

Dear Editor,

Thank you very much for your great help. Many thanks to the reviewers for their valuable time reviewing our manuscript. We would also like to thank the two reviewers for their suggestions and comments, which are of great help to us to improve the manuscript quality. After carefully reading the nice comments and suggestions of the reviewers, the corresponding author made a wide range of rewrites to show the importance of the comments of the reviewers. Please refer to the revised manuscript for details. Below are our replies to each of the comments and suggestions.

Yunfei Fu

**RC1:**

Main comments

1 Lines 21- 24. “Compared with the MBR method, the BFE method can obtain a smaller rain cell area, and the filling ratio is better. However, the MBR method can simplify the data storage volume. Consequently, we employed the MBR method to analyze the precipitation structure of two typical rain cell precipitation cases.” How is difference in storage between two methods? Is difference of data storage between the two methods the only reason to choose MBR method?

Response: Thank you very much. This paragraph has been deleted. This question is answered in the conclusion of the manuscript: “It must be noted that the difference between MBR method and BFE method is only in the horizontal geometric parameters of the rain cell.”[Line 313-314]

The reason why two methods are used is also from scientific considerations, i.e. one more method is better than one. But your question is very good. Let's be clear about our starting point.

2 Fig. 1 shows that there are stratiform, convection and other precipitation. How was this classification made? Is it proved by the used datasets?

Response : Thanks. The identified precipitation types (convective precipitation, stratiform precipitation, other types of precipitation) were provided by the standard data of TRMM PR algorithm, and the three types of precipitation are the basic components of rain cell. The specific algorithm of precipitation type is complicated, which was discussed in detail in papers listed below. Simply, stratiform precipitation was identified by bright-band, convective precipitation was identified by 40 dBZ threshold, and precipitation outside the two categories was other type of precipitation. Since the precipitation type identification method (V-method, Vertical profile method, H-method, Horizontal pattern method) had been proved correct by many studies (except for the Tibetan Plateau), we do not need to spend time to verify.

Since the defined rain cell was composed of different precipitation types, the characteristics of rain cell and its regional differences, changes in the precipitation process, or climate changes can be studied by analyzing the proportion and intensity of different precipitation types in the rain cell. Therefore, the rain cell data established in this study has important scientific significance for the cognition of the rain cell.

Please look the listed two references:

Awaka, J., Iguchi, T., and Okamoto, K.: TRMM PR standard algorithm 2A23 and its performance on bright band detection, *J. Meteorol. Soc. Japan. Ser. II*, 87A, 31–57, <https://doi.org/10.2151/jmsj.87A.31>, 2009.

Fu, Y. F., Liu, Y., Wu, Z. H., Zhang, P., Gu, S. Y., Chen, L., and Nan, S.: A new algorithm of rain type classification for GPM dual-frequency precipitation radar in summer Tibetan Plateau, *Adv. Atmos. Sci.*, <https://doi.org/10.1007/s00376-024-3384-7>, 2024.

3 For the definitions of the rain cell, it is using a threshold of 17 dBZ. Is that mean that

it will miss some weak cumulus cloud, e.g. cumulus without precipitation?

Response: Thank you very much. You asked very good questions! 17 dBZ is the threshold for TRMM PR to identify precipitation, which is determined by the performance of PR wavelength 2.2 cm (frequency 13.8 GHz). For small-scale particles, PR cannot scatter at its wavelength, so PR cannot identify such weak precipitation, so the rain cell we defined does not include such very weak precipitation.

In subsequent studies, we will use FY-3G PMR or GPM DPR data to establish rain cells, because PMR and DPR have Ka-band radar, which can identify weak precipitation. TRMM PR, VIRS, and TRM were selected to build the rain cell data because they have 15 years of observations.

4 It was noticed that this paper is a data description paper. I agree that the increasing improvement of rain cell characteristics can promote our cognition of the precipitation system. The authors developed a new dataset for the rain cell. I think readers want to know what can we do with the new dataset. That says, in which aspect the new dataset can improve our knowledge of the cloud and precipitation system.

