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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.

Anonymous Referee #2

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This work summarizes the size distribution measurements conducted airborne using balloons during summer 2013. Even though 27 flights were conducted, the authors focus on a dust episode that occurred between 15 to 18 June 2013, which involved about half of these flights, because it was the most intense observed during the sampling period.

This work reports that particles greater than 20 μm were identified inside the dust

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Discussion paper

plumes, which is against expected. This is an important finding, within the scope of this journal that certainly should be published after a few minor changes are applied. On top of that, the article is very well written, and easy to follow through. The authors have tried, and have done a very good job, to discuss any questions raised while reading the article.

My main concern is the counting statistics of the LOAC at sizes greater than 40 μm. 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. Redard et al. (2016) reports that for the smaller size classes at least 400 particles must be detected to have a proper signal, which translates 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, Redard 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 μm. Additionally Redard et al. (2016) reports $\pm$60 % uncertainty for concentrations smaller than 1e$-$2/ccm. Since the uncertainty increases with decreasing concentration, can it be that in the 1e-4 range the uncertainty reaches $\pm$100 %?

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?

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.

Minor Comments

Line 207: The back trajectory model flexpart should be accompanied with proper references.

Line 262-263: Please state the magnitude of the uncertainty and do so to the rest of the article.

Line 268: Please mention what do you mean by not very intense, intense etc

Line 296 and elsewhere: When an agreement is mentioned it is proper to be followed by a indication of its robustness. Typically Pearson's R is used (R2 is certainly encouraged).

Line 769: There seems to a typo on that line.

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