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State-of-the-art variance reduction methods for Monte Carlo radiative transfer in atmospheric remote sensing

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Remote sensing in a cloudy atmosphere is an inherently three-dimensional problem which is best solved using the Monte Carlo method as radiative transfer (RT) solver. Although generally much slower than analytic one-dimensional RT solvers, the results obtained by Monte Carlo solvers can help quantify the errors made by the 1D approximation, and can even be used to parameterize the 3D effects in retrieval algorithms.

However, scattering of radiation on water droplets and ice crystals is highly anisotropic, which leads to extremely slow convergence of the Monte Carlo results in the absence of variance reduction techniques (VRT).

I will present several VRTs which reduce the computational time of the Monte Carlo RT solver by several orders of magnitude, thereby making the simulation of passive and active remote sensing instruments feasible. Surprisingly, for some 1D applications the accelerated Monte Carlo method yields to be faster than analytic RT solvers.

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