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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud droplet size and liquid water path retrievals from zenith radiance measurements: examples from the Atmospheric Radiation Measurement Program and the Aerosol Robotic Network" *by* J. C. Chiu et al.

Anonymous Referee #2

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This paper is one of the most comprehensive overviews of techniques (including the one by the authors) that employ zenith-viewing shortwave spectral radiance observations, and the authors can be commended on this, as well as on the thorough validation of their new effective radius and liquid water path retrieval, which is an extension of the retrieval of optical thickness, based on the AERONET cloud mode, presented in an earlier paper (2010). Not only do the authors compare their retrievals with various other observations (MWR, MODIS,...), they also study the impact of 3D effects on the retrieval accuracy.

Minor revision/addition: One of the issues that has been plaguing these kinds of retrievals are the effective radius uncertainties, due to the compensating effects of enhanced forward scattering on the one hand and enhanced absorption on the other, for increasing particle size. Each publication so far has had to describe how the issue was overcome in each particular case. Here, very reasonable assumptions are made about the observational errors, and their propagation into the retrievals. Somewhat surprisingly though, the effective radius uncertainties (and thus, the uncertainties in liquid water path as well) are small. Can the authors provide an explanation as to why their retrieval produces smaller errors than, say, a retrieval combining only two wavelengths (e.g., 870 nm and 1640 nm)? Most likely, the improvement over dual-channel techniques comes from the addition of the 440, 675, and 1020 nm channels, but it would be nice to have this quantified (and explained). For example, a comparison of the magnitude of uncertainties could be made when using the full set of wavelengths vs. only two. Also, the McBride et al. (2011) paper (Figure 10 and text) demonstrates that the uncertainties in reff depend on the cloud optical thickness (there are certain ranges that are more favorable to a reff retrieval than others). How is it here? Would it be possible to add a plot that shows the Reff and/or LWP retrieval uncertainties as function of optical thickness? It should be added that it is entirely possible that 3D effects (nicely included in this paper) outweigh the radiometric uncertainties; it would be nice to see the relative contribution of both these effects (radiometric uncertainties and 3D effects) quantified somewhere, but this is perhaps beyond the scope of the paper.

Minor comments:

* The choice of "source" in figure 1 is unfortunate; how about "reference"?

* Figure 5: This is where the discrepancy between "true" and "retrieved" could be shown as a function of optical thickness.

* p19181, L13: typo: add space before "r_retrieve"

* p19182, L1: Replace "Thank" with "Thanks"

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12, C7878–C7880, 2012

Interactive Comment