

## ***Interactive comment on “Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties, Part I: the retrieval algorithms” by Anne Garnier et al.***

**Anonymous Referee #1**

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The paper “Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties, Part I: the retrieval algorithms” discusses the improvements in the V4 algorithms compared to those used in the version 3 (V3) release. The manuscript presents the development of IIR Level 2 data products, the main changes implemented in the V4 IIR Level 2 algorithm, and describes improvements with respect to V3. In addition, the paper provides updates to the scene classification algorithm, describes the changes implemented to compute the effective emissivities in each IIR channel, detailing microphysical properties and retrievals (effective diameter, ice or liquid water path), and estimations on ice crystal and water droplet concentrations. The study falls within the scope of AMT. The authors have done a thorough job and have a rigorous approach.

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The manuscript is very well-written and structured, the presentation clear, the language fluent and the quality of the figures high. The results support the conclusions. I recommend publication in AMT, however I recommend the following minor revisions and suggestions before it can proceed to be published.

Comments:

1) Regarding references, in the introduction section, an adequate list of references is provided. However, I would suggest the authors to expand the list of references in order to strengthen the manuscript. For example in the very first paragraph, at the end of line 41 (page 2), and at line 42 (page 2) suitable references could be used. 2) Page 2, line 64: At this point the concept of microphysical index,  $\beta_{\text{eff.}}$ , measuring wavelengths, effective absorption optical depths, effective emissivities are introduced in the manuscript. Although the terms are well established, properly explained and presented, this is done later on in the manuscript, leaving a reader to wonder in the early stages of the manuscript. In that case, I would suggest a slight rearrangement, probably would be beneficial for the manuscript, to provide at least brief descriptions at an earlier stage of the manuscript. 3) Page 2, line 69: please provide a more detailed description of the homogeneity criteria used. Although they are detailed in previous studies (Garnier et al., 2012, 2013), as stepping-stone a brief description could be of use. 4) The analysis is mainly in the geographical domain between 60°S and 60°N. Although the biases, the developed algorithms and the improvements are extensively discussed it is not clear the geographical reasons why the analysis is constrained in this domain. I wonder whether the authors can provide an explanation regarding the underlying causes of the geographical preference. 5) Regarding the scene classification, as mentioned, it is based on the characteristics of the layers reported in the CALIOP 5-km cloud and aerosol products. However, as the classification algorithms which is designed to identify suitable scenes containing the required information for the retrievals, sometimes fails to properly classify a cloud/aerosol layer, and moreover in cases of low aerosol/cloud load, due to SNR and CALIOP detection thresholds/capabilities, may

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propagate towards the retrievals, the analysis and the uncertainties. It would be beneficial to discuss more extensively in the manuscript the effects of erroneous feature classifications to the retrieval algorithms. 6) Please provide some more information regarding the algorithm performance on thin clouds/cirrus clouds. 7) Is it possible to provide more detailed description on the motivation for changes in V4, through study cases? If the cases are considered to disrupt the flow of the manuscript, I would suggest their inclusion as supplement. 8) The V4 statistics are very interesting, though they may need further explanation in the manuscript. Is it possible to include in the Statistical Table more statistical indicators (e.g. Relative Difference)? 9) In 3.4.2 section, I would suggest to include more information on the correction functions, as mentioned briefly in paragraph 2. 10) 3.4.3. In the Radiative temperature in liquid water clouds, but also in the rest of the section, I would suggest a more detailed approach and description in the manuscript on the uncertainties introduced due to the applied algorithms. If possible, uncertainties should be included in as many presented results and Figures as possible.

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