Monitoring and Tracking Severe Weather in the Vicinity of Denver Airports

Rita Roberts

National Center for Atmospheric Research

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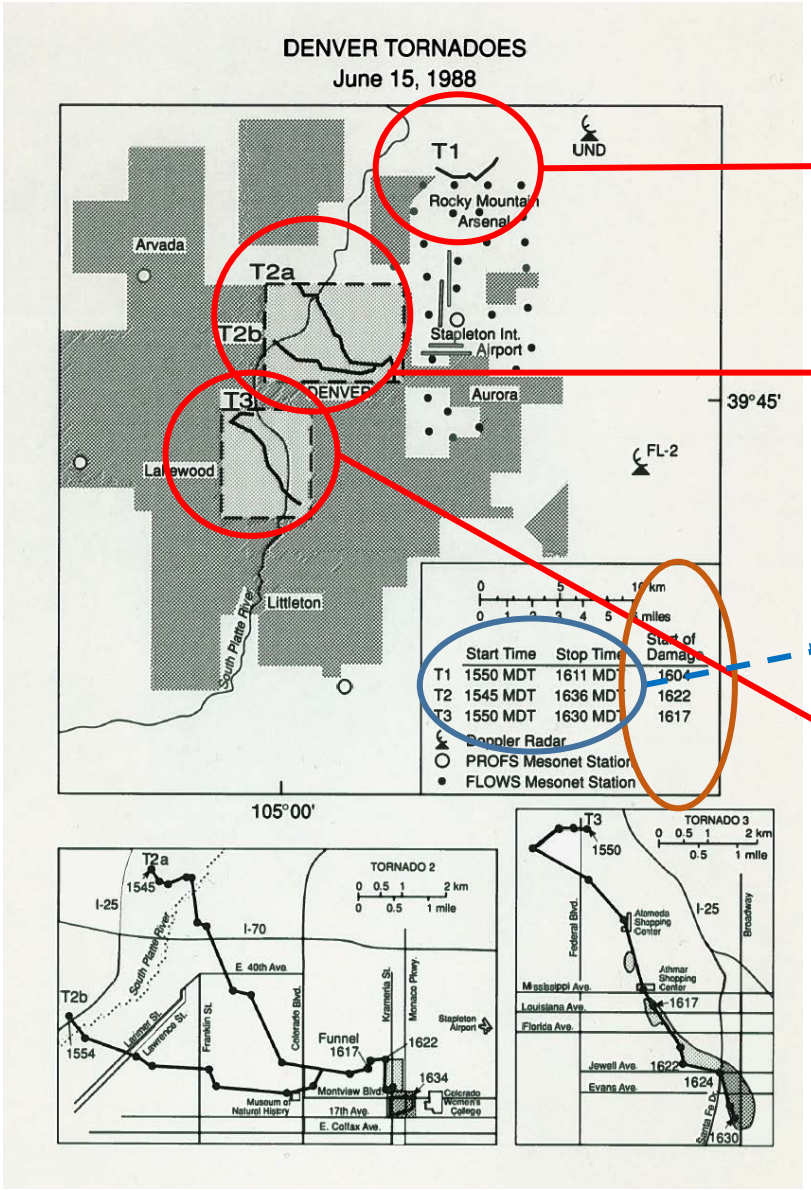
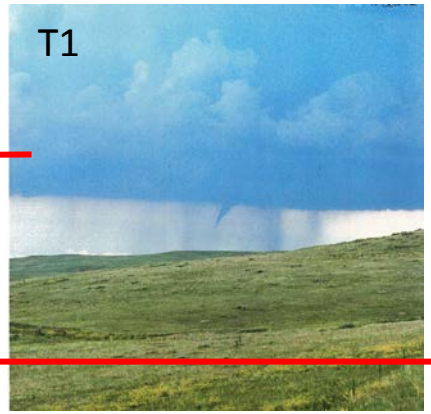
ATC Questions

- When should they evacuate the tower?
- Cells with rotation 3 miles W/NW of tower moving NE. ITWS and other weather tracking tools suggest it is not risk to tower.
- Is this distance too close?
- What are the risks?
- Do these cells have erratic paths?

15 June 1988 Non-Supercell Tornado Events near Denver Stapleton Airport





F1 scale tornado

F2 scale tornado

Duration of rotations on radar

T1 - 22 minutes

T2 - 51 minutes

T3 - 40 minutes

F2-F3 scale tornado

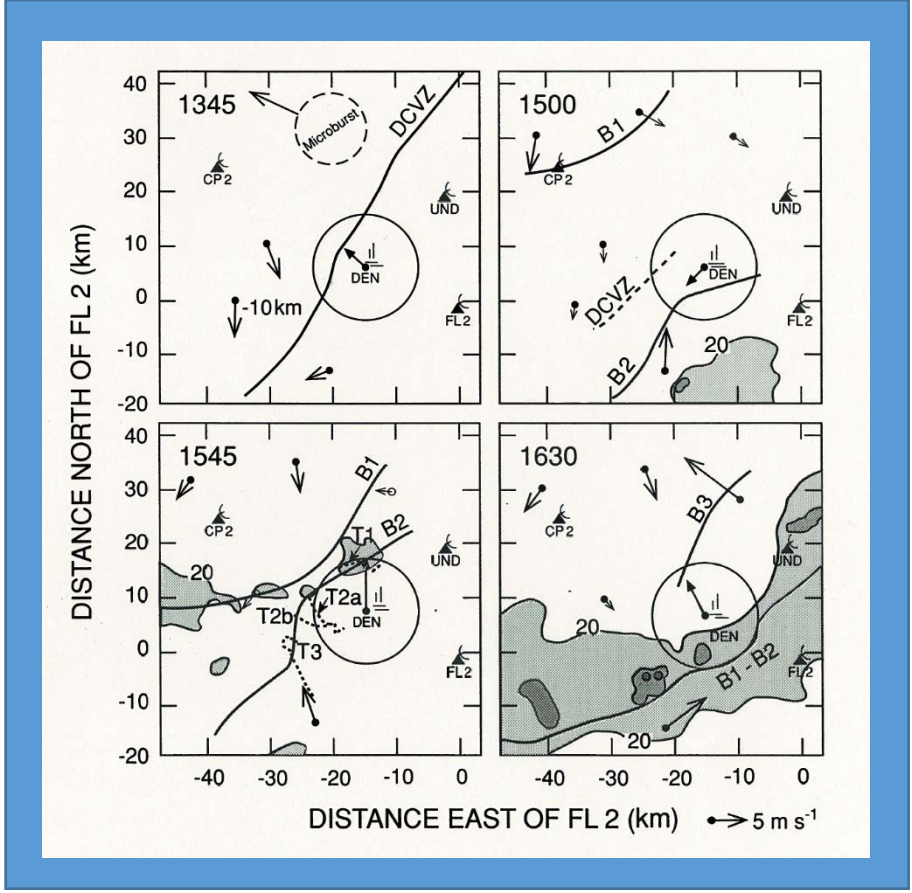
Damage: Hundreds of city-owned trees uprooted, and some damage to buildings and cars.

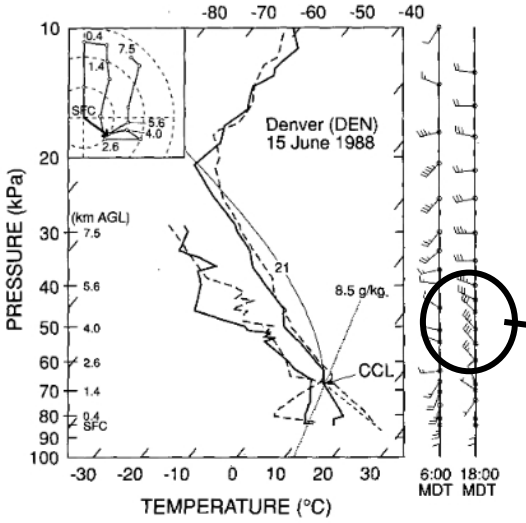
Roberts and Wilson, MWR, 1995

- Monitoring the location of the Denver Convergence Vorticity Zone (DCVZ) and movement of other convergence boundaries, such as gust fronts (e.g., B1 and B2), is important for tracking the movement of the non-supercell tornadoes.

- **Non-supercell tornado rotations remain fixed to the surface convergence boundaries and track in the same general direction. Their paths are more predictable than paths of supercell tornadoes.**

- Monitoring of non-supercell tornadoes is possible because these boundaries are observable on the Denver Nexrad (KFTG) and Denver Terminal Doppler Weather Radars (TDWR).





