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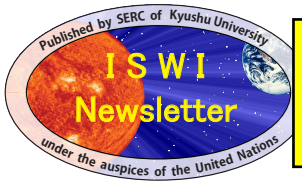

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Committee on the Peaceful Uses of Outer Space

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

Note by the Secretariat

Contents

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I. Introduction

1. In its resolution 64/86, the General Assembly endorsed the recommendation of the Committee on the Peaceful Uses of Outer Space that the Scientific and Technical Subcommittee, at its forty-seventh session, include in its agenda a new item entitled "International Space Weather Initiative", in accordance with the three-year workplan adopted by the Subcommittee at its forty-sixth session (A/AC.105/933, annex I, para. 16).

2. According to the three-year workplan, the Subcommittee would consider 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 would encourage both the continued operation of existing instrument arrays and new instrument deployments.

3. The present document contains reports received from Austria, Canada, Germany, Iraq, Japan, Slovakia and Spain, as well as from the Committee on Space Research (COSPAR), the International Astronomical Union (IAU), the Planetary Society and the World Meteorological Organization (WMO).

II. Reports received from Member States

Austria

[Original: English]

[28 October 2010]

Austria is participating in the European Space Agency (ESA) Space Situational Awareness programme. The effect of space weather phenomena on space objects is a priority topic of the programme. Austria is engaged in several space weather activities: the University of Graz Institute for Geophysics, Astrophysics and Meteorology is conducting observations of coronal mass ejections and solar flares with the overall objective of better predicting space weather-related events. The Austrian Institute of Technology Health and Environment Department is engaged in space weather radiation monitoring and modelling. Overall, the Austrian activities support the definition and implementation of space weather services.

Canada

[Original: English]

[9 November 2010]

Severe space weather events represent a significant concern to Canada owing to its geographic location and the nation's reliance on infrastructure that can be significantly disrupted during such events. This concern is also globally shared, as countries at lower latitudes become equally vulnerable because of technological and economic interdependence and the growing dependence on space assets to deliver vital services. As our global space infrastructure becomes more essential and sophisticated, renewed international effort in this area is critical, and Canada will continue to support international efforts by providing the science community with

data generated by its ground-based and space-based assets in order to increase understanding and enhance predictions of space weather events.

International Space Weather Initiative

Canada sees the creation of the International Space Weather Initiative as an important contribution to the development of space weather science and supports it as a member of the Steering Committee.

The International Space Weather Initiative offers a timely opportunity for Member States to coordinate global monitoring of space weather using space- and ground-based assets. It will also help to consolidate our common knowledge and develop essential forecast capabilities. Through the Initiative, it is expected that the global community will improve the safety of space-based assets by developing improved forecasting, preparedness, common systems and procedures for mutual assistance when major space weather events occur.

Among other things, the Initiative will capture data used for modelling space weather and enable space weather forecasting that will be used by centres around the world, including the Canadian Space Weather Forecast Centre. Canada will also be actively contributing to the Initiative by providing data for studies gathered from its extensive array of ground-based instrumentation, such as magnetometer arrays (CANMOS, CARISMA, AUTUMN, MACCS) and radar arrays.

Canadian Geospace Monitoring

The Canadian Geospace Monitoring system is the world's largest and most advanced ground-based network studying the near-space environment, with more than 100 instruments connected through satellite links to provide near real-time data to scientists and operators.

The Canadian Space Weather Forecast Centre is a regional warning centre of the International Space Environment Service. The global network of the Service monitors a variety of parameters that provide data in order to improve scientific understanding of the near-Earth geomagnetic environment and the timely and reliable forecasting of space weather. Through the centre, Canada actively cooperates with similar ground-based systems in Japan, the United States of America and Europe, and is currently exploring synergies between the Canadian Geospace Monitoring system and the Chinese Meridian Project.

Time History of Events and Macroscale Interactions during Substorms project and Resolute Bay Incoherent Scatter Radar station

Canada and the United States are currently collaborating on two major projects to better monitor the Earth's upper atmosphere and near-space environment in order to understand disruptions in communications and navigation and threats caused by space weather events. One is the Time History of Events and Macroscale Interactions during Substorms (THEMIS) project, a five-satellite mission led by the National Aeronautics and Space Administration (NASA) with the aim of determining the causes of the explosive events that dump huge amounts of energy into the Earth's upper atmosphere during solar storms. The other is the Resolute Bay Incoherent Scatter Radar (RISR-C) research station in Nunavut, in northern Canada, which will allow cutting-edge research to improve our understanding of disruptions

to satellite and aircraft communication, as well as navigation systems. The radar will also look at the impact of space weather on climate change, an important but currently poorly understood area of investigation.

