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Effect of snow impurity content (soot, organic carbon, dust) and snow melt on snow spectral albedo, including the UV range

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Snow that appears white-to-eye can surprisingly have an impurity content that is big enough to affect snow spectral albedo. This effect can be best detected at the wavelengths where ice absorption is theoretically the smallest and impurity absorption the biggest. For example, at the invisible UV range, some impurities absorb strongly, and the ice absorption is small.

The impurity content affects both snow albedo and melt, and snow melt further decreases snow albedo. Diurnally, snow melt can cause a solar zenith angle (SZA) asymmetrical albedo, where albedo in the morning is typically 10 % higher than in the afternoon. In addition, our experimental and very first in situ field measurement data suggest that impurities can decrease the density of melting snow.

The impurity specific spectral absorption capability should be taken into account by combining the impurity concentration and mass absorption coefficient value at various wavelengths, together with the information on melting snow surface residues and clusters of hydrophobic impurities.

Effects of soot, organic carbon and Icelandic volcanic dust on snow albedo (300-2500 nm spectral and broadband data), melt and density are discussed on the basis of our experimental and in situ results during the campaigns in Sodankylä 2013 and Helsinki 2016, and in connection to model simulated albedo results.