

Interactive comment on “Biomass burning and urban air pollution over the Central Mexican Plateau” by J. D. Crouse et al.

Anonymous Referee #1

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2/8/09 Review of J. D. Crouse et al., 8220; Biomass burning and urban air pollution over the Central Mexican Plateau8221;

The paper addresses the apportionment of biomass fire and Mexico City pollutant sources in air masses sampled by the C130 aircraft using HCN and C₂H₂ as characteristic markers and derives 8220; emission ratios8221; for several gases, aerosols and scattering by aerosols. These results and the estimates of the fractional contribution of fire emissions to the total loading of CO, benzene and total reactive nitrogen are certainly worthy of publication in ACP. The results from this paper in combination with those from the Yokelson et al. ACP 2007 paper (in the special issue and with many common authors) give a very informative picture of the importance of and the role of biomass fire sources (gases and especially aerosols) on the regional scale of

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the Mexican plateau. It is clear from the analysis that fires within the region in the dry season contribute a substantial fraction of pollutant gases and aerosols (with subsequent impacts on ozone, visibility, health, etc.). The introduction is nicely written. The conclusions are a bit tepid in comparison to the global impact conclusions of the Yokelson et al. paper, but that is okay. However, I think the remainder of the paper is written too succinctly. Overall, it needs a number of clarifications, some reorganization, and corrections before it can be accepted for publication. Recommendations and issues are listed below (and not necessarily in the order of the text). It is surprising that with 11 co-authors the paper requires a fair number of obvious corrections. The necessary revisions should be straightforward.

Issues/Recommendations (working mostly from printer-friendly copy) 1. P2702, lines 20-25. I recommend that a sentence or two be added to give the reader an idea of the cause of these pine forest fires. Are they ignited for forest management (controlled burns), ignited by people for other reasons, accidental, etc. (Since it is the dry season lightning is probably not the major factor.) Then the reader can decide perhaps how easy it would be to reduce the number of fires during this season (re the conclusions of this paper and mitigation).

2. Suggest P2703, line 20: (3x3 degree box centered on MC, shown in Fig. 2, and termed 8230;..)

3. I would recommend that Figure 3 (a very nice presentation summarizing a lot of work) be accompanied by a new Fig. 3b showing the aircraft flight track (with time markers) superimposed on a standard topographical map of the region (preferable) or an enlarged version of one of the MODIS images. Including the standard box used for the analysis would also be appropriate (I realize the box is given in the current Figure 2). The track should be color coded by altitude. This would help the reader better understand some of the variations in the time plot and allow them to know where the aircraft was relative to Mexico City, the mountains, the fires, the box of emphasis, etc. (The present figure has black circles around data within the box of interest, but

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that really does not give the reader a good perspective of where all the substantial variations in the time plot occur.)

4. Figure 3a as currently given (without flight track) does not really explain why in Figure 2 the C₂H₂ and HCN are (not 8220; appear 8221;) geographically coincident. The coincidence is quite unexpected. Are there other reasons that you can give to offer some understanding? Is a contributor that emissions from fires on the city side of the mountains collect within the basin at night and morning? And also that the aircraft usually sampled in the noon to afternoon period when venting (to the northeast usually) of the basin occurred to various degrees?

5. P 2703 line 27: in the study-needs clarification; do you mean for the seven flights and within the box of Figure 2?

6. One of the major products of the analysis (Table 1, and

The NO_y converter should sample nitrate aerosol (if size less than a few microns) other than crystalline aerosol nitrate. But there is no description of the NO_y inlet, whether isokinetic, whether at right angles to the flow, or whether particle amplification might occur. Some related words would help the reader. MILAGRO also had a number of instruments measuring aerosol composition so some idea of the kind and magnitude of aerosol nitrate should be available at least for the MC air parcels. Also there were fair amounts of ammonia in the MC area, and ammonium nitrate should be measured by the NO_y converter/instrument. The statement in the appendix that aerosol nitrate was added to the observed/measured NO_y (double counting, etc.) seems quite at odds with most NO_y measurers. Some clarification and expansion of the NO_y treatment is absolutely required.

7. I had problems with the present ordering (and quality of some) of the Figures and suggest that some reorganization be made. Figure 1 is repeated by Figure 10 (admittedly in the Appendix). The text could easily be changed to include all of the MODIS images (currently Figures 10, 11, 12 in the Appendix) or a subset of them where the

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present Figure 1 occurs. (Consider whether they are all necessary even if you decide to leave the remaining ones in the Appendix). Even more important, current Figures 10-12 are the antithesis of what figures are supposed to be. It is impossible to see the red fires in all of the print-friendly version. Even in the on-line version the plots have to be zoomed individually by 200-400

8. P2704, line 25: you call the Fy scalars (fine) but then on P2706 line 21 you call them emission ratios. Why not call them what they are right up front. In fact the paragraph beginning on P2706, line 21 to P2707 line 2 might be better placed beginning on P 2704 directly after the equations presented. And then say you determine some things essentially from the slopes of correlation plots as given in Figures 4, 5, 7, 8 etc. At present the discussion of the equations (model) is interrupted by discussion of details (gasoline, diesel, etc) and backgrounds, before finishing the basic description of the application of the model (TLS etc.). (Just a suggestion to improve the flow.)

