



ICAO

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A UN SPECIALIZED AGENCY

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Monitoring the SWx Phenomena & Provision of SWXA

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Introduction

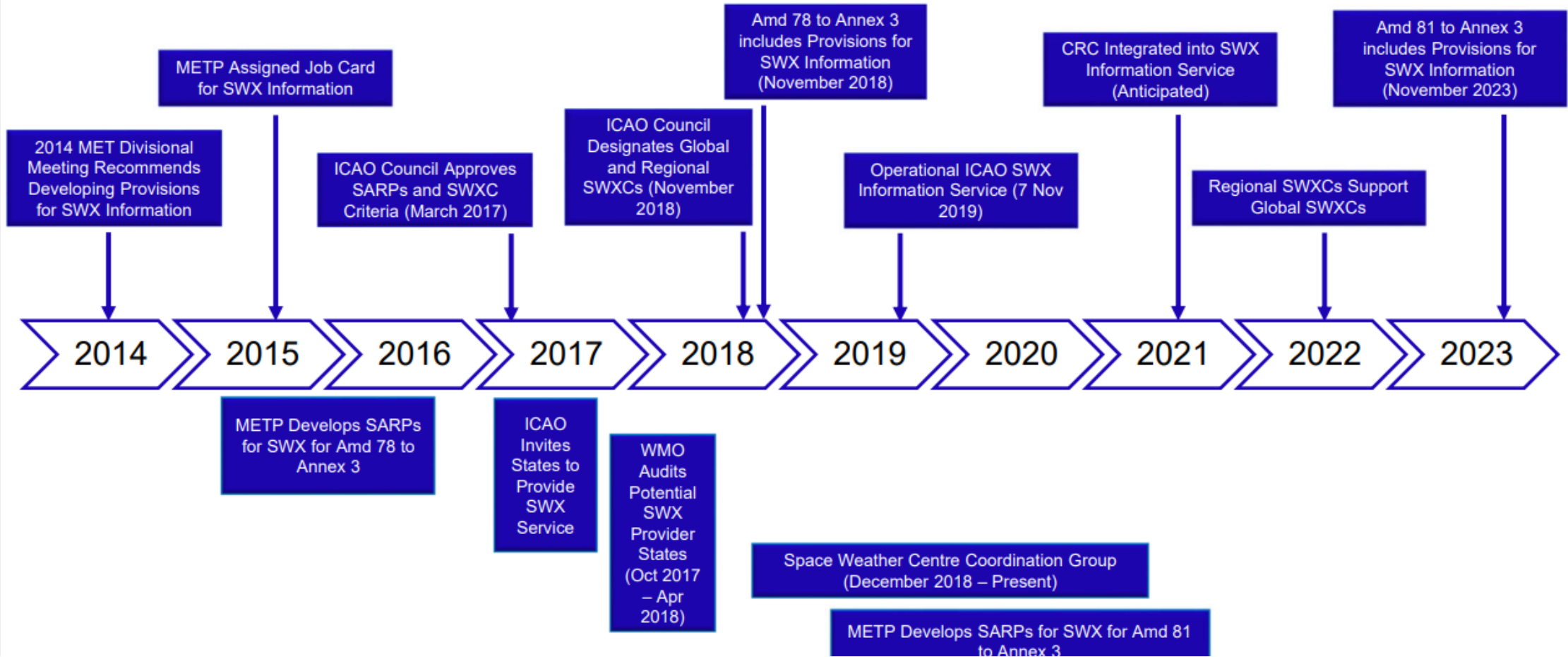


- The sun is subject to complex processes that can cause intense energy releases.
- The emitted energy and particles can travel through interplanetary space to the Earth and can affect its environment.
- **Global Navigation Satellite Systems (GNSS)**, relying mainly on Radiofrequency waves, are subject to perturbations and outages in case of solar events.
- In some use cases, those perturbations can **impact satellite-based navigation performance**.
- Consequently, it becomes of interest **to detect or forecast space weather perturbations** and **inform the international air navigation of any major space weather event potential impact**.

