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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Austria Symposium on Space Weather Data, Instruments and Models: Looking Beyond the International Space Weather Initiative

(Graz, Austria, 16-18 September 2013)

I. Introduction

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), through its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development", recommended that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States, at both the regional and international levels, in a variety of space science and technology activities, by emphasizing the development and transfer of knowledge and skills to developing countries and countries with economies in transition.[1]

2. At its fifty-fifth session, in 2012, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and expert meetings related to the socioeconomic benefits of space activities, small satellites, basic space technology, human space technology, space weather and global navigation satellite systems (GNSS) to be held in 2013.[2] Subsequently, the General Assembly, in its resolution 67/113, endorsed the report of the Committee on the work of its fifty-fifth session.

3. Pursuant to General Assembly resolution 67/113 and in accordance with the recommendations of UNISPACE III, the United Nations/Austria Symposium on

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[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1, sect. I, para. 1 (e)(ii), and chap. II, para. 409 (d)(i).

[2] *Official Records of the General Assembly, Sixty-seventh Session, Supplement No. 20* (A/67/20), para. 89.

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Space Weather Data, Instruments and Models: Looking Beyond the International Space Weather Initiative was held in Graz, Austria, from 16 to 18 September 2013.

4. The Symposium, the twentieth in a series of United Nations/Austria symposiums held since 1994, was organized by the United Nations in cooperation with the Austrian Academy of Sciences and Joanneum Research and supported by the Austrian Federal Ministry for European and International Affairs, the European Space Agency (ESA), the Austrian State of Styria, the city of Graz and Austrospace. The Austrian Academy of Sciences hosted the Symposium on behalf of the Government of Austria.

A. Background and objectives

5. The Symposium was held as a follow-up to the activities conducted under the International Heliophysical Year 2007 and the International Space Weather Initiative, which was concluded in 2012. Those activities were part of the Basic Space Science Initiative in the framework of the United Nations Programme on Space Applications (see A/AC.105/2013/CRP.11).

6. In 2012, at the conclusion of the International Space Weather Initiative, a number of recommendations, including for regular interaction and the continuation of international cooperative efforts, were made at the United Nations/Austria Symposium on Data Analysis and Image Processing for Space Applications and Sustainable Development: Space Weather Data, held in Graz, Austria, from 18 to 21 September 2012 (see A/AC.105/1026) and at the United Nations/Ecuador Workshop on the International Space Weather Initiative, held in Quito from 8 to 12 October 2012 (see A/AC.105/1030).

7. The purpose of the present Symposium was to address the need to follow up on the recommendations of the International Space Weather Initiative related to space weather instrument availability, data-sharing and modelling requirements by bringing together space weather experts from developed and developing countries, including representatives of the major instrument operators and data providers.

8. Participants were tasked with reviewing the status of space weather instrument arrays (both ground-based and space-borne arrays), data collection efforts and data access conditions, as well as current modelling efforts, the availability and accuracy of models, and access to documentation on data and models in order to identify possible synergies between the various ongoing projects and initiatives and to improve international scientific cooperation.

9. The objectives of the Symposium were as follows:

(a) To review, as an expert group, existing and planned worldwide space weather-related data collection and development activities, including space-based and ground-based observations and modelling and forecast development, and identify any gaps;

(b) To review international cooperation activities and the role of international cooperation in addressing space weather-related issues, such as possible further cooperation towards truly global space weather monitoring capabilities;

(c) To identify opportunities for international cooperation in the standardization, sharing and wider and timely use of data, including for operational purposes, while considering data interoperability and formats, as those were important aspects of any standardization;

(d) To review current repositories of models and identify opportunities for international cooperation in order to identify, create and better share optimized models to produce accurate simulations and predictions and timely forecasts tailored to the needs in each country or region;

(e) To identify concrete cooperation and knowledge-sharing in this domain with other relevant initiatives or consortiums, such as the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP);

(f) To discuss options for the continuation of the activities begun under the International Space Weather Initiative and to contribute to the discussions under the new regular agenda item on space weather at the sessions of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses Of Outer Space.

