

P/04 rev - 28 July 2026

The Fourth Meeting of the North American, Central American
and Caribbean Working Group (NACC/WG) Implementation of
Aeronautical Meteorology (MET) Task Force (MET/TF/4)



Quantitative Volcanic Ash (QVA) Concentration Information Service

Karen Shelton-Mur, Federal Aviation Administration, and
Larry Burch, AvMet Applications, Inc.



**Federal Aviation
Administration**

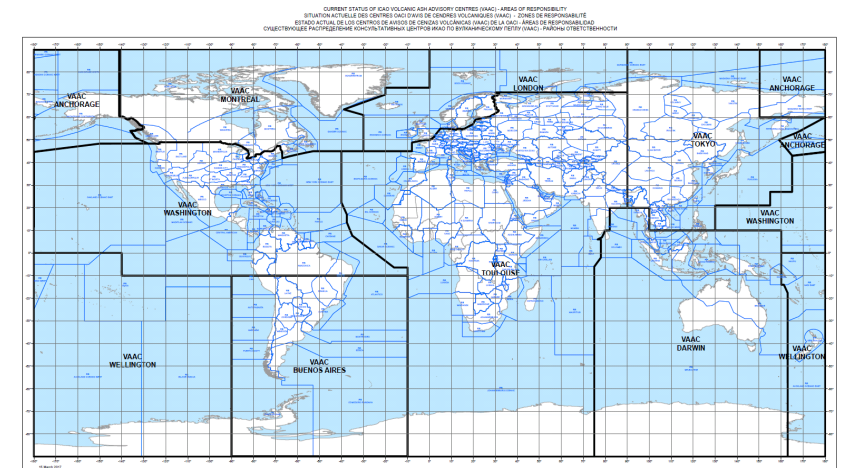
Introduction of QVA Information Service

Amendment 82 to Annex 3 – *Meteorological Service for International Air Navigation, and Procedures for Air Navigation Services – Meteorology (PANS-MET, Doc 10157)*

- Volcanic ash presents a significant hazard to aviation; particularly to aircraft in flight.
- International Civil Aviation Organization (ICAO) designated 9 centers as Volcanic Ash Advisory Centers (VAAC) in the 1990s.
- VAACs currently issue VAA/VAG (OBS/EST VA, and FCST +6, +12, +18hr)
- This information is qualitative, since the advisories do not include information on how **much** ash is expected at a given location.

