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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 #1

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The paper describes a new and interesting model (SCOPE) that integrates radiative transfer models with energy balance, photosynthesis, chlorophyll fluorescence and surface temperature modules. Above canopy visible to thermal infrared radiance spectra are linked to fluxes of water, heat and carbon dioxide, as a function of vegetation structure and biochemistry and within canopy profiles of temperature and fluxes. I see a lot of relevance in this type of integrated modeling framework. However there should be a greater effort to explain SCOPE application areas; supported by actual implementation examples, if possible. Should at least elaborate more on the potential applications of the model.

It is a well-written and very theoretical paper with 43 equations listed in the main manuscript. The methods are sound and the manuscript is well-structured. A validation section would be a great addition to the manuscript as the current evaluation section is very vague. I feel that some validation is needed to complete the paper and to demonstrate its usefulness and utility within various application areas.

SCOPE appears to still be in a development stage and effort should be made to provide a fully integrated model (e.g. SCOPE - MODTRAN) to make implementation straightforward by potential users.

Specific comments:

1. The abstract is short and lacks important information. The presence of a photosynthesis module should be mentioned. The evaluation section is very vague and the statement "Model simulations ..." is in my opinion not sufficiently supported by the presented results (the paper would greatly benefit by a more thorough validation effort). The abstract should also focus more on highlighting the potential application areas of SCOPE. 2. The introduction describes some of the interesting application areas of the model (page 6028) but little effort is done to describe/demonstrate how to use SCOPE for these applications (there could be a section in the discussion part). 3. Page 6028 L21: "A validation of the model ....". The paper would greatly improve its relevance if a validation section were to be included. 4. Effort should be made to clarify the model structure description (page 6030) and the interaction between the various modules. It may help if the associated fig. 1 was improved (it is currently a little confusing). Fig. 1 also contains many commas (",") in odd places that need to be removed. The iteration sequence should also be displayed in Fig. 1. 5. Section 2.2: The need to setup and run MODTRAN independently of SCOPE before SCOPE can be run is a definite drawback of the scheme. As described in the text, this is not a trivial task. I would have preferred that the MODTRAN (or any alternative atmospheric radiative transfer model) computations (equations 6 and 7) were an integral part of SCOPE in order to minimize the complexity of setting up SCOPE for a new user. 6. Page 6036 L3: The

model needs to include a wide spectrum of soil reflectance spectra in order to be useful for the list of potential application areas listed in the introduction. 7. Page 6036 L11: I see a strength in the detailed leaf to canopy scaling technique that considers sunlit and shaded leaves at 60 leaf layers, 13 leaf inclination angles and 36 leaf azimuth angles. It would be interesting to see how that may affect the energy balance computations compared to a more simple scheme. 8. Page 6043 L9: Please mention that the photosynthesis module distinguishes between C3 and C4 crops. 9. Page 6044 L6: The linking of Prospect parameters (such as leaf chlorophyll) to parameters of the biochemical model (e.g. Vmax) is an excellent idea and a useful way to constrain the parameter space. This is something that needs to be pursued in future studies. 10. Page 6050 L10: Jacquemoud et al. 2000 only reports validation/comparison of canopy reflectance spectra within the shortwave region (400 - 2500 nm). Additional references should be given for validating turbulent heat fluxes. 11. Fig. 4 is difficult if not impossible to grasp. The caption should also note what each line represents (sunlit, shaded, weighted average temperature) and which line is what exactly? And indicate on the y-axis the direction of increasing/decreasing depth. 12. Page 6053: I would suggest adding a discussion section here explaining potential SCOPE application areas, benefits of using SCOPE for these task and how to setup/implement SCOPE (examples would be nice). Highlight and demonstrate what kind of applications SCOPE would be particularly useful for. 12. Page 6054 L1-L4: A good and informative statement that should also appear in some form in the abstract.

Technical corrections:

1. Page 6028 L26 to page 6028 L3 is a word by word repeat of the abstract which is not appropriate. 2. Page 6051: The parameter values chosen for the simulation runs are a little odd (e.g. why use a LAI value of 3.22 and not simply 3?) 3. Table 2: N in the PROSPECT model is a leaf structure variable (leaf mesophyll structure) and is not directly related to leaf thickness. 4. Fig. 5: Azimuth angles should be indicated on the plots. 5. Fig. 6: The line types are difficult to distinguish especially in the top plot.

The caption contains a few typing errors ("a all direct..", "..is remains unchanged") 6. Page 6059 L18: "Kg=0.4" should be K=0.4 7. Page 606 L17: Could list an appropriate reference here (rs as a function of soil moisture) 8. Eq. B9-B10: Wrong symbol used for von Karman's constant (should be K) 9. Page 6064 L20: Change Modi-fication to Modification.

Interactive comment on Biogeosciences Discuss., 6, 6025, 2009.