

***Interactive comment on “Nitrogen fertilization did not affect decay of old lignin and SOC in a <sup>13</sup>C-labeled arable soil over 36 years” by A. Hofmann et al.***

**Anonymous Referee #1**

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Hofman et al. analyze the effects of nitrogen addition on soil organic matter decomposition in a long-term (36 y) field experiment. Taking advantage of differences in the <sup>13</sup>C signatures of old and new SOC, the authors show that N fertilization does not enhance nor retard decomposition of the SOC initially present. N addition did increase the decay of recently produced lignin though.

The experiment that the authors utilize is rare for its longevity. Compound-specific isotopes are an appropriate tool for separating out different components of SOM.

The lack of a general response in SOM decay to N addition is an important finding. As different experiments in different ecosystems are compared, the generality of the

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results will become clear. The results are solid and likely to be an important component of our understanding of the complex dynamics of SOC and soil N.

Specific comments In the meantime, the authors need to develop the context of the research more.

1) The authors focus on N, while also P was added. A short literature review of P addition and SOM dynamics is important so as not to over-interpret the N results. 2) The calculations of lignin production are dubious and not an overall asset to the paper. This could be mentioned in the discussion, but it dilutes out the results section. 3) Not all lignin is of similar chemical recalcitrance. The authors focus mostly on quantity in the discussion, but N fertilization could be decreasing the recalcitrance of lignin the plants are producing. 4) I like the last paragraph contrasting stabilized and non-stabilized SOC. N addition might have no effect on bound C, but affect non-stabilized SOC. Point 3 of the conclusions seems a bit harsh, in this light. For example, there is a lot of excellent work on soil exoenzymes that would provide insight into recalcitrant C dynamics, without measuring lignin.

Introduction P1658 L24 The initial jump here from increased plant production to increased decay of SOM is too terse. A few more sentences joining these two statements would be helpful.

For SOC storage, it would be good to acknowledge that net storage is a balance between production and decay.

P 1659 L10. I would remove the dependency on microflora. Tangential for the paper.

P1660. L1. The introduction could use more development here. Can you describe this a bit more? Maybe give a hypothesis?

Methods. In the site description, can you include mean annual temperature and precipitation?

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