- The parent storms generally move in direction of the mean steering wind

- In this event, the storms moved from NW to SE.

Roberts and Wilson, MWR, 1995

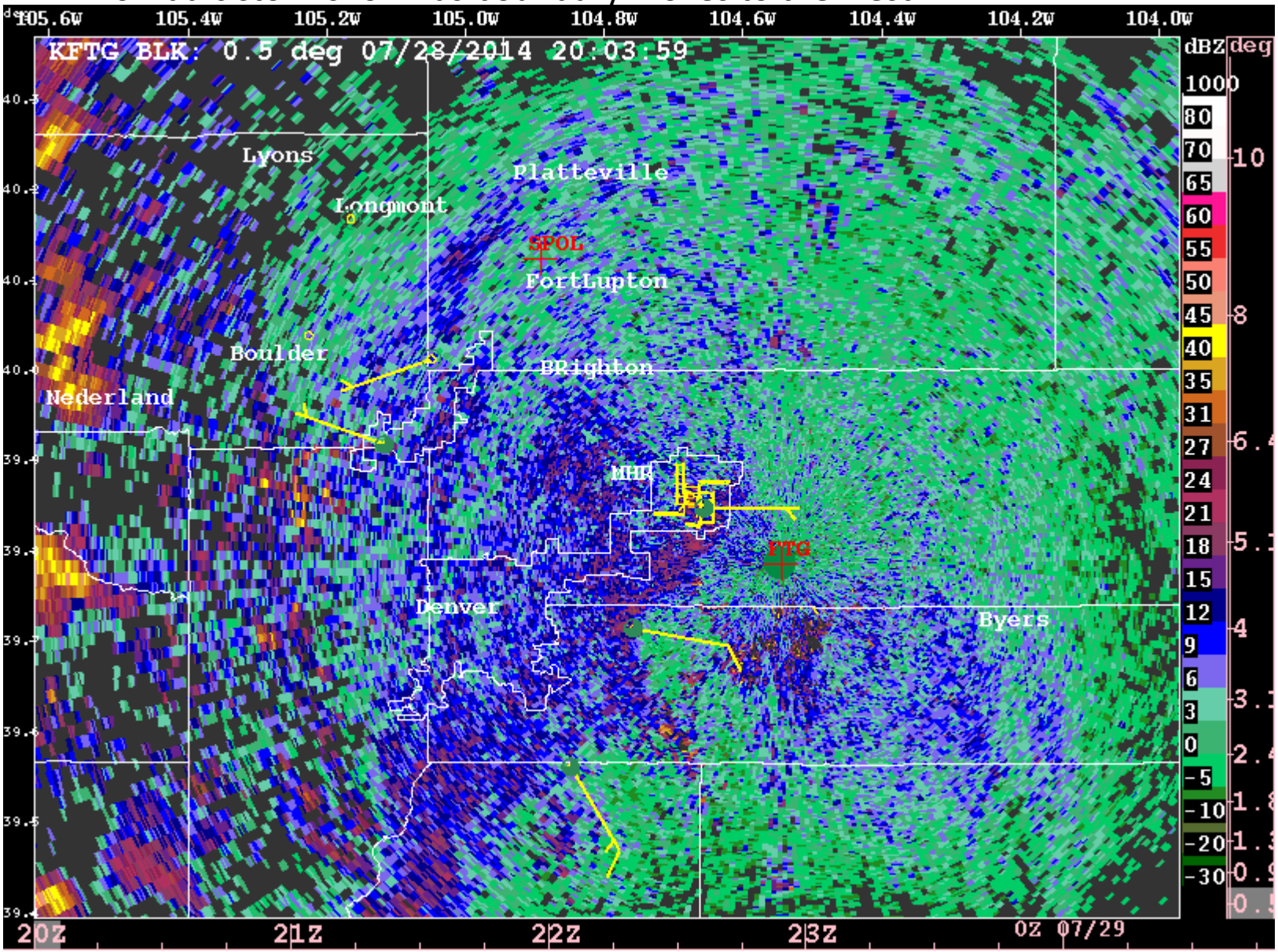
28 July 2014 Non-Supercell Tornadoes

Commerce City. This is not a drill. Debris funnel just east of civic center heading north to Refuge on 28 July 2014 **#cowx**

A tornado formed next to Denver International Airport on Monday, July 28, 2014 as airline officials moved passengers into safe areas of the airport. (Photo/Sara McCook)

- A tornado warning was issued for Adams and Denver counties at around 4 p.m.
- During the warning, at least one twister was spotted in the northeast portion of Aurora, which prompted Denver International Airport officials to order travelers there to seek shelter in concourses.
- Trained National Weather Service spotters reported that one tornado touched down at around 3:53 p.m. near Fort Lupton.
- Another tornado was spotted at around 4:09 p.m. in the southwest section of the Rocky Mountain Arsenal National Wildlife Refuge, about 7 miles southwest of DIA in Adams County.

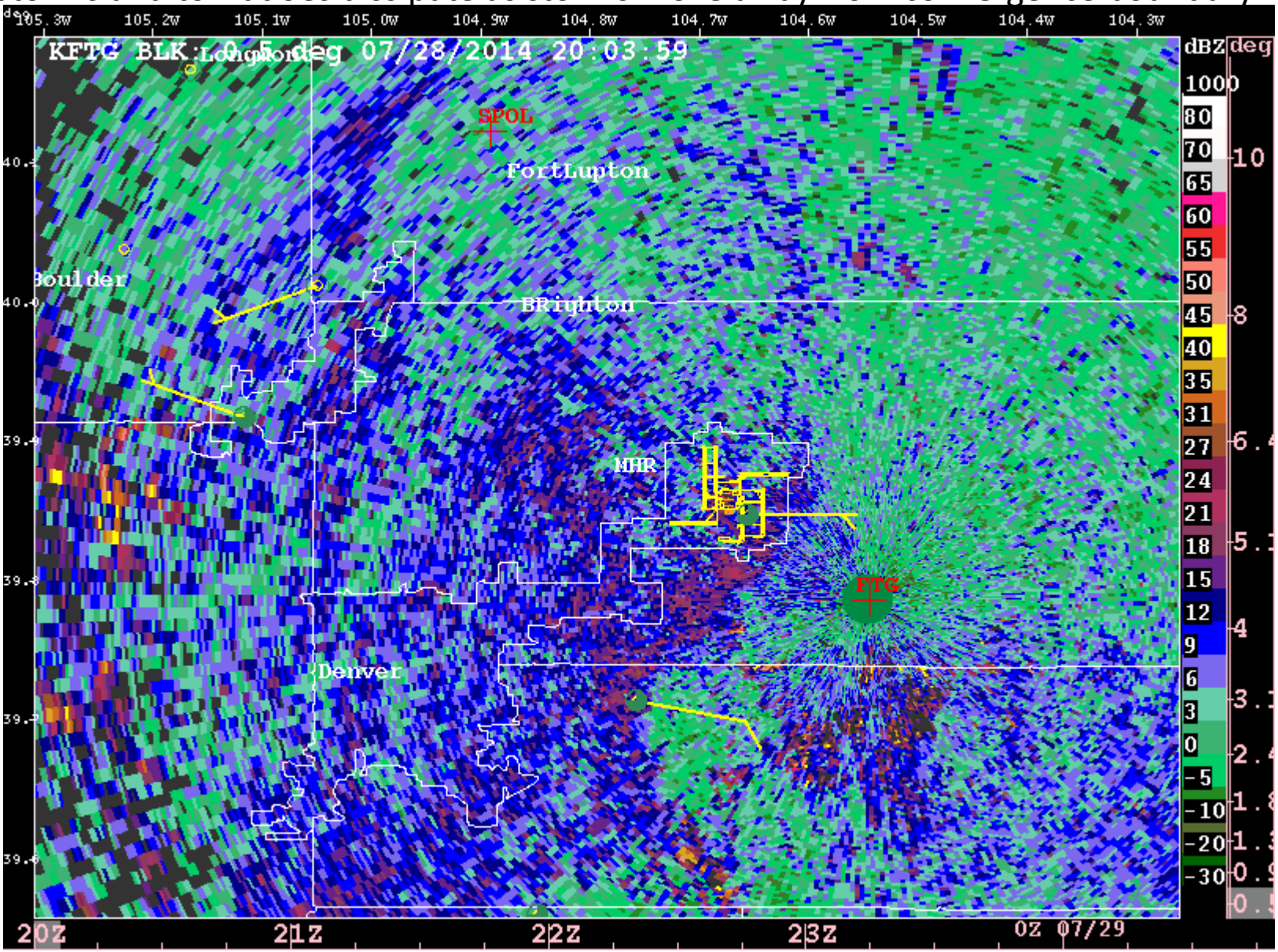
- Storms initially form near Denver along a semi-stationary DCVZ
- Tornadic storms form as boundary moves to the west



28 July 2014

Monitoring Storm and Boundary Motions are important for Assessing Risk to DIA.

