

ICAO's restructured Annex 3 (Amendment 81) and new *Procedures for Air Navigation Services* – *Meteorology* (PANS-MET, Doc 10157)

Presented to: NAM/CAR/SAM Workshop

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**Federal Aviation
Administration**

Agenda

- **Changes with Amendment 81 to Annex 3 and PANS-MET**
 - State Letter AN 10/1-23/1 arising from the 5th meeting of ICAO's Meteorology Panel (METP)
 - Restructured Annex 3 and new PANS-MET
 - Space weather information services
 - Quantitative information on volcanic ash and International Airways Volcano Watch (IAVW)
 - ICAO Weather Exchange Model (IWXXM)
 - World Area Forecast System (WAFS)
 - Improved definition of the Meteorological Authority
 - Impact on remaining ICAO annexes and documents



State Letter AN 10/1-23/1

- Initial Proposal 1 in Attachments B and C contains the proposed **restructured Annex 3 and new PANS-MET** (*without any changes to space weather, volcanic ash information, WAFS, etc.*)
- Initial Proposal 2 in Attachments B and C are the proposed changes to **space weather** information
- Initial Proposal 3 in Attachments B and C are the proposed changes to quantitative information on **volcanic ash** and IAVW
- Initial Proposal 4 in Attachments B and C are the proposed changes to **IWXXM** format
- Initial Proposal 5 in Attachments B and C are the proposed changes to the **WAFS**
- Initial Proposal 6 in Attachments B and C are the proposed changes related to the “**meteorological authority**”
- Attachments D through J are the proposed consequential amendments to other annexes and documents



Restructured Annex 3 and new PANS-MET

- Refer to Initial Proposal 1 in Attachments B (pages B-2 to B-48) and C (pages C-2 to C-107) of the State Letter
 - Important to remember that this does not include the proposed changes to space weather information, volcanic ash information, IWXXM, WAFS, and “meteorological authority”



Restructured Annex 3 and new PANS-MET

- **Annex 3 has traditionally contained two parts**
 - Part 1: Core Standards and Recommended Practices (SARPs)
 - Part 2: Appendices and Attachments
 - Appendices contain SARPs that are technical specifications and means of compliance to the Core SARPs
 - Attachments are supplementary to the SARPs
- **What is the PANS-MET, Document 10157**
 - In simple terms, it is basically a repackaging of Part 2 from Annex 3



Restructured Annex 3 and new PANS-MET

The restructured Annex 3:

- Only contain SARPs
- Organized by chapters only
 - They are the same chapters in the current Annex 3, with some minor changes



Restructured Annex 3 and new PANS-MET

PANS-MET

- **Contains the technical specifications and means of compliance to the SARPs in Annex 3**
- **Organized by chapters, appendices, and attachments**
 - The **chapters** are basically the appendices from Part 2 of the current Annex 3
 - The **appendices** contain all the tables (e.g., templates for METAR) and examples from Part 2 of the current Annex 3
 - The **attachments** are the same attachments from Part 2 of the current Annex 3
- **“Shalls” and “shoulds” in the appendices in Part 2 of the current Annex 3 are retained in the PANS-MET**



Restructured Annex 3 and new PANS-MET

- **The Meteorological MET Divisional Meeting (2014) recommended the creation of a PANS-MET**
 - To better document the move from "product centric" to an "information centric" environment under SWIM
- **Task assigned to METP** (Working Group on Meteorological Requirements and Integration [WG-MRI])
 - Review all provisions in Annex 3
 - Retain in Annex 3 the SARPs that contain organizational and technical requirements and are stable in time
 - Move the technical specifications and means of compliance, which evolve more rapidly, to the PANS-MET
- **Example on next two slides**



Restructured Annex 3 and new PANS-MET

- **Example:**

- Annex 3 retains the listing of the meteorological information of the METAR, SPECI and TAF
- The listing of the non-meteorological information (location indicator, time, date, etc.) moved to PANS-MET (*shown in next slide*)

Editorial Note.— The intent of the deleted text in 6.2.3 is incorporated in the PANS-MET, paragraph 4.1.1.1 and the associated notes.

