United Nations A/AC.105/C.1/102

General Assembly

Distr.: General
21 December 2011

Original: English

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Forty-ninth session
Vienna, 6-17 February 2012
Item 13 of the provisional agenda*
International Space Weather Initiative

Reports on national and regional activities related to the International Space Weather Initiative

Note by the Secretariat

Contents

* A/AC.105/C.1/L.310.

V.11-88274 (E) 130112 160112

I. Introduction

1. In accordance with the three-year workplan under the agenda item "International Space Weather Initiative", adopted by the Scientific and Technical Subcommittee at its forty-sixth session (A/AC.105/933, annex I, para. 16), the Subcommittee will consider at its forty-ninth session reports by interested Member States, scientific organizations and the International Space Weather Initiative secretariat on regional and international plans to implement the Initiative. The Subcommittee will finalize a report on regional and international plans and will encourage both the continued operation of existing instrument arrays and the deployment of new instruments.

II. Reports received from Member States

Japan

[Original: English]
[31 October 2011]

In Japan, the Solar Terrestrial Physics Programme (STPP) subcommittee of the Science Council is participating in the International Space Weather Initiative as a follow-on programme of the International Heliophysical Year (2006-2009). The Chair (Kiyohumi Yumoto of Kyushu University) and other members of the subcommittee are moving forward with their instrument deployment plans and are constructing database systems for public access. The table shows a list of Japanese scientists who have deployed instrumentation overseas and will gradually make all acquired data available for public use (with some conditions attached). The leading instrument programmes (Flare-monitoring telescopes under the Continuous H-alpha Imaging Network (CHAIN), Global Muon Detector Network (GMDN), Magnetic Data Acquisition System (MAGDAS), Optical Mesosphere Thermosphere Imagers (OMTIs), and South-East Asia Low-Latitude Ionosonde Network (SEALION)) have been actively expanding their operations since the beginning of 2010. In addition, the National Institute of Information and Communications Technology (NICT) has actively expanded space weather outreach activities. It should be noted that more members of the STPP subcommittee are preparing to join the instrument programme or establish database systems, or both.

To create awareness of the International Space Weather Initiative in Japan, the STPP subcommittee organized a meeting at Kyushu University in March 2010. Soon after that, a session dedicated to the Initiative was held during the international symposium of the Japan Geoscience Union on 25 and 26 May. In 2011, the STPP subcommittee organized another session on the Initiative during the international symposium of the Japan Geoscience Union on 25 May 2011. During the session, host scientists in charge of instruments and contributors who provide their own data to the Initiative presented their achievements and future plans. Several foreign researchers were invited to present their activities, with particular emphasis on international collaboration. The symposium was highly successful and will be held again in 2012, which will be the last time during the International Space Weather Initiative (2010-2012).

Outside Japan, three major International Space Weather Initiative workshops have been scheduled: in Egypt in 2010, in Nigeria in 2011 and in Ecuador in 2012. The 2010 International Space Weather Initiative United Nations/National Aeronautics and Space Administration (NASA)/Japan Aerospace Exploration Agency (JAXA) workshop was held on the campus of Helwan University, Egypt, from 6 to 10 November 2010.

Several instrument array sessions were scheduled. Among them was the MAGDAS session, where 31 persons (MAGDAS hosts from all over the world, but mostly from Africa) delivered 20-minute presentations. The presentations are available from the website of the Space Environment Research Center of Kyushu University (www.serc.kyushu-u.ac.jp).

The general theme of the MAGDAS session was capacity-building, which consists of three phases: (a) development of instrument capacity, (b) development of data analysis capacity and (c) development of science capacity. Capacity-building is one of the major goals of the International Heliophysical Year and the International Space Weather Initiative, as specified by the organizers of those initiatives. All MAGDAS hosts are members and partners in the capacity-building that is undertaken as part of the MAGDAS project of the Space Environment Research Center at Kyushu University. Thanks to MAGDAS hosts, the Center is able to successfully operate ground observatories all over the world. This is a good example of the International Space Weather Initiative in action.

