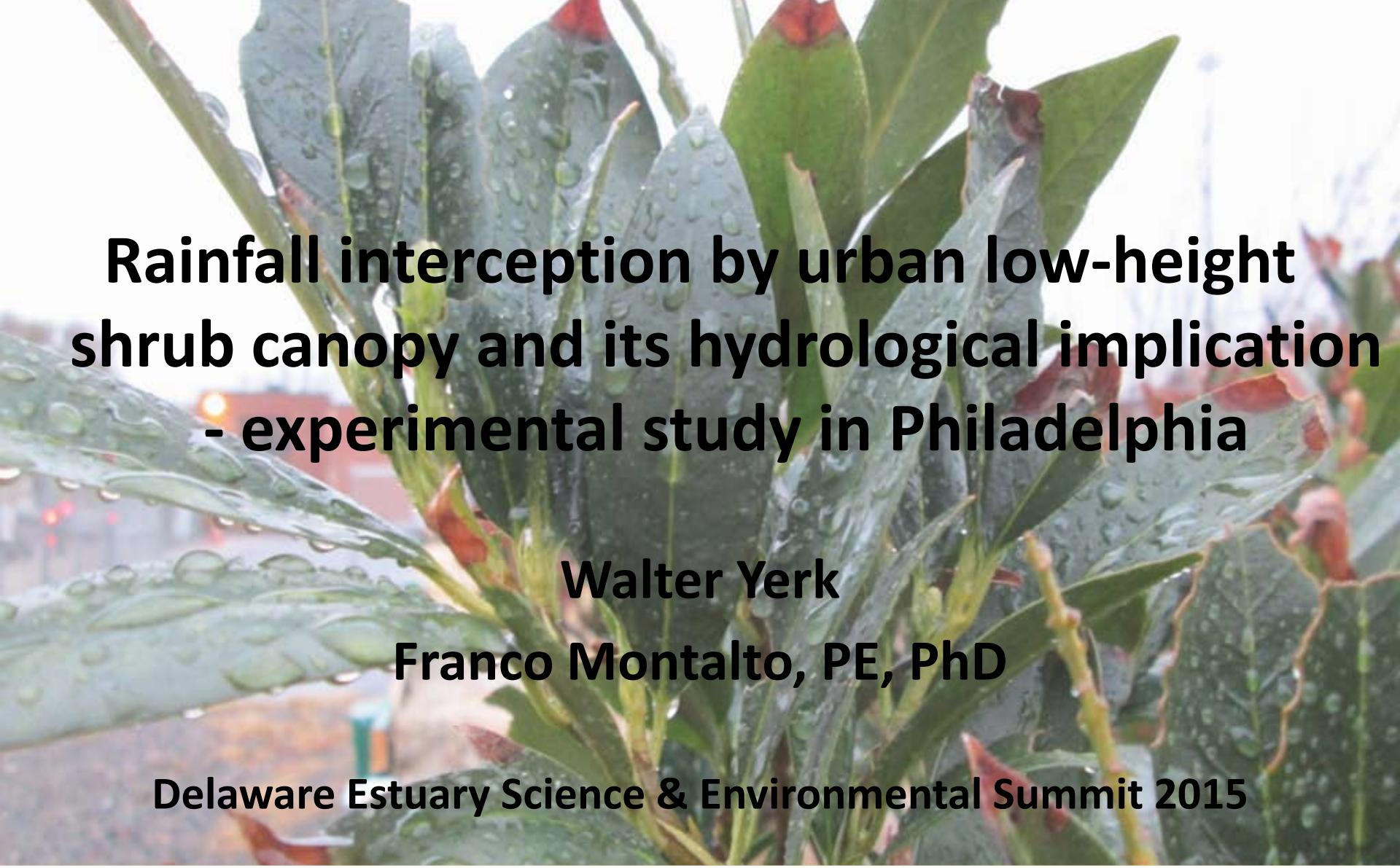


Rainfall interception by urban low-height shrub canopy and its hydrological implication - experimental study in Philadelphia

Walter Yerk

Franco Montalto, PE, PhD

Delaware Estuary Science & Environmental Summit 2015

DREXEL UNIVERSITY
Civil, Architectural, and Environmental Engineering
College of Engineering

