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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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ASECNA Seminar on the Implementation of requirements for the provision of Space Weather Information to Aviation: From Awareness to Operational Readiness

Dakar, 8-12 December 2025, Dakar, Senegal

Session 2 : ICAO Requirements and Global Framework

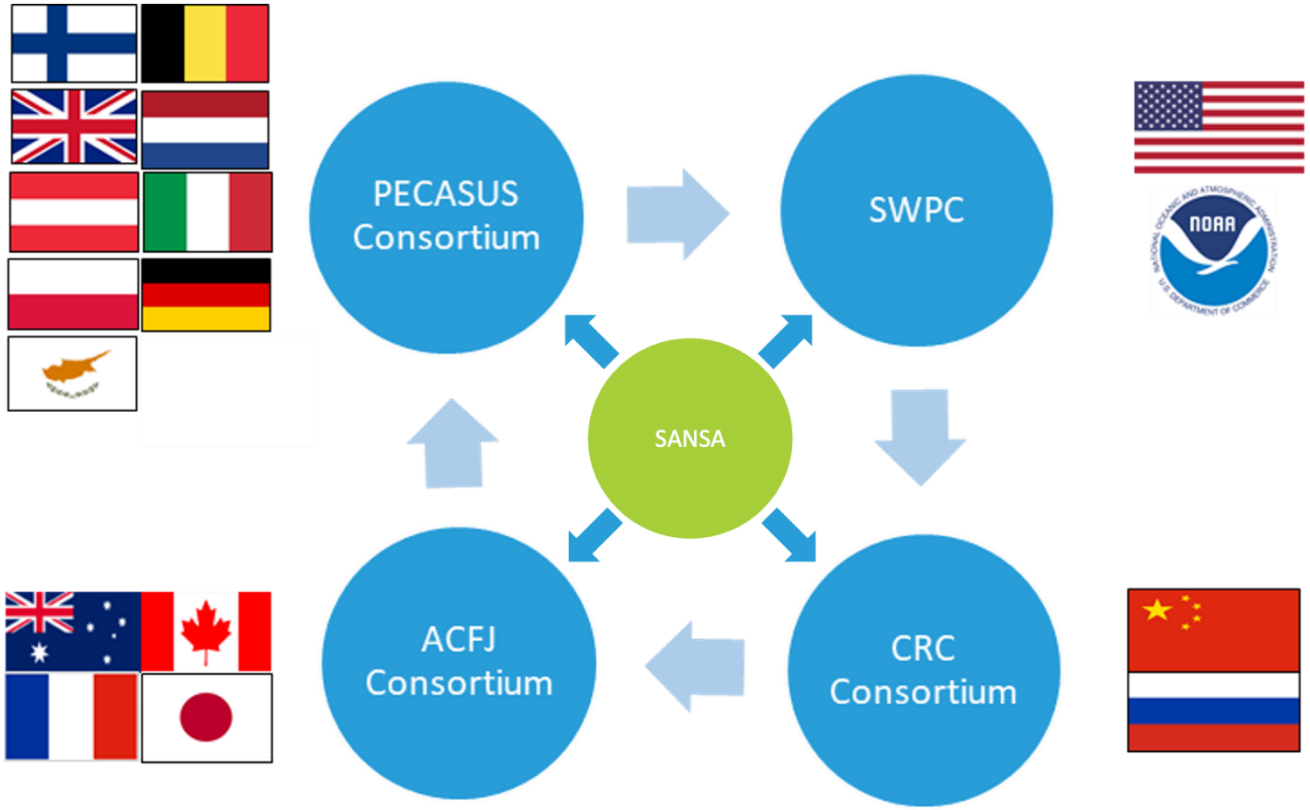
The Secrétariat

Bureau WACAF

ICAO

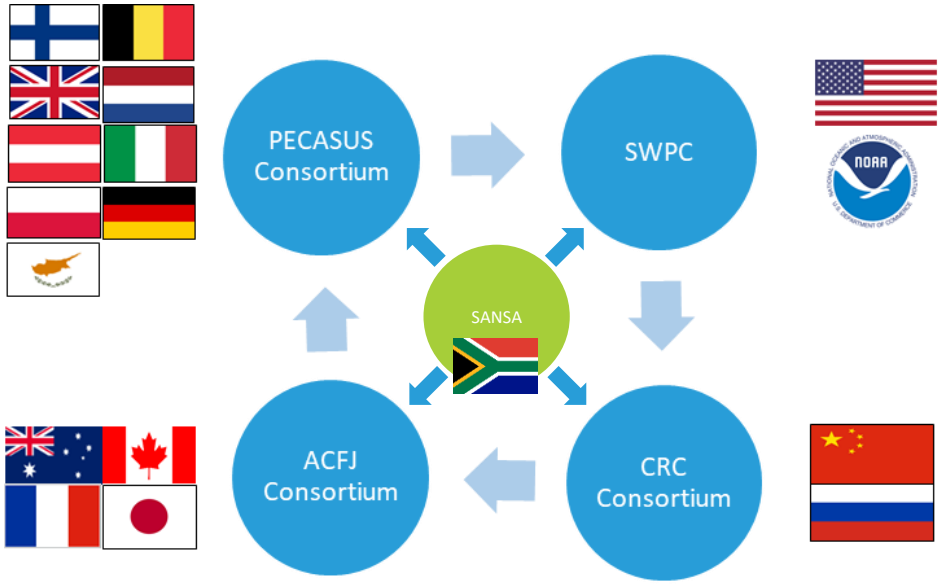
2.4

SWIS Operational framework



Operational SWIS service framework

- **ICAO Space Weather Information service framework provides 24/7 service for aviation**
  - harmonized single-voice information without redundancy and inconsistency
  - quality sharing space-based, airborne, and ground-based observations, as well as forecasting skills
  - operational efficiency and continuity
- **Coordinated scheme of global SWXCs**
  - ODC: On Duty Centre *responsible for advisory issuance
  - PBC: Primary Backup Centre
  - SBC: Secondary Backup Centre
  - MOC: Maintenance and Observation Centre
- **Regional SWXC integration from November 2025**
  - Support global SWXCs in situational awareness
  - Share observation data to add further quality



Space Weather Advisory information (SWXA)

- Target impact areas:
  - HF Communications (HF COM)
  - GNSS-based navigation and surveillance (GNSS)
  - Radiation impacts on avionics and human health (RAD)
  - Satellite Communications (SATCOM)
- Two intensity thresholds, “MOD” and “SEV”
  - defined in ICAO SWX Manual (Doc 10100*)
- Space Weather Advisory Data Requirements
  - Space-based data
    - Proton flux, X-ray flux
  - Ground-based data
    - Neutron Monitors, Ionosondes, GNSS receivers, Scintillation receivers, Riometers

Impact	Parameter	MOD	SEV
RAD	Effective dose	30 µSievert/h	80 µSievert/h
GNSS			
Ampl. Scint.	S_4	0.5	0.8
Phase Scint.	σ_ϕ	0.4 rad	0.7 rad
Total el. Cont.	TECU	125	175
HF COM			
Auroral Abs.	Kp	8	9
Pol. Cap. Abs.	Riometer abs.	2 dB	5 dB
Shortwave Fadeout	Solar X-rays	10^{-4}W/m^2 (X1)	10^{-3}W/m^2 (X10)
Post Storm Depr.	MUF	30%	50%

*ICAO Doc 10100 — Manual on Space Weather Information in Support of International Air Navigation

Example: Space Weather Advisory (HF COM)

- SWXA provides observed areas of SWX impact and its forecast up to 24 hours
  - further details of the phenomena and its impact can also be provided in the Remarks

