

Space Weather for Aviation - SWIC course-

Part 2

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24 May 2023



Addendum: Miscellaneous slides plus Detailed information on ICAO SWx advisories



Motivation



SPACE WEATHER PREDICTION CENTER

Thursday, April 20, 2023 04:00:03 UTC



https://www.swpc.noaa.gov/products/solar-cycle-progression





SIDC - Solar Influences Data Analysis Center

ium forecast of 12 Jul 2021 Fl

Flares: Quiet Geomagnetism: Acti

PRESTO ALERT

Source	SIDC (RWC-Belgium)
Frequency	ASAP, when needed
Format	Plain text
Mail header	PRESTO ALERT
SIDC code	presto
<pre>:Issued: 2023 Mar 29 0827 UTC :Product: documentation at http://www.sidc.be/products/p # # FAST WARNING 'PRESTO' MESSAGE from the SIDC (RWC-Belg # An X1.1-class flare has occurred with a peak time at 02: Its source region, NOAA AR 3256, is currently the most c the visible side of the solar disk with a beta-gamma con photospheric magnetic field. This region is currently lo South-West solar limb. Closely before the recorded flare starting at 02:12 UTC on March 29, an associated coronal (CNE) was observed in SOH0/LASCO-C2. Based on the width and the location of the source region, we do not expect Earth. The flaring activity over the next 24 hours is ex mostly at low levels with C-class flares, with possible for a core years.</pre>	resto fium) # 33 UTC on March 29. complex region on ifiguration of the coated near the peak time, mass ejection of the observed CME the CME to reach isolated M-class approxed the communication the observed communication the observed communication the observed communication the communication the observed communication t
# Solar Influences Data analysis Center - RWC Belgium # Royal Observatory of Belgium #	15 / ye

Details

Not available yet. Check the ISES code book for information on ISES codes

https://www.sidc.be/products/presto/

NOAA SPACE WEATHER SCALES

 Physical measure	Average Frequency (1 cycle = 11 years)		
X20 (2 x 10 ⁻³)	Less than 1 per cycle		
X10 (10 ⁻³)	8 per cycle (8 days per cycle)		
X1 (10 ⁻⁴)	175 per cycle (140 days per cycle)		
M5 (5 x 10 ⁻⁵)	350 per cycle (300 days per cycle)		
M1 (10 ⁻⁵)	2000 per cycle (950 days per cycle)		

https://www.swpc.noaa.gov/noaa-scales-explanation



➢ Rules

FAA requires radiation dose information, not accounting, for all
 and a radiation exposure mitigation plan for polar flights

About Jobs Search News **Federal Aviation** dministration Aircraft Air Traffic Airports Pilots & Airmen Data & Research Regulations Spa FAA Home + Regulations & Policies + Advisory Circulars (ACs) Advisory Circulars (ACs) AC 120-61B - In-flight Radiation Airworthiness Directives (ADs) Exposure FAA Regulations Document Information Forms Advisory Circulars home Handbooks & Manuals Notices to Air Missions (NOTAM) Orders & Notices 120-61B - In-flight Radiation Exposure Pilot Records Database Policy & Guidance Date Issued Rulemaking November 21, 2014 **Temporary Flight Restrictions Responsible Office** (TFRs) AFS-200 Description This advisory circular (AC) provides basic background information and links to sources of more detailed information that can be used to improve air carrier programs that inform crewmembers about in-flight ionizing radiation exposure. AC 120-61B (PDF, 131 KB)

https://www.govinfo.gov/app/details/CFR-2016-title14-vol3/CFR-2016-title14-vol3-part121-appP https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1026386 14 CFR Appendix P to Part 121 - Requirements for ETOPS and Polar Operations

Summary	Documen	t in Context	Related Documents ()				
Category		Regulatory Infor					
Collection		Code of Federal Regulations (annual edition)					
SuDoc Class	Number	AE 2.106/3:14/					
Contained W	/ithin	Title 14 - Aeronautics and Space					
		Chapter I - FEDERAL AVIATION ADMINISTRATION, DEPARTMENT OF					
		TRANSPORTATION (CONTINUED)					
		Subchapter G - AIR CARRIERS AND OPERATORS FOR COMPENSATION OR HIRE:					
		CERTIFICATION AND OPERATIONS					

(....) Section III.