The Sustainable Water Resource Engineering Laboratory at Drexel University

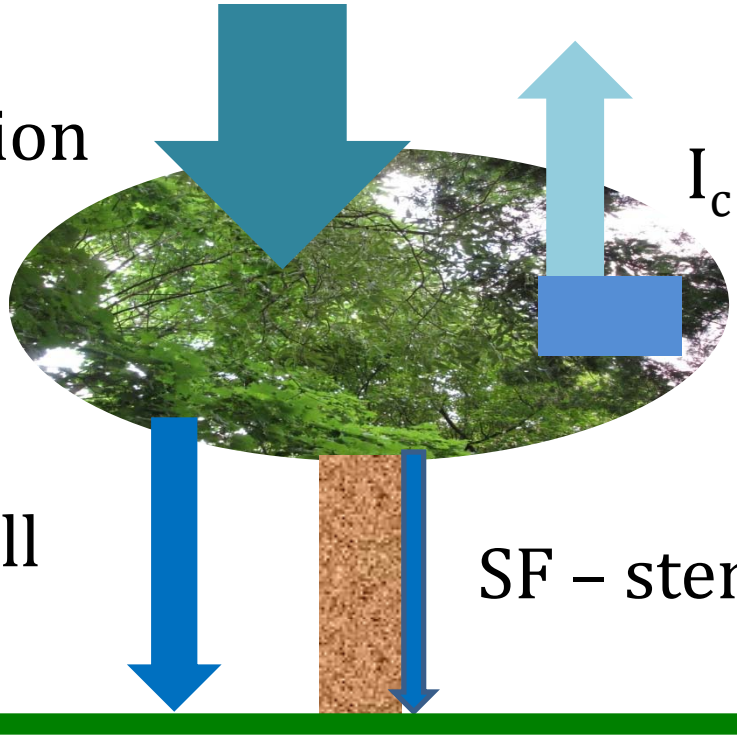
Urban hydrology

Objectives

- Quantify canopy interception by different shrub species
- Investigate difference in interception performance between a small isolated and a closed canopy
- Investigate hydrological significance of interception by a shrub canopy

Canopy water budget

P – gross precipitation



I_c – interception

TF – throughfall

SF – stemflow

$$P = TF + I_c + SF$$

Species selection

Itea virginica "Little Henry"

LAI 1.4

Cornus sericea "Kelseyi"

LAI 3.4

Species selection

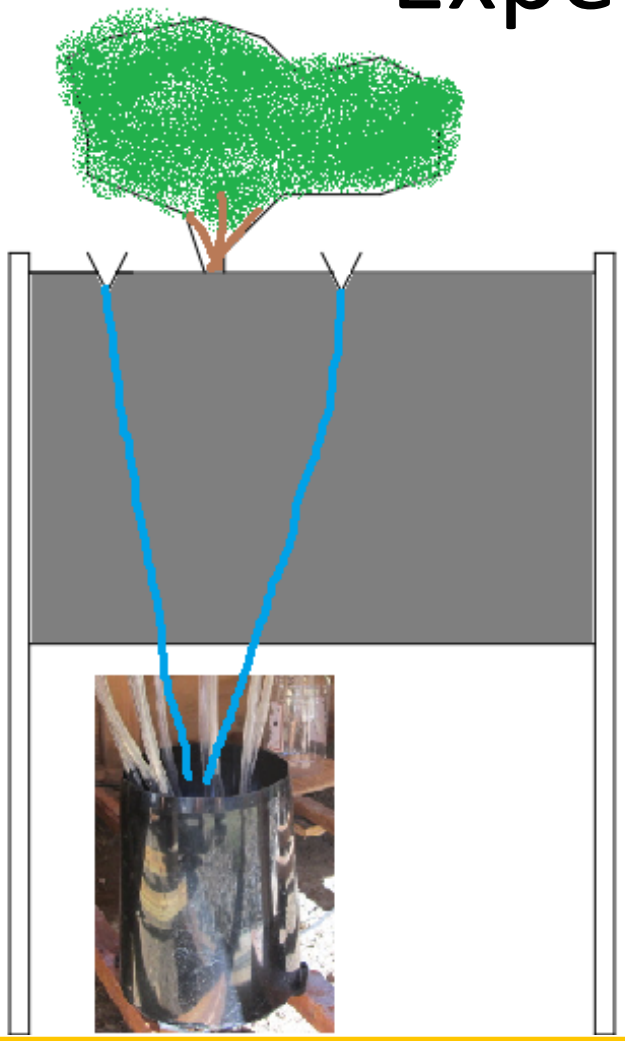
Prunus laurocerasus "Otto"

LAI 2.6

Hydrangea quercifolia "Alice"

