CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Living with Volcanic Ash Episodes in Civil Aviation

The New Zealand Volcanic Ash Advisory System (VAAS)

and

The International Airways Volcano Watch (IAVW)

Peter Lechner

Updated February 2022

Version 14b

Table of Contents

0. Introduction

0.1 Events and experience show there is a clear and significant risk to aviation worldwide from the ejection of volcanic ash and gases into the atmosphere. The magnitude of the risk has increased due to the enhanced technology of aircraft and engines. Risk and consequence will continue to increase with the growth of air traffic.

0.2 The Civil Aviation Authority of New Zealand (CAA) recognises the civil aviation community's need and ability to manage operations in proximity to volcanic ash and gases, with the aid of the accepted and prescribed domestic and international civil aviation procedures and information systems. The New Zealand Volcanic Ash Advisory System (**VAAS**), is effectively the local implementation of the International Civil Aviation Organization (ICAO) International Airways Volcano Watch system (**IAVW**).

0.3 The VAAS is provided primarily through the interactions of aircraft operators, Airways Corporation of New Zealand (Airways NZ) and the Meteorological Service of New Zealand (MetService), with important volcanic information input from the Institute of Geological and Nuclear Sciences (GNS Science).

0.4 This document illustrates the relationships between the VAAS participating parties, bringing focus to their various obligations in providing enhanced volcanic hazard information for aviation, and providing information on the international context of volcanic hazard warning systems for aviation.

0.5 The CAA does not take any part in the provision of operational volcanic hazard information; however, the CAA is accountable for ensuring an effective system is in place to provide the aviation community with useful and timely information in the event of significant volcanic activity. The CAA promotes awareness of the VAAS, its place in international operational frameworks (the IAVW), and an understanding of the volcanic hazard threat to civil aviation in New Zealand and the South Pacific.

1. Historical Background

1.1 New Zealand has a number of active volcanoes on or near the mainland, and a significant number of volcanoes within its area of IAVW obligation (see 5.6 New Zealand's Areas of Responsibility).

1.2 The volcanic activity of Mt Ruapehu during 1995 and 1996 had a significant impact on civil aviation in New Zealand, with flights cancelled and many more diverted or re-routed. These episodes were the first impact of volcanic ash on modern aviation in New Zealand.

1.4 As a result of the Mt Ruapehu eruptions, significant work has been undertaken to implement and refine the VAAS with respect to New Zealand's overarching IAVW responsibilities:

(a) GNS has implemented the GeoNet project (refer http://www.geonet.org.nz) on behalf of the Earthquake Commision (EQC) to monitor the active volcanoes in New Zealand. This feeds important ground-based observation information into the aviation system through the issue of Volcano Observatory Notices for Aviation (VONA) and throughthe Volcano Alert Bulletin (VAB).

(b) The CAA now designates Volcanic Hazard Zones (NZVxxx) around those volcanoes that are known to be at Volcanic Alert Level (VAL) 1 or higher (refer AIP ENR 5.3) or have been at Volcanic Alert Level 1 in recent history. There are five permanent Volcanic Hazard Zones.

(c) MetService has strengthened its Wellington Volcanic Ash Advisory Centre (VAAC) production of Volcanic Ash Advisories in text form (VAA) and graphical form (VAG), MWO volcanic ash SIGMETs and its use of ash dispersion models and provision of other supporting information.

(d) Airways Corporation has also set up a set of standard, ready to use, NOTAM to notify a change to the alert status (and therefore lateral and vertical dimensions) of designated NZVxxx in New Zealand airspace. As the central agency in the VAAS, MetService manages the issue of these NOTAM by disseminating a request for NOTAM issue form to Airways Corporation under appropriate conditions.

(e) Airways Corporation has established a system to notify operators of what routes and procedures will be affected by each level of volcanic activity. VFR or IFR aircraft that require an ATC clearance to operate within the area of concern will not knowingly be granted a clearance without a specific request from the pilot.

(f) Airlines have incorporated safety risk management procedures to routinely report volcanic ash activity and implement safety management system-based procedures for aircraft operation near ash. Airlines are clear that the final operating decision is theirs.

(g) A series of background briefings on volcanoes and ash for airline operators and other interested parties are held from time to time. An annual New Zealand Aviation Meteorological Symposium is held each year, incorporating VAAS operational matters. This outreach work is undertaken by CAA, MetService, GNS Science, Airways NZ and airline representatives.

1.5 Work continues internationally by a number of agencies and universities on the remote detection and evaluation of volcanic ash clouds as well as the seismic and remote detection of eruptions and other events. Success in reducing the disruptive effects of ash to aviation is determined by information flow on the eruptions and the communication of relevant information to all interested parties.

1.6 While this document focuses on the more active volcanoes in New Zealand, there is also the risk of volcanic ash from offshore and distant eruptions disrupting New Zealand airspace. This was the case during the 2011 eruptions of the Puyehue Cordón Caulle volcano in southern Chile, where volcanic ash was transported around the southern hemisphere and affected the airspace of Australia and New Zealand. During this extended event, flights were cancelled and many more diverted or re-routed, both domestically and regionally.

2. The New Zealand Volcanoes

2.1 New Zealand Volcano Overview

2.1.1 New Zealand has a number of active volcanoes, each with its own eruptive characteristics. Scientific study indicates that the majority are considered dormant, rather than extinct, and will produce eruptions at some indeterminate time in the future. Prior to any eruption, physical precursors may be identifiable; these may develop over days (and possibly only hours) for the basaltic sites, over months for andesitic sites, and over years for the rhyolitic sites. Such precursors provide the basis for the formulation and issue of warning information.

2.1.2 A volcanic eruption will produce multiple hazards, some of which may make their effects felt at distances of hundreds of kilometres, especially ash. In this and other respects, volcanic planning differs from that undertaken for most other ground level natural hazards. A volcanic event may build up over weeks to years and be relatively difficult to predict in its probable course and timing. However, once volcanic ash and gases are ejected into the atmosphere it can be tracked and its course predicted using conventional meteorological methods and dispersion models. The main hazard for aviation is volcanic ash, while volcanic gases can pose a health hazard to aircraft occupants as well as having a corrosive affect on aircraft components. Expected ashfall can also be modelled – with ashfall a potential issue for airports in the vicinity of the volcano.

2.1.3 There is therefore a need for flexibility when undertaking volcanic planning and this extends to the areas of aviation. How these issues are managed can depend upon the known characteristics of each volcano, the amount of ash ejected and the prevailing conditions at the time of, or during, the event.

2.1.4 The volcanoes of New Zealand should be seen as relatively frequently active. The cone volcanoes Ruapehu, White Island, Tongariro and Ngauruhoe are good recent examples, as is the caldera volcano Raoul Island in the Kermadecs. There are a large variety of hazards associated with volcanoes, but it is volcanic ash that has the greatest impact on aviation, affecting airspace and airports.

