

Interactive comment on “Variability of projected terrestrial biosphere responses to elevated levels of atmospheric CO₂ due to uncertainty in biological nitrogen fixation” by J. Meyerholt et al.

Anonymous Referee #2

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This paper is an excellent examination of how predictions of the terrestrial carbon cycle are sensitive to how nitrogen fixation is modeled. Given that each EaSM with the nitrogen cycle has largely modeled nitrogen fixation differently, a study like this one that implements the different approaches within the same model is needed. The implementation within the same model is critical for standardizing all other differences in carbon and nitrogen formulations that exist between EaSMs. Overall, the study is well executed and described. The discussion explores the broader implications of the nitrogen fixation dynamics so that other modeling groups are able to learn from the study.

My big picture suggestions for improvement are: 1) Consider exploring how inter-

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annual variability in NPP was sensitive to how N fixation was implemented. Did one approach show greater variability than another? This could help think about how the N fixation approach interacts with climate. 2) It might be valuable to explore how the N fixation approach influenced the baseline (1860) patterns and magnitude of N limitation. Did one approach lead to a more N limited state? If N limitation is low in the baseline (1860) state of the model for all N fixation approaches, that could partially explain why the NPP and GPP is so similar between approaches (i.e., nitrogen doesn't matter much in the model). Other work with the O-CN has suggested that N limitation is small in the O-CN (Thomas et al. 2013 Global Change Biology)

Minor suggestions for improvement 1) The color scale on figure 3 and 5 (especially the b panels) makes it hard to see key differences that are highlighted in the text. The greens and blues cover a large fraction of the scale but are difficult to differentiate. 2) I may have missed it but the text doesn't seem to define the NDS and NDS acronyms 3) Page 19433, Paragraph at Line 19: more clearly state that a unique spin-up was done for each N fixation implementation. 4) Page 19443, Line 1: In this paragraph (or somewhere else if more appreciate), it would be good to highlight that the O-CN was able to simulate the different N fixation approaches because it includes dynamic labile C and labile N pools. Without these pools the NDS and NDT approaches could not be simulated. Likewise, the dynamics of the labile C and labile N pools (and the foliar C:N) are likely an example of how the results for the NDS and NDT are partially model specific. 5) Figure 4a: What do the horizontal dotted lines signify?

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