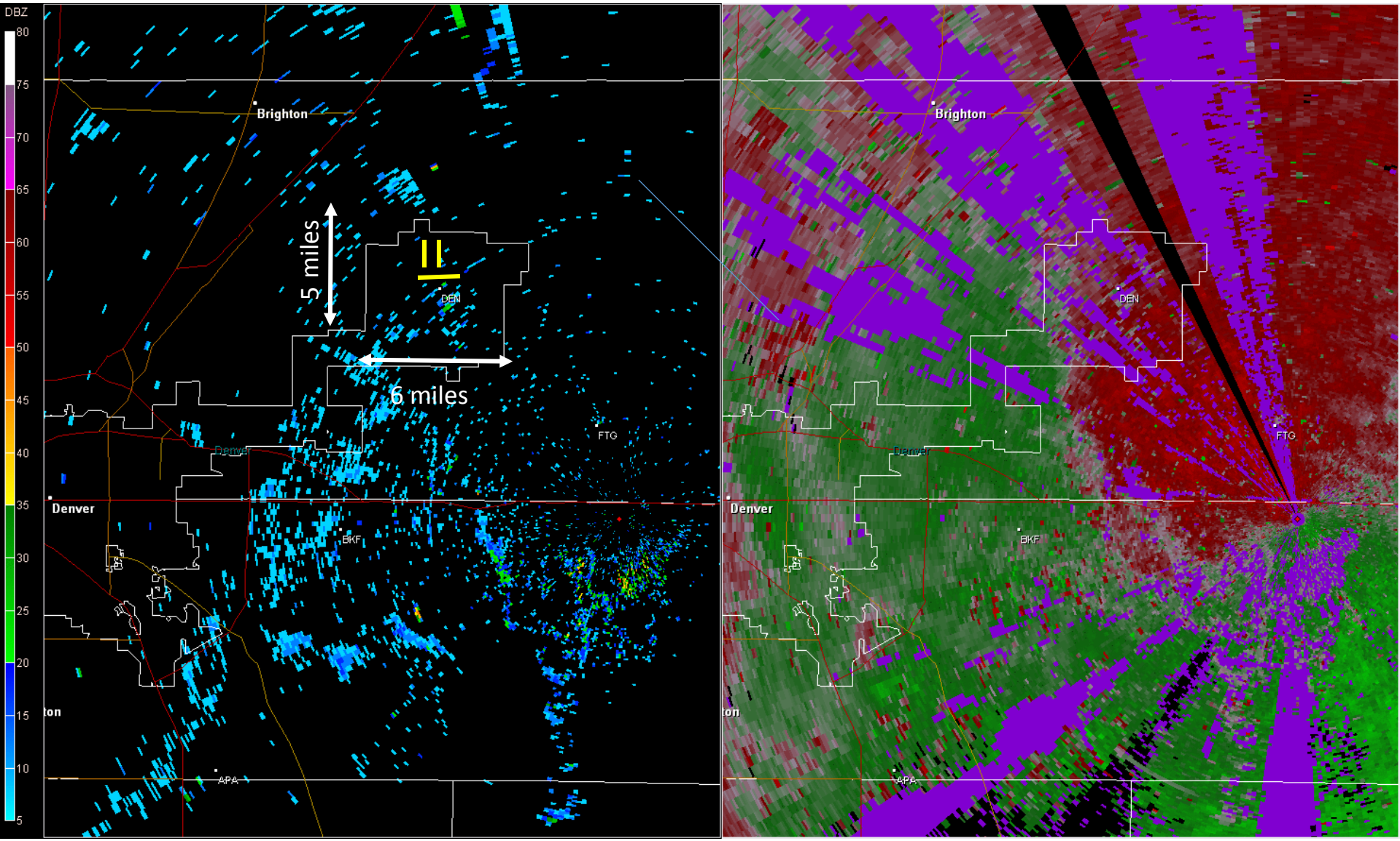
Storms and tornadoes dissipate as storms move away from convergence boundary



