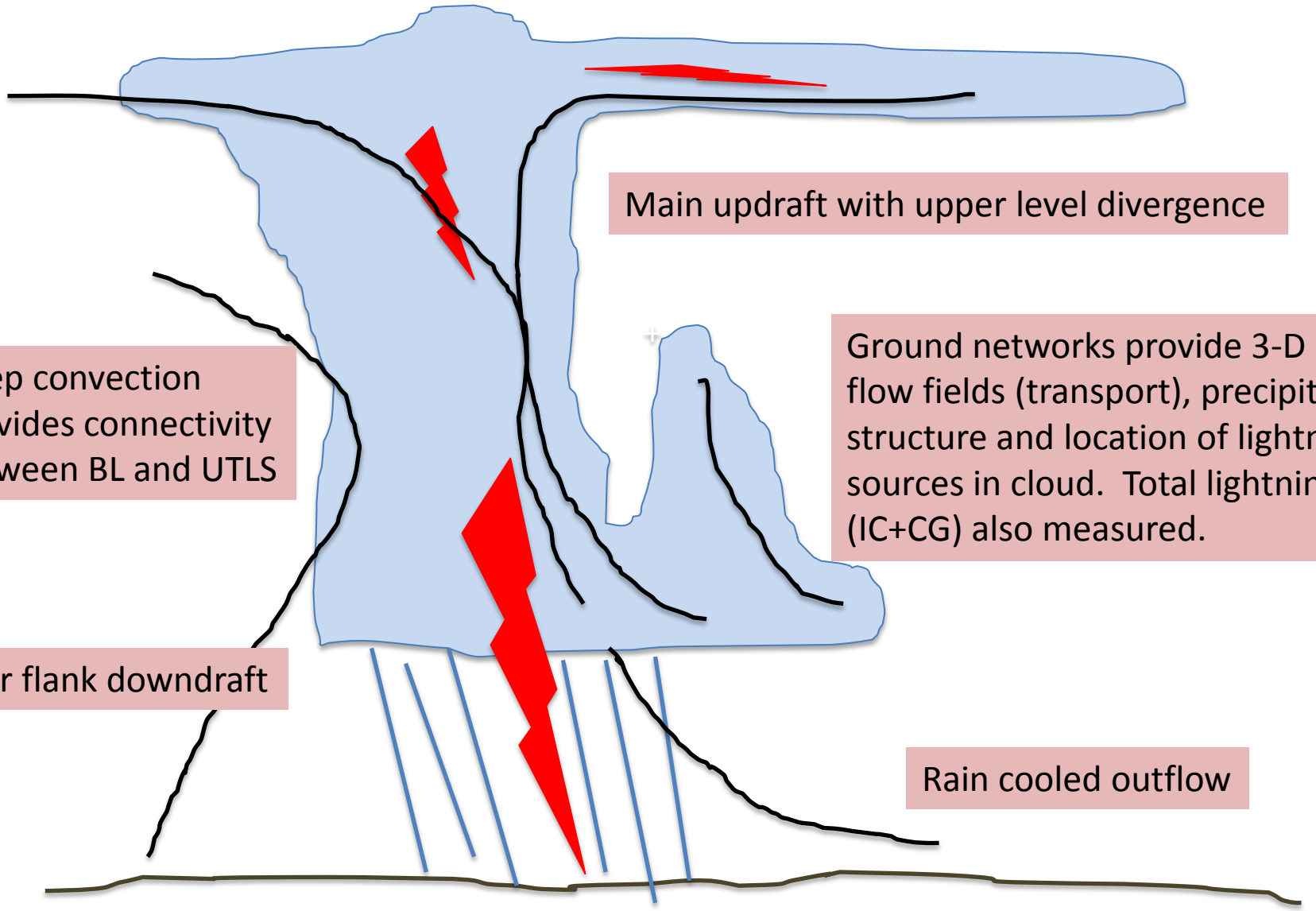
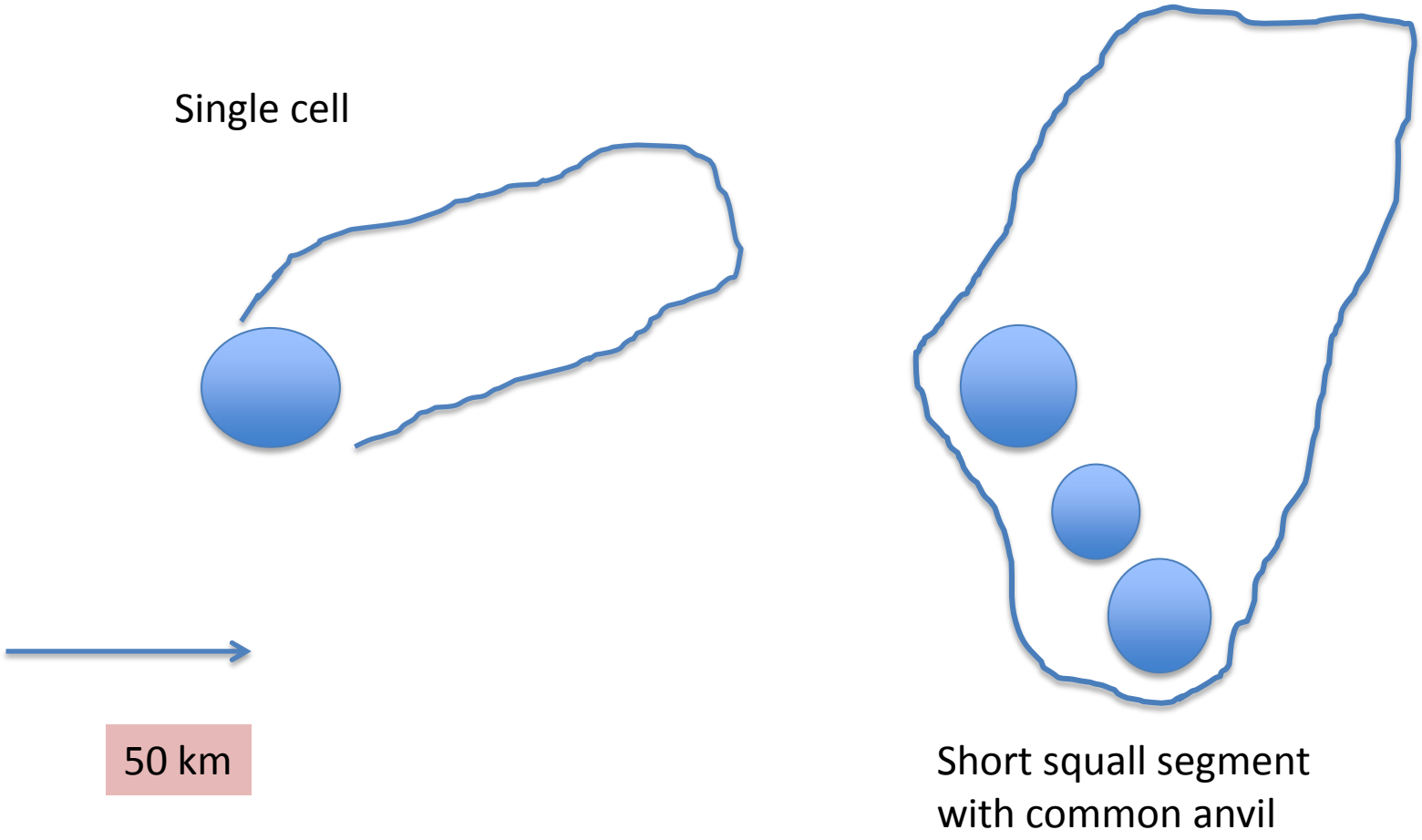


