Thermodynamic and Liquid Profiling for Improved Local Forecasting

Unidata Users Workshop

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UCAR Center Green, Boulder, Colorado

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Click on callout at upper left for presentation notes

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Presentation Summary

- Microwave radiometer photo history
- Radiometer and radiosonde profile comparisons
- Genesis of powder snow in thermodynamic and liquid observations of a upslope winter storm
- Case studies of Colorado tornadoes that occurred last weekend and last year.
- Continuous thermodynamic, liquid and wind profiles can improve local weather forecasting

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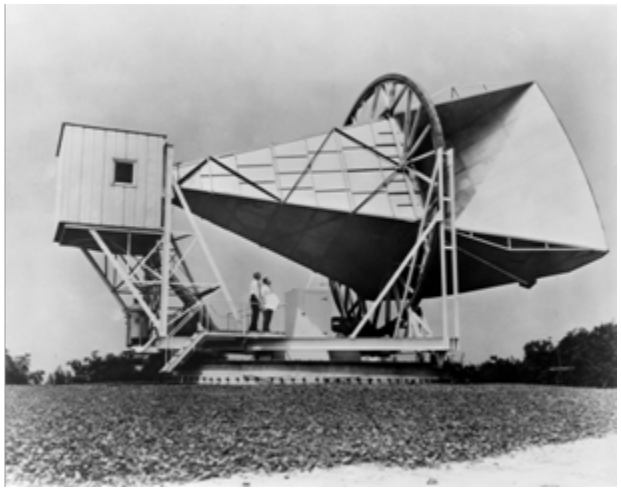
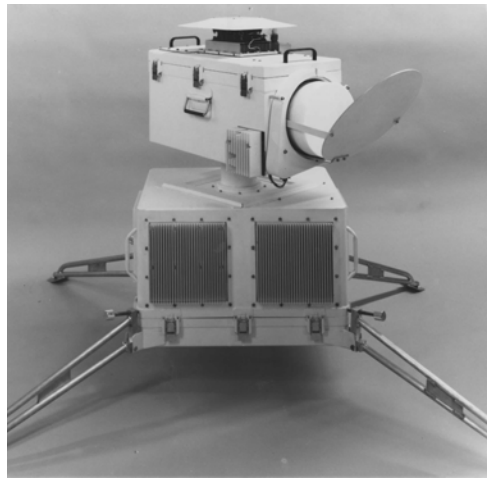


1963 Bell Labs

1978 NOAA Labs



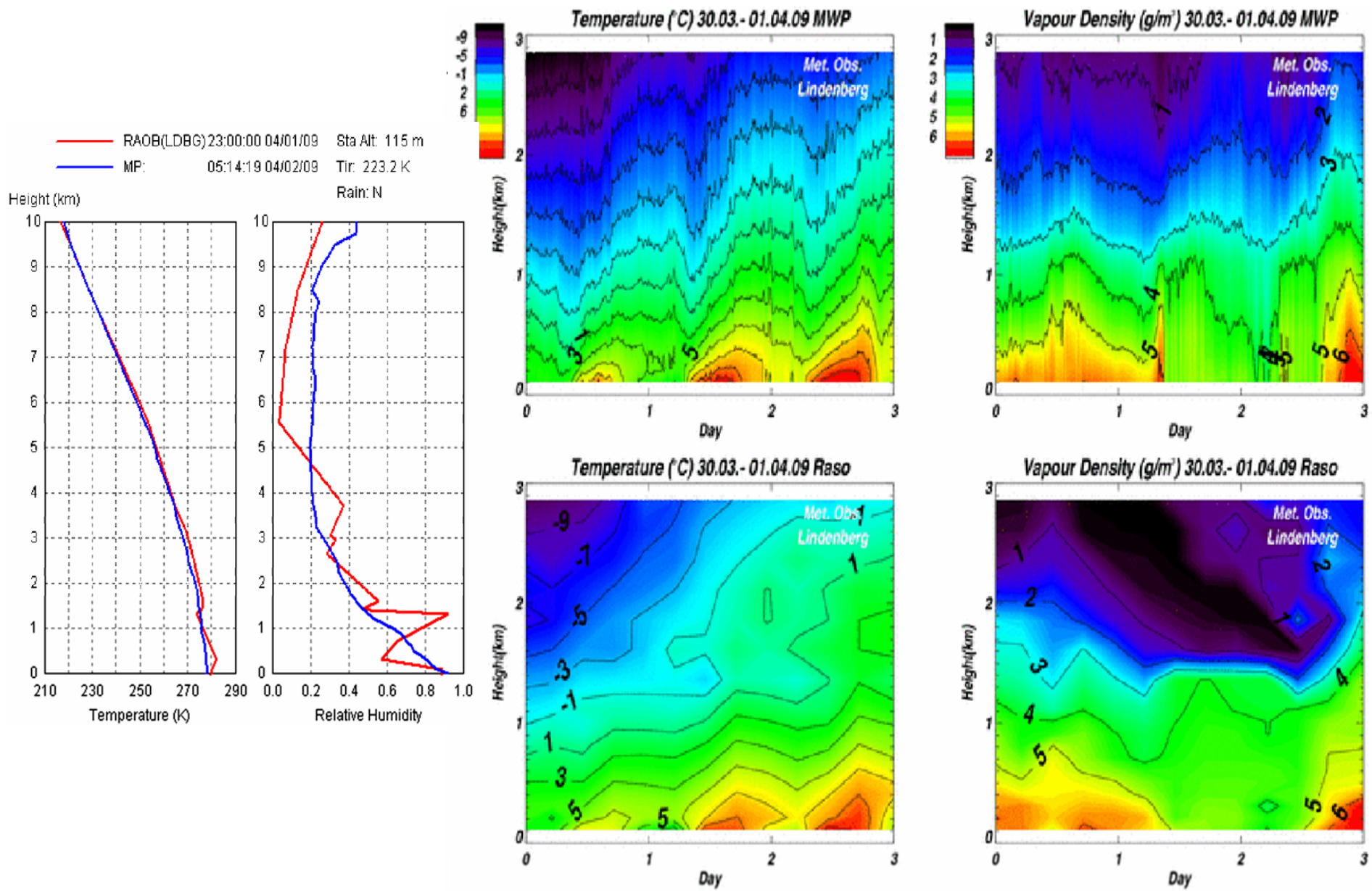
1986 NASA JPL

1990 Radiometrics

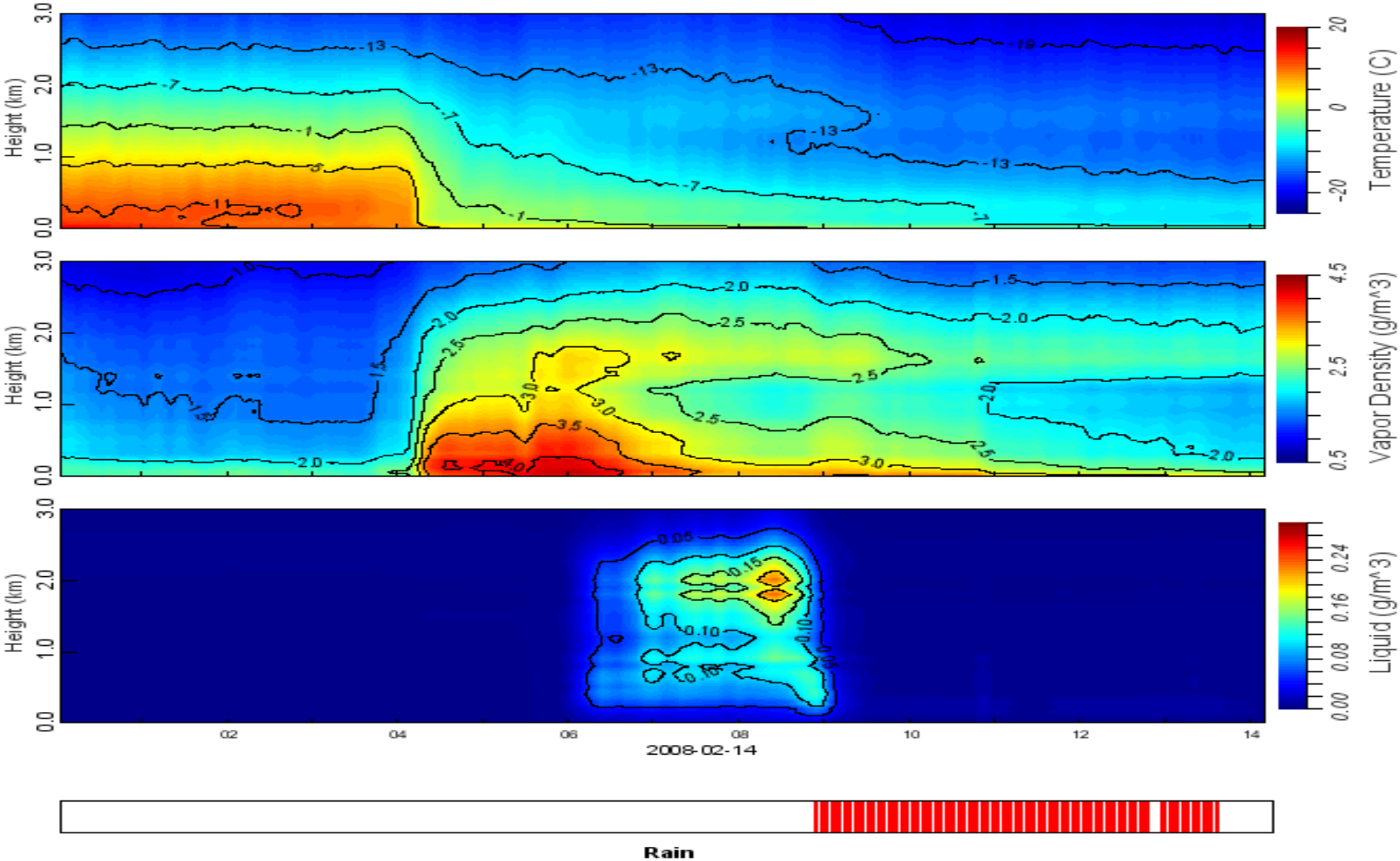
2005 Radiometrics

2009 Radiometrics

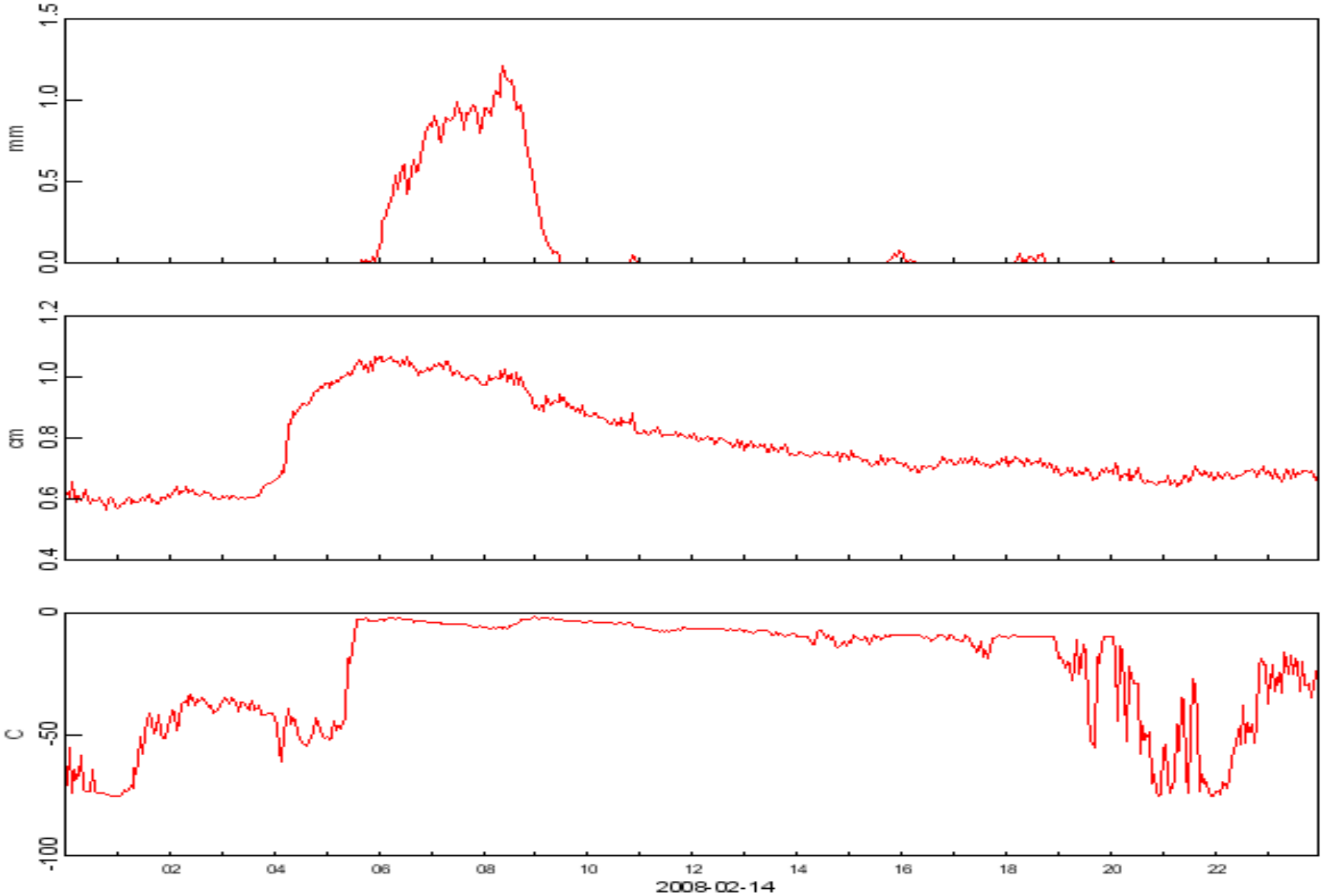
Evolution of ground-based microwave radiometer atmospheric remote sensing equipment.