28 July 2014

18 June 2013 Non-Supercell Tornado

Denver TDWR Radar

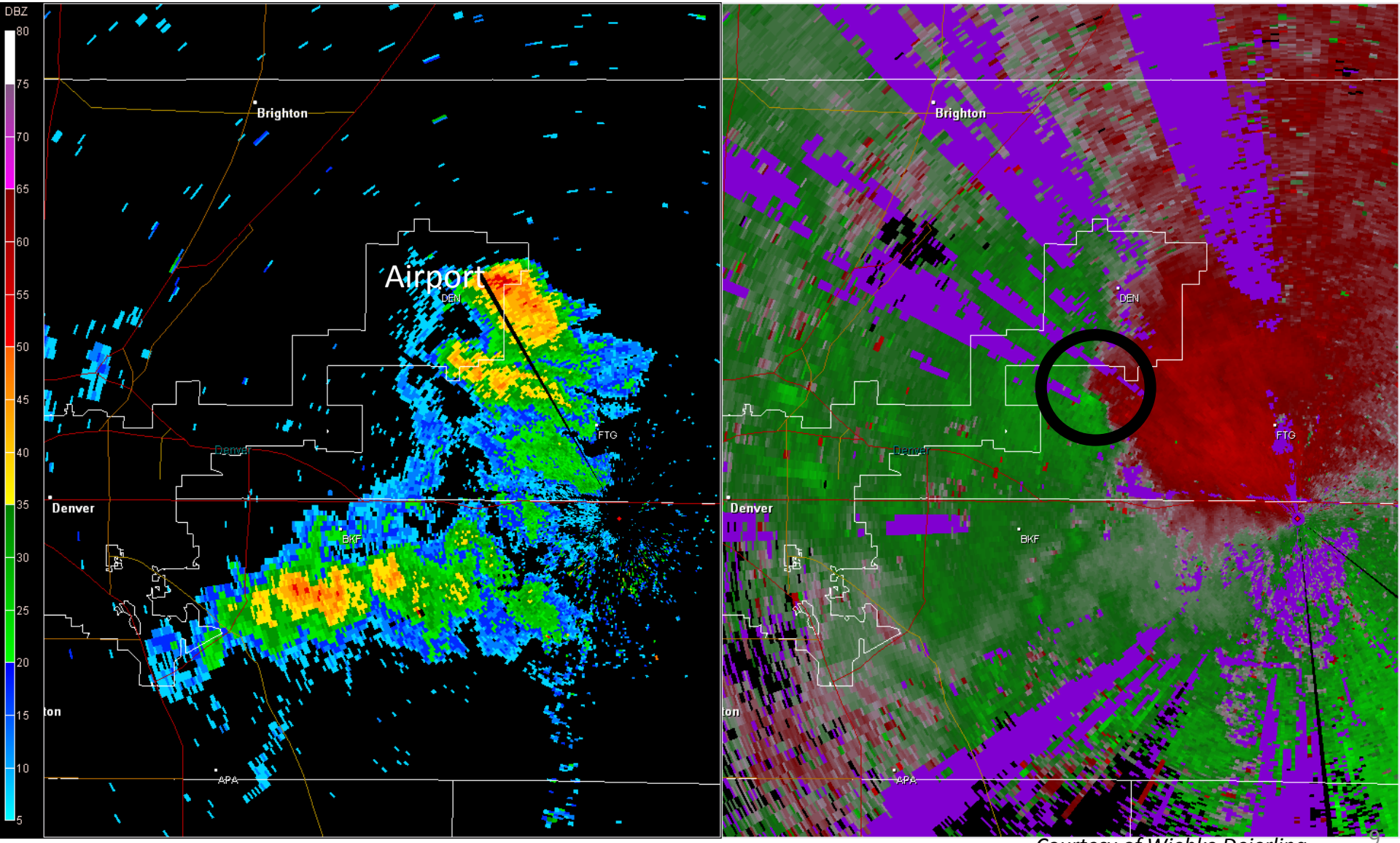


Courtesy of Eric Nelson

19:52 UTC

Quickly developing cell overhead, Ltg close to field

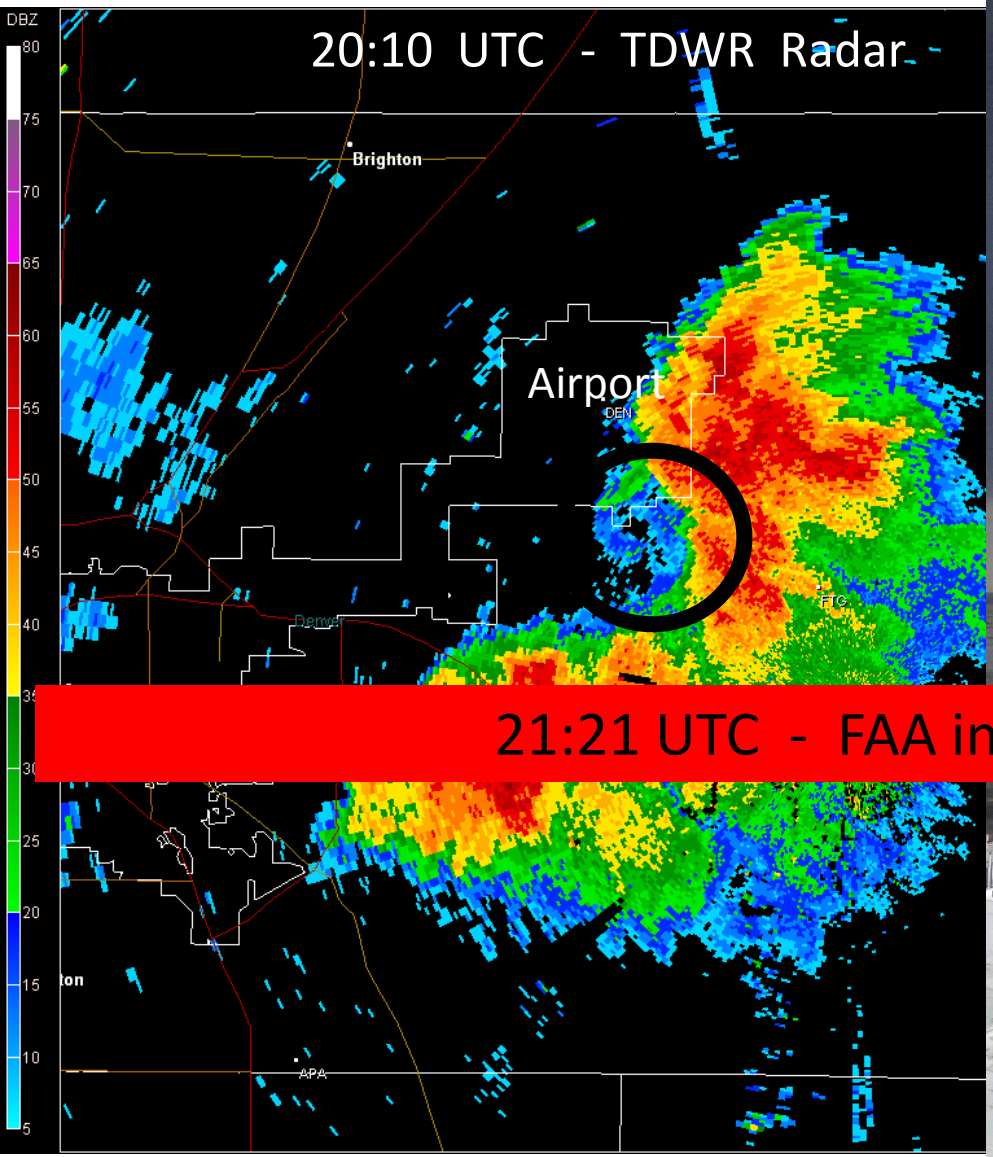
SPC issues a severe thunderstorm Watch at 19:55 UTC

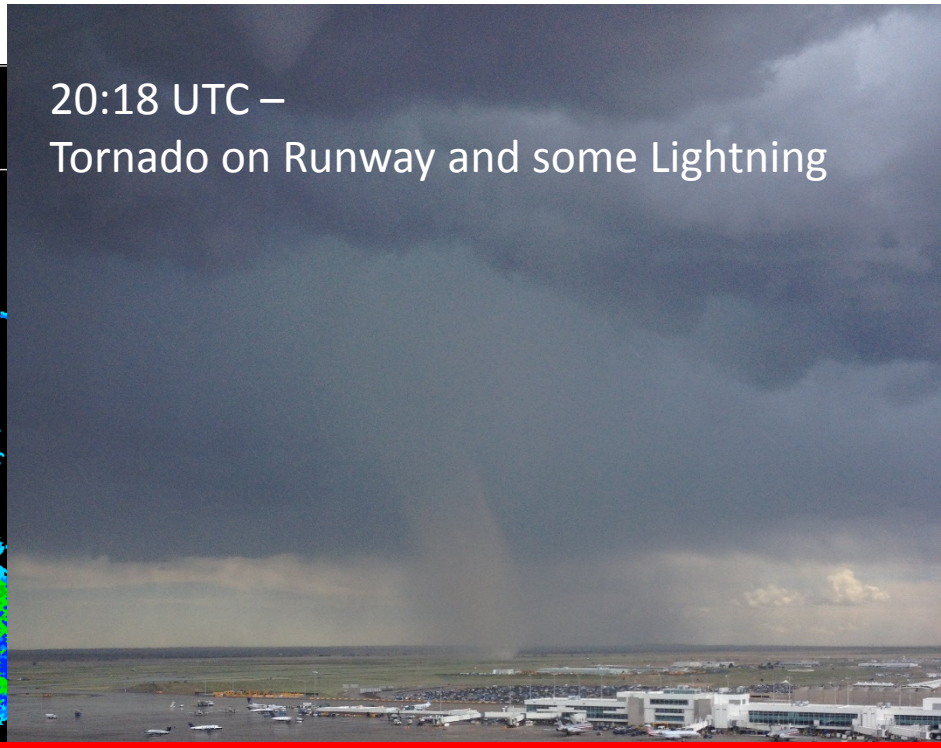


Courtesy of Wiebke Deierling

18 June 2013 Non-Supercell Tornado

Denver TDWR Radar

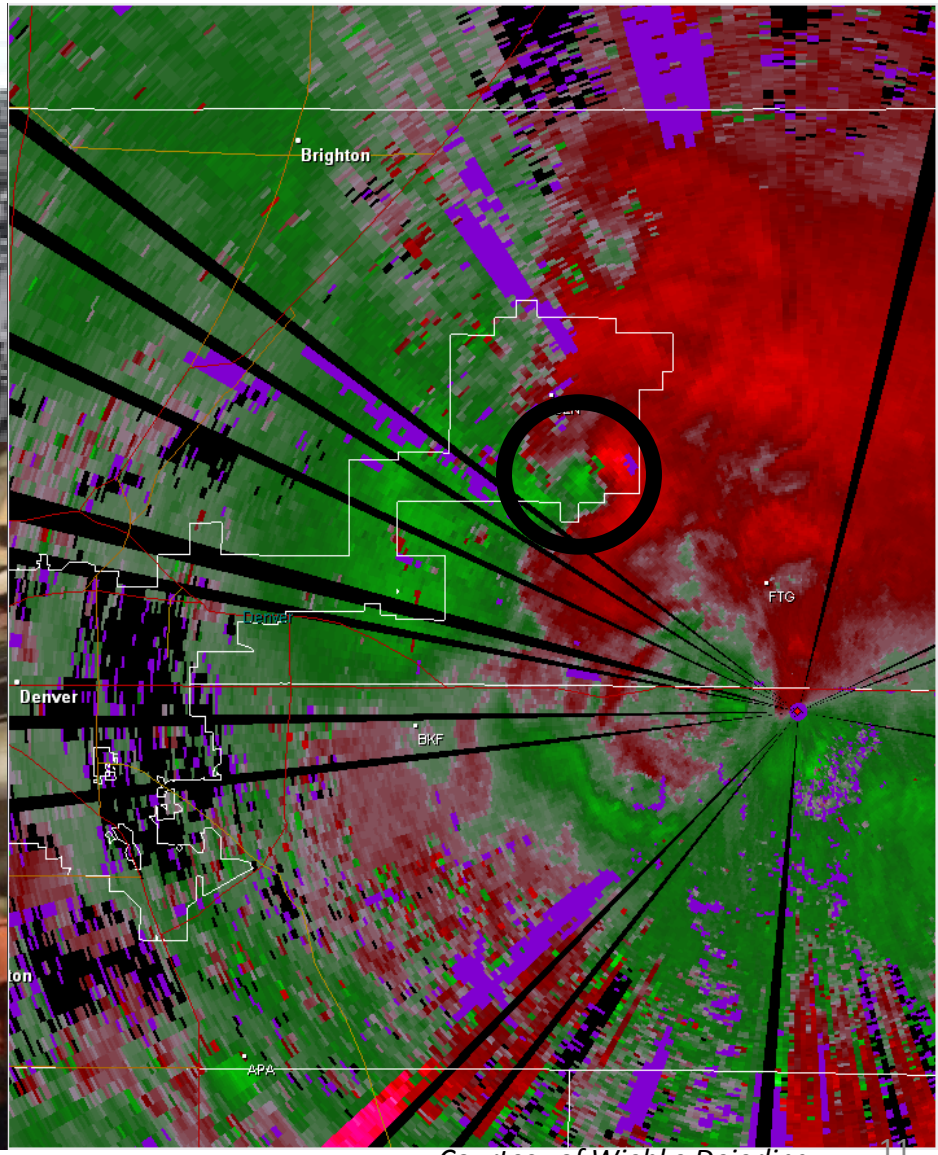




21:21 UTC - FAA internal ground stop

Courtesy of Wiebke Deierling

20:22 UTC TDWR, Evacuations…SPC report: TOR 97 mph
FAA departures not officially on hold/clsd at this time



