Quantifying the contribution of a feather moss cover on the boreal forest ground thermal regime

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ATMOSBIOS Atmospheric biogeosciences in high latitudes

INTRODUCTION

Mosses are present everywhere at higher latitudes. *Sphagnum* species cover the ground of peatlands. Feather mosses (figure 4) commonly cover the ground in the boreal forest, especially in black spruce forests. Mosses influence the **ground thermal regime (GTR)** by **insulating the ground** from warm air temperatures. It is important to consider the contribution of mosses when modelling ground thermal properties and making climate projections for higher latitudes.

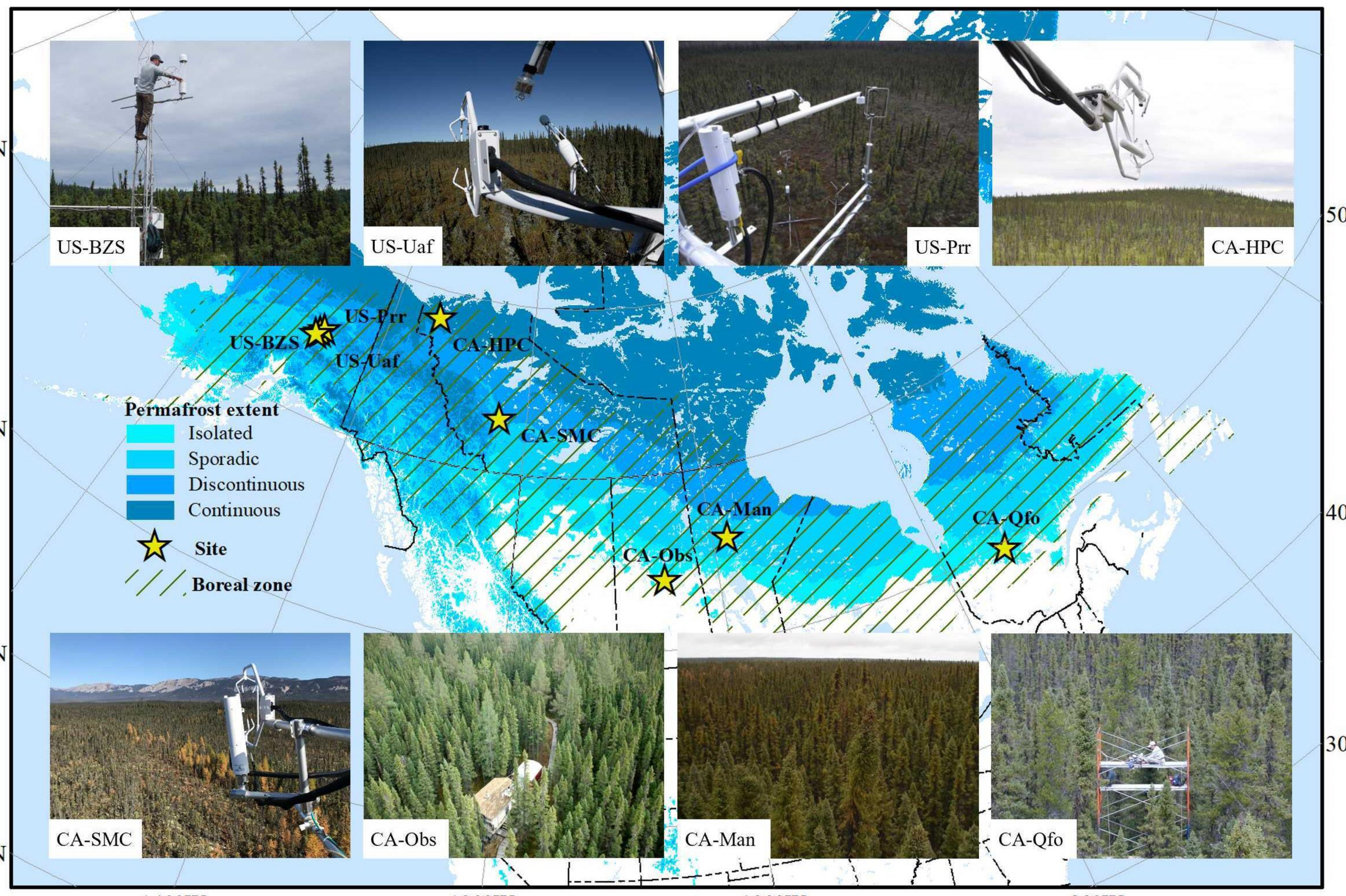

Figure 1: Sites modelled with CLASSIC to quantify the contribution of mosses to the GTR in the boreal forest. Permafrost zones across Canada and Alaska are shown [1].

METHODOLOGY

Description of sites

All the sites that were modelled (figure 1) **are mature boreal forest stands** in Canada or Alaska. They are located on **continuous permafrost, on discontinuous permafrost, or on permafrost-free zones**. The *Sphagnum* and feather moss ground cover varies for each site.

