This study throws up an interesting topic on the precipitation gradients in the Third Pole. However, the presentation of the manuscript is rather rough. Some conclusions drawn from RPGs seem to be unreasonable. The manuscript needs to be further improved. My comments are shown as follows:

General response: Many thanks to the reviewer for the comments and we considered all the comments carefully. We believe these comments are helpful to improve our work. Responses to all comments are detailed below and further revisions will be given in the revised manuscript. We hope these responses have addressed your major concerns.

1. The conclusions in Figure 2 are subjective. It is difficult to conclude that ERA5_CNN is better than the other two products. In Figure 2(b) and (e), the conclusion that ERA5_CNN is the most consistent with rain gauge data is clear. However, in the other sub-basins, the conclusion is not obvious. An indicator to describe the goodness of ERA5_CNN may help.

Response: Thanks for the suggestion. To quantify the performance of these datasets to reflect observed spatial variability of precipitation, the spatial correlation coefficients for these datasets against gauge observations were calculated. As shown in Figure R1, in most sub-regions, the ERA5_CNN has the highest spatial correlation coefficients with gauge observations, therefore, we can conclude that ERA5_CNN can generally better reflect the observed spatial variability of precipitation than the other two products. These results will be added to the revised manuscript.

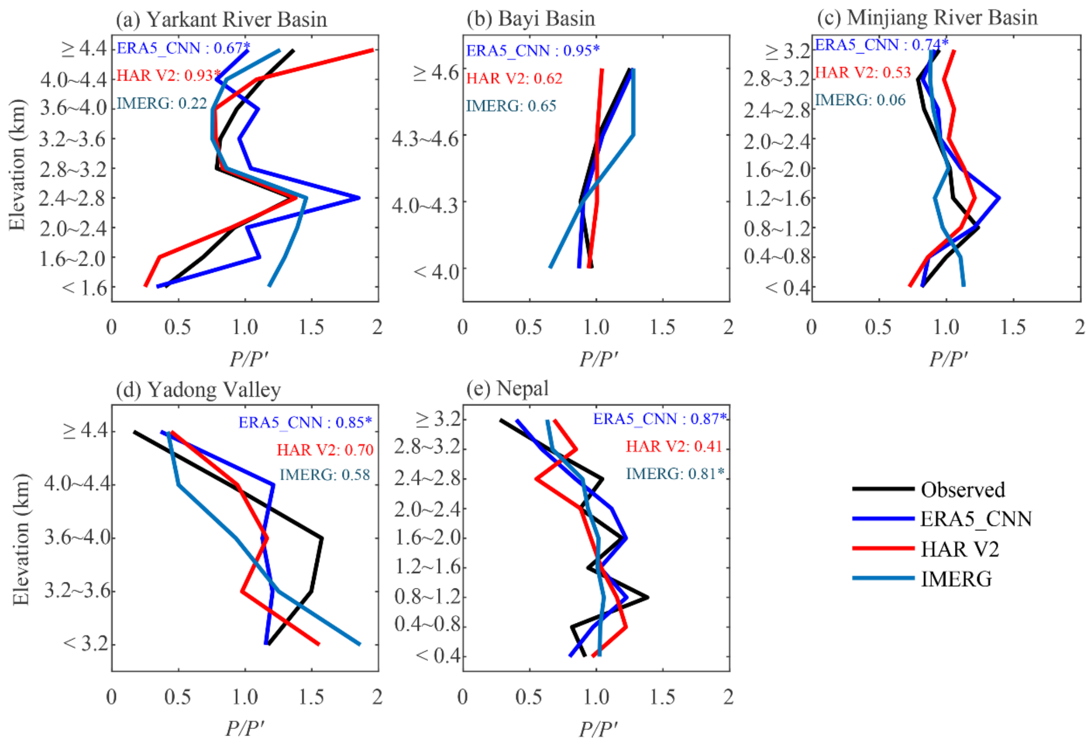

Figure R1 Comparison between the altitude dependence of relative precipitation from ERA5_CNN, IMERG and HAR V2 and that from gauge observations in five networks. *P/P′* denotes the ratio of precipitation amount (*P*) in each elevation zone to the mean precipitation amount (*P′*) at all gauge locations. The numbers within these figures represent the correlations between precipitation from gauge observations and the three datasets. “*” represents correlations significant at the 95% confidence level.

