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Interactive comment on “Nitrogen isotopic evidence for a shift from nitrate- to diazotroph-fueled export production in VAHINE mesocosm experiments” by A. N. Knapp et al.

Anonymous Referee #1

Received and published: 30 December 2015

General: This manuscript is intended to be part of a special issue on mesocosm experiments undertaken to track the fate of nitrogen fixed by diazotrophs in a low nutrient low chlorophyll tropical environment (VAHINE project). Complimentary papers have been either published (Berthelot et al., BG, 2015) or are in review (Bonnet et al., BGD, 2015).

The major conclusion by the authors is that diazotrophically derived nitrogen (DDN; by UCYN-C) effectively contributes significantly to export of PON, but indirectly, after being recycled and incorporated into non diazotrophic phytoplankton (mainly diatoms). Aggregated UCYN-C cells are reported to contribute to export but only to a minor de-

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gree (<10%). This conclusion differs from the one in the Bonnet et al. paper (BGD, 2015) in which aggregation of UCYN-C cells into larger particles is highlighted. Such aggregates are reported by Bonnet et al. to contribute as much as 22.4 % of the POC export. The other contributors to export effectively being non-diazotrophs who benefited N transfer from the diazotrophs. There is a need here to clarify and homogenise the conclusions formulated in these two papers.

In their introduction (and again at page 19920) the authors raise the point that while export of DDN would effectively transfer isotopically light N to the thermocline region it cannot account for elevated NO₃/PO₄ ratios (i.e., regions with N* >0), since micro-organisms who acquired DDN would export organic matter with Redfieldian stoichiometry. Would the fact that Bonnet et al. (BGD, 2015) indeed assign a significant part of the export to sinking UCYN-C cells (having N/P ratios 25:1 to 50:1) contribute to explain this condition?

The section (pp 19920 to 19922) about the imbalance between DIP that was drawn down and the accumulation of P in different reservoirs is very long and it is unclear what exact purpose it serves.

Specific: The mass balance considered to calculate the fraction of PN export supported by N₂ fixation sets isotopic signature of export = isotopic signatures of the inputs (upward advection of thermocline NO₃ and N₂ fixation). This makes sense for a steady state system, but is this the case here? The approach is valid nevertheless because the NO₃ pool in surface waters is in a state of permanent depletion, and thus isotopic discrimination during uptake is probably muted. Authors could clarify this in the ms.

The issue about differences between DON results for P2 with those published by Berthelot et al. (2015) is a bit disturbing, and one wonders why methods have not been compared earlier.

Page 19912, section 3.3: Decrease of the d¹⁵N-PNsink during phases P1, P2. While this is clear for M1 and M2, M3 on the contrary shows an increase of d¹⁵N from P1 to

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P3. This should be discussed.

Page 19912, section 4.1: the wording 'complete' consumption of NO₃ and NH₄ does not make sense, since concentrations are never zero.

Page 19922, line 15: the sentence about silica matrices inhibiting recovery of the missing P is unclear.

Quality of graphs could be improved bu using coloured symbols.

Interactive comment on Biogeosciences Discuss., 12, 19901, 2015.

BGD

12, C8769–C8771, 2015

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