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Trees as net sinks for nitrous oxide (N2O) and methane (CH4) in tropical rain forest on La Reunion island

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Tropical forests are considered a natural sink for methane (CH_4) and a natural source of nitrous oxide (N_2O), both important greenhouse gases (GHGs). To date, forest ecosystem exchange of CH_4 and N_2O has been mostly estimated based on GHGs exchange at the soil–atmosphere interface only. However, trees of various climatic zones are known to emit CH_4 and N_2O into the atmosphere. Recent research revealed tropical wetland trees as considerable sources of CH_4. Nevertheless, there is little known about CH_4 and N_2O exchange capacity of tropical trees growing under „non-flooded" conditions.

We determined CH_4 and N_2O exchange of soil and stems of mostly endemic tree species (*Syzygium borbonicum*, *Doratoxylon apetalum*, *Antirhea borbonica*, *Homalium paniculatum*, *Mimusops balata, Labourdonnaisia calophylloides*) in a tropical lowland rain forest on lava flow of La Reunion Island in the South Western Indian Ocean. We investigated (1) whether the tree stems exchange CH_4 and N_2O with the atmosphere, (2) how the tree fluxes contribute to the forest GHGs exchange, and (3) whether the tropical rain forest is a source or sink for CH_4 and N_2O at the beginning of the rain season.

The experiment was performed in Mare-Longue Nature Reserve (21˚21'S, 55˚45'E) in October-November 2018. The studied forest is situated on 400 years old pahoehoe basaltic lava flow covered with irregular and thin soil layer. Fluxes of CH_4 and N_2O in mature tree stems (n=24) and soil (n=24) were measured using non-steady-state chamber systems and a portable FTIR gas analyser.

The stems of studied tree species were net sinks for both CH_4 (-15.1 $\pm$ 2.2 μg CH_4 m^{-2} stem area h^{-1}, mean $\pm$ s.e.) and N_2O (-3.1 $\pm$ 0.8 μg N_2O m^{-2} h^{-1}). Such uptake potential for CH_4 and N_2O by tropical tree species represents a novel and unique finding which is in contrast to current limited studies presenting tropical trees as CH_4 emitters. The soil was a significant net CH_4 sink (-79.5 $\pm$ 11.5 μg CH_4 m^{-2} soil area h^{-1}). However, the soil might indicate also potential for CH_4 emission under high soil water content (e.g. due to extreme precipitation events), as one small-scaled wet soil area was characterized by CH_4 emissions (192 $\pm$ 117 μg CH_4 m^{-2} h^{-1}). The soil N_2O fluxes showed a high spatial heterogeneity including both N_2O emissions and uptake (net flux -0.18 $\pm$ 1.61 μg N_2O m^{-2} h^{-1}).

Concluded, the studied tropical tree species were net sinks for CH_4 and N_2O. The tropical lowland rain forest situated on a lava flow seems to be a net sink for CH_4 and to play only a minor role in the global N_2O exchange at the beginning of the rain season.

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