SENSITIVITY OF SUPERCELL SIMULATIONS TO INITIAL-CONDITION RESOLUTION

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MOTIVATION

- The NOAA Warn-on-Forecast (WoF) program aims to deploy real-time ensemble data assimilation (DA) and prediction systems to improve short-term forecasts and warnings of convective hazards
- Ensemble initial condition (IC) resolution is limited
  - Real-time DA on < 3-km grids is computationally difficult
  - Atmosphere is generally unobserved at scales < 1 km
- Knowledge of IC resolution dependence of storms needed to:
  - Better understand practical predictability of severe storms
  - Develop optimal hybrid-resolution WoF ensembles
  - Calibrate and interpret WoF output
  - Prioritize model & observational improvements

METHODS

- Generate 250-/333-m supercell simulations (CNTL)
  - Idealized: 24 May 2011 (El Reno, OK)
  - Full-physics: 19 May 2013, 6 May 2015 (Norman, OK)
- Filter CNTL at time of mature storm, then re-integrate model
  - Remove wavelengths < 2, 4, 8, or 16 km from IC
- Compare filtered-IC sims to CNTL to assess impact of initially absent scales
- Use ensemble approach to obtain general results
  - Generate ensembles by adding white noise to IC's
  - Examine probability-matched means

RESULTS

- Missing IC scales largely recovered within 5 min (Fig. 1)
- After that, storm evolution qualitatively insensitive to missing IC scales ≤ 8 km (Figs. 2-5)
- Exception: timing of low-level rotation (Fig. 6)
- See Potvin et al. (2017, *JAS*)

IMPLICATIONS

- Analysis Δx < 3km or denser radar data may not substantially improve forecasts
- Computational resources are better spent reducing *forecast* Δx

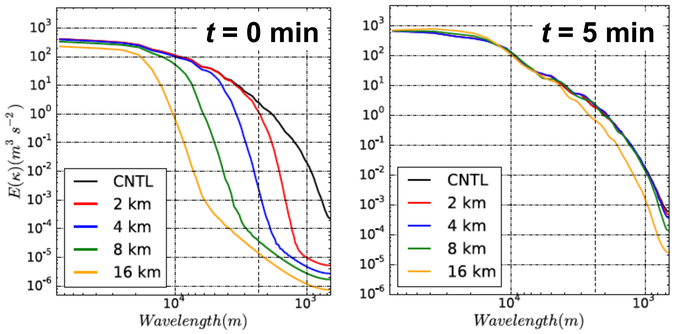

Fig. 1. 2D vertical velocity energy spectra averaged over lowest 5 km of El Reno simulations at (left) t = 0 and (right) t = 5 min.

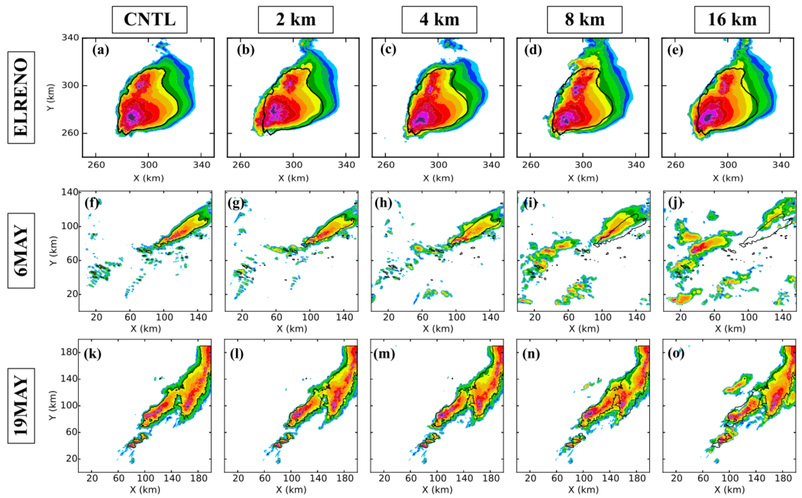

Fig. 2. Reflectivity (dBZ) ~ 2 km AGL at t = 120 min.

