



# **VAAC LONDON QUANTITATIVE VOLCANIC ASH (QVA) API USER GUIDE**

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**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

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## RECORD OF AMENDMENTS

AMENDMENTS		
No.	Date	Pages affected
1	21/07/2025	Original issue
2	10/11/2025	<ul style="list-style-type: none"><li>• Correction to thresholds for low description in table 1.</li><li>• Removal of disclaimer at the start of chapter 4.</li><li>• Addition of para 4.26 to describe alignment of metadata between the VAAC London and Toulouse data sets</li><li>• 4.27 removal of disclaimer.</li></ul>
3	08/01/2026	Update to section on Durable topics (5.11 onwards)
4	16/02/2026	<ul style="list-style-type: none"><li>• 4.24 URL used within payload responses for the gridded data sets changed</li><li>• New section added to chapter 5 (5.19 specifically) to give advice on how to connect to the notifications broker using Python.</li></ul>

# TABLE OF CONTENTS

<b>GLOSSARY .....</b>	<b>III</b>
<b>REFERENCE DOCUMENTS .....</b>	<b>IV</b>
<b>CHAPTER 1. INTRODUCTION TO THE VAAC LONDON QVA API .....</b>	<b>5</b>
BACKGROUND .....	5
INTERNATIONAL OVERSIGHT OF VAAC SERVICE PROVISION .....	5
ACCESS TO THE VAAC LONDON QVA API .....	7
API REGISTRATION .....	7
<b>CHAPTER 2. QVA FORECASTS .....</b>	<b>8</b>
INTRODUCTION .....	8
HOW ARE QVA FORECASTS CREATED .....	8
HOW CAN THE QVA DATA BE USED .....	11
WHAT WILL HAPPEN TO THE EXISTING VAA AND VAG? .....	11
<b>CHAPTER 3. API SPECIFICATION .....</b>	<b>12</b>
API CONFORMANCE .....	12
ACCESS AND AUTHENTICATION .....	12
SERVICE DESCRIPTION .....	12
<b>CHAPTER 4. USING THE QVA API .....</b>	<b>13</b>
GENERAL INFORMATION .....	13
GRIDDED DATA .....	13
QVA FEATURES/OBJECTS .....	17
RESTRICTIONS .....	17
DATA PAYLOADS .....	18
<b>CHAPTER 5. NOTIFICATIONS SERVICE .....</b>	<b>20</b>
GENERAL INFORMATION .....	20
TOPICS .....	20
NOTIFICATIONS MESSAGES .....	20
HEARTBEAT MESSAGE .....	21
DURABLE TOPIC SUBSCRIPTIONS AND MESSAGE RETENTION .....	22
SPECIFIC GUIDANCE FOR CONNECTING TO THE NOTIFICATIONS BROKER USING THE PYTHON QPID PROTON PYTHON CLIENT .....	23
<b>CHAPTER 6. VISUALIZING QVA DATA .....</b>	<b>26</b>
INTRODUCTION .....	26
GRIDDED DATA VISUALISATION .....	26
<b>CHAPTER 7. SUPPORT AND BACKUP .....</b>	<b>30</b>
SUPPORT .....	30
BACKUP .....	30

# Glossary

## ABBREVIATIONS AND TERMS

Annex 3	Refers to ICAO Annex 3 – <i>Meteorological Service for Air Navigation</i>
AMQP	Advanced Message Queuing Protocol – the protocol used by the notifications part of the service.
API	Application Programming Interface
FL	Flight level
IAVW	International Airways Volcano Watch
ICAO	International Civil Aviation Organization
IWXXM	ICAO Meteorological Information Exchange Model
METP	Meteorological Panel (ICAO)
NAME	The dispersion model used by VAAC London
NetCDF	Network Common Data Form is a file format for storing multidimensional scientific data
OCG-EDR	Open Geospatial Consortium - Environmental Data Retrieval (technical framework used by the API).
PANS-MET	Refers to ICAO Doc 10157, <i>Procedures for Air Navigation Services - Meteorology</i>
QVA	Quantitative Volcanic Ash
SWIM	System Wide Information Management
URL	Uniform Resource Locator, is a web address that specifies the location of a resource on the internet
UTC	Co-ordinated Universal Time
VAA	Volcanic Ash Advisory
VAAC	Volcanic ash advisory centre
VAG	Volcanic Ash Graphic
WG-MOG	Meteorological Operations Group (reporting to METP)
WMO	World Meteorological Organization

## Reference documents

- ICAO Annex 3      *Meteorological Service for International Air Navigation*
- Doc 10157      *Procedures for Air Navigation Services – Meteorology (PANS-MET) from Nov 2025*
- Doc 9766      *Handbook on the IAVW*
- Doc 9855      *Guidelines on the Use of the Public Internet for Aeronautical Applications*
- Doc 10003      *Manual on the ICAO Meteorological Information Exchange Model.*

### **Air Navigation Plans**

- Doc 7754      *Air Navigation Plan — European Region*
- Doc 7474      *Air Navigation Plan — Africa-Indian Ocean Region*
- Doc 8733      *Air Navigation Plan — Caribbean and South American Regions*
- Doc 8755      *Air Navigation Plan — North Atlantic, North American and Pacific Regions*
- Doc 9634      *Air Navigation Plan — North Atlantic Region*
- Doc 9673      *Air Navigation Plan — Asia and Pacific Regions*
- Doc 9708      *Air Navigation Plan — Middle East Region*
-

# Chapter 1. INTRODUCTION TO THE VAAC LONDON QVA API

## Background

1.1. Volcanic ash clouds in the atmosphere pose a risk to aviation if the ash is ingested into engines causing long term engine damage or in extreme cases engine malfunction. In turbofan engines temperatures can exceed the melting point of silica rich ash leading to engine surging and flame outs. The abrasive effect of volcanic ash particles can also damage engines, as well as damage the outer skin of the aircraft and windscreen. The traditional volcanic ash advisory forecasts (VAA) simply highlight areas where “discernable ash” is present, i.e. from satellite imagery which equates to a concentration around 0.2mg/m<sup>3</sup> work out advances in volcanic ash modelling.

1.2. Quantitative Volcanic Ash (QVA) forecasts provide higher resolution information on the location of ash in the atmosphere than the traditional VAA. QVA also offers operators the opportunity to move away from traditional discernible/visible ash criteria and instead use certified engine susceptibility volcanic ash concentrations for flight route planning and inflight replanning. Operators with approval and procedures/practices will be able to use QVA information to fly more efficient routes while maintaining safety in accordance with their safety management program.

1.3. As part of its responsibilities as the London Volcanic Ash Advisory Centre (VAAC) the [Met Office](#) is required to provide services related to volcanic ash as defined in ICAO Annex 3 - *Meteorological Service for International Air Navigation*<sup>1</sup>, and from November 2025 ICAO Doc 10157 *Procedures for Air Navigation Services – Meteorology (PANS-MET)*<sup>2</sup>.

1.4. The recommendation to provide QVA Forecasts is introduced with Amendment 82 to Annex 3, applicable November 2025.

1.5. The purpose of this *User Guide* is to give an overview of the available QVA data and to provide information on using the VAAC London QVA. It is intended to complement the information provided within the API specification itself and technical manuals which will accompany the individual software that is provided by third parties to interact with and visualise data which is downloaded.

1.6. This *User Guide* is published on the Met Office website <https://www.metoffice.gov.uk/services/transport/aviation/regulated/international-aviation/vaac/qva/qva-api>. The guide will be reviewed annually and updated when changes are made to the system or data provided. Additional information on VAAC London QVA forecasts is available on the Met Office QVA webpages <https://www.metoffice.gov.uk/services/transport/aviation/regulated/international-aviation/vaac/qva/index>.

## International oversight of VAAC service provision

1.7. The London VAAC is one of 9 VAACs worldwide, designated by the International Civil Aviation Organization. Each VAAC has specialist forecasters who produce volcanic ash advisories and guidance products using a combination of volcano data; satellite-based, ground-based and aircraft observations; weather forecast models and dispersion models.

1.8. Volcanic ash forecasts are provided to the standards and set by ICAO in Annex and the PANS-MET when a volcanic eruption emits ash into the atmosphere. This includes the VAA and VAG products.

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<sup>1</sup> ‘Annex 3’ hereafter

<sup>2</sup> ‘PANS-MET’ hereafter

1.9. The area of responsibility of each VAAC is shown in figure 1. VAAC London is responsible for issuing advisories for volcanic eruptions originating in Iceland and the north-eastern corner of the North Atlantic. VAAC London provides backup for VAAC Toulouse and vice versa.

1.10. The ICAO Meteorological Panel (METP) – through its Meteorological Operations working Group (WG-MOG) meets annually to oversee the work of the VAACs to ensure that the forecasts provided meets the needs of the aviation industry. It will act on behalf of users to address complaints and any difficulties which have not been resolved through normal day to day operational oversight by the VAAC's. This group also develops and defines new service requirements.

