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Comment on acp-2021-421

Anonymous Referee #2

Referee comment on "Longwave radiative effect of the cloud–aerosol transition zone based on CERES observations" by Babak Jahani et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-421-RC2, 2021

This paper presents a novel method to estimate the impact of the transition zone on outgoing longwave radiation, an under explored area, using CERES observations with help from MODIS measurements. The authors, as well as other recent studies, showed that the impact of the transition zone on longwave radiation is quite significant compared to clear atmospheric conditions. The paper is well written and the method is sound. The paper could provide useful information to the community. However, I do have some questions and suggestions. I hope that could help the authors improve the manuscript before it could be published.

Major comments:

- The "conventional" transition zone study focused on low level clouds such as Eytan et al. (2020) referenced in line 55. However, this paper does not mention if they looked at the transition zone near low level clouds. This is important because high thin cirrus could have similar LW effects but the cloud processes of thin cirrus clouds are completely different from low level clouds. This needs to be clarified.
- The classification of undefined pixels (Lost A, Lost B, Lost C) is useful. However, the paper lacks the description of how to match MODIS pixels to CERES footprints. Since this paper mainly presents a method to estimate the longwave effects of the transition zone, matching MODIS pixels to CERES footprints is a critical step, and it should be described.
- CERES products provide both radiances and fluxes. The authors used LW radiance without no mentioning the reason not using the LW in the product. Is the sub-footprint cloud variability that makes the radiance-to-flux conversion difficult? Some discussions are necessary.
- The definition of temperature dT is not clear. It seems dT is the difference between surface air temperature and cloud stop temperature (lines 227-235). It is hard for me to comprehend very small values of dT. What is the physical meaning when dT is very small? Is it because clouds are very low? Is it because of sub-pixel clouds in MODIS observations that makes cloud top temperature appears low? Some discussions are

necessary.

Minor:

Line 34: "a phase called transition zone". "phase" has been used several times for the transition zone (e.g., line 40, line 217: "a phase of particles between the cloudy and so-called cloud-free skies..", line 289: "an important phase of particle suspensions..", line 293: "intermediate phase of particle suspension..".) To me the transition zone is not another phase of matters (e.g., solid, liquid, vapor). Even clouds contain liquid drops, ice crystals, and water vapor. I would use "a special region" to distinguish from clouds and cloud-free areas.

Line 81: "homogenous" -> homogeneous

Line 85: "These products were obtained for all MODIS-Aqua granules that contain data in the region 0° E – 15° E and 10° S –30° S during August 2010, which **their** data spreads over the **area between 21° W – 21° E and 10° N –50° S."** Not understand.

Line 85: "MODIS-Aqua". I would use Aqua MODIS (e.g, Minnis 2011)

Line 275: "3783 cases have been found…" I would change it to 3783 CERES footprints.

Not sure if the boxplot inset of Figure 3 is necessary since all information is already available from the cumulative distribution and median and mean values indicated. If it do not provide additional information, it would be better to remove it.

In the bar chart in Figure 3, should we expect to the sum of LOST A, B, and C to be one? I might have missed something. It would be nice to add some description in the caption so that the potential reader could see it immediately.