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北西太平洋域における下層雲の経年変動と付随する大気海洋相互作用
Interannual variability of low-level stratified clouds over the western North Pacific and associated air-sea interaction

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Low-level stratiform clouds, which act to cool the earth/atmosphere system, tend to prevail in summer over maritime regions where low-level stratification is high. Previous studies on low-level clouds focused mostly on subtropical regions, including those off California and Peruvian coasts. Much less attention has been paid, however, to the subpolar western North Pacific, where summertime low-level stability and cloudiness are as high as those observed off California. Some previous studies suggested that a positive feedback loop may be operative within the subarctic oceanic frontal zone over the western Pacific among summertime anomalies in low-level clouds, near-surface stratification and sea-surface temperature (SST). Based on archived shipboard measurements, however, those analyses were limited to their seasonal-mean anomalies and therefore unable to resolve characteristics of interannual variability for each calendar month in the presence of apparent seasonal evolution of the climatological-mean state under the influence of the East Asian monsoon.

Utilizing the 25-year long ISCCP archive of satellite measurements of clouds and their radiative properties, a state-of-the-art reanalysis dataset of the global atmosphere (ERA-Interim) with fine vertical resolution in the lower troposphere and high-resolution satellite-measured SST (OISST), the present study investigates detailed aspects of the seasonal march and interannual variability of summertime low-level cloudiness over the western North Pacific and its linkage with particular focus on the cloud amounts itself and associated meteorological and oceanic variables.

Our analysis reveals that, unlike what has been suggested from shipboard measurements, significant positive correlation in interannual variability between low-level cloudiness and lower-tropospheric stability (LTS: defined as potential temperature difference between the 700hPa level and the surface) is observed in rather limited domains. In June and July, the positive correlation is observed only in the subtropical oceanic frontal zone, which is located south of the Honshu and then migrates northeastward into July. It is only August when the significant positive correlation is observed over the entire subarctic oceanic frontal zone in the Kuroshio-Oyashio Extensions. In those regions, the low-level cloudiness also exhibits significant negative correlation with SST, confirming with satellite data that the aforementioned positive feedback loop can be operative only in the limited spatial domains and calendar months but not ubiquitously over the extratropical North Pacific.

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