9. Page 2705, lines 28, 29: How does the reader infer from (8220;see Table 18221;) that the contribution of biomass burning to C₂H₂ accounts for less than 10

10. Page 2706, lines 20-25. Don't errors in the measurements (or shouldn't errors in the measurements) contribute to the weighting? Since the HCN measurement by CIMS is new, the Appendix at least needs to have a statement of the calibration procedure, the precision and the estimated accuracy of the instrument. Same for all the other instruments. Currently only CO has a precision and estimated accuracy statement.

11. P2706, lines 10-11: Background at the top of P2705 is defined as 8220;the amounts of these tracers advected into the region from afar8221;. More explanation is required on why the background for HCN or C₂H₂ would be different for the aerosol analysis versus other gas analysis for a given flight. Other backgrounds (CO) are derived from corrections to a model. Others from higher altitude or clean air. No background is discussed for NO_y. Does not seem like a very consistent procedure.

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As well, it all begs the question of how sensitive the derived quantities are to the various backgrounds. No discussion is given but there should be a few words added. 12. P2707, line 12: Please clarify: You say all observations made from the C-130 during MILAGRO for CO. Do you mean all flights for the entire campaign or are you talking about the 7 flights?

13. CO background. It is essentially constant in Figure 3. Why do you need to invoke a model (MOZART) and a bias (between MOZART and observations) to arrive at the background. Why was the procedure not the same as used for other gases? i.e. 8220; clean air 8221; coming into the region or higher altitudes, etc.

14. P2708, line 4: Why re the aerosol discussion do you now skip a couple of Figures and refer to Fig. 8. (Relates to earlier discussion of reorganizing some of the paper.)

15. Regarding Figures 4, 5, 7, 8: As written, the authors seem to say that the correlations are high or good. Certainly true for some, but Fig 4c, 4f, Fig 5b, 5c, Fig 8c give poor to bad correlations. Often the points with the highest toluene to acetylene ratios are well displaced from the correlation line, and very often these are the data within the box (i.e., circled in black). There is very little discussion of the poor correlations. A few sentences need to be added-and how these poor correlations relate to or control the uncertainties given in Table 1. Indeed, in the smaller panels of the figures, the correlations seem to be often controlled by the large number of points external to the box of interest and points within the box (often fresher air parcels) are well off the correlation line. Some additional discussion would serve the paper well. If the correlations were restricted to data within the box what would the numbers be?

16. Table 1 footnote (and several places in the text) says that the median values are from the Yokelson et al. 2007b paper (part of this special issue). The Yokelson paper does not give median values but only gives mean values. I think there should be consistency between this paper and the Yokelson paper unless you add some text as to why you want to use medians instead of means.

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17. Further on Table 1-the Yokelson paper does not give (measure) a NO_y fire emission ratio. They do give a NO_x as NO ratio but your listing it as a NO_y emission ratio requires some assumptions. Some explanation is necessary in the main text.

18. Figure 6: Robust least squares (add a reference and a few words about the difference from regular least squares please). Is the correlation coefficient the same for the (regular?) least squares and the Robust least squares? Only one is given in the figure.

19. Figure 9: Top and bottom mean values at 1.5 km and 5.5 km look odd. Why are the altitude bins chosen to cover where there is no data below about 2 km or above about 5.3 km. Or at least plot the means at the mean altitude of the points within that altitude bin. It seems that if the bins were 2-3, 3-4 and 4-5.3 km the altitude dependence would be much less and you would need to revise the discussion. Why are mean values used here, when most of the rest of the paper uses medians (see earlier comments)? Perhaps show means and medians.

Errors 20. P. 2700: two asterisks on now at: AAAS Science and Technology 8230;8230;. 21. 2704 line 3: should be Figure 2b not 2c. 22. 2705 line 12: text says 0.054 (mol/mol) in two places in the paragraph, Table 1 lists 0.056. 23. 2705 line 18: grammar-should be on 29 March from other days, not on 29 March than on other days. 24. Figures 5a and 7a do not have any numbers on the x-axis. 25. Figures 4 b,c,e,f, 5 b,c, 7 b,c, 8 b,c-please clarify. The y-axes are labeled observed C₂H₂ or observed HCN while the captions state they are C₂H₂* or HCN*. Which is it? If they are really the asterisked variable then shouldn't observed be deleted.

ACPD advice to reviewers:

1) Does the paper address relevant scientific questions within the scope of ACP? - Yes
2) Does the paper present novel concepts, ideas, tools, or data? - Yes
3) Are substantial conclusions reached?- conclusions are a bit tepid in comparison to the Yokelson et al. paper which has a substantial overlap of authors.
4) Are the scientific methods and assumptions valid and clearly outlined?- Not always- see comments
5) Are

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the results sufficient to support the interpretations and conclusions? - Yes 6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? - Not always-see comments 7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? - Yes 8) Does the title clearly reflect the contents of the paper? - Yes 9) Does the abstract provide a concise and complete summary? - Yes 10) Is the overall presentation well structured and clear? 8211; No - see comments 11) Is the language fluent and precise? -Yes 12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? - OK 13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? - yes-see comments on text and figures 14) Are the number and quality of references appropriate? - good 15) Is the amount and quality of supplementary material appropriate? 8211; see comments on Appendix.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 2699, 2009.

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