Consistency between In-situ and Radar Observation of Hail Storms

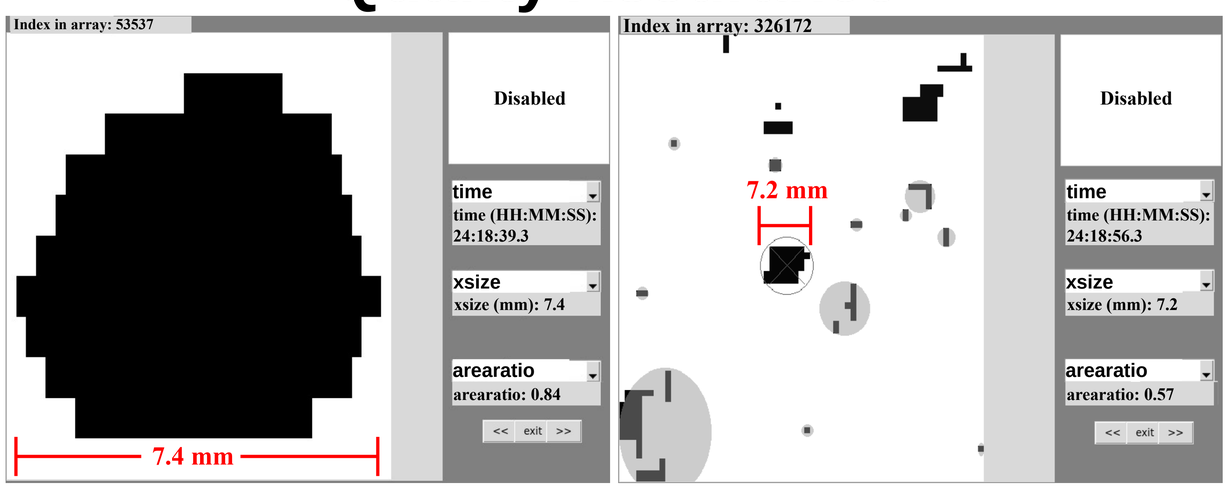
David J. Delene[1], James Klinman[1], Andrew Detwiler[1], Ivan Arias Hernandez[2], Patrick Kennedy[2], V. Chandrasekar[2]

[1]University of North Dakota (UND), [2]Colorado State University (CSU)

Overview

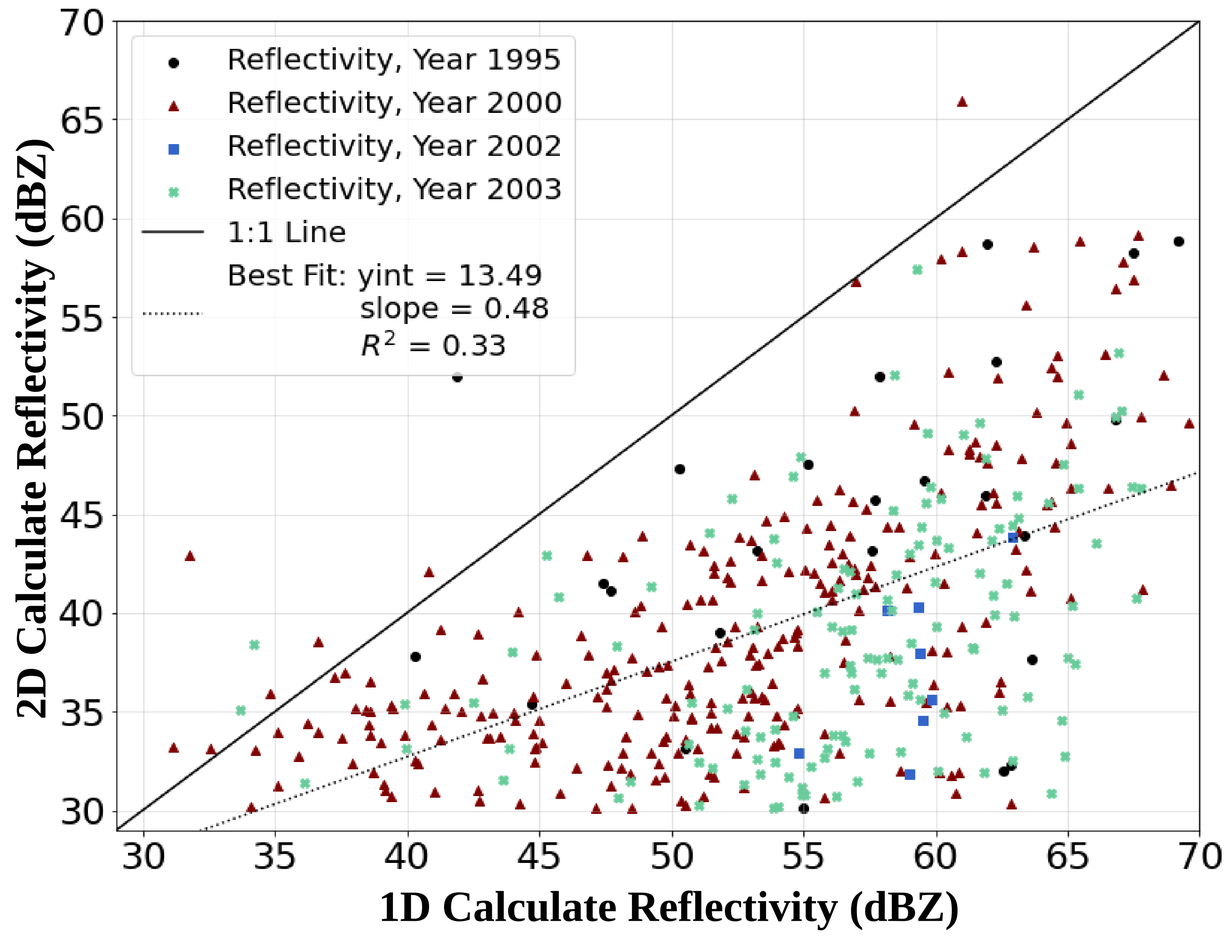
- The project's objective is to compare hailstorms radar observations with radar parameters derived from in-situ measured particle size distributions.
- The analyzed dataset comes from T28 aircraft measurements and the CSU-CHILL radar during a series of field projects between the years 1989-2003.
- The T-28 is unique since the aircraft could sample in hailstorms with up to 3 inch diameter particles.
- The Hail Spectrometer on the T-28 aircraft initially only provided one-dimensional (1D) size information; however, an upgrade provided two-dimensional (2D) sizing information for four different field projects.
- There are 11 flights where 2D particle spectrum data are available. This available 2D particle spectra are analyzed to determine what percentage of the observations are consistent with water being a component of the observed particles.