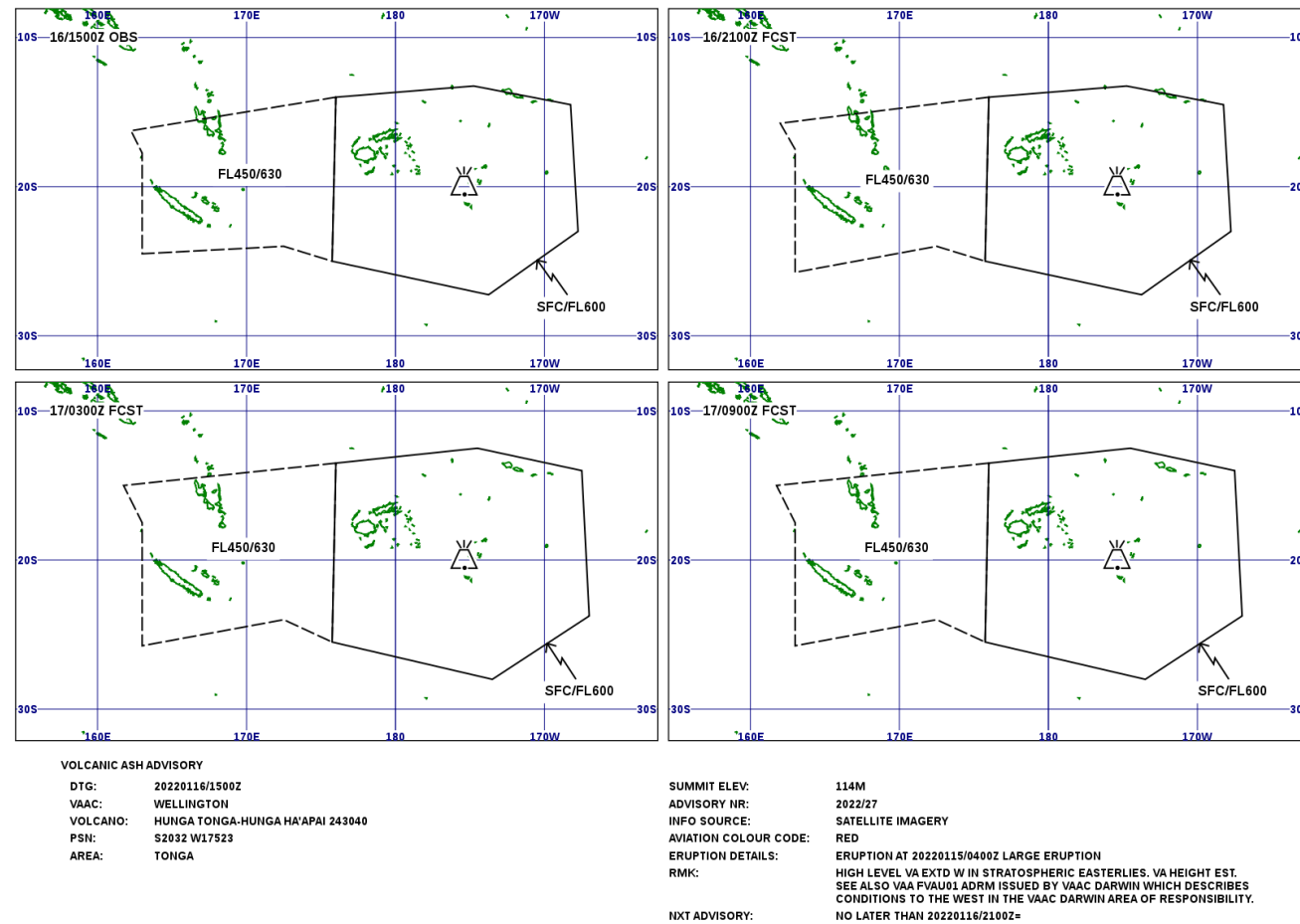


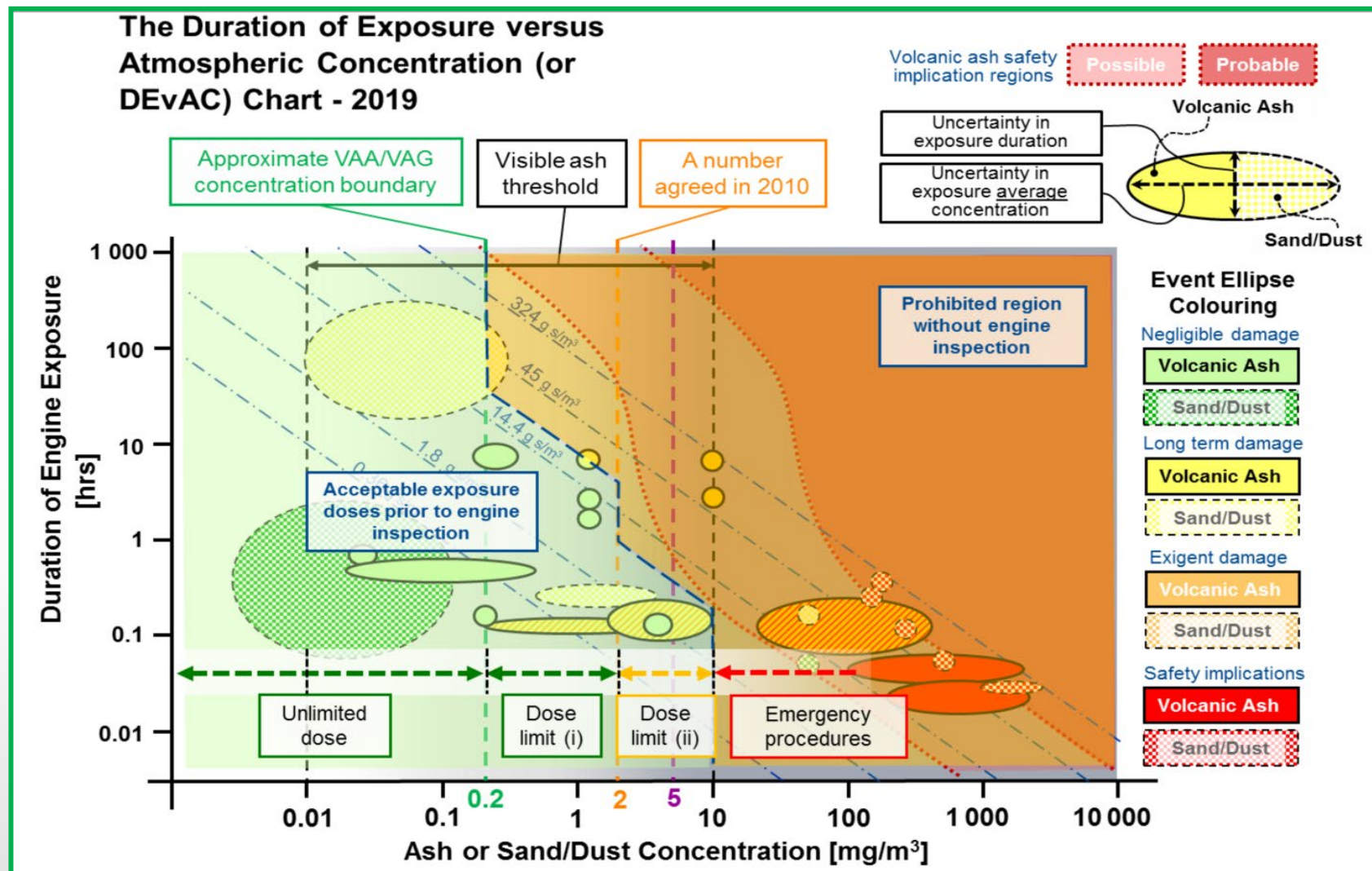
*Hunga Tonga-Hunga Ha'apai eruption, 15 January 2022.
Photo from aircraft and included in VONA from TMS.*



Examples of current Volcanic Ash Advisories & Graphics

FVPS01 NZKL 161500
 VA ADVISORY
 DTG: 20220116/1500Z
 VAAC: WELLINGTON
 VOLCANO: HUNGA TONGA-HUNGA HA'APAI 243040
 PSN: S2032 W17523
 AREA: TONGA
 SUMMIT ELEV: 114M
 ADVISORY NR: 2022/27
 INFO SOURCE: SATELLITE IMAGERY
 AVIATION COLOUR CODE: RED
 ERUPTION DETAILS: ERUPTION AT 20220115/0400Z LARGE ERUPTION
 OBS VA DTG: 16/1500Z
 OBS VA CLD: SFC/FL600 S2715 W17345 - S2500 E17545 - S1400
 E17600 - S1315 W17445 - S1430 W16815 - S2300 W16745 MOV S
 05KT FL450/630 S2500 E17545 - S2400 E17230 - S2430 E16300 -
 S1745 E16300 - S1615 E16215 - S1400 E17600 MOV W 30KT
 FCST VA CLD +6 HR: 16/2100Z SFC/FL600 S2715 W17345 - S2500
