Retrieval of optical thickness and droplet effective radius over vertically inhomogeneous water clouds

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Marine water clouds play an important role in the Earth-atmosphere system through their radiative effects and microphysical processes. Since scattering properties of spherical water droplets are well known through the Mie theory, we can infer cloud droplet effective radius (CDER) and cloud optical thickness (COT) from solar reflectivity at visible and near-infrared wavelengths (the so-called bispectral method [1]) through the radiative transfer equation using a simplified atmosphere-cloud model, i.e. the single-layer plane parallel homogeneous (PPH) cloud assumption. By using the method, satellite remote sensing techniques have provided a global picture of CDER as well as COT for a couple of decades. However, in general clouds are known as vertically inhomogeneous scattering media and strictly speaking, the PPH assumption is not applicable to water clouds in nature. In fact, several studies demonstrated that satellite CDER retrievals are affected by vertical inhomogeneity of CDERs [2].

In this study, we propose an improved retrieval method, which incorporates CDER vertical inhomogeneity, using the Moderate Resolution Imaging Spectroradiometer (MODIS) visible and two near-infrared reflectance/radiance and the CloudSat radar reflectivity profile. In this study, we will demonstrate radiative impacts and retrieval biases associated with CDER vertical inhomogeneity over the global open ocean.

References


Preferred mode of presentation: Poster