Radar Observations of Storms for Education

Megan Amanatides, Sara Berry, Nicole Corbin, Jason Endries, Matthew Miller, and Sandra Yuter

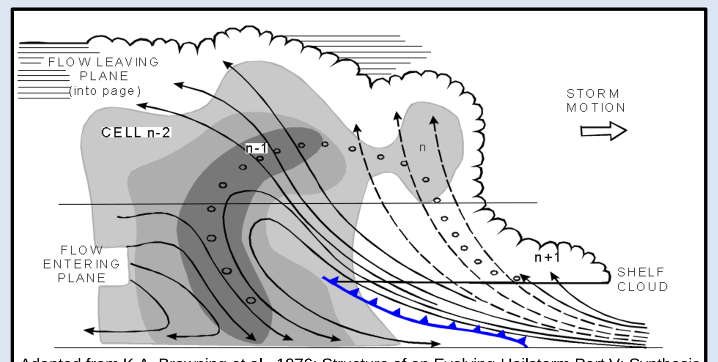
CP3 NC STATE UNIVERSITY
Clouds and Precipitation Processes and Patterns Group

Department of Marine, Earth, and Atmospheric Sciences – North Carolina State University, Raleigh, NC

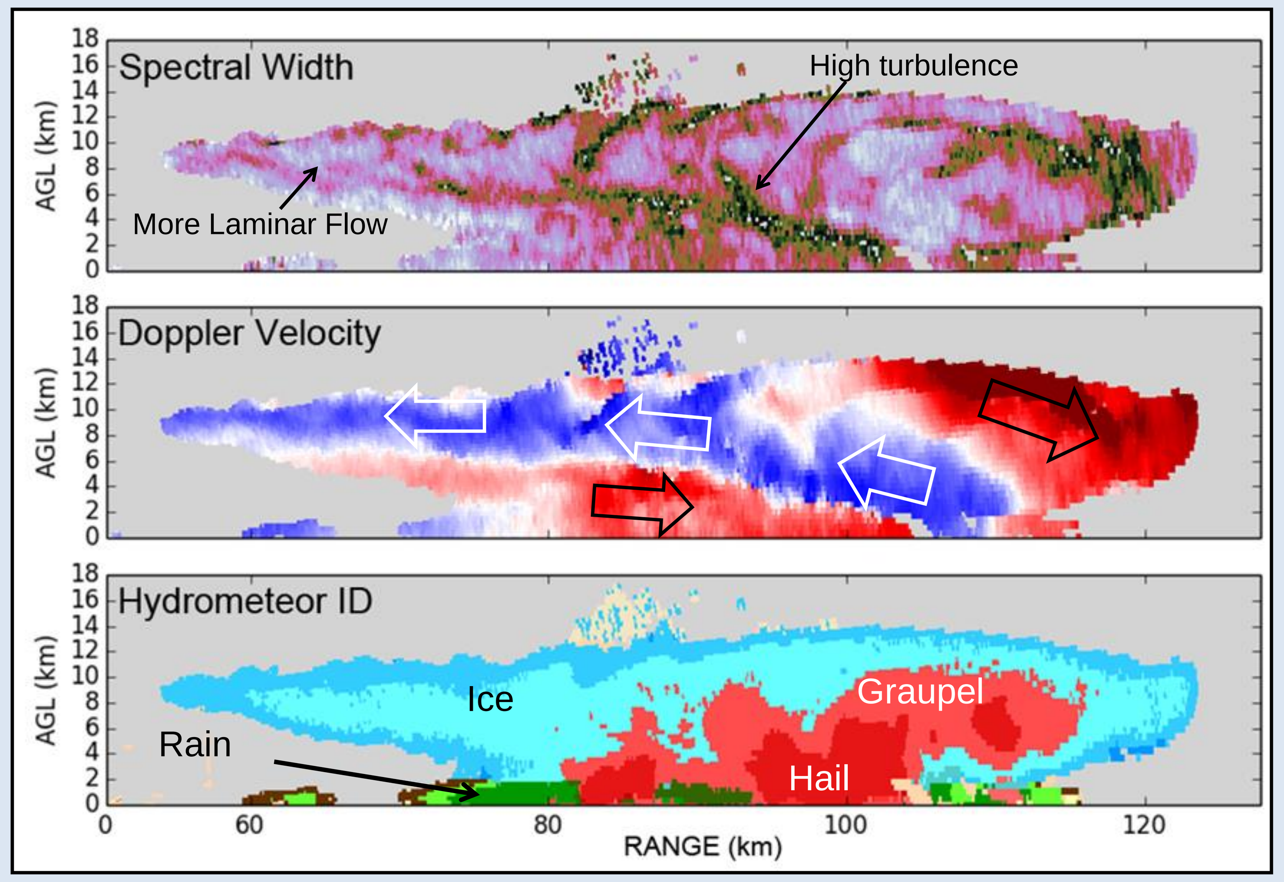
NSF

Introduction

Schematics and conceptual model diagrams are a cornerstone of mesoscale precipitation systems education in the university meteorology curriculum. These drawings allow students to visually simplify the complicated dynamics of the systems they are studying. The use of conceptual models has been shown to measurably increase student understanding, particularly when they are made available to compare and contrast with real data (Gilbert and Ireton, 2003: Understanding Models in Earth and Space Science).



