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Can we retrieve the microphysical properties of broken clouds from polarization observation? Theoretical information content analysis

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The objective of this study is two-fold: 1) we will develop a radiative transfer framework based on the combination of cloud resolving model and 3-D polarization radiative transfer model to simulate observations from multi-angular, multi-spectral polarimeter for spatially heterogeneous scenes that contain both cloud and aerosol. 2) Using this framework, we will investigate how 3-D radiative transfer effects influence the information content of polarization observations for cloud microphysical property retrievals. We will attempt to address the following questions: i) is it possible to retrieve the microphysical properties of "broken clouds", i.e. effective radius and the effective variance of cloud droplet size distribution? ii) What ancillary data, e.g., cloud fraction, cloud top height, cloud morphology, etc., are needed to make such retrieval possible? iii) How do instrument factors, e.g., spatial resolution, angular resolution and spectral coverage, affect the information content? iv) How and why are retrievals based on polarization different from those based on conventional method, in particular, the bi-spectral look-up-table method?