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Bryophyte layer as a boundary between the atmosphere and soil: effects on energy, water, and carbon balances in boreal ecosystems

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In boreal and arctic ecosystems, mosses (bryophytes) forms ground cover that stretches from upland forests to peatlands being ubiquitous component of plant communities. The bryophyte cover in boreal landscape forms a biologically active boundary between the atmosphere and soil having an influence on the nutrient, carbon and water cycling as well as the energy balance at the ground surface.

The presence of moss cover on soil surface is known to significantly mediate soil moisture, reduce diurnal and annual temperature amplitudes and active layer depth. It is much less known how diversity of bryophyte species and communities affect coupled surface energy and water balances. It is widely accepted that when exposed to given environmental conditions, the variations in energy, water and carbon exchange rates among bryophytes are related their physical and structural properties.

With the modelling, it is possible to study biogeochemical feedbacks between canopy and soil between different environments. Water, energy and carbon balances in boreal ecosystems were studied by using a 1-dimensional multilayer, multispecies soil-vegetation-atmosphere transfer model APES (Atmosphere-Plant Exchange Simulator) with separate bryophyte layer. The model was applied in environmental gradients found in boreal landscape to study effect of bryophyte properties in different ecosystems.

In the study, the effect of two types of bryophytes on water and energy balances were investigated, feather and sphagnum mosses. The two groups grow on different light and moisture conditions having distinctive photosynthetic and water holding properties. In the study we identify the key functional traits of both groups that are important in different environments with same meteorological conditions.

Environmental gradients covered changes in canopy structure and soil characteristics (mineral and peat soils). Change in canopy structure (from open canopy to dense) have an effect on microclimate, especially on light conditions in both environments, forests and peatlands. Change in soil characteristics forms a hydrological gradient from well drained mineral soil to water logged peat soil.