Abstract View

Volume 18, Issue 6 (June 1988)

Journal of Physical Oceanography
Article: pp. 834–850 | Abstract | PDF (936K)

Analytical Theory of the Steady State Coastal Ocean and Equatorial Ocean

Wolfgang Fennel

Academy of Sciences of GDR, Institute of Marine Research, Rostock-Warnemünde, GDR

(Manuscript received February 11, 1987, in final form November 27, 1987)

DOI: 10.1175/1520-0485(1988)018<0834:ATOTSS>2.0.CO;2

ABSTRACT

Two linear stratified models—a coastal ocean on the *f*-plane and an unbounded equatorial β-plane—with Rayleigh friction and Newtonian cooling are examined. The problems are analytically tractable and a general formal solution can be formulated by means of a Green's function technique.

In particular the stationary response of a coastal and an equatorial ocean to a longshore and a zonal wind patch, respectively, are calculated. Generally, the solutions are found as expansions of vertical modes.

The main purpose of this paper is to show that in certain cases the mode sums can be expressed by elementary functions. Thus closed analytical solutions are given for the coastal jet and the coastal undercurrent, as well as, the Yoshida jet and the equatorial undercurrent. Such expressions require various idealizations, in particular, a simple friction mechanism, constant or weakly varying Brunt–Väisälä frequency, a simple forcing structure, alongshore geostrophy in the coastal case, and the long-wave approximation in the equatorial case. In spite of these simplifications the solutions reproduce many of the observed features of the coastal and equatorial current systems.

The presented theory demonstrates the close relationship between some of the dynamical features of a coastal and an equatorial ocean mentioned earlier by Yoshida and Gill.