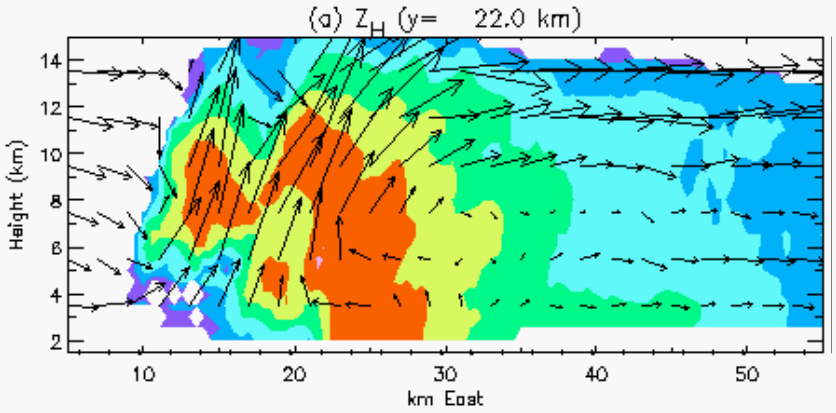
Radar scans designed to sample entire storm volume such that the 3-D flow field can be diagnosed

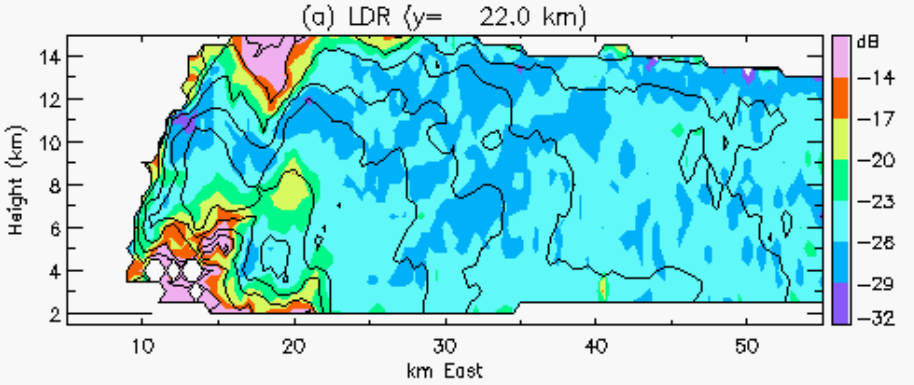
Radar volume scans will be 120 or 150 degrees in width to sample full storm
Elevation angles selected to "top" storm at all ranges (as practical)
Temporal resolution determined by sector width, storm height and antenna scan rates
We will strive for 3-6 minute update times
NEXRAD radar data will be key for providing real time guidance to the DC3 aircraft since the research radars will be in sector mode

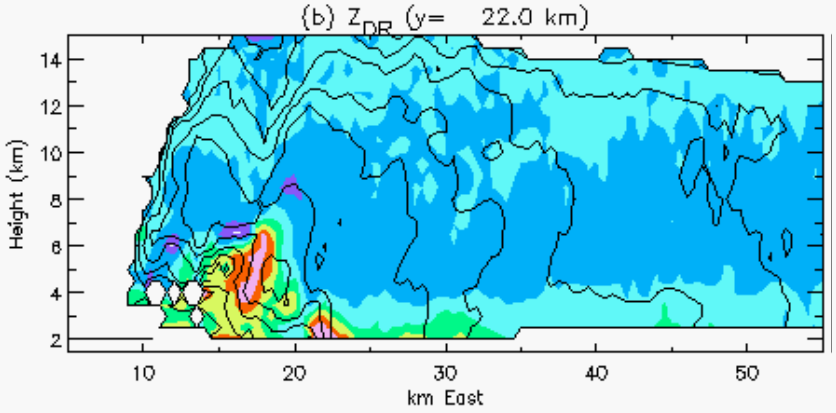


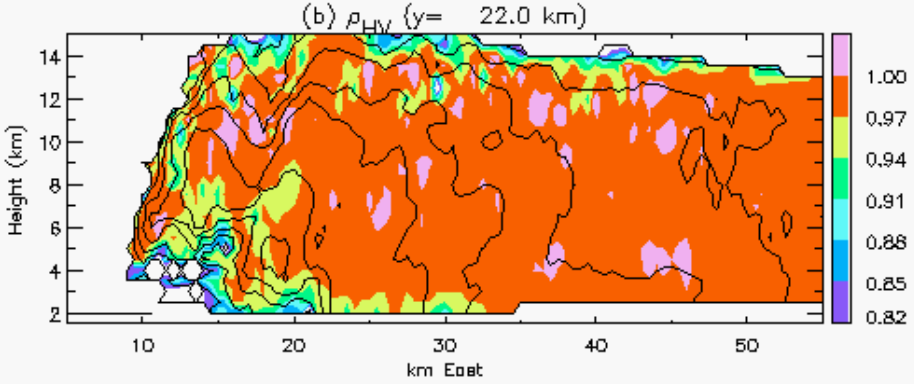
Such storms will be observable by the dual-Doppler networks only for a few hours

