International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)

INFORMATION PAPER

GREPECAS/22 — IP/08
28/08/24

Fourth GREPECAS–RASG-PA Joint Meeting and
Twenty-second Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/22)
Virtual Phase (Asynchronous, 16 September to 11 October 2024)
In-Person Phase (Lima, Peru, 20 to 22 November 2024)

Agenda Item 5: **CAR/SAM Air Navigation Services (ANS) Implementation**
5.3 Aeronautical Meteorology and Environment

MET PROGRAM PROGRESS REPORT

(Presented by the Secretariat)

EXECUTIVE SUMMARY

This Information Paper presents to GREPECAS/22 the most relevant results in the implementation of the MET requirements for the CAR and SAM Regions, achieved since the GREPECAS/21 Meeting

Strategic Objectives:	• Operational Safety • Air Navigation Capacity and Efficiency • Environmental Protection
References:	• Annex 3 – International Air Navigation Meteorological Service Twentieth edition, July 2018 – Amendment 80 and proposed amendment 81 in progress. • Twenty-First Meeting of the Regional Planning and Implementation Group CAR/SAM (GREPECAS/21), Santo Domingo, Dominican Republic, from November 15 to 17, 2023.

1. Introduction

1.1 The Secretariat continues to work with the States and the support of other organizations on the implementation of the Standards and Recommended Practices (SARPs) contained in Annex 3 – Meteorological Service for International Air Navigation.

1.2 The secretariat, with the support of other organizations, has worked on capacity building and dissemination of information related to extra-tropical cyclones

1.3 The Secretariat has postponed further follow-up activities for the dissemination of Amendment 81 to Annex 3 and the introduction of the PANS-MET Document, given the complexities inherent in the ICAO Council's amendment process.

1.4 The Secretariat continues to monitor the implementation of the Basics Building Blocks (BBBs). Likewise, the Secretariat promotes the performance of exercises or tests on volcanic ash (VOLCEX), the dissemination of the new capabilities of the World Area Forecast Center (WAFC) and the progressive introduction of new services such as Quantitative Volcanic Ash (QVA).

2. Analysis and Discussion

2.1 The GREPECAS Secretariat continues to work on the follow-up of the implementation of the requirements, which include:

a) Implementation of quality management systems in MET processes;
b) Implementation of the OPMET information exchange in IWXXM format;
c) Implementation of international airways volcano watch;
d) Implementation of the requirements included in the amendments to Annex 3 and other ICAO documents related to the MET area;
e) Training of MET personnel.

2.2 GREPECAS has closed the MET projects considering that all the documentation to support the implementation of the MET requirements had been generated and has urged that these be followed up through the secretariat.

2.3 The GREPECAS secretariat has worked with the Expert-Team on Aviation (ET-AVI) Group of the Regional Association IV of the World Meteorological Organization, in capacity building, through a series of webinars on topics such as SIGMET, Quality Management System, Calibration, Aerodrome Warnings and Severe Weather Events, among other relevant topics.

2.4 In accordance with GREPECAS Conclusion 21/17, subparagraph (a) had requested that the Secretariat and the States/Territories work on the dissemination of Amendment 81 to Annex 3 as well as the new requirements included in Doc. 10157 PANS-MET. This activity has not been completed due to the ICAO Council approving only one recommended practice as Amendment 81, as a result of the creation of Doc. 10199 – PANS-IM, and postponed other components of the original Amendment 81 and the creation of the PANS-MET to be effective from November 2025, as part of Amendment 82 to ICAO Annex 3.

2.5 The Secretariat, through webinars and teleconferences, continues to follow up on the implementation of the quality management system, the exchange of OPMET messages in IWXXM format, as well as the preparation and provision of harmonized SIGMET messages

2.6 The Secretariat, with the support of the World Meteorological Organization and the States of the NACC/SAM Regions, have organized a Workshop on Tropical and Extra-tropical Cyclones, in virtual format.