B. Attendance

10. Qualified space weather experts and scientists from developing and industrialized countries from all regions were invited by the United Nations to participate in and contribute to the Symposium. Invitations to participate in the Symposium were also disseminated through the offices of the United Nations Development Programme worldwide and permanent missions to the United Nations and through various space science and space weather mailing lists. Participants were selected on the basis of academic qualifications and professional working experience in the space weather field or the applicants' involvement in the planning and implementation of space weather activities of relevant governmental organizations, international or national agencies, non-governmental organizations, research or academic institutions or private sector companies.

11. The Symposium was attended by 42 space weather experts from governmental and non-governmental institutions, universities and other academic entities from the following 13 countries: Austria, Brazil, Bulgaria, China, France, Germany, India, Japan, Libya, Malaysia, Rwanda, Switzerland and United States of America.

12. Funds provided by the United Nations, the Government of Austria through the Federal Ministry for European and International Affairs, ESA, the city of Graz and Austrospace were used to defray, fully or partially, the costs of the air travel, daily subsistence allowance and accommodation of 20 participants. The sponsors also provided funds for local organization, facilities and the transportation of participants.

C. Programme

13. The programme of the Symposium was developed by the Office for Outer Space Affairs of the Secretariat in cooperation with the programme committee of the Symposium. The programme committee included representatives of national space agencies, international organizations and academic institutions. An honorary

committee and a local organizing committee also contributed to the successful organization of the Symposium.

14. The programme consisted of an opening session, three technical sessions, two panel discussions, and discussions on observations and recommendations, followed by closing remarks by the co-organizers. The presentations in the sessions were chosen from among the abstracts submitted by Symposium applicants.

15. The chairs and rapporteurs assigned to the technical sessions and panel discussions provided their comments and notes as input for the preparation of the present report. The detailed programme, background information and full documentation of the presentations made at the Symposium have been made available on a dedicated website (www.unoosa.org/oosa/en/SAP/act2013/graz/index.html).

16. Copies of the presentations made during the Symposium were also made available to all participants and subsequently posted on the International Space Weather Initiative website (http://iswi-secretariat.org).

II. Summary of the Symposium programme

A. Opening session

17. At the opening session welcoming remarks were made by representatives of the Austrian Academy of Sciences, the city of Graz, the Austrian Federal Ministry for European and International Affairs and the Office for Outer Space Affairs. A representative of the Office for Outer Space Affairs made a presentation reviewing the objectives, expected outcome and follow-up activities of the Symposium.

18. Following the formal opening of the Symposium, a keynote address on the results of the International Space Weather Initiative (ISWI) was delivered by an expert from the Centre for Mathematical Sciences, India. The presentation reviewed the activities conducted under the Basic Space Science Initiative, with a focus on the accomplishments of ISWI. Scientists from more than 100 countries had participated in ISWI, which resulted in the establishment of an ISWI instrument network composed of 16 instrument arrays with instruments in more than 1,000 locations. Three ISWI workshops had been organized by the United Nations, hosted by Egypt (2010), Nigeria (2011) and Ecuador (2012). ISWI contributed to raising awareness on space weather issues among the space science and technology community and the general public, particularly in developing countries. An ISWI newsletter was published by the International Center for Space Weather Science and Education of Kyushu University, Japan, and the ISWI website was maintained by the Bulgarian Academy of Sciences (see www.iswi-secretariat.org).

B. Worldwide instrument arrays and data products

19. At the session on worldwide instrument arrays and data products, participants reviewed the framework for international space weather research cooperation and the status of the worldwide ISWI instrument arrays and their data products.

20. The co-chair of the World Meteorological Organization (WMO) Inter-Programme Coordination Team on Space Weather made a presentation on

WMO activities, including the definition of observation requirements, a review of observation capabilities and gap analysis, the promotion and harmonization of operational products through an online portal, and collaboration with the International Civil Aviation Organization on the specification of space weather services for international air navigation. WMO was aiming to leverage the technical coordination effort initiated by the International Space Environment Service (ISES), fostering integration of meteorological services provided, and was encouraging its members to commit to the long-term provision of services to the community. He stressed the need to raise the awareness of decision makers of the impact of space weather and the emerging capabilities to mitigate the associated risks.

