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Methane and nitrous oxide emissions in the littoral zone of a Chinese reservoir: environmental controls and implications for future designs

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We report fluxes of CH_4 and N_2O using the static closed chamber and gas chromatography techniques from the littoral zone of Miyun Reservoir, a large reservoir providing water for Beijing. Seasonal and spatial variations of CH_4 and N_2O flux and environmental factors were monitored throughout the growing season including a flood event during summer rains. The littoral zone was divided into five areas based on water level. Sites were selected ranging from locations in open water to the dry area on higher ground, to provide five contrasting environments: deep water area, shallow water area, seasonal flooded area, 'seasonally flooded control' area and permanent non-flooded area. Our results showed that flooding increased CH_4 emission sharply but did not influence N_2O emission significantly. CH_4 flux decreased along a transect from open water to dry land, from 3.1 mg m^{-2} h^{-1} at the deep water site to approximately 1.3 mg m^{-2} h^{-1} at the shallow water site, and less than 0.01 mg m^{-2} h^{-1} in the non-flooded area. The largest emission of all was from the seasonally flooded site after the flooding event (up to 21.1 mg m^{-2} h^{-1}). N_2O flux ranged from -2.97 μg m^{-2} h^{-1} to 180.06 μg m^{-2} h^{-1}. Non flooded dry land emitted more N_2O than flooded land, no matter whether it was permanently or seasonally flooded. No significant difference was observed between seasonally flooded sites (3.56$\pm$0.86 μg m^{-2} h^{-1}) and their control sites (3.68$\pm$0.59 μg m^{-2} h^{-1}). CH_4 fluxes were correlated with air temperature, water depth, water dissolved oxygen, biomass and soil parameters including soil water content, bulk density, pH, total carbon, total nitrogen and NH_4^+. N_2O fluxes were correlated with wind speed, air temperature, water dissolved oxygen, soil water content and soil NO_3^-. Thus the emissions of the two gases are controlled in different ways, and we discuss the possibilities of developing a spatio-temporal model to assist in the design and management of future reservoirs under a changing climate.