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The role of ENSO in regulating the stability of the tropical Pacific climatology

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Increasing evidence indicates that the time-mean climate state of the tropical Pacific hovers closely around the neutral point. What enables the climatology to triumph over the destabilizing effect of the radiative heating? The answer may be ENSO. To investigate the role of ENSO in regulating the stability of the tropical Pacific climatology, perturbation experiments are conducted in pairs with a coupled model. Perturbations are introduced through either enhancing tropical heating or increasing subtropical cooling (such perturbations increase the thermal "stress" on the coupled system).In one experiment, the ENSO is turned off while in another experiment the ENSO is turned on. Whether the perturbation comes from enhanced tropical heating or enhanced subtropical cooling, the response of the time mean value of Tw-Tc (the temperature difference between the warm-pool SST and the characteristic temperature of the equatorial thermocline water) is much reduced when ENSO is on than when ENSO is off. In the enhanced tropical heating case, ENSO enables surface heat to be pumped to the depths of the equatorial thermocline and effectively "mix" the heat downward against a stable stratification. In the enhanced subtropical cooling case, the same effect of ENSO enables heat pumped to the depths of the equatorial subsurface to diminish the cooling to the equatorial thermocline water caused by the enhanced subtropical cooling. To the degree that the value of Tw-Tc controls the coupled stability of the tropical Pacific climatology, the numerical experiments suggest a fundamental role of ENSO in regulating the tropical Pacific climatology. The study raises the question whether models with poor simulations of ENSO can give reliable predictions of the response of the mean climate to global warming.