Statement on the Revision of ⟨AMT 2017-182⟩ Based on the Referees' Report

S. Lolli F. Madonna M. Rosoldi J. R. Campbell,
E. J Welton J.R. Lewis Y. Gu G. Pappalardo

November 12, 2017

This statement concerns our revision of the ⟨AMT 2017-182⟩ paper, entitled "⟨*Fu-Liou Gu radiative transfer model used as ...*⟩", based on the referees' report.

Comments by Reviewer #1

> `Although the paper deals with lidar observations of cirrus extinction profiles, there is no information on the laser beam pointing (zenith or off zenith to avoid specular reflection) and no information about the receiver field of view which has an impact on the multiple scattering contribution. On the other side, the depolarization technique is explained (even the 45 deg calibration) although not used. Please re-write this section, update the instrument part to meet the requirements for this paper.`

The information about instrument depolarization channel was suppressed as not relevant for the paper, being the channel not used. On the contrary, we added a paragraph regarding measurement configuration and multiple scattering effects.

> Now, I come to my most important point: The authors use both, the Raman lidar method and the Klett retrieval to determine particle extinction profiles. And EARLINET members (experts in the field of Raman lidars) probably know that the optimum Klett solutions of the backscatter and the extinction profiles are obtained with the 'actual' lidar ratio (profile) from the Raman lidar observations. Ideally, Klett and Raman backscatter and extinction profiles coincide, ... but usually the available Klett codes cannot handle lidar ratio profiles. However, if you apply the method to such a rather rather thin cirrus as done in this paper, then we may have a problem. I would recommend to use a visible, very well developed cirrus cloud deck (not this subvisible cirrus with an optical depth Of about 0.02). Is there a reason why this quite unusual cirrus is taken, and not a very normal one?

In the manuscript new version two more cases are reported and discussed, a thicker cirrus cloud and a case with biomass burning aerosol. Regarding the first part of the comment, we changed the text accordingly to make clear that the goal of this study it is to start a relevant discussion from a quantitative point of view, about the discrepancies of aerosol and cloud direct radiative effect calculated using the Raman technique or the simpler lidar elastic technique retrievals. Inconsistencies may arise also using a mixture of lidar techniques from multiple networks or within the same network. As example, what is the difference in retrieval if, we have data from an MPLNET permanent observation station vs. a more sophisticated (like those operating in the frame of EARLINET) instrument? This first work put the basis for a successive study where a much larger dataset will be analyzed to assess quantitatively how much the different techniques/data processing affect the retrieval of the optical and geometrical properties.

> Nevertheless, by just taking a climatological value for the dust lidar ratio of 45 sr and for the cirrus of 25 sr in the Klett retrievals, and in this way by completely ignoring the reality, i.e., the 'actual' Raman lidar observations of the lidar ratio . . .. it is not surprizing that you obtain different Klett and Raman extinction profiles. The true ones are, by the way, the Raman solutions. The Klett solutions are wrong. If your Klett code cannot handle lidar ratio profiles (from the Raman lidar observations), then you should at least take the dust layer optical depth from the Raman lidar observations to constrain the Klett solution. The Klett column backscatter times the used input lidar ratio must match the Raman solution for the dust optical depth. By playing around with the Klett solutions to find the best lidar ratio, you finally end up with the most appropriate column dust layer lidar ratio. After optimizing the Klett/Raman solution set you may continue with radiation calculations and show remaining differences in terms of TOA and SFC forcings. I am sure they are small.

Thanks for pointing it out but again, we think that we didn't state clearly enough the scope of our manuscript. We revised the text to avoid any possible confusion or misunderstanding. This study is preparatory for a future standardization of existing or future ground-based lidar network using different techniques as well space missions. The used metric for this evaluation is the net radiative effect calculation at TOA and SFC by the Fu-Liou-Gu radiative transfer model. The manuscript focuses on discrepancies between lidar techniques/data processing, not on the assumptions of the single retrieval of aerosol/cloud geometrical optical properties. Theoretically, the analysis can be performed on synthetic signals where all the geometrical, optical and microphysical cloud and aerosol properties are well known. In future work, a quantitative assessment of the differences will be evaluated on real cases taken from a climatological significant database