

Author comment on Anonymous Referee #1

The above-mentioned article focuses on a topic that has received little attention to date, namely the influence of intensive grazing by mobile livestock farming (1), the effects on vegetation (2) and on the soil (3) as well as the resulting changes in permafrost (4). This is demonstrated in two local examples using series of measurements over a period of 14 months in two different exposures.

We thank the referee for the positive feedback on our study and for taking the time to review our manuscript. We share the view that this topic has been currently understudied and feel that our study can provide relevant and novel insight and data. In this response, we have gone through the comments and suggestions made by the referee, which are shown in *blue italics*. Our response is given in normal font whereas our suggestions for the revised manuscript are provided in **bold text**.

However, the title of the article is misleading in that the reader would expect generally valid statements for the whole of Mongolia. I would therefore strongly recommend adapting the title accordingly and also pointing out the limited duration of the measurements.

We agree with the referee that the current title does not accurately reflect the spatial extent of our study. For the revised manuscript, we will adapt the title to “**Impact of livestock activity on near-surface ground temperatures in Central Mongolian grasslands**”. Furthermore, we feel that the duration of our measurements is adequately stated in sentence 2 of the Abstract (line 13), as well as in our description of the study area (line 57). Indeed, a measurement period of 14 months can impact the validity of the findings especially if environmental conditions (such as precipitation) vary significantly from year to year. For this reason, we have included a discussion on this potential limitation (lines 440-444). In the revised manuscript, we will expand on this discussion by providing concrete examples of how our findings align with other studies covering multiple years by adding the following in line 441: **However, multi-year studies in grassland ecosystems show similar seasonal differences in GST as found in this study (Yan et al., 2018; Zhao et al., 2011). For example, Yan et al. (2018) observed summertime soil temperatures in heavily grazed plots on average 2,6°C warmer than at ungrazed plots across years with highly variable precipitation conditions. Furthermore, Zhang et al (2011) analysed 5 years of data from Inner Mongolia and found that denser vegetation cover at ungrazed sites provides insulation, resulting in colder summertime and warmer wintertime soil temperatures.**

Does the paper address relevant scientific questions within the scope of BG? YES

Does the paper present novel concepts, ideas, tools, or data? NO

We agree with the referee that several of the aspects our study build on previously established methods and ideas, and take the opportunity to clarify the novelty of our work. While the impact of grazing on ground surface temperatures has been previously studied, most studies use an experimental design where known animal loads are applied within enclosures (Wang et al., 2023; Yan et al., 2018, 2019; Zhao et al., 2011). Our study, on the other hand, investigates how traditional managed livestock affect ground surface temperatures, which includes how herders and animals seek to optimize the feeding conditions within the rangeland. Another novel aspect of our study is the role exposure has in determining surface cover and subsequently the local ground surface

temperature regime. In the revised manuscript we will clarify this study's original contribution by including the following:

Line 49: **In this study, we investigate how differences in livestock activity due to local fencing and semi-nomadic pastoralism affect vegetation, snow cover and associated GSTs, and how these manifests at sites with opposing topographic aspect. To achieve this we measured GSTs at multiple plots at two sites with different exposure and surveyed snow and vegetation cover in winter and summer.**

Line 314: **We find that in this landscape dominated by traditional pastoralism, the exclusion of grazing livestock allows for the establishment of higher and denser vegetation cover (Table 3 & 4), which leads to a dampened seasonal cycle in GST (Figure 11 & Figure 13). Furthermore, we find that topographic exposure shapes the local GST regime, with the largest differences in GST found at the south-facing Terelj site. Here, the grazed open plot is significantly warmer than the ungrazed fenced plot from April to September, while it is significantly colder in winter (Figure 12).**

Are substantial conclusions reached? NO

We thank the referee for this remark. In the revised manuscript, we will adjust the abstract and conclusion sections as to highlight the original conclusions enabled by this study.

Line 17: **We also find that the effect of grazing intensity depends on topographic aspect, with smaller seasonal differences of +1.4°C and -2.5°C found between grazed and ungrazed plots at a north-facing site. This relates to the lower available solar radiation at north-facing sites, which reduces the differences in vegetation cover between open and fenced plots.**

Line 534: **The difference in GSTs between grazed and ungrazed plots is strongly affected by topographic aspect, with the greatest difference found at the south-facing site. We link this directly, and indirectly through vegetation cover, to excess solar radiation at this site compared to the north-facing site.**

Are the scientific methods and assumptions valid and clearly outlined? YES

Are the results sufficient to support the interpretations and conclusions? YES

Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES

Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES

Does the title clearly reflect the contents of the paper? NO

We agree with the referee that the title needs revision and have suggested an adapted title in response to the referees comment above.

Does the abstract provide a concise and complete summary? YES

Is the overall presentation well structured and clear? YES

Is the language fluent and precise? YES

Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES

Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Partly, see my comment

We have suggested amendments to the manuscript title to improve clarity.

Are the number and quality of references appropriate? YES

Is the amount and quality of supplementary material appropriate? YES

References

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