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ENSO Stability Under Climate Change

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In recent years it has been found there has been an increase in Central Pacific El Nino events, commonly characterised by the occurrence of sea surface temperature anomalies in a more western area of the Equatorial Pacific than the traditional Eastern Pacific El Nino. It is also thought these different events are linked to various ocean-atmosphere interactions. Here we use the Bjerknes' Stability (BJ) Index, a measure of the growth rate of ENSO, to quantify these ENSO processes under a climate change scenario in an ensemble of climate model simulations with the HadCM3 model. In present day conditions it is found ENSO is dominated by the positive thermocline feedback and the negative thermodynamic damping. ENSO stability in the ensemble is found to have a robust response to climate change. The thermocline feedback weakens, and is found to be linked to variations in the response of the thermocline slope to easterly wind stress anomalies during El Nino events. Other weaker positive feedbacks, such as the zonal advective feedback, strengthen, mainly due to a stronger ocean current response to fluctuations in zonal wind stress anomalies. Thermodynamic damping shows the strongest response to climate, with the ensemble mean almost doubling in strength. This is found to be mainly due to a large increase in the short wave component of this damping. This large increase in thermodynamic damping dominates the total stability and results in an overall decrease of the BJ index leading to a more damped ENSO after climate change, despite the ensemble showing an increase in SST variability. The reasons for this paradox are examined.