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Laboratory lysimeters and proximal sensing data for optimizing irrigation water needs

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Objectives

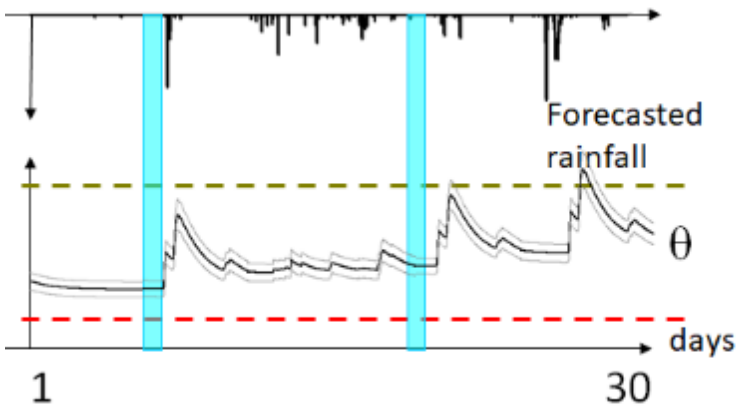
Laboratory experiments with a lysimeter which is fully equipped to measure all the processes of the hydrological cycle

1. Monitoring of soil moisture profiles and the different hydrological processes in the laboratory lysimeter

2. Definition of the irrigation water requirements for different crops

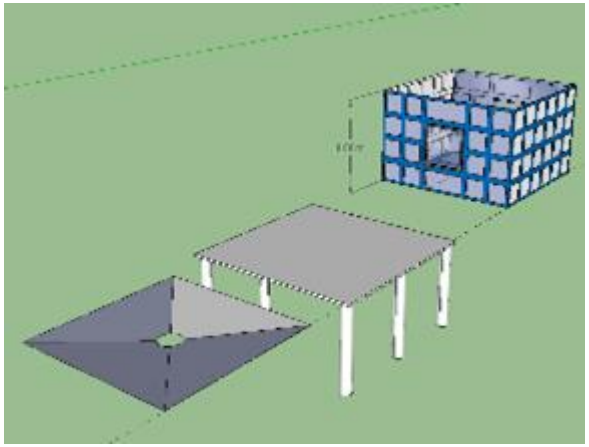
A weighing lysimeter is simply a large "flower pot"

