

# ***Interactive comment on “Modeling the biogeochemical impact of atmospheric phosphate deposition from desert dust and combustion sources to the Mediterranean Sea” by Camille Richon et al.***

## **Anonymous Referee #1**

Received and published: 24 July 2017

The present manuscript “Modeling the biogeochemical impact of atmospheric phosphate deposition from desert dust and combustion sources to the Mediterranean Sea” proposes an analysis of the impact of phosphorus atmospheric deposition comparing different sources: namely desert dust (P<sub>dust</sub>) and combustion sources (P<sub>comb</sub>). The idea is very interesting and useful because the two sources are, in principle, characterized by different spatial and temporal distributions. But, the main weakness of the manuscript is, in my opinion, the insufficient skill of the global atmospheric model LMDz-INCA in reproducing correctly the amount of dust deposition fluxes and

[Printer-friendly version](#)

[Discussion paper](#)



its spatial and temporal variability for the Mediterranean area. Authors cite another model, the higher resolution ALADIN-Climat (Nabat et al. 2012), used for a companion paper (Richon et al. 2017), which gives higher deposition rate. I think that it is necessary to add also a test with the ALADIN-Climat model (equipped with the proper phosphorus deposition model), in order to have at least an ensemble composed by two members, this would make results more robust. Moreover, the choice of selecting only the year 2005 given the high variability of P<sub>dust</sub>, is not clear to me. This high variability is important and its impact should be estimated. Therefore, I suggest that the present manuscript can be published only after major revisions of the simulation protocol.

### Main comments

(Text from Authors in quotes, comments indented)

### ABSTRACT

**lines 18-20:** “The impact of the different sources of phosphate on the biogeochemical cycles is remarkably different and should be accounted for in modeling studies.”

This sentence is, in my opinion, not clear, “remarkably different” with respect to what?

The oceanic model

**Pg 4. line113:line 115 :** “The model satisfyingly reproduces the vertical distribution of nutrients in the basin and the main productive zones that are the Alboran Sea, the Gulf of Lions and most coastal areas (see appendix).”

The comparison/validation shown in the appendix appears quite subjective, no objective statistical indicators are provided.

[Printer-friendly version](#)[Discussion paper](#)

## Results section

### Evaluation of P deposition fluxes.

**Pg6, line 198: Pg 7, line 200:** “We were able to compare the dust deposition flux modeled with LMDz-INCA used to derive P<sub>dust</sub> deposition over the ADIOS sampling period with the measurements. The comparison is shown in Table 1. The dust fluxes produced by the model are realistic.”

I plotted results reported in Tab 1. See figure attached (x-axis stations, y-axis dust deposition, units are g m<sup>-2</sup>yr<sup>-1</sup>). In my opinion dust fluxes produced by the model (brown line; MODEL “ADIOS period”) compared to data (blue line; DATA “ADIOS period”) are very different. In particular there is a strong underestimation of the model, about an order of magnitude, and the spatial variability across stations is absent in the model. So the sentence “The dust fluxes produced by the model are realistic”, should be substituted by something like “model presents a strong underestimation compared to data and it is not able to represent the spatial variability of the data”. Clearly, as stated by Authors, the dataset available is not enough, and continuous times series at different stations should be used to corroborate the model. But, given this situation, the usage of another atmospheric model, for example the ALADIN-Climat is, in my opinion, mandatory. A higher resolution model would allow for more robust results in terms of spatial gradients of dust deposition also.

### Characterization of phosphate deposition from the different sources

**Pg 7, lines 221: lines 226:** also in this case the estimates for the total deposition flux by the model seem low. In a recent paper [Powley et al. (2017), Global Biogeochem. Cycles, 31, 1010-1031] Authors report atmospheric deposition rates of 0.16 109 mol/yr WMS and of 0.38 109 mol/yr

BGD

Interactive  
comment

Printer-friendly version

Discussion paper



EMS (see their Tab. 3). In the present manuscript the estimates are much lower. Given the lack of data it is difficult to reach a conclusion, but anyway this discrepancy raises the question of how robust is the discussion on spatial gradients if the average values present such an uncertainty.

