

Interactive comment on “N₂ fixation in eddies of the eastern tropical South Pacific Ocean” by C. R. Löscher et al.

Anonymous Referee #1

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Eddies are complex phenomenon in the ocean. Their impacts on the biogeochemistry are not well understood. Löscher et al. have done a thorough analysis of biogeochemical parameters in three different eddies (two anticyclonic and one cyclonic) in the eastern tropical South Pacific Ocean. I believe their N₂ fixation analysis is robust. Authors have clearly shown the concurrence of N₂ fixation and N loss, which has been hypothesized in many studies but never observationally proved. However, I think the following issues need to be addressed.

1. Why is carbon fixation higher at the deeper depths and associated with N₂ fixation? Authors concluded that N₂ fixation co-occurred with N loss process. So how was carbon fixation sustained (during the incubations) without reactive nitrogen? In addition, Fig. 3 suggests that C fixation was very high in the centre of eddy B at above 100

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m depth, but there was no reactive nitrogen at that depth either. So what sustained C fixation? My guess is that all these higher carbon fixation rates are sustained by reactive nitrogen from N₂ fixation. If the authors have ammonium (released from the fixed nitrogen) data then my hypothesis can be (dis)proved.

2. Was there sufficient light to sustain carbon fixation at around 300 m depth (Fig. 3).

Minor comments:

Page 18948, Line 2: “Nitrogen.....ocean (Codispoti, 1989)” is slightly incorrect statement. It is reactive nitrogen (NH₄, NO₃) that limits primary production, as ocean has plenty of N in the form of dissolved gas. “is limiting” should be replaced as “limits”

Page 18948, Line 25-29: “In addition..... reported for this region (Chaigneau et al., 2009).” is confusing. Does the last part of the paragraph mean that the no of eddies are increasing, or no. of reported eddies are increasing?

Page 18950, Line 11-13: How was the age of eddies estimated?

Page 18951, Line 2: Why only autotrophic? Why cannot positive P* stimulate heterotrophic N₂ fixation?

Page 18951, Line 8: Replace “N₂/Ar-1” by “N₂/Ar”

Page 18951, Line 13: But anammox can occur at [O₂] > 10 μM

Page 18951, Line 13: M90 does not have any locations in the northern hemisphere. So location 1.67° N seems to be incorrect.

Page 18951, Line 18: Replace “N₂ Ar-1” by “N₂/Ar”

Page 18952, Line 10-12: “For each.....of the rates”. Then mention the range of measured enrichment values.

Page 18952, Line 25: “-” should be replaced by > or ~, whichever applicable.

Page 18956, Line 7-10: “A coastal origin.....signals” How could the movement

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of eddy C be the reason for lower N loss? Explain.

Page 18957, Line 5: Previous studies that the authors have mentioned also presented quantitative rates. Then why the authors say “first quantitative rates of N₂ fixation?”

Page 18958, Line 18: Replace “consistence” with “consistency”

Page 18959, Line 24-27: “As previous. eddy C.”. How? Then N₂ fixation should have also occurred at the surface in the eddies A and B.

Page 18966: Caption of Table 1. Replace “biogeochemical properties” by “biogeochemical parameters”

Page 18967: Caption of Fig. 1. Acronym SSHA does not go together with Aviso sea level anomaly

Page 18968: Caption of Fig. 2. Delete “Hydrographic. 16°45’S.” Page 18969: Enlarge the legend and axes title of Fig. 3

Page 18971: Caption of Fig. 5: Does eddy A stand for eddy A1 or A2?

Page 18972: Caption of Fig. 6: “Strongest negative correlations are present between N₂ fixation and O₂ and N₂ fixation and O₂.” should be replaced by “Strongest negative correlations are present between N₂ fixation and O₂.”

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/12/C9359/2016/bgd-12-C9359-2016-supplement.pdf>

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