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Impacts of regional mixing on the temperature and salinity structures of the tropical Pacific Ocean

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Furue Ryo[1*] ; Jia Yanli[2] ; McCreary Julian P.[2]
FURUE, Ryo[1*] ; JIA, Yanli[2] ; MCCREARY, Julian P.[2]

[1]JAMSTEC, [2]IPRC, Univ. Hawaii
[1]JAMSTEC, [2]IPRC, Univ. Hawaii

We investigate the sensitivity of numerical-model solutions to regional changes in vertical diffusion. Specifically, we vary the background diffusion coefficient, κ_b, within spatially distinct subregions of the tropical Pacific, assess the impacts of those changes, and diagnose the processes that account for them.

Solutions respond to a diffusion anomaly, κ_b, in three ways. Initially, there is a fast response (several months), due to the interaction of rapidly-propagating, barotropic and gravity waves with eddies and other mesoscale features. It is followed by a local response (roughly one year), the initial growth and spatial pattern of which can be explained by one-dimensional (vertical) diffusion. At this stage, temperature and salinity anomalies are generated that are either associated with a change in density (”dynamical” anomalies) or without one (”spiciness” anomalies). In a final adjustment stage, the dynamical and spiciness anomalies spread to remote regions by radiation of Rossby and Kelvin waves and by advection, respectively.

In near-equilibrium solutions, dynamical anomalies are generally much larger in the latitude band of the forcing, but the impact of off-equatorial forcing by κ_b on the equatorial temperature structure is still significant. Spiciness anomalies spread equatorward within the pycnocline, where they are carried to the equator as part of the subsurface branch of the Pacific Subtropical Cells, and spiciness also extends to the equator via western-boundary currents; they are also carried to the Indian Ocean via the Indonesian Throughflow. Forcing near and at the equator generates strong dynamical anomalies, and sometimes additional spiciness anomalies, at pycnocline depths. The total response of the equatorial temperature and salinity structures to κ_b in various regions depends on the strength and spatial pattern of the generation of each signal within the forcing region as well as on the processes of its spreading to the equator.
Keywords: spiciness anomalies, ocean general circulation model, Subtropical Cells