GBVTD-retrieved near-surface vortex structure in a tornado and tornado-like vortices observed by a W-band radar during VORTEX2

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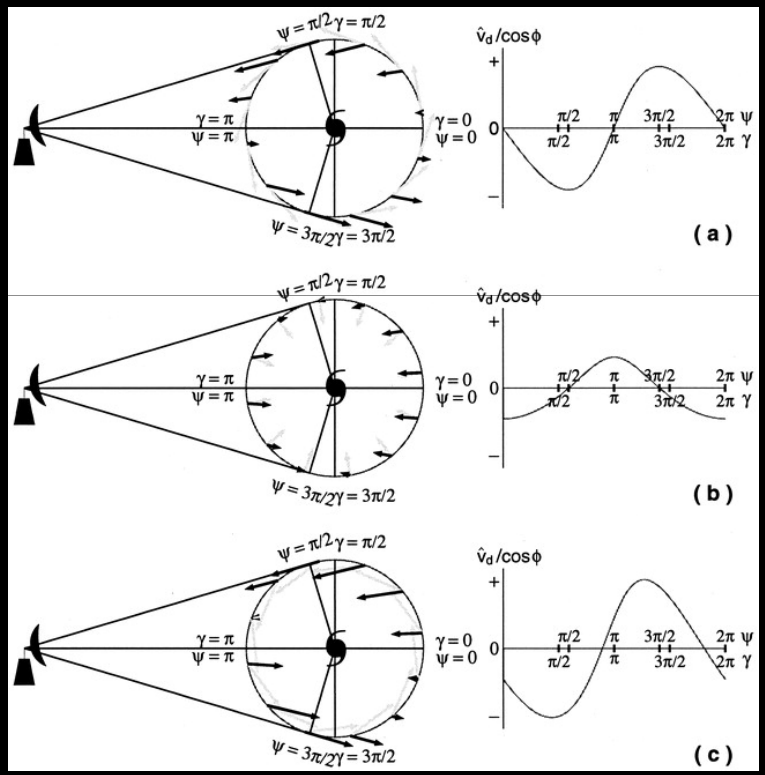
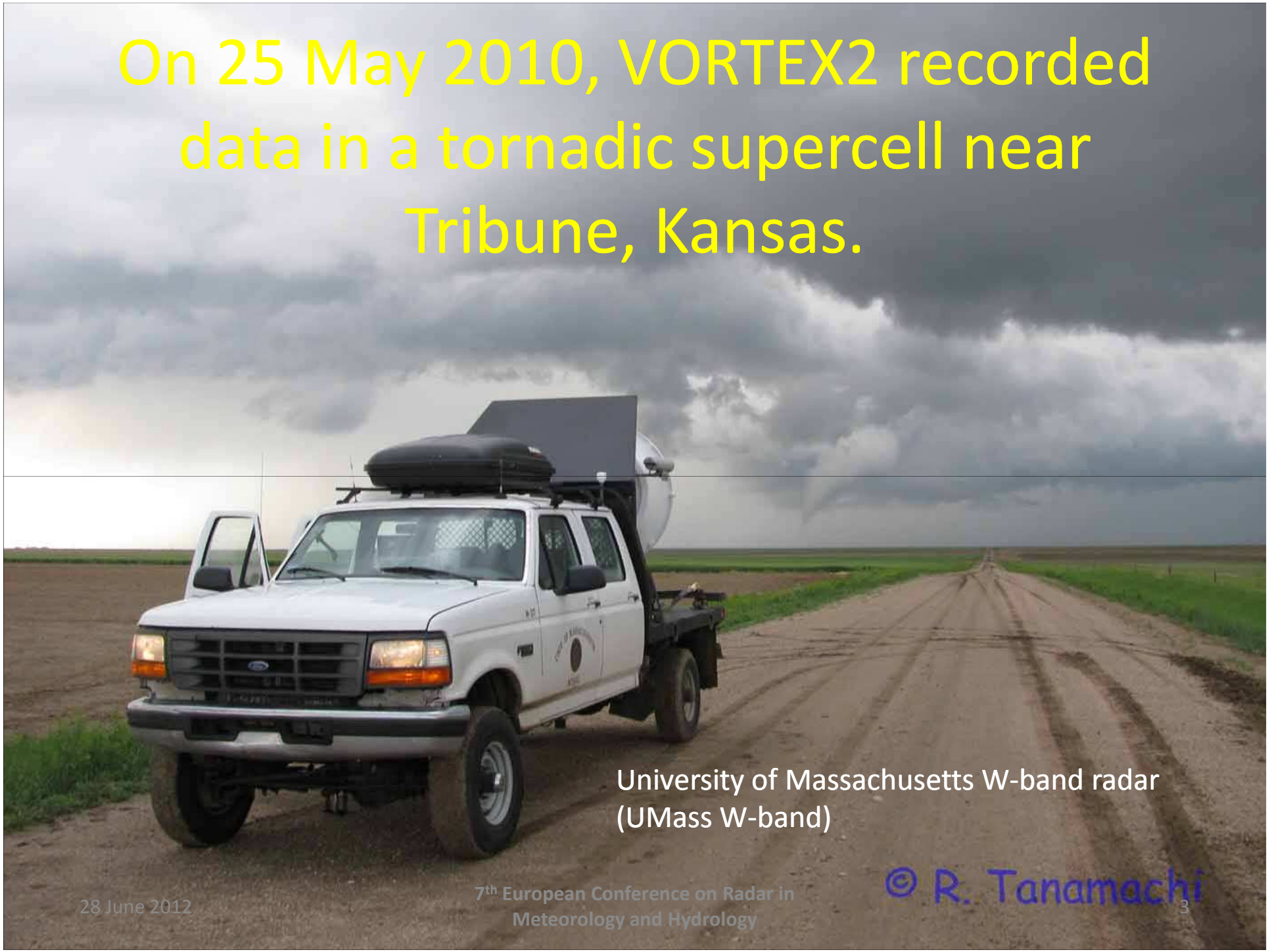
GBVTD is a technique for retrieving vortex structure from single Doppler velocity data.

