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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol airmass type mapping over the urban Mexico City region from space-based multi-angle imaging" *by* F. Patadia et al.

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Dear Reviewers, Thank you for the valuable comments and suggestions on our efforts here. We have accommodated most of the suggestions and we think that it has helped us in improving the presentation of our paper. We hope that we have succeeded in answering your concerns.

Interactive comment on "Aerosol Airmass Type Mapping Over the Urban Mexico City Region From Space-based Multi-angle Imaging" by F. Patadia et al

Reviewer 1

Dear Reviewer, Thank you for your time and valuable comments on our paper. We have improved our paper by making some of the sections more concise. We hope that we have succeeded in answering your concerns (below in blue font).

General remark The paper contains a huge amount of aerosol information from airborne, lidar and satellite observations, and is approriate for ACPD after minor revisions. But it is rather lengthy. The style is often like (sorry. . .!) a boring technical report. A paper should summarize (and in this way condense) the essential findings of a scientific work or project. The opposite is the case here, is my feeling.

A few detailed remarks:

Too many tables are presented. Table 1 a,b,c is a typical example for technical report tables (which certainly make sense to have them for internal project workshops). But in a paper?

Yes we agree that there are many tables. However, this paper is really our first sensitivity study over an urban location and the intention is to develop a benchmark for future work. Some of these details are really important for satellite retrievals of aerosol optical depth and other microphysical and optical properties. For example, the altitude of the stations is important for accurate Rayleigh corrections, more so at these high altitudes. This has significant impact on AOD retrievals. The AOD validation is a dedicated effort carried out by the MISR group. Details on the comparisons become vital for such exercises and saves time re-inventing the wheel. Compared to the general audience for the paper, those particularly interested in the details will take a closer look at these Tables. Therefore, we retain them as supplementary material but have removed them from the paper.

Why do you not show just a map with the locations of observational sites?

Figure 1 does have these details including the B200 flight path and a context satellite image of the case study days.

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Table 2 is a technical report table, too. Table 3, the same.

We do not completely agree on this. Making such Tables available is a practice followed throughout the satellite remote sensing community. One reason is to be transparent about the research conducted and another reason is to allow the community to be able to reproduce the results if and when need be. Third, this information is unique to this study in that the aerosol particles mixtures are uniquely designed to span (1) the range of aerosol particles types found in the Mexico city environment on our study days and (2) to test the sensitivity of MISR aerosol retrievals in an urban set-up, which has not been done at this level of detail before. So we have retained Table 3 in paper but have moved Table 2 into supplementary material.

Table 4 may contain some interesting comparison, but that should then be shown in a plot, at the moment this is again a lengthy technical report table, and so on. . . with tables 5 and 6

Again, we beg to defer with the reviewer here based on our answer to the previous comment. We understand that non-satellite aerosol retrieval experts probably share the sentiments of the reviewer. However, we assure you that these details are indeed important and are the heart of this study for one important audience – the satellite aerosol research/retrieval community – especially Tables 2 – 5. Also, we did produce a figure representing the information in Table 4. Unfortunately, these data do not make a good figure due to the scarcity of data points. So, we decided to present this information only in the Table.

The figures must be improved regarding the axis information. Numbers and axis text are too small, must be significantly be enlarged.

Done.

Figs.3-6 present excellent results, by the way!

Thank you.

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In conclusion, the paper is certainly of high quality, the author list clearly indicates that high-level scientific work is presented. But the style of presentation does not 'suit my taste'. . ..

As mentioned in our reply above, we do understand the "does not 'suit my taste"' part and hence the review. However, we hope that our response will allow the reviewer to appreciate the fact that details in the paper are indeed vital for the aerosol remote sensing community and that presenting such details is a common practice in this community.

Reviewer 3

Dear Reviewer, Thank you for the detailed, valuable comments and suggestions on our paper. We have accommodated most of the suggestions and we think that it has helped us in improving the presentation of our paper. We hope that we have succeeded in answering your concerns.

Overview: The paper presents detailed analysis of MISR aerosol retrievals on 2 episodes over Mexico City during the MILAGRO field campaign, and compares the results with AERONET measurements, supplementary sun photometers and airborne AATS-14 and HSRL. Both strengths and weaknesses of the MISR aerosol retrievals are described with a focus on urban regions. This is valuable for future analysis of the MISR data

General Comments: It seems that one of the key aspects of the paper is the data in Table 4. I would find it valuable to have an additional figure showing the comparisons graphically.

Thank you for this suggestion. We did produce a figure representing the information in Table 4. Unfortunately, these data do not make a good figure due to the scarcity of data points. So, we decided to not add another figure, and present this information only in the Table. We note, more generally, that the lack of extensive, suborbital validation

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data, especially for particle microphysical properties, is a persistent problem regarding satellite aerosol retrieval validation.

There seems to be some overlap of sections 4.3, 5 and 6. I wonder if these could be rationalized / shortened, for example into “Specific Findings” and “General Findings”

Thank you for the suggestion. We have made major changes based on your suggestion. Findings related to MISR L2 Standard retrievals are left in section 4.3 and not discussed in the summary/conclusions section. Section 5 has been removed. The information in section 5 is now combined with section 6. Redundant information in sections 5 and 6 has been removed.

Specific Comments:

Pg 7932-20, 7945-11: For the non-specialist, could you clarify the regular mode and high resolution mode of MISR on pg 7932?