2.7 The Secretariat, in coordination with the Volcanic Ash Advisory Centers (VAACs) in Buenos Aires and Washington, is organizing the Volcanic Ash Exercise (VOLCEX) which will take place in the first weeks of November of this year.

2.8 The Secretariat has disseminated the changes that will be introduced in the World Area Forecast System (WAFS), changes that will take effect from November 2024. Information on Quantitative Volcanic Ash (QVA) has also been disseminated, a message that will come into operation from November 2025. Both documents are found as Appendix to this IP

3. Conclusions

3.1 3.1 It is undeniable that it is necessary to advance in the implementation of the SARPs, related to the provision of meteorological services to support international air navigation, contained in ICAO Annex 3.

3.2 The implementation of the requirements, which are monitored by the Secretariat, is significantly delayed. Despite the efforts to socialize the information of the requirements through webinars, courses, workshops, the level of implementation is still minimal, in terms of:

a) Quality management system in MET processes;
b) Exchange of OPMET message information in IWXXM format;
c) Provision of harmonized SIGMET messages

3.3 The implementation of the Basics Building Blocks (BBBs) is the fundamental basis on which MET improvements in the States should be projected, but there are still opportunities for improvement on this point.

3.4 A fundamental tool is the implementation of the quality management system in MET processes that seeks to ensure the delivery of MET data and messages with quality and timeliness. This tool should include all the aspects that must be observed in the provision of MET services, such as:

a) qualifications, competencies, education and training of meteorological personnel;
a) Evaluation of the operationally desirable accuracy of measurement or observation;
b) Evaluation of the quality and timeliness of MET messages;
c) Evaluation of the operationally desirable accuracy of forecasts;
d) Traceability of MET data, etc.

3.5 It is important to note that the implementation of the OPMET message exchange in IWXXM format is mandatory to have the MET enabler for System-Wide Information Management (SWIM) ready.

3.6 The Meeting is invited to take note of the information contained in this information note.

— END —

METEOROLOGY PANEL

Quantitative Volcanic Ash (QVA) Concentration Information

First edition – 13 September 2022 (corrected l21 June 2024)

1 Introduction

This document describes the quantitative volcanic ash (QVA) concentration information (hereafter referred to as 'QVA information') that is planned to be provided by volcanic ash advisory centres (VAAC) as part of the International Civil Aviation Organization's (ICAO) International Airways Volcano Watch (IAVW). It is the first in a series of information "flyers" on QVA information.

Over the past two decades there were many requests by representatives of the IAVW, through various ICAO and World Meteorological Organization fora, for aircraft and engine manufacturers to provide information on the susceptibility of aircraft and their engines to volcanic ash. The specific desire was for ash concentration thresholds to be identified that did not pose a safety concern but could improve route efficiency. This need has led to the development of QVA information.

QVA information offers operators the opportunity to move away from traditional discernible/visible ash criteria and instead use certified engine susceptibility for flight route planning and inflight replanning. Visible ash is what an observer or flight crew member sees with their eyes. The lower limit of visible ash ranges from approximately 0.01 mg/m^3 to 10 mg/m^3, depending on many factors such as time of day, sky background, position of the sun to the observer (pilot) as well as the angle the ash cloud is viewed (e.g., viewed from the side). Discernible ash is what a satellite or other remote sensing instrument detects. Discernible ash from satellites has been used by the VAACs to define the observed area in the volcanic ash advisories (VAA) in both text and graphic form (VAG) over the past two decades. The lower limit of discernible ash from satellites is approximately 0.1 mg/m^3 to 0.2 mg/m^3, depending on the satellite and other factors.

QVA information will begin with an initial operating capability (IOC) that is planned to be implemented in three phases in the mid-2020s.

2 Initial operating capability (IOC)

The IOC for QVA will provide forecasts of ash concentration in two data formats for significant eruptions.

2.1 Format

QVA information will be provided in two file formats. Objects will be provided in ICAO's Meteorological Information Exchange Model (IWXXM) format. Gridded data will be provided in a file format which has yet to be determined but will probably be a binary format. The IWXXM format contains a subset of the entire gridded data file set.

