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Multiscale asymptotic analysis and numerical simulation of the wind-driven ocean surface boundary layer[1] ZIEMOWIT MALECHA, GREG CHINI, University of New Hampshire, KEITH JULIEN, University of Colorado, Boulder — A primary challenge in physical oceanography is to understand the interaction between small-scale vertical mixing processes in the upper ocean, such as Langmuir circulation (LC), and submesoscale eddies, fronts, and their associated instabilities. This problem is computationally challenging because LC is strongly non-hydrostatic, only weakly affected by the Earth's rotation and density stratification, and has length scales commensurate with the ocean surface boundary layer, O(50) m. In contrast, submesoscale flows are approximately hydrostatic, strongly affected by Coriolis accelerations and density stratification, and have O(10) km lateral scales. In this investigation, we take a first step toward developing a physically consistent and computationally efficient model of this inter-scale coupling using multiscale asymptotic analysis and multiscale pseudospectral numerical simulations. We have achieved over an order of magnitude acceleration of our computations relative to brute-force simulations using a single-scale algorithm.

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