2.1.5 The Volcanic Hazard Zone for each volcano is assigned an identifier, NZVxxx, under the New Zealand airspace management system. CAA assigns the designator when a volcano moves from a historically quiescent state. The assignation of the designator is permanent.

2.2 Ruapehu (S 39 17 22.4 E 175 33 45.6) NZV 314

Ruapehu is a very active andesite volcano with a single historically active vent, usually occupied by a hot acid lake. The presence of the Crater Lake, summit snow and ice fields, creates a major lahar risk in valleys draining from the summit. When the lake is not present, the volcano can produce ash eruptions. Some form of eruptive activity occurs every 5-10 years.

2.3 Ngauruhoe (S 39 09 27.8, E 175 38 04.2) NZV 313

Ngauruhoe is the youngest cone on Tongariro and has grown over the last 7500 years. Historically it has been New Zealand's most active volcano, although its last eruption was in 1975. When erupting, it typically produces ash columns and lava flows. Even though Ngauruhoe is part of the Tongariro massif, it is considered here to be a separate volcano due to its frequent historic activity.

2.4 Tongariro (S 39 07 00, E 175 39 00) NZV 312

Tongariro is a large andesitic volcanic massif, located immediately NE of Ruapehu volcano, that is composed of more than a dozen composite cones. The Te Māri craters are the most recently active vents with eruptions in the 20th century (1926, 1927, 1934, and possibly 1928) and in 2012. Other vents were active during a several hundred year-long period around 10,000 years ago, producing the largest known eruptions at the Tongariro complex.

2.5 White Island (S 37 31 10.9, E 177 10 44.5) NZV 215

An active andesite volcano off the Bay of Plenty coast, White Island was New Zealand's most active volcano from 1977 to 2010, producing numerous small explosive ash eruptions. Significant risks are restricted to the island and it is rare for ash to reach the mainland. The relative eastward setting and low elevation reduce, but do not eliminate the potential for hazardous impact on aviation.

2.6 Raoul Island (S 29 16 00.0, W 177 55 00.0) NZV 010

The northernmost known volcanic centre in the Kermadecs is Raoul Island, the summit of a large caldera structure. Major eruptions have taken place in 1814, 1870 and 1964 producing ash columns. A minor eruption took place in 2006. A major eruption would pose significant risks to international air navigation.

3. NZ Volcanic Alert Level & International Colour Code Systems

3.1 Activity Levels

3.1.1 Ongoing volcano monitoring by the GeoNet project (run by GNS Science) enables the background or normal status of a volcano or volcanic field to be determined. Variations and/or departures of monitored parameters may indicate a change of status and the onset of an eruptive episode. The *status* of a volcano at any time is defined by an assigned *Volcanic Alert Level (VAL)* and an *Aviation Colour Code*. The *Volcanic Alert Level* system is defined in the guidelines to the National Civil Defence Plan, while the *Aviation Colour Code* is defined in ICAO documents.

3.1.2 ***Volcanic Alert Levels*** are based on a 6-level system, with each level defining a change of status at the volcano or field. The lowest level *(no volcanic unrest) is* signified by '0' and the highest (major volcanic eruption) by '5'. The *VAL* is issued by GNS Science and is an important trigger in the issue of NOTAM.

3.1.3 ***Aviation colour codes,*** based on four colours, are intended for quick reference only in the international civil aviation community and are part of the IAVW system. The *Aviation Colour Code* reflects conditions at or near a volcano and are not intended to pertain to hazards posed at a distance or downwind by the drifting ash. The latter information will be contained in SIGMET and VAA. The *Aviation Colour Code* is issued by GNS Science for those volcanoes within New Zealand territory. For volcanoes outside New Zealand but within the Wellington VAAC area of responsibility (see 5.4) the colour code will only be included in a VAA if provided by the appropriate State volcano observatory or authority. The colour code is for aviation information only and does not determine any action or obligation in the New Zealand civil aviation system.

3.1.4 Where information from the GeoNet volcano monitoring programme indicates a change in a volcano's status (either up or down), GNS will adjust the *Volcanic Alert Level* and the *Aviation Colour Code* by issuing *Volcano Activity Bulletins* and Volcano Observatory Notices for Aviation (*VONA*) respectively.

3.1.5 In the case of the status of a volcano moving from Level '0' to Level '1', this does not necessarily signal imminent volcanic activity. Historically, seismic and deformation episodes have occurred at volcanoes like Taupo, Okataina, and Raoul Island, which would have resulted in an adjustment to a Level '1' alert with no accompanying eruption threat. The *Aviation Colour Code* will be set as is appropriate during the unrest.