2.2 Concentration thresholds and ranges

QVA information will consist of the thresholds and ranges shown in Table 1, which were formulated by ICAO's Meteorology Panel in coordination with the International Coordinating Council of Aerospace Industries Associations (ICCAIA). The units for the ash concentration thresholds and ranges are in milligrams per cubic meter (mg/m^3).

Table 1: Thresholds and ranges

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

The QVA information in IWXXM form will be provided as 'objects' for the very high, high, medium, and low concentration ranges. An illustrated example of QVA objects is shown in Figures 1 – 6 on page 5. Figure 7 is an illustrated example of QVA objects compared to a VAG.

2.3 Resolution

During the IOC, QVA information will have the following horizontal, vertical, and temporal resolutions.

2.3.1 Horizontal resolution

Gridded QVA information will be produced with a horizontal resolution of 0.25 degrees latitude and longitude.

2.3.2 Vertical resolution

The vertical resolution of the gridded data will be in 5,000-foot flight levels (FL) from mean sea level to FL 600 (Table 2).

Table 2: Vertical resolution

Mean sea level to FL 50	FL 150 to FL 200	FL 300 to FL 350	FL 450 to FL 500
FL 50 to FL 100	FL 200 to FL 250	FL 350 to FL 400	FL 500 to FL 550
FL 100 to FL 150	FL 250 to FL 300	FL 400 to FL 450	FL 550 to FL 600

2.3.3 Temporal resolution

QVA information will be provided in the following three hourly valid time increments: 0, 3, 6, 9, 12, 15, 18, 21 and 24 hours. QVA information will be updated as necessary but at least every six hours until the volcanic ash cloud is no longer considered a hazard.

2.4 Significant volcanic ash clouds

During the IOC, QVA information will be issued for significant volcanic ash clouds. Significant in this context means an ash cloud that poses a widespread impact to aircraft operations and air navigation. This is based on considerations[1] by the responsible VAAC of known or expected volcanic ash 'cloud'[2] spatial extent and persistence in the proximity of aerodromes and international airways.

[1] Informed by discussions and pre-agreement with relevant aviation users and, to ensure a consistency of approach, the other VAACs and SVOs.

[2] Based on satellite-derived mass-loading detection threshold of 0.2 gm-2 which, although not directly comparable to ash concentration, provides a recognized quantitative constraint (lower threshold) for satellite-based remotely sensed discernible ash.

2.5 Probabilistic forecasts

The traditional approach to weather forecasting is known as deterministic, with only one forecast outcome. While this can provide good advice, deterministic forecasting may not provide users with a full understanding of the possible range of outcomes, or indicate the risk of encountering specific phenomena. Probabilistic information will be provided by combining information from multiple forecasts.

QVA information in gridded code format will include ensemble relative frequency of exceedance for volcanic ash concentration thresholds of 10, 5, 2 and 0.2 mg/m^3. This is simply the number of ensemble members with concentration above a threshold divided by the total number of members at each grid point. Figure 8 shows some examples of QVA information in gridded format for relative frequency of exceedance of ash concentration thresholds 2.0 and 0.2 mg/m^3.

QVA objects in IWXXM form will not include probabilistic information.

2.6 Implementation of QVA

In the IOC, QVA information is planned to be implemented in three phases in accordance with the provisions in ICAO's Annex 3 – *Meteorological Service for International Air Navigation*.

2.6.1 Phase 1 – planned for late 2025

In Phase 1, QVA information will be issued by those VAACs that have developed the capability to issue QVA information for significant volcanic ash clouds. These VAACs will continue to issue VAAs and VAGs for all ash clouds.

2.6.2 Phase 2 – planned for late 2026

Phase 2 is noted by a Recommended Practice in ICAO Annex 3 that all VAACs should issue QVA information for significant volcanic ash clouds. VAACs will continue to issue VAAs and VAGs for all ash clouds.

2.6.3 Phase 3 – planned for late 2027

It is expected with Amendment 83 to Annex 3 that QVA information will be a Standard for all VAACs for significant volcanic ash clouds.

