QLCS Mesovortex Warning System Reference Sheets
NWS Central Region Tornado Warning Improvement Project
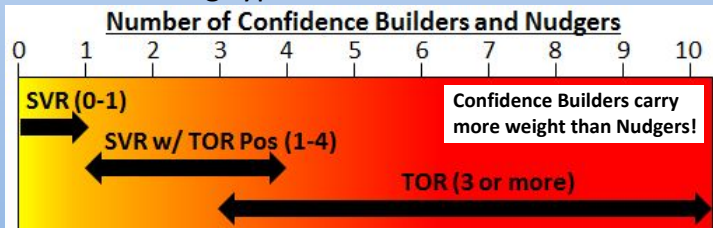
QLCS Mesovortex Warning System

1. Use Three Ingredients Method to anticipate areas where mesovortex genesis is likely over next 30-45 minutes

2. Identify presence of Confidence Builders and Nudgers which indicate an increased likelihood for tornadoes

3. Determine the number and quality of Confidence Builders and Nudgers to issue heightened warning products

4. Draw an effective polygon to capture motion and evolution of key features over next 30-45 minutes

Three Ingredients Method

1. System cold pool and ambient low-level shear nearly balanced or slightly shear dominant **and**

2. 0-3 km line-normal bulk shear magnitude $\geq$ 30 kts **and**

3. Rear-inflow jet (RIJ) or enhanced outflow causes surge or bow within a QLCS

10 Confidence Builders and 4 Nudgers

Descending RIJ/reflectivity drop
Enhancing surge/bow
Line break
Paired front/rear inflow notch
UDCZ entry point
Front reflectivity nub
Boundary ingestion
Tight/strong mesovortex with $V_r \geq 25$ kt
Contracting bookend vortex with $V_r \geq 25$ kt
Confirmed tornado/tornadic debris signature (TDS)
Reflectivity tag intersecting a surge/bow
0 to 3 km MLCAPE ≥ 40 J/kg
Cell merger or reflectivity spike near surge/bow
History of tornadoes (includes prior TDSs)

Note: Confidence Builders carry more weight than Nudgers!

General Rules of Thumb for Warning Types

Once the three Ingredients are met, sum up number of Confidence Builders and Nudgers and use chart below to determine warning type:

Number of Confidence Builders and Nudgers
0 1 2 3 4 5 6 7 8 9 10

SVR (0-1)
SVR w/ TOR Pos (1-4)
TOR (3 or more)

Confidence Builders carry more weight than Nudgers!

Note: Use quality and persistence of Confidence Builders and Nudgers to tweak confidence up or down in overlap regions.


0.5° SRM   0.5° Z

Motions and Evolutions to Consider for Effective Polygon

Segment + Balanced/Shear Dominant Regions + Confidence Builders/ Nudgers + Possible Mesovortex Migration

Three Ingredients Method for Mesovortex Genesis and Intensification

① Locate Balanced and Slightly Shear Dominant Regimes

A. Locate the Updraft Downdraft Convergence Zone (UDCZ) using 0.5° SRM, V, and SW products

B. Compare location of UDCZ to updraft region in 0.5° Z product:
- Shear Dominant – UDCZ within or behind updraft towers
- Balanced – UDCZ on immediate front edge of updraft towers
- Cold Pool Dominant – UDCZ out ahead of updraft towers

