A Messaging Conundrum: High Wind Events In the Ohio Valley

Kristen Cassady • Brian Coniglio • Scott Hickman • *National Weather Service – Wilmington, OH*

Introduction To Study

The Ohio Valley region is susceptible to synoptic scale high wind events causing widespread damage and substantial economic losses. These events, usually initiated by the presence of deep and compact vertically cohesive low pressure systems, often times yield a one or two hour period of destructive severe wind gusts due to the presence and evolution of a favorable mesoscale environment which helps translate strong wind gusts from aloft to the surface. While the events are often viewed as non-convective in nature, it is often convective processes within the favorable synoptic scale environment which support, and ultimately allow, the translation of severe wind gusts to the ground over large areal expanses on a very small temporal scale, lending itself to uncertainties in how to message the short fuse non-traditional wind threat over a large area.

Methodology

Rapid Refresh (RAP) analysis data (13-km grid) is compared with other high-resolution convection-allowing models, including High-Resolution Rapid Refresh (HRRR) parameters. Several reanalysis datasets and local storm reports (LSRs) are compared for two very similar high wind events that impacted the NWS Wilmington, OH (ILN) County Warning Area (CWA). Forecasting and messaging complexities are addressed with both events, each of which was handled differently real-time using traditional NWS guidance and products. WSR-88D radar data is reviewed with respect to archived METAR observations from both ASOS & AWOS to ultimately determine whether the strong and damaging wind gusts in each case were primarily convectively driven or more in line with traditional synoptically induced high wind events.

SVR ? OR ? NPW
Prevailing NWS High Wind Policy

① **Time?** If the convective wind event is expected to equal or exceed warning level values for **one hour or more**, then a **High Wind Warning (HWW)** is recommended. If **less than one hour**, a **Severe Thunderstorm Warning (SVR)** is recommended.

② **Thunder?** If high winds are associated with convection and the **threat of thunder** is marginal, but real, or are associated with a **thunder-free Quasi-Linear Convective System (QLCS),** issue a **Severe Thunderstorm Warning (SVR).**

③ **Convective?** Widespread high winds associated with **weak showers** (non-QLCS that has no thunder) that **mix strong synoptic winds to the ground** should be handled with a **Wind Advisory (NPW)** or **High Wind Warning (HWW).**

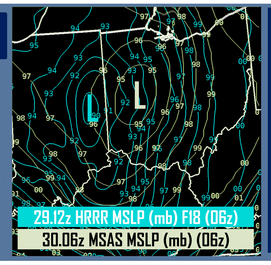
December 30, 2019

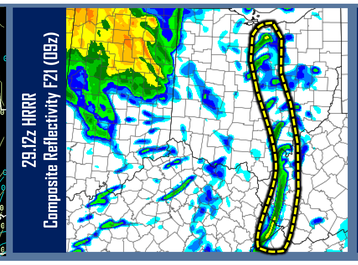
A narrow line of showers moved from northern Kentucky through central Ohio, producing widespread 50-70 MPH wind gusts that lasted less than an hour. **NPWs were issued** due to unknowns regarding how long the strong gusts would last.

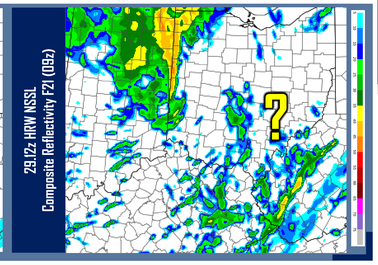
① The Forecast

Challenges: Convective-allowing guidance was inconsistent in depiction of the center low track and whether a fine line of showers coincident with the low-level jet max would develop.

Without the weak showers, would the 40-50+ knot gusts have occurred?

