

Interactive comment on “Chemolithoautotrophic production mediating the cycling of the greenhouses gases N₂O and CH₄ in an upwelling ecosystem” by L. Farías et al.

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This manuscript presents results from a times series study of hydrographic conditions, concentrations of nutrient, dissolved N₂O and CH₄, POC, δ -¹³C signatures of POC and light/ dark autotrophic carbon fixation in the oxygen minimum region of the Chilean upwelling system. Authors also present selective inhibitor experiments to discern relative contributions of Crenarcheota and proteobacterial nitrifiers to dark carbon fixation. The results presented are novel, interesting and scientifically important. I do believe this paper is a significant contribution to Biogeosciences Discussion.

There are many small editorial changes needed which I attribute largely to errors in

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translation to English, rather than fundamental flaws in the science or logic. I list my suggestions/concerns about phrasing in detail below. I do have higher order concerns over a few points that the authors have ignored in the text. The first concern being total disregard for the potential importance of anammox in dark carbon fixation in both the experimental design and discussion of the results. If the authors have valid justifications for ignoring anammox, then they should explicitly say so in the Introduction. Otherwise, they must acknowledge limitations to their interpretation. The second concern is the attribution of all observed dark carbon fixation to chemoautotrophy. I'm sure the authors are aware that a fraction of measured CO₂ incorporation is due to anaplerotic reactions carried out by all ecophysiotypes. So especially in the photic zone where biomasses are highest, a significant fraction of their ρ ¹³CO₂ signal may not be chemolithoautotrophy at all. Authors should estimate what this contribution may be. Thirdly, I believe that referring to their measurements of N₂O and CH₄ as metrics of “cycling” is misleading. What the authors have measured are net fluxes of these gases into headspaces of closed vessels, which will depend upon balance between production and consumption as well as gas solubility. Without directly measuring either production or consumption in addition to net flux, one can say very little about “cycling”, i.e., theoretically the same net flux could be measured if N₂O or CH₄ were cycling slowly or rapidly.

1. Does the paper address relevant scientific questions within the scope of BG? - YES
2. Does the paper present novel concepts, ideas, tools, or data? - YES
3. Are substantial conclusions reached? - YES
4. Are the scientific methods and assumptions valid and clearly outlined? - YES (mostly)
5. Are the results sufficient to support the interpretations and conclusions? - YES

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6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? - YES
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? - YES
8. Does the title clearly reflect the contents of the paper? - YES
9. Does the abstract provide a concise and complete summary? - YES
10. Is the overall presentation well structured and clear? - YES (room for improvement)
11. Is the language fluent and precise? - Not entirely
12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? - YES (but abbreviations and acronyms are over-used. Easy for reader to get lost in alphabet soup!)
13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? - YES (some clarification is necessary. Don't recommend any deletions or combinations)
14. Are the number and quality of references appropriate? - YES
15. Is the amount and quality of supplementary material appropriate? - N/A

Specific Editorial Suggestions:

1. consistently use the term "chemolithoautotrophs" and ban use of "chemosynthetic" which to my way of thinking is much too ambiguous.

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2. pay closer attention to significant figures when presenting data. Too many values to right of decimal place suggests greater than actual precision/accuracy.
3. the redoxcline is a layer of finite thickness. One can sample above, within or below a redoxcline, but not "at the redoxcline". E.g., pg. 6207, line 17
4. Pg. 6207, line 19. To what does "They..." refer?
5. Pg. 6207, line 27. – replace "well reported" with "examined"
6. Pg. 6208, lines 5-7. I suggest mentioning anaerobic methane oxidizers in this section even though not experimentally addressed.
7. Pg. 6208, line 26 – "northerly", not "northernly"
8. Pg. 6209, line 25 – gases and nutrients should be singular.
9. Pg. 6212, line 8 – "in the filter" or "on the filter"?
10. Pg. 6212, line 9 – "In Eq. (2)" I believe you mean Eq. 3.
11. Pg. 6212, line 23 – delete "a similar"
12. Pg. 6214, line 4 – replace "cycling" with "fluxes"
13. Pg. 6215, line 18 – "multiplied"
14. Pg. 6215, line 20 – "linear"
15. Pg. 6215, line 21 – replace "from each meter" with "between each sampled depth"
16. Pg. 6216, line 3 – "August 2002 to date" present date of final data point

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17. Pg. 6217, line 19 – “on average”, not “in average” (phrase appears several times throughout ms)
18. Pg. 6218, lines 1-2 – specify direction of flux
19. Pg. 6218, lines 7-9 – sense of sentence is unclear and some misspelling
20. Pg. 6219, lines 10-12 – I could not follow logic of this sentence
21. Pg. 6219, line 17 – “lower than expected. . .” meaning is unclear
22. Pg. 6219, line 24 – “O-L plus B-L” suggest O-L and B-L combined. I also suggest abandoning abbreviations for surface layer, oxycline and bottom layer
23. Pg. 6219, lines 25-27 – Interpretation of dark CA in surface layer must be done cautiously. Is evidence strong that chemoautotrophy is driving it in this layer?
24. Pg. 6220, lines 1-2 – awkward sentence
25. Pg. 6220, line 16 – “1.282” should be “1,282” I believe
26. Pg. 6220, line 25 – “16.930” should be “-16.930”, shouldn't it?
27. Pg. 6221, line 10 – symbol for correlation coefficients is “r”, not “ ρ ”
28. Pg. 6221, line 10 – “except NO₃” but what N-oxides are included in your budget? Why not just list them rather than imply all N-oxides?
29. Pg. 6221, line 13 – sentence doesn't make sense
30. Pg. 6221, line 20 – sentence doesn't make sense to me
31. Pg. 6221, line 22 – sentence is confusing partially due to organization of Figs. 6a and 6b. I suggest that Fig. 6b becomes Fig. 7

