

## ***Interactive comment on “Field-based observations of regional-scale, temporal variation in net primary production in Tibetan alpine grasslands” by Y. Shi et al.***

### **Anonymous Referee #1**

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This paper is generally well-written, clear in purpose (although objectives must be specifically stated), and compelling in its own way. I particularly like the treatment of interactive effects of grassland species diversity effects on an important (e.g., for terrestrial C sequestration/fluxes) ecosystem “service”: NPP (or ANPP). The experimental design seems powerful, appears to be well designed, and the analysis thorough.

I do, though, have some concerns/questions whose answers may serve to strengthen the paper, if these can be adequately addressed.

1. I wondered about whether the authors may have considered analyzing their data sets with the aim of detecting potential interannual, or even longer, lagged effects (e.g.,

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Reichstein et al. 2013 Nature for broader discussion). I think the authors should evaluate quantitatively the possibility of delayed or prolonged ANPP responses to a particularly warm, cold, dry, or wet year (or years). A study-duration of four years may make this difficult (but perhaps not if an “extreme” year occurred in the first or second year of the observation period). Use of “calibrated” satellite imagery and data from the 49 existing weather stations in the Tibetan Plateau might enable such an analysis. 2. Also, the means by which study sites were selected must be clarified in more detail, especially with respect to grazing history and intensity. 3. The novelty of the study really is the examination of possible plant community species richness effects in combination with climate variability. I don’t believe that there is enough power in the data set to extrapolate to talking about vulnerability to anthropogenic climate change.

Specific comments:

Abstract:

4. Lines 31 (Abstract): Delete “the” and insert “ANPP in” before “Tibetan”. Since you originally hypothesized that temperature would be the primary factor modulating NPP in these alpine grasslands, you could insert the word “surprising” or “surprisingly” somewhere in this sentence to indicate this unexpected result from your study.

5. Line 32: Consider rewording to explain in this result in a direct way. For example: “Finally, we found a reduction in year-to-year variation (i.e., CV) in ANPP with increasing species richness of plant communities suggesting that diversity can . . .”. It is very important to specify what type of variation you are talking about (i.e., interannual).

Introduction:

6. Lines 60-62: Are there really no earlier references that have quantitatively show that grasslands cover 25% of Earth’s land surface area??? At least insert an “e.g.” before the list of references included in the parentheses.

7. Lines 70-71: To make sentence accurate, please modify to read something like: “. . .

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because temperature should be the primary environmental factor constraining vegetation growth ...”.

8. Line 78: After “. . . anthropogenic activities” please insert “, such as . . .” and list the activities you are referring to. Certainly, rising atmospheric CO<sub>2</sub> is impinging on these grasslands, as well!

9. Line 83 to end of paragraph: The authors must state these as objectives! Otherwise, there is no way to know whether the study meets any concrete objectives (e.g., “Thus the objectives of this study were to quantify: (1) . . ., (2), and (3) ...”).

Methods:

10. Lines 96-99: The site selection process needs to be described in more detail. Were these sites selected to accurately represent the alpine grasslands of the Tibetan plateau? Line 97 states that sites were minimally grazed. Line 98 states that “non-grazed” sites were also included and even sites that were inside fenced areas. I understand the practical reason for choosing sites that were either ungrazed (do you mean by domesticated animals?; please specify) or where grazers (both domesticated and wild animals?) were excluded. However, grasslands are notorious for almost always having grazers present during snow-free periods (and even during periods with snow cover). So, it seems that arguments for studying grassland ANPP responses under atypical conditions should be strengthened. Could grazing level be used as a covariate in the analysis?—maybe not even separating into wild vs. domesticated grazing—just “grazing”.

