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INFORMATION PAPER (IP/03)



ICAO

**ICAO ASIA AND PACIFIC (APAC)
THIRTIETH MEETING OF THE METEOROLOGY
SUB-GROUP (MET SG/30)**

Bangkok, Thailand, 20 - 24 July 2026

Agenda Item 5: Planning and Monitoring**COMBINED APAC VAAC MANAGEMENT REPORT**

(Presented by Australia, Japan, New Zealand and United States)

SUMMARY

This paper presents an International Airways Volcano Watch (IAVW) consolidated management report describing activities for the nine volcanic ash advisory centers (VAACs) prepared by the Meteorology Panel (METP) Working Group Meteorological Operations Group (WG-MOG) IAVW workstream for the period 1 January 2025 to 31 December 2025. Additional information is provided by the APAC VAACs Darwin, Tokyo, Washington, and Wellington covering the period 1 January 2026 to 31 May 2026

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 2025 and 31 December 2025 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 In response to a request made at MET/SG/29, an update from VAAC Washington has been included in this paper.

1.3 The consolidated VAAC Management Report for 2025 is provided in Appendix A, with additional information provided by the three APAC VAACs Darwin, Tokyo, Washington and Wellington covering the period 1 January 2026 to 31 May 2026.

2. DISCUSSION2026 update from VAAC Darwin

2.1 Mt Dukono on the Island of Halmahera in Indonesia has been erupting for years. On 8 May 2026 Mt Dukono erupted to FL420. The satellite imagery clearly showed the rapid cloud growth which was supported by a ground report from the Centre for Volcanology and Geological Hazard Mitigation (CVGHM). The volcanic ash quickly separated into 3 layers based on the atmospheric wind profile, FL420 moving northeast, FL350 moving southwest and FL250 moving west. The eruption showed clear signatures for volcanic ash and volcanic gases which made the event easy to track. The

high-level volcanic ash lasted around 24 hours before dissipating. VAAC Darwin issued 11 advisories for the event.

2.2 Mt Marapi on the Island of Sumatra in Indonesia erupted on 15 March 2026 to FL420. The volcanic ash signal was partially detected on satellite imagery amongst heavy meteorological cloud. The volcanic ash signal was moving in two directions, FL420 moving to the southeast and FL240 moving to the east-northeast. The volcanic ash signal was quickly lost in the extensive meteorological clouds, and the models were showing high precipitation. The VAAC relied on using dispersion modelling to guide the dissipation rates. The volcanic ash dissipated after 15 hours and VAAC Darwin issued 7 advisories for the event.

2.3 The Rabaul Volcano Observatory (RVO) in Papua New Guinea reached out to VAAC Darwin on 12 May 2026 requesting some assistance with satellite imagery for activity potentially coming from the Central Bismarck Sea from an unnamed submarine volcano. There was reported thermal anomaly, discolouration in the water and emission from the sea. VAAC Darwin confirmed the thermal activity, discolouration on true colour imagery, and the presence of emission from the sea which included some minor detection of volcanic ash. VAAC Darwin issue the first advisory for the unnamed submarine volcano using the location of Central Bismarck Sea. The activity at the volcano had begun on 8 May according to volcanic reports from RVO, and since then VAAC Darwin has issued 75 advisories during May for activity. The communication between RVO and VAAC Darwin has been successful and timely with RVO sharing volcano information bulletins on the activity. RVO has given the volcano the provisional name of 'Titan Ridge' volcano.

2.4 As part of the move towards quantitative volcanic ash concentration information (QVA) service, VAAC Darwin is moving the Dispersion Ensemble Prediction System (DEPS) interface into the forecasting software Visual Weather. This will improve the workflow for QVA and allow the quality control process for VAAC Darwin to be smoother. Work is underway and the VAAC will be able to test the feature soon before it becomes operational.

2.5 VAAC Darwin and VAAC Wellington use the same forecasting software, Visual Weather, and have engaged the developer IBL for updates related to QVA.

2026 update from VAAC Tokyo

2.6 VAAC Tokyo has initiated a major update of its information dissemination system, with completion scheduled for early 2028. QVA service provision will commence following the update.

2.7 VAAC Tokyo and VAAC Darwin have restructured their communication framework using MS Teams to improve backup and handover operations. In collaboration with the Bureau of Meteorology, VAAC Tokyo forecasters can access a chat platform hosted by VAAC Darwin to support efficient information exchange.

2.8 Volcanic activity on the Kamchatka Peninsula remains elevated. In particular, Sheveluch has produced several significant eruptions, including one reaching FL480 on 3 April 2026. There were 17 events during this period for which volcanic ash advisory duties were handed over to VAAC Anchorage.

2.9 The number of reports of minor eruptions in the Philippines has increased since late last year, especially at Mayon and Kanlaon. On average, around five Volcanic Ash Advisories (VAAs) are issued per day based on Volcanic Observation Notice for Aviation (VONA) reports.

2026 update from VAAC Washington

2.10 Kilauea is a shield volcano located on the southeastern portion of the Island of Hawai‘i (commonly known as the “Big Island”). During the first five months of the year, it experienced nine eruptive episodes, with volcanic ash and gases reaching altitudes up to FL380. These events resulted in delays for numerous flights at Hilo International Airport, which is situated on the island’s eastern (windward) side. In total, twenty-nine Volcanic Ash Advisories and Graphics (VAA/VAG) were issued in response to these eruptions. Effective coordination and communication were maintained among the Hawaii Volcano Observatory, the Honolulu Weather Forecast Office (WFO), and the Washington VAAC, ensuring timely exchange of information as the situation evolved.

2.11 Santa María is a stratovolcano located in western Guatemala. It is typically active, but on April 28–29 it produced an unusually sustained ash event. During this period, multiple significant eruptions sent volcanic ash as high as FL190, with plumes extending offshore into the eastern Pacific. This event was atypical, as Santa María generally exhibits short, intermittent emissions rather than prolonged activity. Communication between VAAC Washington and INSIVUMEH is infrequent, which can make obtaining timely information during such events challenging.

2.12 Puracé Volcano, an andesitic stratovolcano in southwestern Colombia, lies approximately 30 kilometers (18 miles) southeast of the city of Popayán. Activity increased in November 2025 and continued into 2026, with eruptions generally ranging from small to moderate in intensity. Coordination and communication among the Bogotá Meteorological Watch Office (MWO), the Volcanological and Seismological Observatory of Popayán (OVSPop), and the Servicio Geológico Colombiano (SGC) have been effective, with VONAs and SIGMETs issued during periods of activity.

2.13 VAACs Darwin, Montreal and Washington are planning another back-up test in September 2026

2026 Update from VAAC Wellington

2.14 Volcanic activity within the VAAC Wellington area of responsibility has been elevated during 2026, with 84 per cent of the total number of VAA issued in 2025 already issued during the first five months of the year. This activity was primarily associated with Ambae (Vanuatu), with lesser activity from Whakaari/White Island (New Zealand). While most eruptions were considered ‘low level’, several events affected aviation operations, including flights into Port Vila and domestic operations at Tauranga.

2.15 In one instance, volcanic ash from Ambae extended into the VAAC Darwin area of responsibility. Forecasters from both VAACs coordinated their response and agreed that VAAC Wellington would continue to be responsible for the entire volcanic ash cloud, while VAAC Darwin issued rebroadcast advisories for users within its area of responsibility.

2.16 An internal policy change has been implemented whereby a “NO VA EXP” VAA is issued in response to a pilot report (PIREP) of volcanic ash when assessment by VAAC forecasters confirm that no volcanic ash is present. This process provides confirmation that the PIREP has been received, assessed and communicated to stakeholders.

2.17 VAAC Wellington continues to work with the New Zealand SVO to facilitate the issuance of VONA through the MetService VONA Input System. System enhancements are underway to support separate SVO user accounts with customised volcano lists.

2.18 Several VAAC forecasters attended and presented at a workshop hosted by the New Zealand SVO on the operational application of Eruption Source Parameters (ESPs). The workshop included participants from across the Pacific region and provided an opportunity to strengthen collaboration with counterparts from Australia, Solomon Islands and Vanuatu.

