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Interactive comment on "Soil organic matter dynamics under different land-use in grasslands in Inner Mongolia (northern China)" *by* L. Zhao et al.

L. Zhao et al.

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On behalf of my coauthors, I greatly appreciate the anonymous referee #3 for providing valuable suggestions on our manuscript. Generally, after two round revision, there are no much major concerns now. We try our best to address some specific comments below.

Comments Title and topic As highlighted by a previous reviewer, this paper looks more at the quantity and composition of SOM at different sites rather than dynamics. No detail is provided about change over time or space, for example the quantity and composition of SOM, before/after restoration or how biomass inputs vary.

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Interactive Discussion

Discussion Paper

Response: in the manuscript, we already stated that all grasslands are developed under similar climatic and environmental conditions, such as the same pristine dominant grass species and same soil type, but are subject to different land use and management. Therefore, we chose one site which were undertaken the least anthropogenic disturbance (native grassland; or NG) as our reference site, whereas soil organic matter in other three grasslands are compared to this NG. We admit more studies are needed to better understand soil organic matter dynamic at different timescales. Such works are currently conducted in our group.

Abstract Comment 1: Page 1, line 10- Should this say 'a' rather 'the' total of sixteen soils?

Response: we changed "the" into "a" in the revised manuscript.

Comment 2: Page 1, line 14 (and throughout results and discussion) - _ 13C values are claimed to reflect level of degradation and water use efficiency. However, differences do not seem that great between sites and referring to Table 1, only GG is significantly different. Therefore, especially with the lack of detailed vegetation data, can this claim be justified? Could these values also reflect species differences such as different grasses or legacy species?

Response: As we mentioned in the introduction, all grasslands have the same dominant grass species, although restored grassland had been cultivated for potato for ten years. So at least for NG, GG and DG, there is no effect of vegetation species on d13C. Given this fact, the difference of d13C among grasslands are mainly attributed to different degradation stages and water use efficiencies.

Introduction Generally a good introduction, outlining the significance of Mongolian grasslands and rationale for study. Page 2, line 34- remove s in "changes".

Response: we accepted this comment and already removed "s" in "changes".

Materials and Methods 2.1. Study area and sampling Much of the focus of this paper

is on the use of biomarkers and these are known to vary between species. Therefore more details of the specific grass species present needs to be included. Descriptions of cover quality are very qualitative i.e. page 3 line 89- "vegetation in GG is best developed" was any quantitative analysis of vegetation undertaken? I.e. species present or percentage cover.

Response: We admit the quantitative data on grass species and biomass are important for estimating soil organic matter source and dynamic. So far, our collaborators have already conducted some preliminary studies, but the related data have not been published. In the revised manuscript, we cite some data in the section of study area and sampling. We added the sentences as "Among four sampling sites, the dominant vegetation species are Leymus secalinus and Agropyron mongolicum var. villosum. However, in the RG, weed annuals such as Chenopodium acuminatum and Sonchus arvensis are also present besides L. secalinus and A. mongolicum var. villosum in the RG. Vegetation cover varied from 38% to 84% in an increasing order of DG, NG, RG and GG."

2.2. – 2.5. Sections covering analysis A major weakness of this study seems to be that, whilst much discussion of biomarker source is made in the results section, no analysis of vegetation species present appears to have been undertaken. Was any biogeochemical analysis of vegetation undertaken? This would seem particularly useful at the restored site, to look at whether soil organic matter is derived from new grass or legacy crops. If not, I still feel it would be valuable to increase the details regarding vegetation species present and if possible make greater reference to any previous studies that have carried out biogeochemical analysis on these species.

Response: This is a very good suggestion. We have collected different vegetation species from these grasslands in this summer, and will analyze their biomarkers soon. We added vegetation species information in the section of "Study area and sampling" (see above). In addition, we also emphasize this point in the conclusion part as "A future study will be the quantification of biomass inputs from different vegetation to

better understand soil organic matter dynamic under the different land uses in the Inner Mongolia."

Results 3.1. Page 6, line 181- insert 'the' so reads 'by the same factors'. Additionally, suggestion that it is due to source or degradation stage is not backed up, so perhaps best to remove or address in the discussion. ResponseïijŽWe insert "the" in the line 181.

3.2.-3.4. Again, main criticism is that the weakness of the arguments made is the lack of vegetation species analysis.

Response: This is the same comment as 2.2. Please see our response 2.2.

Discussion The discussion is well structured, logically split to examine changes in bulk SOM between land uses and change in molecular compositions between land uses. Nothing major to add following response to previous reviewer comments.

Conclusion Page 11, line 356- 'investigate' rather than 'investigation for' C4135

Response: we made correction according to reviewer's comment.

Page 11, line 356- Would recommend removing or rewording the final sentence, as slightly confusing and detracting from your research. Isn't research to "understand the response of different soil organic matter to land-use changes" what this paper aims to do? Instead it may be more relevant to highlight other areas of research needed to address limitations in this study such as the quantification of biomass inputs under the different land uses studied.

Response: We accept this suggestion. In the revised manuscript, we rewrote the last sentence as "A future study will be the quantification of biomass inputs from different vegetation to better understand soil organic matter dynamic under the different land uses in the Inner Mongolia."

Tables and figures All tables- recommend add sample number (N) either to table or

table caption. Response: we already added such information in the table caption in the revised manuscript.

Table 1- the header row could be made tidier. Response: we made change in the revised manuscript.

Figure 1- Useful, but caption states 'Pictures from Inner Mongolia grasslands'. Are these photos from the study sites or just examples of different cover types?

Response: those pictures were taken at the study sites. So in order to clarify this point, we changed the caption as "Pictures taking from the study sites, DG: degraded grassland by overgrazing; NG: native grassland without apparent anthropogenic disturbance; GG: groundwater-sustaining grassland; RG: restored grassland from potato cropland."

Figure 3-for bottom set of graphs, separate or make bolder the site abbreviations (DG, NG, GG, RG) to clarify that they apply to all graphs. Using different letters (a,b,c,d) to denote significant difference makes sense and are generally well used for the tables. However, slightly unintuitive as to how they are being used for figure 3 graphs. Would be clearer if always used sequentially for each graph (i.e. 'a' always used first) and for reader clarity could you clarify how double letters i.e. 'ab' are used?

Response: In the revised manuscript, we made bolder the site abbreviations. The reviewer is correct that Letters (a,b,c,d) were often used to describe the significant differences between experiment data, and "a" was generally used to represent the highest value. The double letters such as "ab" means no significant difference between "a" and "ab" and at the same time no significant difference between "b" and "ab", which was added in the revised manuscript. For figure 3, we did not start with letter "a" because we organized the sampling site in an order of DG, NG, RG, and GG, as same as that in tables.

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