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INFORMATION PAPER (IP/08)

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(MET SG/29)

Bangkok, Thailand, 18 - 22 August 2025

Agenda Item 5:   **Planning and monitoring**

COMBINED APAC VAAC MANAGEMENT REPORT

(Presented by Australia, Japan and New Zealand)

SUMMARY

This paper presents an International Airways Volcano Watch (IAVW) consolidated management report describing activities for the nine volcanic ash advisory centres (VAACs) prepared by the Meteorology Panel (METP) Working Group Meteorological Operations Group (WG-MOG) IAVW workstream for the period 1 January 2024 to 31 December 2024. Additional information is provided by the three APAC VAACs Darwin, Tokyo, and Wellington covering the period 1 January 2025 to 30 June 2025

1.   INTRODUCTION

1.1   This paper presents the consolidated VAAC management report prepared by the nine VAACs for the METP WG-MOG IAVW workstream. The information in the report covers all products issued during the 1 January 2024 and 31 December 2024 period, key performance indicators, operational improvements, competency, stakeholder outreach, volcanic events of interest, collaboration, and steps towards the implementation of the quantitative volcanic ash concentration information (QVA) service.

1.2   The consolidated VAAC Management Report for 2024 is provided in Appendix A, with additional information provided by the three APAC VAACs Darwin, Tokyo and Wellington covering the period 1 January 2024 to 31 May 2024.

2.   DISCUSSION

2025 update from VAAC Darwin

2.1   Lewotobi Laki-laki, on the Island of Flores in Indonesia, is a twin peak stratovolcano located approximately 450 NM east of Denpasar International Airport. On 20 March 2025, Lewotobi Laki-laki erupted to 53,000ft. The volcanic ash moved southwest into Australian airspace and west over Bali and Denpasar International Airport. There was also a continuous emission at the volcano summit at a lower level of 20,000ft moving southeast from the summit. The Himawari-9 visible and RGB imagery was used to track the volcanic ash as it moved over the airport and impacted flight paths. The volcanic ash to 53,000ft eventually dissipated approximately 30 hours after the initial eruption.

2.2   On 17 June 2025, Lewotobi Laki-laki erupted to 38,000ft as reported by the Centre of Volcanology and Geological Hazard Mitigation (CVGHM). The VAAC reviewed the satellite imagery to assess the situation and were able to determine that the eruption could have been higher than reported by the ground observatory. The brightness temperature of the volcanic ash column from satellite imagery was giving a height of 53,000ft. The height and ash cloud tracking on Himawari-9 visible and RGB imagery matched the winds from model data and the output from the dispersion ensemble prediction system (DEPS). Due to the winds, the volcanic ash was split into multiple levels as it was pushed in multiple direction. The volcanic ash to 53,000ft quickly moved to the west in strong winds. The volcanic ash was quick to reach Bali and Denpasar International Airport as it passed over and continued moving west to the south of Java, Indonesia. The volcanic ash to 40,000ft moved southwest over the ocean south of Bali. The volcanic ash to 35,000ft moved south into the Australia FIR and over the ocean before dissipating. The volcanic ash eventually dissipated approximately 45 hours after the initial eruption.

2.3   During both eruptions, there was good information flow between CVGHM and VAAC Darwin, good discussions during the airline briefings, and a continuous flow of information in the WhatsApp group sharing all products (VONA, VAA/VAG, NOTAM etc) to participating agencies.

2.4   VAAC Darwin, VAAC Montreal and VAAC Washington are planning another back-up test within the next 3 months.

2025 update from VAAC Tokyo

2.5   On 12 May 2025, an eruption at Kanlaon in the Philippines produced an ash cloud with a height estimated at 46,000 ft from satellite imagery. Although the southern part of the cloud appeared to be moving toward VAAC Darwin's area of responsibility (AoR), VAAC Tokyo continued its advisory duties rather than handing over to Darwin because the cloud appeared to consist mainly of gases that were expected to dissipate relatively quickly. Information on the situation was readily shared with VAAC Darwin via a chat platform.

2.6   The Philippine Institute of Volcanology and Seismology (PHIVOLCS) reported a different eruption column height of 23,000 ft for the eruption mentioned above. The 46,000 ft estimation based on satellite analysis may have been overestimated due to meteorological clouds and other factors, although ground observation may also have involved some uncertainty.

2.7   From around 0200 UTC on 21 May 2025, VAAC Tokyo experienced domestic network outage. Its operations were backed up by VAAC Darwin until around 0500 UTC, by which time VAAC Tokyo had activated an internal backup system in another location. During the backup period, no volcanic ash advisories for VAAC Tokyo's AoR were issued by VAAC Darwin. Network operation was re-established at around 0030 UTC on 22 May.

2025 update from VAAC Wellington

2.8   Ongoing low-level volcanic activity continues at Whakaari/White Island, an offshore volcano located approximately 120 NM east-southeast of Auckland International Airport. While prevailing wind patterns typically keep any volcanic ash impacts offshore, on several occasions when ash moved towards regional aerodromes greater scrutiny and engagement with airlines was required to assess and communicate potential impacts on aviation operations.

2.9   In late March and early April 2025, VAAC Wellington conducted three internal workshops aimed at enhancing the skills and operational readiness of our VAAC forecasters. The workshops focused on satellite-based volcanic ash monitoring techniques, volcanic ash dispersion

modelling, ICAO specifications, including QVA, volcano observatory notice for aviation (VONA), VAAC Key Performance Indicators (KPIs) and verification processes, as well as operational case studies to consolidate best practices. These sessions provided valuable opportunities for team development and alignment with evolving international standards.

2.10   On 13 January 2025, VAAC Wellington implemented a change to the coordinate rounding settings in the tool used to produce volcanic ash advisories (VAAs). Going forward, all VAAs will display coordinates rounded to 1-minute intervals, instead of the previous 15-minute increments. This change is in accordance with ICAO Annex 3 and brings VAAC Wellington into alignment with the other eight global VAACs. One key benefit from this change is improved spatial accuracy when depicting volcanic ash affected areas.

<u>Back-up test outcomes</u>

2.11   VAAC Darwin and VAAC Tokyo conducted a back-up test on the 26 June 2025. There were a number of positive responses received for receipt of the test advisory. The VAACs have a few issues to fix for AFTN lists and will look to revise the e-mail distribution for notification of VAAC back-up test as there were a number of e-mails that no longer exist.

2.12   VAAC Darwin and VAAC Wellington conducted a back-up test on the 2 July 2025. The test was successful and both VAACs were able to issue a test advisory on behalf of the other VAAC. Limited responses were received for the test.
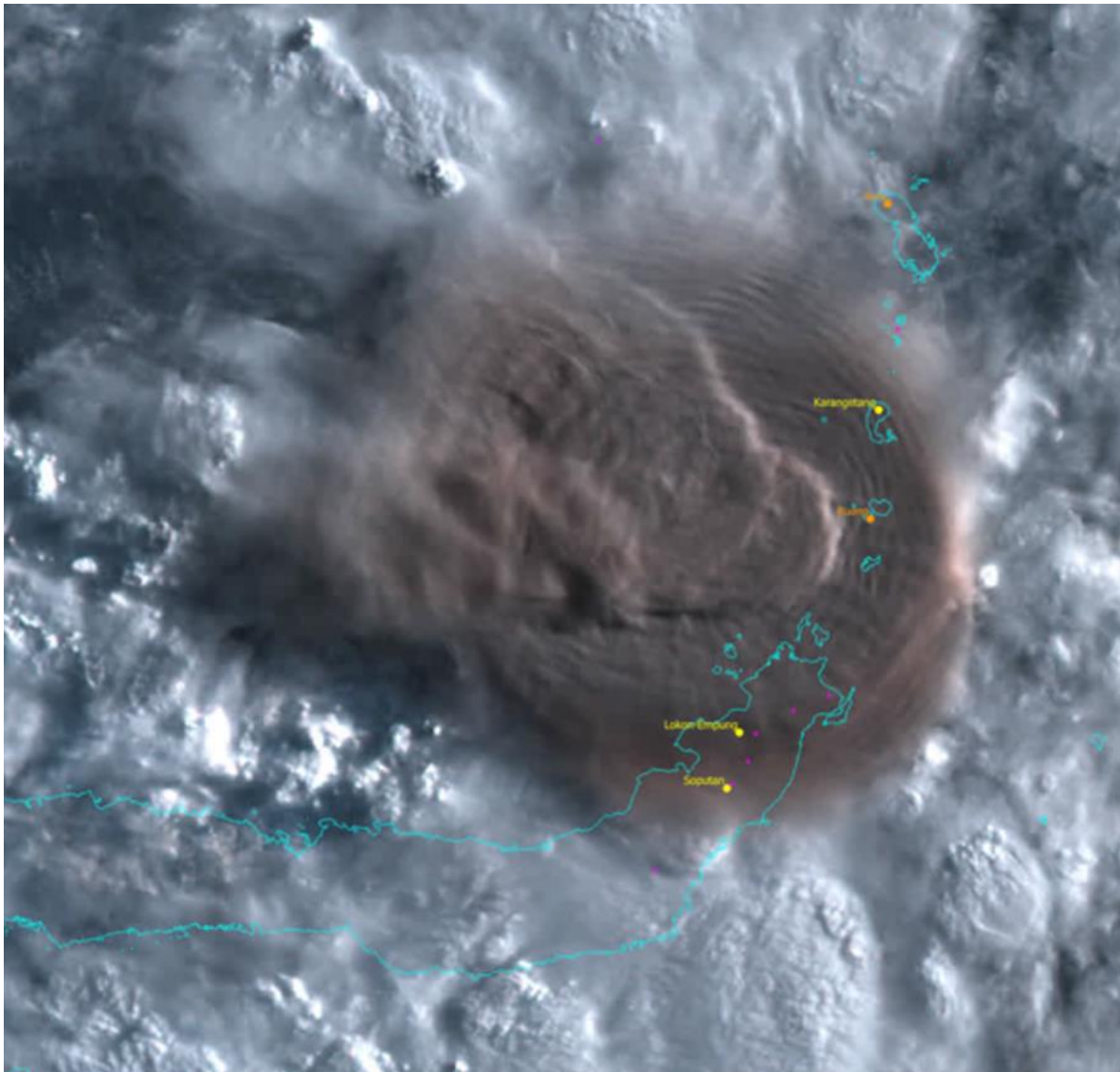
3.   ACTION BY THE MEETING

3.1   The meeting is invited to:

a)   note the information contained in this paper.

