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A tropical - extratropical cloud albedo control on the warm pool, cold tongue, Walker circulation complex

Natalie Burls (1,2) and Alexey Fedorov (2)

(1) AOES Department, George Mason University, Fairfax, VA, USA, (2) Department of Geology and Geophysics, Yale Univeristy, New Haven, CT, USA

What determines the strength of the warm pool, cold tongue, and Walker circulation (WCWC) within the fully coupled ocean-atmosphere system is a central question in tropical climate dynamics. Using a comprehensive coupled model (CESM) we demonstrate how the reflectivity of extratropical, as well as tropical, clouds plays a central role in setting the WCWC strength. In particular, we show that the gradient in cloud albedo between the tropics and mid-latitudes ($\Delta\alpha$) sets the mean east-west SST gradient in the equatorial Pacific. Our experiments reveal a near linear dependence between $\Delta\alpha$ and the warm pool to cold tongue temperature gradient, which is also seen to hold across the CMIP5 preindustrial control simulations. This relationship is critically dependent on the existence of the oceanic bridge (the oceanic Subtropical Cells), as well as atmospheric coupling between the tropics and mid-latitudes. We explain the close relation between the two variables using an energy balance model incorporating the essential dynamics of the warm pool, cold tongue Walker circulation complex and the influence of the extratropics.