Abstract View

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On the Generation of Mesoscale Eddies and their Contribution to the Oceanic General Circulation. II. A Parameter Study

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ABSTRACT

In this investigation the wind-driven ocean circulation theories are extended to include mesoscale eddies as an integral part of the general circulation of the ocean. A two-layer numerical model of ocean circulation in a simple, rectangular basin driven by a steady wind stress is used for this purpose. The equations of motion are integrated as an initial value problem until the solutions reach either a steady state or, in the case of an ocean in which eddies have appeared spontaneously as a result of baroclinic instability, a statistically steady state.

Part I of this study discussed the formulation of the numerical model and presented results from a preliminary numerical experiment. Energetic analyses showed that eddies result from baroclinic instability during the spin-up of the ocean from rest and that, in the final statistically steady state, the eddy momentum and buoyancy fluxes played an important role in establishing the mean circulation. In the particular case examined there, the region of eddy generation was in the westward return flow and not in the strong boundary jets.

In this part of the study, results from ten additional experiments are examined to understand, in a limited way, how eddy generation and the resulting eddy statistics depend upon the basic parameters describing the model ocean. In particular, the dependence of results on the coefficient of lateral viscosity, the wind stress amplitude, the wind stress distribution (one and two gyres), the basin size, and the boundary conditions (slip and no-slip) are discussed. Results show a wide range of model behavior under the conditions examined, but the common result is that the mean circulation of eddying oceans is importantly altered, one might even say largely determined, by the statistical nature of the eddy field.

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