

Kevin Scharfenberg and David Andra  
NOAA/National Weather Service

Jerry Brotzge  
Univ. of Oklahoma/CAPS/CASA

Patrick Marsh and Kiel Ortega  
Univ. of Oklahoma/CIMMS and NOAA/NSSL



**What is the “best” public warning service for brief mesoscale circulations often present in quasilinear convective systems?**

**What we already know on this topic:**

- Mesoscale circulations are frequently observed with research radars in organized convective systems
- A few can grow in intensity to produce enhanced wind damage and/or brief tornadoes
- Most dissipate in a few minutes

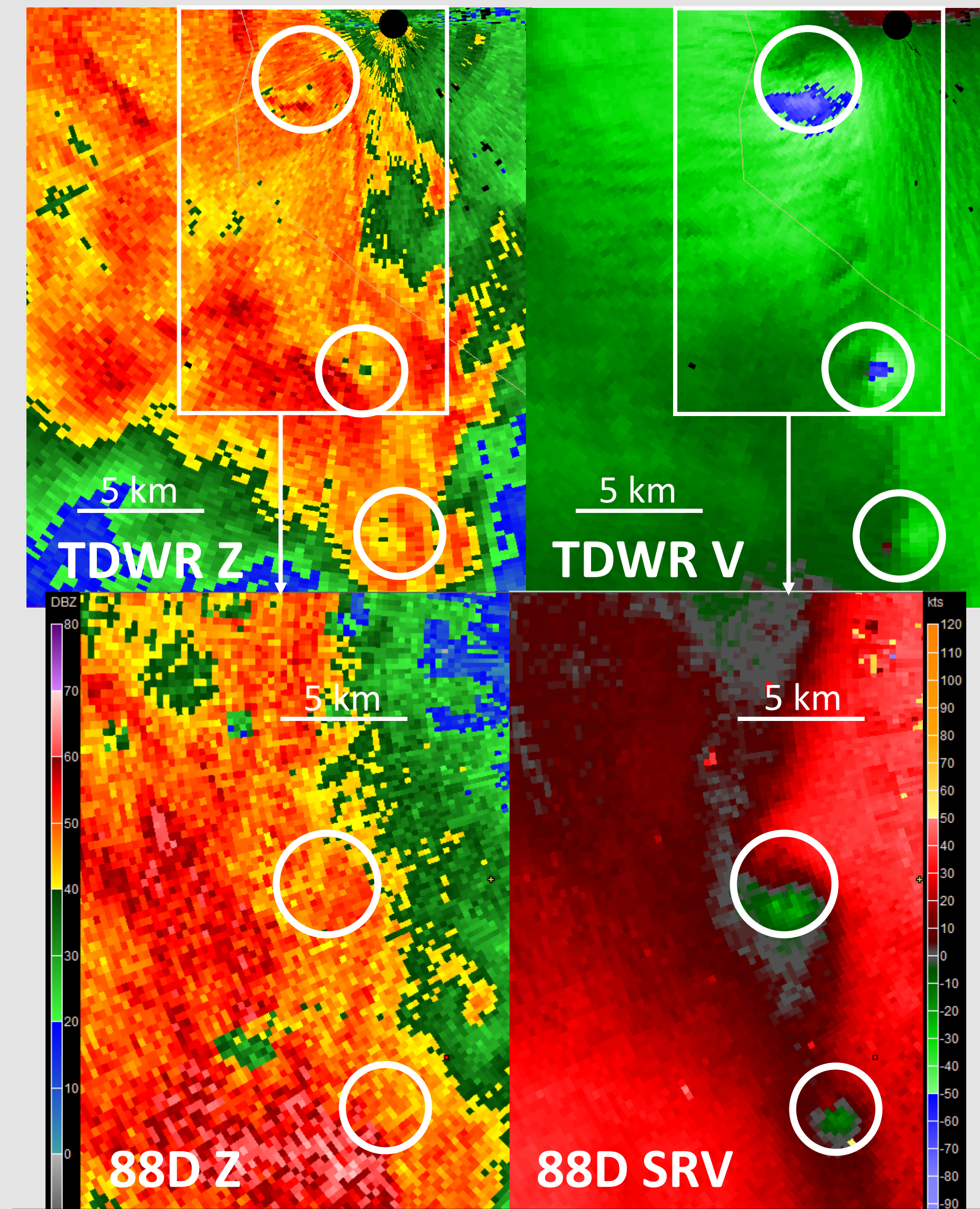
**What this study adds:**

- Examples from high-resolution radar data available in real-time NWS operations
- Information about the resulting damage – if any
- Discussion on the most appropriate public warning strategies for similar events

