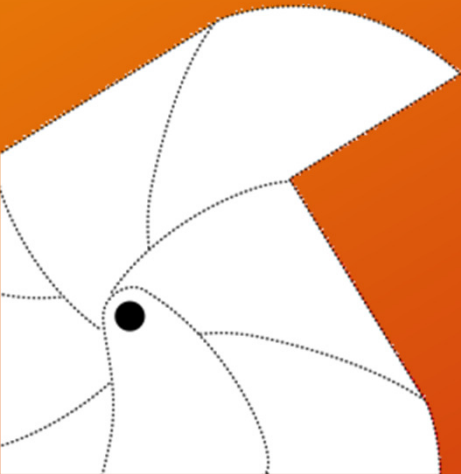


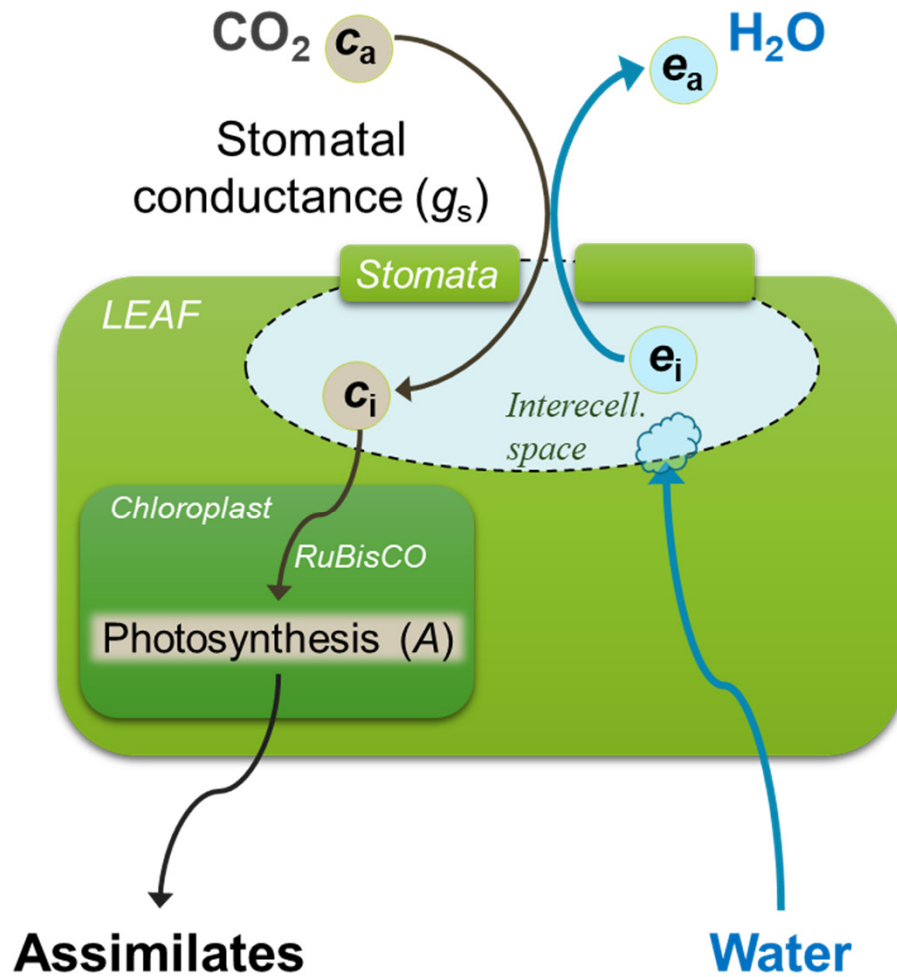
Stomatal response to VPD from gas exchange measurements conceptual and methodological challenges

Juan Pedro Ferrio, Domingo Sancho-Knapik,
José Javier Peguero-Pina, Ana López-Ballesteros,
Miquel Nadal, Eustaquio Gil-Pelegrín

