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ESTIMATING BULK STOMATAL CONDUCTANCE (g_{bs}) IN GRAPEVINE CANOPIES

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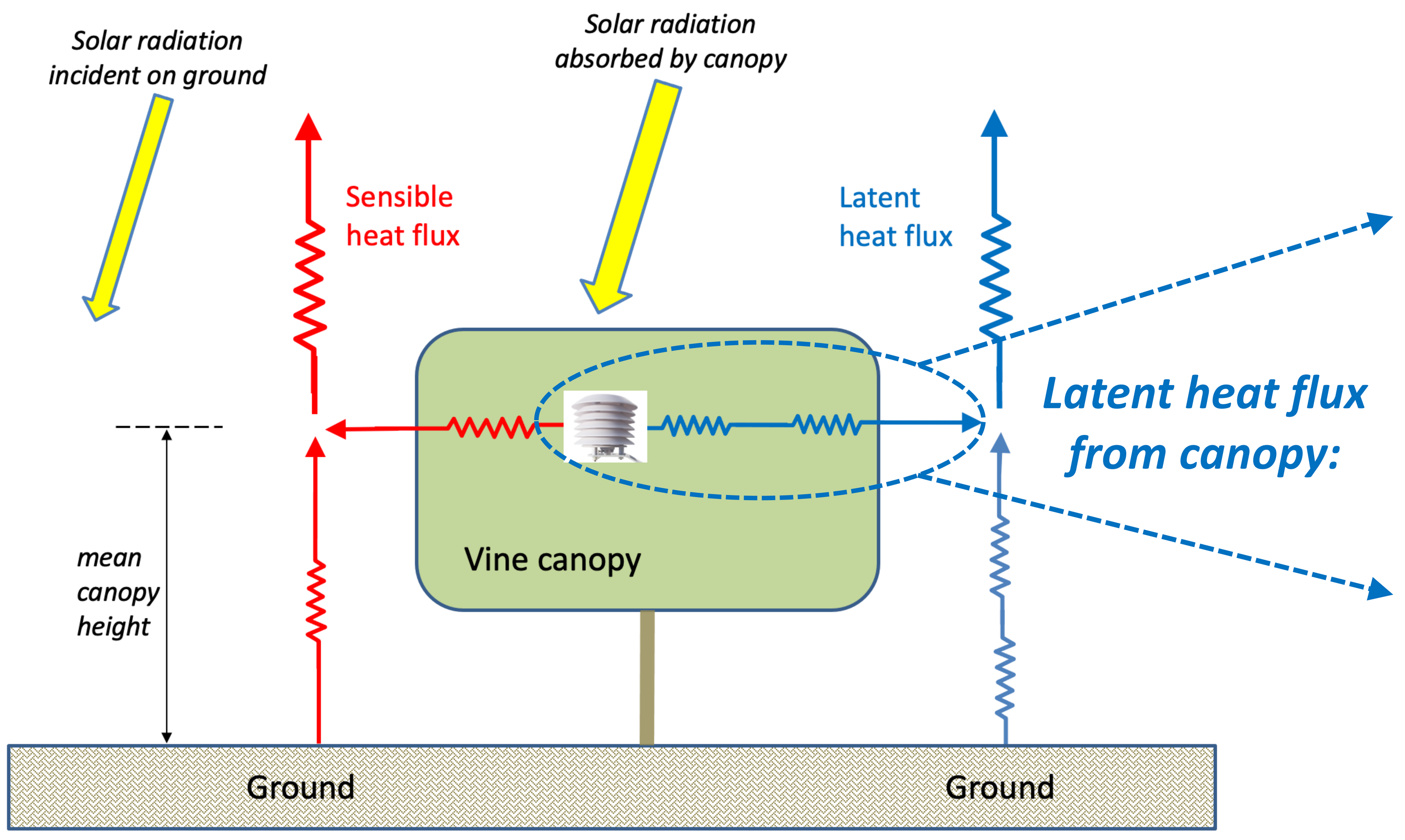
INTRODUCTION