21. The director of ISES made a presentation on how the outcome of ISWI could contribute to improving space weather services and the global benefits for society. The risks posed by space weather were becoming recognized worldwide, and mitigation measures were being developed as awareness of the role of space weather grew. However, space weather services were lagging far behind what was required to ensure the resiliency of global economic and security infrastructure. He stressed that the field of space weather involved more than space science, and what was required was the application of science to societal needs. Both basic and applied research were required to improve knowledge of space weather and the corresponding forecasting capabilities. Four elements were necessary to improve capabilities in the field of space weather: (a) user needs — users had to understand the risks and actions required; (b) targeted services — useable capabilities had to be derived from basic science knowledge; (c) observing infrastructure — a shared approach for the long-term continuity of data collections was necessary; and (d) global coordination — a consistent, accurate message on space weather-related issues had to be provided.

22. Ground-based data were collected by the ISWI instrument network, while space-based data were collected through the International Living with a Star Programme, which involved more than 25 space agencies. At the international level, space weather services were coordinated by ISES, which was coordinating the space weather services of 14 regional and 3 associate warning centres and 1 collaborative expert centre, and the WMO Inter-Programme Coordination Team on Space Weather, involving 21 member countries and 7 international organizations. In addition to those two entities, the Coordination Group for Meteorological Satellites, the International Civil Aviation Organization and the Committee on the Peaceful Uses of Outer Space also contributed to cooperation on international space weather.

23. The roles of those organizations were as follows: (a) ISES was to focus on user needs, improved services, the formulation of consistent messages during extreme space weather events and support the growth of service providers; (b) WMO was to work closely with ISES, leverage global infrastructure and membership, build capacity and increase the number of service providers; (c) the Coordination Group for Meteorological Satellites was to develop an understanding of the needs of users of satellite data, improve products, utilize space-based measurements and promote the long-term availability of data; (d) the International Civil Aviation Organization was to refine aviation service requirements based on user needs and current capabilities and ensure a consistent local and global message on space weather-related events; and (e) the Committee on the Peaceful Uses of Outer Space was to facilitate international participation in space weather research

for operations and the long-term continuity of observations. The particular role of the Committee in that enterprise could be to foster the improvement of space weather services by encouraging research activities, data availability and capacity-building that were aligned with service needs, for example, by expanding ISWI activities to include research for operations.

24. The new SCOSTEP scientific programme for the period 2014-2018, entitled "Variability of the Sun and Its Terrestrial Impact", was presented by one of the programme's co-chairs. SCOSTEP, a scientific committee of the International Council for Science, interacts with national and international programmes involving solar terrestrial physics elements in order to achieve the following: (a) conduct long-term (four to five years) international interdisciplinary scientific programmes in solar-terrestrial physics; (b) engage in capacity-building activities; and (c) disseminate new knowledge on the Sun-Earth system and how the Sun affects life and society through outreach activities. The Variability of the Sun and Its Terrestrial Impact programme would have four elements: (a) solar cycle evolution and extrema; (b) the international study of Earth-affecting solar transients and the MiniMax24 observation campaign; (c) specification and prediction of the coupled inner magnetospheric environment; and (d) the role of the Sun and the middle atmosphere/thermosphere/ionosphere in climate. It was noted that the activities of SCOSTEP were highly relevant to and could create synergy with all activities of the Committee on the Peaceful Uses of Outer Space in the field of Sun-Earth connections. SCOSTEP would strive to contribute to the discussions under the Committee's new permanent agenda item on space weather.

25. Three presentations focused on the status of the following instrument networks: the Optical Mesosphere Thermosphere Imagers (OMTIs), the Magnetic Data Acquisition System (MAGDAS) project of the International Center for Space Weather Science and Education, and the Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (e-Callisto) solar radio spectrometer network. OMTIs were in automatic operation at 13 stations in Australia, Canada, Indonesia, Japan, Norway, the Russian Federation, Thailand and the United States. In that context, station information and data plots were available at http://stdb2.stelab.nagoya-u.ac.jp/omti/. There were 72 observational sites in the MAGDAS instrument network. A database for the metadata of ground-based upper atmosphere observation data had been created (www.iugonet.org/en). The e-Callisto instrument network, with 65 instruments at 35 different locations worldwide, was the Swiss contribution to the International Heliophysical Year 2007 and the International Space Weather Initiative (see http://e-callisto.org). All data from e-Callisto were freely available.

