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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Biomass burning emissions disturbances on the isoprene oxidation in a tropical forest" *by* Fernando C. Santos et al.

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Dear Referee#1,

Thank you for your criticisms and suggestions to the manuscript. Most of the modifications were made in the manuscript (attached) and below are the comments to the questions made previously.

Referee comment: 1. Section 2.2: Classification method of flight tracks: Since the study focuses on aircraft measurements, it is very important to understand local background is different from regional background. Although CO background for a large region could be around 150 ppb as suggested by the authors, the local background

could be changing much more dynamically, since it is influenced by plume. One approach might have been to classify flight tracks over a given region based on O3 or NO thresholds and determine local background CO for these tracks. Some discussions of local background variations and justification of a constant CO background is needed

Author comment: The flights were classified according to their scientific objectives as either biogenic or biomass burning flights. Additionally, we only considered the data collected below 2,000 m and between 11:00 am and 6:00 pm to capture the difference in the oxidative capacity activity along the planetary boundary layer (PBL) during daytime, since the OH concentration is regulated by photochemistry. Some flights, despite the classification in the planning phase, had parts of their tracks passing through unpolluted regions, smoke haze, or even interception of fresh smoke plumes. An alternative would be the geographic classification of flights in different groups and for each group having a background value, but the insufficient number of flights (n) for some regions, especially the cleaner regions, restricted the use of such method. According to the literature, the Amazon rainforest atmosphere has a background level of CO mixing ratio typically around 100 ppbv. However, the mean CO inflow into the Amazon basin during the SAMBBA period at 500 hPa, retrieved from Atmospheric Infrared Sounder (AIRS) measurements onboard the AQUA satellite, ranged between 140 and 160 ppbv (Figure 1.a). Figure 1.b shows that this hemispheric inflow is quite homogeneous along the vertical column up to around 400 hPa and in fact, there were few SAMBBA samples with CO mixing ratio values $\sim$100 ppbv. The histogram (Figure 2) also present the frequency distribution for all SAMBBA flights, with the value of 150 ppbv as an upper limit. Therefore, in this case, we adopted a threshold of 150 ppbv to represent the background of CO in the Amazon atmosphere during SAMBBA campaign.

Referee comment: 2. Table 2: Values of ER (delta ozone/delta CO) vary significantly in different regions. While a threshold of <0.1 as an upper limit may be reasonable for fresh biomass smoke (based on Table 2), using this same threshold as a lower limit for aged smoke is not very convincing. At the minimum, some sensitivity tests

are needed where the threshold for aged smoke is increased to say 0.5. How will this change in threshold affect results presented in this study? Also, ozone formation and photochemistry can be slowed down in thick smoke plumes or under cloudy conditions. Is this considered in the ER comparisons?

Author comment: Based in the study of Mauzerall et al., 1998, we choose the value ER = 0.1 as a representative value of ∼2 hours plume age. In fact, the ER data (delta ozone/delta CO) are scarce in the literature and we had difficulties in getting them together as an organized table (Table 2). All the factors mentioned by the referre #2 can impact the ER values, although we had worked with the definition of fresh/recent plume from Mauzerall et al., 1998 and the available observations of plume age in tropical and subtropical sites.

Referee comment: 3. Figure 9: There are large differences between Karl et al. 2007 and the results presented in this study for vertical profiles of OH. Can additional supporting evidence from measurements be provided to show which approach is better? One approach might be to look at trends with altitude. For example, as altitude increases from 0 to 2000 m, Karl et al. 2007 report OH increases by a factor of 2 (2.5 e7 to 5 e7). But the authors report a much larger increase (close to zero at 500 m to 1e6 at 2000 m). Did the authors observe large increases in ozone and NO with altitude similar to OH increase? In other words, even if quantitative OH measurements may not be available, some analysis about predicted OH trends with altitude and whether these can be justified based on other measurements like ozone and NO could be provided.

Author comment: Unfortunately, we did not have a direct measurement of [OH] during SAMBBA campaign and our comparison is based in absolute [OH] values, as you can see in the literature presented in the manuscript. Our conclusions are based on the absolute value of [OH], calculated using the new plume age methodology and comparing with recent GoAmazon campaign. We also added

some comments in the manuscript and in the section S5 (attached) we added the vertical profile for [NOx] and [O3] mixing ratios during SAMBBA campaign.

