Abstract View

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The Langmuir Circulation Instability as a Mixing Mechanism in the Upper Ocean

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ABSTRACT

A numerical study of the fully nonlinear instability of the ocean to Langmuir circulations is reported. The extended Craik-Leibovich theory is used to compute the development of a mixed layer in an ocean of infinite depth as an initial value problem. A wind stress and surface wave field are imposed on a quiescent ocean with a linear temperature gradient. The initial response to the applied stress is a rectilinear current that is unstable to Langmuir circulations. The resulting convective motions appear to cascade energy from small-scale circulations to more vigorous ones of larger scale. Horizontal averages allow one to identify the Reynolds stress, heat flux and mixing efficiency of the Langmuir “eddies.” Mixing efficiencies several times (up to an order of magnitude) larger than those reported in laboratory experiments are possible. It is suggested that numerical experiments such as these may offer a means of parameterizing the effects of sea state and Langmuir circulations for use in one-dimensional and mixed-layer models.