Abstract View

Volume 11, Issue 2 (February 1981)

Journal of Physical Oceanography
Article: pp. 209–230 | Abstract | PDF (1.11M)

Baroclinic and Barotropic Instabilities of Coastal Currents

L.A. Mysak, E.R. Johnson, and W.W. Hsiem

Department of Oceanography, University of British Columbia, Vancouver, B.C., Canada V6T 1W5

(Manuscript received August 15, 1979, in final form September 17, 1980)

DOI: 10.1175/1520-0485(1981)011<0209:BABIOC>2.0.CO;2

ABSTRACT

The two-layer baroclinic instability model of the California Undercurrent from Mysak (1977) is modified to investigate the effects of the lateral boundary conditions on the stability properties of the system. As is common in baroclinic instability calculations, Mysak (1977) assumes the mean flow along the continental rise to be bounded laterally by vertical rigid walls, thus allowing the cross-stream structure of the perturbation flow to be decomposed into simple normal modes. Instability then occurs when waves of the same cross-stream structure interact. The dominant instability is that associated with the gravest mode.

In the first model presented here we consider the effect of replacing the rigid outer boundary with a quiescent, constant-depth ocean. Waves of short longshore wavelength are not greatly affected by the open seaward boundary. However, as consideration is turned to waves of longer longshore wavelength, the cross-stream wavenumber departs further from the integral values of the channel-flow problem and another class of baroclinic instabilities occurs due to interaction between waves of differing cross-stream structure. Nevertheless, the dominant baroclinic instability remains that associated with the gravest mode. A new barotropic instability is also present, drawing energy from the horizontal shear between the coastal current and the quiescent ocean.

In the second model the rigid outer boundary is retained but the inner boundary is replaced by a shallow sloping region, modeling the effects of a sloping shelf adjoining the coastal current which flows along the continental rise. Topographic waves are present above the sloping inshore region. These waves are coupled with the channel waves. Once again the cross-stream wavenumber departs from the integral values of the channel problem and instabilities are present due to interaction between waves of differing cross-stream structure. As in the previous model the dominant baroclinic instability is that of the gravest mode and a new barotropic instability is present due to the lateral shear in the mean flow at the shelf break.

For both models, a parameter study is presented in which we determine the effects of varying the shear, stratification and bottom slope.

top

Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
Allen Press, Inc. assists in the online publication of *AMS* journals.