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APPENDIX A

Consolidated Volcanic Ash Advisory Centre Management Report 2024

True Colour Imagery, Himawari 9 (courtesy of JMA)

High-level eruption (estimated VA height of FL850) at Ruang, Indonesia,

29 April 2024, 2210UTC

Version Control

Version	Date	Change record	Approved
1.0	19 December 2024	First Draft	
2.0	14 March 2025	Second Draft	VAAC Managers
3.0	27 March 2025	Third Draft	Task Lead and Co Lead (VAAC Wellington and Washington Managers)
4.0	28 April 2025	Fourth Draft	METP-WG/MOG-IAVW members

Executive Summary

Since 2018 the nine global volcanic ash advisory centres (VAACs) have been producing a Consolidated VAAC Management Report. This report covers the operations of the nine VAACs for the calendar year 2024.

In 2024, the nine VAACs issued 14,160 volcanic ash advisories (VAA) for approximately 1,460 events[1] averaging 38 advisories per day and 4 new events per day. This represents a 7% increase in VAAs issued compared to the previous year.

The VAACs are generally meeting their performance targets for timeliness and compliance, as set in 2018. However, some delays in meeting these targets were caused by technical issues, missing information in eruption reports, or the simultaneous issuance of multiple VAAs.

Continuous technological advancements and improvements in tools are enhancing volcanic ash (VA) analysis and forecasting operations. Section 2.3 outlines the specific satellite, model, and technical changes implemented by each VAAC to support these improvements.

Ongoing education and training are crucial for maintaining competent staffing levels at VAACs, ensuring staff are familiar with the VA response process, and testing system functionality, especially in VAACs for whom ash eruptions are rare. Section 2.4 discusses the competent staffing levels, as well as the ongoing education and training of new staff at each VAAC.

The involvement of each VAAC in outreach events, meetings and workshops is outlined in Section 2.5. Additionally, it was agreed at the 2023 Meteorology Panel (METP) Working Group - Meteorological Operations Group (WG-MOG) International Airways Volcano Watch (IAVW) Work Stream meeting, that the VAACs would conduct a User Satisfaction Survey using a common set of questions. Out of 150 respondents, 75% were satisfied or very satisfied with the VA service provided by their VAAC. However, some users expressed a desire for more frequent updates. Satisfaction dropped to 61% when it came to the perceived accuracy of the VA products, with feedback indicating that the areas covered were too broad for practical use. This feedback supports the case for implementing the quantitative volcanic ash concentration information (QVA) service.

User satisfaction further decreased to 39% regarding coordination between VAACs, with some users noting instances of conflicting information. It's important to note that 23% of responses to this question were "I don't know," as some user groups aren't set up to receive VA products from multiple VAACs, or it is rare for some VAACs to encounter situations requiring handing over to others.

Lastly, 45% of respondents were aware of the proposed QVA service, though some expressed concerns about relying on it without further research or specific guidelines to ensure its safe use.

Section 2.6 highlights notable events experienced by each VAAC. VAAC Darwin observed multiple eruptions with stratospheric ash injections, including one where the ash cloud was trapped above the tropopause, allowing aviation operators to continue operating below it. VAAC Tokyo described an interesting event where an ash cloud drifted east, was handed over to VAAC Anchorage, and then returned west, being handed back to VAAC Tokyo.

In 2024, VAACs continued to collaborate closely, utilizing technology to connect with neighbouring VAACs for idea-sharing, training, and practice backups. This collaboration ensured continuous VAAC coverage and allowed staff to stay familiar with the backup process. Several meetings and workshops were also held, further strengthening the connections and ties between VAACs.

A key focus for the VAACs is the advancement of the QVA service. This service, initially for significant volcanic ash clouds[2] only, is included in Amendment 82 to Annex 3, as a Recommended Practice for VAACs that are in a position to implement it from November 2025 and then a Recommended Practice for all VAACs from November 2026. Section 3.1 provides a summary of the progress made by VAACs in this area.

Contents

Acronym List

AoR	Area of Responsibility
APAC	Asia and Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation
ATS	Air Traffic Services
AIREP	Aircraft Report
AMF	Aeronautical Meteorological Forecaster
EST	Estimated
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FALL3D	A model used for modelling ash distribution and concentration.
GOES	Geostationary Operational Environmental Satellite
IAVW	International Airways Volcanic Watch
ICAO	International Civil Aviation Organization
IWXXM	ICAO Meteorological Information Exchange Mode
KPI	Key performance indicator
Meteosat	Geostationary meteorological satellites operated by EUMETSAT
MTG	Meteosat Third Generation satellite
MWO	Meteorological Watch Office
NAME	Numerical Atmospheric-dispersion Modelling Environment
NESDIS	National Environmental Satellite, Data, and Information Services
NO VA EXP	No Volcanic Ash Expected
NOAA	National Oceanic and Atmospheric Administration
NOAA ARL	NOAA Air Research Laboratory
OBS	Observed
PIREP	Pilot report

QMS	Quality management system
QVA	Quantitative volcanic ash concentration information
RODB	Regional OPMET data banks
RHEL	Red Hat Enterprise Linux
RSMC	Regional Specialised Meteorological Centres
SVO	State volcano observatories
VAA	Volcanic ash advisory
VAAC	Volcanic ash advisory centre
VAG	Volcanic ash graphic
VAGFNR-AF	Volcanic Ash Graphic Forecast for Narrow Area of Hypothetical Routine Eruption and Ash Fall
VIIRS	Visual Infrared Imaging Radiometer Suite
VOLCEX24	Volcanic Ash Exercise conducted in 2024
VONA	Volcanic observatory notification for aviation
WMO	World Meteorological Organization
WG-MOG	Working Group on Meteorological Operations Group

1. INTRODUCTION

1.1   Introduction of World Volcanic Ash Advisory Centres

There are nine volcanic ash advisory centres (VAACs) that operate under an international system called the International Airways Volcano Watch (IAVW), set up and co-ordinated by the International Civil Aviation Organization (ICAO).

The function of each of the nine centres under the IAVW is to respond to reports of volcanic ash within their region (refer Figure 1) and provide forecasts to the aviation community of ash cloud extent and movement, and from November 2025, forecasts of ash concentration. Observations may come from ground stations and volcano observatories, aircraft in flight or orbiting satellites. The ash information is issued in the form of volcanic ash advisories (VAA), and a corresponding volcanic ash graph (VAG), describing the current and forecast extent of ash.
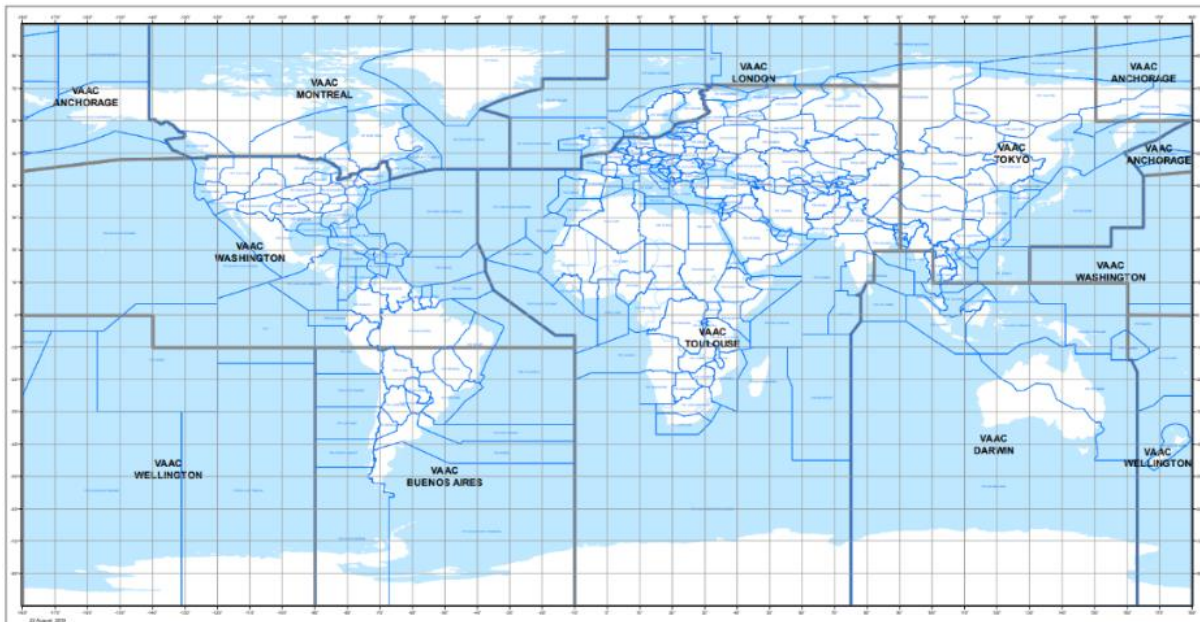

Figure 1: Area of responsibility for each VAAC (2019 version of map)

2   DISCUSSION ON OPERATIONS

2.1   Issuance of VAA and VAG for the period 1 January 2024 to 31 December 2024

2.1.1 The table below contains a breakdown of the number of advisories issued by each VAAC, as well as a total. Note, the column "Volcanic Ash Advisory" includes nearly all advisories issued by the VAAC, including those for re-suspended ash, as well as re-broadcast and back up advisories. Note that advisories for re-suspended ash are also tallied in the column entitled "Re-suspended ash". Only test and exercise advisories are not included in this column: they are accounted for in the "Test and exercise advisory" column.

Volcanic Ash Advisory Centre	Volcanic Ash Advisory	Volcanic Ash Graphic	Re-suspended ash	Test and exercise advisory	"False alarm" VAA
Anchorage	105	42	19	0	0
Buenos Aires	1372	1366	4	9	0
Darwin	5885	5885	0	2	4[1]
London	11	11	0	31	0
Montreal	0	0	0	18	0
Tokyo	1154	426	126	2	0
Toulouse	103	103	0	25	0
Washington	5311	5286	15	5	1
Wellington	219	219	0	5	0
Total	**14,160**	**13,338**	**164**	**97**	**5**

Table 1: The total number of advisories issued by each VAAC including the number of test/exercise or back-up advisories for each VAAC between the period of 1 January 2024 to 31 December 2024 (inclusive).

Notes:

1. The false alarms for VAAC Darwin were clouds later deemed not volcanic by the State volcano observatory (SVO) and one volcano observatory notice for aviation (VONA) issued by mistake for a volcano next to a major airport. All four VAAs were cancelled within a reasonable time following the issuance of the initial VAA.

2.2   Key Performance Indicators

2.2.1   The ICAO Meteorology Panel (METP) Working Group Meteorological Operations Group (WG-MOG) has agreed key performance indicators (KPIs) for all VAACs to report against. These KPIs are as outlined in the following paragraphs.

