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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical interpretation of the spectral radiative signature in the transition zone between cloud-free and cloudy regions" *by* J. C. Chiu et al.

Anonymous Referee #1

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Review of "Physical interpretation of the spectral radiative signature in the transition zone between cloud-free and cloudy regions" by Chiu et al

As the authors stated, understanding clouds and cloud aerosol interactions is of great importance to climate research, and retrieving correctly the microphysical and optical properties of aerosols in the vicinity of clouds is a great challenge.

The paper reads well and the examples are clear and easy to follow but the regime discussed in this paper is only the cloud halos and the authors missed few key studies related to this topic.

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Interactive Discussion
Discussion Paper

While the title of the paper and in the text the authors refer to the transition zone, the paper deals only with the cloud halos. Cloud halos are regions of enhanced humidity surrounding clouds, which are associated with atmospheric dynamics, as they reflect features of cloud formation and dissipation, and might also serve as the predominant region of cloud-associated new particle formation. Halos were studied by in situ measurements and clouds resolving models mostly by Hobb's group in the 90's. The halos found to extend up to distances of several cloud radii for small cumulus clouds similar to what is shown in this paper.

While one can define the halo as a transition zone, the transition zone defined by the referenced papers (Charlson et al., 2007; Koren et al., 2007) deals with the cloud field properties stating that what is considered a cloud free atmosphere may have unique optical and microphysical properties due to the enhanced humidity and undetected clouds. In fact from the total sky images shown in this study, most of the zone that is shown in between the detected clouds can be considered as a transition zone and may have significant optical differences compare to a clearer sky conditions (when the TSI sees no clouds in a radius of more than 10km around the zenith).

Once the regime issue will be clearer the paper provides useful information on the optical and microphysical properties of the halo. The authors should consider the dependence of the halo properties on the cloud type, and cloud age. While young cloud may have sharper gradients (smaller halo) due to drying by the downdrafts (therefore the inhomogeneous mixing assumption may be valid), old dissipating clouds should have a larger halo with smaller humidity gradients and therefore the mixing can be different. The author can find more information on the microphysical and optical properties of the halos in:

Perry, K. D., and P. V. Hobbs (1996), Influences of isolated cumulus clouds on the humidity of their surroundings, J. Atmos. Sci., 53, 159– 174

Radke, L. F., and P. V. Hobbs (1991), Humidity and particle fields around some small

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cumulus clouds, J. Atmos. Sci., 48, 1190– 1193.

Lu, M.-L., R. A. McClatchey, and J. H. Seinfeld (2002), Cloud halos: Numerical simulation of dynamical structure and radiative impact, J. Appl. Meteorol., 41, 832– 848.

Lu, M.-L., J. Wang, A. Freedman, H. H. Jonsson, R. C. Flagan, R. A. McClatchey, and J. H. Seinfeld (2003), Analysis of humidity halos around trade wind cumulus clouds, J. Atmos. Sci., 60, 1041– 1059.

These references are linked directly to the presented study.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17549, 2008.