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

Response to Interactive comment from Anonymous Referee #3

First, we would like to thank the referee for the thoughtful comments and suggestions.

Referee #3 Specific Comments:

1- *The paper's exposition needs some help.*

Authors: We are working to improve the revised manuscript exposition.

2- *In particular, the paper makes the distinction between static and dynamic runs, but this is not explained thoroughly in the text. I became particularly confused on reading the last few sentences of section 2. Does the dashed line in Figure 2 represent the static model? (Apparently, yes). Do the separate lines in Figure 2 represent the dynamic model? (Apparently, yes). This distinction should be made clearer, and discussed somewhat earlier in the paper (maybe around lines 10-15, page 17471, at which point the aerosol radiative models are first mentioned).*
Authors: We agree that a clear distinction between and discussion about static and dynamic runs is needed. Static run corresponds to the model simulation performed prescribing elsewhere in the model domain a fixed aerosol optical model based on the reference optical model (Fig.2 dashed line). Dynamic run corresponds to the simulation prescribing a spatially varying optical properties based on mean aerosols optical properties from each AERONET sites (Fig.2, separate lines). Hoelzemann et al. (2009) defined areas of influence of each of those AERONET sites by correlating spatially aerosol optical depth variability over a specific site with the AOD field over South America during biomass burning season(using MODIS data). Their developed a map of anisotropic areas of influence of each AERONET sites by preserving areas characterized by a high degree of correlation. We used this map to prescribe spatial varying optical properties for the dynamic run. This description will be added in the revised manuscript.

3- *The authors conclude that differences between modeled results and observations are probably mostly driven by emissions. This seems to be a frequent conclusion for model evaluation studies, and points out the need to develop emission inventories of higher quality. The authors can optionally comment on this, if they think it is appropriate.*
Authors: Yes, emission is indeed a major issue, especially in the modeling of biomass burning activity. Prescription of emissions based on fire spots and burned area remote sensing improved significantly the treatment of smoke emission in models (Longo et al., 2010). However, this approach has critical aspects, such as the resolution/scan issues (as pointed out by referee 2) and cloud cover, whose impacts on modeled smoke field are yet to be fully evaluated. Model spatial resolution also contributes to difficulties in the prescription of emission field, mainly regarding localized source. Emission efficiency and combustion factors uncertainty are also likely to affect the model x observation comparison. Aspects not related to emission, such as inaccuracy of transport, removal

processes and optical properties assumptions are expected to play a role. The evaluation of the individual contribution of each of these factors to the differences between the model and observations is a hard task. However, temporal and spatial features of the differences provide some indications of the dominant factor. Larger divergences between the model and AERONET are in general temporally localized. Most of the time, the model presents a fairly good agreement with AERONET, which suggests that there is a balance between the modeled processes. Even during the period when the model presented significant divergence from observations in terms of the AOD magnitude (Aug. 24-29), the spatial distribution of the regional plume was consistent with satellite observations (see additional supplement, pdf file). This suggests that regional transport is ok. During this period, the main difficulty of the model seems to be the representation of the sharp gradients in AOD observed by satellite, which are likely to be related to local sources. Therefore, the emphasis is placed on emission as the main driver of the differences between modeled results and observations. Ongoing research in our group (following the scientific community effort) is evaluating emission based on Fire Radiative Power (FRP), preliminary results are already shows differences between our conventional scheme and FRP scheme.

4- *It would be interesting to do some emission sensitivity runs to determine how the results changed with increases and decreases in emissions. This is too much to ask for this paper, but please keep it mind for future studies.*

Authors: A previous study on model sensitivity to biomass burning emission inventories was performed (Longo et al., 2010), but still there are other tests to be done. We will perform some sensitivity test as suggested, mainly regarding aspect related to satellite fire spots input.

Referee#3 Technical comments:

5- *The authors probably are not native English speakers, and they should be commended for writing a paper using fairly good English. However, there are a lot of grammatical errors – too many for me to list here. I recommend that the authors avail themselves of an editing service, so that these errors can be cleaned up.*

Authors: We appreciated the recommendation. The paper went through a careful English revision in order to improve its reading.