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Regional patterns of tropical Indo-Pacific climate change linked to the Walker circulation slowdown

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Regional patterns of tropical Indo-Pacific climate change are investigated over the last six decades based on a synthesis of in situ observations and ocean model simulations, with a focus on physical consistency among sea surface temperature (SST), cloud, sea level pressure (SLP), surface wind, and subsurface ocean temperature. A newly developed bias-corrected surface wind dataset displays westerly trends over the western tropical Pacific and easterly trends over the tropical Indian Ocean, indicative of a slowdown of the Walker circulation. This pattern of wind change is consistent with that of observed SLP change showing positive trends over the Maritime Continent and negative trends over the central equatorial Pacific. Suppressed moisture convergence over the Maritime Continent is largely due to surface wind changes, contributing to observed decreases in marine cloudiness and land precipitation there. Furthermore, observed ocean mixed layer temperatures indicate a reduction in zonal contrast in the tropical Indo-Pacific characterized by larger warming in the tropical eastern Pacific and western Indian Ocean than in the tropical western Pacific and eastern Indian Ocean. Similar changes are successfully simulated by an ocean general circulation model forced with the bias-corrected wind stress. Whereas results from major SST reconstructions show no significant change in zonal gradient in the tropical Indo-Pacific, both bucket-sampled SSTs and nighttime marine air temperatures show a weakening of the zonal gradient consistent with the subsurface temperature changes. All these findings from independent observations provide robust evidence for ocean?atmosphere coupling associated with the reduction in the Walker circulation over the last six decades.

Keywords: climate change, Walker circulation, air-sea interaction, tropical Indo-Pacific