Responses to Reviewer #3:

The paper establishes 1) that the warming in the TP is elevation dependent and this warming is higher than the rate generally quoted for global warming, 2) The TP elevation-dependent warming is treated as a simple warming source for forcing precipitation variations in China and SE Asia, and 3) diagnose the changes of precipitation pattern in terms of circulation changes. It contributes to the understanding of the impact of TP in forcing the north-dry south-wet moisture pattern in China. The writing is understandable but clearly needs improvement. The approach uses linear regression for the trends and regression coefficients for examining relations. Vigor is lacking in some discussions, especially in the correlation fields. Two concerns on the paper: 1) to examine the impact of the TP warming, correlation pattern with and without the TP trend is compared. It is not clear why the variance of due to the "total" TP time series is removed? 2) There are discussions on the relation of TP warming on global warming. The linkage has not been explicitly discussed. So jumping to the conclusion of the "most sensitive" feature is not warranted. There are inappropriate usage of the English language some of which I have tried to document below. I recommend publication after a rewrite to improve readability.

Response: Thanks again for the reviewer's valuable comments and suggestions that allowed us to improve the manuscript substantially. We have carefully considered these comments and suggestions, and revised the manuscript thoroughly.

(1) We think that the remaining part after the removal trend represents the interannual variability. We first detrend all quantities to allow focused analysis on correlations in interannual variability. In the remaining section, we believe that it contains long-term trend signals and interdecadal signals. To examine whether the impact of the TP warming is annual variability or trend, correlation pattern with and without the TP trend is compared. In the revised manuscript, decadal change is analyzed too.

(2) The relationship between TP warming and global warming is not clear yet.

Originally we just wanted to express TP warming is a special phenomenon under the global warming. In the first manuscript, our expression is unclear. We have reviewed the relevant literature and reorganized the sentences to express more correctly. The grammar has been thoroughly tidied up in the revision. In the correlation fields, we have added more detailed discussion. Thanks for your comments and suggestions, which effectively improved our manuscript. Please see below for our point-by-point response. The original comments are quoted in *Italic*.

Minor comments:

Comment 1: *In Abstract Line 23 rewrite as: The present study documents the <effect of elevation-dependent temperature changes > on East Asian precipitation in summer over the Tibetan Plateau (TP).*

Response: Thank you for your advice. Revised as suggested.

Comment 2*: Line 25 Change <altitude> to <elevation>; Note: elevation refers to a place above sea level, altitude indicates an object above sea level. Line 26 change <troposphere> to <standard tropospheric lapse rate>. Delete <magnitude of the> and add <trend> after temperature. Line 28 change <the> to <an>. Line 29 change <relations> to <impact>, change <amplify> to <increases>. Line 30 change <weak> to <weaken>, delete <compared with>. Line 31 delete "amplification". Line 32 "rate of" Line 103 is "the coupling of the circulation and large scale terrain" sensitive to: : :*

Response: Thank you for your advice. Revised as suggested.

Comment 3*: Line 110 indicate if this is GMT or Beijing time. Change at the "cumulative time" to "average over the period".*

Response: Thank you for your advice. Revised as suggested.

***Comment 4**:* Line 140 change “including” to “it includes” simply references to linear regression. It has been widely used in meteorological statistical applications. what is the purpose of quoting these examples, such as NDVI using linear regression? Delete these references unless you will refer to them later in the text.

Response: Thank you for your advice. Revised as suggested, and we have delete these references.

***Comment 5**:* See Wilkes Line 170 compute the SD for these two periods to enable a quantitative comparison.

Response: Thank you for your advice. “To get quantitative comparison, Mann-Kendall non-parametric test and Theil-Sen estimator are both used, and SD for these two periods are also added. Both methods show that the trend for these two periods are tested at 99% level of significance, but the trend and SD of TP temperature are both larger than global warming. To check whether the trend of TP temperature is reliable or not, Mann-Kendal method is used to test whether there is a regime shift in TP temperature. Result showed that a regime shift is found in 1997, and it is tested statistically significant at the 95% confidence level. Then the time is broken into two period, 1980-1996 and 1997-2016. Both methods show that the trend for these three periods are tested at a certain level of significance.” The above results and analysis have been supplemented in the paper. (Figure 2, P3, L194-204)

