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Cloud radiative properties and aerosol - cloud interaction

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The presented research discusses different techniques for improvement of cloud properties measurements and analysis. The need for these measurements and analysis arises from the high errors noticed in existing methods that are currently used in retrieving cloud properties and implicitly cloud radiative forcing. The properties investigated are cloud fraction (cf) and cloud optical thickness (COT) measured with a suite of collocated remote sensing instruments. The novel approach makes use of a ground based “poor man’s camera” to detect cloud and sky radiation in red, green, and blue with a high spatial resolution of 30 mm at 1km. The surface-based high resolution photography provides a new and interesting view of clouds. As the cloud fraction cannot be uniquely defined or measured, it depends on threshold and resolution. However as resolution decreases, cloud fraction tends to increase if the threshold is below the mean, and vice versa. Additionally cloud fractal dimension also depends on threshold. Therefore these findings raise concerns over the ability to characterize clouds by cloud fraction or fractal dimension. Our analysis indicate that Principal Component analysis may lead to a robust means of quantifying cloud contribution to radiance.
The cloud images are analyzed in conjunction with a collocated CIMEL sky radiometer, Microwave Radiometer and LIDAR to determine homogeneity and heterogeneity. Additionally, MFRSR measurements are used to determine the cloud radiative properties as a validation tool to the results obtained from the other instruments and methods. The cloud properties to be further studied are aerosol- cloud interaction, cloud particle radii, and vertical homogeneity.