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Contribution of transpiration of taiga forest for atmospheric water vapor at Eastern Siberia

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Eastern Siberia locates under continental severe arid climate with annual precipitation amount of less than 300mm and occupies 1/4 of surface forest. Since it is reported that evapotranspiration exceeds precipitation occasionally and 2/3 of annual precipitation is observed during summer period, recycled water from vast taiga forest is essential for maintaining of taiga. Moreover, taiga forest is also important for carbon and nitrogen cycle due to its large area and it is necessary to understand current water cycle system formed in taiga to consider the effects on taiga forest under the progress of global warming in the future. Thus the contribution of water supply from taiga forest was focused on in this research as the main purpose and water samples such as atmospheric water vapor, precipitation, soil water, and sap water were collected for isotopic analysis in taiga forest neat Yakutsk city in Eastern Siberia from latter July to early August of 200 6, 2007 and 2008. The contribution of water supply from taiga forest was estimated from isotopic variation of those samples and other meteorological data.
Isotopic composition of atmospheric water vapor (delta-^{18}O) ranged from -30 to -18 permil and d-excess (= delta-D -8*delta-^{18}O) ranged from 3 to 24 permil through observation periods of 3 years. In 2006 and 2008, positive correlation was found between atmospheric water vapor delta-^{18}O and mixing ratio (R^2= 0.93 and 0.94, respectively) and negative correlation was found between atmospheric water vapor d-excess and mixing ratio (R^2= 0.96 and 0.86, respectively). This result indicates that atmospheric water vapor in taiga forest consists of two water sources: transpired water vapor with high delta value and water vapor with low delta value generated through precipitation event. In 2007, however, those correlations were not found. The soil water content was higher in 2007 than in 2006 and 2008, and it seemed that it induced the constraint of transpiration of plants.
Moreover, the delta-^{18}O values of transpired water vapor and water vapor generated through precipitation events were assumed to be -16 permil and -32 permil, respectively, according to the relationship obtained from isotopic data of 2006 and 2008. The contribution of transpired water vapor in 2006 and 2008 was calculated with those values and resulted in that transpired water vapor occupied 80% of atmospheric water vapor in maximum. In addition to the results, it was also assumed that the relationship obtained from isotopic data could be extended to the time scale of latter summer period (July and August). The contribution of transpired water vapor in that time scale was also calculated and resulted in that transpired water vapor occupied more than 50% of atmospheric water vapor during more than half of the period. The variation was similar to that of temperature and relative humidity, which indicated that contribution of transpired water vapor increased as the transpiration was activated with increase of temperature.
Those results reveal that transpired water vapor of taiga forest plays role as the origin of atmospheric water vapor and existence of taiga forest is important for the water cycle system in ecosystem.

Keywords: isotopic composition of water, Eastern Siberia taiga forest, atmospheric water vapor, transpiration