

The implications of differences in stomatal conductance model parameters on estimates of ecosystem-atmosphere energy exchange

*Bill Bauerle, Dave Barnard, Grace Lloyd, Alex Daniels,
Dan Banks, Gretchen Reuning, & Brianna Miles*

Colorado State University

MAESTRA

Background on
models

Sensitivity
analyses

Understanding g_0

Understanding g_1

Conclusions

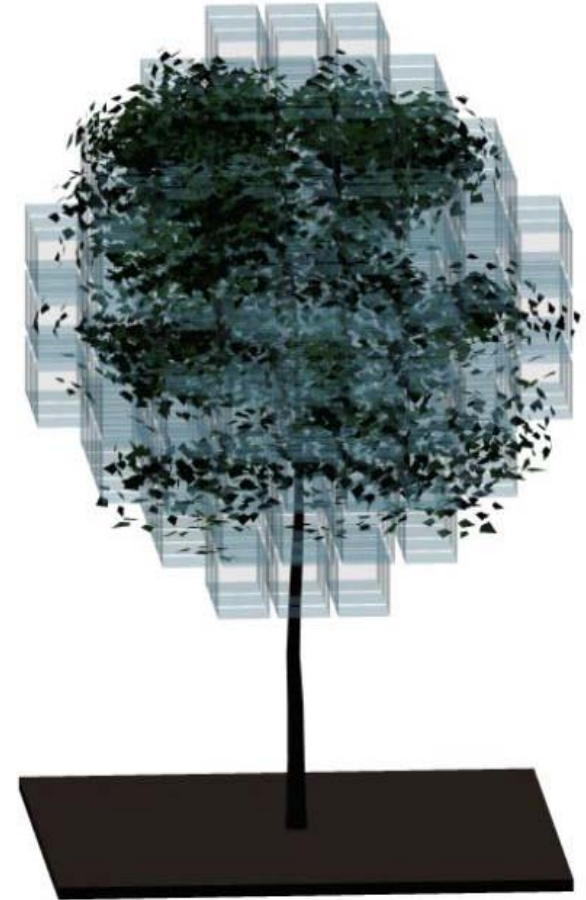
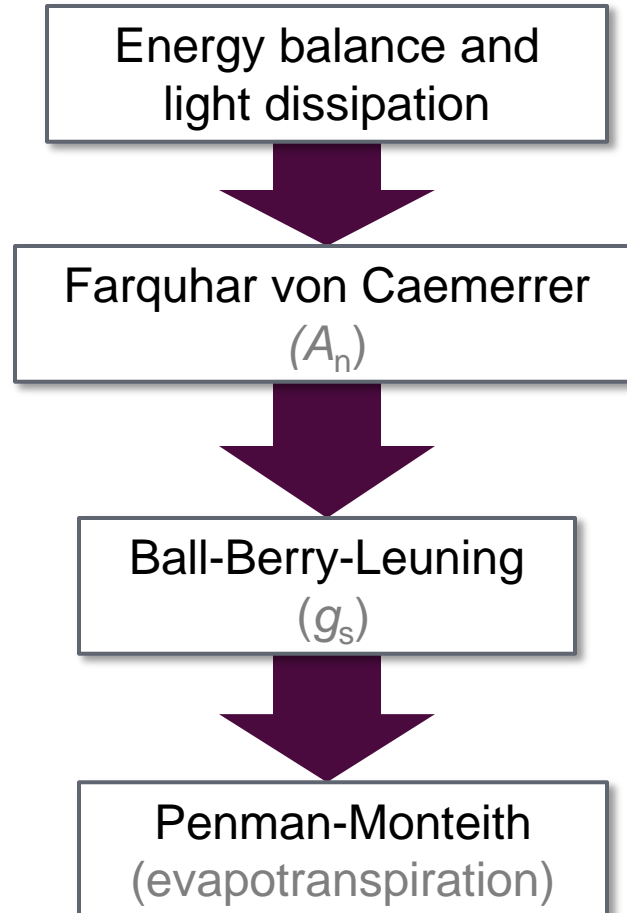


Image - Bauerle & Bowden 2011. JXB:4295-4307.

Sub-model (g_s)

Background on
models

Sensitivity
analyses

Understanding g_0

Understanding g_1

Conclusions

$$g_s = g_0 + \frac{g_1 A_n}{(C_s - \Gamma) \left(1 + \frac{D_s}{D_0} \right)}$$

e.g. Ball-Berry g_s model as modified by
Leuning (1995)

