Patterns of leaf gas exchange along a continental-scale rainfall gradient in north Australia

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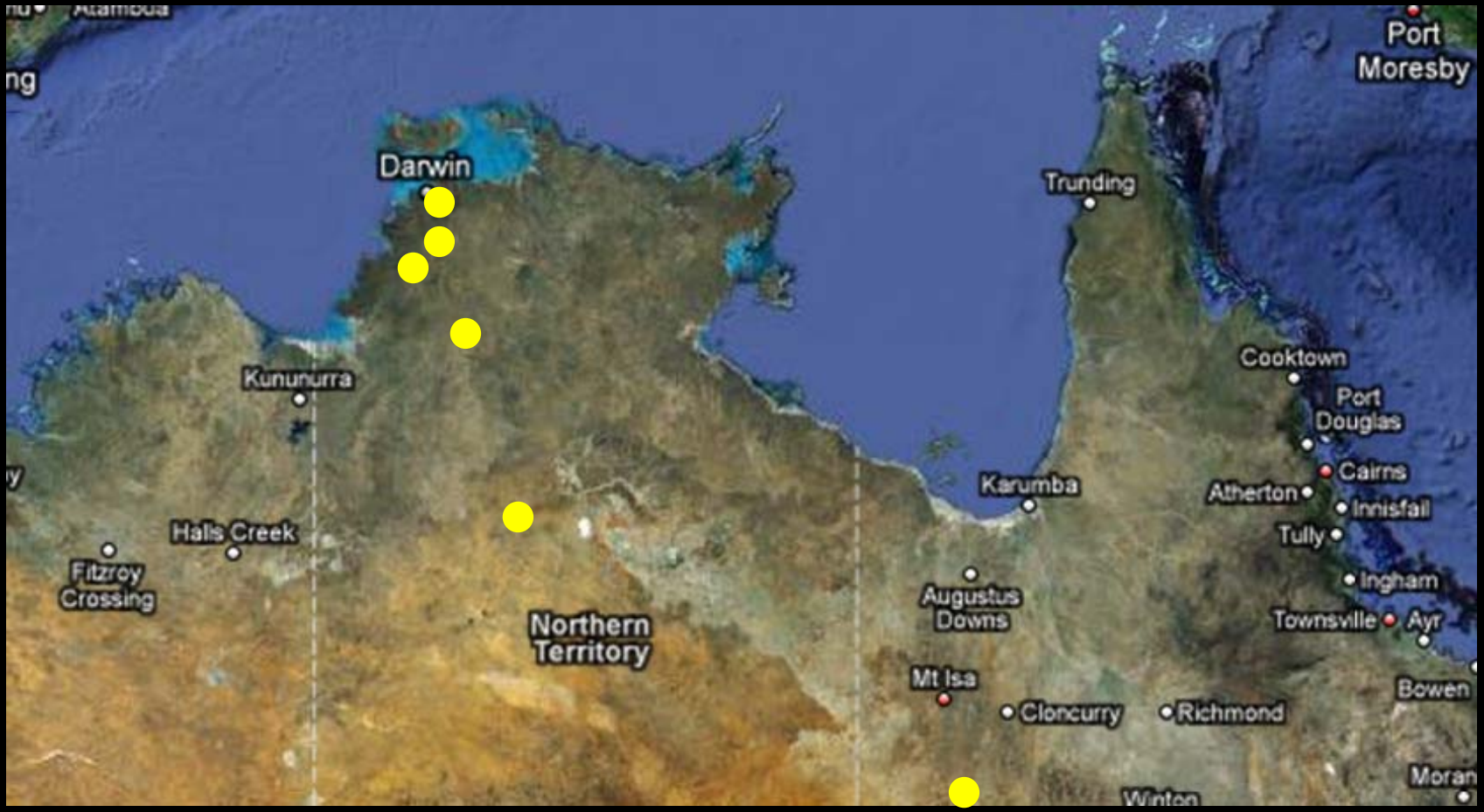
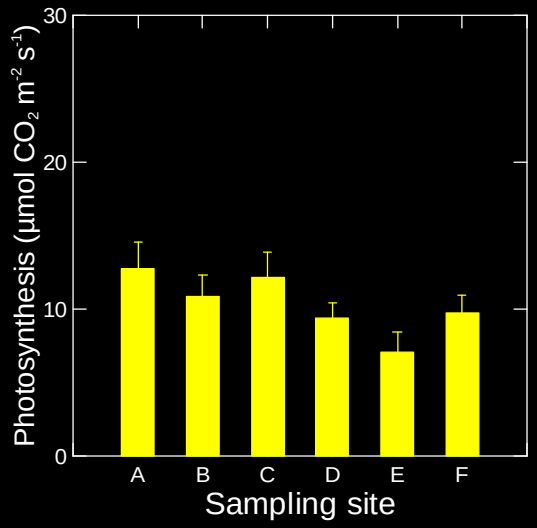
Sampling sites

