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Optical properties of Icelandic volcanic 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. About 4.5 million tons of dust is annually distributed over local Icelandic glaciers, but dust is likely deposited on the Arctic glaciers as well. Dust events in NE Iceland occur mostly in May-September, while half of dust events in SW Iceland were at sub-zero temperatures or in winter. Snow-Dust storms are frequent phenomena in Iceland.
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 FIGIFIGO (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.
The snow experiments were conducted for dust-snow and black carbon-snow interactions. Two dust samples were used – fine glaciogenic silt and large volcanic sand particles. 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.
Laboratory reflectance measurement of pure volcanic sand was about 0.03 measured by the spectroradiometer coupled with a contact probe and reflectance measured with FIGIFIGO ranged between 0.02 and 0.04. These are measurements nearly of "black body" equivalent. Glaciogenic silt had a reflectance ranging 0.05 and 0.19 (FIGIFIGO) caused by its light-brown colour in a dry state, but showing also a very low number. Present laboratory experiments give first information on optical properties of volcanic dust from Iceland, which can be applied for suspended particles traveling in the atmosphere.