



# ECA

European Cockpit Association

## Space-WX for Aviation 1.0

Klaus Sievers

06 / 2019

**PECASUS**

PAN-EUROPEAN CONSORTIUM  
FOR AVIATION SPACE WEATHER  
USER SERVICES

2019 STCE annual meeting

# A word about pilots' organizations.....



IFALPA, Montreal < > ICAO & other institutions

ECA, Brussels < > European institutions

VC, Frankfurt < > national issues



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# A word about history.... 2004



## FIRST MEETING OF THE INTERNATIONAL AIRWAYS VOLCANO WATCH OPERATIONS GROUP (IAVWOPSG)

*(Bangkok, Thailand, 15 to 19 March 2004)*

### 4.3.4 Assessment of the need of provision of information on solar radiation storms and other bio-hazards

4.3.4.1 It was noted that Recommendation 1/20 c) of the MET Divisional Meeting (2002) had called for the assessment of the need for the provision of information for international air navigation on solar radiation storms and other bio-hazards by an ICAO suitable body, in consultation with WMO. At the time of the divisional meeting, it had been proposed that this information should be provided to aircraft, in addition to the existing arrangements for the provision of information on radioactive materials released accidentally into the atmosphere. It had been pointed out that with the opening of new polar routes, aircraft operating in these high latitudes could be exposed to hazardous levels of solar radiation that could affect health, communications and the global positioning system.

### Conclusion 1/33 — Report on developments related to solar radiation storms and other bio-hazards

That, the member from the United States present a report on developments related to solar radiation storms and other bio-hazards in time for consideration by the IAVWOPSG/2 Meeting.



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# A word about history.... 2011



3 November 2011

Mr. Raul Romero  
IAWOPSG Secretary  
International Civil Aviation Organization

Dear Raul Romero

At the last IAWOPSG/6 meeting which was held at the Western and Central Africa Regional offices in Dakar, the group agreed on Conclusion 6/31 about the Development of Operational requirements for space weather products. The conclusion stated that;

- a) IATA be invited to develop a high-level user requirement for space weather and provide this to the Secretary by 1 November 2011;
- b) the Secretary place both the high-level user requirement for space weather referred to in a) above, and the Draft Concept of Operations for International Space Weather Information in Support of Aviation (as provided in Appendix A to this report), on the IAWOPSG website by 1 December 2011;
- c) ICAO be invited to write to States requesting that they submit, by 1 July 2012, any views they may have on these documents and the best manner of providing operational space weather products to international aviation; and
- d) the members from Australia, New Zealand, the United States and IATA consolidate the responses from States and International Organizations, make the appropriate modifications to the Concept of Operations, compile a summary of submissions and develop a draft set of product requirements, and report back to IAWOPSG/7.

Considering the impact that space weather may have on flight operations, IATA has drafted high level statements with background and impacts of Space Weather that justify the need to develop service needs for Space Weather products.

Attached you will find these high level statements that make reference to detailed requirements initially developed by Cross Polar working group which have now been listed in the Concept of Operations.

IATA, however, requests that user input be taken into account in developing the products and that any regulations relating to Space weather must be done in consultation with users before implementation.

Thank you for posting this attached document alongside the concept of operations to IAWOPSG site for public review and comments.

Again, thank you for your continued support.

Yours sincerely,

Jens Bjarnason  
Director Operations, IATA

[www.iata.org](http://www.iata.org)

International Air Transport Association  
800 Place Victoria, P.O. Box 113  
Montreal, Quebec, Canada H4Z 1M1  
Tel: +1 (514) 874 6202  
Fax: +1 (514) 874 9632

## ATTACHMENT

### IATA - Space Weather (Background and Impacts) Leading to the Need for User Requirements

#### **Background:**

- Modern aircraft are equipped with increased navigation capabilities which have facilitated Performance Based Navigation (PBN) with the use of Satellite Positioning technology being the primary component.
- PBN has already demonstrated benefits to the airlines and future planning is being designed to rely on GNSS as the primary means of navigation.
- A growing number of Oceanic and Continental flights use Communication and Surveillance technologies such as CPDLC and ADS-B or C that are mostly dependent on Satellite technology.
- The NextGen and SESAR future air transportation initiatives are just two of Regional programs designed to meet future capacity and flight safety needs. These programs are built on the foundation of satellite technology and other evolving technologies.

The operators, therefore, must take into account the systems requirements listed above during the flight planning, dispatch and in-flight phases.

