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Exercise Directive

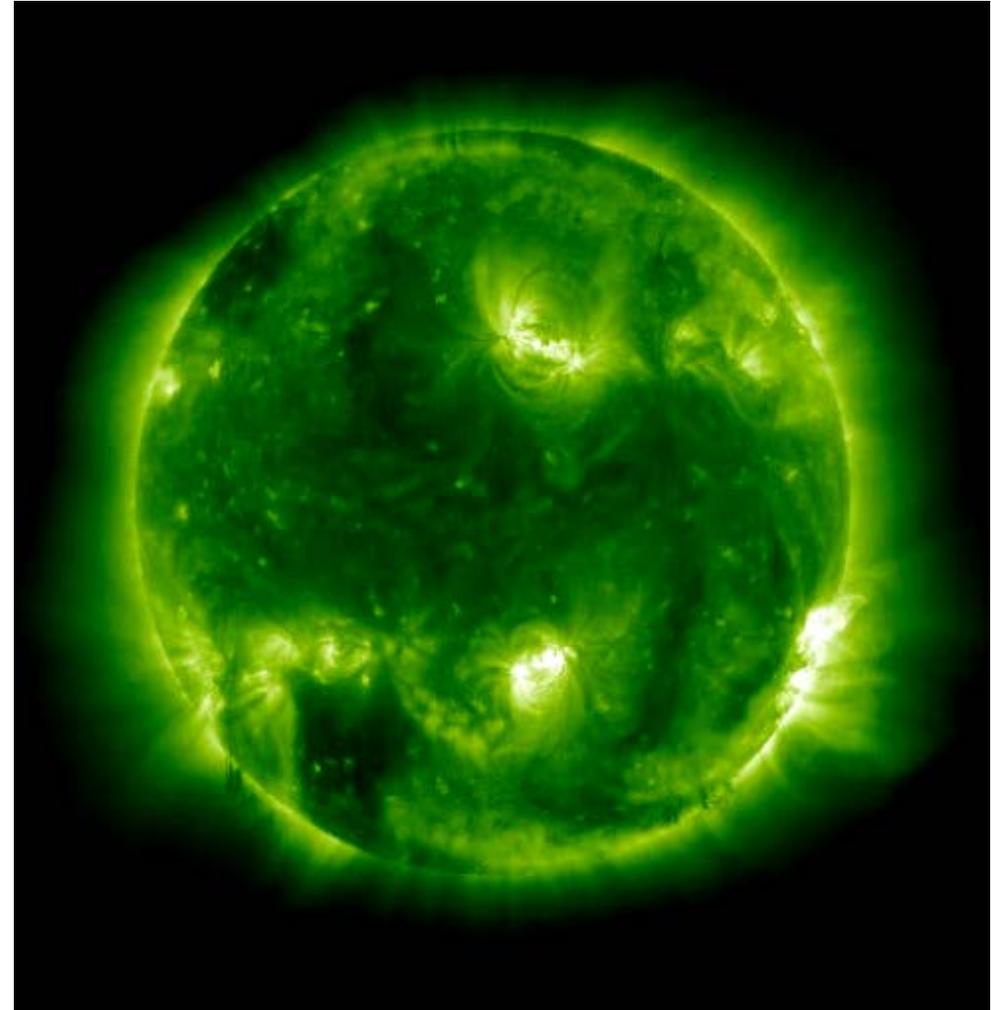
Christopher Keohan
Regional Officer, EUR/NAT Office

Workshop on formulating a space weather exercise

15-16 November 2023

Draft Space Weather Exercise (SWXEX) Directive

- Introduction
- Participating Agencies
- Aims and Objectives
- Supporting Documents
- Exercise Duration
- Exercise Phenomenon
- Exercise Scenario
- Exercise Schedule
- Exercise Scenario Messages



Draft Space Weather Exercise (SWXEX) Directive

- Communications
- Special Instructions
- Transmission of Information Concerning Space Weather Activity
- Descents by Aircraft due to Solar Radiation from Space Weather Events
- Dynamic Airborne Reroute Procedure
- Roles of Stakeholders
- Measure Effectiveness of SWXEX

