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Interactive comment on “Evaluating MODIS cloud retrievals with in situ observations from VOCALS-REx” by N. J. King et al.

Anonymous Referee #2

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This is an insightful evaluation of the MODIS retrievals of cloud microphysical properties for the southeast Pacific stratocumulus region. The work follows on two previous papers reaching similar conclusions (MODIS retrievals of effective radius appear to be biased high) based on insitu data collected during VOCALS, one using NCAR C-130 data(Painemal and Zuidema, 2011, PZ11 hereafter) and another using DOE G1 aircraft data (Min et al., 2012, ACPD). This manuscript extends beyond these previous papers, by assessing the information content of the vertical variation in droplet size through forward modeling synthetic MODIS radiances based on the insitu information, and performing an optimal estimation retrieval on the synthesized radiances. The authors more closely emulate the effective radius at the vertical depth most relevant to the MODIS retrievals than did the previous papers, adding further depth to the evaluation. In so doing, the authors demonstrate little if any useful information on the droplet verti-

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cal structure can be ascertained from the MODIS retrievals at 3 different wavelengths, for their dataset.

Another useful assessment provided by the authors is a comparison of the CDP cloud probe data gathered from their UK BAe-146 platform with that from the C-130 plane. The CDP bin sizes for the C-130 dataset were altered to bring the CDP LWC into agreement with that from the King probe, as done in PZ11. The UK CDP probe was calibrated before each flight using glass beads of known size. During the one intercomparison flight the BAe-146 CDP effective radius was found to exceed the C-130 effective radius by about one micron. This is the only documented in-situ comparison from VOCALS that I am aware of. The intercomparison provides a valuable insight into the accuracy of the CDP probe, something PZ11 were not able to assess well with their one dataset, but with important ramifications for the MODIS retrieval assessment. The intercomparison result is consistent with the finding of Lance et al (2010), that the optical model applied to the glass bead calibration leads to an oversizing by one micron.

The following specific comments are intended to improve the manuscript further:

The abstract should mention the platform (BAe-146) somewhere. The abstract also currently fails to include any mention of the CDP probe intercomparison, and of its ramifications for the MODIS retrieval evaluation - a major oversight.

The discussion on the MODIS cloud top determination on p. 23700-23701 didn't make sense to me. The MODIS operational cloud top location algorithm I am aware of uses the CO₂ splitting technique with wavelengths in the 13-14 micron range, producing a cloud top pressure estimate that is only then converted to a temperature or altitude. See e.g. Holz et al. 2008 JGR, Menzel et al. 2008 JAMC for more background. This is the cloud top that is referred to in the Garay et al and Harshvardhan papers. The 3.7 micron cloud top temperature alluded to by the authors needs a reference - I am assuming it is a MODIS variable as otherwise the authors would not be using it. Is it

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producing a cloud top temperature, from which a cloud top pressure is inferred? Or are these separate retrievals? Fig. 9 shows discrepancies of 250-300 hPa in insitu and modis CTP, which would be consistent with the CO2 technique, but is inconsistent with the 1-2K insitu-modis cloud top temperature differences shown. What products exactly did the authors use? Coincidentally, the MODIS cloud top temperature underestimate is consistent with a comparison to radiosondes done in Zuidema et al., 2009, J Clim, using an 11 micron derived cloud top temperature.

p. 23701: The authors mention the MODIS algorithm uses a standard deviation of 0.35 for its lognormal size distribution. This is equivalent to an effective variance of 0.13. MODIS has been using an effective variance value of 0.10 since its Collection 4 (Steve Platnick, personal communication). The change isn't reported in any of the MODIS papers thus difficult for outside researchers to know. It is equivalent to a standard deviation of ~ 0.32 . The authors are advised to check with Steve Platnick to confirm.

4) The authors conclude MODIS also overestimates cloud optical depth, in contrast to PZ11. It may be worth looking at a couple of those scenes more carefully, in particular those indicated with red points in Fig. 3, to see if an explanation can be found.

Figures:

A figure showing the locations of the BAe profiles used (near-shore? far-off?) would be useful - Table 1 is helpful but a figure is easier to take in. Similarly, another column in Table 1 indicating the Gregorian calendar date of the flights would be useful.

Several of the figures are quite difficult to read: Fig 2, 5, 6, 7, 8, 9, 10, 11, 12 - basically most of them. Please increase the font size.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 12, 23679, 2012.

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