The paper presents the AM-COL processor and AM-CTH and AM-ACD products of EarthCARE mission and evaluates their performance using simulated scenes. The paper is of high importance for the exploitation of the EarthCARE mission and falls within the scope of the AMT and the "EarthCARE Level 2 algorithms and data products" special issue. The manuscript is well structured and well written to the majority of its extent. I would suggest the publication of this work after the consideration from the authors to revise the manuscript based on the following comments/suggestions, targeted to improve the clarity of the discussions and results.

General comment:
Along AM-CTH and AM-ACD products, the paper presents the AM-COL processor. It would make sense to include AM-COL in the title as well.

EarthCARE Aerosol types: (a) Why in EarthCARE ice is included in the Aerosol types and not in the cloud types? (b) Why do marine and dusty mix have in their name additionally the "aerosol" wording, while not all the other aerosol types? CALIPSO has "marine" and dust mixtures types also, without the "aerosol" addition specifically for this type. Can this be harmonized for EarthCARE aerosol types also? Eg "dust, marine, continental pollution, smoke, dusty smoke, dusty mixtures"?

Because they are many processors and products discussed in the paper, it would be helpful for the reader if the abbreviations don't change during the different sections of the paper. A confusing example is the AM-CTH product which is presented in Section 3.1 and Figure 2 with this name, while later on in Section 4.1.2 it is discussed both as AM-CTH and "CTH detected by AM-COL", with its legend in the plots in fig 7 (and 8,9,10) to be "CTH AM-COL", and in Section 4.1.3 is discussed as "AM-COL CTH" or "CHT AM-COL". It is advised to describe at first from which processor each product is derived and then continue in the presentation of the flowcharts, plots, and discussions mentioning the product name (eg. AM-CTH for this case). Another case is the M-CLD or MIS CTHs in the text (eg. page 17 line 316 and 374) which in the plots is CTH M-CLD and again it would be nice to be homogenized throughout the manuscript.

Specific comments
Page 1, line 20: "Two definitions of the CTH from 20 the model-truth cloud extinction fields are compared": if there is a take-home message from this comparison, it would be interesting to be included in the abstract.

Page 3, line 71: "The dominant aerosol type can be compared to the aerosol mixing ratios applied in M-AOT." This is confusing, as is not clear what is done. Can this be revised to be more clear? Or else add a note for the reader that this will be presented/discussed in section 3.2.1.

Page 3, line 71: "The combination of ATLID observations at 355 nm with MSI retrievals for wavelengths ≥ 670 nm (Docter et al., 2023) further supports the aerosol typing." Is not very clear what/how this is used. Can you elaborate a little? Even if this will be mentioned in any of the 2 papers referred earlier, 1-2 sentence can be useful to the reader.

Page 4, lines 94+: Could you include the Sentinel 5P CTH retrievals in the 2.1 overview? This would be relevant to the reader who may need to use simultaneously EarthCARE and Sentinel 5P/5 for applications (e.g. for data assimilation).

Page 5, line 142: "wind lidar mission Aeolus": It would be nice if you could add a reference here for Aeolus mission or Aladin lidar.

Page 7, lines 162-164: "The A-LAY products … are already provided on JSG with this resolution (approximately 1 km) along track ... The MSI products … are provided on the finer resolution of the MSI grid (500 m)... The surrounding nine MSI pixels correspond to one JSG pixel": With 1 center pixel and 8 surrounding pixels (9 in total) of 500 m JSG would have 1.5 km resolution. How can 9 surrounding pixels of 500 m correspond to 1 km JSG along track? Maybe an explanatory diagram would clarify this question.

Figure 2: It would be very helpful to the reader if the flowchart is more detailed, including not only the steps followed but also the decisions in each step. So one can get from the flowchart all the information for which pixels AM-CTH data are provided and how.

Page 10, line 227: "(default 75 pixels in each direction along track)". Can you include here the distance in km this refers to? In MSI grid, this would mean 37.5 km along the track, in JSG grid of 1 km, this would mean 75 km.

