Modeling the mass balance and fate of copper in San Diego Bay

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ABSTRACT: Because of its presence in antifouling coatings, stormwater, and industrial and municipal discharges, copper is a ubiquitous contaminant in estuarine and coastal environments. We integrated a system-wide field program with a one-dimensional model to evaluate the overall mass balance of copper in a representative coastal harbor, San Diego Bay, California. Field results from four surveys over 1 yr showed remarkably similar distributions of total copper, with a general increase from the ocean into the Bay followed by a slight decrease in the inner Bay. Total copper concentrations ranged from 5 nmol L^{-1} to nearly 60 nmol L^{-1}. Highest levels for both total and dissolved copper were observed during the winter. Results from a one-dimensional model accounting for the balance of sources, flushing, and losses to the sediment illustrated the importance of accounting for losses of copper to the sediment, without which water column concentrations are overestimated by as much as a factor of five. The time scale for the loss term is on the order of 8-10 d. The model reproduced the field measurements quite well with a loss term controlled by partitioning and settling parameters. The overall balance of total copper in the Bay appears to be split between losses to the ocean via tidal flushing and losses to the sediments via settling. Settling plays an important role in the fate of copper in the Bay, and the sediments are a key endpoint for copper.