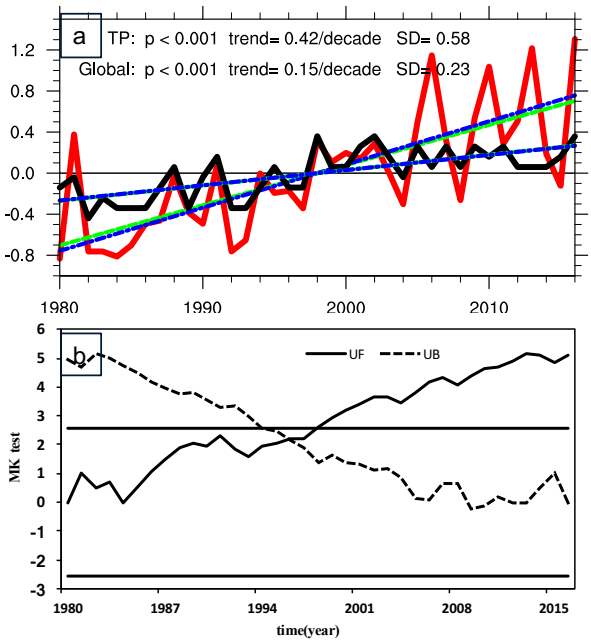

Figure 2. (a) Interannual change of summer temperature averaged by the TP (red) and global (blue). Trend significant test are from Mann-Kendall test (blue line) and the Theil-Sen estimator (green line). (Units: °C). (b) Mann-Kendall regime shift test of the temperature of the eastern part of the TP. Both trends are statistically significant at the 99% confidence level.

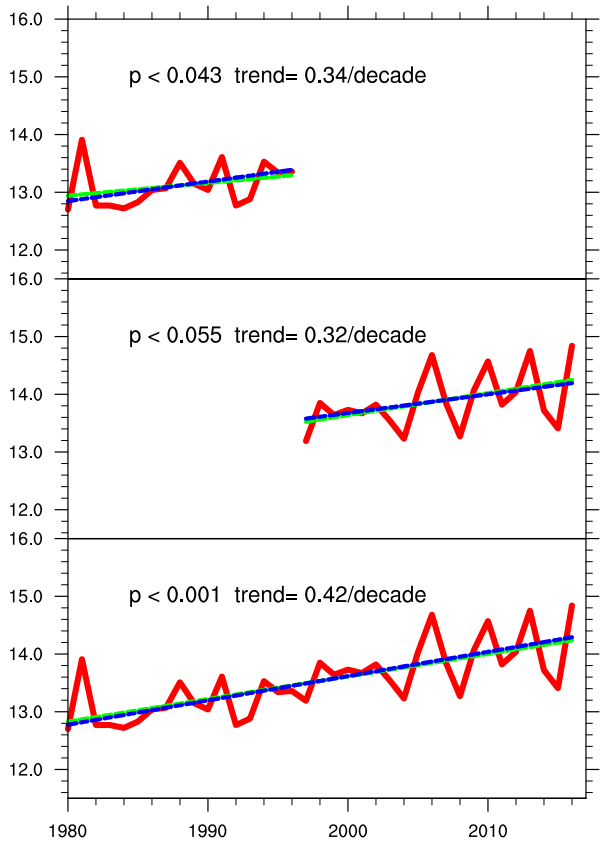

Figure S2. Trend analysis by Mann-Kendall test (blue line) and the Theil-Sen estimator (green line) for 1980-2016, 1980-1997 and 1998-2016 (unit: °C; red line) respectively. Statistically significant at the 95%, 94%, 99% confidence level respectively.

Comment 6*: Line 176 include "area" after "monsoon" Line 187 change altitude to elevation. Note: Lapse rate is the decrease in temperature with height. Change "tropospheric atmosphere" to "troposphere." Line 191 change altitude to elevation. Line 204 change fitting to fits.*

Response: Thank you for your advice. Revised as suggested.

