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Contribution of the understory to the overall water use by temperate deciduous forest

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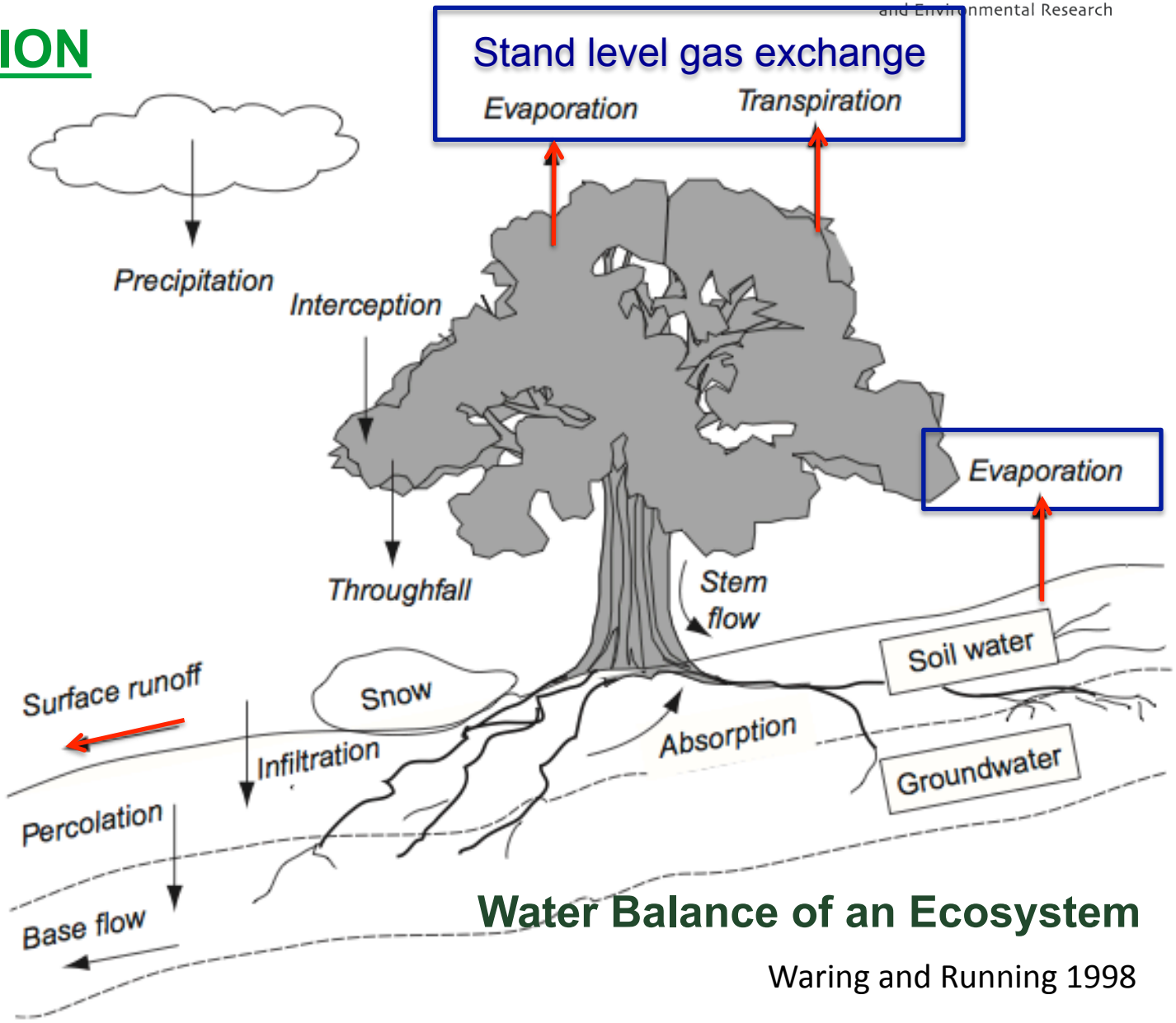
INTRODUCTION



Water Balance of an Ecosystem

Waring and Running 1998

INTRODUCTION

Condition in the canopy

Energy Available
- always lower than the upper surface of the canopy
- much greater in open than in close canopies

Climate
- wind speed will be small - transport processes are less effective
- humidity will tend to be high, particularly if the ground and litter layer are wet.
- fluxes – particularly of water vapor – will be a significant fraction of the total canopy flux.

