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Tree-mediated methane emissions from tropical and temperate peatlands.

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Methane production and transport processes in peatlands are fairly well understood, but growing evidence for emission of methane through trees has highlighted the need to revisit methane transport processes. In wetland trees, morphological adaptations such as development of hypertrophied lenticels, aerenchyma and adventitious roots in response to soil anoxia mediates gas transport, transporting both oxygen from the atmosphere to oxygen-deprived roots and soil-produced methane from the root-zone to the atmosphere. Although, tree-mediated methane emissions from temperate tree species have been confirmed, methane emissions from tropical tree species and processes that control tree-mediated methane emissions remain unclear.

This study explains the role of trees in transporting soil-produced methane to the atmosphere and uncovers the principal mechanisms of tree-mediated methane emissions. Methane emissions from eight tropical tree species and two temperate tree species were studied in situ. The mechanisms and controls on tree-mediated methane emissions were investigated using three year old common alder (Alnus glutinosa; 50 trees) grown under two artificially controlled water-table positions. Methane fluxes from whole mesocosms, the soil surface and tree stems were measured using static closed chambers.

Both temperate and tropical tree species released significant quantities of methane, with tropical trees dominating ecosystem level methane fluxes. In temperate peatlands, both the methane gas transport mechanism and quantity of methane emitted from stems is tree-species dependent. In Alnus glutinosa, no correlations were observed between stomatal behaviour and tree-mediated methane emissions, however, stem methane emissions were positively correlated with both stem lenticel density and dissolved soil methane concentration. In Alnus glutinosa, no emissions were observed from leaf surfaces. The results demonstrate that exclusion of tree-mediated methane emissions from flux measurement campaigns in forested peatlands will lead to an underestimation of ecosystem-wide methane emissions.