Intercomparisons of CloudSat and ground-based radar measurements during satellite overpasses

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The CloudSat satellite, which carries a nadir-pointing W-band cloud profiling radar (CPR), passes over a number of ground-based operational and research precipitation and cloud radars. Close time and 3-D space collocations of satellite and ground-based radar measurements are possible during the overpasses. Due to excellent calibration of the CPR, collocated measurements can be used for the relative calibration of the ground-based radars and also for intercomparisons of the microphysical retrievals for matched vertical profiles. Matched profile intercomparisons largely avoid uncertainties associated with different space averaging of gridded satellite and ground-based radar products thus allowing for detailed evaluation of the retrieval algorithms and better understanding of their uncertainties. This presentation will focus on retrieval results of such precipitating ice microphysical parameters as hydrometeor characteristic size, ice/snow water content and snowfall rate. The data sets used in this study were collected during CloudSat overpasses near the Oliktok Point Alaska Atmospheric Radiation Measurement (ARM) program’s Mobile Facility 3 (AMF3) and several operational Weather Surveillance Radar-1988 Doppler (WSR-88D) S-band units in the continental United States. Oliktok Point overpass intercomparisons are also used for verifications of the absolute calibration of the AMF3 scanning dual-wavelength Ka-W-radar and for assessing effects of zenith non-Rayleigh reflectivity enhancements. An approach to use S-W-band dual-wavelength measurements for snowflake sizing during CloudSat overpasses near WSR-88D sites is evaluated. It shows a promise for estimating the characteristic size of snowflakes for higher reflectivities values (Z> 0 dBZ). Novel polarimetric techniques for snowflake sizing using polarimetric WSR-88D measurements are also tested and assessed based on satellite and dual-wavelength retrievals. Overall, the intercomparisons reveal relatively large discrepancies in the matched microphysical retrievals. Such discrepancies are not only observed when comparing ground-based and satellite algorithms but also are present for different routine satellite algorithms which used to generate CloudSat products. The sources of retrieval uncertainties and possible approaches for algorithm enhancements will also be discussed. The CloudSat satellite, which carries a nadir-pointing W-band cloud profiling radar (CPR), passes over a number of ground-based operational and research precipitation and cloud radars. Close time and 3-D space collocations of satellite and ground-based radar measurements are possible during the overpasses. Due to excellent calibration of the CPR, collocated measurements can be used for the relative calibration of the ground-based radars and also for intercomparisons of the microphysical retrievals for matched vertical profiles. Matched profile intercomparisons largely avoid uncertainties associated with different space averaging of gridded satellite and ground-based radar products thus allowing for detailed evaluation of the retrieval algorithms and better understanding of their uncertainties. This presentation will focus on retrieval results of such precipitating ice microphysical parameters as hydrometeor characteristic size, ice/snow water content and snowfall rate. The data sets used in this study were collected during CloudSat overpasses near the Oliktok Point Alaska Atmospheric Radiation Measurement (ARM) program’s Mobile Facility 3 (AMF3) and several operational Weather Surveillance Radar-1988 Doppler (WSR-88D) S-band units in the continental United States. Oliktok Point overpass intercomparisons are also used for verifications of the absolute calibration of the AMF3 scanning dual-wavelength Ka-W-radar and for assessing effects of zenith

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