Climate of the Past Discussions

Clim. Past Discuss., referee comment RC1
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# Comment on cp-2021-5

Anonymous Referee #1

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Referee comment on "Monitoring landcover change and desertification processes in northern China and Mongolia using historical written sources and modern vegetation indices" by Michael Kempf, Clim. Past Discuss., https://doi.org/10.5194/cp-2021-5-RC1, 2021

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## General Comments

Kempf uses current climate data, satellite NDVI, paleoenvironmental proxies and historical written sources to compare and evaluate the landcover change and land degradation in the Mongolian Plateau. The major source of data for evaluating the land degradation is the NDVI values for current time period, although it is unclear what indices where used to evaluate the land degradation for the historical time period. I commend the author for putting so much effort in deriving meaningful information from historical written records. Main findings of the study were that vegetation change was not related to any climate variables and therefore the authors attributed grassland degradation to increasing livestock density in the region. The manuscript is generally well written (although there were few places where I found too long sentences) and within the scope of the Climate of the Past journal. However, there are several methodological issues, clear hypothesis, linkage between historical data and current land surface conditions and the overall findings of the study. Therefore, substantial revision is necessary prior to improve the manuscript.

- The author uses four different data sources (historical written sources, paleoenvironmental data, remote sensing products and current gridded climate data) to find the relationship between the climate data and vegetation indices. It is unclear how the connection between past environmental changes and current land degradation rates, desertification and grassland productivity is made in the study. While I commend the authors approach and time in analyzing the historical records based on Gerbillon in year 1688, there is no connection made between 1688 and current land degradation rates. The only connection the author made was the linkage between climate data and NDVI for current conditions. I was left wondering whether there is a need to examine

the year 1688 (with all the work put forward), which does not add any information to the relationship between climate and NDVI for current conditions.

- The authors conclusion that if there is no environmental and land degradation relationship, current land degradation rates is likely due to intensive livestock grazing needs to be reconsidered. In this study, the authors did not show any relationship between NDVI and livestock grazing, although such data are available at province level from FAO and other sources. While I agree that livestock grazing is likely the cause of current land degradation, there is still a debate on the contribution of land degradation from climate and livestock grazing. It is hard for me to believe that the author used precipitation totals and maximum temperature data to point out no changes in precipitation and an increase in tmax. The reason is NDVI values does not really work in desert areas or areas that is heavily degraded. Yet, the author tried to establish a relationship between NDVI and climate.
- Another issue with the paper is the lack of clear understanding of the contributing factors to desertification or land transformation in Mongolia and Inner Mongolia. The political system of Inner Mongolia and Mongolia have diverged greatly since the collapse of Soviet Union. As a result, land cover change is taking place more rapidly in Inner Mongolia than in Mongolia. Shifts in policy between inner Mongolia and Mongolia had led to differences in grassland response to climate change and grazing pressure (Chen et al. 2015). I think this should be highlighted in this study and assuming that the Inner Mongolia and Mongolia had similar response to grazing pressure and environmental changes would be questionable given that land response has been increasingly linked to political and policy changes in the region.
- It is also unclear how the desertification process or the land degradation rates are estimated in this study. To my understanding, the author is using NDVI values with low NDVI denoting land degradation/desertification. I have serious concern about using NDVI as an indicator of degradation particularly in arid and semi-arid grasslands. I at least want the author to show or cite some previous work that the NDVI can actually detect grassland or ecosystem degradation in arid and semi-arid regions.
- The relationship between precipitation variability, tmax increase and river runoff is unclear. The author need to justify how increase in tmax and a decline in vegetation cover had no effect on river runoff in the region.

Other minor comments

- Figures: There are 10 figures and a lot of these figures are irrelevant in the main manuscript. For example, Figure 2 is unnecessary since the readers can visually get no information beside the fact that there is no overall change in precipitation between Mongolia and Inner Mongolia. The same applies to other figures.
- Texts: Some of the text are too long and probably need to be splitted into multiple lines. For example lines 28-30 have too many information, which can easily be divided into multiple lines. I also suggest the author to shorten the text just focusing on what the scope of this paper.
- Lines 19-20: I thought precipitation did not change while there was an expansion of bare lands in modern Mongolia. This lines seems contradictory to the findings.
- Lines 21-22: Can you also add a line on why there was no relationship between Ptotal, tmax and NDVI values? Is it because of the previous year precipitation totals that the

current year NDVI is higher? You can easily show this in scatter plot as well. I think climate is still a dominant factor that should define NDVI values given that there are little management activities in the region and given that they practice nomadic pastoralism.

- Line 42: I am wondering what makes an author really great. Can we just say "emphasized by other studies".
- Line 52: overprint or "footprint"
- Lines 96-98: I thought potential land cover maps should have been used here not the current aps.
- Lines 138-139: what does this line even mean? Are you implying that the NDVI values in this small section are similar to regional NDVI trend based on MODIS?
- Lines 157-159: I am lost here. How does elevation determine semi-arid conditions? Aridity is a function of precipitation and potential evapotranspiration.

Chen et al. Policy Shift influence the functional changes of the CNH systems in the Mongolian Plateau. Env Res. Letters 10 085003