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Orbital pacemaking of ENSO

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Using a coupled general circulation model the response of the annual cycle and the El Niño-Southern Oscillation phenomenon to orbital changes is studied. We perform a 1650-year-long simulation with accelarated orbital forcing, representing the period from 142,000 years B.P to 22,000 years A.P. (after present). Our simulation shows that the amplitude of ENSO is strong in phases where the annual cycle forcing is weak and vice versa. Since the strength of the annual cycle forcing depends on the orbital parameters, the response of ENSO to insolation changes originates from a nonlinear interaction between ENSO and slow changes of the annual cycle. These results are confirmed using a simple coupled atmosphere-ocean model for the tropical Pacific. Furthermore, it is shown that the oceanic stratification plays a key role in controlling the interplay between the annual-cycle and ENSO.