Page 10, lines 225-229: The search for agreement starts at the closest along-track pixel. It continues by searching one pixel before …and one pixel after … from the closest pixel along track … This alternating search is continued until an agreement is found or the configurable maximum search distance … is reached. If a measurement at swath fits to an along-track measurement for all criteria, then the observed CTH difference from the track is assigned to the swath pixel". When reading this part is a little confusing. Only for this one swath pixel the CTH difference is assigned? And then the search for agreement stops for a more far-away grid? Please revise if it is not the case and all pixels are searched until a disagreement is found (which would be the expected case).

Figure 3: Same suggestion as for figure 2.

Page 11, line 243: "Seven aerosol types (dust, marine aerosol, continental pollution, smoke, dusty smoke, dusty aerosol mix, ice)..." This is very confusing. Why ice is in aerosol types and not in cloud types? Is this the case for the EarthCARE Aerosol type product? Why it couldn't be included in the cloud types, as is the case of CALIPSO?

Page 11, line 243: "Seven aerosol types (dust, marine aerosol, continental pollution, smoke, dusty smoke, dusty aerosol mix, ice)..." Why marine and dusty mix have in their name additionally the "aerosol" wording, while not all the other aerosol types? CALIPSO has "marine" and dust mixtures types also, without the "aerosol" addition specifically for this type. Can this be harmonized for EarthCARE aerosol types also? Eg "dust, marine, continental pollution, smoke, dusty smoke, dusty mixtures"?

Page 11, line 243: "Seven aerosol types (…) are distinguished". Here it would be useful to mention from which processor and in which product the aerosol types are provided.

Page 11, line 244: "If the aerosol type ice dominates the column integrated 245 aerosol classification, a cirrus cloud is included in the profile which was not detected by the A-CTH algorithm". (a) This is very confusing. If there is an ice cloud, it should be included in the A-CTH product and not be treated from the AM-CTH. And not in the Aerosol types. Why this is not the case? (b) You state that "If the aerosol type ice dominates...". If ice is present but doesent dominated, is the pixel again excluded? I believe it should be.

Page 12, of section 3.2.1 and Table 3: With the description provided on this page for section 3.2.1, it is not clear how the comparison will reach agreement or not. Can Table 3 be enhanced with the used thresholds of the agreement for each A-TC type? Also, can one column with the M-AOT aerosol classification be included in the Table?

Page 13, line 268: "If the dominant aerosol type agrees (see Sect. 3.2.1)". It would be helpful in this section to mention how the dominant aerosol type is defined. Eg., the M-AOT HETEAC component with the biggest %?

Figure 6: How y axis density is calculated? Scaled to the total number of pixels for every case, with 1 as a cumulative sum? Maybe is worth mentioning it. Also, the colorbar in model truth comparison plot (and relevant plots from there on) can use a legend/units (eg. nr pixels).

Page 17, lines 375-376: "Especially the cirrus clouds between 9 and 13 km height are detected by AM-CTH above a COT of 0.25". This is confusing. From Figure 6 I would conclude that the cirrus clouds between 9 and 13 km height are detected by AM-CTH below a COT of 0.25. But maybe there is something else you wanted to highlight. Please rephrase to make it clear.

Page 18, line 378: "The amount of data points within an interval of ±i m around the 1:1 line (fi in Fig. 7 and 8) shows a similar behavior for AM-COL to extinction-based model truth (40, 63, 83% for 300, 600, 1500 m) and M-CLD to COT-based model truth (31, 53, 77% for 300, 600, 1500 m)". Earlier in the manuscript (page 17 line 366) was mentioned that "40% are within ±300 m which was defined in the mission requirements". Does the statistics on page 18 show us that only the AM-COL is within the mission requirements, while the M-CLD isn't? Please consider if you would like to highlight it in this part of the paper.

Page 22, line 418: "Thus, the dominant". Why thus? Could it be the case that the classifications are not so successful, hence "thus" is not correct? Or there is a connection between the simplicity of the scene and the fact that the classifications are successful? If possible, modify the text to make it clear.

Page 22, lines 420-422: "The ice cloud at 34◦N was only partly detected by the MSI cloud mask and thus the AOT of the ice crystals is included in the M-AOT product". One wouldn't expect to find ice OD in AOT products. Why this is not the case for EarthCARE products?

Page 22, line 420-422: "Here, as well the ice crystals are included in the AOT, which differs from the CAMS model truth AOT provided for aerosol only". Please revise to improve the syntaxis.