2.2.2   Following the receipt of information from a credible source of volcanic ash in the atmosphere within a VAAC area of responsibility (AoR),

- the initial VAA/VAG product is to be issued within 20 minutes on 95% of occasions
- the first subsequent VAA/VAG (forecast, cancellation, or amendment) is to be issued within 75 minutes on 95% of occasions
- forecast VAA/VAG to be issued no later than the time stated in the 'Next advisory' element of the VAA/VAG, until no further advisories are advised
- "Rebroadcast" of neighbouring VAAC's polygon information (within 555km/5deg of border) within 20 minutes of neighbouring VAAC's issue of the primary VAA.

2.2.3   **Compliance**: Both initial and forecast VAA to be Annex 3 compliant, where all fields of the VAA are correctly filled out (where information is available to do so), and appropriate time stamps and headers are used.

Volcanic Ash Advisory Centre	Initial VAA/VAG within 20 minutes	First subsequent VAA/VAG issued within 75 minutes	Subsequent VAA/VAG issues no later than 'next advisory' time	"Rebroadcast" of neighbouring VAA within 20 minutes (within 555km or 5 degrees of VAAC boundary)	Annex 3 compliance – All fields filled out correctly and appropriate time stamps and headers are used
Anchorage	N/A	N/A	100% (28/28)	70% (44/63)	80% (93/105)
Buenos Aires	75% (24/32)	88% (7/8)	99%	N/A	99%
Darwin	94% (436/464)	100% (427/427)	98%	87% (19/22)	97% [1]
London	100% (7/7)	N/A	100% [2] (1/1)	N/A	100% (7/7)

Montreal	N/A	N/A	N/A	N/A	N/A
Tokyo	100% (483/483)	100% (302/302)	100% (369/369)	100% (29/29)	100% (1154/1154)
Toulouse	96% [3] (75/78)	99% (77/78)	100% (78/78)	N/A	99% [4] (77/78)
Washington	98% (379/386)	100% (1/1)	97.5% (4204/4310)	33% [5] (5/15)	97.9%
Wellington	60% [6] (6/10)	90% (9/10)	100% (8/8)	N/A	97% [7]

Table 2: Percentage of advisories that meet the KPIs and the total number of advisories analysed for the period from 1 January 2024 to 31 December 2024. Volcanic ash advisories that are issued as part of tests and exercises are not included in this table.

N/A = not applicable, as none were issued.
All percentages rounded to the nearest whole number.

Notes:

1. <u>VAAC Darwin</u> - The non-compliance is usually an issue with VAA header time, where the system header time has not updated.

2. <u>VAAC London - </u>Only effusive eruptions occurred this year with only Initial/End VAA/VAG required. One set of VAA/VAG with polygons was issued mid-way through one eruption on May 29th when ash occurred for a brief period unexpectedly (first VA observed since 2011), and the NO VA EXP was issued well before next advisory due time.

3. <u>VAAC Toulouse</u> - Three delays due to technical issues.

4. <u>VAAC Toulouse</u> - One VAA with a wrong number. A correction was immediately provided.

5. <u>VAAC Washington</u> - Some of the late 'Rebroadcast' VAA (not within 20 minutes) were due to the issuance of other VAA/VAG within Washington VAAC Area of Responsibility

6.   <u>VAAC Wellington</u> – Quite often reports received are related to low level activity and are missing some key details (i.e. which volcano is suspected to be erupting). This means the forecaster is required to spend some additional time investigating the report before issuing an initial VAA.

7.   <u>VAAC Wellington</u> - Non-compliance related to Advisory numbering of 'UNKNOWN' volcano

2.3   Significant satellite imagery, modelling or technical changes

This section describes significant satellite, model or technical changes that influenced the performance of operations. The aim is to summarise how technology has been used to enhance the operational capability of the VAACs.

VAAC Anchorage

VAAC Anchorage is using NASA, NOAA NESDIS, VIIRS Ash and SO2 Index products. The products greatly improved VA analysis and forecaster confidence to safely reduce warning/advisory areas when used in conjunction with geostationary false colour imagery.

VAAC Buenos Aires

Following the GOES-R programme of NOAA, VAAC Buenos Aires is working on updating the data reception system to be ready when GOES-19 begins its operations. Work is also started on an update of FALL3D model (version 9.0) including new features to estimate ash concentration in layers.

VAAC Darwin

As of the 21 March 2024, there was a change to VAAC Darwin's policy where VAA will now be issued when ground reports (such as VONA etc) indicate an eruption has taken place with an estimated polygon, even if the VA is not yet visible on satellite imagery. In this instance, the plume and affected area may need to be estimated based on dispersion modelling and this is indicated in the advisory by EST rather than OBS. This change in policy will support decision making, volcanic ash SIGMET generation, and enable safer operations near volcanoes. For a discrete or short eruption in the VONA, there will be an estimated observation and possibly a T+6 forecast as these eruptions usually dissipate quickly. For a continuous eruption in the VONA, there will be an estimated observation and forecast.

The Bureau of Meteorology has been upgrading its supercomputer, which will allow faster processing of model and NWP data including the VAAC Darwin ash dispersion models

VAAC London

London VAAC still uses Visual Weather Feature Editor (VAIT, Volcanic Ash Intervention Tool) on version 3.7.11 with continual updates and bugs fixes to keep it current, as well as reading the package for assisting in QVA transmission by allowing the forecaster to control what is sent by the building, and soon to be controlling graphics that go to the new QVA-ready webpage (yet to be published). In the coming years, VAIT is likely to be replaced by another system designed by the same provider. Until then, VAIT will continue to be used to deliver the current VAA/VAG and concentration charts.

The VAAC London NAME dispersion model is fully QVA-ready with deterministic and probabilistic output which is, at the time of writing, being served in the Aviation Data Service system in a "Private Beta" to a handful of key customers (as of 20th February 2025).

VAAC Montréal

An interface was added to the software used to prepare advisories that allows a satellite image to be displayed in the T+0 panel of the VAG. Forecasters can thus choose the satellite image that best shows the location of the volcanic ash to draw its location at the initial time more precisely than in the past.

Several types of RGB satellite images (ash, dust, SO2 and GeoColour) were added to the operational software used in VAAC Montréal. Furthermore, the production of such images is supported 24/7, increasing the robustness of the VAAC response.

Work is being done to add Himawari images to the satellite images available in the operational software. This will allow for better tracking of volcanic ash over the western and central Pacific Ocean, as well as increasing the robustness of VAAC Montréal's response.

Work was done to allow forecasters at the Meteorological Watch Office in Edmonton, Canada, to load a draft of a VAA produced by VAAC Montréal before it is officially transmitted. This allows for better coordination between VAAC Montréal and MWO Edmonton and leads to both the VAA and VA SIGMET being issued simultaneously.

The way that VAAC products are transmitted was modified to be quicker and more efficient than in the past.

VAAC Tokyo

The Japan Meteorological Agency updated its supercomputer system in March 2024. Information quality remains unchanged.

VAAC Tokyo began issuance of VAGFNR-AF (Volcanic Ash Graphic Forecast for Narrow Area of Hypothetical Routine Eruption and Ash Fall) for overseas volcanoes on 28 November 2024. VAGFNR-AF information shows forecast movement of volcanic ash for every hour. It also shows the predicted range of ash fall up to three hours ahead with the assumption of a single eruption for volcanoes with high potential for eruption.

VAAC Toulouse

QVA have been provided for a first familiarisation during VOLCEX24. It was challenging for Meteo France and VAAC Toulouse: It was very interesting and stimulating for the Tools and Numerical Models Team, who provided QVA in an operational context for the first time. It was a good opportunity to test algorithms, probabilistic system, and graphics tools. The Tools and Numerical Models Team ran ash

dispersion models on an atmospheric archived dataset. It was a good opportunity to improve knowledge, tools and practices.

The VAAC Toulouse website has already been improved to make QVA available. This improvement will continue.

MTG, the new Meteosat satellite, is helpful for better ash cloud detection.

VAAC Washington

VAAC Washington is transitioning from GOES-16 to GOES-19 and are in the preliminary stages of testing and setting up data flow to operational areas. Product generation software is being updated to configure from RHEL6 to RHEL8 and new compute farms. At the same time, product and dissemination scripts for VAA/VAG to be issued are being updated.

A new large eruption module was created to help new analysts with workflow, product generation and dissemination. One of the challenges of being a new analyst is trying to manoeuvre all the different scenarios and things that need to be done during these large eruption events.

VAAC Wellington

On 2 April 2024, the tool that VAAC Wellington uses to create and issue VAA/VAG was upgraded to a newer version. As part of the change management plan, a TEST VAA was issued following the upgrade and requested RODB Brisbane to confirm receipt to prove a successful connection. This upgrade also removes an issue which was previously identified related to volcano names with a forward slash included e.g. Whakaari/White Island.

2.3.1   VAAC Modelling Tables

The operational configurations of dispersion models used by the VAAC can be found via this link:

Beckett, F. M., Bensimon, D., Crawford, A., Deslandes, M., Guidard, V., Hort, M. C., Jeoffrion, M., Kristiansen, N., Lucas, C., Nishijo, A., Osores, S., Renard, E., Servranckx, G., Snee, E., Trancoso, R., & Vazquez, E. (2024). VAAC Model Setup Tables 2023.
Zenodo. https://doi.org/10.5281/zenodo.10671098

2.4   Competency, Training and Education

This section highlights any noteworthy competency, training or education work undertaken at the VAACs during the reporting period.

VAAC Anchorage

When fully staffed, VAAC Anchorage has 12 forecasters. Training is always ongoing to maintain a high level of performance. Quarterly staff meetings are held to review operations and timeliness of products. Additionally, various events are reviewed for successes and areas for improvement.

VAAC Buenos Aires

VAAC Buenos Aires staff is composed of 19 forecasters, 15 of them re-certified in competencies in May 2023, 1 re-certified in Jul 2024, 3 of them certified in Sep 2024 and 1 forecaster still training. During the year VAAC Buenos Aires has run, for the second time, a course in ash dispersion modelling including an introduction to QVA information and QMS.

VAAC Darwin

There are 20 VAAC competent members working in the Hazardous Weather Unit (HWU) which contains VAAC Darwin operational desk. VAAC Darwin has been busier than normal with 4 to 6 active advisories each day which has been keeping the forecasting team busy. This has provided a well-rounded on-the-job training session for the newest VAAC competent forecasters.

The VAAC Darwin competency training course has undergone a refresher. There are now 5 major modules in the course and quizzes covering topics including Fundamentals, Volcanic Ash and Aviation, Volcanic Monitoring and Observational Data, Volcanic Ash Detection Techniques, and Forecasting and Dispersion Modelling. The competency course also contained a workplace observation to ensure forecasters are maintaining a high quality of service and are issuing products to a high standard. There is also a case study simulation of a previous major event which helps assess the staff against a major event with multiple information sources for consideration.

Education brochures on volcanic ash and volcanic ash advisory under the knowledge repository on the Bureau of Meteorology Australia webpage have been updated.

