Electron Microburst Size Distribution Derived with AeroCube-6

Response to Reviewer Feedback

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21 December 2019

Dear reviewers,

Thank you for taking your time to read and evaluate this manuscript. I have addressed your comments and made the necessary changes to the manuscript. In this letter, my responses are marked in green and your simple suggestions that do not warrant a detailed response are marked done.

**Reviewer 1**

By using observations from the twin AC6 CubeSats, authors statistically studied the size of >35 keV electron microburst, which is typically considered as chorus-driven precipitations. The obtained size is a few tens km in low earth orbit (LEO) and within 200 km when mapping to the equator. This is roughly consistent with previously reported scale size of microburst (10s km) and chorus packets (100s km). To the reviewer's knowledge, this paper, for the first time, calculated the scale size of >35 keV electron microburst in a statistical sense, by taking the advantage of the high time resolution (10 Hz) and close conjunctions of a pair of AC6 CubeSats. The objectives are compelling and the manuscript is well-organized and well-written. This reviewer recommend the manuscript to be published in JGR after addressing the following comments.  
  
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Major comments  
Several essential technical details should be specified.

(a) Lines 151-155, Please define the burst parameter and how this parameter as well as the selected threshold value works in identifying microbursts.

I defined and explained the burst parameter in the manuscript, closely following the arguments in O’Brien at al., 2003

(b) Lines 168-169, Please specify the time window for the CC and AC calculations?

The AC window was two seconds wide and CC window was one second wide. This has been added to the manuscript.

(b) Lines 182-185, Is there an overlapped time period between two successive CC calculations? Is there a time lag introduced to the CC calculation?

(c) Lines 182-185, The time window to calculate the CC is 1 or 1.2s, which is small and can sometimes be smaller than the duration of one microburst event such as the example in Figure 2e. Is this time window good enough for these long duration microbursts? How is the result sensitive to the time window, for example, what is the statistical size of microburst if the authors apply a 2s time window?

Thank you for pointing out the issues with the duration of the CC. We chose one second CC window to encompass at least one microburst, which we defined to last up to a second, and avoid correlating the background. This result does not appear to be sensitive to CC window widths of one and two seconds. We also correlated microbursts with a two second CC window and cleaned the remaining dataset by eye. The LEO distribution of microbursts as a function of separation was negligibly different.

For both the one and two second CC windows we estimated the average microburst widths from both spacecraft. Our idea was to see if microburst widths were influenced by the CC window size. We estimated the microburst width at half of the peak prominence and found that 1/6th of microbursts had a width of greater than 1 second. Both spacecraft observed a strongly peaked, ~0.5 second average microburst width. Finish thought  
  
Lines 230-233, The second peak exists only at 70-80 km for different L ranges is surprising, considering the data samples are still large (> ~1000; Figure 3c). If this is caused accidentally by limited events, it is not expected to exist in all the four L ranges. If this is due to a two-size microburst distribution, although this is not realistic, there should have more events within the 30-60 km separation bins, considering a huge number of samples in these bins. Do authors have a reason for it?  
  
Is it possible to add some discussion on how does the microburst scale size change versus L shells? The authors have already divided the results into four L shell ranges, but few descriptions are made regarding this point. It will be a valuable information to describe the microburst scale size vary as L shell changes and comparing it to the trend of chorus scale size.  
  
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Minor comments

Line 39 'complete loss'. Sub-second electron Microbursts are typically caused by wave-partical interactions due to chorus wave via pitch angle scattering process, whose efficiency has energy and pitch angle dependences. Without specifying the electron energy and pitch angle, I would recommend to reword 'complete' to other words like 'significant', 'dramatic', etc.  
  
Lines 175-177, Please explain why not include events that are only observed by one of the two satellites? Most of these events are caused by the s/c separation is larger than the microburst size. By including them may potentially make the Figure 3a drops faster.   
  
Figure 3a and 3b, Is it possible to shift each point to match the center of each bin in Figure 3c for an easier way to see the one-to-one correspondence? Same for Figure 4.

**Reviewer 2**

This paper uses AC6 data along with model results to determine the likely size of microburst populations in the radiation belt. It is a useful study to the community, furthering knowledge of microburst populations and driving mechanisms, and could be published with some moderate clarifications and corrections.

**Moderate clarifications and corrections**

Lines 139-140: Is the small precession in MLT a limitation of your study? If so, this should be discussed later in the paper.

Figures 3 & 4: Is it important that the AC6 microburst size histograms are divided into L bins? This doesn’t seem to factor into the subsequent discussion.

Lines 255-261: Consider expanding this paragraph greatly, or publishing Appendix A as a separate paper – doesn’t seem associated with the rest of the work.

Figures 3 & 4: Why are a) and b) shown as lone plots when they are histograms? This makes them appear to be continuous functions.

Lines 276-277: Why is the microburst footprint assumed to be circular? Please clarify.

Section 5.3: Are the microburst size model results at the equator or in LEO? This is not clear in the text.

Please make sure that all figure captions are fully explained and expanded in body text. Some of the figures appear to be most fully explained in the caption, and that makes reading the text a bit disjointed (see Figure 5).

**Minor clarifications and corrections**

Lines 74-90: Did these studies discuss the energies of their observed microbursts?

Lines 103-108: Does ‘microburst size distribution’ refer to microburst spikes, packets, or regions?

Lines 154-155: What is ‘good’?

Lines 253-254: Is the PDF trend in Figure 3 and 4 actually similar?

Line 314: Small typo: “must less” -> “must be less”

Line 432: Does nature actually prefer a microburst PDF? What do you mean? Maybe it’s the PDF that nature most resembles?