P3.5

T-28 Research Aircraft and Polarimetric Radar Observations of Hailstorms

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2022 North American Workshop on Hail and Hailstorms
September 20-22, Boulder, Colorado USA

Basic Idea

- *In situ* observations of hail in storms that are also being observed with a polarimetric radar.
- Compute polarimetric signature in a region based on aircraft *in situ* observations.
- Compare computed signatures to observed signatures.
- Try to understand the agreement and disagreement between the *in situ* and radar observations.

Assess Uncertainties

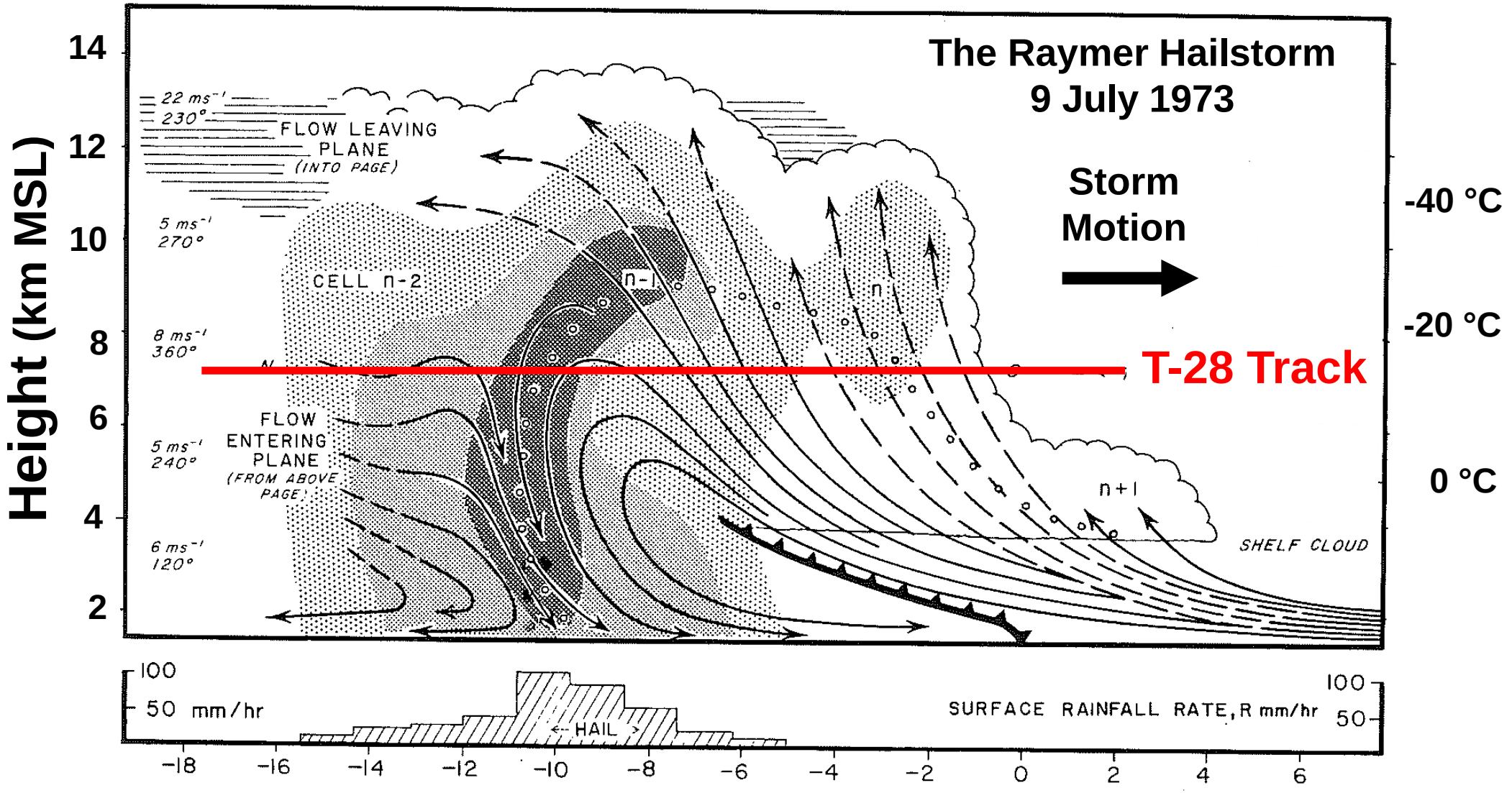
- Test sensitivity of computed signature to variations in the *in situ* observations within the uncertainty of those observations.
  - Temperature, LWC, Particle Shape, Particle Size and Density Distribution
  - Computation using Discrete Dipole vs T-matrix Approach
- Assess uncertainty in observed radar signature resulting from constraints due to time and spatial resolution of radar.