Establishment of SWx Services

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Space Weather Information Service



The ICAO initiative: Global Space Weather centers designated

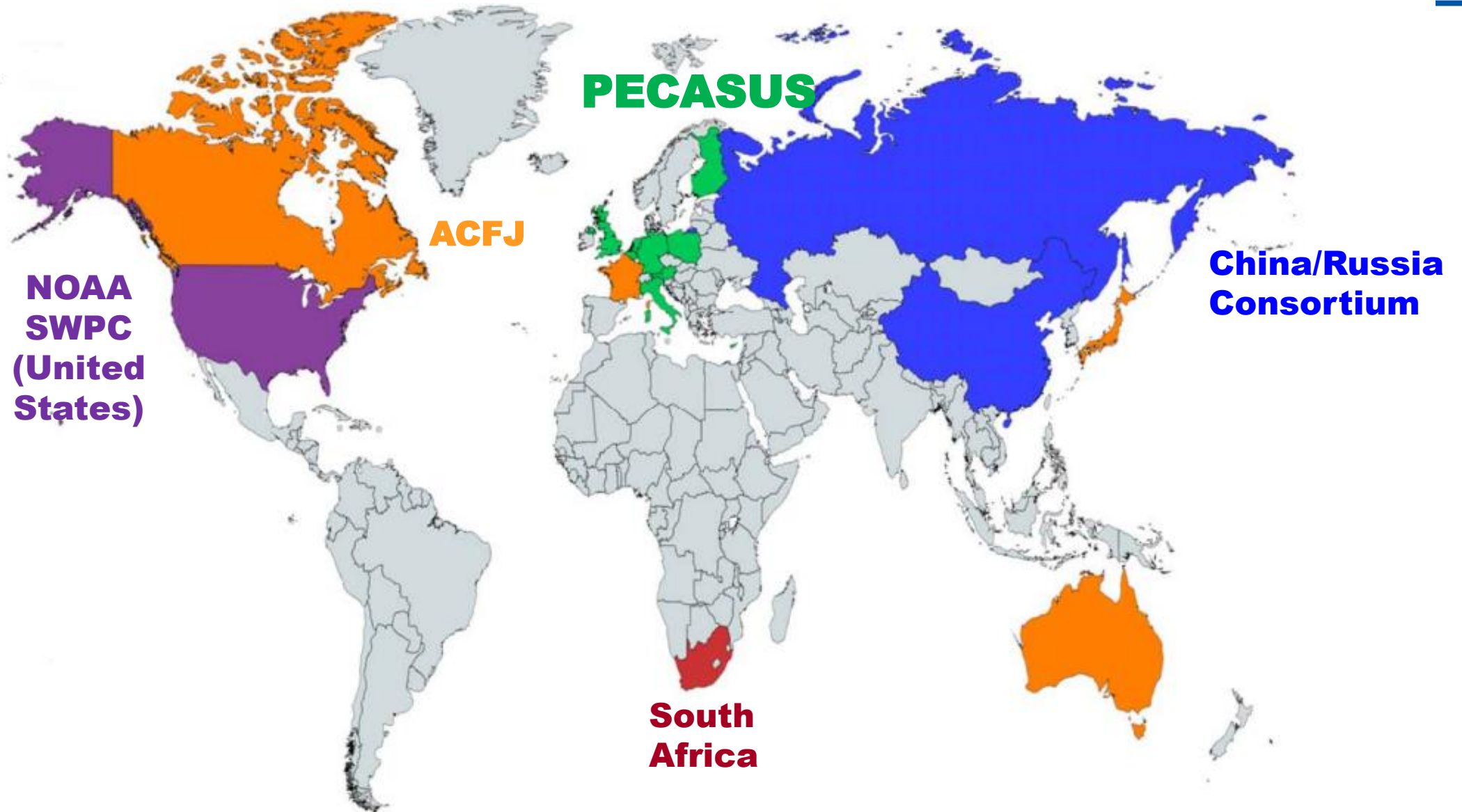
In its 215th Session (29 Oct – 16 Nov. 2018) the Council of International Civil Aviation Organization has designated **three global space weather service centers (SWXC)** to be operated by :

- the **PECASUS Consortium** (Finland, United Kingdom, Germany, Austria, Poland, Italy, Netherlands, Belgium and Cyprus);
- **United States**; and
- **ACFJ Consortium** (Australia, Canada, France and Japan).
- And one Regional SWxC operated by **South Africa**.

The **fourth Global SWXC, China-Russia Consortium** was established, November 19, 2021.

