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The Influence of Snow, Water Bodies, and Permafrost Degradation on Shallow Soil Energy and Hydrology in the Arctic and Antarctic

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We have been monitoring shallow ground temperatures (along with soil moisture and soil tension in some cases) in active layers in the Arctic (tundra sites near Toolik Field Station, Alaska) to determine how permafrost degradation influences soil energy and hydrology dynamics, and in the Antarctic (McMurdo Dry Valleys) to determine how discontinuous snow patches and water bodies influence adjacent soil energy and hydrology dynamics. At our Arctic tundra sites, we find that deeply incised thermo-erosional features tend to collect more snow than the adjacent landscape, thereby enhancing over-winter insulation of the subsurface but also delaying summer warming. On an annual basis, however, the soils within these forms are warmer and taliks developed during the thermokarst processes may be preserved. In the Antarctic Dry Valleys, the presence of liquid water from snow patch melt or wicked from adjacent water bodies in otherwise very dry soils substantially modifies the thermal properties of the soils resulting in greater thaw depths, but lower average temperatures with lower variability, compared to dry soils. In both cases, the timing and magnitude of soil moisture is a critical determinant of the soil thermal regime.