Authors greatly appreciate all the valuable comments and suggestions from the reviewers. Line and figure numbers correspond to the ones in the revised manuscript, and texts that are modified are in red colors in the revised manuscript. A comprehensive read-through is done to correct for English/grammar structure.

Main changes in the revised manuscripts are:
-Figure 7 is removed based on a comment from RC2.
-Table 4 is added.
-Figs. 8 and 9 are modified using different color bars that are colorblind-friendly.
-Fig 10 includes additional run with WSM6 microphysical scheme.
-Section 4.2 is modified using three month of data in 2020.
-Appendix A is added.

RC2

General Comments:

Latent heating (LH) is an important process-level cloud variable. To address the temporal gap in LH observations (arising due to satellite estimates only being available periodically), the authors develop a new GOES-based LH retrieval. They compare their GOES LH retrievals with existing satellite and NEXRAD estimates, and then demonstrate the impact (on precipitation forecasts) of assimilating the new LH into WRF. The analyses of impact on precipitation forecasts are fairly minimal (skill scores are shown for a few boxes for a few forecast hours), so this part could be thought of as a proof of concept for using GOES LH in WRF.

My major questions are:

1. Why is only 1 month of data compared across the products? Can additional months be aggregated with some averaging over connected convective features to remove the substantial noise that shows up in instantaneous pixel comparison plots (e.g., Fig. 8)?

   Section 4.2 is modified based on the new analysis, and the plot is modified using 3 months data in 2020.

2. There is a lot of discussion of this quantity: total LH. As best I can tell, this is not an average convective LH, nor is it a vertical integral. It is a sum of convective LH profiles in a box. I did not understand the purpose of just showing the sum, which is largely a result of summing profiles over different convective area counts (and the convective area counts are product dependent, being different for NEXRAD, CSH and GOES). The average profile structure and convective area differences should be portrayed and analyzed separately. If my understanding of total LH computation is incorrect, then it needs to be clarified through the manuscript.

This was done because different techniques have different intrinsic spatial resolutions and thus different magnitudes and profiles. By adding the LH in both the horizontal and vertical axes, we felt that the total heating that is injected into the model could be compared more directly.

3. The analysis of the impact on precipitation forecasts is pretty minimal, and as a reader, I was not convinced that the abstract text stating "improving the forecast significantly" is warranted quite yet. I would re-phrase the text in parts to suggest that this is more of a proof of concept or demonstration of the potential value of assimilating LH.

   We agree with the reviewer's point. It is rephrased in lines 26-27, and a sentence to say that it is a proof of concept study is added in the conclusion as well (lines 700-701).

I did not comment on grammar, but I emphasize that a comprehensive read-through is needed to correct many sentences for English/grammar structure. The content overall is appropriate for AMT. My comments above and specific comments below probably warrant a recommendation of major revisions, after which the article -- whose topic is important and intersesting -- will be more useful to the community.

Specific Comments:

First line in abstract: It is unusual to say LH is the essential factor driving convective systems. It is also a product of convection. I would reword to say it is an essential factor connected to convective system circulations.

This sentence is rephrased to "affecting intensity or structure of convective systems" in lines 7-8.

Line 30: convection is definitely not resolved explicitly at a few kilometers. Over a decade has passed since the 2011 paper cited, and this is appreciated even more. Perhaps mesoscale convective effects become resolved, but at this resolution, convection is "permitted."

Please see line 31 for an alternate suggestion that simply says that 3km is convection permitting. (This sentence is deleted but "convection permitting" is added in line 30.)

L72: recommend rewriting first part of sentence to: "These products provide instantaneous heating estimates, but their temporal resolutions are low compared…"

It is rephrased to "Although these products have been useful for keeping climate records and understanding impacts of LH in long-lasting systems like tropical cyclones, their temporal resolutions are too low to be used for weather forecasting, especially compared to 2-minute observations available from ground-based radars." in lines 74-76.

L75-80: Can this sentence by written differently? I'm not sure what is trying to be conveyed as written: "Cloud top information from geostationary data is included when creating cloud

analysis during data assimilation (Benjamin et al., 2016), and thus LH retrieved based on cloud top temperature, can be useful in the forecast model by keeping consistency of retrieved LH with the updated cloud analysis."

This sentence is rewritten as "Since the RAP model already uses cloud top information from geostationary data in its forecast (Benjamin et al., 2016), and the HRRR model uses the RAP model outputs as initial and lateral boundary conditions, LH profiles derived from cloud top temperature should be consistent with the model cloud field." in lines 80-82.

L320-322: details about converting units is probably unnecessary information in the article: "but provided in different units. LH from GOES-16 and NEXRAD are in K/s to easily match with modeled heating rate, while DPR products are in K/hour. Therefore, LH in K/hour from DPR products are converted to K/s for comparison."

Authors included these details as other readers of the manuscript had thought that this point was not clear.

L352-353: what is the reason for interpolating to the WRF grid at this point? WRF will rarely get the convection in the exact right place at the right time as observations due to a different surface relative to reality, so why this is done is not clear to me.

