University of Reading

IMPACT CASE STUDY

Volcanic Ash

Monitoring and forecasting risk to aircraft

Research to develop instrumentation and to develop models relevant to the dispersal of volcanic ash played a key role in establishing the requirement for a flight ban during the eruption of the Eyjafjallajökull volcano, but also in the adoption of a flexible approach to its staged lifting as the emergency continued. This led to new procedures being put in place across Europe which minimised the economic costs and human inconvenience caused by such eruptions without unacceptable risks to passengers and crew.

Research

The Eyjafjallajökull eruption on 14th April 2010 in Iceland resulted in a large ash plume covering the UK and Europe. This caused safety concerns over the use of aircraft in UK airspace, as volcanic ash can seriously damage aircraft engines, and a flight-ban was enforced from 15th April. Prior to the eruption, research from the Department of Meteorology at the University of Reading had developed a range of sensors and data acquisition system for weather balloons, to study cloud and dust electrification. The Cabinet Office requested the help of the research team and their instrumentation during the early phase of the flight ban to sample and give expert guidance on the size, location and make-up of volcanic ash clouds over UK airspace.

The Met Office's NAME (Numerical Atmospheric dispersion Modelling Environment) model was being used to provide information about the plume. Assistance to perform detailed analysis of the NAME model output during the crisis was requested by the Met Office, and so a further strand of research at Reading focussed on analysing the output of the model alongside different measurements taken of the plume from a range of sources. This work was initially started in order to validate the forecasts produced by the model, however it also became apparent that the model was limited in terms of not being able to produce a realistic quantitative forecast, so the team worked with the Met Office on the NAME model to develop the methodology in order to produce a concentration forecast of the volcanic ash plume.

The Eyjafjallajökull eruption resulted in the closure of European airspace; with 100,000 flights cancelled, and over 10 million people directly affected by the disruption

Impact

The Eyjafjallajökull eruption resulted in the closure of European airspace; with 100,000 flights cancelled, and over 10 million people directly affected by the disruption. The International Air Transport Association (IATA) has estimated the airline industry worldwide lost £130 million per day as a result of the Eyjafjallajökull eruption (as reported in The Guardian newspaper, 16 April 2010).

The flight bans were brought into effect due to the severe damage that volcanic ash causes to jet aircraft. The decisions made by European nations were based on scientific advice provided by the London VAAC (Volcanic Ash Advisory Centre, part of the Met Office), and relayed by the European Organization for the Safety of Air Navigation (EuroControl). However, national authorities soon came under pressure from European airlines to lift the bans, and after the bans had been in place for three days all major airlines claimed that authorities had been overly cautious in their approach. In particular, they disputed the validity of the Met Office's NAME model in use by the VAAC, and dismissed the estimates it gave of the extent of the ash cloud as being 'theoretical'. The validity of the NAME model therefore became one of the central issues in the crisis and its testing became an urgent requirement.

The measurements taken by using the dust-monitoring technology developed by the research team helped to immediately support the data derived from the NAME model and to map the ash cloud. During the initial phase of the Eyjafjallajökull eruption, the measurements provided by the instrumentation confirmed that, under the 'zero risk' procedure in force at that time, a flight ban should remain in place.

The research on the NAME model itself compared the predictions from the model to many actual observations including those from ground-based lidar. Further research by the team also developed a methodology to enable the model to come up with a realistic quantitative forecast. This enabled NAME to provide a forecast which was able to give concentrations of volcanic ash.

The impact of this was that VAAC were able to divide NAME predicted maps into three zone types (depending on the degree of contamination), and in this way, flight bans could be restricted to smaller regions as the eruption progressed. On April 20th, there was a partial reopening of European airspace, and by April 22nd, eight days after the eruption had begun, regular flight schedules resumed. Financially, this meant that losses by the airline industry were reduced during the latter days of the eruption.

The impact of flight bans was not only limited to the cost incurred by the airline industry, there were also impacts on freight and cargo, on displacement of individuals who were stranded in transit, on events which required the travel of individuals (such as sporting events) and on business, with several sectors that depend on air freighted imports and exports being badly affected by the flight disruptions.

42,600 flights were cancelled on the first three days of the Eyjafjallajökull crisis. However, for the subsequent Grímsvötn eruption in May 2011, there was a much reduced impact on aviation and only 900 flights were cancelled in the corresponding interval. The research effort described here contributed to this, by enabling the accurate assessment of air space hazard. The reason for this reduction in flight cancellations was highlighted by the EU, with Europa.eu (the official website of the EU) Memo/11/346 stating: 'This is partially due to the different nature of the Grímsvötn volcano as well as different weather conditions. But to a much greater extent it is due to the more precise risk assessment procedures that have been put in place in Europe – allowing for a much more graduated response and minimising closure of European airspace.'

Funding:

This instrumentation development and related research described here was funded through a NERC PhD studentship and the NERC-funded Saharan dust electrification (DREAME) projects. Related work continued through a NERC technology development funding project (MORSE). An NCAS (Natural Centre for Atmospheric Science) Weather Core Grant funded the research on the development of the Met Office's NAME model.

The production of this case study has been funded by Natural Environment Research Council.

NATURAL ENVIRONMENT RESEARCH COUNCIL

For more information, please contact:

Professor Giles Harrison, Dr Helen Dacre

Department of Meteorology
University of Reading

r.g.harrison@reading.ac.uk
h.f.dacre@reading.ac.uk

www.reading.ac.uk/meteorology