Thank you very much for your constructive suggestions and questions. We will first address the major ones and then the minor ones.

Major parts.

The major question mainly concentrates on the elevation-bias part. The referees both thought that this part was weak because no statistically significant relationships between elevation and bias were found.

To improve this part, we introduced 24 topographic variables to develop a more comprehensive analysis of the bias-topography relationship since elevation as a single variable cannot totally represent the influence of topography. To obtain variables, a buffer of 0.25 °km was generated for each gauge station to match with the bilinearly interpolated satellite rainfall. Elevation, slope and aspect were then easily calculated from 30 arcs digital elevation model (DEM) within the buffer. To obtain relief data, DEM was first smoothed by a 101×101 moving window and the resultant surface represented the large-scale topographic features (Yin et al. 2008). The smoothed surface was then subtracted from original DEM to generate local relief. All topographic variables were described in Table 1.

The variables were used in Yin et al. (2008) to correct satellite monthly rainfall estimates and they found significant improvements over original satellite estimates when a regression model was used based on topographic variables. Their results implied that topographic variables may be capable of interpreting errors of satellite rainfall data. Because some variables were related, principle component analysis (PCA) was employed to reduce the redundancy in the topographic dataset and seven rotated principle components (RPCs) were determined because they explained more than 90% of the variance of the original topographic datasets. Listed in Table 2 were RPCs and original variables they represented that were useful to identify topographic factors related to satellite rainfall biases. Note that only the highest loading variables were listed.

A regression model was employed to interpret rainfall biases based on RPCs. Note that all variables were normalized before they were used in the model. It is not helpful to use TMPA to analyze the bias-topography relationship because TMPA was bias-calibrated by gauge data. In this analysis, TMPA real time (RT) that represented biases of satellite itself was used. Note that TMPA was also used for comparison.

The regression model was first run using all the seven RPCs. Then only PRCs with significant level lower than 0.01 were maintained for analysis. Results of regression models were shown in Table 3. TMPA showed the lowest correlation with R^2 less than 0.1. This result may be ascribed that bias-calibrated procedures using gauge data employed in TMPA made it less possible to explore biases of the satellite itself. Biases of CMORPH also presented low correlation with topography. Contrary to TMPA, topography can best explain biases of TMPA RT. The highest coefficient of RPC2 in the regression model implied that elevation played important roles in explaining biases because RPC2 mainly represented variability of elevation and surface roughness. PERSIANN also presented similar results. The difference is that PERSIANN required more topographic variables to interpret biases, especially aspect. This may be why we failed to develop bias-elevation relationship even if the regression was done in different climate zones.

In a summary, we decomposed 24 topographic variables into seven independent RPCs using PCA. A regression model was then employed to explain biases of satellite rainfall in the 166 stations. Biases of TMPA showed the weakest dependence on topography, which may be due to the gauge-calibrated processes that reduced biases and then weakened bias-topography relationship. The dependence of biases of CMORPH on topography is also weak. However, biases of TMPA RT and PERSIANN presented dependence on topography. Also, variability of elevation played important roles in explaining their biases.

Table 1. Topographic variables and their descriptions.

Variable	Description
MEAN_slp	Mean slope angle inside 0.25 °buffers
MEAN_hshd	Mean lighting condition inside 0.25 °buffers, as represented by relative solar radiation with solar azimuth at 180 °(south) and alt of 55 °
MIN_dem	Minimum elev inside 0.25 °buffers
MAX_dem	Maximum elev inside 0.25 °buffers
RANGE_dem	Range of elev values inside 0.25 °buffers
MEAN_dem	Mean elev inside 0.25 °buffers
STD_dem	Std dev of elev inside 0.25 °buffers
SUM_dem	Sum of all elev values inside 0.25 °buffers
MEDIAN_dem	Median elev inside 0.25 °buffers
MIN_relief	Minimum relative relief inside 0.25 °buffers, based on a 0.5 °search radius
MAX_relief	Maximum relative relief inside 0.25 °buffers, based on a 0.5 °search radius
MEAN_relief	Mean relative relief inside 0.25 °buffers, based on a 0.5 °search radius
STD_relief	Std dev of relative relief inside 0.25 °buffers
Flat_asp	Proportion of flat terrain inside 0.25 °buffers, where slope aspect is coded as 0
North_asp	Proportion of area with north-facing slopes inside 0.25 °buffers
Northeast_asp	Proportion of area with northeast-facing slopes inside 0.25 °buffers
East_asp	Proportion of area with east-facing slopes inside 0.25 °buffers
Southeast_asp	Proportion of area with southeast-facing slopes inside 0.25 °buffers
South_asp	Proportion of area with south-facing slopes inside 0.25 °buffers
Southwest_asp	Proportion of area with southwest-facing slopes inside 0.25 °buffers
West_asp	Proportion of area with west-facing slopes inside 0.25 °buffers
Northwest_asp	Proportion of area with northwest-facing slopes inside 0.25 °buffers

Table 2. Topographic variables represented by each RPC. Note that only variables with the most negative or the most positive loading values are listed. The values are in the bracket.

