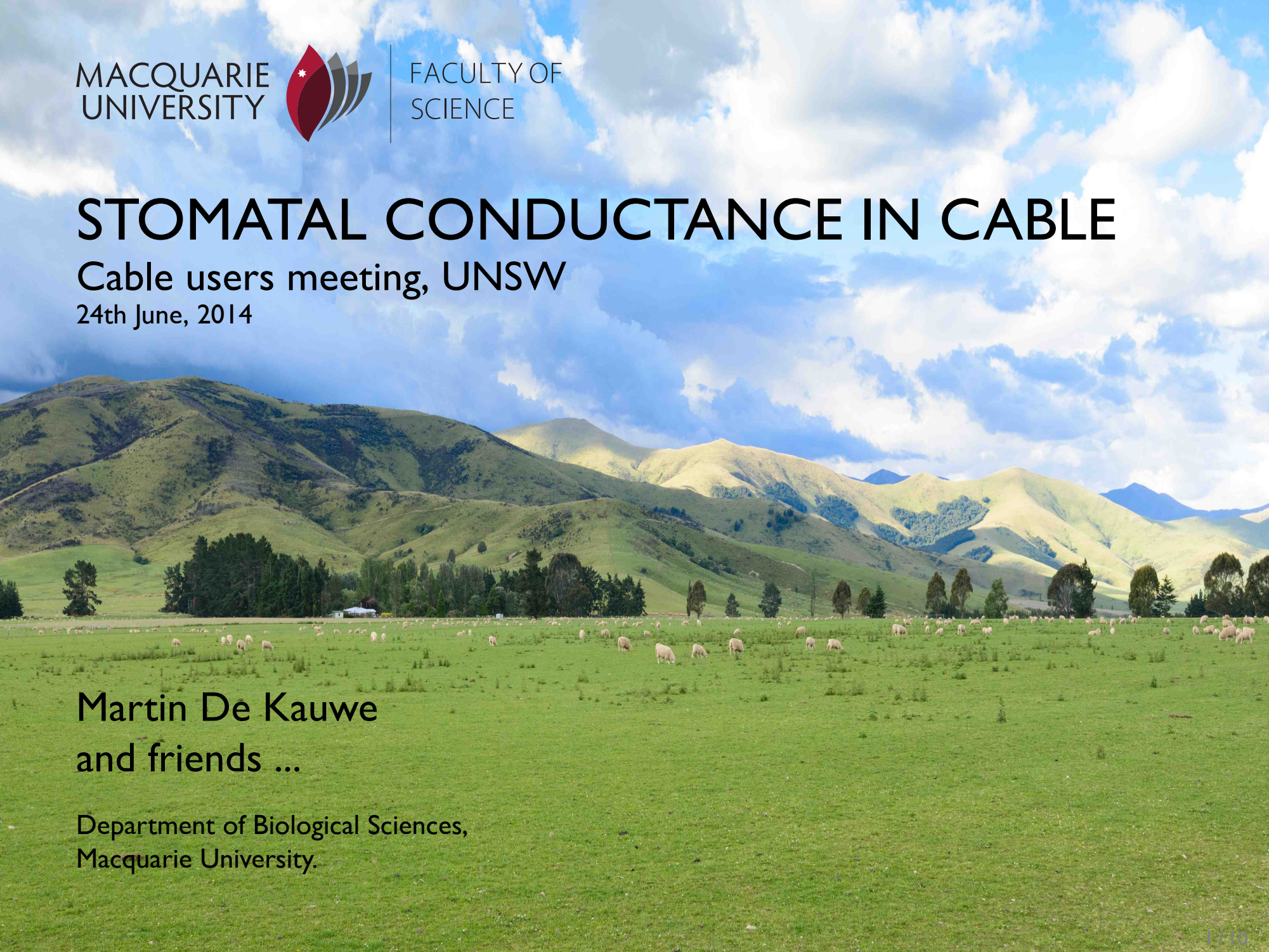


STOMATAL CONDUCTANCE IN CABLE

Cable users meeting, UNSW

24th June, 2014

Martin De Kauwe
and friends ...

Department of Biological Sciences,
Macquarie University.

Stomatal conductance model

Why change the stomatal conductance model?

- Ideally CABLE should be more modular.
- Currently the world is represented by ***2*** parameters.
- Where do these parameters come from?

What have we changed?

