Abstract View

Volume 11, Issue 10 (October 1981)

Journal of Physical Oceanography
Article: pp. 1311–1324 | Abstract | PDF (812K)

Salinity Intrusion in Estuaries

D. Prandle

Institute of Oceanographic Sciences, Bidston Observatory, Merseyside, England L43 7RA

(Manuscript received February 17, 1981, in final form July 27, 1981)

DOI: 10.1175/1520-0485(1981)011<1311:SIIE>2.0.CO;2

ABSTRACT

One dimensional time-averaged solutions are examined for salinity intrusion in estuaries with a breadth variation $B_L(X/\lambda)^n$ and a depth variation $H(X/\lambda)^m$, where X is the distance from the head of the estuary. These solutions emphasize the importance of the rate of change of cross-sectional area in determining salinity distribution.

Assuming a constant longitudinal-dispersion coefficient $D_x = D$, the salinity distribution is shown to be highly dependent on the dimensionless parameter $V' = U_1 \times X_1/D$, with U_1 the velocity of the fresh-water flow at position X_1, where the estuary is effectively at oceanic salinity. [This parameter V' is equivalent to the flushing number F introduced by Arons and Stommel (1951) for the case of an estuary of rectangular cross section.] For eight estuaries, comparisons are made between calculated and observed salinity distributions, where for each estuary the value of D in the calculated distribution was chosen to produce the best agreement with the observed distribution. For six of the eight estuaries, the chosen value of D was within the range 50 m^2 s^{-1}<D<500 m^2 s^{-1}, in good agreement with corresponding values found in previous studies. However, it is shown that the salinity distribution is highly sensitive to the specified value of D, implying that the usefulness of the one-dimensional, time-averaged solutions may be somewhat restricted.

Theoretical distributions of salinity also were obtained for $D_x = D_1 dc/dx$ and $D_x = D_2(dc/dx)^2$, where dc/dx represents the time-averaged longitudinal salinity gradient and D_1 and D_2 are constant coefficients. While reasonable agreement is again obtained with observed distributions, certain limitations in the application of these two forms for D_x are shown.

Attempts to derive a more rational dimensionless form for D_x in terms of gross estuarine parameters proved unsuccessful.

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.