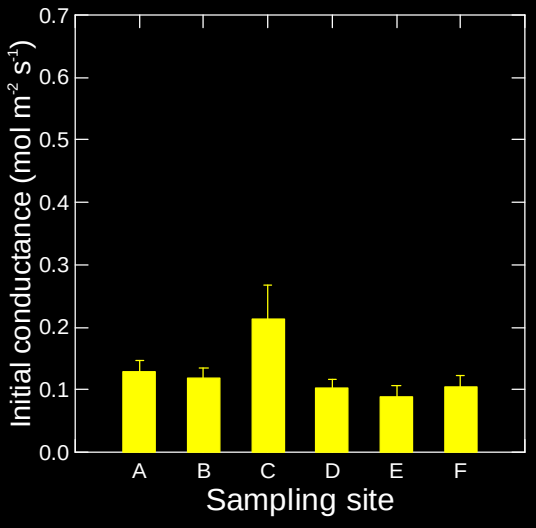


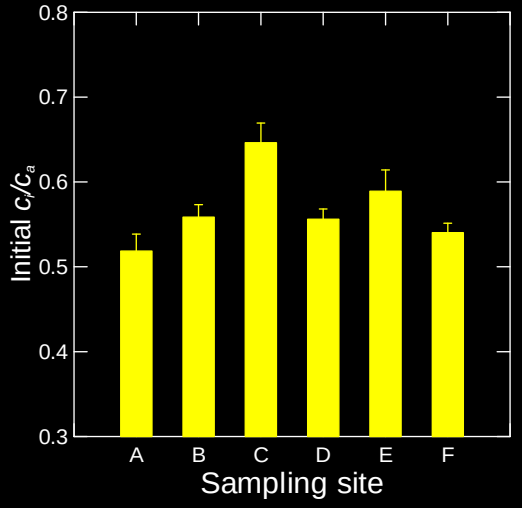
Leaf gas exchange measurements

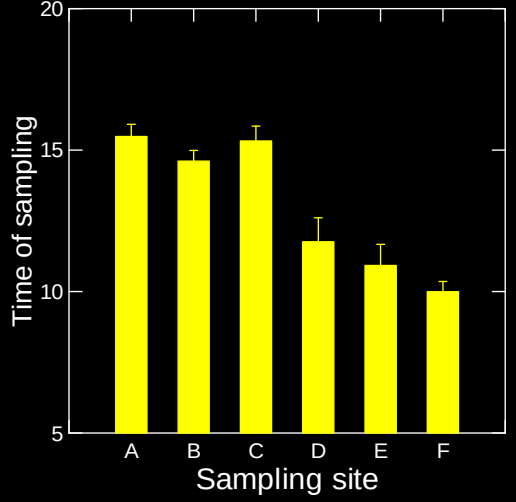
Leaf gas exchange measurements- Boulia

Leaf gas exchange summary by site



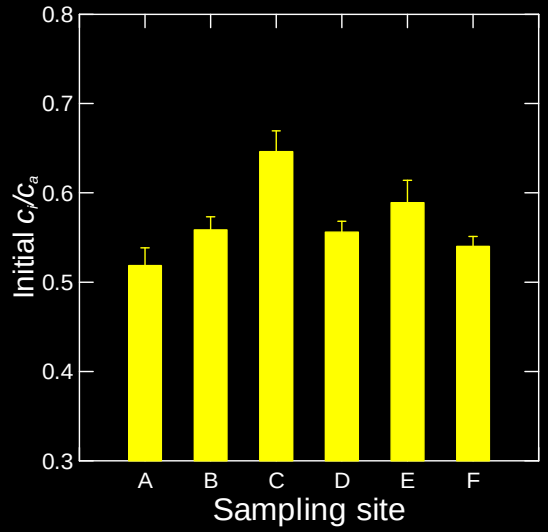


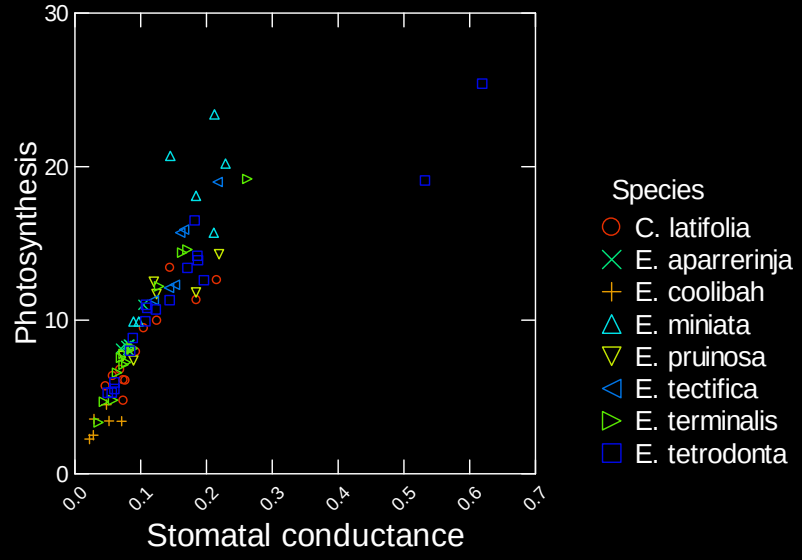




Sampling sites
A- Howard Springs
B- Adelaide River
C- Daly River
D- Dry Creek
E- Sturt Plains
F- Boulia