- Added Belinda Medlyn's optimal g_s model (Medlyn *et al.* 2011, *Global Change Biology*, 17, 2134–2144).
- Added PFT parameters derived from a large global synthesis of 314 species from 56 sites (Lin *et al.* in prep).

Optimal g_s model

- Model is derived from an optimisation approach whereby stomata act to minimize the amount of water used per unit carbon gained.

- Model has the same form as the standard empirical approach (and fewer parameters than the current Leuning model).

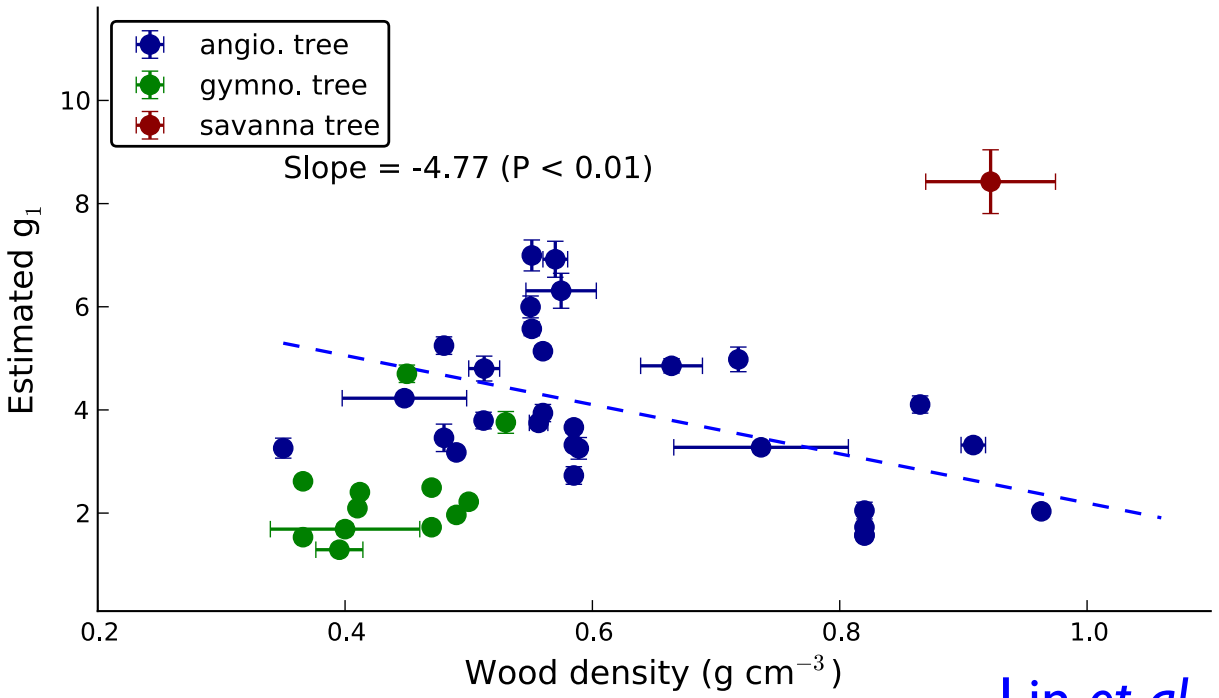
$$g_s = g_0 + 1.6\left(1.0 + \frac{g_1}{\sqrt{D}}\right)\frac{A}{C_a}$$

- Parameters have a theoretical "meaning": g_1 is related to the marginal cost of water to the plant.

- Model has been widely tested, including data from elevated CO_2 experiments.

Stomatal synthesis

- g_1 parameter is linked to plant water use strategy.

