Because of permafrost thaw, soil microbial respiration is releasing carbon that had been perennially frozen to the atmosphere in the form of CO₂ or CH₄. These greenhouse gas emissions could however be partly—or completely—counterbalanced by the emergence of shrubs in northern latitudes, as they absorb atmospheric carbon and reincorporate it in the soil through litter formation.

Objectives

- Determine the impact of the emergence of dwarf birch in the low Arctic on the tundra’s carbon budget.
- Estimate the rate of carbon storage due to shrub growth.

Methods

- The study site is located near Umiujaq (Fig. 1 & 2), where the soils contain very little ancient carbon (< 1 kg m⁻²).
- 23 soil pits were dug in the lichen tundra, where dwarf birch shrubs are emerging.
- At each study site, the lichen and birch biomass was measured.
- Shrub age was determined using dendrochronology.
- SOC stocks were measured to a depth of 30 cm.
- Carbon storage was determined from SOC and aerial and root biomass.

Dendrochronological studies (Fig. 5 & 6), indicate that the minimum age of the sites, based on the oldest shrub sampled, ranged from 26 to 79 years.

- The age of the sites was not found to be a determining factor in estimating SOC stocks.
- Birch + moss sites are not necessarily older than birch + lichen sites.

Shown in Figure 7 is the Tasiapik Valley’s overall carbon budget, which includes soil, lichen and birch carbon stocks. On average, birch sites hold 7 ± 3 kg m⁻² of carbon. Results are underestimated, as the carbon from the moss covers found at birch sites was not accounted for.

The overall carbon stocks at every site (soil, lichen, birch) are not dependent on the age of the shrubs (Fig. 8). Results are in close accordance to those of Fig. 5, as soil is by far the largest carbon compartment in the valley.

Conclusions

- The transition from a lichen to a shrub tundra has increased the surface carbon budget from 2.2 ± 0.4 to 7 ± 3 kg m⁻².
- The carbon stocks in the valley have rapidly reached a steady state within less than 30 years of shrub growth.
- Shrub growth around Umiujaq will not cause a long term carbon sink.

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