ID: H51B-0766 Transpirational water use and its regulation in the mountainous terrain of S. Korea

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Introduction

Mountains are crucial as water towers and better understanding of their hydrology and ecology is critical for sustainable management. Quantifying water use by forests on complex mountainous terrain is however, difficult and understanding of controls on water use a challenge. There is a growing need for new research approaches designed with attention to the particular needs and constraints of large-scale studies and that have the potential to generate reliable and accurate data. Sapflow-measurement techniques provide an opportunity to monitor water use by the understory and canopy forest trees at micro-scale, allowing for accurate estimation of total forest water use. The obtained data, in conjunction with intensively measured climatic variables, allow for better understanding and interpretation of transpiration results. A research initiative under the International Training Group: Complex Terrain and Ecological Heterogeneity (TERRECO) seeks to address pertinent issues related to forest water use and production in complex terrain.

- Establish appropriate approaches to accurately estimate whole tree water use in complex terrain.
- Determine stand water use in mixed forests through simple approaches.
- Establish factors that influence whole tree water use in such complex terrenes.

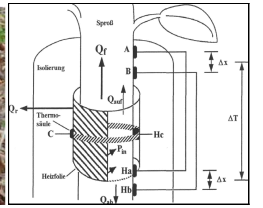
Site Description

Sites	Gyebangsan	Guangneung
Latitude	38°2'N	37°45'N
Longitude	128°6'E	127°9'E
Elevation	800-1000	300-340
Aspect	SW	SE
Temperature (°C)	6.3	11.3
PPT (mm)	1578	1365
Mean DBH (cm)	12.9±3	28.1±17
Tree density/ha		1473
Mean tree height (m)	9.7±1.5	18.6±7.5
Dominant species	*Quercus mongolica*	*Quercus serrata*
No of Species measured.	7	2
No of trees measured	32	9
Sensor type	HD	HD+SHB

Measurements

Meteorology

(a) (b) (c)



Soil Water Content

(a-b) Stem Heat Balance (SHB) Methodology - Sakuratani, 1981
(c)Thermal Dissipation Probe (TDP) Methodology - Granier, 1987

Stem Heat balance (SHB) and Heat Dissipation techniques have been employed to measure sapflow in the understory woody plants and on canopy trees respectively. Measurements have been stratified to account for differences in tree sizes and species diversity. In addition to soil water content (Echo probes), a range of micrometeorology sensors have been set up below, within and above the canopy to monitor microclimate.

Data Evaluation

$$Jsi = 119 * 10^{-6} \left(\frac{\Delta T_m - \Delta T}{\Delta T} \right)^{1.231}$$

K-factor

In cases where the heating needle was longer than conducting sapwood, the "k" component of the eq. was modified as:

(8mm) (21mm) Quercus mongolica

$$\Delta T_{csw} = \left(\frac{\Delta T - b\Delta T_m}{a} \right)$$

where *b=(1-a)*

Clearwater et al. 1999

Results

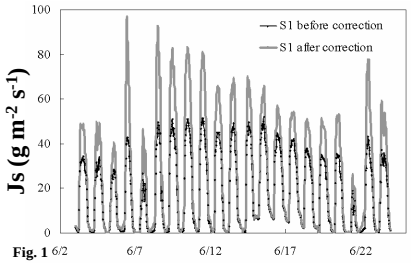


Fig. 1

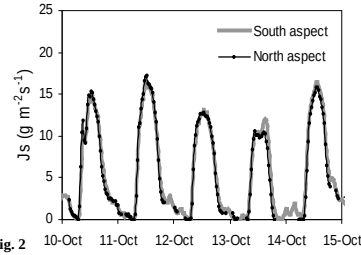


Fig. 2

Tree water use is overestimated in cases where the sensor overlaps into the non-conducting heartwood (Fig. 1). Accurate estimates achieved through corrections suggested by Clearwater et al.1999. In closed canopies, the sensor orientation has no influence on flux estimates (Fig 2.). Upscaling to stand level is done with DBH (Fig. 3).

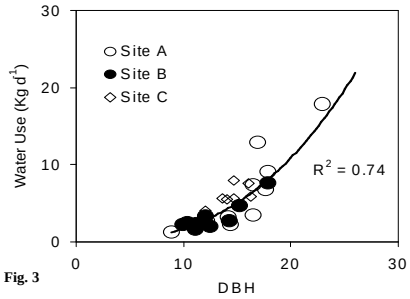


Fig. 3

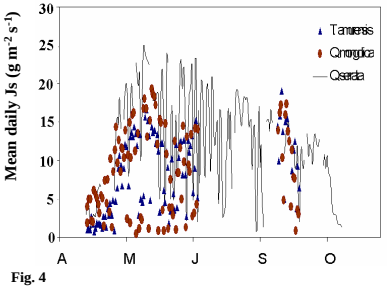


Fig. 4

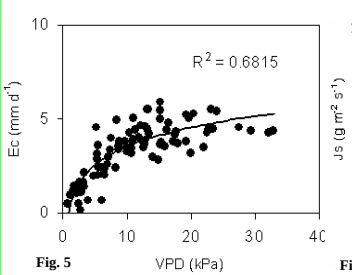


Fig. 5

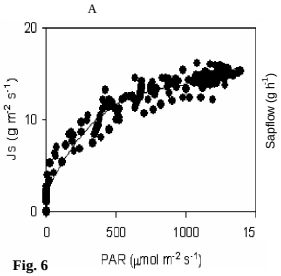


Fig. 6

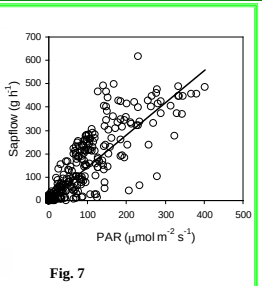


Fig. 7

The main environmental drivers for tree water use are VPD (Fig. 5) and PAR (Fig. 6). PAR is a critical single determinant of understory contribution of (Fig. 7). Soil water is available throughout the year.

Discussion

The need to correct for sap flux values before up-scaling has been underscored. Deciduous forests of S.Korea rarely suffer from water stress and the main driving factors for forest water use are radiation and VPD. The contribution of the understory is significant and should not be ignored, especially in forests with relatively open canopies. Simple allometric relationships such as DBH appear universal enough and transcend the species boundaries and could provide easier and rapid options to upscale water use in the diverse multi-species forests of S. Korea.

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References

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