International Civil Aviation Organization

SUMMARY OF DISCUSSION

ICAO MID WORKSHOP ON FORMULATING A SPACE WEATHER EXERCISE

(CAIRO, EGYPT, 15 – 16 NOVEMBER 2023)

1. INTRODUCTION

1.1 The ICAO MID Workshop on Formulating a Space Weather (SWX) Exercise (SWXEX) was successfully held 15 – 16 November 2023 at the ICAO MID Regional Office in Cairo.

1.2 The objectives of the Workshop are to develop a SWXEX Directive in order to test aviation stakeholders' response to a SWX event. This may require formulating a core group of stakeholders to develop the SWXEX Directive in order to determine dates and times of the exercise as well as develop exercise objectives and SWX scenario supporting testing the objectives. A future meeting/workshop (virtual, hybrid, in person) will likely be needed prior the SWX exercise.

1.3 For background material, the Workshop was encouraged to review material from the ICAO MID SWX Advisory Information Webinar held from 3-4 March 2021 at https://www.icao.int/MID/Pages/2021/MET%20SWX%20Webinar.aspx. This material includes background on SWX information, ICAO Provisions on SWX, dissemination of SWX Advisory Information and Webinar Conclusions and Recommendations.

1.4 The Workshop was attended by a total of twenty-one (21) participants from seven (7) States (Egypt, Jordan, Kuwait, Oman, Saudi Arabia, UAE and USA) and one (1) Organization (IFALPA). The list of participants is at **Attachment A**.

1.5 The Webinar's materials including, Agenda as provided in PPT01, presentations and the Summary of Discussion are available at https://www.icao.int/MID/Pages/2023/MET%.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 SWX 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. Specifically, SWX advisories are issued for High Frequency (HF) Voice/Data and Satellite (SAT) Communications (COM); Radiation (RAD) Exposure to Crew and Passengers; and Global Navigation Satellite System (GNSS) Based Navigation and Surveillance.

2.2 The Workshop noted that four Space Weather Centres (SWXCs) have been selected by the ICAO Council to provide this service.

2.3 The Workshop also noted the availability of the *Manual on Space Weather Information in Support of International Air Navigation* (ICAO Doc 10100, published October 2019). In addition, provisions for ATS and operators are provided in PANS-ATM (ICAO Doc 4444).

3. DISCUSSIONS

3.1 *ICAO SWXC Provisions*

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

3.1.2 This session reviewed SWX impacts to HF COM that have a range of effects from noise to outage and lasts for tens of minutes to several hours on the sunlit side of the Earth without advanced warning.

3.1.3 SWX impacts caused by RAD included elevated RAD levels that may last for several days with advanced warning possible from minutes to hours and impacts to HF COM in the Polar Regions affecting cross-polar routes and high latitude routes. The Workshop noted that RAD observations would help with model validation, data assimilation and operational decision making. With reference to SWX advisories issued in 2023, of the several hundred of these advisories issued thus far this year, none included RAD. This was believed to be due to the current sun cycle not as active as in the 1950s. More observations would assist SWXCs to analyse the data to determine if the thresholds related to RAD need to be adjusted.

3.1.4 SWX impacts to 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 ionospherically-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.

3.1.6 The Workshop noted that SWX advisory information is provided by four global SWXCs noting that consortiums are considered as one centre: PECASUS (Austria, Belgium, Cyprus, Germany, Finland, Italy, Poland, the Netherlands and the United Kingdom); ACFJ (Australia, Canada, France and Japan); United States National Oceanic Atmospheric Administration (NOAA) Space Weather Prediction Centre (SWPC); and China/Russian Consortium. There is one Regional SWXC (South Africa) that is integrated in the above system in some capacity. The arrangement between these centres is such that there is only one on-duty centre at any given time with a two-week rotation.

3.1.7 The Workshop noted that the SWX advisory information must be supplied by the SWXCs to: Area Control Centres (ACC)s, Flight Information Centres (FIC)s, aerodrome meteorological office (AMO)s, other SWXCs, international OPMET databanks, international NOTAM offices and aeronautical fixed service Internet-based services (WIFS and SADIS).

