ABSTRACTS (MASTER THESIS)

An analysis on the variation in low clouds over the subtropical ocean using satellite data

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Clouds strongly contribute to the earth's radiation budget. In particular radiative forcing of low clouds is large and it is about 60% of the total net radiative forcing averaged over the globe (Hartmann et al., 1992). Therefore it is important to investigate the variation of low clouds in terms of the earth's climate. It is known that low clouds mostly occur where the sea surface temperature (SST) is low, then Klein and Hartmann (1993) found a positive correlation between the seasonal evolutions of low cloud amounts observed from ship in the subtropical ocean and those in lower-tropospheric stability (LTS). Moreover, Wood and Bretherton (2006) proposed a use of estimated inversion strength (EIS) that was an improved measure of LTS, and found that the correlation between low cloud amounts and EIS is good even over the mid-latitude ocean. As the dataset they used consists of three-month mean climatologies of low cloud amounts, they only discussed about the seasonal variation, but not about the interannual variation. On the other hand, satellite cloud data have been used for the analyses of low cloud variations recently, but they are mostly concentrated on specific areas. In this study we use monthly mean cloud data from the satellite observations to investigate characteristics in seasonal and interannual variations of low cloud, EIS, and SST over the following 5 areas, off-shores of Peru, Namibia, California, west Australia, and Canary Islands.

First the seasonal variations for the five areas are investigated. Except the offshore area of the western Australia, we found high correlations between EIS and low cloud amounts, supporting the previous studies. The offshore area of the western Australia is assumed that horizontal advection should be taken into account for the understanding of variations in low cloud amounts over this area, because there are fair amounts of low cloud such as fog at high latitudes. Also the relation between SST and EIS is different in each of the five areas; the offshore areas of Peru and Namibia show very strong correlations, those of California and west Australia do not show clear correlations, and that of Canary Islands shows a slight correlation. These correlations suggest that EIS could be affected by temperatures at different height range, thus we need to pay attention to the vertical structure of EIS in detail.

Next we look at the interannual variability of low cloud amounts for each season averaged over three months. In the areas where the seasonal correlation between EIS and low cloud amounts is high, we found high correlations in interannual variations between EIS and low cloud amounts during the season when the variability of low cloud amounts is largest. Contrarily, in the areas where the seasonal correlation between SST and EIS is high, we found lowest correlations in interannual variations of SST and EIS during the season when the variability of SST is largest. Moreover, it could be expected that there may exist interannual variability in low cloud amounts and EIS in relation to the El-Nino and La-Nina cycle over the offshore areas of Peru and California, but it was not clearly seen. This is also the case for the area where the SST variations in association with the El-Nino and La-Nina cycle is evident at low latitudes.

References

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[3] Wood, R., and C. S. Bretherton (2006), *J. Climate*, 19, 6425-6432.