Geophysical Research Abstracts
Vol. 17, EGU2015-3895-1, 2015
EGU General Assembly 2015

Parameterization of single-scattering properties of snow

Petri Räisänen (1), Alexander Kokhanovsky (2,3), Gwennole Guyot (4), Olivier Jourdan (4), and Timo Nousiainen (1)

(1) Finnish Meteorological Institute, Helsinki, Finland (petri.raisanen@fmi.fi), (2) EUMETSAT, Darmstadt, Germany, (3) Institute of Remote Sensing, University of Bremen, Germany, (4) Laboratoire de Meteorologie Physique, Universite Blaise Pascal/CNRS/OPGC, Aubiere Cedex, France

Snow consists of non-spherical ice grains of various shapes and sizes, which are surrounded by air and sometimes covered by films of liquid water. Still, in many studies, homogeneous spherical snow grains have been assumed in radiative transfer calculations, due to the convenience of using Mie theory. More recently, second-generation Koch fractals have been employed. While they produce a relatively flat scattering phase function typical of deformed non-spherical particles, this is still a rather ad-hoc choice. Here, angular scattering measurements for blowing snow conducted during the CLimate IMpacts of Short-Lived pollutants In the Polar region (CLIMSLIP) campaign at Ny Ålesund, Svalbard, are used to construct a reference phase function for snow. Based on this phase function, an optimized habit combination (OHC) consisting of severely rough (SR) droxtals, aggregates of SR plates and strongly distorted Koch fractals is selected. The single-scattering properties of snow are then computed for the OHC as a function of wavelength λ and snow grain volume-to-projected area equivalent radius r_{vp}. Parameterization equations are developed for λ=0.199–2.7 μm and r_{vp} = 10–2000 μm, which express the single-scattering co-albedo β, the asymmetry parameter g and the phase function as functions of the size parameter and the real and imaginary parts of the refractive index. Compared to the reference values computed for the OHC, the accuracy of the parameterization is very high for β and g. This is also true for the phase function parameterization, except for strongly absorbing cases ($\beta > 0.3$). Finally, we consider snow albedo and reflected radiances for the suggested snow optics parameterization, making comparisons with spheres and distorted Koch fractals.

Further evaluation and validation of the proposed approach against (e.g.) bidirectional reflectance and polarization measurements for snow is planned. At any rate, it seems safe to assume that the OHC selected here provides a substantially better basis for representing the single-scattering properties of snow than spheres do. Moreover, the parameterizations developed here are analytic and simple to use, and they can also be applied to the treatment of dirty snow following (e.g.) the approach of Kokhanovsky (The Cryosphere, 7, 1325–1331, doi:10.5194/tc-7-1325-2013, 2013). This should make them an attractive option for use in radiative transfer applications involving snow.