In situ Airborne Data Set

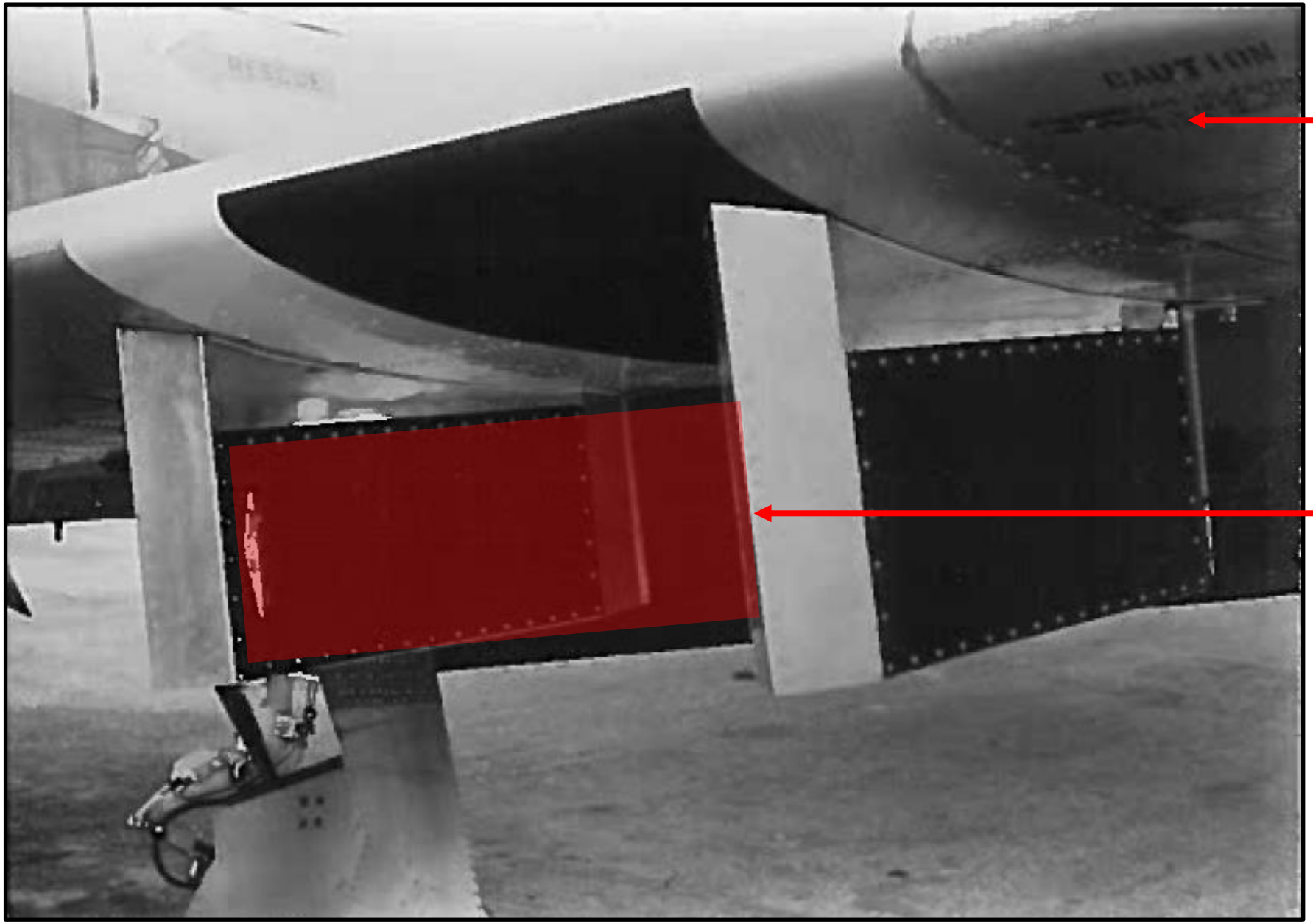
- Start with hail observations identified in Field *et al.* 2019.
  - There are 18 flights from 1995-2003.
  - More than 300 10-sec flight segments with hail reported in pilot audio recordings.
  - Add windscreen audio recordings for these segments.
  - Add optical array probe imagery when available.
- Expand data set by adding additional flights from several earlier years for which audio recordings are not available but hail is indicated in written field notes.

