Comparison of Disdrometer and X-band Mobile Radar Observations in Convective Weather

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1. Motivation

1. How do dual-polarimetric Doppler radar and disdrometer measurements from supercell thunderstorms compare?
2. What are the error sources in disdrometer and radar measurements and how do we correct them?
3. Can disdrometer data be used to indicate when radar attenuation correction schemes will perform poorly?

2. Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2) - Instruments

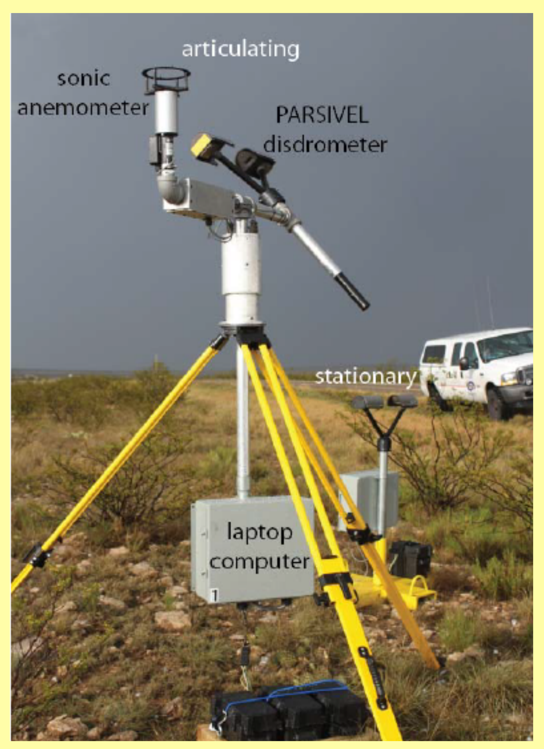
NOAA's X-band, Dual-polarized (NO-XP) Mobile Radar

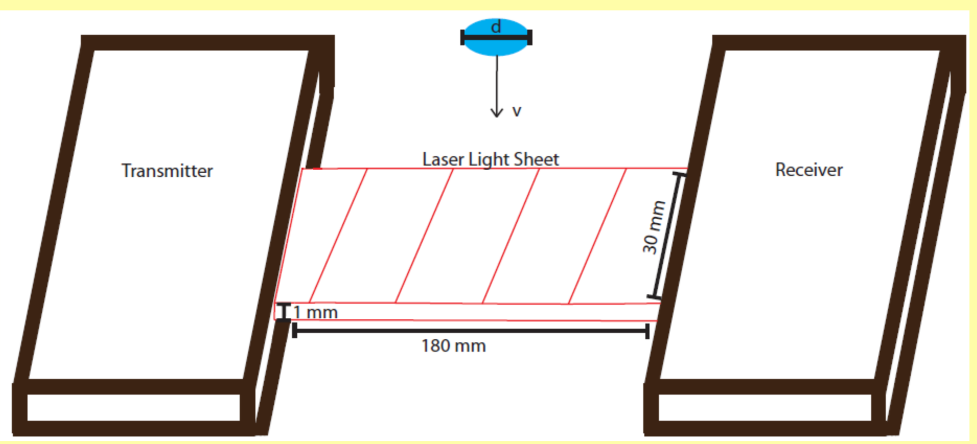
Measures:

1. Reflectivity (Z)
2. Doppler velocity
3. Differential reflectivity (Z_{DR})
4. Differential phase

Particle Size and Velocity (PARSIVEL) Optical Disdrometer

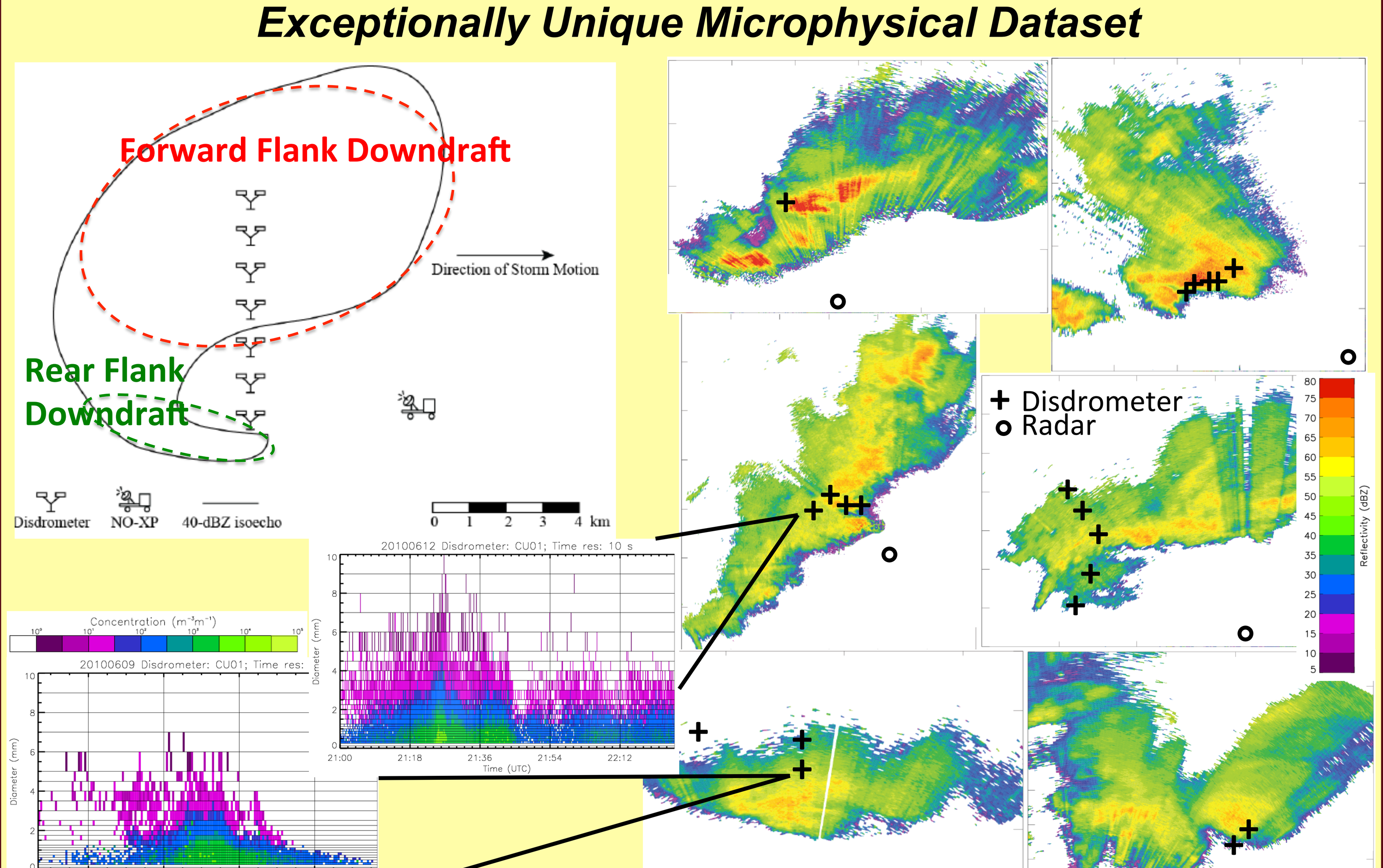
Measures particle diameter and fall speed



