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The Structure and Characteristics of a Mesoscale Convective Vortex on Mei-yu Front

Yinong Pan
School of the Atmospheric Sciences, Nanjing University, Nanjing, 210093, China (pyn@nju.edu.cn)

In this paper, using the data of Japanese GANAL regional model output, IR1 data of Japanese MT1R satellite, TRMM rainfall data and NCEP reanalysis data, we explored the structure and characteristics of a mesoscale convective vortex (MCV) which formed on Chinese Meiyu-front in 0600 UTC July 25th 2008 and lasted for almost two days.

The center of the MCV located on the midtroposhere (600hPa-400hPa) which was the transition layer between the upper diabatic heating and lower diabatic cooling of stratiform region. In view of the maximum tangential wind radius, the diameter of the vortex was nearly 200km. The maximum vorticity of the vortex exceeded 3×[U+3016]10[U+3017](-4) s(-1). On the west of the MCV, there was another mesoscale cyclonic vortex in the lower troposphere (900hPa-700hPa), and we call it low-level cyclonic vortex (LCV). Although we did not find out the exact reason of its formation, it appeared that it had a close relationship with the Southwest Vortex (SV) which is very famous and often-detected during the summer monsoon season in China. The thermal structure of the mature MCV showed a positive upper anomaly of potential temperature and a negative lower anomaly of potential temperature, which enforced the stability of the MCV and was essential for MCV's long-lasting. The vertical thermal structure of LCV was less stable than that of MCV. The inner thermal stability was the main factor to distinguish MCV and LCV.

In the duration of the MCV, there were two obvious moist activities. The former one was resulted from stratiform, while the latter one was an obvious secondary convection forming on the downshear side of MCV. MCV's ability to focus moisture, wet LCV, and formation of deep wet column were all essential for the formation of the secondary convection. Although the updraft in stratiform rain case was nearly twice as large as that in convection, its maximum located in a high level. On the opposite, for the secondary convection, its extreme updraft was at low-level, which could lift the low-level wet air mass up and formed convection.

In this case, the MCV experienced intensification, then weakening, and re-intensification. During its first intensification, the vorticity of the MCV reached its maximum value. However, during its second intensification, the growth of its vorticity was limited, but the area it affected obviously extended. The formation of the MCV might be the result of the vortex stretching responding to the strong convergence of the stratiform region. In diagnose of vorticity budget, the stretching term was always the most dominant one, while the result of tilting was much more complex and seemed less important.