VAAC London

There are currently around 18 multi-skilled Operational Meteorologists within the Hazard Centre team (in which the provision of VAAC London sits, including Space Weather, RSMC, and other dispersion, health and specialist meteorological services). These 18 forecasters of the London VAAC operational team undertake a VA competency assessment in line with AMF quality standards to ensure their proficiency. In addition, the team attend an annual VA training course led by the Met Office dispersion

and observation science teams to ensure that they are up to speed and refreshed with volcanic dispersion and observational techniques, but also for the first time in 2024 the concept of QVA was introduced.

Since London VAAC rarely has to respond to significant ash eruptions in its area of responsibility, daily VA response practice is encouraged per-shift to ensure continued familiarity, tease out training and mentoring requirements, and to test the data dissemination so that readiness is maintained.

VAAC Montréal

There are 16 members of the VAAC Montreal team. Weekly tests are performed to ensure that staff practice components of the VAAC response and to ensure that the software required for this response is working correctly. A subset of the VAAC team has been trained to perform backup duties for VAAC Washington since 2019 and starting in 2023, this training was extended to all team members. Since all members of the VAAC team have other regular duties and since volcanic ash events requiring a response are rare, an important aim of this extended training is to increase staff's familiarity and comfort level with the VAAC response.

VAAC Tokyo

Five VAA forecasters from the Volcanic Observation and Warning Center (VOWC) at JMA's Tokyo headquarters (responsible for mitigating ground-based eruption hazards) support the provision of VAAC Tokyo services. The Center runs five operation units for around-the-clock monitoring of volcanic activity, each employing three forecasters and two monitoring staff tasked with issuing VAAs, volcanic warnings/forecasts and ash fall forecasts.

All VAA forecasters meet the requirements of the Basic Instruction Package for Meteorologists (BIP-M). BIP-M-compliant Aeronautical Meteorological Forecaster (AMF) training is also provided toward development in the VAA forecasting field. VAAC Tokyo holds monthly meetings/seminars between forecasters and management to encourage appropriate issuance based on the Quality Management System. Reviews of past major volcanic ash events and actual related operation contribute to the enhancement and standardisation of forecasting skills.

In the event that headquarters become incapacitated due to a significant incident, operations are conducted in an internal back-up centre. Back-up drills were conducted at the centre, involving several forecasters and updated workflow.

VAAC Toulouse

Three new forecasters, who joined the department this year, received training and practice in VAA/VAG procedures. The training included exercises and testing.

Because of the more than 100 VAA issued this year, each forecaster has experience issuing products in a real situation.

VAAC Washington

VAAC Washington has 12 forecasters and 1 in current training. Each new analyst will go through 24-28 operational shifts with a trainer. They are trained to be able to work from home and the office. Also, each new analyst is certified based on a list of requirements by the Washington VAAC. This is either pass/fail. A training module was created to train new forecasters on dealing with large scale eruptions, using the Soufriere St. Vincent eruption as the example.

The VAAC Washington Standard of Procedures (SOP) was updated in May 2024. This details all the ins and outs of Volcanic Ash Operations.

Quick guides were produced for improved workflow of most common daily operations. These included, for example, Initial, Standard, NEAR VAA, Large Scale eruption, and dealing with the media.

In January of each year, an end of year review is held with each forecaster. If needed and requested by the forecaster, further review and/or training can be provided.

VAAC Wellington

VAAC Wellington has 16 AMF Competent Forecasters who regularly work shifts that cover both VAAC and 'standard' aviation work. There are an additional 16 AMF Competent Forecasters, that work in other forecasting sections, who can be called on to assist with back up if required.

Three forecasters who were 'VAAC only' had their competency lapsed this year, as resourcing levels made it difficult for those forecasters to remain current. Alternate options will be investigated in 2025 to upskill forecasters in other forecast sections, particularly to assist with VAAC monitoring during evening hours.

A temporary procedure was implemented to help with the current information gap related to increased unrest of a volcano in the wider South Pacific. In cases where the Aviation Colour Code (ACC) is increased to yellow or higher (with no ash identified), and no NOTAM for unrest is issued, a one-off VAA is issued to highlight the ACC change for broader awareness. This is a temporary measure until either NOTAM for volcanic unrest is implemented or use of VONA as a Recommended Practice becomes applicable in November 2025.

VAAC Wellington is currently focusing on running a Volcanic Ash Workshop for forecasters, which is scheduled for April 2025.

2.5   Outreach for stakeholders and SVOs

This section discusses any outreach events, meetings, triumphs, issues, concerns, new ideas, etc.

VAAC Anchorage

VAAC Anchorage participated in several meetings with the Alaska Volcano Observatory (AVO). The meetings were held for staffing familiarity, ways to foster collaboration using Slack, and improving workflows. Additionally, a tabletop exercise was designed and conducted for an Alaska Cook Inlet volcanic event. There were four NWS offices and the AVO involved with the exercise. In 2025, the tabletop will be built out and include additional external partners.

VAAC Buenos Aires

VAAC Buenos Aires manager was invited to a regional workshop consisting of Monitoring Volcanos on International Airways and a VOLCEX Exercise from 17 to 20 of June in the regional office of SAM ICAO at Lima, Perú. This workshop brought together different IAVW users including WMO, ACC, SVO, ATS and IFALPA. During the meeting the first VOLCEX exercise was organised in the SAM region. After this preparation, the SAM VOLCEX exercise took place over 12 hours on the 3rd of December, beginning at 15:00Z. VAAC Buenos Aires had two volcanos in the AoR and issued six VAA/VAG messages.

VAAC Darwin

VAAC Darwin hosted the annual aviation industry engagement meeting of the Vulcan Working Group on 17 October 2024. The meeting attendees included aviation operators, meteorological services, aviation regulators and volcanological agencies. These representatives were from Australia, Japan, Indonesia, New Zealand and US.

The group discussed all things QVA including the implementation, supplemental graphics, and promoted the outcoming workshop held by ICAO, and a special overview from VAAC Washington as well as other operational requirements.

VAAC Darwin has been supporting Papua New Guinea with their air navigation deficiency in the provision of SIGMETs. The exercise has been done offline through e-mails so that Papua New Guinea can show the organisers how they generate the VA SIGMET, based on a number of advisories. The work will continue in 2025.

VAAC London

London VAAC (operations and science teams) are regularly in touch with the main active SVO, Iceland Met Office and sits in twice-a-year for 2 or 3-day meetings with them which also include NCAS (National Centre for Atmospheric Science) and BGS (British Geological Survey), working on common-interest collaborative activities spanning operations and science surrounding the VA provision. This working group is called the NAVHP (North Atlantic Volcanic Hazards Partnership).

Ongoing multi-stakeholder consultation continues internationally surrounding the VA and QVA provision, through the WG-MOG IAVW and through VOLCEX exercise committees.

VAAC Montréal

VAAC Montréal participated in the 4th NASA-VAAC workshop in February 2024. Discussions were held with VAAC Washington and various stakeholders in North America for the organisation of a virtual tabletop exercise called VOLPAC25 to be held in March 2025.

A VAAC satisfaction survey sent to stakeholders on 13 November 2024 and was open for a month.

VAAC Tokyo

JMA holds annual aviation weather meetings with domestic airlines and related stakeholders. In August 2024, VAAC Tokyo met with domestic stakeholders to present QVA.

Two volcanic eruption scenarios will be presented by VAAC Tokyo at VOLPAC 2025 (a North Pacific volcanic ash exercise) in March.

VAAC Toulouse

VAAC Toulouse have worked with the SVOs of Portugal and Spain to organise exercises. There has also been much contact with SVOs in Italy and parts of Africa due to real eruptions.

VAAC Washington

Within the US, VAAC Washington has worked with many different groups.

Alice Crawford of Air Resource Laboratory and Jamie Kibler of the Washington VAAC were invited to give presentations at the Airlines for America (A4A) annual meeting on volcanic ash operations, modelling, and QVA in December 2024.

A VAAC satisfaction survey was sent to stakeholders on 21 July and closed on August 21. This took 2 months for approval from different NOAA levels.

In April 2024, VAAC Washington presented at the National Centre for Environmental Prediction (NCEP) Ocean Prediction Centre (OPC) Mariner's Weather Hazards Workshop. VAAC Washington also participated in the 4th NASA-VAAC workshop in February 2024.

VAAC Washington has worked on many international outreach projects.

VAAC Washington participated in December 2024 and helped plan the SAM VOLCEX with ICAO Lima Peru office and the Buenos Aires VAAC. A VAAC Washington representative attended the planning workshop.

VAAC Washington were invited to speak at the Vulcan Working Group Meeting (Industry Day) hosted by the Bureau of Meteorology (BOM/Darwin VAAC) in October 2024.

In February 2024 VAAC Washington was invited to present at the German National Weather Service on volcanic ash operations. In December 2024, we were invited to and gave several presentations at the World Meteorological Organization (WMO) Aviation Workshop in San Jose Costa Rica on volcanic ash operations, QVA, and NWSCHAT 2.0.

Finally, in October 2024, VAAC Washington invited Aeromexico airlines to discuss operations and interaction between the two groups for aviation safety. The visit was for two days.

VAAC Wellington

The VAAC Wellington Manager attended the ICAO APAC MET/SG in July 2024 and presented an Information Paper on the 'Combined APAC VAAC Management Report' on behalf of VAACs Darwin, Tokyo and Wellington. This year, the paper contained a copy of the 2023 Combined VAAC Management Report, as well as a brief update from the three APAC VAACs to cover the period 1 January – 31 May 2024.

A combined paper was also presented to update the meeting on APAC VAAC Back Up Tests and Arrangements. The meeting is comfortable now that back up test/practice is well established and has removed 'Back Up Test Updates' from future meeting agendas.

VAAC Wellington has been supporting Nauru with their APANPIRG air navigation deficiency for the Provision of SIGMET information, by providing sample VAA and feedback to Papua New Guinea during a series of exercises (who will provide SIGMETs on their behalf).

Goals for 2025 include supporting SVOs in the VAAC Wellington area of responsibility with training/education around VONA issuance, and relooking at a series of small exercises in the Solomon Islands area.