c_i/c_a relatively constant among sites





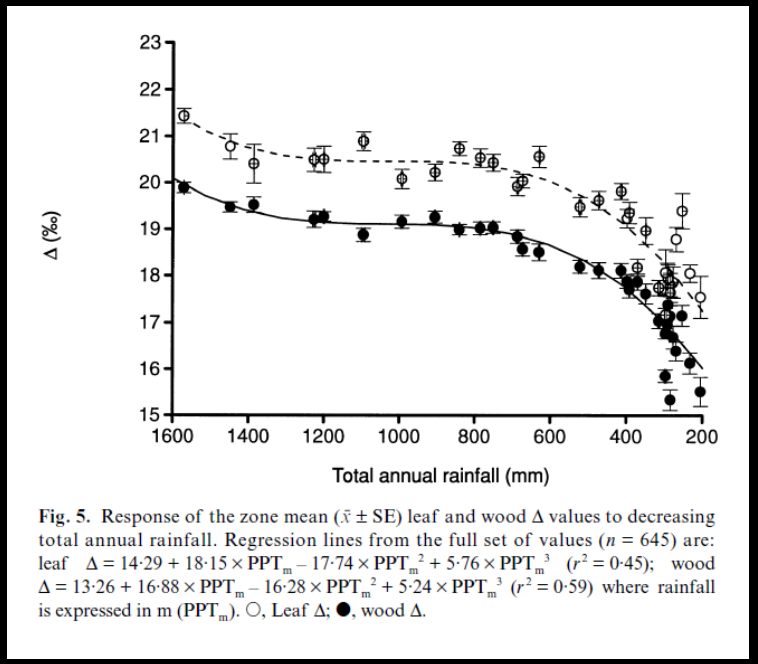
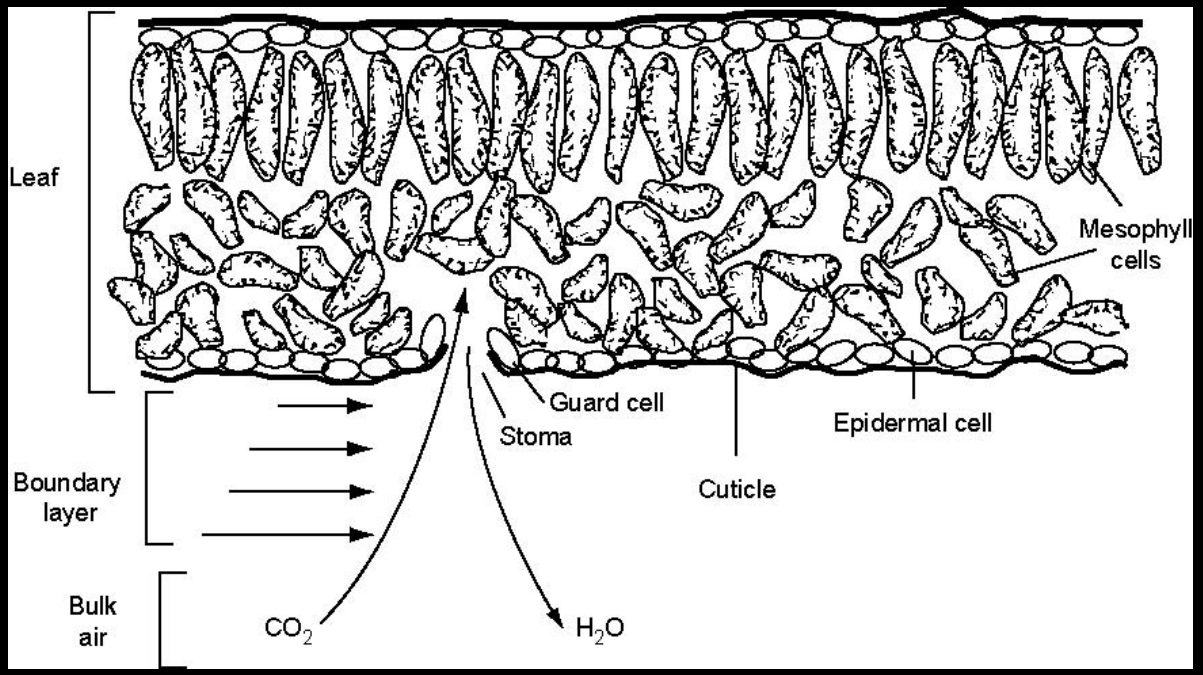


Fig. 5. Response of the zone mean ($\bar{x} \pm$ SE) leaf and wood Δ values to decreasing total annual rainfall. Regression lines from the full set of values ($n = 645$) are: leaf $\Delta = 14{\cdot}29 + 18{\cdot}15 \times PPT_m - 17{\cdot}74 \times PPT_m^2 + 5{\cdot}76 \times PPT_m^3$ ($r^2 = 0{\cdot}45$); wood $\Delta = 13{\cdot}26 + 16{\cdot}88 \times PPT_m - 16{\cdot}28 \times PPT_m^2 + 5{\cdot}24 \times PPT_m^3$ ($r^2 = 0{\cdot}59$) where rainfall is expressed in m (PPT_m). ○, Leaf Δ; ●, wood Δ.

