Anonymous Referee #1:

1.1 "This paper develops a new version of MIMICS with nitrogen cycling that is coupled to carbon using the standard theory of element limitation. Like its predecessor, MIMICCN is tested against litter decomposition experiments conducted across a wide range of sites, but this time focusing on C and N interactions. General fits of other pools and ratios are also shown to correspond with data collected from several synthesis studies. This paper is well within the scope of GMD, it describes the model clearly and provides a thorough continental-scale analysis of model predictions. I do not have any major issues with the paper but do have some suggestions that I hope will be useful."

We appreciate the supportive and helpful comments from Referee #1. We agree with the bulk of their suggestions and have made modifications to the text and figures that we think addresses those suggestions.

1.2 "It is interesting that initial litter quality does not control the soil C:N. I just saw a paper that uses the bare fallow experiments to argue the opposite (https://www.nature.com/articles/s41598-019-55058-1), but with a very different model. Just something to think about – and possibly to address in the discussion."

This is an insightful comparison. We added text to the discussion to note that our "result directly contradicts a recent study using a first-order linear model which presumed that litter quality and soil quality at equilibrium were directly proportional (Menichetti et al., 2019). Although many soil biogeochemical models prescribe soil C:N ratios for individual pools, the stoichiometry of SOM in MIMICS-CN is an emergent property of the model." We also note that the current parameterization of MIMICS-CN provides predicts relatively low soil C:N ratios with little variation among sites (Fig. 5, Table 3).

1.3 "L32: I suggest "These models *can be* as good as" instead of they are. You can say the models with microbes are better in the papers cited at the end of the sentence, but not about the untested models in the previous sentence (to which the subject "these models" seems to refer)."

We agree; the text now reads "While these models serve different purposes, some can be as good as or better than models without explicit microbial pools…"

1.4 "L206: MIMICS-CN does "as well as or better than DAYCENT" based on what criteria? From the following sentences, I assume and would make explicit here that you are using RMSE. Because using R2 I would say DAYCENT does a bit better, and using bias they are equivocal but in different ways (I don't think this undermines your development, since this model also provides uniquely testable predictions). I would also give a brief summary of the R2 and bias measures in text since they are in the table."

Thank you for this feedback; the text now reads: "Across a broad range of biomes, MIMICS-CN and DAYCENT both show good agreement with LIDET observations. Across sites MIMICS-CN has similar R^2 and RMSE values but lower bias compared to DAYCENT for mass loss (MIMICS-CN: R^2=0.63, RMSE=16.0, bias=-0.12; DAYCENT: R^2 = 0.67, RMSE=14.4, bias=4.73), and percent N remaining (R^2=0.29, RMSE=0.34, bias=0.03; DAYCENT: R^2=0.30, RMSE=0.40, bias=0.08). Broadly, MIMICS-CN outperformed DAYCENT in the warmest biomes while DAYCENT excelled for colder sites for both C

and N (Table 2), but the differences in model fit to data were slight and would be difficult to attribute to any particular differences in model structure.”

1.5 “L220: I would change “red dots” to red triangles or symbols throughout, since the word dots makes me look for circles.”
Changed; thank you.

1.6 “L273-274: This sentence sounds like you are guessing that microbes are C-limited, but you can know for sure by checking for overflow respiration.”
We clarified the language to reference our specific simulations and model output values for overflow respiration. We did check for overflow respiration, but we agree the sentence was ambiguous. The text now reads “At equilibrium, microbes in our MIMICS-CN simulations primarily obtained N through recycling of SOM pools with favorably low C:N ratios, with the result that modeled microbes were almost always C-limited at equilibrium and rarely exhibited overflow respiration.”

1.7 “L297: I agree that microbial community dynamics can add variability, but there are a lot of other possibilities also, like soil moisture and mineralogy (that which isn't captured by clay, like Fe and Al content).”
We agree and added some new language and relevant citations. The text now reads “Spatial variability in ecosystem processes, like N mineralization rates, may be linked to factors like local-scale microbial community composition, soil moisture, or mineralogy (Graham et al., 2016; Smithwick et al., 2005; Soranno et al., 2019; Doetterl et al., 2015).”

1.8 “L350: I think doing this is a reasonable way to get the right soil C:N given the structure of MIMICS, but I don't think POM/free light explains it all because that fraction is not physically protected. You could also be missing a protection mechanism that bypasses microbial biomass like aggregation of POM.”
We agree, but we think that aggregation is a stabilization mechanism that has proven incredibly difficult to parameterize and model, and that it is beyond the scope of what MIMICS-CN attempts to capture. In the last paragraph we clarify that “Future work could compare model formulations that take different approaches to microbial community and stoichiometric parameters (e.g. flexible microbial parameters like C:N or CUE, additional microbial groups, partitioning microbial metabolism into a greater number of pathways) and refinement of mechanisms that confer SOM persistence.”

1.9 “Figure 1: This figure is a little confusing because DIN is a N-only pool, but the other pools are C and N together. It might look a little unwieldy to show all C and N pools since you have additional pools. You could shade/color the background or the outline of each pool with two colors to represent that it is partly C and partly N. Figure 1 of these papers try some different strategies: https://doi.org/10.5194/gmd-11-2111-2018, https://doi.org/10.1002/2017JG003796, https://doi.org/10.1016/j.soilbio.2009.02.031)”
Thanks for this suggestion; we have revised Figure 1 to illustrate C and N pools in the model.

1.10   "Figure 2 : Can these panels have the same y-axis ?"
Done, changed axes to be more easily compared.