

JULES – surface exchange

JULES 2nd science meeting

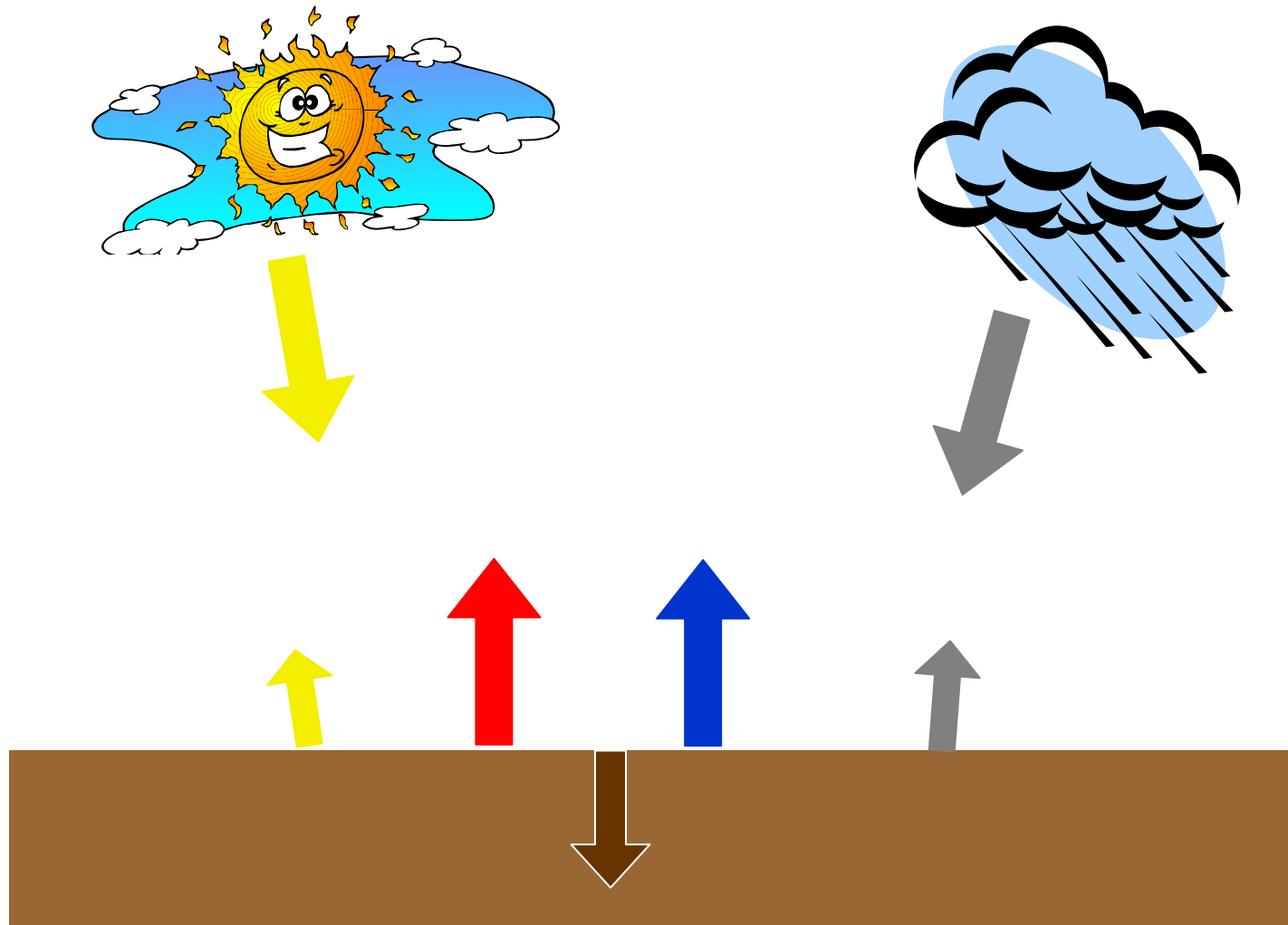
Martin Best, CEH Wallingford, 8th January 2008



