Dear the Editor of Biogeosciences,

We appreciate the valuable comments on our manuscript. We have attempted to address all the concerns of the reviewer and editor and list our responses in the reply below. In our reply, we have repeated each comment, followed by our response. All referenced changes have been implemented in the revised manuscript.

Sincerely yours,

Yongguang Zhang

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Referee Comment, Anonymous referee COMMENT:

COMMENTS: Using the integral of EVI (iEVI) as a surrogate of NPP, the authors explore the NPP response to inter-annual variations of maximum temperature (Tmax) finding a contrast response of forest and grassland sites to Tmax. The methodology is valid and the results contribute to our ongoing understanding to the asymmetric ecosystem responses to climate variations.

Response: Thank you for your positive comments.

COMMENTS: My primary concern on the methodology is that the iEVI approach is not as accurate as the authors claimed. For example, if you only look at the temporal correlation between iEVI and NPP, rather than the spatio-temporal correlation, will you still get high R2 like 0.90? The possibly lower R2 does not suggest the approach is invalid but suggest that the uncertainties in this approach are larger than the authors indicated. This should be clearly stated in order not to mislead readers.

Response: This is a good comment. We agree that the temporal correlation between iEVI and ANPP (interannual site-level variability) is not as strong as the spatio-temporal correlation. However, as shown in the Fig.1below with field measurements from two sites in Table 1 (Central Plain and Jornada), the temporal relationships are still very strong (around R^2 =0.70, P<0.01) at the site scale and hence iEVI can pick up temporal variation of ANPP. On the other hand, it should be pointed out that we did not use this relationship to estimate ANPP for our sites from iEVI. Here, we presented this relationship to just demonstrate that iEVI could give a good estimate of the production like many other studies did. We argued that ' iEVI can be used to accurately quantify the dynamics of ANPP with confident and provide consistent sensitivity across biomes ranging from arid grassland to forest'. We redraw the Figure 1 in P22.

We added such explanations in P7, Line 124-135 as' It should be noted that Eq. 1 is a spatiotemporal relationship between ANPPG and iEVI across biomes. At the site scale, the temporal relationship between ANPPG and iEVI is not as strong as Eq.1, but the site-specific comparison with ANPP from the ground measurements from two sites in Table 1 (CP and JN) showed generally good agreement during 2000-2009 periods (Fig.1 inset, around R2=0.70, P<0.01) and hence iEVI could show the inter-annual variability of vegetation growth. On the other hand, the spatial correlation is also significantly positive between ANPPG and the corresponding iEVI as shown in Fig. 1 (inset) for the year of 2001 across biomes (R2=0.88, P<0.001).'



Figure 1. The relationship between annual ANPP_G (ground measurements) and the corresponding iEVI derived from MODIS data during 2000-2009 period for CP and JE selected sites (R^2 =0.63 and 0.74, RMSE=27.47 and 36.89, respectively, P<0.01).

Minor comments:

COMMENTS: Since the results were fully based on the 12 sites, it is still of fairly good risk that the phenomenon found may not represent the general behavior of forests and grasslands. It may help should the authors acknowledge such risks in the conclusion.

Response: We agree with this comment. We mentioned such risk in the discussions about this limitation and point out the more future work to test our results in P12, Line 238-243 as' It should be noted that, however, due to data limitations, only 12 sites were used in this study. We need more data from all ecosystems to test whether the contrasting effect of temperature extremes is a general behavior on forest and grassland ecosystem. The ongoing field measurements of carbon flux and meteorological data from eddy covariance flux method for different ecosystem may provide an opportunity to validate the assumption in this study.'

COMMENTS: The section 3.2 mixed the discussions of spatial and temporal correlations, which is a bit difficult to follow. I think it will be good if they could be separated in two paragraphs.

Response: We have made this change in P9, Line 177-178.

COMMENTS: Page 6003 "Fig. 1" should be "Fig. 2"

Response: Corrected in P8, Line 155-156.

COMMENTS: Errorbars in Fig. 5 seems missing

Response: We have added the error bars in Fig. 5.

Editor's comment:

COMMENTS: The manuscript appears to be a reasonable approach to evaluating the effect of heat waves on net primary production as estimated from satellite remote sensing. It will be of interest to the BG readership, but requires major revisions before it is suitable for final publication.

Response: We appreciate the positive feedback and the suggested considerations. We have adequately addressed the comments by the reviewer and editor as shown in the response and the revised manuscript.

COMMENTS: Unfortunately, there are numerous grammatical errors that should be corrected to make the text more readable.

Response: We have made the grammatical corrections through the manuscript.

COMMENTS: All the concerns of the reviewer should be addressed, especially a more careful evaluation and explanation of the differences between the spatial and temporal trends, prior to resubmission. The generalizations of the specific results from this study should be applied to other ecosystems more cautiously.

