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Recent permafrost eco-hydrological changes in eastern Siberia

Yoshihiro Iijima[†]; Hotaek Park; Tetsuo Ohata
[†] Japan Agency for Marine-Earth Science and Technology, Japan
Leading author: yiijima@jamstec.go.jp

In the last decade, unusual increases in soil temperature and thaw depth (active layer thickness) have been taking place in eastern Siberia where is the center of the continuous permafrost region in the Eurasian Continent. The peculiar feature of the warming is that the soil moisture correspondingly increases within the active layer observed at many sites in the central Lena river basin. This hydro-thermal change is primarily due to wetting climate conditions rather than atmospheric warming with abnormally large amounts of winter snow accumulation and summer precipitation in the central and southern part of the Lena River basin. The wet conditions in Eastern Siberia are likely due to enhancement of cyclonic anomaly over the Arctic Ocean and eastward propagation of storm activities in summer and early winter. Water vapor flux from Pacific side was enhanced in conjunction with the manifested precipitation over the eastern Siberia. As results, consecutive positive anomalies of winter snow accumulation and next summer precipitation which had seldom occurred in the second half of the last century effectively humidified land surface on the permafrost region after 2005 resulting abrupt soil warming in active layer and upper part of permafrost. Deepening of active layer in accordance with over-saturated soil moisture under the wetting climate activates thermokarst subsidence in and around alas lakes and correspondingly causes fatal damage to the growth of boreal (larch) forest in this region. The extent of alas lakes have been markedly expanded during the last five years estimated by satellite data. The circumference of the water filled lake is to flood and erode the thermokarst slopes and the forest surrounding the lake is exposed to waterlogged soil. According to the year-to-year sap flow measurements, transpiration from the forest significantly reduced because the most of the trees standing in the concaved micro-topography have been withered and dead after the long waterlogged conditions. These facts indicate that the wetting climate in permafrost region in relation to arctic climate change may lead to unexpected ecohydrological responses corresponding with the permafrost degradation in eastern Siberia.