Abstract View

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Integral Constraints on Bottom and Surface Isolated Eddies

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ABSTRACT

General integral relationships are derived for joint eddies in a three-layer ocean model as considered by Nof. The model is composed of two eddies in two superposed layers, the third layer being motionless. Two cases are examined, first when the two active layers are near the bottom (bottom eddies) and, second, when they are located near the surface of the ocean (surface eddies). For bottom eddies the β effect is due to the presence of a slope as a bottom topography. For surface eddies the β effect comes in through the variation with latitude of the Cariolis frequency.

The novelty of the present work consists in the derivation of mathematically exact integral properties, from which the translation speed of the system is deduced. Contrary to Nof no scaling assumptions are made and therefore the result applies to a wide range of physical situations. In particular, barotropic isolated vortices and bottom eddies in a two layer ocean are within the range of application of the present results since the Boussinesq approximation has not been used in the study. Consequently, the integral theorems given in this paper extend previous theorems by Flierl and Stern. The paper's emphasis is on the mathematical aspects but important physical implications are readily deduced from the general result. In particular, as was first pointed by Nof, it is shown that isolated eddies propagate eastward under certain conditions.