REAL-TIME STORM-SCALE DATA ASSIMILATION AND FORECASTING EXPERIMENTS FOR NOAA'S WARN-ON-FORECAST PROJECT

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MOTIVATION

•The NOAA Warn-on-Forecast (WoF) Project is tasked with developing a regional 1-km storm-scale prediction system for the United States that assimilates radar, satellite, and conventional (e.g., surface) data

•The proposed WoF system, to become operational sometime in the next decade, will generate new 0-3 h probabilistic forecasts 3-4 times an hour, for the purpose of predicting hazardous weather phenomena, such as thunderstorm rotation, hail, high winds, and flash flooding

•A prototype system—known as the NSSL Experimental Warn-on-Forecast System for ensembles (NEWS-e)—has been developed in collaboration with the Global Systems Division (GSD)

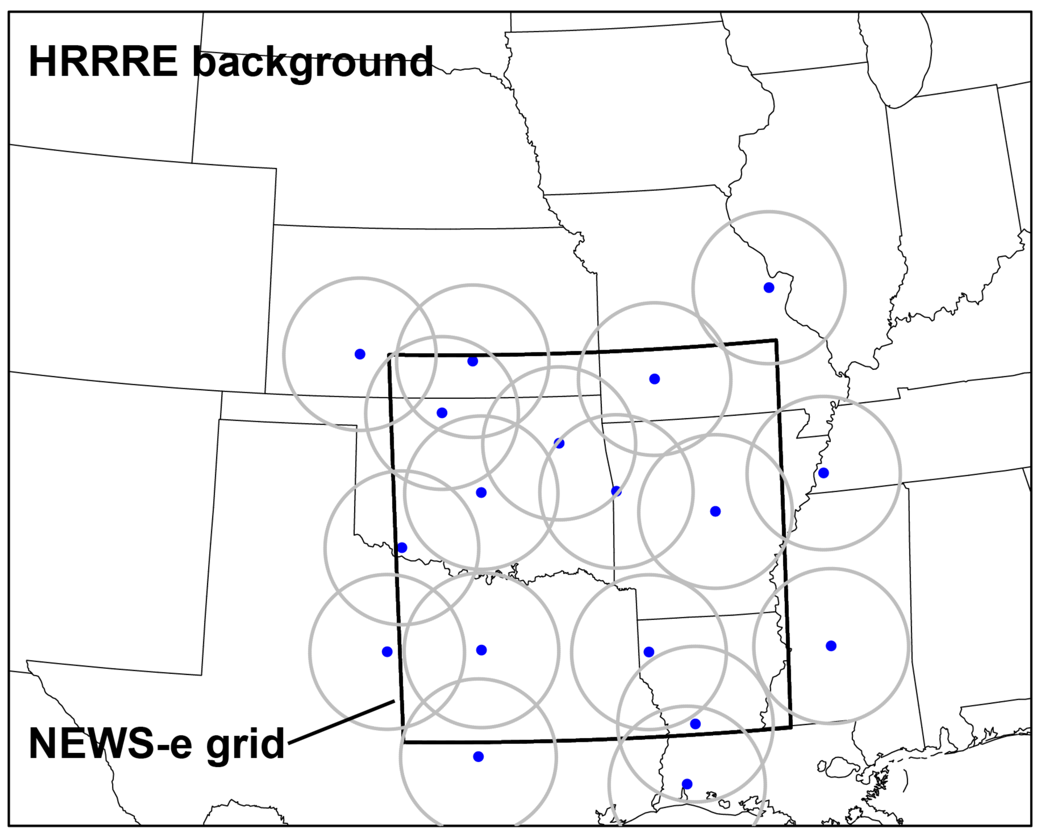

Fig. 1. A typical 3-km HRRRE background and nested NEWS-e grid (from 9 May 2016). Radar locations within NEWS-e grid shown as blue dots with 150-km range rings

