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Slowdown of the Walker circulation driven by tropical Indo-Pacific warming

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A suite of ship observations including sea level pressure, marine cloud, surface wind, and ocean subsurface temperature show that the Walker circulation has slowed down for the past century. The cause of this slowdown is investigated using a multi-model ensemble of atmospheric GCM simulations forced by several datasets of historical SST. The models reproduce observed changes well if the right SST datasets are used. The results show that the Walker circulation change over the past six decades was induced mostly by changes in zonal SST gradient across the Indo-Pacific Oceans, and that the warming over the Indo-western Pacific is not as large as previously thought. The widely-used SST datasets show intense warming over the tropical Indo-western Pacific, where uncertainty of SST warming trend is especially large. As a result, atmospheric GCMs forced by the conventional SST datasets tend to strengthen the Walker circulation, in disagreement with observations. The observed circulation change over the tropical Pacific contains large natural variability but provides a useful constraint on historical SST reconstruction.

Keywords: Walker circulation, Climate change, Tropical Pacific, Tropical Indian Ocean, Ocean-atmosphere interaction