INFLUENCE OF ATMOSPHERIC PRECIPITATION ON LONG-PERIOD TEMPERATURE DYNAMICS OF UPPER PERMAFROST (CENTRAL YAKUTIA, AREA OF GAME STATION)

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Abstract

Measurements data show that for the last 20 years there were no direct long-period (10 years and more) changes temperature of permafrost in Central Yakutia despite air temperature increase. It happened due to decrease of snow cover thickness that in turn is due to decrease of solid precipitation amount at the beginning of winter. Moreover, at the last 20 years there is also a tendency of summer precipitation decrease that led to prevalence of the periods with low amount of pre-winter soil moisture content. These factors redressed the air temperature increase influence at the permafrost that is why their temperature at the long-term period did not change considerably.

Keyword: temperature, permafrost, atmospheric precipitation, snow cover, soil moisture content

Interannual temperature dynamics of upper permafrost of taiga landscapes was observed in 1996-2003 at the area of GAME station in Central Yakutia. In this period considerable interannual jumps of atmospheric precipitation amount were noted, both for the year and seasonal total amounts. It caused the sizeable interannual change of pre-winter soil moisture content (in 2-3 times) and of snow cover depth (in 2-4 times).

It was found out that increase of pre-winter soil moisture content (average value of gravimetric moisture for the whole section of the active layer) by 10% led to prolongation of freezing period in average by 30-40 days for silt soils and by 20-30 days for sandy soils. Prolongation of freezing period of the active layer by month leads to increase of average annual soil temperature and upper permafrost in average by 0.8^0C for sands and by 1^0C for silt-loams.

For the period of 1996-2003 changes in average annual temperature of upper permafrost at natural landscapes were 1,2-1,8^0C (fig. 1). The biggest interannual changes of average annual soil temperature (to 3,2^0C) were noted at the areas of larch forests cuttings, which create proper conditions for the most considerable interannual variations of the active layer moisture content.

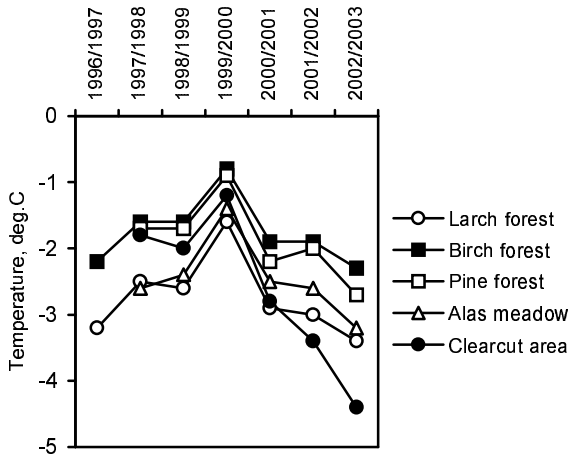

Fig. 1. Short-term interannual variation in the mean annual permafrost temperature (depth 3.2 m) in taiga landscapes of Spasskaya Pad area.
Note: the annual period: 1 October - 30 September.

Short periods (not longer then 3 years) of temperature increase in upper permafrost take turns with the same periods of its decrease according to short-period nature of interannual changes of soil soil moisture content and snow cover thickness in 1996-

2003.

It is known that the evidence of long-period temperature changes of permafrost is the change of their temperature at the lower boundary of the heat turnovers layer, which is 15-18 m in Yakutsk region. Measurements data at these depths show that for the last 20 years there were no direct long-period (10 years and more) changes of average annual temperature of permafrost (fig. 2) in given region despite air temperature increase (fig. 3). It happened due to decrease of snow-cover thickness that in turn is due to decrease of solid precipitation amount at the beginning of winter (fig. 4). Moreover, at the last 20 years there is also a tendency of summer precipitation decrease (fig. 5) that led to prevalence of the periods with low amount of pre-winter soil moisture