Approvals for operations whose airplane routes are planned to traverse either the North Polar or South Polar Areas. (...) (6) A training plan for operations in these areas.

(7) A plan for mitigating crew exposure to radiation during solar flare activity.

(8) A plan for providing at least two cold weather anti-exposure suits in the aircraft (...)



➢ ICAO

SPACE WEATHER CONTINGENCY PROCEDURES

NORTH ATLANTIC REGION

1. Introduction

1.1 Space Weather is a phenomenon associated with solar activity events such as Geomagnetic Storms, X-ray Flares, Solar Radiation Storms, Ionospheric Storms and Sunspot which present a recognised risk to air transport. Typically, the amount of solar radiation detected increases with increasing altitude but during a severe space weather event, increased levels of solar radiation can be experienced globally by aircraft both at altitude and at ground level.

1.2 Severe space weather events may cause degradation or loss of multiple ATC Systems, Aircraft Systems including GNSS, Microwave Links, Satellite reliant communications, RF issues (i.e., VHF Datalink) and may cause National Power Grid outages. Effects can be localized to only one FIR or may affect multiple FIRs, including the whole of the North Atlantic Region (NAT) and beyond.

1.3 Various space weather types are predictable to variable extents; however, the operational impact of these phenomena is hard to quantify both in severity and in location. ANSPs are well aware of HF issues and have many years of experience mitigating the operational impacts. GNSS uncertainties are more significant in the NAT Region and may require contingency processes such as greater spacing between aircraft as a function of phase of flight or the use of alternative means of communication, navigation and/or surveillance.

1.4 ANSPs and Operators should be aware of the range of potential difficulties that space weather phenomena can cause and should monitor space weather forecasts and have in place contingency measures to mitigate possible negative effects.

((Excerpt))

https://bit.ly/3XQCpDT



≻ EU / EASA §§§

L 289/12 EN

Official Journal of the European Union

12.8.2021

COMMISSION IMPLEMENTING REGULATION (EU) 2021/1338

of 11 August 2021

amending Implementing Regulation (EU) 2017/373 as regards reporting requirements and reporting channels between organisations, and requirements for meteorological services

(.....)

On 7 March 2018 and on 9 March 2020, the International Civil Aviation Organization (ICAO) adopted Amendment 78 and Amendment 79, respectively, to Annex 3 to the Convention on International Civil Aviation, signed on 7 December 1944 in Chicago ('the Chicago Convention') aiming, among other things, to enhance and improve harmonisation as regards the exchange of meteorological observations and reports (aerodrome routine meteorological reports (METAR)/aerodrome special meteorological reports (SPECI)), aerodrome forecasts (TAF), information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations (AIRMET), volcanic ash and tropical cyclone advisory information, space weather advisory information, etc., in a system-wide information management (SWIM)-compliant environment. Those amendments are applicable in the

ICAO Contracting States as of 8 November 2016 This Regulation shall enter into force on the twentieth day following that of its publication in the Official Journal of the format, the date of application of which is aligned European Union.

should be reflected in Implementing Regulation Point 32 of Annex IV and Annex V shall apply from 12 August 2021. requirements for meteorological service providers s

(.....

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 11 August 2021.

