Interactive comment on "Modeling the South American regional smoke plume: aerosol optical depth variability and shortwave surface forcing" by N. E. Rosário et al.

Support to the responses to Interactive comments from referees

1) Following the suggestion of referee #2 (J. Reid) we compared modeled AOD to the AERONET derived fine mode AOD using the O'Neill Spectral Deconvolution Algorithm (SDA) (O'Neill et al., 2003). Figures 1 and 2 present, respectively, the new and the former seasonal variability comparison between the model and AERONET. Figures 3 and 4 compare scatter plots considering the two options. Using the fine mode AOD a better agreement is observed between the model and AERONET, mainly for Cuiaba, Balbina and Belterra. In general, at these sites the coarse mode aerosol contribution is higher than at AERONET sites in the southern Amazon basin. Essentially, the new comparison suggests that most of the divergence between the model and AERONET over these sites was related to the coarse mode contribution. This new results will be included in the revised manuscript and the discussion on the divergence will be updated. However, the divergence at Alta Floresta during the period between August 24 and 29 persists.

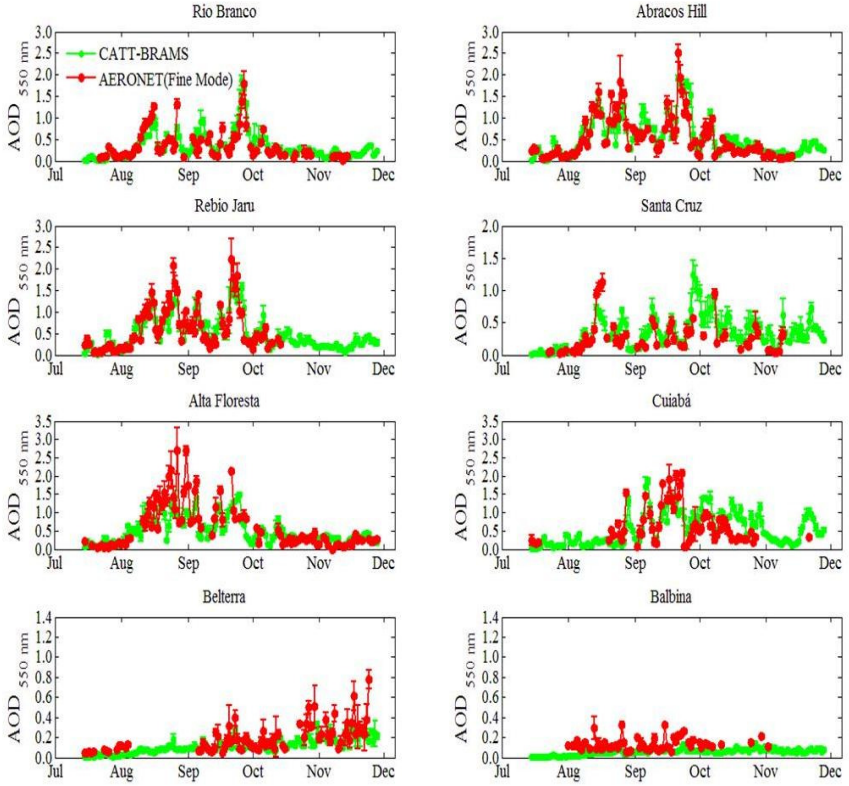

Figure 1 - Intra-seasonal variability of daily mean aerosol optical depth at 550 nm as modeled by CCATT-BRAMS and measured by AERONET (USING O'NEIL SDA FINE MODE PRODUCT) sites during the 2002 biomass burning season in South America.

