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Spatiotemporal heterogeneity in carbon exchange at a restored peatland in Alberta, Canada

Scott MacDonald (1), Ian Strachan (1,2), and Maria Strack (3)

(1) Department of Geography, McGill University, Montreal, Canada (scott.macdonald@mail.mcgill.ca), (2) Department of Natural Resource Sciences, McGill University, Sainte-Anne-de-Bellevue, Canada, (3) Department of Geography and Environmental Management, University of Waterloo, Waterloo, Canada

Boreal peatlands store a substantial portion of Earth's soil carbon, but the commercial peat extraction process upsets this carbon-sink dynamic. A best-practices restoration process has been developed that aims to return the vegetation and ecosystem functions of post-extraction peatlands. This includes the blocking and infilling of ditches, leveling of the peatland surface and re-introduction of vegetation through the moss layer transfer technique. The dynamics of carbon gas exchange in these restored peatlands are still poorly understood.

We investigated ecosystem-scale and microscale carbon flux in a recently restored, post-extraction peatland near Seba Beach, Alberta, Canada. Two eddy covariance (EC) towers continuously measured CO_2 and CH4 fluxes in hydrologically distinct parts of the peatland site. Here, we report on growing season measurements made during the fourth year following extraction. Regular static chamber measurements during June-August 2016 were also taken to study gas fluxes across an infilled drainage ditch on the site.

Results suggest that if the peatland restoration process successfully returns high water table position, strong carbon uptake may be attained within several years of restoration. However, differences in peatland topography resulted spatial heterogeneity in carbon dynamics at this restored site. A gradient of revegetation success and attendant carbon-flux dynamics were observed, with much stronger net uptake of CO_2 and substantial CH4 efflux measured at the tower with higher vegetation cover. Revegetation elsewhere was much sparser, and thus low CO_2 uptake rates persisted at much of the peatland, though these conditions conversely inhibited substantial CH4 efflux. More broadly, the contrast in flux data between our two EC towers at the site suggests that attention be made to the selection of representative carbon flux values in similar restored peatlands.