Comment 7*: Line 206 how does this observation relates to global warming? State how did you show that this temperature change is due to global warming?*

Response: Thanks for your comments. We apologize for our over-interpreted. We have reviewed the relevant literature and reorganized the sentences as following: "Various reasons have been related to the elevation-dependent warming. Common explanation is associated with the snow-albedo feedback mechanism (Giorgi et al. 1997; Pepin and Lundquist 2008; Ceppi et al. 2010). Moreover, the cloud-radiation effects (Liu et al. 2009), water vapor and radiative fluxes (Rangwala 2013), are also responsible for it. " (P3, L255-258)

Reference:

Ceppi P., Scherrer S., Fischer A., Appenzeller C.: Revisiting Swiss temperature trends 1959–2008, Int J Climatol 32:203–213, https://doi.org/10.1002/joc.2260 , 2010

Giorgi F., Hurrel J., Marinucci M., Beniston M.: Elevation dependency of the surface climate change signal: a model study. J Clim 10:288–296. https://doi.org/10.1175/1520-0442 , 1997.

Liu X., Cheng Z., Yan L., and Yin Z.: Elevation dependency of recent and future minimum surface air temperature trends in the Tibetan Plateau and its surroundings. Global Planet Chang, 68:164–174, https://doi.org/10.1016/j.gloplacha.2009.03.017, 2009.

Pepin N., Lundquist J.: Temperature trends at high elevations: patterns across the globe. Geophys Res Lett 35: L14701. https://doi.org/10.1029/2008GL034026, 2008.

Rangwala I.: Amplified water vapor feedback at high altitudes during winter. Int J Climatol 33:897–903. https://doi.org/10.1002/joc.3477 , 2013.

Comment 8*: Line 220 add "fit" after curve Line 221 change than to "compared to" Line 223 what is the unit of the SD? Again change altitude to elevation. Just state the means and SDs of the normal distribution fit. You can use a t test to check if there is a significant difference.*

Response: Thanks for your advice. The unit of the SD is °C/decade. We have added the statistical significant test, and the means and SDs of the normal distribution fit are also added in the upper right corner of the diagram.

"Kolmogorov-Smirnov test is applied to check the statistical significance of normal distribution. If the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis that the sample follows a normal distribution. "(P2, L175-177).

"The statistical significance of climate mean analysis is determined by the standard two-tailed Student's t test method. "(P2, L184-185).

"As shown in Figure 4a and 4b, the normal distribution curve fit of the 2000–6000 meters temperature rate is significantly more concentrated and shifted to the right compared to that of 0–2000meters. The average temperature-change rate increases from 0.26°C/decade to 0.39°C/decade ($p<0.001$). It can be seen that, with the increase of elevation, the temperature-change rate of the TP and its surrounding areas increases significantly. There is the same phenomenon between the MERRA reanalysis data and the observational data despite difference in value. There are also significant differences between 0-2000 and 2000-4000m layers changes. The average temperature-change rate increases from 0.02°C/decade to 0.07°C/decade ($p<0.001$). Between 2000-4000 and 4000-6000m, the average temperature-change rate increases from 0.07°C/decade to 0.28°C/decade ($p<0.001$). " The result is agreed with previous

conclusion. The results and analysis above have been supplemented in the paper. (Figure 4; P2, P3, L244-252)

