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Geoscientific Model Development Discussions

Interactive comment on "IPR 1.0: an efficient method for calculating solar radiation absorbed by individual plants in sparse heterogeneous woody plant communities" *by* Y. Zhang et al.

Anonymous Referee #1

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This paper presents a very clever tilting of the calculation of sunlit and shaded leaf area from directly overhead to the direction of the beam of incoming light. I believe this is unique and that other attempts to model the penetration of light into the canopy look at horizontal planes. The inclusion of the code and a manual with its annotated input and output lists are exceedingly useful. However, as the manuscript is now written, it is somewhat inaccessible. It is difficult to follow the development of the model and I didn't understand the usefulness of the model until I got to the discussion section. I still don't understanding the testing of the model... Furthermore, the authors miss a few potentially exciting applications, see below. None of these problems are insurmountable or scientific in nature and I hope the authors will undertake to make their work

more accessible through a well considered rewrite of the manuscript. Listed here are a few essential improvements.

1. Figures 5-8 show a comparison of the model with "the random approach". This is essential as it is the evidence that the model works. But I never understood what the random approach was other than a random placing of plants such that they don't overlap — what is the analytical solution of this that you refer to? And it seems the analytical solution is excellent, so be more explicit about why your model is needed. 2. How is this model different from multi-layered canopy models (e.g. Mercado et al 2007, Tellus 59B, 553)? This is really important too for it explains why this work is useful and new. There is the start of a discussion of this in the Discussion section but it is not complete as it doesn't include the multi-layered models. Also, you need to elaborate a bit on the terms canopy models and individual-based radiation models. This discussion of the originality of this work needs to go in the introduction, and possible the abstract, as it sets the context of the work 3. And mention far earlier, perhaps in the abstract, that this code can be easily implemented into big-leaf models, etc etc and that the code and a users manual are available in the supplementary material along with a nice annotated list of inputs and outputs. This is great stuff! Advertise it!

The authors miss out on some important applications of their work âĂć This model has the potential to improve modeling of savannahs in global dynamic vegetation models (e.g. Sitch et al 2003). Savannahs often behave differently from forests and grasslands in vegetation models and the current models struggle to capture this behavior âĂć There are also applications to the diffuse fertilization effect which the authors have not mentioned and this further enhances the usefulness of their approach (e.g. Mercado et al 2009, Nature 458: 1014–1017).

Finally, it was rather difficult to follow the line of reasoning in the paper. âĂć It was quite heavy going with all the equations. Could a large portion of them be relegated to the supplementary material and only the key setting up equations and the main ones used in the code be presented in the text? âĂć Consider making some kind of diagram,

perhaps a flow chart, which documents your model's steps. âĂć It might help to provide a few sentences at the end of the introduction which state what the following sections are about âĂć The language standard is generally very high, but there are a number of places where it is impossible to discern the meaning.

Specific comments âĂć "K0 is the light distinction coefficient" do you mean light extinction coefficient? âĂć "when leaves are distributed side by side" – what does that mean? âĂć Equation 5 – in the third expression F[1-exp(- k r l)] dA I don't think the dA should be there and therefor it should be in the denominator of the last expression dL K /dA âĂć In equation 8 – should the dz term also carry a contribution of cos theta to make that component perpendicular to the incoming solar radiation? âĂć Is the symbol of an upside down U in equation 17 mean to be a capital Π? meaning multiplying all the terms in the series? You may wish to clarify the symbol and write out the meaning. âĂć Can you comment on the physical circumstances under which the 2-leaf model fails? I.e. at what LAIs? âĂć It would be really nice to see the 2-leaf model on the same panel as your model . . .

Interactive comment on Geosci. Model Dev. Discuss., 6, 6927, 2013.