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The seesaw response of the Intertropical and South Pacific convergence zones to hemispherically asymmetric thermal forcing

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Arguments based on atmospheric energetics and aqua-planet model simulations link the latitudinal position of the Intertropical Convergence Zone (ITCZ) to atmospheric cross-equatorial energy transport –- a greater southward transport corresponds to a more northerly position of the ITCZ. This idea is often invoked to explain an interhemispheric dipole pattern of precipitation anomalies in paleoclimates. In contrast, here we demonstrate that in the tropical Pacific the response of the fully coupled ocean-atmosphere system to a hemispherically asymmetric thermal forcing, modulating this energy transport, involves an interplay between the ITCZ and its counterpart in the South Pacific - the Southern Pacific Convergence Zone (SPCZ). This interplay leads to interhemispheric seesaw changes in tropical precipitation, such that the latitudinal position of each rain band remains largely fixed, but their intensities follow a robust inverse relationship. The seesaw behavior is also evident in the past and future coupled climate simulations of the Climate Model Intercomparison Project Phase 5 (CMIP5). We also show that the tropical Pacific precipitation response to thermal forcing is qualitatively different between the aqua-planet (without ocean heat transport), slab-ocean (with climatological ocean heat transport represented by a ``Q-flux'') and fully-coupled model configurations. Specifically, the induced changes in the ITCZ latitudinal position successively decrease, while the seesaw precipitation intensity response becomes more prominent, from the aqua-planet to the slab-ocean to the fully-coupled configuration. Thus, the ITCZ/SPCZ seesaw can explain the paleoclimate precipitation dipole pattern without invoking a too strong climate forcing and is relevant to future projections of tropical precipitation.