Courtesy of Wiebke Deierling

20:28 UTC TDWR, 20:30 UTC concourse reported evacuated

Courtesy of Wiebke Deierling

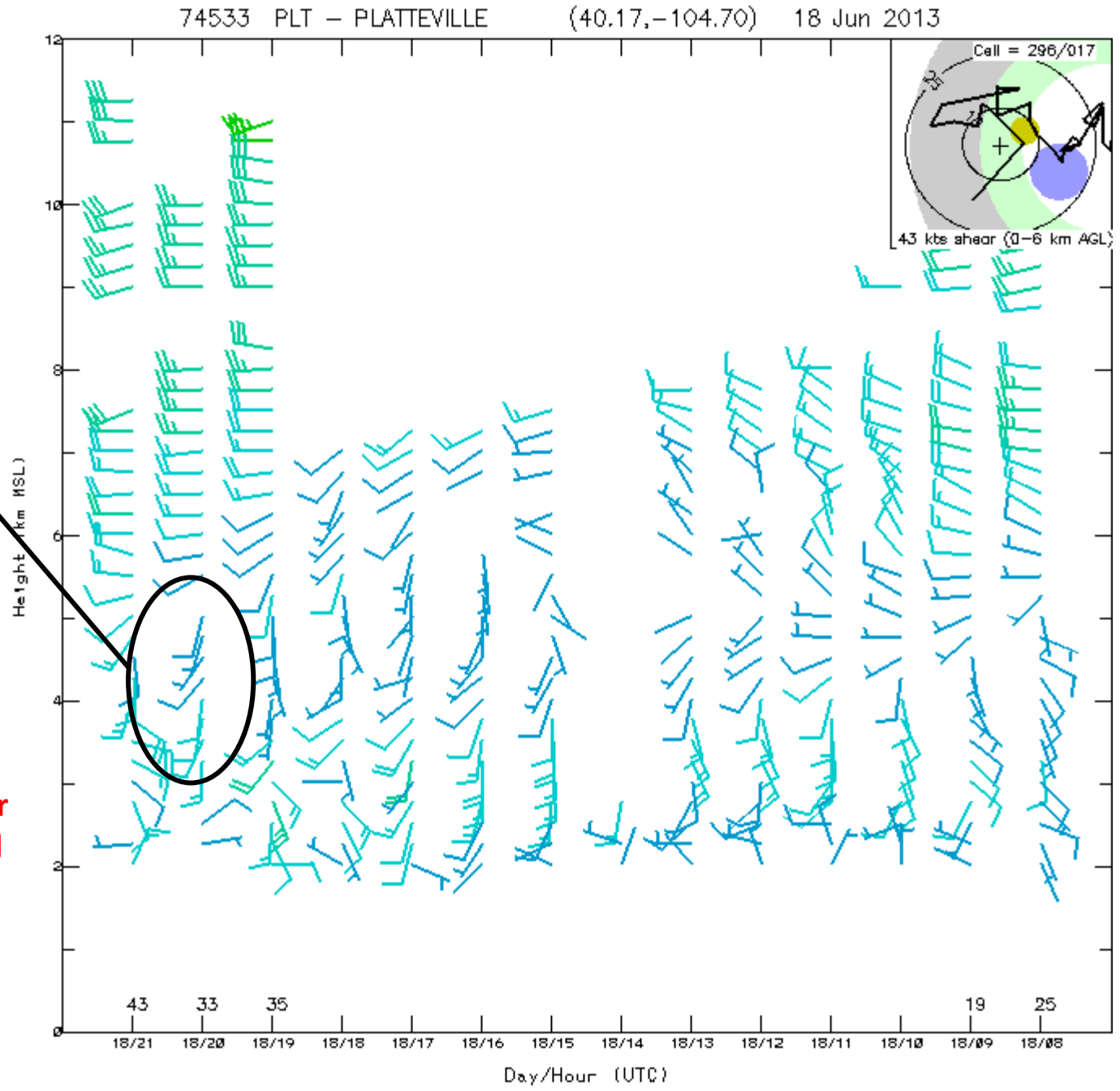
- Lightning induced ramp closures occurred first
- Tornado warning shortly thereafter, FAA internal ground stop ~10 minutes later
- Ramp closure exceeded tornado warning, not FAA internal ground stop

Courtesy of Wiebke Deierling

Low-level rotation on radar, associated with the tornado, moved from south to north

Storms generally moved from S-SW to N-NE, with steering level winds at 20 UTC

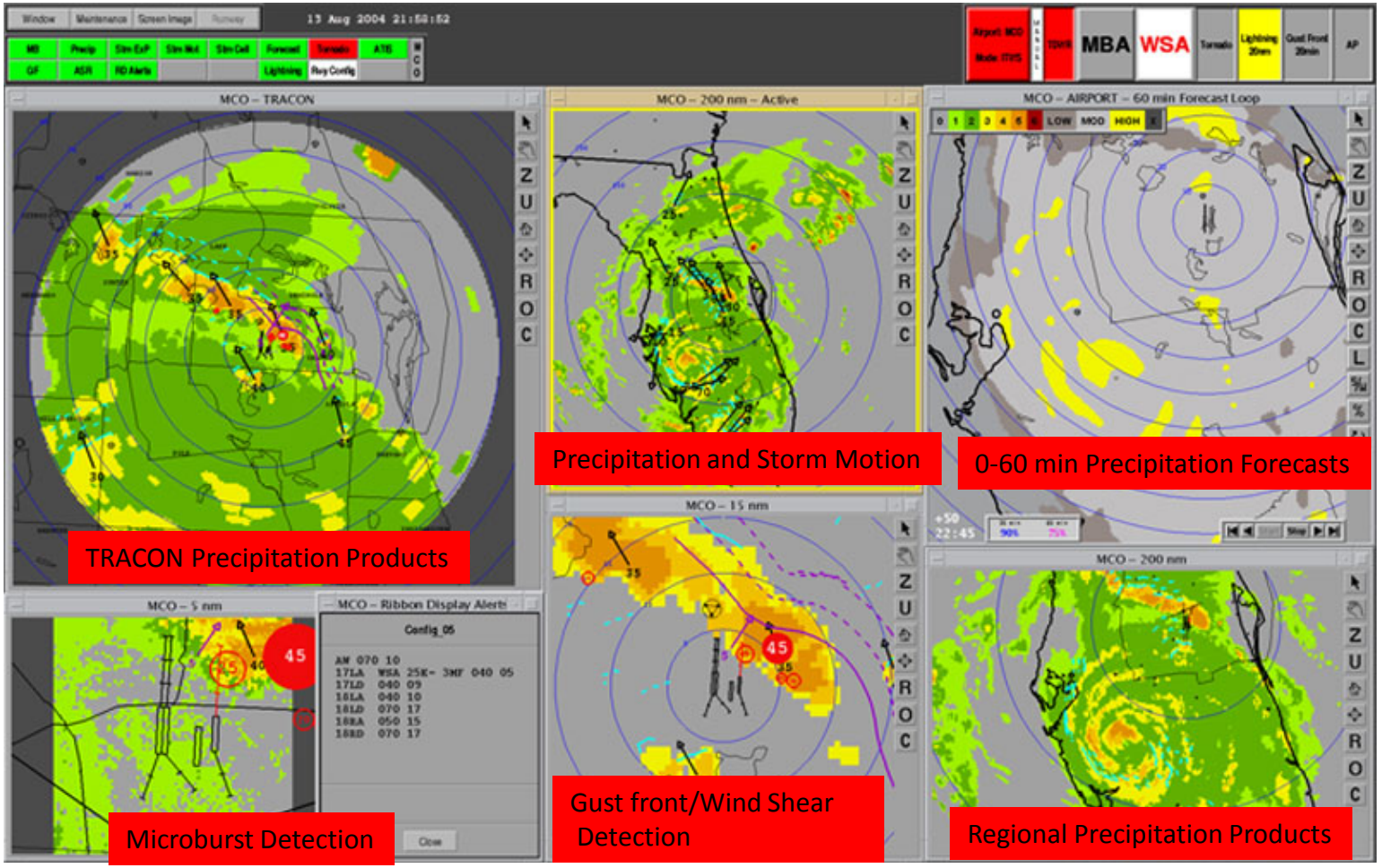
Risk to DIA was higher, as convergence boundary remained semi-stationary over DIA and storms and tornadoes both moved north over airport



