Heterogeneous long-term changes in taiga and shrubland cover in the Kolyma lowland are not captured by coarser-scale greening trends

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Abstract

Changes in shrub and tree cover concurrent with rising air temperatures are a widespread phenomenon in Arctic-Boreal ecosystems. The expansion of tall shrubs and trees can alter ground thermal regimes and soil moisture impacting permafrost and biogeochemical cycling. Changes in shrub and tree cover can be difficult to characterize with limited *in-situ* observations and moderate/coarse resolution satellite imagery, thereby posing challenges in disentangling changes in vegetation growth from shifts in vegetation composition. We pair high resolution historical (KeyHole9, 1971) and current satellite imagery (World View 3, 2020) with a Convolutional Neural Network approach to predict taiga, shrubland, and surface water cover within a region of the Kolyma lowland (171 km^2) in eastern Siberia. We found an overall net increase in shrubland cover of 14 km^2 and little net change in taiga cover, but changes in both landcover classes were highly heterogenous across the landscape. Increases in shrubland cover were highest in proximity to surface water (<100m) and in close proximity to areas with stable shrubland cover. We found that changes in shrubland cover did not correlate with greening trends derived from moderate resolution spectral indices, and changes in vegetation along bodies of water may be more difficult to capture due to the heterogeneity within moderate resolution pixels. Our findings highlight that ongoing vegetative land cover change in Siberian lowlands is highly heterogeneous and the need for a better quantification of the drivers and consequences of landscape change in these carbon- and ice- rich permafrost ecosystems.

Keywords vegetative change, land cover, Convolutional Neural Network, Arctic, Boreal