We would like to thank the reviewers for a list of corrections and suggested improvements. We've addressed them all and we coloured our answers in blue to make them easier to find.

RC1:
MAJOR COMMENTS:

1. Either the structure of the paper or the naming of the sections are inconsistent. "Section 2: Algorithm Description" only contains "Section 2.1: liquid cloud and light drizzle retrieval", while "Section 3: Optimal Estimation Retrievals" contains both the description of the OE algorithm and its evaluation. I don't mind whether the solution is restructuring the paper or renaming/numbering the sections.

   The numbering of the sections and their names has been updated. Also, the product validation has been separated from the description of the algorithm description section.

2. The treatment of melting snow is well-justified in the text, with the application of constraints on precipitation rate and characteristic diameter across the melting layer, while also including the melting layer attenuation as a retrieved variable. Figure 4 appears to show that no forward-modelled measurements or retrieved water contents and characteristic diameters are reported within the melting snow. While this is understandable for the forward-modelled variables since these regions are not included in the OE retrieval, would it be possible to report the values of the water content and characteristic diameters that are already implicit in the continuity constraint, just by a simple interpolation between the lowest snow and highest rain parts? The reason is that this would improve the usability of the C-CLD product: for example, a naive application of the product to creating a CFAD of precipitation water content with height would include a misleading deficit in water content through the melting layer. Presumably the product metadata and a quality status flag or hydrometeor classification variable could be used to clarify that these reported values in melting snow are not explicitly retrieved using a representation of melting particles.

   We masked the microphysical properties within the melting layer intentionally to avoid any misconception that these data were estimated by the algorithm. Having said that, your comment raises a very important issue of product usability. Indeed, providing a continuous retrieval with no data gaps makes it much easier for users to use. Therefore, we will take your advice, and we will deliver a continuous microphysical retrieval but making it clear that the hydrometeor classification from the C-TC product must be used to infer the melting layer extent where the data are only interpolated between the solid and liquid phases not retrieved.

MINOR COMMENTS:
Section 2.1: The separate treatment of non-precipitating and lightly drizzling liquid clouds is justified here, but it's worth being very clear here what is reported in the C-CLD product:

- The user is likely to interpret "liquid water content" as pertaining to cloud droplets, but here cloud and drizzle water content are both included.

We added the following statement at the end of the section: “Note that the estimate of the liquid water content reported here includes both cloud and drizzle water content.”

- It’s understood that the Doppler velocity is not used in retrieving very light drizzle. But is a drizzle precipitation rate also reported?
  The C-CLD algorithm is not reporting rain rates at all, for any hydrometeor type. The retrieval outputs the mass content along with the characteristic size (D_m) estimate which is also the case for light drizzle.
- How are these LWC values combined with the “cloud liquid water” from the OE part of the algorithm? Are they reported in the same or different variables?
  There are two scenarios: the first one is the situation when liquid cloud is not precipitating, or it is drizzling. Then a simple power-law formula is used to estimate the liquid water content in the radar profile. There is no spatial overlap between liquid cloud/light drizzle and precipitation that requires the OE retrieval.
  The second scenario is when the radar profile is classified as “precipitation” and the optimal estimation retrieval is used. In that case, we retrieve the liquid cloud water path, and we distribute it in the column according to the formula (2).
  In both cases, the algorithm makes a clear distinction between the cloud liquid water and the precipitation mass content.

Section 3.1: “Unknown variables” is used interchangeably with “state variables” and “retrieved variables” throughout, but probably “State vector” or “Retrieved variables” works better as a section title than “unknown variables”.
Section 3.1 The title has been changed to “State vector”.

Figure 6: An overlaid grid on these panels (at least at the zero-values) would help the reader interpret the position of the crosses compared to the origin.
Figure 6. A grid has been added to these panels.

TYPOS:
L5: Should the PIA also be mentioned as a radar measurement?
PIA is mentioned in the abstract now.
L176: Is the term “optimal estimate” applied in its technical sense here?
These estimates are not obtained using the optimal estimation technique, so we modified this sentence as follows:
“The CPR processor (C-PRO; Kollias et al., 2022b) derives an estimate of the CPR measurements with their associated uncertainties”.
L218: “Our analysis confirmed” doesn’t need a comma.
Done
L265: The Hitschfeld and Bordan paper is cited later, but needs a citation here.
Changed
L269: I know the “warm rain simulations” mentioned here are described in the immediate next section, but since we don’t always read papers linearly please point to where these simulations are described.

We direct the reader to the appropriate section: “This formula is based on the statistical analysis of warm rain simulations over the Cape Verde islands described in Sect. 3.”

L277: reference to Qu et al. is incomplete.

Corrected.

L412: “...not fitted as in Tridon…”

Changed according to your suggestion.

L429: “difference” instead of “distance”?

Changed.

L478: The phrase “...both the mass and the content of rain” isn’t clear.

It reads now: “This is due to the characteristics of the forward model, namely the fact that the reflectivity depends on both the size and the mass content of rain.”