Back-up test outcomes

2.19 The VAAC Darwin and VAAC Wellington back-up test was conducted on 3 June 2026. During the test, both VAACs issued Volcanic Ash Advisories (VAAs) using the new additions to the Annex 3 template, which allow the OBS VA DTG and OBS VA CLD fields to be specified as “NOT PROVIDED”. The test generated minimal responses from users. Both VAAC Darwin and VAAC Wellington will investigate the reasons for the limited level of feedback received.

2.20 As an alternative approach, VAACs Darwin and Wellington would like to investigate the possibility of using the annual APAC SIGMET test as an opportunity to verify whether users are receiving the advisory messages. This approach would not affect the SIGMET test, as Meteorological Watch Offices (MWOs) will continue to issue WV SIGMETs regardless of whether a VAA has been received.

2.21 The VAAC Darwin and VAAC Tokyo back-up test is scheduled for 1 July 2026. For this test, both VAACs will use the previous volcanic ash advisory formatting with OBS VA DTG and OBS VA CLD with a time and VA NOT IDENTIFIABLE FM SATELLITE DATA WIND. The VAACs have revised the e-mail notification to users ahead of the back-up test with the intent to capture all users for their involvement.

2.22 VAACs Darwin, Montreal, and Washington conducted backup testing on 5 March and 9 June 2026. Overall, the tests were successful. Each VAAC utilised the Slack Huddle feature in place of MS Teams or Google Meet, as each center operates with its own required video conferencing software. Slack Huddle is approved for all three VAACs to use. Testing of backup support messaging on the VAAC Washington webpage was intended to ensure advisories generated and disseminated by VAACs Montreal and Darwin were displayed on their respected webpages. VAAC Washington is currently transitioning to new compute farm infrastructure, which resulted in VAA/VAG products issued by Darwin and Montreal not appearing on its webpage. An additional issue involved messages from Darwin and Montreal not being received through the VAAC Washington LISTSERV.

2.23 From 20 April through 12 June 2026, VAAC Washington provided daily backup support to VAAC Anchorage from 1400 to 2100 UTC. The operations are proceeding smoothly; initial minor hurdles regarding daily notifications to the Tokyo VAAC and adapting to distinct Anchorage operational protocols have been successfully resolved.

2.24 After months of testing different eruption scenarios, the new VAAC Washington VAG is in final stages of becoming operational. It will provide a much cleaner and more user-friendly way to visualise volcanic ash events and their potential impacts on aviation. It will also streamline workflows enabling volcano analysts to disseminate information more efficiently. The new VAG will present key information such as ash location, movement, extent, and text in a more sharp and visually intuitive format, that helps both operational partners and decision makers quickly understand the situation at a glance. This text-driven approach utilizes an automated spiral-search algorithm to intelligently place forecast labels without overlapping ash areas, entirely eliminating the need for manual placement. To ensure seamless graphic production, integrated error checking now uses popup alerts to help analysts correct common VAA formatting issues before they can impact the final VAG.

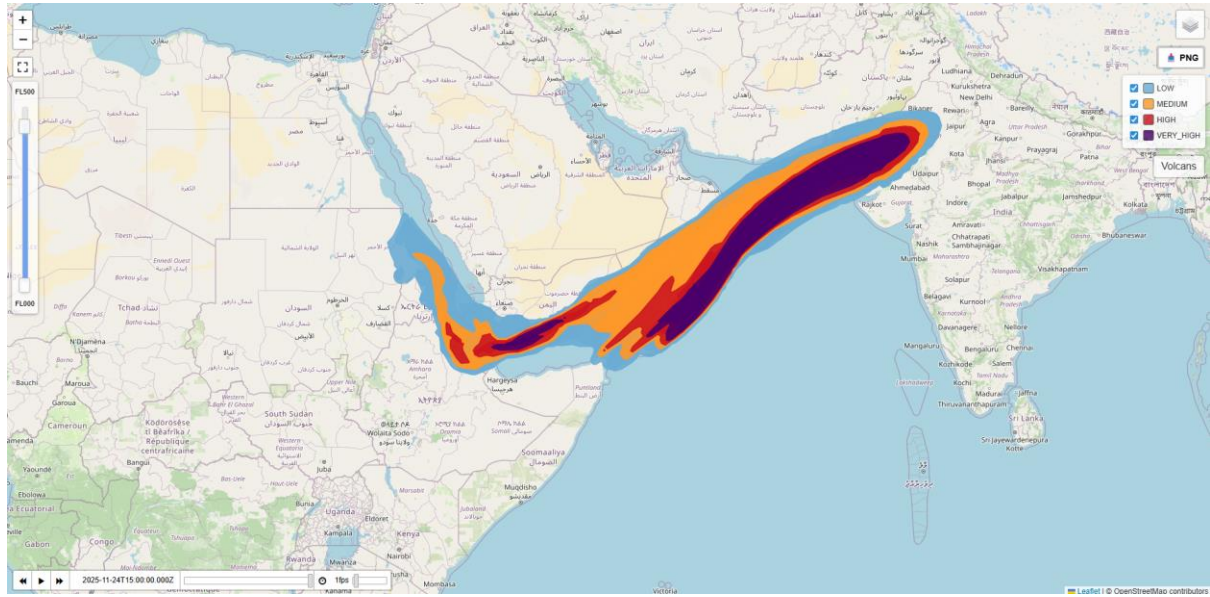
2.25 The Volcanic Ash Workflow was recently modernized to enhance redundancy, improve analyst efficiency, and automate manual processes. Operations are now driven by a new user interface featuring a real-time quality-control console and a custom VAAC-specific spell checker. On the backend, post-processing was transitioned from local workstations to a highly resilient, multi-site virtual machine infrastructure distributed across College Park, Maryland and Boulder, Colorado.

3. ACTION BY THE MEETING

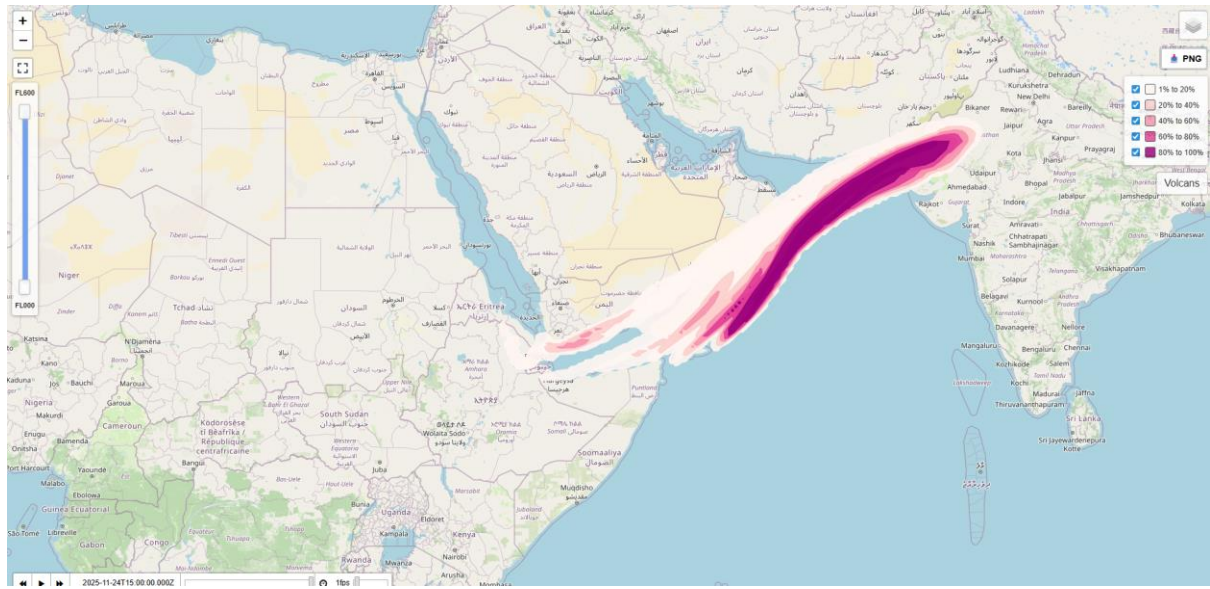
3.1 The meeting is invited to:

- a) note the information contained in this paper.

