Twenty-First Meeting of the Cross Polar Trans East Air Traffic Management Providers' Work Group (CPWG/21)

(Montreal, Canada, 17-20 May 2016)

Agenda Item 8: Communications, Navigation, Surveillance (CNS) and Air Traffic Management (ATM) issues

Space Weather, a New Service for Annex 3, Meteorological Service for International Air Navigation

(Presented by United States of America)

SUMMARY

This paper provides information on the new services that will be introduced for Space Weather, effective November 2018.

1 Introduction

1.1. At the 12th Air Navigation Conference, the meeting agreed that the provision of space weather information is of high priority in support of performance based navigation. In addition, the ICAO *Global Air Navigation Plan* (GANP - ICAO Doc. 9750, 4th Ed.) identifies the need for space weather information in Performance Improvement Area 2: Globally Interoperable Systems and Data, Module B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term).

1.2. In 2015, the Air Navigation Commission (ANC) established the MET Panel by State Letter inviting a cross representation of States to advance selected Recommendations of the Meteorology Divisional Meeting held in Montreal from 7-18 July 2014 ,with one of those recommendations being the introduction of the provision of space weather information.

1.3. The MET Panel objective, per the tasking from the ANC, is to recommend operational solutions for global problems. The ANC recognized that space weather events such as solar radiation storms, solar flares, geomagnetic storms, and ionospheric disturbances pose a risk to flight safety, impacting communication, navigation systems, onboard avionics, and also posing a risk to the health of aircraft occupants. They concluded that there is a need for space weather information and have tasked the MET Panel to introduce the provision of Space Wx Information as part of Amendment 78 to Annex 3 with an applicable date of November 2018. This new service is to meet the operational requirements in line with the GANP and be integrated space into System-Wide Information Management (SWIM).

2 Discussion

2.1. The MET Panel is organized into four working groups to address the job cards assigned to them from the ANC. The Working Group on Meteorological Information and Services

Development (WG-MISD) was assigned the responsibility to develop standards and recommended practices (SARP) for Space Weather information.

2.2. To achieve this objective, along with other operational issues for new meteorological services, the MISD set about to establish a well-defined system engineering process to support a robust requirements development process before a SARP is drafted and recommended to the ANC to be included in next amendment cycle of Annex 3. In order to be able to develop a mature SARP, a series of steps needs to be carried out. These steps include understanding the shortfall in desired services versus current capabilities, definition of a concept of operations (ConOps), and the development of functional and performance requirements. Once these steps are complete, an analysis of alternatives is conducted as to how best to provide the required services.

2.3. For this discussion, and reflecting the maturity of this process at its current state, the focus of this information paper is on the development of a ConOps and the development of the functional and performance requirements.

2.4. At the present time, a ConOps has been developed and is undergoing final review for adoption. The development of a ConOps is not to be seen as an operational solution set, but rather, to define the operational requirements for services that are articulated in the functional analysis and performance requirements to provide this service. Later, after validation of requirements is complete, an analysis of alternatives is conducted on how to best provide the service. This analysis of alternatives will include selection criteria to assess Provider States who are in the best position to fulfill the obligation of providing space weather information.

2.5. It is well-accepted that the global scale of space weather events can result in multiple users over a wide geographic area being impacted by a single event. In addition, the collaborative nature of some aviation decisions in which multiple users in multiple Flight Information Regions (FIR) have input into the same decision, such as aircraft separation on trans-oceanic routes, requires users to have simultaneous access to the same information. The global nature space weather will require seamless and well-coordinated information to support effective and timely decision making.

2.6. Consequently, the challenge is to define the functional and performance requirements to meet this operational requirement. The following table represents the draft, high-level functional requirements. These areas represent the most significant impacts from space weather and they focus on delivering information that best supports aviation decision making. This represents a paradigm shift in many space weather services to date, focusing less on the driving space weather phenomena itself and translating that phenomena-centric information into information more applicable to aviation decision making.

