Department for Transport

Met Office

BGS

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Transport hazard summary series

Volcanic eruptions

Although the UK has no active volcanoes, it is still at risk from eruptions elsewhere, particularly from Iceland which has around 30 volcanic systems.* Ash-producing eruptions pose the most serious hazard to transport, most notably to aviation. Well-established safety procedures are in place to manage these hazards if UK airspace is affected by volcanic ash. Nevertheless, disruption could include severe flight delays, diversions and cancellations, impacting both passenger and freight movement.

The Department for Transport, Met Office and partners, including the British Geological Survey, have created this series of transport hazard summaries to explain natural hazards and other hazards that are not the result of malicious acts, their impacts and how they may change in the future.

This summary will introduce what is meant by volcanic eruptions and how they can impact transport. It offers further information to help decision makers manage and adapt to these risks.

Research has estimated a 20% chance of an eruption causing an ash plume over northern Europe in any 10-year period.†

* Icelandic Meteorological Office, Institute of Earth Sciences, University of Iceland, and Civil Protection Department of the National Commissioner of the Iceland Police, 'Catalogue of Icelandic Volcanoes', available at: **https://icelandicvolcanos.is/**

† Watson, E.J., Swindles, G.T., Savov, I.P. and others, Earth and Planetary Science Letters, 'Estimating the frequency of volcanic ash clouds over northern Europe', volume 460, pages 41 to 49, 2017, available at: **https://doi.org/10.1016/j.epsl.2016.11.054**

What are volcanic eruptions?

Volcanic eruptions happen when magma (molten rock) in the Earth's crust breaks through the Earth's surface, releasing volcanic ash, gases, particles and sometimes lava. The hazards that are of greatest concern for UK transport are volcanic ash and volcanic gases.

Volcanic ash is composed of fine, sharp particles of rock and glass made from solidified magma. If carried by winds, volcanic ash plumes can affect areas up to thousands of kilometres from the eruption site. Ash plumes pose a serious risk to aircraft as ash can damage engines, flight instruments and external surfaces such as windscreens.

Volcanic gases such as sulphur dioxide can be harmful and may be transported by the wind. Volcanic gases can also react in the atmosphere to create microscopic particles. If an aircraft passes through high concentrations of volcanic gas and particles, they might impact aircraft passengers' health, especially those with existing respiratory illnesses.*

There are two main styles of volcanic activity: explosive and effusive.†

Explosive activity violently blasts ash, gases and particles high into the atmosphere, often causing widespread disruption.

Effusive activity mainly produces lava as well as volcanic gases and particles low in the atmosphere and generally does not cause disruption to transport in the UK.

A volcanic eruption will generally produce a combination of ash, gases and particles at the immediate onset and initially it may not be clear whether it will produce a disruptive ash plume. The style of the eruption can change over time.

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* Horwell, C.J., Ravenhall, S., Clarkson, R. and others, Journal of Applied Volcanology, 'Physical, psychological and behavioural responses of aircraft occupants to volcanic emissions', volume 14, article number 5, 2025, available at: **https://doi.org/10.1186/s13617-025-00153-4**

† British Geological Survey, 'Eruption styles', available at: **https://www.bgs.ac.uk/discovering-geology/earth-hazards/volcanoes/eruption-styles/**

What are the impacts of volcanic eruptions on the UK?

Where do eruptions occur?
Volcanoes are found across the globe, but the UK's main volcanic risk comes from Iceland.* Although unlikely, large eruptions in Europe or North America could also directly affect the UK if winds carry the ash, gases and particles in the right direction. Disruption from eruptions across the globe could also have knock-on impacts to flights to and from the UK.

When do eruptions happen?
Volcanic eruptions can happen at any time of year and may be anticipated if a volcano is monitored. Research has estimated a 20% chance of an eruption causing an ash plume over northern Europe in any 10-year period.†

How long do the impacts last?
Some eruptions last only a few hours or days, while others, like that of the Eyjafjallajökull volcano in Iceland in 2010, can continue for weeks or months. If an effusive eruption comparable in scale to the 1783 to 1784 Laki eruption in Iceland occurred today, it could cause repeated pollution episodes each lasting from hours to weeks, leading to poor air quality, disruption to aviation and serious health impacts across the UK.‡

Volcanic ash and air quality advisories

The UK Civil Aviation Authority and the London Volcanic Ash Advisory Centre (hosted by the Met Office) issue advisories and forecasts for the North Atlantic region to allow flight safety decisions to be made.§ These advisories are updated to reflect changes in wind direction and volcanic activity. More information can be found in 'Further reading'.