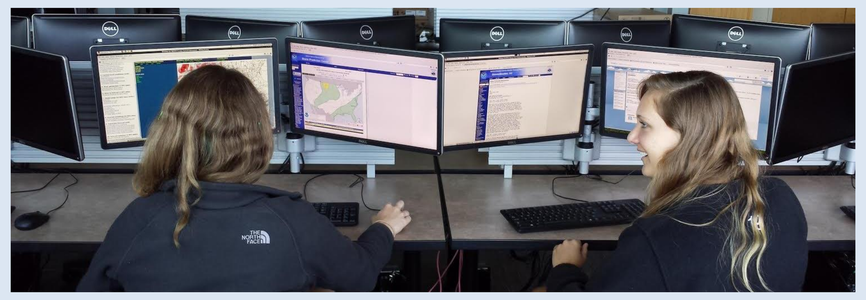
Adapted from K.A. Browning et al., 1976: Structure of an Evolving Hailstorm Part V: Synthesis and implications for Hail Growth and Hail Suppression. Mon. Wea. Rev., 104, 603–610.



We are developing a series of guided case studies of commonly observed storm structures for use in upper level undergraduate and graduate mesoscale meteorology courses. Data were collected from two NSF research radars in Colorado, CSU-CHILL and NCAR S-Pol, from 20 May to 20 June 2014

Forecasting and Operations

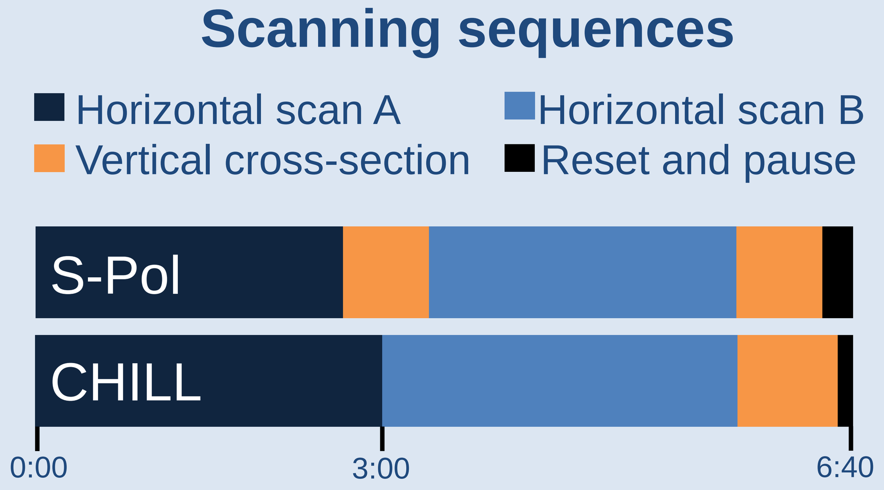
Undergraduate students at NCSU operated the two radars and forecasted the potential for convective activity. Forecasts included times of convective initiation and dissipation as well as convective mode. The students made real time decisions on the locations for vertical cross-sections during operations.



