

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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Received and published: 3 June 2015

Response by B. Laurent et al. on interactive comment 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.

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General comments

This is a good paper which describes a robust and smart device for the determination of insoluble aerosols deposition and gives a first interesting data set obtained in Frioul Island.

Specific comments

- The device Are you sure that no matter remains stuck on the funnel inner surface? From my own experience rinsing is not sufficient to remove clay particles, even with associated vibrating. Perhaps the funnel graphite material is especially suitable but you should give proof of that (observations, references).

=> Yes, we are sure that the sampling is efficient enough since no particle matter stuck on the inner surface of the funnel was observed. During the first six months, the collector was tested in the field and the rinsing flow and the intensity of the funnel vibration were adjusted. Since the CARAGA has been operating on Frioul Island, we did not observe of particles in the funnel after the rinsing. The only matter sometimes observed on the inner surface of the funnel was bird's droppings, which were carefully cleaned during the maintenance of the collector.

Do you have encountered problems with insects, coarse vegetal debris or pollens on your filters? How did you solve them?

=> A PTFE strainer is always installed in the funnel to limit the impact of large insects or vegetal debris (larger than 2 mm) on the sampling. This point is now mentioned in the section introducing the CARAGA. When insects or vegetal debris are collected on the filters they are manually removed only if this manipulation does not affect the sample. If the removal of these elements could damage the sample, we leave them on the filter and the ignition of the samples at 550°C eliminates these organic matters. A noticeable undefined deposition was observed once on a filter (see Figure 3, fourth row and 2nd column). When we had a look at it, it seemed to be organic matter. After

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the calcination, the organic part of the deposit was eliminated.

=> Two sentences were added in the paper: “A PTFE strainer is always installed in the funnel to limit the impact of large insects or vegetal debris (larger than 2 mm) on the sampling”. “When insects, vegetal debris, pollens or organic matters are collected on the filters they are manually removed only if this manipulation does not affect the sample. If the removal of these elements could damage the sample, we leave them on the filter and the ignition of the samples at 550°C eliminates these organic matters”.

Have you made experiments on the evolution of flow across the filter when covered with different amounts of dust material? Do you have assessed the risk of overflow in case of strong rain events? It could happen for daily precipitation rate higher than 50mm as a first raw estimation. Do you have data on rainfall intensity (at least on a daily basis) during your survey in Frioul? In your other sampling stations?

=> Yes, the risk of overflow was taken into account. During lab tests we noticed that, for heavy load contents on the filter, the filtration could be slow, but no quantitative estimation the evolution of flow across covered filters was done. The daily rainfall intensity in Frioul has been recorded. Weekly precipitations (in mm) are reported in Figure 4 and large rain amounts can be observed (for instance in May 2015). These elements pushed us to take into account the risk of overflow. An electronic system can be adapted to control the water level in the filter holder and periodically closes a pinch valve installed on the tube at the bottom of the funnel if this level is too high. This avoids overflow of the filter holder and the loss of a part of the wet deposition in case of heavy rain.

- The data set for Frioul site. You recorded insoluble particles deposition almost every week in spite of the sporadic deposition of Saharan dust; what are the possible other sources for these non Saharan insoluble particles? Have you an estimation of their relative contribution to the total deposition of insoluble particles? You should discuss this point before classing total insoluble deposition as Saharan dust deposition.

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=> A discussion was added in the paper: “Others insoluble aerosols from anthropogenic activities and biomass burning are also present in the Mediterranean atmosphere and can affect the deposition measurements. Field studies performed in the Eastern Mediterranean Basin pointed out that these particles are mainly in the fine submicron aerosol fraction (Lelieveld et al., 2002), and that their mean mass concentrations are one order of magnitude lower than natural dust ones (Sciare et al., 2005). From atmospheric measurements performed in Corsica for elements indicating the major aerosol sources (natural and anthropogenic), Bergametti et al. (1989) concluded that strong daily variations of concentrations were mainly due to Saharan dusts inputs (for the crustal elements) and to the removal of aerosols by precipitation events. These results point out that anthropogenic aerosols and biomass burning present in the Mediterranean atmosphere could constitute a background deposition flux, but during Saharan dust outbreaks mineral deposition sampled on filters is mainly due to Saharan dust.”

It is incorrect to give annual values of dust deposition when almost 2 months are lacking for each year; especially for 2012 the data of November, which is usually a “good dusty” month, are lacking. Give the beginning and ending dates for your data set.

=> The term “annual” was removed. Beginning and ending dates for the data sets were added.

The standard deviation of 2 values for your time serie in figure 5 is perhaps illusive. It would be better to give the 2 values for each month and mention “no data” for January, February 2011 and November, December 2012.

=> A comment was added in the legend of Figure 5: “The standard deviations of the mean monthly values are reported (bars) except for January, November, and December as no measurements were performed in 2011 or 2012.”

The backward trajectories are not very convincing. . . the arrival dates/ hours are probably not well chosen. Perhaps could you show more appropriate ones?

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=> All the Hysplit backward trajectories were recomputed at different times and altitudes. The new backward trajectories are presented in Figure 6. They better support the discussion and illustrate the origins (South of the Mediterranean Sea and Sahara) of the air masses reaching Frioul during the main deposition events.

