



Eruptive flow rate resonance during the Grímsvötn 2011 volcanic eruption in Iceland

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The Grímsvötn volcano in Iceland erupted 21-28 May 2011 under the SW caldera rim at a similar place as the November 2004 eruption. The eruption started at or just before 19:00 UTC on 21 May. During the first night the plume reached 20-25 km altitude over a 10 hour period, after which the strength of the eruption appeared to decrease exponentially.

Two weather radars monitored the plume during the eruption; a fixed C-band radar in Keflavík and a mobile X-band radar at Kirkjubæjarklaustur, 257 and 75 km from the volcano, respectively. The plume height of the radar time-series was used to calculate the mean eruptive flow rate. Both the plume height and estimates of eruptive flow rate show very strong regular oscillations with periods of about 5 hours. During the first 12 hours the 1 hour mean dense rock equivalent flow rate oscillated between about 1000 and 8000 m³/s.

During the eruption, over 16 000 lightning strikes were recorded near Grímsvötn by the ATDnet (Arrival Time Difference) network of the UK Met Office. The peculiar variations in the rate of lightning occurrence became evident during real-time monitoring of the lightning data during the first night of the eruption. The calculated flow rate oscillations agree well with the observed lightning oscillations, both in phase and relative amplitude. The same oscillations can also be seen in tiltmeter data from Grímsfjall, about 6 km East of the vent. In hindsight, there also appear to have been some regular long period oscillations in lightning rate and plume height during the much smaller Grímsvötn 2004 eruption. The causes of these oscillations are not clear.