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Atmospheric Chemistry and Physics Discussions

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

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General comments:

This paper reports on very interesting Lidar measurements across an urban area. While this is a valuable dataset, I agree with the other referees that this paper should expand the analysis section to address specific science questions.

Response to the General Comments: We appreciate the effort from the reviewer. The scientific purpose of the study was twofold. First, it answered the question of what was the spatial distribution of aerosols in Mexico City and the southern vicinity in the morning of March 7th, 2006. Second, it demonstrated a truly unique measurement approach involving a mobile lidar and aerosol size distribution measurements, which when com-

bined resulted in an estimate of aerosol mass concentration. Although the dataset addressed only one case of aerosol spatial distribution, we believe that the results and approach are well worth presenting to the adventage of the aerosol community and future measurements.

Major comments:

Comment: 1. Are there more comparisons possible with other aerosol measurements that would add value to the current analysis, as well as adding value to surface or point measurements by comparing them with vertical profiles?

Response: This is a great comment. Although, the comparisons between the lidar derived aerosol mass concentrations and other point measurements are possible, they pose several difficulties. First, the lidar derived concentrations were retrieved at 200m above the ground and other point measurements (as for example RAMA) were ground based. Second, comparing spatially resolved measurements (or line measurements for that matter) with point measurements would require some degree of spatial interpolation and could confuse readers more than clarify the problem. To shortly answer the question, the comparisons are possible but they are conceptually difficult and not as straightforward as co-located in-situ measurements.

Comment: 2. There should be more detailed meteorological analysis and/or combination with some modeling studies, to lend extra significance to the results reported, please see comments below for specific examples.

Response: Good point. A more extended discussion on meteorological conditions and vertical stability of the lower troposphere is now included in the results section. The discussion is based on the balloon sounding from Mexico City 1200UTC on March 7th, 2006.

Comment: 3. Discussion of the aerosol size distribution does not seem to take into account the location of the measurements along the route.

Response: In the section covering the MEE results, there is a short discussion on the three aerosol size distribution measurements from the three different locations. The conclusion of the discussion is such that although the measurements were performed at various locations, the size distribution data is similar in the three cases. Please keep in mind that these were column average aerosol size distribution measurements and surface conditions/location were averaged over the entire column. We could not distinguish between the surface and the free troposphere aerosol size distribution. Therefore we could not include a detailed discussion on the aerosol size distribution along the route (even though we agree that it's going to vary across the path).

Comment: 4. In Section 4.2, the discussion of ASD and MEE: is it possible to account for varying composition of urban plume versus crustal and biogenic aerosols? Should this section contain a discussion of the sensitivity of the Lidar to aerosol size - is there the possibility that the signal may be swamped by dust in certain places? Could this also be discussed at the end of Section 4.4?

Response: Good point. It is impossible to account for varying composition of urban plume with a simple total column ASD estimates from the sun photometer. A discussion on the sensitivity of the lidar with respect to a particle size is now included in section 4.4 as suggested. The paragraph includes the conclusion that the overestimation can be contributed from particles of a certain size, to which the lidar is more sensitive.

Minor comments:

Comment: 1. 7 March was an unusually clean day, how does it relate to other days of the campaign, and to typical days in Mexico?

Response: Good comment. In fact, March 7th, 2006, was a clear sunny day. This also allowed for proper sun photometer (sky radiance) measurements. An additional discussion on meteorological conditions was added to the section 4.3. The readers are also referred to the detailed description of the meteorological conditions during the experiment (de Foy et al. 2008 and Fast et al. 2007).

Comment: 2. Were there measurements on other days? Even if they are not included in this analysis, it would be interesting to know about them.

Response: There was more than one transect but unfortunately the other transects suffered from various problem such as instrumentation malfunction, clouds in the lower troposphere, clouds obstructing the aerosol size distribution measurements, etc. The transect of March 7th shown is single most complete set of the data and therefore is most appropriate to successfully accomplish the purpose of the study. The other datasets (or parts of the datasets) from other routes have a potential for future reasearch although the research would not be directly related to March the 7th, 2006, transect. An appropriate paragraph was added to the manuscript in the Introduction.