Draft Space Weather Exercise (SWXEX) Directive

- Introduction
 - The exercise will simulate a Flare and CME eruption from the Sun
 - Exercise date and time (UTC)
 - Exercise Leader
 - Initial Exercise Report – to be submitted to the Exercise Leader by each participating organization by due date
 - Debrief Meeting time and venue

Draft Space Weather Exercise (SWXEX) Directive

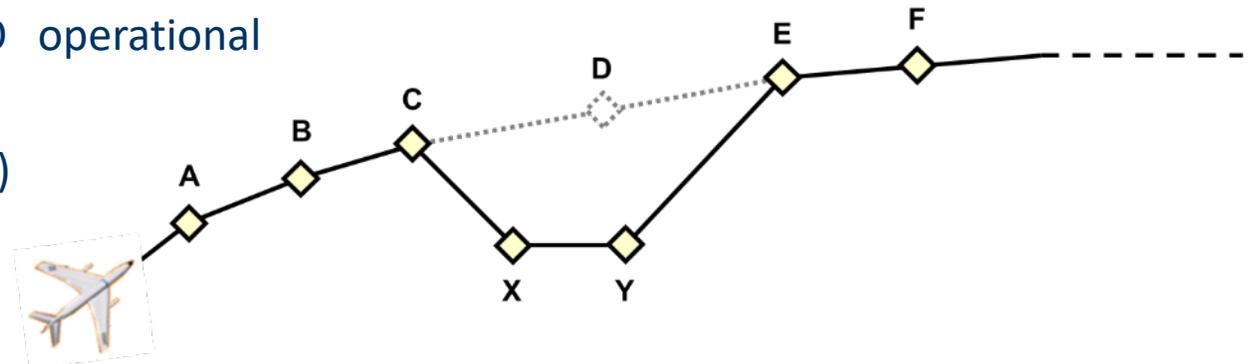
- Participating Agencies
 - Aerodrome Meteorological Offices (in some cases this coincides with the Meteorological Watch Office (MWO))
 - Air Navigation Service Providers (ANSP)
 - Airline Operators (AO)
 - NOTAM Offices (NOF)
 - Space Weather Advisory Centres (SWXC)
 - Regional OPMET Centres (ROC)
 - Regulators
 - ...



Draft Space Weather Exercise (SWXEX) Directive

- Aims and Objectives

- Typically – exercise compliance to the Regional ATM Contingency Plan
 - Space weather not yet included in MID Doc 003 – *MID Region ATM Contingency Plan*
 - Safety Risk Assessment (SRA) policy
 - Origination, dissemination and reception of SWX related aeronautical/meteorological information
- Test the ATM responsiveness to need of AO operational flexibility
- Test Dynamic Airborne Reroute Procedures (DARP)
 - Minimize use of contingency procedures by pilots
 - Reduce ATC and pilot workload
 - Use of Controller Pilot Data Link Communications (CPDLC) reduces errors in the changed routing – this would have to be done prior the impacts to communications
 - Downstream FIR coordination between ANSPs



Draft Space Weather Exercise (SWXEX) Directive

- Supporting Documents

- ICAO Annex 3, *Meteorological Service for International Air Navigation*
- ICAO Doc 4444, *Procedures for Air Navigation Services Air Traffic Management (PANS-ATM)*
- ICAO Doc 10100, *Manual on Space Weather Information in Support of International Air Navigation*

- Exercise Duration

- Date and time of exercise
- Which SWXC to issue SWX exercise advisories every 6 hours
- Time of operational teleconferences (who will host the teleconference)