Enhanced Polar Outflow Probe

The Canadian Space Agency (CSA), with the collaboration of a team of researchers and engineers from several Canadian and foreign universities and research institutes (University of Calgary, York University, University of Alberta, Royal Military College of Canada, University of New Brunswick, University of Saskatchewan, University of Western Ontario, University of British Columbia, Athabasca University, Communications Research Centre Canada, United States Naval Research Laboratory, University of New Hampshire, Japan Aerospace Exploration Agency (JAXA)), as well as Canadian industry, is looking forward to launching the Enhanced Polar Outflow Probe (ePOP) payload on board the Canadian small satellite CASSIOPE in 2011. The ePOP probe will include a suite of eight scientific instruments to collect data about the effects of solar storms. It will bring a significant improvement in spatial resolution to the field and will be capable of studying space phenomena with unprecedented precision in the regions where solar wind interacts with the Earth's magnetic field.

Swarm

Canada is also contributing an instrument to each of the ESA Earth Explorer Constellation Swarm satellites, aimed at improving the measurement of electromagnetic energy flow to the ionosphere. Other international missions that are currently being considered for launch later in the decade, coupled with more capable ground-based arrays and sophisticated models, are expected to significantly improve our ability to predict space weather events and their impact on space assets and infrastructure.

Polar Communications and Weather mission

Planning continues for the construction and deployment of a two-satellite Polar Communications and Weather mission, which is intended to vastly improve detection of weather systems and ensure the preparation of detailed weather forecasts, in addition to penetrating the northern Arctic to supply dedicated telecommunications services. The mission plans to launch two satellites in 2016.

Germany

[Original: English]

[4 November 2010]

Solar and space weather research is performed in Germany at several universities and research institutes. The Max Planck Institute for Solar System Research, the University of Goettingen, the Astrophysical Institute Potsdam (AIP) and the University of Kiel make essential contributions to solar research. Data analysis is based on satellite missions such as STEREO, ACE, SOHO and Proba 2. AIP contributes to the European LOFAR project by studying solar radio emissions.

Besides measurements of solar radiation, monitoring of galactic cosmic rays (GCRs) is an important issue. Measurements by various particle detectors have shown that the intensity varies on different time scales because the Sun's activity and geomagnetic variation. The role of interplanetary coronal mass ejections in causing Forbush decreases, and corotating interaction regions causing recurrent decreases in the GCR intensity observed on Earth, has been well-established for the last 20 years. In order to get a better understanding of the geomagnetic filter over the solar cycle, the Christian-Albrechts-Universität of Kiel, DESY Zeuthen and the North-West University in Potchefstroom, South Africa, agreed on a regular monitoring of the GCR intensity as a function of latitude, by developing a portable device that is planned to be installed on a research ship. The German research vessel *Polarstern*, operated by the Alfred Wegener Institute, is ideally suited for the research campaign because it covers extensive geomagnetic latitudes (i.e. goes from the Arctic to the Antarctic) at least once per year. The University of Greifswald currently operates a muon detector for monitoring space weather effects.

At the Fraunhofer-Gesellschaft specific payloads capable of measuring solar radiation and plasma parameters are under development. Extreme ultraviolet fluxes are being measured by the ISSESA-SolACES experiment. New payloads and missions are discussed closely with the European Aeronautic Defence and Space Company Astrium Friedrichshafen. The Swarm satellite mission of ESA is under preparation at the German Research Center for Geosciences (GFZ) Potsdam.

The German Aerospace Center (DLR) is currently establishing the Space Weather Application Center-Ionosphere (SWACI) at its site in Neustrelitz (http://swaciweb.dlr.de). The project is essentially supported by the state government of Mecklenburg-Vorpommern. SWACI results contribute to the Space Weather European Network and are integrated in a number of projects of ESA and the seventh Framework Programme of the European Commission. In particular, considerable efforts are made to contribute with a SWACI-based ionospheric data and information service to the space weather element of the Space Situational Awareness programme of ESA.