- Single Doppler radars only record the along-beam component of motion in a vortex.
- Fourier decomposition on concentric rings is used to reconstruct the 2D or 3D wind field (wavenumber 0-3 components)
- Often applied to tropical cyclones, but also tornadoes.



from Lee et al. (*Mon. Wea. Rev.*, 1999)

On 25 May 2010, VORTEX2 recorded data in a tornadic supercell near Tribune, Kansas.



University of Massachusetts W-band radar (UMass W-band)

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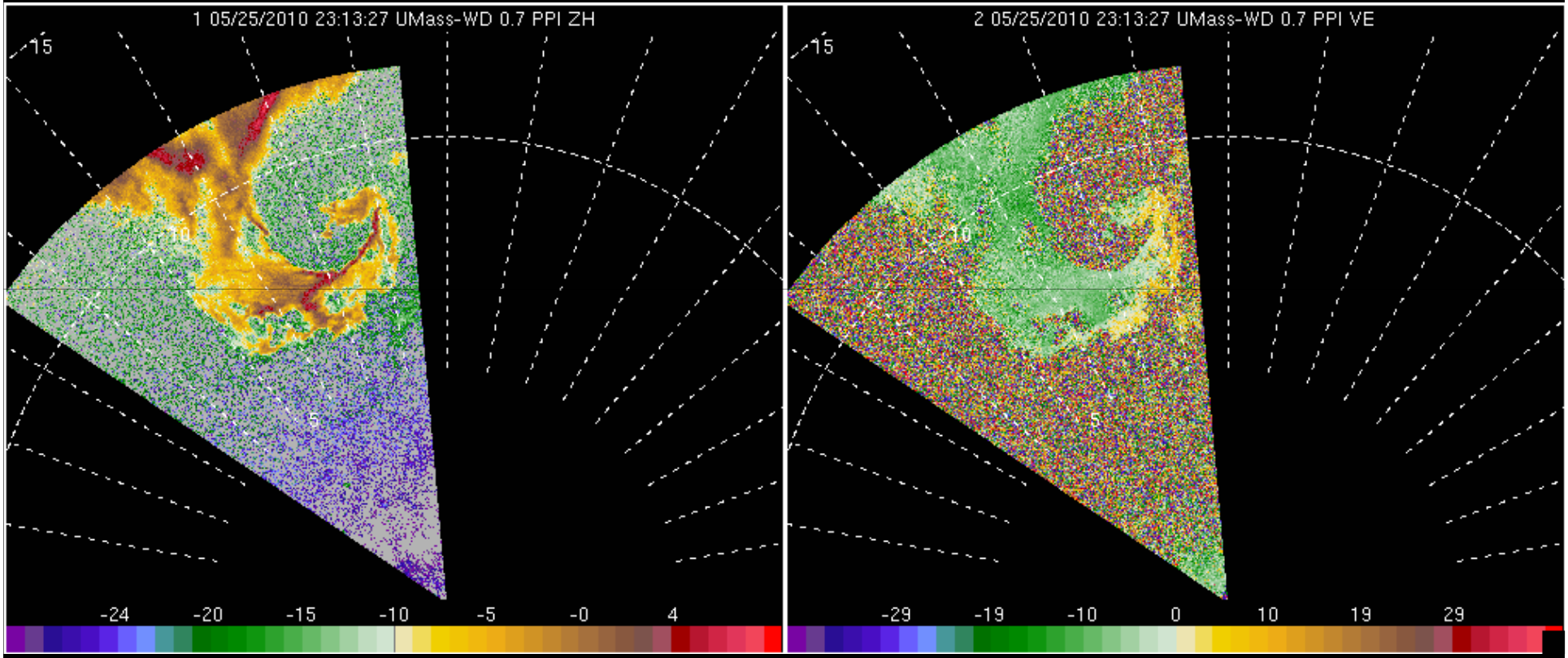
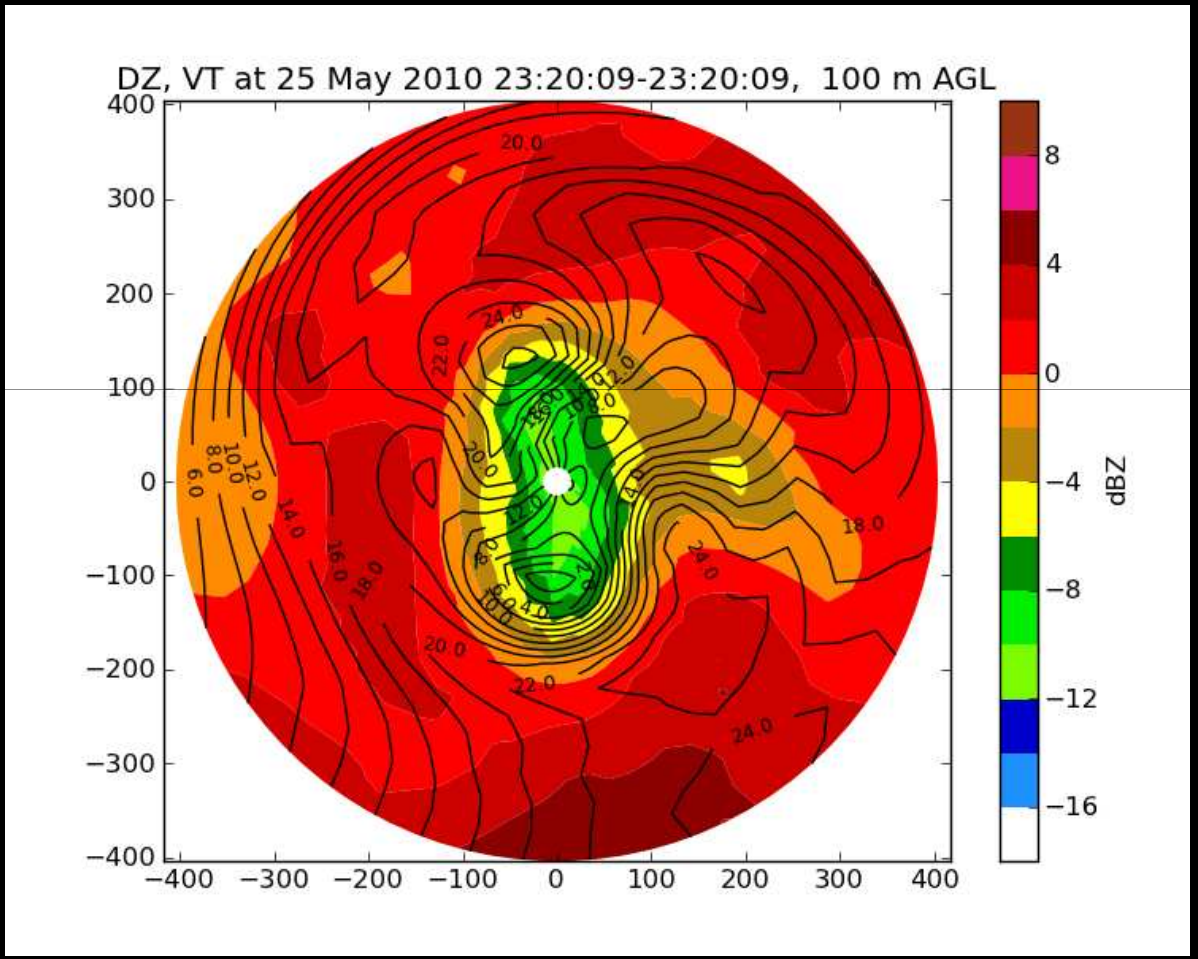
Time-lapse video