ARAID / Dpto. Sistemas Agrícolas, Forestales y alimentarios, CITA



Drought: soil and atmosphere

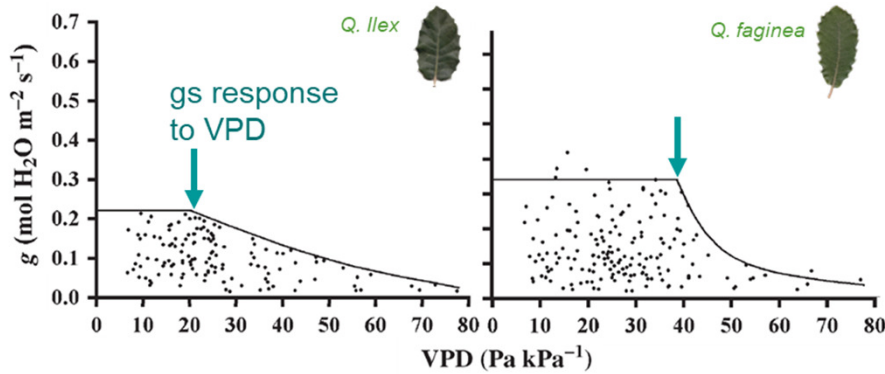


Response to VPD

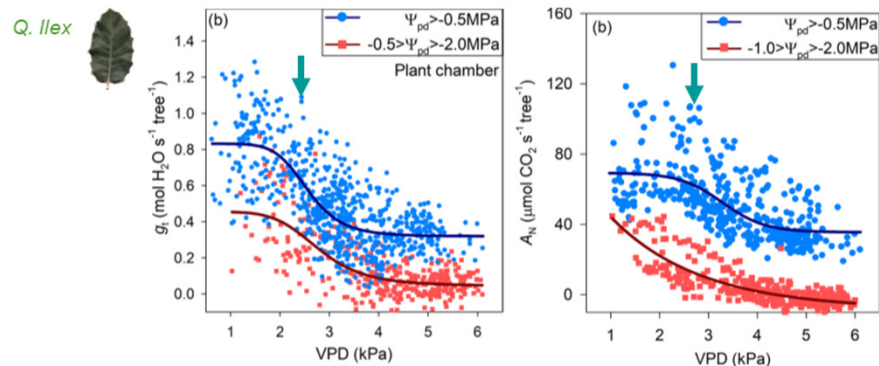


➔ Stomatal response to VPD is species-specific

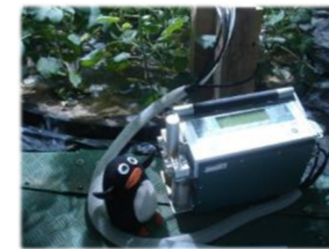
... but difficult to assess



Mediavilla & Escudero 2003



Sancho-Knapik et al. 2022



Leaf cuvette
+ manipulative experiments

- artificial conditions
- feedback leaf → chamber

Objectives



Best strategy to build VPD curves in leaf cuvette

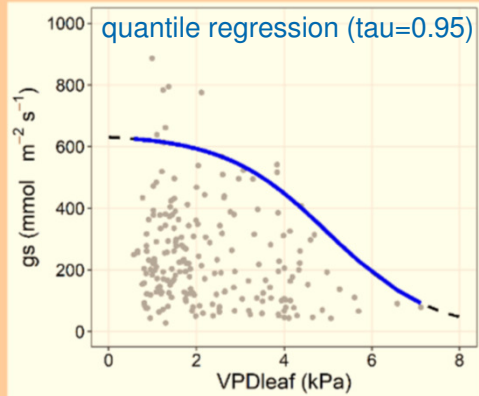


Differences between cuvette and open air response

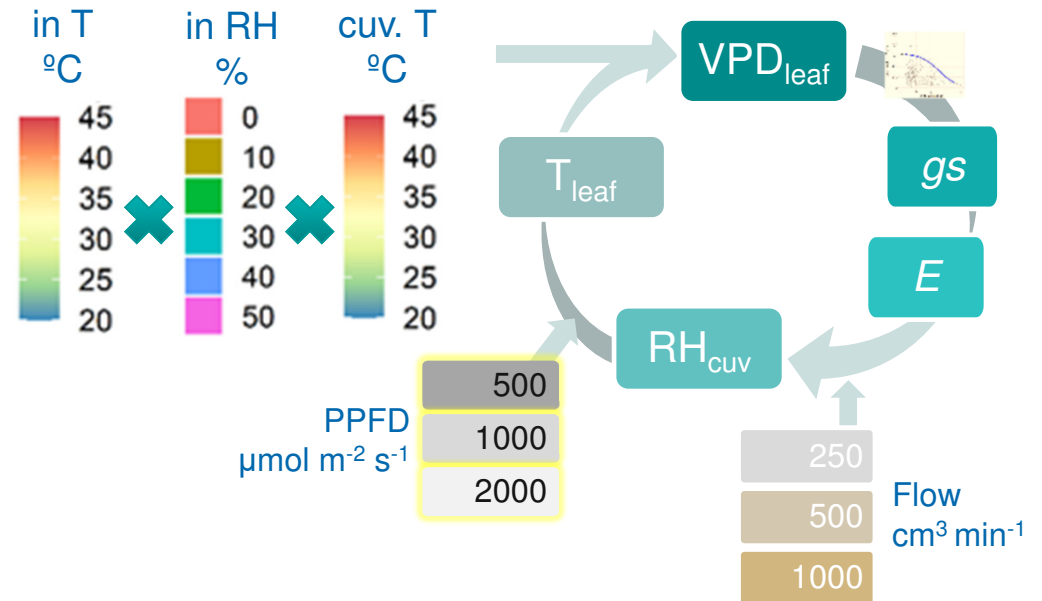
→ SIMULATION EXPERIMENT

Methods

1) Build VPD_{leaf} response curve



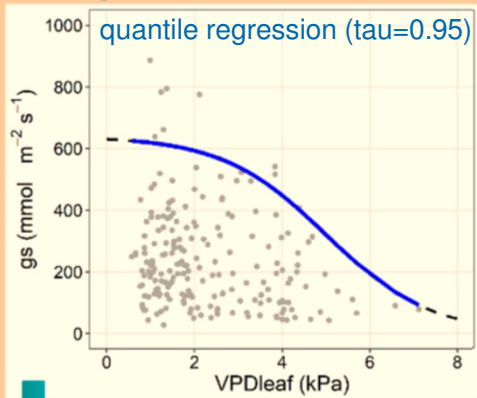
2) Model gas-exchange cuvette (1944 scenarios)