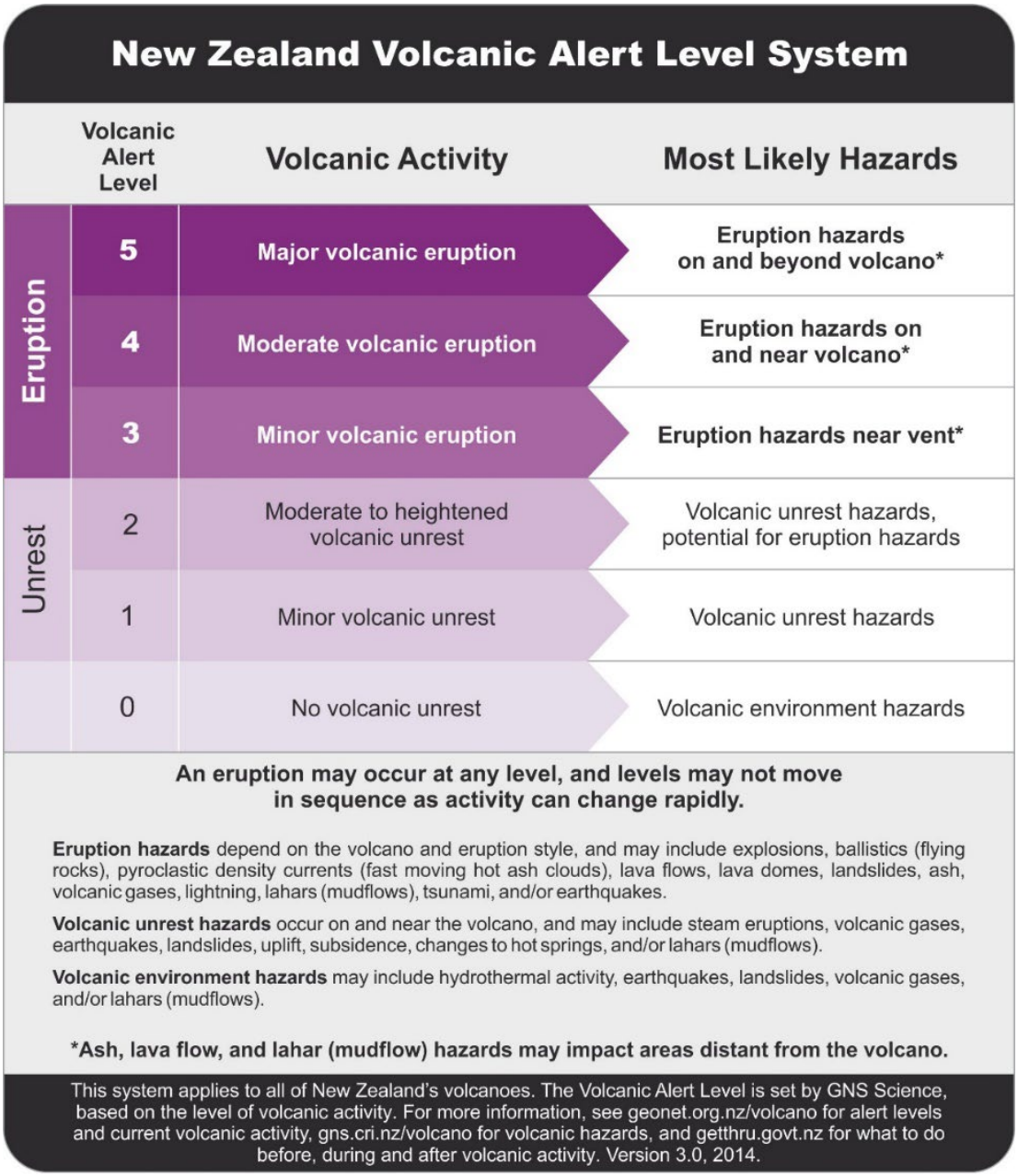
3.1.6 The *Volcanic Alert Levels* act as an important trigger for the issue of Civil Defence warnings in the form of a *National Advisory* notice. More importantly, for the civil aviation community a change in the *Volcanic Alert Level* will trigger the immediate generation or change of a NOTAM for a Volcanic Hazard Zone (NZV).

3.1.7 The movement from ***Volcanic Alert Level 0*** **to** ***Volcanic Alert Level 1*** (or greater) at any New Zealand volcano notified by GNS Science and not already having an established NZV designator will trigger the establishment of a new (possibly temporary) NZV by the CAA.

3.1.8 ICAO Aviation Volcano Level - Colour Code

ICAO Colour code	Status of activity of volcano
GREEN	Volcano is in normal, non-eruptive state. *or, after a change from a higher alert level*: Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state.
YELLOW	Volcano is experiencing signs of elevated unrest above known background levels. *or, after a change from higher alert level*: Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE	Volcano is exhibiting heightened unrest with increased likelihood of eruption *or,* Volcanic eruption is underway with no or minor ash emission *[specify ash-plume height if possible].*
RED	Eruption is forecasted to be imminent with significant emission of ash into the atmosphere likely. *or,* Eruption is underway with significant emission of ash into the atmosphere *[specify ash-plume height if possible]*.

3.1.9 The NZ Volcanic Alert Level System (GNS Science)



New Zealand Volcanic Alert Level System

	Volcanic Alert Level	Volcanic Activity	Most Likely Hazards
Eruption	5	Major volcanic eruption	Eruption hazards on and beyond volcano*
Eruption	4	Moderate volcanic eruption	Eruption hazards on and near volcano*
Eruption	3	Minor volcanic eruption	Eruption hazards near vent*
Unrest	2	Moderate to heightened volcanic unrest	Volcanic unrest hazards, potential for eruption hazards
Unrest	1	Minor volcanic unrest	Volcanic unrest hazards
	0	No volcanic unrest	Volcanic environment hazards

An eruption may occur at any level, and levels may not move in sequence as activity can change rapidly.

Eruption hazards depend on the volcano and eruption style, and may include explosions, ballistics (flying rocks), pyroclastic density currents (fast moving hot ash clouds), lava flows, lava domes, landslides, ash, volcanic gases, lightning, lahars (mudflows), tsunami, and/or earthquakes.

Volcanic unrest hazards occur on and near the volcano, and may include steam eruptions, volcanic gases, earthquakes, landslides, uplift, subsidence, changes to hot springs, and/or lahars (mudflows).

Volcanic environment hazards may include hydrothermal activity, earthquakes, landslides, volcanic gases, and/or lahars (mudflows).

***Ash, lava flow, and lahar (mudflow) hazards may impact areas distant from the volcano.**

This system applies to all of New Zealand's volcanoes. The Volcanic Alert Level is set by GNS Science, based on the level of volcanic activity. For more information, see geonet.org.nz/volcano for alert levels and current volcanic activity, gns.cri.nz/volcano for volcanic hazards, and getthru.govt.nz for what to do before, during and after volcanic activity. Version 3.0, 2014.

3.1.10 Volcanic Hazard Zones for Each Volcanic Alert Level

Volcanic Alert Level	*Radius from Vent (nm)*	*Upper Limit*
RUAPEHU Volcanic Hazard Zone (NZV 314)		
0	**3**	**12,200ft AMSL**
1	**3**	**12,200ft AMSL**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**
NGAURUHOE Volcanic Hazard Zone (NZV 313)		
0	**3**	**10,500ft AMSL**
1	**3**	**10,500ft AMSL**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**
TONGARIRO Volcanic Hazard Zone (NZV 312)		
0	**3**	**9,500ft AMSL**
1	**3**	**9,500ft AMSL**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**
WHITE ISLAND Volcanic Hazard Zone (NZV 215)		
0	**3**	**4,500ft AMSL**
1	**3**	**4,500ft AMSL**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**
RAOUL ISLAND Volcanic Hazard Zone (NZV 010)		
0	**3**	**4,500ft AMSL**
1	**3**	**4,500ft AMSL**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**
ANY OTHER NZ VOLCANO Volcanic Hazard Zone (NZVxxx)		
0	**3**	**3,000 ft above top of vent**
1	**3**	**3,000 ft above top of vent**
2	**8**	**FL 150**
3	**16**	**FL 330**
4	**27**	**FL 480**
5	**50**	**FL660**

4. VAAS Participating Agency & Aircraft Operator's Roles

4.1 Civil Aviation Authority of New Zealand

4.1.1 Responsibility

The CAA is responsible for ensuring a satisfactory means exists whereby civil aviation aircraft operations can be safely carried out near volcanic ash.

The CAA is not responsible for providing any service to airlines to directly assist them with such operations.