Transpiration estimate parameter sensitivity

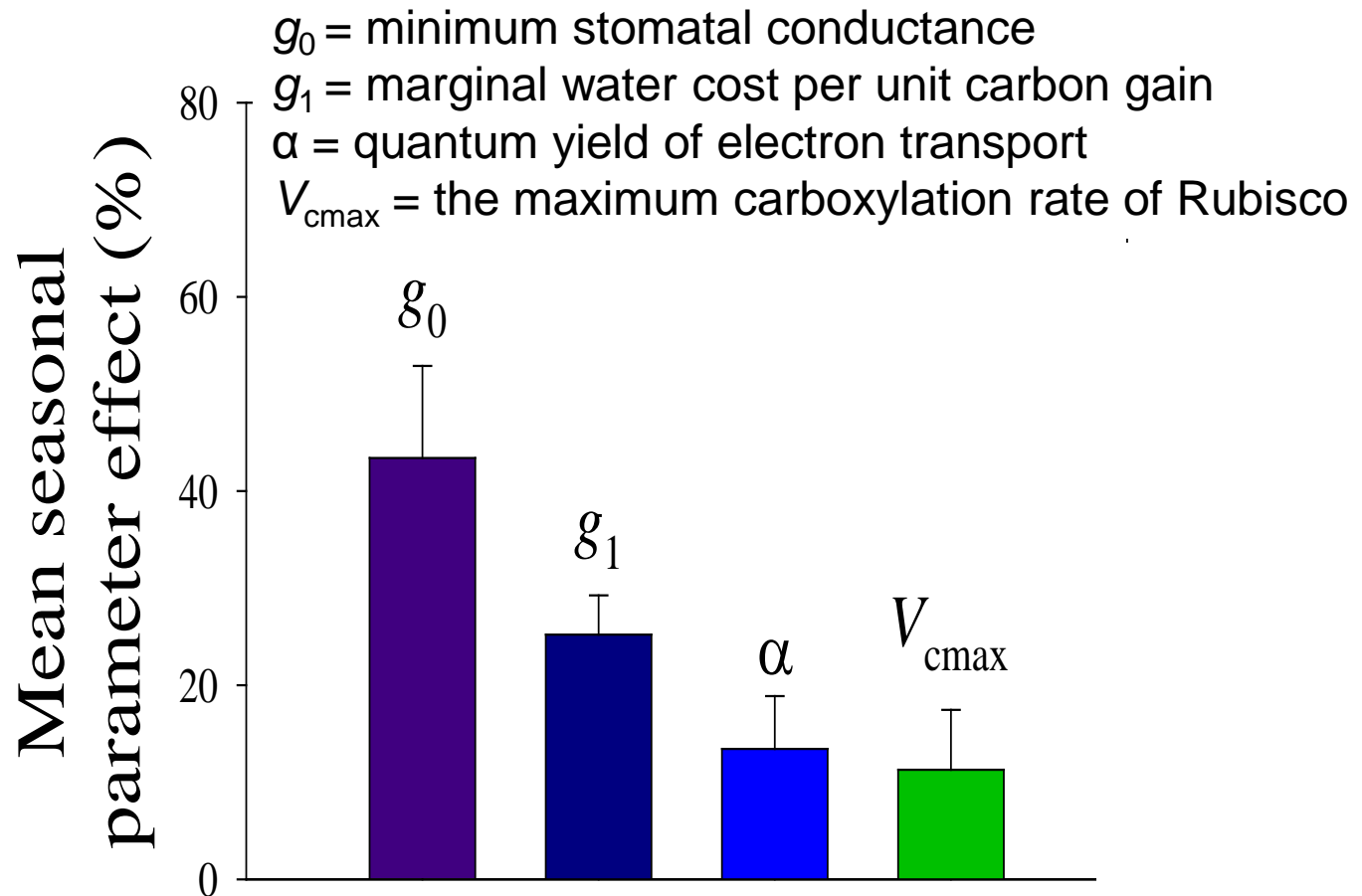
Background on
models

Sensitivity
analyses

Understanding g_0

Understanding g_1

Conclusions



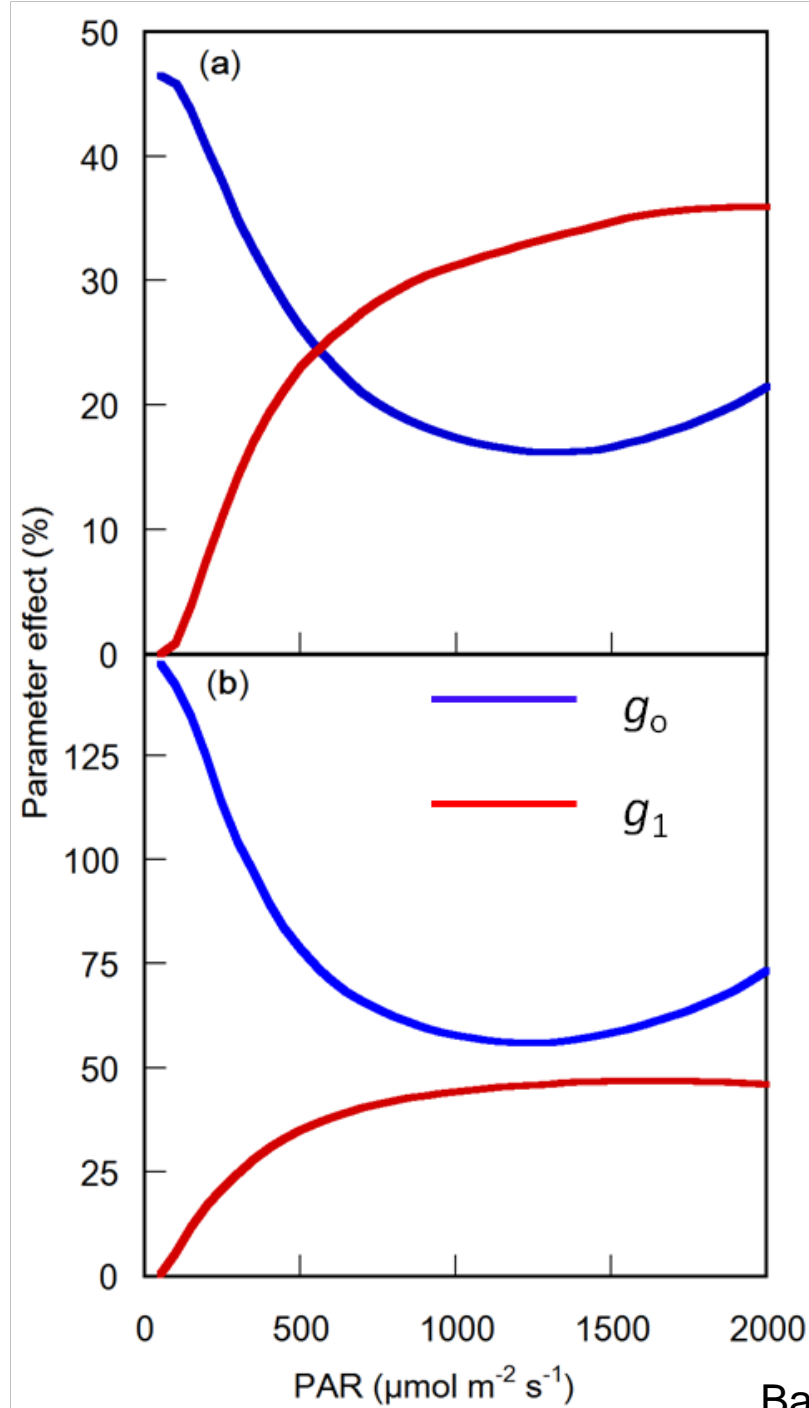
Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions



Intraspecific

C_3

Parameter interactions with environment

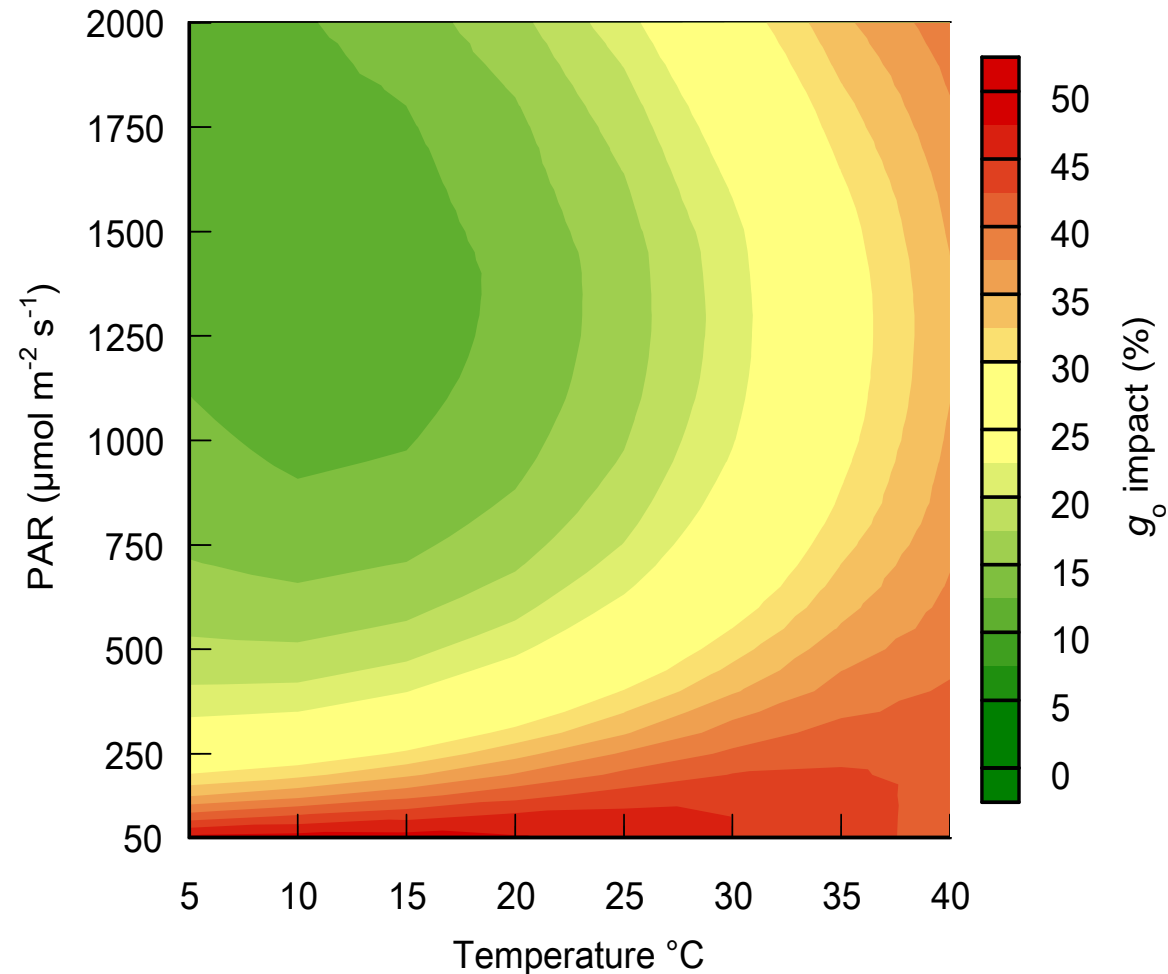
Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions