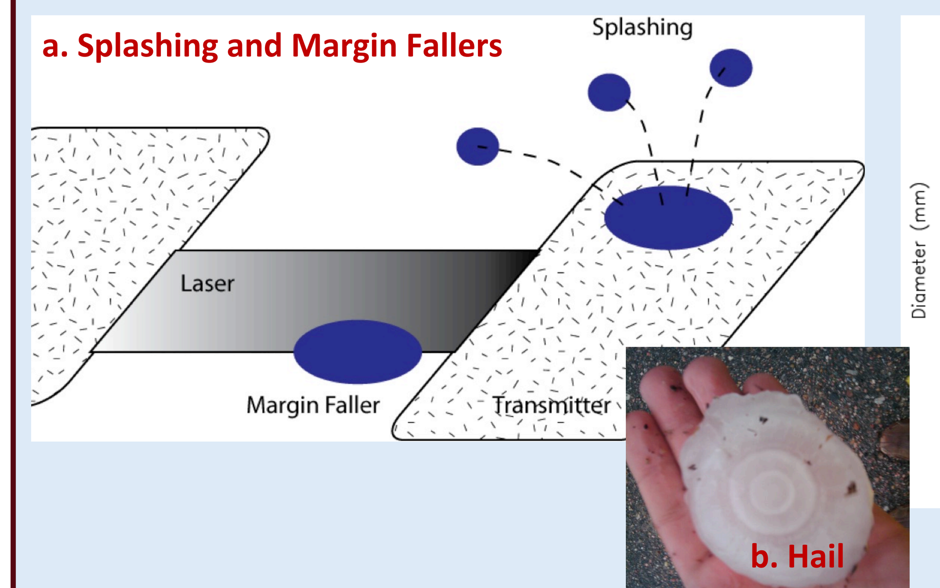


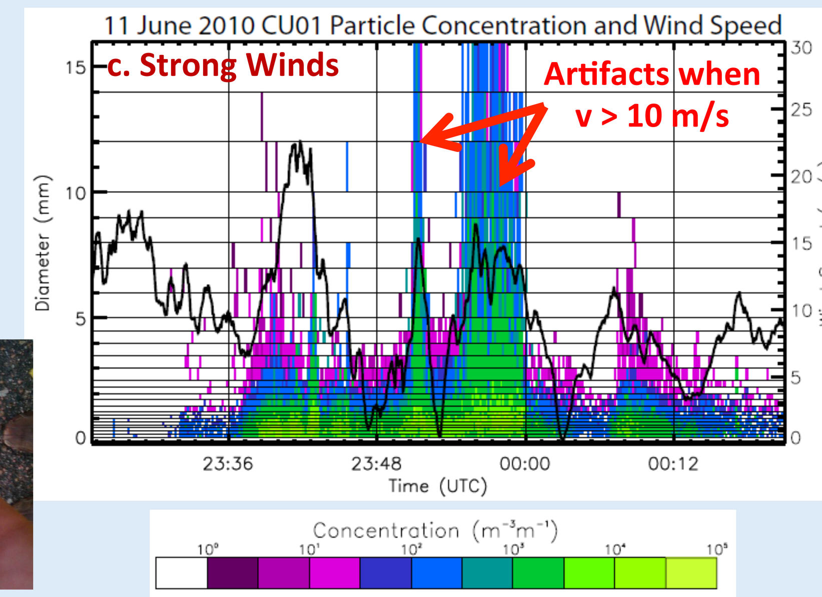
3. First Set of Coordinated Obs. in Supercells