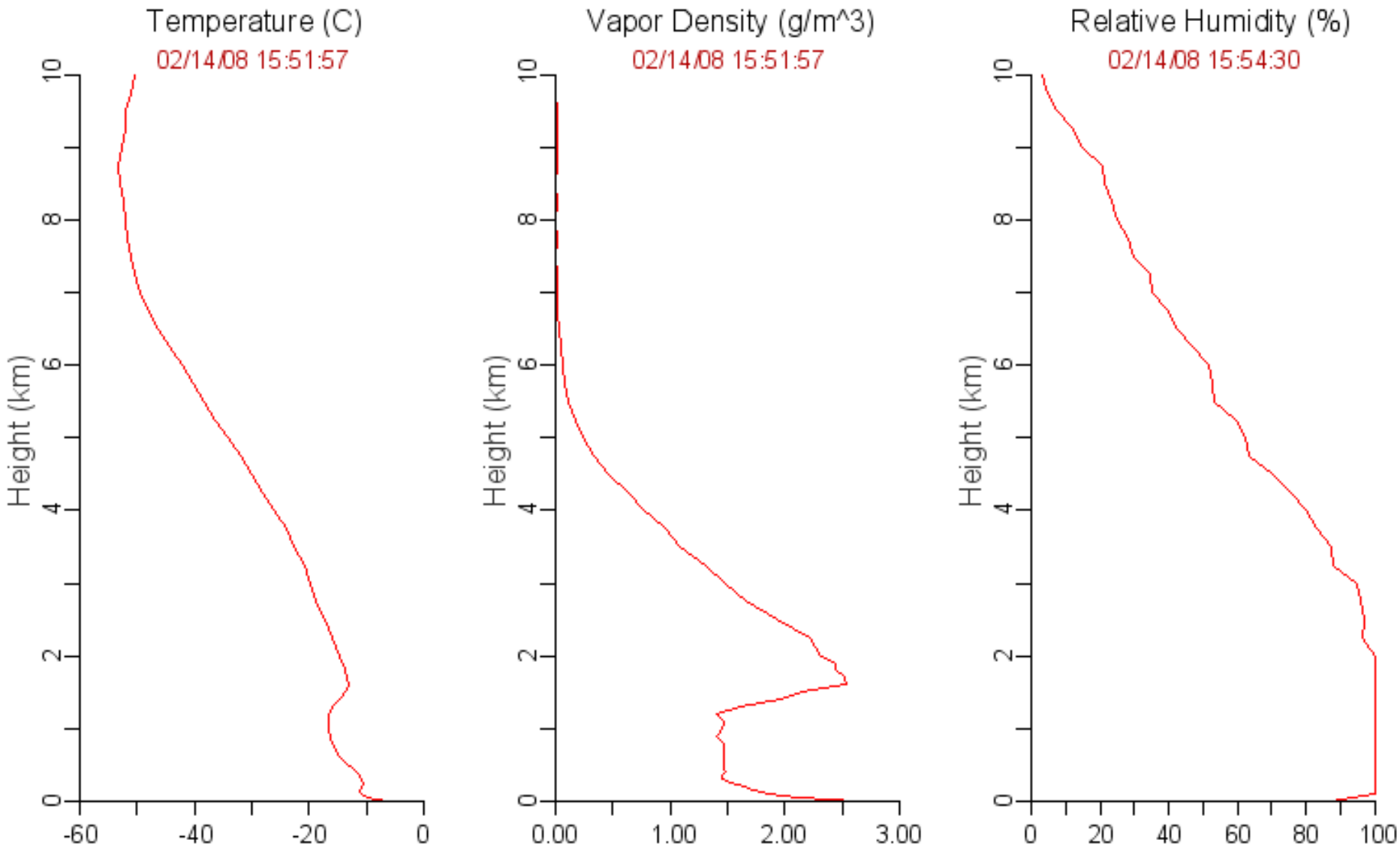
Real time radiometer-radiosonde comparisons from the German Weather Service website.



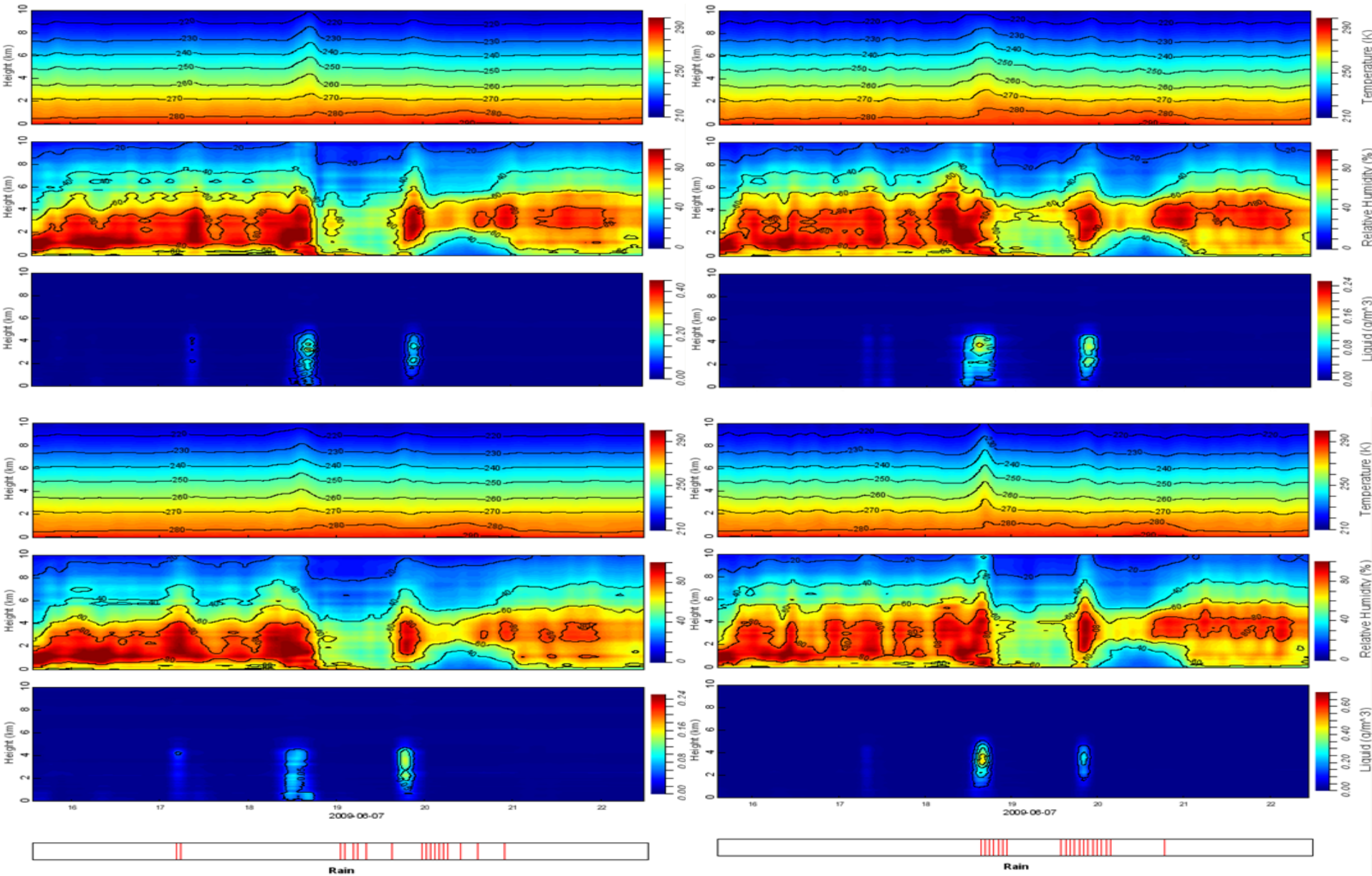
Thermodynamic and liquid profiles during the Valentine's Day 2008 Denver Basin upslope storm showing powder snow genesis consistent with the Wegener (1911) hypothesis.



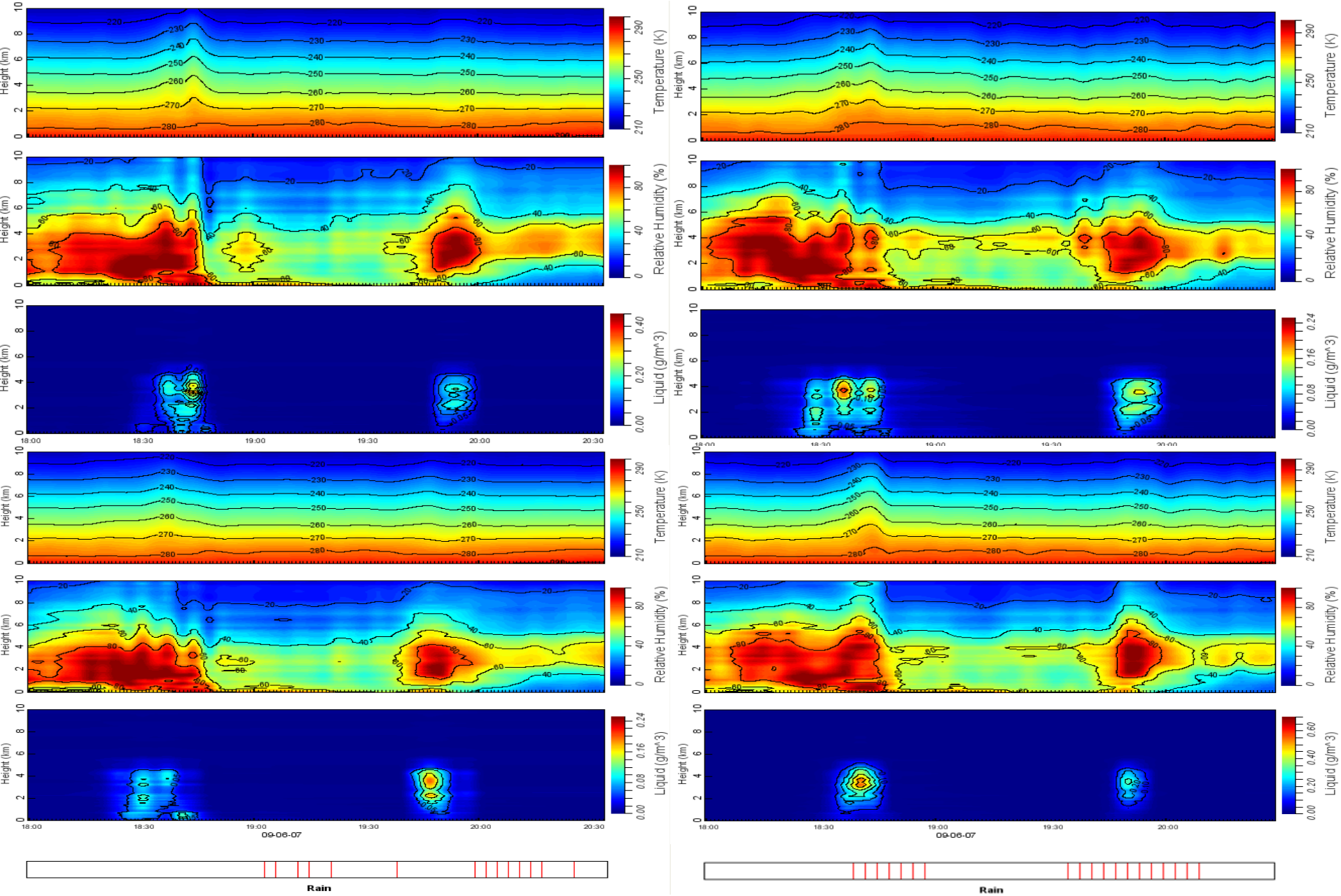
Integrated liquid (mm), vapor (cm), and cloud base temperature (C).



