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Agenda item 10: Space Weather

**Steering Committee Meeting of the International Space
Weather Initiative (ISWI), 19 February 2016:**

**Report on the Adoption of an Open Data Policy for the ISWI
Instrument Network,**

**Submitted by the Rapporteur of the Expert Group on Space
Weather**

Executive Summary

1. The annual Steering Committee meeting of the International Space Weather Initiative (ISWI) was organized on the margins of the 53rd session of the Scientific and Technical Subcommittee (STSC) of the United Nations Committee on the Peaceful Uses of Outer Space (COPOUS) on 16 February 2016. The Meeting provided an update of the status of various IWSI instrument networks that are deployed throughout the world to collect data on space weather. The ISWI Steering Committee established a subcommittee to deal with the data issues following the United Nations/Japan Workshop on Space Weather: “Science and Data Products for ISWI Instruments” held from 2-6 March, 2015, in Fukuoka, Japan. The charter of the subcommittee was to develop a data policy and rules of the road for the usage of data from the ISWI instrument networks. The data subcommittee submitted its report including the data policy, rules of the road, and recommendations on how to implement the policy. The ISWI Steering Committee discussed the report and approved the data policy on February 19, 2016. This conference room paper provides a complete description of the ISWI data policy as approved by the ISWI Steering Committee and includes recommendations to implement the data policy.

2. The ISWI Data Policy report

ISWI is a program of international cooperation. The success of ISWI depends on unrestricted flow of data across geo-political and organizational boundaries. In support of an open data environment, ISWI data should remain freely available, accessible and usable to all users. The ISWI data policy described below is a result that follows the recommendations from the United Nations/Japan Workshop on Space Weather:



“Science and Data Products for ISWI Instruments” (held on 2-6 March, 2015, in Fukuoka, Japan) that the ISWI Steering Committee should address data sharing issues as a priority item. The policy describes the roles and responsibility of both data providers and users and the guidelines (rules of the road) by which all ISWI participants are expected to follow.

I. Preamble: Purpose, General ISWI Guidelines, Justification, and Scope

2. The purpose of this document is to establish the guidelines that govern the ISWI data access and distribution rights and protocol. Anyone who participates in the ISWI project or seeks to use ISWI instrument data understands that he or she should fully abide by the ISWI data policy and rules of the road as stipulated in this document.

3. A key goal of the ISWI project is to produce and disseminate high-quality data from its network of instruments (see sect. 2.2) to support research, operations, and education. Since space weather applications and heliophysics research in general often require an integration of data from many instrument platforms (ground-based and space-based), the success of ISWI depends on unfettered flow of data at all stages of data production, dissemination, and archiving, with a close collaboration between scientific and technical teams. The ISWI data policy is guided by two overarching principles: (i). Access to the data obtained under the auspices of ISWI should be open and freely available for the betterment of the world society. ISWI data will be made *independently usable* and *publicly accessible* as soon as practical; and (ii). To encourage continued ISWI operations and availability of data, support of ISWI and efforts to produce and make ISWI data usable and accessible should be formally acknowledged. To that end, users of ISWI data are expected to follow the rules of the road and protocol described in Section 8 of this document.

4. Justification. Space weather analysis and modeling, for both research and operations, require the use of observations (data) to assess the potential impact of space weather events. Availability and accessibility of data are thus critical for continued operations of ISWI. Through international cooperation, ISWI can strengthen the capacity and resilience of data services by ensuring adequate observing infrastructure and global coordination, and that data requirements are met. The ISWI data policy will provide the guidelines and general protocol with which ISWI instrument data access, distribution and use are permitted under international space weather cooperation. Such cooperation will contribute to more efficient sharing of data, better coordination of observations, creation of an international space weather roadmap and framework, and the promotion of education and capacity-building.

5. Scope. This ISWI data policy applies broadly to all ISWI participants and data users.

II. Roles and Responsibilities of ISWI Participants

6. ISWI Overview: ISWI is a program of international cooperation to advance the space weather science by a combination of instrument deployment, analysis and interpretation of space weather data from the deployed instruments in conjunction with space data, and communicate the results to the public and students. Information about ISWI can be found on the ISWI Secretariat website at <http://www.iswi-secretariat.org/>.

7. The goal of the ISWI is to develop the scientific insight necessary to understand the science, and to reconstruct and forecast near-Earth space weather. This includes instrumentation, data analysis, modeling, education, training, and public outreach.

8. The ISWI organizational chart that shows the oversight and operational components and their relationships can be found on the ISWI Secretariat website (<http://iswi-secretariat.org/>). The ISWI data policy being described in this document serves to provide the guidelines that should be subscribed by each of the ISWI components and data users.

9. ISWI projects and instrument teams: ISWI program implementation is schematically represented in Figure 2. Program success clearly depends critically on having continuous (unfettered) data flow beginning from the instrument arrays to users.