	RPC1	RPC 2	RPC3	RPC 4	RPC 5	RPC 6	RPC 7
Variables	MEAN_slp (0.924)	MIN_dem (0.988)	Northeast_asp (-0.772)	North_asp (-0.714)	West_asp (0.814)	Flat_asp (0.714)	MEAN_relief (0.959)
	MEAN_hshd (-0.700)	MAX_dem (0.876)	South_asp (0.858)	East_asp (0.835)	Northwest_asp (0.744)	Southwest_asp (0.630)	
	RANGE_dem (0.964)	MEAN_dem (0.976)		Southeast_asp (0.726)			
	STD_dem (0.957)	SUM_dem (0.981)					
	MIN_relief (-0.837)	MEDIAN_dem (0.976)					

MAX_relief
(0.852)
STD_relief
(0.959)

Table 3. Regression model results of each satellite rainfall dataset. Note that the model was developed based on data from all 166 stations. All variables in the model are independent and statistically significant at level 0.05.

Satellite rainfall data	R^2	Regression model
PERSIANN	0.50	Bias = -0.174 - 0.146 RPC1 + 0.756 RPC2 - 0.169 RPC3 - 0.235 RPC4 - 0.196 RPC6 + 0.366 RPC7
CMORPH	0.12	Bias = -0.313 - 0.133 RPC3 + 0.233 RPC7
TMPA RT	0.60	Bias = 1.940 + 0.593 RPC1 + 1.445 RPC2 + 0.302 RPC7
TMPA	0.08	Bias = -0.112 + 0.111 RPC1 - 0.095 RPC2

Minor Parts.

Referee 2.

Abstract:

Page 2- line 7: Which version of TMPA is used? Be specific. I read it is 3B42 V6 in later text but it is also important to inform readers earlier in the abstract.
Replies: We have followed your suggestion in main texts.

Page2- line 17-19: Figure 6c doesn't support this claim of "PERSIANN produces obvious underestimation at low elevations and overestimation at high elevations." It seems to me that PERSIANN underestimates on the lower-right and overestimates on the lower-middle of Figure 6c (where they have comparable elevations.). Yes, Figure 8 tries to clarify this, but it is not statistically significant to make such a claim. The significance of the fit is small (<0.5) in almost all for PERSIANN. However, I agree with the statements on CMORPH and TMPA.
Replies: Because we rewrote the elevation part, we will rewrite the abstract to revise the conclusions.

Introduction:
Page 2- line 23: Replace "4000 m" by "more than 4000m".
Replies: We have followed your suggestion.

Study Area:
Page 5- lines 19-25: In Table 2, it would be better to show gauge-derived precipitation instead of satellite estimates, for accuracy reasons.

Replies: The accuracy of gauge-derived rainfall depends on the number of gauges in the climate zone. For zones with only one or two gauges, it is not convincible to use gauge rainfall to represent the area rainfall amount in rainy seasons. On the other hand, despite errors in the three satellite products, they may be better ways to denote the long-term area rainfall amount.

Rain gauge data:

Page 7- line 1: Spatial or temporal mean? Be specific.

Replies: Spatial mean. We have revised corresponding texts.

Page 7- line 17 - : Would be better and easier for readers to include more details on the downscaling method used here. The authors, understandably, refer to Sapiano and Arkin (2009) for the methodology, but I suggest more explanation is provided here because it is basically the backbone of the data set up for the evaluation work.

Replies: It refers to the theory of bilinear interpolation which is usually used in the image processing. A good description of bilinear interpolation can be found in Wikipedia http://en.wikipedia.org/wiki/Bilinear_interpolation. Matched rainfall series for each gauge station are built by combining the nearest four grids points from the satellite analyses. The weights for each grid is determined by linear interpolation first in x direction and then in y direction according its position relative to the location of targeted gauge. Since the linear interpolation is used twice, this method is called bilinear interpolation.

Evaluation as a factor of elevation:

Pages 12-13: The whole discussion on this section depends on Figure 8 a-g, where linear fits have been tried (biases vs elevation). However, none of the fits show if there is any clear bias-elevation dependence for all precipitation estimates. The significance of fit (R) is consistently low. Therefore I suggest that this section (section 3.4) be rewritten accordingly to report that there is no significant effect of elevation on the satellite precipitation in the TP; or completely left out of the paper if they do not create any important knowledge.

Replies: This part has been rewritten and the main idea is shown in the major part.

Tables and Figures:

Table 1: Please correct the caption, specifically the second sentence.

Replies: The caption is rewritten as follows. Table 1. The indices that are used to divide TP into climate zones. Note that E_T denotes annual evapotranspiration (mm), and P denotes annual precipitation (Sun and Zheng 1999).

Table 2: As mentioned above, better to show the mean of precipitation from rain gauges instead of satellites.

Replies: This question repeated another question above.

Table 2: I see that the names of the climatic zones are later explained on legend of Figure 2, but it is important for readers of the HESS (great journal) to understand what they stand for when reading Table 2 as well. So may be add a sentence or two to the caption of table 2?

Replies: We added a sentence in table 2 as follows. Meanings of the zone names are referred to

Figure 2.

Table 3: Caption “versus”.
Replies: We have followed your suggestion.

Figure 2: Add the source of the climatic zone classification (reference?).
Replies: We have followed your suggestion.

Figure 7: Is the underestimation of the high magnitude precipitation (Figure 7 c & d) due to the fact that satellite is spatial average over a grid (which dampens the peaks by averaging over area) while gauge is point measurement? If this is the case then, this result is not surprising. Please provide more explanation on this.
Replies: The averaging nature of satellite grid works to smooth rain rate in the grid. It dampens the peaks when rain rate in the location of gauge is higher than peripheral areas, as you suggested. But on the other hand, when rain rate in the location of gauge is lower than peripheral areas, the peaks would be exaggerated. Overall, the two errors caused by averaging would cancel each other.