(Landsberg and Gower, 1997)

Understory species does a significant roll in terms of forest water use in deciduous temperate forest, also.

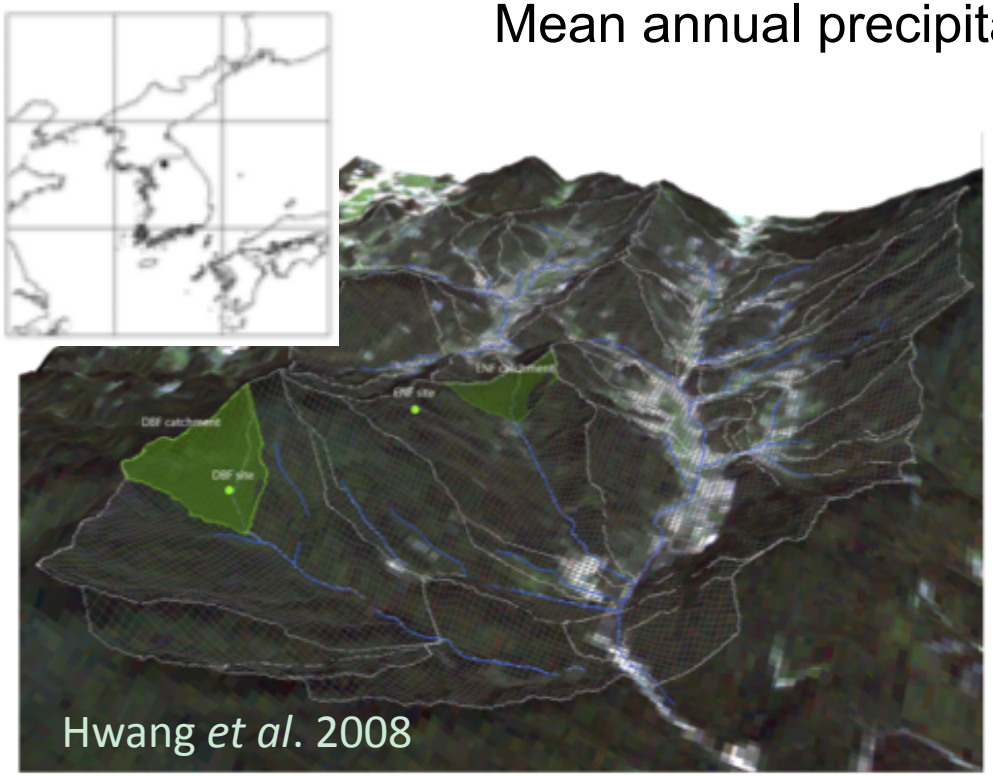
STUDY SITE

Gwangneung Experiment Forest, Korea

37° 45’ 25.37” N, 127° 9’ 11.62” E, 340m a.m.s.l.

Mean annual air temperature 11.5 °C,

Mean annual precipitation 1332 mm (Lee *et al*. 2007)



Hwang *et al*. 2008


May, 2008

METHODS

1. Sap flow measurements

Quantify tree water use by over- and under-story tree species !

- Thermal Dissipation Probes

(**TDP**, Granier 1987)

➔Overstory Trees (DBH > 10 cm)

Species	Sample Trees	DBH (cm)	TH (m)
Quecus serrata	Q1	35.4	15
	Q2	58.8	17
	Q3	38.8	17
Carpinus laxiflora	C1	43.0	18
	C2	33.0	16
	C3	24.1	10

Species	BA (m^2/ha)	%
Quercus serrata	2.72	70.6
Carpinus laxiflora	0.86	22.2

Lim (unpublished data)

TERRECO

METHODS

1. Sap flow measurements

Quantify tree water use by over- and under-story tree species !

Species	Sample Trees	DBH (cm)	TH (m)
Euonymus oxyphyllus	SHB1	2.5	1.8
	SHB2	3.5	2.0
	SHB3	3.0	1.9
Celtis jessoensis	SHB4	2.5	1.7
Sorbus alnifolia	SHB5	3.5	2.0

