Abstract View

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Rossby Wave Driven Eulerian Mean Flows Along Non-Zonal Barriers, with Application to the Hawaiian Ridge

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ABSTRACT

We show that the reflection of baroclinic Rossby waves from a non-zonal barrier generates a Eulerian mean flow along the barrier. In order to produce a mean current of realistic magnitude, friction (in the form of Rayleigh damping) has to be incorporated into the theory. However, the wave-induced mean flow still exists in the absence of friction; the key requirement for mean flow production is the non-zonality of the reflecting wall.

The theory is applied to the Hawaiian Ridge where the incident Rossby wave field is known for the 5° square 20–25°N, 155–160°W (Magaard, 1983). The mean flow produced by this incident wave field consists of 1) a narrow eastward coastal jet ~ 20 km wide, and 2) a band-structured flow of alternating directions beyond the coastal jet. The width of each band in 2) is ~ 50 km, and the envelope of the current oscillations decreases (from a maximum surface value of ~ 0.75 m s^{-1}) exponentially with distance from the Hawaiian Ridge. In the region between the western side of Maui and the eastern side of Hawaii (a span of ~ 300 km), the structure of the predicted current system agree fairly well with the surface flow field found in White's (1983) recent analysis of historical hydrographic and XBT data.

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