Parameter importance changes with environment

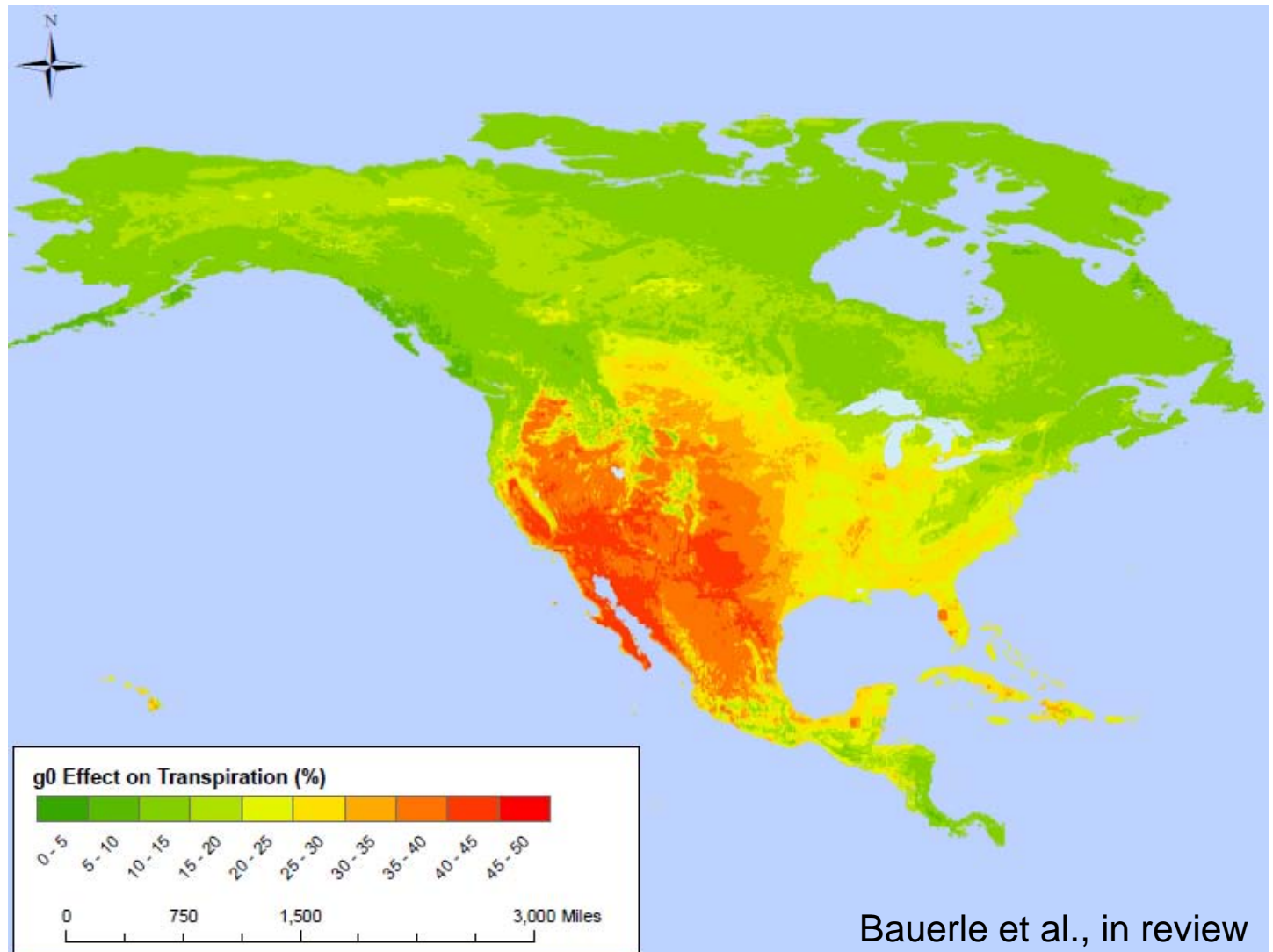
Background on models

Sensitivity analyses

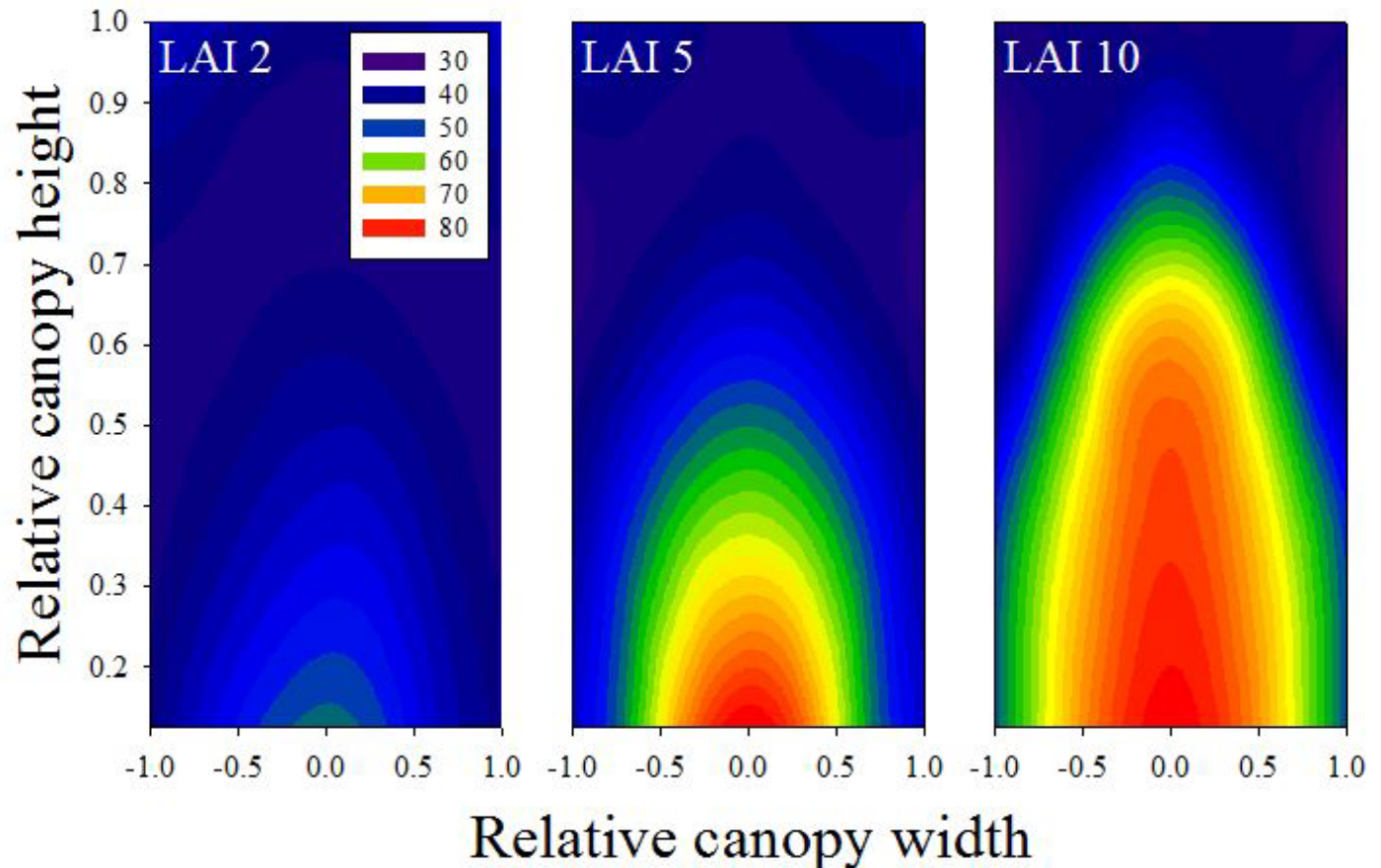
Understanding g_0

Understanding g_1

Conclusions



Parameter effect increases with canopy depth



Sub-models (g_s)

