

Estimation of transpiration using sap flow sensors calibrated with whole canopy transpiration measurements

1ST LIAISE CONFERENCE AND
DETERMINING EVAPOTRANSPIRATION CROSSCUT WORKSHOP

Lleida, March 27, 2023

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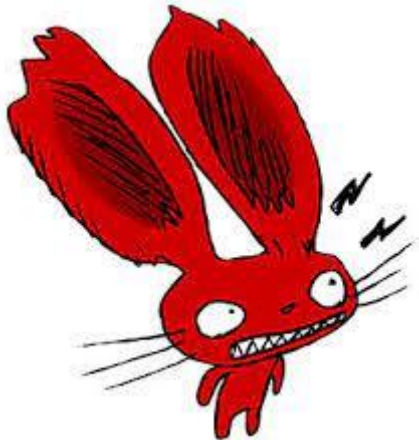
Dr Joan Girona and Dr Omar Garcia-Tejera

Ús Eficient de l'Aigua en l'Agricultura

Institut de Recerca i Tecnologia Agroalimentària

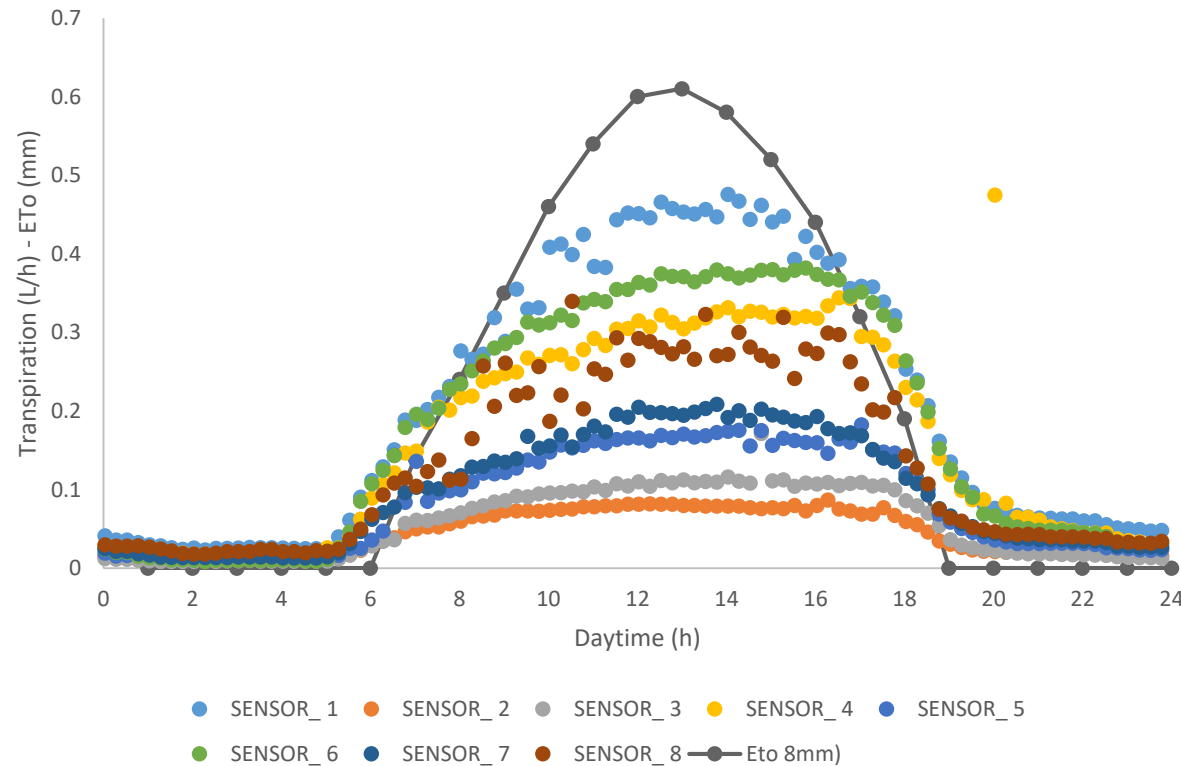
Background:

- The original goal of the experiment:
 - Assessment of the effects of summer pruning (crop forcing technique) of Tempranillo grapevines on whole canopy transpiration (Vines were fully irrigated ($\Psi_s > -0.8$ Mpa))
 - Three treatments were performed: non-pruned vines, vines pruned on June 3 and vines pruned on July 1
 - One sap flow sensor was installed in four vines per each treatment to measure transpiration (Dr García-Tejera).
 - Vines were fully irrigated ($\Psi_s > -0.8$ Mpa)
 - 80% of the sap flow wires were destroyed by furious rabbits (exactly when vines were pruned) affecting dramatically data quality and the whole experiment