4.1.2 Role

a) Review the effectiveness of the volcanic ash information system from time to time.

b) Ensure Airways, MetService and GNS Science have any delegations or permissions required under the Civil Aviation Act 1990 to carry out their respective roles.

c) Publish, in the appropriate medium a clear statement of how the volcanic ash information system will work in New Zealand (this document).

d) Continue to publish any appropriate educational or technical information on aircraft operation in or near volcanic ash, the volcanic situation in New Zealand or any other relevant material.

e) Establish any new Volcanic Hazard Zones (NZV) that may be needed to cover volcanoes other than those already established and designated.

4.2 Meteorological Service of New Zealand Ltd (MetService)

4.2.1 Responsibility

To provide civil aviation with timely Volcanic Ash Advisories in text form (VAA) and graphical form (VAG), SIGMETs, and any other volcanic activity or ash information packages required pursuant to New Zealand's ICAO obligations.

To issue the required volcanic ash NOTAM requests to Airways.

4.2.2 Role

a) Maintain a watch over actual and possible volcanic ash events in the VAAC Wellington region of responsibility and the immediately adjacent areas of neighbouring VAAC area of responsibility, using satellite and land based meteorological observation systems and the use of atmospheric trajectory and dispersion models.

b) Notify GNS by telephone of any possible eruption detected in New Zealand not already notified by GNS Science.

c) Use suitable atmospheric trajectory and dispersion models to identify the probable path of ejected ash notified by GNS, identified by MetService itself or notified via any other credible source.

d) Use all appropriate internal and external procedures to generate timely VAAs, VAGs and SIGMETs to notify civil aviation of the present and likely future position of volcanic ash in New Zealand's area of responsibility.

e) Maintain a VAA (text and graphical) and Volcanic SIGMET watch and update the VAA, VAG, and SIGMET as necessary and within the ICAO guidelines.

f) Provide, on a case-by-case basis, any extra information such as expert advice, satellite imagery, ash trajectory information or other graphics that may be requested by civil aircraft operators, for volcanic ash events in the VAAC Wellington region of responsibility.

g) Provide information to GNS Science such as satellite imagery, radar data, wind profile data or independent observation information that may be appropriate.

h) When notified by GNS Science of a change in the official activity level (*Volcanic Alert Levels*), where the alert level moves up or down from a level of at least 2, immediately request Airways to issue the appropriate NOTAM by AFTN message to NZCHYNYX. All such NOTAM will be with a 1-month validity to ensure the systematic management of NOTAM currency.

i) Maintain the currency of any NOTAM relating to particular volcanoes in liaison with Airways (Airways will notify MetService 24 hours before the expiry of a given NOTAM and request an update or confirmation of cancellation).

j) Ensure the Airways NOTAM Office is notified (according to CAR Part 175.59) as to who (by name or position) in MetService are authorised to request volcanic ash NOTAM.

k) Maintain a watch over actual events in the immediately adjacent areas of neighbouring VAAC area of responsibility and co-ordinate handover protocols for ash expected to be advected into the Wellington area.

l) Maintain a robust set of back-up arrangements with the adjacent VAACs.

m) Maintain a watch on technological developments in the area of remote volcanic eruption detection and ash trajectory modelling and apply any advances in this area to its operations.

n) Example of a **SIGMET** for Volcanic Ash supplied by the Wellington MWO:

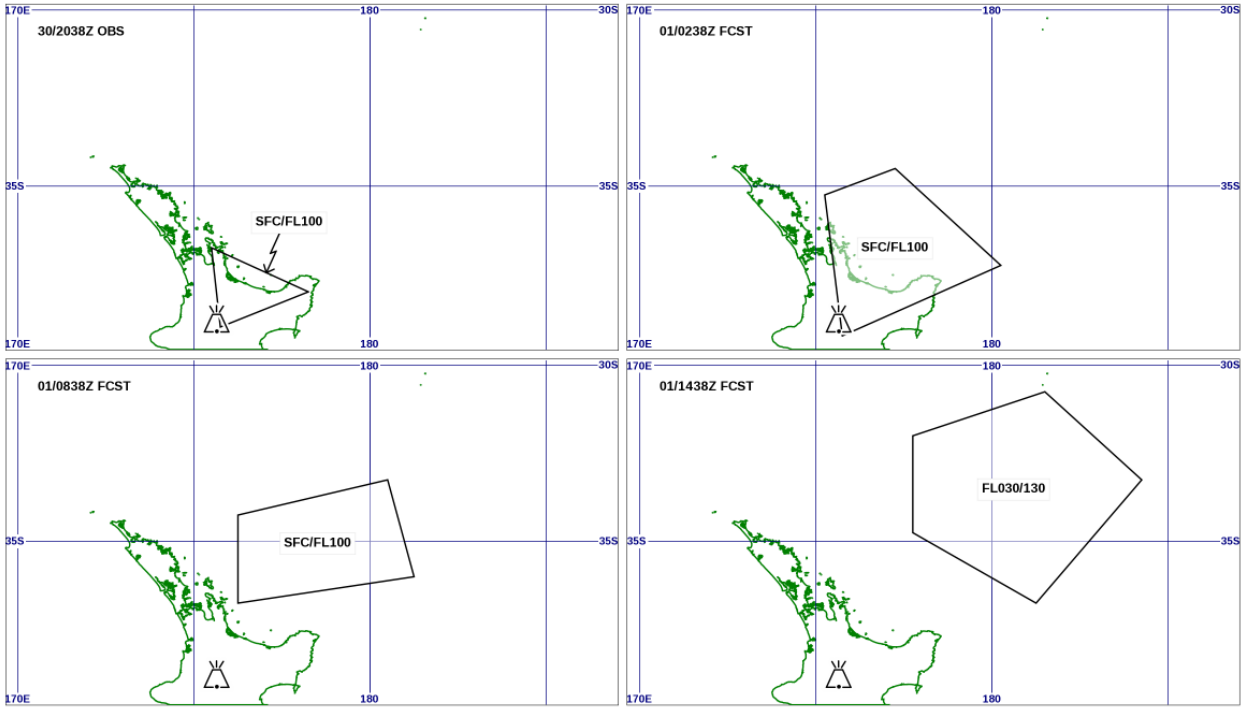
```
WVNZ21 NZKL 070000
NZZC SIGMET 2 VALID 070000/070600 NZKL-
NZZC NEW ZEALAND FIR VA MT TONGARIRO PSN S3907 W17539 VA CLD OBS AT 0000Z WI
S3845 E17530 – S3845 E17915 – S4000 E17845 – S3930 W17530 – S3845 W17530 SFC/FL200
FCST AT 0600Z WI S3845 E17530 – S3845 E17915 – S4000 E17845 – S3930 W17530 – S3845
W17530=
```

o) Example of a Volcanic Ash Advisory (VAA) issued bythe Wellington VAAC:

```
FVPS01 NZKL 182220
VA ADVISORY
DTG:                    20120807/0020Z
VAAC:                   WELLINGTON
VOLCANO:                TONGARIRO 241080
PSN:                    S3907 E17538
AREA:                   NEW ZEALAND
SUMMIT ELEV:            1978M
ADVISORY NR:            2012/5
INFO SOURCE:            PIREP; GNS; HIMAWARI IMAGERY
AVIATION COLOUR CODE:   ORANGE
ERUPTION DETAILS:       PLUME OBS TO FL200
```