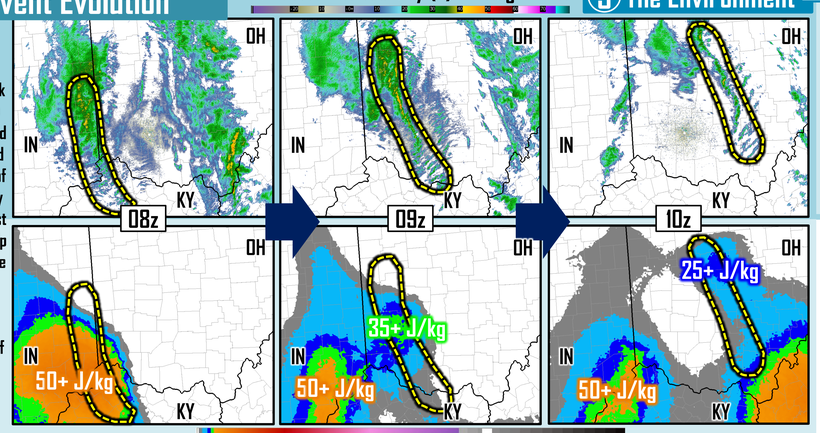






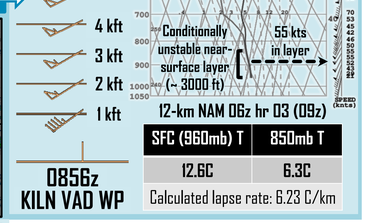
② Event Evolution

A narrow overlap between weak (~ 50 J/kg) surface-based buoyancy and the fine line of showers may have been just enough to help enhance some mixing and subsequent downward momentum of stronger winds from just off the surface.



LAPS Surface Positive Buoyancy Energy (J/kg)

③ The Environment

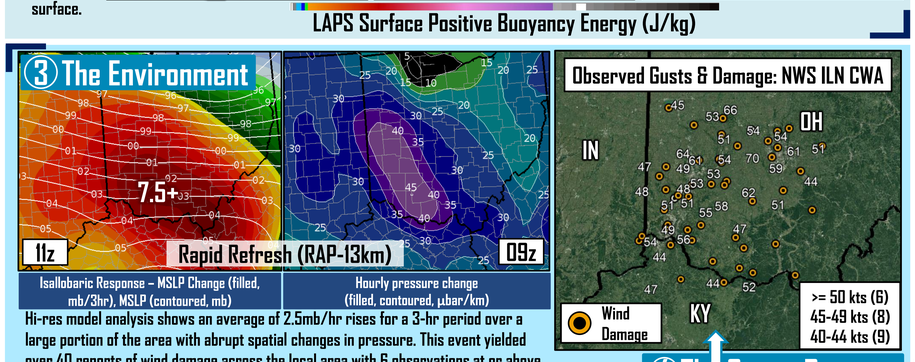


0856z KILN VAD WP

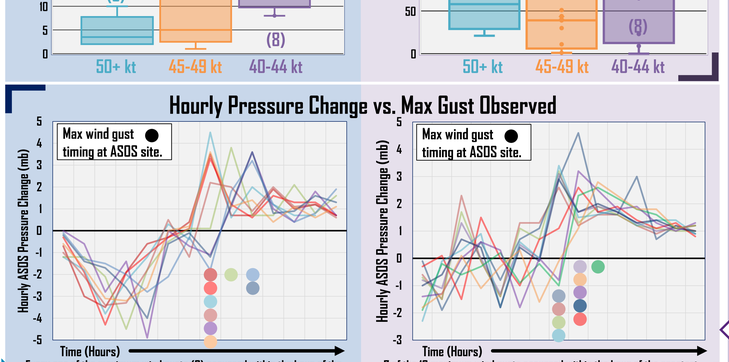
12-km NAM 06z hr 03 (09z)

