Abstract View

Volume 8, Issue 1 (January 1978)

Journal of Physical Oceanography
Article: pp. 47–62 | Abstract | PDF (1.16M)

The Arrested Topographic Wave

G.T. Csanady

Woods Hole Oceanographic institution, Woods Hole, Mass. 02543

(Manuscript received June 11, 1976, in final form August 8, 1977)

DOI: 10.1175/1520-0485(1978)008<0047:TATW>2.0.CO;2

ABSTRACT

The mean circulation in a coastal zone of variable depth may under certain circumstances be modeled by linear equations, including a bottom friction linear in the depth-averaged velocity. The resulting steady-state problem is similar to the problem of topographic wave generation by wind. The equation governing the pressure field has the form of a one-dimensional heat conduction equation, with longshore distance in the direction of topographic wave propagation playing the role of time. The effects of wind stress or of freshwater influx are felt only over the forward portion of a long shelf (i.a., that portion to which topographic waves propagate from the source region).

Various simple solutions can be written down for the arrested topographic wave problem in virtue of the heat conduction analogy. They generally show the presence of a pressure field trapped in a nearshore band. For periodic wind stress, for example, the scale width of the trapped pressure field is $L=(2r/fks)^{1/2}$, where r is a bottom resistance coefficient (dimension velocity), f the Coriolis parameter, k the longshore wavenumber of the wind stress and s bottom slope, assumed constant.

The model is applied to the eastern North American continental shelf in an attempt to determine the physical origin of the southwestward pressure gradient which has recently been identified as the main driving force of the observed longshore flow. It is shown that neither wind stress nor freshwater influx can reasonably be held accountable for this pressure gradient. On the other hand, a longshore surface elevation gradient imposed at the shelf break by the dynamics of a deepwater current produces exactly the type of response observed over the shelf.

The same model also accounts for the mean circulation in winter of Lake Ontario, as well as for some features of the summer circulation.

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.