1.11. Each VAAC is responsible for the provision of QVA data through its own System Wide Information Management (SWIM) API, and the VAACs have agreed to use the same framework and approach that the VAAC London QVA API uses. To get full global QVA forecast coverage users will need to connect to 8 different API's (note data for VAAC Washington and VAAC Anchorage will be via a single API service)

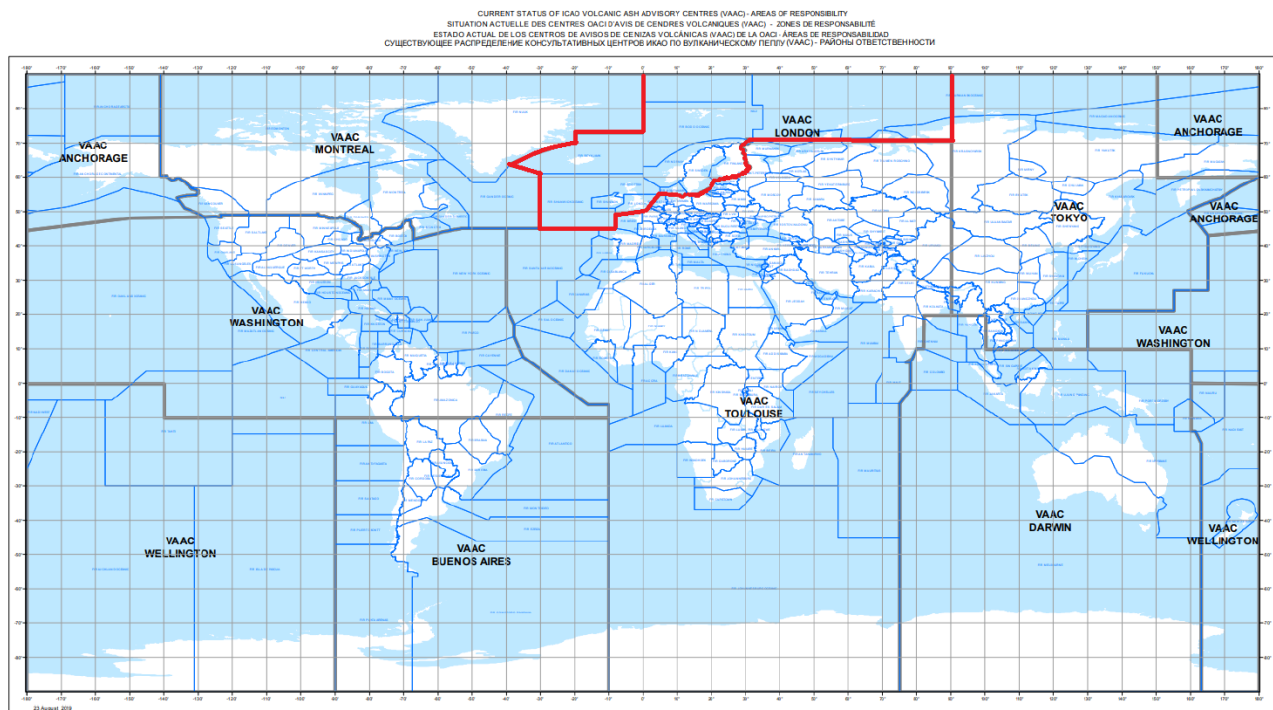


Figure 1 – Volcanic Ash Advisory Centre areas of responsibility. The VAAC London area of responsibility is outlined in red.

## Access to the VAAC London QVA API

- 1.12. Authorized access to the VAAC London QVA API will be granted if the Met Office is satisfied that the user organisation provides services to the aviation industry. This includes airlines, air navigation service providers, flight planning providers, providers of systems visualizing aviation meteorological data, and national meteorological services.
- 1.13. If your organization has rights under ICAO Annex 3, Chapter 2 for the provision of meteorological services to operators, flight crew, air traffic service units, airport management and others concerned with the conduct of international air navigation the data available on the VAAC London QVA API may be shared to third parties in your area of responsibility. If this is the case, the Met Office should be notified (this is purely so we can assess the global benefit that our forecast data has).
- 1.14. Without the rights described in paragraph 1.13. the data held on the VAAC London QVA API should not be retransmitted or redistributed outside of your organization in their original form.
- 1.15. Data from the VAAC London QVA API should be downloaded to a central server in your organization before cascading to individual workstations or devices. A fair use policy is in place, with an upper daily cap to the number of downloads that can be made, and API usage will be monitored to ensure this is adhered to.
- 1.16. The VAAC London QVA API is free to use and will be permitted as long as the API user terms and conditions are adhered to.

## API registration

- 1.18. To use the API, a registration process needs to be completed. This consists of the following:
- Completion of a registration form
  - Agreeing to a set of VAAC London QVA API user terms and conditions which are available to view here: <https://www.metoffice.gov.uk/policies/aviation/qva/qva-terms-and-conditions>
  - Onboarding to the Met Office API management system (to get an authentication key so that the API can be accessed). Instructions on this process will be sent to you separately once the previous two steps have been completed.
- 1.19. The registration process can be instigated by e-mailing [QVA@metoffice.gov.uk](mailto:QVA@metoffice.gov.uk)

## Chapter 2. QVA FORECASTS

### Introduction

2.1. Quantitative Volcanic Ash (QVA) forecasts provide higher resolution information on the location of ash in the atmosphere than the traditional volcanic ash advisory (VAA) products and unlike the VAA, also include ash concentration information (how much ash). QVA also offers operators the opportunity to move away from the traditional 'discernible ash'- based criteria for avoiding ash and instead use certified engine susceptibility volcanic ash exposure thresholds for flight route planning and inflight replanning. Operators with approval and procedures/practices will be able to use QVA information to fly more efficient routes while maintaining safety in accordance with their safety management program.

2.2. The QVA information service comprises of three data sets:

- The expected ash concentration as a gridded data set.
- The probability of the ash exceeding four different concentration thresholds (0.2mg/m<sup>3</sup>, 2mg/m<sup>3</sup>, 5mg/m<sup>3</sup> and 10mg/m<sup>3</sup>) as a gridded data set.
- Features/objects, in IWXXM format, that show the expected ash areas for where ash exceeding the four concentration thresholds (0.2mg/m<sup>3</sup>, 2mg/m<sup>3</sup>, 5mg/m<sup>3</sup> and 10mg/m<sup>3</sup>) is expected to occur.

2.3. The gridded data sets will be provided for twelve vertical slices of the atmosphere between the ground and 60,000ft (Flight level 600), each 5000ft thick. The IWXXM objects represent a subset of the gridded data with each spanning the minimum to maximum height for a given threshold. All the data sets will be provided covering the period from T+0 hour to T+24 hours at 3-hourly intervals from the time they are issued and will be updated every 6 hours while a significant ash cloud remains.

### How are QVA Forecasts created

2.1. London VAAC forecasts are generated using an atmospheric transport and dispersion model called [NAME](#). The model represents the expected behaviour of the volcanic ash cloud, the direction and speed of travel as well as processes which act to remove volcanic ash from the atmosphere: through precipitation, sedimentation (falling out through gravity) and interaction with the Earth's surface.

2.2. NAME is driven by 4D meteorological fields, the weather forecast. The weather forecast is generated from the Global configuration of the [Unified Model](#), Numerical Weather Prediction (NWP) model. The NAME simulations are initialized with a set of information which describes the release of ash into the atmosphere, these are referred to as Eruption Source Parameters and include the location and height of the release, how much ash is being released, timings of the event and the physical characteristics of the particles. Every step is underpinned by observations.

2.3. The Eruption Source Parameters are difficult to measure, but information can be provided by state volcano observatories. For the VAAC London area of responsibility this function is carried out by the Icelandic Meteorological Office who are experts at monitoring their volcanoes.

2.4. Once the NAME simulation is complete, a deterministic (i.e. most likely) ash concentration is calculated for each model grid box.

2.5. The VAAC London forecasters then compare this output to observations, namely satellite imagery and discrepancies are adjusted for. If necessary, the model is re-run prior to publication with adjusted settings to create an output that aligns more closely with the latest observations.

2.6. The forecast data gives the exact ash concentration values for each grid box, but ICAO have also agreed descriptive terms that can be used when displaying the data. These were formulated by ICAO's Meteorology Panel in coordination with the International Coordinating Council of Aerospace Industries Associations (ICCAIA). The units for the ash concentration thresholds and ranges are in milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ).

2.7. These descriptive terms are shown in table 1, whilst figure 2 shows what a deterministic ash forecast could look like for an erupting volcano in Iceland using these thresholds.