Comment: 3. Some of the description of the Lidar information was a little scattered in Section 1 and Section 2.1, it could be usefully rearranged.

Response: The Introduction (Section 1) provides a general description of the lidar technique. From the introduction the reader should understand why the lidar was an adequate tool to accomplish the goal of the study. The Instrumentation (Section 2.1) provides detailed information on the specific type of lidar that was used for the project. This level of detail would not fit into a general introduction. Likewise, moving the general information on lidars from the introduction would make the section incomplete, and lacking basic knowledge on why such an instrument was chosen for measurements. The authors suggest that the distinction between the general and specific information on lidars would stay intact.

Comment: 4. What were the details of the RAMA PM10 measurements?

Response: Great comment. The RAMA website (in Spanish) provides rather general information about the PM10 measurements. The website explains that the principle of operation of PM10 instruments is based on the attenuation of beta radiation. The information does not specify the uncertainty of the measurements. An appropriate paragraph was added to the Instruments section of the manuscript. (RAMA website

http://148.243.232.112/simat/pnrama2.htm)

Comment: 5. pg 6836, line 27: Wouldn't the Lidar identify the difference between droplets and aerosols? At that height, is it really plausible that diurnal cooling causes the changes proposed?

Response: Good point. Unfortunately, an elastic lidar cannot distinguish between solid and liquid particles. As for the condensation on particles at 4500m MSL, the balloon sounding from Mexico City confirm the LCL (lifted condensation level) at about 4500m MSL. An appropriate discussion was included in the section.

Comment: 6. pg 6837, line 10-15: Please specify where and when this is. This discussion would benefit from more detailed wind analysis of available data to know where this pollution 'outburst' is from.

Response: Good point. The location of the traffic congestion event was specified in the text. The wind analysis was also added in the paragraph above. The details of the balloon sounding were included in the manuscript.

Comment: 7. pg 6838, line 5-8: This is potentially very interesting, but there is insufficient data shown to support the claims being made or to figure out what is really happening to the plume.

Response: True. We have no wind profile data to make the definite claims. It is evident in the lidar graph (figure 6b) that the 3000m MSL layer disappeared ($\sim$10:25am). The text only states the change observed with the lidar and does not interpret why or how the 3000m MSL layer disappeared. The lidar observed more turbulent mixing in the pass and outside the basin, which is also evident in the lidar graph (e.g. 10:50am-11:00am). And yes, we agree. This really is an interesting transition between the inside and the outside of the basin conditions.

Comment: 8. pg 6840, line 21: 1-minute data is available and would probably be worthwhile in this case.

Response: If the reviewer can only provide this sort of data, we would gladly use the 1-minute data.

Comment: 9. pg 6841, line 2: Boundary layer heights routinely get much bigger than this, please discuss this question in light of other measurements available.

Response: Great comment. We agree, the boundary layer can get higher. Although on March 7th, 2006, in the locations along the transect, the pollution was observed between the surface level ($\sim$2200m) and as high as 3700m MSL. To our best knowledge, the only other PBL height measurment active on March 7th, 2006, was a wind profiler at T0 (Shaw et al. 2007) but as shown in Figure 9, the T0 was not even within the morning plume and any comparisons would only introduce confusion. If the reviewer is aware of any dataset that could be technicaly possible to compare, we would gladly use such an opportunity.

Comment: 10. pg 6841, line 13-16: It seems that there are large discrepancies that should still be discussed, so that people using this data have a better understanding of the uncertainties.

Response: Excellent point. The discussion on uncertainties was largly extended to the advantage of potential users of the lidar dataset. The section includes an empirical analysis of lidar and MEE uncertainties and an overall uncertainties of concentration estimates.

Comment: 11. Would it be possible to label route locations on Fig. 6? Also, would a zoom of the surface layer help interpreting the data?

Response: Good question. Figure 6 is in fact in presented only in the time domain. The authors also thought that that was a major limitation and came up with an idea for Figure 9 (geolocating each of the lidar scans in space). There is really no better way of spatially labeling Figure 6 than presenting the data in Figure 9. As for the zoom of the surface layer, since the article is in the electronic format, the reader will have the ability

to zoom in to the desired level of detail and location within the document.

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