Case study on mesoscale convective system near Japan from the perspective of diurnal cycle

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The diurnal cycle of convective cloud, which can be explained by various processes, is an important feature to understand the mechanism for better weather forecast via the improvement of parameterization of physical processes. In the vicinity of Japan, the typhoon is a major target in the previous study and has a significant convective peak in the morning (e.g. Wu *et al.*, 2015). In contrast, mesoscale convective system (MCS) formed in this region is not well understood because of the lower frequency of occurrence. In this study, we examine the diurnal cycle of MCS, which appeared over the Yellow Sea on July 17, 2017 and moved southeastward to the northwest Pacific Ocean over July 22.

For cloud property data, we used the retrieval results from the Himawari-8 brightness temperature (Iwabuchi *et al.*, 2018). To reveal the process of MCS development, we classified the high cloud into three types with cloud optical depth (COD) and calculated the cloud cover for each cloud type. Clear diurnal cycle of cloud cover was observed after July 19, when the Baiu front disappeared in the weather maps. It developed with a maximum of thick-cloud cover at 0900 Japan Standard Time (JST) following the peak of rainfall intensity around 0700 JST and matured with the peak of cirrus cover at 2100 JST. Accompanying by the cloud cover expansion, diurnal pulse of cloud top height propagated outward from the convective center, the centroid of MCS weighted by COD, starting at 0400-0700 JST. In addition, COD became smaller as the pulse propagation.

We further conducted a composite analysis with meteorological field data for investigating the difference of convection between predawn (0300 JST) and afternoon (1500 JST). The result shows that deep convection (convection in upper tropospheric layer) appears within 100 km of the convective center at predawn (in the afternoon). Moreover, the diurnal anomaly of horizontal temperature anomaly with respect to the domain average is negative (positive) at predawn (in the afternoon) around the convective center in the upper troposphere. It is hard to argue that these characteristics of MCS are general near Japan because our research is just a case study. Nevertheless, these results indicate that the radiative cooling in the upper layer cloud at night may have a significant impact on the deep convection in the morning in our target region.

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