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Interactive comment on "Profiling of fine- and coarse-mode particles with LIRIC (LIdar/Radiometer Inversion Code)" *by* M. R. Perrone et al.

M. R. Perrone et al.

perrone@le.infn.it

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Dear Referee #2, many thanks for your comments which have allowed improving the paper. Answers and/or notes to your comments are reported below. A marked copy of the paper where all changes are highlighted has also been posted as supplement.

General comments

Considering the specifics and the number of analysed cases, some of the conclusions concerning the accuracy of the aerosol model used in LiRIC sound too general.

The LIRIC tool assumes that the fine and coarse mode radii are height independent

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We would like to mention that the main goal of the paper was to investigate the impact on LIRIC results of the LIRIC constrain that the fine and coarse mode radii are height independent. To this end, 3 properly selected study cases have been analyzed and LIRIC results have been compared with the corresponding ones retrieved from the CII procedure-graphical framework scheme. It was beyond the paper objectives the accuracy test of the aerosol model used in LIRIC, which could be afforded in a separate paper.

Specific comments

I have to point out that, what concerns the site and the cases selected for study, at least two of them demonstrate a presence of rather well-mixed aerosols, which places LiRIC in an unfavourable condition for retrievals.

In accordance with the paper main objective outlined above, we have used two case studies which put LIRIC in unfavorable conditions, and a case study to show that both LIRIC and the CII-graphical framework scheme can provide results in satisfactory accordance when the aerosol properties are weakly dependent on altitude.

Also, LiRIC results are highly dependable on the estimations of aerosol columnar properties provided by AERONET inversion, you should mention level of the data you've used (1.5. or 2.0) and the aerosol optical thickness, measured by the sun-photometer for that case, as it is directly defines the accuracy of such estimations (see more details in Dubovik, O., Smirnov, A., Holben, B. N., King, M., Kaufman, Y. J., Eck, T. F., and Slutsker, I.: Accuracy assesments of aerosol optical properties retrieved from Aerosol Robotik Network (AERONET) sun and sky radiance measurements, Journal of Geophysical Research, 105, 9791–9806, 2000.)

We are aware of the paper by Dubovik et al., 2000. However, the sensitivity analysis of LIRIC results with respect to the user-defined parameters is beyond the scope of this work. It will be included in future works. We have used level 2 AERONET data when they were available, otherwise we have used level 1.5 data.

Technical comments

p. 8886, line 23: "two aerosol modes" instead of "two aerosol mode"

Done

p. 8887, line 5: "LIRIC searches for particle lidar profiles that best match the AERONET-derived column volume concentrations. . ." In the first place, as I understand, LIRIC searches the profiles that best match the multi-wavelength lidar measurements and the columnar concentration is used as an additional constraint.

The above sentence has been replaced with the following one:

"LIRIC searches the concentration profiles that best match the multi wavelength lidar measurements. It is also required that the integral of the retrieved concentrations matches the AERONET-derived column volume concentrations. . ."

p. 8888, line 10–11. "However, we believe that the indicated one to go too well." There is clearly some error in this sentence, please rephrase it to make It understandable.

The sentence has been replaced with the following one:

"However, we believe that the used procedure can be considered as satisfactory."

Figures 2, 4, 6, 7, 12, 10, 14: Consider making proper legends for these plots. If there are 6 different lines, so the legend, to my taste, should describe all of them. That makes a comparison at a glance much easier.

Figure captions have been changed in the revised manuscript. The new legends are reported below:

Fig.2. (a) Vertical profiles of the fine (black) and coarse (violet) particle volume concentrations with corresponding uncertainties retrieved from LIRIC by using lidar measurements performed on August 29, 2011 from 13:56 to 14:27 UTC. (b) Vertical profiles of extinction coefficients at 355, 532, and 1064 nm from LIRIC (dotted lines) and the

CII procedure (solid lines). (c) Lidar ratio vertical profiles at 355, 532, and 1064 nm from LIRIC (dotted lines) and the CII procedure (solid lines). (d) Vertical profiles of the fine mode fractions at 355, 532, and 1064 nm from LIRIC. Error bars represent $\pm$ 1 standard deviation (SD) of mean values.