- Exercise Phenomenon

- Flare & CME from the Sun N3000 – N6000 from E03000 – E06000

Draft Space Weather Exercise (SWXEX) Directive

- Exercise Scenario
 - SWX effects from Flare and CME eruption from Sun at specific time:
 - ~8 minutes later – Radio (HF) communications are lost (HF COM)
 - ½ hour to 16 ½ hours later – satellites and polar flights affected (SATCOM, RADIATION)
 - 1-4 days later – electric power, navigation systems and radio communications affected (GNSS)
 - FIRs to be impacted (in MID Region):
 - Tripoli, Cairo, Amman, Beirut, Damascus, Jeddah, Baghdad, Kuwait, Tehran
 - *Note that some FIRs south of the SWX event may need to coordinate with the impacted FIRs on rerouting aircraft further south than planned*
 - WMO Headers to be used – e.g. for TAC - FNXX01 EGRR – and IWXXM – LNXX01 EGRR
 - 01 = GNSS; 02 = HF COM; 03 = RADIATION; 04 = SATCOM

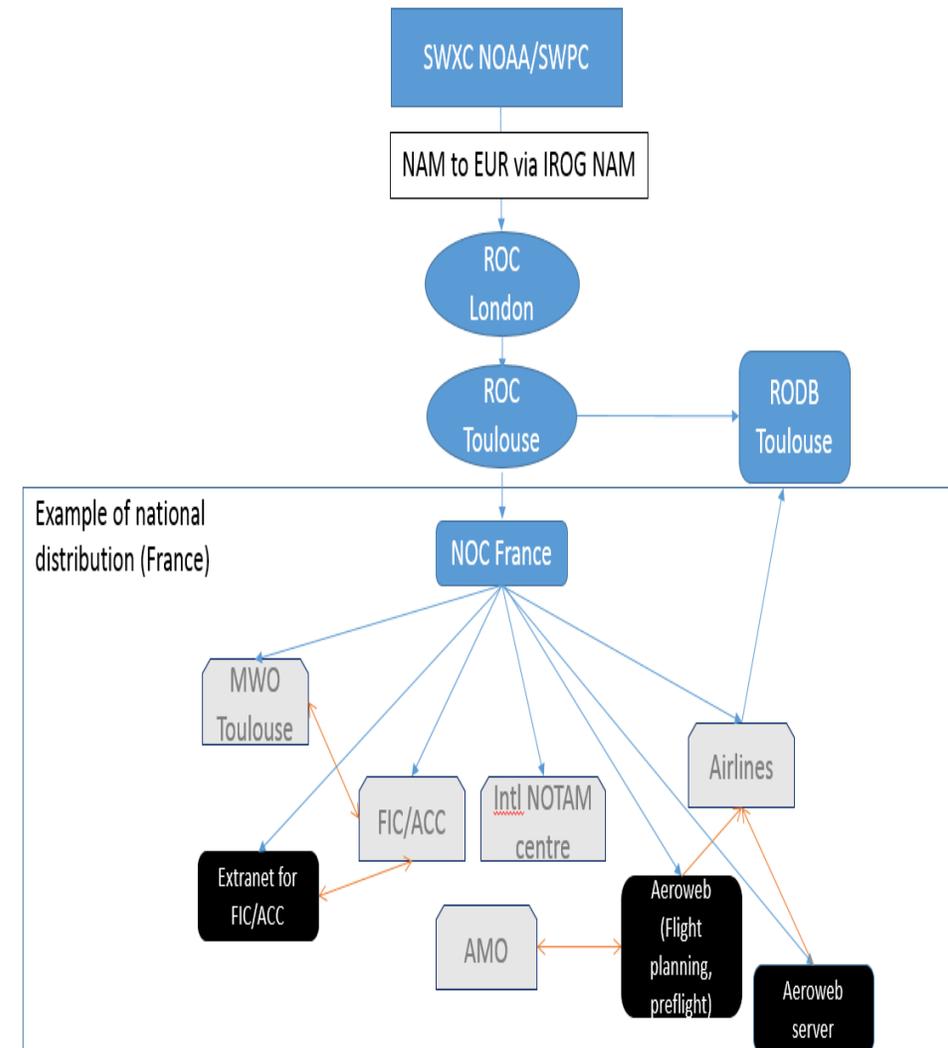


Draft Space Weather Exercise (SWXEX) Directive

- Exercise Schedule
 - When, Who and What is done during the Exercise
- Exercise Scenario Messages
 - Example messages e.g. SWX Advisories are provided in an App.
- Communications
 - Use of “EXERCISE SWXEX24 EXERCISE” at start of NOTAM and AIM messages and “EXERCISE – SWXEX23 – EXERCISE” at end of message
 - Note that SWX Advisories use the term EXER after the term SWX ADVISORY to indicate an Exercise
 - Note that there is a line break in Annex 3, Table A2-3 before and after the use of EXER

Special Instructions

- Teleconference instructions as well as roles of participants are provided in an App.