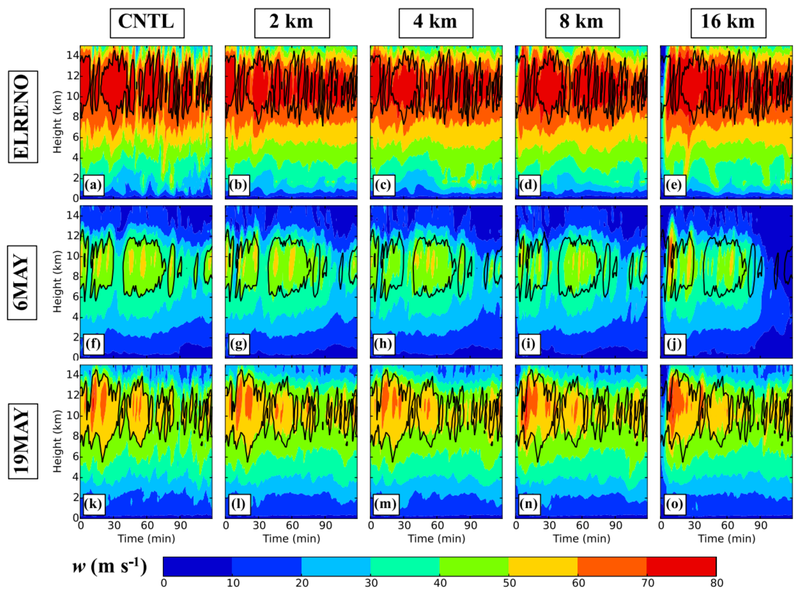

Fig. 3. Time-height vertical velocity composites. CNTL 70, 40, and 50 m s^{-1} contour overlaid in El Reno, 6 May 2015 and 19 May 2013 panels, respectively.

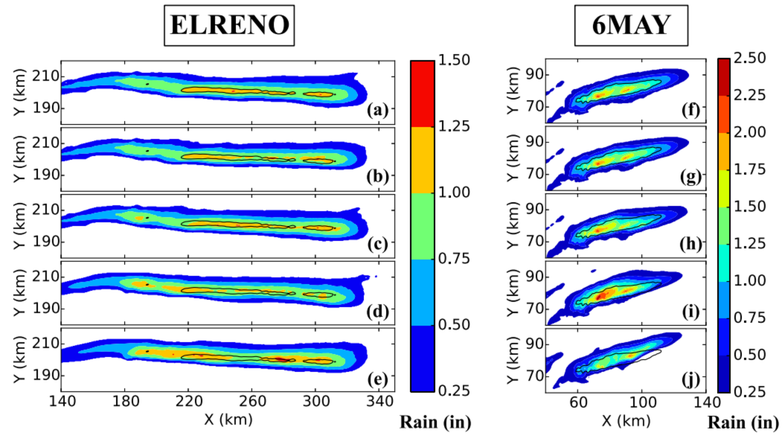

Fig. 4. Total rainfall for (left) El Reno and (right) 6 May 2015 for (top to bottom) CNTL, 2-km, 4-km, 8-km, 16-km ensembles. CNTL 1-in contour overlaid in each panel.

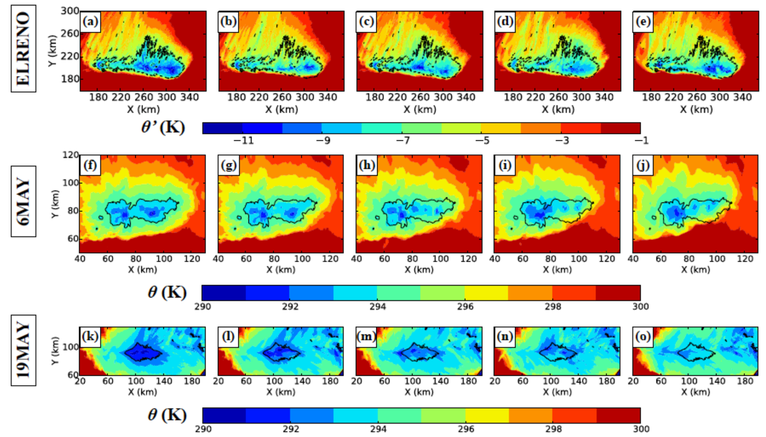

Fig. 5. Horizontal composites of lowest-level θ' or θ.

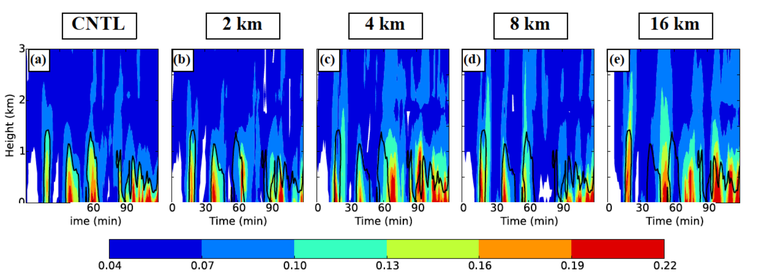

Fig. 6. Time-height vertical vorticity composites (s^{-1}) for El Reno. CNTL 0.1 s^{-1} contour overlaid in each panel.