

TG4 Newsletter Vol. 6, October 2011

Inside this Issue

Article 1: Results from the C/NOFS Satellite Mission.....	1
Article 2: MAARSY—A new powerful MST radar in the Arctic.....	3
Highlights on Young Scientists: Low-latitude Radio Beacon Receiver Network for Ionosphere and Space Weather.....	5
Short News 1: Swarm Science and Validation Opportunity	6
Short News 2: ISEA-13: Second Announcement and call for papers.....	6
Short News 3: News from the SCOSTEP Bureau.....	6
Short News 4: TG4 business meeting at IUGG in Melbourne.....	7
List of upcoming meetings.....	7

Article 1

Results from the C/NOFS Satellite Mission

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Odile de La Beaujardière

The Communication/Navigation Outage Forecast System (C/NOFS) satellite was launched in April 2008 in a 13° inclination orbit between 400- and 850-km altitude. C/NOFS is an Air Force mission with participation from NASA and the Navy to study the equatorial ionosphere with the goal of improving forecasts of ionospheric scintillation and electron density profiles. A network of ground instruments that monitor the presence of scintillation is also part of the C/NOFS Mission.

Six instruments on the satellite measure electric fields, plasma characteristics, neutral winds, and the strength of scintillation-producing irregularities. Models and algorithms assimilate the satellite observations, and combine them with ground-based and other satellite data to forecast the global ion density as well as the regions where strong ionospheric irregularities are likely to produce scintillation. C/NOFS was launched during the deepest solar minimum in almost 100 years. Thus, the most interesting findings in the mission correspond

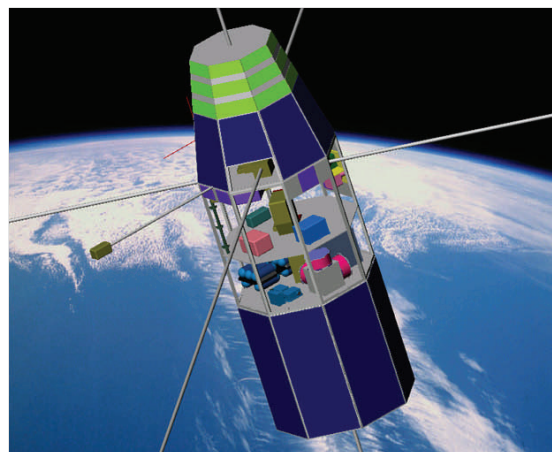


Figure 1. C/NOFS satellite with 6 state-of-the-art instruments:

- *VEFI: Electric & Magnetic Field
- *CINDI: Ion Velocity Meter (IVM)
+ Neutral Wind Meter (NWM)
- *PLP: Plasma Langmuir Probe
- *CORRIS: GPS receiver
- *CERTO: Beacon Transmitter

