Observations and Challenges from the 24 April and 26 October 2010 QLCS Events in Central Kentucky

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Quasi-Linear Convective Systems (QLCSs) are a common severe weather mode in central Kentucky and southern Indiana. Given the complexity and interactions of cells within these systems and the environments in which they develop and propagate, warning decisions (particularly for tornadoes) often are a challenge. This was the case during the 24 April and 26 October 2010 QLCS events, which were complicated by near-storm environmental changes and convective storm and boundary evolution.

On 24 April, a very dynamic synoptic and mesoscale environment featured a deep surface low (985 mb) over eastern Missouri and a 70 kt low-level jet and tremendous low-level shear (RUC 0-1 km helicity around 600 m^2/s^2) over central Kentucky. SPC indicated a moderate-to-high risk of severe over the lower Ohio Valley. The environment favored supercells and tornadic mesovortices along the QLCS which developed. An area of convection preceding the QLCS, however, provided modest boundary layer stabilization, making tornado touchdowns more problematic along the line. In addition, reflectivity structure suggested mesovortices would be along the leading edge of convection, although storm-relative velocity and spectrum width data revealed the effective boundary was back within the rain shield behind the leading edge, an unusual observation. This boundary resulted in multiple, rapidly evolving mesovortices, at least two of which were able to penetrate through the surface inversion producing EF0-1 tornadoes. A video of one of the tornadoes will be shown. These factors resulted in a challenging warning environment for forecasters, despite the initial pre-storm environment.

On 26 October, central Kentucky again was in a moderate-to-high risk of severe within a classic cool-season type environment characterized by very strong low and deep-layered shear, but weak instability. The environment and radar signatures suggested robust tornado potential with several cells, despite a lack of real-time reports ("2 out of 3" rule). Over time, the QLCS transitioned into cellular convection as an organized, linear cold pool broke down and became focused within individual cells and bow echoes. Mesovortex generation and strength actually increased with several of the cells, despite the demise of the integrity of the line as a whole. Numerous tornado warnings were issued for these cells. However, overall wind damage and the number of documented tornadoes were much less than originally thought. Negating factors may have included limited downward CAPE and low-level lapse rates immediately along the line despite strong low-level wind fields, and even the drought at the time making it more difficult for trees to be uprooted. Ahead of the line, there were several wind reports as pre-line steeper low-level lapse rates and turbulent mixing favored strong gradient winds due to downward momentum transfer. These factors again made for an interesting and challenging warning scenario.

This presentation will focus on environmental and radar observations associated with these two events. Comments from attendees will be welcome at the end of the talk.