



RESERVOIRS DEGASSING: QUANTIFYING CH₄ EMISSIONS AT ITAIPU AND ASSESSING GLOBAL VARIABILITY

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Reservoirs are human-made systems that receive, transform, store and release carbon. In these environments, carbon can be emitted through multiple pathways, including diffusion upstream and downstream of the dam, ebullition, plant-mediated flux and degassing. Among these processes, degassing remains poorly quantified at the global scale. To address this gap, we quantified the dynamics of degassing at the Itaipu Hydroelectric Power Plant over three samplings campaigns conducted across a two-year period. In parallel, we carried out a literature review to assess degassing in reservoirs worldwide. At Itaipu, degassing was estimated by integrating water discharge with the difference in CH₄ concentrations between pre-turbine water and water immediately downstream of the dam. Additionally, we quantified downstream emissions by mapping CH₄ fluxes along a 10 km river reach. During this period, pre-turbine CH₄ concentrations ranged from 3.8 to 48 mg/m³, resulting in an average annual degassing emission of 0.6 Gg C-CH₄. Notably, 85% of degassing emissions occurred during the sampling campaign with the highest water level (219.5 m), compared to periods with lower water levels (217.6 m to 218.5 m). Spatial analysis showed that diffusive CH₄ emissions declined progressively downstream, stabilizing approximately 5 km from the dam. Beyond this point, emissions appeared to be influenced by other anthropogenic activities. Despite its large water volume, Itaipu emits six times less CH₄ via degassing than the global average. Our global review indicates that degassing varies widely, ranging from 0 to 39 Gg C-CH₄ per year. This variability confirms that



degassing is a key emission pathway in hydroelectric reservoirs that should not be overlooked in hydropower assessments.

Palavras-chave: *Methane Degassing; Hydroelectric Reservoirs; Greenhouse Gas Emissions; Downstream Carbon Flux.*