6.2.1.3 Aerodrome forecasts and amendments thereto shall be issued as TAF, and include the following meteorological information in the order indicated:

- a) identification of the type of forecast;
- b) location indicator;
- c) time of issue of forecast;
- d) identification of a missing forecast, when applicable;
- e) date and period of validity of forecast;
- f) identification of a cancelled forecast, when applicable;

Highlights and Notes

B-23

- g1) surface wind;
- h2) visibility;
- i3) weather;
- j4) cloud; and
- k5) expected significant changes to one or more of these elements during the period of validity.

Optional elements shall be included in TAF in accordance with regional air navigation agreement.

Note 1.— Technical specifications of the issuance of aerodrome forecast are contained in the PANS-MET (Doc 10157) Chapter 4, 4.1.1.1 and 4.1.1.2.



Restructured Annex 3 and new PANS-MET

- Example (continued):
 - Text in PANS-MET:

In addition to the meteorological elements listed in Annex 3, 4.5.1, the reports also contain: a) identification of the type of report; b) location indicator; c) time of the observation; and d) identification of an automated or missing report, when applicable, as indicated in the template shown in Appendix 2, Table A2-2.

- No changes were made to the products
- Note that all product templates are in the PANS-MET

4.1 AERODROME FORECASTS (TAF)

Editorial Note.— Origin of Section 4.1: Annex 3, Appendix 5, Section 1, included herein in toto, with the following changes: a) elimination of the Note following 1.2 and 1.6 which have been included in Annex 3 as a note after the title of Chapter 6 and as 6.2.1.7, respectively; b) reformulation of 4.1.1.1 (requirement to follow the template now stated in Annex 3, 6.2.1.3), including the addition of “content and order” (previously in Annex 3); and c) addition of a note after 4.1.1.1 listing the non-meteorological information to be included in TAF.

4.1.1 Format, issuance and period of validity

4.1.1.1 TAF shall be issued and disseminated in the TAF code form prescribed by the World Meteorological Organization (WMO), in accordance with the template shown in Appendix 4, Table A4-1, following the content and order of elements indicated therein.

Note 1.— *The TAF code form is contained in the Manual on Codes (WMO-No. 306), Volume I.1, Part A — Alphanumeric Codes.*

Note 2.— *In addition to the meteorological information listed in Annex 3, 6.2.1.3, TAF also contains: a) identification of the type of forecast; b) location indicator; c) time of issue of forecast; d) identification of a missing forecast, when applicable; e) date and period of validity of forecast; and f) identification of a cancelled forecast, when applicable, as indicated in the template shown in Appendix 4, Table A4-1.*

4.1.1.2 TAF shall be disseminated in IWXXM GML form in addition to the dissemination of the TAF in accordance with 4.1.1.1.

Note 1.— *The technical specifications for IWXXM are contained in the Manual on Codes (WMO-No. 306), Volume I.3, Part D — Representation Derived from Data Models. Guidance on the implementation of IWXXM is provided in the Manual on the ICAO Meteorological Information Exchange Model (IWXXM) (Doc 10003).*

Note 2.— *Geography markup language (GML) is an encoding standard of the Open Geospatial Consortium (OGC).*



Restructured Annex 3 and new PANS-MET

- **Mr. Burch created and coordinated within the METP's WG-MRI several draft versions of the restructured Annex 3 and PANS-MET (2017-2018)**
 - The restructured Annex 15 and the new PANS-Aeronautical Information Management (AIM) were consulted as a model (e.g., detailed specifications of the NOTAM, including the format, were moved to the PANS-AIM)
- **ICAO contractor finalized (2020)**
- **METP endorsed (2021)**
- **Reviewed by the 193 ICAO States (2023)**
- **Expecting both to be published in July 2024 and in effect in November 2024**