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- Future structure

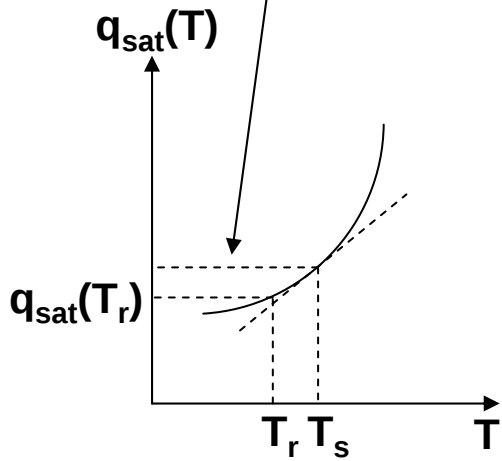
Surface Energy Balance



SEB Equations

$$\alpha = \left. \frac{dq_{sat}}{dT} \right|_{T_s}$$

$$\alpha(T_s - T_r) + q_{sat}(T_r)$$



$$H = \frac{\rho C_p}{r_a} (T_s - T_a)$$

$$\lambda E = \frac{\rho \lambda}{r_a + r_s} (q_{sat}(T_s) - q_a)$$

$$G = A_s (T_s - T_{s1})$$

$$R_n = H + \lambda E + G$$

Monin-Obukhov similarity theory

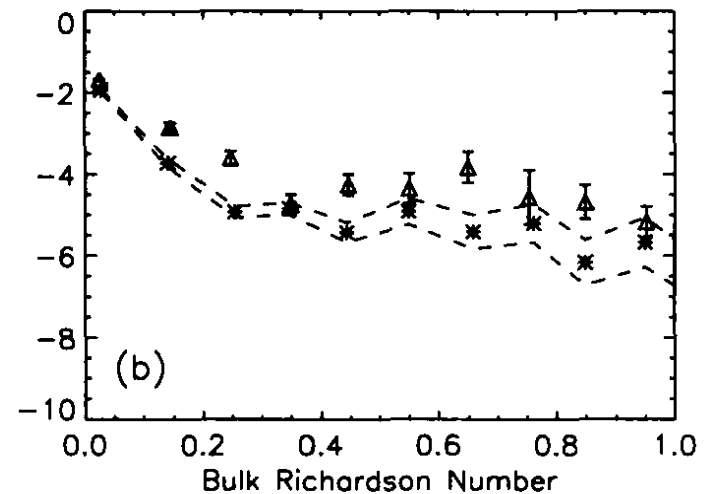
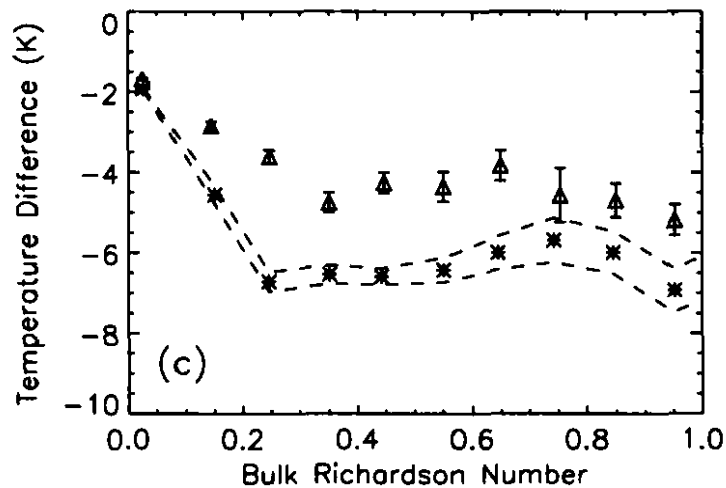
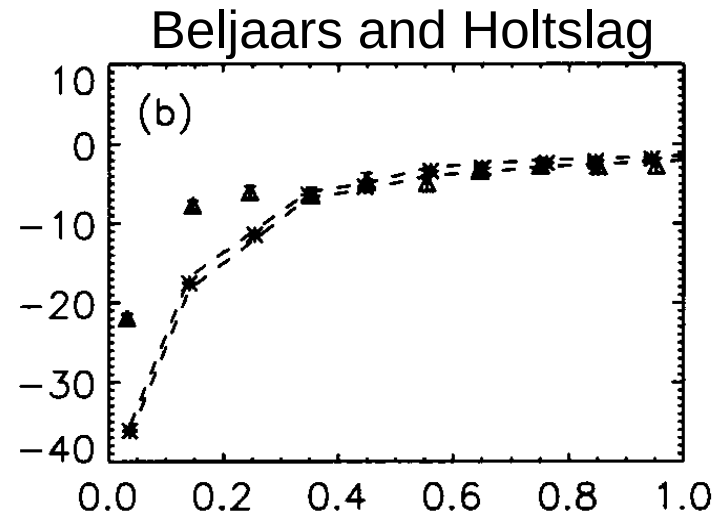
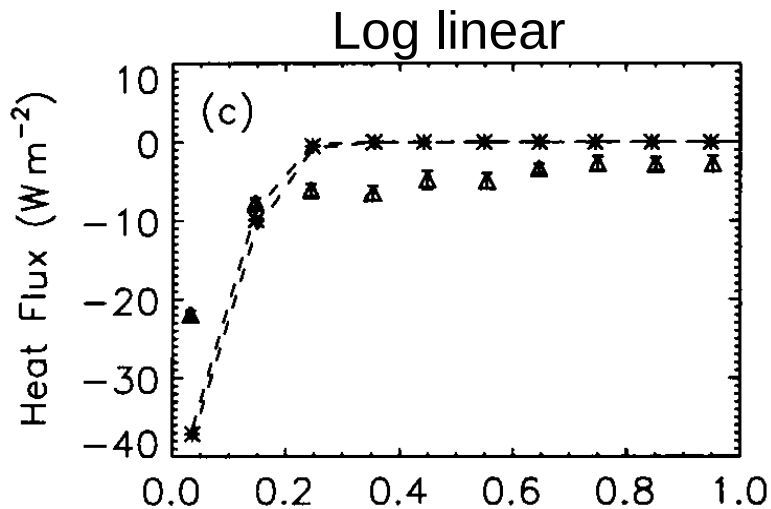
$$\frac{dU}{dz} = \frac{1}{\kappa} \frac{u_*}{z}$$