SWX ADVISORY

DTG: 20191108/0100Z

SWXC: ACFJ

ADVISORY NR: 2019/1

SWX EFFECT: HF COM SEV

OBS SWX: 08/0100Z HNH HSH E180 – W180

FCST SWX +6 HR: 08/0700Z DAYLIGHT SIDE

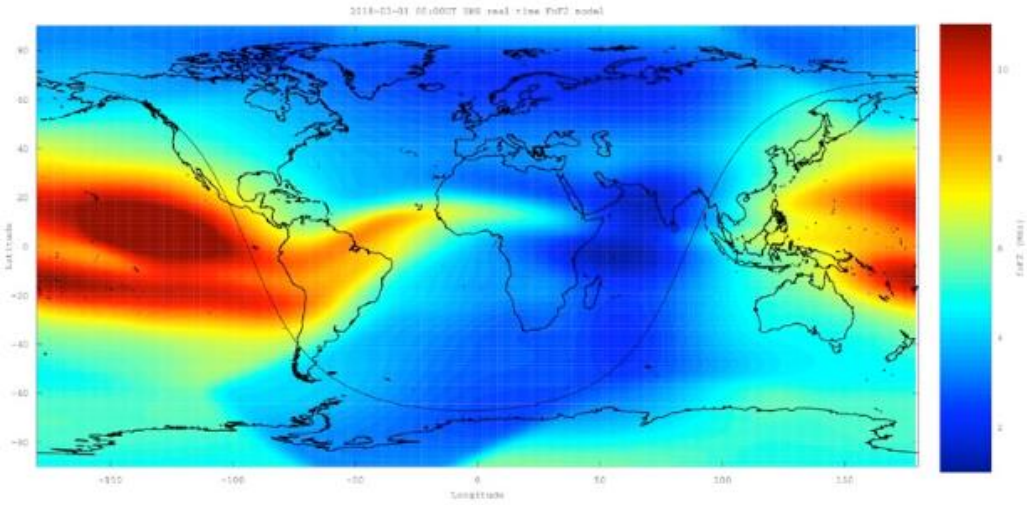
FCST SWX +12 HR: 08/1300Z DAYLIGHT SIDE

FCST SWX +18 HR: 08/1900Z DAYLIGHT SIDE

FCST SWX +24 HR: 09/0100Z NO SWX EXP

RMK: SPACE WEATHER EVENT (SOLAR FLARE) IN PROGRESS IMPACTING LOWER HF COM FREQUENCY BAND ON THE DAYLIGHT SIDE. HIGHER FREQUENCIES MAY BE LESS IMPACTED. FURTHER PERIODIC LOSS OF HF COM ON THE DAYSIDE POSSIBLE NEXT 24 HOURS.

NEXT ADVISORY: WILL BE ISSUED BY 20191108/0700Z



Global map of maximum useable frequency for HF Radio users.
