

## **Responses to Reviewers' Comments**

We sincerely appreciate the time and effort devoted by the anonymous reviewers and editor. We thank the reviewers for these constructive and professional comments again. And Our point-to-point responses can be found below. The reviewer comments/suggestions are in *italic* font, and our responses are underlined and in blue. The file name "Manuscript with marked changes" is abbreviated as "mms".

### **Referee #2 Evaluations:**

*The authors have provided pertinent responses to my comments. In particular, the innovative aspect of this study compared with previous ones is now discussed and justified. I also appreciated the inclusion of a discussion of the delay between the detection of the first radar volume and the first flash as seen by the 3 lightning detection networks, and about the characteristics of the lightning sources for the first lightning flash.*

*Below are a few minor points to be corrected. A detailed re-reading of the manuscript is still necessary.*

### **Specific comments**

*Lines 67-68: natural lightning flashes are not defined as intracloud and cloud-to-ground; they can be categorized as intranuage or cloud-to-ground.*

Reply: The draft has been revised as suggested. Please see mms (Lines 67–69).

### Lines 67–69 in mms:

"Moreover, natural lightning flashes can be categorized as intracloud lightning and cloud-to-ground lightning (Uman and Krider, 1989)."

*Line 73: aadition → addition*

Reply: Corrected.

*Lines 77-79: remove < the aerosol... in cloud electrification >; this sentence makes no sense here.*

Reply: Corrected.

*Lines 82-86: make two sentences*

Reply: The draft has been revised as suggested. Please see mms (Lines 80–84).

### Lines 80–84 in mms:

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“The NIC was proposed on the basis of cold-chamber laboratory experiments (Reynolds et al., 1957; Takahashi, 1978). Subsequently, field observations demonstrated that lightning production is critically linked to ice processes (i.e., graupel signatures) (Dye et al., 1986; Takahashi et al., 1999; Carey and Rutledge, 2000; Basarab et al., 2015; Stolzenburg et al., 2015; Mattos et al., 2016, 2017; Takahashi et al., 2017, 2019; Hayashi et al., 2021; Zhao et al., 2022).”

*Line 113: do you mean < polarimetric radar is the best observation system for tracking ...>?*

**Reply:** Yes, this sentence has been corrected.

*Lines 152-156: make two sentences*

**Reply:** The draft has been revised as suggested. Please see mms (Lines 147–151).

**Lines 147–151** in mms:

“In Zhao et al. (2021a), the dataset was first shown to the public. They obtained observations of 57 (39) isolated thunderstorms (non-thunderstorms) that occurred over South China in the warm season (from late May to early September) of 2016 and 2017 from the S-band polarimetric radar and three independent lightning location systems.”

*Line 168: remove <regarding>*

**Reply:** The draft has been revised as suggested.

*Lines 188-189: the black circle indicates a distance of 70 km from the centre of the LFEDA network*

**Reply:** The draft has been revised as suggested. Please see mms (Lines 183–184).

**Lines 183–184** in mms:

“...the black circle indicates a distance of 70 km from the centre of the LFEDA network.”

*Lines 265-269: this sentence is not clear. Please rephrase this sentence.*

**Reply:** The draft has been revised. Please see mms (Lines 258–262).

**Lines 258–262** in mms:

“A recent study (Mattos et al., 2017) also revealed that in ~98% of thunderstorms, the first IC flash preceded the first CG flash, and the IC flashes occurred approximately 29

minutes after the first radar echo, CG flashes were most frequently delayed by approximately 36 minutes.”

*Figure 2: most of the time, the time of the first flash occurrence in the LFEDA and ENLLS datasets are the same. However, for some thunderstorms, the delay between the first flash detection with these two systems can reach 20 min. How can you explain this fact?*

**Reply:** It depends on the detection efficiency of the lightning location system. As described in context, the LFEDA has the superior detection efficiency in this analysis area. Thus, if the LFEDA detects the accurate first flash but the ENLLS missed it, and the ENLLS takes the later lightning flash for the first flash, the delay between the first flash detection with the LFEDA and ENLLS can reach 20 min.

*Lines 481-482: please explain this statement.*

**Reply:** We have rephrased this sentence. The heights of the initiation sources and propagation sources of the first lightning flashes within isolated thunderstorms over Guangzhou are concentrated at an approximate  $-10^{\circ}\text{C}$  isotherm height, which provides supplementary evidence that the main negative charge layer is located at  $-10^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$  isotherm height on Earth, as reported by Krehbiel (1986). Please see mms (Lines 462-466).

**Lines 462-466** in mms:

“The heights of the initiation sources and propagation sources of the first lightning flashes within isolated thunderstorms over Guangzhou are concentrated at an approximate  $-10^{\circ}\text{C}$  isotherm height, which provides supplementary evidence that the main negative charge layer is located at  $-10^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$  isotherm height on Earth, as reported by Krehbiel (1986).”

*Lines 481-484: make two sentences*

**Reply:** The draft has been revised as suggested. Please see mms (Lines 462-469).

**Lines 462-469** in mms:

“The heights of the initiation sources and propagation sources of the first lightning flashes within isolated thunderstorms over Guangzhou are concentrated at an approximate  $-10^{\circ}\text{C}$  isotherm height, which provides supplementary evidence that the main negative charge layer is located at  $-10^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$  isotherm height on Earth, as reported by Krehbiel (1986). The values of  $Z_H$  ( $Z_{DR}$ ) corresponding to the initiation

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sources and propagation sources of the first lightning flashes suggest that are differences in particle shape and/or size between initiation sources and propagation sources, although the differences are too subtle to quantify in this study.”

Figure 6a: <Altitude (km above AGL)> → <Altitude (km AGL)>

Reply: Corrected.