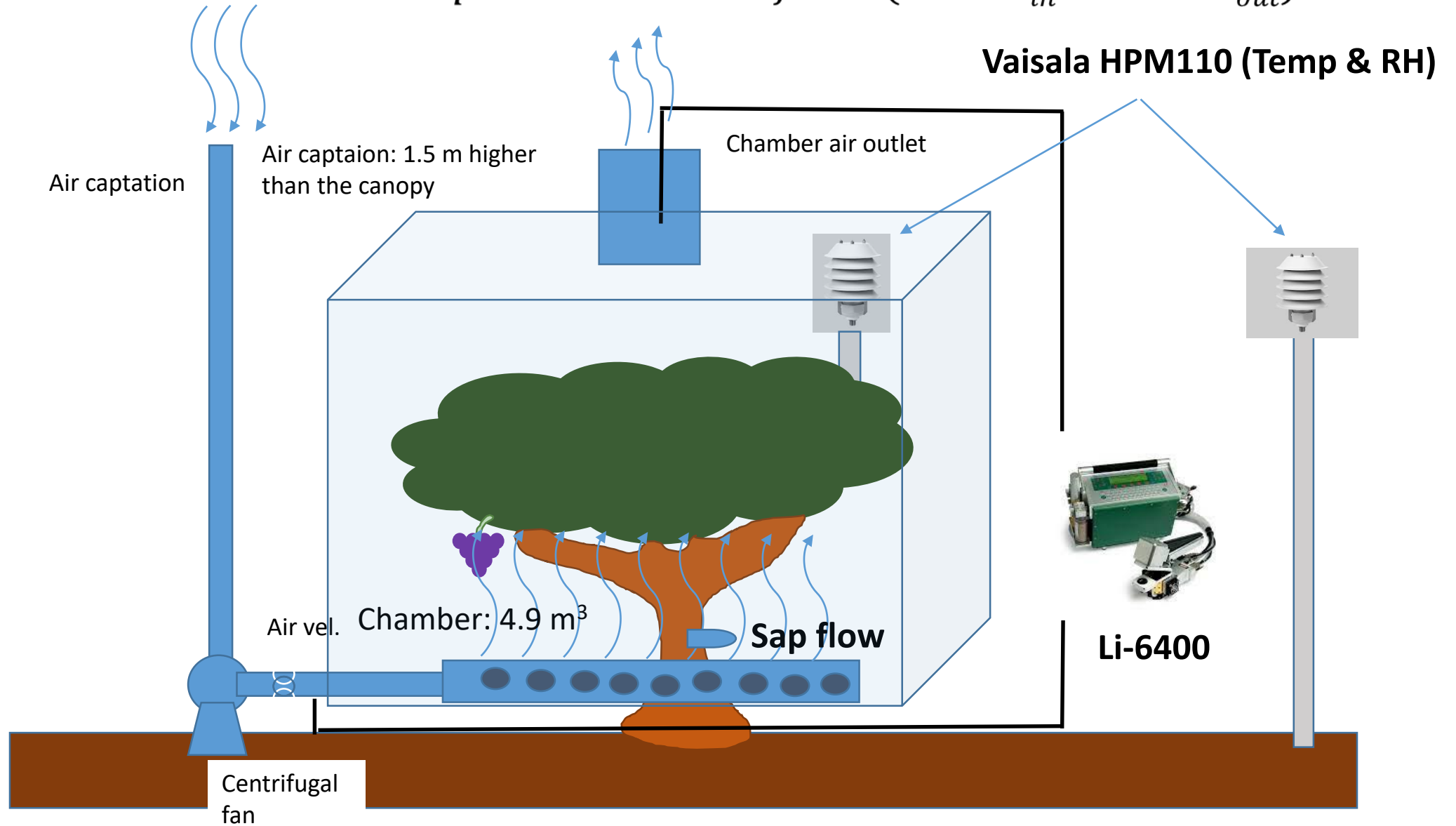
Can we take a reliable measurement of transpiration with one sap flow sensor per vine????

We can't! => controversial but not new



LA: 8.33 m²
LA: 7.07 m²
LA: 8.66 m²
LA: 9.7 m²
LA: 10.41 m²
LA: 10.53 m²
LA: 5.34 m²
LA: 6.96 m²

$$\text{Transpiration} = \text{Air flow} (Water_{in} - Water_{out})$$



Calibration method: whole canopy gas exchange chamber



Managing whole canopy chambers:

Tedious

Technically skilled staff

Difficult to move between rows: BIG PROBLEM (big distance between vines)

It was suggested to calibrate as many sap flows as possible in one day:

