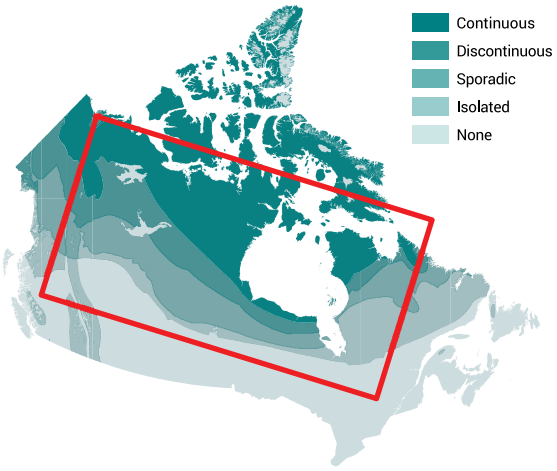
Evaluating the influence of mosses on the carbon and nitrogen cycles in the boreal forest



Study locations: Five boreal forest stands across Canada.

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This research implemented a feather moss plant functional type (PFT) in the computer model CLASSIC (Canadian Land Surface Scheme Including Biogeochemical Cycles). Feather mosses influence the ground thermal regime due to their insulating properties. They provide nitrogen to the ecosystem by fixing it from the atmosphere and incorporating it into the soil. This provides essential nutrients for other plants. With a new feather moss PFT, model simulations reproduce observation-derived data of carbon fluxes more closely. CLASSIC output of soil temperatures can now be compared to field measurements for sites with a feather moss ground cover.

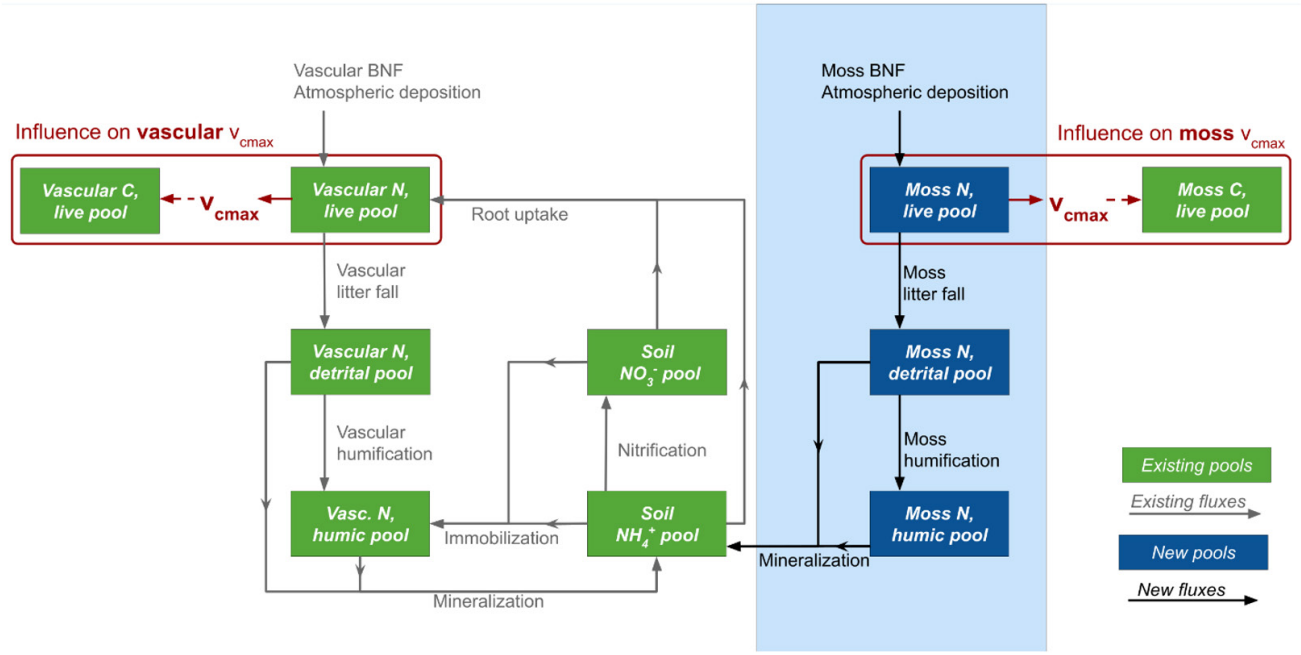

Figure 1. Schematic outlining how we implemented feather mosses in CLASSIC's nitrogen (N) cycle. This updated version of CLASSIC can be used to compare soil temperature measurements to model output for boreal forest sites with a feather moss cover.