Exceptionally Unique Microphysical Dataset



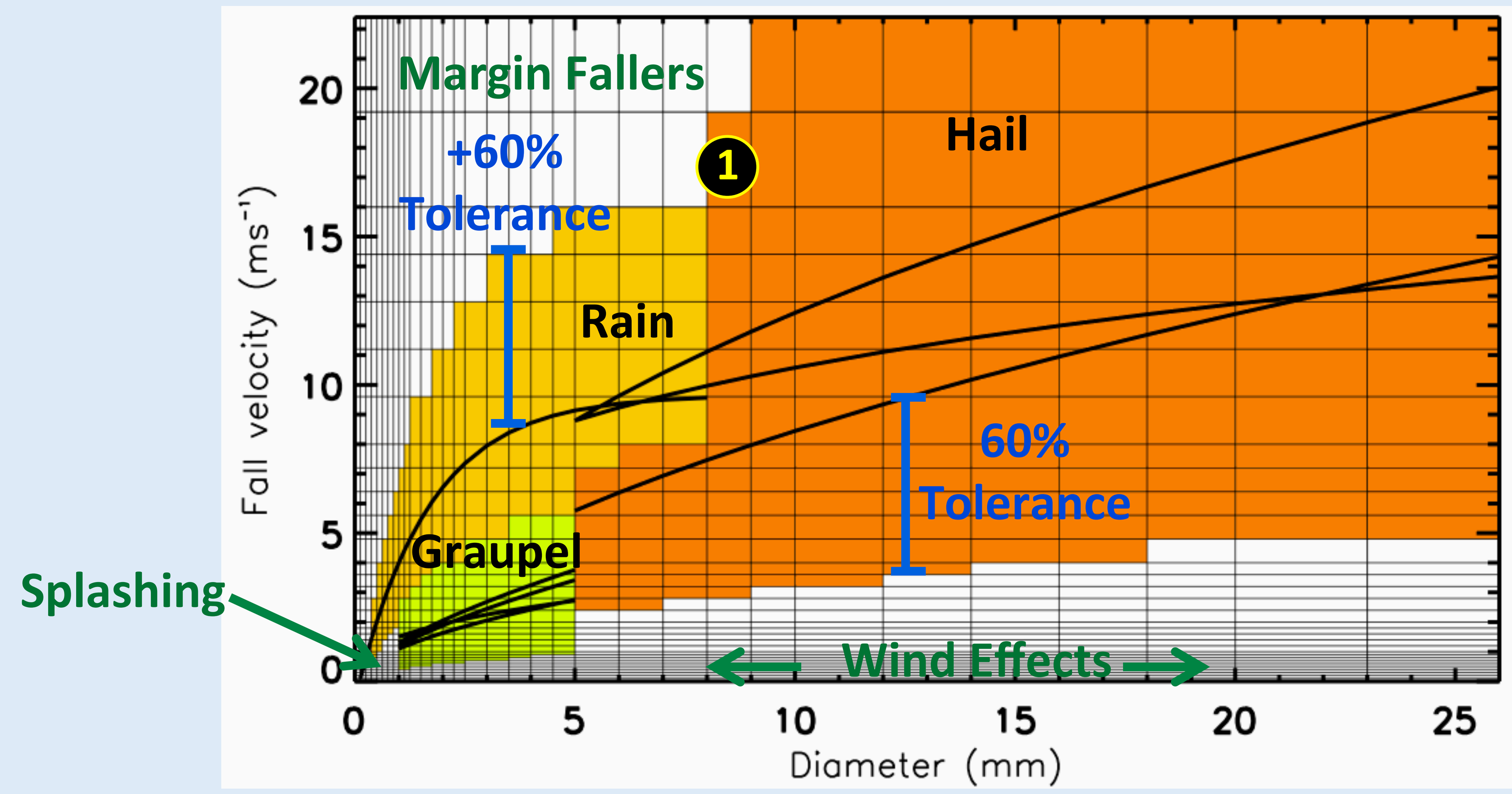
4. Quality Issues: Disdrometer Data





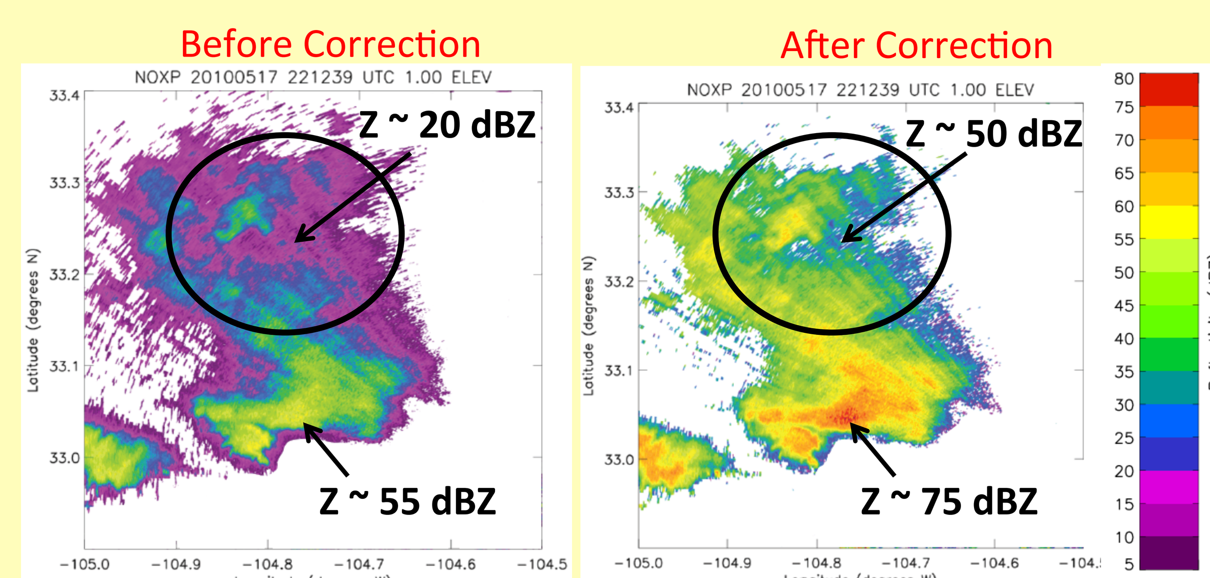
Problem: How can we remove margin fallers, splashing, and wind effects from the data, and how can we differentiate between rain, graupel, and hail?

Solution: Combine observed diameter and fall speed with established relationships between diameter and fall speed for rain, graupel, and hail. The result is a new quality control and particle discrimination scheme for PARSIVEL disdrometer observations in thunderstorms.