UDCZ UDCZ
Shear Dominant
Balanced
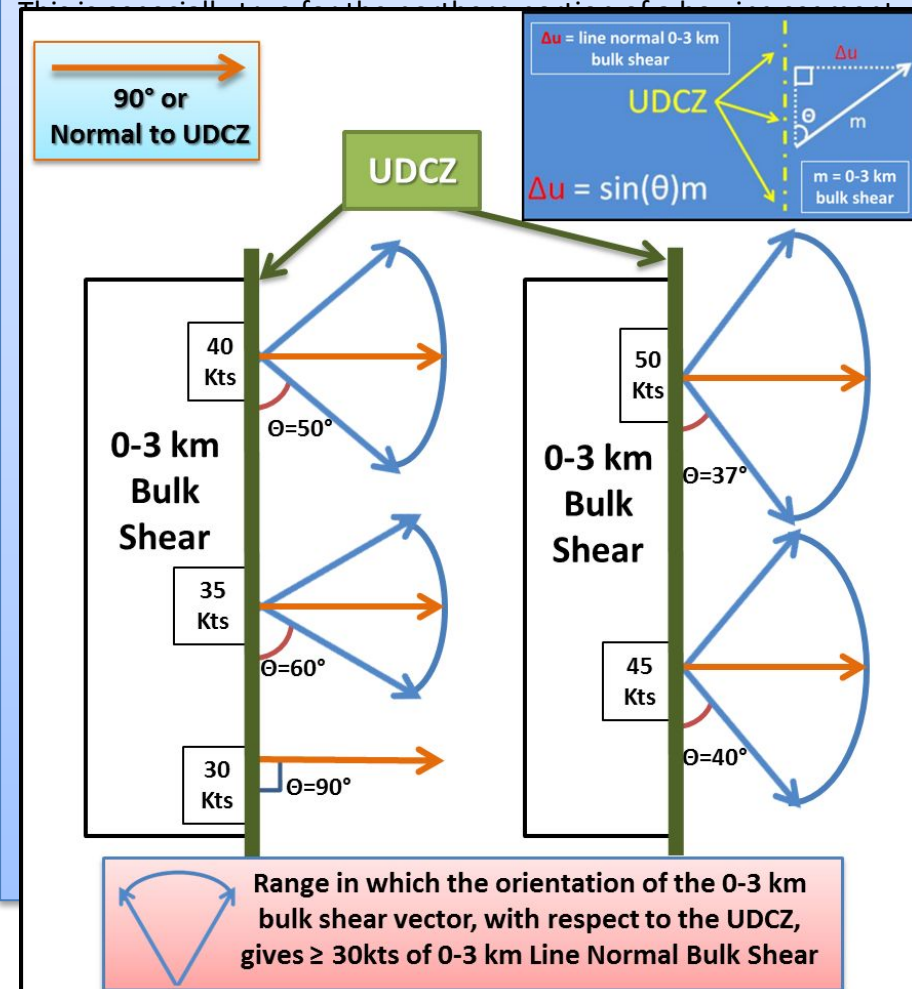Cold Pool Dominant
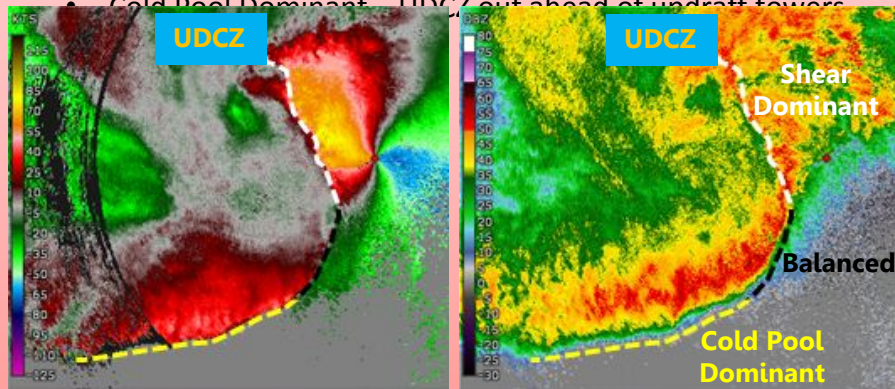
③ Locate Bows and Local Surges

A. A rear inflow jet or enhanced outflow are likely candidates to cause a local surge or bow
- Look for MARC signatures in the 8-16 kft layer as a precursor to bows
- Low level V, SRM, and SW products often reveal developing local surges quicker than Z product