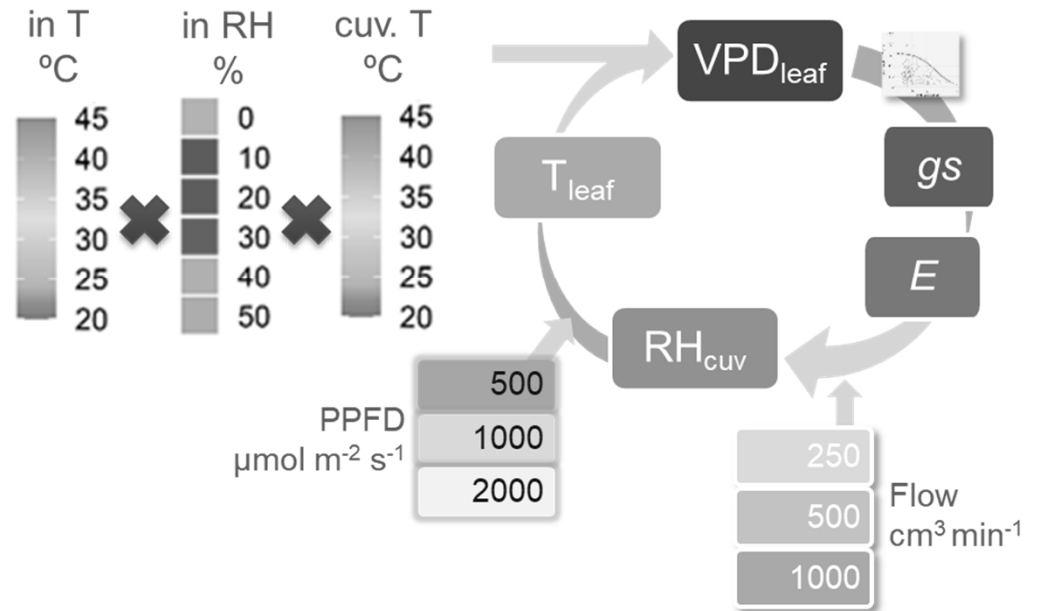
Methods



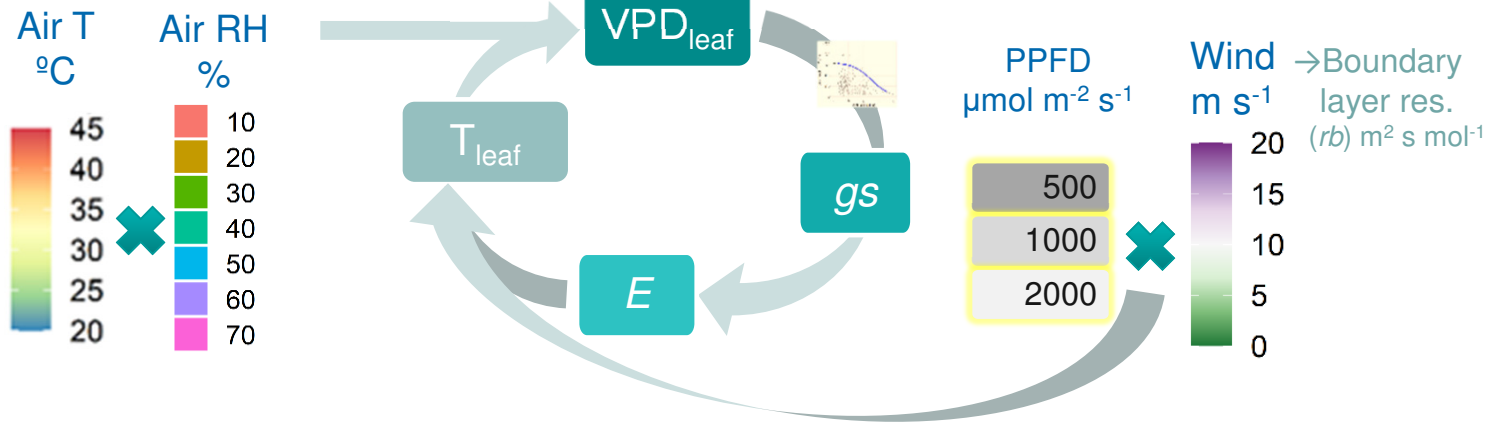
1) Build VPD_{leaf} response curve



2) Model gas-exchange cuvette (1944 scenarios)



3) Model open air (1386 scenarios)



Methods

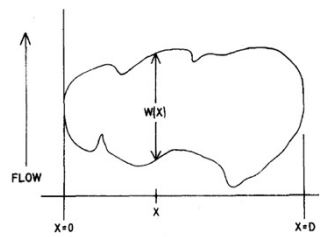
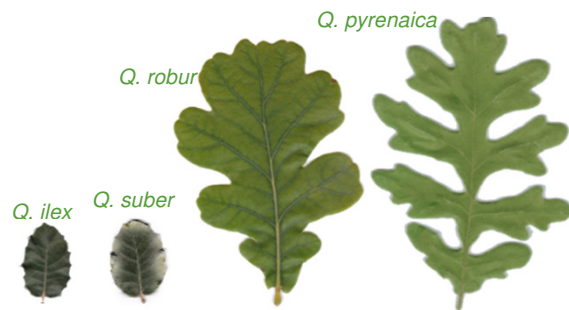
Boundary layer