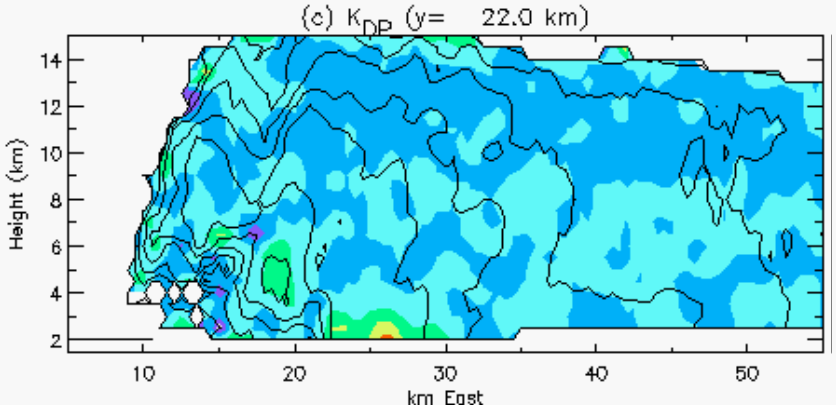
Polarimetric radar observations used to infer precipitation structures

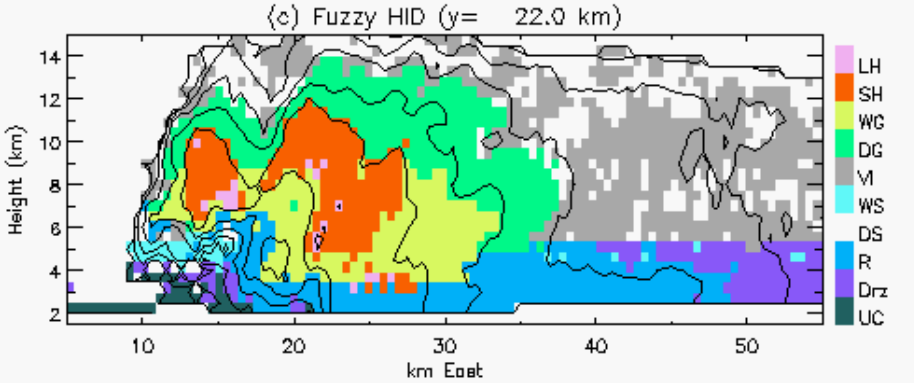




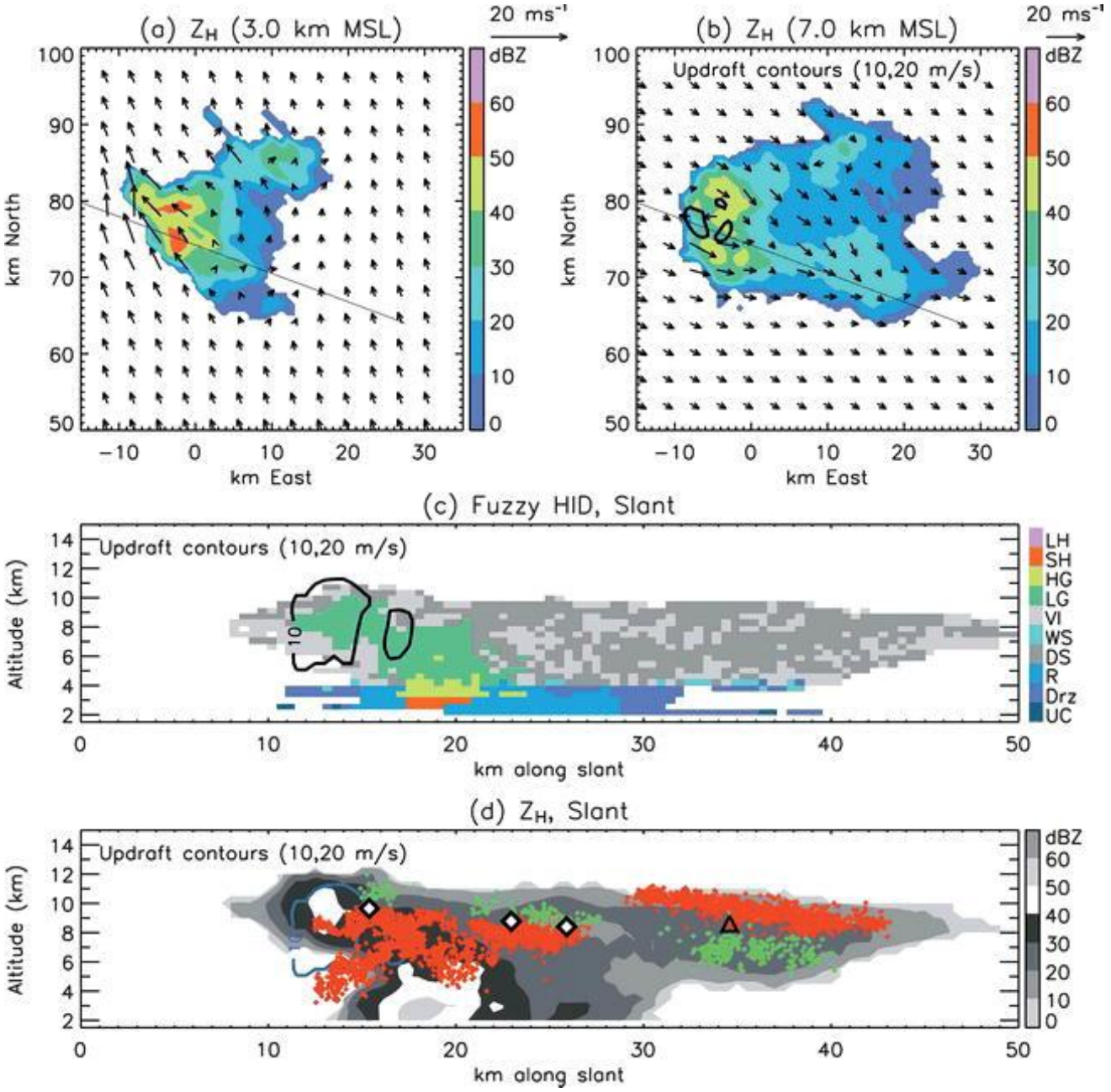








Tessendorf, Wiens and Rutledge (JAS, 2007)