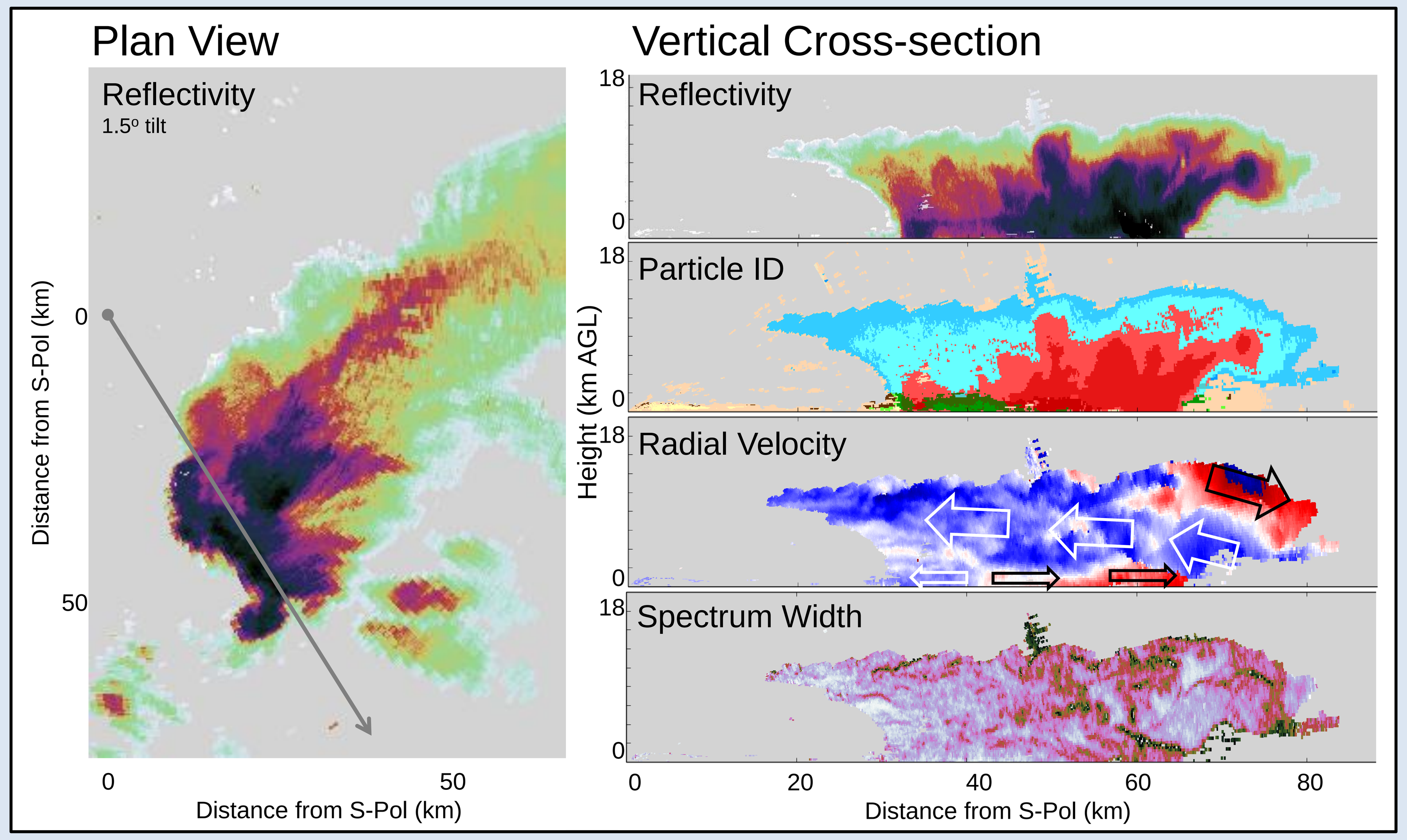
Above: S. Berry and M. Amanatides
Right: S. Berry, N. Corbin, M. Amanatides, J. Endries