$$u_* = f_1(z / L)$$

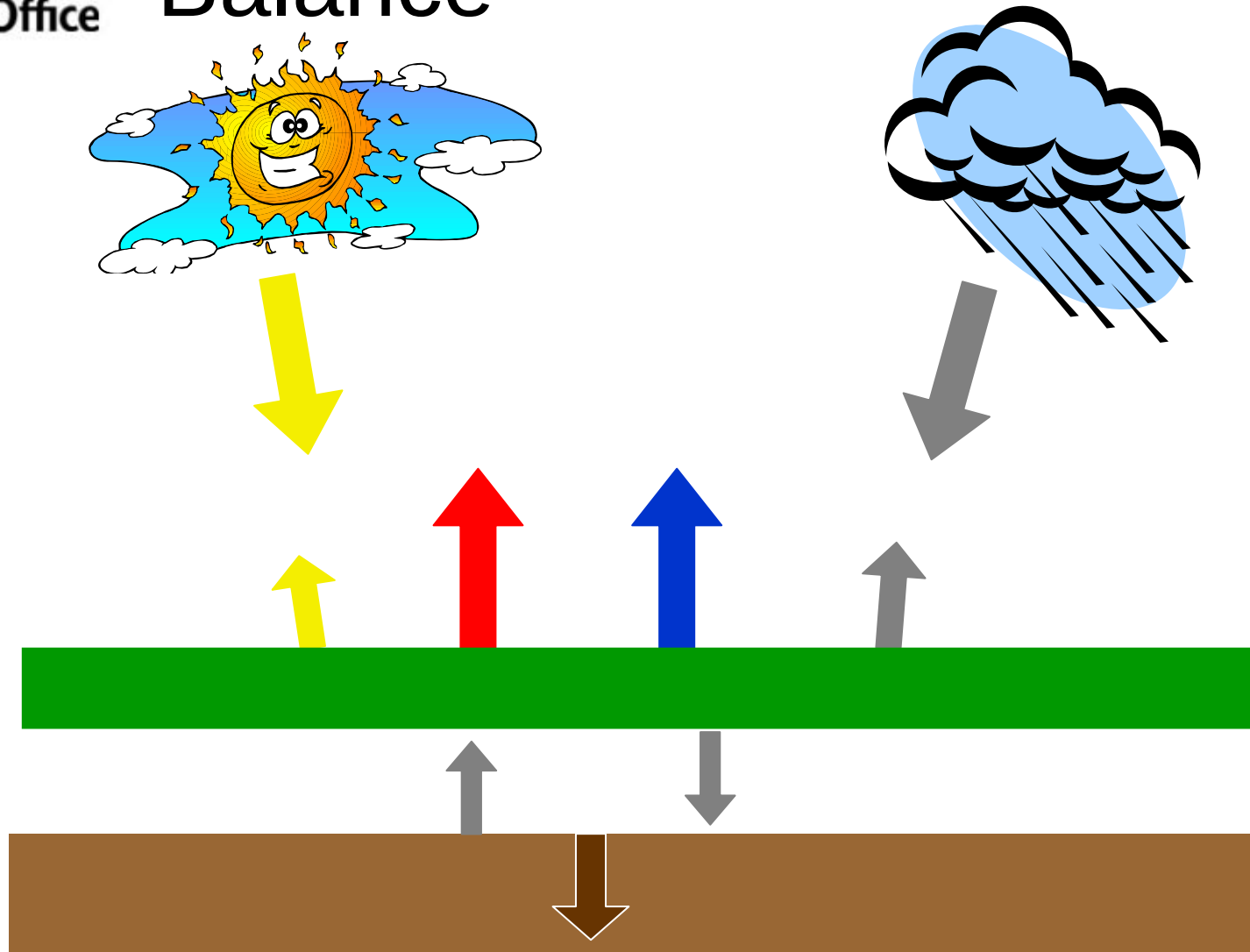
$$H = f_2(z / L)$$

$$L = f_3(u_*, H)$$

Impact of stable stability functions



Canopy Surface Energy Balance

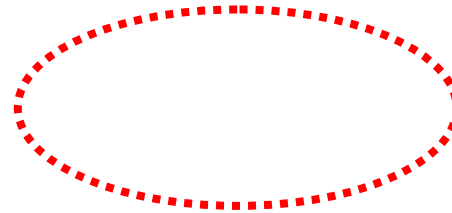


SEB Equations for Canopy

$$G = A_s (T_s - T_{s1})$$