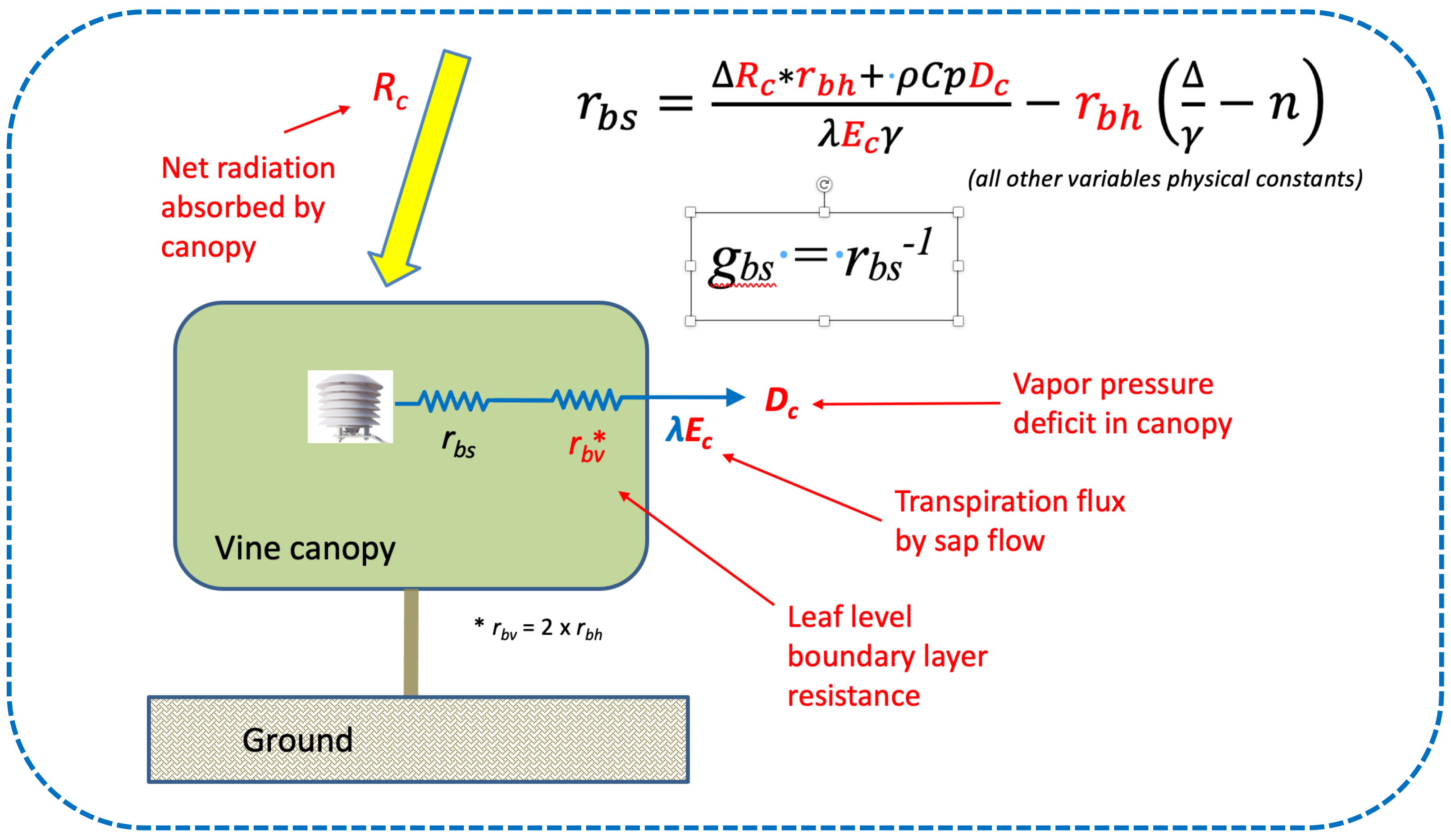
A simplified method for determining bulk stomatal conductance (g_{bs}) in grapevine canopies was developed using a two-source energy flux model and measurements of individual vine sap flow, temperature and humidity in the vine canopy, and estimates of net radiation absorbed by the canopy. This method respects energy flux dynamics of vineyards with open canopies, while avoiding problematic measurements of soil heat flux and boundary layer conductance needed by other methods. Based on this method and measurements from several vines in a non-irrigated vineyard in Bordeaux France, bulk stomatal conductance was estimated on 15-minute intervals from July to mid-September 2020.