Fig. 4 Vertical profiles of (a) Å(532, 1064, z) and Å(355, 532, z) by green and blue lines, respectively, and of (b) Å(355, 1064, z) (black lines) and the spectral difference (red lines) from LIRIC (dotted lines) and the CII procedure (solid lines), with corresponding SDs of mean values (error bars).

Fig. 5 Graphical framework calculated for n = 1.455 and k = 0.0047 at 532 nm. Solid lines represent the ïĄÍGF values at 532 nm equal to 1, 10, 30, 50, 70, 90, and 99%. Dashed lines represent the $R_{f,GF}$ values equal to 0.02, 0.05, 0.1, 0.15, 0.20, 0.30, and 0.40 μm. Open triangles provide ΔÅL(z) versus ÅL(355, 1064, z) mean values with corresponding SDs retrieved from LIRIC by using the lidar measurements performed on August 29, 2011 from 13:56 to 14:27 UTC. Full dots represent ΔÅ(z) versus Å(355, 1064, z) mean values obtained from the CII-procedure. Error bars represent SDs of mean values. Different colors are used to represent spectral difference and Ångstrom values referring to different altitudes z, as indicated by the color bar on the right of the figure.

Fig. 6 (a) Vertical profiles of the fine (black) and coarse (violet) particle volume concentrations with corresponding uncertainties retrieved from LIRIC by using lidar measurements performed on September 12, 2011 from 14:06 to 14:36 UTC. (b) Vertical profiles of the extinction coefficients at 355, 532, and 1064 nm from LIRIC (dotted lines) and the CII procedure (solid lines). (c) Lidar ratio vertical profiles at 355, 532, and 1064 nm from LIRIC (dotted lines) and the CII procedure (solid lines). (d) Vertical profiles of the fine mode fractions at 355, 532, and 1064 nm from LIRIC. Error bars represent $\pm$ 1 SD of mean values.

Fig. 7 Vertical profiles of (a) Å(532, 1064, z) and Å(355, 532, z) by green and blue

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lines, respectively, and of (b) Å(355, 1064, z) (black lines) and $\triangle$Å(z) (red lines) from LIRIC (dotted lines) and the CII procedure (solid lines) with corresponding SDs of mean values (error bars).

Fig. 10 Vertical profile of the linear particle depolarization ratio (black line) with corresponding uncertainties (error bars) retrieved from lidar measurements performed on August 6, 2012 from 14:57 to 15:21 UTC, and of the dust mass concentration (red line) simulated by the BSC-DREAM at 12:00 UTC of August 6, 2012.

Fig. 12 (a) Vertical profiles of the fine (black dotted line) and coarse (violet dotted line) particle volume concentrations with corresponding uncertainties retrieved from LIRIC by using lidar measurements performed on August 6, 2012 from 14:57 to 15:21 UTC. (b) Vertical profiles of the extinction coefficients at 355, 532, and 1064 nm from LIRIC (dotted lines) and the CII procedure (solid lines). (c) Lidar ratio vertical profiles at 355, 532, and 1064 nm from LIRIC (dotted lines) and the CII procedure (solid lines). (d) Vertical profiles of the fine mode fractions at 355, 532, and 1064 nm from LIRIC. Error bars represent $\pm$ 1 SD of mean values.

Fig. 14 Vertical profiles of (a) Å(532, 1064, z) and Å(355, 532, z) by green and blue lines, respectively, and of (b) Å(355, 1064, z) (black lines) and $\triangle$Å(z) (red lines) from LIRIC (dotted lines) and the CII procedure (solid lines), with corresponding SDs of mean values (error bars).

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/7/C3103/2014/amtd-7-C3103-2014-supplement.pdf

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