Biogeosciences Discuss.,
doi:10.5194/bg-2015-615-AC2, 2016

Biogeosciences Discussions
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Interactive comment on "Introduction to the project VAHINE: VAriability of vertical and tropHIc transfer of diazotroph derived N in the south wEst Pacific" *by* S. Bonnet et al.

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Received and published: 1 March 2016

Dear Reviewer,

We thank you for the constructive comments and suggestions, which have improved the manuscript. We have addressed the concerns in a point by point response below (comments are copied with our replies below) and in a revised manuscript.

Best Regards, Sophie Bonnet

Reviewer 2.

Page 3 line 32-34, Page 4, line 1-7 The four stated research questions could be better

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formulated. I would recommend removing the three subquestions or making them independent. Have you considered structuring them to indicate any priority in research? At the moment it sounds like you wanted to measure everything.

The three subquestions have been removed and the questions formulated as research priorities as follows: 'The main scientific research priorities of the project were: i) To quantify the DDN which enters the planktonic food web, ii) To investigate how the development of diazotrophs influences the subsequent diversity, gene expression, and production of primary producers, heterotrophic bacterioplankton, and subsequently the zooplankton abundance, iii) To examine whether different functional types of diazotrophs significantly modify the stocks and fluxes of the major biogenic elements (C, N, P), iv) To elucidate whether the efficiency of particulate matter export depends on the development of different functional types of diazotrophs.

You might also want to consider including a single sentence next to each of the research questions highlighting the results from the project to provide the reader with an immediate answer as to what was found.

Please see response to Reviewer 1: We decided not to provide one or two sentences of the major results after each scientific question, as it would require many explanations. We rather extended the section 4 of the manuscript 'Special issue presentation' and summarized the major results of each contributing paper to the special issue to provide the reader the main findings of this study. Section 4 has thus been totally modified.

Page 5 Line 7. I have not read the DUNE project work, but I recommend including some additional references to the use of mesocosms in ecological studies.

An additional sentence and aadditional references have been provided, among which a review paper on mesocosms (Stewart et al., 2013) page 5 line 15: 'Mesocosms are now widely used in ecological studies (Riebesell et al., 2013; Stewart et al., 2013) and enable isolation of water masses of several cubic meters from physical dispersion for several weeks. . .'. The Stewart et al. reference has also been added page 5 line 25:

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'Among the different types of mesocosms available (Stewart et al., 2013), the model of mesocosms chosen for this study (surface 4.15 m2, volume ∼50 m3, Fig. 1) are sea-going mesocosms entirely transportable that can be used under low to moderate wind/wave conditions (20-25 knots/2.5 wave height). They have been designed in the framework of the DUNE project (Guieu et al., 2010; Guieu et al., 2014) and consist in large transparent bags made. . .'

Page 16 Line 18 A black and white map would be equally useful as the color images shown demarking the position of the mesoscom experiment. I realize its bland but can be effective.

Figure 3b has been replaced by a black and white map.

Page 7 Line 21 How was the concentration of DIP decided and what would have happened if you added more or less?

We decided to add 0.8 μM of phosphate because such concentrations have already been measured in the New Caledonian lagoon and pre-experiment modelling studies and were shown to be able to stimulate N2 fixation. We knew that phosphate availability was the ultimate control of nitrogen inputs by N2 fixation there (Moutin et al., 2005, 2008). Finally, simulated (thanks to the ECO3M model, see Gimenez et al., 2016, This issue) and experimental responses obtained after a 0.8 μM phosphate enrichment are close, and simulated response without phosphate enrichment show a very different and low response of the plankton community inside the mesocosms (Gimenez et al., 2016). The addition of more phosphate might not change so much the short term (20 days) response of the system because the time of the response is mainly controlled by the lag time between change in growth rate at the cell level and change in growth rate at the population level (Gimenez et al., 2016). The following sentence has been added to the text: 'Such concentrations have already been measured in the New Caledonian lagoon and were shown to be able to stimulate N2 fixation. The amount of DIP added was also chosen based on the modelling work performed by Gimenez et al. (2016),

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confirming a clear stimulation of N2 fixation by 0.8 μmol L-1 DIP in our experimental systems, and an absence of stimulation without any DIP enrichment.

