprising phenomena that have been observed above thunderstorms in the last twenty years; these are huge electric discharges in the stratosphere and mesosphere, and energetic bursts of gamma-radiation observed from satellites. Their late discovery demonstrates that our understanding of thunderstorms and of processes in the atmosphere above them is limited. They further underscore the point that thunderstorms affect not only the troposphere but all atmospheric layers and near-Earth space, and that several research fields must combine to advance our knowledge of the effects of thunderstorms on the atmosphere-ionosphere system. In June 2012 a summer school was held in Malaga, Spain for international students and researchers. TEA-IS is led by Torsten Neubert from Denmark.

The ARISE Design Study project proposes to design a new infrastructure that integrates different atmospheric observation networks to provide a new 3D image of the atmosphere in the different atmospheric layers from ground to mesosphere with unprecedented spatio-temporal resolution. The infrastructure coverage will be Europe and outlying regions, including polar and equatorial regions.

The implied networks are the infrasound network developed for verification of the Comprehensive Nuclear -Test-Ban Treaty (CTBT), the Network for the Detection of Atmospheric Composition Changes (NDACC) using LIDAR (LIght Detection And Ranging) and the Network for the Detection of Mesopause Changes (NDMC), dedicated to airglow layer measurements in the mesosphere. It also integrates complementary infrasound stations developed in different countries, specific infrasound stations located near volcanoes for volcanic sources studies and ionospheric arrays to determine coupling with near Earth space. The ARISE project aims to revive existing collaborations among European scientists while developing and integrating, for the first time, a large set of complementary topics such as infrasound, gravity and planetary waves, stratosphere and mesosphere disturbances, satellite atmospheric studies and modelling of the atmosphere, and atmospheric dynamics. Data collected by these multiple networks will be analyzed to extract optimized estimation of the evolving state of different atmospheric layers, which would help to constrain the parameterization of gravity waves and to better initialize forecasts of the middle and upper atmosphere. The ARISE project is led by Elisabeth Blanc of France.

Article 4

Summary of the TG4 Business Meeting at COSPAR in Mysore, India, 20 July 2012

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[3]Indian Institute of Geomagnetism, India

Jens Oberheide

The fourth TG4 business meeting was held during the COSPAR 2012 meeting on 20 July 2012, 19:00 – 21:00, in Mysore, India, with 22 scientists in attendance, including all TG4 co-leaders, the CAWSES-II co-chair Prof. Tsuda and the SCOSTEP scientific secretary Prof. Shepherd. Five project leaders were present, representing projects 1-4.

The meeting started with an overview of CAWSES-II news by Kazuo Shiokawa and TG4 news by Jens Oberheide: Drs. Davila and Tsuda replaced Drs. Avery and Rodgers as CAWSES-II co-chairs. A final CAWSES-II symposium will be held at Nagoya University, Japan, 18 -22 November 2013. Dr. Subramanian Gurubaran has been appointed as an additional TG4 co-leader, to emphasize the contribution and importance of CAWSES-India to the TG4 objectives. TG4 continues to publish newsletters every 3 months, edited by Michi Nishioka. Three workshops were supported by TG4 during the past year. The scientific highlight was the 2nd LONET campaign in Sep.-Oct. 2011 that was conducted by project 2. Subramanian Gurubaran then overviewed the CAWSES-India activities and their relevance to TG4. See the companion article in this newsletter for details.

The major part of the business meeting was the report and discussion of the individual projects as summarized below:

Project 1, given by Drs. Ward and Abdu: The tidal campaigns will focus on securing the obtained data for long-term storage and to find a way to make data access easier. The follow-up discussion addressed how SCOSTEP and CAWSES can help with that. Dr. Tsuda suggested the setup of metadata within the framework of world data centers. This issue was also discussed in

