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Greenhouse gases concentrations and emissions in different inland water bodies in Chengdu Plain

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ABSTRACT

Freshwater systems are important sources of greenhouse gases (CO_2, CH_4, N_2O) in the atmosphere, but their contributions to the regional GHGs budgets remain uncertain due to numerous types, complex carbon and nitrogen cycle processes, and human disturbance. This study monitored the concentrations and fluxes of CO_2, CH_4 and N_2O in different inland waters including rivers, irrigation canals, reservoirs and ponds in Chengdu Plain (Xinjin District), so as to explore the characteristics and influencing factors of greenhouse gas emission in different inland waters in Chengdu Plain. The total evasions of CO_2, CH_4 and N_2O from different types of waters were estimated. The results showed that the concentrations of carbon, nitrogen and phosphorus vary significantly in different inland waters with the highest level found in pond systems and polluted river sections, followed by the irrigation canals and the generally lower values detected in reservoirs and rivers. It was suggested that pollution load is higher in artificial waters. The dissolved CO_2, CH_4, N_2O concentrations in all inland waters ranged from 15.7–153.1 μmol L^{-1}, 0.099–0.986 μmol L^{-1} and 0.016–0.354 μmol L^{-1}, respectively. And, CO_2, CH_4 and N_2O concentrations in artificial irrigation canals, ponds and polluted rivers were significantly higher than those in the unpolluted rivers and reservoirs. The estimation of greenhouse gas fluxes based on the boundary layer method showed that the CO_2 fluxes from irrigation canals were the highest (197 ± 52 mmol m^{-2} d^{-1}), followed by ponds (114.04 ± 42.20 mmol m^{-2} d^{-2}), rivers (65.49 ± 50.70 mmol m^{-2} d^{-2}), reservoirs (22 ± 30 mmol m^{-2} d^{-1}); the CH_4 and N_2O fluxes from irrigation canals and ponds were the highest, approximately 2~3 times those from rivers and reservoirs; the greenhouse gases fluxes from seriously polluted rivers were also higher than these from other unpolluted rivers. Based on the extrapolation method, the total greenhouse gas evasions from inland waters in Xinjin District were estimated as 2.5 × 10^4 t CO_2 y^{-1}, 107 t CH_4 y^{-1} and 69 t N_2O y^{-1}, whose CO_2 equivalent converted was about 5.0 × 10^4 t y^{-1} according to the global warming potential. The greenhouse gas fluxes from irrigation canals, ponds, reservoirs and rivers accounted for 19%, 24%, 1% and 56% of the total evasion from all inland water in Xinjin District, respectively. The irrigation canals and ponds had small water areas but showed high greenhouse gas emissions. The regression analysis showed that the concentrations and fluxes of CO_2, CH_4, N_2O were positively correlated with the conductivity and carbon, nitrogen and phosphorus concentrations, while negatively

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correlated with dissolved oxygen. The abundance of biogenic elements in freshwater and water pollution are crucial to the greenhouse gas fluxes, particularly, human activities have an obvious influence on greenhouse gas emissions from different inland waters.

Keywords: Chengdu Plain; Different freshwater; Greenhouse gas; Spatial characteristics; Influencing factors