In the event of volcanic ash, gas and particles reaching the UK, relevant information on the levels of these pollutants can be found from the ground-level air pollution forecasts provided by the Department for Environment, Food and Rural Affairs.¶ For more information see the 'Air quality and air pollution' transport hazard summary.

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* Met Office, 'Volcanic activity in Iceland', available at: **https://www.metoffice.gov.uk/services/transport/aviation/regulated/international-aviation/vaac/iceland**

† Watson, E.J., Swindles, G.T., Savov, I.P. and others, Earth and Planetary Science Letters, 'Estimating the frequency of volcanic ash clouds over northern Europe', volume 460, pages 41 to 49, 2017, available at: **https://doi.org/10.1016/j.epsl.2016.11.054**

‡ Witham, C., Aspinall, W., Braban, C. and others, Effusive Eruption Modelling Project Final Report: 'UK hazards from a large Icelandic effusive eruption', 2015, available at: **https://nora.nerc.ac.uk/id/eprint/512598/1/N512598CR.pdf**

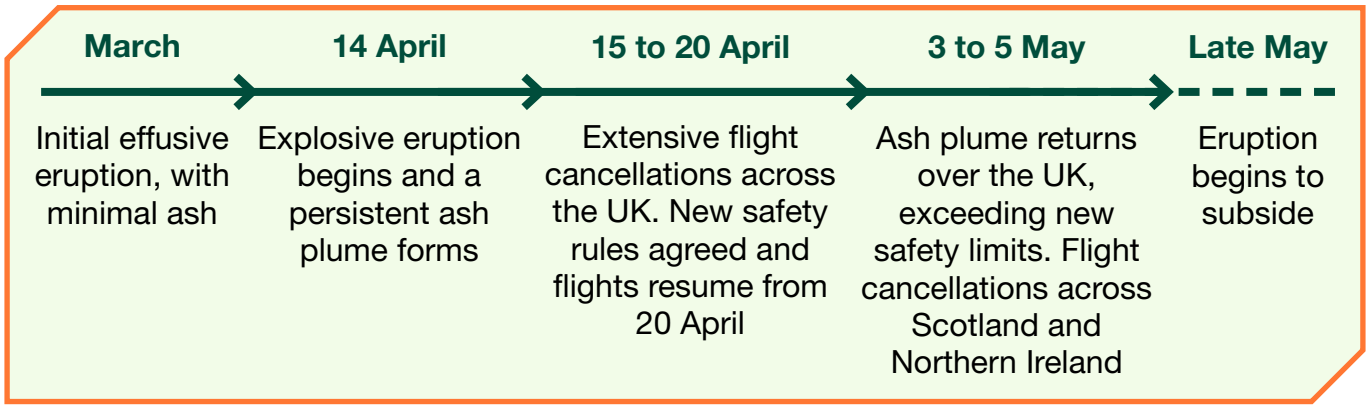
§ Met Office, 'Volcanic Ash Advisory Centre (VAAC) – International Aviation', available at: **https://www.metoffice.gov.uk/services/transport/aviation/regulated/international-aviation/vaac/index**

¶ Department for Environment, Food and Rural Affairs, 'UK Air Information Resource', available at: **https://uk-air.defra.gov.uk/**

Case study

In 2010, the Eyjafjallajökull volcano in southern Iceland erupted, producing an ash plume that at times drifted across Europe.* Although moderate in size compared with eruptions such as Mount St Helens in 1980 or Laki in 1783 to 1784, the eruption caused severe disruption to air travel across Europe, with knock-on impacts to other modes of transport.†

Figure 1: Timeline of the 2010 eruption of Eyjafjallajökull volcano.*



Aviation: In April 2010, around 100,000 flights were cancelled over an eight-day period, affecting an estimated 10 million people across the UK and Europe.‡ At times, almost all commercial flights in and out of UK airports were suspended, stranding passengers and aircraft across the globe and having knock-on effects for airline operations for weeks. The disruption highlighted aviation's vulnerability to volcanic ash, prompting new safety measures and improved management.

Other transport modes: While ash did not significantly impact roads or rail in the UK, the loss of air travel shifted demand heavily onto cars, coaches, ferries and rail services. UK railways and cross-channel ferry operators experienced surging passenger numbers and were forced to increase service capacity to manage the transport crisis.

