A Numerical Case Study on a Tornado that Formed in a Quasi Linear Convective System

*Eigo Tochimoto[1], Hiroshi Niino[1]

1. Atmosphere and Ocean Research Institute, The University of Tokyo

Tornadoes are mainly classified into three groups based on different types of convective systems: supercells, quasi-linear convective systems (QLCSs), and non-supercells. In the United States, it is estimated that 18% of all tornadoes are spawned by QLCSs. In Japan, although tornadoes associated QLCSs also occur and cause severe damages, the detailed features and formation mechanism of tornadoes have not been well under stood. Thus, we performed a high-resolution numerical simulation to reproduce and examine the formation process of a tornado that formed in a quasi linear convective system at Chiyoda-town, Ibaraki prefecture, Japan on 8 December 1992.

A quadruple-nested simulation using Japanese Meteorological Agency non-hydrostatic model was performed. A simulation with horizontal scale of 2km successfully reproduced the QLCS, which propagated eastward quickly and reached around Chiyoda-town at 0830 JST. A cold pool and its associated downdrafts existed behind the convection region with strong updrafts (>10m/s). A simulation with the finest horizontal scale of 50m successfully reproduced the tornado in the QLCS. The vertical vorticity and horizontal velocity exceeded 0.7 $s^{-1}$and 47m/s, respectively. At around 500m height, a low-level mesocyclone, which was accompanied by strong updrafts (>20m/s), formed and developed around the location of tornadogenesis. Near the surface, at 1 or 2 minutes before the tornadogenesis, strong rear-inflow jet (RIJ) accompanied by relatively cold air developed, and then tornado formed in the north of the RIJ. Thus, it is suggested that the RIJ play some roles in the formation and development of the tornado.

Keywords: Tornado, Convection

