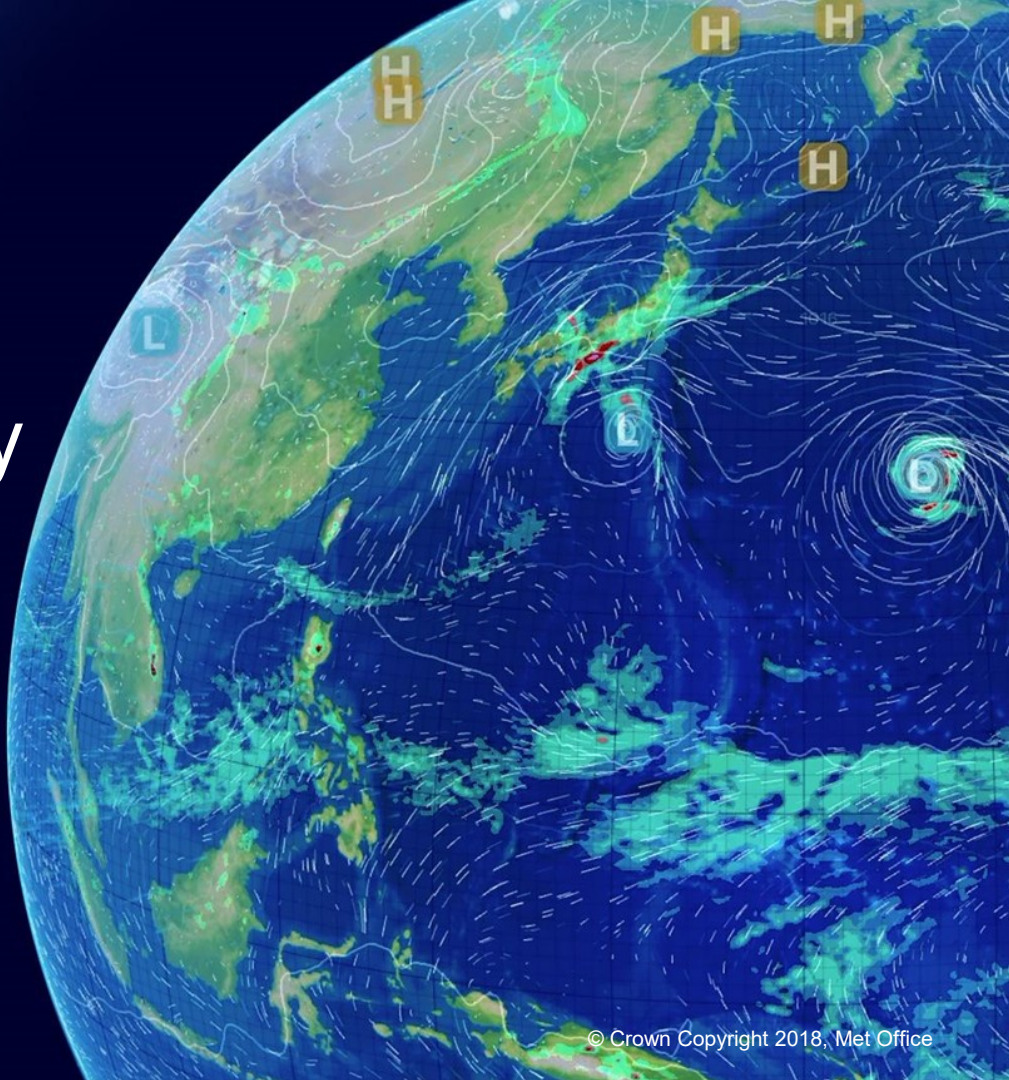




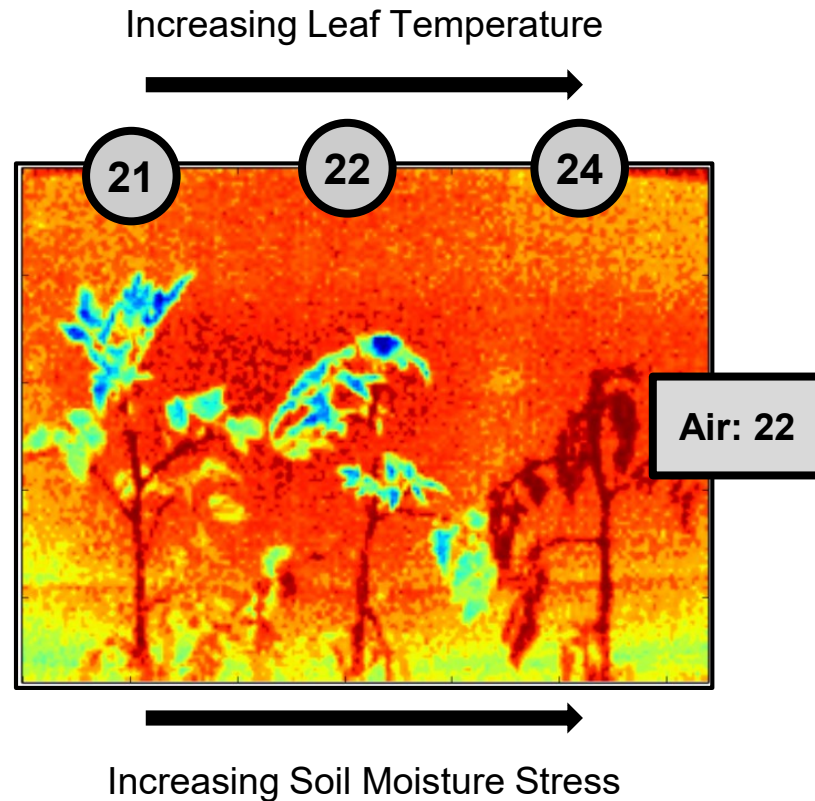
Modelling Sub-Canopy Temperature Profiles

Rob King



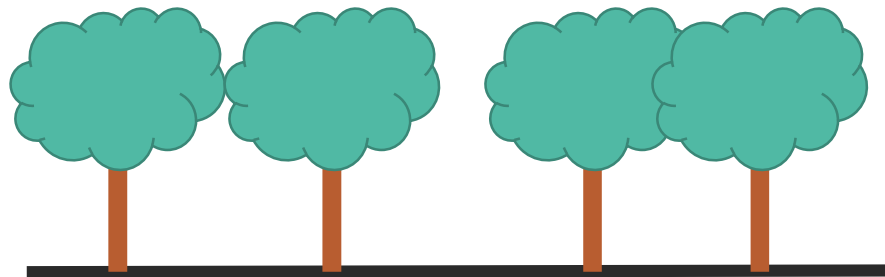
Motivation

- Interested in LST and relationship to Leaf Temperature
 - Soil moisture stress
 - Resilience to stress
- Example : Tomato plants
 - 3 different stress levels



