International Civil Aviation Organization

INFORMATION PAPER

ICAO Asia and Pacific (APAC)
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Agenda Item 6: Research, development and other initiatives

USAGE OF QUANTITATIVE VOLCANIC ASH CONCENTRATION INFORMATION IN MULTI-REGIONAL TRAJECTORY BASED OPERATION DEMONSTRATION

(Presented by Japan)

SUMMARY

This paper overviews data usage from live flight demonstrations conducted by Japan, Thailand, Singapore and US ANSPs in June 2023. The activity included mock QVA issuance by VAAC Tokyo and pilot/flight dispatcher interaction for flight route decisions.

1. INTRODUCTION

1.1 Building on previous lab demonstration activities, the Federal Aviation Administration (FAA), the Japan Civil Aviation Bureau (JCAB), the Civil Aviation Authority of Singapore (CAAS), Aeronautical Radio of Thailand (AEROTHAI) and industry partners have undertaken a multi-regional trajectory-based Operation (MR TBO) project to collaborate and demonstrate TBO concepts with a live flight demonstration. The exercise took place over a period of six days in June 2023 with four scenarios highlighting flights between various regions. Scenario 2 in particular highlighted live flight departures from Narita International Airport to Changi International Airport in Singapore, illustrating interaction among Air Navigation Service Providers (ANSPs) and related aircraft operators based on seven cases (see Multi-Regional TBO on the FAA website for further information).

1.2 Quantitative Volcanic Ash Concentration Information (QVA) has been proposed for inclusion in Annex 3 to the Convention on International Civil Aviation as a component of the 81st amendment, applicable as of November 2024. The proposed text is shown below.

3.5.2 **Recommendation**.— Until 26 November 2025, for significant volcanic ash "clouds", VAACs in a position to do so should issue forecasts of quantitative volcanic ash concentration information in a volcanic ash "cloud" to meteorological authorities and other users, as approved by the Contracting State on advice from the meteorological authority.

3.5.2 **Recommendation**.— As of 27 November 2025, for significant volcanic ash "clouds", VAACs should issue forecasts of quantitative volcanic ash concentration information in a volcanic ash "cloud" to meteorological authorities and other users, as approved by the Contracting State on advice from the meteorological authority.

Note 1.— The VAACs in a position to provide quantitative volcanic ash concentration information are included in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766).

Note 2.— Significant volcanic ash "clouds" in this context means an ash "cloud" that poses a widespread impact to aircraft operations and air navigation. Guidance on the criteria is provided in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766).

1.3 Technical QVA details are still under discussion by the ICAO Meteorology Panel (METP). Issuance will be in gridded-data and IWXXM format containing a subset of the entire gridded data file set to provide level of concentration and probabilities exceeding concentration thresholds of 10, 5, 2 and 0.2 mg/m^3 (interpreted as very high, high, medium and low, respectively). Planned spatial and temporal resolutions are given below.

1) Thresholds

	Concentration ranges
Very high	≥ 10 mg/m^3
High	≥ 5 and < 10 mg/m^3
Medium	≥ 2 and < 5 mg/m^3
Low	≥ 0.2 and < 2 mg/m^3
Very low	< 0.2 mg/m^3

2) Horizontal resolution: 0.25° latitude/longitude

3) Vertical resolution:
5,000-foot flight levels (FL) from mean sea level to FL 600

4) Temporal resolution: three-hour valid time increments (0, 3, 6, 9, 12, 15, 18, 21 and 24 hours)