3 June 2000
W. Kansas

Mesoscale Convective System

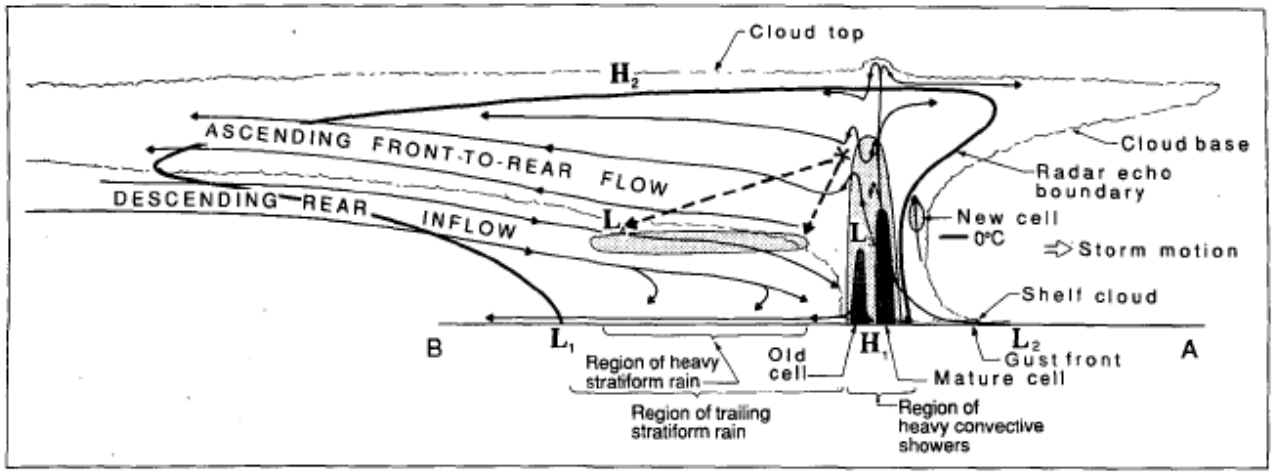


FIG. 1. Conceptual model of a squall line with a trailing stratiform area viewed in a vertical cross section oriented perpendicular to the convective line (i.e., parallel to its motion). See text for further explanation.

Linear vs. asymmetric

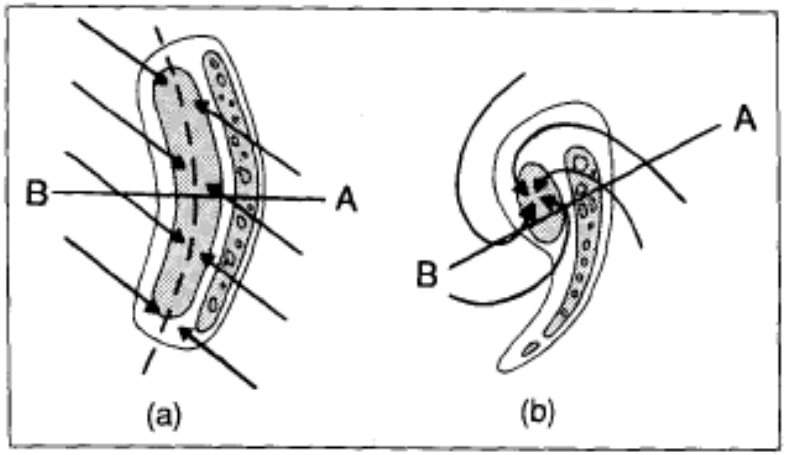


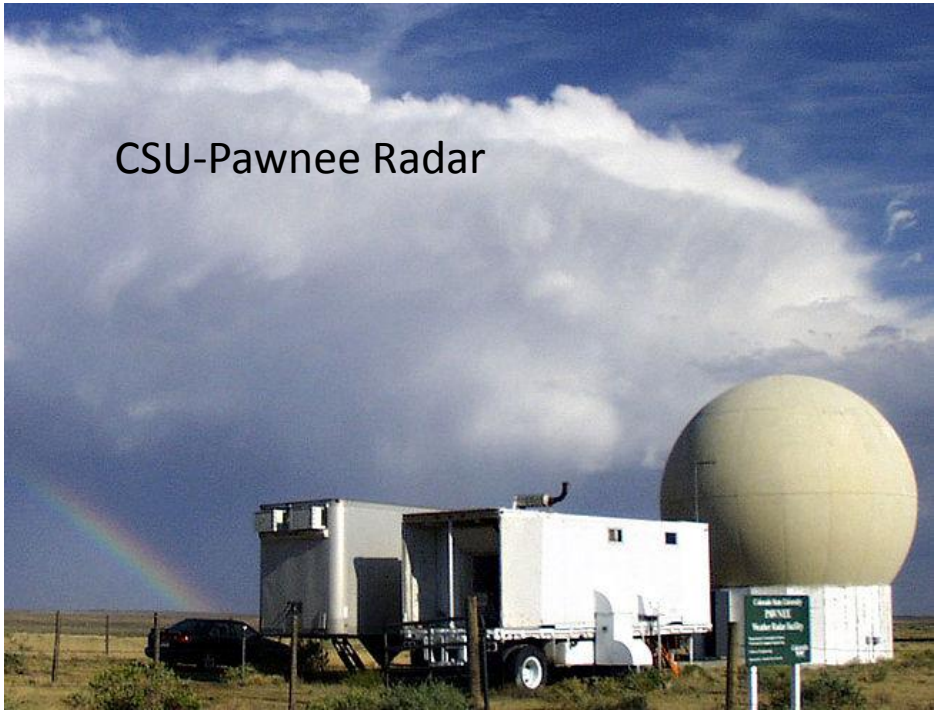
FIG. 2. Conceptual model of a mid-level horizontal cross-section through (a) an approximately two-dimensional squall line, and (b) a squall line with a well-defined mesoscale vortex in the stratiform region. In each case, the midlevel storm-relative flow is superposed on the low-level radar reflectivity. The stippling indicates regions of higher reflectivity.

Houze et al. (1989, BAMS)

CHILL's offset S-band antenna

CSU-CHILL National Facility

CSU-Pawnee Radar



NE Colorado DC3 Network

CSU-CHILL S-band, polarimetric/Doppler radar

CSU-Pawnee S-band Doppler radar

3-D Lightning Mapping Array (NMIMT)

Mobile radiosonde, MGAUS

Cheyenne and Denver WSR-88D Doppler radars

All ground networks are symmetric in the sense of providing 3-D coverage of the flow field and precipitation structure, and lightning locations/flash rates