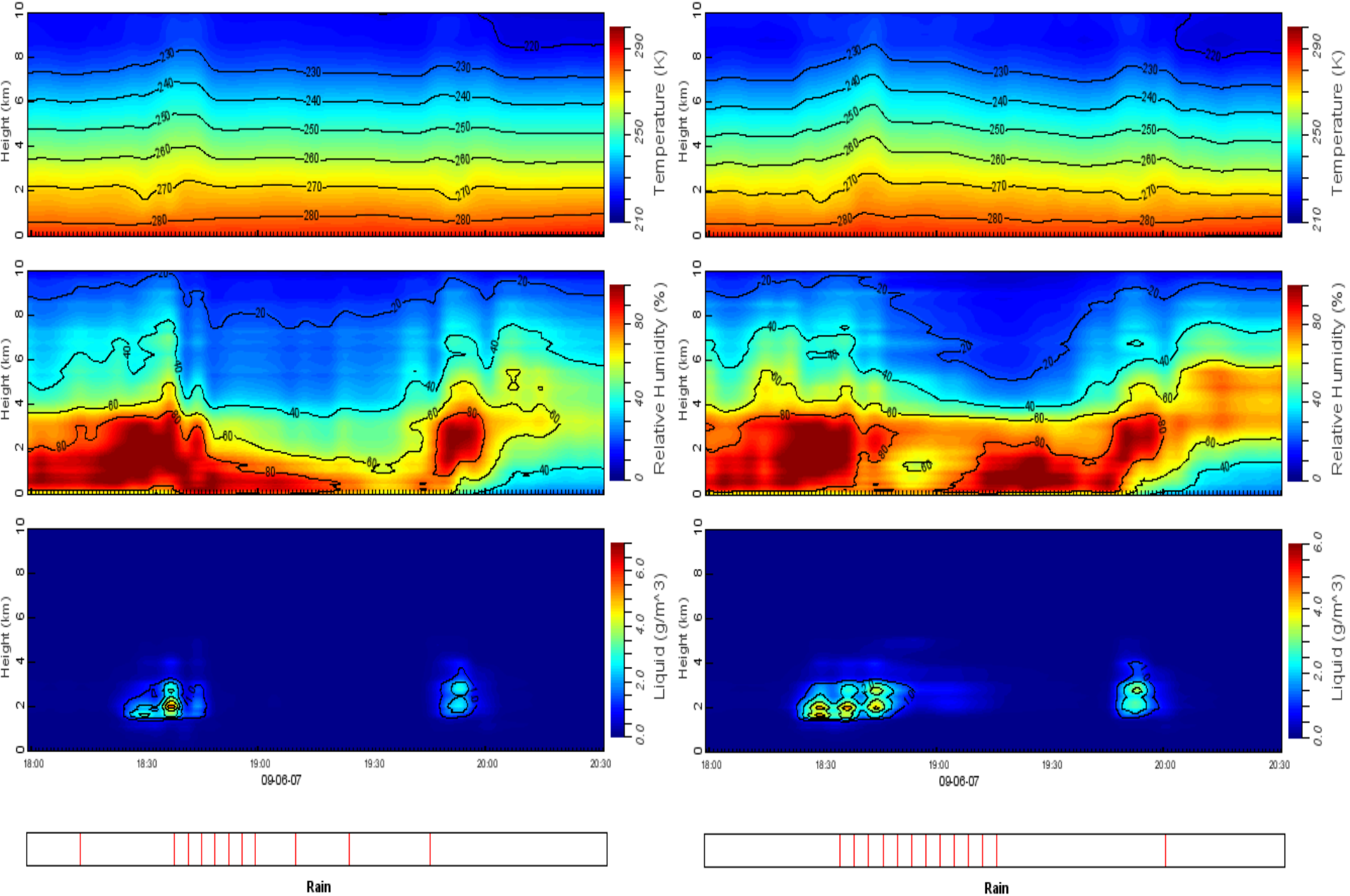
Temperature, vapor density and relative humidity profiles at 15:51 UT 14 Feb 2008.



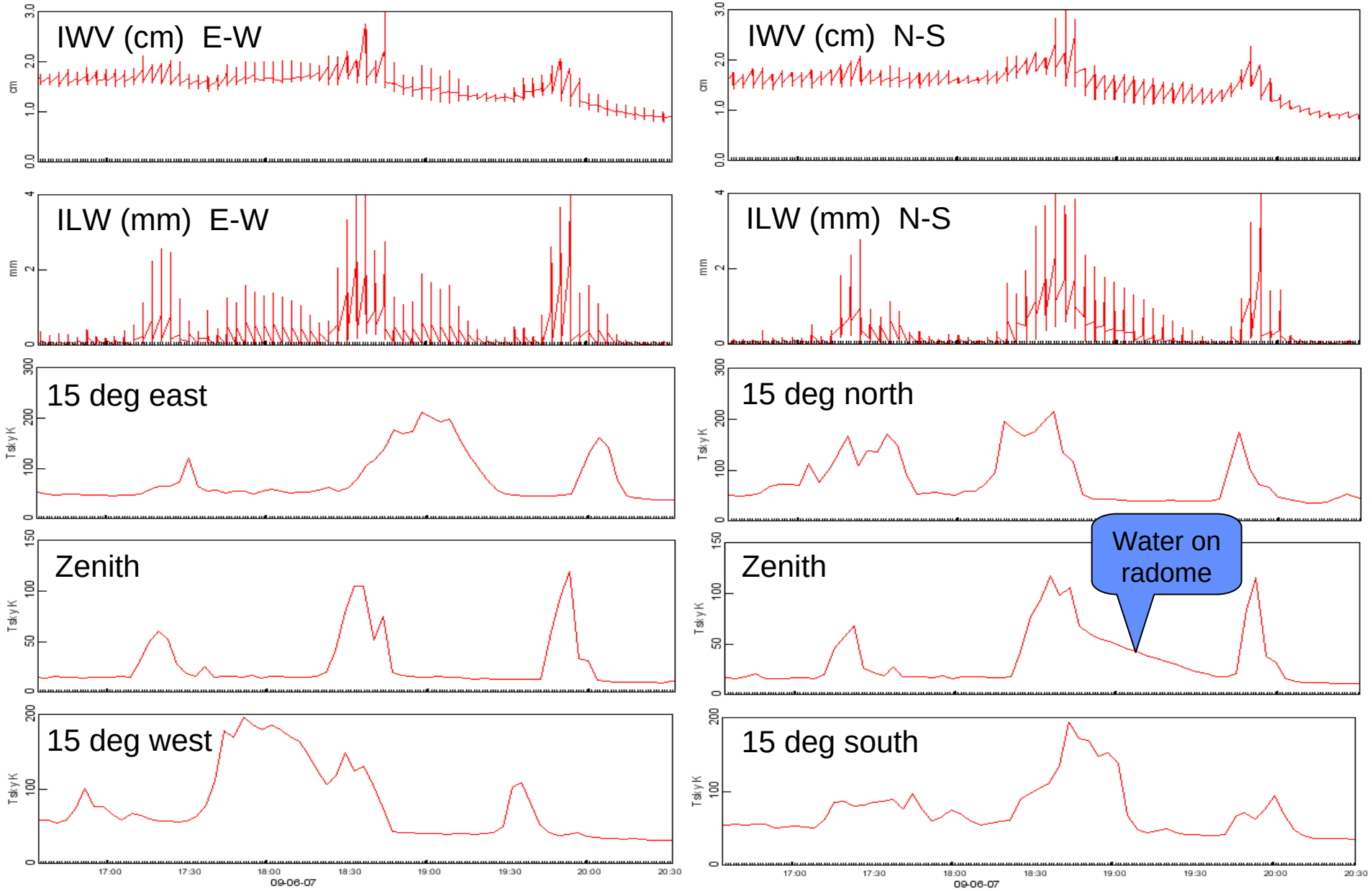
Thermodynamic and liquid (TL) profiles observed 16-22 UT 7Jun09 at 60 deg elevation E-W (Profiler 22A - left) and N-S (Profiler 24A - right) at Boulder, Colorado. A tornado touched down at 1915 UT 7 June 2009, 23 km ESE of the TL Profilers.



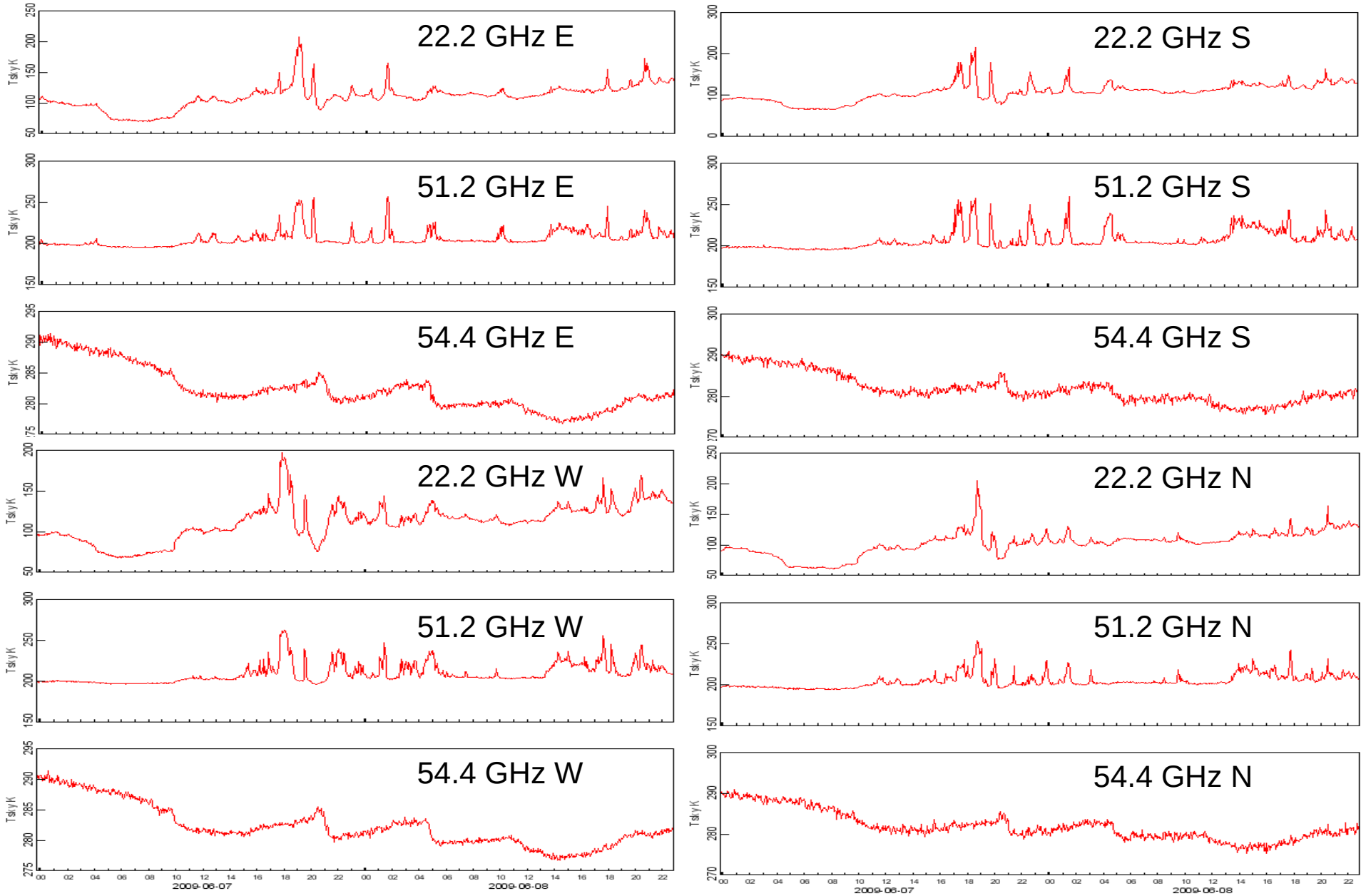
Same as previous slide for the time period 1800-2030 UT.