3 Full operating capability (FOC)

Details for the FOC have yet to be determined. It is anticipated that QVA will be provided in finer vertical and temporal resolutions. Probability information may be added to the IWXXM objects.

With the FOC, it is anticipated that QVA information will be issued for all volcanic ash clouds (rather than for significant), which would lead to the retirement of the current versions of the VAAs and VAGs.

Implementation date of the FOC has yet to be determined but is not likely until the next decade.

4 Using QVA information

User education material is expected to be developed that will provide flight crew and other users with information on the subtleties, uses and limitations of the QVA information.

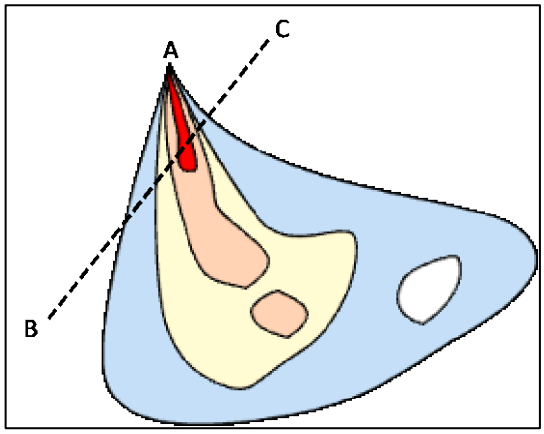
QVA information provides users with a high-resolution four-dimensional representation of a volcanic ash cloud, providing a more realistic depiction of the ash cloud. The 3-hourly timesteps of QVA information provides users with more accurate forecast positions of the ash cloud, compared to the 6-hourly timesteps of the VAA/VAG.

QVA information will likely have its greatest utility with ash cloud events that have a widely dispersed ash cloud with mostly lower levels of ash concentration. Operators with approval and procedures/practices, e.g., maintenance for planned flight into select thresholds of ash concentration, will be able to use QVA information to fly more efficient routes in accordance with their safety management program.

Probabilistic QVA information is intended for use in operator's flight planning and decision support systems. Operators will use probabilistic QVA information in conjunction with their safety management program to optimise airspace and plan more efficient routes during significant volcanic ash cloud events.

Visual illustrations of QVA information IWXXM objects

Colour legend: White = <0.2mg/m^3, Blue = ≥ 0.2mg/m^3, Yellow = ≥ 2mg/m^3, Orange = ≥ 5mg/m^3, Red = ≥ 10mg/m^3. Note that colours were randomly chosen and do not infer any visualization guidelines.



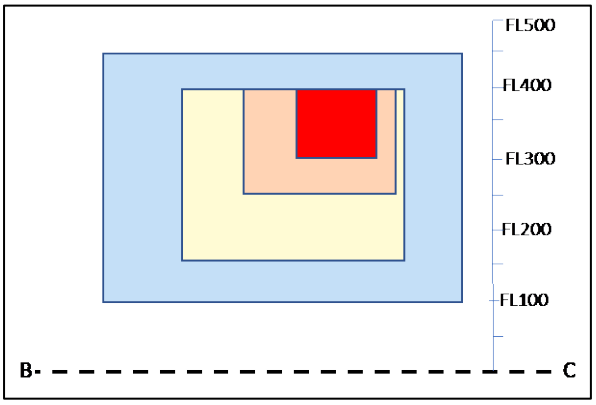


***Figure 1 (left)**. IWXXM objects showing all QVA thresholds depicted in the horizontal from a fictitious volcano located at A. The vertical depiction along line B-C is shown in **Figure 2 (right)**.*

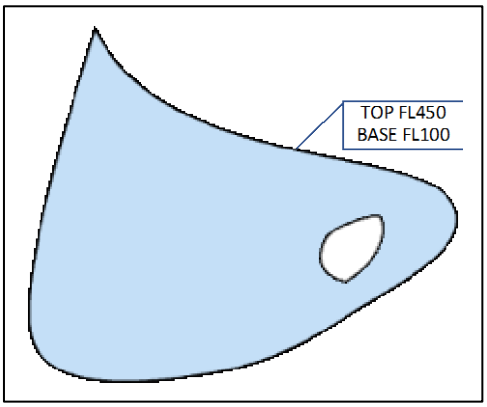


Figure 3.