Description of CLASSIC

The sites were modelled with **a modified version** of the **Canadian Land Surface Scheme Including Biogeochemical Cycles (CLASSIC)** that allows a **representation of a ground cover of feather mosses.** Previously, only *Sphagnum* mosses were represented in the model for peatland simulations [2]. To represent feather mosses, a **set of new parameters** was added alongside the existing *Sphagnum* moss parameters. In the model, the feather mosses are represented as a top soil layer **with properties different from mineral soil**.

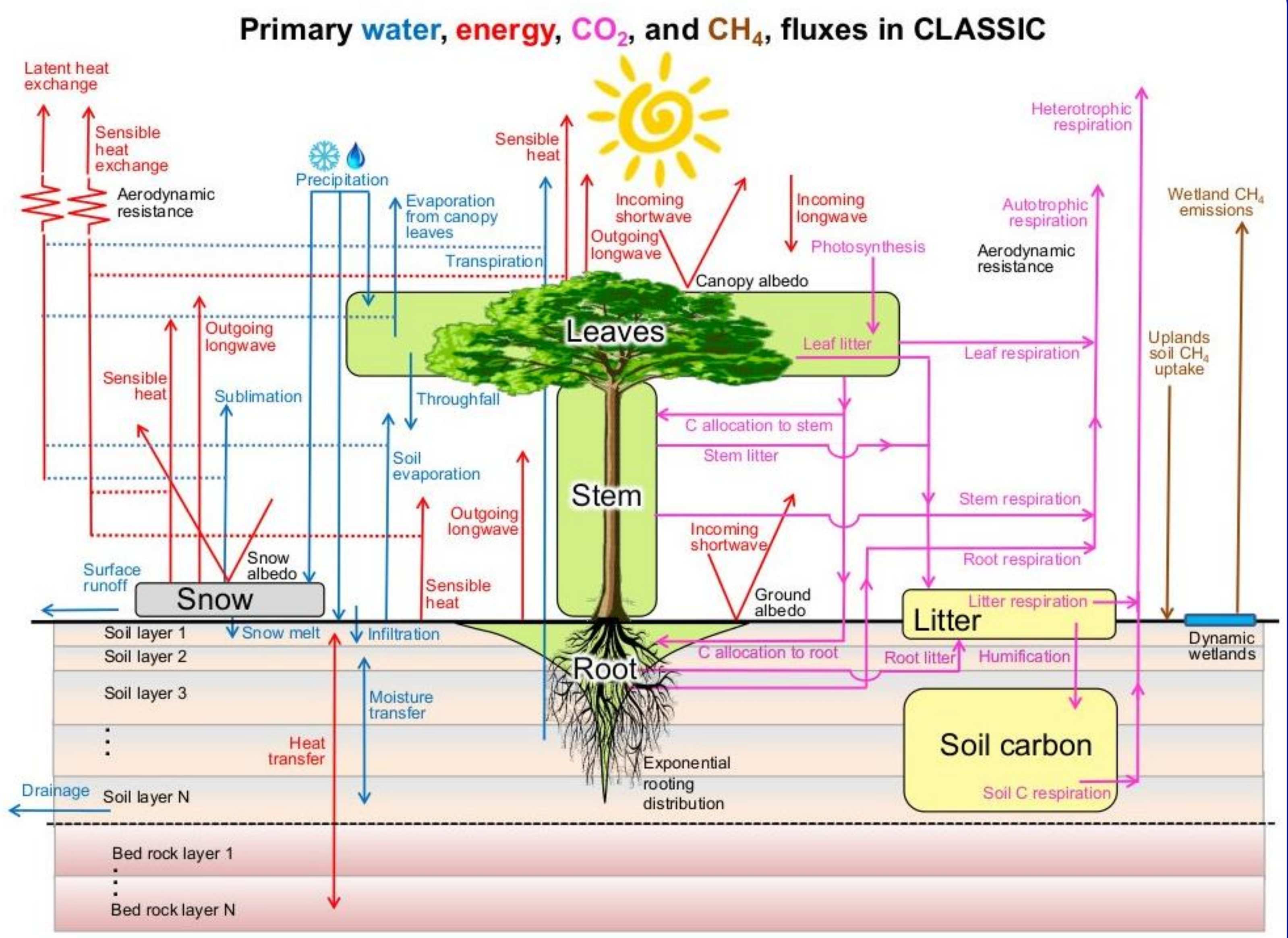

Figure 2: The CLASSIC land surface model [3]. The soil temperature for each of the 20 soil layers is one of the values simulated by the model.

