

# HAZARDOUS WEATHER PHENOMENA

## Volcanic Ash

Bureau of Meteorology › Weather Services › Aviation



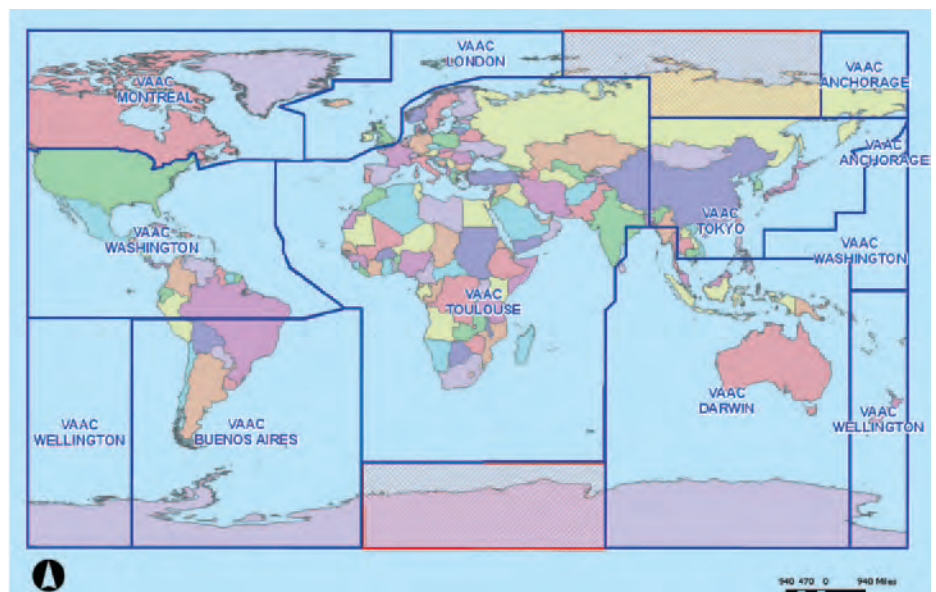
Augustine Volcano, 2006, courtesy of the United States Geological Survey.

Volcanic ash in the air is composed of fine pulverised rock, minerals and glass and is accompanied by a number of gases which are then converted into droplets of sulphuric acid and other substances. It is potentially deadly to aircraft and their passengers.

### Introduction

Volcanic ash in the air is composed of fine pulverised rock, minerals and glass, and is accompanied by a number of gases which are then converted into droplets of sulphuric acid and other substances. It is potentially deadly to aircraft and their passengers. The most critical effect is caused by ash melting in the engine, and then fusing into a glass-like coating on components, causing loss of thrust and possible engine failure. In addition, there is an abrasion of engine parts, the airframe and those parts protruding from the aircraft, and possible clogging of the fuel and cooling systems.

Nine regional Volcanic Ash Advisory Centres (VAAC) are placed throughout the world to detect, track and forecast the movement of volcanic ash clouds and to provide advice to meteorological watch offices in their area of responsibility. These VAAC are located in Anchorage (US), Buenos Aires (Argentina), Darwin (Australia), London (UK), Montreal (Canada), Tokyo (Japan), Toulouse (France), Washington (US) and Wellington (NZ).



Volcanic Ash Advisory Centres – Areas of Responsibility.

The highest concentration of active volcanoes lies along the rim of the Pacific Ocean, the so-called 'Pacific Ring of Fire' which stretches northwards along the western edge of South and North America, across the Aleutian and Kuril Island chains, down through the Kamchatka Peninsula (Russia), Japan and the Philippines and across Indonesia, Papua New Guinea and New Zealand to the islands of the South Pacific. In a 40,000 km horseshoe shape, it is associated with a nearly continuous series of oceanic trenches, volcanic arcs, and volcanic belts and/or plate movements. Other active regions are in Iceland, along the Great Rift Valley in Central and East Africa, and in countries around the Mediterranean.





Tavurvur Volcano, Rabaul, Papua New Guinea, photo by Taro Taylor, courtesy of Creative Commons.



The Pacific Ring of Fire.

