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Amazon CH4 budget and its controls based on atmospheric data from vertical profiles measurements

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Wetland emissions are considered the main natural global Methane (CH_4) source, but it is budget remains highly uncertain. Tropical regions like the Amazon, host some of the largest wetlands/seasonally flooded areas on the globe. However, tropical regions are still poorly observed with large-scale integrating observations. Here we present the first atmospheric sampling of the lower troposphere over the Amazon using regular vertical profile greenhouse gas and carbon monoxide (CO) observations at four sites. Since 2010 we collected bimonthly CH_4, to provide solid seasonal and annual CH_4 budgets with large spatial resolution. Vertical profiles are sampled using light aircraft, high-precision greenhouse gas and CO analysis of flask air, fortnightly between 2010 to 2018. The results show a regional variation in CH_4 emissions. There are comparably high emissions from the northeast part of the Amazon exhibiting strong variability, with particularly high CH_4 fluxes in the beginning of the wet season (January to March). A second period of high emissions occurs during the dry season. The cause of the high emissions is unclear. In the other three sites located further downwind along the main air-stream are observed lower emissions, that represents approximately 25-30% of what is observed in the northeast region and with a clear annual seasonality. In addition, these data show an interannual variability in emissions magnitude, so we discuss how these data can be correlate to climate variables (like temperature and precipitation) and with human-driven changes (like biomass burning) that could be influencing this variability. Over the full period the Amazon (total area of around 7.2 million km^2) was a source of CH_4, of approximately 46 ± 6 Tg/year, which represent 8% of the global CH_4 flux to the atmosphere. Using a CO/CH_4 emission ratio calculated in this study we find a biomass burning contribution varying between 10 and 23% of the total flux at each site.

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