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Discussions

Interactive comment on "Global component analysis of errors in five satellite-only global precipitation estimates" *by* Hanqing Chen et al.

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Discussion comment 1 (The PDF version of the response can be found in supplement)

Understanding the error components of satellite products is very important to the algorithm developers and end-users. This manuscript presents the error analysis of five commonly used products. The finding is useful for the development on the future satellite retrieval algorithms. The topic is attractive and suitable for HESS.

We would like to sincerely thank the reviewer for his/her valuable comments and suggestions.

Major comments

Given that the performance of IMERG-late is very similar to the performance of IMERG-early, I suggest removing one of them.

Thanks. We will remove the IMERG-Early and GSMaP-NRT in revised version considering their similar performance relative to corresponding late-level products.

The dataset for China and for the rest of the world are different. I suggest authors discuss the effect of this inconsistency on the conclusion.

Good suggestion. In this study, these two different reference datasets were used to explore the error components of SPPs. The calculation processes of spatial maps of their biases and systematic errors include two major steps: (1)The spatial maps of biases and systematic error for the global land areas were given by using CPCU data as the benchmark, and then the ones of biases and systematic error for mainland China were given by using CGDPA data as the reference. (2)The spatial maps of biases and systematic error for mainland China using CGDPA data as the benchmark were used to replace the Chinese mainland part of the global land areas.

As for the error components of SPPs under different precipitation intensities, the precipitation values from satellite and ground reference over the globe (except for mainland China) were stored in vector S1 and vector G1, respectively. Then, the precipitation values from satellite and ground reference over mainland China were stored in vector S2 and vector G2, respectively. Third, S1 and S2 form a new vector S (S=[S1,S2]ˆT), while G1 and G2 form a new vector G (G=[G1,G2]ˆT). Finally, the error components of SPPs under different precipitation intensities were computed by using equations (1)-(9). Therefore, we can conclude that the inconsistency of reference data has little impact on the evaluation results. We will further clarify this point in the revision.

Section 4.1 Potential for the transferability of the regional assessment results to other areas. I don't think that comparison between CONUS and China is a good example to show the transferability. Although these two regions have similarities in coverage area, and latitude range, the topography characteristics and climate regimes are very different. In addition, these two regions are very large and have dramatic heterogeneity in land surface property and climate, which is not suitable for the comparison

We thank the reviewer to propose this question. We fully agree with the opinion that the topography characteristics and climate regimes are rather different over COUNS and China. We also consider that these two areas might not be suitable to be used for discussing the transferability. In our revision, we have selected Chinese Fujian (FJ) and Zhejiang (ZJ) provinces to intercompare and analyze the transferability of evaluation results, due to these two adjacent areas located in southeastern China having similar topography and climate. The spatial maps of the total bias for the three SPPs over FJ and ZJ were shown in the following Fig. 1. One can see that the spatial maps of the total biases of each SPP between FJ and ZJ regions show significant differences for all four seasons. This indicates that the evaluation results between similar areas could not be extended to one another, which might be due to the large performance differences between various satellite sensors and the differences of the satellite samples used in satellite precipitation retrieval systems between various areas. We will revise this issue in the revised version.

Figure 9: What is the sample size of each category? What is the uncertainty of these results?

Thanks. We have provided the available gauges of each category, as shown in the following figure 2. One can see that the gauge number of each category is over 135, suggesting that the enough sample size of each class supports the reliability and robustness of the results. We will add the related discussion for this point in the section 3.3.

Figure 10 shows that the relation between the normalized error component (NEC) and elevation is very similar to that between the system error and elevation. What is the added value of NEC? What is significance of the index? Please clarify this.

Good questions. The relationship between the normalized error component (NEC) and

topography is very similar to that between the system error and topography, which is due to the close values of mean precipitation in all topography categories. This phenomenon can be explained by following definition equation of NEC (also see equation (10) in the manuscript) NEC=$(\sum_(i=1)^n (S-G)^2)/((\sum_(i=1)^n (S-G)^2)\times$G ÌĚ) The high similarity does not mean that NEC score is meaningless in investigating the impact of solely topographic factor on systematic error. This only indicates that when the mean precipitation of all terrain classes is very close, the relationship between NEC and topography degenerates into the relationship between systematic error and terrain. In practice, one of the functions of NEC is to exclude the interferences of the differences of precipitation intensity on systematic error, and it works only when the rainfall intensities are obviously different. However, the mean precipitation of all topography categories is very close in the humid regions of China, which leads to high similarity between the two relationship plots (i.e., Figs. 10a and b). In addition, NEC is a useful evaluation score in some cases, for example, avoiding increased values of systematic error with increasing temporal scales when investigating the relationship between systematic error and temporal scale. We will clarify the significance of this metric in section 2.3.2.

