Evapotarsnpiration and its driving force in an eastern Siberian larch forets

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To clarify the features of interannual variation (IAV) on evapotranspiration and water balance in eastern Siberian taiga, water and energy fluxes were measured at two sites (larch and pine forests) in the Yakutsk area of eastern Siberia. Plus, the components of evapotranspiration and driving force are examined in this research.

More than 70% of the annual precipitation evaporated between May and September. Annual evapotranspiration, including interception loss, was relatively steady at 169-220 mm compared with the wide range in annual precipitation (111-347 mm year^{-1}). The evapotranspiration rate was 1.49-2.30 mm day^{-1}. This feature is one of the remarkable characteristics of the water balance in eastern Siberian forests where permafrost exists, as mentioned above. The thaw depth of the permafrost quickly deepened after 2004 such that the maximal thaw depth varied from 127 to over 200 cm during the study years. At the same time, the moisture content of the surface soil increased greatly. Inflow of meltwater produced by thawing at deeper layers may have contributed to the increase, which could not be explained by annual precipitation alone. Evapotranspiration showed only slight IAV, but yearly evapotranspiration ratio (A) ranged from 0.3 to 0.45. Among factors determining A, soil moisture content was the most important. This result differs somewhat from previous satellite-based findings pointing to air temperature as a major variable for plant activity. One explanation for this difference is that the IAV of the soil water content did not correspond to the IAV of the precipitation amount because of the presence of permafrost. In contrast, the soil water content was strongly affected by the precipitation of the previous summer.

The ratio of evapotranspiration from understory vegetation (Eu) to evapotranspiration from whole ecosystem (Eo) during the growing season was 55% (2005) and 57% (2006), and the contribution of Eu was large. The aerodynamic term occupied about 80% of Eo and 70% of Eu; VPD is a primal driving energy for Eo and Eu in this site. There were relatively large year-to-year differences in 10-days accumulated E for both whole ecosystem and understory vegetation. The year-to-year difference in E had negative relationship with that in the decoupling factor (Omg); this relationship means that increase in Omg, indicating larger contribution of Eeq to E, leads decrease in E. Year-to-year difference in E had no correlation with that in equilibrium evaporation (Eeq), but had clear positive relationship with that in imposed evaporation (Eimp). These results support that VPD is more important energy to control E than Rn. In this site, Ga is significantly larger than Gs because of very sparse forest canopy of larch, and therefore Omg is small. This small Omg may be one of reasons to explain that the primal energy to control E is VPD rather than Rn. On the other hand, soil water conditions of 2005 and 2006 were rich. Since Gs can vary largely depending on the soil water condition, similar analysis will be needed for dry years to obtain more general conclusion.