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Atmospheric Measurement Techniques Discussions

Interactive comment on "LOAC: a small aerosol optical counter/sizer for ground-based and balloon measurements of the size distribution and nature of atmospheric particles – Part 1: Principle of measurements and instrument evaluation" *by* J.-B. Renard et al.

Anonymous Referee #1

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The manuscript "LOAC: a small aerosol optical counter/sizer for groundÂ■based and balloon measurements of the size distribution and nature of atmospheric particles – Part 1: Principle of measurements and instrument evaluation" by Renard et al. presents a new optical particle spectrometer. The instrument is light enough to be deployed on a weather balloon and is next to its capability of sizing particles able to give a rough idea about the chemical composition. The general lack of light weight

particle sizers renders the topic of the manuscript very interesting to a broad audience. However, I can not recommend the manuscript for publication for the following reason. As the title states, the main purpose of the manuscript is to explain the principle of the measurement and to evaluate the instrument. The explanation of the principle is vague and contains errors. In order to evaluate the instrument the authors present a vast amount of atmospheric measurement with aerosol conditions which can not be considered well constrained. From the perspective of the reader it is almost impossible to get an idea of the capabilities and limitation of the instrument.

Detailed comments:

1) The authors use the index of refraction to explain the concept of the speciation. In the following text they use the vague phrase "nature of the particles" as if there is more to it then the index of refraction. What is it and what is its expected effect on the instruments functionality?

2) To better explain the concept of speciation the authors should consider plotting mie curves for the two angles as a function of refractive index.

3) Figure 2: a Particle with a size of 300 nm would result in a peak 3 orders of magnitude smaller than a particle with a diameter of 5000 nm. The 5000 nm particle in figure 2 has a amplitude of 80 which means a 300 nm particle would give rise to a peak with an amplitude of 0.08 which is well below the noise level in figure 2. With such signal to noise ratio the smallest detectable particles would have a diameter of $\sim$ 700 nm.

4) Page 1210 line 5 and Figure 2: The authors never mention which of the two detectors this data is recorded with.

5) Page 1211 line 1: "Fortunately, real atmospheric particles are not perfect spheres and will not produce Mie oscillations." This sentence is misleading and wrong.

6) The mie calculation in figure 3 is incorrect. It looks to me as if the theoretical data is not actually plotted in log scale along the y axes. In a loglog plot the slope should be

$\sim$6 for diameters smaller than the laser wavelength.

7) I do not understand the author's argumentation of the origin of the upper count limits (page 1213). The width of a detected peak is, unless the size of the laser focus is diffraction limited, dominated by the dimensions of the laser. This means the actual duration of a scattering event and therefore the width of a peak is the same for all particle sizes and so is the probability for coincidences. My suspicion is that the instrument needs coincidences in case of small particles in order to get the scattering intensities above the detection threshold.

8) To get a better picture of the accuracy and precision of the instrument the authors should show a figure of the size distributions when sampling the calibration material,e.g. PSL at 200 nm, 400 nm and 800 nm and some for the calibration material produces with the sieves.

9)The authors estimate an uncertainty in the count rate of small diameter particles of 15 % purely on the statistical deviation between different instruments and state that LOAC has no systematic bias. However, when looking at the comparison between different instruments there are strong deviation which can not be explained. In particular in the 200Â■300 nm regime I see no correlation to other instruments.

10)Some technical details which would be useful for the reader: a) Instrument dimensions b) Do you need some additional computer to run the instrument or is all the peak analysis, data storage, etc. done on the board visible in fig. 1 c) Does the instrument capable of transmitting its data? d) what is the diameter of the sample stream? e) how does the instrument adjust to pressure changes without affecting the flowrate? f) Is there a sheath flow? g) how does the instrument manage to measure light intensities over so many orders of magnitude? (the scattering intensity ratio between 200 nm and 100 um diameter particles is theoretically $\sim$ 6 orders of magnitude.)

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 1203, 2015.