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Growing Season Carbon Balance of a Permafrost Peatland in the Mackenzie River Delta

Wesley Skeeter (1), Andreas Christen (2), Greg Henry (1), and Trevor Lantz (3)

(1) University of British Columbia, Vancouver, Canada (wesley.skeeter@alumni.ubc.ca), (2) University of Freiburg, Freiburg, Germany (andreas.christen@meteo.uni-freiburg.de), (3) University of Victoria, Victoria, Canada (tlantz@uvic.ca)

Terrestrial Arctic landscapes are currently a net greenhouse gas sink, but climate warming and permafrost disturbances are anticipated to weaken or offset this sink in the future. The issue is further complicated in Arctic wetlands where methane (CH_4) emissions disproportionately offset carbon dioxide (CO_2) uptake. To study the sensitivity of CO_2 and CH_4fluxes to various environmental controls (temperature, permafrost depth, water table), we continuously measured growing season trace gas exchange at a peatland site in the Mackenzie River delta, NWT, Canada (69.37234497˚N, 134.8810577˚W). Fluxes were measured using an eddy covariance on a floating platform at a height of 2.87 m from June 23 to September 13, 2017. The site is characterized by low center polygonal terrain and continuous permafrost, with *Sphagnum* sp., *Equisetum* sp., and *Carex* sp. in the polygons and *Salix* sp. present along the polygon rims. Active layer thickness increased from 20 cm to 51 cm over the season. Mean water table depth was 12 cm, ranging from 19 cm in mid-July to 6 cm in late-August. Neural network models were used identify factors most strongly influencing the fluxes and to gap fill the time series. Photon flux density and soil temperatures were found to be the strongest controls over CO_2 fluxes. Manual chamber measurements of soil respiration suggest the polygon rims emit more CO_2 per unit area than polygon centers. CH_4 emissions were influenced by non-linear interactions between multiple factors including wind speed, photon flux density, active layer depth, and water table depth. The mean growing season CO_2 flux was -1.76 $\pm$ 0.31 g CO_2 m^{-2} d^{-1}, peaking in mid-July with minimal uptake after late August. Mean CH_4 flux was 48.7 $\pm$ 2.44 mg CH_4 m^{-2} d^{-1}, also peaking in July but displaying a more muted seasonal trend and high variability on short timescales. Accounting for the 100-year global warming potential of CH_4, daily growing season fluxes are estimated to be -0.40 $\pm$ 0.29 g CO_2 eq. m^{-2} d^{-1}.