Intercomparison of Vertical Structure of Storms Revealed by Ground-based (NMQ) and Spaceborne Radars (CloudSat-CPR and TRMM-PR)

Veronica M. Fall[1,2], Qing Cao[3], and Yang Hong[3,4,5]

[1]National Weather Center Research Experiences for Undergraduates Program, [2]Valparaiso University, [3]Advanced Radar Research Center, [4]Hydrometeorology and Remote Sensing Laboratory, [5]School of Civil Engineering and Environmental Sciences

Purpose

- Spaceborne radars provide great opportunities to investigate the vertical structure of clouds and precipitation.
- W–band Cloud Profiling Radar (CPR) on NASA's CloudSat satellite
- Ku–band Precipitation Radar (PR) on the TRMM satellite
- S-band NEXRAD–based National Mosaic and Multisensor QPE (NMQ) system
- Identify hydrometeors and improve radar-based quantitative precipitation estimation
- Analyze the microphysics above, within, and below the melting layer from a 18 January 2009 storm.

CloudSat/NMQ and TRMM/NMQ

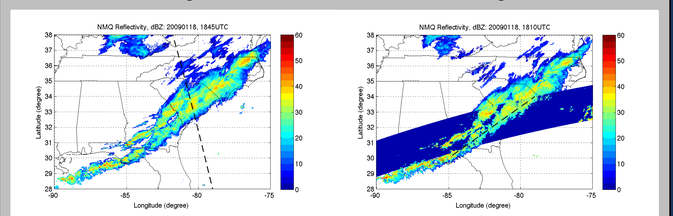

Figure 1. The CloudSat track overlaid with NMQ Composite Reflectivity at 1845 UTC (left) and the TRMM track overlaid with NMQ Composite Reflectivity at 1810 UTC (right) on 18 January 2009.

NMQ Reflectivity Cross-Sections

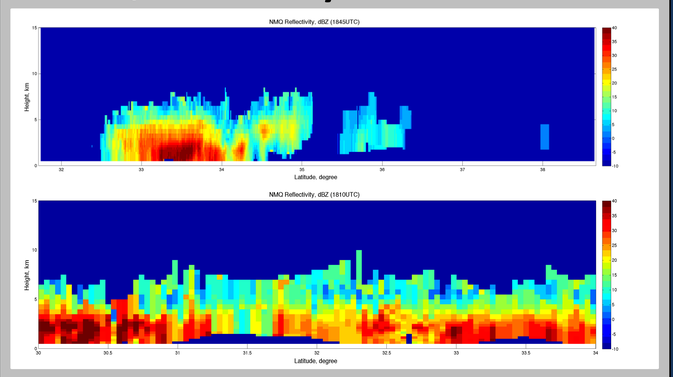

Figure 2. The NMQ reflectivity cross-section through the CloudSat path at 1845 UTC (top) and through the TRMM track at 1810 UTC (bottom).

CloudSat Reflectivity and CPR vs. NMQ Reflectivity

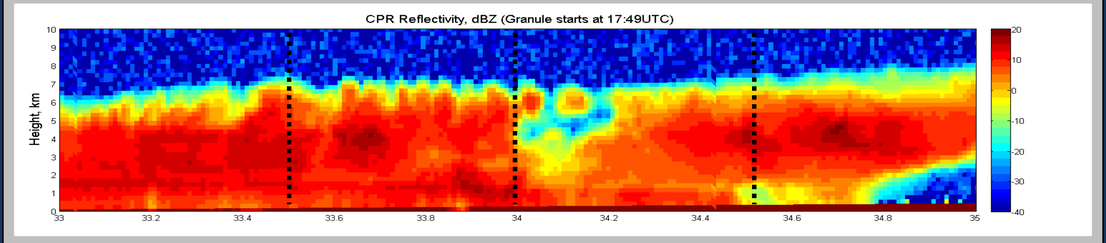

Figure 3. CloudSat CPR reflectivity cross-section from 33°-35°N.

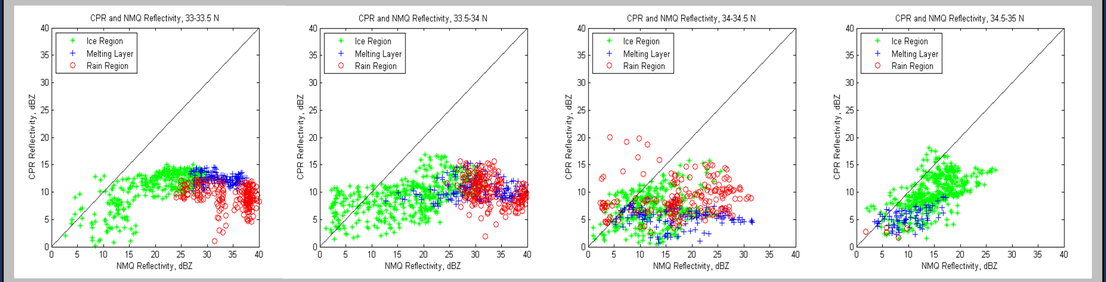

Figure 4. Scatterplots of NMQ and CPR reflectivity values from 33°-33.5° N, 33.5°-34°N, 34°-34.5° N, and 34.5°-35°N. The diamonds indicate the ice region, the crosses indicate the melting layer, and the circles indicate the rain region.