SWACI contributes directly to the International Space Weather Initiative through the Solar and Ionosphere Monitoring Network (SIMONE) by hosting a web platform for uploading, downloading, visualizing, analysing and archiving observation data. SIMONE consists of a network of very low frequency (VLF) receivers operated at various schools in the northern part of Germany. The VLF receivers, provided partly by Stanford University and developed partly under the leadership of the DLR School-Lab, are capable of monitoring sudden ionospheric disturbances caused by solar flares. Thus, SIMONE directly supports the International Space Weather Initiative activities initiated by Stanford University as part of the International Heliophysical Year.

SWACI also contributes to the establishment of an African dual frequency global positioning system (GPS) network. DLR is installing a high rate global navigation satellite system (GNSS) receiver capable of measuring radio scintillations at Bahir Dar, Ethiopia.

DLR and the National Oceanic and Atmospheric Administration (NOAA) agreed on receiving the NASA Advanced Composition Explorer spacecraft in Neustrelitz. ACE is located at the Earth-Sun libration point L1, carrying out in situ

measurements of particles originating from the solar corona, the interplanetary medium, the local interstellar medium and galactic matter. Since 2 September 2009, DLR Neustrelitz has been part of the real-time solar wind (RTSW) monitoring capability of NOAA. The RTSW data are used to provide accurate alerts and warnings of major geomagnetic storms with a lead time of about one hour. The data will be used to improve forecasts of the ionospheric perturbation degree in near real time.

Participation in conferences and meetings on the International Space Weather Initiative

N. Jakowski of DLR made a scientific and technical presentation entitled "Space weather impact on radio systems" to the Scientific and Technical Subcommittee at its forty-seventh session, in 2010. C. Koch of DLR gave two lectures at the first International Space Weather Initiative summer school, in Bahir Dar, Ethiopia, on 28 October and 4 November 2010.

Iraq

[Original: Arabic]

[23 November 2010]

Activities of the Science Centre for Air and Space Technology in the field of space weather

Interest in space weather activities, as reflected in the monitoring of solar activity, ionosphere strata and magnetic fields, began long ago in Iraqi scientific institutes. Given the importance of these activities and their impact on the Earth's environment and climate change, the Science Centre for Air and Space Technology was established within the Ministry of Science and Technology in 2003. The Centre is involved in the activities mentioned above, in addition to others within its mandate.

The Science Centre for Air and Space Technology is interested in space weather in the domains described below.

Solar activity

The Centre monitors solar activity as manifested in solar phenomena, such as solar scintillations, mass fluxes, wind and solar spots, in addition to daily variations of solar factors with impacts on the atmospheric environment, through global sites. In view of the importance of measuring solar radiation, as manifested in ultraviolet rays, sensors were provided to measure the intensity of ultraviolet rays. The sensors were installed on the premises of the Ministry of Science and Technology, located at Al-Jadriah.

Ionosphere

The Centre monitors daily changes in the ionosphere through monitoring stations located near Iraq and other stations. It also monitors ionosphere changes

relying on signals received from GPS stations. It undertakes surveys of software and models designed to calculate and predict ionospheric factors and to warn of possible interruptions in communications.

In view of the importance of the ionosonde system in serving all security-related ministries and the media, and as a response to a request by the Ministry of Interior to reactivate the ionosphere survey and monitoring system, a survey of modern ionosphere monitoring technologies was initiated to identify the optimal systems for the beneficiaries.

Ozone

The Centre monitors changes in the ozone layer through space data and images available from some international monitoring stations. Such data are used in studies and reports to help understand scientific facts and changes affecting the ozone layer. Given the importance of the ozone layer in protecting the environment from exposure to ultraviolet rays, sensors were provided to measure the ozone concentration at different altitudes, within the Space Environment Monitors project.

Moreover, the Centre plans to provide the necessary tools (receiver station, data and image presentation equipment, data verification and storage facilities, and report-production facilities) to monitor solar, magnetic and ionospheric factors and to archive data for use in research and studies. The Centre seeks to have its technical staff participate in scientific workshops, using available data related to the atmosphere, which is affected by solar activity (in particular the ionosphere, the Earth's magnetic field and the ozone layer) for further development in this domain.