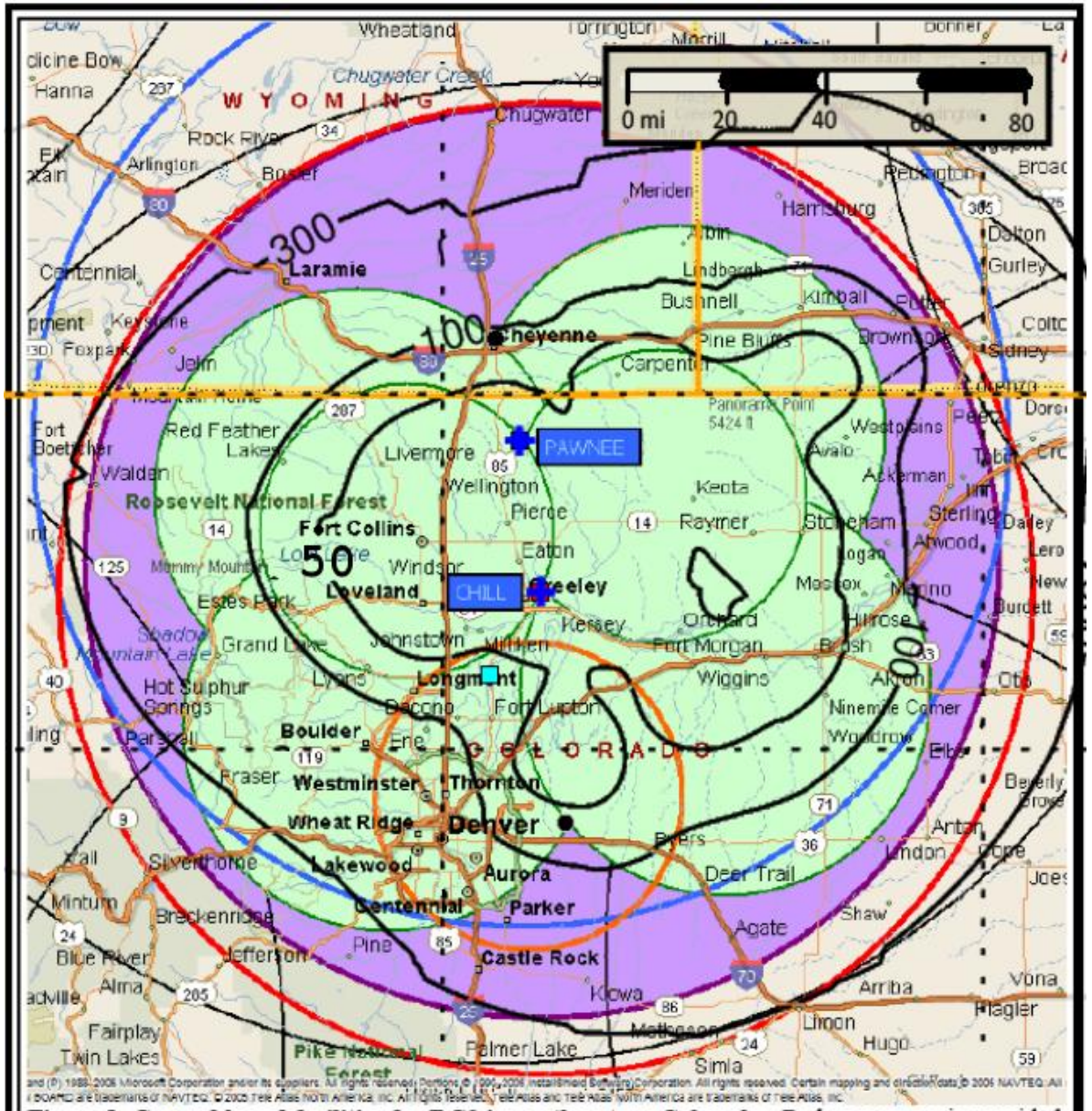
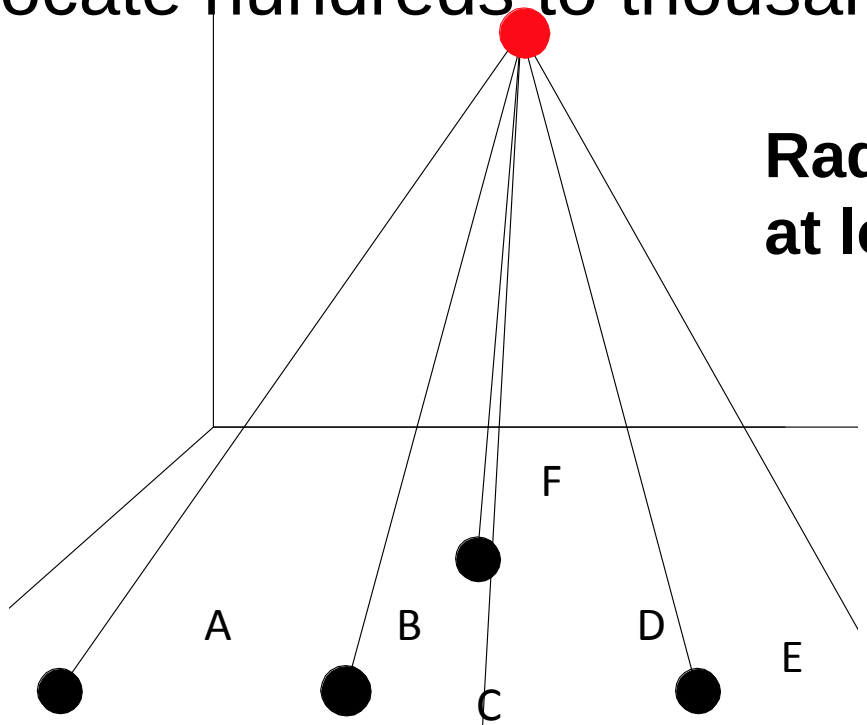


Figure 1. Ground based facilities for DC3 in northeastern Colorado. Radar coverage is provided by the CSU-CHILL facility near Greeley (red square), the PAWNEE radar (blue square), and the NEXRAD radars near Denver and Cheyenne (black circles). The polarimetric coverage for CHILL is indicated by the red circle and the non-polarimetric coverage for PAWNEE is indicated by the blue circle. Dual-Doppler coverage by combinations of these radars is shown by the filled green circles. The filled purple circle shows the coverage of the lightning mapping array network. The orange circle shows the Class B controlled airspace for Denver International Airport. The NOAA facility at Platteville is indicated by the light blue square.

