

## **CO-CHAIR'S REPORT**

*(Submitted by Terry Onsager and Xiaoxin Zhang, ICTSW Co-chairs)*

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### **Summary and Purpose of Document**

This report gives the highlights of recent and planned ICTSW activities.

Significant work was achieved since ICTSW-4 in particular in the area of the definition of space weather services to global air traffic navigation, in collaboration with ICAO, which will remain a high priority for the year to come. The review of observation needs and priorities was initiated and will soon be completed by an update of the Statement of Guidance for Space Weather Observation. This Statement should then be a tool to guide and advocate the evolution of space weather surface- and space-based observation capabilities.

In parallel, efforts have been made to increase the involvement of WMO Members in ICTSW and raise the visibility of Space Weather within WMO and in the wider international community. New ICTSW members have been nominated by Norway, Pakistan, Spain and Sweden. Space Weather – through the contribution of the WMO ICTSW- is now addressed at every regular meeting of the Coordination Group for Meteorological Satellites (CGMS). The work of ICTSW is acknowledged in international fora such as COPUOS and COSPAR. The ICTSW and the International Space Environment Service (ISES) have also agreed to conduct some joint activities.

The WMO Executive Council raised the importance of space weather and requested the ICTSW to develop a detailed four-year plan of activities for submission to the seventeenth World Meteorological Congress in May 2015. This is a major opportunity to formalize the involvement of WMO Members in space weather. Developing this plan will thus be the highest priority of ICTSW during this fifth meeting and the following weeks. After Congress, it should provide the framework for our activity.

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### **ACTION PROPOSED**

The Inter-Programme Coordination Team is invited to take note.

## Discussion

The ICTSW conducts its activities in accordance with the following Terms of Reference defined by CBS and CAeM:

- (a) Standardization and enhancement of space weather data exchange and delivery through the WMO Information System (WIS);
- (b) Harmonized definition of end-products and services, including e.g. quality assurance guidelines and emergency warning procedures, in interaction with aviation and other major application sectors;
- (c) Integration of space weather observations, through review of space- and surface-based observation requirements, harmonization of sensor specifications, monitoring plans for space weather observation;
- (d) Encouraging the dialogue between the research and operational space weather communities.

The ICTSW has made progress in all areas identified in its Terms of Reference, combining regular telecons with annual face-to-face meetings. At ICTSW-4 held in November, 2013, a total of 34 actions and 19 recommendations were decided. Many of the actions have been completed; however, many remain and will continue to be addressed as part of the team's evolving activities. In addition, ICTSW jointly participated in the 2014 annual meeting of the International Space Environment Service, ensuring effective coordination among these two organizations.

Progress in the areas defined by the Terms of Reference is briefly summarized below.

### **(a) Standardization and enhancement of space weather data exchange and delivery through the WMO Information System (WIS);**

Substantial progress has been made over the past year to understand the requirements of WIS and to identify the focus of a pilot project to test the utilization of WIS for the discovery, access, and potential redistribution of space weather information. This effort is being conducted together with ISES. The initial space weather parameters have been chosen, which consist of core space weather forecasts and alerts contained in the ISES codes.

The BUFR format was initially selected based on consultation with colleagues working closely with WIS, and an initial BUFR framework for the space weather products was drafted. However, it was later realized that in the development of the ICAO World Area Forecast System, a change is being implemented to replace the current significant weather forecasts (SIGWX) in BUFR format with forecasts in XML/GML format.

Consequently, it was decided that the WIS Pilot Project team will investigate the use of XML/GML for space weather products. Of particular interest is getting a better understanding of how XML/GML is being used by ICAO and how standards are being established and maintained. The data format decision should be expedited so that the later stages of the pilot project, such as defining the metadata and registering the test products, can proceed as quickly as possible.

The ICTSW is also exploring the benefits of using the GTEX format for the exchange of GNSS data and exploring ways to foster interaction among the meteorology/climate and space weather communities through the dual use of GNSS radio occultation data.

ICTSW members participated in the organization of an Ionosphere-Atmosphere Coordination Workshop held by the Space Weather Sub-group of the CGMS International Radio-Occultation Working Group (IROWG). The main objectives of this workshop were to: 1. increase synergy between ionosphere and neutral atmosphere uses of GNSS; 2. increase scientific interaction between these two communities; 3. further the goal or dual-

use of GNSS sensors; and 4. make progress on issues related to data formats and future missions. For space weather applications it is noted that a basic data parameter derived from the radio occultation data needs to be identified and made routinely available through the WIS. This parameter (or parameters) would be the space weather equivalent of the bending angle used in meteorology/climate. Line-of-sight total electron content is likely to be one such parameter, with another parameter related to scintillation also a possibility.

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

The ICTSW has been working closely with ICAO on the development of space weather service requirements for aviation and on recommendations for how the provision of these services should be organized globally. The ICTSW provided extensive comments and suggested revisions for the Concept of Operations for International Space Weather Information in Support of International Air Navigation, as well as comments and suggested revisions for the space weather Standards and Recommended Practices (SARPs) proposed for Amendment 77 to Annex 3 – *Meteorological Service for International Air Navigation*.

These contributions were included in a WMO Information Paper to IAVWOPSG/8: Content and Structure of Operational Space Weather Services to Air Navigation, as well as in an information paper for the ICAO/WMO Met Divisional Meeting in July, 2014. These Information Papers also provided guidance on the recommended network organization and functions of space weather centers for civil aviation. The guidance recommended coordination at the global level (e.g. two mutually mirroring centers) for information regarding large scale phenomena, such as solar radiation storms, solar flares, and forecasts of geomagnetic and ionospheric disturbances. Information at the regional level was recommended for shorter timescale alerts and warnings and for monitoring the local aspects of the events.

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

A major effort over the past year has been to update space weather observing requirements and the Statement of Guidance (SOG), an important component of the WMO Rolling Review of Requirements process. New requirements have recently been added for space weather observations in the thermosphere and for measurements of radiation levels at aircraft altitudes. In addition, a number of other updates to the requirements have been identified and will be evaluated.

The new SOG is a substantial revision from the original Space Weather SOG drafted in May, 2012. This new SOG follows the guidelines recommended by the Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE), and it will include a prioritization of the recommendations.

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

ICTSW members are actively engaged in solar and space physics research and in efforts to utilize research advance to improve operational services. For example, many ICTSW members participated in the Committee on Space Research (COSPAR) Assembly and in the associated Panel on Space Weather Sessions. The Panel on Space Weather session co-organized by ICTSW members was titled: "Research Directed toward Space Weather Services". This session was attended by many of the space weather service providers and researchers around the world with an interest in service-oriented applications. The session

highlighted a growing awareness of space weather and a strengthening of connections to users of space weather services. Also emphasized in this session was the worldwide deployment of new instrumentation, including in South-East Asia, South America, and Africa, as well as on geostationary and low-Earth-orbit satellites.

This year's COSPAR assembly was also used to present and to discuss the COSPAR Space Weather Roadmap that has been drafted over the past year with ICTSW representation. The Space Weather Roadmap was commissioned by COSPAR and the International Living With a Star program to develop a strategic assessment of how to advance the science of space weather with the explicit aim of addressing user needs and improving space weather services.

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