Objectives

- How cloud inhomogeneities affects the area-average radiative properties under the Equivalent Homogeneous Cloud Approximation (EHCA)?
- What are the “inhomogeneity parameter” pertinent to radiative processes?

Methodology

Simulation of reflectance, transmittance, absorptance and Bidirectional Reflectance Distribution Function (BRDF) by Monte Carlo method of 1D and 2D bounded cascade inhomogeneous clouds for three mean optical depths (5, 10, 30) and two solar zenith angles (0° and 60°)

Concept of the Equivalent Homogeneous Cloud Approximation (EHCA)

The EHCA relies on the definition of effective optical depth and effective single scattering albedo, so that the radiative fluxes of inhomogeneous cloud might be reproduced by an equivalent homogeneous cloud. The effective radiative parameters could be expressed, as a function of mean parameters and inhomogeneity parameters $\rho_L$, at an averaging scale $L$:

$$\tau_{eff} = \frac{\zeta(\omega, \rho_{hom}, \omega_{inhom}, \phi_{inhom}, \phi_{inhom})}{\tau_{hom}}$$

$$\rho_{eff} = \frac{\zeta(\omega, \rho_{hom}, \omega_{inhom}, \phi_{inhom}, \phi_{inhom})}{\rho_{hom}}$$

EHCA and BRDF

The ratio of inhomogeneous BRDF (calculated by Monte Carlo) to those calculated by three different ways:

1. EHCA method, providing effective parameters to compute effective BRDF.
2. IPA method, providing average BRDF computed from plane-parallel cloud BRDF for each pixel cloud
3. P-P method, providing plane-parallel cloud BRDF with identical mean optical depth

Conclusions

- $\rho_L$ is a very simple and efficient parameter to take account of 1D & 2D cloud inhomogeneity types effects under EHCA.
- Ratio EHCA increases with $\rho_L$.
- EHCA is a valid approach with respect to average fluxes and BRDF of bounded cascade clouds, as far as $\rho_L < \approx 2$.

Perspectives

- To parameterize the Ratio EHCA.
- To validate EHCA approach with other types of cloud inhomogeneity (gaussian model, morphological approach).