The study describes basic cloud properties based on the MCIT cell tracking algorithm. This is useful and timely research, but it could benefit from the following comments:

1. The authors should acknowledge that the core algorithm of MCIT is based on Rosenfeld (1987), and an associated very similar study of the relationships between the tracked cloud properties based on it (Gagin et al., 1985).

   Done.

2. Line 24-37, another key reason models usually fail in a real case simulation is that modelers mostly focus on reflectivity comparison between model and radars. Reflectivity can be a very confusing parameter for cloud microphysical analysis since it is proportional to the first moment of particle concentration and 6^{th} moment to the size of particles within each radar gate volume. Recent efforts to use forward operators (Ryzhkov et al., 2011, Wolfensberger and Berne., 2018, and Kumjian et al., 2019) to simulate dual polarimetric parameters like ZDR, KDP, and Rhohv demonstrate stronger confidence in cloud microphysical analysis.

   Added this discussion to the introduction at lines 29-33 in the new version of the manuscript.

3. Line 62-65, Hu et al., 2019b indicate the dataset is roughly 3000 cells during a multi-year window of cell tracking within the greater Houston area. This study did analyze general characteristics (Figs 2,3, 6-8) of cloud lifecycles of many cells. So I won't say this is only "a few convective clouds".

   We reworded this section to address your comment. It can be found at lines 65-67.

4. Line 68, add space "aroundthe".

   Done.

5. Line 80-82, it is recommended to use radar site centric domain instead of city landmarks to avoid radar beam size inhomogeneity at the same distance from the center of domain. In addition, the authors domain is over 100 km from the radar. Please justify the vertical extent the authors are focusing on and why.

   Apologies, the domain is radar centric (the domain center is KHGX). This section was worded incorrectly and has been fixed to reflect this. As for the vertical extent, we are investigating the depth of the troposphere. Cells within 15 km of the radar have been removed based on major comment 1 from reviewer #2. We are focused on

investigating the vertical evolution of shallow, modest deep, and vigorous deep convective storms through their entire depth in order to better understand how they evolve over time in a bulk sense.

6. Line 92-93, what is the vertical resolution for VIL calculation?

   It varies with range from the radar. The lowest resolution for VIL is at the edge of the domain and conversely highest near the radar. However, because of the cone of silence, VIL calculations within several kilometers of KHGX are not valid because they do not consider the entire depth of a given cell at those distances.

7. Equation 1, Is there any Z limit for VIL calculation? Say if Z is 60 dBZ, is it still used to calculate VIL?

   No, there is no limit for the VIL calculation.

8. Line 117, for CTH detection, what reflectivity threshold, if any, is used here? Or how did the authors determine if the 88D radar data is noise or weather echoes?

   The reflectivity threshold for CTH (changed to ETH based on comments from reviewer #2) is -10 dBZ. This has been added to the manuscript to improve clarity at line 138.

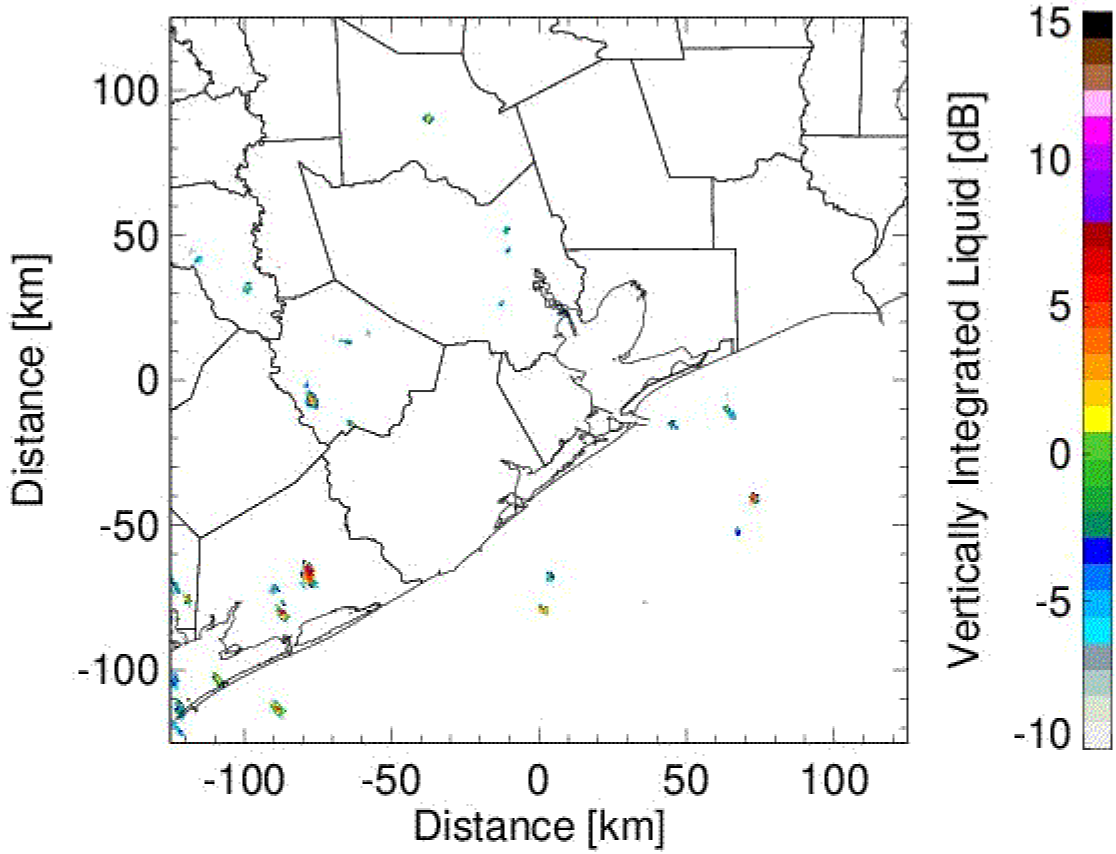
9. Line 118, the lowest gate of radar detectible signal is forced by the range from radar as well, so how did the authors make a correction about that?