Consolidated Volcanic Ash Advisory Centre Management Report 2025



Above: Deterministic output of the Hayli Gubbi eruption issued on 23 November 2025 for validity 24 November 2025 at 1500UTC by VAAC Toulouse



Above: Probabilistic output for 'very high' concentrations For Hayli Gubbi issued on 23 November 2025 for validity 24 November 2025 at 1500UTC issued by VAAC Toulouse

Both were snapshot of the first ever supplementary QVA images issued and published on VAAC Toulouse website

Version Control

Version	Date	Change record	Approved
1.0	23 December 2024	Shared template with VAAC Managers for first draft	VAAC Wellington
2.0	16 February 2025	Shared with VAAC Washington for editing	VAAC Wellington
3.0	17 February 2025	Shared with VAAC Wellington with edits	VAAC Washington
4.0	20 February 2025	Shared with VAACs for finalisation	VAAC Wellington
5.0	23 February 2025	Final version submitted as attachment to IAVW/32 SN	VAAC Wellington

Executive Summary

For 2024 and 2025, global Volcanic Ash Advisory Centre (VAAC) activity remained high, with roughly 14,000 volcanic ash advisories (VAA) issued annually. VAACs Anchorage and Tokyo saw significant increases in volcanic activity, while VAAC Buenos Aires experienced a large decrease. Re-suspended ash advisories rose slightly, test/exercise advisories increased, and false alarms remained very low.

Operational performance remained strong, with most centres sustaining timely issuance of both initial and follow up advisories while maintaining high compliance with Annex 3 standards. Minor decreases in the rebroadcast of neighbouring advisories pointed to occasional cross boundary coordination challenges. At the same time, shadow shifts, targeted training, and exercise participation strengthened forecaster readiness and reinforced procedural consistency.

In 2025, VAACs strengthened operational capability through enhancements to satellite monitoring, dispersion modelling, and software tools, alongside the continued rollout of Quantitative volcanic ash concentration information (QVA). Live eruptions including Hayli Gubbi, as well as structured exercises, validated procedures and QVA outputs. Inter-centre coordination improved forecast accuracy, situational awareness, and overall system resilience.

Throughout the year, VAACs maintained close engagement with aviation stakeholders, State Volcano Observatories (SVOs), and international partners to further strengthen communication, collaboration, and coordinated response efforts. Also, collaboration through backup exercises, shadow shifts, and shared contingency planning further strengthened interoperability and preparedness across the global VAAC network.

Finally, VAACs London and Toulouse are now fully operational with QVA production, delivering real-time probabilistic forecasts. Other centres continued preparations for full operational implementation by late 2026.

Contents

1.	INTRODUCTION	6
1.1	Introduction of World Volcanic Ash Advisory Centres.....	6
2	DISCUSSION ON OPERATIONS.....	7
2.1	Issuance of VAA and VAG for the period 1 January 2025 to 31 December 2025	7
2.2	Key Performance Indicators.....	9
2.3	Significant satellite imagery, modelling or technical changes	12
2.3.1	VAAC Modelling Tables.....	15
2.4	Competency, Training and Education	16
2.5	Outreach for stakeholders and SVOs	19
2.6	Volcanic events of interest.....	22
2.7	VAAC collaboration	26
3	Future developments, steps towards ConOps and Roadmap of the IAVW.....	28
3.1	QVA Progress	28

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
NAVHP	North Atlantic Volcanic Hazards Partnership (UK, Iceland, Norway)
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 observatory
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
VOLC###	Volcanic Ash Exercises (led by London and/or Toulouse. The ### postfix can be: ICE (Iceland), AZO (Azores), ITA (Italy) and EX (regulated ICAO-led exercise involving North Atlantic and European industry)
VONA	Volcano Observatory Notice 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 some VAAC since 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 graphic (VAG), describing the current and forecast extent of ash.

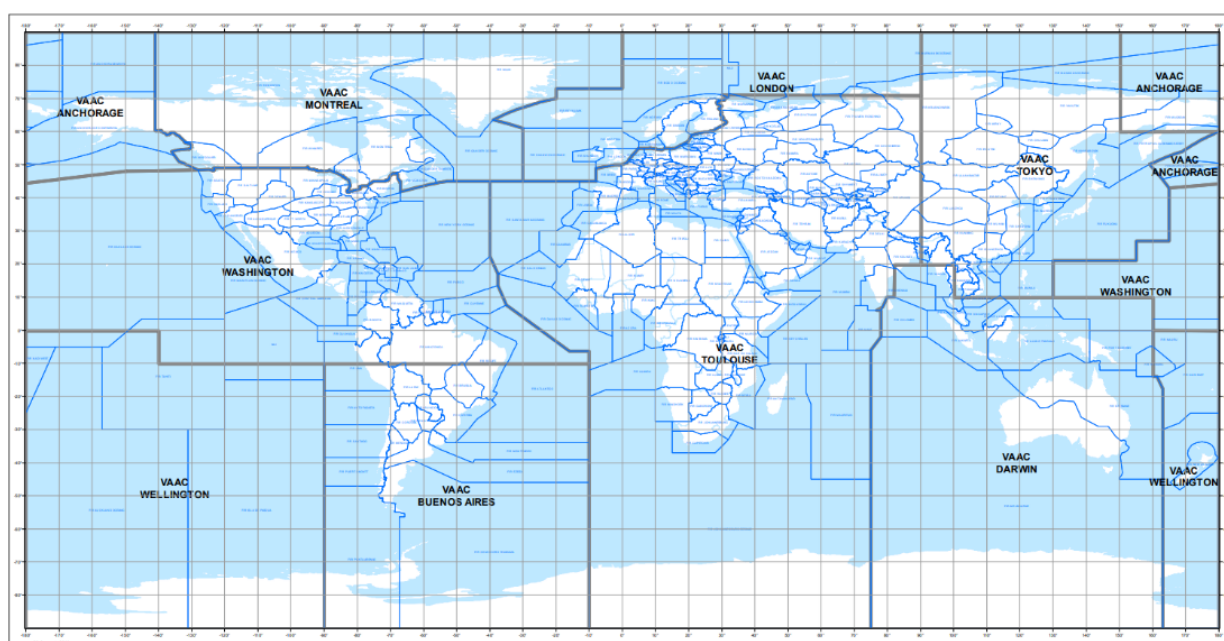


Figure 1: Area of responsibility for each VAAC (2019 version of map)

2 DISCUSSION ON OPERATIONS

2.1 Issuance of VAA and VAG for the period 1 January 2025 to 31 December 2025

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	285	176	110	1	0
Buenos Aires	109	107	26	2	0
Darwin	5669	5669	0	3	0
London	6	6	0	51	1
Montreal	2	2	0	17	0
Tokyo	1733	714	72	2	0
Toulouse	126	126	0	27	0
Washington	5582	5567	16	8	0
Wellington	259	259	0	4	2
Total	13771	12526	224	115	3

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 2025 to 31 December 2025 (inclusive).

Notes:

1. VAAC London – 41 EXER and 10 TEST activities were conducted. There were 2 real eruptions (both non-ash producing) and 1 false alarm, during which our forecaster mistakenly issued polygons for an effusive eruption. Throughout the year, numerous exercises were carried out, along with several QVA (including VAA/VAG) tests to evaluate the system and demonstrate the product.
2. VAAC Toulouse – 21 EXER and 6 TEST activities were conducted. Exercises were carried out with different States, including Italy, Spain, and Portugal. An additional exercise was planned

with Greece; however, it could not take place due to intense seismic activity around Santorini Island.

3. VAAC Wellington – In two false alarm cases, an initial VAA/VAG was issued following reports of volcanic activity. However, after further investigation and consultation with the SVO, it was determined that no volcanic ash was present. The advisories were subsequently cancelled within a reasonable timeframe.