$$R_n = H + \lambda E + G$$

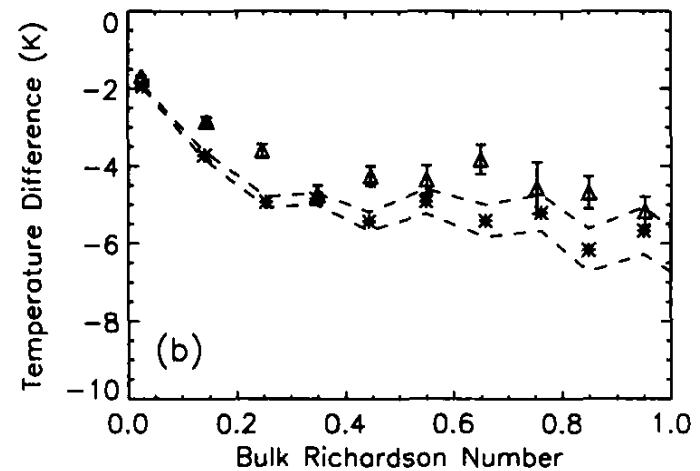
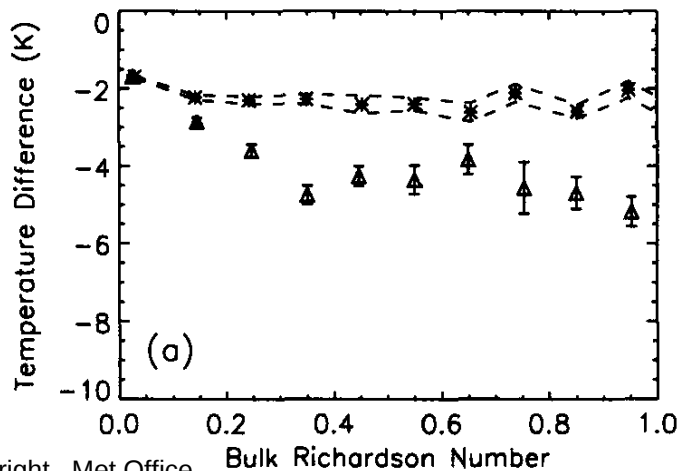
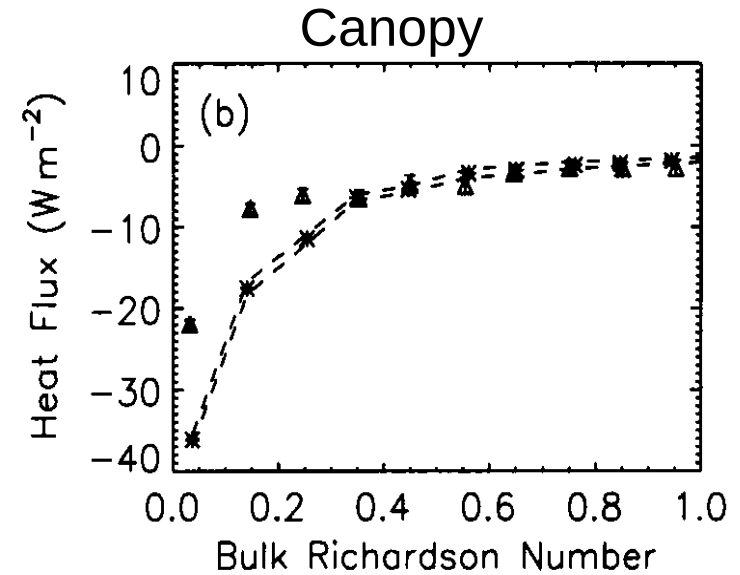
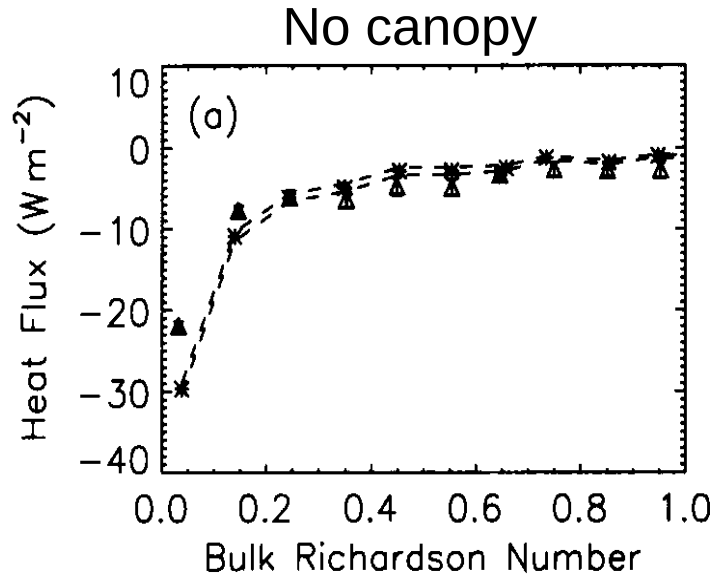
$$G = \nu (\sigma T_s^4 - \sigma T_{s1}^4) + (1 - \nu) A_s (T_s - T_{s1})$$



