Effects of Chlorinated Disinfectants on Greenhouse Gases Emissions from Urban Inland Waters

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Chlorinated disinfectants are widely used in urban wastewater treatment systems. Excessive use of these disinfectants can lead to higher levels of residual chlorine and disinfection by-products (DBPs) being discharged into surface waters and even water sources through effluent discharge and surface runoff, potentially affecting the health of aquatic ecosystems, including microbial communities. However, the potential impacts of these emerging contaminants on key carbon and nitrogen cycling processes and greenhouse gases (GHGs) emissions in water remain largely unknown. In this study, we selected 15 wastewater treatment plants (WWTPs) in a megacity in China as our research subjects to investigate the effects of effluent discharge on GHGs emissions in upstream and downstream river. The results showed that in summer, the N_2O, CO_2, and CH_4 fluxes from WWTPs were 114.07 ± 10.81 mmol $m^{-2}·h^{-1}$, 9.65 ± 7.59 mmol $m^{-2}·h^{-1}$, and 0.16 ± 0.10 mmol $m^{-2}·h^{-1}$, respectively. The average concentration of residual chlorine was 0.72 ± 0.34 mg L^{-1}. We detected DBPs in almost all water in the vicinity of the WWTP, with a total concentration range of 0-39.68 μg L^{-1}, with the highest concentrations of 14.31 ± 10.38 μg L^{-1} for HAAs, 7.78 ± 7.90 μg L^{-1} for THMs, and 0.99 ± 1.17 μg L^{-1} for HANs. Additionally, we found that water with higher concentrations of DBPs had lower concentrations and fluxes of GHGs, suggesting that DBPs may alter the activity of related microbial communities, thereby affecting the GHGs production process and reducing GHGs emissions. To further reveal the potential mechanisms by which residual chlorine and DBPs impact GHGs, we plan to conduct further laboratory culture experiments to explore the effects of DBPs on GHGs production and emission in urban rivers.