october 6, 2014 – A. Ducharne

QUESTION: Raised by Fuxing → there seems to lack some β in enerbil

MY UNDERSTANDING FROM READING JAN'S DOCUMENTS:

→ it has not been like that at the beginning of ORCHIDEE or at least SECHIBA

→ when has the change been performed?

→ the new formulation is incorrect.

THE NEW FORMULATION IS INCORRECT: DEMONSTRATION

I'm using here notations that are close to the ones of the 6-page note of Jan, 1st written in the 90's.

We all agree until section 2.3, except for the $\Delta\theta_0$ factor in Eq 29, as reported by Fuxing.

NB: I also have interrogations on the G flux, I'll come back to it another time.

This leads us to $E^{t+1} = \tilde{E} - E' \Delta\theta_0$ (27)

with $\tilde{E} = \dfrac{B_Q - q_s(\theta_0^t)}{1/K - A_Q}$ (a)

$E' = \dfrac{Q'/c_p}{1/K - A_Q}$ (b)

Here:
- I neglect α
- $K = \dfrac{K_{q,1/2} \cdot \beta}{\delta z_0}$

where β can either be 1 (E_{pot}) or not

This goes along w/ the surface energy balance equation 31, which hold for $\beta = 1$, but also for $\beta < 1$, provided β is included in $K = \dfrac{K_{q,1/2} \cdot \beta}{\delta z_0}$.

This argument is consistent with Eq. 26 in Polcher et al. 98

with section 3 'Previous method' in SECHIBA.

To prove that Eq 33 is incorrect, we 1st need to redefine some variables; in this Equation, $\tilde{E}$ and E' correspond to the unstressed evaporation, ~~the same we get~~ Therefore, I call them $\tilde{E_p}$ and E_p', and I reserve $\tilde{E}$ and E' for the stressed case.

It follows that Eq 31 is valid w/ $\tilde{E_p}$ and E_p', as intended in Jan's note, but also w/ $\tilde{E}$ and E', as stated above, and consistent w/ section 3, and Dufresne and Ghattas (2009).

With these notations, Eq 33 can be rewritten as:

(c) $$\frac{C_s}{\Delta t}\Delta\Theta_0 = \left[\tilde{R_n} + \ldots + (1-f_s)L_e\beta\tilde{E_p} + G\right] - \left[R_n' + \ldots + (1-f_s)L_e\beta E_p'\right]\Delta\Theta_0$$

~~If this equation is correct, then~~

If this equation is correct, and since Eq 31 is valid for the unstressed E, then we should have

$$\begin{cases} \beta\tilde{E_p} = \tilde{E} \\ \beta E_p' = E' \end{cases} \iff \begin{cases} \frac{\tilde{E}}{\tilde{E_p}} = \beta = \frac{E'}{E_p'} \end{cases}$$

Using Eqs (a) and (b):

$$\begin{cases} \tilde{E_p} = \dfrac{B_\varphi - q_s(\Theta_0^t)}{\frac{\delta z_0}{K_{q,1/2}} - A_\varphi} & (\text{since } \beta = 1) \\ \tilde{E} = \dfrac{B_\varphi - q_s(\Theta_0^t)}{\frac{\delta z_0}{K_{q,1/2}\cdot\beta} - A_\varphi} \end{cases}$$

$$\tilde{E}/\tilde{E_p} = \beta\left(\frac{\delta z_0 - K_{q,1/2}\cdot A_\varphi}{\delta z_0 - \beta\cdot K_{q,1/2}\cdot A_\varphi}\right) \neq \beta \quad (\text{unless } \beta = 1)$$

(Same thing for E'/E_p').

THUS EQ 33 ~~IS~~ (Eq. c) IS INCORRECT