Eyjafjallajökull
Volcano
By
Joshua sweat

How to say Eyjafjallajökull
Where?

[Map of Iceland with marked location of Eyjafjallajökull Glacier]
What Happened?

- Eruption occurred Saturday evening April 17
- Southern Iceland's Eyjafjallajokull glacier
- Emitting gaseous volcanic ash plume into the stratosphere (~32Km high!)
- Plume
  - Ash
  - Rock and Dust
  - Volatile Chemicals
Height of Icelandic volcano ash cloud

- **Commercial airliner (not to scale)**: 35,000 to 40,000 ft
- **Ash cloud spreading east**: 20,000 to 35,000 ft
- **Eruption plume extent**: 18,000 ft
- **Eyjafjallajökull volcano**: 5,465 ft
Forecast scope of ash up to 20,000ft

- 22 April 0000 GMT
- 22 April 0600 GMT

No-fly zone
(area at risk based on new criteria)
- 22 April 0000 GMT

Source: Met Office
Effects: Short Term

• UK's National Air Traffic Control (NATS) closed parts of the continent's airspace for six days.
  – Grounding plains at London’s Heathrow international airport.

• Cost airlines $1.7 billion in lost revenue.
  - International Air Transport Association (IATA)
Why Close Air Space?

• Two sides
  – Commercial Airlines
  – Civil Aviation Authority
Commercial Airlines

- “Ash cloud posed little risk to air travel.”
  – Willie Walsh, British Airways CEO
- "Airspace was being closed based on theoretical models not on facts.” - IATA
Civil Aviation Authority (CAA)

• “The decisions made were the right ones and we absolutely stand by those.” - Bristol, NATS spokesman

• "We would never be forgiven if we had let planes fly and there was a real danger to people's lives," - Prime Minister Gordon Brown
BUT WHY?

• Ash
  – “Experts say the tiny particles of rock, glass and sand contained in the ash cloud could jam aircraft engines, as has happened in previous incidents of planes flying into plumes of volcanic ash.”

• Volatile chemicals
  – Sulfate particles

\[
\begin{align*}
\text{SO}_2 + \text{OH} + \text{M} & \rightarrow \text{HSO}_3 + \text{M} \\
\text{HSO}_3 + \text{O}_2 & \rightarrow \text{HO}_2 + \text{SO}_3 \\
\text{SO}_3 + \text{H}_2\text{O} & \rightarrow \text{H}_2\text{SO}_4 \\
\text{H}_2\text{SO}_4(g) & \rightarrow \text{H}_2\text{SO}_4(aq) \\
\text{Or SO}_2 + \text{particles} & \rightarrow \text{H}_2\text{SO}_4 \\
\end{align*}
\]

• Sulfuric Acid corrodes metal on plane!
Effects of volcanic ash on jet engine

- Melts and forms glassy coating
- Erodes metal
- Clogs fuel system and cooling system

Diagram labels:
- Fan
- Compressor
- Fuel nozzle
- Turbine
- Combustion chamber
When is it safe to fly?

• Previous Rule: ZERO TOLERANCE LEVEL!
• "The whole of Europe has been in the same position, acting according to the same aviation safety rules," - Prime Minister Gordon Brown
When is it safe to fly?

• New Rule:
  Raised threshold of ash density in the atmosphere at which flying is deemed safe from zero to:

  0.002 grams per meter cubed per hour

  – Civil Aviation Authority

• Engines have "increased tolerance levels in low ash density areas" – Civil Aviation Authority

• Under new regulation closer would not have happened!

• But how is ash density measured?
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<th><strong>Method</strong></th>
<th><strong>Applications</strong></th>
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<td>Direct sampling</td>
<td>Collection of emissions in glass containers and on filters for laboratory chemical and isotopic analysis</td>
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<td>Spectroscopic and remote sensing techniques</td>
<td>Ground-, airborne-, and satellite-based measurements of gases in volcanic plumes to obtain emission rates</td>
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<td>Soil gas measurements</td>
<td>Determination of diffusive fluxes of volcanic gases in volcanic regions</td>
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<td>Chemical sensors</td>
<td>Continuous in-situ monitoring of the concentrations of volcanic gases in fumaroles, soils, and ambient air</td>
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<td>Leachate analysis</td>
<td>Determination of the amounts of gas adsorbed on surfaces of ash</td>
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Result

• Flights resumed Thursday April 22
• New regulation should prevent future closers
• Increased safety for European air travel
• "We're now at a situation where (engine manufacturers) know what their engines can cope with," he said. "It's something that shouldn't happen again because now we know what we're dealing with.” –Bristol, NATS Spokesman
Other Effects: Long Term

SO$_2$ + OH + M $\rightarrow$ HSO$_3$ + M
HSO$_3$ + O$_2$ $\rightarrow$ HO$_2$ + SO$_3$
SO$_3$ + H$_2$O $\rightarrow$ H$_2$SO$_4$
H$_2$SO$_4$(g) $\rightarrow$ H$_2$SO$_4$(aq)

Cl + O$_3$ $\rightarrow$ ClO + O$_2$
ClO + O $\rightarrow$ Cl + O$_2$
Net: O$_3$ + O $\rightarrow$ O$_2$ + O

Global Warming?
References


video @: http://www.youtube.com/watch?v=BicT13ecUbc&feature=player_embedded


QUESTIONS?