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* UK Civil Aviation Authority, 'A history of ash and aviation', available at: **https://www.caa.co.uk/safety-initiatives/safety-projects/volcanic-ash/a-history-of-ash-and-aviation/**

† Gudmundsson, M.T., Thordarson, T., Höskuldsson, A. and others, Scientific Reports, 'Ash generation and distribution from the April-May 2010 eruption of Eyjafjallajökull, Iceland', volume 2, article 572, 2012, available at: **https://doi.org/10.1038/srep00572**

‡ Eurocontrol, 'Ash Impact on Traffic', 2010, available at: **https://www.eurocontrol.int/sites/default/files/article/attachments/201004-ash-impact-on-traffic.pdf**

Future impacts of volcanic eruptions

If a similar event to the 2010 Eyjafjallajökull eruption happened today, it would be less likely to cause widespread disruption. Aviation authorities now operate under new safety regulations for volcanic ash, meaning the widespread airspace closures seen in 2010 would be less likely to occur.* However, the UK is increasingly reliant on aviation for travel and trade. UK airports handled around 30 million passengers a year in 1970, rising to almost 300 million by 2019.† As flights and passenger numbers keep rising, the potential impact of a larger eruption in Iceland or elsewhere could still be greater.

How do volcanic eruptions affect the climate?

Volcanic eruptions can influence the global climate by injecting vast amounts of ash, gas and particles into the atmosphere. These volcanic particles can reflect sunlight away from Earth, temporarily cooling the planet.

- The 1815 eruption of Mount Tambora in Indonesia caused 1816 to be known as the 'year without a summer' in Europe. Volcanic emissions from Tambora's eruption spread worldwide, making western Europe, including the UK, abnormally cold and wet that summer and causing widespread crop failures.‡
- The 1991 eruption of Mount Pinatubo in the Philippines led to a global temperature drop of around 0.6°C over the following year.§

Colder, wetter conditions can mean more snow, ice, heavy rain and fog, leading to increased weather-related transport disruption. The cooling effects from volcanoes are usually short-term, but they show how eruptions can affect climate at a global scale.

Does climate change affect volcanic eruptions?

There is some evidence for links between climate change processes and volcanic processes before, during and after eruptions, but the overall impact is currently very uncertain.¶

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* Lechner, P., Tupper, A., Guffanti, M., Loughlin, S., and Casadevall, T., 'Volcanic ash and aviation: The challenges of real-time, global communication of a natural hazard', in: Fearnley, C.J., Bird, D.K., Haynes, K. and others (eds.), Observing the Volcano World: Advances in Volcanology. Springer, pages 51-64, 2017, available at: **https://link.springer.com/chapter/10.1007/11157_2016_49**

† Department for Transport and Civil Aviation Authority, 'Aviation statistics: data tables (AVI)', 2018, available at: **https://www.gov.uk/government/statistical-data-sets/aviation-statistics-data-tables-avi**

‡ University Corporation for Atmospheric Research, 'Mount Tambora and the year without a summer', available at: **https://scied.ucar.edu/learning-zone/how-climate-works/mount-tambora-and-year-without-summer**

§ NASA Earth Observatory, 'Global effects of Mount Pinatubo', available at: **https://earthobservatory.nasa.gov/images/1510/global-effects-of-mount-pinatubo**

¶ Aubry, T.J., Farquharson, J.I., Rowell, C.R. and others, Bulletin of Volcanology, 'Impact of climate change on volcanic processes: current understanding and future challenges', volume 84, article 58, 2022, available at: **https://doi.org/10.1007/s00445-022-01562-8**

Direct transport impacts due to volcanic eruptions

Vehicle operations

- Volcanic ash can melt inside jet engines and re-solidify as glass in cooler parts, blocking airflow and causing damage that may lead to engine failure. This happened on flight BA009 in 1982, which experienced temporary failure of all four jet engines after flying through an ash plume.* Ash is also abrasive and can damage propeller blades and helicopter rotor blades.
- Windscreens and external aircraft parts can become scratched, reducing visibility during flights and requiring repair or replacement.
- Volcanic ash can clog air filters in aircraft engines, reducing performance and increasing maintenance requirements.

Service operations

- Flight cancellations due to volcanic ash plumes can increase demand on roads, railways and ferries as passengers seek alternatives. Freight normally taken by air may be delayed, affecting supply chains. IT systems and servers may also come under heavy load as large numbers of people rearrange travel plans.