The W-band radar captured the entire life cycle of the Tribune tornado, from genesis to decay.

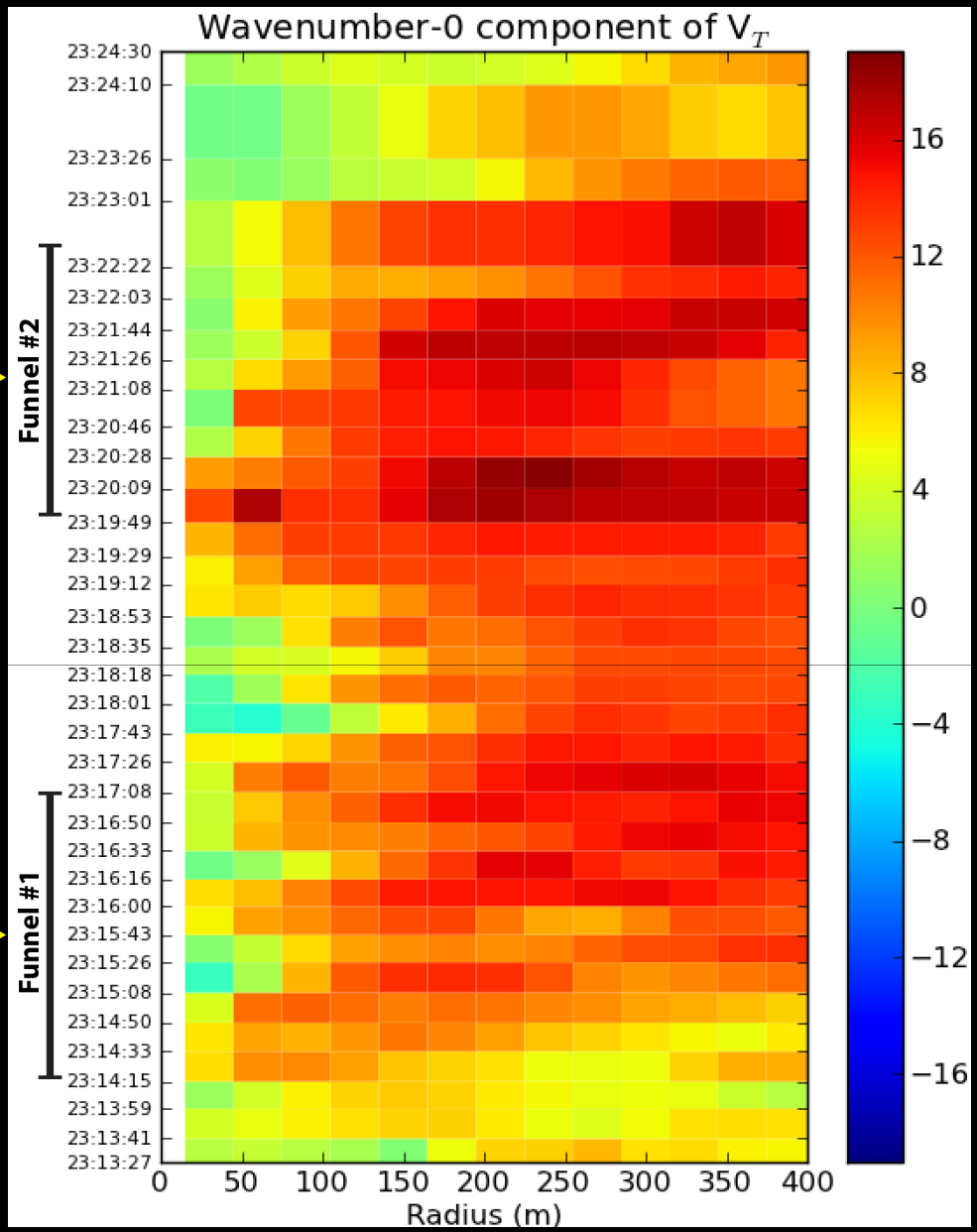


Using GBVTD, we retrieved the vortex structure in the Tribune tornado.

