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## Enhanced methane concentrations measured over the Amazon rainforest

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Recently, global mean methane concentrations have increased strongly. Methane is one of the most important greenhouse gases and plays a key role in atmospheric chemistry. Especially, due to its long lifetime of approx. 10 years and its significant effect on Earth's climate change, a detailed knowledge of its source regions and their temporal evolution is crucial.

In this study, we present a unique data set of methane measured in situ over the Amazon rainforest region during the wet season in the CAFE Brazil (Chemistry of the Atmosphere Field Experiment) aircraft campaign from December 2022 to January 2023 in Manaus, Brazil. Methane was measured with an infrared quantum cascade laser absorption spectrometer on board the High Altitude and Long-range aircraft (HALO). These observations show enhanced concentrations of methane in and above the boundary layer of the Amazon rainforest. Locally, dry air mixing ratios of up to approx. 2100 ppbv could be measured up to 4 km of altitude. Detailed analysis shows only a small contribution from anthropogenic sources. Especially over permanent wetlands and deforested areas, the methane concentrations were enhanced. Furthermore, the data has been compared to satellite measurements from the National Oceanic and Atmospheric Administration (NOAA), indicating good agreement in the free troposphere. Nevertheless, the mean levels directly above the Amazon rainforest are approx. 100 ppbv higher than the global background. Moreover, a global distribution based on airborne data from several campaigns (PHILEAS 2023, CAFE Brazil 2022/23, SouthTrac 2019, CAFE Africa 2018, WISE 2017, ATom 2016/17, OMO 2015, ESMVal 2012) shows that the methane surface concentrations over the Amazon rainforest has a local maximum. This calls for more detailed investigations of methane near the surface in the Amazon and raises an important question: Have we underestimated the Amazon rainforest as a significant source of the global methane budget?