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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.

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Parkes et al. present a fairly straightforward study of the suitability of using aircraft in situ measurements of cloud microphysical properties as input into the delta-Eddington approximation to estimate the shortwave albedo of clean marine stratocumulus clouds. To test this technique they compare the shortwave cloud albedo derived from the microphysical measurements of the Cloud Droplet Probe on the aircraft to direct measurements of the shortwave cloud albedo measured by up- and down-looking shortwave radiometers on the aircraft. Based on this limited comparison (only 4 short flight segments) they conclude that the delta-Eddington approximation is suitable as long as the

solar zenith angle is less than 65 degrees. In the revised manuscript we now study 9 clouds all of which have a SZA of less than 65 degrees and are therefore appropriate for use with the DE approximation.

This paper mainly deals with the validation of a technique and is not really a description of the "albedo properties of ...stratocumulus...during VOCALS-REX..." as the title indicates. As a 'descriptive' type paper I would be concerned that it only looks at a limited number of case studies (only 4 short flight segments). But as a 'validation of a technique' type paper the number of cases is not as big of a concern (although more is always better). Also, as a 'validation of a technique' paper I would ordinarily recommend that it is more appropriate for the Journal of Atmospheric and Oceanic Technology. But since it is part of the VOCAL's special issue I feel it's appropriate for ACPD. We have changed the name of the manuscript and agree that it is more suitable.

Specific Comments: Title: - For the reasons mentioned above, I think this paper is mis-titled. A more appropriate title may be something like, "Validation of the delta-Eddington Approximation to derive the albedo of clean stratocumulus clouds during the VOCALS-REX field campaign" Abstract: - The abstract is succint and to the point. - Page 30021, Line 11: Recommend changing "below 65 degrees" to "less than 65 degrees" since "below" could be confused with lower in the sky, when really smaller solar zenith angles mean higher in the sky. A) Corrections to the title and abstract have been made

1. Introduction: Page 30021, Lines 19-20: Specify which country VOCALS-REX was based out of. Specify off the coast of which country were the aircraft measurements made. Page 30021, Line 22: It should be specified that the Ron Brown and IMARPE are research vessels. Page 30021, Lines 23-24: Specify the country where Paranal and Iqueque are located. Page 30021, Lines 24-26: The sentence "Data from the UK's ..." is incomplete Page 30021, Line 25: "Facility" is misspelled. Page 30022, Lines 1-6: Paragraph starting with "Much of the investigation...": Since this paper does not investigate the effects of cellular convection on cloud albedo there is no need for this

paragraph. A) Corrections to the title and abstract have been made

2.1 Instruments: Page 30023, Lines 14-17: This description of how the uncertainties in the pyranometer measurements were derived is too cursory. It's not clear how you came up with 10Wm- 2 and this number appears arbitrary. Is this meant to be plus or minus 10 W/m2? How were they based on the comparisons to UKMO standards? Since these measurements are central to the paper this should be elaborated more. This has been done in section 2.3

Page 30023, Lines 14-17: Were the pyranometer measurements corrected at all for the attitude of the aircraft? This is more important for the up-looking radiometer which can be significantly affected by any tilting of the instrument due to the pitch and roll of the aircraft. This tilting can introduce offsets into the signal that can then throw off the albedo measurements. If you did do these corrections you should explain how you did them. And if you did not do these corrections you should explain why you did not. A) These corrections are automatically applied by FAAM

Page 30023, Line 18: Remove "of" from "major of sources" A) Done

2.2 Observed Data: Page 30024, general comment: I'm curious why you only looked at 'clean' clouds? It seems like VOCALS provided an excellent dataset to investigate the use of the ïAËŻd'- Eddington approximation for a wide range of marine stratocumulus clouds from 'clean' to 'polluted', from precipitating to non-preciptating. Investigating more and a wider range of cases would have provided a more valuable contribution. A) Six flights and 9 clouds are now analysed

Page 30024, Line 10: Eliminate "and" from "...2D-S instruments and be free..." This sentence has been changed.

Page 30024, Lines 10-19: In your description of the flight segments used in the analysis you describe climbing into the cloud, doing a straight and level leg in the cloud to obtain the microphysical measurements, then climbing out of the cloud. But you don't describe

how you measured the albedo above the clouds with the pyranometers? Did the aircraft retrace the flight path of the in cloud flight leg? How high above the cloud tops was the aircraft when it made the radiometer albedo measurements? A) As described in Slingo et al (1982) the SW radiometers can be used in cloud and have been in this case. This has been made clear in the manuscript.

This is my main concern with this study: Were the radiometer measurements of the albedo made above the cloud? Or did you use the radiometer measurements of the leg in the cloud? If you used the radiometer measurements in the cloud then I'm not sure what your analysis means since you are just looking at the albedo inside the cloud, and not the top of the cloud albedo which is really what is required. A) We do use the in cloud radiometric results as has been done in Slingo et al 1982. We agree that a top of cloud albedo is of more use however this is a limitation of trying to use a single platform in cloud. Further work analysing the change in cloud albedo through a direct transact of a cloud is an interesting concept which we would like to expand upon in a future publication.

If you are using radiometer measurements above the cloud, then you need to describe this in detail. How did you ensure that you were sampling the same area of the cloud so you could relate the in situ microphysical measurements to the above cloud radiometer measurements? Were there only clear skies above the aircraft for the albedo runs? A) We have now described that the albedo measurements from the radioemeters were taken in cloud.

Conclusions: Page 30027, Line 16: You mention that each of your cloud cases required satellite coverage, but you did not do anything with satellite data in this study so I'm not sure why this was a requirement. This phrase is not required. A) The reference to satellite data has been removed.

Page 30027, Line 24-26: The final conclusion of this paper is perhaps a bit too strong given the limited number of cases investigated. A more appropriate conclusion may be

something like "The results of this limited study show that for clean marine stratocumulus clouds the delta-Eddington approximation can be suitable for deriving the albedo of the clouds for solar zenith angles less than 65 degrees. This agrees with the theoretical work in Joseph et al. (1976)." A) This change has been made

Page 30033 and 30034, Figures 2 and 3: Is the y-axis the albedo measured by the pyranometers or is it the albedo calculated using the given micropysical measurements (effective radius, LWP) as input to the delta-Eddington approx? If it's the pyranometer measured albedo, how did you relate each microphysical measurement to the pyranometer measured albedo? This goes back to my comments above about how you measured the albedo with the pyranometers, in or above the cloud? If above the cloud, how did you correlate each albedo measurement with the in situ microphysical measurement? If this is the pyranometer measured albedo in the cloud, then I'm not sure if there's any value to this analysis. A) The albedo is the pyranometer albedo and is calculated using data which has been collected simultaneously with the microphysical data.

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