How Does Moss Resist Evaporation? Towards Elucidating Site-Specific Influences on Sphagnum Moss Resistance

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Measuring Moss Resistance in Peatlands

- Measuring Evapotranspiration in peatlands is made difficult by the heterogenous vegetation cover (Figure 1), which contains both vascular and non-vascular species, including extensive moss carpets comprised of various Sphagnum species.

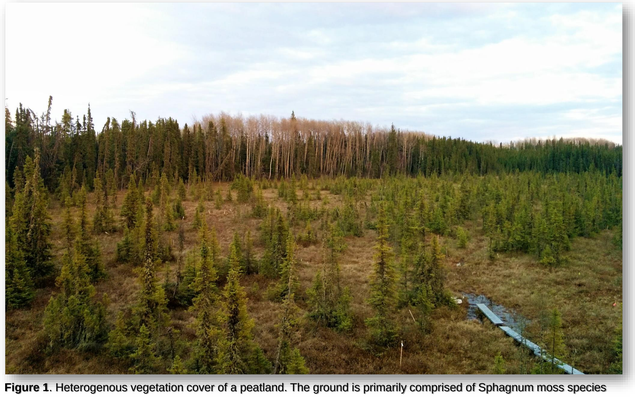

Figure 1. Heterogenous vegetation cover of a peatland. The ground is primarily comprised of Sphagnum moss species

- Estimating sphagnum moss evaporation necessitates the use of a surface resistance term for the non-vascular species
- Sphagnum moss resistance to evaporation initiates when the upward flux of water, as controlled by the unsaturated hydraulic conductivity (K_{unsat}) can no longer meet evaporative demand

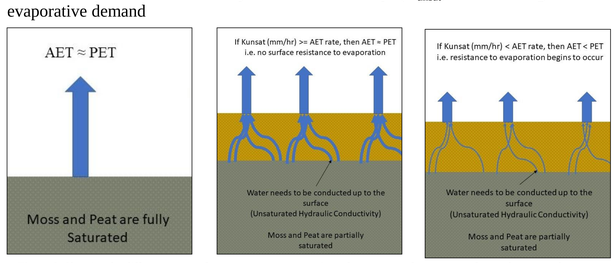

Figure 2. Showing the different stages of evaporation resistance. As soil moisture in the unsaturated zone decreases, the unsaturated hydraulic conductivity (K_{unsat}) decreases also, limiting the amount of moisture that can be conducted up the evaporating surface. This reduction is assumed to be the resistance.

- Approaches often use the inversion of an evaporation equation that contains a surface resistance term, such as the Dalton Equation
- There is a wide range in the literature for reported moss resistance values and so it is a difficult parameter to constrain when estimating moss evaporation
- In order to improve our estimates of peatland evapotranspiration and gain a better understanding of peatland feedbacks to drought, it is important to better understand Sphagnum moss resistance
- **Research Questions:** How does Sphagnum moss resistance vary with species and microform and ecohydrological conditions?

Study Location and Data Collected

- Sphagnum Moss evaporation data, measured using chamber measurements from 2 peatland sites in Alberta, Canada, were used to determine Sphagnum Moss resistance values (sec/m)

Site	Time	Sphagnum Species	Microform
Pauciflora (50 Km South of Fort McMurray Alberta)	June, July, (2013) May, June (2017) April, May (2018)	S. *angustifolium (n=19)* S. *magellanicum (n=5)*	Hummocks and Hollows
BD35 (70 Km North of Slave Lake)	June, July, August, September (2008) May, June, July, August (2009)	S. *fuscum (n=6)* S. *angustifolium (n=2)*	Hummocks and Hollows

Figure 3. Sphagnum species found in chambers including a) S.*fuscum* b) S.*angustifollium* c) S.*maggellanicum*

Moss Resistance Range, Grouped by Species, and by Microtopography

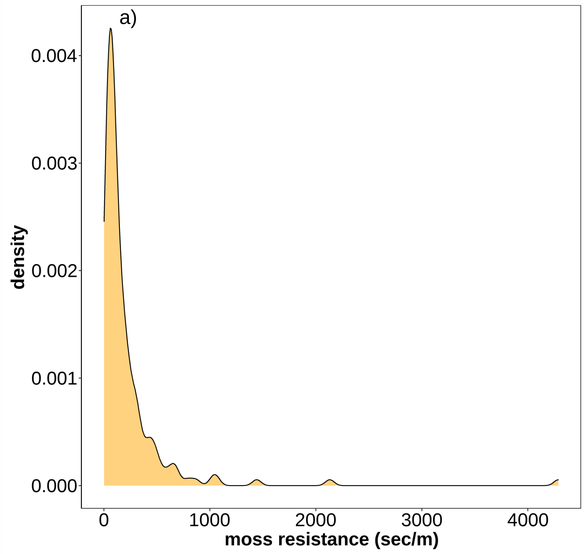

Figure 4. Density distribution of moss resistance (a) and grouped by species (b), and microtopography (c)

