

FOUR-YEAR PLAN FOR WMO SPACE WEATHER ACTIVITIES

(Submitted by the Secretariat)

Summary and Purpose of Document

This document addresses the response to the request from the Executive Council to *“develop a detailed four-year plan of activities, taking into account the evolving service-oriented nature of space weather services, to inform the WMO planning processes, to address user needs, to articulate the activities of space weather providers with the applicable WMO programme areas, and to increase the awareness of Members in this area”*.

It is suggested that this plan be composed of:

- An introductory part giving a definition of space weather, recalling the background, summarizing the societal needs and trends for space weather services, the specific role of WMO in the international context, setting high-level goals and principles, and defining key WMO activities in space weather;
- For each of the activities involved, an analysis of the specific goals, main challenges, assets and opportunities, short-term and long-term objectives, deliverables and benefits;
- The implications in terms of working structure, mapping with existing WMO organization and programmes, external partnerships, management structure, resources, implementation principles, roadmap and milestones.

The draft four-year plan is to be completed by December 2014 for submission to the WMO Congress in May 2015. A preliminary draft is provided in a separate Attachment to this document as a basis for ICTSW-5 discussion.

ACTION PROPOSED

To review and complete the preliminary draft provided in the Attachment to ICTSW-5/Doc.4 (1), with particular attention to:

- The short- and long-term objectives, associated deliverables and benefits;
- The organizational implications and implementation roadmap.

APPENDICES

- A. Congress statement on global preparedness for space weather hazards (Cg-16)
- B. Activities recommended by the Executive Council (EC-66)

DISCUSSION

1. BACKGROUND

In 2011, the sixteenth WMO Congress took note of the statement on global preparedness for space weather hazards provided in Appendix A. The Congress noted that *“a coordinated effort by Members [was] needed to address the observing and service requirements to protect against the global hazards of Space Weather. It invited the WMO Space Programme, in coordination with the Inter-programme Coordination Team on Space Weather and with the support of the relevant technical commissions, to develop near-term and far-term action plans, including education and training, and work with the WMO Regional Associations to implement a coordinated strategy for Space Weather.”*

In 2014, bearing in mind that space weather services were supporting several application areas including, but not limited to the aeronautical sector, the Executive Council highlighted the need of a coordinated approach among WMO Members. It requested the ICTSW *“to develop a detailed four-year plan of activities, taking into account the evolving service-oriented nature of space weather services, to inform the WMO planning processes, to address user needs, to articulate the activities of space weather providers with the applicable WMO programme areas, and to increase the awareness of Members in this area”*, along the lines of the proposal given in Appendix B. The Council requested this work be carried out in consultation and coordination with CAeM and inform the Executive Council Working Group on Strategic and Operational Planning (EC WG/SOP) so that plans, activities, and supporting expert groups are in consistency with wider WMO and ICAO efforts.

2. HIGH-LEVEL GOALS

The high-level goals and guiding principles of WMO activities in space weather should be defined taking into account:

- The societal needs for space weather information including the needs expressed by ICAO, by ITU, by COPUOS, the evolving market demand and the need to address space weather hazards as highlighted by Cg-16.
- The range of international initiatives in this area and the regular calls for filling a gap in international coordination of space weather activities;
- The particular relevance of space weather to WMO activities considering e.g. the potential coupling of NWP models and ionosphere or other geospace models, the interaction between space weather and climate, the impact of space weather on meteorological observations, the impact of meteorology on space weather observation, and the potential synergy in the delivery of services.
- The constrained resource environment, which requires that Members seek synergies and benefits through improved collaboration, sharing and integration.
- The diversity of experience of WMO Members in Space Weather, whereby some Members have a well-established operational space weather activity within the mandate of the National Meteorological and Hydrological Service (NMHS), in some cases it is outside the NMHS, and in many cases there is only a research activity or no significant space weather activity at the national level.

3. DETAILED CONTENT OF ACTIVITIES

Considering the outcomes of Congress and Council deliberations contained in Appendix A and B respectively, the following breakdown of key activities is suggested:

- (a) Evaluating user requirements for space weather products and services, in particular in support of aviation, radio-propagation and radio-navigation, geomagnetic effects on infrastructure, spacecraft operations and overall disaster risk management;
- (b) Developing best practices for generating products and delivering such services to the users;
- (c) Training and building capacity, to enable the provision of services and support user uptake;
- (d) Prioritizing and coordinating ground and space-based observations of key space weather phenomena and their precursors and developing best practices to ensure the quality and interoperability of these observations;
- (e) Promoting and facilitating data management, standardization and exchange;
- (f) Developing best practices for modelling, analysing, and forecasting space weather environment, promoting transition from research to operations and synergy with climate and weather modelling;
- (g) Ensuring a science-based, authoritative voice on space weather situation and representing the operational space weather community in the United Nations system.

