REMOVING ACOUSTIC-MODE PRESSURE OSCILLATIONS FROM STORM-SCALE ENKF ANALYSES

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MOTIVATION

- Radar data assimilation introduces dynamical imbalances that lead to acoustic waves (**Fig. 1**)
- Resulting pressure oscillations inhibit investigation of storms
- Solution: thermodynamically retrieve balanced pressure

THERMODYNAMIC RETRIEVAL

- Traditionally, π' (hereafter, p) and θ' retrieved from dual-Doppler wind synthesis and reflectivity-derived mixing ratios using equations of motion
- In this study, only p retrieved, and wind/thermal/hydrometeor fields taken from EnKF analysis
- 2D methods lead to vertically varying constant offset in p
- 3D methods permit unique solution for dp/dz, but errors in vertical motion equation terms degrade dp/dx, dp/dy
- Proposed method combines strengths of 2D & 3D:
  1) Do 2D retrieval → p_{2D} 2) Do 3D retrieval → p_{3D}
  3) Estimate vertically varying p offset as: $\langle p_{2D} - p_{3D} \rangle$
  4) Subtract offset from 2D retrieval: $p_{final} = p_{2D} - \langle p_{2D} - p_{3D} \rangle$

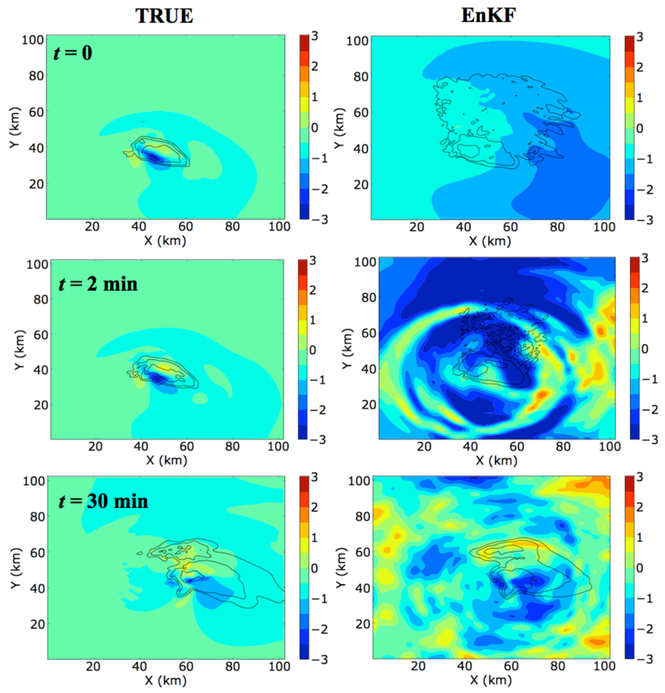

Fig. 1. True and EnKF mean posterior p (shading; hPa) at z = 0.9 km after zero, one, and fifteen 2-min forecast cycles. Reflectivity contoured at 10, 30, 50 dBZ.

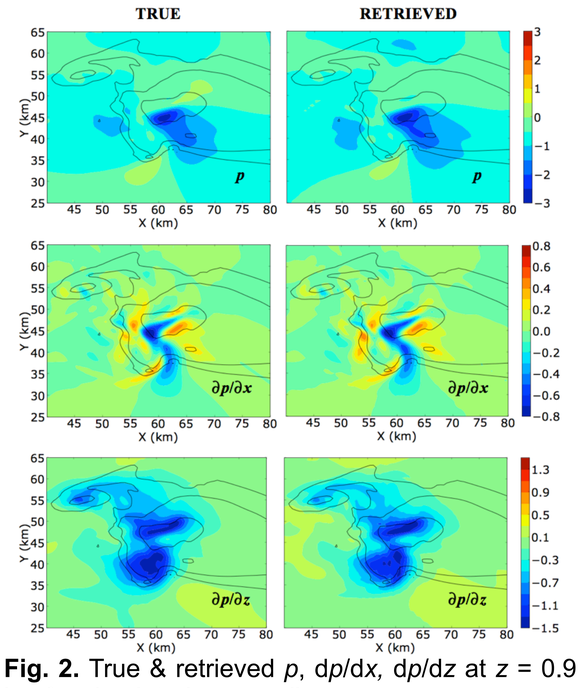

Fig. 2. True & retrieved p, dp/dx, dp/dz at z = 0.9 km for simulated supercell.