* LAI of understory = 0.9 ± 0.3 in July 2008

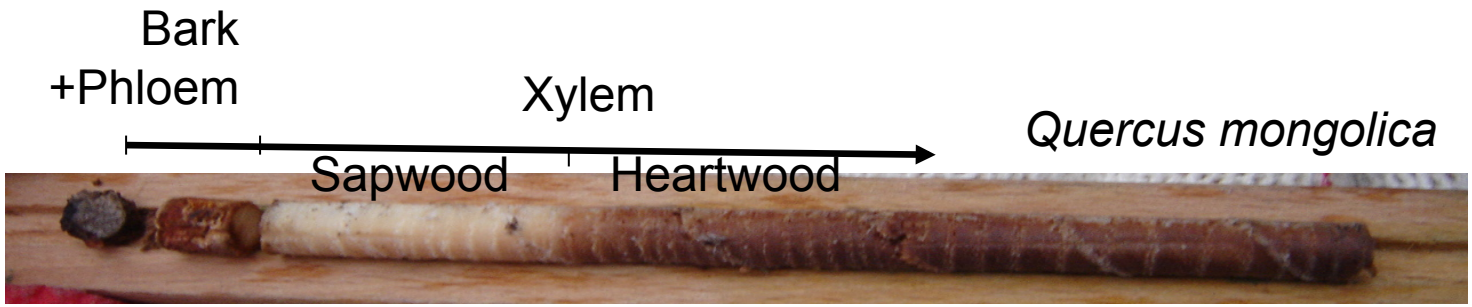
- Stem Heat Balance

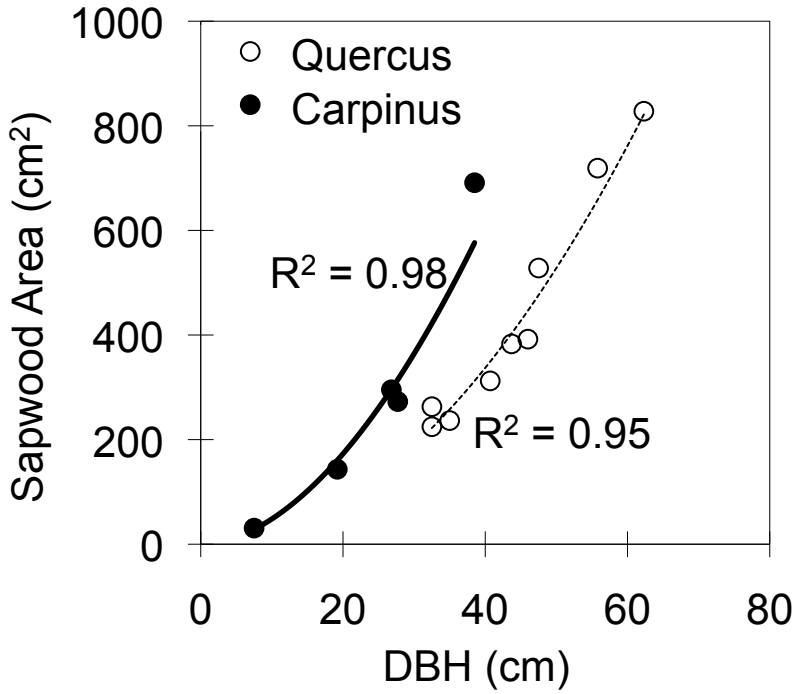
(**SHB**, Sakuratani 1981)

➔Understory Trees (DBH < 10 cm)

