Abstract View

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Equatorial Shelf Waves on an Exponential Shelf Profile

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ABSTRACT

The theory of barotropic nondivergent waves trapped on an exponential shelf lying on an equatorial β-plane is presented. The bottom contours are parallel to the equator so that phase propagation is either eastward or westward. according to the following general rule: when the shelf region is entirely in the Northern (Southern) Hemisphere the shallow water is to the right (left) of the direction of the phase velocity. When both the shelf and deep sea regions are located in the same hemisphere (case 1), the results concerning the dispersion curves and eigenfunctions are qualitatively similar to those obtained by Buch-wald and Adams (1968) for shelf waves on a mid-latitude exponential shelf on an *f*-plane. However, when the shelf region is on one side of the equator and the deep sea region extends across the equator (case 2), the dispersion curves and eigenfunctions are quite different. In case 2 the dispersion curve for each trapped mode has a long-wave cutoff. However, the cutoff for each mode generally does not preclude the existence of a zero group velocity at an intermediate wavelength. a phenomenon which always occurs in case 1. In case 2 the range of oscillation for each eigenfunction is generally much larger than that of the corresponding eigenfunction in case 1. Finally, when the shelf region straddles the equator (case 3), both westward and eastward propagating modes may exist. Further, one set of these modes has a long-wave cutoff (e.g., if the coast is in the Southern Hemisphere with deep water to the north, the westward propagating modes have a long-wave cutoff). In case 3 the oscillations of each eigenfunction tend to be concentrated near the shelf edge.

The theory is applied to the Gulf of Guinea. where a 0.07 cycle per day (cpd) oscillation in the sea surface temperature has been observed to propagate westward along the Ghaina-lyory coast. It is shown that this signal may be due to the presence of a fundamental mode shelf wave of the type discussed in this paper.

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