AOGS 2005

Simulation of Wintertime Supercell Storm over the Taiwan Strait in a Subtropical Environment

GEORGE TAI-JEN CHEN[1], CHUNG-CHIEH WANG[2], and SHAN-CHIEN YANG[1]
[1]*Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan*
[2]*Department of Environmental Management, Jin-Wen Institute of Technology, Taipei, Taiwan*

Over Fukien Province of China and Taiwan, hailstorms were observed on successive days during 18-21 December 2002, and caused widespread damages in lives and properties. Such events were very rare in a subtropical environment even in wintertime. Synoptic analysis suggests that the area of southern China and Taiwan was located behind the surface cold front but ahead of the 850-hPa trough. Above a shallow layer of near-surface cold air, thick southwesterly flow existed with a strong upper-level westerly jet at 200 hPa, providing significant vertical wind shear, abundant moisture, and convective instability needed for storm development. In the afternoon of 19 December, three supercell storms formed near the coast of Fukien with a northeast-southwest alignment, and intensified and moved eastward across the Taiwan Strait then the island of Taiwan. The convective Richardson number (R_{ic}) was 26.3 and suitable for supercells [1]. All three storms, each about 30-35 km in horizontal scale, experienced storm-splitting for several times, with the southern one being the stronger cell after the split.

The Cloud-Resolving Storm Simulator (CReSS) developed by the Hydrospheric-Atmospheric Research Center of Nagoya University [2] was used to simulate the initial development and subsequent movement of these supercell storms. It was found that along the eastern slope of the Wuyi Mountain in Fukien, southeasterly upslope wind during daytime induced local convergence and upward motion, which was strong enough to achieve free convection and trigger storm development. The CReSS model also reproduced the storm-splitting process, and a pair of cyclonic and anticyclonic vortices, strongest near 700 hPa, was resulted, consistent with theory [3, 4]. The vorticity budget analysis confirmed that the vortex pair was produced through the tilting of background (vertical) shear vorticity by differential vertical motion.

Keywords: Supercell storm; hailstorm; numerical simulation; CReSS

References

[1] M. L. Weisman and J. B. Klemp. *Mon. Wea. Rev.*, **110**, 504 (1982).
[2] K. Tsuboki and A. Sakakibara. *High Performance Computing, Springer*, 243 (2002).
[3] J. B. Klemp and R. B. Wilhelmson. *J. Atmos. Sci.*, **34**, 1097 (1978).
[4] R. Rotunno. *Mon. Wea. Rev.*, **109**, 577 (1981).