Minor comments

Line 17: IMERG-late, not MERG-late

Thanks, we have revised this mistake.

Line 333: “false bias” should be “miss bias”.

Thanks, we have changed ‘false bias’ to ‘miss bias’.

Lines 365: “increase” should be “decrease”.

Thanks, we have replaced the word ‘increase’ with ‘decrease’.

Figure 1: add the unit for density of rain gauge, add the source of precipitation data (1891-2018), and delete the legend on distance.

Ok, we will revise the Figure 1 according to this comment. The source of precipitation data (1891-2018) will be provide in the description.

Figures 2-5: the objective of this study is to compare bias among different products. It could be more visually distinct to put the same bias category (for example, total bias) of different products in a column or row.

We have completely revised the Figures 2-5 according to the reviewer’s suggestion.

Figure 7: delete “false bias” in the description, as no false bias is presented in the figure.

OK, we have deleted ‘false bias’ in the description.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2020-294/hess-2020-294-AC1-supplement.pdf

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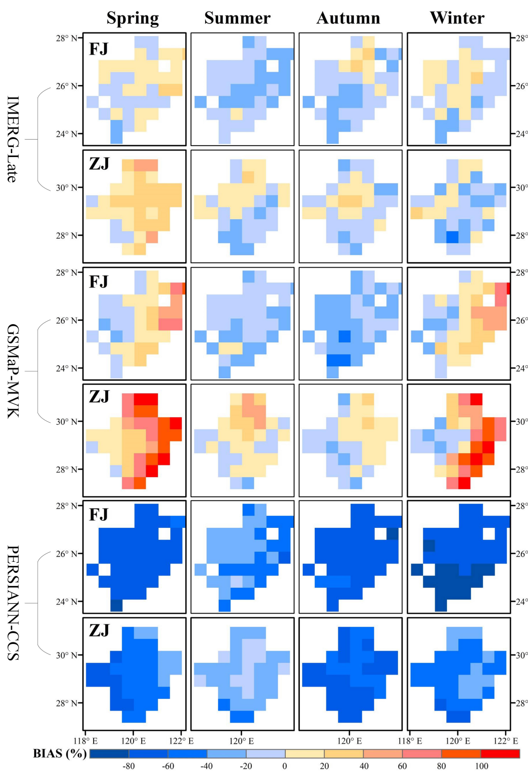

Fig. 1. The spatial maps of the total biases of three SPPs for four seasons over the Fujian (FJ) and Zhejiang (ZJ) provinces, respectively.

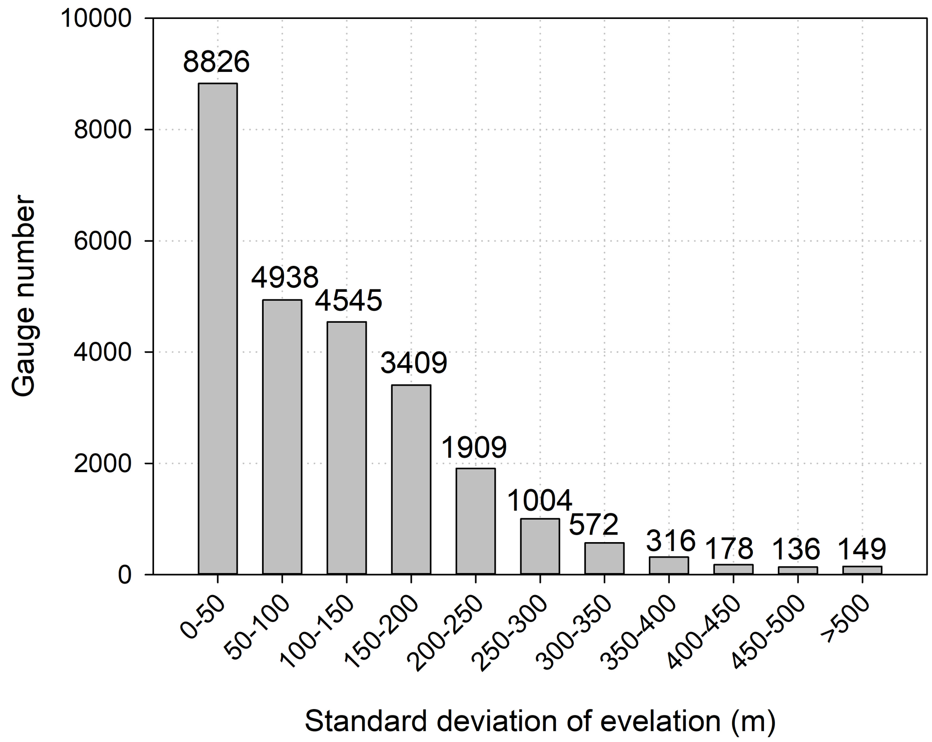

Fig. 2. The gauge number of each topography class.