Anticipating QLCS Tornadogenesis: The Three-Ingredient Method During the 19-20 February 2017 South-Central Texas Tornadic QLCS Event

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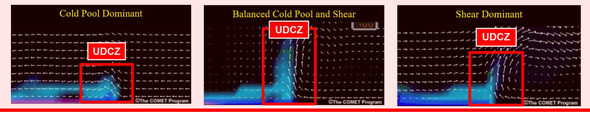
INTRODUCTION

Quasi-linear convective systems (QLCS) present a unique challenge for a warning forecaster. The system can change rapidly, evolving from relatively benign to producing numerous mesovortices in a short period of time. For these reasons, probability of detection (POD) and lead times for QLCS tornadoes are much worse than those for supercell tornadoes. This also makes it difficult to keep NWS core partners, such as media and local emergency managers, abreast of the immediate and short-term threat areas for tornadoes during QLCS events.

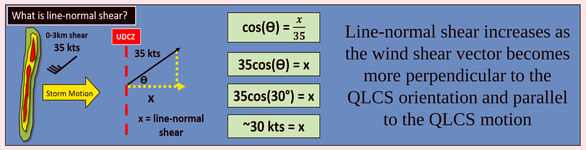
THE THREE-INGREDIENT METHOD

The three-ingredient method for anticipating QLCS mesovortexgenesis was developed by Schaumann and Przybylinski (2012) in an effort to improve performance in QLCS events.

Ingredient 1) Identify regions of a QLCS line in which the system cold pool and ambient low-level wind shear are nearly balanced or slightly shear dominant along the updraft/downdraft convergence zone (UDCZ)

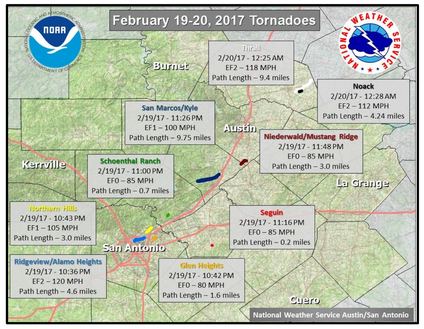


Ingredient 2) Identify regions of a QLCS line in which the 0-3 km line-normal wind shear are equal to or greater than 30 knots



Ingredient 3) Look for surges or bows in the QLCS line due to rear inflow jets (RIJ) or local outflow enhancements

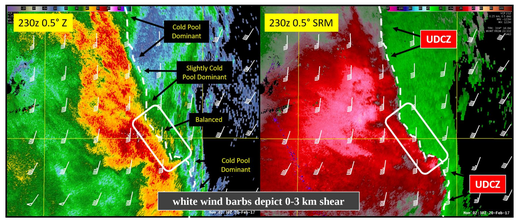
19-20 FEBRUARY 2017 QLCS TORNADOES ACROSS SOUTH-CENTRAL TEXAS



- 9 confirmed tornadoes
  - 3 EF-2
  - 2 EF-1
  - 4 EF-0
- EF-2 tornado caused extensive damage to north-central San Antonio
- Largest tornado event in month of February
- Second largest tornado event in over a decade

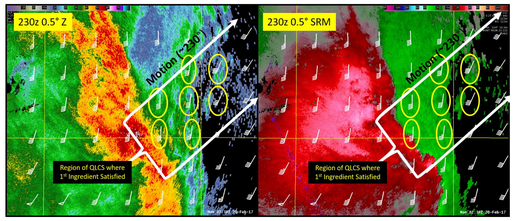
APPLYING THE THREE-INGREDIENT METHOD TO THE 19-20 FEB 2017 QLCS TORNADO EVENT

Non-tornadic period of the QLCS 130z – 400z 20 Feb 2017



Ingredient 1: Identify cold pool/wind shear balance regime

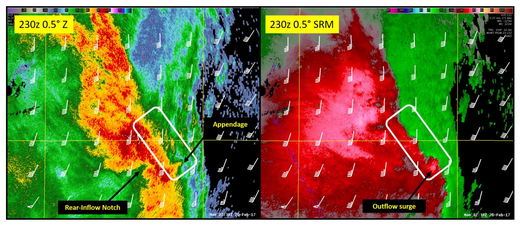
- Identify the UDCZ using lowest-tilt SRM
- Compare the location of the UDCZ to the leading edge of the QLCS convective line
- 1st Ingredient satisfied within the region encapsulated by the white rectangle



