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Modeled and measured spectral albedo of surface snow over central Greenland

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The albedo of snow is determined both by the near-surface profile of the physical and chemical properties of the snowpack and by the spectral and angular characteristics of the incident solar radiation. Simultaneous measurements of the physical and chemical properties of snow at Summit, Greenland in May and June 2011 were carried out along with spectral albedo measurements. The main objective was to test our ability to predict snow albedo by comparing the measured snow spectral albedo with the albedo calculated with a radiative transfer model.

Daily snow stratigraphies down to about 80 cm were recorded. The snow density and specific surface area (SSA) were measured at the highest possible vertical resolution. For SSA, we used DUFISSS (DUal Frequency Integrating Sphere for Snow Ssa), to measure the reflectance of snow in the near infrared (at 1310 nm and 1550 nm). In addition to regular SSA vertical profiles with a resolution of 1 to 4 cm, the SSA of the surface layer was measured during events such as snowfall, blowing snow, rime or surface hoar formation. During several periods of intensive sampling, we also measured simultaneously SSA and albedo at several spots in order to study the horizontal variability of these properties.

The spectral albedo of the snow was measured in the range 350-2500 nm at the same spot (prior to the other measurements), using an ASD spectroradiometer. Samples were also collected for chemical analyses including trace elements and elemental carbon, to evaluate the impact of absorbers in snow.

From these data sets, the surface albedo was calculated using the DISORT model (DISCrete Ordinate Radiative Transfer) and compared to the measured values. The overall agreement is very good but some differences are observed for several wavelengths. These discrepancies and their possible sources, such as shadows of the observer, ice optical indices, and uncertainties in snow SSA and radiometric measurements are discussed.