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Atmospheric Measurement Techniques Discussions

AMTD

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Interactive Comment

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 2: First results from balloon and unmanned aerial vehicle flights" *by* J.-B. Renard et al.

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Reviewer 1 An important part of the paper deals with measurements using a floating or drifting balloon. The instrument used draws air into a sensitive volume using a mechanical pump. This pump is producing aerosol particles as every pump is doing that by wear and abrasion. The wind velocity in the environment of a drifting balloon is zero. So the pump under the balloon is creating its own "pollution" aerosol cloud. The

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Interactive Discussion

Discussion Paper

paper is not discussing, how such a cloud is influencing the measurements, the particle size distribution. The cloud of the balloon certainly is not reflecting the undisturbed atmospheric aerosol at that altitude. The paper should address this question and/or discuss, how the pollution by the pump is avoided or controlled. Indeed, this comment concerns drifting balloons (the other kinds of balloons are in motion in respect with the air masses). In all cases, the aerosols were rejected inside the gondola, to prevent the creation of a pollution cloud around the balloon. Also, we have performed flights under drifting and meteo balloons having a very good time and spatial coincidence. Both measurements (at the same altitude) are in very good agreement, confirming that no pollution cloud was around the drifting balloon.

Reviewer 2 General Comments: This paper presents the applications of the developed LOAC under different platforms (UAV and a variety of scientific balloons) for the measurements and characterization of particle size distributions, which is within the scope of AMT. The measurements of the vertical profile of particle size, concentrations and speciation of atmospheric aerosols are very important. However, the accuracy and the significance of the reported LOAC depending on the critical assessment of the instrument performance presented in the companion paper (part 1). In this paper (part 2), there are too many figures. A lot of figures are very much the same. For the demonstration of the ability of the application of LOAC, one or two flights described in detail is enough, except there are new findings. The discussions of the experiment results or data processing methods are not enough, which made the paper a little weak in the sense of scientific research. Further improvement is still needed.

Most of the reviewer's comments can be answered by the part 1 of the paper. The data processing methods are described in the paper 1. We disagree with the reviewer. All the figures show measurements in different geophysical conditions (including the nature of aerosols) from different aerial vehicles. Also, we present original results. To our knowledge, it is the first time that measurements under tethered balloon have been conducted in urban air, to distinguish the different natures of particles, as well as measurements from drifting balloons. For each case, at least one paragraph is dedicated to the analysis of the results.

Specific Comments:

1, The "Introduction" Section would benefit from more discussion of the scientific background and the recent progress in the vertical profile measurement of aerosol size distribution ? What is the motivation of the development and application of LOAC ? What about the advantages and disadvantages of LOAC compared with other instruments ?

This is already done in the part one of the paper. Is it necessary to do it again here ?

2, Line 113, is there any consideration of the sampling loss of the LOAC ?

We think that the reviewer speaks about the detection efficiency (we don't speak of sampling loss in line 113). This is discussed in the paper 1.

3, Line 135, what is the value of the pressure inside the cavity ? The pumping system works in extreme condition as at ground, however, the atmospheric pressure is different up to an altitude of 34 km. Is there any correction for the pressure change of the LOAC ? The stability of the pumping system was about $\pm$5%, what are the corresponding errors of particle number and concentration measurement ?

The cavity, or optical chamber, is open, thus the pressure is the same as outside. We will add this comment in the manuscript. No correction is necessary for the pressure changes (the rotation speed of the pump is constant whatever the pressure). The uncertainty in the pump stability adds uncertainties in the measurements, as explained in the paper 1.

4, Line 146, a large number of LOAC flights under different kinds of platform, but no intercomparison of the vertical profiles with other commercial or well developed instruments is shown. How to make sure that the measurement result is correct ?

LOAC was designed to work also under low temperature and low pressure. But we are not sure that the other commercial instrument can work under such conditions. Also, most of them cannot be mounted on-board balloon gondolas (weight, electricity consumption, flight security). Thus it is not possible to conduct direct cross-comparisons. We can convert LOAC measurements to extinction, using Mie scattering (which is not really representative of the optical properties of irregular particles . . .) and compare them to satellite data. The values we have obtained are in general agreement with average values in the upper troposphere and lower /middle stratosphere available in the literature. We will add this result in the revised version of the manuscript.

5, Line 186, the data processing method used for speciation analysis is missed, which is very important for the data quality assessment.

This is done in paper 1.

6, Line 277, the daytime average aerosol optical depth at 550 nm is shown in Fig. 12. More discussions or explanations are needed here ?

This is averaged optical depth satellite data from day-time measurements (observations cannot be conducted at night). We will add this in the revised version.

7, Line 343, the Section "4 Discussion" would benefit from more considerations of Paper following questions : (1) The influence of the atmospheric pressure and RH ? (2) The validation of the ground calibration for high altitude platforms ? (3) Data quality control. 8, Line 586, Fig. 3, a three dimension figure or image graphs will be helpful to the understanding of the results.

(1) During our tests, we have not detected any effect of pressure on the LOAC working. On the other hand, there is a risk of condensation or ice in case of low temperatures and pressure. Ice on the optical chamber would produce strong stray light contamination, and the data would be rejected. But because humidity is low in the tropopause region and in the stratosphere, these problems will not occur. They could occur only inside thick tropospheric cloud (in general the balloon will not operate in such extreme

environment), although they were not observed yet. We will add in the revised version a paragraph explaining the risk of balloon measurements inside tropospheric clouds.

(2) We understand the reviewer's concern. Low temperature and low pressure can be produced at ground in laboratory and LOAC was tested in such conditions. But, as said before, it seems that no commercial instrument can be operated safely in such conditions.

(3) We don't understand this comment. Can the reviewer be more precise about his suggestion of a 3-D representation?

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 1261, 2015.

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