WORLD METEOROLOGICAL ORGANIZATION
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COMMISSION FOR BASIC SYSTEMS
COMMISSION FOR AERONAUTICAL METEOROLOGY

INTER-PROGRAMME COORDINATION TEAM ON SPACE WEATHER

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SPACE WEATHER SERVICES TO AVIATION
ICAO requirements for Space Weather services

(Submitted by ICAO)

Summary and Purpose of Document

This document addresses the development, by the International Civil Aviation Organization, of requirements (Standards, Recommended Practices and supporting guidance material) for space weather. It describes the development process for the referred provisions and provides detailed information about the draft requirements. This document also outlines current status and future steps concerning the establishment of space weather centres (SWXC) tasked to provide information on space weather affecting the earth's surface or atmosphere that is expected to affect communications and navigation systems and may pose a radiation risk to flight crew members and passengers. It also highlights the need for the WMO Inter-Programme Coordination Team on Space Weather (ICTSW) to assist towards the establishment of Space Weather services in support of international air navigation.

ACTION PROPOSED

The Inter-Programme Coordination Team is invited to:

a) Note the information provided in this paper regarding the requirements by international civil aviation which will be applicable in November 2016; and

b) Discuss ways and means to organize the provision of space weather information services to fulfil the said requirements.

APPENDIX Draft ICAO provisions relating to space weather developed by the IAVWOPSG.

DISCUSSION

1. INTRODUCTION

1.1 Outcome of IAVWOPSG

The Meteorology (MET) Divisional Meeting held in Montreal in September 2002 requested that ICAO arrange for a suitable body, in coordination with WMO, to assess the need for providing information for international air navigation on solar radiation storms and other bio-hazards (Recommendation 1/20 refers). As a follow-up, the International Airways Volcano Watch Operations Group (IAVWOPSG) has been working since 2004 to establish operational requirements for the provision of Space Weather-related services for international air navigation. As an initial step, guidance material was developed with the assistance of the IAVWOPSG to increase awareness on this issue and was made available at the IAVWOPSG website at : http://www.icao.int/safety/meteorology/iavwopsg. At the IAVWOPSG/6 Meeting (Dakar, Senegal, September 2011) the group formulated Conclusion 6/31 which called for the development of operational requirements for space weather. The said conclusion also tasked an ad-hoc group to consolidate the responses from States and international organizations regarding a draft Concept of operations for Space Weather. In accordance with the above conclusion, after the endorsement by the ICAO Air Navigation Commission, a State letter was sent in January 2012 requesting comments from States by 1 July 2012. Draft Standard and Recommended Practices (SARPs) were developed by the IAVWOPSG/7 Meeting in Bangkok, Thailand in March 2013. The group agreed to include the draft SARPs in Amendment 77 to Annex 3 - *Meteorological service for International Air Navigation* with intended applicability in November 2016.

1.2 New developments

In parallel with the above developments in the IAVWOPSG environment, WMO, as part of its responsibilities as IAVWOPSG Member, decided to involve the Inter-Programme Coordination Team on Space Weather, due to its specific expertise, in the review of the draft Concept of operations for Space Weather, with a view to optimize the content of the document. Lately, ICAO has participated in the ICTSW meetings remotely with a view to assisting the community towards the goal of optimizing the SARPs development process.

1.3 Scope of the document

This document presents to the consideration of the ICTSW the draft requirements developed by ICAO (See Appendix). As the group may be aware, in accordance with the *Working arrangements between ICAO and WMO*, Doc 7475, it is the responsibility of ICAO to establish the requirements for the provision of the meteorological service for international air navigation and for WMO to establish ways and means to fulfil such requirements.

2. CHALLENGES AND OPPORTUNITIES

2.1 Challenge 1

The first challenge is for the ICAO planning and implementation regional groups (PIRGs) to decide the need for and endorse the establishment of regional centres for space weather taking into account the advice of WMO.

2.2 Challenge 2

The second challenge is for ICAO, through the PIRGs, to designate a number of regional centres expected to be tasked to provide information on space weather for international air navigation.

2.3 Challenge 3

The third challenge is for those States, designated by the PIRGS as regional centres for space weather, to arrange for the provision of space weather information services by November 2016 in accordance with the requirements expected to be approved by ICAO Council in the first quarter of 2016.

