Abstract Details

AOGS 1st Annual Meeting > Ocean and Atmospheres > Diagnosis of an intense cyclogenesis event and the accompanying tropopause folding in the Meiyu season >

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Title: Diagnosis of an intense cyclogenesis event and the accompanying tropopause folding in the Meiyu season

Abstract: During 21-26 June 1987, a cyclone developed along the Meiyu front over the Yangtze River Valley. The cyclone then intensified and moved southeastward over the ocean and reached its maximum intensity near 27.5°N. During this period, a cut-off low formed at the base of the mid tropospheric trough. The positive vorticity advection to the east of this cut-off low appeared to steer the low-level cyclone southeastward. At the same time, an upper-level trough also arrived over the surface low, while exhibiting processes of narrowing and formation of cut-off low. The low-level cyclone reached its peak intensity when both the middle- and upper-tropospheric cut-off lows moved over the surface low without vertical tilting. The vertical structure of potential vorticity (PV) showed that the tropopause extended downward significantly during the period of intense low-level cyclogenesis, with no vertical tilting between the upper-level and low-level high PV centers. Results from the piecewise PV inversion suggested that the contribution from upper-level dry PV was the major mechanism for the low-level cyclogenesis, where as the effect of latent heat release was not important in this case. To investigate the processes responsible for downward extension of tropopause, a budget analysis of PV tendency was performed at the tropopause. It was forced that the major factor was the horizontal advection, while diabatic effects were very weak. During the period of most intense downward extension of the tropopause, however, the effect of vertical advection was larger than that of horizontal advection. Calculation of vertical motion indicated that the largest effect of vertical advection was accompanied by obvious descending motion to carry high PV values from the lower stratosphere downward into the troposphere. After the period of the most intense development of the low-level cyclone, a tropopause fold occurred due to the vertical wind shear that was modulated by the appearance of a strong cyclone in the lower troposphere. The mechanism responsible for the intense cyclone to develop over the ocean and reached maximum intensity around 27.5°N in this case was different from majority of the cases that contributed significantly by latent heat release in the Meiyu season. The low-level cyclone was vertically coupled with an upper-level disturbance without westward tilting with height. The intensification of the surface low through the interaction between the lower- and upper-level disturbances was also different from that due to the baroclinic instability. In this case, rapid development of low-level cyclone was due to strong downward extension of the tropopause, and the cyclogenesis in turn changed the vertical wind shear to lead to the folding of the tropopause. This was a very rare phenomenon particularly occurred during the Meiyu season. yclone in the lower troposphere.

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