For the Commission The President Ursula VON DER LEYEN

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1338&from=EN



≻ EU / EASA §§§

Easy Access Rules for Air Traffic Management/Air Navigation Services (Regulation (EU) 2017/373)



MET.OR.240 Information for use by operator or flight crew

Regulation (EU) 2021/1338

An aerodrome meteorological office shall provide operators and flight crew members with the latest available:

- (a) forecasts, originating from the WAFS, of the elements listed in points (1) and (2) of point MET.OR.275(a);
- (b) METAR or SPECI, including TREND, TAF or amended TAF for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;
- (c) aerodrome forecasts for take-off;
- (d) SIGMET and special air-reports relevant to the whole route;
- volcanic ash, tropical cyclone and space weather advisory information relevant to the whole route;
- (f) area forecasts for low-level flights prepared in combination with the issuance of AIRMET, and AIRMET relevant to the whole route;
- (g) aerodrome warnings for the local aerodrome;
- (h) meteorological satellite images;
- (i) ground-based weather radar information.

https://www.easa.europa.eu/en/downloads/125141/en



➤ real NOTAM, different event/day

> ADVISORY: **GLOBAL HF SEV.** Go or no-go ?

A0071/23 NOTAM

Q) BIRD/QGAAU/I /NBO/A /000/999/6539N01804W005 A) BIAR B) 2303231016 C) 2303291559

E) BE AWARE OF LESS THAN NOMINAL EGNOS AVAILABILITY:

- LIKELYHOOD OF AVAILABILITY OR CONTINUITY LOSS INCREASED
- LPV FLIGHT PLANNING IS STILL POSSIBLE WITH THESE SERVICE LIMITATIONS

23 MAR 2023



NOTE:

Airline

Briefing

Packages

may not

contain

NOTAM !!

SBAS

Space Weather impacting Aviation - Examples: Navigation

➤ WAAS and EGNOS NOTAM sources

) SAFETY			Sea	rch	٩	
About ICAO Glob	al Priorities Events	Information Resources	Careers	UnitingAviation	ICAO TV	Subscribe	
ICAO / Safety / iStars / N	OTAMS						
iSTARS iSTARS 4.0 Coming Soon	NOTAMS						
iSTARS 4.0 Advisory Group	In-h	NOTAMA					
What is iSTARS?		NOTAIVIS					
Register to Access iSTARS							
How does iSTARS work?							
Catalogue of Solutions	Global repository	of actual NOTAMS	5				
iSTARS User Group (iUG/01) Meeting	This application p	rovides search an	d analysis o	apabilities of NC	TAM message	s. NOTAMs are collec	ted on a 12h
iUG/01 Agenda and Presentations	schedule from the searched using ke	e US Defense Inter eywords.	rnet NOTAN	1 Service and cla	assified. NOTAN	//S are grouped by Q-	code and can be
NOTAM Services	Search through a	INOTAMS by ent	ering your k	eywords or by se	electing a prede	efined search combina	ation like the EBOLA
NOTAM	Outbreak worldv	vide.					
Chat with NORM	Messages where	the title is in blue	with a left bl	ue bar are new,	meaning create	ed in the preceding 72	hours.
Get NOTAM Data	The application is	a simplified version	on of the NC	TAM applicatio	on on iSTARS 2	2.0 SPACE. Additional	l features include
NOTAMETER	personalization	of State grouping	gs, saving a	and sharing of s	earch criteria	and generation NOT	AM analysis
Example of iSTARS Apps	graphs. Register	now to have acce	ss to all tho	se features.		*	
Al-driven A40 WPs	Location type An	v					
Airspace Contingency Planning	Airport or Airspac	e code(s)					
Air Transport Accessibility	Comma seperated, takes precedence ov	er any state or region selection					
Tsunami Awareness	Share-separation means 4NP. Calambas	thmuch the whole MOTEM text					
Accident Statistics	ECNOS	a unougraphe vinture reconnected.					
Approach Paths	EGNOS				or		

https://www.icao.int/safety/istars/pages/notams.aspx

Select area of interest, choose 'Any' location type, look for WAAS or EGNOS as required.

