# Relationships between the Maritime Continent and the Walker Circulation

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The existence of the islands of the Maritime Continent in the western Pacific Ocean has a profound effect on tropical atmospheric circulation. The Walker Circulation, which is made up of ascent over the western Pacific, decent over the central Pacific, and upper-level westerlies and surface easterlies over the Pacific, may be enhanced by atmospheric heating over the Maritime Continent. The amount of land surface area of the Maritime Continent has increased in the past ~3-4 million years in large part because New Guinea has moved northward into the tropics (Cane and Molnar, 2001). A change in tropical climate also occurred ~3-4 Ma. Prior to this time, a permanent El Niño state is thought to have persisted in the Pacific Ocean (Cane and Molnar, 2001). A steepened thermocline and increase in SST gradient across the Pacific Ocean lead to a change to the El Niño – Southern Oscillation state of present day (Ravelo *et al.*, 2004; Wara *et al.*, 2005).

We analyze 5 years of precipitation rate data over the Maritime Continent and Western Pacific Warm Pool from the Tropical Rainfall Measurement Mission (TRMM) satellite (data product 2B31, which combines measurements from the satellite's precipitation radar and microwave imager) from March 2000 to February 2005. Precipitation rates are largest over central New Guinea, central Borneo, and off the west coast of Sumatra (Dayem *et al.*, 2005). Rates are also large over the warm pool (Figure 1). We correlate average precipitation rate over the Maritime Continent and the warm pool (Figure 1) with *u* and *w* from the NCAR/NCEP reanalysis data set. Precipitation rates over both the Maritime Continent and the warm pool correlate positively with *w* over the western Pacific, indicating enhanced ascent with increased precipitation over these areas (Figure 2). Increased precipitation rates over the Maritime Continent correlate positively with enhanced upper-level westerlies and surface easterlies over the Pacific (enhanced Walker Circulation), but precipitation rates over the warm pool correlate with weakened upper-level westerlies and surface easterlies over the Pacific (suppressed Walker Circulation) (Figure 3). These results suggest that latent heating of the atmosphere over the Maritime Continent is an important feature of the Walker Circulation, but latent heating of the atmosphere over the warm pool is not (Dayem *et al.*, 2005).

We compare GCM simulations (CAM3) without the entire Maritime Continent and without New Guinea to a control simulation with present-day topography. Where land is removed it is replaced by open ocean with a sea surface temperature linearly interpolated from nearby ocean data. Preliminary results indicate that ascent is localized over the islands of the Maritime Continent in the control case, but is spread more evenly across the region when the islands are removed (Figure 4b). When only New Guinea is removed, ascent is reduced over New Guinea's position but is localized over the remaining islands (Figure 5b). Surprisingly, upper-level westerlies are stronger when the Maritime Continent is removed, but surface easterlies are weakened (Figure 4b). Upper-level westerlies are similar in the control and removed New Guinea cases, but surface easterlies are slightly reduced when New Guinea is removed. This suggests that the islands of the Maritime Continent serve to localize ascent, and their presence may be related to a strengthened Walker Circulation.

**References**

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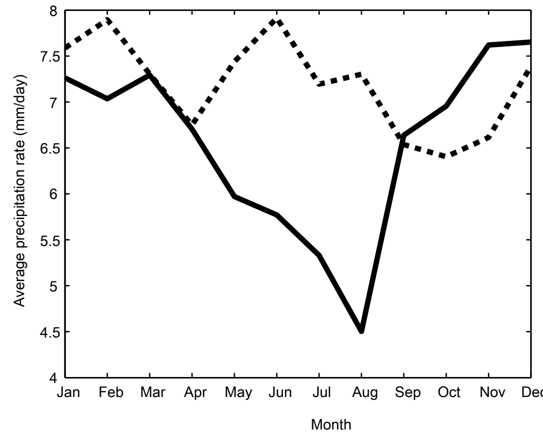



**Figure 1:** March 2000 - February 2005 monthly average precipitation rate (mm/day) over the Maritime Continent (solid line) and the Warm Pool (dashed line).

