Impacts of the Eyjafjallajökull Volcanic Eruption on Aviation

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Research Overview

This presentation seeks to address how the April 2010 Eyjafjallajökull (E) volcanic eruption impacted aviation guidelines and safety.

Introduction to the Eruption

- E erupted twice: once during the initial phase and once at the dramatic phase.
- **Initial phase:** March 20th - April 12th. **Dramatic phase:** began mid-April and lasted several weeks.
- The largest eruption plume occurred from April 14th to April 17th, reaching altitudes between 5-9kms.
- The dramatic phase brought with it pyroclastic materials, significant glacial melting, and intense ash clouds (**Fig. 1**).
- Significant amounts of ash were cast into the atmosphere and stayed over the Atlantic and Europe.
- This blocked air travel, resulted in ash advisories and significant flight cancellations, and led to heavy economic impacts on airlines/ businesses, and health impacts on people.
- Post-eruption, **ICAO**, along with airlines and other aviation organizations, drafted and modified volcanic eruption contingency plans.

Ash Advisories and Flight Impacts

- Aircrafts (e.g. airplanes) that are in flight when ash is present can be damaged (**Fig. 2**).
- **VAAC advisories:** purpose is to alert airlines the location and elevation of the ash plume.
- Ash advisories influenced the decision for airlines and cities to close >300 airports and cancel >100,000 flights from approximately April 15 - 21, 2010 (**Fig. 3**).
- On April 17th, 2010 there was an approx. 20,000 flight decrease between the estimated number of flights and the number of flights that occurred.
- During the April eruption Finland, Ireland, and the United Kingdom saw a 90% decrease in air traffic that lasted for 5 consecutive days.
- **Most impacted cities (after Icelandic cities):** Helsinki, Dublin, Manchester, and Edinburgh who each saw a net flight loss of approx. 25% over an 8-day period.

Figures 1 - 3

Figure 1: Eyjafjallajökull, Iceland volcano's 2010 eruption plume as shown from above. Source: Fu et al., 2015.

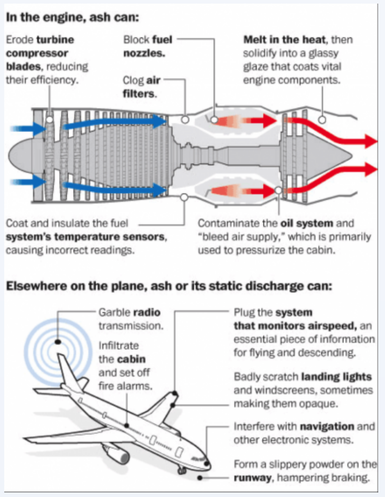

Figure 2: Engine and general aircraft impact as a result of ash. Source: Volcanic Ashfall Impacts Working Group, 2015.

Figure 3: Expected number of flights (grey) and the actual number of flights (black) that took place in Europe over the 8-day period of April 14, 2010 and April, 22 2010. Source: Alexander, 2013.

Response to the Eruption

- The eruption changed the way aviation agencies handle vocalic ash and eruptions, specifically in relation to the Volcanic Ash Contingency Plan and ICAO's no-ash tolerance policy.
- Iceland's Meteorological office began using an aviation color-coded warning system (**Table 1**) originally created by the Alaska Volcano Observatory during the Redoubt Volcano eruption.
- **Four colours:** green (=normal), yellow (=unrest), orange (=precursory unrest or minor ash eruption), red (=major ash eruption soon or currently) (**Table 1**).
- In June 2014, the North Atlantic Systems Planning Group drafted a new Volcanic Ash Contingency Plan.
- ICAO's 2017 workshop in Paris outlined four distinct phases relating to volcanic ash eruption that aviation businesses must use.
- **Four phases:** pre-eruption, start of eruption, ongoing eruption, recovery (includes NO VAEXP phase).

Level	Activity
Green	Volcano is in normal, non-eruptive state *or, after a change from a higher level:* Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state
Yellow	Volcano is exhibiting signs of elevated unrest above known background levels *or, after a change from higher level:* Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase
Orange	Volcano is exhibiting heightened unrest with increased likelihood of eruption *or,* Volcanic eruption is underway with no or minor ash emission
Red	Eruption is forecast to be imminent with significant emission of ash into the atmosphere likely *or,* Eruption is underway with significant emission of ash into the atmosphere

Table 1: Color-coded aviation alert system ranking volcanic activity from normal (green) to undergoing eruption (red). Source: Guffanti & Miller, 2013.

Conclusion

To tackle the question of how the Eyjafjallajökull eruption of 2010 impacted aviation, I divided my paper into three main sections. The first section discussed what risks the large amounts of ash among other pyroclastic materials cast into the atmosphere posed on aviation. It notably focused on the consequent financial and flight number impacts and the health impacts. The second section discussed how the eruption shaped the way aviation agencies deal with volcanic ash and eruptions, specifically in relation to the Volcanic Ash Contingency Plan and ICAO's "zero ash tolerance" (Petursdottir et al. 2015, pp. 314).

Proposed Next Steps

Though airline safety and regulations regarding volcanic ash have greatly improved following the 2010 eruption, additional steps should be taken to ensure the safety of aircrafts, people, and financial stability. Proposed solutions include:

1. **Improved communication** between airlines, cities, and businesses to mitigate the financial impacts caused by a volcanic eruption.
2. **Clearly defined emergency procedures** for patients and people who are especially vulnerable to ash. These should be clarified and strengthened to ensure that people can not only be evacuated, but that they also do not suffer from the potential impacts of diminished air travel (e.g. an impact such as not being able to receive a transplant).
3. **Information regarding what airlines are canceling flights** should be shared with the public, perhaps through a text message or call, to ensure that people can best look through their options and respond to the disaster.

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