Photo: Bureau of Meteorology

Example: Space Weather Advisory (Radiation, GNSS)

Radiation

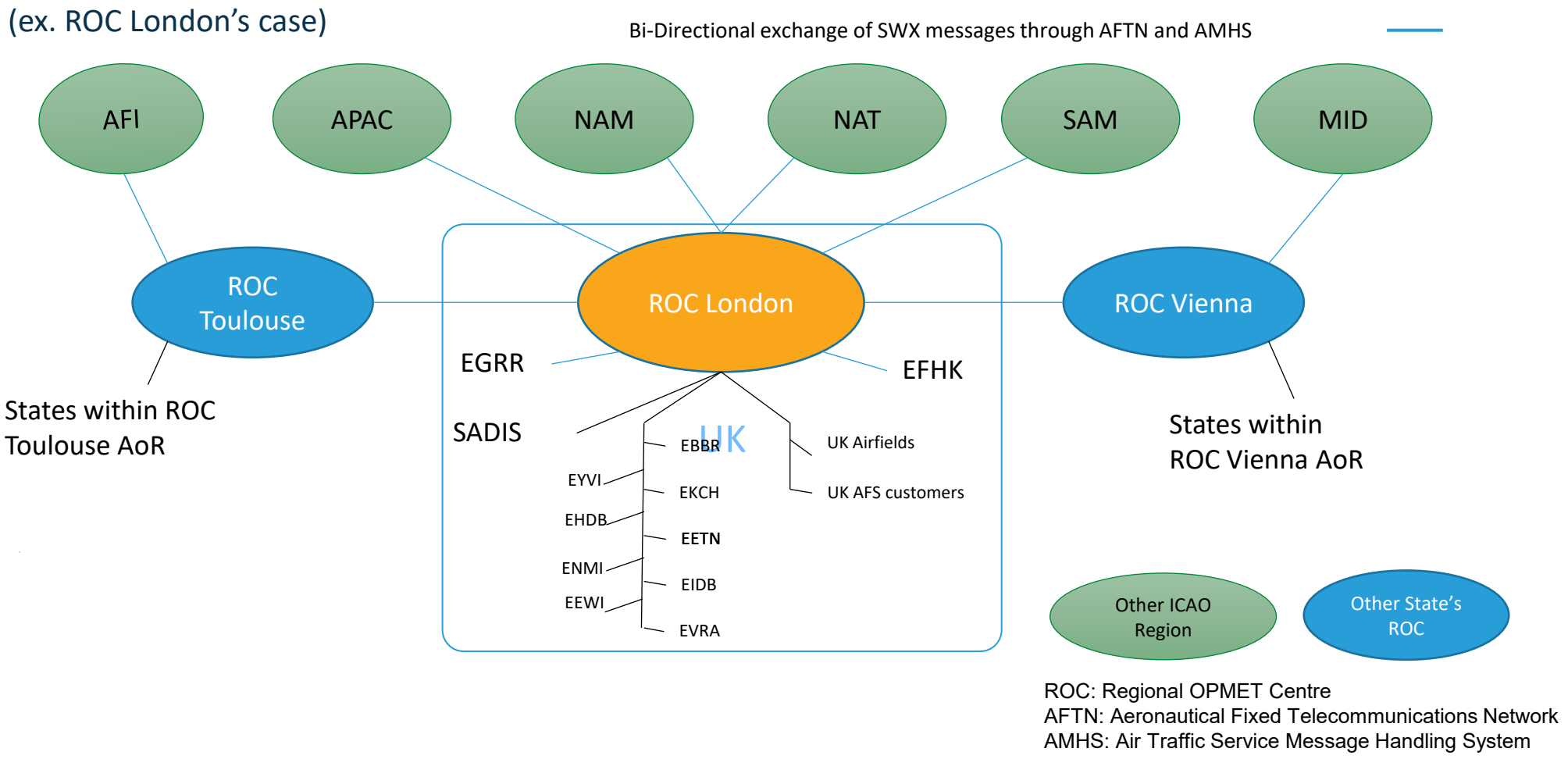
SWX ADVISORY
DTG: 20191108/0003Z
SWXC: SWPC
ADVISORY NR: 2019/1
SWX EFFECT: RADIATION MOD
OBS SWX: 08/0100Z HNH HSH E180 – W180 ABV FL 350
FCST SWX +6 HR: 08/0700Z NO SWX EXP
FCST SWX +12 HR: 08/1300Z NO SWX EXP
FCST SWX +18 HR: 08/1900Z NO SWX EXP
FCST SWX +24 HR: 09/0100Z NO SWX EXP
RMK: SPACE WEATHER EVENT IN PROGRESS CAUSING INCREASED RADIATION LEVELS AT FLIGHT ALTITUDE. RADIATION EVENT HAS PEAKED AND EXPECTED TO RETURN TO NORMAL VALUES WITHIN THE FCST PERIOD
NXT ADVISORY: WILL BE ISSUED BY 20191108/0700Z