OPEN AIR $rb = f(\text{wind speed, leaf size/shape})$

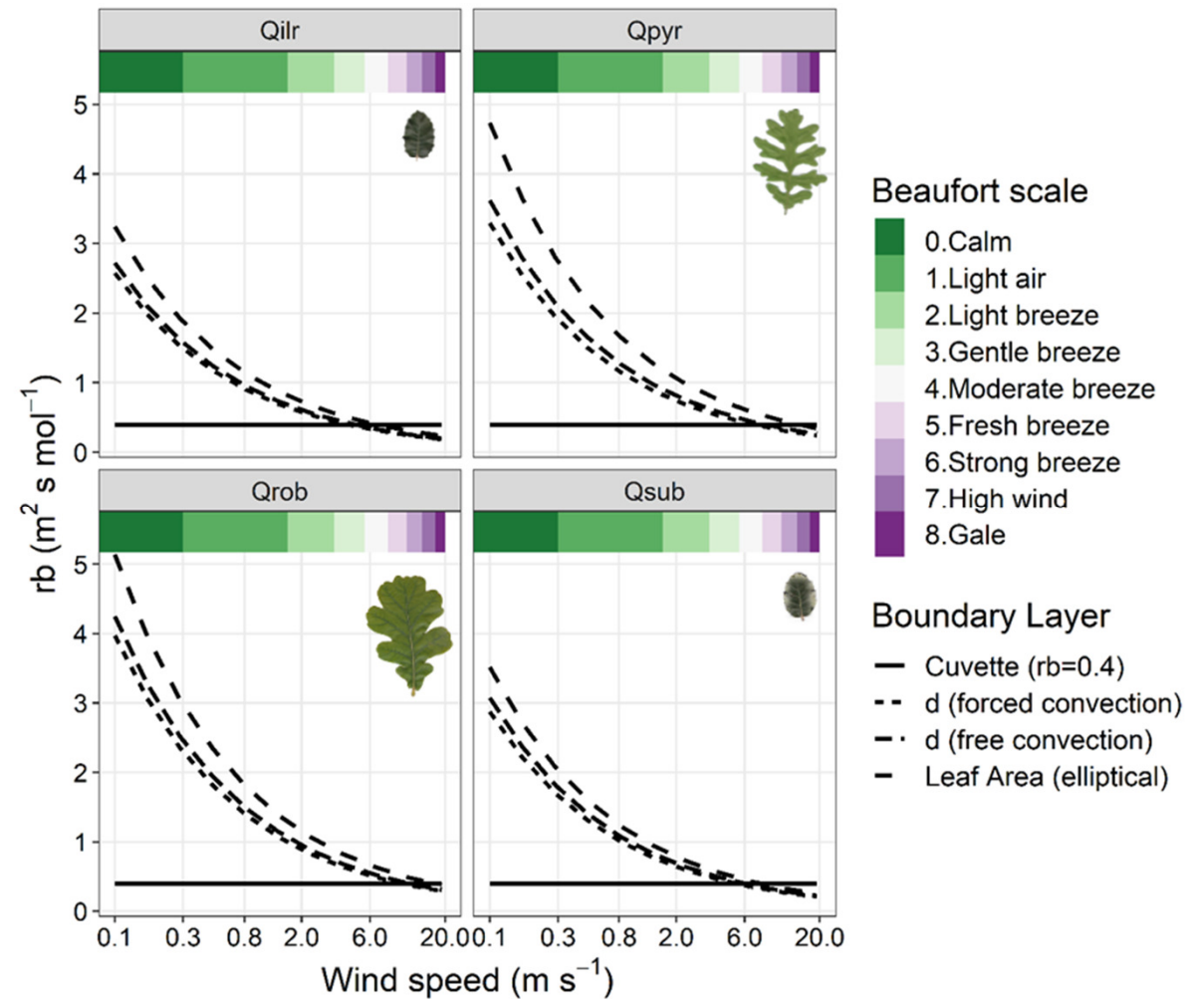
d (characteristic dimension) or Leaf Area (=elliptical)

Leaf cuvette $rb = 0.4 \text{ m}^2 \text{ s mol}^{-1}$

(CIRAS3 factory value for 18 x 25 mm window)