3.1.8 The Workshop noted that this information is produced in Traditional Alphanumeric Code (TAC) as well as IWXXM since Amendment 79 to Annex 3 (applicable 5 November 2020). Furthermore, 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 SWX phenomena the contents contain (01=GNSS, 02=HF COM, 03=RADIATION, 04=SATCOM).

3.1.9 The Workshop 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 SWX advisory information. The NOC should assure that the SWX advisory information is sent to ACCs/FICs, AMOs (can coincide with Meteorological Watch Offices (MWOs)) and NOF. The MET Service shall provide SWX advisory information relevant to the whole route to operators and flight crew members. The NOF provides NOTAM for observations or forecasts of SWX 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. Note that NOTAM on SWX advisory information will no longer be issued as of 28 November 2024 (this date may be deferred to 2025).

3.2 ***European Aviation Crisis Coordination Cell (EACCC) SWX Exercise 2023***

3.2.1 This session was provided in PPT03 presented by the Secretariat and PPT05 presented by IFALPA. The workshop noted that the European Aviation Crisis Coordination Cell (EACCC) SWX Exercise 2023 took place from 8 to 9 November 2023 at EUROCONTROL with hybrid capabilities. The objectives of this exercise was to test the Network resilience by: creating awareness and common understanding in the aviation community; review local procedures; discuss scenarios with subject matter experts and other stakeholders; translate scientific results into practical information; and improve national contingency and crisis management plans.

3.2.2 The severity of the SWX event was chosen in order to trigger a response by aviation stakeholders and States as well as check the suitability of existing SWX services for these kind of events. HF COM – SEV occurred in the beginning and toward the end of the exercise. In addition, GNSS – SEV occurred in the beginning of the exercise. After an hour and half for near a few hours, RAD – SEV occurred.

3.2.3 The main outcomes of this exercise included:

- feedback from the field (e.g. operators, ACCs) is needed in order to verify the ICAO SWX advisories for which the thresholds used for various SWX elements may need to be updated;
- SWX advisory improvements (e.g. use of polygons, finer temporal and horizontal resolutions, use of D-index and geomagnetic latitude, translate information to impacts to operators/stakeholders, use of colour coding and improve cancelling methodology);
- improve the dissemination of SWX advisories at the national level (e.g. NOCs need to provide this information to ACC/FIC and AMO so that this information is in flight documentation and briefings);
- continuously improve the forecasting of SWX;
- harmonize the SWX advisory information amongst the 4 SWXCs;
- develop guidance regarding passenger radiation exposure;
- test regional response to multiple aircraft requesting descents and/or reroutes further south to minimize radiation exposure;
- develop communication plan for informing the media about events; and
- develop regional and national contingency plans for SWX events.

3.2.4 From the perspective of IFALPA, this exercise revealed the following:

- No heads-up product is provided by ICAO;
- No aircraft manufactures were present to provide possible RAD effects on avionics;
- No satellite operators were present to provide SWX effects that would cause shutdown of satellites; and
- No limits to RAD exposure to passengers is provided noting that pilots would not likely fly into a zone of RAD – SEV.

3.2.5 The Workshop noted that RAD experts at this exercise provided information on the type of sickness from RAD exposure for commercial flights, which would not be immediate, but long-term in nature.

3.3 ***Exercise Directive***

3.3.1 This session was provided in PPT04 presented by the Secretariat. Subjects reviewed included:

- Introduction
- Participating Agencies
- Aims and Objectives
- Supporting Documents
- Exercise Duration
- Exercise Phenomenon
- Exercise Scenario
- Exercise Schedule
- Exercise Scenario Messages
- Communications
- Special Instructions
- Transmission of Information Concerning SWX Activity
- Descents by Aircraft due to Solar Radiation from SWX Events
- Dynamic Airborne Reroute Procedure
- Roles of Stakeholders
- Measure Effectiveness of SWXEX

3.3.2 The Workshop noted that other stakeholders such as SWXC, COM, ATFM, Flight Information Officers (FIO), operators and regulators as well as those in the relevant scientific community would be needed to develop such an exercise. Furthermore, as with volcanic ash exercises, the exercise leader would typically represent an ANSP in the capacity of ATS.

