OZONO E VEGETAZIONE:
IL CONTRIBUTO DELLA RICERCA ITALIANA
(dieci anni dopo …)
Dipartimento di Scienze Agrarie, Alimentari e Agro-ambientali,
Università di Pisa

Role of urban and peri-urban forests in ozone removal: a case study in the Metropolitan city of Rome.

Fusaro[1] L., Salvatori[1] E., Mereu[2] S., Marando[1] F., Manes[1] F.

[1] Department of Environmental Biology, Sapienza University of Rome, p.le Aldo Moro, Italy.
[2] Departement of Science for Nature and Environmetal Resources, University of Sassari, Italy.
**lina.fusaro@uniroma1.it*

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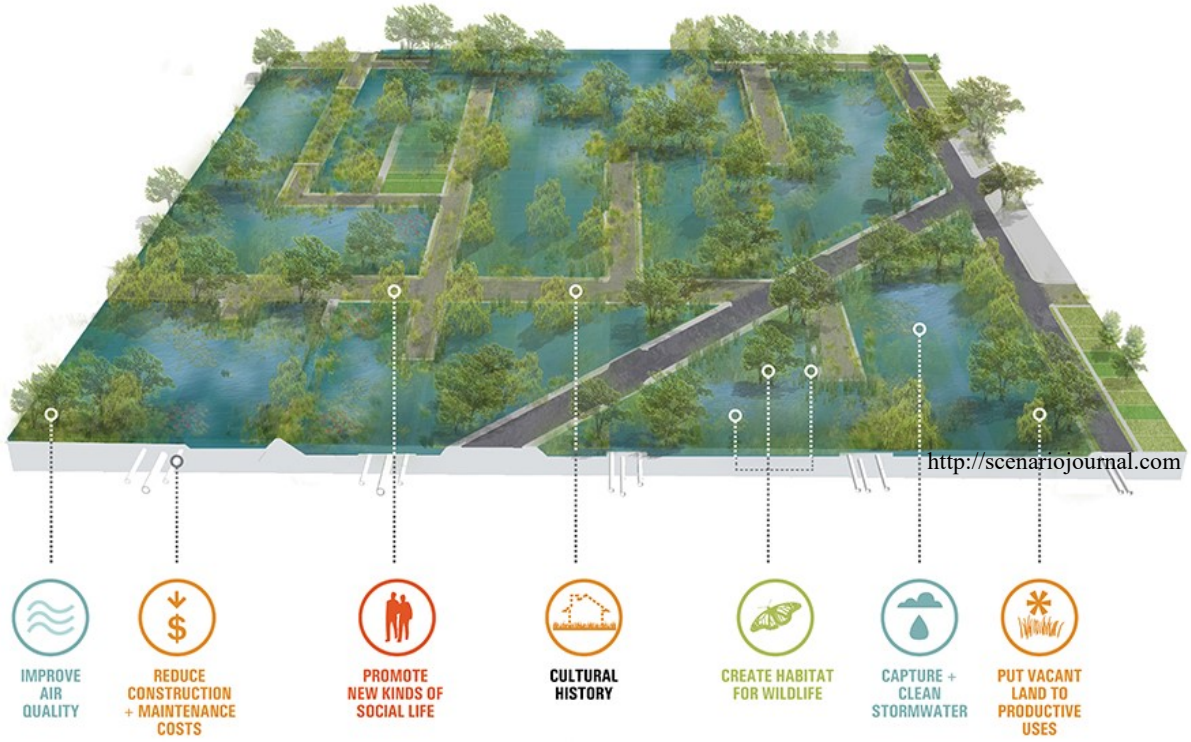
URBAN ECOSYSTEM and GREEN

Framework

Urban vegetation had direct or indirect effects on the air quality at local and regional scale i.e. microclimate regulation; pollutants removal

(Nowak et al., 2002; Manes et al., 2012; Barò et al., 2014)

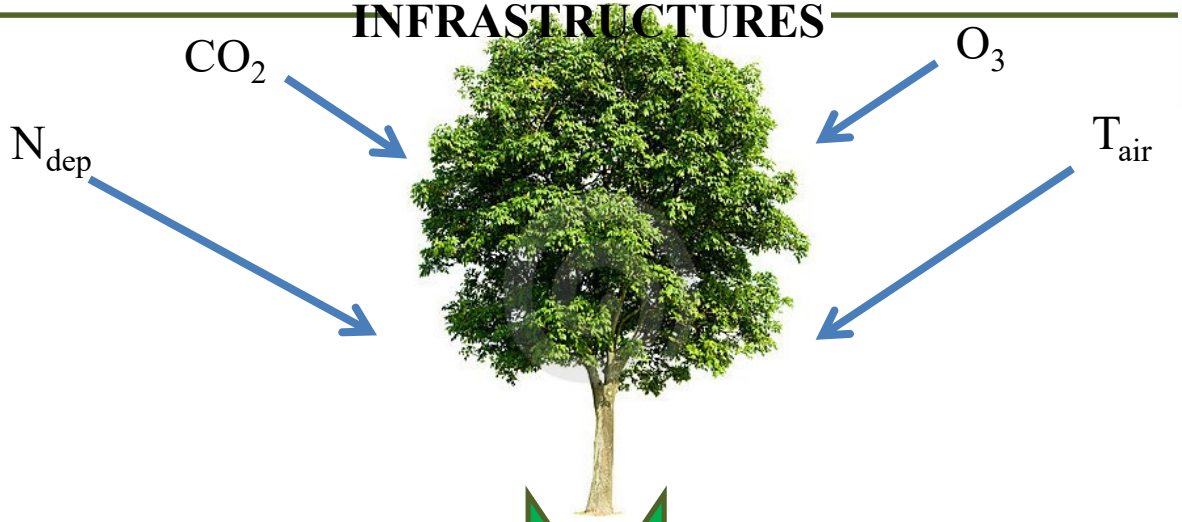


Assesment of Ecosystem Services (Lafortezza & Chen 2016)

Broad-scale assessments to extrapolate indicators, which measure the provision of ecosystem services for the entire landscape and/or region (*Strassburg et al., 2010*).

Single ecosystem service assessments in a small area using mathematical function able to explain the performance of the service (eg. pollutants removal) in relation to one or more proxy variables eg. gas exchange (*Harrington et al., 2010*)

STRESS IMPACT on GREEN INFRASTRUCTURES



LAI, gs, P_N, Phenology, growth

Key Environmental Services

Pollutant uptake, Runnoff reduction,
Microclimatic effect,
Carbon sequestration.

URBAN PLANT PHYSIOLOGY

Calfapietra et al., 2015

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How the environmental differences
among the two
UF affect functionality of *Quercus ilex* L.
and consequentely
its capacity to ameliorate the air quality

Quantify the contribution of urban and periurban forests to air quality improvement in the metropolitan area of Rome, assessing the O_3 removal.

Experimental SET UP (2013-2014)

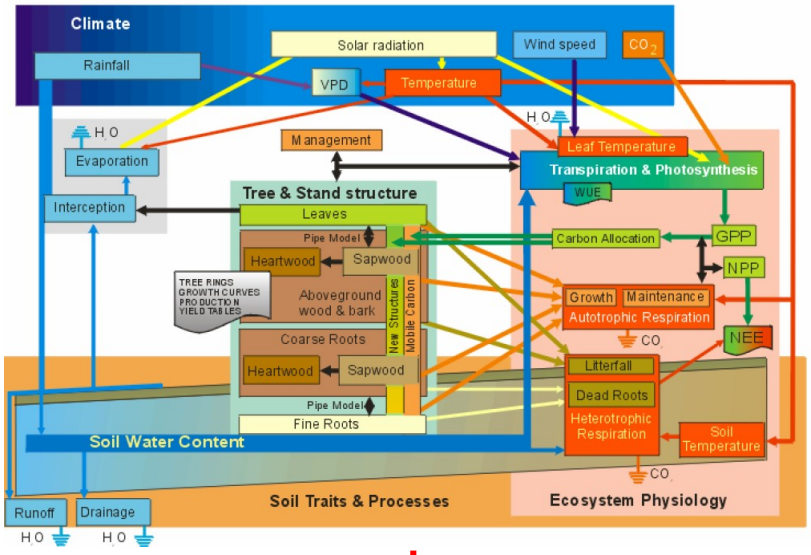
Assessment of vegetation structural attributes: DBH, crown diameter, basal area;

Leaf Water Potential:
pre-dawn and midday water potential (Ψ_{PD}; Ψ_{MD}) tramite camera di Scholander (PMS Instruments, Oregon, USA); Water use strategy;

Gas Exchange Measurements:
Assimilation (P_N, $\mu molCO_2\ m^{-2}s^{-1}$), Stomatal conductance (gs, $mmolH_2O\ m^{-2}s^{-1}$), Leaf traspiration (E, $mmolH_2O\ m^{-2}s^{-1}$), Leaf dark respiration (R_D, $\mu molCO_2\ m^{-2}s^{-1}$).