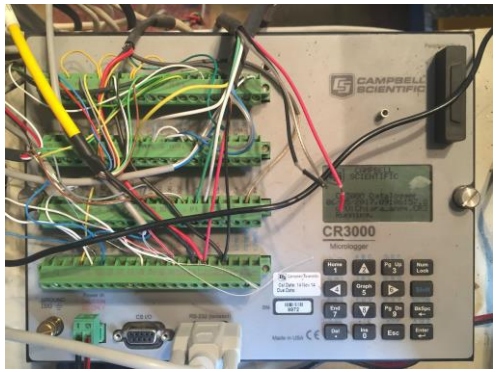
ENVLAB

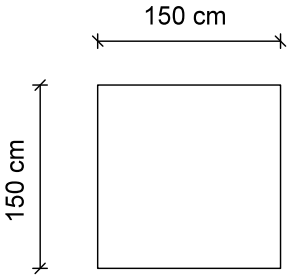


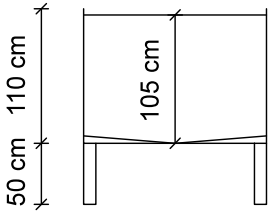
The lysimeter: project and instruments

Structure weight = 956kg
Soil volume = 2.25m^3



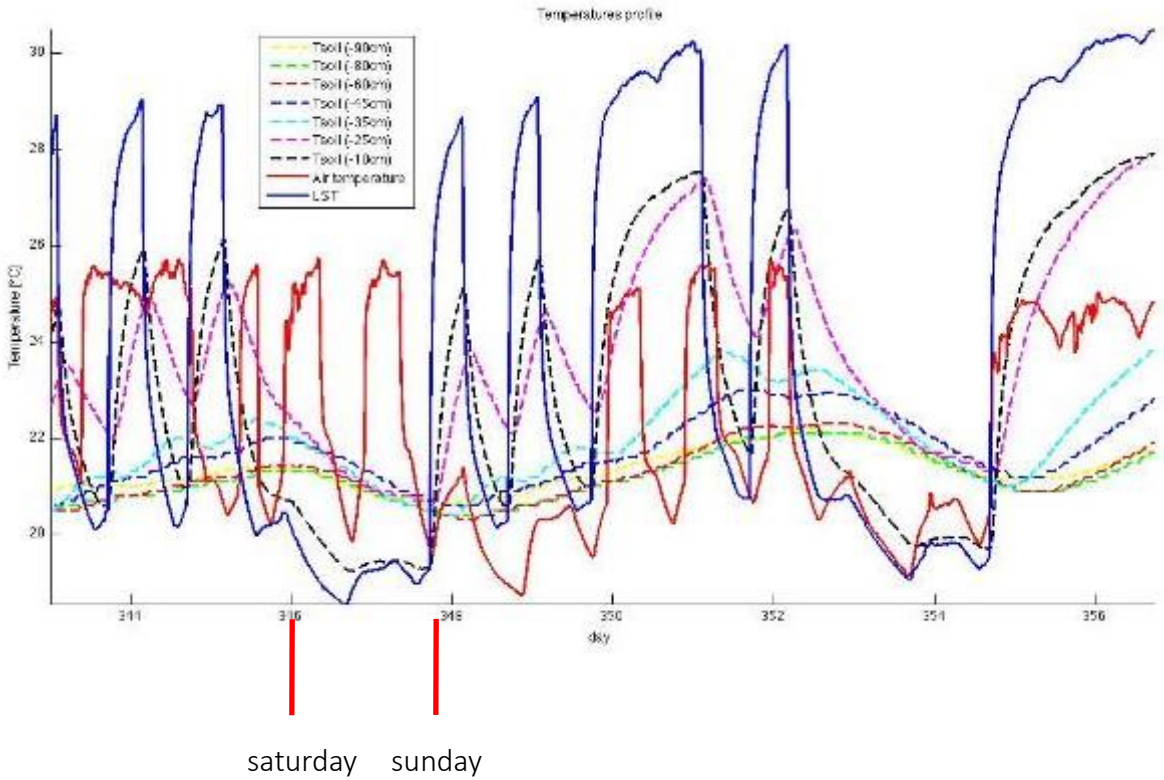




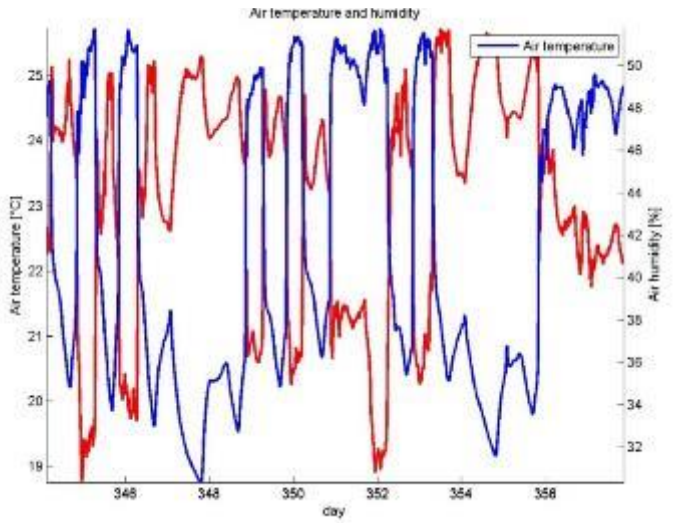


Meteorological conditions of the lab and temperature profiles

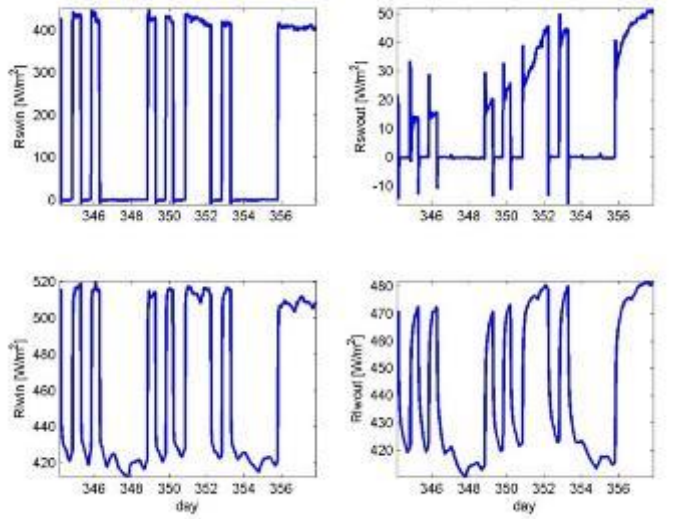
- Daily cycle for air temperature, LST and soil superficial Temperature
