AOGS 2005

Numerical Experiment on the formation of Convergence zone and thick cloud band over the Northern part of the Sea of Japan during cold-air outbreaks

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In winter, various types of cloud systems form over the Sea of Japan associated with cold air outbreaks from the Euasian land mass. Muramatsu (1979) reported that a distinct thick cloud band with the width of about 50km sometimes develops in the northern part of the Sea of Japan, and causes heavy snow falls in Hokkaido Island, Japan.

In this study, the formation mechanism of the thich cloud band was investigated through a series of nonhydrostatic numerical experiments. A cold-air outbreak case on 4 January 2004 was selected. GMS satellite images showed a thick cloud band reached the west part of Hokkaido Island. The analysis of QuikSCAT data revealed that the north-northwesterly (northwesterly) wind is prominent over the northeasten (southwestern) side of the thich cloud band, indicating that there exists a large-scale convergence zone.

The Nonhydrostatic model ARPS was used to investigate the formation mechanism of the cloud band and the large-scale convergence zone. The model reproduced both the large-scale convergence zone and a continuous band of updraft. Through the sensitivity experiments in which the topography of the windward mountain area was varied, it was confirmed that the windward mountain chains was responsible for the formation of the large-scale convergence zone, while an isolated mountain near the coast was found to trigger the cloud band. The wind over the mountain chain turn clockwise as a consequence of the conservation of the potential vorticity. As a result, large-scale convergence zone forms between the deflected wind and the synoptic-scale wind. The large-scale convergence is thought to be important for the development of cloud band caused by the isolated mountain.

Keywords: cold air outbreaks, cloud band, topography

References

[1] Muramatsu, T., 1979: Cloud line enhanced by upwind orographic features in winter monsoon situations. *Geophys.Mag*., **38**, 1-14.