Characteristics of mesoscale convective systems associated with the Meiyu front over HuaiHe–Yangtze River transition zone for 2001-2003

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1. Introduction

To facilitate understanding of the characteristics of mesoscale convective systems (MCSs) around the Meiyu front over east part of continental China, we classified MCSs into 2 types by system propagation speed based on Hefei radar data from 2001 to 2003.

2. Data and methodology

Yearly 2 months of HeiFei radar data are used to examine the activity of MCSs within radar range. The surface synoptic map and Regional Objective Analysis dataset provided by JMA are used to determine the position of surface front. Twice daily sounding data are also used to analyze the environmental situation as well.

3. Results

13 MCSs with covective rainband (> 30 dBZe at the height of 3 km) are analyzed. Convective rainband is categorized as fast propagating type (>7m/s) (5 cases), and slow propagating type (<4 m/s)(8 cases). Features of 2 types of convective rainband are listed as follows.

1) Fast propagating type

With the averaged CAPE of 270 J/kg, the environment is characterized as moist and unstable at low-level troposphere but dry and stable at mid-level, as well as strong wind shear at both low and mid-level.

Core of mean intensity of radar reflectivity (37 dBZe) locates at 3 km and 15 dBZe echo top reaches 12 km.

Airflow toward convective system is from surface to 1.5 km, the outflow associated with the maximum downdraft that located at about 2–4 km above surface pushes the front forward. Convective echoes mainly distribute along the front. The surface front that overlapped with the gust front sloped greatly with height, as shown in Fig.1. Exception is one case that gust front is ahead of the Meiyu front.

2) Slow propagating type

Environment's wind shear is characterized by strong at low level and weak at mid-level, moist air penetrates throughout troposphere and the mean CAPE of 665J/kg associated with instability at low level.

Core of mean intensity of reflectivity (34 dBZe) locates at 3 km and 15 dBZe echo top reaches 10 km. Convective echoes mainly distribute ranging between 60 km to south and north of the front. Northerly wind predominates from surface to 2 km behind the surface front, whereas southerly wind ascends gently along the frontal interface, as show in Fig.2.

Two types as shown in Fig.1 and Fig.2 share several features: the same height of echo core at 3 km, instability and strong wind shear at low level. There are a few contrasts; intensity of fast type is stronger than that of slow type, and the mid-level air is dry in fast type whereas moist in slow type. It is considered that moisture and wind shear play an important role in formation and maintaining of the convective rainband, and the coupling of strong wind shear, moist air at low level and relatively dry air at mid level are favorable for formation and development of intense convective rainband. In turn, the intense convective rain bands affect dynamic and thermodynamic structure of ambient atmosphere.

4. Conclusion

13 cases of MCSs are obtained by analyzing three years of HeiFei Doppler radar data during the Meiyu season. We classified convective rainband into fast propogating and slow propogating types. The coupling of strong low-level wind shear, moist air at low level and relatively dry air at middle level prefer to form and maintain the intense convective rainband.

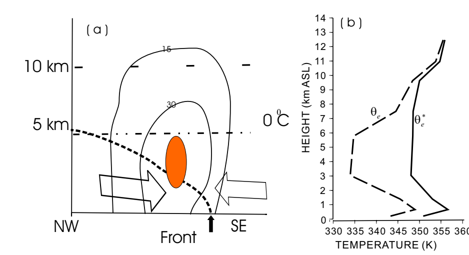

Fig. 1 Illustration of fast propagating type. (a) Vertical cross-section of convective rain band. Thick dash line indicates frontal interface, open arrows express inflow and outflow. (b) Profile of mean equivalent potential temperature (dash line) and saturated equivalent potential temperature (solid line).

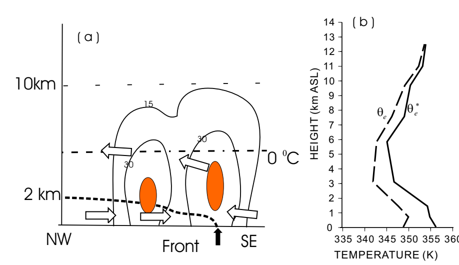

Fig. 2 Same as in Fig.1, but for slow propagating type.