Further development of space weather information services

- Refer to Initial Proposal 2 in Attachments B (pages B-49 to B50) and C (pages C-108 to C-118) of the State Letter



Further development of space weather information services

- **Annex 3:**
 - Clarification of the roles of both global and regional space weather centers
 - Promotes the advisory from a Recommended Practice to a Standard
 - Removes the requirement to issue NOTAM for space weather



Further development of space weather information services

PANS-MET:

- **Improvements to the Space Weather Advisory product:**
 - Moves the “Intensity” from the “Effect” line to the “Observed” and “Forecast” lines, which allows for the intensity to change within an advisory as well as allows for multiple intensities
 - Adds “NIGHTSIDE”
 - Changes the polygon resolution from 10° latitude and 15° longitude to 5° latitude and longitude to allow for finer resolution advisories
 - Permits the use of polygons instead of fixed latitude bands for all phenomena



Further development of space weather information services

Example A7-3. Space weather advisory message (HF COM effects)

SWX ADVISORY	
DTG:	20201108/0100Z
SWXC:	DONLON*
SWX EFFECT:	HF COM
ADVISORY NR:	2020/1
OBS SWX:	08/0100Z SEV MNH EQN EQS MSH DAYSIDE MOD NIGHTSIDE
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:	SWX EVENT IMPACTING LOWER HF COM FREQ BAND. SEE WWW.SPACEWEATHERPROVIDER.WEB
NXT ADVISORY:	WILL BE ISSUED BY 20201108/0700Z

* Fictitious location



Quantitative information on volcanic ash and International Airways Volcano Watch (IAVW)

- Refer to Initial Proposal 3 in Attachments B (pages B-51 to 55) and C (pages C-119 to C-134) of the State Letter



Quantitative information on volcanic ash and IAVW

- **Minor updates to the Volcanic Ash Advisory (VAA) format**
 - PANS-MET:
 - Replace “summit elevation” with “source elevation”
 - Removed the colour code
- **Volcano Observatory Notice for Aviation (VONA)**
 - Annex 3:
 - Promotion to a Recommended Practice
 - PANS-MET:
 - Revised and formalized the format
 - To be issued in text and IWXXM forms



Quantitative information on volcanic ash and IAVW

Annex 3

- **Phased implementation of new quantitative volcanic ash (QVA) forecasts**
 - To be issued by a few Volcanic Ash Advisory Centers (VAAC) in Nov 2024 (*those in a position to do so*)
 - Should (i.e., Recommended Practice) be issued by all VAACs in Nov 2025
 - Issued for “significant” eruptions and ash clouds
 - Information “flyer” developed that can be shared with all users

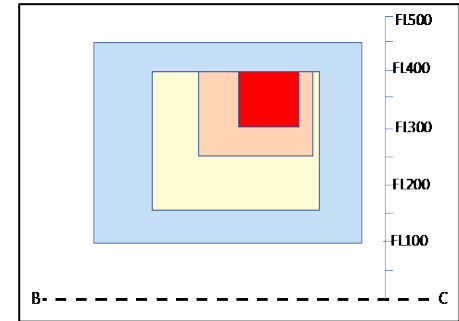
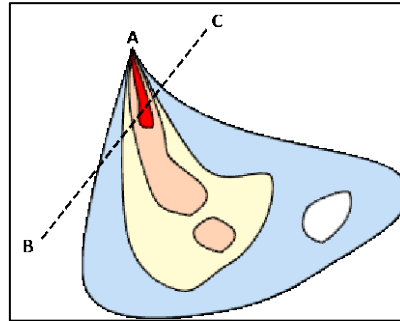


QVA forecasts

PANS-MET:

- QVA forecasts include five levels of ash concentrations

Descriptor	Concentration thresholds and ranges
Very high	$\geq 10 \text{ mg/m}^3$
High	≥ 5 and $< 10 \text{ mg/m}^3$
Medium	≥ 2 and $< 5 \text{ mg/m}^3$
Low	≥ 0.2 and $< 2 \text{ mg/m}^3$
Very low	$< 0.2 \text{ mg/m}^3$



Note: The lower limit of visible ash ranges from 0.01 to 10 mg/m³. The lower limit of discernable ash from satellites is approximately 0.1 to 0.2 mg/m³.



