Responses to Anonymous Referee #3:

General Comments:

Gridded precipitation data are very useful for hydrological application and others and ground-observation-based ones have been developed for many regions. This study investigated a methodology to develop gridded precipitation data for the Nu River basin based on the ground-observed precipitation combined with vegetation indices. As an interpolation method, the data fusion may be a strong tool especially for a sparse observation area. Its application to the Nu River with sparse observations may contribute to expanding a hydrological knowledge. This paper requires some more analyses to make readers more convinced of the effectiveness. Therefore, I recommend to revise this manuscript based on comments below before publication.

Response: We thank the reviewer for the positive feedback. Our detailed responses are given after each comment (*italics*) below.

Major comments:

1) *The regression for RME uses all the data at the gauge stations and for the entire years. Such regression provide the climatological mean relationship between precipitation and NDVI. This regression cannot be applied for individual year as seen Table 1 where the coefficients distinct vary with year. Authors must mention the limitation of the proposed method in an appropriate paragraph.*

Response: We agree with the reviewer that the limitation in applying the RME regression to each year's data needs to be appreciated, which has been added in Section 5 of the revised manuscript as follows:

> In addition, although the RME model can utilize the full knowledge of precipitation in the entire study period compared with RMI models, the difference in the coefficients suggests apparent inter-annual variability of precipitation that should be considered when applying these models. Given the duration of study period and purpose, we suggest the RME model be used for long-term climatology identification while RMI models for inter-annual variability examination.

2) *Judging from Figure 6, climatological mean annual precipitation seems to depend on elevation. The dependence of precipitation on elevation is a well-known fact. In order to clarify the effectiveness of your method, it is better to compare the geographical distributions of climatological mean precipitation between your methods and a method by a regression between precipitation and elevation. A figure of the difference between the two may provide an important suggestion about strong points of your method.*

Response: We thank the reviewer for the insightful suggestion. In the revised manuscript, we compare our method (i.e., RME) with the precipitation-elevation regression (DEMP) model and present the difference of their precipitation estimates as the new Figure 9, which is reproduced as follows:

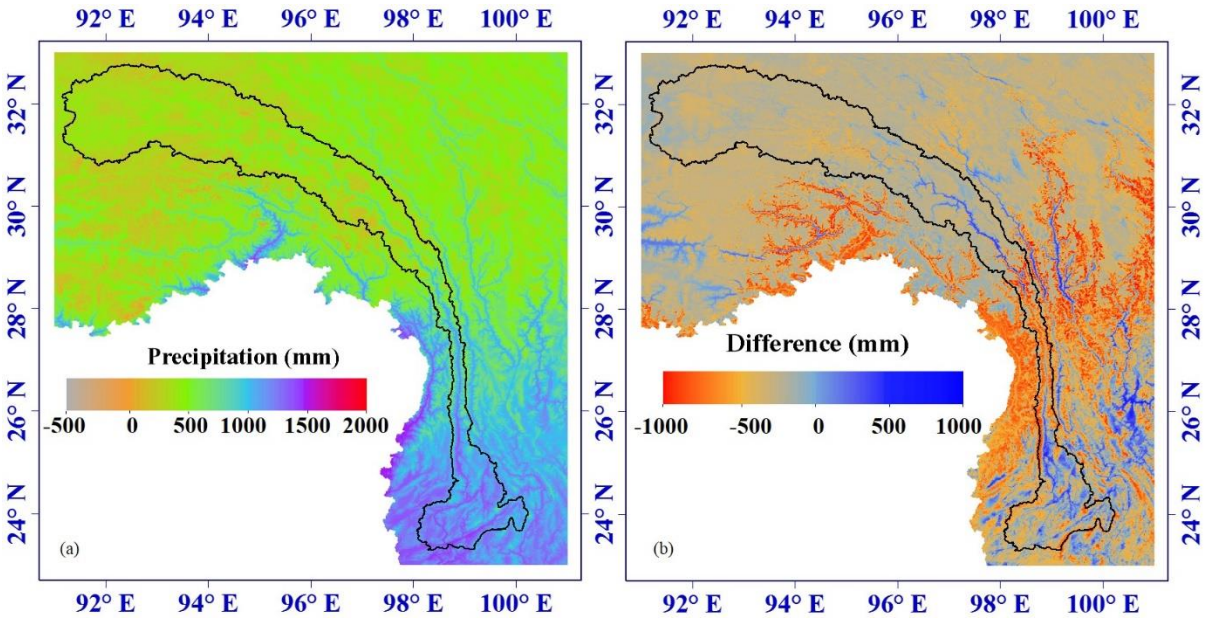

Figure 9 (a) The map of precipitation estimates of DEMP; (b) difference in precipitation estimates between RME and DEMP.