2.4 Opportunities

In accordance with the Working arrangements between ICAO and WMO, Doc 7475, opportunity exists to take an informed and coordinated approach towards the provision of information on space weather for international air navigation.

3. PROPOSED SOLUTION

In view of the foregoing, the ICTSW is invited to discuss challenges 1 and 3 in order to properly advise the WMO Member within the IAVWOPSG regarding a number of regional centres expected to be in a position to provide information on space weather and on the necessary arrangements for the establishment of space weather services in support of international air navigation by November 2016.

4. NEXT STEPS

The Standard and Recommended Practices (SARPs) (until now draft requirements) which were developed by the IAVWOPSG/7 Meeting in Bangkok, Thailand in March 2013, to be included in Amendment 77 to Annex 3 - *Meteorological service for International Air Navigation*, will be considered together with other MET related proposals by the ICAO/WMO MET Divisional Meeting to be held in Montreal, Canada in July 2014.

DRAFT ICAO PROVISIONS RELATING TO SPACE WEATHER DEVELOPED BY THE IAVWOPSG

DRAFT AMENDMENT TO ANNEX 3 — *METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION*

(EIGHTEENTH EDITION — JULY 2013)

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PART I. CORE SARPs

CHAPTER 1. DEFINITIONS

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1.1 Definitions

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Space weather centre (SWXC). A centre designated by regional air navigation agreement to provide information on space weather affecting the earth's surface or atmosphere that is expected to affect communications and navigation systems and may pose a radiation risk to flight crew members and passengers.

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CHAPTER 3. WORLD AREA FORECAST SYSTEM AND METEOROLOGICAL OFFICES

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Editorial Note.— Insert the following new text.

3.8 Space weather centres

3.8.1 A Contracting State, having accepted, by regional air navigation agreement, the responsibility for providing a space weather centre (SWXC), shall arrange for that centre to provide information on space weather affecting the earth's surface or atmosphere expected to affect communications and navigation systems and which may pose a radiation risk to flight crew members and passengers by arranging for that centre to:

a) monitor relevant ground-based, airborne, and space-based observations to detect the existence and extent of the following in the area concerned:

   1) geomagnetic storms;

   2) solar radiation storms;

   3) solar flares that result in radio blackout; and

   4) ionosphere activity.

b) provide space weather information regarding the type, intensity and extent of the space weather referred to in a);

c) supply space weather information referred to in b) to:

1) area control centres and flight information centres serving flight information regions in its area of responsibility which may be affected;

2) other SWXCs; and

3) international OPMET databanks, international NOTAM offices, and centres designated by regional air navigation agreement for the operation of aeronautical fixed service satellite distribution system and internet-based services

3.8.2 SWXCs shall maintain a 24-hour watch.

3.8.3 In case of interruption of the operation of a SWXC, its functions shall be carried out by another SWXC or another meteorological centre, as designated by the SWXC Provider State concerned.

Note.— Guidance on the provision of space weather information is provided in the Manual on the Effects of Space Weather on International Air Navigation *(Doc ####)*.

END OF NEW TEXT

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CHAPTER 9. SERVICE FOR OPERATORS AND FLIGHT CREW MEMBERS

9.1 General provisions

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9.1.3 Meteorological information supplied to operators and flight crew members shall be up to date and include the following information, as established by the meteorological authority in consultation with operators concerned:

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j) ground-based weather radar information~~.~~; and

k) space weather information relevant to the intended route including aerodrome of departure, intended landing and alternate destination.

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9.3 Flight documentation

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9.3.1 Flight documentation to be made available shall comprise information listed under 9.1.3 a) 1) and 6), b), c), e), f) and, if appropriate, g) and k). However, when agreed between the meteorological authority and operator concerned, flight documentation for flights of two hours' duration or less, after a short stop or turnaround, shall be limited to the information operationally needed, but in all cases the flight documentation shall at least comprise information on 9.1.3 b), c), e), f) and, if appropriate, g) and k).

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PART II. APPENDICES AND ATTACHMENTS

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APPENDIX 2. TECHNICAL SPECIFICATIONS RELATED TO WORLD AREA FORECAST SYSTEM AND METEOROLOGICAL OFFICES

(See Chapter 3 of this Annex.)

