Planktonic carbon cycling and transport in surface waters of the highly urbanized Hudson River estuary

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ABSTRACT: We examined variations in organic carbon (OC) pools and microplanktonic carbon fluxes at three stations in the Hudson River estuary during 12 cruises between Octobers of 1996 and 1998. Phytoplankton biomass and net primary production varied from 5 to 40 µmol C L^{-1} and 0.3 to 318.3 mmol C m^{-2} d^{-1}, respectively. Biomass and production of bacterioplankton in the surface layer commonly exceeded those of phytoplankton, varying from 0.2 to 72 mmol C L^{-1} and 1.4 to 70 mmol C m^{-2} d^{-1}, respectively. Median planktonic respiration varied from 275 to 605 mmol CO2 m^{-2} d^{-1} between stations along the salinity gradient. Primary production/respiration (P :R) ratios varied temporally and spatially between 0.003 and 6.60, averaging 0.22. Carbon mass balances revealed that under low river discharges (<250 m^3 s^{-1}), the estuary processed 2.4-fold more carbon internally and advected 2.7-fold less carbon seaward than under higher flows. Annual OC budgets suggest that ~19 x 10^9 mol C yr^{-1} of total organic carbon (TOC) entered the estuary, whereas 30 x 10^9 mol TOC yr^{-1} was exported seaward, representing a net gain of 11 x 10^9 mol TOC yr^{-1} within the estuary. Microplankton processed ~32 x 10^9 mol C yr^{-1}, of which 5.6 x 10^9 mol C was attributed to photo- and chemoautotrophic (~72%) and heterotrophic (~28%) production; the remainder was respired to CO_2 (26.5 x 10^9 mol CO_2 yr^{-1}). The persistent imbalance between carbon oxidation and carbon fixation strongly suggests that the Hudson River estuary usually is net heterotrophic and is a significant source of inorganic carbon to the coastal ocean and atmosphere.

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