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Geoscientific Model Development Discussions
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Interactive comment on "A multi-level canopy radiative transfer scheme for ORCHIDEE (SVN r2566), based on a domain-averaged structure factor" *by* Matthew J. McGrath et al.

Anonymous Referee #1

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This paper presents an adaptation of an existing 1D RT model developed for large scale parameter retrieval, and modifies it to include vertical canopy layering for improved RT treatment in land surface modelling. The paper is clear and well-written and presents a practical, incremental advance of the application of the Pinty et al 2 stream approach to multi-layer canopies. There are a few general issues which could be addressed to improve the paper, which I discuss below, followed by some minor technical and grammatical comments. If these are addressed I think the paper can be published.

General comments. The analysis is presented in many cases in a rather quantitative way - terms like 'good', 'reasonable' etc are used. What is needed is a statement at the outset of what might be considered to be a good enough agreement between the

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1 and multi-layer case for example. How good is good enough from the perspective of the LSM(s) into which such an RT scheme might be embedded? This might affect how likely you would be to think about incorporating this approach, as well as how many layers you might decide to use. This latter point is also not addressed - why would I use 2 layers, or 5, or 10? What would determine how many layers I might use?

So, see p8, line 25: this is crucial - where does your definition of what's acceptable come from and why is this acceptable? All the model results in the paper are essentially a function of this, or have to be interpreted in this light. So this needs clear definition and justification at the outset. Given the likely applications for the LSM with the RT embedded, what is the divergence threshold that would preclude the use of the LSM with the embedded multi-stream RT model?

There are a lot of results (like S5 for eg) which are useful, but are in Supp Info. I'm not sure about the balance here of material in the main paper v suppl. - maybe too much in the latter. Could consider this.

Regarding some of the key figures - see the comment on p8, line 24: "Although the previous figures (Figures 2, 3, and 4) give a satisfactory pictorial overview ..." no, they don't! The choice of the same symbol with no transparency for all fluxes means they cover each other and as a result the figures are too hard to interpret properly. We have to take on trust some of the discussion of these results as we certainly can't see all points for all fluxes. These results need to be presented much better- smaller points, different symbols etc.

Technical/minor comments p1, 8-9: acceptable? Can this be quantified properly?

p2, 6: multilayer canopy models *within* larger LSMs?

p2, 11: well yes, there are a lot of very detailed RT models - I think you mean here RT model schemes embedded in larger LSMs? If so, be explicit.

p2, 28: garbled sentence: "Studies that involve of multi-layer models of the energy

budget models..." - whole sentence needs re-writing.

p2, 33: "To be consistent across the model," not clear what that means here - it's sort of implicit but this issue of structural and radiometric consistency (which is what I think is meant) is important, and should be clarified.

p3, 1: but what is 'expensive' - compared to what?

p3, 8: RT parameter values?

p4, 9: the effective LAI term hasn't been described properly yet (or leaf sscatt albedo - although that is well-defined anyway). Best to define this at the outset of 2 when describing Pinty model, as this is the key parameter of the scheme. Might also be worth introducing the other parameters for the single layer scheme i.e. from p7, lines 9-10 d1, sza, and soil refl.

p4, 22: appropriate assumption?

p4, 27: single-scattered (and elsewhere in the text)

p5, 6: need to say how the empirical factor is/was arrived at.

p7, 11: isn't it simpler *just* to use LAI_eff from here on then, unless you really mean actual LAI?

p7, 25: 'as albedo'?

p8, 6 (and elsewhere): avoid use of subjective words like 'well' unless you have defined. So either define what you mean (in terms of RMSE for eg) or, better, just give the RMSE and/or r2. So for fig2, would be good to know what cases of largest departure are.

p8, 14: " a small fraction ... may be ...." - well, can you test that? If not, why?

p8, 31-and on: so why not express it in a different way?

p9,9: leaf single-scattering albedos. This is probably not surprising is it, in that these are the cases where the layers, and veg properties within each layer, have the most

impact? This is reinforced in the next para when we see that the leaf single-scattering albedo is the biggest determinant - this controls the amount and direction of the fluxes between layers.

p9, 30: number of iterations to converge - does this scale linearly with number of layers? Results in Figure S5 suggest this might be so - so couldn't you calculate that analytically? Or at the least show a case with a moderate number of layers eg 5.

p11, 1: 'good agreement' - meaning what? You give the figure (0.04 albedo) so just leave it at that unless you define at the outset what you consider to be 'good', 'acceptable', 'poor' etc.

p11, 2: '...deviations are typically...' - give a number, what fraction, for 2 and 10 layer cases?

Suppl Info

Caption of Table 1 - ontents. And also missing figure numbers.

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