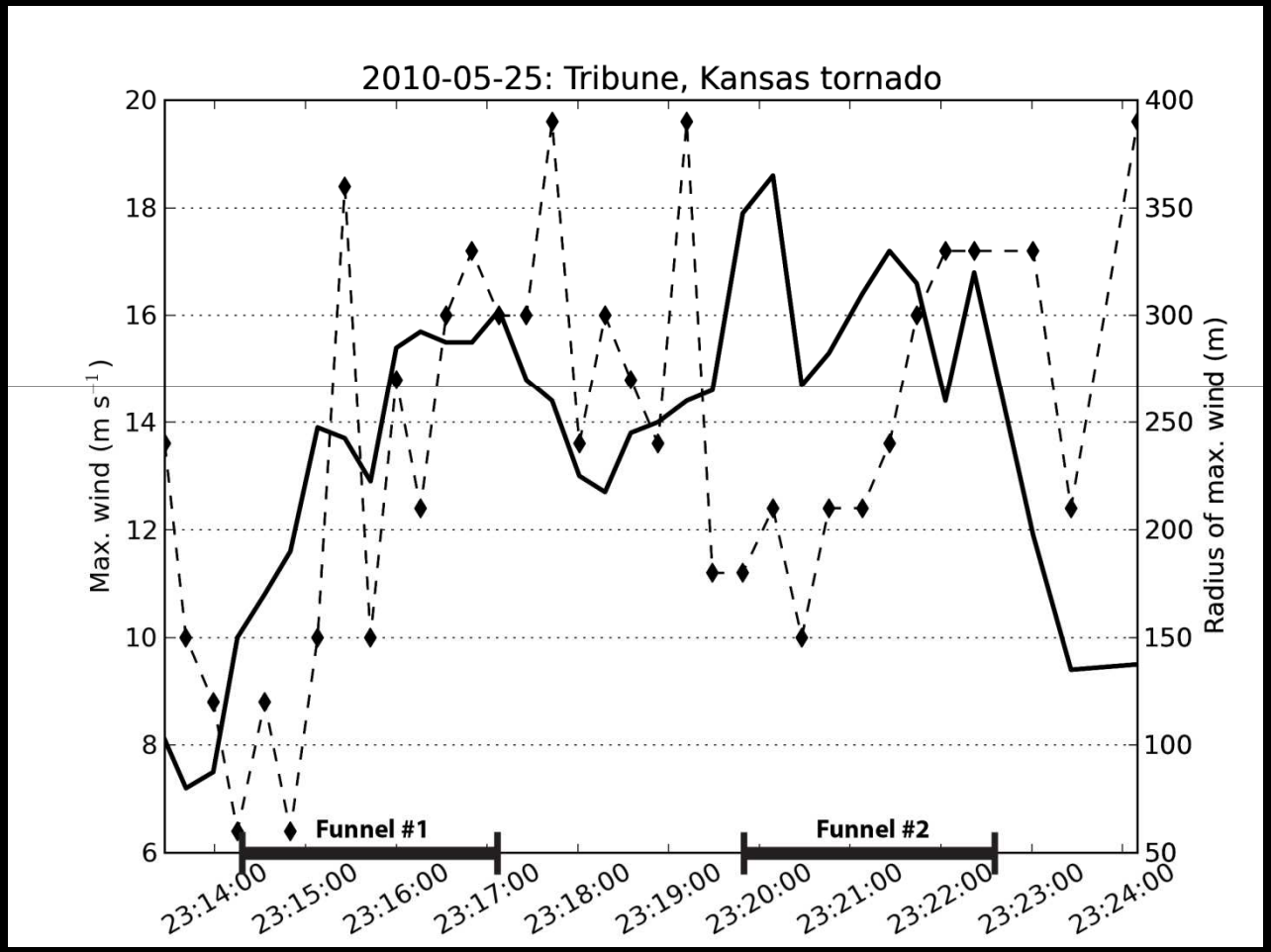


Tangential velocity in m s^{-1}

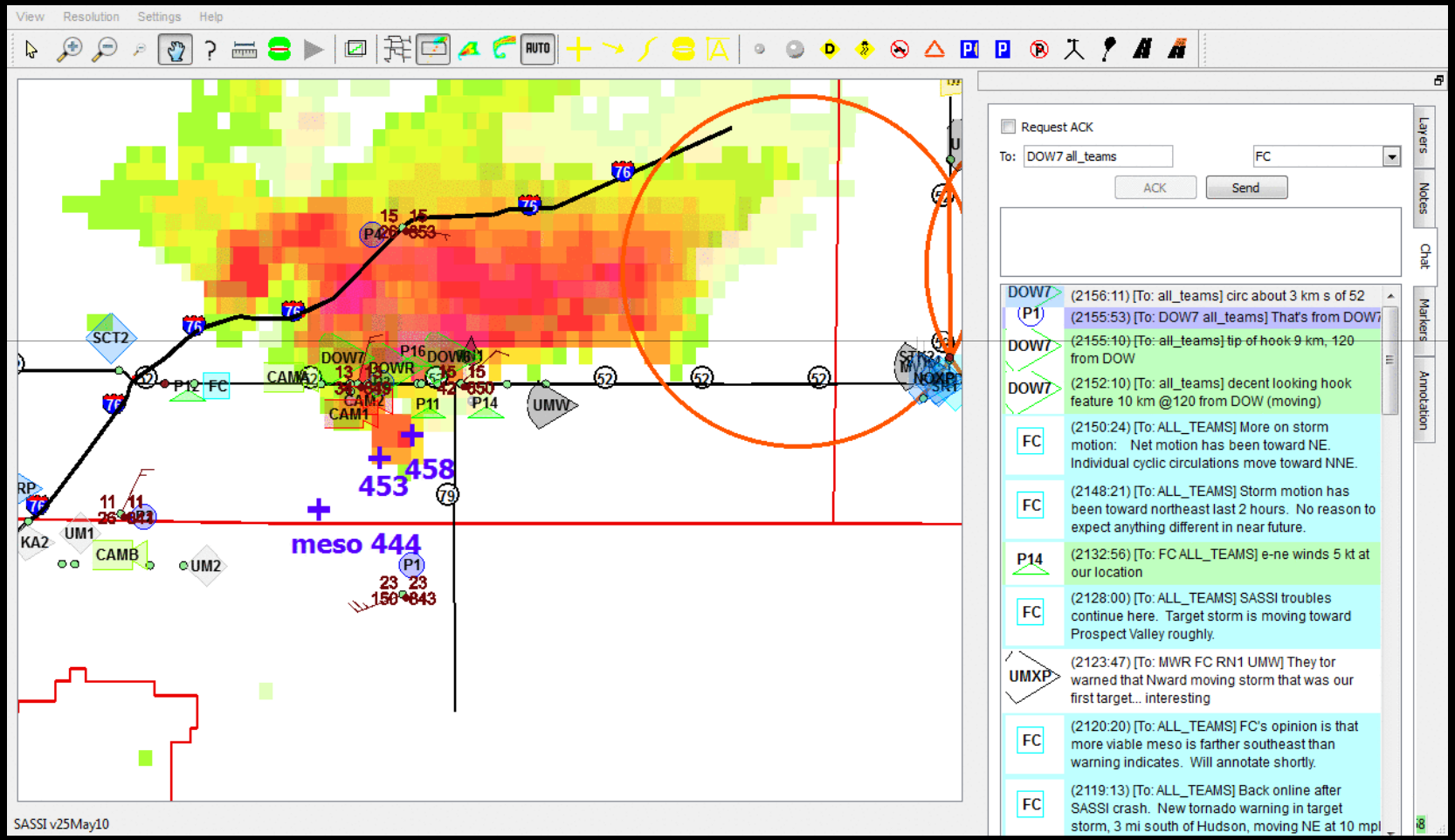
2 condensation funnels