2.5.1   IAVW Survey Results

At the WG-MOG/20 IAVW, an action was formed for all VAACs to send out a User Satisfaction Survey. All VAACs agreed to a common set of questions but independently distributed the survey through their own channels. Each VAAC conducted their survey between June and December 2024.
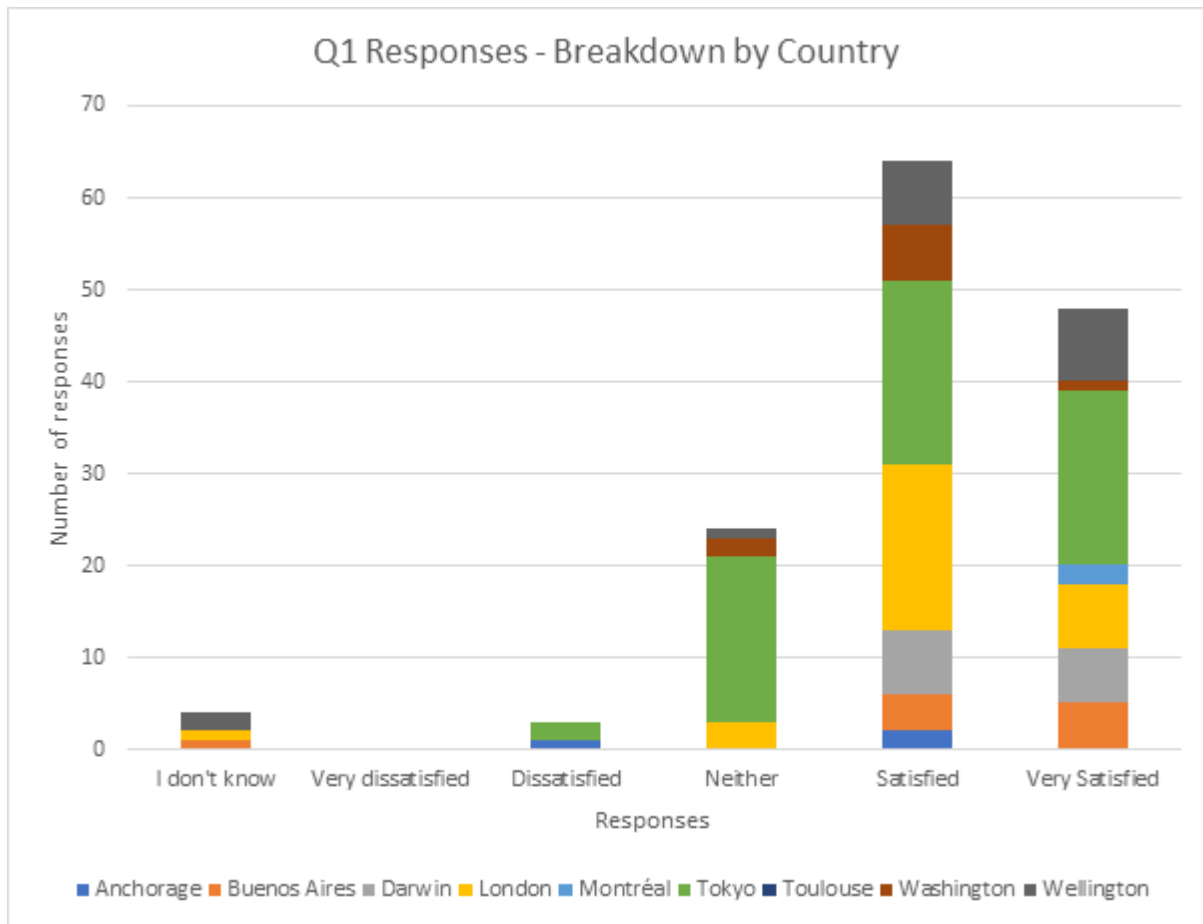
Number of Respondents:

Anchorage	3
Buenos Aires	12
Darwin	13
London	30
Montréal	4
Tokyo	61
Toulouse	0
Washington	9
Wellington	18
Total	**150 (individual responses)**

Question 1.

How satisfied are you with the overall Volcanic Ash service provided by the VAAC in fulfilling your organisation's mandate?

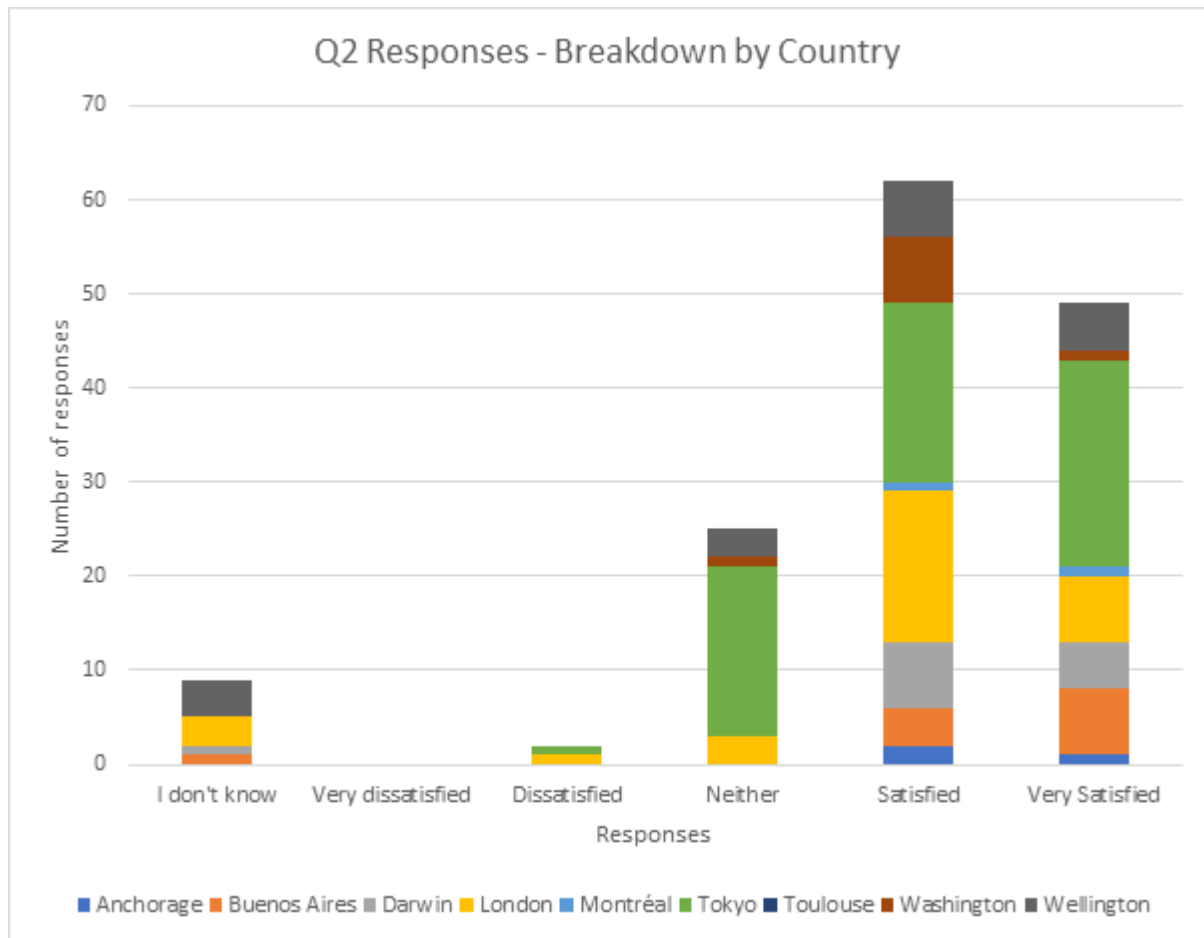|	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	1	0	2	0
Buenos Aires	1	0	0	0	4	5
Darwin	0	0	0	0	7	6
London	1	0	0	3	18	7
Montréal	0	0	0	0	0	2
Tokyo	0	0	2	18	20	19
Toulouse	-	-	-	-	-	-
Washington	0	0	0	2	6	1
Wellington	2	0	0	1	7	8
Total	**4**	**0**	**3**	**24**	**64**	**48**

Q1 Responses - Breakdown by Country

- **Any comments of interest/areas a VAAC intends to follow up on?**

1. VAAC Wellington – One respondent commented that they would like to see historic advisories on the VAAC website (it only shows current advisories in force). This will be considered when the website is revamped as part of the QVA project.

Question 2.

How satisfied are you with how quickly you receive the VAG/VAA product at the beginning of an eruption?

|	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	0	0	2	1
Buenos Aires	1	0	0		4	7
Darwin	1	0	0	0	7	5
London	3	0	1	3	16	7
Montréal	0	0	0	0	1	1
Tokyo	0	0	1	18	19	22
Toulouse	-	-	-	-	-	-
Washington	0	0	0	1	7	1
Wellington	4	0	0	3	6	5
Total	**9**	**0**	**2**	**26**	**62**	**49**

Q2 Responses - Breakdown by Country

- **Any comments of interest/areas a VAAC intends to follow up on?**

None received

Question 3.

How satisfied are you with the timeliness of receipt of the VAG/VAA updates during an ongoing eruption?