#### **Impacts of Space Weather to Commercial Aviation:**

- In addition to the impact on global navigation satellite systems, Space Weather adversely affects HF communications, increases solar radiation levels in humans, and impedes aircraft surveillance. Therefore, access to timely, impact-based information about Space Weather is an operational requirement and it will have a growing importance as future technology evolves.
- There are regulatory requirements today for Polar Operations.
  - In the regions north of 83N and south of 60S HF is often the primary means of communication, although the use of CPDLC and ADS-C/B utilizing the IRIDIUM constellation is expected to increase.
  - Some Regulators require that Operators take into account the impact that Space Weather may have on communications and crew health due to increased risks of exposure to solar radiation.
- In the future, IATA anticipates that there will be more stringent regulatory environment due to the maturing of PBN and regional ATM programs such as NextGen and SESAR. This will then result in the need for increasingly accurate, consistent and specific Space Weather products.
- Detailed Operational and Functional requirements have been documented in the Concept of Operations (CONOPS) for Space Weather, specifically chapters 2.5 and 5.2, and will be available for public review before its adoption.
- In addition to helping establish requirements, IATA will explore all means to optimize the costs, including the required level of service. This could mean, for example, requesting that only two global centers are established, one each in the north and southern



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# A word about history.... 2011



3 November 2011

Mr. Raul Romero  
IAWOPSG Secretary  
International Civil Aviation Organization

Dear Raul Romero

At the last IAWOPSG/6 meeting which was held at the Western and Central Africa Regional offices in Dakar, the group agreed on Conclusion 6/31 about the Development of Operational requirements for space weather products. The conclusion stated that;

a) IATA be invited to develop a high-level user requirement for space weather and provide this to the Secretary by 1 November 2011;

b) the Secretariat support of the Concept of Operations for the Western and Central Africa Region by 1 December;

c) ICAO be invited to develop a high-level user requirement for space weather and provide this to the Secretary by 1 November 2011;

d) the member States be invited to develop a high-level user requirement for space weather and provide this to the Secretary by 1 November 2011;

Considering the level of service needed for the Western and Central Africa Region, the Secretariat will continue to work with the member States to develop a high-level user requirement for space weather and provide this to the Secretary by 1 November 2011.

Attached you will find the Concept of Operations for the Western and Central Africa Region, which was developed by the Secretariat and the member States.

IATA, how do you intend to implement this?

Thank you for posting this attached document alongside the concept of operations to IAWOPSG site for public review and comments.

Again, thank you for your continued support.

Yours sincerely,

Jens Bjarnason  
Director Operations, IATA

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- PBN has already demonstrated benefits to the airlines and future planning is being designed to rely on GNSS as the primary means of navigation.
- A growing number of Oceanic and Continental flights use Communication and Surveillance technologies such as CPDLC and ADS-B or C that are mostly dependent on Satellite technology.
- The NextGen and SESAR future air transportation initiatives are just two of Regional programs designed to meet future capacity and flight safety needs. These programs are

hemispheres. This would maximize the provision of forecast and warning information while minimizing costs to the users.

- Appropriate performance metrics must be defined to establish quality standards for these newly emerging Space Weather products.

**Therefore, provision of Space Weather information is considered an operational requirement.**

- In the future, IATA anticipates that there will be more stringent regulatory environment due to the maturing of PBN and regional ATM programs such as NextGen and SESAR. This will then result in the need for increasingly accurate, consistent and specific Space Weather products.
- Detailed Operational and Functional requirements have been documented in the Concept of Operations (CONOPS) for Space Weather, specifically chapters 2.5 and 5.2, and will be available for public review before its adoption.
- In addition to helping establish requirements, IATA will explore all means to optimize the costs, including the required level of service. This could mean, for example, requesting that only two global centers are established, one each in the north and southern



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## A word about history.... 2012



SWPC Space Wx Workshop 4 / 2012



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# A word about history.... 2012



Venue: Académie Royale de Belgique



Presentations, Discussions, Poster-Sessions



2012



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# A word about history....

Assessing Users' Requirements per market sector:

[Source: SWENET UR – DIAS UR – COST ES0803 Paris Workshop minutes – COST ES0803 SG2.1 and SG2.2 Surveys – discussions at ESWWx (e.g. during end user lunches)]

What is needed?

e.g., severity of storm, onset time, duration, regions & boundaries [lat, long]

When is it needed?

