

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-97

Anonymous Referee #1

Referee comment on "Latent heating profiles from GOES-16 and its comparison to heating from NEXRAD and GPM" by Yoonjin Lee et al., Atmos. Meas. Tech. Discuss.,
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This manuscript describes an approach for estimating latent heating profiles from high-temporal resolution geostationary satellite observations to fill the need for more frequent observations for assimilation into NWP models. While ground-based radar is currently used for this purpose, such observations are only available over well-instrumented land areas creating gaps in coverage that can negatively impact forecasts. While latent heating has been estimated from low-earth orbiting satellites, these platforms do not provide sufficient temporal resolution to fill this need. Thus the development of a GOES-based algorithm is well-motivated and there is evidence supporting the suggestion that geostationary visible and infrared radiances carry information for identifying convection from which it may be possible to derive approximate latent heating profiles.

Regrettably, while the material is appropriate, the manuscript suffers from several critical flaws that render it unsuitable for publication in *Atmospheric Measurement Techniques* at this time. The description of the algorithm lacks several important details and a number of important assumptions are insufficiently validated. Only one snapshot is presented as verification of algorithm performance so the conclusions lack justification. In addition, the narrative suffers from numerous grammatical errors that make the manuscript difficult to read and many arguments hard to follow. While this alone would not lead me to reject the paper, when coupled with the scientific flaws, I feel the manuscript is not currently suitable for publication. requires substantial editing before it can be submitted elsewhere for publication. For these reasons, I do not recommend the paper be accepted for publication at this time.

Major Comments

- My primary concern with the study is the fact that the results are insufficient to provide a sufficient assessment of the algorithm performance. A single snapshot from one

single convective scene is presented as justification that the approach has merit. Furthermore, the limited results that are presented show some very significant differences between estimates that warrant further investigation and explanation. The overall conclusion from Section 4 appears to be that substantial differences in individual latent heating profile estimates coupled with substantial differences in the areal coverage appear to offset one another to yield area-mean latent heating profiles that are in reasonable agreement in this particular scene. However, very little deeper explanation is conducted to explain these large compensating errors and there are no guarantees that such errors will always offset each other as they do here. Given the very indirect relationship between cloud top properties, model vertical motion, radar reflectivity, and latent heating, substantially more investigation is required to convince the reader that the algorithm is providing reasonable results. In addition to case studies, some statistical analysis of a much larger volume of data needs to be presented.

- Another significant flaw concerns the description of the algorithm itself and verification of the associated assumptions. Section 3.1 notes that growing convection is identified in GOES-16 observations when ' T_b decrease over ten minutes for two water vapor channels ... is greater than the designated threshold' but neither the channels nor the threshold is specified. Similarly, the paper states 'For mature convection, the method looks for grid points that have continuously high reflectance, low T_b , and lumpy cloud top over ten minutes' but no quantitative information is provided regarding the definition of the qualitative terms continuous, low, and lumpy. More importantly, given the goal of reproducing radar-based latent heating estimates, how do convective distributions identified using these definitions compare to the 28 dBZ threshold used by NEXRAD? The only direct comparison provided in the manuscript is a single snapshot in Figure 3 with no quantitative analysis. This lack of verification is amplified in the subsequent assignment of a corresponding vertical motion threshold to mimic these criteria. The only support provided for the 1.5 ms^{-1} threshold is a table comparing convective areas from 'observations' and different vertical velocity thresholds but its not clear what data are used to derive these cases or how well this vertical velocity threshold actually compares to the 28 dBZ radar-based method.
- The description of the cases used to drive the model simulations is also incomplete and no verification of model performance is provided, e.g. against NEXRAD observations.
- The description of the TRMM and GPM algorithms in Section 2.2. is difficult to follow and I'm not sure the non-expert reader would glean even a basic understanding of how these algorithms work from this discussion.

Additional Comments

- The manuscript requires substantial editing to improve grammar and readability.
- For completeness in the introduction, Nelson et al (2016) and Nelson and L'Ecuyer (2018) introduce an algorithm analogous to SLH for retrieving latent heating profiles from shallow convection.
- The sentence at the end of Section 1 is not really a complete thought.
- The labels on many figures, especially the panels in Figures 1 and 3 are much too small.
- It is not obvious what all of the variables listed on Line 113 represent.
- It is not clear what is meant by the sentences: ' T_b at 11.2 which is used to construct the LUT is mostly sensitive to hydrometeors or water vapor. Accordingly the signal received by the channel will be largely from layers with high cloud water contents.' The 11.2 micron channel is a window channel and not very sensitive to water vapor and the

signal received will typically come from the highest cloud layer in the atmosphere not the layer with the highest cloud water contents.

- How well do the values in Table 3 compare to observations? Couldn't NEXRAD and GOES be combined to examine this.

References

Nelson, E., T. S. L'Ecuyer, S. Saleeby, S van den Heever, and S. Herbener, 2016: Toward an Algorithm for Estimating the Latent Heat Released in Warm Rain, *J. Atmos. Oceanic Tech.* **33**, 1309-1329.

Nelson, E. L. and T. S. L'Ecuyer, 2018: Global character of latent heat release in oceanic warm rain systems, *J. Geophys. Res.* **123**, 4797-4817.