3.3.3 The Workshop also noted that ATFM in MID will be a multi-nodal network and this service should be in place when an exercise is conducted.

3.3.4 The Workshop also suggested that a multi-regional exercise (e.g. including MID and EUR and NAT) may be preferred in order to manage traffic flows from EUR/NAT and MID in an efficient and harmonized manner.

4. WEBINAR CONCLUSIONS AND RECOMMENDATIONS

- Continue awareness campaign on SWX through webinars/workshops;

- Regulatory authority should assure NOC distributes SWX advisories to ACC/FIC, AMO and NOF and that these advisories are included in flight documentation and briefings (depending on internal communications in how this is done);

- Liaise with other stakeholders (SWXC, ATM, COM, FIO, regulators, operators and relevant science community) on further developing a SWXEX Directive;

- Consider broader exercise to include other Regions (e.g. EUR and NAT as well as MID);

- Keep abreast of other regional developments related to space weather exercises and contingency arrangements in line with the GANP.

5. CLOSING

5.1 The Workshop noted that objectives of the Webinar were met from the perspective of sharing information on SWX provisions and impacts to aviation, but that more had to be done to include all relevant stakeholders in order to plan an actual SWX exercise in the future.

5.2 Mr. Abu Baker Farea, Regional Director, MID Regional Office, Mr. Mohamed Smaoui, Deputy Regional Director, MID Regional Office and Mr. Christopher Keohan, Regional Officer Meteorology, Europe and North Atlantic Regional Office, thanked all participants for their active participation, fruitful discussion and valuable outcomes.

Attachment A

Eleventh Meeting of the MIDANPIRG Meteorology Sub-Group (MET SG/11)
***(Cairo, 14 - 15 November 2023)* and**

Workshop on Formulating a Space Weather Exercise
(Cairo, 15 - 16 November 2023)

List of Participants

State/ Org	Contact	Title
Egypt	Mr. Yasser Abdelgwad El Sayed	Director of Cairo Airport Forecast Center
	Mr. Mahmoud Abrahim M. Abdou	Deputy Director of Egyptian Meteorological Watch Office
	Mr. Ahmed Abd Al-Radi Abdelrahman	Meteorologist of Cairo Airport Forecast
	Mr. Ahmad Mohammad Zoulfakar	Meteorologist of Cairo Airport Forecast
	Mrs. Nadia Abdel Fattah Elsebaey	1st Specialist International Affairs Dept, MET Authority
	Dr. Lamiaa Salim Y. Mohammed	Meteorologist
	Mr. Mohammed Essam El Nayeb	ANS Inspector
	Mr. Shawki Abdel Fattah Soker	Chief Inspector MET
Jordan	Mr. Dafi Mohammad Mustafa Elryalat	ANS/MET Inspector
Kuwait	Mrs. Ameera Falah Al-Azmi	Head of MET Aviation
Oman	Mr. Mansoor Hilal Said Al Shabibi	Chief of Aviation Forecasting
	Mr. Mohammed Mustahil Salim Kashoob	Acting Head of Meteorological Ops
Saudi Arabia	Mr. Waleed Yousef Alsulaim	Air Navigation Meteorology Head
	Mr. Sami Ben Mansour Elwafi	Manager of Aviation
	Mr. Alaa Ben Madany Elsanousi	Deputy Manager
	Mr. Majed Ben Khaled Mahjoub	ROC-Jeddah
	Mr. Mansour Mortada BenGabi	Supervisor
UAE	Mr. Sultan Abdul Aziz M. Lootah	Inspector – Air Traffic Service
USA (FAA)	Mrs. Karen Shelton-Mur (virtual)	Senior Meteorologist and Int'l Aviation Weather Program Lead
	Mr. Joseph Kunches (virtual)	Advisor on Space Weather to US member of ICAO Met
IFALPA	Mr. Klaus Sievers (virtual)	IFALPA
ICAO	Mr. Christopher Keohan	RO/MET
	Mrs. Manal Wissa	Programme Analysis Associate

- END -