METEOROLOGY PANEL

METP SWX User Workshop, 20 October 2025, Rome, Italy

Space Weather Advisory

User Feedback

Robyn Fiori
Natural Resources Canada
on behalf of SWXCCG

Objective and Goal

- Objective
  - To provide situational awareness and advise aviation users of space weather events likely to have a moderate or severe impact on GNSS or HF COM technologies or enhanced radiation at flight altitudes.
  - Actionable information
    - Inform pre-flight planning (e.g. route selection, altitude selection, fuel loading)
    - Real-time warning of space weather events
    - In-flight route or altitude deviations

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Current Advisory

Advisory Header

FNXX01 LFPW 220920
SWX ADVISORY
DTG: 20250328/0615Z
SWXC: ACFJ
ADVISORY NR: 2025/1
SWX EFFECT: GNSS MOD
OBS SWX: 28/0615Z EQN EQS E090 - E150
FCST SWX +6 HR: 28/1300Z NOT AVBL
FCST SWX +12 HR: 28/1900Z NOT AVBL
FCST SWX +18 HR: 29/0100Z NOT AVBL
FCST SWX +24 HR: 29/0700Z NOT AVBL
RMK: SWX EVENT (IONOSPHERIC DISTURBANCE) INPR POSSIBLY IMPACTING GNSS PER. COULD LEAD TO DEGRADATION OF TIMING AND POSITIONING PER. INTST MAY VARY ACROSS THE REGION AND WITH TIME BUT GENERALLY STRONGER ON THE DAYSIDE.
NXT ADVISORY: WILL BE ISSUED BY 20250328/0915Z=

