METEOROLOGY PANEL

ICAO Meteorology Panel

International Airways Volcano Watch Work Stream of the Working Group - Meteorology Operations Group

Quantitative Volcanic Ash Concentration Information Workshop

31 October 2024, ICAO EUR/NAT Office, Paris

Summary of Proceedings

Welcome and Introduction

Mr Mark Gibbs, Rapporteur of the Meteorology Panel Working Group – Meteorology Operations Group (METP WG-MOG) and Head of Transport and Head of Space Weather at the Met Office, United Kingdom, welcomed attendees to the workshop, saying he was pleased to see such a large group of stakeholders with a wide diversity in roles.

Mr Gibbs explained to the workshop that the MET WG-MOG International Airways Volcano Watch (IAVW) work stream had been meeting for the previous three days to discuss the provision of quantitative volcanic ash concentration information (QVA) to the aviation community, including a half day workshop for volcanic ash advisory centre (VAAC) representatives to discuss mechanisms for consistency in QVA service.

With QVA going live for the European VAACs by the end of 2025, and for other VAACs (in a position to do so) from then also, this workshop provided an opportunity to reach a common understanding of QVA – from a science and service perspective, but also from the perspective of the end user, in how the information will be used in operations. Mr Gibbs encouraged all attendees to engage in discussion and to take advantage of the unique opportunity where experts from both the science and operations, and from industry, were present in one room, to ensure all attendees finish the day better informed.

Presentations

Presentations were made to the workshop, with copies of slides available at:

https://www.icao.int/meteorology-panel-qva-workshop-2024

Engine susceptibility to volcanic ash - an overview Presenter: Dr Rory Clarkson, Rolls-Royce (video)
Dust Economics: Cost-based trajectory optimization in contaminated air Presenter: Raimund Zopp, Flightkeys (video)
Fulfilling Pilots' Association requirements Presenter: Cptn Klaus Sievers, IFALPA (video)
Quantitative volcanic ash – a new operating requirement: London VAAC case study Presenters: Dr Frances Beckett & Dr Matt Hort, UKMO (video)
Proposed VAAC forecaster workflow for QVA issuance Presenter: Dr Jarrad Denman, VAAC Darwin (video)
Accessing QVA demonstration Presenter: Karen Shorey, UKMO (video)
Plans and preparation for VOLCEX 2024 – demonstrating the value of QVA Presenter: Sarah Puginier, VAAC Toulouse (video)

Posters

A QVA Case Studies poster session was held during the afternoon break. Copies of the posters in PDF format are available at:

https://www.icao.int/meteorology-panel-qva-workshop-2024

- Probabilistic Ash Forecasts: Case study of Mauna Loa eruption in 2022
- Advances in QVA information at VAAC Buenos Aires
- QVA verification with ash retrieval on Sheveluch 2023

Industry Panel Discussion Summary

Moderator: Com.te Gianlorenzo REGIS, ICAO Flight Operations Panel Volcanic Ash Sub-group Rapporteur, ENAC Italy.

Participants: Halldís Hulda HREINSDÓTTIR – Icelandair
Wayne SNYDER – American Airlines
Richard ALLEN-WILLIAMS – British Airways
HOMMA Fumiya – Japan Airlines
[Plus further commenters from the floor]

Key discussion points

- Many airlines currently have an 'avoidance' policy, but may choose to fly over areas of volcanic ash, with certain constraints. Traditionally, all volcanic ash clouds are treated equally, with no consideration of concentration. There is a big opportunity, especially in active volcanic regions, for airlines to take advantage of QVA, allowing greater flexibility in supporting operations during volcanic ash events. **To fully utilise QVA, there will need to be a cultural change for many pilots and dispatchers, undoing years of avoidance practice**.
- Having understanding of the impact of volcanic ash on the aircraft components is important, and this **will require clear information from all Original Equipment Manufacturers (OEMs), to contribute to training resources**.
- Pilot training on the understanding and use of QVA is critical, as the pilot will be responsible for the decision to fly through (as well as around/over/under) known areas of volcanic ash. **It will be important for State regulators to include QVA information in training requirements**. Inclusion of QVA, along with OEM volcanic ash tolerance information, in flight simulators is key to providing realistic training scenarios.
- Many pilots currently do not have the necessary understanding of QVA and how it is created, and while this can be rectified via education, the time to do so does compete with other training requirements and so the **requirement for such training should be supported by appropriate regulation**.

