Authors reply to reviewers' comments

Dear Anonymous Referees,

Thanks for your careful review of the manuscript. We read the reviewers' comments carefully, have considered and responded to all the reviewers' comments, and revised the manuscript accordingly. My detailed responses, including a point-by-point response to the review and a list of all relevant changes, are as follows:

Reviewer #2: ADTD and 3D-LLS are both nationwide Lightning Location Systems (LLSs) in China. However, up to now, the performance of the two LLSs in the whole country is not clear yet. This manuscript compared the records of the two LLSs during 2020 in the first part, and then analyzed the temporal and spatial CG distributions as well as the difference between +CG and -CG over China based on the ADTD dataset during 2016-2021 in the second part. It must be pointed out that the analysis and conclusions in the second part are meaningful only when the performance parameters of ADTD are available. However, the current analysis in the first part is definitely not enough to provide reliable performance evaluation of ADTD. It is suggested that the authors make a comparative analysis between ADTD dataset and contemporaneous data from other LLSs with known performance evaluation parameters (such as WWLLN), to get a general understanding of the overall performance of ADTD in China.

Response: Through careful consideration, we also agree that the first part is somewhat irrelevant to the second part, so we decided to keep only the second part of the content. And following your valuable comments, the second part of the content has been extensively revised and enriched. The wording of the entire text has also been significantly modified. There are three main changes made:

a. The original system abbreviation, ADTD, has been changed to CNLDN (China National Lightning Detection Network) based on its latest official name, and a valuable site layout has been obtained, as shown in Fig. 1.

b. When analyzing the differences between +CG and -CG flashes, a more detailed statistical analysis was performed by dividing China inland into four regions, in your valuable opinion.

c. The analysis of the distribution of +CG and -CG discharge current was added.

Major revisions are required before the acceptance of this manuscript. Major issues are listed in the following:

1. This manuscript is mainly divided into two parts, but the connection between the two parts is not tight. The support of the first part to the second part is weak. Some problems

exist in the comparison between the two LLSs in the first part.

a) Lines 13, 139, and 470: The authors declared that the CG flash detection efficiency (DE) of 3D-LLS is twice that of ADTD, because the total CG records of 3D-LLS is about twice that of ADTD in 2020. However, the authors also stated that many +CG records of 3D-LLS were misclassified from IC events. Furthermore, the comparison is limited to those records detected by 5 or more sensors and the sensors distribution of 3D-LLS network is not uniform. Therefore, such a conclusion is debatable.

b) Line 147: The authors mentioned that the CG flash density in the vicinity of the Canton Tower was 20/km^2/year. Is this an average value for several years or just for 2020? Does the term "DE" at line 153 refer to "CG flash DE"? If so, a CG flash DE of 24.5% is quite poor for a modern LLS. Considering that the sensors of 3D-LLS have already been densely distributed in southern and eastern China (see Line 117), the CG flash DE of 3D-LLS (50.5%) is also far from good. In addition, though TOLOG data can provide very good ground truth, but the comparison with the ground truth from a certain station can only give the performance parameters of a LLS in a local region, not in the nationwide area. Hence, it is necessary to conduct an evaluation for a large range combining with other data.

c) Line 172: The authors mentioned that the DE difference between the two systems can be up to a hundred times. It could also be found in Figure 1 that the DE difference between the two systems exceeds at least 10 times in many areas in Sichuan, Neimeng, Jilin, Shandong and some other provinces. This indicated that the DE of ADTD in those areas is no more than 10%, even if the DE of 3D-LLS is speculated as good as 100%. Such low DE will seriously affect the reliability of the analysis results in the second part. In addition, If the sensors distribution of 3D-LLS network is very uneven and the ADTD network is relatively uniform, it will be meaningless to compare the two LLSs in the whole nationwide region, because such comparison can't lead to a quantitative and reasonable performance evaluation results of ADTD in the nationwide area.

d) None of the sensor distribution map of the two LLSs was presented in this manuscript, which does pose a great obstacle to the understanding of the analysis results. It is suggested that the authors should not compare the two LLSs in the whole country, but to choose some certain areas where both LLSs have good sensors distribution to conduct the comparison and achieve a more reliable result. In addition, it is recommended that the authors further provide more information about the network distribution of the two LLSs as detailed as possible, such as the number of the sensors and the average baseline length in each province.

e) Line 198: The authors stated that "Comparing the detection results for the same radiation source is necessary for valuing the difference between the two networks". It seemed that the authors used a time difference threshold of 1 s for matching common CG strokes detected by both LLSs in 2.3. It can be expected that such a rough standard

will lead to a large number of mismatches.

f) Line 218: “The two networks have different criteria for grouping flashes, and if there was a missed stroke in a lightning flash and they did not use the same stroke to represent the flash, the same lightning flash could not be matched in this case, leading to the low matching ratio” is confusing. If so, why not match stroke, but flash?

