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Upland beech trees significantly contribute to forest methane exchange

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Methane (CH_4) can be emitted not only from soil, but also from plants. Fluxes of CH_4were predominantly investigated in riparian herbaceous plants, whereas studies on trees, particularly those lacking an aerenchyma, are rare. In soil produced CH_4 can be taken up by roots, transported via intercellular spaces and the aerenchyma system, or transpiration stream to aboveground plant tissues and released to the atmosphere via lenticels or stomata. Although CH_4 might be also produced by microorganisms living in plant tissues or photochemical processes in plants, these processes are relatively minor. It has been shown that seedlings of European beech (*Fagus sylvatica*) emit CH_4 from its stems despite the lack of an aerenchyma.

Our objectives were to determine the CH_4 fluxes from mature beech trees and adjacent soil under natural field conditions, and to estimate the role of trees in the CH_4exchange within the soil-tree-atmosphere continuum.

Measurements were conducted in two mountain beech forests with different geographical and climatic conditions (White Carpathians, Czech Republic; Black Forest, Germany). CH_4 fluxes at stems (profile) and root bases level were simultaneously measured together with soil-atmosphere fluxes using static chamber systems followed by chromatographic analysis or continuous laser detection of CH_4 concentrations.

Our study shows that mature beech trees have the ability to exchange CH_4 with the atmosphere. The beech stems emitted CH_4 into the atmosphere at the White Carpathians site in the range from 2.00 to 179 μg CH_4 m^{-2} stem area h^{-1}, while CH_4 flux rates ranged between -1.34 to 1.73 μg CH_4 m^{-2} h^{-1} at the Black Forest site. The root bases of beech trees from the White Carpathians released CH_4 into the atmosphere (from 0.62 to 49.8 μg CH_4 m^{-2} root area h^{-1}), whereas a prevailing deposition was observed in the Black Forest (from -1.21 to 0.81 μg CH_4 m^{-2} h^{-1}). These fluxes seem to be affected by soil water content and its spatial heterogeneity. Compared to beech trees, forest floor was a sink for CH_4 on the both sites. The deposition rates reached -52 and -161 μg CH_4 m^{-2} soil area h^{-1} at the White Carpathians and Black Forest site, respectively. Concluded, CH_4 emissions from upland beech trees significantly contribute to total CH_4 flux and have to be counted towards the overall CH_4 balance of beech forest.

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