Any way you slice it: a comparison of residence time calculations using simple compartment models of the Altamaha River Estuary

Joan E. Sheldon and Merryl Alber, Dept. of Marine Sciences, University of Georgia, Athens, Georgia, 30602

Abstract

Residence time and flushing time calculations have been hindered by the difficulty in determining a representative set of box boundaries that are consistent with observed throughflow conditions. This paper presents a comparison of residence time calculations using simple compartment models of the Altamaha River Estuary. Residence time calculations were made for a variety of box sizes, including both fixed and variable boundaries. Residence times were compared to estimates made from a measured freshwater discharge time series.

Objectives

1. Develop simple, single-box models for residence time calculations of the Altamaha River Estuary.
2. Compare simple models with more realistic models that incorporate multiple box boundaries.
3. Compare residence and flushing times for four river-flow cases.

Definitions of Time Scales

1. Residence time: a measure of the average amount of time a particle or substance will remain in a reservoir.
2. Flushing time: the time required for the freshwater inflow to equal the amount of water removed.

Model Data Requirements

Observe the properties of these simple models to be that they are not readily:

1. Estuarine, mesotrophic, estuaries.
2. River flow (e.g., flow from upstream sources).
3. Affinity, slowly reacting, slowly mixing.

Modeling

The models compare well to observed data, with the exception of the largest box model (64 km).

Conclusions

1. Simple models can provide useful estimates of residence times.
2. Residence times can be used to identify water quality issues.
3. Residence times can be used to identify areas for further study.

Literature Cited


Presented at the Estuarine Research Federation meeting Nov. 4-8, 2001, St. Pete Beach, Florida. Manuscript submitted to Estuaries (special issue: “Freshwater Inflow: Science, Policy, Management”).