

Land use and cover change in Northeast China and its impacts on the Xing'an permafrost in 1980-2020

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Abstract

Vegetation plays important roles in the development and protection of permafrost; it is one of the main local and ecosystemic factors that affect the thermal stability of the underlying soil strata. Multi-period land use and cover change (LUCC) data and long-time series of air temperature were chosen. Based on these data, spatiotemporal changes in mean annual air temperature (MAAT) were simulated by the Ordinary Least Squares (OLS) method and Ordinary Kriging (OK) model in the 1980s-2010s in Northeast China. The influences of LUCC on MAAT in Northeast China and distribution of the Xing'an permafrost were analyzed and the results showed that: (1) Decadal average of MAAT increased from 4.60°C (1980s) to 5.38°C (2010s) in Northeast China, with an upward trend of 0.25°C/10a. (2) During the 1980s to 2010s, the total permafrost area showed a decreasing trend ($-3.668 \times 10^4 \text{ km}^2/10\text{a}$). (3) In permafrost regions, LUCC had undergone significant structural changes: forested land showed a consistent decreasing trend and other lands showed an overall increasing trend. (4) The effects of different LUCC on MAAT in the permafrost region varied substantially. The mean MAAT of forested land was the lowest (-2.33°C), and; that of unused land, the highest (0.37°C). The change rate in MAAT of cultivated land was the highest (0.37°C/10a), and; that of unused land, the lowest (0.28°C/10a). (5) The degradation rates of permafrost in forested land ($-1.822 \times 10^4 \text{ km}^2/10\text{a}$) and grassland ($-1.397 \times 10^4 \text{ km}^2/10\text{a}$) were the largest from 1980s to 2010s.

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