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# *Interactive comment on* "Variability of projected terrestrial biosphere responses to elevated levels of atmospheric $CO_2$ due to uncertainty in biological nitrogen fixation" *by* J. Meyerholt et al.

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As the developer of the "NDT" model (from the FUN model) [Fisher et al., 2010; Brzostek et al., 2014; Cai et al., 2016; Shi et al., 2016], a few notes:

- BNF in FUN was constructed *relative* to the costs of the other N uptake pathways. BNF would not occur if the other pathways are cheaper. So, if this is left un-checked in O-CN (this wasn't clear), then you may get BNF occurring when it otherwise should not be.

- As such, the cost of BNF in FUN was specified *high* relative to the other costs, so



you wouldn't actually get it much except under very high N limitation. So, I wouldn't necessarily say that "NDT" has "low N fixation costs". I guess everything is relative.

- As Reviewer 1 insightfully pointed out, NDT should also be constrained by NPP and demand relative to C:N ratios. Even in strong N limitation (e.g., those boreal forests where BNF increased "beyond plausible rates"), if there isn't much NPP, then BNF cannot occur. The NPP used in FUN is after respiratory costs. Perhaps the NPP is too high in O-CN in these regions?

- The eCO2 case would provide more C to pay for BNF in NDT, as you correctly pointed out; but, payment is still limited by available water and C:N ratios. FUN wouldn't just pay for more BNF ad infinitum just because it could.

- Finally, you (and I've heard this from others, so I'm in the minority here) remarked that the sensitivity of NDT to "instantaneous" changes is a bad thing. I still wonder about that. For instance, we find many observations of N fixing plants that have stopped fixing in relative instantaneous time scales because N has become more readily (i.e., cheaper) available from the soil, or N demand/NPP has come down; this can change if conditions change. Again, timing is all relative.

Anyway, really excellent analysis and paper! I enjoyed reading it and hope that the analysis can be used by others to continue this investigation forward.

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