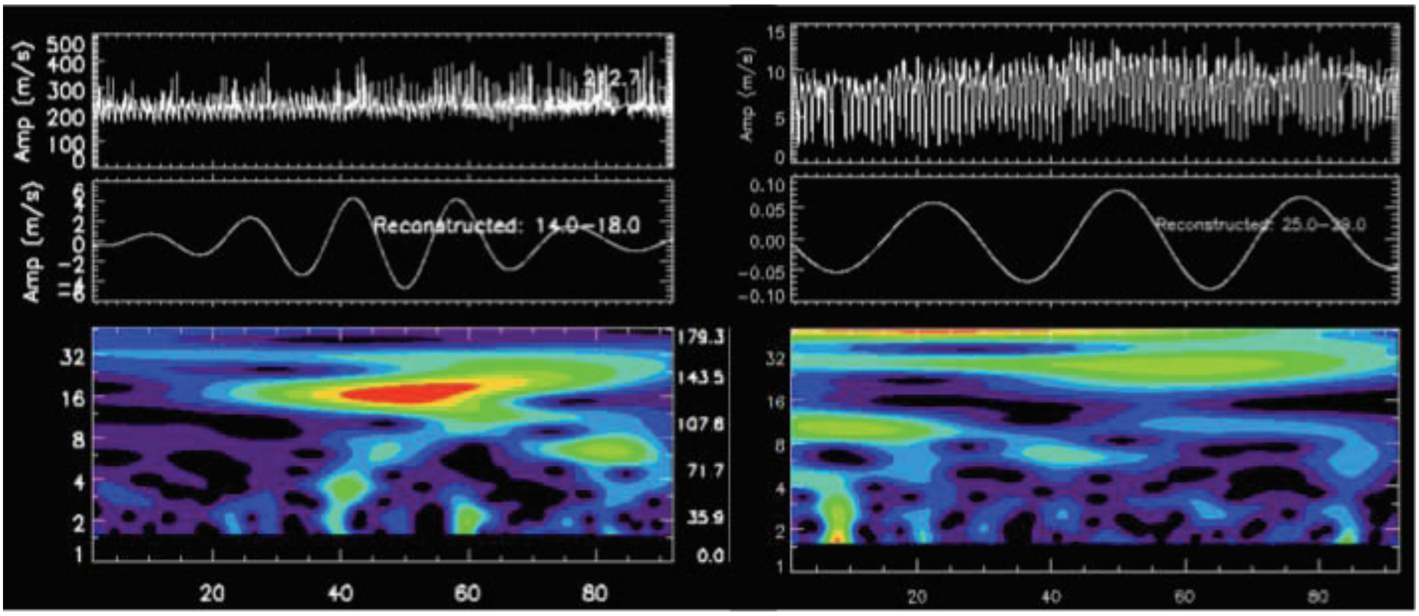

Figure 1. Wavelet spectral analysis of ionospheric h'F and foF2 at Fortaleza (3.9S, 38.4W), Brazil, during the period from September 1 to November 30, 2010. A clear 16-day oscillation is evident in h'F while foF2 shows a 27-day oscillation. Figure courtesy of Hisao Takahashi, INPE, Brazil.

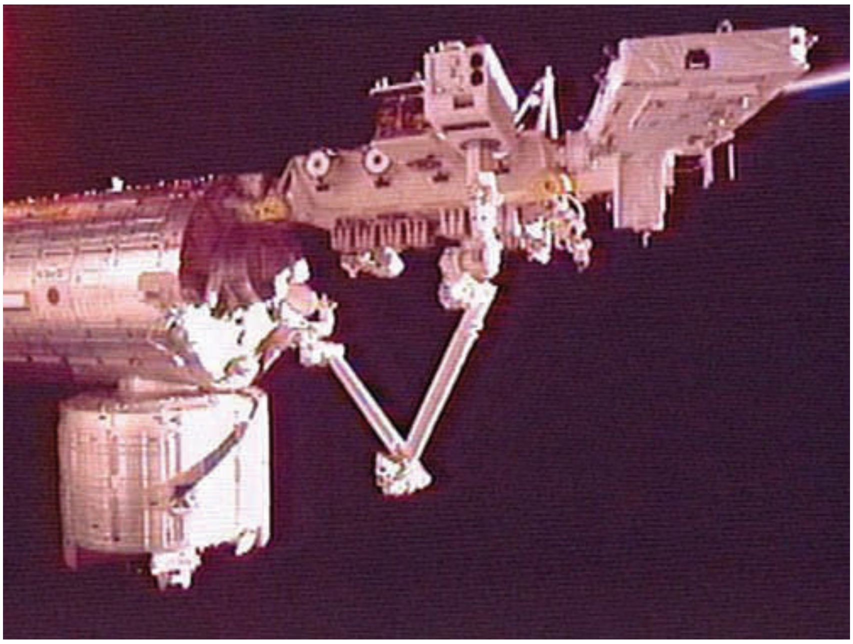

Figure 2. On August 9, the Japanese Multi-mission Consolidated Equipment (MCE) with the IMAP and GLIMS instruments was installed on the ISS. Photo courtesy of JAXA/NASA.

the general CAWSES-II business meeting the day after. Dr. Tsuda will contact the data centers and let TG4 know how to proceed. Dr. Shephered offered SCOSTEP support for data storage if a short proposal is submitted in which the value of the data and their need as a basis for future SCOSTEP programs has to be made clear. This also applies to all other projects.