Issuing Centre

Type

Magnitude

Observed Conditions

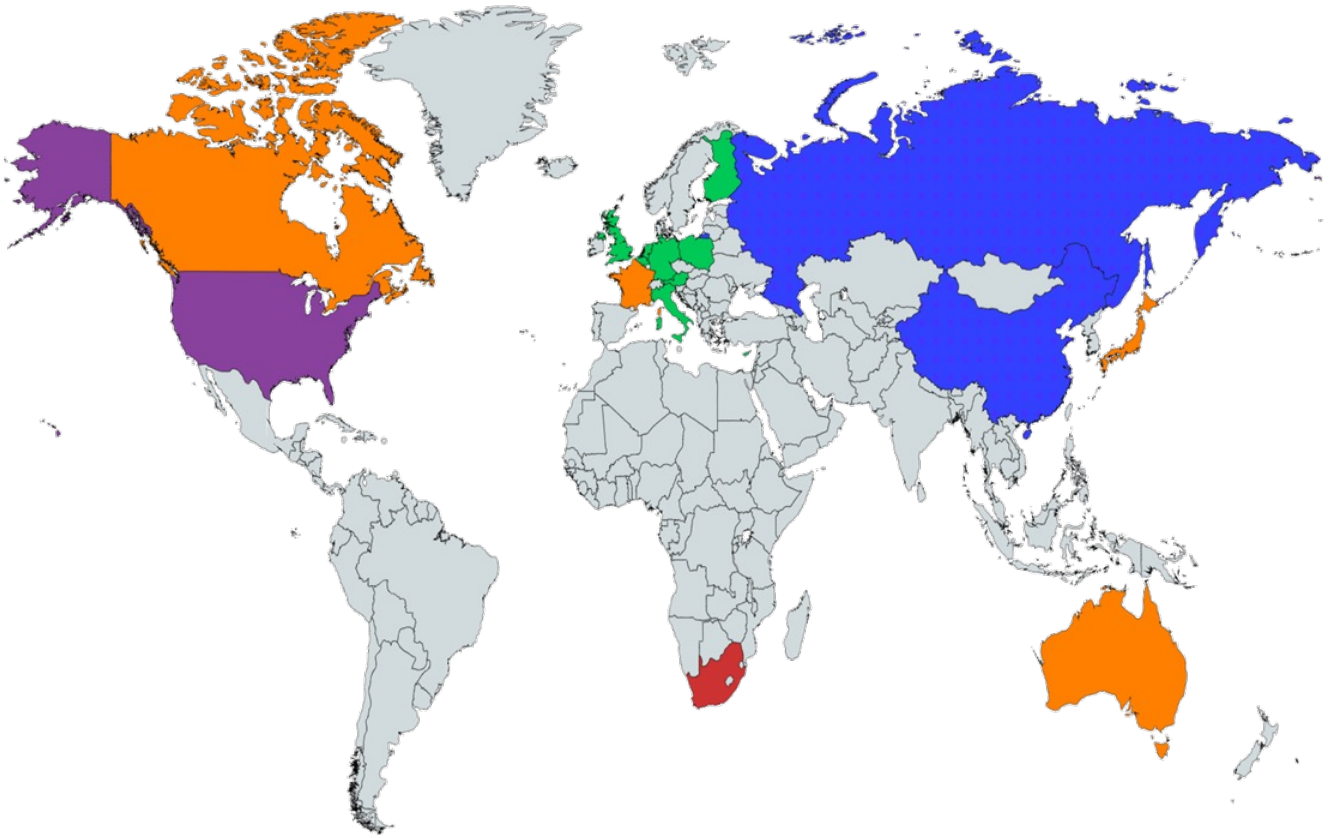
Affected Region

Forecast Conditions

Remarks

Issuing Centre

- ICAO-designated centres
  - Four global warning centres
    - **PECASUS:** Austria, Belgium, Cyprus, Finland, Germany, Italy, Netherlands, Poland, United Kingdom
    - **ACFJ**: Australia, Canada, France, Japan
    - **SWPC:** United States
    - **CRC:** China, Russia
  - One regional center
    - **South Africa**



Karen Mur-Shelton, FAA

Type, Magnitude

Table 1 *Space weather effects covered by aviation advisories, including parameters and thresholds for issuance.*

[Manual] §3.6 and table 3-1

Effect	Sub-effect	Parameter used	Moderate	Severe
GNSS	Amplitude Scintillation	S4 (dimensionless)	0.5	0.8
GNSS	Phase Scintillation	Sigma-phi (radians)	0.4	0.7
GNSS	Vertical Total Electron Content (TEC)	TEC units	125	175
RADIATION		Effective dose rate (micro-Sieverts/hour)*	30	80
HF COM	Auroral Absorption (AA)	Kp	8	9
HF COM	Polar Cap Absorption (PCA)	dB from 30MHz riometer data	2	5
HF COM	Shortwave Fadeout (SWF)	Solar X-rays (0.1-0.8 nm) ($W\text{-}m^{-2}$)	$1x10^{-4}$ (X1)	$1x10^{-3}$ (X10)
HF COM	Post-Storm Depression	MUF** (maximum usable frequency)	30%	50%
SATCOM***	N/A	N/A	N/A	N/A

* MOD advisories will only be issued when the MOD threshold is reached at FL460 and below. SEV advisories will be issued when the SEV threshold is reached at any flight level. [Manual], §3.6, table 3-1

** As compared to a 30-day running median of the critical frequency of the F2 layer (foF2). [Manual], §3.6, table 3-1

*** There are no advisory thresholds specified for SATCOM effects. [SWAG] §1.2, table 1

- Type indicates the impacted system or effect
  - GNSS
  - HF communications (HF COM)
  - RADIATION (RAD)
  - SATCOM [not yet defined]
- Magnitude
  - Moderate (MOD)
  - Severe (SEV)

Affected Region

- Latitude bands
  - 30˚ resolution in latitude
  - 15˚ resolution in longitude

HNH	60˚ to 90˚	HSH	-60˚ to -90˚
MNH	30˚ to 60˚	MSH	-30˚ to -60˚
EQN	00˚ to 30˚	EQS	-00˚ to -30˚

