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Comparison of Ice Cloud Properties Derived for CERES with Active Sensor Datasets

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The accurate representation of clouds in weather and climate models is critically important because they have a significant influence on the dynamics and thermodynamics of the atmosphere. They impact the vertical distribution of atmospheric heating and play an essential role in the Earth's hydrologic cycle. Satellite observations are contributing important information needed to validate and improve the characterization of clouds and their effects in models. This is due in large part to the compliment of satellite remote sensors flying together in the A-Train formation, which contribute unique and complementary information on clouds that currently cannot be obtained with any single remote sensor. Active satellite sensors such as the Cloud Profiling Radar on CloudSat and the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) on the CALIPSO satellite are nadir pointing and unable to scan wide areas. However, they have the ability to penetrate clouds with different but complimentary sensitivities, and thus provide excellent vertical resolution. Passive sensors such as the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Aqua satellite have the ability to scan wide areas, resolving the horizontal variability in cloud properties, but with poor vertical resolution. Because many applications require information on clouds in all three spatial dimensions, there is great interest in using the two, synergistically, to improve the characterization of cloud water in the atmosphere.

The purpose of this study is to compare the ice water content fields being derived with various methods using A-Train data. The comparison is performed in a global, climatological sense by examining the seasonal variation in zonal mean vertical profiles. The various approaches being used to derive the vertical profile of ice water content (IWC) from A-Train data include several products generated by the CloudSat science team, and a product generated by the Clouds and Earth's Radiant Energy System (CERES) project, among others. The CloudSat products are derived from (1) the radar reflectivity only (2B-CWC-RO), (2) the radar reflectivity and MODIS visible reflectance (2B-CWC-RVOD), and (3) using a combination of the radar reflectivity and lidar backscatter (2C-ICE). The CERES cloud water content (CWC) profiles are constructed at the footprint level ($\sim$20 km) of the CERES broadband radiometer to obtain radiative closure, and part of an integrated CALIPSO, CloudSat, CERES, MODIS (CCCM, C3M) merged data product. We will also compare passive sensor retrievals of IWP, derived from MODIS data by the CERES cloud team, with that computed using the various profile datasets.

The results of this study provide a prerequisite understanding of the relative uncertainties associated with the various methods to retrieve IWC and IWP that should improve the future utility of these data for validating and improving the characterization of clouds in weather and climate models.