Seasonality and Regionality of Intraseasonal Radiative Feedback and Surface Heat Flux Feedback over the Tropical Warm Pool

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要旨

In the present study, intra-seasonal variation of column-integrated moist static energy (CMSE) is examined over the tropical warm pool. Under the weak temperature gradient approximation, the evolution of CMSE can be regarded as the evolution of column-integrated moisture (or “precipitable water”), which is essentially important for the development of intra-seasonal oscillation (ISO) particularly the Madden-Julian oscillation (MJO). Diabatic sources such as radiation and surface heat flux contribute significantly to the accumulation of MSE. Therefore, we focused on the seasonal and geographical patterns of the feedback of radiation (RF) and surface heat flux (SHFF) for the intra-seasonal variations of MSE. Here, the feedback is defined as the amplitude of the intra-seasonal variations of the diabatic source normalized by the amplitude of intra-seasonal precipitation.

Results revealed that radiative feedback and surface heat flux feedback vary seasonally and geographically. For example, the SHFF peaks between the northern and southern hemispheres, corresponding to the latitude of maximum insolation. In contrast, the seasonal change of RF is subtle compared to SHFF. In addition, the RF peak is more pronounced over the Indian Ocean than over the western and central Pacific. These results would indicate that ″moisture mode″, which is the most promising hypothesis of the ISO, is destabilized by the different process over the different season and location; the SHFF would be essentially important for the intra-seasonal oscillation in the boreal summer or winter, while the RF works effectively over the Indian Ocean. The RF can account for 6%-14% of the precipitation variability, while the SHFF contributes 2%-10% of the precipitation. Therefore, radiative feedback plays an essential role in maintaining intra-seasonal precipitation anomalies, especially over the IO, by driving the upward transport of moisture in the upper troposphere.