In situ Airborne Data Set

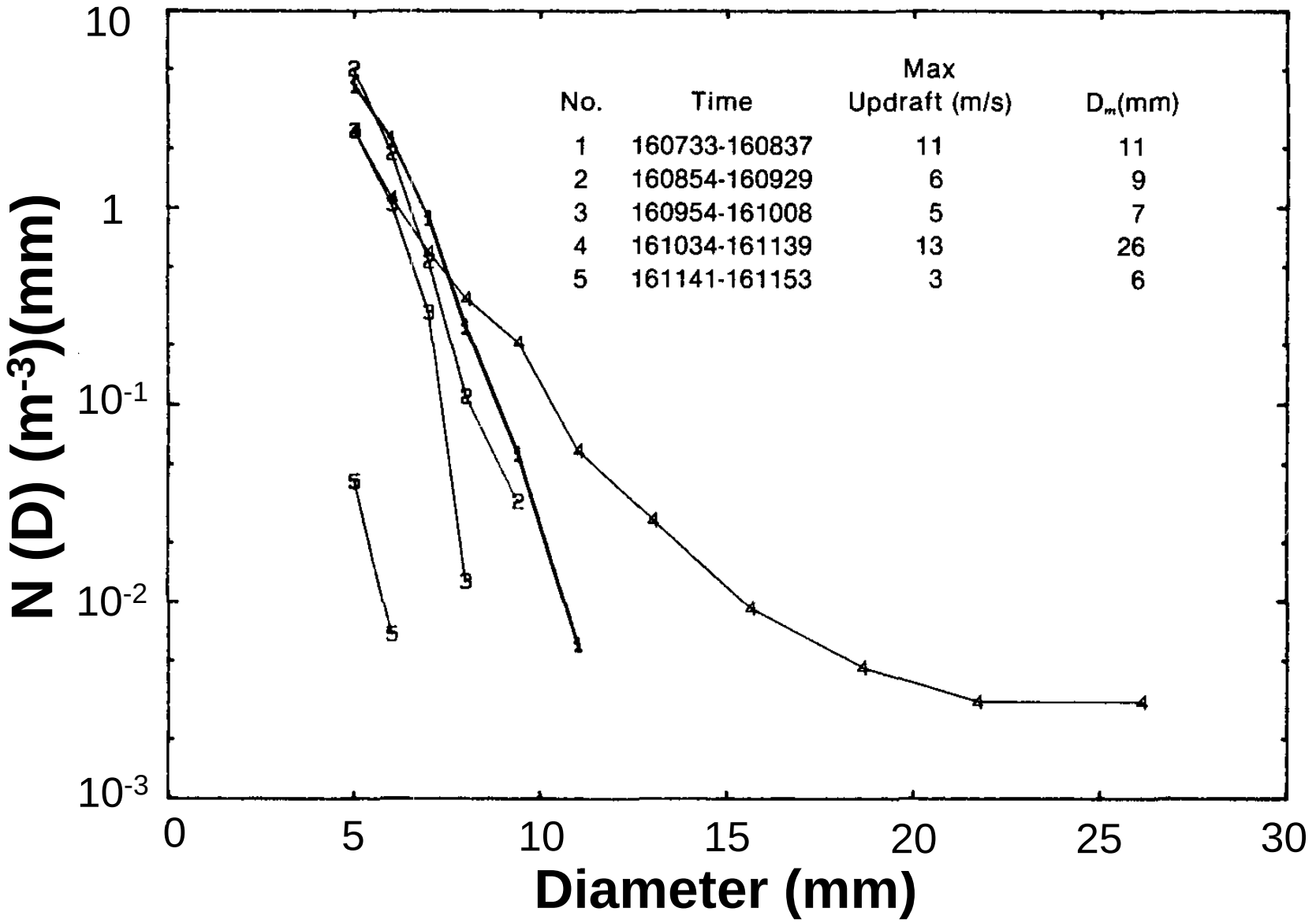
Typical Storm Sampling Pass



