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Methane cycling within wetland trees

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Wetland soils play a key role in regulating the net amount of methane (CH_4) being released to the atmosphere due to simultaneous production and consumption of CH_4 in soil. Up to 90% of CH_4 is consumed in certain wetlands (i.e., rice paddies), thereby emitting only a fraction of CH_4 produced in soils to the atmosphere. In recent years, wetland trees have been recognised as an important pathway for CH_4 emission; however, the potential role of CH_4 cycling - consumption and production of CH_4 - within tree stems are relatively unknown. In this study, we measured potential rates of CH_4 consumption and production in tree stem and soil cores together with in situ CH_4 fluxes from wetland tree stems and soils across latitudes (tropical, temperate and boreal wetlands). All trees investigated (n = 1500) released significant quantities of CH_4 ranging between 0.05 – 330 mg m^{-2} hr^{-1}, with tropical trees emitting the largest quantity of CH_4. Methane production potentials were occasionally observed (>5% of the samples) in tree stems, suggesting that CH_4 production within the trees stems played a minor role and soil produced CH_4 to be the dominant source of CH_4 emitted via tree stem surfaces. Tree stem cores when aerobically incubated to measure potentials for CH_4 oxidation, offered evidence to support both high affinity and low affinity methanotrophic activity in 57 and 65% of the stem cores extracted, respectively, despite the net fluxes measured at the tree surfaces across all sites being always positive. The methanotrophic activity changed from low to high affinity with increasing height above the soil surface most likely as a result of decreasing availability of CH_4 higher in the tree stem. These results highlight the complex cycling of CH_4 within the trees and that the tree stems may offer additional exchange sites where CH_4 could potentially be oxidised.