**Atmospheric
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Interactive comment on "Vertical distribution of aerosols in Mexico City during MILAGRO-2006 campaign" *by* P. A. Lewandowski et al.

Anonymous Referee #1

Received and published: 30 April 2009

This paper describes how a lidar system was deployed during the MILAGRO field campaign and presents some sample results. It is useful to have some sort of documentation of what was measured in the field, especially for non-standard or routine instrumentation. However, this paper fails to utilize other available measurements that could be used to help interpret the lidar measurements and the authors have not provided the scientific purpose for deploying such an instrument. There is a wealth of information that could be employed to strengthen the analyses in this study and put their measurements into perspective with other studies already published. I have made a number of suggestions to improve the scientific content of the paper.

Major Comments:

1) What was the measurement strategy for the mobile lidar measurements and what

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Interactive Discussion

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were the scientific objectives that were going to be addressed? Right now the paper sounds like the investigators have an instrument; therefore, they deployed it in the field and to see what they would find. What problem was this deployment supposed to address? Did the measurement strategy include coordination with other instrumentation? For example, was the sampling coordinated with aircraft that could be used to inter-compare the measurements (in a similar manner as the RAMA data)? A few additional paragraphs that answer these questions is warranted in the introduction.

2) Was there only one transect made during the entire campaign? Or were there others that are not being described? Please be specific. If there were other transects, why not include a description of them in this paper? Will analysis of other measurements be a subject of future research?

3) The authors bring up an important point on page 6840 (line 13). Yes, quantities derived from lidars would be useful for modelers because it provides vertical and time variations that point samples cannot provide. But the uncertainties need to be relatively low, and I'm not sure this study shows they are low enough. A 30% overestimation in optical depth is large and the present analyses do not adequately show the uncertainties in particulate mass. It would be useful to include another plot that includes ground concentrations derived from the lidar that has been averaged to hourly intervals and then overlaid with RAMA measurements (only those within a time frame when the lidar passed by). It is difficult to assess the differences by comparing Fig. 6b and 8.

Minor Comments:

I suggest changing the title to "Vertical distribution of aerosols in the vicinity of Mexico City during the MILAGRO-2006 campaign" since the measurements were not made only within Mexico City.

Page 6829, line 19: It is true that vertical gradients in particulates can be used to infer PBL height, but not definitively. There can be multiple layers of particulates present, such as those from residual layers, so that defining the PBL height from vertical gra-

dients alone would not necessarily agree with PBL height derived from meteorological measurements.

Page 6830, line 26: Are the sun photometer measurements instantaneous at 1-2 intervals or are they averaged quantities over the 1-2 periods? Please define.

Page 6835, line 19: It is strange to refer to windblown dust as biogenic pollution. Also, wind blown dust in Mexico City usually occurs late in the afternoon when the surface wind speeds often increase. So it seems a bit odd that there would be a lot of dust around during the early morning. It would be useful to indicate the surface wind speeds from some of the RAMA stations at those times. There are also measurements of crustal material made at the T1 site.

Page 6836, line 19: If the winds were northerly, why is a substantial portion of the Mexico City plume extends northward between T1 and T2 (Figure 9)? In fact, the winds shown in Fast et al. (2007) are a bit more complicated than indicated here. As indicated by my other comments, the authors have not fully utilized other measurements to help explain their data.

Page 6836, starting at line 27: Although the authors provide a plausible explanation of the changes in the "residual layer" at 4500 ASL, there is no direct evidence of aerosol water. There were soundings made during the experiment that could be used to confirm whether RH was relatively high at that elevation and whether it decreased during the day. Those special sounding probably did not start yet on March 7, but the 12 UTC and 18 UTC soundings from Mexico City could be used. Another plausible explanation is that the aerosol layer was simply transported away. One must be a bit cautious on these explanations since both time and space vary in this plot.

Page 6837, line 21: Suggest changing "relaxed" to "decreased".

Page 6838, lines 1-4: Again there is no evidence to support the hypothesis that the terrain acts to trap the ground pollution. Are there meteorological measurements that

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Interactive Discussion

Discussion Paper

suggest that a shallow stable layer persists until ~10 am? What about the surface wind patterns measured in the city?

Page 6838, lines 5-9: In addition to PBL mixing, the lidar is moving out of the basin which also likely leads to lower concentrations.

Page 6838: lines 21-26: I do not see how plotting lidar data in 3-D is novel, nor have they described how the topography affects the vertical structure of the boundary layer.

Page 6840: line 8: The RAMA stations are hourly averaged values, so that would explain some of the differences as well. This is mention later in the text, but is relevant here. It seems pretty obvious that the major roadways would have localized concentrations not representative over a large area, so why were transects not performed on minor roads?

Page 6840, line 26: Unless it was very windy (not shown), I would not expect the major differences between RAMA and lidar to be attributed to particles greater than 10 microns. Big particles would readily fall out otherwise.

Page 6841, line 1: I'm not sure what the first sentence means at all. What is the impact that is being examined?

Page 6841, line 2: The fact that ground pollution can reach as high as 1500 m is inferred from boundary layer mixing (after 10 am on this particular day). This is not a very useful conclusion given that there is a lot of aircraft data over the city that has been used to infer how high material is transported above the city and on different days. The authors use the word "pollution" here, but what they really mean is aerosols, since the lidar cannot differentiate between anthropogenic and natural sources.

Page 6841, lines 7-12: The authors should acknowledge they are only looking at one case.

Page 6841, lines 15-16: The authors really didn't show this, but my suggestion of an additional figure in my major comments would substantiate this statement.

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Figure 2: The RAMA site names are far too small.

Figure 6: I suggest capping the y-axis on b) to 5000 m. Right now the scale is such that much of the details near the surface are very hard to see.

Figures 6 and 7: Why choose 200 m for these plots. Please state so in the text. Does the lidar not see anything between the surface and 200 m? That would also complicate comparisons with the RAMA surface measurements.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 6827, 2009.