In 2011, under the MAGDAS project and with Kiyohumi Yumoto as principal investigator, the first MAGDAS school in Africa, the International Space Weather Initiative/MAGDAS School on Litho-Space Weather, was launched. A 264-page textbook entitled *Selected Papers of MAGDAS* was published prior to the School, containing MAGDAS-related papers that had been published in peer-reviewed journals. That book enabled students of the School to grasp the real purpose of the MAGDAS project, which now has 57 real-time magnetometers operating around the globe. The School, located near Lagos, Nigeria, on the campus of Redeemer's University, was highly successful. It attracted 59 participants, of whom eight were instructors, mainly from Kyushu University. The remaining participants were Nigerian students and representatives of MAGDAS host stations in Africa.

The United Nations/Nigeria Workshop on the International Space Weather Initiative was held from 17 to 21 October 2011 in Abuja. It attracted over 100 participants from 21 countries. Representatives of the CHAIN project of Kyoto University and the MAGDAS project of Kyushu University gave extensive reports on their capacity-building activities that were well received by the participants of the Workshop.

During the Workshop, it was proposed that an international centre for space weather science and education should be established as a permanent institution to advance space weather research and education. The Space Environment Research Center of Kyushu University offered to host the centre. That offer was incorporated into the Abuja International Space Weather Initiative Resolution, which was approved after considerable discussion by all participants in the Workshop.

Japanese International Space Weather Initiative officials

The International Space Weather Initiative bureau members in Japan are Kiyohumi Yumoto of Kyushu University and Hajime Hayakawa of JAXA. The International Space Weather Initiative Newsletter Office (on behalf of the United Nations) is led by Kiyohumi Yumoto of Kyushu University, Publisher, and George Maeda of Kyushu University, Editor. The National Coordinator for Japan is Takahiro Obara of JAXA.

Current Japanese instruments (as of February 2011)

Instrument	*Lead scientist*	*Country*	*Objective*
Flare-monitoring telescopes under the Continuous H-alpha Imaging Network (CHAIN)	S. Ueno, K. Shibata (Kyoto University)	Japan	Time variation and 3-D velocity field of solar activity, flares, filament eruptions and shock waves (Moreton waves) by using multi-wavelength H-alpha images of the full-disk Sun
Global Muon Detector Network (GMDN)	K. Munakata (Shinshu University)	Japan	To identify the precursory decrease of cosmic ray intensity that takes place more than one day prior to the Earth-arrival of shock driven by an interplanetary coronal mass ejection
Magnetic Data Acquisition System (MAGDAS)	K. Yumoto (Kyushu University)	Japan	Study of dynamics of geospace plasma changes during magnetic storms and auroral substorms, the electromagnetic response of iono-magnetosphere to various solar wind changes, and the penetration and propagation mechanisms of DP2-ULF range disturbances
Optical Mesosphere Thermosphere Imagers (OMTIs)	K. Shiokawa (Nagoya University)	Japan	Dynamics of the upper atmosphere through nocturnal airglow emissions
South-East Asia Low-Latitude Ionosonde Network (SEALION)	T. Nagatsuma (NICT)	Japan	Monitoring and study of ionospheric disturbances in the equatorial region by ionospheric and geomagnetic field observations
Education and outreach activities on space weather	S. Watari (NICT)	Japan	Education and outreach activities under the International Space Environment Service

Report on the status of five instrument arrays

Continuous H-alpha Imaging Network project, Kwasan and Hida Observatories, Kyoto University

In March 2010, a Flare Monitoring Telescope (FMT) was installed at the San Luis Gonzaga Ica University in Peru under the CHAIN project to observe the full-disk Sun. FMT is beginning to achieve some observational results, such as the observation of important solar flares occurring during the night in Japan.

As part of that project, the Japan-Peru FMT Summer School and Data Analysis Workshop was held in Japan in July 2011. Peruvian, British, Egyptian and young

Japanese researchers were among the attendees. Participants advanced data analysis and scientific investigation of the important aforementioned solar active phenomena and engaged in productive international academic exchanges.