 E17545 - S1400 E17600 - S1315 W17445 - S1430 W16815 - S2300
 W16745 FL450/630 S2500 E17545 - S2400 E17230 - S2545 E16300
 - S1730 E16300 - S1545 E16200 - S1400 E17600
 FCST VA CLD +12 HR: 17/0300Z SFC/FL600 S2800 W17330 - S2530
 E17545 - S1330 E17600 - S1230 W17430 - S1400 W16730 - S2345
 W16700 FL450/630 S2530 E17545 - S2400 E17230 - S2545 E16300
 - S1730 E16300 - S1500 E16145 - S1330 E17600
 FCST VA CLD +18 HR: 17/0900Z SFC/FL600 S2800 W17330 - S2530
 E17545 - S1330 E17600 - S1230 W17430 - S1400 W16730 - S2345
 W16700 FL450/630 S2530 E17545 - S2400 E17230 - S2545 E16300
 - S1745 E16300 - S1730 E16300 - S1500 E16145 - S1330 E17600
 RMK: HIGH LEVEL VA EXTD W IN STRATOSPHERIC EASTERLIES. VA
 HEIGHT EST. SEE ALSO VAA FVAU01 ADM ISSUED BY VAAC DARWIN
 WHICH DESCRIBES CONDITIONS TO THE WEST IN THE VAAC DARWIN
 AREA OF RESPONSIBILITY.
 NXT ADVISORY: NO LATER THAN 20220116/2100Z=