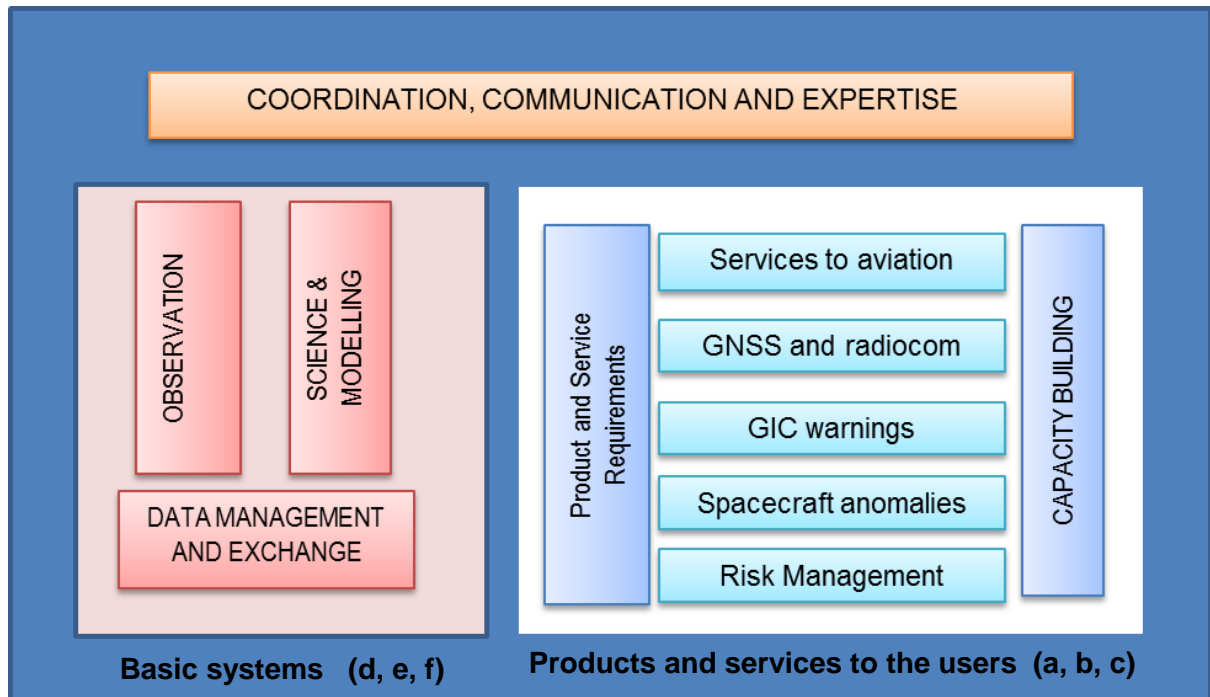


Figure: Schematic block diagram of the proposed key activities

It is suggested to analyse, for each of these activity areas:

- The most important goals to achieve a breakthrough
- Challenges, assets, and opportunities
- Proposed short-term (4 years) and longer-term objectives
- Corresponding deliverables
- Expected benefits
- Prerequisites, enabling or facilitating activities, partners.

The short-term objectives are expected to include, or at least be consistent with, the actions and recommendations agreed at previous ICTSW sessions.

4. ORGANIZATION AND IMPLEMENTATION ISSUES

The organizational implications of these activities should be considered in terms of :

- Mapping with wider WMO activities and strategic priorities;
- Working structure ensuring an effective mobilization and efficient use of the competencies of space weather experts of WMO Members;
- Appropriate linkage with existing WMO structure (Technical Commissions such as CBS, CIMO, CAeM) and activities (WIGOS, WIS, GFCS, GDPFS, AMP);
- User engagement, partnerships;
- Effective activity monitoring, coordination, and management;
- Communication and advocacy;
- Financial and staff resources from Members and from the WMO Secretariat;

An implementation roadmap should be defined, with milestones, taking into account:

- The formal request from ICAO to collaborate on the definition of space weather services to aviation to be implemented in the years to come;
- The excellent foundation provided by ICTSW since its creation;
- The need, however, to further demonstrate the benefit of improved coordination, integration and data sharing as opposed to uncoordinated space weather activities with high risk of gaps and overlaps;
- The time necessary for advocacy and mobilization of international support;
- The desirable consistency with the WMO decision cycle based on four-year Financial Periods following WMO Congress sessions.

5. CONCLUSION

A number of questions are to be addressed, but the ICTSW is well equipped to complete such a task, in the light of its experience and membership.