Although Kyoto University had also planned to install a new FMT in Algeria in collaboration with the Centre de Recherche en Astronomie, Astrophysique et Geophysique (Centre for Astronomical, Astrophysical and Geophysical Research), the plan had to be postponed owing to the current unfavourable financial situation in Japan. However, during 2010, some foreign institutes, such as the Center of Astronomy and Geophysics of the Mongolian Academy of Sciences, the King Saud University and the King Abdulaziz University in Saudi Arabia and the Bosscha Observatory in Indonesia offered to participate in the CHAIN project. As a result, the exchange of technical and scientific information with those institutes has begun in the framework of the CHAIN project.

Global Muon Detector Network, Shinshu University

A gap that exists in the viewing directions of GMDN is going to be plugged by adding a new detector at Sierra Negra, Mexico, a high-altitude (4,600 metres above sea level) mountain. The detector will be installed in 2012 and will be used primarily for observing solar neutrons but also as a muon detector. The detector (SciBar), consisting of approximately 15,000 scintillator strips (2.5 × 1.3 × 300 cm^{3} each) viewed by approximately 250 multi-anode photomultipliers, is capable of precisely measuring particles produced by various interactions of primary cosmic rays with atmospheric nuclei. Preliminary experiments using a small prototype detector are under way.

Magnetic Data Acquisition System Project, Space Environment Research Center, Kyushu University

The MAGDAS project now has 57 real-time magnetometers deployed throughout the world, which constitutes the largest real-time magnetometer array globally. In the past 12 months, three new MAGDAS stations have been activated: ICA station in Ica, Peru, HVD station in Khovd, Mongolia, and CAN station in Canberra. The data from each MAGDAS station are transferred in real time via the Internet to the Search Environment Research Center at Kyushu University. At the Center, the data are processed, distributed and stored. Under the supervision of Kiyohumi Yumoto, five students from Egypt, Malaysia, the Philippines and the Sudan are participating in the MAGDAS project and working on their doctoral degrees. In this way, they learn the instrumentation, how to do data analysis and how to achieve world-class research in the space science field.

Optical Mesosphere Thermosphere Imagers, Solar-Terrestrial Environment Laboratory, Nagoya University

The array started taking automated measurements of gravity waves, winds and temperatures in the upper atmosphere in Darwin, Australia, in March 2011, using an all-sky airglow imager and a Fabry-Perot interferometer. Darwin is located at a geomagnetically conjugate point of Japan, giving an opportunity for new simultaneous measurements of hemispheric coupling of the upper atmosphere and ionosphere at middle latitudes. The automated measurements of the upper

atmosphere, including the measurements at Darwin, were being carried out worldwide in 2011 by using 12 airglow imagers and 5 Fabry-Perot interferometers.

South-East Asia Low-Latitude Ionosonde Network project, Space Weather and Environment Informatics Laboratory, Applied Electromagnetic Research Institute, National Institute of Information and Communications Technology

The SEALION project operates six ionosondes, four global positioning system (GPS) receivers, two GPS scintillation monitors, two magnetometers and one all-sky airglow imager. In addition, the project installed a meteor radar instrument on Biak Island, Indonesia, in June 2011 for monitoring lower thermospheric and mesospheric winds. To expand the capability of monitoring ionospheric and thermospheric conditions in East Asia (which includes Japan and South-East Asia), there has been collaboration with various institutes in South-East Asia to share ionospheric total electron content data derived from GPS receiver networks operating in each country of the subregion. For example, the King Mongkut's Institute of Technology Ladkrabang, Thailand, developed the Thai GPS and Ionospheric Data Center, partly using support from the SEALION project. They are now collecting data from more than 20 GPS receivers in Thailand. In Indonesia, the National Institute of Aeronautics and Space has collected data from more than 100 GPS receivers to produce two-dimensional GPS-total electron content maps throughout Indonesia. Those data acquisition activities are important not only for each country but also for the entire region of East Asia, including Japan, because severe ionospheric disturbances such as plasma bubbles are generated at low latitudes and often reach mid-latitudes during high solar activity.

