Abstract View

Volume 16, Issue 7 (July 1986)

Journal of Physical Oceanography
Article: pp. 1158–1164 | Abstract | PDF (510K)

Linear Stability of Large, Elliptical Warm-Core Rings

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(Manuscript received May 18, 1985, in final form December 2, 1985)

DOI: 10.1175/1520-0485(1986)016<1158:LSOLEW>2.0.CO;2

ABSTRACT

An analytical solution for a confined, elliptical lens of light water is perturbed to test the linear stability of elongated warm-core rings. The asymptotic expression of the solution when the eddy's radius is “large” (three times the deformation radius or more) is used to suppress inertial oscillations and render the problem easily tractable. It is found that, in this large-scale limit, the eddy's stability is independent of its size and dependent only on its eccentricity. The critical threshold is a ratio of semi-major to semi-minor axes equal to 1.8. More circular eddies are stable to all infinitesimal perturbations while more elongated ones are unstable to at least a mode 3 (egg shape). In the present, reduced-gravity formalism, baroclinic instability is absent, and the instability mechanism is purely of frontal nature (presence of a curved outcrop). With an active stratum, baroclinic processes can probably set instability at even more moderate eccentricities. It is suggested that the instability of elongated lenses of water is the reason that precludes their existence even in areas known for their intense ring activity.