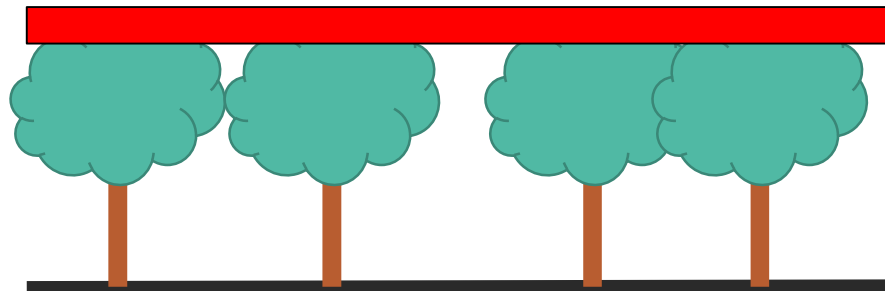
Motivation

- LST



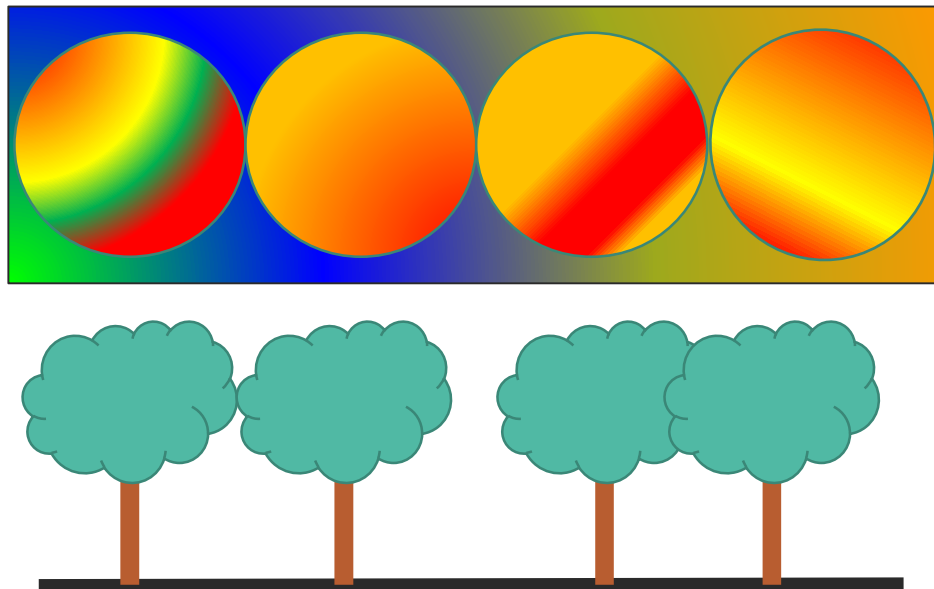
Motivation

- Single 'skin' temperature from JULES and observations



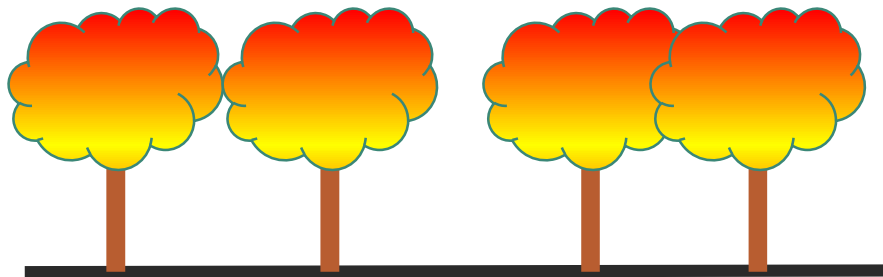
Motivation

- That's different to structure seen from above
- “can see through”