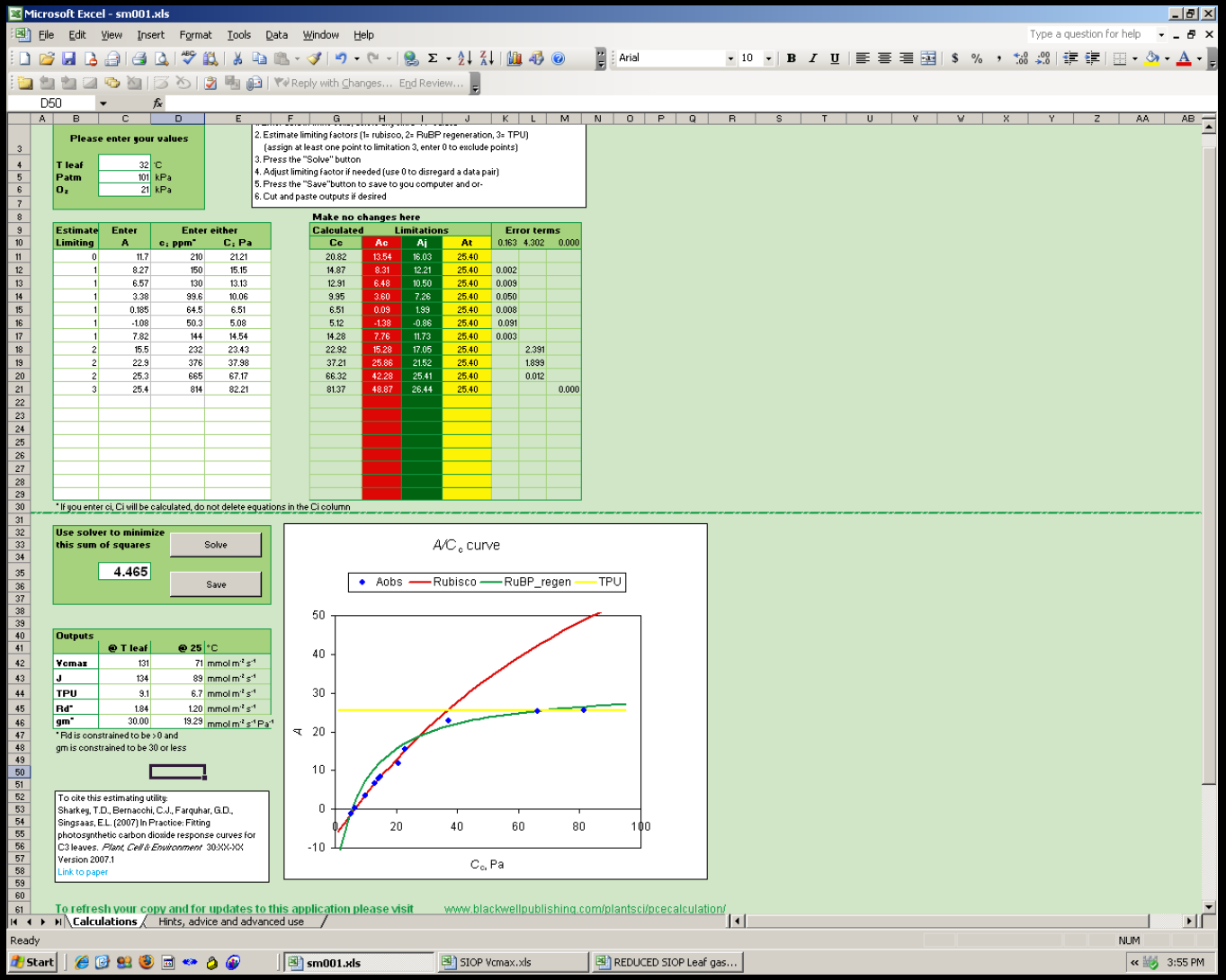
Water-use efficiency partly controlled by c_i/c_a



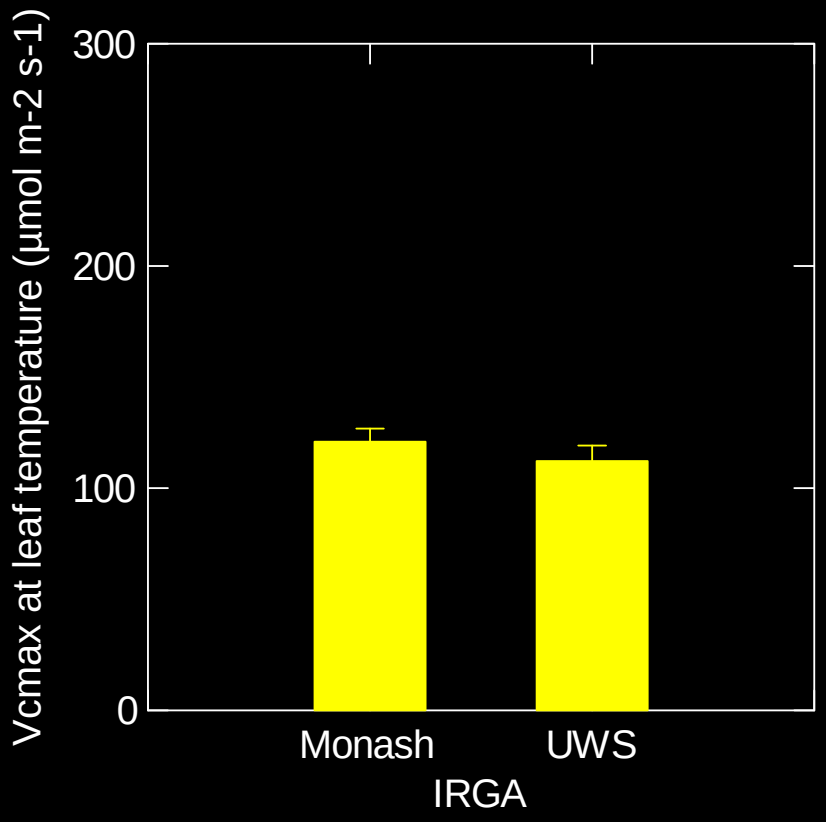
$$\frac{A}{E} = \frac{c_a\left(1 - \frac{c_i}{c_a}\right)}{1.6v}$$

