

Comment on amt-2022-247

Anonymous Referee #4

Referee comment on "Retrieval of terahertz ice cloud properties from airborne measurements based on the irregularly shaped Voronoi ice scattering models" by Ming Li et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-247-RC3>, 2022

This study implements Voronoi and spherical ice crystal models in observed brightness temperatures at 380, 640 and 874 GHz to retrieve Ice water path(IWP) and effective particle radius (R_e). Authors show that Voronoi model can better reproduce results compared to previous 'standard' values. I think such result is obvious and can be easily predicated as simple spherical model is less adequate for irregular-shaped ice particles, but authors showed it quantitatively. In my opinion, there exist mistakes/incompleteness in English language, methodology, and scientific discussions, as outlined in specific comments below. Authors are suggested to improve the manuscript by considering the comments given below as well as by carefully improving the English writing/expression.

- Line 19: '.. we completed the..'--> completed is what sense? rewrite it.
- Line 48 : '..signfinifiantly developed...': rewrite the sentence.
- Line 132: What is 'CoSSIR-MCBI' algorithm? A brief description is important with relevant references.
- Lines 140-143: Specify ice particle sizes either in table or describe size interval in the text. Provide same information for 20 wavelengths mentioned here.
- Line 149: Specify what refractive index values are used for ice particles here. Give a reference.
- I think Figure 1 is confusing. Either make Figure 1 clear or remove it and describe the mythology clearly in the text.
- Line 179: I do not understand how clear sky days are selected here. Are they before and/or after the cloudy sky days or average of certain week (or month etc.)?
- Lines 188-189: 'statistical multiple linear regression method': Write a few lines to clarify it. For example, what are dependent and independent variables in this method?
- Line 199: A reference for Eq. (3) is required.
- Lines 214-219: Please specify the coefficient terms either in table or in text.
- L222: Is BTD_{1-3} is same to BTD_{1-2} - BTD_{2-3} ? If so, better to write BTD_{1-3} instead of BTD_{1-2} - BTD_{2-3} .
- Lines 227-229: I think BTD depends strongly on cloud top temperature as well as surface temperature along with cloud properties. Since they are fixed here, errors are expected in retrieved values. Can authors provide error ranges in retrieved parameters due to such assumptions? If possible, authors are suggested to use actual data from

cloud top and surface temperatures rather than assumptions.

- A theoretical perspective should be given for using BTD_{2-3} and $BTD_{1-2} - BTD_{2-3}$ in Eq. 4. (Why these two are important in cloud properties retrieval among several possible combinations of three wavelengths). Further, there should be an error term in Eq. 13. It is further necessary to describe in detail about the methodology. For example, what are the convergence criteria, how the initial values are determined, and how measurement errors can affect the retrieved values etc.
- Line 250: Since the x-axis is size parameter (not radius), it is difficult to understand where 120um exist. Either rewrite the text or make Figure 2 clear by adding additional x-axis.
- Lines 250-254: Why large difference exists for large sized particles in Figure 2 remains undiscussed.
- Lines 261-264: What could be the plausible reasons for such results for relatively larger particles?
- I do not understand why BTD_2 is shown in Figure 6 as it is not used in the retrieval (see Eq. 4).
- Please make Figure 7 easy to understand. For example, indicate the values of IWP and Re with dots (e.g., Nakajima and King plot). As there are overlapping lines in Figure 7, how cloud properties are retrieved if data fall under such overlapping lines?