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Editorial Note.— Insert the following new text.

6. SPACE WEATHER CENTRES (SWXC)

6.1 Space weather information

6.1.1 **Recommendation.—** *Information on space weather should be issued in abbreviated plain language, using approved ICAO abbreviations and numerical values of self-explanatory nature, and should be in accordance with the template shown in Table A2-3. When no approved ICAO abbreviations are available, English plain language text, to be kept to a minimum, should be used*.

Note.— The effects of space weather may be hemispheric or global in nature and may not be specific to traditional aeronautical boundaries such as flight information regions.

6.1.2 **Recommendation.**— *Space weather information should be made available in digital form.*

6.1.3 Space weather information if disseminated in digital form shall be formatted in accordance with a globally interoperable information exchange model and shall use extensible markup language (XML)/geography markup language (GML).

6.1.4 Space weather information if disseminated in digital form shall be accompanied by the appropriate metadata.

Note.— Guidance on the information exchange model, XML/GML and the metadata profile is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information *(Doc 10003).*

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Table A2-3. Template for notice message for space weather information

Key: M = inclusion mandatory, part of every message;
O = inclusion optional;
= = a double line indicates that the text following it should be placed on the subsequent line.

Element		*Detailed content*	*Template(s)*	*Examples*
1	Identification of the type of message (M)	Type of message	SWNA	SWNA
2	Time of origin (M)	Year, month, day, time in UTC	DTG: nnnnnnnn/nnnnZ	DTG: 20121108/0113Z
3	Space weather type	Type of space weather event (geomagnetic storms, solar radiation storms, radio blackout)	SPACE WEATHER TYPE: GEOMAGNETIC STORM *or* SOLAR RADIATION STORM *or* SOLAR RADIO BLACKOUT	SPACE WEATHER TYPE: GEOMAGNETIC STORM
3	Name of SWXC (M)	Name of SWXC	SWXC: nnnnnnnnnn	SWXC: BOULDER
4	AREA (M)	Area of the globe affected	AREA: nnnnnnnnnn	AREA: NP-60N SP-70S NP-80N SP-80S
5	Notice number (M)	Number with year in full and unique message number	NOTICE NR: nnnn/[n][n][n]n	2013/1
7	Space weather details (M)	Concise statement that describes the activity	SPACE WEATHER DETAILS: Free text up to 256 characters	SPACE WEATHER DETAILS: ….
8	Onset of event (O)	If known, specify time of onset. Year, month, day, time in UTC	ONSET OF EVENT: nnnnnnnn/nnnnZ	ONSET OF EVENT: 20121108/0100Z
9	Duration of event (O)	If known, specify the expected duration of effects. Year, month, day, time in UTC	DURATION OF EVENT: nnnnnnnn/nnnnZ	DURATION OF EVENT: 20121108/1200Z
10	Remarks (O)	Brief comments on related topics (monitoring data, recent history of solar eruptions, etc.)	RMK: Free text up to 256 characters	RMK: ….
11	Contact (O)	Names, phone numbers (voice/fax), email addresses	CONTACT: Free text up to 256 characters	CONTACT: ….
12	Next notice (M)	Year, month, day, time in UTC	NXT NOTICE: nnnnnnnn/nnnnZ *or* Free text up to 256 characters *or* NO FURTHER NOTICE	NXT NOTICE: 20121108/0600Z NXT NOTICE: WILL BE ISSUED WHEN SPACE WEATHER CONDITIONS WARRANT CHANGING THE AVIATION COLOUR CODE OR WHEN A SIGNIFICANT SPACE WEATHER EVENT OCCURS WITHIN THE CURRENT COLOUR CODE. NXT NOTICE: NO FURTHER NOTICE

END OF NEW TEXT

APPENDIX 8. TECHNICAL SPECIFICATIONS RELATED TO SERVICE FOR OPERATORS AND FLIGHT CREW MEMBERS
(See Chapter 9 of this Annex.)

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4. SPECIFICATIONS RELATED TO FLIGHT DOCUMENTATION

4.1 Presentation of information

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4.1.6 Space weather information shall be presented in accordance with local arrangements made by the meteorological authority and the operator.

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