Descriptor	Concentration thresholds and range
Very high	$> 10 \text{ mg}/\text{m}^3$
High	$> 5 \text{ and } < 10 \text{ mg}/\text{m}^3$
Medium	$> 2 \text{ and } < 5 \text{ mg}/\text{m}^3$
Low	$> 0.2 \text{ and } < 2 \text{ mg}/\text{m}^3$
Very low	$< 0.2 \text{ mg}/\text{m}^3$

Table 1 – Ash concentration descriptors

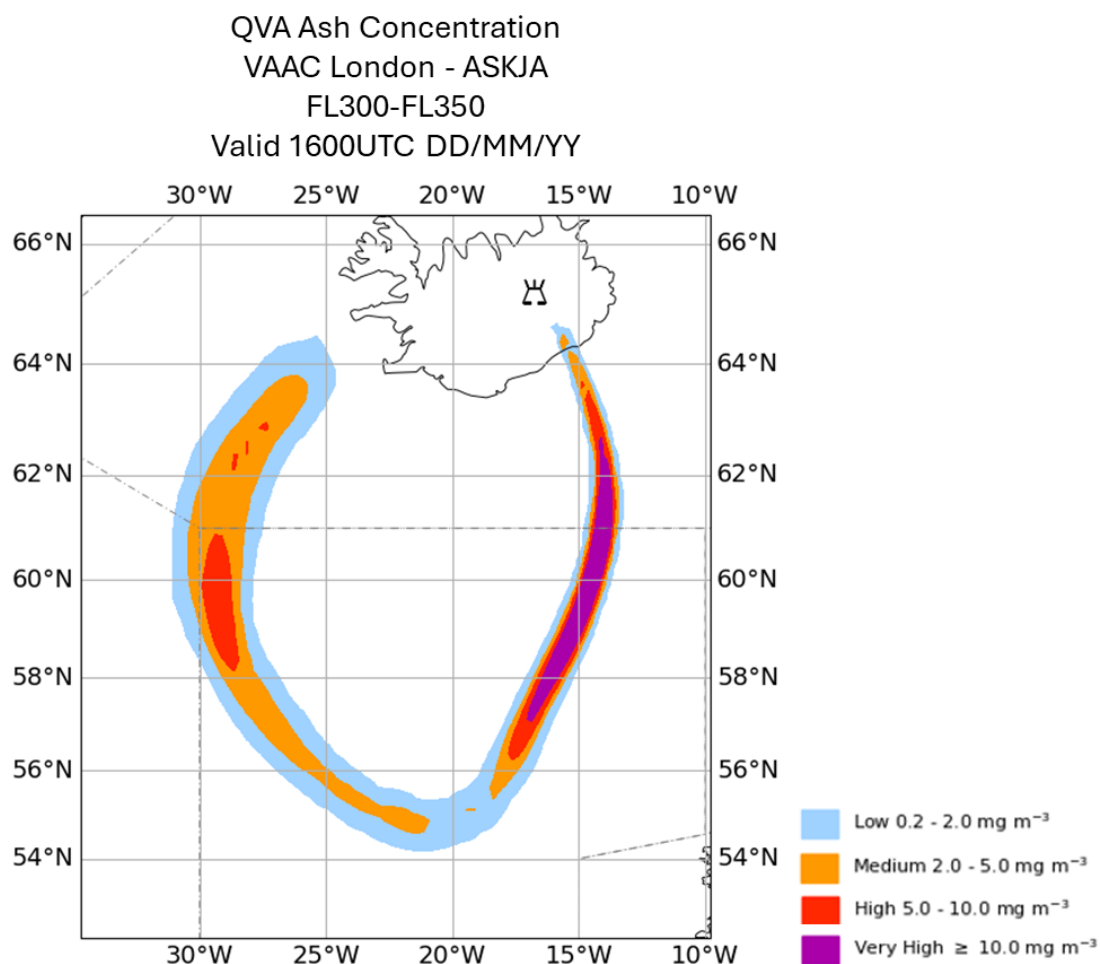


Figure 2 – example deterministic ash plume coming from a volcano erupting in Iceland

2.8. In addition to the deterministic forecast, a probabilistic ash forecast is created. An approach called [Ensemble Meteorology](#) is used to represent uncertainty in the perturbations used to initialize NWP models, from which a range of weather scenarios are presented. At the Met Office an 18-member ensemble called [MOGREPS-G](#) is used to provide global probabilistic weather forecasts. NAME is run with Ensemble Meteorology to generate probabilistic volcanic ash forecasts for the London VAAC, these represent the uncertainty associated with the weather forecast. A probability of 100% means that every weather scenario results in a forecast which predicts that the ash concentration will exceed the prescribed threshold, and a 50% probability means that half of the scenarios predict that the concentration threshold will be exceeded.

2.9. The probabilistic QVA forecast is calculated for four different concentration thresholds:  $0.2\text{mg}/\text{m}^3$ ,  $2\text{mg}/\text{m}^3$ ,  $5\text{mg}/\text{m}^3$  and  $10\text{mg}/\text{m}^3$ .

2.10. Figure 3 shows example probabilistic output for one of the concentration thresholds

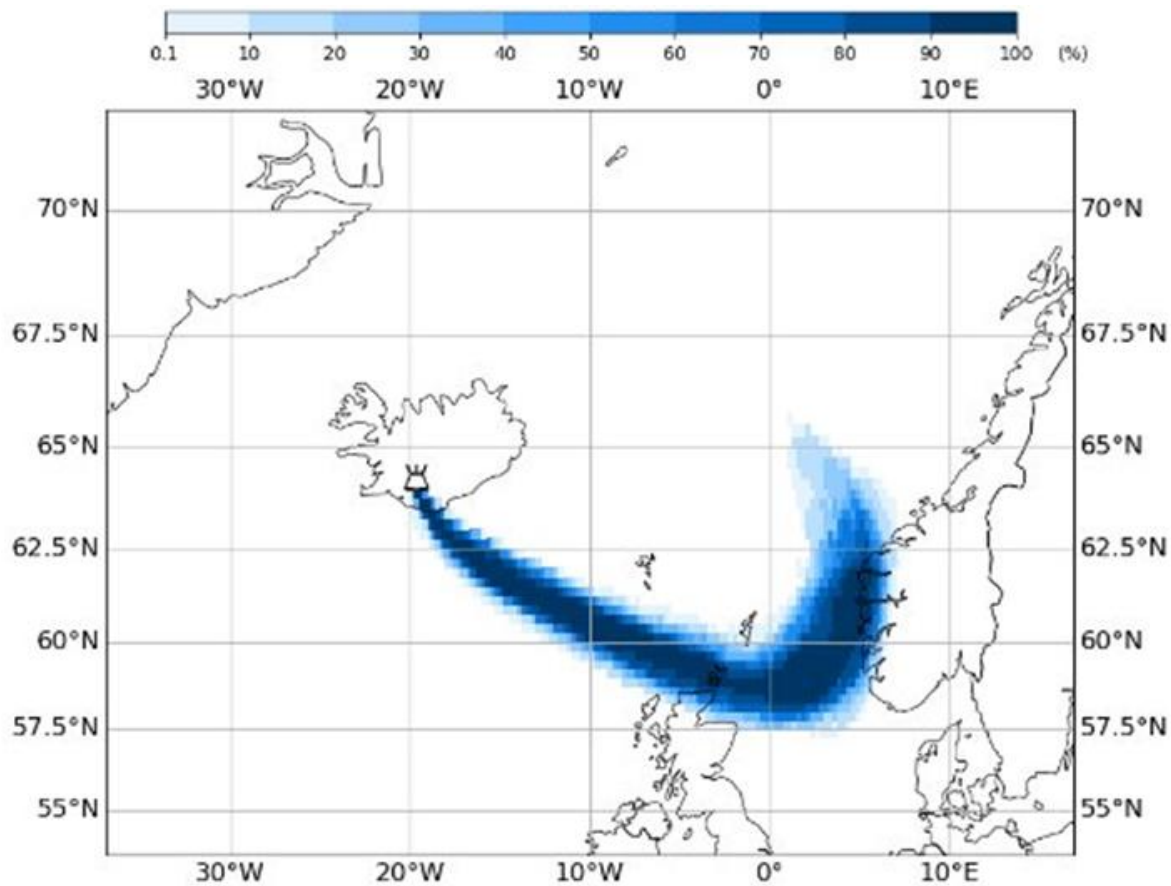


Figure 3 – example probabilistic ash forecast, for the  $0.2\text{mg}/\text{m}^3$  threshold. The darker the blue colour, the higher the probability of the specific ash threshold being exceeded

2.11. Both the deterministic and the probabilistic data sets can be used in the decision-making process. For the probabilistic data actions taken can depend on both the concentration threshold being considered and the probability. For example, if the probability of exceeding  $5\text{mg}/\text{m}^3$  is  $\geq 30\%$  we will take action A, but if the probability is 20% we will take action B. Examination of the data for different ash concentration thresholds, the vertical levels and forecast timesteps will help users to determine how a flight could be re-routed to reduce the concentration of ash an aircraft is likely to encounter.

2.12. In addition to the gridded data, an additional type of QVA forecast data is provided. VAAC London takes the deterministic data and processes it to turn it into sets of polygons for four different thresholds, each with base and top attributes. Once visualized these enable the location of ash to be quickly assessed by pilot in a style users of WAFC SIGWX charts are familiar with. Further information is provided in chapter 6 of this user guide.

### **How can the QVA data be used**

2.13. The VAA forecasts that have been provided for many years give very simplified information on where volcanic ash is expected. They contain coordinates for a simple polygon that marks where “discernable ash” occurs. “Discernable Ash” broadly equates to a concentration of  $0.2\text{mg}/\text{m}^3$  which is the lower limit of ash that can be detected on satellite imagery. The VAA also contains information on the upper and lower boundary of this polygon.

