

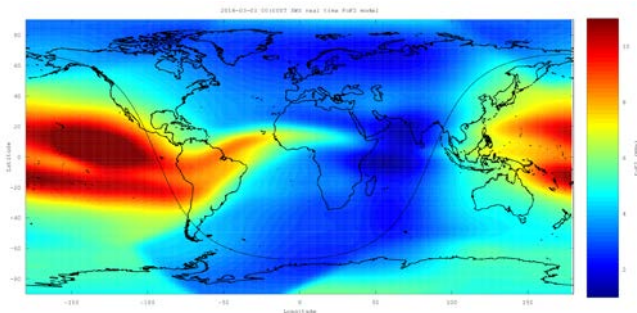
Space weather advisories

The Bureau of Meteorology is one of the ICAO designated Space Weather Advisory Centres responsible for monitoring and providing advisory information on space weather phenomena to the aviation industry.

Space weather advisories

Space weather can be described as the solar activity on the surface of the sun creating certain atmospheric events that can affect us here on earth. These environmental conditions are important for us to monitor as they can affect the performance and reliability of our satellites, navigation systems and radio communications. Those flying at high altitudes are also at risk of increased radiation exposure.

The effects of space weather events can last anywhere from a few seconds to a number of days. Space weather forecasts for international air navigation address the impact of particular types of disturbances, such as solar radiation storms, geomagnetic storms, ionospheric storms and solar flares. These forecasts enable operators to maintain awareness of potential hazards and to formulate alternative plans should the impending conditions be of a magnitude and/or type that could disrupt normal operations.



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



The aurora is the visible manifestation of space weather in the polar regions. Credit: NASA.

Space weather definitions

Code	Definition
SWX	Space Weather
SWXC	Space Weather Centre
ACFJ	Australia, Canada, France and Japan Consortium
PECASUS	Pan-European Consortium for aviation space weather user services
SWPC	Space Weather Prediction Centre
CRC	China Russia Consortium
HF COM	High frequency communications (propagation, absorption)
SATCOM	Communications via satellite (propagation, absorption)
GNSS	Global navigation satellite system-based navigation and surveillance (degradation)
RADIATION	Radiation at flight levels (increased exposure)
HNH	High latitudes northern hemisphere
MNH	Middle latitudes northern hemisphere
EQN	Equatorial latitudes northern hemisphere
EQS	Equatorial latitudes southern hemisphere
MSH	Middle latitudes southern hemisphere
HSH	High latitudes southern hemisphere

Space weather impacts and thresholds

The space weather advisory service targets three broad space weather impact areas for aviation: HF Communications (HF COM), GNSS-based navigation and surveillance (GNSS) and radiation impacts on avionics and human health (RADIATION). A fourth impact area (SATCOM) has been identified, however advisories for SATCOM will not be issued by any space weather centres until further work is undertaken to develop and validate operationally relevant advisory thresholds for this impact area. Further information can be found in the companion hazardous phenomena – space weather brochure.

Advisories are issued at either of two intensity thresholds: Moderate (MOD) and Severe (SEV). Alerting thresholds are defined in the ICAO Manual on Space Weather Information in Support of International Air Navigation (ICAO Doc 10100) and reproduced in the table below.

Effect	Sub-effect	Threshold Parameter	MOD	SEV
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 index	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) ($W\cdot m^{-2}$)	1×10^{-4} (X1)	1×10^{-3} (X10)
HF COM	Post-Storm Depression	Maximum Usable Frequency (MUF)**	30%	50%
SATCOM	No threshold has been set for this effect			

*MOD advisories will only be issued when the MOD threshold is reached between FL250 and FL460. SEV advisories will be issued when the SEV threshold is reached between FL250 and FL600.

