Abstract View

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# On the β-Induced Movement of Isolated Baroclinic Eddies

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ABSTRACT

In this paper an analytical method is proposed for calculating the nonlinear β-induced translation of isolated baroclinic eddies. The study focuses on frictionless anticyclonic eddies with a uniform anomalous density and a lens-like cross section which translates steadily in a resting Ocean. The depth of these eddies vanishes along the outer edge so that as they translate westward their entire mass anomaly is caused along with them.

The proposed method for calculating the translation speed incorporates the nonlinear equations of motion in an integrated form and a simple perturbation scheme. It relates the translation of the eddy to its intensity, size and volume, but requires only an approximate knowledge of the corresponding numerical values.

The power and usefulness of the proposed method is demonstrated by its application to a class of simply-structured eddies whose swirl velocity increases monotonically with the distance from the center. It is found that the translation of these eddies is considerably smaller than that of a simple Rossby wave. A small Rossby number eddy whose swirl velocity increases monotonically with the distance from the center translates westward at approximately $\frac{1}{3}\beta R_d^2$ (where $R_d$, is the deformation radius), whereas the most nonlinear eddy (whose negative relative vorticity approaches the vorticity of the earth) translates at $\frac{2}{3}\beta R_d^2$.

The proposed method is tested by its application to more complicated anticyclonic eddies representing those shed by the Loop Current in the Gulf of Mexico. For these eddies, the predicted westward translation speed is $0.32\beta R_d^2$ which agrees very well with both numerical experiments and field observations.

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