When all three ingredients are co-located within a QLCS, there is an increased likelihood for mesovortex genesis and intensification, along with increased tornado potential.
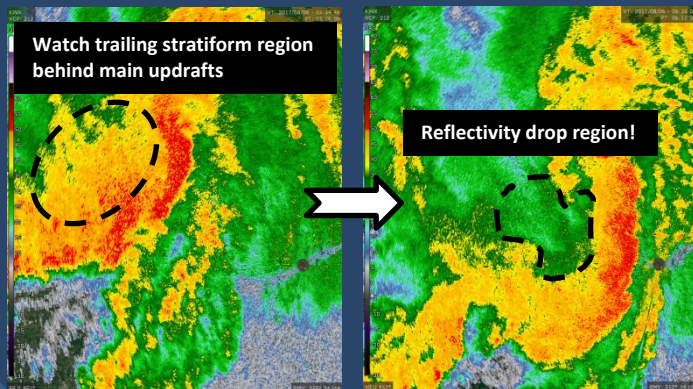
② Locate Regions where Line-Normal 0-3 km Bulk Shear is ≥ 30 Knots

A. Determine 0-3 km bulk shear just ahead of the QLCS (must be ≥ 30 knots for ingredient to be fulfilled)

B. Use equation below to determine line-normal bulk shear values as they relate to the UDCZ
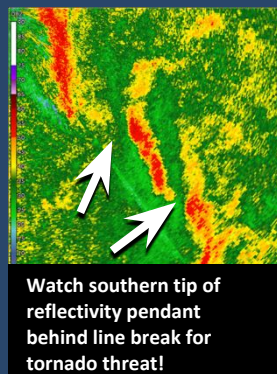
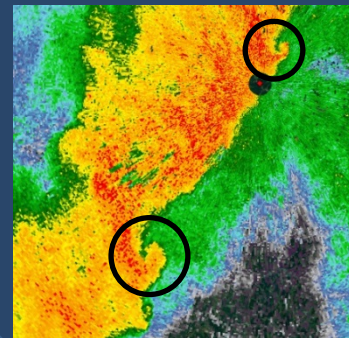Tip: Local surges and bows often change the orientation of the UDCZ. This is especially true for the northern portion of a bowing segment

90° or Normal to UDCZ

Δu = line normal 0-3 km bulk shear

UDCZ

$\Delta u = \sin(\theta)m$

m = 0-3 km bulk shear

UDCZ

0-3 km Bulk Shear

40 Kts $\theta=50°$
35 Kts $\theta=60°$
30 Kts $\theta=90°$

0-3 km Bulk Shear

50 Kts $\theta=37°$
45 Kts $\theta=40°$

Range in which the orientation of the 0-3 km bulk shear vector, with respect to the UDCZ, gives ≥ 30kts of 0-3 km Line Normal Bulk Shear

Tornado Warning Confidence Builders

Descending Rear Inflow Jet/Reflectivity Drop

Watch trailing stratiform region behind main updrafts

Reflectivity drop region!

Line Break

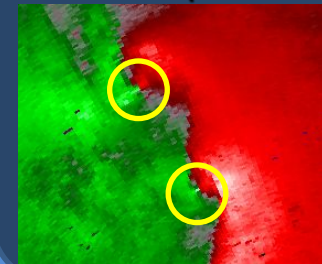Watch southern tip of reflectivity pendant behind line break for tornado threat!

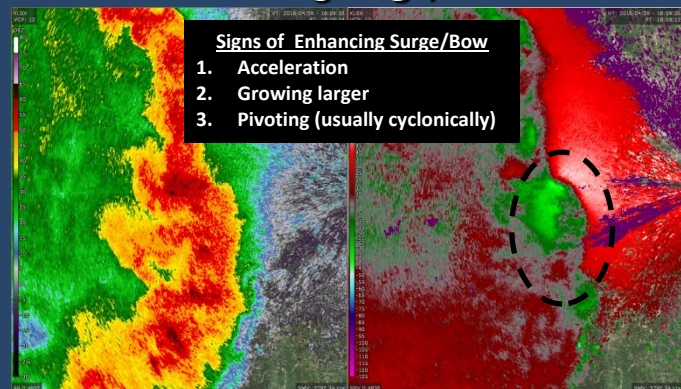## Front Reflectivity Nub

Tight/Strong Mesovortex (Vr ≥ 25kt)

