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Contribution of riparian vegetation to the carbon budget of an urban stormwater pond

MD ABDUS SABUR, SARAH KAYKHOSRAVI, STEPHANIE SLOWINSKI AND PHILIPPE VAN CAPPELLEN

University of Waterloo

Presenting Author: masabur@uwaterloo.ca

Small inland freshwater bodies, including the rapidly growing number of urban stormwater ponds (SWPs), emit significant amounts of carbon dioxide (CO_2) and methane (CH_4) while also sequestering organic and inorganic carbon. Establishing the net effect of urban SWPs on carbon cycling is therefore far from straightforward. Here, we present the carbon budget of a SWP in the greater metropolitan area of Toronto, Canada. The CO_2 flux required to close the carbon budget was compared with the CO_2 efflux from the pond surface estimated from the SWP's surface water chemistry (note: CH_4 emissions were found to be minor). The budget calculations included the dissolved and particulate carbon fluxes at the inflow and outflow points of the pond, plus the particulate carbon burial fluxes associated with the sediments accumulating in the pond (Fig. 1). According to the carbon budget, the SWP sequesters about 30×10^3 moles of carbon per year. The water chemistry data, however, imply that the SWP emits around 57×10^3 moles of CO_2 annually. This contrasting result, therefore, indicates a missing carbon influx into the pond, which we identify as organic carbon (OC) produced through photosynthetic CO_2 fixation by the riparian vegetation. Part of this OC is eroded into the pond where mineralization generates the missing CO_2. We estimate that around 86×10^3 moles of riparian OC must be mineralized to CO_2 to balance the SWP's carbon budget (Fig. 1). Altogether, when including the riparian vegetation, the SWP system acts as a net CO_2 sink, although it emits CO_2 because the surface waters are supersaturated. Furthermore, the emitted CO_2 is primarily contributed by the mineralization of OC from the riparian vegetation, rather than catchment-exported OC. Our work highlights the importance of considering OC production by the vegetation closely surrounding SWPs and the transfer of this OC into the pond and its subsequent mineralization. Our results also caution against only relying on floating flux chamber measurements when assessing the overall effect of SWPs on pond-atmosphere CO_2 exchanges.

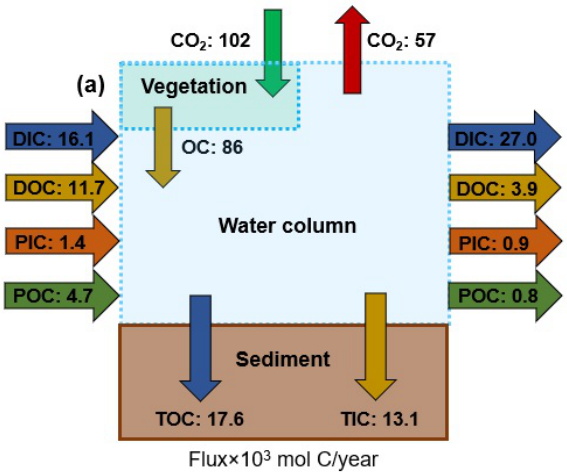

Fig. 1. SWP's carbon budget.