The Origins of the Mei-yu/Baiu Frontal Cyclones

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1. Introduction

During the Mei-yu/Baiu season, most of cyclones inducing rainfall events over Japan are originated over the China continent. Thus, understandings of the Mei-yu/Baiu frontal cyclones over China continent are very important not only for the Chinese Meteorology but also the Japanese Meteorology, that is, they should contibute for the development of the Asian Meteorology. Here, we select two Baiu frontal cyclones induced strong rainfall events over Japan on 27 and 29 June, 1999, and find out their origins by using simulated results with a hydrostatic model.

2. Model description

Numerical simulations are conducted with the Regional Spectral Model (RSM) which is operationally used for a weather forecast in Japan. The RSM has 257 × 217 grid points in horizontal and 36 σ-levels. Its horizontal spacial resolution is about 20 km. Outputs with the RSM are provided for the 3 days of 27, 28 and 29 June 1999 every 1 hour. An analysis domain is set as shown in Fig. 1.

3. The origins of the two cyclones

At 08 JST (Japan Standard Time) on 29 June 1999, a strong rainfall event was induced by a Baiu frontal rainband associated with a cyclone in northern Kyushu (Fig. 2). The cyclone strongly developed near the Korean Peninsula, the frontal structure in the western side of the cyclone had a large baroclinicity and strong low-level convergence. This cyclone is called the 29 June cyclone in the following. The structure and formation mechanisms of the frontal rainband has already investigated by several researchers using data from the X–BAIU–99*

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*The X–BAIU–99 is a research project for the Baiu frontal precipitation systems over Kyushu and

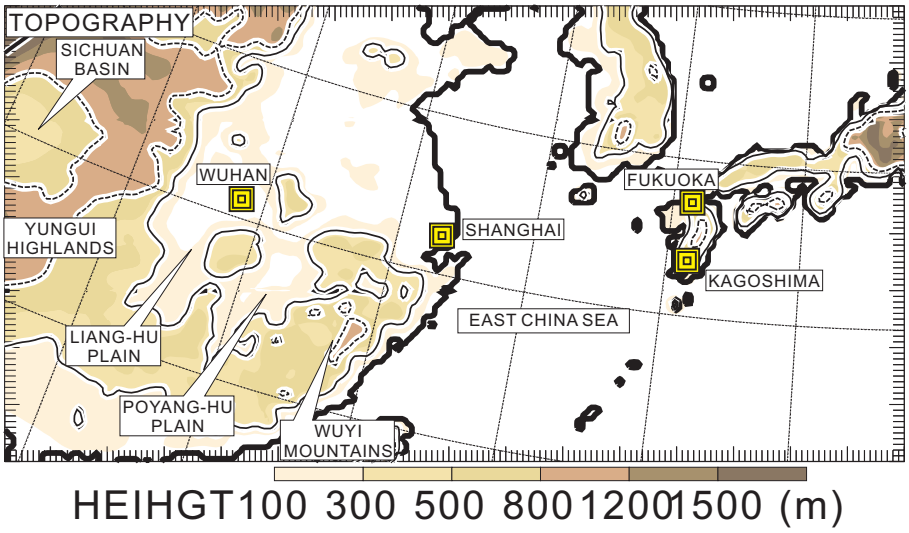

Fig. 1. An analysis domain with a 20-km resolution regional spectral model (RSM).

