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GHG emissions from urban wetland under changing water-level conditions

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Greenhouse gases such as CO_2, CH_4 and N_2O contribute to climate change. Next to anthropogenic emissions, wetlands play a significant role in natural emission contributions. While ponds (small lakes) cover only a small part of the Earth surface, they play an important role in the exchange of greenhouse gases between water surface and atmosphere. We investigated urban ponds under different water level conditions to assess their contribution.

Using a closed dynamic chamber system (SEMACH-FG) supported by a float, we measured gas fluxes directly (CO_2) within the chamber by IRGA. Gas samples were taken in 5-minute intervals for 30-minute sections and later analyzed by gas chromatography (SRI 8610 C, SRI Instruments) for CH_4 and N_2O, and again CO_2 for additional quality control. Respiration was investigated from a shallow urban pond in the city of Freiberg, Saxony, Germany. Measurements were repeatedly taken during normal water-level conditions and again during a dewatering period caused by a dam failure.

Under normal water-level conditions (water depth 1.4 m), we found average respiration fluxes of -0.05 μmol CO_2 m^{-2} s^{-1}, 5.79 μmol CH_4 m^{-2} h^{-1} and 0.08 μmol N_2O m^{-2} h^{-1}. During "dry" conditions (measured from the pond bottom directly), respiration fluxes were 1.23 μmol CO_2 m^{-2} s^{-1}, 24.87 μmol CH_4 m^{-2} h^{-1} and 0.69 μmol N_2O m^{-2} h^{-1}. The former minor CO_2 sink became a source, and the emissions of CH_4 and N_2O increased rather drastic, too.

Under temperate climate conditions, Oertel et al. (2016) compiled worldwide data and calculated ranges of 1.2–8.1 μmol CO_2 m^{-2} s^{-1}, -1.8–28 μmol CH_4 m^{-2} h^{-1}, and -1.6–4.4 μmol N_2O m^{-2} h^{-1} for natural wetlands, including river stretches, lakes and reservoirs. The data presented here, fit well inside these ranges – and demonstrate the impact of drought on this important source. Under conditions of climate change with increasing drought period in many regions, this observed effect may enhance the feedback and increase atmospheric GHG concentrations.