- Weekly cycle for the soil deeper probes



Air temperature and humidity

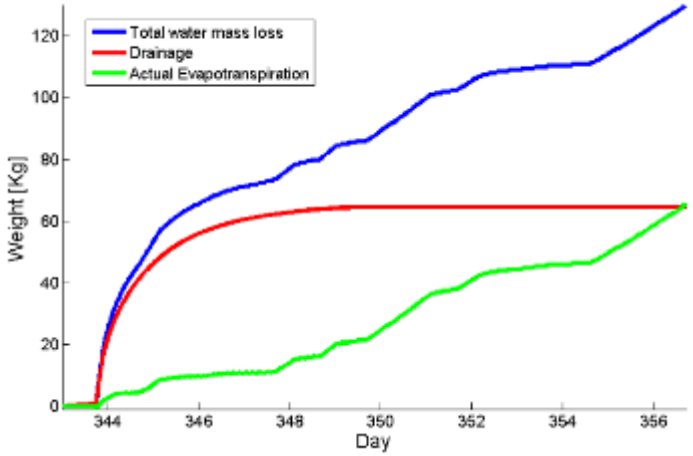


Net radiation



Evapotranspiration estimates and soil moisture profiles

Evapotranspiration estimated from the difference between the scale weight change and the drainage flux

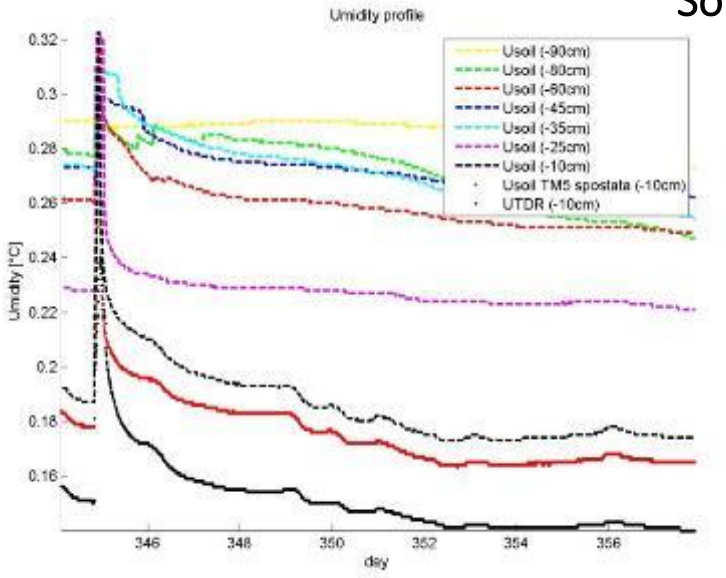


ET eff = DP - Q_{perc} = 68.38kg

DP ⟶ weight change (133kg)

Q_{perc} ⟶ drainage from rain gauges (64.62kg)