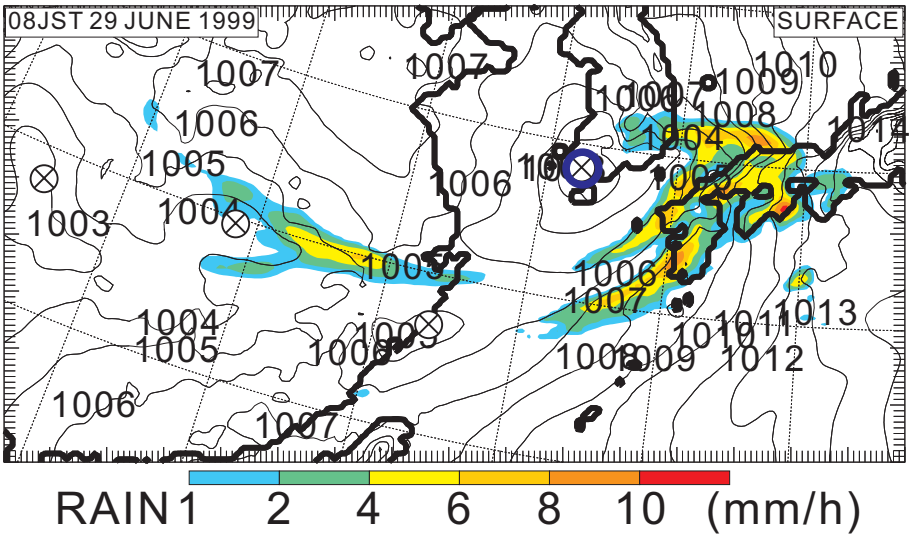

Fig. 2. Rainfall area (shaded) and sea level pressure at the surface (contoured every 1 hPa) at 08 JST 29 June 1999. Cross marks indicate the centers of cyclones. The blue cross mark indicates the center of the cyclone inducing a strong rainfall event in northern Kyushu.

project (e.g. Yoshizaki et al., 1999). 2 days before on 27 June, the 29 June cyclone was located near Wuhan (Fig. 3).

At 12 JST on 27 June, another rainfall event was induced by two merged rainbands associated with a cyclone in southern Kyushu. The two rainbands has also studied in detail by Moteki et al. (2003a) and Moteki et al. (2003b). The cyclone is called the 27 June cyclone in the following. Horizontal scale of the 27 June cyclone is smaller

the eastern part of the East China Sea.

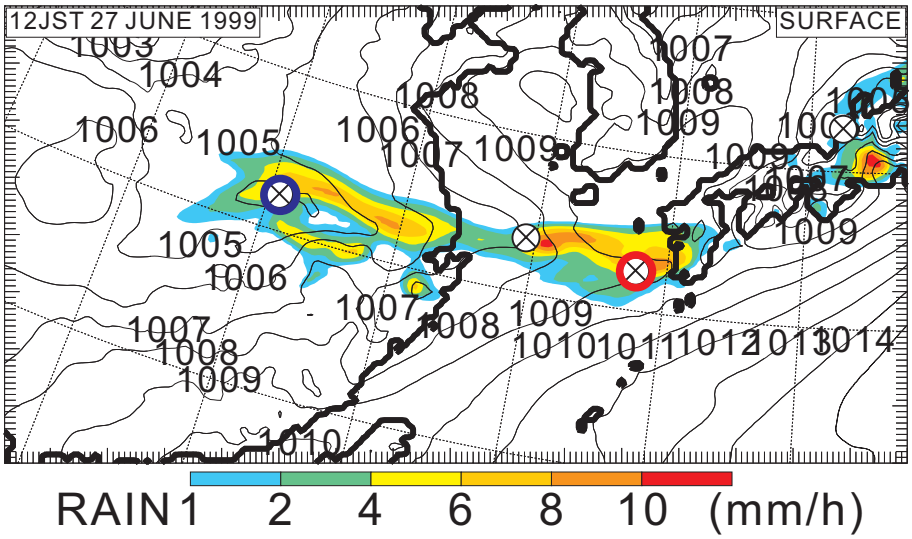

Fig. 3. Rainfall area (shaded) and sea level pressure at the surface (contoured every 1 hPa) at 12 JST 27 June 1999. Cross marks indicate the centers of cyclones. The blue cross mark indicates the center of the cyclone induced a strong rainfall event in northern Kyushu on 29 June. The red cross mark indicates the center of the cyclone inducing a strong rainfall event in southern Kyushu.

than that of the 29 June cyclone, that is, the 29 June and 27 June cyclones has synoptic and meso-α scales, respectively.

The two cyclones are traced backward in time as in Fig. 4. The 29 June synoptic-scale cyclone was originated in the lee side of Yungui Highlands. The 27 June meso-α-scale cyclone was originated in the lee side of northeastern Wuyi Mountains. It was confirmed that some synoptic-scale and meso-α-scale cyclones were generated in the lee side of the Yungui Highlands and northeastern Wuyi Mountains, respectively.

As shown in the 9 days mean field of TBB, it is found that the most remarkable peak of low TBB is located over the Yungui Higlands. This peak reflects that several cloud clusters associated with synoptic-scale cyclones are frequently generated over the Yungui Highlands and develop in the lee side of the highlands near Wuhan.

