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# *Interactive comment on* "The direct radiative effect of biomass burning aerosols over southern Africa" *by* S. J. Abel et al.

**Anonymous Referee #3**

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The authors give a comprehensive model assessment of the radiative forcing of southern African biomass burning aerosols that includes results from remote sensing and in situ measurements. The study also quantifies the uncertainty of the radiative forcing by varying the input parameters within their respective uncertainties. Thereby, the parameters are identified where a reduction of uncertainty in future studies would be most beneficial for a higher accuracy in the radiative forcing of biomass burning aerosol.

The article is well written overall and suitable for publication in ACP. Specific comments are itemised below.

**sec. 2.2.2, paragraph 3; sec. 2.3, paragraph 1:** The single scattering albedo of biomass

burning aerosol shows a significant dependence on wavelength (Eck et al., 2003) which changes with time. Also, it has been demonstrated that the aerosol radiative forcing depends strongly on the state of mixture of absorbing and non-aborbing particle components (Haywood and Shine, 1995). This dependence is caused by a change of magnitude and wavelength dependence of the aerosol optical properties with state of mixture.

The radiative transfer model used in this study assumes internally well-mixed particles (Mie-particles) which are characterised by one refractive index for all particles. This transfers into an implicit assumption on the wavelength dependence of the particle optical properties. An even stronger assumption is contained in the MODIS retrieval of the aerosol optical depth, which apparently uses a wavelength independent single scattering albedo. Although absorbing and non-absorbing components are unlikely to be externally mixed in a biomass burning aerosol, it is certainly possible that the coated sphere particle approximates reality better than internally well mixed particles. Consequently, it would be a useful addition to the article to also quantify the sensitivity of the radiative forcing to the assumption on the aerosol state of mixture and the simplifications made concerning the wavelength dependence of the aerosol optical properties. While this addition might go beyond the scope of the article, it should be mentioned that the assumptions made on the state of mixture introduce another, potentially significant systematic uncertainty for the calculated radiative forcings.

**p. 1174, ll. 12-13:** It should be mentioned which particle density was assumed to calculate the specific extinction coefficients in Table 2.

**p. 1175, ll. 26-27:** It is simply stated that the MODIS retrieved effective cloud droplet radius is higher than the one measured in situ. An explanation should be given for this phenomenon, especially since it is stated in section 3.3 that the MODIS retrieved effective cloud droplet radius is low biased.



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**p. 1176, l. 3:** “Startocumulus” should be “stratocumulus”.

**p. 1179, l. 29:** "It is also clear in Fig. 8 that the MODIS white-sky albedo (isotropic illumination) $>$ MODIS black-sky albedo (direct illumination)."
Mathematical symbols should not be a substitute for proper grammar.

**p. 1183, ll. 21-25; Tables 3 and 4:** It is not apparent how the “range” referred to in the captions of Tables 3 and 4 as well as in the quoted text is obtained. This should be briefly explained.

**p. 1184, l. 19:** "The sensitivity to variations in the threshold value required to assign fresh aerosol properties to a grid box based on satellite fire counts is reduced to 300 from the base case of 500."
It is not the sensitivity that is reduced, rather the treshold to assess its influence on the radiative forcing. This sentence should be rephrased.

**Fig. 11:** This figure is too small to be readily readable which is probably an editing problem. It should be made sure that the figure is large enough in the final version.

## References

[1] Eck, T. F., Holben, B. N., Ward, D. E., Mukelabai, M. M., Dubovik, O., Smirnov, A., Schafer, J. S., Hsu, N. C., Piketh, S. J., Queface, A., Le Roux, J., Swap, R. J., Slutsker, I., February 2003. Variability of biomass burning aerosol optical characteristics in southern africa during the SAFARI 2000 dry season campaign and a comparison of single scattering albedo estimates from radiometric measurements. J. Geophys. Res. 108 (D13), 8477.



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[2] Haywood, J. M., Shine, K. P., March 1995. The effect of anthropogenic sulfate and soot aerosol on the clear sky planetary radiation budget. Geophys. Res. Lett. 22 (5), 603–606.

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