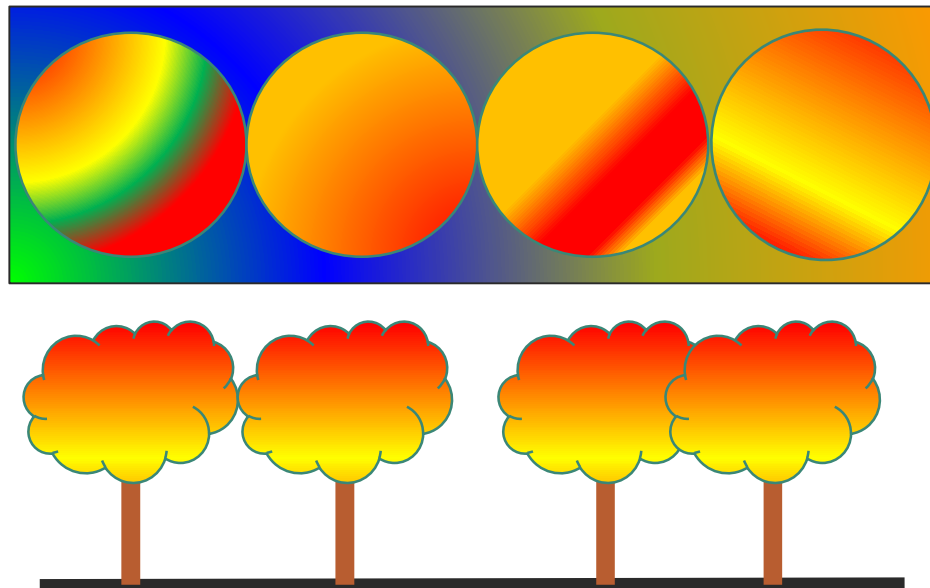
Motivation

- Also thermal gradients through the canopy



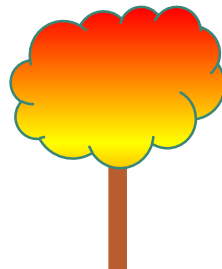
Motivation

- Model sub-canopy variation in temperature
- Vertical gradients
- Understand processes and impacts
 - LST
 - Photosynthesis
 - Pest incubation
 - ...

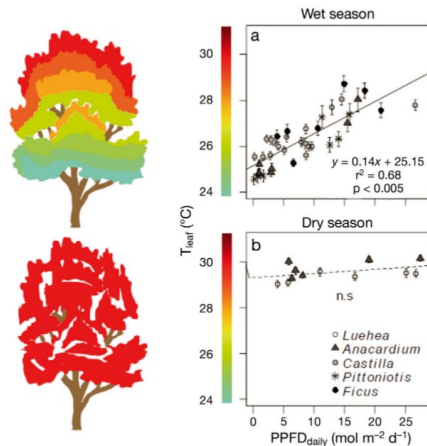


Outline

- Want to create:
 - Simple model that can be run from JULES outputs and driving data
 - Could run in JULES
 - Used to investigate effects of temperature variation through the canopy

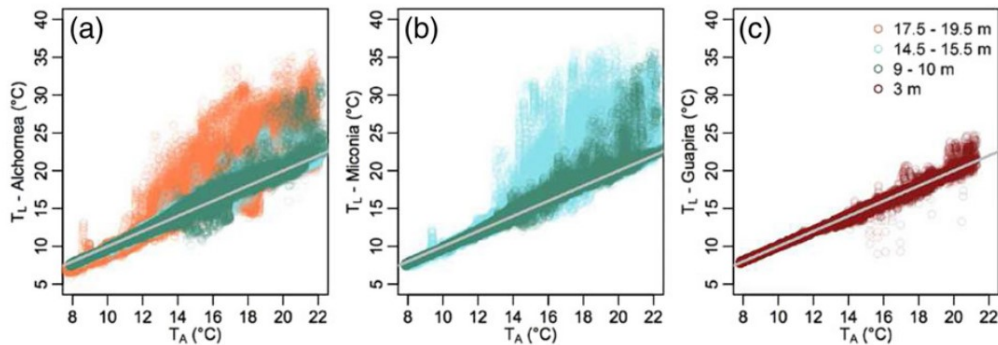


Examples



Seasonal and diurnal
temperature distributions

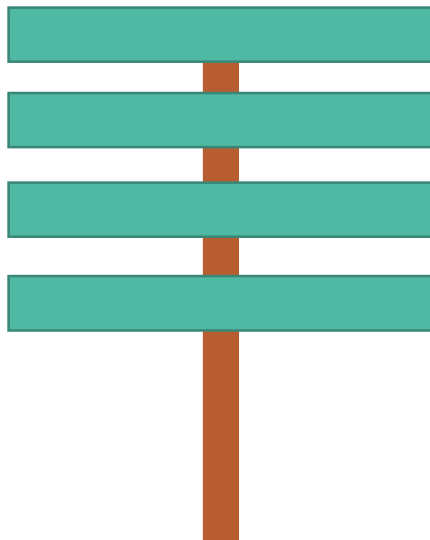
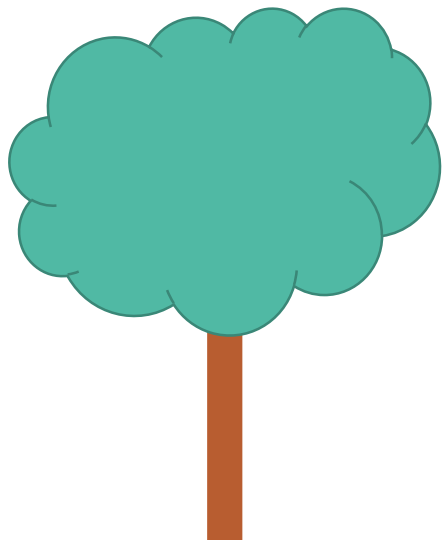
Rey-Sanchez et al. 2016 Fig. 3