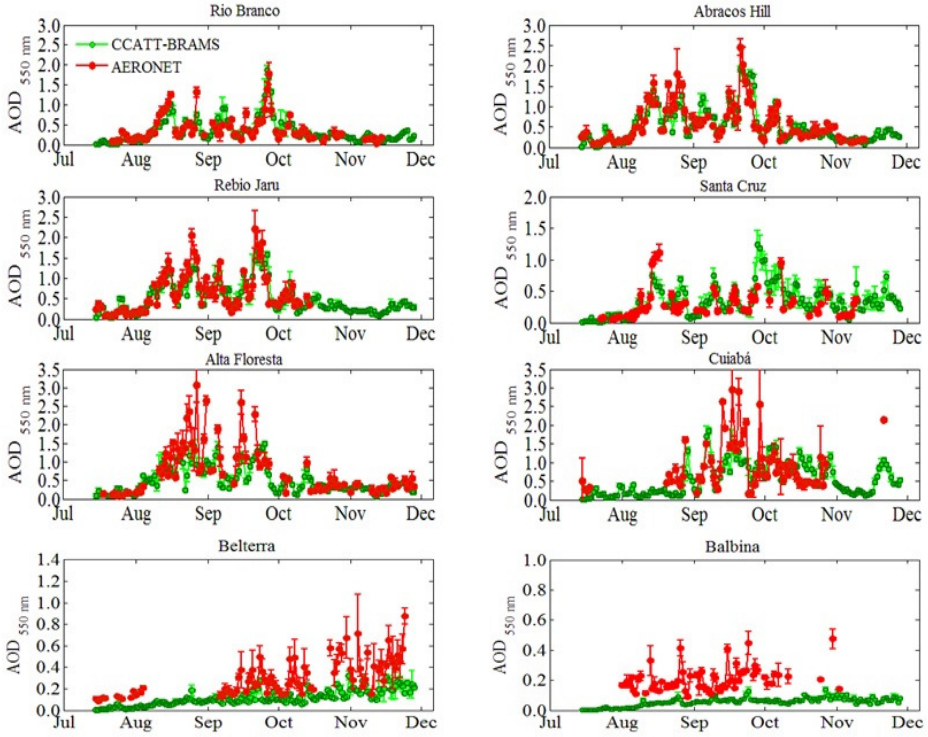

Figure 2 - Intra-seasonal variability of daily mean aerosol optical depth at 550 nm as modeled by CCATT-BRAMS and measured by AERONET (AOD_TOTAL: ORIGINAL COMPARISON) sites during the 2002 biomass burning season in South America.

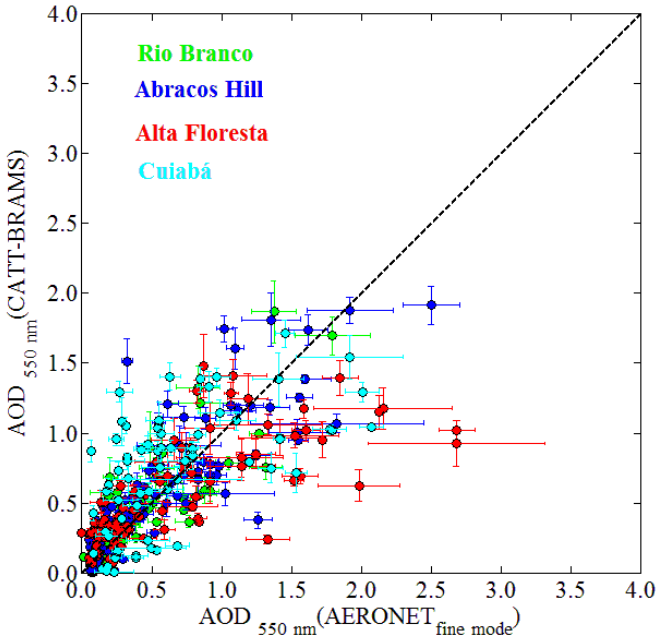

Figure 3 - Modeled (CCATT-BRAMS) versus observed (AERONET, USING O'NEIL SDA FINE MODE PRODUCT) daily mean aerosol optical depth (AOD) at 550 nm over AERONET sites. Bars consist of standard deviation and represent daytime variability of AOD.