2023



- Space Weather impacting Aviation Examples: Navigation
 - ➤ WAAS and EGNOS NOTAM sources

	FAA) }		FNS NOTAM Search				음 Sign In	i Disclaimer	Feedback	? Help -	Weld &	on Ex	
Searched a → Locat	t: 2023-03-24 06 ion search o	:17:29 UTC 4	6 NOTAM(s) filtere	d.) (s) found.									[Char
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0	FDC	3/1931	Procedure	03/23/2023 2339	C	3/24/2023 2200	NAV WAAS VNA	V/LPV/L	P MINIMA M	AY NOT BE AVE	L 2303232339-2	2303242200	EST	

- Enter location code KFDC. That's an administrative code normally <u>NOT SHOWN</u> in briefing packages
- ➢ Use filter function for 'WAAS' to find WAAS NOTAM

Condition

NAV WAAS VNAV/LPV/LP MINIMA MAY NOT BE AVBL 2303232339-2303242200EST

https://notams.aim.faa.gov/notamSearch/nsapp.html#/

Airline Briefing Packages may not contain SBAS NOTAM !!



- Space Weather impacting Aviation Examples: Navigation
- WAAS GPS short term , local service interruption during Sept. 2017 solar activity



WAAS LPV200 Coverage Contours

Summary

The Wide Area Augmentation System, a GPS enhancement, had a very localized, short term service interruption during the Sept. 2017 solar flares / ionospheric disturbances.



> ADVISORY: GNSS SEV. Go or no-go ? That's the question !



https://www.nstb.tc.faa.gov/



STCE Newsletter

21 Nov 2022 - 27 Nov 2022



Published by the STCE - this issue : 2 Dec 2022. Available online at https://www.stce.be/newsletter/ .

The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

> The Science

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Final Editor : Contact : Petra Vanlommel R. Van der Linden, General Coordinator STCE, Ringlaan - 3 - Avenue Circulaire, 1180 Brussels, Belgium







ICAO SWx advisories Website of PECASUS, with link to real-time advisories

	In anusaa	Drone forecast into Fi
	Weather on map.	LLF-forecast Warnings
PECASUS Strengths	Warnings © 2022-04-02 16:08:00 FNXX02 EFKL 021607 SwX ADVISORY DTG: 20220402/1608Z SWXC: PECASUS ADVISORY NR: 2022/33 SwX EFFECT: HF COM MOD OBS SWX: 02/16012 HNH HSH W180 - E180 FCST SWX +6 HR: 02/23002 HNH HSH W180 - E180 FCST SWX +10 HR: 03/1002 HNH HSH W180 - E180 FCST SWX +12 HR: 03/11002 HNH HSH W180 - E180 FCST SWX +24 HR: 03/11002 HNH HSH W180 - E180 FCST SWX +24 HR: 03/11002 HNH HSH W180 - E180 FCST SWX +24 HR: 03/11002 HNH HSH W180 - E180 RMK: SPACE WEATHER EVENT (HF COM POLAR CAP ABSORPTION) IN PROGRESS. IMPACT ON LOWER HF COM PREQUENCY BANDS EXPECTED AT HIGH LATTIUDES. HIGHER FREQUENCY BANDS MAY BE LESS IMPACTED. SOUTHERN HEMISPHERE LESS IMPACTED MAY BE LESS IMPACTED. SOUTHERN HEMISPHERE LESS IMPACTED MAY ADVTSORY: WTU BE TSSIED BR 202/02/22012	A UNE
<image/> <image/> <image/>	SIGMET + ARS + WXREP SUX TC+VA Warnings (current + 24h history) SUX TC+VA ©2022-04-02 16:08:00 FNXX02 EFLK 021607 SWK ADVISORY DTG: 2022/0402/16:082 SWK ADVISORY DTG: 2022/33 SWK FEFECT: HF COM MOD 065 SWK: OSS SWK : EFFECT: HF COM MOD DFS SWK : 12 HR: 03/1002 HNH HSH W180 - E180 FCST SWK +12 HR: 03/1002 HNH HSH W180 - E180 FCST SWK +12 HR: 03/11002 HNH HSH W180 - E180 FCST SWK +14 HR: 03/11002 HNH HSH W180 - E180 FCST SWK +14 HR: 03/11002 HNH HSH W180 - E180 FCST SWK +24 HR: 03/11002 HNH HSH W180 - E180 FCST SWK +24 HR: 03/11002 HNH HSH W180 - E180 FCST SWK +24 HR: 03/11002 HNH HSH W180 - E180 RCST SWK +24 HR: 03/11002 HNH HSH W180 - E180 RWK: SPACE WEATHER EVENT (HF COM POLAR CAP ABSORPTION) IN PROFERSES. IMPACT ON LOWER HF COM FREQUENCY BANDS EXPECTED AT HIGH LATITUDES. HIGHER FREQUENCY BANDS MYT ADVISORY: WILL BE ISSUED BY 20220402/22012= NYT ADVISORY: WILL BE ISSUED BY 20220402/22012=	
	Finnish Meteorological Institute ilmailu@ilmatieteenlaitos.fi 0600 9 3808./2 532/min	