**Pg 8, line 239: line 226** : “However, riverine inputs are the dominant external source of phosphate for almost all Mediterranean regions”

Given the uncertainty on phosphorus deposition, and apparently its under-estimation, this sentence appears not demonstrated.

## Discussion

**Pg 11, line 363: line 365** : “The atmospheric model LMDz–INCA has a low resolution given the regional Mediterranean scale:  $P_{dust}$  deposition forcing has  $280 \times 193$  grid points globally and  $500$  grid points covering the Mediterranean, and  $P_{comb}$  forcing has  $144 \times 143$  grid points in total and  $200$  grid points covering the Mediterranean. These forcings reproduce well the average deposition patterns at the basin scale but may not be reliable when analyzing small scale deposition patterns.”

The statement that the global forcing reproduces well the average deposition should be somehow proved.

**Pg 12, line 381:line 384** : “Natural dust emissions, transport and deposition to the Mediterranean are shown to be highly variable from a year to the next (e.g. Moulin et al., 1997; Laurent et al., 2008; Vincent et al., 2016) so that the relative contributions of  $P_{comb}$  and  $P_{dust}$  may also vary.”

Authors focused on an average (or median) year, namely the 2005. But given the high inter-annual variability, at least of  $P_{dust}$ , what is the meaning

of such a choice? It would be better to consider many years and analyse the temporal variability to have a better quantification of the reality? What is the role of extremes?

---

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-242>, 2017.

**BGD**

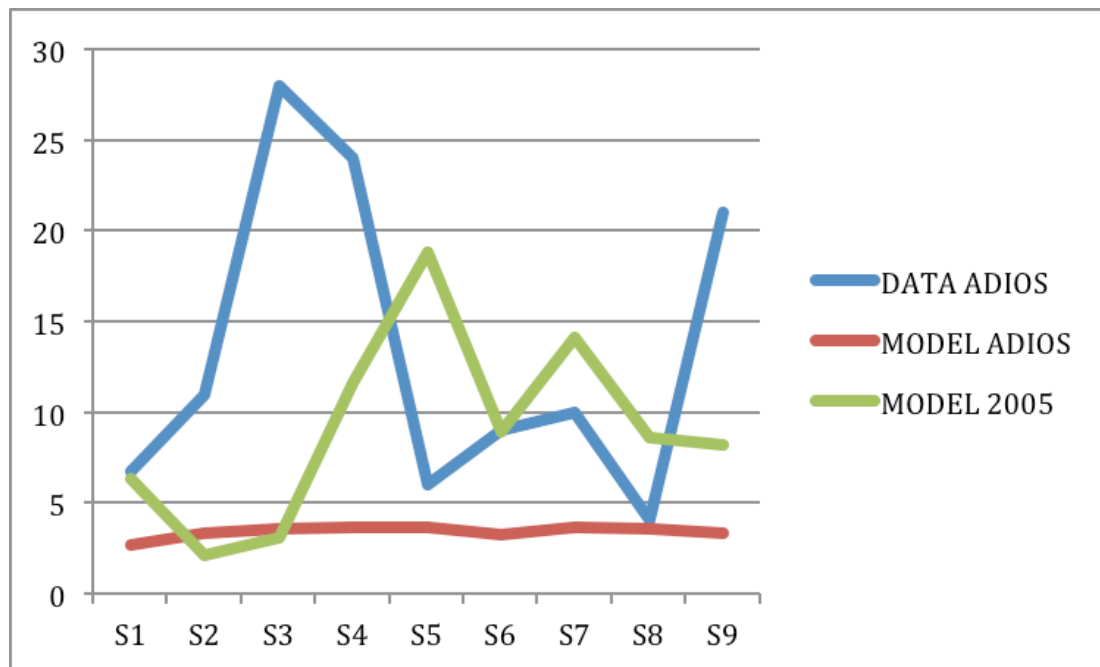
---

Interactive  
comment

Printer-friendly version

Discussion paper





**Fig. 1.** Dust Deposition fluxes from Tab1, present manuscript.

[Printer-friendly version](#)

[Discussion paper](#)

