Interactions between topography, permafrost, and vegetation in Siberian larch forest: a simulation study

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In eastern Siberia, larches (Larix spp.) often exist in pure stands, constructing the world's largest coniferous forest, of which changes can significantly affect the earth's albedo and the global carbon balance. Siberian larch area locates on the environmental edge of existence of forest ecosystem, and hence small difference in environmental condition alters existence of larch trees.

Indeed, there is a quantitative pattern that topographic properties controls the abundance of larch forest via both drought and flooding stresses in this region; larch abundance appears to be controlled by drought stress in mountainous regions, while controlled by flooding stresses in plain areas (Sato& Kobayashi 2018). Besides, this region is underlaid by permafrost, vegetation productivity is constraint by depth of active layer; plant productivity becomes lower for shallower active layer by reducing liquid-state-water holding capacity (Beers et al. 2007). At the same time, active layer depth is a function of soil wetness, because wetland soil has larger ice content in active layer, which facilitates downward heat conduction to the permafrost, resulting in shallow thaw for the active layers (Woo & Xia 1996).

To reconstruct such complicated interactions between topography, permafrost, and vegetation in Siberian larch forest, the TOPMODEL, which is a physically based streamflow and water-table-depth computation scheme was implemented to a dynamic vegetation model SEIB-DGVM (Sato et al. 2016), which works with a thermohydrology model. In this presentation, I will talk how this integrated model reasonably works, and how it can be employed for future projection of environmental conditions of the Siberian larch region.

Citations

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