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Interactive comment on "Carbon-nitrogen coupling under three schemes of model representation: Traceability analysis" *by* Zhenggang Du et al.

Anonymous Referee #2

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[General comments] In this paper, the authors evaluate three different schemes of Carbon-Nitrogen coupling in a terrestrial model, which can largely change both C and N dynamics reproduced by models. For this, they used an existent framework for analyzing the difference between the models. This paper is clearly written, and the results are informative for readers. I recognize the importance of this study because CN coupling is one of the emergent processes to be evaluated / constrained in such land ecosystem modeling. However, I think there are places to be improved: the figures are informative, but the explanation is not enough for readers. My comments will not require a lot of effort to improve.

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[Detailed comments] - P6, L129: “biomass production date” should be “biomass production rate” ?

- P6, L129: What purpose the data “standing biomass and biomass production date” used for your study? Do you mean the datasets are used to determine the parameters associated with the processes? In addition, CN concentration for plant and soil (Finzi et al., and Lichter et al.) are also used for your analysis (I suppose the SM2 simulation need such data because of the fixed CN ratio, but it is not clear in the text). Please clarify them.

- P6, L138: It might be better to clearly mention first that the model is newly developed and used in this study for the first time.

- P7, eq(1)-(6): The detail description of C allocation scheme of TECO-CN v2 is shown here, but it seems the equations are not referred in other places. In my simple thinking, the detail descriptions with the equations are not necessary for your analysis, and it looks no problem if your put them into supplement. If you want to keep the eqs in the main body, it should be qualitative explanations how the C allocation scheme act on CN dynamics in simulations.

- P8, L177- : Although it is shown in the Table 1, it will be helpful for readers to mention here again the fact that CN ratio in SM2 scheme is fixed, while other two are flexible.

- P12, L309: Which level of CO2 concentration do you give to the model in the spin-up? Are the CO2 concentration and climate forcing in simulations given as a cyclic manner? Please clarify them.

- P13, L319: “SˆCRT” should be “SˆMRT” ?

- P15, L390: It looks less references to your figures and tables in the discussion section: It was a bit difficult for me to figure out which claims in the discussion section are supported by your own results.

- P15, L405: You mention here that SM1 has a feedback from leaf N concentration

to photosynthetic capacity, but eq.(7) seems not. I have overlooked something, but if the SM1 actually has leaf-N concentration feedback, you should touch it in the section 2.1.1.

- P16, L426 “C cost of fixing”: Is the effect of C cost actually considered in your simulation of SM3? Which equation in the section 2.2.2 represents the effect? In addition, if you consider the C cost in the SM3 simulation, does the lowest NPP of SM3 attribute to the increase of autotrophic respiration in SM3? It would be nice if you can discuss on this.

- P16, L427: I will appreciate if you can add more explanation why BNF of SM1 lead to the highest NUE. In my understanding, if BNF in SM1 works as the complement to nitrogen uptake, the process works to increase the uptake, and then the NUE(=NPP/PNU) should be decreased. I wonder the SM1 has a mechanism to have BNF that satisfy a minimum N requirement by plants, but it was not clear.

- P16, L428: Although same N loss process are shared between the schemes, I suppose the original models (TECO-CN/CLM/OCN) actually differ in that point. Readers can get benefit if you can discuss it briefly.

- P17, L443: You discuss here how CN ratio in SM1 scheme affects the N regulation on plant production processes. As you discuss in the section 4.2, SM3 also has the mechanism of flexible CN ratio. How did the flexibility of SM3 act on plant production processes?

- P17, L445 “leading to a high microbial N immobilization”: I cannot understand why high CN ratio in plant tissues bring models to have a high microbial N immobilization. Need further detail.

- P18, L475 “Fig. 6c” is likely to be “Fig. 7c” ?

- P18, L484: What does “structural litter quality” mean?

- P18, L498: Maybe “Fig. 7” is likely to be “Fig. 8”.

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- In the analysis, plant production and C/N status are evaluated in steady state. Although I recognize the usefulness of the analysis using steady states, I believe many readers get interested how your conclusions can be extended to non-steady state simulations, because N limitation on C cycle can be intensified in the condition where CO2 concentration increasing. I will be happy if I can see the discussion on this. In addition, displaying N status in the three simulations will be helpful for readers to get the whole picture of the CN dynamics: mineral N is displayed (in Fig.3), but others (plant, litter, and SOM) are not. Since your analysis is based on steady-state, such information can be a support to understand the relationship between N-fluxes and N-pools. My suggestion is to include it in supplement.

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