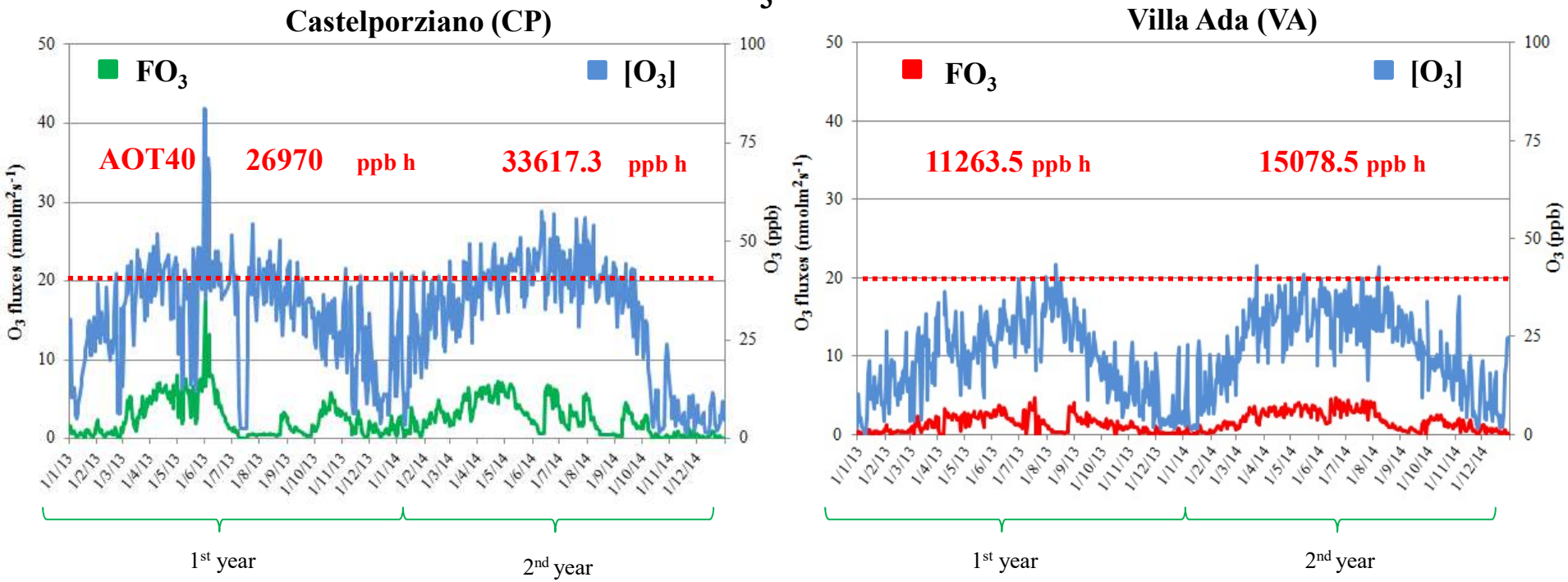
Environmental parameters
air temperature, °C,
Precipitation, mm
O_3 concentration

