**Biogeosciences
Discussions**

Interactive comment on "An integrated model of soil-canopy spectral radiance observations, photosynthesis, fluorescence, temperature and energy balance" *by* C. van der Tol et al.

Anonymous Referee #3

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General comments

This paper describes in detail a coupled model of a soil-canopy system regarding several physical processes: radiative transfer in solar and thermal regimes, photosynthesis, fluorescence, and temperature and energy balances. This is a very relevant topic for Biogeosciences.

The paper is carefully written, and contains a clear model description. The model is thorough in its physical aspects. However, this nice description is not sufficient for publication in Biogeosciences. What is missing is the validation and (a limited) application of the model to real data. In the paper the validation is promised for a following paper;

but this "paper II" is not available. Validation is needed to judge the validity and usefulness of this new model. Furthermore, the strength of this new coupled model is not clear from the few examples given. Preferably, all the topics of the title should appear in the application(s). This would make the paper more in balance.

The paper could be accepted if some validation and application to real data is shown.

Detailed comments

Title: spectral radiance observations > spectral radiances (since ". . . . model of observations . . . " sounds strange)

Abstract:

- "high spectral resolution" is too vague; please give a number. This also appears later on in the paper.

- The sentence "Model simulations were evaluated against observations . . . ": Is this true? I could not find this in the paper; no validation is shown.

Introduction:

- Discuss also the relation of SCOPE to the FluorSAIL model and the 4SAIL model, which are both mentioned later on in the paper.

- Last paragraph of the Introduction should mention the sections where the topics are discussed. The last sentence of the Introduction does not belong here, but in the Outlook; however, see the general comment on the missing validation of the model.

Sect. 2.1:

- Discussion of modules in Fig. 1: "3 Energy balance module for latent ...": here no reference is given. Is this the new part of the model, described in this paper? Please indicate what is new and what is old in the SCOPE model.

- Paragraph "The geometry of the canopy ...": why are these specific values of 60 layers, 13 leaf inclinations and 36 azimuth angles fixed? Are these constants of nature? This specific choice is probably due to computational limitations, custom, required accuracy, allowed types of canopy, etc.. Please present these numbers as variables. This also comes back later, in Sect. 2.4, and Sect. 2.8, e.g. Eq.29. There the numbers *must* be replaced by variables, because 60-as-a-number and 60-as-a-variable are two different things in a formula!

Sect. 2.2:

- which version of MODTRAN is used?

- Paragraph "An important quantity ... is the spherical albedo". Please add that it is the spherical albedo of the atmosphere for illumination from below.

- Eqs. 1-5: where are these equations coming from?

- " ... E_sun, the solar irradiance on the horizontal ground surface. . . ": isn't E_sun the solar irradiance at the top of the canopy?

- In Eq. 6 symbol a is used for surface albedo, but this does not appear in the symbol list, Table 1.

Sect. 2.3: "... numerically safe ...": do you mean: numerically stable ? This occurs more often in the paper

Sect. 2.4:

- Above Equation 11: here the subscripts s and d mean different things than in Sect. 2.2; there s=sun and d=diffuse. Please use symbols consistently in the model description.

- The equations belong to the sentences, so please try to use interpunction consistently – e.g. point after Eq. 11; this also holds for other places.

Sect. 2.6: first sentence: "... per element ..": element of what?

Sect. 3.1: first para: which MODTRAN4 spectral resolution was used?

In Sect. 3 each subsection starts with "Fig. n shows ....". Please write less monotonously.

Sect. 4: Please discuss the novelty and uniqueness of the model. Since SCOPE is a combination of several existing modules, this aspect is not clear to me. It is appreciated that the limitations of SCOPE are mentioned. A statement on the accuracy of SCOPE should be added. This is related to the validation.

Appendix A: The sentence below Eq. A6 seems not correct.

References: please check the bibliography for consistency of journal abbreviations.

Comments on Table 1:

- please order the symbols correctly: first Latin symbols, then Greek symbols, both according to their own alphabet

- if possible, also give the equation number where the symbols are introduced

- there are several missing symbols, like \alpha for absorptance (but \alpha is also used in Eq. 32), a for surface albedo, t for top, ... Please check the list.

Table 2, caption:

- PROSPECT. . . : give reference

- ". . . spherical distribution." Add: . . . of leaves

The Figures were not numbered. Please number also the subplots.

The figures with vertical axis "depth" *must* have a unit (dimensionless is OK); now it is not clear in which direction the quantity is increasing.

Fig. 1: please indicate in the figure the relevant horizontal levels: TOA, TOC, and the soil level.

Caption Fig 1: model > SCOPE model

Fig. 2: what is the solar and viewing geometry? Is it upward or downward radiation?

Discriminate the solar and thermal radiances by line-color.

Caption Fig. 3: Outgoing ..: at TOA or at TOC?

Figure 6: Are there 2 or 3 lines? Please use colored lines, so that the symbols on the line "Direct radiation replaced . . . " can be removed.