METHODS

2. Sapwood area estimation



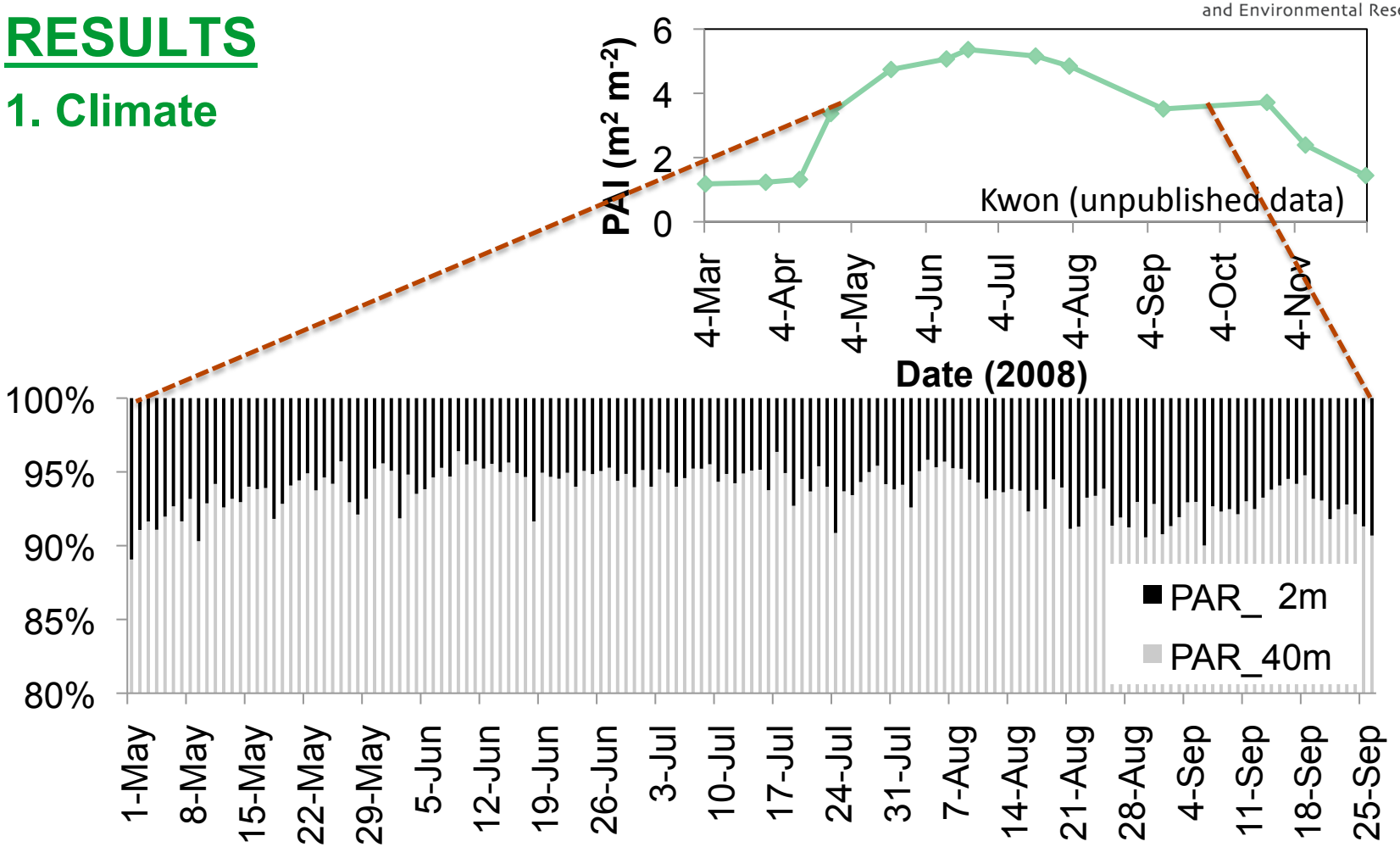


$$\text{Sapwood Area} = B_0 \times DBH^{B1}$$

Vertessy *et al*. 1995
Wullschleger *et al*. 2001

RESULTS

1. Climate

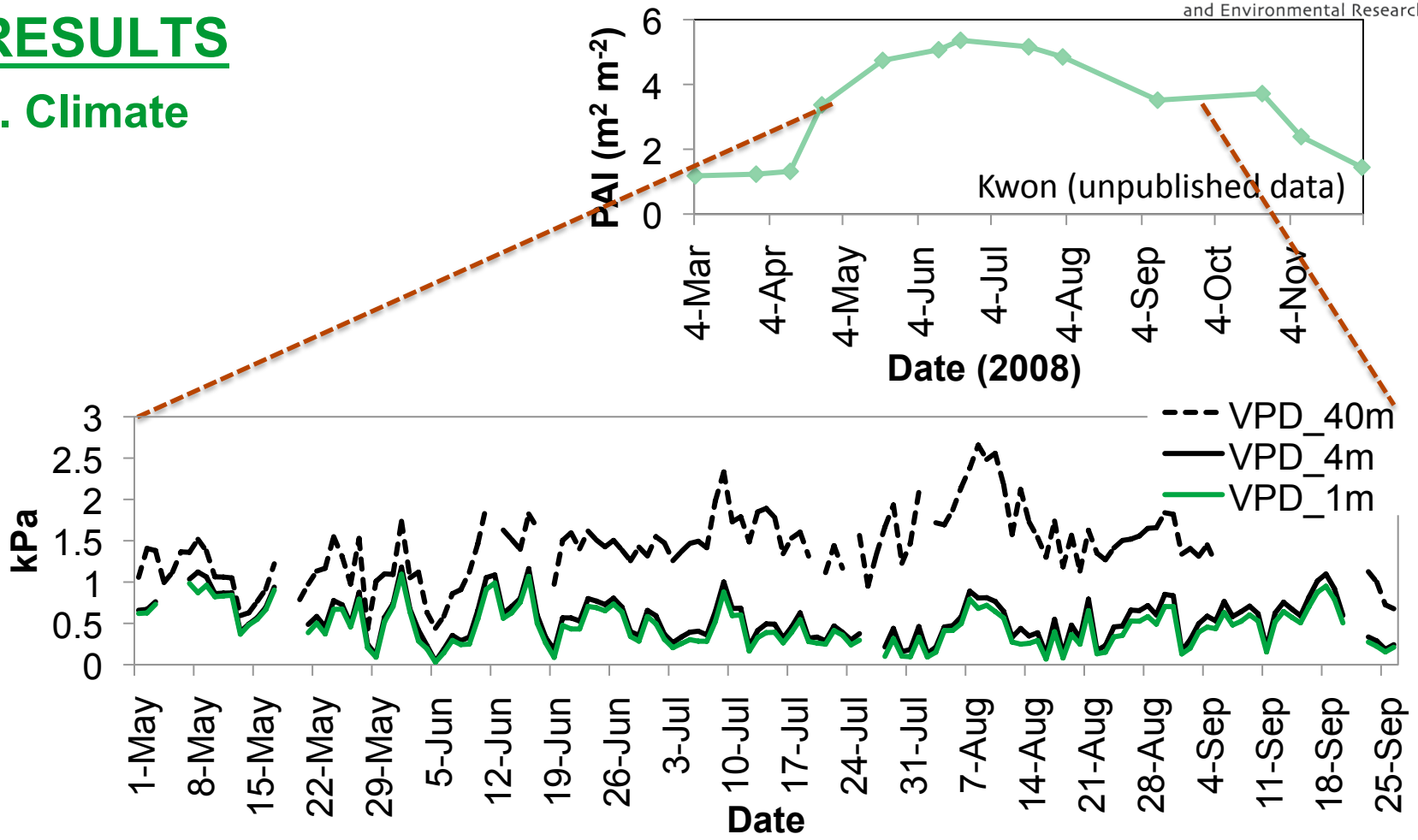