The draft four-year plan resulting of ICTSW-5 discussions should be completed in December 2014 and finalized after consultation of the CBS and CAeM Management Committees.

It is envisaged to inform the Scientific and Technical Sub-Committee (STSC) of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) on the highlights of this draft plan, in February 2015.

The four-year plan shall be communicated to the Executive Council Working Group on Strategic and Operational Planning (EC WG/SOP) and shall be submitted to the seventeenth WMO Congress for approval in May 2015.

Annex to paragraph 4.4(5).12 of the general summary of EC-66

1. Purpose of this Document

This document summarizes the needs for space weather services and recommends a set of activities to be undertaken within WMO to achieve a breakthrough in the capabilities to meet these needs.

2. Societal Demand for Space Weather Services

The demand for space weather services is increasing as the dependence on technologies impacted by space weather continues to grow. For example, a dramatic increase in the use of polar airline routes exposed to space weather events has generated requirements for global space weather information to air traffic navigation. The expanded uses of satellite-based navigation and timing and the optimization of electric power grid operations, also increase exposure to space weather events and hazards. Industries and governments are becoming more engaged in assessing the risks and developing mitigation strategies. Emergency management agencies are developing procedures to manage the risks of severe space weather events as part of their overall risk management approach. Space weather services are regularly used today in some countries by the commercial airlines, the satellite industry, drilling and surveying operations, and users of satellite-based navigation systems. It is anticipated that this demand will considerably expand with a broader awareness of the impact of space weather events.

On the international scene, the International Civil Aviation Organization (ICAO) is establishing requirements for space weather services. Within the Committee on Peaceful Uses of the Outer Space (COPUOS) of the United Nations General Assembly, the need was expressed to strengthen international coordination of efforts to monitor the space environment to support the long-term sustainability of space assets and activities. The Committee on Space Research (COSPAR) of the International Council for Science (ICSU) is developing a roadmap to identify the main scientific and observational challenges for the understanding of space weather processes. An operational coordination as foreseen by WMO is the missing link between these important initiatives.

Improving the provision of space weather services worldwide requires international coordination and cooperation, in order to create a shared satellite-based observing system, to secure the availability of critical global and regional observations, and to ensure the global consistency of the end products.

3. ICTSW activities

Since its establishment in May 2010, the WMO Inter-Programme Coordination Team on Space Weather (ICTSW) has demonstrated the relevance and benefits of its early activities responding to these demands. Focusing on operational services, WMO has established a framework whereby its Members are joining efforts to advance space weather observations, products and services, and leveraging their capabilities to produce benefits on a global scale. This is being done in close partnership with the International Space Environment Service (ISES), ICAO, the International Telecommunications Union (ITU), COPUOS, COSPAR and CGMS, taking account and advantage of the complementary capabilities and interests of these organizations.

4. Space Weather within WMO Programmes and Activities

Initial space weather activities are integrated into a number of WMO Programmes and projects.

In the WIGOS perspective, these accomplishments have included the establishment of a Space Weather Product Portal, of the identification of space weather observing requirements, and an assessment of the current gaps in our observing systems as documented through the Statement of Guidance for Space Weather Observations. Space weather is fully integrated in the Rolling Review of Requirements and in the WMO Implementation Plan for the Evolution of the Global Observing Systems.

A pilot project is underway to use the WMO Information System for the exchange of space weather forecast products (geomagnetic activity, solar flares, and solar energetic particles).

Within the Aeronautical Meteorology Programme, WMO has worked with ICAO to define space weather services for global air traffic navigation. The ICTSW reviewed the ICAO Concept of Operations related to space weather and has provided guidance on the future organization of an effective operational space weather service delivery. WMO will have the responsibility to coordinate the response to these ICAO requirements. ICAO recognizes the ICTSW as the WMO technical body to provide advice on space weather matters. The active participation of WMO will be essential as it is anticipated that Annex 3 of the ICAO Convention will require such space weather services for civil aviation.

5. Proposed goals for space weather activities

WMO can provide a global framework for the emerging space weather services, helping Members through the following:

- (a) Evaluating space weather user requirements for observations, products and services;
- (b) Coordinating ground and space-based observations of key space weather phenomena and their precursors and ensuring their interoperability;
- (c) Promoting and facilitating data exchange and standardization;
- (d) Developing best practices for observing, recording, analyzing, forecasting, warning, and communicating the resulting information to the users;
- (e) Training and building capacity, promoting transition from research to operations, and subsequent user uptake;
- (f) Ensuring a science-based, authoritative voice on space weather situation.

Given the broad field of activity to be pursued, it is suggested that WMO focus in a first step on a limited number of pilot projects to be determined in accordance with the resources that the Members are ready to share to support, and benefit from, these activities.