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	100% (1/1)	N/A	95% (121/127)	59% (64/108)	87% (246/284)
Buenos Aires	83% (35/42)	100% (3/3)	98% (55/56)	N/A	93% (101/109)
Darwin	94% (409/434)	100% (429/429)	99%	84% (21/25)	99%
London	50% (1/2)	N/A	67% (4/6)	N/A	67% (4/6)
Montreal	N/A	N/A	N/A	50% (1/2)	79% (15/19)
Tokyo	99% (589/590)	100% (356/356)	99% (778/787)	100% (26/26)	99% (1728/1733)
Toulouse	92% (22/24)	100% (24/24)	100%	100% (1/1)	98% (98/99)
Washington	97% (942/970)	75% (3/4)	99%	69% (11/16)	97%
Wellington	79% (27/34)	100% (34/34)	100% (32/32)	N/A	83% (221/265)

Table 2: Percentage of advisories that meet the KPIs and the total number of advisories analysed for the period from 1 January 2025 to 31 December 2025. 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. VAAC Darwin – The initial advisory for rebroadcast can be slower than 20 minutes due to competing priorities but the subsequent advisories are within the 20 minutes timeframe. Generally, the forecasting software does not allow any options which are non-compliant with Annex 3, however, some issues were reported with incorrect headers.
2. VAAC London – A human competency issue was identified during the July 2025 eruption on the Reykjanes Peninsula. Products were not issued incorrectly in a hazardous sense; however, they were issued in the “safe” direction. Specifically, two sets of unnecessary observation/forecast polygons were disseminated (leading to a markdown to 67% compliance), and a blank VAA/VAG was not issued until 55 minutes later, which acted to cancel the erroneous products. This delay is largely academic, as the initial (erroneous) polygon VAA/VAG was itself issued a little over 20 minutes after the eruption. Of these two erroneous issues, the “No Further Advisories” compliance wasn’t followed leading to 67% score there. Given the relatively low sample size of events handled by VAAC London, this highlights the impact that limited operational exposure can have on performance consistency.

3. VAAC Toulouse -

One initial VAA/VAG after 20 minutes. The VONA was received by email; however, no follow-up phone call was made, and the forecaster viewed the VONA email with delay.

One initial VAA/VAG (Hayli Gubbi) was issued more than 20 minutes after the start of the eruption because the volcano is not monitored, and the eruption was detected only via satellite imagery.

Annex 3: One error occurred in the VAA numbering (subsequently corrected in the following message), and one VAA exceeded the permitted length, resulting in a dissemination error.

4. VAAC Washington – The rebroadcast/NEAR VAA can take longer than 20 minutes to disseminate due to competing priorities and receiving time vs. the advisory time.
5. VAAC Wellington – Of the 34 initial VAAs issued, 31 were associated with a New Zealand based volcano for which we are also responsible for VA SIGMET issuance. At the request of our users, an initial VA SIGMET is required prior to the issuance of the initial VAA, and this requirement results in delays to the initial VAA issuance. Changes to the VAA template to ensure compliance with Amendment 82 to Annex 3 are scheduled for implementation in January 2026, allowing additional time for testing of the tool.

2.3 Significant satellite imagery, modelling or technical changes

VAAC Anchorage

In August 2025, VAAC Anchorage tracked and forecast VA north of 70N in the Arctic Ocean. During a portion of this event, geostationary satellite became unusable due to parallax error, pixel growth and complex backgrounds. Various products from low-earth-orbiting (LEO) satellites were used to reduce and then end the event that would have otherwise gone on for several more days using geostationary imagery and products. LEO satellite data is a critical piece in properly geo-locating hazards and limiting the warning area growth at high latitudes. The presence of sea ice, coastlines with variations in ground cover, and high terrain can cause real problems in the analysis. Satellite products struggle with these features, in producing both false alarms and missed VA analysis. This can be made more difficult in attempts to differentiate VA from volcanic gases, and this played a role in the 'false alarms' from geostationary imagery. VAAC Anchorage collaborated with experts in academia on these specific issues to better understand these scenes and their interpretation.

VAAC Buenos Aires

During 2025, a new integrated toolkit for model and satellite analysis, as well as VAA/VAG production, was developed and tested. Its operational implementation is expected at the beginning of 2026. The software has also been designed to run and manage QVA outputs; this capability is expected to become operational by mid-2026.

Updates were introduced to ensure full compliance with the changes to VAA specified in amendment 82 to Annex 3.

VAAC Darwin

VAAC Darwin did an upgrade in its forecasting software Visual Weather (VW) to VW 8.6 which included the amendment 82 to Annex 3 changes. The upgrade went smoothly; however, multiple users contacted the Bureau of Meteorology asking about the removal of the aviation colour code including non-aviation users who used the aviation colour code for other purposes. VAAC Darwin engaged with these users to understand their usage of the VAA and aviation colour code. The team provided the updated information that the aviation colour code is in the VONA which will be issued by each SVO and then helped the agencies develop new procedures around this product.

VAAC forecasters have developed tools to support satellite monitoring for volcanic activity, assessment of NWP and wind movement, as well as additional maps in Visual Weather. Development work is underway to uplift these forecaster tools and maps in Visual Weather to support the quick issuance of the VAA, support during back-up operations, and to ensure they are operationally supported.

VAAC London

Following the Hayli Gubbi eruption in Ethiopia on 23 November 2025, which was covered by VAAC Toulouse, it became evident to VAAC London that some of our volcanic ash satellite coverage available to forecasters was limited across parts of Africa. As a result, improvements to available data and dedicated African cut-outs for forecaster access have been implemented, both to enhance routine operations and to provide parallel and backup support to VAAC Toulouse if required.

The primary focus of our modelling and technical resources during the period was the delivery of QVA, which reached full and final operational release in late May 2025. Modelling adjustments since then have been minimal, as most developments had been completed in previous years. The majority of subsequent work by the dispersion team has focused on improving functionality within the forecaster interface, including enabling the use of historic NWP data for VAAC exercises and case studies, and ensuring compatibility with the new version of our Global Model, which became operational in mid-January 2026 following several months of delay.

Minor technical adjustments and incremental improvements remain ongoing. The current modelling focus is research into improving source term prediction, particularly through further development of our inversion scheme, InTEM. Although InTEM is not yet fully operational, a version is available for use within operational NAME, and its use is mandated during real eruption events.

The amendment 82 to Annex 3 schema changes were implemented in Visual Weather (version 3.7.11) during the first week of December.

It is also worth noting that the QVA API is being populated daily with new data from simulated eruptions, generated by forecasters as part of routine familiarisation and system testing. This ensures that industry partners have access to a substantial volume of engineering sample data while developing their systems and operational policies.

VAAC Montréal

All available resources have been dedicated to the development of QVA. The crux of the development has been creating scripts that allow calculations of QVA and coordinating with other VAACs to ensure that QVA is generated in a consistent manner between centres.

Many changes to the software used to create VAAC products have been made and tested in 2025 owing to an upgrade of supercomputer resources planned for March 2026. These changes are necessary and require many resources but are transparent to users.

Changes were made to the software to be compliant with changes made to VAA specified in amendment 82 to Annex 3.

VAAC Tokyo

On 27 November 2025, VAAC Tokyo's information distribution system software was updated in line with the new VAA template defined in amendment 82 to Annex 3.

VAAC Toulouse

This year was largely dedicated to ensuring the operational readiness of QVA. Significant efforts were made in modelling development, harmonisation of data formats (NetCDF), and alignment of API protocols with VAAC London. All VAAC forecasters received training on both the use and production of QVA products.

The website (<https://vaac.meteo.fr/>) was modernised and enhanced to enable improved display and access to QVA products.

Exercises were organised with Portugal, Spain, and Italy, as well as with VAAC London acting as backup. These exercises consistently provide valuable opportunities to refine tools and improve operational procedures.