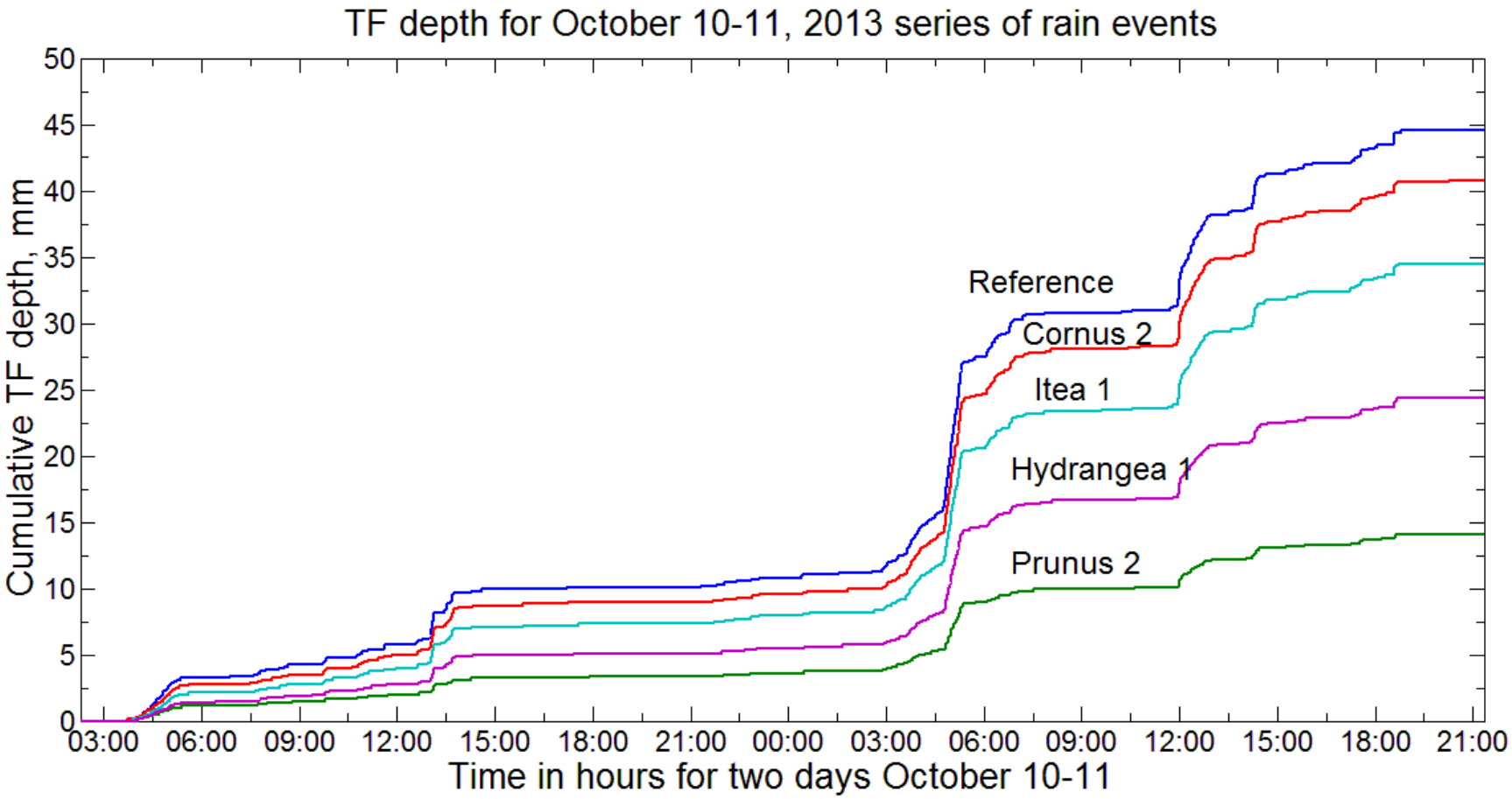
LAI 2.2

Experimental setup

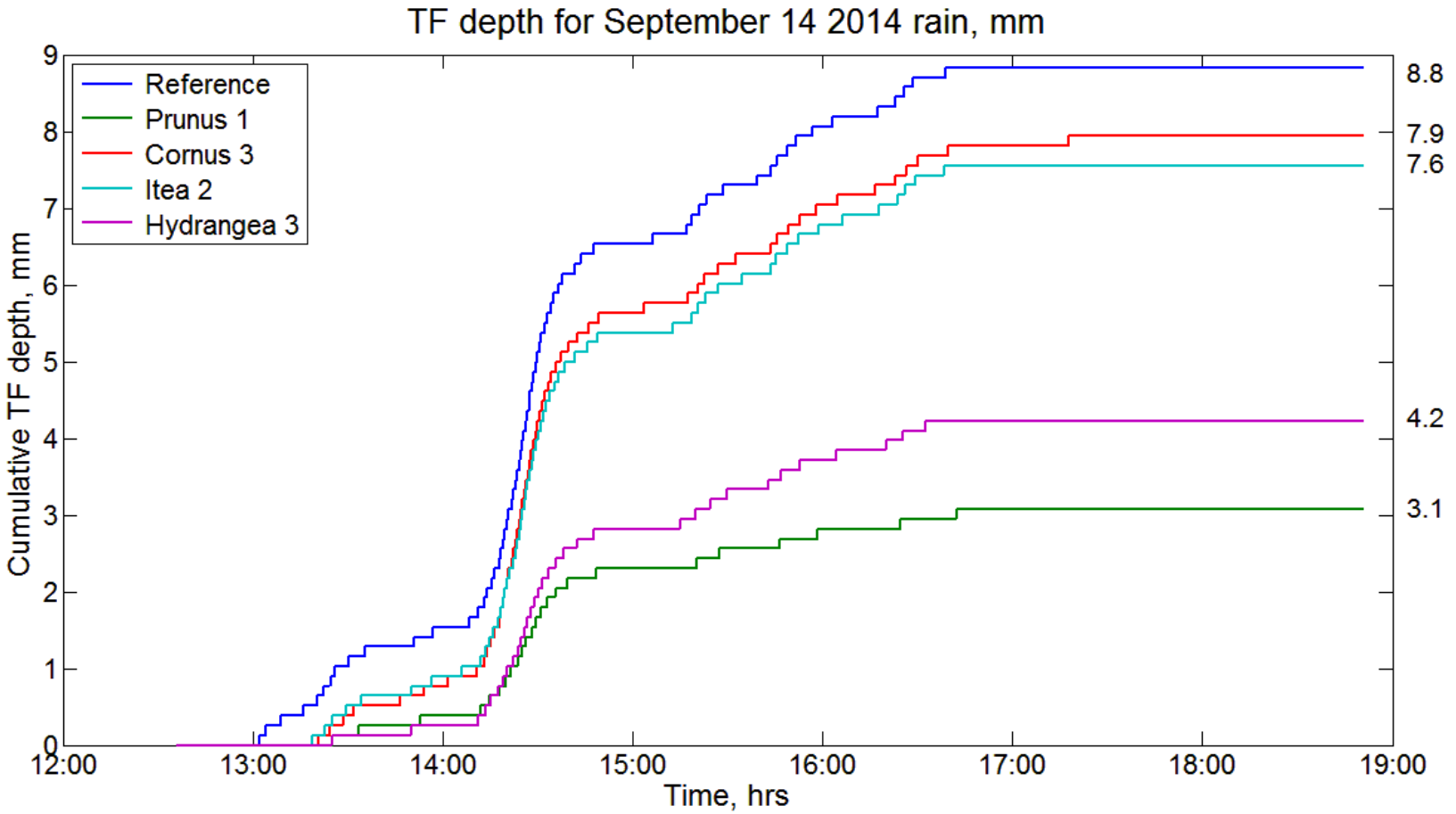