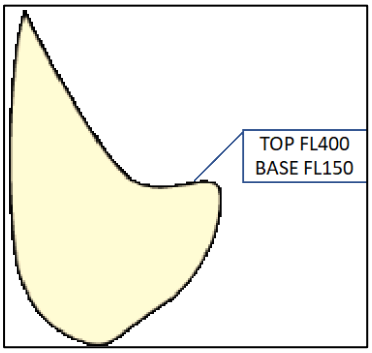


Figure 4.

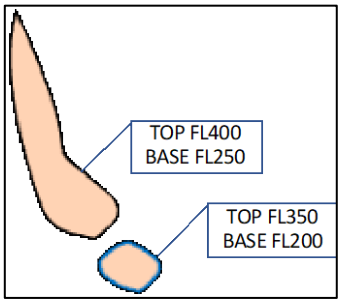


Figure 5.

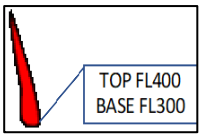


Figure 6.

Figures 3 through 6 depict the individual IWXXM objects from Figure 1. Figure 3 is IWXXM object ≥ 0.2mg/m^3 (the "hole" is ash <0.2mg/m^3). Figure 4 is IWXXM object ≥ 2mg/m^3. Figure 5 is IWXXM object ≥ 5mg/m^3. Figure 6 is IWXXM object ≥ 10mg/m^3.

Visual illustration of QVA information IWXXM objects and volcanic ash advisory in graphic form (VAG)

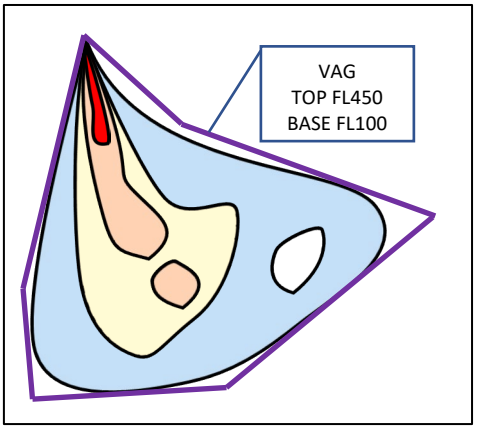


***Figure 7**. Same as Figure 1 but overlayed with the VAG (purple polygon).*

Visualized examples of QVA grid point probability information

(Provided by VAAC Buenos Aires using FALL3D model and correspond to the exercise of 10 December 2021)