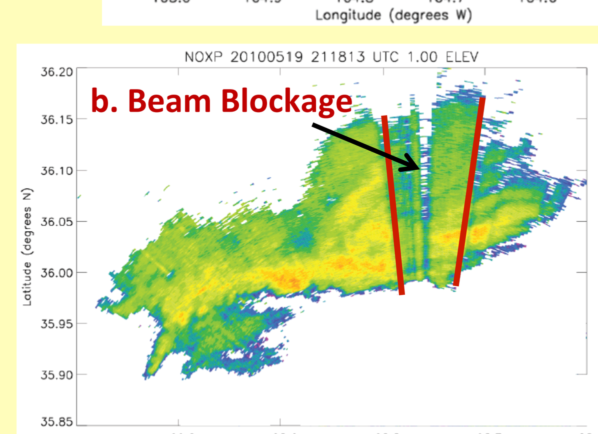


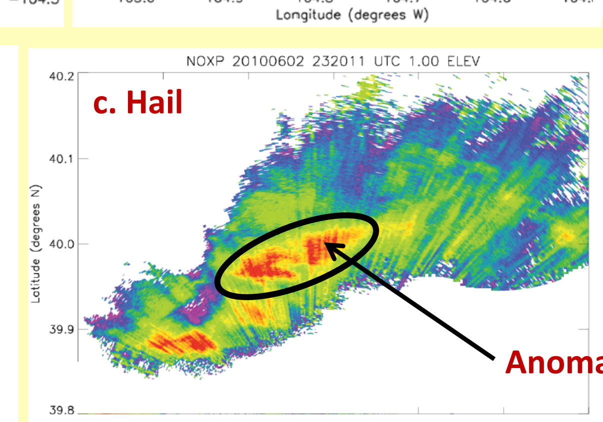
5. Quality Issues: Radar Data

a. Radar Beam Attenuation



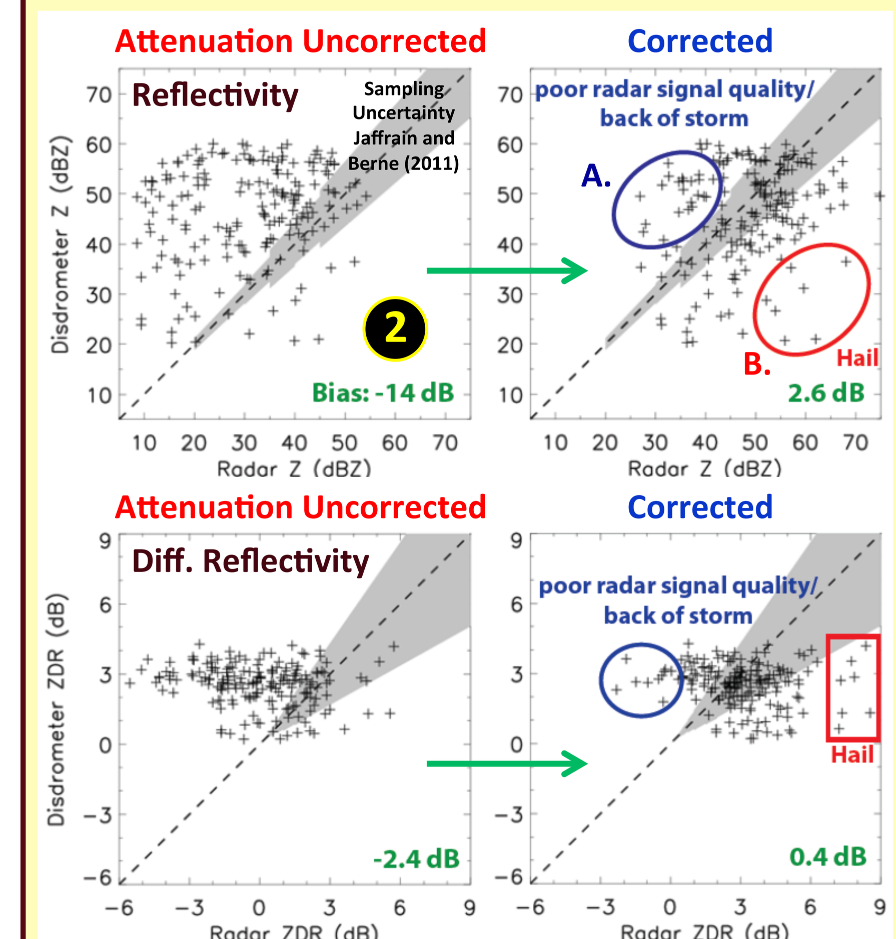
Solution: Use attenuation correction scheme from Steiner et al. (2009).