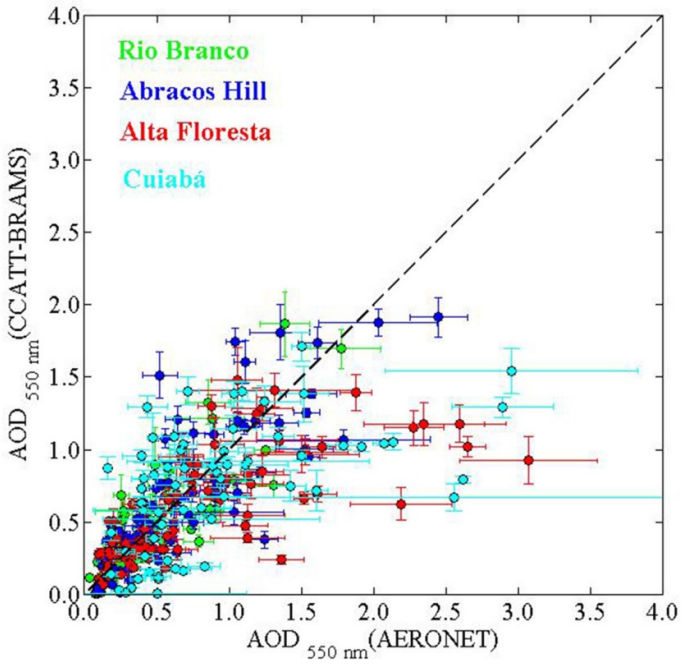

Figure 4 - Modeled (CCATT-BRAMS) versus observed (AERONET, ORIGINAL COMPARISON) daily mean aerosol optical depth (AOD) at 550 nm over AERONET sites. Bars consist of standard deviation and represent daytime variability of AOD.

2) The goal of the following plots is to compare the modeled spatial distribution of AOD with MODIS AOD in order to further address the divergences between the model and AERONET attributed to emission issues. We selected the period characterized by significant divergences between the model and the AERONET site at Alta Floresta (Figure 1). However, first we needed to correct the well known MODIS tendency to overestimate AOD under high aerosol loading in this region (Hoelzemann et al., 2009; Levy et al. 2010; Hyer et al., 2011; Shi et al., 2010). Hoelzemann et al., 2009 performed a correlation study between MODIS and the AERONET sites analyzed in the present study and provided regression coefficients (**Table 1**). We to applied a straightforward correction to MODIS AOD based on the average of these regression coefficients.

Table 1

Site	slope	Intercept	R^2	Reference
Alta Floresta	1.44	-0.19	0.88	Hoelzemann et al., 2009
Abracos Hill	1.51	-0.22	0.86	Hoelzemann et al., 2009
Cuiabá	1.67	-0.31	0.83	Hoelzemann et al., 2009
Santa Cruz	1.35	-0.11	0.89	Hoelzemann et al., 2009
Averaged	**1.49**	**-0.21**		**Applied to correct MODIS AOD**

Figure 5 shows a comparison between model results and MODIS aboard TERRA without correction. Figures 6 and 7 show comparisons after the AOD correction for the MODIS sensor aboard TERRA and AQUA, respectively. We would like to emphasize the high frequency of unfavorable MODIS geometry (large satellite zenith angles and uncovered areas) regarding the region that can be identified as the core of biomass burning activity. Given the MODIS detection algorithm sensitivity to smaller and cooler fires, these problematic geometries are expected to affect emissions. Associated with the geometry issue is the cloud impact. Toward the end of September a frontal system arrived at the central regions of Brazil, bringing cloudy conditions that reduced the MODIS AOD retrieval over most of the country. Our hypothesis is that these factors plus the challenge of the model in representing local sources very likely dominate the difficulties in reproducing the sharp AOD gradients observed in the MODIS field. However, a careful study is needed in order to be more precise in this attribution. Despite the observed divergences, in regional terms, model transport is consistent with MODIS.