Setup: gauges

Sample results



Sample results



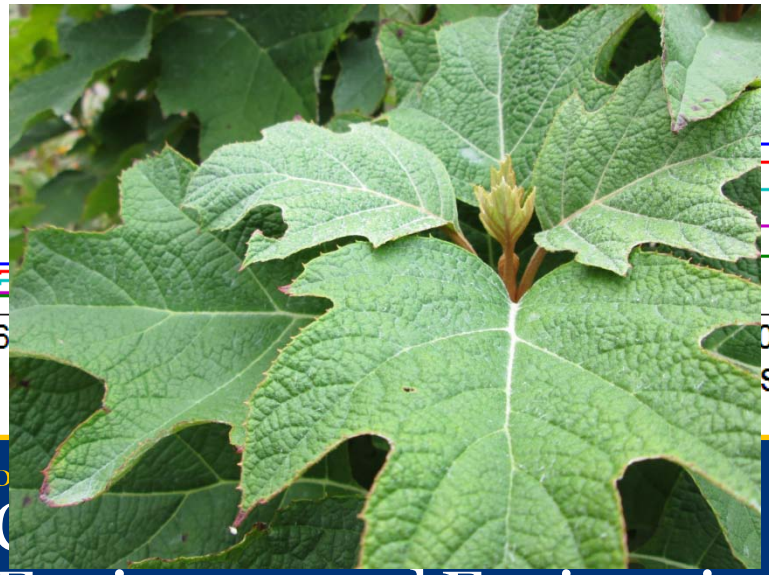
Sample results

TF deficit (mm)	3.72