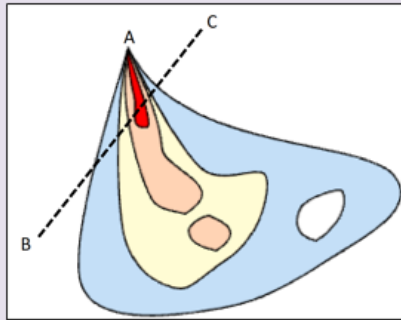
Dr Rory Clarkson and Harry Simpson – *Maximising Airspace Use During Volcanic Eruptions: Matching Engine Durability against Ash Cloud Occurrence*

QVA Format

QVA information will be provided in two file formats

Objects

Deterministic

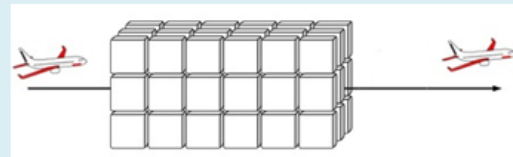


Illustrated Example of QVA

Forecasts of ash concentration to be provided in IWXXM format

Gridded Data

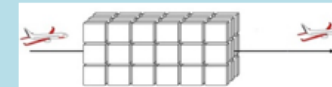
Deterministic



Each grid point has ash concentration value

Probabilistic

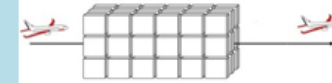
Very high



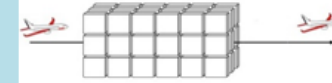
High



Medium



Low



Each grid point has ensemble relative frequency of exceedance for volcanic ash concentration thresholds

Intended for use in operator's flight planning, etc.
File format has yet to be determined but will probably be a binary format

