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Interactive comment on "Introduction to the project DUNE, a DUst experiment in a low Nutrient, low chlorophyll Ecosystem" *by* C. Guieu et al.

Anonymous Referee #1

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General comments

This paper describes the background and logistics associated with a series of mesocosm experiments in the west Mediterranean Sea aimed at elucidating the impact of dust deposition on surface water biogeochemistry, planktonic biodiversity, biomass and productivity and carbon export. It also summarises the results of these experiments which are primarily discussed in greater detail in associated papers in the Special Issue. The paper describes a novel approach in an area of science appropriate to BG. The introductory background & logistics information are a little cursory and, although the results and conclusions from other accompanying papers are very interesting, the actual data presented within this paper only provide context to the other papers and do not contribute to the conclusions or abstract. It is a challenge with an Introduction

paper to balance the discussion of results in accompanying papers, with some unique data or insight to ensure the paper has stand-alone value. To achieve this, the authors should consider the suggestions below.

Specific comments

Introduction

a) Comparison of regional deposition with experimental additions - how do the dust additions in the experiments compare to regional trends in deposition (composition & temporal variation)- particularly for wet deposition (for which the respective experiments show significant responses).

b) Regional variation and controls on pelagic plankton ecosystems & productivity – how significant is deposition as a source of nutrients relative to other pathways (the paper mentions that stratification during summer results in deposition being the only pathway but there is no information or citation to support this).

c) Global context – how significant is dust deposition in the W Mediterranean relative to other regions (composition/magnitude/pathways)?

All the above are discussed, but would benefit from more information to provide context for the experiments.

Approach & Logistics

d) Although the mesocosm logistics have been published previously in Guieu et al (2010b) more information is required in this paper, particularly to accompany Figure 2 and also on the preparation of artificial wet & dry deposition material.

e) Particle export is an important component of the study and so the sediment taps warrant description.

f) Information is required on mixing/turbulence in the mesocosms as this is a critical factor influencing biological response & particle export.

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g) How significant was the variation between treatment replicates, and also between the Control mesocosms and outside the mesocosms? This may be covered in the accompanying papers, but a useful role for an introduction paper is in the validation of the experimental approach.

Results

h) This paper would be more valuable if it included results and insights not reported elsewhere. The data currently presented are temperature, light & chlorophyll which, although providing context for the following papers, do not contribute to the conclusions. See suggestions below re inclusion of an export and/or iron budget.

Summary/conclusions

i) The paper ends abruptly & would benefit from addition of a few sentences summarizing the overall key findings of the experiments, & what these contribute to our understanding. This could include recommendations for further experiments/research directions. This summary could be achieved by reorganizing the current text by placing the final paragraph on the foodweb model earlier in the discussion, and finishing the paper with the primary conclusion of a net increase in carbon export resulting from dust deposition.

j) It would be useful to finish by extending the conceptual diagram in Fig 1 to a budget by inclusion of process rates and stocks, for export and/or iron. These may be in accompanying papers in the Special Issue, but if not these would be a valuable addition.

Pg 12498. Line 20-23 It would be useful to add a plot showing the temporal variability in regional dust deposition for the region, perhaps reproducing the time series of Loye-Pilot and Martin, 1996) and/or more recent datasets, to provide context for the use of the deposition rates of 10 mg m_2 in the experiments. For example, this would indicate more clearly how often events of this magnitude occur. More information on both variability and composition of regional dusts would be useful, particularly for wet

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deposition as these experiments showed significant responses relative to the controls.

Fig 2 is informative but is not supported by information in the text. Although dust collection, treatment & aging methods are available in Guieu et al (2010b) it would be useful to add brief details of the processing to complement Fig 2.

Reproduce the mesocosm schematic from Guieu et al (2010b) to accompany Fig 2, & provide a few more details. For example details of the sediment trap arrangement

Line 12499 Line 21. Were the mesocosms cleaned during experiments, or between experiments DUNE-P & Q? How?

Turbulence and mixing measurements in the mesocosms would be useful, as would comparison with mixing outside the mesocosms, as this will influence particle settlement and export. It would also be useful to include comparison of temperature profiles outside the mesocosm in Fig 4b to show whether development of stratification was similar, and also comparative PAR profiles inside and outside the mesocosms.

Were sediment traps also deployed outside the mesocosm? Again comparison with controls mesocosms would be useful.

Pg 25000 Line 25-30. The wet and dry deposition experiments have significantly different nitrogen content. It is unclear as written whether HNO3 was used deliberately in the dust processing to raise the N content, or whether this was an artefact. Guieu et al (2010b) show that regional dust concentrations have high N content, which suggests the non-EC (dry deposition) dust containing low N used in DUNE-Q is not representative of local dry deposition? Please clarify.

Pg 12506 Line 13. “Those results have all clearly shown the potential for Saharan wet deposition to modify the in situ concentrations of elements of biogeochemical interest such as P, Fe, N”. As no change in DIN was detected (due to analytical constraints) it can only be inferred that N was modified by dust. The absence of a response in DUNE-P may reflect the low N content on the untreated dust. Both of these points

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should be noted. To support this, it would be useful to include an estimate of how much N would have been added to the water column by the artificial dust addition, particularly in the wet deposition experiments, and how much primary production this could support (perhaps this is in Ridame et al (2013)?).

Technical corrections

Incorrect language is used in places; below are some suggested corrections for the Abstract and Introduction:-

Abstract replace “submitted to atmospheric input” with “subjected to atmospheric input”

“During the thermal stratification period, only atmospheric deposition is prone to fertilize Mediterranean surface waters” would be better written as “atmospheric deposition is the only source of nutrients to Mediterranean surface waters during periods of thermal stratification”?

Introduction

Line 11 – “particularly well adapted to tackle the question of the role of atmospheric input” – replace “adapted” with “suited”

Line 17 – “those natural particles” – unclear what natural particles are being referred to here as the preceding sentence describes anthropogenic dust sources

Line 23 - “allowed to export at 200m” – ”resulted in export to 200m”

Pg 2 Line 7 “Does a same deposition flux reproduce or not the same effects and why? - this is unclear & should be rephrased, perhaps as “ Do deposition fluxes of similar magnitude and duration result in similar impacts?”

Pg 12498 Line 5 “Indeed, the particularity of the atmospheric input being that it is associated with a significant particulate flux after it has reached the sea surface ‘. Rephrase as unclear what is meant by “particularity”

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Pg 12498 Line 30 “This was achieved by experimental simulation of (i) the production of desert dusts and (ii) the chemical aging mimicking their transport and cloud processing in the atmosphere.” Reference Guieu et al 2010b here

Pg 12505 Line 30 “confirming their interest as dust proxy in sediment traps” – replace “interest” with “value” or “utility”.

Interactive comment on Biogeosciences Discuss., 10, 12491, 2013.