WCCH was measuring for three hours in each vine

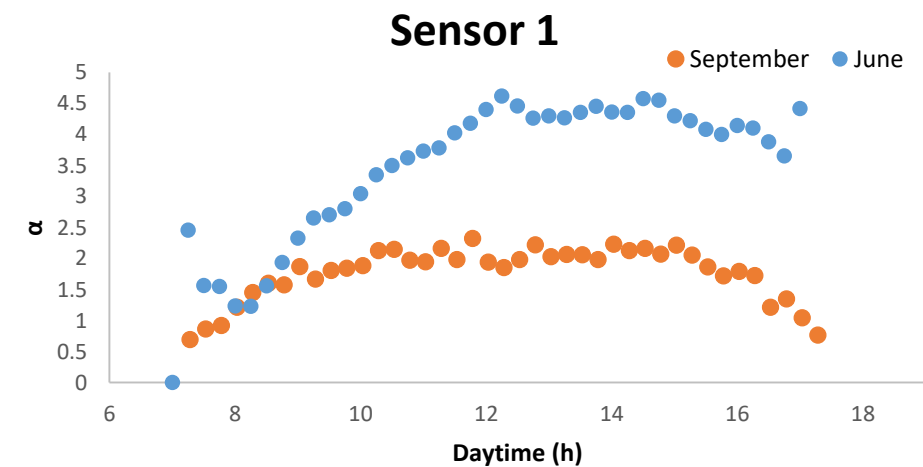
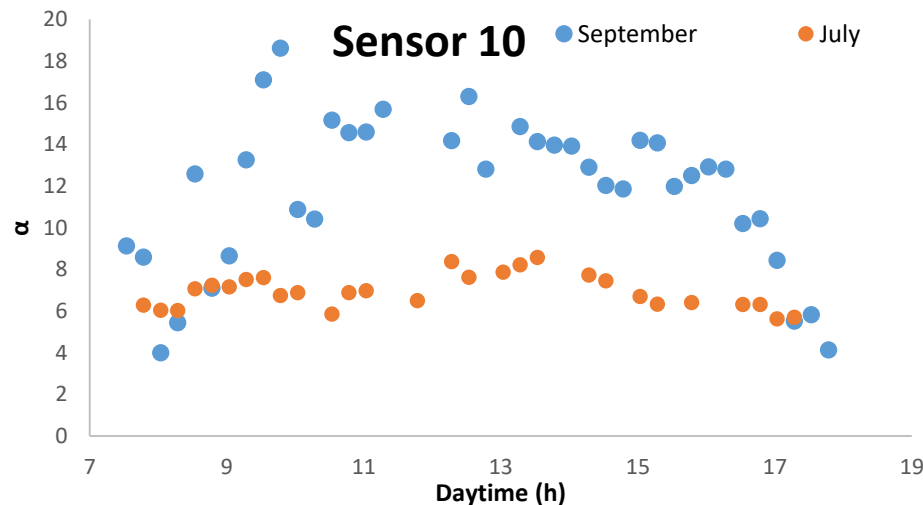
We only have one Li-6400

