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ENSO regimes and the late 1970's climate regime shift: The role of synoptic weather and South Pacific ocean spiciness.

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South Pacific subtropical density compensated temperature and salinity (spiciness) anomalies are known to be associated with decadal equatorial variability, however, the mechanisms by which such disturbances are generated, propagate and the degree to which they modulate the equatorial thermocline remains controversial. During the late 1970's a climate regime transition preceded a period of strong and sustained El Nino events. Using an ocean general circulation model forced by the constituent mechanical and thermodynamics components of the reanalysed atmosphere we show that the late 1970's transition coincided with the arrival of a large-scale, sub-surface cold and fresh water anomaly in the central tropical Pacific. An ocean reanalysis for the period 1990-2007 that assimilates subsurface Argo, XBT and CTD data, reveals that disturbances occur due to the subduction of negative surface salinity anomalies from near 35°S, 100°W which are advected along the $\sigma = 25 - 26kg\ m^{-3}$ isopycnal surfaces. These anomalies take, on average, seven years to reach the central equatorial Pacific where they may substantially perturb the thermocline before the remnants ultimately ventilate in the region of the western Pacific warm pool. Positive (warm–salty) disturbances, known to occur due to late winter diapycnal mixing and isopycnal outcropping, arise due to both subduction of subtropical mode waters and subsurface injection. On reaching the equatorial band (10°S–0°S) these disturbances tend to deepen the thermocline reducing the model's ENSO. In contrast the emergence of negative (cold-fresh) disturbances at the equator are associated with a shoaling of the thermocline and El Nino events. Process studies are used to show that the generation and advection of anomalous density compensated thermocline disturbances critically depend on stochastic forcing of the intrinsic ocean by weather. We further show that in the absence of the inter-annual component of the atmosphere forcing Central Pacific El Nino events are manifest.