	10.04
	20.21
	30.38

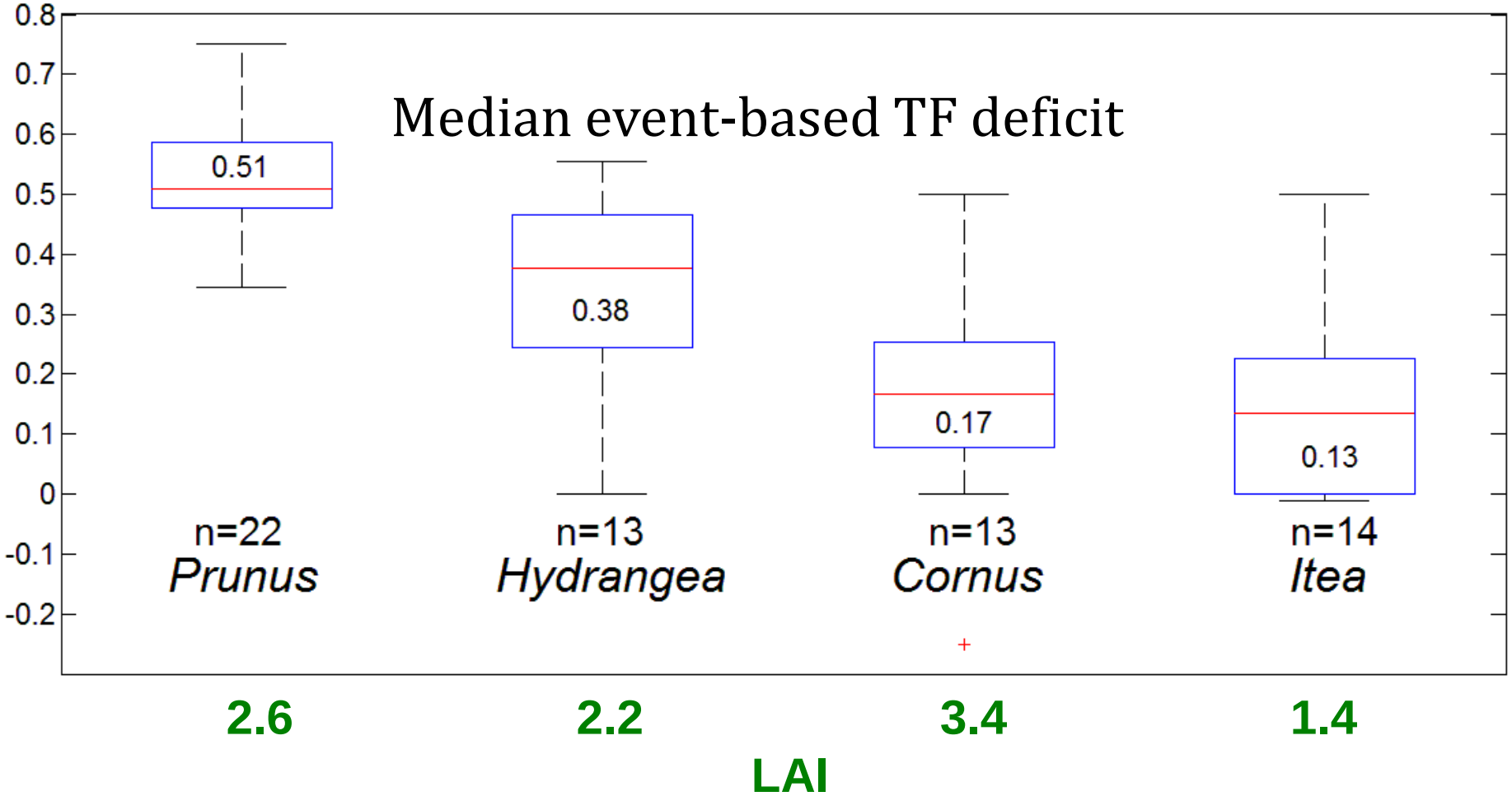
pth for October 10-11, 2013 series of rain events