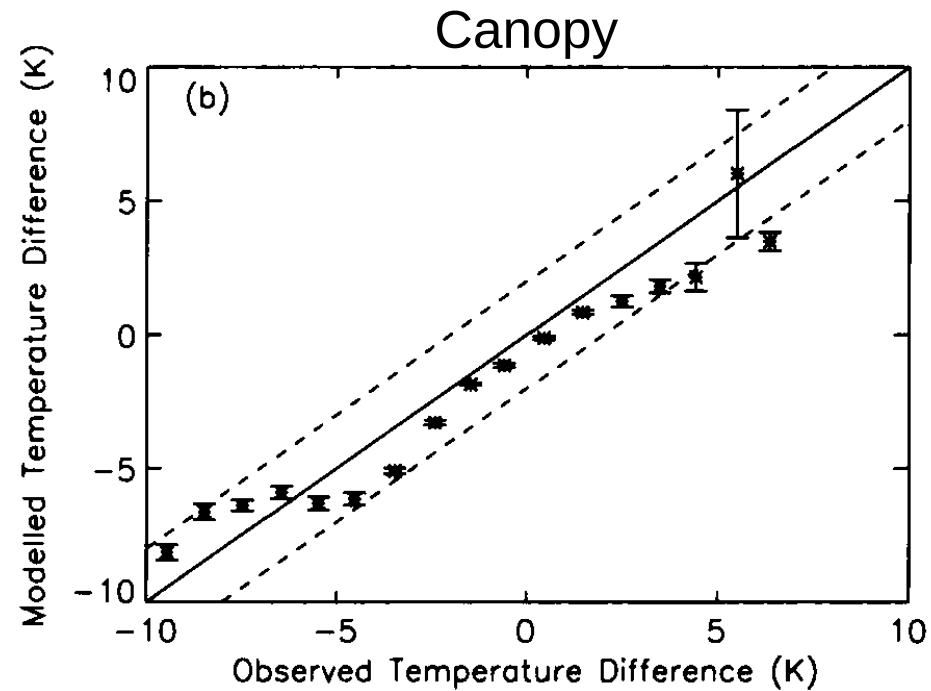
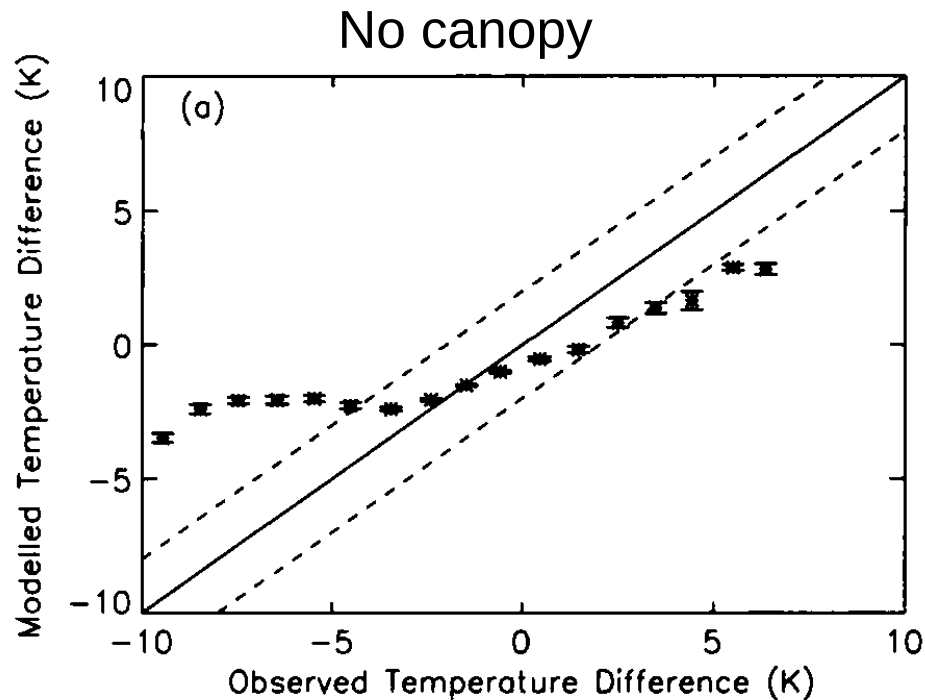
$$S_{w\downarrow} - \alpha S_{w\downarrow} + L_{w\downarrow} - \sigma T_s^4 = H + \lambda E + G + \frac{C}{\Delta t} (T_s - T_s|^n)$$