- Airlines 'operationalise' the theoretical knowledge pilots learn during initial training. **For a pilot to fly through known volcanic ash, they need confidence – which requires understanding and does not have to be onerous.** This comes back to the initial training and the need for quality information, at an appropriate scientific level, from the VAACs.
- Noted that a pilot typically does not get a large amount of time to prepare for their flight. Once they are airborne, decisions become tactical – **the pilot must have confidence in the QVA forecast, particularly as the data begins to age**.
- Airlines will make decisions within the operations specifications, determined by their national regulators. In Europe, experience in considering volcanic ash concentration levels has been built up since 2010. Based on the use of the existing European ash concentration charts, some airlines have authorisations from their national regulator to operate in different concentrations of ash (low, medium, high). **Globally, regulators will need to understand the implications of airlines utilising QVA to continue operations through regions of volcanic ash, and ensure there are regulations in place to support both the safe and efficient operations of those aircraft.**
- **It is important to have standardisation in QVA service between VAACs**, so that airlines can have confidence that, for example, a 40% likelihood of a given volcanic ash concentration exceedance is equivalent between each VAAC dataset. Noted by VAACs that this is a gradual improvement process, where not all possible uncertainty is able to be captured. **It is already accepted that there are differences in operational approaches by meteorological service providers (e.g., using different weather models for their forecasts) and QVA will be no different in this regard.**
- **Air traffic controllers will need to be flexible with the advent of QVA**, in accommodating aircraft requests, particularly when updated QVA information is issued, for changes in the flight tracks. Any re-routes issued by controllers that passes through an area of volcanic ash will need to consider whether the aircraft is approved to fly through a given concentration of volcanic ash. **Air traffic controllers need a common understanding of QVA, so they can assess the likely aircraft behaviour.**
- **QVA is a tool to support risk management**, allowing airlines to understand where is the greater risk posed by the volcanic ash cloud and to accept or avoid as appropriate. Probabilistic QVA will **give pilots confidence to operate *closer* to volcanic ash clouds** (if not through the clouds), reducing additional fuel requirements.
- Verification of QVA is important to support user confidence, however it is worth noting that **volcanic ash dispersion models have been tested and constantly**

improved for decades. QVA is an *evolution* of the traditional volcanic ash advisory, not an entirely new service.

Summary of breakout session 1: Education and guidance material needs

Many representatives from the aviation industry were present and represent intended users of QVA. They were invited to share questions or comments they had regarding this future service. Below is a summary of the discussion.

- Most meteorological watch offices (MWO) currently use information within volcanic ash advisories (VAA) to produce SIGMETs. How will MWO use QVA to issue SIGMETs?
    - QVA will be issued alongside traditional advisories and graphics, which will continue to exist for the foreseeable future. MWO should continue to use VAA to create SIGMETs but also are able to consult the more detailed QVA forecasts, if preferred. For example, the area where the lowest concentration threshold of QVA is forecast (0.2 mg/m^3) is approximately equivalent to the outlined areas of volcanic ash in traditional products.

- Who do the VAACs see as their users?
    - Pilots, dispatchers, air traffic controllers are considered to be the main users.
    - Weather providers collect the weather and provide it to flight planners. Private websites also provide aviation data to users.

- How will users access QVA data? Will this depend on their ability to use application programming interfaces (API)?
    - Current concentration charts produced by Météo-France and the Met Office UK will continue to exist through 2026.
    - QVA is expected to be available as of 2025, from at least some VAACs. IWXXM[1] format QVA data and gridded QVA data will be available via APIs.
    - All VAACs also intend to produce QVA supplemental charts to aid users (even if such charts are not mandatory). These QVA charts are being developed jointly by the VAACs and will be similar from one VAAC to the next, since they will use the same colour schemes and refer to the same flight levels, time steps, etc.

- How can users interpret the QVA probability forecasts?

[1] ICAO Meteorological Information Exchange Model

- The probability value gives the forecast likelihood of volcanic ash being at/or exceeding the indicated concentration. It is determined by calculating the proportion of predictions from within an ensemble of ash dispersion predictions (representing the range of potential meteorological, eruption and dispersion scenarios) that meet the concentration criteria.
- Uncertainty exists in today's forecasts but is not usually reflected in traditional aviation products (the exception being PROB inclusions in TAF). VAACs and State volcano observatories estimate what is emitted from a volcano, but that estimate has uncertainty around it. Uncertainties also exist elsewhere, such as in the meteorological fields from weather prediction centres that are input to dispersion models. Trying to account for all such uncertainties leads the VAACs to create forecasts which indicate the probability of finding different concentration thresholds.

- What do the users do with the probabilistic forecasts?
  - The deterministic and probabilistic products are complementary, and it is expected that both will be used in conjunction with each other to varying degrees.
  - It was noted that they may also be used separately to support different aspects of airline operations. For example, deterministic product may more easily be integrated with cost of flight/flight optimisation software and processes, while probabilities may better support flight risk assessment.
  - Regulators may use or require the use of the probabilistic forecast in approving airline safety risk assessments and approval of operations for the differing concentration bands.
  - Probabilistic forecasts are new and so the range of use cases and how they will integrate it not yet fully understood. However, the VAACs will provide education material, explaining what these products mean and during events will provide additional interpretation to support operators use of the probability and deterministic products.

