



**Second Interim Threat Assessment
Ash cloud following volcanic eruption in Iceland
20 April 11:00 CET**

SOURCE AND DATE OF REQUEST

European Commission, 16 April 2010

PUBLIC HEALTH ISSUE

Potential public health impact of the ash cloud released by the eruption of a volcano in Iceland.

CONSULTED EXPERTS

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EVENT BACKGROUND INFORMATION

A volcano under Iceland's Eyjafjallajökull glacier erupted Wednesday 14 April for the second time in a month, spewing clouds up to 10,000 metres into the air. The volcanic plume is currently highly dispersed, spreading from roughly Atlantic Canada to Moscow and from the Arctic Circle to the Mediterranean region, hovering at an average of 6,000 metres. However, the altitude of the plume may vary over time and place.

Volcanic eruptions are composed of gasses and pyroclastic compounds¹. Volcanic ash is composed of fine particles of fragmented volcanic rock. It consists of hard particles that do not dissolve in water, are very abrasive and mildly corrosive. Ash varies depending upon the type of volcano and the type of eruption. Ash in the

atmosphere can block sunlight and sometimes causes complete darkness during day light, particularly in the areas close to the eruption site.

Iceland posted a EWRS message indicating the chemical analysis of the ash taken from samples on the ground in Iceland on 15 April 2010². The main constituents are:

- 60 % SiO₂, silicon dioxide (silica)
- 16% Al₂O₃, aluminium oxide
- 10% FeO, iron oxide

The ash is finer and more acidic than anticipated and widely dispersed. It contains high levels of silica and its dust is abrasive and irritating in high concentrations. The ash fallout has not been detected in Sweden or England, except for minor traces of dust. Fallout has been observed in southern Norway (from an eruption of the same volcano earlier this year), and unconfirmed dry fallout in Switzerland at 3,600m. It is expected that wet deposits have occurred, but no details are currently available.

Gaseous component of volcanic eruptions typically includes sulphur dioxide (SO₂), hydrogen chloride (HCl), hydrogen fluoride (HF), hydrogen sulphide (H₂S), carbon monoxide (CO) and radon (Rn)³. These gasses can pose a public health threat when in close proximity to the eruption and in high concentration. There is no current information about the composition of the gas related to this specific eruption. However, the gaseous component of volcanic eruptions of a previous eruption of the same volcano revealed at the beginning of April, gas flux of sulphur dioxide (SO₂) of approximately 3,000 tons per day, hydrogen fluoride (HF) of approximately 30 tons per day.

Radiation measurements taken across the UK and Europe indicate no evidence of radioactive material of any significance⁴.

On the 16 of April, Iceland issued a EWRS message to acknowledge that:

- Currently no adverse effects on human health have been reported in Iceland due to the volcanic ash and gas;
- Chemical analysis of the ash is ongoing. 25% of the particles are less than 10 microns in size and can therefore reach the lower respiratory airways;
- Some basic protective recommendations were issued by the Icelandic authorities:
 - Wear protective clothing and high-efficiency dust masks outside;
 - If no approved mask is available, a fabric mask improvised from handkerchiefs, cloth, or clothing will filter out the larger ash particles which may contribute to throat and eye irritation;

- Patients with chronic bronchitis, emphysema, and asthma are advised to stay inside and avoid unnecessary exposure to ash;
- In fine-ash environments, wear goggles or corrective eyeglasses instead of contact lenses to protect eyes from irritation;
- Keep all doors closed when there is a heavy accumulation of ash.

Potential health impact background information

Short-term effects of exposure to ash fallout

Population exposed to ash falls or noxious gases (mainly sulphur dioxide) could experience short-term respiratory, ophthalmic and/or dermatologic symptoms.

a. Respiratory symptoms

Some ash particles can be so fine that they are inhaled deep into the lungs. With high exposure, even healthy individuals will experience chest discomfort with cough and irritation. Short-term symptoms can include:

- Slight dyspnoea (shortness of breath);
- Nasal irritation and discharge;
- Airway irritation;
- Sore/irritated throat, sometimes accompanied by dry cough;
- People with respiratory underlying conditions like asthma or bronchitis might experience an exacerbation of their respiratory disease.

Asthma sufferers, especially children who may be heavily exposed to the ash when playing outside, may suffer bouts of coughing, tightness of the chest and wheezing. Some people who have never knowingly had asthma before may experience asthma-like symptoms following an ash fall, especially if they go outdoors in the ash and over-exert themselves.

b. Ophthalmic symptoms

Eye irritation is a common health effect as pieces of grit can cause painful scratches, corneal abrasions and conjunctivitis. Contact lens users need to be aware of this problem and leave out their lenses to prevent corneal abrasion from occurring.

