Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW07-P01 Room:Poster Time:April 29 18:15-19:30

Evaluation of transpiration in a mature stand of Japanese cedar in Kanto region, Japan

IIDA, Shin'ichi[1*] ; SHIMIZU, Takanori[1] ; TAMAI, Koji[1]

[1]Department of Soil and Water Conservation, Forestry and Forest Products Research Institute

Forests cover about 70% of land area of Japan, and Japanese cedar (*Cryptomeria japonica*) occupies about 20% of total forested area. To understand the hydrologic cycle in Japan, we need measurements conducted in forested area, especially for the most representative species of Japanese cedar. Recently, the water balance of a stand of Japanese cedar has been made clear quantitatively by using eddy-covariance method and sap flow technique in Kyushu Island, south-western part of Japan (Kumagai et al., 2014; Shimizu et al., submitted). However, although Japanese cedar is most representative species in Japan, very few studies have been carried out in other part of the country. Based on the sap flow technique, we started to evaluate the amount of transpiration of a stand of Japanese cedar located in Kanto region, in the central part of Japan. In this paper, we show the relationship between outermost sap flow (Q_{0-20}) and single-tree transpiration (Q), tree-size parameter affecting Q, and correlation between stand transpiration (TR) and meteorological factors.

We conducted measurements in a mature stand of Japanese cedar, whose age is 61, within Tsukuba Experimental Watershed located in southern part of Mt. Tsukuba, Japan. Tree density is 1115 trees/ha, and annual mean leaf area index measured with LAI-2000 (LI-COR, USA) is 3.6. We set an observation plot in a Japanese cedar stand, and measured sap flux densities for all trees of the plot, 13 trees, with Granier method (Granier, 1985). Based on the wood core sampling with an increment borer, we determined the width of sapwood for 13 trees. Japanese cedar has white zone, in which water movement stops, in the sapwood area. We injected acid fuchsin into stem, and distinguished colored area as sapwood. The length of Granier sensor was 20 mm: in case that the width of sapwood was more than 20 mm, additional sensors were inserted into the sapwood at the depths from 20 to 40 mm and 40 to 60 mm. The sap flow at each depth is calculated as the product between the sapwood area corresponding to the depth and measured sap flux density. Q is finally obtained as total sum of sap flow of all depths. We calculated TR as the sum of Q of 13 trees divided by the area of the plot. On the meteorological tower, air temperature, humidity and net radiation were measured. Analyses are performed in the period from August to November, 2013.

The value of $Q/(Q_{0-20})$ had positive linear relationship with canopy projection area unshaded by other trees (CPA_{TH}). This trend implied that the contribution of Q_{0-20} to Q is small for trees having good light condition. Q had positive linear correlation with diameter at breast height (R^2=0.62), however, the higher correlation (R^2=0.70) was found between Q and CPA_{TH}. In this stand, CPA_{TH} is probably important factor affecting distribution of sap flow within the stem and tree-to-tree difference in Q. On the other hand, through the analysis period, TR had high positive correlation with equilibrium evaporation (R^2=0.83), but had lower correlation (R^2=0.39) with vapor pressure deficit (D). Focused on the summer period from August to September, we found higher correlation between TR and D (R^2=0.74). Thus, in summer, the driving energy of transpiration is mainly D due to the large aerodynamic conductance at the stand. However, the correlation between TR and D became small in the autumn. This stand is located in the north-facing slope, and has very high contrast in meteorological condition between summer and autumn. The different relationship between TR and D probably implies that plant physiological response of Japanese cedar in summer is different from that in autumn.

Cited paper
Granier 1985. Ann. Sci. For. 42: 193-200.
Kumagai et al. 2014. J. Hydrol. 508: 66-76.
Shimizu et al. Submitted for publication.

Keywords: Japanese cedar, sap flow, transpiration, tree-size parameter, vapor pressure deficit