Referee report to version 2.

Overall this is a major improvement since the last draft. I recommend acceptance after minor revision.

After reviewing the revised manuscript and the authors' response, I think there is one major problem that the authors should clarify: The inconsistency between N2 production and gross N2O production with acetylene, which is demonstrated in figure 3d and 4d. Current understanding is that, N2O is an intermediate in the sequence of denitrification. When N2 production is measured by nitrite reduction, N2O production with acetylene should have similar rates. This was not observed in the result; quite surprisingly, N2 production and N2O production decoupled. The authors can add some comments in line 30, page 10.

Three minor issues concerning the nitrite production experiments that I would hope the authors clarify.

First, in section 3.3.3 (page 10-11), the authors claimed major sources of nitrite as either nitrate reduction or ammonium oxidation in September sampling. Drawing this conclusion should be careful because the oxygen condition was manipulated, at least for 25 m samples, in the incubation experiment.

Second, the authors should point out that ammonium oxidation to nitrite occurred under helium-purged samples, in section 3.3.3 and section 4.2.3. And use some of their 'response to reviewers' in the main text to support their experimental findings (i.e. high oxygen affinity during ammonium oxidation in cultures and natural waters). In page 6, line 31 – 34 the authors stated the procedure of the incubation. Unless the authors transferred the water in oxygen-free environment (e.g. glove bag or anaerobic chamber), oxygen contamination is highly likely. I think it more important to validate the oxygen concentration in the 12 ml vials, rather than the 250 ml bottle.

Third, I would encourage the authors to acknowledge their GC7 and ATU inhibitor experiments provided internally consistent data, and both inhibitors were working well (P14, L6 – 8). As I have stated earlier, the sum of nitrite production rates of ATU- and GC7-treatments matches, within the scale of error bars, the rate using 15-ammonium without inhibitor. Because ATU experiments yielded very low rates, nitrite production during the GC7 experiment was close to the rate from the control. If GC7 was not an effective inhibitor, then ATU would not be effective as well, and the experimental results would become a big question mark. I think the central Chilean upwelling system is unique in that bacterial contribution to ammonium oxidation is more significant because of influence from shelf sediment. For this case, it is not an issue that the authors found different things than the other investigators. It is an issue treating their own data unfairly.

Other wording issues:

P2, L 2-3: Confusing sentence. Do you mean the oxycline, from oxygen saturation to anoxia, spans only a few meters, located in 30 – 50 meters depth?

P2, L4: Nitrification is not considered as nitrogen removal process. Please revise accordingly

P2, L15: What do you mean by ‘main subsidiary processes’? Wordiness and confusing. Also, define DNRA because in the main text there are terms like ‘DNaRA’ and ‘DNiRA’. Please make it easier to the readers. I would recommend using the full name of these processes.

P4, L3: Delete ‘mechanism or’

P4, L4: What is ‘almost completely’? Wordiness and confusing. Under anoxia (no oxygen), N2O is completely reduced to N2.

P6, L30: Change to ‘purged with He for 15 min’

P10, L25: I would choose ‘September’ rather than ‘spring’ here. I request once again about naming of the seasons and sampling times throughout the text. When referring to sampling period, which happens in a short time scale, I suggest using “September” and “January”. When discussing seasonal features on a longer time scale, please use “spring” and “summer”.

P14, L6: Please change: ‘related to’.

P17, L11 – 15: Here, I would suggest adding some simple calculation, just as they showed in the ‘response to reviewers’, to demonstrate the N fixation is a source of nitrate that should not be neglected.

Caption in figure 4: State that the N2O production rate when measured under C2H2 addition, is ‘gross production rate’.