Reply to the referee on the paper: "Variability of mineral dust deposition in the western Mediterranean basin and South-East of France" by J. Vincent et al.
The modifications in the manuscript are indicated in red.

Interactive comments on "Variability of mineral dust deposition in the western Mediterranean basin and South-East of France" by J. Vincent et al.

M.-D. Loÿe-Pilot (Referee)

This paper deals with the spatio-temporal variability of mineral dust deposition to the Western Mediterranean. Five sites were monitored over 3 years. A good data set is given and its analysis is interesting. However any points are to be discussed more thoroughly and any conclusions should be more cautiously given.

Specific comments

1. Mineral deposition versus Saharan dust deposition.
The protocol used gives the mineral particles deposition. Along the text, mineral dust seems to become more or less equivalent to Saharan dust, especially when annual fluxes are reported (§4-1). Saharan dust weekly deposition events are chosen among most intense weekly mineral deposition (MID) defined as being above a threshold. There is no true significance for this threshold value. Don't you have any criteria (filter color, mineralogical composition) to separate local/regional terrigenous contribution from long range transported dust? Are the authors sure or did they check that even with low deposition you don't have got Saharan dust. And the opposite seems verified (one case at Le Casset). In fact the question of local / regional mineral dust contribution is not clearly posed and it should be.

In this paragraph, the referee addresses different questions that will be answered separately below:

1- **Concerning the use of the term "Saharan Dust" in our paper, we took care to use it only in the second part of our manuscript, i.e. when additional information such as air-mass trajectories and satellite images were used to confirm or not the African origin of the deposited mass. In the first part of the manuscript, when only MIDD were selected, we used only the term of "mineral dust deposition".**
2- **The threshold we used was not chosen to select Saharan dust episode but only for selecting the highest mineral dust deposition events. Thus, we considered that the highest deposition events should be located in the upper 16.6% (called the sextile) of the distribution of deposition fluxes. We verified that such a selection led to retain for each station at least 50% of the total deposited mass over the sampling period. We add the following sentence in the revised text: "The MID represent at least more than half of the whole deposition flux measured at each station (Table 2)".**
3- **The goal of this procedure is not to select all the Saharan dust deposition events but only the most intense events. Thus, as mentioned by the referee and in our manuscript ("the most intense Saharan dust deposition…. will be discussed**

Saharan deposition events of lower intensity were not retained for further analysis.

4- **I is well known that all deposition measurements, whatever the technique used for sampling can be subject to local contamination, especially during high wind periods by soil particles remobilization. For minimizing this effect, the funnel of the CARAGA collector was installed 2.5 m above the surface. It is also for this reason that we only selected the highest deposition events for which the contribution of possible local contamination is reduced. To better underline this point, we add in the text the following sentence: "We cannot exclude that local mineral contribution, especially during high wind speed periods at the station, may affect some samples, in particular those for which the deposition due to long-range transported dust is the lowest. Moreover, for the station located the farest from the African coasts such as Frioul or Le Casset, the anthropogenic background in refractive material may also contribute for a limited part to the insoluble mineral deposition".**

2. Adequacy of the data set to the goal of the paper.
Due to the gaps in the monitoring at the different sites over the 3 years, the spatio-temporal pattern of Saharan dust deposition cannot be ascertained with the strong confidence displayed in the conclusions: for example for the South- North deposition gradient, the seasonality of the MIDD for each station (in spite of a partial reduction of the uncertainty: beginning of the paragraph 4.3) and the implicit comparison between the sites displayed in figures 5 and 6.

The data recovery rate of our data set varies between 77% and 91% depending on the station. Moreover, at least 1-yr of continuous measurements is available for each station. Obviously, the results and our conclusions correspond to the situation observed for the investigated time period at the locations where the samplings were performed.
Nevertheless, our results support the fact that a strong temporal variability is observed: the deposition fluxes measured at a station can vary over two orders of magnitude. The deposition fluxes measured at the different sites illustrate clearly the spatial variability of the dust deposition in the Western Mediterranean basin. Part of the conclusion was rephrased: "A South to North decrease of the intensity of the deposition fluxes is noticed. Moreover, during the investigated period, different source regions contribute to the dust deposition in different locations of the central and western Mediterranean in relation with different dust transport pathways. Our results suggest a seasonal pattern of the Saharan high dust deposition within the western Mediterranean basin for the investigated period, which could be refined with longer time series of deposition measurements".

3. Wet versus dry deposition.
Weekly sampling is not very adequate to check the mode of deposition. However the authors have mitigated this drawback by using dust plumes trajectories and times of arrival. There is, as noted by the authors, an imprecision in the arrival time, but offset by checking rain data 24h before the arrival date. Rain data are checked up to 24h after the arrival of the dust plume: that means that the episode is assumed lasting 24h at the most; but many dust events last more than 24h. This is a first source of uncertainty. The second source of uncertainty comes from the fact that dust deposition may occur only with a few drops which are not recorded either by automatic or manual rain gauges. This leads to an overestimation of dry deposition So the figures given for dry deposition must be looked on with some cautiousness.