11. Lines 124-127: I’m wondering about the appropriateness of using a presumably coarse spatial scale (cokriging) modeling of climate data that is so critical to the outcome of the study. Does the cokriging procedure include slope and aspect? Why weren’t air T/RH dataloggers, or gauges, used to measure actual climatic conditions at each 10 x 10 m site? It has been long known that microclimatic conditions on spatial scales used in this study can play as large a role as general larger-scale

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whether/climatic conditions (e.g., Larcher 2003 book; Körner 2003 book). Was slope aspect considered in the estimation of microsite climate? Can any modeled climate vs. measured climate comparisons be pointed to in order to convince the reader that climatic conditions at each of the 40 sites were reliable? If some data are available that would demonstrate reliability, they should be shown as a figure either in the paper or in the supplementary section (e.g., regression scatter plot; better in the paper itself).

12. I did not see a reference to Figure 1 in the text.

Results:

13. Lines 170-172 belong in the Methods section.

14. Line 170: I am uncertain about the meaning of the first part of this sentence (“To detect temporal changes in the spatial pattern . . .”). I did not see an objective that sought to quantify this, or anything about spatial pattern. Do you mean, “To detect temporal changes in ANPP [temporal, or year-to-year variation in ANPP] across all 39 sites, . . .”? Please clarify to make sentence unambiguous.

15. Line 176 is also unclear in the same way “. . . spatial sequence . . .”.

16. Line 177: Do you mean “. . . corresponding changes in ANPP”? In other words, did ANPP change in correspondence with changes in climate?

17. Lines 186-187: It would be much easier to actually “see” this result if Figure 4 were converted into two-dimensional graphs—rather than 3D. It is very difficult to determine where points and best-fit lines lie in the three dimensions. A two-way scatter of (a) CV-ANPP on CV-AT (b) CV-ANPP on CV-AP, (c) CV-ANPP on CV-GST, and (d) CV-ANPP on CV-GSP .

18. Line 190: To be consistent and unambiguous, please replace “temperature” with “AT” and “aboveground NPP” with “ANPP”.

19. Line 193: In line 191, you state that you entered rainfall factors first into GLMs, but

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in this line it looks like CV-AT was entered first. I am confused. 20. Line 201: Replace “temporal” with “interannual”.

Discussion:

21. Repetition of results in the Discussion should be minimized. For example, lines 207-208 and 214 in the Discussion are nearly identical and repeat line 163 in the Results. Other occasions follow.

22. I also do not think the subheadings are needed in the Discussion – at least not in such grandiose style. The data are worth publishing without grandstanding; especially since there is an entire subsection dedicated to “limitations” (which I think need to be incorporated in the main part of the discussion where needed).

23. Line 212: I am not completely comfortable with the use of the term “vulnerable” or “vulnerability”. It seems that you can/should talk mainly about ANPP responses to year-to-year climate variability – focusing on precipitation and specifying precipitation as the dominant controlling climate variable rather than continuing to talk in general terms about “climate”, when your data indicate that annual temperature had little explanatory power. And extrapolation to “ecosystems” seems a bit of a stretch. There is no harm in using the term “productivity” in the heading (even if this is already an extrapolation since the present study did not include BNPP). Vulnerability also implies loss of species from an ecosystem or community, and your study did not look at this.

24. Line 230: Same comment as in 21.

25. Line 244: Please replace “NPP” with “ANPP”.

26. Line 245. Lines 266-270: This header in the text reminds me once again that it would be good to show a simple time-course figure in the paper covering the 4 years of your study, with three lines: mean $\pm$ SE of ANPP (n=39); (b) mean $\pm$ SE of AT; and (c) mean $\pm$ SE of AP. On this graph, you could also show some measure of monsoon intensity for each year of your study.

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27. Lines 266-270: If AT and AP moved synchronously, wouldn't this suggest that AT could be playing as much a role as AP?

28. Line 271+: This is not stated as an objective of the study, so it seems strange to see this discussed here (see comments on this above). Please state as an objective. It is also implied by the separation of results into alpine steppe and alpine meadow (which seem puzzling without a “need” to know this).

29. Lines 340-356: I would eliminate this section and build these ideas into the previous parts of the Discussion. Another option is to state the findings in more of a moderate way using words like “suggest” or “may indicate” rather than definitive wording.

30. Lines 352-356: Delete! This does not belong in a paper.

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Interactive comment on Biogeosciences Discuss., 10, 16843, 2013.

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