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Role of understory vegetation in decadal variation of water and carbon dioxide exchange over larch forest of eastern Siberia

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This study investigated evapotranspiration and carbon dioxide exchange by the eddy covariance methods over larch-dominated forests in the middle part of the Lena basin, eastern Siberia. Forest ecosystem in this region is characterized by low precipitation, a short growing season, and extensive permafrost. Seasonal thawing permafrost supplies soil water, which is prevented to infiltrating by an impermeable frozen layer, and supports forest development. A decadal observation of hydro-meteorological variables shows inter-annual variability including extreme environmental conditions such as unusually wet active layer, which was maintained for a few years. Some mature larch trees locating poor drainage area suffered wet damage, while young birch and willow trees developed and herbs with water tolerance expanded. Compared to fluxes of the whole ecosystem, those based on the understory layer changed through the study period due to increase biomass and change of inside canopy environments; plentiful light and soil water, and enhanced turbulent mixing. Evapotranspiration from the understory layer increased and contribution to the whole forest flux reached 60%. Although this layer always acts as carbon dioxide source in seasonal average through the study period, source strength weaken and changed to temporal sink in the early summer. On contrast, contribution of the larch layer, in spite of remaining uncertainty in quantity, decreased in both of evapotranspiration and carbon dioxide uptake. Interactions between larch and understory support maintenance of this forest ecosystem. Decline of larch contribution is made up by understory growing, resulting in relatively stable whole forest exchange rate at least until this wet event.