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Capstone Research Write-up

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For the spring semester of 2016, I have been working with Professor Greg McFarquhar on the analysis of raindrop size distributions from the Mid-latitude Continental Convective Clouds Experiment (MC3E). The goal of this analysis is to determine of the concept of normalized size distributions can be applied to these data. To that end, I have been applying techniques by Testud et al. (2001) for the normalization of distributions. The shape of raindrop size distributions help us determine the physical characteristics and processes of rain and clouds. The ability to normalize and characterize these distributions may aid our general understanding of rain and clouds, and could lead to better modeling and prediction of such.

Initial analysis consisted of plots of the distributions, averages, and comparison with rain rate of the distributions processed by the National Center for Atmospheric Research (NCAR). The plots of distributions were created to qualitatively analyze the data to ensure that they are realistic and similar to distributions observed in previous studies. Inspecting these plots, the distributions were extending into diameters of 1 to 2 centimeters, which is very unrealistic for raindrops, where the largest observed raindrop had a diameter of 8mm.

I followed the methods by Testud et al for nomalization. I determined the scaling parameter for concentration N­­0­­\*, and the scaling parameter for diameter Dm for the NCAR distributions. Then I made a series of plots comparing these parameters and the distributions with respect to rain rate similar to Testud et al. Initial results show smaller values of N0\* by an order of magnitude. Average values of Dm were larger by about 1mm. The shapes of the normalized and raw distributions were similar to those of Testud et al.

After contacting Aaron Bransemer, we learned that the probe image processing was done using ice recognition algorithms. We asked him to process the images for a single flight for water. I then ran the same analysis as above using the new water-processed data. I then compared it against the ice-processed plots. This is still in process, as there are large inconsistencies between the re-processed data in ice and water, and the original ice data. However, the water-processed data has more realistic distributions, most ending around 6mm in diameter and following the same shape as previous studies.

Thus far results from analysis of the MC3E data is similar to that of Testud, but with varying magnitude. The shapes of the normalized distributions are also very similar. Still to be seen is normalized distributions averaged across rainrate. Testud found that all of the averaged normalized distributions are nearly the same. We need to see if we get the same result with the MC3E data.