Monitoring SWx phenomena

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The ICAO initiative: Global Space Weather centers designated

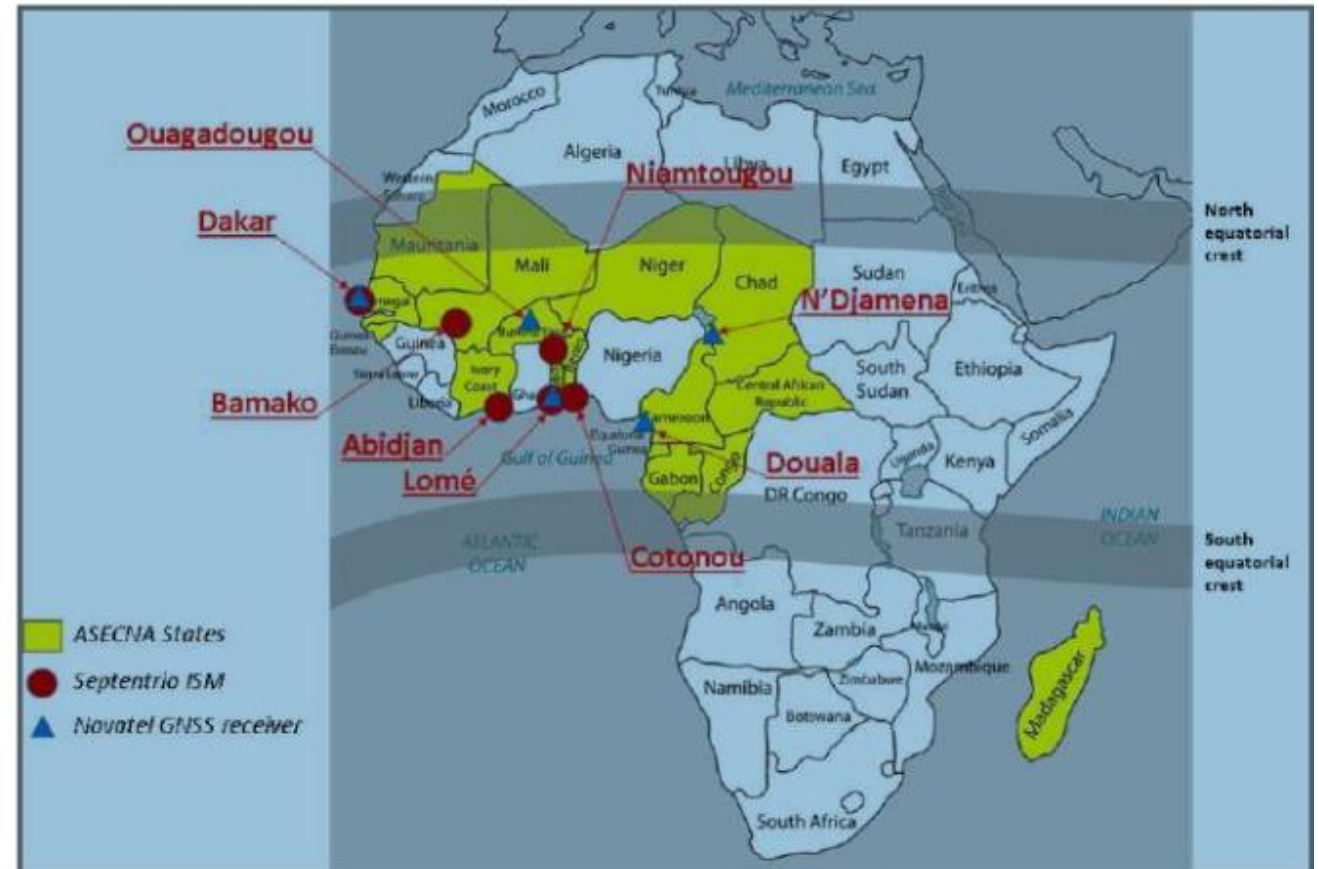
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Roles and Responsibilities of SWxCs

- The global centers **broadcast alert advisories** to the aviation to warn about solar and geomagnetic storms **that not only can cause disruptions to the communication and positioning systems** but also **expose aircraft crews and passengers to high levels of radiation**.
- Each global Space Weather monitoring center is in charge of **delivering a continuous Space Weather monitoring service** by publishing daily briefs describing the space weather situation **and by publishing advisories** in case of events that could impact the aviation.
- The Regional SWxC **support** the Global SWxC through monitoring and providing information on the occurrence or expected occurrence of SWx to the Regional SWxCs.

ACFJ Experience : France

Ionosphere scintillation
monitoring **operated by**
France in cooperation with
ASECNA



A3- 3.8 Space weather centres

STD 3.8.1 A Contracting State, **having accepted the responsibility for providing a space weather centre (SWXC), shall arrange** for that centre to monitor and provide advisory information on space weather phenomena in its area of responsibility by arranging for that centre to:

- a) monitor relevant ground-based, airborne and space-based observations to detect, and predict when possible, the existence of space weather phenomena that have an impact in the following areas:
 - 1) High frequency (HF) radio communications;
 - 2) Communications via satellite;
 - 3) GNSS-based navigation and surveillance; and
 - 4) Radiation exposure at flight levels;

Monitoring TC and Provision of TC Information

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A3- 3.8 Space Weather Centres

- b) **issue advisory information** regarding the extent, severity and duration of the space weather phenomena that have an impact referred to in a);
- c) **supply the advisory** information referred to in b) to:
 - i. **ACCs, FICs and AMOs in its area of responsibility** which may be affected;
 - ii. **other SWXCs**; and
 - iii. **International OPMET databanks, international NOTAM offices and aeronautical fixed service Internet-based services.**

STD 3.8.2 SWXC shall maintain a **24-hour watch**.

