

The Process of Active Layer Development in Alas Grassland and Taiga Forest in Eastern Siberia

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Introduction

In Eastern Siberia, there are patch scale grasslands called Alas. The Alas occupies 30% of the area especially near the Yaktsuk city and right bank of Lena river. Alas was created as a result of forest cutting and subsequent increase of incoming energy from sun to the permafrost. To understand the process of active layer development, the energy movement in vegetation, land-surface, soil environment must be investigated. Therefore we observed energy distribution within the two types of land i.e., grassland and forest. The purpose of this study is the estimation of the energy flow for the development of the active layer, and evaluation the effect of vegetation/land surface/soil system to the active layer.

Methods

Three observation sites were established in taiga forest, northern and southern part of Alas. There is a pond in the center of the Alas, and vegetation form concentric circle from the pond toward the outer edge of the Alas. Topography, soil temperature and moisture, LAI (Leaf Area Index) and soil physical properties (hardness, bulk density, porosity, solid ratio, soil heat capacity and heat conductivity) were observed from early spring through summer. At the forest canopy and the center of the Alas, net radiation and air temperature were also observed.

Results

The thickness of active layer was determined from daily soil temperature profile, and was found to be thicker in at the northern part of Alas and thinner at forest floor and southern part of the Alas. The difference of net radiation at each vegetation canopy has no relation the difference of active layer thickness. There are marked difference of LAI among three sites, and as a result, net radiation penetrating to the soil surfaces and the energy transferring efficiency from soil surface to the air were also different. The soil heat conductivity at the southern part of the Alas is smaller than that at forest floor and northern part of the Alas. The soil ice content was also found very different between the Alas and the forest. The soil water content and porosity which determine the soil heat properties were lower at the southern part of the Alas and higher at northern part of the Alas. Among these differences, LAI and soil moisture appear to be the major factor that determine the active layer thickness. LAI difference is also controlled by soil moisture, however. Energy regime difference to develop the active layer is caused by 3-dimensional distribution of soil water content in the Alas and forest floor.