High-level Functional Requirements (Draft)
The Provider State shall provide information about ***HF absorption*** resulting in radio communications degradation and outages
The Provider State shall provide information about ionospheric conditions resulting in ***reduced maximum useable frequencies (MUFs) for HF*** radio communications
The Provider State shall provide information about ***ionospheric scintillation conditions impacting GNSS-based navigation and surveillance***
The Provider State shall provide information about the ***impact of anomalous ionospheric delay on GNSS-based navigation and surveillance***
The Provider State shall provide information about the ***background radiation exposure environment (quiet time)***
The Provider State shall provide information about ***enhancements to the background radiation exposure environment (space weather-driven sudden increases)***
The Provider State shall provide information about ***radio bursts affecting surface-based air traffic control radars and satellite-based navigation (under consideration)***

Table 1 – Driving Functional Requirements (Draft)

2.7 With respect to the detailed functional and performance requirements that will be derived from the driving, high-level functional requirements shown in Table 1, the specification of current conditions and forecast requirements may differ significantly. In general, space weather modeling has progressed to the point where information of relatively high skill is available on the nowcast (the specification of what's happening now) to short-term forecast (10 to 10's of minutes) timescales. In the forecast phase, however (multi-hour to days), the level of skill varies significantly by driving phenomena. For example, the normal, daily variations in the ionosphere that create equatorial GNSS performance issues can be predicted with some skill, including their longitudinal or local time dependence (e.g. strongest impacts from dusk to midnight) on the hours-to-days timescale. However, for impacts driven by eruptive solar activity, the forecasts remain largely probabilistic and large uncertainties remain in the exact timing, duration, and intensity. A balance will be struck between what is achievable and what is ideally needed. These requirements will also be used to identify gaps in services and drive developments to improve targeted products and services.

2.8 Also, one of the challenges is to determine the level of global coverage. It is generally understood that space weather is considered global or hemispheric in nature, but it is also know that certain areas of the global are more susceptible to space weather than other areas. Most notable are the high latitude flights also referred to as the polar routes. However, space weather is also a concern both equatorially and at mid-latitudes.

2.9 In addition, and depending on the type of the phenomena, the dynamics and impacts can vary greatly. Thus there is a need to assess how information can be provided from a global center(s) supplemented by Regional Centers with the understanding that a Region should not be understood to be associated with current ICAO Regions otherwise referred to as Planning

Implementation Regional Groups (PIRG) that have defined boundaries. We know that users, including nearly all international operators, have consistently advocated the following principles:

- Consistency of the message
- Ease of use including seamless integration into decision support tools, and
- Global Harmonization