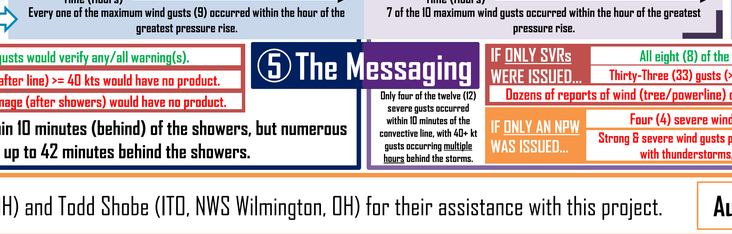
SFC (960mb) T	850mb T
12.6C	6.3C

Calculated lapse rate: 6.23 C/km



Hi-res model analysis shows an average of 2.5mb/hr rises for a 3-hr period over a large portion of the area with abrupt spatial changes in pressure. This event yielded over 40 reports of wind damage across the local area with 6 observations at or above 50 kts. Zero of the twenty-three (23) AWOS/ASOS observed gusts over 40 kts lasted even an hour.





Every one of the maximum wind gusts (9) occurred within the hour of the greatest pressure rise.

7 of the 10 maximum wind gusts occurred within the hour of the greatest pressure rise.

④ The Storm Reports

⑤ The Messaging

Event Criteria Thresholds	Yes/No	NWS Policy Recommendation
Did we meet time criteria? (At least 1 hour)	No ✗	Severe Thunderstorm Warning (SVR)
Did we have thunder? (QLCS)	No ✗	Non-Precipitation Warning (NPW)
Did we have convective processes w/ synoptic winds?	Yes ✓	Non-Precipitation Warning (NPW)

IF SVRs WERE ISSUED...	All six (6) severe gusts would verify any/all warning(s).
	Eight (8) gusts (>10 min after line) >= 40 kts would have no product.
	Dozens of reports of wind (tree/powerline) damage (after showers) would have no product.

All six (6) severe gusts occurred within 10 minutes (behind) of the showers, but numerous 40+ kt gusts continued up to 42 minutes behind the showers.

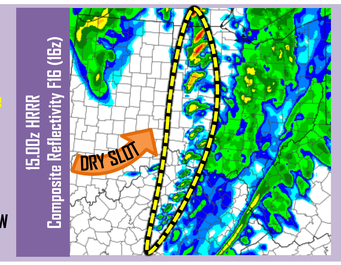
November 15, 2020

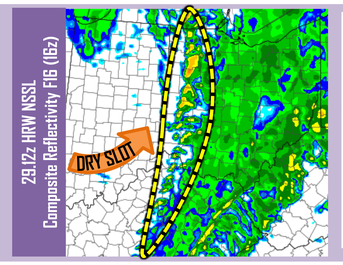
A strong low pressure system tracked through the Great Lakes region, with a line of storms developing, helping translate numerous gusts of 50-65+ MPH to the ground. **Both NPWs and SVRs were issued** with tree & powerline damage occurring both with storms and after storms had passed.

① The Forecast

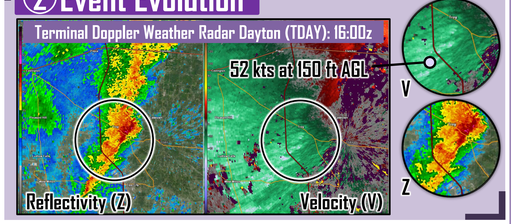
The event was well-forecast from a NWP standpoint, with many high-resolution, convection-allowing models showing a **line/narrow convective line** just ahead of the **impinging dry slot** wrapping around the southeast periphery of the low center.

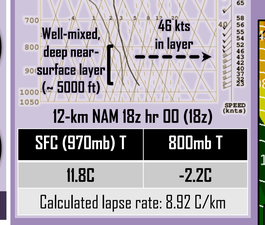
Challenges: It was unclear that the convection was going to be as robust amidst an increasingly well-mixed and deep boundary layer. However, **enhanced wind signatures coincident with convection initiated a pivot in messaging to issuing SVRs with the NPW already out.**