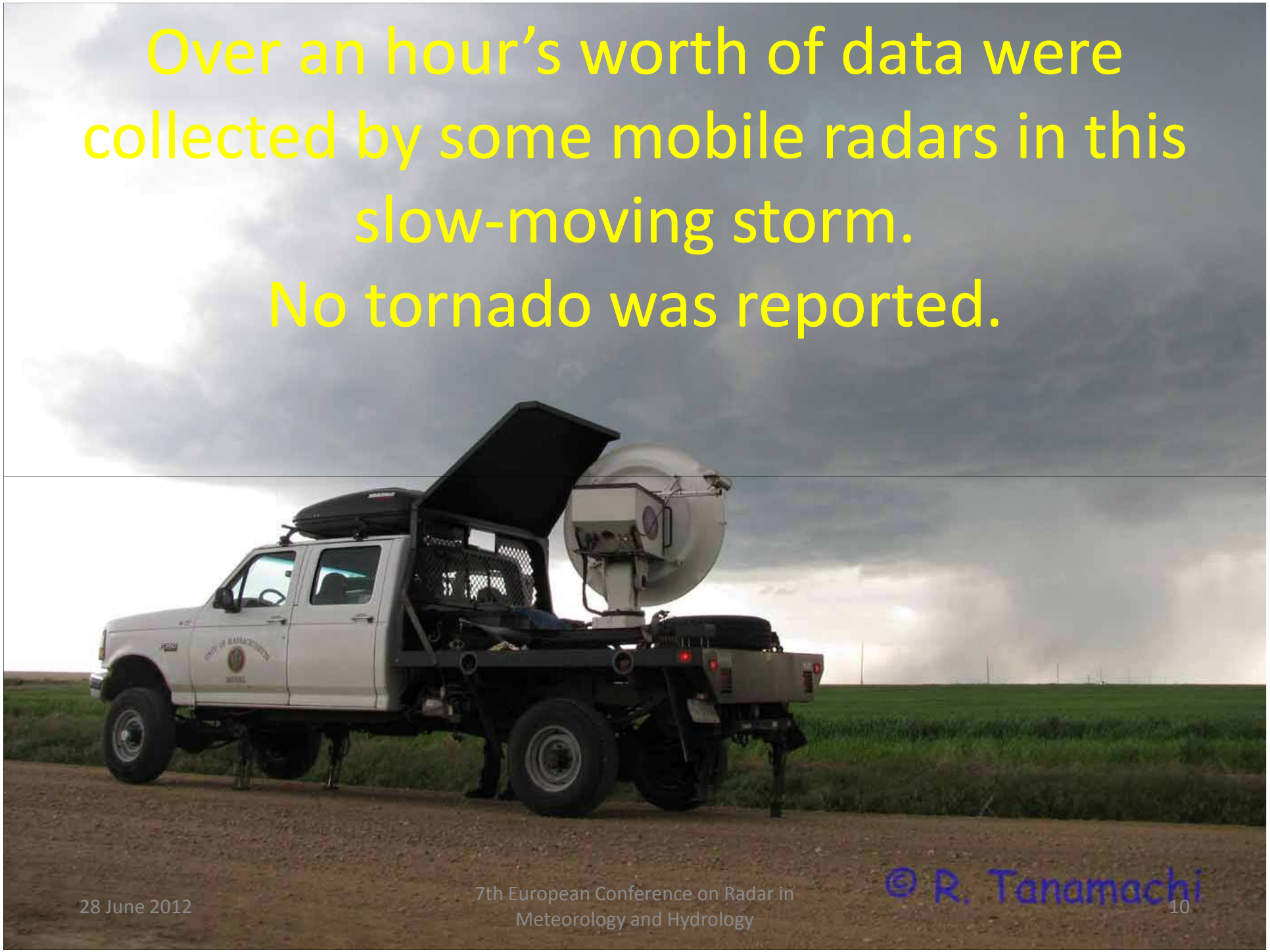
The axisymmetric component of tangential velocity increased (decreased) with the appearance (disappearance) of a condensation funnel.