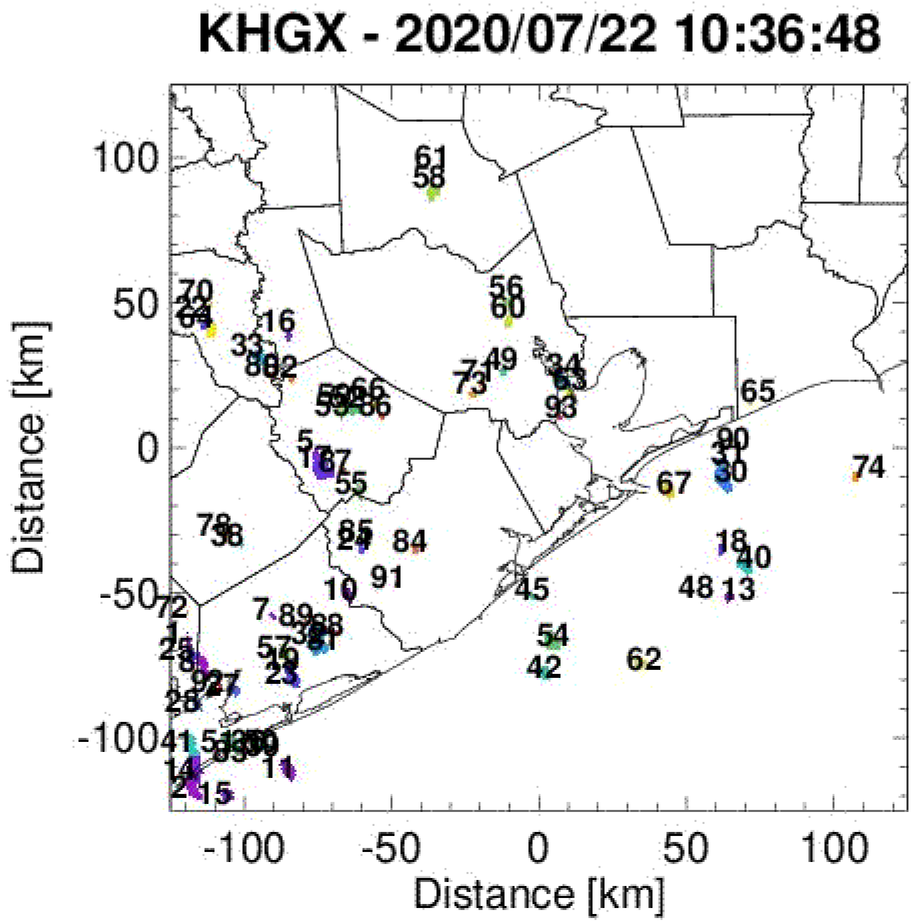
   Corrections were not made and values for H_{cell} are affected by this issue. The maximum height of a gate at the edge of our domain (ignoring the effects from any ducting), is approximately 2 km above radar level since KHGX scans at the lowest elevation of 0.5°.

10. Table 1, is it possible for the authors to provide a time series or movie of one of the tracked cases to demonstrate the labeling of shallow, modest, and vigorous convective cells? Please include the cell boundaries as contours when generating the figure/movie, in the supplementary materials would be sufficient.