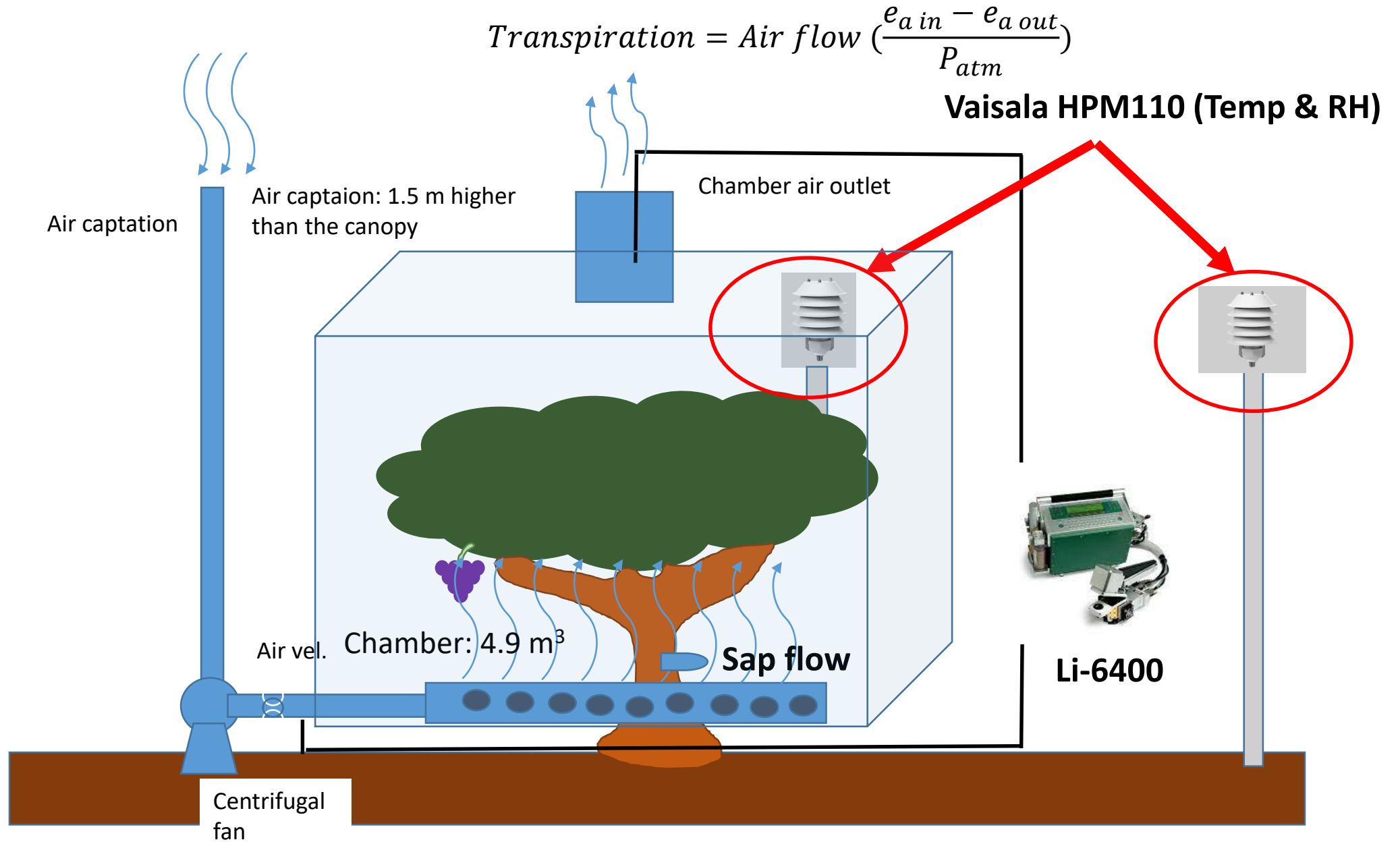
Calibration method:

$$\text{Actual Transpiration} = T_{sap} \alpha$$

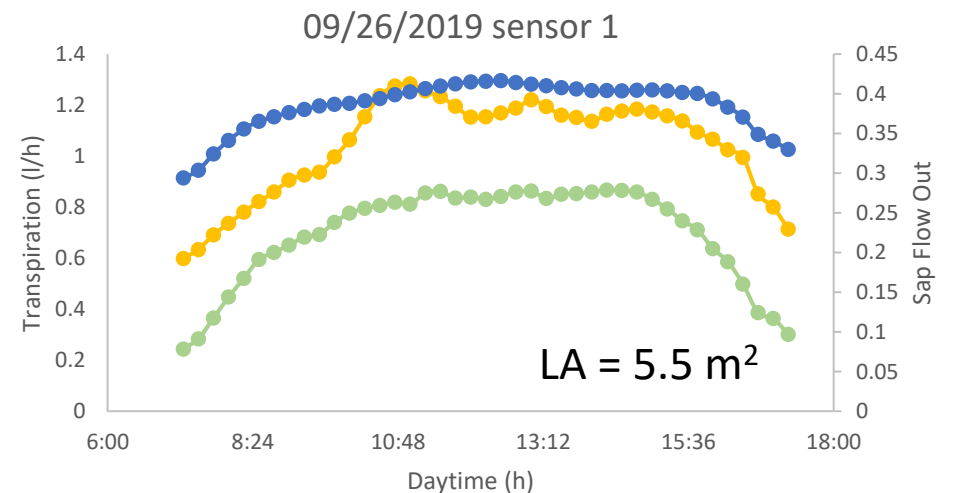
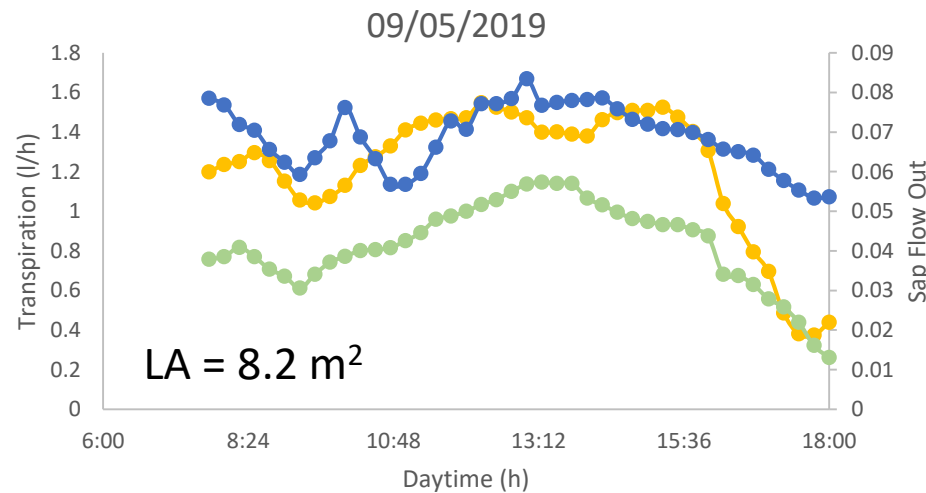
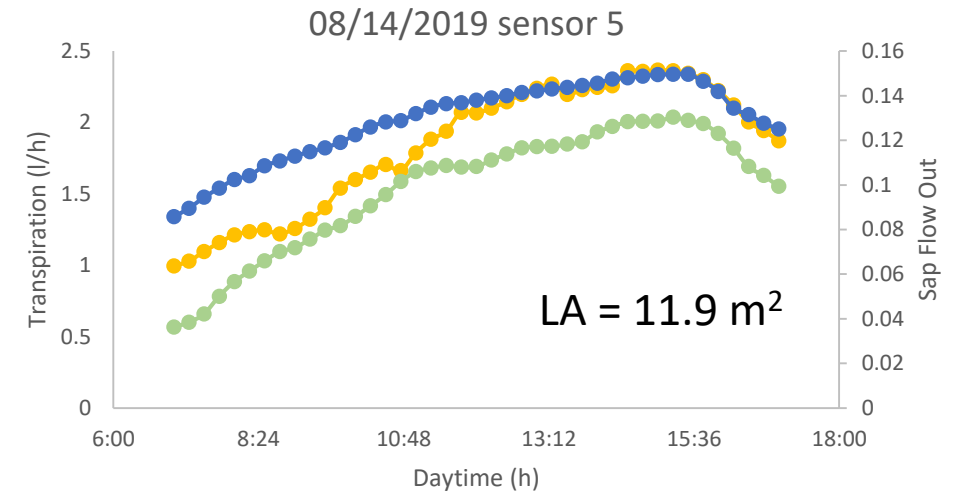
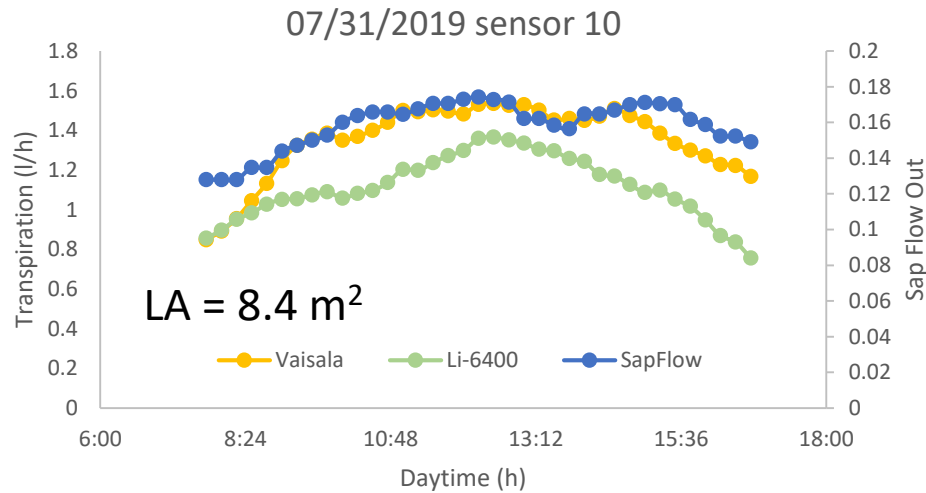
Where α is the calibration coefficient ($T_{chamber} / T_{sap}$)

$T_{chamber}$ was measured one day of the year, for 3 hours in each chamber.