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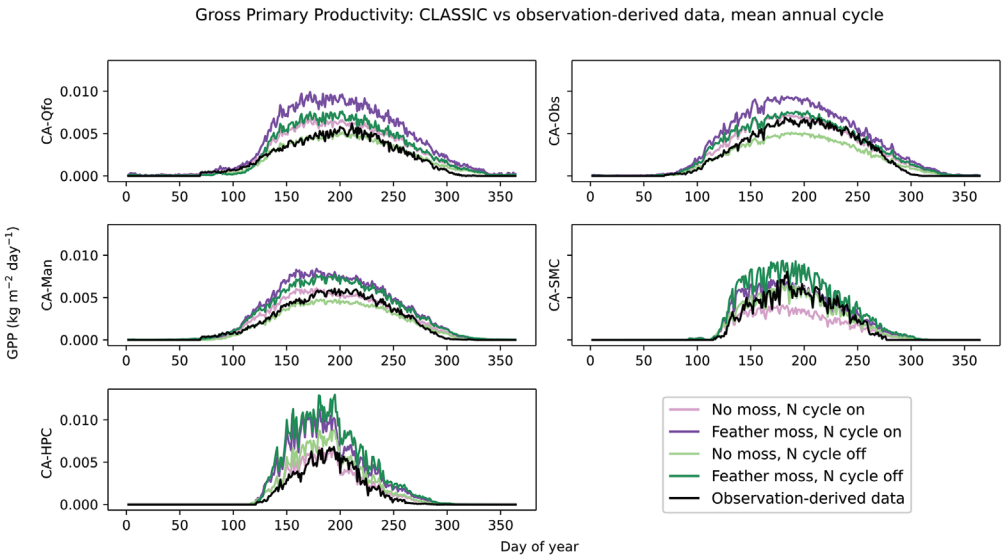

Figure 2. Comparison of observation-derived gross primary productivity (GPP) at five boreal forest sites against the model output of different configurations of CLASSIC. GPP corresponds to carbon added to the ecosystem as a result of photosynthesis.

Research summary

The boreal forest is experiencing changes due to climate change. There is much uncertainty around the important quantity of carbon it stores. Terrestrial biosphere models such as CLASSIC allow us to produce climate projections by simulating quantities related to the ground thermal regime, the carbon cycle, and the nitrogen cycle. In CLASSIC, plant species are regrouped as PFTs, but feather mosses are not represented. We added a feather moss PFT to CLASSIC to represent the influence of feather mosses on the ground thermal regime and on the carbon and nitrogen cycles. CLASSIC's ability to reproduce observation-derived carbon flux data was improved when accounting for feather mosses' impact on the nitrogen cycle. To our knowledge, no other TBM accounts for the influence of feather mosses on the nitrogen cycle.

Taking action

With CLASSIC, we can simulate ground temperature, which we can then compare to field measurements. Further work with our version of CLASSIC could include a comparison of CLASSIC's output against soil temperature measurements at boreal forest sites. Having field measurements to evaluate CLASSIC's performance allows a better tuning of its parameters representing the physical properties of feather mosses. In return, we can gain confidence in CLASSIC's simulations of sites where measurements are unavailable.

Connections to other projects

This project is part of Theme 3 — *Prediction of permafrost change*, and related to other projects in the theme, such as *Fate of carbon in Canadian permafrost-affected soils* by Charles Gauthier and *Simulating land cover change and its influence on permafrost in CLASSIC* by Muhammad Umair. The project is also linked to projects in Theme 2 — *Monitoring of permafrost change*.

Partners, team members and support

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Acknowledgment, thanks and funding

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References

NSERC PermafrostNet (2023). *L'inclusion des mousses dans le modèle CLASSIC*. [PermafrostNet online video]. Available at: https://youtu.be/PvOQJQat4I0 (Accessed 28 February 2025).

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