Radiation variations with height
in canopy

Fauset et al. 2018 Fig. 3

Method



- Model temperature of individual layers
- Capture interactions between layers
- Use layer temperature to drive processes / other models

Method



I can model a plane!
Radiation, Convection
Latent heat, ...



A tree is just lots of planes

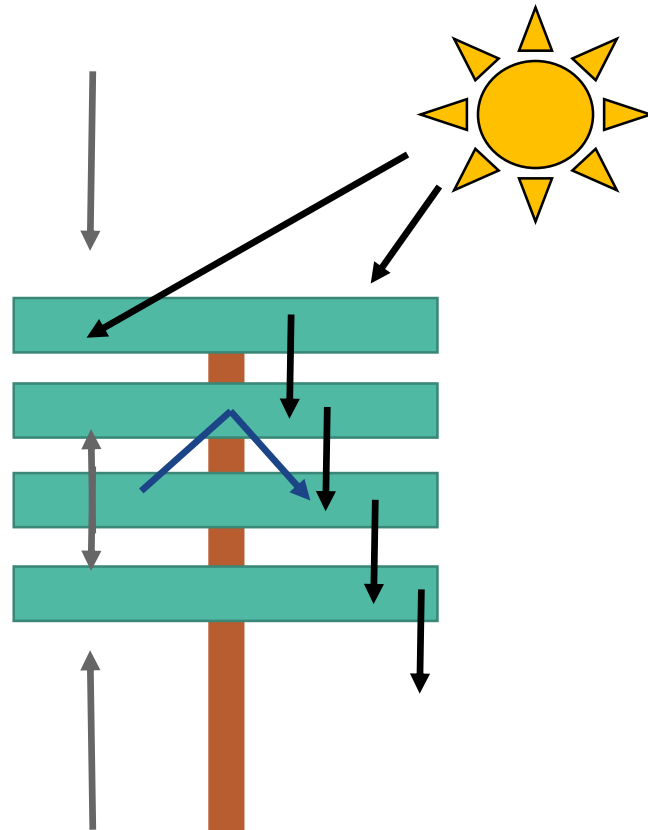
Maybe....