Gotilwa +



$$FO_3 = Gs_{canopy} * [O_3] * 0.613$$

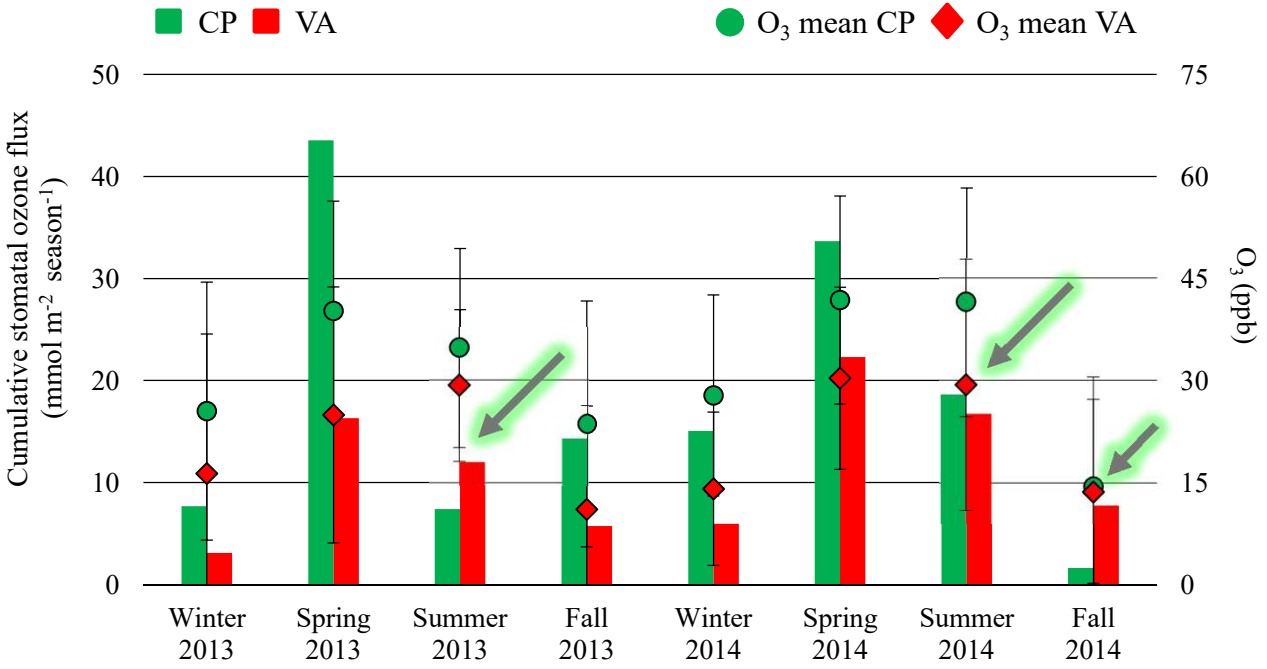
O_3 Fluxes

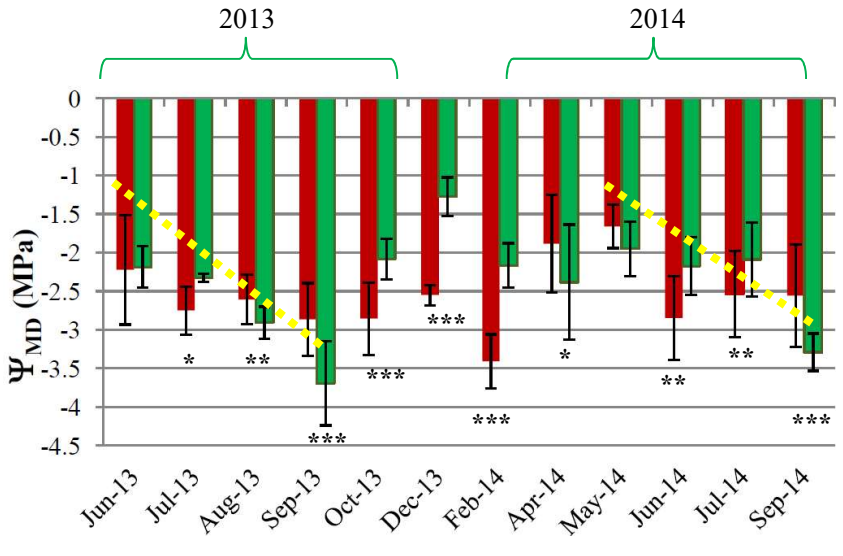


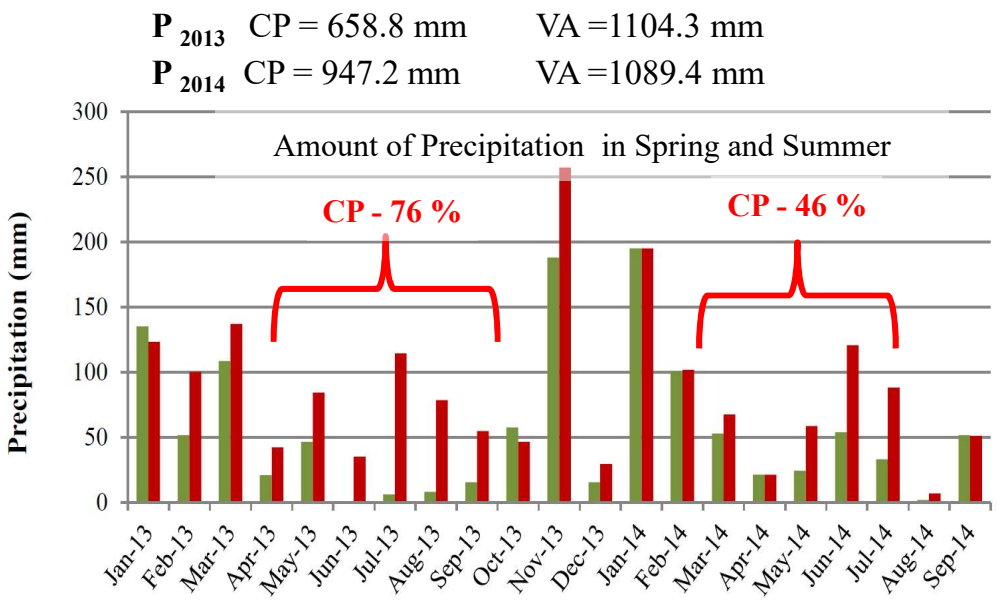
Stomatal behavior and responsiveness to VPD differed between the two sites.