Farquhar, O'Leary, and Berry (1982) Australian Journal of Plant Physiology 9**:** 121-137

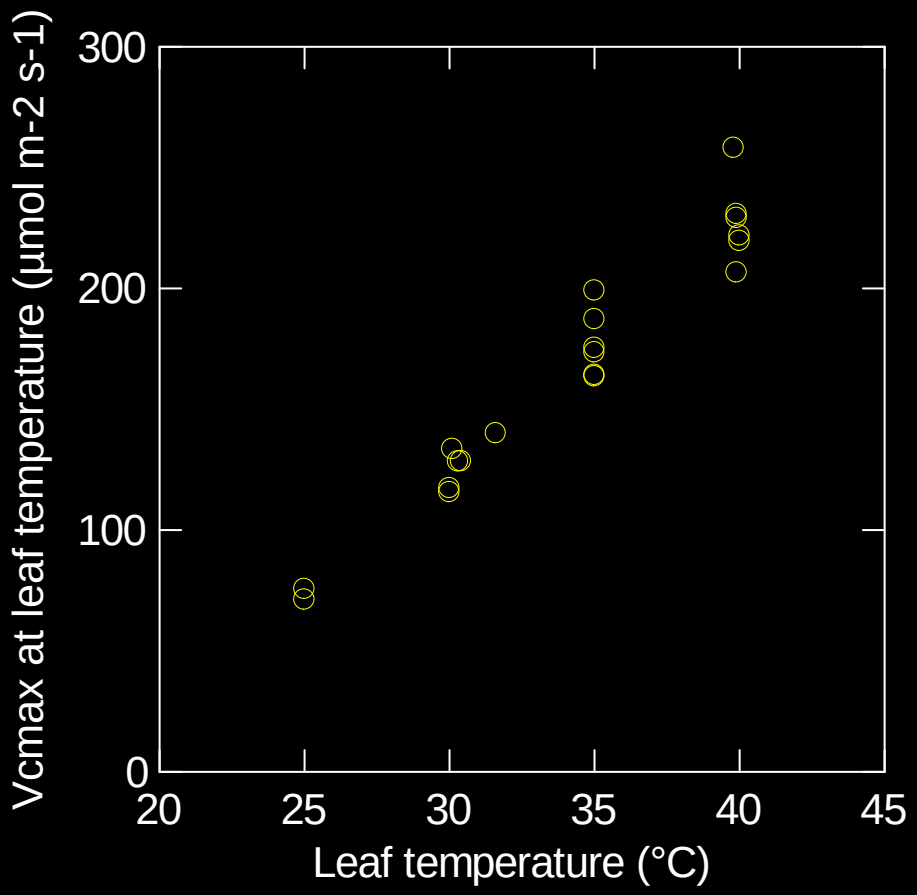
Excel utility for fitting A-C_i curves (Sharkey et al. 2007)



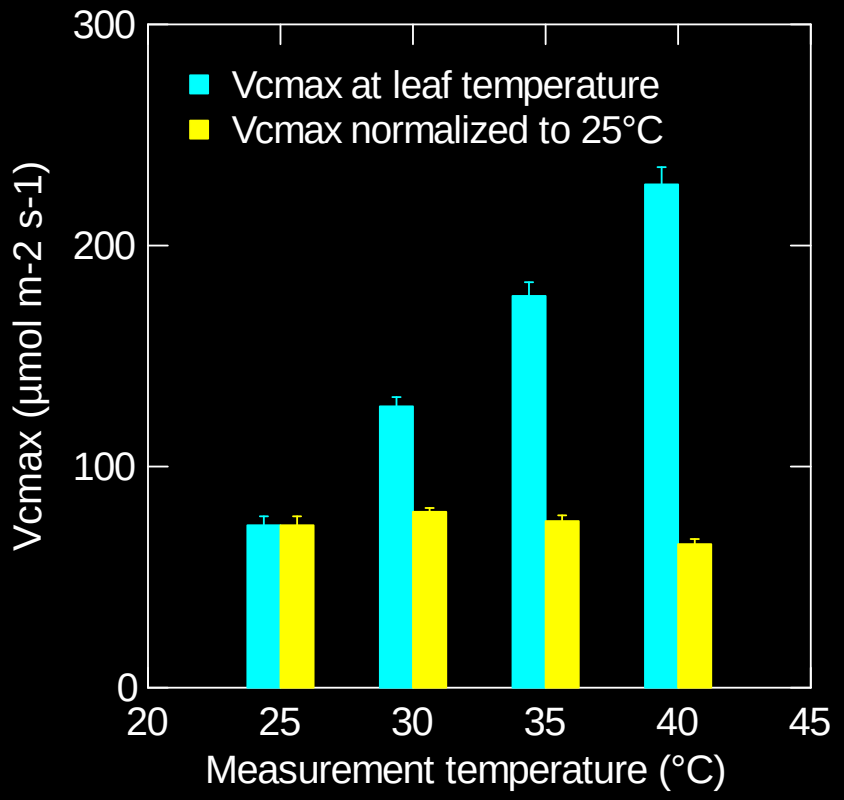
No apparent bias depending on which IRGA was used