Figure 12: Can you comment on why some values (with the highest AOT) are flagged out in the 355 nm AOT, although some seem to have quality status = 0?

Page 22-23, lines 434-439: "The derived …at 607 nm". Is there an error estimation for this new product (AM-ACD AOT 355)? If yes, does it consider/include the uncertainty due to the Ångström exponent bias mentioned?

Page 35, lines 469-470: "However, the brightness temperature difference between 10.8 and 12.0 µm was not sensitively enough simulated to clearly detect multi-layer cloud scenarios by MSI." I believe that the brightness temperature sensitivity is not discussed earlier when the results from the multi-layer cloud scenarios are presented. It would be interesting to include a comment on this in the earlier session also.

Page 27: "Q_{CTH} = 4: Bad data. Observations on MSI grid are not consistent on (coarser) JSG". Coarser JSG is not defined in the text. Can you define it here?

Technical corrections/suggestions (bold text & red ";:"):
Page 1, line 1: "is **a** combination of multiple active…".
Page 1, line 6: "characterize the 3-dimensional scene", a suggestion to change to "characterize **a** 3-dimensional scene", or "characterize the 3-dimensional scene**s**".
Page 1, line 7: "(A-LAY)**,** ~~and~~ ~~the~~ MSI L2a data from the MSI Cloud Products processor (M-CLD)**,** ~~and~~ the MSI Aerosol Optical Thickness processor (M-AOT)**,** as well as MSI Level 1c (L1c) data are used as input to produce the synergistic columnar products".
Page 1, line 14: "CTH detected by ATLID **and retrieved/provided** MSI is calculated": retrieved or provided by MSI is a more representative term for this product.
Page 1, line 18: "The quality status depending on day/night conditions or the presence of multiple cloud or aerosol layers is provided with the products". The syntax could be improved.
Page 2, line 34: "**a** three-dimensional (3D) scene**s** (e.g., Qu et al., 2022a; Mason et al., 2022) to calculate ~~the~~ radiative flux**es** which ~~is~~ **are** compared..".
Page 2, line 40: "about the scene ~~apart from~~ **arround** the satellite track".
Page 3, line 46-48: "It provides vertical profiles along the satellite track of the particle backscatter and extinction coefficient, the lidar ratio**,** and the particle linear depolarization ratio which are ~~provided~~ **stored** in the ATLID L2a product A-EBD". Suggestion because they are 2 provided in 1 sentence and is less clear.
Page 3, line 52-53: "et al., 2022)**,** and to retrieve cloud optical properties such as the cloud optical thickness (COT), CTH and the effective radius of the cloud droplets which ~~is~~ **are** provided in the MSI Cloud Optical and Physical product".
Page 3, line 56: "for ~~the~~ **a** 3D scene". Is it a requirement for this scene presented in the paper, or for overall the scenes? If the 2nd "a" is needed there.
Page 3, line 9:"**a** reasonable estimate**s**".
Page 4, line 84: " using ~~the~~ common test scenes".
Page 4, line 86: "Conclusion**s**"
Page 4, line 96: "with lidar**s as for example** from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations": CALIPSO is not the only lidar that has been used for CTH detection.
Page 4, line 100: "in dependence ~~on~~ **of** the type".
Page 4, line 105: "the CTH ~~for~~ **of** high".
Page 5, line 119: "not from ~~the~~ **a** space lidar".

Table 1: "and the products (with references) in which they are contained **(bold, with references)**".

Page 7, line 158: "…after the ~~complete~~ ATLID L2a and MSI L2a processing is completed".

Page 8, line 180: " **Then** the scene…".

Page 10, line 234: "over ocean)**,** ~~and~~ the respective Ångström exponents**,** and their uncertainties".

Page 14, lines 299-300: "**And more specifically w** ~~W~~ith the EarthCARE End-to-End Simulator specific test scenes **which** were created to test the full chain of EarthCARE processors". Something is missing in this sentence. A possible suggestion.

Page 14, line 327: "There are several reasons:": It would read better if you clarify after this text the reasons. Eg. "reasons of failure" "reasons AM-CTH can't be retrieved".

Page 15, line 340: "The central question is~~,~~**:** how to define the CTH from the true cloud extinction fields**?**".