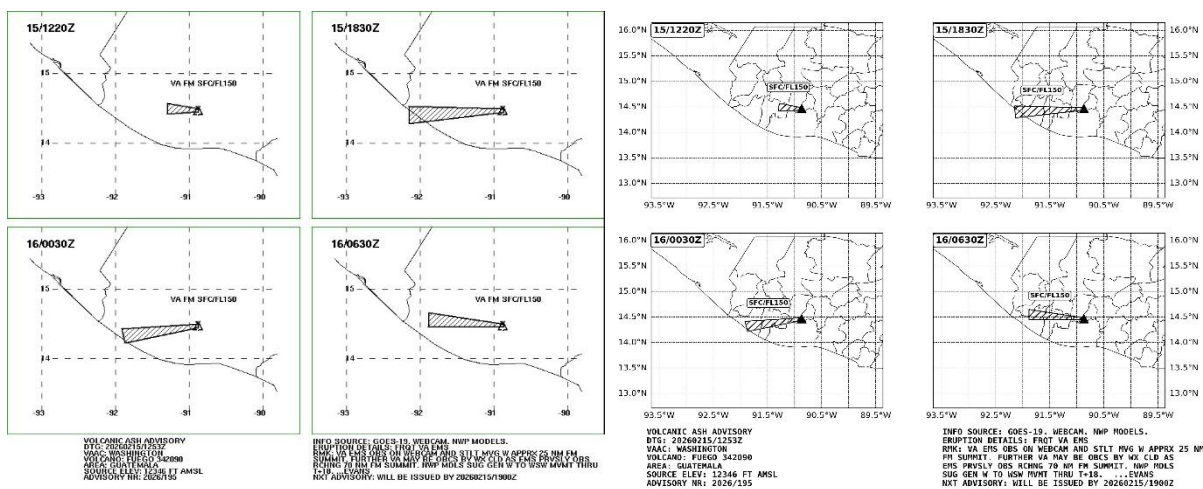
Amendment 82 to Annex 3 upgrades was successfully implemented.

A special report was produced on the historic eruption of Hayli Gubbi on 23 November 2025. This event provided an opportunity to issue QVA products under operational conditions. The results of the QVA information were very encouraging; however, it is important to recognise that modelling and forecasting volcanic ash clouds remains inherently challenging, particularly for less intense eruptions.

VAAC Washington

Upgrades to VAAC Washington's software suite was completed to ensure full alignment with latest updates to amendment 82. These updates specifically address required changes to the VAA template.

Development and testing have been completed for a redesigned Volcanic Ash Graphic (VAG). The new VAG highlights critical plume features more effectively, providing aviation users with improved situational awareness and enhanced clarity of hazard boundaries. March 2026 is the expected introduction of the new VAG into operations.



Continued development of QVA was carried out across multiple technical, operational, and coordination aspects.

VAAC Wellington

During the reporting period, much of VAAC Wellington's activity involved monitoring volcanoes producing thin, low-level plumes dominated by steam and gas with a minor ash component. These events provided valuable opportunities to further develop expertise in satellite-based ash detection, particularly where ash signatures are subtle. Ground-based observations and complementary satellite products supported increased confidence in identifying minor volcanic ash, despite the inherent complexity of these plume types.

Use of additional satellite products was expanded during the year, including greater routine application of SO₂ and thermal detection imagery. This enhanced situational awareness and improved the team's ability to recognise and manage false alarms. Relevant case studies were developed and shared internally, strengthening collective knowledge and consistency across the VAAC.

Progress was also made in improving operational resilience by increasing the internal production of satellite imagery. This reduced reliance on third-party tools and supported faster, more robust operations, particularly across the eastern portion of the VAAC area.

A change is required to the tool used to produce VAA/VAG to comply with the recently published amendment 82 to Annex 3. Implementation is expected to be completed, and the tool fully operational, by the end of January 2026.

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

VAAC Anchorage

VAAC Anchorage staff have begun training on a new operational system that will produce its VAA, VAG, and other MWO warning products (SIGMETs). This new system will replace a very old production system in 2026 that is the source of several minor format issues within the VAA production process. The new system is more intuitive, efficient and should allow the VAAC to leverage QVA data in the VAA production process.

VAAC Buenos Aires

VAAC Buenos Aires staff currently comprises 19 forecasters. Of these, 18 have been re-certified in the required competencies, while one forecaster is a new staff member currently undergoing training.

During the reporting year, two audits were conducted to evaluate VAAC forecasting practices. The results were positive and provided valuable input for planning competency and training activities for the following year.

VAAC Darwin

VAAC Darwin has 22 competent staff as of the end of the 2025 calendar year. Each forecaster undergoes a comprehensive VAAC competency course to gain their initial VAAC Competency and then a VAAC recertification process every 5 years to maintain their competency.

VAAC Darwin did a major overhaul of its VAAC competency course in 2024. In 2025, the course has been used to test new VAAC forecasters who have gained their competency since the go live date. For an initial competency each forecaster will do a minimum of 15 dualling shifts, complete the VAAC Competency Assessment course, complete a workplace observation and a VAAC high-level simulation to test their knowledge and understanding before gaining their VAAC Competency. The VAAC Competency Assessment course contains 5 modules: Fundamentals, Volcanic Ash and Aviation, Volcanic Monitoring and Observational Data, Volcanic Ash Detection Techniques, Forecasting and Dispersion Modelling.

During the Vulcan Working Group Industry meeting, aviation customers expressed their willingness to share information on the impacts of volcanic ash on operations in our area of responsibility to ensure a well-round training course. VAAC Darwin will engage with the aviation customers to develop further updates to the VAAC competency course.

VAACs Buenos Aires, Darwin and Tokyo, with VAAC Darwin as the lead, have supported the Expert Team of Education, Competency and Training (ET-ETC) under WMO for the development of a VAAC forecaster competency framework. The work was previously reviewed by all the VAACs; however, the Basic Instruction Package for Meteorologists (BIP-M) has been updated to the 2025 version so the ET-ETC reached out to the Advisory Group on Volcanic Science for Aviation Application (AG-VSA) to check that the mapping between the VAAC forecaster competency framework still aligned with the updated 2025 BIP-M course.

VAAC London

Forecasters continue to undertake daily practice and familiarisation with the full end-to-end operational process. This activity also serves to populate the QVA API with engineering sample data for industry use. None of these practice outputs are disseminated externally via live operational channels.

The team currently fluctuates between 16 and 18 trained forecasters, although not all are dedicated exclusively to VAAC duties. Staffing levels vary due to turnover and the presence of a significant proportion of part-time personnel. The rollout of QVA included targeted training, in addition to the annual in-house refresher courses. Where compliance issues have been identified, one-to-one training and mentoring have been provided. Business Managers and the VAAC Manager have also undertaken external engagement activities, consulting with and training industry stakeholders in the use of QVA.

A new round of VAAC-AMF (UK CAA-endorsed) assessments recommenced in December 2025, following earlier delays due to resourcing constraints. The inclusion of QVA competencies is planned as an addendum to the AMF framework, as these are not currently covered. Work is ongoing to define the specific competency elements required, noting that from a technical perspective QVA demands comparable, or in some respects lower, competencies than the manual production of VAA/VAG/concentration charts. It is anticipated that QVA-specific competencies will focus on source term management, the application of new schemes such as InTEM, and an understanding of the physical and technical differences between QVA and traditional VAA/VAG/concentration chart production.

VAAC Montréal

There are 19 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 Centre (VOWC) at Japan Meteorology Agency's (JMA) Tokyo headquarters (responsible for mitigating ground-based eruption hazards) support the provision of VAAC Tokyo services. The Centre 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 VAAC 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 joined the department this year. They underwent training and practical exercises to ensure they can issue VAA/VAG in the event of an eruption. They also participated in tests and exercises throughout the year.

With approximately 100 VAA issued this year, each forecaster had the opportunity to practise in real operational cases. Special training sessions were organised for all VAAC forecasters to ensure full competency in the use and production of QVA products.

VAAC Toulouse participated in workshops, meetings, and working groups to support user familiarisation with QVA. VAAC Toulouse also took part in a workshop dedicated to Volcanic Ash and its management, organised by the International Civil Aviation Organization / Western and Central African Office (WACAF).