		CP	*VA*
gs_{max}		241.4	262.6
f_{VPD}	VPD_{max}	2.60	3.50
	VPD_{min}	4.30	5.30

O_3 fluxes : seasonal estimate of removal potential

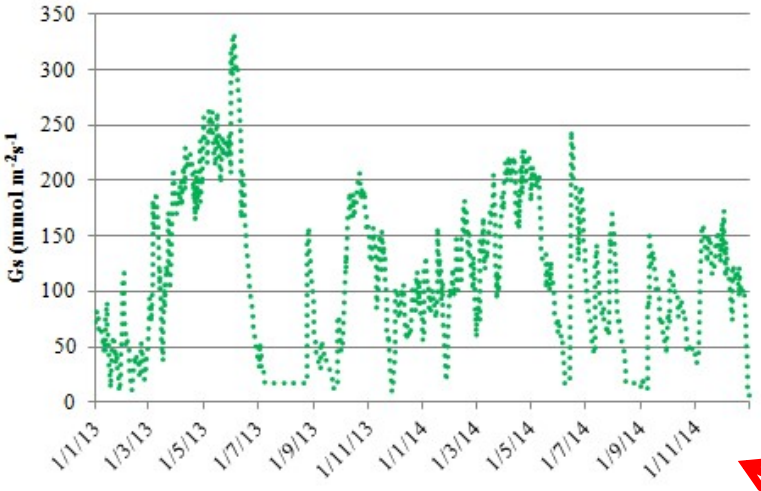


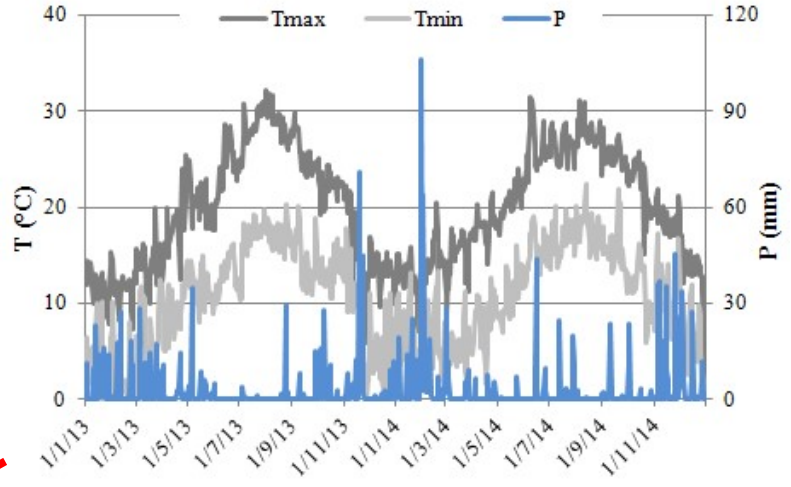




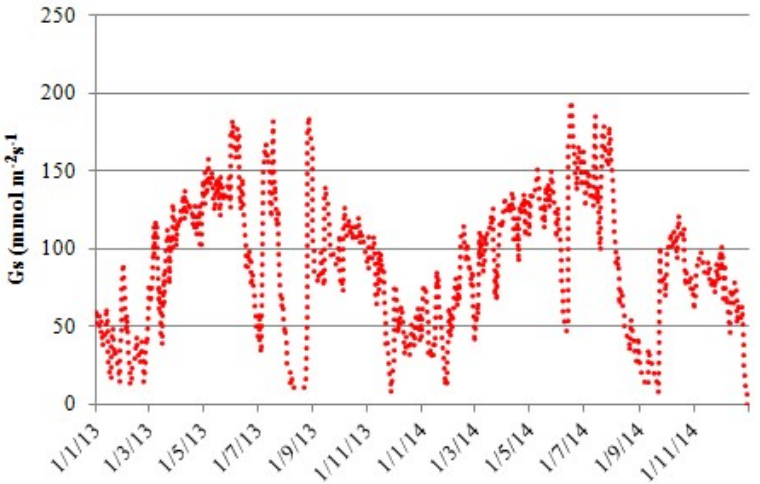
SIMULATIONS

Castelporziano

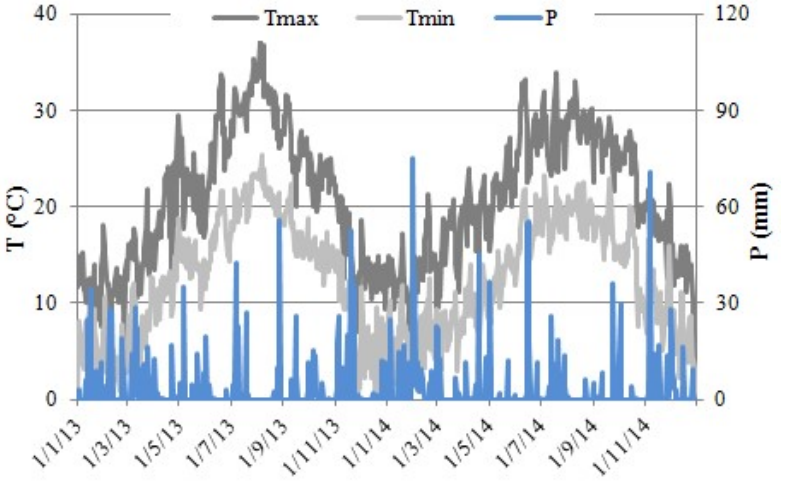




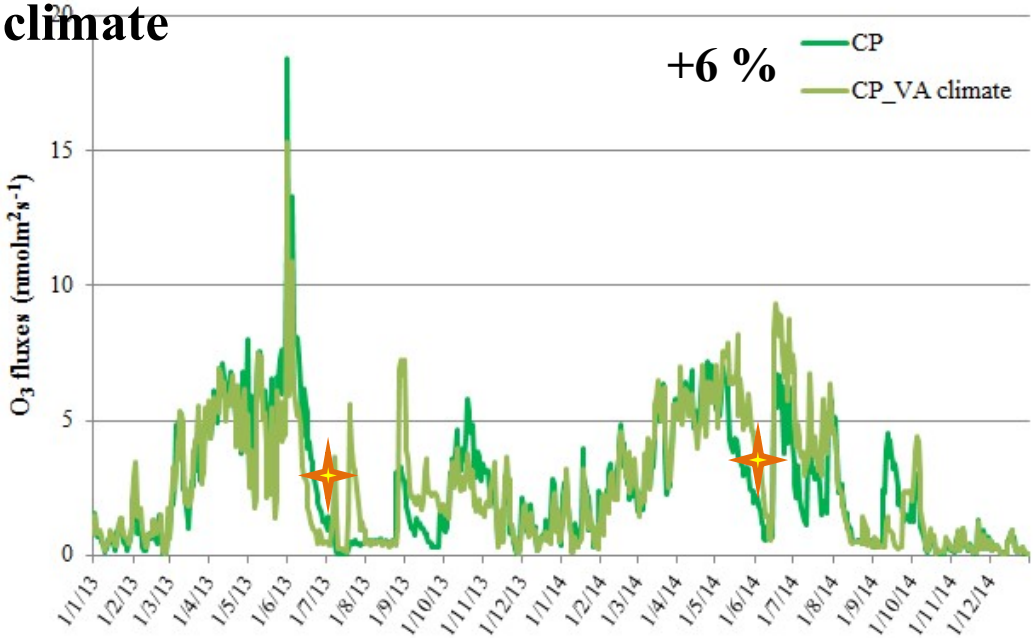
Villa Ada



+ irrigation

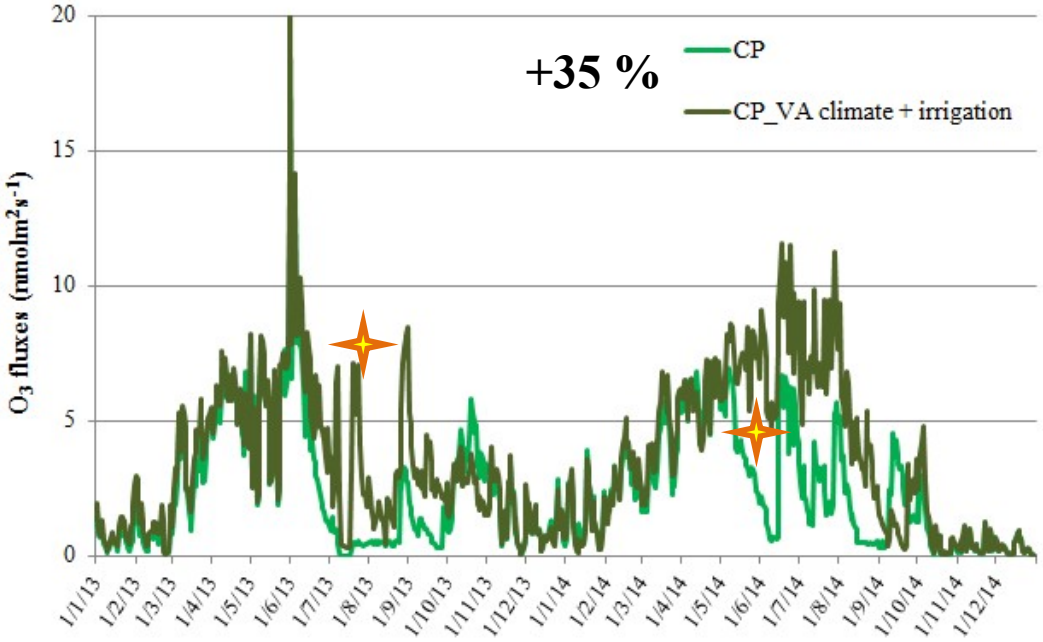


O_3 fluxes in the peri-urban forest: estimate of removal potential under different climate

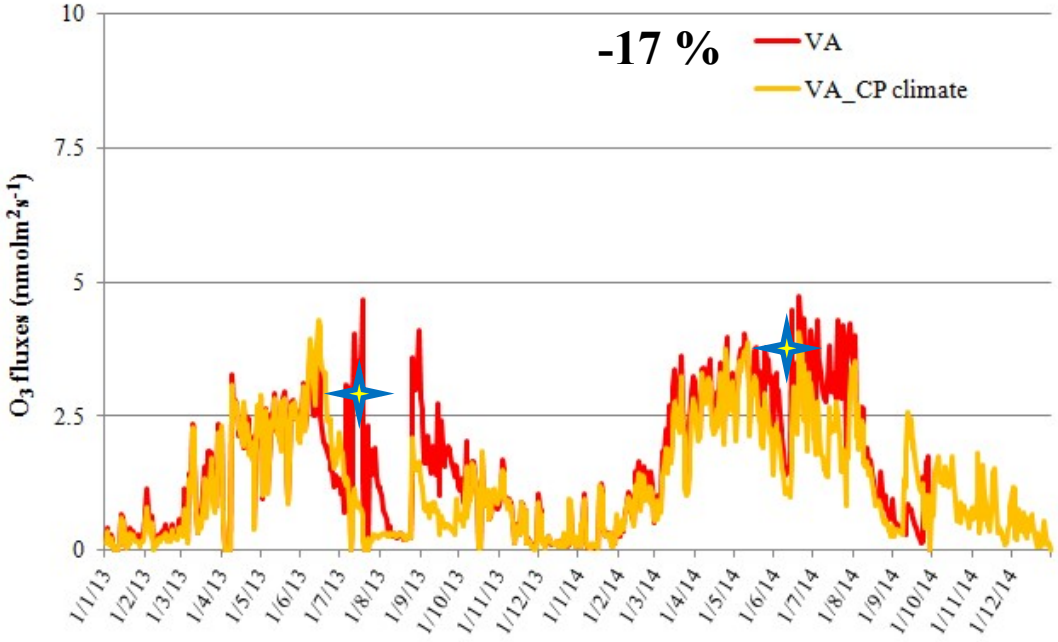


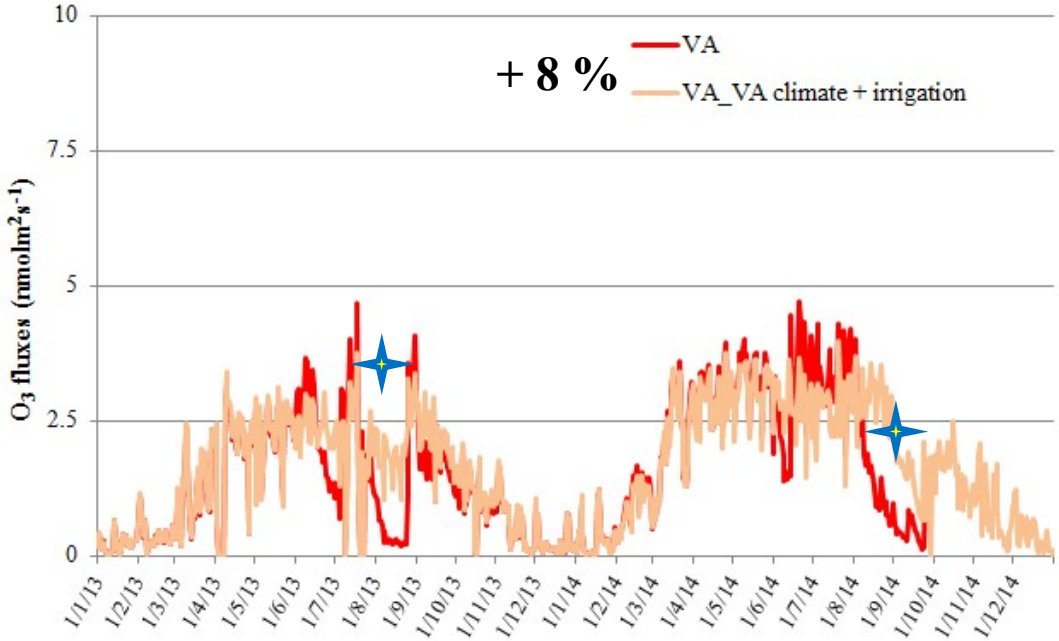
Increase of Gs_{canopy} during the summer
(no water stress in urban site)

Decrease of Gs_{canopy} during the spring
owing to fast stomatal responce to T_{air} and VPD
(Manes et al., 2007)



O_3 fluxes in urban forest : estimate of removal potential under different climate





