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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.

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Dear Michael King,

We would like to thank your suggestions in order to improve the manuscript, which are fully addressed below. Please note that your comment are numbered.

1. General observations: Throughout the manuscript the radiative forcing is done only for a solar zenith angle of _60_. It would be more valuable to do it for a daily average (since these are day time forcing properties), and the length of day and solar zenith angle variation varies by location and time of year. Consider amplifying this analysis, which would be more climatologically significant than a fixed solar zenith angle representative of no particular time of year.

The main purpose of this work is to compare radiative forcing effects for different aerosol types in similar observational conditions (that mainly means similar solar zenith angles, sza). To do so, we have used the operational AERONET products and, thus, the analysis was limited to sza between 50° and 80°. Note that the AERONET radiative forcing estimates are operationally calculated with the inversion aerosols products (i.e. aerosol size distribution, single scattering albedo, refractive index, etc.), which are obtained with a complete set of restrictions to assure the quality of the products [Dubovik et al., 2000]. One of these restrictions sets a limit to the scattering angle, which limits the solar zenith angles (sza) between roughly 50°-80°. Due to the aerosol radiative forcing strongly depends on solar geometry, the study was focus on a limited sza range: 60±5°. This interval concentrates the maximum number of AERONET almucantar retrievals and, thus, it may be representative of the AERONET sza range (50°-80°).

The daily averages of aerosol radiative forcing are more climatologically significant, as Editor commented, especially for evaluating climate aerosol effects and comparing to other studies. However, the daily averaged fluxes may strongly depend on several factors other than aerosol properties, e.g. location of sites, seasons, etc. In addition, derivation of daily fluxes required making extra assumptions and extra efforts that were outside of the framework of this paper. Note that the AERONET operational products of radiative forcing and forcing efficiency are only provided for sza between 50° and 80°.

2. Comments about surface albedo: Page 32652, line 28ff - reference is made to 'the surface spectral reflectance was modeled using climatological values provided by MODIS. . .' MODIS provides surface albedo every 16-days at 7 spectral wavelengths, and thus there is seasonal, spectral, and geographic values. There is no reference given in the text or elsewhere, and presumably the work being used is Moody et al. (2005, 2008). References should be given, and elsewhere throughout the manuscript when surface albedo is mentioned, only one value is given (what wavelength, broad-

band, etc.). This is not arbitrary and is characteristic of a specific AERONET location, though it does change seasonally. Since this is such an important impact on radiative forcing, along with the aerosol properties (optical thickness, size distribution, and single scattering albedo), some attention to this detail should be given throughout the manuscript. Page 32663, line 13 - mentions considering a unique value of the spectral SA for each measurement. This depends on location and time of year. The text mentions using a spectral average of surface albedo from the V2 AERONET algorithm, which I believe is Moody et al. (2005) in origin, but then extrapolated to the 4 AERONET wavelengths. In the paper, these four are again averaged for a single value. Again this does depend on a specific AERONET site and on time of year, but it is not clear what the paper used, whether they just considered broad areas of surface albedo or site-specific and time of year specific values. Some clarification of this is important.

The surface albedo is a crucial parameter in evaluating the aerosol radiative forcing, especially at the Top of Atmosphere. Therefore, following the editor's comment, an explanation in detail of how it is calculated has been included in the manuscript in the page 32652.

"The appropriate characterization of the surface albedo is a critical issue to estimate aerosol radiative effect [Myhre et al., 2003] as well as an important error source in the retrieval of aerosol properties [Dubovik et al., 2000; Sinyuk et al., 2007]. For that reason, the surface reflectance is approximated by a bidirectional reflectance distribution function (BRDF): Cox-Munk model for over water [Cox and Munk, 1954] and by Ross-Li model over land [Ross 1981; Li and Strahler 1992; Wanner et al. 1995]. The BRDF parameters for land sites are adopted from MODIS Ecotype generic BRDF models (courtesy of Feng Gao, NASA/GSFC). The BRDF models are mixed according to Ecotype map of Moody et al. [2005, 2008] and NISE SSM/I snow and ice extent and MODIS snow cover map. For Cox-Munk calculations we adopted the wind speed from NCEP/NCAR Reanalysis data."

3. The rest of minor comments have been modified following the editor's recommen-

dations.

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