

Influence of environmental parameters on the concentration of subsurface dissolved methane in two hydroelectric power plants in Brazil

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Methane (CH₄) is a trace gas in the atmosphere of great importance for atmospheric chemistry as one of the main greenhouse gases. There are different sources with the largest individual production associated with the degradation of organic matter submerged in flooded areas. The amount of dissolved methane that reaches the surface depends on the production in the sediments and consumption in the water column. Both processes are associated with microbial activity and consequently dependent on the physico-chemical environmental conditions. The construction of hydroelectric dams cause flooding of areas near the river that can change the characteristics of the environment and cause changes in subsurface methane concentration. In this work, we studied two hydroelectric plants located in Brazil: Batalha (17°20'39.52"S, 47°29'34.29"W), under construction when the samples were taken, and Itaipu (25°24'45.00"S, 54°35'39.00"W) which has been flooded over 30 years ago. The water samples to determine dissolved methane were collected approximately 5 cm near the surface. In each collection point was measured depth, water temperature, pH and redox potential. The range of dissolved methane between the two dams was similar: 0.07-10.33 µg/l (Batalha) and 0.15-10.93 µg/l (Itaipu). However, the Batalha's average (4.04 × 3.43 µg/l; median = 3.66 µg/l) was higher than that observed in Itaipu (2.15 × 1.59 µg/l; median = 2.53 µg/l). The influence of environmental parameters on the concentration of dissolved methane was evaluated by multivariate statistical techniques (Principal Component Analysis - PCA). All of the parameters had some correlation with dissolved methane, however, the greatest contribution in Batalha was associated with pH while in Itaipu was the depth. The pH variation of the various points studied in Batalha may be associated with periods of drought and flooding of the river and hence the incorporation of organic matter in the environment. The organisms responsible for the production and oxidation of methane in water are very susceptible to changes in pH, resulting in variations in the amount of gas that is transported to the surface. In Itaipu, depth variation was shown to have more influence than the other parameters. The increase of the water column results in a longer path through which methane is transported, increasing the oxidation potential by bacteria in the water, decreasing the amount of CH₄ can be emitted to the atmosphere. The comparison between the two dams

showed that the environmental parameters influences the the production and consumption of methane in water and the importance of each parameter can vary according to the characteristics of each reservoir.

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