Enhancing Surge/Bow
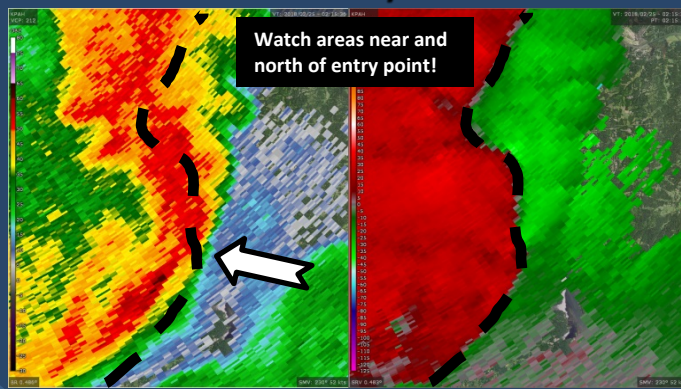
Signs of Enhancing Surge/Bow
1. Acceleration
2. Growing larger
3. Pivoting (usually cyclonically)

Paired Front/ Rear Inflow Notch

Boundary Ingestion

Most Ideal
1. Stationary or quasi-stationary boundary
2. Boundary perpendicular to bow

Outflow Boundary

Bow Ingesting Boundary

UDCZ Entry Point
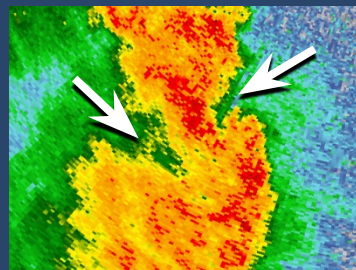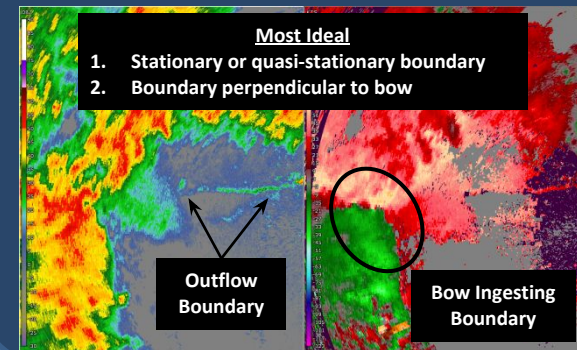
Watch areas near and north of entry point!

Contracting Bookend Vortex with Vr ≥ 25 kt

Bookend Vortex

Tornadic Debris Signature(TDS)

0.5° Z

0.5° SRM

0.5° CC

0.5° ZDR

Reflectivity Tag Intersecting a Surge/Bow

Tag motion

Line motion

Tag crossing surge!

0-3 km MLCAPE ≥ 40 J/kg

PARCEL	CAPE	CINH	LCL	LI	LFC	EL		SRH
SURFACE	1950	-31	1023m	-4	1506m	43967'	SFC - 1 km	
MIXED LAYER	1817	-27	1119m	-4	1557m	43967'	SFC - 3 km	
FCST SURFACE	2660	0	1526m	-5	1526m	44460'	Eff Inflow Layer	
MU (973 mb)	2185	-31	920m	-4	1456m	43604'	SFC - 6 km	

PW = 1.92 .in   3CAPE = 90 J/kg   WBZ = 14283'   WNDG = 0.1   SFC - 8 km
K = 28   DCAPE = 497 J/kg   FZL = 15268'   ESP = 1.0   LCL - EL (Cloud La
MidRH = 73%   DownT = 68 F   ConvT = 89F   MMP = 0.03   Eff Shear (EBWD)

Cell Merger/Reflectivity Spiking Near Surge/Bow

Cells Merged!

Reflectivity Spiking Near Surge!

