72

# Performance of the NSSL Experimental Warn-on-Forecast System for Ensembles (NEWS-e) during VORTEX-Southeast

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## Overview

- The NSSL Experimental Warn-on-Forecast System for ensembles (NEWS-e; see presentations 8B.5, 8B.6, poster 100) has been run within an experimental High-Resolution Rapid Refresh Ensemble (HRRRE; see presentations 8B.1, 8B.2, 8B.3, and 8B.4) for case studies during the winter of 2015 and spring of 2016
- As part of the VORTEX-SE project (see Session 3), NEWS-e forecasts were produced for four days of severe weather in the southeastern United States to compare system performance to spring events in the Great Plains

## Cases

- ***23 December 2015:*** Strong tornadoes in MS
- ***31 March 2016:*** Low CAPE/high shear tornadoes in AL
- ***29 April 2016:*** Nontornadic QLCS in AL
- ***10 May 2016:*** Supercell and QLCS tornadoes in KY

## Methodology

- For each event, NEWS-e produced 90 (180) minute forecasts at the bottom (top) of each hour from 1900 to either 0130 or 0300 UTC
- NEWS-e forecasts assimilate radar (Wheatley et al. 2015) and satellite (Jones et al. 2016) data into an 18-member ensemble with 3 km horizontal grid spacing
- Low-level rotation (0-2 km mean vertical vorticity) objects in NEWS-e forecasts are verified against 0-2 km MRMS az. wind shear objects
- Rotation objects are identified every 5 minutes according to a 30-minute rotation track centered on the forecast time
- Objects are "matched" using a spatiotemporal weighting scheme similar to the MODE software (Davis et al. 2006)
- Forecast objects occurring within ~32 km and 16-minutes of an observed object are considered "matches", with others considered "false alarms"

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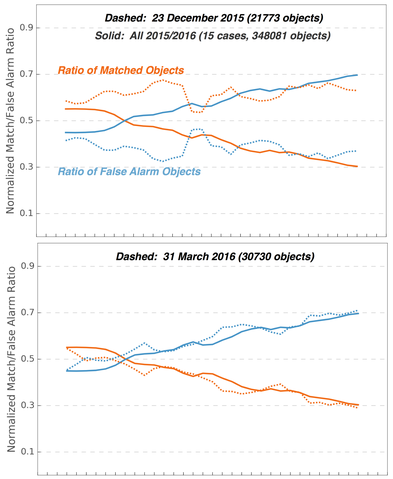
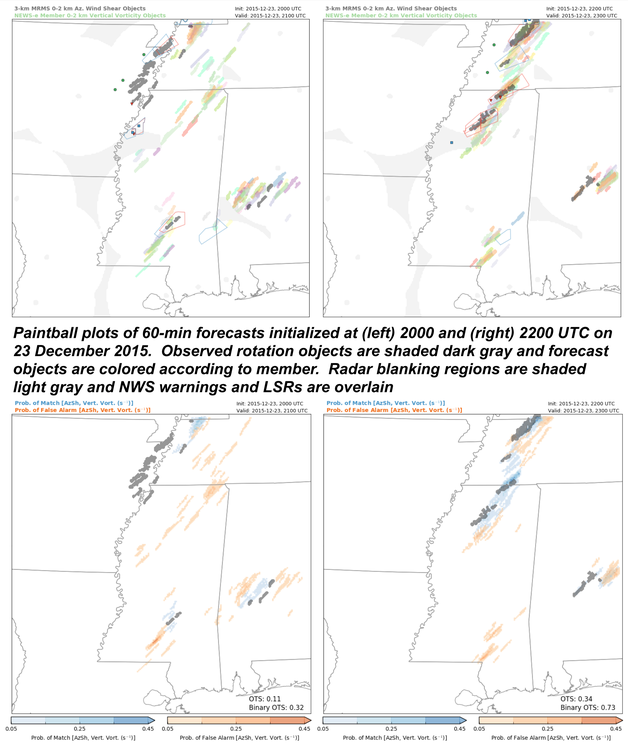


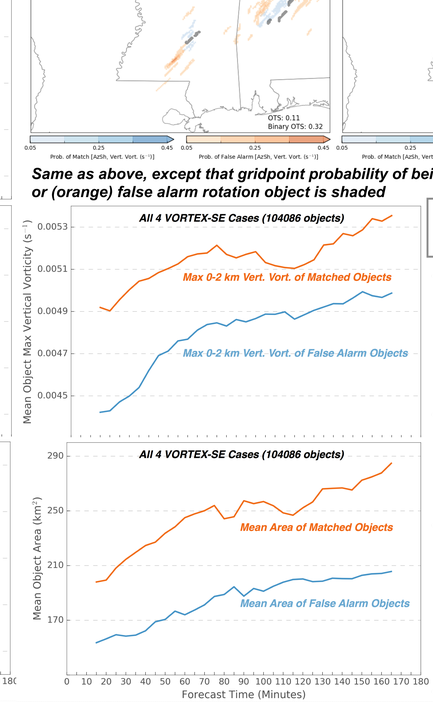

***Ratio of area-weighted matched rotation objects to false alarm rotation objects binned by forecast minute. Solid lines are for all 2015/16 cases and V-SE cases are plotted with dashed lines***



