

Interactive comment on “An automatic collector to monitor insoluble atmospheric deposition: an application for mineral dust deposition” by B. Laurent et al.

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Response by B. Laurent on comments on “An automatic collector to monitor insoluble atmospheric deposition: an application for mineral dust deposition”

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=> We would like to thank the three reviewers for their insightful and helpful comments on the manuscript. These comments have helped us to improve the manuscript. Please find hereafter Reviewer’s comments and our responses.

The manuscript presents a customized system to collect bulk deposition samples unat-
C1394

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tended for several months, if one sample a week is taken. This will be great for sampling at remote locations. Of course, there is no perfect system to collect deposition for all purposes. The CARAGA system suits best the collection of the non-soluble nonorganic fraction. This will suit a certain number of atmospheric and geological-related studies. As it misses the organic fraction, by burning, and the soluble fraction, as much of it will leach out from the washing, CARAGA will be less adequate for ecosystem impact studies. The paper also goes into tests that were done to select the type of filter to be used and the protocol for burning these filters and weighing the minerals left. In addition, an almost two year time series from Frioul Island is presented and compared to previous determinations of deposition using other systems. It would have been nice to have done the reference collection simultaneously as well, but I understand the probable logistical and budgetary constraints. I only have minor comments; mostly needed clarifications that need to be addressed before a positive recommendation for publication. In addition, although the paper is neatly written, an English editor needs to go through the manuscript.

Line 37. Deposition does NOT control atmospheric concentration. Concentration is one factor controlling deposition.

=> The sentence was modified: "Deposition is one of the key terms of the mineral dust cycle."

Methods. There is no universally perfect device for collecting aerosols, or measure deposition. The CARAGA will not be suitable for ecosystem analyses of the deposition when the nutrients that are supplied are a key issue. Since a large amount of the bioavailable nitrogen, phosphorus, silica and even carbon will be leached with the water (or ethanol 20%) added and the leachate is discarded, there will be an underestimate of the deposition flux of these materials. Organics will also be burned. Probably the weight percentage of the removed chemicals is small and thus should not affect much total mass flux determination.

=> We agree with the comment of the reviewer.

Line 232. All these filter types with the exception of the polycarbonate membrane are meshes without a nominal defined pore size. Thus, the porosity is some mean value, but larger particles, especially in a preferred direction-dimension could pass through. Has a test been made? I would like to see comments on this.

=> Sheldon (Limnology and Oceanography, 1972) pointed out that “all cellulose ester membranes (Millipore) retained particles much smaller than the stated pore size, even from small samples with low particle concentrations”. Sheldon (1972) also presented very satisfying retention curves for Millipore filters: up to 80% for particles of $0.5 \mu\text{m}$ in diameter with a $0.45 \mu\text{m}$ filter porosity, and up to 90% for particles of $1 \mu\text{m}$ in diameter with a $1.2 \mu\text{m}$ filter porosity (estimation based on Figure 2 published in Sheldon R.W., Size separation of marine seston by membrane and glass-fiber filters, Limnology and Oceanography, 17, 3, 494–498, 1972).

=> A sentence was added in the text: “Moreover, Sheldon (1972) indicate that Millipore[®] cellulose esters filters, with porosity ranging from 0.45 to $8 \mu\text{m}$, have high percentages of retention of particles of $1 \mu\text{m}$ ranging from 80% to 100%.”.

Line 244. The mass variation is 0.3 mg . How is this compared to the amount of collected material in 1 week of background deposition (without Saharan dust?). It could become critical at certain time. For instance if the minimum collected has been $1 \text{e-}3 \text{ g m}^{-2}$ in one week, this means that what was actually collected is 0.2 mg during that week because the funnel is 0.2 m^2 . This is even below the 0.3 mg error!!

=> The reviewer is right. In a few cases we didn't have noticeable particles deposition on the filters, and the mass collected was of the order of the mass variation. The sentence was modified: “The weekly total insoluble deposition fluxes of mineral dust at the Frioul site also exhibit a large variability ranging over two orders of magnitude, from no noticeable deposition (in the range of the uncertainty) to $3.3 \text{ 10}^{-1} \text{ g m}^{-2}$ (Figure 2).”.

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Line 256. In many situations these are important background components of aerosols. I would like to see a discussion, even if based on literature estimates of the possible interference.

=> Please refer to the answer to Reviewer 1. Mediterranean aerosols are discussed based on the works of Bergametti et al. (Tellus, 1989), Lelieveld et al. (Science, 2003) and Sciare et al. (ACPD, 2005). A discussion is now presented in the paper as recommended by the reviewers.

Line 280. Are the filters first dried, say at 60° for 24 h, before weighing? If the filters contain a certain amount of moisture weighing is not accurate and readings tend to be erratic.