2.14. With 12 vertical levels, and a horizontal resolution of 0.25 degrees of latitude and longitude the QVA data provides much more detailed information on the location of volcanic ash. Visualizing the data allows users to examine how the ash concentration varies in the vertical and identify a better flight level to traverse the area.

2.15. The probabilistic data allows a risk-based approach to be taken by operators. For example, if an ash concentration greater than  $2\text{mg}/\text{m}^3$  is forecast with more than a specific probability then different actions could be taken if there is less than say 30% chance of it occurring compared to a greater than 30% chance of it occurring. These actions are for operators to determine in conjunction with their regulators, and VAAC London cannot advise on this.

2.16. “Ash dose” that an aircraft engine has been subjected to could also be calculated for a flight that traverses through an area of ash. This could then, with the guidance of the aircraft engine manufacturer, be matched to specific engine maintenance activities that should take place when a specific cumulative ash dosage is reached.

### **What will happen to the existing VAA and VAG?**

2.17. The existing VAAs and VAGs issued by the VAACs will continue to be produced alongside the new QVA forecasts and will be published via the existing routes (SADIS, WIFS and over the Aeronautical Fixed System). The traditional alphanumeric version of the VAA is expected to be retired in November 2030 (subject to ICAO Air Navigation Commission approval), but the IWXXM version will continue to be provided beyond that date (a final end date has not yet been determined).

2.18. The VAA and VAG will not be published on the VAAC London QVA API, they will continue to be provided via the AFS, SADIS and WIFS.

## Chapter 3. API SPECIFICATION

### API Conformance

3.1. In accordance with the ICAO Global Air Navigation Plan (GANP) (Doc 9750) <https://www4.icao.int/ganpportal/> the VAAC London QVA API has been built in accordance with the System Wide Information Management (SWIM) requirements. SWIM consists of Standards, Infrastructure and Governance, enabling the management of Air Navigation Services related information and its exchange between qualified parties via interoperable services.

3.2. The VAAC London QVA API is provided in accordance with UK SWIM policy and standards and the Met Office will seek compliance sign off in due course. The API also conforms to the EUROCONTROL SWIM 'Yellow Profile' technical specification <https://www.eurocontrol.int/publication/eurocontrol-specification-swim-technical-infrastructure-ti-yellow-profile> and uses the Open Geospatial Consortium (OGC) Environmental Data Retrieval (EDR) API framework <https://ogcapi.ogc.org/edr/>.

### Access and Authentication

3.3. When access to the VAAC London QVA API is granted, users will be provided with information on how to sign up for the Met Office API developer portal. This will include application names for you to use (this will be set by the Met Office).

3.4. If you already have signed up to the developer portal (for example you are a SADIS user) you can use the same account. If not, consideration should be given as to who manages the API registration for your organisation so that you don't lose access to the developer portal should someone leave. Please note that during the registration process there will be a step in which you have 30 minutes in which to enter a verification code, so if you have a high degree of latency in your e-mail system this may not leave you much time.

3.5. Where possible registrations should be made with an organizational e-mail address.

3.6. OAuth2 tokens are used for authentication and are valid for 60 minutes, after which a new token is required. Users are advised to set up an automated process to run that refreshes the token just prior to them expiring.

3.7. During the token transition, if there is a request in-flight using the old token this may fail, so re-try logic should be applied.

3.8. Only one token per API is valid at any given time. If more than one token is required (for example during setup and testing when multiple systems may be requesting data) then additional subscriptions can be set up. If you wish to do this, please contact [QVA@metoffice.gov.uk](mailto:QVA@metoffice.gov.uk) to request it.

### Service Description

3.1. The VAAC London QVA API comprises of two API endpoints where data can be accessed:

- VAAC London QVA Gridded Data API
- VAAC London QVA Products API

3.2. To accompany these, and due to the infrequent nature of volcanic eruptions in the VAAC London area of responsibility, a notifications service provides machine-to-machine notifications via AMQP protocol to inform you when new data is ready for collection.

## Chapter 4. Using the QVA API

### General Information

4.1. Two APIs are available:

- <https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0> is the API root endpoint for the gridded deterministic and probabilistic data sets.
- <https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0> is the API root endpoint for the objects/features.

4.2. These are the `{baseUrl}`. These API root endpoints will give you general information about the API in JSON format, plus links to the other metadata files and specific collections that are available.

4.3. General information/metadata on the API endpoints in JSON format can be found using the following resource paths:

- `{baseUrl}/api` gives general information on the API specification
- `{baseUrl}/conformance` gives information on the specification that the API conforms to

`{baseUrl}/collections` gives information on the collections available

4.4. QVA forecast data sets are either:

- **OPERATIONAL** - the data relates to a real volcanic eruption and therefore data can be used operationally.
- **EXERCISE** - the data relates to a formal volcanic ash exercise that is taking place. There is a VOLCICE exercise on the second Tuesday of each month (if no real eruption is taking place).
- **TEST** - the data relates to non-operational data. Given the sporadic nature of volcanic eruptions in Iceland, the API will publish test data twice daily to allow you to test downstream processes and services. Please be aware that test data sets may not always contain the probabilistic data sets and may on occasion contain more than 24 hours' worth of data. Once your systems are set up, please set your systems to ignore test data.

4.5. During a real eruption, exercise and test data is suspended.

### Gridded data

4.4. In accordance with the OGC-EDR API framework the QVA gridded data is organized into a series of collections. The QVA gridded API has two collections available. The `{collectionId}` are:

- `qva_deterministic`
- `qva_probabilistic`

4.5. A request for <https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/{collectionId}> will return information on that specific collection if forecast data has been published. For example, [https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/qva\\_deterministic](https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/qva_deterministic) will return information on the available deterministic QVA data.

4.6. Key information contained within these response messages is described below:

- The type of data (OPERATIONAL, TEST or EXERCISE) is indicated in the `/collections` and `/collections/{collectionId}` API endpoints' metadata under the `description` and `keywords` fields.
- If data relates to a real, live volcanic eruption, only OPERATIONAL data will be published and any TEST or EXERCISE data in the system will be removed to avoid ambiguity.

```
"id": "qva_probabilistic",
"title": "qva_probabilistic",
"description": "OPERATIONAL - This collection forecasts the likelihood of
ash concentration exceeding four set thresholds in mg/m3: 0.2, 2.0, 5.0 and
10.0. It includes four separate datasets (one per threshold).",
"keywords": [
  "QVA",
  "Volcanic Ash",
  "Probabilistic",
  "OPERATIONAL"
```

- The response will indicate what the validity times are for the available data set. In this example, nine forecast timesteps between 06/02/25 1000Z and 07/02/25 1000Z at 3-hour intervals:

```
"temporal": {
  "interval": [
    [
      "2025-02-06T10:00:00Z",
      "2025-02-07T10:00:00Z"
    ]
  ],
  "values": [
    "2025-02-06T10:00:00Z",
    "2025-02-06T13:00:00Z",
    "2025-02-06T16:00:00Z",
    "2025-02-06T19:00:00Z",
    "2025-02-06T22:00:00Z",
    "2025-02-07T01:00:00Z",
    "2025-02-07T04:00:00Z",
    "2025-02-07T07:00:00Z",
    "2025-02-07T10:00:00Z"
  ]
},
```

If data for more than one volcano has been published, then the combined set of timesteps will appear in the “values” list. For example, if the same time appears in both volcanoes, it will appear once in the list. All timesteps will be present, which means the total time may exceed 24 hours to account for differing start times for each volcano.

- The response will indicate which vertical levels are available (there are always twelve vertical levels for the gridded data) displayed as ranges in 5,000ft atmospheric thick slices:

```
"vertical": {
  "interval": [
    [
      "0_50",
      "550_600"
    ]
  ],
  "values": [
    "0_50",
    "50_100",
    "100_150",
    "150_200",
    "200_250",
    "250_300",
    "300_350",
    "350_400",
    "400_450",
    "450_500",
    "500_550",
    "550_600"
  ]
}
```

- The response will indicate which volcano or volcanoes there is data for. In this example, the volcano\_id is "373050" ([Kverkfjoll](#) in Iceland):

```
"parameter_names": {
  "373050": {
    "type": "Parameter",
    "id": "373050",
    "label": "volcano_id",
  }
}
```

4.7. A request for [https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva\\_deterministic](https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva_deterministic) or [https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva\\_probabilistic](https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva_probabilistic) will only return information on the data that is available within those collections if QVA forecast data has been issued. If there is no published data, an HTTP 404 response code will be returned instead.

4.8. Within each of these collections data is organised by locations. This enables the system to publish data for multiple erupting volcanoes at the same time. As many volcano names are complicated and there can be ambiguity over the name and location, the QVA forecast data is classified by its volcano number. Every active volcano has an allocated number, which is defined in the Smithsonian volcano database [https://volcano.si.edu/faq/gvp\\_vnums.cfm](https://volcano.si.edu/faq/gvp_vnums.cfm).

