CONVECTIVE-SCALE ANALYSES AND FORECASTS OBTAINED USING LETKF VS. SERIAL DATA ASSIMILATION

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BACKGROUND

- The NOAA Warn-on-Forecast (WoF) program aims to deploy real-time ensemble data assimilation (DA) and prediction systems to improve short-term forecasts & warnings of storm hazards
- Which is better for convective-scale DA: LETKF or serial filters?
- Each filter type has advantages/disadvantages; no clear winner
  - ➢ LETKF potentially scales better to huge core counts
  - ➢ LETKF better preserves mass balance
  - ➢ Serials filters may accelerate ensemble spin-up
- Thompson et al. (2015, *QJRMS*) found LETKF competitive with EnSRF using cloud model (NCOMMAS)
- We extend this work to full-physics (WRF-ARW) model with exclusive focus on real-data experiments

METHODS

- Compare 3-km ensemble analyses/forecasts from NSSL WRF-LETKF vs. previous version of NSSL Experimental WoF System ensemble (NEWS-e), which uses WRF-DART EAKF
- Three supercell cases: 19 May 2013, 20 May 2013, 27 Apr 2014
- IC/BC for LETKF obtained from NEWS-e 3-km grid
- 36 members; Thompson microphysics; radiation/PBL/surface physics diversity (see Wheatley et al. poster)
- 15-min cycles; three 88D's and Oklahoma mesonet assimilated
- Both systems used Additive Noise; LETKF used Return to Prior Perturbation (RTPP), NEWS-e used DART Adaptive Inflation

RESULTS

- Similar obs diagnostics quality for both systems (Fig. 1)
- LETKF updates are more balanced (Fig. 2)
- Neither system produces generally better cold pool temperatures (Fig. 3), storm rotation (Fig. 4), or rainfall (Fig. 5)
- Preliminary conclusion: consistent with Thompson et al. (2015), LETKF and serial filters have similar convective-scale accuracy
- *This motivates continued exploration of the potentially superior computational scaling of the LETKF*