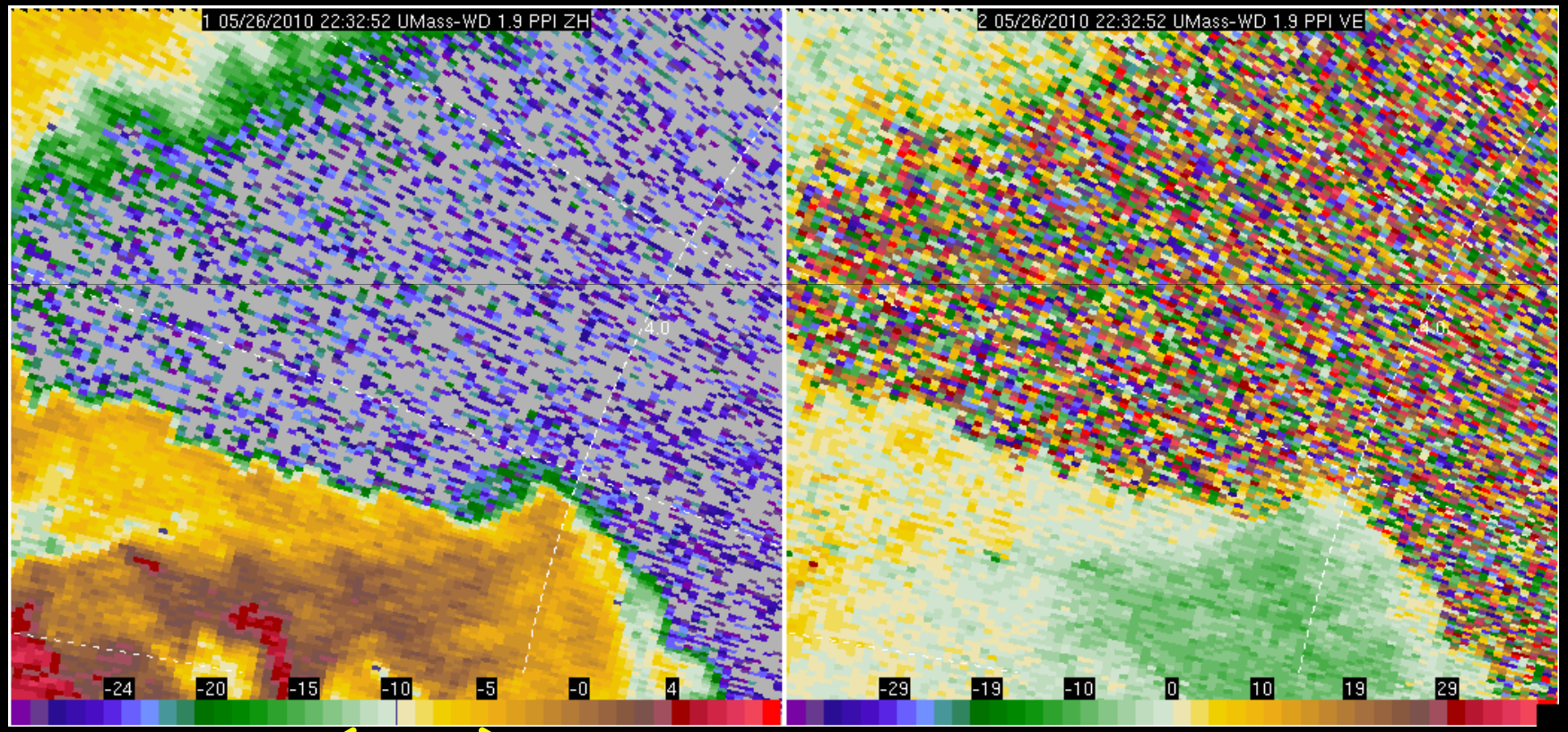
On 26 May 2010, VORTEX2 targeted a supercell in northeast Colorado.



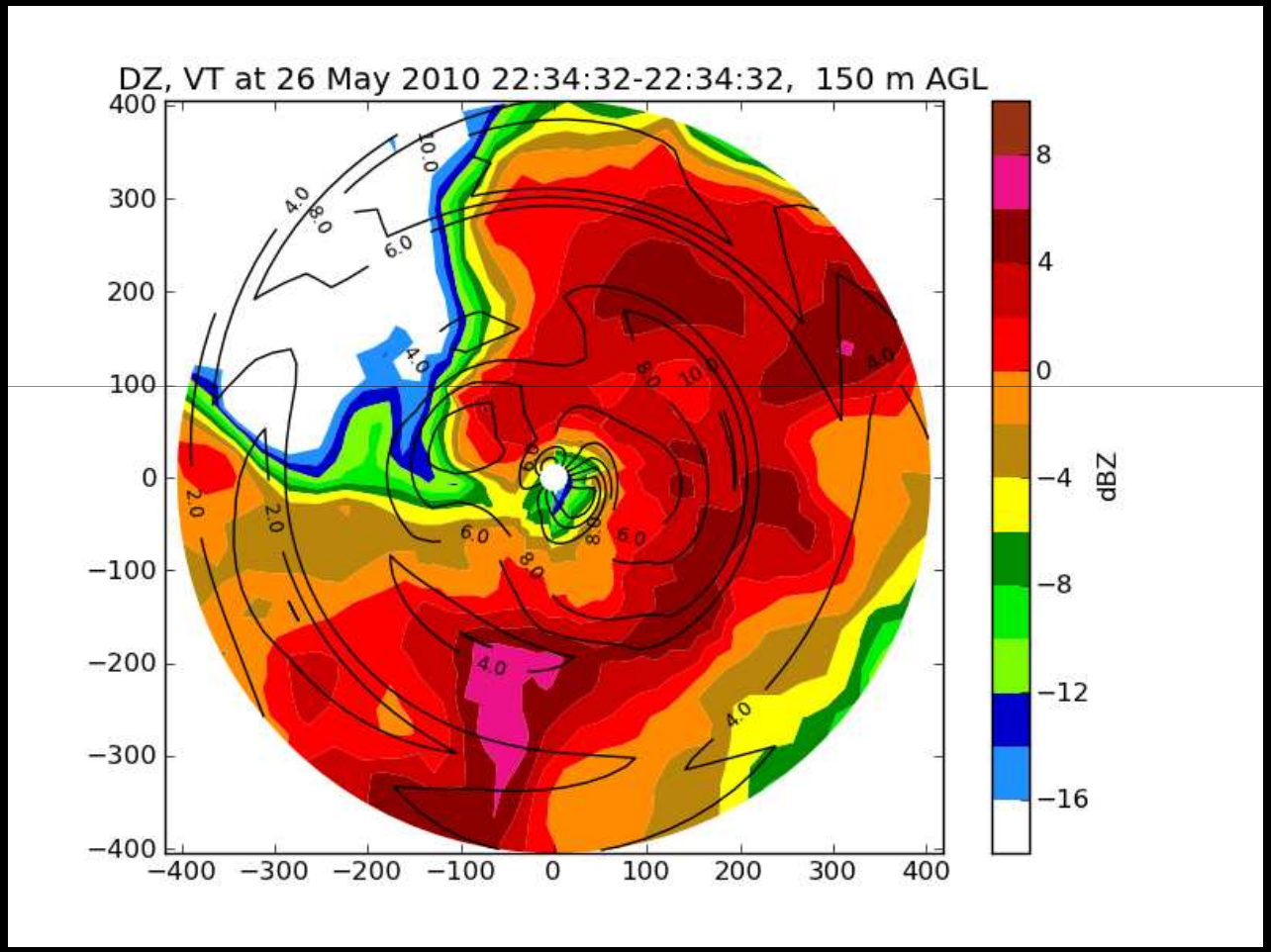
Over an hour's worth of data were collected by some mobile radars in this slow-moving storm.
No tornado was reported.