Need to capture the
interaction between
layers

And planes don't
normally 'feedback' to
temperature changes

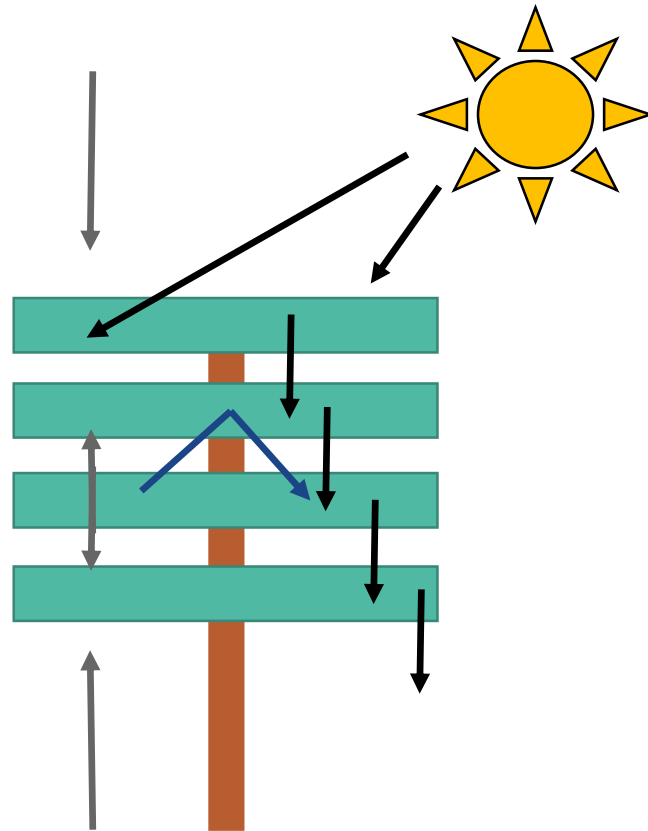
Radiation

- Absorption and transmission from layer to layer
- LW also emission, and upward source from ground
- Reflections and multiple paths to consider
- Using Tristan Quaife's standalone
 - *canradmod* = 4

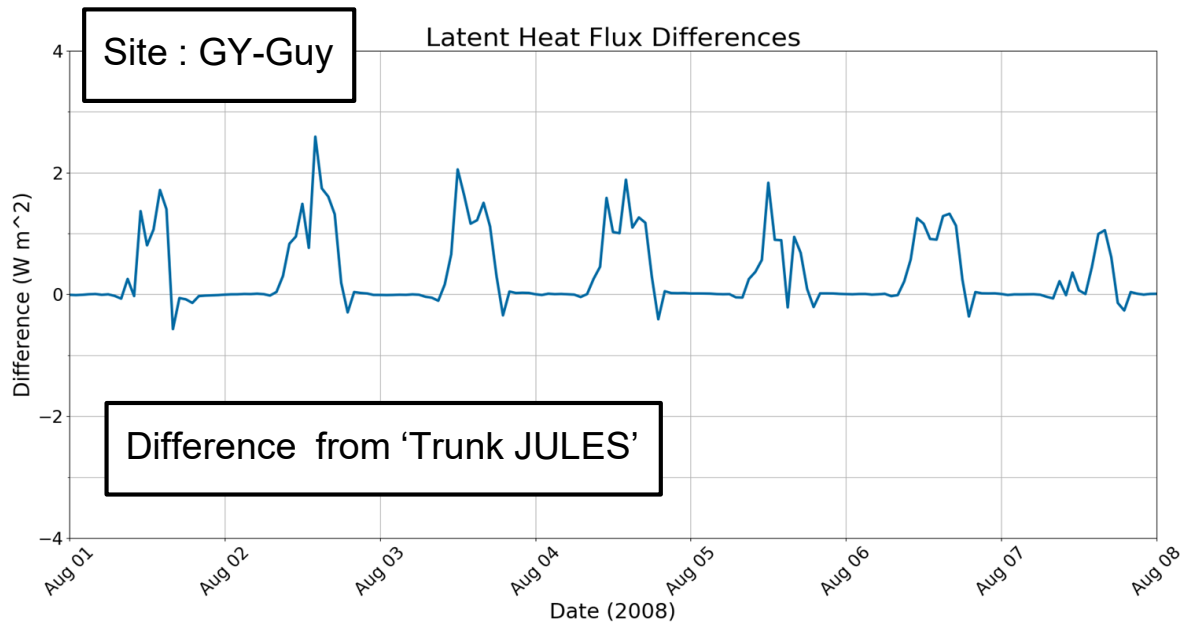


Radiation

- Other schemes, eg. Zhao and Quals (2006)
 - Scientifically different to JULES
- Want to remain consistent with JULES



JULES (very) Preliminary Example



- Changing Vcmax temperature dependence
- Tstar - 5 K
 - Simple but approximates average canopy temperature being cooler
- Rose suite
 - Karina Williams, Anna Harper, Patrick McGuire, Carolina Duran Rojas
 - U - AL752
- FLUXNET 2015 driving data
- JULES V5.4 (with my modification)

Work in progress

- Not quite fully working
- Probably LW radiation issue
 - How to transmit LW from all sources
- Initial validation work with BIFoR
 - Interested in other validation datasets...

Work in progress

- Air temperature constant at all levels
 - i.e. not coupled
- No latent heat terms yet
 - Interesting as this is something a two-way coupling will effect
- Different properties in different layers