Thermodynamic and liquid (TL) profile retrievals from zenith observations (Profiler 22A - left) and (Profiler 24A - right) for the time period 1800-2030 UT.



Integrated vapor and liquid mapped to zenith at 15, 60 and 90 deg elevation (top two rows), and 30 GHz brightness temperatures (bottom three rows).



Brightness temperatures at 15 degrees elevation
E-W (left) and N-S (right) for 7-8 June 2009.

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Colorado Tornadoes

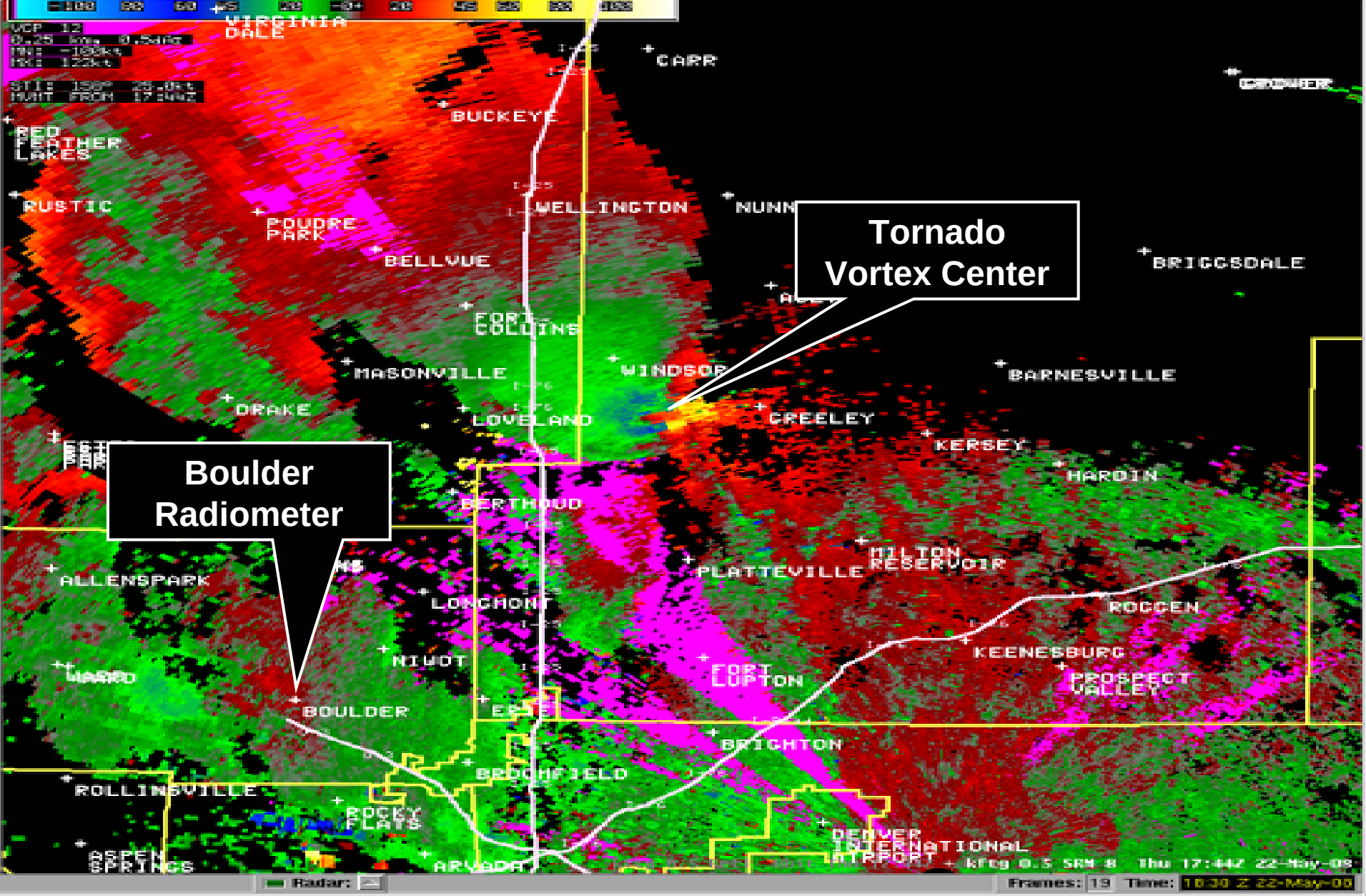
- A cluster of tornadoes swept through Northern Colorado on May 22, 2008.
- Radar, radiosonde and microwave radiometer observations are presented.
- The radiometer provides continuous upper-air thermodynamic and liquid data.
- A tornado case study is underway.



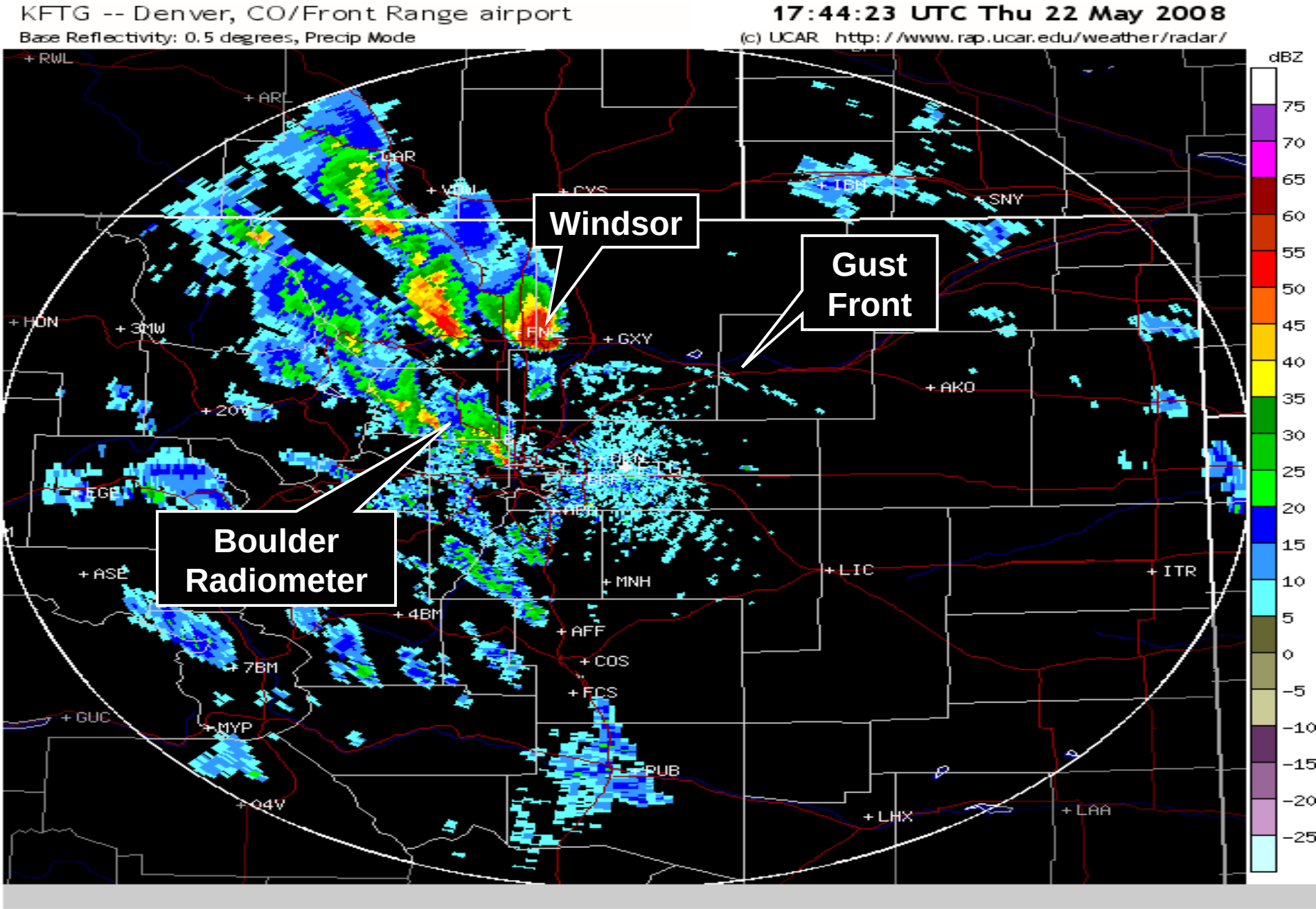



Windsor, Colorado, was hit by a mile-wide tornado around lunch time, and at least one person died as a cluster of twisters carved a swath of destruction through Northern Colorado. The tornadoes badly damaged dozens of houses, semis and cars.

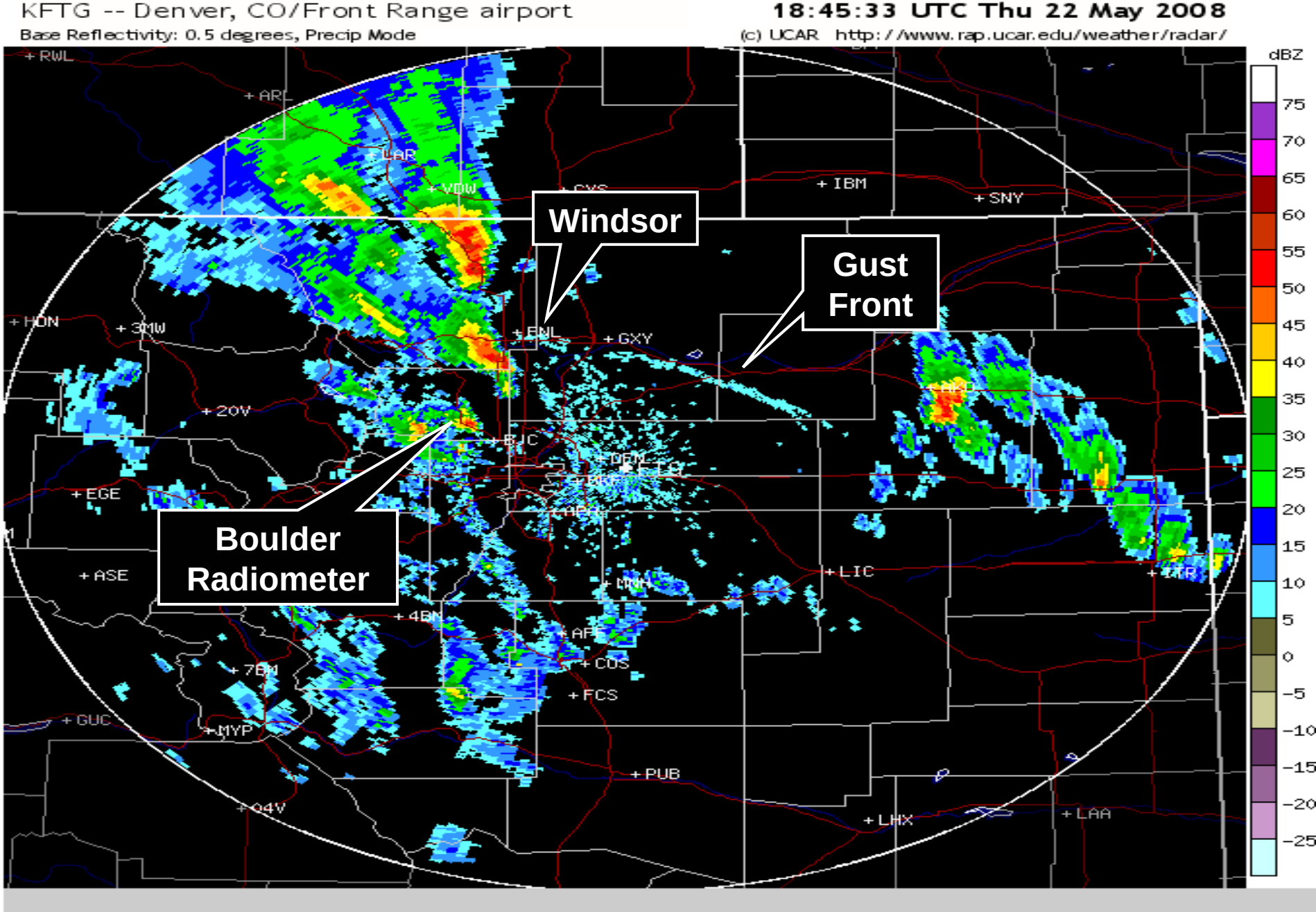
(Denver Post, 5-22-08)



