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MID-LEVEL AND DEEP CONVECTIVE CLOUD CHARACTERISTICS ACROSS THE TROPICAL PACIFIC

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ABSTRACT

Convective clouds of various shapes and sizes are an obvious feature in satellite images of tropical latitudes due to their high shortwave albedos. However, depending on the atmospheric state and large-scale dynamics different convective cloud types can develop. Within a given convective cloud type we may also observe great variability in cloud macro- and microphysical properties. These different cloud types and cloud characteristics may have vastly different impacts on the local water and energy budgets.

We use ship-based remote sensing observations and soundings from the EPIC 2001 field experiment coupled with a simple entraining parcel model in order to address the following questions about deep convective cloud types: 1) Which environmental factors play a role in determining the depth of tropical convective clouds? 2) What environmental parameters are related to entrainment rate in cumulus congestus clouds? We compare these results to previous (Jensen and Del Genio 2006) and ongoing analysis in the tropical Western Pacific. Our results suggest that in regions with a relatively low frequency of deep convection a drying of the mid-troposphere is a more likely to be responsible for limiting convective cloud-top heights than a stabilizing of the freezing level. We also find that low-level CAPE and the RH profile account for the largest portion of the variance in cumulus congestus entrainment rates, consistent with the idea that entrainment rate depends on the buoyant production of turbulent kinetic energy. Initial results from the Eastern Pacific ITCZ (EPIC 2001) indicate that in regions with more intense deep convection the stability at the freezing level plays a much more important role in limiting the depth of cumulus congestus clouds.

We also present some results from the analysis of several years of observations of tropical deep convective systems by the Moderate Imaging Spectroradiometer (MODIS) aboard NASA's Terra and Aqua satellites. The statistical analysis involves the determination of cloud-averaged values of several important cloud properties (e.g. cloud particle effective size, cloud-top temperature, optical thickness, cloud-top pressure, shortwave albedo). We use a cloud identification algorithm to define convective cloud systems. Our analysis concentrates on two regions of the Pacific Ocean, the tropical eastern Pacific region (as sampled during the EPIC 2001 ITCZ) and the tropical Western Pacific which has a history of field projects (TOGA COARE) and long-term monitoring sites (ARM).
