

Thank you very much for the reviewers' comments. The questions and suggestions are very good, which will help us to make further improvements. Now we will answer all the questions one by one.

Comment1: what is actually new and innovation of this paper?

PS: This is a good question. So far, no scholars (including Chinese scholars) have carried out a comprehensive, systematic introduction, analysis and evaluation of the CMA lightning detection network. This paper mainly introduces the development history of CMA LDN, and analyzes the operational capability of CMA lightning network by using the index used in the service. This paper also introduces lightning location algorithms that can be automatic selected to use by CMA LDN business software, according to the number of detectors which detected same one the lightning signals. Change of various algorithms use frequency is analyzed to prove the network performance and positioning accuracy improvement from another perspective. Based on the analysis of the CMA LDN, this paper uses the data of 5 years to analyze the temporal and spatial distribution characteristics and climate characteristics of lightning activities in China, these results can be used to compare with abroad similar networks, which should help foreign counterparts to understand China LDN. Otherwise, it would be a pity that there is no recent China's lightning detection network information in the world literatures database.

Comment2: What is the scope of manuscript?

PS: First, I'm sorry. Title of the manuscript is modified according to another reviewer's suggestion. Maybe it's not very suitable, but we have accepted it.

As reviewer say, the main content of this manuscript has two parts. The first part mainly introduces the basic information, development history and operational capability of CMA lightning detection network, including location algorithm brief description and business application. Referring to the reviewer's comment, we add some basic information about lightning location equipment (line 66-72) in the introduction section. The history of the number of detection stations has been introduced in section 2.1. About future plans, the manuscript has added some information in the line 73-78, the following diagram gives us the basis of the layout design of CMA lightning sites and the distribution plan of the site in 2020. Owing to the length of the article, we are not going to add it to the manuscript. Please see the specific content in revised paper. With regard to data reliability, we think the reliability of lightning data has been proved by analysis of section 1 and 2 in the paper.

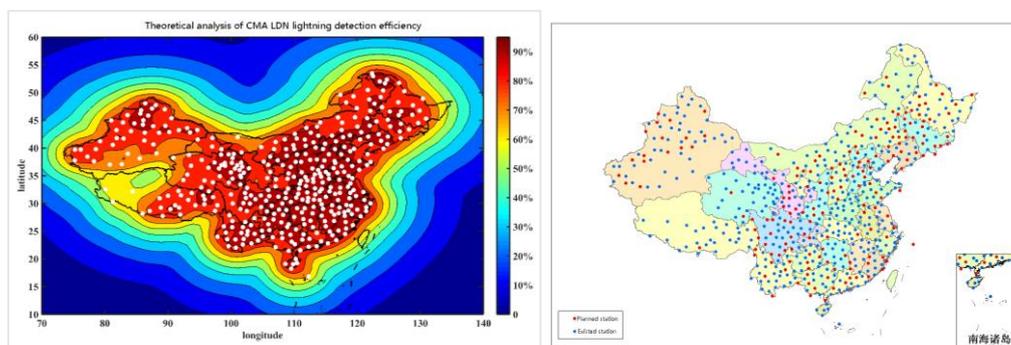


Fig.1 Left is theoretical distribution map of detection efficiency, right is CMA LDN station

distribution plan map (blue point is existed station, red point is planned station, total station number is 599) .

The main content of the second part, is to analyze Chinese lightning activity spatial and temporal distribution and climate change characteristics by using 5-year data collected by CMA LDN. The reliable data reveals the fact of Chinese lightning event and inter-annual variation possible reason. These results can be used to compare with the existing results of other lightning nets. Limited to the length of the article, this article does not make a comparison. But, according to reviewer's comment , we have added an analysis related to other climate variables in section 3.1.

Comment 3: About references

PS: According to the journal requirements and expert comments, we have supplemented all foreign reference DOI, but for the Chinese literature, I regret that, due to differences in file system functionality, DOI cannot be provided.

Some responses to detailed comments

Comment4: abstract need be revised

PS: Thank you very much for your comments. We have made a careful revision of the abstract according to your opinion, and more clearly defined the purpose and scope of this study.

Comment5: “ what does 50% accuracy mean?(line 17-18)”

PS: As we all know, the quality of the lightning detection network depends on the efficiency and accuracy of the lightning location. However, it is very difficult to confirm the efficiency and accuracy of lightning location. Generally, it is accepted that both the hybrid method and the multi-station method are better than the two-station method, the magnetic direction method and the amplitude method in the positioning efficiency and accuracy.

Due to the geographical conditions, the number of base stations and network layout, CMA LDN cannot be all unified use multi-station positioning algorithm. Our strategy is to automatically select the location algorithm by the business software based on the number of detectors detected same one lightning signals. From the point of view of spatial distribution, where the higher the usage frequency of multi-station method is, the more reasonable the detection station location is, the higher the quality of lightning data. From the point of view of time variation, the higher multi-station method usage frequency is, the higher the detection ability of the whole lightning network, and the higher the quality of the lightning data, and vice versa.

According to statistics, in practical applications, M3 usage frequency has increased year by year, the frequency of use is close to 50% by 2013. Therefore, we believe that the detection accuracy of the whole CMA LDN is improving continuously.

Thus, the sentence “**50% accuracy**”(line 17-18) is not expressed accurately and has been modified in the abstract.

Comment6: “Which algorithm was used for the results shown in section 3?”

PS: According to explanation in **Comment5**, I believe reviewers have already understood that the lightning data used in section 3 is the result of various algorithms. The location algorithm of each lightning event is chosen automatically according to the number of stations.

Comment7: Figs. 1, 3, 5, 6: What is the reason for the insertion in the lower right corner? This should be skipped or clarified.

PS: According to the Chinese publication requirement and regulations, the South China Sea Islands must be printed in the lower right corner of China map. This is already an international rule, and scholars familiar with Chinese scientific research have accepted it. We hope you understand it and thank you for reminding me.

Acknowledgments

Firstly, thanks to comments of reviewers, we have made a great deal of amendments and supplements to the full text. I would like to express my heartfelt thanks to you.

Because of the length and scope of paper, it is impossible for us to involve all scientific and technological problems of Chinese lightning. Therefore, we cannot meet the different concerns of all reviewers in this manuscript, we express our apologies. This also shows that international communications in the field of China's lightning research and business work is too little, and there is not enough reference and literature to provide foreign scholars. Next, we will continue to improve CMA LDN and timely share the development of China's lightning research and business development with foreign counterparts. Finally, we would like to express our heartfelt thanks to reviewers.