Products needed to answer this question : extended outlook, warning, alert, updates, and current conditions

How is it delivered?

e.g., graphic and text form, distribution protocols



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# A word about history.....

Concept of Operations  
(ConOps)  
for  
International  
Space Weather Information  
in  
Support of Aviation

June 2011

Version 1

CONCEPT OF OPERATIONS  
(CONOPS)  
FOR  
INTERNATIONAL  
SPACE WEATHER INFORMATION  
IN  
SUPPORT OF INTERNATIONAL AIR  
NAVIGATION



September 2012

Version 2.1

CONCEPT OF OPERATIONS  
(CONOPS)  
FOR  
SPACE WEATHER INFORMATION  
IN SUPPORT OF  
INTERNATIONAL AIR NAVIGATION

6 December 2013

Draft Version 3.0



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# A word about history.....

**Humans: YES**

Concept of Operations  
(ConOps)  
for  
International  
Space Weather Information  
in  
Support of Aviation

June 2011

Version 1

**NO**

CONCEPT OF OPERATIONS  
(CONOPS)  
FOR  
INTERNATIONAL  
SPACE WEATHER INFORMATION  
IN  
SUPPORT OF INTERNATIONAL AIR  
NAVIGATION



September 2012

Version 2.1

**YES**

CONCEPT OF OPERATIONS  
(CONOPS)  
FOR  
SPACE WEATHER INFORMATION  
IN SUPPORT OF  
INTERNATIONAL AIR NAVIGATION

6 December 2013

Draft Version 3.0



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# A word about history.....



**INTERNATIONAL  
CIVIL AVIATION  
ORGANIZATION**



**WORLD  
METEOROLOGICAL  
ORGANIZATION**

MET/14-WP/11  
CAeM-15/Doc. 11  
17/1/14

Meteorology (MET) Divisional Meeting  
(2014)

Commission for Aeronautical Meteorology  
Fifteenth Session

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Montréal, 7 to 18 July 2014

## Agenda Item 5: Standards, Recommended Practices and Procedures

5.1: Amendment 77 to Annex 3/Technical Regulations [C.3.1]

5.2: Proposed *Procedures for Air Navigation Services — Meteorology* (PANS-MET, Doc xxxx), First Edition (not later than 2019)

5.3: Consequential amendments, if any, to other Annexes or PANS

### **DRAFT AMENDMENT TO ANNEX 3 AND CONSEQUENTIAL AMENDMENTS TO RELEVANT ICAO DOCUMENTS, AND OUTLINE OF PROPOSED PANS-MET**

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*Editorial Note.— Insert the following new text.*

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### **3.8 Space weather centres**

3.8.1 A Contracting State, having accepted, by regional air navigation agreement, the responsibility for providing a space weather centre (SWXC), shall arrange for that centre to provide information on space weather affecting the earth's surface or atmosphere expected to affect communications and navigation systems and which may pose a radiation risk to flight crew members and passengers by arranging for that centre to:

- a) monitor relevant ground-based, airborne, and space-based observations to detect the existence and extent of the following in the area concerned:

# A word about history.....



INTERNATIONAL  
CIVIL AVIATION  
ORGANIZATION



WORLD  
METEOROLOGICAL  
ORGANIZATION

MET/14-WP/11  
CAeM-15/Doc. 11  
17/1/14

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- a) monitor relevant ground-based, airborne, and space-based observations to detect the existence and extent of the following in the area concerned:

# A word about history.....



ICAO

International Standards  
and Recommended Practices

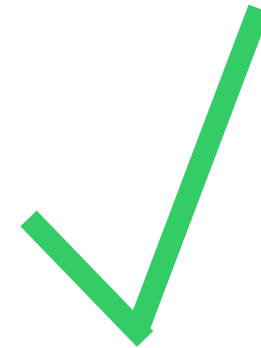
## Annex 3 to the Convention on International Civil Aviation

### Meteorological Service for International Air Navigation

Part I — Core SARPs

Part II — Appendices and Attachments

Twentieth Edition, July 2018



#### 3.8 Space weather centres

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;

# ICAO publications: Annex 3, valid 08 Nov. 2018

## 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:*

<i>HF communications (propagation, absorption)</i>	<i>HF COM</i>
<i>communications via satellite (propagation, absorption)</i>	<i>SATCOM</i>
<i>GNSS-based navigation and surveillance (degradation)</i>	<i>GNSS</i>
<i>radiation at flight levels (increased exposure)</i>	<i>RADIATION</i>

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

<i>moderate</i>	<i>MOD</i>
<i>severe</i>	<i>SEV</i>



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YES: only 3 intensities of space-wx...