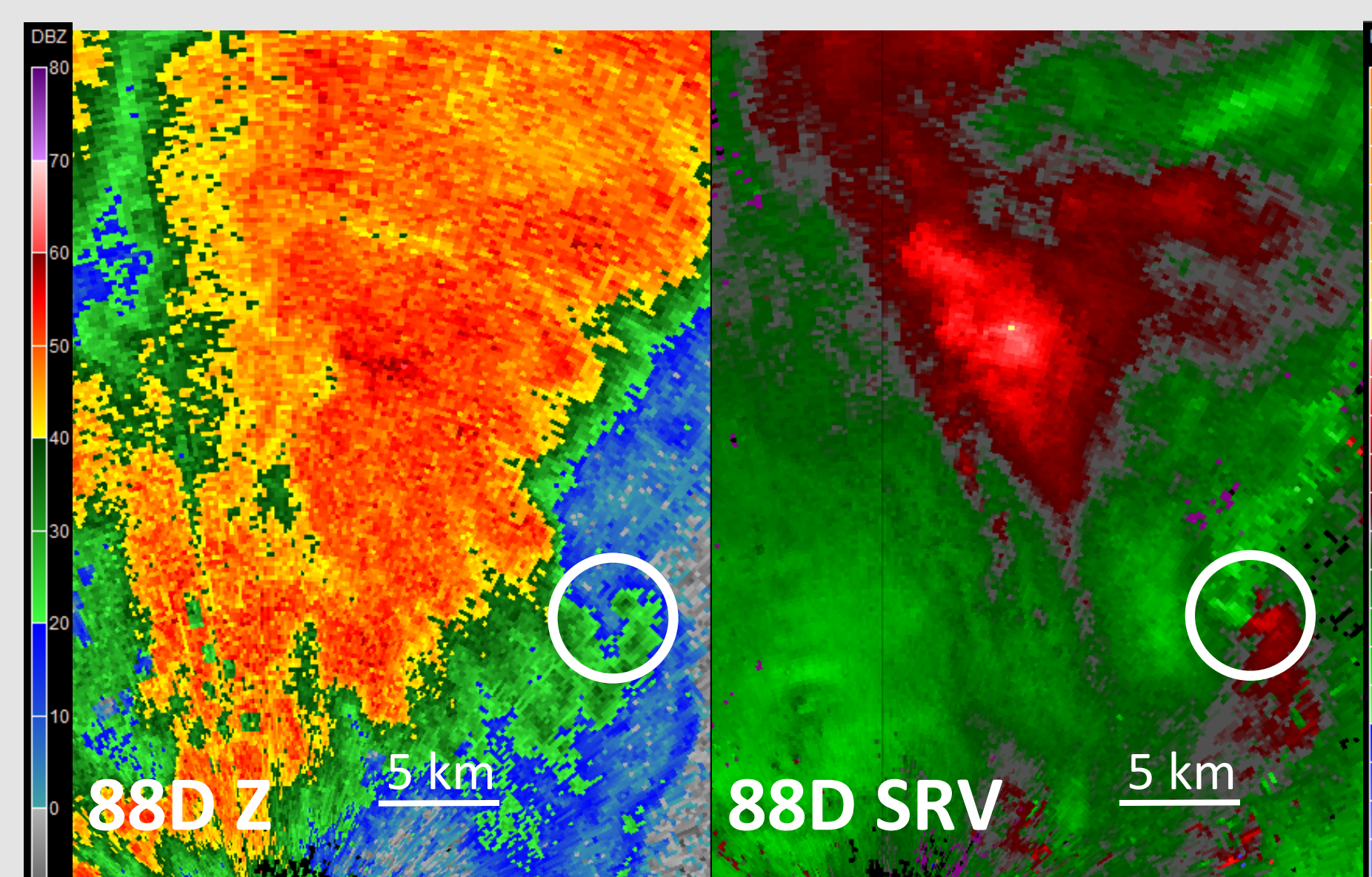
**Acknowledgments and Disclaimers:**

This work is supported in part by the Engineering Research Center Program of the National Science Foundation under NSF award number 0313747. Additional partial funding was provided by NOAA/Office of Atmospheric Research under NOAA-University of Oklahoma Cooperative Agreement #NA17RJ1227.

Any opinions, statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of the National Science Foundation, the National Severe Storms Laboratory, the National Weather Service, the National Oceanic and Atmospheric Administration, or the U.S. Department of Commerce.



**Figure 1:**  
(Top) Terminal Doppler Weather Radar (TDWR) view at close range of a series of mesoscale circulations (circled) in a quasilinear convective systems at various stages of development.  
(Bottom) WSR-88D view of the northern two circulations, also at close range but from a different viewing angle.



**Figure 2:** WSR-88D view at close range of a mesocyclone (circled) along the gust front of a quasilinear convective system.