QVA forecasts

PANS-MET:

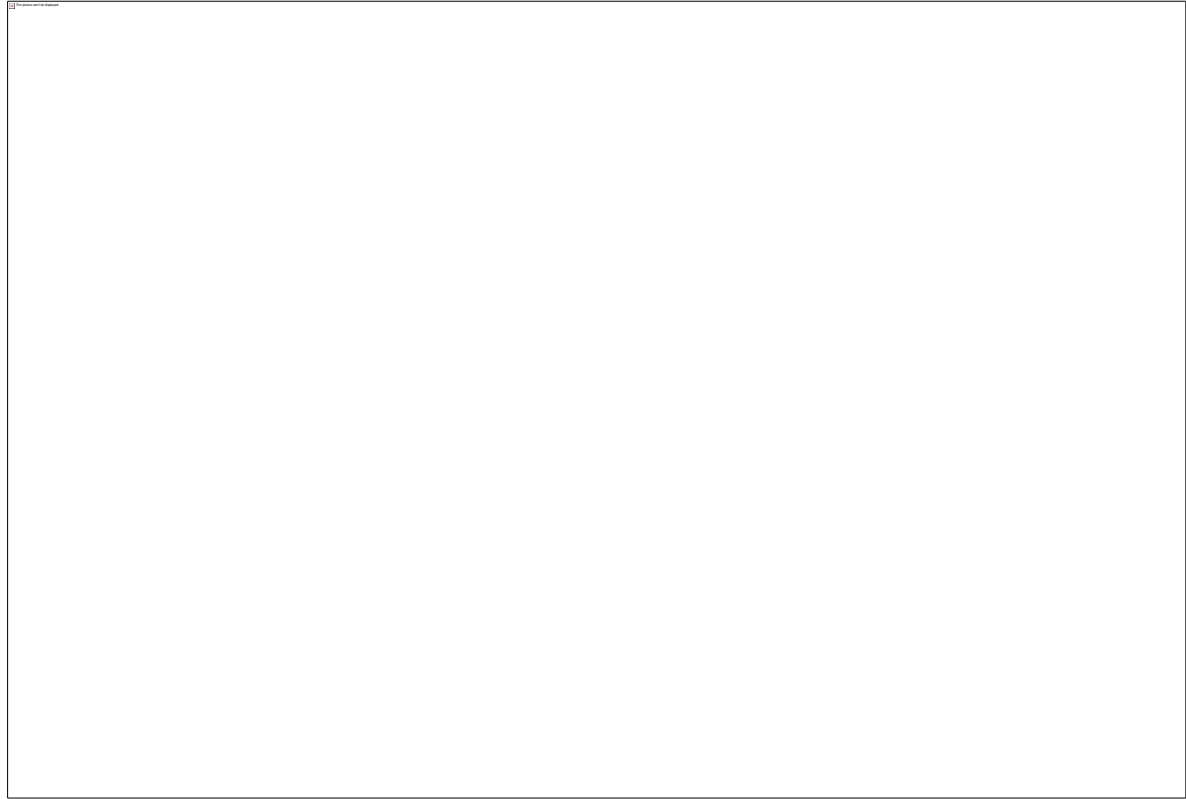
- Valid for 3-hourly time increments through 24 hours (0, 3, 6, 9, 12, 15, 18, 21, 24 hours)
- Updated at least every 6 hours
- Vertical resolution of 5,000 foot flight levels (FL) from mean sea level to FL 600
- Horizontal resolution of 0.25 degree latitude and longitude



QVA forecasts

PANS-MET:

To include probability,
i.e., relative frequency
of exceedance for
concentration
thresholds of 10, 5, 2
and 0.2 mg/m³