    We have included animations of VIL (dB) and the tracked cells from a day where shallow, modest deep, and vigorous deep cells were prevalent. On this day, we analyzed 258 shallow, 71 modest deep, and 81 vigorous deep convective cells.

KHGX - 2020/07/22 10:36:48





11. Figure 4. Are there any restrictions on the lifetime of cells here? Say at least 30 min? Or 5-6 radar volume scans? In addition, please elaborate on the reasoning for peak differences between the three convection types.

No, there are no restrictions on cell lifetime. All of the restrictions placed on cells are all outlined in table 1. Below we have included the figure 4 with and without a 30-minute lifetime threshold for each case type. While there is a substantial reduction in the number of cases (especially for shallow convective cells, the distributions of initiation times remain relatively unchanged.

Figure 4 (no lifetime filter)

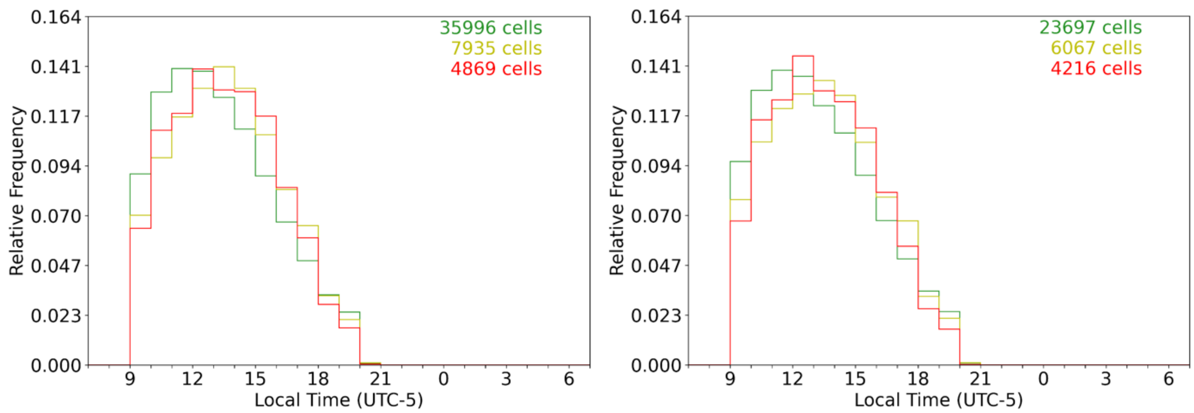
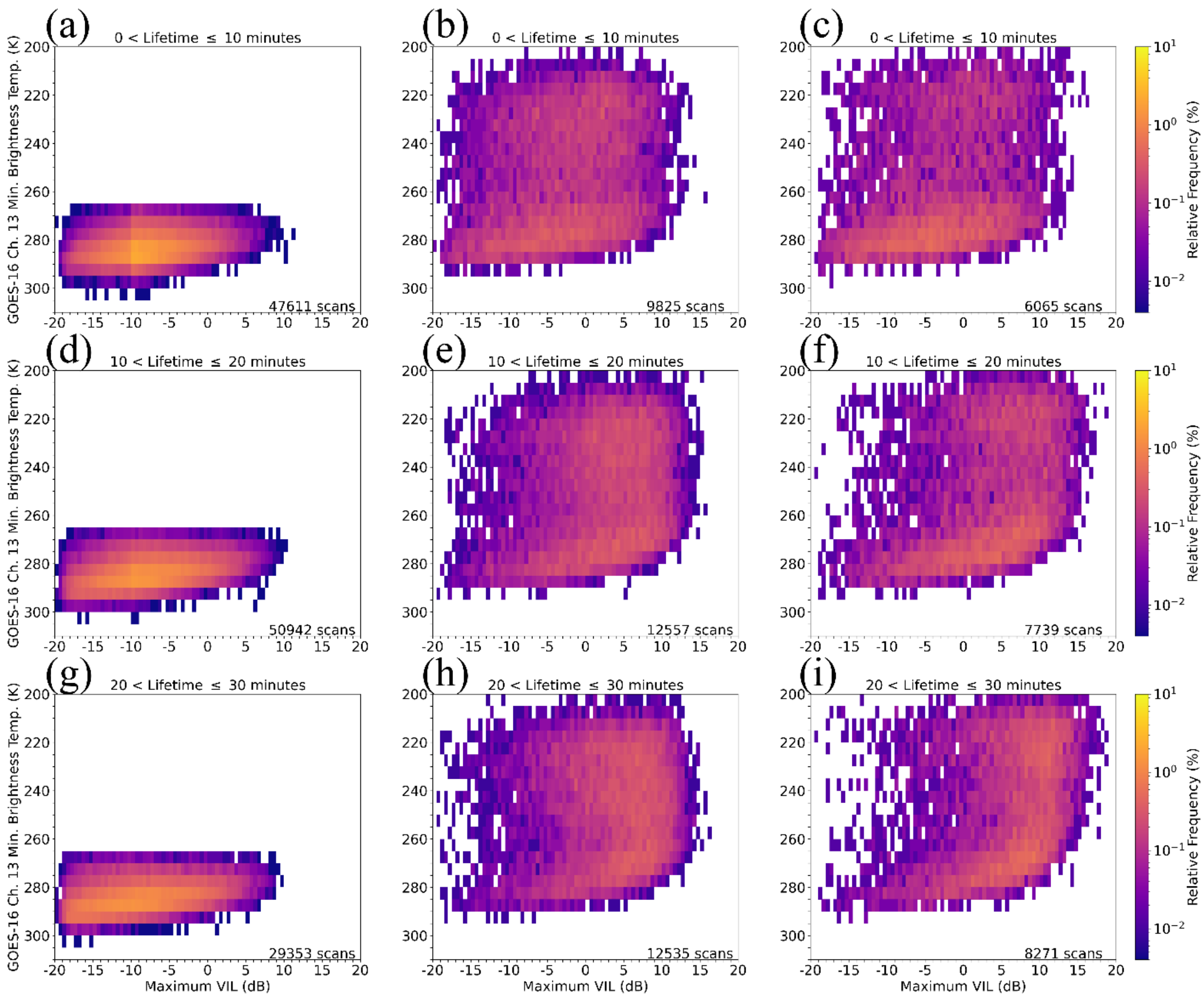


