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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The albedo properties of four clean stratocumulus clouds studied during the VOCALS-REX field campaign" *by* B. Parkes et al.

Anonymous Referee #1

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This manuscript presents a comparison of the albedo of stratocumulus clouds derived from two different methods that utilise in-situ aircraft measurements made during the VOCALS field experiment. The first method uses aircraft radiometric data, and the second is derived from cloud microphysical measurements made during runs through the cloud layer in combination with an equation for the delta-Eddington approximation. The authors use this comparison to conclude that the delta-Eddington approximation applied to the cloud microphysical data is only valid for solar zenith angles less than 65 degrees.

I have major concerns about the methodology, the breadth of the observations used

and the overall purpose of the paper. These are outlined in more detail below. I therefore recommend that the paper is rejected in its current form.

1. There is a general lack of information relating to what the purpose of this paper is. For example, why is it important to compare the two methods of calculating albedo? What implications do the conclusions have? How does this work compare to previous studies? What is novel about the work done in this study?

2. I have concerns about the method used to derive cloud optical depth, and hence the cloud albedo from the Cloud Droplet Probe (CDP). In equation (2) the effective radius should be representative of that near cloud top, whereas the authors use that derived from droplet size spectra measurements made lower down within the cloud layer, where the effective radius will presumably be smaller. I am also very dubious about the derived LWP measurements which are also used in equation (2). The LWP is assumed to be the LWC data measured at the aircraft flight level in the cloud layer multiplied by the cloud thickness below the aircraft. Even if one thinks of an idealised stratocumulus cloud that exhibits a triangular adiabatic LWC profile, then this assumption will only be correct if the aircraft is flying at a certain level within the cloud, which is almost certainly not the case. The authors could look at how the derived LWP compares to the integrated LWC made from aircraft profiles through the depth of the cloud layer e.g. at 1200 to 1400 seconds in Fig 1. The authors also assume a constant value of the asymmetry factor in equation (1). They could actually calculate this by including the measured drop spectra in Mie scattering calculations, although the same caveats about the data not being representative of that at cloud top would still exist. All of these factors lead me to suspect that there is a much larger uncertainty in the albedo and LWP derived from the cloud microphysical data than is indicated by the error bars shown in figures 3 and 4. In addition, I am also unsure of how the radiometric albedo measurements are actually made. Are these made by the aircraft overflying the same cloud layer that is analysed for the in-situ cloud microphysical measurements?

3. For cloud segment 1, the authors show poor agreement in the albedo calculated

from the two methods, and attribute this to the high solar zenith angle. It is also the case where the aircraft was flying lower down in the cloud layer for the cloud microphysics measurements, and so may be subject to enhanced biases in the derived optical depth than the other cases for some of the reasons mentioned in point 2.

4. The authors have used a very limited observational dataset. From the 13 research flights made with the FAAM BAe-146 aircraft only four cloud segments are analysed. The authors select these cloud segments based on requirements to have “good CDP and radiometric data with satellite coverage and contain little to no coastal pollution”. Firstly no satellite data is used in the paper so why is it a constraint? Secondly why do the authors only look at clean cases, where contrasting this with more polluted cases near the coast would be of interest? Thirdly why not use all research flights to increase the number of cases, so that any conclusions made are more robust?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 30021, 2012.