VAAC Washington

VAAC Washington's current staffing consists of 12 forecasters/analysts. New analysts undergo an intensive training program consisting of 24 to 28 operational shifts under the guidance of a certified trainer. Training protocols ensure all staff are fully proficient in executing operational duties from both the office and remote work environments. Three new volcanic ash forecasters were successfully trained and certified during the 2025 calendar year.

An end-of-year review was conducted at the start of 2025 to evaluate analyst statistics and identify specific areas for professional improvement. The next comprehensive performance and statistical review for all volcano analysts is scheduled for February 2026.

Quarterly backup exercises were conducted with VAACs Montreal and Darwin to maintain operational readiness and cross-train forecasters on international backup procedures for all three VAAC. Additional collaborative exercises are planned to further synchronize standards and operational consistency among the three VAACs during backup events.

VAAC Wellington

VAAC Wellington is supported by 16 AMF Competent Forecasters who routinely cover both VAAC and standard aviation forecasting duties, with a further 16 Competent Forecasters available to provide operational support as required.

A Volcanic Ash Workshop was held during the year to strengthen capability and awareness across the forecasting workforce. The workshop covered core VAAC monitoring techniques, recent regulatory updates, and case studies from recent events, and was recorded to support broader staff access and ongoing learning.

Operational procedures were updated following the implementation of amendment 82 to Annex 3, including the retirement of legacy practices no longer aligned with current requirements. In addition, experience gained from recent operational scenarios prompted review and discussion of VAA issuance practices, contributing to ongoing refinement of standard operating procedures and alignment with international best practice.

2.5 Outreach for stakeholders and SVOs

VAAC Anchorage

In September of 2025, VAAC Anchorage hosted the 2025 QVA Operations and Partner Meeting in Anchorage. This meeting includes representatives from VAACs Anchorage, Washington, Tokyo, and Montreal, NWS Headquarters, NOAA Air Resources Laboratory, and the Alaska Volcano Observatory. The workshop also included a discussion and feedback session with local Alaska air carriers on QVA and its use.

VAAC Buenos Aires

Throughout 2025, VAAC Buenos Aires maintained continuous communication with the SVO's of Argentina, Chile, and Peru.

On 16 December 2025, following the WOVO meeting, VAAC Buenos Aires hosted a coordination meeting with AOR OAVV-SEGEMAR (Argentina), OVDAS-SERNAGEOMIN (Chile), and CENVUL-IGP (Peru) to further discuss the upcoming changes to the VONA format and associated coordination procedures.

The VAAC Buenos Aires Manager was also invited to deliver a presentation at the Annual Aviation Industry Engagement Meeting of the Volcanic Ash Working Group, held on 19 November 2025 and hosted by VAAC Darwin.

VAAC Darwin

VAAC Darwin hosted the annual aviation industry engagement meeting of the Vulcan Working Group on 19 November 2025. The meeting attendees includes Aviation operators, Meteorological service Aviation regulators and Vulcanological agencies. These representatives were from Australia, Japan, Indonesia, New Zealand, US and Argentina. The meeting was provided updates from each VAAC, with a special presentation from VAAC Buenos Aires as the special guest.

VAACs Darwin and Wellington discussed collaboration work in the region and New Zealand provided an overview of the VONA Input System (VIS). A larger session was held for QVA where there was an overview on QVA and the QVA workshop held in Paris 2024; VAAC QVA updates from VAACs Darwin, Wellington, Washington and Tokyo; and a QVA discussion on the proposed information or suggested ideas for guidance materials going into the Handbook on the IAVW and QVA Flyer. The group was provided with the updated section from Handbook of the IAVW and the previous QVA Flyer and were asked what additional information and guidance would be needed to understand and be able to utilise the QVA service. The discussion included regulators to help education them on QVA and see what information and understanding they required to consider regulations around QVA.

Initial ideas included guidance on how to operate using QVA if approval to fly through low levels of volcanic ash is not provided and agreement on the list of proposed next changes.

VAAC London

Extensive regional outreach on QVA has been undertaken by the Business Managers and the VAAC Manager to showcase the capability and support industry onboarding. This engagement activity remains ongoing.

VAAC London representative, Karen Shorey, visited Brussels on 30 October 2025 to work directly with industry partners on the introduction of QVA, including delivery of a live demonstration exercise. The VAAC Manager has also provided advice, workshops, and training sessions to UK NATS and the VOLCEX committee on the operational use of QVA.

VAAC London has been working closely with EUROCONTROL on the development of the new version of EVITA, which is pivotal for European and North Atlantic air traffic management during volcanic ash events. EVITA is a web-based collaborative platform designed to visualise the impact of crises—specifically volcanic ash clouds—on European air traffic and airspace capacity.

VAAC London also maintains strong relationships with the Icelandic Meteorological Office (Iceland SVO) through ongoing operational workstreams and coordination activities, including participation in the monthly VOLCICE exercises and NAVHP committee meetings.

VAAC Montréal

In March 2025, VAAC Montréal participated in VOLPAC25, a virtual tabletop exercise which had participants explain how they would respond to 4 different volcanic eruption scenarios.

On 3 April 2025, a presentation on QVA was given to heads of forecast offices across Canada for their awareness. This was especially pertinent to the two Canadian Meteorological Aviation Centres, who are responsible for issuing volcanic ash SIGMETs.

VAAC Tokyo

JMA holds annual aviation weather meetings with domestic airlines and related stakeholders. VAAC Tokyo held an extra workshop on November 2025 to provide airlines with an overview of VAAC operations.

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

Close coordination was maintained with the SVO's of Portugal and Spain to organise joint exercises. Additionally, frequent contact was maintained with the SVO of Italy in response to real eruption activity.

VAAC Washington

VAAC Washington attended and presented at the annual Vulcan Working Group on November 19 2025 bringing together aviation operators, regulators, and VAAC for global ash efforts and understanding. A dedicated session focused on QVA, featuring a retrospective of the 2024 Paris workshop and operational updates from VAACs Darwin, Wellington, Washington, and Tokyo. The group collaborated on refining proposed guidance materials and establishing best-practice frameworks for the international aviation community.

VAAC Washington met with partners from the National Weather Service (NWS), United States Geological Survey (USGS), VAACs Montreal and Tokyo, and local Alaska regional airlines to discuss QVA, volcanic ash modelling, and other operational volcano issues. During the meetings, VAACs were able to discuss QVA workflow, backup and transfer of responsibility procedures along with other important operational tasks that VAACs will encounter with the upcoming production of QVA. The event was hosted by the Alaska Aviation Weather Unit (AAWU)/VAAC Anchorage.

Collaborated on a poster presentation for the American Geophysical Union (AGU) meeting held in December 2025 in New Orleans, Louisiana, and on a presentation for the American Meteorological Society (AMS) meeting held in January 2026 in Houston, Texas. These presentations provided detailed updates on VAAC Washington's history, operations, and the development of QVA.

Several presentations provided to multiple NOAA agencies on VAAC Washington and QVA throughout 2025.

VAAC Wellington

VAAC Wellington continued to strengthen regional and international partnerships during the year. Engagement with the Vanuatu Meteorology and Geohazards Department (VMGD) was enhanced, with new operational contacts established to support more effective communication during eruptive events. Given Vanuatu's significance within VAAC Wellington's area of responsibility, this represents an important improvement in regional situational awareness.

Strong collaboration was also maintained with the New Zealand SVO, Earth Sciences New Zealand (formerly GNS Science), particularly through the sharing of observational data to support confirmation of minor volcanic activity at Whakaari/White Island.

Planning has commenced to re-engage with Solomon Islands partners through a volcanic ash exercise, proposed for 2026 in collaboration with VAAC Darwin, to further strengthen regional preparedness and coordination.

Significant progress was made in the development of a VONA platform to support SVO compliance with amendment 82 to Annex 3. The platform is nearing completion, with implementation planned for the New Zealand SVO in early 2026 and the option to extend availability to Pacific SVOs thereafter.