Done

Pg 7934-24: You mention that Redemann et al., 2008 and Livingston et al., 2008 analyze MODIS and OMI results respectively. It would be good to discuss how these findings compare with the MISR results. Maybe this section of the introduction can be shortened and/or replaced with an item in the discussion & conclusion section discussing the relevance of the papers.

We have removed this part of the discussion from the introduction and retained relevant information in Section 3.

Pg 7936-21: This section could be reduced to describe only the data used in this study (2 aircrafts?).

Done

Pg 7938-22: Please define the “Golden Days”

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Descriptions (1), (2) and (3) in this paragraph describe the “Golden Days”. I have edited the text in this paragraph for clarity.

Pg 7939-22, 7942-10: There is also a smaller scale meteorological analysis in: “Basin-scale wind transport during the MILAGRO field campaign and comparison to climatology using cluster analysis,” de Foy et al., ACP 2008. The discussion of the results could include the finer transport categories presented there (South Venting, O3-South), and also mention the climatological representativeness of these cases.

Thank you for the suggestion. We have incorporated it.

Pg 7942-21: Could the first part of this section on MISR retrievals be shorter? Also, could tables 2 and 3 be moved to supplementary material?

This is the heart of the MISR retrievals used in this study and is very relevant for anyone doing aerosol retrievals. We have tried hard to talk to the point in this section. And hence it is difficult to shorten it. So, we left it mostly as is. However, instead, in the data section, we have shortened the MISR-L2 product description.

Thank you for the suggestion.

Pg 7941-3: What are the results from these other publications that are relevant to the current study? Is MISR in agreement with all of them? Does the extra spatial coverage add some insight to the understanding of regional pollution? Eg. Both Crounse et al., 2009 and Querol et al., 2008 discuss the omnipresence of dust and the implications or studying aerosols in and around the MCMA. de Foy et al., 2011 has detailed HSRL transects for both March 6 and 15.

As appropriate, we reference the key suborbital measurement papers relevant to the MISR validation study performed here, including Crounse et al., deFoy et al., and Querol et al. The presence of at least 3 aerosol types i.e. smoke, dust and pollution is one big result that is relevant to the current study (e.g. Lines 260-262). MISR agrees with this result. This section only talks about what was present in the region in terms of

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aerosol types because that sets the stage for us to present the sensitivity study, which includes selecting aerosol particle models. What we are demonstrating in this study is that MISR can indeed qualitatively distinguish between small and medium/large particles in a complex urban setting. It can qualitatively tell whether one study day was dustier than the other or if smoke was more prevalent on one of the days or over one part of the region. Importantly, on a given day, it can provide the same information regarding the aerosol type spatial distribution. So, the insight that the study adds to existing literature is that MISR can be used to qualitatively differentiate days and regions with different aerosol air mass – and we have a global data record that is more than 13 years long. This has also been discussed in other papers related to MISR. However, the INTEX-B data and other relevant publications (as you mention here) provide validation of MISR retrieval capabilities (both strengths and weaknesses) and help establish its value in distinguishing aerosol air masses over the larger data record. Without this validation bank, this study would not be possible.

Pg 7946-23 + Fig. 5: How were regions I and II defined? How large are air masses A1-A4? (are they multiple MISR pixels?)

Regions I and II were defined based on visual distinction of the spherical vs. non-spherical aerosol type distribution seen in the Figure 5b maps. Air masses A1-A4 cover multiple MISR pixels. Based on visual reading, our best approximation of the air mass sizes are computed as follows: (1) By counting the number of MISR retrieval pixels that fall into each air mass and multiplying by the retrieval pixel size (825 m x 825 m). Air mass size by this method is:

A1 $\sim$ 75 km2 A2 $\sim$ 50 km2 A3 $\sim$ 35 km2 A4 $\sim$ 25 km2

We have included this information in Table 5.

Pg 7952-5: MCMA and surroundings has a lot of dust and very bright surfaces. Does this mean that the results of the paper are limited to this type of city? What can still be said about other types of urban regions?

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Urban regions are typically characterized by bright surfaces, vehicular and/or industrial pollution and construction, which is an integral part of urbanization. If anything, MCMA represents among the most difficult types of scenes over which to perform retrievals due to its complexity at small scales, and extensive bright surface regions. Burning of garbage, fossil fuel burning, and land-clearing practices in sub-urban regions of developing nations also subject many of the urban regions to smoke and other particle pollution. Considering that MISR can qualitatively distinguish aerosol air mass in this study based on two sizes (small vs. medium/large), two shapes (dust vs. non-dust) and two SSAs (absorbing vs. non-absorbing), it is safe to assume that the results from this paper will be applicable to most urban locations that have even the relatively challenging characteristics described above. In other words, MISR should be able to tell the difference between small absorbing aerosol particles (e.g smoke / pollution) and medium/large non-absorbing particles (e.g. dust), and which of these aerosol types dominates an air mass.

A map of the MCMA with station locations would be helpful.

Figure 1b,c and 2b,c show the MCMA with ground stations and relevant flight paths superposed. We did this to present consolidated information about what the study days looked like (in satellite images) and location of the stations with respect to the aerosol distribution. Since the MCMA map and stations are also provided in Molina et al's review paper, we chose to provide the information relevant to this paper concisely in Figures 1 and 2.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7931, 2013.