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Optical properties and climate forcing of Icelandic dust

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Iceland is an active source of dust originating from glaciogenic and volcanic sediments. The frequency of days with dust suspension exceeded 34 dust days annually in 1949-2011. This figure represents a minimum value as many dust storms occur without the dust passing the weather stations recording the events. Comparison of meteorological synoptic codes for dust observation and direct particulate matter mass concentration measurements in 2005-2013 showed that the mean number of dust days in Iceland can increase up to135 dust days annually. Dust events in NE Iceland occur mostly in May-September, while almost half of all dust events in SW Iceland were at sub-zero temperatures or in winter.
Icelandic dust is different from the crustal dust; it is of volcanic origin and dark in colour. It contains sharp-tipped shards and is often with bubbles. Such physical properties allow large particle suspension and transport to long distances, e.g. towards the Arctic. To estimate the further impacts of dust transport, both laboratory and snow spectropolarimetric measurements were done using the Finnish Geodetic Institute Field Goniospectrometer FIGI-FIGO (http://www.polarisation.eu/index.php/list-of-instruments/view-submission/172), an automated portable instrument for multiangular reflectance measurements. The albedo, hemispherical directional reflectance factor (HDRF), polarization, and other snow properties were monitored on the snow and areas affected by the dust deposition through the following melting period in spring 2013 in Lapland during the Soot on Snow (SoS) 2013 campaign.
Glaciogenic silt deposited on snow made the snow optically darker. The melting, metamorphose and diffusion processes were fast during the measurement time while the sun heated the particles, snow melted around, and the particles diffused inside the snow. Smaller particles diffused faster than the larger. Fine silt particles tended to form larger grains.
Larger volcanic sand particles had lower reflectance than fine silt particles both in laboratory and deposited on snow. Icelandic volcanic sand was of similar optical properties as black carbon both deposited on snow or in laboratory.
This experiment showed that the Icelandic volcanic dust may both directly and indirectly act as a positive climate forcing agent. We suggest that Icelandic dust may be a contributor to the Arctic warming.

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