4. Conclusions

This study investigates the origins of the two cyclones induced strong rainfall events over Japan on 27 and 29 June 1999. The trajectories of the two cyclones are summarized in Fig. 6. The 29 June synoptic-scale cyclone was originated in the lee side of Yungui Highlands. The 27 June meso-α-scale cyclone was originated in the lee side of northeastern Wuyi Mountains. The mechanism of lee cyclogenesis could be important for the initiation and generation of the Mei-yu/Baiu frontal cyclones. It is found

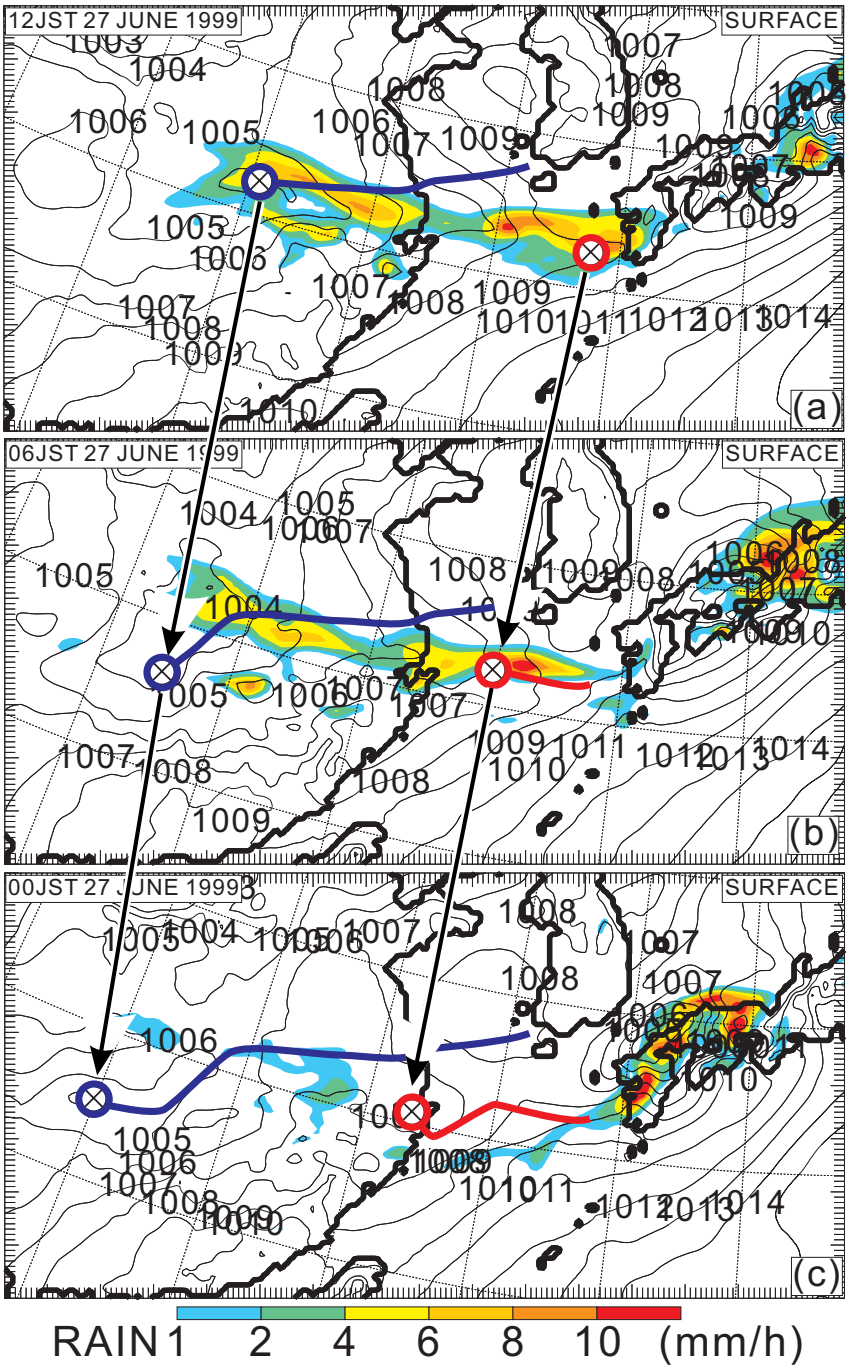

Fig. 4. Rainfall area (shaded) and sea level pressure at the surface (contoured every 1 hPa) at (a) 12 JST 27 June, (b) 06 JST 27 Juen and (c) 00 JST 27 June.

that the regions around Wuhan and Shanghai are very important as the origins of the Mei-yu/Baiu frontal cyclones.