Enhancing Existing Automated Tools

For Tracking Severe Storms and Convergence Boundaries

ITWS
(Graphical Situational Display)

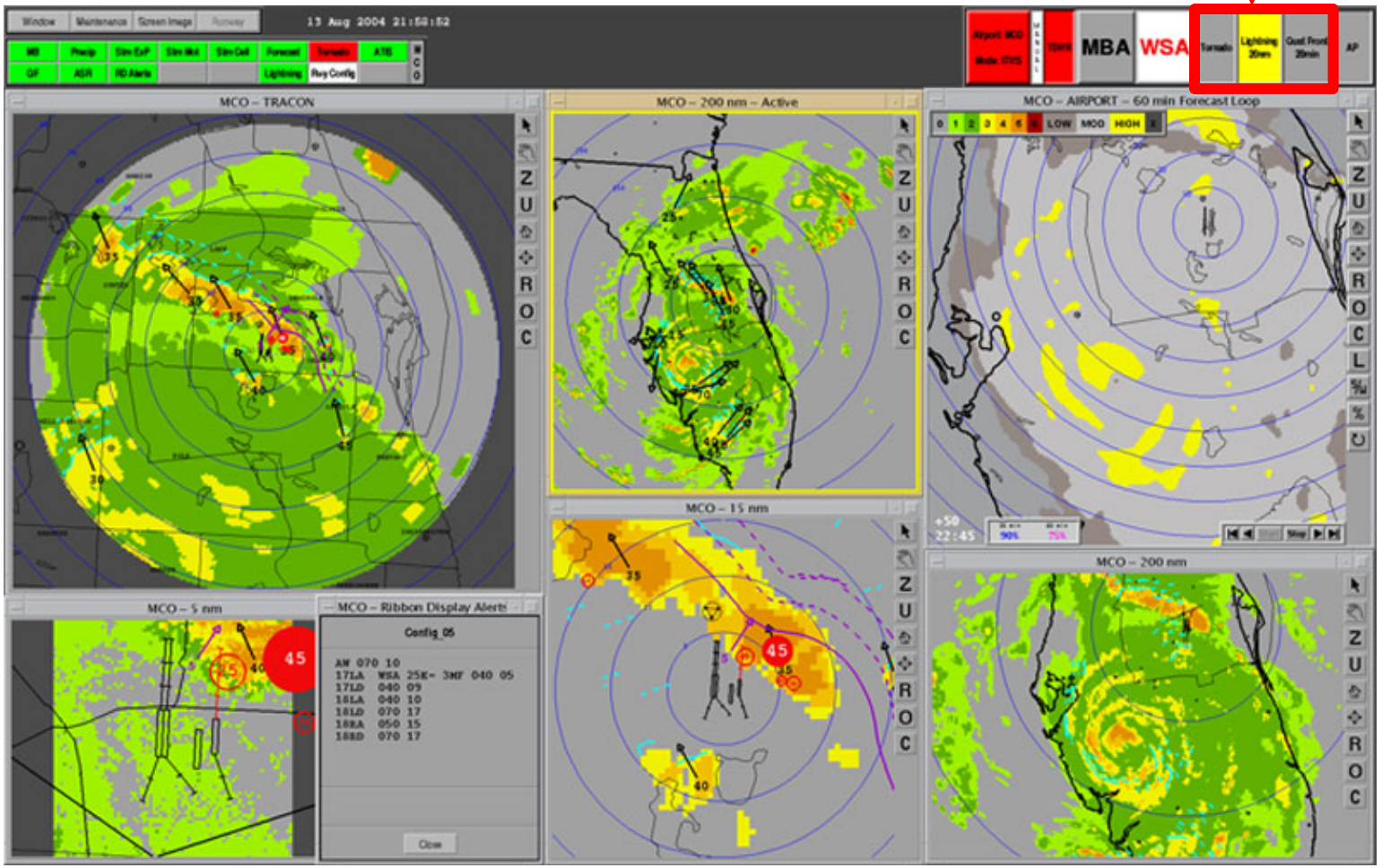


Common Situational Display Used By Tower, Terminal Area Radar Control (TRACON), and Enroute Controllers and Supervisors

Courtesy of Paul Bieringer

ITWS

(Severe Weather Products)

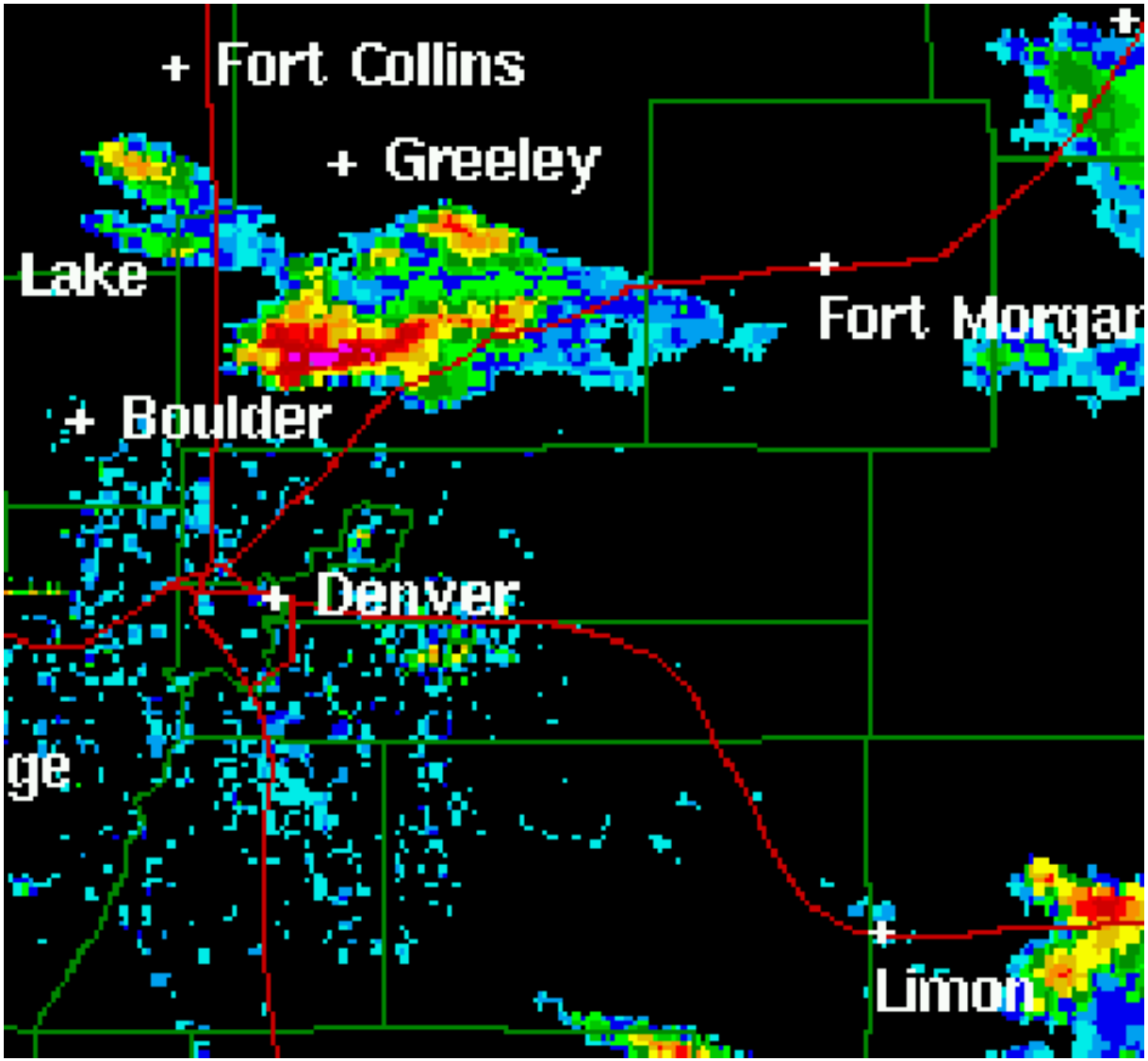


Ground Operations Are Typically Suspended During Severe Weather (Lightning, Tornadoes, High Winds) Warnings Provided When Present

Courtesy of Paul Bieringer

20-21 June 2001 Hailstorm Event at Denver's DIA

50 min Movie: 00:57 – 01:48 UTC



Hailstorm dropped golf ball to baseball sized hail.

