Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

AAS02-10 会場:201B 時間:5 月 26 日 16:40-16:55

2012 年 5 月 6 日に発生したつくば竜巻の超高解像度シミュレーション
Super high-resolution simulation of the 6 May 2012 Tsukuba Supercell Tornado (2012)

益子 渉 [1]*
MASHIKO, Wataru[1]*

[1] 気象庁気象研究所
[1]Meteorological Research Institute, JMA

Detailed structure of tornadoes remain poorly understood because of difficulties in collecting observational data around a tornado with fine spatial and temporal resolutions. Most of previous studies have been conducted by photogrammetric analyses, laboratory experiments, and large eddy simulations, which contains nonnegligible calculational errors or some unrealistic aspects. In this study, we performed downscale experiments under realistic conditions for the Tsukuba Supercell Tornado (2012) using nested grids with as small as 10-m horizontal grid spacing to resolve the fine-scale tornado structure. The numerical model used in this study is the Japan Meteorological Agency Nonhydrostatic Model. The model contains 4001 x 3001 grid points in the horizontal and 250 vertical levels with grid intervals of 10 m near the surface.

Minimum pressure of a simulated tornado reaches 937 hPa (pressure deficit; 65 hPa), and maximum ground-relative surface wind speeds exceed 70 m s^{-1}. During the rapid intensifying stage, the vortex core region accompanying large vertical vorticity contracted and was gradually occupied by downdraft. After that, the central downdraft intensified, and multiple vortices formed with an increase of horizontal dimension of a tornado. Thus, it is evident that the simulated tornado evolved from one-celled to two-celled tornado and subsequently exhibited multiple vortices, which are consistent with a tornado-like vortex evolution in laboratory experiments. There exist two prominent cyclonic subvortices associated with pressure deficit when most significant multiple vortices formed. Although subvortices locally intensify winds owing to the superposition of the velocity field associated with the small-scale subvortex and the larger-scale tornado, the strongest wind is found in the shrinking stage prior to multiple vortices. The evolution of the tornado structure roughly depended on the swirl ratio. When the swirl ratio got large, the multiple vortices became prominent.

キーワード: 竜巻, スーパーセル, 数値シミュレーション
Keywords: tornado, supercell, numerical simulation