Abstract View

Volume 18, Issue 10 (October 1988)

Journal of Physical Oceanography
Article: pp. 1415–1434 | Abstract | PDF (1.48M)

Estimation and Verification of Tidally Induced Residual Currents

Kim-Tai Tee and Peter C. Smith

Physical and Chemical Sciences, Department of Fisheries and Ocean, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada

Denis Lefaivre

Institut Maurice Lamontagne, Mont Joli, Quebec, Canada

(Manuscript received October 1, 1987, in final form April 14, 1988)

DOI: 10.1175/1520-0485(1988)018<1415:EAVOTI>2.0.CO;2

ABSTRACT

Using a multiple regression technique that includes both tidal and wind forcings, the tidally-induced residual current can be estimated from current meter records. However, the estimated mean (long-term averaged) tidally induced residual current is found to be very sensitive to an uncertain coefficient, ϵ, associated with the tidal forcing u_a^{ϵ}, where u_a is the semi-major axis of the tidal ellipse. Thus, the estimated mean tidally induced residual current cannot be used directly to verify model results. It is suggested that the verification be carded out on $\hat{u}^2 = (\hat{u}^2/\hat{u}^a)\bar{u}^a$ where $\hat{u}^a$ and $\hat{u}^2$ are respectively the spring-neap oscillation of the semi-major axis and the tidally induced residual current, and $\bar{u}^a$ is the mean value of the semi-major axis. The suggestion is derived from the findings that 1) the value of $\tilde{u}^2$ estimated from the current meter data is insensitive to the coefficient ϵ, and 2) the computed $\tilde{u}^2$ from the numerical tidal model is insensitive to the specified spring-neap oscillation of the tidal forcing (surface elevation) at the open boundaries.

By using Tee's three-dimensional tidal model, the mean and spring–neap variation of the tidally induced residual currents in the Cape Sable area, southwest of Nova Scotia were simulated. The computed values of ϵ are found to vary significantly in both the horizontal and vertical directions. The numerical model reproduces all the residual currents at the shallowest station where the estimation of the observed tidally induced residual current is most statistically reliable. At the other stations, the numerical model reproduces most of those currents that have high signal-to-noise ratios.

To reduce the effect of uncertainty in ϵ on the estimation of the mean tidally induced residual current from current meter data, the estimation can be carried out by using the values of ϵ computed from a reliable tidal model. An

example of the estimation using this method is shown for a Cape Sable station where the computed $\bar{u}^2$ has been verified by observation. In the absence of tidal modeling or in the case where accurate values of ϵ cannot be computed, it is suggested that $\epsilon = 2$ be used for the estimation. This suggestion is derived mainly from the finding that the estimation using $\epsilon = 2$ is reliable over a wider range of true ϵ values in the Cape Sable area than that using $\epsilon =$ 1 or 3.

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