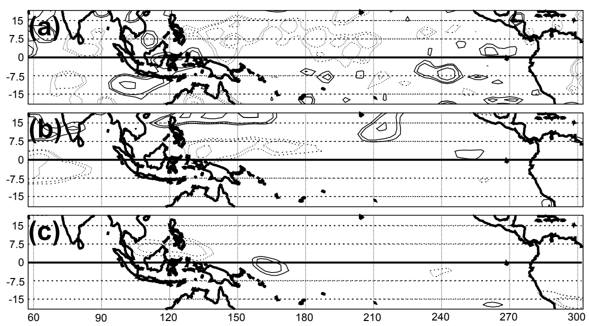



**Figure 2:** Significance levels of correlation of 5-yr average precipitation rate anomalies over the Maritime Continent with (a) $w_a$ at 850 mb, (b) $u_a$ at 850 mb, and (c) $u_a$ at 250 mb. Contours of 80%, 90%, and 99% confidence are solid (dashed) for positive (negative) correlation.

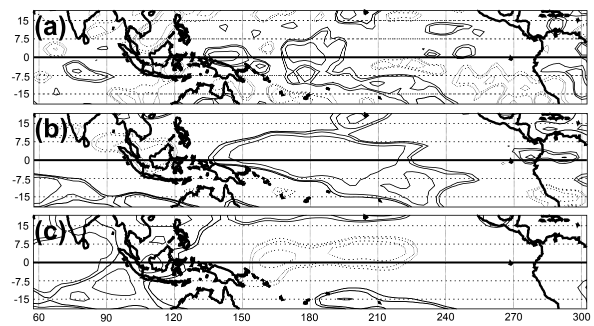
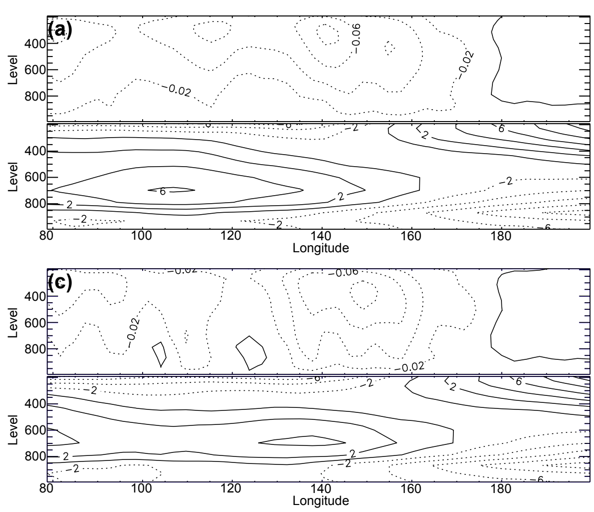



**Figure 3:** Significance levels of correlation of 5-yr average precipitation rate anomalies over the Warm Pool with (a) $w_a$ at 850 mb, (b) $u_a$ at 850 mb, and (c) $u_a$ at 250 mb. Contours of 80%, 90%, and 99% confidence are solid (dashed) for positive (negative) correlation.



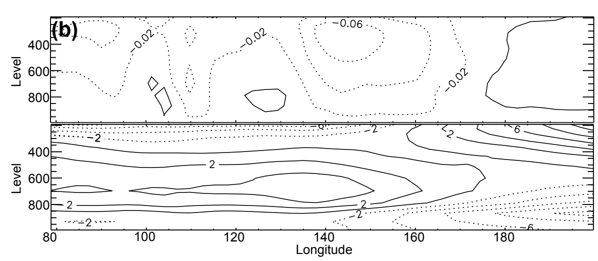




**Figure 4:** GCM simulation results of (a) run without the Maritime Continent, (b) run without New Guinea, and (c) a control with present-day topography. The top panel shows ω and the bottom show *u*. Values are averaged over latitudes from 7°S to 7°N.