Figure 4 (30-minute lifetime threshold)

12. Figure 8, for the shallow case, why there's not much difference at different life stages? A similar concern applies to the vigorous type of convection. For example, in panel i, the majority of cell max Z is still very high over 8 km (from 10-over 50 dBZ) here. This raises concerns about the cell tracking quality of this dataset. Cell dissipating should not have Z still over 50 dBZ, that is a hail signature, but in panel l, Z over 50 dBZ is over 10 km and has the highest frequency, although it is less frequent compared with panel i, but still the highest under this normalized lifetime category. It seems that the tracking was terminated due to a splitting event or continuing under another cell identity. This problem was addressed and fixed by Yin et al. (2022). This is an improved version of MCIT that keeps track of all the splits.

We are not sure why there is not much difference at different life stages for shallow convection. We have included a figure below that recreates figure 8, but for 10-minute bins for the first 30 minutes of cell lifetimes rather than 0.25 normalized lifetime bins. This supplementary figure shows the same general trends as figure 8 and captures 89.4% (127,906 of 142,923 volume scans) of all shallow cases, 37.6% (34,917 of 92,798 volume scans) of all modest deep cases, and 23.2% (22,075 of 95,219 volume scans) for all vigorous deep cases.



There is a shift to the upper right for subplots d and g in figure 8 and the above figure, which starts and returns to the bottom left early and late in shallow cell lifetimes, respectively. As far as vigorous convection goes, while there are obvious shifts over the course of the lifetimes of these cells in figure 8, you are correct in that there are anomalous values still present. We have attempted to mitigate this by removing cells which begin or end their life along a domain boundary, but this does not seem to have completely addressed the problem. Some of the modifications we made to the MCIT algorithms were also with respect to handling splits and merges. The specifics of the changes we made to the MCIT algorithm can be found below.

In cell identification, an ambiguous situation arises when iterating over all cells when more than one cell (cell A and cell C) considers the same neighbor (cell B) as a candidate for cell merging. In this case, the algorithm has been modified to merge the cells with the same neighbor (cells A and C merge with cell B) and with one another (cells A and C merge together), recursively. In cell tracking, an ambiguous situation may arise in two different scenarios:

A cell from map(t+1) is the potential split or continuation of two or more cells from map(t). In this case, continuation has been set to prevail over split situations. Nevertheless, if different cells from map(t) are the potential source of the cell from map(t+1), the cell with maximum integrated common VIL is the one selected.

A cell in map(t) has two or more potential split or continuity cells in map(t+1). In this case, as before, continuation prevails over split situations, but if different cells are candidates, the cell with maximum integrated common VIL is the one selected. Only one cell can be defined as continuity, the rest are labelled as splits.

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Thank you for your comments on this manuscript that have helped to clarify and improve the quality of the analyses presented therein.