



Environmental conditions for alternative tree cover states in high latitudes

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Previous analysis of the vegetation cover from remote sensing revealed the existence of three alternative modes in the frequency distribution of boreal tree cover: a sparsely vegetated treeless state, a savanna-like state, and a forest state. Identifying which are the regions subject to multimodality, and assessing which are the main factors underlying their existence, is important to project future change of natural vegetation cover and its effect on climate.

We study the impact on the forest cover fraction distribution of seven globally-observed environmental factors: mean annual rainfall, mean minimum temperature, growing degree days above 0, permafrost distribution, soil moisture, wildfire occurrence frequency, and thawing depth. Through the use of generalised additive models, regression trees, and conditional histograms, we find that the main factors determining the forest distribution in high latitudes are: permafrost distribution, mean annual rainfall, mean minimum temperature, soil moisture, and wildfire frequency. Additionally, we find differences between regions within the boreal area, such as Eurasia, Eastern North America, and Western North America. Furthermore, using a classification based on these factors, we show the existence and location of alternative tree cover states under the same climate conditions in the boreal region. These are areas of potential interest for a more detailed analysis of land-atmosphere interactions.