The eruption that missed Europe

A comparison of the weather situation during the Eyjafjallajökull 2010 and Grímsvötn 2011 eruptions in Iceland

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Two Eruptions

The 2010 volcanic eruption of Eyjafjallajökull in Iceland lasted 39 days, 14 April-23 May. During an explosive phase 14-19 April, persistent winds aloft lead to ash dispersal into the airspace of continental Europe resulting in widespread airspace closures during 15-23 April. In May explosive activity again lead to sporadic closures, but not on same scale as in April. The erupted volume during the 39 days is estimated 0.17 – 0.19 km3 dense rock equivalent (DRE).

The eruption of the Grímsvötn volcano in Iceland in the spring of 2011 was a far more intense eruption, but of shorter duration 21-28 May, with the most intense phase during the initial 30 hours. Based on plume altitude data, the eruptive volume has been estimated to be 0.15 – 0.25 km3 DRE, most of which was erupted during the initial 30 hours.

We examine the atmospheric circulation during the during the Eyjafjallajökull mid-April 2010 event and contrast that with the circulation during the Grímsvötn May 2011 eruption

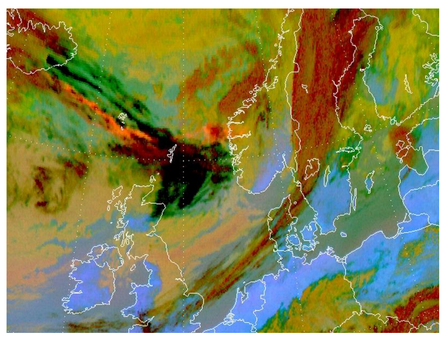

Figure 1. Seviri BTD image from 12UTC April 15 2010
An orange colored ash cloud can be seen extending from Eyjafjallajökull volcano towards N – Europe.

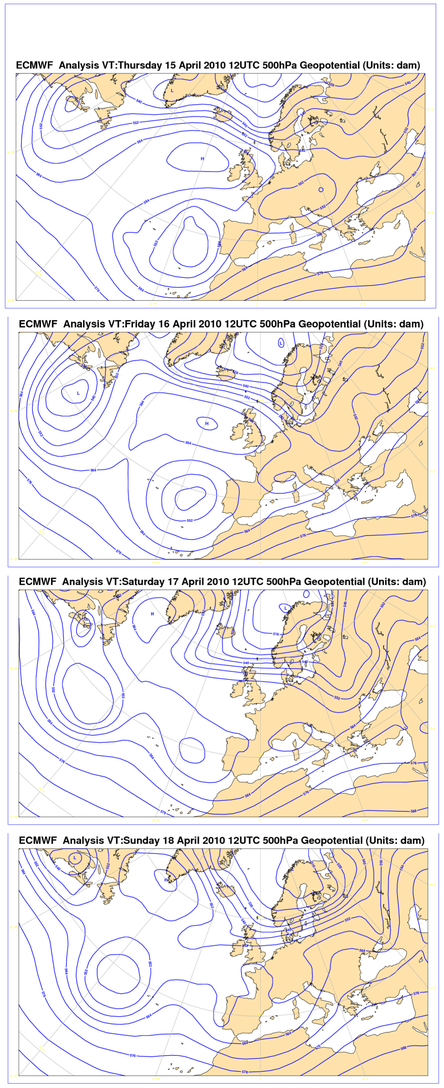

Figure 2. ECMWF analysis showing the North Atlantic atmospheric circulation during the mid-April 2010 ash event.
An atmospheric jet lies over Iceland and is oriented south-east towards Europe.
As a consequence mid- and upper tropospheric winds transported ash produced at Eyjafjalla-jökull volcano towards Europe (see Figure 1).

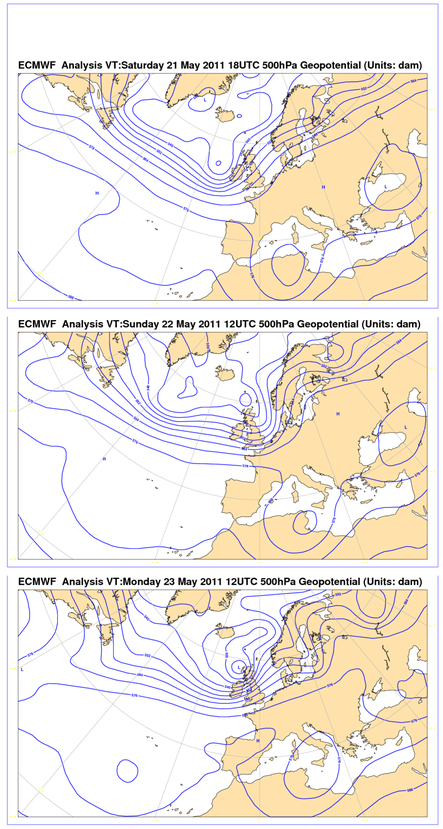

Figure 3. The North Atlantic atmospheric circulation during the initial phase of the Grímvötn 2011 eruption.
The atmospheric jet is located well south of Iceland, upper level ash transport is towards north.