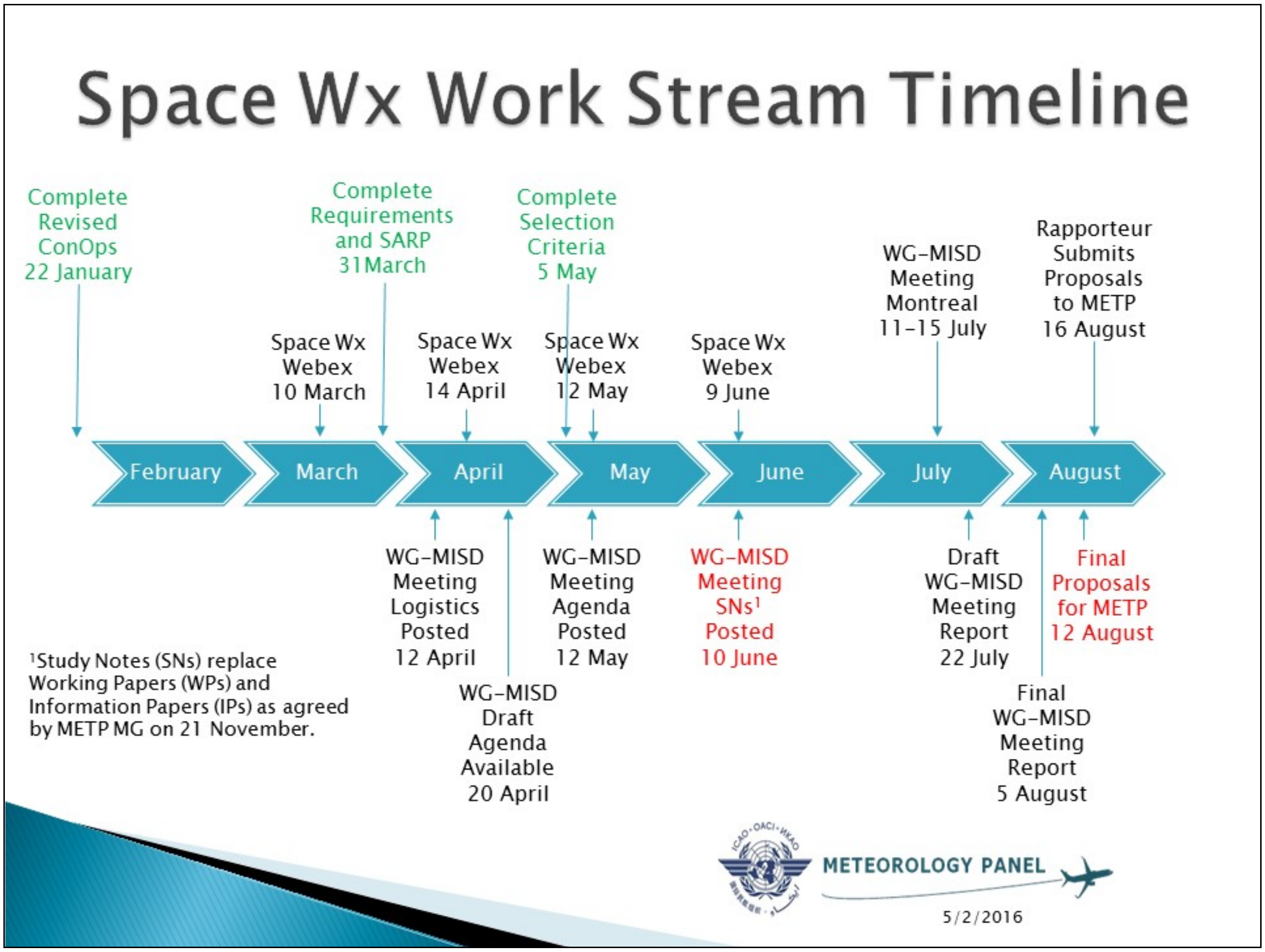
2.10 The United States' National Weather Service Space Prediction Center, as an example of one mature space weather service provider, is preparing for provision of the space weather information in support of the planned introduction of a requirement from ICAO to establish global and regional centers for space weather in support of international air navigation. The driving functional requirements will require services, that in many cases, go beyond the products and services available today. However, robust services are achievable and under development to meet the November 2018 applicability.

2.11 Appendix A provides a timeline for the development of the information in support of the introduction of this new service into Annex 3.

3 Recommendation

3.1. The Meeting is invited to note the information provided in this paper.

APPENDIX A


Space Wx Work Stream Timeline
Complete Revised ConOps 22 January
Complete Requirements and SARP 31March
Complete Selection Criteria 5 May
WG-MISD Meeting Montreal 11-15 July
Rapporteur Submits Proposals to METP 16 August
Space Wx Webex 10 March
Space Wx Webex 14 April
Space Wx Webex 12 May
Space Wx Webex 9 June
February
March
April
May
June
July
August
WG-MISD Meeting Logistics Posted 12 April
WG-MISD Meeting Agenda Posted 12 May
WG-MISD Meeting SNs¹ Posted 10 June
Draft WG-MISD Meeting Report 22 July
Final Proposals for METP 12 August
¹Study Notes (SNs) replace Working Papers (WPs) and Information Papers (IPs) as agreed by METP MG on 21 November.
WG-MISD Draft Agenda Available 20 April
Final WG-MISD Meeting Report 5 August
METEOROLOGY PANEL
5/2/2016