GNSS

SWX ADVISORY
DTG: 20191108/0103Z
SWXC: PECASUS
ADVISORY NR: 2019/2
NR RPLC: 2019/1
SWX EFFECT: GNSS MOD
OBS SWX: 08/0100Z HNH HSH E180 – W180
FCST SWX +6 HR: 08/0700Z NO SWX EXP
FCST SWX +12 HR: 08/1300Z NO SWX EXP
FCST SWX +18 HR: 08/1900Z NO SWX EXP
FCST SWX +24 HR: 09/0100Z NO SWX EXP
RMK: SPACE WEATHER EVENT IN PROGRESS IMPACTING GNSS PERFORMANCE IN THE AURORAL ZONE. THIS ACTIVITY IS EXP TO SUBSIDE IN THE FCST PERIOD.
NXT ADVISORY: WILL BE ISSUED BY 20191108/0700Z

SWXA distribution via Aeronautical Telecommunication Network

- SWXA is distributed through established telecommunication network.



ROC: Regional OPMET Centre
AFTN: Aeronautical Fixed Telecommunications Network
AMHS: Air Traffic Service Message Handling System

Summary

- Eruptive solar activity poses immediate/long-term safety risks for aviation, by disrupting HF/Satellite communications, degrading GNSS, causing radiation exposures by air occupants.
- ICAO SWIS has been implemented to meet aeronautical user's operational requirement for the provision of advisory information on space weather phenomena and its intensity and impact.
- Global and regional SWXCs were designed by ICAO based on the result of technical evaluation and assessment by ANC, with support of METP.
- Designated global/regional SWXCs have established operational coordination framework for continuous 24/7 monitoring and timely issuance of advisory information, addressing duplication and efficiency.
- Sustainable provision of SWIS is required to mitigate safety impact by massive solar events in modernized air navigation system.

ASECNA Seminar on the Implementation of Space Weather Requirements for Aviation:
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Session 4: SWX Advisory Interpretation – Hands-On Exercise

ICAO guidance material on SWIS

ICAO guidance material is published to guide States and aeronautical users to understand space weather impact and operational SWIS.

- “Manual on Space Weather Information in Support of International Air Navigation” (Doc 10100) https://portal.icao.int/icao-net/ICAO%20Documents/10100_cons_en.pdf

- “Global Navigation Satellite System (GNSS) Manual” (Doc 9849) also contains description of space weather impact on GNSS.

Thank You!

ICAO