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# Distribution of greenhouse gases ($CH_4$ and $N_2O$) in South American Atlantic coastal lagoons (Uruguay)

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Coastal regions receive inputs of organic matter and nutrients, leading to the production of greenhouse gases (GHG) such as methane ($CH_4$) and nitrous oxide ($N_2O$). While coastal ecosystems emit varying amount of $CH_4$, their role as a net source or sink of $N_2O$ is uncertain, in particular in the southern hemisphere (Rosentreter et al., 2023). Here, we investigated the distribution of $CH_4$ and $N_2O$ in three coastal lagoons located on the Atlantic coast of Uruguay (Laguna de Rocha, Laguna Garzón, Laguna José Ignacio). These lagoons integrate the UNESCO biosphere reserve "Reserva de Biosfera Bañados del Este", and are designated as protected landscapes under the National System of Protected Areas, as well as being part of the Ramsar Convention for wetlands. Samplings were conducted seasonally, during February, May, August, and November in 2021, 2022 and 2023. The concentration of $CH_4$ and $N_2O$ were determined by gas chromatography. $CH_4$ concentrations ranged from 8.0 to 332.6 nM, with $CH_4$ saturation levels ranging from 285.9% to 11663.0%, indicating oversaturation of $CH_4$. On the other hand, $N_2O$ concentrations ranged from 6.0 to 22.3 nM, with saturation levels between 70.3% and 781.0%. Overall, in the three lagoons water-atmosphere fluxes of $CH_4$ were positive throughout the study period (from 5.6 to 3319.0 μmol $m^{-2}$ $d^{-1}$). In contrast, $N_2O$ fluxes exhibited seasonal variability, with mean positive fluxes during February and May, and negative fluxes during August and November (from -77.3 to 1194.8 μmol $m^{-2}$ $d^{-1}$). The study revealed that the Uruguayan coastal lagoons act as a source of $CH_4$ to the atmosphere consistently, as source of $N_2O$ in summer and autumn, while acting as a sink of $N_2O$ in winter and spring. This work is the first GHG characterization in these lagoons, and its results are expected to improve our understanding of regional variations from coastal systems.

**Key words:** greenhouse gases, atmospheric flux, coastal lagoons, South Hemisphere

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