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Conference Abstract

Vegetation communities and summer net ecosystem CO_2 exchange on western Axel Heiberg Island, Canadian High Arctic

Theresa L.E. Gossmann‡, Christopher R. Omelon‡

‡ Queen's University, Kingston, Canada

Corresponding author: Christopher R. Omelon (c.omelon@queensu.ca)

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Abstract

Climate change is expected to result in the Arctic transitioning from a carbon sink to a carbon source environment, with models predicting half of the carbon stock of the upper 3 m soil layer to be released by the year 2300 (van Huissteden and Dolman 2012). However, uncertainty in latitudinal warming and changes in Arctic ecosystem functions, such as gross carbon ecosystem exchange (GEE), are poorly understood, in part a reflection of a high variability in vascular plant community diversity that is dependent upon and sensitive to physiographic controls, such as soil moisture, topography, and seasonal active layer depth (Walker et al. 2005). This heterogeneity complicates assessments of carbon fluxes on a landscape scale and how they will change in the future (Shaver et al. 2007), especially given their sensitivity to local changes in climate, such as warming and higher rates of rainfall (Bintanja 2018, Bintanja and Andry 2017).

As part of the creation of a long-term ecological and environmental monitoring program at the McGill Arctic Research Station at Expedition Fiord, western Axel Heiberg Island, field-based studies in 2021-2022 of plant surveys and summer net ecosystem CO_2 exchange monitoring were undertaken to:

1. define the major vegetation communities;

2. quantify and investigate CO_2 fluxes with chambers and their analogous biophysical variables; and
3. upscale plot level CO_2 measurements to the landscape scale using high spatial resolution remote sensing data.

The Expedition Fiord area is recognized as a polar oasis, with high plant species richness existing within an environment of heterogeneous physiography. At the moment, five vegetation communities have been identified (*xeric dwarf shrub barren*, *xeric-mesic dwarf shub barren*, *mesic dwarf shrub tundra*, *cassiope heath*, and *sedge meadow*) that varied as a function of species diversity, percent cover, soil moisture, and net ecosystem carbon exchange. Barren vegetation communities having stronger respiration fluxes (i.e., carbon source environments) while more vegetated communities have stronger photosynthesis fluxes (i.e., carbon sink environments). Landcover classification revealed with high accuracy (79.3%) that barren ground and barren vegetation communities cover a much larger area compared to wetter habitats. Upscaling summer season measured carbon fluxes based on the landcover map revealed that Expedition Fiord is a carbon source environment, with an average efflux of +94.6 g CO_2/day. Ongoing work focuses on the expansion of carbon flux and subsurface monitoring locations, as well as studies of soil carbon and microbial diversity across the different land cover classifications, which will help to better resolve how soil microorganisms, plant detritus, labile organic carbon, soil moisture, slope, aspect, and bedrock geology influence CO_2 fluxes throughout the summer season in this high Arctic setting.

Keywords

Arctic; vegetation; carbon dioxide; net ecosystem exchange

Presenting author

Christopher R. Omelon

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Conflicts of interest

The authors have declared that no competing interests exist.

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