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Interactive Comment

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 #2

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This paper describes a novel technique to retrieve optical depth from the solar background measured by lidars. The authors show the technique to be valid for stratiform clouds and then go on to explore relationships between retrieved cloud properties. The focus is on comparing drizzling versus non-drizzling stratiform clouds. This paper may be suitable for publication after the authors address the following issues.

Major comments:

The comparison of cloud properties includes the use of liquid water path (LWP) from a microwave radiometer (MWR). However, LWP is not valid when the MWR window is wet. The authors mention this on page 8970 lines 21-23, stating that these wet window cases are removed. Therefore, the results of drizzling cloud properties in this paper could be biased since they cannot include any observations where drizzle has reached the surface or those observations just after such times when the window will remain wet. Some discussion is needed on how many profiles are excluded because of this and, if this number is significant, the authors need to address the impact on their results.

page 8968 lines 12-14: Assuming the solar background light has the same uncertainty as an AERONET (5%) is not appropriate. In lidar studies, the background noise is determined by taking the standard deviation in the high altitude region (i.e. 45-55km for the MPL). In addition, there is an uncertainty due to detector noise that depends on signal strength. I suspect the noise is the lidar observations are likely larger then 5% and therefore the authors should revisit their claim of a 10% overall uncertainty.

Throughout the paper the authors write that the cloud optical depth is retrieved using the "solar background light". This is misleading since a radiance is needed for the look-up tables but the "solar background light" is measured by the MPL as photon counts. It be more correct to say "calibrated solar background light" since the photon counts are converted to a radiance via calibration to AERONET.

Page 8969 lines 6-18: Instead of establishing backscatter thresholds, why not just compare the measured backscatter above cloud to the solar background signal? If the two are similar, then the laser beam is completely attenuated and the cloud is optically thicker, otherwise it is optically thin. This would make the author's method more readily adaptable to other lidars beside the ARM MPL and wouldn't require the lidar backscatter profile to be calibrated which is needed if these thresholds are to be used.

Section 3.1: Since the focus later in the paper is on drizzle and non-drizzling cases it seems warranted that an example of retrieval performance for a drizzling case be included here.

Page 8973 line 19: What percent of the original 1 hour time periods identified by ARSCL does the 5200 min of data points represent? i.e. what fraction of the stratiform periods during these 2 years are included in your analysis of cloud properties?

Repeating the validation in Fig 5 with the AERONET observations would be nice to see. Although the sample size would be smaller than the ARM Min observations, if other researchers wanted to extend this lidar optical depth method to other sites a sun photometer may be their only means of validation (since one is required for calibration).

Does using the Min observations result in the same relationships between cloud properties (i.e. Fig 6-7 and the power law relationships)? Many readers, including myself, may wonder if the differences between the more established ARM Min product and the authors' new lidar retrieval in Fig 5 has any effect on the resulting relationships between cloud properties.

Fig 6: There is an extra bin in panel (b) at optical depth = 75 that is not present in panel (c) or (d).

Fig 5b: increase the limits of x and y axis to 100 so it matches the optical depth histogram in 5a

Minor comments:

page 8964 line 5: change "signal" to "signals"

page 8965 lines 2-3: remove "and many others"

page 8965 line 18: why is the relationship "of particular interest"?

page 8966 line 14: suggest changing "Campbell et al. 2002" to "e.g. Campbell et al. 2002" page 8967 line 14: suggest changing "between 45 and 55 km" to "between 45 and 55 km where the molecular backscatter is negligible"

page 8970 line 15: explain what is meant by "worked better"

page 8973 line 17: Define what an "unphysical 1 min averaged LWP" is.

page 8974 lines 8-10: Aren't both flux and lidar retrievals averaged to 1 min for this comparison? Why then does only the flux based retrievals smear out these variations?

page 8980 lines 24-26: It would be more accurate to say that: "This new method can be easily adapted to existing lidar networks where sun photometer measurements are available"

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