Referee #2

This paper analyzes the influence of past and present climate on the contemporary biodiversity pattern of grassland on the Mongolian Plateau. They compare the influence of modern climate (MAT, MAP, Aridity Index) with that of mid-Holocene and Last Glacial Maximum (LGM) climate on contemporary biodiversity. For this purpose, the authors sampled 152 sites on the Mongolian Plateau during field surveys between 2014 and 2018 and determined three categories of biodiversity, i.e., taxonomic, phylogenetic, and functional biodiversity. Furthermore, they simulated the climatic conditions during the mid-Holocene and the LGM. Finally, they used Random Forest and Structural Equation models, They found that both paleoclimate changes and modern climate governed contemporary biodiversity patterns, while community biomass was mainly affected by the modern aridity index.

The paper is well written. The methods for determining the three different biodiversity categories and for analyzing the relationship between past and present climate on the one hand, and biodiversity patterns on the other, appear to be scientifically sound. Overall, the paper adds knowledge to the previously published results of the same group of authors on the effect of humidity on the relationship between species richness and biomass. Therefore, it could be considered for publication in Biogeosciences. However, there are some specific questions and issues that need to be addressed before the paper becomes acceptable for publication. Those points are specified below.

Specific comments:

L147: How did you define “limited human interference”?

Answer: Grazing is the main land use mode in Mongolian plateau steppe. “Limited human interference” mainly refers to the selection of areas with less human activities such as grazing for investigation. The species composition, community structure and habitat were consistent within the community. There are fewer degenerate indicators.

L148: Which criteria were used to decide whether one or three 10 m x 10 m quadrats were set?

Answer: According to the methods and protocols for plant community inventory

proposed by Fang et al. (Fang et al., 2009), most vegetation survey in this study was conducted by setting one 10 m x 10 m quadrat at the site. However, in a few areas with sparse vegetation and large heterogeneity, we set three 10 m × 10 m quadrats to ensure the accuracy of the survey data.

L150: Why only three quadrats at a few sites?

Answer: I'm sorry we didn't describe it clearly. Five 1 m × 1 m plots were set up in each corner and center of the quadrat to investigate vegetation, and the species name, height, density and coverage of the 5 plots were recorded. Three 1 m × 1 m plots along the diagonal line were selected from the five plots to measure the standing biomass of each species. Both biomass and biodiversity calculations were based on three plots.

L168: Which reference period did you choose for "present-day" climate? 1961-1990? 1981-2010? Or else? Please specify here.

Answer: Current climate data refer to temperature and precipitation averages from 1979 to 2013, which have been supplemented in the manuscript (L 158-159).

L169: With simple calculation of temperature or precipitation differences, you get a simple measure of climate change from past to present, but not of climate variability in the period between. This should be made clear here, otherwise the term climate variability is misleading here.

Answer: Thank you very much for your comments. I revised it to change "climate variability" to "climate change".

L180: Do you really mean median, or mean? In the following sentence you have calculated the mean value of the range (L 183).

Answer: I was not making it clear here. This is the mean value of the range. I have modified this.

L286-293: Please specify contribution of AI, MAT, MAP for each of the four periods because it could be MAT, MAP, AI, or a combination of those.

Answer: Based on the results of the Random Forest model, we identified the climate variables that significantly affected biodiversity and divided them into composite variables. In Fig. 4, both present climate and paleoclimate change are complex variables. Principal component analyses (PCAs) were used for complex variables with multiple predictors. Modern climate is the compound variable of AI and MAT, and the

first principal component explains 70.30% of the total variable (Table S2). Paleoclimate change is the compound variable of $AMAT_{mid}$, $AMAT_{lgm}$ and $AMAP_{lgm}$, and the first principal component explains 64.67 of the total variable (Table S2). Fig. 5 shows the full model of the impacts of major climate factors (AI, MAT, $AMAT_{mid}$, $AMAT_{lgm}$ and $AMAP_{lgm}$) on biodiversity and biomass, with no significant effects of $AMAP_{lgm}$ on biodiversity and productivity (L301-307). So the detailed contribution of each climate factor was not described here (L284-291).

L297-298: Please decide: MAT anomaly or MAT & MAP anomaly.

Answer: Sorry, this is the MAT anomaly from the Middle Holocene to the present, the MAT and MAP anomaly from the Last Glacial Maximum to the present.

L344: Please cite some key papers.

Answer: I have added references here (L 345).

L345: Give a reason why further studies are needed. Should ideally become clear already in the Introduction.

Answer: I have revised this sentence (L 346).

L355: "and especially climate change": It is not clear how you assessed or quantified past climate change in the respective region. You had simulated mid-Holocene and LGM climate, but as far as I have understood, no information on the periods in between, i.e., no information on how climate changed in the meantime, was available.

Answer: I'm sorry that I didn't make it clear. The climate change here mainly refers to the climate anomaly, that is, the change in MAT between LGM and MID and the present.

L355: "Paleoclimate changes filtered": Same here: how did you assess past climate change? By simple linear interpolation between LGM and mid-Holocene and present-day climate? Please explain.

Answer: This still refers to climate anomaly, which I have modified (L 356).

L368: Do you mean MAP and temperature here? Otherwise MAT and temperature are repetitive.

Answer: According to Fig. 5, PD was negatively correlated with the present climate (MAT) and temperature anomalies in the Mid-Holocene ($AMAT_{mid}$). I have modified this to prevent ambiguity (L 368).

L372-374: This sentence does not really explain the differences between your results for Mongolian grasslands and the literature reports on global forests. Please elaborate.
Answer: We added in the discussion section.

L375-376: If functional richness was negatively related to LGM climate anomaly, it means that functional richness was decreased more strongly with greater climate anomaly, but then it can't be due to the tolerance of plant traits to past climatic conditions, but due to their intolerance.
Answer: Thank you very much for your suggestion. I quite agree with you and have revised it.

L379: This sentence backs up my statement that there was very likely a reduction of functional diversity in the past.
L412: Your previous research (Li et al., 2020), where you described the influence of humidity on the relationship between SR and biomass, should also be mentioned in the introduction
Answer: I supplement my previous research in the introduction.

Fig. S1: It would be good to also show the MAT of the current climate, as well as the Aridity Index of mid-Holocene and LGM climate for the sake of consistency.
Answer: Thank you for your advice. I added MAT of the current climate in the Fig. S1, while the aridity Index of MID and LGM was not added because it was not used in the manuscript.

Technical corrections: see annotated manuscript.
Answer: I have revised the whole manuscript according to the annotation.

References

Fang, J.-y., Wang, X.-p., Shen, Z.-h., Tang, Z.-y., He, J.-s., Yu, D., Jiang, Y., Wang, Z.-h., Zheng, C.-y., Zhu, J.-l., and Guo, Z.-d.: Methods and protocols for plant community inventory, Biodiversity Science, 17, 533-548, 10.3724/sp.J.1003.2009.09253, 2009.