

A physical model and inversion approach for remote measurement of snow properties.

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A physical model has been developed for the spectral reflectance of snow based on the complex refractive index of ice. Mie scattering calculations have been used to model the single scattering properties of ice spheres over the spectral range from 400 to 2500 nm at 1 nm spectral resolution. These calculations span a range of grain size and liquid water content. With these inputs, a discrete ordinate radiative transfer code has been used to model the spectral reflectance properties of a snow over a range of grain sizes, melting conditions, illumination, and observation conditions. This model was used to derive grain size and liquid water fraction parameters (with units and uncertainties) from imaging spectrometers measurements. The model has shown good agreement with measured snow reflectance spectra where the liquid water fraction and grain size were independently measured. This remote measurement approach is based upon the optical constants of water and calculations describing the interaction of electromagnetic radiation with matter. It provides an example of the type of remote measurement approach based in physics that may be pursued for other more complex materials.