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EFFECT OF THAW DEPTH ON FLUXES OF CO2 AND CH4 IN MANIPULATED ARCTIC COASTAL TUNDRA OF BARROW, ALASKA

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Changes in CO_2 and CH_4 emissions represent one of the most significant consequences of drastic climate change in the Arctic, by way of thawing permafrost, a deepened active layer, and decline of thermokarst lakes in the Arctic. This study conducted flux-measurements of CO_2 and CH_4, as well as environmental factors such as temperature, moisture, and thaw depth, as part of a water table manipulation experiment in the Arctic coastal plain tundra of Barrow, Alaska during autumn. The manipulation treatment consisted of draining, controlling, and flooding treated sections by adjusting standing water. Inundation increased CH_4 emission by a factor of 4.3 compared to non-flooded sections. This may be due to the decomposition of organic matter under a limited oxygen environment by saturated standing water. On the other hand, CO_2 emission in the dry section was 3.9-fold higher than in others. CH_4 emission tends to increase with deeper thaw depth, which strongly depends on the water table; however, CO_2 emission is not related to thaw depth. Quotients of global warming potential ($GWPCO_2$) (dry/control) and $GWPCH_4$ (wet/control) increased by 464 and 148 %, respectively, and $GWPCH_4$ (dry/control) declined by 66 %. This suggests that CO_2 emission in a drained section is enhanced by soil and ecosystem respiration, and CH_4 emission in a flooded area is likely stimulated under an anoxic environment by inundated standing water. The findings of this manipulation experiment during the autumn period demonstrate the different production processes of CO_2 and CH_4, as well as different global warming potentials, coupled with change in thaw depth. Thus the outcomes imply that the expansion of tundra lakes leads the enhancement of CH_4 release, and the disappearance of the lakes causes the stimulated CO_2 production in response to the Arctic climate change.