Parkhurst et al. 1968 *Agr. Meteo.*

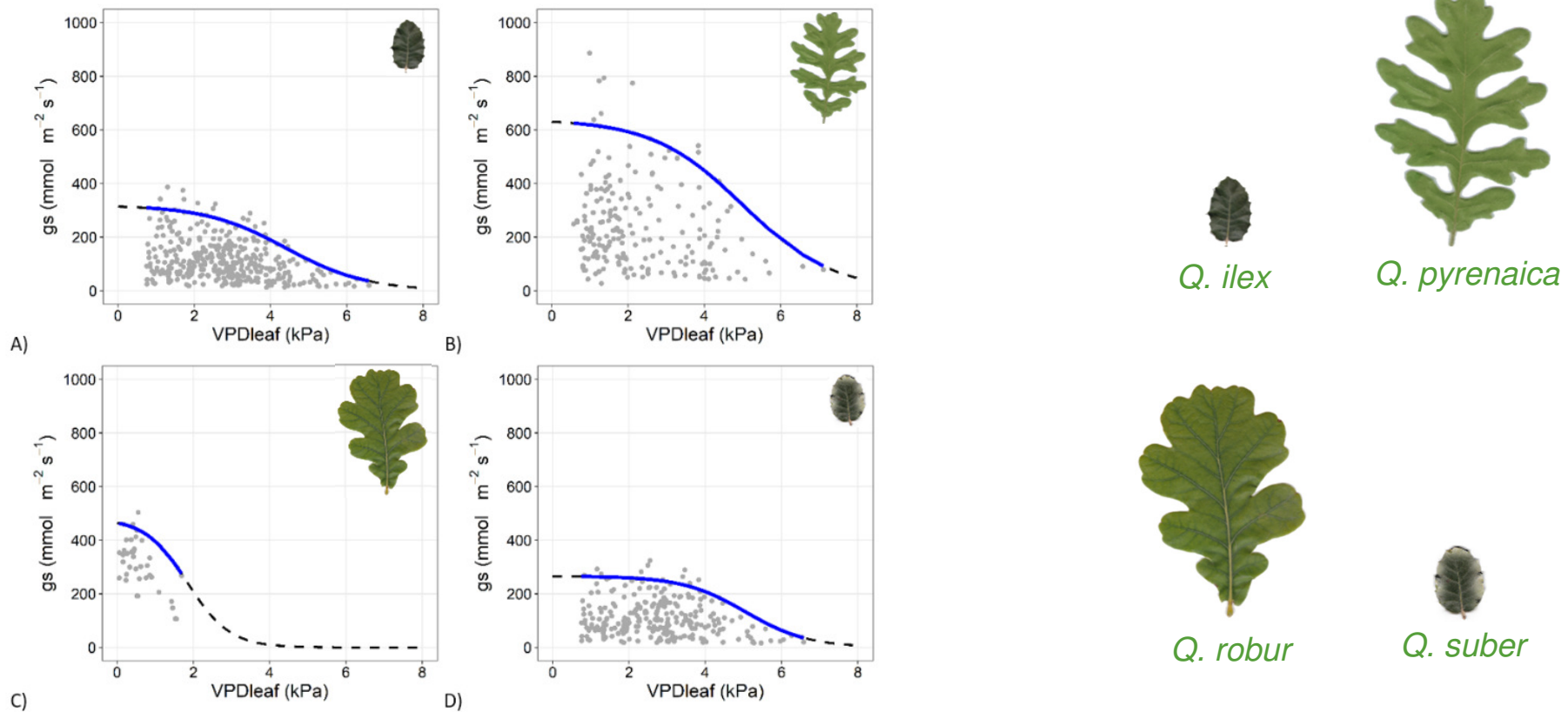


Methods



VPD_{leaf} response curve 4 oak species

Different sensitivity and leaf morphology

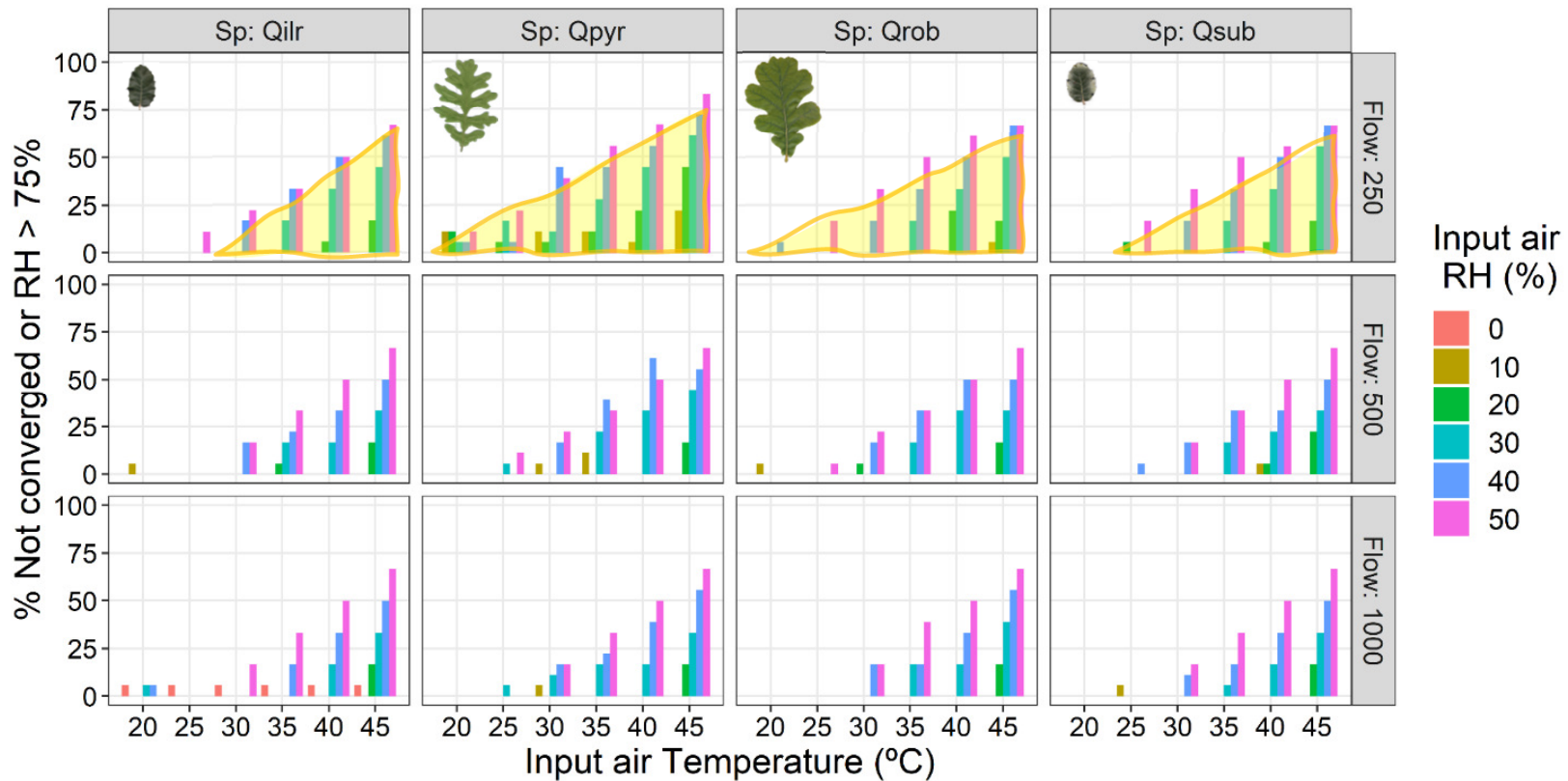


Results: gas exchange cuvette



Check 'failure' scenarios
(not converged or cuvette RH > 75%)

- ⊘ ↑ input T ⊘ ↓ Flow
- ⊘ High g_s (e.g. *Q. pyr*)