Did you consider also adding iron or something micro-nutrient?

New Caledonian soils are very rich in metals. A third of its surface (5500 km2) is covered by soils originating from ultramafic rocks (peridotites and serpentinites) which have exceptionally high levels of metals such as Fe, Ni, Cr, Co, and Mn. Lagoon waters are thus rich is metals as well and Fe in particular is not limiting for phytoplankton growth. We thus decided not to supplement the mesoscosm with trace metals. The following sentence has been added page 8 line 31: 'New Caledonian soils are very rich in metals. A third of its surface (5500 km2) is covered by soils originating from ultramafic rocks which have exceptionally high levels of metals such as Fe, Ni, Cr, Co, and Mn (Jaffré, 1980). Consequently, dissolved trace metals are particularly abundant in the Noumea lagoon (Migon et al., 2007). Iron concentrations measured during the Diapalis cruises around New Caledonia were higher than those reported in the sub-tropical North Pacific and the high iron inputs in this region are hypothesized to drive the South West Pacific towards a DIP depletion (Van Den Broeck et al., 2004). Metals were thus not supplemented to the mesocosms'.

Page 8 Line 30 Why did you stop sampling after 23 days when you had the maximum fluorescence? I realize this probably relates to logistics, but clearly there were still changes occurring inside the bags that would have been good to capture.

We totally agree with this comment, it would have been very interesting to sample after day 23 as we reached the maxima of fluorescence at that period. The R/V Alis was assisting the project and for logistical reasons (time ship allocated to the project), it was planned in advance that the experiment could only last for 23 days. The Eco3M model platform (companion paper from Gimenez et al., 2016) was used to simulate carbon export up to day 35 and shows that C export greatly increased after day 23.

Figures: I am not sure that Figure 5a-c is necessary. I am not a big fan of the ocean

data view color palette. For example it is difficult to interpret changes in fluorescence.

Nitrate concentrations were close to quantification limits during the course of the experiment, indicating that other sources of nitrogen (among which N2 fixation) were providing the major sources of nitrogen to the system. We believe it is important to keep the nitrate plots in Figure 5 to inform the reader of the nitrate deficiency in the system with respect to phosphate. However, the figure has been slightly modified.

Literature cited Gimenez, A., Baklouti, M., Bonnet, S., and Moutin, T.: Biogeochemical fluxes and fate of diazotroph derived nitrogen in the food web after a phosphate enrichment: Modeling of the VAHINE mesocosms experiment, Biogeosciences Discussions, doi: doi:10.5194/bg-2015-611, 2016. 2016. Guieu, C., Dulac, F., Desboeufs, K., Wagener, T., Pulido-Villena, E., Grisoni, J.-M., Louis, F., Ridame, C., Blain, S., Brunet, C., Bon Nguyen, E., Tran, S., Labiadh, M., and Dominici, J.-M.: Large clean mesocosms and simulated dust deposition: a new methodology to investigate responses of marine oligotrophic ecosystems to atmospheric inputs, Biogeosciences, 7, 2765-2784, 2010. Guieu, C., Dulac, F., Ridame, C., and Pondaven, P.: Introduction to project DUNE, a DUst experiment in a low Nutrient, low chlorophyll Ecosystem, Biogeosciences, 11, 425-442, 2014. Jaffré, T.: Etude écologique du Peuplement Végétal Des Sols Dérivés de Roches Ultrabasiques en Nouvelle-Calédonie, Paris, 1980. Migon, C., Ouillon, S., Mari, X., and Nicolas, E.: Geochemical and hydrodynamic constraints on the distribution of trace metal concentrations in the lagoon of Noumea, New Caledonia, Estuarine, Coastal and Shelf Science, 74, 756-765, 2007. Riebesell, U., Czerny, J., von Bröckel, K., Boxhammer, T., Büdenbender, J., Deckelnick, M., Fischer, M., Hoffmann, D., Krug, S. A., Lentz, U., Ludwig, A., Muche, R., and Schulz, K. G.: Technical Note: A mobile sea-going mesocosm system – new opportunities for ocean change research, Biogeosciences, 10, 1835-1847, 2013. Stewart, R. I. A., Dossena, M., Bohan, D. A., Jeppesen, E., Kordas, R. L., Ledger, M. E., Meerhoff, M., Moss, B., Mulder, C., Shurin, J. B., Suttle, B., Thompson, R., Trimmer, M., and Woodward, G.: Mesocosm Experiments as a Tool for Ecological Climate-Change Research, Advances