**SEVERE** thresholds for **SEVERE** reached/exceeded

**MODERATE** thresholds for **MODERATE** reached/exceeded

no message thresholds for Moderate not reached



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# ICAO publications: Annex 3, valid 08 Nov. 2018

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](http://WWW.SPACEWEATHERPROVIDER.WEB)

NXT ADVISORY: NO FURTHER ADVISORIES

**ICAO - EXAMPLE**

**Volcanic Ash Advisory**

**Space WX Advisory**

European Cockpit Association



# ICAO publications: Annex 3, valid 08 Nov. 2018

## ICAO - EXAMPLES

SWX ADVISORY

DTG: 20161108/0000Z  
SWXC: DONLON\*

ADVISORY NR: 2016/2

NR RPLC: 2016/1

SWX EFFECT: RADIATION MOD

FCST SWX: 08/0100Z HNH HSH E18000 – W18000  
ABV FL 350

FCST SWX +6 HR: 08/0700Z HNH HSH E18000 – W18000  
ABV FL 350

FCST SWX +12 HR: 08/1300Z HNH HSH E18000 – W18000  
ABV FL 350

FCST SWX +18 HR: 08/1900Z HNH HSH E18000 – W18000  
ABV FL 350

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

RMK: RADIATION LVL EXCEEDED 100 PCT OF BACKGROUND  
LVL AT FL350 AND ABV. THE CURRENT EVENT HAS PEAKED  
AND LVL SLW RTN TO BACKGROUND LVL. SEE  
[WWW.SPACEWEATHERPROVIDER.WEB](http://WWW.SPACEWEATHERPROVIDER.WEB)

NXT ADVISORY: NO FURTHER ADVISORIES

SWX ADVISORY

DTG: 20161108/0100Z

SWXC: DONLON\*

ADVISORY NR: 2016/1  
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: PERIODIC HF COM ABSORPTION AND LIKELY  
TO CONT IN THE NEAR TERM. CMPL AND PERIODIC  
LOSS OF HF ON THE SUNLIT SIDE OF THE EARTH EXP.  
CONT HF COM DEGRADATION LIKELY OVER THE NXT  
7 DAYS. SEE [WWW.SPACEWEATHERPROVIDER.WEB](http://WWW.SPACEWEATHERPROVIDER.WEB)

NXT ADVISORY: 20161108/0700Z

Full details available in ICAO Annex 3, 20.Edition



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**Space-Wx : Pilots' view**



## So, we have SpaceWx, are we done ?

Missing items -probably incomplete list-

- A) ICAO ANNEX 3, 20th edition, including amendment 78, to be put into national law , for example: EASA rules
- B) Actions to take upon receipt of a MOD or SEV space-wx advisory to be discussed and put into the operations manuals for pilots, dispatch and controllers
- C) basic education of pilots, dispatchers, ATC personnell on space-wx effects

Thank you for your attention.



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So, we have SpaceWx, are we done ?

## United States Regulations

- FAA not planning any new regulations, or changes to current regulations around ICAO Space Weather Advisories
- How individual airlines use Space Weather Information can be defined in their Operations Specifications



Bill Bauman, FAA  
@ SWPC annual meeting 2019



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# So, we have SpaceWx, are we done ?

EASA SIB No: 2012-09



## EASA Safety Information Bulletin

**SIB No.:** 2012-09  
**Issued:** 23 May 2012

**Subject:** Effects of Space Weather on Aviation

**Ref. Publication:**

1. EU OPS 1.390 Cosmic Radiation;
2. SIB 2012-10 Single Event Effects (SEE) on Aircraft Systems Caused By Cosmic Rays;
3. Appendix 1 contains a list of useful web-site and identify those that provide information or prediction on actual space weather.



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So, we have SpaceWx, are we done ?



## **Delta Hazard Avoidance Procedures & Use of Space Weather Information**

Space Weather Workshop  
Aviation & Space Weather Session  
24 April 2012  
Boulder, CO  
Tom Fahey & Gregg Scott



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So, we have SpaceWx, are we done ?