## Volcanic Activity

The behaviour of erupting volcanoes ranges from a quiet, steady effusion of lava to highly explosive eruptions which blast several cubic kilometres of volcanic ash and corrosive gases high into the atmosphere and over a wide area for several days. This explosive activity is of greatest concern to aviation, mainly because of the great volume of ash and the heights that the ejecta can reach in these types of eruptions. An ash cloud from a large volcanic eruption can remain in the atmosphere in dangerous concentrations for many days. Over this time, it can travel many thousands of kilometres with the prevailing winds.

Some volcanoes eject modest ash clouds on a regular basis, whereas others are generally quiet until a big eruption event. Semeru (Java), Dukono (Halmahera), and Rabaul (New Britain) are examples of volcanoes that are known to be regular emitters of modest amounts of volcanic ash. Some switch between modes very easily, for example Rabaul and Manam (Papua New Guinea).



Manam Volcano, Papua New Guinea, October 2004, courtesy of NASA.



Mount Pinatubo, 1991, courtesy of the United States Geological Survey.

The movement, spread and dispersion of volcanic ash clouds depends upon:

- The altitude reached by the ash cloud (of primary importance)
- The nature and strength of the eruption
- The meteorological condition of the atmosphere, e.g. atmospheric stability, wind shear and precipitation (as ash particles can be 'rained out')
- The ash concentration and the size distribution of particles.

## Detection & Monitoring

The Darwin VAAC ([bom.gov.au/info/vaac/](http://bom.gov.au/info/vaac/)) is responsible for the monitoring of various sources of information (e.g. ground reports, satellite imagery, pilot reports, online news stories) for volcanic activity within its area of responsibility (which includes Indonesia, the southern Philippines, Papua New Guinea and the western Solomon Islands).

A pilot in command of an aircraft must make a special AIREP report as soon as practicable after encountering or observing any volcanic ash cloud, pre-eruption volcanic activity or volcanic eruption.

A pilot approaching an ash cloud may not be able to distinguish the ash from other clouds such as cumulonimbus. Indications that an aircraft has entered a volcanic ash cloud include the appearance of smoke or dust in the cockpit, and fine ash collecting on flat surfaces. Pilots have reported an acrid odour similar to electrical smoke and the smell of sulphur. Outside the cabin, lightning and St Elmo's Fire may be observed around the aircraft along with a bright orange glow around jet engine inlets, torching from the tailpipe, and flameouts. The windscreen can become eroded and opaque very rapidly and there is the likelihood of electrical equipment overheating and warning lights coming on.

## Forecasts & Warnings

The Darwin VAAC is responsible for the issuance of Volcanic Ash Advisories (VAA) within its area of responsibility, and of SIGMET for the Brisbane and Melbourne Flight Information Regions (FIR).

It is important that pilots flying over areas known for volcanic activity review all relevant advisories and forecasts prior to departure and monitor updates enroute.

While long-term forecasting of volcanic eruptions is not possible, volcanologists are able to give short-term forecasts based on their own monitoring techniques (e.g. seismic activity, ground deformations). Although primarily used for providing warnings to local communities, this information can be used by VAAC in providing advice to the aviation industry on imminent eruptions and their expected nature (e.g. whether an eruption is likely to reach cruising levels).

The following aviation products can include volcanic ash information:

- Volcanic Ash Advisory (VAA)
- SIGMET
- Significant Weather Chart (SIGWX)
- Meteorological Report (METAR/SPECI)
- Aerodrome Forecast (TAF)
- Trend Forecast (TTF)
- Area Forecast
- Aerodrome Warning
- Volcanic Activity Report
- Special Air Report

In addition the Darwin VAAC produces a daily Volcanic Activity Summary for volcanoes in the region.



Sarychev Volcano, Kuril Islands, 2009, courtesy of NASA.





**Australian Government**  
**Bureau of Meteorology**

Airservices Australia is the official distributor of aviation forecasts, warnings and observations issued by the Bureau of Meteorology. Airservices' flight briefing services are available at [www.airservicesaustralia.com](http://www.airservicesaustralia.com). Telephone contact details for elaborative briefings are contained in Airservices' Aeronautical Information Publication Australia (AIP), which is available online through their website.

Other brochures produced by the Bureau of Meteorology's aviation weather services program can be found at [www.bom.gov.au/aviation/knowledge-centre](http://www.bom.gov.au/aviation/knowledge-centre).