## 1. Mesoscale circulations

Mesoscale circulations (diameter on the order of 40 m to 4 km) in organized convective systems have been frequently-observed with research-quality radars.

Increased temporal and spatial resolution of operational radars, and increased availability of research radar data in operations, now allow for better real-time identification of these features.

Most of these circulations have been observed to quickly develop and dissipate with little damage, but some grow larger and/or stronger and are associated with tornadoes and/or enhanced wind damage.

## 2. Example cases

Each of the radar images presented here was available to operational forecasters in real-time. The near-storm environments for each case were similar, with sufficient instability and bulk shear for organized convection, and moderate to strong low-level shear.

- Fig. 1: The northern two mesocyclones were each associated with isolated reports of minor wind damage to trees, utility poles and signs.
- Fig. 2: No known damage, though with a lack of spotters and few wind damage indicators. The mesocyclone quickly dissipated.
- Fig. 3: Shown at peak intensity, this mesocyclone quickly grew large (~4 km diameter) and was associated with significant wind damage
- Fig. 4: No known damage, though with a lack of spotters and few wind damage indicators. The mesocyclone quickly dissipated.

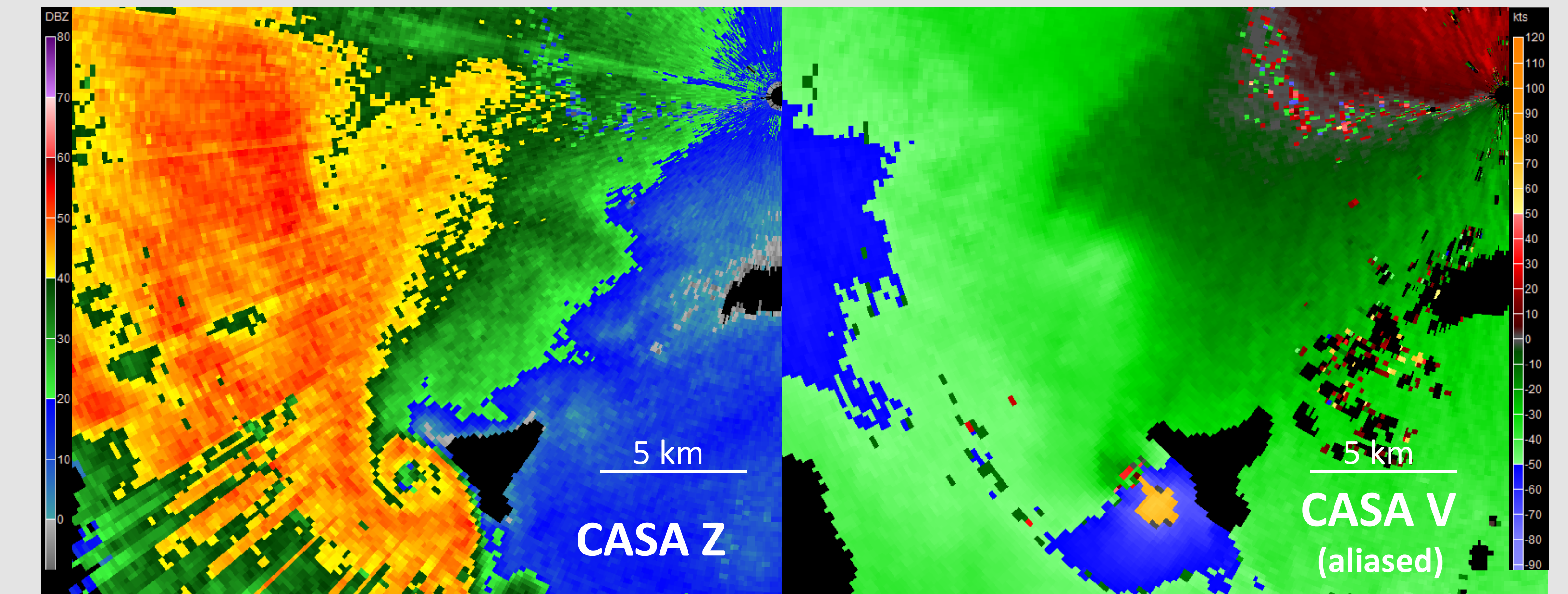
Note: The event in Fig. 4 was near in time and space to the event shown in Fig. 3.