TRMM Reflectivity and PR vs. NMQ Reflectivity

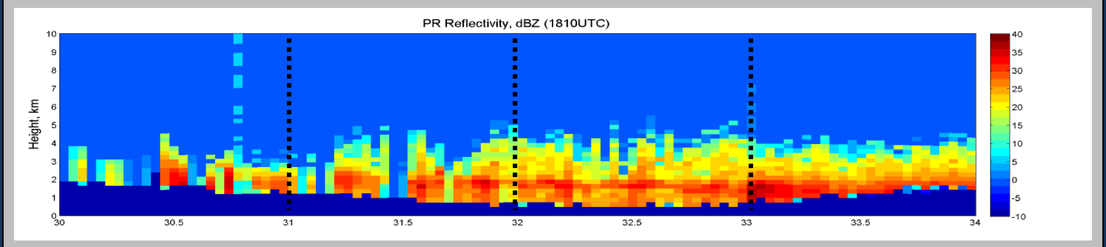

Figure 5. TRMM PR reflectivity cross-section from 30°-34° N.

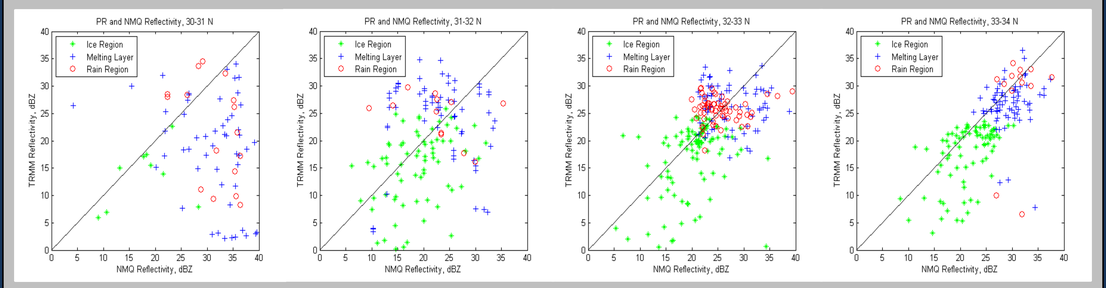

Figure 6. Scatterplots of NMQ and PR reflectivity values from 30°-31° N, 31°-32° N, 32°-33° N, and 33°-34° N. The diamonds indicate the ice region, the crosses indicate the melting layer, and the circles indicate the rain region.

Vertical Profiles of Reflectivity

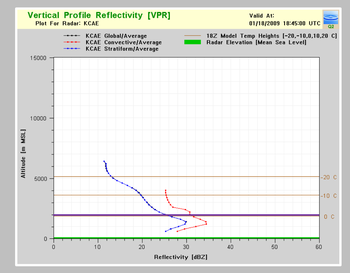

Figure 7. VPR from Columbia, SC can be used to compare the brightband and freezing levels.

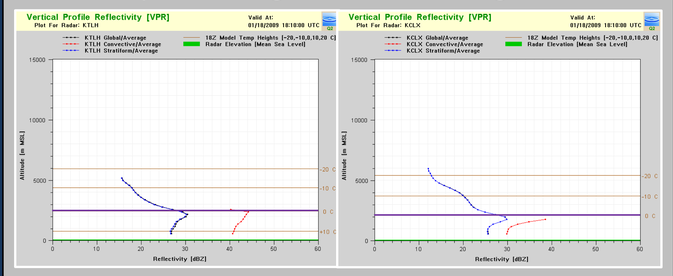

Figure 8. VPR from Tallahassee, FL (left) and Charleston, SC (right).

Conclusion

- The CloudSat satellite's Cloud Profiling Radar is very useful in the diagnosis of storm structure.
- The CPR has a better resolution than the TRMM PR and is able to provide important information about the different levels within a storm, specifically above the freezing level and at the freezing level itself.
- Using different radar systems allows for cross–verification of observations, as shown by comparing the reflectivity cross–sections and VPRs.
- Using CloudSat and TRMM products, the NMQ system has been used to verify the freezing level and brightband level, as well as to provide a comparison of the reflectivity values as recorded by the different systems.
- Will lead to improved quantitative precipitation estimation and forecast modeling.

This material is based upon work supported by the National Science Foundation under Grant NO. AGS—1062932.