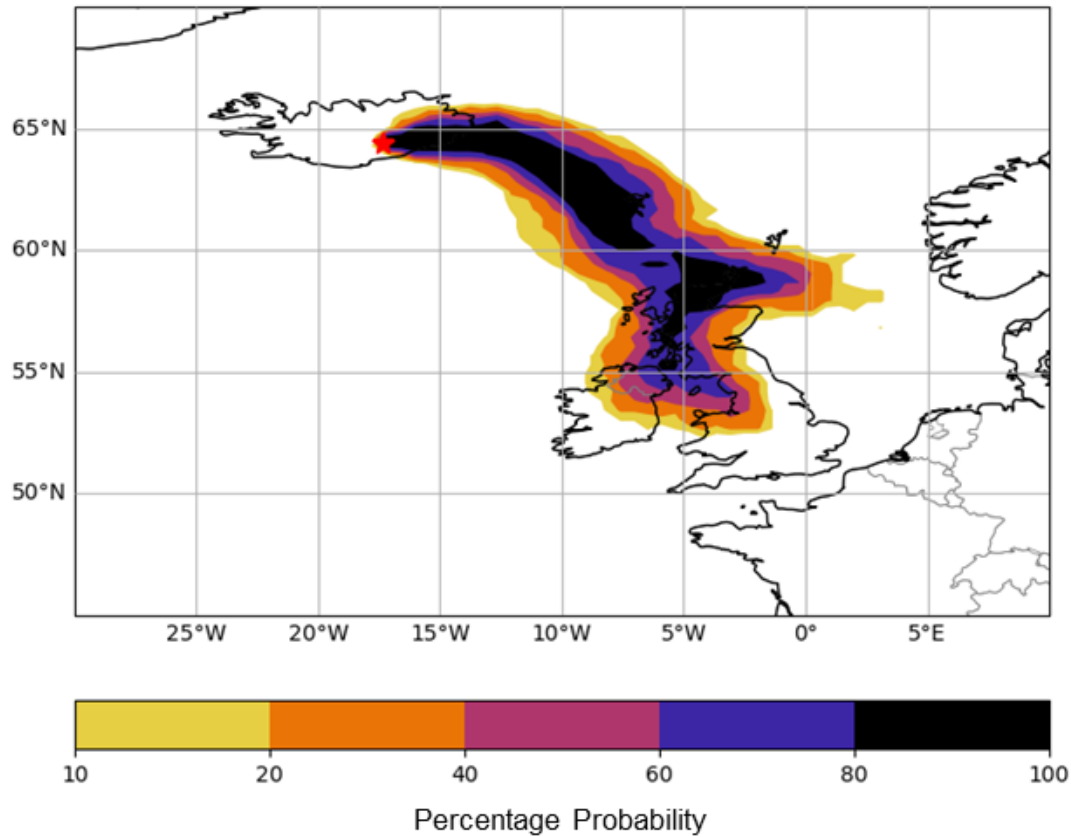
QVA Thresholds and Resolution

	QVA Information	VAA/VAG
Concentration thresholds and ranges	Very high $\geq 10 \text{ mg/m}^3$ High $\geq 5 \text{ and } < 10 \text{ mg/m}^3$ Medium $\geq 2 \text{ and } < 5 \text{ mg/m}^3$ Low $\geq 0.2 \text{ and } < 2 \text{ mg/m}^3$ Very low $< 0.2 \text{ mg/m}^3$	N/A
Horizontal resolution	0.25 degrees lat/lon for gridded data	polygon vertices coordinates provided with 1-minute accuracy
Vertical resolution	5,000 ft (MSL to FL50, FL50 to FL100, ..., FL550 to FL600) for gridded data	N/A
Temporal resolution	3 hours (FT0, 3, 6, 9, 12, 15, 18, 21, 24)	6 hours (FT0, 6, 12, 18)
Update interval	at least every 6 hours	at least every 6 hours
Probabilistic forecast	ensemble relative frequency of exceedance for volcanic ash concentration thresholds	N/A
Format	Objects: IWXXM format Gridded data: TBD (probably in a binary format)	Text message, IWXXM format, PNG format
VA clouds for which information is issued	Significant VA clouds	All VA clouds