- DAYLIGHT SIDE (extent of the planet in daylight)
- Polygon
  - multiple vertices
  - 5˚ x 5˚ resolution in latitude and longitude for the corner points
- For radiation
  - MOD issued for FL250 to FL460
  - SEV issued above FL250

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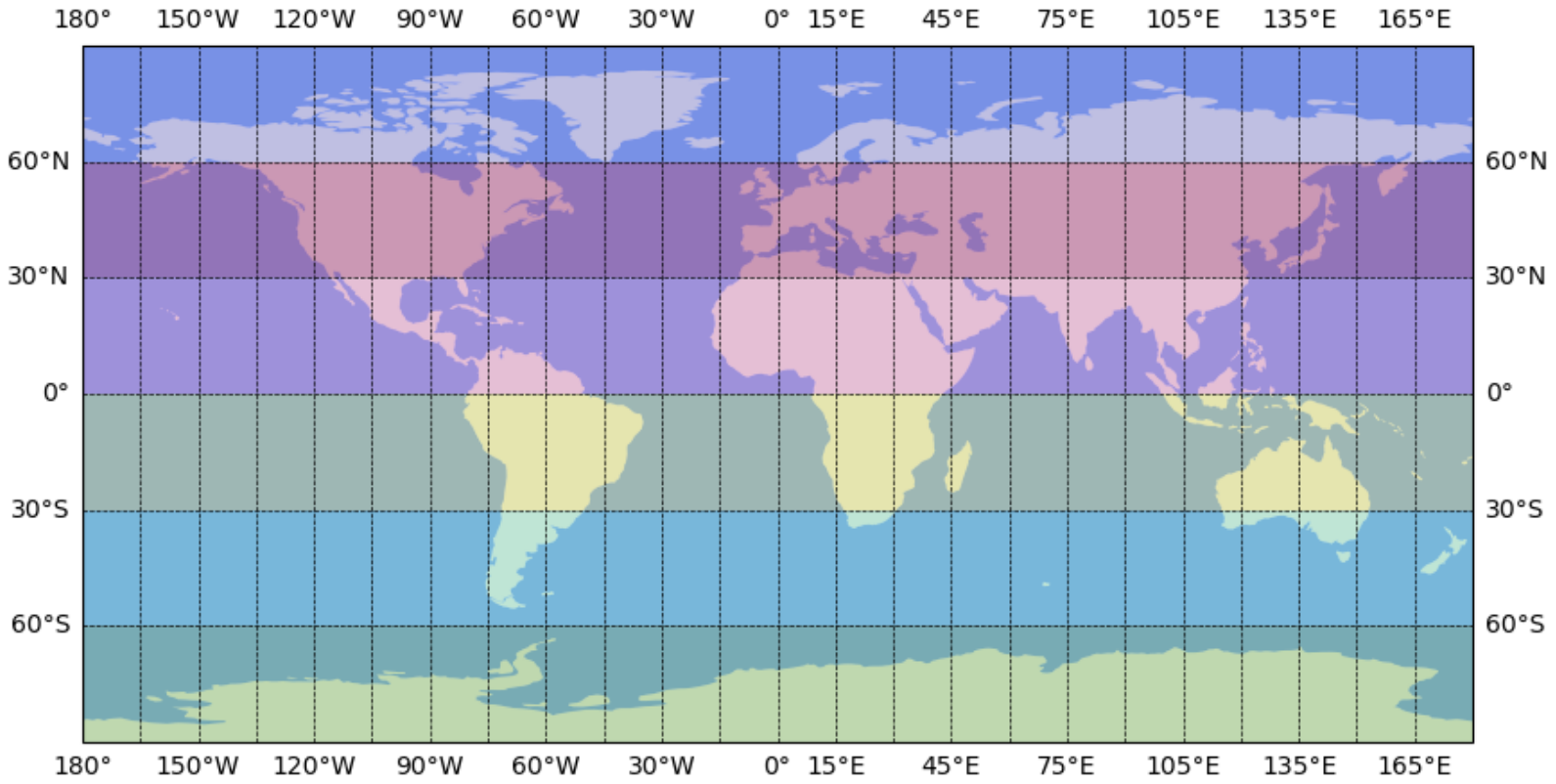
Affected Regions - Latitude Bands



