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Interactive comment on "Estimates of direct radiative forcing due to aerosols from the MERRA-2 reanalysis over the Amazon region" *by* Brunna Penna et al.

Anonymous Referee #3

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This study presents an analysis of the aerosol optical depth (AOD) and the clear-sky aerosol direct radiative effect (DRE) based on observations from ground-based (AERONET) and satellite sensors (MODIS) and from the recent NASA MERRA-2 reanalysis, which assimilates AOD from numerous NASA satellites and AERONET.

While the paper presents a nice analysis of the seasonality of AOD from both observations and analysis, there are a number of weaknesses in its analysis of the DRE. First, the empirical "Method 1" for calculating DOE parameterized only by AOD is not justified sufficiently; while the cited work may have found this relationship to work for their considered purposes, there seems no reason for it to work all the time, particularly

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[Discussion paper]

at the top of the atmosphere where the DRE depends on other aerosol parameters (e.g. single scattering albedo) and surface albedo (see Chylek and Wong, GRL, 1995). Furthermore, "Method 1" and "Method 2" (which is really just the output of the double radiation call from MERRA-2) are not comparable because (a) Method 1 assumes a baseline AOD = 0.11 while Method 2 has a clean baseline (AOD = 0.0) and (b) Method 1 is applicable for a single wavelength while Method 2 is for broadband conditions in the shortwave and longwave.

I recommend that this study eliminate consideration of Method 1 and refocus their efforts on evaluating the MERRA-2 aerosol products over the Amazon region. As an example, they can see the case studies of MERRA-2 evaluation presented in Buchard et al. 2017 (J. Clim). There are numerous aerosol products available from MERRA-2 that can be examined further over this region using a number of observational datasets. Such an analysis will provide stronger evidence of the authors' suggestion that MERRA-2 is a useful tool for examining the DRE over this important biomass burning region.

Minor comments are below:

Page 1, Line 25: "...and the total amount of aerosols is generally obtained ...". Do you mean "ARF is generally calculated for all aerosols combined, as estimates by species are less consistent". Also, ARF should be DRE - this is not a forcing because it does not reference some past state, and because natural aerosols are included.

Page 2, Line 14. It should not be "assimilation of aerosols" but "assimilation of aerosol optical depth"

Page 2, Line 17-18. "Thus, MERRA-2 is a great tool for studies of aerosols and their impact on climate". I would not say this is a given. Remove this sentence.

Page 3, Lines 16-19. Remove Lines 16-19 and the equations. It is sufficient to state "The AOD of 550 nm was obtained using the Angstrom relationship. Also, the equations

are incorrect.

Remove Page 3, line 25. MODIS AOD products are available at 0.47, 0.55, and 0.65 microns; be careful not to imply they are available throughout the wide spectral range.

Page 4, Line 10. MODIS Collection 5 Neural Net Retrieval Equation 4: Is this an AOD at a specific wavelength? What wavelength?

Page 5, Lines 1-13. This whole section can be shortened to simply: We calculate the DRE using output from the MERRA-2 double radiation call for clear (no clouds) and clean and clear (no clouds or aerosols) conditions in both the long wave and short-wave. Diagnostics are available from the tavgM_2d_rad_Nx collection (provide the doi reference for this collection).

Page 5, Line 22: Randles et al. 2017 provided comparisons to AERONET at Alta Floresta; how do your results compare?

Page 7, Table 1: Do you sample the reanalysis like MODIS or is this just a comparison of monthly means? MODIS has a clear-sky bias and this can impact comparisons made in such a fashion

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