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Atmospheric Measurement Techniques Discussions

Interactive comment on "Enhancement of aerosol characterization using synergy of lidar and sun – photometer coincident observations: the GARRLiC algorithm" *by* A. Lopatin et al.

Anonymous Referee #2

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General: This paper can be regarded as a milestone in the development of combined techniques based on active and passive remote sensing. The paper is very appropriate for AMT.

However the present version of the paper is not easy to read, the contents not easy to understand.

Minor revisions (but many points) are needed which will further improve the paper.

Details:

Abstract: is too long, too general, the first 10 lines of the abstract should be removed,

they are appropriate for the introduction, but not for the abstract. Abstract should contain briefly: goal of the paper, techniques and methods used, observational campaigns (if any), main findings (numbers).

Abstract, line 13: what do you explicitly mean with aerosol loading (calibration?, at reference height)?

Abstract, page 2255, line 6: do you mean .... just one or several AERONET sites?

Page 2255, line 13: .... Being common atmosphere pollutant aerosols also have... I do not understand ...

Page 2255, line 22: strange references... from 1996 and 2000, are there no better, actual ones, from 2005 or later?

Page 2256, line 1: South-Eastern SKYNET.... Is that in Asia? Please be more precise!

Page 2256, line 18: There are several aerosol closure field experiments, all better than the mentioned INDOEX (Ramanathan 2001), e.g., LACE 98 (special issue, JGR), TARFOX (special issue JGR), ACE 1, ACE 2 (Tellus special issue), ACE Asia (JGR), and SAMUM and AMMA related campaigns and aerosol closure studies

Page 2257, line 20: .... from entire data base.... What does that mean, please specify!

Page 2257, line 23-30: Concerning lidar ratio: start with Raman lidar (reference, Mueller et al., 2007, lidar ratio paper„ then HSRL (reference Burton et al., ACP/AMT 2012, Gross et al., ACP/AMT 2012/13) and then lidar column backscatter /AERONET AOT combination (authors may know best appropriate reference here).... Leave out scanning techniques or slope method, nobody is using that!

Page 2258, line 1: Please check HSRL observations and aerosol typing (Burton et al., 2012, Gross et al., 2012 or 2013?, ACP? or AMT?). Should be added.

Page 2258, line 6: ..rather complex?... appears to be no longer true, see Althausen et al. (JAOTech, Polly) or Baars (JGR, 2012, Amazonian Raman lidar observations).

Page 2258, line 29: . . .aerosol vertical mixing. . .? Please specify what you mean here!

All in all: Introduction is very long, could be shorter, more focussing on the goal itself. . ., readers always like to see short and fresh introductions, to present a general intro is always abit boring.

Page 2260, line 10-18: again, very general, and only insiders understand what is stated. . .

Page 2263, line 17: Is the usage of climatological data (temperature and pressure profiles to compute Rayleigh scattering) sufficient? I would expect that you need actual weather prediction model data (forecast data) or actual radiosonde obs. of temperature and pressure profiles. For an accurate consideration of 355 nm Rayleigh scattering and backscattering. . .

Page 2264, line 6: You describe the previous version of the forward model, but what are the differences to the operational version which is applied for GARRLIC? Could you please provide more details. In this way the differences between LIRIC and GARRLIC become more clear. Does GARRLIC make direct use of sky radiances, i.e., basic sun photometer (raw) data?

There seems to be no difference between LIRIC and GARRLIC regarding lidar data input (just elastic backscatter signals at three wavelengths)?

General remark; Why not presenting a table with all input (which lidar signals, which atmospheric and aerosol assumptions, which are height dependent, which are height-independent, aerosol-mode-dependent, aerosol-mode-independent, and finally with all the products retrieved), one table column for LIRIC and one column for GARRLIC. In this way a very clear contrast between LIRIC and GARRLIC becomes visible. Many people will work with LIRIC (or GARRLIC) later on, and will appreciate such an overview table.

Page 2265, line 11: Cattrall et al. is mentioned. What did Schuster et al. (2012)

commented in this direction. He stated some contradicting remarks concerning the Cattrall approach. Any comment here?

