

Interactive comment on “The impact of land cover generated by a dynamic vegetation model on climate over East Asia in present and possible future climate” by M.-H. Cho et al.

Anonymous Referee #2

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Review of Cho et al., submitted to Earth System Dynamics.

The authors test the sensitivity of the climate dynamics in east Asia to different land cover datasets, including one dataset derived from DGVM, and to the modified dust loadings resulting from the different land cover. They base the experiment and the analysis on a previous study that had a southeast Asia focus. Results show substantial regional differences in energy fluxes, surface temperature and precipitation when the different land cover datasets are used, in large part due to a major difference in bare soil fraction over northern China. This study is a great example of how a basic issue in ESM model predictions can be compounded, or even compensated for, by the response in other model processes. Future precipitation in some areas also appears to be sensitive

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to the land cover although regionally averaged surface temperatures were insensitive to the future changes examined. Changes in dust loading have even larger impacts on the lower-level wind patterns than the land cover changes (present day). These are interesting questions to address and I have several major comments and suggestions for how the paper could be improved.

Major comments:

1. I think in this case it is important to be very specific about how this study is different from ML12 since the same datasets are being used and it was unclear whether any additional modeling was done for this study. It is noted of course (pg 1322, L19) that this is an extension of ML12 to East Asia, but it would be helpful to include additional references in ML12 in Section 2 to remind the reader where the model setup and results are coming from. For example, Pg 1323, L16 you could change “The experiment configuration. . .” to “The experiment configuration from ML12. . .”. Also, somewhere in this section it could be mentioned that while ML12 apply certain specific methods to southeast Asia, we apply them in the same way (or in a different way if that is the case) to East Asia.

2. The authors mention a couple times, citing ML12, that the increase in bare soil over northern China is unrealistic or excessive, a result of the precipitation bias in the particular model used to generate the land cover. In fact, if my understanding of the use of “fractions” in Fig. 4c,f is correct, then a huge area in northern China that was >50% grass becomes >60% bare ground. This is indeed a major change and it is likely that the dust response would be large. However, given the unlikelihood of the DGVM land cover, it is also unlikely that this study could hope to show realistic responses in dust emissions, loading, and impacts. It is, therefore, more useful as a sensitivity study showing what would happen if these major land cover changes were ever to take place, or how the differences in model land cover could lead to different model climates. The authors do a nice job of stressing that this is the purpose of the study, even in the abstract, but to place this study into context better some discussion could be added

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about whether the dust response would still be important for more subtle land cover changes, or land cover changes in general that do not include huge increases in bare soil cover. I think this is a way of saying – do the authors have a sense for how specific these results are to these two land cover datasets and this one particular region of precipitation bias in the GCM?

3. Since the impacts of dust are a main part of this study and also seem to play a major role in the climate response to the land cover changes, it would be helpful to include more details in Section 2 about how the model treats these processes. Specific questions: How are dust emissions modeled and how dependent is this on the bare soil fraction? It appears that dust are radiatively active in the LW and SW but this is not explicitly stated in the methods section. Is dust microphysically active? Does the model represent the semi-direct effect on clouds from atmospheric heating from increased dust?

If the answer to either of the last two questions is yes then more discussion of how these dust effects might impact the climate response would probably be needed. Further simulations would be required to really isolate these effects, dust vs. no-dust simulations, probably beyond the scope of this study. In any case it should be explicitly stated in the methods section what effects are included in the phrase “dust radiative effects” and something should be said about how the results might change if excluded radiative or microphysical effects were considered.

Minor comments:

Pg 1322, L13-14: I had trouble understanding this sentence and I am not sure my suggestion will carry the original intended meaning, but I would suggest something along these lines: “ML12 investigated the impacts on climate of land cover changes and associated dust effects that resulted from model systematic biases.”

Pg 1322, L 15: Change “Hurrel” to “Hurrell”

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Pg 1323, L2: I suggest changing “performed” to “produced”

Pg 1324, L1-10: Please provide references for the greenhouse gas forcing and future land use datasets.

Pg 1324, L11-13: In this sentence I would suggest making it clear that the only difference between the simulation sets is the land cover.

Pg 1325, L10: Thank you for providing a table, this makes it much easier to navigate the shorthand.

Pg 1325, L19: I recommend changing “typical” to “climatological”

Pg 1327, L1-3: See major comment #3 – it is not clear exactly how the dust is impacting the rainfall, whether through semi-direct effects, or through a sfc temperature response?

Pg 1327, L7-10: This sentence was difficult to understand, I recommend something like “This suggests that precipitation over East Asia is more sensitive to the radiative effects of dust associated with land cover changes than to the land cover change alone.”

Pg 1328, L13: Change “soil” to “bare soil”

Pg 1328, L22-23: I suggest changing “are represented by” to “lead to”

Pg 1330, L12: Referring to some of the CMIP5 models as “good” might be too subjective a description. Rather, refer to the models used in the cited paper as a “subset of CMIP5 models”. Also in this sentence, there are several references for CMIP5 predictions of precipitation change under RCP8.5 (IPCC AR5 for example) that would make a better comparison here than RCP6.0. I suggest replacing this citation with a reference to precip changes in RCP8.5.

Pg 1331, L17: Change “The atmospheric response of” to “The atmospheric response shown in”

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Figure 1 caption: Assuming both panels show JJA data, it would be more clear to note that they are JJA in the description of panel a and panel b instead of only at the end.

Figure 2 caption: Define “observations” here (GPCP). Also, if it is not difficult to do, it would be helpful to have the region acronyms (NC, KR, SC) written in the appropriate locations in Fig. 2c,d.

Figure 5 caption: Same, note which observations are being used (GPCP again I believe).

Figure 6, 14 caption: Despite the definition of summer in the main text, for consistency I prefer using “JJA” in the place of “summer” here.

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