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A Numerical Study on a Tornado that Formed in a Quasi Linear Convective System over Kanto plain in Japan

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Quasi-linear convective systems (QLCSs) spawn about 18% of tornadoes in the United States (Trapp et al. 2005). Although tornadoes associated QLCSs also occur and cause severe damages in Japan, their detailed features and formation mechanism have not been well understood. Thus, we performed a high-resolution quadruply-nested numerical simulation to reproduce a Chiyoda-town, Ibaraki prefecture tornado spawned by a QLCS over Kanto Plain in Japan on 8 December 1992 and to examine the formation process of the tornado.
The simulation using Japanese Meteorological Agency non-hydrostatic model (Saito et al.. 2006) in the outer domain with horizontal grid size of 2km successfully reproduced the QLCS, which propagated eastward and reached around Kanto Plain at 0830 JST. Downdrafts and an associated cold pool existed behind the convection region with strong updrafts exceeding 10m/s. The simulation in the innermost domain with the horizontal grid size of 50m successfully reproduced the tornado in the QLCS. The vertical vorticity and horizontal velocity of the simulated tornado exceeded 0.7 /s and 47m/s, respectively. At around 500m AGL, a low-level mesocyclone, which was accompanied by strong updrafts (>20m/s), formed and developed around the location of the tornadogenesis. Near the surface, strong rear-inflow jet (RIJ) accompanied by relatively cold air developed behind the location of the tornadogenesis. Thus, the RIJ appears to have played an important role in the formation and development of the tornado.