Quality Assurance



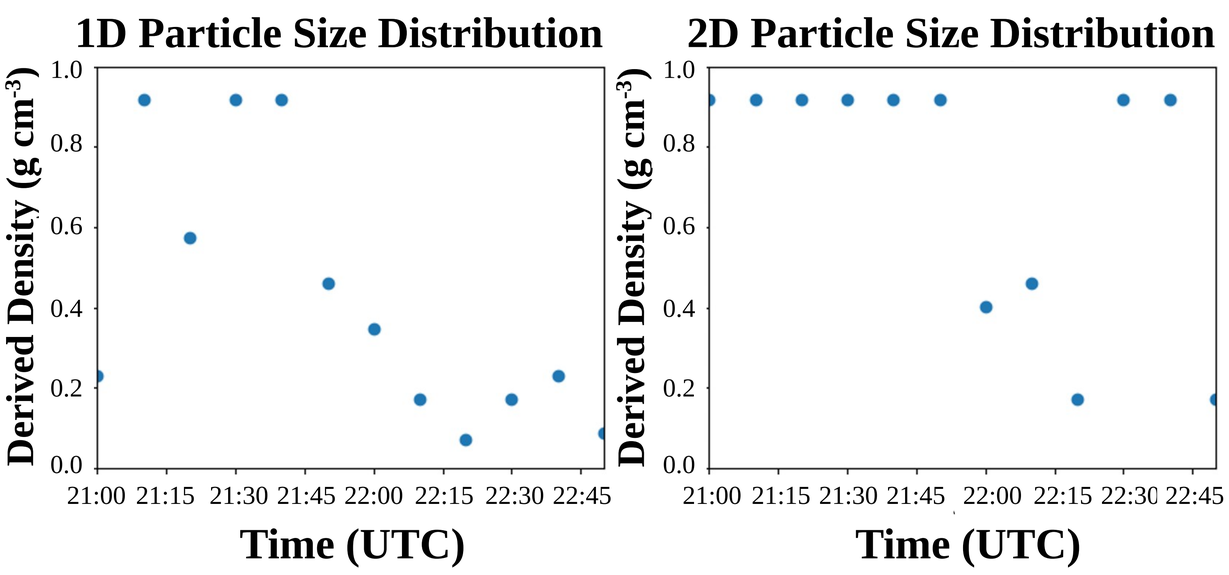
Pbp_viewer software Screenshots showing image with respective characteristics (top), and buffer with selected images (bottom).