Background

g_0 response to drought/season

Model performance

Sensitivity analysis

Understanding g_0

Larger scale implications

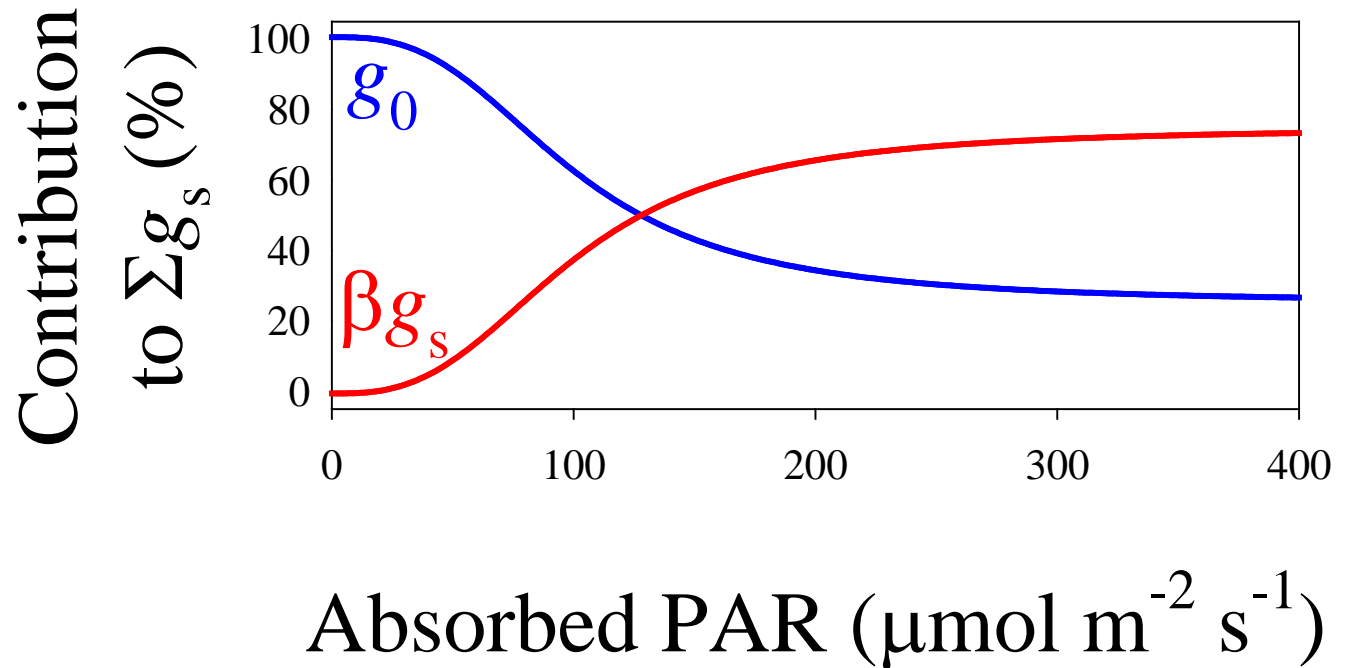
Conclusions

$$\Sigma g_s \rightarrow g_s = g_0 + \frac{g_1 A_n}{(C_s - \Gamma) \left(1 + \frac{D_s}{D_0} \right)}$$

βg_s

Ball-Berry g_s model as modified by Leuning (1995)