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32. Pg. 6221, line 27 – methanotrophs are not archaeal, so why would GC7 act on them?
33. Pg. 6222, line 2 – that figure only has 2 time points! Authors can not claim linearity based on 2 time points.
34. Pg. 6222, lines 15-18 – N₂O production was not measured. Net flux to headspace was measured.
35. Pg. 6222, line 19 – “ten-fold net consumption rate.”
36. Pg. 6223, lines 7-8 – sinking POM doesn't respire, the associated biota do.
37. Pg. 6223, line 11 – “Carbon cycling is a vague term in this context.
38. Pg. 6223, lines 18-19 – I believe “linear depth integration” is actually interpolations??
39. Pg. 6223, line 23 – aren't all Gibbs free energies negative?
40. Pg. 6224, line 14 – Cariaco Basin with capital B
41. Pg. 6224, line 18 - Cariaco Basin is misspelled
42. Pg. 6224, line 19 – Mariager fjord is misspelled
43. Pg. 6224, line 28 – “but held high” probably should be “but exhibited high”
44. Pg. 6225, lines 1-4 – I have trouble following the sense of this sentence.
45. Pg. 6225, line 7 – strike “visible”
46. Pg. 6225, line 8 – oxidized misspelled

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47. Pg. 6225, line 9 – I dispute this is “confirmed”, evidence is suggestive or supportive
48. Pg. 6225, lines 8-14 – passage is unclear. I recommend restructuring
49. Pg. 6225, line 12 – Hollibaugh
50. Pg. 6225, line 19 – “in OM”
51. Pg. 6225, line 20 – “heavier”
52. Pg. 6225, lines 19-22 – sentence is confusing.
53. Pg. 6226, line 3 – higher than what?
54. Pg. 6226, line 5 – “This distribution is consistent with..”
55. Pg. 6226, lines 10-12 – This statement is difficult to accept since samples are acidified to remove carbonates and non-organic ¹³C-fractions. More support is required for this statement or alternatively delete altogether.
56. Pg. 6226, line 13 – “responsible for” instead of “significantly involved in”
57. Pg. 6226, line 19 – strike “in terms”
58. Pg. 6226, lines 21-25 – Sentence is unclear.
59. Pg. 6226, line 27 – Jansson is misspelled
60. Pg. 6227, lines 4-8 – Sentence is unclear
61. Pg. 6227, lines 10-12 – How was CA rate per archaeal cell determined???
62. Pg. 6227, lines 13-14 – What efficiencies and assumptions were employed for these calculations? Needs more explicit description.

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63. Pg. 627, lines 22-24 – Sentence is confusing.
64. Pg. 6228, lines 1-4 – These sentences need refinement are not entirely accurate. I refer authors to Lin et al. 2006,2008 for recent advances.
65. Pg. 6228, lines 8-10 – “affiliation” and how was this identification made?
66. Pg. 6228, lines 12-13 – subheading strikes me as awkward
67. Pg. 6229, line 3 – “higher if methanotrophs did not act” must be a better way to express this concept.
68. Pg. 6229, lines 5 and 18 – “cycling rates” replace with “fluxes”
69. Pg. 6229, lines 6-10 – net rates not consumption
70. Pg. 6229, line 13 – enzyme
71. Pg. 6229, lines 15-18 – I don’t understand the point of this sentence.
72. Pg. 6230, line 2 – “is not discarded..” meaning unclear. Anaplerotic reactions should be considered here.
73. Pg. 6230, line 15 – “in the long term,..” do you mean something along the lines of “global sense”?
74. Pg. 6236, Table 1 – units are concentration and integrals, but titles refer to fluxes. Which is correct? Gray regions are difficult to see. “upwelling favorable period”. “irradiance”
75. Pg. 6237, Table 2 – meaning of “their content percent” is unclear. footnote C is unclear. “Average”
76. Pg. 6238, Table 3 – “Time Series”, “includes”

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77. Pg. 6239, Table 4 – meaning of “recycling” in title. Please convert O₂ concentrations to μM , “Metabolism”, “%Microbes sensitive to ATU, etc.” – was this actually measured? If so, how? “Gas cycling” = net flux??. pay attention to significant figures, meaning of footnote is unclear.
78. Pg. 6240, Table 5 – meaning of title? Value for Cariaco is 5-30 mg C m⁻³ d⁻¹ (0.32-1.90 g C m⁻²d⁻¹) for Taylor et al. 2001 for Ho et al. 2004, it's 2.4-31.2. footnote h is unclear. HS- accumulation is actually $\leq 75 \mu\text{M}$. “within redoxcline”
79. Pg. 6242, Fig. 2 – “indicates the presence of the ESSW”
80. Pg. 6246, Fig. 5 – what is difference of POM and POC?
81. Pg. 6246, Fig. 6 – labeling and title are confusing. Make Fig. 6b Fig. 7
82. Pg. 6247, Fig.6b – are y-axes labeled correctly? How can a rate be determined at T₀?

Interactive comment on Biogeosciences Discuss., 6, 6205, 2009.