$$T_s^4 = T_{s1}^4 \left(1 + \frac{T_s - T_{s1}}{T_{s1}} \right)^4$$

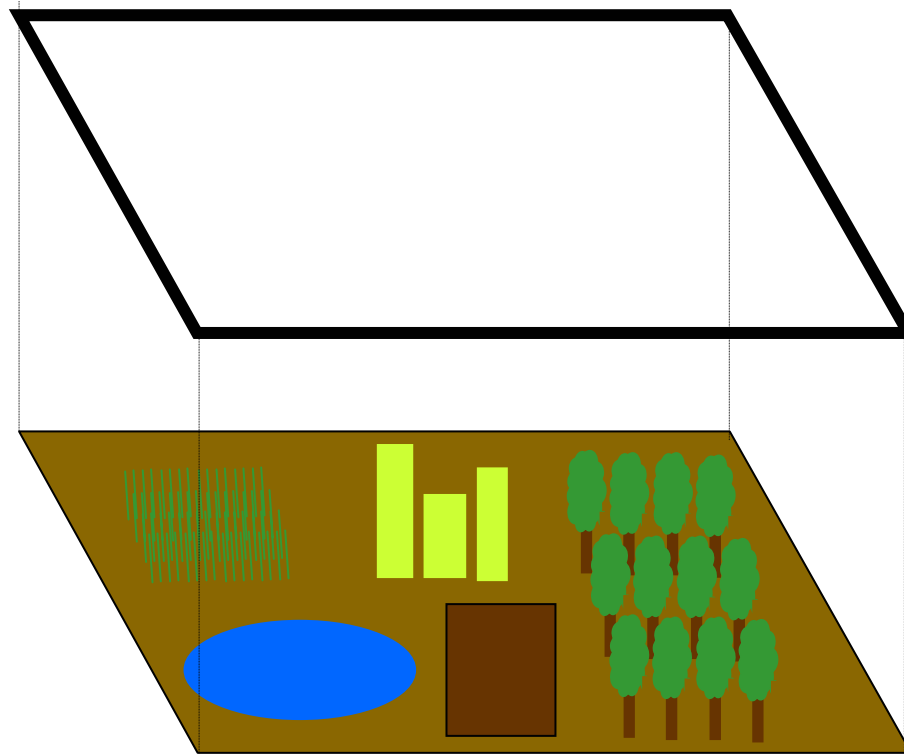
Impact of vegetation canopy



Impact of Vegetation Canopy



Heterogeneity





Future developments

- Multi-stage surface energy balance calculations
 - i. Fully explicit calculation
 - ii. Penman Monteith calculation
 - iii. Implicit atmospheric calculation
- Multiple source tiles



Questions and answers