Response: That's a very good reminder. Thank you very much. In the conclusion of the revised manuscript, I have added a paragraph describing the use of the rain cell data: "The new rain cell data in this study can be used to study the peculiarity of rain cell geometric and physical parameters. Although a lot of achievements have been made in this aspect, systematic and in-depth analysis is still needed, such as the regional differences of these parameters and the characteristics of climate change. It can also be used to analyze the relationship between the physical and geometric parameters of rain cell, which also have regional differences. The effective radius of cloud particles, optical thickness, liquid water path and other parameters in rain cell can be obtained by combining retrieval algorithms of visible and near infrared reflectivity, which can analyze the characteristics of cloud physical parameters of rain cell. These parameters such as cloud water and ice water in column, cloud temperature and rain rate in rain

cell can also be obtained by using microwave brightness temperature retrieval algorithms, and the relationship among these parameters can be analyzed.” [Line 317-326]

5 The illustration of the new data via cases shown in Fig.1. How do the authors choose these cases and what is special characteristics of these cases? If we want to use the dataset to investigate the rain cell, what should we carefully concern?

Response: Thank you very much. These two rain cells were randomly selected, one had more weak precipitation (stratiform precipitation) and another more strong precipitation (convective precipitation). Usually, we have knowledge of the two kinds of precipitation systems. Compared with the geometric and physical parameters of the rain cell identified in this study, the results were also in line with our inherent cognition on the two kinds of precipitation system, such as the weak rain cell is not deep in the vertical direction with small rain rate, and the strong rain cell is deep with low infrared brightness temperature. The rain cell identification algorithm of this study will be provided to the National Satellite Meteorological Centre of CMA. It is believed that the rain cell data will be available to use in the near future, and detailed explanations will be given. There are no special precautions when using.

Minor comments

1 Line 20. I think word “well” is more proper than “better”.

Response: Changes were made in the revised manuscript. Thanks.

2 The format of Table 1 should be refined. Text of column 2 occupies space of column 3.

Response: Thank you for your nice suggestion. Changes have been made in the revised manuscript.

**RC2:**

This paper presents a different method for defining “rain cells” using TRMM data, and publishes the new dataset for public use for meteorological studies. The method fuses TMI, PR, and VIRS data and uses a minimum bounding rectangle method to construct its features, as opposed to fitting ellipses, which has been the traditional method in the literature. Referring to other methods in the literature, there is already an extensive body of work constructing precipitation features with TRMM data, combining all three datasets. The authors reference this body of work but fail to describe how their dataset is an improvement beyond the state of the art. For this reason, I recommend rejection. I would recommend revision and resubmitting a paper in the same journal but selected as a method paper instead of a data paper, detailing how the MBR method is advantageous and presents a feature dataset beyond that which is already constructed by the Liu/Zipser groups and readily available.

Response: Thank you very much for your frank comments and suggestions, but I regret your negative decision. I would like to reply you as follows, perhaps you will change your previous decision.

First of all, I want to tell you that the corresponding author has made significant rewrites to the original manuscript, because there were many unreasonable descriptions in the original expression. Secondly, we describe the starting point of this study, that is, the previous study results must be respected, such as the contributions made by Dr. Liu, Nesbitt, Zipser, et al. in this field. This is the scientific ethics that subsequent Scientific workers must follow, so the revised manuscript makes positive comments on their methods and results. In the revised manuscript, it is pointed out that the identified rain cell is within the PR scanning range to ensure the integrity of the identified rain cell. We know that the rain cell data established by Dr. Liu/Zipser is very good and widely used. We often read the articles published by their group and are deeply inspired by them.

In our study, the proposed rain cell identification method and the corresponding data may be another choice for studies, after all, more datasets should be better than one for scientific research.

I hope you will be satisfied with my response to your comments. Since we are colleagues, I welcome you to communicate with us. Thanks again.

## Major Comments

1 Title: I would suggest removing the multiple “and”s and using commas

Response: Thank you. The title has been revised.

2 Literature: The background section reads as thoroughly as a textbook, going back to the 1970’s for a definition of a “rain cell” – the references need to be updated to more relevant sources and some discussion of the motivation behind a consistent definition of a “rain cell” is needed, here. Different scales and boundaries are useful for different reasons.

Response: Thanks. The revised manuscript was rewritten. The history of rain cell studies was mentioned to highlight the importance of Nesbitt, Liu and Zipser's work on the identification of rain cell “With the massive data observed by PR, VIRS and TMI, Nesbitt et al. (2006), Liu et al. (2007, 2008), Liu and Zipser (2013) made spick-and-span studies in the field of rain cell identification and its parameters with elliptic fitting method. Their rain cell data were also widely used on analyzing the temporal and spatial distribution characteristics of rain cell (Zhou et al., 2013; Yokoyama et al., 2014; Ni et al., 2015), such as that line shaped convective systems occurred more frequently over ocean, and showed higher frequency in the subtropics (Liu and Zipser, 2013).” [Line 55-60]

Because this study laid emphasis on the rain cell method (MBR and BFE) so the previous rain cell identification methods were briefly summarized, and those specific studies will be discussed later studies. Thanks again.