Draft Space Weather Exercise (SWXEX) Directive

- Transmission of Information Concerning Space Weather Activity
 - PANS-ATM 9.1.3.8
 - Information on space weather phenomena that have an impact on high frequency radio communications, communications via satellite, GNSS-based navigation and surveillance systems, and/or pose a radiation risk to aircraft occupants at flight levels within the area of responsibility of the ATS unit, shall be transmitted to the affected aircraft by one of more of the means specified in PANS-ATM 9.1.3.1.1 ((a) the preferred method of directed transmission on the initiative of the appropriate ATS unit to an aircraft, ensuring that receipt is acknowledged; or (b) a general call, unacknowledged transmission to all aircraft concerned; or (c) broadcast; or (d) data link. *Note. – It should be recognized that in certain circumstances, e.g. during the last stages of a final approach, it may be impracticable for aircraft to acknowledge directed transmissions.*)
 - ICAO Annex 3, Chapter 9
 - provides detailed Standards and Recommended Practices for meteorological information to be supplied to operators and flight crew members for preflight planning, inflight replanning, used by flight crew members before departure, and aircraft inflight (Annex 3, Chapter 9, paragraph 9.1.3 k) refers)

Draft Space Weather Exercise (SWXEX) Directive



- Descents by Aircraft due to Solar Radiation from Space Weather Events
 - PANS-ATM 15.5..5
 - Air traffic control units should be prepared for the possibility that aircraft may, on rare occasions, experience a rise in solar radiation which requires them to descend to lower levels. When such a situation is known or suspected, air traffic control units should take all possible action to safeguard all aircraft concerned, including any aircraft affected by the descent.
 - *Note. – All aircraft in a particular portion of airspace and above a certain altitude may be affected at the same time, and the event may be accompanied by a deterioration or loss of air ground communications. It is expected that the aircraft will alert air traffic control units before the radiation reaches a critical level and will request a descent clearance when the critical level is reached. However, situations may occur in which the aircraft will need to descend without waiting for a clearance. In such cases, the aircraft are expected to advise air traffic control units, as soon as possible, of the emergency action taken.*
 - The *Manual on Space Weather Information in Support of International Air Navigation* (ICAO Doc 10100) indicates that lowering the altitude by 7,000 ft can reduce radiation exposure by approximately one-half.
 - Another possible mitigation is to fly at lower latitudes (e.g. less than 60N).

Draft Space Weather Exercise (SWXEX) Directive

- Dynamic Airborne Reroute Procedure (DARP)
 - What is DARP?
 - The procedure for executing a reroute clearance initiated by a request from AOC (Aeronautical Operational Control), the Flight Crew, or ATC
 - Why use DARP?
 - The purpose of DARP is to allow AOC to initiate the process for an airborne aircraft to be issued an amended route clearance by the ATS unit
 - Operator, flight crew and ATC work together to coordinate a change in aircraft routing with little to no operational impact on the flight
 - Loadable Controller Pilot Data Link Communications (CPDLC) route clearance uplinks are expeditious, eliminate flight crew typing errors and in the case of unexpected concentration levels of volcanic ash (or other hazards); enable reroutes into safer airspace
 - Reduces workload for flight crew and ATS