Specific Comments:

3) *L66: The objective of this study should be more specified in terms of spatio-temporal scale: climatological annual mean and 1 km.*

Response: Added in the abstract and introduction as suggested.

4) *L103: The center of a certain box is not used in computing the averaged value of the grid box? If so, please provide a reason.*

Response: We thank the reviewer for pointing out incorrect statement. The center of a certain box is used in calculating the averaged value of the grid box. Related statement is corrected in the revised manuscript.

5) *L157: The number of rain gauge stations in the Nu River basin seems smaller than 13 as long as it is judged from Figure 2.*

6) *L158: Moreover, the 59 stations are not plotted on Figure 2.*

Response: We thank the reviewer for pointing out the inconsistency between the original Fig. 2 and text. We now have corrected Fig.2 with all the 59 gauges displayed, which is reproduced as follows:

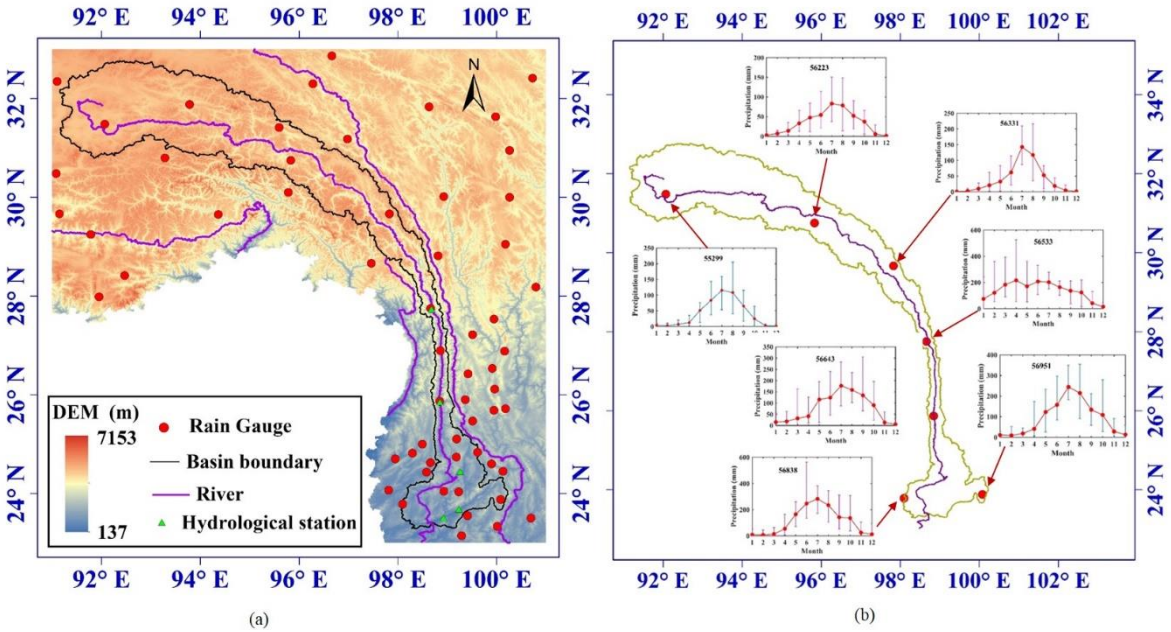

Figure 2 (a) Terrain map of the study area (the Nu-Salween basin and its adjacent areas). (b) The distribution of precipitation during the year across the Nu River.

7) *L159: Please explain what you mean by "climatic and topographic conditions are consistent with the Nu River basin."*

Response: We mean the enlarged area has similar climatic and topographic conditions as the Nu River basin: both regions are characterized as mountainous areas under the subtropical climate influenced by southeast and southwest monsoons. Such explanation has been added in the revised manuscript.

8) *L162: You use three terminologies: uncertainty, reliability, and accuracy in the 3.2.1 subsubsection. Please provide short definitions if you distinguish them in this manuscript.*

Response: We are sorry about bringing up the confusion due to the inconsistency in our terminology. We now only use "reliability" across Section 3.2.1 in the revised manuscript.