Cornus LAI 3.4

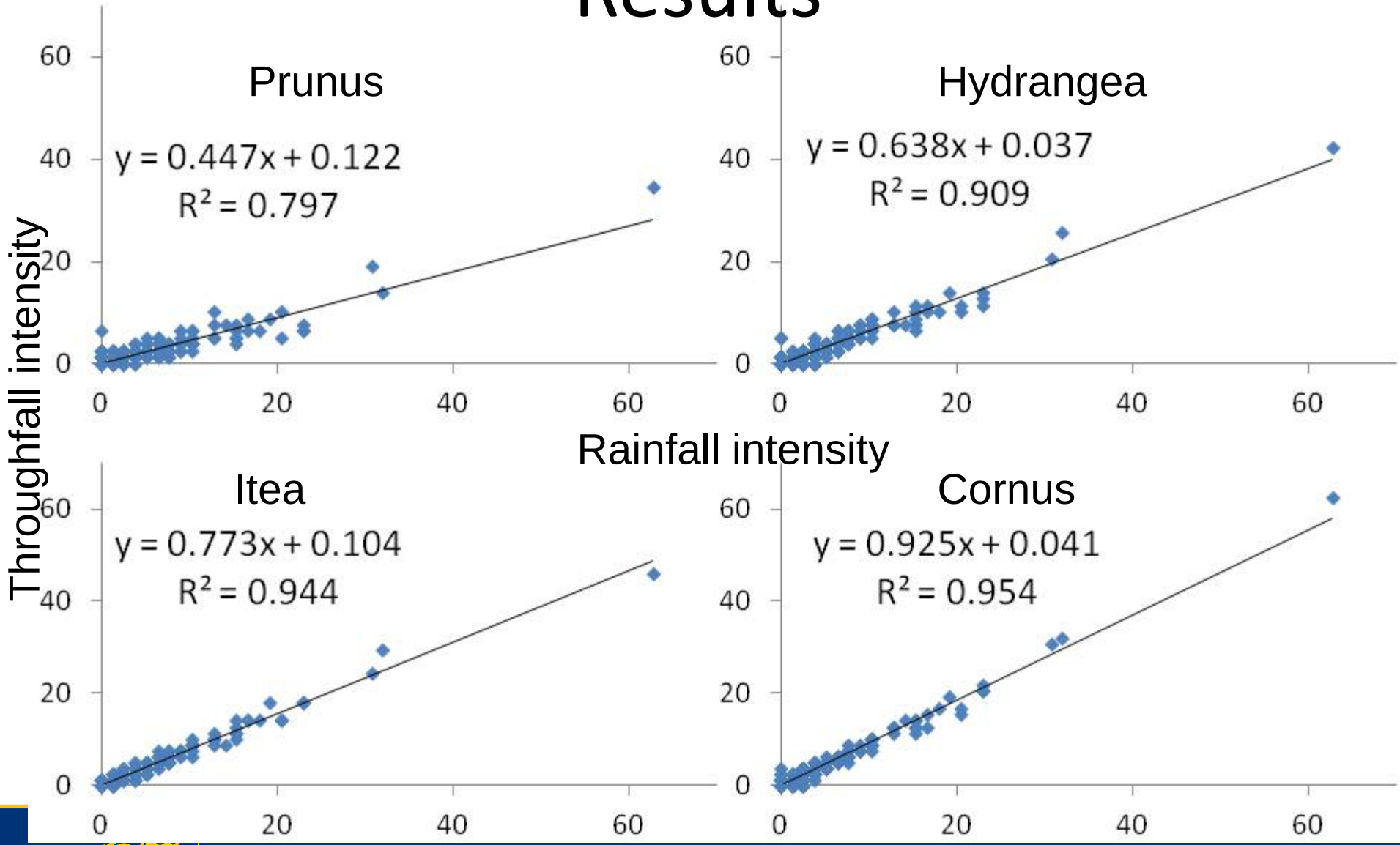
Hydrangea LAI 2.2



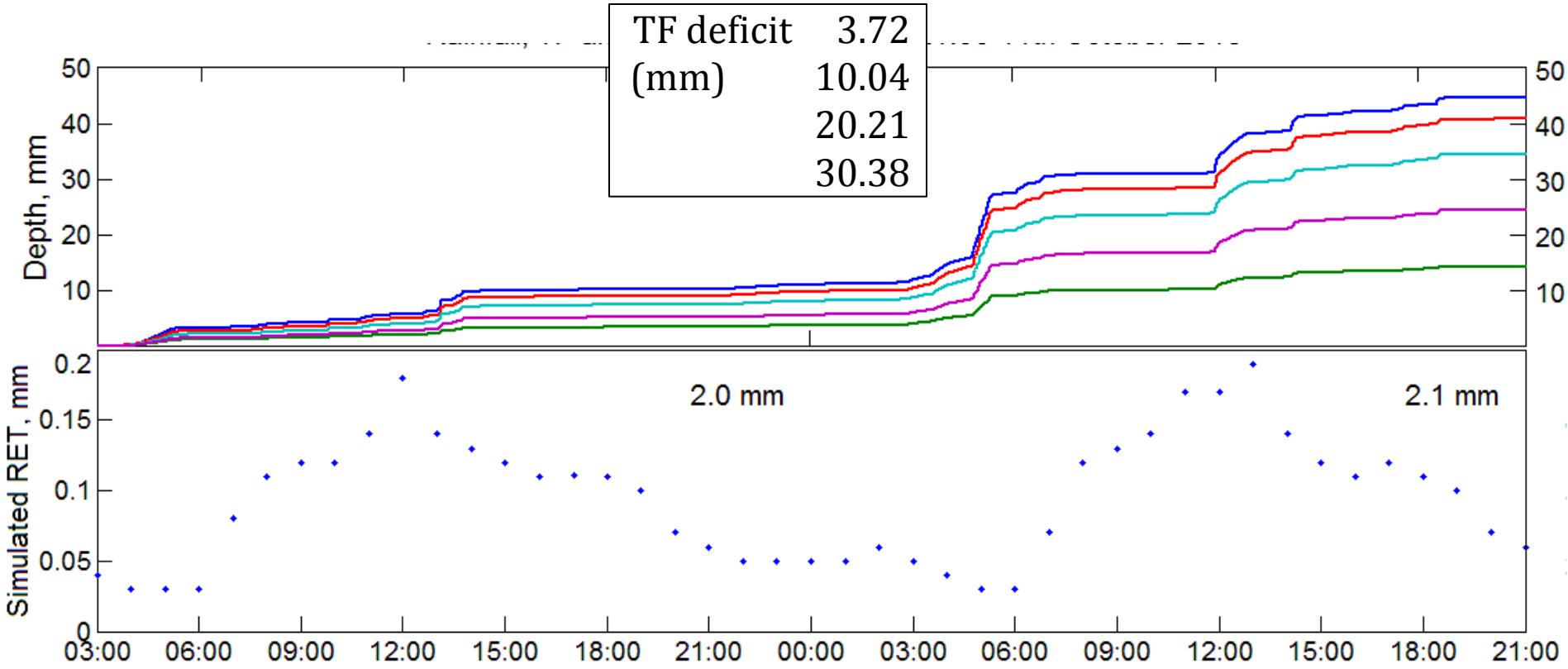
Results


Median event-based TF deficit
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0.51
0.38
0.17
0.13
n=22
Prunus
n=13
Hydrangea
n=13
Cornus
n=14
Itea
2.6
2.2
3.4
1.4
LAI

