"Adaptive scaling model of the main pycnocline and the associated overturning circulation"

This study examines a number of factors and processes that control the large-scale structure of the main pycnocline and the associated overturning circulation that maintains the ocean stratification. We develop an adaptive scaling model that conceptually captures and incorporates the key water-mass transformation processes at the first order approximation. The constructed semi-empirical polynomial transformation balance equation, that linearly superimposes various transformation rate terms, is tested in a number of simplified single-basin configurations of a general circulation model.

The results provide us with further understanding of the ocean controlling mechanism and prediction of how the average depth of the main pycnocline, and the deep-water production and export rate, will change from one steady state to another. We show that wind-driven transformation processes can be decomposed into contribution from the mid-latitude westerly and the low-latitude easterly wind (also dependent on the mixed layer depth). This low-order model smoothly connects both classical limits (diffusive and advective). The proposed framework, that unifies wind-driven and thermohaline processes, give us more encompassing insight into the problem of the “Drake Passage effect without Drake Passage”. The modification of different transformation pathways in the Southern Hemisphere can result in the equivalent net conversion changes.

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