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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Improving the seasonal cycle and interannual variations of biomass burning aerosol sources" *by* S. Generoso et al.

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We would like to answer here to the anonymous referee #1 concerning the following points:

1/ there are no discussions about how our approach differs from previous studies, in particular from that of Schultz (2002).

Thanks to both Bryan Duncan and the referee #1 comments, we have realized that, indeed, we do not stress on the differences with Schultz (2002) and Duncan et al (2003). Our method differs in particular that it accounts differently for fires location and vegetation types. We characterize the average fluxes emitted by each detected fire thanks to a scaling applied on a large region basis (thirty regions have been selected based upon the vegetation cover and the burning season). In this way, fires locations are rearranged within each large region with respect to ATSR observations. If the original inventory presents some discrepancies with the observed fire locations, the spatial distribution of fires may not be corrected using an approach with too small grid boxes. For instance, the annual emission of Liousse et al (1996) inventory presents a maximum over Colombia whereas the ATSR observations, thus our derived inventory, present a maximum over Venezuela in 1998. This rearrangement has been done within the large region, which includes all the northern part of South America (see Fig. 1). Other examples could be found (for instance in North Australia). We will stress them on the revised version of the manuscript.

Another significant difference concerns the statistical error made on the emission constant (see our answer to B. Duncan, paragraph 2 page S453).

2/ the analysis of our model results are not extensive, in particular in comparison with the work of Chin et al (2002).

The referee #1 questions the results shown in Fig.2, in particular over Africa. We would like to emphasize that two different type of information are shown in Fig.2. First, the information on the phase of the burning season. The improvements to the seasonal cycle are given by the phasing of the simulated curves (red and green) with the observation curve (blue). We maintain here that the phase of the burning season is improved in some regions such as South America, or not degraded in others (Africa). In Africa, we clearly write in the paper that there are no improvements (nor degradation) to the original inventory because it correctly describes the phase of the burning seasons. The other information in Fig.2 concerns the aerosol load, which is directly linked to the amplitude of the curves. Here, we certainly agree that large discrepancies remain between simulated and observed field, and we do point it in the original manuscript. Our work assumes that the total annual estimates of the original inventories are correct (as climatologically averaged values). Although the original mass emission inventories might be blamed for the significant discrepancies on the optical thicknesses, the assumed optical properties of the aerosol and the time-dependent hydrophilic/hydrophobic character of the carbonaceous aerosol need to be improved.

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The last remark made on Fig.2 concerns the work of Chin et al (2002). The aim of the latter study is to assess the results of the model used for all the aerosol components whereas we focus on how the representation of the seasonal cycle of biomass burning aerosols might be improved. We present comparisons to 5 AERONET sites in the regions mainly influenced by biomass burning. We have selected in each biomass burning regions all available sites with sufficient amount of data to look at both the intra and inter-annual variability. Amongst the 20 AERONET sites that Chin et al (2002) uses in their comparison only 5 of them are situated in regions influenced by biomass burning. We use the same number of stations to study the improvement of the representation of biomass burning aerosols. Moreover we present year to year comparisons to observations whereas Chin et al (2002) present averages (at least three years for South America), which does not show interannual variability. Finally, the comparisons to TOMS data in Chin et al (2002) show only 4 months in the year, and we deem that analysing all twelve months is a better representation of the biomass burning season. The difference observed with the simulated aerosol optical thickness shown in Chin et al (2002) may be explained by their estimation of the total annual biomass burning emissions (the climatologically averaged values) which are a factor 1.7-2 larger than those obtained by Liousse et al. (1996), whereas we have assumed these estimates to be correct. Note also that Chin et al (2002) have estimated OC and BC emission from Duncan et al. (2003) method assuming the same emission factor for all vegetation types whereas our method accounts for different emission factors, implicitly the ones used by Liousse et al (1996) and Lavoue et al (2000).

Finally, the anonymous referee #1 reproaches the Indonesian example shown in Fig. 4 to be qualitative and inconclusive. The idea here is simply to show that the method accounts for large interannual variations. We illustrate it by Fig.4 where it is clearly shown that the method improves significantly the emissions between an El Niño and a "normal" year. It is also shown that this event is not taken into account at present time in the models using the original inventory. We have never claimed to lead a quantitative study on Indonesian fires as it is clearly written in the text. Nevertheless, we will add

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a table, which summarizes the emitted quantities in order to allow comparisons with other studies.

3/ "this paper adds little to the existing body of literature on the subject of estimating emissions from biomass burning"

We present in this paper our contribution to the question of estimating aerosol emissions from biomass burning. The Liousse et al (1996) inventory, on which we have applied our method, is probably the most widely used inventory to evaluate carbonaceous aerosols sources. Our method allows to correct some discrepancies between this inventory and the observed seasonal cycle of biomass burning in some regions (see the shift in time with POLDER AI on Fig. 3 over South America). The corrected inventory presents a significant improvement to the original Liousse et al (1996) inventory.

Unlike Duncan et al (2003) and Schultz (2002) we simulate atmospheric aerosol loads using both the ATSR-derived emission inventory and the original one. A direct quantification of how the use of satellite retrieved fire location improves aerosol distribution and seasonality was not clearly documented before. Therefore we believe that our results are original and particularly well suited when focusing on the representation of the seasonal cycles and interannual variations of biomass burning aerosols.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1973, 2003.