Page 2265, line 12: Is that also in agreement with Mueller et al. (2010a,b, 2012, JGR), SAMUM observations? I do not know any publication where it was demonstrated how well this spheroidal approach works in the case of lidar (180 deg scattering angle). So at least this issue must be handled with caution.

Page 2265, line14: Toledano et al. show nice cases of dust and smoke (SAMUM, Tellus 2011)

Page 2268, line 1: what does . . .. normal distribution . . .. mean here?

Page 2268, first paragraph as a whole: sounds like: from tail to head. . .! . . .. not necessary! . . ..for what? I was thinking this was just what you want and need: vertical profile information from lidar in AERONET retrieval!

Page 2268, line 14: strange form of writing. . ., better: for h > h-max and h < h-min .

Page 2269, line 6: you mean power of received signal. . .. and not power of the laser pulse

Page 2269: Eq.(13) is in contradiction with Eq.(12). If no aerosol particles are present above h-ref in Eq.(13), then c(h) for h>h-ref in Eq.(12) should be zero, an exponential decrease of c(h) above h-max does not make sense. Or is h-ref different from h-max?

Page 2270/71: please check Eqs.(15)-(18), link between W, epsilon, and C in these formulars something seems to be wrong after all the substitutions to get Eq.(18).

Page 2269, Eq.(18): what is s-p?

Page 2271, lines 20-22: instead of i=1,2,3, shouldn't it be k=1,2,3..?

Page 2272, line 20: What does that mean: A is the accumulation of the signal ?

Page 2272, Eq. 20: ν instead of ω ?

Page 2275, section 5.1, first paragraph: How is sphericity and non-sphericity explicetly considered here

Page 2275, line 3: Two realistic scenarios. . ..? Which one, how are they defined. . ., simulated. . .

Page 2278, line 15: Ok this example is well defined and easy to understand, but in all other cases of mixtures, I am unable to get a good idea about all the numbers in the figures describing the mixtures, they are to my opinion not consistent.

Page 2278, lines 24-28: I am not able to find out, when Re/Im is constant, when the ratio varies? Or with other words: Figure 9: besides size distribution information is missing, what is the fixed IM value in the left plot, what is the RE value in right plot?

Page 2279, lines 3-6: If the solution is ok (without error), why should there be a sensitivity of the aerosol contribution to the wavelength?

Page 2280, line 13: lidar ratio as function fine or coarse mode, what about lidar ratio as function of spherical/non-spherical, as in Figure 9? Figure 10 shows strange spectral dependencies, or?

Page 2281, line 3-4: How do you handle C-sph/C-nonsph? . . .. remains unclear. . .

Page 2282, line 26: generally in the middle between. . . this is not the case in Figure 14, lower left plot.

Page 2283, line 12: where are these unnatural lidar ratios. . .? Please be specific. I found the lidar ratios in Fig. 10 even more unnatural.

Page 2283, lines26-28: Typical lidar ratios (found in Dubovik et al., 2002a, Cattrall et al., 2005) . Are such AERONET-based lidar ratios trustworthy? Better check the literature for Raman lidar observations, may be check Mueller et al. (JGR, 2007), Tesche et al. (Tellus 2009, 2011), Gross et al. (Tellus 2011), and and may Schuster et al. (AERONET, ACP/AMT 2012), and many EARLINET observations done by Mona et

al., deTomasi et al., Amiridis et al., Papayannis et al., etc.

Page 2284, line 5: Is the lidar ratio height independent in the GARRLIC retrieval?

Page 2284, second paragraph: What about an impact of used climatological profiles of temp and pressure (via Rayleigh computations)? The largest uncertainty then is in the blue lidar signals. . ., the lowest in the red signals, spectral slope changes, retrieved size distribution changes. . .

Figure 15. Dates are mixed or plots mixed?

Figure 16: 30sr and lower, quite low values. . .!

Figure 19: smoke lidar ratios are strange, 80 to 90 sr at 355-532nm, and then 35 for 1064nm,. . ., dust lidar ratrios 30sr(1064nm), 35sr (532nm), 40-45sr (355nm) quite low. . ..!

Figure 22: Does it make sense to keep Rayleigh included?

General impression: I do not see, based on the results presented here , that GARRLIC is better than LIRIC, please comment on that!

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 2253, 2013.