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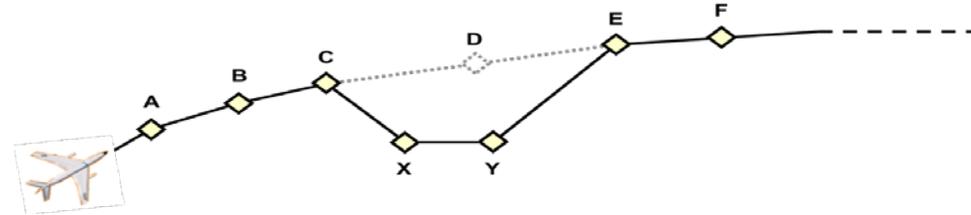
- DARP
 - What is needed for DARP?
 - Aircraft with operational CPDLC capability
 - Reference ICAO Doc 10037, *Global Operational Data Link Manual (GOLD)*
 - See chapter 5 that contains AOC- and ATC-initiated reroute procedures
 - Communications between ACCs
 - Air Traffic Services (ATS) Inter-facility Data Communications (AIDC) or Online Data Interchange

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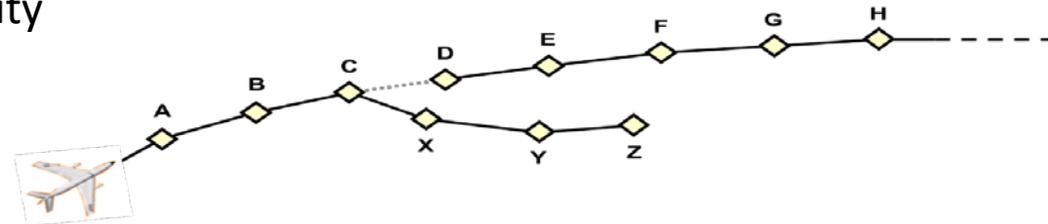
- DARP

- Examples of DARP provided

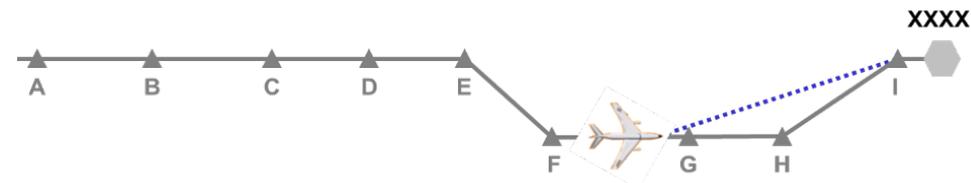
- ATC-initiated reroute – the CLEARED TO waypoint in the new route is on the current route and there is no route discontinuity



- ATC-initiated reroute – the CLEARED TO waypoint in the new route is not on the current route and there is a route discontinuity



- ATC-initiated reroute – aircraft is cleared direct to a fix that is located downstream in the current route



Draft Space Weather Exercise (SWXEX) Directive

- Operational Teleconferences

1	Welcome – Exercise Leader	Run through the list of participants.
2	PECASUS (UK)	Update on the space weather event. The SWXCs participate during the first 10 minutes of the teleconference only.
3	Exercise Leader	Assumptions made for purposes of this exercise.
4	Exercise Leader	Current Network situation Summarise the individual state intentions regarding the SRA approach Inform the participants of the current ATFCM situation and events Discuss the predicted evolution of the space weather event for the next 18 hours and the intentions of AOs and ANSPs in response.
5	AMOs	Current situation including Weather.
6	ANSPs	ANSP current situation. Address individual FMPs about their intentions and ability to respond to AO needs for operational flexibility. Discuss use of DARP.
7	AO	Outlook and requests – Address AO participants individually for their flight operational input in comparison with the applicable ATM Network Impact simulation and their needs for operational flexibility (e.g. relaxation of airspace flight planning restrictions). Discuss use of DARP.
8	Exercise Leader	Summary and next teleconference.