**As compared to a 30-day running median.

Spatial ranges and resolution

Element to be forecast	Range	Resolution
Flight level affected by radiation	FL250 – FL600	30
Longitudes for advisories (degrees)	000° – 180° (E&W)	15
Latitudes for advisories (degrees)	00° – 90° (N&S)	10
Latitude bands for advisories (degrees and minutes)	High latitudes northern hemisphere (HNNH)	N90 – N60
	Middle latitudes northern hemisphere (MNNH)	N60 – N30
	Equatorial latitudes northern hemisphere (EQNNH)	N30 – N00
	Equatorial latitudes southern hemisphere (EQNSH)	S00 – S30
	Middle latitudes southern hemisphere (MNSH)	S30 – S60
	High latitudes southern hemisphere (HNSH)	S60 – S90

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 (optional field) – indicator of test or exercise.

TEST or EXER

Time of origin – year, month, day and time of issue followed by the letter Z (Coordinated Universal Time, UTC).

DTG: 20191108/0100Z

Name of SWXC – the name of the Space Weather Centre.

SWXC: ACFJ

Advisory number – year in full and unique message number.

ADVISORY NR: 2019/2

Number of advisory being replaced – number of the previously issued advisory being replaced. This field is not used for a new event.

NR RPLC: 2019/1

Space weather effect & intensity – effect and intensity of the space weather phenomenon.

SWX EFFECT: GNSS MOD

Observed or expected space weather phenomenon – day and time (UTC) of observed phenomenon (or forecast if phenomenon have yet to occur).

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

OBS SWX: 08/0100Z HNH HSH W075 – W030

Forecast (+6 HR) – day and time (UTC) (6 hours from the Time of Observation, rounded to the next full hour).

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

FCST SWX +6 HR: 08/0700Z HNH HSH E180 – W180

Forecast (+12 HR) – day and time (UTC) (12 hours from the Time of Observation, rounded to the next full hour).

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

FCST SWX +12 HR: 08/1300Z HNH HSH E180 – W180

Forecast (+18 HR) – day and time (UTC) (18 hours from the Time of Observation, rounded to the next full hour).

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

FCST SWX +18 HR: 08/1900Z HNH HSH E180 – W180

Forecast (+24HR) – day and time (UTC) (24 hours from the Time of Observation, rounded to the next full hour).

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

FCST SWX +24 HR: 09/0100Z HNH HSH E180 – W180

Remarks – remarks, as necessary.

RMK: SPACE WEATHER EVENT IN PROGRESS IMPACTING GNSS PERFORMANCE IN THE AURORAL ZONE. THIS ACTIVITY IS EXP TO SUBSIDE IN THE FCST PERIOD.

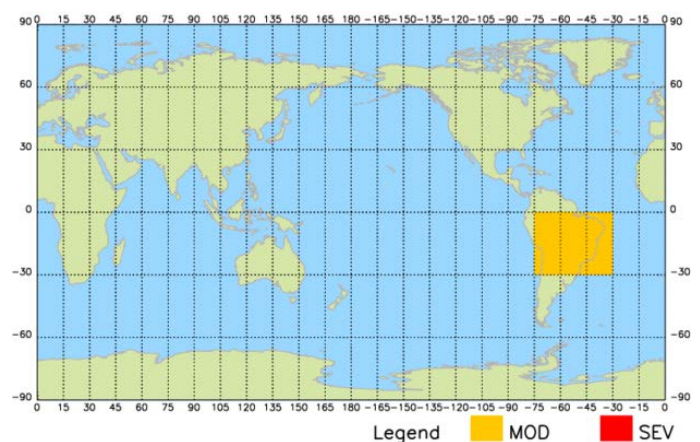
Next advisory – next update (year, month, day and time in UTC) or end of event by stating 'No Further Advisories'.

NXT ADVISORY: NO FURTHER ADVISORIES

Examples – observed or expected space weather phenomena

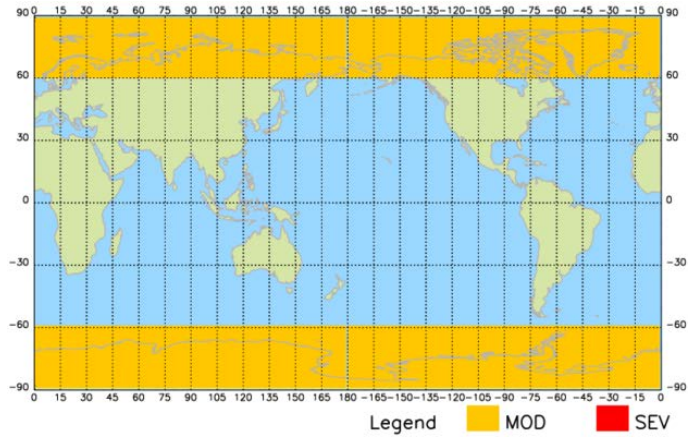
Space weather advisory message (GNSS effects)

