



1. INTRODUCTION

1.1 The ICAO MID SWX Advisory Information Dissemination Webinar was successfully held 3 – 4 March 2021, from 11:00 to 12:30 UTC using MS Teams facility.

1.2 The objectives of the Webinar are to share information of the background and developments of ICAO Provisions related to Space Weather Advisory Information as well as review the dissemination requirements of this information.

1.3 The Webinar was attended by a total of ninety five (95) participants from fourteen (14) States (Austria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Sudan, UAE, USA (FAA) and Yemen) and two (2) Organizations (ACAO and IFATCA). The list of participants is at **Attachment A**.

1.4 The Webinar's materials including, Agenda/Work Programme, presentations and the Summary of Discussion are available at <https://www.icao.int/MID/Pages/2021/MET%20SWX%20Webinar.aspx>.

2. OPENING REMARKS

2.1 Mr. Christopher Keohan, Regional Officer Meteorology, Europe and North Atlantic Regional Office, welcomed all participants and noted that provisions related to Space Weather Advisory Information were introduced in Amendment 78 to Annex 3 in 2018 in order to advise stakeholders of possible communication disruptions and increased radiation exposure. Furthermore, Space Weather Centres have been selected by the ICAO Council to provide this service.

2.2 The MID MET SG/9 meeting (7 to 9 December 2020) requested a Webinar to provide more information related to Space Weather Advisory Information and in particular the dissemination of this information.

2.3 The Secretariat was pleased to inform the participants that the United States Federal Aviation Administration (FAA) agreed to assist with providing the Webinar information on space weather as well as ICAO provisions and background information. In addition, the dissemination of Space Weather Advisory Information at the State level and also inter-regionally would be provided with the assistance of Austro Control. Lastly, input from States in the MID Region related to implementation in this regard was expected.

3. DISCUSSIONS

3.1 *Background on SWX Information Dissemination*

3.1.1 This session was provided in PPT02 presented by the United States FAA. An overview of space weather and phenomena (solar flares, radiation storms and geomagnetic storms) and their impacts to aviation was provided.

3.1.2 This session reviewed space weather impacts to High Frequency (HF) communications that have a range of effects from noise to outage and lasts for 10's of minutes to several hours on the sunlit side of the Earth without advanced warning.

3.1.3 Space weather impacts caused by radiation included elevated radiation levels that may last for several days with advanced warning possible from minutes to hours and impacts HF communication in the Polar Regions affecting cross-polar routes and high latitude routes. The Webinar noted that radiation observations would help with model validation, data assimilation and operational decision making.

3.1.4 Space weather impacts to Global Navigation Satellite System (GNSS) results in position errors with advanced warnings possible from just under a day to several days based on Coronal Mass Ejection (CME) transit times from the Sun to the Earth. The Webinar noted that additional GNSS frequency adoption could mostly eliminate ionospheric-induced position errors.

3.1.5 Geomagnetic storms impacts Performance Based Communication and Surveillance (PBCS) that may last hours to one or two days with advanced warnings of 15 to 60 minutes and advance watch products of one to two days.

3.2 *ICAO Provision on Space Weather*

3.2.1 This session was provided in PPT02 presented by the United States FAA. The Webinar noted that provisions for Space Weather Centres and Space Weather Advisory Information were introduced in Amendment 78 to Annex 3 in 2018. Specifically, advisories are issued for HF Voice/Data and Satellite Communications; Radiation Exposure to Crew and Passengers; and GNSS Based Navigation and Surveillance.

3.2.2 Space Weather Advisory Information is provided by four global Space Weather Centres noting that consortiums are considered as one centre: PECASUS (Finland – lead, United Kingdom, Germany, Austria, Poland, Italy, Netherlands, Belgium and Cyprus); ACFJ (Australia, Canada, France and Japan); United States National Oceanic Atmospheric Administration (NOAA) Space Weather Prediction Centre (SWPC); and China/Russian Consortium (expected to be operational in Oct 2021). There is one Regional Space Weather Centre (South Africa) that will be integrated in the above system in some capacity by 2022.

3.2.3 The Webinar noted the arrangement between these centres is such that there is only one on-duty centre at any given time with a two-week rotation.

3.2.4 The Webinar also noted the availability of the Manual on Space Weather Information in Support of International Air Navigation (ICAO Doc 10100, published October 2019).

3.3 *Dissemination of Space Weather Advisory Information*

3.3.1 This session was provided in PPT03 and PPT04 presented by the Secretariat and Austro Control, respectively. The first presentation provided the Webinar ICAO provisions related to the dissemination of Space Weather Advisory Information.

3.3.2 Specifically, the advisory information must be supplied by the Space Weather Centres to: Area Control Centres (ACC)s, Flight Information Centres (FIC)s, aerodrome meteorological office (AMO)s, other Space Weather Centres (SWXC)s, international OPMET databanks, international NOTAM offices and aeronautical fixed service Internet-based services (WIFS and SADIS).