Draft Space Weather Exercise (SWXEX) Directive

- Role of Exercise Leader
 - Define the scenario (in conjunction with SWXC and the SWX SG)
 - Produce the Exercise Directive in accordance with the timeline as agreed during the exercise planning meeting
 - Coordinate with all participants in the preparatory tasks
 - Manage the exercise tasks
 - Collect exercise assessment reports produced by all participants
 - Produce global exercise report draft and submit it to the appreciation of all participants
 - Produce global final exercise report to be presented at the debriefing meeting
 - Chair the debrief meeting

Draft Space Weather Exercise (SWXEX) Directive

- Role of SWXC
 - Process all available data
 - Produce and issue the SWX Advisory messages that have an impact on HF, SATCOM, GNSS and RADIATION exposure at flight levels with identified and projected areas
 - Issue advisory information regarding the extent, severity and duration of the space weather phenomena
 - Supply advisory information to ACCs/FICs, AMOs in its area of responsibility which may be affected, other SWXCs and international OPMET databanks, NOFs and aeronautical fixed service Internet-based services

Draft Space Weather Exercise (SWXEX) Directive

- Role of ANSPs
 - Paying attention to the advisory messages of the exercise (SWX Advisories, NOTAMs, AIMs) and identify if those advisories affect their areas
 - Following ICAO SWX Contingency Plan
 - Producing and provide the full assessment of mitigation actions and their impact based on the space weather event situation and the impact to ATFM
 - Analyse what airspace restrictions can be relaxed to accommodate rerouting traffic most efficiently
 - *Note that as this is a virtual scenario not intending to affect real traffic, ANSPs do not usually drill control tasks, but only exercise and test air traffic management situations*

Draft Space Weather Exercise (SWXEX) Directive

- Role of NOFs

- Issue NOTAMs requested by ACCs /FMPs and AD authorities after they receive SWX Advisories
 - This information includes 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
- In the case of NOF agencies responsible for more than one affected FIRs they may consider, in close coordination with the respective ACCs/FMPs, the production of multi-FIR NOTAMs. This is a known procedure to shorten the response time in contingency situations. So, its use shall be carefully thought and only applied if the following conditions are assured:
 - Responsibility for NOTAM request is clearly defined and expressed
 - Coordination is strongly assured
 - Shortening response time clearly justify the procedure
- *Note that NOTAM related to space weather advisory information is expected to be removed in ICAO Provisions in November 2024.*

Draft Space Weather Exercise (SWXEX) Directive

- Role of AMOs
 - Provide SWX advisory information relevant to the whole route to operators and flight crew members (included in flight documentation)
 - Share current weather hazards and information with stakeholders
- Role of State Regulators
 - Ensure that all the Operators, ANSPs and Aerodromes are aware of the current ICAO SWX Contingency Plan and understand how this will be implemented
 - Ensure that their State has a clear policy in respect of the SRA approach (reference ICAO Doc 9974)
 - Ensure that the various NOTAMs are issued at the agreed times and with a good quality and in accordance with ICAO policy
 - Ensure that AMOs provide SWX advisory information relevant to the whole route to operators and flight crew member (included in flight documentation)

Draft Space Weather Exercise (SWXEX) Directive

- Role of Aircraft Operators

- assess the way that early information is received by them, whether the content is sufficient for them to assess the level of activation of their resources, etc.
- required to analyse the space weather forecast and give feedback during the teleconferences on what actions they would have taken with their flights compared to the ATM network impact
- indicate airspace restrictions (e.g. RAD restrictions) which they would like to see relaxed to enable most efficient re-routings
- assess the flight impact according to their company approved SRA taking into consideration the policy communicated by each State
- encouraged to use DARP in requesting reroutes

Draft Space Weather Exercise (SWXEX) Directive

- Measure Effectiveness of SWXEX
 - Dissemination (timeliness and effectiveness) of operationally relevant information (SWXC advisories/NOTAM etc.) - quantitative assessment
 - Evaluation of ATM responsiveness to AO need for operational flexibility (qualitative and quantitative assessment)
 - Ability of States to manage their airspace (qualitative assessment) and publish operational information (quantitative assessment) and the Airline use of the information to plan flights (qualitative assessment) Effectiveness of internal State communications (qualitative assessment)
 - Use of DARP by AOs and ANSPs (qualitative and quantitative assessment)
 - Use of the ICAO SWX Contingency Plan by Operators, ANSPs and Aerodromes and understanding any issues associated with its implementation (qualitative assessment)
 - Review of SWXCs performance



Thank You!