OBS VA DTG:	07/0020Z
OBS VA CLD:	SFC/FL200 S3900 E17645 - S3845 E18000 - S3915 W17515 - S4000 W17515 - S4045 E18000 - S4000 E17630 - S3900 E17645 MOV N 20KT
FCST VA CLD+6HR	07/0620Z SFC/FL200 S3845 E18000 - S3900 W17330 - S4000 W17330 - S4045 W17745 - S4045 E17745 - S3930 E17815 - S3845 E18000
FCST VA CLD+12HR:	07/1220Z SFC/FL200 S4015 E17930 - S3915 W17915 - S3845 W17645 - S3930 W17000 - S4015 W17000 - S4045 W17500 - S4200 W17915 - S4145 E17845 - S4015 E17930
FCST VA CLD+18HR:	07/1820Z SFC/FL200 S4200 E18000 - S3915 W17730 - S3900 W17430 - S3945 W16745 - S4045 W16745 - S4115 W17500 - S4200 W17745 - S4200 E1800 FL200/600 NO VA EXP
RMK:	FURTHER FORECAST TO FOLLOW
NXT ADVISORY:	NO LATER THAN 20120807/0620Z

p) Example of a Volcanic Ash Graphic (VAG) supplied by the Wellington VAAC:



VOLCANIC ASH ADVISORY

DTG:	20141130/2049Z
VAAC:	WELLINGTON
VOLCANO:	TONGARIRO 241080
PSN:	S3908 E17539
AREA:	NEW ZEALAND
SUMMIT ELEV:	1978M
ADVISORY NR:	2014/11
INFO SOURCE:	MTSAT
AVIATION COLOUR CODE:	RED
ERUPTION DETAILS:	ERUPTION AT 20141130/2038Z
RMK:	NIL
NXT ADVISORY:	NO LATER THAN 20141201/0249Z

Note – VAAC Darwin, operated by the Bureau of Meteorology, is the official backup for VAAC Wellington. If VAAC Wellington goes into backup mode, a VAA will be issued by VAAC Darwin alerting users of the change of responsibility.

VAAC Darwin contact details are in Table 4.2 of the IAVW Handbook (ICAO Doc 9766).

4.3 Airways Corporation of New Zealand Ltd (Airways)

4.3.1 Responsibility

To provide to civil aviation the NOTAM service, access to volcanic ash SIGMET and appropriate Volcanic Activity Reports (VAR) information pursuant to New Zealand's ICAO obligations.

To collect, from aircraft, VAR information and disseminate this information immediately to MetService, GNS Science and accessible aircraft operators.

4.3.2 Role

a) Ensure that meteorological reports passed to MetService and civil aviation contain appropriate information on the presence (or not, as the case may be, during a volcanic episode) of volcanic ash or other volcanic phenomena. This may require specialised training.

b) Ensure that all AIREPs containing information on volcanic ash and VARs received from aircraft are passed with utmost urgency to MetService and any other addressees (airlines, CAA, GNS etc) on the VAR distribution list using the AFTN and other means as may be appropriate. It is anticipated that flight crews will not forward duplicate VARs to those already forwarded from other aircraft. If at all possible, transmit VAR information by email or other means to GNS Science and those major operators who do not have access to the AFTN or the Internet.

c) Ensure that updated volcanic ash SIGMETs provided by MetService are expeditiously passed to aircraft in flight, especially those operating in the vicinity of any ash (ICAO requirement).

d) Upon the receipt of a correctly authorised notification from MetService that the activity level (*Volcanic Alert Levels*) of one of the New Zealand volcanoes (or any other volcano for which a new VHZxxx has been classified by CAA) has been changed, immediately issue the appropriate NOTAM and send a copy to MetService at NZKLYMYX.

- The content of the NOTAM is dependent on the volcano activity level as set out below and have a validity period of approximately 1 month
- The layout of the NOTAM should follow ICAO prescribed requirements

NOTAM example - given a change to volcanic activity from *VAL* 1 to 2 at Ruapehu and with regard to CAA Part 71 where a Volcanic Hazard Zone is designated (NZV314 in this case);

Bnnnn/09 NOTAMN	
A)	NZZC
B)	yymmddhhmm
C)	yymmddhhmm EST
E)	VOLCANIC HAZARD ZONE NZV314 MT RUAPEHU IS REDEFINED AS FLW DUE TO INCREASED VOLCANIC ACT, VOLCANIC ALERT LEVEL NOW 2: ALL THAT AIRSPACE BOUNDED BY A CIRCLE OF RADIUS 8NM CENTRED ON 39 17 22.4 S 175 33 45.6 E MT RUAPEHU PILOTS ARE REQ TO REP LOCATION OF VA AND ANY VOLCANIC ACT OBS PRESCRIBED PURSUANT TO CIVIL AVIATION RULE PART 71 UNDER A DELEGATED AUTHORITY ISSUED BY THE DIRECTOR OF CIVIL AVIATION SEE GEONET.ORG.NZ FOR VOLCANIC ACTIVITY BULLETIN DETAILING VOLCANIC HAZARDS
F)	SFC

G)	FL150

Note – the radius and height of the volcanic hazard zone depends on the actual VAL provided.

e) Notify MetService before the expiry of a given NOTAM and request an update or confirmation of cancellation.

f) Advise operators immediately of the routes and procedures affected by an NZV including VAL 5 by way of standard NOTAM texts. Notification of what routes and procedures are affected by volcanic activity at a location where no NZV exists will not be as immediate because a special evaluation will have to take place. ATC will not issue a clearance to operate in an NZV at night, and by day will issue a clearance to operate in an NZV only when requested by a pilot.

4.4 Institute of Geological and Nuclear Sciences (GNS Science)

4.4.1 Responsibility

To keep MetService and aviation users informed as to any volcanic activity taking place in New Zealand.