2016 REALTIME FORECAST EXPERIMENT

- Run daily from 1800 UTC (Day 1) – 0300 UTC (Day 2)
- The starting point for each day's experiment was a 3-km, hourly cycled High-Resolution Rapid Refresh Ensemble (HRRRE) under development at GSD (see http://rapidrefresh.noaa.gov/HRRRE/)
- Ensemble Design (36 members)
  - Based on the Weather Research and Forecasting (WRF) model
  - 3-km horizontal gridpoint spacing; 51 vertical levels
  - 250 x 250 gridpoints (750 km x 750 km) domain, whose daily location targets the severe weather anticipated
  - Multi-physics ensemble (except all members use Thompson microphysics and the RAP land-surface model)
- Storm-scale analyses generated every 15 min
  - Observations
    - Reflectivity (> 20 dBZ); includes radar 'zeroes'
    - Radial velocity
    - Cloud water path retrievals from GOES imager; includes satellite 'zeroes'
    - Oklahoma mesonet (when available)
- Ensemble forecast schedule
  - 180-min (90-min) storm-scale forecast launched at :00 (:30) past the hour; 5-min model output

RESULTS FROM 9 AND 16 MAY 2016

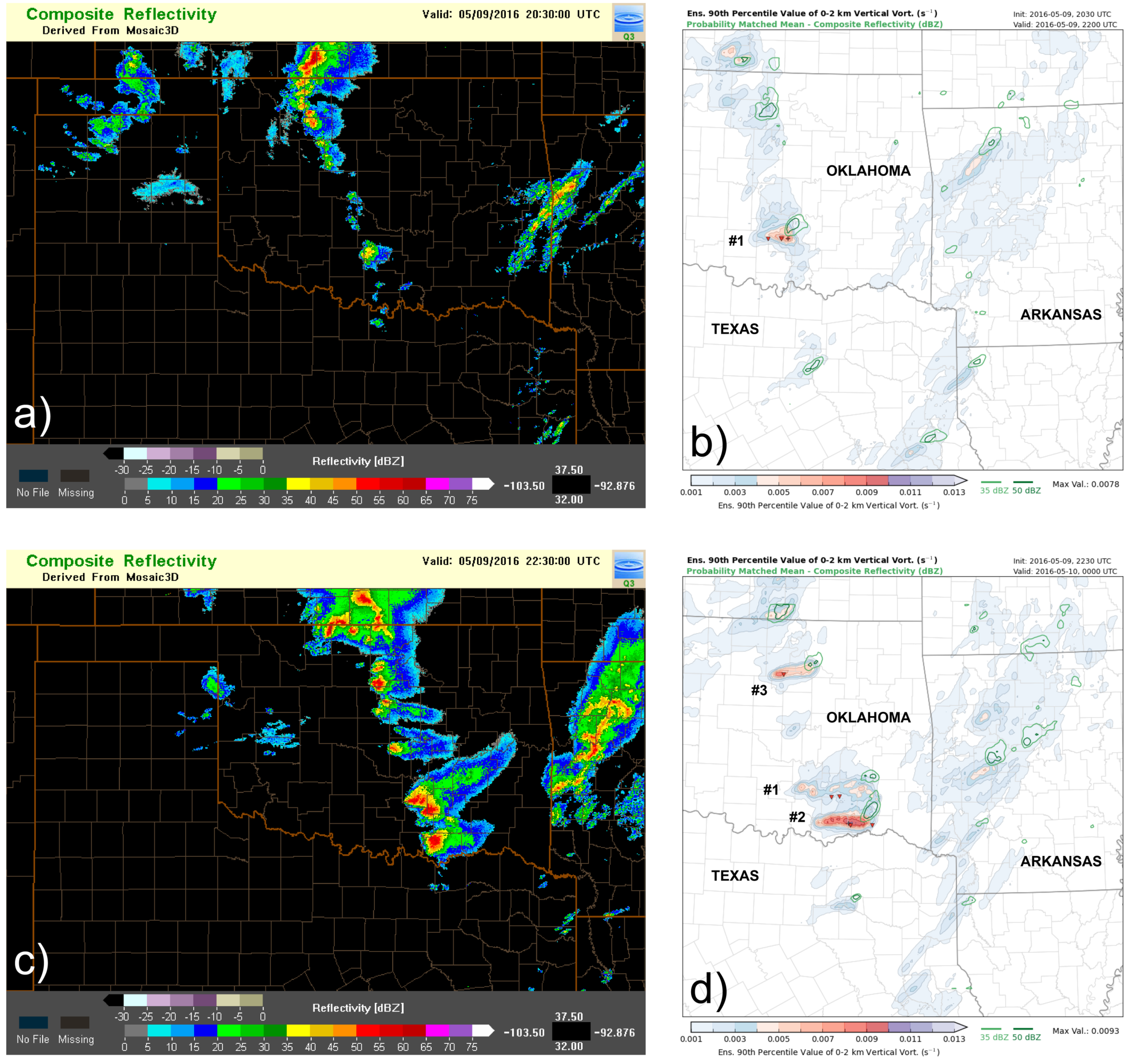

Fig. 2. Obs. reflectivity and ens. 90th percentile 0-2 km vertical vorticity (s^{-1}) at (a)-(b) 2030 UTC and (c)-(d) 2230 UTC 16 May 2016. In panels (b) and (d), red triangles indicate tornado reports

•Forecasts generally produce vorticity swaths coincident with tornado reports at lead times of 30 min (or more)
•Storm #1 (see panel B)—which produced the most violent tornado on 9 May—is characterized by relatively weak vorticity values, compared to storms #2 and #3 in panel D

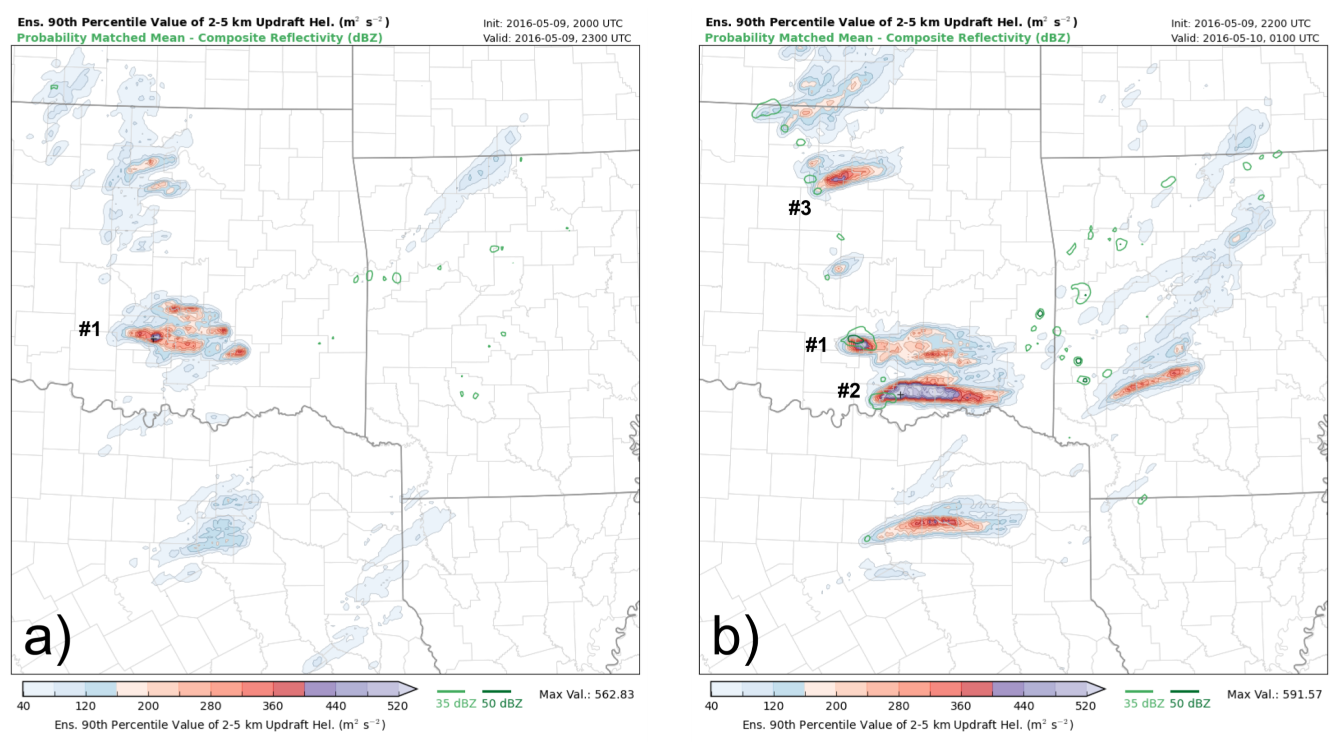

Fig. 3. 3-h forecasts of ens. 90th percentile value of 2-5 km updraft helicity (i.e., updraft rotation) initialized at (a) 2000 UCT and (b) 2200 UTC 16 May 2016.

