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Growth of trees on permafrost: habitat driven response to climate

Marina Bryukhanova (1), Patrick Fonti (2), Alexander Kirdyanov (1), Matthias Saurer (3), Rolf Siegwolf (3), Natalia Pochebit (4), Olga Sidorova (3,1), and Anatoly Prokushkin (1)

(1) V.N. Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia (bryukhanova@ksc.krasn.ru), (2) Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland, (3) Paul Scherrer Institute, Villigen, Switzerland, (4) Siberian Federal University, Krasnoyarsk, Russia

Global change is expected to alter boreal forest conditions with far reaching consequences for tree growth in these ecosystems. Within this study we aimed at determining which limiting factors control tree-growth on permafrost under different site conditions.

A tree-ring multi-proxy characterisation of mature Larix gmelinii (Rupr.) Rupr. from a continuous permafrost zone of Siberia (Russia, 64°18' N, 100°11' E) was used to identify the physiological principle of responses related to the plant-soil system. Tree-ring width (1975-2009), carbon and oxygen stable isotopes, and xylem structural characteristics (2000-2009) indicated that an increased depth of the soil active layer favors a better exploitation of the available resources.

Our study used a mechanistic description of expected soil thermo-hydrological changes associated with a detailed comparison of tree growth responses, and supplied possible scenarios of northern larch stands development under projected climate change and permafrost degradation. By using a "space for time" approach along a 100 m long transect characterized by distinct permafrost regimes combined with measurements of physiological and structural tree responses, it become possible to propose a mechanism responsible for the differing climatic-growth responses. The results obtained indicate global warming to promote large increases in tree productivity of permafrost larch stands with a shift from a cold to a water limited environment.

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