9) *L163: In this paragraph, please provide the spatio-temporal resolution of the MODIS dataset.*

Response: The temporal and spatial resolutions of the MOD13A3 and MYD13A3 data we used are 1 month and 1 km, respectively. This information has been added in the revised manuscript.

10) *L176: "m" in "merged" should be in standard font.*

Response: Corrected as suggested.

11) *L185: How do you classify an upscaled 1 km pixel when it is composed of two forest and two cropland pixels? You do not consider the mixed pixel? If so, please provide this information.*

Response: If any of the four 500 m pixels in MCD12Q1 classified as water, urban, snow or ice and cropland, the upscaled 1 km pixel will be classified as abnormal pixel (or non-natural vegetation) and assigned with a missing value (i.e. -9999), otherwise will be classified as normal pixel (or natural vegetation) and assigned with a 1 value.

12) *L196: Readers may know the rationale about the selection of the regression form. Not by "not shown here" but "judging from Figure 3" is better.*

Response: We thank the reviewer for the suggestion. Figure 3 is modified to include the comparison of the four regression forms and updated in the revised manuscript.

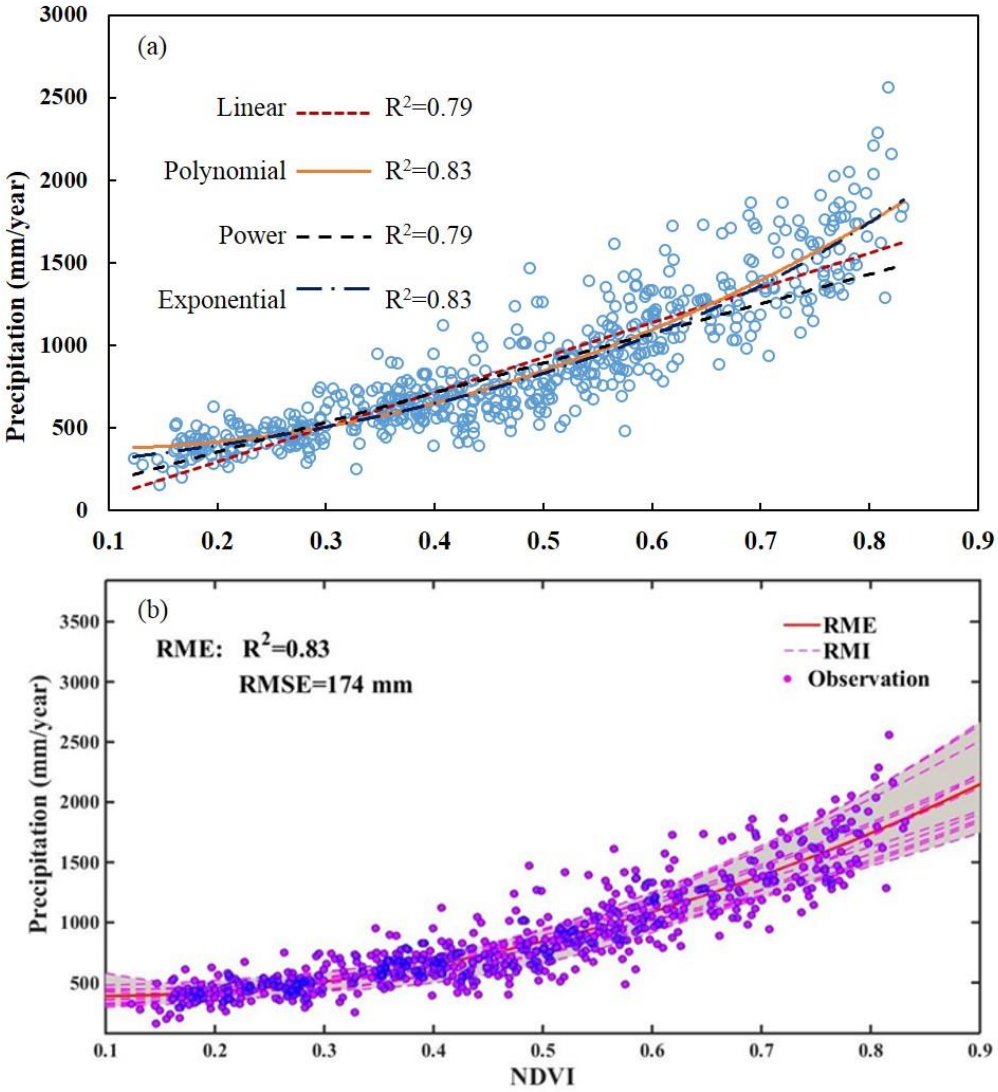

Figure 3 (a) Different regression forms for precipitation –NDVI relationship; (b) The precipitation-NDVI relationships for RME and RMI