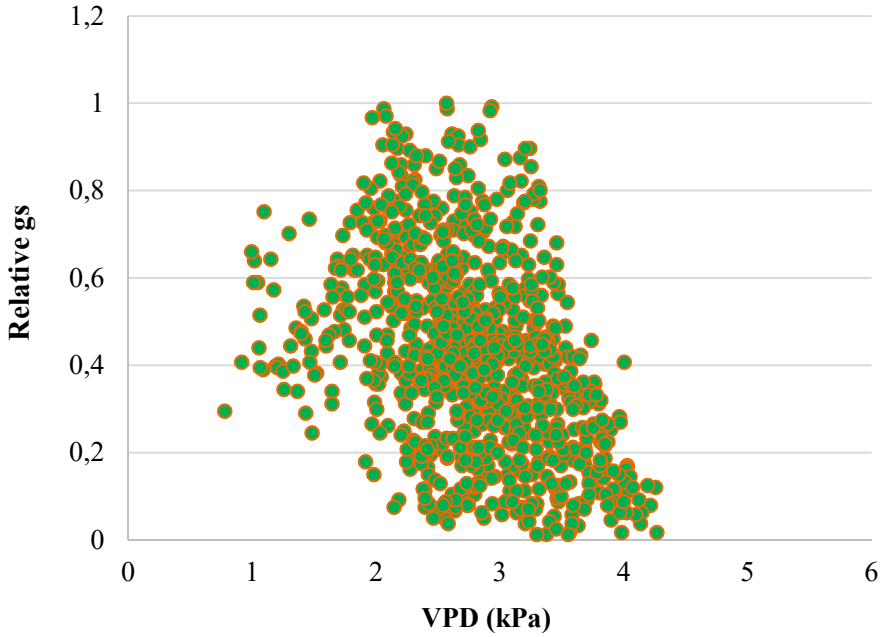
Urban and peri-urban forests can play an important role in air quality amelioration.
Increase the quality and quantity of Green Infrastructure in urban and peri-urban areas should contribute to mantain and improve the temporal continuity of the Ecosystem Services supplied

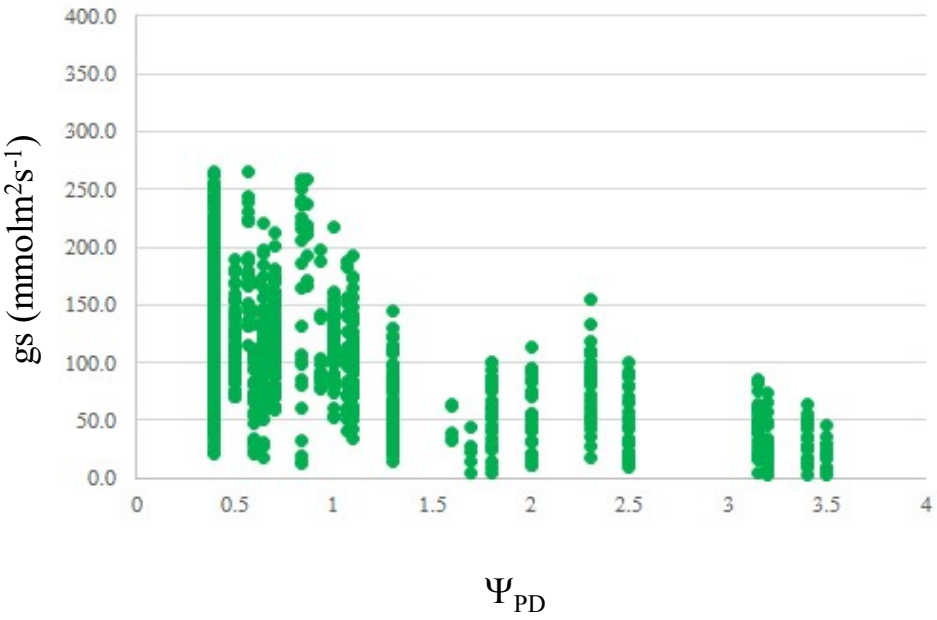
Pay attention in applying oversimplified models to the sites where environmental conditions and management practices may greatly differ and accordingly ecophysiological responses of the same species

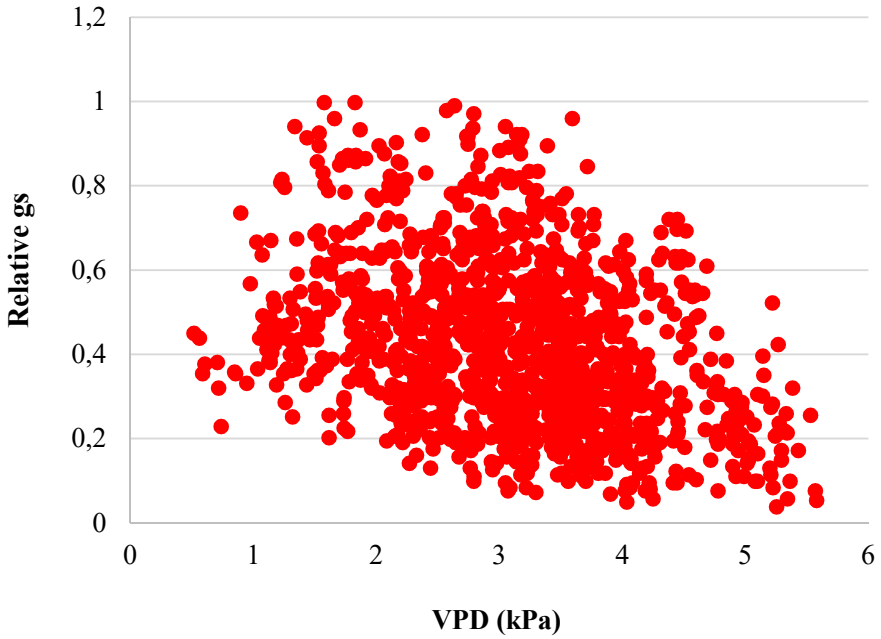
…Future Perspective

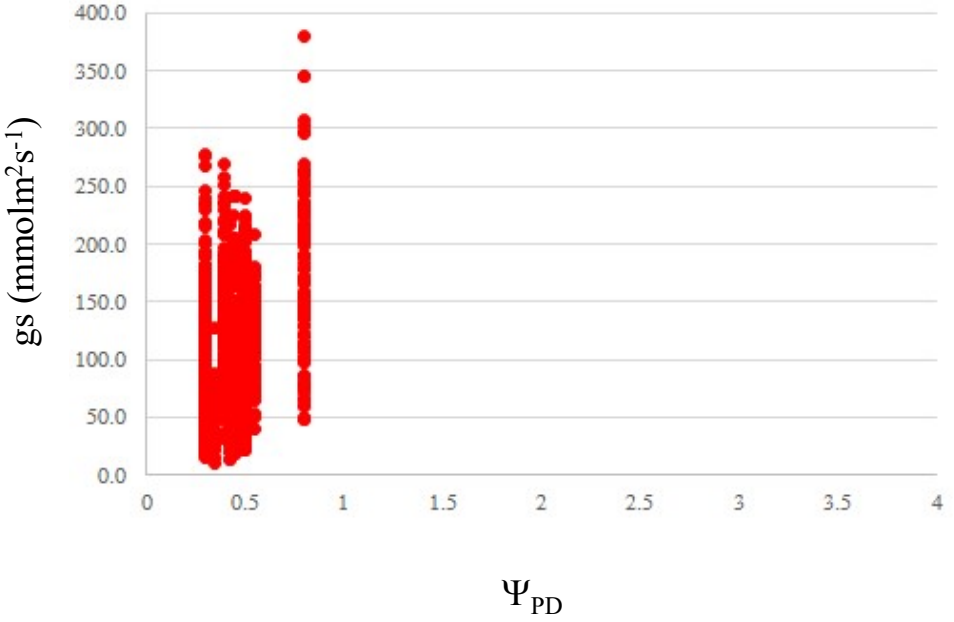
Next steps involve the exploitation of measured data to analyze the plasticity of *Q. ilex* to evaluate the actual ability of this species to modify its functional performance in a changing environment


...Thank you
for your attention


Relative gs
1,2
1
0,8
0,6
0,4
0,2
0
0
1
2
3
4
5
6
VPD (kPa)


gs (mmolm²s⁻¹)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0
0.5
1
1.5
2
2.5
3
3.5
4
ΨPD