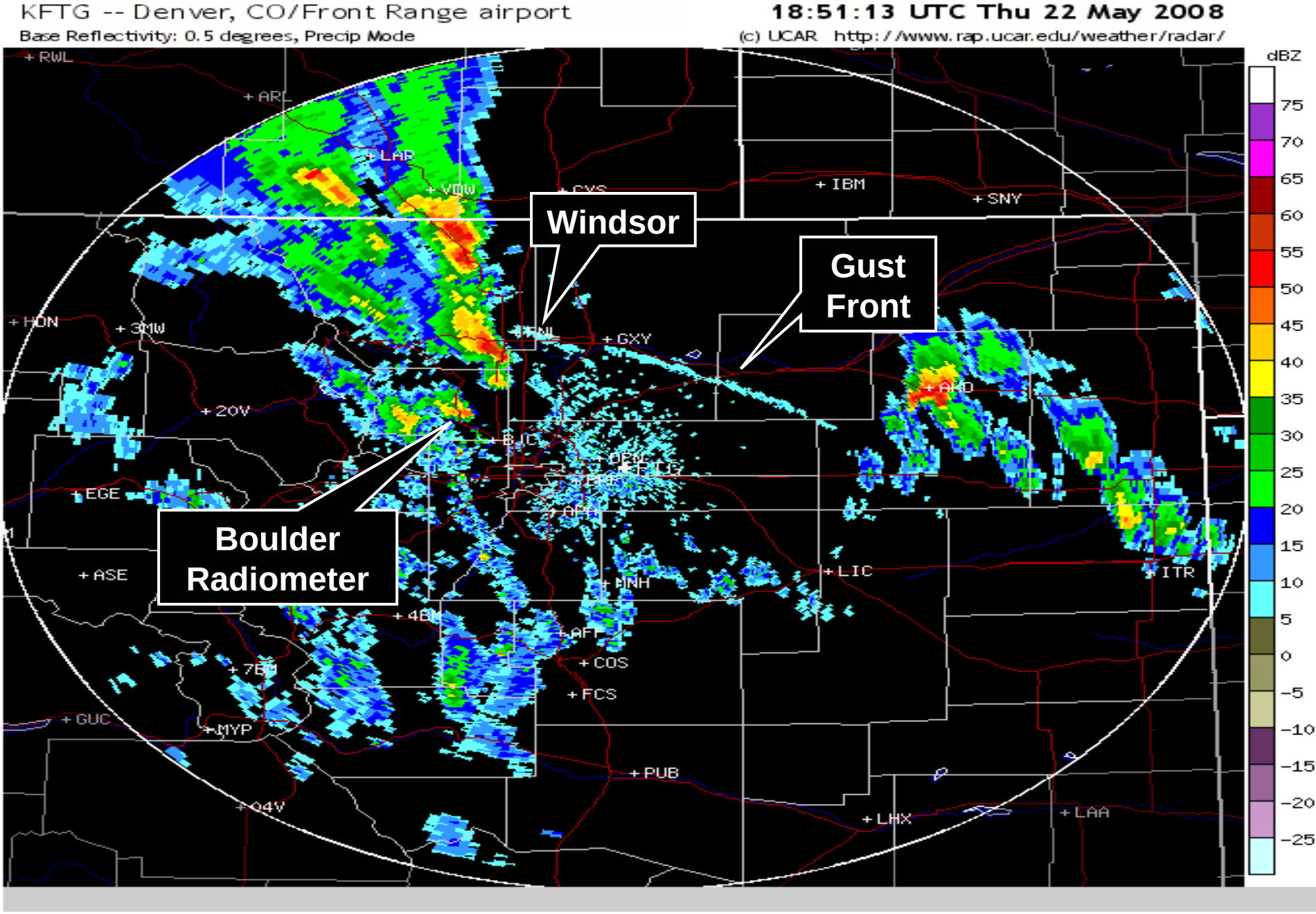
Denver radar showed 180 mph winds near Windsor at 11:44 am (local time) 22 May 2008.



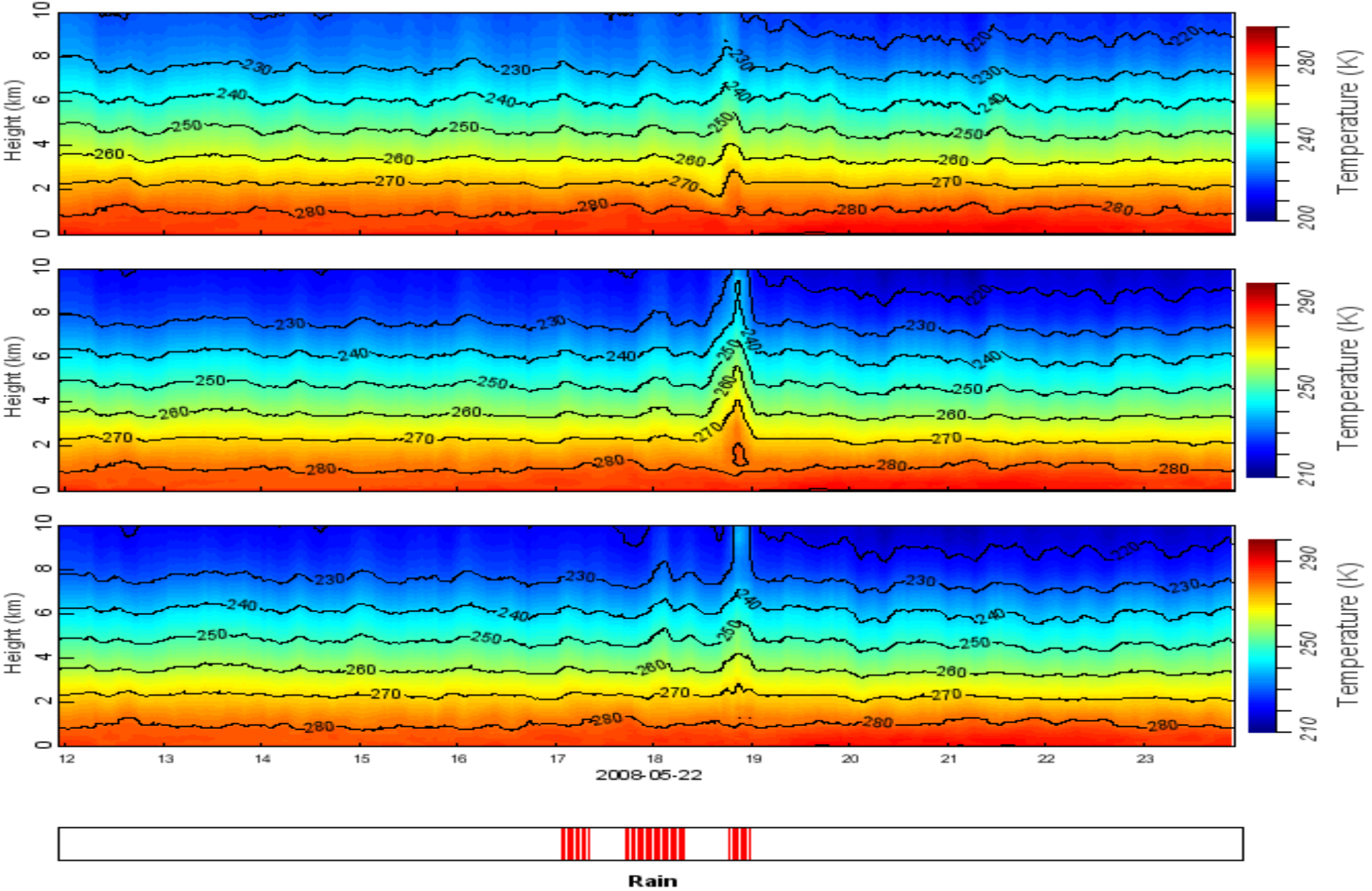
Strong reflectivity near Windsor at 11:44 am (local time).



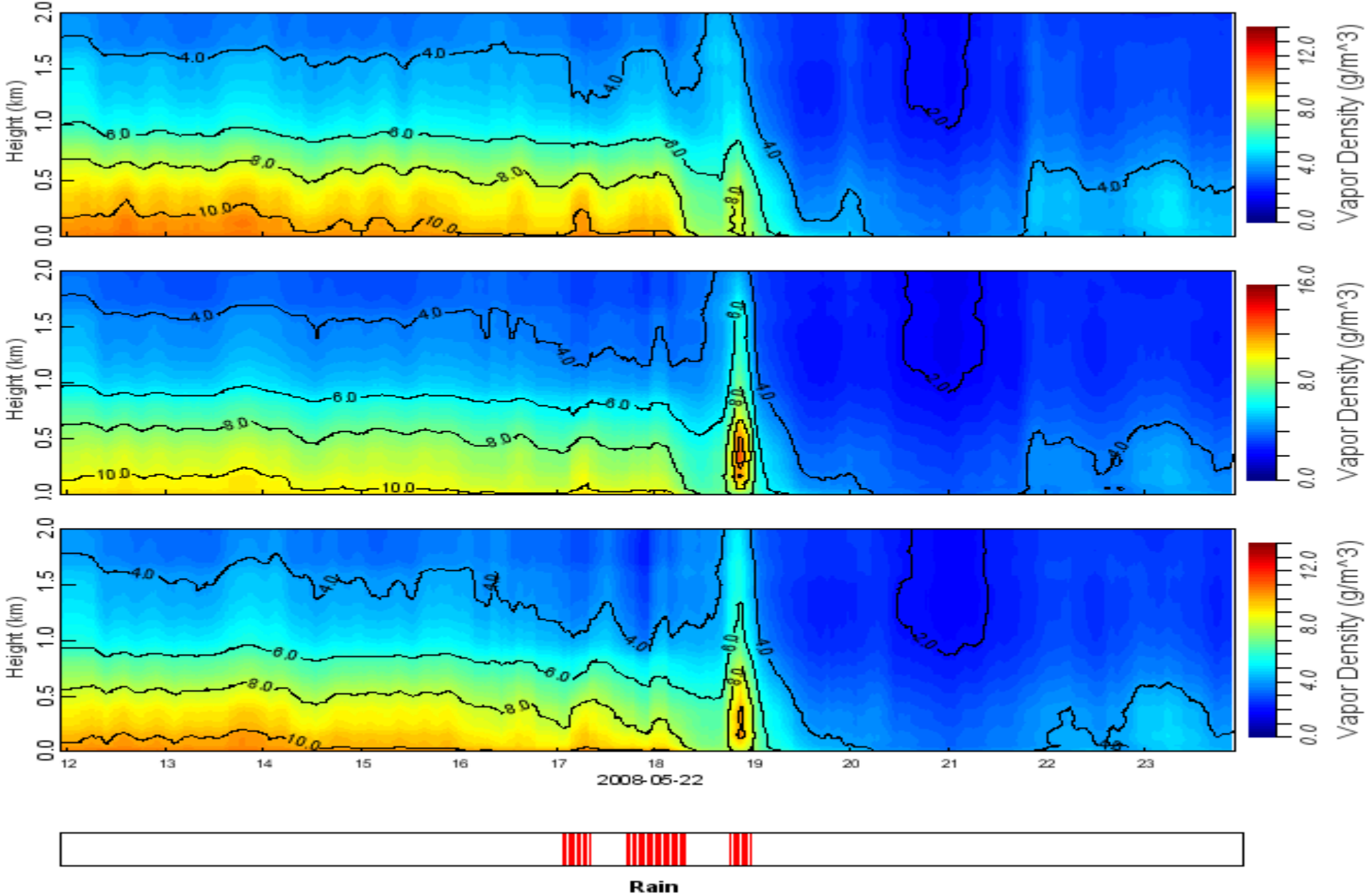
Strong reflectivity south of Boulder at 12:45 am (local time).