26. The final two presentations in that session provided examples of ongoing space weather research and international cooperation activities at the Institute of Space Science at the National University of Malaysia (UKM) and at the Laboratory for Space Environment Exploration of the Chinese Academy of Sciences.

C. Data analysis and models

27. At the third session, participants discussed examples of the use of space weather data and models. The first presentation introduced the concept of

non-extensive statistical mechanics and its potential applicability to space weather science. The entropy of a system composed of several parts was often equal to the sum of the entropies of all the parts. That was the case if the energy of the system was the sum of the energies of all the parts and if the work performed by the system during a transformation was equal to the sum of the amounts of the work performed by all the parts. However, in cases where those conditions might not be fulfilled, the Boltzmann-Gibbs statistical mechanics needed to be generalized. One such approach was the theory of non-extensive statistical mechanics. It was shown how such a theory might be applicable to solar, nuclear and neutrino physics and space weather phenomena.

28. Ionospheric delay was the main source of error in using GNSS, especially over the equatorial region, such error being referred to as "equatorial ionospheric anomaly". In that context, a presentation was made on the significance of three-dimensional regional ionospheric modelling over the equatorial region to improve GNSS measurement precision and accuracy; the presentation also made reference to the applications of satellite-based positioning systems in Malaysia. That was followed by a presentation of observational data on the ionospheric response to the geomagnetic storm of 15 May 2005 (caused by an M8 class solar flare and the associated coronal mass ejection) that occurred over mid-latitudes in the day and night sectors, simultaneously, on 13 May.

29. In another presentation, an analysis was provided on how the Sun affects the Earth and its environment. In the heliosphere, which was the part of space directly affected by the Sun through the solar wind, the large-scale structure of the solar wind was dominated by two types of disturbances: transient and co-rotating disturbances. Transient disturbances were associated with episodic ejections of material into interplanetary space from solar regions not previously participating in the solar wind expansion, such as solar flares and coronal mass ejections. Co-rotating disturbances were associated with spatial variability in the coronal expansion and solar rotation that occurred in response to the interaction of fast and slow solar winds. Geomagnetic storms in the Earth's magnetic environment generated by those disturbances; Forbush decreases in the heliosphere and on Earth; and solar energetic particles in the heliosphere and ground-level enhancements on Earth were all discussed in detail.

30. The session ended with a presentation on automatic flare recognition and filament eruption detection at Kanzelho□he Observatory of the University of Graz. Near real-time data were available from http://cesar.kso.ac.at/main/esa_live.php.

D. Data analysis and tools

31. New products for monitoring and forecasting space weather in South America, including regional magnetic indices and operational GNSS vertical error maps were presented by the head of the Brazilian Space Weather Study and Monitoring (EMBRACE) programme of the National Institute for Space Research (INPE) of Brazil. All data were freely available from the Institute's website (www.inpe.br/spaceweather).

32. A presentation was made on the results of global positioning system total electron content measurements at low latitudes using the University of New

Brunswick (Canada) Ionospheric Modelling Technique to provide ionospheric corrections for communication, surveillance and navigation systems operating at one frequency. It was expected that the solar maximum would provide ample opportunities to study in detail solar-terrestrial events using that method in order to better understand the effect of solar activity on total electron content at low latitudes.

33. The operational space weather observing and data processing system of the National Space Science Center of the Chinese Academy of Sciences, established in 1992 to support China manned space missions, automatically delivered accurate and reliable data (30 gigabytes/day) in real-time and around the clock. Data from the Space Environment Prediction Center were available from www.sepc.ac.cn.

34. Magnetic reconnection was a universal mechanism of the conversion of energy into plasma, acting as a driver of space weather changes. That mechanism of space weather changes was described in detail in a presentation by the Space Research Institute of the Austrian Academy of Sciences.

35. Following an introduction to the characteristics of geoeffective solar and interplanetary shock events and geomagnetic storms and the applicable methods of investigation, the results of a descriptive and statistical analysis of magnetic storms and associated solar and interplanetary shock precursors during solar cycle 23 were presented.