Results

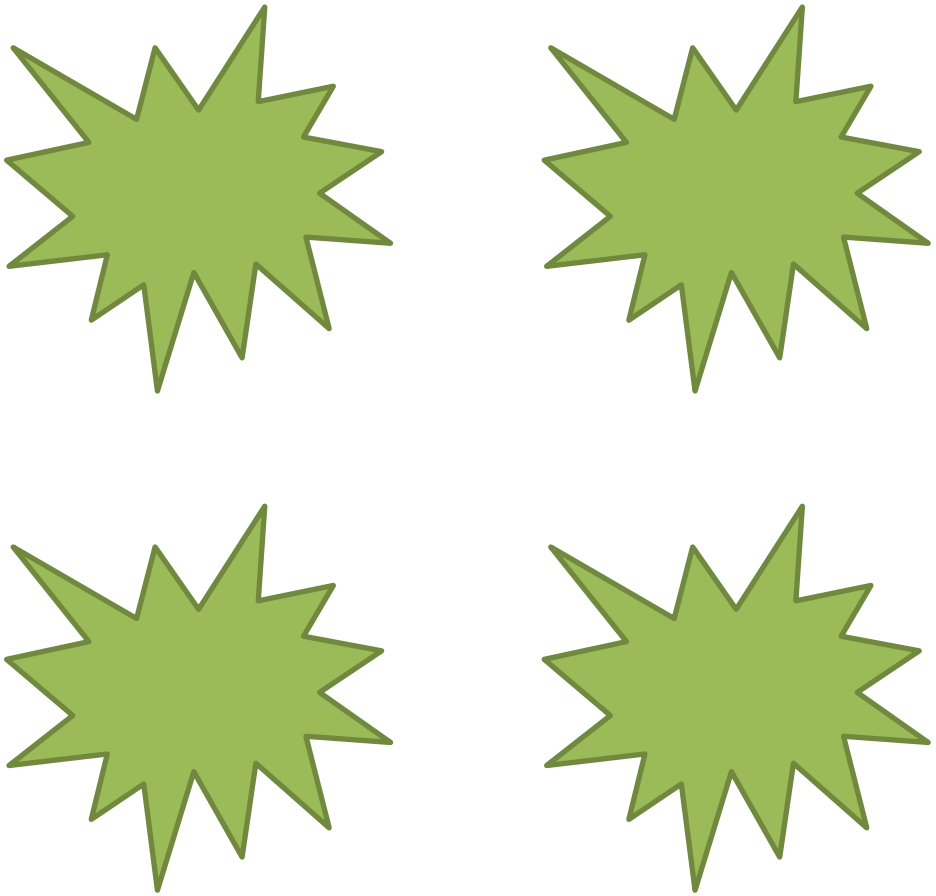

Throughfall intensity
Rainfall intensity
Prunus
y = 0.447x + 0.122
R² = 0.797
Hydrangea
y = 0.638x + 0.037
R² = 0.909
Itea
y = 0.773x + 0.104
R² = 0.944
Cornus
y = 0.925x + 0.041
R² = 0.954
0
20
40
60

Rainfall, TF and simulated RET 03:00 10th to 21:00 11th October 2013



Simplified FAO-56 Pennm.-Month. RET, after Valiantzas (2013) *J. Hydrol.*

Impact on runoff



0.45 (area)
x
0.4 (P depth)
=
0.18 (P depth over all area)

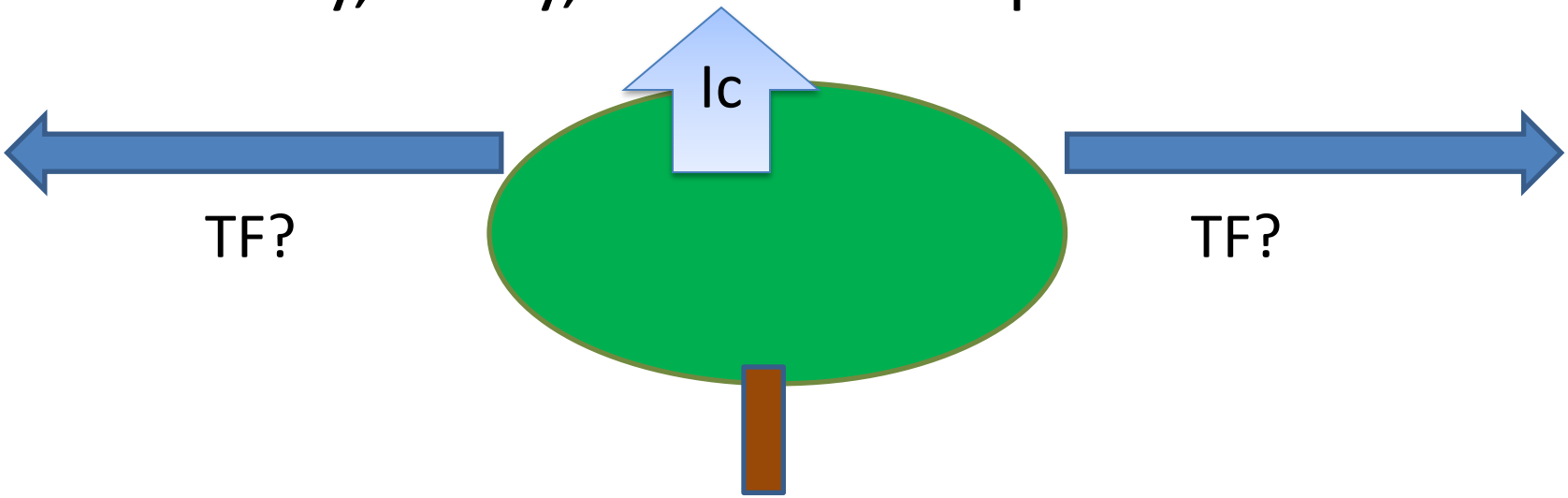
Sparsity appears to be the **key**

Discussion

- LAI is not a dominant canopy traits influencing interception performance
- Isolated canopies demonstrate different than continuous canopies rates of water removal
- Can we effectively implement hydrological benefits of interception by small canopies?

