# Assessment of CloudSat Using ARM, AMF, and CloudNet Observations


## Contributors
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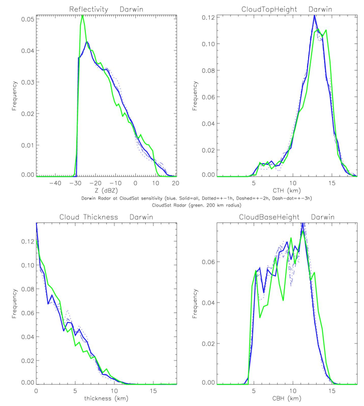
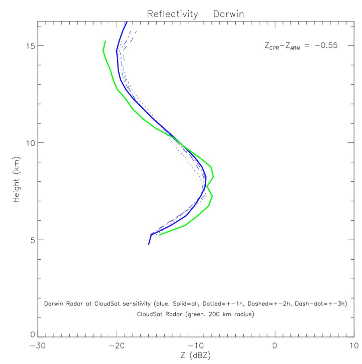
## Research Highlight
A crucial factor to improve our ability to forecast future climate change and short-range weather is a better representation of convection and clouds in large-scale models. This requires a better understanding of the statistical properties of clouds and deep convective storms, as well as the variability of these properties as a function of different temporal, spatial, or physical parameters. The A-Train mission represents an unprecedented and unique opportunity to address this broad objective both at regional and global scales. However, this mission is the very first of its kind, so an extensive verification of the measurements and standard products is needed before using these measurements and products for quantitative studies.

Our approach has been to carefully evaluate statistical differences between CloudSat 2B-GEOPROF reflectivities and cloud morphology (base, height, thickness) and ground-based observations collected at the ARM Climate Research Facility (ACRF) Darwin and Nauru sites, at the Convective and Orographically Induced Precipitation Study (COPS) and African Monsoon Multidisciplinary Analysis (AMMA) ARM Mobile Facility (AMF) deployments, and at the Lindenberg and Site Instrumental de Recherche par Teledetection Atmospherique (SIRTA) sites. Two to six months of data have been processed over each site. Caution has been exercised to put all radars at the same sensitivity for each comparison. As shown by the illustration for the Darwin site probability distribution functions (PDFs) and mean vertical profiles, the agreement between the CloudSat and millimeter wave cloud radar (MMCR) reflectivities is excellent. The weighted-mean difference between the spaceborne radar and the ground-based radars is within +-0.5 dB, which is of the order of magnitude of the expected accuracy of the calibration of these radars.

Long-term ground-based radar-lidar observations can be used in a statistical way to evaluate cloud properties as derived from spaceborne radar-lidar observations. The present study shows that CloudSat is very well calibrated (to within 0.5 dB), and produces statistical properties of cloud morphology that are unaffected by the lower resolution of the instrument when compared to ground-based ones.



PDF of cloud reflectivity (upper-left), cloud top height (upper-right), thickness (lower-left), and cloud base height (lower right) as measured by the Darwin MMCR (blue) and CloudSat cloud profiling (CPR; green) radars. The other blue curves are the Darwin MMCR results when only +-1 hour (dotted), +-2 hours (dashed), and +-3 hours of data are retained around the CloudSat overpass.



Mean vertical profile of cloud reflectivity as measured by the Darwin MMCR (blue) and CloudSat CPR (green) radars. The other blue curves are the Darwin MMCR results when only +-1 hour (dotted), +-2 hours (dashed), and +-3 hours of data are retained around the CloudSat overpass.


## Reference(s)
Submitted.


## Working Group(s)
Cloud Properties