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Continuous Analysis of Stable Carbon Isotopes in CO_2 and CH_4 Fluxes with an Automated Chamber Flux System at Mer Bleue Bog, Ottawa, Canada

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Northern peatlands are one of the largest sources for methane (CH_4), a greenhouse gas approx. 28 times more potent than carbon dioxide (CO_2). To analyze feedback effects as well as patterns and controls of CH_4 fluxes from these ecosystems, studies using the stable isotopic composition of CH_4 and CO_2 provide a promising approach, given that pathways of CH_4 formation and methanotrophy affect the resulting isotopic composition of emitted CH_4. So far, mostly single-sample ^{13}C-values are being used to calculate signatures specific to particular environmental CH_4 sources, however, these target signatures might not be stable and instead vary, depending on changing pathways of production and emission. The aim of this study was thus to assess the temporal and spatial variability in the source signatures of CO_2 and CH_4 emitted throughout the 2018 growing season at Mer Bleue, a temperate, ombrotrophic bog in Canada and compare results with first dataset, recorded in 2017. With the help of continuous laser-based, spectroscopic isotope analysis connected to an automated flux chamber system, we analyzed fluxes of 12 transparent chambers and calculated source signatures. We grouped our results by vegetation composition in each chamber: shrubs (predominantly *Chamaedaphne calyculata*); sedges (predominantly *Eriopherum vaginatum*); mixed (shrubs and sedges) and compared observed patterns to other recorded environmental variables.

While fluxes of CH_4 and CO_2 were in typical ranges as observed at this site over the past, isotopic signatures of the emitted CH_4 were surprisingly more ^{13}C depleted (-63.5 to -70 ‰) compared to values typically assigned to CH_4 being emitted from northern peatlands (-58 ‰) and showed considerable variation. As expected, CH_4-fluxes in sedge-dominated chambers were higher than in other vegetation groups, but they also showed different ^{13}C-source signatures, presumably due to a different gas transport mechanism: By aerenchyma transport, sedges allow the emitted CH_4 to effectively bypass the methanotrophic layer, reducing CH_4 oxidation and causing an emission of slightly more ^{13}C depleted methane (3-6 ‰ more depleted in sedge-plots compared to shrub-plots). As we were using transparent chambers, ^{13}C-signatures in CO_2 were mostly driven by photosynthetic activity, heterotrophic and autotrophic respiration. In summary, our study demonstrates the high value of online, continuous isotope analysis, although accuracy and precision of such instruments under field conditions is hard to maintain and calibrating for- and measuring low atmospheric concentrations still remains a challenging task. The s/n-ratio still is the biggest influence on precision and could only be factored out by a large sample size of this kind of datasets.