Soil moisture profiles

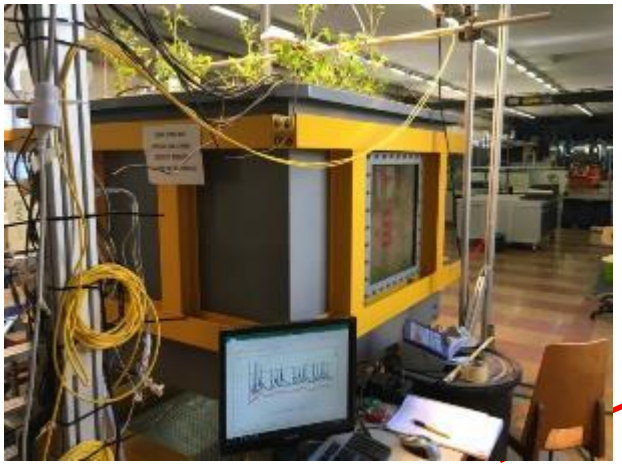


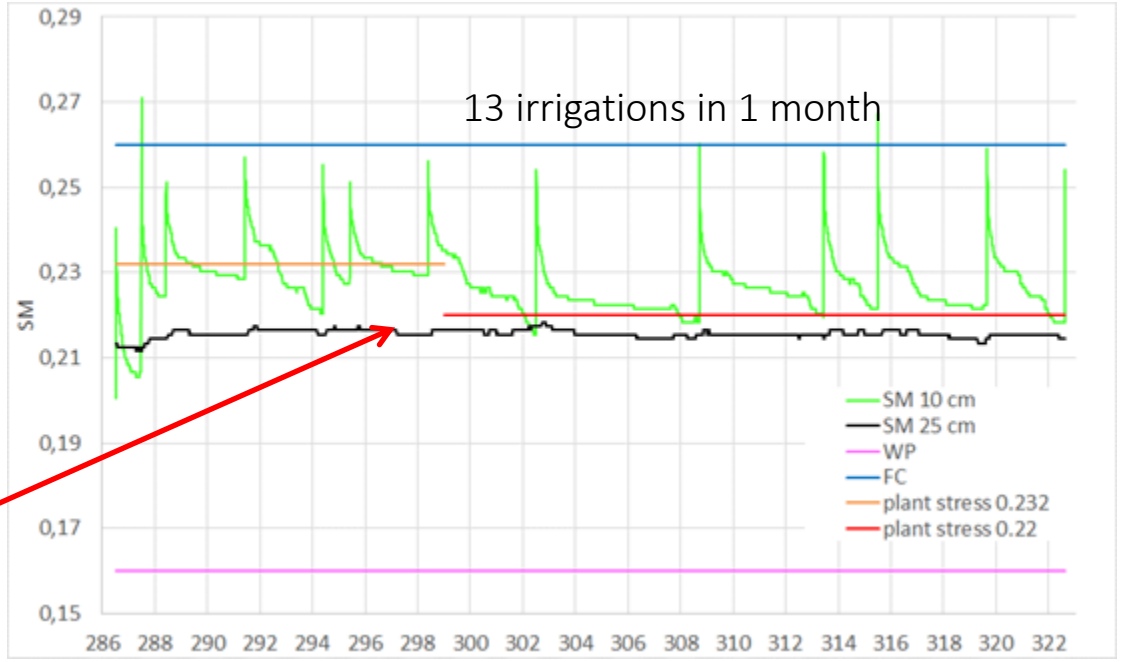
Saturation soil moisture value reached by the superficial probes (10 cm, 25 cm)

18 hours before irrigation
Just after irrigation
2 h after irrigation
27 h after irrigation
13 days after irrigation

What happens with vegetation? When to irrigate?

Triggering irrigation according to measured (or forecasted) **soil moisture** value and **plant stress threshold**



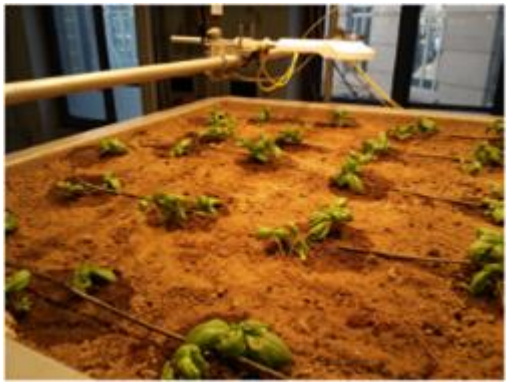


After 14 days the plant threshold (from FAO) is lowered

Stress threshold is a function of:
- soil type
- vegetation type
- vegetation growth stage
- climatology

(http://www.fao.org/)