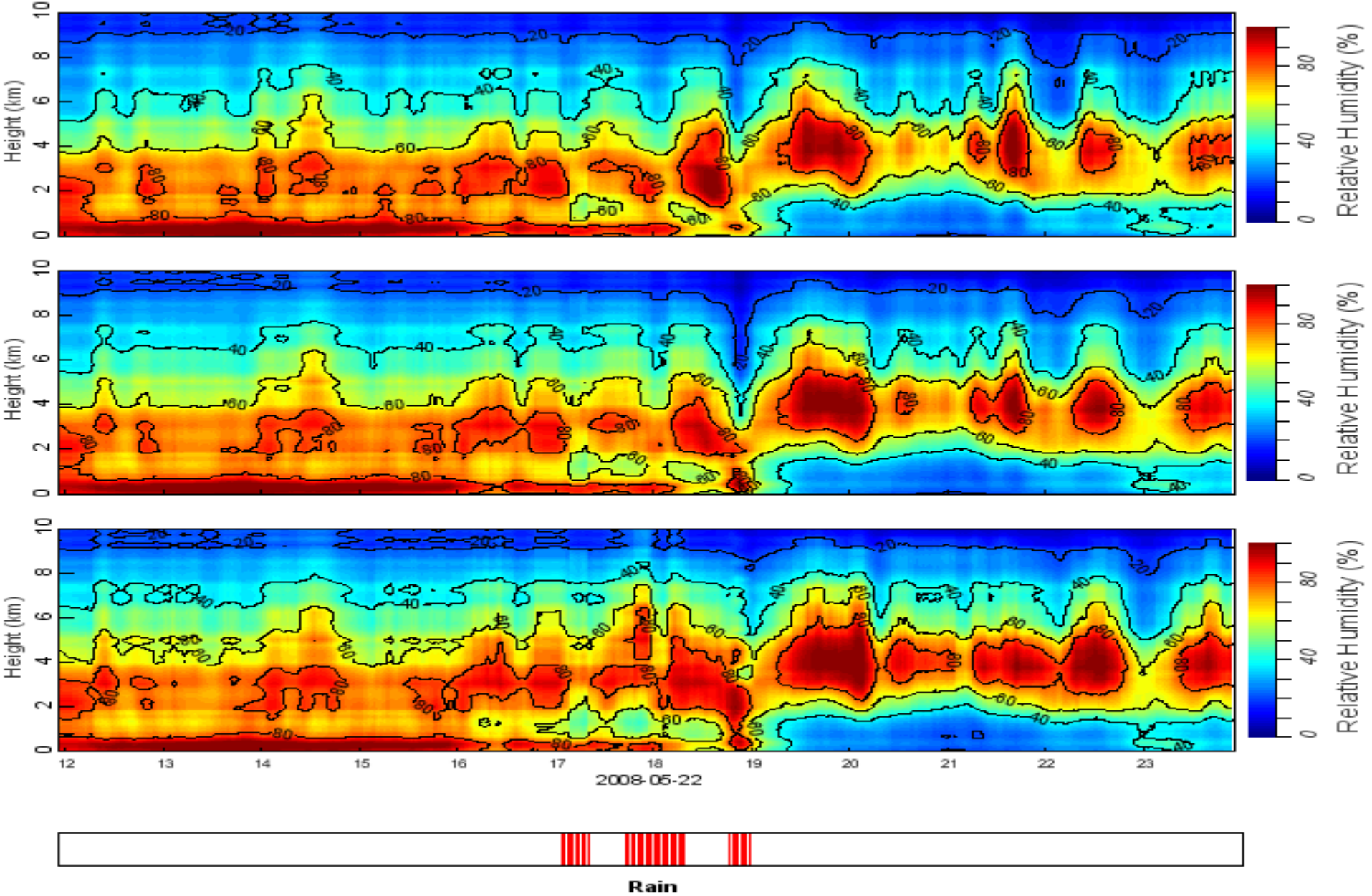
Strong reflectivity north of Boulder at 12:51 am (local time).



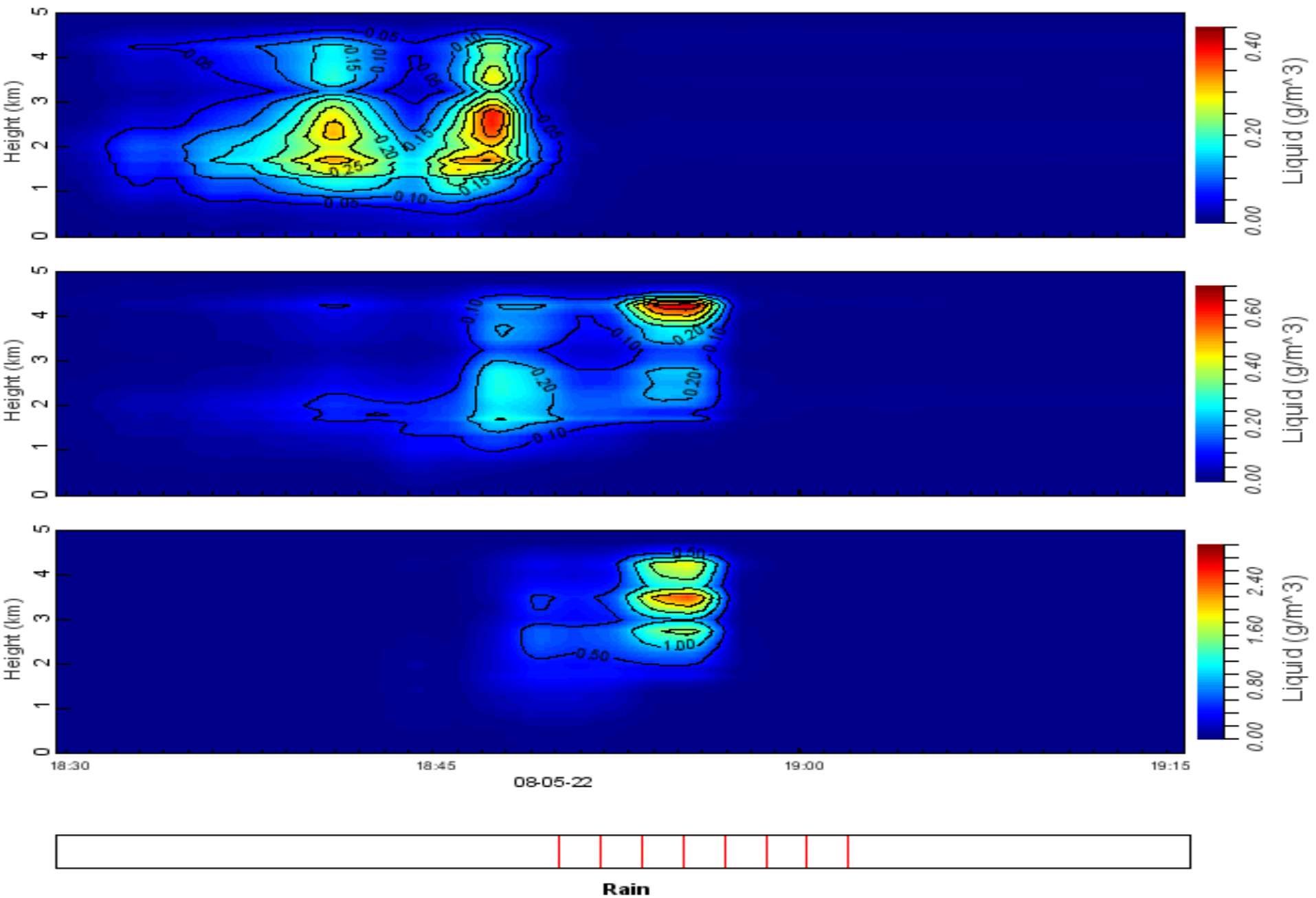
South, zenith and north (top to bottom) temperature profiles to 10 km height were strongly affected by local convection.



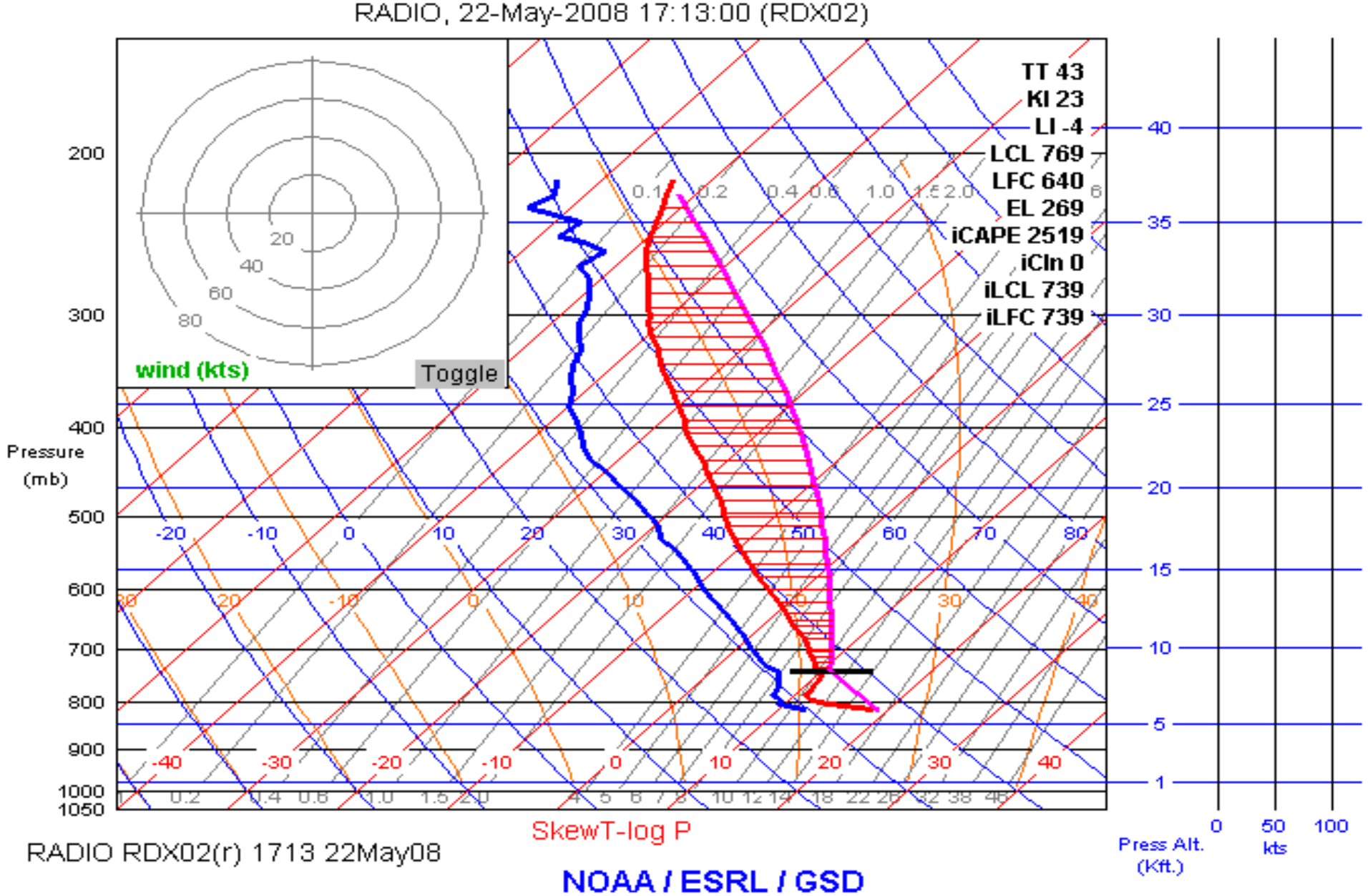
South, zenith and north vapor density profiles to 2 km height show high variability during local convection.