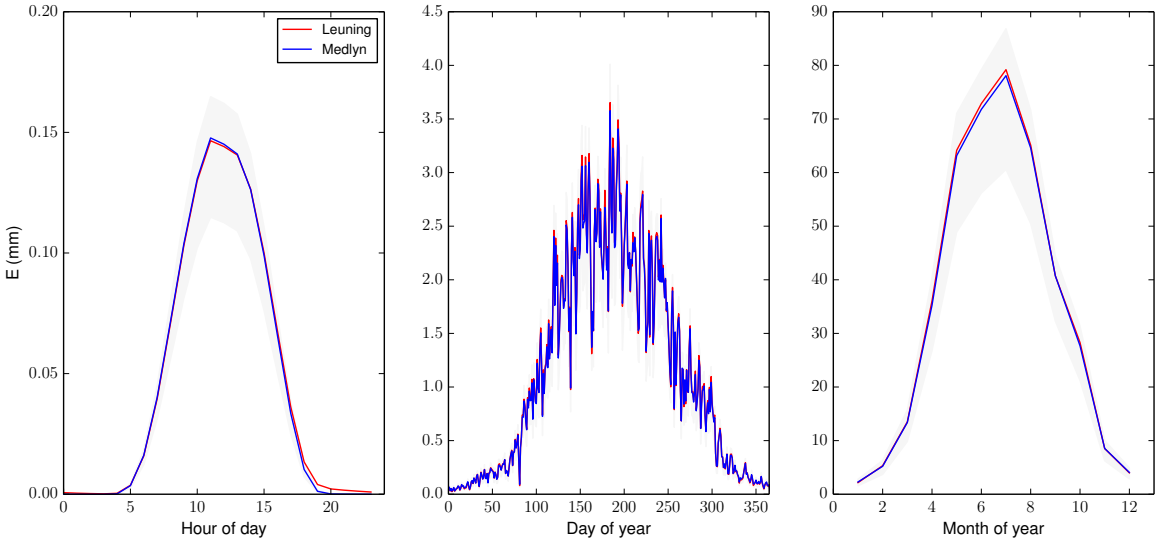


Lin *et al.* in prep.

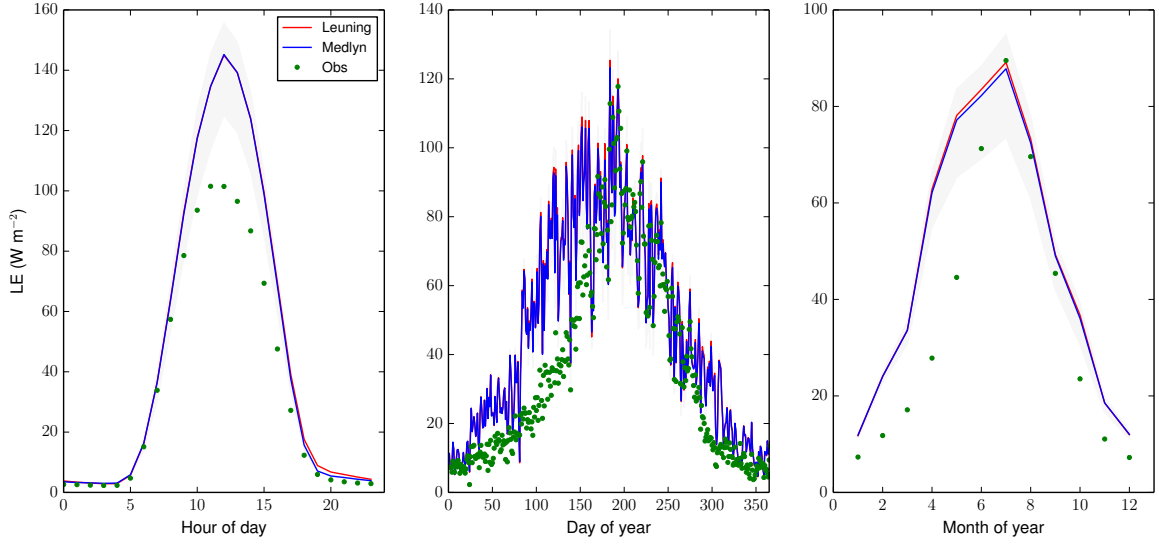
- No data for:
  i. deciduous needleleaf –> evergreen needleleaf.
  ii. C4 crops –> C4 grases.
  iii. Wetlands –> C3/C4 grases