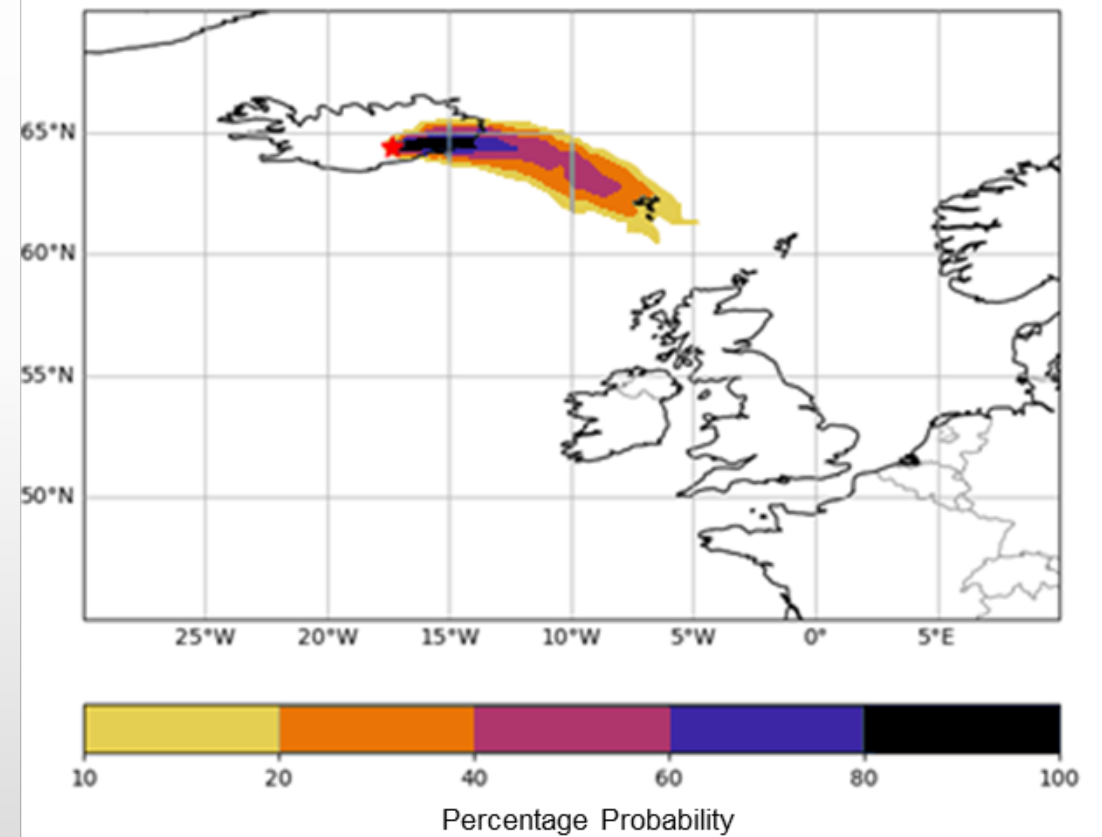
Example

The probability of exceeding 0.2 mg/m^3 and 2.0 mg/m^3 for the FL250-FL300 level.

Probability of exceeding 0.2 mg/m^3
From FL250 to FL300
Valid 18:00UTC 05/08/2022



Probability of exceeding 2 mg/m^3
From FL250 to FL300
Valid 18:00UTC 05/08/2022



Visual illustrations of QVA IWXXM objects

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

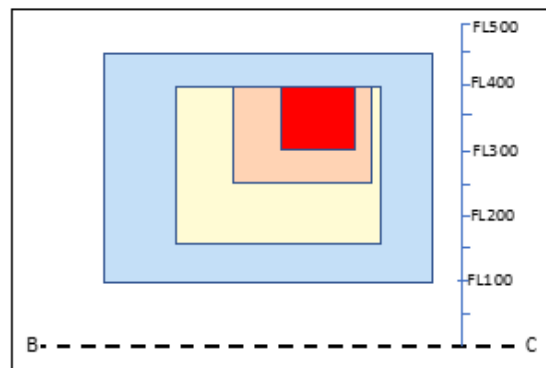
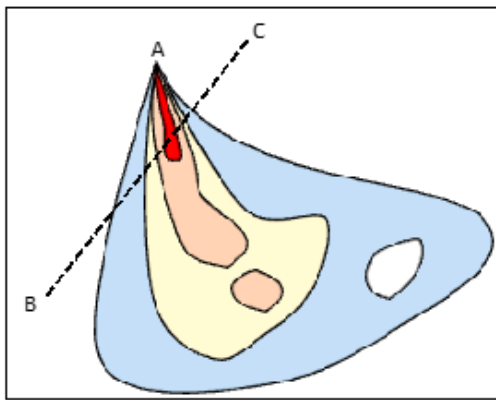


Figure 1 (left). IWXXM objects showing all QVA thresholds depicted in the horizontal from a fictitious volcano located at A. The vertical depiction along line B-C is shown in Figure 2 (right).

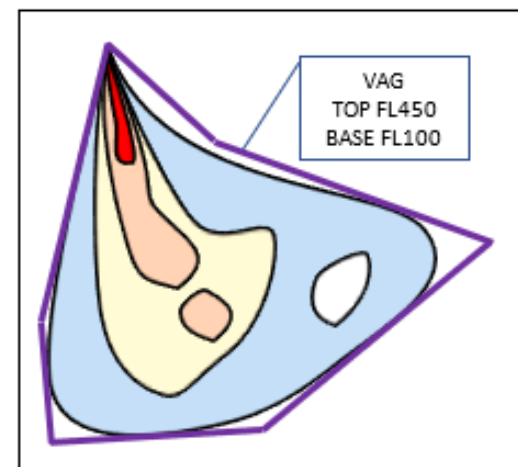


Figure 7. Same as Figure 1 but overlaid with the VAG (purple polygon).