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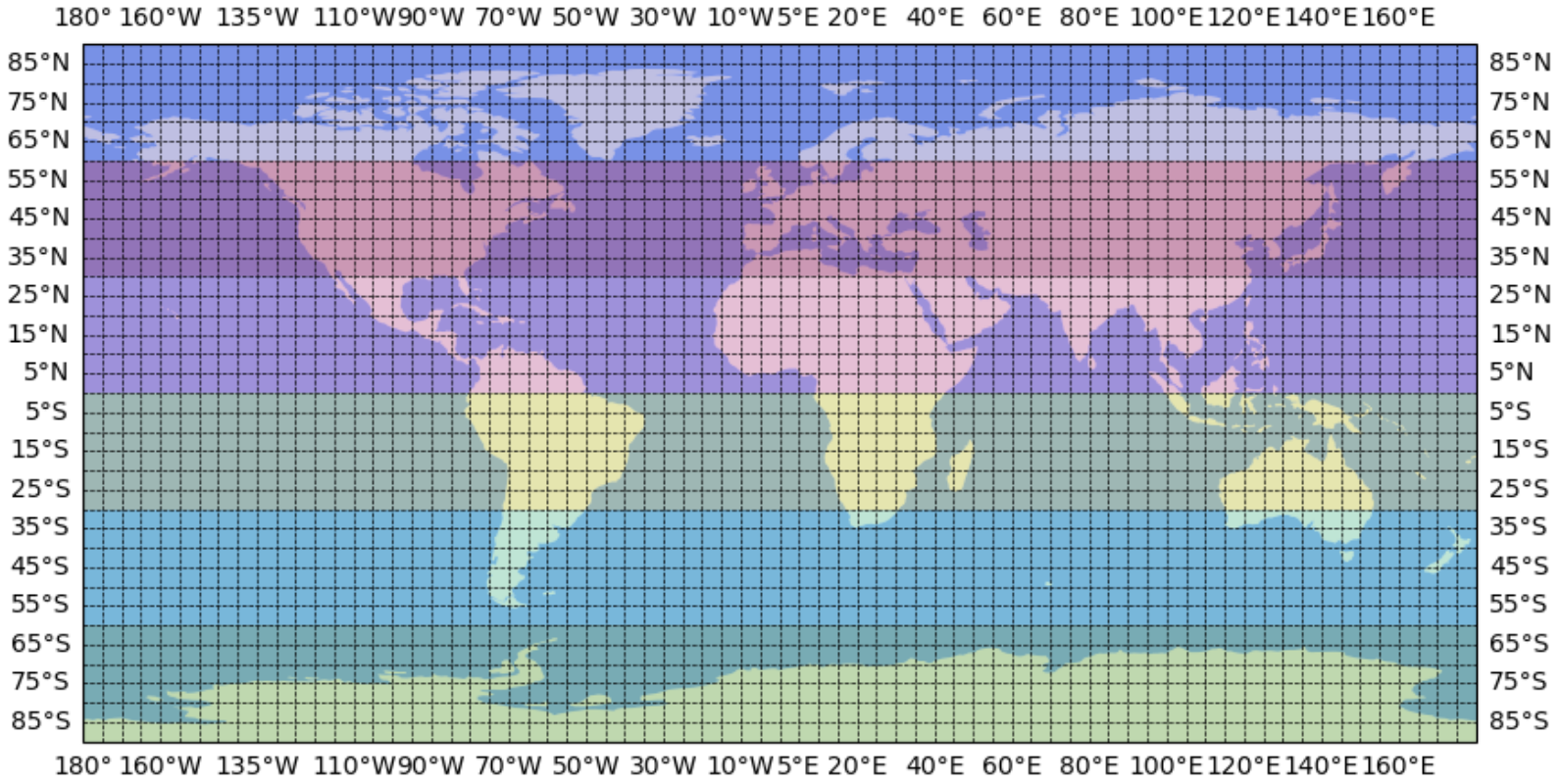