1) Two-source energy flux model



- Sensible and latent heat flux from crop canopy and ground separately (Shuttleworth & Wallace, 1985 Q. J. R. Meteorol. Soc., **111** 839-855)
- More realistic representation of open canopies (like vineyards) than *big leaf* crop canopy model approaches

2) Inverted Penman-Monteith Equation



- Calculation based on latent heat flux component from vine canopy
- Flux based conductance (inverse of resistance) given in terms of vineyard ground area with units = m s^{-1} or mmol m^{-2} s^{-1}
- Equivalent to the sum of stomatal conductance of every leaf in the canopy

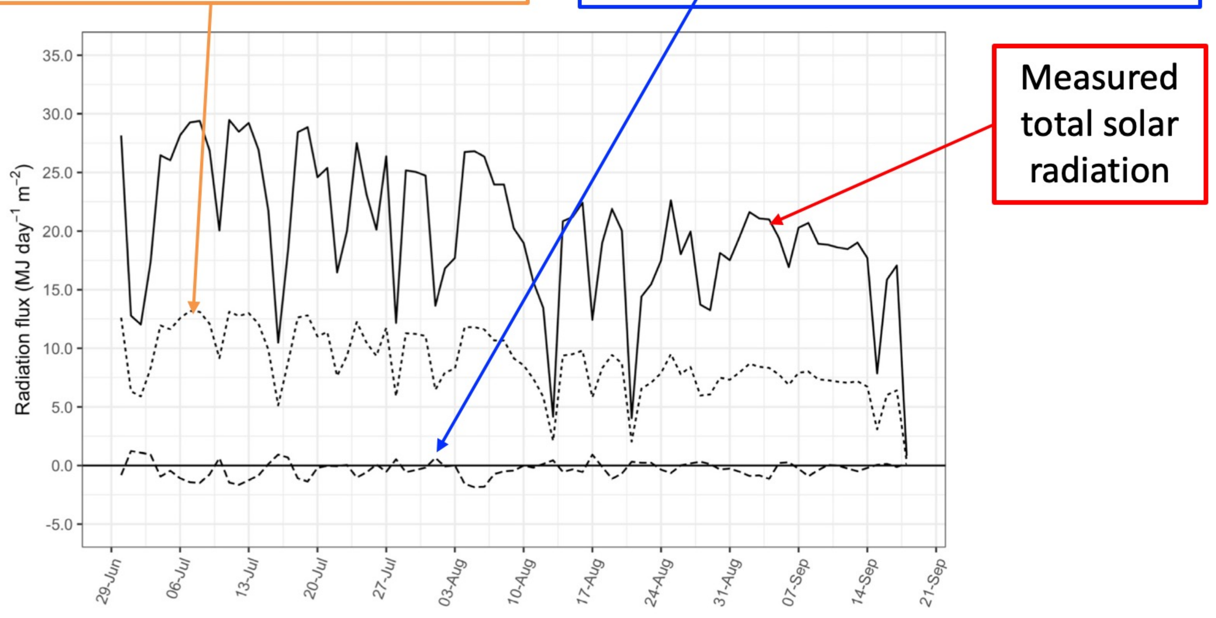
3) Net radiation absorbed by canopy (*Rc*)

Shortwave (solar) radiation absorbed by vine canopy from:
- Direct beam
- Diffused
- Reflected (from ground / canopy)

(Riou et al., 1989 Agronomie **9**, 441–450)

