



Spectral-invariant behavior of zenith radiance near cloud edges: Simulations and implications

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Knowledge of aerosol and cloud properties in the transition zone between cloudy and clear air is crucial for determination of aerosol direct and indirect forcing. However, retrieving aerosol and cloud properties in this zone is challenging, because the separation between cloudy and clear air from remotely sensed observations is always ambiguous. Recently, we discovered a surprising spectrally-invariant behavior in zenith radiance spectra measured by the shortwave spectrometer of the Atmospheric Radiation Measurement (ARM) program. The behavior suggests that the shortwave spectrum near cloud edges can be determined by a linear combination of zenith radiance spectra of the cloudy and clear regions. In this paper, we will identify factors that characterize the spectrally-invariant behavior based on 1D and 3D radiative transfer calculations. We will also show that the spectrally-invariant behavior will help us better understand cloud growth and evaporation processes in the transition zone, and make it possible to retrieve cloud properties near cloud edges even with insufficient or no knowledge about spectral surface albedo and aerosol properties.