Ingredient 2: Determine if 0-3 km line-normal wind shear ≥ 30 knots

- Look at shear vectors near and slightly downstream of the QLCS

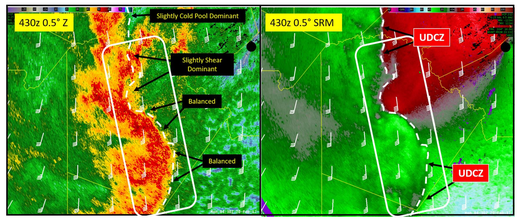
- In this case, the line-normal 0-3 km shear was only about 25 knots



Ingredient 3: Look for surges or bows in the QLCS line

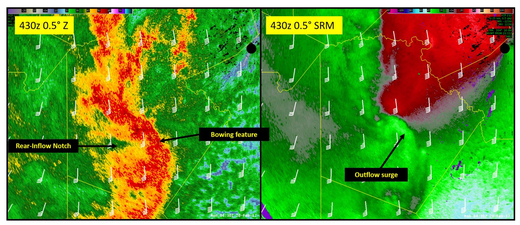
- Look for features such as rear-inflow notch, bowing features, or outflow surges
- In this case, a rear-inflow notch and associated appendage on the front edge of the convective line was present, as well as indications of an outflow surge, but no bowing feature

Tornadic Period of the QLCS 430z – 630z 20 Feb 2017



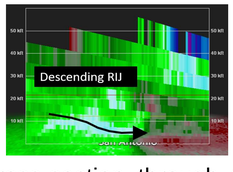
Ingredient 1: Identify cold pool/wind shear balance regime

- At this point, a large region of the QLCS was balanced or slightly shear dominant
- 1st Ingredient satisfied within the region encapsulated by the white rectangle

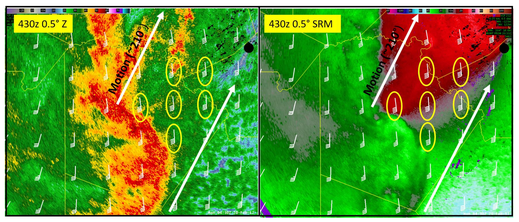


Ingredient 3: Look for surges or bows in the QLCS line

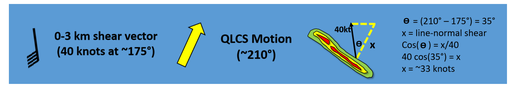
- In this case, a rear-inflow notch and associated bowing segment was present
- An outflow surge was present, which helped to create a bowing of the QLCS. This surge also changed the motion of the QLCS from ~230° to ~210°



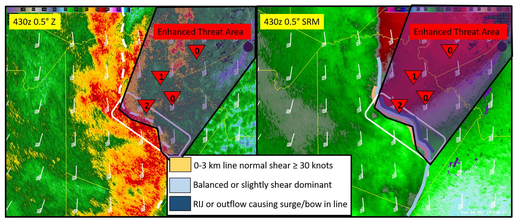
- Taking a cross-section through the bowing segment, a descending rear-inflow jet was identified



Ingredient 2: Determine if 0-3 km line-normal wind shear ≥ 30 knots



- A change in the motion of the QLCS line created a more favorable shear vector orientation, increasing the line-normal 0-3 km shear to closer to 35 knots



Identifying the Enhanced Threat Area

- Once you identify the location where all three ingredients are satisfied, you have identified the specific region most favorable for mesovortex genesis and thus tornadogenesis
- Applying the QLCS motion and shear vectors downstream, determine greatest QLCS tornado threat area for the next 0 to 30-45 minutes
- Strongly consider issuing a tornado warning once all three ingredients are met
- Convey this information to core partners
- What happened: 4 tornadoes occurred between 436z and 5z (denoted by red triangles)

BEST PRACTICES AND CONCLUSIONS

- Have devoted mesoanalyst keeping close watch on the 0-3 km bulk shear vectors along and downstream of the QLCS
- Overlay RAP 0-3 km bulk shear wind barbs over radar data or use SPC Mesoanalysis page (found in multi-parameter fields section)
- Update warning team periodically and/or project onto a situational awareness display
- Have backup radar personnel periodically checking on the cold pool/wind shear balance regimes as well as searching for indications of bowing segments or outflow surges
- **Utilizing the three-ingredient method can greatly enhance warning forecaster situational awareness and has promising implications for improving POD and lead times for QLCS tornadoes**