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SWX ADVISORY
DTG: 20221109/0057Z
SWXC: PECASUS
ADVISORY NR: 2022/60
SWX EFFECT: GNSS MOD
OBS SWX: 09/0054Z EQS W075 - W030
FCST SWX +6 HR: 09/0700Z NOT AVBL
FCST SWX +12 HR: 09/1300Z NOT AVBL
FCST SWX +18 HR: 09/1900Z NOT AVBL
FCST SWX +24 HR: 10/0100Z NOT AVBL
RMK: SPACE WEATHER EVENT (IONOSPHERIC DISTUR-
BANCE) IN PROGRESS. IMPACT ON GNSS PERFORMANCE
POSSIBLY LEADING TO LOSS OF GNSS SIGNALS
AND/OR DEGRADATION OF TIMING AND POSITIONING
PERFORMANCE.
NXT ADVISORY: WILL BE ISSUED BY 20221109/0654Z=
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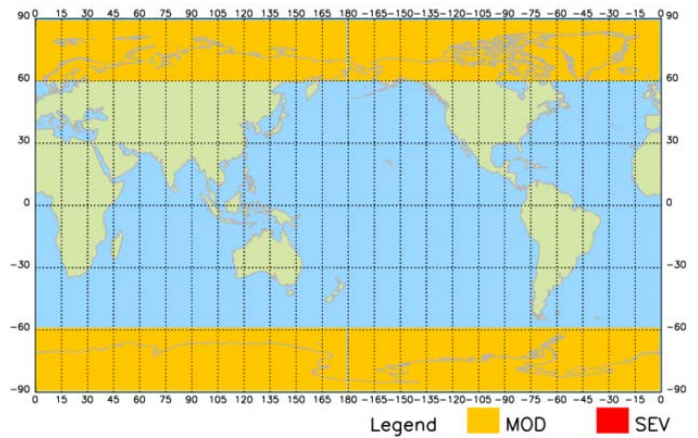
Space weather advisory message (GNSS effects)

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



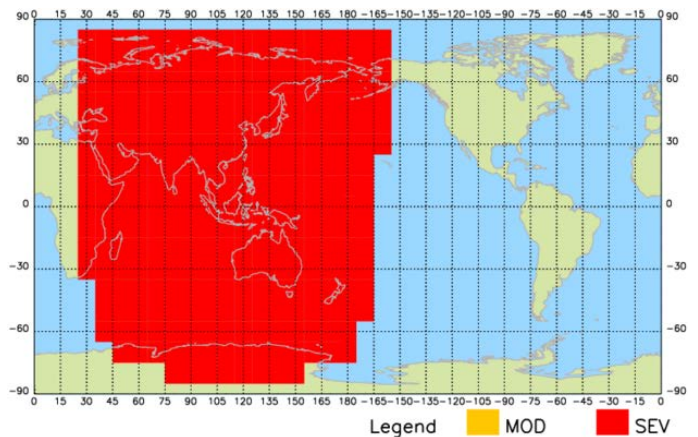
Space weather advisory message (RADIATION effects)

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



Space weather advisory message (HF COM effects)

SWX ADVISORY
 DTG: 20191108/0100Z
 SWXC: ACFJ
 ADVISORY NR: 2019/1
 SWX EFFECT: HF COM SEV
 OBS SWX: 08/0100Z DAYLIGHT SIDE
 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.
 NXT ADVISORY: WILL BE ISSUED BY 20191108/0700Z



Further aviation educational resources produced by the Bureau of Meteorology can be found at www.bom.gov.au/aviation/knowledge-centre.

| A vertical line in the margin indicates a text amendment since last update.

Contact us



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