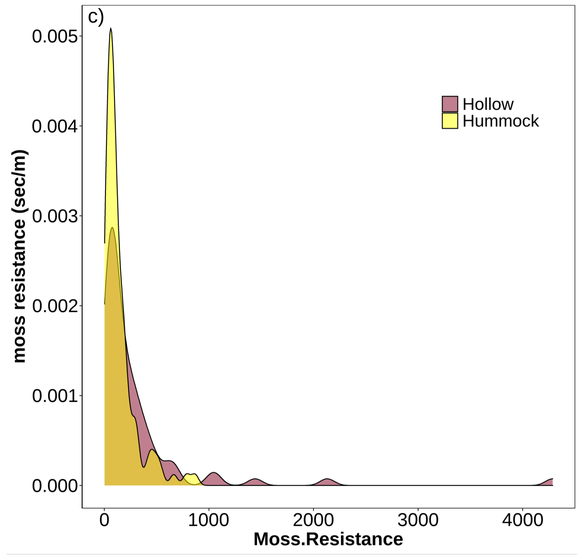

Table 1. The percentage overlap between distributions of moss resistance, grouped by species and then grouped by microtopography

angustifolium-magellanicum	angustifolium-fuscum	magellanicum-fuscum
74%	65%	53%
Hummock-Hollow		
78%		

- There is a high degree of overlap between the distributions, including both species and microtopography, however S. *fuscum* appears to have a lower overlap relative to the others
- There is a large amount of overlap between Hummock and Hollow

Potential Environmental Controls on Moss Resistance

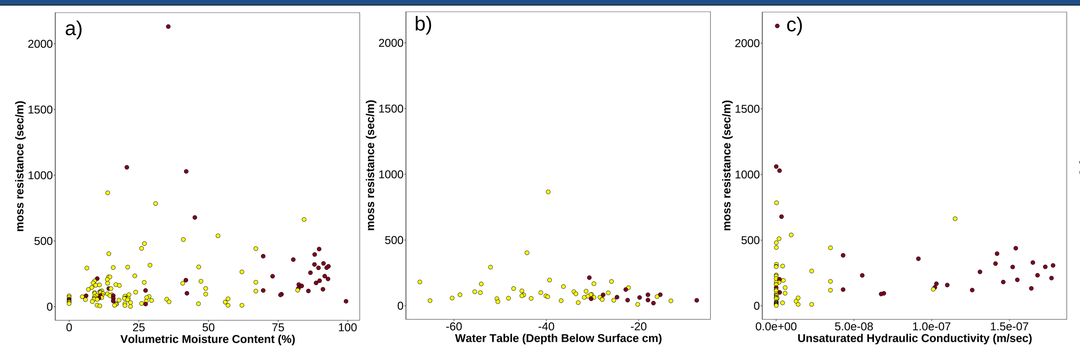

Figure 5. Potential relationships between environmental controls and moss resistance including a) VMC, b) Water Table, c) Kunsat. Colours indicate microtopography

- Does not appear to be strong trends between water table and moss resistance and VMC
- There does appear to be a sharp threshold response between K_{unsat} and moss resistance

Implications of Moss Resistance

- Resistance values for the moss appear to largely be less then 1000 sec/m
- S. fuscum appears to maintain lower resistance values relative to the other two species, which may be due to its tightly packed configuration, which would maintain K_{unsat} under drier conditions
- However generally, there is a lot of overlap between species and between the hummocks and hollows suggesting that for these sites, they may not be a primary control
- Next steps include adding more data from more hydrometric regimes and more site specific K_{unsat}
- More comparisons will be made with environmental controls such as SGI and soil tension
- Proper accounting for moss resistance will aid in improving peatland evapotranspiration estimates

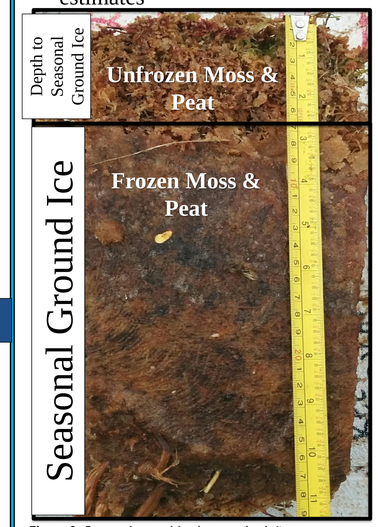

Figure 6. Seasonal ground ice in a peatland. Its presence can increase or decrease VMC at the surface, and could have a potential impact on moss resistance to evaporation

Acknowledgements

We wish to acknowledge that the data used in this study came from locations that took place on the traditional territories of the Cree, Metis and Denendeh peoples
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