

***Interactive comment on* “Reviews and syntheses: Influences of landscape structure and land uses on local to regional climate and air quality” by Raia Silvia Massad et al.**

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We thank Referee #2 for their careful reading and useful comments. Both reviews have very conflictual views of our paper. Reviewer 2 thinks we have done a relatively good job and encourages us with a limited amount of suggested changes. Reviewer 1 rejects our work with a very critical point of view. A 3rd review would have been quite helpful in that sense.

General Comments

Thank you for inviting me to review this paper. First and foremost, I would like to state

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that it is one of the most comprehensive manuscripts I have seen for some time. It has the potential to be a significant “go to” paper for anyone with interest in measuring or modelling land-atmosphere interactions. The reference list is – as might be expected for a review – very thorough, and it certainly alerted me to papers I was not aware of.

I think it is important first to note what the paper does not include. This is not to detract from it in any way at all, but simply to gain understanding as to what its main messages are. The authors may like to consider a set of words to capture this, possibly towards the end of the Introduction. So not addressed in detail are:

Comment: Many existing studies focus on the role of the land surface in mitigating carbon dioxide emissions. Significant effort is placed in closing the global carbon cycle, and there is a view that the land surface (and associated land-atmosphere CO₂ exchanges under a changing climate) is where much uncertainty remains. In the most general terms, approximately 25% of CO₂ emissions are believed to be drawn-down by the terrestrial ecosystems. Of concern is that this fraction may decrease into the future, especially through higher respirations or nutrient limitation. There is a small reference to this, indirectly, in Table 2 “Change in atmospheric concentrations of GHG”. The title is clear, with no word “global” used, but it does mention “climate”.

*Reply: In this review we choose to treat the effects on air quality and local climate. The impact on the global climate (GHG emissions) is not the focus of our study. We will add an explicit phrase in the introduction to better explain this point.

Comment: Related to (1) above, much is described in the IPCC reports, and especially the recent 1.5°C and 2.0°C threshold assessment, about the role of BioEnergy with Carbon, Capture and Storage (BECCS). This form of large-scale geo-engineering of the global carbon cycle is not included here (for instance, the CO₂ cycle is omitted from Schematic Figure 5)

*Reply: Again as for global climate, the C cycle is not the focus of our study. This topic has been already extensively reviewed, even though we agree that there are still a lot

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of gaps and challenges ahead. We will specify this point in the Introduction and will refer the interested readers to recent reviews (e.g., Le Quere et al., 2018; Sauniois et al., 2018).

Comment: The paper is very much a qualitative assessment, with most display items more schematic in format. Hence, it is presently difficult to compare effects, and so the logical conclusion is the one that the authors present. That is, there is a need for an overall integrated tool that would allow effective intercomparison of regional effects, drivers and feedbacks.

*Reply: We agree with this analysis, and, upon suggestion from reviewer R1, we have re-organised the manuscript so as to better show how those conclusions are reached.

Comment: The major part of the paper concerns geochemical feedbacks, rather than the more physical one. There are some exceptions. For instance, one page 14, there are citations to papers describing how different land cover types have the potential to either suppress or aggravate any future extremes in a changed climate.

*Reply: These citations are presented in the section talking about physical effects. This section will be merged with others according to Land Cover Changes (LCC) and Land Intensification (LI). We will in this sense try to homogenize with other effects and consider if this is a point that should be more thoroughly reviewed or removed from our manuscript

Comment: By stating something along the lines (1) – (4) will then make the paper stronger, as clearer than what the paper does encompass. Moreover, this is where I believe the manuscript is very powerful indeed. It is arguably that of the range of environmental concerns, climate change has taken too much of the attention. Many of the more local/regional effects will be just as important to the individuals concerned. This is especially true of air quality, or strong local pollutants that threaten food security – both of which are either modulated by the land surface or impact on it.

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This paper, for the first time, places emphasis on non-global pollutants, and it is revealing from much of the literature cited that the implications are likely to be large in many instances. Those who build the air quality and atmospheric tracer components of weather forecasts, regional climate models or even full Earth System Models will appreciate this manuscript, bringing the latest understanding of the terrestrial role into a single document.

This review is slightly different to usual because most papers have quantitative plots which can be assessed and studied in detailed, and then commented on. So really it is only possible to give an overview here. The authors can if they like, consider the points above and associated context-placing. As always with manuscripts, please read through carefully again – especially as now a break since submitting. The paper is very long, and so possibly look for any places where the writing can be tightened. As environmental science is evolving fast, it might be worth a quick, targeted literature search of any very recent 2018 papers on Scopus or the Web-of-Science. Otherwise, I think the document could be published almost in its current form.

*Reply: We will re-read the paper as suggested to avoid repetitions. As specified to reviewer R1, didactic sections will be moved to an appendix to shorten the manuscript. Moreover, we will also update the literature.

Comment: A very small thing - the legends in Figure 2 are in small font – please make them slightly bigger.

*Reply: Will be changed.

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