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Remote mechanisms for shifting the tropical Pacific warming pattern

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Changes in the sea surface temperature (SST) pattern in the tropical Pacific modulate radiative feedbacks to greenhouse gas forcing, the pace of global warming, and regional climate impacts. Therefore, elucidating the drivers of the pattern is critically important for reducing uncertainties in future projections. However, the attribution of observed changes over recent decades, an enhancement of the zonal SST contrast coupled with a strengthening of the Walker circulation, has not been successful. Here, we review existing mechanisms of the forced response, categorized as either an energy perspective that adopts global/hemispheric energy budget constraints or a dynamical perspective that examines the tropical atmosphere-ocean coupled processes. We then collectively discuss the relative contributions to the past and future SST pattern changes to propose a narrative that reconciles them. Despite uncertainties, the balance of evidence suggests that the mechanisms leading to strengthening the zonal SST contrast have been efficient in the past and those leading to a weakening were less efficient but will become dominant in a future climate. We particularly focus on the role of Southern Ocean SST changes in shifting the tropical Pacific warming pattern. Finally, we present opportunities to resolve the model-observation discrepancy regarding the recent trend.