Further development of ICAO Weather Exchange Model (IWXXM)

- Refer to Initial Proposal 4 in Attachments B (page B-55) and C (pages C-135 to C-140) of the State Letter



Further development of IWXXM

PANS-MET

- **Removes the constraint on the number of points (latitude longitude coordinates) for SIGMET, AIRMET, VAA, Tropical Cyclone Advisory (TCA) and Space Weather Advisory (SWXA) when issued in the IWXXM format**
 - Constraint of up to 7 points remains for these same products when issued in text (abbreviated plain language) format
- **WAFS Significant Weather (SIGWX) forecasts to be in IWXXM format**
 - A subset of SIGWX will be issued in legacy BUFR format until Nov 2025 and in PNG format until further notice (~2026?)
 - Icing included in the IWXXM SIGWX but not the BUFR or PNG (too cluttered)



Further development of IWXXM

PANS-MET

- **For METAR and SPECI in IWXXM form:**
 - Changed the reporting of air and dew point temperatures to tenths of degrees Celsius, for those in a position to do so.
 - Changed the reporting of Runway Visual Range (RVR) to all runways (*compared to up to 4 runways in TAC*)



Further development of the World Area Forecast System (WAFS)

- Refer to Initial Proposal 5 in Attachments B (pages B-56 to 58) and C (pages C-141 to C-164) of the State Letter



Further development of the WAFS

PANS-MET

- **WAFS grid point forecasts**

- Upper-air wind, temperature, humidity, turbulence severity, icing severity, cumulonimbus (CB) cloud extent, bases and tops
 - 0.25 degree horizontal resolution
 - 1,000 ft vertical resolution from FL050-600 (wind, temperature), FL100-450 (turbulence), FL050-300 (icing), FL050-180 (humidity)
 - 1-hourly intervals from 6-24 hours, 3-hourly from 27-48 hours (all phenomena), 6-hourly from 54-120 hours (wind, temperature, humidity)
- Subset of wind, temperature, and humidity at the legacy 1.25 degree for users unable to process 0.25 data
 - 17 FLs at varying resolution from FL050-530
 - 3-hourly from 6-36 hours
- WAFS grid point data set increases by 230% (from 28 MB to 6.5 GB)
- Information “flyer” developed that can be shared with all users



