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Biogeosciences
Discussions

Interactive comment on "Phytoplanktonic response to contrasted Saharan dust deposition events during mesocosm experiments in LNLC environment" *by* C. Ridame et al.

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We would like first to thank the reviewers for their relevant comments and suggestions which helped us to improve our manuscript.

The title has been changed into 'Contrasted Saharan dust events in LNLC environment: impact on nutrients dynamics and primary production' to be more representative of the scientific content of the paper. Indeed, the main goal of this study is to explain why different phytoplanktonic responses (stimulation or no change) were observed after contrasted Saharan dust deposition event (wet versus dry; single deposition versus two successive deposition events) through the changes in the atmospheric supply of

new nutrient (N, P, Fe).

SPECIFIC REPLY TO REFEREE 2

GENERAL COMMENTS

The authors tried to examine the responses of phytoplankton biomass in terms of Chl-a concentration and primary production to Saharan dust events through the mesocosm experiments conducted as part of the DUNE project. The differences in phytoplankton responses against the dry and wet depositions were rather clear and interesting. A number of companion papers such as Giovagnetti et al. (2013) and Ridame et al. (2013) in the DUNE project were very supportive to this paper, whereas the originality and significance of this paper would become rather weak. Below is my specific comments, mainly in the methodology the authors used, on this manuscript.

SPECIFIC COMMENTS

P760, L17_18: How did you collect seawater for the measurements of primary production? Did you use a trace metal clean technique?

RESPONSE: Seawater was collected for primary production samples as well as for all the parameters measured during the DUNE experiments using a trace metal clean system of permanent PVC tubing placed at the center of the bags and connected to a Teflon pump (as already mentioned in the submitted version p759, L2-5, section 2.1) (see details in Guieu et al., 2010). For more clarity, we have also added this information in the 2.2 section ('Primary production'): ' One sample per depth of unfiltered seawater was collected using the trace metal clean system, in the morning at two depths (0.1- and 5 m depth) during DUNE-1-P and -Q and at 5 m depth during DUNE-2-R for determination of primary production (PP). '

P760, L27_P761, L1: Please describe the methodology for the determination of total dissolved inorganic carbon (DIC) in seawater in order to calculate the excess value of 13C.

RESPONSE: The excess value of 13C was calculated from DIC concentrations measured at LOCEAN (SNAPO-CO2, Service National d'Analyse des Paramètres Océaniques du CO2) by a potentiometric method (e.g. as described by Corbière et al., 2007) using Certified Reference Materials (Batch 99) provided by Prof. A.G. Dickson (Scripps Institution of Oceanography, San Diego, USA) for calibration. The following sentence has been added in section 2.2 'The atom% excess was calculated using measured dissolved inorganic carbon (DIC) concentrations at LOCEAN laboratory (see detailed protocol in Corbière et al., 2007).'

P761, L14_17: This assumption could be invalid if the downward irradiance declined rapidly between 5 and 12.5 m. Please indicate the relative PAR levels (%) at the two layers to the surface.

RESPONSE: Photosynthetically available radiation (PAR) was not measured during DUNE-1. However, during DUNE-1, at some selected sampling days, PP was measured at the 3 depths (0.1, 5 and 10m depth). These data show that PP at 10m was on average 12% lower than PP measured at 5m depth. At these selected sampling days, depth-integrated PP calculated from measured data at 0.1, 5 and 10m depth was ~4% lower than that extrapolated from data measured at 0.1 and 5 m (assuming that PP at 12.5m depth was similar to that measured at 5m depth). This difference of 4% between both values is lower than the mean variation coefficient between the triplicate measurements in the Dust- and Control-meso (11%). This test shows that indeed, the extrapolation is accurate and a paragraph has been added to section 2.2.

P761, L17_19: Did you integrate the PP value at 5 m from 0 to 12.5 m assuming a rectangular distribution? Even if Chl-a profiles are uniform within the euphotic layer, as mentioned above, primary productivity can change with depth mainly due to a decrease in downward irradiance. I believe PAR data would be essential to estimate the depth integrated primary production, especially in the wet deposition experiments where Chl a concentrations increased.