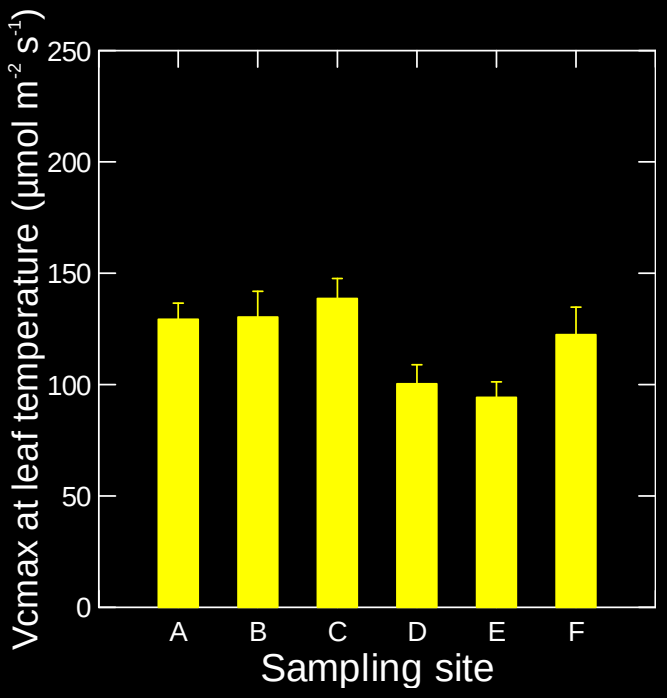
Eucalyptus tetrodonta temperature response (Daly River)

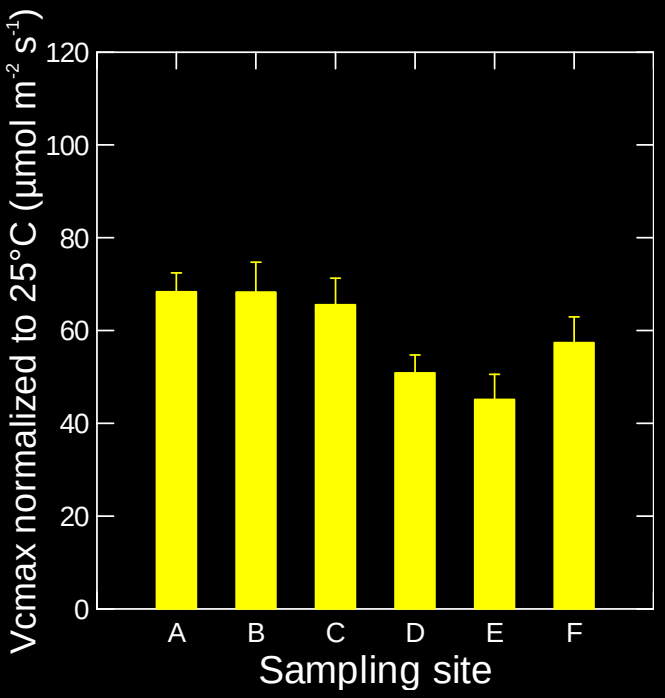


Eucalyptus tetrodonta temperature response (Daly River)