III. Reports received from international organizations

Asia-Pacific Space Cooperation Organization

[Original: English]
[24 October 2011]

The projects "Electromagnetic Satellite Payload for Earthquake Prediction" and "Research on Determining Precursor Ionospheric Signatures of Earthquakes by Ground Based Ionospheric Sounding" have recently been approved by the Council of the Asia-Pacific Space Cooperation Organization (APSCO). APSCO is presently going through a phase of assessing the requirements of its member States. At the third APSCO Symposium, which was held in Beijing in September 2011, one of the topics discussed was the consolidation of requirements of APSCO member States and the completion of feasibility studies. After a preliminary assessment of requirements, detailed proposals will be invited from APSCO member States and discussed in an expert meeting planned for the second half of 2012.

Discrete technical proposals on the Electromagnetic Satellite Payload for Earthquake Prediction and Research on Determining Precursor Ionospheric Signatures of Earthquakes by Ground Based Ionospheric Sounding projects will be consolidated with a cost and benefit analysis and implementation plan. These will be presented to the APSCO Council by mid-2012 for approval. The research and implementation of these projects will focus on ionospheric signatures, thermal

infrared activities, long-wave radiations, atmospheric changes etc., and will contribute to modelling space weather.

Committee on Space Research

[Original: English]
[28 October 2011]

The central objectives of the International Space Weather Initiative focus on developing the scientific insight necessary to understand, reconstruct and forecast near-Earth space weather. In addition, strong focus will be put on education, training and public outreach.

Through collaborative data analysis and modelling activities, the Initiative aims to extend current exploitation of existing data sets, both independently and in conjunction with freely available space-based data. The organization of a number of dedicated training schools provides additional scientific background to students and young scientists in support of these aims.

One of the main focuses of the International Space Weather Initiative is deployment of instrumentation capable of making good-quality scientific measurements and involving scientists from the host institutes in data analysis and exploitation. While scientific research is the primary focus, a longer-term goal is to make such data available in a timely manner in support of space weather monitoring activities.

The Panel on Space Weather of the Committee on Space Research (COSPAR) supports these goals and encourages coordination with the space weather applications community both for training and in order to identify key data products that, in future, could potentially be incorporated into existing and planned space weather monitoring data streams. An open data policy is also encouraged, as well as the development and establishment of standard data access protocols and tools.

Overall, the International Space Weather Initiative is of considerable interest to the Panel on Space Weather, as the Panel aims to support activities that improve its capability to provide expert knowledge on the space environment to society and also encourages the development of predictive techniques capable of forecasting changes in the space environment in a timely manner.

The activities of the International Space Weather Initiative were discussed during the events of the Panel on Space Weather, held during the 38th COSPAR Assembly in Bremen, Germany, in 2010, and it is anticipated that progress made by the Initiative will be discussed during the Panel on Space Weather events scheduled for the 39th COSPAR Assembly in Mysore, India, in 2012, with a view to further cooperation.

International Astronomical Union

[Original: English]
[2 November 2011]

The International Space Weather Initiative, a programme affiliated with the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, is a follow-on programme to the International Heliophysical Year, which ran from February 2007 to February 2009. Activities of the International Heliophysical Year included the deployment of new instrument arrays, especially in developing countries, and an extensive education and public outreach component.

The objectives of the International Space Weather Initiative are to help to develop the scientific insight necessary to understand the physical relationships inherent in space weather, to reconstruct and forecast near-Earth space weather, and to communicate knowledge on these subjects to scientists and the general public. This is being accomplished by (a) continuing to deploy new instrumentation, (b) developing new data-analysis processes, (c) developing predictive models using International Space Weather Initiative data from the instrument arrays to improve scientific knowledge and to enable future space weather prediction services, and (d) continuing to promote knowledge of heliophysics through education and public outreach.

The goals of the International Space Weather Initiative are achieved through:

(a) Instrumentation (expanding and continuing the deployment of new and existing instrument arrays);

(b) Data analysis (expanding data-analysis efforts for instrument arrays and existing databases);

(c) Coordinating data products to provide input for physical modelling (inputting instrument array data into physical models of heliospheric processes and developing data products that reconstruct past conditions to facilitate assessment of problems attributed to space weather effects);

(d) Coordinating data products to allow predictive relationships to be developed to allow predictive relationships that enable the forecasting of space weather to be established that can easily be assimilated into real-time or near real-time predictive models.

