Atmos. Chem. Phys. Discuss., 3, S452–S455, 2003
www.atmos-chem-phys.org/acpd/3/S452/

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.

S. Generoso et al.

Received and published: 29 April 2003

Dear Dr. Duncan,

we would like to thank you for your comment on the manuscript. We will integrate to the final version of the paper a more precise discussion of how this study is different from previous publications. Here are point by point answers to your comments.

1/ The study that is presented here was done independently of that of M. G. Schultz (2002). Note that M. G. Schultz stands for Martin G. Schultz and not for Michael Schulz who co-authored this paper.

Both our method and the one developed by Schultz (2002) are based on the hypothesis that the annual estimates of emissions from biomass burning are correct but that their temporal and spatial distribution may be improved by the use of satellite data. Hence, the general idea that underlines the two studies is similar and we mention it in our article by ”This work has some similarities with that of Schultz (2002)”. But, our approach differs from the one of Schultz (2002) in that it accounts differently for emissions locations and vegetation type. Indeed we separate the globe into thirty regions based upon their vegetation cover and the burning season. Thereby, we characterize the average fluxes emitted by each detected fire with respect to the region of occurrence. The scaling is thus applied on a large region basis. In this way, fires locations are rearranged within each large region with respect to ATSR observations of fire location and not with respect to the locations given by the original inventory. If the scaling is applied by 1°x1° grid boxes, the boxes are too small to change the distribution of the original inventory even if within each small boxes the fire distribution is given by ATSR observations.

Another significant difference concerns the statistical error made on the emission constant. As our method consists in estimating a statistical emission constant (in g/detected fire), we believe that 1°x1° grid boxes are statistically too small in terms of number of fires. We have estimated than in Amazonia and Africa (two of the main biomass burning regions) at least 80% of the 1°x1° grid boxes contain less than 20 fires per grid boxes and per months (for the main months of the burning season). The statistical error on the emission factor ($>$ the reciprocal of the square root of 20) is therefore still large. The emission factor that we have derived with our method is based on thousands of hot spot detected for these same regions and months.

Another aim of this article is to assess the impact of the method that we have developed on the original emission inventory. We emphasize differences between the Liousse et al. (1996) inventory and its spatial distribution with the one based on ATSR fires described here. The improvement to the atmospheric burden of carbonaceous aerosols was not looked at in the paper of Schultz (2002). But we agree with you that some elements allowing comparisons with different studies are missing and we will add in the final version of the manuscript a table, which summarizes the quantities of carbonaceous aerosols emitted with our method.

2/ We certainly agree that the method proposed by Duncan et al. (2003) applies to different kind of species and different inventories. We will correct this sentence in our article to reflect it more. We acknowledge that the work made by Duncan et al (2003) is extensive since they have combined ATSR fire count with TOMS AI to estimate the interannual variability for 20 years. But at the time that we have started our study, the paper of Duncan et al (2003) was not published. Hence our method has been developed independently of this study and we present here our contribution to the problem of improving the seasonal cycle and interannual variations of biomass burning. Moreover even if the general idea of the method developed by the two studies is similar, their aims are different. Duncan et al (2003) uses CO as an example of applications of the developed method. We focus on biomass burning aerosols and we use a GCM to look at the impact of our method on the previous inventory and to compare our results to observations. We show year-to-year comparisons to AERONET data and comparisons to POLDER observations, which we find particularly well suited to study biomass burning. We believe that these comparisons are original and of particular interest when looking at the impact of our method on carbonaceous aerosols.

The last remark that you have made concerns the study of Chin et al. (2002). The aim of this study is to assess the results of their model for the different aerosol components whereas we focus on how the representation of the seasonal cycles of biomass burning aerosols is improved. They estimate OC and BC emissions due to biomass burning from the method that you have developed (Duncan et al., 2003) assuming an emission factor that is the same 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). Liousse et al (1996) have estimated that the total particulate emission factor could vary by more than a factor of two between savanna and forest fires, something we implicitly account for. Then, Chin et al. (2002) have estimated the total annual biomass burning emissions for BC and OC (the climatologically averaged values) to be a factor 1.7-2 larger than those obtained by Liousse et al. (1996), whereas we have assumed that the total annual estimates of Liousse et al. (1996) are correct (as climatologically averaged values). If we increase our emission by a factor of two with the same chemical transport model, which we have used in our study, the resulting optical depths in South America will be in disagreement with observed values. Then the comparisons to AERONET data presented in Chin et al. (2002) are multi-year averages (at least three years for South America for instance). This smoothes out the year to year spatial and temporal variability of the burning season, which prevents any precise analysis of the representation of the seasonal cycle of biomass burning aerosols.

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

ACPD

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Interactive Comment