Northern Colorado Lightning Mapping Array

Time of Arrival Lightning Mapping System

- Measure time RF pulse arrives at multiple stations
- Determine position and time of source
- Locate hundreds to thousands of sources per flash



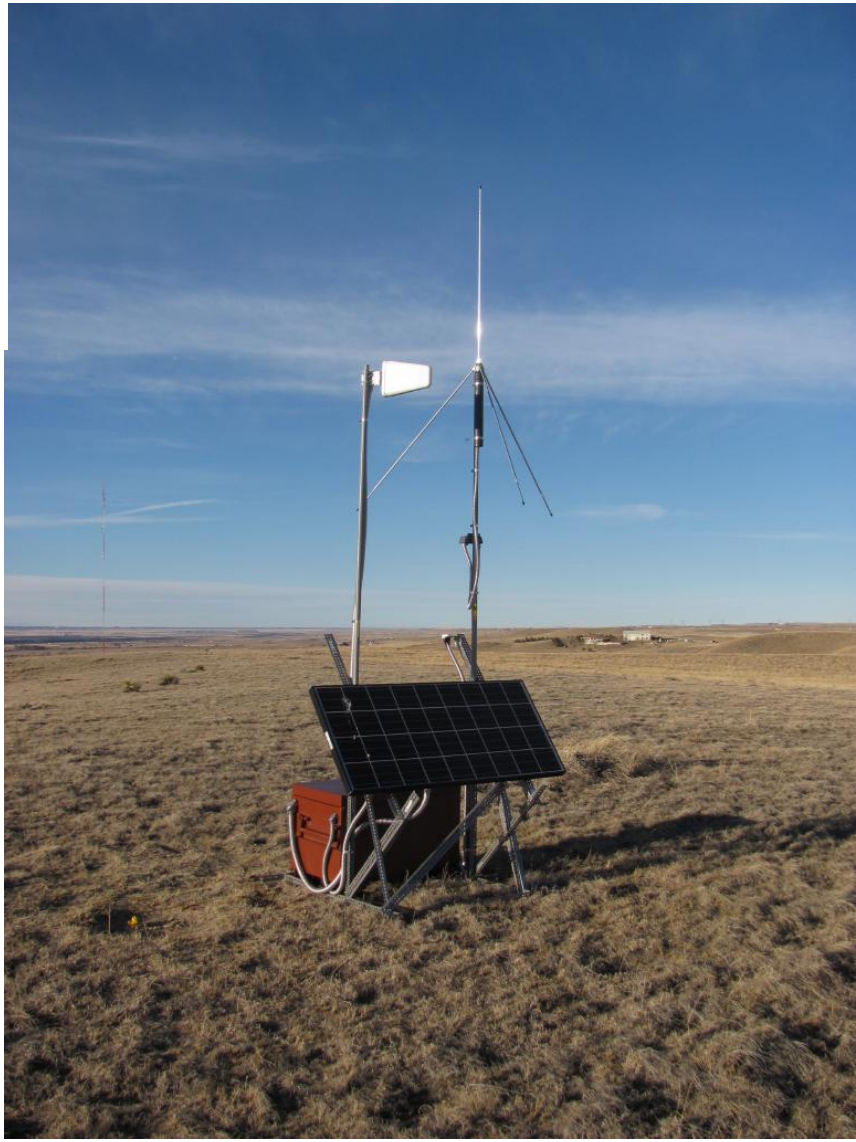
Radiation occurs at time t, at location (x, y, z)

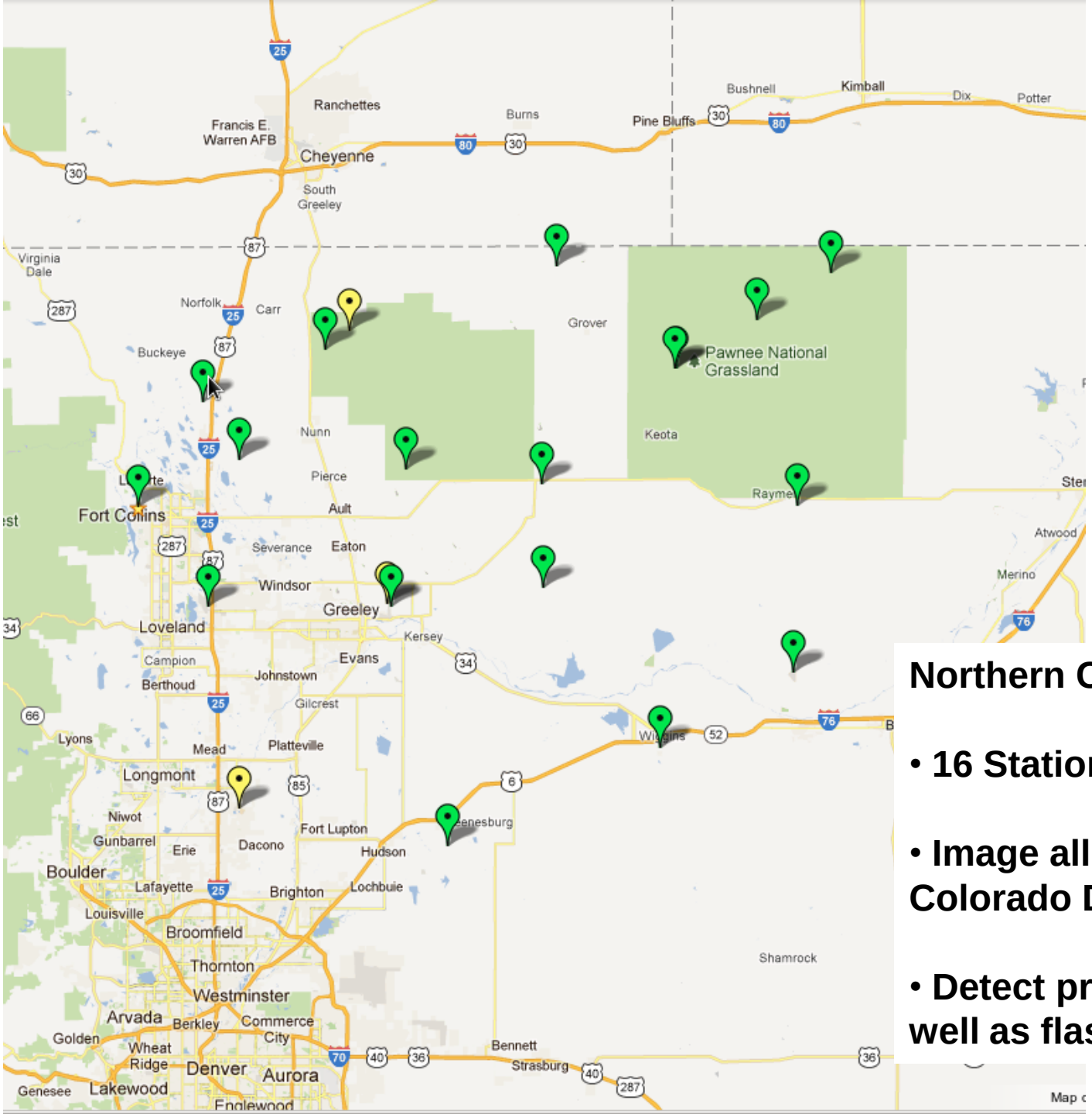
Radiation arrives at station i at time t_i, location (x_i, y_i, z_i)

$$t_i = t + \frac{\sqrt{(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2}}{c}$$