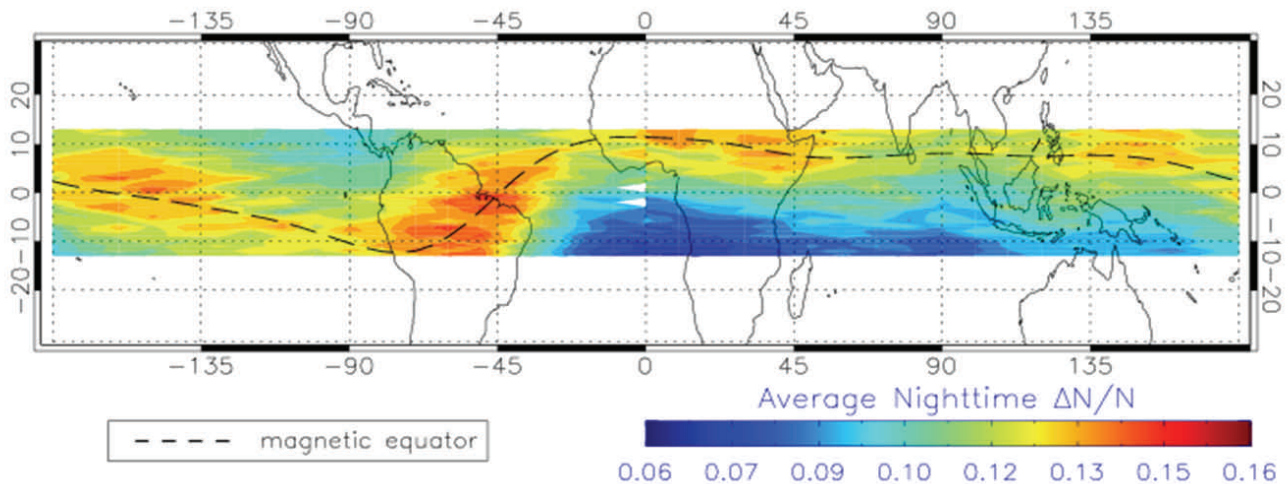


Figure 2. Average nighttime $\Delta N/N$ from May 2008 to March 2010, measured from C/NOFS (Dao et al. GRL, 2011). Tides propagating to the upper atmosphere are responsible for the apparent four-wave pattern.

to results related to low solar activity and EUV flux. A few of these findings are listed below:

- C/NOFS data confirmed that forcing from low altitudes can dominate the ionosphere. Tidal structures have been observed in ion density, ionospheric irregularities, electric fields and neutral density.
- Due to the low solar EUV levels, the altitude extent of the ionosphere was significantly smaller than reference models would predict for these levels of solar activity. The height at which 50% of the ions are from atomic oxygen was as low as 450 km at night and rose to only 850 km during the day.
- Deep ambient plasma depletions were observed at dawn. Plasma irregularities were often embedded within them. Their frequencies strongly depended on longitude and season. Coincident polar satellite passes showed that these depletions were narrow in

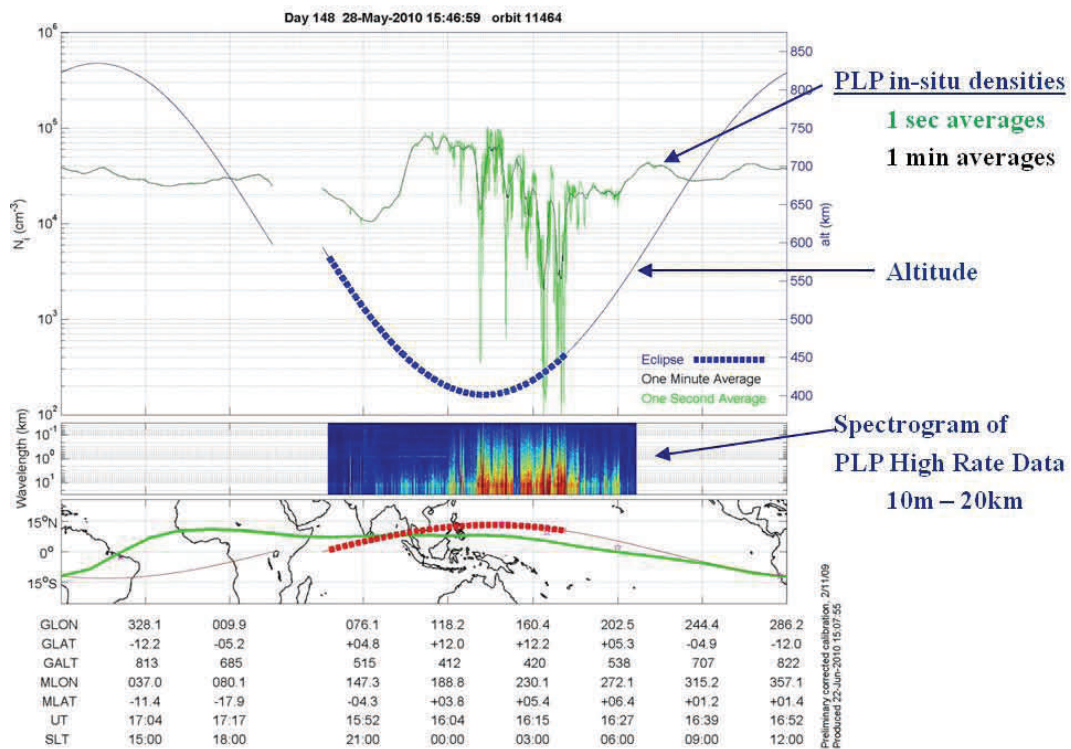


Figure 3. C/NOFS data for one orbit, 28 May 2010, 15:46:21 UT, showing example of equatorial plasma bubbles seen after midnight, but not at dusk.

the zonal direction ($\sim 15^\circ$) but very wide in the meridional direction ($\sim 50^\circ$). Using electric field measurements from C/NOFS as inputs, the assimilative physics-based ionospheric model (PBMOD) successfully reproduced these density depletions, thus confirming that they were caused by strong upward ion convection drifts.