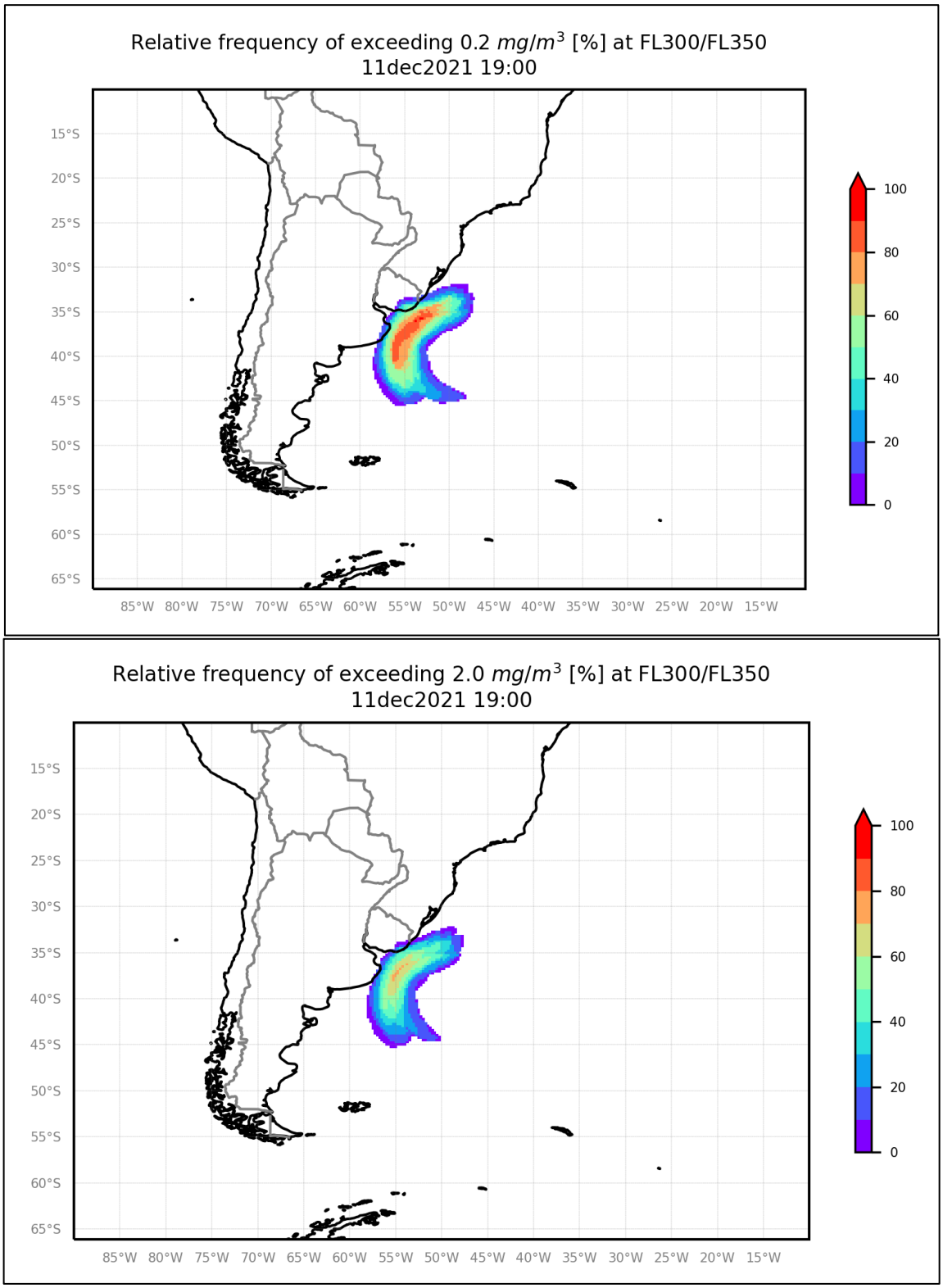


Figure 8. *Visualized examples of QVA grid point probability information from FL 300 to FL 350. Upper frame is the probability of exceeding 0.2 mg/m³. Lower frame is the probability of exceeding 2 mg/m³.*

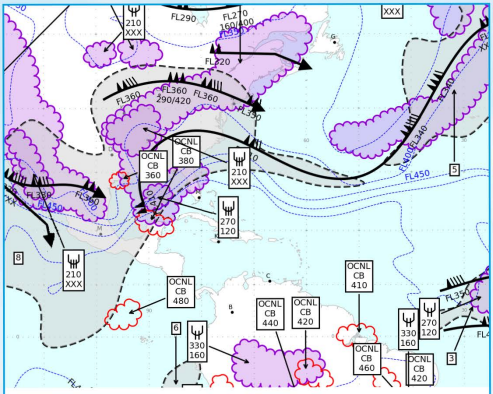
-END-

Changes to WAFS SIGWX Forecasts

In November 2024 the World Area Forecast System (WAFS) SIGWX charts will be changing as the London and Washington World Area Forecast Centres (WAFCs) introduce multi-timestep SIGWX forecasts for the first time.