Understory light is closely dependent on the canopy structure.

(Sharpe et al., 1996)

RESULTS

1. Climate

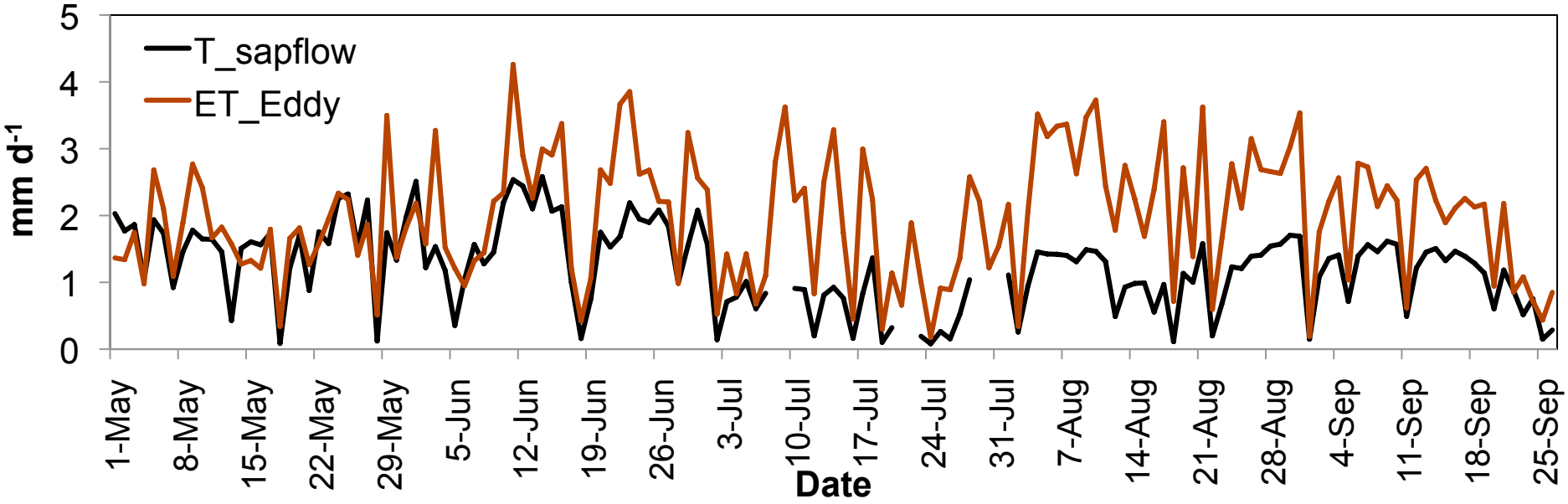


Air temperature and air humidity in the understory are dependent on canopy structure, particularly canopy density.

