Biogeosciences Discuss., 6, C482–C487, 2009
www.biogeosciences-discuss.net/6/C482/2009/

Biogeosciences Discussions

Interactive comment on "The influence of hypercapnia and macrofauna on sediment nutrient flux – will ocean acidification affect nutrient exchange?" *by* H. L. Wood et al.

H. Wood

hawo@pml.ac.uk

Received and published: 21 May 2009

The influence of hypercapnia and macrofauna on sediment nutrient flux – will ocean acidification affect nutrient exchange?

Authors response to referees comments, Wood et al.

Reply to referee #1

We firstly thank Referee #1 for their comments. We believe the changes initiated as a result of these comments will strengthen the message of our manuscript

Referee: The authors should introduce a brief study area description. Depth situation,

is an intertidal benthic ecosystem?

The site was subtidal; we will add a full description of the collection site to the revised manuscript.

Referee: Seasonal variability or some characteristics related to the nitrogen cycling processes, known nutrients rates of change through the water-sediment interface?

There is only data available for the summer months and this experiment was conducted in January. It was for this reason that we included animal-free cores as part of our experiment, in order (within the control) to characterise the 'typical' nutrient fluxes for this time of year. We will highlight this intention within the methods and further separate out this 'baseline' result in the results section.

Referee: Typical density of A.F.?

This information will be included in the revised manuscript.

Referee: Microphytobenthos production rates-abundances?

We will add reference to publications indicating that photosynthetic activity of microphytobenthos may be one of the processes controlling sediment–water nutrient fluxes.

Referee: Maybe a map?

We have included the latitude and longitude of the site. With the addition of the site information suggested by the reviewer (above) we feel there is sufficient information on the site, and do not feel a map would give the reader any further insight. However if the reviewers still feel this would be of value to the publication we are able to add a map.

Referee: There are many references to other previous works in the experimental set-up this makes a bit unfriendly for the reader to follow. The authors should include some brief description of how the samples were taken (multicore-boxcore-diving?) and the acidification facility.

We agree that additional information on the experimental set-up would make this section easier to follow; this information will be added to the revised manuscript.

Referee: The authors must specify the light conditions where the cores were kept during the experiments; this is an important issue since the Microphytobenthos is thought to be playing a significant role in the nutrient exchange.

We agree and will address this issue in the revised manuscript.

Referee: Section 3.4, the authors should refer only to the significant interaction (pH-A.F. density and flux) results

It is a little unclear as to which nutrient the reviewer is referring to with regards to section 3.4 as the pH-A.filiformis interaction is discussed with respect to all of the nutrients in turn, as indicated by the section title. The intention was indeed to discuss the significant interactions, but also whether there was a significant interaction or not. We will revisit this section to ensure the intent of the paragraph is clear within the revised manuscript.

Referee: There are several statements that are more related to a discussion section (P.2395-L.24 towards P.2396-L.5)

We agree these statements are better suited to the discussion, and they will be moved in the revised manuscript.

Referee: Figures 1,2,3 should also be edited: include the A.F density in the bottom of all graphs and remove the grid lines in the graph area since they interfere with the observation of the fitted lines results of your experiments under different pH.

Moving the A.filiformis density indication to the bottom of the graph, and removing grid lines will improve the readability and will be done for the revised manuscript

Referee: I think that the authors adjust their discussion to classical processes ruling nitrogen cycling. I missed some visiting of other nitrogen processes in this study area, such as dissasimilative nitrate reduction to ammonium (DNRA) or anammox?. Could

this processes be active?

Referee: If denitrification is present in this kind of sediment, therefore it is possible also to expect the presence of other anaerobic processes, If so, it is possible that A.F. density-related acidification interaction (nitrate versus ammonium observed fluxes in 6.8 pH for example) might infact trigger one type of process over the other?

We can confirm that denitrification is an important element of N cycling in this sediment and therefore it is likely that a host of other anaerobic processes are also active. We agree that these processes are important and we will include mention of them in a revised discussion. However, from the few studies published to date (Huesemann et al 2002; Widdicombe & Needham 2007; Widdicombe et al. 2009) evidence would suggest that anaerobic processes, such as denitrification and anammox, are relatively unaffected by lowered pH compared with aerobic processes such as nitrification. Of course, as the reviewer notes, impacts on nitrification could alter the ammonium-nitrite-nitrate balance, which in turn could affect the supply of nutrients to anaerobic processes thereby altering the relative importance of each of these. We will address this possibility in a revised discussion.

Referee: The authors centered an important role to macrophytobenthos however the discussion is very speculative in this point and lack scientific evidence. The authors should convince that the MPB are actually an important player in the sediments of the study area first and in they experiments. I guess that the authors don‘t have data on the abundance of MPB in their cores? However, are there published values of macrophytobenthos abundances or production in the study area? During conditions similar than during the sample collection time? With this information it is possible to calculate using redfield the expected N and P uptake and establish potential influence on net fluxes in the control experiments.

Unfortunately, as the reviewer states, we do not have data for MPB abundance. The primary aim of this study was to examine the impact of seawater acidification on the im-

portant biological relationship that existed between an active bioturbating species and a key ecosystem function (nutrient exchange across the sediment – water interface). We accept that the sections of our discussion which deal with the potential role of the MPB in the responses we observed are speculative. However, we feel this discussion serves to highlight an important area for future research. Even though we are unable to categorically demonstrate the exact processes underlying the significant changes in nutrient fluxes we observed, we maintain that the data presented in our paper is both novel and extremely interesting. We also feel it gives an important insight into which areas of the N-cycle could be prioritised for future study. We accept that the paper could be clearer that our conclusions are highly speculative with respect the MPB and will make this point clearer in our revised paper.

Referee: Specific comments in the discussion P.2397, "cryptic phrase" (L.9 - L.12) needs to be rephrased is difficult to understand, separate in two ammonia oxidising versus interactive factors.

The sentence the referee is referring to is 'By the same principle ammonia-oxidising activity is likely to have increased at increased animal density (Satoh et al., 2007); while neither animal density nor pH significantly altered ammonium release from the sediment, the interaction between these factors was significant'.

The confusion has primarily arisen as this is a typographical error and there should have been a full stop after the reference. However we will also clarify the text thus. "While neither animal density nor pH significantly altered ammonium release from the sediment, the interaction between these factors was significant. This result suggests that the level of statistical discrimination available within each independent factor was insufficient to demonstrate a significant relationship between ammonium flux and either animal density or pH. However, the extra statistical power generated when comparing across both factors (12 df compare with 3 df for pH and 4 df for density) is sufficient to demonstrate that the biological control of ammonium flux was dependant on seawater pH.

Referee: P.2397, L.23 introduce microphytobenthos acronym!

MPB will be added as an acronym for microphytobenthos.

Interactive comment on Biogeosciences Discuss., 6, 2387, 2009.