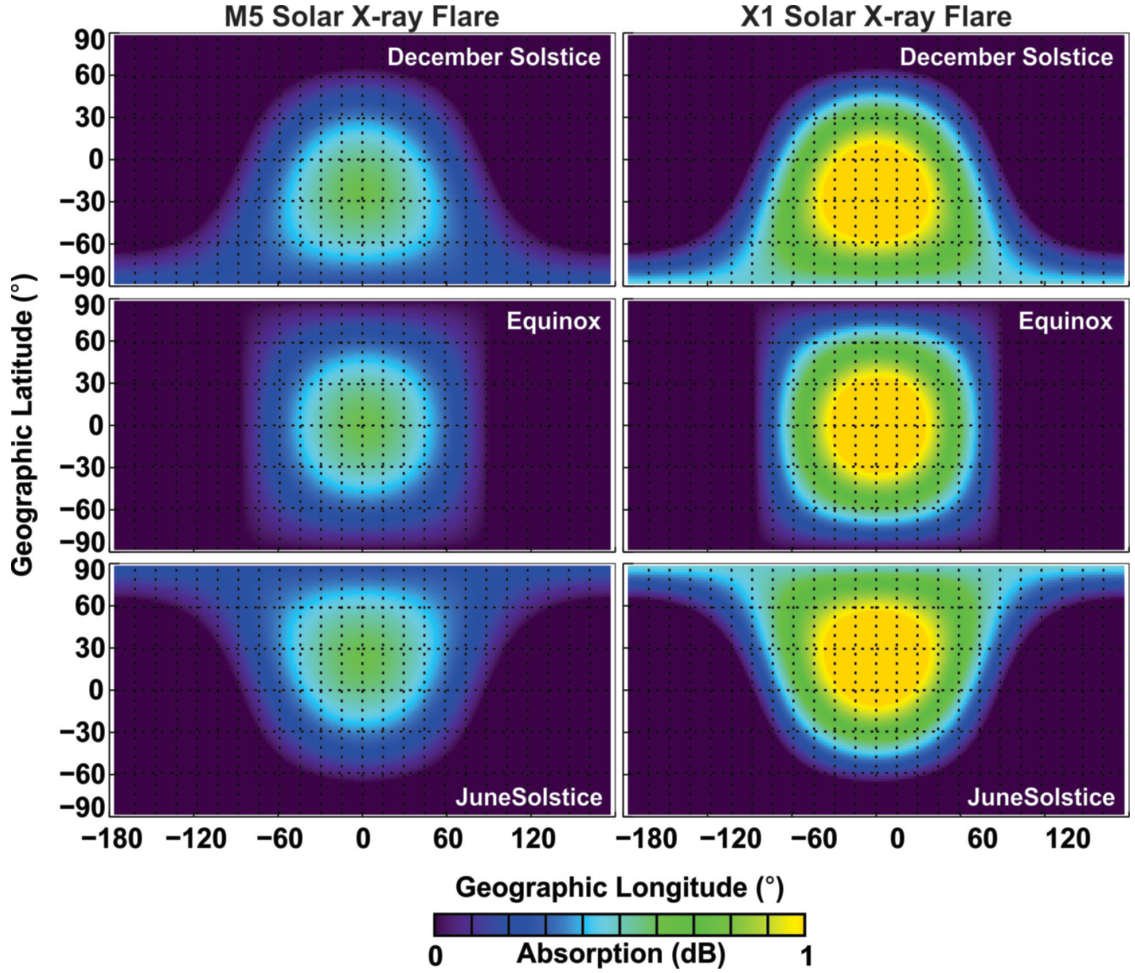
Affected Regions - Polygons