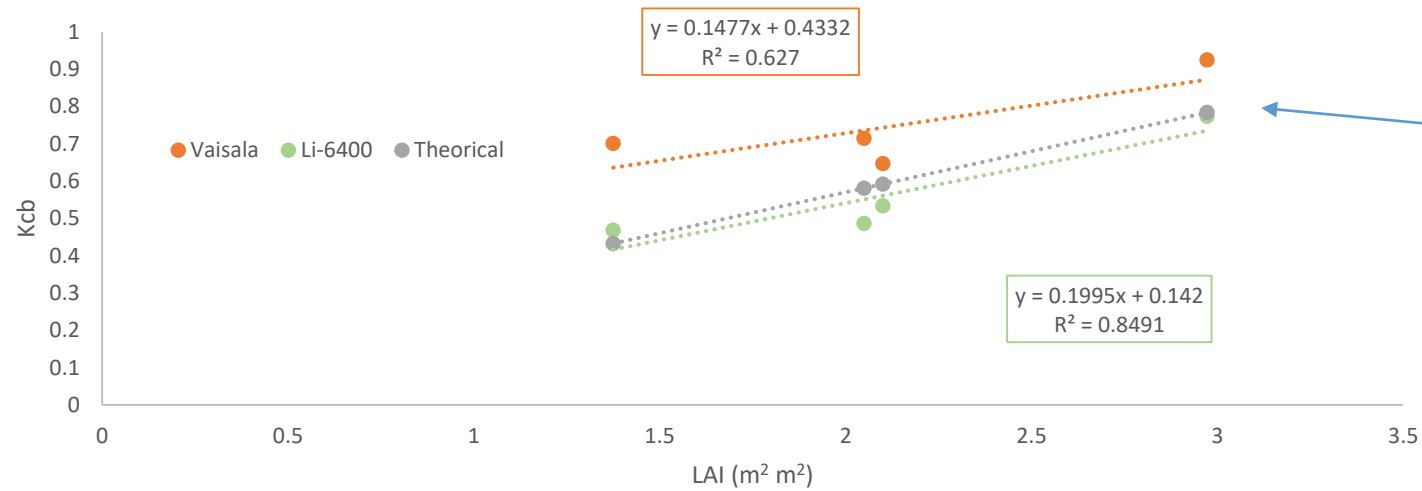


Comparison between two methods



Comparison between two methods and calibration

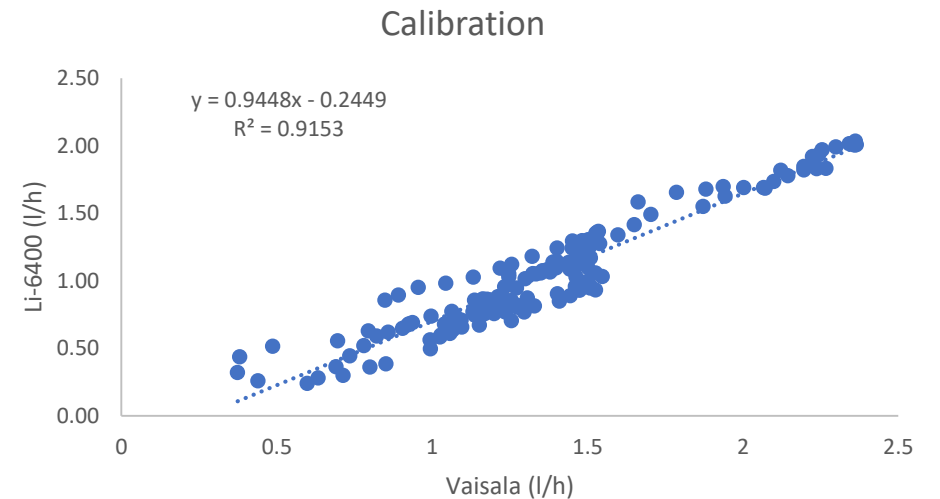
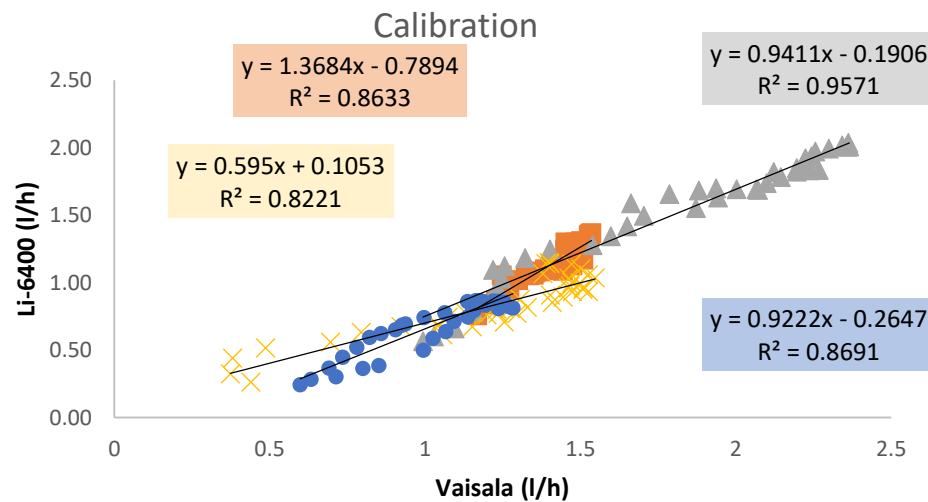
$$k_{cb} = \text{Transpiration} / ETo$$



Effects of canopy size and water stress over the crop coefficient of a “Tempranillo” vineyard in south-western Spain