=> Please find enclosed the new Figure 6: HYSPLIT backward air mass trajectories computed for 72h at multiple locations in the surrounding of Frioul site for the nine main deposition events recorded on Frioul Island: (a) July 11 2011 12UTC at 2500 m agl, (b) October 25 2011 00UTC at 2500 m agl, (c) April 30 2012 12UTC at 2500 m agl, (d) May 20 2012 18UTC at 500 m agl, (e) June 20 2012 12UTC at 2500 m agl, (f) July 1 2012 12UTC at 2500 m agl, (g) August 25 2012 12UTC at 500 m agl, (h) September 5 2012 12UTC at 2500 m agl, (i) September 29 2012 12UTC at 2500 m agl.

- Small details Loss at 550°: note that the percentage of loss for the F7 (l. 292) is high but the absolute difference is quite near of the precision of your balance.

=> Yes, even if a greater loss in percentage (18.2%) was observed for the F7 sample, the loss is of the order of magnitude of the precision of the protocol. A sentence was added: "For filters without high load of particles, the loss is the same order of magnitude of the uncertainty on the protocol."

l. 302 : I am surprised that kaolinite displays a loss of 18% at 550° and smectite less than 2.5% in the publication of Sun et al. Probably the kaolinite mineral analyzed by Sun et al, which is a commercial product , is not a pure kaolinite sample.

=> We have no other clue than the one proposed by the reviewer on the quality of the mineral samples.

Technical remarks

L 39 : suppress : "concentration" => Done.

L45 : add of Saharan dust in "This collector is used to sample atmospheric deposition..)

=> The sentence was modified as asked by the reviewer.

L 46-47 : suppress : “over which Saharan dust 46 can be transported and deposited”.
=> Done.

L227 : references are wished

=> The sentence was modified and references were added: “The mass of mineral dust is considered to be dominated by large particles (Whitby et Cantrell 1976) contributing to PM concentrations in the Mediterranean area (Sciare et al., 2005; Pey et al., 2013).”

- Pey et al., African dust outbreaks over the Mediterranean Basin during 2001–2011: PM10 concentrations, phenomenology and trends, and its relation with synoptic and mesoscale meteorology, *Atmos. Chem. Phys.*, 13, 1395-1410, doi:10.5194/acp-13-1395-2013, 2013. - Sciare et al., Aerosol mass closure and reconstruction of the light scattering coefficient over the Eastern Mediterranean Sea during the MINOS campaign, *Atmos. Chem. Phys.*, 5, 2253–2265, 2005. - Whitby and Cantrell, Atmospheric Aerosols: Characteristics and Measurement, International Conference on Environmental Sensing and Assessment (ICESA), Institute of Electrical and Electronic Engineers (IEEE), September 14-19, 1975, Las Vegas, NV, 1976.

L299-30: you should regroup minerals without a significant LOI < 0.2%- (quartz, feldspars, calcite, hematite) on one side and typical clay minerals with LOI higher than 1% on the other side.

=> The sentence was modified: “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)”.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, 8, 2299, 2015.

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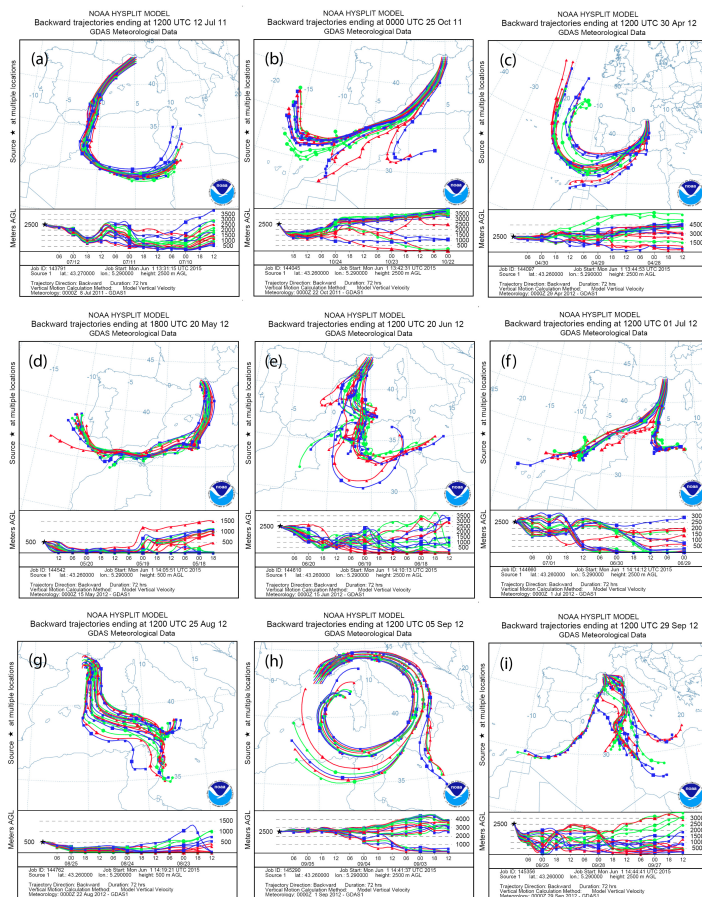
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Fig. 1. Figure 6: HYSPLIT backward air mass trajectories computed for 72h at multiple locations in the surrounding of Frioul site for the nine main deposition events recorded on Frioul Island