36. A presentation by a participant from the University of Graz discussed the effects of space weather on habitability and planetary evolution in other star systems. So far, more than 2,500 exoplanets had been detected, and statistical interpretation of recent data from the Kepler mission suggested that there might be billions of potentially habitable planets in our galaxy alone. For a planet to be habitable, it must orbit the right type of host star at the right distance, in the so-called “habitable zone”. Certain conditions for the planet’s surrounding environment must also be met, such as the existence of a magnetic field, the evolution of an atmosphere, interactions with the heliosphere, the stability of the planetary system and the local stellar neighbourhood, the development of plate tectonics and the existence of a large satellite.

37. There were many discussions on potential space weather effects on terrestrial human life. However, to date there had been no conclusive evidence. The indication of a potential influence of space weather and variations in the Earth’s magnetic field on pineal melatonin production in animals determined in rigorous experiments was discussed. Such interaction, if confirmed, might also affect melatonin production in humans.

38. The Space Weather European Network, involving 24 countries and ESA, was established in 2003 through action 724 of the European Cooperation in Science and Technology. The Network had agreed on a definition of the term “space weather”:

> Space weather is the physical and phenomenological state of natural space environments. The associated discipline aims, through observation, monitoring, analysis and modelling, at understanding and predicting the state of the sun, the interplanetary and planetary environments, and the solar and non-solar driven perturbations that affect them; and also at forecasting and nowcasting the possible impacts on biological and technological systems.

The definition was presently being translated into as many languages as possible. The translations would be presented at the Tenth European Space Weather Week, to be held from 18 to 22 November 2013 in Antwerp, Belgium.

39. The Journal of Space Weather and Space Climate was an open access journal striving to provide a link between all the communities involved in space weather and space climate, such as, but not limited to, space, solar and atmospheric scientists, engineers, forecasters, social scientists, economists, physicians and insurance experts. (The journal was available from www.swsc-journal.org.)

40. The final presentation of the session provided an update on the latest changes and additions to the ISWI website and newsletter (http://iswi-secretariat.org).

E. Panel discussions

41. Panel discussions were held on the following topics: “Towards reliable space weather forecasts: results of the International Space Weather Initiative” and “Recommendations for the space weather expert meeting at the session of the Scientific and Technical Subcommittee to be held in February 2014”.

1. Towards reliable space weather forecasts: results of the International Space Weather Initiative

42. The panellists were tasked with reviewing ISWI achievements and the progress made towards operational space weather forecasts (using reliable science to provide reliable weather forecasts), as well as with identifying possible missing links and future actions.

43. There was agreement that the most outstanding output of ISWI was in the field of capacity-building. While the ISWI instrument networks collected vast amounts of ground-based data, the quality of the data were generally not being assessed and the data were not being processed to contribute to actual space weather forecasts. It was recognized that intercalibration would be necessary to improve overall data quality. However, calibration was difficult, expensive and time-consuming and often beyond the capabilities of a single scientist.

44. While it was desirable to disseminate data as widely as possible, care must be taken to also provide the metadata that made it possible to assess the quality and reliability of the data, as there was a danger that faulty data could be used for research and operational use.

45. The panellists agreed that it would be necessary to continue the efforts begun by ISWI to further develop the science, for example, by better connecting solar and atmospheric scientists, and to improve the ability to predict space weather by bringing together those working in the basic sciences and those involved in developing operational forecast systems. Panellists also pointed out that continued efforts should be made to raise awareness on space weather issues among the general public and decision makers.

2. Recommendations for the space weather expert meeting at the session of the Scientific and Technical Subcommittee to be held in February 2014

46. The overall aim of the new item on space weather on the agenda of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, introduced in 2013, was to exchange views on national, regional and international activities related to space weather research and to promote greater international cooperation in support of efforts to close existing gaps in the field of space weather research (see A/AC.105/1001, para. 226).

47. On the margins of the fifty-first session of the Scientific and Technical Subcommittee, to be held in 2014, an expert meeting on improving space weather forecasting in the next decade would be held. The purpose of the meeting was to bring together international scientists currently working in space weather research to discuss paths for the improvement of space weather forecasting during the next decade and to discuss future space-based and ground-based instrumentation for space weather research and forecasting.

