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A Diagnostic Case Study on the Interaction Between Meiyu Front and Mesoscale Convective Systems Near Taiwan

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The present study performed diagnosis on an east-west oriented Meiyu front case located over southeastern China and Taiwan during the period of 6-7 June 2003. The front was shallow with weak thermal gradient and little vertical tilt, but was associated with strong horizontal shear [1]. During the period several large mesoscale convective systems (MCSs) were in active development along and to the south of the front, and the horizontal vorticity associated with the front increased significantly at 850 hPa. Eventually, a low-level jet (LLJ) also formed south of the MCSs, which led to heavy rainfall over central and southern Taiwan when traveling eastward across the island. In the upper troposphere, no significant trough-ridge system or upper-level jet (ULJ) existed aloft, thus it was clear that the intensification of the Meiyu front was not due to baroclinic development. Using piecewise potential vorticity (PV) inversion technique (PVIT), the increase in frontal intensity, as determined from 850-hPa horizontal vorticity, was diagnosed. It was found that the PV perturbation related to latent heating in lower to mid-levels was the major contributor to the frontal strength as compared to other perturbation components. A vorticity budget analysis also suggested that the maintenance of the front was mainly through horizontal convergence. Thus, this Meiyu front case intensified through the nonlinear-CISK mechanism [2], in which the front organizes the convection while the convection-induced pumping and low-level convergence enhanced the front, both in thermal gradient and in horizontal wind shear through Coriolis torque. Therefore, a LLJ appeared to the south as the lower branch of the transverse circulation induced by the MCSs experienced Coriolis acceleration and was superimposed upon the prevailing westerly flow [3]. As the MCSs were large and persistent enough to effectively heat the upper troposphere, the 850-hPa frontal vorticity increased from 8 to 16 times 10 to the minus 5 per second even though the front was located south of 25 deg. N in a background of relatively weak planetary vorticity. Keywords: Meiyu front, mesoscale convective system (MCS), CISK. References G. T.-J. Chen and C. P. Chang. Mon. Wea. Rev., 108, 942 (1980). H. R. Cho and G. T.-J. Chen. J. Atmos. Sci., 52, 2109 (1995). G. T.-J. Chen, C.-C. Wang, and S. C.-S. Liu. Mon. Wea. Rev., 131, 2680 (2003).