② Event Evolution



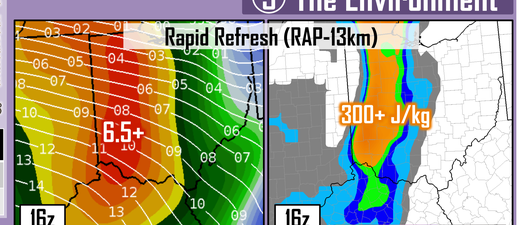


12-km NAM 18z hr 00 (18z)

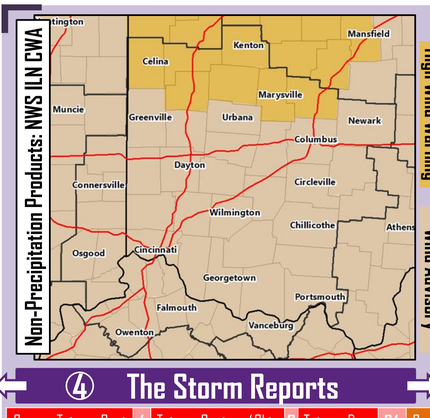
SFC (970mb) T	800mb T
11.8C	-2.2C

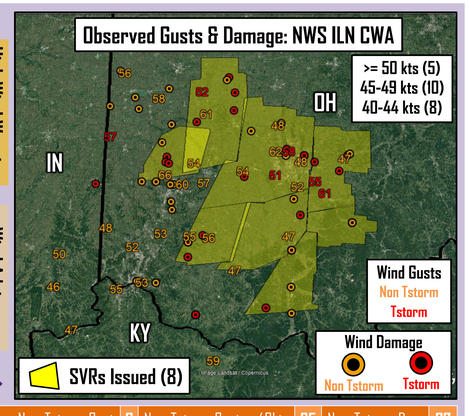
Calculated lapse rate: 8.92 C/km

③ The Environment



Model soundings show a deep and well-mixed boundary layer evolving behind the convective line, with very steep lapse rates to support efficient momentum transfer. Hi-res model analysis shows an average of 2.2 mb/hr rises for a 3-hr period over a large portion of the area with sufficient surface-based instability as the convective line was moving through. This event also yielded over 25 reports of wind damage across the local area in the post-frontal mixed environment, with 8 separate observations >= 50 kts during this period. These 50 kt gusts occurred up to 4 hrs after the convection moved through as a favorable diurnally-enhanced mixed low-level environment evolved with steepened lapse rates.





④ The Storm Reports

Severe Tstorm Gust	4	Tstorm Gust >= 40kts	8	Tstorm Dmg	24	Severe Non-Tstorm Gust	8	Non-Tstorm Gust >=40kts	25	Non-Tstorm Dmg	27

⑤ The Messaging

IF ONLY SVRs WERE ISSUED...	All eight (8) of the warnings were verified with wind damage.
	Thirty-Three (33) gusts (>10 min after line) >= 40 kts would have no product.
	Dozens of reports of wind (tree/powerline) damage (after showers) would have no product.
IF ONLY AN NPW WAS ISSUED...	Four (4) severe wind gusts would've been missed (not in HWW).
	Strong & severe wind gusts producing damage would've been occurring coincident with thunderstorms, potentially causing confusion for the public.

Only four of the twelve (12) severe gusts occurred within 10 minutes of the convective line, with 40+ kt gusts occurring multiple hours behind the storms.

Thresholds	Yes/No	NWS Policy Recommendation
Did we meet time criteria? (At least 1 hour)	Yes ✓	Non-Precipitation Warning (NPW)
Did we have thunder? (QLCS)	Yes ✓	Severe Thunderstorm Warning (SVR)
Did we have convective processes w/ synoptic winds?	Yes ✓	Non-Precipitation Warning (NPW)

Acknowledgements

A special thank you is extended to Seth Binau (SOO, NWS Wilmington, OH) and Todd Shobe (ITO, NWS Wilmington, OH) for their assistance with this project.

Authors Contact Info: kristen.cassady@noaa.gov, brian.coniglio@noaa.gov, scott.hickman@noaa.gov