2. Are the sub-basins used in this study reasonable? It has been mentioned in the manuscript that the

precipitation decreases with altitude above 2500 m. In a sub-basin, the altitude can change from below 2500m to above 2500m. As a result, the precipitation gradients in a sub-basin are not consistent. It may need more discussion on the basin-scale precipitation gradients.

Response: This comment is very thought-provoking. The precipitation gradient is fitted using all grids with a specific sub-basin, therefore, the precipitation gradient is scale-dependent. Accordingly, we investigated and compared precipitation gradients at different spatial scales, as shown in Figures R2 and R3. It can be seen that precipitation gradients calculated at different spatial scales differ greatly. In addition, we can find that precipitation gradients tend to be larger and more likely to be positive at smaller spatial scales. These results will be discussed in detail in the revised manuscript.

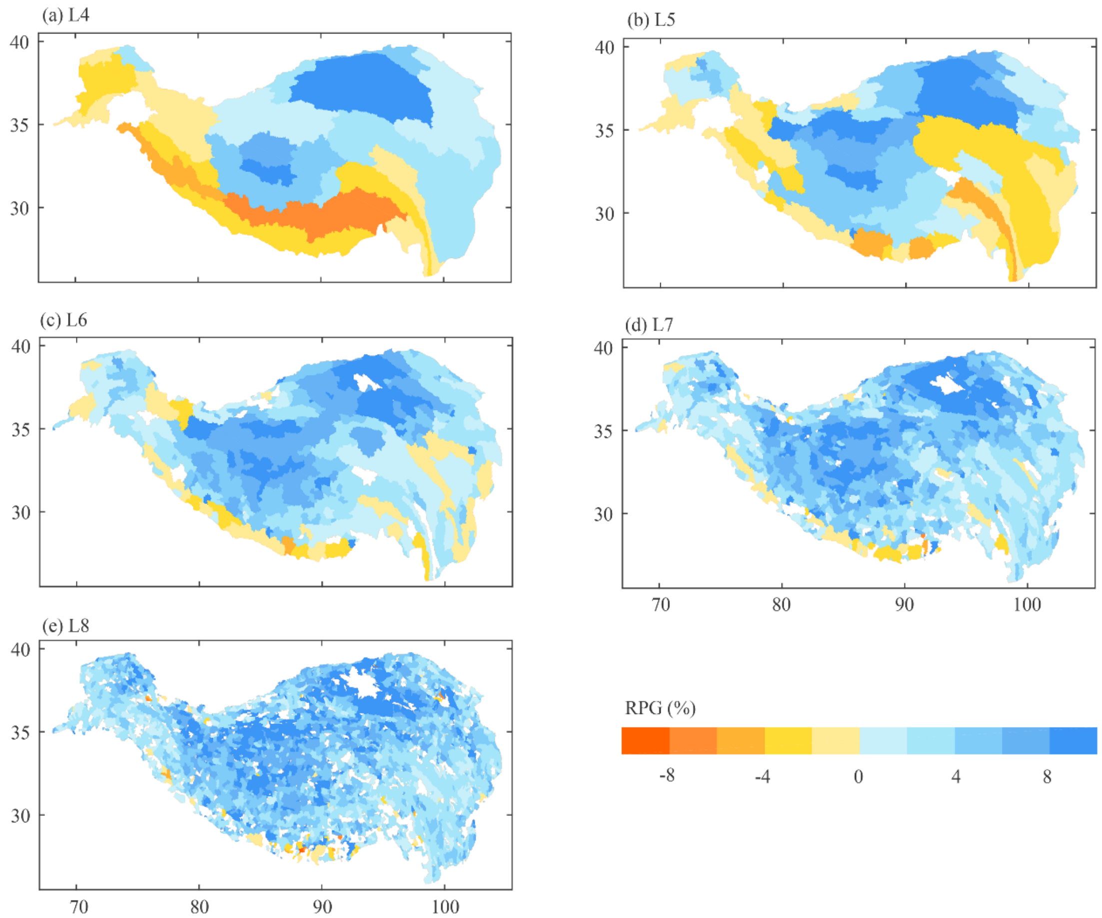

Figure R2 Spatial patterns of RPGs calculated at different sub-basin levels. The spatial scales of sub-basins (i.e. sub-basin area) generally decrease from L4 to L8.

