Analysis of A Semi-Permanent Downwelling Zone in the East China Sea Using Hybrid Coordinate Ocean Model (HYCOM) with and without Tides

The East China Sea (ECS) is a dynamic marine environment heavily influenced by complex topography and an energetic Kuroshio, contributing to an intricate system of permanent and temporary flows. Although our scientific understanding of the ECS has increased significantly with the use of satellite data, the scarcity of in-situ observations dictates the necessity of enlisting high-resolution models to discern the unique ocean processes. The focus of this research is on analyzing vertical motion from simulations of the East China Sea using a 1/12.5⍰regional HYbrid Coordinate Ocean Model (HYCOM) from 2018-2022. This regional model spans the western Pacific from 4S to 42N and from 99E to 138E using output from a global HYCOM reanalysis at the open boundaries. The hybrid coordinate system uses z, sigma, and isopycnal vertical coordinates to optimize thickness of the 41 grid-layers over the complex bathymetry of the ECS. The simulations with tides examined in this study are forced by the astronomical tidal potential of the four largest semidiurnal constituents (M2, S2, N2, and K2) and the four largest diurnal constituents (K1, O1, P1, and Q1) with time varying TPXO tides applied at the open boundaries. Constituents are enabled/disabled to address research questions of interest, including their role in modulating vertical and upslope motion along the Okinawa trough and on the ECS shelf. Surface forcing is applied using Climate Forecast System Reanalysis (CFSR). Here we present a preliminary discovery: an area of persistent downwelling ~350 km East-Northeast of Taiwan along the 200 m isobath where the Kuroshio meets the continental slope. Analysis of daily mean vertical velocity (w) at 50 m shows a 9,000 km2 zone of strong and persistent downwelling where w < -3 × 10-5 ms-1 is observed over 50% of the time in a 5-year period. A seasonal variation also exists, as the feature's area is at a maximum in summer and reduces to less than half the size during winter. The authors explore key mechanisms behind this unique feature including geostrophically-driven cross-isobath flow, topography, and Ekman transport. Distribution Statement A. Approved for public release: distribution is unlimited.

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