Japan

[Original: English]

[29 October 2010]

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. The Chair of the STPP subcommittee (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 (CHAIN, GMDN, MAGDAS, OMTIs, SEALION) have been actively expanding their operations since the beginning of 2010. Also, 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. During that 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 will be held every year in Japan during the International Space Weather Initiative (2010-2012).

Outside Japan, three major International Space Weather Initiative workshops are scheduled: in Egypt in 2010, in Nigeria in 2011 and in Ecuador in 2012. The 2010 International Space Weather Initiative United Nations/NASA/JAXA workshop was held on the campus of Helwan University, Egypt, from 6 to 10 November 2010.

Several instrument array sessions are scheduled. One of those is the Magnetic Data Acquisition System (MAGDAS) session, where 31 persons (mainly MAGDAS hosts from all over the world, but mostly from Africa) are scheduled to deliver 20-minute talks. The general theme of the MAGDAS session is 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. Because of MAGDAS hosts, the Space Environment Research 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.

Japanese International Space Weather Initiative officials

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 2010)

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

Instrument	*Lead scientist*	*Country*	*Objective*
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

Slovakia

[Original: English]

[22 October 2010]

Institutions in Slovakia participate in the International Living with a Star programme (http://ilwsonline.org/ilws_organization.htm) and the International Space Weather Initiative programme (http://stara.suh.sk/id/iswi/iswi_SK-en.htm, 2010-2012). In past years Slovak institutes participated actively in the International Heliophysical Year (http://ihy.saske.sk) and the International Year of Astronomy (www.astronomy2009.org/organisation/nodes/national/view/SK) programmes.

An important step was the creation of the Space Research Centre on influences of space weather, in eastern Slovakia. The project was supported by European Union funds allocated by the Ministry of Education of Slovakia. Three institutes, namely, the Astronomical Institute of the Slovak Academy of Sciences, in Tatranská Lomnica (the main institution), the Institute of Experimental Physics of the Slovak Academy of Sciences, in Košice, and P. J. Šafárik University, also in Košice (the partner institutions), constituted the Centre. With the support of the European Union, experimental and computational bases for various ground-based and satellite measurements were planned to be updated, and new experiments would be established in the frame of international collaboration.

Space weather activities of the Slovak Central Observatory, in Hurbanovo, are focused on analysis of various forms of solar and space weather data (both ground-based and satellite data). Two sudden ionospheric disturbance monitors (http://solar-

center.stanford.edu/SID/sidmonitor/) to register solar flares will be installed in Slovakia.

Spain

[Original: Spanish]

[8 November 2010]

Activities relating to the study and prediction of space weather are a further component of the Space Situational Awareness programme, of which activities carried out in Spain are a part.

This area includes activities relating to the study and prediction of space weather, such as measurement of the radiation environment — through the inclusion of sensors in various space missions — and the development of new measurement systems, space environment models and prediction methods. All these activities represent an important contribution to the advancement of knowledge regarding the space environment and space weather.

III. Reports received from international organizations

Committee on Space Research

[Original: English]

[27 October 2010]

Introduction and relationship with the Committee on Space Research Panel on Space Weather

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.

The scientific benefits of the programme are expected to include an extension of the existing global ground-based measurement infrastructure, giving a more comprehensive view of the Earth's response to external inputs. A data-analysis and modelling programme will, in parallel, extend current exploitation of existing data sets and modelling codes through scientific exchange and sharing of data-analysis tasks.

The International Space Weather Initiative programme builds on work done within the framework of the International Heliophysical Year, in particular in the area of instrument deployment, where the same approach will be adopted.

Initially the focus will be on deploying instrumentation capable of making good-quality scientific measurements and involving scientists from host institutes in the analysis and exploitation of data. In the longer term, it is expected that these networks will provide real-time data valuable for "nowcasting" and forecasting.

The above-mentioned activities are of considerable interest to the Panel on Space Weather, as it aims to support activities that improve our 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.

Current activities

The first of a series of International Space Weather Initiative workshops was held in Helwan, Egypt, from 6 to 10 November 2010. The workshop focused on access to data from ground-based and space-based facilities through data archives and virtual observatories. Emphasis was placed both on making existing databases available to the whole scientific community and on tools to access existing data resources. Papers cover all disciplines included in International Space Weather Initiative scientific activities: solar physics, planetary magnetospheres, heliosphere and cosmic rays, planetary ionospheres, thermospheres and mesospheres, upper atmospheres, climate studies and heliobiology. Both the aims and the diverse range of disciplines covered by the workshop will support the furthering of our understanding of the physical phenomena underpinning space weather.

