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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Identification of key aerosol populations through their size and composition resolved spectral scattering and absorption" *by* F. Costabile et al.

Anonymous Referee #3

Received and published: 27 November 2012

This manuscript by Costabile et al., "Identification of key aerosol populations through their size and composition resolved spectral scattering and absorption", analyzed absorption and scattering measurements and proposed a scheme to optically classify aerosols. This is an interesting approach, and in my mind, the manuscript could be published after a rather substantial revision to improve, strengthen and clarify several points that are suggested below.

General comments:

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The authors proposed a "paradigm" to classify the aerosols, but no reasoning was

given to support (theoretically) this particular choice, other than that it "revealed some relations" (block 17510, line 10, where it is discussed first time). Also, since similar classifications have been proposed before (with slightly different variables in y- and x-axis), it is important to discuss (to give theoretical justifications) those aspects of this scheme that gives now a more detailed picture about the dominating aerosol types, if compared to the previous methods.

It is absolutely necessary to show SAE467-660 (or EAE as suggested by the other reviewer) vs. AAE467-660 and vs. dSSA also separately; at least in the review response, but probably also in the revised manuscript. Those kind of relationships have been plotted before, so then the reader could better see and appreciate the novelty of your approach. These could be included in one three-panel plot, similar to the Figure 1 but with different x-axes: first showing AAE in x-axis (a-panel), then dSSA in x-axis (b-panel), and finally AAE*dSSA (your current Figure 1) in c-panel.

You have Cimel instrument in your site too. There are very little level2 inversion data, due to the AOD threshold: the single scattering albedo and absorption optical depth are considered having too high uncertainty below AOD of 0.4 at 440nm. Apparently you considered all the measurements, regardless of the aerosol loading. Do you consider there is a similar aerosol loading dependent uncertainty in your measurements (that could affect your analysis, although you have now ignored that)? Please discuss this issue also in the revised manuscript.

Since there are not much level2 AERONET data, I took level15 and applied all the same criteria than in level2 except for the AOD threshold (e.g. sky-error and sza limits) and plotted Rome data according to your paradigm. Clearly the strongest density of data are centered at SAE440-670 of around 1.7 and at AAE440-670*dSSA(670-440) of around -0.025, so best matching the region of AM in your plot. On the other hand, only very little data are in positive x-axis side, where you, on the other hand, have the majority. What do you think is the reason why your surface in-situ data are VERY different, in this regard, to Cimel measurements in the same site? The manuscript

would be strengthened, if you would discuss this also there.

Specific comments:

Block 17509, line 20. You mentioned having used Lidar data and meteorological variables in the data interpretation. How they were used?

Block 17512, lines 14-16. Please specify which reference was used for each type. For instance, please give the the reference explicitly for SM (imaginary part of 0.047, which sounds relatively high), so that the reader can go and find the source for this particular choice. And similarly for all the types. Perhaps this could be done by a citation in the Table 2 for each row.

Block 17513, line 3, "size-dependent m". Do you mean type-dependent here?

Block 17523, line 11, what do you mean by "STRICT agreement" (that the point number 8, for instance, is precisely where it "should be")?

Figure 5. How exactly did you locate the data from the previous studies into this figure? If I look at Dubovik et al 2002 and their Figure 1, for instance, I see that dSSA is negative for ALL the sites except for the sites in the "desert dust" category. So why is the number 6 (Mexico City) in the positive x-axis? Or data for ICARTT, which has also negative dSSA; why is it exactly at zero in x-axis? Just to give two examples.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 17503, 2012.