Variability in the vertical structure of the vertical motion and latent heating profiles over the life cycle of tropical convective systems

Yi-Chien Chen¹ and Hirohiko Masunaga²

¹Graduate School of Environmental Studies, Nagoya University, Nagoya, Japan ²Institute for Space-Earth Environmental Research, Nagoya University, Nagoya, Japan

This study combines the ERA5 reanalysis data and satellite measurements from the TRMM PR and GSMaP products to examine the variability in the large-scale vertical motion and latent heating profiles over tropical oceans. Composite time series are constructed using the precipitation maxima identified with GSMaP rainfall as the reference for understanding the development processes of deep and shallow convections as well as stratiform precipitation. The analysis is focused on how the top-heaviness of vertical motion and latent heating profiles varies over time for the different precipitation types.

The findings confirm that the top-heaviness of latent heating profiles changes during the convective life cycle with a time-lag between the convective and stratiform rains, as expected from the development of intense convection at an early stage and the vital role of stratiform rain at a later stage. At the same time, the large-scale vertical motion profile becomes top-heavy even later than expected from the evolution of the latent heating profile. We examine the CERES SYN1deg radiation datasets to look into the possibility that upper-tropospheric radiative heating could partially reconcile the unexpected temporal shifting in the top-heaviness in large-scale vertical motion.