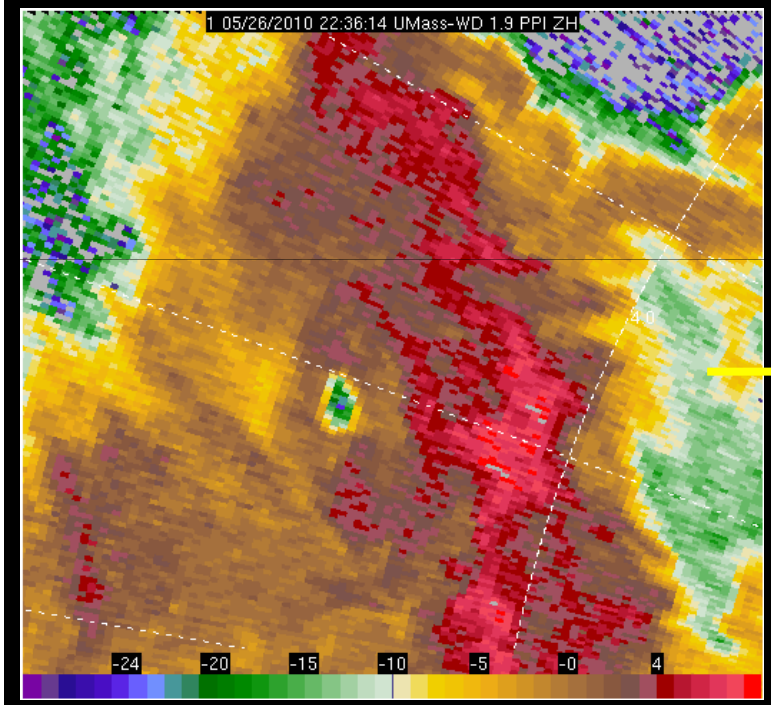
Small tornado-like vortices (TLVs) in the hook echo can be seen in animated W-band radar data.

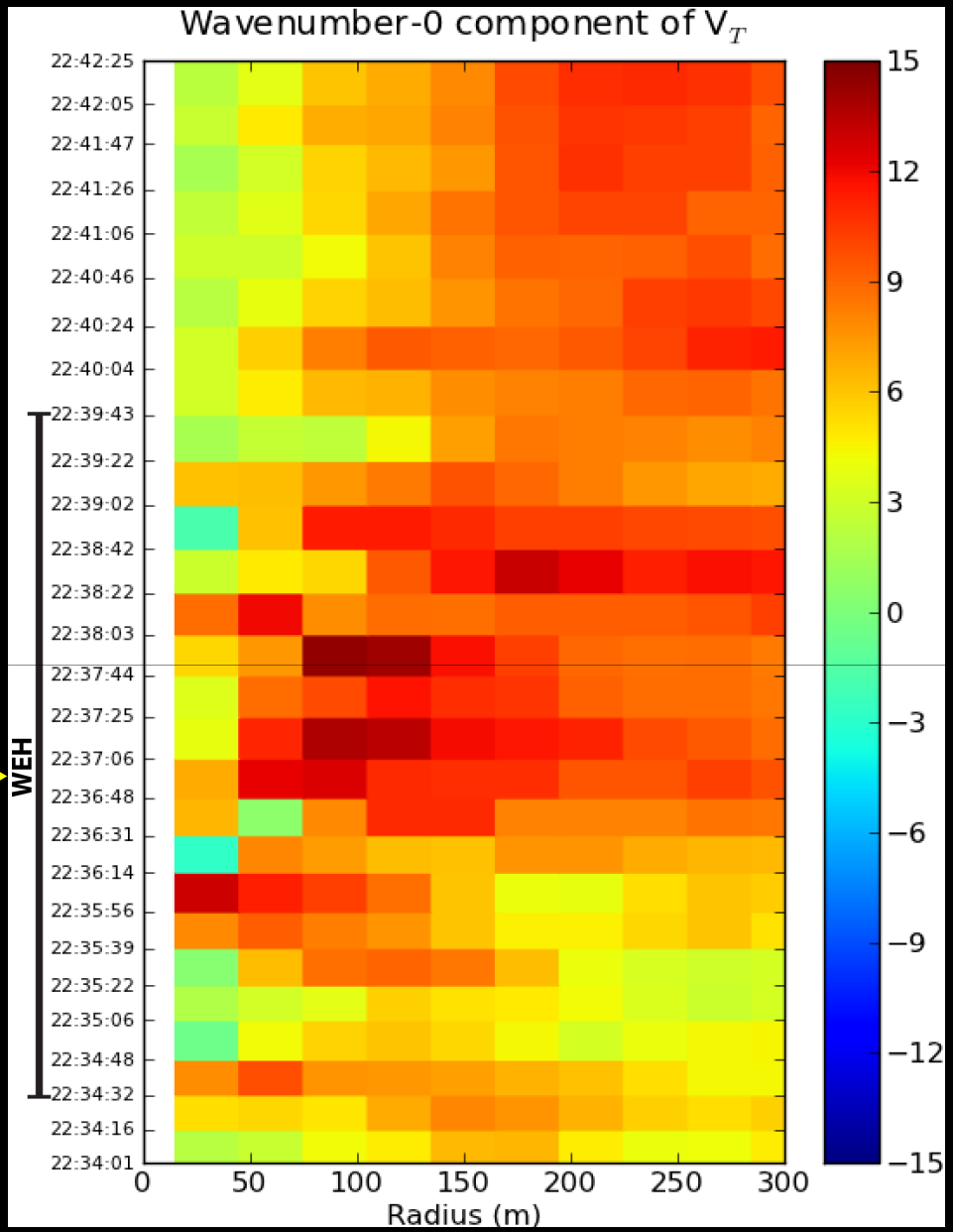


We analyzed the TLV data the same way we did the tornado data.

