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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 #2

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The paper presents an interesting study of lidar data in the Mexico City. I am not aware of any other series of lidar measurements from a moving vehicle. The article provides an indication that such measurements may be used to observe the spatial variability in the vertical distribution of aerosols above a major city. The paper also attempts to use these data to provide estimates of aerosol mass loading above Mexico City.

While the paper presents an interesting dataset, there aspects of this paper that prevent me from recommending publication.

Major comments:

1. There is far too little information provided regarding the uncertainties associated with the attempts to compute mass extinction efficiency and mass loading. In section

4.4 the authors acknowledge that the algorithms presented have numerous assumptions (such as a known refractive index, proper calibration, sphericity of the particles, spatial and temporal homogeneity of the aerosol distribution, reliance on Mie theory, meteorological conditions, the exact location of the instrument, uncertainties in the lidar retrievals of aerosol extinction). However, little if any attempt is made to estimate the size of these uncertainties or their impact on the retrievals of mass extinction efficiency and mass loading. There should be some attempts made to estimate these uncertainties and their impacts on the mass com; otherwise, there is little likelihood that such estimates will be useful for modelers.

2. In the abstract and elsewhere, the paper states that the aerosol mass estimates have a 1.5 m vertical resolution. This is apparently based on the 1.5 m vertical resolution of the lidar backscatter measurements. However, this does not reflect that the size distribution measurements used to compute these estimates are a column average and, therefore, contain no information about how the aerosol size distribution varies with altitude. The authors have made the assumption that the size distribution is constant with altitude and that the only variation is represented by the lidar measurements of backscatter. Given the complexity of the aerosols observed (combustion, pollution, dust, etc.), this does not seem to be a very good assumption. There were airborne measurements of aerosol size, composition, etc. made by several aircraft throughout MILAGRO that the authors could have consulted to examine this assumption.

3. There were many other aerosol-related investigations and measurements made during MILAGRO. Some of these measurements, in particular other lidar measurements of aerosol distributions in the Mexico City region, would have been quite relevant to this study. However, there was no mention or reference to these measurements and how the lidar measurements presented in this paper relate to these other lidar measurements. This is a major omission.

4. In the abstract, the authors seem to imply that aerosol loading derived from the lidar measurements compares well with the hourly-averaged PM10 ground observations

from the RAMA network. However, there are no detailed comparisons of these measurements and so it is very difficult to really assess the level of agreement between these measurements. In the conclusion, the paper states that the lidar derived estimates have a similar order of magnitude as the observations from the RAMA network. Does this really constitute good agreement?

Minor comments:

1. (abstract, line 12) Is this supposed to say ". . .compares well. . ." As discussed above, there is little indication of this provided in the paper.

2. (p. 6831, line 25) What is the lowest altitude for the lidar backscatter measurements?

3. (p. 6832, line 9) The Langley method provides a means to calibrate the direct solar measurements; how are the sky radiance measurements calibrated? 4. (p. 6823, line 12) Were the Sun photometer measurements made while the vehicle was moving? How long did it take to acquire each set of measurements?

5. (p. 6833, line 16) The Klett solution requires an estimate of the lidar ratio to derive aerosol extinction from backscatter. What value(s) was (were) used in these retrievals? How were the values obtained? What is the uncertainty in the retrieved aerosol extinction values associated with uncertainty in the lidar ratio?

6. (p. 6834) The discussion of MSEE should include an indication that n(r) and Qext(r) are functions of altitude and location.

7. (p. 6835, line 5) SKYRAD.pack.4.2 assumes spherical particles which is likely not a good assumption with all the nonspherical dust particles observed over Mexico City.

8. (p. 6836, line 27) How do you know that the concentration decaying with time is due to water condensation on the particulates? What measurements indicate or support this?

9. (p. 6838, line 24) The pseudo-3D display of the lidar data on a digital elevation map

is not new.

10. (p. 6839, line 25) Were the lidar estimates of AOD obtained by integrating the lidar extinction profiles between the surface and about 3 km above ground? If so, what is the estimate of the amount of AOT above 3 km that the lidar estimates would not include? This additional amount would increase the size of the lidar overestimate.

11. (p.6840, line 7) How much higher are the lidar estimates of concentrations than the RAMA measurements? These comparisons have not yet been discussed. It looks like sections 4.5 and 4.4 should be switched. Also, elsewhere in the paper, it is implied that the lidar and RAMA mass estimates are in agreement. Here the statement is that the lidar is overestimating the RAMA measurements; which is it, good agreement or overestimate?

12. (p.6840, line 14) Without providing uncertainty estimates, it is not possible to judge the utility of the method.

13. (p. 6840, line 26) With all the other potential problems and uncertainties associated with the assumptions and analyses, it is hard to believe that the major reason the lidar and RAMA estimate is due to particles larger than 10 micrometers affecting the lidar measurements and not the RAMA measurements.

14. 14. (figure 4) What do the various lines in each of the graphs represent?

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