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Carbon fluxes in an eutrophic urban lake

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Eutrophic lakes have a still unknown net effect on greenhouse gas emission. On one hand, the high photosynthetic rates enhance the freshwater carbon dioxide (CO_2) sink. On the other hand, the intense organic matter decomposition may lead to high CO_2 release and, when the sediment becomes anoxic, also to more methane (CH4) production. Here, we measured CO_2 and CH4 emissions from a highly eutrophic urban lake monthly during summer, autumn and winter, over 24 hour periods. The lake was predominantly a net carbon source to the atmosphere. On the few periods when the lake was a CO_2 sink, the magnitude of CO_2 influx to the water was small. The CO_2 diffusive emission at night was higher than during the day due to daytime CO_2 uptake by photosynthesis. The same pattern was not found for CH4 diffusive emission, which was high both during the day and night even though CH4 oxidation reduced the CH4 emission in almost 50%. CH4 emission through bubbles was proven highly dependent on temperature and no bubbles were emitted during colder months. In our study lake, CO_2 and CH4 production through mineralization in the water column and in the sediment should be offsetting CO_2 fixation by primary production. The greenhouse emission from this system can be even higher considering CO_2-equivalents. As conclusion, our data confront the usually accepted idea that eutrophic lakes are carbon sinks.