13) *L202: Did you use these results when you draw Figure 6? If not, why don't you use these important information?*

Response: We did use these results in making the original Figure 6 (now Figure 8 in the revised manuscript). However, we didn't make any correction to the pixels out of the range from 400 mm to 1500 mm because there is no justifiable methods for such correction. Given the limited fraction of invalid pixels (10% in the whole study area and 7% in the Nu River basin), we still have them plotted in the Figure 8 to demonstrate a full picture of the spatial precipitation pattern in the study area, but we note those pixels are of large uncertainties and should be interpreted with caution.

14) *L220: Two spaces exist between of and regression.*

Response: The redundant space is removed.

15) *L222: Scenario should be Scenarios.*

Response: Corrected as suggested.

16) *L242: Please provide rationale about the use of the IDW method here.*

Response: IDW is one of the most popular methods for spatial interpolation of precipitation due to its easy implementation and flexibility in incorporating other auxiliary information (e.g., elevation).Such statement has been added in the revised manuscript.

17) *L264: Precipitation by the RME method often the largest among the three in Figure 10 is reasonable? Can you validate this precipitation estimates larger than the other two by sub-basin water balance such as observed river discharge = P – E. In other words, large amount of precipitation is better than small one in order to explain the observed river discharges.*

Response: We thank the reviewer for this suggestion. However, we deem that it would still be difficult to justify the magnitude order of estimates by the three methods even if the observed river discharge of a certain sub-basin is provided: the ***observed*** river discharge implies the response of a basin to the only ***realistic*** precipitation rather than different ***estimates***. In other words, it is difficult to infer the impacts of different inputs (i.e., precipitation estimates by different methods) based on a single output (i.e., river discharge observation).

To evaluate the accuracy of different precipitation estimates, we utilize MODIS evapotranspiration products MOD16 to calculate the water balance based precipitation (i.e. ET+R). Then we compare it with 5 precipitation products and the results are presented in Fig. R2. DEMP represents precipitation based on precipitation-elevation relationship, BandP represents precipitation based on precipitation-NDVI relationship with consideration of elevation band. It can be found that RME and BandP produce closer estimation to water balance based precipitation, implying that the precipitation mapping result based on precipitation-NDVI relationship is reasonable.

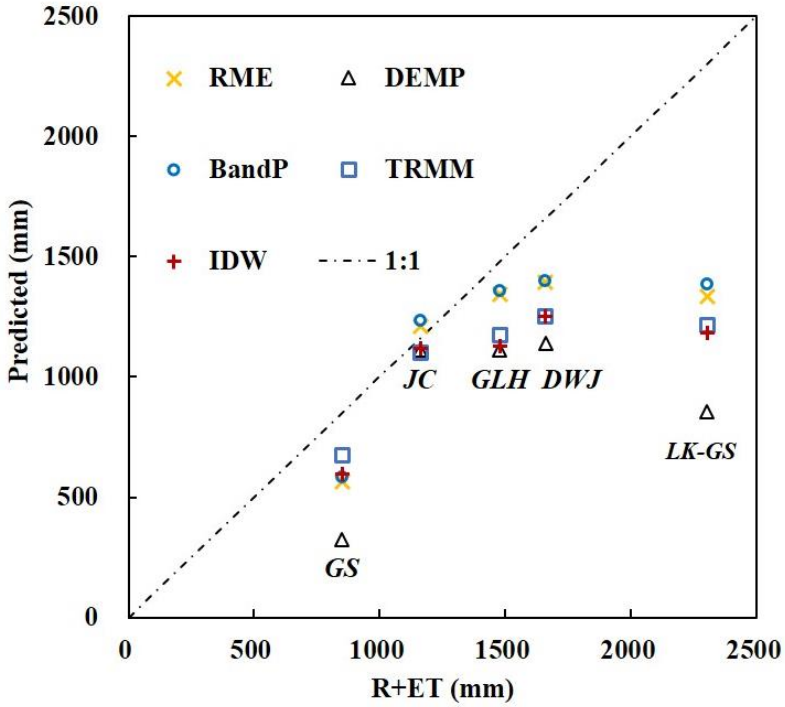

Figure R2 Comparison between water balance based precipitations (R+ET) and 5 precipitation products: DEMP (P-elevation relationship), BandP (P-NDVI relationship with consideration of elevation band), RME, TRMM and IDW. Here GS, JC, GLH, DWJ and LK-GS stand for Gongshan, Jiuchen, Gulaohe, Dawanjing and Liuku-Gongshan, respectively.