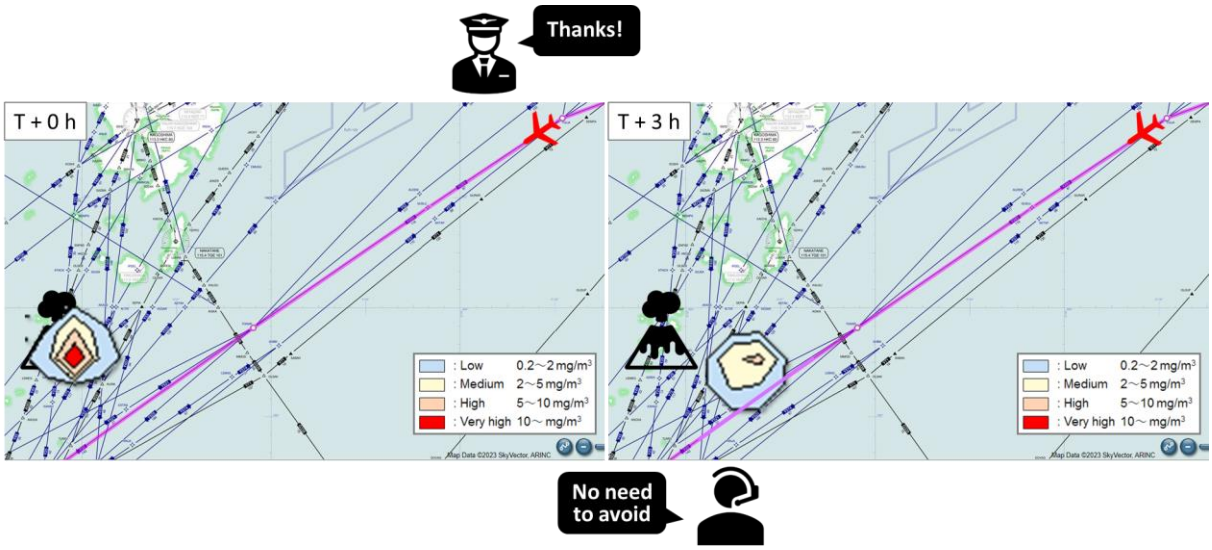
- Updated as necessary; at least every six hours until disappearance of volcanic ash cloud hazard

2. DISCUSSION

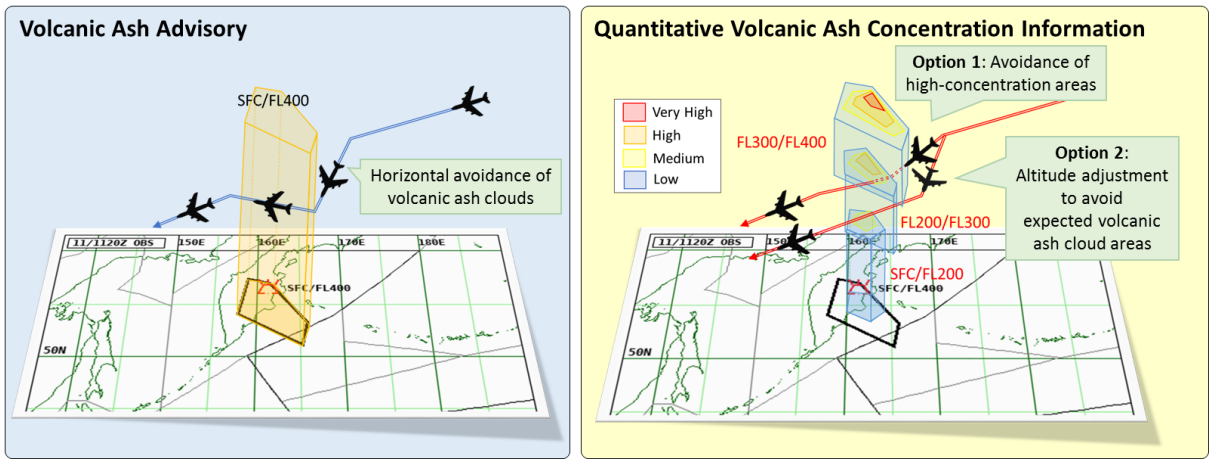
2.1 In this scenario, an aircraft reaches cruising altitude around 20 minutes after departure. The crew is informed that Mt. Suwanosejima has erupted in the planned flight around an hour before passage over the area. A Pilot Report (PIREP) issued by an aircraft near the volcano specifies a 20,000-foot ash plume.

2.2 The Volcanic Ash Advisory Center (VAAC) Tokyo imminently issues a QVA, and the crew starts interacting with the flight dispatcher via the Electric Flight Bag (EFB), which enables QVA viewing. Based on this chat message exchange, it is concluded that only a low-concentration area would affect the planned flight path, so engine exposure to volcanic ash would be below the acceptable limit[1] and there is no need to detour.

1 Such information may be provided by engine manufacturers (e.g., Volcanic Ash and Aviation – Rolls-Royce Position, May 2017)



2.3 The experiment demonstrated that advanced information (such as QVA with 4-D quantitative/probabilistic forecasting) effectively supports prompt decisions in trajectory-based operations. As per the figures below, QVAs give more information than conventional Volcanic Ash Advisories (VAAs), leading to more efficient aircraft operation along with time savings, reduced fuel consumption and lower greenhouse gas emissions.



3. ACTION BY THE MEETING

3.1 Note the information contained in this paper.

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