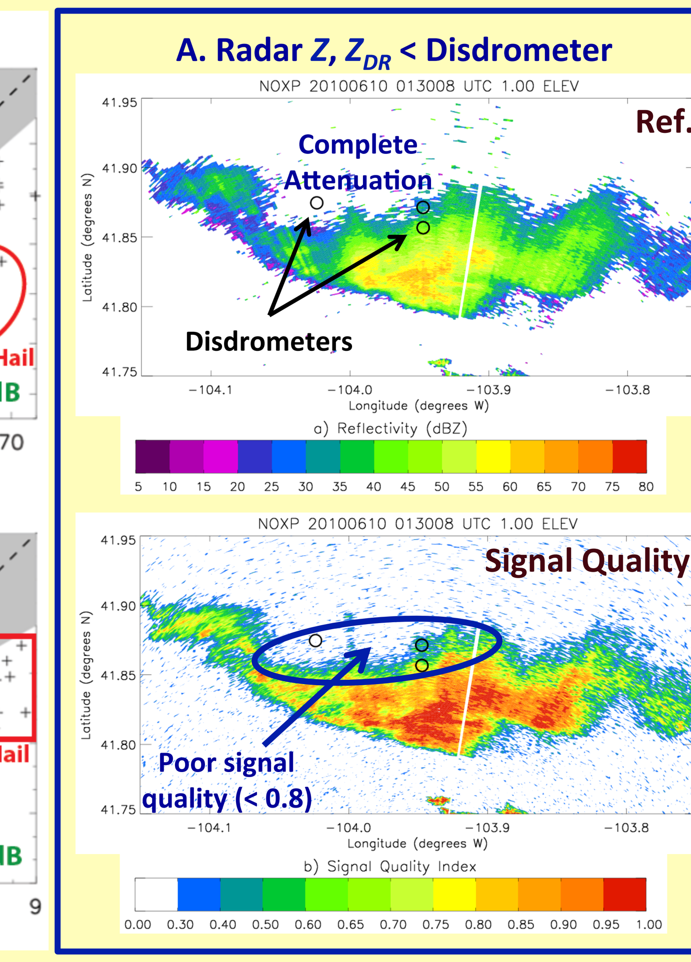


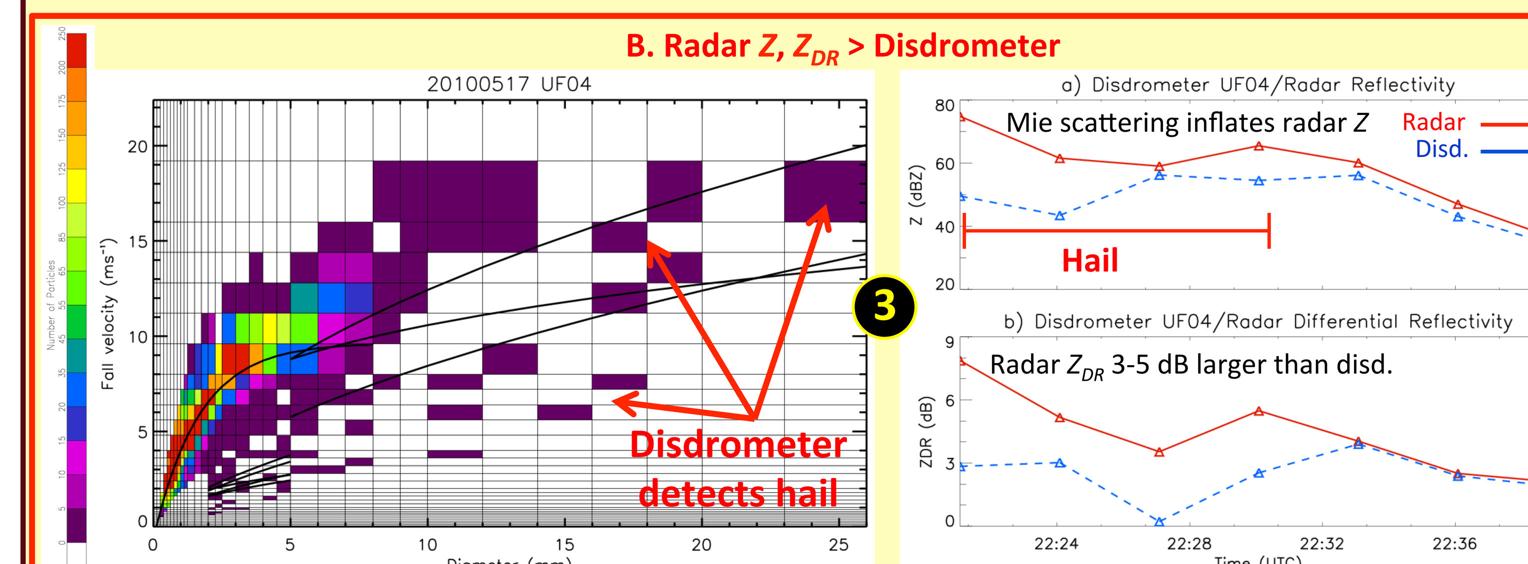


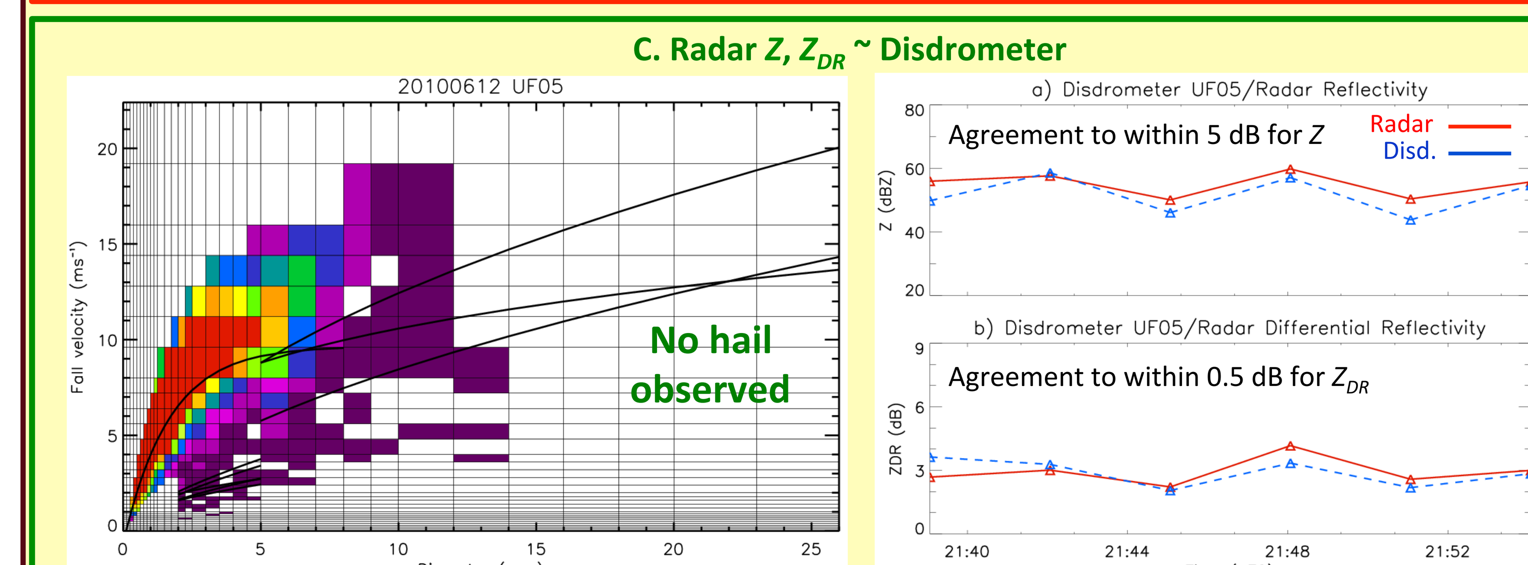
Solution: See if disdrometer observed hail; flag attenuation correction as suspect if hail is present (see section 6B).

6. Radar and Disdrometer Data Comparison









7. Conclusions

1. Disdrometer measurements can be corrected for margin fallers, splashing, and strong wind effects using a new quality control and particle discrimination scheme for PARSIVEL disdrometers.
2. Radar data must be corrected for attenuation prior to comparison with disdrometer data. The biases in radar Z and Z_{DR} measurements were -14 dB and -2.4 dB, respectively, before correction, and improved to 2.6 dB and 0.4 dB after correction. However, it was determined that the attenuation correction scheme may perform poorly in regions of hail and low radar signal quality (< 0.8).
3. Disdrometer data can be used to identify the presence of hail and to flag times when the radar attenuation correction scheme may not yield reliable results.

References

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Steiner, M., G. Lee, S. M. Ellis, and J. Vivekanandan, 2009: Quantitative precipitation estimation and hydrometeor identification using dual-polarization radar: Phase II. NCAR Tech. Rep., 74 pp. [Available online at ftp://ftp.eol.ucar.edu/pub/temp/users/sellis/Steiner_etal_2009/.]

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