Project 2, given by Dr. Takahashi: Two LONET campaigns involving ionosondes and magnetometers were conducted so far. The first campaign in Sep-Nov 2010 emphasized PW coupling (Figure 1) while the data analysis of the 2nd campaign Sep-Nov 2011 is under way. Results will be presented at the 2013 Nagoya meeting. The dates of future campaigns will continue to be defined in advance because some instruments need to be operated in different modes to meet the LONET requirements. It was emphasized that the community has an urgent need for data from Africa. The following discussion showed that this remains an unsolved problem though sponsoring scientific activities in Africa might be the way to go. Possible approaches could be the SCOSTEP spaceweather initiative (Boston College) and ICSU as possible funding sources for capacity building workshops.

Project 3, given by Dr. Yamamoto: Results were presented during the TG4 sponsored IAGA/ICMA/CAWSES workshop in Prague in February 2011. A special issue in JASTP about the important finding is about to be published. This triggered a general discussion of how to collect TG4 and CAWSES-II publications, to demonstrate the program success. This turned out to be difficult because CAWSES does not provide funding for individual research projects and thus does not appear in the acknowledgement.

Project 4, given by Dr. Kosch: A new Pansy radar was installed at Syowa station in Antarctica. ISS-IMAP will be launched (was successfully launched, Figure 2) on July 22. The ESR-SDI campaign was conducted in February 2010. A new measurement capability for mesospheric ozone has been developed, based on inexpensive standard TV satellite dishes at 11.072 GHz, with an integration time of about 6-10 hours. Several new science results from observations in Scandinavia and Antarctica were presented.

Project 5, given by Dr. Shiokawa on behalf of the project leaders: Improved lightning detection networks are now operational: WWLN (Washington University), ATDnet (MetOffice), GEON/AVON (Hokkaido University). The NHK Cosmic Shore Campaign for TLEs was conducted in July 2011. The GLIMS instrument for TLE observations was successfully launched to the ISS (Figure 2).

After these very informative and excellent overviews, the meeting was adjourned because new business was not brought up.

Highlights on Young Scientists

Modeling the observable effects of gravity waves in the Mesosphere and Lower Thermosphere

Jonathan Snively

Jonathan Snively
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My research focuses on the modeling of gravity wave propagation in the mesosphere and lower thermosphere (MLT). Since 2010, I have been working with students and colleagues here at Embry-Riddle on studies of small-scale wave propagation, interaction, and dissipation processes, and their perturbations to MLT-region airglow layers.

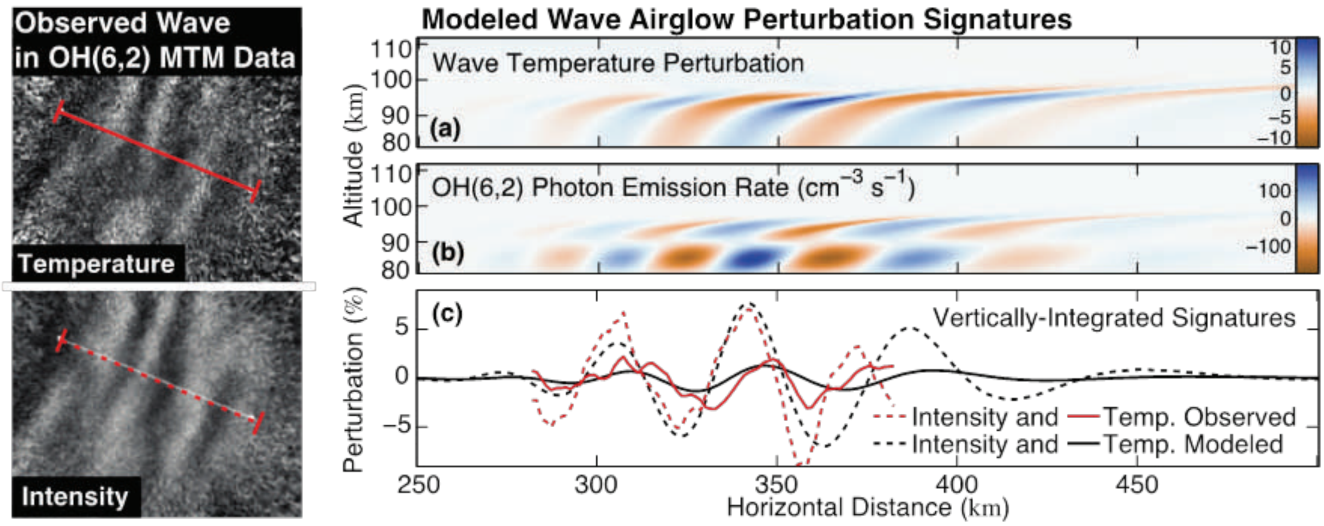

Figure 1. Left: OH(6,2) temperature and intensity images of an ~18 minute, ~37 km wave captured by the USU mesospheric temperature mapper (MTM), over Maui, HI, on 11 April, 2002 [*Taylor et al.*, Rev. Bras. Geof., 25, 2007]. Right: Nonlinear model simulation of wave (a) temperature and (b) OH(6,2) emission perturbations, and comparison of integrated signatures (c) between model and observation. (*Wave velocity fields are shown in Figure 2.*)