Hail Spectrometer

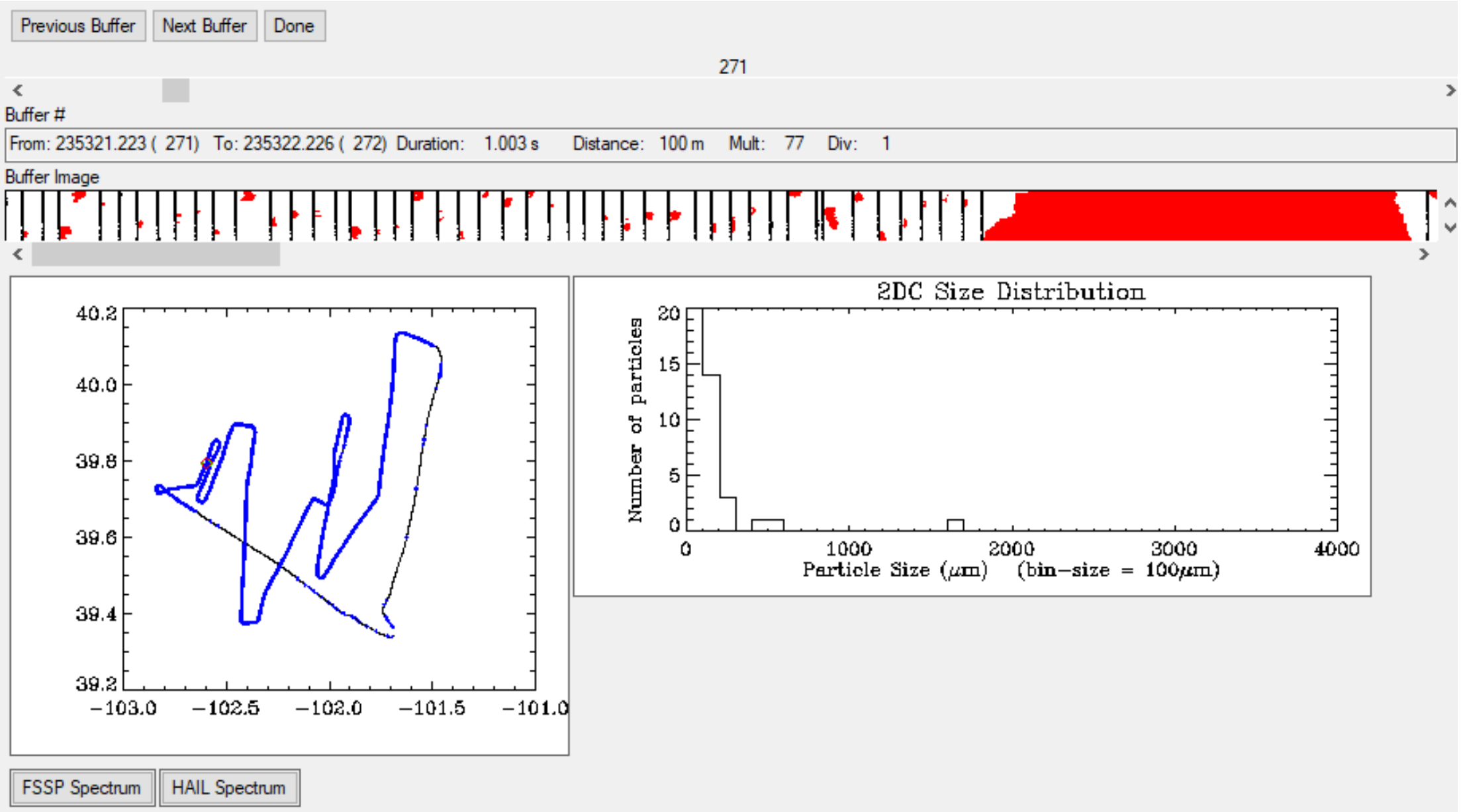


Hail Spectrometer “1D” Size Spectrum (CCOPE 1981)