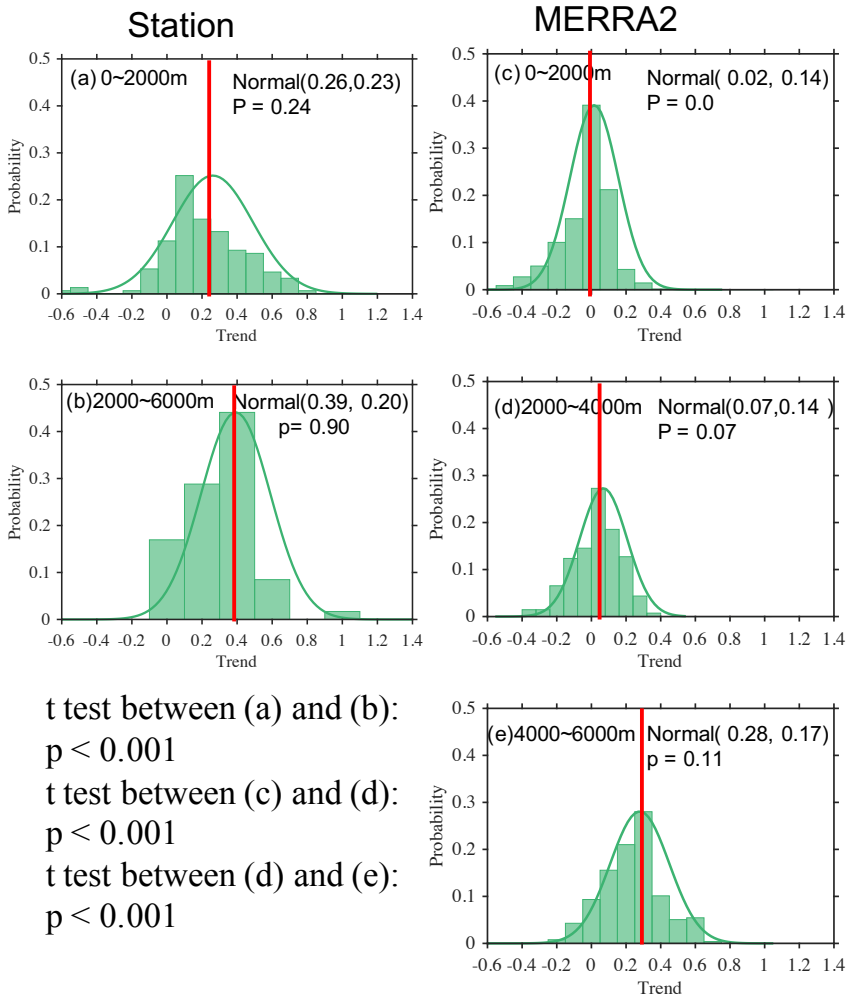

Figure 4. Distribution of probability density function of temperature trend (a, b, observational data; c, d, e, MERRA data; units: °C/decade) in the TP and its surrounding areas. The histogram represents the samples size, and the curve is a normal distribution fit line. The means and SDs of the normal distribution fit are also added in the upper right corner of the diagram. (a), (b) indicates the altitude ranges of 0–2000 m, and 2000–6000 m, respectively. (c), (d), (e) indicates the altitude ranges of 0–2000 m, 2000–4000 m and 4000–6000 m, respectively. All graphs are statistically significant of normal distribution at the 95% confidence level by Kolmogorov-Smirnov test except (c). All mean tests are passed by student t test.

***Comment 9**: Line 225 change to read "there are no significant differences between 0-2000m and 2000-4000m layer changes.*

Response: Thank you for your advice. Revised as suggested.

***Comment 10**: Line 233 again global warming is invoked here, what is the supporting argument that this is due to global warming? Is there model simulation that show the magnification of the surface warming in the TP region? Even with supporting GHG simulation, one can only conclude that the data support the simulation?*

Response: Thanks for your comments. We apologize for our over-interpreted. We have reviewed the relevant literature and reorganized the sentences as following: "Various reasons have been related to the elevation-dependent warming. Common explanation is associated with the snow-albedo feedback mechanism (Giorgi et al. 1997; Pepin and Lundquist 2008; Ceppi et al. 2010). Moreover, the cloud-radiation effects (Liu et al. 2009), water vapor and radiative fluxes (Rangwala 2013), are also responsible for it. " (P3, L255-258)

Reference:

Ceppi P., Scherrer S., Fischer A., Appenzeller C.: Revisiting Swiss temperature trends 1959–2008, Int J Climatol 32:203–213, https://doi.org/10.1002/joc.2260 , 2010

Giorgi F., Hurrel J., Marinucci M., Beniston M.: Elevation dependency of the surface climate change signal: a model study. J Clim 10:288–296. https://doi.org/10.1175/1520-0442 , 1997.

