Retrieving complex refractive indices using multiple-scattering methods

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We present a simulation framework for deriving the imaginary parts of the refractive indices for specific materials. The simulations are performed by utilizing a MATLAB optimization code that uses the measured spectrum of the material and a SIRIS4 light-scattering code [1][2][3], that takes inhomogeneous waves into account and simulates light scattering by Gaussian-random-sphere particles large compared to the wavelength of the incident light. The light-scattering code uses incoherent input and computes phase matrices by utilizing incoherent scattering matrices. Bisectional minimization method is applied to derive the imaginary parts of the refractive indices.

We demonstrate our approach by deriving the complex refractive indices for clinopyroxene. The measured reflectance spectra of clinopyroxene for grain sizes 12 µm, 22 µm, 44 µm, 60 µm, and 94 µm are obtained from an existing database. We derive the imaginary parts of the refractive indices for the 44 µm grain size and then further utilize the derived values in SIRIS4 to model the reflectance spectra for grain sizes 12 µm, 44 µm and 94 µm. The modeled spectra are compared with the measured spectra in order to study how the spectrum changes when using a different grain size.

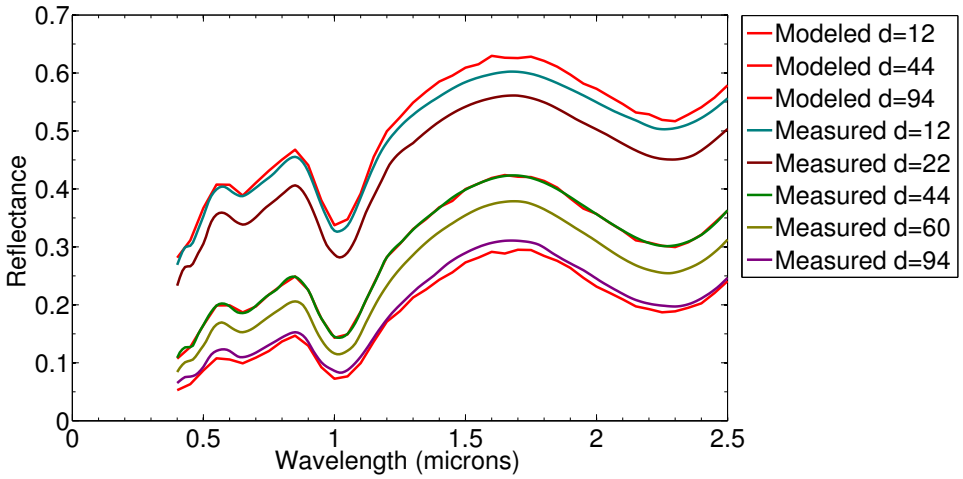

Figure: The measured and modeled spectra of clinopyroxene with different grain sizes.

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References: [1] Martikainen et al. (2017), JQSRT, Submitted; [2] Lindqvist et al. (2017), JQSRT, In preparation; [3] Muinonen et al. (2009), JQSRT 110, pp. 1628–1639.