Coupled responses to the equatorial emergence of spiciness anomalies

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The shallow subtropical cell brings water to the low latitudes whose temperature and salinity have been set at subtropical subduction regions and conditions along the transit in the ocean's thermocline. Anomalies of these properties have been hypothesized to modulate tropical climate on decadal time scales. This conjecture is investigated for density compensating temperature and salinity (spiciness) anomalies emerging in the upwelling region of the equatorial Pacific.

In a sophisticated, coupled ocean–atmosphere model, artificial sources of heat and fresh water are are places in the upper thermocline of the western Pacific such that the warm and salty anomalies are generated, but the water's density is unchanged. These spiciness anomalies are advected eastward and mixed in the equatorial Undercurrent as a passive tracer. Upon emerging at the surface in the central equatorial Pacific the associated temperature anomalies interact with the atmosphere. The emergence of warm and salty spiciness anomalies leads to a venting of heat to the atmosphere, primarily by the latent heat flux and to an enhancement of atmospheric convection in the western Pacific and Intertropical Convergence Zone. The trade winds strengthen east and weaken west of the dateline, which deepens the thermocline in the central equatorial Pacific, and raises it in the east.

These dynamical changes feed back on equatorial ocean temperatures and enhance the warming in the central equatorial Pacific by the deepened thermocline and warm water subduction from the southern hemisphere. From the northern hemisphere source regions of equatorial thermocline waters, cool and fresh anomalies result from the changed air-sea fresh water fluxes and wind-driven changes of the transit path to the equator.

The amplitude of the simulated El Nino/Southern Oscillation is reduced for warm spiciness anomalies, due to a reduction of the thermocline feedback. The changes in the tropics are teleconnected via the atmosphere to the North Pacific, and, for the emergence of warm spiciness anomalies in the equatorial region, shift the northern edge of subtropical gyre equatorward, with cool surface temperature anomalies in the Kuroshio/Oyashio extension.