Liu X., Cheng Z., Yan L., and Yin Z.: Elevation dependency of recent and future minimum surface air temperature trends in the Tibetan Plateau and its surroundings. Global Planet Chang, 68:164–174, https://doi.org/10.1016/j.gloplacha.2009.03.017, 2009.

Pepin N., Lundquist J.: Temperature trends at high elevations: patterns across the globe. Geophys Res Lett 35: L14701. https://doi.org/10.1029/2008GL034026, 2008.

Rangwala I.: Amplified water vapor feedback at high altitudes during winter. Int J Climatol 33:897–903. https://doi.org/10.1002/joc.3477 , 2013.

Comment 11: *Line 237 add "change using" after "precipitation". Line 240 change "present" to "showing" Line 241,242 what is meant by "above normal and pronounce?" is it simply "higher?" Line 252 change "stronger" and "weaker" to "higher" and "lower"*

Response: Thank you for your advice. Revised as suggested.

Comment 12*: Line 258 change Regression to Relation, replace the first sentence with "Summer precipitation in East Asia has been regressed against the regional-average temperature (see Fig 1b) and the regression coefficients are presented in Figure 5.*

Response: Thank you for your advice. Revised as suggested. (P3, L48-51)

Comment 13: Line 275 by change to read "removing the linear trend of temperature," and delete "change." Why only the trend is removed and not the trend itself? Line 280 weak to weaker Line 309 "change is" to "has".

Response: Thank you for your advice. Revised as suggested. I am very sorry that our statement is not clear. Here we removed is the trend itself.

Comment 14: *Line 320 how do you do linear fitting of the wind field? Are these streamlines? Line 360 are these vector fields significant? Should probably not include any points when the correlation is not significant.*

Response: Linear fitting of zonal wind and meridional wind is calculated separately, and then the two regression coefficients are combined into a vector. Previous manuscript are performed with streamlines instead of arrow. The revised manuscript, we indicated it with an arrow (Figure 6). If it is not including any points when the correlation is not significant, pictures may show certain discontinuities and may not identify the pattern. So, we plot all points, and shading the significant point.

Comment 15: *Line 383 the link between the TP warming and global warming is not clear. Also make changes in the figure captions to correspond to those in the text.*

Response: Thanks for your comments. (1) The same problem has occurred several times, and we apologize for our over-interpreted. We have reviewed the relevant literature and reorganized the sentences as following: "Various reasons have been related to the elevation-dependent warming. Common explanation is associated with the snow-albedo feedback mechanism (Giorgi et al. 1997; Pepin and Lundquist 2008; Ceppi et al. 2010). Moreover, the cloud-radiation effects (Liu et al. 2009), water vapor and radiative fluxes (Rangwala 2013), are also responsible for it. " (P3, L255-258)

(2) We have checked several times and changed the figure captions to correspond to the title in the text.

Reference:

Ceppi P., Scherrer S., Fischer A., Appenzeller C.: Revisiting Swiss temperature trends 1959–2008, Int J Climatol 32:203–213, https://doi.org/10.1002/joc.2260 , 2010

Giorgi F., Hurrel J., Marinucci M., Beniston M.: Elevation dependency of the surface climate change signal: a model study. J Clim 10:288–296. https://doi.org/10.1175/1520-0442 , 1997.

Liu X., Cheng Z., Yan L., and Yin Z.: Elevation dependency of recent and future minimum surface air temperature trends in the Tibetan Plateau and its surroundings. Global Planet Chang, 68:164–174, https://doi.org/10.1016/j.gloplacha.2009.03.017, 2009.

Pepin N., Lundquist J.: Temperature trends at high elevations: patterns across the globe. Geophys Res Lett 35: L14701. https://doi.org/10.1029/2008GL034026, 2008.

Rangwala I.: Amplified water vapor feedback at high altitudes during winter. Int J Climatol 33:897–903. https://doi.org/10.1002/joc.3477 , 2013.