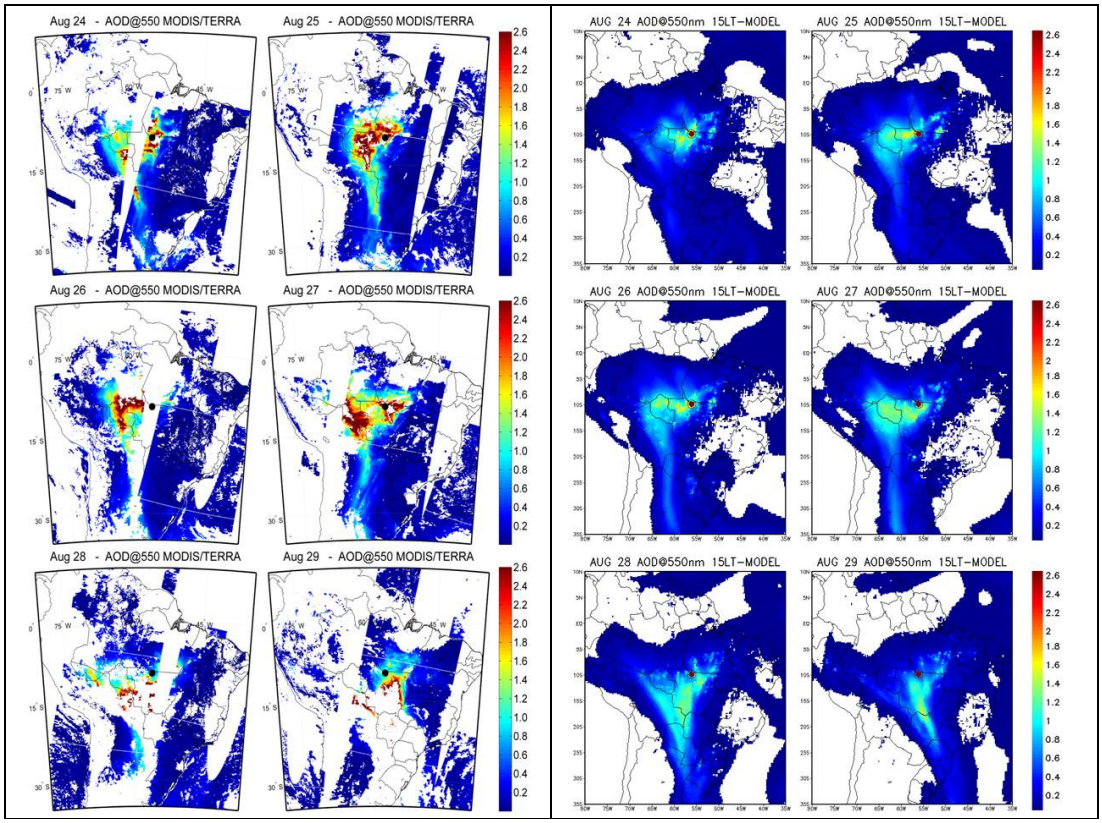

Figure 5 – MODIS/TERRA AOD (550 nm) field without correction versus modeled AOD (550nm) from August 24 to August 29.

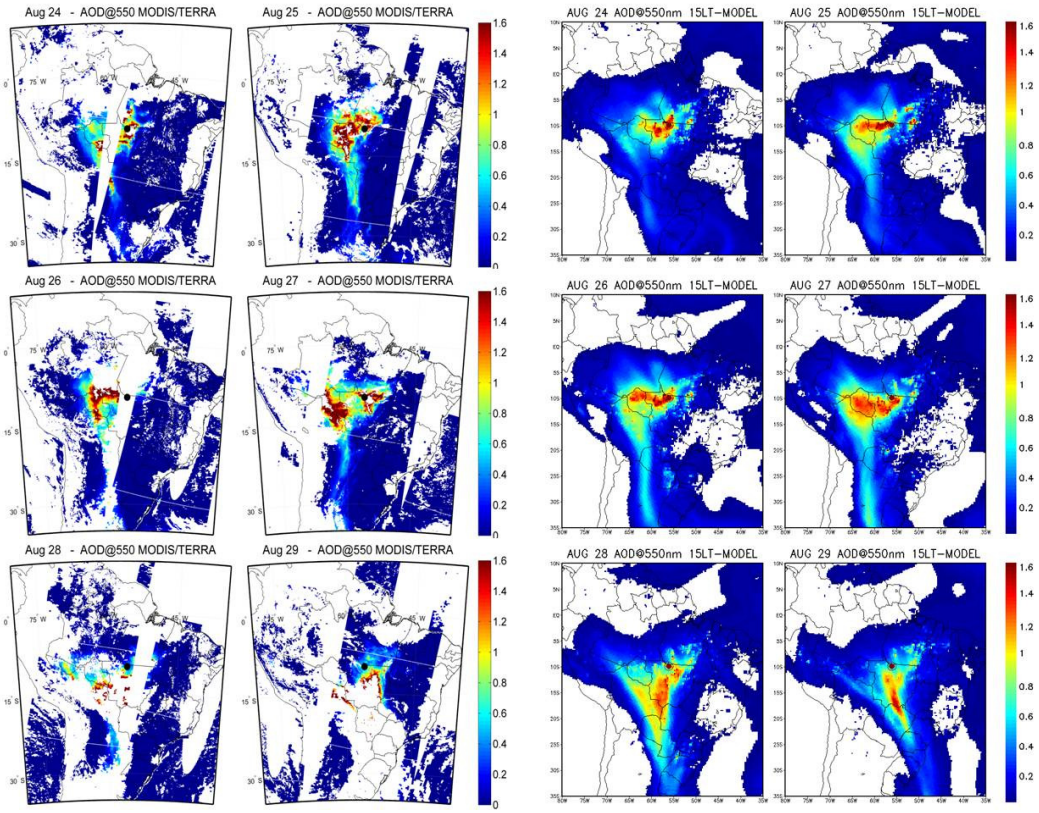

Figure 6 - MODIS/TERRA AOD (550 nm) field corrected versus modeled AOD (550nm) from August 24 to August 29.