The referee is right: dust events can last more than 24h. In order to better account for the duration of the dust events, the number of MIDD were computed for three time periods (24h, 48h and 72h) after the arrival time of a dust plume at the sampling sites according to the air-mass trajectories. These results are now reported in Table 4. The following sentences were added in the text: "Thus, a dust deposition event for which no precipitation is recorded at the station 24 h before and up to 72 h after the dust plume arrival is defined as "dry". The 72-h time period after the arrival of the dust air mass over the sampling site is splitted in three periods (24, 48 and 72 h) in order to take into account for the duration of the dust events that can last more than one day (Table 4)".

		Number of MIDD				MIDD cumulated mass			
	Time period after dust arrival	Total	Wet deposition	Dry deposition	Wet + dry deposition (mixed)	Total mass ($g\ m^{-2}$)	Wet deposition (%)	Dry deposition (%)	Wet + dry deposition (mixed, %)
Le Casset	24h	15	12	3	-	1.2	77	23	-
	48h		13	1	1		82	14	4
	72h		13	1	1		82	14	4
Frioul	24h	17*	10	6	1	2.7	61	27	12
	48h		11	5	1		66	22	12
	72h		11	5	1		66	22	12
Corsica	24h	11	7	3	1	1.9	69	15	16
	48h		7	3	1		69	15	16
	72h		8	2	1		74	10	16
Mallorca	24h	20	12	6	2	7.6	36	15	49
	48h		14	4	2		41	10	49
	72h		14	4	2		41	10	49
Lampedusa	24h	34	18	15	1	13.5	51	46	3
	48h		18	15	1		51	46	3
	72h		18	15	1		51	46	3

Table 4: MIDD during which DDE occur only by dry, by wet or by mixed (wet + dry) deposition. The wet (or dry) conditions are defined considering the precipitation occurrence (or not) during the 24 h before the arrival time of a dust plume at the sampling sites according to the air-mass trajectories and 24, 48 and 72 h after its arrival time. * Precipitation data was not available for one MIDD at the Frioul station.

Concerning the second part of the referee's comment, we agree that rain gauges are not sufficiently sensitive and/or rapid to detect very short rain event or periods during which fog can occur. This is a general problem and thus we add in the text a sentence indicating such a possible artefact: "As mentioned by Löye-Pilot and Martin (1996), significant deposits can occur in almost "dry conditions", i.e. very low and short rain events and/or fog periods that classical meteorological rain gauges cannot detect. As a consequence, in these cases, the deposition is considered as dry and this leads to a possible overestimation of the contribution of the dry-only deposition to the total deposited flux". The following comment was also added in the abstract: "the contribution of dry deposition **(in the sense that no precipitation was detected at the surface)".**

Technical comments

- Representation of dust provenance areas (figures 6 and 8). The Saharan dust sources areas are now relatively well known. They are more or less displayed in the figure 7. So a more realistic representation of Saharan dust sources is possible. If the authors prefer this geometric representation they should at least exclude the Northern fringe of Western Maghreb.

According to their limited accuracy, backward trajectories and satellite AOD only provide information that allow to define an area from which the dusts are coming. This is the reason why we selected such a representation (not so precise but consistent with the accuracy of the information we had) of the regions of provenance of the dust. However, we agree with the referee concerning the Northern fringe of Western Maghreb which is now excluded from the DPA 7 region.

- Small points

. page 34682, lines 24-25. The deposition reported by Loÿe-Pilot et al (1986, 1996), Guieu et al (2010) and Ternon et al (2010) is Saharan dust deposition, not indifferentiated mineral dust. Idem for the deposition values quoted from these papers.

The sentences were rephrased: "In the late 1980s and 2000s, the mean annual Saharan dust deposition measured in Corsica by Loÿe-Pilot et al. (1986), Loÿe-Pilot and Martin, (1996) and Ternon et al. (2010) were of 14.0, 12.5 and 11.4 g m^{-2} yr^{-1}, respectively".

. According to the point 1, the title of §4.1 should be more precise "... deposition of mineral dust ..." and the title of §4-4 and 4.5 be "... Saharan dust deposition events".

The titles of the paragraphs were modified following the referee's comment: "4.1 Weekly mineral dust deposition in the western Mediterranean basin", "4.4 Identification of Saharan dust deposition events, "4.5 Transport routes of the Saharan dust deposition events".

. page 34678, line 15. Quote the reference: "... in Corsica on 11 years (Loÿe-Pilot and Martin 1996)".

Done. "… but also a strong inter-annual variability with deposition fluxes ranging from 4 to 26 g m^{-2} yr^{-1} in Corsica over an 11-year period (Loÿe-Pilot and Martin, 1996)".

. page 34682, line 11. "...located in the northern western Mediterranean..."

Done. "The maximum deposition recorded for the stations located in the northwestern Mediterranean basin and South of France (Corsica, Frioul and Le Casset) …".
