Generation mechanisms of convections by gravity waves

Hiromu Seko[1], Syugo Hayashi[1] and Kazuo Saito[1]
[1]Meteorological Research Institute, Japan
(Hiromu Seko, hseko@mri-jma.go.jp)

1. Introduction

Because convective storms sometime cause mudslides or floods, it is important to understand the generation and development mechanisms of convection. In this study, the generation mechanisms of convection by gravity waves (GWs) were investigated using the outputs of a nonhydrostatic model (NHM).

2. Ideal experiment of 2-dimensional model

To understand the generation process of convection, ideal experiments using a 2-dimensional model were performed (Yamasaki and Seko, 1992). Typical profiles of temperature and humidity in the tropical atmosphere were used as the basic fields. Two sets of four bubbles were placed in the domain of the numerical model. Figure 1 shows time sequence of updraft at z=1.2 km. GWs were generated at the convections and propagated to both directions. Convection **F** was generated at the overlapped area of GWs from convection **A** and **C**. Convection **F** was developed when GWs from convection **B** and **E** arrived. When GW approached, temperature was decreased and relative humidity was increased (not shown). Updraft of GW and these changes caused by GWs are the favorable conditions for the generation and development of convection. There was no cold pool where convection **F** was generated (not shown). This distribution indicates that GW generates and develops convection.

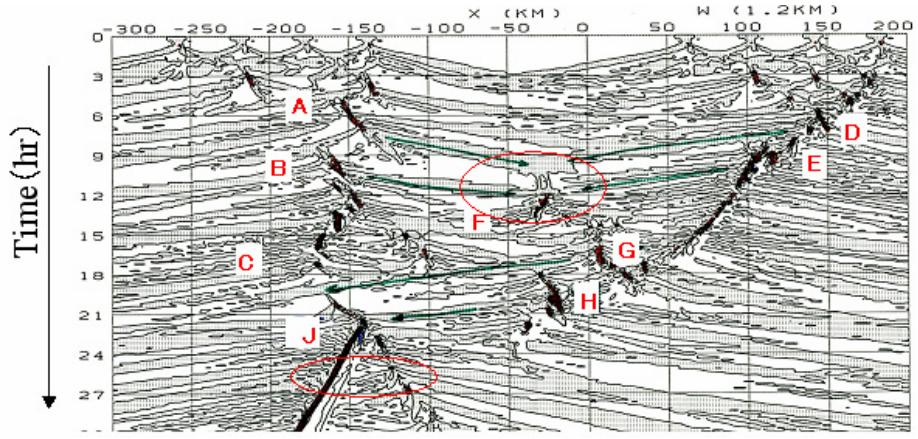

Fig.1 Time sequence of updraft at z=1.2 km (After Yamasaki and Seko, 1992)

3. Generation mechanisms of convections by gravity waves

Numerical simulations using NHM were performed from the initial conditions produced from JRA25 data. Initial time was 12 UTC 28 2008. Downscale forecast experiments were performed with the grid intervals of 5 km and 1 km. In the reproduced fields by 5km-NHM, a convective band extending southeastward was generated at the eastern side of Sumatra by the weak convergence of westerly flow and northwesterly flow. When horizontal resolution of 1 km was used, the convective cells were resolved. We focused on convection **A** on the eastern side of the convective band. The convection of **A** was successively generated at the eastern side of the band. When convection **A** was generated, the cold pool did not exist near it (not shown). Figure 2 is the time sequences of vertical wind, mixing ratio of rain, and dew-point deficit (T-Td) at P=850 hPa along the line that crossed the convection **A**. Convection **A** was generated when GW was propagated from the east (broken line in Fig. 2a). When GW was propagated, temperature was decreased (not shown) and dew point deficit became smaller (Figs. 2b). The updraft of GWs makes the atmosphere cooler and moister, which are favorable conditions for the generation and development of convection.

4. Summary

Updraft of GWs makes the atmosphere cooler and moister. Updraft and these changes are favorable conditions for the generation of convection. When the weak convergence or weak cold pools exist, GWs determine the generation point and timing of convection.

References

Yamasaki, M., and H. Seko, Effect of the gravity wave on the convections, 1992, Proceedings of Spring meeting of Meteorological Society of Japan, A108 (in Japanese).

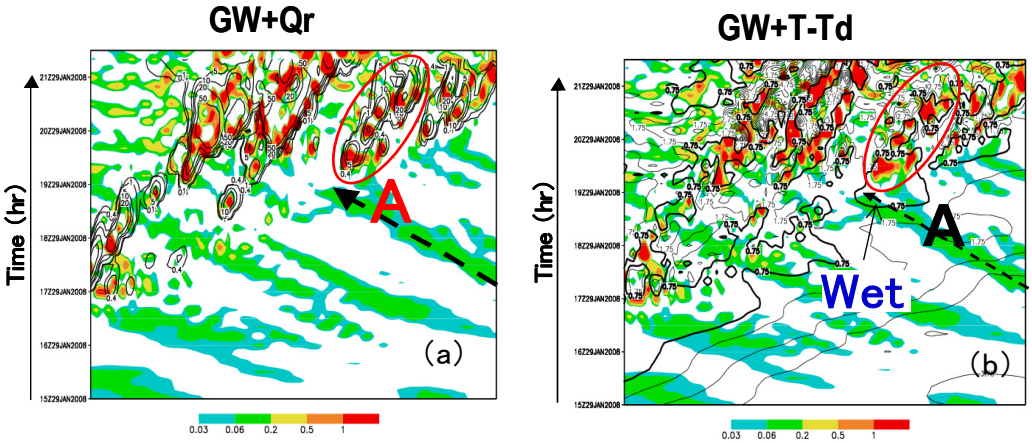

Fig.2 Time sequence of updraft (shaded region) at P=850hPa. Contour lines indicate (a) mixing ratio of rain and (b) dew point deficit at P=850hPa.