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Interactive comment on "Effects of global climate change and organic pollution on nutrient cycling in marine sediments" *by* C. Sanz-Lázaro et al.

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Reply to Anonymous Referee #1. The reply of the authors is written after the word "REPLY:", immediately after the comment of the referee.

The manuscript deals with an experimental study using short sediment cores which were incubated under different temperatures in order to simulate the effects of increasing temperatures and eutrophication on early diagenetic release of nutrients. Incubation was done at three different temperatures representing present conditions as well as those simulated for global change scenarios in 50 and 100 years. A second incubation was done with added ground fish feed in order to simulate the addition of labile organic matter. Part of the study, namely the CO2 release, oxygen uptake, sulfate release and sulfide enrichment, was published in an earlier paper. The present paper is

focused on the mobilization of phosphate and ammonium and uses a regression analyses to determine the efflux of the nutrients with and without organic matter addition. The results are that phosphate release increases linearly with increasing temperatures while ammonium is released according to an exponential fit with an increase starting only at temperatures elevated by >6_C. Another important finding is that only a very small proportion of added phosphorous is released probably due to binding of phosphates to Fe-oxides while up to two thirds of the added nitrogen is released as ammonium. The paper is well written, well illustrated and findings are sound and supported by the data.

A problem is, however, that nitrite and nitrate were not measured. It is very likely that nitrification took place under the oxygenated conditions so that the exponential curve may be an artefact of the lack of nitrite and nitrate data. It is feasible that under slightly elevated temperatures nitrate is released while under higher temperatures as more oxygen has been consumed ammonium is released in lager proportions. The authors mention this and discuss the problem shortly but it needs to be stressed and discussed in more detail.

REPLY: We agree that it would add more information having NO2- and NO3- data, but we do not agree that the exponential curves of NH4+ sediment efflux along temperature is an artefact because of lack of NO2- and NO3- data. This graph is presenting the amount of NH4+ that is released to the water column. Another different fact is that part of the mineralized organic N could be effluxed as NO2- and NO3-. Although NO3- in the pelagic system can be at comparable concentration levels as NH4+, NO3- effluxes are generally much lower (around one magnitude order below) that the NH4+ effluxes (e.g. Hansen & Kristensen, 1998; Alsterberg et al. 2012). As regards, NO2- concentration levels are always notably low compared to NH4+ effluxes (around one or two magnitude orders below) when the water column is under oxic conditions. Anyway, we think that the referee highlights an important point that should be clarified and we followed their recommendation of discuss this in more detail. We have added at the

end of this paragraph: “Despite so, NH4+ is mostly the dominating form of dissolved inorganic N effluxing from organic enriched sediments (Christensen et al. 2000;Holmer et al. 2003), while coupled nitrification-denitrification rarely exceeds 1-2 mmol m-2 d-1 in marine sediments (Middelburg et al. 1996). We are therefore confident that the NH4+ release rates can act as a proxy for total inorganic N release to the water column.”.

References used in this comment: Christensen, P. B., Rysgaard S., Sloth N. P., Dalsgaard T., and Schwaerter S.: Sediment mineralization, nutrient fluxes, denitrification and dissimilatory nitrate reduction to ammonium in an estuarine fjord with sea cage trout farms, Aquat. Microb. Ecol., 21, 73-84, 2000. Holmer, M., Duarte C. M., Heilskov A., Olesen B., and Terrados J.: Biogeochemical conditions in sediments enriched by organic matter from net-pen fish farms in the Bolinao area, Philippines, Mar. Pollut. Bull., 46, 1470-1479, 2003 Middelburg, J. J., Soetaert K., Herman P. M. J., and Heip C. H. R.: Denitrification in marine sediments: A model study, Global Biogeochemical Cycles, 10, 661-673, 1996.

Specific comments: Page 22, line 5/6: "especially: : :may just be additive” This statement is rather vague and would need a lot of explanation. I think it is better to delete this as it is beyond the scope of an abstract.

REPLY: Done

p. 23, l. 21/22: delete “and needs to be fixed again: : :” until the end of the sentence.
REPLY: Done

p. 27, l. 7: typo “slices to”

REPLY: Done

p. 29, l. 5ff: this sentence sounds a bit strange to me, may be it is best to end with : : :was calculated.

REPLY: We have modified the sentence and the followings of the paragraph, but we

have started with “was calculated” instead of ending with it. We did so because the active form seemed to us simpler and easier to understand.

We thank the referee for the time taking to comment the Ms and thus participating in improving it.

Interactive comment on Biogeosciences Discuss., 12, 21, 2015.