(1) Instrumentation and data analysis

- Expand existing instrument arrays
- Deploy of new arrays
- Expand data analysis effort for ISWI data and other relevant data bases

(2) Coordinate data products to provide input for physical modeling of the Sun-Earth System

- Input instrument array data into physical models of heliophysics processes
- Provide data products in a form useful for modelling
- Enable Space Weather forecasting

(3) Promote Education, Training and Outreach

- Encourage and support space science courses and curricula in Universities that provide instrument support
- Develop public outreach materials unique to the ISWI, and coordinate the distribution

10. There are currently 17 ISWI instrument teams. More specific information on various ISWI instrument teams can be found at <http://newserver.stil.bas.bg/ISWI/pi-addr.html>. This page shows only 15 instruments]. In general, an ISWI instrument project functions with:

- The lead scientist or principle investigator (funded by his/her country) providing the instrumentation (or fabrication plans) and data distribution
- The host country providing the workforce (host scientists, students, etc.), facilities, and operational support for the operation of an ISWI instrument project, typically at a local university
- Host scientists becoming part of the instrument science team
- All data will be publicly shared and made accessible

11. ISWI teams are the generators and primary distributors of their instrument data. As data providers, they hold the key to the success of the ISWI. Due to time sensitivity of real-time data, the instrument team should also be responsible for making their real-time data available and readily accessible on near-real time basis. Data products for research and modeling purposes can be distributed from the instrument team's data facility, ISWI-designated data distribution centers, or relevant data archives.

12. Instrument teams' commitment to the ISWI success is important. To that end, all ISWI instruments shall do their best to secure the resources and support needed to provide their data at highest quality possible in terms of resolution, cadence, calibration, usability, availability, and continual accessibility. Data products to be made available to users by ISWI instruments should be specified and described in the instrument project data management plans (PDMP).

13. New instrument arrays are welcome. Proposals for new instrument array should be submitted to the ISWI Executive Director (<http://www.iswi-secretariat.org/>).

14. ISWI data archives and distributors: Raw data taken by an ISWI instrument is sent to the instrument's data center or facility for processing and data products generation. Data processing facility here refers to a step in the data product generation pipeline rather than a specific location, so the facility can be distributed between instrument sites and any dedicated data distribution centers. For distribution of real-time data, the data processing facility should be located at/near the instrument site to minimize the delay in data distribution. Data products that are suitable for retrospective analysis or modeling, including real-time products that are suitable for space weather models development, should be adequately documented and distributed freely without unnecessary delay. The responsible instrument team should also submit the data and associated products to an ISWI-designated data distribution site for further dissemination and archiving.

15. ISWI Data Users: The primary goal of ISWI is to collect and provide relevant observations to support space weather research and operations. With the necessary data and infrastructure support, ISWI instrument data can be accessed by worldwide users: scientists, operational facility, students, and the public to gain understanding of the of space weather and increase awareness and appreciation of the impact of space weather on life on Earth.

16. ISWI Community: ISWI is a program of international cooperation to support space weather science and operations so as to improve life on Earth. The success of ISWI depends on the collaboration of many individuals and teams, and the cooperation between different countries. For the purposes of this policy, the ISWI community refers to (1) the ISWI instrument teams that are responsible for developing, deploying and operating the instruments, and (2) the ISWI data users. Under the auspices of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), the ISWI Steering Committee has the oversight responsibility for the maintenance of this data policy. By virtue of utilizing any ISWI infrastructures and resources, all ISWI participants have agreed explicitly or implicitly to adhere to this policy.

III. ISWI Policy on the Exchange of Data and Related Products

17. All data and associated documentations and tools produced under the auspices of ISWI should be made freely and readily accessible to worldwide users. As such, there should be no restriction on data and knowledge exchange between ISWI participants, provided acknowledgments about the sources are explicitly given in the work and products being produced by the users. Protocols for acknowledgments are stipulated in the ISWI Rules of the Road in Section 8 below.

IV. Data Standards: Formats and Metadata Model

18. To facilitate data exchange and utilization, all ISWI data products and tools should be properly documented, described and stored in *standard formats*. The use of

standards means that the customization of tools and interfaces for data access and exchange can be minimized. Data formats commonly used for space and Earth science data are: CDF, HDF, netCDF, FITS, and ASCII. While some data formats (e.g., CDF) are self-documenting and self-describing, it is also useful for the metadata of the ISWI data products to conform to standard metadata models, such as the Space Physics Archive, Search and Extract (SPASE) metadata model. Using standard metadata dictionary and protocol will facilitate the ISWI data to be searched and accessed by existing heliophysics data systems, such as NASA's heliophysics virtual observatories (VxOs), leveraging those existing infrastructure to help disseminate the ISWI data.

