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Geoscientific Model Development Discussions

Interactive comment on "Are vegetation-specific model parameters required for estimating gross primary production?" *by* W. Yuan et al.

Anonymous Referee #2

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Authors assess whether light use efficiency (LUE) based models require vegetation dependent values of LUE, and based on testing seven models at several sites conclude that they don't.

LUE models are generally driven with satellite derived vegetation indices (normalized difference vegetation index or enhanced vegetation index) or absorbed photosynthetically active radiation (APAR). However, there is another class of vegetation models called the dynamic global vegetation models (DGVMs) that also simulate gross primary productivity (GPP) among several other vegetation and terrestrial carbon related quantities. The manuscript makes no mention of DGVMs and the fact they have always used several vegetation dependent parameters, most importantly V_{max} – the maximum rate of photosynthesis. Any advances in LUE based models do not necessarily trans-

fer to more process-based DGVMs which have become a primary tool for investigating effect of climate change and changing composition of our atmosphere on Earth's terrestrial biosphere.

Even if DGVMs are ignored, I am not convinced as a reader that the manuscript has shown to a sufficient extent that LUE is indeed vegetation independent. Having read the eye-catching title of the manuscript, I was hoping a simulation at the global scale and comparison with some observation-based GPP product such as that of Beer et al. (2010). In its current form, there is no comparison with observations of any kind. Results from global simulations with and without vegetation dependent LUE with an observation-based GPP product are likely to help understand if LUE dependency on vegetation type is worth considering or not.

The manuscript also fails to introduce its readers to how exactly LUE based models work. Few equations describing the basic approach and how they are implemented in the seven models would be extremely helpful.

The manuscript claims to have conducted a global comparison. In a strict sense, this is not entirely correct because authors have compared models with and without vegetation-dependent LUE at several selected sites.

In Table 1, ϵ_0 varies over an order of magnitude across models, and easily more than twice when the VPRM model is excluded. So what does LUE actually means in these models? Is it just another tunable parameter or does it have some physical meaning? And, for some of the models in Table 1, ϵ_0 is more vegetation dependent than others. Why?

The reason a model-specific constant LUE may work (although the paper doesn't show this globally using results from a global simulation) is that any satellite-derived vegetation index is an integrator of a number of vegetation attributes including leaf N content as authors themselves say.

DGVMs do not have the luxury of using satellite-derived vegetation indices. In these models all vegetation attributes, including leaf area index (LAI), must be internally simulated and it would be very difficult to simulate realistic global patterns of GPP without using vegetation-dependent parameters.

The manuscript lacks the connection of results obtained to wider scale application of DGVMs in the community.

Clearly, at an annual scale simple models like the Miami model may be used to estimate net primary productivity as a function of just mean annual temperature and precipitation (if I am correct). But such models don't have any predictive capabilities. So where do the LUE-based models lie on the spectrum of models from the simple Miami model to the process-based DGVMs.

I suggest that the manuscript needs a major revision including comparison with a global observation-based GPP product, a more thorough assessment of implication of the results for the wider vegetation modeling community, or at the very least some discussion that LUE based models depend on satellite-derived products so cannot be used in a truly predictive mode.

References

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