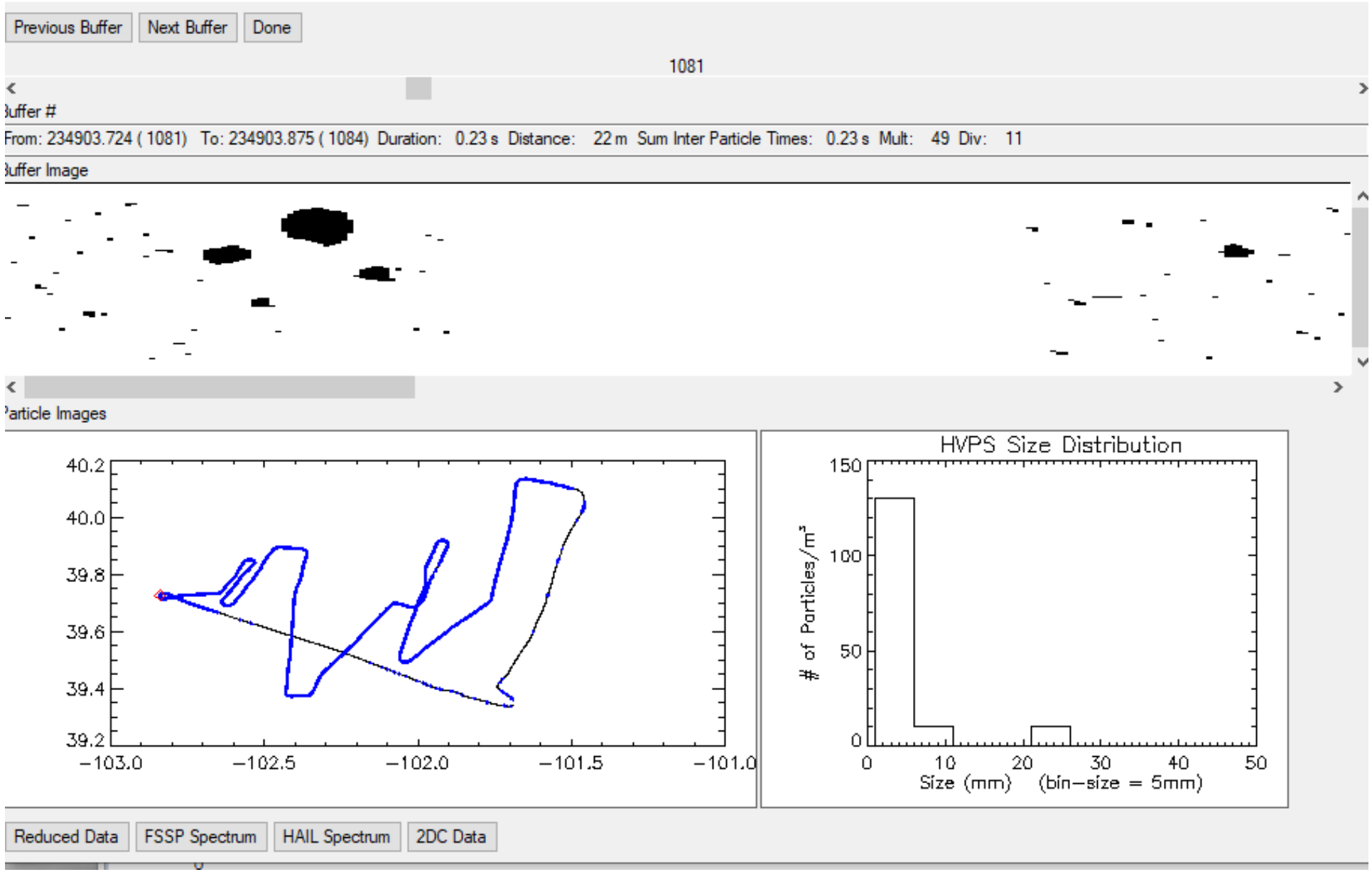


Musil et al. 1991: Some interior observations of southeastern Montana hailstorms. J. Appl. Meteor.