Harvard forest

Transpiration Uncertainty ≈ -94–50 mm/year



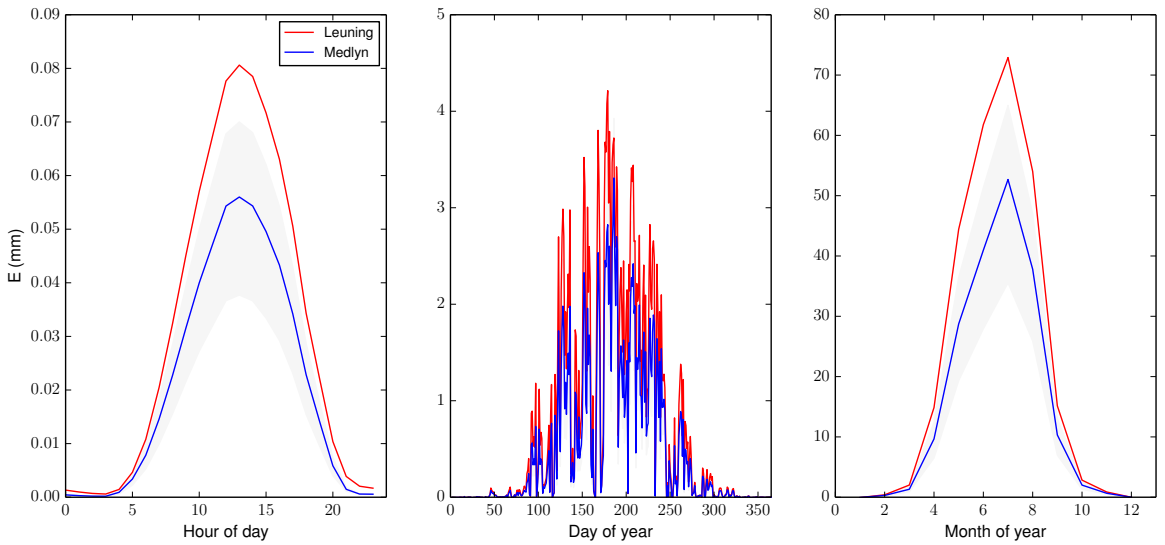
Negligible impact for Broadleaf PFT.