4.4.2 Role

a) Maintain monitoring of volcanoes within New Zealand territory on a 24-hour basis. This should encompass the ability to confirm or deny any reported or suspected ash eruption.

b) Notify Wellington VAAC (MetService), Airways NZ, and national airline operations offices, by means of a *Volcano Observatory Notice for Aviation* (VONA) via email (and by telephone to MetService if appropriate) of any change in activity, positive or negative, of any New Zealand volcano (including changes in *Aviation Colour Code*) immediately that decision has been made.

c) Notify Wellington VAAC (MetService), of any change in Volcano Alert Level for any New Zealand volcano through the provision, by email (and by telephone if appropriate), through the issue of timely *Volcanic Activity Bulletins (VAB)*.

d) Maintain awareness, as able and appropriate, of volcanic activity in the overall Wellington Volcanic Activity Advisory Centre (Wellington VAAC) area of responsibility and advise MetService as appropriate.

e) Maintain complimentary contact with MetService (Wellington VAAC), regarding any eruption in New Zealand or the wider VAAC area of responsibility with respect to;

   i. eruption time and expected activity period,

   ii. the eruption type if possible (steam, gas, ash), and

   iii. any other advice as may be requested from time to time.

VONA Example

Item	**Element**	Content
1.	**Message Title:**	Volcano Observatory Notice for Aviation
2.	**Issued:**	201908020315Z
3.	**Volcano:**	White Island 241040
4.	**Current Aviation Colour Code:**	Yellow
5.	**Previous Aviation Colour Code:**	Green
6.	**Source:**	GNS Science, New Zealand
7.	**Notice Number:**	NZ VONA 19/02
8.	**Volcano Location:**	37 31 S 177 11 E
9.	**Area:**	White Island, Bay of Plenty, North Is, New Zealand
10.	**Summit Elevation:**	1053FT
11.	**Volcanic Activity Summary:**	No eruptive activity
12.	**Volcanic Activity Height:**	Nil
13.	**Other Volcanic Cloud Information:**	Nil
14.	**Remarks:**	Crater lake level increased. Gas flux increase. Volcanic tremor increase. On-going monitoring.
15.	**Contact:**	Duty Volcanologist, +64 x xxx xxxx
16.	**Next Notice:**	Will be issued if there is a change in aviation color code or when a significant volcanic event happens within the current color code.

4.5 Aircraft Operators

4.5.1 Responsibility

To ensure their aircraft do not operate in volcanic ash and follow any applicable volcanic risk mitigation procedures. To provide Volcanic Activity Reports (VARs) when appropriate.

4.5.2 Role

a) Ensure procedures are incorporated in operations manuals for the reporting of volcanic events and ash, including the generation and distribution of these reports (VARs) following the prescribed international guidelines (ICAO).

b) Ensure that aircrew are fully aware of their civil aviation regulatory obligations insofar as volcanic Conditional areas (NOTAM) are concerned.

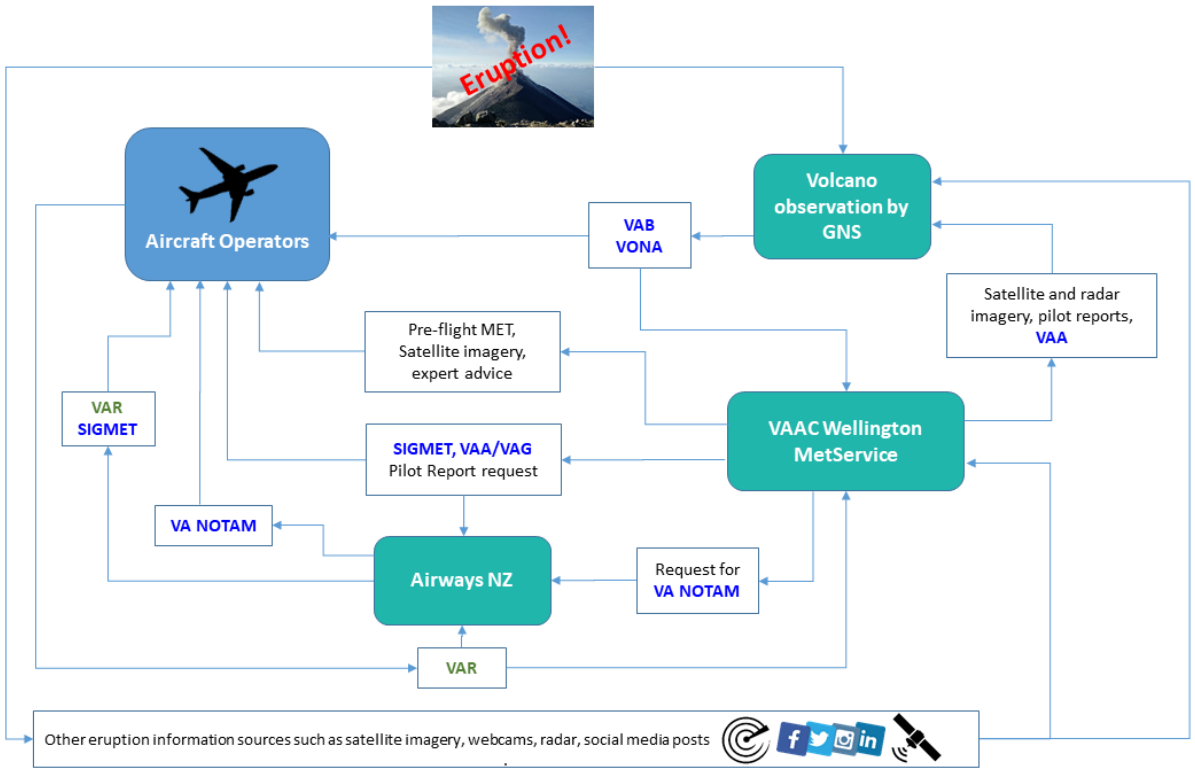
c) Ensure that aircrew have adequate background knowledge of the atmospheric and airframe effects of volcanic events especially in the context of the New Zealand volcanic situation.

d) Ensure procedures are incorporated in operations manuals for the safe operation of aircraft near areas of volcanic ash.

e) Ensure that Airways are aware of their particular ash episode re-route preferences.

f) When possible, for research purposes, share with CAA detailed reports of any volcanic ash encounters by aircraft.

4.6 VAAS Role and Information Flow



4.7 Initial VAAS Information Flow (NZ Volcanoes)

#	Product	Source	Approximate Timing + minutes	Intended Primary Users
1.	**Initial Eruption Report**	▪ Aircraft ▪ Civil agency ▪ Public ▪ GNS Science ▪ Satellite (MetService)	Eruption + x*	✈ GNS
2.	**Intial quick response notification or confirmation**	▪ GNS Science	Report receipt + 5	✈ MetService ✈ Airways
3.	**VONA, VAB**	▪ GNS Science	Report receipt + 10	✈ MetService ✈ Aviation operators ✈ Airways
4.	**SIGMET – initial basic****	▪ MetService	VONA receipt + 5	✈ Aviation operators ✈ Airways
5.	**VAA** – *initial basic****	▪ MetService	VONA receipt + 10	
6.	**VAA** – *detailed*	▪ MetService	VONA receipt + 30	
7.	**SIGMET** - *detailed*	▪ MetService	VONA receipt + 35	

* "x" is the time it takes for any observation of an eruption to enter the VAAS system. The time taken is contingent on the particular circumstances of each event.