PMS 2D-C Imagery

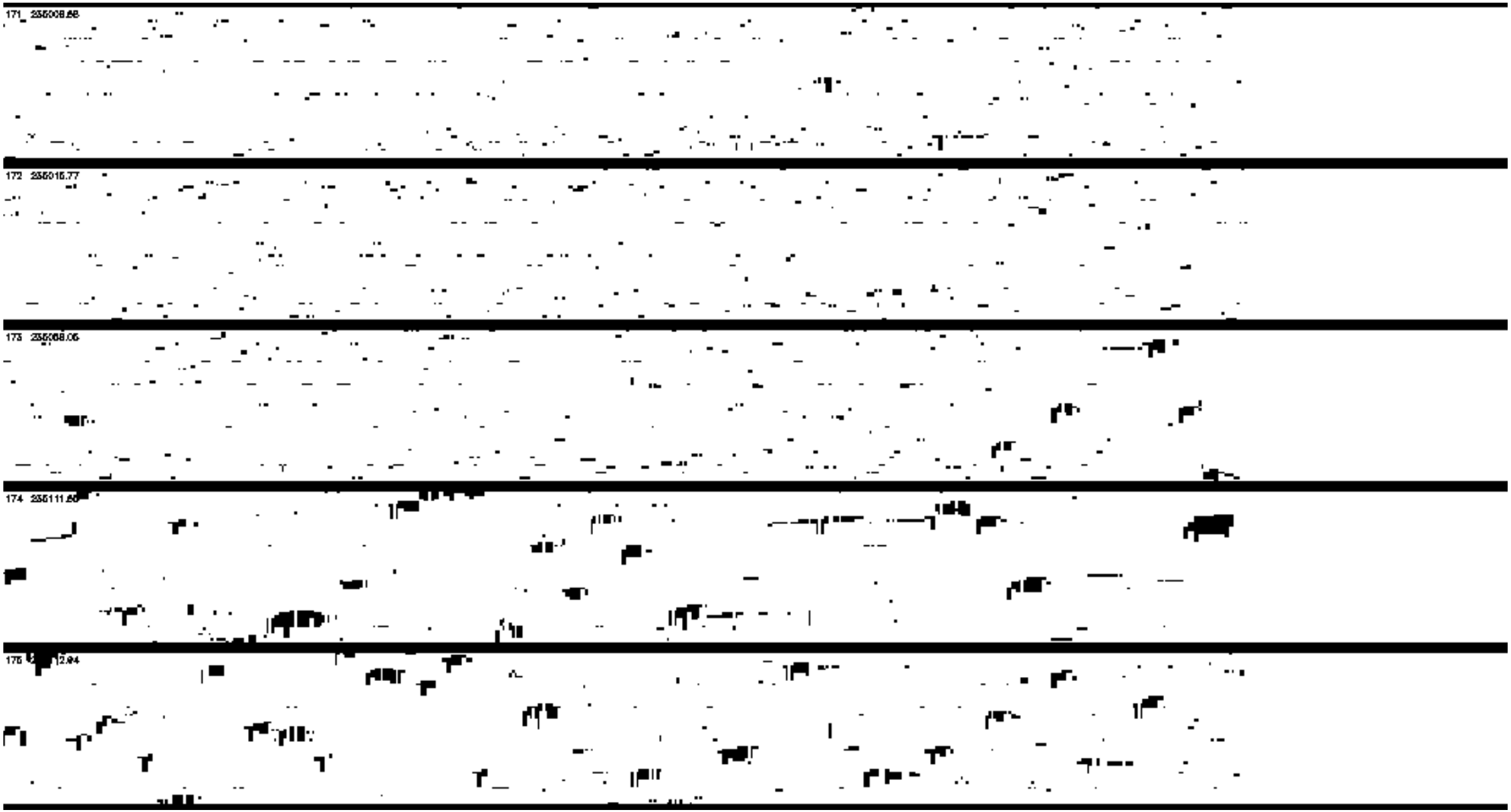


SPEC HVPS-2 Imagery



4.0 cm

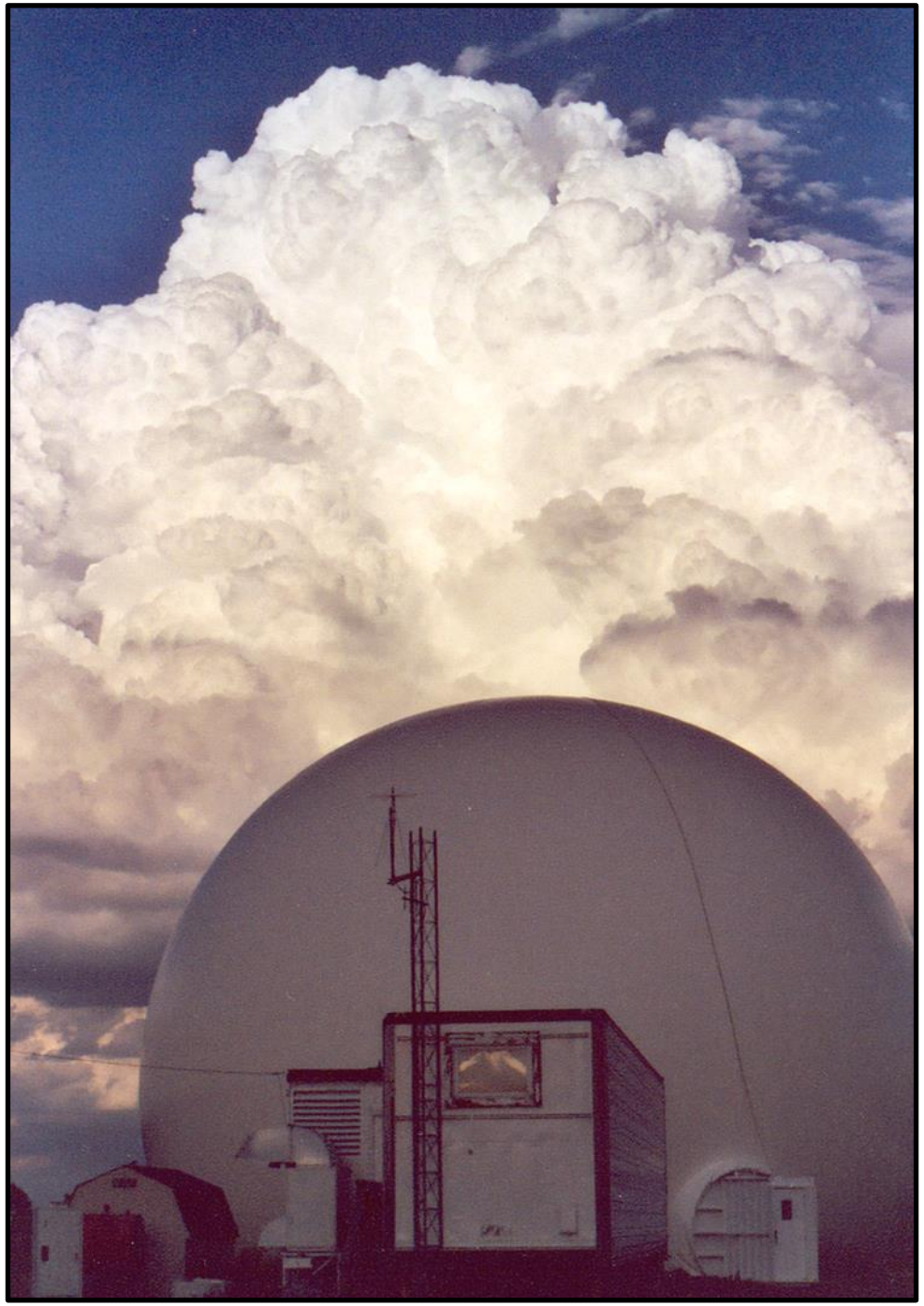
Hail Spectrometer Imagery



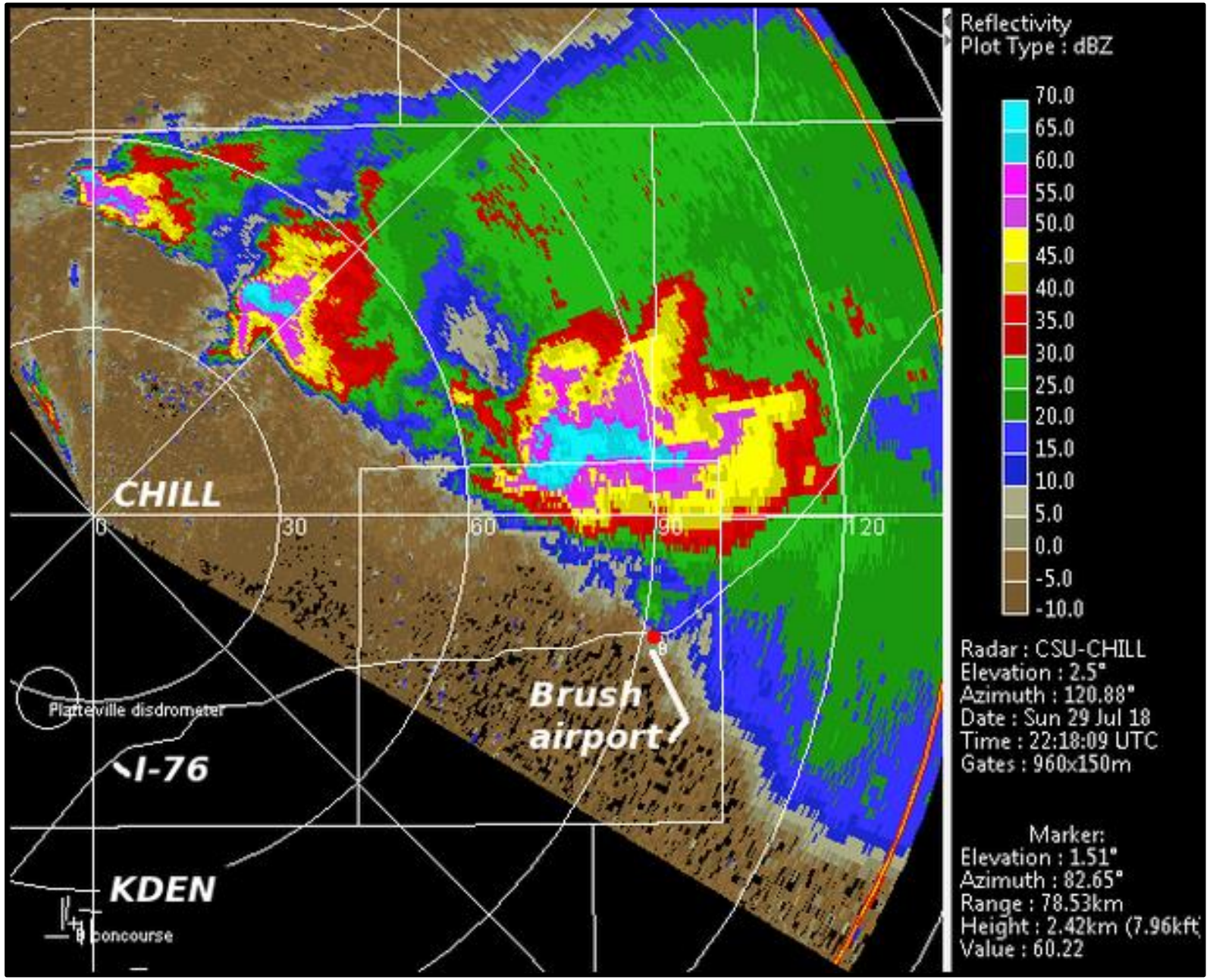
Radar Data Set

- Radar data is from EOL field project archive for flight days.
  - Z_h and Z_v – Reflectivity at Horizontal and Vertical Polarization
