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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Shortwave radiative forcing and efficiency of key aerosol types using AERONET data" *by* O. E. García et al.

Anonymous Referee #2

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Review for Atmospheric Chemistry and Physics

Title: Shortwave radiative forcing and efficiency of key aerosol types using AERONET data

Authors: O. E. Garcia, J. P. Diaz, F. J. Exposito, A. M. Diaz1, O. Dubovik, Y. Derimian, P. Dubuisson, and J.-C. Roger

General Comments: The authors of this manuscript present much detailed analysis of aerosol radiative forcing for many geographic regions, utilizing data from many AERONET sites. However since these computations of short wave forcing and forcing efficiency are only for a very small solar zenith angle range (∼60 degrees SZA; only a small fraction of the day), the results presented are of limited use to the sci-

entific community in general. The authors should be clear about this in the abstract, conclusions and throughout the text. Nearly all published studies of aerosol radiative forcing present 24-hour radiative forcing computations, since this is really what is most important for climate forcing. These can then be directly compared to greenhouse gas forcing computations, which are also made for the daily or annual cycle. Additionally, the AERONET AOD shown in Figure 2 are very puzzling. For the Mauna Loa Observatory (MLO) site the AERONET climatology of AOD at 500 nm (see AERONET website for AOD climatology Tables) shows many years of data for every month, yet Fig. 2l shows no data for some months. The AOD values at MLO in Fig 2l are nearly twice as high as from the AERONET website for all months. This may be due to the authors only using AOD associated with Level 2 almucantar retrievals rather than all direct sun AOD measurements. The AOD for the Banizoumbou site (Fig. 2b) shows a variable saw-tooth pattern from March through July however the climatology table from AERONET shows a smooth seasonal progression. These 'noisy' AOD annual patterns exist for other sites in Fig. 2 and are not truly representative of the complete AERONET database, as the data you utilized are a small and sometimes biased subset of all observations of AOD. The omission of most data from sites in China in this paper is puzzling since this is an extremely important region for aerosol forcing effects, and you even state this on page 32659 lines 17-18. There are several long-term sites such as Beijing, Taihu, and Xinaghe available. The analysis of stations grouped into natural and anthropogenic aerosol categories (page 32667, lines 1-14) is suspect due to insufficient number of stations to accurately characterize either category of aerosols globally.

I suggest this paper may be suitable for publication after major revisions regarding these issues and the specific ones listed below.

Specific Comments:

Page 32648, lines 18-20: Aerosols do not contribute to the greenhouse gas effect as you say, as the aerosol forcing effects may be in the same or opposite sign and they

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are very short lived compared to greenhouse gases. Please rewrite this sentence.

Page 32649 lines 7-8: Please give a reference for these GHG emissions.

Page 32649 lines 17-19: You say that absorbing aerosols favor unstable conditions through the semi-direct effect, but this is the opposite of what occurs (read the Koren et al. reference).

Page 32652 lines 28-29: How do you model the surface reflectance from satellite data? Your use of vocabulary may be confusing here.

Page 32653 lines 19-29: You need to mention here that AOD data of high accuracy are key to good quality retrievals, and give a reference to the AERONET accuracy of AOD, $\sim$0.01-0.02.

Page 32654 lines 17-18: Is the total number of data (22190) the number of almucantar retrievals or the number of days of data?

Page 32656 lines 1-4: Would be very useful to plot fine fraction for all sites in Fig 3.

Page 32657 lines 16-19: It is misleading to claim that 2 sites define the regional AOD climatology especially when these sites differ so much in seasonality.

Page 32658 lines 7-10: To say 'coldest months' is strange for the Amazon, since there are no cold months. The burning season in the Amazon basin is driven by lower rainfall in these months, not temperature differences.

Page 32658 lines 14-15: "...in fortuitous or provoked forest fires in the continental platforms of North America and Eurasia." What do you mean here? The choice of vocabulary is confusing here, try to get a native speaker to proof read the paper.

Page 32659 lines10-12: Your choice of 2 stations (GSFC and Baltimore) that are only $\sim$40 km apart, does not "cover the East Coast" as you suggested here.

Page 32663 lines1-2: You should not use the term "AOD regional mean" when dis-

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cussing only 2 stations each in a different ocean basin.

Page 32663 lines19-20: I don't know what chemical composition you are referring to here, do you mean SSA variation that implies differences in chemistry?

Page 32664 lines19-20: "However, it should be mentioned that despite instantaneous forcing for high sun elevation can present positive values, for low sun it can remained negative therefore the daily average forcing can still be negative. Anyway, in these situations, aerosols cooling effect is significantly reduced and they do not strongly counteract the warming effect of the greenhouse gases." Your statement here supports my claim that the instantaneous forcing values are of limited value.

Page 32665 line 25: There are no 'Central Africa region sites', you mean West Africa region.

Page 32667 lines 22-23: You should also mention that the uncertainty in SSA for the free tropospheric aerosols is VERY large since at such low AOD there is very low sensitivity to absorption in the AERONET retrievals. You should not use SSA from AERONET that are not Level 2 (AOD (440 nm) > 0.40). The uncertainty in SSA contributes to uncertainty in estimates of free tropospheric forcing.

Page 32670 lines 10-12: "However, it is quite difficult to compare directly the obtained results on literature due to the different methodologies and data used." This statement in your Conclusions section is the reason why I say that your use of instantaneous values of aerosol forcing in this study are of limited value, since you cannot compare them to other studies.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 32647, 2011.

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Interactive Comment