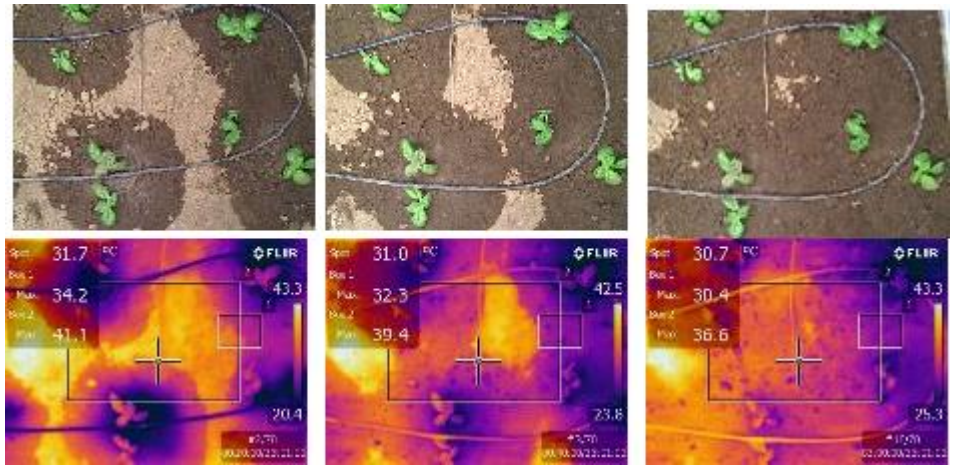
Basil planted on 12 october (day 286)



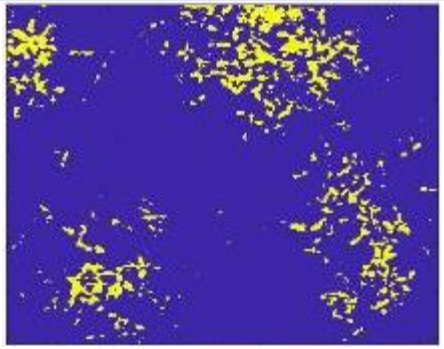
17 november (day322)

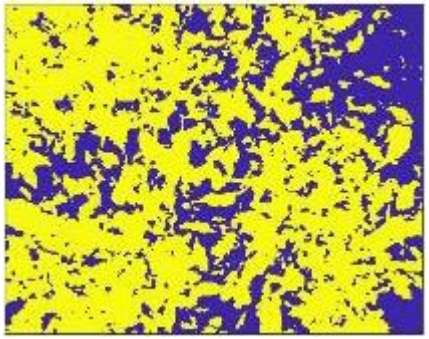
LST changes and Leaf area index estimation

