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Atmospheric Measurement Techniques Discussions

Interactive comment on "Ground-based Observations of Cloud and Drizzle Liquid Water Path in Stratocumulus Clouds" *by* M. P. Cadeddu et al.

Anonymous Referee #1

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General comments

This manuscript presents a new technique for obtaining cloud and drizzle liquid water path by combining multi-channel microwave radiometer, Doppler cloud radar and ceilometer measurements. The new technique is applied to observations of precipitating stratocumulus clouds and evaluated qualitatively by comparison with Doppler cloud radar spectra.

The technique shows great promise and will aid the community investigating the properties of stratocumulus by providing a new piece of information, although the full potential is not explored deeply in this initial study. This manuscript is almost ready for

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publication, with a few technical aspects to correct.

Technical comments

Line 18: Replace 'exists' with 'exist'.

Line 22: Suggest opening with 'Marine stratocumulus clouds have a significant impact on the Earth's radiation balance as they reflect a greater amount of solar radiation back to space compared to the ocean surface, and emit a similar amount of longwave radiation as the surface.'

Line 26: Replace 'Feingold and A. McComiskey 2016' with 'Feingold and McComiskey 2016'.

Line 31: Move comma from after 'properties' to after 'instrumentation' .

Line 32: Do you mean moments here, or would it be more realistic to state 'the shape of the drop size distribution'? Otherwise you should explain what you mean by moments in this context.

Lines 35-36: This statement needs some qualification. Review papers discussing LWP estimation from multi-channel microwave radiometers usually state that care must be taken in the presence of precipitation, and that LWP estimates are not reliable in strong precipitation.

Line 58: Replace 'since summer of 2015' with 'since the summer of 2015'.

Line 61: Suggest stating 'reflectivity-weighted Doppler spectrum'

Line 61: Replace 'Collocated to' with 'Collocated with'.

Line 63, 75, 92 and elsewhere: Replace 'backscatter' with 'attenuated backscatter'.

Line 71: The correct reference for 'auto-calibration of cloud lidar' is O'Connor et al. (2004) not (2005).

Line 103: Lidar ratio for cloud droplets at 905 nm is about 19 sr, and is even lower for

larger drizzle droplets.

Line 104: The ceilometer attenuated backscatter peaks at cloud base due to the large return from the small but much more numerous cloud droplets, relative to drizzle droplets.

Line 106: Do you mean here, 'the average modal diameter of the full drop size distribution including drizzle drops and cloud droplets'? How reasonable is this assumption considering that these are two distinct hydrometeor populations, normally giving rise to a skewed distribution if they overlap?

Line 161: Small drizzle drops may not display a negative Doppler velocity if they are falling into a strong updraft. It is true to state that drizzle drops have a significant terminal fall velocity, but the observed Doppler velocity is the sum of the fall velocity and the air motion.

Line 167: Suggest using the term 'drizzle shafts' here and elsewhere in the manuscript.

Line 176: Suggest rephrasing to '.. are as negatively skewed as the Doppler spectra at cloud base'.

Lines 177-178: The terminal fall velocity of cloud droplets is very small, and their observed Doppler velocity distribution is a result of turbulence.

Line 185: Not quite true. For Rayleigh scattering, reflectivity is proportional to mass-squared, but the larger drizzle drops are in the Mie scattering regime.

Line 264: Do you mean in-cloud DWP here?

Figure 1: 'together with cloud boundaries from KAZR (cloud top) and ceilometer (cloud base)' 'ceilometer attenuated backscatter coefficient'

Figure 4: In (a), does cloud LWP include in-cloud drizzle (DWP) or cloud droplet LWP only?

Figure 5: 'Downward motion'. It is not clear how the x-axis is derived.

Figure 10: The solid line represents the mean of the total LWP measured in each flux divergence bin? How about the bars? The figure caption should be clear.

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