Further development of the WAFS

PANS-MET

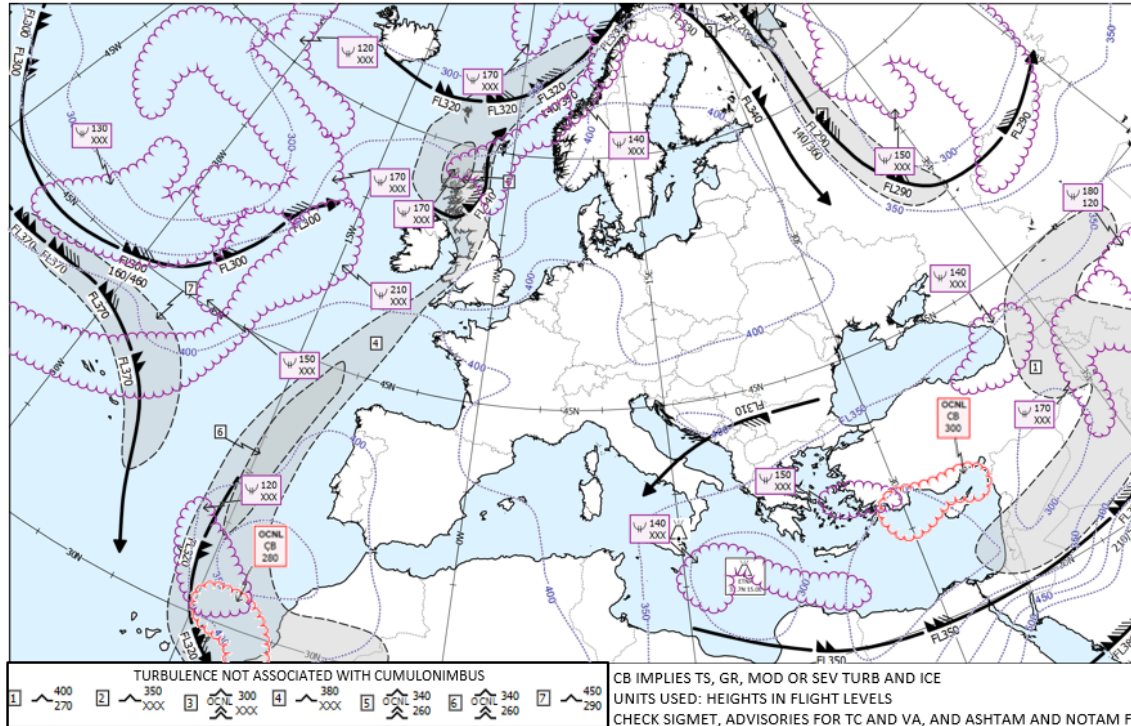
- **New Significant Weather (SIGWX) forecast**
 - Expands high level from FL250-630 to FL100-600
 - Removes medium level (FL100-250), which was only for select geographical areas
 - Increases the forecast valid times from 24 hours to 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, and 48 hours, which will be done through automation
 - IWXXM only. 24 hours for BUFR and PNG
 - Only occasional (OCNL) and frequent (FRQ) CB clouds will be shown. It is not possible to show embedded (EMBD) CB clouds
 - Tropopause spot heights will be replaced by tropopause contours
 - Turbulence will include both clear air and orographic turbulence. There will be no in-cloud turbulence



New WAFS Significant Weather (SIGWX) forecast

ISSUED BY WAFS LONDON, PROVIDED BY XXXX
 FIXED TIME PROGNOSTIC CHART. SIGWX FL100-FL600

FORECAST ISSUE TIME: 12UTC 15 FEB 2023 T+18
 FORECAST VALID AT 06UTC ON 16 FEB 2023



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Improvement of the definition of “meteorological authority”

- Refer to Initial Proposal 6 in Attachments B (pages B-59 to 75) and C (pages C-165 to C-180) of the State Letter



Improvement of the definition of “meteorological authority”

- **In order to better clarify roles and responsibilities:**
 - Improved the definition of the MET authority
 - *Meteorological authority.* The authority ~~entity~~ ~~providing or~~ arranging for the provision of meteorological service for international air navigation on behalf of a Contracting State, and ~~providing oversight and regulation of the meteorological service.~~
 - Added definition of the MET service provider
 - *Meteorological service provider.* The relevant entity providing meteorological service for international air navigation on behalf of a Contracting State.
- **Replaced “MET authority” with “MET service provider” where appropriate in many places in Annex 3 (Amendment 81) and PANS-MET**



Impact in the remaining annexes and documents

- Refer to Attachments D through J (pages D-1 to J-8) of the State Letter
 - Attachment D: *Operations of Aircraft* - Annex 6, Parts I, II, and III
 - Attachment E: *Aeronautical Telecommunications* - Annex 10, Volume II
 - Attachment F: *Air Traffic Services* - Annex 11
 - Attachment G: *Aeronautical Information Services* - Annex 15
 - Attachment H: *ICAO Abbreviations and Codes* - PANS-ABC (Doc 8400)
 - Attachment I: *Aeronautical Information Management* - PANS-AIM (Doc 10066)
 - Attachment J: *Air Traffic Management* - PANS-ATM (Doc 4444)



Impact in the remaining annexes and documents

- References to PANS-MET added to Annex 6, Annex 10, Annex 11, PANS-ABC, and PANS-ATM
- Replaced “**meteorological authority**” with “**meteorological service provider**” where appropriate in Annex 11, PANS-AIM, and PANS-ATM
- Removed requirement to issue **NOTAM** for space weather in Annex 15



Questions