4.9. A request for <https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/{collectionId}/locations> will return information on the specific data held in that collection. The response contains “properties” information which includes the validity time of the forecast information (“datetime”) the volcano number (“id”) and a link to the full endpoint to retrieve the data itself.

```

    "properties": {
      "datetime": "2025-03-11T09:00:00Z/2025-03-12T09:00:00Z",
      "parameter-name": [
        "volcanic ash air concentration"
      ],
      "label": "volcano_id",
      "edrqueryendpoint": "https://gateway.api-
management.metoffice.cloud/vaac-london-qva-gridded-
data/1.0/collections/qva_deterministic/locations/370010"
    },
    "id": "370010"
  
```

4.10. A request for <https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/{collectionId}/locations/{locationId}> using the volcano number (“id”) in the {locationId} will return data for that specific erupting volcano. The gridded data will be provided as a NetCDF file containing all available forecast levels and timesteps.

A full request might look like this for probabilistic QVA data for Hekla (volcano number 372070) [https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva\\_probabilistic/locations/372070](https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva_probabilistic/locations/372070).

4.11. The probabilistic QVA data contains data for four different concentration thresholds, and it is possible to use the `parameter-name` query parameter for filtering which of these are downloaded.

- Using `?parameter-name=0.2` after the {locationId} would return just the  $\geq 0.2$  mg/m<sup>3</sup> concentration threshold data. The other threshold values of 2.0, 5.0 and 10.0 could be used instead of 0.2.  
For example, [https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva\\_probabilistic/locations/372070?parameter-name=0.2](https://gateway.api-management.metoffice.cloud/vaac-london-qva-gridded-data/1.0/collections/qva_probabilistic/locations/372070?parameter-name=0.2)
- To request data for two or three concentration thresholds then they can be listed separated by a comma. For example, `?parameter-name=0.2,2.0,5.0`
- Omitting the `parameter-name` query parameter all together will return you the data for all four concentration thresholds.

4.12. It is also possible to request data for specific forecast time periods by using the `datetime` query parameter. To do this, information on the available timesteps needs to be obtained first from the metadata from a specific collection (see paragraph 4.9).

- Data for an individual forecast timestep can be obtained by appending this type of query after the volcano number:  
`?datetime=2025-02-06T10:00:00Z`
- Data for a range of forecast timesteps (bounded interval) can be obtained by appending this type of query after the volcano number:  
`?datetime=2025-02-06T10:00:00Z/2025-02-06T19:00:00Z`

- Data for a half-bounded interval can be obtained by appending one of these types of requests after the volcano number:

```
?datetime=2025-02-07T01:00:00Z/.. (data from)
```

```
?datetime=../2025-02-07T01:00:00Z (data up to)
```

- Omitting the `datetime` query parameter entirely will return all nine forecast timesteps.

4.13. It is possible to use both `parameter-name` and `datetime` query parameters simultaneously. For example:

```
?parameter-name=0.2&datetime=2025-02-06T10:00:00Z
```

## QVA Features/Objects

4.15. The <https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0> API endpoint contains the QVA IWXXM format forecast data. There is only a single `{collectionId}` which is `qvaci_iwxxm`.

4.16. [https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0/collections/qvaci\\_iwxxm](https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0/collections/qvaci_iwxxm) will return metadata about the data available this collection and the structure [https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0/collections/qvaci\\_iwxxm/locations/{locationId}](https://gateway.api-management.metoffice.cloud/vaac-london-qva-products/1.0/collections/qvaci_iwxxm/locations/{locationId}) is applied in the same way as for the gridded collections. Filtering using the `datetime` query parameter can be used, but `parameter-name` filtering is not available.

## Restrictions

4.18. A limitation on the number of requests that can be made by a user is being imposed to protect the system from unreasonable downloading practices.

- The VAAC\_London\_QVA\_Gridded\_Data API is limited to **1500** individual requests per day.
- The VAAC\_London\_QVA\_Products API is limited to **500** individual requests per day.

4.19. It is possible to download all data published for an individual volcano by making only four requests:

- One request to find out the volcano number from the collections information
- One request for all deterministic gridded data
- One request for all probabilistic gridded data
- One request for all IWXXM data

4.20. During a normal eruption the forecast information is updated at 6-hourly intervals, so the rate limitations given in 4.18 are more than sufficient to cover multiple erupting volcanoes each day even if every timestep and threshold is individually requested.

4.21. The VAAC London QVA manager will monitor the number and volume of downloads made to ensure that the system is operating effectively.

## Data Payloads

4.23. A successful response will return a “302 Found” response with a “Location” header which provides a unique URL which can be used to access the requested data set. This URL is valid for a 1-hour period only. When following the redirect URL, you will get a 200 response and the requested gridded data, which you can save as a netCDF (.nc) file in your systems.

4.24. The data payloads will be available from the following base URLs:

- VAAC London QVA Products API: <https://objects.aviation-gridded-data.api.metoffice.gov.uk>
- VAAC London QVA Gridded Data API: <https://objects.qva-gridded-ads.api.metoffice.gov.uk>

4.25. The downloaded gridded data file will contain a series of individual netCDF files, one after the other, which encompass all the levels, timesteps and for probabilistic thresholds chosen for that request.

4.26. VAAC London and VAAC Toulouse have tried to align their NetCDF files as much as possible. One known difference is the order in which the forecast variables are listed within the file, but the files themselves contains metadata that specifies the order that is used.

4.27. The downloaded IWXXM data (.xml) will return all the information within a single file. This will adhere to the schema IWXXM Schematrons published here: <https://schemas.wmo.int/iwxxm/>

4.28. Data in this collection is returned in IWXXM format, with the IWXXM collect schema used to group the selected forecast timesteps into a single output file.

4.29. The size of downloaded data files varies with the different parameter types. Typical file sizes for the global tiles are shown in table 2.

Collection	Typical size (for all timesteps)
Deterministic QVA	2.7 MB
Probabilistic QVA (1 threshold)	2.7 MB
Probabilistic QVA (all thresholds)	9.5 MB
IWXXM features/objects	0.1MB

Table 2 – typical downloaded file sizes

4.30. If your request is unsuccessful, one of the following response types will be returned:

<b>400 Bad Request</b>	<p>The server cannot or will not process the request due to an apparent client error. For example, a query parameter had an incorrect value. This could include:</p> <ul style="list-style-type: none"> <li>• An invalid value was used for the <code>parameter-name</code> query parameter.</li> <li>• An invalid value was used for the <code>datetime</code> query parameter e.g. requesting data for a validity period that isn't present in the collection.</li> </ul>
------------------------	---

<b>401 Unauthorized</b>	Valid security credentials were not provided by the client, or the token has expired.
<b>403 Forbidden</b>	The client is not authorised to perform the requested operation on the resource.
<b>404 Not Found</b>	<p>The requested resource does not exist on the server. For example, a path parameter had an incorrect value. It may also occur if there is no published data in a collection and the collection metadata is requested.</p> <p>The client has entered an invalid URL, invalid collection name or location ID.</p> <p>The client may be attempting to access a resource that has not yet been published.</p>
<b>500 Internal Server 502 Bad Gateway 504 Gateway Timeout</b>	Unexpected server error, please retry.

Table 3 – Response message types when query is invalid in some way.

## Chapter 5. Notifications service

### General Information

5.1. As eruptions in the VAAC London area of responsibility are irregular, a notifications service is provided that will publish a message to the topics that make up the service whenever new data sets are published on the API.

5.2. The ActiveMQ message broker is available here:

<amqps://aviation-notifications.service.metoffice.gov.uk>

5.3. The QVA Service manager will provide users with a username and password so the broker can be accessed. Users will also be given a unique “ClientID” to use.

### Topics

5.4. Four topics are available

- [MO.VAAC.London.QVA.1-0/collections](#)
- [MO.VAAC.London.QVA.1-0/collections/qva\\_deterministic](#)
- [MO.VAAC.London.QVA.1-0/collections/qva\\_probabilistic](#)
- [MO.VAAC.London.QVA.1-0/collections/qvaci\\_iwxxm](#)

5.5. When setting up your connection you may need to put “topic” in front of these names e.g. [topic://MO.VAAC.London.QVA.1-0/collections/qvaci\\_iwxxm](#)

5.6. There is one topic for each of the three different data types, and then the [MO.VAAC.London.QVA.1-0/collections](#) topic will publish a message there is new information related to any of the other three QVA collections. Normal QVA data production will result in new deterministic, probabilistic and IWXXM data.

5.7. It is not necessary to subscribe to all four topics. Normal routine data issue will involve in new data for the deterministic, probabilistic and IWXXM collections being simultaneously made available.

### Notifications messages

5.8. The Notification message contains the information on the volcano name, volcano number, publish time and the data (event) type.

- **OPERATIONAL** means the data relates to a real volcanic eruption and therefore data can be used operationally.
- **EXERCISE** means the data relates to a formal volcanic ash exercise that is taking place. There is a VOLCICE exercise on the second Tuesday of each month (if no real eruption is taking place).
- **TEST** means the data relates to non-operational data. Given the sporadic nature of volcanic eruptions in Iceland at present, test data will be published regularly, at least in the first year, to allow users to test downstream processes and services.