History of Tornadoes (Includes prior TDSs)

0.5° CC
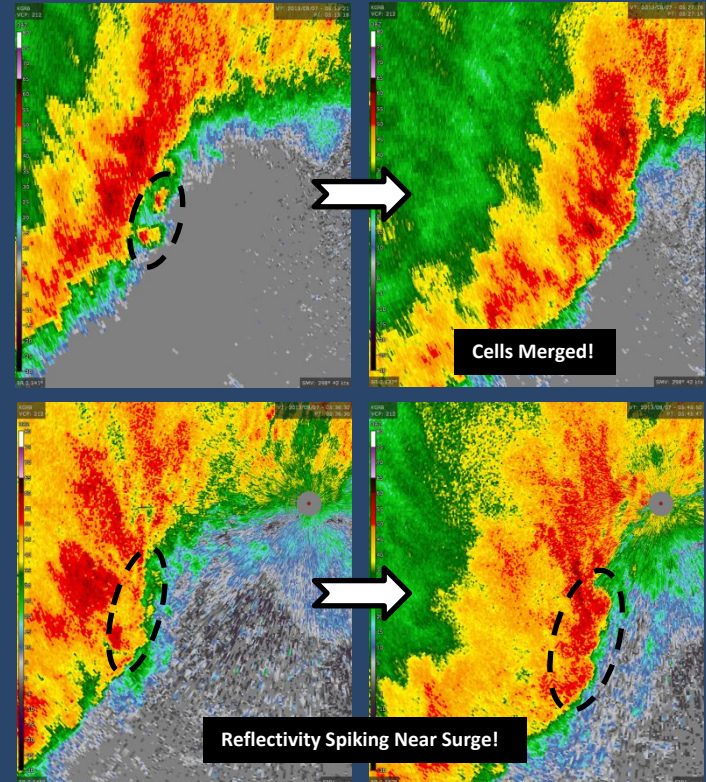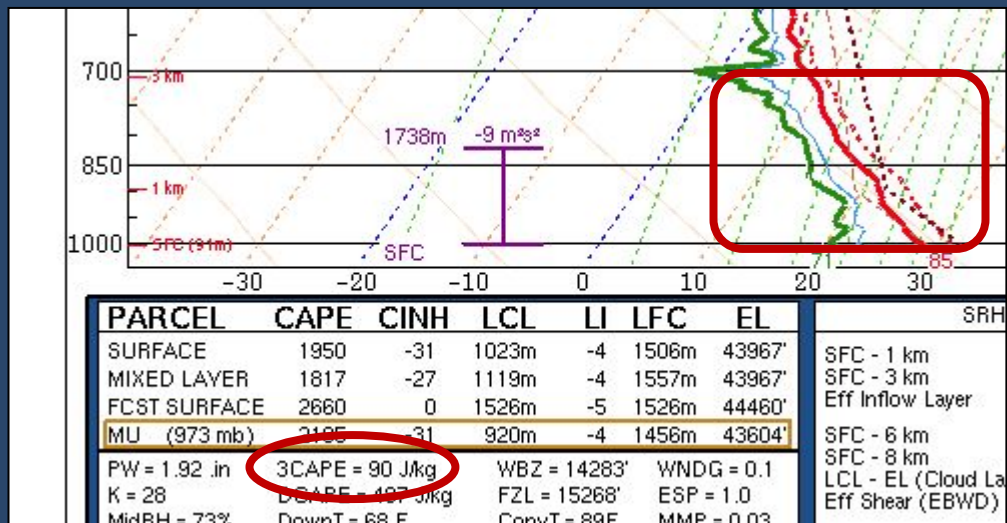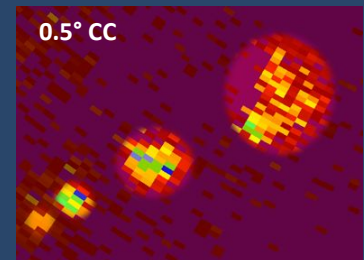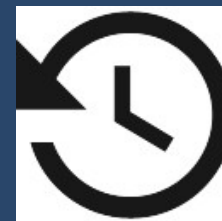
Tornado Warning Nudgers