https://www.ilmailusaa.fi/warnings.html#top=0#id=swx#FMILang=en#select-area=4

Under development: MAP service: https://swx-map-service-test.herokuapp.com/



ICAO SWx advisories Overview of affected systems covered. Advisories only provided when thresholds are reached

Annex 3 — Meteorological Service for International Air Navigation

Appendix 2

6. SPACE WEATHER CENTRES

6.1 Space weather advisory information

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)	SATEOM
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	MOL
severe	SEV



ICAO SWx advisories

> Thresholds for ICAO SWx advisory issuance

Table 3-1. Thresholds for space weather advisory

		Moderate	Severe
GNSS			
	Amplitude Scintillation (S4)(dimensionless)	0.5	0.8
	Phase Scintillation (Sigma-Phi)(radians)	0.4	0.7
	Vertical TEC (TEC Units)	125	175
RADIATION			
	Effective Dose (micro-Sieverts/hour)*	30	80
HF			
	Auroral Absorption (Kp)	8	9
	PCA (dB from 30MHz Riometer data)	2	5
	Solar X-rays (0.1 - 0.8 nm)(W-m ⁻²)	1X10 ⁻⁴ (X1)	1X10 ⁻³ (X10)
	Post-Storm Depression (MUF)**	30%	50%

* 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 FL.

** As compared to a 30-day running median of the critical frequency of the F2 layer (foF2).

Note.— A more detailed description of how these values were determined can be found in Appendix 1.

Source: ICAO Doc 10100



➢ ICAO SWx advisories

Locating space-weather phenomena



Summary

Similar to the geographic coordinate system, there is a geomagnetic coordinate system which shows relationships for the earth's magnetic field and the earths magnetic poles.

The magnetic field has a prominent role in radiation shielding, which is strongest around the equator. The bent latitude lines indicate similar magnetic (shielding) properties, relevant to space weather .



Source: ICAO Doc 10100



ICAO SWx advisories

- Locating space-weather phenomena: merging the geomagnetic chart and the geographic chart.
- \succ A simplification to make working with SWx possible.



Source: ICAO Doc 10100



ICAO SWx advisories

Locating space-weather phenomena



Chart: Australian Bureau Of Meteorology http://www.bom.gov.au/aviation/space-weather-advisories/



Volcanic Ash Advisory <> SWx Advisory (ICAO Annex 3)

FVXX23 KNES 141138 VA ADVISORY DTG: 20181014/1138Z

VAAC: WASHINGTON

VOLCANO: FUEGO 342090 PSN: N1428 W09052

AREA: GUATEMALA

SUMMIT ELEV: 12346 FT (3763 M)

ADVISORY NR: 2018/548

INFO SOURCE: GOES-EAST. NWP MODELS. CIMSS VOLCAT.