- Plasma density irregularities were mostly observed after midnight and at dawn, instead of just after sunset as they had been expected. The absence of equatorial plasma bubbles just after sunset was consistent with the E-field measurements: the pre-reversal enhancements in the E-field were almost never seen during this solar minimum. Similar ef-

fects observed in DMSP data confirmed that irregularities were present in the dawn side of the orbit rather than in the dusk side.

In conclusion, C/NOFS provided unusual observations of the ionosphere and its coupling to the lower atmosphere during this last very low solar minimum.

Acknowledgements. The C/NOFS mission is supported by the Air Force, the National Aeronautics and Space Administration and the Naval Research Laboratory.

Note: The C/NOFS satellite data are open to all interested scientists.

Article 2

MAARSY – A new powerful MST radar in the Arctic

R. Latteck, W. Singer, and M. Rapp

Leibniz-Institute of Atmospheric Physics e.V. at the Rostock University, Kühlungsborn, Germany.



R. Latteck

A new powerful VHF radar was installed by the Leibniz-Institute of Atmospheric Physics in Kühlungsborn, Germany (IAP) on the North-Norwegian island Andøya (69.30°N , 16.04°E). The Middle Atmosphere Alomar Radar System (MAARSY) is designed for atmospheric studies from the troposphere to the lower thermosphere with high spatial and temporal resolution. First mesospheric studies were directed to the investigation of horizontal structures of Polar Mesosphere Summer Ech-

oes (PMSE) caused by mesospheric ice clouds. This is motivated by the desire to study their 3D morphology, and also to infer information on 3D structures of the background atmosphere owing to e.g. gravity waves and turbulence.

MAARSY is designed as a monostatic radar with an active phased array antenna inspired by the MU radar located at Shigaraki, Japan. The MAARSY antenna array consists of 433 individual antennas connected to an



Figure 1. View of the MAARSY site in July 2011 showing the main antenna array, the six equipment buildings at the perimeter of the array and the main building housing control and data acquisition hardware.