The education, training and public outreach aspects of the International Space Weather Initiative are achieved through universities and graduate schools (by encouraging and supporting space science courses and curricula in universities that provide instrument support) and public outreach (by developing public outreach materials unique to the International Space Weather Initiative and coordinating their distribution).

The International Space Weather Initiative secretariat is directed by Joseph Davila and Nat Gopalswamy of the United States of America and Hans Haubold of the Office for Outer Space Affairs of the United Nations Secretariat. There are currently national coordinators in over 85 countries who help to coordinate International Space Weather Initiative activities in those countries. The International Space Weather Initiative is governed by a Steering Committee of 16 scientists from

13 countries. Within the International Astronomical Union (IAU), International Space Weather Initiative activities are coordinated by Division II (Sun and Heliosphere), in particular its Working Group on International Collaboration on Space Weather, which is chaired by David Webb. Mr. Webb was the IAU representative for the International Heliophysical Year and is currently the representative for the International Space Weather Initiative.

The International Space Weather Initiative currently has 15 instrument array projects in deployment or under development. These are located in 101 countries and coordinated by scientists from Armenia, France, Japan, Switzerland and the United States, as well as Africa. The benefits of the instrument deployment programme are: (a) by observing in new geographical regions, a more global picture of Earth's response to solar wind inputs can be obtained; (b) the Sun can be constantly monitored at radio and H-alpha wavelengths; (c) instrument arrays provide 3-D information that can be used in tomographic reconstructions; (d) long term, these arrays will provide real-time data valuable for forecasting and "nowcasting"; and (e) modelling projects allow better exploitation of existing data sets.

In response to the International Space Weather Initiative Steering Committee's recommendation to increase its science activities, partly by creating a programme similar to the Coordinated Investigation Programme of the International Heliophysical Year, an International Space Weather Initiative Science Programme has been launched. The programme is led by David Webb, who will develop and maintain Internet communications among International Space Weather Initiative science representatives for the purpose of promoting and enhancing the science results that come from the data collected by International Space Weather Initiative instrumentation.

The second International Space Weather Initiative workshop was held in Abuja from 17 to 21 October 2011 for participants from Europe and Africa. The third workshop is planned for Ecuador in October 2012. A Solar Radio Workshop under the auspices of the International Space Weather Initiative will be held at the University of Pune, India, from 23 to 25 November 2011.

Following the six highly successful space science schools operated during the International Heliophysical Year, a space science school programme is being promoted through the International Space Weather Initiative. In 2011, the International Space Weather Initiative sponsored the following schools: the second space science school in Abuja (in August), the third in Tatranska Lomnica, Slovakia (also in August), the fourth in Kinshasa (in September) and the fifth in Rabat (from 5 to 16 December).

Continuing projects for the International Space Weather Initiative include: (a) identifying appropriate sites for new instrument deployments, (b) identifying additional instruments for deployment and (c) utilizing these new instrument data sets in modelling and predictions and through the Science Programme. Additional information on the International Space Weather Initiative can be found at http://iswi-secretariat.org and on Twitter: ISWINews.

Secure World Foundation

[Original: English]
[31 August 2011]

Better knowledge of the potential for space weather events to disrupt orbital operations is an important component of safe and sustainable space operations. Hence, the Secure World Foundation considers that understanding and coping with this aspect of operating in space is of great importance. The Department of State of the United States has nominated the Foundation's Executive Director, Ray Williamson, to serve as a member of the Expert Group on Space Weather in support of the Working Group on Long-Term Sustainability of Outer Space Activities. Mr. Williamson has also recently been appointed to the panel of the International Academy of Astronautics' Cosmic Study on space weather.

United Nations Educational, Scientific and Cultural Organization

[Original: English]
[9 November 2011]

The work of the International Space Weather Initiative is related to research about near-Earth space weather. In the area of Earth weather, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO) works in close cooperation with the World Meteorological Organization (WMO). There is a long history of collaboration between the Commission and WMO, where oceanographers and meteorologists work together making extensive use of satellite data, which could be an area of cooperation with the International Space Weather Initiative.