(Sharpe et al., 1996)

RESULTS

2. Transpiration vs. Evapotranspiration



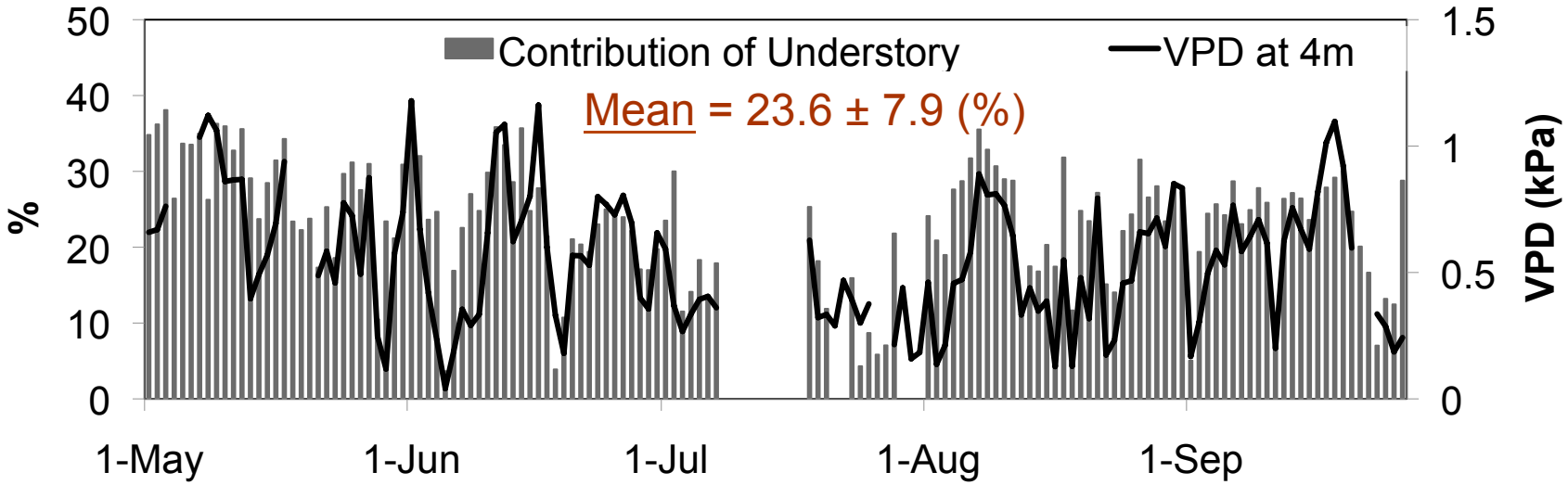
Evapotranspiration from Eddy Covariance (above the canopy)

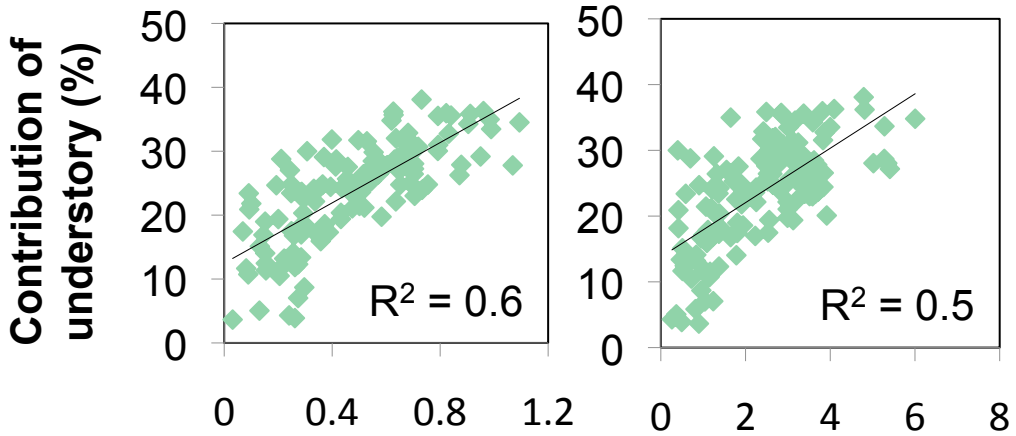
= Transpiration (E_t) + Soil Evaporation (E_s) + Interception (E_i)

