

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-453

Anonymous Referee #1

Referee comment on "Optically thin clouds in the trades" by Theresa Mieslinger et al.,
Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-453-RC1>, 2021

General Vote:

The manuscript provides an important contribution to the state of the art focused on remote sensing of optically thin clouds in the trades. It presents interesting and valuable results, which help to identify gaps in common cloud masking algorithms, highlights the problems and mismatches they struggle with and introduces a proper solution. I highly recommend its publication after the authors have revised the manuscript with regard to the comments listed below.

Referee's Synopsis:

The authors introduce a method to identify optically thin clouds in ASTER images, which are not detected by common ASTER cloud mask algorithms. Such undetected optically thin clouds bias, e.g., the cloud fraction and the cloud radiative forcing. The measurements used for this study were derived in parallel to the EUREC4A campaign, which provides the authors a great chance to compare their results to independent airborne observations. The method to identify the optically thin clouds in the ASTER images is based on a "clear-sky" approach using radiative transfer simulations and comparisons to the cloud masks provided by ASTER. Each step is well explained. Based on example images and appropriate graphs the method is easy to follow from the very beginning to the final results, which are then well supported by comparisons to independent airborne observations with the WALES lidar. Already the introduction to this method and its verification would be worth to be published. However, the authors go already a step further and evaluate their results with regard to aerosol-cloud interactions and biases in the cloud radiative forcing, which is great. More details regarding the simplified clear-sky model are given in the appendix, which helps to shorten the main part of the manuscript and prevents it from being too lengthy while still providing all information.

In total, the manuscript is already very well written and has a well-thought-out structure. Still, after reading it again and again, it is hard to identify gaps in the story or major issues. Therefore, I only have one major issue, which likely might turn out to be only a minor one.

Major comment:

Cirrus: The ASTER thermal band is not used, which would help to identify cirrus (on the

expense of a lower resolution). Has it been tested, if there might be cirrus (especially optically very thin cirrus)? Because, the authors use radiative transfer simulations to estimate the cloud free state. Afterwards, they use ASTER pixels, which were clearly identified by the common ASTER cloud mask as cloud free, to adapt the aerosol optical depth (AOD) in the simulations. If there is optically thin cirrus, which is not considered or undetected by the cloud mask, I guess it would bias the adaption of the AOD. I suggest to elaborate a bit further, if there could be cirrus or not. In the case of yes it would be good to know how much such a cirrus might bias the method of identifying optically thin clouds. Even, if there was less or no cirrus during EUREC4A, the discussion about cirrus would help to decide, if this method can be easily transferred to regions somewhere else on the globe.

Minor comments:

- **Acronyms:** Acronyms are often used several times before they are introduced the first time. Examples are EUREC4A, WALES, HALO. I don't know if I got them all. Please check all acronyms throughout the manuscript and introduce their full names whenever they are used for the first time.
- **Clear-Sky:** It should be rather called cloud free. Clear-sky would also mean aerosol free. I would suggest to check it throughout the whole manuscript and exchange clear-sky by cloud free wherever it is appropriate.
- **Indices and units:** Indices are sometimes written in italic letters and sometimes in non-italic letters. Throughout the manuscript this happens also for one and the same index (as an example Eq. A1 and Eq. A2). For reasons of consistency you should write all indices in non-italic letters.
- **Fig. 1 and L70-L71:** This figure is not showing the measurements itself, but rather the position, where they were taken.
- **Fig. 4:** The dark blue line is really hard to identify. Maybe it helps to draw it in red color to increase its contrast compared to the black line. Furthermore, compared to the inset figure, the number of only 8 % seems to be too small. But this might be only an optical illusion due to the distribution of the clouds.
- **P7, L154-L155:** ... select 20000 pixel ...; Just from the number it is hard to estimate, if 20000 pixel are a lot or not. Maybe it is worth to include some information on the total pixel number per image in Sect. 2.1. I might be wrong, but I think it should be 5000 pixel per swath, but only three quarter of them are used depending on the viewing direction.
- **Tab. 1 and Tab. 2:** I would suggest to combine both tables. The header is already the same. Otherwise it is confusing, why there are two tables, with identical header, but different values. If the authors prefer to keep two tables I would suggest to include at least the parameter description (Dp(OTC), DE(R|OTC)) also in table and not only in the table caption.
- **Tab. 3:** The authors should include a third row indicating the cloud cover, which was originally derived by the ASTER cloud mask and probably name the first row "undetected optically thin cloud cover". Of course, it can be easily calculated from the difference, but it avoids confusion (different number in L319, if I calculate it from the table) and helps to highlight the large number of the so far undetected optically thin clouds.
- **Fig. 9:** The section (L361-L372) related to Fig. 9 and Fig. 9 itself needs to be revised. Please include (a) and (b) in the panels. Maybe it is a good idea to include headlines in the single panels. Otherwise it is hard to understand what the single panels are about and why the two panels are different. Also from the related section it became not clear to me.

Technical comments:

- **P1, L14:** Typo: overestiamtion à overestimation
- **Sun:** "Sun" is a proper name and should be written with capital letter. It appears several times throughout the manuscript.
- **P2, L51:** hectometer à hectometre
- **P2, L52:** reflectances à I think it should be without plural-s, "reflectance"; It appears several times throughout the manuscript.
- **P5, L118:** Space sign between number and unit
- **P6, L148:** light à radiation
- **P6, L141:** 1D à one-dimensional (1D)
- **P6, L146:** chapter 2.3 à 2.3
- **P7, L187:** an distribution à a distribution
- **P14, L319-L320:** from the table I calculate 23 %. Probably due to rounding errors.
- **P15, Tab. 3:** missing space sign in $60 \times 60 \text{ km}^2$
- **P17, Fig. 9:** Include (a) and (b) in the panels and maybe include headlines, naming the properties (all-sky reflectance, cond. prob. of total cloud reflectance), which are shown.
- **P17, L365-366:** "As expected,..." This sentence is missing something. It is hard to understand, what it is about.
- **P22, L497:** ... simple clear sky model (SCSM). In Sect. 3.1 it was called simplified clear sky model.