Northern Colorado LMA Station

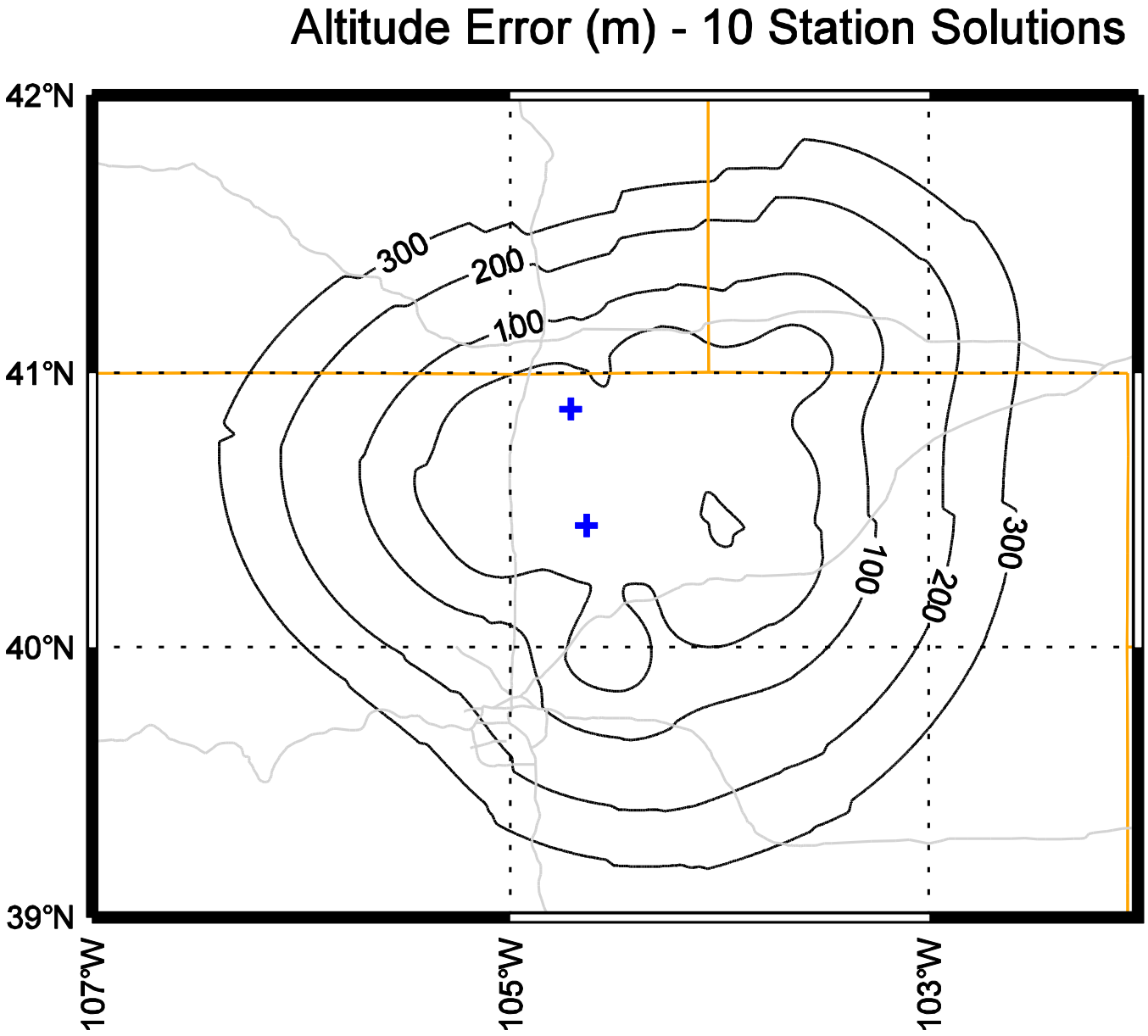
- Solar Powered
- Cell Phone Modems for Comms
- Real-time data updated every second
    - Java program to display real-time data
- Web-based display updated every minute