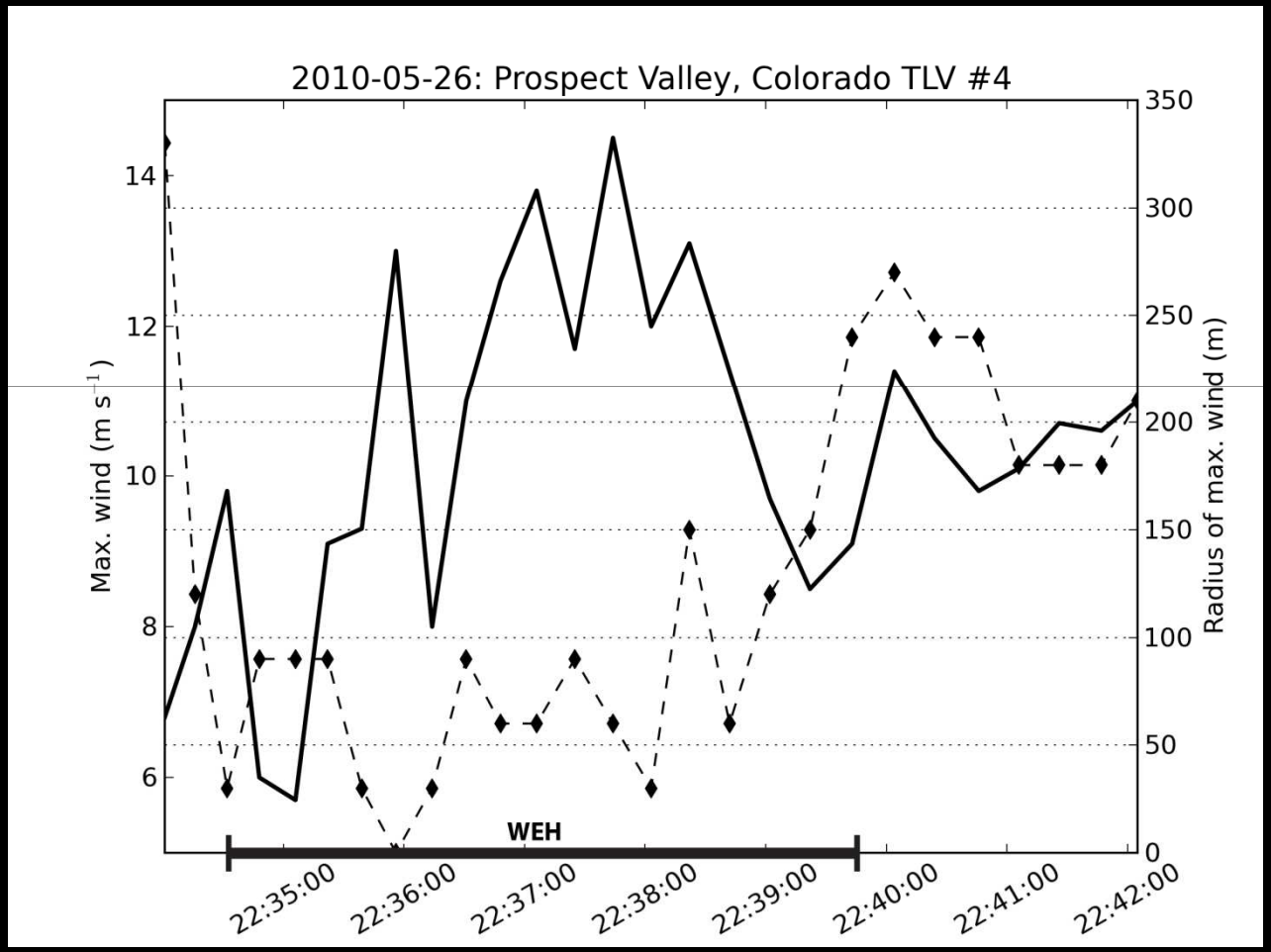


Axisymmetric tangential velocities in TLV #4 increased when a weak-echo hole (WEH) appeared.



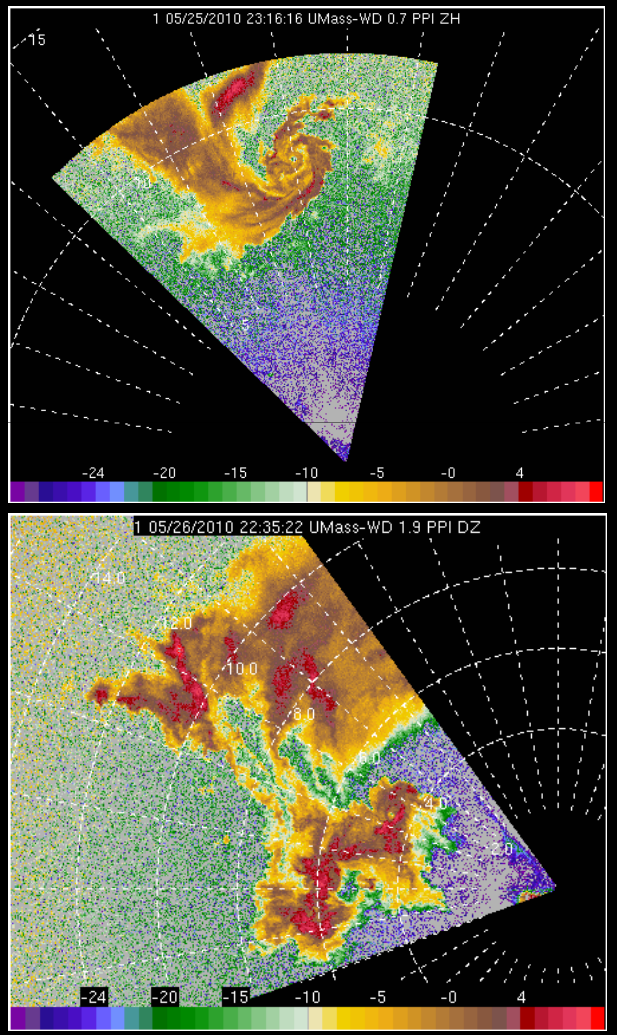


The maximum analyzed axisymmetric tangential wind in TLV #4 was 15 m s^{-1}.



The 25 and 26 May 2010 vortices were similar in size, duration, and intensity.

- Yet, one had condensation funnels, the other did not.
- TLV #4 on 26 May appears to have been a weak, invisible tornado.
- The difference may lie in moisture availability.



Definition of “tornado” from the American Meteorological Society glossary:

- “A violently rotating column of air, in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, and **often (but not always) visible as a funnel cloud**.” (Glickman 2000)