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CONTROL ID: 1811897

TITLE: Feedbacks between tall shrubland development and active layer temperatures in northwest Siberian arctic tundra

ABSTRACT BODY: Permafrost soils are a globally significant carbon store, but changes in permafrost thermal regime observed in recent decades across much of the Arctic suggest that permafrost carbon balance is likely to change with continued climate warming. Critical to changes in permafrost carbon balance in a warmer world, however, are feedbacks between changes in the composition and density of surface vegetation, and the thermal state of permafrost. Shrub expansion has been widely observed in the northwest Siberian Low Arctic, but the magnitude and direction of shrub-induced impacts to permafrost temperature and stability remain poorly understood. Here we evaluate changes to active layer properties and thermal regime that occur during tall shrubland development (shrubs > 1.5 m height) within a northwest Siberian landscape dominated by well-developed, small-scale patterned ground features (e.g., non-sorted circles). We measured the annual time-series of soil temperature at 5 cm and 20 cm depth, and the structural attributes of vegetation at patterned-ground microsites across four stages of tall shrubland development: low-growing tundra lacking erect shrubs, newly-developed shrublands, mature shrublands, and paludified shrublands. Mean summer soil temperatures declined with increasing shrub cover and moss thickness, but winter soil temperatures increased with shrub development. Shrubland development strongly attenuated cryoturbation, promoting the establishment of complete vegetation cover and the development of a continuous organic mat. Increased vegetation cover, in turn, led to further reduced cryoturbation and an aggrading permafrost table. These observations indicate that tall shrub expansion that is now occurring in patterned-ground landscapes of the northwest Siberian Arctic may buffer permafrost from atmospheric warming, and increase carbon storage in these systems at least in the short term.

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INDEX TERMS: 0718 CRYOSPHERE Tundra, 0706 CRYOSPHERE Active layer, 0702 CRYOSPHERE Permafrost, 0476 BIOGEOSCIENCES Plant ecology.

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