Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-305-AC1, 2020

Geoscientific Model Development Discussions

Interactive comment on "One-dimensional models of radiation transfer in heterogeneous canopies: A review, re-evaluation, and improved model" *by* Brian N. Bailey et al.

Brian N. Bailey et al.

bnbailey@ucdavis.edu

Received and published: 14 August 2020

We graciously thank the reviewers for their critical comments, and careful reading of the manuscript to identify several important typographical errors. We have addressed all comments provided by the reviewers below, and have incorporated them into the revised manuscript.

———————————- Comments by Referee #1 ———————————-

1. This work mainly focuses on between crown heterogeneity. Cases simulated mainly explores densely clumped vegetation with open canopies. Cases 1 and 2 especially

focuses on isolating the effects of crown scale clumping. However, heterogeneity with in the crown warrants more discussion. While case 5 using realistic canopy structure includes sub-crown scale clumping, its effects seems overshadowed by the significant crown scale clumping. For example, how will the models behave for a not very dense forest (LAI<2.5) but with mostly closed canopy?

Reply We believe that Case 6 illustrates a similar point to what the reviewer is mentioning, but we may not have been sufficiently clear in emphasizing this. Although the geometry for Case 6 is not a tree, it still has significant and realistic sub-crown heterogeneity, as the plant was generated procedurally by following a hierarchical branching structure. The previous version of the manuscript did not directly report the LAI for all geometries in Case 6, so it was probably unclear that the overall LAI for Case 6 was fairly low even when the canopy was mostly closed (L = 0.67). We have added explicit mention of this to the manuscript (lines 336-337).

2. The Leaf angle distribution function (G) is also an important canopy structural characteristic. All cases presented (except 6 perhaps?) use G=0.5. How will other G functions affect results?

Reply Case 6 had a highly anisotropic leaf angle distribution, although we acknowledge that the range of values was not explicitly mentioned in the manuscript. Explicit mention of the range of G values for Case 6 was added for clarity and to emphasize the anisotropy for this case (lines 333-334).

While one case of a highly anisotropic G was included, we did not exhaustively explore the effect of G in detail in order to keep the work focused on the effects of heterogeneity, and because our previous work has looked at this in more detail and found that, provided G is symmetric in the azimuth, the impact of G is usually small compared to the impact of heterogeneity (see Ponce de Leon and Bailey 2019 as referenced in the paper). In that work, G was artificially set to be equal to 0.5 even when the actual leaf angle distribution was anisotropic, which had a surprisingly small impact on daily inte-

grated radiation interception. In the present paper, we are substituting the exact value of G into the model, so any impacts of G should be even lower.

As requested by the reviewer, we have added some additional discussion regarding the expected role of G (lines 405-407).

3. Line 76: should be I(r;s') to be consistent

Reply Corrected to be semicolon instead of comma.

4. At Line 94, ah=L. While L is listed in Table 1, please include the physical representation of L (LAI) here for clarification.

Reply Clarification has been added as suggested: "...noting that the leaf area index (LAI) is defined as..".

5. Figure 8 caption: Error in legend label for Ni10_P. Document shows 'Ni10_P ((eLine),'.

Repy Corrected.

———————————- Comments by Referee #2 ———————————-

1. L67. It should say "was explored."

Reply Corrected.

2. L75. The distinction between s and sâĂš seems back to front here. If sâĂš is the incident direction, then s should appear in the first three terms of the equation. Alternatively, if it is the scattered direction, then s and not sâĂš should appear in the radiance in the final term.

Reply The reviewer is correct. The intensity in the final (scattering) term should not have a 'prime' on the s. This has been corrected in the manuscript.

3. L111. This should be "incurs".

Reply Corrected.

4. L149, L162. "Augment" suggests an increase. Typically, $\Omega < 1$.

Reply We did not mean to imply an increase. This has been re-worded to say: "...and the canopy begins to appear homogeneous with attenuation determined by the value of $G\Omega L$."

5. Figure 2. The third tree appears to be shown in plan view. This is not explained.

Reply Clarification has been added to the caption to indicate that two of the trees are shown from the side view, and the other from a top view.

———————————- Comments by Editor David Ham ———————————-

We have added source code for Helios v1.0.14 to the permanently archived repository. The code availability statement in the manuscript now reads:

"Helios code version 1.0.14 along with associated project files and output files can be downloaded from the archived repository https://doi.org/10.25338/B85C97. The current version of Helios can be downloaded from https://www.github.com/PlantSimulationLab/Helios."

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-305, 2020.