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Biosphere-climate interaction over Eurasia through water cycle

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In this paper, we discuss one typical example of the biosphere-climate interaction via water cycle in the northern Eurasia. Taiga in the boreal zone plays important and sensitive roles in global and regional water?energy?carbon (WEC) cycles and in the climate system. Recent in situ observations suggested that Siberia taiga is strongly coupled with its permafrost through the seasonal and interannual variations of WEC processes. In other words, the taiga (represented by larch trees) and the permafrost may behave as a coupled eco-climate system across a broad boreal zone of Siberia.

The model demonstrates that under the present climate condition in eastern Siberia, larch trees help control the seasonal melting of permafrost, which in turn provides sufficient water to the larch trees. Without permafrost processes, larch may not survive and may be replaced by a dominance of pine and other species that tolerate drier hydroclimatic conditions. Climate warming sensitivity experiments show that this symbiotic system cannot be maintained under warming of about 2 degree or more. Under this condition, sub-boreal forests are dominated, decoupled from the permafrost processes. Our results thus suggests that future global warming could drastically alter the taiga?permafrost coupled system, with associated changes of WEC processes and feedback to climate.

In addition, interannual variability of summer precipitation in the east Siberia depends partly on evapotranspiration from the Taiga forest, combined with water vapor transport from the Arctic Sea.

The results discussed here are based on Zhang, Yasunari and Ohta(Env.Res. Lett.,2011).and Watanabe (2012 Master thesis, Nagoya Univ.).

Keywords: biosphere-climate interaction, water cycle, Eurasian continent