Light dependence of g_0



Background on models

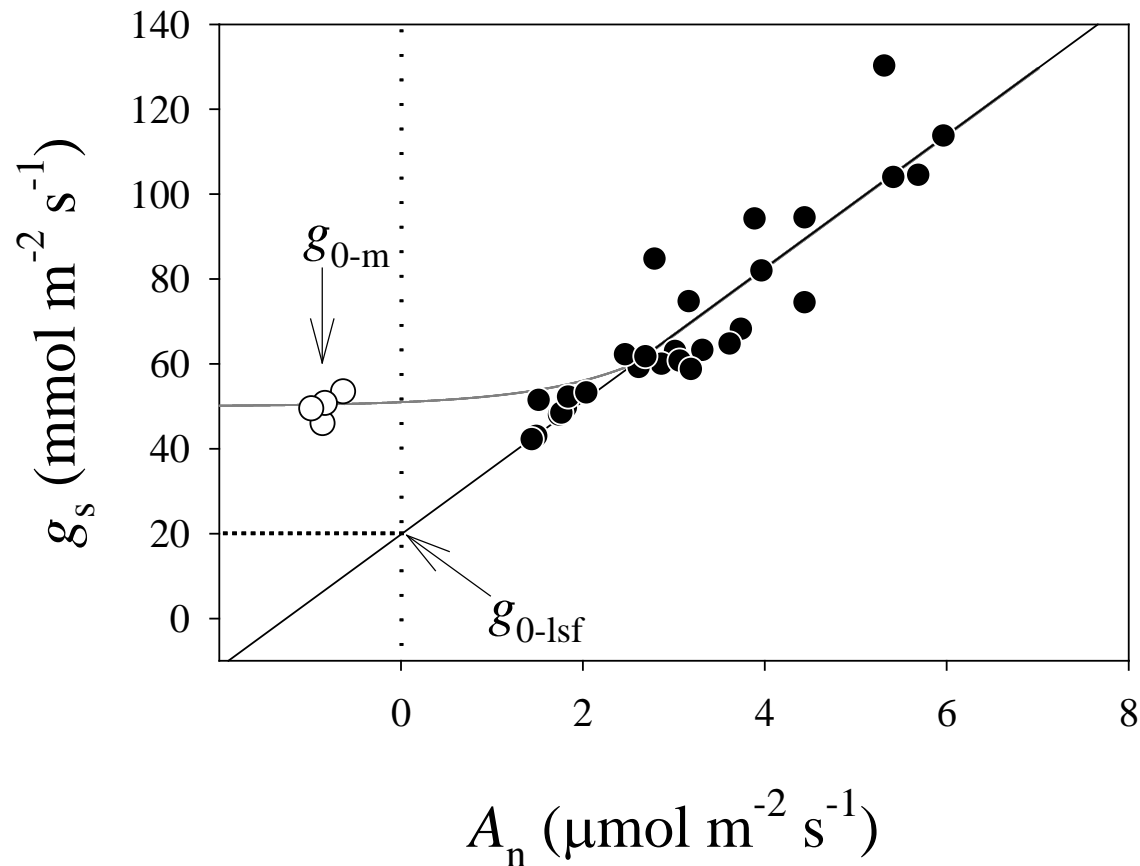
Sensitivity analyses

Understanding g_0

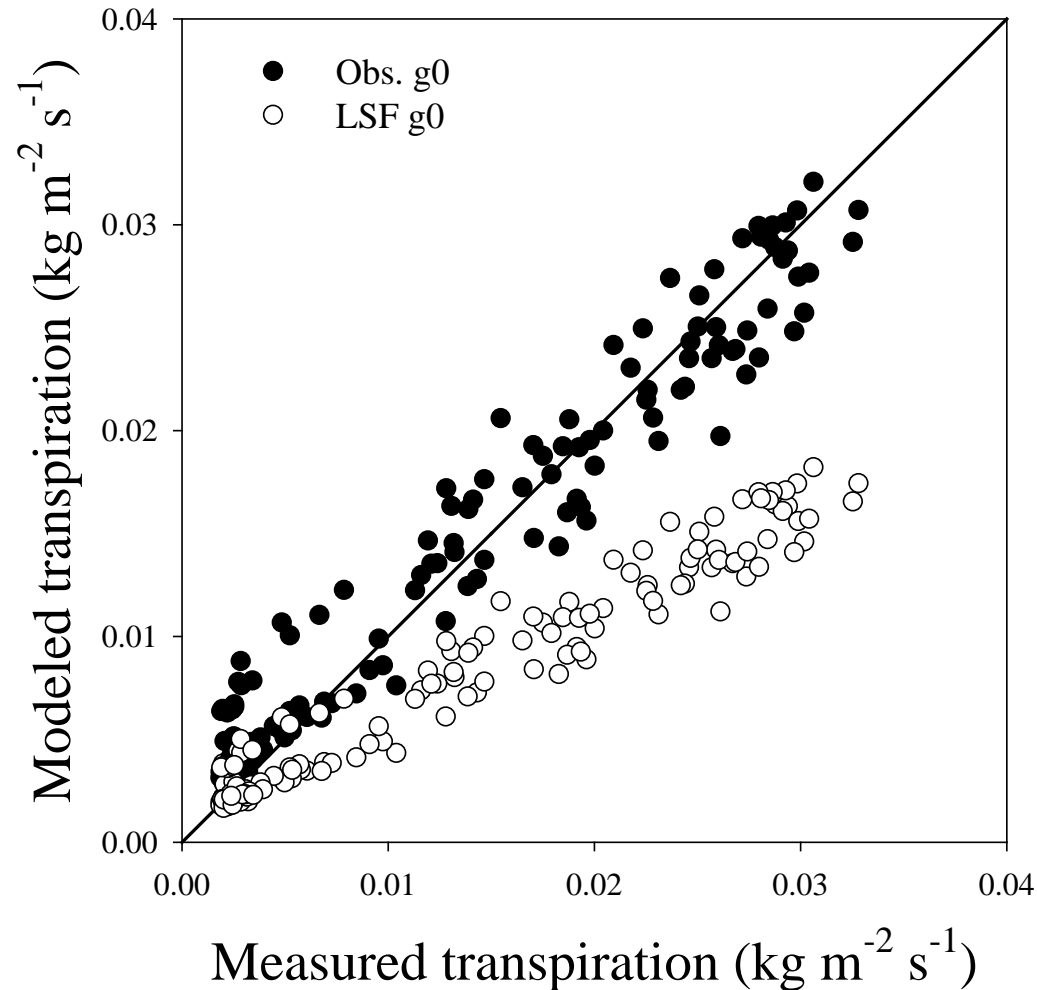
Understanding g_1

Conclusions

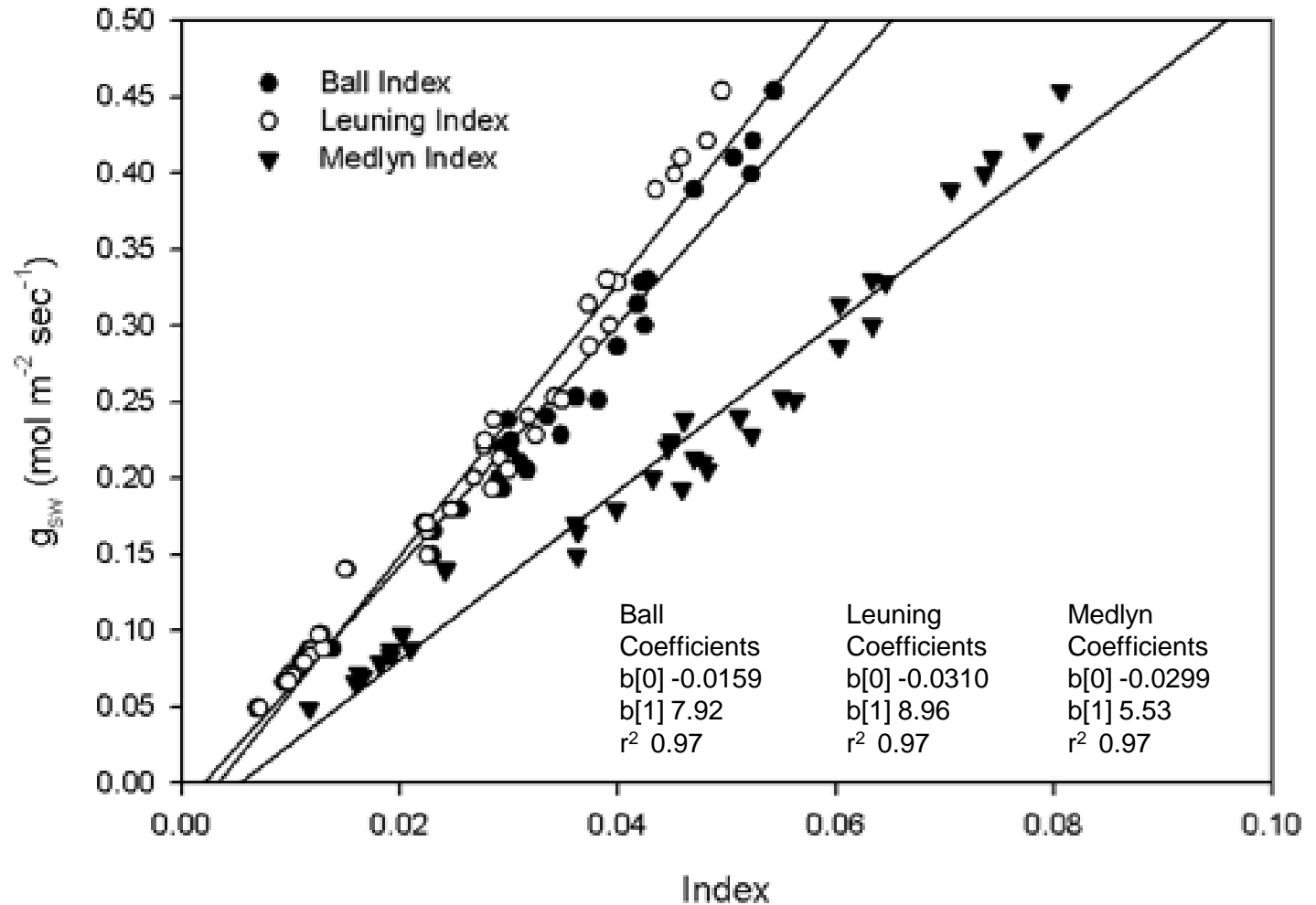
Error propagation of g_0 parameter fit



g_0 estimate error



g_1 – differences among index



Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions

Water stress response

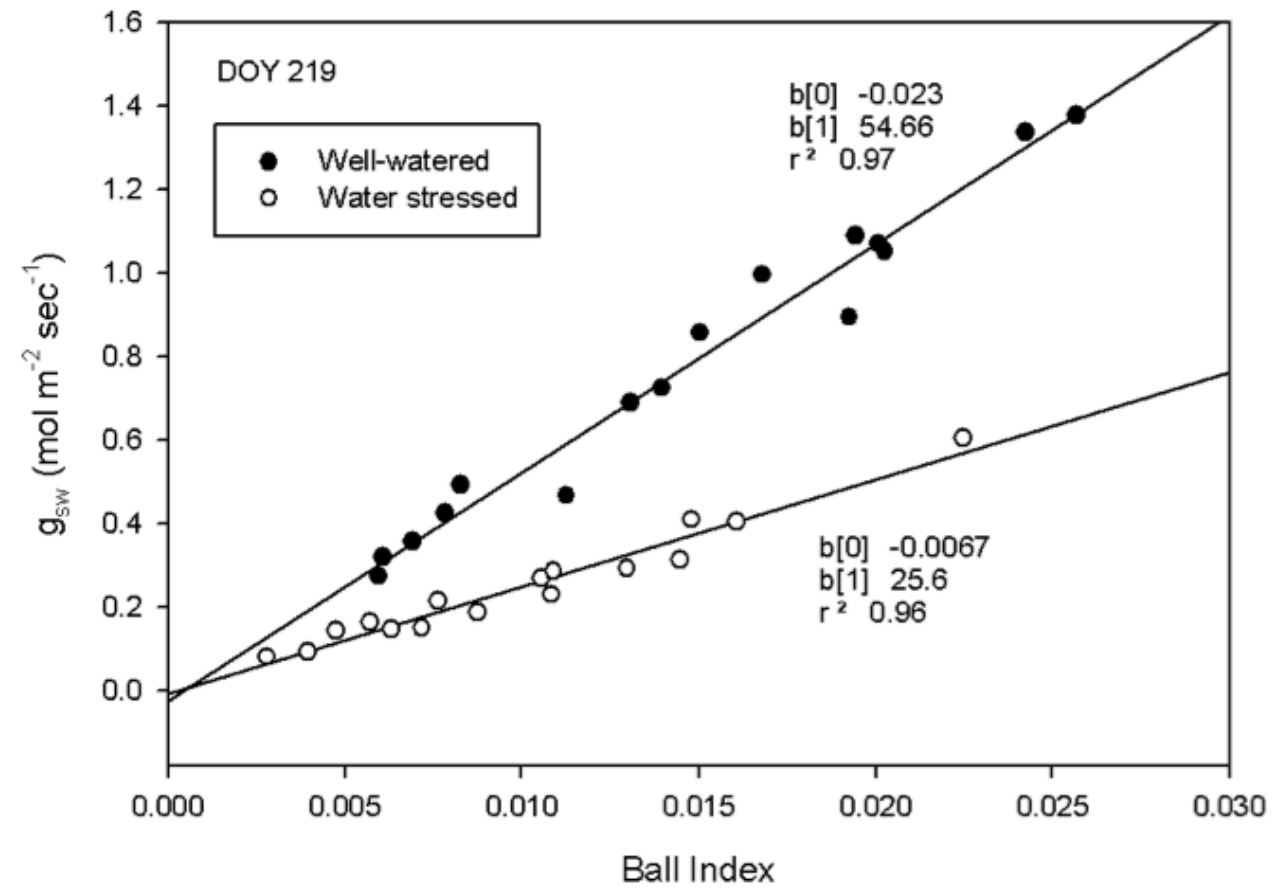
Background on models

Sensitivity analyses