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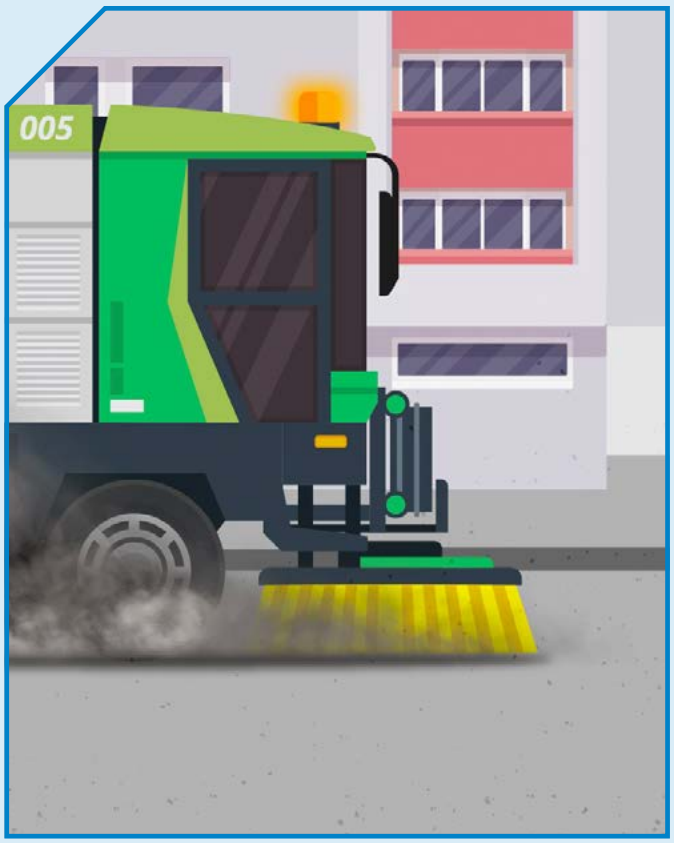
* Meach, R., Horwell, C.J., de Terte, I. and others, International Journal of Disaster Risk Reduction, '"All Four Engines Have Failed": A qualitative study of the health impacts, reactions and behaviours of passengers and crew onboard flight BA009 which flew through a volcanic ash cloud in 1982', article number 105558, 2025, available at: **https://doi.org/10.1016/j.ijdrr.2025.105558**



Infrastructure

- In the UK, ash fall from past eruptions has been too light at ground level to affect infrastructure. However, a larger eruption could deposit ash on roads, runways and railway tracks, requiring increased cleaning and maintenance.

Human health and safety

- Volcanic ash can irritate eyes and skin, and cause breathing difficulties for people on aircraft, especially those with respiratory conditions.*
- Volcanic gases such as sulphur dioxide can cause irritation and breathing difficulties for people on aircraft. Even healthy individuals may experience immediate eye, nose and throat irritation from high sulphur dioxide levels in a pressurised cabin.*
- Flight cancellations create stress and uncertainty for travellers and can spill over to other modes as demand surges for alternative travel arrangements.
- Rerouting of flights could place additional pressure on air traffic control, airline crews and airport staff.

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* Meach, R., Horwell, C.J., de Terte, I. and others, International Journal of Disaster Risk Reduction, '"All Four Engines Have Failed": A qualitative study of the health impacts, reactions and behaviours of passengers and crew onboard flight BA009 which flew through a volcanic ash cloud in 1982', article number 105558, 2025, available at: **https://doi.org/10.1016/j.ijdrr.2025.105558**

Risk mitigation and adaptation

There are already a range of methods used in the UK and internationally to reduce the impact of volcanic eruptions on transport networks. Examples include:

- developing emergency transport plans to increase capacity on other modes of transport if flights are grounded due to volcanic ash, helping maintain passenger and freight movement
- being alerted to volcanic ash plumes that could affect UK airspace through advisories and forecasts from the Met Office's London Volcanic Ash Advisory Centre and the Icelandic Met Office, and knowing the limits for aircraft in volcanic ash so flights can be rerouted, delayed or cancelled as needed
- training pilots and crew on recognising and responding to volcanic gas exposure, including potential effects on passengers and cabin air quality
- conducting regular contingency planning and exercises, ensuring that airports, airlines and air traffic control have clear procedures for rapid response, rerouting flights and communicating with passengers

Questions for decision makers

- Have you integrated volcanic ash advisories into your emergency response plans?
- Do you have clear procedures for diverting, delaying or grounding flights if ash threatens safety?
- Can your transport network cope with a sudden surge in demand for alternatives to air travel?
- Are your vehicles and infrastructure protected against ash exposure?
- Are you able to quickly inform passengers, freight operators and the public about cancellations, delays and diversions caused by volcanic ash?

Further reading

Volcanic Ash Advisory Centre – Met Office

Volcanic ash – UK Civil Aviation Authority

Volcanoes geology overview – British Geological Survey

Volcanic monitoring in Iceland – Icelandic Met Office

Climate information and risk assessment

See the ‘Transport hazards, risks and resilience’ transport hazard summary for more information on identifying and planning for risks to transport.