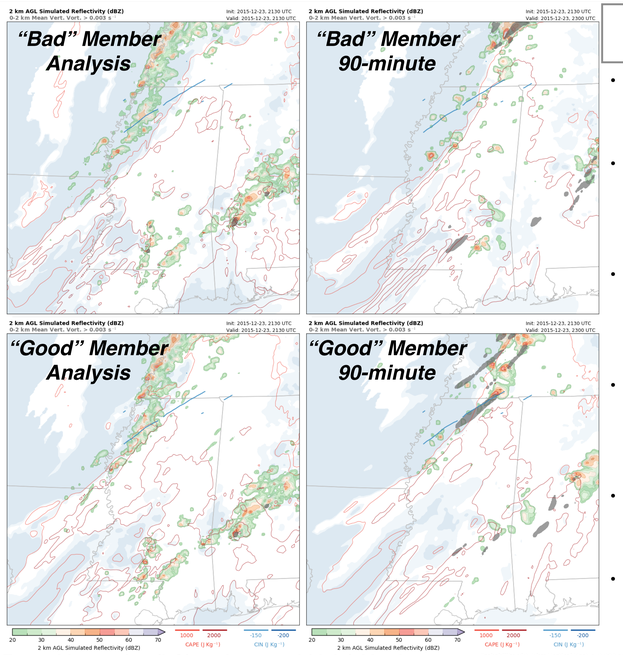

***Paintball plots of 60-min forecasts initialized at (left) 2000 and (right) 2200 UTC on 23 December 2015. Observed rotation objects are shaded dark gray and forecast objects are colored according to member. Radar blanking regions are shaded light gray and NWS warnings and LSRs are overlain***




***Same as above, except that gridpoint probability of being within a (blue) matched or (orange) false alarm rotation object is shaded***




***Comparison of the mean of the (top) maximum vertical vorticity ($s^{-1}$) in (orange) matched and (blue) false alarm rotation objects. The bottom panel is the same, except for the mean area of matched and false alarm objects***




***Ensemble member (left) analyses and (right) 90-minute forecasts where the front is analyzed further ("bad") east or ("good") west relative to the ensemble mean. 2-km AGL reflectivity is shaded, CAPE (J $kg^{-1}$) is contoured in red, CIN (J $kg^{-1}$) shaded blue, 0-2 km vertical vorticity ($s^{-1}$) swaths are dark gray and damage paths light blue***

## Object Statistics

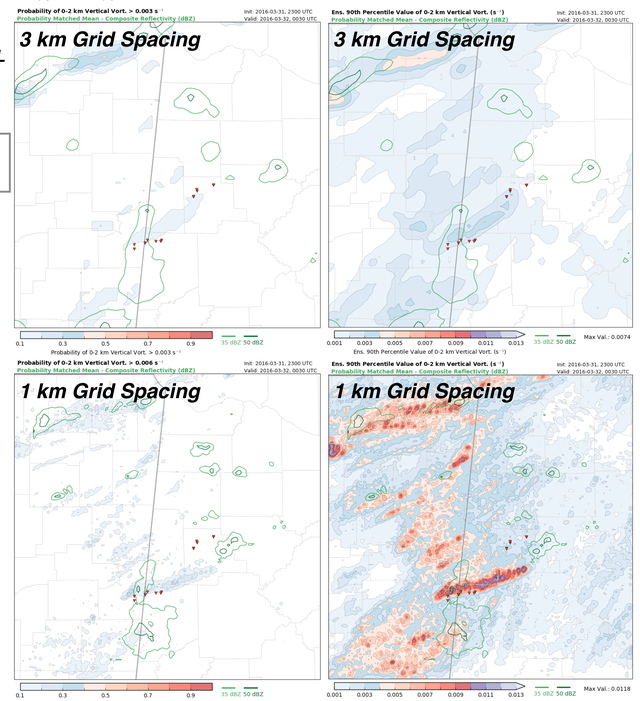
- Events characterized by more favorable tornado environments (23 December, 10 May) performed better than the composite of all events
- Events with marginal environments (31 March, 29 April) performed worse than the composite of all events
- Comparisons of diagnostic properties of rotation objects indicate that stronger, larger forecast rotation objects are more likely to be matched to observed objects
- This discrepancy may indicate improper tuning of vertical vorticity/az. wind shear thresholds used to identify objects

## 31 March 2016

- Poor rotation forecasts are produced for a series of tornadoes in northern AL
- Tornadoes developed within small cells embedded within a large region of thunderstorms; it is possible that 3-km grid spacing is insufficient to resolve these storms
- Downscaled 1-km forecasts from the 3-km analysis reveal some improvements
- Probability of low level rotation remains for the tornado producing storm
- However, the largest 90th percentile values are produced across the track, indicating a low probability of a high-impact event

## 23 December 2015

- Best ratio of matched to false alarm objects of the four V-SE cases and better than the yearly composite for all forecast times
- However, forecasts perform poorly during the early portions of the event (~2000 - 2100 UTC) before improving rapidly in later forecasts
- Examination of individual members reveals that small east-west errors in the placement of a stationary front can lead to large errors in resulting storm-scale forecasts
- Radar assimilation in members with frontal placement too far to the east places storms behind the front in a low CAPE/high CIN environment and storms are not sustained
- In contrast, members with frontal placement to the west produce forecasts of strong rotation over observed tornado tracks
- Limited evolution of frontal position in analyses suggests radar/satellite data have small effect on environmental features




***NEWS-e 90-minute forecasts for 31 March 2016 with (top) 3-km and (bottom) 1-km horizontal grid spacing. Left panels are probability of 0-2 km vertical vorticity > 0.003(0.006) $s^{-1}$ and right panels are the 90th percentile of vertical vorticity.***