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Spatial and temporal variations in sap flux density in Japanese cedar (*Cryptomeria japonica*) trees, central Taiwan

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Sap flow measurement method is a technique widely used for measuring forest transpiration. However, variations in sap flow distribution can make accurately estimating individual tree-scale transpiration difficult. Significant spatial variations in sap flow across the sapwood within tree have been reported in many studies. In contrast, few studies have discussed azimuthal variations in sap flow, and even fewer have examined their seasonal change characteristics. This study was undertaken to clarify within-tree special and temporal variations in sap flow, and to propose an appropriate design for individual-tree scale transpiration estimates for Japanese cedar trees. The measurement was conducted in a Japanese cedar plantation located in Central Taiwan. Spatial distribution of sap flux density through the sapwood cross-section was measured using Granier's thermal dissipation technique. Sensors were installed at 1.3 m high on the east, west, north and south sides of the stem at 0–2 cm in 8 trees, and at 2–4 cm in the 6 larger trees.

We found, in radial profile analysis, that sap flux densities measured at the depth of 2–4 cm were 50 % in average of those measured at depth of 0–2 cm. In azimuthal profile analysis, we found significant azimuthal variations in sap flux density. In one individual tree, the ratio of sap flux density on one aspect to another could be approximately 40–190 %, with no dependency on directions. Both radial and azimuthal profiles in most sample trees were fairly consistent throughout the measurement period. We concluded that radial and azimuthal variations in sap flow across sapwood might introduce significant errors in individual tree-scale transpiration estimations based on single point sap flow measurement, and seasonal change of within-tree spatial variations in sap flow could have insignificant impacts on accuracy of long-term individual tree-scale transpiration estimates.

Keywords: transpiration, sap flow measurement, scaling up, sap flow within tree variability