Reviewer #1

This study investigated the global and regional response of drought to deforestation by analyzing results from CMIP6-LUMIP experiments. The authors compared the differences between the piControl and deforest-global simulations, in order to infer the impacts of deforestation. This study provides good information on the regional response of drought to idealized deforestation. However, the authors should be more cautious in their conclusions, due to the uncertainties in attributing the climatic effects of deforestation in models. There are some issues that the authors need to properly address during the revision.

Thanks for the appreciation of our work and the useful feedback to improve the quality of the manuscript. We addressed them as described in the answers below.

1. Introduction, pp.3-4, lines 65-93: Perugini et al. (2017) reviewed the existing scientific literature regarding the biophysical effects of land cover change on temperature and precipitation. I think it is inappropriate to cite this review paper in many places in the Introduction section describing the previous findings on the topic of climatic effects of forest cover change. Maybe cite and specify some classic or recent articles to illustrate the impacts of forest cover changes.

   Thanks for the comments. We have modified the text and citation to describe some classic or recent articles to illustrate the impacts of forest cover changes. (Line XXX)

2. 6-7, lines 177-187: I am intensely curious why the authors do not use the CESM and MPI-ESM1-2-LR model simulations from CMIP6-LUMIP? For example, CESM2 also have three runs, similar to IPSL-CM6A-LR, while MPI-ESM1-2-LR has seven members. Please note that climatic responses across individual runs due to model internal variability may also show considerable differences. I think single model with multiple realizations can provide a better estimate of climate responses due to deforestation. I encourage the author discussing more on these.

   Yes, the two models contribute to the CMIP6-LUMIP. However, some variables necessary for calculating drought are missing from the two models. Therefore, we excluded the two models in our study. We added two sentences to explain it.

   We also added text to discuss the limitations/advantages of one single model and multi models in estimate of climate responses to deforestation.

3. Lines 248-249: The full name of the Dry_n, Dry_s, T_n, … etc should be displayed upfront when it is used for the first time.

   We have added the full name of the abbreviations.

4. Sections 2.2 and 2.3: I think these two paragraphs are the core of the analysis methods section, even the core of the whole paper. However, it is not clear enough. For example, how the authors calculated the SPEI in the CMIP6-LUMIP model simulations?

   Thanks for the comments. We have modified the text in Sections 2.2 and 2.3 to clarify the calculation of SPEI in our study.

5. What is the rationale to perform cubic spline regression analysis? Is it sensitive to a given interval?

   We use the cubic spline regression to exclude the interannual variability, and show the changes of SPEI induced by deforestation is almost consistently. Different interval has a slight impact on the curve. We use "gam" function to select a best interval.

6. Lines 284-285: One possible reason is that UKESM1-0-LL still exhibits forest cover changes after the year 50 due to its model structure? (e.g., Fig. S2 in Boysen et al., 2020).

   Yes, this is one possible reason of the different climate response to forest cover change in UKESM1-0-LL compared to other models. We did not include these text in the revision based on the Q7.

7. Section 3.1: I suggest Section 3.1 must be shortened and greater clarity in the presentation of new findings, as previous studies (e.g., Boysen et al. 2020; Luo et al. 2022) have examined the temperature and precipitation responses to idealized deforestation (i.e., deforest-global vs. piControl) in the CMIP6 models.

   We have shortened the Section 3.1 to focus on the non-linear relationship between deforestation area and precipitation or temperature changes across regions.

8. Figure 2 and other similar figures: Please note that forest fractions in Antarctica did not show a change in the deforest-global experiment. Why the models exhibit few significant variations due to idealized deforestation in the SPEI in Antarctica? Please explain a little bit about it. Internal noise in models?

   Thank you for this comment. We added one paragraph to discuss this.

9. The deforest-globe simulations are initialized from their pre-control runs, so the initial fraction of forest cover in each model may be different. That's why the drought patterns (Figs. 2 and 3) and the temporal variations (Figs. 4 and 5) due to deforestation exhibit large differences (e.g., EC-Earth3-Veg and GISS-E2-1-G), in particular in the temperate and boreal regions. I think the authors should add relevant discussions on the temporal and spatial differences among the CMIP6 models.

   Yes, the relevant discussions on temporal and spatial differences among the CMIP6 models will be add in the revision.

10. Authors should also pay attention to the model uncertainties (e.g., LUCID Pitman et al., 2009, also LUMIP Boysen et al., 2020). I suggest the author discussing more on these. The drought responses must be treated with caution due to lack of a sufficiently large ensemble.

    Thank s for the comments. We will add the discussion about model uncertainties in the revision.

11. In the manuscript, I didn't see many mentions or linkages to physical and biophysical processes implemented in the nine models. Is there any chance to find an explanation of the present diagnostic results, namely, links between deforestations and drought?

    We will add new discussions in the revised manuscript regarding the potential biophysical processes implemented in the nine models to links between deforestations and drought.