



Black alder as a regulator for methane emissions: High temporal variability of stem emissions in a hydrologically dynamic alder carr

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Rewetting drained peatlands has become a popular measure to prevent high carbon dioxide (CO₂) emissions. Yet, as a consequence of rewetting, anoxic conditions prevail in the water-saturated soils leading to high methane (CH₄) emissions. For many years, research has focused on soil to atmosphere fluxes. In recent years, it is becoming apparent, that long-known stem-based emissions of CH₄ from trees might be more relevant than previously thought on ecosystem scale CH₄ budgets. However, data regarding seasonal and spatial variability are still scarce. Further, it is of great interest to understand the interaction with soil emissions and other environmental variables in order to include stem methane emissions in overall ecosystem GHG-balances.

We measured stem emissions regularly for 12 months with 21 chambers on six black alder (*Alnus glutinosa* (L.) J. Gaertn.) trees alongside measurements of soil emissions in a drained and a rewetted alder carr. Due to the variable weather patterns in northern Central Europe in 2017/2018, we collected data under climatically and hydrologically contrary phases. In addition, we ran a sampling campaign to address spatial and diurnal variability. The data reveals that CH₄ emissions of tree stems are highly dependent on the hydrologic regime and interact with soil CH₄ emissions. Additionally, overall variability is high in time and space, resulting in fluxes being at the upper limit of the range reported for stem methane fluxes for temperate wetland forests. During the study period, the sites showed water table fluctuations of up to 1.4 m. When the water level was above the soil surface soil emissions decreased while stems seem to have acted as shunts for CH₄ being produced in the soil. Contrary to this, soil emissions increased strongly when the surface water receded whilst stem emissions came to a quick halt. In conclusion, stem emissions contributed considerably to overall CH₄ emissions in the alder carr, however, only under certain conditions and during limited periods of time.