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ROLE OF MOISTURE FEEDBACKS IN CONVECTIVE-SCALE ENERGETICS OVER A MJO CYCLE

Jun-Ichi Yano, Francoise Guichard
LMD
E-mail: Jun-Ichi.Yano@lmd.jussieu.fr
fax: 01 44 27 62 72

A possible role of moisture-convective feedbacks in Madden–Julian Oscillations (MJO) has received much attention, especially due to a clear association of dry intrusions events with MJO. The present talk addresses this issue by analyzing the energy cycle at the convective scale as simulated by a cloud-resolving model. For this purpose, we pay an attention to the fact that CAPE (convective available potential energy) can be interpreted as an estimation of a possible conversion rate of the potential energy into the kinetic energy. The same estimate is performed by Arakawa and Schubert's cloud work function for entrainment plume models. It is straightforward to use the same definition as Arakawa and Schubert's cloud work function but use locally–measured buoyancy and vertical velocity obtained from CRM simulations. We call this quantity the potential energy convertibility (PEC), which may alternatively be interpreted as a vertical integral of convection-driving buoyancy, that actually drives convective vertical motions, in place of the hypothetical parcel-lifting buoyancy. Then we can estimate the entrainment rate required to recover the same buoyancy profile by an entrainment plume model assuming the conservation of the moist static energy. This analysis framework is applied to the three CRM simulations for the three phases of a MJO cycle during TOGA-COARE.

The magnitude of convection-driving buoyancy varies dramatically over a MJO cycle from the dry phase to the wet phase. However, the associated entrainment profile does not change substantially over the period. Instead, the dryness of the environment, as measured by moist static energy, controls the degree of convection-driving buoyancy, in quantitative support of the speculated role of the free tropospheric moisture in controlling convection.