

Willows strongly emit methane (CH₄) during dormant season

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Wetlands are considered to be a substantial natural source of methane (CH₄), due to CH₄ production by methanogens in flooded soil. Trees, especially wetland tree species possessing an aerenchyma system in roots, are known to emit CH₄ into the atmosphere. However, information about the seasonal dynamics of tree CH₄ emissions is rare.

We determined CH₄ emissions from stems of mature willow trees (*Salix pentandra*, *S. fragilis*) in wetlands from March 2014 to September 2015. We aimed to investigate the seasonal changes of CH₄ emissions within the soil-tree-atmosphere continuum and the impact of environmental parameters on these emissions. An intensive campaign investigating vertical profile of CH₄ emissions in stems was performed in May 2016.

The measurements were performed in sedge-grass marsh surrounding the ecosystem station Wet Meadows in South Bohemia, Czech Republic (49°01'30"N, 14°46'20"E), with scattered willow trees. Emissions of CH₄ were determined from stems and adjacent soil each month using static chamber systems and laser analyses.

Our study revealed that all trees studied consistently emitted CH₄ from their stems over the whole year. The CH₄ emissions were significantly higher in *S. fragilis* (up to 14.2 mg CH₄ m⁻² stem area h⁻¹) than in *S. pentandra* (up to 1.03 mg CH₄ m⁻² h⁻¹), and dramatically decreased within first 1.5 m of stem height with highest emissions detected close to the soil surface. Even though the CO₂ exchange of willow stems, as an indicator of their physiological activity, showed strong seasonality typical for tree species of temperate zone (high CO₂ emissions during vegetation season followed by low, but still detectable emissions in dormant season), the stems emitted CH₄ in an opposite pattern. The CH₄ emissions were the lowest in summer months (from June until August/September) and dramatically increased from September onwards and remained very high and almost constant until May. The soil even deposited CH₄ from the atmosphere from June until August/September, and emitted CH₄ during the rest of the year with highest emissions at the beginning and end of vegetation seasons. We assume that CH₄ is "passively" taken up by tree roots in the deep soil layers, transported via aerenchyma system to the bottom part of stems and released into the atmosphere independently on the physiological activity of the trees. Ongoing regression analyses with environmental/micrometeorological parameters will closer clarify the aspects of the unique and very strong emissions of CH₄ from the willow trees in winter time.

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