## Delta Avoidance HF Comms & Health Related

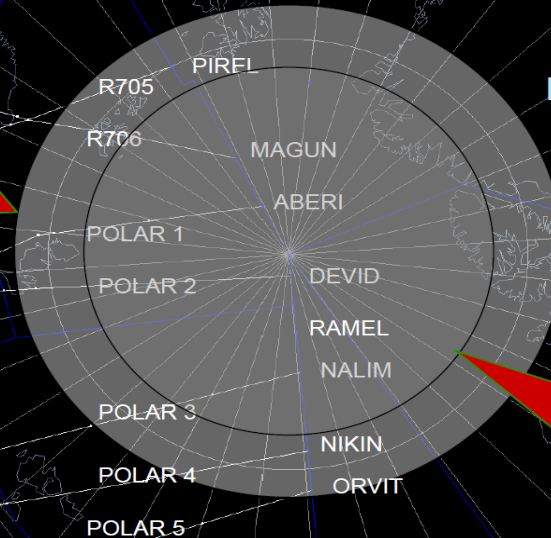
Each flt must maintain constant communication with ATC & with the company.

Delta's Primary Comms Method: ACARS using VHF or SATCOM

Delta's Secondary Comm Method: Voice Communications using HF Radio or SATCOM

### Health

**No Ops on  
all  
Polar Routes  
During Strong  
Solar Radiation  
Storms  
Due psbl Health  
affect**



### Communications

**Inmarsat SATCOM is not  
available North of 82N.**

**VHF ACARS is not  
available in the  
Polar Region.**

**No Ops North of  
82N  
During Strong  
Geomagnetic  
Storms  
Due psbl loss HF**



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# Space Weather Info

## Storm Scales & Delta TP Product

Storm Scale of 3 or higher requires Delta TP Alert or Advisory

Storm Scale	TP	Geomagnetic Storm Effects
G1		Communications: No Effect Satellite Navigation: No Effect
G2		Communications: Possible HF radio fade Satellite Navigation: No Effect
G3	Alert Issued	Communications: Possible intermittent HF radio outages Satellite Navigation: Possible intermittent satellite navigation problems
G4		Communications: Possible sporadic HF radio outages Satellite Navigation: Possible satellite navigation degraded for hours
G5		Communications: Possible HF radio outages for 1-2 days Satellite Navigation: Possible satellite navigation degraded for days
Storm Scale	TP	Solar Radiation Storm Effects
S1		Communications: Possible minor effects on HF Radio Satellite Navigation: No Effect Biological: No Effect
S2		Communications: Possible small effects on HF Radio Satellite Navigation: Possible navigation at polar cap affected Biological: Possible elevated radiation risk
S3**	Alert Issued	Communications: Possible HF radio degradation Satellite Navigation: Possible satellite navigation errors Biological: Possible elevated radiation risk
S4**		Communications: Possible blackout of HF radio for several days Satellite Navigation: Possible satellite navigation errors for several days Biological: Possible elevated radiation risk
S5**		Communications: Possible complete blackout of HF radio for several days Satellite Navigation: Possible satellite navigation errors for several days Biological: Possible elevated radiation risk
Storm Scale	TP	Solar Flare - Radio Blackout Effects
R1		Communications: Possible minor degradation to HF radio on sunlit side of Earth Satellite Navigation: No Effect
R2		Communications: Possible blackouts to HF radio for tens of minutes on sunlit side of Earth Satellite Navigation: No Effect
R3	Advisory Issued	Communications: Possible blackouts to HF radio for an hour on sunlit side of Earth Satellite Navigation: No Effect
R4		Communications: Possible blackouts to HF radio for 1-2 hours on sunlit side of Earth Navigation: Possible minor disruptions to satellite navigation on sunlit side of Earth
R5		Communications: Possible complete blackout to HF radio for several hours on sunlit side of Earth Satellite Navigation: Possible satellite navigation errors for several hours on sunlit side of Earth

\*\*\* Radio Blackouts impact the entire sunlit side of the earth. They also serve as a warning for potential Geomagnetic storms or Solar Radiation storms (1/2hr-1 day from Sun to Earth). \*\*\*

Comment: GNSS / Satcom missing



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# So, we have SpaceWx, are we done ?



## Space Weather Info Summary of Delta's Actions

- R Scale ( Level 3, 4 or 5)
  - Advisory TP Issued: Only as an “Observed”
  - Action Required: None
    - Issued as an FYI only: Other events psbl. No restrictions.
- S Scale ( Level 3, 4 or 5)
  - Alert TP Issued: As “Forecast” or “Observed”
  - Action Preflight: No Polar Routes (78N to Pole).
  - Action if En Route: Reroute or reducing altitude to FL310.
- G Scale (Level 3, 4 or 5)
  - Alert TP Issued: As “Forecast” or “Observed”
  - Action Preflight: No Routes between 82N to Pole.
  - Action if En Route & HF Problems: Try other HF freqs, use SATCOM, &/or reroute. Last resort, land short.