## 3. Feedback and discussion questions

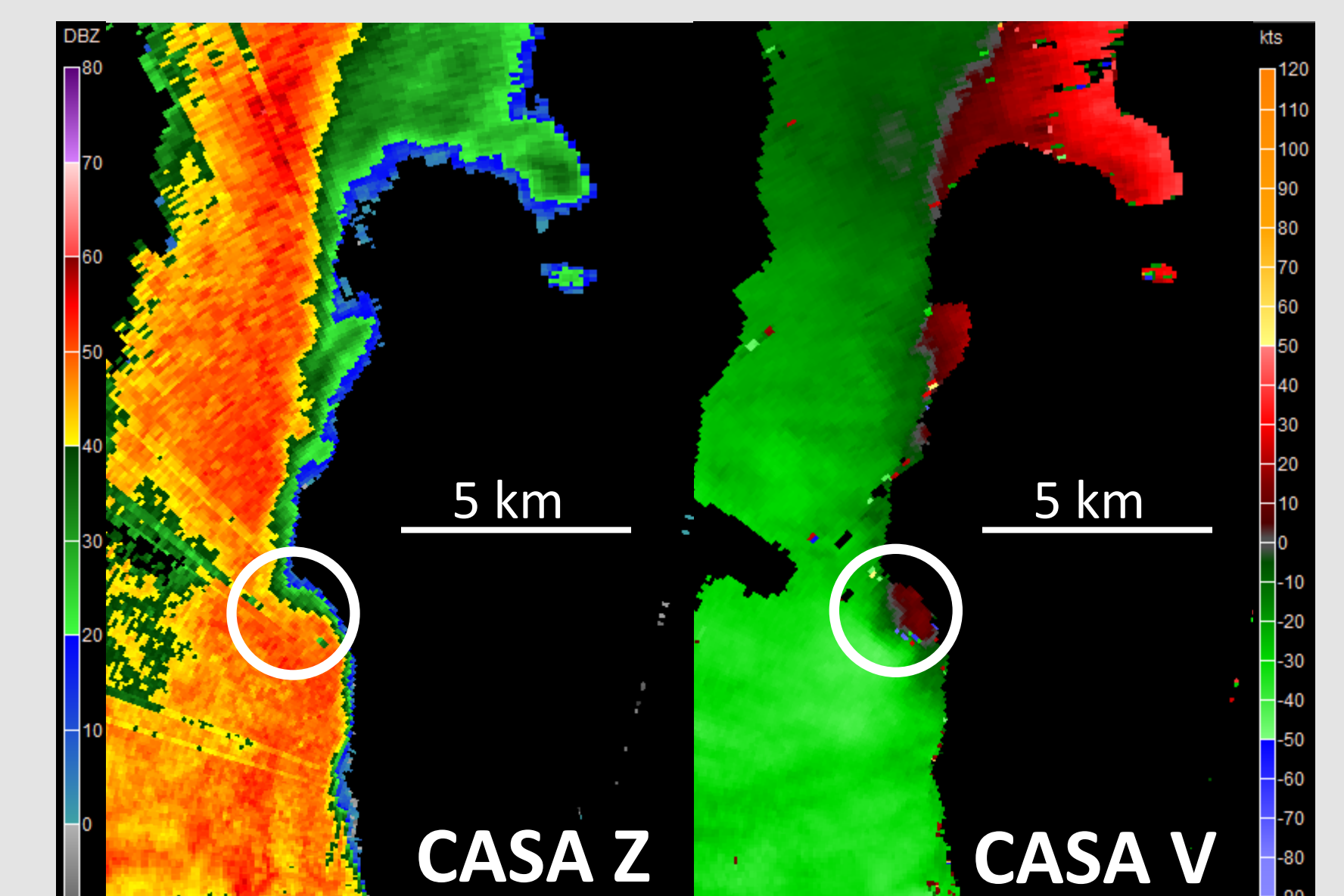
- Now that these circulations are more easily identified in real-time, what is the appropriate way to disseminate associated severe weather hazard information to the public?
- A small percentage of these circulations are associated with tornadoes, but with limited predictability, so are tornado warnings appropriate?
- How does the dissemination cycle of a tornado warning compare to the remaining lifetime of a detected mesoscale circulation?

## 4. Summary

Operational experience so far suggests that the predictability of where and when mesoscale circulations will become damaging is poor, and it is also unclear what proportion grow strong enough to be capable of producing significant damage. Issuance of tornado warnings on all such circulations would be frequent and carry a very high false alarm rate.



**Figure 3:** Collaborative Adaptive Sensing of the Atmosphere (CASA) radar view of a large, mature, intense mesoscale circulation along the leading edge of a quasilinear convective system. The system was moving northeast toward the radar site at a forward speed of nearly  $25 \text{ m s}^{-1}$ . Peak radial speeds ( $< 100 \text{ m AGL}$ ) detected by the radar exceeded  $40 \text{ m s}^{-1}$  on the right side of the circulation and were near  $0 \text{ m s}^{-1}$  on the left side of the circulation.



**Figure 4:** CASA radar view of a mesoscale circulation along the leading edge of a narrow squall line.