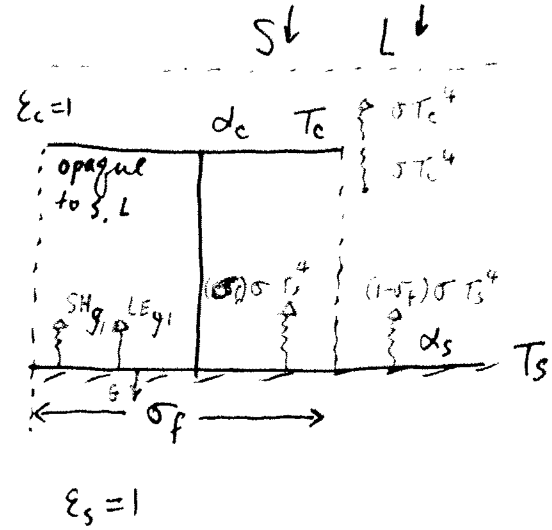
Quiz #3 10-20-2005

(1) For the canopy,



its absorbed (net) solar radiation $= S_{nc}$

$$= \sigma_f S^{\downarrow}(1-\alpha_c)$$

its absorbed (net) longwave radiation $= L_{nc}$

$$= \sigma_f L^{\downarrow} + \sigma_f \sigma T_s^4 - 2\sigma_f \sigma T_c^4$$

its turbulent fluxes $= SH_c + LE_c$

Assuming the heat storage of the canopy is zero, we have

$$S_{nc} + L_{nc} - SH_c - LE_c = 0$$

$$\therefore \sigma_f S^{\downarrow}(1-\alpha_c) + \sigma_f L^{\downarrow} + \sigma_f \sigma T_s^4 - 2\sigma T_c^4 \cdot \sigma_f = SH_c + LE_c$$

For the ground, underneath the canopy,

its absorbed solar $= S_{ng1} = 0$

its absorbed longwave $= L_{ng1} = \sigma_f \sigma T_c^4 - \sigma_f \sigma T_s^4$

its turbulent flux $= SH_{g1} + LE_{g1}$

its ground heat flux $= \sigma_f G$

unvegetated,

its absorbed solar $= S_{ng2} = (1-\sigma_f) S^{\downarrow}(1-\alpha_s)$

its absorbed longwave $= L_{ng2} = (1-\sigma_f) L^{\downarrow} - (1-\sigma_f)\sigma T_s^4$

its turbulent fluxes $= SH_{g2} + LE_{g2}$

its ground heat flux $= (1-\sigma_f) G$

$$\therefore S_{ng1} + L_{ng1} - (SH_{g1} + LE_{g1} + \sigma_f G) + S_{ng2} + L_{ng2} - [SH_{g2} + LE_{g2} + (1-\sigma_f) G] = 0$$

$$\therefore \sigma_f \sigma T_c^4 - \sigma_f \sigma T_s^4 - (SH_{g1} + LE_{g1} + \sigma_f G) + (1-\sigma_f) S^{\downarrow}(1-\alpha_s) + (1-\sigma_f) L^{\downarrow} - (1-\sigma_f)\sigma T_s^4 - (SH_{g2} + LE_{g2} + (1-\sigma_f) G) = 0$$

$$\sigma_f \sigma T_c^4 - \sigma T_s^4 + (1-\sigma_f) S^{\downarrow}(1-\alpha_s) + (1-\sigma_f) L^{\downarrow} - (SH_{g1} + LE_{g1} + SH_{g2} + LE_{g2} + G) = 0$$

(2) $P = \rho R_d T$ is the ideal gas law where R_d is a constant

Let $P = \overline{P} + p'$

$\rho = \overline{\rho} + \rho'$

$T = \overline{T} + T'$

the over bar → an average

the prime → a deviation from the mean

$\therefore\ \overline{P} + P' = (\overline{\rho} + \rho')\, R_d\, (\overline{T} + T')$

$= R_d\, (\overline{\rho}\,\overline{T} + \overline{\rho}\, T' + \rho'\,\overline{T} + \rho' T')$

Using the over bar (or applying average on both sides), then

$\overline{\overline{P} + P'} = \overline{R_d\, (\overline{\rho}\,\overline{T} + \overline{\rho}\, T' + \rho'\,\overline{T} + \rho' T')}$

Because $\overline{\overline{P}} = \overline{P}$, $\overline{P'} = 0$, $\overline{\rho'} = 0$, $\overline{R_d} = R_d$, $\overline{T'} = 0$

$\overline{\overline{T}} = \overline{T}$, $\overline{\overline{\rho}\,\overline{T}} = \overline{\rho}\,\overline{T}$, $\overline{\rho'\,\overline{T}} = \overline{\rho'}\,\overline{T} = 0$

$\therefore\ \overline{P} = R_d\, (\overline{\rho}\,\overline{T} + \overline{\rho' T'})$

$\doteq R_d\, (\overline{\rho}\,\overline{T})$