48. The panel concluded with a number of observations and recommendations for further discussion under the space weather agenda item and in the expert meeting at the fifty-first session of the Scientific and Technical Subcommittee (see section III below).

III. Observations and recommendations

49. The participants in the Symposium made the following observations:

(a) Research through international efforts, such as the International Heliophysical Year 2007 and ISWI, had helped to motivate and improve space weather research and generate awareness about its importance, particularly in developing countries. The further continuation and development of such activities would improve understanding and the ability to predict the behaviour of the Sun-Earth environment through international cooperation;

(b) Many national, regional and international organizations and a wide range of programmes and projects were contributing to space weather research activities and to fostering international cooperation in the field;

(c) The instrument networks established during the International Heliophysical Year 2007 and ISWI were continuing to collect data, but there was a need to improve data-sharing, calibration and intercalibration of data, and overall data quality, in order to realize the potential of ISWI data to contribute in the future to operational space weather services.

50. Although observations of solar phenomena and in situ data collected by spacecraft can now provide limited early warning of the potential threat of space weather events to ground-based and space-based systems, more accurate and reliable warning systems would require the following:

(a) Further improvements of models of solar ejections, solar wind and the magnetosphere;

(b) Continuous and uninterrupted space-based and Earth-based observations;

(c) Concerted efforts to maintain and upgrade existing facilities;

(d) Easy access to real-time data.

51. Participants took note of the various mathematical models employed to analyse the data and the wide range of ongoing research activities in the field of space weather being conducted worldwide, as well as the availability of new data products. The WMO Space Weather Product Portal listed approximately 40 space weather product references in 10 different categories (www.wmo.int/sat). ISWI data products and information on data access conditions were available from the ISWI website and data access website (www.iswi-secretariat.org and http://newserver.stil.bas.bg/ISWI/Projects/ISWI-DATAaccess.html).

52. The particular role of the Committee on the Peaceful Uses of Outer Space in that enterprise could be to foster the improvement of space weather services by encouraging research activities, data availability and capacity-building aligned with service needs, for example, by expanding ISWI activities to include research for operations.

53. With the support of Member States under the umbrella of the Committee, efforts should continue to achieve the goal of reliable space weather prediction, involving the whole space science community in general and the space weather community in particular.

54. Participants in the Symposium recommended that activities begun under ISWI, including global capacity-building, education and outreach activities, should be continued and expanded by means of the following:

(a) Taking greater advantage of cooperation between ISWI and scientific programmes such as the SCOSTEP Variability of the Sun and Its Terrestrial Impact programme;

(b) Encouraging scientists, researchers and other members of the ISWI community to establish links to existing space weather activities for the establishment of global space weather observing requirements, such as the WMO space weather observing requirements for services, research and climatology (see www.wmo.int/sat) and the Committee on Space Research road map for space weather (to be completed in mid-2014);

(c) Encouraging the scientists, researchers and other members of the ISWI community to contribute to the discussions on space weather issues under the Working Group on the Long-term Sustainability of Outer Space Activities of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, in particular to the work of expert group C, on space weather, and to circulate their relevant reports to the relevant actors;

(d) Encouraging all ISWI instrument principal investigators to facilitate the sharing of their data, including metadata and tools for data analysis and use;

(e) Organizing intercalibration workshops or launching intercalibration campaigns;

(f) Continuing the ISWI website and newsletter as an important contribution to bringing together the international space weather community;

(g) Leveraging data centres that are willing to share data, such as the Data Collection or Production Centres of the WMO Information System, and the International Council for Science world data system, and making data-sharing a central issue at the forthcoming space weather expert meeting to be held in February 2014;

(h) Including easily accessible links on the ISWI website to ISWI instrument (and other) data and metadata for data-sharing purposes (see www.iswi-secretariat.org).

55. Member States, their national space agencies and entities funding relevant research should continue to make basic space science and operational space weather research priority areas for funding.

IV. Conclusions

56. The Symposium, by bringing together space weather experts and instrument hosts from around the world, contributed successfully to highlighting the need to better understand space weather events.

57. The observations and recommendations made by the participants will be brought to the attention of the scientific community and to the States members of the Committee on the Peaceful Uses of Outer Space during the discussion of space weather issues at the fifty-first session of the Scientific and Technical Subcommittee, in 2014.