5.9. An example notification message for the qva\_deterministic topic is shown below.

```
{
  "id": "740e5834-3a29-46b4-9a6f-16142fde533a",
  "pubtime": "2024-04-08T17:04:43.330256",
  "type": "Feature",
  "geometry": null,
  "properties": {
    "operation": "update",
    "vaac_id": "EGRR",
    "event_type": "OPERATIONAL",
    "sources": [
      {
        "volcano_id": "370010",
        "volcano_name": "SNAEFELLSJOKULL"
      }
    ]
  },
  "links": [
    {
      "href": https://api-management.metoffice.cloud/qva-service/1.0/collections/qva\_deterministic,
      "rel": "collection",
      "type": "application/json"
    }
  ]
}
```

## Heartbeat message

5.10. The notifications service will publish a “heartbeat” message so that connection to the service can be monitored by VAAC London and users. This heartbeat message will be published once an hour and will look like a normal notification message but will not contain any data.

```
{
  "id": "0473f53c-05ad-4300-8f96-6a3e1ef2c391",
  "pubtime": "2025-04-28T15:00:31.361286Z",
  "type": "Feature",
  "geometry": null,
  "properties": {
    "operation": "create",
    "vaac": [
      {
        "id": "EGRR",
        "name": "London"
      }
    ]
  },
}
```

```

    "collections": [
      "qva_probabilistic"
    ],
    "event_type": "HEARTBEAT",
    "sources": [],
    "data_id": "2025-04-28T15:00:31.361286Z"
  },
  "links": []
}

```

## Durable topic subscriptions and message retention

5.1. Connect **daily** to consume messages, ideally between every 5 to 60 minutes, rather than weekly or monthly. This will optimise your connection and download speeds. It will also ensure that your client is continuously connected to the service.

5.2. Please specify a **durable** subscription. This ensures that you will receive all notifications that have occurred between your client connections. A non-durable subscription will result in your client missing notifications sent from our message broker as these notifications will not have been retained between your client connections.

5.3. A durable topic subscription is created by specifying a unique Client ID and subscription name when registering a subscription with the broker.

Set both your Client ID and Subscription Name in your client for every message broker destination. For example:

```

MO.VAAC.London.QVA.1-0/collections/qva_probabilistic,
MO.VAAC.London.QVA.1-0/collections/qva_deterministic
MO.VAAC.London.QVA.1-0/collections/qvac_iwxxm

```

5.4. The Subscription Name can be arbitrary, but it must be unique for the destination. For example, "receiver1", "test-receiver1" or "deterministic-receiver" are all valid Subscription Names.

5.5. Further information on how to connection to the notification broker using Python can be found in section 5.19

5.6. An instance of each message sent to a notification service topic is created for each topic subscriber but persisted only for durable topic subscribers. We automatically expire messages older than 5 days, so you do not need to set a maximum message age in your client if a 5-day expiry period is adequate for your needs. However, please feel free to set the message expiry period to less than 5 days if you prefer.

5.7. If the topic subscription receives no activity from the user within 10 days (i.e., the user has not read any message instances sent to their subscription within 10 days), then the user's subscription will be automatically deleted, and the user must resubscribe to the topic.

5.8. If you are using Python to connect to the QVA notification service, we recommend using the *python-qpid-proton* library. We cannot guarantee to diagnose problems experienced with other third-party libraries when connecting to the QVA notifications service.

## Specific guidance for connecting to the notifications broker using the Python Qpid Proton Python Client.

### 5.19. You will need:

- Python 3.9+
- python-qpid-proton installed using pip
- Valid broker credentials (username/password) already supplied by the QVA Service Provider

### 5.19.1. Install Python dependencies using this Command in a Python environment:

```
pip install --upgrade python-qpid-proton
```

### 5.19.2. Connection Settings:

- **QVA\_NS\_URL** : amqps://aviation-notifications.service.metoffice.gov.uk
- **TOPIC\_COLL** : Select the topic you want to connect to:
  - MO.VAAC.London.QVA.1-0/collections
  - MO.VAAC.London.QVA.1-0/collections/qva\_deterministic
  - MO.VAAC.London.QVA.1-0/collections/qva\_probabilistic
  - MO.VAAC.London.QVA.1-0/collections/qvac\_iwxxm
- **container\_id** : As communicated to you by the QVA Service Manager
- **user** : The username communicated to you by the QVA Service Manager
- **password** : The password communicated to you by the QVA Service Manager
- **receiver\_name** : A stable name for your durable subscription

### 5.19.3. Python Example

You may wish to use the following script. Save it as `qva_subscriber.py` and run it:

```
from proton.handlers import MessagingHandler
from proton.reactor import Container, Copy, DurableSubscription

QVA_NS = "amqps://aviation-notifications.service.metoffice.gov.uk"
TOPIC_COLL = "MO.VAAC.London.QVA.1-0/collections"

class QVA_receiver(MessagingHandler):

    def __init__(self, url, topic, container_id, user, password, receiver_name):
        super(QVA_receiver, self).__init__()
        self.url = url
        self.topic = f"topic://{topic}"
        self.container_id = container_id           # Stable Client ID provided by the
QVA Services Manager
        self.user = user                           # Username provided by the QVA
Services Manager
        self.password = password                   # Password provided by the QVA
Services Manager
        self.receiver_name = receiver_name        # Name of the durable subscription
```

```

def on_start(self, event):
    event.container.container_id=self.container_id
    event.container.schedule(300, self)
    conn = event.container.connect(self.url, user=self.user,
password=self.password)
    receiver = event.container.create_receiver(conn, source=self.topic,
name=self.receiver_name, options=[DurableSubscription()])
    print("on_start ok")

def on_message(self, event):
    print(event.message)
    print("-----")
    print(event.message.body)
    print("=====\n")

def on_connection_opened(self, event):
    print(f"CONNECT: Connected to '{self.url}'")

def on_connection_error(self, event):
    print(f"CONNECT: Error connecting to '{self.url}'")

def on_link_opened(self, event):
    print(f"LINK OPENED: {event.link} source: {event.link.source.address}")

def on_link_remote_close(self, event):
    print(f"LINK REMOTE CLOSED: {event.link.remote_condition}")

def on_transport_error(self, event):
    print(f"TRANSPORT ERROR: {event.transport.condition}")

def on_disconnected(self, event):
    print("DISCONNECTED")

try:
    Container(QVA_receiver(QVA_NS, TOPIC_COLL, "YOUR_STABLE_CLIENT_ID",
"YOUR_USERNAME", "YOUR_PASSWORD", "qva-collections-receiver")).run()

except KeyboardInterrupt:
    pass

```

The above class takes `container_id` as an argument which must be stable and unique. It must be the same as the ClientID provided by the QVA Service manager.

When connecting to the AMQP message broker to create a  durable subscription , please make sure that the user and password arguments match the username and password provided by the QVA Service manager at the time you registered for the service.

The code provided creates a durable subscription to the following topic:

- MO.VAAC.London.QVA.1-0/collections

If you want to receive notifications from other topics, then you should execute a similar script for each topic of interest.

#### 5.19.4. Security

Please note the above example uses hard-coded values for username and password for demonstration purposes

You should:

- NOT write your actual password in your production or source-controlled code.
- Retrieve your password from your environment variables (or secrets manager) in your production systems.

#### 5.19.5. Running the script to create a durable subscription

From within your python environment – execute the following command:

```
python qva_subscriber.py
```

#### 5.19.6. Troubleshooting

If the terminal reads "on\_start ok" but you are not receiving any messages, please follow these steps:

- Check that `TOPIC_COLL` matches the topic you are trying to subscribe to.
- Check that the `container_id` argument matches the ClientID provided by the QVA service manager.
- Check that the user and password arguments match the username and password provided by the QVA service manager.
- Check that outbound port 5671 is allowed.
- Allow some time for messages to come through (you will receive at least one message per hour).

## Chapter 6. Visualizing QVA Data

### Introduction

6.1. Whilst the VAAC London QVA API provides the mechanism for moving data between VAAC London and individual user organisations, data will need to undergo additional processing to visualise and use it in calculations to plan safe and efficient flights.

6.2. Users intending to use the gridded data will need a data processing system that is able to decode and display netCDF and IWXXM format data for their specific purposes. Visualization software will be needed to produce graphical depictions of the IWXXM data sets.

6.3. Visualised QVA data should include a clear reference to the validity times of the data and possibly also reference to synoptic hour on which the forecast is based. For example,

“Valid at 12UTC on 23 February 2025, based on 18 UTC data on 22 February 2025”

“T+24 forecast valid at 12UTC 23 February 2025”.

6.4. Display packages may enable users to manipulate the information presented to the workstation. This may be a useful feature for users who wish to use their workstation for the production of national products; however it is important that users appreciate that any modification to the meteorological content of information invalidates that information as being a de facto VAAC London forecast. In such a case, the forecast becomes a national product. It is imperative that such a change be clearly reflected in the legend that would be assigned to the forecast.

