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COMMITTEE A

Agenda Item 2: Enabling the global air navigation system
2.3: Future provision of aeronautical meteorological service

FACILITATING INTERACTIONS BETWEEN SPACE WEATHER INFORMATION SERVICE PROVIDERS AND USERS

(Presented by Japan)

EXECUTIVE SUMMARY

This paper discusses global needs for the promotion of further utilization of space weather information service, which will be implemented by Amendment 78 to ICAO Annex 3 — *Meteorological Service for International Air Navigation*, taking into account operational needs by aviation users. Close coordination between space weather information service providers and the users are essential for the establishment of operationally useful space weather information service.

Action: The Conference is requested to agree to the recommendation presented in paragraph 3.1.

1. INTRODUCTION

1.1 Space weather can be defined as "the physical and phenomenological state of the natural space environment, including the Sun and the interplanetary and planetary environments" according to the World Meteorological Organization (WMO). Impacts of space weather phenomena to the aeronautical systems are being considered in the areas of high frequency (HF) communication, satellite communication, global navigation satellite system (GNSS), and radiation dose of flight crew members and passengers.

1.2 ICAO started discussion on the operational space weather information service in 2002. In 2011, the International Air Transport Association (IATA) sent a letter to ICAO on the operational needs of provision of space weather information. Since then, the International Airways Volcano Watch Operations Group (IAVWOPSG) and subsequently the Meteorology Panel (METP) have continuously discussed the development of the concept of operations of space weather information service as well as the amendment to ICAO Annex 3 — *Meteorological Service for International Air* Navigation. In the Asia and Pacific (APAC) Region, the Ionospheric Studies Task Force (ISTF) was established under the APANPIRG CNS-SG in 2011. The ISTF developed a detailed report on the impact of space weather phenomena on communications, navigation, and surveillance (CNS) systems. METP has developed a proposal of amendment to Annex 3 to include the space weather information as advisory information that

shall be provided to airline operators, air navigation service providers, and flight crew members. Amendment 78 to Annex 3 will become applicable on 8 November 2018.

1.3 The amendment to Annex 3 includes the establishment of space weather centres (SWXCs), operated by a Contracting State or a consortium of some Contracting States, to provide information on space weather at global and/or regional scale that is expected to affect communications, navigation and surveillance systems and may pose a radiation risk to flight crew members and passengers. Designation of SWXCs is being discussed by ICAO.

1.4 The contents of the space weather information include the levels of space weather impacts on communications, navigation and surveillance systems and the radiation risk. Details on how the space weather information should be used for aircraft operations have been discussed by METP. And the space weather information service manual is being developed by METP. Although the operational needs of space weather information are high, there still exists a gap between the space weather information to be provided by SWXCs and the operational needs by users.

1.5 Information on ionospheric disturbances is needed by RTCA to develop a minimum operational performance standards (MOPS) of global navigation satellite system (GNSS)-inertial navigation system (INS) coupled avionics. In operations of GNSS performance monitoring systems, space weather information is needed to distinguish performance degradations due to intentional radio interference and due to space weather phenomena, such as scintillation and solar radio bursts.

1.6 GNSS is one of the core technologies to enable the performance-based navigation (PBN) to enhance airspace capacity, efficient aircraft operations, and safety. In the low magnetic latitude region where the ionospheric disturbances are severe, however, mitigation of ionospheric impacts are still being investigated, which prevents GNSS from being widely adopted in the region.

1.7 Dual-frequency and multi-constellation (DFMC) GNSS is one of the solutions to mitigate the ionospheric impacts. However, development of DFMC GNSS standards and promulgation of the DFMC avionics requires a substantial time, while the number of single-frequency GNSS users are increasing. Therefore, effective mitigation of ionospheric impacts is still an urgent task, and provision of space weather information on ionospheric disturbances that could improve availability of GNSS-based systems in the low magnetic latitude regions are desirable to facilitate implementation of PBN, based on GNSS.

1.8 METP and the Navigation Systems Panel (NSP) have just started coordination to make space weather information service useful for navigation systems users. In the 3rd Joint Working Groups Meeting (JWGs/3) of NSP, NSP discussed with the METP Secretariat on the proposed space weather information service. In the discussion, it was agreed that further coordination between METP and NSP is necessary to fill the gap between operational needs of users and the space weather information to be provided.

2. DISCUSSION

2.1 In NSP JWGs/3, it was agreed that NSP will contribute to the development of the space weather information service manual by METP. Volunteers from NSP have been identified and will coordinate with the relevant ad-hoc group under METP to achieve the provision of appropriate space *weather information and effective utilization by users. Japan is willing to contribute to the coordination activities from the both groups, utilizing expertise in navigation systems and space weather.

2.2 From users' side, it is necessary to consider how to utilize the space weather information provided according to Annex 3. For example, users may need to consider necessary actions to the information on expected impacts on HF communications, GNSS and surveillance, satellite communications and radiation risks provided in only two levels (MOD (moderate) and SEV (severe)). It is also important to provide feedbacks to the space weather information providers from the users' experience and operational needs, in order to fill the gap between the desired and provided space weather information and consequently make the space weather information service more useful. To achieve this, in addition to the collection and analysis of historical data, highly advanced researches on the impact of space weather phenomena on aeronautical systems are also necessary.

2.3 For further improvement of space weather information, contribution by all relevant stakeholders is important to evaluate space weather information, such as aeronautical information service (AIS) and air traffic flow management (ATFM) units, surveillance and communication service providers, aircraft operators, air navigation service providers (ANSPs), civil aviation authorities (CAAs) as well as SWXCs, who are involved in the pre- and in-flight decision making. Interaction between METP and NSP is a good example of such contribution. Through close coordinated actions between the stakeholders, the space weather information service should be made more and more useful for aviation users.

3. CONCLUSION

3.1 In light of the above, the Conference is invited to agree to the following recommendations:

Recommendation 2.3/x — Provision of space weather information service that meets users' operational needs

That the Conference:

a) request ICAO to continue to facilitate the coordination between the space weather information service providers and users to clarify the needs and solutions to improve safety and efficiency of civil aviation by the space weather information service;

b) request ICAO to coordinate with other international organizations such as International Telecommunication Union — Radiocommunication Sector (ITU-R) and World Meteorological Organization (WMO), to facilitate research of operational impacts of space weather phenomena on civil aviation by performance-based approaches and the establishment of requirements for using the space weather information for civil aviation; and

c) request States to encourage research of operational impacts of space weather phenomena on civil aviation by performance-based approaches and establish requirements for using the space weather information for civil aviation.

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