GNSS / Satcom missing  
Translation of ICAP MOD / SEV missing



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# So, we have SpaceWx, are we done ?



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[Application Forms](#) ∨

[Regulations](#) ∨

[Agency Decisions](#) ∨

**[Rulemaking Process](#)** ∧

09  
JUN  
2016

## NPA 2016-03(A)

*Technical review of the theoretical knowledge syllabi, learning objectives, and examination procedures for air transport pilot licence, multi-crew pilot licence, commercial pilot licence, and instrument ratings*



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# So, we have SpaceWx, are we done ?



European Aviation Safety Agency

## Notice of Proposed Amendment 2016-03(D)

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Technical review of the theoretical knowledge syllabi, learning objectives, and examination procedures for air transport pilot licence, multi-crew pilot licence, commercial pilot licence, and instrument ratings

*Subject 050 — Meteorology*

*Subject 061 — General navigation*

*Subject 062 — Radio navigation*

RMT.0595 — 9.6.2016

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# So, we have SpaceWx, are we done ?

Comments  
by **ECA**

050 09 11 00 (New!!!)	X	<b>Insert new chapter on space-weather in preparation for upcoming amendments to ICAO Annex 3</b> Formulate learning objectives based on the appropriate EASA SIB. <a href="http://ad.easa.europa.eu/ad/2012-09">http://ad.easa.europa.eu/ad/2012-09</a>
Syllabus Ref. -1	X	Explain that Space weather is a generic term which refers to the environmental conditions in the space around the Earth extended up to the Sun.
Syllabus Ref. -2	X	Explain that the major drivers for the space weather are flows of energetic charged particles and electromagnetic radiation which can penetrate and interact with the Earth's ionosphere/atmosphere and magnetic field.
Syllabus Ref. -3	X	Describe that geomagnetic storms and solar radiation storms can lead to strong degradation of shortwave radio (radio blackout)
Syllabus Ref. -4	X	Describe that Ionospheric and solar radiation storms can lead to irregularities in the ionosphere which can disturb satellite navigation systems
Syllabus Ref. -5	X	Describe that the cosmic background radiation combined with solar radiation / solar radiation storms cause a radiation dose to electronics and humans which increases with flight altitude.
Syllabus Ref. -6	X	State radiation protection laws are in effect for Europe that require accounting for dose encountered by flight crew and may limit the allowable dose.



**ECA**

European Cockpit Association

# So, we have SpaceWx, are we done ?

Comments  
by **ECA**

050 09 11 00 (New!!!)	X	<b>Insert new chapter on space-weather in preparation for upcoming amendments to ICAO Annex 3</b> Formulate learning objectives based on the appropriate EASA SIB. <a href="http://ad.easa.europa.eu/ad/2012-09">http://ad.easa.europa.eu/ad/2012-09</a>
Syllabus Ref. -1	X	Explain that Space weather is a generic term which covers environmental conditions in the space environment extended up to the Sun.
Syllabus Ref. -2	X	Explain that the major disturbances of the Earth's magnetic field are flows of energetic charged particles which can cause ionospheric disturbances and magnetic storms and solar radiation storms.
Syllabus Ref. -3	X	Describe that ionospheric and solar radiation storms can lead to irregularities in the ionosphere which can disturb satellite navigation systems.
Syllabus Ref. -4	X	Describe that the cosmic background radiation combined with solar radiation dose to flight altitude.

Regarding your comment referring to LO 050 09 11 00 new: **Not accepted.** EASA will take the new LO in account as soon as upcoming amendments of ICAO Annex 3 are finalised.

## Appendix to ED Decision 2018/001/R Subject 050 — METEOROLOGY

## So, we have SpaceWx, are we done ?

Missing items -probably incomplete list-

- A) ICAO ANNEX 3, 20th edition, including amendment 78, to be put into national law , for example: EASA rules
- B) Actions to take upon receipt of a MOD or SEV space-wx advisory to be discussed and put into the operations manuals for pilots, dispatch and controllers
- C) basic education of pilots, dispatchers, ATC personnell on space-wx effects



**ECA**

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Thank you for your attention !

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