Radar Data Collection

To illustrate the complex, evolving nature of storms, we tailored a scan strategy that included vertical cross-sections and volume scans updating every 3 minutes. Research radars were required since National Weather Service operational radars do not take vertical cross sections and update volume scans every 6+ minutes.

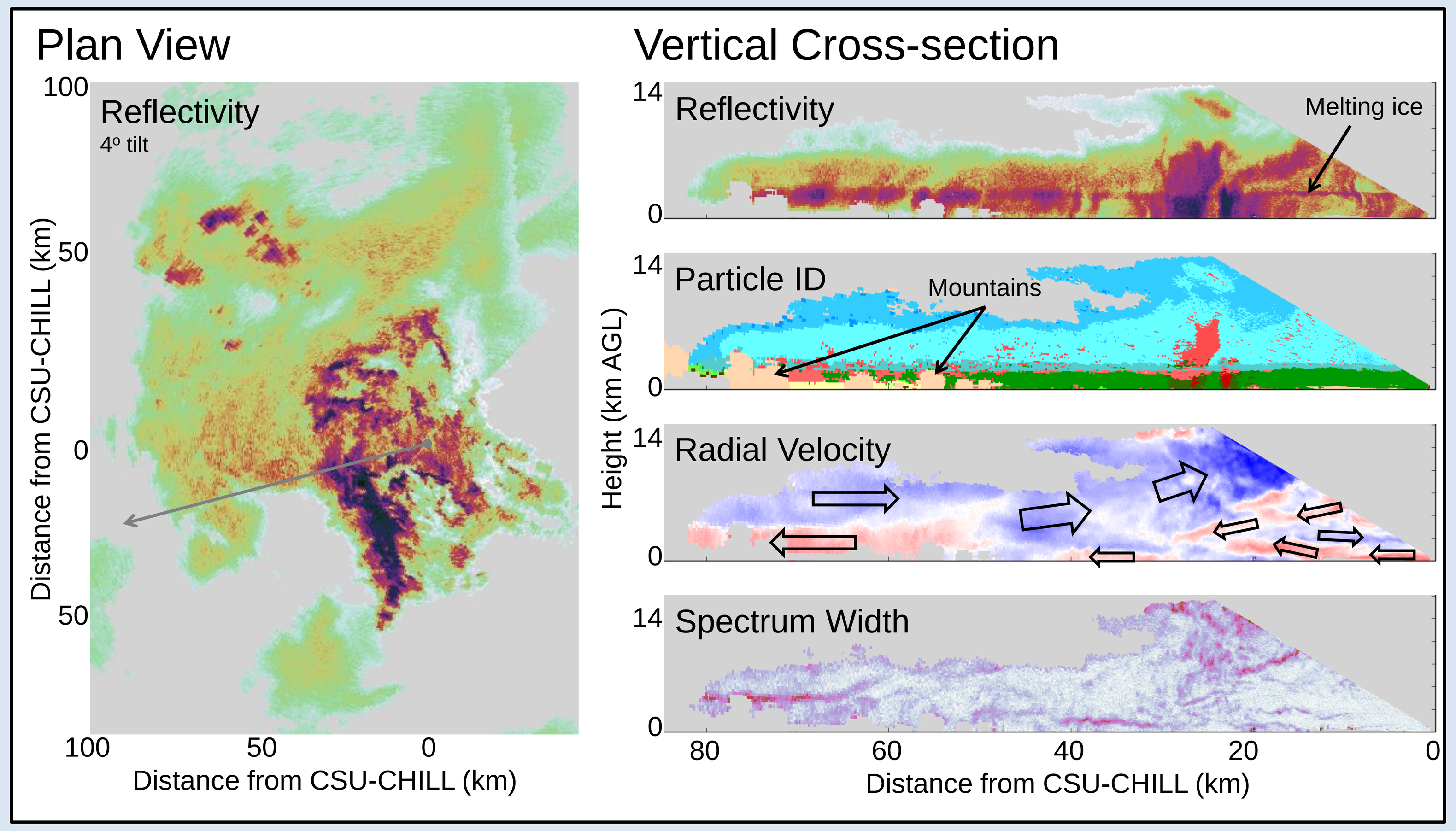


Hail storm



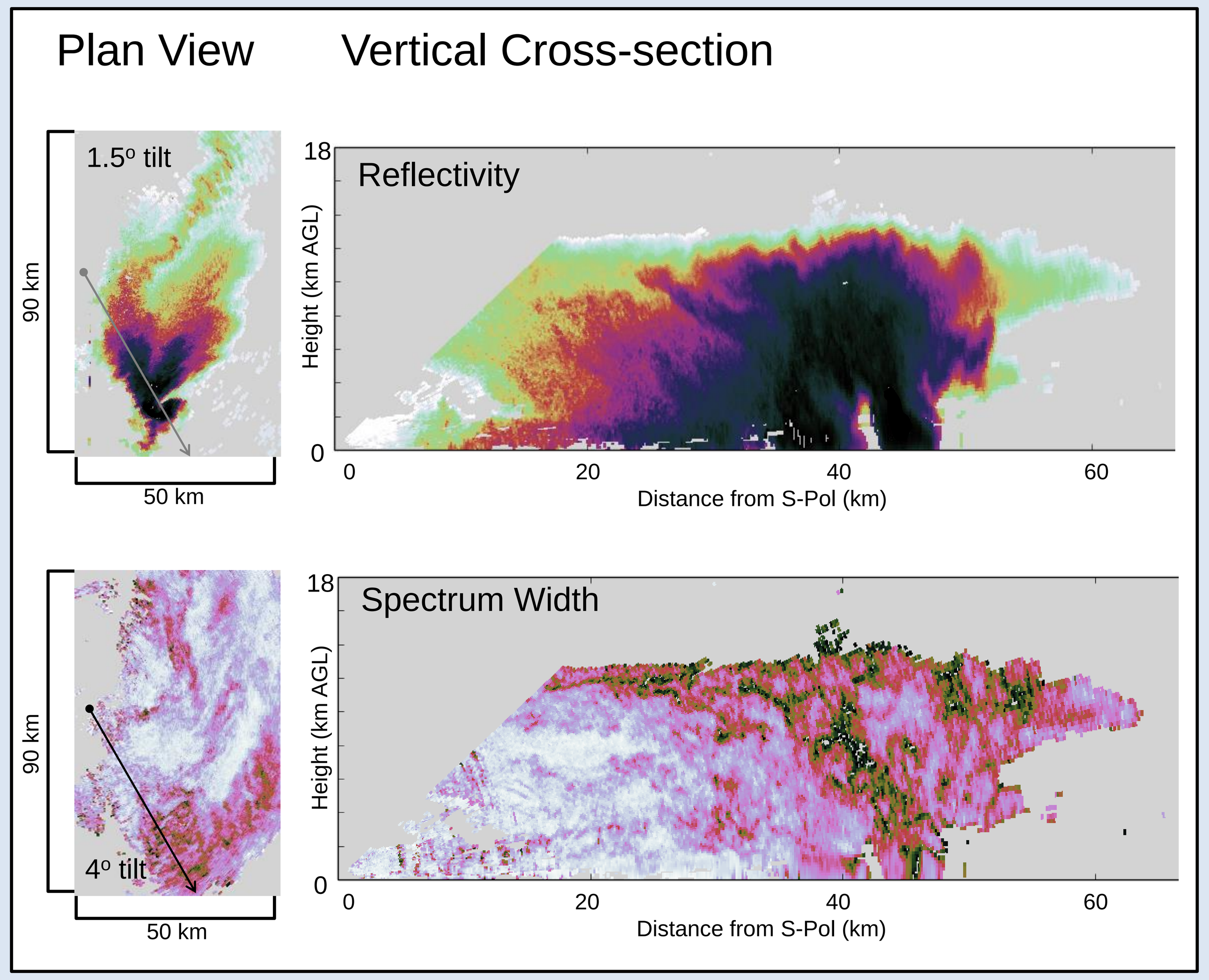
Arrow on the left panel indicates the location of the vertical cross-section. 1.5” hail was reported in this area east of Denver, CO at this time. In contrast to the schematic to the left, the hail region extends much further into the storm.

