Artificial sap flow measured by heat field deformation and heat ratio methods in the laboratory

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Recently, newly developed sap flow techniques, that is heat ratio method (HR, Burgess et al., 2001) and heat field deformation method (HFD, Nadezhdina et al., 2012), have been available in Japan. However thermal dissipation method (TD, Granier, 1985) has been widely used in Japan (e.g., Kumagai et al., 2014), and there are quite a few numbers of studies measuring sap flow of trees in a forest by HFD and HR. Iida et al. (2015; 2016) applied TD, HR and HFD for a mature tree of Japanese cedar (*Cryptomeria japonica*) during a year, and confirmed their availability to detect diurnal changes in sap flow. This preliminary measurement was carried out in the Japanese cedar stand located in Mt. Tsukuba: the condition of comparisons cannot be controlled. Shinohara et al. (2016) has established the equipment to generate the stable water flow with the variable intensities within a stem by using a vacuum pump, and compared TD measurements with the artificial flow. Our primal objective is, by using the equipment in the laboratory (Shinohara et al., 2016), to compare the HR and HFD measurements with controlled sap flow.

We sampled four stems from four Japanese cedars planted in the nursery of Forestry and Forest Products Research Institute, Japan. Their ages are 12 years, tree height was from 9.0 to 10.0 m and diameter at breast height was from 10.9 to 12.5 cm. The width of active sapwood was about 3 to 4 cm. We used sensors of HR and HFD manufactured by ICT international Pty Ltd (type SFM1 and HFD8, respectively) and another HR measurement system developed by Kominami et al. (2016). Outputs of HR and HFD showed clear correlations with the vacuum pressure, indicating the basic availability of these methods to measure activities of sap flow for Japanese cedar as suggested by Iida et al. (2015; 2016). At the presentation, we will show the radial and azimuthal variations in sap flow generated by the equipment (Shinohara et al., 2016) and will analyze the effect of some corrections related to calculations of heat pulse velocity for HR. We will also provide the results of comparisons between the artificial sap flux density and that calculated by the equation proposed for HFD (Nadezhdina et al., 2012).

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