



URBAN LAKES ACT AS GLOBAL ANTHROPOGENIC CARBON HOTSPOTS

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Although lakes occupy a small fraction of continental land, they play a disproportionately large role in global carbon emissions. Urban lakes, in particular, act as intensive sources of CO₂ and CH₄, fueled by heavy anthropogenic nutrient loads, elevated temperatures, and surrounding population density. Yet, their global climate impact and the key drivers of their emissions remain poorly understood. In this study, we coupled a systematic review and meta-analysis of emission rates with GIS spatial mapping to present the first global estimation of carbon fluxes from urban lakes. Spanning over 7,000 km², urban lakes account for 4.8% of total emissions from human-made freshwater systems, despite occupying an area 155 times smaller. Furthermore, the global area of urban lakes has expanded by ~1.3% annually over the past four decades, potentially adding an estimated ~0.7 Tg CO₂eq/yr to the atmosphere. We found that these massive fluxes are primarily driven by temperature, eutrophication, and human population density, intensifying toward equatorial regions. Notably, nutrient-rich urban lakes exhibit emission rates up to three orders of magnitude higher than nutrient-poor ones. Our findings highlight that controlling nutrient discharge into urban lakes is a critical global strategy for achieving net-zero carbon goals.



Palavras-chave: *urban lakes; carbon emission; eutrophication; global climate change*