Abstract View

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A Rossby Wake due to an Island in an Eastward Current

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ABSTRACT

A mathematical barotropic model based upon the conservation of absolute vorticity is used to determine the effect of the spherical shape of the rotating earth [approximated by the beta (β) effect] on a steady uniform eastward current streaming past a cylindrical island in an unbounded ocean of uniform depth. Upstream far-field conditions are introduced that confine the disturbance pattern produced by the island to the region downstream from the island.

For an initially uniform eastward flow of velocity u_0 streaming past a cylindrical island of radius a, the downstream disturbance consists of a trail of meanders and eddies. The amplitude of these features depends upon the magnitude of the Island number [Is=$(\beta a^2/u_0)^{1/2}$ and the radial wavenumber equals $(\beta/u_0)^{1/2}$, which is, the Rossby wavenumber for stationary planetary waves.

In order to confirm the theoretical results of the beta-plane wake for an eastward flow situation, appeal is made to a laboratory model, consisting of a rotating annulus with a sloping bottom to simulate the beta effect. Dynamic similarity is achieved through the nondimensional Island number. The resulting flow pattern reveals a uniform flow field upstream from the island with the formation of a stationary disturbance downstream that agrees qualitatively with the theoretical results.