- 3-h forecasts able to identify most persistent storms, with some false alarms (over Texas and Arkansas)

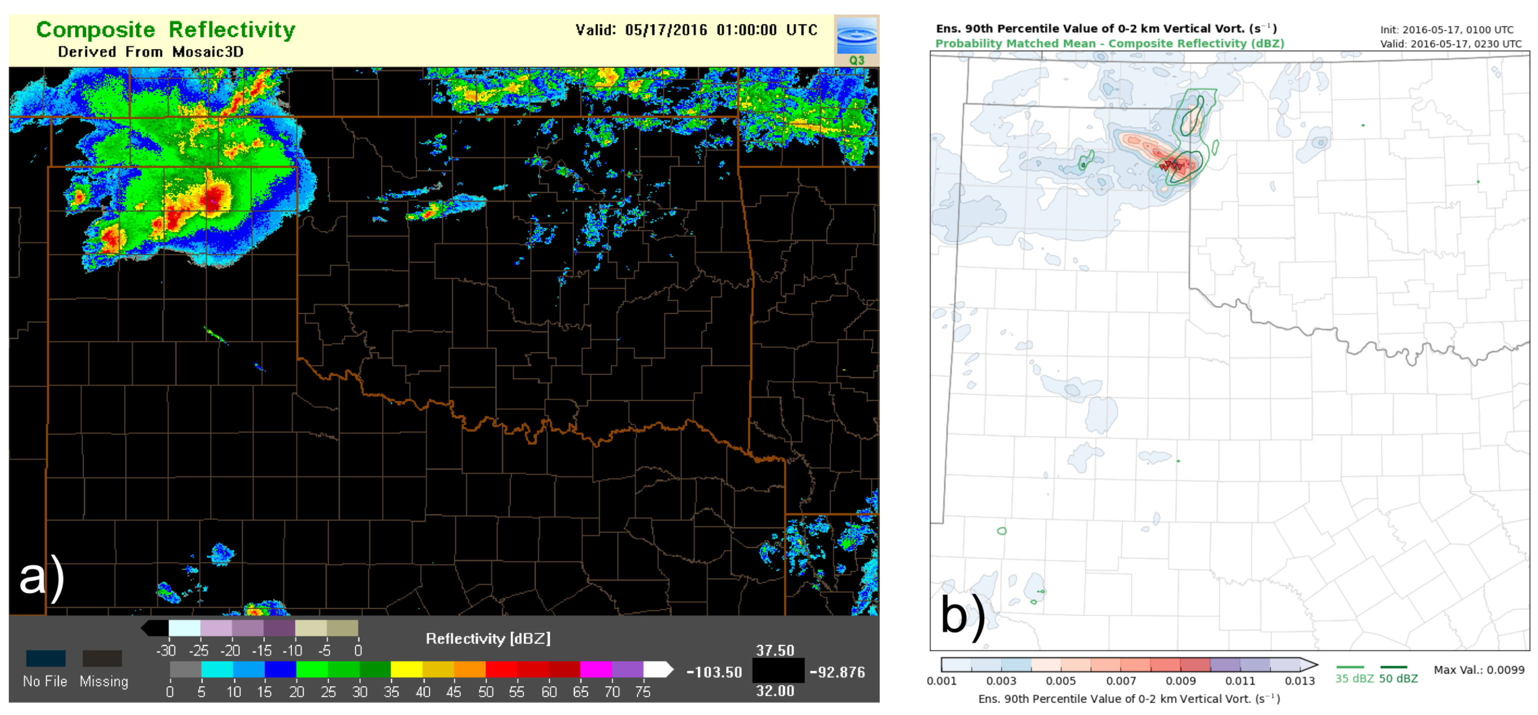

Fig. 4. Same as Fig. 2, except at 0100 UTC 17 May 2016

- Forecasts produce elevated vorticity values coincident with tornado reports over 1 h prior to first report
- Seemingly higher mesoscale predictability a possible factor