	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	1	0	1	1
Buenos Aires	0	0	0	0	5	7
Darwin	1	0	0	0	6	6
London	5	0	1	3	11	10
Montréal	0	0	0	0	0	2
Tokyo	0	0	3	20	17	19
Toulouse	-	-	-	-	-	-
Washington	0	0	1	4	4	0
Wellington	3	-	-	5	5	4
Total	**8**	**0**	**6**	**32**	**49**	**49**
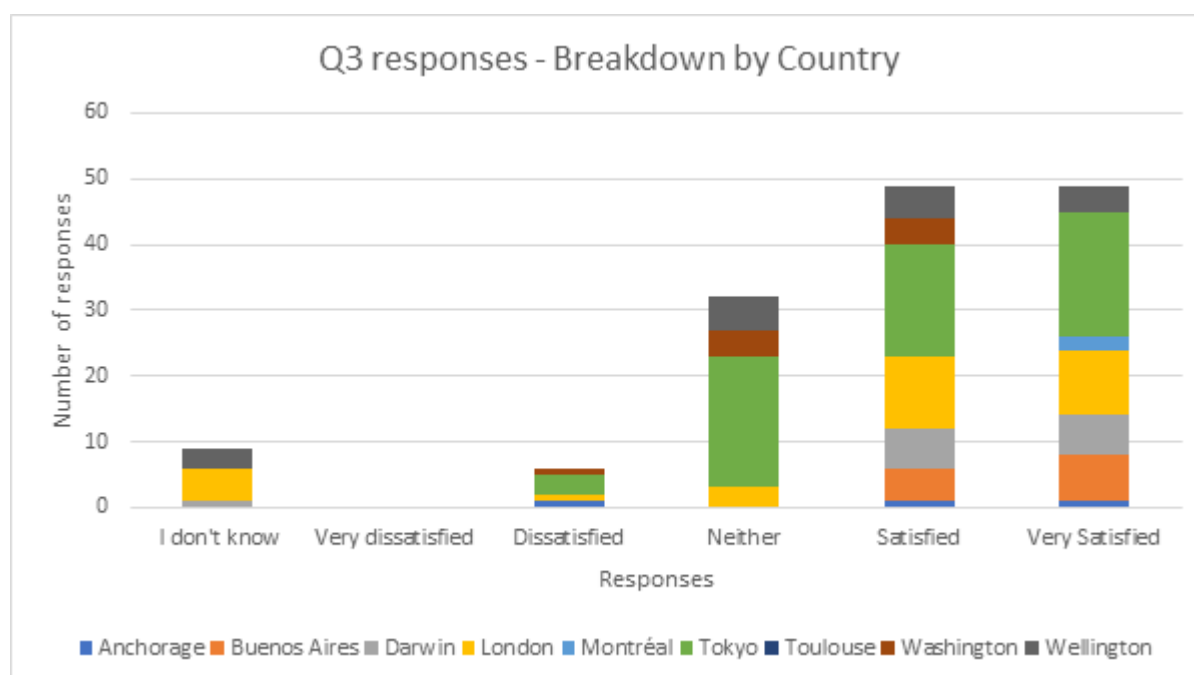
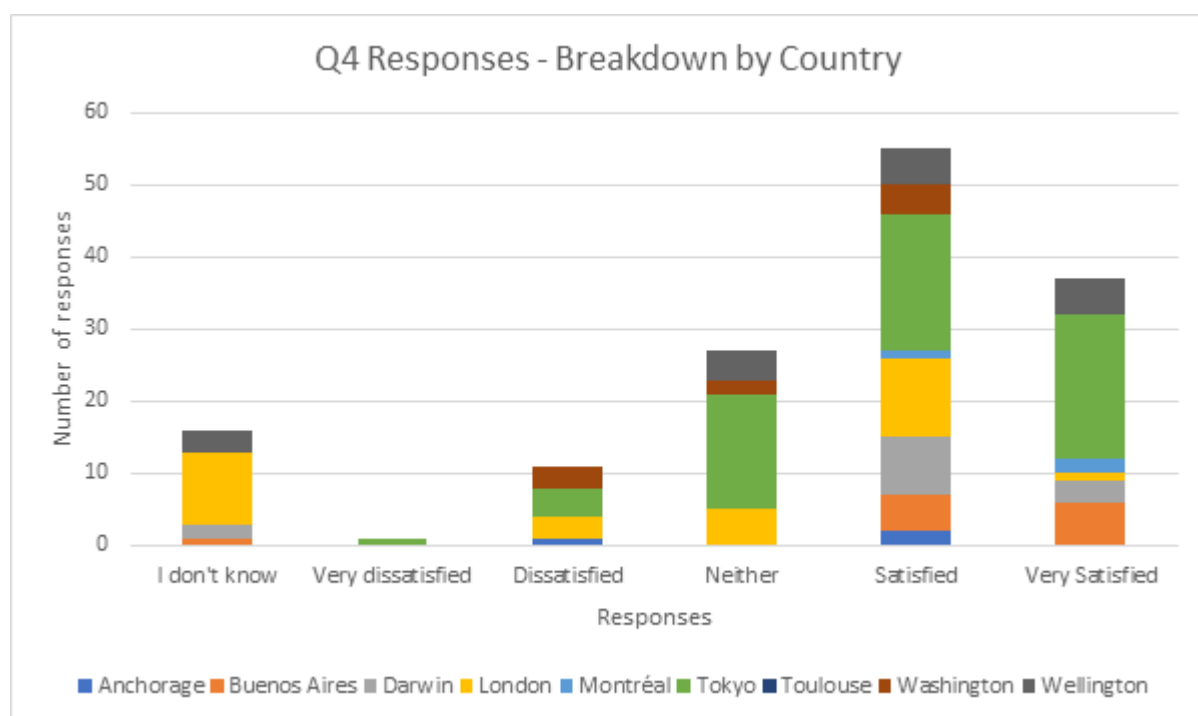- **Any comments of interest/areas a VAAC intends to follow up on?**

1. **VAAC Washington comments from users:** *"My answer isn't so much about the timeliness of receipt, but about the six-hour intervals between subsequent issuances. A shorter interval would be of great value."*

2. **London VAAC:** One user who responded with "Neither" mentioned *"All products and procedures are align with the current timelines, in this view it is OK. However, in order to provide more precious information more frequent update could needed."* – suggesting QVA is the way forward.

Question 4.

How satisfied are you with the perceived accuracy of the VAG/VAA product?

	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	1	0	2	0
Buenos Aires	1	0	0	0	5	6
Darwin	2	0	0	0	8	3
London	10	0	3	5	11	1
Montréal	0	0	0	0	1	2
Tokyo	0	1	4	16	19	20
Toulouse	-	-	-	-	-	-
Washington	0	0	3	2	4	0
Wellington	3	0	0	4	5	5
Total	**16**	**1**	**11**	**27**	**55**	**37**

- **Any comments of interest/areas a VAAC intends to follow up on?**
1. **VAAC Washington comments from users:**

a. *"The cover too broad an area to be of practical use. By issuing them more often, could the coverage area be tightened up?"*
b. *"The products are too conservative at times."*

2. **London VAAC interesting comments:**
   a. One respondent mentioned *"In generally - satisfied. Except in VOLCEX 23 Exercise, where serious inconsistency between VA concentration charts and VAG/VAA product was observed."* This reflected how inefficient VAA/VAG are compared with concentration charts since the polygons are smoother and more detailed – supports QVA drive.
   b. Another user rightfully commented on the need to clarify which map projection is required to re-draw VAA coordinates, as getting the incorrect projection leads to large differences across high latitudes. Currently there is no way of communicating this within a VAA apart from in the comments.
   c. *"Extremely difficult to verify"*
   d. *"VAA/VAG are known to have a very coarse resolution. This is why the concentration charts are always consulted in addition. As the only basis for the SIGMET issuance for an FIR, the VAGs are therefore very vague."* – Supports QVA business case.

Question 5.

If you operate across an area where VAG/VAA products are provided by more than one VAAC, how satisfied are you with the level of co-ordination between the VAACs (e.g. is each VAAC providing a consistent story)?

|	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	3	0	0	0
Buenos Aires	6	0	0	0	6	0
Darwin	4	0	0	3	4	2
London	16	0	1	5	6	0
Montréal	0	0	0	0	0	0
Tokyo	0	2	2	14	17	14
Toulouse	-	-	-	-	-	-
Washington	0	0	4	1	2	2
Wellington	9	1	0	3	3	2
Total	**35**	**3**	**10**	**26**	**38**	**20**

Q5 Responses - Breakdown by Country
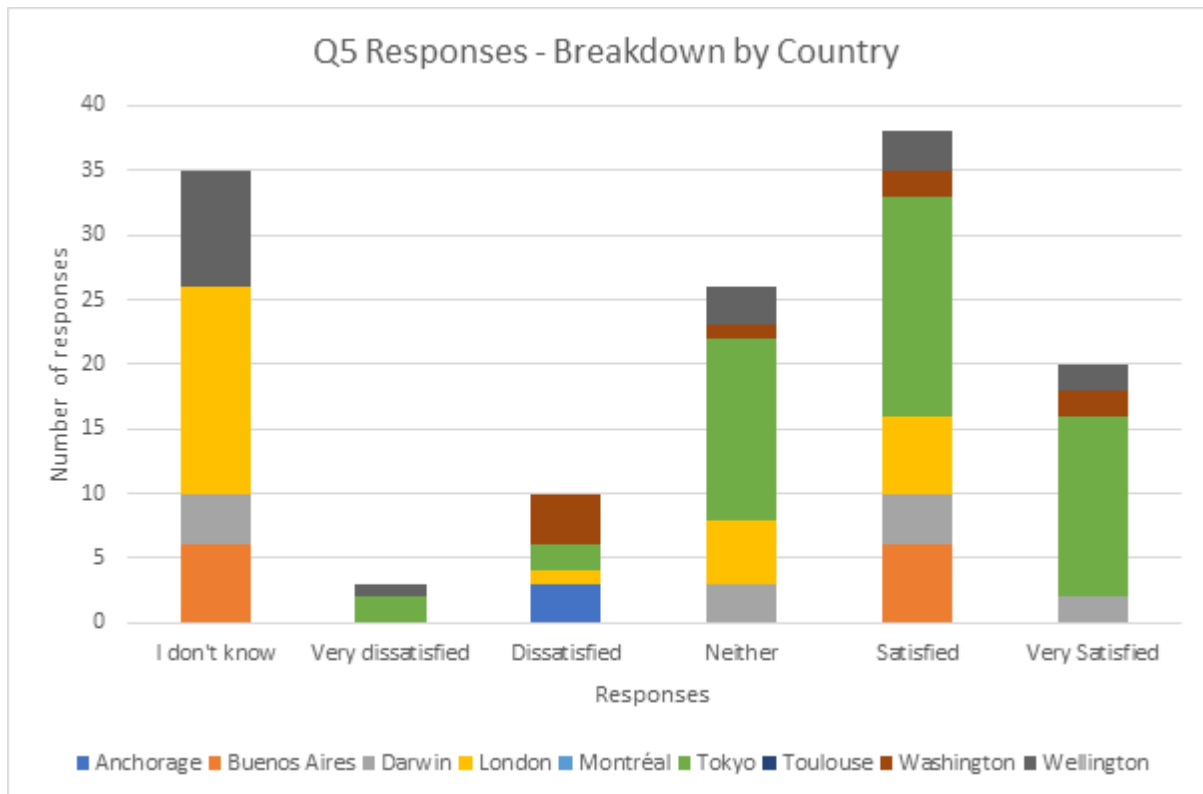
- **Any comments of interest/areas a VAAC intends to follow up on?**

1. **VAAC Wellington** – The comment from the people (anonymous) who answered 'very dissatisified' responded that they 'don't personally receive or use info'. They also responded 'don't know' to every other question in the survey.

2. **VAAC Darwin** – The 'I don't know" responses were from people who do not operate between different VAACs.

3. **A comment received by VAAC Tokyo** - *"Sharing of information on the need for adjustment in relation to forecast discrepancies between adjacent VAACs may be useful."*

4. **Comments received by VAAC Washington –**
    a. *"There have been several instances where they are conflicting, and which one is controlling."*
    b. *"For the most part everything seems to be transparent, but there have been times when a different VACC will issue overlapping an area and it is hard to discern what one is valid or if both are."*

5. **VAAC London:** On the whole, VAAC-handover hasn't really been an occurrence for us and Toulouse, but one user stated for "I don't know" - *"it is important that VAAC London and VAAC Montreal coordinate their products"* – not sure what this is in relation to, but it is correct.

Question 6.

How satisfied are you with your communication with the VAAC?