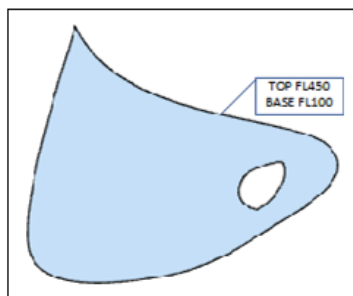


Figure 3.

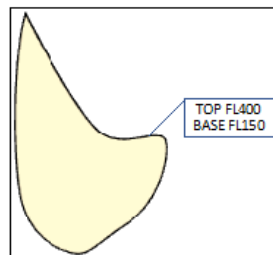


Figure 4.

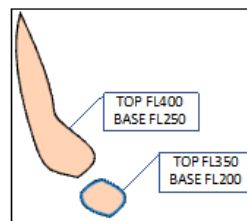


Figure 5.

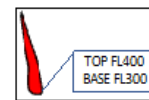


Figure 6.

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

“Significant” volcanic ash clouds

- Initially, QVA information will be provided for only “Significant” volcanic ash clouds – defined in Annex 3 as “*an ash cloud that poses a widespread impact to aircraft operations and air navigation*”. See Annex 3, Chapter 3, paragraph 3.4.2 Note 2.
- How ‘significant’ will be defined is still being determined by each VAAC but may include:
 - Whether the volcanic ash cloud is impacting an international airport or a busy domestic airport.
 - Whether the volcanic ash cloud is being transported a long way from the volcano and so impacting air routes.
 - Whether the volcanic ash cloud concentration is greater than 0.2 mg/m³

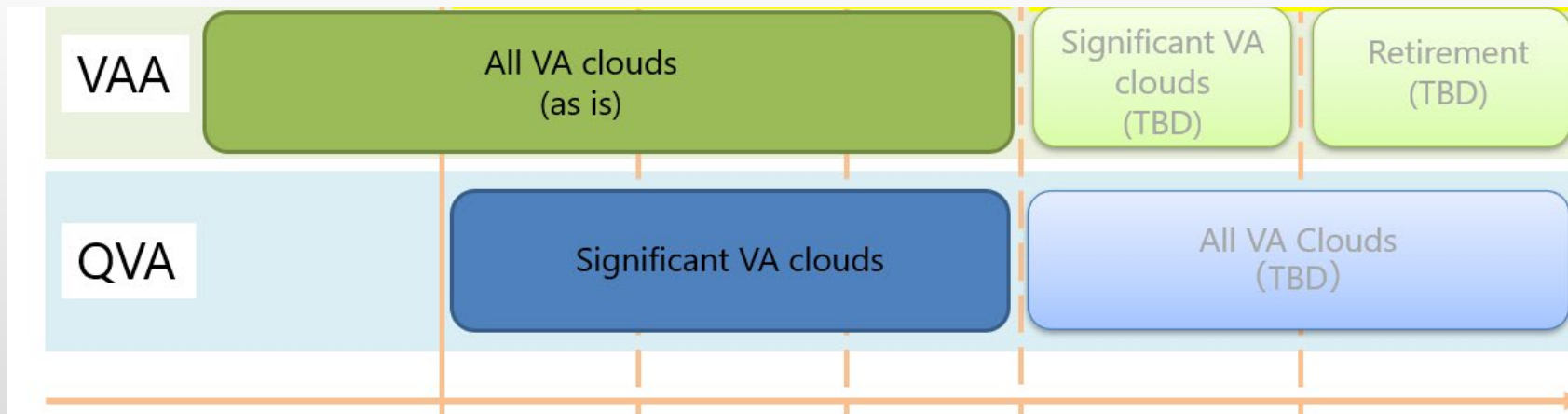
Data Distribution

- The QVA service will be issued by each designated VAAC and will offer the same capabilities and features.
 - the information is intended to be used by service consumers within the aviation domain.
- VAAC's will provide a SWIM compliant Application Programming Interface (API) to allow access to the data.
- QVA service will be a “Publish subscribe” service, also known as the Advanced Message Queuing Protocol (AMQP) suit the irregular nature of volcanic eruptions.
 - the service consumer can subscribe to the service to receive notification when an update to an existing ash cloud or a new significant ash cloud occurs.