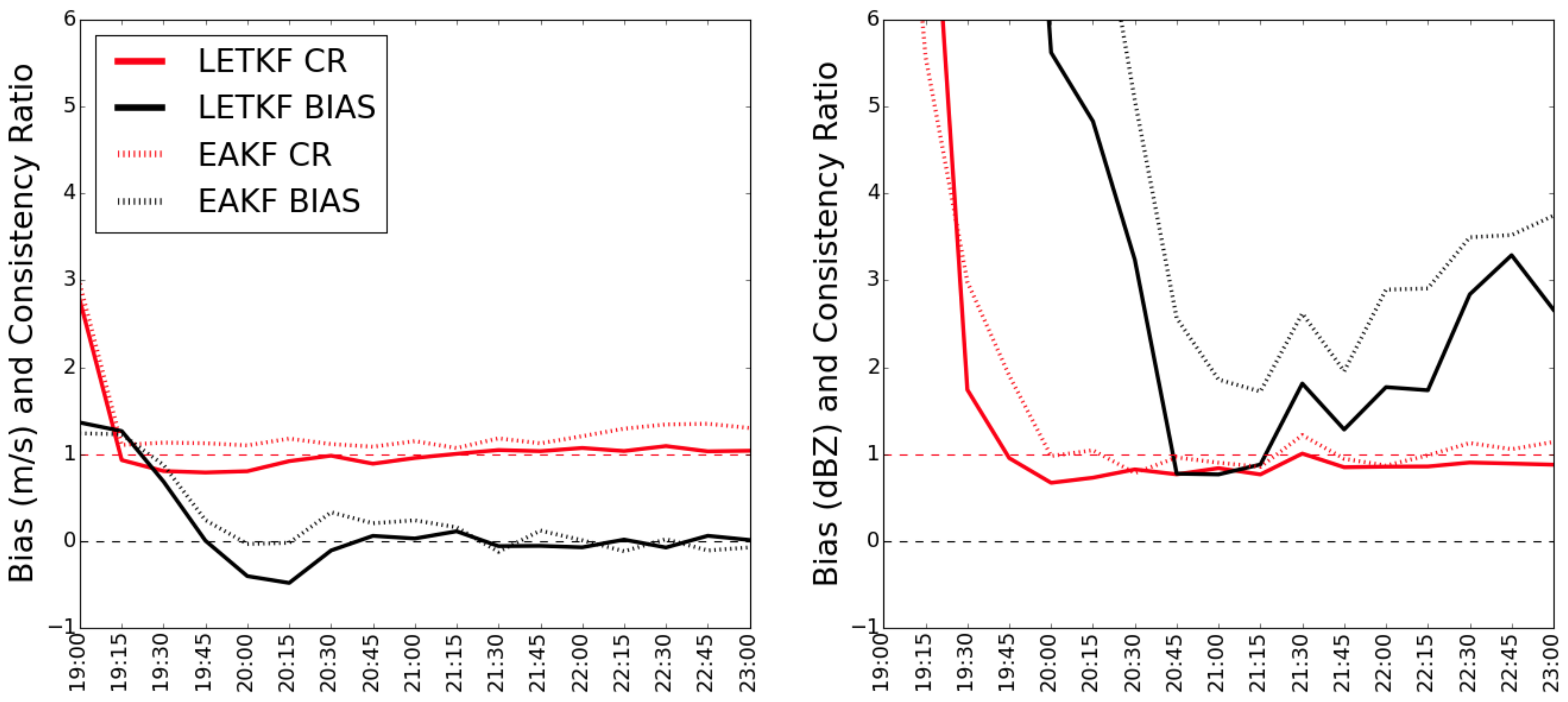

Fig. 1. Mean innovations and consistency ratios for 19 May 2013 analyses.

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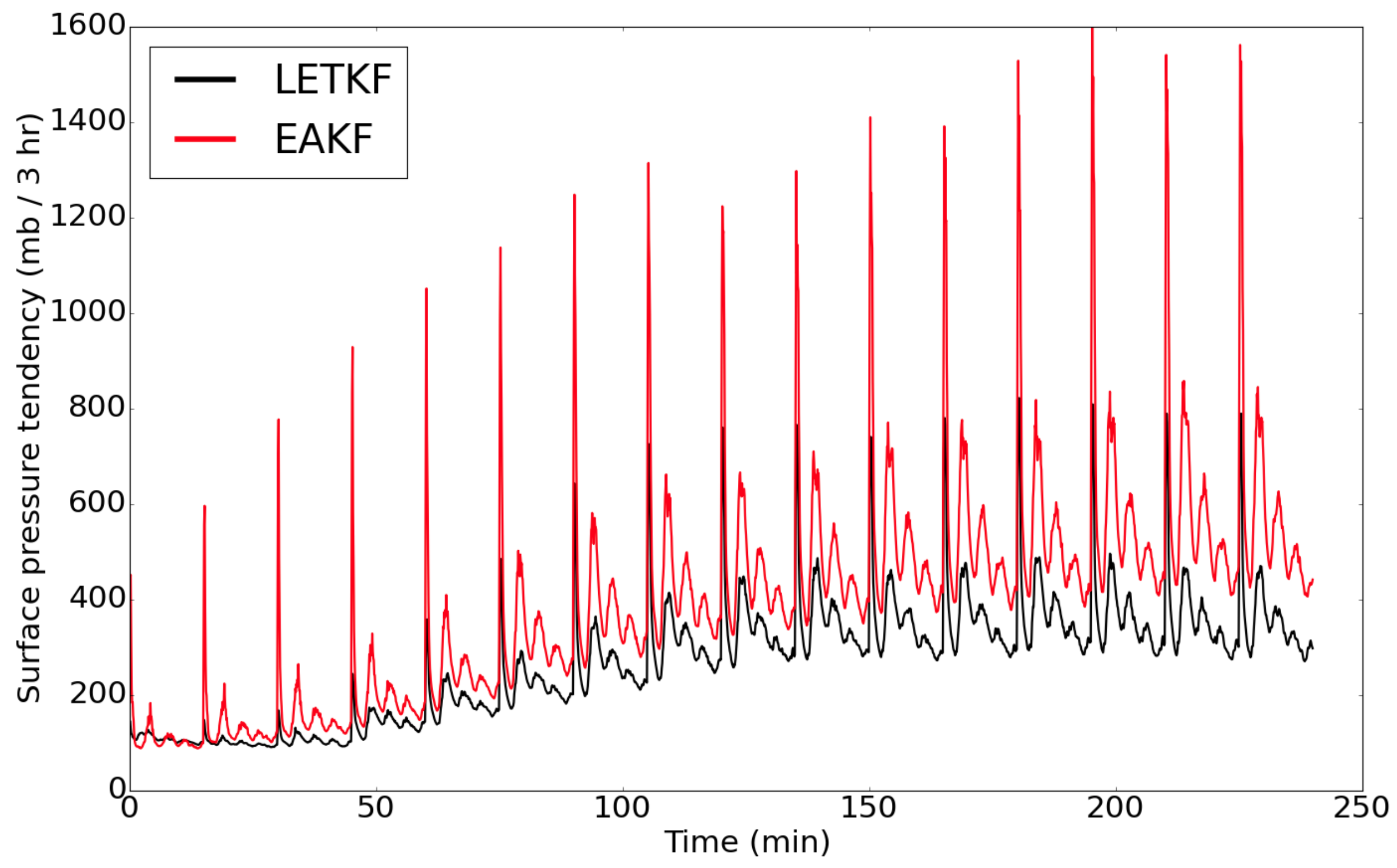