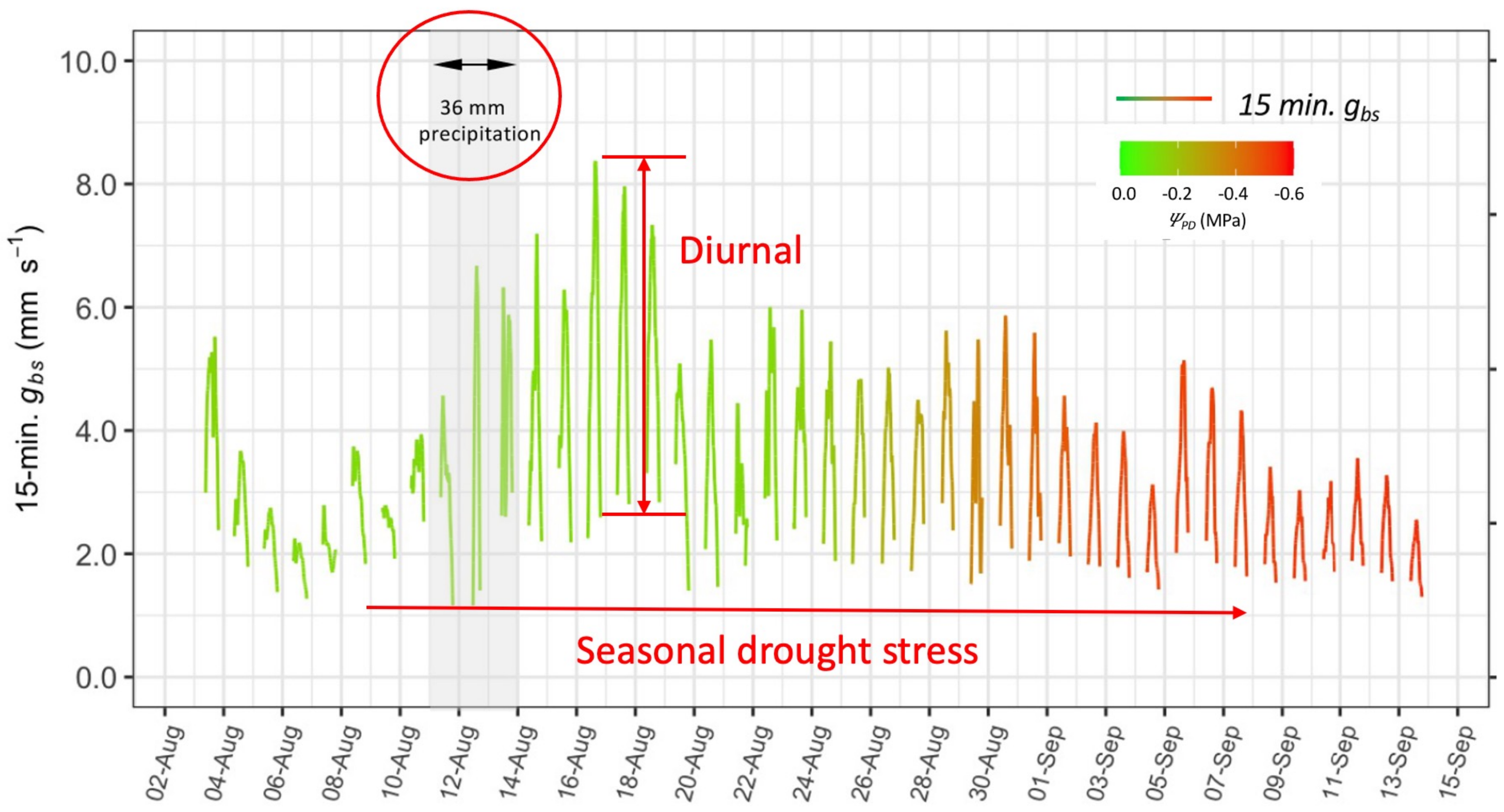
Long wave radiation absorbed by vine canopy from:
- Sky and surrounding ground
- Adjacent vine canopies
- Emitted by canopy

(Pieri, 2010 Ecol. Model. **221** 791–801)



- Net long wave radiation was a very small overall contribution and was eliminated from calculations (as done in other studies)
- Possibly simplify future studies by eliminating long wave radiation measurement in vineyards with similar configurations

4) Diurnal and seasonal variability in g_{bs}



- Decreases in predawn water potential (Ψ_{PD}) over season reduced overall g_{bs} and its diurnal amplitude. Results similar to other studies in vineyards
- Increase in g_{bs} after 36mm. rainfall relieved water stress in mid-August
- Sensitivity analysis found boundary layer resistance to be low importance

Summary

- Based on more realistic two-source energy flux model
- Inverted Penman-Monteith equation used to calculate g_{bs}
- Using continuous sap flow, radiation, and VPD measurements
- E_c and D_c found to be of greatest importance in determining g_{bs}
- Performed in realistic vineyard conditions
- Soil heat flux or boundary layer measurements not needed
- May not need measurement of long wave radiation
- Useful for studying canopy conductance response to drought

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