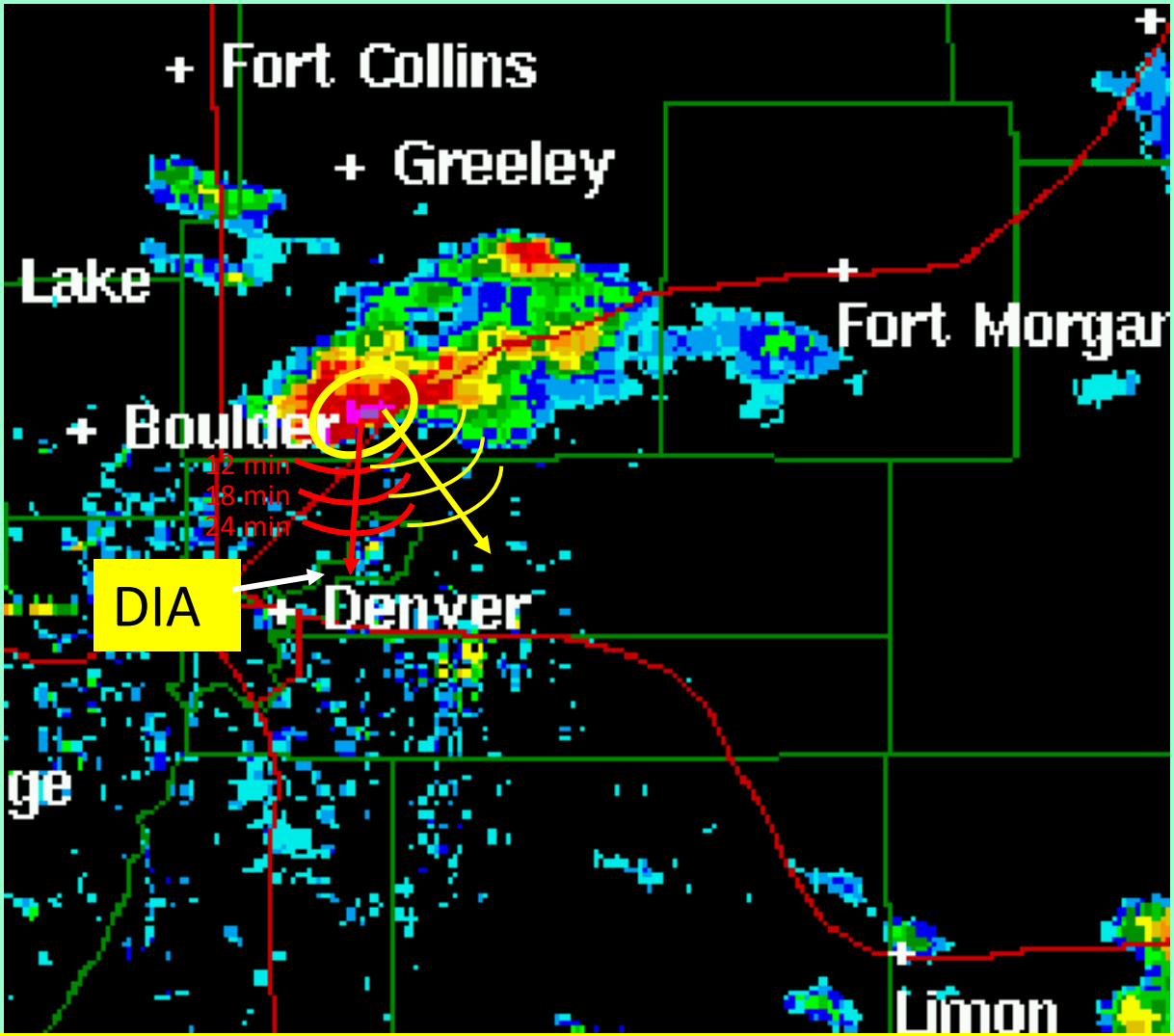
Planes and ground surveillance radar were damaged at airport.

200 people were left homeless when the same storm moved through a mobile home park in Watkins.

State Farm Insurance estimated the hailstorm caused nearly 17 million dollars in damages.

(Storm reports from NWS)