Wilson *et al*. 2001

RESULTS

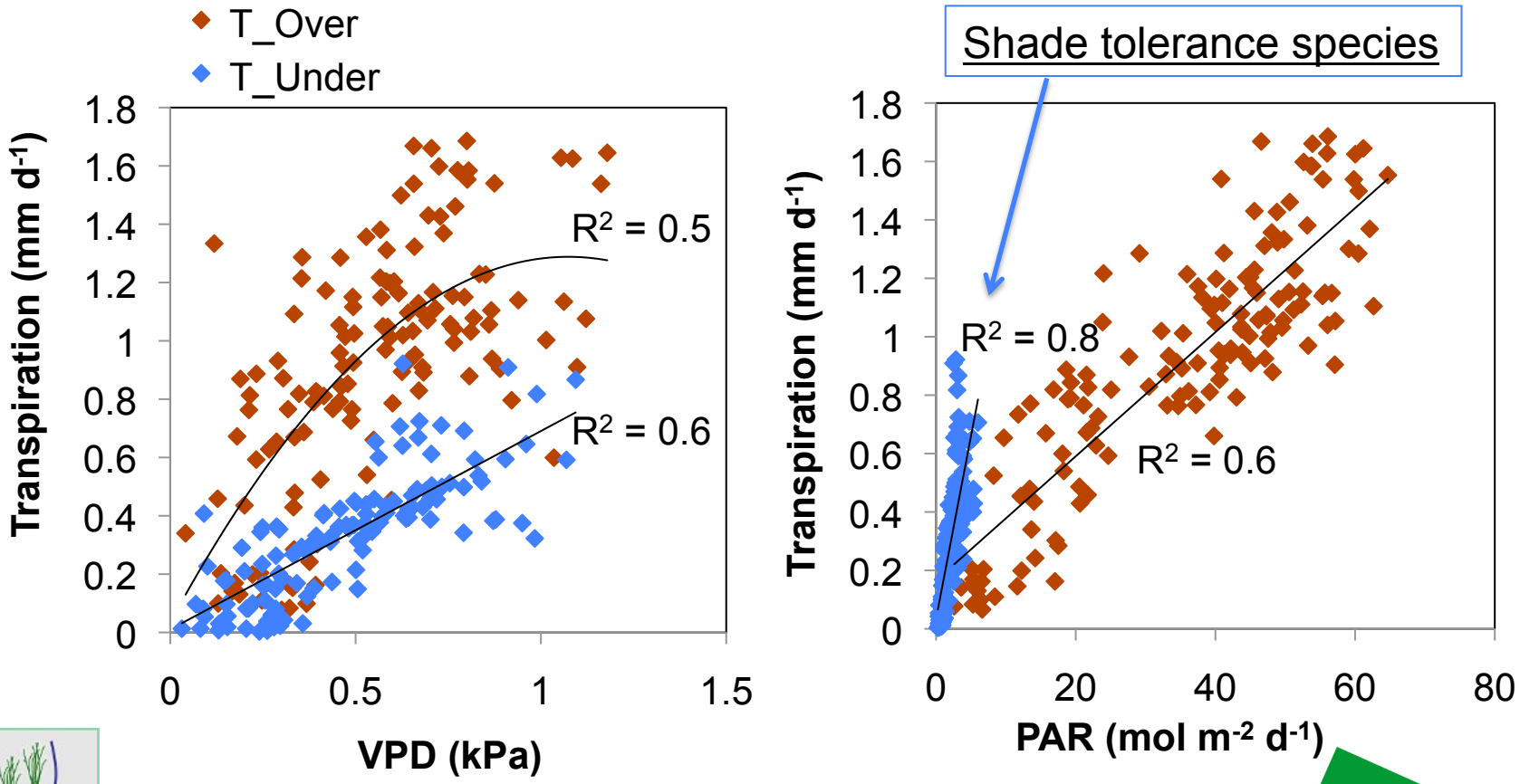
2. Contribution of understory to overall stand transpiration