18) *L295: As mentioned above, in addition to RME+T and RME+H, how the regression of T or H onto precipitation works for producing climatological mean annual precipitation like Figure 6.*

Response: Our intention of using RME+T and RME+H was to demonstrate the inconsistent trends of precipitation with temperature and elevation. According to Table 5 and Fig. 15, the differences in performance metrics and the regression coefficients between RME+T, RME+H and RME are minimal. Therefore, we think that the influence of including H and T on the regression results is limited.

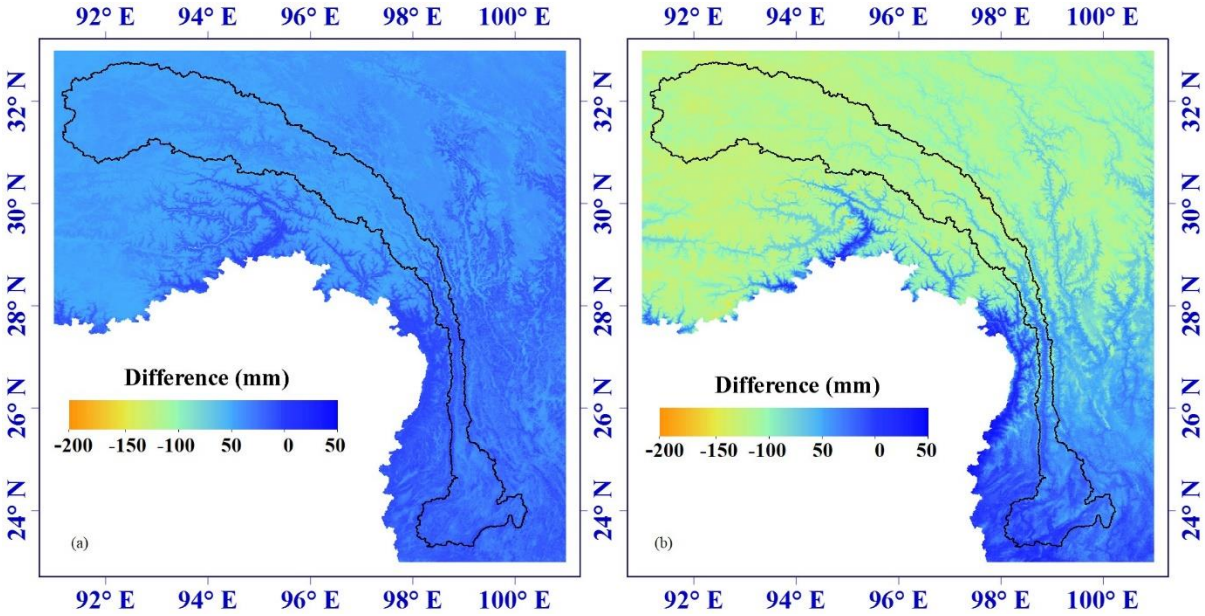

Figure 15 Spatial precipitation difference between RME and (a) RME+H; (b)RME+T

19) *Figures 1: Font color should be the same as in outline color of boxes.*

20) *Figures 2, 6, 7, 8, and A2: Minutes and seconds should be removed from the annotations of the coordinates. Font size should be enlarged so as to see them easily.*

Response: Modified as suggested.

21) *Figure 4: Please provide explanations about two symbols in the figure caption.*

Response: We thank the reviewer for this suggestion .The triangle markers denote the values (R, R^2 and RMSE) of RME model. The plus markers represent the outliers that are out of the range from (Q1-1.5IQR) to (Q3+1.5IQR). Q1 and Q3 are the 25^{th} and 75^{th} percentiles, and IQR (=Q3-Q1) is the interquartile range. Such explanation has been added in the revised manuscript.