SPACE WEATHER SERVICE FOR AVIATION

ICAO Space Weather Service

PECASUS

PAN-EUROPEAN CONSORTIUM FOR AVIATION SPACE WEATHER USER SERVICES Kari Österberg, Chief Operating Officer of PECASUS Riikka Pusa, Head of Aviation and Defence **www.pecasus.org**

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- Why we are here? Part one
 - What is space weather (SWX)
 - The effects of SWX on aviation
- Why we are here? Part two
 - Delivery issues
 - Example of Space Weather Advisories
 - Global Space Weather Centers
 - Dissemination of Space Weather Advisories

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Introduction video of Space Weather

https://www.youtube.com/watch?v=xWPdVe7hPlU

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Space weather impacts civil aviation

• Disturbances in HF communication

- Anomalous propagation paths
- Variations in the usable frequencies
- Problems in Global Navigation Satellite Systems (GNSS)
 - Errors in positioning
 - Scintillation in the signal amplitude and phase
- Radiation at flight altitudes
 - Flights across polar regions
 - Air crew: Accumulated doses





History of Space Weather Information Service (SWX)

- **1970** Interest in SWX Information originated from supersonic operations
- 2011 IATA informed ICAO that space weather information is considered an operational requirement
- 2011-2012 Development of the Concept of Operations for SWX
- 2014 ICAO, in coordination with WMO, decided to develop SARPs for Space Weather Information Service
- Jun 2018: ICAO Council approved the requirements for SWX in Annex 3 (Amd 78)
- Nov 2018: ICAO Council designated 3-4 global SWX Centers to provide
- Nov 2019: Global SWX Centers started SWX service provision



ICAO's Specification for Space Weather Service

SWX Center monitors and predicts space weather phenomena that have an impact on:

- HF radio communications (HF COM)
- GNSS-based navigation and surveillance (GNSS)
- Radiation exposure at flight levels (RADIATION)

SWX advisories are mandatory briefing information to operators and flight crew members based on Annex 3





• According to IFALPA and some individual pilots:

Pilots don't know about the space weather service and they've NEVER seen an advisory

- About 100 SWX advisories has been issued this year
- Airlines don't have it on their EFB
- Activity of the sun is increasing



Picture: ESA; Forecast NOAA



Example of Space Weather Advisory

- SWX Advisory is similar in structure to volcanic ash and tropical cyclone strictly formulated advisories
- Spatial range of SWX Advisory can be very large
- SIGMETs or NOTAMs are not issued based on SWX Advisories
- Detail specification in ICAO Annex 3

FNXX01 LFPW 2523	FPW 252339		
SWX ADVISORY			
DTG:	20221025/2321Z		
SWXC:	ACFJ		
ADVISORY NR:	2022/31		
SWX EFFECT:	GNSS MOD		
OBS SWX:	25/2245Z EQN EQS W090 - E015		
FCST SWX +6 HR:	26/0500Z NOT AVBL		
FCST SWX +12 HR:	26/1100Z NOT AVBL		
FCST SWX +18 HR:	26/1700Z NOT AVBL		
FCST SWX +24 HR:	26/2300Z NOT AVBL		
RMK:	SWX EVENT (SCINTILLATION) INPR POSSIBLY		
	IMPACTING GNSS PER.		
NXT ADVISORY:	WILL BE ISSUED BY 20221026/0521Z=		



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Example of SWX Advisory Effect Area

GNSS MOD

GNSS MOD

FNXX01 LFPW 252339 SWX ADVISORY DTG: 20221025/2321Z SWXC: ACFJ ADVISORY NR: 2022/31 SWX EFFECT: GNSS MOD OBS SWX: 25/2245Z EQN EQS W090 - E015 FCST SWX +6 HR: 26/0500Z NOT AVBL FCST SWX +12 HR: 26/1100Z NOT AVBL FCST SWX +18 HR: 26/1700Z NOT AVBL FCST SWX +24 HR: 26/2300Z NOT AVBL SWX EVENT (SCINTILLATION) INPR POSSIBLY RMK: IMPACTING GNSS PER. WILL BE ISSUED BY 20221026/0521Z= NXT ADVISORY:



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Example of SWX Advisory Effect Area

FNXX02 KWNP 020625 SWX ADVISORY DTG: SWXC: ADVISORY NR: SWX EFFECT: OBS SWX: FCST SWX +6 HR: FCST SWX +6 HR: FCST SWX +12 HR: FCST SWX +18 HR: FCST SWX +24 HR: RMK: NONE NXT ADVISORY:

20221002/0625Z PECASUS 2022/84 HF COM MOD 02/0610Z DAYLIGHT SIDE 02/1200Z NOT AVBL 02/1800Z NOT AVBL 03/0000Z NOT AVBL 03/0600Z NOT AVBL

NO FURTHER ADVISORIES=







SWX advisories are provided by four global Space Weather Centres

Only one center at a time is disseminating SWX advisories

Each Centre has two weeks shift with different responsibilities



Dissemination of SWX Advisories via AFS

- SWX Advisories are disseminated via AFS network as all OPMET data
- Users can obtain SWX Advisories through:
 - their National OPMET Center (NOC)
 - the secure internet services: SADIS or WIFS



Member State

SWXC



Dissemination of SWX Advisories via AFS

WMO message headers

- SWX advisories with different effects (GNSS, HF COM,..) have different WMO headers
- TAC and IWXXM format advisories have different WMO headers
- Every SWX center has own WMO header

	WMO Headers		
	TAC Advisory	IWXXM Advisory	
ACFJ – Australia	FNXX <mark>01</mark> YMMC	LNXX01 YMMC	
ACFJ – France	FNXX01 LFPW	LNXX01 LFPW	<mark>01</mark> = GNSS
PECASUS – Finland	FNXX01 EFKL	LNXX01 EFKL	02 = HF COM
PECASUS – UK	FNXX01 EGRR	LNXX01 EGRR	03 = RADIATION
CRC – China	FNXX01 ZBBB	LNXX01 ZBBB	04 = SATCOM
CRC – Russia	FNXX01 UUAG	LNXX01 UUAG	
SPWC – USA	FNXX01 KWNP	LNXX01 KWNP	

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More information of ICAO SWX service

- Specification
 - ICAO Annex 3
 - Manual on Space Weather Information in Support of International Air Navigation" (ICAO Doc 10100)
- WMO message headers
 - <u>https://www.icao.int/airnavigation/METP/Panel%20Documents/Space%20Weather%20Additional%20Information%20to%20SL%20AN%20101%20–20115.pdf</u>
- WWW.PECASUS.org
 - Quick guide to space weather abbreviations in advisories
 - User's guide to Space Weather Advisories for Pilots



Doc 10100

Manual on Space Weather Information in Support of International Air Navigation

First Edition, 2019



Approved by and published under the surfactly all the Secondary General

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Thank you for your attention !

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More information: www.pecasus.org