Atmos. Meas. Tech. Discuss., 3, C345–C349, 2010
www.atmos-meas-tech-discuss.net/3/C345/2010/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Synergy between CALIOP and MODIS instruments for aerosol monitoring: application to the Po Valley" *by* P. Royer et al.

Anonymous Referee #3

Received and published: 6 May 2010

General

The paper presents original material. A CALIPSO/MODIS method already applied to the Saharan air layer over the tropical Atlantic Ocean (Liu et al., JGR, 2008, CALIPSO-MODIS synergy) is now applied to the highly polluted Po Valley in northern Italy. So, the method used is not new, but now applied over land. The goal of the paper remains a bit unclear. The goal (as stated) is to present the results of a multiannual study of Po Valley aerosol conditions . . .involving a synergy between MODIS and CALIPSO spaceborne instruments. . .... Most of the paper is dealing with the retrieval method itself.

The retrieval of lidar ratios (1/BER) is one of the main points of the paper. The authors should switch to LIDAR RATIO (extinction-to-backsatter ratio), a well-established quantity, that is used by 98% of the aerosol lidar specialists around the world (including the CALIPSO science team). BER (backscatter-to-extinction ratio) was introduced to quantify the 180deg scattering phase function in cirrus (Eloranta in the 1980ies). But the aerosol can be highly absorbing so that BER parameter no longer describes the scattering properties alone, and thus the authors should use the main street notation (lidar ratio).

Details

Page 1324, line 13: avoid the word: homemade, scientific work is always more or less homemade.

Page 1324, line18: the lidar ratio is NOT a product of the CALIPSO measurements, it is just a look-up-table value!

Page 1325, line 5, megalopolis, better use . . . megacities . . .

Page 1325, line 20 to page 1326, line 6: many French references, no other work to be mentioned (e.g., Liu et al. JGR, 2008, and may be references in that paper)? All the references in the manuscript here are dealing with the synergy of a standard backscatter lidar with satellite remote sensing or Sun photometer. But there are probably better alternatives? Raman lidars/HSRL combined with passive remote sensing! When inhomogeneous layering (may be boundary layer haze and lofted Saharan plume on top) is present, the synergy of standard backscatter lidar and passive remote sensing may be poor. At the moment, the introduction gives the impression that the synergy of simple backscatter lidar with passive remote sensing is the optimum.

Page 1327, line 21, . . .level-2 data. . . there is a new releases of level-2 data a few weeks ago?

Page 1327, line 24, as mentioned, switch to lidar ratio, please, ...throughout the paper.

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Page 1330, line 23, give the explicite reference, on which your algorithm is based, Klett (1981) is not appropriate, holds for particles (no Rayleigh) only.

Page 1330, line 25, . . . from CALIPSO/MODIS you retrieve a height independent lidar ratio only, but the lidar ratio can be highly variable so that the column value poorly reflects the reality.

Page 1331, line 8, please explain tau-MO already here..

Page 1333, line 17, results based on nightime CALIPSO and daytime MODIS data (>9 h time difference) should be generally removed. They are at all not trustworthy.

Page 1336, line 4, What does it mean: . . . does not converge. . .. Does it mean that the solutions become instable? Klett forward retrieval problem?

Page 1336, line 14, . . . the vertical profile of the lidar ratio (CALIOP). . . is taken from look-up tables. Such values cannot be interpreted as products (they are input to obtain the other products).

Page 1336, line 21, Again: Please avoid the impression that CALIPSO measures the lidar ratio. This standard lidar CALIOP may measure color ratios, depolarization ratio, and so on, . . . to come up with the most appropriate look-up-table lidar ratio value for the analyzed scene, but it is by far not a lidar ratio measurement. That must be clearly said!

In this context, I miss comparisons with real-world lidar ratios from Raman lidars (see Muller et al., JGR, 2007?, aerosol type dependent lidar ratio from Raman lidar) and other EARLINET lidar ratio observations. There must be a lot.

Page 1337, line 14, avoid . . ..homemade. . ., shorten the lengthy discussion, omit data of combined daytime MODIS and nighttime CALIPSO observations, one should however more frequently mention how sensitive the CALIPSO approach (Klett method, forward mode) is to small errors in the applied lidar ratios so that backscatter uncertainties are in general not just low.

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Page 1338, line 27, the only pure-dust lidar ratios were obviously measured during this SAMUM campaign. . .please check the special issue in Tellus (2009?). All the EARLINET results on dust lidar ratios (at least at lower heights, <4 km) may be influenced by marine particles (lidar ratio of 25sr) or urban haze (mixing with pollution at the northern African coast). Cantrall et al. used photometer observations (photometers do not measure 180 backscatter) and estimated the lidar ratio from phase function extrapolation to 180 deg.(based on some assumptions on particle shape that may introduce large errors).

Page 1339, line 21, Again: Because the Klett forward integration method must be used in the case of CALIOP this may introduce large errors in the profile, when not constraint to some AOD observations. This aspect is the main goal when combining MODIS and CALIPSO observations.

Page 1340, line 10, this paper fulfils the validation requirements of CALIOP operational algorithm over a polluted area. I do not understand what you mean? May be skip this sentence.

One should state that the whole approach is ok (provides satisfying agreement and products) when most of the aerosol is in the polluted boundary layer. The method may not be that good and, at least to some extent, questionable in the case of an optically thick Saharan dust layer over the polluted Po valley haze so that the lidar ratio is highly variable.

Figure 8, in general, the lidar ratios are, to my opinion, too high (BER values are too low, BER values varying around 0.012 means lidar ratios varying around 85!), is that a special thing of Po Valley? Or just a bias introcued by your retrieval . . .. There are some European Raman lidar observations of the lidar ratio available in northern/central Europe and southern Europe (e.g., Greece,. . .should be comparable to Po Valley. . ., Amiridis et al, ACP, JGR). Please check.

Figure 9, the plot B. . ., the discrepancies can easily be caused by the Klett forward

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approach. . .. Did you check nearby AERONET data (AOD values). Who is right?

All in all, the paper is a nice application of state-of-the-art satellite observations. This is the first time that the approach is applied to observations over land (may be that should be stressed clearly, contrast to Liu et al. 2008). Po Valley is an interesting, heavily polluted area. But more links to the real world (Raman lidar observations) will improve the paper.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1323, 2010.