

Interactive comment on “Biogeochemical and biological impacts of diazotroph blooms in a Low Nutrient Low Chlorophyll ecosystem: synthesis from the VAHINE mesocosm experiment (New Caledonia)” by S. Bonnet et al.

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Dear Jorge Corredor,

First, we would like to thank you very much for your constructive comments. We made our best to take into consideration all comments and suggestions. Comments and questions are copied with our replies below in bold font.

Sophie Bonnet on behalf of co authors

Referee #1

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SPECIFIC COMMENTS p.16: 19-20 – Authors argue that detritus and DON ... “likely provided” the balance of bacterial N demand unaccounted by DDN since concentrations of these two components “decreased during the 23 days of the experiment”. A couple of rapid calculations can easily dispel this doubt providing a better view of relative magnitudes and revealing gaps in this budget if at all.

The sentence has been modified as follows: “Calculations based on C:N molar ratios show that N₂ fixation may have provided ~30 % of the N demand of the N-limited bacteria during P2 (compared to ~20 % during P1), the rest (representing 0.6-0.7 $\mu\text{mol L}^{-1}$) was likely provided by detritus and DON (Van Wambeke et al., 2015), which concentrations decreased by $\sim 0.9 \mu\text{mol L}^{-1}$ during the 23 days (Berthelot et al., 2015b).”

p. 17:7-28 - The review of the role of *Trichodesmium* in N export, while pertinent to the discussion, is beyond the scope of the mesocosm experiment and should thus be abbreviated considerably

A *Trichodesmium* bloom occurred during the VAHINE experiment, albeit outside the mesocosms. Nevertheless, this bloom has been characterized and results are presented in Spungin et al. (2016) in the present special issue. We strongly believe that these results are worth considering in the present synthesis article. Nevertheless, we considerably reduced this section as follows: “Similar experiments (15N₂ labelling, flow cytometry cell sorting and nanoSIMS) performed on three naturally-occurring *Trichodesmium* spp. blooms in the southwestern Pacific illustrated that DDN was predominantly transferred to diatoms (Bonnet et al., Accepted). These results indicate that the extensive oceanic blooms of *Trichodesmium* spp. can contribute to a subsequent indirect yet large downward flux of organic matter by promoting large cells growth (e.g., diatoms and dinoflagellates) characterized by efficient export rates (Nelson et al., 1995, Bonnet et al., Accepted; Devassy et al., 1979; Lenes et al., 2001). Direct export flux of *Trichodesmium* spp. blooms may also occur in cases where rapid (< 2 d) bloom mortality occurs via a programmed cell death (PCD) (Berman-Frank et al., 2004; Berman-Frank et al., 2007). PCD in *Trichodesmium* spp. is characterized

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by the loss of buoyancy (collapse of gas vesicles) and increased production of TEP and aggregation leading to enhanced and massive vertical flux (Bar-Zeev et al., 2013). A *Trichodesmium* spp. bloom that occurred outside the VAHINE mesocosms on days 23-24 displayed mechanistic features of PCD including mass mortality within 24 h, loss of gas vesicles, and high production of TEP (Berman-Frank et al., 2016; Spungin et al., 2016). While we could not directly quantify the export flux as no sediment traps were deployed in the lagoon outside the mesocosms, the characteristics of the bloom, minimal grazer influence and the demise of biomass suggests this would lead to high rates of export (Spungin et al., 2016) as demonstrated in culture simulations (Bar-Zeev et al., 2013) (Fig 5c). “

TECHNICAL CORRECTIONS

Abstract: 9 – delete “potential”

This word has been deleted

p.7 11-23 – It is preferable to pose your objectives as statements rather than questions. Indeed, objective iii is posed as a statement but provided with an erroneous question mark! The same for the first line in objective iv.

The objectives have been reformulated as statements as in the Introductory paper in the same SI: 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 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.

27 – consider changing “stable” for “unique”

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p.8 14 – change “has been” to “was”. (The experiment is not ongoing; it was terminated after 23 days).

16 change “harbouring” to “exhibiting”

These changes have been applied.

p.13 21 – refrain from citing your work as the “first”. If it really is, others will identify it as such.

We concur and have changed this especially on page 15.

26 – Change “way” to “pathway” p.14 1- Change “the one” to “that” 15- Change “The export” to “Export”; change “has not” to “was” 26 – Rephrase to eliminate inappropriate question mark. 28 – Eliminate redundancy; change second “UCYN-C” to “these” p.15 6 – Rephrase to avoid “first”. Perhaps, “We thus demonstrate that UCYN blooms may result in substantial DDN release.”

The suggested changes have been applied.

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