A summer school took place in Bahir Dar, Ethiopia, from 22 November to 3 December 2010. The school was co-sponsored by COSPAR and supported the training of young scientists, following on from the successful African regional International Heliophysical Year school in Nigeria in 2008. The school focused on the areas of space physics, data analysis and interpretation, numerical methods and programming skills.

An international mailing list has been established and is circulated by Kyushu University. The list provides information and announcements on events of interest to both the scientific and applied space weather domains.

International Astronomical Union

[Original: English]

[29 September 2010]

The International Heliophysical Year was an international programme of scientific collaboration involving thousands of scientists from more than 70 countries, which ended in February 2009. Along with programmes devoted to research, outreach and the commemoration of International Geophysical Year 1957, 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.

It was recognized early in the planning of the International Heliophysical Year that the understanding of the global ionosphere and its linkage to the near-Earth space environment was limited by the lack of observations in key geographical areas. To address this need, a series of workshops was held to facilitate collaboration between research scientists in scientifically interesting geographic locations and researchers in countries with expertise in building scientific

instrumentation. Science teams were put together, each led by a scientist who provided the instruments or fabrication plans for instruments in the array. Support for local scientists, facilities and data acquisition was provided by the host nation. As a result of the International Heliophysical Year programme, scientists from many countries now participate in instrument operation, data collection and analysis, and publication of scientific results, working at the forefront of scientific research.

The instrument deployment programme was one of the major successes of the International Heliophysical Year. Arrays of small instruments, such as magnetometers to measure the Earth's magnetic field, radio antennas to observe solar coronal mass ejections, GPS receivers, very low frequency radio receivers, all-sky cameras to observe the ionosphere and muon detectors to observe energetic particles, were installed around the world. Those arrays continue to provide global measurements of heliospheric phenomena. An interesting side benefit of the instrument programme was the seeding of new heliophysics research groups in universities and the strengthening of existing research groups where new instruments were installed.

Through the International Space Weather Initiative, coordinated international research is continuing on universal processes in the solar system that affect the interplanetary and terrestrial environments, and there will be continued coordination on the deployment and operation of new and existing instrument arrays. The main focus of the International Space Weather Initiative is on understanding and predicting the impacts of space weather on the Earth and the near-Earth environment. Participation in the Initiative is open to scientists from all countries as either instrument hosts or instrument providers.

The International Space Weather Initiative secretariat is directed by Joseph Davila and Nat Gopalswamy of the United States and Hans Haubold of the Office for Outer Space Affairs. It is governed by a Steering Committee of 16 members, which meets once a year to assess progress and provide prioritization for the upcoming year. There are currently national coordinators from 81 countries that help to coordinate activities in each country. Details and information archives on the Initiative can be found at www.iswi-secretariat.org/. Within IAU, International Space Weather Initiative activities are coordinated by the Division II Working Group on International Collaboration on Space Weather, chaired by David Webb. He was also the IAU representative for the International Heliophysical Year and is currently the representative for the International Space Weather Initiative.

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 to the general public.

This will be accomplished by (a) continuing to deploy new instrumentation, (b) developing 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 International Space Weather Initiative currently has 14 instrument arrays in deployment or under development. They are located in many countries and are

provided by institutions from Armenia, Brazil, France, Japan, Switzerland and the United States. The first international workshop on the Initiative was held in Helwan, Egypt, from 6 to 10 November 2010, for the Western Asia region. Future workshops have been tentatively scheduled to be hosted by Nigeria (2011) for Africa and Ecuador (2012) for Latin America and the Caribbean. The 2009 United Nations/ESA/NASA/JAXA Workshop on the International Heliophysical Year 2007, held in the Republic of Korea in 2009, started implementing the Initiative as endorsed by the Committee on the Peaceful Uses of Outer Space.

During the International Heliophysical Year, space science schools in Brazil, China, India, Nigeria and the United States provided training to hundreds of graduate students and new researchers. The International Space Weather Initiative is continuing to provide support for space science schools and to promote space science and the inclusion of space science curricula in universities and graduate schools. The Initiative also supports public outreach projects. It is essential to communicate the excitement and the relevance of heliophysical research to scientists from other disciplines, and to the public at large. Through the Initiative, unique public outreach materials will continue to be developed, and their distribution will be coordinated through individual contacts and outreach workshops.

