#1."*In this manuscript, Yeung et al. develop a new framework and model for the effect of N addition on soil organic matter cycling, accounting for both enhanced decomposition of N-poor substrates/soils and slower decomposition in N-rich soils and MAOM. The theory is tested using a model experiment, and the results compared to a meta-analysis of experimental responses to N addition. Overall, I think the manuscript will be an excellent contribution to the literature. The model experiment approach is compelling evidence for the hypothesized framework. The writing is very clear and the model is well-explained."*

We thank reviewer #1 for the positive evaluation of our manuscript.

#2. "*Major comment: How can the decomposition retardation framework (equations 3 to 5) can apply to both SOC2 (lignin-containing materials) and protein-rich MAOC? From the equations, it appears the effect is driven by the difference of the C:N of the pool compared to TER, but it seems like the C:N of SOC2 would nearly always be higher than TER. How would this simulate the observed inhibition of lignin-degrading enzymes?*

Furthermore, the framework shown in figure 1 implies that decomposition lignin-rich but N-poor substrates like deadwood increase with N addition."

While it is true that the C:N of SOC2 is higher than MAOC and may experience less "N-excess" (hence less decomposition retardation), we wish to emphasize that not all lignin-containing OM (e.g., SOC2 and deadwood) is the same and experiences the same N effect. For example, the C:N ratio of SOC2 can vary from 12 to 57 in our model (see Supplement 2). In addition, we calculated the "labile C:N" (**eq. (4)**), not just the "C:N of SOC2" itself, to compare to TER and estimate the retardation (and CUE) effect. The labile C:N around SOC2, as well as litter and deadwood can be lower than TER (N-excess, retardation) according to our simulations under N addition (see **Fig. 4bgh**).

Since SOC2 (POC) covers a large C:N range (hence labileCN_{POC}), both a decomposition retardation and a stimulation response are possible (**Fig. 4b**). So, it is not contradictory that, as the reviewer suggested, SOC2 may not experience retardation if its C:N ratio is high, only some SOC2 did. The same goes for deadwood with its very high C:N ratio. Moreover, conceptually, deadwood lying on the forest floor and the organic matter in the H horizon differ in their C:N ratios and are also spatially separated, hence their lignin oxidases may have different responses to N. The multiple findings we highlighted in **lines 501-510** confirm these varying effects.

We understood the complexity of these concepts, and so we will make changes to clarify them (e.g., not all lignin-containing OM experiences the same N effect) in the sections *Introduction*, *Nitrogen-induced decomposer responses*, *Exogenous nitrogen effects on soil organic matter*. We will also modify the caption of **Figure 7** to highlight that the synoptic overview shows just the general response, and individual response may vary.

#3. "*Minor comments:*

Line 159: "parameters" rather than "parameter"

Line 169: Suggest "turns over" instead of "turnovers"

Line 187: suggest adding "see section 2.6", as the meta-analysis approach has not been introduced at this point in the manuscript."

We will make all the suggested edits accordingly.