World Meteorological Organization

[Original: English]
[9 November 2011]

Background

At the sixteenth World Meteorological Congress, held from 16 May to 3 June 2011, the need was acknowledged for a coordinated effort by embers of WMO to address the observing and service requirements for protecting against the global hazards of space weather. The WMO Space Programme, through the Inter-programme Coordination Team on Space Weather, was invited to develop near-term and long-term action plans, including education and training, and to work with the WMO regional associations to implement a coordinated strategy for space weather.

The Inter-programme Coordination Team on Space Weather, officially established in May 2010, includes members nominated by Australia, Belgium, Brazil, Canada, China, Colombia, Ethiopia, Finland, Japan, the Republic of Korea, the Russian Federation, the United Kingdom of Great Britain and Northern Ireland and the United States, and by the following international

organizations: the European Space Agency, the International Civil Aviation Organization, the International Space Environment Service, the International Telecommunication Union, the Office for Outer Space Affairs and WMO.

The overarching goal of the Inter-programme Coordination Team on Space Weather is to facilitate international coordination and improvement of space weather observations, products and services, in an operational perspective, in accordance with the following terms of reference:

(a) Standardization and enhancement of space weather data exchange and delivery through the WMO information system;

(b) Harmonized definition of end products and services, including quality assurance guidelines and emergency warning procedures, in interaction with aviation and other major application sectors;

(c) Integration of space weather observations, through the review of space- and surface-based observation requirements, harmonization of sensor specifications, monitoring plans for space weather observation;

(d) Encouraging dialogue between the research and operational space weather communities.

Inter-programme Coordination Team on Space Weather

The current strategy pursued by the Inter-programme Coordination Team on Space Weather is to increase global awareness of space weather impacts, advocate for improved observations, coordinate data exchange and operational services, foster partnerships to share responsibilities and encourage research to improve these services.

Advocating for improved observations

A first version of space weather observing requirements was developed and made available online as part of the WMO Observing Requirements Database (available at www.wmo-sat.info/db), under the application area “Space Weather.” Following on from that, an inventory of space weather observing capabilities and plans is being made, including both space-based and surface-based observation infrastructure. The Inter-programme Coordination Team on Space Weather will conduct a first assessment of the unmet needs and develop a statement of guidance to address the highest-priority gaps in observations.

Raising awareness of space weather impacts

The impacts of space weather were brought to the attention of the World Meteorological Congress in 2011, which led to the recognition of space weather coordination as a new task of the WMO Space Programme (more information on the Programme is available from www.wmo.int/sat). In October 2011, the Coordination Group for Meteorological Satellites also recognized the impact of space weather on Earth observation satellites, as well as the contribution that such satellites can provide to ongoing space weather observations.

A web-based space weather demonstration site is being developed, with the aim of enhancing the usage of a few specific products by providing easy access and

product-specific training. The initial operating capability for the demonstration site is planned to include multilanguage training and access to global products that could serve a worldwide user base.

Coordination of operational space weather products and services

As a first step, in order to enhance the visibility and usage of space weather products, a space weather product portal is being developed. The aim is to gather information on products that meet minimum requirements, providing convenient access to those products. Global and regional products are being identified according to impact and usage categories, such as ionospheric disturbances, geomagnetic disturbances, radiation environment and solar conditions. The Inter-programme Coordination Team on Space Weather will strive to harmonize the definition of end products, including assessments of quality.

In addition, the Inter-programme Coordination Team on Space Weather will identify opportunities for coordinating services in response to high-priority needs, such as support for global aviation through the International Civil Aviation Organization. Beyond the definition of adequate products, this entails adopting standard practices among operational space weather centres around the globe, including operational procedures for producing and communicating both routine and warning information.

Conclusion

It is recognized that vulnerability to space weather is increasing as we become more reliant on advanced technology. A framework of ground-based and space-based observations is already in place, and actions to improve space weather capabilities are being taken today by industries and Governments. The high-level coordination of satellite-based assets for space weather is encouraged to ensure that high-priority gaps are addressed in a cost-effective manner through shared capabilities.