3.3.3 The Webinar noted that this information is produced in Traditional Alphanumeric Code (TAC) as well as IWXXM. Because IWXXM can only be exchanged via AMHS, a full AMHS-path has to be in place between the originator and the user. Also, this information is sent with specific World Meteorological Organization (WMO) headers and the number used in these headers allows for the recipient to know what space weather phenomena the contents contain (01=GNSS, 02=HF COM, 03=RADIATION, 04=SATCOM).

3.3.4 The meeting noted the dissemination schema inter-regionally that relies on a global network of Inter-Regional OPMET Gateways (IROG)s and Regional OPMET Centres (ROC)s and/or Regional OPMET Data Banks (RODB)s for intra-regional exchange. The ROC/RODB then provides the National OPMET Centres (NOC)s within their area of responsibility the Space Weather Advisory Information.

3.3.5 A State example was provided showing that the NOC then distributes the advisory information to ACCs/FICs, AMOs and NOF. The MET Service provides space weather information relevant to the whole route to operators and flight crew members. The NOF provides NOTAM for observations or forecasts of space weather phenomena, the date and time of their occurrence, the flight levels where provided and portions of the airspace which may be affected by the phenomena.

3.3.6 The Webinar also noted provisions for ATS and operators in PANS-ATM (ICAO Doc 4444).

4. WEBINAR CONCLUSIONS AND RECOMMENDATIONS

- Space Weather Advisories on HF, SATCOM, GNSS and RAD have a range of operational impacts;
 - o e.g. HF from noise to no signal;
 - o GNSS unknown position errors to denial of service
 - o RAD exposure difficult to validate without dosimeters on aircraft noting thresholds used were considered conservative due to cumulative effects;
- Scientific community is still learning about space weather impacts to aviation;
- Relevant thresholds used in producing advisories must change with time based on validation and improved understanding and shared with stakeholders;
- Space Debris Information not yet identified as a requirement in the MET Panel; however, could be considered in the future as a need due to increased air traffic and utilization of higher flight levels;
- The integration of Regional Centre South Africa with Global Centre(s) is ongoing;
- If a State were interested to contribute to the Space Weather Advisory Information Service, they may contact one of the Consortiums to be considered also noting that the MET Panel will conduct a full review of these services in the future;
- Space weather information is expected to be provided in a form that is compatible with the SWIM environment in the future;
- SIGMET is not issued for space weather information and Annex 3 will be updated in 2023 noting a Meteorology Watch Office (MWO) may serve as an AMO and therefore be a recipient of this information;
- ROCs act as a relay of information e.g. ROC Jeddah advisory messages are sent to NOCs in its area of responsibility, independent of whether the State is affected or not. The plan for the future is, that SWXCs send directly to NOCs affected;
- Very high frequencies (e.g. 4.2 GHZ) are more resilient in space weather events;
- Will investigate in the future the impacts to other systems (e.g. VHF, UHF, secondary surveillance radar) – currently not included due to the high false alarm rate;
- Need to check with operators what is critical level of radiation used with reference to PANS-ATM procedures and given an example of descent procedures planned by an airline in case of radiation exposure.
 - o States encouraged to investigate (e.g. survey) to check with operators in their State on their operational procedures in space weather events and provide feedback on their experience.

5. CLOSING

5.1 Mr. Christopher Keohan, Regional Officer Meteorology, Europe and North Atlantic Regional Office, thanked all participants for their active participation and fruitful discussion and valuable outcomes. He indicated that from an ICAO perspective, the objectives of the Webinar were met (share information on the background and developments of ICAO Provisions related to Space Weather Advisory Information as well as review the dissemination requirements of this information).

5.2 Mr. Keohan expressed his gratefulness to the speakers from the United States FAA and Austro Control as well as the support from the ICAO MID Region.

5.3 Lastly, any questions in relation to space weather can be sent to ckeohan@paris.icao.int (soon to change to ckeohan@icao.int) for forwarding to the FAA and/or Austro Control who kindly offered assistance in this regard.

ICAO MID SWX ADVISORY INFORMATION DISSEMINATION WEBINAR
(Virtual, 3 – 4 March 2021, 11:00 – 12:30 UTC)

State/ Org	Contact	Title
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	Mr. Mahmoud Abdrahem Abdou	Meteorologist of Cairo airport forecast center
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	Mr. Ahmed Abdelwahab M. El Morady	Senior ANS/ATM Inspector
	Mr. Ahmed Mostafa M. Arman	Senior CNS Inspector
	Mr. Ahmed Mohammed Zoulfakar	Meteorologist Inspector
	Mr. Islam Awad Zaki Awad	Air Navigation Inspector
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	Mr. Ali Gamal Ali	Telecommunication Officer
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	Mr. Nasser Aboud Hassan	ATCO
	Mr. Abdallah Ahmed A. Eid	ATCO
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	Mr. Mohammad Shahravi	ATC Expert
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	Mr. Ali Hamzah El. Alkhaibari	Airspace Planning & Designer Sup.
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