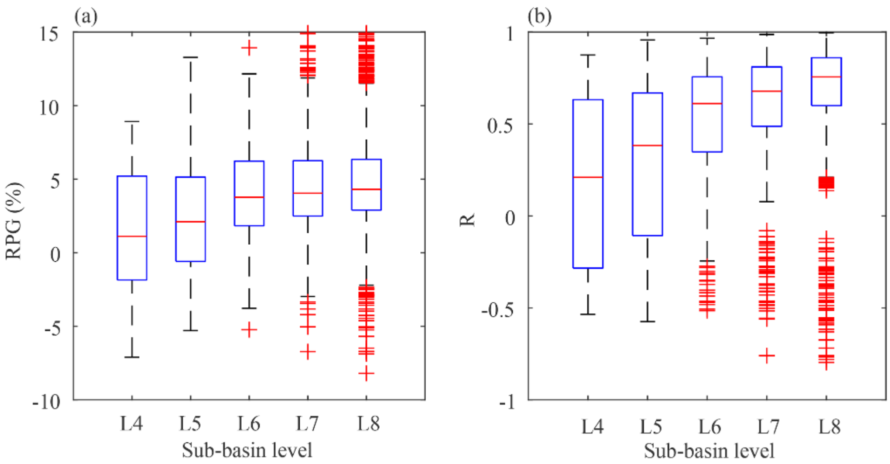

Figure R3 Comparison of (a) RPGs and (b) correlations between precipitation and altitude within each sub-basin at different sub-basin levels. Each box represents the distribution of RPGs or correlations of all the sub-basins over the TP.

3. As the numbers of gird cells in different sub-basins are different, the same values of R in different sub-basins have a different mean. For instance, R with the value of 0.5 may mean a weak correlation in a 10-grid-cell sub-basin but a strong correlation in a 100-grid-cell sub-basin. Significance tests are necessary to show the strong correlations between precipitation and altitudes.

Response: Thanks for the suggestion. We tested the significance of the correlation (Figure R4). It can be found that most sub-basins passed the 95% significance tests for the correlations. This figure will be added to the revised manuscript.

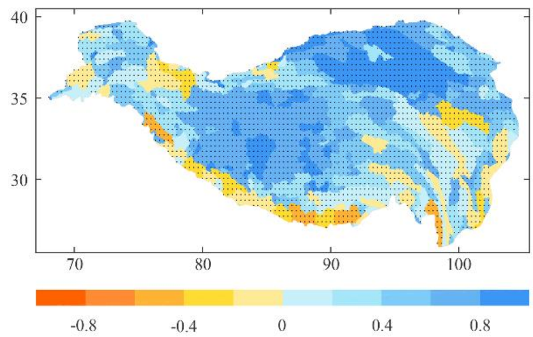

Figure R4 Spatial pattern of correlations between the annual average precipitation from 1980 to 2018 and altitude for all grids within each basin. The dots represent correlations significant at the 95% confidence level.

4. In Section 4.3.1, more evidence is needed to support that strong seasonal variation exists in RPGs. The RPG is a value that the absolute precipitation gradient divided by the basin mean precipitation. The RPG will show a strong seasonal variation even if the absolute precipitation gradient has not changed. The strong seasonal variation in RPG exists but may not have any meaning.

Response: Affected by the monsoon climate, precipitation over the TP has a strong seasonal cycle with generally large precipitation amount in summer but small in winter. This leads to a strong seasonal cycle in the absolute precipitation gradients, as shown in Figure R5. Comparing the absolute precipitation gradients provides little information about the spatiotemporal variability of precipitation-altitude relations because the magnitude of the absolute precipitation gradient contains the intrinsic seasonal variability of precipitation.