Symptoms could include:

- Corneal abrasions or scratches;
- Acute conjunctivitis or the inflammation of the conjunctival sac that surrounds the eyeball due to the presence of ash, which leads to redness, burning of the eyes, and photosensitivity;
- Foreign body sensation in the eyes due to particles;
- Eyes becoming painful, itchy or bloodshot;
- Sticky discharge or tear flow.

c. Dermatologic symptoms

While not common, volcanic ash can cause skin irritation for some people, especially if the ash is acidic.

Symptoms could include:

- Irritation and reddening of the skin;
- Secondary infections due to scratch.

In spite of these potential symptoms, epidemiologic studies of populations exposed to past volcanic eruptions are inconclusive.

A four year prospective cohort study for the 1980 Mt. St. Helen's eruption showed a significant exposure-related decline in FEV (Forced Expiratory Volume) occurring in the 1st year of exposure. However the decline was short-lived. Self-reported symptoms of cough, phlegm, and wheeze were also short-lived⁵.

A separate study of acute health effects, relating to the 1996 eruption of Mt. Ruapehu, showed a borderline increase of acute bronchitis and conflicting evidence of cardiovascular disease. However, the effects were limited and deemed to be of minor public health importance⁶.

In another study, no association between living in an area exposed to volcanic ash particles and either asthma symptoms or use of asthma medication. There was a small but non significant increase in nocturnal shortness of breath in the exposed group⁷.

Long-term effects of exposure to ash fallout

No evidence suggesting long-term health effects of ash fallout has been identified.

ECDC threat assessment for the EU

1. Public health risks (short-term)

Iceland:

- Significant overall risk due to higher concentration of ash and potential risk of gasses, but dependent on weather patterns;
- Direct contact with dust may lead to respiratory, dermatological or ophthalmological irritation;
- High concentrations of fluoride deposits mainly affect animal health due to livestock grazing.

Rest of Europe:

- Gas fallout (e.g. SO₂) is not considered to have a major health impact due to diffusion of plume and nature of atmospheric reactions which prevent gasses from reaching the ground;
- Highly dispersed nature of plume is expected to result in low concentration of particulate matter at ground level, with low risk to public health across the EU. Ongoing analysis is needed;
- Low contribution to ground-level concentrations of particulate matter should lead to minimal health effects attributed to the eruption;
- Main fallout anticipated during rain episodes could lead to skin irritations due to abrasive nature of particles and potential acidity of the rain;
- Respiratory risk appears to be minimal due to size of particles expected to fall out. More analysis on the size distributions of particles is needed.

2. Public health risks (long-term)

Iceland:

- High concentrations of chemicals near the site of eruption may pose a threat for contamination of water and the food chain;
- Considerable exposures to fluoride can pose a public health threat;
- Heavy metals, e.g. Cr, Ni, Zi, can also pose public health risks with high exposure levels.

Rest of Europe:

- The long-term public health risks are very low;
- Fluoride concentration in ash plume is not expected to be a significant long-term risk in locations distant from site of eruption.

3. Public health impacts (indirect)

- Substantial interruptions to air traffic. This could have health implications such as:
 - Medical materials cannot be delivered, e.g. bone marrow for leukaemia patients;
 - Some difficulties moving surgeons around to sites of patients / scheduled operations;
 - Medical evacuation in remote areas (e.g. oil rigs) in addition;
 - Supply of drugs or spare parts for medical equipment.
- Impacts upon agriculture and water supplies; ash fallout could impact crop production⁸, animal health (esp. grazing livestock), and water quality⁹;
- Psychological impact of the situation on the populations:
 - Those directly exposed to ashes in Iceland;

- Those experiencing travel problems.

Conclusions

Populations in the close vicinity of the volcanic eruption are at risk to be affected by noxious gas and by the high concentration of ashes in the atmosphere. Such population are only located in parts of Iceland directly exposed to the ashes. Iceland has implemented preventive measures. Iceland and a few EU Member States, such as UK and France, have syndromic surveillance in place and are using it to monitor potential impact.

In the rest of Europe, population might be exposed to very low concentrations of ashes. The public health impact of such low exposure is considered negligible. Any such health effects are likely to be short-term and should be monitored. Some Member States have advised risk groups, such as asthmatics, to carry inhalers with them and avoid excessive outdoor activity in case of exacerbated symptoms.

Member States are monitoring particulate matter in real-time across 700 stations in the EU, and have not observed any noticeable impact related to the eruption. In areas experiencing rainfall, the possibility of skin irritations caused by ash fallout exists. Wet deposits should be monitored.

Should continued volcanic activity persist, the threat assessment may need to be updated in light of altered levels of exposure to ash fallout.

CONTACTS

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UPDATE

This is an interim threat assessment, and will be updated as more information accrues.

