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Characterization of the isotopic signature in methane from several biogenicsources in the central Amazon

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The decreasing global trend in □□13□□ − □□□□4 suggests that rising biogenic sources of methane are a plausible explanation for the current methane atmospheric growth rate. Furthermore, tropical wetlands represent one of the largest sources of uncertainty in the global methane budget and the Amazon basin plays a crucial role in this context as approximately 20% of its area is annually flooded. However, the availability of methane isotopic composition data for tropical wetlands is scarce, undermining our understanding of these tropical sources.

In this study, we present results from two sampling campaigns during the dry season, one in September 2019 and the other in August 2022. During each campaign, we collected air samples at different locations within the area around the Amazon Tall Tower Observatory (ATTO), such as in a black-water seasonally flooded forest (i.e. igapó), in an upland swampy valley (i.e. baixio), at the Uatumã black-water river and on the 80-m tower located on the upland terra-firme forest at the ATTO site. Air samples were collected with pressurized glass flasks and pre-evacuated vials and were analyzed for the isotopic composition of methane (□□13□□ and □□□□) with gas source isotope ratio mass spectrometer. We estimated isotopic source signatures of CH4 emissions from the four different sites using the intercept of an orthogonal fit in a Keeling plot.

Relative to the Amazon atmospheric background value of -59 ‰ per mill (Beck et al., 2012), our isotopic source signatures are more depleted in $\delta^{13}C$ ranging from -60 ‰ to -68 ‰, which confirms -as expected- a strong wetland-related biogenic source. Within this range, methane source signatures from areas near the Uatumã river (-68 ‰) and a periodically flooded valley (representing small streams of the region) have more depleted signatures (- 66 ‰). Using this range of source $\delta^{13}C$ signatures we explore the possibility of identifying different biogenic sources at the Tower based on continuous measurements (in-situ) of

$\delta^{13}C - CH_4$ and a Lagrangian atmospheric transport model to obtain the isotopic background (i.e. the isotopic signature of the air masses before entering the continent). Our results contribute valuable insights into the methane isotopic signature for different ecosystem types in central Amazonia, which could serve as a reference for measurement-based source attribution studies as well as a based on measurements and also for atmospheric transport modeling estimates.