  - Z_{dr} – Differential Reflectivity
  - ρ_{hv} – Co-polar Correlation Coefficient
  - K_{dp} – Specific Differential Phase
  - Φ_{dp} – Differential Propagation Phase
  - LDR – Linear Depolarization
- Mainly CHILL, some Spol

CSU CHILL
S-band
Polarimetric Radar



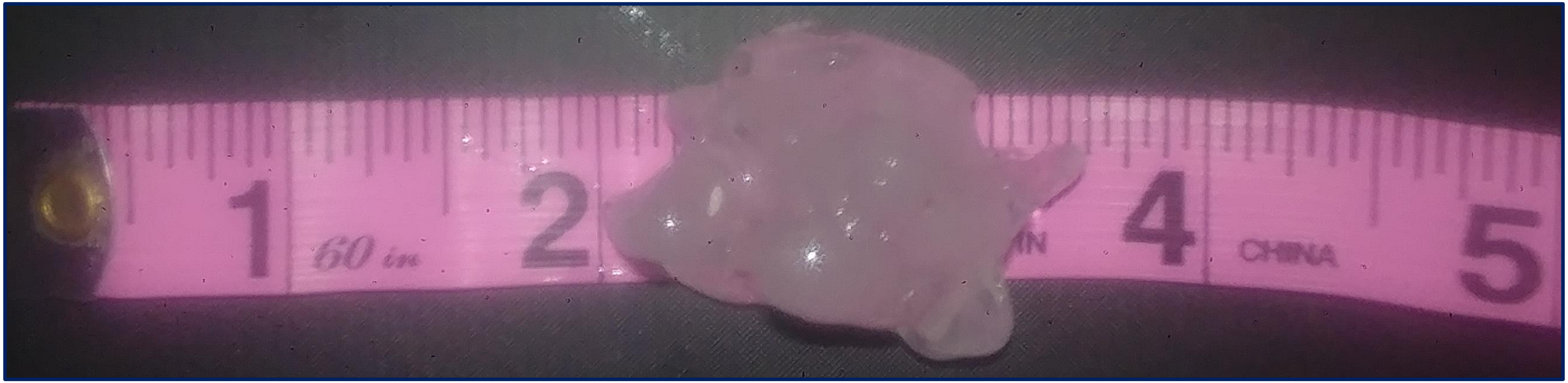
Low-elevation Angle PPI through a Group of Hailstorms



Outcome

- Produce more quantitative interpretation of polarimetric radar returns from hail-bearing storm regions.
  - Hail Size, Shape, Density, and Liquid Water Content
  - Hail Mass Concentration
  - Hail Kinetic Energy and Kinetic Energy Flux

June 16, 2022



Questions and Suggestion

Student Position Available

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June 16, 2022
David Delene