Interpolation is done because three products have different resolutions. It doesn't mean that it's interpolated into the WRF grid point where there is convection, but it means that it is interpolated into the same 3km WRF grid. We agree that the sentence is confusing so it is rephrased to "Since the three products have different spatial resolutions, LH profiles from NEXRAD, GOES-16, and CSH for these clouds are interpolated into the same WRF grid with 3km resolution for a direct comparison" in lines 426-428.

L369-370: changes in buoyancy are related to the vertical derivative of heating, not absolute heating rate at any level. If heating is increasing with altitude, then there is a dampening effect on buoyancy specifically. So, it is not about buoyancy here; convection can be initiated because LH increasing with height induces surface convergence which favors convective initiation (which the authors happened to mention near the introduction near L34). Clarify this statement.

Authors agree that the sentence was miswritten. It is rephrased to "This heating at lower levels induces convergence in the lower atmosphere and divergence in the upper atmosphere, and thus, convection can be effectively initiated from the added heating." in lines 444-445.

L374-376: some papers using ARM radars (papers led by Die Wang) indicate that 40 dBZ is a good proxy for convection overall. From that perspective, 28 dBZ is too low too.

We agree that 28dBZ is not a perfect threshold to determine convection, but it is the threshold used in the HRRR model to determine where to apply heating. Therefore, 28dBZ is chosen in this study because the goal of this study is to compare forecast results with what the HRRR model does.

L450-459: I do not understand Fig. 7. For total LH, are you simply summing up all the LH for each convective pixel? So, if for example there are 100 convective pixels, the total LH is the straight sum across all 100 and not an average? Or is total LH some combination of convective for every product + stratiform from CSH? In the literature, total LH as typically reported as the combination of all convective + stratiform + non-raining + anvil LH. If Fig. 7 "total" (and Table 4) is calculated simply by summing convective LH, then I do not understand the value of this figure. It would largely be reflecting differences in convective area and not LH profiles since the previous figures suggested similarity in LH profiles for GOES and CSH. Instead of summing LH, I would strongly recommend showing the convective area differences for each box and product, and then the reader will be able to infer an overall difference in LH as a combination of both convective area differences as well as profile structure differences.

For Figure 7, only the convective LH profiles were used, and horizontally integrated LH was shown. Authors understand the confusion that readers might have by "total LH" used in Figure 7 because we used "total LH" in section 4.2 again but with different meaning. For this reason, authors decided to remove Figure 7, but leave Table 5 that has the same meaning of "total LH" as in section 4.2. Convective regions for each box are shown in Figure 3, but Table 4 is added to show the number of convective grid point so that readers can use Figure 3/Table4 and Figure 6 to guess the results in Table 5.

L510-511: initiating convection certainly depends on structure and not "total" heating. Is there a reference to support that the impact on initiating convection is similar if the total heating is similar? And, again for clarification, what is meant by "total" here – column integrated, or the sum of all individual convective heating profiles?

The "total" in this study is the sum of all individual convective heating profiles, which is horizontally and vertically integrated for each convective cloud. To author's knowledge, there has not been a literature that analyzes impacts of total LH in convective initialization of HRRR model. The authors agree that the horizontal and vertical structures of LH are important factors when it comes to initiating convection. However, GOES LH and NEXRAD LH have different vertical structure as shown in section 4, and convective area detected by GOES and NEXRAD differ because of different detection method. Therefore, it is not reasonable to compare each pixel value at each level, and the only way to provide a good estimate of how the two products differ would be to use total heating. Please also refer to the comment made in "major2". Lines 524-532 are modified to reflect this comment.

L512: the text: "and some conditions that are used…are applied before the comparison to be useful for the real application" is very vague. I do not know what this sentence means.

The whole paragraph (lines 544-550) is modified to explain more concisely.

L529-530: there is a lot of scatter in Fig. 8, and I am uncertain again on what is being shown: the vertical integral ("total") or different levels all combined into a scatterplot of the "total" LH shown for convective regions of Fig. 7? Perhaps the authors should think about doing some averaging of convective LH over the identified convective regions for each rainfall system and then aggregating those convective-system averages and comparing? There is almost too much noise to infer anything from Fig. 8, despite the 0.83 correlation.

What was plotted in Fig. 8 was the total LH of all 939 convective clouds that occurred during June of 2017, not just the convective regions of Fig. 7. This plot was modified to include three months of data in 2020, and the whole section of 4.2 has been changed to include the new analysis. This plot is presented to show that the total heating amounts for each convective cloud from GOES and NEXRAD are within the reasonable range as the case study in section 4.1.

L565-600: Fig. 9, NEXRAD (9c) shows convection in the yellow box, but it disappears when GOES LH was used. Why? I recommend commenting on this. Also – is convective LH assimilated everywhere or only in the 4 boxes?

It is because GOES convection detection algorithm couldn't detect that convection in yellow box, and thus no heating is applied. This was mentioned in the original manuscript, but is now stated more clearly in lines 607-608 to avoid future issues.

L670-672. "Even though one might think… it is actually more than just one brightness value." This sentence is too informal for a publication, and should be re-written.

The sentence is rewritten in lines 671-672.