	I don't know	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied
Anchorage	0	0	0	0	3	0
Buenos Aires	2	0	0	0	3	7
Darwin	1	0	0	0	5	7
London	12	0	0	5	7	4
Montréal	0	0	0	0	0	2
Tokyo	0	1	1	21	19	18
Toulouse	-	-	-	-	-	-
Washington	1	0	1	2	3	2
Wellington	3	0	0	0	8	7
Total	**19**	**1**	**2**	**28**	**48**	**47**
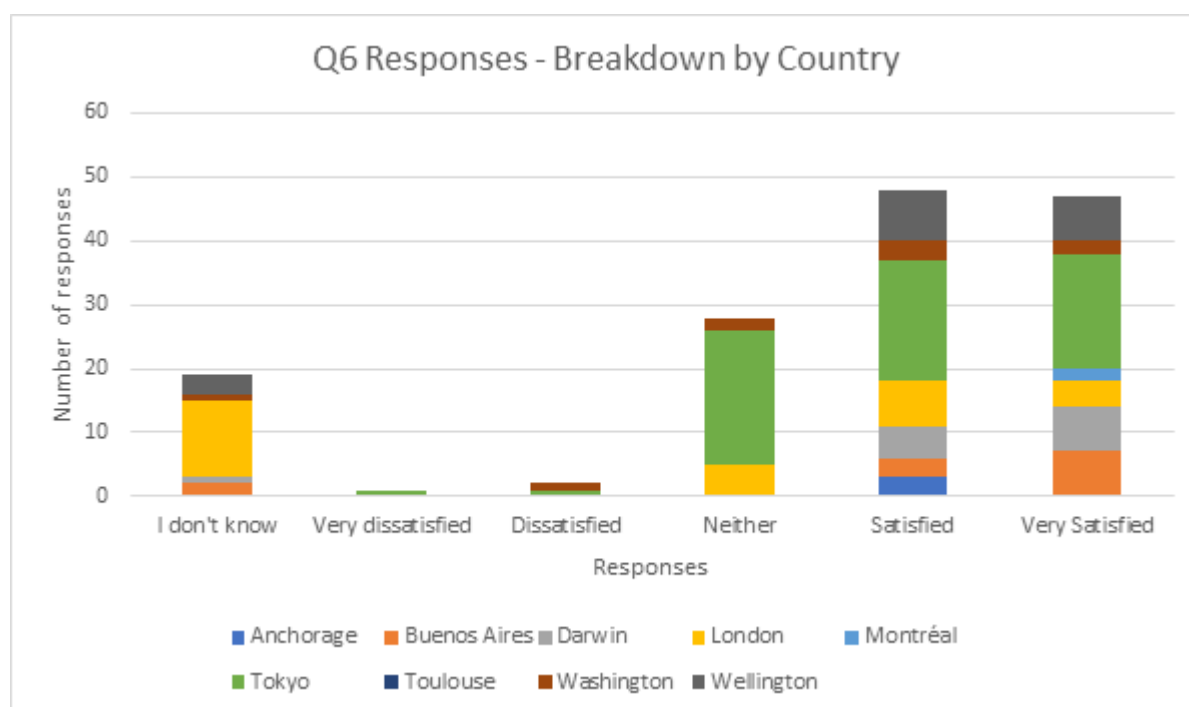
- **Any comments of interest/areas a VAAC intends to follow up on?**
1. **VAAC Washington comments from users:**

a. There have been events where it would have been beneficial to have an easily accessible option (i.e. phone number on the Washington VAAC website) to contact the Washington VAAC.

2. **London VAAC:**
    a. "I don't know" column was used for an answer we had on our survey which was "N/A or no need for communication".

Question 7.

A new Quantitative Volcanic Ash (QVA) service has been proposed by ICAO and the VAACs. Are you aware of the concept of QVA and what this service will provide?

	Yes	**No**	**Don't Know**
Anchorage	3	0	0
Buenos Aires	7	5	0
Darwin	6	4	3
London	20	8	1
Montréal	1	3	0
Tokyo	22	17	20
Toulouse	-	-	-
Washington	4	4	1
Wellington	4	12	2
Total	67	53	27
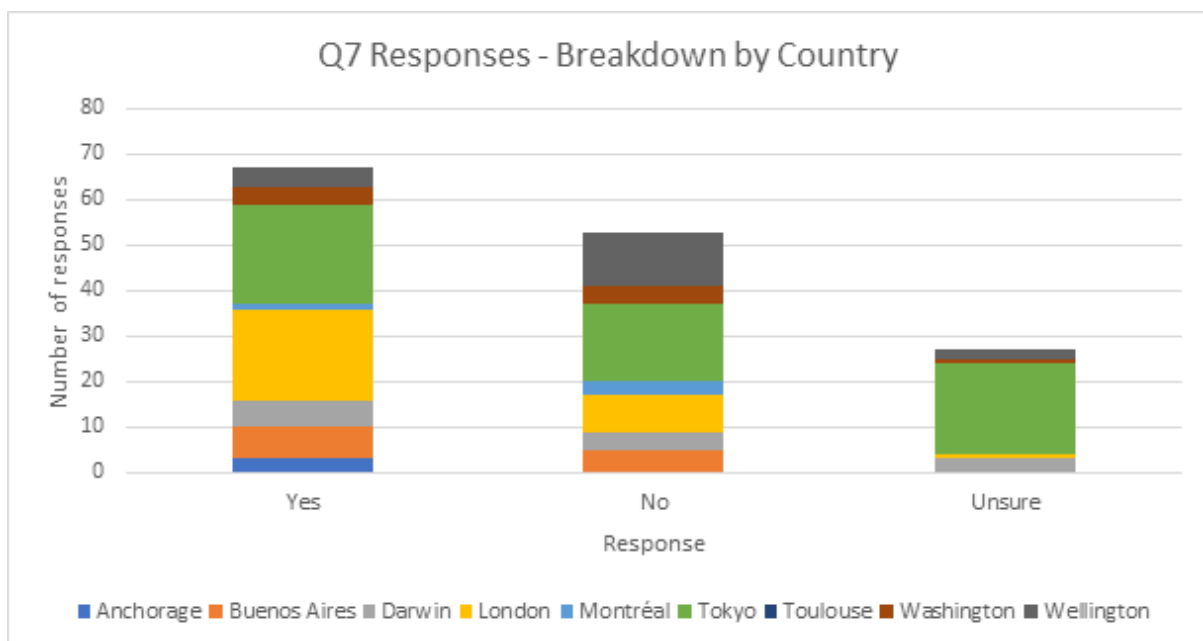
- **Any comments of interest/areas a VAAC intends to follow up on?**

1. **(A comment received by VAAC Tokyo)** *"It is good if QVA will also become available on CSI platform (a webtool produced by JMA), just like VAG/VAA."*

2. **VAAC Wellington** – Planning an industry meeting in February 2025, where QVA information update will be presented.

3. **VAAC Washington comments from users:**
   a. *"While a better product, QVA will be of limited use without specific guidance from aircraft and engine OEMs, which has not been forthcoming."*
   b. *"How confident are we in the actual concentrations during/after eruption? We would need some solid research to trust flying into an area that has traditionally been avoided."*
   c. *"How much has this been tested and actually verified? More information to all parties that are an end user would be greatly appreciated."*

1. **(A comment received by VAAC Tokyo)** *"It is good if QVA will also become available on CSI platform (a webtool produced by JMA), just like VAG/VAA."*

2.6 Volcanic events of interest

This section highlights events of interest that VAACs wish to share. This can include summaries, analyses, insights, lessons learned, etc.

VAAC Anchorage
There were no eruptions originating within the VAAC Anchorage area of responsibility.

VAAC Buenos Aires

A re-suspended ash cloud event took place during the afternoon of the 19 of March until midday on 20 of March near the city of Malargüe, Mendoza. The estimated ash cloud top height was FL120 and it was also discernible during the night.

Also, Sabancaya volcano continued erupting uninterrupted during the year, with variations in height and extension. During the 16 and 17 of April we experienced the most intensive activity with some puff eruptions reaching heights of FL330 (a VONA reported 4km above volcano summit). During 2024, VAAC Buenos Aires issued 1311 advisories from Sabancaya which represented 95% of the total VAA/VAG issued during the year. Fortunately, in recent months, activity has been decreasing.

VAAC Darwin

On 17 April 2024, Ruang located in Sangihe Islands in Indonesia had a significant eruption to approximately 80,000 feet with stratospheric injection. The volcanic ash that reached the stratosphere moved quickly to the west but there was a large amount of volcanic ash that reached the tropopause which was moving radially out in all directions above the volcano. Himawari-9 visible, split window and RGB imagery was used to continuously track the volcanic ash as it was providing strong ash signatures as well as glaciated volcanic ash and large volumes of sulphur dioxide (SO_2).

The volcanic ash and gases continued to move west over Borneo until the ash signal was no longer discernible as it moved over the South China Sea. The volcanic ash at the volcano continued to spread in all directions as it slowly dissipated impacting the local airports with ashfall. The high-level volcanic ash from the eruption fell below discernible levels two days after the initial eruption.

On 29 April 2024, Ruang had a second significant eruption, again to approximately 80,000 ft. This eruption showed strong stratospheric injection as the ash was moving to the west but slower than the previous event. On Himawari-9 true colour imagery the brown ash signature was visible, and it was well above the tropospheric meteorological clouds. The ash produced in the 29 April eruption moved slower than the previous event but still moved across Borneo. 30 hours after the initial eruption, the volcanic cloud moving west was still providing a strong ash signal but had passed over many tropospheric thunderstorm clouds. The volcanic ash that was being tracked was in the stratosphere and there were no reports of ashfall at airports. The base of the volcanic ash was estimated to be 45,000 ft as the analysis suggested the cloud of volcanic ash was trapped above the tropopause, which was consistent with no observed ashfall. The base was flight levels just below the stratosphere.

VAAC Darwin reached out to MWOs for PIREPs but there were no reports of volcanic ash. Aviation operators continued to operate under the stratospheric ash cloud like during the Hunga Tonga Hunga Ha'apai eruption back in 2022. Around four to five days after the initial eruption, the volcanic ash moving west was no longer discernible by satellite imagery and was finalised.

On the 4th of November, Lewotobi (known as Lewotobi Laki Laki in Indonesia) located on the island of Flores, Indonesia erupted to 50,000 ft. In the subsequent days the volcano erupted to the tropopause or above with volcanic ash dispersing in multiple directions. The impact was mostly to the local area, but the volcanic ash did move into Australian airspace as well. The eruptive activity changed from multiple discrete eruptions to a continuous plume.

Due to the ash rich continuous eruption to lower levels from the volcano, the volcanic ash signal was tracked moving west in the 15 to 20 kt winds for multiple days. Lewotobi is approximately 830 km east of Denpasar international airport on the Island of Bali, Indonesia. With the strong winds and ash signal strength it was having an impact on the operations of multiple small Indonesian airports as well as Denpasar International airport. There were impacts to flights as the ash moved past, but the ash signal was getting weaker as it approached the airport. With the introduction of QVA, it could change the impacts that were experienced during this eruption.