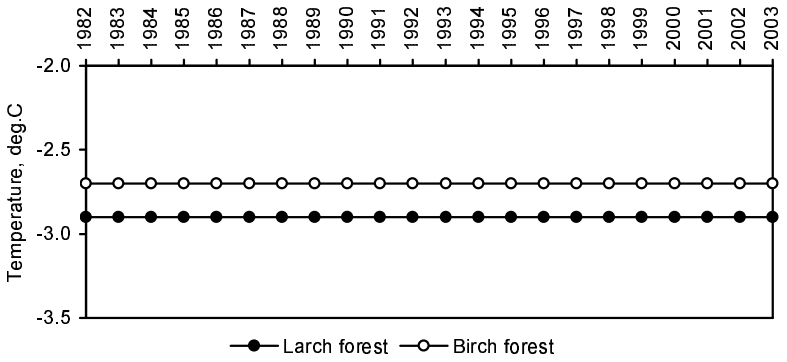

Fig. 2. Permafrost temperature at the depth 20 m, 1982-2003 yy. (experimental site "Umaybyt").

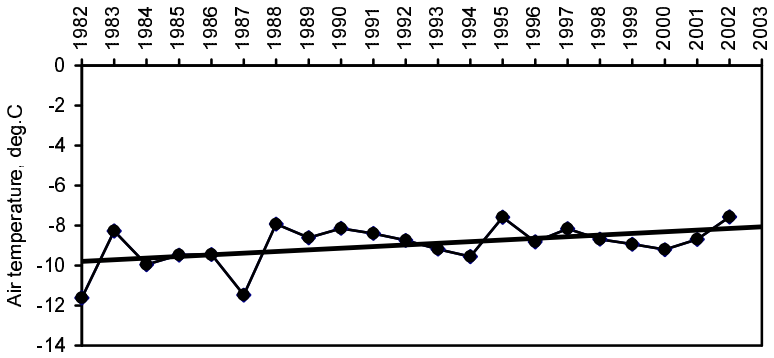

Fig. 3. Mean annual air temperature (Yakutsk weather station, 1982-2002), ^{0}C.

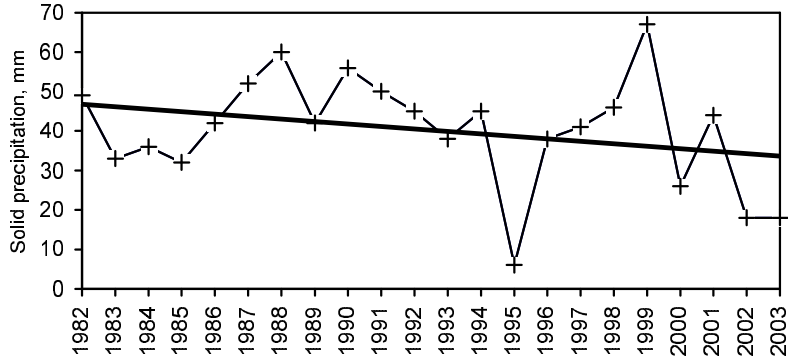

Fig. 4. The amount of solid precipitation at the beginning of winter (October-December) 1982-2003 yy. (Yakutsk weather station).

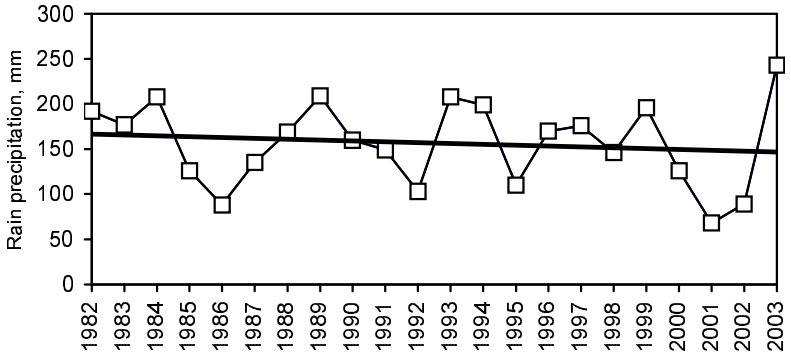

Fig. 5. The amount of precipitation at the warm season (May-September), 1982-2003 yy.(Yakutsk weather station).

content. These factors redressed the air temperature increase influence at the permafrost that is why their temperature at the long-term period did not change considerably.

Thus the achieved results show that stable or unstable thermal conditions of permafrost of Central Yakutia depend considerably in future on long-period dynamics of atmospheric precipitation.