Fig. 2. Ensemble- and domain-averaged surface pressure tendencies for 19 May 2013 analyses.

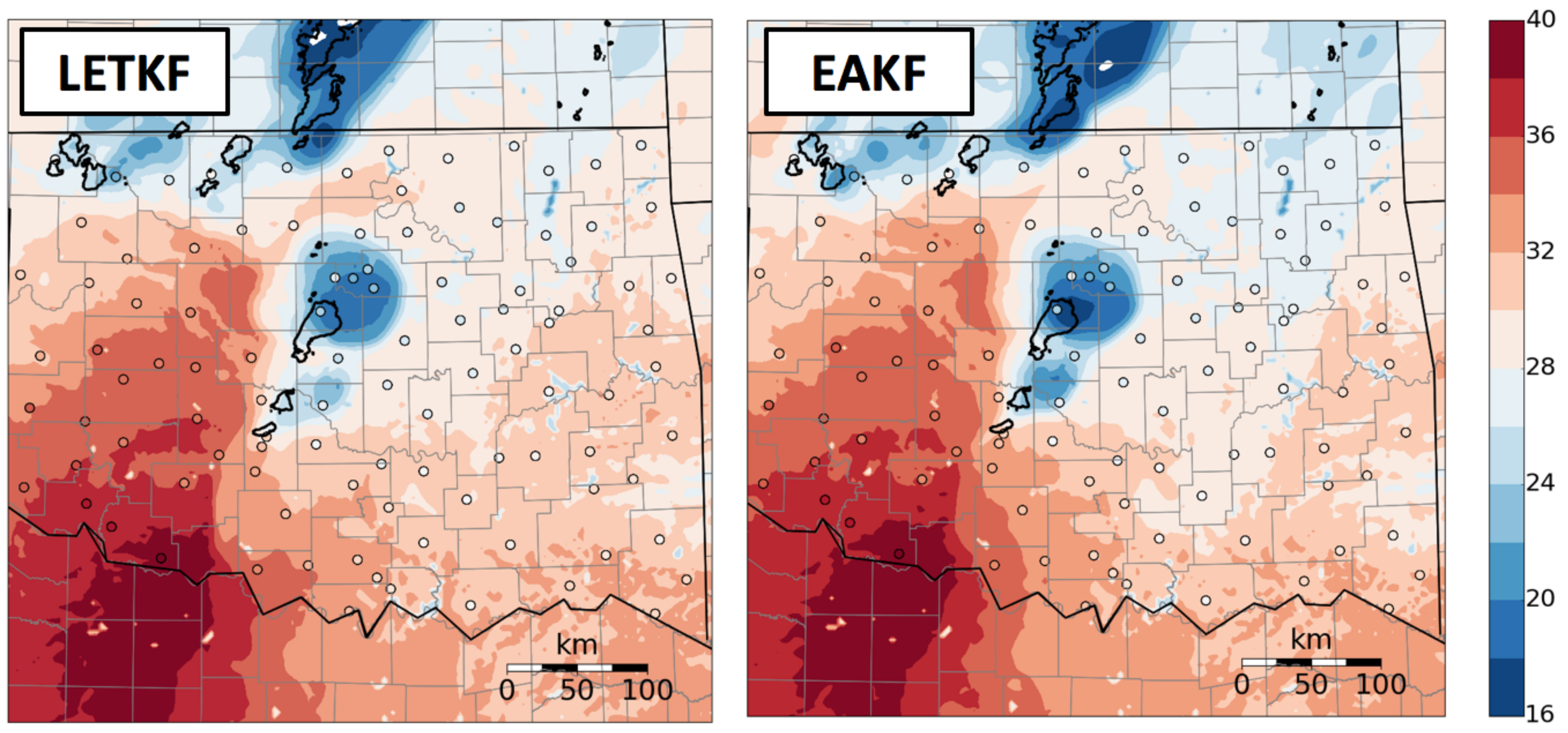
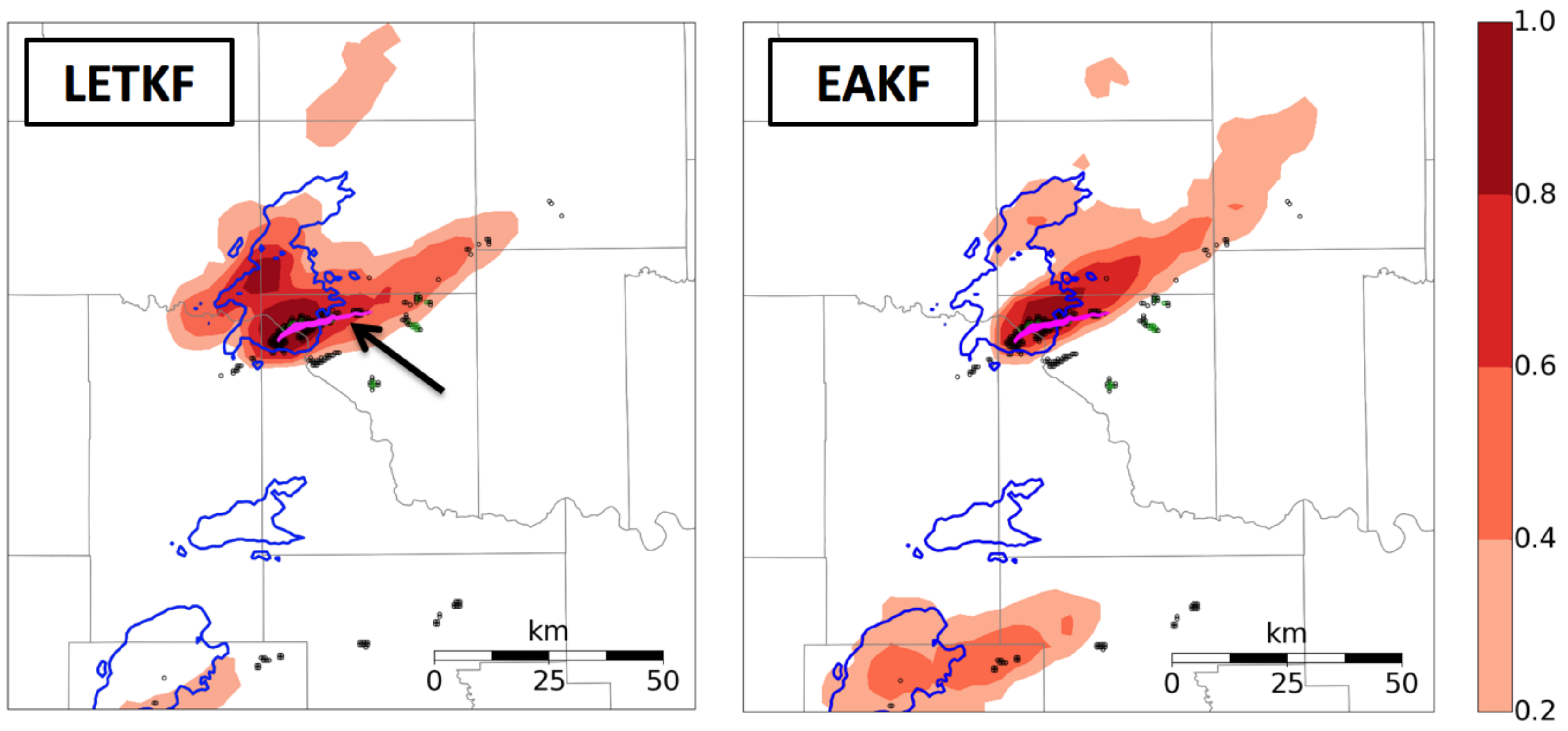
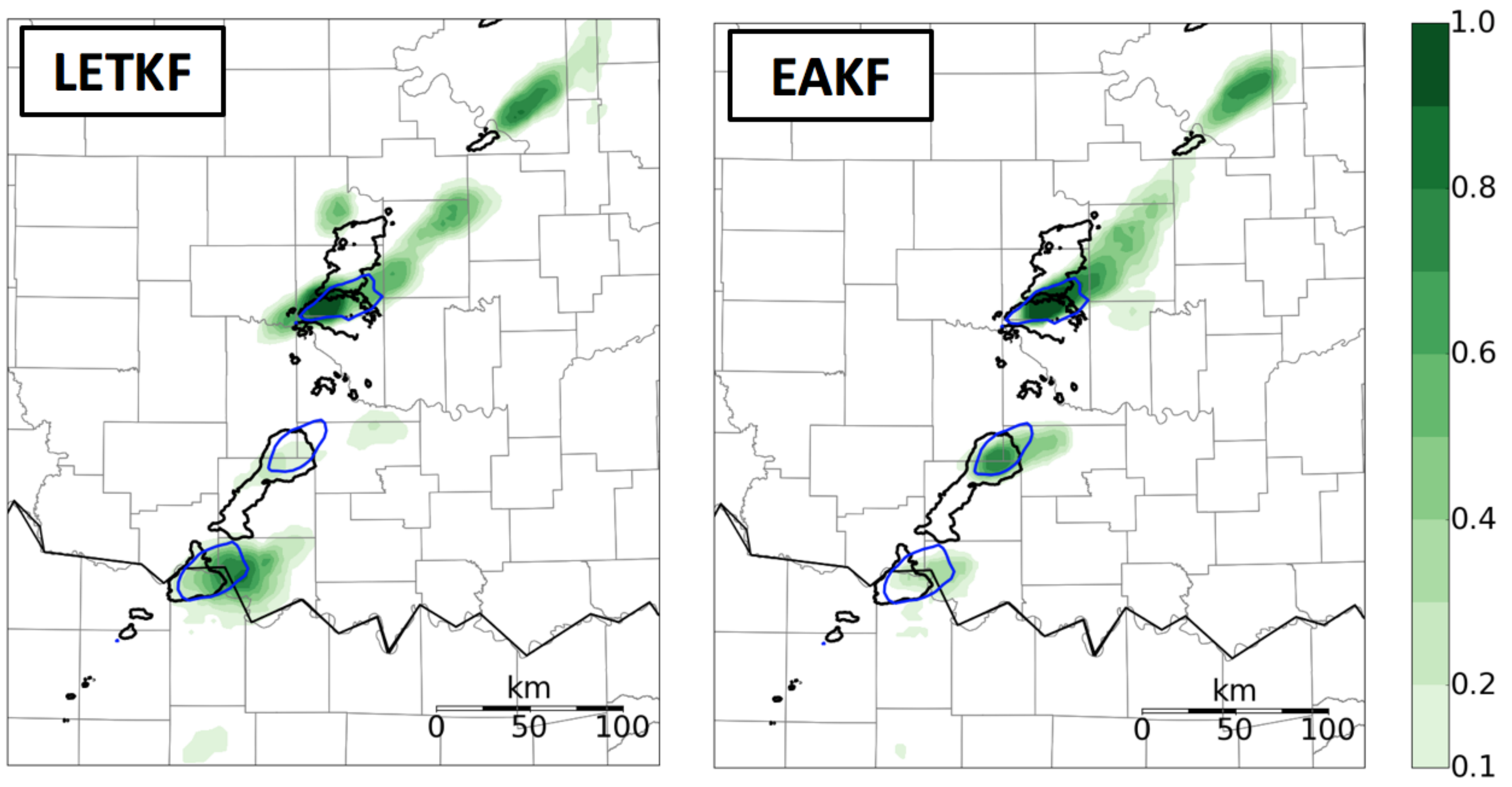


Fig. 3. Minimum 2-m *T* for 19 May 2013 2100-2200 UTC forecast.
Shading: ensemble mean Circles: Oklahoma mesonet obs
Contours: 40 dBZ obs at initial time



Shading: neighborhood ensemble probability $\zeta > .005\ s^{-1}$ below 2 km AGL
Contours: 40 dBZ obs at initial time; tornado damage path (1956-2035 Z)
Dots: NSSL rotation detections 1900-2200 Z (green = stronger)

Fig. 4. Vorticity swaths for 20 May 2013 1930-2030 UTC forecast.



Shading: Neighborhood ensemble probability of 1-h rainfall > 0.5"
Blue contours: NCEP Stage-4 rainfall > 0.5" Black contours: 40 dBZ obs at 20 Z

Fig. 5. Rainfall swaths for 20 May 2013 20-21 UTC forecast.