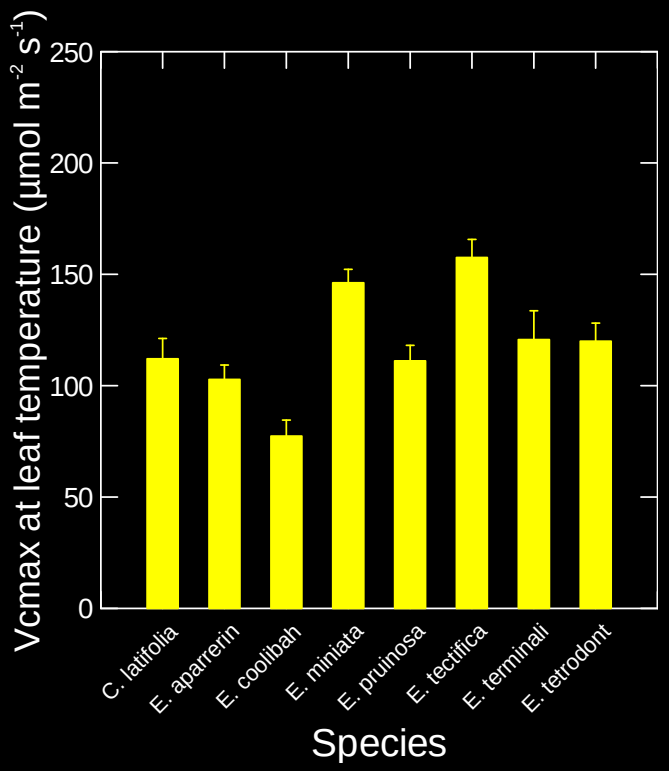


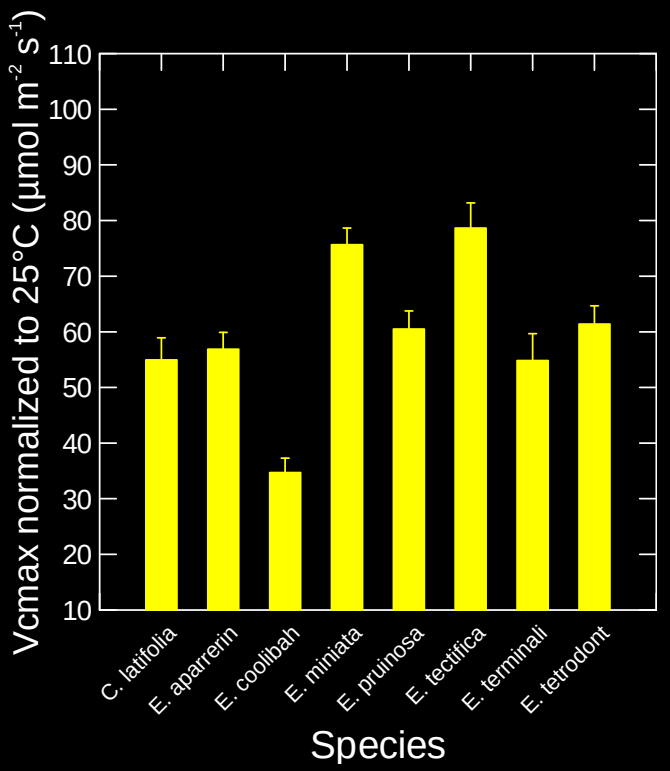
Variation among sites in Vcmax



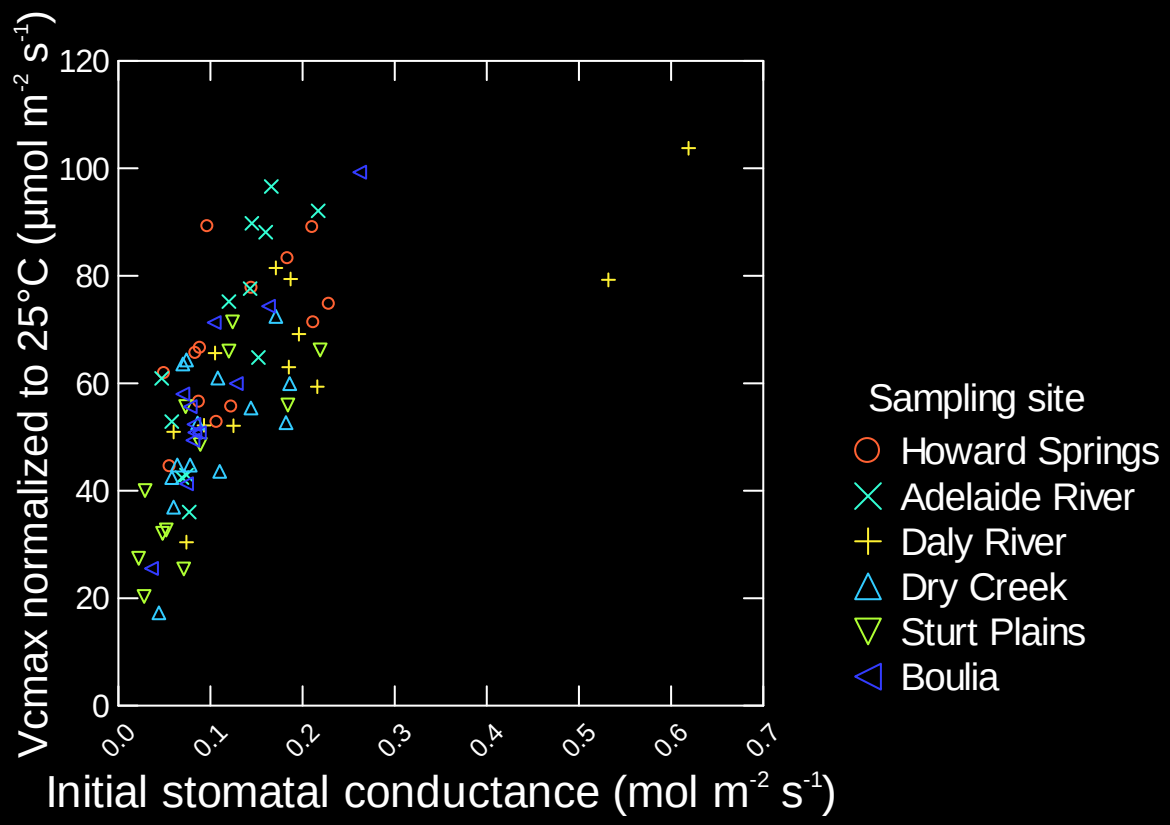


Variation among species in Vcmax





Vcmax showed a strong dependence on initial stomatal conductance



Initial stomatal conductance was the strongest term in ANOVA for Vcmax, but site and species were also significant

Categorical values encountered during processing are:

SITE$ (6 levels)