VAAC London

The effusive eruptions of Reykjanes peninsula have remained dominant in 2024 with several periodic and surprisingly predictable eruptions due to excessive monitoring (highly studied area). The eruption frequency has decreased from 3 weeks to ~3 months, but volume of magma output between recharge seems to be increasing. Eruptions usually result in a 3-4km long fissure that erupts for 1-2 days before consolidating into 1 small vent for a month or so, then plugging.

There have been one or two bouts of small ash, one of which occurred during the 29th of May eruption which is thought to have been caused by groundwater interception and resulted in London VAAC's first VAG with polygons on it since 2011 (hand-drawn, no model as was too little ash for NAME).

Meanwhile, other more "dangerous" volcanoes continue to recharge underground and show some slight unrest, such as Askja, Grimsvotn, Bardarbunga and occasionally Katla, though all generally considered "background" activity for now.

VAAC Montréal

2024 was a quiet year in terms of volcanic activity, with no eruptions taking place that required a response from VAAC Montréal.

VAAC Tokyo

The number of VAAs issued in 2024 was around half the corresponding figure for 2023. The number of advisories for highly active volcanoes (such as Sakurajima, Suwanosejima and Sheveluch) also

practically halved. Mayon erupted frequently in 2023 before becoming inactive in 2024. Overall, volcanoes in the Tokyo AoR were less active than the yearly average.

A FL360 eruption observed at Sheveluch at 10 UTC on 7th November continued until around 18 UTC on 10th November, emitting an ash cloud at FL200-320. Handover to the Anchorage VAAC was performed at 18 UTC on the 8th and 21 UTC on the 10th as the cloud spread eastward. The part of the cloud which entered the Anchorage AoR on the 8th returned to the Tokyo AoR due to swirling atmospheric winds and was handed back from Anchorage to Tokyo at 21 UTC on the 9th.

VAAC Toulouse

Some AIREPs were difficult to analyse, because the ash clouds described by pilots seemed to have no evidence of ash based on satellite and webcam evidence.

In general, AIREP evidence of volcanic ash was missing. AIREP dissemination could be improved.

VAAC Washington

Several large eruption events with Sangay volcano in Ecuador took place with ash reaching to FL400 and higher. These were short lived eruption events with ash dissipating within 24-36 hours but reaching the coastline into the Pacific and into parts of western Brazil.

Popocatepetl just south of Mexico City had an above normal active period for about two weeks in late October into early November with ash reaching near FL400 at several times. Ash reached as far north as southern Texas, southwest Louisiana and as far east as just west of Florida and south of the Gulf Coast states.

VAAC Wellington

It was a busier year in the VAAC Wellington area, with over double the 10-year average of VAAs issued. Whakaari/White Island, an offshore volcano located within 27 nm north of the nearest aerodrome, and around 110 nm southeast of New Zealand's busiest international aerodrome has been regularly emitting low levels of volcanic ash on and off since July 2024. Due to its proximity to the main island, it did on occasion interrupt flight activity, with pilot reports of VA in the vicinity of an aerodrome.

2.7 VAAC collaboration

This section mentions work done by VAACs on common tasks, visits, information exchanges, etc.

VAAC Anchorage

The VAAC managers typically meet quarterly to share and discuss any issues and/or successes to improve VAAC services. VAAC Anchorage uses Slack to communicate with the Alaska Volcano Observatory, United States Coast Guard, and the Federal Aviation Administration.

VAAC Buenos Aires

VAAC Buenos Aires coordinated with VAAC Washington to provide backup during technical upgrades on two occasions. VAAC Forecasters used NWSChat to maintain communication with VAAC Washington and to notify them of updates.

A project was finalised with IGP Perú on the use of AI that combines remote sensing data from seismic networks, visual cameras, and meteorological models, focusing on the Sabancaya volcano. This project aims to automatically estimate some eruptive source parameters, such as the time of eruption and column height. The development is currently being tested and will be shared for operational use by VAAC Buenos Aires.

VAAC Darwin

VAAC Darwin continues to collaborate on procedures between VAAC Wellington and VAAC Tokyo. Looking to conduct some 'shadow shifts' with VAAC Washington staff to understand their area of responsibility for back-up purposes.

From the 30th of October to the 3rd November, the Bureau of Meteorology hosted two volcanic ash experts from the Japan Meteorological Agency for discussions on QVA, tools, methods for monitoring, detection and operational procedures.

VAAC London

The London VAAC is involved in many QVA-related activities with all VAACs (likewise all VAACs met in Paris ICAO at the end of October for the IAWV and QVA Workshop to progress a few things). The VAAC Survey was rather successful in quite a number of replies were received, with some useful feedback from stakeholders/users.

The London VAAC is involved in planning for VOLCEX exercises. Shaping what is required for VOLCEX25 brings together most of European and Trans-Atlantic stakeholders/partners.

VAAC Montréal

VAAC Montreal acted as backup to VAAC Washington on 3 different occasions in 2024. These gave staff in Montréal an opportunity to become more accustomed to the tasks involved when backing up a neighbouring VAAC and strengthened ties to this VAAC as well.

VAAC Tokyo

An MS Teams VAAC Darwin-Tokyo chat group serves as a platform for rapid communication and sharing of mutual back-up operation request files. The annual backup test between VAAC Tokyo and VAAC Darwin was conducted on 27th June 2024.

On 17th October 2024, a delegation of VAAC Tokyo representatives gave presentations on management reporting and QVA supplemental graphics at a Vulcan Working Group Meeting hosted by Australia's Bureau of Meteorology.

VAAC Tokyo shares expertise in volcanic plume modelling in the modellers community to support advanced development and QVA implementation.

VAAC Tokyo runs monthly VONA issuance drills with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) to support prompt issuance in actual events.

VAAC Toulouse

With the upcoming implementation of QVA, the QVA workshop held in Paris in October 2024 was opportunity to connect and exchange ideas.

VAAC Washington

VAAC Washington continued efforts to register international users across Central and South America to NWSCHAT. The platform is a powerful communication tool where groups can exchange any type of volcanic ash information (text, graphical etc) and collaborate face to face on volcanic ash events. Most of the users registered were from State volcano observatories.

During the year, VAAC Washington provided backup to the Anchorage and Buenos Aires VAAC on several occasions.

VAAC Montreal and Darwin provided backup support to VAAC Washington on three events, with one lasting a record 37 hours due to a major network outage involving the National Weather Service that effect VAAC Washington dissemination and data flow.

VAAC Wellington

VAAC Wellington is working closely with VAAC Darwin on QVA implementation. Both organisations use the same tool to produce volcanic ash information. 'Shadow Shifts' are held with Darwin, where Forecasters from both VAACs have a Teams call to share information, tools, procedures.

3 Future developments, steps towards ConOps and Roadmap of the IAVW

This section describes work that has been done towards progressing the future of IAVW such as QVA forecasts, probabilistic forecast and concentration plot capabilities, information sharing capabilities (collaboration tool), etc. Both the IAVW ConOps and Roadmap are guiding documents for the work described in this section.

3.1 QVA Progress

Current progress and roadblocks/challenges towards progressing QVA.

VAAC Anchorage

Similar to last year, VAAC Anchorage, VAAC Washington, NOAA's ARL, and other collaborators continued the development of QVA for both U.S. VAACs. Many questions still remain for QVA; what platform, and the processes to produce and disseminate QVA are among them.

VAAC Buenos Aires

VAAC Buenos Aires participated in two VAAC model exercises to test the initial capabilities to produce QVA in the framework of VAAC modellers group from WMO. Supplemental figures colour maps were implemented and tested in the second exercise. VAAC Buenos Aires is working on developing the IOC Netcdf format and the IWXXM required.

VAAC Darwin

VAAC Darwin continues to progress towards QVA with the aim to be operational as close to November 2025 as possible. Looking to work on operational examples of QVA datasets based on previous eruptions to conduct case studies. Continuing to work on forecaster workflow including the forecasting software changes.

VAAC London

VAAC London are nearly QVA-dissemination-ready, with the final stages now nearing completion following a delay from the initial target of November 2024. A QVA "Private Beta" to customers was recently launched at the time of writing the report (Feb 20th 2025), with a Public Beta scheduled in for early April. The Private Beta is a live dissemination environment to a restricted set of key stakeholders/users to VAAC London. Forecasters are sending regular test data to this service, which will soon be published on a new design of website too (QVA-ready website in development).

It is currently anticipated that the VAAC London provision of QVA will be in operational status (live and finalised) by early June 2025.

VAAC Montréal

VAAC Montréal pursued the development of QVA in 2024. Most of the work involved coordination with colleagues in research and development to ensure that the input variables required by the dispersion model were output by the numerical weather forecast model that feeds it.

VAAC Tokyo

In VAAC Tokyo's work on QVA verification, area and ash mass loading from past events are compared among QVA forecasts, forecaster observation and satellite analysis. Based on any significant discrepancies observed, the results are used for model enhancement and parameter setting. Further statistical and scientific expertise need to be pursued in this regard. The use of satellite LIDAR data is also a target for future work.

QVA verification progress is reported on at a domestic academic conference on 29th May and at a QVA workshop hosted by ICAO on 31st October.

New requirements for an information distribution system to support QVA dissemination are currently being considered, including the design of a user interface and internal process flow.

VAAC Toulouse

See § 2.3

VAAC Washington

VAAC Anchorage, VAAC Washington, NOAA's ARL, and other collaborators continued the development of QVA for both U.S. VAACs. It coincides with development of the new AWIPS-2 platform going on at the same time.

VAAC Wellington

VAAC Wellington continues to progress work for producing QVA, targeting early 2026 for go-live. The QVA model was tested by running the eruption parameters from the 1995 Ruapehu eruption but using 'the weather of the current day'. The next steps are focusing on forecaster workflow and further education pieces of key clients in the region.

3.2   Other Future Developments

VAAC London

VAAC London has taken steps to improve the VAAC public website as part of QVA introduction.

VAAC Wellington

Amendment 82 to Annex 3 will include a Recommended Practice for State volcano observatories (SVOs) to provide volcanic activity information using the VONA template. Given most SVOs do not have access to Aeronautical Fixed Services (AFS), it will be a significant challenge to disseminate any VONAs into the aviation system. This is a particular challenge for SVOs in the Pacific region, where often the State meteorological service may not have access to the AFS. New Zealand has been considering how to assist New Zealand and Pacific SVOs for some time and developed a concept for a VONA Input System (VIS). Development of the VIS was largely completed by the end of 2024, with user testing expected to happen early in 2025.