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Geoscientific Model Development Discussions

Interactive comment on "SCOPE 2.0: A model to simulate vegetated land surface fluxes and satellite signals" *by* Peiqi Yang et al.

Anonymous Referee #2

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This study improves the widely-used radiative transfer and biophysical model SCOPE by implementing 1) soil reflectance simulation, 2) xanthophyll cycle modulation, 3) vertical variations of vertical properties, 4) dynamic ground heat flux simulation, 5) a full energy balance closure solution, and 6) multiple strategies for computational efficiency. These improvements are significant advances and I believe the proposed SCOPE 2.0 will benefit the vegetation remote sensing community. The paper is well written and I only one major comment followed by several minor comments.

Major comment:

1. While the improved algorithms are well described, the performance/effects of the new algorithms are not fully demonstrated.

(1) Can you compare TOC reflectance, GPP and SIF between using a vertically variant Cab and using an invariant Cab? This is very interesting as I see many studies, including ESA's products, interpret canopy chlorophyll content as the product of LAI and Cab without considering the vertical variation of Cab. SCOPE 2.0 can help us understand this impact.

(2) Can you compare typical diurnal cycles of G between G = 0.35Rn and the new parameterization?

(3) Can you use figures/tables to show 1) how energy balance closure is improved by using the new iteration algorithm, and 2) why Eq. 7 is a sufficiently accurate approximation?

Minor comments:

1. L16: I would suggest add some introduction of other models that can simulate radiative transfer and fluxes and provide distinct feature of SCOPE comparing to these models.

2. L87: SCOPE lacks the consideration of clumping effect, right? If so, I suggest add some words about that so that users can keep it in mind.

3. Table 1: The term "each leaf" is unclear. How many "leaves" in SCOPE 2.0? 13*36*n for sunlit and shaded, respectively?

4. L128: What type of aerodynamic resistance scheme is used in SCOPE 2.0? Series or parallel?

5. L180: Why is z "typically 2.5 times the vegetation height"? If we use meteorological data from site data or reanalysis data, they are fixed, right?

6. Table 2: Is there a relationship between Cab and Cs because senescenced leaves have lower Cab? Is there a relationship between Vcmax and Cab in terms of vertical variation? Why is Ball-Berry intercept parameter missed? Are their emissvity parame-

ters?

7. L218: I'm confused here. If we need to conduct a time series simulation or spatial simulation, do we need to provide variant tau and rho parameters?

8. L227: While canopy FPAR can be obtained from outputs by FPAR = APAR/PAR, how can we get FPAR for leaves (sunlit/shaded at different layers)?

9. Table 3: What's the relationship between LST, Tcave and Tsave? Is this LST term comparable to ground/satellite estimates?

10. Section 3.3: How to input multi-layer vegetation parameters seems not mentioned. Also curious if vertical variation of meteorological data is modeled?

11. Figure 5: This figure is not cited in the text.

12. Figure 8: Does the bias indicate that the lite option is not suitable for thermal remote sensing? I think such clarification might be useful to users.

13. L418. While the "improved computational efficiency" is shown in Table 4, the "improved model stability" does not have evidence in the manuscript.

14. L419. The topic "understory and overstory" is never mentioned in the manuscript. Does SCOPE 2.0 has understory and overstory LAI separated?

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