ERUPTION DETAILS: ONGOING VA EMS

OBS VA DTG: 14/1115Z

OBS VA CLD: SFC/FL170 N1429 W09053 - N1428 W09052 - N1412 W09119 - N1426 W09122 - N1429 W09053 MOV SW 5-10KT

FCST VA CLD +6HR: 14/1730Z SFC/FL170 N1429 W09053 - N1428 W09052 - N1413 W09123 - N1428 W09126 -N1429 W09053

FCST VA CLD +12HR: 14/2330Z SFC/FL170 N1429 W09053 - N1428 W09052 - N1412 W09123 - N1428 W09126 - N1429 W09053

FCST VA CLD +18HR: 15/0530Z SFC/FL170 NO ASH EXP

RMK: VA EMS CONT TO MOV WSW AND EXTD ROUGHLY 30 NM FM SUMMIT. NWP MODEL GUIDANCE CONT TO SHOW A W-LY MOV THRU T+12 HRS. ...KIBLER SWX ADVISORY DTG: 20161108/0100Z

SWXC: DONLON*

ADVISORY NR: 2016/2

NR RPLC: 2016/1

SWX EFFECT: HF COM MOD AND GNSS MOD

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

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

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

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

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

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

NXT ADVISORY: NO FURTHER ADVISORIES



ICAO SWx advisories in flight operations First real SWx advisory ever issued. 28 September, 2020

(92020-09-28 05:55:00 FNXX01 YMMC 280555 SWX ADVISORY DTG: 20200928/0555z SWXC: ACFJ ADVISORY NR: 2020/26 SWX EFFECT: HF COM MOD OBS SWX: 28/0532Z HNH MNH E000 - E060 FCST SWX +6 HR: 28/1200Z NO SWX EXP FCST SWX +12 HR: 28/1800Z NO SWX EXP FCST SWX +18 HR: 29/0000Z NO SWX EXP FCST SWX +24 HR: 29/0600Z NO SWX EXP SPACE WEATHER EVENT (MAXIMUM USABLE FREQUENCY RMK: DEPRESSION) IN PROGRESS IMPACTING HIGHER HF COM FREQUENCY BAND. LOWER FREQUENCIES MAY BE LESS IMPACTED, ISOLATED AREAS OF SEV HE COM DEGRADATION POSSIBLE. NXT ADVISORY: WILL BE ISSUED BY 20200928/1140Z=

No warnings



Decoding

Issued 2020 Sep 28, 0555 GMT, by SWx Centre ACFJ Impact: HF COM MOD Observed SWx at 05:32 GMT: affected area: high latitudes N hemisphere mid latitudes N hemisphere 00E - 060 E Forecast SWx 28 / 12 GMT no SWx expected (...)





ICAO SWx advisories in flight operations ADVISORY: RADIATION MOD

r		Decoding
SWX ADVISORY		
DTG: SWXC:	20161108/0000Z DONLON*	Issued 2016 NOV 08, 00:00 GMT, by SWx Centre DOLON (fictitious)
ADVISORY NR.	2016/2	Impact: Radiation Moderate
NR RPLC:	2016/1	Forecast SWx 08 / 01 GMT
SWX EFFECT:	RADIATION MOD	high latitudes N hemisphere
FCST SWX: FCST SWX +6 HR·	08/0100Z HNH HSH E18000 – W18000 ABV FL 350 08/0700Z HNH HSH E18000 – W18000 ABV FL 350	high latitudes S hemisphere
FCST SWX +12 HR:	08/1300Z HNH HSH E18000 – W18000 ABV FL 350	180E to 180 W
FCST SWX +18 HR:	08/1900Z HNH HSH E18000 – W18000 ABV FL 350	100E 10 160 W
FCS1 SWX +24 HR:	09/0100Z NO SWX EXP	Above FL 350
KMK:	AND ABV THE CURRENT EVENT HAS PEAKED AND I VI SI W RTN TO	()
	BACKGROUND LVL. SEE WWW.SPACEWEATHERPROVIDER.WEB	
NXT ADVISORY:	NO FURTHER ADVISORIES	Meaning: above FL 350, radiation dose
* Ficticious location	(sample advisory, ICAO Annex 3)	rate will be above moderate threshold.



Consequences (EASA):

Planning: plan to fly below this FL.

En route, in flight: request lower FL from air traffic control if flying higher than FL 350. Check fuel reserves - they may / may not be sufficient. Maintain FL, if no lower FL is available. Study on mitigation: https://www.swscjournal.org/articles/swsc/pdf/2015/01/swsc140044.pdf



End of presentation - addendum

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