Method Comparison



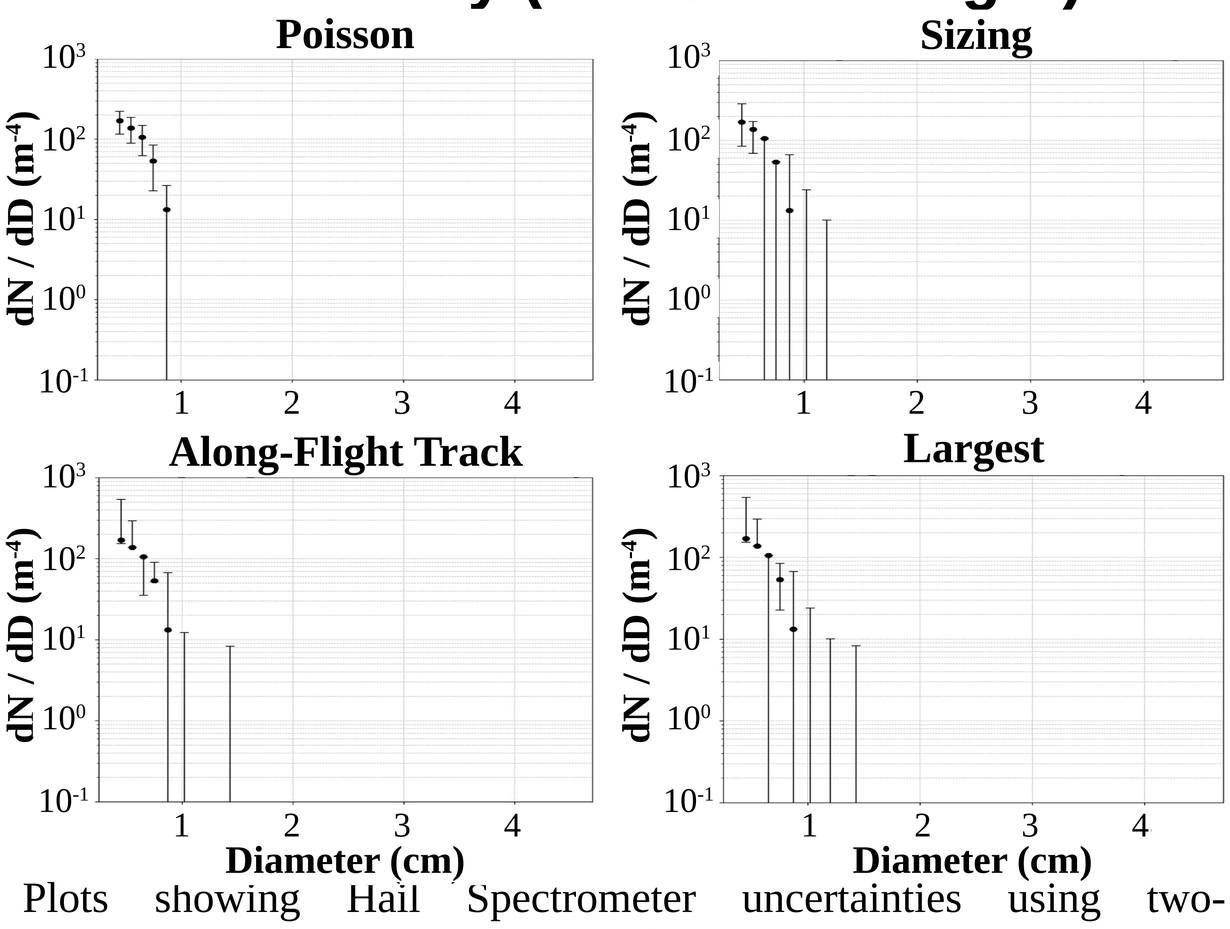
Plot showing relationship between reflectivity calculate using 1D and 2D particles size distributions. Only points where both reflectivities exceed 30 dBZ are included. A total of 446 reflectivity pairs are included.

Method Impact on Particle Density



Derived particle densities used T-matrix calculations and matching the Hail Spectrometer particle size distributions during Flight 757 (24:21:00-24:23:00 UTC). The particle air fraction is used to obtain the best agreement between computed and observed reflectivities

Uncertainty (2000/06/23 Flight)



Plots showing Hail Spectrometer uncertainties using two-dimensional processing at 24:21:50-24:22:00 UTC. The "Largest" uncertainty is the greatest uncertainty from the 3 methods presented.

Conclusion

- The two-dimensional (2D) methodologies provide better PSDs than the one-dimensional (1D) methodology.
- Reviewing several cases indicates that the 1D processing provides too few small particles and too many large particles. The 1D processing results in higher calculated reflectivities than the 2D processing.
- The best PSDs have been used to calculate radar parameters differential radar reflectivity, specific differential phase, and hv correlation coefficient. Having the correct PSDs is found to be critical for determining liquid water fraction in the hail particles.

Acknowledgments

The presented research is supported by the National Science Foundation collaborative research award 2221719 (UND) and 2221720 (CSU).