

Interactive comment on “2-D mineral dust radiative forcing calculations from CALIPSO observations over Europe” by Maria José Granados-Muñoz et al.

Anonymous Referee #2 Received and published: 10 July 2019

General comments

The paper focuses on analyzing the dust radiative effects in SW and LW spectral ranges combining satellite data (CALIPSO, MODIS, etc) and radiative transfer modelling (GAME). The authors use also ground-based aerosol profiles, taking advantage of the simultaneous and quasi-located EARLINET stations, for validation. Despite this, the most interesting part of this work is the application to CALIPSO profiles. The radiative forcing and heating rates obtained show good agreement when comparing with the obtained using ground-based aerosol profiles and the same GAME RTM. I think the paper is of interest for aerosol research and modelling community due to the great potential of CALIPSO data to be operationally used in model assimilation. Therefore, the argument and application of this paper is solid and then suitable for publication in ACP. However, several minor issues should be addressed before the paper is published.

We would like to thank the reviewer for his/her valuable comments and remarks. Responses to the specific comments are provided next:

Specific comments

Abstract L8: What does the forcing efficiency variability depend on? solar zenith angle, surface type and albedo?

It depends mostly on the SZA and the surface albedo, together with the aerosol vertical distribution. The SSA and g are also affecting the FE, but in our case these aerosol properties remain constant along the orbit tracks.

Pag 11. L9: At Granada, we cannot consider EARLINET and CALIPSO as collocated measurements, since the distance between both is more than 100km. What implications could this distance have in the operational assimilation of CALIPSO data by the modelling community?

For this case the distance is more than 100 km, but, as indicated in the text, the severity of the dust event suggested similar dust characteristics for CALIPSO and EARLINET. In general and specifically for operational assimilation purposes the threshold of 100 km should be kept. Cases as the one presented here are exceptional and special consideration would be needed for assimilation in models.

Pag 12.L22: I do not understand why the authors describe so detailed the meteorological variables, even using a big plot, if then, these variables are not taken into account neither related to the radiative forcing analysis.

The meteorological data are taken into account in order to retrieve the radiative fluxes which are necessary to obtain the DRE. They are used as input in the GAME radiative transfer model. This sentence has been added to the manuscript:

“Meteorological profiles, including vertically-resolved temperature (T), relative humidity (RH) and O₃ concentration, are necessary for the calculation of the radiative fluxes in GAME.”

Pag 12.L25: The sentence "..general, even though a stratospheric O3 intrusion is affecting 25 the GR orbit increasing the O3 concentration in some regions." is difficult to understand can you rewrite it, please?

Done. The sentence now reads

P12, l27: "Larger T values and O₃ concentration are observed for the BU case in general. However, O₃ values larger than 0.07 ppmv are observed in the GR orbit related to a stratospheric intrusion."

Pag 13.L14: What constrained by MODIS AOD really means? Is not clear if you are using the alfa profile by CALIPSO or you are inverting the Lidar raw data using MODIS AOD?

We use the extinction profile provided by CALIPSO multiplied by the ratio of MODIS AOD to CALIPSO AOD. The information is now included in the manuscript:

P12, l11: "The first dataset (hereafter denoted as DAT1), presented in the current study, uses satellite-based extinction profiles from CALIPSO constrained by MODIS AOD, meaning that CALIPSO extinction profiles are normalized so that the integral of the extinction profile matches MODIS AOD."

Pag 15.L10: Please, remove the second "increasing" in the sentence

We think that the reviewer refers to Page 14, line 20. The second "increasing" is removed.

Figure 1 is confusing, can you use different colors for the EARLINET stations and for the CALIPSO track to better distinguish them? can you include more lat and long values to improve the visual appreciation of the distances?

The colors in the figure have been modified. By increasing the spatial coverage in the figure it is difficult to observe the variations in the AOD along the orbit, thus we would rather maintain the current latitude and longitude ranges.

Figure 10. Caption: Please specify "Average heating rate profiles and standard deviation"...

It is specified afterwards in the caption: "Averaged profiles and standard deviation (error bars) and certain plots of the HR profiles"