2.6 Volcanic events of interest

VAAC Anchorage

From 2–17 August 2025, AAWU (MWO)/VAAC Anchorage issued 249 products in response to four volcanic ash events. These included 102 VAAs, 40 VAGs, and 107 Volcanic Ash SIGMETs, in addition to 214 automated VA SIGMET graphics. VAAC Anchorage also distributed 40 partner emails containing VAG information.

During this period, VAAC Anchorage conducted six formal handovers of responsibility with other VAACs—five with VAAC Tokyo and one with VAAC Washington—and coordinated as necessary with Aviation Weather Centre and VAAC Montreal.

In the context of volcanic ash operations, this 15-day period represents an approximately 800% increase over the five-year average for comparable products (VAAs and VA SIGMETs). It ranks as the third-highest 15-day volcanic product output in the office's 30-year history.

VAAC Buenos Aires

On 1 August 2025, a mixed volcanic ash and mineral dust event occurred in north-western Argentina. Satellite analysis indicated the resuspension of ancient ash deposits from the Cerro Blanco volcano over the Fiambalá Basin, combined with mineral dust originating from the Laguna Blanca region in Catamarca.

Due to the proximity of these source areas, it was challenging to clearly distinguish between the volcanic ash plume and the mineral dust cloud. This situation led to the diversion of one flight to an alternate aerodrome and caused delays to flights operating to and from Tucumán.

VAAC Darwin

Lewotobi Laki-laki, on the Island of Flores in Indonesia, is a twin peak stratovolcano located approximately 450 NM east of Denpasar International Airport and during 2025 it erupted multiple times to high levels. Only a few of the eruptions will be summarised here. 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.

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.

On 7 July 2025, Lewotobi Laki-laki erupted up to 53,000 ft and moved towards the west and southwest. The volcanic ash was quickly separated into multiple levels based on wind movement in the NWP data and visuals on satellite imagery. The volcanic ash was easily tracked on satellite imagery as it passed over Denpasar International Airport and into Australian Airspace. The activity last just over 30 hours before the satellite imagery was clear of any volcanic ash signal and the advisory was cancelled. There were other large eruptions from Lewotobi Laki-laki but those had limited impact to aviation operations.

During the Lewotobi 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. VAAC Darwin and Bureau of Meteorology also conducted airline briefing conference calls to share information for some operators who had long haul flights that were impacted.

Semeru is on the Island of Java, Indonesia and is located 135 NM from Denpasar International Airport and 380 NM from Jakarta. On 19 November 2025, Semeru erupted to 59,000 ft. The eruption was confirmed by webcam imagery and a CVGHM ground report. A second eruption was also reported an hour after the initial eruption. The area was completely covered by meteorological cloud; however, a strong feature was observed in multiple satellite images growing over the volcano location to a height above the meteorological cloud in the area. The activity was confirmed as volcanic and the advisories were issued for volcanic ash moving towards the southwest over the ocean and towards the Australian airspace. With major thunderstorm activity in the area, it made it difficult to track the volcanic ash but as the meteorological cloud began to clear it showed that the area was also clear of volcanic ash, and the products were cancelled around 24 hours after the initial eruption.

VAAC London

The “Reykjanes Fires” on the Reykjanes Peninsula in southwest Iceland continued during 2025, although at a much lower eruption rate than in previous years. Only two eruptions occurred:

- **Eruption #11 (1 April 2025)** – A very short-lived event (approximately four hours), during which most of the magma was released subsurface along a fissure.
- **Eruption #12 (16 July 2025)** – Marked by a return to more extensive surface fissuring.

No significant volcanic ash was observed during either event. Since Eruption #12, activity has remained dormant. However, the underlying magma chamber is considered close to eruption threshold at the time of writing, and intermittent seismic activity continues along the peninsula. These events form part of the ongoing activity cycle associated with the Reykjanes Peninsula volcanic system.

The only other eruption of significant operational impact during the year was the short but powerful Hayli Gubbi eruption in Ethiopia on 23 November 2025, which was managed by VAAC Toulouse. This event was notable as the first known eruption of Hayli Gubbi in living memory, producing ash to FL500 (50,000 ft). The event required a formal handover procedure with VAAC Tokyo.

Although QVA was not yet officially operational at that time (operational launch: 27 November 2025), industry stakeholders regarded the event as a highly valuable live demonstration of capability.

Feedback was very positive, while also identifying expected lessons learned for future refinement, including VAA ash-handover consistency and clearer guidance on when QVA should and should not be issued.

The eruption also highlighted the need for VAAC London to strengthen satellite monitoring coverage and refine procedures for providing backup support to Toulouse. It provided an opportunity to test our QVA capability in a live-event context. Model outputs were largely consistent with those produced by VAAC Toulouse.

VAAC Montréal

An eruption of Klyuchevskoy generated a volcanic ash plume that came sufficiently close to the VAAC Montréal area of responsibility to require rebroadcasting two VAA from VAAC Anchorage on 13 August 2025.

VAAC Tokyo

Krasheninnikov on the Kamchatka Peninsula erupted for the first time in approximately 600 years on 2 August 2025, and the next day a volcanic ash cloud reaching FL280 was reported in a VAA. Volcanic activity has continued ever since.

In early August 2025, Klyuchevskoy on the Kamchatka Peninsula also became highly active. Following an eruption with a volcanic ash cloud reaching FL400 on 7 August 2025, coverage of part of the cloud area was handed over to VAAC Anchorage. After a period of ongoing monitoring of eruptive activity and ash cloud movement, responsibility for the whole of the area was handed back to VAAC Tokyo.

A volcanic ash cloud from the eruption of Ethiopia's Hayli Gubbi on 23 November 2025 moved into VAAC Tokyo's area of responsibility and was handed over by VAAC Toulouse on 24 November 2025. VAAC Tokyo continued to issue related VAAs for approximately 48 hours afterward and held an extra online briefing for domestic airlines and other stakeholders to provide details of observation and the advisories issued.

VAAC Toulouse

The Hayli Gubbi volcano, located in Ethiopia within the East African Rift, had been dormant for over 8,200 years before erupting on Sunday, 23 November 2025. The volcanic ash cloud rapidly crossed the Red Sea and the Gulf of Aden, south of the Arabian Peninsula, reaching the Gulf of Oman in the early hours of Monday, 24 November 2025.

VAAC Toulouse initially held responsibility for issuing information regarding the volcanic ash cloud. Responsibility was subsequently transferred to VAAC Tokyo, while VAAC Darwin maintained monitoring of the situation.

This eruption provided an excellent opportunity to verify the correct application of procedures and to test the entire production and dissemination chain of VAA/VAG and SIGMET, and more specifically the QVA product, shortly before its transition to operational status. QVA products were made available through the Metgate_MF API and displayed on the modernised VAAC Toulouse website (<https://vaac.meteo.fr/>).

The results obtained from the QVA information were very encouraging. Nevertheless, it is important to recognise that forecasting volcanic ash clouds remains inherently complex, particularly for less intense eruptions.

Many active or potentially active volcanoes worldwide are not monitored by SVO's. In cases where no source-term description is provided by an SVO, delivering high-quality QVA products can be challenging. This underscores the need for improved satellite-based eruption detection and enhanced monitoring of potentially active volcanoes. It also highlights the value of accompanying QVA products with expert commentary, as provided in the "remarks" section of the VAA during this event.

A dedicated report on this eruption has been prepared.

VAAC Washington

Volcanic activity at Popocatepetl persisted throughout 2025, with several notable events resulting in ash transport extending nearly 500 nautical miles from the volcano. During these events, ash reached areas just south of the Mexico and United States border and with some ash events extending into the Gulf of Mexico.

Kilauea exhibited elevated levels of activity in 2025 compared to previous years. Multiple eruptive episodes produced emissions dominated by volcanic gases with minor ash content, with plume heights reaching above FL300. Lava fountain activity exceeded 1,000 feet above the vent during several events too. Over 37 eruptive events happened in 2025 and reported by the USGS.

