

Interactive comment on “Evidence of the impact of deep convection on reactive volatile organic compounds in the upper tropical troposphere during the AMMA experiment in West Africa” by J. Bechara et al.

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Received and published: 5 January 2010

We thank the anonymous reviewer for agreeing to read our paper and taking the time to provide commentary and criticism. We have the following responses to the referee's comments.

Referee comment: 1. Both CO and O₃ are highly variable in the lower troposphere and when lofted to the upper troposphere, they maintain their initial condition for several days. When combined they may be indicative of a “recent” convective event, however

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that signature will persist much longer than that of many of the short lived NMHC this analysis attempts to characterize. This could potentially contribute to the observed variability seen in the samples determined to be “convectively influenced”. It is mentioned that NO_x was measured on the aircraft, was NO_y measured. If so, the ratio of NO_x/NO_y provides a more robust indicator of the time and air mass has been in the UT since being convectively lofted and permits the determination of freshly convected air.

Response : NO_y was not measured. Indeed, sampling time after convection plays a determining role in short-lived NMHC variability. But MCS was explored at similar time after passage. Moreover, we can't see a homogenous variation even for long-lived NMHC (e.g. benzene).

Referee comment: 2.Recent direct measurements of OH reactivity by Mao et al [ACP 9, 163, 2009] show OH reactivity in background UT air that was of order 1 sec⁻¹, where over 60% of the reactivity was attributed to CO? The values presented here indicate that R(CO+OH) was significantly less. I am surprised by the statement that CO contributes a negligible amount to OH reactivity? What about methane? Also, I am confused by the origin of the isoprene reactivity numbers given in line 25, page 20324. These numbers (0.9 and 1 sec⁻¹) appear to be larger than the total reactivity?

Response : Mao et al 2009 show that CO contributes to 60% of OH reactivity based on measurements in Hawaii and Alaska in order to study Asian pollution outflow. These air masses ages are probably of several days (even weeks) and NMHC may have already reacted while CO is more stable and remains in the air masses and contribute to the largest part of OH reactivity. CO is also a by-product of NMHC oxidation. The reactivity calculated in our paper is the contribution of the gases we measured to the total reactivity; it does not take into account methane or other non-measured reactive gases. The sentence “The vertical profile of relative contribution of each NMHC to ROH as well as the contribution of CO and O₃ is shown in Fig. 9. Isoprene is the main reactant with OH at all altitudes, contributing up to half the total reactivity of 0.9s⁻¹

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in the low troposphere (44%) and 1s-1 in the upper troposphere (27%)” seems to be not clearly written. 0.9 and 1 s-1 indicate the total reactivity, not isoprene contribution which is of 44% of this total reactivity in the LT and 27% in the UT.

Referee comment: 3. In section 6.4, please include the individual numbers for each of the compounds used to calculate f . How many compounds were used? This analysis will likely be more robust for compounds that exhibit little variability in the lower troposphere and have a strong vertical gradient. Where did the uncertainty come from in this analysis? Is this the standard deviation of the mean?

Response : All measured NMHC have been used (15 compounds). f values range from 10 to 80% depending on the compound. The uncertainty is the standard deviation of the average of all calculated fractions for each NMHC. This information will be added to the text.

Referee comment: 4. The assumptions made in using equation 4 (section 6.5) are that isoprene is not lost in deep convection, that OH is 2×10^6 in cloud, and the air mass is sampled immediately after being detrained into the upper troposphere. There is little discussion of the uncertainty in each of these approximations. For example the uncertainty in the assumed OH has to be at least 50% if not 100%. I would expect the time since detrainment would be at least 20-30 minutes unless the aircraft was flying directly through the anvil region. I would expect in cloud OH levels to be much lower than 2×10^6 and the UT processing time to be significant. It is likely that these values cancel one another in some complex fashion. I expect that the uncertainty quoted (10 minutes) is grossly smaller than the true uncertainty in this determination.

Response : Concerning isoprene, we assume that during a convective event, its degradation is of similar timescale than vertical transport. So, isoprene is a good tracer for vertical transport and during transport, the variability of its mixing ratio is an indication of vertical transport time. Also, air masses were sampled immediately in the outflow after detrainment in a time range of few minutes. OH concentration is assumed at

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2.106 based on models results (Lawrence et al. 2001). This value corresponds to estimated OH concentration in the low troposphere in the region. A high uncertainty is undertaken but if OH concentrations are divided by 2, time will be multiplied by 2 and will be of about 50 minutes which is still fast comparing to the typical vertical transport timescale which is of about 1 month. This issue will be added to the text and discussed in more details.

Referee comment: 5. Throughout the analysis it would be helpful to have an indication of how many samples are included in each mean. For example, in Figure 6, is the variability in the C-UT simply because there are only 5 data points? I would suggest adding the number of points to these figures.

Response : Figure 6 takes into account all observations and measurement points in convective conditions (25 points). The information will be added in the text.

Referee comment: Line 5, page 20310 – define AMOVOC Line 26, Page 20310 – give an altitude range for this or convert to m sec-1 Line 22, Page 20312 – While these observations certainly add significantly to a poorly sampled region of the atmosphere, I would not say that AMMA “exhaustively explored” West Africa. Line 22, Page 20319 – typo (in situ produced in situ)

Response : These have been corrected in the revised paper.

Referee comment: Line 3, Page 20321 – Is the size of the box in figure 5 the spatial extent to which the samples were integrated over? It would be helpful to know spatially how big these boxes are.

Response : The boxes do not represent the spatial extent of the sampling time. It corresponds to the middle of the sampling time of 10 minutes. To have an order of magnitude, each flight leg corresponds to 30 minutes.

Referee comment: Line 11, Page 20325 – typo (specie)

Response : These have been corrected in the revised paper.

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