T-28 Aircraft Image Probe Data Processing: Hail Storm Uncertainty and Radar Coupling

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

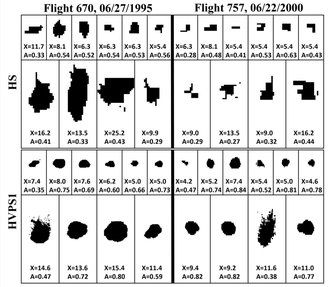
[1]University of North Dakota, [2]Colorado State University

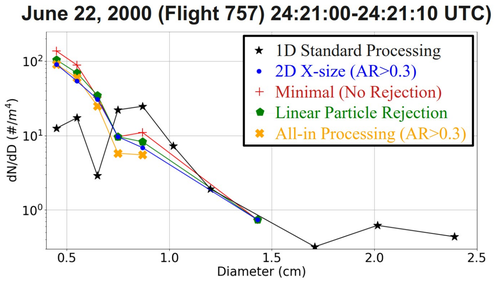
Motivation and Objective



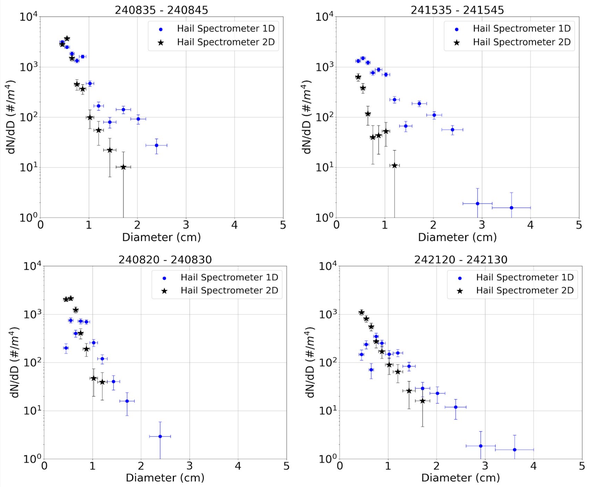
- The project's objective is to compare hailstorms radar observations with radar parameters derived from in-situ measured particle size distributions.
- The analyzed dataset comes from T28 aircraft measurements and the CSU-CHILL radar during a series of field projects between the years 1989-2003.
- The 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.

Methodology



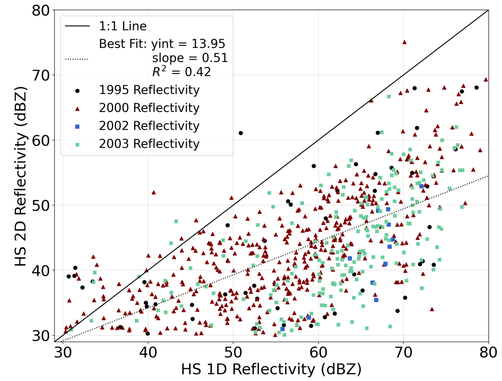


New software (left) to review individual particles from 2-dimensional probes was developed to determine overall assessment of image quality, which provides confidences in using an area ratio threshold of 0.3 for particle rejections that give improved results than the 1D processing (right).



- Analysis quantitatively evaluates 2D image quality
- 1D and 2D PSDs do not agree.
- 1D PSDs have too many large particles and too few small particles.

Results

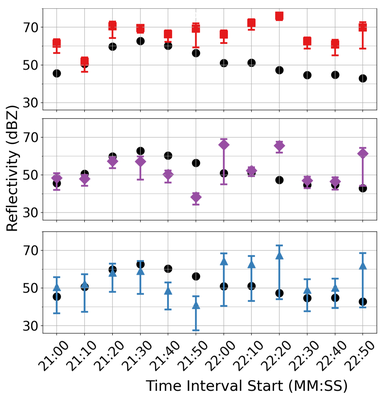


1 Particle, 1 cm:
Z_e = 37.6 dBZ

1 Particle, 2 cm:
Z_e = 56.4 dBZ (x76)

1 Particle, 3 cm:
Z_e = 67.2 dBZ (x917)

June 22, 2000 (Flight 757): Radar Comparison



- 1D PSD has reflectivity consistently higher than the radar.
- 2D x-size (XS) PSD reflectivity has over and underestimates compared to the radar.
- 2D mean (M) of all PSD overlaps within the uncertainty for 10 out of 12 for the 10 s intervals.

Conclusions

- 1D processing has consistently higher concentration of large particles than the 2D processing PSDs.
- The 2D processing should be used when available since it provides a more consistent PSD shape and is more consistent with manual image analysis.
- Manuscripts are under development for publication shortly.

Acknowledgments

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