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Comment on acp-2021-453

Anonymous Referee #3

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-RC4, 2021

Review of the manuscript "Optically thin clouds in the trades" by Mieslinger et al., 2021

In this manuscript, the authors explore the wholistic cloudiness by estimating the contribution of optically thin, undetected, clouds to the reflectance distribution.

The inputs for this analysis are high-resolution (15 m) ASTER data over the trade Cu cloud fields supported by lidar information and reanalysis of winds data.

They use the ASTER cloud mask to detect pixels that are cloudy and those that are regarded as cloud-free. They match the satellite's cloud-free reflectance distribution to a theoretical one that is calculated using a radiation transfer model. They use the surface winds to estimate the expected ocean reflectance with estimated variance to match the clear-sky observed variance. Then they change the maritime-tropical aerosol loading to match the distribution's amplitude.

Deviations from the clear-sky distribution are attributed to thick clouds that could be directly measured and thin clouds which is the residual of the two.

The proposed method is interesting but few clarifications are needed:

- A more detailed discussion on the sensitivity to some of the main controlling parameters. The authors do discuss sensitivities of the wind and the variance and show that they are expected to be low. However, since the residual estimation supposed to be super sensitive to the properties of the distribution, and especially to the variance, more information would be needed. For example, the authors use fixed variance, and intuitively I would expect the variance to be a function of the wind. Also, I miss the sensitivity discussion to the AOD estimations. I expect a tradeoff between errors in the ocean reflectance and the AOD that can explain the cloud-free reflectance distribution.
- On the same note - L. 162-170: Can variability in the AOD contribute to the clear-sky distribution variance? Since the variance is estimated from clear-sky images (97% confidently clear), it can be biased to clear sky aerosol distributions. As the authors mention, aerosols and meteorological conditions (especially surface wind) tend to correlate. I suspect that the variability in AOD will be larger in convective days that

permit clouds (due to meteorology and not due to cloud "twilight" effects). Can the authors include a sensitivity test regarding this issue or disavow the argument?

- 61: Please mention if all the analyzed images were of trade wind cumulus and if there were any steps taken to filter out cold clouds and optically thin cirrus clouds.
- 228: What does it mean conceptionally, can you explain? Wouldn't the pixels with cloud shadows (which are not considered by the SCSM) will be classified as optically thin clouds? Can this explain OTC contribution in the lowest reflectance values (<0.05) in Fig. 3?
- 295 or Figure 6 captions: What literature was used to quantify the possible 3D biases?
- 428: Does the translation to mean bias of -6 W/m^2 is for the entire solar spectrum or only for a monochromatic channel?
- 448: There are also modeling studies that suggest considerable effects of aerosols on clouds.
- The ASTER cloud mask is a central component of the analysis. More details should be provided on it in this paper.
- 146: I suggest giving a reference here to Cox and Munk and not only in the appendix.