High CH$_4$ and N$_2$O emissions from soil and stems of disturbed swamp forests in Peruvian Amazon

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Introduction

- Amazon swamp forests sequester carbon into trees and peat.
- Respiration from them may outweigh it under disturbance.
- Anaerobic decomposition of the tree biomass and peat yields methane (CH$_4$).
- Suboxic processes release nitrous oxide (N$_2$O).
- Drought is a quickly increasing disturbance in Amazonia which may shorten the growth period and impose tree decline (IPCC, 2019). The short-lived warming events increase ecosystem respiration and may be further enhanced by a positive feedback on soil microbes.
- The role of Amazonian trees, and stem cryptogams and saptrotrophs in the greenhouse gas (GHG) fluxes is poorly understood.
Material and methods

- With an objective to clarify the GHG budget of Amazon swamp forests, the University of Tartu in collaboration with CzechGlobe, UNAP and IIAP held a measurement campaign in Iquitos, Peru from September 2019 to March 2020.

- We observed CO₂, CH₄ and N₂O fluxes in the soil and tree stems using opaque chambers, and potential environmental factors in three sites with various disturbance histories:
  a) *Mauritia flexuosa* palm dominated swamp forest; 3°50'03.9"S, 73°19'08.1"W,
  b) secondary swamp forest grown on fallow pasture and banana plantation in 12 years 3°50'10.7"S, 73°21'45.0"W, and
  c) slash-and-burn cassava field 3°51'00.0"S, 73°22'45.8"W.
Results along the schematic profile of study sites

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Soil respiration was positively related to water table depth. Thus, the secondary swamp forest respired large amounts of CO$_2$.

CO$_2$ efflux from the palm (*Mauritia flexuosa*) and boarwood (*Symphonia globulifera*) stems equalled $\frac{1}{4}$ of soil respiration.

The wet swamp forest sites, especially palm stems, emitted large amounts of CH$_4$. The dry slash-and-burn cassava field consumed CH$_4$.

Session-average soil and palm-stem CH$_4$ emissions were reversely correlated between each other, implying dynamic competition between the pathways.

**Anaerobic swamp peat** produced a session average of up to 420 µg N$_2$O-N m$^{-2}$ h$^{-1}$ from the 190 mg kg$^{-1}$ soil NH$_4^+$-N. The secondary swamp forest floor and slash-and-burn cassava field emitted a considerable 12...55 µg N$_2$O-N m$^{-2}$ h$^{-1}$.

Most of the observed relationships are novel for and unexplained by current literature.

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