Latent Heat

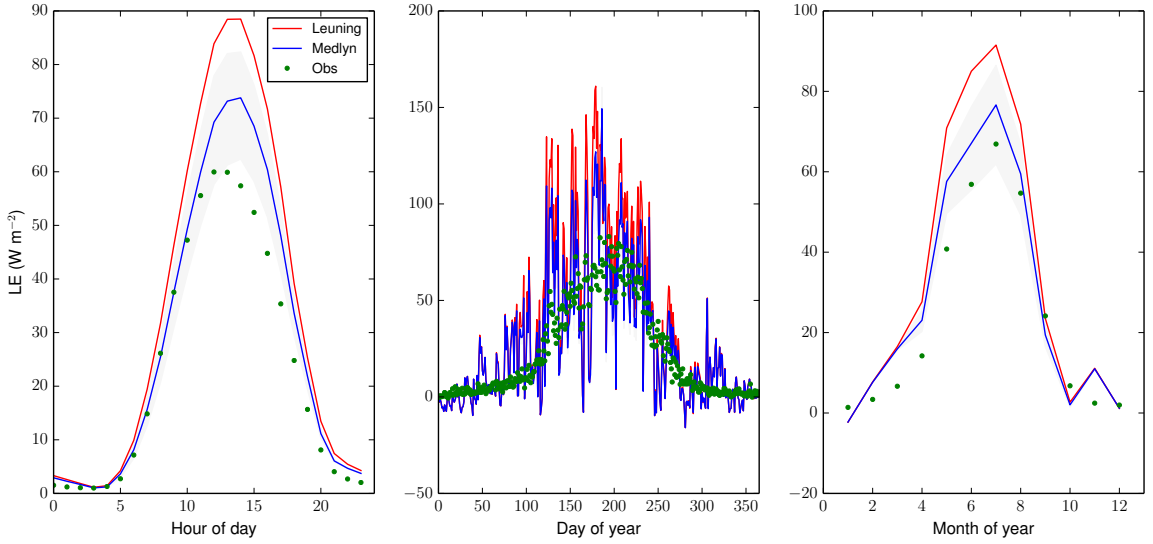
Hyytiala forest

Transpiration



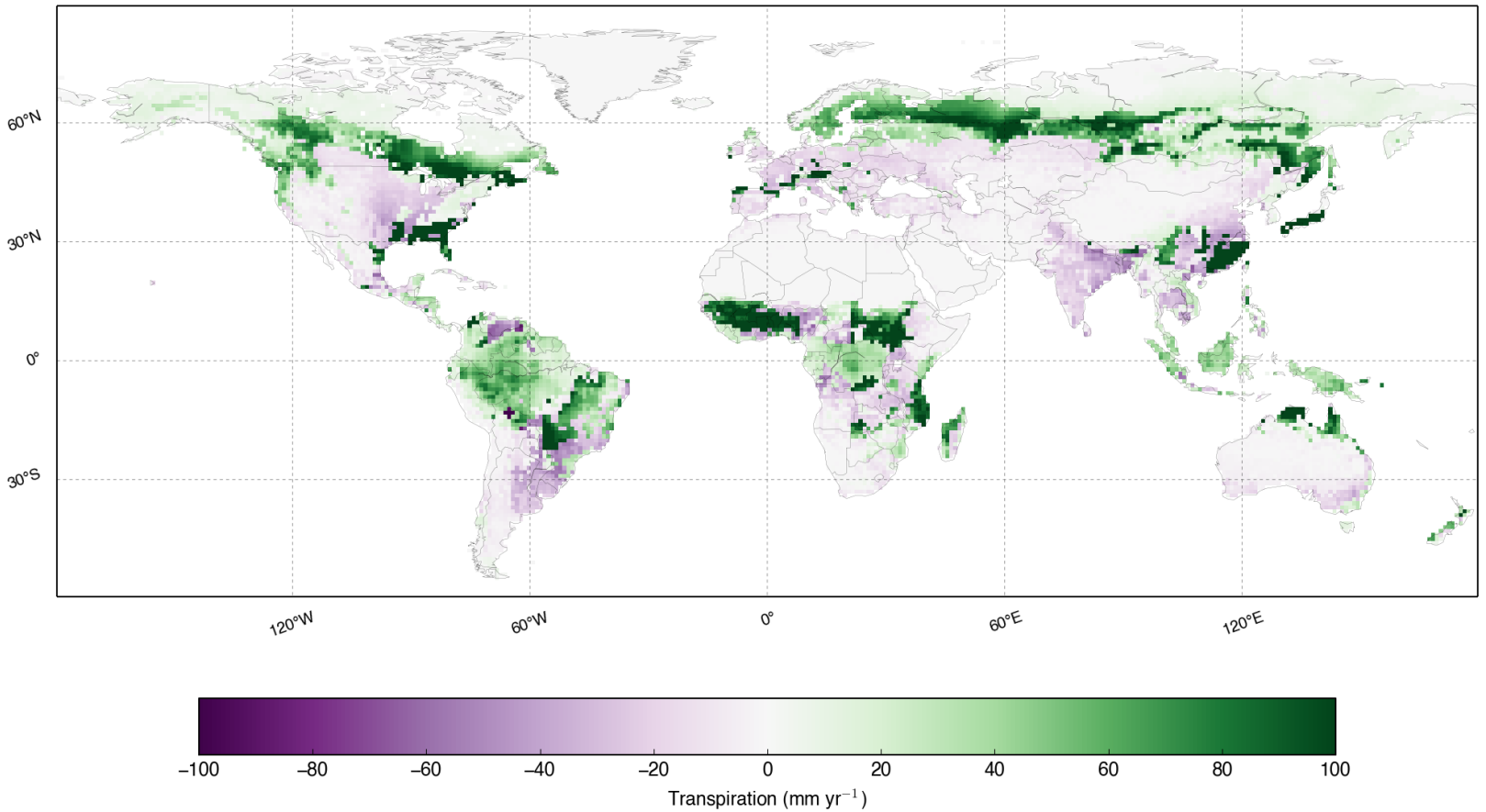
Clear impact for Needleleaf PFT: more conservative water use strategy.

Latent Heat



Transpiration - GSWP2

Medlyn is higher ; Leuning is higher



Response to drought – 1

Plant responses to drought within most models lacks mechanistic process.

- Two different plants on the same soil, with the same rooting depth would behave in the same way in CABLE. This is not what we see in reality ...

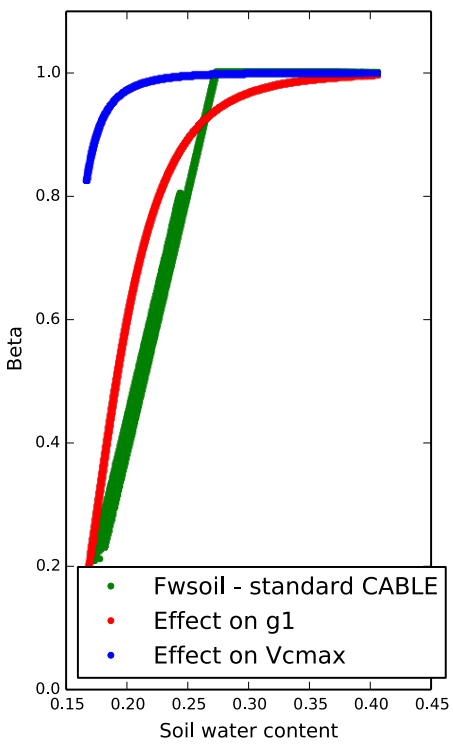
- Following work by Zhou *et al.* 2013, *Agricultural Forest Meteorology*, 182–183, 204–214.