13 october during irrigation



03/11	18/12





Vegetation fraction

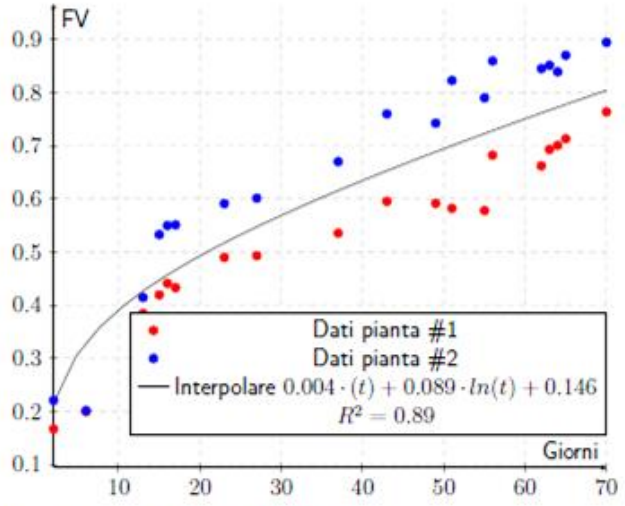
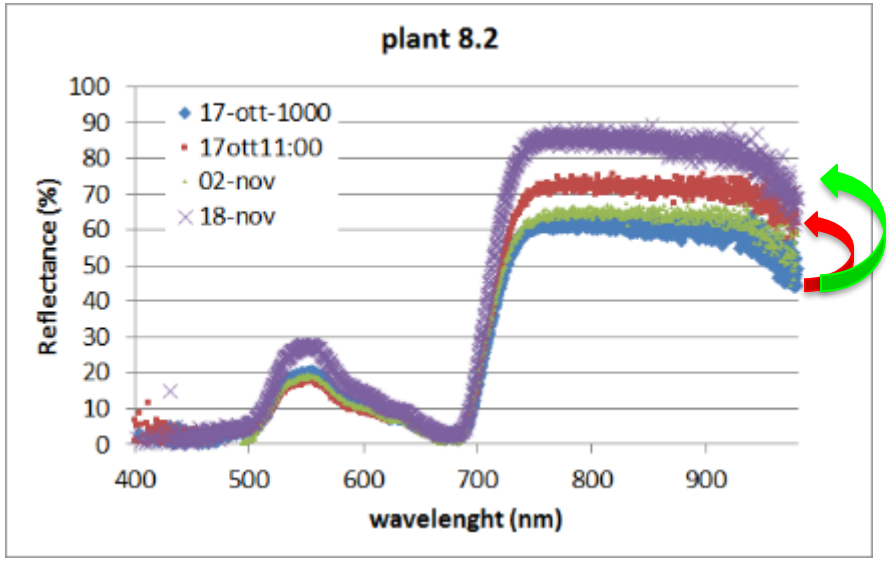
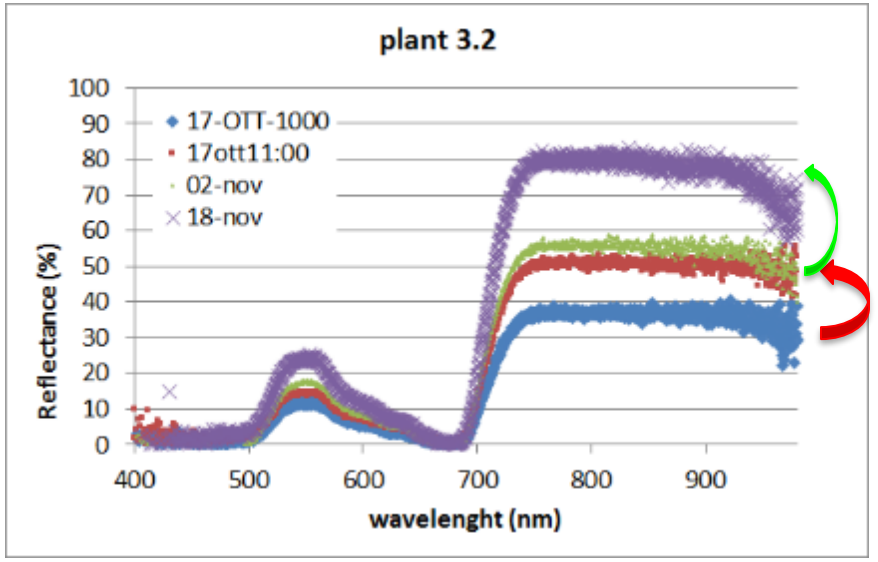


Figura 3.33: Andamento del valore di FV durante l'esperimento

Vegetation spectra and water content





1) Considerable difference in the spectra according to water stress: + VIS, -NIR

	SM		Days from last irrigation
17 october 2016 10:00	0.22	**Strees thr**	4
17 october 2016 11:00	0.251		1 hour after irrigation
2 november	0.221	**Strees thr**	5
18 november	0.23		1 day after irrigation

2) Plants are growing:
Large difference in the green and NIR bands from 17 october to 18 november

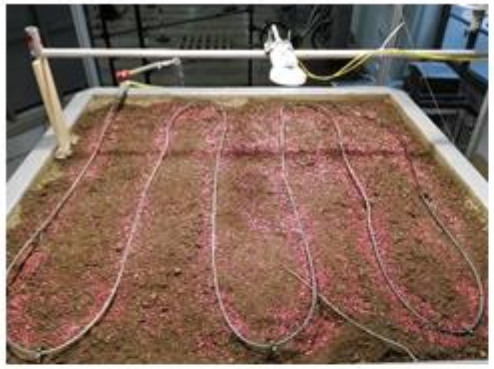
Conclusions … work in progress

- The instrumented lysimeter allowed to measured the different hydrological fluxes and soil mositure dynamics under different irrigation techniques

• Vegetation analysis allows to better define irrigation water needs

• Testing different irrigation volumes according to crop stress thresholds

18th Oct



3rd Nov

22th Nov

19th Dec