6. Need for Expanded Space Weather Structure

Space weather activities have been initiated in many WMO core programme areas. However, a single team like ICTSW does not have the capacity or the focused expertise to develop fully the required capabilities in all areas. Therefore, it is envisaged to review the best mechanisms to address the evolving needs of Members by considering how to engage the appropriate expertise in the areas below..

WIGOS:

- Maintain observing requirements, the Statement of Guidance (gap analysis), and the OSCAR database content;
- Coordinate measurement specifications and support interoperability and integration of observations;

- Identify observing assets in each Region that can be included in global observing systems;
- Promote a high-level coordination of satellite-based and ground-based observing assets to ensure that high-priority gaps are addressed in a cost-effective manner through shared capabilities.

WIS:

- Standardize and enhance space weather product and information delivery through WIS;
- Maintain and expand the products available through the Space Weather Product Portal;
- Harmonize the definition of products and services in consultation with key user groups;
- Identify NMHSs within each Region that can participate in the collection of data and the production and dissemination of services.

Applications:

- Advise major application programmes and activities such as aeronautical meteorology, disaster risk reduction, services to the energy and telecommunication sectors, etc, on space weather service capabilities and the recommended approach to service delivery;
- Establish quality assurance guidelines and emergency warning procedures based on user requirements;
- Establish real-time communication mechanisms to share urgent information and maintain consistency of information during extreme events;
- Conduct post-event analyses to refine capabilities and document information reliability.

Capacity Development:

- Determine the current level of services available within each Region;
- Provide training and sharing of knowledge to allow the utilization of existing products and services by all Members and to encourage participation in regional service provision;
- Foster the development of operational, data-assimilative, predictive models, benefiting from advanced weather and climate prediction capabilities.

Global Framework for Climate Services:

- Coordinate the space weather observing requirements with the weather and climate monitoring architectures.

In order to be fully efficient, the activity of these expert teams will require increased support from the Secretariat and strong engagement of the Members. Space weather is an evolving effort and we must address how to meet Members' needs in a manner that is efficient and consistent with the WMO structure.

7. Summary

The early results obtained in the current financial period illustrate the broad field of activity that could benefit from WMO involvement in space weather, and demonstrate the capability of WMO to effectively facilitate a breakthrough in this area. Given the increasing demand for space weather services to aviation and other sectors, it is thus recommended that WMO engages at a larger scale, and on a sustainable basis, to improve global space weather capabilities.

Annex to paragraph 3.7.11 of the general summary of Cg-XVI

**STATEMENT FROM THE WMO SIXTEENTH CONGRESS SIDE-EVENT
ON GLOBAL PREPAREDNESS FOR SPACE WEATHER HAZARDS**

The participants in the Cg-XVI Side Event on Space Weather acknowledged:

- The increasing risks of Space Weather events to all WMO Members due to the increasing reliance on advanced technologies;
- The diversity of sectors impacted by Space Weather, including: navigation, communication, electric power, pipelines, satellites, and aviation, as well as the impacts on core meteorological observations;
- The actions being taken today by industries and governments to prepare for, and respond to, Space Weather storms and related indirect hazards;
- The progress already achieved in establishing ground-based and space-based observing networks;
- The progress already achieved in establishing a framework of Space Weather prediction and service centres;
- The need for coordinated near-term and far-term actions in order to plan and implement capabilities that will meet regional and global Space Weather requirements, as identified in the WMO Rolling Review of Requirements (RRR) in a sustained, comprehensive, robust, efficient and integrated fashion;
- The capacity of WMO Members to contribute to a globally coordinated system of observations and services, relying on their national R&D and operational assets, as well as on international partnerships;
- The benefits that can accrue to all WMO Members from increased WMO coordination of Space Weather activities;
- The need to raise awareness, advocate the benefits, and provide training so that WMO Members can take advantage of coordinated Space Weather activities.

The participants in the Cg-XVI Side Event on Space Weather therefore recommended:

- To develop and implement near-term and far-term action plans that will enable Members to determine needs and requirements, and to benefit from existing services;
- That WMO Members will contribute, where possible, to enhance regional and global capabilities, including observation collection and information delivery;
- To strengthen the statements included in paragraph 3.7.11 of Document 3.7 for the WMO Space Programme along the following lines: “The Congress noted that a coordinated effort by Members is needed to address the observing and service requirements to protect against the global hazards of Space Weather. It invited the WMO Space Programme, in coordination with the Inter-programme Coordination Team on Space Weather and with the support of the relevant technical commissions, to develop near-term and far-term action plans, including training and education, and work with the WMO Regional Associations to implement a coordinated strategy for Space Weather.”