Future work

- Stemflow
- Identify, if any, TF lateral displacement



- Create (multiple?) regression model
- Inform H&H models

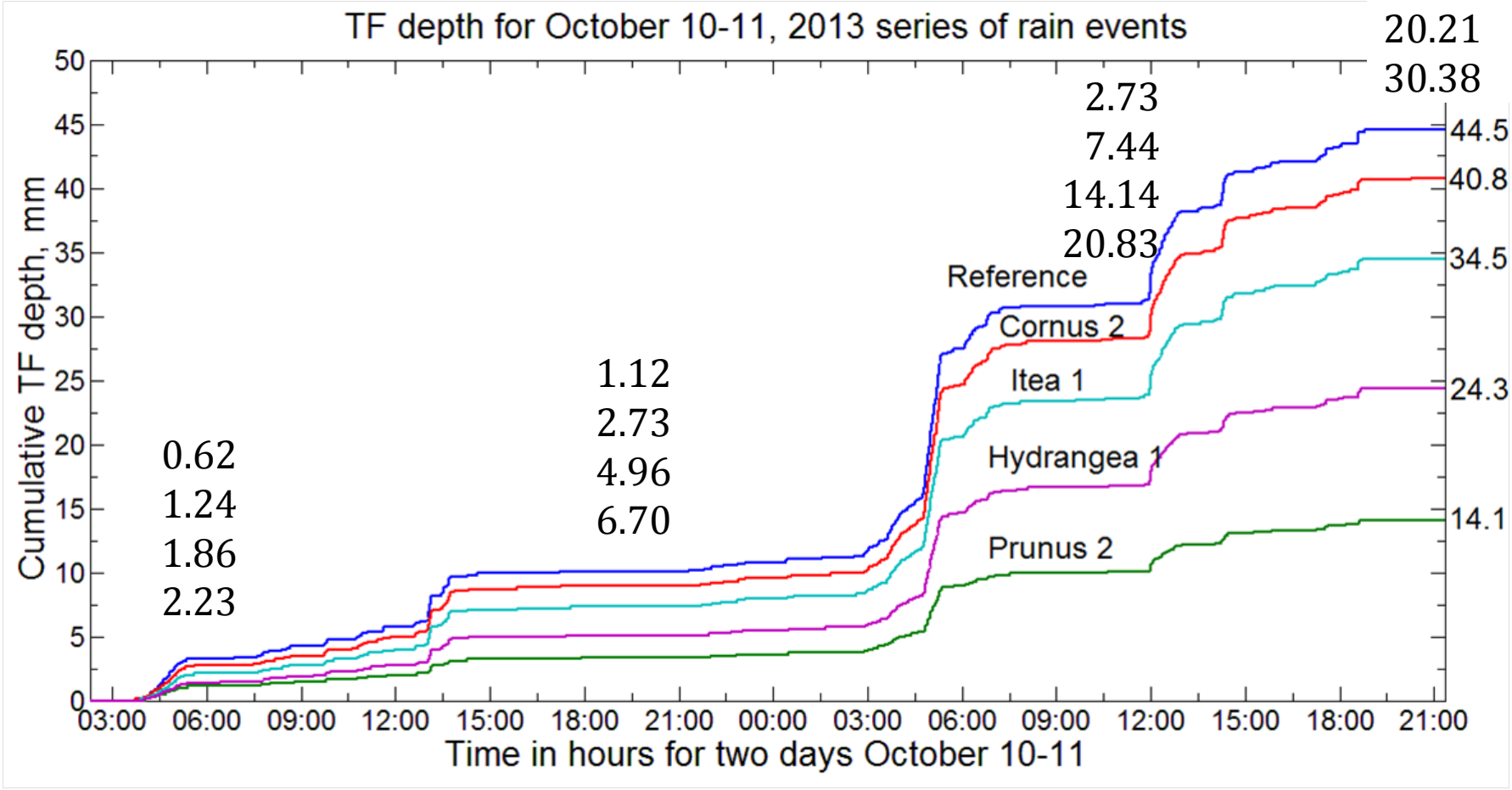
Thanks!

Walter Yerk

wgy23@drexel.edu

Stemflow

Sub-events TF deficit



Preliminary conclusions

- Horizontally projected canopy area receives 13- 50% less water than adjacent reference sites
- Interception fractions vary by species
- Canopy properties seem to play a key role
- Drop-splash evaporation is suspected