Abstract View

Volume 14, Issue 3 (March 1984)

Journal of Physical Oceanography
Article: pp. 629–645 | Abstract | PDF (1.13M)

On Steady Salinity Distribution and Circulation in Partially Mixed and Well Mixed Estuaries

Li-Yauw Oey

Geophysical Fluid Dynamics Program, James Forrestal Campus, Princeton University, Princeton, NJ 08540

(Manuscript received June 16, 1983, in final form October 16, 1983)

DOI: 10.1175/1520-0485(1984)014<0629:OSSDAC>2.0.CO;2

ABSTRACT

Perturbation analysis based on small $\alpha = \mathrm{Ra}^{0.23} F_m^{0.9}$, where Ra is the Rayleigh number and F_m is the Froude number, is used to study steady-state circulation and salinity distribution in estuaries. The classical Hansen and Rattray's similarity solution is obtained for the special case of linear variation of longitudinal dispersion coefficient K_H, in a channel of constant width B and depth D. It is argued that K_H, B and D must vary in real estuaries in such a way that the general solution is regular throughout the length of the estuary and shows a salinity structure which resembles that observed in a real estuary.

It is shown that Hansen and Rattray's theory for predicting the importance of upstream salt transport due to the vertical gravitational circulation in estuaries is valid to a good degree of approximation for arbitrary longitudinal variations in width, depth, fresh water discharge, wind stress and various dispersion and mixing coefficients. This finding is checked against available observations in the Mersey estuary, in the channel of Rio Guayas and in the Hudson River. It is also checked against a real-time three-dimensional numerical model's results of New York Harbor.

Finally, Printchard's classification of estuaries in terms of their principal tidally-averaged advective and diffusive processes is translated on the Hansen-Rattray circulation-stratification diagram. The diagram shows the relative importance of various terms in the salt balance equation.

top

Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
Allen Press, Inc. assists in the online publication of *AMS* journals.