

Interactive comment on “Global climate response to idealized deforestation in CMIP6 models” by Lena Boysen et al.

David Lapola (Referee)

dmlapola@unicamp.br

Received and published: 18 August 2020

This is a relevant study that shows the modeled climatic impacts of an concerted removal of forests across the globe. The authors should be applauded for the effort in first conducting this multi-model exercise and also for the well-organized and systematized analysis. The article presents a proper level of self-critique regarding the lack of surface-atmosphere feedbacks such as the missing effects of CO₂ emitted with such a deforestation and its physiological (e.g. CO₂ fertilization) and radiative feedbacks to the land vegetation (this much should be highlighted in the abstract!).

My major concern is regarding the influence of the ocean on the resulting climatic patterns. In the introduction (L70) the authors state that atmosphere-only simulations of

C1

this kind tend to present a stronger (-than-real?) signal-to-noise ratio for deforestation. Using ESMs is indeed a huge advantage over an atmosphere-only approach. However the authors lose an ideal opportunity to demonstrate this by showing the incurred changes in sea surface temperature and circulation patterns. There is historically a number of atmosphere-only modeling studies showing indeed a strong temperature sensitivity to deforestation, especially in the tropics. Not much has been said in these previous studies on the Time of Emergence, a nice tool the authors use in this current manuscript. Is the ToE presented here related to the climatic inertia of the ocean? The exploration of the ocean-related variables could clarify this, as well as other issues presented in the article (e.g. cooling of western Europe in some models and reduction of precipitation in the tropics).

As a minor suggestion, the authors could at least discuss the probable results from a separate experiment of deforestation in the boreal zone alone and another one of deforestation in the tropics alone.

Other minor comments:

L51: future losses in what time horizon?

L52: not only to free land for food and bioenergy but to speculate on land ownership itself (i.e. to justify land grabbing [see Rajão et al. 2020 Science]).

L70: “An experimental setup with atmosphere-only models in which sea surface temperatures are prescribed allows to increase the signal-to-noise ratio of models’ response to deforestation. This setup assumes that the effect of large-scale circulation changes is small and can be ignored.” Please explain this better. You mean the sensitivity of models to deforestation increases (artificially?) in atmosphere-only model setups? “(...)the effect of large-scale (atmospheric?) circulation changes is small (compared to what?) and can be ignored.”

L125: if tree and forest are different things why using them interchangeably then?

C2

Table 1: are you sure the units of delta Pr is mm/yr?

L323: is this somewhat related to an acceleration of the Atlantic THC? By the way that is the only region the IPCC shows as cooling in the SRES scenarios. Please explore the implications of this result deeper.

L353: the increase in leaf area is such that LAI surpasses that of a typical tropical forest?

L359: But this also decreases incoming shortwave radiation, doesn't it? Fig 3f doesn't show a considerable increase in longwave radiation.

L378: a "global" cooling effect due to CO₂ removal...

L379: uncertain

L389-390: Is this based on in-field experimental studies or modeling? How trustful is it?

L414: Tas or Tsurf?

Fig 6a: ToE in the tropics seems restricted to 30 years or more (i.e. values smaller than 30yr do not occur). Is that due to the use of a 30-yr moving average?

L501: "...robustly detectable after a few decades". What is that time lag attributable to? Influence of slower thermal sensitivity of the adjacent oceans? That's one strong reason to show sea surface temperature and circulation changes in this article.

L508-509: but notice that this study did not test that (i.e. the climatic effects of re/afforestation). Would be a nice follow-up.

L523: What is an unfavourable climatic condition? I suggest a different term also on L546.

Fig 9: after how many years?

L591: I think the authors should present arguments why the C4 grasses are "overly" C3

productive. C4 grasses like sugarcane or others can indeed have a NPP higher than that of tropical forests.

L621: It is unclear why figure 9f shows a steep decline of GPP in northern Amazon, considering that considerable increase in precipitation for that specific region was previously presented in the paper for BCC.

L765: Why wasn't this analysis of large-scale circulation patterns done in this study?

L67: "...temperature gradient may alter the large-scale circulation..." Atmospheric or oceanic?

L774: Is it possible to be a bit more specific on the sort of observational data needed?

Fig S13: the brownish color in the tropics in panel f and in the boreal zone in panel d doesn't seem to correspond to any color in the legend.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2020-229>, 2020.