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CH_4 production in the deep soil as a source of stem CH_4 emission in *Fagus sylvatica*?

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Predicting greenhouse gas (GHG) fluxes on a global scale requires understanding fluxes on the local scale. Understanding GHG processes in soil-plant-atmosphere systems is essential to understand and mitigate GHG fluxes on the local scale. Forests are known to act as carbon sink. Yet, trees at waterlogged sites are known to emit large amounts of CH_4, what can offset the positive GHG balance due the CO_2 that is sequestered as wood. Generally, upland trees like European beech (*Fagus sylvatica* L.) are assumed not to emit CH_4, and the upland forest soils are regarded as CH_4 sinks.

Soil-atmosphere fluxes and stem-atmosphere fluxes of CH_4 were studied together with soil gas profiles at two upland beech forest sites in Germany and Czech Republic. Soil was a net CH_4 sink at both sites. While most trees showed no or low emissions, one beech tree had exorbitant CH_4 emissions that were higher than the CH_4 sink capacity of the soil. A soil survey showed strong redoximorphic color patterns in the soil adjacent to this tree. Although the soil around the tree was taking up CH_4, the soil gas profiles around this tree showed CH_4 production at a soil depth $>$0.3 m.

We interpret the coincidence of the production of CH_4 in the deep soil below the beech with the large stem emissions as strong hint that there is a transport link between the soil and stem. We think that the root system represents a preferential transport system for CH_4 despite the fact that beech roots usually do not have a special gas transport tissue. The observed CH_4 stem emissions represent an important CH_4 flux in this ecosystem, and, thus, should be considered in future research.

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