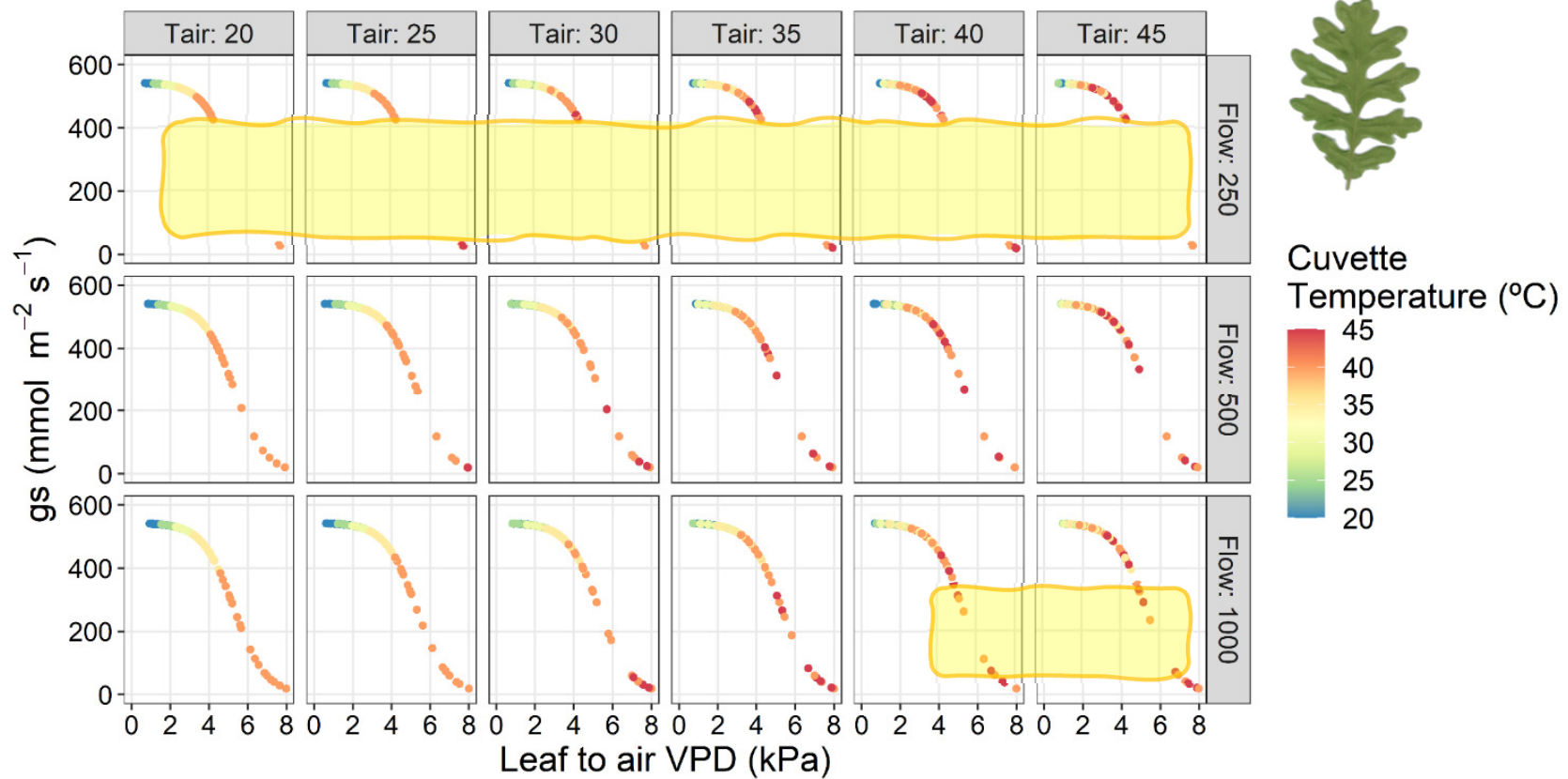


Results: gas exchange cuvette



'Failure' conditions removed

Still difficult to attain intermediate VPD with \downarrow Flow / \uparrow input Tair