These results lead the following suggestion to the future observation projects over China continent. Even though rainfall intensity is not strong or rainfall amount is not large in the observation area, it is quite valuable that we perform upper-air sounding and wind profiler observations. To un-

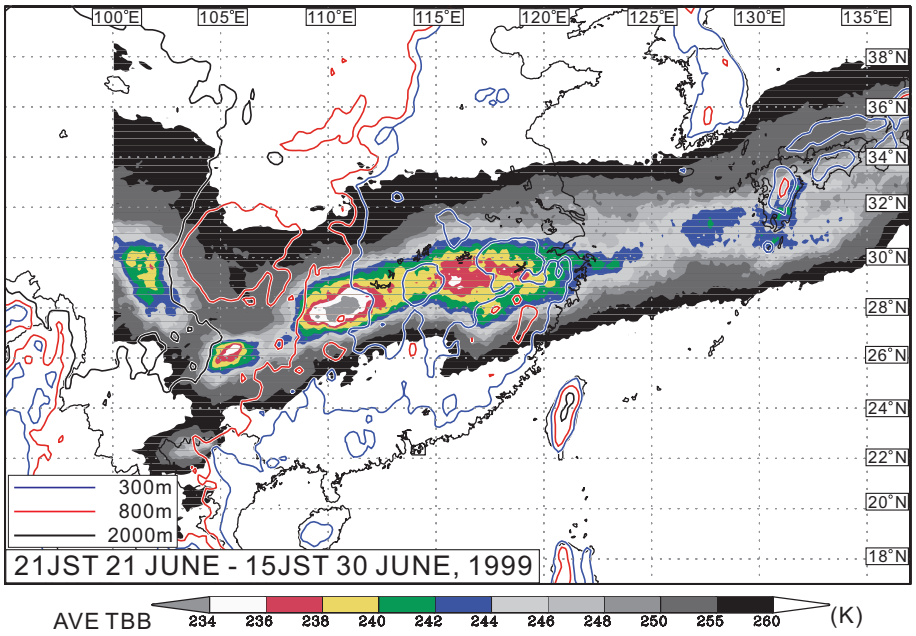

Fig. 5. 9 days mean (21 JST 21 June to 15 JST 30 June 1999) field of blackbody temperature.

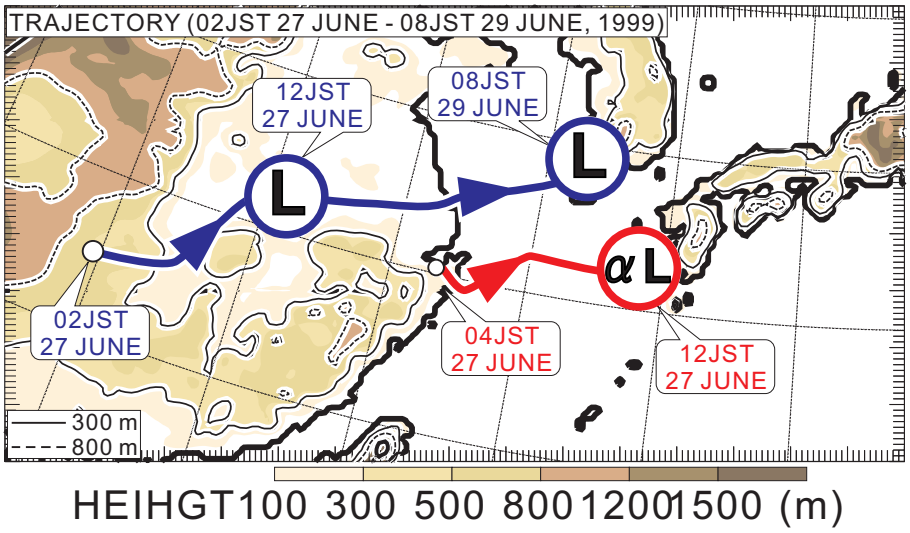

Fig. 6. Topography map (shaded) and trajectories of the two cyclones from 21 JST 26 June to 08 JST 29 June 1999. The trajectories of the 29 June synoptic-scale cyclone and 27 June meso-α-scale cyclone are blue and red lines, respectively.

derstand the initiation and generation of the Mei-yu/Baiu frontal cyclones, a temporal equable dataset needs to be constructed. Based on the understandings of the cyclones, we can study the detailed strucuture, evolution, and formation of the Mei-yu/Baiu frontal precipiation systems.

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