STD 3.8.3 In case of interruption of the operation of a SWXC, **its functions shall be carried out by another SWXC or another centre**, as designated by the **SWXC Provider State concerned**.

AMD 78 to A3
(METP/2)
&
AMD 79 to A3
(METP/4)

A3 App.2 : §6.11
Space Weather
Advisory
Information

Space weather advisory information

- *6.1.1 Recommendation.— Advisory information on space weather should be issued in abbreviated plain language, using approved ICAO abbreviations and numerical values of self-explanatory nature, and should be in accordance with the template shown in Table A2-3. When no approved ICAO abbreviations are available, English plain language text, to be kept to a minimum, should be used.*
- **6.1.2 Recommendation.**— *As of 7 November 2019 and until 4 November 2020, space weather advisory information should be disseminated in IWXXM GML for, in addition to the dissemination of space weather advisory information in abbreviated plain language in accordance with 6.1.1.*
- **6.1.2 STD** - *As of 5 November 2020, space weather advisory information shall be disseminated in IWXXM GML form, in addition to the dissemination of this advisory information in abbreviated plain language in accordance with 6.1.1*

6.1.3 Recommendation.— One or more of the following space weather effects should be included in the space weather advisory information, using their respective abbreviations as indicated below:

HF communications (propagation, absorption) HF COM

communications via satellite (propagation, absorption) SATCOM

GNSS-based navigation and surveillance (degradation) GNSS

radiation at flight levels (increased exposure) RADIATION

6.1.4 Recommendation.— The following intensities should be included in space weather advisory information, using their respective abbreviations as indicated below:

moderate MOD

severe SEV

Note.— Guidance on the use of these intensities is provided in the Manual on Space Weather Information in Support of International Air Navigation (Doc 10100).

6.1.5 Recommendation.— Updated advisory information on space weather phenomena should be issued as necessary but at least every six hours until such time as the space weather phenomena are no longer detected and/or are no longer expected to have an impact

Space Weather Advisory Messages

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SWXA Message Format – Reference to A3, Table A2-3. Template for advisory message for space weather information

Message Structure

WMO header

The World Meteorological Organization header is included to facilitate the international exchange of messages.

Message type

The message type is identified as SWX (space weather) ADVISORY.

SWX ADVISORY

Status indicator

Indicator of test or exercise.

TEST or EXER

Time of origin

Year, month, day and time of issue followed by the letter Z (universal time coordinated, UTC).

DTG: 20161108/0100Z

Name of SWXC

The name of the Space Weather Centre.

SWXC: DONLON*

Advisory number

Year in full and unique message number.

ADVISORY NR: 2016/2

Number of advisory being replaced

Number of the previously issued being replaced.

NR RPLC: 2016/1

Space weather effect & intensity

Effect and intensity of the space weather phenomena.

SWX EFFECT: GNSS MOD

Observed or expected space weather phenomena

Day and time (UTC) of observed phenomena (or forecast if phenomena have yet to occur).

Horizontal extent (latitude bands and longitude in degrees) and/or altitude of space weather phenomena.

OBS SWX: 08/0100Z HNH HSH E18000 – W18000

Forecast of the phenomena (+6 HR)

Day and time (UTC) (6 hours from the time given in Item 8, rounded to the next full hour).

Forecast extent *and/or* altitude of the space weather phenomena for the validity period.

FCST SWX +6 HR: 08/0700Z HNH HSH E18000 – W18000

Forecast of the phenomena (+12 HR)

Day and time (UTC) (12 hours from the time given in Item 8, rounded to the next full hour).

Forecast extent *and/or* altitude of the space weather phenomena for the validity period.

FCST SWX +12 HR: 08/1300Z HNH HSH E18000 – W18000

Forecast of the phenomena (+18 HR)

Day and time (UTC) (18 hours from the time given in Item 8, rounded to the next full hour).

Forecast extent *and/or* altitude of the space weather phenomena for the validity period.

FCST SWX +18 HR: 08/1900Z HNH HSH E18000 – W18000

Forecast of the phenomena (+24HR)

Day and time (UTC) (24 hours from the time given in Item 8, rounded to the next full hour).