** May only advise of eruption and name/location of volcano.

*** May not contain H+0, H+6, H+12 and H+18 volcanic ash positions, as modelling of this information could still be in progress

4.8 Initial VAAS Information Flow (Volcanoes outside NZ)

#	Product	Source	Approximate Timing + minutes *	Intended Primary Users
1.	**Initial Eruption Report**	▪ Aircraft ▪ Civil agency ▪ Public ▪ Satellite	Eruption + x	✈ Wellington VAAC
2.	**VONA**	▪ Civil agency of foreign State - where implemented.	Report receipt + 10	✈ Wellington VAAC
3.	**VAA** - – *initial basic***	▪ Wellington VAAC	VONA or other credible evidence receipt + 10	✈ Aviation operators ✈ Airways
4.	**VAA** - *detailed*	▪ Wellington VAAC	VONA or other credible evidence receipt + 30	

* "x" is the time it takes for any observation of an eruption to enter the VAAS system. The time taken is contingent on the particular event circumstance, particularly in regions where there is no volcano monitoring, due to the requirement for VAAC to investigate credibility of eruption evidence.

** May not contain H+0, H+6, H+12 and H+18 volcanic ash positions, as modelling of this information could still be in progress

Note that the issue of SIGMET for foreign FIRs is the responsibility of the States concerned – refer to the ICAO Handbook on the IAVW - Operational Procedures and Contact List (Doc 9766).

Click here to see a Google Map of the Holocene volcanoes (erupted within the last 10,000 years) in the VAAC Wellington area of responsibility.

5. The International Airways Volcano Watch System (ICAO)

5.1 The IAVW is an operational programme set up by ICAO and binding on all member States. Oversight of IAVW operations is undertaken by the ICAO Meteorology Panel. The IAVW made up of two main components:

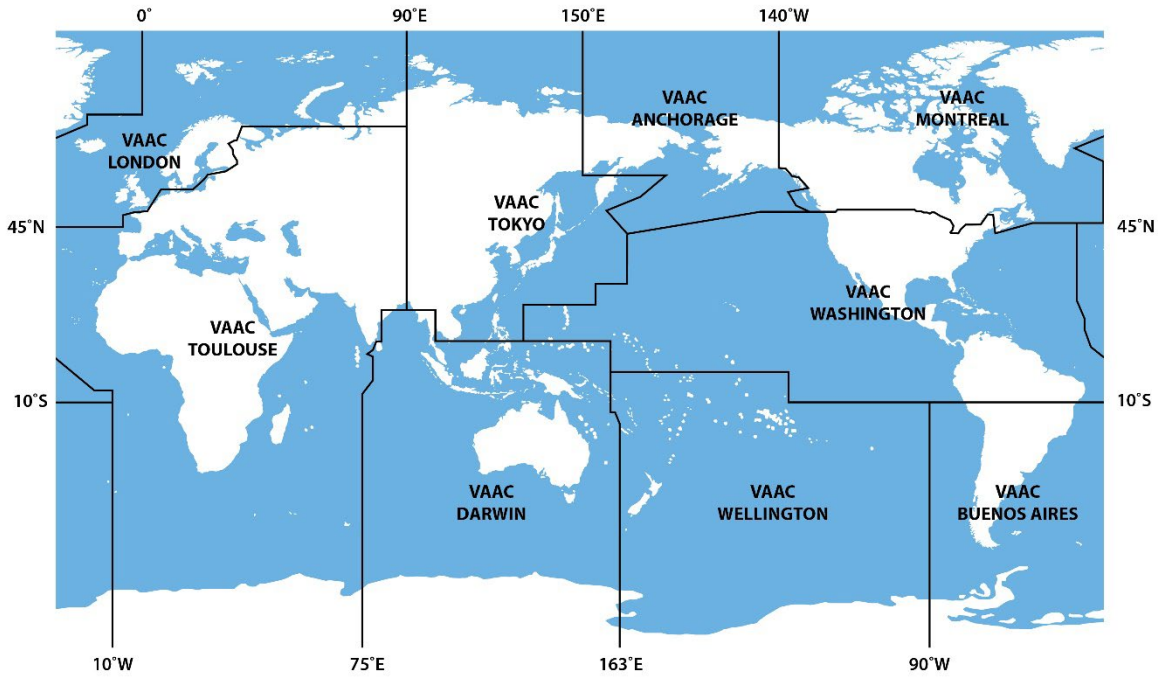
(a) **Observing component** - this comprises observing sources based on existing international ground-based networks, global satellite detection and in-flight air reports, in order to observe/detect volcanic eruptions/ash cloud and pass the information quickly to appropriate Area Control Centres (ACC), Meteorological Watch Offices (MWO) and Volcanic Ash Advisory Centres (VAACs).

(b) **Warning component** - this provides the necessary warnings to aircraft through SIGMETs issued by MWOs, and air route closures/diversionary instructions in NOTAMs (or ASHTAMs) issued by ACCs through AIS units (international NOTAM offices). The SIGMETs and NOTAMs (or ASHTAMs) are based on advisory information supplied by nine designated Volcanic Ash Advisory Centres (VAAC) whose areas of responsibility cover all the major air traffic flows.