Implementation Timeline

Date	Stipulated by	SARP	VAACs to implement QVA
Until 25 Nov 2026	Annex 3 Amd 82	Recommendation	VAACs in a position to do so
From Nov 26, 2026	Annex 3 Amd 82	Recommendation	All VAACs
As of Nov 2030	Annex 3 Amd 8x	Standard	All VAACs

VA clouds for which VAA and/or QVA is issued



Using QVA

- User education material is being developed for training and education of flight crew and other users with information on the subtleties, uses and limitations of the QVA information.
- QVA Workshops and Webinars
 - Oct 2024 – ICAO Workshop on QVA was held
 - Nov 2025 – VAAC London Webinar
 - Next ICAO workshop to be determined
- 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.
- 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 optimize airspace and plan more efficient routes during significant volcanic ash cloud events.



METEOROLOGY PANEL



Quantitative Volcanic Ash Concentration Information

Updated 19 February 2026

1 Introduction

This document describes the quantitative volcanic ash concentration information (QVA) service that is to be provided by Volcanic Ash Advisory Centres (VAACs) in support of the International Civil Aviation Organization's (ICAO) International Airways Volcano Watch (IAVW). This flyer is intended to give an overview of QVA for all users of this service and provide information that may be of interest to stakeholders such as regulators and State volcano observatories (SVO).

QVA offers operators the opportunity to move away from traditional discernible/visible ash criteria and instead use engine susceptibility information for flight route planning and in-flight 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/m³ to 10 mg/m³, depending on many factors such as time of day, sky background, position of the sun to the observer (pilot), as well as the angle at which 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 both the text-based volcanic ash advisories (VAA) and the volcanic ash graphic (VAG) since the late 1990s. The lower limit of discernible ash from satellites is approximately 0.1 mg/m³ to 0.2 mg/m³, depending on the satellite and other factors.

QVA provides users with forecast volcanic ash information at a higher spatial and temporal resolution than that which the traditional advisories and graphics offer. The traditional products are limited to a small number of vertices, with 6-hour resolution, sometimes leading to polygons of volcanic ash that overestimate the area of contaminated airspace. With QVA providing more detailed forecasts of the expected location of volcanic ash, this will support more efficient flight planning.

The traditional approach to weather forecasting is known as deterministic, with only one forecast outcome. While this can provide good advice, the addition of probabilistic QVA data sets, provided by combining information from multiple forecast scenarios, will provide users with a fuller understanding of the possible range of outcomes or indicate the risk of encountering specific phenomena.

2 QVA Data and Access

2.1 Data Sets

QVA forecasts are made up of three data sets:

- Gridded deterministic volcanic ash concentration information – these provide a **specific** forecast ash concentration value for each model grid point.
- Gridded probabilistic volcanic ash concentration information – which indicates the likelihood of the ash concentration **exceeding** four thresholds: 0.2 mg/m³, 2.0 mg/m³, 5 mg/m³, and 10 mg/m³ for each model grid point.
- Ash objects (polygons) in which the gridded deterministic forecast is turned into simple polygons by the VAACs for the very high, high, medium and low quantitative volcanic ash concentration ranges (as applicable) given in table 1. Each polygon will have attributes that indicate the vertical extent of that polygon (i.e., base and top). Examples are given in figures 1 to 7 (inclusive).

The gridded deterministic and probabilistic data sets will be provided in NetCDF format, and the ash objects will be provided in the ICAO Meteorological Information Exchange Model (IWXXM format).

While the gridded deterministic forecast will provide a specific expected ash concentration value (in mg/m³) for each model grid point, these values could be assigned the categories as described in table 1. These ranges were formulated by

QVA Information Flyer



Thank you!

For questions:
email Karen.Shelton-Mur@faa.gov

