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Spectrally-invariant approximation; how well can it be applied to cloud remote sensing?

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Certain algebraic combinations of single-scattering albedo and solar radiation reflected from cloudy atmospheres vary only weakly with wavelength. We identify the conditions under which the spectrally-invariant approximation can accurately describe the extinction and scattering properties of cloudy atmospheres. Validity of the assumptions and accuracy of the approximation has been tested with plane-parallel radiative transfer calculations.

We discuss the physics behind this phenomenon, its mathematical basis, and possible applications to remote sensing of cloud microphysical properties. The spectrally-invariant approach has been applied to aircraft measurements during the SEAC4RS field campaign. The retrievals of droplet size, cloud optical thickness and liquid water path have been compared with the ones from the Research Scanning Polarimeter (RSP) that uses a parametric fitting algorithm for the droplet size distribution and with the classical Nakajima-King approach. The same RSP measurements have been used for all three approaches. The results of the comparison will be discussed. Note that the spectrally-invariant approximation is free from the plane-parallel homogeneous cloud layer assumption and, in general, can work for any inhomogeneous cloud scene.