Barrier Layers in a High-Resolution Model in the Eastern Tropical Pacific

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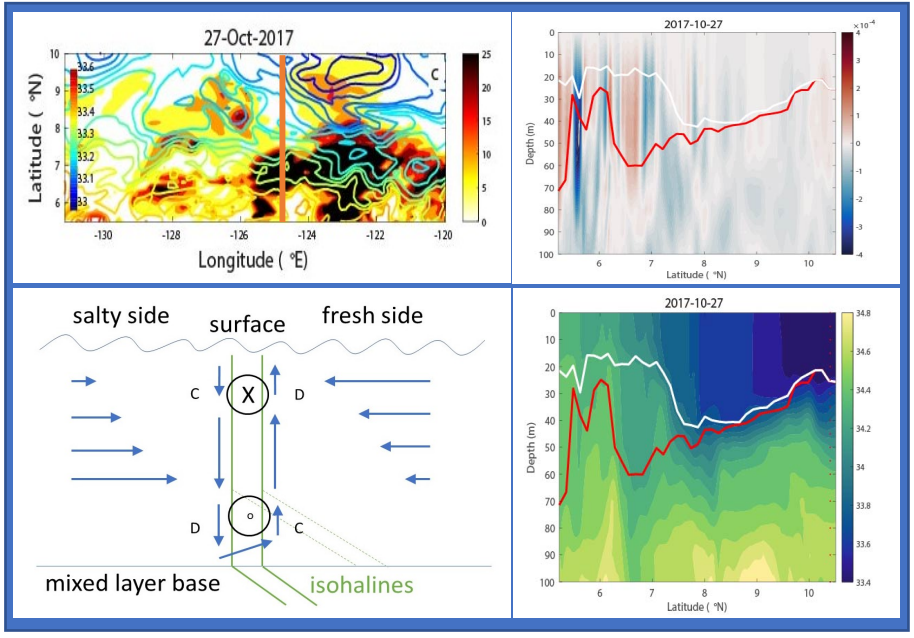

Upper left: SSS and BLs on 27 October 2017 from a high-resolution ocean model. Contours: SSS with color scale at left. Shading: BLT in meters with color scale at right. BLT, barrier layer thickness; SSS, sea surface salinity.

Upper right: Vertical velocity section along 125°W – the red line in upper left panel. Color scales (in m/s) are at right. Red colors are upward and blue downward. Barrier layer is between the red and white lines, thickest around 7°N.

Lower left: Schematic view of proposed BL formation mechanism in the ETP showing a section across a salinity front in the mixed layer.

Lower right: A salinity section along 125°W – the red line in upper left panel on 27 October. Color scale is at right. BL is between the red and white lines.

Problem: Barrier layers (BLs) play an important role in regulating the transfer of heat, momentum, and freshwater across the ocean's surface and into the ocean interior. BLs are shallow layers near the ocean surface where vertical density change is controlled by salinity. These layers appear intermittently in the tropical ocean and can vary in thickness. Previously, there have been gaps in understanding about the relationship between surface flow and barrier layer thickness. This study looked at two BL events in the Eastern Tropical Pacific (ETP) to investigate this using a numerical model.

Data and methods: Using output from a high-resolution ocean model, we computed BL thickness and surface divergence. Divergence is the extent to which flow near the surface comes together or pushes apart and is often associated with vertical motion and formation of fronts. We also looked at such factors as winds, sea surface temperature, and vorticity (the swirling motion of the water); and found divergence to be the most important indicator of the formation of BLs.

Key findings: Vertical circulation combined with surface divergence and convergence (its opposite) is proposed as a formation mechanism for BLs. BLs are associated with surface salinity fronts which tilt toward the fresh side at their base.

Broader significance or implications: BLs are ubiquitous features in the ETP that introduce variation into the transfer of heat and freshwater across the surface. This may create a positive feedback loop which increases variation in salinity and creates fronts and more BLs. It is possible that this feedback loop may lead to or accelerate the extension of the low surface salinity feature that stretches across the tropical Pacific during the summer and fall.

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