RESULTS

3. Transpiration vs. Climate



CONCLUSION

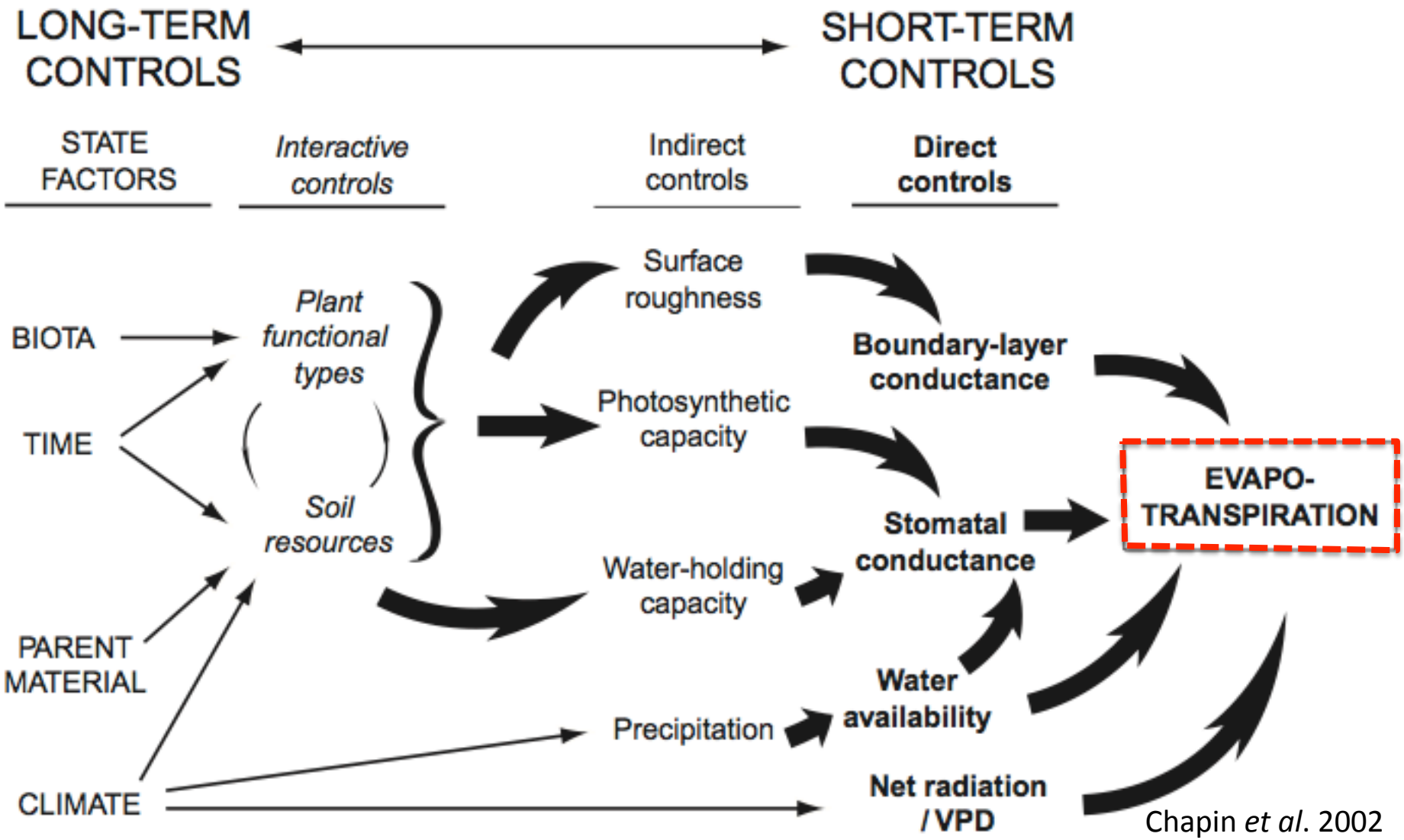
* Total T = 100 %

	ET		T -Total		T - Overstory		T - Understory	
month	mm d^{-1}	%	mm d^{-1}	%	mm d^{-1}	%	mm d^{-1}	%
MAY (dry)	1.7 ± 0.6	100	1.5 ± 0.6	88.9	1.1 ± 0.4	70.1	0.5 ± 0.2	29.9
JUL (monsoon)	1.6 ± 0.9	100	0.6 ± 0.3	39.8	0.6 ± 0.3	82.0	0.1 ± 0.1	18.0
SEP (wet)	1.8 ± 0.8	100	1.1 ± 0.5	61.0	0.8 ± 0.3	75.7	0.3 ± 0.1	24.3

Contribution of understory species to the overall stand transpiration was controlled by the microclimate below the canopy.

THANK YOU!

INTRODUCTION



Chapin *et al*. 2002