J. Picón-Toro · V. González-Dugo · D. Uriarte ·
L. A. Mancha · L. Testi

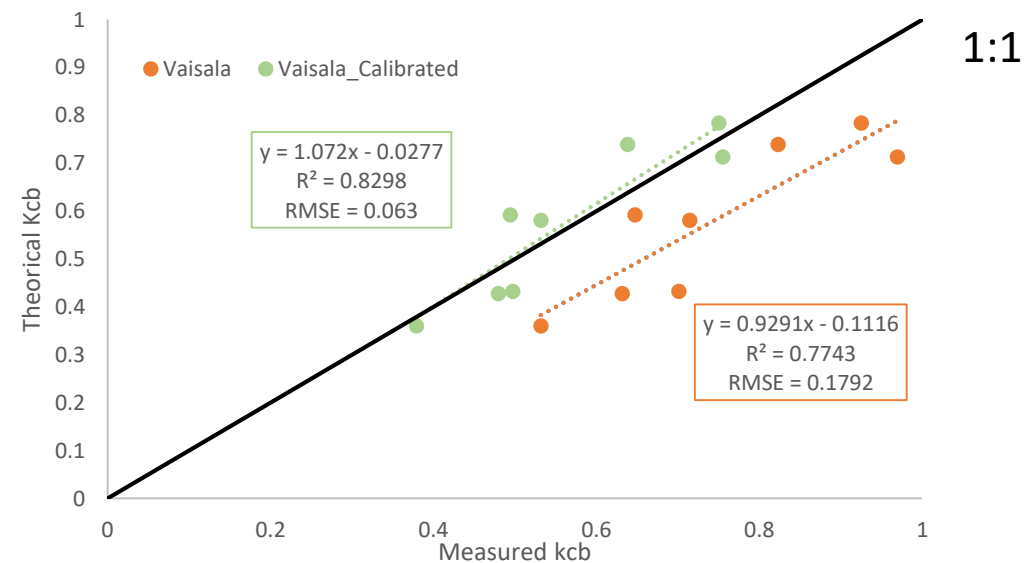
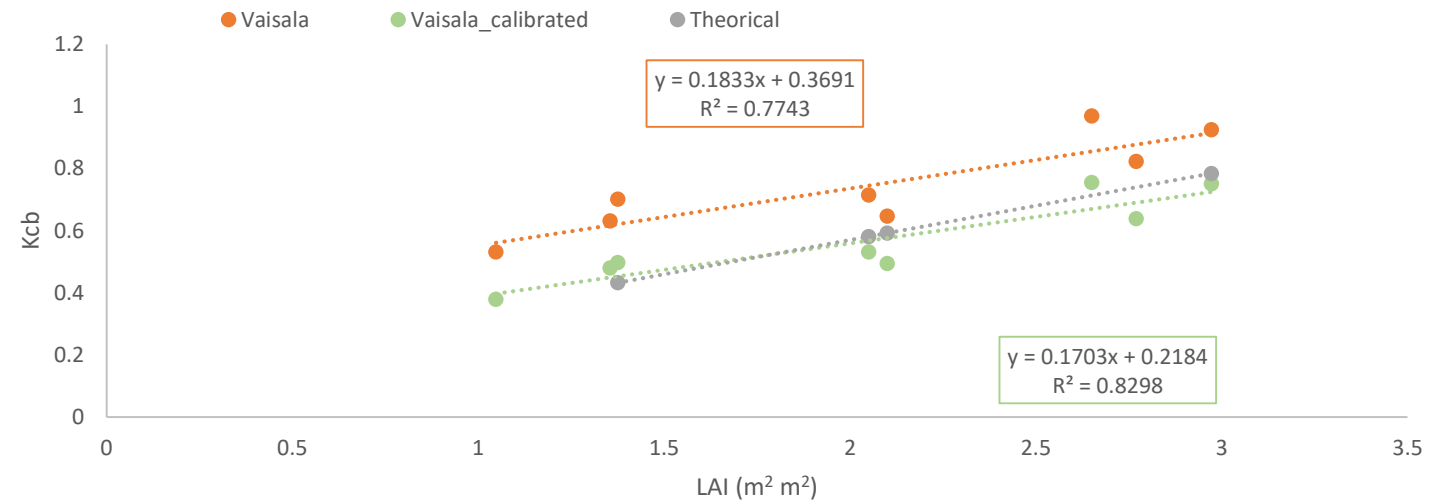
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Vaisala Calibrated validation:

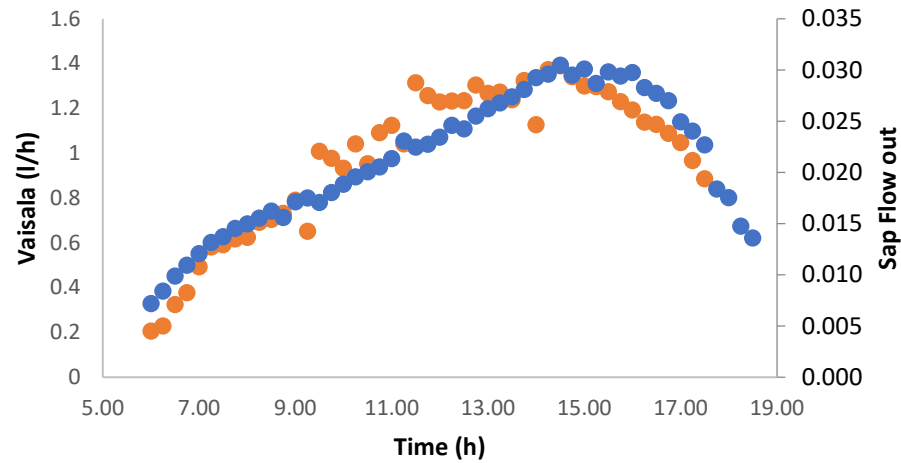
$$k_{cb} = \text{Transpiration} / ETo$$

We used the calibration to other whole canopy chambers without Licor-6400 measurements

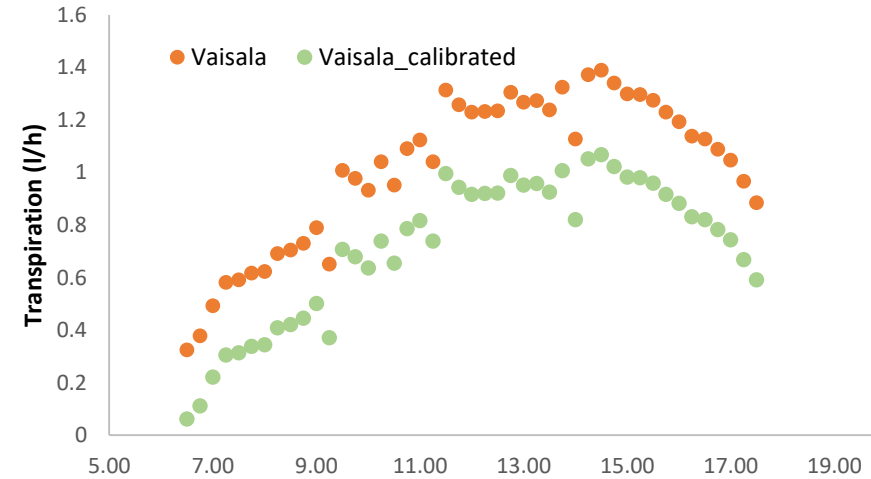


Sap flow double calibration:

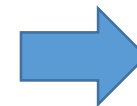
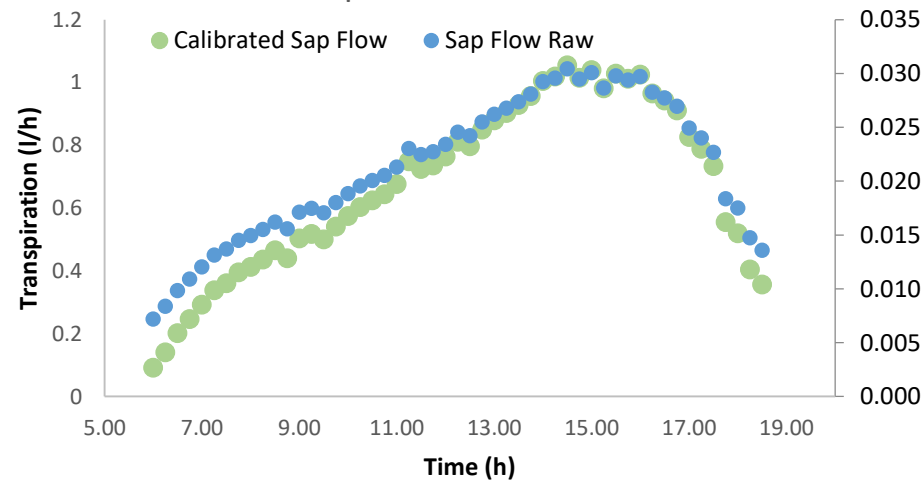
Non calibrated



Vaisala Calibration



Sap flow calibration



$$K_{cb} = 0.40 \approx 0.37 \text{ (theoretical)}$$

Conclusions:

- Sap flow sensors need to be calibrated for a whole day and at different days of the year
- Vaisala calibration with Li-6400 improved the data
- Vaisala-sap flow Double calibration is a good choice in case of spatial limitation for using portable gas exchange system system
- Vaisala calibration is cheaper than using several portable gas exchange systems
- Vaisala system allow to measure transpiration continuously

THANK YOU!