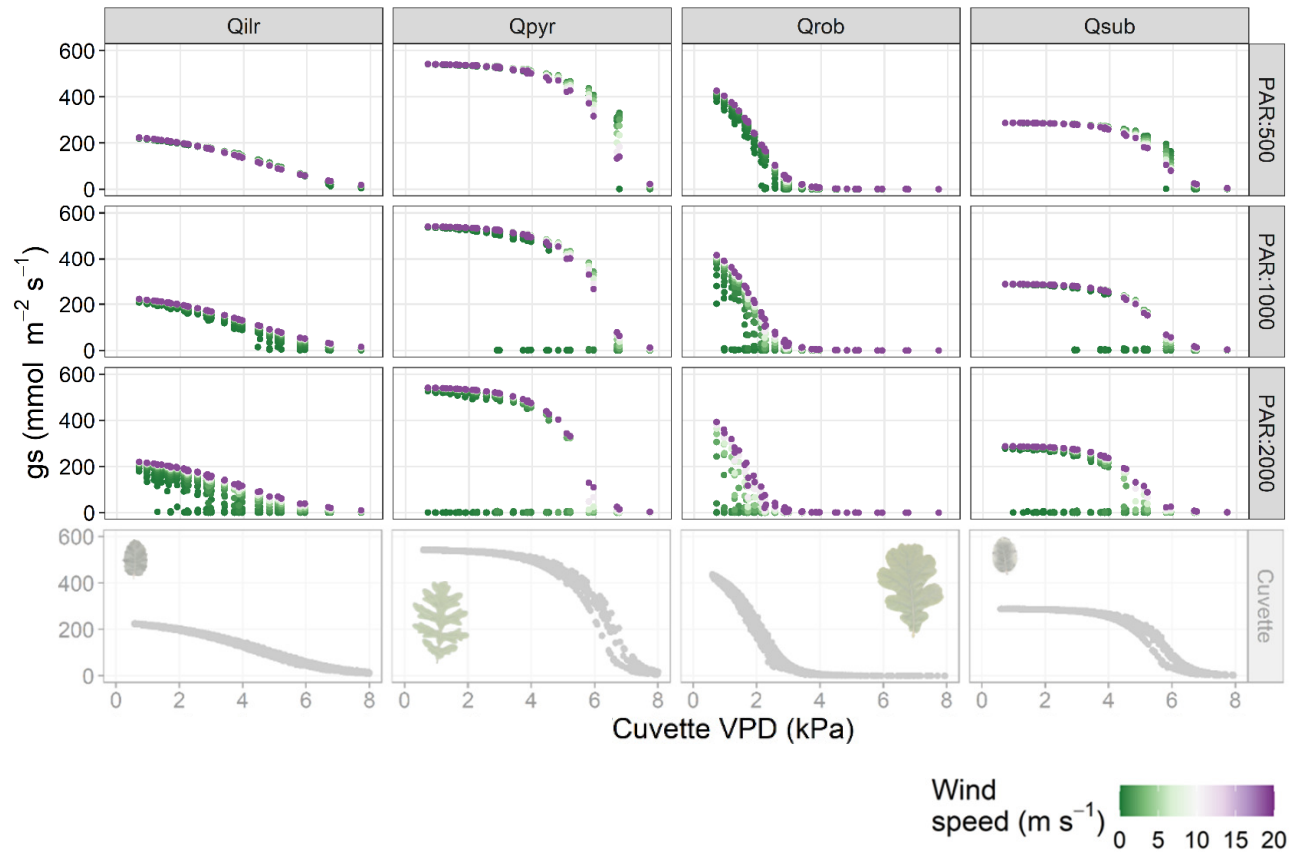
Results: open air



How different is cuvette from open air?

In cuvette $VPD_{cuvette} \approx VPD_{leaf} \rightarrow$ low IR, low rb

In open air $VPD_{air} \neq VPD_{leaf} \rightarrow$ low wind (high rb), radiation



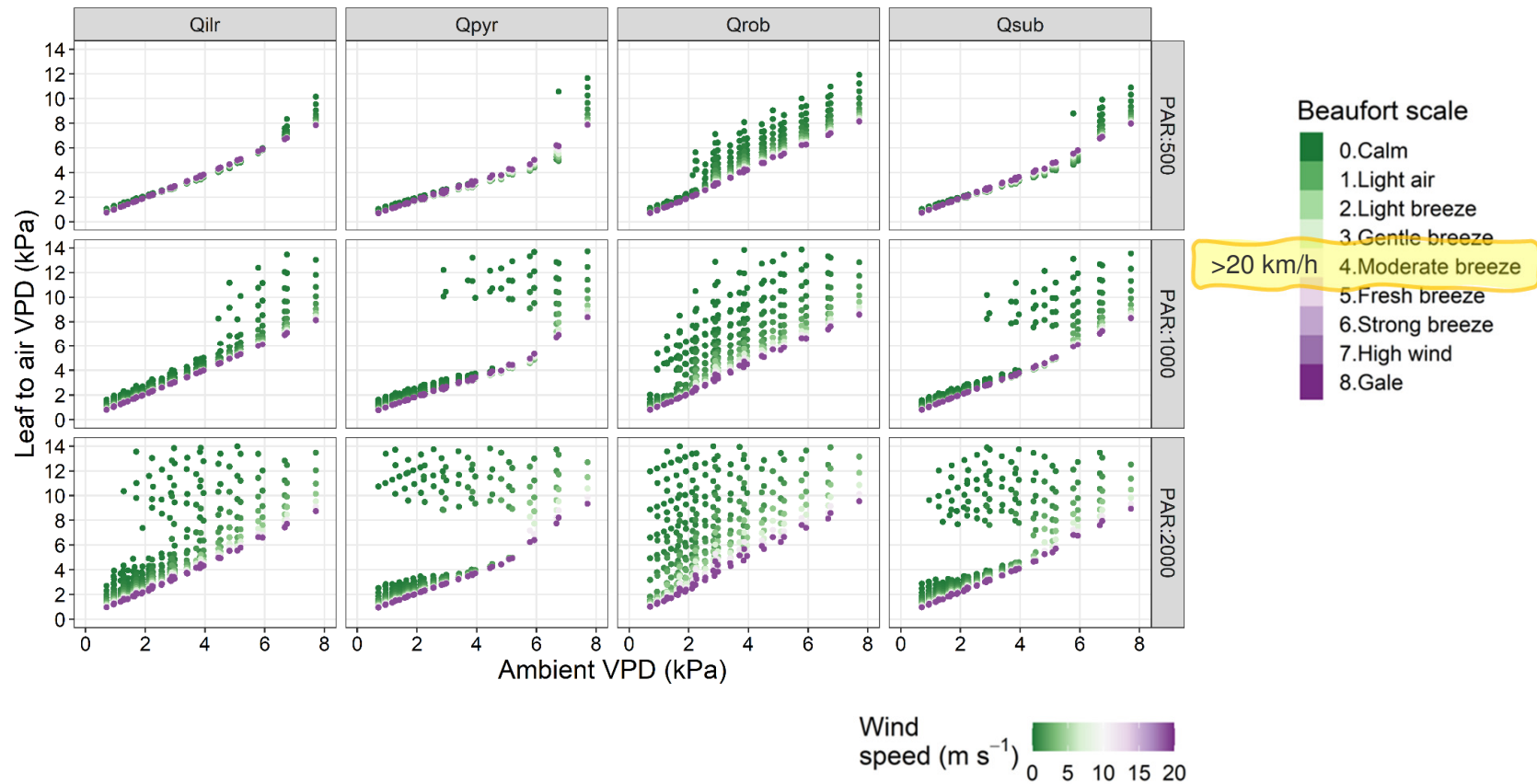
Results: open air



How different is cuvette from open air?

