Quantification of Impacts of Black Carbon on Snow: an Experimental Approach

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In order to quantify the effects of absorbing material on snow and define its contribution to climate change, we have conducted a series of dedicated bidirectional reflectance measurements in the frame of Soot-on-snow experiments [1, 2]. Chimney soot, volcanic sand, and glaciogenic silt were deposited on snow in a controlled way. The bidirectional reflectance factors of these targets and untouched snow have been measured using the FGI's field goniospectrometer FIGIFIGO, see, e.g., [3, 4] and references therein. It has been found that the contaminants darken the snow, and modify its appearance mostly as expected, with a clear directional signal and a modest spectral signal. A remarkable feature is the fact that any absorbing contaminant on snow enhances the metamorphism under strong sunlight. Immediately after deposition, the contaminated snow surface appears darker than the pure snow in all viewing directions, but the heated soot particles sink down deeply into the snow within minutes. The nadir measurement remains darkest, but at larger zenith angles the surface of the soot-contaminated snow changes back to almost as white as clean snow. Thus, for an observer on the ground, the darkening by impurities can be undetectable, overestimating the albedo, but a nadir looking satellite sees the darkest points, now underestimating the albedo. Furthermore, to estimate the effect on climate change caused by black carbon (BC) deposited on snow, one need to take into account possible rapid diffusion of the BC inside the snow from its surface. The BC deposited on snow at warm temperatures initiates rapid melting and may cause dramatic changes on the snow surface.

References

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