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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Seasonal variability of aerosol optical properties observed by means of an elastic-Raman lidar over Northeastern Spain" *by* M. Sicard et al.

Anonymous Referee #1

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In the spirit of stimulating the discussion, I post the following comments. I will post other comments, or correct some of the following, after another reading of the manuscript.

I refer in the following to the discussion paper page numbering, x-y) mean x-th page, y-th row from the top.

The major points are the following:

Section 3.1)

14061-15) I read "..comparing the probability density function (PDF) and annual cycle of the AOT retrieved from both the daytime lidar measurements and the daily sun-

photometer data". But, as far as I can understand from section 2.2, the lidar AOT has been determined varying the lidar ratio to match the sun photometer AOT. So, it seems fairly obvious that the comparison of both quantities and related function (probability density function, averaged annual cycle) is good.

After some thinking, I realised that, since the Cimel is an automated instrument, it is like that the number of photometer measurements is much larger than the number of lidar measurements. Thus, what is called "AOT lidar" is actually the subset of the photometer measurements when lidar measurements are available too. Figure 1 and 2 show that this subset has more or less the same characteristics of the larger set, so that we can conclude that the lidar measurements are representative of a larger sample. Maybe there is some statistical test to state this unambiguosly, but I must confess that statistics is not my preferred matter. I suggest to avoid terms that can be misleading, like "PDFs from both instruments" (14062-11), "agreement between both instruments" (14062-11, 14063-3, etc). This is not a comparison between instruments, but a comparison between datasets, and this should be stressed in the text.

Section 3.2)

What is the physical meaning of the daytime lidar ratio ? I understand that it is the lidar ratio that makes the lidar-derived AOT matching with the sun photometer AOT, at a certain wavelength. But it is not clear how this parameter is related to the "real" lidar ratio. Intuitively, I would expect that it should be a proxy to an average lidar ratio (defining properly the average), but this should be demostrated.

Ideally, this lidar ratio should be compared to the lidar ratio obtained from Raman measurements, but I know that it is difficoult to perform such measurements in daytime. Maybe, it could be interesting to compare this this lidar ratio with the corresponding quantity that could be derived from the sun-photometer single scattering albedo.

Section 3.3)

Could it make sense to compare the Raman derived lidar ratio PDF and cycle with the corresponding quantities at daytime? This could indirectly answer the previous question about the physical meaning of the daytime lidar ratio .

I find interesting that average profiles show a stratification. Similar measurements performed in other cities (ex. Leipzig, Thessaloniki, Lecce) show an exponential decay of the extinctin coefficient. This difference is probably due the particular Barcelona orography. This aspect should be emphasized in the text, and possibly explained, in the beginning of the section.

However there is an important technical point that should be discussed. We can see from figure 7a that, in winter, the backscattering coefficient decreases going from 0.59 km and 1 km, while the extinction coefficient correspondingly increases. The two measurements are however affected differently by possible sistematic errors. In principle, the backscattering measurement is independent of the overlap function of the system, while the extinction is dependent on the derivative of the logarithm of the overlap function. Even if this is almost 1, it could happen that the derivative could affect the value, decreasing the observed extinction. This effect should at least be estimated.

Furthermore I see some problems in the presentation of data. What was the criterium to consider data good? The scales of x - axis should be expanded to show also the negative part of the fluctuations. There are some strange height interval. What happens in fig. 7a) between 3.5 and 4 km ? It seems that for some reasons extinction cannot be defined.

In fig 7b), in the same height interval, I see a decrease of the error bars. I suppose that it could be related to changes in spatial resolution of the measurements, but this should be explained. I find also strange to find a backscattering close to zero around 3 km and an extinction significantly different from zero. Maybe it is just a problem of scale (backscattering reduces much more than the extinction), but this should be discussed.

An average lidar ratio 42+-99 (Fig. 7a) is meaningless. It could make sense to say that

the average is somewhere between 0 and 150, but negative lidar ratio should not be considered in the average. If they have not be considered but the estimated variation leads to negative values, I would say that the statistical hypothesis at the basis of the ML method is not verified. Maybe the simplest is to remove this point.

Minor points

14058-16) It is well known that, for analog signals, there could be a problem of time-variable background. Has this effect been taken into account?

14059-7) It is not clear wether the extinction is that derived from the Raman signal or from the elastic backscattering multiplied by the lidar ratio (or both)

14059-19) I know that Earlinet measurement are scheduled at 13:00 UT +- 1 hour, and at a first glance it seems that Barcelona is more or less at the same longitude than Greenwich, so I should say that 13:00 UT is not the same than 14:00 LST. Unfortunately I cannot find an official document stating what is the scheduled Earlinet day time, the authors should check.

14067-25)

" We believe that the increase of the PBL height in June and July is partially due to two factors: 1) the constant increase of incoming solar radiation between June and August"

To my knowledge, the solar radiation (I suppose it is meant the solar radiation flux) increases, in the northern emisphere, up to the summer solstice, then it decreases in July and August.

14067-27) " ..the main holiday exodus from the Barcelona area during July and especially August. The first point has two opposite effects: the growing of the convective PBL and the amplification of the Iberian thermal low which prevents the vertical development of the PBL. "

The growing of the convective PBL could be a reason of the observed increase of the

PBL height, but I suppose that it is due more to the increase of the turbulent flux at the surface, grossly proportional to the soil-air difference, than to the increase of the solar radiation.

I do not understand the second part: if the Iberian thermal low, which prevents the vertical development of the PBL is amplified, why the effect of this should be an higher average PBL ?

14068-1) "The second point induces a drastic decrease of the PM levels emitted at ground level (Pey et al., 2010) and thus a decrease of the number of aerosols to be mixed in the convective PBL. " OK, but what is the relation with the PBL height ?

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In conclusion, I think that some revisions are needed to make the presentation of the results more clear.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 14053, 2010.