

## ***Interactive comment on “Injection in the lower stratosphere of biomass fire emissions followed by long-range transport: a MOZAIC case study” by J.-P. Cammas et al.***

**J.-P. Cammas et al.**

Received and published: 29 July 2009

We are grateful to referee 2 for the thoughtful and constructive comments that we generally agree with and have taken into account in writing the revised manuscript.

*Specific comments:*

*Page 20926*

*Line 5: "is done using" -> "uses"*

Changed as reviewer 1 has recommended: is based on

*Lines 15-20: At first glance these two sentences seem somewhat contradictory - if the model showed pure boundary layer air then shouldn't the deposition be 100% of the boundary layer tracer, not 15-20%. I think there is not really an inconsistency here,*

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*but a bit more clarity might help.*

These sentences have been reworded for more clarity: It is shown that the order of magnitude of the time needed by the parameterized convective detrainment flux to fill the volume of a model mesh (20 km horizontal, 500m vertical) above the tropopause with pure boundary layer air would be about 7.5h, i.e. a time period compatible with the convective diurnal cycle. Over the area of interest, the maximum instantaneous detrainment fluxes deposited about 15 to 20% of the initial boundary layer tracer concentration at 335 K. According to the 275-ppbv carbon monoxide maximum mixing ratio observed by MOZAIC over eastern Atlantic, such detrainment fluxes would be associated with a 1.4 - 1.8 ppmv carbon monoxide mixing ratio in the boundary layer over the source region.

*Page 20927*

*Line 1: I'd delete "too" (penultimate word), it doesn't feel right for a paper (more like something one would write in a proposal).*

Done

*Page 20928*

*Line 1: "... is challenging. Additional studies of other events are required to better ..."*

Done

*Page 20929*

*Line 17: I didn't really understand the discussion of "conversion of  $HNO_3$ ". Is this the conversion of  $HNO_3$  to something directly detected by the sensor? Why is this relevant for calibration?*

Yes, as is outlined in detail in Volz-Thomas et al. (2005) and references cited therein, the  $NO_y$  instrument employs the detection of NO by chemiluminescence, after conversion of the atmospheric oxidation products by catalytic conversion with  $H_2$  on a hot gold surface. The method was invented in the 19eighties and has been employed by many investigators (see, e.g., literature in Volz-Thomas et al., 2005).  $HNO_3$  is one of the major components of  $NO_y$  in the lower stratosphere and in the upper troposphere, in

addition to organic nitrates, particularly PAN, and  $NO_2$ . The MOZAIC  $NO_y$  instrument is automatically calibrated in flight with NO to check the sensitivity of the chemiluminescence detector and with  $NO_2$  for the conversion efficiency of the converter. The conversion of  $HNO_3$  is only determined in the laboratory before deployment of the instrument. The conversion efficiency for  $HNO_3$  was always found to be identical with that for  $NO_2$  (i.e. >95%). The  $NO_y$  data during the period of concern for this paper were later found suspicious, because the  $NO_y$  to  $O_3$  ratio measured in the lower stratosphere was much lower than what is normally observed and what has been observed by other authors, e.g. Murphy et al. (1994). Although not unambiguously proven, a likely reason could be that the instrument was not detecting  $HNO_3$  during the period of concern due to contamination of the converter. This is why only the relative changes are discussed in the paper. The relevant information has been added in the revised version of the manuscript.

Murphy, D.M. and Fahey, D.W., 1994. An estimate of the flux of stratospheric reactive nitrogen and ozone into the troposphere. J. geophys. Res. 99, pp. 53258211;5332

*Page 20930*

*Line 20: 0.2 degrees - is this latitude, longitude, great circle? Might it be better to quote this in km?*

The increment of 0.2 degrees is in latitude or in longitude. Added in the revised version.

*Line 21-23: Are the details on height change -> trajectory launch criteria really needed here, given the UT/LS focus. How about simply saying: "Also, whenever it changes by more than 400m above 3km (with finer criteria at lower altitudes)"*

Done

*Page 20931*

*Line 1: delete comma add "are" after "calculations"*

Done

*Page 20932*

*Line 3: Add "2004" after "30 June"*

Done

*Line 23: "strong values" -> "large abundances"*

Replaced by enhanced values as proposed by reviewer 1

*Page 20934*

*Line 4: "terms" -> "the", "prevents from using" -> "precludes the use of"*

Done

*Page 20938*

*Line 17: "center of interest" -> "focus"*

Done

*Page 20939*

*Line 6: delete "a" before "slightly"*

Done

*Page 20940*

*Line 8: "cube" -> "box" (the sides are different length)*

Done

*Page 20943*

*Line 17: "of" after "impression"*

Done

*Line 18: "did come" -> "came"*

Done

*Line 26: "...indication OF where emissions..."*

Done

*Figure 1*

*All the labels (contour labels and axis labels) are way too small in this figure. The*

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*contours are very hard to see against the colors. I'd have fewer, bolder contours, 2-3 for each field only.*

The figure has been modified accordingly.

#### *Figure 2*

*This figure sorely needs a legend, or labels on the lines. The reader should not have to wade through a wordy caption to identify the lines. Again the text is far too small.*

The figure has been modified accordingly.

#### *Figure 3*

*The labels are too small for the top plot. There are too many vertical dotted lines in the bottom right figure, also the x-axis labels are colliding.*

The figure has been modified accordingly.

#### *Figures 4 and 5.*

*Again, the labels are too small. The caption needs to give more details about how to interpret the colored contours. I think I got it but some readers may be at a loss. Why bother to show (c) and (d) in the bottom half, given that they're so close to (b)? For that matter there is little difference between (a), (b) and (c) in the top half.*

The size of the labels have been increased. The caption now explicitly states that the colored contours indicate the age (days) of air masses considered. Values on the y-coordinate indicate either the aircraft altitude (black line, km) or the CO mixing ratio (ppbv) of air masses considered. Results from the sensitivity tests for injection altitude below 1000m and 150m, as well as results for total anthropogenic pollution from  $SO_2$  and  $NO_2$  have been removed, as requested.

#### *Figures 6*

*The small numbers are simply impossible to see, make them bigger/bolder. Part of the problem is your choice of dense grid, I'd leave it off or at least make it coarser.*

The small numbers showing the daily positions of the retroplume centroids were inessential, i.e. did not important informations for the understanding which is given

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by the biomass fire CO source contribution itself. Accordingly, the sentence has been removed from the caption.

### *Figure 7*

*I don't really see what the colored aircraft track adds here, and using the same color scale for both this and the contour fields leads to very unhelpful units. I'd put the contour field in hours not percent, and show the CO aircraft track with a different color scale, or perhaps just show the high CO points in black and low CO in grey or something. In the caption express the  $7.2e4$  s as 20 hours.*

The figure has been modified accordingly.

### *Figures 8-12*

*Text too small, particularly for figure 11.*

The figure has been modified accordingly.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20925, 2008.

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