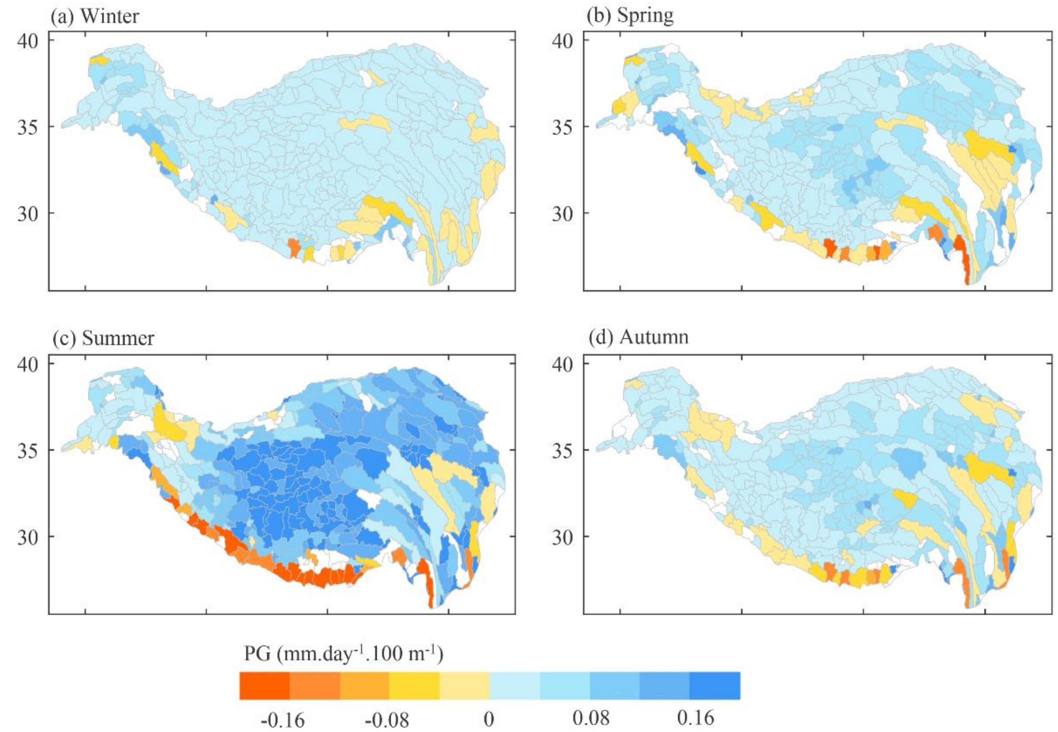

Figure R5 Spatial patterns of the absolute precipitation gradients (PGs) in (a) winter (December to February), (b) spring (March to May), (c) summer (June to August) and (d) autumn (September to November). The PGs are calculated based on seasonal precipitation averaged from 1980 to 2018.

5. Why do the authors use the average RPGs of the five sub-regions to study the interannual variations? The interannual variations of RPGs in some sub-basins may be covered. It does not make sense to average RPGs of the sub-basins to represent the RPG of a sub-region.

Response: Thanks for the comment. Accordingly, we calculated the Coefficient of Variation (CV) and trends for RPGs at each sub-basin and shown in Figure R6, which allows us to analyze the interannual variations of RPGs in each sub-basin. This figure will be added to the revised manuscript and discussed.

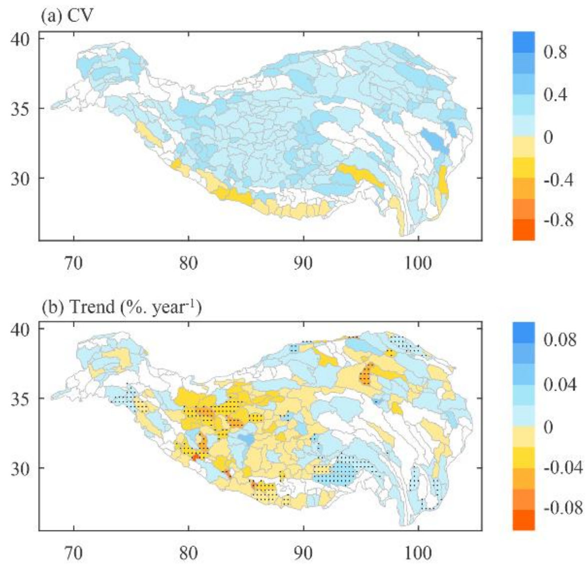

Figure R6 Spatial distribution of (a) the Coefficients of Variation (CVs) and (b) trends for annual RPGs during the period from 1980 to 2018. CVs and trends at sub-basins with missing RPGs during the analysis period were filled with white color. The dots represent trends significant at the 95% confidence level.