Planetary Society

[Original: English]

[15 September 2010]

The Planetary Society supports the International Space Weather Initiative. Space weather can profoundly affect our power and communications grids and the many satellites that provide services to society. Predicting space weather reliably is not possible; we need to understand much more about the Sun and its dynamic behaviour. The Planetary Society supports the Solar Probe and other missions to observe the Sun.

The Planetary Society also supports efforts to warn the Earth of solar events that can trigger ionospheric effects. Reliable measurements of solar flux between the Earth and the Sun are required. Increasing warning time is highly desirable. The Planetary Society LightSail project is developing the capabilities for solar sail spacecraft to hover between the Earth and the Sun to do just that: increase the warning time regarding solar events affecting the Earth. The effort of the Planetary Society is privately funded and may lead to the development of commercial capability to provide such solar weather monitoring.

World Meteorological Organization

[Original: English]

[13 December 2010]

Introduction

In June 2008, the WMO Executive Council recognized the importance of space weather for WMO, since space weather affects meteorological satellites and radio communications, two key components of meteorological operations. Furthermore, space weather affects economic activities such as aviation, spacecraft operations, electric power transmission, radio communication and satellite-based navigation. Those activities involve major users of meteorological services; therefore, there is a potential for synergy between the emerging operational activities in the area of space weather and current WMO activities regarding meteorological service delivery to user communities. The Executive Council therefore agreed that WMO should support international coordination in this area, taking advantage of its experience in global coordination of observation, telecommunications, service delivery networks and global cooperation in general.

In June 2009, it was decided to establish an Inter-programme Coordination Team on Space Weather, whose terms of reference have been developed by the Commission for Basic Systems in consultation with the Commission for Aeronautical Meteorology. The Inter-programme Coordination Team was initiated in May 2010.

Membership of the Inter-programme Coordination Team on Space Weather

The Inter-programme Coordination Team on Space Weather includes members nominated by 12 countries — Belgium, Brazil, Canada, China, Colombia, Ethiopia, Finland, Japan, Republic of Korea, Russian Federation, United Kingdom of Great Britain and Northern Ireland and United States — and by the following international organizations: ESA, International Civil Aviation Organization (ICAO), International Space Environment Service, International Telecommunication Union, Office for Outer Space Affairs and WMO.

Two co-chairs were designated, by the Commission for Aeronautical Meteorology and the Commission for Basic Systems, respectively: Zhang Xiaoxin, China, and Terrance Onsager, United States.

Terms of reference and workplan

The terms of reference include four main topics:

(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 activities in 2010

The Inter-programme Coordination Team on Space Weather has developed an initial workplan, which is contained in the annex. Regular meetings are held via teleconference and an active dialogue is maintained by correspondence.

Observation requirements

The initial work of the Inter-programme Coordination Team on Space Weather has been focused on observation requirements. The Inter-programme Coordination Team has determined a list of geophysical variables to be measured, with definitions and units. Draft requirements have been proposed and will be further reviewed by the team in the coming months, following the approach defined in the WMO rolling review of requirements. It is planned to post those requirements for open review by the community.

This review of observing requirements, together with a review of existing and planned capabilities, will serve as a basis to identify gaps and priorities for future observing systems and missions.

User requirements for products and services

During this exercise, user requirements for products and services are also being identified, as a preliminary step towards harmonization of operational products.

Data exchange and data management

The experience of WMO will be considered to enhance data exchange and, when relevant, the harmonization of data management practices in accordance with WMO information system principles. In particular, consideration will be given to the possible registration of the International Space Environment Service regional warning centres as data-collection or -production centres in the WMO information system framework, with a view to ensuring broad accessibility of the data worldwide.

Annex

Terms of reference and initial objectives of the Inter-programme Coordination Team on Space Weather

Background

Space weather affects meteorological satellites and radio communications, two key components of meteorological operations. It also affects important economic activities such as aviation, spacecraft operations, electric power transmission, radio communication and satellite-based navigation. These activities involve major users

of meteorological services; therefore there is a potential for synergy between the emerging operational activities in the area of space weather and current WMO activities regarding meteorological service delivery to those user communities.