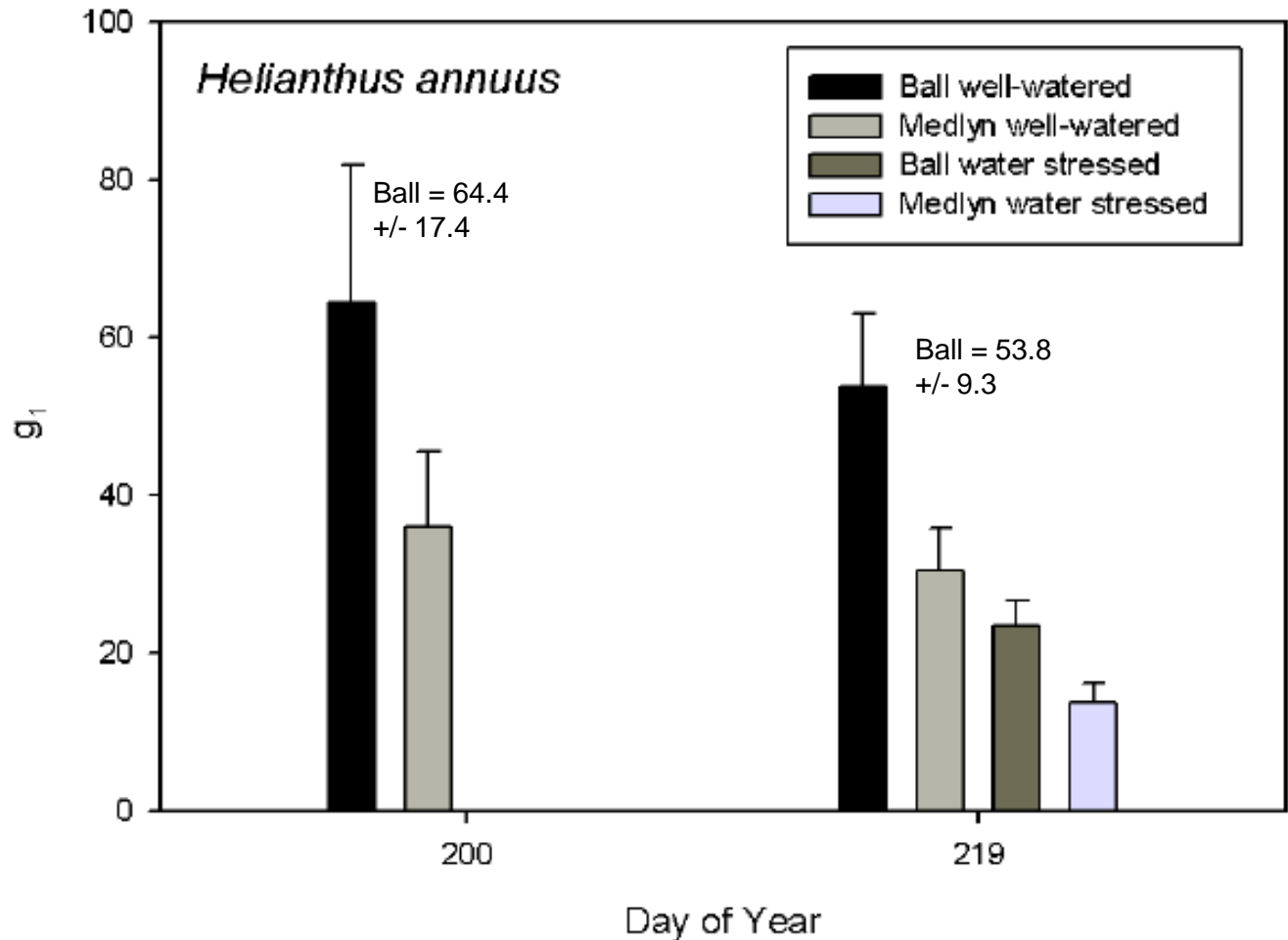
Understanding g_0

Understanding g_1

Conclusions



g_1 – Time and water stress response



Water stress response

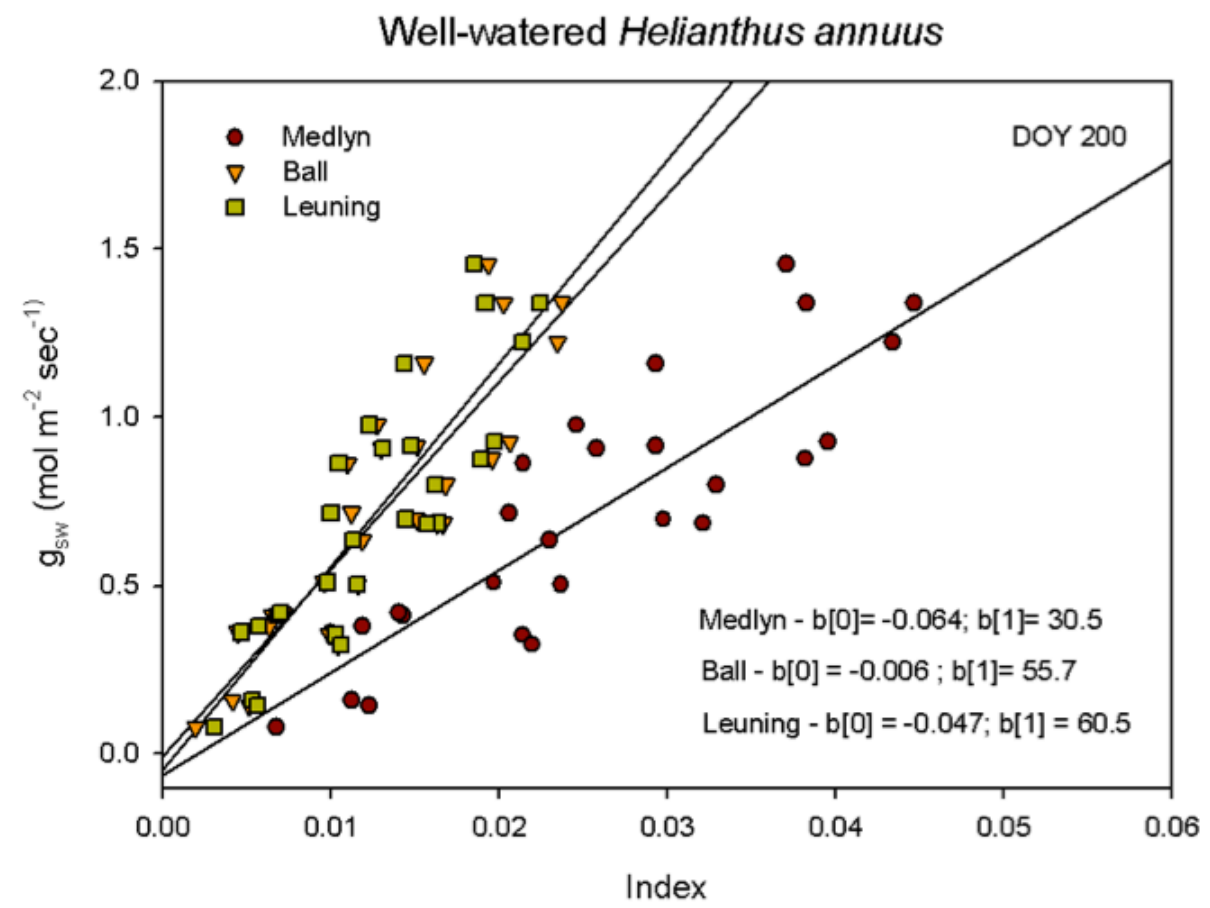
Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions



Conclusions

- g_0 is the parameter with highest influence on transpiration estimates (in 3-dimensions)
- The g_0 parameters importance changes with environmental conditions
- The magnitude of the g_0 parameter is indirectly proportional to absorbed light
- Using measured g_0 gave better model estimates than linear estimates

Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions

Conclusions

- g_1 is the parameter with second highest influence on transpiration estimates (in 3-dimensions)
- g_1 values can be different among calculation indices
- The g_1 parameter changes over time and in response to water stress
- We are revisiting the methods of “measuring” the g_1 parameter

Background on models

Sensitivity analyses

Understanding g_0

Understanding g_1

Conclusions