The response of ENSO 'flavors' to orbital forcing: Implications for interpreting proxies.

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We explore mechanisms driving changes in ENSO 'flavors' that involve orbitally induced changes in the annual cycle of the tropical Pacific during the mid-Holocene. We study long simulations of the pre-industrial and mid-Holocene climate performed with the Community Climate System Model 4 (CCSM4). We find that the simulated probability density functions of central and eastern Pacific 'flavors' of ENSO change in the mid-Holocene climate. Eastern Pacific (EP) events almost disappear, while the frequency of Central Pacific (CP) events remains mostly unaltered. To attribute this differential response of EP and CP ENSO to orbital forcing, we study the termination mechanisms, as well as the heat budget for the two flavors in the pre-industrial and the mid-Holocene climate. We find that in the mid-Holocene the termination mechanism for strong EP events that is associated with a southward shift of the wind anomalies in the west Pacific is stronger. Also, the thermocline feedback is weaker in the mid-Holocene due to weaker climatological stratification in the east Pacific, which results from weaker climatological winds in the WP. These mechanisms only apply to EP and not CP events, which could explain the differential response of ENSO flavors to orbital forcing. These changes in ENSO flavors lead to changes in rainfall teleconnections in the tropics that could reconcile the interpretation of apparently conflicting evidence from coral proxies from the central Pacific, which show unchanged ENSO variability during the mid-Holocene, with rainfall proxies from the coast of South America and the Galapagos, which are typically interpreted as a decrease in overall ENSO variability.