5˚ resolution

Affected Regions – Daylight side



- Modelled absorption for an M5 and X1 flare at different times of year demonstrate the extent of the “daylight side”

Forecast

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NXT ADVISORY: WILL BE ISSUED BY 20250328/0915Z=

- Forecast information at +6, +12, +18, and +24 hours
- 3 possible entries
  - Affected region
  - NO SWX EXP
  - NOT AVBL

What do these mean?

NO SWX EXP

NOT AVBL

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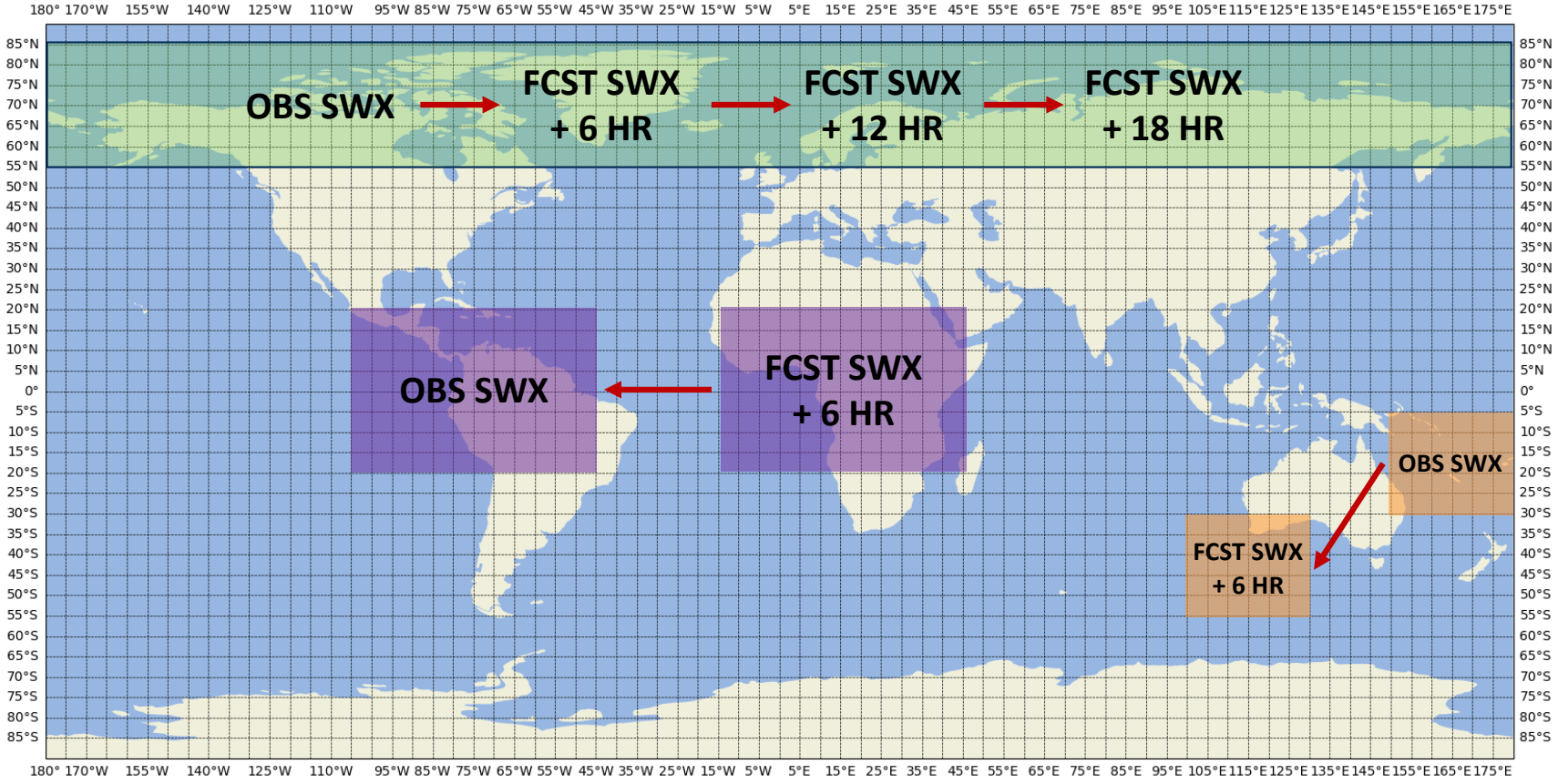
Forecast



