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A 3D polarized Monte Carlo Lidar system simulator for studying cirrus inhomogeneities effects on Caliop/Calipso measurements

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Lidar is a powerful tool for deriving the cirrus properties, but the main difficulty to overcome is the significant extinction of the Lidar beam in its path through the cloud, and one must take into account multiple scattering (Hogan, 2006). In reality, the "apparent" backscatter estimated by the Lidar system from the "basic Lidar equation" is not equal to the "true" backscatter of the cirrus as multiple scattering is omitted and cirrus properties are assumed to be horizontally homogeneous into the Lidar system "footprint". Our objective is to quantify the effects of cirrus inhomogeneities represented by 3D spatial fluctuations of extinction on the apparent polarized backscatter measured by Caliop/Calipso.
To assess this effect, we are developing a 3D polarized Lidar simulator based on 3DMCPol (Cornet et al., 2010). This tri-dimensional Monte Carlo radiative transfer model allows computing of total and polarized radiances of tri-dimensional cloud. The input cloud properties are simulated with a model called 3Dcloud which is based on a simplified dynamic/thermodynamic scheme. This is done in order to get cloud characteristic shapes while the cloud scale invariance properties are enforced by using a Fourier stochastic approach.
In order to validate our Lidar simulator, we will compare the total apparent backscatter simulated with our Lidar simulator to those simulated with the fast Lidar simulator of Hogan (2008). This will be done for an academic homogeneous cirrus cloud with a Henyey-Greenstein phase function in a standard atmosphere. Then, we will show cirrus inhomogeneities effects on the "apparent" backscatter by comparing the total and polarized apparent backscatter of 3DCloud ice cirrus to those of equivalent homogeneous ice cirrus. Both of them will be simulated with our Lidar simulator.

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