Observational study on energy and moisture budgets in the atmospheric boundary layer of the tropical deep convective regimes

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In order to deepen our understanding of what determine intensity of tropical deep convective systems, we analyze observational data taken by Research Vessel *Mirai* over tropical Indo-Pacific warm pool domain. Our analysis is based on boundary layer (BL) quasi equilibrium concept, in which import of moist static energy (MSE) to the BL in the form of turbulent surface heat fluxes is balanced with exports of MSE due to intrusion of convective downdraft, entrainment through the BL top, and radiative cooling in the BL. MSE is composed of dry static energy (DSE) and water vapor mixing ratio. Considering the budgets of these two conservative quantities separately, we can estimate daily mean mass flux of the convective downdraft and that of the entrainment from upper air sounding data and surface meteorology data. The convective downdraft mass flux exhibits daily time series that correlates significantly with measures of convective activity around the vessel, such as onboard gauge precipitation and fractional area covered by strong radar echo (>30 dBZ) within 30 km range. We then discuss what determine the variability in the convective outflow mass flux and find positive and significant correlation between the mass flux and surface sensible heat flux, which may primarily represent interaction between convection and the surface flux. The DSE of downdraft air parcels, which is primarily determined by mid-tropospheric humidity, also exhibits positive and significant correlation with the mass flux, which is consistent with well-known relationship between convective activity and precipitable water vapor.

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