Increased use of forecast information will reduce the number of advisories and aid in planning.

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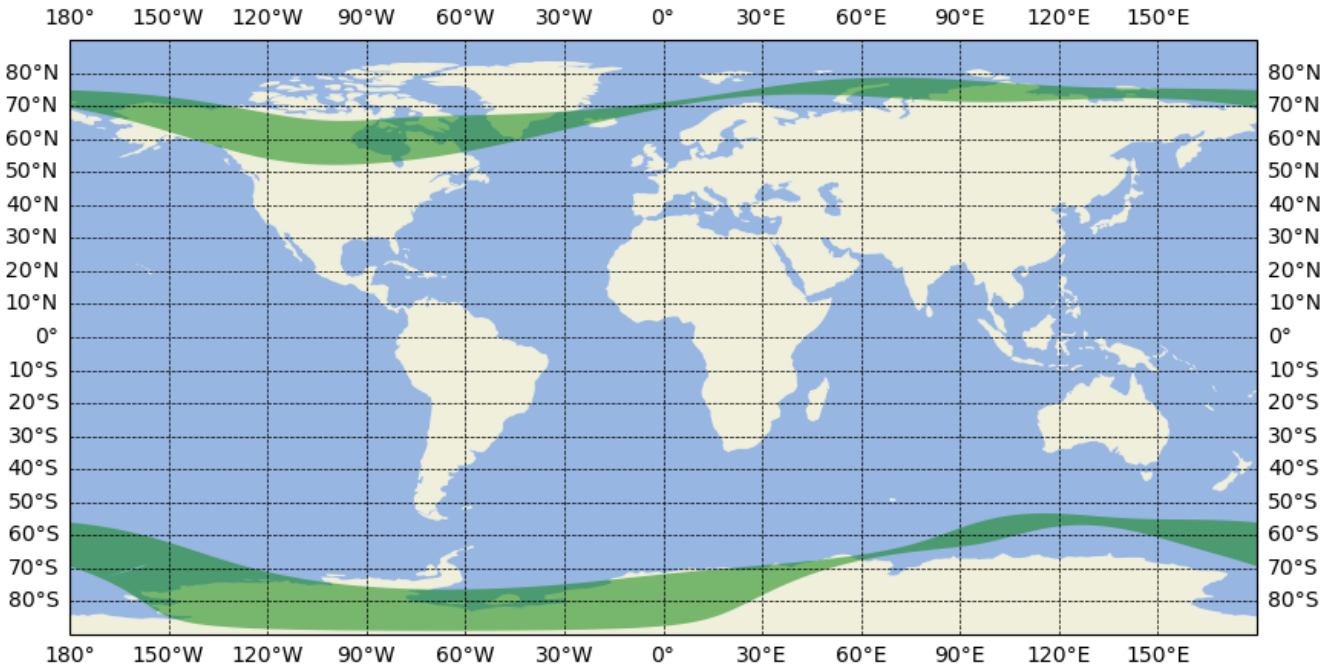
Challenges