L500: “a-priori”

Corrected

RC2:
This manuscript describes the Level 2 cloud retrieval algorithms, which are intended for the use with measurements taken by the prospective EarthCARE 94-GHz radar. Overall, this will be a useful/important paper to publish after the authors address the comments below.
Main comments

1. The EarthCARE spaceborne radar mission is essentially a follow up of the highly successful CloudSat spaceborne radar mission. Plenty of statistical information about clouds and precipitation was derived from CloudSat measurements. For consistency of cloud and precipitation statistics and evaluating long term trends in retrieved parameters it will be important to understand if there are mutual biases between L2 CloudSat and L2 EarthCARE products. One way to understand this is to run a set of CloudSat Z profiles for some representative meteorological situations using adjusted EarthCARE L2 algorithms (e.g., without Vd measurements) and compare the retrievals with those available from the L2 CloudSat algorithms. I understand that this is out of the scope of the current study, but some discussion of how to achieve a reasonably unbiased continuity (or evaluate the potential biases) in the CloudSat and EarthCARE retrievals would be useful.
   We have added the following discussion in the Concussions section:
   "The CloudSat mission radar measurements and the information about clouds and precipitation derived from them provide a strong heritage for the C-CLD product development. However, this legacy poses a challenge of consistency of the retrieved parameters for the two missions. Continuity between the products is important for evaluation of the long-term trends in precipitation statistics and climate change studies. To address this issue, the information content of Doppler measurements and their impact on the retrieval must be evaluated. The knowledge about the cloud and precipitation properties gained with this additional measurement can be transferred to the reflectivity-only algorithm via refinement of the a-priori assumptions. The updated C-CLD algorithm (i.e., without Doppler measurements and considering differences in the instrument specifications), can be applied to the CloudSat measurements, and compared to its products for an assessment of potential biases. In case of detection of systematic differences, the CloudSat dataset can be reprocessed to provide a consistent long-term cloud and precipitation record."
2. What is the uncertainty of the EarthCARE Doppler velocity measurements? What is the improvement in estimated retrieval uncertainties when using Doppler information (e.g., for ice clouds and precipitation) compared to the case when only reflectivity measurements are available?
   The uncertainty of the EC Doppler measurements is estimated by the C-CD processor, and they are fed into C-CLD algorithm as they are provided. In high signal to noise ratio (SNR) conditions the Doppler velocity uncertainty is approximately 0.2 m/s and it increases with decreasing SNR. We added this discussion in Sect. 2.2.3:
   "The measurement errors are assumed to be uncorrelated, and so the matrix R_m is diagonal. The reflectivity and Doppler velocity errors depend mainly on the number of independent samples and on the signal-to-noise ratio (SNR); for a typical measurement, they are 1 dB and 0.2 m s^{-1}, respectively. An uncertainty estimation of the PIA is more complex, e.g., it depends on the surface characteristics within the

radar field of view, but it is provided by the C-PRO (for more detail on the PIA estimator see Kollias et al., 2022b)."
The improvement in the retrieval due to addition of Doppler velocity is briefly discussed in Sect. 3.4.

3. How do the retrievals handle the situation when PIA estimates are not available (e.g., complete attenuation in rain)?
   The retrieval is still performed without the PIA estimates, but these results are much more uncertain and must be used with caution.

4. Is PIA used only for retrievals over ocean where the surface returns under the clear sky conditions are assumed to be known? Is PIA used over land?
   Since the normalized radar cross-section of the surface over the land exhibits very large variability due to its dependency on vegetation, surface slope, soil moisture, snow cover etc., the estimates of PIA are only provided over the ocean.

5. Some more information needs to be given about the forward model and assumptions about particle shapes and orientations, which influence radar returns.
   We added the following statement in the section describing the forward model: "The scattering properties of snow particles are obtained by using discrete dipole approximation corresponding to realistic snowflake shapes (see Leinonen et al., 2016). These snowflakes are composed of dendrites of different size, and they are subject to various degrees of riming. In the computations, the radar is pointing vertically, the particles are aerodynamically aligned with the maximum dimension oriented horizontally, and particles are discretized to a collection of 40 µm dipoles."

6. Line 178. How the vertical air motions are removed from measured Doppler velocities?
   To clarify this we wrote this statement in the text: "The estimation of the sedimentation velocity from raw EarthCARE CPR Doppler velocity measurements is a multistep, complex process consisting of non-uniform beam filling correction, velocity unfolding, spatial averaging and finally the sedimentation velocity estimate where the contribution of the vertical air motion has been removed (based on the methodology of Kalesse and Kollias, 2013)".

7. Is attenuation in liquid phase accounted for?
   Yes, the attenuation due to liquid cloud is taken into account in the forward model.

8. Is (25) assumed to be valid for all rain types and intensities?
   This formula is used only in warm rain for all rain intensities. In cold rain, the a-priori estimate of the cloud water path is set to 0.1 g/m^3. The relative uncertainty of this estimate is set to 100 dB which reflects no prior knowledge of this parameter. It is described in the section about the cold rain retrieval.
9. Information about the radar sensitivity and resolution would be helpful.
   At the end of the section with the measurements we added the following statement:" The vertical resolution of the retrieval matches the radar sampling, and it is equal to 100 m. Note that the actual vertical resolution of the radar is 500 m

which implies a factor of 5 oversampling. Thanks to a large antenna (2.5 m) and low aircraft altitude (400 km) the CPR is expected to achieve an unprecedented in space sensitivity and collect measurements as low as -36 dBZ."

Editorial comments

1. Show the integration limits in (7). They were added.
2. Line 190. Correct the name: not "Tikhov" but "Tikhonov". Changed
3. Define J, F in (15)-(16). Is it the forward model matrix? Yes, they are the Jacobian and the forward model. The text has been updated.
4. Show units in (5), (6), (20). Units were added to the formulas.
5. Consider changing the notation of MC for ice to IWC which is more widely used in the literature (or at least mention it).
   We added this statement in the section that describes the state vector: It is important to note that we do not use separate notation for the mass content of ice and rain in this study, although it is commonly referred to as "ice water content" (IWC) and "rain water content" (RWC) in the literature.