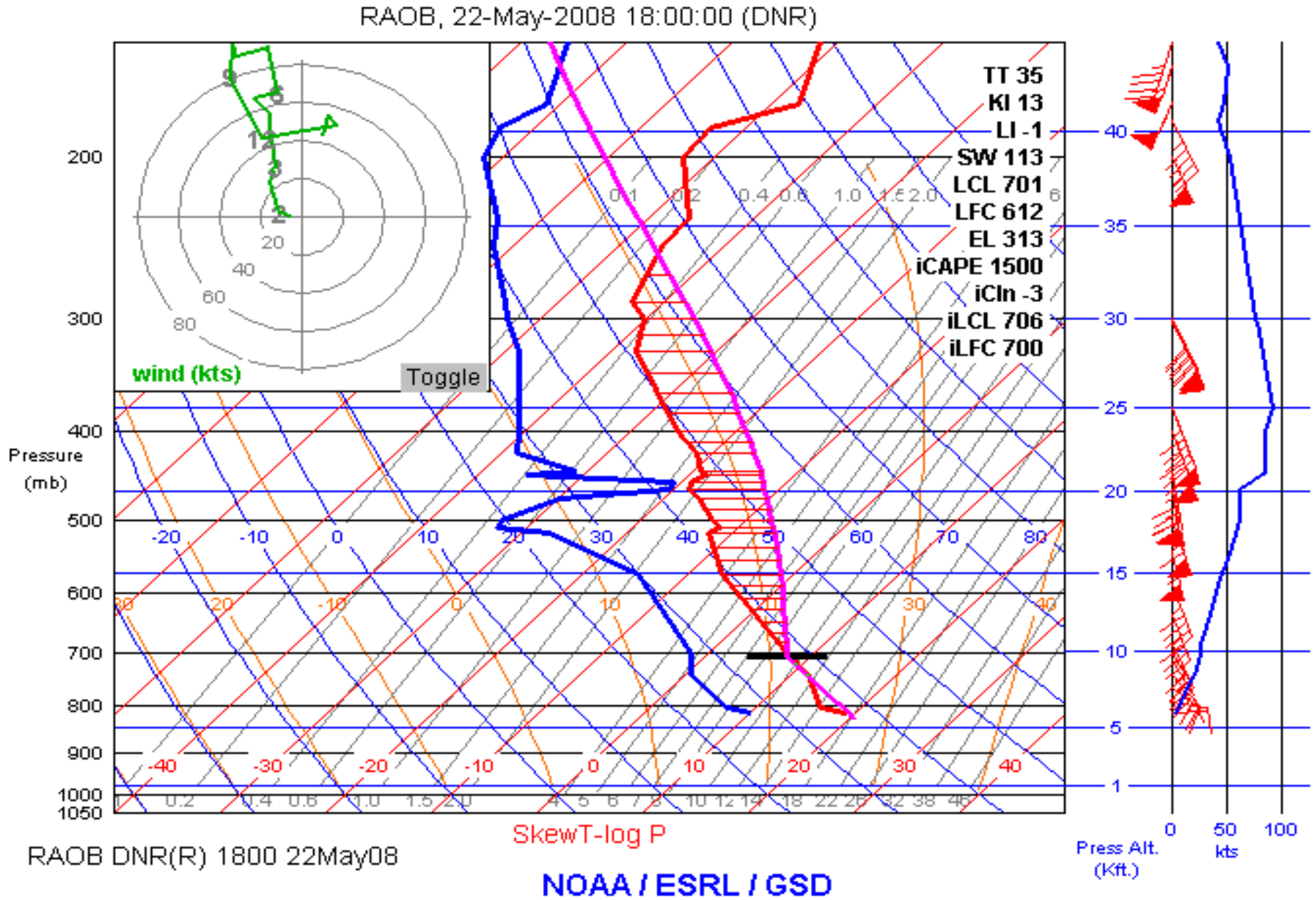
South, zenith and north 10-km relative humidity profiles show transition from high to low latent heat.



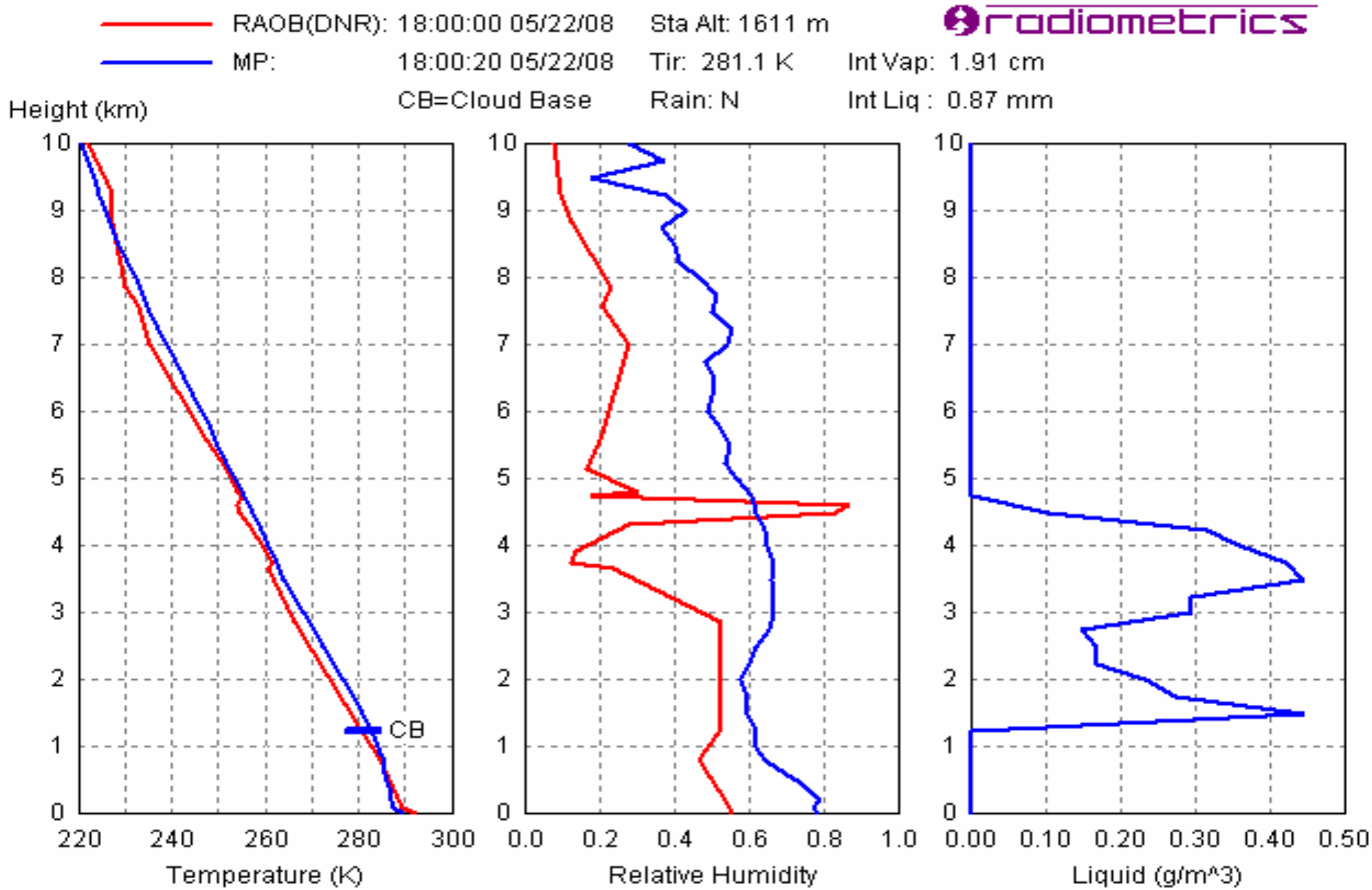
South, zenith and north 5-km liquid density profiles.



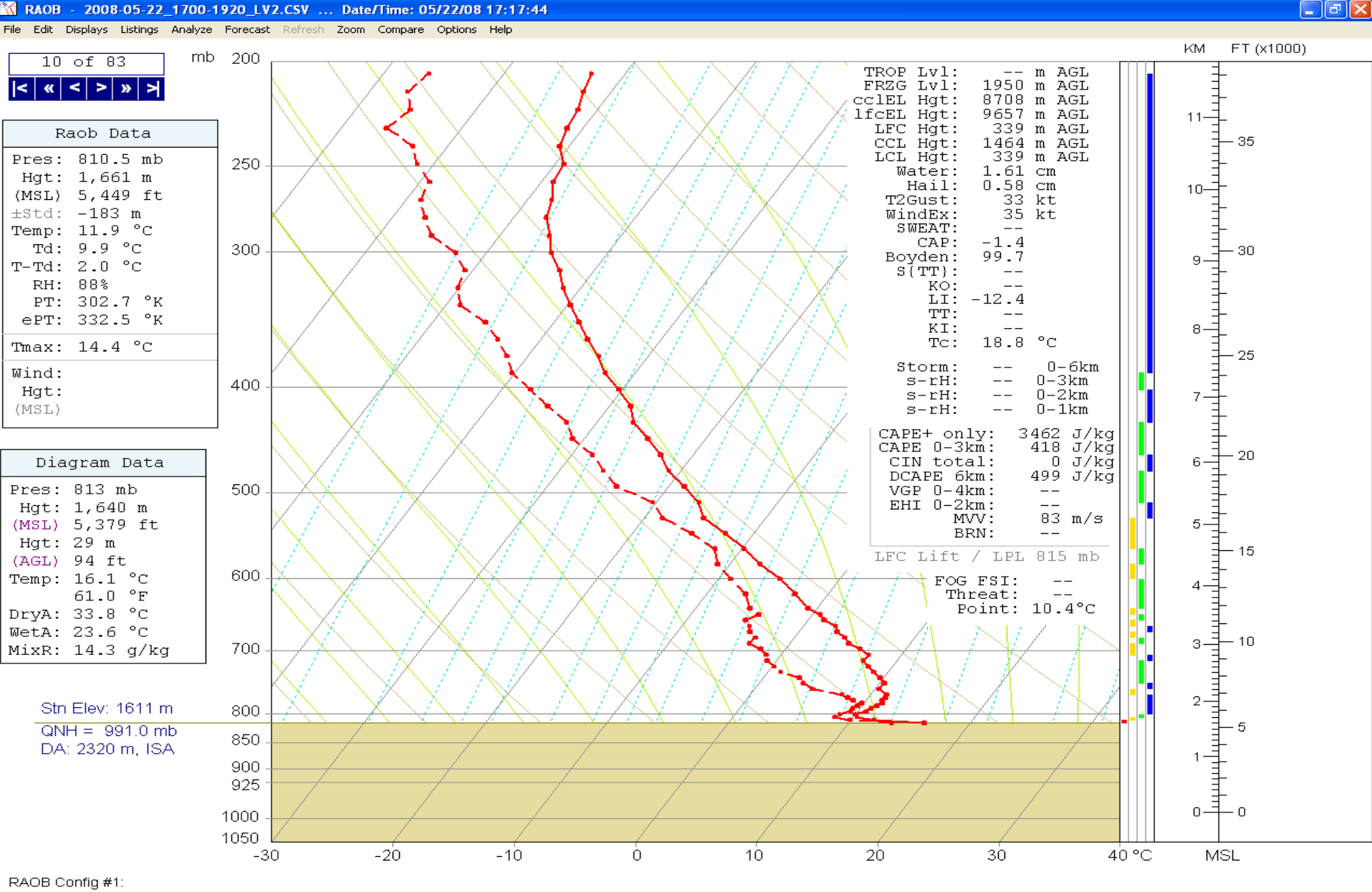
The Boulder radiometer observed maximum CAPE at the time of tornado touch down at Platteville.



