review of manuscript AMT-2019-148

In this manuscript, a relatively simple scheme for inferring the location of the upper and lower boundaries of clouds based mainly on infrared window channels is suggested and demonstrated. The idea is novel and as a suggested scheme for the remote sensing of clouds, it is highly relevant to Atmospheric Measurement Techniques. In general, the results of the new scheme are impressive and interesting. However, there are a number of clarifications that I suggest would be helpful to the reader, as follows.

(1) Given that at least ten different techniques already exist for retrieving cloud top heights with passive infrared radiation, it might be better to make the title more specific. Perhaps something like "A relatively simple scheme for inferring ice cloud boundaries using spectral cloud emissivity and its uncertainty..." would better emphasize the uniqueness of the current method as compared to the ones that already exist. See also my comment number 5.

(2) lines 7-8: "...generally assume a plane-parallel homogeneous cloud exists in each field of regard, or pixel, but this assumption ignores vertical homogeneity." – Strictly speaking, the plane-parallel assumption only ignores horizontal homogeneity within each pixel and *does* allow for vertical homogeneity. The more relevant argument here is that similar schemes additionally assume that the cloud is optically thin to the extent that there is only one value of cloud emissivity and only one value of cloud temperature per cloud in each pixel.

(3) line 14: "single-layer thin and thick ice clouds, and multi-layered clouds" – The distinction between these three categories is not precise. To be clear, I would write "single-layer thin ice clouds, single-layer [geometrically or optically?] thick ice clouds, and multi-layer clouds". This is true here and throughout the manuscript (e.g., lines 64-65).

(4) line 18: "become larger" – Cite how large here.

(5) Section 1 Introduction – In general, I think it would be helpful to the reader if the authors put the need for their scheme into better perspective. For example, it would be helpful to know from the outset under what circumstances non-window schemes, such as CO_2-slicing, can and cannot be used for the same purpose. Likewise, is the scheme suggested in the current study expected to provide an advantage over CO_2-slicing (a) because there an issue of availability of appropriate channels for implementing CO_2-slicing with wide enough spatial and temporal coverage, (b) because there is some issue of reliability with the CO_2-slicing technique, (c) because CO_2-slicing suffers from similar biases in that the cloud is assumed to be at a single altitude and to possess a single temperature, or (d) because the current scheme is just simpler? See also my comment number 14.

(6) lines 77-78: Briefly mention what scheme is used to retrieve cloud emissivity in the C6 MYD06 product.

(7) line 115: "a parameterization is adopted" – I believe that at these wavelengths, where scattering (by molecules) is negligible, $\exp(-\kappa z/\mu)$ is considered an accurate expression for the transmissivity based on the Beer-Lambert law and not a parameterization.

(8) line 118: “the quantity $\kappa z/\mu$ is called the optical thickness...” – I believe that κz is considered to be the optical thickness, rather than $\kappa z/\mu$.

(9) line 139: $\mathbf{T}_c$ is already in bold font, but it would be a good idea to emphasize in the text that this is a vector of possible values of cloud temperature rather than a single value.

(10) lines 151-152: In other words, one does not need to assume a ratio of cloud optical depths between the two channels, such as the ratio 1.08 in Equation 5, or is there some similar implicit assumption?

(11) line 155: “we obtain two T_c values...” – Actually, a list of possible T_c values, including the minimum and maximum possible values, is obtained, correct?

(12) lines 156-157: “... by a dynamical lapse rate...” – Does this mean that it is assumed that T_c varies within the cloud layer, or does the lapse rate only apply to the atmospheric layers outside of the cloud layer?

(13) line 158: “any cloud height is not allowed...” – “no cloud height is allowed...”

(14) lines 163-166: “In fact, ... day and night.” – These sentences belong in the Introduction. Refer also to my comment number 5.

(15) lines 97-98: “... based on an empirical relationship...” – Does this mean that the authors’ Equation 4 is not used, or is the empirical relationship related to Equation 4?

(16) lines 264-266: “It is interesting that...” – I think that this should be emphasized better. It is not an interesting side note but an impressive demonstration of the concept suggested in this paper.

(17) line 266: “... and the eye of the Goni...” – It does not seem that there are data points right in the eye, only at the edges of the eye, correct? Also “scattered from” is not the best wording here and throughout the discussion.

(18) lines 267-269: Again, I think the success of the authors’ method should be emphasized better here. These sentences explain the difference between the results of their method and the other data in the regions of the cloud edges and the eye of the hurricane. However, given that the left side of the image appears to contain multiple cloud layers that are likely moving, the fact that the authors’ results and the CALIOP VFM data exhibit similar variation and similar values near the tropopause actually demonstrates a rather decent qualitative correspondence between the two.

(19) lines 278-279: Once again, I think the success of the authors’ method should be emphasized better here. The bias for min($\mathbf{H}_c$) from the cloud base is larger than that of optically thin clouds, but it is still better than the EEL, which is what would have been predicted.

(20) line 315: “... minimum value” – Was “maximum value” intended here?

(21) Figures 6-8: The orange contours are barely visible. Perhaps they are not necessary to include. Also, a closing parenthesis seems to be missing from the end of each of the three figure captions.