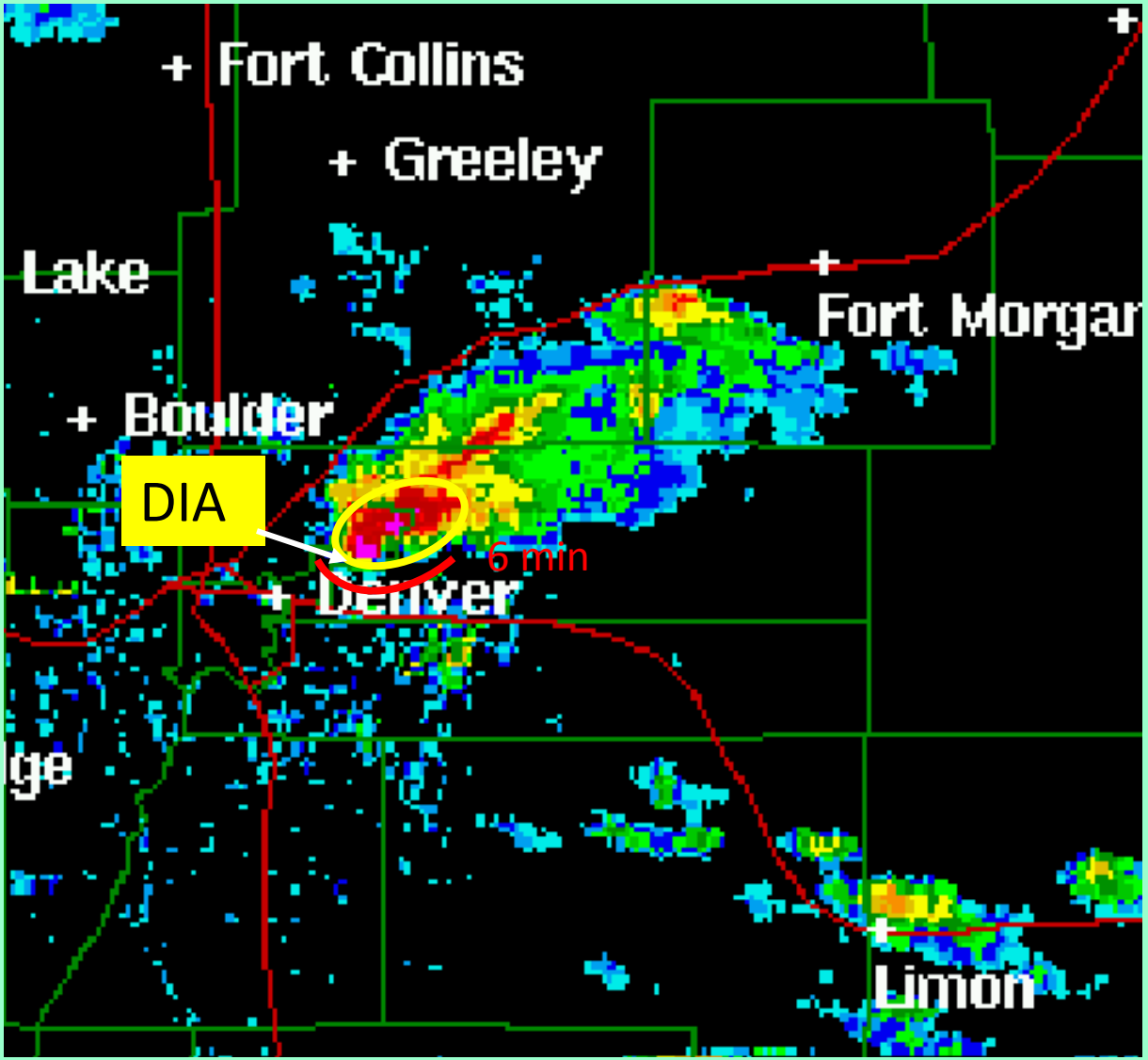
Hail Storm hits DIA – 20 June 2001



Current Time:
01: 07 UTC,
21 June

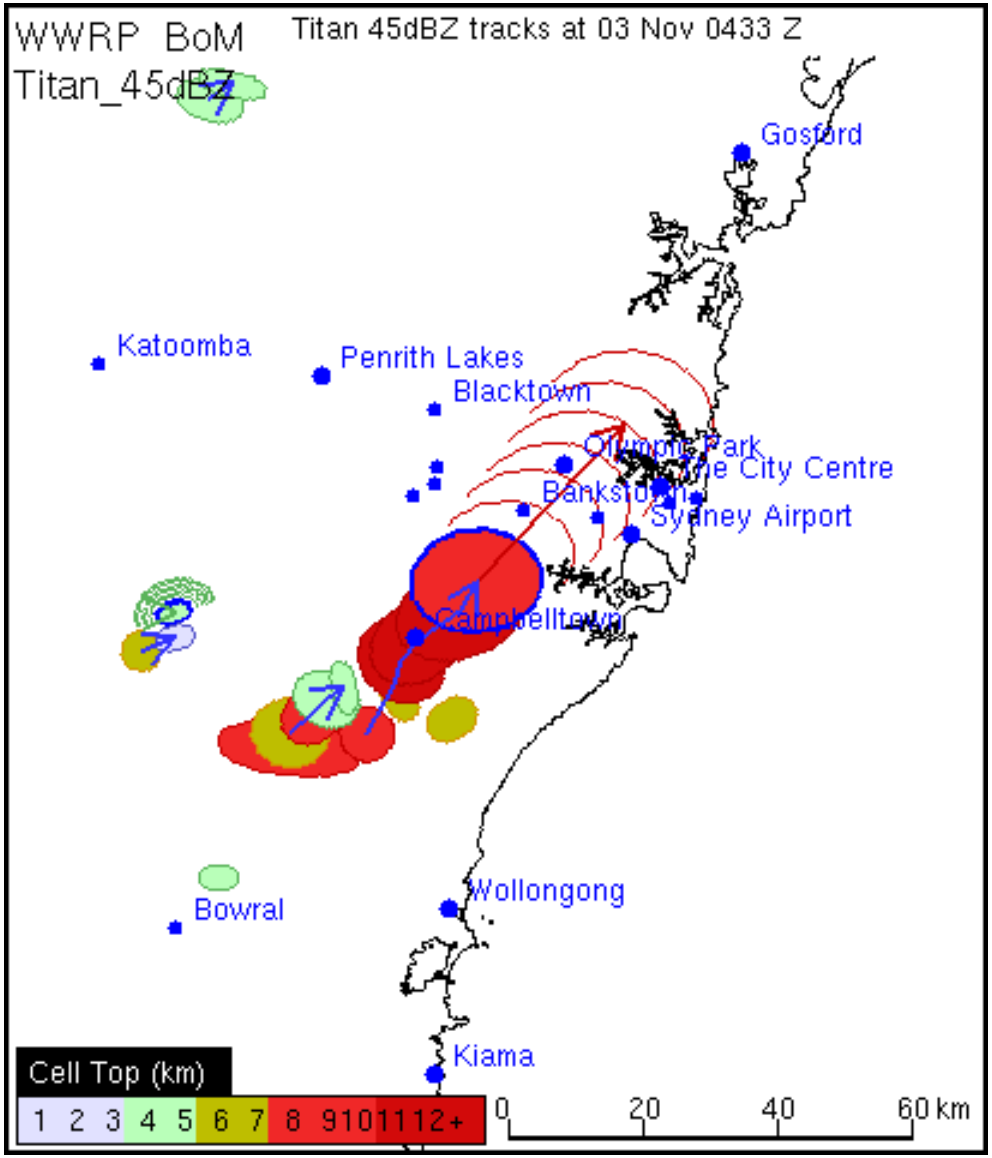
Example of TITAN tracking algorithms applied to the 20 June 2001 hailstorm near DIA. **Yellow** – Track associated with the movement 35 dBZ storm envelope, **Red** – Track of 60 dBZ core

20 June 2001 - 0133 UTC

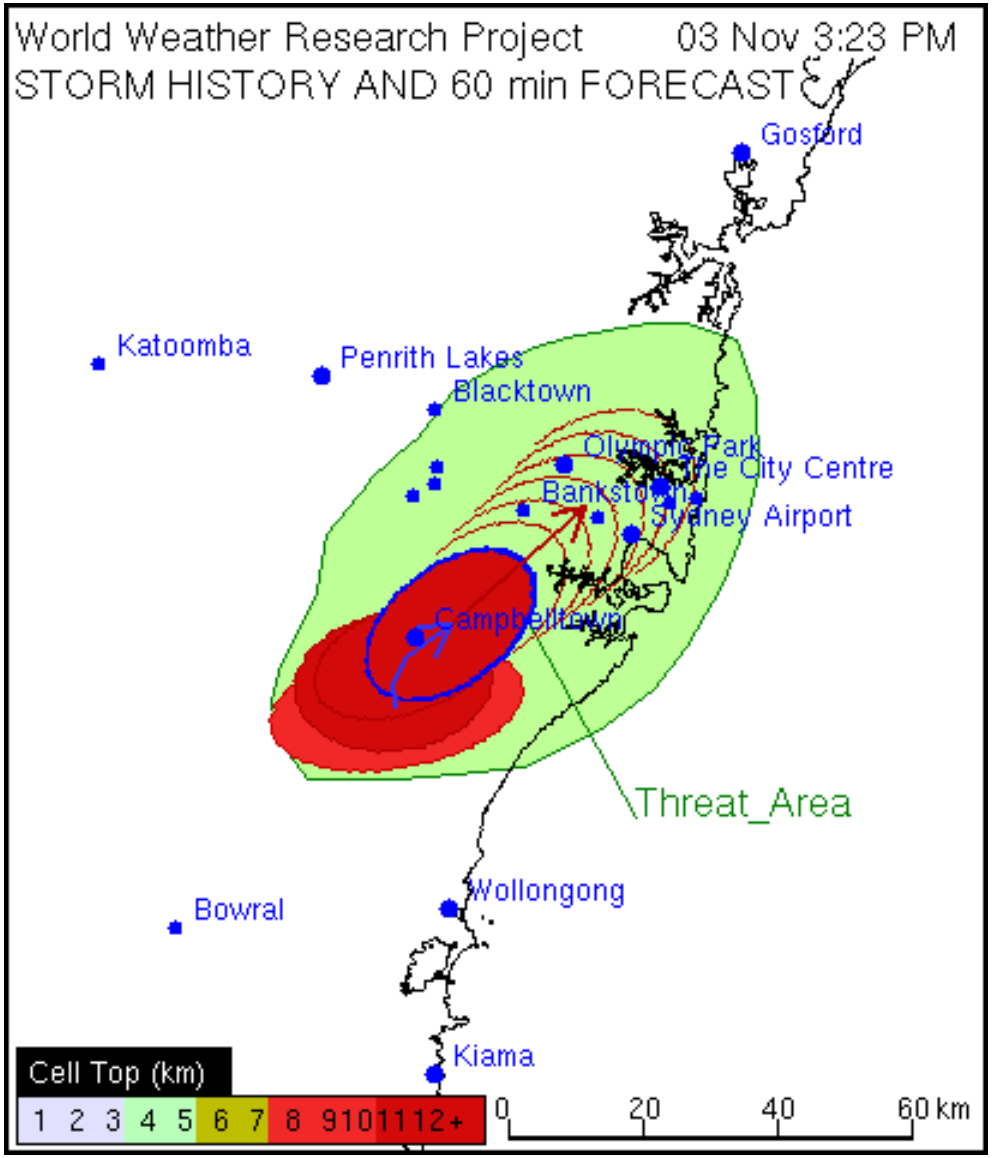


26 min later,
at 01:33 UTC,
21 June

Example of NCAR's TITAN storm tracker that tracks the 45 dBZ core



Forecaster-entered threat area in green incorporating the most likely track of the storms with allowance for other possible storm track motions



Australia's BMRC "Thunderbox" Warning Tool

Detection and Extrapolation of Convergence Boundaries

In addition to tracking gust fronts, could use similar capabilities for providing the location of the DCVZ