=> For the Cape Verde and Tunisian samples (Table 2) and for the first samples collected in Frioul (Table 3), the filters were dried up to 40°C for 2 hours before weighing. This was enough to remove the remaining humidity. This is now mentioned in the paper. For the deposition dataset presented in Fig. 4, the ignition protocol up to 550°C was applied before weighing. Moisture and humidity of the samples and filters don't affect the accuracy of the weighing.

Figure 1. The solar panel seems to be placed at a rather suboptimal angle. However, nothing is to be said if the CARAGA has been operating for two years without a problem.

=> For the first tests conducted mid-2010, a solar panel was fixed on a specific tripod in order to adjust its orientation to an optimal angle. Two weeks after in-situ installation the solar panel was stolen. We decided to fix the solar panel on the collector with a southward orientation. The position of the panel, as presented in Figures 1 and 2, is sufficient to charge the battery and to deliver power supply. No problem due to the solar panel orientation has been observed for the CARAGA installed in Frioul,

Figure 4. To appreciate the error with respect to the lower measurements perhaps a

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log scale for deposition would be more suitable. My recommendation is to have two plots one with a linear y-axis and the other with a log y-axis.

=> We made the two plots, one with a linear y-axis and the other with a log y-axis. On balance, the log scale would not appear to be more suitable to visualize the temporal variability of the deposition.

Figure 5a. The no error bars for Jan, Nov and Dec is misleading as only data for 1 year is available.

=> In fact, the bars on Fig. 5a are not error bars. They correspond to the standard deviation computed for mean monthly values (except Jan., Nov. and Dec.). The legend of this Figure was rephrased to make this clearer.

Figure 5b. Seeing the very large variability in the longer time series of TERNON et al. (2010), the conclusion is that there is a very large interannual variability. If seasonal patterns need to be inferred, it is clear that a much longer time series is needed, and that the annual pattern observed in Fig. 5a. does not mean much.

=> The reviewer is right, we could not discuss the interannual variability of deposition based on our almost 2 years dataset only. More long term data on different locations are needed (this is why we develop the CARAGA). This is now mentioned in the paper. Nevertheless, the study performed by M.D. LOÏE PILOT and MARTIN (1996) in Corsica constitutes a much longer time series (11 years) and a relevant dataset to investigate this question. We noticed that our results match quite well the mean deposition tendency observed by M.D. LOÏE PILOT and MARTIN (1996).

Table 2. It seems that at 550° some organic matter not belonging to the filter is being burned. Has it been estimated if this is consistent with the expected organic matter in the sample? It should be done, just to make sure that the temperature and burning time is right.

=> The loss on ignition is a common method to estimate organic matter in a sample.

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Indeed, organic matter not belonging to the filter is being burned. As mentioned in the text, our results are consistent with previous studies on soil and minerals loss on ignition. The results presented in Table 3 indicate that organic matter can represent up to 10% of the sample. "... a temperature of 550°C ensures the loss on ignition of the filter, and of the organic matter which is destroyed below 450°C (Hoenig and Thomas, 2002). Moreover, Sun et al. (2009) recorded only a small mass loss (lower than 0.2%) for the quartz, feldspar, calcite and hematite during ignition at 550°C. Mass losses between 1 and 2.5% for the smectite, chlorite, illite and goethite, and up to 18% for the kaolinite were observed (Sun et al., 2009). These authors showed that the structural water loss for 17 soil samples ranges from 0.56% to 2.45% at 550°C. This is consistent with the mass loss results obtained for the Douz soil which contains a significant proportion of quartz and calcite (Lafon et al., 2014). The larger mass loss observed for the Cape Verde soil can be partly due to its composition of quartz, potassic feldspars and an assemblage of illite-kaolinite-chlorite (Rognon et al., 1996; Desboeufs et al., 1999). The larger loss on ignition observed for the atmospheric deposition suggests a higher fraction of volatile compounds in the Frioul samples than in the tested soils." This latter result is in agreement with the organic aerosol proportion presented by Sicare et al. (2005) during the MINOS campaign in Eastern Mediterranean.

Table 3. Why are the filters for the lab test 27% heavier than the filters used for the Frioul tests?

=> The mean mass of the filters used for the soil samples is 0.084 ± 0.004 g. The mean mass of the filters used for Frioul samples is 0.077 ± 0.001 g. The filters used for the soil are 9% heavier than the filters used for the Frioul tests. The same Mettler[®] AE240 electronic microbalance (sensitivity 10⁻⁴ g) was used in the same controlled room. The same filters were used (Millipore cellulose esters filters, 47 mm, 0.8 μm, AAWP reference), but from two different sets. The only explanation is a possible mass variability of the filter from a set to another. We made a new weighing test between two sets of Millipore cellulose esters filters and a mass difference of 4.5% was obtained,

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which can partly explained the difference observed.

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