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Interactive comment on "Fu-Liou Gu radiative transfer model used as proxy to evaluate the impact of data processing and different lidar measurement techniques in view of next and current lidar space missions" *by* Simone Lolli et al.

Anonymous Referee #3

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General comments

The main objective of this paper, entitled "Fu-Liou Gu radiative transfer model used as proxy to evaluate he impact of data processing and different lidar measurement techniques in view of next and current lidar space missions" is to quantify inconsistences in aerosol (one case in this study : dense dust aerosol event) and cloud (one case in this study : thin cirrus) radiative forcing at Top Of the Atmosphere and at surface due to

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[Discussion paper]

two different ground lidar techniques (elastic and Raman lidar, i.e. the Multi-wavelengh System for Aerosols (MUSA) Lidar (Madonna et al., 2011)) and/or data processing (i.e. effect lidar measurement with different vertical resolution together with smoothing techniques). Vertical profiles of aerosols and cloud optical properties (i.e. extinction) are retrieved with classical algorithm (lidar ratio is set to 45 Sr for the aerosol event and to 25 Sr for the cirrus) and with the more accurate Raman lidar techniques. Then radiative forcing is computed with the help of Fu-Liou Gu radiative transfer. Sensitivity of radiative forcing to input parameters (extinction) is evaluated applying a Monte Carlo technique. Aerosol type is the number 17 in the radiative transfer model, and effective diameter of cirrus crystals is computed from Heymsfield et al. (2014) parametrisation. Finally, on the basis of this two study cases, authors conclude that radiative forcing is affected by the measurement and retrieval techniques as well as on the data processing constrainst/assumptions from 0.5% to 35%.

This paper address relevant scientific topics within the scope of AMT. Scientific methodologies and assumptions are valid but not always clearly outlined (see my specific comments). Description of experiments and calculations are rather complete. The overall presentation is rather structured and clear.

Nevertheless, I have two problems when I review this paper. Firstly, even if scientific methodology and calculation are interesting, scientific contribution of this work is not very novel. This paper is rather a sensitivity study of radiative forcing to vertical profiles of extinction retrieved by two different lidar techniques (classic and Raman lidar) but for only two specific two cases (an aerosol event and a thin cirrus). It is also obvious that vertical resolution of lidar measurement (and smoothing techniques) affects computed radiative forcing. I don't understand why these only two cases are representative of the numerous atmospheric conditions. I have the feeling that this paper presents early results and do not reach the scientific level of AMT. Maybe authors could go further in their investigations by, for example, analysing typical atmospheric conditions and/or more extreme atmospheric conditions (cirrus with large optical depth, with different

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effective radius, altitude, different aerosols, etc. . .).

Secondly, there is no coherency between the work and results presented in this paper and the title that do not reflect the contents of this paper. Fist off all, the title talk about "next and current lidar space missions". When I read this title and introduction, I expected that authors investigate also the sensitivity of radiative forcing due to the difficulty (spatial and temporal averaging scale) of retrievals of extinctions with CALIOP/CALIPSO or with CATS or with EarthCARE. However, authors refer this fact in the introduction but not in their computations and analyses. Moreover, EarthCARE lidar is a high spectral resolution lidar, witch is not exactly the same technique as the Raman technique. Next, I do not understand why authors make emphasis on the Fu-Liou Gu radiative transfer model. Certainly, this model is a good model. But why this model is considered by the authors as a proxy? Why it is stressed in the title like that?

Finally, number and quality of references are not always appropriate and authors give their own references too often. To conclude, this paper can be accepted with major revisions (see also my specific comments further).

Specific comments

Page 1, line 17 (and further in the text) : Please give the mathematic definition of the net radiative forcing. In general we talk about radiative forcing defined as the change in the net (down minus up) irradiance.

Page2, line 2-3 : references are not appropriate.

Page2, line 3 : Cloud and aerosols have been also studied with POLDER/PARASOL.

Page2, line 21 : Please give other references on the retrievals of aerosol and cloud properties with Raman lidar. By the way, what are the effects of multiple scattering with Raman lidar ? References ?

Page2, line 26, eq 1 : This equation is not well written (exp)

Page 3, line 2 : Please give other references.

Page 4, line3 : Reference of Campbell et al., 2016 is not provided.

Page 4, line 7 : You talk about CATS and EarthCARE. What about the high spectral resolution technique compared to Raman technique?

Page 4 , line 18 : Heymsfield et al. (2014) is not appropriate.

Page 4, line 24 : Why aerosol type number 17. What are optical properties of this aerosol?

Page 5, line 3 : MUSA seem a great lidar, with polarization measurement. Why do not use polarization information in this study ?

Page 5, line 2 : What is the crystal shape of the cirrus ? What is the effect of changing effective diameter on the computed radiative forcing ?

Page 6, line 8 : This cirrus is very optically thin. What is the vertically optical depth ? Why do you choose such a small optical thickness? What is append if optical depth is large (1.5 to 3) ? What about the effect of multiple scattering? Do the retrieval algorithms (classic and Raman) take account of multiple scattering? For space mission lidar data, multiple scattering effects can be not negligible.