6. Where are the CV of annual RPGs for the sub-regions? The results should be shown in the manuscript. As RPG is a percentage, it is necessary to clarify the unit of CV. With the value of CV less than 0.12, it does not account for the conclusion that RPGs change little between different years. For example, the maximum and minimum values of RPGs in Qaidam are ~9% and ~13% respectively. Considering the range of RPGs, the change is not little. Moreover, it can be seen that there is a periodic variation in RPGs in Figure 5.

Response: Sorry that the Coefficient of Variation (CV) was not defined in the manuscript. The CV is dimensionless and can be calculated as follows:

$$CV = \frac{\sigma}{\mu}$$

where σ and μ are the standard deviation and mean of a series of RPGs, respectively. The closer the CV value is to zero, the smaller the dispersion is.

A CV value of 0.12 represents that the standard deviation of RGPs during the analysis period is equal to 12% of the mean value of these RPGs. The definition of CV will be detailed in the revised manuscript.

7. The trend tests are not found in the manuscript. How to draw a conclusion that there is no significant trend in RPGs in all the sub-regions?

Response: Thanks for the comment. We conducted trend test for RPGs at each sub-basin and shown in Figure R6. It can be found that the trends for annual RPGs at most sub-basins are between ±0.04% and do not pass the 95% significance tests. Therefore, that there is no significant trend in RPGs in most sub-basins is accepted. Figure R6 and the corresponding analysis will be added to the revised manuscript.

8. Because of the equation RPG=a/P and the positive correlation between P and RH, there is an

inverse proportional relationship, rather than a linear relationship between RPG and RH. This analysis in Figure (a)-(e) does not make sense.

Response: We investigated the relations between precipitation from ERA5_CNN and relative humidity from ERA5 and shown in Figure R7. It can be found that the positive correlations between P and RH are not obvious. However, Figure 6 in the manuscript shows that there are good correlations between RPG and RH, which indicates that RH is indeed a determinant of RPG.

In addition, the motivation for analyzing the relations between RPG and RH was not clarified clearly in the manuscript. By analyzing the relations between RPGs and meteorological factors, we hope that the RPGs can be estimated empirically according to the meteorological conditions, which can broaden the implication of this study. From this perspective, any factor that has good correlations with RPG can be used. We will further clarify the motivation for analyzing the relations between RPG and RH in the revised manuscript.

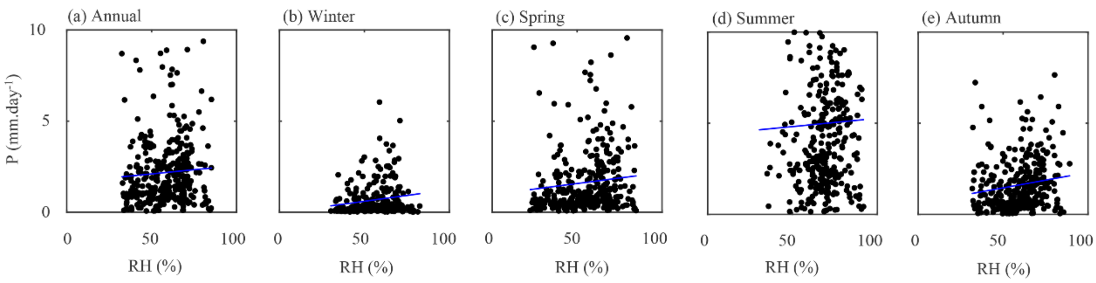

Figure R7 Relations between basin-average precipitation (P) and relative humidity (RH) in different periods. P and RH were averaged from 1980 to 2018.