Relationships between Nitrogen Loading and Concentrations of Nitrogen and Chlorophyll in Coastal Embayments

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We describe results obtained with a simple model that uses loading rates of total nitrogen (TN), defined as dissolved inorganic nitrogen plus dissolved and particulate organic nitrogen, to calculate annually and spatially averaged concentrations of TN in coastal embayments. We also describe ongoing research to extend this model to estimate planktonic chlorophyll a from nitrogen loading.

The Embayment Nitrogen Model (ENM) is a simple mass balance model that predicts annual average concentrations of TN in coastal embayments from TN input rates from watersheds, atmospheric loading, and point sources. The ENM calculates internal loss rates of nitrogen in the embayment to processes such as denitrification and burial in sediments as first-order in nitrogen, net export across the seaward boundary from the embayment flushing time, and input across the seaward boundary from salinity data and the nitrogen concentration at this boundary. The model demonstrates the importance of flushing time in determining the magnitudes of nitrogen losses to flushing and internal sinks. It has been used to calculate annually and spatially averaged concentrations of TN in numerous embayments, and appears to be useful for estimating sensitivity of embayments to nitrogen loading.

Research in Long Island Sound has revealed power-law relationships between chlorophyll a and TN concentrations and has provided insights into seasonal and interannual variations in these correlations, as well as their causes. These relationships are being evaluated for possible addition to the nitrogen model to permit prediction of chlorophyll a concentrations from TN loading. Data from Boston Harbor and Massachusetts Bay have shown similar relationships between TN and chlorophyll a, and data from other embayments are now being analyzed to determine their generality, including the degree of interannual and system-to-system variability.

Key words: chlorophyll, eutrophication, nitrogen, marine embayments, modeling

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