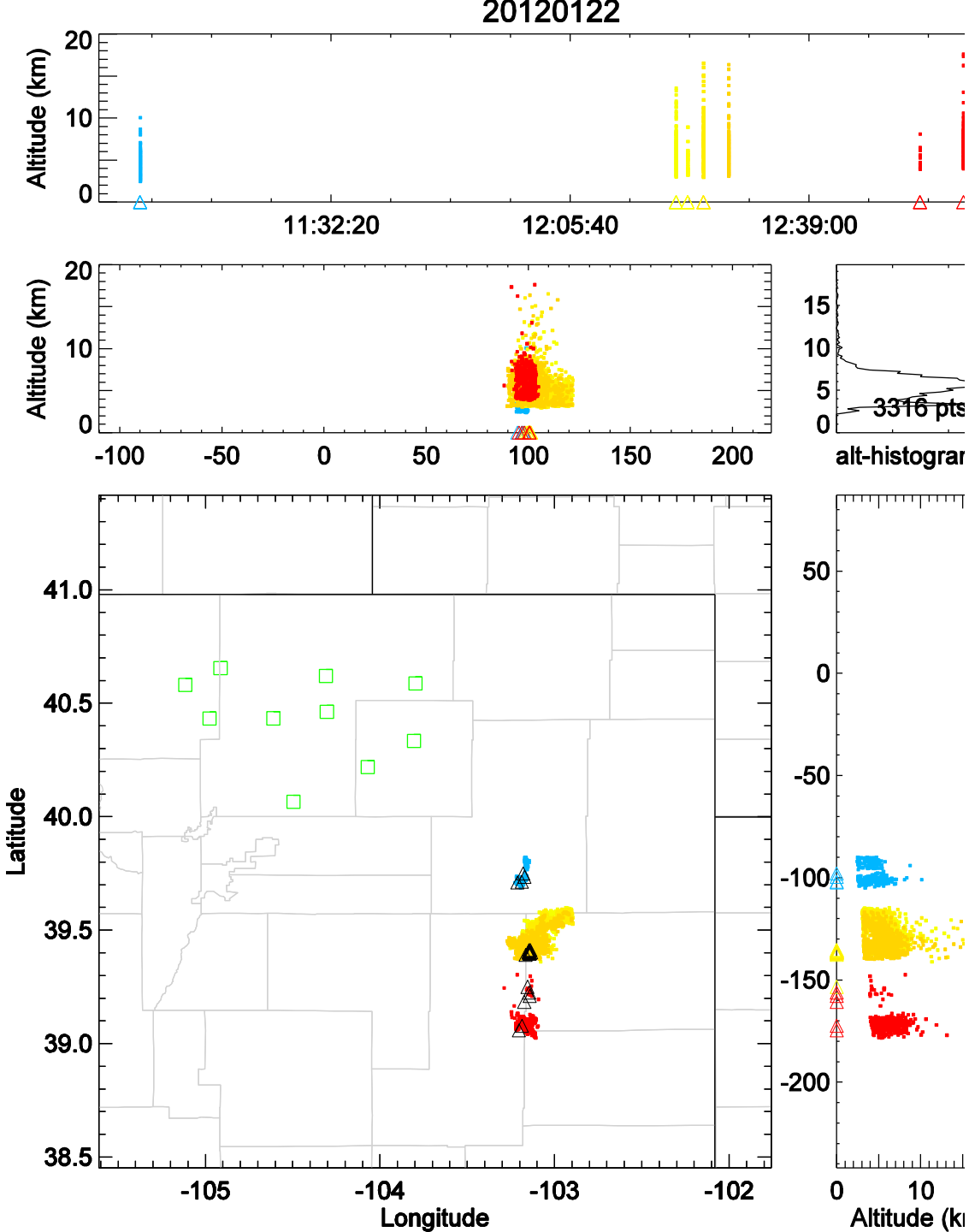
Northern Colorado LMA

- **16 Stations**
- **Image all lightning over Colorado DC3 area**
- **Detect precursor events as well as flashes**


Altitude Error (m) - 10 Station Solutions
42°N
41°N
40°N
39°N
107°W
105°W
103°W
300
200
100
100
200
300

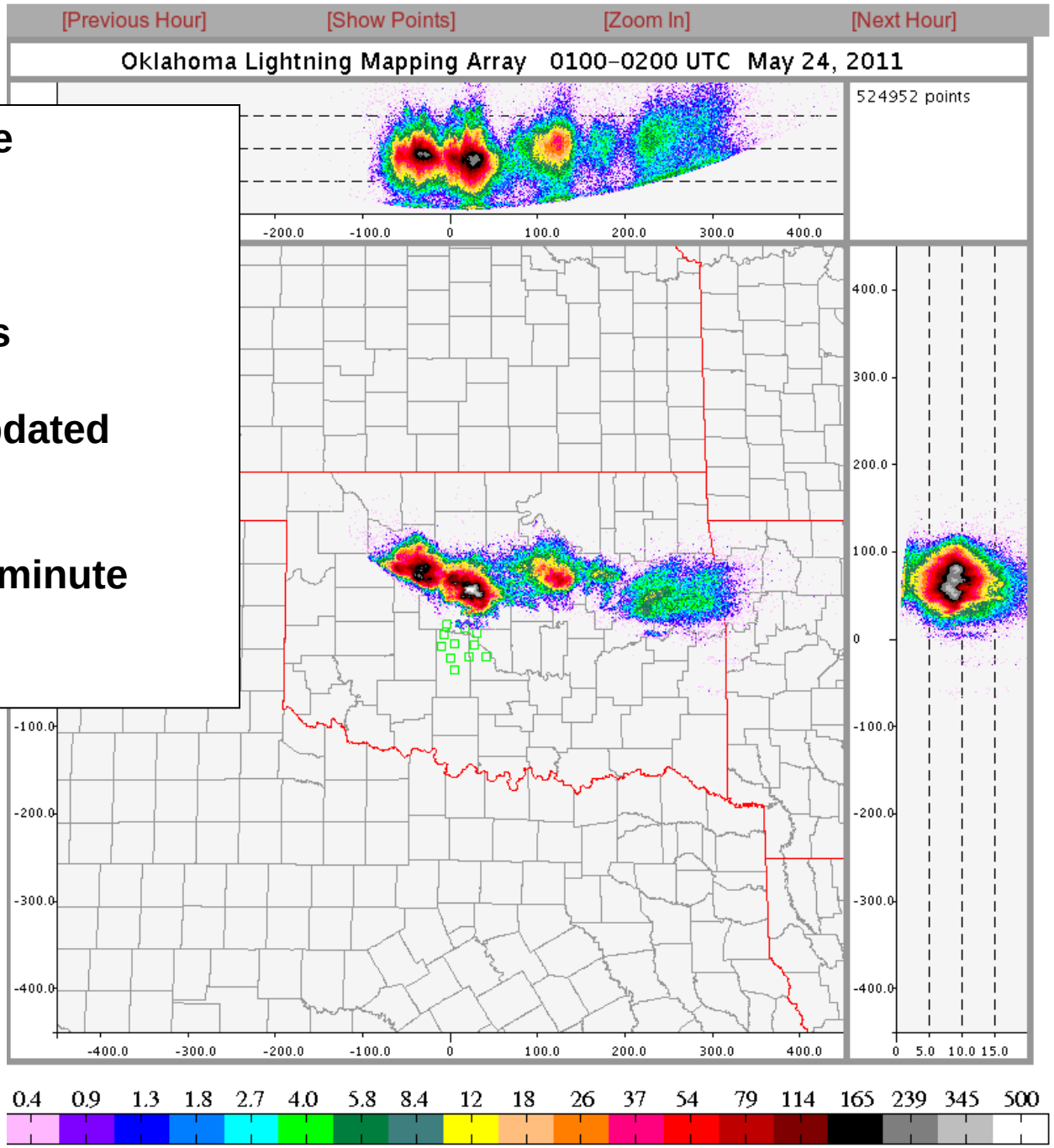
First Lightning from Northern Colorado LMA

- Small storm 175 km SE
- 7 flashes in three hours
- Storm moved to south
- CO LMA imaged all NLDN-detected flashes
- 10 active LMA stations during storm



OKLMA Web Page

- Hourly overview
- Ten-minute plots
- Current plots updated every minute
- Hourly and ten-minute plots archived



Data Format

- Images available on web
  - One minute updates, two minute latency
- ASCII data of source locations can be sent via UDP to any IP address
- Java program LiveLMA can display real-time data
  - One second updates, two second latency
- In what form do users need data?