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Geoscientific Model Development Discussions

Interactive comment on "Application of a computationally efficient method to approximate gap model results with a probabilistic approach" *by* M. Scherstjanoi et al.

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text of referee in italics

reply from authors in plain text

First, we should note that there are 3 types of terrestrial vegetation models: (type 1) big leaf models, (type 2) truly individual-based models, and (type 3) approximated models for a truly individual-based models. Each model has own strength and weakness. Type 1 models are the most computationally efficient. Since your model is type 3,

what is your strength over type 1? You evaluated your results based solely on carbon balance. However, a well-parameterized big leaf model can reproduce carbon balance like this (or better). So, you must provide some aspects of your results that show the uniqueness of type 3 models over type 1 models. I suggest to show a map that describe plant type distributions.

In fact, technically one possibility would be to simulate vegetation dynamics with the LPJ-GUESS population mode (equals the LPJ-DGVM model, uses big leaf approach). For two reasons, with regard to contents it would not bring the paper much further. First, Smith et al. (2001) and Hickler et al. (2004) already demonstrated the advantages of the LPJ-GUESS cohort mode over the LPJ-GUESS population mode, which especially take effect in mixed forests, and drought affected or frequently disturbed forests. Second, the LPJ-GUESS disturbance function is not implemented in the population mode. Including the effect of small scale disturbances requires a gap model approach which only the LPJ-GUESS cohort mode is using.

To make more clear that we exclude the big leaf approach from the beginning on we replaced the sentence in the Introduction (Page 1537, lines 4-6):

"However, the first generation DGVMs did not take into account forest structure, and showed limitations in modeling competition and disturbances (Quillet et al., 2010)."

with

"The first generation DGVMs simulate the vegetation of one plant functional type or species in a stand aggregated in one individual (big-leaf approach). Therefore, they do not take into account forest structure and show limitations in modeling competition and disturbances (Quillet et al., 2010), which might especially affect mixed forests and the vegetation growth under dry conditions (Smith et al., 2001).

Comparing against ED, you said "GAPPARD has a higher computational effi-

ciency but on the cost of less precision on smaller time scales." I am very interested to see differences between your results and ED. Can you show us a case study?

We have to admit, that our assessment about ED at the moment cannot be proven. Unfortunately, there is no such case study. Therefore, we changed our formulation (Page 1538, lines 21/22):

"Hence GAPPARD has a higher computational efficiency but at the cost of less precision on smaller time scales."

to

"Hence, and also due to a lower spatial resolution in ED (Moorcroft et al. 2001), GAPPARD has most likely a higher computational efficiency. However, this increase in efficiency comes along at the cost of less precision on smaller time scales."

What is the ultimate goal of your model? A regional model only for Switzerland? Or for the entire Europe? Or to cover the whole globe? If so, what do you need to fulfill your intension in the future studies?

The main goal was to apply the GAPPARD method successfully on a country-wide scale. I think, we met this aim. From a technical point of view, one could easily apply the method to any scale and any model that uses the Gap Model approach and that does not include interactions between neighboring grid cells or patch-to-patch interactions. From an ecological point of view the biggest challenge would be to parameterize all relevant species in the modeled region.

To address this issue we added the following sentences to the end of the Conclusions and Outlook section:

"In this paper, we successfully applied the GAPPARD method to simulate climate change effects on forest dynamics over the whole of Switzerland. We are optimistic

that it can be used for any scale and any model that uses the Gap Model approach and that does not include interactions between neighboring grid cells or patch-to-patch interactions. Regardless of whether using GAPPARD or not, if applying LPJ-GUESS to different regions one big challenge will be to parameterize all relevant species."

Interactive comment on Geosci. Model Dev. Discuss., 7, 1535, 2014.