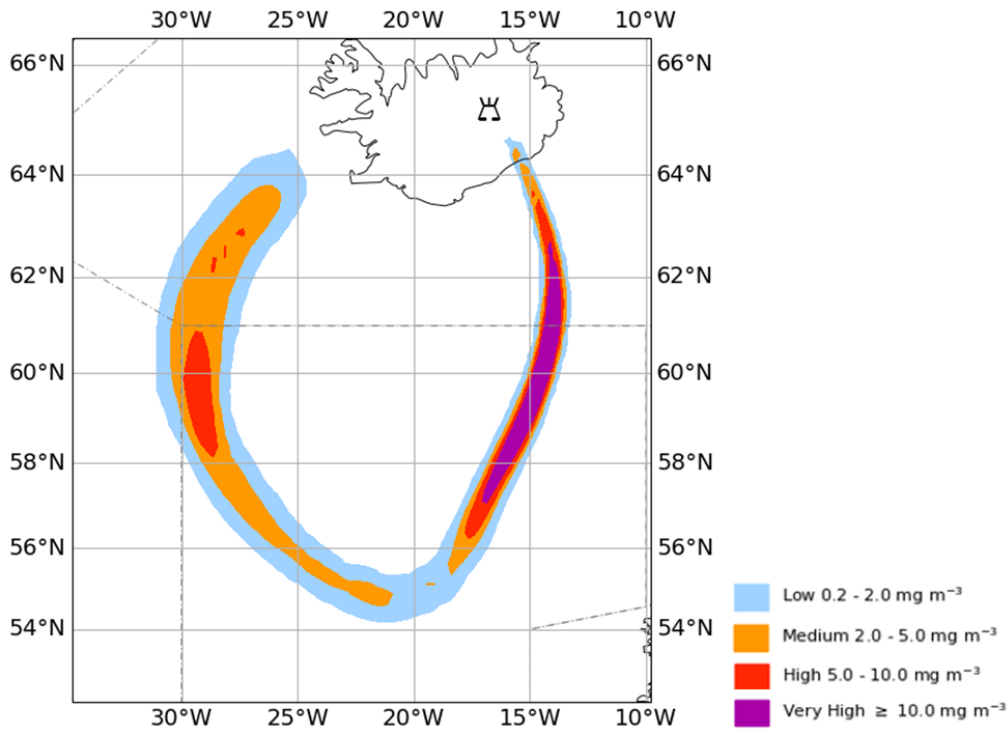
6.5. It should be noted that there is an obligation for States to retain flight documentation for at least 30 days in case of an enquiry (Annex 3, 9.3.7).

### Gridded Data visualisation

6.6. Examples of ways in the gridded data sets can be visualised are shown in the examples below. Users are free to choose the presentation style, colour scheme, and map projection that fits their organisational needs but should consider the guidance in Annex 3 and Doc 9766 – Handbook on the IAVW.

6.7. The Met Office will also publish their own charts showing the gridded QVA data on their website when an eruption is taking place. The charts can be viewed here: <https://www.metoffice.gov.uk/services/transport/aviation/regulated/international-aviation/vaac/quantitative-volcanic-ash> and don't form part of the core QVA provision, and they will not be supplied directly to users via API or e-mail.

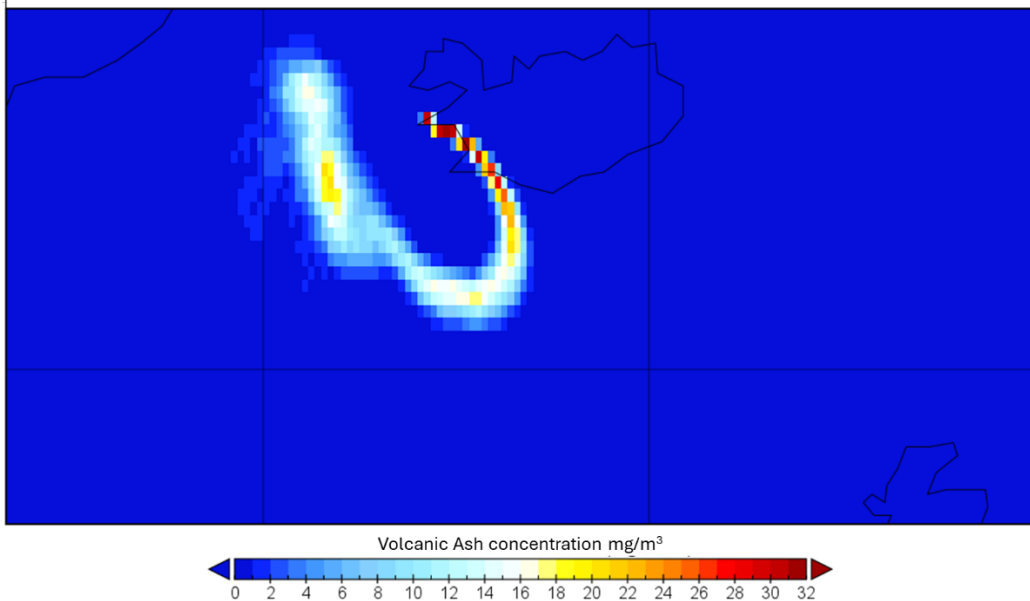
QVA Ash Concentration  
 VAAC London - ASKJA  
 FL300-FL350  
 Valid 1600UTC DD/MM/YY



Example 1, Chart showing deterministic QVA forecast for FL300 to FL350.

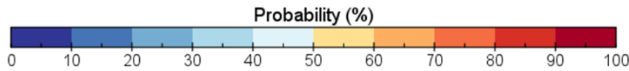
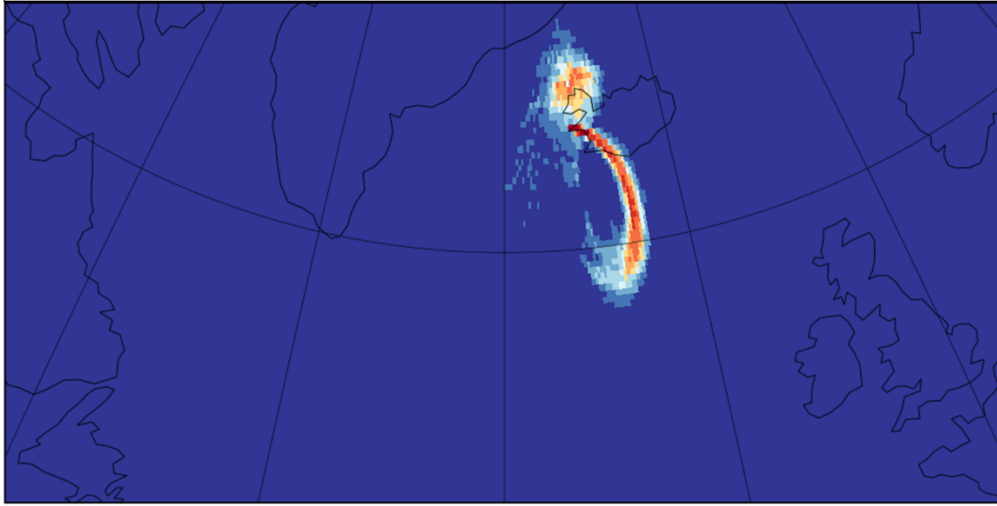
The colour scheme shown is what will be used by VAAC London in its own visualisations of this data, but other colour schemes can be used.

QVA - ASH CONCENTRATION  
 SNAEFELLSJOKULL FL250 - FL300  
 VAAC LONDON FORECAST VALID 09:00 UTC DD/MM/YYYY



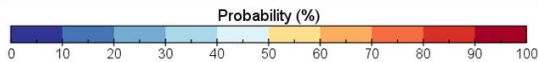
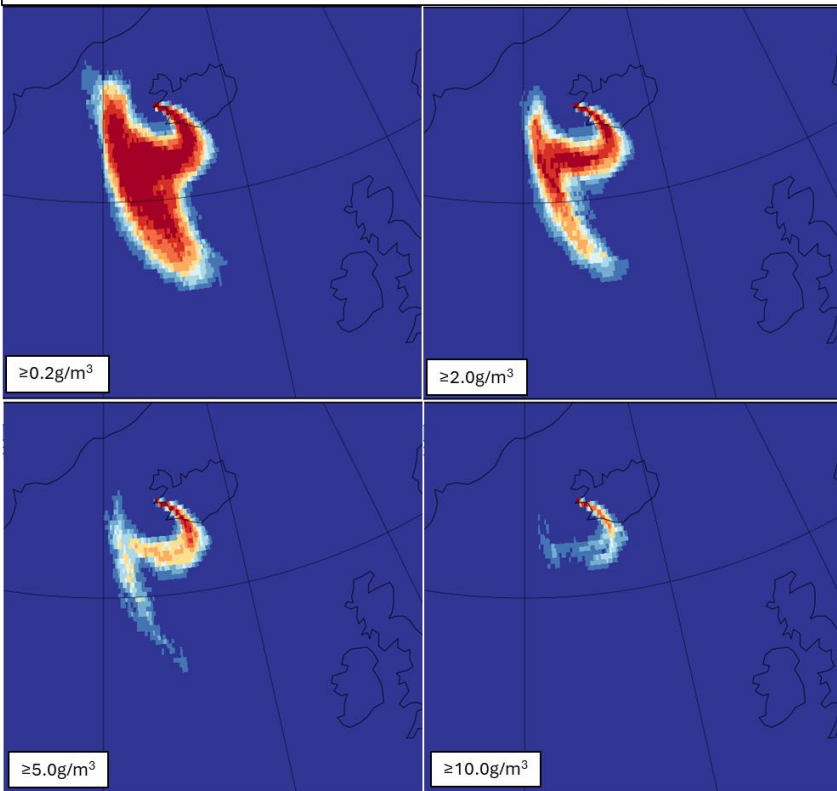
Example 2, Chart showing deterministic QVA forecast for FL250 to FL300.