What is new:

- Forecasts will be produced for T+6, T+9, T+12, T+15, T+18, T+21, T+24, T+27, T+30, T+33, T+36, T+39, T+42 and T+48 timesteps, four times daily.
- The SIGWX forecasts will span FL100 to FL600
- The SIGWX forecasts will include the following features:
  - Jet stream information
  - Tropopause height contours
  - MOD and SEV Turbulence areas (this includes clear air and orographic turbulence)
  - OCNL and FRQ cumulonimbus areas, and cumulonimbus top information
  - MOD and SEV Icing areas
  - Volcano, tropical cyclone and nuclear emergency markers
- This new data is designed for digital use where users can control the map projection, zoom level, colour schemes, and are able to toggle individual features on and off.
- The new SIGWX forecasts will be provided in IWXXM format and will need to be visualised by you or your software providers systems before you can use it for briefing purposes. IWXXM schema information is available here: **https://schemas.wmo.int/iwxxm/2023-1/**



Example SIGWX display

IWXXM Format

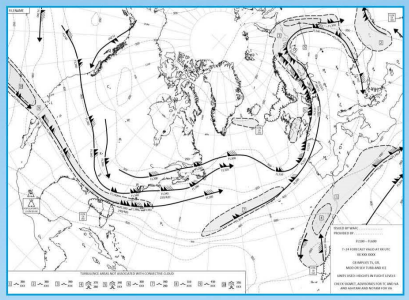
IWXXM SIGWX data is now available on the new SADIS API and WIFS APIs for testing and set up purposes.

Please contact the SADIS and WIFS provider for information: **wifs.admin@noaa.gov** or **SADISManager@metoffice.gov.uk**

Note: you may have seen earlier communications on changes to the WAFS SIGWX that involved retiring the medium-level SIGWX products in July 2024. This flyer supersedes that information.

What about the existing T+24 WAFS SIGWX charts?

- The medium and high level SIGWX charts for 17 map areas that are produced by WAFC London and WAFC Washington will continue to be produced until Nov 2028.
  - Medium level SIGWX will span FL100 to FL450
  - High level SIGWX will span FL250 to FL600 (note: there will be a small decrease in the upper limit from FL630 to FL600)



The appearance of the T+24 WAFC produced SIGWX charts will change a little:

- **Embedded (EMBD) cumulonimbus clouds will no longer be included which means that there will not be any areas of "ISOL EMBD CB",** Only OCNL and FRQ amounts of cumulonimbus will be shown.
- Tropopause will be shown as contours (as a thin dashed line) instead of spot heights.
- CAT areas will become "Turbulence" areas, which encompasses CAT and orographic turbulence types. MOD and SEV Turbulence areas will be shown
- Cumulonimbus bases will not be shown in the cumulonimbus labels. These are almost always "XXX" even in the medium level SIGWX.
- On medium level SIGWX charts, the combined in-cloud icing and turbulence areas will be replaced with areas of MOD and SEV icing.
- Jet stream information, volcano, tropical cyclone and nuclear emergency markers will not change.

Further information on the upcoming SIGWX changes is available on at https://www.metoffice.gov.uk/services/transport/aviation/regulated/wafs-2023

What do you need to do?

1. Make sure that your software provider or IT department is aware of the upcoming changes and encourage them to start setting up systems to pull test data from the new SADIS or WIFS API.
2. Upgrade systems to be able to visualise the new IWXXM format SIGWX data sets.

Users are encouraged to switch to using the new multi-timestep SIGWX forecasts as soon as possible after the go live date in November 2024 as the new SIGWX offers greatly improved situational awareness extending out to the T+48 forecast period as well as the ability to get SIGWX forecasts valid at the time of the flight which were produced from a more recently produced set of UK and US model data.

Note: ICAO Annex 3 will not reflect the new SIGWX forecasts until November 2025. The UK and US will be filing a difference against Annex 3 in November 2024 to facilitate the changes related to embedded cumulonimbus clouds that are described in this flyer.

Please contact **wifs.admin@noaa.gov** or **SADISManager@metoffice.gov.uk** for further information on the changes or to arrange access to the SADIS and WIFS API's