High-resolution Ensemble Experiments for the Tsukuba City Supercell Tornado in Japan on 6 May 2012

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1. Introduction
To clarify mechanisms of supercell tornadogenesis, it is useful to perform statistical analyses using ensemble forecasts of observed tornadoes. In the present study, we carried out 33-member ensemble forecasts with 50-m horizontal resolution for a supercell tornado in Japan on 6 May 2012. With ensemble-based analyses, we examined which variables are important for the tornadogenesis.

2. Data Assimilation with Nested-LETKF System

- Outline of nested-LETKF system
  - 5/3, 09JST
  - 5/6, 03JST
  - 5/6, 09JST
  - 5/6, 13JST
- Distribution of radars and dense surface observations
- Polarimetric Doppler radar (radial wind was assimilated)
- Distribution of surface observations

3. Forecasted Tornado

- #1 (Member with strongest max. vorticity at $z^*=30m$)
  - Colored: temperature at $z^*=1.5m$ (K)
  - Cloud water mixing ratio $\sim g$ kg$^{-1}$
  - Vertical vorticity $>0.2s^{-1}$
  - Vertical vorticity $>0.6s^{-1}$
  - Arrows: horizontal wind at $z^*=30m$ (m s$^{-1}$)

4. Origin of Tornado Circulation

- Circulation and baroclinic and friction terms of backtracked circuits
- Friction contributes dominantly to change the circulation $\Gamma$ (baroclinic term is small), but does not necessarily increase $\Gamma$.
  → Tornado strength does not depend on the origin of circulation.

5. Correlation of Tornado Strength

- Scatter plot of vorticity and water vapor 3-min before the time of max. strength
- Time from max. vorticity at $z^*=30m$ [min]
- Low pressure associated with strong mesocyclone
- Large buoyancy because of low LFC associated with humid parcel

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References