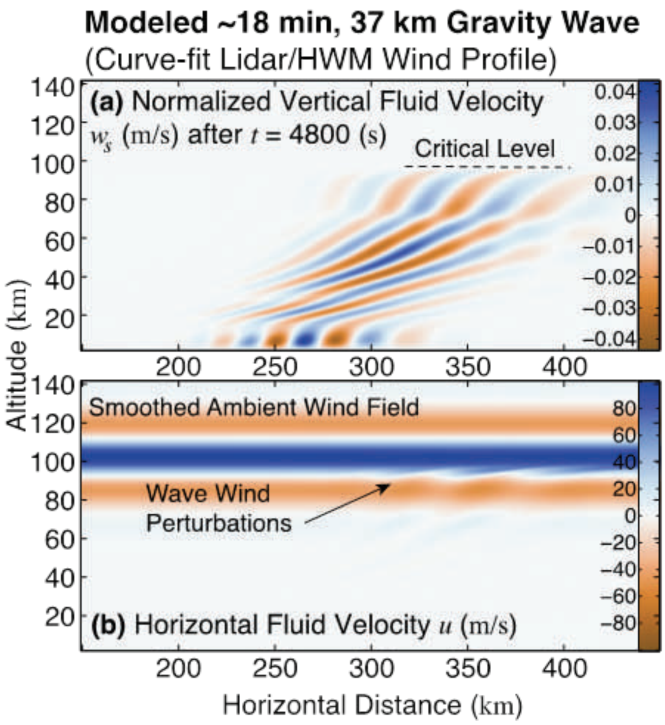

Figure 2. Nonlinear simulation of a wave inspired by MTM data (Figure 1), as it propagates upward through wind, temperature, and species profiles reconstructed from University of Illinois Na lidar data and MSISE90/HWM93 model profiles. At ~95 km, this wave encounters a critical level, which limits its upward propagation.

I first began developing numerical models for acoustic and gravity waves while studying as a graduate student at Penn State University with Victor Pasko; these models were later extended to describe wave perturbations to the oxygen and hydroxyl airglow layers. In 2008, I took the opportunity to work as an NSF CEDAR postdoc at Utah State University with Mike Taylor, constructing modeling studies using airglow, radar, and lidar data to investigate wave processes and to validate the models.

Figures 1 and 2 show an example model case study, to elucidate the propagation of a small-scale gravity wave observed in airglow data over Maui, Hawaii. An important goal of this research is to improve our understanding of small-scale (<100 km) gravity waves and effects in the MLT region, and their propagation to altitudes above. These studies benefit significantly from high-quality airglow, radar, and lidar data, which, although not always available, are crucial for the interpretation of specific wave events.

Upcoming meetings related to CAWSES-II TG4

Conference	Date	Location	Contact Information
International Symposium on Sola-Terrestrial Physics	Nov. 6-9, 2012	Indian Institute of Science Education and Research, Pune, India	http://www.iiserpune.ac.in/~isstp2012/
AGU Chapman Conference on Longitude and Hemispheric Dependence of Space Weather	Nov. 12-16, 2012	Addis Ababa, Ethiopia	http://www.agu.org/meetings/chapman/2012/fcall/
International CAWSES-II Symposium	Nov. 18-22, 2013	Nagoya, Japan	http://www.stelab.nagoya-u.ac.jp/cawses2013/

The purpose of this newsletter is to make more communications among scientists related to the CAWSES-II Task Group 4 (particularly between those of the atmosphere and the ionosphere). **The editors would like to invite you to submit the following articles to the TG4 newsletter.**

Our newsletter has four categories of the articles:

1. Articles— ~500 words and four figures (maximum)
   on campaign, ground observations, satellite observations, modeling, workshop/conference/symposium report, etc
2. Highlights on young scientists— ~200 words and two figures
   on the young scientist's own work related to CAWSES-TG4
3. Short news— ~100 words
   announcements of campaign, workshop, etc
4. List of planned workshop

Category 2 (Highlights on young scientists) helps both young scientists and TG4 members to know each other. Please contact the editors for recommendation of young scientists who are willing to write an article on this category.

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