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Atmospheric Measurement Techniques Discussions

Interactive comment on "Cloud heterogeneity effects on cloud and aerosol above cloud properties retrieved from simulated total and polarized reflectances" *by* Céline Cornet et al.

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Spatial distribution of aerosol and cloud microphysical properties and aerosol/cloud interaction are highly concerned by our community. In this context, the theoretical study performed by Cornet et al. on cloud heterogeneity effects on cloud and aerosol above cloud remote sensing is important and fits very well the direction of remote sensing algorithm development.

I have no questions about the tools (including the Monte Carlo polarized radiative transfer model and POLDER cloud and above-cloud aerosol retrieval algorithm employed in this study) as they have been well developed and validated in LOA over the last two

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decades. Beyond the opinions of the other three reviewers, I have a few comments on the technical aspects:

1) The authors may double check Eq.(1) as it is more like a definition for bidirectional reflectance factors (BRF) instead of for “total reflectance”? In addition, to define polarized reflectance, it is better to use sqrt(Qˆ2+Uˆ2+Vˆ2) instead of “I” in Eq(1) for clarity. 2) Does the AOT retrieval closure test use the simulated signals from the whole scattering angular range from 60 to 180 degree ? It can be observed from Figs. 4 and 6 that the 3D impact is more remarkable in the scattering angular ranges from 60 to 80 degrees and from 160 to 180 degrees. What if the authors try doing the aerosol optical thickness (AOT) retrieval using the signals from 80-160 degrees range only (where 1D RT apparently has less plane-parallel bias) and re-evaluating the 3D impact on AOT retrieval ? I assume the aerosol information residing in this reduced angular range may be good enough for AOT retrieval (and may result in reduced error). 3) For solar incidence angles 20 and 40 degrees, the cloudbow signals (e.g. in the principal plane) should appear in two sides around incidence ray. And their magnitudes should be somehow different. But such a difference is not observed in Figs. 4-6. Is this due to the signals at the same scattering angles are just averaged regardless of the difference in viewing angles ? It may be more clear if the authors plot both of them in those figures. 4) It may be necessary to describe a little more on the criterion for setting 50 m as the small scale (pixel scale). Is this set up due to the sufficiency in ensuring a) representativeness of cloud microphysical property variation and/or b) accuracy of cloud signals in a certain scale ?

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