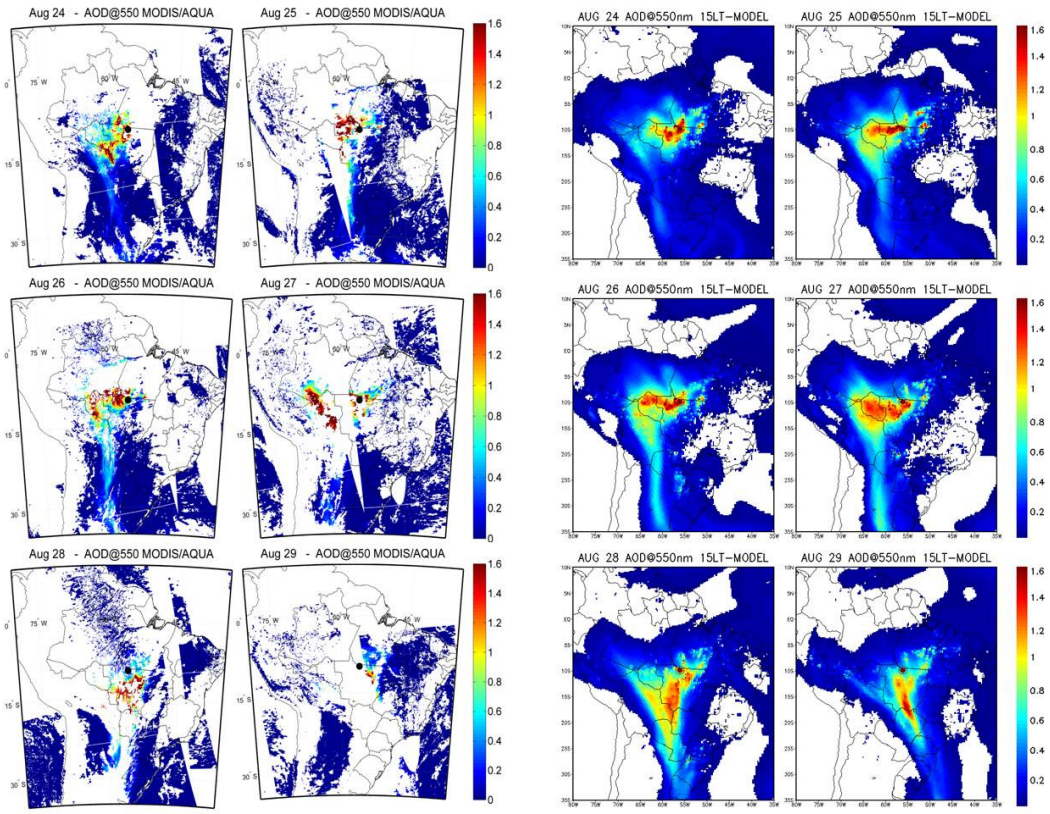

Figure 7 - MODIS/AQUA AOD (550 nm) field corrected versus modeled AOD (550nm) from August 24 to August 29.

Reference

Hoelzemann, J. J., K. M. Longo, R. M. Fonseca, N. M. E. do Rosa´rio, H. Elbern, S. R. Freitas, and C. Pires (2009), Regional representativity of AERONET observation sites during the biomass burning season in South America determined by correlation studies with MODIS Aerosol Optical Depth, J. Geophys. Res., 114, D13301, doi:10.1029/2008JD010369

Hyer, E. J., Reid, J. S., and Zhang, J.: An over-land aerosol optical depth data set for data assimilation by filtering, correction, and aggregation of MODIS Collection 5 optical depth retrievals, Atmos. Meas. Tech., 4, 379–408, doi:10.5194/amt-4-379-2011,

2011.

Levy, R. C., Remer, L. A., Kleidman, R. G., Mattoo, S., Ichoku, C., Kahn, R., and Eck, T. F.: Global evaluation of the Collection 5 MODIS dark-target aerosol products over land, Atmos. Chem. Phys., 10, 10399–10420, doi:10.5194/acp-10-10399-2010, 2010.

O'Neill, N. T., Eck, T. F., Smirnov, A., Holben, B. N., and Thulasiraman, S.: Spectral discrimination of coarse and fine mode optical depth, J. Geophys. Res.-Atmos., 108(D11), 4559, doi:10.1029/2002JD002975, 2003.