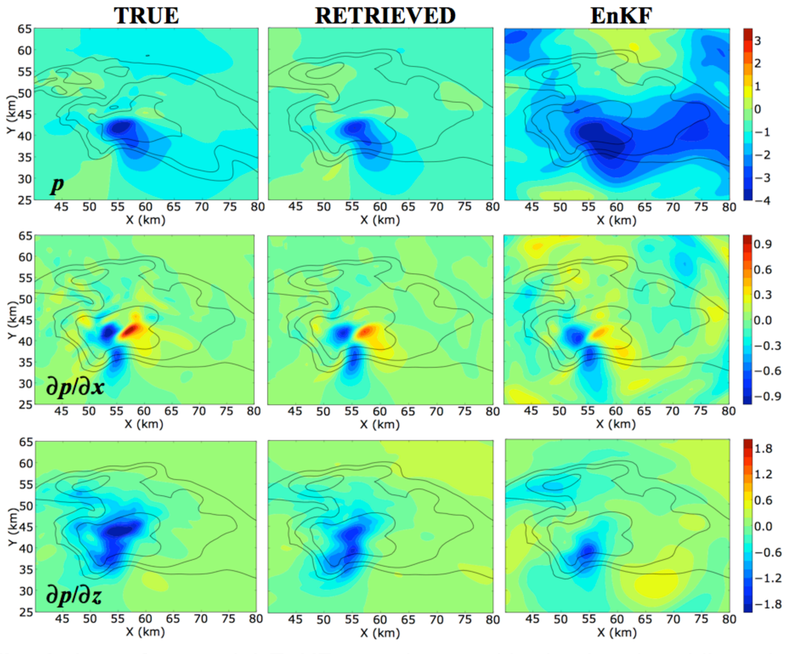

Fig. 3. Imperfect-model EnKF experiment with simulated mobile radar data. Valid after 20 min of assimilation at z = 0.9 km.

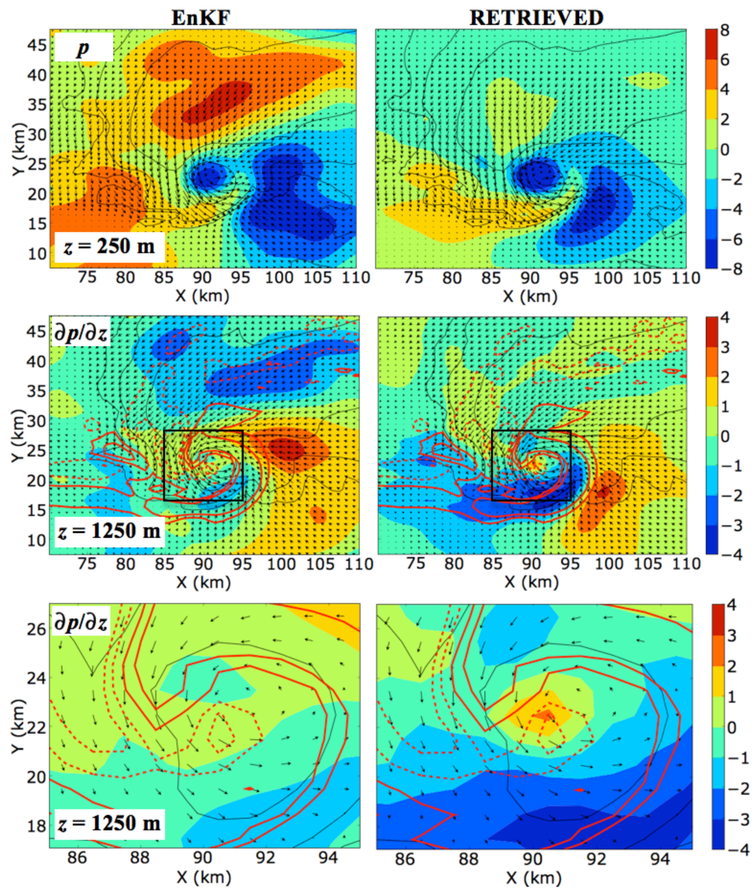

Fig. 4. EnKF mean posterior & retrieved p at z = 250 m and dp/dz at z = 1250 m. Black squares in middle row outline domain (centered near occlusion updraft) in bottom row. EnKF mean w (red; dashed = negative) contoured at -5, -2, 2, 5 m s^{-1}. Arrows: EnKF mean u, v.

RESULTS

- p retrievals for simulated supercell very successful (**Fig. 2**)
- In imperfect-model OSSE, retrieval improves upon EnKF p (**Fig. 3**)
- Retrieval from EnKF analysis of real mobile radar observations of a supercell corrects obvious errors in EnKF p, and yields more plausible vertical pressure gradient near analyzed occlusion downdraft (**Fig. 4**).
- **More results:** Potvin and Wicker (2013), *Adv. In Meteorology*