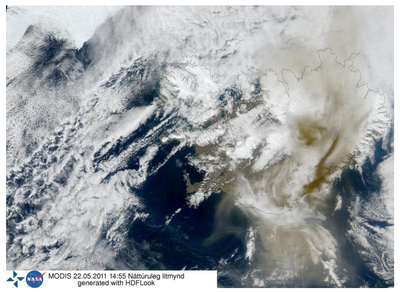

Figure 4. MODIS image of the Grímsvötn ash plume taken at 14:55 UTC on May 22 2012, about 20 hours into the eruption. Low level ash cloud can be seen in the south of Iceland, but at higher levels ash extends to the north.

Atmospheric circulation

During the first explosive phase of the Eyjafjallajökull eruption the atmospheric jet was over Iceland perfectly oriented for carrying ash injected in the mid- and upper troposphere towards Europe (figures 1 & 2).

In contrast, during the inital 30 hours of the Grímsvötn eruption the atmospheric jet was positioned well south of Iceland, and upper level winds and ash dispersal over the volcano were relatively weak and towards north (figure 3).

Most of the ash produced during the initial 30 hours fell into the atmospheric boundary layer close to the volcano and was carried by local winds into adjacent regions in southern Iceland (figure 4).

Ash injected into the upper troposphere and lower stratosphere was transported towards the north (figures 4 & 5).

By the time the circulation changed, the eruption strength was much reduced.

Had the eruption started 50 hours later upper level ash would have been transported towards Europe (figure 6).

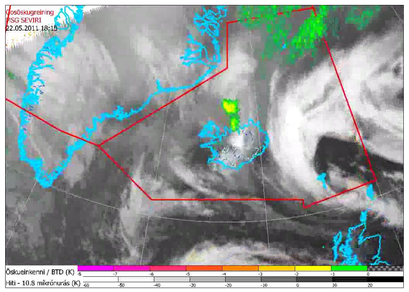

Figure 5. Seviri BTD image at 18:15 on May 22, about 23 hours into the eruption. Green color shows ash cloud north of Iceland indicating that upper level winds transported the ash towards the north.

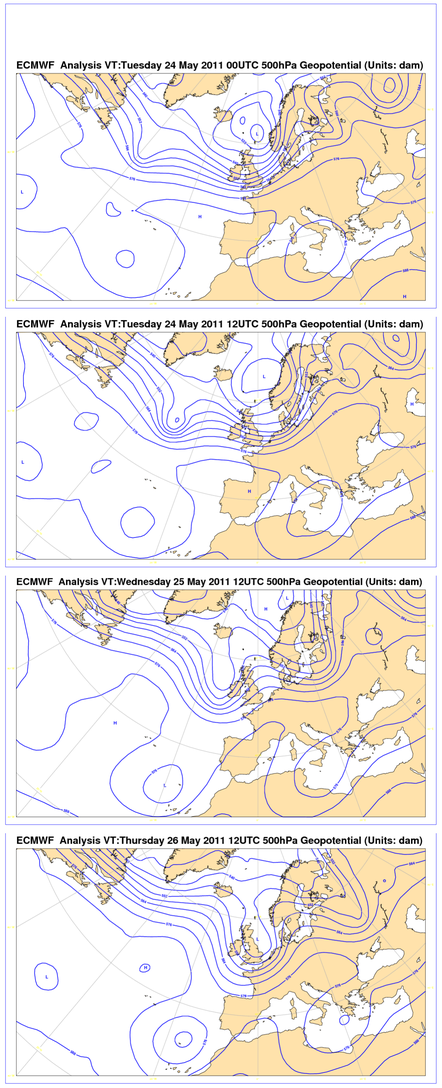

Figure 6. The North Atlantic atmospheric circulation during the days following the inital phase of the Grímsvötn eruption.
By the time the jet assumed a position that could carry ash towards Europe, the eruption was much reduced in strength.

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