Relative gs
1,2
1
0,8
0,6
0,4
0,2
0
0
1
2
3
4
5
6
VPD (kPa)


gs (mmolm²s⁻¹)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
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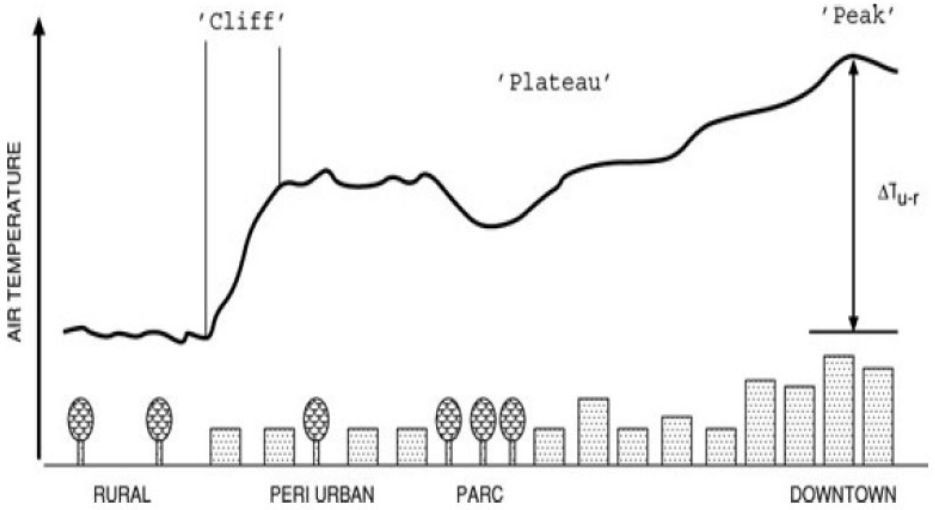
0.5
1
1.5
2
2.5
3
3.5
4
ΨPD



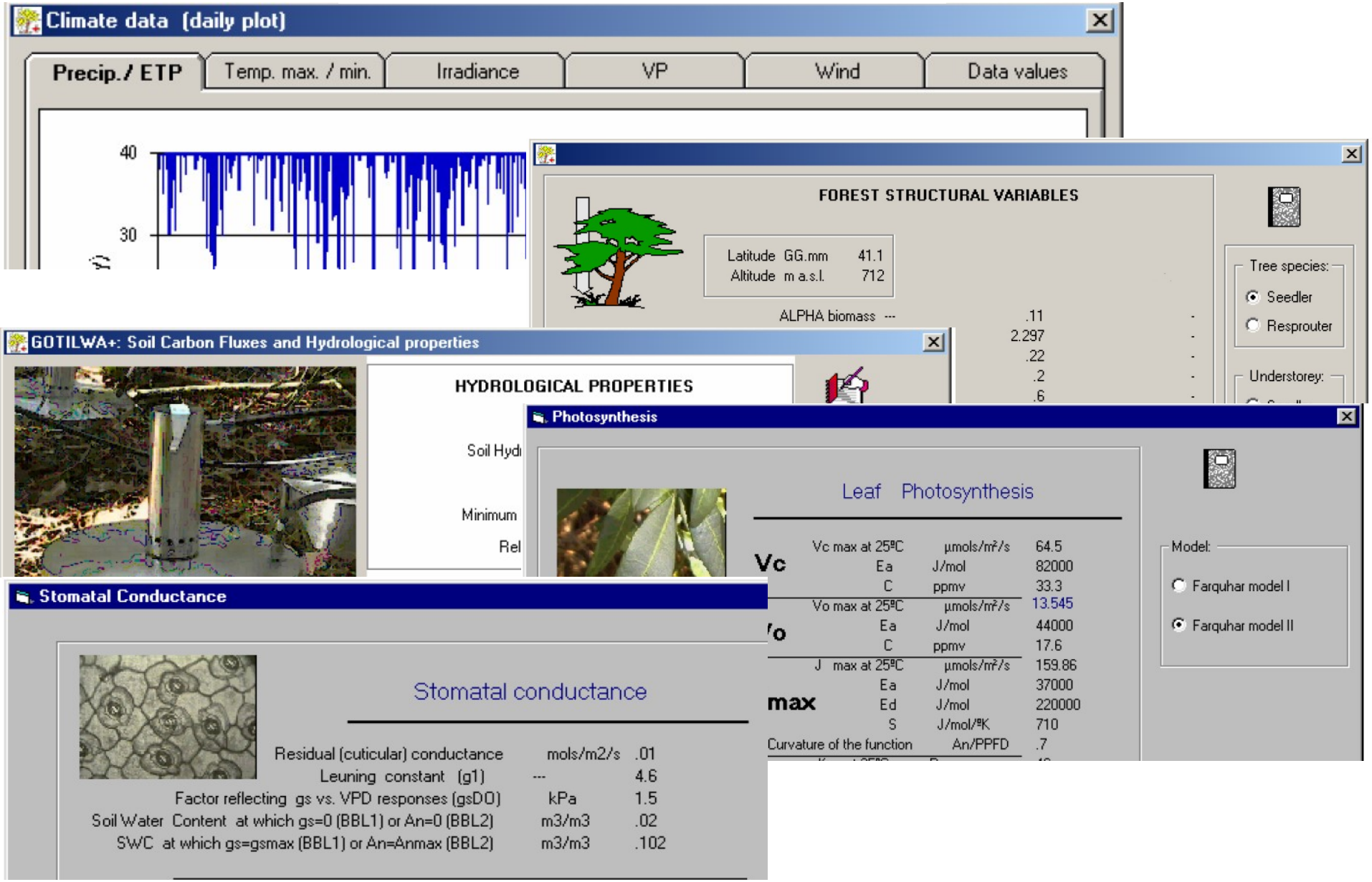
Hidalgo et al., 2008

	T (°C)		VPD (mbar)	
Mounth	**CP**	**VA**	**CP**	**VA**
Jun-13	32.59± 1.1	**35.66± 1.8**	32.06± 3.2	**42.73± 6.8**
Jul-13	31.87± 1.1	**32.72± 1.6**	28.27± 2.9	**34.31± 4.5**
Aug-13	32.83± 0.9	**33.33± 2**	36.67± 3.2	**40.13± 7.6**
Sep-13	27.83± 2.1	27.67± 1.2	**28.63± 3.2**	27.72± 3.05
Oct-13	**28.39± 1.2**	27.97± 3.2	26.64± 2.0	**29.98± 6.2**
Dic-13	**18.14± 1.9**	15.93± 2.9	**12.79± 2.1**	11.77± 2.9
Feb-14	23.55± 1.2	23.67± 2.4	20.21± 2.4	**22.10± 3.7**
May-14	28.96± 1.6	**30.20± 1.5**	28.66± 4.3	**31.92± 4.4**
Jun-14	31.28± 1.1	**32.53± 1.6**	25.47±2.5	**35.25± 5**
Jul-14	32.07± 1.1	**33.12± 2.1**	31.39±3.2	**37± 6.8**
Sep-14	30.92± 1.3	30.35± 2	**24.73±3.1**	21.63± 4.7