V. Data Archiving

19. The data products available from each ISWI instrument are generally described in the instrument PDMP and on the instrument websites. There are generally two types of ISWI instrument data products: real-time, or near real-time, data and retrospective data. Real-time (near-real time) data are produced primarily for satisfying operational needs, such as space weather forecasting or nowcasting; whereas retrospective data are used primarily for research or modeling purposes. Real-time data, if suitably adapted, can also be used for research purposes. When properly processed, documented, organized, stored and maintained, the scientific value and usability of the ISWI data are preserved. When made freely available and accessible, worldwide users will be able to use the data in endeavors (e.g., research and capacity-building efforts) that cause positive societal impact. Archiving is thus important to ensure the long-term utility of ISWI instrument data. Since ISWI is an international collaborative project, through the working of the cognizant instrument science team members, the country in which an ISWI instrument is located and operates should be substantially responsible for ensuring the data generated in their country are delivered for archiving. The final archiving location, which may change as necessary, should be specified and updated in the instrument's PDMP.

VI. Data Distribution and Accessibility

20. ISWI instrument data are useful only if they are accessible to and usable by users. The most efficient way to disseminate ISWI data is for users to access the data directly from data access portals over the internet. This implies that data distribution centers, such as data archives or instrument institutions, should provide adequate data services in order to ensure the success of ISWI. In addition, instruments that produce real-time data should have the necessary infrastructure to broadcast their real-time data products, and archive those data, if needed, for retrospective analysis. The methods by which each ISWI instrument will disseminate their data products are described in the instrument PDMP.

VII. ISWI Data Management Policy Review and Revision

21. Keeping ISWI data unrestricted with free electronic access is key to the success of ISWI. The ISWI data policy serves to provide the guidelines to which all ISWI participants should adhere with regard to the management, distribution and use of ISWI data (see Rules of the Road below). Due to changes in the world's geopolitical and economic landscapes and the disparities in technological capacity among member states and instrument teams, an ISWI Data Working Group should be established to assist the ISWI Steering Committee to ensure that the policy is being followed.

VIII. Rules of the Road for ISWI Data Use and Acknowledgments

22. ISWI participants should confirm their commitment to the ISWI data policy by providing free and unrestricted access to ISWI data and products, and using the data responsibly. In particular, all ISWI participants agree:

(i) To provide on a free and unrestricted basis essential data and products for the provision of services in support of the protection of life and property, and the well-being of all nations, particularly those data and products required to describe, understand, and forecast space weather;

(ii) To provide freely without cost and restriction the data and products which may be required to sustain the ISWI Program at the global, regional, national and international levels and to assist other ISWI Members in their fulfillment of their ISWI responsibilities in their countries;

(iii) To provide free, unrestricted electronic access to all ISWI data and products to the research and education communities, for their non-commercial activities;

(iv) To acknowledge relevant ISWI instrument teams, PI and/or science team members, for providing the data and any assistance for using the data. The following standard acknowledgment should be included in formal and informal publications, presentations, and communications;

“We gratefully acknowledge that the data used in this paper/presentation/communication has been generously provided by the ISWI XXX Team” (www.ISWI_TeamWebsite).

(v) To include relevant ISWI instrument PI/team members as co-authors on any formal or informal communications, unless the co-authorship is declined by the team personnel.

IX. ISWI Instrument Data Management Plans

23. Each ISWI instrument shall provide an instrument project data management plan (PDMP). These documents are integral parts of the ISWI data policy. They provide the plans by which all ISWI instrument teams manage the data and metadata generated by their instruments. It describes how the team will handle and process the data from the point when the data have been taken by the instrument. Each plan will also describe the various data products to be produced by the instrument. The goal of the data management plan is to describe and explain the many aspects of data management, metadata generation, and data preservation, so that data users will have understanding of how they may access and use the data products produced by the instrument. The plan ensures that data are well-managed in the present, and are prepared for preservation and use in the future. ISWI PDMPs should be reviewed and revised as necessary.

24. A data management plan defines and describes all the data products to be produced from the instrument. It also describes the data format, parameter organization, processing procedures, and other information needed to understand and use the instrument data. The plan should also document the development of different versions of the data so details about how a given data product came about can be traced. Well-documented data will ensure understandability of the data, which is important for ensuring proper use of the data by both data collectors and researchers worldwide.

25. Another component of data management is the data archiving plan. Long-term data can be used for model construction and trend analysis. Data that are documented and preserved have the potential to lead to new, unanticipated discoveries. Archiving of data at dedicated data storage facilities also provides insurance against loss of the data.

26. For understanding of the instrument data, each data product should have clear and complete descriptions (metadata). Metadata, commonly referred to as “data about data”, are the contextual details about the data, including any information important for the correct use of the data. This may include descriptions of instrument setup, operational details, measured parameters, temporal and spatial performance characteristics, units, files, caveats, etc. The metadata for the data products from each ISWI instrument may consist of three parts:

- (i) Descriptive metadata that provides high-level instrument and contact information;
 - (ii) Structural metadata that documents the relationships within and among data resource objects or terms; and
 - (iii) Administrative metadata that helps manage and distribute information resources through elements such as version number, archiving date, and other technical information for purposes of file management, rights management and preservation.
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