In cuvette $VPD_{cuvette} \approx VPD_{leaf} \rightarrow$ low IR, low rb

In open air $VPD_{air} \neq VPD_{leaf} \rightarrow$ low wind (high rb), radiation



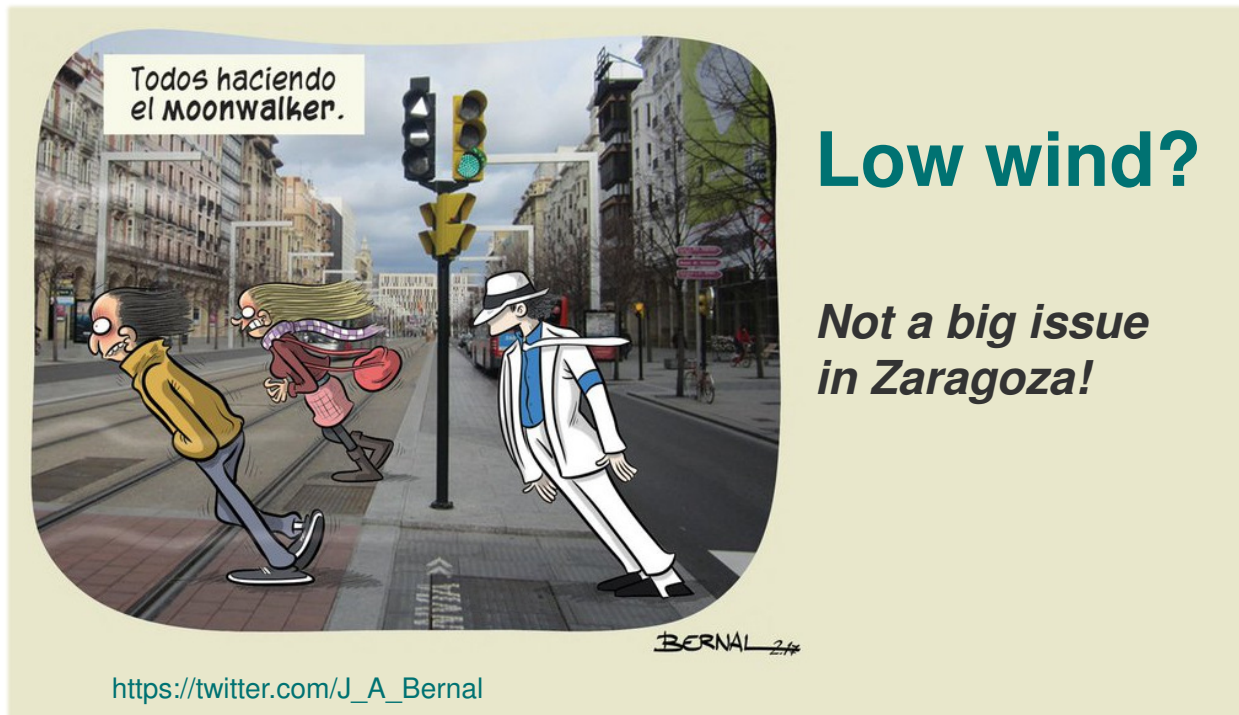
Results: open air



How different is cuvette from open air?

In cuvette $VPD_{cuvette} \approx VPD_{leaf} \rightarrow$ low IR, low rb

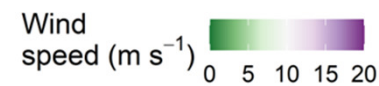
In open air $VPD_{air} \neq VPD_{leaf} \rightarrow$ low wind (high rb), radiation



Beaufort scale

- 0. Calm
- 1. Light air
- 2. Light breeze
- 3. Gentle breeze
- 4. Moderate breeze
- 5. Fresh breeze
- 6. Strong breeze
- 7. High wind
- 8. Gale

>20 km/h



Conclusions



 VPD curve in cuvette is easier with
high flow, low T_{in}

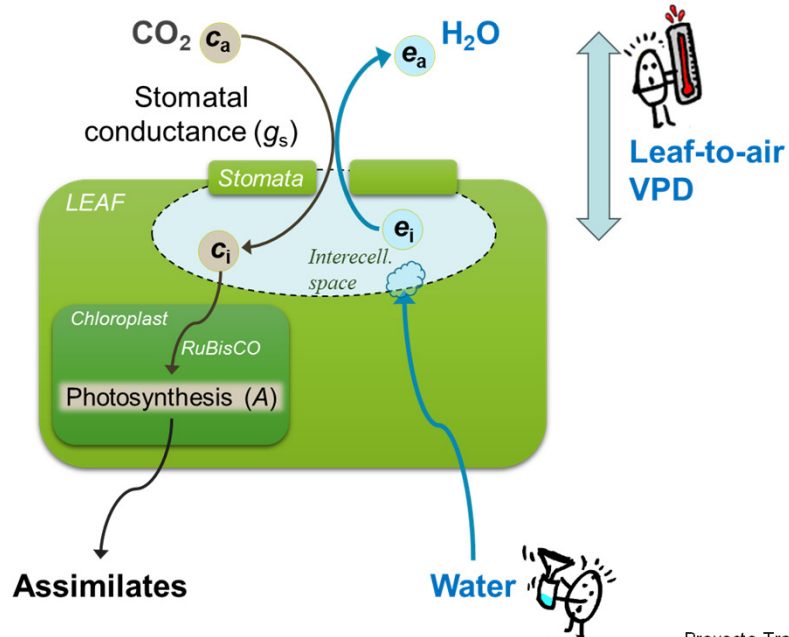
 Species with high transpiration

 Open air conditions show larger uncertainty
 $VPD_{air} \neq VPD_{leaf}$

FUTURE CHALLENGE:

Response to cuvette vs. surrounding conditions

¡Gracias! Obrigado!



Proyecto Retos Investigación **CO₂PPICE**



Proyecto PID2019-106701RR-I00, financiado por:



<https://twitter.com/cppice>

Proyecto Transición Ecológica y Digital **MANAGE4FUTURE**
 Proyecto Consolidación **RESIS2DRY** (CNS2022-136156)
 Proyecto Retos Investigación **TUBEROAK** (PID2022-136478OB-C32)



Grupo de investigación S74_23R, DGA
 IJC2020-045630-I, MCIN/AEI/10.13039/501100011033