Referee comment: Line 355: 360: Fresh biomass plumes could be expected to be low NOx since VOC/NOx ratio may be very high in these plumes, even though fires also emit NOx. Could the authors comment on how the ratio of isoprene oxidation products to isoprene would vary depending on whether NOx regimes are low or high in plumes, and also how these NOx regimes would differ in the local background?

Author comment: We detected the highest values for NOx in the fresh and aged smoke plumes (∼850 m) and the ratio [MVK+MACR+ISOPOOH]/[Isoprene] also presented a strong enhancement from 250 to 1250 m. These results go towards to the reaction of isoprene with peroxy radicals (HO2) as an alternative pathway to produce OH in an unpolluted environment.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2017-1083/acp-2017-1083-AC2-supplement.zip

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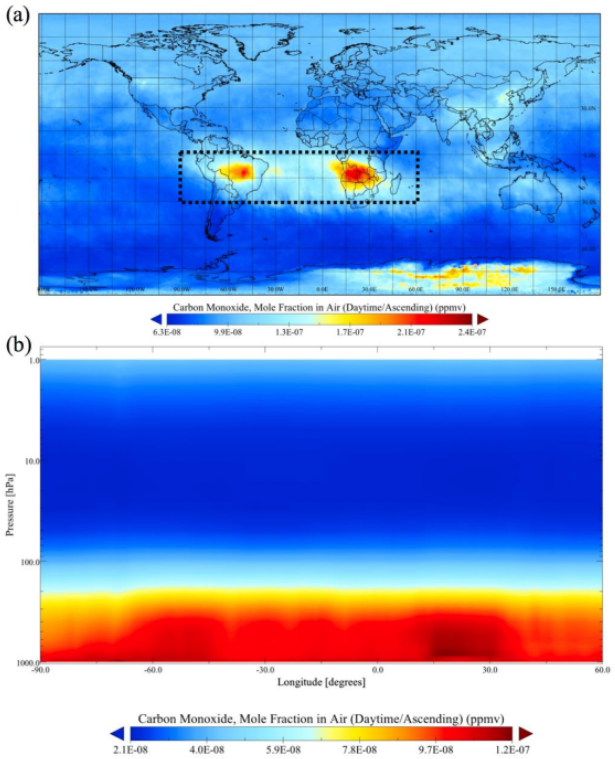

Fig. 1. Time averaged CO (ppmv) over SAMBBA period from AIRS onboard AQUA satellite during daytime: (a) global map at 500 hPa, and (b) cross section of longitude-pressure within the region on the map.

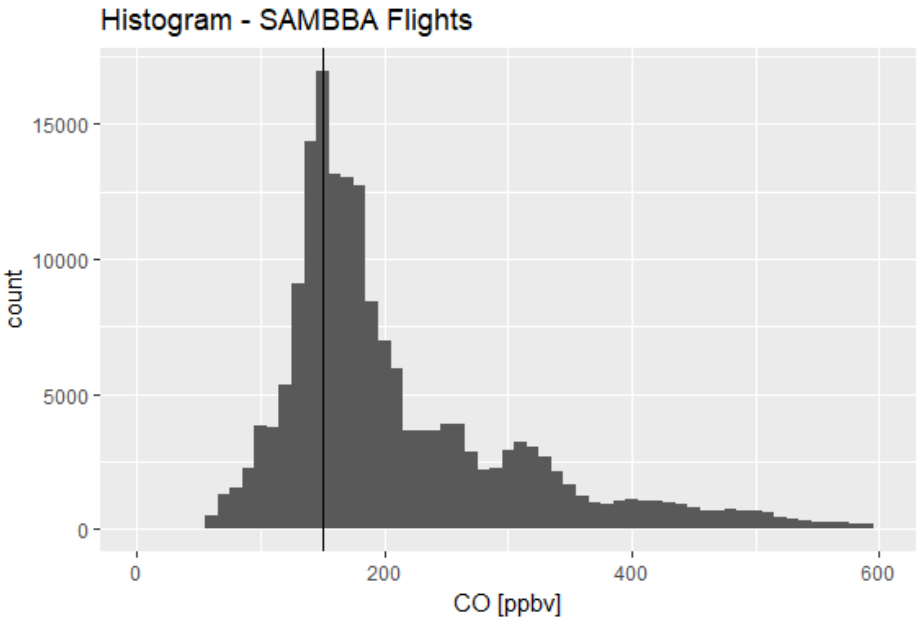

Fig. 2. Histogram that present the frequency distribution of CO [ppbv] for all SAMBBA flights in Amazon rainforest.