- Space weather doesn't
  - conform to a geographic coordinate system
  - rotate with the Earth
- Space weather impacts can be
  - sporadic
  - unexpected
  - short-lived
- Space weather varies between types and sub-effects

Many advisories over a short period of time

Upcoming Changes

- Amendment 82 (November 2025)
  - MOD and SEV directly linked to the affected region instead of being reported in a separate line
  - Multiple affected regions reported at once, with multiple activity levels
  - Possibility to close multiple advisories simultaneously
  - Polygons (next presentation)
  - “DAYLIGHT SIDE” replaced with “DAYSIDE” and “NIGHTSIDE”
- Amendment 83 (November 2027)
  - Changing the FCST period from +6, +12, +18, +24 hours to +3, +6, +9, +12 hours.
  - Vertical resolution of RAD advisories changes from 1000 ft to 5000 ft
- Future changes
  - SWX forecast information product for +12 to +24 hours

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FNXX01 LFPW 191432
SWX ADVISORY
DTG: 20250328/0615Z
SWXC: ACFJ
SWX EFFECT: GNSS
ADVISORY NR: 2025/1
OBS SWX: 28/0615Z MOD S15 E080 - S15 E150 - N00 E150 - N00 E080 - S15 E080 MOD N15 E085 - N15 E145 - N30 E145 - N30 E085 - N15 E085
FCST SWX +6 HR: 28/1300Z NO SW EXP
FCST SWX +12 HR: 28/1900Z NO SW EXP
FCST SWX +18 HR: 29/0100Z NO SW EXP
FCST SWX +24 HR: 29/0700Z NO SW EXP
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Example 1 - GNSS

FNXX01 LFPW 220920
SWX ADVISORY
DTG: 20250328/0615Z
SWXC: ACFJ
ADVISORY NR: 2025/1
SWX EFFECT: GNSS MOD
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NXT ADVISORY: WILL BE ISSUED BY 20250328/0915Z=

What does it mean?

What actions would you take?

Example 2 – HF COM

FNXX02 KWNP 030034
SWX ADVISORY
DTG: 20250503/0034Z
SWXC: SWPC
ADVISORY NR: 2025/104
SWX EFFECT: HF COM SEV
OBS SWX: 03/0030Z EQN E030 - E105
FCST SWX +6 HR: 03/0700Z EQN W060 - E015
FCST SWX +12 HR: 03/1300Z EQN W150 - W075
FCST SWX +18 HR: 03/1900Z EQN E120 - W165
FCST SWX +24 HR: 04/0100Z EQN E030 - E105
RMK: HF COMM (SEV) POST STORM DEPRESSION (MAXIMUM USABLE FREQUENCY)EVENT IN PROGRESS
NXT ADVISORY: 20250503/0700Z=

What does it mean?

What actions would you take?

Example 3 - RAD

FNXX03 EFKL 242123
SWX ADVISORY
DTG: 20240324/2123Z
SWXC: PECASUS
ADVISORY NR: 2024/6
NR RPLC: 2024/4
SWX EFFECT: RADIATION SEV
OBS SWX: 24/2122Z HNH HSH MNH MSH W180 - E180
ABV FL430
FCST SWX +6 HR: 25/0400Z NOT AVBL
FCST SWX +12 HR: 25/1000Z NOT AVBL
FCST SWX +18 HR: 25/1600Z NOT AVBL
FCST SWX +24 HR: 25/2200Z NOT AVBL
RMK: SPACE WEATHER EVENT IN PROGRESS CAUSING INCREASED RADIATIONLEVELS AT FLIGHT ALTITUDE(S).
NXT ADVISORY: WILL BE ISSUED BY 20240325/0306Z=

What does it mean?

What actions would you take?

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Discussion Points

- Do you use the ICAO space weather advisories?
- Is the information actionable? Pre-flight vs in-flight?
- How much lead time is reasonably required to inform flight decisions?

Thank You