Monitoring Contrasting Belowground and Aboveground Processes as Drivers of Methane Dynamics in Dominant Tropical Peatland Vegetation Communities

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With the current rise in atmospheric methane, understanding the contribution of wetlands and peatlands to methane emissions is crucial, as they are considered significant sources, particularly in South America. Peatlands are heterogeneous ecosystems with complex interactions between hydrology, vegetation, topography, climatology, nutrient availability and peat properties. These variables configure and determine the different methane dynamics and fluxes and their variation at different spatial scales. How these different components of the ecosystem interact, defining the peatland and the methane fluxes within it is currently poorly understood. To accurately analyze and model how peatlands contribute to methane emissions, it is necessary to understand the role of each component. The hydrological regime, depending on the main water source, divides them into minerotrophic and ombrotrophic, depending on whether the peatland is mainly fed by surface water flows or by rain, respectively. This different hydrology also determines the type of flooding of the peatland, its nutrient availability and can influence the ecosystem productivity and the dominant vegetation. Peruvian peatlands can be dominated by different types of vegetation, being the most abundant palm-dominated peatlands in the aguajales or palm swamps, represented by the palm trees like the aguaje (*Mauritia flexuosa*), aguajillo (*Mauritiella armata*) or huasaí (*Euterpe precatoria*). Peatlands can also be dominated by hardwood trees like *Platycarpum loretense* or *Tabebuia* insignis and *T. incana*, forming the pole forests called varillales. These different types of vegetation are expected to generate different methane fluxes, with palm trees associated with higher stem methane emissions than hardwood trees. As peat is made by partially degraded organic material, these vegetation types will generate a different chemistry in the peatland. Our objective is quantifying the variability of methane dynamics in South American peatlands at spatial and temporal scale, assessing environmental drivers across contrasting vegetation types and nutrient regimes. We will establish an intensive methane monitoring network across four sites spanning nutrient availabilities and vegetation types. The characterization of the peatland includes the monitoring of above and belowground processes such as the different methane fluxes, the hydrology, ecosystem productivity and properties of the peat, as well as the role of trees in methane transport. A vertical profile of the methane emissions through the stem of the tree will also be implemented to more accurately understand the fluxes generated and expected. To conduct these analyses, we will use a modification of the Global Ecosystem Monitoring network protocol to establish a series of intensive monitoring sites. This monitoring will take place throughout dry and wet seasons to provide a better understanding of the effect of seasonality and the differential relevance of each process in methane dynamics under different flooding. The plots were set during the first trimester of 2025, and the variables will be checked on a monthly, seasonal and annual basis, adapting the periodicity to each variable; allowing for a comprehensive monitoring of the peatland dynamics and an accurate identification of the role of each process at different across time in the different peatlands.