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Influence of Plant Communities on Active Layer Depth in Boreal Forest

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Vegetation plays a crucial role in determining active layer depth (ALD) and hence the extent to which permafrost may thaw under climate change. Such influences are multifaceted and include, for example, promotion of shallow ALD by insulation from moss or shading by plant canopies in summer, or trapping of snow in evergreen tree canopies that reduces snow insulation of soil in winter. However, while the role of different vegetation components are understood at a conceptual level, quantitative understanding of the relative importance of different vegetation components and how they interact to determine active layer depth is lacking. In addition, major abiotic factors such as fire and soil hydrological properties will considerably influence the role of vegetation in mediating ALD, though again this is not well understood.

To address this we surveyed 60 plots across 4 sites of contrasting vegetation and fire status, encompassing a range of soil moisture and organic matter thickness, in the discontinuous permafrost zone near Yellowknife, NT, Canada. In each plot we measured ALD and a range of vegetation and soil parameters to understand how key characteristics of the understory and canopy vegetation, and soil properties influence ALD. Measurements included moss depth, tree canopy LAI, understory LAI, understory height, vegetation composition, soil organic matter depth, slope and soil moisture. By undertaking these surveys in sites with contrasting hydrological conditions in both burned and unburned areas we have also been able to determine which characteristics of the vegetation and soil are important for protecting permafrost, which characteristics emerge as the most important factors across sites (i.e. irrespective of site conditions) and which factors have site (ecosystem) specific influences. This work provides a major insight into how ecosystem properties influence ALD and therefore also how changes in ecosystems properties arising from climate change may influence ALD.