Briefing

2010 Eyjafjallajokull, Iceland Volcanic Eruption

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1. Iceland has about 30 volcanoes. A given volcano erupts every 50 to 200 years, or so. Thus, Iceland has an eruption every 5-10 years, or so. The geologic reason for volcanism in Iceland is well-understood and is related to its location on a tectonic plate boundary.

2. The April 2010 eruption of Eyjafjallokull is relatively modest in size, with a Volcanic Explosivity Index (VEI) of 3. Its ash cloud is similar in size to that of the 1963 Surtsey eruption. Much bigger eruptions, up to 100 times as large in terms of ash emission, have occurred in Iceland, such as the 1625 eruption of Katla.

3. This eruption had premonitory activity that included uplift in 1999, increased earthquake activity in December 2010 and a flank eruption of spectacular lava flows on March 20, 2010. This pattern is typical of volcanoes, which often (but not always) give several weeks of warning signs prior to eruptions.

4. Although not every eruption produces large ash clouds, both Eyjafjallokull and neighboring Katla volcano are known to have done so during historic eruptions. The potential of a volcano to produce ash is well understood, and is related to the viscosity (stickiness) of the lava and the amount of dissolved water. Ash (technically, tephra) is finely-pulverized volcanic rock and has a consistency (and abrasiveness) similar to sand.

5. The danger that volcanic ash poses to air traffic has been known since the 1990's. For instance, approximately 20 air safety incidents occurred during the 1991 Mt. Pinatubo eruption (Phillipines), two of which involved engine failure. Ash can lead to engine failure, to air speed sensor malfunctions, to scouring of windows (rendering them opaque) and to slippery runway conditions.

6. Current air traffic response is based on avoidance of all ash rather than the assessment of the potential danger of a particular ash cloud, even though danger is believed to be small for clouds with low ash content. Current satellite technology is extremely good at detecting ash clouds, even clouds with very low ash content, but poor at determining ash content.

7. The decision by EuroControl to close European Air Space was a reasonable response given the limited information that was available and the ash-avoidance procedures that were, at the time, best-practice. However, better information and more nuanced risk-assessment procedures would have allowed more limited closures and hence less economic impact.

8. The air industry now realizes that more research is needed to develop procedures for quantifying content of clouds and to evaluate the risk of a given ash content to engines of a specific design. Improvements in the ash content assessment methodology will require both better determination of the amount of ash being spewed out by the volcano and better models of its transport by the wind.

9. The current eruptive phase, which started on April 14, is subsiding but is not over. This eruptive phase is typical in that it has lasted a few weeks, tapering off after the first few days. Eruptions that consist of a several such phases of similar intensity, occurring over a period of a few months to a few years are typical. Such additional phases, were they to occur, could emit similar ash to the April 14 phase.

10. Historically, eruptions of Eyjafjallajokull have been followed by eruptions of the neighboring volcano, Katla. The correlation is strong, with each of the three historic Eyjafjallajokull eruptions (in 920, 1612 and 1821) being followed (up to 18 months later) by a Katla eruption. Katla is a larger volcano than Eyjafjallajokull, with historic eruptions up to VEI 5 (in 1625). A Katla eruption could potentially cause greater economic loss than the current Eyjafjallajokull eruption. The possibility of such an eruption should be taken seriously, even though no premonitory activity has been detected at Katla, so far.

11. The Eyjafjallajokull eruption is being monitored by Icelandic scientists at the Icelandic Meteorological Office and at the University of Iceland. These are small but extremely competent groups (in aggregate about 10 volcano-related scientists) with world-class people. Their technical competence is high, but their overall capabilities are limited by their small staff.

12. Current volcanic monitoring instrumentation in Iceland is adequate, but only barely so.

13. Intensive monitoring of both Eyjafjallajokull and Katla is needed for the next 2-3 years. Current Icelandic efforts probably cannot be sustained for this duration, owing to temporary installation not being capable of operating during the harsh Icelandic winter and because the personnel base is not large enough to sustain the current intensive monitoring effort indefinitely.

14. Current dissemination of technical information out of Iceland is marginal, at best.

15. Economic losses in Iceland are currently minimal, and are due to: losses associated with the closure of European airspace and (for less time) of Reykjavik and Keflavik Airports; agricultural losses in now-evacuated farms near Eyjafjallajokull; future agricultural losses due to contamination of farmland with flourine-containing ash, which is poisonous to grazing animals; damage to roads (especially Route 1) by glacial floods originating on the volcano; and increased transportation costs during the period (3 days, so far) that Route 1 has been closed. No deaths, injuries or ash-related illnesses have been reported in Iceland.

16. Economic losses in Europe have so far been limited to those associated with the air traffic shutdown. Some minor ash falls were reported in northern Europe that could possibly cause minor damage to manufacturing facilities, especially those with poor air-filtering equipment. However, no such damage has been reported.

17. A hypothetical large Katla eruption could possibly cause more serious ash falls in Europe and would pose hazards to ground transportation (ash is slippery when wet), to public health (inhalation of ash can irritate the reparatory tract), and to livestock (some ash contains fluorine, which is poisonous to grazing animals). A large (VEI 5) Katla eruption could also have a long term (one year) cooling effect on European climate, which could impact the agricultural and tourism sectors.

18. International efforts are needed now to 1) ensure the continued monitoring of Eyjafjallajokull and Katla volcanoes, and especially for assessing day-to-day ash emissions and for detecting premonitory activity (if any) at Katla; 2) develop a contingency plan for mitigating the hazard posed by a possible larger Katla eruption; 3) develop technologies for better assessing the risk of ash clouds, especially at low ash contents; and 4) disseminating technical information to relevant authorities and research institutions.