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Mirror Layer of Temperature and Salinity in the Ocean

Gang Wang (1,2)

(1) First Institute of Oceanography, Ministry of Natural Resources (MNR), China, (2) Laboratory for Regional Oceanography and Numerical Modeling, Pilot National Laboratory for Marine Science and Technology (Qingdao), China

Temperature and salinity are fundamental and independent thermodynamic variables of seawater. However, it was determined from monthly Argo data that the correlation coefficient of layer-averaged temperature and salinity (T-S) time series peaks at a depth of approximately 300 m. Meanwhile, T-S patterns around that depth are consistent. Therefore, this layer is designated the "T-S mirror layer". In four sets of objectively analyzed ocean data products, which are based on observation (WOA13, EN4, Ishii and Argo), we also derived the “mirror layer” (to differentiate, we call it “A-mirror layer”) with a spatial correlation of the T-S patterns reaching a maximum at 120-200 m. We observed that the A-mirror layer couples with the quasi-linear “slender waist” in T-S scatter diagrams; this coupling is typical in low- and mid-latitude oceans. The slender waist bridges high-temperature, high-salinity seawater at the bottom of the mixed layer and low-temperature, low-salinity seawater in the deep ocean. Its quasi-linear structure yields that the T-S patterns mirror each other in a restricted range. We propose that the slender waist in the T-S scatter diagrams is driven by evaporation-precipitation processes in the subtropical ocean surface waters. Therefore, the T-S mirror layer is not simply determined by ocean circulation and mesoscale eddies, as has been suspected, but it is also determined by a thermodynamic phenomenon. Our work links two phenomena in ocean temperature and salinity and provides a new viewpoint for surveying the horizontal thermohaline pattern around the pycnocline.