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The thermocline feedback in the western-central equatorial Pacific: A key player for ENSO in a warming climate?

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Vertical stratification changes at low frequency over the last decades are the largest in western-central Pacific and have the potential to modify the balance between ENSO feedback processes. Using Reanalysis products, we show evidence of an increase in thermocline feedback in the western-central equatorial Pacific over the last 50 years, and in particular after the climate shift of 1976. The thermocline feedback becomes more effective due to the increased stratification in the vicinity of the mean thermocline, which is shown to be concomitent with long-term change of the recharge-discharge process. The increased stratification leads to an increase of vertical advection variability twice as large as its increase resulting from the increased in ENSO amplitude (positive asymmetry) in the eastern Pacific that connects to the thermocline in the western-central Pacific through the basin-scale 'tilt' mode. Although the zonal advective feedback is dominant over the western-central equatorial Pacific, the more effective thermocline feedback allows for counteracting its warming (cooling) effect during warm (cold) event, leading to the reduced covariability between SST and thermocline depth anomalies in the NINO4 (160°E-150°W; 5°S-5°N) region after the 1976 climate shift. This counter-intuitive relationship between thermocline feedback strength as derived from the linear relationship between SST and thermocline fluctuations and stratification changes is also investigated in a long-term coupled general circulation model (CGCM) simulation. A recharge-discharge conceptual coupled model is used to show that the change in thermocline feedback associated to increased vertical stratification in the central-western Pacific as simulated by the CGCMs in which the green-house gazes concentration is increased (CMIP5) can lead to an ENSO regime accounting for Central Pacific El Niño events.