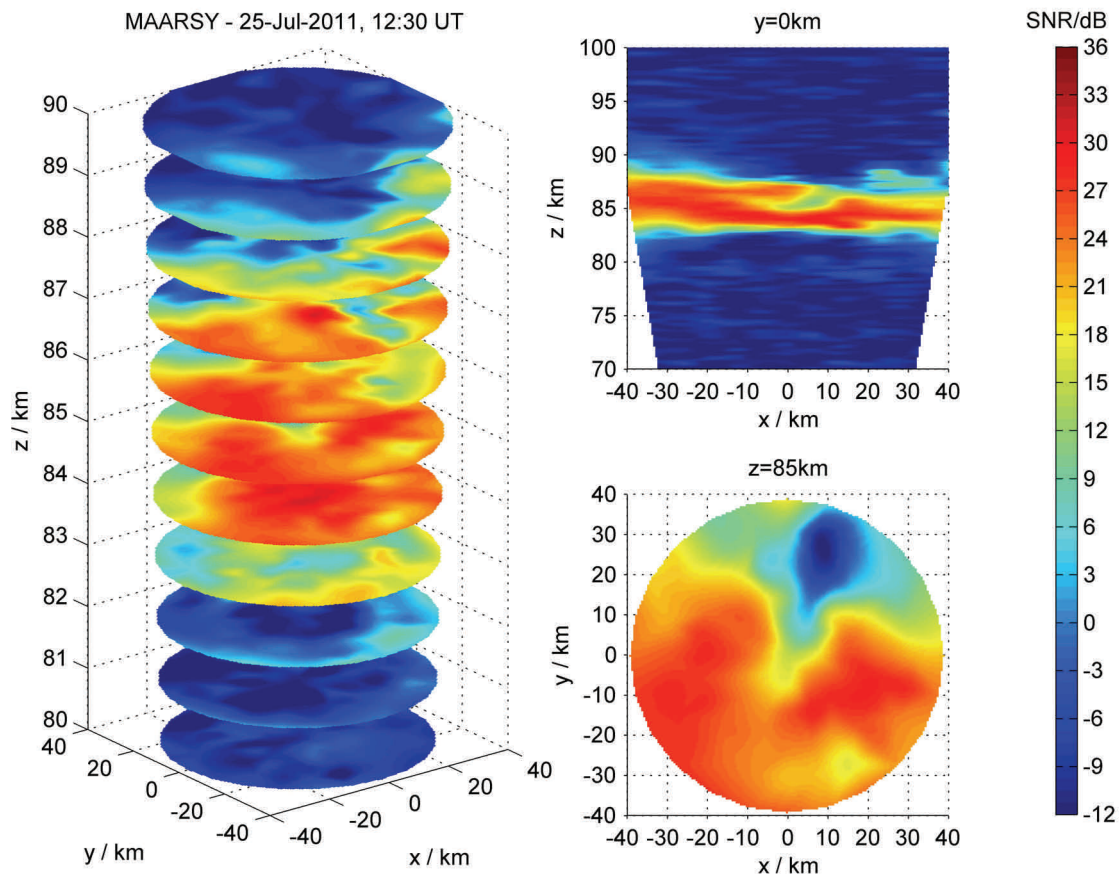


Figure 2. 3D structure of a PMSE observed with 97 beams quasi-simultaneously on the 25th of July 2011.

identical number of transceiver modules with independent control of phase and frequency and a scalable output up to 2kW. This arrangement allows very high flexibility of beam forming and beam steering with a symmetric radar beam and arbitrary beam pointing directions down to 30° off-zenith. The nearly circular antenna array with a diameter of approximately 90m corresponding to an aperture of approximately 6300m² results in a symmetric antenna radiation pattern with a half power beam width of 3.6°. Pulses with various shapes and length from 0.33 μ s up to 200 μ s can be transmitted within an allocated bandwidth of 4 MHz around 53.5MHz. The operating frequency and the beam position can be changed after each interpulseperiod. 55 sub-groups consisting of 7 antennas each can be selected from the main array. The corresponding receiving signals can be further combined or directly processed by a 16 channel data acquisition unit. Alternatively, separate located receiving antennas used for e.g. interferometric observations of meteors or bi-static boundary layer observations can be connected to the data acquisition. This functionality allows a wide range of receiving arrangements for interferometric or multireceiver applications in the MST region.

The construction of the antenna array started in May 2009. The radar began full-time unattended operation for PMSE observation in May 2010 using an initial expansion stage consisting of 196 transceiver modules. An upgrade to 343 transceiver modules was installed in November 2010 and the installation was completed in May 2011. The major objectives for building MAARSY, the investigation of horizontal structures of Polar Mesosphere Echoes, were successfully tested during several campaigns in 2010 and 2011. 3D resolved structures of Polar Mesosphere Summer and Winter Echoes were observed using multi-beam experiments with up to 97 beams quasi-simultaneously. First meteor head echo observations were conducted during the Geminid meteor shower in December 2010.

An upgrade of the MAARSY array is scheduled for autumn 2012. Additional 433 Yagi antennas will be installed perpendicular to the existing antennas allowing radar operation with circular polarization to higher altitudes.

Highlights on Young Scientists

Low-latitude Radio Beacon Receiver Network for Ionosphere and Space Weather

S. Tulasi Ram

Research Institute for Sustainable Humanosphere (RISH), Kyoto University, Japan.



S. Tulasi Ram

As a JSPS post-doctoral fellow in RISH, Kyoto University, I have been working on the low-latitude GNU Radio Beacon Receiver (GRBR) project to study the atmospheric coupling processes related to Equatorial Spread-F (ESF). A network of radio beacon receivers is currently established in the low latitudes of Southeast Asia and Pacific regions by the joint efforts of RISH, Kyoto University and SRI International, USA which is further expanding into Indian and African low latitudes. The principal experiment involves dual/tri-band frequency, differential phase measurements at spatially distributed locations from LEOs to study the three dimensional structures of ionospheric electron content. My activity in this project involves development of procedures for TEC estimation, scintillations and ionospheric tomography and support to integration and deployment of new receiving stations.

