

Overview

The manuscript by Boysen et al. quantifies the biogeophysical and biogeochemical effects of deforestation. A consistent configuration among Earth system models (ESMs) derives from the use of the “deforest-globe” experiment, which is part of the Land Use Model Intercomparison Project (LUMIP) effort. This analysis, then, presents a unique opportunity to evaluate the magnitude, pattern, and time of response to a global deforestation of about 20 million square kilometers. This analysis, then, gives an original and useful insight into the global and regional climate and carbon cycle response to a wide and rapid global deforestation. At this stage, the manuscript requires some clarifications before being ready for publication, as described in the following sections.

General comments

The analysis presented in this manuscript applies to nine Earth system models, and many variables are analyzed. For this reason, the correct reference and the proper variable-model linkage may be lost in the text. This issue, then, can make the text hard for the reader. Among the different "Results and Discussion" sections, section 3.3.1 results easier to follow. This section, indeed, contains a straightforward model-by-model description and variable analysis. In this case, then, it is easier to extrapolate information about each model and each analyzed variable. I think that a similar level of clarity should also be attained in the other "Results and Discussion" sections. Moreover, six out of nine models present some divergence from the protocol. If the analysis is performed only on the remaining three models, is it changing the main results?

Among these six models, MIROC exhibits a limited response to the deforestation forcing. Since MIROC allows for a forest regrowth, and, so, a divergence from the protocol: is it worth to keep it in this analysis?

Specific comments on the unclear portions of the text are listed below.

Specific comments

Line 107: supplementary figure 2 is cited before figure S1. Invert figures S1 and S2.

Line 127: “kilometres” should be “kilometers”.

Lines 150-161: Six out of nine models present some divergence from the protocol. If the analysis is performed only on the remaining three models, is it changing the main results?

Lines 163-164 and Line 206: How many members does MPI provide? Seven or eight?

Line 170: the “branching year” is not given for all models in Table S1.

Equation 1: $T_{surf,piControl}$ should be $T_{surf,piControl}$ with “surf,piControl” subscript.

Table 1: which symbol denotes non-significant changes (it is missing in my pdf version)?

Table 1: does “Pr” stand for precipitation?

Table 1: in “ Δ Land over ΔF ” of “MPI” there is an extra parenthesis “)”.

Figure 2 caption: “near surface air temperature” refers to ΔT_{as} ?

Figure 3: why don’t you directly use Figure S3 as Figure 3? Figure S3, indeed, contains the same information in Figure 3, but it also shows the global versus deforested grid-cell comparison. In figure S3, you could add the multi-model mean values, as done in figure 5.

Lines 323-324: where can I see the changes in evapotranspiration and latent heat flux?

Line 326: “net shortwave”, but the brown line in Figure 2 shows incoming shortwave and not the net one.

Line 327: the temperate and boreal areas are introduced, but the latitudinal range of these regions are only reported later on in the text (caption of Figure 4).

Line 328: Figure S5 shows the distribution of albedo changes. It is not showing that “increasing albedo are stronger than reduction in longwave radiation”.

Lines 328-329: “net shortwave reduces”, is it shown in figure S4c?

Line 329: “incoming shortwave radiation increases”, is it brown line in Figure 3?

Lines 330-331: “MPI and IPSL reduction in cloud cover”, is it shown in Figure S4f?

Line 332: “turbulent heat flux”, is it shown in Figure S4a?

Line 342: “increase in albedo”, is it visible in Figure S5?

Line 343: “reduced cloud cover”, is it shown in Figure S6?

Line 343-344: where is shown the comparison between changes in incoming shortwave from clouds and incoming shortwave from albedo?

Line 347: “as also observed” should be “is also observed”.

Line 352: “net warming”, is it visible in Figure 2c?

Line 352: “evaporative cooling”, is it shown in Figure S8i?

Line 354: “sensible heat fluxes”, is it shown as cyan lines in Figure 3?

Line 355: “BCC temperature increase”, is it visible in Figure 2f?

Line 359: “evaporation decrease”, is it shown in Figure S8f?

Line 359: “increase cloud formation”, the cloud increase seems limited over the Amazon in Figure S6f.