in Ecological Research, 48, 71-181, 2013. Van Den Broeck, N., Moutin, T., Rodier, M., and Le Bouteille, A.: Seasonal variations of phosphate availability in the SW Pacific Ocean near New Caledonia, Marine and Ecological Progress Series, 268, 1-12, 2004.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/bg-2015-615/bg-2015-615-AC2-supplement.pdf

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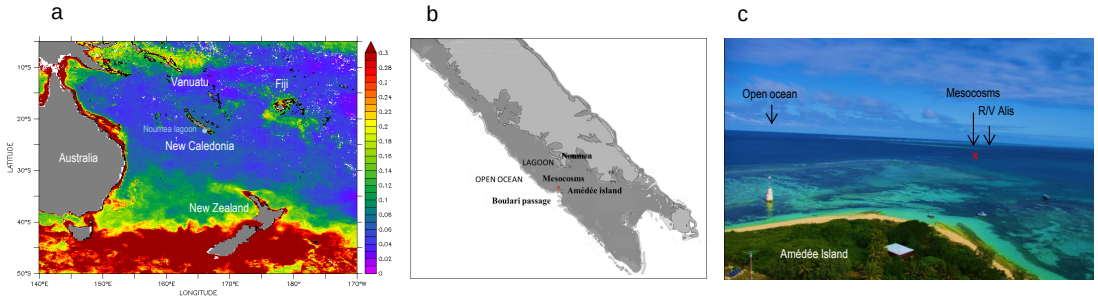

Figure 3.

Fig. 1. Figure 3

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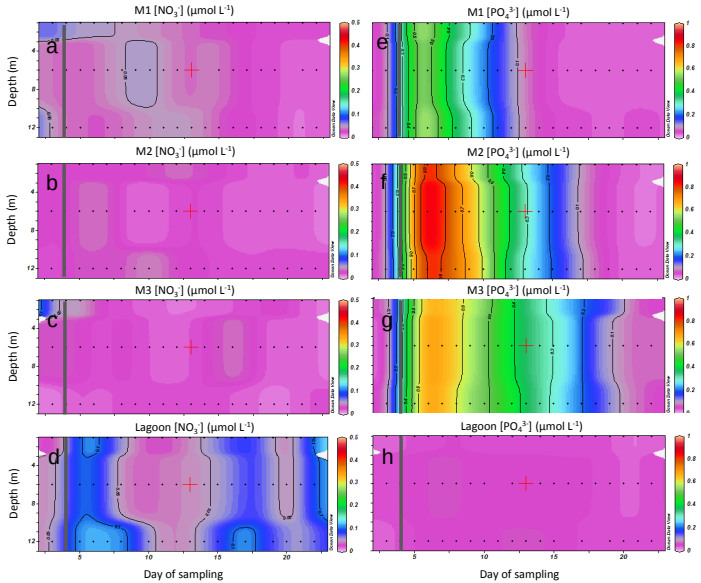

Figure 5.

Fig. 2. Figure 5

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