

Interactive comment on “Characteristics, impacts and direct radiative forcing of aerosols at the ARM Southern Great Plains Central Facility” by M. G. Iziomon and U. Lohmann

Anonymous Referee #1

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This paper presents a number of aerosol measurements which have been made at the ARM site in the Southern Great Plains (SGP), United States, and some interpretation of these measurements. Generally speaking, the paper is too discursive, there are many digressions, while the objectives of the study are not clear. When the authors present an analysis of the measurements, it is either too shallow (e.g., section 4.1) or flawed (e.g., sections 4.3 and 4.4). In particular the calculation of the aerosol radiative forcing is not acceptable. I do not recommend publication of this study in Atmospheric Chemistry and Physics which, although being a new journal, should have the ambition of a high standard and reputation.

My main comments are listed below:

* Part of the data and analysis has been published in Iziomon and Lohmann (2003). At the very least, the authors should mention that in the introduction, state the objectives of the paper, and explain why it goes beyond their previous study.

* A large part of the paper is about aerosol data but there is hardly any discussion about the measurement errors and uncertainties. The reader does not even know whether the \pm sign (e.g., in the abstract or on pages 2359 and 2364) represent uncertainties or the standard deviation of the measurements.

* The discussion of aerosol variations is too discursive and disgressive. Here are some examples. We already know that there are more (and more absorbing) aerosols at a polluted continental site than at a maritime site. Obviously aerosols sampled in maritime air masses during ACE-1 have not "been near land for many days" (p. 2363, l. 27) but does it mean that the coarse-mode sea-salt which was sampled there was "well aged"? I am not sure that light-absorbing aerosols are associated with acid deposition as stated on p. 2365, l. 13-14. What is the reason for presenting a case study (Figs. 8 and 9)? What does it bring to the discussion of the aerosol climatology at the SGP site?

* There are however some interesting features in the data which are presented, but they would deserve a deeper analysis. For instance, it is speculated that the diurnal cycle in aerosol concentrations (Fig. 3, upper left plot) has something to do with the diurnal cycle in precipitation (Fig. 4). This could easily be tested by looking separately at the diurnal cycle in aerosol concentrations on rainy and non-rainy days.

* Looking at trends with 5 year data containing one El Nino and one La Nina year is awkward, whatever the outcome of a statistical test.

* There is no justification for using simplified expressions for estimating the aerosol radiative forcing. In any case more details should be given about the radiative calculations of sections 4.3 and 4.4, but I personally think that these simplified expressions should not be used any longer. The parameter β is not defined, but I assume that is

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stands for the upscatter fraction for isotropic radiation. Actually the upscatter fraction depends on solar zenith angle. Therefore the daily-averaged upscatter fraction depends on the distribution of SZA in the day, and hence on the season. This effect is not accounted for in the simplified expressions, which flaws the discussion of the seasonal variations in aerosol radiative forcing (p. 2369). Moreover it is not clear whether ΔF_R (top-of-the-atmosphere??) is the shortwave aerosol radiative forcing (as implied by the unit given in Table 4) or the aerosol radiative forcing at the 550 nm wavelength (as stated in the caption of Table 4), in which case the unit is inappropriate. If ΔF_R is the shortwave aerosol radiative forcing, it should be specified how the simplified expressions have been modified to account for the spectrally-varying aerosol optical properties.

* I am very suspicious about estimating the aerosol (scattering) optical thickness from surface nephelometric measurements. Aerosol optical thickness depends on the aerosol vertical profile, and hence height of the boundary layer, which has diurnal and seasonal variations. If these effects are not accounted for, then again the discussion on the seasonal variations in aerosol radiative forcing is flawed.

* Usually aerosol radiative forcing refers to the change in radiation (at the TOA) from *anthropogenic* aerosols, while here it includes both natural and anthropogenic aerosols. It is therefore not appropriate to compare the aerosol radiative forcing given by IPCC to those computed in this study. I do not recall IPCC (2001) giving a range for the total radiative forcing by aerosols. Moreover comparing a local value with a global average has a limited interest.

* Aerosol optical properties should not be reported without giving the wavelength at which it has been measured. This piece of information often comes too late in the paper, for instance wavelength is not given in the abstract (p. 2354, l. 8). What are λ_1 and λ_2 in equation (4)? The number concentrations of particles (p. 2357, l. 1) are *not* optical properties – although I understand that they have been measured optically. Therefore they should not be given at a particular wavelength, as it is the case in

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Table 1. The aerodynamic diameter D_p is a physical property, it should not be attached to a particular wavelength (p. 2357, l. 22).

* p. 2371, l. 15–24: this is pure speculation.

Minor comments:

p. 2355, l. 21: Kaufmann should read Kaufman

p. 2357, l. 11: the "Anderson and Ogren (1998)" reference is missing

p. 2358, l. 15 and 17: equation (6) is not consistent with the units given on line 17.

p. 2361, l. 6: "submicrons" should be "submicron"

p. 2364, l. 15: the "Pueschel et al. (1969)" reference is missing

p. 2371, l. 27: "staffs" should be "staff"

p. 2372, l. 22: this paper has been published in GRL rather than JGR

p. 2374, l. 14: this paper not in alphabetical order

p. 2375, l. 21-23: year of publication is missing

Tables: tables are difficult to read when one entry refers to several lines, e.g., in Tables 1, 2, and 4.

Figures: figures 2, 3, 5, and 6 are hardly readable on the print version.

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