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The reflectance of solar light from snow: theory and experiments

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Snow is an important regulator of the Earth's climate. Due to its high reflectance, it has a cooling effect on the Earth-atmosphere system. It is well known that at the moment ice/snow extent is decreasing at the alarming rate. Also the snow albedo decreases due to anthropogenic influences. This contributes to the global warming through nonlinear feedback mechanisms.

Therefore, it is of great importance to monitor snow properties on a continuous basis using ground stations and also airborne or spaceborne observations. Spaceborne observations are of particular importance because most of snow areas (Arctic, Antarctica) are not easily accessible. Optical, infrared, and microwave space observations are currently used to monitor various ice and snow characteristics based on the analysis of the reflected or emitted radiation. The accuracy of retrieved snow parameters is greatly influenced by the choice of the appropriate snow radiative transfer model and assumed a priori parameters.

In this work we compare results of ground and satellite measurements of snow reflectance with the results of radiative transfer calculations for various shapes and sizes of snow grains for the case of thick snow layers. The models of hexagonal crystals and also fractal ice particles are used for the interpretation of ground-based and spaceborne observations of snow spectral and angular reflectance. It is found that the standard radiative transfer theory is capable to explain most of observable phenomena.