Response: We have addressed the concerns of the reviewer. We have made a new plot of Figure 1 and provided a more explanation of the differences between the spatial and temporal trends as shown in the above response to the reviewer and the comment below. Meanwhile, we mentioned the limitations of the study in the discussion in P12, Line 238-243.

COMMENTS: Additionally, please provide more details on the data that were used in Equation 1. How many data points were used (sites and years)? (Please provide the number that was used for the statistics). How would Eq 1 change if site or year was held constant?

Response: As shown in Table 2, we totally used 53 site-years data from 9 sites for Eq.1. As shown in the plot response to the reviewer above, the temporal relationships are still quite strong (around $R^2=0.70$) at the site scale. If for a given year (e.g., 2001in Table 2), we found the spatial relationship is also significant and the resulted equation between ANPP and iEVI is similar to

Eq.1 (Fig.2). We have integrated Fig.1 and 2 into Figure 1 in the revised manuscript in P20. Some explanations were added in P7, Line 124-135.



Figure 2. The relationship between annual $ANPP_G$ (ground measurements) and the corresponding iEVI derived from MODIS data in 2001 across sites ($R^2 = 0.88$, P<0.0001).

COMMENTS: The reviewer also asked for clarification about the accuracy of Eq. 1 when applied to spatial or temporal correlation. This analysis would help inform the discussion of temporal versus spatial patterns observed in the data. Also, on Line 107, what is meant by a "pixel-based quality assurance (QA) control"? Please provide a citation.

Response: Please see the above response to reviewer for the accuracy of Eq.1 when applied to temporal correlation. For the "pixel-based quality assurance (QA) control", we used the quality flag in the MODIS EVI (MOD13Q1) product to remove low-quality, cloud- and aerosol-contaminated pixels and observations made at large sensor zenith angles (>30 °). A citation is provided in the revised manuscript in P6, Line 108-111.

List of changes in the manuscript

According to the valuable comments by the reviewer and editor, relevant changes made in manuscript are listed in the form of P (page) and L (line) numbers as follows in blue letters. Here pages and lines refer to the revised manuscript. We have improved our manuscript further in the language by a native expert.

- We have made all the grammatical corrections throughout the whole manuscript, e.g., in P2 Line 13 'During the past several decades, observational data has shown a faster increase in hot temperature extremes than the change in mean temperature.'
- Clarified the quality control (QA) for EVI data process as 'In order to eliminate the noise of low quality, cloud and aerosol contaminated pixels, a pixel-based quality assurance (QA) control was applied to generate a less noisy time series dataset based on the quality flag in MOD13Q1 product (Ponce-Campos et al. 2013).', and add a citation in P6 in Line 109-111.
- 3. We used 9 sites and 53 years totally for Eq.1.The number of sites and years for Eq.1 have been added in P6, Line 118-122 as 'ground measurements of ANPP (ANPP_G) during the period 2000-2009 were compiled for 9 sites (53 years totally) across the United States (Table 2).'
- 4. To address the concerns of the reviewer and editor about accuracy of the spatio-temporal correlation between iEVI and ANPP, we have made a new Figure 1 and provided more explanations in the differences between the spatial and temporal trends in P7, Line 124-135 as 'It should be noted that Eq. 1 is a spatio-temporal relationship between ANPP_G and iEVI across biomes. At the site scale, the temporal relationship between ANPP_G and iEVI is not as strong as Eq.1, but the site-specific comparison with ANPP from the ground measurements from two sites in Table 1 (CP and JN) showed generally good agreement during 2000-2009 periods (Fig.1 inset, around R²=0.70, P<0.01) and hence iEVI could show the inter-annual variability of vegetation growth. On the other hand, the spatial correlation is also significantly positive between ANPP_G and the corresponding iEVI as shown in Fig. 1 (inset) for the year of 2001 across biomes (R²=0.88, P<0.001).'.
- 5. Corrected the error in the subtitle of 3.1 and 3.2.

- Separated the discussions of spatial and temporal correlations into two paragraphs in P9, Line 177-178.
- 7. Due to the data limitations, there are some risks to generalize our findings for more broad scale. We gave some discussion about the limitations of the study and pointed out the future work to validate our findings in P12, 238-243 as 'It should be noted that, however, due to data limitations, only 12 sites were used in this study. We need more data from all ecosystems to test whether the contrasting effect of temperature extremes is a general behavior on forest and grassland ecosystem. The ongoing field measurements of carbon flux and meteorological data from eddy covariance flux method for different ecosystem may provide an opportunity to validate the assumption in this study.'
- 8. Added two missing references in P14, Line 287-293.
- 9. Redraw the Figure 1 to include the temporal and spatial correlation between ANPP and iEVI in P22.
- 10. Redraw the Figure 5 to add the error bars in P26.