Response: Thank you very much for your serious and meaningful comments above. The first part has been removed in the opinion of the first reviewer.

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2. In 3.1, the authors divided China into four major regions according to geographical and climatic factors. Should these four regions be analyzed separately when analyzing the differences between +CG and -CG in 3.2?

Response: This suggestion helps us a lot. In the new vision of the text, we conduct statistical analysis separately for four geographic regions, which can also reduce the errors caused by using the same time zone. Also by the dividition, some interesting new findings are obtained.

3. In Figure 7b, the average peak current of +CG strokes (It is no doubt that the authors should recheck and clarify the words “flash” and “stroke” in this manuscript to avoid confusion) in summer is significantly lower than that in other seasons. Especially in August, it seemed that the median value of peak current of +CG strokes was even lower than that of the -CG strokes. Does this imply that the summer +CG dataset used in this manuscript was seriously contaminated by IC events?

Response: We have supplied in lines 100-103, the lightning data used in this study are flashes grouped from strokes, and the first detected stroke represents the entire flash.

In our study, +CG flashes with currents less than 10 kA are not removed to make sure the comparison between +CG and -CG fair. However, in order to prove the reliability of our conclusions, we have drawn a comparison after removing +CG flashes with peak current less than 10 kA. It can be seen from the below figures that even after removing the weak +CG flashes, the average current of +CG flashes is still lower than -CG flashes in August, which is an interesting finding of this study.

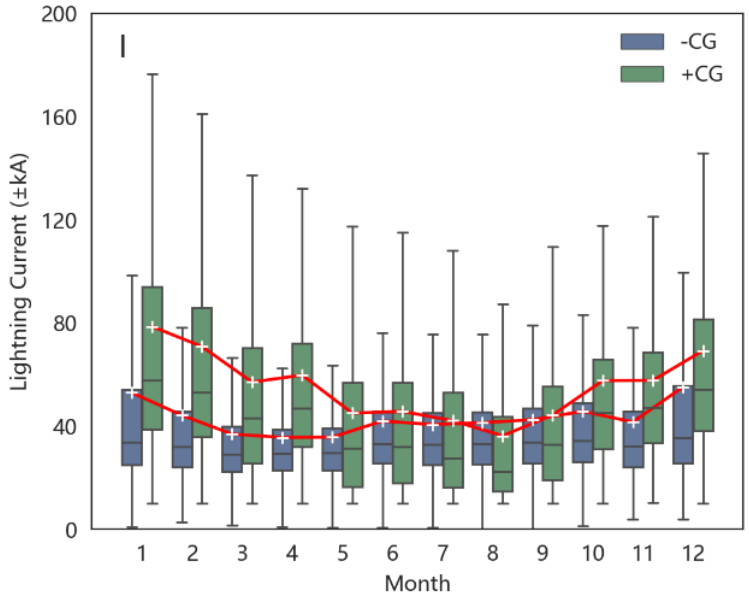

Figure a. Monthly variation of the peak current distribution of the +CG and -CG flash in Southern China. The +CG flashes with peak current lower than 10 kA have been removed.

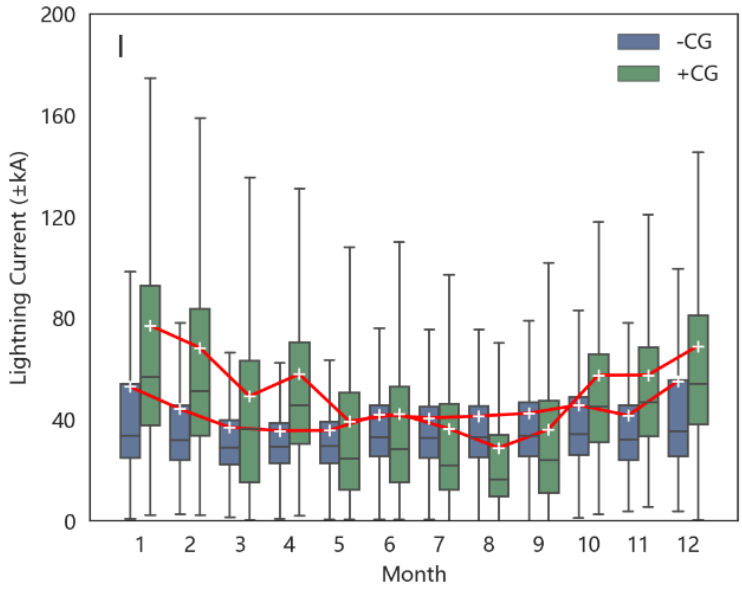

Figure b. Monthly variation of the peak current distribution of the +CG and -CG flash in Southern China. The +CG flashes with peak current lower than 10 kA are kept.