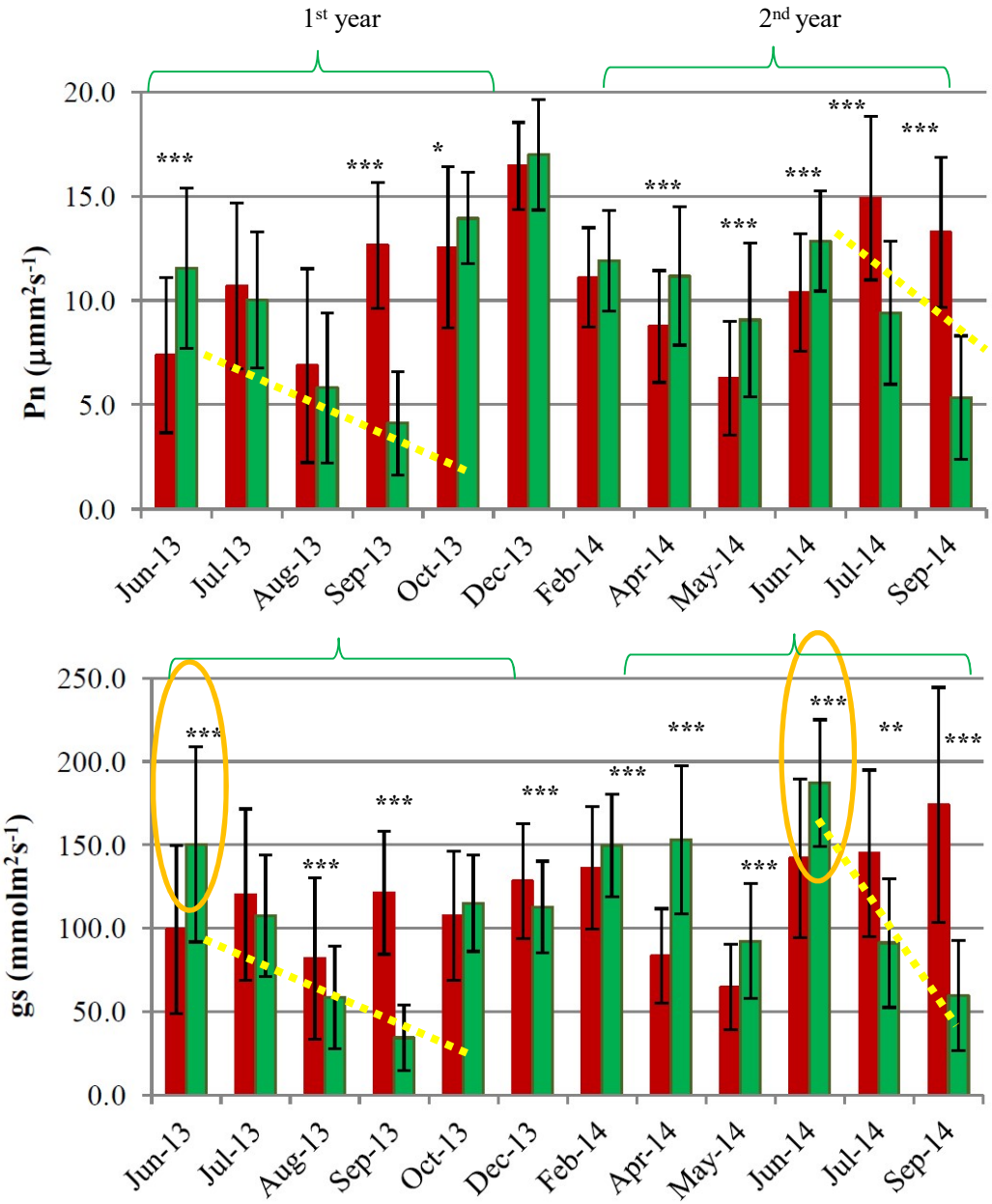
GOTILWA+

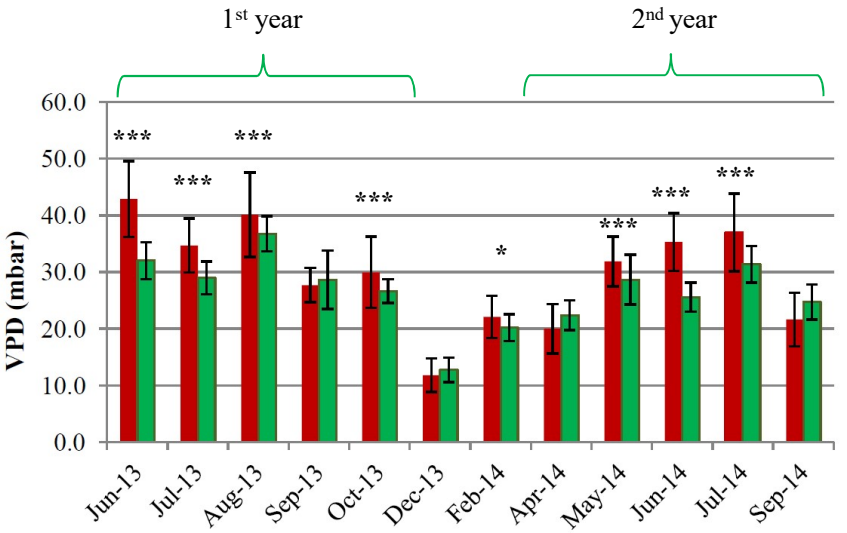
An integrated model of forest growth

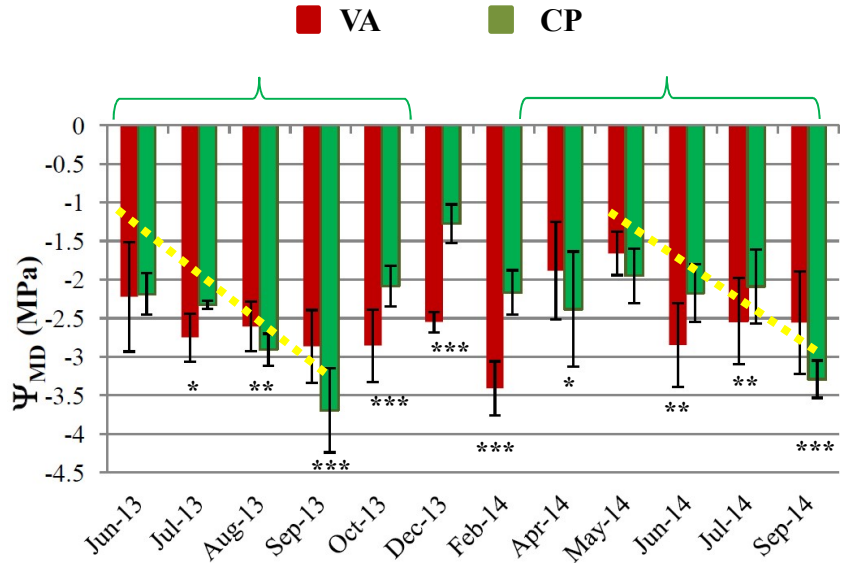
(Gracia et al., 1999)



SEASONAL TREND of GAS EXCHANGES:
Influences of soil water availability and evapotraspirtaive atmospheric request