Forecast extent *and/or* altitude of the space weather phenomena for the validity period.

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

Remarks

Remarks, as necessary.

RMK: LOW LVL GEOMAGNETIC STORMING CAUSING INCREASED AURORAL ACT AND SUBSEQUENT MOD DEGRADATION OF GNSS AVBL IN THE AURORAL ZONE. THIS STORMING EXPTO SUBSIDE IN THE FCST PERIOD. SEE WWW.SPACEWEATHERPROVIDER.WEB

Next advisory

Year, month, day and time in UTC.

NXT ADVISORY: NO FURTHER ADVISORIES



ICAO

WMO Headers for Advisories

The WMO message headers (TTAAii CCCC) for space weather advisories in Traditional Alphanumeric Code (TAC) and in ICAO Weather Exchange Model (IWXXM)

WMO Headers		
	TAC Advisory	IWXXM Advisory
ACFJ – Australia	FNXX01 YMMC	LNXX01 YMMC
ACFJ – France	FNXX01 LFPW	LNXX01 LFPW
PECASUS – Finland	FNXX01 EFKL	LNXX01 EFKL
PECASUS – UK	FNXX01 EGRR	LNXX01 EGRR
CRC – China	FNXX01 ZBBB	LNXX01 ZBBB
CRC – Russia	FNXX01 UUAG	LNXX01 UUAG
SPWC – USA	FNXX01 KWNP	LNXX01 KWNP

Source FAA

01 = GNSS

02 = HF COM

03 = RADIATION

04 = SATCOM

Element to be forecast		Range	Resolution
Flight level affected by radiation		250 – 600	30
Longitudes for advisories (degrees)		000 – 180	15
Latitudes for advisories (degrees)		00 – 90	10
Latitude bands for advisories:	High latitudes northern hemisphere (HNH)	N9000 – N6000	30
	Middle latitudes northern hemisphere (MNH)	N6000 – N3000	
	Equatorial latitudes northern hemisphere (EQN)	N3000 – N0000	
	Equatorial latitudes southern hemisphere (EQS)	S0000 – S3000	
	Middle latitudes southern hemisphere (MSH)	S3000 – S6000	
	High latitudes southern hemisphere (HSH)	S6000 – S9000	

Examples of Space Weather Advisories

A3 Chap.3, App. 2

Table A2-3.
Template for
advisory message
for space weather
information

Space weather advisory message : SPWC – USA 2024-11-22 16:57:00

FNXX02 KWNP 221657

SWX ADVISORY

DTG: 20241122/1657Z

SWXC: SWPC

ADVISORY NR: 2024/333

SWX EFFECT: HF COM MOD

OBS SWX: 22/1655Z HNH HSH E180 - W180

FCST SWX +6 HR: 22/2300Z HNH HSH E180 - W180

FCST SWX +12 HR: 23/0500Z HNH HSH E180 - W180

FCST SWX +18 HR: 23/1100Z HNH HSH E180 - W180

FCST SWX +24 HR: 23/1700Z HNH HSH E180 - W180

RMK:

NXT ADVISORY: 20241122/2300Z=

Examples of Space Weather Advisories

A3 Chap.3, App. 2
Table A2-3.
Template for
advisory message
for space weather
information

Space weather advisory message :: SPWC – USA 2024-11-22 17:02:00

FNXX02 KWNP 221702

SWX ADVISORY

DTG: 20241122/1702Z

SWXC: SWPC

ADVISORY NR: 2024/335

NR RPLC: 2024/333

SWX EFFECT: HF COM MOD

OBS SWX: 22/1701Z NO SWX EXP

FCST SWX +6 HR: 23/0000Z NO SWX EXP

FCST SWX +12 HR: 23/0600Z NO SWX EXP

FCST SWX +18 HR: 23/1200Z NO SWX EXP

FCST SWX +24 HR: 23/1800Z NO SWX EXP

RMK: INADVERTANTLY ISSUED NEW ADVISORY.

NXT ADVISORY: NO FURTHER ADVISORIES=



ICAO
Headquarters
Montréal

European and
North Atlantic
(EUR/NAT) Office
Paris

Asia and Pacific
(APAC) Sub-office
Beijing

North American
Central American
and Caribbean
(NACC) Office
Mexico City

Western and
Central African
(WACAF) Office
Dakar

Middle East
(MID) Office
Cairo

Asia and Pacific
(APAC) Office
Bangkok

South American
(SAM) Office
Lima

Eastern and
Southern African
(ESAF) Office
Nairobi

Thank You!