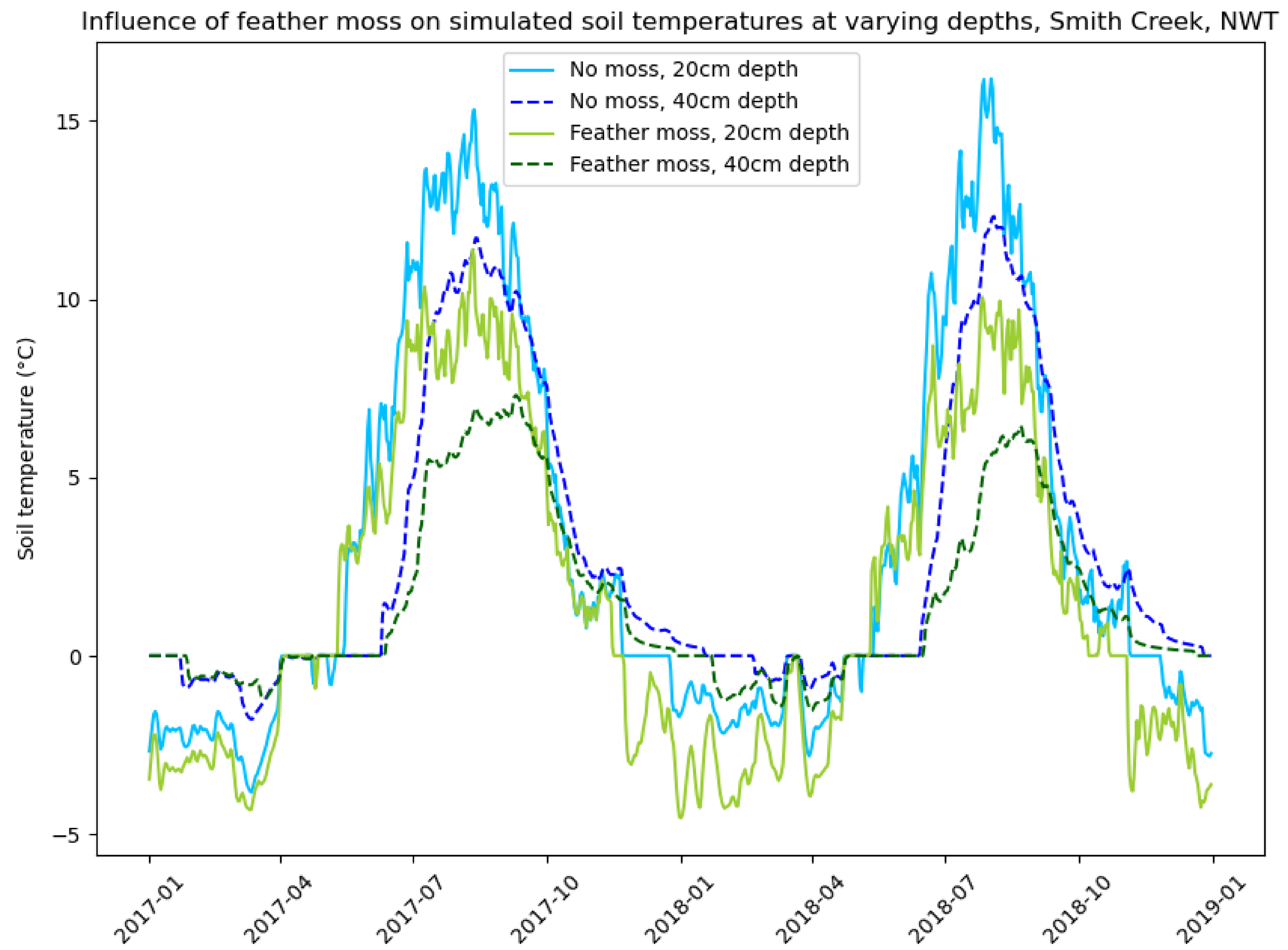

Figure 3: Ground temperatures simulated with CLASSIC at Smith Creek, Northwest Territories (CA-SMC, figure 1). Different runs of the model were made to show the impact of the presence of moss. The **blue lines** are from an upland simulation **without a feather moss ground cover**, and the **green lines** from an upland simulation **with a feather moss ground cover**. In both cases, the **solid line** corresponds to a **depth of 20cm**, and the **dashed line** to a depth of **40cm**.

RESULTS

Figure 3 shows that for both ground cover cases, the soil temperature **varies more at lower depths**: at a depth of 20cm, the soil is warmer in the summer and cooler in the winter than at a depth of 40cm. At both depths, during summer, the **feather moss ground cover (FMGC) prevents the soil temperature from rising as high** as the soil temperature without a moss cover. Additionally, at both depths during winter, **the FMGC allows the soil to reach cooler temperatures** than it does when there is no moss cover.

DISCUSSION

Moss is **porous**. It creates an **insulating barrier** between the atmosphere and the soil when it is dry. In the summer, when the air temperature is higher than the soil temperature, the **FMGC prevents the ground from heating as much** as the ground without a moss cover [4]. These lower summer temperatures could also explain why winter ground temperatures are also lower with a FMGC.

This is consistent with simulation results from CLASSIC (figure 3). During summer, **the insulating FMGC keeps the soil cooler** than it would be without a moss cover. The ground temperature is then also lower during winter.

Feather mosses influence the soil temperature in the boreal forest. Thus, it is important to include a **representation of feather mosses** in models used to make **GTR projections**, especially at higher latitudes.

Figure 4: *Pleurozium schreberi*, a feather moss species. Hermann Schachner, CC0 1.0.

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