Atmos. Meas. Tech. Discuss., 7, C133–C137, 2014
www.atmos-meas-tech-discuss.net/7/C133/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol microphysical retrievals from Precision Filter Radiometer direct solar radiation measurements and comparison with AERONET" *by* S. Kazadzis et al.

Anonymous Referee #3

Received and published: 8 March 2014

The authors present results of measurements with a precision filter radiometer and compare their results to collocated measurements carried out with an AERONET (CIMEL) sun photometer. The purpose of the study is to show that the measurements of the precision filter radiometer, which is used by the GAW aerosol network, can be used to extend the data available from AERONET sun photometers. The authors show aerosol optical depth and Angstrom exponents. Results for effective radius and volume concentration are derived with the linear estimation inversion technique (LE method) which has been published before by one of the coauthors of this publication. The authors derive effective radius and volume concentration from data taken with the filter

radiometer and the AEROENT sun photometers. They compare their results to the results that are obtained from AERONET data using the standard AERONET inversion algorithm. The advantage of the LE method is that is does not require almucantar measurements in order to derive some key aerosol properties (size and volume concentration)

The paper is acceptable if some mandatory changes are made. The idea of extending the available set of sun photometer data by data from the GAW filter radiometers certainly is of value. Still I miss a more in-depth rationale why using additional data would be useful. Are these stations closing gaps in the dense network of AERONET stations? Do these filter radiometers provide data that are not available from AERONET? Do these radiometers from GAW in any other way supplement the AERONET data? The fact the LE method is applied to the GAW-PFR data is an insufficient justification to publish this paper, as the LE method has already been presented before, and the authors do not go into any depth to explain the contradictions they find in the results presented in their study. For the most part their text reads more like a summary. I miss the critical scientific evaluation of their findings and how they intend to resolve the contradictions they identified in their study.

The authors provide a comparison of results of the LE method applied to filter radiometer data and AERONET CIMEL data. Even though the same algorithm is used, there are differences, and I do not understand the reasons that cause these differences. Could one reason be the fact that the authors only use a few measurement cases for their study? I am missing a more detailed discussion of possible reasons. The authors provide an error analysis on the basis of synthetic data. The range of input parameters (two size distributions only?) is clearly insufficient for a robust, statistically significant error analysis. The error analysis presented in section 3.3 reads as if it was only added because there was no choice to avoid the topic of error analysis. The section is short, does not cover the real problems one is facing in error analysis, does not treat a sufficiently large number of aerosol scenarios that would allow the reader judge the quality

of the results of the experimental data. Using just one refractive index in the error analysis is clearly insufficient, particularly in view of the complex aerosol cases presented in this paper. Figure 6 clearly shows the retrieval errors that occur at high solar zenith angles. I may have missed or not fully understood that section of the paper in which they authors point out to this effect and discuss in how far their evaluation of the usefulness of the LE method is biased by the fact that retrieval results need very careful correction of data taken at high solar-zenith angles. Why do the results for AERONET-LE differ so much to the PFR-LE results? It is the same method and the measurement time was nearly the same. Is it because different measurement wavelengths were used? I am also puzzled by the underestimation of the volume concentration from the LE method compared to the volume concentration that is obtained with the standard AERONET algorithm, see figure 8. Again: I may have missed the main point in the paper that explains it. Could the difference be because the AERONET standard algorithm provides particle size distributions that separate fine and coarse mode fractions? Does the LE algorithm do the same or does it only provide an "average" size distribution, i.e. it does not separate into fine and coarse mode? In that case I would almost naturally expect differences as the averaging (mean particle size distributions without distinguishing between coarse and fine mode) may create a bias. Given the fact that there are systematic difference between results from the LE method and the standard AERONET retrievals I am missing a more detailed description of the filter radiometer technical features. Which wavelengths are used, what is the field of view of the instruments, which instruments parameters could be reasonable for the differences? The results of figure 10 concern me: minimum errors for the coarse mode size distribute are at least 30 -50%. Could these errors be the result of the limited "inversion range" which seems to be lower than the 15 micrometer that is usually used by AERONET standard retrieval? Please comment on this and provide an explanation. Figure 11 is not needed. It would be more useful to show a map of the Athens area in which the location of the instruments is shown. This might help to understand a bit better why there are differences of the results from the two methods (LE and AERONET algorithm).

Detailed comments:

The abstract is too detailed. Please mention the main points and the implications of this study. Details can be given in the main text.

I am missing a summary of the specific features of the LE method, how it compares to the standard AERONET algorithm and what work has been done before. It is hard to judge how many "new findings" are presented in this paper, except for the fact that the data from the GAW radiometers can be included into existing AERONET data.

Fig 1: please merge figures 1a and 1b into one figure. This would make it much easier to see the correlation between changes of AOT and changes of Angstrom exponents. Please also show the AERONET and Angstrom exponents from AERONET in a separate plot.

I find figure 2 confusing, it does not tell me a lot expect that there was a strong pollution event around 18/19 July. The logarithmic scale for radius does not really help to understand the time series.

Figure 4, a: is it an instrument problem that causes the significant differences of AOT measured with CIMEL and the PFR at low AOD at 500 nm? It does not become clear in the text in how far this bias causes the problems for effective radius and volume concentration.

Figure 5: please show several representative error bars for the PFR-LE, AERONET-LE and Angstrom.

The reference list needs considerable extension with references that deal with AERONET measurements, quality assurance tests, validation studies. There have been no comparisons of AERONET results to airborne in-situ measurements or studies that compare lidar retrievals to AERONET data? AERONET presents the current standard in terms of aerosol data products, so there should be at least a summary of the current studies regarding quality assurance of AERONET data. To my knowledge

there are not many studies that compare AERONET results to results from other instruments, so the literature search should be quite straightforward. The results from this search would be the starting point to judge the quality of the GAW-PFR results. Publications that show the current status of the GAW filter radiometers in terms of previous measurements and main outcomes should be presented as well. At the moment most of the literature is quite general and does not help understanding the main results of this study.

The reference Hansen and Travis 1974 is very old. Are the findings presented there still valid in view of the enormous progress that has been in the past 30 years of aerosol research with radiometers?

Page 104, line 21: course » coarse

Page 104, line 26: excludedfrom » excluded from

Page 105, line 1: utily???

Page 105, line 21: quantify the “residual”

Page 108, line 17: resultsfrom » results from

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 99, 2014.