Responses to Reviewer 2

The authors gratefully acknowledge the helpful comments and suggestions of the reviewer.

General

1. **Technically, the paper is very well written, and the authors show a real mastership about their equations. The equations which do involve the "="-sign are flawless, and their assumptions are well explained.**

   No comment.

2. **Equations involving the "is about equal to"-sign are often obscure. The authors want to show in the end that the approximations may cause problems (see results section), but even so it remains to be explained why approximations are made in this and not in another way. For example Equation 16: this is said to be based on taking the harmonic means but that cannot be true, the same holds at other places where the "harmonic mean" is invoked. It seems as if the choice between taking an arithmetic or harmonic mean is made ad hoc, trusting that the components are so similar, or at least correlating, that the exact method does not matter much.**

   Approximations are made to simplify the general formulation in order to reach the common basic formulation. So, the steps of the approximations are generally imposed by the form of the simplified equation commonly used (for instance Penman-Monteith equation).

   The different leaves of the canopy act as parallel resistors for the transfer of sensible heat and water vapour. Consequently, harmonic means are chosen to represent their effect at canopy scale, while arithmetic means would be used if conductances were involved instead of resistances.

3. **Although the set-up of each modeling method can be completely inferred from the text, there are so many methods that a reader can easily become confused. It is unsatisfactory that a reader has to go through all equations to know which assumptions are made for each method. It would be better if clear names could be given to the methods, expressing their properties; or if a table could be added to list the differences. Also, when figures are described, the methods behind them should not be indicated only by referring to equation numbers (like with figure 3), or only in the figure captions.**

   The following table will be added. It gives clear names (symbols) to the different methods and the new figures will directly refer to these symbols.

Description	References	Symbol
Dry canopy		
General equation without any assumption	Eq. (7) with surface resistances given by Eqs. (6) and (8)	GE_d
Simplified equation where available energy is equally distributed, soil surface being included.	Eq. (13) with surface resistances given by Eqs. (20) and (21)	SE_d
Common Penman-Monteith equation where soil surface is ignored	Eq. (10) with surface resistance given by Eq. (9)	PM_d

Partially wet canopy		
General equation without any assumption	Eq. (28) with resistances given by Eqs. (27) and (24)	GE_w
Simplified equation where available energy is equally distributed, soil surface being excluded	Eq. (33) with surface resistance given by Eq. (34)	SE_w

4. **Most important, I am concerned about the significance of the paper in its present state, mainly because of its very one-sided emphasis on theory. It is tried to replace the modern method of calculating canopy fluxes layer-by-layer by the older (though not obsolete) method of using bulk resistances, but trying to accurately express the latter in resistances of vegetation/soil elements leads to difficulties which remain unsolved; on the other hand, approximate expressions yield systematic deviations in the resulting fluxes. All this is honestly highlighted in the conclusions, and it is admitted that much of this has been considered already long before. Some qualitative conclusions are drawn in the conclusions, which are however already commonplace in the cited (often old) literature.**

We recognize that the paper is essentially theoretical. In fact, it tries to establish a bridge between “the modern method of calculating canopy fluxes layer by layer” and the common practice of using combination equations with bulk resistances. This “bridge” allows us to clearly identify the different approximations required to reach simpler formulations.

5. **The translation to the world of the practitioner is hardly made. In my opinion, it should be tried to substantially enhance the significance by trying to translate the findings, so that relevant questions of hydrologists are answered, such as: how have bulk resistances that have been measured under certain circumstances (e.g. dry soil, dry canopy) have to be modified when applied under other conditions (moister soil, wetted canopy)? And how should the errors be estimated? Are the estimated improvements robust with respect to the uncertainties e.g. about the distribution of the available energy over the layers? I understand that certain assumptions are hypothetical, making quantification difficult, but even qualitative statements about the direction and significance of the corrections are a step ahead. The numerical exercises show that the authors already possess the tools to answer such questions to a considerable extent. The paper could be made more useful by further working out this matter.**

Some simulations (and the corresponding figures) will be added to the present MS in order to better answer relevant questions in hydrology, as suggested by the reviewer:

First, under dry conditions and parallel to Fig. 2, a new figure will be added showing the variation of canopy surface resistance as a function of $r_{s,l,n}$ (minimal stomatal resistance) for case (a) (significant soil contribution) and (b) (negligible soil contribution). This new figure could be simply embedded within Fig. 2. Only the methods SE_d and PM_d (see Table) will be considered since the general equation (GE_d) does not allow a bulk canopy surface resistance to be clearly defined. Second, under partially wet conditions, a new figure will be inserted into Fig. 3 showing the variation of the surface resistance $r_{s,pw}$ as a function of the wet proportion W.

Concerning the distribution of available energy over the layers, simulations will be undertaken with a different profile of leaf area: instead of a uniform function of height (our Eq. C4), a gamma function will be used to represent a canopy with a high leaf area density in the top layers and a lower density in the bottom layers, as frequently occurs. Beer’s law will be kept to distribute the radiation within the canopy. New figures (similar to Figs. 2, 3, 4) will be drawn with this new profile of leaf area and conclusions will be drawn by comparison with the uniform case.

Specific comments

1. **C4 is a strange assumption (but this is not an essential point).**

A second profile of leaf area (Gamma function) will be added in the simulation process (see comment 5).

2. **Figure 2: the fact that some experiments do and some don't take the soil contribution into account makes comparison difficult. It would seem more logical to compare canopy contributions without soil, and to evaluate on the other hand the importance of the soil contribution.**

The fact of considering high values of soil surface resistance ($r_{s,s}$) in the simulation process (for instance greater than 1 000 s m^{-1}) means than soil evaporation is negligible. Consequently, the 3 formulations tested in Fig. 2 with $r_{s,s}$ = 100 (a) and 1000 s m^{-1} (b) constitute a response to this comment: case (a) corresponds to a situation where soil surface contribution to evaporation is significant and case (b) a situation without soil contribution.

3. **Figure 2: a and b should be reversed to get better consistence with the order in which they are discussed.**

OK. Change made.

Technical corrections

At the end of the results section, figures 4a and 4b are sometimes referred to as 1a and 1b.

OK. Error corrected.