The processes leading to initial seeding of Equatorial Spread-F is one of the challenging problems that remained to puzzle the space weather researchers since several decades. In this context, study of large scale wave structures (LSWS) in the bottom side F-region electron density which sounds bearing on the occurrence of ESF is my primary scientific interest in this project. These zonal wave-like structures can be earliest identified even before the sunset, grow significantly after E-region sunset, and appear to provide required initial seeding for ESF. The low-latitude GRBR network lays an excellent platform to study the LSWS characteristics and its source mechanisms to uncover the yet enigmatic day-to-day variability of ESF.

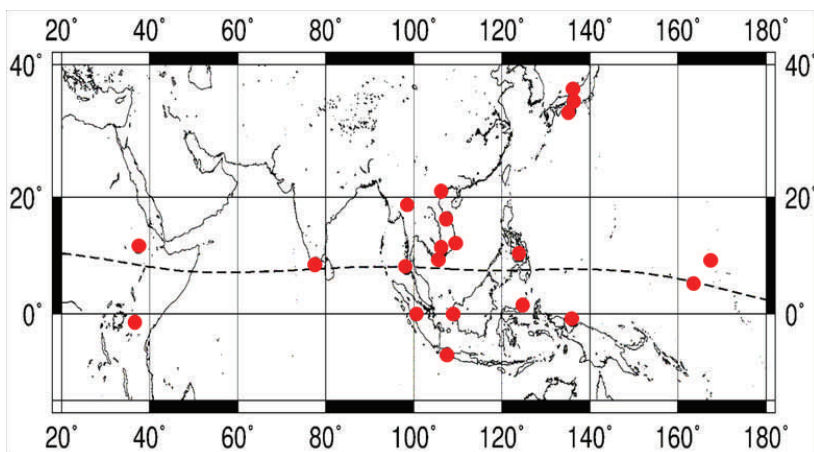


Figure 1. The geographical distribution of low-latitude GNU Radio Beacon Receiver (GRBR) network.

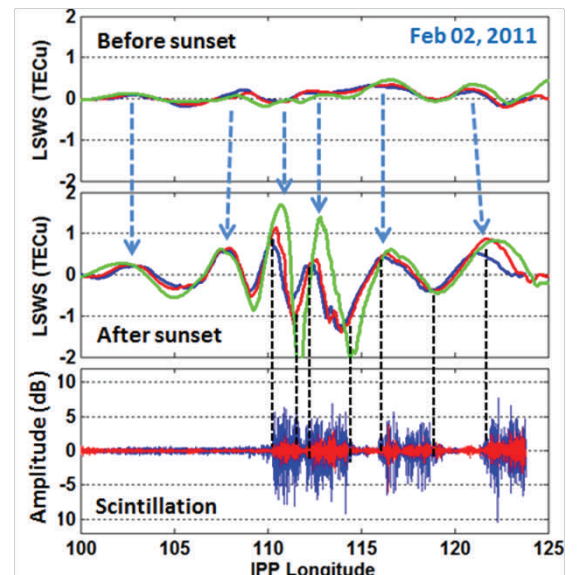


Figure 2. Growth of LSWS amplitude after sunset and subsequent development of scintillations at the peaks of LSWS.

Short News 1

Swarm Science and Validation Opportunity**Rune Floberghagen**

GOCE & Swarm Mission Manager, Mission Management Office, Directorate of Earth Observation Programmes, ESRIN, Italy

In the framework of its Earth Explorer Missions, ESA is developing Swarm, a constellation of three satellites with multiple instruments to survey the magnetic field and its the near-Earth environment. Swarm is planned to be launched in mid-2012 and will provide over 4 years data to the user community.

Swarm will provide high-precision and high-resolution measurements of the strength, direction and variation of the magnetic field, as well precise navigation, accelerometer and electric field measurements. ESA is pleased to notify you of the release of a Swarm Science and Validation Opportunity (SSVO) aiming:

I. To engage expert groups in the validation of Level 1B data products.

II. To further develop the Swarm user community by announcing research opportunities using Level 1b and Level 2 data products from this new ESA mission.