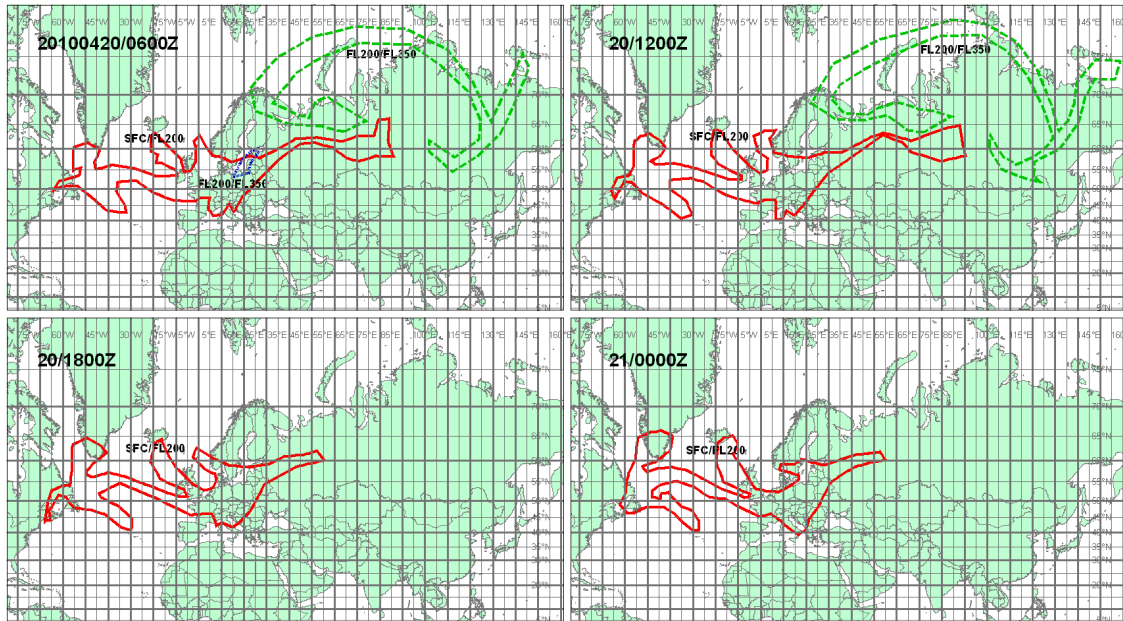
REFERENCES

- <http://volcanoes.usgs.gov/ash/properties.html>
- http://www.ivhhn.org/index.php?option=com_content&view=article&id=55&Itemid=61
- <http://www.metoffice.gov.uk/corporate/pressoffice/2010/volcano.html>
- European Centre for Medium-Range Weather Forecasts <http://www.ecmwf.int>
- Institute of Earth Sciences, Iceland (it has a page on publications) http://www.earthice.hi.is/page/ies_Eyjafjallajokull_eruption

- Scottish Environment Protection Agency
http://www.sepa.org.uk/about_us/news/2010/volcanic_ash_cloud_-_the_lates.aspx

Appendix

The Met Office (UK's National Weather Service) has produced maps of the projected extension of the ash cloud during the 24-hour period of 20 April:



VA ADVISORY
DTG: 20100420/0600Z
VAAC: LONDON
VOLCANO:
EYJAFJALLAJOKULL 1702-02
PSN: N6338 W01937
AREA: ICELAND

SUMMIT ELEV: 1666M
ADVISORY NR: 2010/025
INFO SOURCE: ICELAND MET OFFICE
AVIATION COLOUR CODE: RED
ERUPTION DETAILS: ERUPTION CONTINUING
TO AROUND 4000M WITH LAVA VISIBLE IN THE
CRATER.

RMK: NO SIG ASH ABOVE FL350, AND FROM 20/1800Z NO SIG ASH
ABOVE FL200
NXT ADVISORY: 20100420/1200Z

¹ <http://volcanology.geol.ucsb.edu/frags.htm>

² <http://www.earthice.hi.is/page/IES-EY-CEMCOM>

³ Hansell A. & Oppenheimer C. 2004. Health hazards from volcanic gases: A systematic literature review. *Archives of Environmental Health*, Vol. 59: 628-639/

⁴ http://www.sepa.org.uk/about_us/news/2010/volcanic_ash_cloud_-_the_lat-1.aspx

⁵ Buist S. et al. 1986. A four-year prospective study of the respiratory effects of volcanic ash from Mt. St. Helens. *American Review of Respiratory Disease*, Vol. 133(4): 526-34.

⁶ Hickling J. et al. 1999. Acute health effects of the Mount Ruapehu (New Zealand) volcanic eruption of June 1996. *International Journal of Environmental Health Research*, Vol. 9: 97-107.

⁷ Bradshaw L. et al. 1997. Under the volcano: fire, ash and asthma? *New Zealand Medical Journal*, Vol. 110: 90-91.

⁸ Cook R.J. et al. 1981. Impact on Agriculture of the Mount St. Helens Eruptions. *Science*, Vol. 211 (2 January): 16-22

⁹ Hindin E. 1982. 'Rendering ash contaminated water potable'. In: Keller, S.A.C. (ed.), *Mount St. Helens: One Year Later*, Eastern Washington University Press.