Line 361: “not shown”, the difference between longwave and longwave clear sky is displayed in Figure S7. Are you referring to different variables? Otherwise, the difference is shown. The described difference is not visible to me in Figure S7.

Line 364: is CNRM case shown in Figure 3e?

Lines 369-370: formatting error: the new line is started too early.

Line 383: available energy should be Figure S4b instead of Figure S4a.

Line 385: “cloud formation”, is it visible in Figure S4f?

Line 386: turbulent heat flux should be Figure S4a instead of Figure S4b.

Line 386: is latent heat flux visible in Figure S4d?

Line 388: “[...] over temperate and boreal over grassland [...]”, the second over should be deleted.

Lines 416-421: The temperature changes per unit fraction of grid cell deforested range between 4 and -20, why Figure S9 has values between 2 and -2?

Similarly, the temperature changes per unit area deforested reported in Figure S10 and the text cover a different range of values.

Line 431: "On average [...] 0.27 °C frac⁻¹", does it refer to Figure 4a?

Line 434: "reverse at higher ΔF ", does it refer to Figure 4c?

Line 434: "regions_there" should be "regions (Fig. 4b) there".

Lines 465-467: "Over South America [...] over Eurasia", where are these changes shown?

Line 485: "30% and 10% of deforestation still left", is it visible in Figure S12?

Line 506: "2013) and" should be "2013; and".

Line 572-573: "For all models but MIROC [...] ($\Delta cSoil$).", is it visible in Figure 8?

Line 577-579: "Below ground carbon [...] several decades)", are fast and medium soil carbon pools displayed in Figure S17?

Line 585: "large NEP", is it visible in Figure 10d?

Lines 594-595: are heterotrophic respiration and net ecosystem productivity shown in Figure 10?

Line 598: "NPP reduction", is it depicted in Figure 10b?

Lines 617-618: "cVeg change [...] carbon pools", is it visible in Figure 8?

Lines 618-619: "The exception [...] soil carbon pool", where is it shown?

Lines 621-622: "In BCC, [...] simulation period", is it shown in Figure 10?

Line 628: "uniform global increase in NPP", is it visible in Figure 10b?

Lines 628-629: "especially in the tropics", where is it shown?

Lines 630-631: "GPP changes are [...] south-east Asia", is it shown in Figure 9b?

Lines 634-636: NBP values are the ones shown in Figure 10f?

Lines 644-645: "GPP reductions [...] GPP increase in time", are the changes shown in Figure 9?

Lines 680-684: The range of values displayed in Figures S20 and S21 are different from the values reported in the text. For example, Figure S20 shows values between -20 and 20 kg m⁻² frac⁻¹, while the text describes changes between -40 and -90 GtC.

Lines 686-687: "Fig. S25" should be "Fig. S22".

Lines 691-692: "In the tropics, IPSL [...] forest removals.", is it visible in Figure S22a?

Line 695: "removal in South America", is it shown in Figure S20c?

Conclusions: the conclusions should also report the opposite biogeophysical response between boreal/temperate forests and tropical forests. The possibility to identify a "threshold" latitude below which re/afforestation could have both biogeophysical and biogeochemical cooling effect is significant.

Figure S2 caption: "Mkm²" should be "Mkm²" with "2" as apex.

Figure S7: why doesn't this figure report CESM2?

Figure S9 caption: "frac⁻¹" should be "frac⁻¹" with "-1" as apex.

Figure S10 caption: “km²” should be “km²” with “2” as apex.

Figure S13: “Only statistically significant areas as found in Fig. 2 are shown.” but the figure’s legend report also “non-sign.”. Are non-significant areas plotted or not?

Figure S15 caption: “m²” should be “m²” with “2” as apex. Add why some models are not plotted.

Figure S16 caption: “km² year⁻¹” should be “km² year⁻¹” with “2” and “-1” as apex. Add why some models are not plotted.

Figure S18 caption: “ToE in years [...]” should be “ToE and FoE in years [...]”.

Figure S19 caption: “Same as Fig S19 but for the ToE of gross primary productivity” should be “Same as Fig S18 but for the ToE and FoE of gross primary productivity”.

Figure S20 caption: Add why some models are not plotted.

Figure S21 caption: Add why some models are not plotted.

Figure S23 caption: Add why some models are not plotted.