Abstract View

Volume 8, Issue 4 (July 1978)

Journal of Physical Oceanography
Article: pp. 690–702 | Abstract | PDF (940K)

On Geostrophic Adjustment in Sea Straits and Wide Estuaries: Theory and Laboratory Experiments. Part I: One-Layer System

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(Manuscript received May 17, 1977, in final form January 17, 1978)

DOI: 10.1175/1520-0485(1978)008<0690:OGAISS>2.0.CO;2

ABSTRACT

The dynamics of outflows from sea straits and wide estuaries are examined through a simplified frictionless model whose primary motions are not constrained to be quasi-geostrophic. The potential vorticity equation is solved by means of approximate analytical methods. Some of the model predictions are tested in the laboratory.

The mathematical model predicts that an outflow from a channel with uniform velocity distribution deflects to the right or left depending on the depth of the basin into which it debouches. There is a "critical" Rossby number below which the flow separates from one of the basin banks. When a non-uniform velocity is introduced upstream the direction of deflection may differ substantially from the upstream uniform flow case. The model shows that rotation is important whenever the ratio between the relative depth variation to the Rossby number is not negligible; rotational effects can be important even if the ratio between the channel width and the Rossby deformation radius is entirely negligible.

An experimental system consisting of a rotating channel with an abrupt cross-sectional variation was used in the laboratory to test the theory described above. Deflections resulting from "supercritical" conditions were tested qualitatively with favorable results.