Interactive comment on "Insights into mechanisms governing forest carbon response to nitrogen deposition: a model-data comparison using observed responses to nitrogen addition" by R. Q. Thomas et al.

Anonymous Referee #2

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The manuscript "Insights into mechanisms governing forest carbon response to nitrogen deposition: a model-data comparison using observed response to nitrogen addition" describes the effect of a series of modification of the CLM-CN model structure on the response to N deposition and N fertilization. These modifications included among others the sink strength of microbial vs. plant uptake, the way plant N uptake is regulated and buffered, and pathways/mechanisms of N loss. The modifications veered towards a more closed nitrogen cycle allowing for greater retention of nitrogen. The results may help to better understand disparate responses to short term nitrogen fertil-

ization experiments vs. the long term "chronic" and N deposition changes.

The paper is well written and describes in a hands-on way the characteristics of CLM-CN with respect to formulation that will determine its response to increasing atmospheric CO2 and increasing reactive N deposition. It highlights ideas and "philosophies" across different existing coupled carbon nitrogen models and quantifies the effects of such notions nicely and in a succinct way. As rightly stated by the author, such evaluation – if carefully carried out as here – provide as a valuable insight as model intercomparisons across models. I particularly also like how the basic C-N coupling within CLM-CN and the subsequent model modification were laid out to the reader. This is a very important study, well conceived and executed, and I therefore propose only a few minor modifications:

P1645L1-8: It would likely help if the authors would introduce already here the "European levels" as stated later and in the table, to facilitate a better connection across experimental setup and results. P1647L10: "at a single site" instead of "at single site" P1647L18: "baseline production", I assume NPP? P1647L11-20. How did you arrive at the parameter values such that you have the same baseline production, by manually "zooming" in into the parameter value? P1648 L19+. Although a lot of the table data is repeated here (this is something Editors often don't like to see) the numbers actually help the reader here. P1650 L5: The first sentence of this section is hard to understand. Perhaps rephrasing "The mean retention of N deposition within ecosystem was larger in clm4mod than clm4cn, mirroring the dC_ACI/dN_deposition response" or similar. P1651L2: Sentence starting with "dC_ACI/dN_deposition increased.." is difficult to understand. P1652L17-19: It is important to note that the competition of plants against N losses shifts as you shift the loss parameters around to maintain equal productivity across the model modification. P1653L15: delete either "are" or "had" after "turnover-dependent N losses" P1653L20: As noted by the authors N losses scale to internal N throughput, which in turn scale to internal pool. Setting turnover losses sufficient high thus leads to N limitation (Menge, 2010). Concentration dependent losses on the other

hand (as noted by the authors, too), occur substantially only under N saturation (when NH4,NO3 are elevated). Although "N saturation" can occur periodically within clm4cn (or any other N model) through a very tight coupling between C:N. P1656L18+: There is a sudden appearance of a simulation of N-unlimited productivity. Perhaps it would be helpful to also introduce this set of simulations in the method section.

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