Methane emissions from Scots pine and Norway spruce in the spring

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Plant shoots can emit methane (CH\textsubscript{4}) which is produced by an unknown aerobic, non-enzymatic process within the plant. Only a few publications report shoot CH\textsubscript{4} fluxes outside a laboratory setting, and those of boreal trees come to contradictory results (Machacova et al., 2016; Sundqvist et al., 2012). Resolving the CH\textsubscript{4} fluxes of boreal trees is needed in order to understand the role of boreal forests in the global methane budget.

We conducted shoot chamber measurements on Scots pine (\textit{Pinus sylvestris}) and Norway spruce (\textit{Picea abies}) between April and May 2019, to find out if the shoots of boreal conifer trees are a source of aerobic CH\textsubscript{4} during the early growing season. The experiment was done with potted 2-3 year old nursery saplings in a common garden experiment, to enable regular measurements over a period of six weeks. CH\textsubscript{4} fluxes were measured 2-3 times per day, on two days per week from seven saplings (four \textit{P. sylvestris} and three \textit{P. abies}, respectively). We also conducted two around the clock campaigns where we measured the saplings hourly throughout the day and night. The CH\textsubscript{4} and carbon dioxide (CO\textsubscript{2}) exchange were quantified with a portable LGR online greenhouse gas analyser connected in closed loop to custom-made, transparent shoot chambers. Photosynthetically active radiation (PAR) was measured concurrently with a PP Systems EGM-4 monitor.

Our measurements show emissions of CH\textsubscript{4} from both tree species, ranging from 0.25 to 7.64 and -0.45 to 6.42 g\textsuperscript{-1} needle dry weight h\textsuperscript{-1} (inter-quartile range) from \textit{P. sylvestris} and \textit{P. abies} shoots, respectively. The shoot CH\textsubscript{4} emissions from both species correlated positively with PAR. During the around the clock measurements the emissions showed a diurnal pattern. Our experiment demonstrates that the shoots of both \textit{P. sylvestris} and \textit{P. abies} can be a source of CH\textsubscript{4} in the spring and that the source process is likely driven by solar irradiation.

References