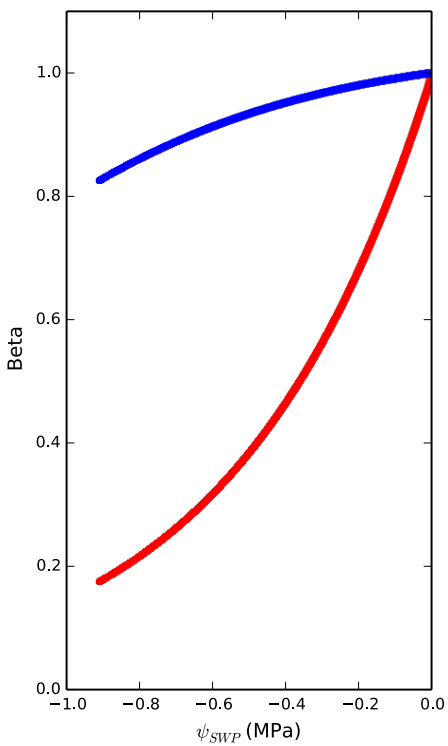
- Link to optimal g_s model – Stomatal limitation (via g_1) and non-stomatal limitation (via V_{cmax})

Response to drought – 2

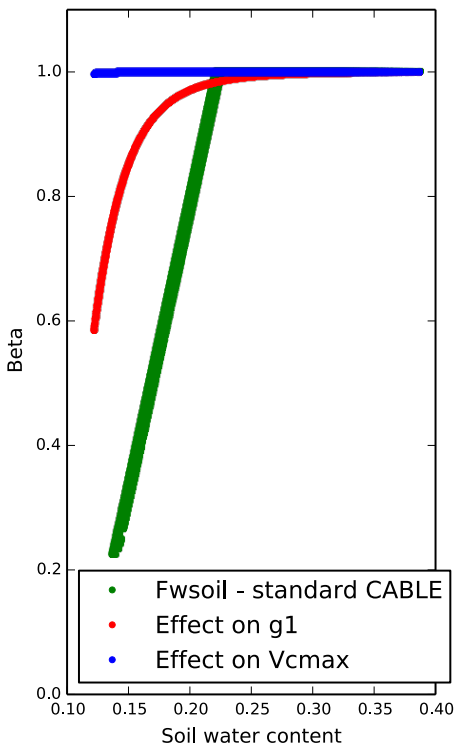
Ability to parameterise different "risk taking" behaviour.

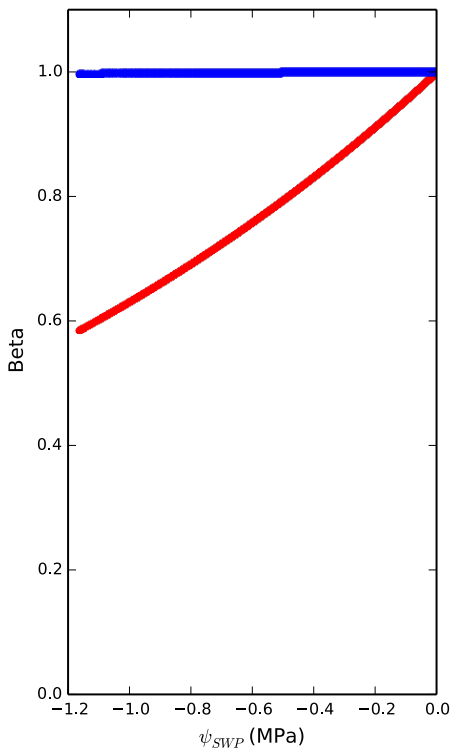
Castelporziano





El Saler





Thanks to...

- Jatin Kala (UNSW)
- Yan-Shih Lin (MQ)
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- Andy Pitman (UNSW)
- Gab Abramowitz (UNSW)