Should you be interested in participating to this opportunity, you are welcome to submit your proposal directly onto the call web site: <http://eopi.esa.int/SwarmSVO>. Further details on the particular nature of this opportunity, the Swarm Mission and data description are available on-line at the link above. The deadline for submission is 30 October 2011. For any further information, please do not hesitate to contact us, either by fax or e-mail at: EOHelp_at_esa.int or Fax: +39 06 94 180 292.

On behalf of ESA:

Y. Menard, Swarm Project Manager

R. Haagmans, Swarm Mission Scientist

R. Floberghagen, Swarm Mission Manager

Short News 2

ISEA 13: Second Announcement and Call for Papers - August 2011**Kazuo Shiokawa**

Solar-Terrestrial Environment Laboratory., Nagoya University, Nagoya, Japan

The International Organizing Committee (IOC) is pleased to make the 2nd announcement regarding the 13th International Symposium on Equatorial Aeronomy, to be held in Paracas, Peru March 12-16, 2012. At this time, we invite all colleagues who are interested in attending ISEA 13 to submit abstracts for oral and poster presentations of their work. The ISEA 13 home page (<http://jro.igp.gob.pe/isea13>) has instructions on how to submit an abstract. The web site also contains information on registration, hotel reservation, financial assistance and travel.

DEADLINES:

Abstract submission: November 30, 2011

Financial assistance: December 15, 2011

Hotel reservations in Paracas (special ISEA 13 price): January 12, 2012

Early registration (\$450): January 12, 2012

Airline information (for arranging group transportation to Paracas): February 20, 2012

The ISEA 13 International Organizing Committee: Jorge L. Chau (Chair), Archana Bhattacharyya, Clezio M. Denardini, David L. Hysell, Erhan Kudeki, Jonathan Makela, and Kazuo Shiokawa

Short News 3

News from the SCOSTEP Bureau**New CAWSES-II Co-chairs and CAWSES-II 2013 Symposium in Japan****Kazuo Shiokawa**

The SCOSTEP Bureau has appointed Drs. Joseph M. Davila (NASA/GSFC) and Toshitaka Tsuda (Kyoto University) as new co-chairs of the CAWSES II program. The new co-chairs bring in complementary experience to lead the CAWSES II program to its completion in 2013. The SCOSTEP Bureau has also approved the request from Japan to hold a symposium in Nagoya (2013 Fall), Japan to showcase the achievements of CAWSES II. This also means that each task group adjust the goals towards a successful completion of the proposed tasks.

Short News 4

TG4 Business meeting at IUGG in Melbourne**Kazuo Shiokawa**

Date and Place: July 6, 2011,
18:20-19:10, room MR 106

Attendance: 22 colleagues

First, Kazuo Shiokawa briefly reviewed current status of the TG4 activity, including status of the campaigns, publications, newsletters, and mailing lists. Kazuo Shiokawa also reported the results of the SCOSTEP gen-

eral council meeting held during IUGG where the new president, Nat Gopalswamy, and the new vice-president, Franz-Josef Luebken were elected. Then project leaders report succeeded by Ward (project 1, Tidal campaign from August-October this year), H. Takahashi (project 2, LONET planning this Sept-Oct, together with the tidal campaign), M. Yamamoto (project 3, ground beacon network and some meeting status), D. Pancheva (project 3, Prague meeting), K. Shiokawa for project 4 (ppt supplied by M. Kosch and H. Fujiwara for EISCAT/PFISR observation and status of global modeling efforts). Then F.-J. Luebken made some comments as a new vice-president of SCOSTEP, saying that discussion for SCOSTEP programs after CAWSES-II has now been started.

**Upcoming meetings related to CAWSES-II TG4**

Conference	Date	Location	Contact Information
The 10th Layered Phenomenon of the Mesopause Region	Oct. 24-27, 2011	Blacksburg Virginia, USA	http://www.cpe.vt.edu/LPMR/
ISEA-13	Mar. 12-17, 2012	Paracas, Peru	http://jro.igp.gob.pe/isea13/
39th COSPAR Scientific Assembly	Jul. 14-22, 2012	Mysore, India	http://www.cospar-assembly.org/
CAWSES-II 2013 Symposium	Fall 2013	Nagoya, Japan	

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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This newsletter is also available on the web at http://www.cawses.org/wiki/index.php/Task_4