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Interactive comment on “The interdependence of continental warm cloud properties derived from unexploited solar background signal in ground-based lidar measurements” by J. C. Chiu et al.

Anonymous Referee #1

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The paper evaluate a method using lidar background signals to retrieve warm cloud optical depth, which provide a new way to provide cloud optical depth in zenith direction, which make it more easy to combine with other zenith pointing measurements, such as, microwave radiometer, to more effectively study cloud microphysical properties. The approach can able be used for lidar only measurements world wide to provide a large cloud optical depth dataset with ground-based lidar networks. I'd recommend it for publication after the following comments are properly addressed.

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Major issues:

1. How do multi-layer clouds impact the retrievals? The results presented in the paper are based on the ARM SGP site measurements, where radar measurements are available to be used to identify multi-layer clouds. In the summary (page 8990, line 21-28), you indicated that the approach can be applied to lidar network and ceilometer measurements. For these lidar-only measurements, multi-layer clouds identification is a challenging task. Thus, related discussion along the line will be useful for others to implement the approach. 2. The paper will be enhanced if the discussions consider more underline physical processes. For example, the statement between line 21-23 in page 8975, is hard to make sense in general. For stratiform clouds with the same base temperature and optical depth, continental clouds should be thinner than marine clouds due to higher droplet concentrations in continental clouds. However, marine stratiform clouds typically have warmer base temperature, which could be the main reason behind the statement. Keeping this point in mind, it will be useful to bin data into different temperature ranges for analyses conducted in the paper. 3. The effective radius is derived from LWP and optical depth based on Eq. (1). Thus, they are interlinked by Eq. (1), which makes it hard to understand the results presented in Fig. 6b, d and Fig. 7d. Fig. 6b shows similar LWP and optical depth relationships though the magnitude differences. From Fig. 6b, we could simply expect similar optical depth dependency of effective radius. But Fig. 6d shows quite different trends for low optical depth range. Some discussion to clarify this will be useful. 4. In the section, it will be useful to highlight the differences of different methods, which make the differences in the case study easier to understand. In the case study, you emphasizes the approach capturing cumulus on 15 June. For the cumulus clouds, inhomogeneity could be an issue to use plane parallel assumption for the radiative calculation.

Minor issues: 1. Page 8965, line 4: compared with low cloud over ocean, the amount over land is much lower (see Sassen and Wang 2008, Geophys. Res. Lett., 35, L04805, doi:10.1029/2007GL032591). 2. Page 8966, bottom paragraph: MPL has

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a small FOV and the other system has large FOV. How does your Fig. 1 depend on FOV if the approach is applied to other system. 3. Page 8967, line 14-15: Providing more details related to calibration will be helpful. If there is not AERONET measurements, how the calibration should be done? 4. Page 8968, line 28-29: -7.5 is the typical value for optical depth large than 3, which is still at the right site of the peak in the Fig. 1. 5. Page 8969, line 11: Fig. 1a shows the peak larger than 5. 6. Page 8969, line 17: To use these thresholds, MPL signals need to be calibrated. Achieved MPL data are not calibrated. More details along the line will be useful for readers. 7. Page 8973, line 17: Provide details for “unphysical”. 8. Page 8974, line 6: What does “later” refer to? 9. Page 8978, line 19: For difference indicated here could be linked with different targeted clouds. Thus, providing a few details of clouds studied by Nauss and Kokhanovsky (2006) will be useful. 10. Page 8980, line 13: Is the 15um is for continental clouds or marine clouds or all clouds in general.

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