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Comment on acp-2021-853

Anonymous Referee #2

Referee comment on "Characterising the dynamic movement of thunderstorms using very low- and low-frequency (VLF/LF) total lightning data over the Pearl River Delta region" by Si Cheng et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-853-RC2, 2021

This manuscript employs total lightning observations from the Foshan total lightning locating system to characterize the movement and size of eight thunderstorms in 2014. However, it isn't clear how they are useful or novel. Additionally, I have concerns about the data processing leading to their conclusions. For instance, some of the storm velocities touted by the paper are physically unrealistic (e.g., >200 km h^{-1}). I recommend rejection in present form.

Major comments:

- While the paper indicates eight storms were selected for analysis, there is no justification given for why these eight storms were retained and others discarded. With only eight storms this study is missing the sample size to make generalizable conclusions while simultaneously lacking the detail of a case study. There either needs to be a larger number of storms considered, or these eight storms must be analyzed in greater detail (i.e., compare to convective environmental conditions, synoptic wind fields, etc). For instance, it is hard to conduct a thunderstorm morphology study without characterizing the environmental conditions (e.g., CAPE, wind shear, etc) since those parameters are influential determinants of the size and longevity of convection.
- I am concerned about the method of calculating the thunderstorm's direction, velocity, and furthest distance parameters. There is no mention of how thunderstorms spanning multiple 12-min grids are joined into a single multi-grid thunderstorm. While connected neighborhoods labeling can be performed in three dimensions, the paper does not indicate this capability was utilized. Figure 4 shows that 12-min increments were joined, but this aspect of the methodology is important and not discussed at all. Without a clear method of joining multi-timestep storms, it is hard to account for storm splits and mergers that could easily sway the velocity, duration, and FD calculations that span multiple 12-min grids. In fact, the maximum velocity reported in the abstract of >200 km h^{-1} (a physically unrealistic value), as well as the highly variable storm velocities in Figure 5, suggests the methodology is not joining thunderstorms across

multiple 12-min frames effectively. While the storm velocities are touted as a finding with "great significance" in lines 200-205, I believe it is more likely a deficiency in the methodology.

- The detection efficiency of the FTLLS will vary with distance from the network. Storms that move into the periphery of the detection area will experience inconsistent detection efficiency and the calculation of the movement metrics will be biased at these ranges. For instance, according to the longitudes in Figure 4, the storm in pane (a) extends nearly an entire degree east of the FTLLS domain in Figure 1. The detection efficiency, particularly for IC flashes, must erode at this distance, and making the calculations of FD, VA, and velocity questionable. The effect of the FTLLS detection efficiency on the thunderstorm classification needs to be investigated.

Minor comments:

- Line 51-52: Citation?
- Lines 53-55: I don't follow this reasoning
- Line 111: How many thunderstorms are excluded by this condition?
- Lines 124-135: I'm confused where the subscripts 1 and 2 come from. It seems like each storm would receive one Clat and one Clon, so how are two Clat's and two Clon's being calculated to derive the direction and velocity? If this is referencing Clats and Clons from multiple 12-min grids, how were the joined into a single storm?
- Line 128: Normally true North serves as the benchmark. This decision results in some hard-to-interpret graphics later in the paper. For instance, west-to-east moving storms (as these appear to be from Figure 4), receive directions of ~0 or ~360 degrees, as opposed to 270 degrees that we normally associated with westerly wind.
- Line 141: Are lightning events the same thing as flashes? Or are they strokes? Please clarify in text.
- Line 164: What is the significance of comparing each storm's lightning to the rest of the lightning observed by the FTLLS?
- Line 186, 208: "Severe" storms have a particular meaning (i.e., producing some sort of surface hazard that makes them severe), and surface hazards were not mentioned in the analysis.
- Line 287: How do the rivers affect the storms?
- Line 288: Figure 4 seems to indicate the storms move from west to east?
- All – Needs editing and spelling check (e.g., "dimention" and "adjacenct")