

Interactive comment on “The impact of nitrogen and phosphorous limitation on the estimated terrestrial carbon balance and warming of land use change over the last 156 yr” by Q. Zhang et al.

Q. Zhang et al.

qian.zhang@bnu.edu.cn

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We thank the reviewer for his/her constructive comments and suggestions. Here are our responses and revision made to the manuscript for each comment. The reviewer's comments are in italic, our answers below.

This study makes use of a low-resolution atmosphere only model coupled to a nutrient cycle to simulate changes in climate and C stores over the recent past. The interaction of nutrients and LULCC is a relatively novel experiment with relatively little literature covering this interaction.

Agreed and many thanks. No change is made here.

C357

The study makes use of an atmosphere only model driven by SSTs. The lack of a coupled ocean limits the analysis of the climate effects, but appropriate caveats are included and this is only a secondary focus to the biogeochemical implications.

Agreed. No change is made.

My main comment is the need for greater clarification in the methods on how both nutrients and LULCC change are implemented in the models. Similarly, some clarity over what is considered a LULCC associated flux would also be useful.

We have added a new section 2.4 (see P8-9) to clarify how nutrient limitation on carbon flux is represented in our model.

We have now clarified what are the carbon fluxes as the LULCC associated fluxes that have included in our study (see L29 on P5 to L7 on P6, and P7, L7-15).

2.1. Although appropriate references to CASA-CNP are included more background information would be useful.

Agreed. See new section 2.4 (P8-9).

2.2. Some justification for the use of 1990s time-invariant N and P deposition rates.

Agreed. See the justification (P5, L23-27) and discussion (P15, L14-17).

2.3 This section could do with clarification. For instance, implied in the 2.2 is that time varying maps of PFTs distribution are used - thus including both deforestation and regrowth. How exactly are the timescales of regrowth calculated?

Agree and clarified. See added text (P6, L2-7).

Is this flux fw^ in this section? Or is this flux actual wood harvest that doesn't involve any fractional area change in PFT extent? What happens to root C is this assumed to be harvested as well?*

Clarified, see added text (P6, L2-7 and P7, L9-12).

C358

Eq 8 (fluc) implies this calculation is done using two simulations to bring out the net LUC emission, however this is not clear in the text.

This is now clarified on P7, L13-15.

P514 L16 - something missing/not reproduced in my version.

This has been checked with associated editors. We hope that this problem in printing has now been resolved. No change made.

3.1 This section focuses on net changes in pool size, and mean annual fluxes between 1850 and 2005. However, Fig 3 shows some interesting behaviours in the 50/60s. Some analysis of the time series would be useful as would additional figures to 4/5 showing the time series of fluxes between pools (i.e. fLUC).

Thank you for pointing this out. We have now included three additional figures as supplemental material. Our analysis found that the switch from a source to a sink in land biosphere with LULCC during 1950's to 1960's was a result of rapid increase in atmospheric [CO₂] and slow-down in global deforestation after around 1960. This is now explained in the text (see P14, L8-12).

4. Using fixed SSTs the result found here is for a net cooling through LULCC. However, am I right to understand that previous versions of this model found a net warming due to LULCC (LUCID, 2012). Might this be related to climate biases (Pitman, 2011) influencing the model response to LULCC?

Our results in this study have shown that LULCC has net cooling effect on global land surface temperature. This is consistent with the results using an earlier version of the model (see Fig. 2 of Pitman et al. (2009) and Table 5 of de Noble-Ducoudre et al. (2012)).

Please also note the supplement to this comment:

<http://www.earth-syst-dynam-discuss.net/4/C357/2013/esdd-4-C357-2013->

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supplement.pdf

Interactive comment on Earth Syst. Dynam. Discuss., 4, 507, 2013.

C360