Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-720-AC1, 2018
© Author(s) 2018. This work is distributed under
the Creative Commons Attribution 4.0 License.

Atmospheric Chemistry and Physics Discussions
Open Access
EGU

Interactive comment on "In situ measurements of desert dust particles above the western Mediterranean Sea with the balloon-borne Light Optical Aerosol Counter/sizer (LOAC) during the ChArMEx campaign of summer 2013" *by* Jean-Baptiste Renard et al.

Jean-Baptiste Renard et al.

jbrenard@cnrs-orleans.fr

Received and published: 25 January 2018

Reviewer: My main concern is the counting statistics of the LOAC at sizes greater than 40 micrometers. The authors report 1e-4/ccm as the maximum observed concentration. For 1 minute sampling (averaged over 6x10 sec measurements) in 1.7 Lpm means that 0.17 particles were sampled. Renard et al. (2016) reports that for the smaller size classes at least 400 particles must be detected to have a proper signal, which trans-

Printer-friendly version

Discussion paper

CC BY

lates to 1 mV accuracy in the case of 20 mV noise. However, for higher channels it is not mentioned how many particles are required for a proper signal. Furthermore, Renard et al. (2016) reports a good match with a fog monitor over the size range in question, but for concentrations up to 0.1/ccm (ie 3 orders of magnitude higher). As a result I encourage the authors to discuss the detection limit of LOAC at sizes greater than 40 micrometers. Additionally Re[n]ard et al. (2016) reports ±60 % uncertainty for concentrations smaller than 1e-2/ccm. Since the uncertainty increases with decreasing concentration, can it be that in the 1e-4 range the uncertainty reaches ±100 %? Answer: In case of large particle, the proper signal translate is of about 100 mV or more, thus well above the noise. The statistical constraints for the detection of the smallest particles do not apply to the largest ones. The number of large particles necessary for their detection is just one per size class. In fact, the accuracy is depending on the integration time. The given value in the Renard et al. paper is for the basic integration time of 10s. For the results presented here, the integration time is one minute (LDB flight) and 20 minutes (BPCL flight). Thus, the uncertainties are reduced by about 2.4 and 11, respectively. It is why the detection of the largest particle is more accurate during the BLBP flights than during LBD flight. For a concentration of 10-4 particles cm-3, the uncertainties can be up to 200% in case of a LDB flight but down to 25% in case of a BLBP flight. We have modified the text in part 2.1: "In contrast, the uncertainty is up to about 60% for concentration values smaller than 10−2 particle per cm3 for a 10-s integration time." We have added at the end of part 2.1:" The concentrations uncertainties are depending on the integration time. Higher is the integration time, more accurate are the measured concentrations; this is a strong constraint for the detection of the largest particles in low concentration. Typically, for concentration lower than 10-4 particles cm-3, the uncertainties can be high as 200% during a LDB flight, and down to 25% for the BLBP flights with an integration time of 20 min." We have also modified the end of part 3 to: "Since the concentration of these large particles is low and subject to large uncertainties, the analysis of this mode from measurements during LBD flights is limited. Long duration measurements performed at constant altitude using the LOAC

Printer-friendly version

Discussion paper

instrument on BLPB gondola with much longer measurement integration time are better adapted to evaluate the concentration of these large particles (with an accuracy down to 25%) and to discuss this third, giant size mode."

Reviewer: My second major point has to do with the sampling. Two sampling methods were implemented, LDB and BLDB. From reading the article, I am left with the impression that both methods apply a vertical (to the ground) inlet. For LDB this is understood, but for the BLDB method, this would be devastating taking into account that inside dust plumes high wind speeds are frequently encountered. Can you please clarify? Answer: The inlet was horizontal for the BLBD flight. Also, the BLBD balloon is just carried by the wind, so that the relative velocity between the air and the inlet is close to zero. We have changed the text in part 2.1:"The horizontal speed of a drifting balloon relatively to ambient air is supposedly close to zero and the LOAC sampling the inlet was oriented horizontally, so that the particle sampling efficiency should be close to 100%."

Reviewer: Fig 14 is very puzzling to me. If I understand correctly diamonds (left graph) are the measurements and the vertical line on these diamonds the uncertainty (1 std? it is not mentioned). If this is the case the uncertainty line should overlap with 68% of the lines in the graph on the right. In other words the measurement uncertainty should somewhat match the range of fitted distributions. It does not and it is problematic. If the vertical lines on the left graph are not the uncertainty, please add it. It is important. Answer: Indeed, the legend was not clear. The left figure is just one example. The right figure contains all measurements. We have added the underlined words to the legend: "Left: Example of particle volume size distribution within the desert dust plume from the BLPB flight of 19 June 2013 at an altitude of 3.3 km, from one measurement at 12:30 UT. The black diamonds are the LOAC measurements (with 1-ïĄş error bars), the coloured curves represent the lognormal functions for each of the observed modes, and the black curve represents the overall fit (sum of the 3 modes). The geometric mean diameters (Dm) of the 3 modes are of 0.27, 4.6 and 34 micrometers, respectively,

CC BY

with respective geometric standard deviations (ïĄş) of 1.79, 2.14 and 1.35. Right: The 41 fitted size distributions when the third mode was detected, retrieved from all measurements during the 19 June BLPB flight at float altitude."

Reviewer: Line 207: The back trajectory model flexpart should be accompanied with proper references. Answer: We have referenced the Flexpart model with Stohl et al. (2002): Stohl, A., Eckhardt, S., Forster, C., James, P., Spichtinger, N., and Seibert, P.: A replacement for simple back trajectory calculations in the interpretation of atmospheric trace substance measurements, Atmos. Environ., 36, 4635–4648, doi:10.1016/S1352-2310(02)00416-8, 2002.

Reviewer: Line 262-263: Please state the magnitude of the uncertainty and do so to the rest of the article. Answer: The LOAC uncertainties for extinction are already given and discussed in lines 249-259 (now lines 195-205). The Lidar uncertainty is represented by the scatter of the profiles in Figure 8

Reviewer: Line 268: Please mention what do you mean by not very intense, intense etc Answer: We have changed the text to: "The 28 June-2 July event was not intense in terms of aerosol load."

Reviewer: Line 296 and elsewhere: When an agreement is mentioned it is proper to be followed by an indication of its robustness. Typically Pearson's R is used (R2 is certainly encouraged). Answer: We understand the reviewer concern. On the other hand, the vertical sampling of the instruments is different, thus it is necessary to interpolate the profile before calculating the correlation coefficients. We are not in favor of such approach, since the correlation could be dependent on how the interpolation is performed.

Reviewer: Line 769: There seems to a typo on that line. Answer: Correction done.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-720, 2017.

CC BY