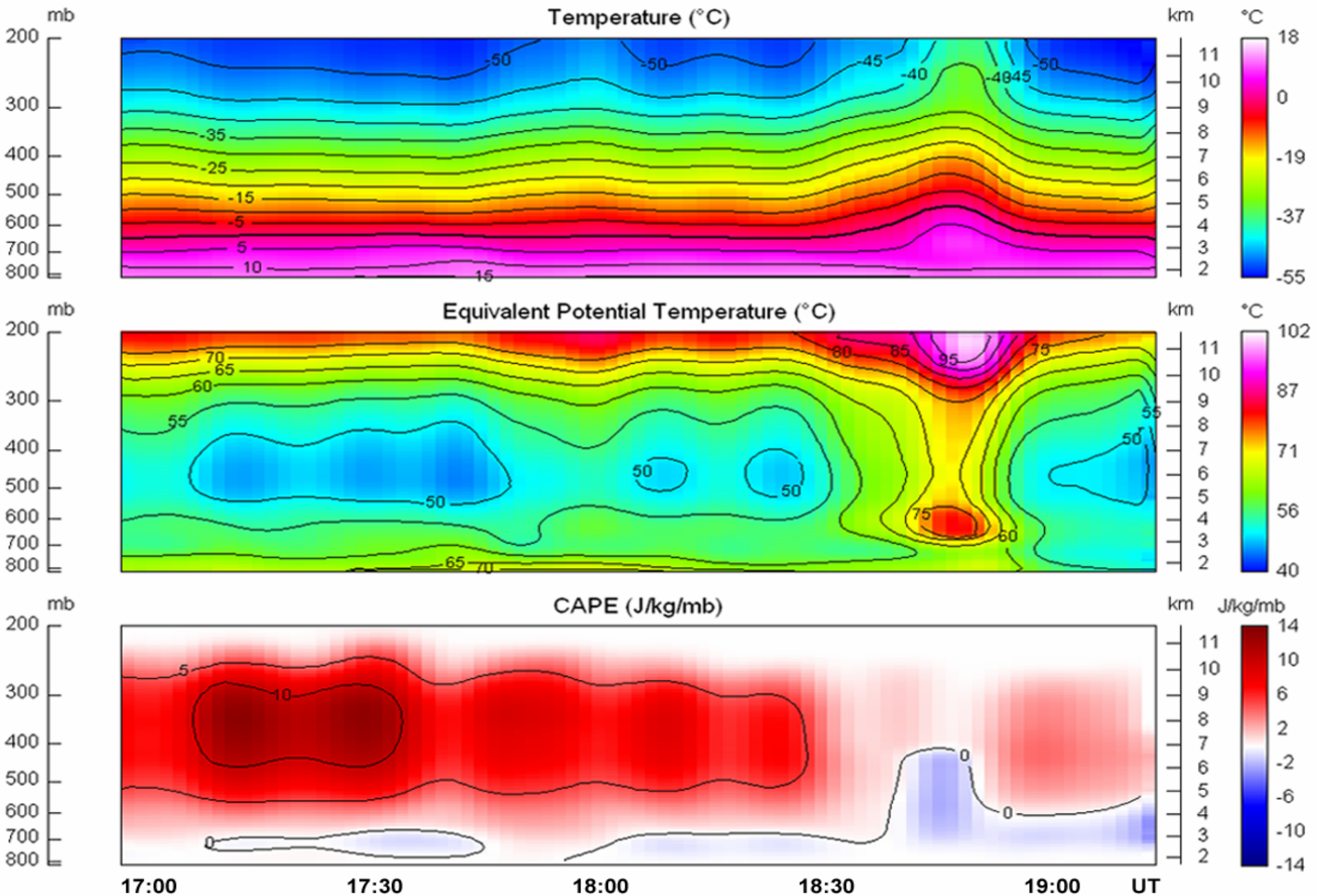
NOAA radiosonde display at Denver at 12:00 noon (local time).



Denver radiosonde and Boulder radiometer temperature, relative humidity and liquid at 12:00 noon (local time).

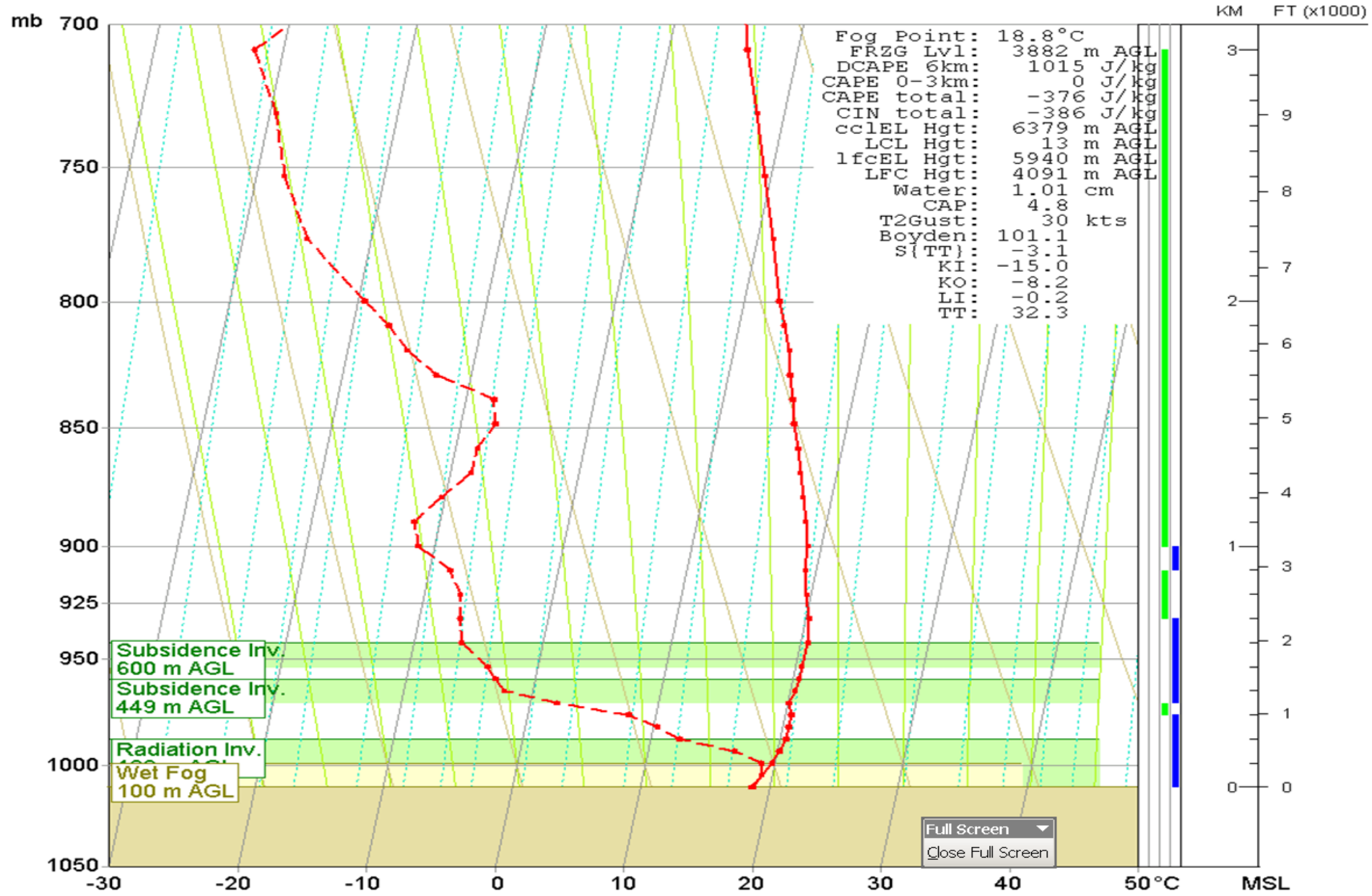


The radiometer observed maximum CAPE (3,462 J/kg) at 11:17 am (local time) when the tornado touched down near Platteville.



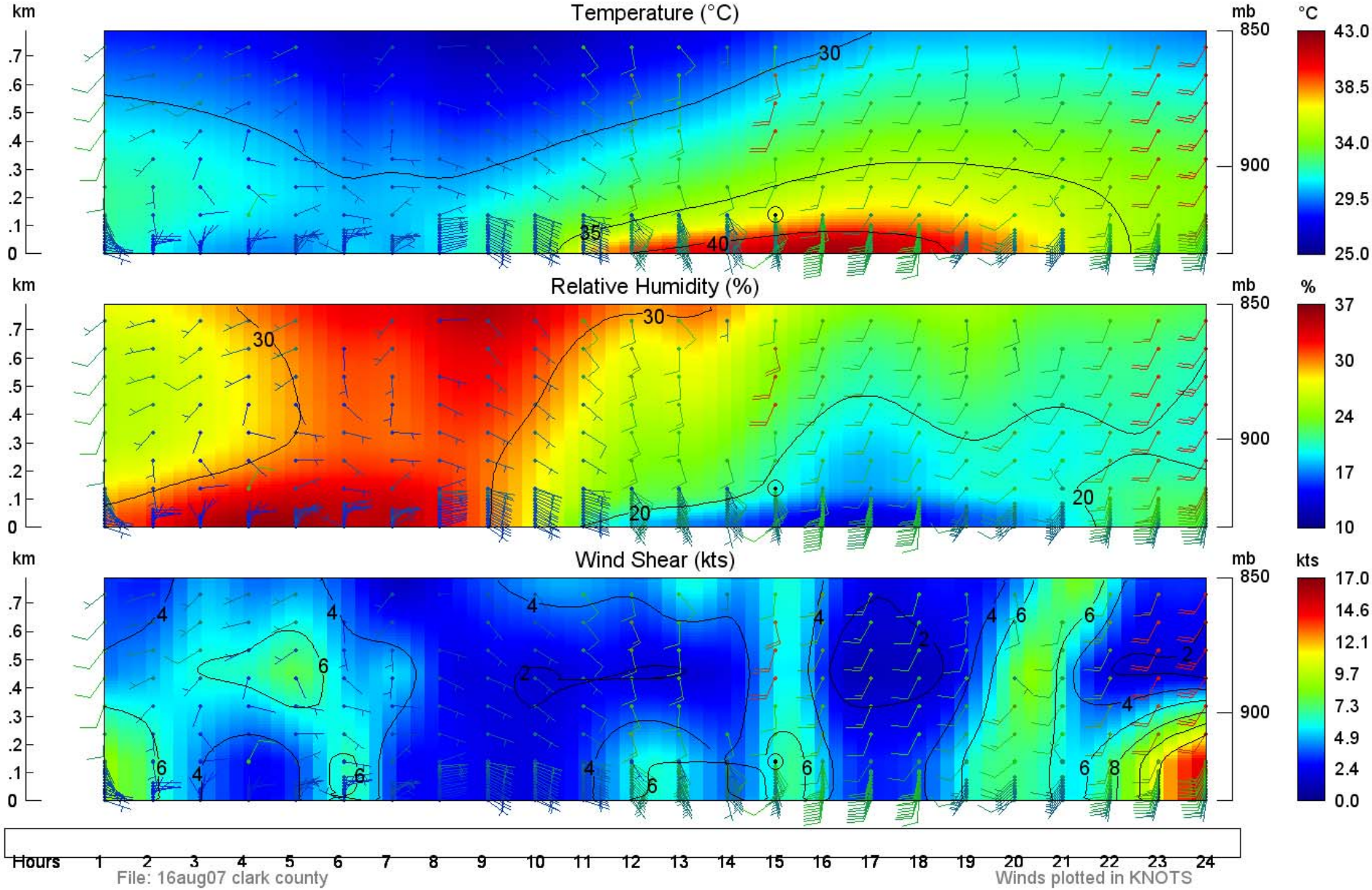
Radiometer temperature, equivalent potential temperature and CAPE.

Thermodynamic and liquid profiler at the Dubai International Airport – a key component of the aviation weather system.



22.2, 30, and 51.2 GHz brightness temperature observations at 15 degrees elevation east.

Thermodynamic, liquid and wind profilers at Las Vegas, Nevada.



Boundary layer temperature, relative humidity and wind shear at Las Vegas, courtesy of Clark County Air Quality Department.

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Continuous Profiling for Better Local Weather Forecasting

- Thermodynamic, wind and liquid profiles define local weather conditions
- Forecast indices generated from continuous profiles can improve local weather prediction
- Continuous upper air profiling data can be assimilated into weather models to improve local and convective weather forecast skill

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U.S. DOE ARM Program
Barrow, Alaska

Dubai International Airport
United Arab Emirates

German Weather Service
Lindenberg

Met Service Canada
Vancouver Winter
Olympics

Pearson International Airport
Toronto, Canada

Chinese Meteorological
Administration
Beijing Olympics