Adelaide Riv, Boulia, Daly River, Dry Creek, Howard Sprin, Sturt Plains

SPECIES$ (8 levels)

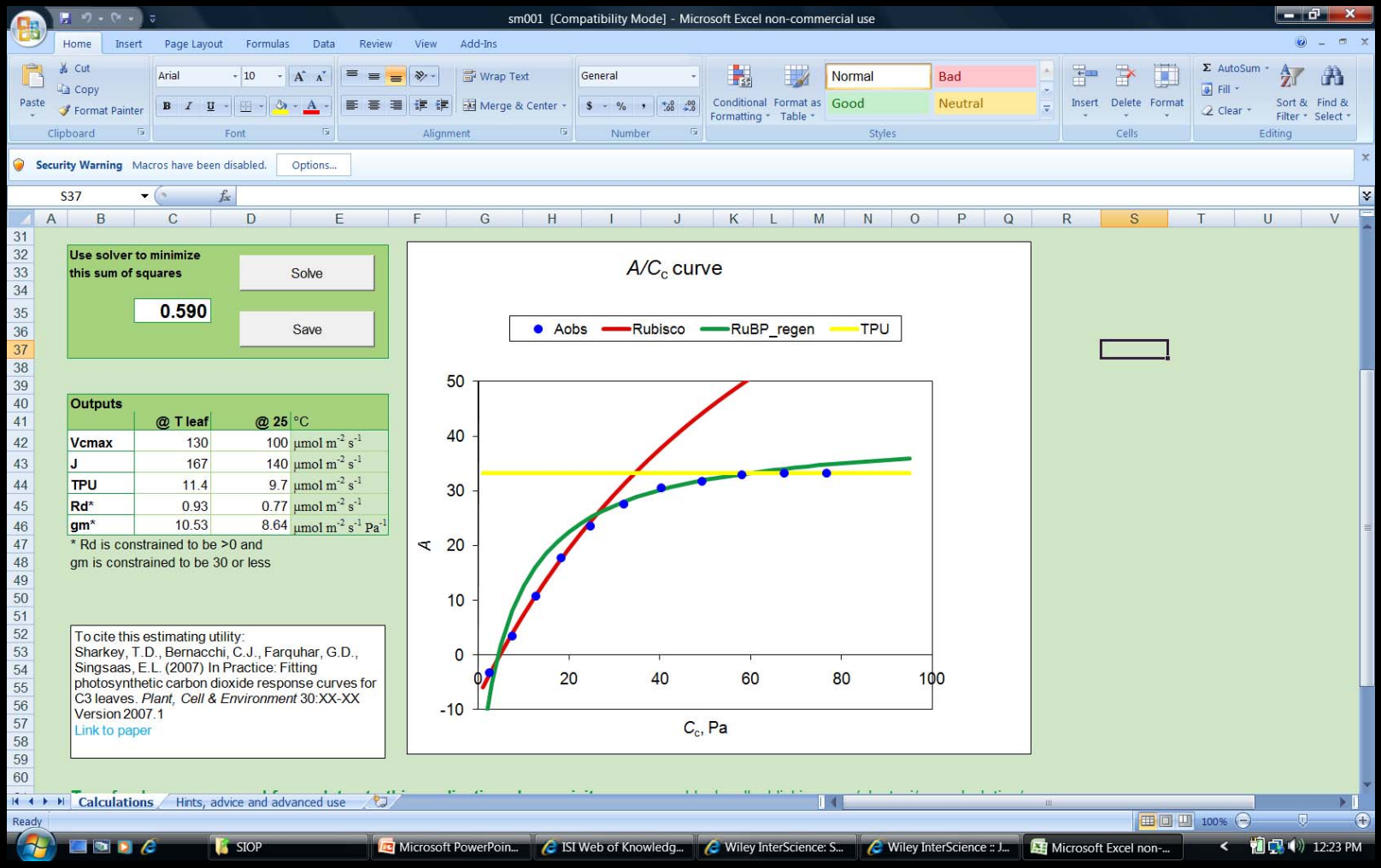
C. latifolia, E. aparrerin, E. coolibah, E. miniata, E. pruinosa,
E. tectifica, E. terminali, E. tetrodont

Dep Var: VCM_25 N: 75 Multiple R: 0.88820 Squared multiple R: 0.78891

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
SITE$	2403.78371	5	480.75674	4.80614	0.00098
CONDUCTANCE	3570.33391	1	3570.33391	35.69276	0.00000
SITE$*CONDUCTANCE	3032.64716	5	606.52943	6.06350	0.00014
SPECIES$(SITE$)	2619.54663	6	436.59111	4.36462	0.00108
Error	5701.68929	57	100.02964		

Excel utility for fitting A-C_i curves (Sharkey et al. 2007)



Conclusions and future directions

- Photosynthesis, conductance and c_i/c_a did not show large variation among sites along the rainfall gradient

- These gas exchange data are consistent with previous measurements of ^{13}C discrimination (Miller et al. 2001)

- Vcmax, estimated assuming constant mesophyll conductance of 3 mol m^{-2} s^{-1} bar^{-1}, showed strong dependence initial stomatal conductance

- Mesophyll conductance and stomatal conductance likely co-vary

- Leaf samples currently being processed for nitrogen concentration and $\delta^{13}C$