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MEAN THERMODYNAMIC PROFILES IN COARE IN RELATION TO THE EASTERN PACIFIC

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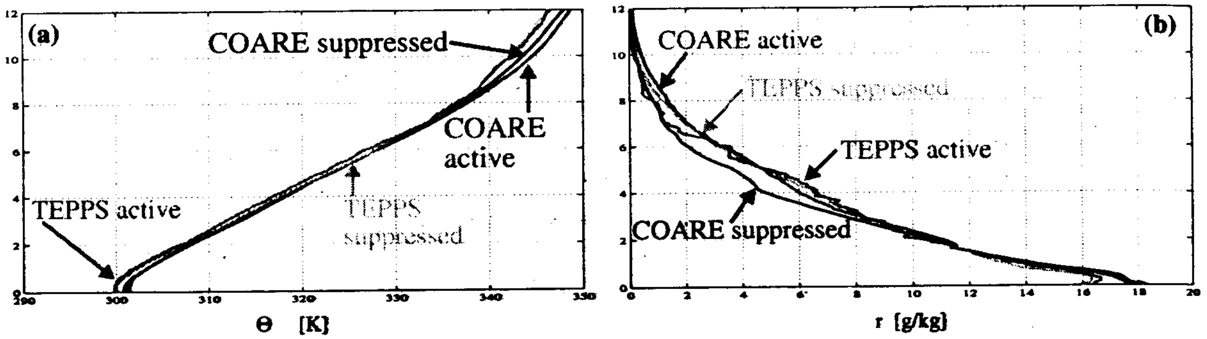
We compare the mean thermodynamic profiles observed in COARE with those observed in the Tropical Eastern Pacific Process Study (TEPPS) in order to understand the COARE environment in the broader context of the tropical Pacific and to identify factors contributing to the intraseasonal variability of convection observed in COARE. Parcel theory supports the results from radar analysis, that on average the depth of the active convection in the eastern Pacific is shallower than that in the COARE region for events with comparable surface reflectivities. These differences do not appear to be simply a matter of a higher tropopause in the COARE region, as the depth of convection in the eastern Pacific is generally well below the height of the tropopause in this region. The mixed layer depth and mean mixed layer temperature and moisture differ between these regions, as does the free-atmosphere stratification. In general COARE atmospheric mixed layers are warmer, moister and somewhat deeper than those of TEPPS. The CAPE and convective inhibition (CIN) also differ significantly, mainly because of these differences in the stratification of the lower atmosphere. We find that CAPE values are larger and CIN values are smaller in the COARE region than in the eastern Pacific as a result of these differences. The thermodynamic structure resulting from both the local surface and the large-scale variability in each region is discussed in relation to the convective activity in each region.

1. INTRODUCTION

The intraseasonal oscillation (ISO) dominated the large-scale variability over the warm pool region during COARE and served to organized the wide spread convective activity into three active periods lasting 10-15 days each over the four months of the program [Chen *et al.*, 1997]. Within these active periods, deep, wide-spread convection was observed in areas of enhanced surface westerlies. In contrast preliminary analysis indicates that the ITCZ region is dominated by shorter time period variability in the surface meridional winds, on the order of 4-5 days, with surface southerlies being well correlated with deep convective events during TEPPS [Yuter, 1998]. Based on these results, we revisit the COARE data set, focusing on the transition from the suppressed to active phase of the ISO observed in the month of December, and combine it with similar data collected in the east Pacific, in an effort to gain a more general understanding of the factors influencing large-scale active convective periods in the equatorial Pacific. We focus on the sounding data to provide the basis for our analysis, compositing similar stages of convection within each region.

2. CLASSIFICATION OF SOUNDINGS

Each sounding station in COARE is assigned a convective category based on cloud-top area at least partly contained within a 2^{o} x 2^{o} area centered on the station within 30 minutes of launch time [Yuter et al., 1995]. For the TEPPS soundings, convective categories are defined based on the precipitation area determined from radar reflectivities within approximately 1^{o} of the ship, also within 30 minutes of launch time [Yuter, 1998]. Visual comparison of satellite images from COARE and TEPPS for equivalent convective ratings show that the radar-based ratings compare well with the satellite-based ratings used for the COARE soundings. If the convective rating is suppressed for three hours prior to and following a launch, the sounding is considered suppressed. If the activity increases within an hour following launch or, in the case of COARE, at least one other sounding station is rated active at launch time, the sounding is considered active.



3. RESULTS AND DISCUSSION

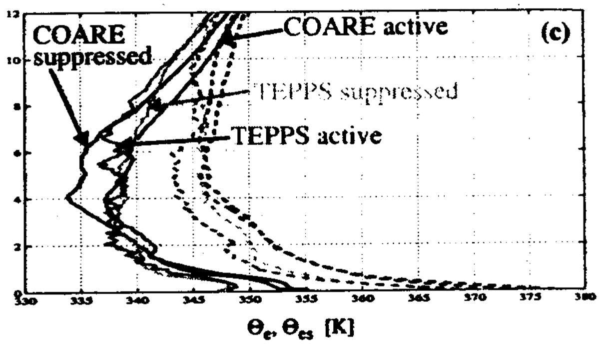


Figure 1-(a) potential temperature, (b) mixing ratio and (c) saturated (dashed) and column (solid) equivalent potential temperature profiles for active and suppressed conditions.

Figure 1 compares the vertical profiles of potential temperature, mixing ratio and equivalent potential temperature for the suppressed and active soundings in COARE and TEPPS. For suppressed conditions a warmer, moister and somewhat deeper mixed layer (100 m deeper on average for COARE) is observed in the warm pool region as compared to the ITCZ, with a drier atmosphere from 2 to 9 km. The warm pool equivalent potential temperature suppressed composite indicates a thicker statically unstable layer, in contrast to the neutral static stability above the boundary layer seen in the ITCZ composite. The average mixed layer CAPE in the warm pool during suppressed (active) conditions is 840 (444) J/kg, while that for the ITCZ is 100 (258) J/kg. Convective inhibition (CIN) is -20 (-35) J/kg on average in the warm pool, as compared to -70 (-24) J/kg in the ITCZ for suppressed (active) conditions.

The depth of convection is significantly shallower in the ITCZ than in the warm pool for equivalent surface reflectivities in part because of the more statically neutral environment and the lack of CAPE in this region. Climatically colder surface temperatures reduce the instability of the mixed layer and increase CIN, creating a more unfavorable environment for convection than that observed in COARE. The scale and depth of convection in the warm pool region appears to be strongly tied to the surface and mixed layer characteristics. Drying just above the boundary layer appears to only occur during the suppressed phase of the ISO. The large scale dynamics found to control this drying [Yoneyama *et al.*, 1998] may be an important factor in suppressing convection during these periods. Likewise, large-scale moistening in the COARE region and variability in surface wind speed in both regions appear to be important factors in triggering convection.

4. REFERENCES

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