- Can we expect education material from the VAACs for users?
  - Yes, the VAACs plan on providing users with education material, building on the initial QVA Flyer (available at: https://www.icao.int/airnavigation/aeronautical-meteorological-service/documents).

- Is there a plan to replace traditional volcanic ash advisories and graphics with QVA?
    - QVA will initially be introduced as complementary to the traditional products, with no immediate plans to discontinue advisories, nor volcanic ash SIGMETs.
    - The longer-term intent is for QVA to eventually replace traditional products, but this will take some time. When the requirement for volcanic ash advisories and graphics is removed from Annex 3 to the Convention on International Civil Aviation (*Meteorological Services for International Air Navigation*), the usual State consultation by ICAO will occur.

- Other key discussion points:
    - There is a need from airlines to see more from the OEMs on what volcanic ash concentration values engines, airframes and avionics can tolerate. It would be preferable for the airlines to set their own risk tolerance.
    - Airlines purchase airplanes and then often sell them to leasing companies, from whom they then lease the planes. This industry is huge and should be tied in with this community, since the leasing companies may have their own opinion on where planes can fly or not and their own needs for OEM data.
    - Confidence is important for pilots. The evolution of the background of how QVA came about and how things have evolved is important to explain in education material. If pilots perceive this as something new, it may not have good acceptance.
    - New satellite capabilities have allowed for the progression of VAA to QVA, but this progress needs to benefit operators and be explained to them. For example, satellite data is helping to improve dispersion models and the VAAC forecasts.

Summary of breakout session 2: Regulatory Considerations

What are the regulatory barriers that could prevent full utilisation of QVA?

- **Education of regulators is critical**. Noted that some European operators are approved to operate through low, and in some cases, medium concentrations of volcanic ash (related to current European VAAC volcanic ash concentration charts). Important to learn from – and build upon – the experiences of these operators and their regulators.

- **Guidance from regulators to airspace users on how to use QVA is required**. Need to ensure that regulators and operators have a common understanding of QVA, to support approval of utilisation of QVA by operators.

    - EASA guidance for national regulators is required. A Notice of Proposed Amendment (NPA) is expected in 2025, however there is concern in the time that this process may take. The Safety Information Bulletin also needs to be updated.
    - The United States policy is currently to avoid volcanic ash, but there is interest in further research that may lead to potential future policy change.
    - Regulators can share experiences to ensure the entire globe is included in the journey.

- The utilisation of QVA is made more difficult due to only one engine manufacturer declaring volcanic ash dosage tolerances – **need other engine manufacturers to take the necessary steps to declare the ash tolerance of their products**.

- **ICAO should lead this work**, with coordination across relevant Panels – in particular, the Flight Operations Panel and Meteorology Panel. This will require an update to ICAO Doc 9974 *Flight Safety and Volcanic Ash* and may potentially also require a new job card.

- There is concern from users around the effort to move from current procedures to those that will be required for QVA – what will happen to existing European safety risk assessment approvals?

- For those (few) operators approved to fly through 4 mg/m^3, noted that they can **recreate this threshold through the gridded deterministic QVA datasets**. However, the IWXXM and probabilistic gridded thresholds are fixed at 0.2, 2.0, 5.0, 10.0 mg/m^3.

- The **transition to QVA utilisation can be a gradual process** – use QVA for ash avoidance initially, working towards flying through known ash levels as confidence is built.

- Emphasised that QVA is a different (and much more granular) way to view the forecast information that the nine global VAACs already provide through the VAA/VAG – **users can have a level of confidence already, as they have been using a subset of this information for decades** (VAA/VAG is simply showing the areas of ash approximately greater than 0.2 mg/m^3).

Key messages

- Education of users and regulators is critical to facilitate the full utilisation of quantitative volcanic ash concentration information.
- Coordination between appropriate ICAO Panels, in coordination with airspace users, to develop guidance material is necessary to ensure information is relevant and useful.
- Original equipment manufacturers must urgently conduct the necessary activities to determine the volcanic ash tolerance of their products.
- ICAO needs to update its volcanic ash operations documentation to reflect the provision and use of QVA, including the volcanic ash contingency plans.
- Worldwide regulatory implementation of rules and guidance on the use of QVA must begin with urgency.

Next steps for ICAO MET Panel WG-MOG IAVW work stream

- ICAO MET Panel WG-MOG IAVW work stream to continue to develop QVA guidance material, in coordination with Flight Operations Panel and other interested Panels, and airspace users.
- Find opportunities for further workshops, both in ICAO regions and globally, as QVA implementation and operationalisation is progressed.