Department of Ocean & Resources Engineering

Seminar

Calculation of Residual Vertical Circulation in Tidal Estuaries

by

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Abstract

Definition:
In the following residual currents will be defined as Eulerian residual currents

Calculation of tidal-averaged residual currents in tidal estuaries is important:

- it can deliver quick qualitative insight concerning the relevant physical parameters in transport through the estuary. This holds especially for buoyant or nearly buoyant particles and for contaminants.
- it may reveal morphological characteristics of the estuary; for instance morphological feedback: either accelerated growth either damping of initial bottom disturbances.

By starting investigations on above-mentioned topics with analytic considerations and by using tidal-averaging, irrelevant short-term features and variables are eliminated. This draws the attention to the physically important parameters. At least two different mechanisms for tidal-averaged residual currents can be supposed, and those mechanisms counteract each other. Thus it is worthwhile to estimate the order of magnitude of both mechanisms and to weight one relatively to the other. These are:

- if one schematizes the estuary as containing a fluid with uniform density:
  non-linear interactions because reality deviates from a linear schematization; this may lead to local tidal-average resultant currents;

- taking into account, that water in an estuary mostly has a decreasing density in inland direction
  -effect of salt wedges:
    Depending on the Richardson number the salt concentration will differ in vertical sense. This may result in a circulation, where tidal exchanges can be multiples of the tidal volume:

  and/or: -effect of horizontal density gradient:
    Also when there exists no vertical density gradient, a horizontal density gradient generates a residual calculation.

Comparison between analytic and numerical computations will be given.