Abstract View

Volume 6, Issue 5 (September 1976)

Journal of Physical Oceanography
Article: pp. 646–664 | Abstract | PDF (1.45M)

A Numerical Model of the Somali Current

H.E. Hurlburt and J. Dana Thompson

National Center for Atmospheric Research, Boulder, Colo. 80303

(Manuscript received March 4, 1976, in final form June 7, 1976)

DOI: 10.1175/1520-0485(1976)006<0646:ANMOTS>2.0.CO;2

ABSTRACT

We have sought to simulate and understand consistently observed features of the Somali Current system during the southwest monsoon using a two-layer, nonlinear numerical ocean model driven from rest by a uniform south wind in a flat bottom, rectangular geometry. High spatial resolution in both equatorial and coastal boundary regions was retained in this free-surface model.

The model Somali Current is best classed as a time-dependent, baroclinic inertial boundary current. Analytical solutions to a quasi-steady linear model of the Somali Current are shown to be self-inconsistent with the linear approximation. While linear theory predicts perfect symmetry about the equator, the nonlinear numerical solutions exhibit marked asymmetries in less than a month as the model Somali Current becomes strongly inertial. By day 30 the current has attained its maximum value (140 cm s^{-1}) within a few degrees of the equator, in accord with observations. In this time-dependent case, boundary layer separation occurs at the northern end of the inertial current as the northward advection of the current precedes the adjustment of the mass field. Associated with the northward movement of the baroclinic inertial boundary current is a "great whirl" similar in scale and intensity to that observed. This remarkable whirl is characterized by anti-cyclonic *inflow* in the upper layer, cyclonic *outflow* in the lower layer, and a northward translation speed of about 27 cm s^{-1}. At the coast, west of the whirl, is an upwelling maximum also found in the observations.

A consideration of the eastern and equatorial solution shows that the south wind case excites the n=0 mode for equatorially trapped inertia-gravity oscillations. These oscillations are strongly coupled to the eastern boundary layer and excite a poleward propagating train of internal Kelvin waves. Prior to the arrival of the leading edge of the wave train, upwelling (downwelling) occurs south (north) of the equator at the eastern boundary. Due to the symmetry properties of the solution, no internal Kelvin wave of significant amplitude is excited anywhere along the western boundary. The trapped inertia-gravity oscillations are damped as a Yanai wave propagates away from the western boundary. Significantly, in the eastern equatorial ocean the time scale for *cessation* of vertical motion driven by a meridional wind is the same as that for *onset* for a zonal wind.

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.