QVA – PROBABILITY OF EXCEEDING ASH CONCENTRATION OF 2.0g/m<sup>3</sup>  
**SNAEFELLSJOKULL** FL350 – FL400  
 VAAC LONDON FORECAST VALID 09:00 UTC DD/MM/YYYY

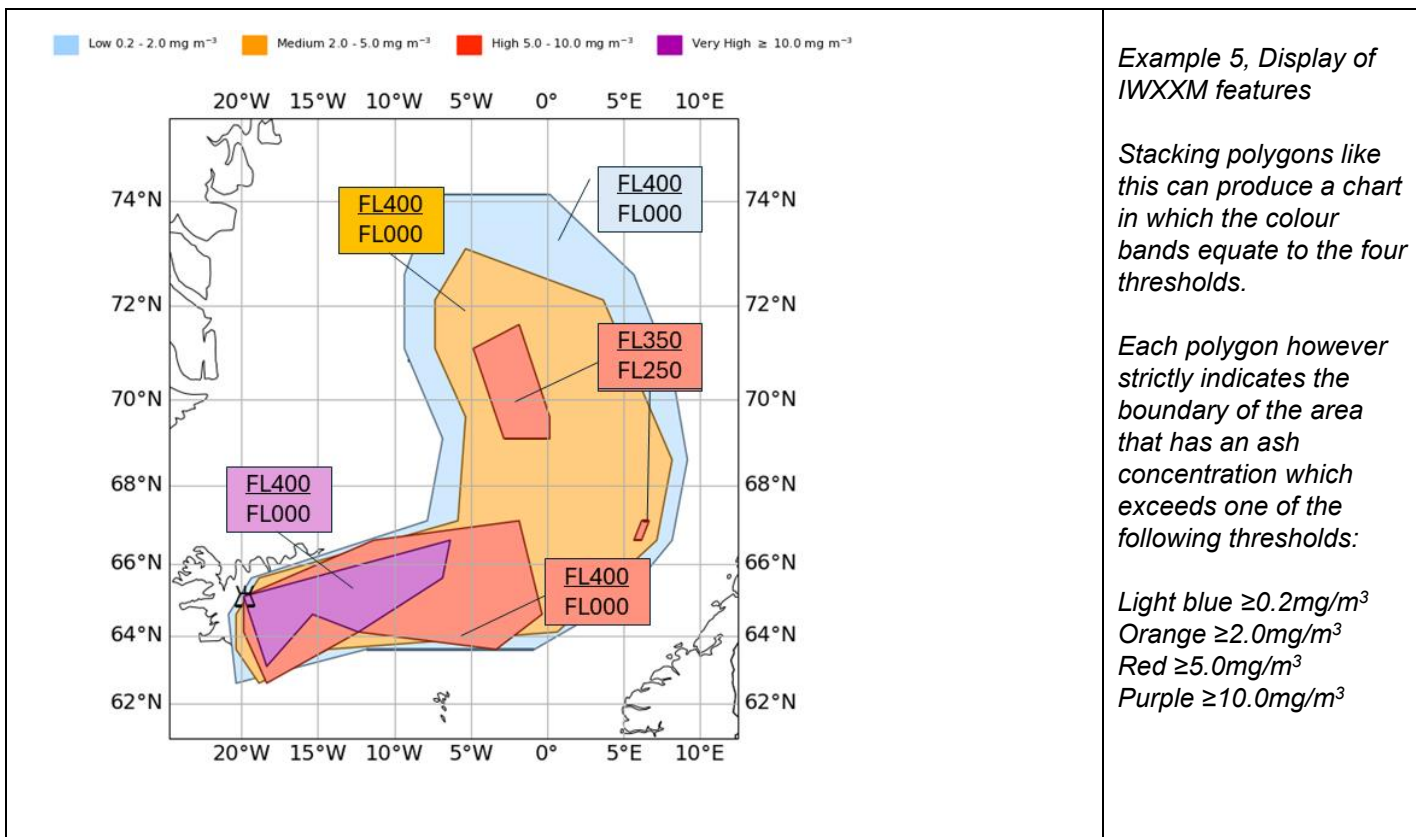


*Example 3, Probabilistic QVA for a single concentration threshold for a specified validity date/.*

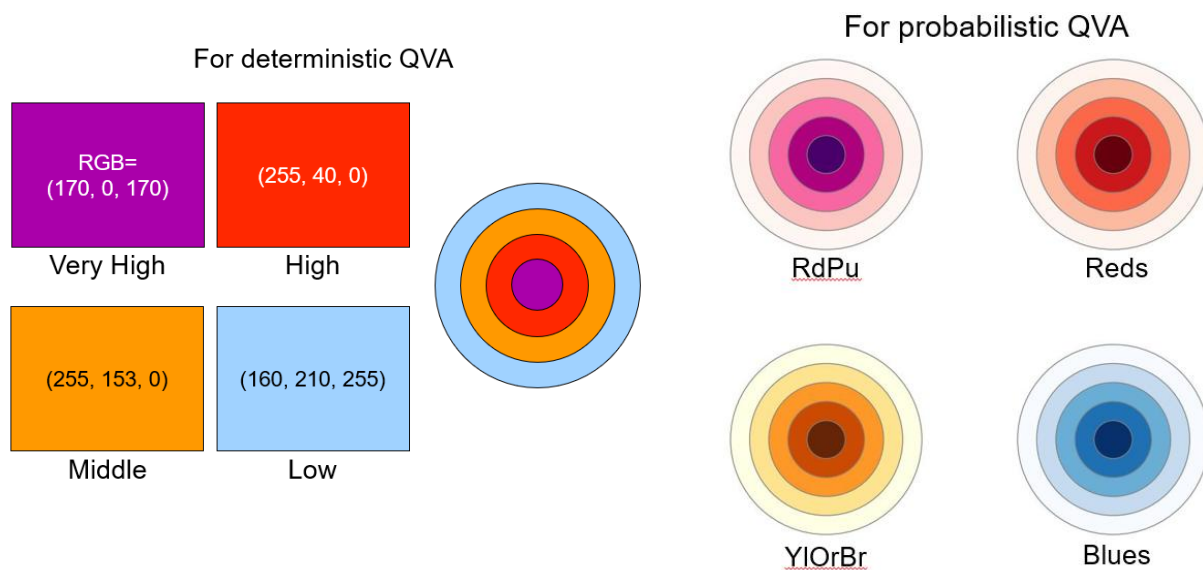
QVA – PROBABILITY OF EXCEEDING SPECIFIED ASH THRESHOLD  
**SNAEFELLSJOKULL** FL200 – FL250  
 VAAC LONDON FORECAST VALID 15:00 UTC DD/MM/YYYY



*Example 4, Probabilistic QVA for all four ash concentration thresholds for a specified validity date/time and flight level shown at the same time.*



6.8. The colour scheme for QVA forecasts, as advised in Doc 9766 - Handbook on the IAVW, is shown below:



## Chapter 7. Support and Backup

### Support

7.1. End users of the VAAC London QVA API are encouraged to contact API Provider in the event of problems. Met Office staff will assist where possible to resolve problems experienced by users if the fault lies within the API. It may of course be the case that the fault is with the user's own software, equipment or internet connection. Under such circumstances, the supplier of the original hardware/software or the user's Internet service provider should be contacted.

7.2. If support is required, please report the issue to:

#### **24-HOUR HELPLINE/FAULTS DESK**

**Tel.: +44 (0) 330 135 4444**

**E-mail: [servicedesk@metoffice.gov.uk](mailto:servicedesk@metoffice.gov.uk)**

7.3. The QVA Service manager may also be able to offer support, but please note that this is only during normal working hours. Typically, 9am – 5pm UK time, Monday to Friday.

QVA MANAGER (Monday-Friday 9am-5pm UK time)

E-mail: [QVA@metoffice.gov.uk](mailto:QVA@metoffice.gov.uk)

### Backup

7.1. VAAC Toulouse and VAAC London provide backup cover for each other. In the event there is a problem with QVA data production, or the QVA API at VAAC London we will ask VAAC Toulouse (Meteo France) to issue QVA forecast data (and the standard VAA and VAG) on our behalf. The QVA forecast will be published on their API. If VAAC London is asked to issue data on behalf of VAAC Toulouse it will be published on our API.

7.2. If VAAC Toulouse are providing backup for VAAC London charts won't be available on the [Met Office QVA charts page](#), but will instead be available on the Meteo France QVA chart viewer. If VAAC London is providing back up for VAAC Toulouse charts for the eruption will appear on the Met Office QVA chart page.

7.3. It is the users own responsibility to set up their system to be able to use the VAAC Toulouse QVA API if a backup is required.

7.4. Information on the VAAC Toulouse QVA service is available here: <https://eur-registry.swim.aero/services>