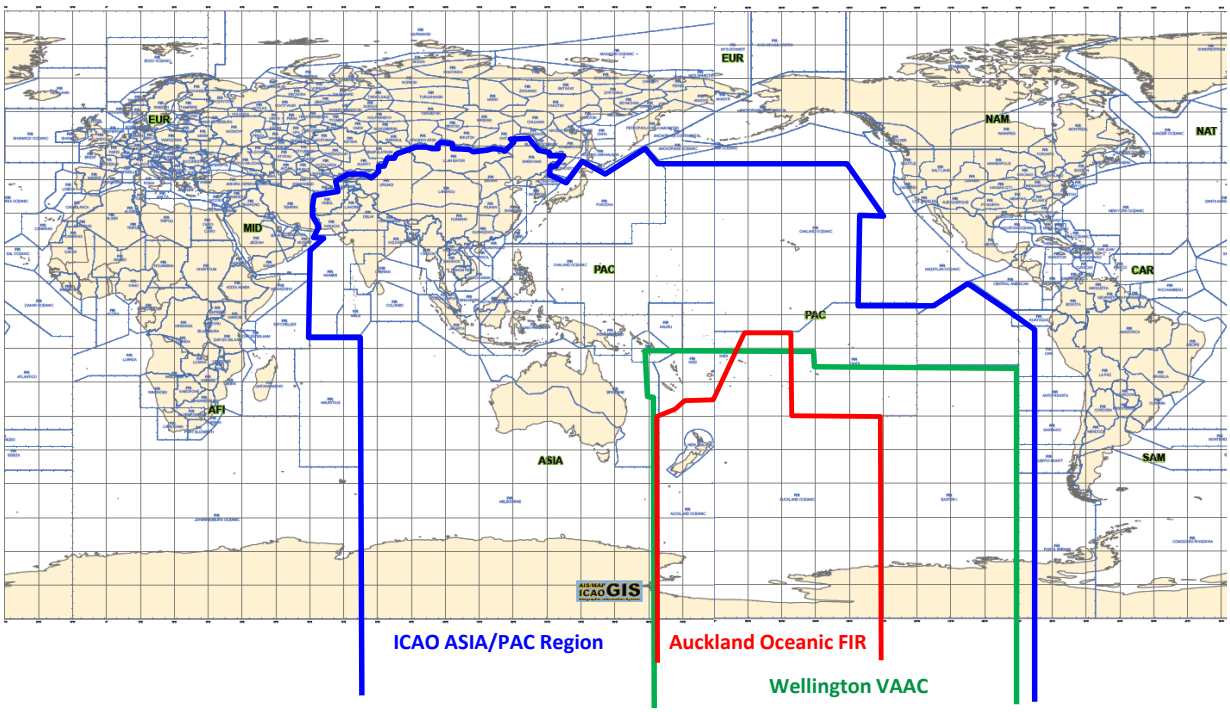
5.3 In any one week, there are usually at least two or three volcanoes erupting somewhere around the globe to trigger the IAVW.

5.4 Work is underway within the Meteorology Panel to develop a volcanic sulphur dioxide (SO2) information service, due to the health impacts of SO2 on aircraft occupants and the corrosive affect of the gas on aircraft components.

5.5 The designated VAACs in the IAVW system are: Anchorage, Buenos Aires, Darwin, London, Montreal, Tokyo, Toulouse, Washington and Wellington with the areas of responsibility shown in the following map.

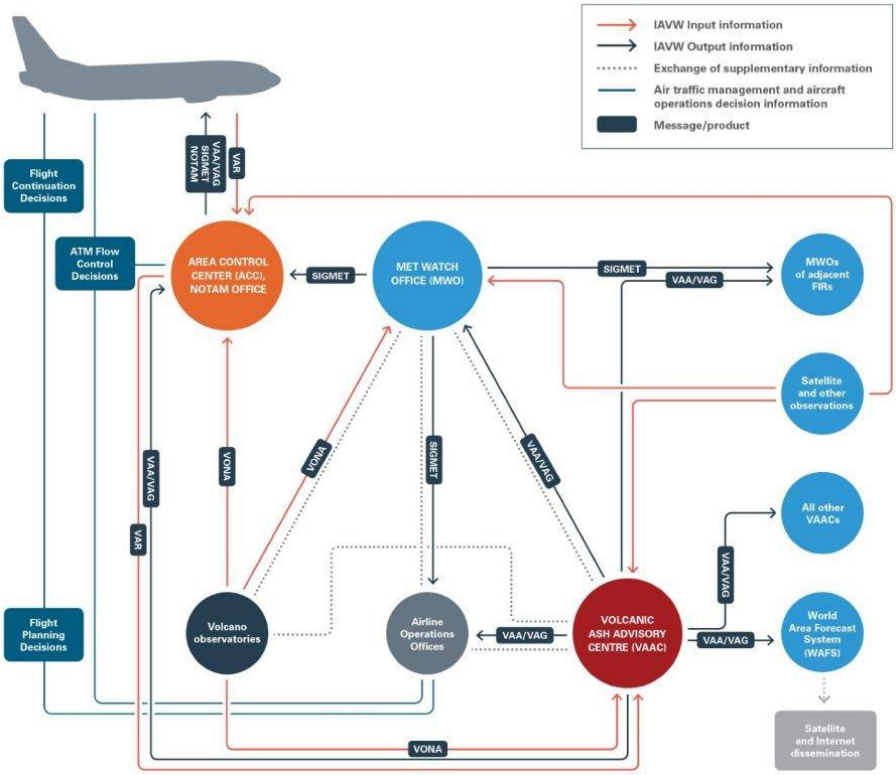


5.6 New Zealand's Areas of Responsibility



Note: the chart above also shows all Flight Information Regions (FIRs). MetService also operates the MWO for the New Zealand and Auckland Oceanic FIRs.

5.7 IAVW System



6. References

Volcanic Activity Report (VAR) forms

Available on the CAA website: https://www.aviation.govt.nz/assets/forms/CA010.pdf

National Civil Defence Plan

https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/

ICAO documents:

- Annex 3 - Meteorological Service for International Air Navigation, Chapters 3, 4, 7 and 9 and Appendices: order through: https://store.icao.int/publications.html
- Handbook on the IAVW - Operational Procedures and Contact List (Doc 9766) https://www.icao.int/airnavigation/METP/Pages/Public-Documents.aspx
- Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691): available through https://store.icao.int/publications.html
- Flight Safety and Volcanic Ash (Doc 9974) http://www.icao.int/publications/pages/publication.aspx?docnum=9974

VAAC Websites:

Anchorage:	https://www.weather.gov/vaac/
Buenos Aires:	https://ssl.smn.gob.ar/vaac/buenosaires/inicio.php?lang=en
Darwin:	http://www.bom.gov.au/aviation/volcanic-ash/
London: https://www.metoffice.gov.uk/services/transport/aviation/regulated/vaac	
Montreal:	https://weather.gc.ca/eer/vaac/index_e.html
Tokyo:	http://ds.data.jma.go.jp/svd/vaac/data/index.html
Toulouse:	http://vaac.meteo.fr/
Washington:	https://www.ssd.noaa.gov/VAAC/washington.html
Wellington:	http://vaac.metservice.com/

Web links:

Civil Aviation Authority	http://www.aviation.govt.nz
GNS Science	http://www.gns.cri.nz
Airways Corporation of NZ	http://www.airways.co.nz
AIP New Zealand	http://www.aip.net.nz
MetService	http://www.metservice.com
GeoNet	http://www.geonet.org.nz

7. Change Record

Date	Change
09/02/2022	Update to reflect change in name of Volcanic Alert Bulletin to Volcanic Activity Bulletin. Clarification that any new VHZ established may be temporary in nature. Various website address updates.