The main international coordination mechanism for space weather is currently the International Space Environment Service. As the field of space weather is evolving from research to operational services, the International Space Environment Service expressed in 2007 interest in cooperating with WMO, considering that the WMO framework would be appropriate to enhance international cooperation on operational aspects of space weather, and that several WMO members have placed space weather activities under the authority of their national meteorological or hydrological services. WMO responded favourably to the Service and agreed, in 2008, to engage in this field, in partnership with relevant international organizations.

The Inter-programme Coordination Team for Space Weather has been established to carry out the activities described below, in accordance with the terms of reference defined by the WMO Commission for Basic Systems and Commission for Aeronautical Meteorology. The overarching goal of the Inter-programme Coordination Team is to facilitate, in partnership with the International Space Environment Service and other organizations, the international coordination of space weather observations, data, products and services, building on the assets of International Space Environment Service and of WMO.

Terms of reference and initial objectives

A near-term objective of the Inter-programme Coordination Team on Space Weather is to demonstrate value to WMO members by identifying and documenting one or more specific examples of the coordination of key space weather information that leads to improved services. Following the activities outlined within each of the terms of reference, an initial workplan will be developed and implemented.

Standardization and enhancement of space weather data exchange and delivery through the World Meteorological Organization information system

The following measures are to be taken to standardize and enhance the exchange and delivery of space weather data:

(a) Review the current status of data formats, exchange procedures and delivery mechanisms, and identify the feasibility and benefits of using WMO information system;

(b) Identify and prioritize space weather observations and products that would benefit from inclusion in the WMO information system;

(c) Review the possible implementation of the WMO information system interoperability standards and conventions (file naming, metadata, catalogue search);

(d) Develop a workplan with a timeline for the incorporation of some initial space weather observations in WMO information system.

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

The following measures are to be taken to harmonize definitions:

(a) Include the products and services and assessments of quality from all International Space Environment Service regional warning centres. All Inter-programme Coordination Team on Space Weather members can contribute a description of the end products and services they currently provide and/or their interests and priorities for future services;

(b) Coordinate with the ICAO international airways volcano watch operations study group on supporting operational requirements for airline navigation, communication and radiation issues;

(c) Identify opportunities to coordinate existing services and high-priority service needs, with an emphasis on aviation and other major application sectors;

(d) Develop a workplan to initiate the harmonization of end products and services and document high-priority service needs.

Integration of space weather observations, through a review of space- and surface-based observation requirements, harmonization of sensor specifications and monitoring of plans for space weather observation

The following measures are to be taken to integrate space weather observations:

(a) Obtain space weather requirements from the International Space Environment Service regional warning centres and other applicable organizations;

(b) Catalogue the space weather data currently available in near real time and the data services planned for future deployment. Utilize the International Space Environment Service regional warning centres for this information;

(c) Develop an initial draft of space weather observing requirements. Focus on the highest-priority observations and those for which global coordination is critical and WMO can provide a valuable augmentation to the efforts of the International Space Environment Service;

(d) Coordinate those requirements with the Commission for Basic Systems expert team on the evolution of the Global Observing System to have space weather recognized as a new application area within the “rolling requirements review” of the WMO Integrated Global Observing System;

(e) Review the categories of instruments used for space weather observations, their characteristics and implementation status and plans and the possibility of organizing sensor intercalibration procedures;

(f) Develop a workplan for documenting space weather observing requirements, harmonizing sensor specification and intercalibration, and monitoring future plans.

Encouraging the dialogue between the research and operational space weather communities

The following measures are to be taken to encourage dialogue:

(a) Identify opportunities to advocate for operational needs among researchers (e.g. COSPAR Panel on Space Weather, International Academy of Astronautics study group on international cooperation on space weather, International Space Weather Initiative);

(b) Review and seek harmonization of the requirements for the operational use of global numerical models in space weather forecasts;

(c) Identify best practices for operational models developed within the numerical weather prediction community and their integration into operational meteorological services with the intention that those best practices could be applied to space weather operational models;

(d) Review the possibility of organizing a set of formalized models and forecast methods for particular phenomena of space weather (arrival of coronal mass ejections, magnetic storms, etc.) and assess their quality;

(e) Develop a workplan to define best practices and to provide models with an adequate level of accuracy and reliability, through interaction between the research and operations communities.