

Interactive comment on “GOLUM-CNP v1.0: a data-driven modeling of carbon, nitrogen and phosphorus cycles in major terrestrial biomes” by Yilong Wang et al.

Anonymous Referee #1

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Overall this is an interesting and detailed summary of an improvement to an existing model. Though not the first to put in a N cycle, the P cycle is relatively novel and there is clearly diligent work done by the authors to ensure values are appropriately backed up by data where possible. There are a few points that I think need clarifying and some aspects of the model that seem to me a bit odd, and therefore need provisos about the appropriate (or inappropriate) use of the model. Some of the conclusions about openness are a bit of a stretch given the model setup. But with some extra information discussing the limitations, this will be a worthwhile model description.

Major points

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The issue of this being an equilibrium model for the present day/recent past is a concern to me. It isn't sufficiently explained how an equilibrium estimate (including anthropogenic N deposition) is valid in equilibrium. I can see the justification if it's pre-industrial (excluding anthropogenic N deposition), but it doesn't make sense to me as it is. In particular, the openness of the system seems to me to be almost completely determined by the assumption of equilibrium. If the outputs and inputs are balanced (i.e. the equations are solved to 0, as is stated on P7 L32), then surely the store size is at least partly determined by something we know to be wrong. Given that the equilibrium assumption should increase the carbon storage, it's odd that in Table 2 (assuming these are present-day values), the NPP and the soil and vegetation pools are all smaller than many other models and global estimates suggest.

Reading between the lines, it seems that the N fixation is about 120Tg/year. How does this square with other estimates, e.g. Vitousek et al. 2013 (44Tg/year)? Since it's not discussed where this N fixation number came from (and the reference isn't available), or where the N deposition number came from, it makes it difficult to give much credibility to the openness discussions which rely on these.

The relationship between GOLUM-CNP and CARDOMON is opaque and needs to be clarified. It is particularly unclear with regard to what the relationship between the code provided and CARDOMON is. For example, does this code work independently? Or does it need CARDOMON to run? If CARDOMON is part of the code provided, which parts are new and which are CARDOMON?

It's not explained what the intended use of this model is. It's essential early on in the paper to have some examples of use, as well as specific limits on what it shouldn't be used for, (particularly given the limitation of it being an equilibrium model). This is slightly covered right at the end of the paper, but needs to be earlier and more extensive.

The code is very dense, making it very difficult to read. Code should have comments

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every 1 - 10 lines, depending on how interpreted/dense, etc. the code is. Ideally, code should be commented so that, if you stripped out the actual code or if you didn't know python at all, you could re-write it in another language just from the comments. I was also a bit surprised not to see any functions used.

Minor points

P.2 L6-7. Yes, but also water, light etc. are essential controls - if there's no light and water it doesn't matter how much N or P there is, nothing will grow.

P.2 L17 - 30. This seems to mix up P and N fertiliser. It would be better to keep the two issues separate wherever possible.

P18. L28. Reference to Peng missing.

P21. Table 2. When is this table referring to? (Pre-industrial? Present day?) It needs to be specified.

P22. Figure 1. The caption would be more useful if the terms at the top of the figure were defined first, and then worked downwards.

P24. Figure 3. This is a very difficult to read. A table or a series of bar plots would be much better.

P28. Figure 7. Two points need to be addressed for this figure. First that the text is so small that it is impossible to read printed A4. That's true of the ones in the SI too. Second that it's ironic that a red-green color scheme is used, despite one of the authors being color-blind. I just... Other color schemes are available.

P29. Figure 8. It would be a courtesy to your readers to include in the key what YC1, etc. are. It could literally just go beneath the current labels.

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