VAAC Wellington

In 2025, VAAC Wellington issued 259 VAA, with 190 relating to Whakaari/White Island, located 26 nm north of New Zealand's Bay of Plenty coast. Frequent low-level ash emissions, generally below FL100, resulted in several events affecting a small area of the North Island and nearby aerodromes, supported by multiple reports from pilots and air traffic control. This level of activity made 2025 VAAC Wellington's busiest year since 2018.

Operational experience during the year also informed procedural development. In December 2025, pilot reports of volcanic ash from Whakaari/White Island were received in the absence of supporting satellite or webcam evidence. A VAA was issued acknowledging the PIREPs while noting the lack of corroborating observations. Subsequent discussions, including input from VAAC Darwin, have contributed to consideration of incorporating acknowledgement or 'NIL' VAAs into standard operating procedures.

2.7 VAAC collaboration

VAAC Anchorage

No Information added

VAAC Buenos Aires

VAAC Buenos Aires coordinated with VAAC Washington for two backup periods during scheduled technical upgrades to the VAAC Buenos Aires servers. During this period, forecasters used NWSChat2.0 Slack to maintain continuous communication and share operationally relevant information. In both instances, the application of backup arrangements was pre-coordinated within the respective VAAC managers.

VAAC Darwin

VAACs Darwin, Tokyo and Wellington have continued to conduct VAAC back-up tests in 2025. VAAC Darwin continues to collaborate on procedures between VAACs Wellington and Tokyo to align work between the three VAACs.

VAACs Darwin and Wellington continue to conduct 'shadow shifts' and there is the potential to start similar 'shadow shifts' with VAACs Darwin and Washington to better understand their area of responsibility for back-up purposes. These shadow shifts have proven to be beneficial to both VAACs as the forecasters are able to discuss procedures, tools, back-up processes etc.

VAAC London

VAACs London and Toulouse have been working closely together throughout the year with regards to technical and scientific QVA alignment, especially with data file formats, comms and other matters of consistency.

VAAC London acted as backup to VAAC Toulouse on a couple of occasions but without needing to send any VAA/VAG. We also held our regular backup test in July 2025, and a partial backup test near the end of the year for Toulouse to test systems. We also continue to work together on the annual Pan-European and North Atlantic VOLCEX exercises.

VAAC Montréal

VAAC Montréal acted as backup to VAAC Washington on 3 different occasions in 2025, issuing a couple of VAA in the process.

VAAC Montréal collaborated with colleagues at Natural Resources Canada on a study looking at volcano risk reduction in Canada.

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 VAACs Tokyo and Darwin was conducted on 26 June 2025.

VAAC Tokyo remotely attended a QVA operational meeting held by VAACs Washington and Anchorage from 24 - 26 September 2025. Meeting coverage included QVA handover, instruction on APIs, and actual situations for QVA issuance.

On 19 November 2025, a delegation of VAAC Tokyo representatives gave presentations on management reporting and the latest QVA development 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 Toulouse

VAAC Toulouse maintains close collaboration with VAAC London to harmonise volcanic ash cloud management. This includes aligning tools, data file formats, and API protocols to ensure consistency and interoperability across centres.

The two VAACs also organise joint backup exercises, which provide opportunities to test procedures, improve operational readiness, and ensure continuity in the event of real volcanic activity.

VAAC Washington

Multiple live and backup exercises were conducted between VAACs Washington, Darwin and Montreal to ensure seamless transfer of advisory responsibilities during potential operational outages. During technical testing with VAACs Darwin and Montreal, a critical issue affecting product dissemination to the OSPO/VAAC Washington webpage was identified, and targeted troubleshooting efforts were initiated with IT leads to ensure continued availability of VAA and VAG products during future live and backup exercise events.

Quarterly backup tests were successfully executed between VAACs Washington, Anchorage and Montreal to maintain regional operational readiness. In addition, several live backup exercises were conducted with VAACs Anchorage and Buenos Aires. VAAC Washington was designated as the official backup center for VAACs Anchorage, Buenos Aires, and Montreal.

VAAC Wellington

VAAC Wellington continued shadow-shift activities with VAAC Darwin, allowing forecasters to share knowledge, tools, and procedures, strengthening regional consistency and operational resilience.

This collaboration was reinforced during two brief software outages in 2025, when back-up support was requested from VAAC Darwin. In both instances, VAAC Wellington maintained full monitoring of its Area of Responsibility, with no active VAAs at the time.

The two VAACs also worked closely on developing shared workflows for QVA production, leveraging common tools to improve efficiency and alignment.

VAAC Wellington is planning to implement an enhanced learning management system to support staff development. VAAC Darwin has generously shared access to their online competency programme, providing a consistent foundation for training and professional development across both centres.

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

3.1 QVA Progress

Current progress and roadblocks/challenges towards progressing QVA.

VAAC Buenos Aires

VAAC Buenos Aires continued advancing the development of its QVA system based on the FALL3D model, in accordance with PANS-MET requirements and VAAC agreements regarding supplemental graphics.

VAAC Buenos Aires modellers actively participated in VAAC modelling meetings and in the QVA exercises conducted to ensure harmonised service implementation among VAACs.

The new visualisation and production toolkit was developed with the capability to incorporate and display QVA outputs. The operational implementation of this software capability is expected by mid-2026.

VAAC Darwin

VAAC Darwin is continuing with the updates and transition of the Dispersion Ensemble Prediction System (DEPS) for QVA in operations. The discussions with the forecasting software provider IBL for Visual Weather are underway. VAACs Darwin and Wellington have discussed the workflow required for QVA between the VAACs and then share a consolidated workflow to IBL for QVA development.

VW would be the tool used to generate the supplemental graphics. Full operational implementation is planned for November 2026.

VAAC London

We have now completed our QVA operational implementation roadmap and are now focussing on industry onboarding, ICAO documentation updates, VAAC best practices and ongoing/future technical upgrade work (such as the work done with the AG-VSA). This work is weighted heavily in current IAVW meeting workstreams, including Action 27/10 on processes on how to incrementally improve QVA going forward.

We are also heavily involved in shaping the new ICAO VACP (Volcanic Ash Contingency Plan) for Europe and North Atlantic, catalysed by our VOLCEX exercises, to incorporate QVA into the plan for wide industry use.

We also continue to be involved with various SVO workstreams (mainly with Iceland), including scientific and observational-based topics with the NAVHP (North Atlantic Volcanic Hazards Partnership), and implementing VONAs into the global transmission systems.

VAAC Montréal

Development of QVA got into high gear in 2025 with the scripts required to generate these forecasts coming to fruition in development mode. This progress allowed VAAC Montréal to participate in an intercomparison exercise with other VAACs in November 2025. The modelling results for the scenario

of a fictitious eruption of Meager were then compared and discussed amongst VAAC developers, with the intention of ensuring that VAACs generate QVA in the most consistent manner possible.

VAAC Tokyo

A major system update for QVA implementation is currently underway, with changes in data formatting and visualization based on discussions among VAAC developers. Forecasting workflows, handovers and backup procedures are also being considered with liaison among VAACs in preparation for the start of QVA operation.

VAAC Toulouse

Alongside previously mentioned QVA updates, a new API protocol (OGC EDR 3.0) will be implemented to ensure full compliance with amendment 82 to Annex 3.

VAAC Washington

QVA continued to be a primary focus, with ongoing development and enhancement of modelling capabilities, the development and introduction of an application programming interface (API), and efforts to educate forecasters on potential operational workflows. In addition, a QVA Concept of Operations (CONOPS) was initiated to document end-to-end processes and to identify the roles of the various groups involved in the production and dissemination of QVA concentration information.

VAAC Wellington

VAAC Wellington, in collaboration with VAAC Darwin, developed a proposal for VAAC Forecaster Workflow for QVA issuance, which was presented at the internal Volcanic Ash Workshop in May 2025 and received positively by staff.

Considerable effort has been invested in preparing modelling capabilities, including upgrading the HYSPLIT trigger interface for QVA readiness and participating in the global VAAC modellers group. Ongoing discussions with the tool provider, in partnership with VAAC Darwin, are shaping specifications to support QVA production. Full operational implementation is planned for November 2026.