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Interactive comment on "Spatial changes in soil stable isotopic composition in response to carrion decomposition" *by* Sarah W. Keenan et al.

Lukas Kohl (Referee)

lukas.kohl@mun.ca

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General comments

Keenen and co-authors investigated the effect of carrion decomposition on the underlying soil. In particular, they studied the spatial extent to a beaver carrion decomposition hotspot changed soil biogeochemical parameters (mainly C:N and d15N) one year post deposition. They find that elevated d15N values due to N inputs from the decomposing beaver were detected to 60cm lateral and 10cm depth.

The manuscript covers an important and understudied topic of terrestrial ecosystem ecology. The authors used state of the art methods and their results justify their con-

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Discussion paper

clusions. The manuscript reads very nicely and is surely of high interest to the Biogeosciences readership.

Specifc comments

- I think the main weakness of the manuscript is that the authors pooled all control samples (soils collected in some distance from the placed beavers) and analysed only a single composite sample. This means we cannot know the spatial variability of control soil properties, or the uncertainties associated with the measured average.

- The manuscript's use of biogeochemistry is somewhat confusing (e.g. L19-21). In my opinion, changes in soil d15N values may result from either changes in soil N biochemistry, or from changes in the d15N values of N inputs to soils. The manuscript's data largely suggest the latter is the dominant effect observed here. Where actual changes in the soil biogeochemistry are implied (again, e.g. L19-21), it would be better to be more specific and describe the changes in soil biogeochemistry that they think are indicated by changes

- I think that assumptions that are needed for the 13C/15N three-endmember mixing model to calculate input sources for deeper soil layers are likely not met. Such a model assumes that C and N of a given soil sample originate in the same proportions from the same sources, which is not true .

Furthermore, the authors need to clarify what the mixing model acutally estimates (e.g. L223: ".. evaluated the proportional contributions of three distinct sources to the stable isotopic composition in hotspot deep profiles ..") - mixing models do not estimate contributions to the isotopic composition, but to the contribution of distinct sources to a particular pool of matter (soil organic matter, soil nitrogen, etc).

If I understand correctly, I think the authors use this mixing model to distinguish differences in d15N due to depth from differences due to source (soil N vs. beaver N). 13C is used as an additional variable to allow for a third endmember. However, this doesnt't work for several reasons. Most importantly, C and N in the same soil sample can have different sources. As a consequence of this, 13C and 15N do not necessarily show linear co-variance through the soil profile. Furthermore, it is not clear if the 15N signature of N inputs is modified as N migrates down along the soil profile. However, I don't think this mixing model is required to support the authors conclusions and I would remove is.

- Similarly, I find the Δ15N values confusing and I'm not sure what they contribute to the manuscripts story. In my opinion, Fig 5a should be sufficient for report that – unlike in control soils– d15N values decrease with depth at the hotspot, representing the recent 15N-enriched N inputs from the top of the soil profile.

- It would be interesting to see a plot % beaver derived N (as in Fig 4) vs. %N (or C:N) – this would provide additional evidence that the lower C:N ratios at the hotspots have developed due to beaver N inputs.

- Would it be possible to make an estimate of the total amount of beaver-derived N retained in the soils (under a carcass) and relate that to the total amount of initial beaver N? i.e., what fraction of beaver-N is retained in the soil after 1 year?

Technical comments L47-51: this section could be more specific (e.g. use "increase/decrease"| instead of "change") L55: "insects and animals" - aren't insects animals too? L74-75: rather additional N inputsReview Keenan et al, Biogeosciences than enhanced reactions, right? L85: what's the size of the carcass (cm diameter?) - I'm wondering how much of the 60 cm diameter enrichement was located directly under the carcass L210-214: I think the main result is not a less positive slope, but rather that the linear relationship between log(%N) and d15N is lost. This makes a lot of sense as the natural processes that typically for the 15N depth gradient are masked by the recent input of 15N-enriched nitrogen. L222:"distinct isotopic enrichment" - rather distinct N sources. Enrichment is a process, not just the a differences in distinct N pools (see Z. Sharp's comments on isotope terminology https://digitalrepository.unm.edu/unm_oer/1/ chapter 2) L297-299, 304-307: I don't really see much support for these claims for changes in biogeochemistry or discrimination in the data that is not explained by the mixing of two distinct N sources, so I would recommend removing these speculative sections. L316-318: This is a mis-interpretation of the poor linear relationship. The most shallow soil horizons have d15N value of 8.4 permil. If these horizons contain a mixture of soil and beaver N, the beaver N source signature has to be larger than 8.4 (consistent with the endmember value used in the 15N mixing model.)

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