Mesoscale Convective System



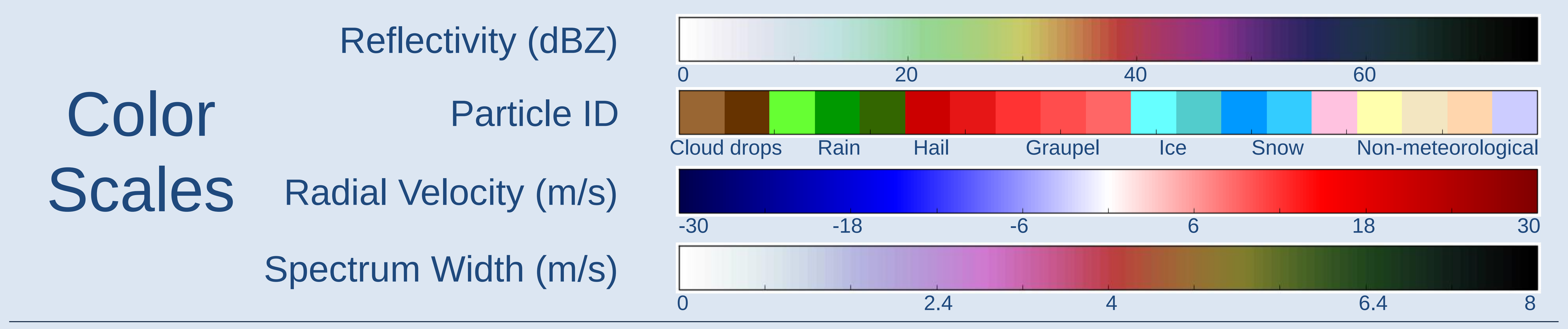
Line of strong convection with stratiform precipitation to the north. While the stratiform region exhibits a simple, layered flow, the convective region has more complicated flow with small flow branches.

Tornadic Supercell



Classic supercell radar signatures such as a bounded weak echo region, hook echo, and v-notch are shown in the particle ID and reflectivity fields. Mid-level rotation associated with a mesocyclone is observed in the radial velocity plan view panel.

High turbulence is observed both at the interface between opposing flows and within the main updraft.



Summary and Future Work

Undergraduate students simultaneously learned more about storms and radar operations during a month-long data collection campaign. A diverse radar dataset including hailstorms, stratiform precipitation, ordinary thunderstorms, and a tornadic supercell was acquired during this project. The vertical cross-sections in particular provide great detail on the airflows and hydrometeor types within these storms. These data will be used in guided modules that will supplement schematic diagrams commonly used in mesoscale meteorology courses.

Acknowledgements

We would like to thank the National Center for Atmospheric Research Earth Observing Laboratory S-Pol radar facility, and the Colorado State University CHILL radar facility for their contributions. Special thanks to Scott Ellis and Pat Kennedy for their support during the field phase of the project. This material is based upon work supported by the National Science Foundation (AGS-1303025).