

## General comments

Much material has been added to the second version, and the model description has become more explicit where this is needed. However, some of the presentation of especially the new pieces needs improvement. Some main points: Explanations (or introductions) of details are often lacking; the descriptions of radiation occur no less than three times now; there are problems with referring to figures and tables (which are sometimes not included); the descriptions of long wave radiation and of the alternative induction method are not yet intelligible. More details are given in the following.

One suggestion for the presentation was not carried out: The present lack of possible abridgements in the equations in the supplement is far from attractive, but it may be of some use if it helps the authors to check the model code, as they say.

Concerning the content, the changes seem to be in accordance with the requirements of reviewers, and the errors that were pointed out have been well corrected. New calculations have been done with updated schemes for vegetation resistances and multi-layer albedo, as asked by reviewers (we do not comment on this here).

The model seems promising, but the enormousness of the description, whilst having its advantages, makes it difficult to check everything, so in the following things may have been overlooked. Moreover, certain details may have been misunderstood in this review.

## Main text, minor comments

219: Schmidt number seems to be nowhere explained.

224 etc.: CO<sub>2</sub> should not be written in italic (check for other occurrences)

232: "than can": "that can" ?

233: Eq. (29): check number.

266 etc. : use curved d's for differentiation here (because differentiation to x,y,z is also involved, namely when the divergence is taken). Same remarks for Eqs. 17-18. Errors of this kind also occur elsewhere.

375: "+-" should be "-".

451: use of  $T^{t+1}$  contradicts the statement in line 447 that the future T has not been used; contradictory statements on this point are haunting the main text and the supplement (keywords: implicit/explicit). Apparently the authors chose to mix temperatures for time t+1 through the radiative expressions, but the description of what is done is very confused (see below). Is it the purpose to use for any layer, the local  $T(t+1)$  for calculating emission, whereas the  $T(t)$  from the other layers is simultaneously used to calculate absorption ? In that case, systematic errors might occur. This could be

checked by comparing results obtained with implicit and explicit calculation method (all other things being equal).

471 (Equation 43): alpha is not specified for the combination of vegetation-i with  $j=0$ , or  $j=m+1$ ; in the two expressions with four terms, the last term has the wrong sign; the last three expressions seem to pertain to a layer above the canopy, so their usefulness is unclear. The second and second last line may have been swapped. Not sure about the middle line, should this be  $2\text{trans}(l_i)/\text{trans}(l_{i-1}) - 2$  ?

Equation 47: In the left hand side one would expect  $T(t+1)$  and not  $T(t)$  as written here, and the next forms Eqs. 48,49 cannot be correct (wrong dimension).

Equation 50: Is there a factor 4 missing here ?

518: "transmitted albedo" is this a good term ?

520 etc.: a bit more information on the calculation of  $\psi^{\text{collided}}$  would be interesting, now the reader has to rely entirely on the references.

Eqs. 52-58 follow from balance considerations, and might be superfluous.

Eq. 54: how is the incoming downward contribution accounted for ?

600,602: "forced": unclear. "prescribed" ?

604, 613: Table 4: has not been included, on the second occurrence Table 3 seems to be understood.

605: Strange start second sentence.

618: has a missing space.

619: Question mark for reference.

649: "smaller magnitude": on average it seems to be a larger magnitude.

659: Figure S3: not found.

662: "was able": not very well ....

662: Figure 6b/c: check consistency between text, figure and list of figures, b and c are sometimes reversed.

669, 670 et passim: check the occurrences of "positive gradient" and "negative gradient", here the terms are used wrong, the correct definition is given in the discussion.

680-682: Reformulate.

685: Reformulate first half.

701: "to a standard comparable to single layer models": is there no advance then ?

701: “interative” : “iterative” ?

706: “have”: “has” ?

815: A redundant dot.

Figure 5e/f: have “net down-welling radiation”, but list of figures has “net radiation”.

Figure 6: remove “top of canopy” in little block.

### **Supplement, minor comments**

Page 2, second half: here, in the equations, no curved d’s but delta’s should be used (the first version was in principle correct). Curved d’s should only be used in numerator/denominator pairs.

Section S2.1 has very much overlap with section 3.2, there is no need for two long pieces saying the same.

Eq. S2.3: Re is not explained here (though it is explained in the main text).

Eq. S2.4: add subscript H. Is “r” the same as “R” ?

Eq. S2.5: the Schmidt number is nowhere explained fully.

Eq. S2.6: add subscript E.

Eq. S2.8: df unexplained; form is different from the foregoing.

Section S2.1, last paragraph: the information comes too late.

Page 4, bottom: why is block italisised ?

Same: There is also a question mark, and Pm is not explained.

Page 5, second half, and page 6 first half: this block should be integrated better into the remainder of the text. A lot of parameters are used here without introduction. Sorry for not commenting on this in the first round.

Page 10: this whole derivation can be skipped in my opinion.

Page 10, first and last equation: use curved d’s . Also for equation S3.13 etc. Because in all cases, chi is differentiated in several “directions”.

Eq. S3.10: a “div” is missing.

Pages 11, 12: note that “k d2 chi/dz2” is not the same as “(d/dz) (k d chi/dz)”, and only the second expression is correct here (with curved d’s).

Page 13 at two-fifth: “that the single order”: “than the single order”.

Page 13: the description of  $\eta_2$  is incomplete, it also contains things from the same layer.

Section S3.10 again uses the mysterious term “completely explicit”.

Sections S3.11 and S3.12 have very much overlap with the main text, and they also reoccur at the end of the Supplement !

Page 15, Equations S3.25-S3.27 : inconsistent (also dimensionally). See also the general comment on long wave radiation.

Page 15, Equation S3.28: a factor 4 missing ?

Page 17 etc. : subsections S3.12.1-3.12.3 have wrong numbers as they are not subsections of S3.12.

Page 17, S3.38: the use of the  $\eta$ 's etc. has not yet been revised.

Page 19 top: question marks.

Page 26, equations S3.81/82: these are incomplete and can better be abbreviated as

$$u_i^{t+1} = E'_i u_{i+1}^{t+1} + F'_i$$

(since E is a matrix now, the equivalent of eq. S3.81 also involved  $q_{a,i+1}^{t+1}$  etc.).

After stating the meaning of u, an explanation is needed: “The reason that  $T_{\text{leaf}}^{t+1}$  is not needed as a component of u, is that it can be expressed into the other two components. For, the original expression ....”

Page 26, equation S3.83: the use of the  $\eta$ 's etc. has not yet been revised.

Page 27: The two lines between equations S3.87 and S3.88 can be better replaced with

“... we can substitute

$$u_{i-1}^{t+1} = E'_{i-1} u_i^{t+1} + F'_{i-1}$$

This results in an expression of the form:”

Page 27: In equations S.88-90, the inverted matrix which occurs 4 times, occurs too late for all cases (it belongs at the beginning of the terms). One has to be careful because such matrices do not commute !!

Page 27: in eq. S3.88 there should be brackets around  $D'_i + C'_i F'_{i+1}$

Page 36: explain the meaning and usefulness of the  $\xi$ 's.

Page 42-43: Table 1: Is this a copy of the table in the main text ? then it is redundant.

General: the supplement has no figures, yet occasionally the main text refers to figures in the supplement.