

Influence of increased rainfall on the hydrological and thermal conditions of the active layer in a larch forest, Yakutsk

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We studied the influence of a simulated drastic rainfall increase on the thermal and hydrological conditions of the active layer in a larch forest in Yakutsk, eastern Siberia, from 2003 to 2006. We conclude that irrigation of a boreal forest ecosystem underlain by permafrost effectively heats the ground and leads to increased maximum thaw depth, unless the active layer is near-saturated. After 3 years of irrigation (350 mm in total; the total summertime precipitation was about 550 mm) during the thawing seasons, the maximum thaw depth at the irrigated plot was about 13% deeper than that at the control plot. Most of this increase in maximum thaw depth occurred in the first year of irrigation, during unsaturated conditions. The influence of irrigation in the second and third years was obscured by extremely wet weather conditions during the late stages of the 2005 and 2006 thawing seasons. Our analysis of the hydrological and thermal regime in the active layer revealed the importance of the timing of water input for boreal forests underlain by permafrost. Soil water content at close to saturation levels caused runoff of input water, thereby preventing the infiltrating of rainwater and associated heating of the ground. In the short term, irrigation extended the zero curtain period during early winter and hindered progress of the thawing front in the upper active layer during the following thawing season. These findings suggest that recent climate change might have a significant influence on the thawing and freezing regimes of the active layer.