3 This paper discusses, disjointedly, the Precipitation Feature Databases constructed by the Liu/Zipser groups at the University of Utah and Texas A&M Universities at Corpus Christi. The PF database has evolved into a massive undertaking with cells of every size and strength, and defined by PR radar (RPFs), and passive-microwave polarization corrected temperature (PCTFs). Some focusing solely on precipitation, convection, MCSs, tropical cyclones, etc. They are freely available for download from <https://pps.gsfc.nasa.gov/> or <http://atmos.tamucc.edu/trmm/>.

While this manuscript references the dataset, it does not elucidate how the work advances the state of the art of constructing precipitation feature (or rain cell) databases, beyond trying a new boundary-definition method.

There are many other boundary definition methods currently used to define precipitating areas from satellite data, such as convex hull or K-means clustering. Many of the Precipitation Features (PF) are defined using contiguous pixels, and do not require a bounding ellipse to be drawn.

It is not made clear in this manuscript how the authors' method advances this technique of defining features.

Response: Thank you for your frank questions. There is some ambiguity in the expression concerning your questions in our original manuscript. In the rewrite manuscript, we made drastic changes and additions, such as the use of data (see the last paragraph in the conclusion).

This study presents a slightly different approach to the rain cell from that used by Dr. Liu/Zipser's group. The main difference was rain cell identified within the scope of PR scan, and rain cell data of two cases was supplied.

As you said, it is a huge project to build a massive database that is easy for everyone to use. The China Satellite Meteorological Center is already implementing this project, and we are also involved. As an independent study unit, programs need to be written by itself and methods need to be established by itself. However, we can learn from the data provided by the international community and the methods already adopted, which

is also a respect for the existing studies.

I hope my above answer will please you, because you have recognized that we have a spirit of independent study and respect for previous study results and scientists. Thank you very much again.

Minor Comments:

1 13 “Previous studies have mostly analyzed rain cells from a single radar data” This statement is false, there is a wealth of studies of rain cell (feature) database analysis from satellites.

Response: Thank you. It's missing from the rewrite.

2 17 Swath truncation: is this in reference to the ends of orbit files creating boundary artifacts? Or the edge of the swath on the sides cutting off features prematurely? It is not made clear in the rest of the manuscript.

Response: Thank you. Although this issue is not specifically discussed in the revised manuscript, we have been redescribed to avoid confusion. Please see line 130 to 133 “According to the working mode of PR, its swath consists of 49 pixels (from number 1 to 49), so if the identified rain cell has pixels at the edge of the PR swath (the first pixel and 49th pixel), the rain cell is not included. If the identified rain cell is at the beginning and end of the PR swath, the rain cell is also eliminated.”, and line 137 to 139 “The slight differences of geometric parameters calculated by MBR method and BFE method show in the length and width of rain cell, while the physical parameters calculated by the both methods are the same.”. Dr. Liu/Zipser's approach is not wrong either, we just have a slightly different focus. You know that very well.

3 28 Many journals do not allow citations in an abstract



Response: Thanks for reminding us, we will follow the requirements of ESSD.

4 33 suggest “the literature”

Response: Thank you. It's missing from the rewrite manuscript.

5 79 suggest “over East Asia”

Response: Thank you. It's missing from the rewrite manuscript.

6 83-84 How is what you have created different from previous datasets in the literature?  
Specifically, the PF database?

Response: Thank you. First of all, the data set created in this study has something in common with the PF database, both were built based on the TRMM multi-instrument observations. By defining different characteristic conditions, PF database forms various precipitation parameters, including microwave brightness temperature, infrared temperature and lightning information, which shows that the information of PF database is very comprehensive and worth to learn. The data set of this study took the rain cell within the swath of PR scanning as the object, defined its geometric and physical characteristics parameters. The identified rain cells were numbered and convenience search. The specific differences between our dataset and the PF database will be further studied.

7 156 Please clarify if you are referring to the edge of the swath or the end of the orbit

Response: Thanks for reminding me. In revised manuscript, the sentence had been changed into “According to the working mode of PR, its swath consists of 49 pixels (from number 1 to 49), so if the identified rain cell has pixels at the edge of the PR swath (the first pixel and 49th pixel), the rain cell is not included. If the identified rain

cell is at the beginning and end of the PR swath, the rain cell is also eliminated.” [Line 131-133]

All the above have been modified in the revised manuscript. Thank you again.