Carbon, nitrogen, and phosphorus budgets for a shallow subtropical coastal embayment (Moreton Bay, Australia)

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ABSTRACT: Average annual carbon, nitrogen, and phosphorus budgets were constructed for Moreton Bay. Primary production was the dominant source of carbon (by two orders of magnitude), N fixation was the dominant source of nitrogen, and point sources were the dominant source of phosphorus to the bay. About 41% of the nitrogen and 70% of the phosphorus entering Moreton Bay was exported to the ocean, and about 56% of the nitrogen was lost to denitrification. The high percentage loss of phosphorus to the ocean was directly related to the short residence time of the bay (46 d), which was consistent with other shallow coastal ecosystems. In contrast, the percentage loss of nitrogen to the ocean was low compared to other coastal systems due to the high percentage loss through denitrification associated with autotrophic sediments in the bay that enhance denitrification. Because most denitrification studies have been carried out using only dark incubations, the importance of denitrification to the nitrogen budgets of coastal systems in general may be underestimated. Carbon loss from Moreton Bay was dominated (by two orders of magnitude) by atmospheric exchange of CO_2 associated with benthic and pelagic respiration. The distinct difference between Moreton Bay (subtropical) and temperate systems was the dominance of biological (microbial: N fixation and denitrification) over physical inputs and losses of nitrogen. High N fixation in turn fuels a positive annual mean net ecosystem metabolism (NEM) of 21 g C m^{-2} yr^{-1} and suggests that primary production in the bay is phosphorus limited at the whole ecosystem scale.