Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-121-AC4, 2019

Biogeosciences
Discussions

Interactive comment on "Effect of crustose lichen (*Ochrolecia frigida*) on soil CO_2 efflux in a sphagnum moss community over western Alaska tundra" *by* Yongwon Kim et al.

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Received and published: 24 November 2019

Soil CO2 efflux-measurements represent an important component for estimating an annual carbon budget in response to changes in increasing air temperature, degradation of permafrost, and snow-covered extents in the Subarctic and Arctic. However, it is not widely known the significant effect of curstose lichen (Ochrolecia frigida)-infested sphagnum moss on soil CO2 emission. Here, continuous soil CO2 efflux measurements by a forced diffusion (FD) chamber were investigated for intact and crustose lichen-infested sphagnum moss within covering over a tundra ecosystem of western Alaska during the growing seasons of 2015 and 2016. We found that CO2 efflux in

crustose lichen infested moss during the growing season of 2016 was 14 % higher than in intact sphagnum moss community. This suggests that temperature relative to soil moisture is an invaluable driver in stimulating soil CO2 efflux, regardless of the restraining functions of soil moisture over emitting soil carbon. Soil moisture does not influence soil CO2 emission in crustose lichen, reflecting the constraint of ecological and thermal functions relative to intact sphagnum moss. During the growing season of 2016, there was a significant difference between soil CO2 effluxes in intact and crustose lichen sphagnum moss, compared to 2015, based on a t-test at the 95 % confidence level ($p < 0.05$). Mean snow-covered and snow-free CO2 contributions to annual carbon budgets correspond to 28.4 % and 71.6 % in intact sphagnum moss, and 25.0 % and 75.0 % in a crustose lichen sphagnum moss, respectively. Therefore our findings demonstrate that soil CO2 emissions in the crustose lichen-infested sphagnum moss would be steadily stimulated by a widespread outbreak of airborne lichen over intact sphagnum moss. This might result in rapid degradation of permafrost in the Subarctic and Arctic.

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