Arason, P., A. J. Bennett and L. E. Burgin (2012), Volcanic lightning during the 2010 Eyjafjallajökull eruption, *92nd American Meteorological Society Annual Meeting / 28th Conference on Interactive Information Processing Systems (IIPS)*, Presentation 201192, New Orleans, 22-26 January 2012.

Volcanic lightning during the 2010 Eyjafjallajökull eruption

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There is not a consensus on how charge is generated in volcanic plumes. Although lightning is commonly observed in such plumes, indirect measurements have not been able to distinguish between plausible charge generation processes. Several likely processes have been proposed to explain the electrification of volcanic plumes, including quenching magma-water interactions, the fracturing or internal friction of fine grained ash, and the freezing of plume water at height. To what extent these processes contribute to the observed charge generation in volcanic plumes is not known, but there are some indications that there might be more than one process at work. During the 39 days of the Eyjafjallajökull volcanic eruption in Iceland in April-May 2010, the eruption went through a few phases and its strength varied. The intensity of the lightning measured by a long-range network varied greatly, with long quiet periods; generally, there was intense volcanic lightning when the eruption plume was high. However, during 3-10 May the plume was fairly high with no observed lightning, followed by intense lightning during 11-20 May. At this time the altitude of the isotherms for droplet freezing (about -20°C) dropped drastically below the plume-top. Therefore, it appears that the atmospheric conditions around the plume were influencing or even controlling the lightning activity. The critical plume-top temperature, which appears to have turned on and off the lightning activity during the Eyjafjallajökull eruption is estimated to be between -20° and -24°C. This suggests that the charge generation process of the observed volcanic lightning was probably analogous to processes in meteorological thunderclouds.