RESPONSE: PAR was measured only at the subsurface of the mesocosms during DUNE-2-R (Giovagnetti et al., 2013; Guieu et al., 2014). For DUNE-2-R, we have integrated measured PP at 5m depth from 0 to 12.5 m assuming a uniform or rectangular distribution over the entire mesocosm. As for DUNE-1, PP was measured at the 3 depths (0.1, 5 and 10m depth) at some selected sampling times during DUNE-2-R. At these selected sampling days, depth-integrated PP calculated from measured data at 0.1, 5 and 10m depth was not significantly different (~+4% which is lower than the mean variation coefficient between the triplicate measurements in the Dust- and Control-meso (~14%)) from that extrapolated from data measured at 5m depth (assuming an uniform distribution over the mesocosm depth). The 2 last sentences have been added in section 2.2.

P762, L9 and P762, L15: Do not start a sentence with a numerical character. Two liters and Twenty milliliters would be better, respectively.

RESPONSE: This has been changed in the text.

P762, L22: Why did you not measure new production using 15N technique? The results of NPdust using the equations have already been published in Ridame et al. (2013). Therefore, I do not think that the section of 2.3 is necessary.

RESPONSE: New production (NP) can be estimated from 15N2 and 15NO3- uptake rates. In the DUNE experiments (P, Q, R), N2 fixation rates were measured and we have shown that the contribution of N2 fixation to the estimated NP was low after dust seedings ranging between 2-10% (Ridame et al., 2013). As a consequence, NP was mainly supported by NO3− as source of N. During DUNE-2-R, we performed experiments of 15NO3- uptake to calculate NP. The nitrate concentrations were under detection limit (< 30 nM) in the Control-meso over the duration of the experiment as well as in the Dust-meso before the seeding and at the end of the experiment. Under these conditions, enrichment of the dissolved fraction with 15N may range from 50 to 100% and cause a strong overestimation of the uptake rates. Nevertheless, we were able to calculate the 15NO3- uptake rate (40 nmol N. l-1.d-1) 24 hours after the first seeding in the Dust-meso. This flux was much higher than the corresponding N2 fixation rate (0.3 nmol N. l-1.d-1) meaning that ∼99% of NP was supported by nitrate uptake 24 hours after the seeding. Based on measured particulate C/N ratios at t=24h, calculated NP (as the sum of 15N2 and 15NO3- uptake rates) represented on average 63% of PP which is in good agreement with the NP/PP ratio (65%) from our estimated NP (details of calculation in section 2.3 of the submitted version). In the same way, the calculated NP (15N2 and 15NO3- uptake rates) and the estimated NP in the Dust-meso, 24 hours after the second seeding led also to similar results (NPcalculated/PP=65% and NPestimated/PP=69%). These results show that our estimates of NP are accurate. We decided to not publish those data because (i) they are fragmented for DUNE-2-R (no nitrate uptake rates in the samples where nitrate concentrations were under detection limit) and (ii) having not these data for DUNE-P made the comparison tricky between experiments.

The section 2.3 has been removed as equations and NPdust results have already been published in Ridame et al., (2013).

P762, L12: Strickland and Parsons, 1972?

RESPONSE: This has been changed in the text.

Table 1: This table is completely the same as Table 1 in Ridame et al. (2013). So it should be removed.

RESPONSE: We have chosen to keep this table in this manuscript even though it is the same that in Ridame et al., 2013. It allows the readers to have key supporting information directly in the paper without referring to another paper.

Fig. 1: These pictures are not informative for readers. I would recommend the authors delete them.

RESPONSE: these pictures have been removed in the revised version

Fig. 8: How did you make these figures? Please describe the modeling methods of nitrate and DIP in text in detail.

RESPONSE: We did not use a modeling method to perform fig. 8. These lines represented the general trend of the temporal variations of nitrates and DIP concentrations. For a better understanding, this figure has been changed by using the calculated variation (DUST-CONTROL) of the DIP and nitrate stocks.

References

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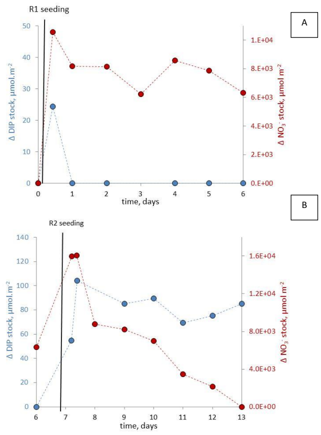

Fig.8: Averaged temporal changes in the variation (Dust-Control) of NO_3^- (red line) and DIP stock (blue line) (A) after the DUNE-2-R1 seeding and (B) after the DUNE-2-R2 seeding.

Fig. 1.