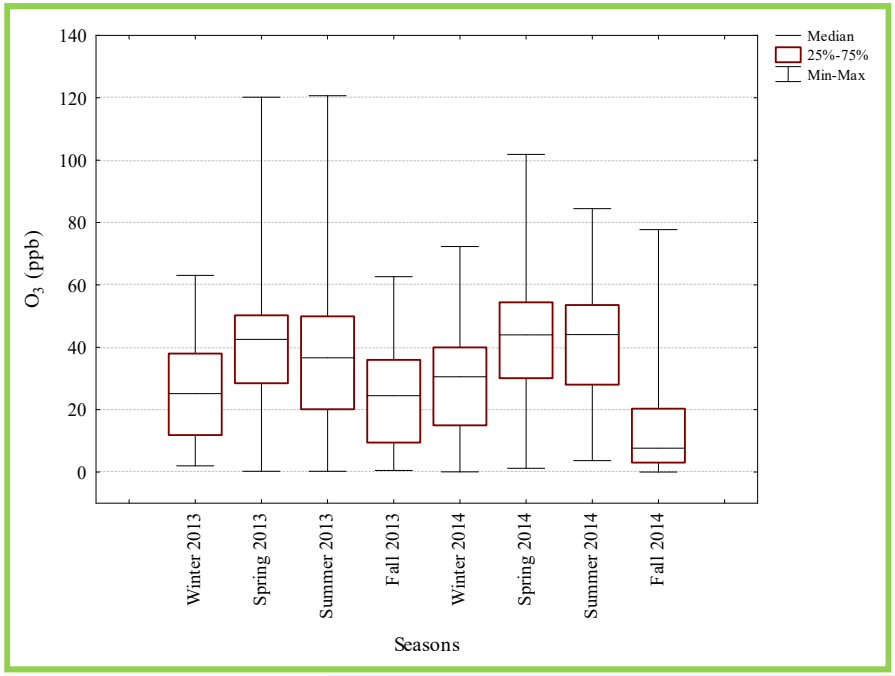




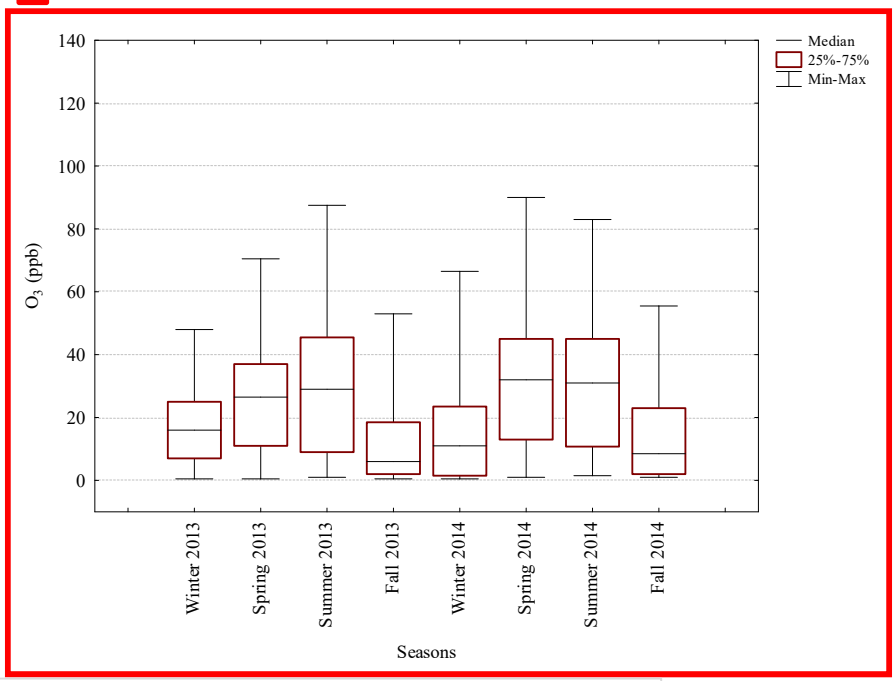


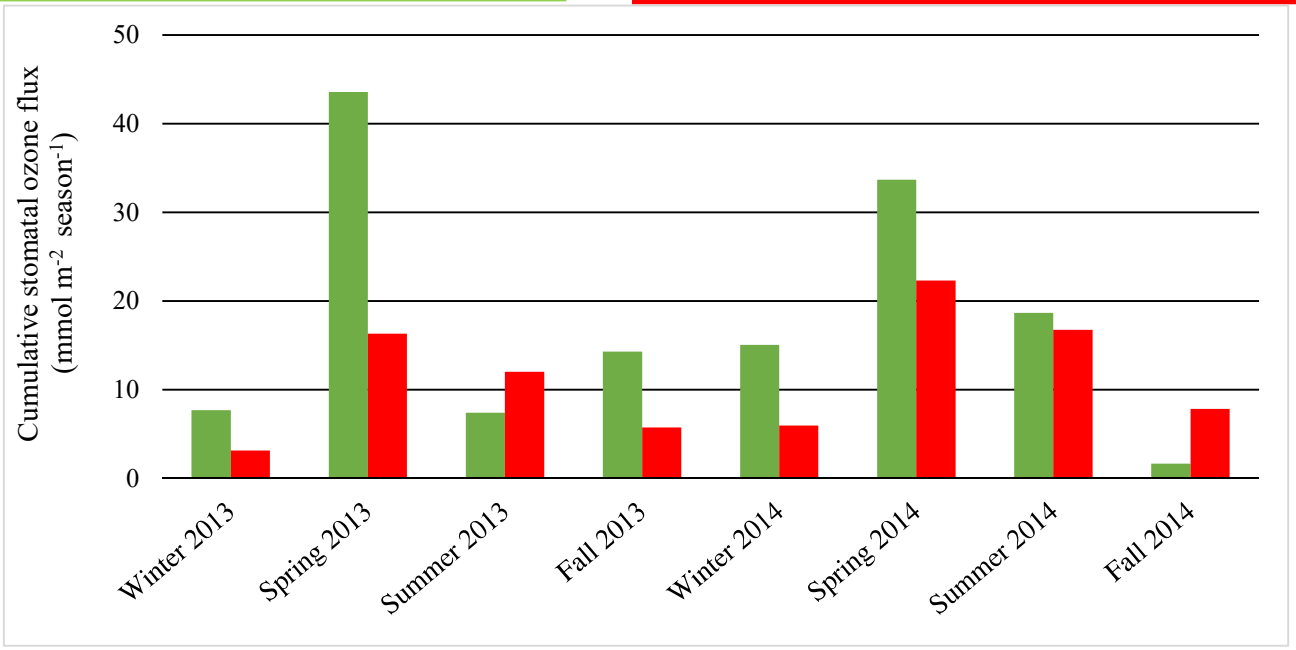
O_3 fluxes : seasonal estimate of removal potential

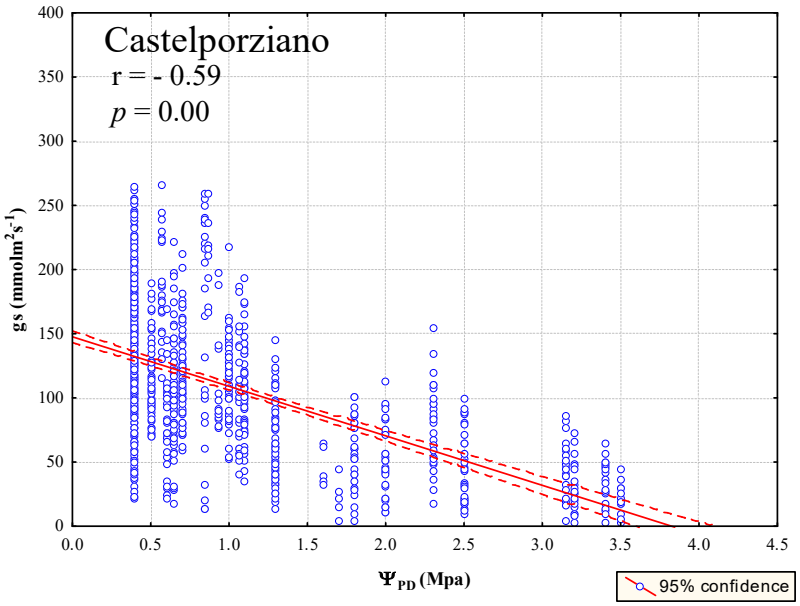
CP

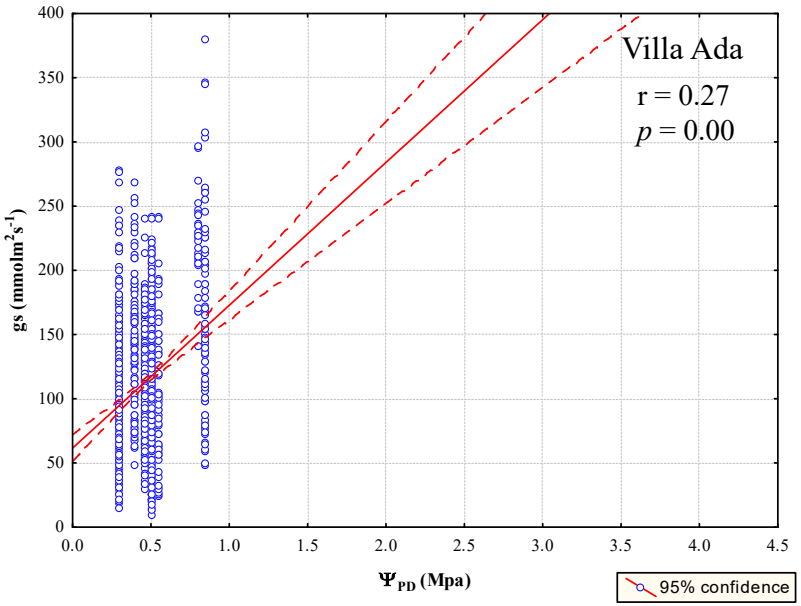


VA






Castelporziano
r = - 0.59
p = 0.00
gs (mmolm-2s-1)
ΨPD (Mpa)
95% confidence


Villa Ada
r = 0.27
p = 0.00
gs (mmolm-2s-1)
ΨPD (Mpa)
95% confidence

Relationship between gs and midday Leaf water Potential: involvment for O_3 removal potential