

白鳳丸太平洋上ゾンデ観測で捉えられた2012年12月の寒気吹き出し Cold surge event observed by the research vessel Hakuho-maru over the Pacific in December 2012

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1. Introduction

A cold surge from the Siberian High is the typical phenomenon of the Asian winter-monsoon that sometimes reaches the southeast Asian regions, such as Philippines and the Indochina Peninsula, across the Pacific and resulted in heavy rainfall there. Airmass transformation is one of the key processes for this phenomenon. However, the quantitative evaluation based on the observation has not yet been done so far. We succeeded in observing a cold surge event by radiosondes from the research vessel over the Philippines Sea in the end of December 2012. The preliminary results are reported in this paper.

2. Observation and data

We conducted radiosonde observations on board the research vessel "Hakuho-maru" during December 21, 2012 and January 4, 2013. Figure 1 shows the observation points and the launch time of the radiosondes. We launched radiosondes with 6-hour or 12-hour intervals during 23 to 24 December between 21N and 29N along the cruise from north to south. At the southernmost point (21N, 133E), we further carried out the fixed-point observation of 3-hour intervals for about 1.5 days during 24 to 25 December.

3. Synoptic fields

The cold surge from the Siberian High was intensified during December 20 to 26. Northwesterly winds were intensified around Japan and the northeasterly was strengthened in the Pacific Ocean and the Philippine Sea. Convections were activated over the Philippines, and the precipitation also became strong in the coastal area. The cyclonic disturbance propagated westward near the equatorial region over the western Pacific. The easterly flow at the northern edge of the disturbance and the northeasterly by the cold surge formed convergence zone over the offshore of Philippines.

4. Results

Latitude-height section of potential temperature and water vapor mixing ratio obtained by the moving observation during 23 to 24 December revealed the cold air intrusion was observed in the lower layer from the surface to 2 km height. The stable layer was formed at the top of the cold air intrusion (about 2 km height). The temperature and humidity were higher in the southern area. Time-height section of potential temperature and water vapor mixing ratio obtained by the fixed-point observation during 24 to 25 December showed that the stable layer around 2 km height were gradually intensified and that below the stable layer both the potential temperature and the water vapor mixing ratio had the uniform vertical distributions, which is consistent with the well-mixed layer during the cold surge event. The transition to such a typical mixed-layer structure was captured by high temporal resolution observation.

With the help of the operational radiosonde data at Minami-daitojima and at Chichijima, we performed a thermodynamic energy budget analysis and evaluated the transfer of thermodynamic energy between the atmosphere and the ocean. The result indicates that the amount of the energy transfer from the ocean to the atmosphere was even large over the Pacific remote from the Eurasian continent and compares with the one that observed near-continent area over the East China Sea by the AMTEX project (Ninomiya, 1975, JMSJ). The effect of the energy transfer to the precipitation over the Philippine area will be discussed.

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